I-40 OPERATIONAL IMPROVEMENTS
FROM HARRISON AVENUE (SR 1652) TO I-440/US 1-64
WAKE COUNTY, NORTH CAROLINA

WBS ELEMENT – 36597.1.1
S.T.I.P. PROJECT NO. I-4744
FEDERAL AID PROJECT NO. IMNHF-040-4 (134) 289

ADMINISTRATIVE ACTION

CATEGORICAL EXCLUSION

SUBMITTED PURSUANT TO THE NATIONAL ENVIRONMENTAL POLICY ACT
42 USC 4332(2) (C)

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

AND

N.C. DEPARTMENT OF TRANSPORTATION

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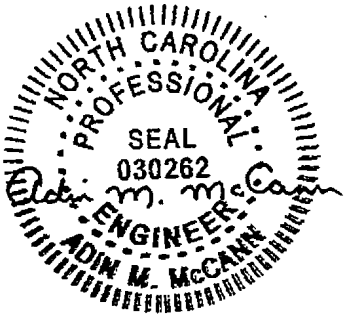

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January 2009

I-40 OPERATIONAL IMPROVEMENTS
FROM HARRISON AVENUE (SR 1652) TO I-440/US 1-64
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PDEA

- Coordinate project construction schedule with Triangle Transit.
- A field survey was conducted for Michaux's sumac (*Rhus michauxii*) on June 3-4 2008. If the project let date extends two (2) years or more beyond the date of the last field survey, an additional field survey will be conducted prior to letting of the project for construction.
- A field survey was conducted for Dwarf wedgemussel (*Alasmidonta heterodon*) on July 16, 2008. If the project let date extends two (2) years or more beyond the date of the last field survey, an additional field survey will be conducted prior to letting of the project for construction.

ROADWAY DESIGN

- Utilize design standards for Sensitive Watersheds during final design.
- Utilize Best Management Practices (BMPs) for Protection of Surface Waters.

CONSTRUCTION – DIVISION 5

- No burning will be performed at the project site or within the project boundaries.

TABLE OF CONTENTS

LIST OF GRAPHS

LIST OF TABLES

LIST OF FIGURES

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North Carolina Department of Transportation

STIP Project I-4744, I-40 Operational Improvements, Wake County
Harrison Avenue to I-440/US 1-64
Categorical Exclusion

This report is a Categorical Exclusion (CE) for the proposed improvement of I-40 in Wake County, North Carolina.

This CE has been prepared by the North Carolina Department of Transportation (NCDOT) in coordination with the Federal Highway Administration (FHWA). It is intended to satisfy the requirements of both the National Environmental Policy Act (NEPA) and the North Carolina Environmental Policy Act. The document conforms to the Council on Environmental Quality (CEQ) guidelines, which implement the procedural provisions of NEPA, and the FHWA Guidance for Preparing and Processing Environmental and Section 4(f) Documents (Technical Advisory T6640.8A, 1987).

1. PURPOSE AND NEED FOR ACTION

1.1. Introduction

The North Carolina Department of Transportation (NCDOT) proposes to construct operational improvements to Interstate 40 between Harrison Avenue (SR 1652) and the I-440/US 1-64 interchange. I-40 is designated by the NCDOT Board of Transportation as part of a statewide Strategic Highway Corridor System (SHC). According to the *NCDOT 2009-2015 State Transportation Improvement Program (STIP)*, construction is scheduled to begin in 2010.

1.1.1. Background

The section of I-40 currently under study for improvement is approximately 6.2 miles in length and extends from Harrison Avenue (SR 1652, Milepost 287) to I-440/US 1-64 (Milepost 293). This section of I-40 is currently a busy four-lane urban freeway with frequent traffic congestion. I-40 is the primary commuting artery in the Triangle region, serving major employment centers in Raleigh, Durham, Chapel Hill, and the Research Triangle Park. Figure 1.1 shows the project location.

The improvements proposed as part of this project are included in the *North Carolina Department of Transportation (NCDOT) 2009-2015 State Transportation Improvement Program (STIP)* as STIP Project I-4744. The *NCDOT 2009-2015 STIP* includes approximately $38.5 million for construction and right-of-way costs for Project I-4744. Construction improvements considered for this proposed project include the addition of one 12-foot lane and one 12-foot shoulder in each direction within the existing median between Wade Avenue (Milepost 289) and I-440/US 1-64 (Milepost 293). As part of the project, NCDOT is considering an option to re-stripe the pavement on I-40 eastbound between the Harrison Avenue (Milepost 287) and Wade Avenue interchanges to provide an auxiliary lane. No right-of-way acquisition is anticipated, and no modifications to interchanges or intersecting facilities are planned as part of the proposed project. Construction is scheduled to begin in federal fiscal year (FY) 2010.

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STIP Project I-4744 is proposed to provide operational improvements to enhance traffic mobility on I-40 within the project study area. STIP Project I-4744 is intended to be one part of a multi-faceted solution to address congestion and mobility issues on Interstate 40 in the Triangle region. I-40 from Wade Avenue to I-440/US 1-64 is currently the only section of I-40 in the Raleigh area with a typical section less than six lanes. West of the Wade Avenue interchange, I-40 consists of eight through lanes. East of I-440/US 1-64, the I-40 cross-section consists of six through lanes. Adding an additional travel lane in each direction between Wade Avenue and I-440/US 1-64 resulting in a six-lane cross section, will better match the existing cross-sections west of Wade Avenue and east of I-440/US 1-64, improve operational deficiencies, and allow for more efficient travel along I-40. The pavement re-striping on I-40 eastbound to provide an auxiliary lane between the Harrison Avenue and Wade Avenue interchanges will improve operational efficiency by providing supplemental accommodations for maneuvering of traffic on this segment of freeway.

STIP Project I-4744 complies with state and local transportation plans. In addition to the *NCDOT 2009-2015 STIP,* the NCDOT has designated the project as a Strategic Highway Corridor. The North Carolina Board of Transportation developed the *Strategic Highways Corridor Vision Plan* to identify, protect and maximize the use of highway corridors, such as I-40, that play a critical role in statewide mobility. The widening of I-40 to six-lanes between Wade Avenue and I-440/US-64 was identified in the *I-40 High Occupancy Vehicle/Congestion Management Study* as a project which would improve operations on I-40. The project is also included in the *Capital Area Metropolitan Planning Organization's (CAMPO) 2030 Long Range Transportation Plan* (LRTP) and is designated as a regionally significant project.

I-40 is also part of the Federal Strategic Highway Network (STRAHNET)[1]. The STRAHNET includes a network of highways which are important to the United States strategic defense policy and which provide defense access, continuity, and emergency capabilities for the movement of personnel, materials, and equipment in both peace time and war time. The STRAHNET system is designated by the Federal Highway Administration (FHWA) in coordination with the Department of Defense.

1.1.2. Project History

STIP Project I-4744 was developed to improve traffic mobility on I-40 between Wade Avenue and I-440/US 1-64. Widening the facility to a six-lane cross-section is currently programmed in the *NCDOT 2009-2015 STIP.* However, in prior years, STIP Project I-4744 was identified by CAMPO as its Priority #3 in the *2007-2013 Metropolitan Planning Organization Project Priority List*. Additionally, in 2007, the Regional Transportation Alliance identified STIP Project I-4744 as the highest priority freeway expansion in the Triangle Area. STIP Project I-4744 is currently listed by CAMPO as Priority #1 in its *2009-2015 Metropolitan Transportation Improvement Program (MTIP) Roadway Project Priority List*.

The recommendations for this project have been developed in coordination with the *NCDOT 2009-2015 STIP*, and *CAMPO's 2030 LRTP* as interim improvements in an effort to eliminate the cost and effort that would result from planned long-term improvements.

[1] Title 23, Part 470, Section 107 (23 CFR 470.107)

1.2. Project Setting

1.2.1. Study Area

The STIP Project I-4744 Project Study Area is located in central Wake County, bordering southwest Raleigh and northeast Cary in North Carolina. The Project Study Area is generally bounded by Reedy Creek Road, William B. Umstead State Park access roads and trails to the north; Edwards Mill Road, Athens Drive, Avent Ferry Drive, and Gorman Street to the east; Tryon Road to the south, and Southeast Maynard Road, Reedy Creek Road, Harrison Avenue, Weston Parkway, and Old Reedy Creek Road to the west. Table 1-1 lists STIP projects in the Project Study Area. Figure 1.2 shows the new location and capacity improvement STIP projects located in the Project Study Area.

Table 1-1. STIP Projects in Project Study Area (*NCDOT 2009-2015 STIP*)

STIP Project Number	Description	Status*
Interstate Projects		
I-4709	Pavement repair and resurfacing on I-40 from Wade Avenue (SR 1728) to east of I-440/US 64 (Milepost 302).	Construction completed.
I-4744	Add lanes on I-40 from Wade Avenue (SR 1728, Milepost 289) to I-440/US 1-64 (Milepost 293).	Planning and design in progress. Right-of-way scheduled to begin in FY 2009. Construction scheduled to begin in FY 2010.
I-4902	Signing revisions and upgrades on I-40 from Wade Avenue (SR 1728) to east of I-440/US 64 (Milepost 302) and I-440 from US 1-64 at I-40 to I-40 near Sunnybrook Road (SR 2544).	Let. Contract award pending.
I-4908	I-40 signing revisions and upgrades from Wade Avenue to east of I-440/US 64 and I-440 from US 1-64 to Sunnybrook Road.	Under construction.
I-5111	Add lanes to I-40 from I-440/US 64 (Exit 301) to US 70 Clayton Bypass.	Right-of-way scheduled for FY 2014. Construction unfunded.
Urban Projects		
U-2719	Widen I-440 (Cliff Benson Beltline) to multi-lanes from south of Walnut Street (SR 1313) to north of Wade Avenue (SR 1728).	Programmed for Planning and Environmental Study only. Project unfunded.
U-3817	Edwards Mill Road Extension, multi-lane on new location from NC 54 to Western Boulevard.	Project unfunded.
Hazard Elimination Projects		
W-5128	Install median barrier on I-40 from I-440 to Jones Sausage Road (SR 2547).	Construction scheduled for FY 2009.
W-5130	Install median barrier on I-40/I-440 west of Wade Avenue (SR 1728) to Lake Wheeler Road (SR 1371).	Construction scheduled for FY 2009.

Source: *NCDOT 2009-2015 State Transportation Improvement Program*

* FY = Fiscal Year

1.2.2. Geometric Features of the Existing Facility

I-40 from Wade Avenue to I-440/US 1-64 is a 4-lane median-divided, controlled-access facility with 10-foot outside paved shoulders and 4-foot inside paved shoulders. I-40 from Harrison Avenue to Wade Avenue is an 8-lane median-divided, controlled-access facility with 10-foot outside paved shoulders and 4-foot inside paved shoulders. For approximately 3,600 feet, I-40 is five lanes wide in the westbound direction between Wade Avenue and Harrison Avenue before dropping a lane at the Harrison Avenue off-ramp. The ramp from Harrison Avenue to I-40 eastbound is approximately 1,500 feet in length before merging with I-40. The remaining section of I-40 eastbound between Harrison Avenue and Wade Avenue (approximately 3,800 feet) is four lanes wide. These eastbound travel lanes split evenly at the I-40/Wade Avenue interchange. The majority of the project corridor is comprised of four 12-foot travel lanes with an existing grass median approximately 90 feet in width. The right-of-way width varies along the project corridor, ranging from approximately 350 feet west of the Wade Avenue interchange to approximately 500 feet in the area of the I-440/US 1-64 interchange.

Existing interchanges within the project limits are located at:

- **Harrison Avenue (SR 1652)** – a diamond interchange with signalized ramp terminals providing full access movements with Harrison Avenue bridged over I-40.
- **Wade Avenue (SR 1728)** – a freeway to freeway interchange for the I-40/Wade Avenue split with dual two-lane bridges carrying I-40 over the eastbound lanes of Wade Avenue and a loop ramp providing the connection from Wade Avenue westbound to I-40 eastbound.
- **Chapel Hill Road (NC 54)** – a partial cloverleaf (consisting of four ramps and two loops with the loops located in diagonal quadrants) providing full access movements with NC 54 bridged over I-40.
- **Cary Towne Boulevard/Western Boulevard (SR 1497)** – a partial cloverleaf (consisting of three ramps and a loop) providing full access movements with Cary Towne Boulevard bridged over I-40.
- **I-440/US 1-64** – a full cloverleaf interchange with collector distributor roads.

Grade separated crossings within the project limits include:

- **Trenton Road (SR 1655);**
- **Trinity Road (SR 1656);**
- **North Carolina Railroad/CSX/Norfolk Southern;**
- **East Chatham Street/Hillsborough Street (SR 1011);**
- **Buck Jones Road (SR 1315); and**
- **Jones Franklin Road (SR 1319).**

1.2.3. History of I-40 in Raleigh and Cary

I-40 is a major east-west cross-country freeway from North Carolina to California. In North Carolina, I-40 is approximately 420 miles in length and serves the cities of Asheville, Winston-Salem, Greensboro, Durham, Raleigh, and Wilmington.

I-40 between Raleigh and the Research Triangle Park in Durham was opened to traffic in December 1971 (http://www.ncdot.org/public/50thanniv/ncinterstates/, accessed 8/12/08). Since that time, I-40 has served as a freeway facility providing direct east-west mobility for commuters through the Triangle region. It is the primary commuting artery in the Triangle region and serves Raleigh, Cary, Durham, Chapel Hill and the Research Triangle Park. Capacity improvements have been made to various sections of I-40 within the Triangle region. However, the section of I-

40 between Wade Avenue and I-440/US 1-64 remains the only four-lane section of I-40 in the Triangle region.

Travel demands on the existing transportation network in the Triangle region, including the use of both existing roads and other modes of transportation, are continually increasing as the area grows. STIP Project I-4744 is located in Wake County, North Carolina.

According to the US Census Bureau, the population of Wake County grew approximately 48.3% between 1990 and 2000. This is more than double the growth rate experienced at the state level (approximately 21.4%) during the same time period (see Table 1-2).

Table 1-2. Population Growth, 1990-2000

Area	Population		Change, 1990-2000	
	1990	2000	Difference	% Change
Wake County	423,380	627,846	204,466	48.3%
North Carolina	6,628,637	8,049,313	1,420,676	21.4%

Source: *US Census Bureau, Summary File 1 – Table P1 (1990 and 2000)*

The widening of I-40 between Wade Avenue and I-440/US 1-64 was initially identified and evaluated in the *I-40 High Occupancy Vehicle/Congestion Management Study* (*I-40 HOV Study*) completed by NCDOT in 2003. Prior to the *I-40 HOV Study*, the widening of I-40 to six-lanes between Wade Avenue and I-440/US 1-64 was not included in the adopted state (*NCDOT 2002-2008 STIP*) and regional (*CAMPO 2025 LRTP*) transportation plans. However, initial traffic planning model projections developed during the *I-40 HOV Study* showed that this section of I-40 would have peak demand exceeding twice the roadway capacity. Due to the extreme demand for roadway capacity on this section of I-40, the Study included this improvement in the evaluated future transportation network. One of the key findings of the *I-40 HOV Study* capacity analysis was the widening of I-40 between Wade Avenue and US 1-64 (I-440/US 1-64) from four to six-general purpose lanes, exclusive of any future I-40 HOV lane development, would "significantly improve operations on I-40." A recommendation was made in the *I-40 HOV Study* to coordinate this project with the Metropolitan Planning Organization (MPO) for inclusion in the subsequent long-range transportation plan update. Consequently, the widening of I-40 between Wade Avenue and I-440/US 1-64 appeared in the *CAMPO Transportation Plan Update 2025* and has been included subsequent MPO long range transportation plans.

1.3. Summary of Need for Proposed Action

Currently, I-40 is a four-lane freeway between Wade Avenue and I-440/US 1-64. According to the *STIP Project I-4744 Traffic Forecast Technical Memorandum* dated September 2008, this section of I-40 carried between approximately 92,700 and 102,200 vehicles per day (vpd) in 2007. Just west of Wade Avenue, the 2007 traffic volume was 151,400 vpd. Just east of the I-440/US 1-64 interchange, the 2007 traffic volume was 106,500 vpd. This project is intended to provide operational improvements that enhance traffic mobility on I-40 within the project study area. The overall purpose and need is further described in the following statement:

- **Improve traffic mobility on I-40 between Harrison Avenue and I-440/US 1-64.**

  I-40 from Wade Avenue to I-440/US 1-64 is currently the only section of I-40 in the Raleigh area that is not at least six lanes. West of the Wade Avenue interchange, I-40 consists of eight travel lanes. East of the I-440/US 1-64 interchange, I-40 consists of six travel lanes. Adding an additional lane in each direction, resulting in a 6-lane typical section, will better match the existing typical sections west of Wade Avenue and east of I-440/US 1-64, improve

traffic operations, and allow for more efficient travel along I-40 in this area. Additionally, the pavement re-striping on I-40 eastbound to create an auxiliary lane between the Harrison Avenue on-ramp and the Wade Avenue off-ramp will help to improve operational efficiency by providing supplemental accommodations for maneuvering traffic on this segment of freeway.

1.4. System Linkage

1.4.1. Existing Road Network

The major freeways and expressways in the study area are shown in Figure 1.1. I-40 provides the east-west backbone for high speed local and regional traffic patterns in the Triangle region. Circumferential "loop" circulation around Raleigh is provided by the I-440 Beltline. A second circumferential freeway system in the Triangle is partially constructed (I-540 and NC 540) and will eventually extend to form a 73-mile loop around most of the urban areas in Wake County. Other major regional thoroughfares are US 70, US 64, US 1, and US 401 in the Raleigh/Wake County area. Major arterials within the study area include Harrison Avenue, NC 54, Cary Towne Parkway/Western Boulevard and Buck Jones Road in Cary, and Jones Franklin Road in Raleigh.

1.4.2. Modal Interrelationships

Travel in Raleigh, Cary, and the Triangle region is heavily dependent on the automobile. However, other modes of transportation are available and include local, regional, and inter-city bus service, ride-sharing (Travel Demand Management programs), air service, motor freight service, and non-motorized transportation alternatives.

Public Transportation

Two local transit providers, one regional transit provider, and one inter-city transit service provider operate public transportation service in the Raleigh/Cary area.

- **C-TRAN**
  The Town of Cary offers daily fixed route transit services through C-TRAN (excluding Sundays) for all passengers, and dial-a-ride transportation services for Cary citizens who are at least 55 years old or disabled. Within the project study area, C-TRAN has daily fixed route service for Harrison Avenue, Maynard Road, East Chatham Street, Walnut Street, Buck Jones Road and through Crossroads Plaza area near the I-40 interchange with I-440/US 1-64. A C-TRAN representative indicated that although designated routes are not shown on I-40, their vehicles do use I-40 when returning to the depot or in conducting door-to-door service.

- **Capital Area Transit**
  Capital Area Transit (CAT) provides daily fixed route service for passengers traveling in the City of Raleigh. Within the study area, CAT has bus routes along Buck Jones Road and in the Roylene Acres neighborhood east of I-40 and north of the I-440/US 1-64 interchange.

- **Triangle Transit**
  Triangle Transit (TT) offers fixed route regional bus service on weekdays for Raleigh and other surrounding municipalities. Within the study area, TT has bus routes along I-40/ Wade Avenue, Harrison Avenue, Walnut Street, NC 54, and Cary Towne Parkway/Western Boulevard. The system-wide map on the Triangle Transit website (accessed 8/12/08) does not show any routes on the section of I-40 between Wade Avenue and US 1-64/I-440; however, local representatives indicate the Triangle Transit

buses do use this section of I-40 on occasion for routes not shown on the map. There are bus routes (express route between Chapel Hill and Raleigh and between Research Triangle Park and Raleigh) that use the section of I-40 between Harrison Avenue and Wade Avenue. Additionally, TT offers vanpooling for commuters that live and work near each other.

Freight Rail Service

There are two freight rail service providers in the project study area: CSX Transportation and Norfolk Southern. CSX Transportation and Norfolk Southern share a rail corridor owned by the North Carolina Railroad that runs east and west through the project study area just south of NC 54. Approximately seven freight trains run daily through the study area. This corridor has its own grade separation with I-40 just north of Chatham Street.

Passenger Rail Service

Amtrak provides intercity daily passenger rail service to the Triangle, with train stations located in downtown Raleigh, Cary, and Durham. Service is provided by three trains: the Piedmont, the Carolinian, and the Silver Service/Palmetto which operate to provide both regional services within North Carolina and national services for stops along the eastern seaboard. The Piedmont train is operated by the NCDOT Rail Division and operates daily between Charlotte, NC and Raleigh. The Carolinian line operates one train per day between Charlotte and New York, NY. The Silver Service/Palmetto daily rail service accommodates regional travel between New York and Miami. Approximately six passenger trains run daily through the study area.

Motor Freight Service

Raleigh is a major transfer point for motor freight service. Numerous freight operators are located in the Triangle region and substantial truck traffic uses I-40, both for local access to freight facilities and for through travel trips to the Coastal Plain area of North Carolina (east) and Piedmont Region (west).

Non-Motorized Transportation

According to the City of Raleigh's *Parks, Recreation, and Greenway Plan*, there is an existing greenway along Richland Creek in Schenck Forest and along Walnut Creek near Lake Johnson. There are also existing trails along Richland Creek and in William B. Umstead Park. A recent upgrade to NC 54 (Chapel Hill Road) was completed and includes striped bike lanes and sidewalks west of I-40 and Trinity Road. According to the Town of Cary's policy, all roads in the town are designated bike routes.

As an access-controlled Interstate facility, there are no existing bicycle or pedestrian facilities along I-40. According to NCDOT Bicycle & Pedestrian Division, there are numerous bicycle and pedestrian facilities in the project study area. There are existing bicycle facilities on NC 54 (Chapel Hill Road) from west of I-40 to west of Maynard Road, and on Walnut Street from Maynard Road to Buck Jones Road. There are scattered sidewalks in neighborhoods adjacent to the I-40 corridor, as well as a sidewalk facility on the north side of the Buck Jones overpass.

1.5. Transportation Demand

1.5.1. Existing and Projected Traffic Volumes

In order to understand what improvements would enable the facility to meet future traffic demand at acceptable levels of service, this study considered existing and projected traffic volumes. Through project scoping meeting discussions and coordination between NCDOT and the Federal Highway Administration (FHWA), the study team analyzed 2007 for the existing base year scenario and a 2035 future scenario.

As outlined in the *STIP Project I-4744 Traffic Forecast Technical Memorandum* (September 2008), the primary tools used to forecast traffic for this study were field-collected traffic data and the latest approved Triangle Regional Travel Demand Model (TRM). The TRM includes all fiscally-constrained projects contained in the currently adopted Capital Area Metropolitan Planning Organization (CAMPO) and Durham-Chapel Hill-Carrboro Metropolitan Planning Organization (DCHC MPO) long-range transportation plans.

Table 1-3 lists existing and anticipated future Annual Average Daily Traffic (AADT) estimates for segments of I-40 in the I-4744 Project Study Area. AADT is the total volume of vehicle traffic of a highway or road for a year divided by 365 days.

Table 1-3. Existing and Projected Traffic Volumes for I-40

Location	2007 Existing AADT	2035 No-Build AADT	NCLOS Maximum AADT for 4-Lane Freeway
I-40 W of Harrison Avenue	144,000	177,000	
I-40 W of Wade Avenue	151,400	186,000	
I-40 W of NC 54	92,700	121,300	78,000
I-40 W of Cary Towne Blvd	102,900	127,600	78,000
I-40 W of US 1-64	102,200	138,500	78,000
I-40 E of US 1-64	106,500	168,500	

Source: *STIP Project I-4744 Traffic Forecast Technical Memorandum, September 2008*
North Carolina Level of Service Software (NCLOS)

As mentioned previously, I-40 from Wade Avenue to I-440/US 1-64 is currently the only segment of I-40 in the Raleigh area with a typical section less than six lanes. Because it has fewer travel lanes than adjacent segments, the traffic-carrying capacity is less and it serves as a bottleneck to traffic on I-40. Based on the NCDOT Level of Service (NCLOS) transportation planning software that uses actual North Carolina roadway and traffic data to estimate capacities and levels of service for roadways, the existing capacity of I-40 as a 4-lane freeway is approximately 78,000 AADT. Therefore, I-40 in the project study area currently operates over capacity according to criteria provided in the Highway Capacity Manual.

Using the daily traffic volumes shown above in Table 1.3, existing (2007) and design year (2035) No-Build peak hour volumes were developed for each corresponding segment of I-40 within the traffic analysis study area. The peak hour volumes were analyzed to determine the existing and projected capacities and levels of service for the I-40 freeway segments.

1.5.2. Level of Service (LOS) Analysis

Level of Service (LOS) is a qualitative measure of traffic operating conditions specific to each type of transportation facility. LOS is measured by letter designations A through F, with LOS A

representing the best operating condition and LOS F denoting the worst (i.e., breakdown) operating conditions. In general, LOS D is considered appropriate for freeways and arterials in heavily developed sections of metropolitan areas, while LOS C in considered appropriate in rural areas.

As summarized from the *Final STIP Project I-4744 Traffic Operations Technical Memorandum* (September 2008), LOS analyses were conducted for uninterrupted flow facilities (freeway sections, ramp merge/diverge sections, and weaving sections). All conducted analyses were based on methodologies presented in the *Highway Capacity Manual 2000* (HCM), produced by the Transportation Research Board (TRB). LOS for freeways is determined by the average density or spacing of vehicles (that is, the average number of passenger cars per mile per lane) during the AM and PM peak hours.

According to the *Highway Capacity Manual 2000* (HCM), weave sections are defined as "a length of highway over which traffic streams cross paths through lane changing maneuvers, without the aid of traffic devices; formed between merge and diverge points." According to the HCM, the presence of weave sections result in intense lane-change maneuvers. Therefore, weave sections are subject to turbulence to which other sections of freeway are not. Based upon certain parameters, this can result in localized congestion and queuing even when desirable levels of service are reached. LOS for weaving sections is determined by the average density of vehicles during the AM and PM peak hours. LOS for freeway ramps is based on the traffic density in the merge or diverge area of the ramp assuming no breakdown in traffic operations within the merge or diverge influence area (e.g., LOS F in freeway section).

Figures 1.3A, 1.3B, and 1.3C show the locations of the twelve freeway segments and fifteen ramp and weave sections that were analyzed for the 2007 AM and PM peak hours. An LOS analysis was also conducted for the 2035 No-Build AM and PM peak hours. The worse case LOS between the AM and PM peak is shown for each segment to provide an overall segment level of service. Figures 1.4A, 1.4B, and 1.4C show the 2035 No-Build scenario LOS analysis results.

1.5.2.1 LOS for Existing (2007 No-Build) Conditions

Based on the 2007 traffic volumes, four of the twelve total analyzed I-40 freeway segments operate at LOS E or worse in the worse case 2007 peak hour period. These four freeway segments are in the area of the Wade Avenue interchange. Table 1-3 summarizes the 2007 No-Build LOS analysis for the analyzed I-40 freeway segments.

Twelve of fifteen total ramp merge/diverge sections and weaving sections operate at LOS E or worse in the worse case 2007 peak hour period. Table 1-4 summarizes the 2007 No-Build levels of service for the analyzed I-40 ramp (merge/diverge) and weaving sections. Due to the amount of traffic weaving between interchanges, localized congestion and queuing may occur on eastbound I-40 between Harrison Avenue and Wade Avenue; eastbound and westbound I-40 between NC 54 and Cary Towne Boulevard; and eastbound I-40 between Cary Towne Boulevard and US 1.

1.5.2.2 LOS for 2035 No-Build Conditions

Based upon the projected 2035 No-Build traffic volumes, traffic operations on I-40 between Wade Avenue and I-440/US 1-64 are expected to deteriorate if no improvements are made. All of the analyzed I-40 freeway segments (12 segments) would operate at LOS E or worse in the worse case 2035 peak hour period. Table 1-4 summarizes the 2035 No-Build LOS analysis for the analyzed I-40 freeway segments.

All fifteen analyzed ramp merge/diverge sections and weave sections operate at LOS F in the worse case 2035 No-Build peak hour period. Table 1-5 summarizes the 2035 No-Build levels of service for the analyzed I-40 ramp (merge/diverge) and weaving sections.

Table 1-4. Level of Service for I-40 Freeway Segments

Segment Name	Segment (limits)	Period	2007 Existing		2035 No-Build	
			LOS	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)
F1	I-40 EB at Wade Avenue	AM	D	31.7	***F***	*
		PM	**F**	*	***F***	*
F2	I-40 EB – Wade Avenue WB to NC 54	AM	C	22.5	***E***	***35.4***
		PM	D	27.3	***F***	*
F3	I-40 EB – at US 1	AM	C	19.7	D	34.8
		PM	C	25.8	***F***	*
F4A	I-40 EB – US 1 to Gorman Street	AM	C	25.9	***F***	*
		PM	D	33.4	***F***	*
F4B	I-40 EB – US 1 to Gorman Street	AM	C	25.9	***F***	*
		PM	D	33.4	***F***	*
F5A	I-40 WB – Gorman Street to US 1	AM	D	33.4	***F***	*
		PM	C	25.9	***F***	*
F5B	I-40 WB – Gorman Street to US 1	AM	D	33.4	***F***	*
		PM	C	25.9	***F***	*
F6	I-40 WB at US 1	AM	C	25.8	***F***	*
		PM	C	19.7	D	34.8
F7	I-40 WB – NC 54 to Wade Avenue	AM	***F***	*	***F***	*
		PM	***E***	***39.6***	***F***	*
F8	I-40 WB at Wade Avenue	AM	***F***	*	***F***	*
		PM	D	31.7	***F***	*
F9A	I-40 WB Wade Avenue	AM	***E***	***37.3***	***F***	*
		PM	D	26.8	***E***	***44.6***
F9B	I-40 WB Wade Avenue	AM	D	26.2	***E***	***43.5***
		PM	C	20.5	D	28.3

Source: *STIP Project I-4744 Final Traffic Operations Technical Memorandum* (September 2008)
* - Value exceeds calculation
Density is defined by HCM as the number of vehicles on a roadway segment averaged over space and can be defined as passenger cars per mile per lane (pc/mi/ln).

Table 1-5. Level of Service for I-40 Ramp Merge/Diverge Sections and Weaving Sections

Segment Name[1]	Segment (limits)	Period	2007 Existing		2035 No-Build	
			LOS	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)
M1	I-40 EB from Harrison Avenue	AM	C	25.0	D	30.2
		PM	D	29.9	***F***	***NA***
W2	I-40 EB – Harrison Avenue to Wade Avenue	AM	D[Δ]	34.8	***F***	***49.3***
		PM	***F***	***46.1***	***F***	***66.0***
M3	I-40 EB from Wade Avenue	AM	D	30.0	***F***	***NA***
		PM	***F***	***NA***	***F***	***NA***
D4	I-40 EB to NC 54	AM	D	28.9	***F***	***NA***
		PM	***F***	***NA***	***F***	***NA***
M5	I-40 EB from NC 54	AM	D	32.5	***F***	***NA***
		PM	***F***	***NA***	***F***	***NA***
W6	I-40 EB – NC 54 to Cary Towne Boulevard	AM	C[Δ]	26.7	***E***	***40.8***
		PM	***E***[Δ]	***36.3***	***F***	***56.9***
W7	I-40 EB – Cary Towne Boulevard to US 1	AM	***E***[Δ]	***36.4***	***F***	***64.0***
		PM	***F***	***46.8***	***F***	***81.9***
D8	I-40 EB to Gorman Street	AM	D	29.5	***F***	***NA***
		PM	D	34.2	***F***	***NA***
M9	I-40 WB from Gorman Street	AM	D	32.5	***F***	***NA***
		PM	C	27.0	***F***	***NA***
M10	I-40 WB from US 1	AM	***F***	***NA***	***F***	***NA***
		PM	D	32.1	***F***	***NA***
D11	I-40 WB to Cary Towne Boulevard	AM	***F***	***NA***	***F***	***NA***
		PM	***F***	***NA***	***F***	***NA***
W12	I-40 WB from Cary Towne Blvd to NC 54	AM	***E***[Δ]	***39.3***	***F***	***62.6***
		PM	D	28.3	***F***	***43.9***
M13	I-40 WB from NC 54 EB	AM	***F***	***NA***	***F***	***NA***
		PM	D	31.4	***F***	***NA***
M14	I-40 WB from NC 54 WB	AM	***F***	***NA***	***F***	***NA***
		PM	***E***	***35.4***	***F***	***NA***
D15	I-40 WB to Wade Avenue EB	AM	***F***	***NA***	***F***	***NA***
		PM	***E***	***38.8***	***F***	***NA***

Source: *STIP Project I-4744 Final Traffic Operations Technical Memorandum* (September 2008)
[1] - M = ramp merge segment, D = ramp diverge segment, W = weave segment
[Δ] - Weave criteria exceed recommended maximums and localized congestion and queuing is expected.
NA – Using HCM Methodology, if section operates at LOS F, the equation for calculating density does not apply. Density is defined by HCM as the number of vehicles on a roadway segment averaged over space and can be defined as passenger cars per mile per lane (pc/mi/ln).

1.6. Transportation Plans and Other Transportation Documents

1.6.1. Capital Area Metropolitan Planning Organization (CAMPO) 2030 Long Range Transportation Plan

The *Capital Area Metropolitan Organization (CAMPO) 2030 Long Range Transportation Plan* (LRTP) was adopted in September 2004, and at that time the MPO's geographic coverage encompassed the entirety of Wake County. The *CAMPO 2030 LRTP* is integrated with land use and air quality strategies and goals for the urban area. The Plan emphasizes improvements to existing highway facilities, as well as construction of new highway, transit, bicycle, and pedestrian facilities. The vision of the Plan is to create a multi-modal transportation network that is compatible with growth, sensitive to the environment, improves quality of life, and is accessible to all. The *CAMPO 2030 LRTP* is the document that Wake County and City of Raleigh both use as

their transportation plan. The Town of Cary has developed a Comprehensive Transportation Plan (see Section 1.6.3) which is a subset of the *CAMPO 2030 LRTP*.

The *CAMPO 2030 LRTP* includes STIP Project I-4744 and considers it a regionally significant project. The *CAMPO 2030 LRTP* describes STIP Project I-4744 as a 3.5 mile widening of I-40 to six lanes from Wade Avenue to US 1-64. Figure 1.5 (dated June 14, 2005) shows the projects listed in the *CAMPO 2030 LRTP* that was adopted September 15, 2004. STIP Project I-4744 is currently listed by CAMPO as Priority #1 in its *2009-2015 Metropolitan Transportation Improvement Program (MTIP) Roadway Project Priority List*.

1.6.2. Raleigh Transportation Plan

The *City of Raleigh's Transportation Plan* (adopted October 2002), which is part of the City's *Comprehensive Plan*, has five parts, including the *CAMPO Transportation Plan Update of 2025*. The regional recommendations contained in the *CAMPO Transportation Plan Update of 2025* include the widening of I-40 between Wade Avenue and I-440/US 1-64.

1.6.3. Cary Comprehensive Transportation Plan

The *Town of Cary Comprehensive Transportation Plan* (adopted May 2001, updated spring 2008) consists of four elements: roadway, bicycle, pedestrian, and transit. The purpose of the Plan is to serve as a guide for the future of transportation in Cary. There is no explicit reference to STIP Project I-4744 in the Plan.

1.6.4. Strategic Highway Corridors Vision Plan

The Strategic Highway Corridors (SHC) concept was adopted by the NCDOT Board of Transportation in September 2004 as part of North Carolina's Long-Range Multimodal Statewide Transportation Plan. The SHC initiative represents an effort to identify, protect and maximize the use of corridors that play a critical role in regional and statewide mobility. The SHC concept includes protecting mobility and connectivity functions of critical highway facilities, while promoting environmental stewardship through the use of existing facilities to the maximum extent possible. The SHC concept is also intended to foster economic prosperity through the quick and efficient movement of people and goods. The SHC concept also offers an opportunity to consider long-term vision, consistency in decision-making, land use partnerships, and overarching design and operational changes. Figure 1.6 shows the Strategic Highway Corridors Vision Plan for the Triangle Area.

I-40 has been designated by the NCDOT Board of Transportation as a Strategic Highway Corridor (SHC) on the statewide Strategic Highway Corridor (SHC) system. The SHC system consists of several different roadway classifications that are primarily based upon the function of the roadway, level of mobility and access. Under the SHC vision, I-40 is designated as a "Freeway." This designation requires that I-40 be a minimum four-lane divided cross-section with full control of access. STIP Project I-4744 is consistent with the SHC vision.

1.6.5. I-40 High Occupancy Vehicle/Congestion Management Study

The NCDOT commissioned a High Occupancy Vehicle and congestion management study to review a broad range of strategies for addressing congestion within the Triangle region. The final report, *I-40 High Occupancy Vehicle/Congestion Management Study* (I-40 HOV Study) was published in March 2003. The purpose of the I-40 HOV Study was to find additional ways to

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maximize both existing and planned transportation system facilities, with a focus on I-40 because it is the Triangle region's primary commuting artery. Although the I-40 HOV Study provided a broad overview of congestion management strategies and techniques, much of the analysis was focused on evaluating the feasibility of HOV lanes on I-40 and other major highways within Johnston, Wake, Durham, and Orange counties.

The study identified the following congestion management strategies as an alternative to single occupancy vehicular travel within the region: managed lanes (particularly HOV lanes), transit system improvements (rail and regional bus), travel demand management (TDM) strategies, freeway management techniques including ramp metering, intelligent transportation systems (ITS), and transportation systems management (TSM).

One of the key recommendations from the I-40 HOV Study included identifying short-term, low-cost improvements to address existing bottleneck issues on I-40. The section of I-40 between Wade Avenue and US 1-64 (I-440/US 1-64) was mentioned specifically as one of the I-40 bottleneck areas. The I-40 HOV Study capacity analysis indicated that the widening of I-40 between Wade Avenue and US 1-64 (I-440/US 1-64) from four to six-general purpose lanes, exclusive of any future I-40 HOV lane development, would "significantly improve operations on I-40." A recommendation was made in the I-40 HOV Study to coordinate this project with the Metropolitan Planning Organization (MPO) for inclusion in the subsequent long-range transportation plan update.

1.7. Purpose for Proposed Action

The overall purpose of the proposed project is to provide operational improvements to enhance traffic mobility on I-40 within the project study area. The overall purpose and need is further described in the following statement:

- **Improve traffic mobility on I-40 between Harrison Avenue and I-440/US 1-64.**

  Need Addressed: I-40 from Wade Avenue to I-440/US 1-64 is currently the only segment of I-40 in the Raleigh area with a typical section less than six lanes. Based upon the projected 2035 No-Build traffic volumes, all of the analyzed freeway segments, ramp/diverge sections, and weave sections along I-40 within the study area will operate at LOS F in the worse case 2035 peak hour period. Capacity improvements to this section of I-40 could have a direct impact on the mobility experienced by users of the facility and allow for more efficient travel between Harrison Avenue and I-440/US 1-64. Additionally, the construction of an additional lane on I-40 eastbound between the Harrison Avenue on-ramp and the Wade Avenue off-ramp should also help to improve operational efficiency by providing supplemental accommodations for maneuvering traffic on this section of freeway.

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2. ALTERNATIVES

2.1 Introduction

Based on the purpose and need for the project outlined in Chapter 1, this chapter discusses the development and evaluation of alternatives considered for the proposed action.

The *I-40 High Occupancy Vehicle/Congestion Management Study* was conducted by NCDOT in March of 2003 to identify various strategies that could improve mobility along the I-40 corridor. Following this study, CAMPO programmed the widening of I-40 between Wade Avenue and I-440/US 1-64 from a 4-lane to 6-lane section in their *2025 LRTP* and identified it as their Priority #3 in the 2007-2013 *Metropolitan Planning Organization Project Priority List.* In 2007, the Regional Transportation Alliance identified STIP Project I-4744 as the highest priority freeway expansion in the Triangle Area. STIP Project I-4744 is currently listed by CAMPO as Priority #1 in its *2009-2015 Metropolitan Transportation Improvement Program (MTIP) Roadway Project Priority List*.

2.2 No-Build Alternative

The No-Build Alternative means that no action would be implemented under this project (STIP Project I-4744). The No-Build Alternative is not consistent with state and local transportation planning objectives to improve traffic mobility and congestion on I-40 within the Triangle region. Therefore, it is not consistent with the purpose and need for the project. However, in accordance with the National Environmental Policy Act (NEPA) (40 CFR 1502.14(d)) and FHWA guidelines (FHWA Technical Advisory 6640.8A, 1987), the No-Build Alternative is given full consideration and provides baseline conditions with which to compare the improvements and consequences associated with the build alternatives.

2.3. Build Alternative

The Build Alternative proposes to add one 12-foot travel lane and one 12-foot inside paved shoulder in each direction within the existing median between Wade Avenue and I-440/US 1-64. This would upgrade this section of I-40 from an existing 4-lane facility to a 6-lane facility. As part of the project, NCDOT is considering an option to re-stripe the pavement on I-40 eastbound between the Harrison Avenue (Milepost 287) and Wade Avenue interchanges to provide one 12-foot auxiliary lane. No additional improvements to interchanges or intersecting roadways are included as part of the Build Alternative. No right-of-way will be acquired for the proposed improvements.

The Build Alternative includes the widening of four mainline bridge structures: I-40 over eastbound Wade Avenue and I-40 over I-440/US 1-64. No modifications are proposed to any of the existing grade-separated crossings of I-40. The existing I-40 right-of-way width varies between approximately 350 feet to 500 feet. All improvements proposed as part of STIP Project I-4744 would be constructed within the existing right-of-way.

2.3.1. Preliminary Construction Cost Estimate

The estimated preliminary construction cost of the Build Alternative in year 2008 dollars is $49,200,000[2]. This cost estimate includes Intelligent Transportation System (ITS), signing, noise abatement measures, and widening of existing I-40 bridge structures at the Wade Avenue and US 1-64 interchanges. ITS components include the installation of two closed circuit television

[2] NCDOT Project Services Unit Preliminary Estimate dated September 25, 2008.

cameras at Wade Avenue and Cary Towne Boulevard. The cost estimate also includes installation of lighting at the Wade Avenue, NC 54, and I-440/US 1-64 interchanges. Based on the preliminary design plans provided by NCDOT Roadway Design Unit (dated May 2008), there are no temporary easements, right-of-way acquisition, or utility relocation costs associated with the project.

2.4. Transportation Demand

2.4.1. Design Year (2035) Traffic Projections

Future traffic projections were developed for a design year (2035) Build scenario based on the Triangle Regional Travel Demand model. As expected, the projected daily traffic volumes for segments of I-40 in the project study area increase due to traffic redistribution effects associated with increased traffic capacity under the Build Alternative.

Table 2-1 provides a comparison between the 2035 No-Build and 2035 Build traffic volumes (AADT) for I-40 within the I-4744 project study area. As mentioned earlier, AADT is the total volume of vehicle traffic of a highway or road for a year divided by 365 days.

Table 2-1. Projected 2035 No-Build and Build Traffic Volumes for I-40

Location	2035 No-Build AADT	2035 Build AADT
I-40 W of Harrison Ave	177,000	181,800
I-40 W of Wade Avenue	186,000	191,600
I-40 W of NC 54	121,300	135,200
I-40 W of Cary Towne Blvd	127,600	142,600
I-40 W of US 1-64	138,500	156,300
I-40 E of US 1-64	106,500	175,300

Source: *STIP Project I-4744 Traffic Forecast Technical Memorandum, September 2008*

Using the daily traffic volumes shown above, design year (2035) Build peak hour volumes were developed for each corresponding segment of I-40 within the traffic analysis study area. The peak hour volumes were then evaluated to determine the projected capacities and levels of service for the I-40 freeway segments under the Build condition.

2.4.2. Level of Service (LOS) Analysis

As summarized from the *STIP Project I-4744 Final Traffic Operations Technical Memorandum* (September 2008), LOS analyses were conducted to determine if the Build Alternative would be consistent with the purpose and need for the project. All analyses were based on methodologies presented in the *Highway Capacity Manual 2000* (HCM), produced by the Transportation Research Board (TRB).

Figures 2.1A, 2.1B, and 2.1C show the LOS for the freeway sections, ramp merge/diverge sections, and weave sections that were analyzed as part of the 2035 Build traffic analysis.

2.4.2.1 LOS for 2035 Build Conditions

The 2035 Build traffic analysis shows that five of the twelve analyzed I-40 freeway segments show an improved LOS in the worse case peak hour condition, as compared to the 2035 No-Build scenario. Four additional I-40 freeway segments show an improved LOS in at least one of the peak hour periods with the construction of the proposed project. Table 2-2 summarizes the 2035 No-Build and Build LOS analysis for the I-40 freeway segments within the proposed project limits.

Nine of the fifteen analyzed I-40 ramp and weaving segments show an improved LOS in at least one of the peak hour periods as compared to the 2035 No-Build. Two sections show an improved LOS in the worst case peak hour conditions. Table 2-3 summarizes the 2035 No-Build and 2035 Build levels of service for the analyzed I-40 ramp (merge/diverge) and weaving sections.

Table 2-2. Level of Service for I-40 Freeway Segments

Segment Name	Segment (limits)	Period	2035 No-Build		2035 Build	
			LOS	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)
F1	I-40 EB at Wade Avenue	AM	***F***	*	D	28.9
		PM	***F***	*	***E***	***41.0***
F2	I-40 EB – Wade Avenue WB to NC 54	AM	***E***	***35.4***	C	25.6
		PM	***F***	*	D	32.1
F3	I-40 EB – at US 1	AM	D	34.8	C	20.1
		PM	***F***	*	D	26.6
F4A	I-40 EB – US 1 to Gorman Street	AM	***F***	*	***E***	***41.2***
		PM	***F***	*	***F***	*
F4B	I-40 EB – US 1 to Gorman Street	AM	***F***	*	***F***	*
		PM	***F***	*	***F***	*
F5A	I-40 WB – Gorman Street to US 1	AM	***F***	*	***F***	*
		PM	***F***	*	***F***	*
F5B	I-40 WB – Gorman Street to US 1	AM	***F***	*	***F***	*
		PM	***F***	*	***E***	***41.2***
F6	I-40 WB at US 1	AM	***F***	*	D	26.6
		PM	D	34.8	C	20.1
F7	I-40 WB – NC 54 to Wade Avenue	AM	***F***	*	***F***	*
		PM	***F***	*	***E***	***41.0***
F8	I-40 WB at Wade Avenue	AM	***F***	*	***E***	***41.0***
		PM	***F***	*	D	28.9
F9A	I-40 WB Wade Avenue	AM	***F***	*	***F***	*
		PM	***E***	***44.6***	D	29.5
F9B	I-40 WB Wade Avenue	AM	***E***	***43.5***	***F***	*
		PM	D	28.3	D	29.5

Source: *STIP Project I-4744 Final Traffic Operations Technical Memorandum* (September 2008)
* - Value exceeds calculation
Density is defined by HCM as the number of vehicles on a roadway segment averaged over space and can be defined as passenger cars per mile per lane (pc/mi/ln).

Table 2-3. Level of Service for I-40 Ramp Merge/Diverge Sections and Weaving Sections

Segment Name[1]	Segment (limits)	Period	2035 No-Build		2035 Build	
			LOS	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)
M1	I-40 EB from Harrison Avenue	AM	D	30.2	***F***	***NA***
		PM	***F***	***NA***	***F***	***NA***
W2	I-40 EB – Harrison Avenue to Wade Avenue	AM	***F***	***49.3***	***F***	***48.9***
		PM	***F***	***66.0***	***F***	***66.0***
M3	I-40 EB from Wade Avenue	AM	***F***	***NA***	C	26.0
		PM	***F***	***NA***	***F***	***NA***
D4	I-40 EB to NC 54	AM	***F***	***NA***	C	26.0
		PM	***F***	***NA***	***F***	***NA***
M5	I-40 EB from NC 54	AM	***F***	***NA***	D	30.7
		PM	***F***	***NA***	***F***	***NA***
W6	I-40 EB – NC 54 to Cary Towne Boulevard	AM	***E***	***40.8***	D	30.9
		PM	***F***	***56.9***	***E***	***42.4***
W7	I-40 EB – Cary Towne Boulevard to US 1	AM	***F***	***64.0***	***F***	***47.8***
		PM	***F***	***81.9***	***F***	***58.9***
D8	I-40 EB to Gorman Street	AM	***F***	***NA***	***F***	***NA***
		PM	***F***	***NA***	***F***	***NA***
M9	I-40 WB from Gorman Street	AM	***F***	***NA***	***F***	***NA***
		PM	***F***	***NA***	***F***	***NA***
M10	I-40 WB from US 1	AM	***F***	***NA***	***F***	***NA***
		PM	***F***	***NA***	***F***	***39.7***
D11	I-40 WB to Cary Towne Boulevard	AM	***F***	***NA***	***F***	***NA***
		PM	***F***	***NA***	***F***	***NA***
W12	I-40 WB from Cary Towne Blvd to NC 54	AM	***F***	***62.6***	***F***	***46.7***
		PM	***F***	***43.9***	D	32.9
M13	I-40 WB from NC 54 EB	AM	***F***	***NA***	***F***	***NA***
		PM	***F***	***NA***	D	29.7
M14	I-40 WB from NC 54 WB	AM	***F***	***NA***	***F***	***NA***
		PM	***F***	***NA***	D	33.6
D15	I-40 WB to Wade Avenue EB	AM	***F***	***NA***	***F***	***NA***
		PM	***F***	***NA***	D	33.0

Source: STIP Project I-4744 Final Traffic Operations Technical Memorandum (September 2008)
[1] - M = ramp merge segment, D = ramp diverge segment, W = weave segment
 # - Using HCM Methodology, density corresponds to LOS in Exhibit 25-4 of the HCM 2000.
[Δ] - Weave criteria exceed recommended maximums and localized congestion and queuing is expected.
***NA** – Using HCM Methodology, if V_{F0}, V_F or V_R = LOS F, the equation for calculating density does not apply.*
Density is defined by HCM as the number of vehicles on a roadway segment averaged over space and can be defined as passenger cars per mile per lane (pc/mi/ln).

2.5 Meeting the Purpose and Need

The Build Alternative meets Purpose and Need by:

- **Improving traffic mobility on I-40 between Harrison Avenue and I-440/US 1-64**

The Build Alternative is intended to be one part of a multi-faceted solution to address congestion and mobility issues on I-40 in the Triangle region. I-40 from Wade Avenue to I-440/US 1-64 is currently the only portion of I-40 in the Raleigh area with a typical section less than six lanes. West of the Wade Avenue interchange, I-40 consists of eight through lanes. East of the I-440/US 1-64 interchange, the I-40 cross-section consists of six through lanes. Adding an additional lane in each direction between Wade Avenue and I-440/US 1-64, will better match the existing cross-sections west of Wade Ave and east of I-440/US 1-64, improve operational deficiencies, and is anticipated to improve mobility through added capacity. Additionally, the pavement re-striping on I-40 eastbound to provide an auxiliary lane between the Harrison Avenue on-ramp and the Wade Avenue off-ramp will help to improve operational efficiency by providing supplemental accommodations for maneuvering traffic on this segment of freeway.

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3. AFFECTED ENVIRONMENT

The data and analyses described in this chapter and in Chapter 4 (Environmental Consequences) are documented in the following technical memoranda: *Natural Resources Technical Report – I-40 Widening* (July 2008), *STIP Project I-4744 Final Air Quality Technical Report* (January 2009), and the *STIP Project I-4744 Final Noise Technical Report* (January 2009). These reports are incorporated by reference. Different study areas have been used as appropriate for specific analyses as described below and shown on Figure 3.1:

- **Project Study Area** – The STIP Project Study Area is located in central Wake County, bordering southwest Raleigh and northeast Cary in North Carolina. The Project Study Area boundaries are described in Section 1.2.1.
- **Direct Community Impact Area (DCIA)** – This area is contained within the Project Study Area and encompasses those areas and communities which may be likely to experience direct effects from the construction of the proposed project.
- **Natural Resources Technical Report (NRTR) Study Area** – The NRTR Study Area traverses approximately 6 miles along I-40 and extends to include all areas within 50 feet of the existing NCDOT right-of-way and all existing interchanges.
- **Future Land Use Study Area (FLUSA)** – The one-mile radius study area defined for evaluating the indirect potential land use impacts resulting from STIP Project I-4744. This study area was the focus for data collection and analysis for the Indirect and Cumulative Assessment; however, it is not meant to infer that land use effects resulting from the project will be felt throughout the FLUSA.

3.1. Existing Land Use

The Project Study Area is urbanized with existing land use comprised of a mixture of uses, including residential, office, retail, recreational, vacant/wooded, and institutional. Residential developments comprise a large amount of the study area with more established single-family residential uses mixed with several newer, higher density residential communities. Several townhome and apartment complexes are located along the corridor, including in the Farm Gate Road area, neighborhoods south of Cary Towne Boulevard, and north of Trinity Road near the Corporate Center. Numerous single family residential neighborhoods also line the project corridor. More information on the neighborhoods adjacent to the project corridor can be found in Section 3.3.1.

Both Meredith College and North Carolina State University are approximately one mile east of the project corridor. North Carolina State's Centennial Campus is located just east of Lake Johnson. There are student populations scattered throughout the study area due to the proximity to these schools. There is a higher concentration of student housing in the southeastern portion of the study area.

Commercial land uses are concentrated at the NC 54/Chapel Hill Road and I-440/US 1-64 interchanges. Recreational and institutional land uses at the northern portion of the project corridor include Schenck Memorial Forest, William B. Umstead State Park and North Carolina State University Field Laboratory on Trenton Road. Lake Johnson Park, WakeMed Soccer Park, and Walnut Creek Park are also located in the study area.

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3.2. Socioeconomic Conditions

In order to analyze the population characteristics of the Direct Community Impact Area (DCIA), a Demographic Area was identified. The Demographic Area is located entirely within Wake County, and partially in both Raleigh and Cary. US Census Tracts and Block Groups were chosen in order to be able to compare 1990 and 2000 data. The Demographic Area is comprised of the following 2000 US Census Tracts and Block Groups (see Figure 3.2):

- Census Tract 524.01; Block Group 1;
- Census Tract 524.02, Block Group 3;
- Census Tract 530.01, Block Group 2;
- Census Tract 530.02, Block Group 1;
- Census Tract 535.01, Block Groups 4 and 5; and
- Census Tract 535.10, Block Groups 3 and 4.

3.2.1. Population and Demographic Characteristics

3.2.1.1. Population and Growth Trends

As indicated in Table 3-1, the Demographic Area experienced a 62.3% population growth between 1990 and 2000, which exceeded the growth pace of Raleigh, Wake County and North Carolina (32.8%, 48.3%, and 21.4% respectively). The Town of Cary experienced a higher population growth rate than the demographic area (115.6%) during the same time period.

Table 3-1. Population Trends, 1990 – 2000

	Population		Change, 1990-2000	
Area	1990	2000	Difference	% Change
Demographic Area	17,155	27,844	10,689	62.3%
Cary	43,858	94,536	50,678	115.6%
Raleigh	207,951	276,093	68,142	32.8%
Wake County	423,380	627,846	204,466	48.3%
North Carolina	6,628,637	8,049,313	1,420,676	21.4%

Source: US Census Bureau, Summary File 1 - Table P1 (1990 & 2000)

3.2.1.2. Ethnicity and Race

According to the 2000 Census, the African American population in the Demographic Area (7.0%) was low compared to Raleigh, Wake County and North Carolina (27.5%, 19.5%, and 21.4% respectively). Individuals identifying themselves as Asian racially represent 7.1% (or 1,970) of the population in the Demographic Area, more than double the County (3.4%) and more than five times the State (1.4%). There was a higher concentration of Asian populations in the northwestern portion of the study area; however, discussions with local planners did not reveal any known Asian communities within the Demographic Area.

The Hispanic population within the Demographic Area as a whole (5.2%) was representative of the municipalities, the County and the State, as shown in Table 3-2. Based on site visit observations and discussions with local planners, several manufactured home parks and apartment buildings in the area have high Hispanic populations, particularly in the Mobile Estates mobile home park which is located west of WakeMed Soccer Park (outside of the

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DCIA) and between Buck Jones Road and Western Boulevard (east of I-40). Upon further analysis of demographic data on the Block Group level, there is a higher concentration of Hispanic populations in the area of Western Boulevard. Census Tract 524.02, Block Group 3 (15.6%) and Census Tract 535.10, Block Group 4 (37.3%), both had a higher concentration of Hispanic populations when compared to the County (5.4%) or the State (4.7%).

Table 3-2. Population by Race/Ethnicity, 2000

Race	Demographic Area	Cary	Raleigh	Wake County	North Carolina
White	78.8%	79.7%	60.3%	69.9%	70.2%
White Hispanic	2.4%	2.5%	3.0%	2.5%	2.0%
Black or African American	7.0%	6.1%	27.5%	19.5%	21.4%
Black Hispanic	0.1%	0.1%	0.3%	0.2%	0.2%
American Indian/Alaska Native	0.2%	0.2%	0.3%	0.3%	1.2%
Hispanic	0.0%	0.1%	0.1%	0.1%	0.1%
Asian	7.1%	8.1%	3.4%	3.4%	1.4%
Asian Hispanic	0.0%	0.0%	0.0%	0.0%	0.0%
Native Hawaiian/Pacific Islander	0.0%	0.0%	0.0%	0.0%	0.0%
Hispanic	0.0%	0.0%	0.0%	0.0%	0.0%
Other Race	0.1%	0.2%	0.1%	0.1%	0.1%
Other Race Hispanic	2.2%	1.3%	3.1%	2.3%	2.2%
Two or More Races	1.5%	1.5%	1.4%	1.3%	1.0%
Two or More Races Hispanic	0.4%	0.3%	0.5%	0.4%	0.3%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
Total Hispanic	5.2%	4.3%	7.0%	5.4%	4.7%

Source: US Census Bureau, Summary File 1 - Table P8 (2000)

3.2.1.3. Income Levels

As shown in Table 3-3, in 1999, the median household income in the Demographic Area was $65,956, which was considerably higher than that of the County ($54,988) and the State ($39,184). The median household income in the Demographic Area grew at 64.2% between 1989 and 1999, higher than the County (51.8%) and the State (47.0%).

Table 3-3. Median Household Income, 1989 and 1999

Area	Median Household Income		Growth, 1989-1999	
	1989	1999	Difference	% Change
Demographic Area	$40,180	$65,956	$25,776	64.2%
Cary	$46,259	$75,122	$28,863	62.4%
Raleigh	$32,451	$46,612	$14,161	43.6%
Wake County	$36,222	$54,988	$18,766	51.8%
North Carolina	$26,647	$39,184	$12,537	47.0%

Source (1989 Data): US Census Bureau, Summary File 1 - Table P3 and Summary File 3 - Table P80A (1990)
Source (1999 Data): US Census Bureau, Summary File 1 - Table P15 and Summary File 3 - Table P53 (2000)

In 1999, 6.3% of the population within the Demographic Area was living below the poverty level (see Table 3-4). This was lower than Wake County (7.8%) and North Carolina (12.3%). The Demographic Area experienced a slight increase in poverty between 1989 and 1999 (0.4%). In contrast, the County and State percentages slightly lowered over the same 10-year period. Although the demographic analysis did not reveal evidence of low income communities within the DCIA, discussions with local planners revealed lower income

neighborhoods concentrated within the DCIA along Walnut Street south of Cary Towne Boulevard.

Table 3-4. Population Below Poverty Level, 1989 and 1999

Area	1989	1999	Change 1989 - 1999
Demographic Area	5.9%	6.3%	0.4%
Cary	3.2%	3.4%	0.3%
Raleigh	11.8%	11.5%	-0.4%
Wake County	8.4%	7.8%	-0.6%
North Carolina	13.0%	12.3%	-0.7%

Source: US Census Bureau, Summary File 3 - Table P117 (1990) and Summary File 3 - Table P87 (2000)

3.2.1.4. Business and Employment Characteristics

Major employment centers within the DCIA are located along Jones Franklin Road, the SAS Campus, the Raleigh Corporate Center, and the Weston Parkway corridor (accessed via Harrison Avenue). The SAS Campus, located immediately south of I-40 between Harrison Avenue and Wade Avenue, is the corporate headquarters for SAS Institute, Inc. SAS Institute Inc. (SAS) is one of the world's largest privately-held software companies with over 10,000 total employees. Other major employers located in Wake County, but outside the DCIA, are the State of North Carolina, North Carolina State University, Wake County Public Schools, and Wake Medical Center.

Between 1990 and 2000, Wake County experienced more than double the employment growth than North Carolina as a whole. As shown in Tables 3-5 and 3-6, the number of total jobs increased by 53.9% in Wake County, as compared to 25.7% in North Carolina. In Wake County, more than 134,000 jobs were gained in the 1990s.

As shown in Tables 3-5 and 3-6, employment growth slowed considerably for Wake County and North Carolina between 2000 and 2006. Growth in Wake County went from 53.9% growth rate in the 1990s to 10.9% growth between 2000 and 2006. The State of North Carolina saw its employment growth rate decrease from 25.7% in the 1990s to 2.2% between 2000 and 2006.

In Wake County, the government sector experienced the largest increase in number of jobs (12,380) and company/enterprise management continued to see the largest percentage-based increase (80.5%). Contrary to the market in the 1990s, five employment sectors in Wake County saw a reduction in the number of jobs, most of which were in the manufacturing sector (6,533 less jobs). North Carolina also saw the largest decrease in number of jobs in the manufacturing sector (approximately 200,000 fewer jobs) between 2000 and 2006. This also translated into the largest percentage of jobs lost in North Carolina (-27.2%). Between 2000 and 2006, health care and social assistance gained over 90,500 additional jobs (the highest in the State), and the educational services sector experienced the largest percent growth (33.0%).

Table 3-5. Employment Growth by Sector, Wake County, 1990-2006

Sector	Employment			Change, 1990-2000		Change, 2000-2006	
	1990	2000	2006	Difference	% Change	Difference	% Change
Agriculture, Forestry, Fishing & Hunting	492	840	795	348	70.7%	-45.0	-5.4%
Mining	600	884	548	284	47.3%	-336.0	-38.0%
Utilities	*	*	1,509	N/A	N/A	N/A	N/A
Construction	15,708	27,780	31,559	12,072	76.9%	3,779.0	13.6%
Manufacturing	24,694	28,251	21,718	3,557	14.4%	-6,533.0	-23.1%
Wholesale Trade	13,769	18,744	19,050	4,975	36.1%	306.0	1.6%
Retail Trade	29,685	47,056	49,271	17,371	58.5%	2,215.0	4.7%
Transportation and Warehousing	9,228	11,139	9,039	1,911	20.7%	-2,100.0	-18.9%
Information	6,725	18,111	16,630	11,386	169.3%	-1,481.0	-8.2%
Finance and Insurance	11,201	13,604	15,134	2,403	21.5%	1,530.0	11.2%
Real Estate and Rental and Leasing	4,081	7,024	8,092	2,943	72.1%	1,068.0	15.2%
Professional and Technical Services	13,214	28,874	35,204	15,660	118.5%	6,330.0	21.9%
Management of Companies and Enterprises	2,127	5,905	10,656	3,778	177.6%	4,751.0	80.5%
Administrative and Waste Services	15,586	32,289	32,631	16,703	107.2%	342.0	1.1%
Educational Services	3,374	4,416	6,247	1,042	30.9%	1,831.0	41.5%
Health Care and Social Assistance	14,917	24,895	33,311	9,978	66.9%	8,416.0	33.8%
Arts, Entertainment, and Recreation	2,432	5,027	5,941	2,595	106.7%	914.0	18.2%
Accommodation and Food Services	18,904	28,080	33,755	9,176	48.5%	5,675.0	20.2%
Other Services (Excluding Public Admin)	7,947	12,205	13,842	4,258	53.6%	1,637.0	13.4%
Public Administration	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Unclassified	*	*	2,149	N/A	N/A	N/A	N/A
Government	50,590	66,558	78,938	15,968	31.6%	12,380.0	18.6%
Total**	**249,771**	**384,299**	**426,015**	**134,528**	**53.9%**	**41,716.0**	**10.9%**

Source: North Carolina Employment Security Commission (NCESC)

** Data Supressed by NCESC*

*** Does not include sectors in which either year's data was supressed*

N/A = Not Applicable

Table 3-6. Employment Growth by Sector, North Carolina, 1990-2006

Sector	Employment			Change, 1990-2000		Change, 2000-2006	
	1990	2000	2006	Difference	% Change	Difference	% Change
Agriculture, Forestry, Fishing & Hunting	21,827	31,371	29,513	9,544	43.7%	-1,858	-5.9%
Mining	3,993	4,261	3,704	268	6.7%	-557	-13.1%
Utilities	26,626	15,090	13,171	-11,536	-43.3%	-1,919	-12.7%
Construction	166,733	231,432	243,440	64,699	38.8%	12,008	5.2%
Manufacturing	820,239	759,012	552,927	-61,227	-7.5%	-206,085	-27.2%
Wholesale Trade	139,697	166,187	176,608	26,490	19.0%	10,421	6.3%
Retail Trade	377,026	454,082	451,067	77,056	20.4%	-3,015	-0.7%
Transportation and Warehousing	82,772	120,863	114,361	38,091	46.0%	-6,502	-5.4%
Information	57,615	84,047	73,103	26,432	45.9%	-10,944	-13.0%
Finance and Insurance	102,412	126,118	148,931	23,706	23.1%	22,813	18.1%
Real Estate and Rental and Leasing	32,488	47,940	51,904	15,452	47.6%	3,964	8.3%
Professional and Technical Services	89,618	145,392	171,111	55,774	62.2%	25,719	17.7%
Management of Companies and Enterprises	35,104	68,391	69,095	33,287	94.8%	704	1.0%
Administrative and Waste Services	108,590	228,782	234,725	120,192	110.7%	5,943	2.6%
Educational Services	22,091	40,263	53,531	18,172	82.3%	13,268	33.0%
Health Care and Social Assistance	203,641	321,748	412,254	118,107	58.0%	90,506	28.1%
Arts, Entertainment, and Recreation	27,952	45,751	48,421	17,799	63.7%	2,670	5.8%
Accommodation and Food Services	205,943	279,328	325,690	73,385	35.6%	46,362	16.6%
Other Services (Excluding Public Admin)	77,172	97,900	98,617	20,728	26.9%	717	0.7%
Public Administration	*	N/A	*	N/A	N/A	N/A	N/A
Unclassified	*	*	24,232	N/A	N/A	N/A	N/A
Government	476,906	603,159	660,258	126,253	26.5%	57,099	9.5%
Total**	**3,079,017**	**3,871,116**	**3,956,664**	**792,099**	**25.7%**	**85,548**	**2.2%**

Source: North Carolina Employment Security Commission (NCESC)

** Data Supressed by NCESC*

*** Does not include sectors in which either year's data was supressed*

N/A = Not Applicable

3.3. Community Characteristics

3.3.1. Neighborhoods

The DCIA is wholly in Wake County, and is split between the City of Raleigh and Town of Cary's jurisdictions. The DCIA is comprised of numerous named and unnamed neighborhoods. A majority of the neighborhoods are moderate single family homes and higher density residential units.

There are two apartment complexes - Trinity Park and Trinity Ridge - just north of the Raleigh Corporate Center, on the east side of I-40. The western side of I-40 between Trinity Road and NC 54 is primarily residential. Newly constructed upscale single-family homes are located in Brandywine, and they are surrounded by older, more modest single-family homes in Medfield Estates and Trinity Woods.

South of NC 54 and to the west of I-40 is WakeMed Soccer Park. Several mobile home parks, including Mobile Estates, are located to the west of the Soccer Park. South of the Soccer Park, and between Cary Towne Boulevard and I-440/US 1-64, are some older, more modest single-family neighborhoods called Ivy Meadows and Walnut Hills. On the eastern side of I-40, between NC 54 and I-440/US 1-64, is a mixture of older, modest single-family homes such as those in Glosson Estates, Hunters Run and Roylene Acres. Multi-family communities are clustered between Western Boulevard and Buck Jones Road. Construction of Clairmont Apartments is ongoing just south of Western Boulevard. There are other apartment complexes in this area as well. Sunpointe Condominiums and Greenbelt Townhomes are located south of the Clairmont Apartments. Additionally, there is some multi-family construction near the Crossroads Plaza, south of I-440/US 1-64.

One of these neighborhoods, Roylene Acres, has an adopted plan to guide development. The *Roylene Acres Neighborhood Plan* (adopted 2007) was developed to make the zoning more compatible with actual development, and is a part of the City of Raleigh's *Southwest District Plan*. The neighborhood is bounded by Buck Jones Road to the north, Walnut Creek to the south and west, and Wilmont Drive to the east. The Plan calls for rezoning of the neighborhood to Neighborhood Conservation Overlay District.

3.3.2. Community Facilities

There are a number of community facilities located in the DCIA. These facilities are shown on Figure 3.2. Community facilities include schools, churches, daycares, a police station, parks and recreation facilities, commercial centers, and historic sites/districts. Based on site visit observations and GIS data, only one school was identified within the study area: Grace Christian School. Two daycares were observed within the DCIA: Childcare Network and Bright Horizons Child Care. The Town of Cary's Crossroad Police Substation, located near Crossroads Plaza, is the only police substation located within the DCIA.

Childcare Network

The following three churches were observed in the DCIA area during site visits: Ephesus Baptist Church, Hope Community Church, and All Saints Orthodox Church. Parks and recreational areas that are publicly-owned include Lake Johnson Nature Park, Walnut Creek Park and Greenway, William B. Umstead State Park, and WakeMed Soccer Park (formerly SAS Soccer Park).

Schenck Forest is in the northern part of the DCIA and is a research forest for the Department of Forestry at North Carolina State University. North Carolina State University owns land in the northern part of the DCIA that is used as an agricultural field laboratory.

Other regionally notable facilities exist outside of the DCIA. These facilities include the RBC Center at Edwards Mill Road and Wade Avenue, the State Fairgrounds at Trinity Road and Blue Ridge Road, Meredith College (located east of I-440 at Wade Avenue), North Carolina State University in the center of Raleigh, and Rex Hospital located on Blue Ridge Road north of its interchange with Wade Avenue.

3.4 Infrastructure and Utilities

3.4.1. Electrical Power Transmission

Based on the subsurface utility engineering (SUE) data contained in the preliminary design plans provided by NCDOT Roadway Design (dated May 2008), overhead electrical power transmission lines run along portions of both sides of the existing I-40 right-of-way in the DCIA:

- Along both sides of I-40 at the start of the project to just west of Trenton Road;
- Along the west side of I-40 between Trinity Road and Chapel Hill Road;
- On the west side of I-40 between Chatham Street and Cary Towne Boulevard;
- Along the western side of I-40 between Buck Jones Road and US 1-64; and
- Crossing I-40 just south of Buck Jones Road along the east side of I-40 to Jones Franklin Road.

3.4.2. Water and Sewer

In the DCIA, water and sewer services are provided by the City of Raleigh and Town of Cary. Municipal water and sewer service is prevalent throughout the DCIA. However, there are some small pockets of residential areas within the DCIA (e.g., Trinity Woods) which are serviced by septic systems and private wells. Based on the available GIS data, it appears there are several municipal water and sewer lines located immediately adjacent to or within the existing I-40 right-of-way within the study area. These lines appear to parallel the existing right-of-way boundary in several areas.

Based on the subsurface utility engineering (SUE) data contained in the preliminary design plans provided by NCDOT Roadway Design (dated May 2008), there are two water lines in the study area. There is a 12” ductile iron pipe that crosses I-40 east of Jones Franklin Road and a 30” ductile iron pipe that crosses I-40 north of NC 54.

Two sanitary sewer lines (27” and 30”) cross I-40 adjacent to Walnut Creek within a 50-ft easement. A 50-foot sanitary sewer and utility easement encroaches into the right-of-way and crosses I-40 between Cary Towne Boulevard/Western Boulevard and Buck Jones Road. Another sanitary sewer and utility easement is located just north of Buck Jones Road and crosses I-40. In addition, an 8-inch sanitary sewer force main crosses I-40 north of Jones Franklin Road.

3.4.3. Natural Gas

Based on the subsurface utility engineering (SUE) data contained in the preliminary design plans provided by NCDOT Roadway Design Unit (dated May 2008), there are three natural gas line crossings in the DCIA. These crossings are located: north of NC 54 (12-inch line), south of Hillsborough Street (8-inch line), and east of Jones Franklin Road (6-inch line).

3.4.4. Telephone and Fiber Optic

Telephone and fiber optic lines run in the following locations along the project corridor: from the start of project on the east side of I-40 then following Wade Avenue off to the east and following Cary Towne Boulevard from the west approaching I-40 and ending in the existing right-of-way on the west side of I-40.

Based on the subsurface utility engineering (SUE) data contained in the preliminary design plans provided by NCDOT Roadway Design (dated May 2008), there are five crossings of telephone and fiber optic lines along I-40 within the DCIA:

- East of Trenton Road (SR 1655);
- South of Trinity Road (SR 1656);
- Over I-40 at Chapel Hill Road via conduit attached to the bridge;
- Over I-40 at Hillsborough Street via conduit attached to the bridge; and
- Over I-40 at Jones Franklin Road via conduit attached to the bridge.

3.4.5. Stormwater

The Project Study Area lies entirely within North Carolina Division of Water Quality (DWQ) subbasin 03-04-02 (NCDWQ 2002) of the Neuse River Basin. Consequently, the proposed project is subject to Neuse Buffer Regulations.

3.5. Cultural Resources

3.5.1. Archaeological and Historic Resources

This project is subject to compliance with Section 106 of the National Historic Preservation Act of 1966, as amended, and implemented by the Advisory Council on Historic Preservation's (ACHP) Regulations for Compliance with Section 106, codified as 36 CFR Part 800. Section 106 requires federal agencies to take into account the effect of their undertakings (federally-funded, licensed, or permitted) on properties included in or eligible for inclusion in the National register of Historic Places and to afford the ACHP a reasonable opportunity to comment on such undertakings.

In a memorandum dated June 4, 2007, the North Carolina State Historic Preservation Office (HPO) determined that the project would not affect any historic structures. Accordingly, NCDOT architectural historians did not initiate a survey of the project area. A copy of this memorandum is included in Appendix A. Further correspondence with the HPO on November 19, 2008 confirmed that there will be no affect to archaeological resources as a result of the project. Accordingly, NCDOT archaeologists did not initiate a survey of the project area. A copy of this correspondence is also included in Appendix A.

3.6. Section 4(f) and Section 6(f) Resources

3.6.1. Background

Section 4(f) of the United States Department of Transportation Act of 1996 states that the Administration may not approve the use of land from a significant publicly owned public park, recreation area, or wildlife and waterfowl refuge, or any significant historic site unless a determination is made that:

1) there is no prudent and feasible alternative to using that land; and
2) the action includes all possible planning to minimize harm to the property resulting from such use.

Section 6(f) of the Land and Water Conservation Act requires that any recreation lands that have received Land and Water Conservation Fund (LWCF) money and are converted to non-recreational purposes must be replaced with land of equal or greater value, location, and usefulness. Any land conversions on property that has received LWCF money must be approved by the US Department of the Interior – National Park Service. In North Carolina, the Land and Water Conservation Fund program is administered by the NC Department of Environment and Natural Resources Division of Parks and Recreation.

3.6.2. Section 4(f) and Section 6(f) Resources in Study Area

Section 4(f) and Section 6(f) resources were identified within the DCIA and are listed in Table 3-7. There were four Section 4(f) resources identified within the study area. The Crabtree Creek Recreational Demonstration Area, now know as William B. Umstead State Park, is also a Section 6(f) resource.

Table 3-7. Section 4(f) and Section 6(f) Resources

Resource Name	Section 4(f) or Section 6(f)
Publicly-Owned Recreation Area	
William B. Umstead State Park	Section 4(f) and Section 6(f)
Schenck Memorial Forest	Section 4(f)
WakeMed Soccer Park	Section 4(f)
Walnut Creek Park and Greenway	Section 4(f)
Lake Johnson Nature Park	Section 4(f)
Resources List or Eligible for Listing in the National Register of Historic Places	
Crabtree Creek Recreational Demonstration Area (William B. Umstead State Park)	Section 4(f) and Section 6(f)

Source: Wake County Property Tax Data (www.wakegov.com), accessed September 2008
National Park Service (www.nps.gov/ncrc/programs/lwcf/), accessed September 2008

3.7. Air Quality

An air quality analysis was performed for the project and is documented in the *STIP Project I-4744 Final Air Quality Technical Report* (January 2009) which is incorporated by reference. This study included a quantitative carbon monoxide (CO) "hotspot" analysis using CAL3QCH (2.0) to determine if the Build Alternative would cause CO levels to exceed the National Ambient

Air Quality Standards (NAAQS). In addition, a quantitative Mobile Source Air Toxics (MSATs) analysis was prepared.

3.7.1. Transportation Conformity

Transportation conformity is discussed at two levels, area and local. The area determination is referred to as regional transportation conformity. The local determination is referred to as project-level conformity.

Regional Conformity

The project is located in Wake County which is in the Eastern Piedmont Intrastate Air Quality Control Region (AQCR #166). This area is within the Raleigh-Durham-Chapel Hill maintenance attainment area for ozone (O_3) and the Raleigh Durham maintenance area for carbon monoxide (CO) as defined by the Environmental Protection Agency (EPA). The 1990 Clean Air Act Amendments (CAAA) had originally designated this area as moderate non-attainment area for CO. However, due to improved monitoring data, this area was redesignated as maintenance for CO on September 18, 1995. This area was previously designated non-attainment for O_3 under the eight-hour ozone standard effective June 15, 2004. However, due to improved monitoring data, this area was redesignated as maintenance for O_3 under the eight-hour standard on December 26, 2007.

Section 176(c) of the CAAA requires that transportation plans, programs, and projects conform to the state air quality implementation plan (SIP). The current SIP does not contain any transportation control measures for Wake County. The *Capital Area Metropolitan Planning Organization 2030 Long Range Transportation Plan* (2030 LRTP) and the Raleigh-Durham-Chapel Hill portion of the *NCDOT 2009-2015 State Transportation Improvement Program* (STIP) conform to the SIP. The United State Department of Transportation (USDOT) made a conformity determination on the *2030 LRTP* on October 1, 2008 and the STIP on October 1, 2008. The current conformity determination is consistent with the final conformity rule found in 40 CFR Parts 51 and 93. There are no significant changes in the project's design concept or scope, as used in the conformity analyses.

Project-Level Conformity - CO, $PM_{2.5}$ and PM_{10}

Project-level conformity analysis is designed to evaluate whether there are air quality impacts on a smaller scale than an entire nonattainment or maintenance area. It includes a hotspot analysis, which evaluates the impact of a project on the NAAQS on a more localized basis. Conformity to the purpose of the SIP means that transportation activities will not cause new air quality violations, worsen existing violations, or delay timely attainment of the Standards. The carbon monoxide (CO) analysis is done on a quantitative basis, to determine whether estimated project concentrations of CO exceed the established one-hour and/or eight-hour standards. If they do not, the project conforms. If required, hotspot analysis for $PM_{2.5}$ and PM_{10} is done on a qualitative basis until appropriate methods and modeling guidance are available for quantitative analysis. $PM_{2.5}$ and/or PM_{10} project-level conformity does not apply to this project, because it is not in a $PM_{2.5}$ and PM_{10} nonattainment or maintenance area.

3.7.2. Mobile Source Air Toxics (MSATs)

MSATs Background

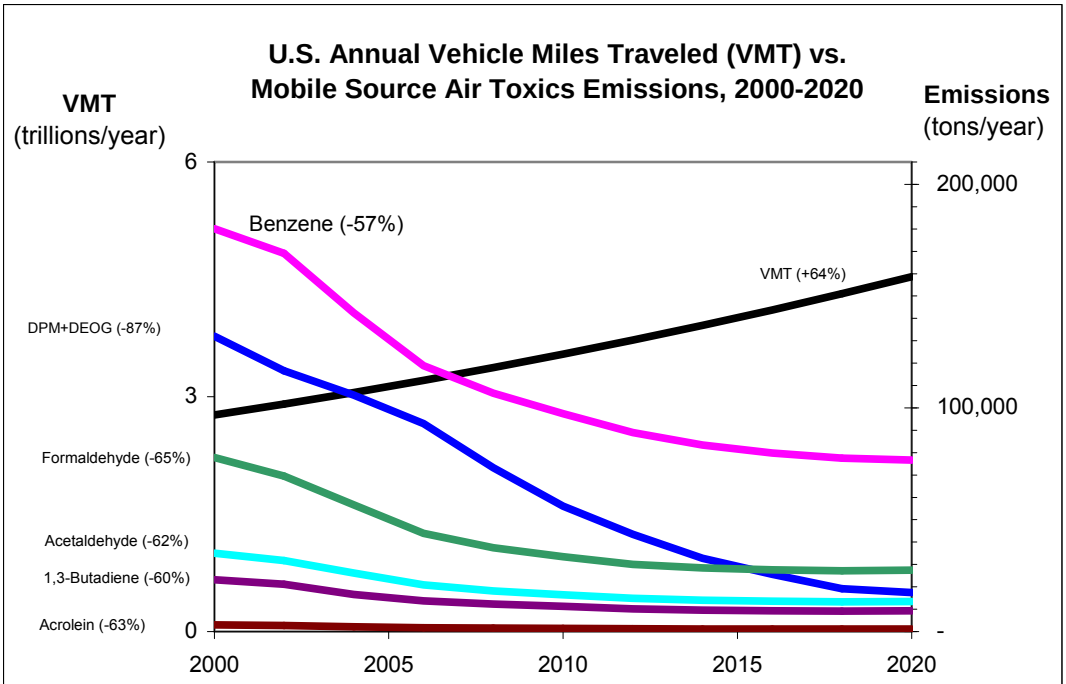
In addition to the air pollutants regulated by EPA under the National Ambient Air Quality Standards (NAAQS), the EPA also regulates air toxics. Most air toxics originate from human-made sources, including on-road mobile sources, non-road mobile sources (e.g., airplanes), area sources (e.g., dry cleaners) and stationary sources (e.g., factories or refineries).

The Clean Air Act identified 188 air toxics, also known as hazardous air pollutants. The EPA has assessed this expansive list of toxics and identified a group of 21 as mobile source air toxics, which are set forth in their March 2001 final rule, Control of Emissions of Hazardous Air Pollutants from Mobile Sources (66 FR 17235). The EPA also extracted a subset of this list of 21 that FHWA refers to as the six priority MSATs. These are benzene, formaldehyde, acetaldehyde, diesel particulate matter/diesel exhaust organic gases, acrolein, and 1,3-butadiene. The MSATs are compounds emitted from highway vehicles and non-road equipment. Some toxic compounds are present in fuel and are emitted to the air when the fuel evaporates or passes through the engine unburned. Other toxics are emitted from the incomplete combustion of fuels or as secondary combustion products. Metal air toxics also result from engine wear or from impurities in oil or gasoline.

The EPA is the lead Federal Agency for administering the Clean Air Act (CAA) and has certain responsibilities regarding the health effects of MSATs. Their March 2001 rule was issued under the authority of Section 202 of the Clean Air Act. In the rule, EPA examined the impacts of existing and newly promulgated mobile source control programs, including its reformulated gasoline (RFG) program, its national low emission vehicle (NLEV) standards, its Tier 2 motor vehicle emissions standards and gasoline sulfur control requirements, and its proposed heavy duty engine and vehicle standards and on-highway diesel fuel sulfur control requirements. Between 2000 and 2020, FHWA projects that even with a 64 percent increase in vehicle miles traveled (VMT), these programs will reduce on-highway emissions of benzene, formaldehyde, 1,3-butadiene, and acetaldehyde by 57 percent to 65 percent, and will reduce on-highway diesel particulate PM emissions by 87 percent, as shown in Graph 3-1.

Early in 2007 and under authority of CAA Section 202(l), EPA issued a new rule, Control of Hazardous Air Pollutants from Mobile Sources, to regulate mobile source air toxics (MSATs). Under this rule, EPA set standards on fuel composition, vehicle exhaust emissions, and evaporative losses from portable containers. Beginning in 2011, refineries will be required to limit the annual benzene content of gasoline to an annual average refinery average of 0.62%. The rule also sets a new vehicle exhaust emission standard for non-methane hydrocarbon (NMHC) including MSAT compounds, to be phased in between 2010 and 2013 for lighter vehicles and 2012 and 2015 for heavier vehicles. These new rules became effective on April 27, 2007. The new standards are estimated to reduce total emissions of MSATs by 330,000 tons in 2030, including 61,000 tons of benzene. Concurrently, total emissions of volatile organic compounds (VOC) will be reduced by over 1.1 million tons in 2030 as a result of adopting these standards.

Graph 3-1:



Notes: For on-road mobile sources. Emissions factors were generated using MOBILE6.2. MTBE proportion of market for oxygenates is held constant, at 50%. Gasoline RVP and oxygenate content are held constant. VMT: *Highway Statistics 2000*, Table VM-2 for 2000, analysis assumes annual growth rate of 2.5%. "DPM + DEOG" is based on MOBILE6.2-generated factors for elemental carbon, organic carbon and SO4 from diesel-powered vehicles, with the particle size cutoff set at 10.0 microns.

MSAT Analysis Guidance

FHWA's *Interim Guidance on Air Toxics Analysis in NEPA Documents* (February 2006) presents a tiered approach for analyzing MSATs. Depending on project specifics, FHWA has identified three levels of analysis:

- Tier I: No analysis for projects with no potential for meaningful MSAT effects;
- Tier II: Qualitative analysis for projects with low potential MSAT effects; or
- Tier III: Quantitative analysis to differentiate alternatives for projects with higher potential MSAT effects.

The proposed I-40 operational improvements meet FHWA's criteria for a Tier III analysis. The widening component of the project would add significant capacity to an urban interstate with traffic volumes projected to be in the range of 140,000 to 150,000 AADT or greater by the design year; and also be located in proximity to populated areas. As such a quantitative analysis of potential MSAT emissions for the six priority MSATs for each alternative is required.

Tier III MSAT Analysis

Daily forecasted traffic volumes in 2035 are projected to exceed 140,000 vehicles per day (annual average daily traffic (AADT) on four segments of the proposed project:

- Western project work limits to the Wade Avenue Interchange (191,600 AADT);
- NC 54 to Cary Towne Boulevard (142,600 AADT);
- Cary Towne Boulevard to I-440/US 1-64 (156,300 AADT); and
- I-440/US 1-64 to the eastern project work limits (175,300 AADT).[3]

Comparable No-Build Alternative 2035 AADT traffic volumes for the same four segments are 186,000, 127,600, 138,500, and 168,500, respectively.[4] The segments south and east of NC 54 are adjacent to residential areas and the Grace Christian School is just east of Buck Jones Road. Based on the Federal Highway Administration's (FHWA's) *Interim Guidance on Air Toxic Analysis in NEPA Documents* (February 3, 2006), the traffic volumes and project setting suggest that the project has a higher potential for Mobile Source Air Toxics (MSATs) effects. Therefore, a quantitative assessment of air toxic emissions has been completed for this project. The discussion of this analysis appears in its entirety in Chapter 4.8.2.

3.8. Noise

3.8.1. Characteristics of Noise

Sound is a form of vibration that causes pressure variations in elastic media such as air and water. Noise is defined as unwanted and disruptive sound. The ear is sensitive to this pressure variation and perceives it as sound. The intensity of these pressure variations causes the ear to discern different levels of loudness. These pressure differences are most commonly measured in decibels.

The decibel (dB) is the unit of measurement for sound. The decibel scale audible to humans spans approximately 140 dB. A level of zero decibels corresponds to the lower limit of audibility, while 140 decibels produces a sensation more akin to pain than sound. The decibel scale is a logarithmic representation of the actual sound pressure variations. Therefore, a 26 percent change in the energy level only changes the sound level one dB. The human ear would not detect this change except in an acoustical laboratory. A doubling of the energy level would result in a three-dB increase, which would be barely perceptible in the natural environment. A tripling in energy sound level would result in a clearly noticeable change of five-dB in the sound level. A change of ten times the energy level would result in a ten-dB change in the sound level. This would be perceived as a doubling (or halving) of the apparent loudness.

The human ear has a non-linear sensitivity to noise. To account for this in noise measurements, electronic weighting scales are used to define the relative loudness of different frequencies. The "A" weighting scale is widely used in environmental work because it closely resembles the nonlinearity of human hearing. Therefore, the unit of measurement for an A-weighted noise level is dBA.

Traffic noise is not constant. It varies as each vehicle passes a point. The time-varying characteristics of environmental noise are analyzed statistically to determine the duration and intensity of noise exposure. In an urban environment, noise is made up of two distinct parts. One is ambient or background noise. Wind noise and distant traffic noise make up the acoustical environment surrounding the project. These sounds are not readily recognized, but combine to produce a non-irritating ambient sound level. This background sound level varies throughout the day, being lowest at night and highest during the day. The other component of urban noise is intermittent and louder than the background noise. Transportation noise and local industrial noise are examples of this type of noise. It is for these reasons that environmental noise is analyzed statistically.

[3] NCDOT STIP Project I-4744 Traffic Forecast Technical Memorandum, HNTB, September 2008.
[4] Ibid.

The statistical descriptor used for traffic noise is Leq. Leq is the constant, average sound level, which over a period of time contains the same amount of sound energy as the varying levels of the traffic noise. The Leq correlates reasonably well the effects of noise on people. It is also easily measurable with integrating sound level meters. The time period for traffic noise is 1-hour. Therefore, the unit of measure for traffic noise is Leq(1h) dBA.

Tires are the dominant noise source at speeds greater than 50 mph for trucks and automobiles. Tire sound levels increase with vehicle speed but also depend upon road surface, vehicle weight, tread design and wear. Change in any of these can vary noise levels. At lower speeds, especially in trucks and buses, the dominant noise source is the engine and related accessories.

3.8.2. Noise Analysis Background

The FHWA's *Procedures for Abatement of Highway Traffic Noise and Construction Noise* is presented in the Code of Federal Regulations, Title 23 Part 772 (23 CFR 772). This regulation, plus other guidance documents written to explain the regulation, sets forth the process for performing a traffic noise analysis. The process includes the following:

- Identify existing and proposed land uses in the study area;
- Determine existing noise levels either:
  - Through modeling, or
  - Noise measurements with concurrent classification counts of vehicles passing the noise monitoring site;
- Model future design year traffic noise levels which will yield the worst hourly traffic noise on a regular basis (design hour noise levels);
- Identify locations that would be exposed to a noise impact based upon the Noise Abatement Criteria (NAC);
- Model noise abatement measures to mitigate the future traffic noise impacts; and
- Modeling must be performed with FHWA's most recent version of the Traffic Noise Model® (TNM).

NCDOT's *Traffic Noise Abatement Policy* is the state's tool for implementing 23 CFR 772. The NAC, which is presented in 23 CFR 772, establishes the noise abatement criteria for various land uses. The noise level descriptor used is the equivalent sound level, L_{eq}, defined as the steady state sound level which, in a stated time period, usually one hour, contains the same sound energy as the actual time-varying sound. The term L_{eq}(1h) or "hourly L_{eq}" is used to describe the L_{eq} in an hour's time. The NAC is presented in Table 3-17.

Based on the NCDOT's *Traffic Noise Abatement Policy*, noise abatement measures will be considered when the predicted noise levels approach or exceed those values shown for the appropriate activity category in Table 3-8, or when the predicted traffic noise levels substantially exceed the existing noise levels. Approach values are defined as being 1 dBA less than the noise levels shown in Table 3-8. The NCDOT has defined a 10 to 15 dBA increase over existing L_{eq} noise levels on a sliding scale from an existing noise level of 50 dBA or less to 55 dBA or more L_{eq} as being a substantial increase.

TNM® is FHWA's "computer program for highway traffic noise prediction and analysis."[5] The following parameters are used in this model to calculate an hourly L_{eq}(1h) at a specific receiver location:

- Distance between roadway and receiver;
- Relative elevations of roadway and receiver;

[5] Ibid, Report Documentation Page.

- Hourly traffic volume in light-duty (two axles, four tires), medium-duty (two axles, six tires), and heavy-duty (three or more axles) vehicles;
- Vehicle speed;
- Ground absorption; and
- Topographic features, including retaining walls and berms.

Table 3-8. Noise Abatement Criteria, Hourly A-Weighted Sound Level-Decibels (dBA)

Activity Category	$L_{eq}(1h)$	Description of Activity Category / Land Uses
A	57 dBA (Exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the lands are to continue to serve their intended purpose.
B	67 dBA (Exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries and hospitals.
C	72 dBA (Exterior)	Developed lands, properties or activities not included in Categories A or B above.
D	---	Undeveloped lands.
E	52 dBA (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals and auditoriums.

Source: Code of Federal Regulations, Title 23 Part 772, Revised April 2005

3.8.3. Existing Noise Levels

Existing noise level measurements were conducted on June 11, 2008 at three (3) representative residential/multi-family sites in the study area. The measurements were made in accordance with FHWA guidelines using an integrating sound level analyzer meeting the American National Standards Institute (ANSI) and the International Electrotechnical Commission (IEC) Type 1 specifications. Traffic counts were taken at each site, concurrent with the noise measurements. The data collected at the three (3) sites are summarized in Table 3-9. The noise levels measured ranged from 60 to 69 dBA L_{eq}.

Table 3-9. Measured Existing Noise Levels

Field Site #	Site Description	Date	Traffic					Noise Level, dBA $L_{eq}(1h)$
			Direction	Auto	Med Truck	Heavy Truck	Speed mph	
FS-1	Residence 6116 Blanche Drive, Cary, NC, south edge of Blanche Drive, 30 feet west Blanche Driver terminus.	June 11, 2008	EB	658	33	92	70	62
			WB	828	49	68	70	
FS-2	Sunpointe Condominiums, parking lot west of Summerpointe Place, south edge of parking lot, 40 east of west edge.	June 11, 2008	EB	681	32	78	65-70	60
			WB	826	48	78	65-70	
FS-3	Residence 1631 Roanoke Ct, Raleigh, NC, 19 feet south and 7 feet west of southwest corner of residence.	June 11, 2008	EB	860	37	76	65-70	69
			WB	959	27	96	65-70	

1) Autos defined as 2-axle, 4-tire; medium trucks as 2-axle, 6-tire; heavy trucks as 3 or more axles.
Source: STIP Project I-4744 Final Noise Technical Report (January 2009)

The FHWA Traffic Noise Model Version 2.5 was used to model the field measurements, using the traffic counts, to determine the applicability of the model to the specific project environment. Comparing the modeled noise levels to the measured noise levels confirms the applicability of the computer model to the specific project. Two (2) of the three (3) modeled sites compared within ±3 dB of the measured levels. This represents reasonable correlation since the human ear can barely distinguish a 3 dBA change in the $L_{eq}(1h)$ noise level in the urban environment.

3.9. Hazardous Materials

Hazardous material is defined as any material or combination of materials that pose a hazard to human health, welfare, or the environment. Hazardous material sites may include underground storage tanks, auto salvage yards, landfills or lagoons. Hazardous materials take the form of gas, liquid, sludge, or solids and can be radioactive, corrosive, flammable, explosive, infectious, toxic or reactive.

A hazardous material survey was conducted by the North Carolina Department of Transportation, Geotechnical Engineering Unit on August 9, 2007. The GeoEnvironmental Section personnel conducted a field reconnaissance survey and consulted GIS databases, NCDENR UST databases, and Sanborn Maps to identify known environmentally impacting sites in relation to the proposed project right-of-way (i.e., the existing I-40 right-of-way). The GeoEnvironmental Section personnel observed no active or abandoned underground storage tank sites, landfills, unregulated dumpsites, or hazardous waste sites during the field visit and regulatory agency database searches.

3.10. Geology and Soils

Based on soil mapping for Wake County (SCS 1970, NRCS 2006), soil types found within the *Natural Resources Technical Report* (NRTR) Study Area include both hydric and non-hydric series. Approximately 14 percent (88 acres) of the NRTR Study Area is mapped as Chewacla, Colfax, Congaree, Mantachie, Wehadkee, and Worsham series. These soils are listed as hydric soils, or those with hydric inclusions, and are largely confined to geomorphic floodplain. Upland soils make up approximately 86 percent (525 acres) of the NRTR Study Area and include Appling, Cecil, Durham, Pacolet, Udorthents, Wake, Wedowee, and Wilkes series.

Farmland

North Carolina Executive Order Number 96, *Preservation of Prime Agricultural and Forest Lands*, requires all state agencies to consider the impact of land acquisition and construction projects on prime farmland soils, as designated by the U.S. Natural Resources Conservation Service (NRCS.) These soils are determined by the Soil Conservation Survey based on criteria such as crop yield and level of input of economic resources.

The Farmland Protection Policy Act (FPPA) is designed to minimize the degree to which federally sponsored programs contribute to the “unnecessary and irreversible conversion of farmland to non-agricultural uses,” and ensure that programs are consistent with state, local, and private programs to protect farmland.

The study area is predominantly urban in nature, and although some small areas are zoned agricultural, there are no known commercial farming operations.

3.11. Water Resources

3.11.1. Water Resource Characteristics

The NRTR Study Area is located within the South Atlantic/Gulf Region in USGS Hydrologic Unit (HU) 03020201 and the NCDWQ subbasin 03-04-02 (NCDWQ 2002) of the Neuse River Basin. The Neuse River Basin extends over a 6,235 square mile drainage area and contains 3,497 miles of freshwater streams. The basin includes all or portions of 18 counties and 74 municipalities. Fifty-six percent of the land in the Neuse basin is forested, while approximately 23 percent is cultivated cropland.

Within subbasin 03-04-02, three named water bodies occur within the NRTR Study Area: Reedy Creek (NCDWQ Index Number 27-33-8), Richland Creek (27-33-11), and Walnut Creek (27-34-1). In addition to Reedy Creek, Richland Creek, and Walnut Creek, thirty-six unnamed tributaries (UTs) also occur within the NRTR Study Area. These UTs share the same NCDWQ Index Numbers, best usage classifications, and support ratings as the streams into which they flow.

NCDWQ stream rating forms and United State Army Corps of Engineers (USACE) Stream Quality Assessment Worksheets are included in Appendix B and Appendix C of the *Natural Resources Technical Report – I-40 Widening* (July 2008). Streams that typically contain permanent flowing water are classified as perennial, while intermittent streams are characterized by temporal flow interruptions.

3.11.2. Best Usage Classifications

Reedy Creek has been assigned a water quality best usage classification of B, NSW by NCDWQ. Richland Creek and Walnut Creek have been assigned a water quality best usage classification of C, NSW. Class B waters are protected for primary recreation which includes swimming on a frequent or organized basis as well as all Class C uses. The C classification indicates suitability for aquatic life propagation and survival, fishing, wildlife, secondary recreation, and agriculture. Secondary recreation includes activities involving human body contact with water on an infrequent or incidental basis. The NSW classification (Nutrient Sensitive Waters) indicates areas with water quality problems associated with excessive plant growth resulting from nutrient enrichment, and requiring limitations to further nutrient input.

No Water Supply I (WS-I), Water Supply II (WS-II), water supply Critical Areas (CA), High Quality Waters (HQW), or Outstanding Resource Waters (ORW) occur within 1.0 mile of the NRTR Study Area (NCDWQ 2002).

Section 303(d) of the Clean Water Act requires states to develop a list of waters not meeting water quality standards or which have impaired uses. Waters may be excluded from the list if existing control strategies for point and non-point source pollution will achieve the standards or uses. Reedy Creek, Richland Creek, and Walnut Creek are all listed on the N.C. 2006 Final Section 303(d) list (NCDWQ 2006). Reedy Creek, from its source to Crabtree Creek (including the NRTR Study Area) is 303(d) listed for aquatic weeds (*Hydrilla* sp.). Richland Creek, from its source to Crabtree Creek (including the NRTR Study Area) is 303(d) listed for impaired biological integrity. Walnut Creek is also listed for impaired biological integrity, but only for reaches outside and downstream of the NRTR Study Area. These three streams are also listed on the N.C. 2008 draft Section 303(d) list (NCDWQ 2008a).

3.11.3. Water Quality

The NCDWQ has initiated a whole-basin approach to water quality management for the 17 river basins within the state. Water quality within the NRTR Study Area is summarized in the *Neuse Basinwide Water Quality Plan* (NCDWQ 2002). Richland Creek is currently listed by NCDWQ as "Impaired" for its designated uses. Walnut Creek is currently listed as "Fully Supporting" its designated uses, while Reedy Creek has not been rated.

Subbasin 03-04-02 of the Neuse River Basin supports 53 permitted, point source dischargers. Six of the permitted dischargers are classified as major dischargers while the remaining 47 dischargers are minor (NCDWQ 2008b). Richland Creek is the only stream in the NRTR Study Area that is listed as receiving permitted discharge. Richland Creek receives minor discharge from two permitted sources: North Carolina State University (10,000 gallons/day) and Wilco Hess (unlimited discharge). Non-point sources of pollution within the Neuse River Basin include runoff from construction activities, roads and parking lots, agriculture, timber harvesting, and failing septic systems (NCDWQ 2002).

3.11.4. Floodways and Floodplains

The North Carolina Floodplain Mapping Program, in cooperation with the Federal Emergency Management Administration (FEMA) and local governments, developed floodplain boundaries and Flood Insurance Rate Maps (FIRM) for the state of North Carolina. Wake County is a participant in the National Flood Insurance Program (NFIP). As part of the NFIP, the Federal Emergency Management Agency determines floodway boundaries as a toll for floodplain management.

Based on FEMA's definition, the floodplain, or special flood hazard area, is divided into a floodway and a floodway fringe. The floodway is the channel of the stream and the adjacent floodplain area that needs to be kept free of encroachment so the 100-year flood can be carried without increasing the level and extent of flood elevations. The 100-year flood is defined as an event that has a one percent chance of occurring in any given year. The area between the floodway boundary and the 100-year floodplain boundary is known as the floodway fringe. Streams for which detailed hydrological studies have not been conducted do not have defined floodways, so only the 100-year floodplain boundaries are estimated and mapped. Within the study area, I-40 has one crossing of a FEMA-regulated floodplain: Walnut Creek.

3.11.5. Waters of the United States (Section 404 Jurisdictional Areas)

Section 404 of the Clean Water Act (CWA) requires regulation of discharge into "waters of the United States." Although the principle administrative agency of the CWA is the United States Environmental Protection Agency (USEPA), the USACE has major responsibility for implementation, permitting, and enforcement of provisions of the CWA. The USACE regulatory program is defined in 33 CFR parts 320-330.

Water bodies such as rivers, lakes, and streams are subject to jurisdictional consideration under the Section 404 program. Wetlands are described by (33 CFR 328.3(b) [1986]) as:

> *Those areas that are inundated or saturated by groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.*

Open water systems and wetlands receive similar treatment and consideration with respect to Section 404 review. Any action that proposed to place fill into these areas falls under the jurisdiction of USACE under Section 404.

Section 401 of the CWA (33 USC 1341) requires an applicant for a Section 404 permit to obtain certification from the State that the project complies with State water quality standards. The agency responsible for issuing Section 401 water quality certification in North Carolina is the North Carolina Division of Water Quality (NCDWQ).

Jurisdictional Resources

Jurisdictional areas (i.e., streams, wetlands, and surface or open waters) within the NRTR Study Area were delineated and located using GPS technology during the period between March and June 2008. As part of this effort, evidence used to determine wetland boundaries were documented using the USACE Routine Onsite Determination Data Form. The delineation of wetlands and streams within the NRTR Study Area was verified by a USACE representative on June 6, 2008.

Twenty-two (22) jurisdictional intermittent streams and twenty (20) jurisdictional perennial streams were delineated within the NRTR Study Area. The following is a summary of the 42 delineated jurisdictional stream segments in the NRTR Study Area:

- Two stream reaches are part of Walnut Creek;
- Three stream reaches are part of Richland Creek;
- Two stream reaches are part of Reedy Creek;
- Eight stream reaches are unnamed tributaries (UTs) to Walnut Creek;
- Nineteen stream reaches are UTs to Richland Creek;
- Eight stream reaches are UTs to Reedy Creek.

Nineteen (19) jurisdictional wetlands were identified within the NRTR Study Area and have been classified according to the *USFWS Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al. 1979). All wetlands found in the NRTR Study Area are considered palustrine and can be categorized into two vegetative classes: forested and shrub/scrub. Dominant plant species and hydrologic characteristics differentiate the wetlands and further classify them.

In addition to wetlands, two areas of open water were found within the *NRTR* Study Area. One open water is a man-made detention basin (approximately 4 feet deep) at the base of a culvert that is designed to trap sediment and slow flow. This basin is located south of the ramp from I-40 eastbound to Wade Avenue and west of the ramp/bridge from westbound Wade Avenue to eastbound I-40. The second open water is an unnamed lake adjacent to I-40 whose northern edge encroaches into the *NRTR* Study Area. These open waters were found to be jurisdictional as well.

3.11.6. Riparian Buffers

The *Nutrient Sensitive Waters Management Strategy for the Protection and Maintenance of Riparian Buffers for the Neuse River Basin* (15A NCAC 02B .0232) provides a designation for uses that cause impacts to riparian buffers within the Neuse River Basin (15A NCAC 02B .0233). The Neuse River Basin Rule applies to 50-foot wide riparian buffers (measured perpendicular to the stream) directly adjacent to surface waters in the Neuse River Basin. Designated surface waters are indicated on USGS 7.5-minute topographic quadrangles and/or county soil surveys.

Changes in land use within the buffer area are considered to be buffer impacts. Land use changes within the riparian buffer are defined as being "Exempt," "Allowable," "Allowable with Mitigation," or "Prohibited." The "Exempt" designation refers to uses allowed within the buffer. The "Allowable" designation refers to uses that may proceed within the riparian buffer provided there are no practical alternatives, and that written authorization from the NCDWQ is obtained prior to project development. The "Allowable with Mitigation" designation refers to uses that are allowed, given there are no practical alternatives, and appropriate mitigation plans have been approved. The "Prohibited" designation refers to uses that are prohibited without a variance. Exemptions to the riparian buffer rule include the footprint of existing uses that are present and ongoing. Impacts to Neuse River Basin buffers that total greater than 150 linear feet will require permitting and mitigation.

3.12. Biotic Communities

3.12.1. Terrestrial Communities

Three distinct plant communities were identified within the *NRTR* Study Area: 1) disturbed/maintained land, 2) Mesic Mixed Hardwood Forest (Piedmont Subtype), and 3) Piedmont/Low Mountain Alluvial Forest. Community names are capitalized if they represent communities described in the *Classification of Natural Communities of North Carolina* (Schafale and Weakley 1990). Individual plant communities and associated wildlife are described below. Wildlife directly observed or determined to be present through evidence (tracks, scat) during field investigations are indicated with an asterisk (*). The following Table 3-10 shows the coverage area of each plant community within the *NRTR* Study Area.

Table 3-10. Terrestrial Communities within the NRTR Study Area

Name	Approximate Size (acres)	Percentage of NRTR Study Area
Disturbed/maintained land	357	58.2
Mesic Mixed Hardwood Forest	161.8	26.4
Piedmont/Low Mountain Alluvial Forest	94.2	15.4
Total	**613**	**100**

Source: Natural Resources Technical Report – I-40 Widening (July 2008)

Disturbed/Maintained Land: Approximately 357 acres (58.2 percent) of the NRTR Study Area is encompassed by disturbed/maintained land. This community is made up of maintained roadside shoulders, center medians, "clover-leaf" interchanges, utility line corridors, and woodland edges. Along roadside edges and within center medians, grasses and herbs dominate the vegetation. Representative species include fescue (*Festuca* sp.), clover (*Trifolium* sp.), dandelion (*Taraxacum officinale*), aster (*Aster* sp.), dogfennel (*Eupatorium capillifolium*), broomsedge (*Andropogon virginicus*), goldenrods (*Solidago* spp.), and wild onion (*Allium canadense*). Open areas within the NRTR Study Area provide habitat for herbivore, granivore, and insectivore foraging resources, but little cover from predation. Wildlife which may occur within the open portion of the NRTR Study Area include herbivores and granivores such as American goldfinch (*Carduelis tristis*), woodland vole (*Microtus pinetorum*), hispid cotton rat (*Sigmodon hispidus*), and eastern cottontail (*Sylvilagus floridanus*); insectivores such as Carolina wren* (*Thryothorus ludovicianus*), song sparrow (*Melospiza melodia*), killdeer (*Charadrius vociferous*), least shrew (*Cryptotis parva*), eastern mole (*Scalopus aquaticus*), Carolina anole (*Anolis carolinsis*), six-lined racerunner (*Cnemidomophorus sexlineatus*), southeastern five-lined skink (*Eumeces inexpectatus*), and southern cricket frog (*Acris gryllus*); omnivores including blue jay (*Cyanocitta cristata*), gray fox (*Urocyon cinereoargenteus*) and eastern box turtle* (*Terrapene carolina*); predators such as red-tailed hawk (*Buteo jamaicensis*) and black racer* (*Coluber constrictor*); and

scavengers including American crow* (*Corvus brachyrhynchos*) and turkey vulture* (*Cathartes aura*).

Within "clover-leaf" interchanges occurring at multiple intersections along I-40, an early successional community has developed with species that commonly occupy disturbed areas. These areas are dominated by loblolly pine (*Pinus taeda*) and contain scattering of other species such as sweetgum *(Liquidambar styraciflua*), red maple (*Acer rubrum*), hickory saplings (*Carya* spp.), muscadine grape (*Vitis rotundifolia*), Chinese privet (*Ligustrum sinense*), and poison ivy (*Toxicondendron radicans)*. This disturbed area is likely to support a community of wildlife which prefers early succession forest. Birds commonly found in early succession forest include gray catbird (*Dumetella carolinensis*), yellow-breasted chat (*Icteria virens*), eastern towhee (*Pipilo erythrophthalmus*), northern bobwhite (*Colinus virginianus*), and blue grosbeak (*Passerina caerulea*). Insectivorous species such as eastern fence lizard (*Sceloporus undulatus*), and gray treefrog (*Hyla chrysoscelis*); herbivores such as white-tailed deer* (*Odocoileus virginianus*) and eastern cottontail; and predators including black racer and gray fox may utilize this habitat for food and/or cover resources.

Along woodland edges and utility line corridors, the sapling and shrub layers consist of individuals of red maple, eastern red cedar (*Juniperus virginiana*), sweetgum, blackberries (*Rubus* spp.), and Chinese privet. Vines are limited to Japanese honeysuckle (*Lonicera japonica*), common greenbrier (*Smilax rotundifolia*), and poison ivy. Representative herbs include clover, dandelion, and fescue. These ecotones provide both food and cover for eastern cottontail and white-tailed deer*. Birds commonly found in shrubby areas and along forest/grassland ecotones include the omnivorous northern mockingbird* (*Mimus polyglottos*), brown thrasher (*Toxostoma rufum*), and brown-headed cowbird (*Molothrus ater*) and the granivorous indigo bunting (*Passerina cyanea*). Insectivorous species such as eastern fence lizard and gray treefrog (*Hyla versicolor*), and predators including black racer utilize this habitat as well.

Mesic Mixed Hardwood Forest (Piedmont Subtype): Approximately 161.8 acres (26.4 percent) of the NRTR Study Area is encompassed by Mesic Mixed Hardwood Forest. Schafale and Weakley (1990) describe this plant community as dominated by mesophytic trees in various moist upland soils found primarily on north-facing slopes, and less commonly on upland flats and islands surrounded by peatland or swamp communities. This community occurs on floodplain slopes and uplands in the NRTR Study Area, and consists of a mature forest characterized by a closed canopy with a dense to moderately open understory.

This community supports a canopy of sweetgum, tulip poplar (*Liriodendron tulipifera),* white oak (*Quercus alba*), and loblolly pine. Sapling and shrub layers include canopy species seedlings and saplings as well as water oak (*Quercus nigra*), Chinese privet, giant cane (*Arundinaria gigantea*), American holly (*Ilex opaca*), American beech (*Fagus grandifolia*), umbrella tree (*Magnolia tripetala*), and flowering dogwood (*Cornus florida*). Vines within this community consist of common greenbrier, Japanese honeysuckle, muscadine grape, and poison ivy. The herbaceous layer is sparsely vegetated by representative species such as Christmas fern (*Polystichum acrostichoides*), spotted wintergreen (*Chimaphila maculata*), beech-drops (*Epifagus virginiana*), and heartleaf (*Hexastylis arifolia*).

The complexity and size of this community allow for a diverse assemblage of wildlife including forest interior species. This community should support predators such as gray fox*, southern ringneck snake (*Diadophis punctatus*), copperhead (*Agkistrodon contortrix*), and barred owl (*Strix varia*); omnivores including blue jay and eastern box turtle; insectivores such as Carolina chickadee* (*Poecile carolinensis*), wood thrush (*Hylocichla mustelina*), red-eyed vireo (*Vireo olivaceous*), southern short-tailed shrew (*Blarina carolinensis*), evening bat (*Nycticeius humeralis*), red bat (*Lasiurus borealis*), Carolina anole, broadhead skink (*Eumeces laticeps*), gray treefrog, spring peeper* (*Pseudacris crucifer*), Fowler's toad (*Bufo woodhousei*), spotted

salamander (*Ambystoma maculatum*), and white-spotted slimy salamander (*Plethodon cylindraceous*); and granivores such as northern cardinal* (*Cardinalis cardinalis*), white-throated sparrow (*Zonotrichia albicollis*), white-tailed deer*, and gray squirrel (*Sciurus carolinensis*).

Piedmont/Low Mountain Alluvial Forest: Approximately 94.2 acres (15.4 percent) of the NRTR Study Area is encompassed by Piedmont/Low Mountain Alluvial Forest. Schafale and Weakley (1990) describe this plant community as occurring within low-lying bottomlands and stream floodplains where flood-carried sediment provides rich nutrients to plants. The association of this community with streams and floodplains is consistent throughout the NRTR Study Area. This community commonly contains a mixture of alluvial species such as river birch (*Betula nigra*), sycamore (*Plantanus occidentalis*), sweetgum, sugarberry (*Celtis laevigata*), green ash (*Fraxinus pennsylvanica*), red maple, and tulip poplar. The understory is dominated by young canopy species and shrubs that range from dense to open. Shrubs often include fetter-bush (*Leucothoe racemosa*), spice bush (*Lindera benzoin*), and silky dogwood (*Cornus amomum*). The herb layer is generally lush and diverse, and may include goldenrods, Christmas fern, Jack-in-the-pulpit (*Arisaema triphyllum),* false-nettle (*Boehmeria cylindrica*), and the invasive Japanese stilt grass (*Microstegium vimineum*).

Mammals that would find suitable habitat in these moist, forested areas include white-tailed deer*, and southeastern shrew (*Sorex longirostris*), raccoon (*Procyon lotor*), and Virginia possum (*Didelphis virginiana*). Many birds typical of the Mesic Mixed Hardwood Forest might be expected to also occur in Piedmont/Low Mountain Alluvial Forest. Other birds expected are American woodcock (*Scolopax minor*), downy woodpecker (*Picoides pubescens*), and yellow-billed cuckoo (*Coccyzus americanus*). A rich amphibian and reptile element is expected and might include eastern newt (*Notophthalmus viridescens*), marbled salamander (*Ambystoma opacum*), southern two-lined salamander (*Eurycea cirrigera*), mud salamander (*Pseudotriton montanus*), red salamander (*Pseudotriton ruber*), gray treefrog, northern cricket frog (*Acris crepitans*), spring peeper* (*Pseudacris crucifer*), eastern box turtle, rat snake *(Elaphe obsoleta),* eastern garter snake (*Thamnophis sirtalis)*, and copperhead (*Agkistrodon contortrix*).

3.12.2. Aquatic Communities

The NRTR Study Area includes three (3) named streams and thirty-six (36) unnamed tributaries (perennial and intermittent) bounded primarily by natural vegetation. These streams are characterized by natural channels providing diverse habitats for fish and wildlife (i.e. riffle-pool complexes, undercut banks, rock and organic debris in the stream beds, and overhanging branches). Perennial streams are expected to support a fishery and benthic population which serves as a food source for aquatic herptiles such as the predatory banded water snake (Nerodia fasciata); omnivores such as eastern musk turtle (Sternotherus odoratus) and eastern mud turtle (Kinosternon subrubrum); and insectivores including southern leopard frog (Rana utricularia), green frog (Rana clamitans), mud salamander, and three-lined salamander (Eurycea guttolineata). Mussels that are possible in the NRTR Study Area tributaries include Asian clam (Corbicula fluminea), eastern elliptio (Elliptio complanata), eastern lampmussel (Lampsislis radiata conspicua) and dwarf wedgemussel (Alasmidonta heterodon).

Minnow-sized fish were observed, but not identified, within multiple streams occurring within the NRTR Study Area. Fish that may be present include smaller species such as mosquito fish (Gambusia holbrooki), margined madtom (Noturus insignis), tadpole madtom (Notorus gyrinus), tessellated darter (Etheostoma olmstedi), sawcheek darter (Etheostoma serrifer), and dusky shiner (Notropis cumminsae).

3.12.3. Rare and Unique Natural Areas

The North Carolina Natural Heritage Program (NCNHP) compiles a priority list of "Significant Natural Heritage Areas" (NCNHP 2005). These areas are designated based on presence of rare plant and animal species, rare or high-quality natural communities, and/or geologic features. These communities are recognized for the protection of natural areas, to calculate the ecological importance of various sites, to evaluate ecological impacts, and to inform the public of the importance of biological diversity. According to NCNHP records, two Significant Natural Heritage Areas are located just outside of the NRTR Study Area: Richland Creek Hardwood Forest and William B. Umstead State Park. These natural communities require special consideration in land-use decisions.

3.12.4. Protected Species

Species with the federal classification of Endangered, Threatened, or officially proposed for such listing are protected under the Endangered Species Act (ESA) of 1973. Federal law requires that any action likely to adversely affect a federally protected species be subject to review by the US Fish and Wildlife Service (USFWS.)

3.12.4.1. Federally Protected Species

Species with the federal classification of Endangered, Threatened, or officially Proposed for such listing are protected under the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq.*). The term "Endangered Species" is defined as "any species which is in danger of extinction throughout all or a significant portion of its range;" and the term "Threatened Species" is defined as "any species which is likely to become an Endangered species within the foreseeable future throughout all or a significant portion of its range" (16 U.S.C. 1532). The USFWS lists three federally protected species for Wake County as of June 10, 2008 (Table 3-11).

Table 3-11. Federally Protected Species Listed for Wake County

Common Name	Scientific Name	Federal Status[1]	Habitat Present
Red-cockaded woodpecker	*Picoides borealis*	E	NO
Dwarf wedgemussel	*Alasmidonta heterodon*	E	YES
Michaux's sumac	*Rhus michauxii*	E	YES

Source: Natural Resources Technical Report – I-40 Widening (July 2008)
1 Federal Status: E--Endangered; a taxon "in danger of extinction throughout all or a significant portion of its range."

Red-cockaded woodpecker (*Picoides borealis*)
Endangered

This small woodpecker (8 to 9 inches long) has a black head, prominent white cheek patches, and a black-and-white barred back. Males often have red markings (cockades) behind the eye, but the cockades may be absent or difficult to see (Potter et al. 2006, USFWS 2003). Red-cockaded woodpeckers require open pine woodlands and savannas with large old pines for nesting (cavity trees) and roosting habitat. Cavity trees must be in open stands with little or no hardwood midstory or overstory. Large, old pines are required as cavity trees because the cavities are excavated completely within inactive heartwood, so that the cavity interior remains free from resin that can entrap the birds. Old pines are also preferred as cavity trees because of the higher incidence of the heartwood decay that greatly facilitates cavity excavation (USFWS 2003). Nest trees tend to occur as an

aggregation of active and inactive cavity trees called a cluster (Walters 1988). The woodpecker drills holes into the bark around the cavity entrance, resulting in a shiny, resinous buildup around the entrance that allows for easy detection of active nest trees (USFWS 1985). Suitable foraging habitat consists of mature pines with an open canopy, low densities of small pines, little or no hardwood midstory or overstory, and abundant native bunchgrass and forb groundcovers (USFWS 2003). Primary nesting and foraging habitat consists of mature to over-mature southern pine forests dominated by loblolly, long-leaf (*Pinus palustris*), slash (*P. elliottii*), and pond (*P. serotina*) pines (Thompson and Baker 1971). Pine flatwoods or pine-dominated savannas which have been maintained by frequent natural or prescribed fires serve as ideal nesting and foraging sites for this woodpecker (USFWS 1985). Principal limiting factors for suitable habitat are fire suppression and lack of mature pines (USFWS 2003).

Dwarf wedgemussel (*Alasmidonta heterodon)*
Endangered

The dwarf wedge mussel is relatively small, averaging 1.0 to 1.5 inches long. The shells are olive-green to dark brown in color and are subrhomboidally shaped. The shells of females are swollen posteriorly, while males are generally flattened (TSCFTM 1990). The preferred habitats are streams with moderate flow velocities and bottoms varying in texture from gravel and coarse sand to mud, especially just downstream of debris and on banks of accreting sediment. This species was previously known only from a few, disjunct populations in the Neuse River Basin (Johnston County) and Tar River basin (Granville County). State-wide surveys conducted since 1992 have expanded this species' range in North Carolina. This species is now known within the Neuse River Basin in Orange, Wake, Johnston, and Nash Counties; and within the Tar River Basin in Granville, Vance, Warren, Franklin, Halifax, and Nash Counties.

Michaux's sumac (*Rhus michauxii)*
Endangered

Michaux's sumac is a densely pubescent, deciduous, rhizomatous shrub, usually less than 2 feet high. The alternate, compound leaves consist of 9 to 13 hairy, round-based, toothed leaflets borne on a hairy rachis that may be slightly winged (Radford et al. 1968). Small male and female flowers are produced during June on separate plants; female flowers are produced on terminal, erect clusters followed by small, hairy, red fruits (drupes) in August and September. Michaux's sumac tends to grow in disturbed areas where competition is reduced by periodic fire or other disturbances, and may grow along roadside margins or utility right-of-ways. In the Piedmont, Michaux's sumac appears to prefer clay soil derived from mafic rocks or sandy soil derived from granite; in the Sandhills, it prefers loamy swales (Weakley 1993). Michaux's sumac ranges from south Virginia through Georgia in the inner Coastal Plain and lower Piedmont.

3.12.4.2. Federal Species of Concern

A Federal Species of Concern (FSC) is defined as a species that is under consideration for listing for which there is insufficient information to support listing. FSC are not afforded federal protection under the Endangered Species Act of 1973, as amended, and are not subject to any of its provisions, including Section 7, until they are formally proposed or listed as Threatened or Endangered. FSC listed as Endangered, Threatened, or Special Concern by the NCNHP list of Rare Plant and Animal Species are afforded state protection under the N.C. State Endangered Species Act and the N.C. Plant Protection and Conservation Act of

1979, as amended. There are 16 FSC listed by the USFWS for Wake County (USFWS 2008). Table 3-12 summarizes FSC listed for Wake County.

Table 3-12. Federal Species of Concern (FSC) Listed for Wake County

Common Name	Scientific Name	Potential Habitat	State Status[1]
American eel	*Anguilla rostrata*	No	--
Atlantic pigtoe	*Fusconaia masoni*	No	E
Bog spicebush	*Lindera subcoriacea*	No	T
Bachman's sparrow	*Aimophila aestivalis*	No	SC
Carolina darter	*Etheostoma collis lepidinion*	No	SC
Carolina madtom	*Noturus furiosus*	No	SC
Grassleaf arrowhead	*Sagittaria weatherbiana*	No	SR-T
Green floater	*Lasmigona subviridis*	No	E
Pinewoods shiner	*Lythrurus matutinus*	No	--
Roanoke bass	*Ambloplites cavifrons*	No	SR
Southeastern myotis	*Myotis austroriparius*	No	SC
Southern hognose snake	*Heterodon simus*	No	SC
Sweet pinesap	*Monotropsis odorata*	Yes	SR-T
Virginia least trillium	*Trillium pusillum* var. *virginianum*	No	E
Yellow lance	*Elliptio lanceolata*	No	E

1 State Status: E = Endangered; SR = Significantly Rare; SC = Special Concern; -T = throughout (these species are rare throughout their ranges [fewer than 100 populations total]) (Franklin and Finnegan 2006; LeGrand et al. 2006)

3.12.4.3. Bald Eagle Protection Act

As of August 8, 2007, the USFWS removed the bald eagle in the lower 48 states from the federal list of Endangered and Threatened wildlife. The species is now protected under the Bald and Golden Eagle Protection Act (BGPA). The bald eagle is a large raptor with a wingspan greater than 6 feet. Adult bald eagles are dark brown with a white head and tail. Immature eagles are brown with whitish mottling on the tail, belly, and wing linings. Bald eagles typically feed on fish but may also take birds and small mammals. In the Carolinas, nesting season extends from December through May (Potter et al. 2006). Bald eagles typically nest in tall, living trees in a conspicuous location near open water. Eagles forage over large bodies of water and utilize adjacent trees for perching (Hamel 1992). The BGPA incorporated "disturb" into the statutory definition of "take." This definitions increases protection to include "to agitate or bother a bald or golden eagle to the degree that interferes with or interrupts normal breeding, feeding, or sheltering habits, causing injury, death, or nest abandonment" (USFWS 2007a).

Current national management guidelines by the USFWS (2007b) outline how far disturbance activities should be located from eagle nests. Visibility of the activity from the eagle nest is also considered in USFWS recommendations because, in general, eagles are more prone to disturbance when an activity occurs in full view. For activities related to the construction of roads, powerlines, and other linear utilities, the USFWS recommends avoiding eagles nests

by a distance of 660 feet (activity visible from nest) or 330 feet (activity not visible from nest). In general, activities should be kept as far away from nest trees as possible, disturbances should be conducted when eagles are not nesting, and activity between the nest and nearby foraging areas should be minimized. Landscape buffers are also recommended.

4. ENVIRONMENTAL CONSEQUENCES

This section summarizes the impacts of the Build Alternative. Impacts, both positive and negative, are discussed with respect to the affected environment described in Chapter 3. Quantitative impacts are shown in tables and figures where applicable.

The No-Build Alternative means no actions would be implemented under this project (STIP Project I-4744). The No-Build Alternative would not incur any right-of-way or construction costs, there would be no short-term disruptions along existing roadways during construction, and there would be no impacts to the human or natural environment. However, the No-Build Alternative would not meet any of the purposes identified for this project, nor would it meet any needs described in Chapter 1. However, in order to provide baseline conditions with which to compare the improvements and consequences associated with the Build Alternative, the No-Build Alternative is also discussed in this chapter when applicable.

4.1. Impacts to Land Use

As discussed in Chapter 1 and Chapter 3, the proposed improvements to I-40 within the existing right-of-way are consistent with local land use plans, zoning ordinances, and transportation plans. The proposed improvements of this limited access facility do not include new interchanges or interchange improvements. Consequently, while the proposed improvements will change the local transportation infrastructure, it is unlikely to create direct changes in land use that would be incompatible with existing plans and ordinances.

4.2 Socioeconomic Impacts

4.2.1. Environmental Justice Impacts

Title VI of the Civil Rights Act of 1964 protects individuals from discrimination on the grounds of race, age, color, religion, disability, sex, and national origin. Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, signed by the President on February 11, 1994, directs Federal agencies to take the appropriate and necessary steps to identify and address disproportionately high and adverse effects of Federal projects on the health or environment of minority and low-income populations to the greatest extent practicable and permitted by law.

Although some minority and low-income populations have been identified within the Direct Community Impact Area (DCIA), no minority or low-income populations have been identified that would be adversely impacted by the proposed project as determined by site visit observations, discussions with local planners and the demographic data presented in Section 3.3. Therefore, this project is compliant with the provisions of Executive Order 12898.

4.2.2. Economic Impacts

Economic impacts are expected to be minimal since STIP Project I-4744 is a widening within the existing right-of-way. No business relocations will occur as a result of the project. Additionally, property values are not expected to be substantially influenced nor should there be any direct or indirect impacts to local businesses. There are not expected to be any impacts to the tax base.

4.3. Community Impacts

4.3.1. Community Facility Impacts

The proposed project will widen I-40 within the existing right-of-way. No proposed modifications to interchanges, intersecting roads, or access are part of the Build Alternative for STIP Project I-4744. Therefore, no direct impacts to community facilities are anticipated.

Although there are no emergency response facilities located within the Direct Community Impact Area, I-40 is an essential route for Emergency Management Services traffic. Consequently, there may be short-term effects to emergency response times due to construction delays and detours. However, in the long term, emergency service response times may slightly improve due to increased capacity on I-40 in the project area.

4.3.2. Access Impacts

Full control of access is maintained along I-40. Access to adjacent neighborhoods and businesses is provided by interchanges with surface streets. Access to neighborhoods, businesses, and institutions within the DCIA will not be interrupted during or after construction; however, there is a potential for delays during construction of STIP Project I-4744.

Although the North Carolina State University Campus and its sports complexes are outside of the DCIA, the study team met with representatives of the University who noted that there are traffic delays at the I-40/Wade Avenue interchange and the I-40/Chapel Hill Road (NC 54) interchange during special events at Carter-Finley Stadium and the RBC Center. These delays may be temporarily exacerbated during the construction activities associated with STIP Project I-4744.

Pedestrian and Bicycle Access

Bicycle and pedestrian activity is concentrated along greenways within the DCIA, on Cary Towne Boulevard/Western Boulevard, and along Chatham Street. Pedestrians and bicycles are prohibited on I-40. The only pedestrian facility crossing the project corridor within the DCIA is an overpass on the north side of Buck Jones Road. There are designated on-road bicycle corridors on streets which go over or under I-40; however, STIP Project I-4744 is not expected to impact pedestrian or bicycle access.

Public Transit

Several transit systems provide fixed route transit service throughout the DCIA. Capital Area Transit (CAT) which serves the Raleigh area has bus routes along Buck Jones Road and in the Roylene neighborhood. A CAT representative confirmed that there are no CAT routes on I-40, nor are any planned. C-TRAN (Cary's transit system) has bus routes along Harrison Avenue, Maynard Road, Walnut Street, Buck Jones Road and through Crossroads Plaza. A C-TRAN representative indicated that although designated routes are not shown on I-40, their vehicles do use I-40 when returning to the depot or in conducting door-to-door service. Triangle Transit has bus routes along I-40 / Wade Avenue, Harrison Avenue, Walnut Street, NC 54, and Cary Towne Parkway/Western Boulevard. The routes map on the Triangle Transit website (accessed 8/12/08) does not show any routes on the section of I-40 between Wade Avenue and US 1-64 / I-440; however, local representatives indicate the Triangle Transit buses do use this section of I-40 on occasion. There are bus routes (express route between Chapel Hill and Raleigh and between Research Triangle Park and Raleigh) that use the section of I-40 between Harrison Avenue and Wade Avenue. Local representatives also indicated that Triangle Transit buses do use this section of I-40 on occasion for routes not shown on the routes map.

While there is a potential for delays in transit services (C-TRAN and Triangle Transit) during construction of STIP Project I-4744, commute times are expected to improve following construction. STIP Project I-4744 should not affect existing transit stops.

Wake County Public School System

The Wake County Public School System buses utilize or cross I-40 between Wade Avenue and I-440/US 1-64. School system representatives expressed concern that the approximately sixty school buses that utilize this portion of I-40 might be delayed or require rerouting during construction of STIP Project I-4744.

4.3.3. Relocation Impacts

Based on the preliminary roadway design plans provided by NCDOT Roadway Design in May 2008, no business or residential relocations are anticipated as a result of STIP Project I-4744.

4.3.4. Impacts to Community Cohesion

The proposed improvements to I-40 will occur in the existing right-of-way and will not physically intrude into surrounding neighborhoods. There will be no physical separation of existing neighborhoods or business centers and the construction of the Build Alternative is not expected to impact stability and cohesion within the community.

4.4. Infrastructure and Utility Impacts

Based on the May 2008 preliminary design plans and subsurface utility information, there are several existing utility lines that cross I-40 within the DCIA. These crossings include one electrical transmission line, two water line crossings, two sewer line crossings, three natural gas line crossings, and two telephone and fiber optic crossings. Additional details regarding these utility crossings can be found in Section 3.4. It is anticipated that impacts to these existing utility crossings as a result of the proposed project will be minimal. All modifications, adjustments, or relocations will be coordinated with the affected utility company. This may also require revised encroachment agreements.

According to the *Natural Resources Technical Report – I-40 Widening* (July 2008), utility impacts to riparian buffers within the Neuse River Basin are considered “exempt” from the Neuse River Buffer Rule if the impacts total less than 40 linear feet or in the impacts are expected to occur within the footprint of existing uses that are present and ongoing (such as maintained sewer easements). Linear impacts to riparian buffers that total greater than 150 linear feet will require permitting and mitigation.

4.5. Cultural Resources Impacts

An intergovernmental review was completed by the North Carolina Department of Cultural Resources (NCDCR) on June 4, 2007. The results of the review indicated that there are no historic or archaeological resources that would be affected by the project. A copy of the intergovernmental review completed by NCDCR and distributed by the North Carolina State Clearinghouse can be found in Appendix A.

4.6. Impacts to Section 4(f) and 6(f) Properties

Based on the preliminary design plans (dated May 2008), all work associated with the proposed operational improvements to I-40 between Harrison Avenue and I-440/US 1-64 is anticipated to take place within the existing right-of-way. Therefore, no use of Section 4(f) properties or Section 6(f) resources are anticipated as part of the Build Alternative for STIP Project I-4744.

4.7. Air Quality Impacts

An air quality study was performed for the project and is documented in the *STIP Project I-4744 Final Air Quality Technical Report* (January 2009) which is incorporated by reference. This study included performing a quantitative carbon monoxide (CO) "hotspot" analysis to determine if the Build Alternative would cause CO levels to exceed the National Ambient Air Quality Standards (NAAQS). In addition, a quantitative analysis of Mobile Source Air Toxics (MSATs) was prepared.

4.7.1. Air Quality Microscale Analysis

CO Hotspot (Microscale) Analysis

CO emissions are greatest from vehicles operating at low speeds and prior to complete engine warm-up (within approximately eight minutes of starting). Congested urban roads, therefore, tend to be the principal problem areas for CO. Because the averaging times associated with the CO standards are relatively short (1 and 8 hours), CO concentrations can be modeled using simplified "worst-case" meteorological assumptions. Modeling is also simplified considerably by the stable, non-reactive nature of CO.

Methodology

CO hotspot analyses are typically performed at the end of relocated ramps or new intersections. Since the proposed widening of I-40 under STIP Project I-4744 would take place within the existing median, it was determined that the highest volume mainline section along I-40 in air quality analysis study area would be modeled. The northern stretch of I-40 between Harrison Avenue and Trenton Road, the segment with the highest forecasted AADT (191,600 AADT), was selected as the worst case location for the microscale CO analysis.

The Environmental Protection Agency's (EPA) MOBILE6.2 was used to develop vehicular emission rates and EPA's approved CAL3QHC 2.0 (CAL3QHC) computer model was used to analyze vehicular emissions and the hourly dispersion of CO at receptors A1 – A6 in the years 2011, 2016, and 2035. The North Carolina Department of Environmental and Natural Resources (NCDENR) provided Wake County specific input for variables for MOBILE6.2.

Results

The results of the CO microscale air quality modeling are presented in Table 4-1. The maximum 1-hour CO concentrations were 6.3 ppm for the year 2011 build and no-build conditions. The 1-hour CO concentrations would range from 4.9 to 5.8 ppm and from 4.9 to 5.7 ppm in 2016 build and no-build conditions. CO concentrations would range from 4.8 ppm to 5.8 ppm and 4.9 to 5.6 ppm in 2035 build and no-build conditions. All concentrations include a background concentration of 3.5 ppm. Comparison of the predicted CO concentrations with the NAAQS (maximum permitted for 1-hour averaging period = 35 ppm; maximum permitted for 8-hour averaging period = 9 ppm) indicates no violation of these standards. Since the results of the

worst-case 1-hour CO analysis for the build scenario is less than 9 ppm, it can be concluded that the 8-hour CO level does not exceed the standard.

Table 4-1. Microscale Air Quality Analysis, Maximum 1-Hour Co Concentrations (ppm)*

Air Quality Receptor ID	2011		2016		2035	
	Build	No-Build	Build	No-Build	Build	No-Build
	1 hour	1 hour	1 hour	1 hour	1 hour	1 hour
A1	5.8	5.8	5.5	5.3	5.4	5.3
A2	5.5	5.4	5.0	5.1	5.0	5.0
A3	5.1	5.1	4.9	4.9	4.8	4.9
A4	6.3	6.3	5.8	5.7	5.8	5.6
A5	5.6	5.7	5.4	5.3	5.4	5.2
A6	5.3	5.3	5.0	4.9	5.0	4.9

**The National Ambient Air Quality Standard for CO is 35 ppm for a one hour average.*
Concentrations include an ambient background level of 3.5 ppm (1 hour)
Indicates maximum concentration for each alternative and year of analysis.
Source: HNTB Corporation, July 2008

Fine Particle ($PM_{2.5}$) and Particulate Matter (PM_{10})

Wake County, North Carolina is an attainment area for for both $PM_{2.5}$ and PM_{10}. Therefore, $PM_{2.5}$ and PM_{10} hotspot analyses are not required for transportation conformity.

Conclusion

Based on the air quality analysis completed for the proposed improvements, this project (STIP Project I-4744) will not cause or contribute to any violation of the National Ambient Air Quality Standards.

4.7.2. Mobile Source Air Toxics (MSAT) Analysis

Quantitative MSAT Analysis

A quantitative analysis was completed to provide a basis for identifying and comparing the potential differences among MSAT emissions—if any—from the various alternatives. The quantitative assessment presented below is derived in part from a study conducted by the FHWA entitled *A Methodology for Evaluating Mobile Source Air Toxic Emissions Among Transportation Project Alternatives*, found at:

www.fhwa.dot.gov/environment/airtoxic/msatcompare/msatemissions.htm

Scope and Methodology

The quantitative MSAT analysis estimates the annual emissions of the six priority MSATs as a function of vehicle miles traveled (VMT) and MSAT emission rates developed by MOBILE6.2. The simplest scope of analysis would be to only calculate emissions for those roadway segments

that would be constructed as part of the project. However, this methodology would not consider the influence of the proposed project on the surrounding areas. Therefore, it is more appropriate to define an Affected Transportation Network to better capture the MSAT emissions that would be generated as a result of the project. This network would include the proposed project plus other transportation links where traffic volumes are expected to change as a result of the project.

The Affected Transportation Network (MSAT Study Area) was based on the project-level traffic forecast area plus Traffic Analysis Zones (TAZs) adjacent to those containing the project. The Affected Transportation Network was defined in coordination with and approved by FHWA. As a practical consideration, a volume change threshold needed to be adopted as a basis for including or excluding links in the Affected Transportation Network. According to FHWA, the typical accuracy threshold of travel demand forecasting is plus or minus five percent AADT. Also, changes of plus or minus five percent AADT can affect changes of plus or minus ten percent or more in emissions on congested roadways. Therefore, a volume change threshold of plus or minus five percent was applied consistently to all analysis years and project alternatives. All the links that experienced a change of plus or minus five percent were included in the Affected Transportation Network.

The links identified by comparing the 2035 Build Alternative with 2007 Existing Conditions were also the links utilized in the 2011 No-Build and Build Alternative Networks and the 2035 No-Build Alternative Network. The MSAT Study Area and Affected Transportation Network are identified on Figure 4.1. Consequently, the vehicle miles traveled (VMT) estimates provided in this analysis do not reflect total VMT from the study area; rather, they reflect only the VMT for roadway segments that meet the volume change threshold – i.e. those that experience a volume change of plus or minus five percent.

The MSAT analysis years included the base year (2007), first full opening year (2011), and design year (2035) for the No-Build Alternative. The MSAT emissions analysis was completed using the current version of EPA's regulatory mobile source emission factor model, MOBILE6.2 dated November 2003 as implemented in FHWA's Easy Mobile Inventory Tool—or EMIT. Based on MOBILE6.2 emission factors, EMIT produced emissions for the six priority air toxic pollutants in tons per year using the following locale-specific input files:

- Vehicle Age Distributions;
- VMT Fraction by Vehicle Classification;
- VMT Fraction by Hour of Day;
- Inspection/Maintenance Program;
- Anti-Tampering Program;
- Seasonal Fuel Specifications, Temperatures and Humidity;
- Ramp Travel as a Percentage of Interstate/Other Freeway VMT;
- Emissions Due to Vehicle Engine Starts (Discounted from the Analysis); and
- Highway Network Travel Data.

The above data were obtained from a variety of sources, including the North Carolina Department of Environment and Natural Resources-Division of Air Quality, the National Climatic Data Center, and the Triangle Regional Travel Demand Model (TRM). Where appropriate, the input parameters were the same as those used for the Triangle Area Transportation Conformity Determination Report (approved June 29, 2007). Highway Network Travel Data was developed from the TRM for the Affected Transportation Network, and included the following information for each link: length, AADT, number of lanes, Highway Performance Monitoring System (HPMS) Area Type, HPMS Functional Classification, free flow speed and capacity.

MSAT Analysis Results

The amount of MSATs emitted in the region would be proportional to vehicle miles traveled (VMT). However, because of improvements in emissions technologies, total MSAT emissions will decline over time, even while VMT increases.

Within the Affected Transportation Network, VMT is expected to increase by 67 percent between 2007 and 2035. The majority of the increase in VMT would occur regardless of whether I-40 was improved under STIP Project I-4744. The estimated VMT in 2035 under the Build Alternative is approximately 2.5 percent higher than under the No Build Alternative (Figure 4.2). This additional VMT contributes to the Build Alternative having slightly higher MSAT emissions compared to the No Build Alternative.

Figure 4.1 – Mobile Source Air Toxics Study Area and Affected Transportation Network

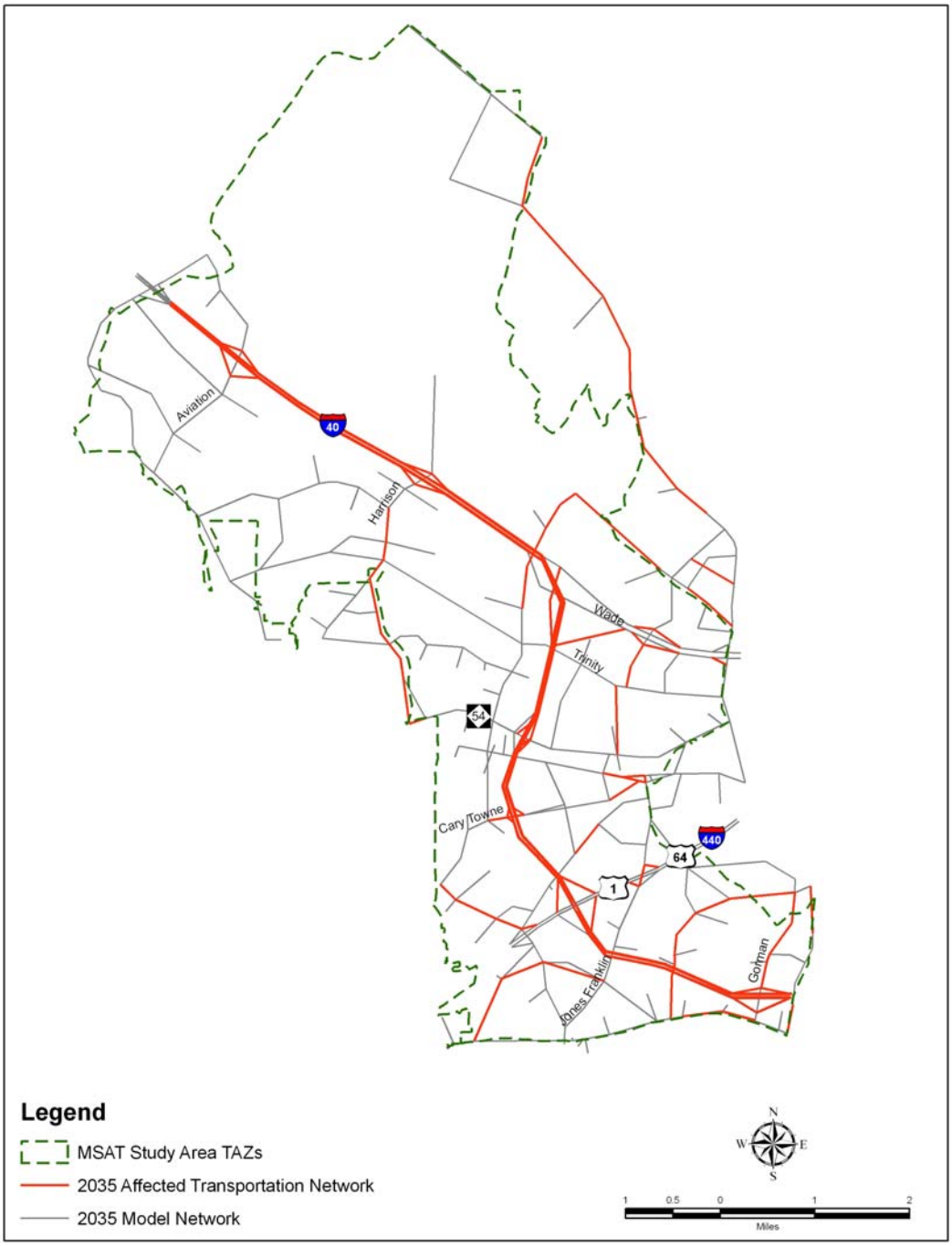
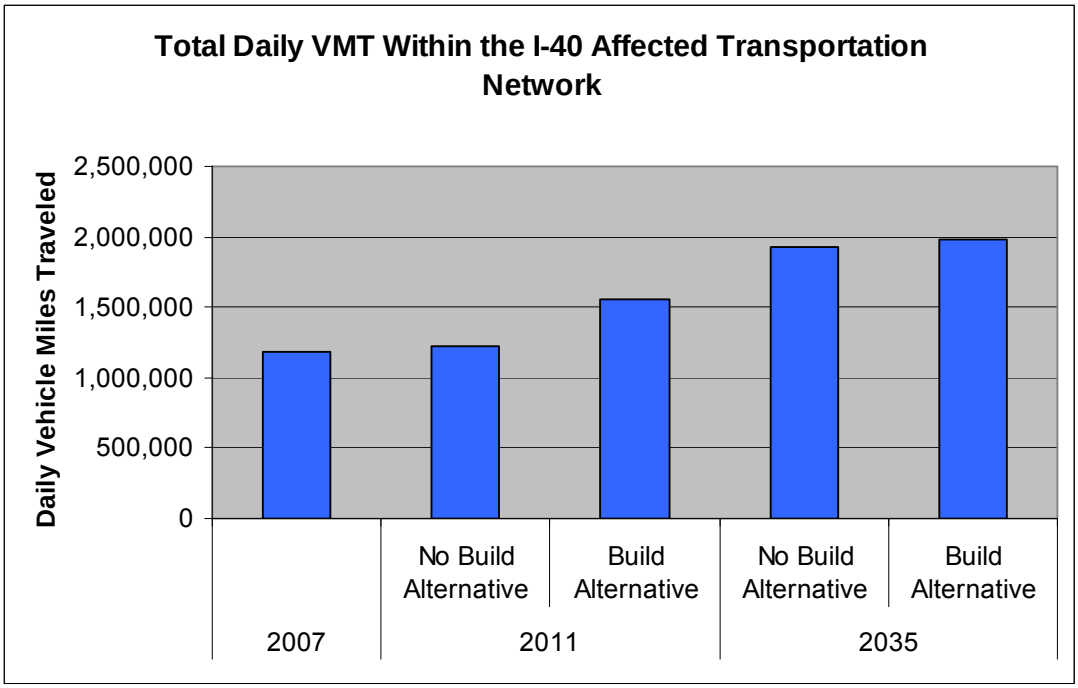
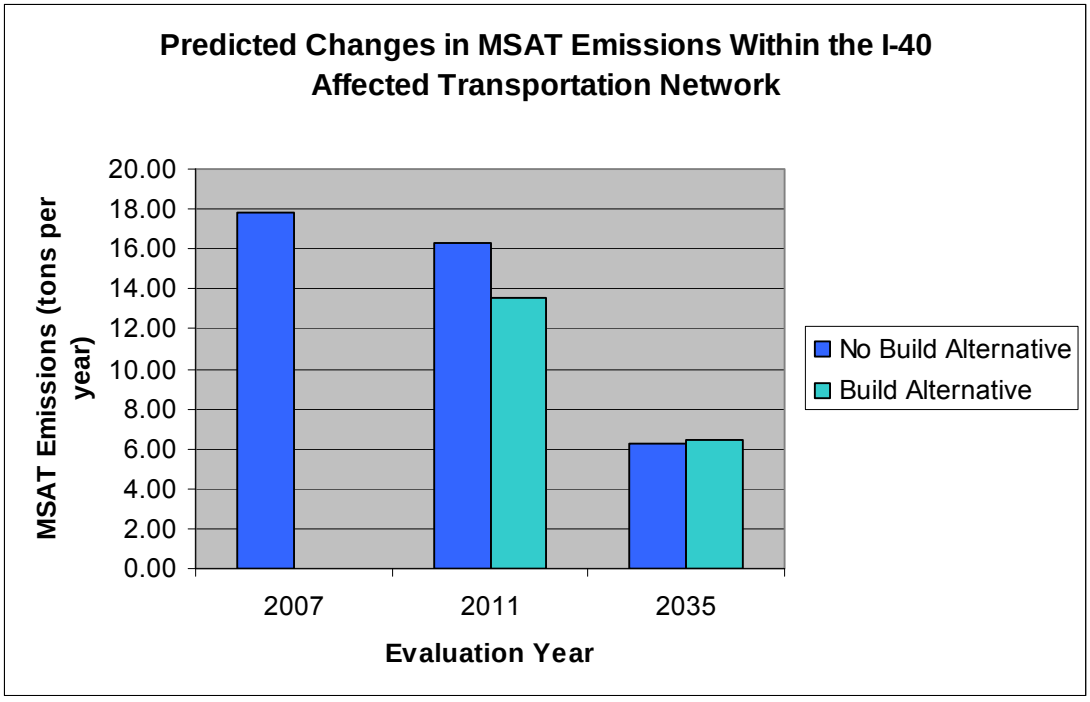


Figure 4.2 – Total Daily Vehicle Miles Traveled



Regardless of the alternative chosen, MSAT emissions will be lower than present levels in the design year as a result of EPA's national control programs. On a national basis, these programs are projected to reduce MSAT emissions by 57 to 87 percent from 2000 to 2020. Local conditions may differ from these national projections in terms of fleet mix and turnover, VMT growth rates, and local control measures. However, the magnitude of the EPA-projected reductions is so great (even after accounting for VMT growth) that MSAT emissions are lower in the future. As shown in Figure 4.3, MSAT emissions in for the Affected Transportation Network are predicted to decrease by 64 percent between 2007 and 2035 despite a 67 percent increase in VMT. Figure 4.3 also indicates that the differences in MSAT emissions between the No Build Alternative and Build Alternative are relatively small, varying by just 2.7 tons per year in 2011 and only 280 pounds (0.14 tons) per year in 2035. The slightly greater MSAT emissions in 2035 associated with the Build Alternative compared to the No Build Alternative are the result of a 2.5 percent increase in VMT.

Figure 4.3 – Predicted Changes in MSAT Emissions



As shown in Table 4-2, the greatest reduction in MSAT emissions is expected for Diesel Particulate Matter (DPM). Smaller reductions are anticipated for the remaining pollutants. Variations between the No Build Alternative and Build Alternative are minor.

Table 4-2. MSAT Emissions, Tons per Year

MSAT Pollutant	Tons per Year					
	2007	2011		2035		Percent Change 2007 to 2035
		No Build Alternative	Build Alternative	No Build Alternative	Build Alternative	
Benzene	4.31	6.51	3.93	2.51	2.56	-40%
DPM	9.45	4.65	5.96	0.98	1.00	-89%
1,3 Butadiene	0.57	0.74	0.52	0.35	0.36	-37%
Formaldehyde	2.45	3.12	2.22	1.73	1.77	-28%
Acetaldehyde	0.88	1.14	0.82	0.64	0.65	-25%
Acrolein	0.13	0.15	0.11	0.08	0.08	-35%
Totals	**17.78**	**16.32**	**13.56**	**6.29**	**6.43**	**-64%**

Note: Totals may not add correctly due to rounding

The additional through travel lanes proposed for this project will be contained within the existing median and will not move traffic closer to nearby homes, schools or businesses. The option under consideration to re-stripe the pavement on I-40 eastbound to create an approximately 2,000 foot long auxiliary lane between the Harrison Avenue on-ramp and the Wade Avenue off-ramp will move a small fraction of the traffic on I-40 slightly closer to the business park adjacent to the corridor. Since the Build VMT is slightly greater than the No Build VMT, there may be localized areas where ambient concentrations of MSATs could be higher under the Build Alternative than the No Build Alternative. Also, MSATs will be lower in other locations when traffic shifts away from them. However, as discussed below, the magnitude and the duration of these potential increases compared to the No Build alternative cannot be reliably quantified due to the inherent deficiencies of current models.

In summary, MSAT emissions in 2035 are expected to be relatively similar under the Build Alternative relative to the No Build Alternative. In comparing the Build Alternative to the No Build Alternative, MSAT levels could be higher in some locations than others, but current tools and science are not adequate to reliably quantify them. However, on a regional basis, EPA's vehicle and fuel regulations, coupled with fleet turnover, will over time cause substantial reductions that will cause region-wide MSAT levels to be significantly lower than today. As this analysis shows, despite VMT increases from 2007 to 2035, MSAT emissions are still anticipated to decline considerably over the same period. The proposed project would not interfere with the substantial emissions reductions forecasted in the project area due to the implementation of EPA's regulations.

Unavailable Information for Project Specific MSAT Impact Analysis Quantitative MSAT Analysis

This report includes a basic analysis of the likely MSAT emission impacts of the proposed I-40 improvement project. In FHWA's view, the lack of a national consensus on an acceptable level of risk and other air quality criteria assumed to protect the public health and welfare, as well as the reliability of available technical tools do not enable us to predict with confidence the project-specific health impacts of the emission changes associated with the alternatives evaluated in the Categorical Exclusion (CE). The outcome of such an assessment would be influenced more by the uncertainty introduced into the process by the assumptions made rather than any real insight into the actual health impacts from MSAT exposure directly attributable to the proposed action. Due to these limitations, the following discussion is included in accordance with CEQ regulations (40 CFR 1502.22(b)) regarding incomplete or unavailable information:

Information that is Unavailable or Incomplete

Evaluating the environmental and health impacts from MSATs on a proposed highway project would involve several key elements; chief among them is what constitutes an "acceptable level" of risk. Incremental risk levels from a new source which are projected to be less than 1 in 1 million are generally considered to be negligible; while, incremental risk levels greater than 100 in 1 million are generally considered to be unacceptable. Indeed, the EPA prevailed in a recent U.S. Court of Appeals for the District of Columbia decision (Natural Resources Defense Council v. Environmental Protection Agency, No. 07-1053, June 8, 2008) that its 2006 hazardous organic NESHAPs (National Emission Standards for Hazardous Air Pollutants) rule reduced emissions to levels that present "an acceptable level of risk and protect public health with an ample margin of safety" at risks less than 100 in 1 million. EPA's benzene NESHAPs is also based on reducing risks to less than 100 in 1 million.

There is also no national consensus on dose-response values for MSATs. For instance, the EPA provides ranges of air concentrations at specific risk levels for lifetime exposure to benzene, with uncertainty spanning perhaps an order of magnitude. The practical uncertainty is even greater,

because the California Air Resources Board (CARB) puts the air concentration risk levels for benzene at an order of magnitude less than equivalent EPA values. In addition, most notably, CARB has implemented an air concentration risk level for diesel PM; whereas, the EPA has not. EPA states in their risk assessment of diesel PM entitled "Health Assessment Document for Diesel Exhaust" (Office of Research and Development, EPA/600/8-90/057F, May 2002, pp 8-15, http://www.epa.gov/risk/basicinformation.htm#g) that:

> "an exploratory risk analysis shows that environmental cancer risks possibly range from 10^{-5} to nearly 10^{-3}, while a consideration of numerous uncertainties and assumptions also indicates that lower risk is possible and zero risk cannot be ruled out. These risk findings are only general indicators of the potential significance of the lung cancer hazard and should not be viewed as a definitive quantitative characterization of risk or be used to estimate an exposure-specific population impact".

In contrast to EPA's risk assessment for diesel PM, there is little-to-no documentation as to precisely how the CARB unit risk value for diesel PM was obtained, nor precisely on what it is based. The uncertainties in the unit risk value for diesel PM are exceptionally large, since epidemiological studies of diesel engine exhaust do not consistently find that exposure to diesel PM causes cancer (cohorts of underground miners exposed to the highest concentrations of diesel PM, for example, appear to have no excess risk of lung cancer). Thus, the EPA has found that the available epidemiological data do not support the development of any unit risk value for diesel PM.

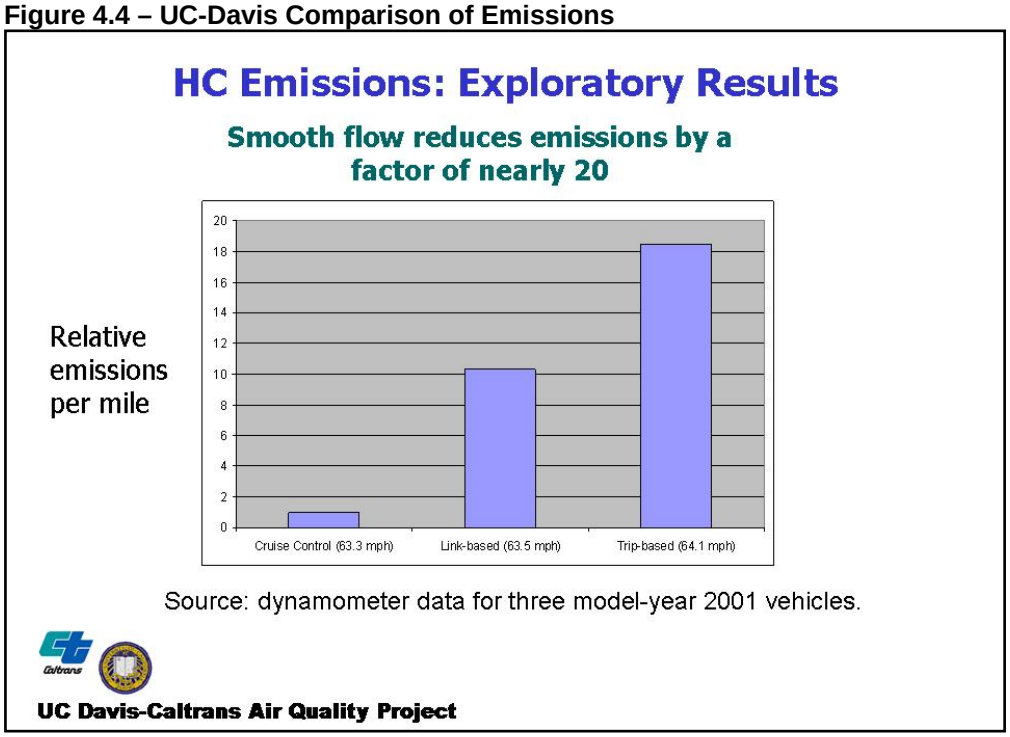
An association between an incremental increase in traffic volumes and the risk level generally considered unacceptable is implied in a screening-level risk analysis included in the National Cooperative Highway Research Program (NCHRP) report entitled "Analyzing, Documenting, and Communicating the Impacts of Mobile Source Air Toxic Emissions in the NEPA Process" (NCHRP 25-25 Task 18, March 2007). For freeways, an incremental increase in traffic volumes of 125,000 to 443,000 AADT is linked with an incremental 1 in 1 million risk level, based on EPA's range of unit risk values for benzene. The analysis was conducted for an overly simplified exposure condition, assuming that emission levels associated with a 2010 vehicle fleet would persist for 70 years, discounting the recognized significant mitigation associated with EPA's Tier 2 and heavy-duty truck emissions standards and the 2007 MSAT rule. By extension, based on the same over-simplification, an incremental increase in freeway traffic volumes of 1,250,000 to 4,430,000 AADT are associated with a 10 in 1 million risk level and an incremental increase in freeway traffic volumes of 12,500,000 to 44,300,000 AADT are associated with a 100 in 1 million risk level – the level above which is generally considered unacceptable. The inherent assumption is that EPA is correctly estimating benzene and diesel PM air concentration risk levels and CARB's estimates are incorrect. Different results and conclusions would be obtained if the reverse is true or if neither EPA nor CARB is correct. Consequently, FHWA finds that there is considerable uncertainty associated with estimates of adverse residual risk after implementation of EPA's 2007 MSAT rule and other control programs.

According to EPA in their Air Toxics Risk Assessment Reference Library, risk and hazard estimates are typically reported as one significant figure. Based on the NCHRP screening-level risk analysis model, the ability to discern between a 1 in million risk level and a 2 in 1 million risk level is associated with a freeway traffic volume increase of 125,000 to 443,000 AADT. In FHWA's view, risk assessment methodologies applied to highway projects are a blunt instrument.

The methodologies for forecasting health impacts include emissions modeling; dispersion modeling; exposure modeling; and then final determination of health impacts – each step in the process building on the model predictions obtained in the previous step. All are also encumbered by technical shortcomings or uncertain science that prevents a more complete determination of the MSAT health impacts of this project.

1. Emissions: EPA characterizes their MOBILE6.2 emission factor model as a regional model and not a project-level model. It is a trip-based model, where emission factors are projected based on a "typical" trip of 7.5 miles and vehicle speeds averaged over the trip. MOBILE6.2 does not have the ability to predict emission factors for a specific vehicle operating condition at a specific location at a specific time. Because of this, it has limited applicability at the project level. EPA will be addressing this limitation in its MOVES model, a replacement to MOBILE6.2. The implication of this limitation is illustrated and noted by UC-Davis in Figure 4.4, i.e., "Smooth flow reduces emissions by a factor of nearly 20", which cannot be reflected in a trip-based or link-based model. Similar results have been found in analyses by UC Riverside (Barth, for CO2) and NC State (Frey, for multiple pollutants).

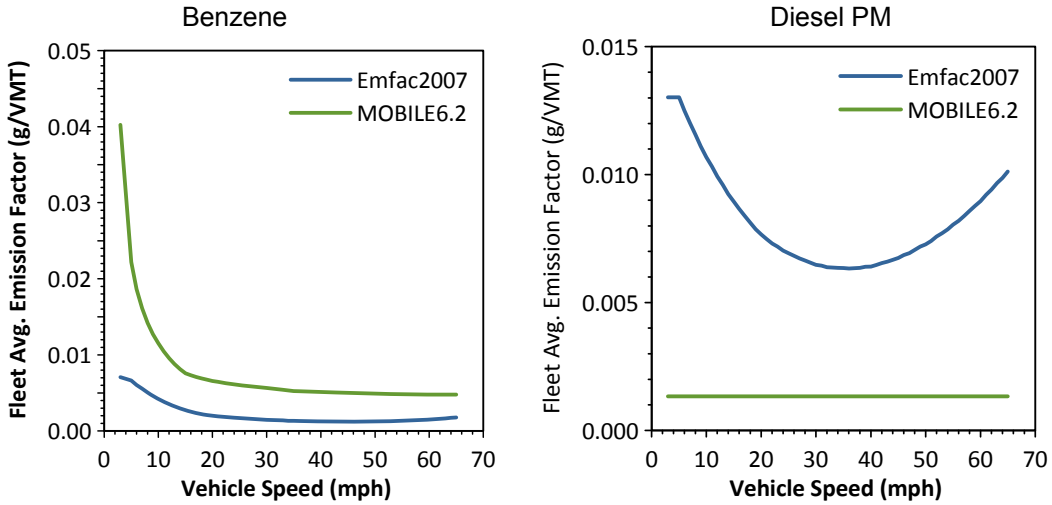
Figure 4.4 – UC-Davis Comparison of Emissions



Even within the confines of regional emissions modeling, EPA and CARB have a different view of what MSAT emissions would look like from a future vehicle fleet required to meet identical vehicle emission standards. Although the same basic concepts were used in developing their respective mobile source emission factor models, widely disparate results are produced for MSATs. EPA's MOBILE6.2 model generally predicts higher emission factors for benzene compared to CARB's Emfac2007 model. Emfac2007 generally predicts higher emission factors for diesel PM compared to MOBILE6.2. Figure 4.5 provides a comparison of emission factors produced by the models for benzene and diesel particulate matter for the 2030 calendar year. Notice that diesel PM emission factors from MOBILE6.2 do not vary with speed; in Emfac2007 they do. In part, because of this, EPA has concluded that (71 FR 12498):

"we continue to believe that appropriate tools and guidance are necessary to ensure credible and meaningful PM2.5 and PM10 hot-spot analyses. Before such analyses can be performed, technical limitations in applying existing motor vehicle emission factor models must be addressed, and proper federal guidance for using dispersion models for PM hotspot analysis must be issued. With the release of MOBILE6.2, state and local transportation agencies now have an approved model for estimating regional PM2.5 and PM10 emission factors in SIP [State Implementation Plan] inventories and regional emissions analyses for transportation conformity. However, MOBILE6.2 has significant limitations that make it unsatisfactory for use in microscale analysis of PM2.5 and PM10 emissions as necessary for quantitative hot-spot analysis."

Figure 4.5 – MOBILE6.2/Emfac2007 Comparison of Emissions (Calendar Year 2030)



The limitations noted by EPA equally apply to diesel PM emission factors.

2. Dispersion. The tools to predict how MSATs disperse are also limited. The EPA's current regulatory models, CALINE3 and CAL3QHC, were developed and validated with emission rates from the MOBILE4 model more than a decade ago. Based on updated emission rates to MOBILE5, an extensive evaluation of the CAL3QHC model was conducted in an NCHRP study as part of the development of the HYROAD model. The study report documents poor model performance at ten sites across the country, 3 where intensive CO monitoring was conducted plus an additional 7 with less intensive monitoring. The report is available online from EPA at www.epa.gov/ scram001/dispersion_alt.htm#hyroad.

3. Exposure Levels and Health Effects. Finally, even if emission levels and concentrations of MSATs could be accurately predicted, shortcomings in current techniques for exposure assessment and risk analysis preclude us from reaching meaningful conclusions about project-specific health impacts. Exposure assessments are difficult because it is difficult to reliably forecast long-term concentrations of MSATs near roadways, and to determine the portion of time that people are actually exposed to those concentrations at a specific location. These difficulties are magnified for lifetime, 70-year risk assessments, particularly because

unsupportable assumptions would have to be made regarding changes in travel patterns and vehicle technology (which affects emissions rates) over that time frame. There are also considerable uncertainties associated with the existing estimates of toxicity of the various MSATs, because of factors such as low-dose extrapolation and translation of occupational exposure data to the general population, a concern expressed by the Health Effects Institute (HEI).

For example, consider the exposure-response relationship for alcoholic beverages. Alcoholic beverages are established causes of cancer in humans; about 3% of all cancers world-wide are thought to be caused by over-consumption of alcoholic beverages. There is a clear dose-response relationship for alcoholic beverages, with risk of cancer death increasing (essentially) linearly for exposures ranging from 2 drinks per day through 6-plus drinks per day. But there is neither evidence nor reason to suppose that, for example, 1 or 0.5 drinks per day also increase people's risk of cancer death. Indeed, the exposure-response data, interestingly enough, show a "J-shaped" dose response relationship, such that people consuming 1 drink per day are significantly less likely to die of cancer than those who drink no alcoholic beverages. If one were to make the standard "regulatory style" assumption about low-level exposure to alcohol, one would both vastly overestimate the cancer risk, and also miss entirely what turns out to be a low-level protective effect. In such a case, it would hardly be "erring on the side of public health" to estimate that exposures that are orders of magnitude smaller than the 2 drinks-per-day cancer-effect-level put people at risk of cancer. This is not to say, of course, that very-low-level exposures to MSAT emissions prevent cancer; nor is it to assert that such exposures are demonstrably or obviously safe. It is only to point out that extrapolation beyond observable exposures and responses are at best an uncertain business and become increasingly uncertain the farther one strays from the empirical data.

Because of these shortcomings, any calculated difference in health impacts between alternatives is likely to be much smaller than the uncertainties associated with calculating the impacts. Consequently, the results of such assessments would not be useful to decision makers, who would need to weigh this information against project benefits, such as reducing traffic congestion, accident rates, and fatalities plus improved access for emergency response that are better suited for quantitative analysis.

Summary of Existing Credible Scientific Evidence Relevant to Evaluating the Impacts of MSATs

Research into the health impacts of MSATs is ongoing. For different emission types, there are a variety of studies that show that some either are statistically associated with adverse health outcomes through epidemiological studies (frequently based on emissions levels found in occupational settings) or that animals demonstrate adverse health outcomes when exposed to large doses.

Exposure to toxics has been a focus of a number of EPA efforts. Most notably, the agency conducted the National Air Toxics Assessment (NATA) in 1996 to evaluate modeled estimates of human exposure applicable to the county level. While not intended for use as a measure of or benchmark for local exposure, the modeled estimates in the NATA database best illustrate the levels of various toxics when aggregated to a national or state level.

The EPA is in the process of assessing the risks of various kinds of exposures to these pollutants. The EPA Integrated Risk Information System (IRIS) is a database of human health effects that may result from exposure to various substances found in the environment. The IRIS

database is located at http://www.epa.gov/iris. The following toxicity information for the six prioritized MSATs was taken from the IRIS database Weight of Evidence Characterization summaries. This information is taken verbatim from EPA's IRIS database and represents the Agency's most current evaluations of the potential hazards and toxicology of these chemicals or mixtures.

- **Benzene** is characterized as a known human carcinogen.
- The potential carcinogenicity of **acrolein** cannot be determined because the existing data are inadequate for an assessment of human carcinogenic potential for either the oral or inhalation route of exposure.
- **Formaldehyde** is a probable human carcinogen, based on limited evidence in humans, and sufficient evidence in animals.
- **1,3-butadiene** is characterized as carcinogenic to humans by inhalation.
- **Acetaldehyde** is a probable human carcinogen based on increased incidence of nasal tumors in male and female rats and laryngeal tumors in male and female hamsters after inhalation exposure.
- **Diesel exhaust (DE)** is likely to be carcinogenic to humans by inhalation from environmental exposures. Diesel exhaust as reviewed in this document is the combination of diesel particulate matter and diesel exhaust organic gases.
- **Diesel exhaust** also represents chronic respiratory effects, possibly the primary non-cancer hazard from MSATs. Prolonged exposures may impair pulmonary function and could produce symptoms, such as cough, phlegm, and chronic bronchitis. Exposure relationships have not been developed from these studies.

Some recent studies have reported that proximity to roadways is related to adverse health outcomes – particularly respiratory problems.[6] Many health studies use an epidemiological approach to relate the possibility of harm due to the proximity to the roadway. FHWA has concerns about reaching conclusions regarding health impacts from highway emissions based on proximity studies in areas known to exceed ambient air quality standards, such as the recent study by Dr. James Gauderman, et al., entitled *Effect of Exposure to Traffic on Lung development from 10 to 18 Years of Age: A Cohort Study*. These studies do not measure specific pollutants but only roadway proximity, so any reported negative health impacts may be due to either the criteria pollutants or MSATs. Epidemiological studies suffer from the limitation that they cannot by their very nature establish causality. They may indicate statistical associations, but other confounding factors may be missed and may represent the true cause of the impact. Furthermore, not all studies show a negative impact. For example, the "Long term Effects of Traffic-Related Air Pollution on Mortality", Beelen et al., only found weak associations between proximity to major roadways and health effects. This fact was also reported as a major shortcoming in health studies of this nature in, *Does Traffic-Related Air Pollution Contribute to Respiratory Disease Formation in Children*, M. Jerritt, ERJ 2007, Vol. 29. In his review, Jerritt also points out another shortcoming in recent health studies dealing with determining the effect of proximity. He points out that most of these studies utilize a basic measure of distance to roadway as a proxy of exposure; however, because of the variable nature of particles and gaseous pollutants, the true variability of air pollutants within the neighborhood scale needs to be captured to identify the health effects of specific components of the air pollution mixture. Additionally, he

[6] South Coast Air Quality Management District, Multiple Air Toxic Exposure Study-II (2000); South Coast Air Quality Management District, Multiple Air Toxic Exposure Study-III (2007); Highway Health Hazards, The Sierra Club (2004) summarizing 24 Studies on the relationship between health and air quality); NEPA's Uncertainty in the Federal Legal Scheme Controlling Air Pollution from Motor Vehicles, Environmental Law Institute, 35 ELR 10273 (2005) with health studies cited therein.

states “exposures assigned on distance to traffic or traffic counts near the home are prone to. . . errors. . . and biased results”.

Because analytical methodologies vary greatly between individual health studies, and all studies have limitations, it is not practical to draw definitive conclusions based solely on individual studies. Rather the total body of literature needs to be consulted before conclusions can be made. To that end, the Health Effects Institute, a non-profit organization funded by EPA, FHWA, and industry, has undertaken a major series of studies to research near-roadway MSAT hot spots, the health implications of the entire mix of mobile source pollutants, and other topics. The first study was completed and the findings published last year in Special Report 16 – Mobile-Source Air Toxics: A Critical Review of the Literature on Exposure and Health Effects, available online at www.healtheffect.org. For each of the MSATs reviewed, the analysis answers three questions:

1. To what extent are motor vehicles a significant source of exposure?
2. Does it affect human health?
3. Does it affect human health at environmental concentrations?

HEI concludes that exposure to many MSATs comes from sources other than vehicles and that mobile sources are the primary sources of exposure for only a few of the 21 MSATs listed by the EPA in its 2001 Rule. For many of the MSATs reviewed, HEI concluded that there is insufficient data for an assessment of ambient exposures on human health.

Relevance of Unavailable or Incomplete Information to Evaluating Reasonably Foreseeable Significant Adverse Impacts on the Environment, and Evaluation of Impacts Based Upon Theoretical Approaches or Research Methods Generally Accepted in the Scientific Community

Given the uncertainties outlined above, a quantitative assessment of the effects of air toxic emissions impacts on human health cannot be reliably made at the project level. While available tools do allow us to reasonably predict relative emissions changes between alternatives for larger projects, the amount of MSAT emissions from each of the project alternatives and MSAT concentrations or exposures created by each of the project alternatives cannot be predicted with enough accuracy to be useful in estimating health impacts. (As noted above, the current emissions model is not capable of serving as a meaningful emissions analysis tool for smaller projects.) Therefore, the relevance of the unavailable or incomplete information is that it is not possible to make a determination of whether any of the alternatives would have "significant adverse impacts on the human environment.”

In this report, the FHWA and NCDOT have provided a quantitative analysis of MSAT emissions relative to the No-Build and Build alternatives. The FHWA and NCDOT have acknowledged that the project may result in increased exposure to MSAT emissions in certain locations, although the concentrations and duration of exposures are uncertain, and because of this uncertainty, the health effects from these emissions cannot be reliably estimated.

4.8. Noise Impacts

In accordance with FHWA guidelines and Title 23 Part 772 (23 CFR 772), a noise analysis was conducted for the project and is documented in *STIP Project I-4744 Final Noise Technical Report* (January 2009) which is incorporated by reference. Traffic noise impacts were assessed in accordance with NCDOT’s *Traffic Noise Abatement Policy* (dated September 2004). Where traffic noise impacts were predicted, the analysis included an evaluation of noise mitigation measures for reducing or eliminating the noise impacts.

In accordance with NCDOT's *Traffic Noise Abatement Policy*, federal and state governments are not responsible for providing noise abatement measures for new developments where building permits are issued within the noise impact area of a proposed highway project after the "Date of Public Knowledge." The Date of Public Knowledge is the approval date of the final environmental document (e.g., Categorical Exclusion [CE], Finding of No Significant Impact [FONSI], or Record of Decision [ROD]).

Predicted Traffic Noise Levels

The traffic noise prediction program, TNM® 2.5, was also used to model existing 2007 and future build 2035 design hour noise levels within the study area. Two hundred (200) receiver locations were selected as representative locations along the I-40 project corridor. These receivers were selected to model the representative noise impacts at two (2) churches, three (3) schools, one (1) play field, one (1) hotel/motel, 19 commercial properties, one (1) tennis court, and 321 residences and multi-family living units which include existing apartments and condominium developments plus two developments presently under construction adjacent to the I-40 corridor. Existing L_{eq}(1h) exterior noise levels range from 44 to 75 dBA. Future build exterior noise levels in the 2035 design year would range from 46 to 76 dBA L_{eq}(1h).

Design hour 2035 noise levels adjacent to the I-40 corridor would approach or exceed the NAC for Activity Category B locations at 48 residential living units and at three (3) Activity Category C commercial establishments. The increase in noise levels along the corridor would range from 0 to 4 decibels. Therefore, none of the noise receivers would be exposed to noise levels that represent a "substantial increase," as defined by the NCDOT *Traffic Noise Abatement Policy*, over existing noise levels.

Mitigation Measures

When a proposed project creates a noise impact, whether the Noise Abatement Criteria (NAC) is exceeded or a substantial increase occurs, noise abatement procedures are to be reviewed to determine if they are feasible and reasonable. Feasibility deals with the engineering considerations of noise abatement, for example, topography, access, drainage, safety, maintenance, other noise sources and the ability to achieve a reasonable noise reduction. Reasonability of proposed noise abatement mitigation measures is a more subjective evaluation, including costs, change in noise levels and the public's views.

Noise barriers were analyzed at two locations along the I-40 project corridor. Noise Barrier 1 was modeled on the west side of I-40 south of Trinity Road adjacent to the developing Brandywine Subdivision. The second noise barrier, Noise Barrier 2, was modeled on the north side of I-40 east of Jones Franklin Road for the residences between Wayne Street and I-40 which are built around 3 cul-de-sacs: Roanoke Court, Hammock Place and Pinna Court.

Brandywine Subdivision – Noise Barrier 1

The Brandywine Subdivision is presently under construction. Thirty-four of the 89 lots have been developed or have acquired a building permit. The noise barrier for this development provided a 5 decibel or greater reduction for 29 residences. The modeled noise barrier, located within existing NCDOT right-of-way, parallels the existing right-of-way boundary for approximately 300 feet and then diagonals towards and follows the shoulder for another 775 feet. The noise barrier would range in height from 9 to 23 feet. The cost for this noise barrier, at $15.00 per square foot, would be $271,076. Dividing the noise barrier cost by the 29 benefited receptors results in a cost per residence of $9,347. The reasonable cost effective amount for this area is $36,000 per benefited receptor. Noise Barrier 1 is both feasible and reasonable. Upon approval of the CE, the

number of lots developed and the number of new building permits will be reviewed to see if the number has increased since June 2008. If the number changes, the noise barrier analysis will be repeated to take into consideration the additional lots developed and those with building permits.

Wayne Street Residences – Noise Barrier 2

There are 54 residences in this area. Forty would be exposed to 2035 build noise levels that exceed the 66 dBA L_{eq} NAC. The noise barrier modeled for this area would cost $316,428. The barrier would range in height from 9 – 25 feet over its length of 1,333 feet. The noise reductions for the residences range would from 2 dBA for the residences furthest from I-40 to 14 decibels for those immediately abutting I-40. This noise barrier was modeled within existing NCDOT right-of-way, paralleling the right-of-way boundary for approximately 560 feet. The noise barrier then diagonals towards the shoulder and follows the shoulder for approximately 580 feet. The eastern terminus of Noise Barrier 2 extends approximately 275 feet past the terminus of the proposed improvements. This is recommended so that the front row residences circling the three cul-de-sacs abutting I-40 within the project limits would all receive a 5 decibel or greater noise level reduction. Forty-seven of the 54 residences would receiver a 5 or more decibel reduction from Noise Barrier 2. Dividing the noise barrier cost by the 47 benefited receptors results in a cost/unit of $6,733. The reasonable cost effective amount for this area is $36,000 per benefited receptor. Noise Barrier 2 is both feasible and reasonable.

Noise Barrier Analysis Conclusions

Both of the noise barriers analyzed meet NCDOT's feasibility criteria of a minimum noise reduction of 5 dBA for first row receptors. Noise Barriers 1 and 2, with costs per unit of $9,347 and $6,733, respectively, also meet NCDOT's definition for reasonableness. There are no other areas adjacent the project corridor that meet the feasible and reasonable criteria for noise abatement measures as defined in the NCDOT *Traffic Noise Abatement Policy*.

Upon approval of the CE, additional research will also be conducted along the project corridor to determine other land use changes since June 2008. The final decision of the installation of noise abatement measures will be made upon completion of the project design and the public involvement process.

The 66 dBA L_{eq}(1h) setback distance along the I-40 corridor would range from 250 ft to 380 feet depending on traffic volumes and topography. The setback distance indicates that noise levels within these distances, measured perpendicular to the centerline of the nearest lane in either direction, is 66 dBA or greater. This setback distance has been developed to assist local planning authorities in developing land use control over the remaining undeveloped lands along the project in order to prevent further development of incompatible land use.

4.9. Impacts on Hazardous Materials

There are no anticipated impacts to hazardous material sites as a result of the Build Alternative.

4.10. Geology and Soils Impacts

The construction of the proposed road improvements would require removal of soils and the placement of fill within the existing right-of-way. However, no adverse long-term impacts to soil, geology, or mineral resources are expected.

Farmland

STIP Project I-4744 would be constructed within the existing right-of-way. Therefore, no impacts to existing farmland or farmland soils are anticipated as a result of the project. The provisions of the FPPA do not apply to this project.

4.11. Water Resources Impacts

In accordance with Section 404 of the Clean Water Act (33 USC 1344) and Section 401 of the CWA (33 USC 1341), impacts to jurisdictional areas from the Build Alternative were identified and coordinated with the responsible regulatory agencies: the United States Army Corps of Engineers (USACE) and the North Carolina Department of Water Quality (NCDWQ). The impacted areas are located in the Neuse River Basin which is subject to riparian buffer rules regulated by NCDWQ. Due to the proposed project being located within the Neuse River Basin, and in order to minimize potential impacts to all water resources, NCDOT's *Best Management Practices for the Protection of Surface Waters* and *Design Standards for Sensitive Watersheds* will be utilized during the pre-construction phase of the project. NCDOT's *Best Management Practices for Construction and Maintenance Activities* will also be strictly enforced during construction of the project. Sedimentation and erosion control guidelines will be strictly enforced during the construction stages of the project.

The Build Alternative is the proposed addition of one 12-foot travel lane and one 12-foot paved inside shoulder in each direction within the existing median. Therefore, impacts to jurisdictional resources and riparian buffers as a result of the project are expected to be minimal to none. Any impacts to jurisdictional wetlands and streams will be further minimized, to the extent practicable, during the final design of the proposed project.

Permitting

Federal and state permits will be required for encroachment into jurisdictional wetlands and surface waters. The type of activity, the extent of the impacts, and the specific environment impacted will be considered by the Wilmington District of the USACE before a determination is made to authorize use of a permit, the requirements of the permit, and the type of permit to be issued by the agency. The USACE issues general and nationwide permits under the provisions of Section 404 of the Clean Water Act, as amended. Nationwide permits (NWP) are a type of general permit used throughout the United States to authorize certain activities that are considered routine and are expected to have minimal adverse consequences to the environment.

Due to the limited nature of impacts to Section 404 jurisdictional resources, it is anticipated that Nationwide Permit No. 14 for linear transportation projects and Nationwide Permit No. 3 for maintenance activities (72 CFR 11180, 11183; March 12, 2007) can be utilized for this project. The use of NWP No. 14 is limited to transportation projects which result in a filled area of no more than 0.5 acre in "waters of the United States." The use of NWP No. 3 is limited to the repair, rehabilitation, or replacement of any previously authorized, currently serviceable, structure, or fill, or of any currently serviceable structure or fill authorized by 33 CFR 330.3, provided that the structure or fill is not to be put to uses differing from those uses specified or contemplated for it in the original permit or the most recently authorized modification.

The North Carolina Division of Water Quality has made available General 401 Water Quality Certifications for NWP No. 14 (GC 3704) and NWP No. 3 (GC 3687). The USACE may extend discretionary authority and require an Individual Permit if avoidance and minimization have not been adequately addressed or if mitigation is inadequate (assuming mitigation may be required under the NWP)). The use of temporary structures for construction activities, access fills, or dewatering of the site is anticipated to be covered under NWP 33 (72 CFR 11180, 11187; March

12, 2007) permit and the associated General 401 Water Quality Certification (GC 3688) will be required.

Mitigation

Currently, impacts to wetlands and streams due to project construction are expected to be minimal and unlikely to require an individual 404 permit from the US Army Corps of Engineers. Any impacts to jurisdictional wetlands and streams will be further minimized, to the extent practicable, during the final design of the proposed project. If mitigation for unavoidable impacts is necessary, compensatory mitigation will be provided.

4.12. Biotic Community Impacts

The proposed improvements to I-40 will utilize the existing median to add an additional travel lane in each direction. No notable habitat fragmentation is expected as a result of project activities because potential improvements will be restricted to adjoining roadside margins, which are mainly comprised of disturbed/maintained areas. Construction noise and associated disturbances are not expected to differ substantially from that resulting from ongoing use of the current roadways and are anticipated to have short-term impacts on avifauna and migratory wildlife movement patterns. Within and adjacent to construction limits, shifts in species composition may occur in favor of species adapted to fragmentation and edge effects. The project would be constructed along an existing transportation corridor, thus, no further bisection of habitats or wildlife corridors would occur.

4.12.1. Endangered and Threatened Species

Species identified by the United States Fish and Wildlife (USFWS) as protected species in Wake County are described in Section 3.14.4 and are listed in Table 3-20 in Chapter 3. The effect of the Build Alternative on these species is discussed below.

Red-cockaded woodpecker (*Picoides borealis*)
Federal Status: Endangered

BIOLOGICAL CONCLUSION: NO EFFECT

The *Natural Resources Technical Memorandum* (NRTR) study area contains no suitable nesting or foraging habitat due to the absence of mature pine forest. The North Carolina Natural Heritage Program (NCNHP) records (reviewed June 2, 2008) document no occurrence of red-cockaded woodpecker within 2.0 miles of the *NRTR* study area. No red-cockaded woodpeckers or suitable habitat were observed during field investigations. Based on NCNHP records and field observations, there will be No Effect on red-cockaded woodpecker as a result of this project.

Dwarf wedgemussel (*Alasmidonta heterodon)*
Federal Status: Endangered

BIOLOGICAL CONCLUSION NO EFFECT

Streams with suitable habitat for dwarf wedgemussel do exist within the *NRTR* study area. NCDOT Natural Environment Unit staff visited the project site on July 16, 2008 for an evaluation of habitat for Dwarf wedgemussel. Mussel surveys were conducted in Richland Creek and Walnut Creek. Both creeks are heavily influenced by urban/suburban development and do not appear to be suitable habitat for this species. No mollusks of any kind were encountered in either creek.

A review of NCNHP data (reviewed June 2, 2008) documents no occurrences of Dwarf wedgemussel within the general area of the project. Records maintained by NC Wildlife Resources Commission do not contain records of this species in Walnut Creek or Richland Creek.

The degraded urban nature of these streams and the lack of mollusks, including tolerant forms, is a good indication that this project will have no effect on the Dwarf wedgemussel.

Michaux's sumac (*Rhus michauxii*)
Federal Status: Endangered

BIOLOGICAL CONCLUSION **NO EFFECT**

Suitable habitat for Michaux's sumac does occur within the *NRTR* study area in the form of disturbed areas along roadsides and interchanges. Areas that are irregularly or lightly maintained, such as woodland edges and shoulders that are mowed only once a year provide the best habitat. NCNHP records (reviewed June 2, 2008) document no occurrence of Michaux's sumac within 2.0 miles of the *NRTR* study area. A systematic plant-by-plant survey was conducted within suitable habitat by qualified biologists on June 3-4, 2008. Prior to the surveys, a known population (Poole Road) was visited to observe the stage of flowering and growth of local plants. The entire *NRTR* study area was then inspected for suitable habitat, and those areas that contained habitat were subjected to detailed surveys using overlapping transects. This survey determined that no individuals of Michaux's sumac occur within the *NRTR* study area; subsequently, the proposed project will have No Effect on Michaux's sumac. However, because this species is likely to migrate if new habitat is created due to clearing, an additional survey will be needed prior to the project let date, if two years have elapsed from the date of the last survey.

4.12.2. Federal Species of Concern

Federal Species of Concern (FSC) are not afforded federal protection under the Endangered Species Act of 1973, as amended, and are not subject to any of its provisions, including Section 7, until they are formally proposed or listed as Threatened or Endangered. A FSC is defined as a species that is under consideration for listing for which there is insufficient information to support listing as Threatened or Endangered. There is only one federally listed of species of concern for which potential habitat exists within the *NRTR* study area: Sweet Pinesap (*Monotropsis odorata*). Based on its current State status (SR-T), this species is not afforded any state protection.

4.12.3. Bald Eagle Protection Act

The *NRTR* study area contains no suitable nesting or foraging habitat for bald eagles due to the absence of large open water. NCNHP records (reviewed June 2, 2008) document no occurrence of bald eagle within 660 feet of the *NRTR* study area. No bald eagles or bald eagle nests were observed during field investigations. Based on field observations and NCNHP documentation, this project will have no effect on bald eagle.

4.13. Construction Impacts

4.13.1. Water Quality and Drainage

Impacts to water resources may result from activities associated with project construction. Activities that would result in impacts are clearing and grubbing on water conveyances, riparian canopy removal, in-water construction, fertilizer and pesticide use for revegetation, obstruction and redirection of surficial groundwater flows, and pavement/culvert installation.

The proposed project is located within the Neuse River Basin. As a result, the project is subject to Neuse Buffer Regulations. Adherence to these regulations, as well as the implementation of NCDOT's Best Management Practices (BMPs) should help to minimize impacts to water resources during the pre-construction, construction, maintenance and repair situations. *NCDOT's Best Management Practices for the Protection of Surface Waters and Design Standards for Sensitive Watersheds* will be followed during the pre-construction phase of the project. *NCDOT's Best Management Practices for Construction and Maintenance Activities* will be followed to minimize impacts to water resources during construction, maintenance, and repair situations.

The Build Alternative for the proposed project crosses three streams (Reedy Creek, Richland Creek, and Walnut Creek) listed on the North Carolina 2006 Final Section 303(d) List (NCDWQ 2006).

4.13.2. Air Quality

Temporary negative air quality impacts would occur as a result of fugitive dust/fine particulate matter during construction operations. However, any associated temporary emissions from construction equipment would be less than the conformity *de minimis* levels established for carbon monoxide and ozone. The contractor would be responsible for controlling dust at the project site and at areas affected by the construction. Dust control measures may include the following activities:

- Minimizing exposed earth surface;
- Temporary and permanent seeding and mulching;
- Watering working and haul areas during dry periods;
- Covering, shielding, or stabilizing material stockpiles; and
- Using covered haul trucks.

Emissions from construction equipment are regulated by federal standards. No burning will be performed at the project site or within the project boundaries.

4.13.3. Noise

The major construction elements of this project are expected to be demolition, hauling, grading, paving, and bridge construction. General construction noise impacts, such as temporary speech interference for passers-by and those individuals living and working near the project, can be expected particularly from demolition, paving operations and from earth moving equipment. In general, construction equipment sound levels generally vary between approximately 69dBA to 105dBA from 50 feet away. Considering the relatively short-term nature of construction noise, impacts are not expected to be substantial. The transmission loss characteristics of nearby structures are believed to be sufficient to moderate the effects of intrusive construction noise.

4.13.4. Construction Waste

All construction waste materials generated during clearing, grubbing, and other construction phases will be removed from the project site and burned or disposed of by the contractor in accordance with state and local regulations. Litter and other general trash will be collected and disposed of at local landfill locations.

4.13.5. Utility Service

Prior to construction, NCDOT will ensure that contractors coordinate with all appropriate service provides to minimize impacts to utilities and to ensure that service disruption, if needed, will be temporary and minimized as much as possible.

4.13.6. Transportation Management

In September 2004, the Federal Highway Administration (FHWA) published updates to the work zone regulations at 23 CFR 630 Subpart J. The updated Rule is referred to as the Work Zone Safety and Mobility Rule (Rule) and applies to all State and local governments that receive Federal-aid highway funding. In accordance with the rule, a Transportation Management Plan (TMP) is currently being developed for STIP Project I-4744. Based on the current schedule, the Draft TMP (50% Preliminary Plans) will be submitted in February 2009, and the Final TMP will be submitted at least three months prior to the project let date. The purpose of the TMP is to identify a set of coordinated transportation management strategies for use in managing the work zone impacts of the road project. Transportation management strategies for a work zone include temporary traffic control measures and devices, public information and outreach, and operational strategies such as travel demand management, signal retiming, and traffic incident management.

As part of the TMP, a general concept has been developed for the maintenance of traffic and sequencing of construction. This concept is intended to minimize traffic delays within the project corridor. Plans for the maintenance and protection of traffic in conjunction with construction activities associated with STIP Project I-4744 will be prepared in accordance with the latest edition of the *Manual of Uniform Traffic Control Devices* and roadway standards of NCDOT.

4.14. Indirect and Cumulative Effects (ICE)

4.14.1. ICE Study Area Description

Future Land Use Study Area (FLUSA)

The NCDOT's and North Carolina Department of Environment and Natural Resources' *Guidance for Assessing Indirect and Cumulative Impacts of Transportation Projects in North Carolina* indicates that the development effects of a new or improved roadway facility are most often found up to one mile around an interchange, and up to two to five miles along major feeder roadways to the interchange. Based upon these assumptions, interviews with local planners, and the fact that STIP Project I-4744 is the proposed improvement of an existing roadway within the existing right-of-way and with no new interchanges, it is believed that any potential land use impacts resulting from STIP Project I-4744 will occur within a one-mile radius (see Figure 4.6). This area is referred to as the Future Land Use Study Area (FLUSA) and is the focus for data collection and analysis for the ICE assessment; however, it is not meant to infer that land use impacts will be felt throughout the FLUSA. More specific areas of potential development within the FLUSA will be identified later in the assessment.

Timeframe for Analysis

Although the design year for the I-40 operational improvements is 2035, effects related to land use change as a result of the proposed project were qualitatively evaluated through 2030 since CAMPO's *2030 Long Range Transportation Plan* and population projections from the Office of State Budget and Management were based on this timeframe.

4.14.2. Transportation Impact Causing Activities

Recent Development Activity

Planners with Wake County indicated that the majority of growth within the FLUSA is residential in nature along Tryon Road. Two subdivisions, Bailey's Landing and The Estates at Brooks Crossing, were recently approved south of Tryon Road and outside of the FLUSA. Planners were not aware of any recent development activity within the FLUSA. Within Raleigh's jurisdiction, there is a mixed use development at Wade Avenue and I-40 currently under construction and an apartment complex being constructed south of Western Boulevard at Farm Gate Road. In Cary, apartments are under construction off Crossroads Boulevard at Jones Franklin Road, and new homes are being constructed in the Brandywine subdivision just west of I-40. Town of Cary planners also noted a mixed use development is under review near the Harrison Avenue interchange and a hospice facility is planned at the intersection of Trenton Road and Trinity Road in Cary.

According to City of Raleigh planners, a regional rail station is planned in Raleigh near Corporate Center Drive. SAS, a large software company headquartered in Cary near I-40 and Harrison Avenue, is planning one additional building on the campus, and they are installing a solar farm off Trinity Road this year.

4.14.3. Indirect and Cumulative Effects Analysis Results

Evaluation of Indirect Effects

The widening of I-40 from Wade Avenue to I-440/US 1-64 in Wake County is expected to improve traffic mobility on I-40 and is consistent with goals and objectives in existing transportation plans. While not specifically mentioned in the local land use plans, the project is included in CAMPO's *2030 Long Range Transportation Plan* and considered in forecasting the socio-economic data of the Triangle Regional Demand Model.

STIP Project I-4744 is in the urban centers of Raleigh and Cary. Residential and non-residential growth is not expected to accelerate or occur due to the project because much of the land is developed, or protected within the William B. Umstead State Park, Schenck Forest, Lake Johnson Park and the Swift Creek Watershed. In addition, STIP Project I-4744 is an improvement of an existing limited access roadway within existing right-of-way, with no modifications to interchanges or intersecting roads. Consequently, access will not change as a result of the project. Land use change as a result of the project is expected to be minimal.

Evaluation of Cumulative Effects

When STIP Project I-4744 is considered with the other transportation projects planned in the area, including STIP Project I-5111, STIP Project I-2719, and STIP Project U-3817, Cary's *Comprehensive Transportation Plan* projects, and CAMPO's *2030 Long Range Transportation Plan* projects, traffic mobility should improve throughout the area, but cumulative effects related to land use change as a result of STIP Project I-4744 are expected to be minimal. This project is just one of many planned in the region, and land use plans have been developed to

accommodate the growth the region is experiencing. Since there are minimal to no direct effects resulting from the project, there are minimal to no cumulative effects expected.

4.15. Preferred Alternative

This section reviews the geometric design characteristics of the Preferred Alternative. The design features identified in this section are preliminary and are subject to change based upon public comments and final design.

Due to its minimal impacts and ability to meet the purpose and need for the project, the Build Alternative – the improvement of I-40 between Harrison Avenue and I-440/US 1-64 – was identified as the Preferred Alternative. Table 4-3 summarizes the direct impacts associated with the Preferred Alternative for STIP Project I-4744.

Table 4-3. Preferred Alternative Impact Summary

Resource	Impact		
Right-of-way	0 acres		
Relocations	0 Residences 0 Businesses		
Hazardous Materials Sites	0		
Historic Properties	0		
Archaeological Sites	0		
Section 4(f) Properties	0		
Chapter 6(f) Properties	0		
Jurisdictional Streams Linear Feet (LF)	<300 LF		
Wetlands (acres)	<0.5 acres		
Floodplains	0 acres		
Protected Species	None		
Noise Impacts (without abatement)	Commercial	3	
	Residential	48	
Air Quality	No Violation of CO NAAQS*		
Cost**		**2008 Dollars**	**Year of Expenditure (2009) Dollars*** **
	Construction	**$49,200,000**	$51,660,000
	Right-of-way	$0	$0
	Utilities	$0	$0

**CO NAAQS – Carbon Monoxide National Ambient Air Quality Standard*
**NCDOT Project Services Unit Preliminary Estimate dated September 25, 2008
***Inflation assumed to compound annually at 5.0%/year.

The Build Alternative is the addition of one 12-foot travel lane and one 12-foot paved inside shoulder in each direction within the existing median between Wade Avenue and I-440/US 1-64. This would upgrade this section of I-40 from an existing 4-lane facility to a 6-lane facility in order to alleviate bottleneck conditions and provide lane continuity on I-40 in the area of Raleigh and Cary. Figure 4.7 shows the typical section for STIP Project I-4744. As part of the project, NCDOT is considering an option to re-stripe the pavement on I-40 eastbound between the Harrison Avenue and Wade Avenue interchanges to provide one 12-foot auxiliary lane.

The Build Alternative includes the widening of four mainline bridge structures: I-40 over eastbound Wade Avenue and I-40 over I-440/US 1-64. No modifications are proposed to any of the existing grade-separated crossings of I-40. No additional improvements to interchanges or intersecting roadways are included as part of the Build Alternative. The existing I-40 right-of-way width varies between approximately 350 feet to 500 feet. All improvements proposed as part of STIP Project I-4744 would be constructed within the existing right-of-way. No relocations are planned as part of the project.

The construction of STIP Project I-4744 will not require modification of any existing culverts.

Figures 4.8A through 4.8H show the Build Alternative for STIP Project I-4744. An index figure is provided on Figure 4.8A.

Noise Barriers

Noise barriers were reviewed for properties that experienced substantial noise increases or noise levels above the criteria outlined in the Noise Abatement Criteria (NAC). Based on NCDOT's *Traffic Noise Abatement Policy* (September 2004), noise barriers were determined to be feasible and reasonable at two locations along the project corridor. One feasible and reasonable noise barrier is located adjacent to the developing Brandywine Subdivision. The second feasible and reasonable noise barrier is located between Wayne Street and I-40 in the area of three cul-de-sacs: Roanoke Court, Hammock Place, and Pinna Court. These noise sensitive areas are indicated on Figures 4.7E and 4.7I. There are no other areas adjacent the project corridor that meet the feasible and reasonable criteria for noise abatement measures as defined in the NCDOT *Traffic Noise Abatement Policy*.

Upon approval of the CE, the noise barrier analysis may be repeated to take into consideration any additional lots developed and those with building permits along the corridor since the initial noise study. Additional research may also be conducted along the project corridor to determine other land use changes since June 2008.

The final decision of the installation of noise abatement measures will be made upon completion of the project design and the public involvement process.

Preliminary Construction Cost Estimate

The estimated preliminary construction cost of the Build Alternative in year 2008 dollars is $49,200,000[7]. This cost estimate includes Intelligent Transportation System (ITS), signing, noise abatement measures, and widening of existing I-40 bridge structures at the Wade Avenue and US 1-64 interchanges. ITS components include the installation of two closed circuit television cameras at Wade Avenue and Cary Towne Boulevard. The cost estimate also includes installation of lighting at the Wade Avenue, NC 54, and I-440/US 1-64 interchanges. Based on the preliminary design plans provided by NCDOT Roadway Design Unit (dated May 2008), there are no temporary easements, right-of-way acquisition, or utility relocation costs associated with the project.

[7] NCDOT Project Services Unit Preliminary Estimate dated September 25, 2008.

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5. PUBLIC INVOLVEMENT

5.1. Start of Study Notification

A start of study regulatory notification letter was mailed on April 20, 2007 to federal and state regulatory agencies and local officials to request comments and information regarding the proposed project studies. Comments were incorporated into the project as appropriate; a summary of the comments with copies of the start of study letter, mailing list, and responses received are included in Appendix A.

The agencies contacted for comments via scoping letters are listed below. An asterisk (*) next to the name indicates that a written response was received.

- U.S. Environmental Protection Agency
- U.S. Army Corps of Engineers
- U.S. Fish and Wildlife Service *
- U.S. Forest Service
- State Clearing House – Department of Administration *
- North Carolina Department of Cultural Resources *
  - Division of Archives and History
  - State Historic Preservation Officer
- North Carolina Department of Environment and Natural Resources (NCDENR) *
  - Division of Water Quality *
- North Carolina Wildlife Resources Commission *
- North Carolina Department of Public Instruction
  - School Planning *
- North Carolina Division of Parks & Recreation
- City of Raleigh
- Town of Cary
- Regional Transportation Alliance

5.2 Agency Coordination

5.2.1. Merger Screening Meeting

A Merger Screening Meeting was conducted on January 17, 2008. The purpose of this meeting was to review the project scope and status, as well as the environmental screening information with the Merger Team. The Merger Team is comprised of agency representatives who participate with NCDOT in the Merger 01 Process. The January 17th meeting was attended by the following Merger Team representatives:

- North Carolina Department of Transportation
- United State Army Corps of Engineers – Wilmington District
- North Carolina Department of Natural Resources – Division of Water Quality

Due to the scope of the work associated with the project, it was agreed by the Merger Team representatives that a Categorical Exclusion would provide sufficient environmental analysis and documentation to support issuance of permits. Additionally, the Merger Team representatives agreed that this project would be exempt from the Merger 01 Process. The Merger Team requested that they be consulted during final design and prior to construction to review hydraulic design and permitting issues.

5.2.2. *Hydraulic Design Review Meeting*

A meeting was held with regulatory agency representatives on June 18, 2008 to review the hydraulic design for the proposed project. The meeting was attended by representatives from the following agencies:

- Federal Highway Administration
- North Carolina Department of Transportation
- U.S. Fish and Wildlife Service
- U.S. Environmental Protection Agency
- United State Army Corps of Engineers – Wilmington District
- North Carolina Department of Natural Resources – Division of Water Quality
- North Carolina Wildlife Resources Commission

Due to the scope of the proposed project and the anticipated impacts to jurisdictional resources, the regulatory agency representatives attending the meeting agreed that a permit drawing review meeting would not be required.

5.3. Public Involvement Plan and Participation

5.3.1. Notices and Newsletters

A comprehensive mailing list was developed for distribution of a newsletter announcing the start of study and requesting comments on the need for the project. The project mailing list included state, federal, and local agencies, property owners adjacent to the project corridor, and citizens who requested to be added to the mailing list. Postcard notices announcing the Citizens Informational Workshop were also distributed using the project mailing list. The start of study newsletter and CIW postcard notifications were sent to over 700 individuals and agencies. NCDOT also prepared a press release announcing the Citizens Informational Workshop. The press release was published in the Raleigh News and Observer and the Cary News in October and November prior to the workshop. The press release was also published in Que Pasa, a weekly Spanish language newspaper, from October 30, 2008 to November 20, 2008. Copies of the April 2007 newsletter, CIW postcard notice, and newspaper advertisement are included in Appendix B.

5.3.2. Local Officials Meeting

A local officials meeting was held on November 20, 2008 at 1520 Blue Ridge Road in Raleigh, North Carolina from 4:00 p.m. to 5:00 p.m. An invitation letter dated November 4, 2008 announcing the local officials meeting was mailed to officials from Wake County, Town of Cary, City of Raleigh, Capital Area Metropolitan Planning Organization (CAMPO), and Regional Transportation Alliance. The local officials meeting was conducted from 4:00 to 5:00 p.m. Two sets of preliminary design mapping were on display for meeting attendee to review. Additionally, representatives from NCDOT and the Project Study Team attended the meeting to answer any questions. During the meeting, the Regional Transportation Alliance expressed strong support for the project. Subsequent to the meeting, the Town of Cary submitted written comments regarding the project. A copy of the letter from the Town of Cary is included in Appendix B.

5.3.3. Citizens Informational Workshop

A Citizens Informational Workshop (CIW) was held on November 20, 2008 at the Raleigh Ramada located at 1520 Blue Ridge Road in Raleigh, North Carolina from 5:00 to 7:00 p.m. The purpose of the workshop was to give stakeholders the opportunity to review the preliminary designs and to ask questions regarding the project to NCDOT and the Study Team. The format

for the workshop was informal. A sign-in sheet, informational handout, and comment forms were provided to the workshop attendees. In accordance with the Americans with Disabilities Act, auxiliary aids and services for disabled persons were available upon request for those workshop attendees requiring them.

Approximately 25 people attended the CIW. At the workshop, a welcome station set-up to greet citizens, provide instructions and informational handouts, and to record attendance. There were two stations with the preliminary design mapping on display. A noise barrier station was also provided for citizens to discuss the findings of the preliminary noise analysis. This station included photographs of standard noise barriers installed on other NCDOT projects. Chairs and tables were set-up on one side of the room to allow citizens to fill out the comment sheets.

Representatives from the NCDOT and its Study Team were available throughout the workshop to answer questions and facilitate discussion with the public. Overall, workshop attendees indicated support for the project. Several homeowners from neighborhoods along the corridor commented on the potential for increased noise resulting from the project. These individuals also inquired as to the type and location of noise mitigation measures that would be constructed as part of the project. Several questions were received regarding the construction phasing and maintenance of traffic during construction. A few questions were also received regarding implementation of Intelligent Transportation Systems (ITS) measures both during construction and as part of the project. A few individuals also inquired about whether vegetative landscaping would be included as part of this project. A total of ten comment sheets were submitted during the CIW and the subsequent comment period. A summary of public comments received at the workshop is included in Appendix B.

5.3.4. Small Group Meetings

In addition to the Citizens Information Workshop and agency coordination meeting, several stakeholder or “small group” meetings were held for the project. These small group meetings were held to clarify stakeholder issues, as well as to thoroughly evaluate the potential impacts from the construction of STIP Project I-4744. Meetings were conducted with representatives from the following groups:

- City of Raleigh;
- Town of Cary;
- North Carolina State University; and
- Wake County.

During these meetings, concern was expressed by multiple stakeholders regarding potential effects of construction on major events such as the North Carolina State Fair, Meredith College events, North Carolina State University football and basketball games, and other events at the RBC Center. An additional concern noted during the meetings was the potential for increased noise resulting from the project. The input obtained during the stakeholder meetings was incorporated into the discussions contained in Chapters 3 and 4 of this Categorical Exclusion.

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APPENDICES

Appendix A – Agency Coordination

Appendix B – Public Involvement

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Appendix A

Agency Coordination

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Appendix B

Public Involvement

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