VOLUME 1 – TEXT

ADMINISTRATIVE ACTION

US Department of Transportation
Federal Highway Administration
and
North Carolina Department of Transportation

SUPPLEMENTAL FINAL ENVIRONMENTAL IMPACT STATEMENT

Winston Salem Northern Beltway
US 158 north to US 52

Federal Aid Project No. (none)
State Project No. 6.628001T
TIP Project No. R-2247

FINAL ENVIRONMENTAL IMPACT STATEMENT

Winston Salem Northern Beltway
US 52 south to I-40 Business and
I-40 Business south to US 311

Federal Aid Project No. NHF-0918 (14)
State Project No. 8.2625101
TIP Project Nos. U-2579 and U-2579A

Submitted Pursuant to 42 USC 4332(2)(c)

Cooperating Agencies
US Army Corps of Engineers

1/9/07
Date

For **Gregory Thorpe, Ph.D.,**
Environmental Management Director,
Project Development and
Environmental Analysis Branch,
North Carolina Department of Transportation

1/11/07
Date

for **John F. Sullivan, III, PE,**
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The proposed actions consist of improvements to the surface transportation system of Forsyth County. This statement documents the need for improvements and evaluates alternatives with respect to costs and social, economic, and environmental impacts. Preferred Alternatives have been identified for Project R-2247 and Project U-2579, as described in this document.

Comments on this document are due by _____ and should be sent to Mr. Thorpe at the above address.

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STATE OF NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

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Note to Reader

Projects Addressed in this Document. This document includes three projects from the NCDOT's Transportation Improvement Program (TIP) that together are commonly known as the Winston-Salem Northern Beltway. The western half of the Northern Beltway is Project R-2247. The eastern half is Project U-2579 and an extension of the eastern half is Project U-2579A.

Document Title. This document is a Supplemental Final Environmental Impact Statement (SFEIS) on the Western Section of the Winston-Salem Northern Beltway and a Final Environmental Impact Statement (FEIS) on the Eastern Section and Eastern Section Extension.

Status of Projects. The three projects that make up the Winston-Salem Northern Beltway were started at different times and have reached different points in the project development process. **Section 1.6** describes where each project is in its development. This SFEIS/FEIS updates information contained in previous planning documents for these three projects and provides new information where appropriate.

Reasons for Preparing a Combined Document for All Three Northern Beltway Projects. The Western Section, Eastern Section and Eastern Section Extension are all part of the Winston-Salem Northern Beltway. Together they would have a combined impact on the human and natural environments. Therefore, all three projects are being addressed here in a single document. This document provides a convenient means to communicate the direct and indirect impacts that all sections of the Northern Beltway, in whole or in part, would have on the environment and the cumulative impact on the environment resulting from the incremental impact of the Northern Beltway when added to other past, present, and reasonably foreseeable future actions.

Document Contents. This document responds to the comments received on the SFEIS/SDEIS during the review period and Public Hearing process and discusses the selection of the Preferred Alternative for the Eastern Section Extension (Project U-2579A), as well as the previously identified Preferred Alternatives for the Western Section (Project R-2247) and the Eastern Section (Project U-2579).

Green Sheet — PROJECT COMMITMENTS

Winston-Salem Northern Beltway
Forsyth County
Federal-Aid Project No. NHF-0918 (14)
State Project Nos. 6.628001T, 8.2625101
TIP Project Nos. R-2247, U-2579, and U-2579A

In addition to the Section 404 Conditions, Regional Conditions, State Consistency Conditions, the North Carolina Department of Transportation (NCDOT) Guidelines for Best Management Practices for the Protection of Surface Waters, General Certification Conditions, and Section 401 Conditions of Certification, the following special commitments have been agreed to by NCDOT:

Project Development and Environmental Analysis:

1. Archaeological site 31FY570**, a historic cemetery, will require avoidance or compliance with North Carolina General Statute, Chapter 70.

2. Temporary construction easements may be needed on the historic Clayton Family Farm property. It has been determined that these temporary easements do not constitute a use under Section 4(f). No permanent right of way will be acquired from the Clayton Family Farm property. All work will be contained in temporary easements, and the encroachment on the property will be minimal. The duration of the temporary encroachment on the Clayton Family Farm property will be shorter than the timeframe for the construction of the project. The land temporarily occupied from the Clayton Family Farm will be fully restored, that is, the Clayton Family Farm property will be returned to a condition that is at least as good as that which existed prior to the project.

3. Eligibility of Site 31FY64 is unknown because archaeologists were denied access to the property. If the site falls within the Preferred Alternative after final design, an assessment would be conducted prior to construction after it is acquired by NCDOT. Currently, the site is adjacent to non-preferred Detailed Study Alternative segment E3.

4. A design noise study will be prepared for the selected alternative. The date of public knowledge for noise abatement purposes is the date the Record of Decision (ROD) is signed.

5. The design noise study for the Project R-2247 portion of the Beltway will include an evaluation of Ronald Reagan High School.

*6. The NCDOT will develop Data Recovery Plans (DRP) for Sites 31FY888, 31FY893**, 31FY901, 31FY902**, 31FY903, 31FY910**, 31FY911**, 31FY912**, 31FY921, 31FY925**, 31FY944, 31FY1053/1053**, all of which will be affected by the subject project, in consultation with the North Carolina SHPO.

* Commitments marked by an asterisk (*) are taken from the Memorandum of Agreement between SHPO, NCDOT, and FHWA regarding addressing the Adverse Effects to historic resources (**Appendix D.1).**

*7. The NCDOT will ensure that each DRP is implemented after Right-of-Way is acquired or once Right-of-Entry is secured from the property owners and prior to construction activities within the site location as shown in the DRP.

*8. As they are developed, each individual DRP will be forwarded for review by the SHPO.

*9. Upon completion of each Data Recovery effort, the NCDOT will prepare and forward a Management Summary to the SHPO detailing the results of the Data Recovery field investigations. The Management Summary will contain sufficient information to demonstrate that the field investigation portion of the DRP has been implemented.

*10. Upon receipt of the Management Summary, the SHPO will respond within ten (10) days to the recommendations contained within the document.

*11. Upon acceptance of the recommendations contained in the Management Summary, the SHPO will issue the NCDOT documentation that the Data Recovery field investigations have been completed.

*12. The analysis and report preparation, detailing Sites 31FY888, 31FY893**, 31FY901, 31FY902**, 31FY903, 31FY910**, 31FY911**, 31FY912**, 31FY921, 31FY925**, 31FY944, 31FY1053/1053** will be completed by the NCDOT, or their consultants, within twenty-four (24) months after completion of each site's fieldwork schedule.

*13. In consultation with SHPO, NCDOT will determine the extent of control-of-access fencing, as well as its type, material, and finish. NCDOT will purchase and then install the control-of-access fencing within the NCDOT right-of-way. NCDOT will maintain the control-of-access fencing.

Roadway Design:

1. NCDOT will continue to work with residents of affected communities to develop mitigation strategies for community impacts. The following options will be considered during final design to minimize impacts to communities/subdivisions: construction of noise abatement barriers landscaping or vegetative screens based on NCDOT policies and guidelines. These types of options already have been incorporated into the Project R-2247, Project U-2579, and Project U-2579A preliminary engineering designs where practicable, but will be further considered during final design.

2. During final design for Projects R-2247, U-2579, and U-2579A, all utility providers and railroad operators would be coordinated with to ensure that the proposed design and construction of the project would not substantially disrupt service.

* Commitments marked by an asterisk (*) are taken from the Memorandum of Agreement between SHPO, NCDOT, and FHWA regarding addressing the Adverse Effects to historic resources (**Appendix D.1).**

3. The development of this project will be further coordinated with the City of Winston-Salem and Forsyth County Parks and Recreation Departments to minimize any conflicts with future parks and greenways planning. Provisions will be considered to maintain the future viability of any impacted proposed greenways.

4. NCDOT will coordinate with the Forsyth County Division of Environmental Health and Laboratory regarding the Reynolds Auto Junkyard and other solid waste sites along the selected alternatives for Projects R-2247, U-2579, and U-2579A. Impacted sites will be remediated as required.

5. NCDOT will consider wildlife crossings where appropriate in the vicinity of stream crossings, which will allow animals to cross under the Beltway.

6. NCDOT will coordinate with the Town of Kernersville regarding the compatibility of the Beltway design with the proposed Big Mill Farm Road interchange at US 421. This coordination will take place once all relevant design information has been obtained regarding the design of the Big Mill Farm Road interchange.

7. NCDOT intends to maintain a connection from Northampton Road to Old Walkertown Road. The final design will be developed based on design constraints and cost considerations.

*8. NCDOT will align the Alexander Hege House driveway opposite the new intersection ramp, so property access will be under full traffic control. This will allow NCDOT and the property owner full movement for equipment and trucks.

NCDOT Hydraulics Unit:

1. All bridges and culverts located in designated FEMA flood zones will be designed such that an increase in flood elevation would not exceed the lesser of 0.5 foot for the 100-year flood event or the elevation needed to protect structures.

2. A conditional Letter of Map Revision will be prepared for any floodway modification, in coordination with Federal Emergency Management Agency.

3. NCDOT will avoid installing bridge bents in creeks to the maximum extent practicable.

NCDOT Roadside Environmental:

1. During design and construction, efforts will be made to minimize the impact to existing vegetative buffers and natural areas. NCDOT will prepare a post construction landscape design/corridor plan to mitigate construction impacts and integrate enhancements, while remaining sensitive to the environment and to the safety of the traveling public.

* Commitments marked by an asterisk (*) are taken from the Memorandum of Agreement between SHPO, NCDOT, and FHWA regarding addressing the Adverse Effects to historic resources (**Appendix D.1).**

2. NCDOT will incorporate sediment and erosion control measures according to the Design Standards in Sensitive Watersheds for all construction in high quality water (HQW) zones in compliance with 15a NCAC 04B.0124.

*3. NCDOT will provide tree protection measures along the National Register boundary lines adjoining project construction areas. NCDOT will exercise best management practices to minimize, as practicable, tree trimming and disturbance of existing plantings along the National Register boundary.

NCDOT Roadside Environmental and Hydraulics:

1. Generally, 2:1 slopes will be used where possible to minimize culvert length, and NCDOT will shorten culvert lengths where possible and daylight systems between culverts where possible in interchange areas.

NCDOT Right of Way Branch:

1. NCDOT will work with the property owner of Walker Mobile Home Park off of Bethania-Tobaccoville Road to determine the feasibility of relocating the homes to another area of the parcel.

2. NCDOT will contact the pastor of Mount Pleasant Holiness Church prior to the public hearing and will, if desired, meet with the pastor and members of the church to discuss the impact of Project U-2579 on the church, NCDOT relocation policies, and potential mitigation. *Action since the 2004 SFEIS/SDEIS: NCDOT and consultant staff met with the pastor and members of Mount Pleasant Holiness Church during the 2005 public hearings. The church representatives declined to attend an additional meeting regarding this project or impacts of the Northern Beltway on the church. Additional information is in* ***Section 6.2.2.3***.

3. NCDOT will contact minority residents of North Oaks subdivision prior to the public hearing and will, if desired, meet with them to discuss the impacts of Project U-2579 on the community, NCDOT relocation policies, and potential mitigation. *Action since the 2004 SFEIS/SDEIS: NCDOT and consultant staff met the with North Oaks community on November 15, 2004. Additional information is in* ***Section 6.2.2.3***.

NCDOT Division 9 and Construction:

1. A pre-construction survey will be done in areas of possible concern regarding structural damage to assess a pre-construction condition.

NCDOT Division 9:

1. During construction for Project U-2579A, NCDOT will coordinate with the Forsyth County School Board to ensure the safety of those students bicycling and/or walking to Sedge Garden Elementary School. If a portion of school property is needed for a temporary construction easement, that area will be fenced to keep school children out of the construction site. The school property will be restored following construction.

* Commitments marked by an asterisk (*) are taken from the Memorandum of Agreement between SHPO, NCDOT, and FHWA regarding addressing the Adverse Effects to historic resources (**Appendix D.1).**

2. NCDOT will coordinate with local media during the construction of the project to alert the public of traffic restrictions and construction related activities.

3. NCDOT shall not approve any new driveway permits along the property of the historic John Henry Kapp Farm within the right of way for the Preferred Alternative. This condition shall be filed in the NCDOT Division office responsible for driveway permits.

SUMMARY

Summary

S.1 FEDERAL HIGHWAY ADMINISTRATION

(X) Supplemental Final Environmental Impact Statement
(X) Final Environmental Impact Statement

( ) Draft Section 4(f) Evaluation attached

This document is a Supplemental Final Environmental Impact Statement (SFEIS) for North Carolina Department of Transportation (NCDOT) Project Number R-2247 and a Final Environmental Impact Statement (FEIS) for NCDOT Project Numbers U-2579 and U-2579A.

According to the regulations implementing the NEPA in 40 CFR Part 1502.9(c)(1), agencies shall prepare supplements to either draft or final environmental impact statements if:

(i) The agency makes substantial changes in the proposed action that are relevant to environmental concerns; or
(ii) There are significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts.

For Project R-2247, NCDOT has not made substantial changes in the proposed action since publication of the 2004 SFEIS/SDEIS. However, there is new information relevant to environmental concerns regarding the project. Specific examples of new information include the redesign of the interchanges of US 52 and at Bethania-Tobaccoville Road. The preferred alternative has been selected in light of current conditions.

For Project U-2579, NCDOT did make substantial changes to the proposed action by adding the Eastern Section Extension (Project U-2579A) to move the southern terminus of the project from US 421/I-40 Business southward to US 311. These changes all were included in the 2004 SDEIS for Projects U-2579 and U-2579A. This FEIS documents the selection of the Preferred Alternative for Project U-2579A, includes and addresses comments from agencies on the document, comments from the public included in the public hearing record, and updates information in the 2004 SFEIS/SDEIS.

S.2 CONTACTS

The following individuals may be contacted for additional information concerning this Supplemental Final Environmental Impact Statement (SFEIS)/Supplemental Draft Environmental Impact Statement (SDEIS):

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S.3 PROJECT BACKGROUND AND HISTORY

The **Preface** and **Note to Reader** provide a discussion of the project background and history and approach taken in this document.

The environmental documentation of three projects from the North Carolina Department of Transportation's *2006-2012 Transportation Improvement Program (TIP)* are combined in this document: Project Numbers R-2247, U-2579, and U-2579A. The **Note to Reader** describes this document and explains its purpose as it pertains to each project.

The three projects collectively are commonly known as the Winston-Salem Northern Beltway. The western portion of the Beltway (Project R-2247) extends from US 158 north to US 52. The eastern portion of the Beltway (Projects U-2579 and U-2579A) extends from US 52 north of Winston-Salem to US 311 southeast of Winston-Salem. The eastern and western portions are independent from one

another and have different purposes and needs (see **Sections 1.3, 1.4, and 2.2.2**). **Figure S-1** shows the three projects.

For clarification, the naming conventions used for these and other TIP Projects are listed below.

Name	**Name(s) used in this document**
TIP Project X-# # # # (any TIP Project)	Project X-# # # #
TIP Project R-2247	Project R-2247 Western Section of the Northern Beltway Western Section
TIP Project U-2579	Project U-2579 Eastern Section of the Northern Beltway Eastern Section
TIP Project U-2579A	Project U-2579A Eastern Section Extension of the Northern Beltway Eastern Section Extension

Preferred Alternatives for Project R-2247 and Project U-2579 were identified through previous NEPA processes for each project, as described below. A Preferred Alternative has been identified for Project U-2579A and is described in this document. **Section 1.6** describes the history of these projects in more detail, including the events leading to this document.

A preferred alternative for Project R-2247 was identified in 1993. A Final Environmental Impact Statement (FEIS) and Record of Decision (ROD) for Project R-2247 were approved in 1996. The ROD was rescinded in 1999 as a result of the settlement of a lawsuit (US District Court for Middle District of North Carolina, Civil Action No. 1:99CV00134).

A Draft Environmental Impact Statement (DEIS) for Project U-2579 was approved in September 1995 and a preferred alternative between US 52 north of Winston-Salem and US 421/I-40 Business east of Winston-Salem was selected in 1996. After the preferred alternative was selected, a decision was made to extend this project to US 311.

Project U-2579A is the extension of Project U-2579 from US 421/I40 Business to US 311. A Supplemental Final Environmental Impact Statement (SFEIS)/Supplemental Draft Environmental Impact Statement (SDEIS) was approved in October 2004 and a Preferred Alternative was identified in March 2005.

The previously identified Preferred Alternatives for Project R-2247 and Project U-2579 remain NCDOT's Preferred Alternatives in this document (see **Sections 2.9.1 and 2.9.2** for a discussion of Project R-2247 and **Section 2.12.6.1 and 2.12.6.2** for a discussion of Project U-2579). **Section 2.12.2.3** discusses the selection of Project U-2579A Preferred Alternative. The alternatives' impacts,

comments on the Supplemental FEIS/Supplemental DEIS, and comments from the public hearing have been fully evaluated and are reported in this environmental document. However, the final selection of preferred alternatives through this process will not be made until the Record of Decision following approval of this document.

In its regulations implementing NEPA, the Council on Environmental Quality (CEQ) specifically permits agencies to identify preferred alternatives. According to the regulations, agencies shall "identify the agency's preferred alternative or alternatives, if one or more exists, in the draft statement and identify such alternative in the final statement unless another law prohibits the expression of such a preference." (40 CFR 1502.14 (e)).

According to FHWA guidance (FHWA, 1987: pg 16), "In those situations where the HA [highway agency] has officially identified a "preferred" alternative based on its early coordination and environmental studies, the HA should so indicate in the draft EIS." In North Carolina, the HA is the North Carolina Department of Transportation.

There is a large body of previously prepared information related to the Detailed Study Alternatives and Preferred Alternatives (if applicable) for each project that this supplemental document incorporates. The dates of this previously prepared information vary by project. The original publication dates are as follows:

Project R-2247 Detailed Study Alternatives	1992 (Draft EIS)
Project R-2247 Preferred Alternative	1996 (Final EIS)
Project U-2579 Detailed Study Alternatives	1995 (Draft EIS)
Project U-2579 Preferred Alternative	1996 (Following Draft EIS)
Project U-2579A Detailed Study Alternatives	2004 (Supplemental Draft EIS)

NEPA regulations state that NEPA documents should "concentrate on the issues that are truly significant to the action in question" (40 CFR Part 1500.1(b)). Following this policy, information in this document is updated where practicable and/or necessary for an adequate comparison of alternatives; to provide a clear understanding of the potential consequences of the proposed actions; and for effective decision-making by public officials.

A broad discussion of the approach taken and the information updated in each of the four major chapters of this document is provided in the **Preface**. At the beginning of each of the four major chapters (**Chapters 1-4**), a discussion of the approach taken and the information updated for that chapter is provided. In addition, detailed discussions of approach and methodology are included in appropriate places throughout the document.

S.4 PURPOSES AND NEEDS FOR PROJECTS

These projects address proposed improvements to the surface transportation network of Forsyth County. The primary purposes and needs of the proposed action are listed below for the Northern Beltway. Additional detail is in Section 1.4 (Needs) and Section 1.5 (Purposes).

S.4.1 Summary of Needs for the Northern Beltway

The transportation needs in the project study area that could be met by constructing the entire Northern Beltway include the following:

- Poor roadway connectivity in eastern and western Forsyth County
- Capacity deficiencies
- Poor Regional, Intrastate, and Interstate Linkage
- Consistent with the state and local land use and transportation plans
- Consistent with Highway Trust Fund Act

The transportation needs in the project study area that the Western Section only (Project R-2247) is intended to address include the following:

- Poor north/south roadway connectivity within and through western Forsyth County
- Capacity deficiencies

The transportation needs in the project study area that the Eastern Section and Extension only (Projects U-2579 and U-2579A) is intended to address include the following:

- Poor intrastate and interstate linkage to the north and south
- Poor roadway connectivity within and through eastern Forsyth County
- Capacity deficiencies
- Above-average accident rates on area roadways
- Corridor for I-74 (a congressionally designated High Priority Corridor on the National Highway System)

S.4.2 Purpose of the Northern Beltway

The Winston-Salem Northern Beltway as a whole would provide benefits that would address the transportation needs identified previously. The purposes for building the entire Northern Beltway include the following:

- Improve roadway connectivity in eastern and western Forsyth County
- Provide congestion relief for area roadways
- Expand options for regional/intrastate/interstate travel
- Help meet the state and local land use and transportation plans
- Help fulfill the Highway Trust Fund Act

The purposes for constructing Project R-2247 are listed below. These also would be served by construction of the entire Northern Beltway.

- Improve north/south connectivity in western Forsyth County
- Provide improved direct connections to US 52, US 421 and I-40
- Provide congestion relief for area roadways

The purposes for constructing Projects U-2579 and U-2579A are listed below. These also would be served by construction of the entire Northern Beltway.

- Improve intrastate and interstate mobility
- Improve roadway system linkage and continuity
- Reduce traffic congestion and carry future traffic at a desirable level of service
- Enhance safety
- Provide a corridor for I-74 (a congressionally designated High Priority Corridor on the National Highway System)

S.5 OTHER MAJOR ACTIONS IN THE PROJECT VICINITY

The *2006-2012 North Carolina Department of Transportation, Transportation Improvement Program (TIP)* includes eight Interstate projects, ten rural projects, twenty-three urban projects, twenty-one bridge replacement projects, two enhancement projects, four bicycle and pedestrian projects, two high

hazard projects, two passenger rail projects, and numerous transit projects for Forsyth County (see **Table 1-2**).

S.6 ALTERNATIVES CONSIDERED

Preliminary alternatives considered for the proposed actions included:

- No-Build Alternative and Partial Build Alternatives
- Transportation Management Alternatives
- Mass Transit/Multi-Modal Alternatives
- Preservation Easements Alternative
- Improve Existing Roadways Alternatives
- Build Alternatives on New Location

Each alternative was assessed with respect to its ability to meet the projects' purposes and needs.

The No-Build Alternative, Transportation Management alternatives, Mass Transit/Multi-Modal Alternatives, Preservation Easements Alternative (for Project R-2247), and Improve Existing Roadways Alternatives would not effectively meet the projects' purposes and needs. Only the Partial Build Alternatives (Build-East and Build-West) and the Build Alternatives on New Location were determined to meet the goals of the proposed projects.

The Partial Build Alternatives include the following:

- Build-West scenario – Build Only Project R-2247 – means build Project R-2247, but no action under Projects U-2579 and U-2579A.
- Build-East scenario – Build Only Projects U-2579 and U-2579A – means build Projects U-2579 and U-2579A, but no action under Project R-2247.

The Partial Build Alternatives would incur only those impacts and result in only those benefits listed for the project that is built (Project R-2247 or Projects U-2579 and U-2579A). As described in **Section 2.7.2**, both Project U-2579 and Project U-2579A would need to be constructed in order to fulfill the projects' purpose as the I-74 corridor since both projects connect to designated Interstate highways. Therefore, in developing the Partial Build Alternatives, Projects U-2579 and U-2579A were not separated.

The evaluations of the alternatives are included in **Chapter 2** of this document. **Chapter 2** also documents the selection of the Preferred Alternative for all three projects (Projects R-2247, U-2579, and U-2579A).

S.6.1 Project R-2247 – Summary of Build Alternatives

S.6.1.1 Detailed Study Alternatives

Development of Detailed Study Alternatives was documented in the 1992 Project R-2247 DEIS and is described in **Chapter 2** of this document.

Using a process known as Land Suitability Mapping (LSM), features that would inhibit or preclude the development of a new roadway were mapped. These included features such as existing and approved residential and commercial development, public and private community facilities (schools, churches, parks, recreational areas), potential historic and archaeological resources, utilities, floodplain limits, and wetlands. Potential roadway corridors identified on the Land Suitability Map were linked to form a network of route possibilities.

In addition, previously identified routes were considered, including functional design routes developed by the Winston Salem/Forsyth County City-County Planning Board in 1988.

The preliminary study corridors were evaluated for their traffic responsiveness, environmental impacts (through an environmental screening process), and relative costs for right of way and construction.

Build Alternatives on new location were developed within the preliminary study corridors. Eight of the Build Alternatives became the Detailed Study Alternatives and were evaluated in detail in the 1992 DEIS and 1996 FEIS for Project R-2247 (See **Figure 2-11**). They are WEST-A, EAST-A, WEST-B, EAST-B, C3-WEST-A, C2-EAST-A, C3-WEST-B, and C2-EAST-B.

S.6.1.2 Project R-2247 Preferred Alternative

Based on the evaluation in **Section 2.9.2**, Detailed Study Alternative C3-WEST-B is selected as the Project R-2247 Preferred Alternative because it avoids impacts to community facilities (two schools and parkland), avoids direct impacts to historic sites (Pfafftown Historic District and John Henry Kapp Farm), has a more desirable interchange design and location with US 52, avoids potential impacts to Rural Hall associated with extending the roadway east of US 52, and avoids crossing the confluence of the Muddy Creek and Silas Creek floodplains (a notable wildlife habitat). Detailed Study Alternative C3-WEST-B is one of the least expensive alternatives, one of two alternatives with the fewest residential relocations, and one of two alternatives with the least floodplain impact. The

selection of C3-WEST-B as the Preferred Alternative by NCDOT is documented in a letter dated September 14, 2006.

S.6.2 Project U-2579 – Summary of Build Alternatives

S.6.2.1 Detailed Study Alternatives

In early 1993, thirty-four preliminary alternative segments (see **Figure 2-16**) were developed through the application of Land Suitability Mapping (LSM), which identified major physical features within the study area to determine how to most effectively minimize freeway impacts. Preliminary alternatives were strategically located to help minimize impacts to these features within the corridor. Engineering factors considered included geometric and roadway design criteria, road-user safety, traffic service provided, and constructability from both economic and engineering feasibility aspects.

Of the 34 preliminary alternative segments studied, eleven were determined not to warrant further study. Using the remaining segments, two detailed alternatives (Eastern Alternative and Western Alternative) and five crossovers were developed between the designated termini at US 52 and US 421/I-40 Business.

In addition to the Eastern and Western Alternatives, eight other detailed study alternatives are possible by combining portions of the Eastern and Western Alternatives and the crossovers (see **Figure 2-17**). The ten Detailed Study Alternatives documented in the Project U-2579 DEIS are as follows:

- Eastern = E1+E2+E3+E4+E5
- Western = W1+W2+W3+W4+W5
- Alternative 1 = E1+C1+W3+W4+W5
- Alternative 2 = W1+C2+E3+E4+E5
- Alternative 3 = E1+E2+E3+C3+W4+W5
- Alternative 4 = W1+C2+E3+C3+W4+W5
- Alternative 5 = E1+E2+E3+E4+C5+W5
- Alternative 6 = W1+W2+W3+C4+C5+W5
- Alternative 7 = W1+W2+W3+C4+E5
- Alternative 8 = W1+C2+E3+E4+C5+W5

S.6.2.2 Project U-2579 Preferred Alternative

Based on the evaluation in **Section 2.11.1.2**, Detailed Study Alternative 7 is selected as the Project U-2579 Preferred Alternative because it is among those with the fewest residential relocations, has the shortest length and requires the least amount of land, impacts the fewest high quality wetlands, minimizes impacts to neighborhoods, minimizes impacts to Salem Lake, and has the southern terminus that minimizes impacts to homes and subdivisions when the Eastern Section Extension is taken into account. The selection of Alternative 7 as the Preferred Alternative by NCDOT is documented in a letter dated September 14, 2006.

S.6.3 Project U-2579A – Summary of Build Alternatives

S.6.3.1 Project U-2579A Detailed Study Alternatives

To develop preliminary alternatives for Project U-2579A, its study area was divided into two parts: one from US 421/I-40 Business to I-40 and one from I-40 to US 311. The preliminary alternatives between US 421/I-40 Business and I-40 are N1, N2, N3, and N4 ("N" standing for north of I-40). The alternatives between I-40 and US 311 are S1, S1A, and S2 ("S" standing for south of I-40).

Major physical features were identified within the study area to determine how to most effectively minimize impacts. Preliminary corridors account for these features and are strategically located to help minimize impacts within the area. The feasibility of each corridor was reviewed on the basis of providing acceptable design, geometrics, costs, and limits to adverse social and environmental impacts.

Segments were developed into continuous alternatives between the studied termini. Several preliminary alternatives for Project U-2579A were investigated as a result of planning studies. They were discussed with the Section 404/NEPA Merger Term, and state and federal regulatory and resource agencies on February 8, 2001 at a meeting to discuss Concurrence Points 1 (Purpose and Need) and 2 (Alternatives). They also were discussed with the Metropolitan Planning Organization (MPO) on March 23, 2001. Preliminary alternative segments are shown on **Figure 2-18**.

On February 8, 2001, the Section 404/NEPA Merger Team agreed that NCDOT would perform a screening of the corridors based on the following criteria:

- Major adverse impact to existing residential communities, including relocations and impact on community cohesion;
- Major adverse impact to businesses, including relocations or adverse impact to accessibility;
- Inconsistency with project purpose and need;

- Undesirable traffic operational or safety conditions;
- Adverse impacts to known archaeological sites and historic properties, and to existing or planned parks and greenways, including Section 4(f) impacts and major Section 106 effects;
- Major adverse impacts to wetlands or other sensitive natural areas; and
- Higher cost of construction.

Of the seven alternative segments, two were determined not to warrant further study (Segments N4 and S1A).

Six alternatives were retained for detailed study, as listed below and shown in **Figure 2-19**. At the request of the Section 404/NEPA Merger Term, the detailed study alternatives have been evaluated both with and without an interchange at Kernersville Road.

- N1-S1
- N1-S2
- N2-S1
- N2-S2
- N3-S1
- N3-S2

S.6.3.2 Project U-2579A Preferred Alternative

Alternative N2-S1 with an interchange at Kernersville Road is the Preferred Alternative for Project U-2579A. A detailed discussion of the selection of the Preferred Alternative is provided in **Section 2.12.7** of this document.

The 2004 SFEIS/SDEIS evaluated six detailed study alternatives (each with and without an interchange at Kernersville Road) for Project U-2579A. These six alternatives represent the combination of five alternative segments – N1, N2, and N3 north of I-40 and S1 and S2 south of I-40, as described in the 2004 SFEIS/SDEIS and in the SFEIS/FEIS in **Section 2.12.2.3**.

Based on the findings of the 2004 SFEIS/SDEIS, the comments of the citizens at the public meetings and hearings, and the identification of Alternative N2-S1 with an interchange at Kernersville Road as the least environmentally damaging practicable alternative (LEDPA) by the Section 404/NEPA Merger Team, NCDOT endorsed Alternative N2-S1 with an interchange at Kernersville Road as the NCDOT Preferred Alternative. This decision was based primarily on residential relocations, economic impacts, stream impacts, and the support of local officials.

Following the identification of the LEDPA, NCDOT formally selected N2-S1 with a single point interchange at Kernersville Road as the Preferred Alternative, as approved by NCDOT in the corridor selection letter dated March 16, 2005. Reasons for selecting N2-S1 as the Preferred Alternative include the following:

- This alternative has the fewest residential relocations and the least impact on neighborhoods.
- This alternative keeps the Union Cross interchange open, which is critical to the success of the area's economic development, especially Union Cross Business Park and Alliance Business Park, which was selected in December 2004 as the future home of a Dell Computer distribution facility.
- The Town of Kernersville strongly desires an interchange at Kernersville Road.
- A single-point interchange at Kernersville Road is feasible for this alternative. This type of interchange would have the least impact and also would improve traffic operations.

S.6.4 Selection of the Northern Beltway Preferred Alternative

The Preferred Alternative for the Northern Beltway is the combination of the Preferred Alternatives for the three sections studied (Alternative C3-WEST-B for Project R-2247, Alternative 7 for Project U-2579, and Alternative N2-S1 with an interchange at Kernersville Road for Project U-2579A). This Preferred Alternative, Alternative C3-WEST-B/Alternative 7/Alternative N2-S1 with an interchange at Kernersville Road, is shown in **Figure S-2**, and the impacts of the Preferred Alternative are shown in **Table S-2**.

S.7 SUMMARY OF ENVIRONMENTAL CONSEQUENCES

This section summarizes the combined environmental consequences for the Project R-2247 Preferred Alternative, Project U-2579 Preferred Alternative, and Project U-2579A Detailed Study Alternatives and Preferred Alternative.

Table S-1 summarizes the various quantitative impacts to the environment for the Preferred Alternatives for Projects R-2247, U-2579, and U-2579A. The individual impacts of the three Preferred Alternatives are presented throughout **Chapter 4** of this document.

Table S-1: Direct Environmental Consequences – Northern Beltway Preferred Alternative

Environmental Issue	Impact
Length (miles)	34.2
Estimated Costs[6]	
Construction Costs (millions $)	785.7
Right-of-Way Costs (millions $)	269.4
Utility Costs (millions $)	20.5
Total Costs (millions $)	1,075.6
Relocation Impact Summary[7]	
Residences (total)	1,019
Owner-occupied	894
Tenant-occupied	125
Minority-occupied (owners or tenants)	155
Businesses	60
Community Services and Facilities Impact Summary	
Schools	1[4,5]
Parks & Recreational Facilities	0
Churches & Cemeteries	8[5,8]
Other Community Facilities	0
Utilities[1]	
Electrical Easement Crossings	9
Electrical Substations	0
Major Gas Mains	2
Directional Radio Antenna Arrays	0
Railroad Crossings	3
Historic Architectural and Archaeological Resources Impact Summary	
# of Archaeological sites requiring preservation in place[2]	0
# of Historic Resources with No Adverse Effect	4
# of Historic Resources with Adverse Effect	1
Section 4(f)/6(f) Resources Impact Summary	
Section 4(f) Resources	0
Section 6(f) Resources	0
Air Quality Impact Summary	
Intersections Exceeding Carbon Monoxide NAAQS	0
Noise Impact Summary	
# of Impacted Receptors – with mitigation in place	269
Hazardous Materials Impact Summary	
Number of Potentially Impacted Hazardous Materials Sites	19
Major Drainage Structure Summary	
Number of Bridges over Streams	18
Number of Crossings with Major Culverts (> 72 inches in diameter)	37
Floodways and Floodplains Impact Summary	
Floodplains/Floodways (# of crossings)	22
Number of Crossings Requiring Floodway Modification	13
Biotic Communities Impact Summary (acres)	
Piedmont/Low Mountain Alluvial Forest	106
Piedmont Bottomland Forest	12
Dry Oak-Hickory Forest	63
Dry Mesic Oak-Hickory Forest	581

Mesic Mixed Hardwood Forest	174
Maintained/Disturbed	1,160
Agriculture	369
Cut-Over	59
Successional Pine Forest	1
Pine Plantation	77
Acres of Prime, Statewide, and Local Important Farmland	1,380
Jurisdictional Issues Summary	
Acres of Wetlands Impacted	7.48
Number of Wetland Crossings	45
Acres of Ponds Impacted	24.71
Number of Pond Crossings	23
Total Linear Feet of Impacted USACE Mitigatable Streams	35,665
Total Linear Feet of Relocated Streams	6,189
Number of Stream Crossings	120
Protected Species Impact Summary	
Bog Turtle (*Clemmys muhlenbergii)*[3]	N/A
Red-Cockaded Woodpecker (*Picoides borealis*)	No Effect
Small-Anthered Bittercress (*Cardamine micrantha)*	No Effect

Impacts were based on revised preliminary engineering designs for the Project R-2247, U-2579, and U-2579A Preferred Alternatives.

[1] Interchange ramp design may cause multiple crossings of the utility corridor at locations of planned interchanges. Only one crossing is noted in the table for each of these locations.
[2] Site 31FY1053(**) in the Project U-2579 study area requires further study.
[3] This species is not biologically endangered or threatened and is not subject to Section 7 consultation.
[4] Sedge Garden Elementary School; temporary impact from Sedge Garden Road detour.
[5] Impact to property does not impact school or church facilities.
[6] Based on 2005-2006 costs for Projects R-2247, U-2579, and U-2579A Preferred Alternatives.
[7] Based on 2005 relocation reports for U-2579 and U-2579A Preferred Alternatives, and 2003 relocation reports for R-2247 Preferred Alternative.
[8] Pfafftown Baptist Church - impacts to parking lot and one outbuilding, but no impact to the church itself.

Issues that are not quantified in the table are summarized below.

Land Use and Transportation Planning (Section 4.1). The Northern Beltway is consistent with state and local transportation plans in the area.

Public Safety (Section 4.2.3). The Northern Beltway would have an overall beneficial impact on the level of public safety in the study area.

Environmental Justice (Section 4.2.5). The Northern Beltway would not have an adverse or disproportionate impact on minority and/or low-income populations.

Visual Impacts (Section 4.6). The Northern Beltway would have minimal visual impacts to the area. Although the roadway would diminish the rural, pastoral atmosphere of much of the affected area, the growth plan described in *The Legacy Plan* indicates that much of the study area will be changing

from the existing rural atmosphere to one of a more developed, suburban character due to anticipated residential development. The roadway probably would not be visible from areas other than the immediate vicinity due to the natural change in elevation, the extensive areas of cut in areas out of the floodplain, and tall trees in the area.

Mineral Resources (Section 4.10). No known mines or quarries are located in the immediate vicinity of the project study area. Therefore, the project would not adversely impact such resources through conversion of their existing land uses.

There are two Forsyth County rock quarries and numerous concrete plants located throughout the county. With a ready source for these materials, construction of the Northern Beltway is not expected to cause a local shortage of construction materials. No other known mineral resources would be impacted as a result of the proposed projects.

Soils (Section 4.11). The soils within the project study area are composed of four main associations: Pacolet-Cecil, Madison-Pacolet, Chewacla-Wehadkee-Congaree, and Wedowee-Louisburg. Soil limitations can be overcome through proper engineering design, including the incorporation of techniques such as soil modification, appropriate choice of fill material, use of non-corrosive subgrade materials, and design of drainage structures capable of conveying estimated peak flows. Decisions regarding soil limitations and methods to overcome them would be determined during final design.

Farmland (Section 4.12). No substantial impacts to farmland would occur under any of the Detailed Study Alternatives for the Northern Beltway, whether constructed in whole or in part.

Water Quality (Section 4.13). Stormwater runoff rates likely would increase slightly due to the increase in impervious surface area. This is an unavoidable, long-term impact resulting from construction of the Northern Beltway in whole or in part. The proposed action also has the potential to temporarily degrade the quality of water in the surrounding streams as a result of soil erosion and sedimentation during construction. Implementation of NCDOT's *Best Management Practices for the Protection of Surface Waters* would minimize these impacts. Quantitative water quality modeling would be conducted for the selected alternatives as part of the Section 401 Water Quality Certification process.

Indirect and Cumulative Impacts (Section 4.20). The methods described in the *NCDOT Indirect and Cumulative Impact Guidance Manuals (Volumes I and II)* were followed to assess the indirect and cumulative impacts of the Winston-Salem Northern Beltway. Four analysis scenarios were chosen for the indirect and cumulative assessment of the Winston-Salem Northern Beltway. These are listed below:

- No-Build

- Build-West – Build Project R-2247 (Western Section) only
- Build-East – Build Projects U-2579 and U-2579A (Eastern Section and Eastern Section Extension) only
- Full-Build Northern Beltway (Projects R-2247, U-2579, and U-2579A)

The time frame for the analysis is the year 2025. The overall study area for the indirect and cumulative impact evaluation is Forsyth County. Potential changes to general land use, accessibility, and development potential/attractiveness were evaluated in this study area. Traffic Analysis Zones (TAZs) used in the Piedmont Triad Regional Traffic Model were used for most of the quantitative analysis.

Overall conclusions of the indirect and cumulative effects assessments are summarized below. These must be tempered by the inherent uncertainty associated with future economic and policy conditions.

- The underlying land use pattern in Forsyth County is, and has been for several decades a low-density suburban growth pattern characteristic of many urban areas in the Southeast. Winston-Salem/Forsyth County has made notable strides in managing this growth, particularly with consideration of protecting open space in outlying areas of the county.
- The TAZs that are expected to face the greatest development pressures over the next 20 years (i.e. with the greatest projected increases in housing and employment) do not vary regardless of whether the Northern Beltway or any if its segments are constructed. However, pace of development may be slightly accelerated and the nature of the development may change partially as a result of the construction of the Northern Beltway at these high growth zones.
- Building the Northern Beltway, or any of its individual segments, does not appreciably increase the amount of suburban type development in Forsyth County, although a greater variety of land uses will be attracted to future interchange locations. The greatest increase in land use in any TAZ that is attributable to the implementation of any build scenario is between three and five percent over the No-Build scenario. In some cases, these growth areas are being actively planned for by the community and are considered desirable changes over the No-Build case.
- The Northern Beltway, in whole or in part, would have a small effect on the desirability of given tracts of land over other, similar tracts of land (tracts near the beltway tend to have slight gains in total employment or housing relative to the No-Build Scenario).
- Development, particularly commercial development, near the proposed interchanges is more likely in the Build cases than in the No-Build case. This is evident from the results of the gravity allocation model, research findings, and comparative case studies of other interchange areas across the State.
- The FHWA's SMITE model was used to provide an estimate of induced travel that may occur related to the Winston-Salem Northern Beltway (**Section 4.20.2.2** defines terminology used in the

indirect and cumulative impacts analysis). In 2025, induced travel for all reasonably foreseeable projects is estimated to be approximately 1.80 percent of total travel. Induced travel with only the Northern Beltway is approximately 1.05 percent. Based on this analysis, it can generally be concluded that the amount of induced travel resulting from construction of the Northern Beltway is not appreciable when examined as a portion of vehicle miles traveled throughout the region.

In summary, the effects attributable solely to the Northern Beltway projects (Projects R-2247, U-2579, and U-2579A) are relatively small, but should be placed in an appropriate context with public policy, available land for conversion to higher-intensity uses, other public infrastructure projects, and market conditions.

Cumulatively, the Northern Beltway, in conjunction with other public and private projects, places some additional pressures from induced development, induced travel, and encroachment –alternative effects on communities, natural habitat, and water quality. While the magnitude of these changes is difficult to quantify with certainty, the nature of the land use changes, the features that may be sensitive to change, and the locations most susceptible to indirect/cumulative effects have been identified. Local governments and stakeholder groups should be prepared for these changes, and be proactive in mitigating for their negative effects while maximizing positive benefits from the proposed Beltway Projects.

S.8 REQUIRED PERMITS AND ACTIONS

Construction of the Winston-Salem Northern Beltway would result in several activities requiring environmental regulatory permits from state and federal agencies. A list of these permits, organized by issuing agency, is provided below. NCDOT would obtain all necessary permits prior to construction.

S.8.1 Permits

United States Army Corps of Engineers

Section 404 Permit. A permit from the US Army Corps of Engineers (USACE) is required for any activity in water or wetlands that would discharge dredged or fill materials into Waters of the United States and adjacent wetlands. To obtain permit approval, impacts to wetlands must be mitigated through avoidance, minimization, and compensation measures in accordance with the *Memorandum of Agreement Between the Environmental Protection Agency and the Department of the Army Concerning the Determination of Mitigation Under the Clean Water Act Section 404(b)(1) Guidelines* (February 1990). Additional policy and

guidance has been established through *An Interagency Agreement Integrating Section 404/NEPA* (May 1997) which is usually referred to as the NEPA/404 Merger Agreement.

Authority. Federal Pollution Control Act Amendments of 1972 and Section 404 of the Clean Water Act of 1977. Regulations promulgated in 33 CFR Part 323.

North Carolina Department of Environment and Natural Resources – Division of Water Quality

Section 401 Water Quality Certification. Any activity which may result in discharge to Waters of the United States requires a certification that the discharge will be in compliance with applicable state water quality standards. A U.S. Army Corps of Engineers Section 404 permit and a water quality certification may be applied for simultaneously.

Authority. North Carolina General Statute 143, Article 21, Part 1. Regulations promulgated in 15A NCAC 2H and 2B.

National Pollutant Discharge Elimination System (NPDES) Permit. A permit is required for projects involving sewer systems, treatment works, disposal systems, and certain stormwater runoff that could result in a discharge to surface waters. The State has the authority to administer the national NPDES program for projects in North Carolina.

Authority. North Carolina General Statute 143, Article 21, Part 1. Regulations promulgated in 15A NCAC 2H.0100.

North Carolina Department of Environment and Natural Resources – Division of Land Quality

Soil and Erosion Control Plan. Persons conducting land-disturbing activity shall take all reasonable measures to protect all public and private property from damage caused by such activities. Pursuant to GS 113A-57(4) and 113A-54(d)(4), an erosion and sedimentation control plan must be both filed and approved by the agency having jurisdiction.

Authority. North Carolina Administrative Code, Title 15A. Department of Environment and Natural Resources Chapter 4. 15A NCAC 04B .0101

North Carolina Department of Environment and Natural Resources – Division of Air Quality

Burn Permit. Any burning done during the construction of the proposed project would be done in accordance with applicable local laws and ordinances and regulations of the North Carolina State Implementation Plan for air quality in accordance with 15 NCAC 2D.0520.

Authority. Regulations promulgated in 15 NCAC 2D.0520.

S.8.2 Subsequent Actions

The approval of this SFEIS/FEIS does not complete the project implementation process. The following is a summary of actions, events, and studies to be completed prior to project construction. Coordination with resource agencies will be maintained throughout the entire process. Items indicated as subsequent actions in the SFEIS/SDEIS that have been performed include the public hearing, review and evaluation of comments, and selection of the Least Environmentally Damaging Practicable Alternative/Preferred Alternative. In addition, preliminary designs have been refined to minimize impacts, particularly to streams and wetlands. Some service road studies have been performed, and others will be performed during final design.

This document will be circulated to environmental agencies and the public for review and comment. Then, the following studies and actions will be completed to advance the project through Concurrence Points 4B (30 Percent Hydraulic Design) and 4C (100 Percent Hydraulic Design) of the NEPA/Section 404 merger process.

After approval of this environmental document, a Record of Decision (ROD) will be published. Following the ROD, a Design Public Hearing will be held to receive public comments on the refined preliminary design for the selected alternatives.

The final roadway design plans will be prepared, taking into consideration all public and agency comments received on the preliminary designs and the next environmental document. The following studies will be conducted as a part of the final design process.

- Investigating the feasibility of additional grade separations and connections, including Northampton Drive at Old Walkertown Road.
- During the permitting phase of the project, NCDOT will investigate on-site mitigation opportunities throughout the area. Off-site mitigation for the project is being implemented by the Ecosystem Enhancement Program.
- Hazardous material studies will be conducted to further review sites which would be impacted.

- Drainage and hydrological studies to identify and design major drainage structures and coordination with FEMA and the Forsyth County Flood Administrator.
- Traffic control plans will be developed to facilitate access during the construction phase.
- Surveys for wells within and adjacent to the proposed right of way limits will be conducted.
- Noise analyses based on updated traffic and detailed design plans will be conducted to evaluate whether or not potential noise barriers are feasible and reasonable.
- Geotechnical investigations will be conducted to recommend techniques and materials to overcome any soil limitations along the selected alternative.
- Project right-of-way limits will be finalized.

Other actions which must be completed prior to the start of project construction include, but are not limited to the following:

- Preparation of an erosion control plan incorporating the NCDOT *Best Management Practices for Protection of Surface Waters*.
- Coordination with municipalities and utilities for relocation and reconfiguration of utility systems.
- Implementation of the Relocation Assistance Program.
- Approval of all required permits and certifications as outlined in **Section S.8.1 and Section 4.25.1**.

S.9 UNRESOLVED ISSUES

There are no unresolved issues per 23 CFR 771.125(a)(2).

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PREFACE

This document was prepared in accordance with the requirements of the National Environmental Policy Act (NEPA) of 1969, as amended, and the North Carolina Environmental Policy Act of 1971 (NCEPA). This is an informational document intended for use by both decision-makers and the public. As such, it represents a disclosure of relevant environmental information concerning the proposed actions.

This document conforms with the Council on Environmental Quality (CEQ) regulations that provide direction regarding implementation of the procedural provisions of NEPA (40 CFR Parts 1500-1508, 1978), the Federal Highway Administration's (FHWA*) Guidance for Preparing and Processing Environmental and Section 4(f) Documents* (Technical Advisory T6640.8A, 1987), and the FHWA regulations implementing NEPA, *Environmental Impact and Related Procedures* (23 CFR Part 771).

P.1 PROJECTS ADDRESSED IN THIS DOCUMENT

The environmental documentation of three projects from the North Carolina Department of Transportation's *2004-2010 Transportation Improvement Program (TIP)* are combined in this document: Project Numbers R-2247, U-2579, and U-2579A.

The three projects collectively are commonly known as the Winston-Salem Northern Beltway. The western portion of the Beltway (Project R-2247) extends from US 158 north to US 52. The eastern portion of the Beltway (Projects U-2579 and U-2579A) extends from US 52 north of Winston-Salem to US 311 southeast of Winston-Salem. The western portion is independent of, and has different purposes and needs than, the eastern portion. (See **Sections 1.3** and **1.4**). **Figure S-1** shows the three projects.

For clarification, the naming conventions used for these and other TIP Projects are listed below. For additional terms and definitions used, a Glossary of Terms and Definitions has been included in **Section 10**.

Project	Alternative names used in this document
TIP Project X-# # # # (any TIP Project)	Project X-# # # #
TIP Project R-2247	Project R-2247 Western Section of the Northern Beltway Western Section
TIP Project U-2579	Project U-2579 Eastern Section of the Northern Beltway Eastern Section
TIP Project U-2579A	Project U-2579A Eastern Section Extension of the Northern Beltway Eastern Section Extension

P.2 Previous Identification of Preferred Alternatives for Projects R-2247 and U-2579

Preferred Alternatives for Project R-2247 and Project U-2579 were identified through previous NEPA processes for each project, as described below. A Preferred Alternative has been identified for Project U-2579A and is described in this document. **Section 1.6** describes the history of these projects in more detail.

A preferred alternative for Project R-2247 was identified in 1993. A Final Environmental Impact Statement (FEIS) and Record of Decision (ROD) for Project R-2247 were approved in 1996. The ROD was rescinded in 1999 as a result of the settlement of a lawsuit (US District Court for Middle District of North Carolina, Civil Action No. 1:99CV00134).

A Draft Environmental Impact Statement (DEIS) for Project U-2579 was approved in September 1995 and a preferred alternative between US 52 north of Winston-Salem and US 421/I-40 Business east of Winston-Salem was selected in 1996. After the preferred alternative was selected, a decision was made to extend this project to US 311.

Project U-2579A is the extension of Project U-2579 from US 421/I40 Business to US 311. A Supplemental Final Environmental Impact Statement (SFEIS)/Supplemental Draft Environmental Impact Statement (SDEIS) was approved in October 2004 and a Preferred Alternative was identified in March 2005.

P.3 Current Identification of Preferred Alternatives in this Document

The Preferred Alternatives for Project R-2247 and Project U-2579 previously identified remain the NCDOT's Preferred Alternatives in this document (See **Section 2.9.1** for a discussion of Project R-2247 and **Section 2.12.6** for a discussion of Project U-2579).

As part of the preparation of this document, the selections of the Preferred Alternatives for Project R-2247 and Project U-2579 were re-evaluated in light of current conditions to determine whether any of the selection factors had changed substantially. Of particular concern were changes that could affect the validity of the selections.

The selection of the 1993 Project R-2247 Preferred Alternative is discussed in detail in **Section 2.9.1. Section 2.9.2** discusses the re-evaluation of the Project R-2247 Preferred Alternative. The selection of the 1996 Project U-2579 Preferred Alternative is discussed in detail in **Section 2.12.6.1. Section 2.12.6.2** discusses the re-evaluation of the Project U-2579 Preferred Alternative**. Section 2.12.2.3** discusses the selection of Project U-2579A Preferred Alternative.

In its regulations implementing NEPA, the Council on Environmental Quality (CEQ) specifically allows agencies to identify preferred alternatives. According to the regulations, agencies shall "identify the agency's preferred alternative or alternatives, if one or more exists, in the draft statement and identify such alternative in the final statement unless another law prohibits the expression of such a preference." (40 CFR 1502.14 (e)).

According to FHWA guidance (FHWA, 1987: pg 16), "In those situations where the HA [highway agency] has officially identified a "preferred" alternative based on its early coordination and environmental studies, the HA should so indicate in the draft EIS." In North Carolina, the HA is the North Carolina Department of Transportation.

Preferred Alternatives are identified by the NCDOT for Project R-2247, Project U-2579, and Project U-2579A. The alternatives' impacts, comments on the Supplemental FEIS/Supplemental DEIS, and comments from the public hearing have been fully evaluated and are reported in this environmental document. However, the final selection of preferred alternatives through this process will not be made until the Record of Decision (ROD) following approval of this document.

P.4 Discussion of Document Type

This document is a Supplemental Final Environmental Impact Statement (SFEIS) for Project R-2247 and a Final Environmental Impact Statement (FEIS) for Projects U-2579 and U-2579A.

According to the regulations implementing the NEPA in 40 CFR Part 1502.9(c)(1), agencies shall prepare supplements to either draft or final environmental impact statements if:

(i) The agency makes substantial changes in the proposed action that are relevant to environmental concerns; or
(ii) There are significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts.

This SFEIS/FEIS contains new information relevant to environmental concerns regarding the project. Specific examples of new information include the redesign of the interchanges at US 52 and at Bethania-Tobaccoville Road. In addition, the previous decisions made with regard to the preferred alternative are re-evaluated in light of current conditions.

For Project U-2579, the NCDOT made substantial changes to the proposed action by adding the Eastern Section Extension (Project U-2579A) to move the southern terminus of the project from US 421/I-40 Business to US 311. These changes all were included in the 2004 SDEIS for Projects U-2579 and U-2579A. This FEIS documents the selection of the Preferred Alternative for Project U-2579A, includes and addresses comments from agencies on the document, comments from the public included in the public hearing record, and updates information in the 2004 SFEIS/SDEIS.

P.5 Approach Taken to Address Projects R-2247, U-2579, and U-2579A in this SFEIS/FEIS

There is a large body of previously prepared information related to the Detailed Study Alternatives and Preferred Alternatives (if applicable) for each project that this supplemental and final document incorporates. The dates of this previously prepared information vary by project. The original publication dates are as follows:

Project R-2247 Detailed Study Alternatives	1992 (Draft EIS)
Project R-2247 Preferred Alternative	1996 (Final EIS)
Project U-2579 Detailed Study Alternatives	1995 (Draft EIS)
Project U-2579 Preferred Alternative	1996 (Following Draft EIS)
Project U-2579A Detailed Study Alternatives	2004 (Supplemental Draft EIS)

In the NEPA regulations, it is stated NEPA documents should "concentrate on the issues that are truly significant to the action in question" (40 CFR Part 1500.1(b)). Following this policy, information in this document is updated where practicable and/or necessary for an adequate comparison of alternatives; to provide a clear understanding of the potential consequences of the proposed actions; and for effective decision-making by public officials.

At the beginning of each of the four major chapters (**Chapters 1-4**), a discussion of the approach taken and the information updated for that chapter is provided. In addition, detailed discussions of approach methods are included in appropriate places throughout the document.

CHAPTER 1

Chapter 1 PURPOSE AND NEED FOR ACTION

1.1 INTRODUCTION

This supplemental document combines three projects from the North Carolina Department of Transportation (NCDOT) 2006-2012 *Transportation Improvement Program (TIP),* Projects R-2247, U-2579, and U-2579A. These projects together are commonly known as the Winston-Salem Northern Beltway.

TIP Projects R-2247, U-2579, and U-2579A are discussed throughout this document. For clarification, the naming conventions used for these and other TIP Projects are listed below.

Name	**Name(s) used in this document**
TIP Project X-# # # # (any TIP Project)	Project X-# # # #
TIP Project R-2247	Project R-2247 Western Section of the Northern Beltway Western Section
TIP Project U-2579	Project U-2579 Eastern Section of the Northern Beltway Eastern Section
TIP Project U-2579A	Project U-2579A Eastern Section Extension of the Northern Beltway Eastern Section Extension

For additional terms and definitions used in this document, a Glossary of Terms and Definitions has been included in **Section 10**.

A Final Environmental Impact Statement (FEIS) and Record of Decision (ROD) were approved for Project R-2247 in 1996. The ROD was rescinded in 1999 as a result of the settlement of a lawsuit (US District Court for Middle District of North Carolina, Civil Action No. 1:99CV00134). A Draft Environmental Impact Statement (DEIS) for Project U-2579 was approved in September 1995. A Supplemental Final Environmental Impact Statement (Project R-2247)/Supplemental Draft Environmental Impact Statement (Projects U-2579 and U-2579A) was approved in October 2004. **Section 1.6** describes the history of these projects in detail and the events leading to this supplemental document.

The 2004 SFEIS/SDEIS identified Preferred Alternatives for Project R-2247 and Project U-2579. This SFEIS/FEIS identifies Preferred Alternatives for Projects R-2247, U-2579, and U-2579A.

However, the final selection of preferred alternatives through this process will not be made until after comments on this Supplemental FEIS/FEIS are fully evaluated. The Record of Decision will document the final selection of the Preferred Alternatives.

In its regulations implementing NEPA, the Council on Environmental Quality (CEQ) specifically permits agencies to identify preferred alternatives. According to the regulations, agencies shall "identify the agency's preferred alternative or alternatives, if one or more exists, in the draft statement and identify such alternative in the final statement unless another law prohibits the expression of such a preference." (40 CFR 1502.14 (e)).

According to the Federal Highway Administration (FHWA) guidance (FHWA, 1987, pg. 16), "In those situations where the HA [highway agency] has officially identified a "preferred" alternative based on its early coordination and environmental studies, the HA should so indicate in the draft EIS."

1.2 APPROACH TAKEN TO ADDRESS PROJECTS R-2247, U-2579, AND U-2579A IN THIS CHAPTER

This section discusses the independent purposes and needs for Project R-2247 and Projects U-2579 and U-2579A and also the benefits that the projects would create if all three are constructed as the Winston-Salem Northern Beltway.

Recent data are provided for the project setting, existing road network, commuting patterns, and modal interrelationships. Social and economic conditions are based on the 2000 Census and current population projections. Recent transportation and local land use plans are described.

Existing traffic volumes are from 2001. Travel demand modeling projections for the future year 2025 no-build and partial-build scenarios are based on the Piedmont Triad Regional Travel Demand Model (1999). Capacity analyses were conducted based on these 2025 projections.

Accident data are updated to 1997-2000 for roads in the western portion (Project R-2247) of the study area and to 1999-2002 for roadways in the eastern portion of the study area (Projects U-2579 and U-2579A).

1.3 PROPOSED ACTIONS

This project addresses proposed improvements to the surface transportation network of Forsyth County.
Figure 1-1 is a map showing the locations of the project study areas in relation to Winston-Salem and the state. The study area for Project R-2247 encompasses a part of western Forsyth County from US 158 north to US 52. As described in the 1992 Project R-2247 DEIS, the Project R-2247 study area was established based on areas that would attract the most traffic. The study area definition for Project R-2247 is discussed further in **Section 2.8.1.**

The study area for Project U-2579 encompasses a part of northeastern Forsyth County from US 52 southeast to US 421/I-40 Business. The study area for Project U-2579A extends from US 421/I-40 Business south to US 311 in eastern Forsyth County. The study area was established based on the adopted thoroughfare plan, the location of existing interchanges, and locations of developed areas such as Walkertown and Kernersville. The basis used for establishing the study areas of Project R-2247 and Projects U-2579 and U-2579A varies due to the differences in the individual projects' purposes and needs (see **Sections 1.4** and **1.5**).

1.4 SUMMARY OF NEEDS FOR PROPOSED ACTIONS

1.4.1 Transportation Needs in the Northern Beltway Study Area

Many transportation needs in the project study area would be met by constructing the entire Northern Beltway. These needs, described in greater detail in **Sections 1.4.2 and 1.4.3**, include the following:

- **Poor Roadway Connectivity in Eastern and Western Forsyth County**

The existing roadway network in the outer areas of eastern and western Forsyth County is dominated by a system of radial arterials that converge on the downtown Winston-Salem area, so circumferential traffic (traffic wanting to travel across the county) must either drive towards the city or must weave through a series of circumferential roadways to reach its destination. The existing roads serving circumferential travel are primarily narrow, two-lane rural roads that are often not continuous across the radial routes and provide circuitous routes. There are no adequate cross-network routes between residential areas and the employment/service centers outside of the central urban area. The growing suburban population will have an increasing need for a circumferential route to travel from these suburbs to various employment/service centers located outside the central portion of the city.

In addition, US 52 creates a barrier between east-west travel in northern Forsyth County. For example, NC 66 and NC 65 provide for east-west travel in eastern Forsyth County, but they end at US 52 and do not cross over to the west. West of US 52, there are only secondary roads connecting to US 52. To reach the nearest NC route west of US 52, which is NC 67 (Reynolda Road), travelers from NC 66 or NC 65 must use Bethania-Rural Hall Road, then Bethania Road (both rural two-lane roads) to reach NC 67. The travel demand scenarios that were modeled indicate there is a desire for travel across US 52, although the heaviest movements are projected to be to/from US 52.

- **Capacity Deficiencies**

Capacity analyses were performed on arterial and collector roadways in Forsyth County for the year 2025 without the Northern Beltway. Traffic data from the Piedmont Triad Regional Travel Demand Model was used in the analysis.

Over half of the road segments analyzed in the study area would operate under very congested conditions – levels of service (LOS) E or F – without the Beltway. These deficient road segments would include such major connecting arterials such as Peace Haven Road, Shattalon Drive, portions of Silas Creek Parkway, Reynolda Road (NC 67), Robinhood Road, Country Club Road, University Parkway, Kernersville Road, West Mountain Street, US 158 (Reidsville Road) and NC 66 (Old Hollow Road). In addition, freeway corridors projected to operate at an undesirable level of service are I-40 from US 52 to NC 66 and US 421/I-40 Business from US 52 to US 158.

- **Poor Regional, Intrastate, and Interstate Linkage**

Currently, all of the interstate highways and freeways serving Winston-Salem (I-40, US 421/Business, US 52, and US 311) connect in or near downtown Winston-Salem. This patterns serves trips oriented to or from downtown Winston-Salem well, but does not serve trips from one freeway to the other that are not oriented to downtown. For example, trips southbound on US 52 to I-40, and trips eastbound on NC 67 to US 158 must pass through the congested central Winston-Salem in order to make those movements. No circumferential freeways exist to route through traffic around the downtown area.

- **Consistent with the State and Local Land Use and Transportation Plans**

A Northern Beltway from US 158 west of Winston-Salem to US 311 east of Winston-Salem is included in *the Winston-Salem Urban Area 2030 Multi-Modal Long Range Transportation Plan (LRTP)* and in the Legacy Development Guide (see **Sections 1.10.2 and 1.10.3**). The purpose of these plans is to prepare for the development of transportation facilities and to provide guidelines for growth and development in the Winston-Salem region. Together, the two plans provide a

unified approach to development and transportation, and both include construction of the Northern Beltway.

- **Consistent with the Highway Trust Fund Act**

The NC Highway Trust Fund Act, enacted in 1989 and amended in subsequent years, establishes a funding stream for urban loops. Included in the law as an urban loop is a multi-lane facility around Winston-Salem on new location from I-40 west of Winston-Salem around the northern portion of Winston-Salem to US 311 in eastern Forsyth County. This Act allocated highway funds to various portions of the state with an objective of providing equitable distribution. Urban loop freeways were included in the Act for seven major cities in North Carolina, including Winston-Salem.

1.4.2 Transportation Needs in Project R-2247 Study Area

The need to improve the transportation system in western Forsyth County is demonstrated by the following summary of existing and projected conditions.

- **Poor North/South Roadway Connectivity Within and Through Western Forsyth County**

As can be seen in **Figure 1-2**, the existing roadway network in the outer areas of western Winston-Salem and in western Forsyth County is dominated by a system of radial arterials. In the late 1800s, this system was developed to bring farmers, farm products, and other materials to the city center, where industry and an urban population were located.

Radial & Circumferential Routes
Radial and circumferential routes can be defined using a wheel analogy. Radial routes would be the wheel spokes and circumferential routes would be the wheel rims.

All of the major arterials converge on the downtown Winston-Salem area, so circumferential traffic (traffic wanting to travel across the county) must either drive towards the city to move north or south, or must weave through a series of north/south roadways to reach destinations inside or outside western Forsyth County. The existing north/south connecting roads are primarily narrow, two-lane rural roads that are generally not continuous across the radial routes (roads going from the city center to the outer areas of the county). Silas Creek Parkway (NC 67), within the Winston-Salem city limits, is the only efficient multi-lane circumferential link connecting the radial roadways on the west side of Forsyth County. For example, traffic wanting to travel from Clemmons (southwest of Winston-Salem) to Rural Hall (north of Winston-Salem), has to drive into Winston-Salem on I-40 and then travel north on Silas Creek Parkway to NC 66. The other option is to travel through a network of primarily rural, north/south roadways.

The need for better north/south connectivity within and through western Forsyth County is a reflection of the growing suburban population and its changing travel patterns. In western Forsyth County, there are no adequate cross-network routes between current and future residential areas and the employment/service centers outside of the central urban area. The growing suburban population will have an increasing need for a circumferential route to travel from these suburbs to various employment/service centers located outside the central portion of the city.

- **Capacity Deficiencies**

Capacity analyses were performed on 74 segments of 39 arterial and collector roadways in western Forsyth County for the year 2025. Traffic data from the Piedmont Triad Regional Travel Demand Model was used in the analysis.

Level of Service

The LOS is defined with letter designations from A to F. LOS A is the best operating conditions along a roadway or at an intersection, and LOS F is the worst. In urban areas, LOS D is generally considered desirable, while in rural areas, LOS C is considered desirable. LOS E and F conditions cause substantial travel delay, increase the potential for accidents, and contribute substantially to the inefficient operation of motor vehicles.

In 2025, under the Build-East scenario (do not build Project R-2247), approximately 59 percent of the roadway segments analyzed in western Forsyth County would operate in the peak morning and evening hours at level of service (LOS) E or F, and another 24 percent would operate at LOS D. There is little difference in ADT volumes on the Project R-2247 study area road network between the two scenarios that involve not building Project R-2247 (Build none of the Northern Beltway and the Build-East scenario). Standard procedures typically assume all other projects in the LRTP are in place. **Section 1.11.2.2** discusses the traffic analyses in more detail.

Roadways in western Forsyth County projected to operate at LOS E or F include major connecting arterials such as Peace Haven Road, Shattalon Drive, and portions of Silas Creek Parkway. Radial routes, such as Reynolda Road (NC 67), Robinhood Road, and Country Club Road also are projected to operate at LOS E or F in 2025.

1.4.3 Transportation Needs in Projects U-2579 and U-2579A Study Areas

The need to improve the transportation system in northern and eastern Forsyth County is demonstrated by the following summary of existing and projected conditions.

- **Poor Intrastate and Interstate Linkage to the North and South**

Currently, there is no multilane, access-controlled facility that provides a continuous link between US 52, US 421/I-40 Business, I-40, and US 311 in northern and eastern Forsyth County outside the limits of Winston-Salem. Locally, travelers from Rural Hall, Stanleyville, and Bethania would benefit from a more direct route to eastern Winston-Salem, Walkertown, and Kernersville. Regionally, drivers traveling between cities north of Winston-Salem such as Mount Airy and cities south and east of Winston-Salem such as Greensboro, High Point and Asheboro also would benefit from a direct freeway route that does not involve travel near Winston-Salem's central business district (CBD).

In addition to the benefits to drivers who wish to bypass Winston-Salem, there are also benefits to drivers who choose to travel on US 52 or I-40 in the form of reduced congestion. **Figure 1-3** shows the existing roadway network in eastern Forsyth County.

As many as 79,000 vehicles per day (2001) currently use US 52 for travel in and through Winston-Salem. US 52 is an access-controlled facility throughout Winston-Salem. However, close interchange spacing, narrow lanes, and substandard lateral clearances that substantially limit roadway capacity prevent US 52 from adequately serving existing and projected traffic volumes.

- **Poor Roadway Connectivity Within and Through Eastern Forsyth County**

Presently, no adequate major circumferential roadway facilities exist in the eastern portion of the study area. Existing roads in the Project U-2579 and Project U-2579A study areas that provide some connectivity include: Old Hollow Road (NC 66), Oak Summit Road, Old Walkertown Road, Hopkins Road, West Mountain Street (NC 66), NC 66 south of Kernersville, Union Cross Road, Sedge Garden Road, Oak Grove Road, and Linville Road. However, non-radial travel along these primarily two-lane roads is discontinuous and circuitous. US 421/I-40 Business, I-40, and US 311 are multi-lane freeways serving primarily east-west traffic, but provide little or no connectivity between many developing portions of the county.

- **Capacity Deficiencies**

Capacity analyses were performed on 21 segments of nine freeway and arterial roadways in northeastern Forsyth County.

In the year 2025, under the Build-West scenario (do not build Projects U-2579 and U-2579A), 57 percent of the roadway segments analyzed in northern and eastern Forsyth County would operate at LOS E or F during the peak hours, and 14 percent would operate at LOS D. There is little difference in ADT volumes on the road networks in the Project U-2579 and Project U-2579A study areas between the two scenarios that involve not building Projects U-2579 and U-2579A (Build none of the Northern Beltway and the Build-West scenario). Standard procedures typically assume all other projects from the LRTP are in place. **Section 1.11.2.3** discusses the traffic analyses in more detail.

The freeway corridors projected to operate at an undesirable level of service are I-40 from US 52 to NC 66, US 421/I-40 Business from US 52 to US 158, and NC 66 (Old Hollow Road) from US 52 to Baux Mountain Road. Segments of University Parkway, Kernersville Road, West Mountain Street, and US 158 (Reidsville Road) also will operate at LOS E or worse.

US 52 (with eight lanes) from 25th Street to US 421/I-40 Business and US 421/I-40 Business from US 158 to Linville Road are projected to operate at LOS D in the Build-West scenario. Eight lanes would be needed to serve traffic demand on US 52 at minimum LOS D under this alternative. The feasibility of providing eight lanes on this facility is addressed in **Section 2.6.3.2**.

- **Above-Average Accident Rates on Area Roadways**

Accident rates were calculated on various segments of area roadways by dividing the total number of accidents on a roadway segment by the number of vehicle miles traveled (VMT) on that segment. These rates were compared to the statewide average accident rates for similar roadways for the years 2000 through 2002. If the ratio between number of accidents and number of VMT, called the safety ratio, is greater than one, it indicates that the roadway segment has an above-average accident rate.

Seven of the thirteen roadway segments analyzed in the Project U-2579 and Project U-2579A study areas had above-average accident rates. These segments were along US 311, US 52, and NC 66 (see **Table 1-12** in **Section 1.12**).

- **Corridor for I-74**

I-74 is a congressionally designated High Priority Corridor on the National Highway System. The I-74 corridor in North Carolina currently is signed as "Future I-74" except for the existing 12-mile section of I-74 connecting I-77 and US 52 in Surry County. It was originally identified by Congress as a high priority corridor, and as such, was included in legislation for the Transportation Equity Act for the 21st Century (TEA-21). The corridor currently runs from Cincinnati, Ohio through Indianapolis, Indiana to Davenport, Iowa, and is planned to extend from

Georgetown, South Carolina to Davenport, Iowa, passing through the cities of Winston-Salem, North Carolina; Portsmouth, Ohio; Cincinnati, Ohio; and Indianapolis, Indiana.

1.5 PURPOSES OF THE PROPOSED ACTIONS

As described in the previous section, the transportation needs in the Project R-2247 study area differ from those in the Projects U-2579 and U-2579A study areas. Consequently, the purposes of Project R-2247 are different than those of Projects U-2579 and U-2579A.

1.5.1 Purposes of the Northern Beltway as a Whole

The Winston-Salem Northern Beltway as a whole would provide benefits that would address the transportation needs identified previously.

- **Improve Roadway Connectivity in Eastern and Western Forsyth County**

The Northern Beltway would provide a new circumferential road that would help to accommodate growth patterns in suburban Forsyth County. It would address the need for a continuous route with additional capacity that would cross the radial routes and connect residential areas with employment and service centers outside of the central urban area.

The Northern Beltway would also provide a more direct route for traffic crossing US 52. According to the forecasted 2025 peak hour traffic volumes for the Northern Beltway, approximately 35 percent of traffic would cross over US 52 from the Western Section of the Northern Beltway to the Eastern Section, demonstrating an added benefit that wouldn't otherwise exist if one section is left out. Likewise, approximately 19 percent of traffic would cross over US 52 from the Eastern Section of the Northern Beltway to the Western Section.

- **Provide Congestion Relief for Area Roadways**

The Beltway would reduce congestion in the study area roadway network. It would provide an alternative route and would supply long-distance travelers a route with less congested conditions.

- **Expanded Options for Regional/Intrastate/Interstate Travel**

With the entire Northern Beltway in place, more regional, intrastate, and interstate trip options would be available. The entire Northern Beltway would provide freeway routes in all directions around Winston-Salem, accommodating trips with origins and destinations outside Winston-Salem and/or Forsyth County, and giving drivers the option to avoid traveling through the

Winston-Salem CBD no matter which direction of travel is desired. For example, travelers from the north heading south would be able to use the Northern Beltway to pass through Forsyth County without having to travel through the Winston-Salem CBD in order to continue traveling southward on I-74, eastward on I-40, or westward on I-40 or US 421.

- **Help Meet the State and Local Land Use and Transportation Plans**

Building the Northern Beltway would provide consistency with the *Winston-Salem Urban Area 2030 Multi-Modal Long Range Transportation Plan (LRTP)* and the Legacy Development Guide.

- **Help Fulfill the Highway Trust Fund Act**

The Winston-Salem Northern Beltway is one of the multi-lane urban road facilities included in the NC Highway Trust Fund Act. Building the loop would be consistent with the intent of the General Assembly when the Highway Trust Fund Act was passed.

1.5.2 Purposes of Project R-2247

The primary purposes of the proposed action in western Forsyth County are:

- **Improve North/South Connectivity in Western Forsyth County**

The Northern Beltway would provide a new circumferential highway that would improve cross-town and cross-county movements in Western Forsyth County. It would connect residential areas with employment and service centers outside of the central urban area.

- **Provide Improved Direct Connections to US 52, US 421 and I-40**

The Northern Beltway would address the need for a continuous route that would connect the existing radial routes. It would improve access of circumferential traffic to US 52, US 421, I-40, and destinations outside of Western Forsyth County.

- **Provide Congestion Relief for Area Roadways**

  The Northern Beltway would address the need for additional capacity on the existing roadway network by providing a new high capacity option for drivers. Of the 74 roadway segments analyzed in 2025 in Western Forsyth County, it would improve the level of service on nine percent of segments, and would reduce traffic volumes on 41 percent of segments.

1.5.3 Purposes of Projects U-2579 and U-2579A

The primary purposes of the proposed action in northern and eastern Forsyth County are:

- **Improve Intrastate and Interstate Mobility**

  The Northern Beltway would provide a direct connection for vehicles traveling to north and east Forsyth County. This new interstate facility would provide a better level of service than the existing two-lane undivided rural routes such as NC 66, and the older, congested urban freeways such as US 52.

- **Improve Roadway System Linkage and Continuity**

  The Northern Beltway would improve continuity of the overall roadway system in Eastern Forsyth County. It would link radial arterials in the northern and eastern portions of the county.

- **Reduce Traffic Congestion and Carry Future Traffic at a Desirable Level of Service**

  The Northern Beltway would improve the level of service on eight of the 17 major arterial segments analyzed, including portions of US 421/I-40 Business and US 52. Both of these major roadways as well as others are projected to operate at a level of service E or F in 2025 without the Beltway, and at level of service D or better with the Beltway.

- **Enhance Safety**

  The Northern Beltway would provide a higher level of safety to traffic that would be diverted from US 52 and NC 66y to the Beltway because of its design as a modern Interstate facility. With the Beltway, the accident rate in the eastern study area in 2025 is projected to decrease 11 to 17 percent (whether average or actual accident rates are used to calculate accident rates).

- **Provide a Corridor for I-74**

The Northern Beltway would address the need for a new I-74 Interstate corridor in a northwest-southeast direction through Forsyth County. It would follow the recommendation of the NC Board of Transportation to follow a new location corridor rather than using the congested sections of US 52 and US 311. I-74 is a congressionally designated High Priority Corridor on the National Highway System.

1.6 HISTORY OF PROJECTS

This section provides the history of the Winston-Salem Northern Beltway in transportation plans and land use plans, milestones in previous studies and documents for Projects R-2247, U-2579, and U-2579A, and events leading to the decision to combine the projects in the 2004 SFEIS/SDEIS and this SFEIS/FEIS.

1.6.1 History of Projects in Transportation and Land Use Plans

The Winston-Salem Northern Beltway was first proposed in 1965 as part of the *Master Transportation Plan* for Forsyth County. Since then, a version of the Northern Beltway has always been included in the City-County Planning Board's roadway plans (*Vision 2005* pg. 56).

The *1980 Winston-Salem/Forsyth County Thoroughfare Plan* showed an example alignment for the Northern Beltway within or along the edges of the Winston-Salem city limits, with much of the Western Section of the route east of Muddy Creek. The 1980 example alignment is shown on the *1987 Winston-Salem/Forsyth County Thoroughfare Plan* in **Figure 1-4**.

The *1987 Winston-Salem/Forsyth County Thoroughfare Plan* modeled several general alignments for the Northern Beltway. Many of these routes were further away from the center of Winston-Salem than the alignment shown on the *1980 Thoroughfare Plan* due to the growth and development occurring in the area.

In 1988, Winston-Salem and Forsyth County adopted *Vision 2005*, a comprehensive plan for the city and county. The *1987 Winston-Salem/Forsyth County Thoroughfare Plan* became a part of *Vision 2005*. Both plans were coordinated and developed simultaneously. The conceptual alignment selected for display on the 1987 Thoroughfare Map included consideration of the corridor's compatibility with the growth management plan in *Vision 2005*. The *1987 Thoroughfare Plan* conceptual alignment is labeled in **Figure 1-4**.

In July 1989, the North Carolina General Assembly enacted the Highway Trust Fund Act to bring 96 percent of the state's citizens within 10 miles of a modern four-lane highway. A part of this law allocates funding for urban loops in seven North Carolina urban areas: Winston-Salem Urban Area, Asheville, Charlotte, Durham, Greensboro, Raleigh, and Wilmington. Projects R-2247 (from I-40 north to US 52), U-2579, and U-2579A are all Highway Trust Fund projects.

The *2005 Thoroughfare Plan* was adopted in January 2005, and the *Winston-Salem Urban Area 2030 Multi-Modal Long Range Transportation Plan* (*LRTP*) was adopted by the Winston-Salem Urban Area Transportation Advisory Committee (TAC) on March 31, 2005. Amendments were adopted by the TAC July 21, 2005 and the *2030 LRTP* (as amended) was approved by the

NCDOT on September 30, 2005. The *2005 Thoroughfare Plan* is the street and highway system component of the *2030 LRTP*. Transportation plans are discussed in more detail in **Section 1.10.2**.

The *Legacy Development Guide* (adopted in *2001)* is the general, long-range policy guide for decisions concerning the overall growth and development of Forsyth County and its eight municipalities. This plan is discussed in more detail in **Section 1.10.3.**

1.6.2 Previous Actions Related to Projects

The following is a list of key milestones in the planning process for Project R-2247:

Date	**Milestone**
June 1992	Draft EIS for Project R-2247
September 1, 1992	Corridor Public Hearing for Project R-2247
April 1993	Preferred Alternative selected for Project R-2247. The Preferred Alternative is a new location freeway along the C3-WEST-B Detailed Study Alternative.
March 14, 1996	Final EIS
May 7, 1996	Record of Decision issued by FHWA
September 5, 1996	Design Public Hearing
October 6, 1997	Corridor Protection Map approved
February 18, 1999	Lawsuit filed in the United States District Court for the Middle District of North Carolina regarding Project R-2247. Civil Action No. 1:99CV00134.
April 15, 1999	FHWA rescinds the Record of Decision for Project R-2247.
June 29, 1999	Order of Dismissal issued by US District Court Judge Bullock specifying terms of settlement.
June 4, 2001	Judicial opinion issued by US District Court Judge Bullock in Civil Action No. 1:99CV00134 regarding attorney's fees.
November 21, 2001	Decision to combine Projects R-2247, U-2579, and U-2579A into one environmental document.

The following is a list of key milestones in the planning process for Projects U-2579 and U-2579A:

Date	**Milestone**
September 1995	Draft EIS for Project U-2579
December 1995	Corridor Public Hearing for Project U-2579
January 1996	Feasibility Study for Project U-2579A
May 1996	Preferred Alternative selected for Project U-2579. The Preferred Alternative is a new location freeway along Alternative 7 (Western, Crossover 4, Eastern).
June 1999	Decision to include Project U-2579A in the planning process for Project U-2579 and to prepare a supplemental DEIS for Project U-2579A and a single FEIS for Projects U-2579 and U-2579A.
November 21, 2001	Decision to combine Projects R-2247, U-2579, and U-2579A into one environmental document.

The following is a list of key milestones in the planning process for the combined Projects R-2247, U-2579 and U-2579A:

Date	Milestone
October 1, 2004	SFEIS/SDEIS for Projects R-2247, U-2579, and U-2579A approved
November-December 2004	Pre-hearing open houses and public hearings for the three projects
March 2005	Preferred Alternative selected for Project U-2579A. The Preferred Alternative is a new location freeway using Alternative N2-S1 with an interchange at Kernersville Road.

1.6.3 Decision to Combine Projects In One Environmental Document

Because Projects R-2247, U-25799, and U-2579A are all part of the Winston-Salem Northern Beltway, and because they together would have a cumulative impact on the human and natural environment, it was decided that all three projects should be addressed in a single document. This document provides a convenient means to communicate all direct and indirect impacts that all sections of the Northern Beltway would have on the environment and the cumulative impact on the environment resulting from the incremental impact of the Northern Beltway when added to other past, present, and reasonably foreseeable future actions.

This document responds to the comments received on the 2004 SFEIS/SDEIS during the review period and Public Hearing process as well as discusses the selection of the preferred alternative for the Eastern Section Extension (Project U-2579A), confirms the Preferred Alternatives for the

Western Section (Project R-2247) and the Eastern Section (Project U-2579), and updates various portions of the SFEIS/SDEIS.

1.7 PROJECT SETTING

The proposed projects are located in Forsyth County in north-central North Carolina. As shown in **Figure 1-1**, the study areas for the proposed projects surround the City of Winston-Salem to the west, north, and east. Winston-Salem is the second largest city in the Piedmont Triad area, which also includes the cities of Greensboro (the largest) and High Point.

Other incorporated towns (see **Figures 1-2** and **1-3**) include Clemmons, Lewisville, Bethania, and Tobaccoville in the Project R-2247 study area, and Rural Hall, Walkertown, and Kernersville in the Project U-2579 and Project U-2579A study areas.

Unincorporated communities in the Project R-2247 study area include Vienna (Yadkinville Road at Lewisville-Vienna Road), Pfafftown (Yadkinville Road at Transou Road), and Seward (Reynolda Road (NC 67) at Seward Circle). Unincorporated communities in the Project U-2579 and Project U-2579A study areas include Stanleyville (Stanleyville Drive and University Parkway) and Guthrie (Mountain Street and Hastings Hill Road).

The project study areas are located in the Piedmont physiographic province. The average elevation of Forsyth County is 870 feet above sea level, and the highest point, located west of Rural Hall, is 1,105 feet above sea level. The topography is gently rolling to hilly, and the interstream areas are fairly broad.

The Project R-2247 study area is in the Yadkin River basin and is drained primarily by Muddy Creek and its named and unnamed tributaries. Named tributaries, from south to north, include Little Creek, Silas Creek, Reynolds Creek, Tomahawk Creek, James Branch, Oil Mill Branch, Bill Branch, and Mill Creek No. 3. Bashavia Creek also drains a small portion of the study area south of Reynolda Road. This creek flows directly into the Yadkin River.

The Project U-2579 and Project U-2579A study areas are primarily in the Yadkin River basin, with a small part in the north draining into the Dan River in the Roanoke River basin. The study areas include the following named creeks, from north to south: Rough Fork Creek, Trick-Um Creek, Buffalo Creek, Grassy Creek, Mill Creek, Five Mile Creek, Frazier Creek, Lowery Mill Creek, Martin Mill Creek, Kerners Mill Creek, Smith Creek, Fishers Branch, Fiddlers Creek, Swaim Creek, and Muddy Creek. Lowery Mill Creek, Martin Mill Creek, Kerners Mill Creek, Smith Creek, and Fishers Branch flow into Salem Lake, which is a secondary source of drinking water for both Winston-Salem and Kernersville.

All study areas include a mix of forested rural, agricultural, and residential land uses interspersed with commercial and industrial development along the major traffic arteries.

1.8 SYSTEM LINKAGE

1.8.1 Existing Road Network

Forsyth County has a radial-dominated transportation system that serves a heavily automobile-dependent population. The system carries relatively high morning and afternoon traffic peaks. While the Winston-Salem CBD is served by a well-developed street grid pattern with numerous one-way streets, the surrounding area is characterized by numerous radial arterials connected directly to residential streets. All of the major arterials converge on the downtown area, so that circumferential traffic must either drive farther in towards the city to move north or south or must weave through a series of residential streets or local roads. Transit service is focused on the Winston-Salem CBD with little suburban circulation.

Forsyth County is served by one Interstate highway, four US highways, and six NC highways. **Figure 1-1** shows the major roadways in Forsyth County. I-40 is North Carolina's major east-west link, connecting Asheville, Winston-Salem, Greensboro, Burlington, Chapel Hill, Durham, Raleigh, and Wilmington. I-40 provides a southern east-west bypass of the Winston-Salem and Kernersville urban areas.

The four US routes are US 421/I-40 Business, US 311, US 158, and US 52. US 421/I-40 Business provides an east-west principal arterial through the Winston-Salem CBD. US 52 is the primary north-south route through Winston-Salem. US 52 connects to I-74 and I-77 to the north and I-85 to the south.

Project U-2579 and Project U-2579A would serve as part of the I-74 corridor. As identified by the FHWA's National Highway System (NHS), the new I-74 corridor is planned to pass through Winston-Salem in a northwest-southeast direction.

1.8.2 Commuting Patterns

Table 1-1 lists the percentages of commuters using various modes to get to work. Commuters in Forsyth County and throughout the state are, as a group, heavily dependent upon the private automobile, with approximately 80 percent of all commuters driving alone to work and 13 to 14 percent using private carpools. Less than seven percent use some mode that is not dependent on an automobile, such as public transportation, walking or bicycling.

Year 2000 average commute times in Forsyth County are typically less than the statewide average (21 minutes and 24 minutes, respectively) (US Census 2000), but are progressively extending over longer periods. Forsyth County's average commute times have increased nearly two-and-a-half minutes between the times reported in the 1990 and 2000 decennial census (Census 1990).

1.8.3 Modal Interrelationships

Forsyth County has a transportation system typical of moderate-sized urban areas. This system depends heavily on automobile use and has substantial morning and afternoon traffic peaks. Available modes of transportation in Winston-Salem and Forsyth County include the private automobile (the primary mode), bus service, ride-sharing, rail service, and air service.

Table 1-1: Journey to Work by Mode

Mode	North Carolina	Forsyth County
Drive Alone	79.4%	80.5%
Carpool	14%	12.8%
Public Transportation	0.7%	1.5%
Walk/Telecommute	2.1%	2.0%
Worked at Home	2.7%	2.5%
Other	1.1%	0.7%
Total	**100%**	**100%**

Source: QT-P23. Journey to Work

1.8.3.1 Public Transportation

The Winston-Salem Transit Authority (WSTA) and the Piedmont Authority for Regional Transportation (PART) provide a variety of services including: bus service, trolley rides, Park & Ride, Park & Shuttle, Ridesharing & Vanpooling (RSVP), bike and ride, and Trans-AID. WSTA was recently named one of the top five public transportation systems in the country in providing the most cost-effective transit services (*Legacy Development Guide*, pg. 57).

The WSTA bus service provides 2.8 million riders with 32 routes, including eight night routes, one trolley route, and one shuttle route. Regular adult fare is $1.00 on fixed routes, with free transfers. The Park & Ride service offers bus service from parking lots around Winston-Salem. The Park & Shuttle service offers free shuttle service to downtown businesses from parking lots on the edges of downtown Winston-Salem (WSTA website,

http://www.cityofws.org/DOT/wsta.html, accessed December 28, 2005). WSTA bus routes are shown on **Figure 2-2**.

Ridesharing Services & Vanpooling of the Piedmont (RSVP) is a state-funded ridesharing program for people in the 12-county Triad region. It is the largest vanpooling program in the Southeast. Through carpool matching and vanpool leasing, RSVP provides commuters with an alternative to single occupancy vehicles. This program, with a fleet of 24 vans, currently eliminates over 737,810 miles of commuter travel in the Triad region each year. Ridership exceeded 319,890 passenger trips in 2005 (personal communication, January 11, 2006).

PART completed the *Triad Major Investment Study Preliminary Draft Report* in November 2002. This report evaluates two alternatives for regional transit; a Rail Alternative and a Bus Rapid Transit Alternative. Several corridors are examined for these alternatives and include: Winston-Salem to Greensboro along I-40 and Business I-40, Winston-Salem to High Point along US 311, and Winston-Salem to Clemmons along I-40. Since the completion of that report, PART has begun the second phase of development with the Triad Transit Alternatives Analysis. The first part of this study was completed in Fall 2003, and identified future needs for the Piedmont Triad region. The current stage of the study builds upon the previous work and will identify and analyze solutions to meet those needs (PART website, *www.partnc.org*, accessed July 25, 2005).

Amtrak operates three passenger trains that serve the Piedmont area. The Carolinian and the Piedmont routes are supported in part by NCDOT. The Carolinian provides daily service from Charlotte to New York through Rocky Mount. The Piedmont provides daily service between Raleigh and Charlotte. The Crescent route provides service between New York and New Orleans. All of these trains make stops in Greensboro and High Point. A connecting bus, the Amtrak Connector, provides service to Winston-Salem.

The Piedmont Triad area also is on the Southeast High-Speed Rail Corridor designated by the US Department of Transportation, which plans to provide high-speed passenger rail service by 2010. Currently, no direct passenger rail service is available in Winston-Salem or Forsyth County.

Finally, the City of Winston-Salem is completing a feasibility study of trolley service between Baptist Hospital and the proposed Piedmont Triad Research Park just east of the CBD, with circulation through the CBD.

1.8.3.2 Freight Rail Service

No railroad lines cross the Project R-2247 study area. Three railroad lines cross the Project U-2579 and Project U-2579A study areas. All of these lines are owned by Norfolk Southern Corporation, which currently uses the lines only for freight trains. The first line crosses the

NC 66 Connector near US 52. The second line generally parallels portions of US 421/I-40 Business and West Mountain Street. The third line generally parallels Old Walkertown Road.

1.8.3.3 Air Service

There are two airports in the region, Smith Reynolds Airport and Piedmont Triad International Airport.

Smith Reynolds Airport is located just south of the Project U-2579 and Project U-2579A study areas. It is the largest general aviation airport in the state, with a growing amount of commuter and private airplane usage.

Piedmont Triad International Airport (PTIA) is located east of the study areas between Kernersville and Greensboro and provides scheduled air service via seven major airlines. Seventy-six daily commercial flights depart from PTIA daily. (PTIA website, *http://www.flyfrompti.com/greensboro_airlines.asp*, accessed January 9, 2007).

On November 16, 2001, the Federal Aviation Administration (FAA) submitted the Final Environmental Impact Statement (FEIS) for changes at PTIA stemming from a proposal to add a FedEx Mid-Atlantic hub to the airport. The FedEx hub will include a new, third runway and a cargo sorting/distribution facility. The Record of Decision (ROD) was issued December 31, 2001. While there has been litigation regarding the environmental documents prepared for that project, the FedEx hub is preparing to begin construction in summer 2006.

1.8.3.4 Motor Freight Service

Located at the intersection of a major east-west interstate (I-40) and north-south freeway (US 52), Winston-Salem has become a major transfer point for freight service. Numerous trucking companies are located in the Winston-Salem area. Consequently, tractor trailer semi-trucks constitute a high percentage of the traffic on the major roadway corridors. In May 2001, tractor trailer semi-trucks accounted for nine percent of the daily traffic on US 52. The presence of these trucks in the traffic stream greatly increases the congestion on existing US 52.

1.9 SOCIAL AND ECONOMIC CONDITIONS

The economy of Winston-Salem and Forsyth County has changed dramatically over the last two decades. Traditional industries like tobacco and textiles have declined largely due to changes in their respective markets. Meanwhile, other local businesses have become increasingly linked to national and global economic trends. As a result, the area has shifted from dependence on a

manufacturing-based economy to a more diversified services-based economy. The following sections highlight key socioeconomic indicators for the study areas.

1.9.1 Demographics

Forsyth County is part of the 12-county Piedmont Triad region. Forsyth County has a total area of 412 square miles, with 408 square miles of land area and 4 square miles of water. There are eight municipalities in the county, with the largest being Winston-Salem, the county seat.

The Piedmont Triad region, including Forsyth County, has been growing more slowly than the state average (21.4%). From 1990 to 2000, Forsyth County's population increased 15.1 percent, from 265,878 people to 306,067 people (US Census Bureau website, *http://quickfacts.census.gov/qfd/states/37.html*, accessed December 26, 2002). From 2000 to 2025, the County's population is projected to grow about 35 percent, from 306,067 people to 411,887 people (State Data Center – State Demographics website *http://demog.state.nc.us/* accessed February 20, 2003).

Forsyth County also has become more urbanized. In 1990, the percentage of people living in urban areas in Forsyth County was about 75 percent (US Census Bureau, 1990 US Census-Summary Tape File 1). The percentages increased to about 91 percent in 2000 (State Data Center – State Demographics website, *http://demog.state.nc.us*, accessed December 26, 2002).

1.9.2 Economic and Infrastructure Data

Winston-Salem and Forsyth County have experienced steady growth since World War II. Population, housing, and the local economy have all grown through the years. As the population has increased, different areas of the city have experienced growth in housing. Although residential subdivisions are present throughout most of the study areas, accelerated residential growth is occurring in the western areas of the city and in areas north of US 421/I-40 Business and southwest of Kernersville. The character of the local economic base has changed somewhat, but has exhibited steady growth in non-recession years. Recent recession years have somewhat slowed population and economic growth in the greater Winston-Salem area. However, the relative attractiveness of the region for business and quality of life is expected to result in continued, though moderate, long-term growth.

There are a substantial number of employment centers and services located in areas of Forsyth County beyond the central city area. These areas do not have direct road connections to the growing residential areas of the County. These centers include Hanes Mills and Lantal Textiles (formerly Langenthal Mills) along US 52 north of the city; major business/industrial parks located along US 158, I-40, US 421 and US 52 outside of the city; and major shopping centers at Hanes Mall southwest of the city and along University Parkway north of the city.

A rail/trucking distribution center (Allied Terminal Systems, Ltd.) for new vehicles is located in the eastern portion of the study area between Old Walkertown Road and US 311. The eastern portion of the study area also includes Tyco Electronics (previously AMP, Inc), an electronics industry, which has a large industrial campus located off Reidsville Road (US 158), about midway between US 421/I-40 Business and Old Greensboro Road. A large industrial park is located near US 52 and Bethania-Rural Hall Road. Dell Computers has recently constructed the first phase of a major manufacturing facility near US 311 at Union Cross Road.

1.10 TRANSPORTATION AND LAND USE PLANS

1.10.1 NC Transportation Improvement Program

The *NCDOT 2006-2012 Transportation Improvement Program (TIP)* includes eight interstate projects, ten rural projects, twenty-three urban projects, one feasibility study, twenty-one bridge replacement projects, two enhancement projects, four bicycle and pedestrian projects, two high hazard projects, two passenger rail projects, and numerous transit projects for Forsyth County. These projects are listed in **Table 1-2**. The interstate, rural, urban and bridge replacement projects with programmed funding are shown in **Figure 1-5**.

Table 1-2: Transportation Improvement Program Projects in Forsyth County

TIP Project Number	Description	Status
Interstate Projects		
I-911	Widening and pavement rehabilitation of I-40 west of NC 801 (Exit 180) to west of SR 1122.	Right of way scheduled for FY 2011. Project partially complete. Remaining construction unfunded.
I-2102	Modify interchange at SR 1101 (Harper Road, Exit 182) on I-40.	Design in progress. Right of way in progress. Construction scheduled for FY 2006.
I-4404	Upgrade US 52 to interstate standards from NC 65 to SR 1147 Interchange.	Project unfunded.
I-4717	Resurface of I-40 from end of Portland Cement Concrete (PCC) pavement to beginning of PCC pavement in the vicinity of US 311 Interchange.	Construction scheduled for FY 2007.
I-4730	Review existing interstate route and evaluate for future improvements for I-40 from Asheville to Winston-Salem.	Scheduled for Planning and Environmental Study only.
I-4741	Pavement rehabilitation of I-40 from west of NC 801 to west of SR 1101 (Harper Road).	Completed.
I-4924	I-73/74 Connector, Winston-Salem Northern Beltway (Future I-74) north of Kernersville to NC 68 (Future I-73) west of Greensboro, Forsyth and Guilford Counties. Multi-lane Freeway on new location.	Programmed for Planning and Environmental Study only by the Turnpike Authority.
Rural Projects		
R-609	US 311 Bypass south of SR 1920 from east of Archdale to west of High Point Reservoir.	Under construction.
R-952	Pavement and bridge rehabilitation of US 421/I-40 Business from west of US 158 to west of SR 1850 in Guilford County.	Part under construction, part unfunded.
R-2201	King-Tobaccoville Road (Main Street). RJR entrance to SR 1115 (Kirby Road). Widen to multi-lanes. Intersection improvements at SR 1005 (Meadowbrook Road).	Design in progress. Right of way in progress. Construction scheduled for FY 2008.
R-2247	Winston-Salem Northern Beltway from I-40 to US 52. Four-lane expressway on new location.	Planning in progress. Project unfunded.
R-2568	Widen NC 109 to multi-lanes with bypass of Wallburg on new location from south of I-85 business in Thomasville to I-40/US 311.	Planning/design in progress. Right of way scheduled for FY 2011 for part, construction scheduled for FY 2006 for part, part complete, part unfunded.
R-2577	Widen US 158 to multi-lane north of US 421/I-40 Business to US 220.	Planning in progress, construction scheduled for FY 2012.
R-3441	Upgrade US 52 to interstate standards from NC 65 in Winston-Salem to I-74 (NC 752) in Surry County.	Project unfunded.

Table 1-2: Transportation Improvement Program Projects in Forsyth County

TIP Project Number	Description	Status
R-4414	Upgrade substandard guardrail, end treatments, and bridge anchor units for US 52, US 74, US 311, US 321, US 421, NC 49, and NC 105.	Completed.
R-4750	Upgrade US 52 to interstate standards from I-85 in Davidson County to I-40 in Forsyth County.	Planning, design scheduled to begin in FY 2006. Right of way scheduled for 2010. Construction scheduled for 2011.
Urban Projects		
U-2579	Winston-Salem Northern Beltway (Future I-74) from US 52 to US 421/I-40 Business. Multi-lane freeway on new location.	Planning in progress. Right of way scheduled to begin in FY 2007. Construction scheduled to begin in FY 2009, part unfunded.
U-2579A	Winston-Salem Northern Beltway (Future I-74) from US 421/I-40 Business to US 311. Multi-lane freeway on new location.	Planning in progress. Right of way scheduled to begin in FY 2008. Construction scheduled to begin in FY 2011.
U-2707	SR 3000 (Idols Road), a two-lane shoulder section on new location, from SR 2999 (Hampton Road) to US 158.	Design and right of way in progress. Some construction complete, part unfunded.
U-2730	Widen NC 65 (Bethania-Rural Hall Road) from US 52 to NC 66.	Project partially complete. Remaining portion unfunded.
U-2728	Pavement rehabilitation and safety improvements to US 421 north of SR 1171 (Concord Church Road) to Yadkin County Line.	Construction in progress.
U-2729	Widen SR 1672 (Hanes Mill Road) from Museum Drive to SR 4000 (University Parkway).	Planning and design scheduled to begin in FY 2006.
U-2800	Widen SR 2601 (Macy Grove Road) to multi-lanes, part on new location, from Industrial Drive to SR 1005 (Old US 421), and convert grade separation at I-40 Business to an interchange.	Planning and design in progress. Construction scheduled for FY 2011.
U-2826	US 52, I-40 to proposed western loop interchange. Widen and upgrade roadway and interchanges.	Planning and design in progress. Right of way and construction scheduled in FY 2008, part unfunded.
U-2827	Pavement rehabilitation and safety improvements to US 421 from I-40 to west of US 158.	Planning and design in progress. Right of way and construction scheduled in FY 2011. Project part complete, part under construction, part unfunded.
U-2923	Widen to multi-lanes SR 2447 (Clemmonsville Road) from SR 2011 (Old Salisbury Road) to South Main Street.	Right of way scheduled for FY 2006. Construction scheduled for FY 2009.
U-2924	Widen SR 4000 (University Parkway) from SR 3973 (North Point Boulevard) to SR 1672 (Hanes Mill Road).	Project unfunded.

Table 1-2: Transportation Improvement Program Projects in Forsyth County

TIP Project Number	Description	Status
U-2925	Widen to multi lanes Salem Creek Connector from Salem Avenue to SR 4325 (Martin Luther King Drive).	Planning and design in progress. Right of way scheduled for FY 2008. Construction scheduled for FY 2010, part unfunded.
U-2926	Realign SR 2456 (South Main Street) Waughtown Street, Alder Street, and Salem Avenue intersections. Construct Roundabout at SR 2456 and Salem Avenue intersection.	Completed.
U-3119	Widen SR 1103 (Lewisville-Clemmons Road) to multi-lane from SR 1891 (Peace Haven Road) to north of US 421.	Planning, design and right of way in progress. Construction scheduled for FY 2007, part under construction.
U-3457	Widen NC 66 (Broad Street) to 3-lanes from SR 2170 (Wallasey Road) to Paso Street.	Project unfunded.
U-3617	Widen SR 2045 (East Mountain Street/Old US 421), SR 1005, SR 1008, NC 66 in Kernersville (Forsyth County) to SR 2001 (Guilford County).	Project unfunded.
U-3837	Widen Hanes Mall Boulevard from Kester Mill Road to west of Westgate Center Drive.	Under construction.
U-4734	Macy Grove Road Extension, SR 1005 (East Mountain Street) to NC 150 (North Main Street). Multi-lane facility on new location.	Planning and design in progress. Project unfunded.
U-4741	Various Greenways and Sidewalks Projects.	Construction scheduled for FY 2007.
U-4742	Intersection improvements at various locations	Construction scheduled for FY 2007.
U-4759	Improve existing facilities on SR 2643 (Union Cross Road) from I-40 to SR 1003 (High Point Road) and SR 2685 (Temple School Road) to High Point Road.	Part under construction. Part scheduled for construction in FY 2006.
U-4760	Construction of an industrial access road off SR 2643 (Union Cross Road).	Under construction.
U-4413	SR 1646 (Broad Street), Wachovia Street to Second Street. Widen Structure H178 and Improve Approaches.	Project unfunded.
Bridge Projects		
B-2881	Replace Bridge Number 372 on Stadium Drive over Salem Creek.	Under construction.
B-2882	Replace Bridge Number 387 on Glade Street over Peters Creek.	Project unfunded.
B-3332	Replace Bridge Number 149 over Fiddlers Creek.	Under construction.
B-3454	Replace Bridge Number 260 over Muddy Creek.	Under construction.
B-3835	Replace Bridge Number 35 over Yadkin River.	Right of way scheduled for FY 2007. Construction scheduled for FY 2007.
B-3839	Replace Bridge Number 139 over Creek.	Right of way in progress. Construction scheduled for FY 2006.

Table 1-2: Transportation Improvement Program Projects in Forsyth County

TIP Project Number	Description	Status
B-4112	Replace Bridge Number 30 over Muddy Creek.	Right of way scheduled for FY 2006. Construction scheduled for FY 2007.
B-4505	Replace Deck Bridge Number 369 on I-40 Business over SR 1005.	Construction scheduled for FY 2010.
B-4506	Rehabilitate Bridge Numbers 319 and 335 on US 52 over SR 1620.	Construction scheduled for FY 2008.
B-4507	Replace Bridge Numbers 221 and 222 on US 421 over Muddy Creek.	Right of way scheduled for FY 2007. Construction scheduled for FY 2008.
B-4509	Replace Bridge Number 210 over Lowery Mill Creek.	Right of way scheduled for FY 2007. Construction scheduled for FY 2008.
B-4510	Replace Bridge Number 368 on SR 2643 over I-40 Business.	Right of way scheduled for FY 2009. Construction scheduled for FY 2009.
B-4511	Replace Bridge Number 201 over tributary of Salem Creek.	Right of way scheduled for FY 2008. Construction scheduled for FY 2009.
B-4512	Replace Bridge Number 286 on South Green Street over I-40 Business.	Right of way scheduled for FY 2011. Construction scheduled for FY 2011.
B-4744	Replace Bridge Number 15 over Little Yadkin River.	Right of way scheduled for FY 2008. Construction scheduled for FY 2009.
B-4745	Replace Bridge Number 322 over 20th Street.	Right of way scheduled for FY 2008. Construction scheduled for FY 2009.
B-4746	Replace Bridge Number 229 over Norfolk and Western Railroad.	Right of way scheduled for FY 2008. Construction scheduled for FY 2010.
B-4747	Replace Bridge Number 83 over Creek.	Right of way scheduled for FY 2008. Construction scheduled for FY 2009.
B-4970	Replace Bridge Number 211 over Norfolk Southern Railway.	Right of way scheduled for FY 2010. Construction scheduled for FY 2012.
B-4862	Rehabilitate Bridge Number 371 on Vargrave Steet over Salem Creek.	Right of way scheduled for FY 2006. Construction scheduled for FY 2007.
B-4909	Environmental mitigation for bridge projects in Division 9.	In progress.
Feasibility Studies		
FS-0309B	Widen SR 1103 (Lewisville-Clemmons Road) from I-40 to US 158.	In progress
Enhancement Projects		
E-4127	Visitor Center at intersection of SR 1611 (Main	Under construction.

Table 1-2: Transportation Improvement Program Projects in Forsyth County

TIP Project Number	Description	Status
	Street) and SR 1688 (Bethania Road).	
E-4948	Silas Creek Parkway Landscaping - South Main Street to Konnoak Drive-Hollywood Street, including intersection of I-40 and Silas Creek Parkway.	Construction scheduled for FY 2007.
High Hazard Projects		
W-4824	Install shoulder rumble strips on I-40 – Section A, Iredell County line Eastward to mile marker 175; Section B, West of NC 801 Eastward to East of SR 1101; Section C, West of SR 1120-1122 Eastward to West of US 158; Section D, East of US 52 Eastward to near US 311; Section E, US 311, I-40 southward to SR 1979; Section F, SR 1979, US 311 to the bridge over Oak Hollow Lane.	Construction scheduled for FY 2006.
W-4823	Install shoulder rumble strips on US 421 – Section A, Yadkin County line Southward to near SR 1171; Section B, near SR 1171 Southward to near SR 1891; Section C, near SR 1891 southward to North of US 158 (Stratford Road); Section D, US 421/I-40, Business Northbound lane South of US 52 Southward to South of US 52; Section E, US 421/I-40 Business South of US 52 to I-40.	Construction scheduled for FY 2006.
Passenger Rail Projects		
Z-3362I	Revise automatic warning devices on SR 1763 (Indiana Avenue) and Reynolds Boulevard at Norfolk Southern Railway Crossing 722 034N.	Funded – Construction not authorized.
Z-3809E	Safety Improvements on 3rd street at Norfolk Southern Railway Crossing 722 052L.	Funded – Construction not authorized.
Transit Projects		
TJ-4933	Provide operating assistance to counties and community transportation systems to meet work first and employment transportation needs	Operations, FY 2006 and 2007.
TL-4933	Provide operating assistance for additional transportation services to the elderly and disabled.	Operations, FY 2006 and 2007.
TA-4910	Expansion buses	Unfunded project.
TA-4708	East-West Corridor PE and DEIS	Unfunded project.
TE-4709	East-West Corridor	Unfunded project.
TP-4726	Transportation/Land Use Plan Update	Unfunded project.
TA-4794, 4795, 4796, 4802, 4803, 4804, 4930, 4931	Replacement buses	Unfunded project.
TD-4734B	Winston-Salem Intermodal Facility	Unfunded project.

Table 1-2: Transportation Improvement Program Projects in Forsyth County

TIP Project Number	Description	Status
TM-4718, 4719, 4720, 4721, 4722, 4723, 4724	Mobility Manager Project	Unfunded project.
TG-4801 TG-4802 TG-4803 TG-4804 TG-4805 TG-4806 TG-4921 TG-4922	Routine capital items - Service trucks, bus lift equipments for maintenance facility, spare parts, bus shelters, security equipment, passenger amenities, supervisor van, building maintenance and preventive maintenance.	Project scheduled for FY 2006 for TG-4801 and 4802, FY 2007 for TG-4803, FY 2008 for TG-4804, FY 2009 for TG-4805 and FY 2010 for TG-4806, FY 2011 for TG-4921, FY 2012 for TG-4922.
Bicycle and Pedestrian Projects		
E-4010	Muddy Creek Greenway-Western Forsyth from Robinhood Road to Country Club Road.	Under construction.
E-4020	Paved multi-use trail. Brushy Fork Creek Greenway, Phases A-C from Salem Creek Greenway to Lansing Drive.	Phase A complete. Phase B construction scheduled for FY 2006.
E-4983	Salem Creek Greenway Extension – Trail from the terminus of the existing Salem Lake Trail at Marketplace Mall to Forsyth Technical Community College and along Peters Creek to Ardsley Street.	Scheduled for Feasibility Study.
E-4984	Piedmont Greenway Trail. Phase I – Trail from the existing Salem Lake Trail at Linville Road to East Forsyth High School.	Scheduled for Feasibility Study.

Source: NCDOT 2006-2012 Transportation Improvement Program
*FY = Fiscal Year

1.10.2 Local Transportation Plans

In 1994, through two allocations, the North Carolina General Assembly appropriated 90 percent of the cost of developing a Regional Transportation Plan for the Piedmont Triad. The first allocation was used to develop a land use plan for the Piedmont Triad region. A Project Steering Committee, comprised of city and county planning directors, transportation directors, and representatives of the NCDOT, was formed to provide study oversight. Additionally, a Citizens Advisory Committee consisting of 70 citizens from a cross-section of the community represented the public in the process (*2025 LRTP*, Comprehensive Planning, p.2).

The second allocation was used to develop a *Regional Transportation Plan* based on the land use plan developed for the Piedmont Triad in Phase 1. The *Regional Transportation Plan* was then used by the Winston-Salem/Forsyth County, Greensboro, and High Point Metropolitan Planning Organizations (MPOs) to project population, employment and households to future years and

create Traffic Analysis Zones (TAZ) for the region. The land use plan and the projected socio-economic data for the region included the construction of the Winston-Salem Northern Beltway.

The *Winston-Salem Urban Area 2030 LRTP* was adopted on March 31, 2005. Federal law requires LRTPs to have a financial plan (that means only those projects that are budgeted for construction by the planning horizon of 25 years may be included) and meet the Environmental Protection Agency's (EPA) air quality conformity standards. **Figure 1-6** shows the roadway portion of the *2030 LRTP*.

The *2030 LRTP* plan shows US 52 through downtown Winston-Salem as widened to six lanes by 2014, with additional improvements through 2030, resulting in a six-lane freeway plus auxiliary lanes. Winston-Salem has completed a comprehensive land use and transportation plan for this corridor (*US 52 Corridor Study*, 2003). The Locally Preferred Alternative identified in the corridor study calls for the widening of US 52 to a continuous six-lane freeway along the entire 12-mile corridor from I-40 north through Winston-Salem, to the Winston-Salem Northern Beltway, with additional lanes provided along sections of the corridor that are expected to have higher traffic volumes (City of Winston-Salem's US 52 Corridor Study website *http://www.us52study.com* accessed July 5, 2004). The US 52 improvements currently appear as Project U-2826 in the *2006-2012 TIP*. Project U-2826 calls for the widening and upgrading of US 52 from I-40 to the Northern Beltway interchange at the northern city limits, and has an estimated cost of $421.1 million.

The *2005 Thoroughfare Plan* is the street and highway system component of the *2030 LRTP*. The Thoroughfare Plan also includes projects that will not be constructed before 2030 based in part on fiscal constraints. The *2005 Thoroughfare Plan* was adopted by the local Transportation Advisory Committee of the MPO on November 18, 2004 and by NCDOT on January 6, 2005. The 2005 Thoroughfare Plan is shown in **Figure 1-7**.

The *2005 Thoroughfare Plan* shows the conceptual location of the Winston-Salem Northern Beltway in a location corresponding to the Preferred Alternatives for Project R-2247 (Western Section), Project U-2579 (Eastern Section), and Project U-2579A (Eastern Section Extension).

The *2005 Thoroughfare Plan* also shows a potential future southern loop connecting the Northern Beltway from US 158 to US 311. The southern loop is not included in the *2030 LRTP* and its associate financial plan or the *NCDOT 2006-2012 TIP* and no planning studies are programmed. It is an unfunded potential project that would occur beyond the horizon year of *2030*, if it occurs at all.

1.10.3 Land Use Plans

The *Legacy Development Guide* is the general, long-range policy guide for decisions concerning the overall growth and development of Forsyth County and its eight municipalities. It does not replace local community plans, but is intended to complement them. The *Legacy Development Guide* was adopted by the City of Winston-Salem and Forsyth County in April 2001, and by the other seven municipalities between April and October 2001 *(The Legacy Development Guide,* Introduction, pg. 2*)*.

The *Legacy Development Guide* is a general guide to manage and promote "smarter growth" for Forsyth County by building at higher densities and in activity centers, by promoting transit-oriented development that reduces auto-dependency and air pollution, and by protecting and enhancing community values. The plan also stresses the importance of protecting open space, farmland, and historic resources, and of revitalizing downtown and older neighborhoods *(Legacy Development Guide, Growth Management Plan and 2030 LRTP, Comprehensive Planning*). "Although adopted as an official public document, *Legacy* is not a development ordinance and does not carry the force of law," (*Legacy Development Guide*, Introduction, pg. 2).

One of the Action Agenda items in the *Legacy Development Guide* is implementation of the *2025 LRTP*. The Northern Beltway is a major new road proposed by the *2025 LRTP* (*Legacy Development Guide*, pgs. 53-55) and by the more recent *2030 LRTP*.

1.11 ROADWAY CAPACITY

1.11.1 Traffic Volumes

1.11.1.1 Existing Traffic Volumes

Existing (2001) average daily traffic (ADT) volumes in the Winston-Salem area are listed in **Table 1-3** and **Table 1-4**, and are shown in **Figures 1-8(a-b)**. These volumes are provided to indicate existing conditions and to provide a basis of comparison to future volumes discussed in **Section 1.11.1.4**. The highest volumes in the region are on I-40 near US 52, where volumes exceed 90,000 vehicles per day (vpd). Volumes on US 52 north of I-40 range from 50,000 to 75,000 vpd, while volumes on US 421/Business I-40 range from 41,000 to 66,000 vpd.

Other roads in the study area with substantial amounts of traffic include Country Club Road (11,000-19,000 vpd), Robinhood Road (8,300-14,000 vpd), Reynolda Road (NC 67) (11,000-32,000 vpd), University Parkway (12,000-32,000 vpd), Reidsville Road (US 158) (13,000-18,000 vpd), Kernersville Road (12,000-14,000 vpd), and US 311 (18,000-20,000 vpd).

1.11.1.2 Travel Demand Models

In 1994, NCDOT and the municipalities in the Piedmont Triad, including the Greensboro, Winston-Salem and High Point metropolitan areas, initiated an update to the Piedmont Triad Regional Travel Demand Model. The update was completed in 1999.

The modeling process includes four steps. The first step is trip generation, which is the relationship between trip making and household characteristics. This process takes the volume of traffic entering and exiting the study area and socioeconomic data for each Traffic Analysis Zone (TAZ) and generates traffic volumes to simulate the road network's actual volumes.

The second step is trip distribution. After the number of trips per TAZ is determined, the trips are distributed to other traffic zones in the network using a Gravity Model. A Gravity Model incorporates the trip patterns that develop due to the activity at the trip origin, the relative attractiveness of the destination and the difficulty of making the trip.

The third step is mode choice. Mode choice is the amount of travel to be made by each available type of transportation (i.e. car, bus, rail, etc.).

The final step is trip assignment. This step determines what route a trip will take to reach its destination.

The Piedmont Triad Regional Travel Demand Model generated traffic volumes for the base year (1999) and for two 2025 growth scenarios, Draft Land Use and Trend Land Use. Year 2025 traffic volumes for the Draft Land Use growth scenario were estimated based on the area's future land use outlined in the *Legacy Development Guide*. At the time the travel demand model was being developed, the *Legacy Development Guide* had not been adopted by all the local governments. Therefore, a second growth scenario was developed, the 2025 Trend Land Use. The Trend Land Use scenario was modeled by estimating the growth in the study area based on current and past growth trends.

Table 1-3: Existing (2001) Traffic Volumes in Project R-2247 Study Area

Roadway	General Location	# of Lanes	Existing Average Daily Traffic Volumes
Bethania-Rural Hall Rd	Walker Rd to Murray Rd	2	9,300
Main St	South of Bowens Rd	2	2,800
Balsom Rd	Seward Rd to Skylark Rd	2	1,100
Walker Rd	Bethania-Rural Hall Rd to Murray Rd	2	1,100
Murray Rd	Near Shattalon Dr	2	4,300
NC 67 (Reynolda Rd)	Near Seward Rd	4	11,000
	Near Shattalon Dr	4	20,000
	Near Polo Rd	4	32,000
	Silas Creek Pkwy to Robinhood Rd	4	20,000
Yadkinville Rd	Near Olivet Church Rd	2	9,800
Robinhood Rd	Near Lewisville-Vienna Rd	2	8,300
	Near Meadowlark Dr	2	14,000
	Silas Creek Pkwy to Reynolda Rd	2	16,000
Shallowford Rd	Lewis-Vienna Rd to Meadowlark Dr	2	11,000
Country Club Rd	Peace Haven Rd to Silas Creek Pkwy	2	19,000
	Silas Creek Pkwy to Northwest Blvd	2	11,000
US 421	West of Styers Ferry Rd	4	28,000
	Styers Ferry Rd to Peacehaven Rd	4	39,000
	East of Peacehaven Rd	6	49,000
	1-40 to Silas Creek Pkwy	6	64,000
	Silas Creek Pkwy to Stratford Rd	4	58,000
I-40	Lewisville-Clemmons Rd to US 421	6	58,000
	US 421 to US 158	6	68,000
	US 158 to Peters Creek Pkwy	6	89,000
	Peters Creek Pkwy to US 52	6	92,000
US 158	Near Clemmonsville Rd	5	16,000
	Near Silas Creek Pkwy	5	24,000
US 52	North of Bethania-Rural Hall Rd	4	59,000
Silas Creek Pkwy	South of Robinhood Rd	4	54,000
	South of Stratford Rd	4	57,000
University Pkwy	Near US 52	4	32,000
	US 52 to Robinhood Rd	4	17,000

Source: NCDOT 2001 ADT maps

Table 1-4: Existing 2001 Traffic Volumes in Project U-2579 and Project U-2579A Study Areas

Roadway	General Location	# of Lanes	Existing Average Daily Traffic Volumes
I-40 Business	US 52 to US 158	4	66,000
	West Mountain St to South Main St	4	41,000
I-40	US 52 to NC 109	6	90,000
	NC 109 to US 311	6	75,000
	US 311 to NC 66	4	53,000
	East of NC 66	4	50,000
US 52	Germanton Rd to 25th St	4	50,000
	25th St US 421/I-40 Business	4	75,000
	US 421/I-40 Business to Waughtown St	4	56,000
	Waughtown St to I-40	4	67,000
	South of I-40	4	32,000
University Parkway	NC 66 to US 52	4	12,000
	US 52 to Cherry St	4	32,000
US 311	I-40 to High Point Rd	4	20,000
	East of High Point Rd	4	18,000
N. Cherry St	Near US 52	2	14,000
Indiana Ave	North Cherry St to US 52	4	16,000
Liberty St	Near US 52	4	16,000
Kernersville Rd	High Point Rd to Oak Grove Rd	2	10,000
	East of Oak Grove Rd	2	12,000
	Near US 421/I-40 Business	2	14,000
Waughtown St	Near US 52	4	9,800
	Near High Point Rd	2	8,700
High Point Rd	Waughtown St to I-40	2	4,500
Union Cross Rd	Near NC 109	2	2,100
	High Point Rd to I-40	2	9,400
	I-40 to US 421/I-40 Business	2	10,000
West Mountain St	US 421/I-40 Business to NC 66 (Old Hollow Rd)	2	10,000
	East of NC 66 (Old Hollow Rd)	2	9,700
	Near South Main St	2	12,000
NC 109	I-40 to Union Cross Rd	2	17,000
	South of Union Cross Rd	2	8,900
US 158 (Reidsville Rd)	US 421/I-40 Business to Old Belews Creek Rd	2	18,000
	Old Belews Creek Rd to NC 66 (Old Hollow Rd)	2	13,000
	North of NC 66 (Old Hollow Rd)	2	7,800

Table 1-4: Existing 2001 Traffic Volumes in Project U-2579 and Project U-2579A Study Areas

Roadway	General Location	# of Lanes	Existing Average Daily Traffic Volumes
US 311 (New Walkertown Rd)	South of NC 66 (Old Hollow Rd)	2	2,800
	Near US 52	2	15,000
Old Walkertown Rd	US 52 to Northampton Rd	2	11,000
	North Hampton Rd to Williston Rd	2	7,500
NC 66 (Old Hollow Rd)	US 52 to Baux Mountain Rd	2	6,500
	Baux Mountain Rd to Old Walkertown Rd	2	7,500
	Old Walkertown Rd to Reidsville Rd (US 158)	2	8,100
	Reidsville Rd to Old Valley School Rd	2	11,000
	Old Valley School Rd to West Mountain St	2	9,100
Baux Mountain Rd	NC 66 (Old Hollow Rd) to Old Rural Hall Rd	2	2,800
NC 8 (Germanton Rd)	NC 66 (Old Hollow Rd) to US 52	2	13,000

Source: NCDOT 2001 ADT maps

1.11.1.3 Selection of Scenarios Used to Estimate Traffic Volumes

The Draft Land Use scenario of the Piedmont Triad Regional Travel Demand Model was determined to be the most appropriate scenario to use for estimating 2025 traffic volumes for the analysis of future year traffic conditions documented in the 2004 SFEIS/SDEIS and this SFEIS/FEIS. Since 1999, the City-County Planning Board, Forsyth County and all eight municipalities have formally adopted the *Legacy Development Guide*. A review of recent zoning decisions indicates that decisions on requests for zoning variances are conforming to the intent of the *Legacy Comprehensive Plan* (*Indirect and Cumulative Impacts Analysis*, 2005). Because current land use patterns (based on recent zoning decisions) appear to conform to the *Legacy Development Guide*, it is reasonable to assume that these patterns will continue conforming to the *Legacy Development Guide* in the future. The Draft Land Use growth scenario was based upon land use trends in the *Legacy Development Guide*; whereas the Trend Land Use growth scenario is based on current and historical growth trends. Therefore, it is reasonable to select the Draft Land Use growth scenario as the best model for forecasting future traffic volumes for the Build Alternatives.

The Piedmont Triad Regional Travel Demand Model, using the Draft Land Use growth scenario, was used to estimate traffic volumes for the year 2025 for the following project scenarios:

- Build scenario – Build Projects R-2247 and Projects U-2579/U-2579A (Western and Eastern Sections and Eastern Section Extension of the Northern Beltway)

- Build-West scenario – Build only Project R-2247 (the Western Section)

- Build-East scenario – Build only Projects U-2579/U-2579A (the Eastern Section and Extension)

- No-Build scenario – Do not build Projects R-2247 or U-2579/U-2579A

For each of the four scenarios, other existing plus committed transportation improvement projects from the *2025 LRTP* were assumed to be in place. Each of the four scenarios also used the same future land use information from the Draft Land Use growth scenario. The *Winston-Salem Northern Beltway Indirect and Cumulative Impacts Analysis* (2005), summarized in **Section 4.20**, concludes that except for localized impacts, each of the Beltway Build scenarios (the first three bullets above) would have minimal effect on the spatial allocation and amount of growth and development within the County compared to the No-Build scenario. Since the presence or absence of the Northern Beltway, in whole or in part, is expected to have only a minor influence on spatial allocations of growth across the County, it was determined to be reasonable to use the same land use scenario to estimate future traffic volumes resulting from either of the four scenarios listed above. The local governments also have not created a land use projection that assumes the Northern Beltway, which has been on local transportation plans since 1965, is not in place; therefore, there is no true no-build land use scenario to incorporate into the model and use to estimate future traffic volumes.

As discussed below, the validity of using the Draft Land Use scenario to forecast various Partial Build and No-Build Alternatives also was considered.

The indirect and cumulative impacts assessment prepared for the projects evaluated changes in land use patterns that might occur under the following four different scenarios:

1. Build Alternative – Build Projects R-2247 and Projects U-2579/2579A (Western and Eastern Sections and Eastern Section Extension of the Northern Beltway)
2. Build-West scenario – Build Only Project R-2247 (the Western Section)
3. Build-East scenario – Build Only Projects U-2579 and U-2579A (the Eastern Section and Extension)
4. No-Build Alternative – Build no sections of the Northern Beltway

All scenarios include committed transportation projects other than the Northern Beltway.

The *Winston-Salem Northern Beltway Indirect and Cumulative Impacts Analysis* (2005) concludes that except for localized impacts, each of the Beltway Build scenarios would have minimal effect on the spatial allocation and amount of growth and development within the County compared to the No-Build scenario. **Section 4.20** summarizes the analysis and conclusions in the Indirect and Cumulative Impacts Analysis.

Since the presence or absence of the Northern Beltway, in whole or in part, is expected to have only a minor influence on spatial allocation of growth across the County, the Draft Land Use growth scenario used in the travel demand model was determined to be a reasonable model condition to use under any of the build, partial build, and no-build project scenarios.

The travel demand model was run using the same four combinations of the Northern Beltway as evaluated in the indirect and cumulative impacts assessment. For other area roadways, the model included existing conditions plus other committed improvement projects from the *2025 LRTP*.

1.11.1.4 Projected 2025 Traffic Volumes

Year 2025 average daily traffic volumes for the following project scenarios are described in this section:

a) No-Build Alternative - Build no sections of the Northern Beltway
b) Build-West scenario (do not build Projects U-2579 and U-2579A)
c) Build-East scenario (do not build Project R-2247)

Figure 1-9(a-b) show the projected 2025 average daily traffic (ADT) volumes for selected roadways in western and eastern Forsyth County, respectively, under the various project scenarios.

Table 1-5 lists the 2025 ADT volumes for the major radial roadways and selected connector roadways in the Project R-2247 study area under two scenarios: No-Build Alternative and the Build-East scenario. As shown in the table, along most roadway segments there are no notable differences between the two scenarios that involve not building Project R-2247. Traffic volumes on roadways closer to US 52 and Projects U-2579 and U-2579A study areas, Silas Creek Parkway and University Parkway, are influenced somewhat by the presence of the Eastern Section of the Northern Beltway.

Table 1-6 lists the 2025 ADT volumes for selected major roadways in the Project U-2579 and Project U-2579A study areas under two scenarios: No-Build Alternative and the Build-West scenario. US 52 was modeled as an 8-lane roadway in 2025 to be consistent with the LRTP. As shown in the table, traffic volumes on University Parkway, US 52, and I-40 are influenced somewhat by the presence of the Western Section of the Northern Beltway. All other roads show very little difference in traffic volumes between the two scenarios.

Sections 2.9.4 and 2.10.3 include traffic discussions of build alternatives, that is, full Beltway build scenarios. For this project, the Build East scenario and Build West scenario are actually "no build" alternatives and are consequently discussed here in Chapter 1. For example, the Build West scenario is the No Build Alternative for Projects U-2579/U-2579A. Similarly, the Build East scenario is the No Build Alternative for Project R-2247.

Table 1-5: Projected 2025 Traffic Volumes in Project R-2247 Study Area

Roadway	General Location	# of Lanes	2025 Average Daily Traffic Volumes*		Difference Between No-Build Scenario and Build East Scenario
			No-Build Scenario	Build East Scenario	
Bethania-Tobaccoville Rd	Around Bethania	2	8,900	9,200	-300
NC 67 (Reynolda Rd)	Near Bethania Rd	4	24,900	24,000	900
Yadkinville Rd	Near Transou Rd	2	15,700	15,900	-200
Robinhood Rd	Near Meadowlark Dr	2	17,000	17,100	-100
Country Club Rd	East of Styers Ferry Rd	2	24,300	23,900	-400
US 421	West of Styers Ferry Rd	4	34,300	34,000	300
	Styers Ferry Rd to Peacehaven Rd	4	50,800	50,300	500
	East of Peacehaven Rd	4	55,300	55,000	300
I-40	South of Lewisville-Clemmons Rd	6	83,100	83,200	-100
	Lewisville-Clemmons Rd to US 421	6	99,200	99,300	-100
	US 421 to Silas Creek Pkwy	6	70,700	70,400	300
US 158	Near Clemmonsville Rd	5	33,600	33,600	0
Lewisville-Clemmons Rd	US 421 to I-40	5	24,600	26,600	-2,000
Silas Creek Pkwy	South of Robinhood Rd	4	52,700	56,300	-3,600
	North of Robinhood Rd	4	60,200	57,500	2,700
	North of NC 67 (Reynolda Rd)	4	49,100	54,100	-5,000
University Pkwy	Near US 52	4	58,500	41,900	16,600

Source: NCDOT 2025 ADT Volumes, 2002 and 2003

* Volumes for the Build scenarios (that is, full-build Beltway) are in Table 2-19 (Build West scenario) and Table 2-22-1 (Build East Scenario)

Table 1-6: Projected 2025 Traffic Volumes in Projects U-2579 and U-2579A Study Areas

Roadway	General Location	# of Lanes	2025 Average Daily Traffic Volumes*		Difference Between No-Build Scenario and Build West Scenario
			No-Build Scenario	Build West Scenario	
I-40 Business	US 52 to US 158	4	88,600	83,000	5,600
	US 158 to Linville Rd	4	54,500	56,300	-1,800
	Linville Road to S. Main St	4	43,700	41,600	2,100
I-40	US 52 to NC 109	6	139,500	139,000	500
	NC 109 to US 311	6	116,700	106,200	10,500
	US 311 to NC 66	4	102,600	102,000	600
US 52	University Pkwy to Germanton Rd	8	71,300	78,200	-6,900
	Germanton Rd to 25th St	8	84,100	91,600	-7,500
	25th St to 12th St	8	104,600	98,100	6,500
	12th St/Liberty St to US 421/I-40 Business	8	92,600	101,600	-9,000
	US 421/I-40 Business to I-40	8	34,400	34,700	-300
University Parkway	US 52 to Cherry St	4	47,700	57,000	-9,300
	Cherry St to Northwest Blvd	4	37,600	33,800	3,800
US 311	I-40 to High Point Rd	4	34,500	34,200	300
Kernersville Rd	High Point Rd to Oak Grove Rd	2	9,200	9,200	0
	Oak Grove Rd to US 421/I-40 Business	2	8,600	8,600	0
W. Mountain St	US 421/I-40 Business to NC 66 (Old Hollow Rd)	2	10,800	9,900	900
	NC 66 (Old Hollow Rd) to S. Main St	2	4,300	4,300	0
US 158 (Reidsville Rd)	US 421/I-40 Business to Old Belews Creek Rd	2	30,000	30,200	-200
	Old Belews Creek Rd to NC 66 (Old Hollow Rd)	2	21,600	21,600	0
New Walkertown Rd	NC 66 (Old Hollow Rd) to Williston Rd	2	12,200	12,000	200
Old Walkertown Rd	US 52 to Northampton Rd	2	15,500	15,200	300
	Northampton Rd to Williston Rd	2	13,000	12,700	300
NC 66 (Old Hollow Rd)	US 52 to Baux Mountain Rd	2	12,800	13,000	-200
Baux Mountain Rd	NC 66 (Old Hollow Rd) to Old Rural Hall Rd	2	2,900	2,900	0
NC 8 (Germanton Rd)	NC 66 (Old Hollow Rd) to US 52	2	18,800	24,100	-5,300

Source: NCDOT 2025 ADT Volumes, 2002 and 2003

* Volumes for the Build scenarios (that is, full-build Beltway) are in Table 2-19 (Build West scenario) and Table 2-22-1 (Build East Scenario)

In a few cases, projected 2025 traffic volumes are lower than existing volumes. These isolated discrepancies, which occur on surface arterials or collector streets with relatively low volumes, are normal and occur to some degree in almost all travel demand models. Overall, the projected 2025 traffic volumes on major routes and corridors are reasonable when compared to existing volumes.

1.11.2 Roadway Capacity Analyses

1.11.2.1 Analysis Methodology

Capacity analyses to estimate peak hour levels of service were performed on roadways in the study areas of Project R-2247, Project U-2579, and Project U-2579A. Traffic data for the 2025 Draft Land Use No-Build and Partial Build scenarios from the Piedmont Triad Regional Travel Demand Model were used in the analysis.

The levels of service along area roadways (2025) were estimated using Highway Capacity Software 2000 (HCS 2000), which is based on the methodologies of the *Highway Capacity Manual* (2000).

The operating conditions of a roadway are qualitatively referred to as levels of service (LOS). These conditions are described in terms of speed, travel time, maneuverability, traffic interruption, convenience, and safety. The Transportation Research Board defines LOS in categories from A to F. LOS A represents ideal, free-flow conditions, while LOS F represents unacceptable forced or breakdown flow with "stop and go" conditions. Generally, LOS D is considered the lowest limit at which traffic flow is desirable during peak periods in urban areas. Traffic flow at LOS D is considered stable, but becoming susceptible to congestion and unstable flow. Therefore, traffic volumes that exceed LOS D (LOS E or F) are considered to be exceeding the capacity at which they can operate safely and efficiently.

1.11.2.2 Capacity Analyses for Project R-2247 Study Area

Capacity analyses were performed on 74 arterial and collector roadway segments from 39 roadways in the Project R-2247 study area.

Table 1-7 shows the segments analyzed, traffic volumes and the LOS for each of those segments. The modeled Build-East scenario assumes that only Projects U-2579 and U-2579A are constructed. As presented in **Section 1.11.1.4**, there is little difference in ADT volumes on the Project R-2247 study area road network between the two scenarios that involve not building Project R-2247 (Build none of the Northern Beltway and the Build-East scenario). Standard procedures typically assume all other projects in the LRTP are in place.

Table 1-7: Projected 2025 Levels of Service for Roadways in Project R-2247 Study Area

Roadway	# of Lanes	Segment	2025 ADT Build East Scenario**	Peak Hour LOS
Balsom Rd	2	Kilmurry Hill Rd to Transou Rd	5,000	E
Bethabara Park Blvd	2	Reynolda Rd to University Pkwy	16,600	E
Bethania Rd	2	Reynolda Rd to Bethania-Tobaccoville Rd	8,400	F
Bethania-Rural Hall Rd	2	Walker Rd to Murray Rd	4,600	C
Bethania-Tobaccoville Rd	2	Tobaccoville Rd to Griffin Rd	4,800	C
	2	Griffin Rd to Preferred Alt	16,900	E
	2	Preferred Alt. to Bethania-Rural Hall Rd	9,600	D
	2	Bethania-Rural Hall Rd to Reynolda Rd (NC 67)	16,600	E
Bowens Rd*	2	Reynolda Rd to Muddy Creek	900	D
	2	Muddy Creek to Bethania-Tobaccoville Rd	800	D
Country Club Rd	3	Jonestown Rd to Peace Haven Rd	31,600	F
	3	Peace Haven Rd to Meadowlark Rd	23,900	E
Griffin Rd*	2	Bethania-Tobaccoville Rd to Shore Rd	900	D
Hanes Mall Blvd	4	Stratford Rd to I-40	40,900	D
I-40	6	Lewisville-Clemmons Rd to US 421	99,200	E
I-40 Business	6	US 421 to Silas Creek Pkwy (NC 67)	70,400	E
Jonestown Rd	2	Country Club Rd to US 421	33,300	F
	2	US 421 to I-40	20,500	E
	2	I-40 to McGregor Rd	10,400	E
	2	McGregor Rd to Stratford Rd (US 158)	9,300	E
Kilmurry Hill Rd	2	Balsom Rd to Skylark Rd	4,200	C
King-Tobaccoville Rd	2	US 52 to Tobaccoville Rd	10,200	D
Lewisville-Clemmons Rd	5	US 421 to I-40	26,600	C
Meadowlark Dr	3	Robinhood Rd to Country Club Rd	18,700	E
Mizpah Church Rd*	2	Bethania Rural Hall Rd to SR 1632	1,300	D
	2	SR 1632 to Bethania-Tobaccoville Rd	1,100	D
Murray Rd	2	NC 65 to Shattalon Dr	7,600	E
Olivet Church Rd	2	Yadkinville Rd to Spicewood Dr	6,200	C
	2	Spicewood Dr to Robinhood Rd	8,900	D
Peace Haven Rd	3	I-40 to US 421	12,900	E
	3	US 421 to Country Club Rd	24,500	E
	3	Country Club Rd to Milhaven Rd	23,300	E
	3	Milhaven Rd to Robinhood Rd	21,200	E
Phillips Bridge Rd	2	Country Club Rd to Styers Ferry Rd	3,900	E
Polo Rd	2	Reynolda Rd to Peace Haven Rd	18,500	E
	2	Peace Haven Rd to Robinhood Rd	11,000	E
Reynolda Rd (NC 67)	2	Vienna-Dozier Rd to Seward Rd	16,000	E
	2	Seward Rd to Transou Rd	24,000	E
	2	Transou Rd to Grandview Club Dr	20,300	E

Table 1-7: Projected 2025 Levels of Service for Roadways in Project R-2247 Study Area

Reynolda Rd (NC 67)	2	Grandview Club Dr to Shattalon Dr	21,000	E
	4	Shattalon Dr to Bethabara Rd	33,800	C
	4	Bethabara Rd to Silas Creek Pkwy	30,000	C
Robinhood Rd	2	Lewisville-Vienna Rd to Olivet Church Rd	14,300	E
	2	Olivet Church Rd to Shattalon Dr	17,100	E
	2	Shattalon Dr to Peace Haven Rd	24,900	F
Seward Rd*	2	Reynolda Rd to Balsom Rd	3,300	E
Shallowford Rd	2	Styers Ferry Rd to Lewisville-Vienna Rd	16,100	E
Shattalon Dr	2	Murray Rd to Reynolda Rd (NC 67)	20,400	E
	2	Reynolda Rd to Yadkinville Rd	14,000	E
	2	Yadkinville Rd to Robinhood Rd	11,500	E
Shore Rd	2	Griffin Rd to Bethania Rural Hall Rd	900	B
Silas Creek Parkway (NC 67)	4	University Pkwy to Reynolda Rd	49,100	D
	4	Reynolda Rd to Robinhood Rd	57,500	E
	4	Robinhood Rd to Country Club Rd	56,300	E
Skylark Rd	2	Balsom Rd to Kecoughtan Rd	2,000	D
Spicewood Dr	2	Balsom Rd to Yadkinville Rd	2,400	C
	2	Yadkinville Rd to Olivet Church Rd	2,700	D
Stratford Rd (US 158)	5	Kinnamon Rd to Jonestown Rd	33,600	B
	5	Jonestown Rd to Somerset Dr	35,200	B
	5	Somerset Dr to Hanes Mall Blvd	40,000	D
Styers Ferry Rd	2	Country Club Rd to US 421	14,300	E
Tobaccoville Rd	2	Bethania-Tobaccoville Rd to Reynolda Rd	5,000	C
Transou Rd	2	Yadkinville Rd to Balsom Rd	4,300	E
	2	Balsom Rd to Reynolda Rd	6,000	E
US 421	4	Jonestown Rd to Peace Haven Rd	55,000	D
	4	Peace Haven Rd to Preferred Alt	50,300	D
	4	Preferred Alt to Styers Ferry Rd	52,000	D
Vienna-Dozier Rd	2	Balsom Rd to Skylark Rd	16,200	E
	2	Skylark Rd to Yadkinville Rd	3,000	D
Walker Rd*	2	NC 65 to Murray Rd	1,700	D
Yadkinville Rd	2	Kecoughtan Rd to Transou Rd	16,300	E
	2	Transou Rd to Spicewood Dr	15,900	E
	2	Spicewood Dr to Shattalon Dr	21,100	E
	2	Shattalon Dr to Reynolda Rd (NC 67)	19,200	E

Levels of service based on the 2000 Highway Capacity Manual
LOS = Level of service
* These roads have poor levels of service due to narrow lanes and shoulders and other existing roadway conditions.
** Volumes for the Build scenarios (that is, full-build Beltway) are in Table 2-19 (Build West scenario) and Table 2-22-1 (Build East Scenario)

Table 1-8 is a summary of the number of roadway segments in the Project R-2247 study area forecast to operate at LOS D, E or F in 2025 under the Build-East scenario.

Approximately 59 percent of the roadway segments analyzed are forecast to operate at LOS E or F in the peak hours in 2025 and another 24 percent are forecast to operate at LOS D. **Figure 1-10a** shows these roadways.

1.11.2.3 Capacity Analyses for Project U-2579 and Project U-2579A Study Areas

Capacity analyses were performed on 21 roadway segments from nine roadways in the Project U-2579 and Project U-2579A study areas.

Table 1-9 shows the segments analyzed, traffic volumes and the LOS for each of those segments. The modeled project scenario assumes that only Project R-2247 is constructed. As presented in **Section 1.11.1.4**, there is little difference in ADT volumes on the road networks in the Project U-2579 and Project U-2579A study areas between the two scenarios that involve not building Projects U-2579 and U-2579A (Build none of the Northern Beltway and the Build-West scenario). Standard procedures typically assume all other projects in the LRTP are in place.

Table 1-8: Summary of Roadway Segment Levels of Service in Project R-2247 Study Area

	2025 Draft Land Use Build Only Projects U-2579/ U-2579A
Number of Roadway Segments Analyzed	74
Segments with LOS D	18 (24%)
Segments with LOS E or F	44 (59%)

Table 1-9: Projected 2025 Levels of Service for Roadways in Project U-2579 and Project U-2579A Study Areas

Roadway	Lanes	Segment	2025 ADT Build West Scenario*	Peak Hour LOS
US 421/I-40 Business	4	US 52 to US 158	83,000	F
	4	US 158 to Linville Rd	56,300	D
	4	Linville Rd to South Main St	41,600	C
I-40	6	US 52 to NC 109	139,000	F
	6	NC 109 to US 311	106,200	F
	4	US 311 to NC 66	102,000	F
US 52	8	University Pkwy to Germanton Rd	78,200	C
	8	Germanton Rd to 25th St	91,600	C
	8	25th St to 12th St	98,100	D
	8	12th St/Liberty St to US 421/I-40 Business	101,600	D
	8	US 421/I-40 Business to I-40	34,700	A
University Parkway	4	US 52 to Cherry St	57,000	F
	4	Cherry St to Northwest Blvd	33,800	C
US 311	4	I-40 to High Point Rd	34,200	C
Kernersville Road	2	High Point Rd to Oak Grove Rd	9,200	E
	2	Oak Grove Rd to US 421/I-40 Business	8,600	E
W. Mountain Street	2	US 421/I-40 Business to NC 66 (Old Hollow Rd)	9,900	E
	2	NC 66 (Old Hollow Rd) to S. Main St	4,300	E
US 158 (Reidsville Road)	2	US 421/I-40 Business to Old Belews Creek Rd	30,200	F
	2	Old Belews Creek Rd to NC 66 (Old Hollow Rd)	21,600	F
NC 66 (Old Hollow Road)	2	US 52 to Baux Mountain Rd	13,000	E

* Volumes for the Build scenarios are in Table 2-19 (Build West scenario) and Table 2-22-1 (Build East Scenario)

Table 1-10: Summary of Roadway Segment Levels of Service in Project U-2579 and Project U-2579A Study Areas

	2025 Draft Land Use Build Only Project R-2247
Number of Roadway Segments Analyzed	21
Segments with LOS D	3 (14%)
Segments with LOS E or F	12 (57%)

Table 1-10 summarizes the number of roadway segments analyzed that were predicted to operate at LOS D or worse in 2025. **Figure 1-10b** illustrates these roadways.

1.12 SAFETY

Traffic accidents are often the visible result of deficiencies in the capacity and safety characteristics of a transportation facility. Moreover, they contribute to delays, congestion, and driver frustration, inducing more accidents. Thus, an examination of accident data can reveal the need to provide a more efficient and safer facility, which is one of the purposes of Projects U-2579 and U-2579A (see **Section 1.5.2**).

Accident data was collected for roadway segments in the Project R-2247 study area for the years 1997-2000 and in the Project U-2579 and Project U-2579A study areas for the years 1999-2002. Accident data collected for these roadway segments includes the total number of accidents; accident rates; and numbers of fatality, injury and property-only accidents. This information is presented in **Table 1-11** for Project R-2247 and **Table 1-12** for Projects U-2579 and U-2579A.

In order to determine if the roadways in the study areas have a higher than average accident rate, the total accident rate for each roadway segment in **Table 1-12** was compared to the critical crash rate for each roadway segment. The critical crash rate is described in more detail following **Table 1-12**. Safety ratios were calculated by dividing the total accident rate for the roadways by the critical crash rates. Safety ratios over 1.00 indicate the roadway accident rate exceeds the critical rate for that type of facility. The critical rate was calculated for the Project U-2579/U-2579A study area only since safety is part of the Eastern Section purpose and need.

Generally, most of the roadways analyzed in the Project R-2247 study area are at or below the applicable statewide average accident rate. Roadways that have an accident rate 25 percent higher than the statewide accident rate or more include segments of Bethania-Rural Hall Road, Murray Road, Shattalon Drive, and US 421. US 421 is a radial route serving western Forsyth County. Bethania-Rural Hall Road, Murray Road, and Shattalon Drive are two-lane roadways with lower speeds and relatively low traffic volumes.

In the Project U-2579 and Project U-2579A study areas, those roadways with safety ratios of 1.25 or higher include US 52 and NC 66; both high-volume roadways that are primary routes in eastern Forsyth County. Safety ratios are as high as 1.69 and 1.63 on segments of US 52 and 1.92 on a segment of NC 66. For these reasons, safety is a component of the purpose and need for Projects U-2579 and U-2579A.

Table 1-11: Accident Data for Roadway Segments in the Project R-2247 Study Area for the Years 1997-2000

Roadway	Segment	Road Type	Length (miles)	Total No. of Accidents	Total Accident Rate*	Statewide Average Accident Rate*	No. of Fatality Accidents	No. of Injury Accidents	No. of Property –Only Accidents
Bethania-Rural Hall Rd	Bethania-Tobaccoville Rd to US 52	2-Lane Undivided Rural NC Route	2.91	42	318.69	182.95	0	25	17
Bethania-Tobaccoville Rd	Tobaccoville Rd to Reynolda Rd	2-Lane Undivided Rural Secondary Route	6.69	77	269.27	347.58	0	36	41
Country Club Rd	Styers Ferry Rd to Silas Creek Pkwy	3-Lane Undivided Urban Secondary Route	4.38	269	287.36	590.63	1	90	179
Meadowlark Dr	Country Club Rd to Robinhood Rd	2-Lane Undivided Rural Secondary Route	1.81	33	281.95	347.58	0	13	20
Murray Rd	Bethania-Rural Hall Rd to Shattalon Rd	2-Lane Undivided Rural Secondary Route	2.18	41	429.00	347.58	0	12	29
Peace Haven Rd	US 421 to Robinhood Rd	3-Lane Undivided Urban Secondary Route	3.93	187	340.61	590.63	0	55	132
Reynolda Rd	Tobaccoville Rd to Silas Creek Pkwy	4-Lane cont. left turn lane Urban NC Route	7.76	151	122.44	321.89	0	55	96
Robinhood Rd	Lewisville-Vienna Rd to Meadowlark Rd	2-Lane Undivided Rural Secondary Route	2.06	17	175.11	347.58	0	10	7
Robinhood Rd	Meadowlark Rd to Silas Creek Pkwy	2-Lane Undivided Rural Secondary Route	4.05	207	358.72	347.58	0	128	79
Shattalon Dr	Robinhood Rd to Reynolda Rd	2-Lane Undivided Rural Secondary Route	3.52	65	213.27	347.58	0	31	34
Shattalon Dr	Reynolda Rd to US 52	2-Lane Undivided Rural Secondary Route	3.78	158	443.46	347.58	0	70	88
Silas Creek Parkway	I-40 to Reynolda Rd	4-Lane Divided Urban Secondary Route	3.47	298	275.94	333.83	0	117	181
Skylark Rd	Transou Rd to Reynolda Rd	2-Lane Undivided Rural Secondary Route	1.19	9	191.68	347.58	0	5	4

Table 1-11: Accident Data for Roadway Segments in the Project R-2247 Study Area for the Years 1997-2000

Roadway	Segment	Road Type	Length (miles)	Total No. of Accidents	Total Accident Rate*	Statewide Average Accident Rate*	No. of Fatality Accidents	No. of Injury Accidents	No. of Property –Only Accidents
Styers Ferry Rd	Lewisville-Clemmons to Country Club Rd	2-Lane Undivided Rural Secondary Route	5.56	41	314.89	347.58	1	16	25
Transou Rd	Skylark Rd to Yadkinville Rd	2-Lane Undivided Rural Secondary Route	0.88	9	259.61	347.58	0	4	5
US 421	Lewisville-Clemmons Rd to I-40	4-Lane Divided Full Access Control Rural US Route	5.73	258	142.51	64.29	2	98	158
Yadkinville Rd	Lewisville-Vienna Rd to Reynolda Rd	2-Lane Undivided Rural Secondary Route	5.36	136	257.23	347.58	0	57	79

* Accident Rate = Number of Accidents / Million Vehicle Miles Traveled
Statewide Averages from NCDOT Traffic Engineering Branch for 2000-2002

Table 1-12: Accident Data for Roadway Segments in Project U-2579 and Project U-2579A Study Areas for the Years 1999-2002

Roadway	Segment	Road Type	Length (miles)	ADT	Total No. of Accidents	Total Accident Rate*	Statewide Average Accident Rate*	Critical Crash Rate**	Safety Ratio***	No. of Fatality Accidents	No. of Injury Accidents	No. of Property – Only Accidents
US 421/I-40 Business	US 52 and NC 66	Urban Interstate	9.88	47,400	304	59.28	125.86	126.68	0.47	3	99	202
I-40	US 52 and NC 66	Rural Interstate	10.48	62,000	460	64.65	67.62	68.13	0.95	8	162	290
US 52	I-40 and US 421/I-40 Business	4-Lane Divided Full Access Control Urban US Route	2.66	57,300	428	256.44	155.81	157.4	1.63	2	129	297
US 52	US-421/I-40 Business and Akron Drive (SR #2264)	4-Lane Divided Full Access Control Urban US Route	3.51	72,000	734	265.24	155.81	157.05	1.69	0	245	489
US 52	Akron Drive (SR #2264) and NC 65	4-Lane Divided Full Access Control Urban US Route	6.03	45,200	253	84.77	155.81	157	0.54	1	90	162
US 311	Williston Road (SR #2381) and I-40	4-Lane Divided Full Access Control Urban US Route	11.82	59,800	1024	132.3	155.81	156.55	0.85	3	358	663
US 311	I-40 and NC 66	4-Lane Divided Full Access Control Urban US Route	7.87	7,700	112	168.78	155.81	158.34	1.07	2	39	71
US 158	US 421/I-40 Business and NC 66	2-Lane Undivided Rural US Route	5.46	49,600	216	72.84	170.47	171.72	0.42	1	89	126
US 311	NC 66 and Williston Road (SR #2381)	2-Lane Undivided Urban US Route	1.01	4,600	17	333.99	321.84	335.02	1.00	0	6	11
NC 66	US 421/I-40 Business and US 311	2-Lane Undivided Rural NC Route	9.43	9,900	364	356.06	182.95	185.16	1.92	2	135	228
NC 66	NC 66 Connector (SR #1840) to Hopkins Road (SR #2649)	2-Lane Undivided Rural NC Route	11.48	9,500	354	296.43	182.95	184.99	1.60	2	152	200
NC 66	Hopkins Road (SR #2649) and US 421/I-40 Business	2-Lane Undivided Urban NC Route	3.97	12,000	233	446.62	334.95	339.13	1.32	1	76	156
NC 66 Connector (SR #1840)	US 52 to NC 66	2-Lane Undivided Rural SR Route	1.00	5,400	6	101.52	347.58	360.28	0.28	0	2	4

* Accident Rate = Number of Accidents / Million Vehicle Miles Traveled
** Critical Crash Rate is used to screen for high accident locations and accounts for exposure on each segment (from *Guidelines for Utilizing NC Statewide Crash Rates*)
*** Safety Ratio = Crash rate versus critical crash rate
Statewide Averages from NCDOT Traffic Engineering Branch for 2000-2002

NCDOT's *Guidelines for Utilizing NC Statewide Crash Rates* states:

> A simple comparison of the roadway crash rate vs. the average crash rate would identify nearly one-half of all locations as having a potential highway safety concern. A more appropriate method is the critical crash rate method. This statistical tool can be used to screen for high accident locations, by utilizing a confidence interval that can be adjusted up or down to accommodate the needs of your safety program. If a segment has an actual crash rate higher than the critical rate, the location may have a potential highway safety deficiency and may deem additional analysis. The additional analyses may include but are not limited to the following: crash pattern studies, severity studies, B/C ratio studies, etc. To compute the critical crash rate for a site, use the following equation:
>
> $$F_c = F_a + k(F_a / M)^{1/2} + 1/2M$$
>
> where:
>
> F_c = the critical crash rate
>
> F_a = statewide crash rate of roadway class or average crash rate
>
> K = a probability constant. Some values are:
>
> K = 1.645 for a 95% confidence level, commonly used for rural areas
>
> K = 3.291 for a 99.95% confidence level, commonly used for urban areas
>
> M = vehicle exposure, the exposure should be calculated in *100mvmt* if *NC* S*tatewide Rates* is used
>
> Another advantage of using the critical crash rate method is because it accounts for exposure. A short segment of roadway could have an extremely high crash rate although the roadway's crash history identified only a small number of crashes. Locations with low exposure will be measured against a higher critical rate. Thus, the locations that have a small segment length (or low ADT) and low crash counts will not be overflagged when compared to locations that have high ADT's and high crash counts.

In accordance with these guidelines, the critical crash rate was calculated for the facilities listed in **Table 1-12**.

CHAPTER 2

Chapter 2 ALTERNATIVES CONSIDERED

2.1 APPROACH TAKEN TO ADDRESS PROJECTS R-2247, U-2579, AND U-2579A IN THIS CHAPTER

This chapter discusses alternatives considered for the proposed actions including:

- **No-Build Alternative and Partial Build Alternatives (Section 2.2)**
  The Partial-Build Alternatives include building Project R-2247 and not Projects U-2579 and U-2579A or vice versa.
- **Transportation Management Alternatives (Section 2.3)**
  Includes discussion of existing (2003) transportation management measures already being implemented in the area. Discussions of these alternatives are based on recent data.
- **Mass Transit/Multi-Modal Alternatives (Section 2.4)**
  The discussion of the Mass Transit/Multi-Modal Alternatives was updated with current information on existing programs and 2000 Census data on commuting patterns.
- **Preservation Easements Alternative (Section 2.5)**
  This alternative was suggested by the Plaintiffs in the lawsuit related to the 1996 Project R-2247 FEIS.
- **Improve Existing Roadways Alternatives (Section 2.6)**
  Improve Existing Roadways Alternatives section for Project R-2247 was updated in 2002 (*Improve Existing Roadways Alternatives Evaluation Technical Memorandum*). A technical memorandum evaluating improving existing US 52 as an alternative for Projects U-2579 and U-2579A was prepared in 2003 (*Improve US 52 Alternative Technical Memorandum*).
- **Build Alternatives on New Location (Sections 2.7, 2.8, and 2.10)**
  For the Build Alternatives on New Location, this chapter traces the development and history of the Detailed Study Alternatives for Project R-2247, Project U-2579 and Project U-2579A. The discussion for Projects R-2247 and U-2579 is based on information from previous documents. This chapter also discusses how this information may have changed over the years and how these changes may affect the preliminary corridors, the Detailed Study Alternatives and the selections of the Preferred Alternatives for Project R-2247 and Project U-2579.

Each alternative is assessed with respect to its ability to meet the projects' purposes and needs.

As detailed in this chapter, the No-Build Alternative, Transportation Management Alternatives, Mass Transit/Multi-Modal Alternatives, Preservation Easements Alternative, and Improve Existing Roadways Alternatives do not effectively meet the projects' purposes and needs.

This chapter identifies the selection of the Preferred Alternative for the Northern Beltway as a whole **(Section 2.12)**. This chapter also identifies the Preferred Alternatives previously selected for Projects R-2247 and U-2579 and re-evaluates these selections through review of current demographics, travel demand modeling, land use planning, and other information that may have changed within the study areas since these selections (see **Sections 2.9 and 2.11**). Finally, this chapter documents the identification of the Preferred Alternative for Project U-2579A (**Section 2.11**).

2.2 NO-BUILD AND PARTIAL BUILD ALTERNATIVES

2.2.1 No-Build Alternative

The No-Build Alternative means no actions would be implemented under any of the three projects (Projects R-2247, U-2579, and U-2579A).

Under this scenario, other projects that are currently shown as funded in the LRTP would be implemented. Combined with the existing roadways, this scenario is referred to as including "existing plus committed projects".

The No-Build Alternative would incur neither right-of-way nor construction costs. There would be no short-term disruptions along the existing roadways during construction. There would be no impacts to streams, wetlands or other natural and cultural resources, nor would there be any residential or business relocations. However, the No-Build Alternative would not meet any of the purposes identified for Projects R-2247, U-2579, or U-2579A, nor would it solve or alleviate any of the needs described in **Chapter 1**.

In accordance with NEPA (40 CFR 1502.14(d)) and FHWA guidelines (FHWA Technical Advisory T 6640.8, 1987: pg.16), the No-Build Alternative is given full consideration and provides baseline conditions with which to compare the improvements and consequences associated with the Detailed Study Alternatives for Projects R-2247, U-2579, and U-2579A.

2.2.2 Partial Build Alternatives

There are two Partial Build Alternatives as listed below:

- Build-West scenario – means build Project R-2247, but no action under Projects U-2579 and U-2579A.

- Build-East scenario – means build Projects U-2579 and U-2579A, but no action under Project R-2247.

Under each partial build scenario, other existing plus committed projects included in the LRTP would be implemented.

As described in **Section 2.7.2**, both Project U-2579 and Project U-2579A would need to be constructed in order to fulfill the projects' purpose as the I-74 corridor since both projects connect to designated future interstates. Therefore, in developing the Partial Build Alternatives, Projects U-2579 and U-2579A were not separated.

The Partial Build Alternatives would incur only those impacts listed for the project that is built (Project R-2247 or Projects U-2579 and U-2579A). **Chapter 4** of this document describes the direct and indirect impacts of the projects individually and in total so the impacts of the projects can be understood in whole and in part.

The impacts for Projects R-2247, U-2579, and U-2579A are described both in whole and in part because Project R-2247 has independent utility from Projects U-2579 and U-2579A. That is, Project R-2247 could fulfill its purposes and needs without Projects U-2579 and U-2579A. It would improve north-south connectivity in western Forsyth County; provide improved direct connections to US 52, US 421, and I-40; and provide congestion relief for area roadways, even if Projects U-2579 and U-2579A were not constructed. Likewise, Projects U-2579 and U-2579A could fulfill their purposes and needs without Project R-2247. They would provide intrastate and interstate mobility, improve roadway system linkage and continuity, reduce traffic congestion and carry future traffic at a desirable LOS, enhance safety, and provide a corridor for I-74.

2.3 TRANSPORTATION MANAGEMENT ALTERNATIVES

2.3.1 Transportation Management Measures

In some cases, transportation management alternatives can be used to improve the overall operation of an existing roadway network. The management tools include Transportation Systems Management (TSM) and Travel Demand Management (TDM).

Sections 2.3.1.1 and 2.3.1.2 provide descriptions of TSM and TDM measures and those measures currently being implemented in Forsyth County. **Section 2.3.2** includes discussions of these measures' ability to meet the purposes and needs for Project R-2247 and Projects U-2579 and U-2579A.

2.3.1.1 Transportation Systems Management (TSM) Measures

Transportation Systems Management (TSM) consists of constructing low-cost transportation improvements to increase the capacity of an existing facility. TSM strategies typically involve minor roadway and intersection improvements that improve the operational characteristics of a facility while minimizing capital outlay and inconvenience to motorists. There are two main types of TSM minor roadway improvements: operational and physical. Examples of these improvements are:

Operational Improvements	Physical Improvements
Traffic law enforcement	Addition of turn lanes
Turn prohibitions	Intersection realignment
Access control in limited areas	Improved signage, variable message boards
Speed restrictions	New signals or stop signs
Signal coordination	Intersection geometric improvements, including roundabouts
Signal phasing or timing	High-Occupancy Vehicle (HOV) lanes

The TSM physical and operational roadway improvements typically are effective in solving site-specific capacity, safety, and use problems in urban areas.

The City of Winston-Salem and NCDOT currently are implementing several TSM measures to minimize traffic congestion. Following is a discussion of these measures.

Changeable Message Signs and other ITS (Intelligent Transportation System) Measures. The City of Winston-Salem and NCDOT both own and operate traffic surveillance camera

systems in the City. The NCDOT cameras are primarily located on access-controlled facilities, such as I-40. The City of Winston-Salem cameras are primarily located at major surface street intersections. The City and NCDOT share the video information and coordinate the operation of the cameras, changeable message signs, and traffic signals to assure that traffic congestion related to incidents is managed seamlessly for the traveling public (*Winston-Salem Urban Area 2030 Multi-Modal Long Range Transportation Plan (LRTP)*, Congestion Management Plan, pg. 1). **Figure 2-1** shows the location of proposed and existing video surveillance cameras and changeable message signs as documented in the *2030 LRTP*.

Signal Improvement. A computerized traffic control system coordinates the operation of over 220 traffic signals in the City to minimize delays associated with unnecessary stops, as well as to coordinate traffic flow on higher volume streets (*2030 LRTP*, Congestion Management Plan, pg. 8).

Congestion Management. The City of Winston-Salem operates a Safety Improvement Program, which identifies and improves areas with high levels of accidents. Examples of improvements made under the Safety Improvement Program include adding turn lanes, widening roads, lengthening acceleration lanes, modifying signal timings, and reconstructing intersections.

Roundabouts. There are nine roundabouts existing or under construction in Forsyth County. These are:

- Turfwood Drive in Bethania
- Westview Drive/Buckingham Road (constructed by City of Winston-Salem)
- Styers Ferry Road at Duke Power facility
- Fraternity Church Road/Hope Church Road
- Waughtown Street/Lomond Street (constructed by Winston-Salem, funded through NCDOT)
- Waughtown Street/Old Salem Road/Main Street multilane roundabout (TIP Project U-2926).
- US 421/Williams Road interchange ramps (construction by NCDOT) (2)
- Old Salisbury Road at Ardmore Road

The roundabouts at US 421 were proposed because a traffic signal which would require widening the bridge over US 421 to accommodate left turn lanes was not as cost-effective since the bridge did not need to be replaced.

TSM Improvements to Existing US 52. The NCDOT proposes to improve safety and capacity on existing US 52 by adding auxiliary lanes in some locations and modifying or closing ramps (TIP Project U-2826B). While this improvement could result in higher capacity and increased

safety, it would not address the long-term need for substantial additional capacity between US 52 and US 311. According to the *NCDOT 2006-2012 Transportation Improvement Program*, construction for TIP Project U-2826B is scheduled to begin in 2008 (see **Section 1.10.1**).

2.3.1.2 Travel Demand Management (TDM) Measures

Travel Demand Management (TDM) strategies include staggered work hours, ridesharing, and High Occupancy Vehicle (HOV) lanes. HOV lanes, usually requiring two or more passengers per vehicle, are most commonly used in heavily developed urbanized corridors, usually on controlled-access facilities, to provide an incentive for ridesharing and to facilitate efficient traffic flow.

Currently, the Winston-Salem Transit Authority (WSTA) is implementing a number of TDM strategies in Forsyth County.

Flexible Work Times. Numerous flex-time opportunities exist within Forsyth County. Several major employers in the Winston-Salem downtown area, such as US Airways, Wachovia Bank, BB&T Bank, and GMAC Financial Services offer flex-time, telecommuting and/or compressed work weeks as options to their employees.

Transit. Ridesharing Services & Vanpooling of the Piedmont (RSVP) is a ridesharing program for people in the 12-county Triad region, provided by PART. It is the largest vanpooling program in the Southeast. Through carpool matching and vanpool leasing, RSVP provides commuters with an alternative to single occupancy vehicles. This program, with a fleet of 24 vans, currently eliminates over 737,810 miles of commuter travel in the Triad region each year. Ridership exceeded 319,890 passenger trips in 2005 (personal communication, January 11, 2006).

TransAid, a county-wide demand responsive dial-a-ride service for elderly and disabled residents is another service operated by WSTA.

The *Legacy Development Guide*, the long-range policy guide for decisions concerning the overall growth and development of Forsyth County and its municipalities, sets forth policies that support telecommuting and RSVP. Employers who participate in RSVP and other WSTA programs allow WSTA to promote various forms of ridesharing at their places of employment.

2.3.2 Ability of TSM/TDM Measures to Meet Purpose and Need

Transportation management strategies (TSM and TDM measures) are important congestion management tools, and they are a critical component of Winston-Salem's thoroughfare planning efforts. However, as discussed below and in **Section 2.4.2**, existing and/or new TSM and TDM measures implemented alone would not meet the purposes and needs for Projects R-2247, U-2579, and U-2579A.

The ability of travel demand management measures to address the needs of western and/or eastern Forsyth County, particularly under a voluntary system, is limited.

Many strategies already are being implemented in Forsyth County, as described in **Section 2.3.1**. The effects these measures have on traffic volumes are accounted for in the calibration of the Piedmont Triad Regional Travel Demand Model (the model used to project future traffic volumes for the region). Additional TSM/TDM measures would not divert substantially more peak hour traffic and would have little effect on reducing projected congestion on the roadway network.

2.3.2.1 TSM/TDM Measures for Project R-2247

TDM measures would not improve connectivity in the discontinuous rural and radial dominated roadway system in western Forsyth County.

TSM measures such as HOV lanes and variable message boards are best suited to controlled-access freeways. There are no controlled-access freeways providing north/south connections in western Forsyth County, so these types of measures would not apply.

Traffic signals in western Forsyth County are primarily located along the radial routes leading to downtown Winston-Salem. A program to implement computerized and coordinated traffic signals is being pursued by the City of Winston-Salem where appropriate. Coordinating signals along the radial routes in western Forsyth County could improve travel to downtown, but would not improve north/south connectivity.

Roundabouts typically are constructed at intersections of relatively low volume, ones that would not be over capacity with a signal in place. They are more efficient than a signalized intersection at these lower volumes and for intersections with predominance of left-turn movements. They can also be of benefit at intersections with high accident rates, especially high rates of left-turn, T-bone type accidents. Roundabouts do not provide a substantial reduction in intersection delay compared to a signalized intersection. As an independent alternative, constructing roundabouts at key locations in the project study area would not meet the purposes and needs for Project R-2247. They would not provide for improved north/south connectivity nor would they provide congestion relief for area roadways.

2.3.2.2 TSM/TDM Measures for Projects U-2579 and U-2579A

TSM improvements to NC 66 and US 158 were considered between US 52 and US 421/I-40 Business. Old Hollow Road (NC 66) and the NC 66 Connector (SR 1840) pass through the study area generally following the corridor of the proposed Eastern Section of the Northern Beltway (Project U-2579) from US 52 to Walkertown. NC 66 then proceeds to US 421/I-40 Business, but is routed through the congested urban areas of Walkertown and Kernersville (see **Figure 1-3**).

Implementing TSM measures on NC 66 from US 52 to West Mountain Street to meet the purposes and needs for Projects U-2579 and U-2579A is not feasible. NC 66 consists of a two-lane facility with poor roadway characteristics and unsafe operating conditions. The poor horizontal and vertical alignment offers few opportunities to pass slower vehicles. NC 66 is routed through the downtown business district of Kernersville and could not adequately carry the truck traffic that would travel this route without improvements that would be beyond TSM and TDM measures. TDM measures, in particular, are not effective for long-distance truck traffic, since they typically address commuter travel.

Another option, using existing NC 66 from US 52 to US 158 and then existing US 158 to US 421/I-40 Business, also is not feasible because of the poor roadway conditions on NC 66. Furthermore, the interchange between US 421/I-40 Business and US 158 would need to be reconstructed to provide for all movements. This routing would be circuitous for the US 52 bypass traffic and cause additional environmental impacts due to its proximity to Salem Lake, a secondary source of drinking water.

HOV lanes are not considered feasible on non-access controlled roads such as those currently serving circumferential movements in the study area, particularly with the existing and projected low transit ridership and low vehicle occupancy rates (see **Section 2.4**). HOV lanes could be added to existing I-40, US 421/I-40 Business, and US 52. Adding HOV lanes to these facilities would add some capacity and would encourage ride sharing. However, even if up to 25 percent of vehicles during peak hours (a generous estimate given the lack of HOV experience in North Carolina) were to use an HOV lane, the remaining lanes would still operate at a level of service (LOS) E or F.

Construction of HOV lanes would have similar impacts as widening existing routes, with the added difficulty of separating HOV lanes from the general traffic stream and providing ingress and egress from the HOV lanes to ramps and other travel lanes. In addition, HOV lanes are most effective when downtown parking is scarce or expensive to commuters, neither of which is a factor in Winston-Salem.

The NCDOT is considering a TSM project to improve safety and capacity on existing US 52 by adding auxiliary lanes in some locations and modifying or closing ramps (Project U-2826B). In addition, intelligent transportation system (ITS) measures are also under investigation, including dynamic message signs (DMS), closed-circuit televisions (CCTV), automatic vehicle detection on the interstate, a web-based interstate traffic flow map, interfacing with the 511 traffic information system, and a truck rollover warning system. While these improvements could result in higher capacity and increased safety, they would not address the long-term need for substantial additional capacity between US 52 and US 311 based on traffic projections.

2.3.2.3 Conclusion

TSM measures would not meet the purposes and needs of Projects R-2247, U-2579, or U-2579A as stated in **Chapter 1**. TSM and TDM Alternatives would not improve connectivity in western Forsyth County, are not applicable, and/or would not provide congestion relief for area roadways. TSM Alternatives would not provide for a future I-74 facility. US 52, US 421/I-40 Business, NC 66, and US 158 would need improvements far beyond the scope of TSM to serve the traffic demand projected for 2025 in eastern Forsyth County. While upgraded computerized signal equipment and additional turn lanes would improve capacity of surface streets somewhat, levels of service would remain unsatisfactory for the TSM Alternative. Transit-related TDM measures are discussed in **Section 2.4.2.**

2.4 MASS TRANSIT/MULTI-MODAL ALTERNATIVE

2.4.1 Background and Description

The Mass Transit/Multi-Modal Alternative would include bus or rail passenger service in addition to travel demand management. A major advantage of mass transit is it can provide high-capacity, energy-efficient movement in densely traveled corridors. It also serves high and medium density areas by offering a low-cost option for automobile owners who do not wish to drive, as well as service to those without access to an automobile.

The WSTA currently operates 32 daily bus routes within the City of Winston-Salem, including eight night routes, one trolley route, and one shuttle route. These routes are shown in **Figure 2-2**. Transit service is focused on the central business district of Winston-Salem with little suburban circulation.

Currently, according to the 2000 US Census, about 1.5 percent of the workers living in the county use public transportation as their primary means of getting to work (2000 Census Transportation Planning Package, American Association of State Highway and Transportation Officials [AASHTO] website *http://transportation.org/ctpp/home/nc/Forsyth_County/Forsyth_County.pdf,*

accessed on March 25, 2003). The Piedmont Triad Regional Travel Demand Model assumed a future ridership of 4 percent mass transit use during peak hours (WSDOT, December 19, 2001).

The *2030 LRTP* proposes that WSTA expand its fixed route system to serve areas outside of Winston-Salem. These include Tobaccoville, Rural Hall, Clemmons, Walkertown, and Kernersville in Forsyth County, and regional fixed route services to Greensboro and High Point. (*2030 LRTP*, Public Transportation Plan, pg. 6).

On December 19, 2001, NCDOT, Winston-Salem DOT, WSTA, and Piedmont Authority for Regional Transportation (PART) met to discuss transit service in Forsyth County. The Winston-Salem DOT and WSTA stated a Northern Beltway would help to improve transit service by providing increased mobility for the bus system (WSDOT, December 19, 2001).

Representatives from PART attending the December 19, 2001 meeting were in agreement. Recently passed legislation gives PART the authority to purchase rail lines. Bus service would need to be extensive to support rail usage. PART representatives stated the Northern Beltway would help to improve PART's transit service and increase ridership of transit (PART, December 19, 2001).

Also, as described in **Section 2.3.1.2**, Ridesharing Services & Vanpooling of the Piedmont (RSVP) is a state-funded ridesharing program for people in the 12-county Triad region that had ridership of about 319,890 passenger trips in 2005 (personal communication, January 11, 2006).

2.4.2 Ability of Mass Transit/Multi-Modal Alternative to Meet Purposes and Needs of Projects

Transit and TDM measures (such as ride sharing) alone would not meet the needs and purposes of Project R-2247 or Projects U-2579 and U-2579A. Local transit agencies stated transit service in Forsyth County would be enhanced with a Northern Beltway by increasing mobility in the county.

Rail transit is being examined by the City and PART as an alternative to building new highways. Most successful rail transit systems are radially oriented and serve residential areas with densities of ten or more dwelling units per acre. Existing and projected residential densities in the proposed project corridors fall short of that density figure, and the proposed Northern Beltway would serve primarily circumferential rather than radial trips. In 2000, population densities in the project study area were rural (320 persons/square mile) and suburban (3,200 persons per square mile). Using Forsyth County's 2000 average household size of 2.39 persons per household and converting square miles to acres (1 square mile = 640 acres), the average household densities in the project study area range from 0.2 to 2 dwelling units per acre.

Transit alone would not attract sufficient ridership to alleviate projected congestion in western and eastern Forsyth County. The Piedmont Triad Regional Demand Model already takes into account transit ridership in the projected traffic volumes for western and eastern Forsyth County, and as described in **Chapter 1**, congestion on area roadways is projected to occur, even with an estimated increase in transit ridership over existing conditions.

Ride-sharing programs are most effective in areas with lengthy commute times, limited parking supply, or high-cost parking. In Forsyth County, about 28 percent of the workers live in, and therefore commute from, other counties (2000 US Census website, *http://www.census.gov/population/www/cen2000/commuting.html*, accessed March 21, 2003). These workers can benefit from the existing ride-sharing programs offered in the Triad region, if they choose to take advantage of them. However, even with an effective ride-sharing program focusing on the Winston-Salem central business district as is currently being implemented, projected levels of service on routes serving circumferential travel in the study area would remain poor. Ride-sharing, like transit, is more effective in providing a viable alternative for radial commuting trips because there is a centralized destination.

In addition, transit and/or ridesharing would not provide for an interstate connection for I-74 through Forsyth County, which is one of the purposes of Projects U-2579 and U-2579A.

2.5 PRESERVATION EASEMENTS ALTERNATIVE

On February 2, 2000, the Friends of Forsyth County (a local citizens group who was a plaintiff in the lawsuit filed against FHWA and NCDOT regarding Project R-2247) requested that the NCDOT consider purchasing easements to preserve undeveloped land along the Winston-Salem Northern Beltway Western Section's corridor as an alternative to building Project R-2247. They suggested an analysis should be done to determine how the removal of such properties from Forsyth County's inventory of developable land would affect regional development patterns and traffic operations.

The Project R-2247 Preferred Alternative would require about 1,559 acres of right of way. Of this area, about 330 acres (about 21 percent) are either existing commercial development (15 acres) or are undevelopable because they are roads (287 acres), utility easements (21 acres), or water and wetlands (7 acres). The remaining 1,229 acres are residential, agricultural, fallow fields, or forested land that could be developed at higher density uses.

Removing the 1,229 acres from the inventory of developable land would not substantially affect regional development patterns because there is more than sufficient vacant land in western Forsyth County to accommodate projected population growth. As discussed in the *Indirect and Cumulative Impacts Assessment* (2005) prepared for this project and appended by reference, the increases in projected population density would be below the build-out densities allowed with

current zoning in all but one of the Traffic Analysis Zones (TAZ) under the No-Build, Partial Build, and Build Alternatives.

The one TAZ projected to have a population density greater than current zoning would allow is TAZ 2706, around southwest Tobaccoville, where the population is projected to be 279 persons per square mile in 2025 under the No-Build Alternative and 288 persons per square mile in 2025 under the Build and Partial Build Alternatives. Current zoning would allow 207 persons per square mile. Any population densities under 320 persons per square mile are considered rural. Therefore, even in this TAZ, the population is projected to remain rural, which means there would still be developable land available in this area in 2025.

Removing the 1,229 acres from the inventory of developable land would not substantially affect regional travel patterns compared to the No-Build Alternative. If projected growth patterns would not be substantially affected and the existing roads remain, travel patterns would not be expected to change.

Preserving the 1,229 acres in western Forsyth County as an alternative to building the western section of the Northern Beltway would not meet the Project R-2247 purposes and needs. It would not improve north-south connectivity, nor would it provide improved direct regional connections to US 52, US 421, or I-40. Also, it would not provide congestion relief for area roadways since it would not attract traffic off of existing roads nor substantially change development patterns (due to the availability of land in the area).

Comprehensive land use planning and transportation planning in Forsyth County have been open to public input and involvement at all levels. The planning process was done on a local level with the ideas and opinions of the citizens of Forsyth County given the highest consideration possible. The citizens and public officials of Forsyth County have shown their support of the Western Section of the Winston-Salem Northern Beltway through their support of the *2005 Winston-Salem Urban Area Thoroughfare Plan*, *2030 LRTP*, *Vision 2005*, and *The Legacy Development Guide*.

The Preservation Easements Alternative was eliminated from consideration because it would not meet the Project R-2247 purposes and needs. NCDOT does not have the legal authority to regulate local land use nor purchase land for uses unrelated to transportation projects. Based on the comprehensive land use planning and transportation planning conducted in Forsyth County that supports a new location Northern Beltway, there does not appear to be support for the Preservation Easements Alternatives at the local level, where there would be land use zoning and planning authority to purchase easements.

2.6 IMPROVE EXISTING ROADWAYS ALTERNATIVES

2.6.1 Project R-2247 – Improve Existing Roadways Alternatives from the 1996 Final Environmental Impact Statement (FEIS)

Three Improve Existing Roadways Alternatives, IM1, IM2, and IM3, were evaluated separately and documented in the 1996 Project R-2247 FEIS. **Figure 2-3** shows the three alternatives. All three were eliminated from further consideration in the previous planning process. Below is a summary of the information from Section 2.4.2.2 of the 1996 FEIS.

Improve Existing Roadways Alternative IM1 includes the widening of Lewisville-Clemmons Road, Styers Ferry Road, Meadowlark Drive, Olivet Church Road, Yadkinville Road, and Shattalon Drive. Alternative IM1 fell short of the established need to improve circumferential continuity and capacity. Alternative IM1 does not provide relief to the 2015 network comparable to the routes on new location (year 2015 was the latest study year at the time the analyses were conducted). Some of the better-connected roads, such as Transou Road and Bethania-Rural Hall Road (NC 65), are constrained from widening due to their location within the Pfafftown and Bethania historic districts. Residential and business relocations along the IM1 route, its relatively inefficient handling of 2015 traffic, and the basically poor connectivity of the circumferential roads in western Forsyth County led to the elimination of Alternative IM1.

Improve Existing Roadways Alternative IM2 includes the widening of Transou Road and Bethania-Rural Hall Road instead of the portion of Yadkinville Road between Transou Road and Shattalon Drive. The roads are constrained from widening due to their location within the Pfafftown and Bethania historic districts. This alternative also would widen Jonestown Road, McGregor Road, and Peace Haven Road in the southern portion of the study area. These roadways are in ridge-valley terrain, in proximity to, and crossing, Little Creek and Silas Creek. Along these routes, traffic service would continue to suffer from the many existing steep grades, sharp turns, and intersections.

Improve Existing Roadways Alternative IM3 includes the widening of Lewisville-Vienna Road, Vienna-Dozier Road, and Tobaccoville Road, which form a circumferential route. Because of its location far beyond the growth areas, this outer route does not provide an effective solution to the need to serve projected growth in the Muddy Creek Basin.

2.6.2 Project R-2247 – Updated Improve Existing Roadways Alternatives

The updated Improve Existing Roadways Alternatives are described in detail in the *Improve Existing Roadways Alternatives Evaluation* (2002), which is appended by reference.

2.6.2.1 Background Information

An updated evaluation of Improve Existing Roadways Alternatives for Project R-2247 was conducted in 2002 based on the Piedmont Triad Regional Travel Demand Model completed in 1999. The travel demand model was used to identify trends and general patterns of travel in western Forsyth County for consideration in the development of new Improve Existing Roadways Alternatives. The model also was used to estimate year 2025 traffic volumes for these alternatives. The updated evaluation intentionally did not refer to the previous evaluation of Alternatives IM1, IM2, and IM3 in order to not limit possible routes. Even though the updated evaluation was developed independently using a newer travel demand model, the Improve Existing Roadways alternatives from the updated evaluation are similar to the improve existing roadways alternatives from the previous evaluation (IM1, IM2, and IM3). These similarities are due to the similar travel demand represented in the travel demand models.

2.6.2.2 Development of Additional Improve Existing Roadways Alternatives for Project R-2247

Two new Improve Existing Roadways Alternatives, RV-A and RV-B, shown on **Figure 2-4a**, were developed that focused on those needs and benefits of Project R-2247 that could be addressed by widening existing roadways. A combination of RV-A and RV-B also was considered.

The needs and benefits that could be addressed by widening existing roads are:

- Improved north/south connectivity in western Forsyth County
- Congestion relief for area roadways
- Improved direct connections to US 52, US 421, and I-40

Improving existing roadways would not provide high speed direct access to US 52, US 421 or I-40.

Alternative RV-A focuses primarily on the first need and includes widening those existing roadways that best serve the north/south mobility needs in the project area. This alternative also would provide some congestion relief on the widened roadways. **Table 2-1** lists the roadways included in Alternative RV-A.

Table 2-1: Alternative RV-A Roadway Segments

Roadway	From	To	Existing No. of Lanes	Proposed No. of Lanes	Proposed Right of Way (feet)
Lewisville-Clemmons Rd	I-40	US 421	2/3	5	*
Styers Ferry Rd	US 421	Country Club Rd	2	4	120
Country Club Rd	Styers Ferry Rd	Meadowlark Dr	2	4	120
Meadowlark Dr	Country Club Rd	Robinhood Rd	2	4	120
Olivet Church Rd	Robinhood Rd	Spicewood Dr	2	4	120
Spicewood Dr	Olivet Church Rd	Yadkinville Rd	2	4	200
Grandview Club Rd	Yadkinville Rd	Reynolda Rd	2	4	200
Reynolda Rd	Grandview Club Rd	Vienna-Dozier Rd	2	4	200
Robinhood Rd	Meadowlark Dr	Shattalon Dr	2	4	120
Shattalon Dr	Robinhood Rd	Murray Rd	2	4	120
Murray Rd	Shattalon Dr	Bethania-Rural Hall Rd	2	4	200
Bethania-Rural Hall Rd	Murray Rd	US 52	2	4	200

* Lewisville-Clemmons Road is being improved under TIP Project Number U-3119 to a five-lane facility.

Alternative RV-B focuses primarily on the second need and includes widening those roadway segments that were most benefited, that is, they experienced the greatest traffic reduction, with the proposed Northern Beltway. This alternative would not provide overall improved north/south connectivity. **Table 2-2** lists the roadways included in Alternative RV-B.

Table 2-2: Alternative RV-B Roadway Segments

Roadway	From	To	Existing No. of Lanes	Proposed No. of Lanes	Proposed Right of Way (feet)
Silas Creek Pkwy	University Pkwy	I-40	4	6	200
Shattalon Dr	University Pkwy	Robinhood Rd	4	4	120
Reynolda Rd	Seward Rd	Polo Rd	2/5	4	200
Polo Rd	Reynolda Rd	Robinhood Rd	2	4	120
Peace Haven Rd	Polo Rd	US 421	2	4	120
Olivet Church Rd	Yadkinville Rd	Robinhood Rd	2	4	120
Meadowlark Dr	Robinhood Rd	Country Club Rd	2	4	120

Also evaluated was a combined Alternative RV-A + RV-B that would encompass as many needs and benefits as possible.

Under Alternatives RV-A, RV-B, or RV-A + RV-B, two-lane roads would be widened to four lanes with grass medians and either 120 feet or 200 feet of right of way. There would be no access control. Major intersections would be signalized.

Silas Creek Parkway (NC 67), included in RV-B, is currently four lanes wide. Under Alternative RV-B, it would be widened to six lanes.

Reynolda Road (NC 67) from Polo Road to Shattalon Drive is currently four-lanes wide with a two-way left turn lane. Under Alternative RV-B, this segment would have a 16-foot raised median with turn bays in order to improve capacity by channelizing left turns.

The widening of Lewisville-Clemmons Road to five lanes from Peace Haven Road to US 421 already is planned under TIP Project U-3119. Therefore, impacts due to the widening of Lewisville-Clemmons Road are not considered in the impact assessment or cost for Alternative RV-A.

Study corridors 400 feet wide that centered on each roadway in the Improve Existing Roadways Alternatives were developed. Aerial photography, Forsyth County Geographic Information System (GIS) data, and site visit inventories were reviewed to develop functional designs within the study corridors. Where practicable, impacts to residences, businesses, and community facilities were minimized.

Right-of-way widths of 120 feet or 200 feet were determined for each roadway based on the characteristics of the roadway and whether the lesser right-of-way width would minimize impacts. Grassed shoulders and wider medians associated with the 200-foot right of way were appropriate for rural areas. The 120-foot right of way and curb and gutter were appropriate for more suburban roadway segments. A roadway with curb and gutter generally costs more to construct, even with less right of way, so this cross-section was proposed only on roadways where residential relocations could be avoided by its use.

Originally, all two-lane roadway widenings were proposed to have grass shoulders and be contained within a proposed 200-foot right of way. However, in response to public comments received at the Citizens Informational Workshop held on November 27, 2001, the right-of-way width was reduced to 120 feet for some roadways as indicated in **Tables 2-1 and 2-2**.

2.6.2.3 Summary of Impacts of Alternatives RV-A, RV-B, and RV-A + RV-B

Table 2-3 summarizes the costs and effects of Alternatives RV-A and RV-B and a combined Alternative RV-A + RV-B compared to the Preferred Alternative for Project R-2247.

In addition to the effects listed in **Table 2-3**, indirect effects and community character also were addressed.

Cost Estimates. Alternative RV-A would have the lowest cost and the Combined RV-A + RV-B would have the highest cost.

Safety. In comparison to the existing two-lane configurations, overall future accident rates along roadways widened under the Improve Existing Roadways Alternatives RV-A, RV-B, and RV-A+RV-B may be expected to decrease. Statewide, accident rates are lower on average for four-lane divided secondary facilities with no access control (258.85 crashes per hundred million vehicle-miles traveled [crashes/100 mvm]) than for two-lane undivided secondary facilities (368.7 crashes/100 mvm) (Statewide 2001-2003 Three-Year Crash Rates, NCDOT).

Because it would be a fully controlled-access facility, the Project R-2247 Preferred Alternative is expected to have lower accident rates (94.84 crashes/100 mvm) (Statewide 2001-2003 Three-Year Crash Rates, NCDOT) than roadways improved under Alternatives RV-A and RV-B.

Travel Times. Travel times between US 52 and I-40 were estimated for the Improve Existing Alternatives and for the No-Build and Preferred Alternatives for Project R-2247.

Travel times for the No-Build Alternative and Alternative RV-A were calculated by dividing the length of the eastern leg of the Alternative RV-A (17.2 miles) by the assumed speeds (45 mph under the No-Build Alternative and 55 mph under Alternative RV-A), and adding to that an assumed delay experienced at each signalized intersection (20 seconds, which is the average delay for an intersection operating at LOS B/C). Traffic signals were assumed at the major cross streets, and totaled fourteen. Twelve of the fourteen intersections currently are signalized. Using roundabouts instead of signalized intersections would not make a difference in the travel time calculations. A delay of 20 seconds would be typical of a roundabout as well as a signalized intersection.

Table 2-3: Project R-2247 - Effects Comparison Matrix for Improve Existing Roadways Alternatives

Effect	Project R-2247 Preferred Alternative	Alternative RV-A	Alternative RV-B	Combined RV-A + RV-B
Right-of-Way Cost (Millions $)*	$92.9	$115.5	$134.4	$221.2
Construction Cost (Millions $)*	$228.2	$114.5	$147.9	$205.9
Total Cost (Millions $)*	$321.1	$230.0	$282.3	$427.1
Average Accident Rates Under Build Alternative vs. Average Accident Rates Under No-Build Alternative	Most Improvement in Avg Rate	Likely Some Improvement in Avg Rate	Likely Some Improvement In Avg Rate	Likely Some Improvement In Avg Rate
Accident Rates vs. No-Build Alternative	Best	Likely Some Improvement	Likely Some Improvement	Likely Some Improvement
North/South Travel Time Improvements vs. No-Build Alternative	46% (~13 minutes)	Up to 18% (~5 minutes)	0%	Up to 18% (~5 minutes)
Road Network Benefits	High	Medium	Low	Medium
Land Use Plans	Consistent	Not Consistent	Not Consistent	Not Consistent
Regional Thoroughfare Plan	Consistent	Not Consistent	Not Consistent	Not Consistent
Residential Relocations	289	184	400	497
Commercial Relocations	10	25	33	45
Community Facilities	0	1	1	1
Major Stream Crossings	16	6	12	17
Noise Impacts	44	120	249	299
Regional Air Quality Conformity Model	Consistent	Not Consistent	Not Consistent	Not Consistent

* - Costs are in 2003 dollars for the Project R-2247 Preferred Alternative and 2002 dollars for the other alternatives.

The eastern leg of Alternative RV-A was selected because the western leg is longer and would have longer travel times. Travel times for the Project R-2247 Preferred Alternative were calculated by dividing the length of the alternative from US 52 to I-40 (16.7 miles) by the speed limit (65 mph).

Alternative RV-B would not improve north/south connectivity and, therefore, was estimated to have the same travel times as the No-Build Alternative.
Alternative RV-A would reduce travel time up to 18 percent (about 5 minutes) compared to the No-Build Alternative. Traffic using the roadways improved under Alternative RV-A would

experience many signals and a number of turns, which would substantially increase travel times and decrease travel speeds. The Project R-2247 Preferred Alternative would reduce travel time about 46 percent (about 13 minutes) compared to the No-Build Alternative for motorists traveling north/south between US 52 and I-40. The Alternative RV-A would not be access-controlled, so its capacity likely would be degraded over time by new driveways or intersections.

Traffic Service and Attraction. A quantitative analysis of design year traffic was conducted to determine the degree of traffic attraction that could be expected if Alternative RV-A is constructed. The traffic volumes from the Draft Land Use Scenario (see **Section 1.11.1.2**) that incorporate *The Legacy Development Guide* were used for this analysis. The benefits to the road network from Alternative RV-A were compared to the benefits of a new location Northern Beltway, as represented by the Project R-2247 Preferred Alternative. Benefited roadways were defined for Alternative RV-A as roadways widened under the alternative or roadways experiencing a traffic volume reduction of 7 percent or more over the No-Build Alternative. Benefits for the Preferred Alternative were defined as roadways experiencing a traffic volume reduction of 7 percent or more over the No-Build Alternative. Seven percent was chosen because a review in the traffic volumes showed it was a clear break point in the range of volume reduction percentages.

Figure 2-4b is a graphical comparison of the roadways benefited by a new location Northern Beltway for Project R-2247 and those benefited by Alternative RV-A. The new location Northern Beltway reduced traffic volumes on substantially more roadways, providing more effective congestion relief. Also, Alternatives RV-A and RV-B would not provide a high speed, access-controlled facility for through travelers that connects US 52, US 421, and I-40.

Alternative RV-B would widen roads that, under the No-Build Alternative, are already carrying a majority of the traffic in the area. Widening the roads under Alternative RV-B was estimated to relieve congestion on these roads more than it would serve to attract substantial additional traffic. Alternative RV-B would not provide improved connections to US 52, US 421, and I-40 for motorists traveling through western Forsyth County.

Land Use and Transportation Planning. The *Legacy Development Guide* and *2030 Multi-Modal Long Range Transportation Plan* support the building of the Western Section of the Northern Beltway. Alternatives RV-A and RV-B would not be consistent with these plans.

Relocations. Alternative RV-A would have the fewest residential relocations (184) and Alternative RV-A + RV-B would have the most (497). The Preferred Alternative for Project R-2247 would have the fewest commercial relocations (10) and Alternative RV-A + RV-B would have the most (45).

Community Facilities. Alternatives RV-A, RV-B, and RV-A + RV-B would likely require relocation of the Special Children's School located at 4505 Shattalon Drive. No community facilities are relocated under the Project R-2247 Preferred Alternative.

Stream Impacts. Alternative RV-A would have the least number of major stream crossings (6).

Air Quality. A Northern Beltway facility on new location is included in the region's air quality conformity model. The air quality conformity model would need to be rerun in order to determine the air quality effects of Alternatives RV-A, RV-B, or RV-A + RV-B.

Noise Impacts. The Project R-2247 Preferred Alternative would have the least number of noise impacts (44 after construction of noise barriers). Alternatives RV-A and RV-B would impact 120 and 249 receptors, respectively. Alternative RV-A + RV-B would impact 299 receptors. Noise walls are not feasible with RV-A, RV-B, RV-A + RV-B since there are numerous driveways and roadway connections. The numerous driveways and roadway connections would require noise walls to have multiple breaks in them, making them ineffective at reducing noise impacts. (This comparison of noise impacts is based on the original noise study, which used the model and NCDOT criteria that were in place at that time.)

Indirect Effects. The widening of existing roadways within a primarily residential area can influence development or conversion of existing land uses. The nature of development within the study area is controlled through the zoning and land use planning efforts of the Winston-Salem/Forsyth County City-County Planning Board.

Although residential growth patterns likely would not change as a result of Alternatives RV-A or RV-B, it can be projected that commercial establishments would be attracted to the improved roadways of Alternatives RV-A and RV-B instead of clustering around nodes identified in *The Legacy Development Guide*.

Community Character. The traffic volumes are expected to increase along many of the roadways improved under Alternatives RV-A and RV-B due to the change in functional classification. These increases represent shifts in travel patterns, not generation of additional traffic. The existing facilities currently act as collector streets. However, widening these roadways may make the roadways act more like arterials. The increase in speed limit and widening could eliminate the rural feel of many of the two-lane roadways.

Even though current zoning is primarily residential, widening the roadways in Alternatives RV-A and RV-B

Collector Street
A surface street providing land access and traffic circulation within residential, commercial, and industrial areas.

Arterial Street
A signalized street that primarily serves through-traffic and that secondarily provides access to abutting properties, with signal spacing of 2 miles or less.

Source: 2000 Highway Capacity Manual

could cause changes in the land use along these roadways over a period of time. The increase in traffic and the existence of four travel lanes could make the land along the improved roadways more attractive for commercial development and less attractive for residential uses. The character of what currently exists as residential could change to commercial strip development, similar to the commercial areas on Reynolda Road south of Shattalon Drive.
According to the *2030 LRTP*, no improvements are planned for most roadways included in Alternatives RV-A and RV-B (see **Figure 1-6**). Segments of Shattalon Drive, Robinhood Road, and Yadkinville Road would be widened to three lanes according to the *2005 Thoroughfare Plan*. Substantial changes in community character could be expected with the implementation of any of the Improve Existing Roadways Alternatives.

Public Comment. A Citizens Informational Workshop to present Alternatives RV-A and RV-B was held on November 27, 2001. Six hundred seventy-one citizens signed in at the workshop.

Three hundred sixteen comments from individuals were received at the Citizens Informational Workshop or by email or mail after the meeting. Only nine of the comments favored either or both Improve Existing Alternatives. More than 275 respondents opposed the Improve Existing Alternatives or supported the Preferred Alternative for Project R-2247.

At the workshop, all roads were shown as being widened within a proposed 200 feet of right of way with grassed shoulders. Some comments questioned the need for 200 feet of right of way to improve the roads included in RV-A and RV-B. The proposed 200-foot right of way was based on a conservative estimate of right of way needed for a typical four-lane rural road with a median. As a result of these comments, the roads were re-examined to identify ones where a narrower right of way of 120 feet, based on a typical four-lane urban road with curb and gutter, might be appropriate. As a result of this review, the proposed right of way for some roadways was reduced to 120 feet.

Most of the comments received in opposition to Alternatives RV-A and/or RV-B were against the proposed road widenings in general, regardless of the typical section or right-of-way width proposed. Consequently, it is believed that public opposition would continue to be strong even with the reduced right-of-way widths.

2.6.2.4 Ability of Improve Existing Roadways Alternatives to Meet Purpose and Need for Project R-2247

Alternative RV-A. Alternative RV-A would not meet the Project R-2247's purposes and needs. Below is a bulleted list of components of the proposed project's purpose and need, interspersed with discussion of Alternative RV-A's ability/inability to meet those various components.

- **Improved north/south connectivity in western Forsyth County.**

Alternative RV-A uses existing roads west of Silas Creek Parkway to provide improved north/south connections. However, the existing system of roadways was not historically established for north/south travel; therefore, this strategy cannot eliminate circuitous travel or provide improved access to facilities outside western Forsyth County. Motorists using Alternative RV-A from US 52 to US 421 would still travel through fourteen signalized intersections on several roadways with no access control and lower speeds than a controlled-access freeway.

- **Increased average travel speeds and decreased vehicle hours traveled.**

The improvements in travel time that can be achieved with Alternative RV-A are directly related to assumed increases in design speeds that would occur when the roadways are widened from two lanes to four lanes. An optimistic estimate of travel time improvements was made, resulting in an estimate of about 18 percent time savings for motorists traveling north/south between US 52 and US 421. These time savings would be expected to degrade over time since the roadways would not be access-controlled and development occurring in the area would require additional driveways. Commercial establishments, with high turning movements in and out of their driveways, would be attracted to the widened roadways, which would decrease capacity and speeds along the roadways over time.

- **Congestion relief for area roadways.**

Congestion relief could occur along the roadways improved under Alternative RV-A and those that would experience traffic volume reductions under Alternative RV-A compared to the No-Build Alternative. However, as described above, development could be attracted to the improved roadways, which would increase congestion and decrease speeds along these roadways over time. The only roadways that are projected to experience traffic volume reductions under Alternative RV-A compared to the No-Build Alternative are Peace Haven Road, Shattalon Drive, and Yadkinville Road. Projected traffic volume reductions range from 10-19 percent.

- **Improved high-speed direct regional connections to US 52, US 421 and I-40.**

Alternative RV-A would not provide high-speed or direct regional connections to US 52, US 421 or I-40. Alternative RV-A would provide very little improvement for through-travelers, even if signed extensively to indicate to through travelers how to reach US 52, US 421, and I-40.

Alternative RV-B. Alternative RV-B would not meet the purposes and needs for Project R-2247. Below is a bulleted list of components of the proposed project's purpose and need, interspersed with discussion of Alternative RV-B's ability/inability to meet those various components.

- **Improved north/south connectivity in western Forsyth County.**

Alternative RV-B would widen several roadway segments that do not create a north/south route. This alternative would not improve north/south connectivity in western Forsyth County nor improve access to facilities outside the area.

- **Increased average travel speeds and decreased vehicle hours traveled.**

Since Alternative RV-B would not provide a connected and improved north/south route through western Forsyth County, it would not improve travel times through the area.

- **Congestion relief for area roadways.**

Alternative RV-B would provide some congestion relief for area roadways, since the roads selected for this alternative were those predicted to experience reduced traffic volumes with the Project R-2247 Preferred Alternative. This simulates the congestion relief benefit provided by the Project R-2247 Preferred Alternative. However, as described above for Alternative RV-A, development could be attracted to the improved roadways, which would increase congestion and decrease speeds along these roadways over time.

- **Improved high-speed direct regional connections to US 52, US 421 and I-40.**

Alternative RV-B would not provide high-speed or direct regional connections to US 52, US 421 or I-40. Alternative RV-B would provide no utility for through-travelers.

Alternative RV-A + RV-B. Combining Alternatives RV-A and RV-B would come closer to meeting, but still not meet all elements of the purpose and need for Project R-2247. This combined alternative still would not provide direct, regional connections, effective north-south connectivity, or long-term travel time savings.

2.6.2.5 Elimination of Improve Existing Roadways from Further Study for Project R-2247

Alternatives RV-A, RV-B, and RV-A + RV-B were eliminated from further study because they would not meet the project's purposes and needs, and for additional reasons as described below.

Decision to Eliminate Alternative RV-A. Alternative RV-A was eliminated from further study because it could not meet the purposes and needs of the project.

Alternative RV-A was strongly opposed in comments received from the public and local officials.

Alternative RV-A is inconsistent with *The Legacy Development Guide*, the local land use plan developed by Forsyth County with extensive public participation. Alternative RV-A also is inconsistent with the *2025* and *2030 Multi-Modal Long Range Transportation Plans*.

Although it would cost less and have less residential relocations, Alternative RV-A would create more noise impacts and have a greater probability of changing community character over a wider area than the Project R-2247 Preferred Alternative.

Any travel time benefits achieved by Alternative RV-A likely would degrade over time, since the roadways included in this alternative would not be access-controlled and the connection of additional driveways as the area develops would decrease speeds and reduce capacity.

Decision to Eliminate Alternative RV-B. Alternative RV-B was eliminated from further study for Project R-2247 because it could not meet the purposes and needs of the project.

Alternative RV-B was strongly opposed in comments received from the public and local officials.

Alternative RV-B is inconsistent with *The Legacy Development Guide*, the local land use plan developed by Forsyth County with extensive public participation. Alternative RV-A also is inconsistent with the *2025* and 2030 *Multi-Modal Long Range Transportation Plans*.

Although it would cost less and have less residential relocations than the Project R-2247 Preferred Alternative, Alternative RV-B would create more noise impacts and have a greater probability of changing community character over a wider area.

Any congestion relief achieved by Alternative RV-B likely would degrade over time, since the roadways included in this alternative would not be access-controlled and the connection of additional driveways as the area develops would decrease speeds and reduce capacity.

Decision to Eliminate a Combined Alternative RV-A + RV-B. Alternative RV-A + RV-B was eliminated from further study for Project R-2247 because it could not meet the proposed project's purposes and needs. A combined Alternative RV-A + RV-B would not be consistent with *The Legacy Development Guide*, the *Thoroughfare Plan*, or the regional air quality conformity model. Because Alternatives RV-A and RV-B were strongly opposed in comments received from the public and local officials, it can be assumed that a combined RV-A + RV-B also would be strongly opposed.

2.6.3 Projects U-2579 and U-2579A - Improve Existing Roadways Alternatives

The 1995 DEIS for Project U-2579 addressed improving existing roadways before Project U-2579A was added to the project, and before I-74 was included as part of the project purpose and need. The following discussion is based largely on analysis in that document. In addition, a new analysis of improving US 52 to eight lanes to meet the project's purposes and needs, including providing a route for I-74, is included. Improving existing facilities would not meet the purpose of providing an interstate corridor unless the existing non-freeway facilities are improved to freeways, or existing freeways such as US 52 are improved.

Three alternative routes were considered for widening existing roadways in eastern Forsyth County. These routes are listed below, shown in **Figure 2-5**, and discussed in the next two sections.

- NC 66 from US 52 to US 421/Business I-40 and Union Cross Road from US 421/Business I-40 to US 311
- NC 66 from US 52 to US 158, then US 158 south to US 421/Business I-40
- US 52 from I-40 to NC 66

2.6.3.1 Improve NC 66/US 158/Union Cross Road

NC 66. NC 66 provides an existing continuous route through the eastern portion of the study area. From just east of US 52 to US 421/I-40 Business at Kernersville, NC 66 consists essentially of a two-lane facility. The current route has two right angle turns where NC 66 follows a portion of University Parkway.

This route passes through the urban areas of Walkertown and Kernersville. Passing through the congested downtown business area of Kernersville, NC 66 is experiencing substantially higher accident rates than other comparable routes statewide. The maintained right-of-way width is 60 feet or less in the rural areas and less in the urban areas. The existing horizontal alignment is poor and few opportunities exist to pass slow moving vehicles.

Roadside development consists of fairly concentrated pockets of residential, commercial, and institutional development located near the highway. Within Kernersville, existing development is dense and includes portions of the downtown commercial district.

Widening of existing NC 66 would result in prohibitive cost and disruption, particularly to the portion of NC 66 from west of Kernersville to US 421/I-40 Business.

US 158. Consideration also was given to widening a 4.3-mile portion of US 158 from NC 66 to Old Greensboro Road. The remaining one-mile portion of US 158 from Old Greensboro Road to US 421/I-40 Business is an existing four-lane divided section and would not require further widening.

The existing interchange at US 421/I-40 Business and US 158, near Salem Lake, does not provide for the major traffic movement to and from the east. Therefore, in order for this alternative to meet the need for improved interstate/intrastate linkage and improved roadway connectivity, the interchange would require total reconstruction to allow for all movements. The reconstruction of the US 421/I-40 Business and US 158 interchange to provide for all movements was determined to be infeasible primarily because of the impact of the construction on Salem Lake and the watershed critical area surrounding the lake.

In order to provide the connection to US 311, this route also would have to be extended south past Salem Lake and through extensive existing development to connect with US 311 at I-40.

Union Cross Road and Other Surface Streets. Widening other local surface streets, such as Kernersville Road, Oak Grove Road, Sedge Garden Road, and Union Cross Road south of US 421, would help to accommodate local traffic in the study area, but would not provide the desired freeway connection or serve long-distance regional/interstate travel from northwest to southeast of Winston-Salem.

Ability to Meet Purpose and Need. Even if the widening of NC 66 or other existing highways were possible with fewer impacts, this alternative would result in an indirect route, would provide a worse level of service, and would have fewer operational efficiencies than would a freeway on new location. To reconstruct NC 66 or to superimpose the desirable features of a freeway (i.e., control of access and grade-separated interchanges) would negate any advantages obtained by using existing NC 66. Little, if any, of NC 66 could be salvaged and the disruption to existing development would be undesirable. The routing of heavy truck traffic through Kernersville and Walkertown also would be highly undesirable on the basis of noise, safety, and traffic operations.

The alternative of widening existing NC 66, US 158 and/or other surface streets would not offer an adequate or cost-effective solution to the transportation goals established by the state, or those established by the regional and local agencies. Widening existing highways would not meet the project's purpose of providing interstate system linkage and continuity, nor would this action provide for the connectivity indicated in the *2005 Thoroughfare Plan*. This alternative also is not compatible with either the *2005 Thoroughfare Plan* or the *Legacy Development Guide* established by the municipalities and the county. For all of the above reasons, widening existing surface streets is not considered to be a viable alternative and was eliminated from further study.

2.6.3.2 Widen Existing US 52

The project development phase of TIP Project U-2826B is currently underway by NCDOT. This project would improve US 52 through Winston-Salem using TSM-type improvements that would include adding auxiliary lanes and revising ramp configurations. In addition, Project U-2826B could include ITS measures, including DMS units, CCTV cameras, automatic vehicle detection on the interstate, a web-based interstate traffic flow map, interface with the 511 traffic information system, and a truck rollover warning system. These improvements would not meet the anticipated traffic demand, as was discussed in **Section 2.3.1.1**.

The City of Winston-Salem has studied the expansion of US 52 from four lanes to six lanes (*US 52 Land Use and Transportation Plan*, 2003). This plan, which assumes construction of the Northern Beltway, was adopted by the Metropolitan Planning Organization (MPO). It is currently an unfunded TIP project and therefore is not reasonably foreseeable. While improving traffic operations and safety on US 52, these improvements without the Northern Beltway would not meet the anticipated traffic demand.

A Widen Existing US 52 Alternative was examined in 2004. This alternative would widen US 52 to eight lanes from I-40 to the NC 66 connector, and was studied in order to determine the cost and feasibility of that action and whether or not it would serve the purpose and need for Projects U-2579 and U-2579A. This alternative's assessment is documented in *Improve US 52 Alternative* (September 2004), appended by reference. The study, an expansion of a study performed for the City of Winston-Salem (City of Winston-Salem, *US 52 Land Use and Transportation Plan*, 2003), would improve US 52 to an eight-lane freeway meeting Interstate standards, and would include reconstructing the interchange at I-40. Other interchanges to be reconstructed include Waughtown Street, US 421/Business I-40, Martin Luther King, Jr. Drive, University Parkway, and Hanes Mill Road.

Interchanges would be eliminated at Sprague Street, Diggs Boulevard/Vargrave Street, Stadium Drive, 5th Street, Liberty Street at 12th Street and 19th Street, Northwest Boulevard, and Patterson Avenue. New interchanges would be constructed at Salem Creek Parkway, Indiana Avenue and Motor Road.

The eight-lane widening would require acquisition of 63 residences and 262 commercial buildings, as well as substantial property acquisitions. The total cost of the project is estimated to be $531 million, in 2003 dollars, including $490 million for construction and $41 million for right of way. Because the right-of-way cost includes land cost and relocations, but not damages or administrative costs, this cost is understated.

Specific impacts of reconstructing and widening US 52 to eight lanes would include the following:

- Property acquisition and relocation of residents and businesses within a minority community between I-40 and US 421/Business I-40 would require a mitigation plan.
- Acquisition of Carolina Steel, an industry likely to have hazardous materials issues.
- Increased noise at Diggs Elementary School and Liberia Baptist Church cemetery.
- Relocation of homes and businesses and acquisition of property from the minority community near Liberty Street.
- Relocation of homes and businesses and acquisition of property from the East Winston minority community.
- Acquisition of public housing in Piedmont Park area at 26th Street.
- Liberty Street would be terminated in the vicinity of Canaan Missionary Baptist Church.
- Property acquisition from the Carolina Metalizing Company, a designated Superfund site.
- Encroachment onto floodplains at Salem Creek, Leak Fork, and Mill Creek.

Based on the above impacts and the fact that the widening would not meet elements of the purpose for U-2579 and U-2579A, including providing mobility to northern and eastern Forsyth County, improving roadway system linkage and continuity, and reducing traffic congestion in northern and eastern Forsyth County, widening of US 52 to eight lanes is not considered to be a viable alternative and was eliminated from further study.

2.7 BUILD ALTERNATIVES ON NEW LOCATION – GENERAL CRITERIA

2.7.1 Design Criteria

2.7.1.1 Project R-2247 - Design Criteria

Facility Type. The full control of access option was selected for the Project R-2247 Build Alternatives on new location because it would provide greater benefit in terms of traffic service than the partial control of access and open access options. Partial control of access and open-access roadways allows development and access along the right of way. Although a facility may start with few traffic conflicts and good service for through-traffic, development along or near the road can result in the addition of driveway entrances, road intersections, traffic signals, etc. All of these create additional traffic conflicts and lead to a gradual degradation in the ability of the facility to efficiently handle traffic. This situation is exaggerated as the volume of through-traffic increases over time.

The citizens of Winston-Salem and Forsyth County had several opportunities to provide input into the type of access management implemented for this project. During the update of the county-wide Thoroughfare Plan in 1986 and 1987, and in the early stages of the 1996 Project R-2247 FEIS, citizens voiced their concern over the type of roadway that would be constructed (expressway versus freeway). Their input led the City-County Planning Board and the North Carolina Department of Transportation to change the concept of the highway from a limited-access facility with driveways and at-grade intersections (expressway) to a full control of access facility (freeway) (1996 Project R-2247 FEIS, Section 2.4.4.3).

Detailed Design Criteria. Rural freeway designs standards were used for the Build Alternatives on new location. Level of Service (LOS) D is the minimum desirable traffic service for the freeway mainlines in the design year (originally 2015, and 2025 in the 2004 SFEIS/SDEIS and this SFEIS/FEIS). The Northern Beltway may be classified as an Urban Freeway by the time of final design, and would be designed accordingly.

The design criteria used for highway design for this project are from NCDOT's *Roadway Design Manual* and *A Policy on Design of Highways and Streets* published by the American Association of State Highway and Transportation Officials (AASHTO). These manuals are periodically updated. The AASHTO manual was updated in 1994 to include metric values, and again in 2001.

The standards and criteria in the 1990 edition of the AASHTO manual were used to develop the functional designs for Project R-2247 Build Alternatives and the 2005 preliminary engineering design for the Project R-2247 Preferred Alternative. These designs were in English units. T**able 2-4** lists the design criteria.

After the Project R-2247 FEIS and Record of Decision were published in 1996, the final design process began on all portions of the Project R-2247 Preferred Alternative except for the segment between US 158 (Stratford Road) and I-40. This engineering design is in metric units, and conforms to the metric standards and criteria contained in the 1994 edition of the AASHTO manual. The design criteria shown in **Table 2-4** are the English equivalents of the metric criteria used for the 2005 preliminary engineering design.

If the Project R-2247 Preferred Alternative is selected for implementation, the roadway design will be reviewed in light of the most current AASHTO manual. If design elements do not conform to updated elements in the manual, changes to the engineering design will be made or NCDOT will apply to the Federal Highway Administration (FHWA) for a design exception for the non-conforming element. Based on an initial review, it is not expected that the footprint of the Project R-2247 Preferred Alternative would need to change substantially to conform to the standards and criteria of the 2001 AASHTO manual nor are any design exceptions anticipated to be required. Any other alternative that may be selected would be designed in accordance with the latest standards and criteria.

Typical Cross-Sections and Numbers of Lanes. **Figure 2-6** shows the proposed typical sections for the 2005 preliminary engineering design for the Project R-2247 Preferred Alternative. The roadway construction limits and right-of-way width varies and depends on the terrain it is passing through.

Six lanes were recommended for the Northern Beltway between US 421 and Robinhood Road in the functional designs. This was decreased to four lanes in the 2005 preliminary designs because the revised traffic in the 1996 Project R-2247 FEIS supported four lanes rather than six.

Table 2-4: Project R-2247 - 1990 Roadway Design Criteria

Design Element	Recommended Standards	
Design Speed	Freeway: Ramp: Loop: Cross Street:	70 mph 50 mph desirable 30 mph desirable In accordance with functional classification
Right-of-Way Width		300 feet min
Lane Width	Freeway: Ramp: Cross Street:	12 feet 16 feet (single lane) 12 feet desirable
Shoulder Width	Freeway:	12 feet outside (10 feet paved) and 12 feet inside (4 feet paved) for four-lane section 12 feet outside (10 feet paved) and 12 feet inside (10 feet paved) for six or more lanes
	Ramp: Bridge:	12 feet desirable (4 feet paved) 10 feet outside and 4 feet inside for a four-lane section 10 feet outside and 10 feet inside for six or more lanes
Median Width	Freeway:	70 feet desirable 46 feet minimum
Horizontal Alignment Degree of Curve	Freeway: Ramp: Loop: Spirals:	1150 feet minimum radius (5° 00' maximum) 764 feet minimum radius (7° 30' maximum) 3° - 6° desirable 220 feet radius desirable 150 feet radius minimum To be used for design speeds greater than 40 mph and on loops - 250 feet minimum
Super elevation Rate	Freeway: Other:	e max - 0.10 ft/ft e max - 0.08 ft/ft
Vertical Alignments	Freeway: Ramp:	4% max, 0.5% min 6% max, 0.5% min
Stopping Sight Distance	1990 AASHTO Standards	
Length of Vertical Curve	1990 AASHTO Standards	
Vertical Clearances	Over freeway and arterials - 16.5 feet min Over local and collector roads - 15.0 feet min Over railroads - 23.0 feet min	

Sources: *A Policy on Design of Highways and Streets,* AASHTO, 1990 and North Carolina Department of Transportation *Roadway Design Manual. Note: 1994 criteria are the same, except they are in metric units.*

The functional designs originally proposed a 46-foot median. However, the 2005 preliminary designs propose 70-foot medians. The wider median was chosen to allow for future widening of the Western Section of the Northern Beltway, if needed, to up to eight lanes.

2.7.1.2 Projects U-2579 and U-2579A - Design Criteria

Facility Type. The characteristics of the Build Alternatives for Projects U-2579 and U-2579A are based on the following general criteria:

- Type of facility — freeway
- Access control — full
- Right-of-way width — 300 feet minimum with additional width at proposed interchanges
- Intersecting road treatment — all intersecting roads are either interchanged, grade-separated, or terminated
- Railroad crossings — all intersecting railroad crossings are grade-separated

Detailed Design Criteria. The design criteria for Project U-2579 are listed in **Table 2-5**. The design criteria for Project U-2579A are listed in **Table 2-6.**

Typical Cross-Sections and Numbers of Lanes. Typical cross-sections for Projects U-2579 and U-2579A are shown in **Figure 2-7**. Project U-2579 includes six lanes and a 46-foot grassed median. Project U-2579A includes four to six through lanes and a 46-foot graded median transitioning to a 70-foot grassed median. Transition locations (between six lanes and four lanes) have been chosen, and will be designed, such that no bottlenecks will occur.

Table 2-5: Project U-2579 - 2001 Roadway Design Criteria

Design Element	Recommended Standards	
Design Speed	Freeway: Ramp: Loop: Cross Street:	70 mph 50 mph desirable 30 mph desirable In accordance with functional classification
Right-of-Way Width		300 feet min
Lane Width	Freeway: Ramp: Cross Street:	12 feet 16 feet (single lane) 12 feet desirable
Shoulder Width	Freeway:	14 feet outside (12 feet paved) without guardrail, 17 feet outside (12 feet paved) with guardrail, 12 feet inside (12 feet paved)
	Ramp: Loop:	14 feet desirable (4 feet paved) without guardrail, 17 feet desirable (4 feet paved) with guardrail 12 feet desirable (4 feet paved) without guardrail, 15 feet desirable (4 feet paved) with guardrail
Median Width	Freeway:	46 feet minimum
Horizontal Alignment Degree of Curve	Freeway: Ramp: Loop:	1,820 feet minimum radius 750 feet minimum radius 250 feet minimum radius
Super elevation Rate	Freeway: Other:	e max - 0.08 ft/ft e max - 0.08 ft/ft
Vertical Alignments	Freeway: Ramp:	4% max, 0.5% min 6% max, 0.5% min
Stopping Sight Distance	2001 AASHTO Standards	
Length of Vertical Curve	2001 AASHTO Standards	
Vertical Clearances	Over freeway and arterials - 16.5 feet min Over local and collector roads - 15.0 feet min Over railroads - 23.0 feet min	

Sources: *A Policy on Design of Highways and Streets,* AASHTO, 2001and North Carolina Department of Transportation *Roadway Design Manual.*

Table 2-6: Project U-2579A - 2001 Roadway Design Criteria

Design Element	Recommended Standards	
Design Speed	Freeway: Ramp: Loop: Cross Street:	70 mph 50 mph desirable 30 mph desirable In accordance with functional classification
Right-of-Way Width		300 feet min
Lane Width	Freeway: Ramp: Loop: Cross Street:	12 feet 16 feet (single lane) 20 feet (single lane) 12 feet desirable
Shoulder Width	Freeway:	14 feet outside (12 feet paved) without guardrail, 17 feet outside (12 feet paved) with guardrail, 12 feet inside (10 feet paved)
	Ramp: Loop:	14 feet desirable (4 feet paved) without guardrail, 17 feet desirable (4 feet paved) with guardrail 12 feet desirable (4 feet paved) without guardrail, 15 feet desirable (4 feet paved) with guardrail
Median Width	Freeway:	70 feet desirable
Horizontal Alignment/ Degree of Curve	Freeway: Ramp: Loop:	1,820 feet minimum radius 750 feet minimum radius 250 feet minimum radius
Super Elevation Rate	Freeway: Other:	e max - 0.08 ft/ft e max - 0.08 ft/ft
Vertical Alignments	Freeway: Ramp: Loop:	4% max, 0.5% min 5% max, 0.5% min 7% max, 0.5% min
Stopping Sight Distance	2001 AASHTO Standards	
Length of Vertical Curve	2001 AASHTO Standards	
Vertical Clearances	Over freeway and arterials - 16.5 feet min Over local and collector roads - 15.0 feet min Over railroads - 23.0 feet min	

Sources: *A Policy on Design of Highways and Streets*, AASHTO, 2001 and North Carolina Department of Transportation *Roadway Design Manual*.

2.7.2 Project Limits

The Project R-2247 Build Alternatives on new location begin at US 158 (Stratford Road) southwest of Winston-Salem and end at US 52 north of Winston-Salem.

The Build Alternatives on new location for Projects U-2579 and U-2579A begin at US 52 north of Winston-Salem and end at US 311 southeast of Winston-Salem.

The FHWA regulations (23 CFR 771.111(f)) outline three general principals to determine project limits. The FHWA also provides guidance for determining logical termini in a memorandum titled *The Development of Logical Project Termini* (November 5, 1993). The regulations state:

In order to ensure meaningful evaluation of alternatives and to avoid commitments to transportation improvements before they are fully evaluated, the action evaluated in each EIS or finding of no significant impact (FONSI) shall:

1. *Connect logical termini and be of sufficient length to address environmental matters on a broad scope;*

2. *Have independent utility or independent significance, i.e.; be usable and be a reasonable expenditure even if no additional transportation improvements in the area are made; and*

3. *Not restrict consideration of alternatives for other reasonably foreseeable transportation improvements.*

As discussed below, as separate projects and as a whole, the termini for the Build Alternatives on new location for Projects R-2247, U-2579, and U-2579A meet all criteria listed above, and are therefore determined logical.

1. Connects logical termini and is of sufficient length to address environmental matters on a broad scope.

The Build Alternatives on new location for Project R-2247 begin at US 158 south of Winston-Salem and end at US 52 north of Winston-Salem, both major highways. The alternatives would not force immediate transportation improvements beyond the terminal points or along the connecting facilities. The Build Alternatives are about 17 miles long and are of sufficient length to address environmental matters on a broad scope. They span the study area and would connect with all major arterial roadways in western Forsyth County.

The Build Alternatives on new location for Project U-2579 begin at US 52 north of Winston-Salem, a major highway, and originally ended at US 421/Business I-40 to the east of Winston-Salem. Based on the finding of a feasibility study completed in January 1996 and in light of the potential for designation as the I-74 corridor, the southern terminus of Project U-2579 was extended to US 311, also a major highway, as Project U-2579A. US 311 is designated as a segment of future I-74, as is US 52 north of Winston-Salem. The Build Alternatives for Projects U-2579 and U-2579A, considered together, are about 13 miles long and are of sufficient length to address environmental matters on a broad scope.

2. Have independent utility or independent significance, i.e.; be usable and be a reasonable expenditure even if no additional transportation improvements in the area are made.

Project R-2247 addresses different needs and serves different purposes than Projects U-2579 and U-2579A. The purpose for Project R-2247 is to improve local and county-wide travel. The purpose for Projects U-2579 and U-2579A is to improve regional and interstate travel.

In order to fulfill its purpose as the I-74 corridor, Projects U-2579 and U-2579A both would need to be constructed since the projects connect to adjoining designated future Interstate roadways. Each of these projects (R-2247 and combined U-2579 and U-2579A) would fulfill these needs and would be useable and reasonable without the other.

3. *Not restrict consideration of alternatives for other reasonably foreseeable transportation improvements.*

Construction of Projects R-2247, U-2579, and U-2579A would not restrict or prohibit implementation of other projects and/or alternatives included in the *2030 Winston-Salem Urban Area Long-Range Transportation Plan*.

As discussed in detail in **Section 2.8**, the previous FEIS for Project R-2247 carefully considered the connection between Project R-2247 and Project U-2579 Build Alternatives and the tie-in at US 52. The development and selection of detailed study corridors for Project R-2247 near US 52 north of Winston-Salem included an evaluation and comparison of the potential environmental impacts of extending the corridors east of US 52. Likewise, the development and selection of detailed study corridors for Project U-2579 near US 421/I-40 Business evaluated the impacts of extending the corridors south of US 421/I-40 Business.

2.8 PROJECT R-2247 – BUILD ALTERNATIVES

This section traces past development of the Project R-2247 Build Alternatives on new location and assesses them in light of current conditions where applicable.

2.8.1 Study Area Definition

The first step in the alternatives identification process, documented in Section 2.4.1 of the 1996 Project R-2247 FEIS, was to narrow the study area to a portion of western Forsyth County. Section 2.4.1 of the 1996 Project R-2247 FEIS states the study area was generally consistent with the short- and long-term growth areas identified in the growth management plan current at the time – *Vision 2005*. Project endpoints were expanded along a four-mile stretch of US 52 and a one-mile stretch of US 158 in response to public comment after the January 1990 workshops. Northern endpoints for the project were constrained by development in and south of the town of Rural Hall and by development south of Shattalon Drive. The southern endpoints were constrained by development east of Jonestown Road and by the Village of Clemmons to the west.

Another factor in the evaluation was how traffic attraction varied with proximity to Winston-Salem.

In the 1996 Project R-2247 FEIS, two basic corridors were modeled using a 2015 horizon year to evaluate the change in traffic attraction as the corridor was moved farther west. Both corridors are shown in **Figure 2-8.**

The Northern Beltway alignment shown on the *1987 Thoroughfare Plan* was located east of the Central Corridor (see **Figure 1-4**). This alignment was eliminated from consideration due to the extensive development within the Winston-Salem city limits.

Results of the traffic modeling clearly showed the Project R-2247 Central Corridor attracted more traffic than the Project R-2247 Western Corridor. Of even greater importance than the volume comparison is the fact that the Central Corridor reduced the traffic on a majority of roads in western Forsyth County that had been shown to be near or over-capacity under no-build conditions in 2015 (Project R-2247 FEIS, pg. 2-4).

Based upon these results, the Project R-2247 study area was drawn to establish preliminary route corridors in the vicinity of the Central Corridor.

2.8.2 Preliminary Corridors

The following information was taken from the 1996 Project R-2247 FEIS Sections 2.4.2 and 2.4.3, and the *Alternative Comparison/Selection Report for the Winston-Salem Northern Beltway (West), Project R-2247* (1990), appended by reference. An updated analysis was done in 2004, and discussions of current (2004) conditions are included where relevant.

Using a process known as Land Suitability Mapping (LSM), the Central Corridor study area shown in **Figure 2-8** was evaluated to identify corridors most suitable for the construction of a new roadway. Features that would inhibit or preclude the development of a new roadway were mapped. These included features such as existing and approved residential and commercial development, public and private community facilities (schools, churches, parks, and recreational areas), potential historic and archaeological resources, utilities, floodplain limits, and wetlands. Potential roadway corridors identified on the Land Suitability Map were linked to form a network of route possibilities.

In addition, previously identified routes were considered, including functional design routes developed by the City of Winston Salem City-County Planning Board in 1988.

The preliminary study corridors for a facility on new location are shown in **Figure 2-9**. They are identified as Corridors R, S, and T, consisting of three main north-south routes with numerous

crossovers linking portions of each. The preliminary corridors represent over 84 miles of new alignment. Major constraints and considerations in the development of these preliminary corridors are discussed below.

Southern Termini.
Project R-2247 begins at US 158 (Stratford Road) west of Winston-Salem. The project terminus is located at US 158 rather than I-40 to provide surface street access from the Beltway. Without access to US 158, the first surface street access would be at Shallowford Road, approximately five miles from the beginning of the Beltway.

Three southern endpoints were evaluated along US 158 (Stratford Road) from West Clemmonsville Road to Fraternity Church Road. One endpoint was west of Muddy Creek (not shown on **Figure 2-9**), one was near the US 158/Fraternity Church Road intersection, and one was near the US 158 (Stratford Road)/West Clemmonsville Road intersection.

Alternatives tying into US 158 (Stratford Road) west of Muddy Creek were not feasible due to residential and commercial development in the Village of Clemmons. This development was still present in 2004.

The two remaining evaluated endpoints are near West Clemmonsville Road (Corridor T) and farther south at Fraternity Church Road (Corridor R). The endpoint near West Clemmonsville Road would attract more traffic and would provide a more continuous route continuing toward the east due to proximity to West Clemmonsville Road. While further extension of Project R-2247 past US 158 is not in the *2006-2012 TIP* or *2030 LRTP*, the corridors were evaluated to determine if there would be any major obstacles to such an extension. Two churches, Fraternity Church and Hope Moravian, and one school, Clemmons Middle School (which was built in 1999) are located near the southernmost endpoint.

The land across from the northernmost two endpoints near West Clemmonsville Road remains sparsely developed and it appears there are no notable features in the immediate vicinity that would make a future extension beyond these endpoints infeasible.

US 158 (Stratford Road) to US 421. Route options in the southern portion of the project area (south of US 421) were constrained to the west by development west of Muddy Creek and the Town of Clemmons municipal limits and by development east of Little Creek (neighborhoods off of US 158 and Jonestown Road). These development patterns still existed in 2004, as shown in **Figure 2-10a**.

Other constraints were the locations of existing interchanges along I-40 and US 421, especially the existing interchanges on US 421. Existing interchanges on US 421 in the study area are located at Peace Haven Road and Lewisville-Clemmons Road, about 1.75 miles apart.

South of I-40, crossings are made of Little Creek, Silas Creek, and Muddy Creek. Two I-40 interchange locations were considered, one in the western margins of the Muddy Creek floodplain and the other east of Muddy Creek in the vicinity of McGregor Road (see **Figure 2-9**). All preliminary corridors are in, or are close to, the Muddy Creek floodplain between I-40 and US 421 and were located to avoid dividing and severely impacting the Moravian Heights residential neighborhood (located just south of US 421 and west of Muddy Creek).

US 421 to NC 67 (Reynolda Road). In this section of the study area, all corridors are located west of Muddy Creek (see **Figure 2-9**). Development along the eastern edge of the Muddy Creek floodplain prevented the placement of routes east of the creek. To the west of the creek, existing development was less dense and opportunities for roadway corridors existed that avoided the Muddy Creek floodplain. These development patterns still existed in 2004.

NC 67 (Reynolda Road) to US 52. In the north, the preliminary corridors swing east and northeast to connect with the Eastern Section of the Northern Beltway along US 52 at five potential endpoints (see **Figure 2-9**). Corridors S and T pass around Bethania to the north and south, respectively, with Corridor R passing through the Seward area farther west along Reynolda Road. Corridor T south of Bethania is constrained by development in the area around Reynolda Road and Shattalon Drive and the boundaries of the Bethania Historic District, a site on the National Register of Historic Places. These development patterns still existed in 2004.

Northern Termini. Five northern endpoints along US 52 were evaluated. These stretch from the Ziglar Road bridge over US 52, north along US 52 to approximately one mile beyond the Shore Road/Westinghouse Road interchange (see **Figure 2-9**). One requirement for a north endpoint is a reasonable traffic connection to the Eastern Section of the Northern Beltway (Project U-2579). Options considered included direct continuous connection between the Western and Eastern Sections of the Northern Beltway and staggered connections between the two new facilities with routing of Beltway traffic along a segment of US 52.

Development around US 52 in the area of Shattalon Drive and University Parkway constrained options to the south. East of US 52, connection to the Eastern Section of the Northern Beltway is constrained to the north by the Town of Rural Hall and its residential and commercial development. These development patterns still existed in 2004.

2.8.3 Preliminary Corridors Eliminated from Further Study

The preliminary study corridors were evaluated for their traffic responsiveness, environmental impacts (through an environmental screening process), and relative costs for right of way and construction. This evaluation is documented in the *Alternative Comparison/Selection Report for the Winston-Salem Northern Beltway (West), Project R-2247* (1990). Comparisons of the values obtained during the evaluation were used to eliminate the least favorable of the corridors. The

preliminary study corridors eliminated are shown in pink on **Figure 2-9**. The findings of the evaluation are discussed below.

The traffic analysis used in the preliminary study corridor phase of the study evaluated a total of nine Build Alternatives on new location. The nine alternatives combined the three main study corridors south of Reynolda Road with a number of options in the north for connection to the Eastern Section of the Northern Beltway along US 52.

In addition to comparing traffic volumes at specific locations in the network, a relative comparison of the travel benefits to the 2015 No-Build network was made by reviewing the overall reduction in the Total Network Travel Time (TNTT) provided by each Build Alternative. TNTT is a measure of the total vehicle hours per day on the Forsyth County network.

Traffic modeling clearly showed the eastern corridor (Corridor T) passing south of Bethania attracted the most traffic. The next highest traffic volumes were found on Corridor T passing north around Bethania. The central and western corridors, Corridors S and R, carried comparable levels of traffic, except on the segments north of Reynolda Road. These northern segments varied according to their connection to the Eastern Section of the Northern Beltway along US 52. The best connection with the Eastern Section from a traffic standpoint was the direct connection located at the NC 66 Connector. The next best was a direct connection near Shore Road/ Westinghouse Road. The offset connections that would use a portion of US 52 to carry Beltway traffic did not serve traffic as well, with worsening results proceeding north along US 52.

US 158 (Stratford Road) to US 421. Corridors involving the southern endpoint along US 158 at Fraternity Church Road were eliminated due to a combination of the following factors: reduced traffic attraction and isolation from West Clemmonsville Road, which is the only existing east-west route for traffic continuing around the south side of Winston-Salem.

US 421 to NC 67 (Reynolda Road). A combination of impacts to potential historic properties and residential areas and incompatibility with growth plans led to the decision to eliminate Corridor R between US 421 and NC 67 (Reynolda Road). The traffic volumes were slightly less than for Corridor S, and both were less than Corridor T. The number of potentially eligible historic properties was greater than for Corridor S, and the route directly affected a number of neighborhoods.
Corridor R was outside the targeted growth areas in the *Vision 2005 Comprehensive Plan* since it is the furthest west and, in some areas, it is on the west side of the ridge which separates the Muddy Creek basin (served by sewer) and the Yadkin River basin (generally not served by sewer).

Based on the latest Growth Management Plan in *The Legacy Development Guide*, about one-half of Corridor R is within the designated Rural Area (not expected to be served by sewer).

Corridor R would be less effective at accommodating the growth projected to occur in western Forsyth County than the other Preliminary Corridors.

NC 67 (Reynolda Road) to US 52. Corridor R and the offset connections with the Eastern Section of the Northern Beltway were eliminated from further study. North of NC 67 (Reynolda Road), the traffic analysis for 2015 provided part of the justification for the rejection of Corridor R, which connects to US 52 a mile northwest of Shore/Westinghouse Roads, and the offset connection options along US 52 (see **Figure 2-9**). Corridor R also had higher costs than Corridor S.

Extending Corridor R east of US 52 to form a continuous roadway with the Eastern Section of the Northern Beltway would either require the Eastern Section to travel through the middle of the Town of Rural Hall, causing substantial impacts to the town, or require a longer route around the north side of Rural Hall. Both of these options would have much greater costs than extending the Northern Beltway from Corridor S and Corridor T [north] (the blue Corridor T on **Figure 2-9**).

Corridor T [south] (the pink Corridor T on **Figure 2-9**), passing around the south side of Bethania, was rejected because it would directly impact the Bethania Historic District or impact an area of dense residential and commercial development to the south. These conditions were still present in 2004.

The alternatives selected for further study are addressed in the next section.

2.8.4 Build Alternatives on New Location

This section draws from Section 2.4 in the 1996 Project R-2247 FEIS. Updated descriptions based on current conditions are included where applicable.

2.8.4.1 Build Alternative Segment Nomenclature

Figure 2-10(a-e) shows the segments of the Build Alternatives on new location developed within Preliminary Corridors S and T that were combined to form alternatives extending from US 158 (Stratford Road) to US 52. **Figure 2-10 Index** provides an overview of **Figure 2-10(a-e)**.

The westernmost Build Alternative consists of segments beginning with ‘A’, with segment numbers beginning in the south with A1 and ending with A6 at the north terminus. The easternmost Build Alternative begins with Segment B1 in the south and ends with Segment B10 at the north terminus. The crossover segments all are labeled with ‘C’, beginning with Segment C1 in the south and ending with Segment C5 in the north.

Due to the large number of possible combinations of segments, every potential full-length route was not given a unique name and is not individually described.

2.8.4.2 Segment Descriptions

Study Corridor Widths. The segments shown in **Figure 2-10(a-e)** represent the centerlines of functional designs developed within corridors approximately 1,200 feet wide, with larger areas around interchanges. For impact quantification and comparison purposes, the narrower roadway functional designs were used, with larger areas around interchanges. The width of the corridor allows flexibility in the design process to minimize impacts by modifying the alignment after a preferred alternative is selected.

Interchanges. Interchanges are proposed at eight crossroads. Major freeway-to-freeway interchanges are proposed at I-40, US 421, and US 52. Minor interchanges (e.g. diamond and clover interchanges) are proposed at the major radial arterials: Shallowford Road or Country Club Road (depending on the corridor), Robinhood Road, Yadkinville Road, NC 67 (Reynolda Road), and Bethania-Tobaccoville Road. These are the major radial roadways in western Forsyth County. In addition, an at-grade signalized intersection is proposed at the southern terminus at US 158 (Stratford Road).

The freeway to freeway interchange at I-40 (**Figure 2-10a**) would require about 150 to 200 acres of right of way. The freeway to freeway interchange at US 421 (**Figure 2-10b**) would require about 225 to 250 acres of right of way due to the proximity of adjacent interchanges at US 421/ Styers Ferry Road and US 421/Peace Haven Road. The freeway to freeway interchange at US 52 (**Figure 2-10e**) would require about 275 to 300 acres due to the proximity of the US 52 interchange at Shore Road/Westinghouse Road to the north and the proximity of the US 52 interchange at NC 65 to the south.

Segment Descriptions. The descriptions below are from the 1996 Project R-2247 FEIS (FEIS pg. 2-18 through 2-21), updated with current conditions where applicable. The segments are grouped by beginning letter (A, B, or C), and are described below in terms of the geography and landmarks in the study area. Roads identified for proposed grade-separated crossings are identified with the word "bridged" in parentheses after the road name.

Segments A1 through A6. These segments total approximately 16.6 miles. They begin with Segment A1 (**Figure 2-10a**) in the south at US 158 (Stratford Road), approximately 900 feet southwest of the intersection of US 158 and Jonestown Road. Segment A1 crosses Lockwood Drive and becomes Segment A2 (**Figure 2-10a**), which parallels Rockingham Drive to the south, crosses Little Creek and Ploughboy Lane (bridged), and then travels in the Silas Creek and Muddy Creek floodplain area for approximately one mile, crossing the two creeks just upstream

of the confluence. The segment stays just east of the Rolling Village Mobile Home Park neighborhood in Clemmons.

A major freeway-to-freeway interchange is planned where Segment A2 crosses I-40, with the segment centerline at the western edge of the Muddy Creek floodplain. The southwest portion of the Stoney Brook Mobile Home Park north of I-40 and some of the commercial area along Gun Club Road south of I-40 could be affected by an interchange.

The Segment A2 centerline crosses Peace Haven Road (bridged) just west of the Stoney Brook mobile home park and east of Boyers Chapel Church of Christ, where it becomes Segment A3 (**Figure 2-10a**). Heading north, Segment A3 passes east of the Clemmons Cove subdivision, Westerly Forest Subdivision, West Forsyth High School and Southwest Elementary School.

Segment A3 crosses Holder Road (bridged) west of the two right-angle turns in Holder Road. Since the early 1990's, a new residential subdivision has been developed between Holder Road to the north and Springfield Farm Road to the south. Most homes in this development were constructed in 1995-1997. Segment A3 passes through the middle of this subdivision, which cannot be avoided by this segment since the West Forsyth High School bounds it on the east and Muddy Creek is on the west.

The crossing of US 421 would be the site of another major system interchange. Segment A3 crosses US 421 about 3,500 feet east of the Lewisville-Clemmons Road/Styers Ferry Road interchange. This segment passes between subdivisions on Marty Lane and Moravian Heights Lane. Portions of both subdivisions would be affected by an interchange, as well as a large area north of US 421 along Kinney Road and Ridings Road.
Segment A3 crosses Phillips Bridge Road (relocated) then Styers Ferry Road (bridged) and becomes Segment A4 (**Figure 2-10b**). This segment crosses Reynolds Creek and passes west of the end of Lura Drive and Jeannine Drive and east of the limits of the Town of Lewisville and the Bradford Place subdivision (homes constructed around 1990-1993). Shallowford Road is crossed just west of Sharon United Methodist Church, where a minor interchange would be located.

Segment A4 then runs parallel and east of Ketner Road. It crosses Brookberry Farm Road (bridged) and Tomahawk Creek. A minor interchange at Robinhood Road would be located about 1,800 feet east of Chickasha Road.

Segment A4 extends northward east of the electrical transmission line to a minor interchange at Yadkinville Road between the Vienna Elementary School and the Forest Lakes neighborhood. The interchange would impact the Forest Lakes neighborhood west of Lake Forest Drive.

North of Yadkinville Road, Segment A4 crosses Kecoughtan Road (bridged) near the electric transmission line crossing. The segment then passes through the subdivisions along the east side

of Kecoughtan Road and the western portion of the Dorchester area (around Mill Wheel Road and Honeycomb Lane). Skylark Road (bridged) is crossed just east of Millstone Lane.

Segment A4 then travels northeast, crossing Balsom Road (bridged) about 500 feet east of Bashavia Creek, and then parallels the creek to NC 67 (Reynolda Road). Segment A4 would have a minor interchange with NC 67 (Reynolda Road) about 750 feet west of Bethania Road/Transou Road and east of the Daybow Park neighborhood.

Segment A4 becomes Segment A5 just north of NC 67 (Reynolda Road) (**Figure 2-10d**). Segment A5 stays west of the transmission line corridor and turns northeast after crossing Mill Creek No. 3. A minor interchange at Bethania-Tobaccoville Road would be located near the intersection of Bethania-Tobaccoville Road with Wide Country Road and would impact the subdivision around Wide Country Road.

Segment A5 crosses Mizpah Church Road (bridged) and becomes Segment A6 (**Figure 2-10d**). Segment A6 crosses Shore Road (bridged) before a major system interchange located at US 52. The major interchange would be positioned between the Westinghouse facility and the Sara Lee facility in the North Ridge Business Park east of US 52.

The Shore Road/Westinghouse Road interchange at US 52 would be kept operational in addition to providing connection with the Eastern Section of the Northern Beltway, which would proceed east across Bethania-Rural Hall Road (NC 65) (bridged) near Perth Road, and the Falconbridge neighborhood. The extension of the Eastern Section of the Northern Beltway was assumed to cross NC 66 (University Parkway) just north of the Crestview Memorial Park.

Segments B1 through B10. These segments total approximately 16.3 miles. They begin with Segment B1 at the current intersection of US 158 (Stratford Road) and Jonestown Road (**Figure 2-10a**). The eastern end of Jonestown Road would be realigned to intersect US 158 approximately 500 feet north of its current location. Segment B1 stays south of Jonestown Road until west of the sharp curve at Huntington Woods where Jonestown Road (bridged) is crossed. It crosses Lockwood Drive and runs through the Little Creek neighborhood prior to crossing Little Creek. Jonestown Road (bridged) is crossed for a second time at McGregor Road. Silas Creek is crossed just west of Cedarwood Drive. A major system interchange is proposed where Segment B1 crosses I-40.

Segment B2 begins after the I-40 interchange and includes a westward realignment of McGregor Road and would impact portions of McGregor Manor (Tilmark Road), McGregor Park, and development along McGregor Road (**Figure 2-10a**). Segment B2 then crosses Peace Haven Road (bridged) east of Sedgemont Woods, then crosses Muddy Creek, ending just south of US 421.

Segment B3 begins before a major system interchange at US 421 (**Figure 2-10b**). The centerline crosses US 421 about 3,500 feet west of the Peace Haven Road interchange. This major interchange would involve large areas in the Muddy Creek floodplain and the eastern end of subdivisions in the Marty Lane area.

Segment B3 crosses Phillips Bridge Road (bridge) just east of Horncastle Road, passes east of the Nottingham subdivision, and then crosses Reynolds Creek. A minor interchange at Country Club Road would be located just east of the intersection with Meadowlark Drive.

Three segments run parallel between Country Club Road and Robinhood Road: Segments B4, B5, and B6 (**Figure 2-10b**). Segment B4 runs just west of Meadowlark Drive. Segment B4 passes through the center of a new neighborhood (constructed about 1999-2000) off Hundley Road and continues across Brookberry Farm Road. The Mount Tabor Fire Station was built in the mid-1990s on the corner of Meadowlark Drive and Fleetwood Circle. The Doub-Yarbrough House, a historic log dwelling from the mid-nineteenth century, is located on Fleetwood Circle. Segment B4 is closer to the Mount Tabor Fire Station and the Doub-Yarbrough House than Segments B5 and B6.

Segment B5 runs just east of Meadowlark Drive and west of Muddy Creek. Segment B5 cuts across Meadowlark Elementary School and Meadowlark Middle School, which were opened recently (mid-1990s) and did not exist when the segments were originally developed.
Segment B5 then crosses undeveloped parkland just south of the schools (also a newer purchase) and through the western section of a recently built (about 1999) neighborhood off of Meadowlark Lane before crossing through another recently built (about mid-1990s) neighborhood, Century Oaks.
Segment B6 passes around the east end of Ashlyn Drive, and then just west of the WSJS radio antennae array. Segment B6 cuts across Meadowlark Elementary School and Meadowlark Middle School and also crosses the other three new residential neighborhoods crossed by Segment B5, but in different locations.

Segments B4, B5, and B6 end after a minor interchange at Robinhood Road. This interchange would be east of the intersections with Meadowlark Drive and Fleetwood Circle, just south of Spicewood Drive.
Segment B7 runs east and parallel to Attanook Road and Storm Canyon Drive, crosses Spicewood Road (bridged) just east of Four Winds Trail and Chipwood Lane (**Figure 2-10c**). It then crosses Oil Mill Branch and Wessex Road in the Buckingham neighborhood, and passes below the dam on Pfaffs Lake at Bills Branch before crossing Yadkinville Road.

A minor interchange for Segment B7 at Yadkinville Road would be located between the existing shopping center east of Transou Road and Grandview Club Road. Segment B7 crosses through a recently built development (2002) behind the existing shopping center. This development is

located within the Pfafftown Historic District boundaries. The segment passes through the eastern edge of the Pfafftown Historic District (an historic district determined eligible for the National Register of Historic Places) and also passes through the western portion of the Lochurst subdivision.

Segment B7 then crosses Balsom Road (bridged) and runs along the east side of Transou Road to Reynolda Road (NC 67). A minor interchange with Reynolda Road would be located just east of the electric transmission corridor. The crossing of Bethania-Tobaccoville Road (SR 1611) would involve an eastward realignment of Bethania-Tobaccoville Road for continued access to Reynolda Road. The segment stays east of the transmission lines, crosses Mill Creek No. 3 and then Poplar Lane east of the creek, crossing Bethania-Tobaccoville Road for a minor interchange near the recent relocation of Kapp Road. Segment B7 crosses Myers Road north of the Town of Bethania Historic District.

Two parallel segments, Segment B8 and Segment B9, are between Bethania-Tobaccoville Road and Ziglar Road (**Figure 2-10d**). Segment B8 is adjacent to Speas Lakes, down the slope, while Segment B9 stays higher on the slope, crossing holes on the Long Creek Golf Club, a public golf course. Segment B9 crosses through a recently built residential area on Fern Tree Court (constructed around 2002).

Segments B8 and B9 join just west of Bethania-Rural Hall Road (NC 65) and become Segment B10 (**Figure 2-10e**). This segment crosses Bethania-Rural Hall Road (NC 65) (bridged) between Mizpah Church Road and Ziglar Road. A major system interchange would be located where the NC 66 Connector exits southbound US 52. The Eastern Section of the Northern Beltway would continue along the NC 66 Connector to University Parkway.

Crossover Segment C1 leaves Segment A1 just east of Little Creek and connects with Segment B2 at the I-40 interchange near McGregor Road (**Figure 2-10a**). It crosses Ploughboy Lane (bridged), Silas Creek, and then McGregor Road (bridged) on the west side of Silas Creek.

Crossover Segment C2 leaves Segment A3 north of Peace Haven Road and joins Segment B3 at the major interchange at US 421 (**Figure 2-10a**). It generally parallels Springfield Farm Road to the north, passing through the middle of a new residential subdivision (constructed around 1995-1997) developed between Holder Road to the north and Springfield Farm Road to the south. This crossover segment then crosses Highland Brook Drive and the east end of the Moravian Heights Lane residential area.

Crossover Segment C3 leaves Segment B2 at US 421 and joins Segment A4 at Styers Ferry Road (**Figure 2-10b**). North of US 421, this crossover segment crosses the east end of Ridings Court, then Ridings Road and Phillips Bridge Road (relocated). Due to design considerations relating to the angles of crossing at US 421, the combination of Crossover Segments C2 and C3 does not

comprise a feasible alignment for the major interchange at US 421. Therefore, the Crossover Segment Combination C2-C3 was not considered in selection and the combination does not appear in any of the Detailed Study Alternatives.

Crossover Segment C4 leaves Segment A4 just north of Mill Creek No. 3 and joins Segment B8 at Bethania-Tobaccoville Road (**Figure 2-10d**). Segment C4 crosses a tributary of Mill Creek No. 3 north of Poplar Lane.

Crossover Segment C5 leaves Segment B7 at Bethania-Tobaccoville Road and joins Segment A6 south of Mizpah Church Road (**Figure 2-10d**).

Crossover Segments C4 and C5 combine to form an alternative to Segment A5. The main difference between the two segments is the location of the interchange at Bethania-Tobaccoville Road. Segment A5 provides greater separation from the Samuel Stauber House and Barn (a property listed in the National Register of Historic Places) located east of Kapp Road on Bethania-Tobaccoville Road. However, it would displace homes in the Wide Country Estates subdivision along Wide Country Road, Gladewater Drive, and Bethania-Tobaccoville Road.

2.8.4.3 Localized Segment Comparisons

Segments in four locations within the Project R-2247 Build Alternatives on new location were analyzed prior to the identification of the Detailed Study Alternatives. These are shown in **Figure 2-10(a-e)** and are listed below:

- Segment B1 and Segments A1-C1 south of I-40
- Segments B4, B5, and B6 between Country Club Road and Robinhood Road
- Segments B8 and B9 between Tobaccoville Road and Bethania-Rural Hall Road.
- Segment A5 and Segments C4-C5 near Bethania-Tobaccoville Road

After functional designs, cost estimates and an environmental study were completed, the segments in each of the four locations noted above were compared to identify preferences. The most favorable segment identified in each of the four locations was then included in the Detailed Study Alternatives carried forward in the study.

Table 2-7 contains a summary of the cost and environmental data for the localized segment comparisons. The data in **Table 2-7** was collected in the early 1990s. Since that time, development has occurred that would increase some of the impacts noted in the table, namely relocations, community facilities impacts, noise impacts, and right-of-way acquisition and relocation costs. Construction costs also will have increased uniformly across the alternatives due to inflation. Forest impacts may have decreased in areas where development has increased.

Wetlands may have changed due to development or weather-related influences. Other impacts are not expected to have changed substantially. These include impacts to streams and floodplains. Neighborhoods and community facilities built since the early 1990s are noted above in **Section 2.8.4.2** and shown in **Figure 2-10(a-e)**.

Table 2-7: Project R-2247 - Segment Comparisons (1990)

Impact Category	Segment*								
	B1	A1-C1	B4	B5	B6	B8	B9	A5	C4-C5
Length (miles)	1.92	2.22	3.13	3.19	3.24	2.28	2.3	2.42	2.45
Right-of-Way area (acres)	166	184	168	183	174	103	102	119	131
Construction Limits (acres)	144	150	139	133	130	77	76	94	104
Forest (acres)	83	85	45	68	84	56	57	46	62
Agricultural (acres)	15	13	70	45	37	8	8	31	32
Wetlands (acres)	5.6	2.5	0	0	1.1	0.6	1	5.3	5.4
Stream Crossings	7	3	5	12	10	5	4	7	6
Stream Channel Relocations (feet)	0	0	500	500	500	0	0	0	0
100-Year Floodplain (acres)	5.6	2.5	0	0	1.1	0.6	1	5.3	5.4
Residential Relocations	42	38	25	25	18	16	19	16	25
Business Relocations	0	1	3	2	0	0	0	0	1
Neighborhoods Crossed	3	4	3	2	2	3	4	1	2
Section 4(f)	0	0	0	0	0	0	0	0	0
Historic Properties Adverse Effect	0	0	1	0	0	1	1	0	1
Schools	0	0	0	0	0	0	0	0	0
Churches	0	0	0	0	0	0	0	0	0
Cemeteries	0	0	0	0	0	0	0	0	0
Parks/Recreation Areas*	0	0	0	0	0	0	1	0	0
Potential Hazardous Waste/ Materials Sites	0	0	1	1	0	0	0	0	0
Noise Impacts Pre-Barrier	60	13	24	22	27	23	29	7	0
Noise Impacts Post-Barrier	12	13	8	0	10	0	6	0	0
Noise Barrier Protected Homes	44	0	33	58	36	40	40	12	0
Barrier Number/Length (feet)	1/ 3850	0	1/3700	2/5600	1/2400	2/4400	2/4400	1/1600	0
Noise Barrier Costs ($M (1990))	1.052	0.000	0.493	1.100	0.564	0.587	0.587	0.260	0.000
Construction Costs ($M (1990))	28.100	31.700	20.000	19.400	19.100	10.600	10.600	16.000	17.400
Right-of-Way Costs ($M (1990))	10.659	6.959	6.855	7.220	5.846	3.567	3.567	3.854	3.035
Total Costs ($M)	39.811	38.659	37.348	27.270	25.510	14.754	14.754	20.114	20.435

* This table is directly from the Project R-2247 FEIS (1996) and is not updated with any changes in land uses or features that occurred since 1990. See text for discussion of new development.

Segment B1 vs. Segments A1-C1. In the alternatives evaluation described in Section 2.6.1.1 of the 1996 Project R-2247 FEIS, Segments A1-C1 were retained for further study. Positive features listed for Segments A1-C1 in the 1996 FEIS include fewer water resources impacts (stream crossings, wetlands, floodplains), fewer human impacts (residential relocations, noise impacts, greater distance from subdivisions), lower total monetary costs, and a better design for future extension to south of West Clemmonsville Road with the railroad grade separation it would require. Based on a review of recent aerial photography and other mapping, it appears the relative comparisons described above remained true in 2004.

The offset alignment of Segments A1-C1 with West Clemmonsville Road would allow flexibility in the future for any potential extension of the roadway. With the location offset from West Clemmonsville Road, Segments A1-C1 could be extended to merge with West Clemmonsville Road or to continue on new location as shown on the *2005 Thoroughfare Plan*.

Segment B4 vs. Segment B5 vs. Segment B6. In the alternatives evaluation described in Section 2.6.1.1 of the 1996 Project R-2247 FEIS, Segment B6 was retained for further study. Positive features listed for Segment B6 included fewer human impacts (residential relocations, business relocations, and farm/agriculture), least impact on historic resources (furthest distance from historic property N100 on Fleetwood Circle), least chance of potential hazardous materials involvement (auto salvage yard and gas station), the potential for providing a scenic overlook/rest area along Muddy Creek, and lower total monetary cost. Negative attributes were listed as impacts to water resources (wetlands and floodplains) and impacts to forested lands.

Since the early 1990s, new development has been constructed along Segments B4, B5, and B6. Segments B5 and B6 would impact two new residential subdivisions, two public schools (Meadowlark Elementary and Meadowlark Middle), and undeveloped parkland. Segment B4 would impact one new residential subdivision and a new fire station (Mt. Tabor Fire Station). Relative comparisons of streams, floodplains, and historic sites were still valid in 2004.

Segment B8 vs. Segment B9. In the alternatives evaluation described in Section 2.6.1.1 of the 1996 Project R-2247 FEIS, Segment B8 between Bethania-Tobaccoville Road and Bethania-Rural Hall Road was retained for further study. Segments B8 and B9 were estimated to have similar impacts, with Segment B8 having slightly less impact to residences and wetlands and having relatively less cost. Segment B8 also would avoid impacting the Long Creek Golf Course, a golf facility open to the public. Based on a review of recent aerial photography and other mapping, it appears the relative comparisons described above were true in 2004. In addition, Segment B9 impacts a new subdivision (see **Figure 2-10e**), which would increase the number of residential impacts for Segment B9, which further supports the choice to retain Segment B8.

Segment A5 vs. Segments C4-C5. In the alternatives evaluation described in Section 2.6.1.1 of the 1996 Project R-2247 FEIS, Segments C4-C5 were retained for further study for the western alternative crossing of Bethania-Tobaccoville Road. Positive features listed for Segments C4-C5 are related to minimizing impacts to the Wide Country Estates residential community along Wide Country Road.

Segment A5 would divide the Wide Country Estates subdivision and likely require the construction of noise abatement barriers to mitigate the noise impacts to the remaining residences. Although Segments C4-C5 would relocate a greater number of residences in the Walker Mobile Home Park and on Myers Road, the disruptive loss of community cohesion and infrastructures would be less with Segments C4-C5 than with Segment A5. The negative feature associated with Segments C4-C5 is the proximity to the historic Samuel Stauber House and Barn. Monetary costs for the two options were similar.

Based on a review of recent aerial photography and other mapping, it appears the relative comparisons described above were true in 2004.

2.8.5 Project R-2247 Detailed Study Alternatives

The eight Detailed Study Alternatives described below were the alternatives evaluated in detail in the 1992 Project R-2247 DEIS.

2.8.5.1 Descriptions of Detailed Study Alternatives

After the segments to be carried forward in the study were identified, Detailed Study Alternatives were developed. The eight Project R-2247 Detailed Study Alternatives are shown in **Figure 2-11** and are named WEST-A, EAST-A, WEST-B, EAST-B, C2-EAST-A, C3-WEST-A, C2-EAST-B, and C3-WEST-B.

The Detailed Study Alternatives consist of two general corridors: western (WEST) and eastern (EAST). Detailed Study Alternatives with "WEST" in their name follow the westernmost segments between US 421 and Bethania-Tobaccoville Road. Detailed Study Alternatives with "EAST" in their name follow the easternmost segments between the same roadways.

South of US 421, Detailed Study Alternatives with no label preceding "EAST" in their name follow the eastern segments. Detailed Study Alternatives with no label preceding "WEST" follow the western segments south of US 421. Detailed Study Alternatives with "C2" preceding "EAST" use the C2 link to switch to the western segments south of US 421. Detailed Study Alternatives with "C3" preceding "WEST" in their name use the C3 link to switch to the eastern segments south of US 421.

In the north, each corridor would connect with the Eastern Section of the Northern Beltway at either of two locations along US 52, "-A" or "-B". The Detailed Study Alternatives ending in "-A" join the Eastern Section near the Shore Road/Westinghouse Road interchange along US 52. The Detailed Study Alternatives ending in "-B" join the Eastern Section near the NC 66 Connector interchange along US 52.

WEST-A and WEST-B follow the western corridor in the south and middle sections of the study area before splitting at Bethania-Tobaccoville Road to reach their northern endpoints. WEST-A consists of Segments A1-A2-A3-A4-C4-C5-A6 and is 17.22 miles long. WEST-B consists of Segments A1-A2-A4-C4-B8-B10 and is 17.59 miles long.

EAST-A and EAST-B follow the eastern corridor in the south and middle sections of the study area before splitting at Bethania-Tobaccoville Road to reach US 52. EAST-A consists of Segments A1-C1-B2-B3-B6-B7-C5-A6 and is 16.31 miles long. EAST-B consists of Segments A1-C1-B2-B3-B6-B7-B8-B10 and is 16.68 miles long.

The remaining four additional Detailed Study Alternatives use the two crossover segments, Segments C2 and C3. These crossover segments allow for a switch between the WEST and EAST corridors in the vicinity of US 421.

C3-WEST-A and C3-WEST-B follow the eastern segments south of US 421 and Crossover Segment C3 to reach western Segment A4 in the middle section of the study area before splitting at Bethania-Tobaccoville Road to reach US 52. C3-WEST-A consists of Segments A1-C1-B2-C3-A4-C4-C5-A6 and is 16.97 miles long. C3-WEST-B consists of Segments A1-C1-B2-C3-A4-C4-B8-B10 and is 17.35 miles long.

C2-EAST-A and C2-EAST-B follow the western segments in the south and Crossover Segment C2 to reach eastern Segment B3 and the eastern segments in the middle of the study area before splitting at Bethania-Tobaccoville Road to reach US 52. C2-EAST-A consists of Segments A1-A2-C2-B3-B6-B7-C5-A6 and is 17.04 miles long. C2-EAST-B consists of Segments A1-A2-C2-B3-B6-B7-B8-B10 and is 17.42 miles long.

2.8.5.2 Possible Connections to the Eastern Section of the Northern Beltway

As stated in **Section 2.8.5.1**, there are two general corridors between Bethania-Tobaccoville Road and US 52 (see **Figure 2-10e**). The Detailed Study Alternatives ending in "-A" connect with US 52 near the existing Westinghouse Road-Shore Road interchange using Segment A6. This is the more western of the two corridors. The Detailed Study Alternatives ending in "-B" connect with US 52 at NC 66 using Segments B8 and B10. This is the more eastern of the two corridors.

In the evaluation of these two general corridors in the 1996 Project R-2247 FEIS, the impacts of a future connection to the Eastern Section of the Northern Beltway were considered. At that time, planning for the Eastern Section of the Northern Beltway (Project U-2579) was underway, but several years behind the planning process for Project R-2247.

When viewed only at its juncture at US 52, Segment A6 is 0.38 miles shorter than Segments B8 and B10, with resultant length-related cost and impact advantages.

When consideration is given to the Eastern Section of the Northern Beltway beyond US 52, an additional two miles is added to Segment A6. As shown in **Figure 2-11**, this provides for a comparison of alternatives with common endpoints in the west at Bethania-Tobaccoville Road, and in the east where the two Eastern Section routes would recombine east of University Parkway.

The addition of the Eastern Section routes makes the comparative length of Segment A6 more than 1.5 miles longer than the combined Segments B8 and B10. Much of this extra length for the extension of Segment A6 lies within the Town of Rural Hall, whereas the Eastern Section extension of Segments B8 and B10 follows an existing highway corridor, the NC 66 Connector, along the southern edge of Rural Hall and across University Parkway.

2.8.5.3 Design Year 2015 Traffic Projections

In Section 2.4.5 of the 1992 Project R-2247 DEIS, traffic projections for the design year 2015 were developed for the easternmost and westernmost Detailed Study Alternatives using the travel demand model available at that time. The travel demand model was updated in 1999 and updated traffic projections were developed for the Project R-2247 Preferred Alternative and the surrounding roadway network as described in **Section 2.11**.

The results of the 2015 projections are included in this document to provide a history of the project and information on the Detailed Study Alternatives not selected as the Project R-2247 Preferred Alternative. Although specific values from the 2015 travel demand model regarding traffic volumes are no longer valid, the relative results between Detailed Study Alternatives are estimated to remain generally valid. As presented later in **Section 2.11**, the 2025 traffic projections for the Project R-2247 Preferred Alternative developed with the 1999 travel demand model follow the same general patterns as the 2015 projections using the older model. Although the specific average daily traffic volumes are different, the highest volumes are still projected to occur between Shallowford Road and Robinhood Road and the lowest are still projected to occur in the end segments.

Detailed Study Alternatives EAST-B and WEST-A were modeled to simulate 2015 conditions for all the Detailed Study Alternatives. **Table 2-8** presents the design year daily traffic volumes for

these generalized routes. Along the eastern alternative, EAST-B, the traffic was shown to be highest between Shallowford Road and Robinhood Road, with a daily volume of 57,000 vehicles. The section of the western alternative, WEST-A, between Shallowford and Robinhood Roads, carried the highest traffic on that route, with 48,800 vehicles per day (vpd).

A review of **Table 2-8** indicates that 2015 projected traffic demand for WEST-A is lower than for EAST-B. The distance-weighted average volume for WEST-A is 36,000 vpd, compared with 42,000 vpd for EAST-B. A distance-weighted average takes into account the varying length of sections by multiplying the volume on a section by its distance, and then dividing the sum of the distance-volumes by the total length of the project. This pattern of traffic demand, with higher volumes on the easternmost alternatives, has been consistent throughout the modeling process.

It was assumed that traffic demand variation with the crossovers would follow this same pattern; thus separate traffic projections for crossover combinations were not made. Instead, WEST-A volumes were used for outer segments of the crossover alternatives and EAST-B volumes were used for inner segments.

2.8.5.4 Year 2015 Capacity Analysis for the Detailed Study Alternatives

As documented in Section 2.5.3 of the 1996 FEIS for Project R-2247, a capacity analysis was performed to determine the required number of lanes along the mainline of the Detailed Study Alternatives. The analysis was done for the easternmost alternative (EAST-B) and the westernmost alternative (WEST-A). The two alternatives modeled are representative of all the Project R-2247 Detailed Study Alternatives.

The analysis used the 1985 *Highway Capacity Manual's* (HCM) planning procedure for basic freeway segments and the 2015 traffic projections listed in **Table 2-8**.

The 1985 *HCM* procedure for analyzing basic freeway segments takes into account the factors affecting the operation of the basic freeway, the average annual daily traffic (AADT) and directional design-hour volume (DDHV), the percentage of trucks, the type of terrain, and the design speed. Values used for all of these factors are shown in **Table 2-9**, along with the computations for the number of lanes required on the freeway to achieve a minimum desirable LOS C. Values for through-traffic and local traffic on the Western Section of the Northern Beltway were obtained from the 2015 traffic modeling process.

Table 2-8: 2015 WEST-A and EAST-B Alternatives Traffic Volumes

PROJECT R-2247 DETAILED STUDY ALTERNATIVE WEST-A			
From	**To**	**Separation (miles)**	**ADT Volume**
US 52	Bethania-Tobaccoville Rd	2.4	25,400
Bethania-Tobaccoville Rd	Reynolda Rd (NC 67)	1.7	32,200
Reynolda Rd (NC 67)	Yadkinville Rd	3.0	38,000
Yadkinville Rd	Robinhood Rd	1.6	38,200
Robinhood Rd	Shallowford Rd	1.7	48,800
Shallowford Rd	US 421	1.6	46,600
US 421	Peace Haven-Styers Ferry Connector	1.0	38,200
Peace Haven-Styers Ferry Connector	I-40	1.2	34,600
I-40	Stratford Rd	2.3	30,400
		Average Volume (Distance Weighted)	**36,000**
PROJECT R-2247 DETAILED STUDY ALTERNATIVE EAST-B			
From	**To**	**Separation (miles)**	**ADT Volume**
US 52	Bethania-Tobaccoville Rd	3.0	30,300
Bethania-Tobaccoville Rd	Reynolda Rd (NC 67)	1.9	37,200
Reynolda Rd (NC 67)	Yadkinville Rd	1.9	37,300
Yadkinville Rd	Robinhood Rd	2.3	49,300
Robinhood Rd	Shallowford Rd	1.9	57,000
Shallowford Rd	US 421	1.3	54,500
US 421	Peace Haven-Styers Ferry Connector	1.0	38,100
Peace Haven-Styers Ferry Connector	I-40	0.8	36,800
I-40	Stratford Rd	2.3	34,100
		Average Volume (Distance Weighted)	42,000

Table 2-9: 2015 Traffic Volumes and Lane Requirements

Segment		2015 Projected Average Daily Traffic		2015 Estimated Design-Hour Traffic		Lane Requirements (number of lanes)	
From	To	Western Alts	Eastern Alts	Western Alts	Eastern Alts	Western Alts	Eastern Alts
US 52	Bethania-Tobaccoville Rd	25,400	30,300	1,270	1,515	2	2
Bethania-Tobaccoville Rd	Reynolda Rd (NC 67)	32,200	37,200	1,610	1,860	2	2
Reynolda Rd (NC 67)	Yadkinville Rd	38,000	37,300	1,900	1,865	2	2
Yadkinville Rd	Robinhood Rd	38,200	49,300	1,910	2,465	2	3
Robinhood Rd	Shallowford Rd	48,800	57,000	2,440	2,850	3	3
Shallowford Rd	US 421	46,600	54,500	2,330	2,725	3	3
US 421	Peace Haven-Styers Ferry Connector	38,200	38,100	1,910	1,905	2	2
Peace Haven-Styers Ferry Connector	I-40	34,600	36,800	1,730	1,840	2	2
I-40	Stratford Rd	30,400	34,100	1,520	1,705	2	2

Assumptions:
Design speed = 70 mph
D (directional split) = 50/50
% trucks (daily) EAST-B = 9%
% trucks (daily) WEST-A = 9%
SFL, LOS C – Rolling Terrain
K (percent of ADT in peak hour) = 10%
PHF = 0.90
% trucks (peak) EAST-B = 5%
% trucks (peak) WEST-A = 5%
Source: 1996 Project R-2247 FEIS, Table 2.5-3, pg. 2-49

The basic freeway segment analysis results shown in **Table 2-9** indicate that three segments of the Eastern Alternatives and two segments of the Western Alternatives would require three through-lanes in each direction to achieve the minimum desirable LOS C for peak periods in design year 2015. The remaining project segments for each alternative could achieve LOS C with two through-lanes in each direction.

In the 1992 Project R-2247 DEIS, it was suggested that to reduce construction costs, the segments identified as requiring three through-lanes in each direction could be initially constructed with two through lanes in each direction and a 70-foot median, with the third through lane added in the median area when warranted.

The preliminary engineering design developed for the Project R-2247 Preferred Alternative in 1995 included four lanes of travel along the entire length of the Preferred Alternative. The median was widened to 70 feet from the originally proposed 46-foot median. Two or four

additional lanes could be constructed within the median in the future. Based on the 1999 travel demand model and new capacity analyses (see **Section 2.11**), a four-lane section for the freeway would overall operate at a desirable level of service in 2025 for the entire length of the Preferred Alternative.

2.8.5.5 Year 2015 Traffic Network Operations Analysis

As documented in the 1992 DEIS and 1996 FEIS for Project R-2247 (FEIS Section 2.5.1.2), a traffic operations analysis was completed to examine the operation of arterials in the western portion of the study area with the construction of the Detailed Study Alternatives.

One hundred ninety one roadway segments in the Project R-2247 study area were evaluated. **Appendix A** includes the results of the analysis. The table in **Appendix A** lists the 2015 average daily traffic volumes, facility type, capacity, volume to capacity ratio, and level of service for the 191 analyzed roadway segments under the 2015 No-Build Alternative, Revised 2015 No-Build Alternative, and Detailed Study Alternatives WEST-A and EAST-B. The 2015 No-Build Alternative included implementation of all the projects in the *1987 Thoroughfare Plan* except the Western Section of the Northern Beltway. The Revised 2015 No-Build Alternative included implementation of only those projects listed in the *NCDOT 1996-2002 TIP* for which funding was committed.

Table 2-10 presents various statistics based on the data from the table in **Appendix A**. An inspection of the table shows that with the Project R-2247 Detailed Study Alternatives, more road segments would experience an improved LOS and volume to capacity (v/c) ratio than would experience a reduced LOS and worse v/c ratio in 2015. The Detailed Study Alternatives would influence the roadway network in similar ways. An improvement in LOS is defined as a change from one level to another, for example from LOS E to LOS D. An improvement in v/c ratio corresponds directly with reductions in traffic volumes.

Table 2-10: Year 2015 Network Operations Summary of Results

Statistic	2015 No-Build Alternative[1]	2015 Revised No-Build Alternative[1]	Detailed Study Alternative WEST-A	Detailed Study Alternative EAST-B
# of Roadway Segments Analyzed	191	191	191	191
# of Roadway Segments at LOS E or F	63	98	56	51
# of Roadway Segments with Improved/Reduced LOS[2] Compared to No-Build Alternative	--	--	48 / 33	50 / 25
# of Roadway Segments with Improved/Reduced LOS[2] Compared to Revised No-Build Alternative	--	--	79 / 10	83 / 20
# of Roadway Segments with Improved/Reduced v/c Ratio[2] Compared to No-Build Alternative	--	--	115 / 57	113 / 55
# of Roadway Segments with Improved/Reduced v/c Ratio[2] Compared to Revised No-Build Alternative	--	--	132 / 43	133 / 45

1. The No-Build Alternative includes all projects in the *1987 Thoroughfare Plan* except Project R-2247. The Revised No-Build Alternative includes all projects in the *NCDOT 1996-2002 TIP* except Project R-2247.
2. LOS = Level of Service v/c Ratio = volume to capacity ratio

Source: 1996 Project R-2247 FEIS

2.8.5.6 Summary of Costs and Effects

Table 2-11 is a summary of the costs and major environmental effects for the eight Detailed Study Alternatives based on the original functional designs developed and documented in the 1992 DEIS and 1996 FEIS for Project R-2247.

Table 2-11: Project R-2247 - Summary of Costs and Effects for the Detailed Study Alternatives

Impact Category[1]	WEST-A	EAST-A	WEST-B	EAST-B	C3-WEST-A	C2-EAST-A	**C3-WEST-B (Preferred Alternative)**	C2-EAST-B
Segments Comprising Alternative	A1, A2, A3, A4, C4, C5, A6	A1, C1, B2, B3, B6, B7, C5, A6	A1, A2, A3, A4, C4, B8, B10	A1, C1, B2, B3, B6, B7, B8, B10	A1, C1, B2, C3, A4, C4, C5, A6	A1, A2, C2, B3, B6, B7, C5, A6	**A1, C1, B2, C3, A4, C4, B8, B10**	A1, A2, C2, B3, B6, B7, B8, B10
Length (miles)	17.22	16.31	17.59	16.68	16.97	17.04	**17.35**	17.42
Right-of-Way area (acres)	1,273	1,163	1,259	1,149	1,215	1,222	**1,201**	1,208
Construction Limits (acres)	1,075	996	1,134	1,055	1,014	1,058	**1,073**	1,117
Forest (acres)	490	538	584	632	481	584	**575**	678
Agricultural (acres)	281	238	239	196	294	238	**252**	196
Wetlands (acres)	12	7	12	7	13	8	**13**	8
Stream Crossings	41	43	49	51	39	45	**47**	53
Stream Channel Relocations (feet)	3,600	1,200	3,800	1,400	2,300	2,500	**2,500**	2,700
100-Year Floodplains (acres)	102	102	118	118	78	161	**94**	177
Bridge Crossings	10	9	13	12	9	13	**12**	16
Box Culvert Crossings	20	14	22	16	15	19	**17**	21
Prime Farmland Soils (acres)	202	155	182	135	214	183	**193**	162
State Important Farmland Soils (acres)	335	295	325	286	301	312	**291**	302
Residential Relocations	385	276	408	292	266	340	**289**	363
Owner	221	229	234	242	246	240	**259**	253
Tenant	164	47	174	57	20	100	**30**	110
Minority	81	43	82	44	43	54	**44**	55
Business Relocations	22	5	25	8	7	15	**10**	18
Community Facilities	1	0	1	0	0	1	**0**	1

Table 2-11: Project R-2247 - Summary of Costs and Effects for the Detailed Study Alternatives

Impact Category[1]	WEST-A	EAST-A	WEST-B	EAST-B	C3-WEST-A	C2-EAST-A	**C3-WEST-B (Preferred Alternative)**	C2-EAST-B
Affected Neighborhoods	22	19	26	23	21	20	**25**	24
Historic Sites 4(f)	0	0	0	0	0	0	**0**	0
Historic Districts 4(f)	0	1	0	1	0	1	**0**	1
Historic Sites Potential Adverse Effect	2	4	2	4	2	4	**2**	4
Schools	0	0	0	0	0	0	**0**	0
Churches	0	0	0	0	0	0	**0**	0
Cemeteries	0	0	0	0	0	0	**0**	0
Parks/Recreation Areas*	1	0	1	0	0	1	**0**	1
Potential Hazardous Materials	3	2	3	2	1	2	**1**	2
Noise Impacts pre-barrier	55	92	78	115	75	99	**98**	122
Noise Impacts post-barrier	30	66	30	66	44	50	**44**	50
Noise Barrier Protected Homes	53	76	93	116	86	122	**126**	162
Barrier Number/Length (feet)	2/4200	2/5600	4/8600	4/10000	3/7700	3/7700	**5/12100**	5/12100
Noise Barrier Costs ($M 1992)	0.987	1.131	1.574	1.718	1.556	1.543	**2.143**	2.130
Construction Costs ($M 1992)	171.300	161.300	173.200	163.200	159.800	168.900	**161.700**	170.800
Right-of-Way Costs ($M 1992)	73.350	55.543	72.860	55.053	57.637	70.956	**57.147**	70.466
Total Costs ($M 1992)	245.637	217.974	247.634	219.971	218.993	241.399	**220.990**	243.396

1. The values in this table are based on the functional designs developed in support of the 1992 DEIS for Project R-2247

-A- indicates a northern connection with the eastern leg of the Northern Beltway near the Shore Road/Westinghouse Road interchange
-B- indicates a northern connection with the eastern leg of the Northern Beltway near the NC 66 Connector interchange
** privately owned*

2.9 PROJECT R-2247 - PREFERRED ALTERNATIVE

2.9.1 Selection of the 1993 Project R-2247 Preferred Alternative

As described in **Sections 2.3, 2.4, 2.5, and 2.6,** Transportation Management Alternatives, Mass Transit/Multi-Modal Alternatives, Preservation Easements Alternative, and Improve Existing Roadways Alternatives were found to be incapable of providing effective solutions to the purposes and needs for Projects R-2247, U-2579, and U-2579A.

The eight Project R-2247 Detailed Study Alternatives, developed using various combinations of segments, were evaluated in detail in the 1992 DEIS and 1996 Project R-2247 FEIS (see **Figure 2-11**). They are WEST-A, EAST-A, WEST-B, EAST-B, C3-WEST-A, C2-EAST-A, C3-WEST-B (Preferred), and C2-EAST-B.

The Project R-2247 DEIS was circulated in the summer of 1992. A Corridor Public Hearing was held in September 1992. After careful review of the potential impacts to the human and natural environments and after weighing the comments provided by the federal, state, and local agencies and the public, NCDOT and FHWA selected Detailed Study Alternative C3-WEST-B as the Preferred Alternative in 1993.

The preferred alternative selection process described in the *Alternative Comparison Summary for Selection of a Preferred Alternative* (1993) and Section 2.6.3 of the 1996 Project R-2247 FEIS are summarized in the remaining text of this section. The post-DEIS analysis of the eight Detailed Study Alternatives resulted in the choice between Detailed Study Alternatives C3-WEST-B and EAST-B, with Detailed Study Alternative C3-WEST-B ultimately selected as the Preferred Alternative. Selection of the Preferred Alternative based on current conditions is described in **Section 2.9.2** of this document.

The Detailed Study Alternatives were evaluated in three sections; region south of US 421, region north of Bethania-Tobaccoville Road, and the middle region between US 421 and Bethania-Tobaccoville Road. Because the regions were divided at crossover segments, selecting a preferred alternative in the south did not eliminate any alternatives in the north. Likewise, a preferred alternative identified in the north did not eliminate any alternatives in the south.

Region South of US 421. **Figure 2-10a** shows the segments in this region. The segments were combined in the Detailed Study Alternatives as shown in **Table 2-12**.

In the region south of US 421, the Detailed Study Alternatives that incorporate Segments A1-C1-B2 were recommended (EAST-A, EAST-B, C3-WEST-A, and C3-WEST-B (Preferred)). These Detailed Study Alternatives take the most eastern route south of US 421. Cost, residential, business and community disruption, aquatic resources, wildlife habitat, and design of the

interchange with I-40 clearly show these alternatives cost less and have reduced impacts on the human and natural environment compared with the Detailed Study Alternatives that use Segments A1-A2 (WEST-A, WEST-B, C2-EAST-A, and C2-EAST-B). **Table 2-12** lists the relevant impacts reported for the region south of US 421 in the *Alternatives Comparison Summary for Selection of a Preferred Alternative* (1993).

Table 2-12: Project R-2247 - Comparison of Segments in Region South of US 421

Category	Detailed Study Alternative*			
	WEST-A and WEST-B	**C2-EAST-A and C2-EAST-B**	**C3-WEST-A and C3-WEST-B (Preferred)**	**EAST-A and EAST-B**
Segments in region south of US 421	A1, A2, A3	A1, A2, C2, B3	A1, C1, B2, C3	A1, C1, B2, B3
Length (miles)	5.27	5.26	5.02	4.52
Forest (acres)	185	233	177	187
Agricultural (acres)	90	88	103	88
Wetlands (acres)	2.3	4.3	2.5	2.5
Stream Crossings	12	14	10	12
Stream Channel Relocations (linear ft)	1,300	1,300	0	0
100-year Floodplains (acres)	90	131	65	72
Residential Relocations	282	239	163	175
Business Relocations	16	11	1	1
Community Facilities	1	1	0	0
Parks/Recreation Areas	1	1	0	0
Potential Hazardous Materials Sites	2	0	0	0
Total Costs (Millions $[1992])	121.9	117.6	95.3	94.2

* Impacts based on functional designs prepared for the 1992 DEIS for Project R-2247

Cost - The Detailed Study Alternatives containing Segment A2 (WEST-A, WEST-B, C2-EAST-B, and C2-EAST-A) cost $22 million to $28 million more than the other Detailed Study Alternatives.

Residential/Community Disruption - The Detailed Study Alternatives containing Segment A2 (WEST-A, WEST-B, C2-EAST-B, and C2-EAST-A) have from 64 to 119 more residential relocations than the other Detailed Study Alternatives.

All Detailed Study Alternatives greatly affect the communities along the north and south sides of US 421. The Detailed Study Alternatives containing Segment A3 (WEST-A and WEST-B) have

the worst effect on these communities due to splitting the Marty Lane-Moravian Heights community south of US 421. Although they also relocate many homes in this area, the other Detailed Study Alternatives (C2-EAST-A, C2-EAST-B, C3-WEST-A, C3-WEST-B (Preferred), EAST-A, and EAST-B) take homes from the far eastern end of the Marty Lane-Moravian Heights community and leave the remainder of the community intact.

Business/Employment Disruption - The Detailed Study Alternatives containing Segment A2 (WEST-A, WEST-B, C2-EAST-A, C2-EAST-B) have severe impacts on the industrial and business park located along the south side of I-40. These Detailed Study Alternatives have from 10 to 15 more business relocations than the Detailed Study Alternatives that do not contain Segment A2.

Natural Resources (Aquatic Resources and Wetlands/Forest/Wildlife Habitat) - In their written responses, the resource agencies clearly favored Detailed Study Alternatives that take the eastern route in the region south of US 421 (C3-WEST-A, C3-WEST-B (Preferred), EAST-A, and EAST-B) due to the involvement of fewer acres of water resources and forested habitat impacts.

Detailed Study Alternatives containing Segment A2 (WEST-A, WEST-B, C2-EAST-A, C2-EAST-B) impact Muddy Creek and its floodplain both north and south of I-40, and at its confluence with Silas Creek south of I-40. These Detailed Study Alternatives impact from 17 to 66 acres more floodplain, relocate 1,300 feet more major stream channel, have wetland impacts from 0.24 to 1.82 acres more, and displace from 7 acres less to 56 acres more forested habitat than the Detailed Study Alternatives containing Segment B2 (C3-WEST-A, C3-WEST-B (Preferred), EAST-A, EAST-B). The crossing of both the Silas Creek and Muddy Creek floodplains near their confluence is considered to be a major fragmentation of wildlife habitat by the Detailed Study Alternatives containing Segment A2.

Traffic Service/Function of the Facility – With respect to design and operation, the Detailed Study Alternatives having the eastern interchange with I-40 (C3-WEST-A, C3-WEST-B (Preferred), EAST-A, EAST-B) are preferred over the Detailed Study Alternatives having the western interchange with I-40 (WEST-A, WEST-B, C2-EAST-A, C2-EAST-B). The eastern location is far enough from adjacent interchanges to function adequately with a system of ramps and loops. The western interchange requires a collector-distributor system between the Winston-Salem Northern Beltway and Lewisville-Clemmons Road. The programmed widening of I-40 in this area would not require modification if the eastern interchange location is chosen.

Region North of Bethania-Tobaccoville Road. **Figure 2-10e** shows the segments in this region. The segments were combined in the Detailed Study Alternatives as shown in **Table 2-13**.

The Detailed Study Alternatives that include Segments B8-B10, which connect to US 52 at NC 66, were recommended (WEST-B, EAST-B, C3-WEST-B (Preferred), and C2-EAST-B). These alternatives are the ones that include the southernmost connection (B-endpoint) to US 52. It has a more desirable interchange design, a greater separation from adjacent interchanges along US 52, and less impacts if extended east of US 52 as the Eastern Section of the Northern Beltway (Project U-2579).

Table 2-13 lists the relevant impacts reported for the region north of Bethania-Tobaccoville Road in the *Alternatives Comparison Summary for Selection of a Preferred Alternative* (1993).

Table 2-13: Project R-2247 - Comparison of Segments in Region North of Bethania-Tobaccoville Road

Category	Detailed Study Alternative*	
	WEST-A, EAST-A, C2-EAST-A, and C3-WEST-A (A-endpoint)	**WEST-B, EAST-B, C2-EAST-B, and C3-WEST-B (Preferred) (B-endpoint)**
Segments in region north of Bethania-Tobaccoville Road	C5-A6	B8-B10
Length (miles)	3.24	3.62
Forest (acres)	151	244
Agricultural (acres)	56	15
Wetlands (acres)	0.4	0.6
Stream Crossings	10	18
Stream Channel Relocations (linear ft)	700	900
100-year Floodplains (acres)	4	21
Residential Relocations	16	39
Business Relocations	2	5
Community Facilities	0	0
Parks/Recreation Areas	1	0
Potential Hazardous Materials Sites	1	1
Total Costs (Millions $[1992])	53.1	55.1

* Impacts based on functional designs prepared for the 1992 DEIS for Project R-2247

Traffic Service/Function of the Facility – The B-endpoint Detailed Study Alternatives (WEST-B, EAST-B, C2-EAST-B, and C3-WEST-B (Preferred)) have a better interchange design and a greater separation from adjacent interchanges along US 52. The separation of the Winston –

Salem Northern Beltway crossing and the NC 65 interchange at US 52 is sufficient for adequate function of the interchange with common collector-distributor roadways.

The crossing of the A-endpoint Detailed Study Alternatives (WEST-A, EAST-A, C2-EAST-A, and C3-WEST-A) at US 52 and the existing US 52 interchange at Westinghouse Road/Shore Road are extremely close. The importance of the Westinghouse Plant to the community requires that the access from Westinghouse Road to US 52 be maintained. The proximity of interchanges and desire to maintain access to the existing interchange require a complex system or ramps, loops, and collector-distributor roads. Driver stress will be greater and confusion will be more likely for those navigating their way to and from the three interconnected facilities – US 52, the Winston-Salem Northern Beltway, and Westinghouse/Shore Roads.

Extension East of US 52 as the Eastern Section of the Winston-Salem Northern Beltway – **Table 2-13** shows that the B-endpoint Detailed Study Alternatives (WEST-B, EAST-B, C2-EAST-B, and C3-WEST-B (Preferred)) cost $2 million more than the A-endpoint Detailed Study Alternatives. However, the Eastern Section of the Northern Beltway would have to be approximately 1.5 miles longer to connect to the A-endpoint Detailed Study Alternatives (WEST-A, EAST-A, C2-EAST-A, and C3-WEST-A) than to the B-endpoint Detailed Study Alternatives (see **Figure 2-10e**). This extra length of the Eastern Section of the Northern Beltway would cause the A-endpoint Detailed Study Alternatives ultimately to be more expensive than the B-endpoint Detailed Study Alternatives.

The B-endpoint Detailed Study Alternatives (WEST-B, EAST-B, C2-EAST-B, and C3-WEST-B (Preferred)) have 23 more relocations than the A-endpoint Detailed Study Alternatives. However, if extended past US 52, the A-endpoint Detailed Study Alternatives would incur substantially greater impacts to the developed areas of the central part of the Town of Rural Hall. These northern alternatives would divide the town and disrupt residential communities within Rural Hall (see **Figure 2-10e**).

The A-endpoint Detailed Study Alternatives (WEST-A, EAST-A, C2-EAST-A, and C3-WEST-A (Preferred)) affect fewer businesses, but the ones they displace at Westinghouse Road (Lantal Textiles [previously Langenthal Mills] and Trucking Firm) have more employment than the small businesses that are affected by the B-endpoint Detailed Study Alternatives near the NC 65 interchange with US 52. If extended past US 52, the A-endpoint Detailed Study Alternatives also would disrupt the businesses within the central part of Rural Hall (see **Figure 2-10e**).

Middle Region. As discussed above, Detailed Study Alternatives EAST-A, EAST-B, C3-WEST-A, and C3-WEST-B were recommended south of US 421 and Detailed Study Alternatives WEST-B, EAST-B, C3-WEST-B, and C2-EAST-B were recommended north of Bethania-Tobaccoville Road. Based on the recommendations for Detailed Study Alternatives in the north

and south regions, two alternatives were common, EAST-B and C3-WEST-B. These two alternatives are very comparable in their costs and impacts to the natural and human environment.

Table 2-14 lists the relevant impacts reported for the middle region in the *Alternatives Comparison Summary for Selection of a Preferred Alternative* (1993).

Table 2-14: Project R-2247 - Comparison of Segments in Middle Region

Category	Detailed Study Alternative*	
	C3-WEST-B (Preferred)	EAST-B
Segments in middle region	C3, A4, C4	B3, B6, B7
Length (miles)	10.01	9.34
Forest (acres)	202	259
Agricultural (acres)	181	124
Wetlands (acres)	9.3	3.3
Stream Crossings	20	24
Stream Channel Relocations (linear ft)	1600	500
100-year Floodplains (acres)	28	52
Residential Relocations	141	151
Business Relocations	4	2
Community Facilities	0	0
Parks/Recreation Areas	0	0
Historic Resources with Adverse Effect	0	2
Potential Hazardous Materials Sites	0	1
Total Costs (Millions $[1992])	102.2	101.2

* Impacts based on functional designs prepared for the 1992 DEIS for Project R-2247

In letters containing their review comments on the DEIS, both the US Fish and Wildlife Service and the Army Corps of Engineers state that they would find both Detailed Study Alternatives EAST-B and C3-WEST-B "acceptable" since they avoid "substantial" impacts to the natural environment.

Detailed Study Alternative C3-WEST-B was selected as the 1993 Project R-2247 Preferred Alternative because Detailed Study Alternative EAST-B would impact Pfafftown Historic District, which is eligible for listing in the National Register of Historic Places. Federal law requires the avoidance of historic properties such as the Pfafftown Historic District when feasible and prudent. Due to the potential for impacts to the proposed Pfafftown Historic District, under provisions of Section 4(f) of the Department of Transportation Act, (23 CFR 771.135(a)(2)),

Detailed Study Alternative EAST-B could only be selected as the Preferred Alternative if there were no other prudent and feasible alternatives. Detailed Study Alternative EAST-B also would impact more archaeological resources in the project area and would involve more construction within floodplain limits than the Preferred Alternative C3-WEST-B.

In conclusion, Detailed Study Alternative C3-WEST-B (see **Figure 2-11**) was selected as the 1993 Project R-2247 Preferred Alternative over the other seven Detailed Study Alternatives because it provided the best balance of improving the transportation network of Winston-Salem and Forsyth County while avoiding the Pfafftown Historic District and minimizing effects to the environment.

2.9.2 Selection of the Project R-2247 Preferred Alternative Based on Current Conditions

A Preferred Alternative for Project R-2247 was selected in 1993. As part of this supplemental document, the selection of C3-WEST-B as the Preferred Alternative was reviewed in light of current conditions.

The original evaluation documenting the selection of C3-WEST-B divided the project area into three regions (see **Appendix B** for the entire 1993 evaluation). This update does the same. The original reasons for keeping or eliminating different segments of the Detailed Study Alternatives in these regions were reviewed. Any changes that have occurred since 1993 are identified. Whether these changes would influence the original reasons for selection of the Preferred Alternative also is discussed.

In general, features and resources that would be expected to change significantly since 1993 are those relating to the human environment. New additions to the human environment of the area include residential neighborhoods and commercial development, construction of new community facilities, and creation of new parkland. A new survey for historic architectural resources in the western portion of the study area also was conducted in 2002; it identified seven historic properties eligible for listing in the National Register of Historic Places in addition to the eleven properties originally identified (one of which has since been demolished). All these properties are shown in **Figure 2-10(a-e)**.

US Census Data from 1990 and 2000 were reviewed to identify overall population trends in the block groups traversed by the Detailed Study Corridors. A comparison of population densities from 1990 and 2000 show that Forsyth County grew increasingly suburban, with a shift from rural to suburban densities occurring primarily in census block groups located in the southern, western, and northeastern portions of the County (*Indirect and Cumulative Impacts Analysis*, 2005).

The relative values of streams and floodplains within each Detailed Study alternative are not expected to be substantially different. Aerial photography and mapping were reviewed to confirm that streams have not changed since the original selection of the Preferred Alternative.

The floodplains shown in the 1996 Project R-2247 FEIS were dated 1983 (pg. 4-53). The most recent flood insurance rate (FIRM) maps for Forsyth County are dated October 1998. Based on a review of the figures showing the floodplains, there were no significant differences between the two maps that would result in new encroachment locations not previously reported in the 1996 Project R-2247 FEIS.

The Preferred Alternative for Project R-2247 was selected in 1993 even though it originally had the highest estimated impacts to wetlands by up to a difference of 6.2 acres (original estimates ranged from a high of 13.2 acres in the right of way of Detailed Study Alternative C3-WEST-B (Preferred) to lows of 7.0-7.1 acres for Detailed Study Alternatives EAST-A and EAST-B). For the Preferred Alternative, engineering design refinements subsequently reduced wetland impacts to 5.8 acres within the construction limits based on 1995 wetland surveys and the 1995 preliminary engineering design. Further refinement of the Preferred Alternative design and updated wetland surveys conducted in 2003 resulted in the current estimate of 3.6 acres of wetland impacts. It is expected that similar reductions in wetland impacts would result if the same procedures were applied to the non-preferred Detailed Study Alternatives.

In the non-preferred Detailed Study Alternatives, reductions in wetland impacts also could have occurred due to long-term drier weather patterns since the early 1990s and/or to wetlands being filled by recent development. Changes due to weather patterns would be similar for all Detailed Study Alternatives (including the Preferred Alternative). Filling of wetlands is more likely to have occurred in the non-preferred Detailed Study Alternatives since development has been prevented by local jurisdictions from occurring in the Preferred Alternative right of way.

In the 1993 selection of the Project R-2247 Preferred Alternative, the selection process narrowed the field to Detailed Study Alternatives C3-WEST-B and EAST-B. Detailed Study Alternative C3-WEST-B was selected over Detailed Study Alternative EAST-B, even though EAST-B had fewer wetland impacts (6.1 acres less).

Even if new field surveys and design refinements for Detailed Study Alternative EAST-B (and all other non-preferred Detailed Study Alternatives) resulted in no wetland impacts, the difference in wetland impacts between these non-preferred Detailed Study Alternatives and the Preferred Alternative would be 3.6 acres. This is not a significant difference in wetland impacts. Therefore, wetland impacts would not "tip the scales" in favor of Detailed Study Alternative EAST-B or any other Detailed Study Alternative, particularly since other factors, as described below, weigh heavily in favor of the current Preferred Alternative.

Region South of US 421. **Figure 2-10a** shows the segments in this region. The segments were combined in the Detailed Study Alternatives as shown in **Table 2-12**.

In the original selection process in 1993, the alternatives that use A1-C1-B2 were recommended due to lower cost, less residential, community, and business disruption, fewer impacts to water resources and wildlife habitat, and a more desirable design of the I-40 interchange.

Cost - Construction costs listed in **Table 2-12** for the Detailed Study Alternatives in the region south of US 421 have increased due to inflation, but are expected to remain the same relative to each other. Therefore, Detailed Study Alternatives that use Segments A1-C1-B2 are still expected to cost the least (EAST-A, EAST-B, C3-WEST-A, and C3-WEST-B (Preferred)).

Residential/Community Disruption - Detailed Study Alternatives that use Segments A1-C1-B2 (EAST-A, EAST-B, C3-WEST-A, and C3-WEST-B (Preferred)) were reported in the previous evaluation to have fewer residential relocations. As shown in **Figure 2-10a**, there are no new residential or commercial developments within Segments A1, C1, B2, or B3 since 1992. Also as shown in **Figure 2-10a**, several new residential developments (Springfield Farm Road area) have been built within Segments A2, A3, and C2 since 1992 that would increase the residential and commercial relocations for the Detailed Study Alternatives that use these segments (WEST-A, WEST-B, C2-EAST-A, and C2-EAST-B).

Business/Employment Disruption – Detailed Study Alternatives that use Segments A1-C1-B2 (EAST-A, EAST-B, C3-WEST-A, and C3-WEST-B (Preferred)) were reported in the previous evaluation to have fewer commercial relocations. As shown in **Figure 2-10a**, there are no new commercial developments within Segments A1, C1, B2, or B3 since 1992. Also as shown in **Figure 2-10a**, a new commercial development (Gun Club Road area) has been built within Segments A2, A3, and C2 since 1992 that would increase the commercial relocations for the Detailed Study Alternatives that use these segments (WEST-A, WEST-B, C2-EAST-A, and C2-EAST-B).

Natural Resources (Water Resources and Wetland/Forest/Wildlife Habitat) - Other reasons cited for selection of the Detailed Study Alternatives that use Segments A1-C1-B2 (EAST-A, EAST-B, C3-WEST-A, and C3-WEST-B (Preferred)) are fewer impacts to water resources and wildlife habitat.

The locations of streams are not expected to have changed since 1992. The latest floodplain information (1996) in this area was compared to the floodplain map shown in the 1996 FEIS for Project R-2247 and the floodplain limits have not changed significantly since 1992. Therefore, the conclusion that Detailed Study Alternatives using Segments A1-C1-B2 (EAST-A, EAST-B, C3-WEST-A, and C3-WEST-B (Preferred)) would have fewer impacts to water resources is still valid.

As mentioned previously, development has occurred within Segments A2, A3, and C2 since 1992. Therefore, the Detailed Study Alternatives that use Segments A2, A3, and C2 (WEST-A, WEST-B, C2-EAST-A, and C2-EAST-B) will have less impacts to forested habitat than previously reported. This decrease in forested habitat impacts would make impacts from Detailed Study Alternatives using Segments A2, A3, and C2 (WEST-A, WEST-B, C2-EAST-A, and C2-EAST-B) closer to the forested habitat impacts from Detailed Study Alternatives using Segments A1-C1-B2 (C3-WEST-A, C3-WEST-B (Preferred), EAST-A, EAST-B). However, the Detailed Study Alternatives using Segments A2, A3, and C2 (WEST-A, WEST-B, C2-EAST-A, and C2-EAST-B) would still cross both the Silas Creek and Muddy Creek floodplains near their confluence, which was considered to be a major fragmentation of wildlife habitat in the previous comparison of alternatives.

In conclusion, the reasons given in the original evaluation for narrowing the choice to Detailed Study Alternatives to C3-WEST-B, C3-WEST-A, EAST-B and EAST-A in the region south of US 421 are still valid.

Region North of Bethania-Tobaccoville Road. **Figure 2-10e** shows the segments in this region and the extension of these segments east of US 52. Segment A6, which ends at US 52 near Shore Road/Westinghouse Road, is used by Detailed Study Alternatives WEST-A, EAST-A, C3-WEST-A, and C2-EAST-A. Segments B8-B10, which ends at US 52 near NC 66, is used by Detailed Study Alternatives WEST-B, EAST-B, C3-WEST-B (Preferred), and C2-EAST-B.

Detailed Study Alternatives WEST-B, EAST-B, C3-WEST-B (Preferred), and C2-EAST-B were recommended in the original selection process in 1993 because they have a more desirable interchange design, a greater separation from adjacent interchanges along US 52, and fewer impacts if extended east of US 52 as the Eastern Section of the Northern Beltway (Project U-2579).

Traffic Service/Function of the Facility – Detailed Study Alternatives WEST-B, EAST-B, C3-WEST-B (Preferred), and C2-EAST-B were reported in the previous evaluation to have a more desirable interchange design and a greater separation from adjacent interchanges along US 52.

The interchange design for the B-endpoint Detailed Study Alternatives (WEST-B, EAST-B, C3-WEST-B (Preferred), C2-EAST-B) has not changed substantially since the 1993 comparison of alternatives. Therefore, it is considered that the design is still better and has a greater separation from adjacent interchanges along US 52 compared to the design for the A-endpoint Detailed Study Alternatives (WEST-A, EAST-A, C3-WEST-A, and C2-EAST-A).

A benefit given in the previous comparison of alternatives was that the greater separation of interchanges provided by the B-endpoint Detailed Study Alternatives (WEST-B, EAST-B, C3-WEST-B (Preferred), C2-EAST-B) would cause less driver stress and confusion given the proximity of adjacent US 52 interchanges. The adjacent US 52 interchange with Westinghouse Road/Shore Road is close to the A-endpoint Detailed Study Alternatives (WEST-A, EAST-A, C3-WEST-A, and C2-EAST-A). The Westinghouse Road/Shore Road interchange is necessary to provide access to the former Westinghouse Plant, which is now owned by TurboCare Corporation, a major manufacturer in the area (*http://www.winstonsalem.com/winstonsalem/www.nsf/doc/chamberprogrsch_majmfg.cm*, accessed June 25, 2004 and *http://www.turbocare.com/turbine_blade.html*, accessed January 10, 2007). Because this interchange must be maintained, driver stress and confusion will be greater with the proximity of the A-endpoint Detailed Study Alternatives to the Westinghouse Road/Shore Road interchange.

The B-endpoint Detailed Study Alternatives would allow the Westinghouse Road interchange to have a greater separation from adjacent US 52 interchanges and would result in a better design than the A-endpoint Detailed Study Alternatives. Therefore, the conclusion that the B-endpoint Detailed Study Alternatives (WEST-B, EAST-B, C3-WEST-B (Preferred) C2-EAST-B) have a better interchange design and a greater separation from adjacent interchanges along US 52 is still valid.

Extension East of US 52 as the Eastern Section of the Winston-Salem Northern Beltway - Consideration of the Detailed Study Alternatives in the region north of Bethania-Tobaccoville Road just to US 52 shows the northernmost Detailed Study Alternatives (WEST-A, EAST-A, C2-EAST-A, and C3-WEST-A) that use the A-endpoint near Shore Road/Westinghouse Road would cost less and have fewer residential and business relocations (see **Table 2-13**). However, when the Eastern Section is taken into account, these A-endpoint Detailed Study Alternatives lose their benefit.

As can be seen in **Figure 2-10e**, the A-endpoint Detailed Study Alternatives are still longer than the B-endpoint Detailed Study Alternatives, if extended past US 52, resulting in a higher cost. Due to more residential and business impacts, extending the northern (A-endpoint) Detailed Study Alternatives through Rural Hall would still be undesirable compared to using the southern (B-endpoint) Detailed Study Alternatives (WEST-B, EAST-B, C3-WEST-B, and C2-EAST-B) (see **Figure 2-10e**). As of 2004, several businesses were located on Westinghouse Road (including Lantal Textiles) and within Northridge Industrial Park. Several of these businesses could be impacted by the A-endpoint Detailed Study Alternatives (WEST-A, EAST-A, C3-WEST-A, C2-EAST-A).

The recommendation for eliminating WEST-A, EAST-A, C3-WEST-A, and C2-EAST-A based on potential impacts of extending the roadway east of US 52 is still valid.

In the south region, the choice was narrowed to Detailed Study Alternatives using Segments A1-C1-B2 (C3-WEST-A, C3-WEST-B (Preferred), EAST-A, EAST-B). Therefore, the remaining Detailed Study Alternatives common in the north and south are C3-WEST-B and EAST-B, which use two different corridors in the middle region, as described below.

Middle Region from US 421 to Bethania-Tobaccoville Road. **Figure 2-10(b-d)** shows the segments in this region. Based on the elimination of Detailed Study Alternatives in the north and south regions, two Detailed Study Alternatives remain: C3-WEST-B and EAST-B. C3-WEST-B uses the western Segment A4 and EAST-B uses the eastern Segments B3-B6. Impacts in the middle region were reported in the 1993 evaluation as being similar between the two alternatives (see **Table 2-14**). Detailed Study Alternative C3-WEST-B was selected because Detailed Study Alternative EAST-B would impact the Pfafftown Historic District.

Since 1992, several new residential developments, two new schools (Meadowlark Middle School and Meadowlark Elementary School), and a new fire station (Mt. Tabor Fire Station) have been constructed and new parkland purchased (just south of the new schools) within the EAST-B corridor. **Figure 2-10(b-d)** shows this new development. Conversely, no new development has occurred in the middle region of C3-WEST-B.

Based on 2003 conditions, residential relocations and impacts to schools, community facilities and parks would be substantially greater for Detailed Study Alternative EAST-B than those reported in the 1996 FEIS for Project R-2247. Water resource impacts are expected to remain relatively similar. Impacts to the Pfafftown Historic District would still occur under EAST-B.

Conclusion. Based on the evaluations described above, Detailed Study Alternative C3-WEST-B is selected as the Project R-2247 Preferred Alternative because it avoids impacts to community facilities (two schools and parkland), avoids direct impacts to historic sites (Pfafftown Historic District and John Henry Kapp Farm), has a more desirable interchange design and location with US 52, avoids potential impacts to Rural Hall associated with extending the roadway east of US 52, and avoids crossing the confluence of the Muddy Creek and Silas Creek floodplains (a notable wildlife habitat). Detailed Study Alternative C3-WEST-B is one of the least expensive alternatives, one of two alternatives with the fewest residential relocations, and one of two alternatives with the least floodplain impact. The selection of C3-WEST-B as the Preferred Alternative by NCDOT is documented in a letter dated September 14, 2006.

2.9.3 Updates to the Preferred Alternative Engineering Design Since 1995

2.9.3.1 History of the Design

Detailed Study Alternative C3-WEST-B was selected as the Preferred Alternative for Project R-2247 in 1993. Preliminary engineering design was completed in 1995, documented in the FEIS, and shown at the Design Public Hearing in 1996. After the 1996 FEIS and ROD were approved, final design commenced on portions of the Preferred Alternative. Based on right of way plans, NCDOT began right of way acquisition for the Project R-2247 Preferred Alternative in 1996 for the US 421 interchange area (Project R-2247 phase CA) and in 1997 for a segment from the US 421 interchange north up to, and including, the Robinhood Road interchange (Project R-2247 phase CB). During this time, NCDOT also acquired parcels on other sections of the Project R-2247 Preferred Alternative from owners who requested hardship acquisition and met the hardship criteria in accordance with 23 CFR 710.503.

Design activities and right of way acquisition continued until 1999, when design activities and most right of way acquisition were halted on the Project R-2247 Preferred Alternative because of the lawsuit filed against NCDOT and FHWA (see **Sections 1.1, 1.6.2, and 1.6.3**). However, NCDOT continues to purchase parcels from owners located in any phase of Project R-2247 that requested hardship acquisition and that meet the hardship criteria. These hardship acquisitions are made with the consent of the Federal Court.

As of September 2004, NCDOT had acquired all the right of way needed for Project R-2247 phase CA except for land in three parcels, and all the right of way needed for Project R-2247 phase CB except for land in twenty-four parcels.

The current engineering design for the Project R-2247 Preferred Alternative is shown in **Figure 2-12(a-k)**.

2.9.3.2 1995 Preliminary Engineering Design for the 1993 Project R-2247 Preferred Alternative

After C3-WEST-B was selected as the Preferred Alternative in 1993, the preliminary engineering design was prepared. This design updated and refined the functional design. The 1995 preliminary engineering design and updated impact analyses were summarized in the 1996 Project R-2247 FEIS and shown to the public at a Design Public Hearing on September 5, 1996. Features of this preliminary engineering design are described below.

After the FEIS and ROD for Project R-2247 were approved, the final design process began for the Preferred Alternative. **Section 2.9.3.4** describes the 2005 preliminary engineering design in detail and notes any changes that have been made since the 1995 preliminary engineering design

shown at the Design Public Hearing. The 2005 preliminary engineering design is shown in **Figure 2-12(a-k)**.

2.9.3.2.1 Median Width and Number of Lanes

As discussed in **Section 2.7.1.1**, the functional designs for the Detailed Study Alternatives included a 46-foot grassed median and four to six travel lanes, depending on the segment. The 1995 preliminary engineering design for the Preferred Alternative for Project R-2247 included four travel lanes and a 70-foot grassed median along the entire length. Future widening to eight lanes could be accommodated within the median.

2.9.3.2.2 Grade Separations and Road Closures

Based upon the 1995 preliminary engineering design plans for the Project R-2247 Preferred Alternative, the roads listed in **Table 2-15** would be crossed via grade separation, have their through access terminated via an at-grade crossing (and therefore creating cul-de-sacs), be realigned, or be entirely within the proposed project right of way.

Table 2-15: Project R-2247 - Grade Separations and Road Closures for the Preferred Alternative

Road Name (from south to north)	Design Treatment		Road Name (from south to north)	Design Treatment
Lockwood Drive	Cul-de-sac		Birchdale Drive	Cul-de-sac
Ploughboy Lane	Grade separation		Tomahawk Lane	Cul-de-sac and realignment
McGregor Road	Grade separation at creek		Santa Maria Drive	Cul-de-sac and realignment
Silas Creek Road	Cul-de-sac at I-40		Indian Wells Terrace	Realignment
Tilmark Drive	Cul-de-sac and realignment		Floral Lane	Entire road in interchange right of way
Bluff Ridge Trail Drive	Entire road in interchange right of way		Lake Forest Drive	Realignment
McGregor Park Drive	Realignment		Shelwin Court	Realignment
Peace Haven Road	Grade separation		Kecoughtan Road	Realignment
Moravian Heights Lane	Cul-de-sac		El Camino Drive	Cul-de-sac
Cedar Forks Road	Cul-de-sac		Millstone Lane	Cul-de-sac and realignment
Ridings Road	Cul-de-sac		Skylark Road	Grade separation
Philips Bridge Road	Realignment		Balsom Road	Grade separation
Ellington Drive	Realignment		Wild Rose Drive	Cul-de-sac
Styers Ferry Road	Grade separation		Roberts Road	Realignment
Sharon Church Road	Realignment		Myers Road	Realignment
Brookberry Farm Road	Grade separation		Village Oak Drive	Cul-de-sac
Ketner Road	Realignment		Bethania-Rural Hall Road	Grade separation
Algood Road	Realignment		Mont Royal Road	Cul-de-sac

2.9.3.2.3 Interchanges

US 158 (Stratford Road). The southern terminus of Project R-2247 is proposed to be a signalized T-intersection with US 158 (Stratford Road).

I-40. This interchange would be a freeway-to-freeway interchange with loops in the northeast, northwest, and southeast quadrants. The movement from eastbound I-40 to northbound Northern Beltway would be a flyover ramp. A collector-distributor road is proposed on westbound I-40 through the interchange area.

US 421. This freeway to freeway interchange would be located between the interchanges of US 421 with Peace Haven Road to the east and Styers Ferry Road/Lewisville-Clemmons Road to the west. The location of the new US 421/Northern Beltway interchange was constrained by these existing interchanges, the floodplain of Muddy Creek, and a residential neighborhood along Marty Lane and Moravian Heights Lane in the southwest quadrant.

This interchange includes a flyover ramp from southbound Northern Beltway to eastbound US 421 and loop ramps in the southeast and northwest quadrants. A loop ramp also is proposed in the northeast quadrant that is separated from the loop ramp in the northwest quadrant. This loop ramp placement minimizes floodplain impacts and would avoid having a weave section with the loop ramp in the northwest quadrant.

Because of the close spacing between the interchanges along US 421, modifications are proposed to the existing US 421/Peace Haven Road interchange and the US 421/Styers Ferry Road-Lewisville-Clemmons Road interchange. The US 421 interchange at Peace Haven Road currently is a diamond interchange. The eastbound off-ramp from US 421 would be relocated to be a loop ramp in the southeast quadrant. The eastbound on-ramp would be relocated to accommodate the loop.

The US 421 interchange at Styers Ferry Road/Lewisville Clemmons Road would be modified by relocating Styers Ferry Road to tie into Lewisville-Clemmons Road at a T-intersection north of US 421. The existing diamond interchange would be shifted slightly to the west.

Shallowford Road. This minor interchange is proposed to be a partial clover, with all loops and ramps located on the north side of Shallowford Road. Ketner Road (SR 1316) would be relocated to the west in the interchange area to maintain its connection to Shallowford Road.

Robinhood Road. This minor interchange is proposed to be a standard diamond interchange. Algood Road (SR 1431) would be relocated to the east in the interchange area to maintain its connection to Robinhood Road.

Yadkinville Road. This minor interchange is proposed to be a standard diamond interchange. Kecoughtan Road would be relocated to the west in the interchange area to maintain its connection to Yadkinville Road. Lake Forest Drive would be relocated to the east in the interchange area to maintain its connection to Yadkinville Road.

NC 67 (Reynolda Road). This minor interchange is proposed to be a standard diamond interchange. Roberts Road would be relocated to the west in the interchange area to maintain its connection to NC 67 (Reynolda Road).

Bethania-Tobaccoville Road. This minor interchange is proposed to be a standard diamond interchange. A service road from Myers Road to the proposed Bethania-Tobaccoville Road alignment would be provided. SR 1870 (Wide Country Road) would have a cul-de-sace at the Beltway and no longer tie directly into Bethania-Tobaccoville Road.

US 52. This complex freeway-to-freeway interchange would include a nested minor interchange with NC 65 (Bethania-Rural Hall Road).

2.9.3.3 Summary of Cost Estimates and Impacts for Preferred Alternative 1995 Preliminary Engineering Design

Table 2-16 lists the costs and impacts for the Project R-2247 Preferred Alternative, C3-WEST-B, based on the 1995 preliminary engineering design, along with the impacts and costs based on the 1992 DEIS functional design. These are the values shown in the 1996 Project R-2247 FEIS.

Table 2-16: Preferred Alternative Summary from 1996 Project R-2247 FEIS

Impact Category	1992 DEIS Functional Design C3-WEST-B	1995 Preliminary Design*
Length (miles)	17.35	--
Segments In Alternative	A1, C1, B2, C3, A4, C4, B8, B10	--
Right-of-Way area (acres)	1201	--
Construction Limits (acres)	1,073	--
Forest (acres)	575	--
Agricultural (acres)	252	--
Wetlands (acres)	12	5.8
Stream Crossings	47	--
Stream Channel Relocations (linear feet)	2,500	--

Table 2-16: Preferred Alternative Summary from 1996 Project R-2247 FEIS

Impact Category	1992 DEIS Functional Design C3-WEST-B	1995 Preliminary Design*
100-Year Floodplain (acres)	94	68.7
Bridge Crossings	12	--
Box Culvert Crossings	17	--
Prime Farmland Soils	193	--
State Important Farmland Soils	291	--
Residential Relocations	289	295
Owner	259	229
Tenant	30	29
Minority	44	37
Business Relocations	10	11
Community Facilities	0	0
Affected Neighborhoods	25	25
Historic Sites 4(f)	0	0
Historic Districts 4(f)	0	0
Historic Sites Adverse Effect	2	0
Schools	0	0
Churches	0	0
Cemeteries	0	0
Parks/Recreation Areas	0	0
Potential Hazardous Waste/ Materials Sites	1	1
Noise Impacts Pre-Barrier	98	--
Noise Impacts Post-Barrier	44	--
Noise Barrier Protected Homes	126	--
Barrier No./Length (feet)	5/12,100	--
Noise Barrier Costs ($M)	2.143	1.080
Construction Costs ($M)	161.700	200.750
Right-of-Way Costs ($M)	57.147	75.000
Total Costs ($M)	220.990	275.750

* The list in this column represents values that were recalculated based on the 1995 Preliminary Engineering Design for the Preferred Alternative and presented in the 1996 Project R-2247 FEIS.

2.9.3.4 Modifications Made Since 1995 Preliminary Engineering Design

As part of this supplemental EIS, the preliminary engineering design presented at the Design Public Hearing in 1996 was compared to the 2005 preliminary engineering design shown in **Figure 2-12(a-k)** to document any changes that have been made since 1995. The changes are described below.

2.9.3.4.1 Interchange at Shallowford Road

When compared to the 1995 preliminary engineering design shown on the 1996 Design Public Hearing Map, the 2005 design plans for the Shallowford Road interchange (**Figure 2-12d**) show that Loop A (the on-ramp to the southbound lanes of the Northern Beltway) in the northwest quadrant is smaller. The off-ramp and relocated Ketner Road in this same quadrant were shifted eastward, closer to the mainlines, making the footprint in the northwest quadrant smaller. The 1995 preliminary engineering design showed a small corner of the Forsyth Country Day School property being taken in this quadrant. The design changes avoid this property.

2.9.3.4.2 Interchange at Robinhood Road

When compared to the 1995 preliminary engineering design, the 2005 preliminary engineering design plans show the mainline and diamond interchange with Robinhood Road (**Figure 2-12e**) was shifted east about 200 feet to minimize wetland impacts in this area. Ramps in the northwest and southwest quadrants of the interchange also were moved east about 70 feet closer to the mainline to minimize wetland impacts.

2.9.3.4.3 Mainline Area North of Yadkinville Road

When compared to the 1995 preliminary engineering design, the 2005 preliminary engineering design plans for the area north of Yadkinville Road (**Figure 2-12f**) show that a service road from Balsom Road (SR 1455) north to a gravel road was removed from the design. The service road was along the east side of the Northern Beltway just north of Yadkinville Road.

2.9.3.4.4 Interchange at Bethania-Tobaccoville Road

The Bethania-Tobaccoville Road interchange was modified from its original design to avoid adverse effects to the historic Samuel Stauber House and Farm. The process of evaluating alternative interchange alignments and the details of the new designs are summarized below. The *Bethania-Tobaccoville Road Interchange Alternatives Evaluation* (April 2003), appended by reference, explains the process in more detail. Two modified interchange designs, Design Alternative 1 and Design Alternative 2, were developed, evaluated, and shown to the public for comment. Design Alternative 2 was chosen as the preferred interchange design and is

incorporated into the Project R-2247 Preferred Alternative's 2005 preliminary engineering design.

Originally Proposed Interchange Design. The original diamond interchange at Bethania-Tobaccoville Road shown in the 1995 Preliminary Engineering Design uses existing Bethania-Tobaccoville Road. The Project R-2247 Preferred Alternative would cross under existing Bethania-Tobaccoville Road. This design is shown on aerial photography in **Figure 2-13a**. The historic Samuel Stauber House and Barn is located on both sides of existing Bethania-Tobaccoville Road just south of the interchange.

As part of the final design process for the Project R-2247 interchange at Bethania-Tobaccoville Road during the late 1990s, a service road study was performed. The study recommended a service road parallel to the northbound on-ramp to provide access to a group of homes on Myers Road south of the proposed project. The State Historic Preservation Office (HPO) expressed concern that the fill needed for the service road could adversely affect the setting surrounding the Samuel Stauber House and Barn. Also, since the original design would use existing Bethania-Tobaccoville Road, any potential future widening of existing Bethania-Tobaccoville Road would directly impact the Samuel Stauber House and Barn. The HPO agreed that the Original Design, the Modified Original Design, and Design Alternative 1 would have an Adverse Effect on the Samuel Stauber House and Barn (see the Agency Coordination section, below).

Design Alternative 1 is shown on aerial photography in **Figure 2-13b**. This alternative shifts the Bethania-Tobaccoville Road interchange to the northeast about 390 feet along the Project R-2247 Preferred Alternative. The Project R-2247 Preferred Alternative would cross under a relocated Bethania-Tobaccoville Road. Existing Bethania-Tobaccoville Road would have a cul-de-sac on each side at the Winston-Salem Northern Beltway. This alternative places the construction limits (slope stakes) of the relocated Bethania-Tobaccoville Road a minimum of 250 feet behind the boundaries of the Samuel Stauber House and Barn.

To the south of the Design Alternative 1 interchange, a service road would connect SR 1629 (Myers Road) with relocated and existing Bethania-Tobaccoville Road.

To the north of the Design Alternative 1 interchange, SR 1870 (Wide Country Road) would have a cul-de-sac at the Project R-2247 Preferred Alternative and no longer tie directly into Bethania-Tobaccoville Road. Residents of Wide Country Road would need to use SR 1871 (Gladewater Drive) and SR 3981 (Bethania Ridge Road) to access Bethania-Tobaccoville Road. This is the same access modification that would occur under the Original Design for the interchange area.

Design Alternative 2 is shown on aerial photography in **Figure 2-13c**. From a design perspective, Design Alternative 2 has the most desirable alignment compared to the Original Design and Design Alternative 1. This alternative shifts the Bethania-Tobaccoville Road interchange to the northeast about 860 feet along the Northern Beltway. The Project R-2247 Preferred Alternative would cross over a relocated Bethania-Tobaccoville Road. Existing Bethania-Tobaccoville Road would have a cul-de-sac on each side at the Northern Beltway. Design Alternative 2 places the construction limits (slope stakes) of the new alignment for Bethania-Tobaccoville Road a minimum of 830 feet behind the Samuel Stauber House and Barn boundaries.

To the south of the Design Alternative 2 interchange, a service road from Myers Road to the proposed Bethania-Tobaccoville Road alignment would be provided. To the north of Design Alternative 2, SR 1870 (Wide Country Road) would have a cul-de-sac at the Project R-2247 Preferred Alternative and no longer tie directly into Bethania-Tobaccoville Road. Residents of Wide Country Road would need to use SR 1871 (Gladewater Drive) and SR 3981 (Bethania Ridge Road) to access Bethania-Tobaccoville Road. This is the same access modification that would occur under the Original Design and Design Alternative 1 for the interchange area.

Impacts. **Table 2-17** is a comparison matrix of the impacts estimated for each interchange alternative. Linear feet of stream impacted are greater for Design Alternatives 1 and 2 than the Original Design Alternative because of the relocation of Bethania-Tobaccoville Road onto new location. Updated surveys for wetlands, streams, and protected species were conducted in the interchange area on April 25, June 27, July 24, and August 6, 2002 and March 11, 2003.

Table 2-17: Summary of Impacts of Bethania-Tobaccoville Road Interchange Alternatives

Factor	Original Design	Design Alternative 1	Design Alternative 2
Construction Costs (2002 dollars)	$20,000,000	$23,300,000	$24,000,000
Right-of-Way Costs (2002 dollars)	$3,325,900	$3,821,400	$3,663,400
Total Costs (2002 dollars)	$23,325,900	$27,121,400	$27,663,400
Residential Relocations	20	19	14
Business Relocations	1	1	1
Community Facilities	0	0	0
Wetlands (acres)	0.44	0.22	0.14
Agricultural Land (acres)	7.7	9.5	10.4
Forested Land (acres)	40.7	48.1	56.8
Maintained/Disturbed Land (acres)	15.7	15.7	17.3
Significant Streams (linear ft)	0	283	634
Unimportant Streams (linear ft)	525	978	724
Total Stream Impacts (linear ft)	525	1,261	1,358
Protected Species	none	none	none

Impacts calculation limits were modified since the SFEIS/SDEIS was published in October 2004. Impact calculation limits are now Northern Beltway Western Section Mainline Station 224+00 to Station 238+60.

Design Alternative 2 has the most desirable design, fewer relocations, fewer impacts to the Wide Country Road area, fewer wetland impacts, and is the farthest from the Samuel Stauber House and Barn.

Agency Coordination. NCDOT met on February 14, 2003 with the HPO and FHWA to present the interchange design alternatives. The alternatives presented were the Original Design, Design Alternative 1, Design Alternative 2, and a modified Original Design.

The owners of the Samuel Stauber House and Barn suggested a modified Original Design that used the interchange location and configuration of the Original Design and the service road configuration of Design Alternative 1.

The HPO stated the Original Design and the Modified Original Design (with relocated service road) would both have an Adverse Effect on the Samuel Stauber House and Barn.

At the meeting, FHWA, HPO, and NCDOT expressed a preference for Design Alternative 2. Design Alternative 2 has an improved design, fewer relocations, fewer wetland impacts, and is the farthest from the Samuel Stauber House and Barn.

In a concurrence form dated March 1, 2004 (see Appendix D.1), the SHPO concurred with the determination of No Adverse Effect to the Samuel Stauber House and Barn from Design Alternative 2. NCDOT met with the SHPO on March 8, 2005 to discuss the effects of Design Alternative 1 on the Samuel Stauber House and Barn. At this meeting, FHWA, HPO, and NCDOT agreed that Design Alternative 1 would have an Adverse Effect on the Samuel Stauber House and Barn.

FHWA and NCDOT met with resource agencies to discuss the Bethania-Tobaccoville Road interchange design on January 25, February 10, and June 9, 2005. The FHWA, NCDOT, and resource agencies agreed that Design Alternative 2 provided the best balance of impacts and concurred with it being part of the Project R-2247 Preferred Alternative. The concurrence form is in Appendix D.4.

Public Involvement. Two local officials meetings and one property owner meeting were held on February 25, 2003 to solicit comments on the preliminary engineering designs of the alternatives under consideration for the Project R-2247 interchange at Bethania-Tobaccoville Road.

The first local officials meeting was held with the Winston-Salem Department of Transportation and the City-County Planning Board. Officials from the Winston-Salem Department of Transportation and City-County Planning Board preferred Design Alternative 2.

The second local officials meeting was an open house at the Alpha Chapel before the property owner meeting. The town officials of Bethania and Tobaccoville were issued a verbal invitation to attend the open house to view the displays and talk with NCDOT representatives.

The Bethania-Tobaccoville Road Interchange Meeting was an open house. Attendees were encouraged to read the handout, view the project displays, and to discuss the project one-on-one with NCDOT representatives. There was no formal presentation given at the meeting. A copy of the meeting invitation and handout are included in **Appendix C.1**.

Thirty-one citizens signed in at the meeting. Several representatives from NCDOT were present to assist with citizens' questions. The comments received from the citizens were fairly equally divided between alternatives.

2.9.3.4.5 Design Changes Made After the October 2004 SFEIS/SDEIS

After the 2004 SFEIS/SDEIS was approved, two design changes were made to the Western Section of the Winston-Salem Northern Beltway that changed impacts (specifically, impacts to streams). These changes are described below.

The connection of Tilmark Road to Peace Haven Road (See **Figure 2-12b** in the 2004 SFEIS/SDEIS) has been eliminated from the design. Recent private development has since provided a connection to Peace Haven Road for this neighborhood area, rendering the proposed Tilmark Road connection no longer necessary. **Figure 2-12b** has been updated in this SFEIS/FEIS. The removal of the Tilmark Road connection eliminates impacts to Stream L (approximately 84 linear feet) (see **Figure 3-11f**).

A service road has been added to connect properties north of Balsom Road and east of the Northern Beltway to Balsom Road. This service road runs directly adjacent to the Northern Beltway right of way. This updated design is shown in an updated **Figure 2-12g**. The service road would cross Stream CC and Stream DD (see **Figure 3-11s**). Approximately 115 feet of Stream CC and 49 feet of Stream DD would be impacted by the service road.

2.9.3.5 Updated Cost Estimates

The construction and right-of-way cost estimates for the Project R-2247 Preferred Alternative were updated in March 2006. The total estimated cost for construction and right of way is $414.6 million dollars. Of this amount, $340.4 million is for construction, $15.0 million is for utility relocations, and $59.2 million is for right of way. The right of way costs include money already spent on right of way (see **Section 2.9.3.1**). These previous expenditures were not inflated to 2006 dollars because they have already occurred and are fixed. The NCDOT 2006-2012 TIP lists a total cost of $418,000,000, including previous expenditures.

2.9.4 2025 Traffic Operations Analyses for the Project R-2247 Preferred Alternative

2.9.4.1 2025 Traffic Projections

Projected design year 2025 average daily traffic (ADT) volumes for Project R-2247 and the surrounding roadway network were developed using the 1999 Piedmont Triad Regional Travel Demand Model. The traffic volumes for the mainlines and interchanges of the Preferred Alternative are shown in **Figure 2-14(a-b)**.

As shown in **Figure 2-14a**, the mainline of the Project R-2247 Preferred Alternative are projected to carry traffic volumes of 21,100 to 44,400 ADT in 2025.

2.9.4.2 Year 2025 Capacity Analysis for the Project R-2247 Preferred Alternative

2.9.4.2.1 Analysis Methodology

Traffic operations analyses associated with the Preferred Alternative are documented in the *Traffic Technical Memorandum for Project R-2247* (2003), which is appended by reference.

Traffic operations analyses for individual freeway elements (basic freeway segments, ramp merge/diverge areas, and weave sections) were conducted using Highway Capacity Software 2000 (HCS 2000), which is based on the methodologies of the *Highway Capacity Manual (HCM 2000)*.

Freeway segment Level-of-Service (LOS) is measured in terms of density (passenger cars per mile per lane) according to the following ranges.

LOS	Density Range (pc/mi/ln)
A	0 to 11
B	12 to 18
C	19 to 26
D	27 to 35
E	36 to 45
F	46+

Traffic operations analyses for the ramp terminal intersections were conducted using Synchro Version 5-Build 317. Results were reported using the HCM report feature of the software, which is based on the *HCM 2000*.

For these analyses, LOS D was assumed as the minimum standard for all operational elements.

Interchange configurations used in these analyses originated from updated/final 2002-2003 engineering design plans, or from the 1996 Public Hearing Map in situations where the engineering design plans had not been updated. The interchange configurations, including ramp intersections, were analyzed without modification. Where operational elements were shown to operate below the minimum standard established for this analysis, configuration modifications were recommended to meet the minimum standard. Generally, these modifications consisted of adding turn lanes at interchange intersections with the surface streets and are not expected to require additional right of way.

2.9.4.2.2 Results of Capacity Analysis for the Preferred Alternative

Mainline Segments. **Table 2-18** shows the levels of service and density (passenger cars per mile per lane) for the mainline segments of the Project R-2247 Preferred Alternative in the PM peak period. The data for northbound and southbound switches for the AM peak period. Most mainline segments would operate at LOS C or better in both the AM and PM peak periods in the design year 2025. Two freeway segments (US 421 to Shallowford Road and Shallowford Road to Robinhood Road) are predicted to operate at LOS D in 2025 (northbound direction during AM peak and southbound direction during PM peak). Also, all of the ramp merge and diverge areas with the Preferred Alternative's mainlines would operate at LOS D or better in the design year 2025.

Non-Directional Interchanges and the US 158 (Stratford Road) Intersection. Non-directional interchanges are those with stop-sign or traffic-signal control at ramp terminals, such as diamond interchanges. The US 158 (Stratford Road) intersection is projected to operate at LOS F in the 2025 AM and PM peak hours primarily due to heavy turning movements. To improve the LOS in the 2025 AM and PM peak hours to LOS C at the US 158 intersection, the following design modifications are required:

- adding a left turn lane from the Beltway onto US 158,
- adding a left turn from US 158 onto the Beltway, and
- adding a right turn lane from US 158 onto the Beltway.

Table 2-18: Projected 2025 Peak Hour Mainline Level of Service

Mainline Segment	Direction of Travel	PM Peak Hour Level of Service and density (pc/mi/ln)*	
US 158 (Stratford Rd) to I-40	Northbound	B	13.5
	Southbound	A	9.0
I-40 to US 421	Northbound	B	13.2
	Southbound	A	10.3
US 421 to Shallowford Rd	Northbound	C	25.3
	Southbound	D	27.7
Shallowford Rd to Robinhood Rd	Northbound	C	19.0
	Southbound	D	28.5
Robinhood Rd to Yadkinville Rd	Northbound	B	16.0
	Southbound	C	24.0
Yadkinville Rd to Reynolda Rd (NC 67)	Northbound	B	15.7
	Southbound	C	22.5
Reynolda Rd to Bethania-Tobaccoville Rd	Eastbound	B	16.7
	Westbound	B	15.3
Bethania-Tobaccoville Rd to US 52	Eastbound	B	14.7
	Westbound	B	14.2

*LOS	Density Range (pc/mi/ln)	LOS	Density Range (pc/mi/ln)
A	0 to 11	D	27 to 35
B	12 to 18	E	36 to 45
C	19 to 26	F	46+

The ramp termini of the non-directional interchanges at Shallowford Road, Yadkinville Road, NC 67 (Reynolda Road), and Bethania-Tobaccoville Road would all be signalized and are projected to operate at LOS D or better in the 2025 AM and PM peak hours. The signalized ramp termini of the non-directional interchange at Robinhood Road on the east ramp terminus are projected to operate at LOS E in the AM peak hour and LOS C in the PM peak hour. To improve the LOS in the 2025 AM peak hour to LOS C, the following design modification is required. For Robinhood Road interchange (east ramp terminus):

- adding a through lane to westbound Robinhood Road entering the intersection.

Freeway to Freeway Interchanges. Freeway-to-freeway (directional) interchanges are those that connect roadways with free-flowing ramps (no stop signs or traffic signals). The Preferred Alternative for Project R-2247 would have freeway-to-freeway interchanges at I-40, US 421, and US 52. Each interchange is discussed below.

In general, the I-40 interchange would operate at LOS D or better in the 2025 peak hours, with the exception being those elements related to I-40. Traffic projections for I-40 exceed the capacity of a six-lane freeway. As a result, all ramps that merge and diverge directly onto or off of I-40 would operate worse than LOS D.

The operational elements of the US 421 interchange would operate at LOS D or better in the 2025 peak hours. As part of the US 421 interchange, the US 421/Peace Haven Road non-directional interchange would be modified from a diamond to a partial clover. Therefore, as part of the US 421 interchange analysis, the ramp terminals with Peace Haven Road were analyzed as signalized intersections and were estimated to operate at LOS C or better in the 2025 peak hours.

The US 52 systems interchange is located at the northern terminus of the Preferred Alternative. As part of the US 52 interchange, there would be a non-directional interchange with NC 65 to the north incorporated into the system of ramps. In general, the interchange system operates at LOS D or better, with the exception being US 52, north of NC 65. Peak hour traffic projections for US 52 at this location exceed the capacity of the six-lane freeway. As a result, the ramp merge and diverge areas associated with the collector-distributor (C-D) road to and from the north operate worse than LOS D. In the southbound direction, the projected volume exiting onto the C-D road exceeds the capacity of the two-lane ramp, thus contributing to the projected low LOS for the NC 65 southbound exit ramp diverge off the C-D and the southbound weaving section on the C-D between NC 65 and the Northern Beltway.

2.9.4.3 Year 2025 Traffic Network Operations Analysis – Western Portion of Study Area

2.9.4.3.1 Analysis Methodology

In order to determine if the Preferred Alternative for Project R-2247 would improve the overall transportation network in western Forsyth County, the changes in traffic volumes and levels of service on arterial roadways in the western portion of the study area between the Build and No-Build scenarios were analyzed. The No-Build Scenario includes other existing plus committed projected included in the LRTP, including construction of the Eastern Section of the Northern Beltway.

Traffic data from the Piedmont Triad Regional Travel Demand Model (1999) was used to update the traffic projections and operations analysis for the roadway network in western Forsyth County. Seventy-four arterial and collector roadway segments from forty roadways were selected for analysis. The majority of these segments correspond to segments analyzed in the 1996 Project R-2247 FEIS.

Levels of service were analyzed for the 74 selected roadway segments using McTrans' Highway Capacity Software (HCS 2000). HCS 2000 was used to determine LOS for two-lane highway, multilane highway and freeway segments. Average daily traffic volumes from the Piedmont Triad Regional Travel Demand Model for the 2025 Draft Land Use scenario (the scenario that incorporates *The Legacy Development Guide*) were input, along with the characteristics noted during field surveys.

2.9.4.3.2 Analysis Results

Network Volumes and Levels of Service. With the Project R-2247 Preferred Alternative in place, more roadway segments would experience improved levels of service and/or reduced traffic volumes than roadway segments that would experience worse levels of service and higher traffic volumes. **Figure 2-15** shows the percentages of traffic volume reduction predicted with the Project R-2247 Preferred Alternative in place**.**

As shown in the figure, Meadowlark Drive, Yadkinville Road, Shattalon Drive, and Silas Creek Parkway (NC 67) are expected to show greater than 20 percent reduction in average daily traffic in the year 2025 along some segments. Also, the one major circumferential route in western Forsyth County, Silas Creek Parkway, would experience up to a 23 percent reduction in average daily traffic volume, as well as an improvement in LOS.

Roadways that would experience higher traffic volumes with the Project R-2247 Preferred Alternative in place are primarily segments of roadways that have interchanges with the Preferred Alternative.

Table 2-19 shows the roadway segments analyzed, projected 2025 average daily traffic volumes for those segments, and the 2025 peak hour LOS estimated for each modeled roadway segment under the 2025 Build and No-Build conditions.

As indicated in the table, several roadways in western Forsyth County are forecast to experience a reduction in 2025 average daily traffic volumes due to the construction of the Project R-2247 Preferred Alternative. **Table 2-20** is a comparison of the 2025 levels of service and changes in traffic volumes between the Build and No-Build conditions based on the information in **Table 2-19**.

As shown in **Table 2-20**, more segments would experience a decrease in traffic volumes than would experience an improvement in LOS. This is because typically it takes a relatively large change in traffic volumes to result in a change in level of service. However, even if a roadway does not experience a change in LOS, decreases in traffic volumes result in less congestion and delays for drivers.

The other Project R-2247 Detailed Study Alternatives would be expected to achieve similar reductions since they also would have interchanges at the same locations.

Table 2-19: Project R-2247 - Local Roadway Network Traffic Volumes and Level of Service

Roadway	Lanes	Segment	No-Build ADT	No-Build LOS	Build ADT	Build LOS
Balsom Rd	2	Kilmurry Hill Rd-Transou Rd	5000	E	5000	E
Bethabara Park Blvd	2	Reynolda Rd-University Pkwy	16600	E	15100	E
Bethania Rd	2	Reynolda Rd-Bethania-Tobaccoville Rd	8400	F	8400	F
Bethania-Rural Hall Rd	2	Walker Rd-Murray Rd	4600	C	4600	C
Bethania-Tobaccoville Rd	2	Tobaccoville Rd-Griffin Rd	4800	C	4800	C
	2	Griffin Rd-Preferred Alt	16900	E	16900	E
	2	Preferred Alt-Bethania-Rural Hall Rd	9600	D	9600	D
	2	Bethania-Rural Hall Rd-Reynolda Rd	16600	E	16600	E
Bowens Rd	2	Reynolda Rd-Muddy Creek	900	D	900	D
	2	Muddy Creek-Bethania-Tobaccoville Rd	800	D	800	D
Country Club Rd	3	Jonestown Rd-Peace Haven Rd	31600	F	58300	F
	3	Peace Haven Rd-Meadowlark Dr	23900	E	29500	F
Griffin Rd	2	Bethania-Tobaccoville Rd-Shore Rd	900	D	900	D
Hanes Mall Blvd	4	Stratford Rd-I-40	40900	D	40900	D
I-40	6	Lewisville-Clemmons Rd-US 421	99200	E	93800	E
I-40 Business	6	US 421-Silas Creek Pkwy	70400	E	64500	E
Jonestown Rd	2	Country Club Rd-US 421	33300	F	37200	F
	2	US 421-I-40	20500	E	20500	E
	2	I-40-McGregor Rd	10400	E	10400	E
	2	McGregor Rd-Stratford Rd	9300	E	9300	E
Kilmurry Hill Rd	2	Balsom Rd-Skylark Rd	4200	C	3000	C
King-Tobaccoville Rd	2	US 52-Tobaccoville Rd	10200	D	10200	D
Lewisville-Clemmons Rd	5	US 421–I-40	26600	C	26600	C
Meadowlark Dr	3	Robinhood Rd–Country Club Rd	18700	E	5200	C
Mizpah Church Rd	2	Bethania Rural Hall Rd-SR 1632	1300	D	1300	D
	2	SR 1632-Bethania-Tobaccoville Rd	1100	D	1100	D
Murray Rd	2	NC 65-Shattalon Dr	7600	E	7600	E
Olivet Church Rd	2	Yadkinville-Spicewood Rd	6200	C	6900	D
	2	Spicewood Rd-Robinhood Rd	8900	D	8900	D
Peace Haven Rd	3	I-40-US 421	12900	E	12900	E
	3	US 421-Country Club Rd	24500	E	21500	E
	3	Country Club Rd-Milhaven Rd	23300	E	19400	E
	3	Milhaven Rd-Robinhood Rd	21200	E	18100	E

Table 2-19: Project R-2247 - Local Roadway Network Traffic Volumes and Level of Service

Roadway	Lanes	Segment	No-Build ADT	No-Build LOS	Build ADT	Build LOS
Phillips Bridge Rd	2	Country Club Rd-Styers Ferry Rd	3900	E	3900	E
Polo Rd	2	Reynolda Rd-Peace Haven Rd	18500	E	16000	E
	2	Peace Haven Rd-Robinhood Rd	11000	E	11000	E
NC 67 (Reynolda Rd)	2	Vienna-Dozier Rd - Seward Rd	16000	E	16000	E
	2	Seward Rd-Transou Rd	24000	E	28900	F
	2	Transou Rd-Grandview Club Rd	20300	E	17300	E
	2	Grandview Club Rd-Shattalon Dr	21000	E	18000	E
	4	Shattalon Dr-Bethabara Rd	33800	C	29800	C
	4	Bethabara Rd-Silas Creek Pkwy	30000	C	26000	C
Robinhood Rd	2	Lewisville-Vienna Rd-Olivet Church Rd	14300	E	14600	E
	2	Olivet Church Rd-Shattalon Dr	17100	E	16700	E
	2	Shattalon Dr-Peace Haven Rd	24900	F	24200	E
Seward Rd	2	Reynolda Rd-Balsom Rd	3300	E	2100	D
Shallowford Rd	2	Styers Ferry Rd-Lewisville-Vienna Rd	16100	E	19100	E
Shattalon Dr	2	Murray Rd–Reynolda Rd (NC 67)	20400	E	15100	E
	2	Reynolda Rd-Yadkinville Rd	14000	E	11500	E
	2	Yadkinville Rd-Robinhood Rd	11500	E	9900	E
Shore Rd	2	Griffin Rd-Bethania Rural Hall Rd	900	B	900	B
Silas Creek Parkway (NC 67)	4	University Pkwy-Reynolda Rd	49100	D	38000	C
	4	Reynolda Rd-Robinhood Rd	57500	E	48900	D
	4	Robinhood Rd-Country Club Rd	56300	E	52000	E
Skylark Dr	2	Balsom Rd-Kecoughtan Rd	2000	D	2000	D
Spicewood Dr	2	Balsom Rd-Yadkinville Rd	2400	C	2400	C
	2	Yadkinville Rd-Olivet Church Rd	2700	D	2000	C
Stratford Rd (US 158)	5	Kinnamon Rd-Jonestown Rd	33600	B	30900	B
	5	Jonestown Rd-Somerset Dr	35200	B	35200	B
	5	Somerset Dr-Hanes Mall Blvd	40000	D	44600	E
Styers Ferry Rd	2	Country Club Rd–US 421	14300	E	15100	E
Tobaccoville Rd	2	Bethania-Tobaccoville Rd-Reynolda Rd	5000	C	5000	C
Transou Rd	2	Yadkinville Rd-Balsom Rd	4300	E	4300	E
	2	Balsom Rd-Reynolda Rd	6000	E	6000	E
US 421	4	Jonestown Rd-S. Peace Haven Rd	55000	D	53200	D
	4	S. Peace Haven Rd-Preferred Alt	50300	D	48600	D
	4	Preferred Alt-Styers Ferry Rd	52000	D	52000	D
Vienna-Dozier Rd	2	Balsom Rd-Skylark Rd	16200	E	16200	E
	2	Skylark Rd-Yadkinville Rd	3000	D	3000	D

Table 2-19: Project R-2247 - Local Roadway Network Traffic Volumes and Level of Service

Roadway	Lanes	Segment	No-Build ADT	No-Build LOS	Build ADT	Build LOS
Walker Rd	2	NC 65-Murray Rd	1700	D	1700	D
Yadkinville Rd	2	Kecoughton Rd-Transou Rd	16300	E	12800	D
	2	Transou Rd-Spicewood Rd	15900	E	15200	E
	2	Spicewood Dr-Shattalon Dr	21100	E	18600	E
	2	Shattalon Dr-Reynolda Rd (NC 67)	19200	E	17700	E

Table 2-20: Project R-2247 - Comparison of Roadway Segment 2025 Traffic Volumes and Levels of Service

	No-Build Alternative	Preferred Alternative
Number of Roadway Segments Analyzed	74	74
Segments with LOS D in 2025 Peak Hours	18 (24%)	19 (26 %)
Segments with LOS E or F in 2025 Peak Hours	44 (59%)	41 (55%)
Segments with Improved LOS in 2025 Peak Hours Compared to No-Build	--	7 (9%)
Segments with Degraded LOS in 2025 Peak Hours Compared to No-Build	--	4 (5%)
Segments with Reduced 2025 Average Daily Traffic Volumes Compared to No-Build	--	30 (41%)
Segments with Increased 2025 Average Daily Traffic Volumes Compared to No-Build	--	9 (12%)

2.10 PROJECTS U-2579 and U-2579A - BUILD ALTERNATIVES

2.10.1 Project U-2579

2.10.1.1 Preliminary Alternative Segments

The Project U-2579 study area was defined in a 1993 scoping meeting (see **Figure 1-1**). The study area was defined to locate the Northern Beltway outside much of the urbanized portion of Forsyth County in order to reduce impacts to communities, while keeping the route close enough to travel destinations to serve Forsyth County traffic in addition to traffic from outside the region. Extending the study area farther to the north and east would have required an expansion of several miles in order to extend beyond central Rural Hall, Walkertown, and Kernersville. A route in this outer area would be considerably longer and would result in substantially greater natural resource impacts as well as increased cost. Shifting the study area closer to central Winston-Salem would result in much greater community impact and potentially impacting Salem Lake and its watershed critical area.

Thirty-four preliminary alternative segments were developed within the study area. The Project U-2579 preliminary alternatives follow the general conceptual location shown on the 2002 and *2005 Thoroughfare Plans* (see **Figure 1-7**). The preliminary alternatives begin east of US 52 at the NC 66 Connector overpass at the Norfolk Southern Railway, and end at US 421/I-40 Business east of the Hastings Hill Road overpass (see **Figure 2-16**). The terminus near US 52 was selected based on interchange spacing and was coordinated with the location of the adjacent Western Section of the Northern Beltway (Project R-2247), as was described in **Section 2.8.5.2**.

Four alternative southern termini locations at US 421/Business I-40 were chosen based on providing adequate spacing from existing interchanges and, in the case of the three eastern locations, avoiding impact to the Salem Lake Watershed critical area. The westernmost southern terminus conformed to the 1987 Thoroughfare Plan alignment and was located largely downstream of Salem Lake. Alternative termini between those locations would have impacted the watershed and also would have had conflicts with existing interchanges. Termini to the east of those chosen for study would conflict with the Kernersville Road interchange and also would have greater impact developed areas of Kernersville.

In early 1993, preliminary alternative segments were developed through the application of Land Suitability Mapping (LSM), which identifies major physical features within the study area to determine how to most effectively minimize freeway impacts. Preliminary alternatives were strategically located to help minimize impacts to these features within the corridor. The preliminary alternative segments are shown on **Figure 2-16**. The LSM was used to show various factors that would limit or control the development of a highway. Some of the major physical features shown on the LSM were:

- Stream crossings and preliminary wetland sites
- The 100-year floodplain and floodways
- Salem Lake and other water supply watersheds
- Parks and recreational open spaces
- Recorded and observed potential hazardous material sites
- Cultural resources (known historic architectural and archaeological sites)
- Neighborhood integrity
- Minorities
- Cemeteries, schools, churches
- Community buildings
- Rescue and fire departments
- Recorded important agricultural and forest lands
- Areas not previously mentioned already developed for use by some other non-roadway activity

Engineering factors considered included geometric and roadway design criteria, road-user safety, traffic service provided, and constructability from both economic and engineering feasibility aspects. At the first Citizens Informational Workshop on April 29, 1993, citizens were provided the opportunity to suggest additional study segments within the study area. Although no new preliminary alternative segments emerged from the workshop, citizens offered suggestions to the proposed project, including widening of existing roads (discussed in **Section 2.6.3**) and routing the Northern Beltway further north and east of Winston-Salem.

2.10.1.2 Evaluation of Preliminary Alternatives

The 34 Project U-2579 preliminary alternative segments were analyzed individually, and were documented in the *Preliminary Alternatives Technical Memorandum* (February 1994), which is appended by reference. The segments are shown on **Figure 2-16**. Those segments determined to be infeasible were eliminated from further detailed study. The remaining segments were then combined into continuous alternatives between the studied termini. A 1,200-foot wide corridor was established along the centerline of each alternative recommended for detailed study. The 1,200-foot width allowed flexibility in fine-tuning the location of the proposed freeway, which is estimated to have a 300-foot right-of-way width (exclusive of interchange areas). The Detailed Study Alternative segments are shown on **Figure 2-17a**, and the Detailed Study Alternatives are

shown on **Figure 2-17(b-c)**. At the second Citizens Informational Workshop on March 8, 1994, the Detailed Study Alternatives were presented to the public for additional comments.

Alternative Segments Considered but Not Recommended for Further Study. Of the 34 preliminary alternative segments studied, eleven were determined not to warrant further study. The reasons for the elimination of these eleven segments from further studies were originally discussed in Section 2.4.2.2 of the 1995 Project U-2579 DEIS, and are updated herein to reflect current conditions. Each segment is described below:

Segment 1 — Segment 1 would impact two schools (Cash Elementary and Kerwin Baptist) and is located close to Kernersville. It would have greater impacts to residential development, streams, and wetlands than the other two comparable segments (Segments 2 and 3). For example, Segment 2 would take homes from the western portion of Windsor Park subdivision, while Segment 1 would bisect the subdivision. While it is located about 0.4 mile and one mile farther from Salem Lake than Segments 2 and 3, respectively, this advantage does not outweigh the impact to schools, homes, neighborhoods, wetlands, and streams. Changes in development since the original evaluation, including additional development in Windsor Park and construction of a new school north of West Mountain Street, have strengthened these conclusions.

Segment 6 — This segment was developed to use the more northerly location (similar to Segments 4 and 20) while providing a nearly perpendicular crossing for the proposed interchange at University Parkway (NC 66). Like Segments 4 and 7, it would affect the automobile junkyard on University Parkway (NC 66). While no contamination has been recorded, the junkyard was identified as a potential hazardous material site. The junkyard is located on the eastern side of University Parkway opposite the intersection of the NC 66 Connector (SR 1840).

Segment 6 is anticipated to relocate approximately nine fewer residences than Segments 4 and 20. However, Segment 6 has a less desirable crossing at Stanleyville Drive and would involve more impact on wetlands than the northernmost segments. It also has poor alignment characteristics east of Stanleyville Drive. For these reasons, it was eliminated. Since the original evaluation, the boundaries of the Clayton Family Farm (a property eligible for listing in the National Register of Historic Places) have been expanded. Segment 6 would cross through a large portion of the farm. It is not possible to avoid the farm using this alternative, another important reason for eliminating this segment from further consideration.

Segments 5 and 23 — These segments provide a less direct route than the comparable segments (2.2 miles using Segments 4, 5, and 23 versus 1.8 miles using Segment 7). There would be poor roadway geometry at the proposed interchange at Germanton Road. Additionally, several more residential neighborhoods would be impacted and additional streams would be crossed between Stanleyville Road and Germanton Road. There are no benefits for using these segments as opposed to either Segment 7 or Segments 4 and 20. Therefore, Segments 5 and 23 were

eliminated. No changes have occurred in either roadway geometry, neighborhoods that would be impacted, or streams since the original evaluation that would change these conclusions.

Segment 10 — This short segment (0.4 mile) provides a connection between Segment 25 and Segment 22. Combined Segments 25, 10, and 22 have less desirable geometrics and are slightly less direct than combined Segments 24 and 11. Also, two additional intersecting roads would require grade separation structures, and Segment 10 was eliminated due to the additional cost for the grade separation structures, geometrics, and the less direct route. The characteristics of Segment 10 that caused it to be eliminated previously – its need for two additional grade separations and its less direct and poorer geometry – are still issues today, so Segment 10's elimination remains valid.

Segment 12 — This segment is anticipated to be more disruptive to the Mill Creek floodplain than the other preliminary alternative segments. A proposed interchange at Baux Mountain Road would be located almost entirely within the 100-year floodplain. This segment was eliminated because of the extensive construction that would be required in the Mill Creek floodplain. Changes in the floodplain constraint have not changed since the original evaluation, so this conclusion remains valid.

Segment 13 — This segment was eliminated due to its impact on the John Day House, a historic property identified as eligible for listing in the National Register of Historic Places (NRHP). The entire 11-acre property of the John and Charles Fries Day Farm is still considered eligible for the NRHP.

Segment 15 — The elimination of Segments 28 and 13 necessitates the elimination of Segment 15.

Segment 17 — This segment generally follows the same alignment shown on the adopted *1987 Thoroughfare Plan*. This alignment would not function well as a circumferential loop, but would be more of a radial facility. This segment would superimpose the Northern Beltway as a freeway facility upon the existing and uncontrolled access portion of US 158 between Old Greensboro Road and US 421/I-40 Business. There are major disadvantages with doing this. These disadvantages include the required interchanging of the proposed Eastern Section of the Northern Beltway with US 158/Old Greensboro Road; providing access to a large industry (Tyco Electronics) located just east of US 158 between Old Greensboro Road and US 421/I-40 Business; and having to conduct major construction activities adjacent to Salem Lake to replace the existing directional interchange of US 421/I-40 Business at US 158 with a full-movement freeway-to-freeway interchange. Salem Lake is used as a secondary water supply source for the City of Winston-Salem and for recreational purposes.

The proposed interchange at US 421/I-40 Business would disrupt an industrial park just south of the interstate, as well as a cemetery in the northwest quadrant of the existing US 421/I-40 Business and US 158 interchange. This cemetery (Masten Graveyard) has been assessed as potentially eligible to the National Register of Historic Places. Any impacts to Salem Lake Park would constitute an impact under Section 4(f), and the cemetery would likely also involve Section 4(f). Due to the aforementioned problems, upgrading the existing four-lane US 158 facility to a freeway would not be prudent. The advantages of this segment, including serving higher traffic, do not outweigh the substantial disadvantages. These conditions still existed in 2004 and concern for watershed protection has increased since the initial evaluation. In addition, a large residential subdivision has been built west of US 158 near Belews Creek Road, in the path of this segment.

Segment 28 — This segment would take property from the John and Charles Fries Day Farm, which is eligible for listing in the National Register of Historic Places. Segment 8 was developed to avoid this historic resource and does not result in substantial impacts on other factors. Therefore, Route Segment 28 was eliminated from further consideration. The John and Charles Fries Day Farm still exists and remains eligible for the National Register.

Segment 29 — This segment, in combination with Segments 13 and 15, has less desirable geometric features than Segment 8 and offers no identifiable advantages. This conclusion was still valid in 2004.

Other Alternatives Considered and Determined to be Non-Viable Alternatives. Several citizens attending the workshop held in April 1993, including the Mayor of Walkertown, requested that the Northern Beltway be located north of Walkertown. Consideration was subsequently given to expanding the study area. It was determined that locating the Northern Beltway north of Walkertown is not desirable because of the low existing and projected traffic volumes in that area, circuitous travel required (about 1.5 miles in additional length), additional disruption to development, and the additional cost of construction and right of way.

2.10.1.3 Project U-2579 Detailed Study Alternatives

Using the remaining segments, two Detailed Study Alternatives (Eastern Alternative and Western Alternative) and five crossovers were developed between the designated termini at US 52 and US 421/I-40 Business.

In addition to the Eastern and Western Alternatives, eight other Detailed Study Alternatives are possible by combining portions of the Eastern and Western Alternatives and the crossovers. The ten Detailed Study Alternatives are as follows:

- Eastern = E1+E2+E3+E4+E5
- Western = W1+W2+W3+W4+W5
- Alternative 1 = E1+C1+W3+W4+W5
- Alternative 2 = W1+C2+E3+E4+E5
- Alternative 3 = E1+E2+E3+C3+W4+W5
- Alternative 4 = W1+C2+E3+C3+W4+W5
- Alternative 5 = E1+E2+E3+E4+C5+W5
- Alternative 6 = W1+W2+W3+C4+C5+W5
- Alternative 7 = W1+W2+W3+C4+E5
- Alternative 8 = W1+C2+E3+E4+C5+W5

The Detailed Study Alternative segments are shown on **Figure 2-17a**, and the alternatives are shown on **Figure 2-17(b-c)**. Alternatives are described on the following pages. **Figure 2-17(d-e)** shows the 1,200 foot alternative segments on a detailed study map that shows environmental constraints. These figures help compare the Detailed Study Alternatives with respect to their impacts on the social and natural environment.

These alternatives were first presented to the public during the second Citizens Informational Workshop on March 8, 1994. The width of each of the alternative corridors and crossovers is 1,200 feet unless otherwise noted (additional width is required at the proposed interchange locations). The actual right-of-way width to be purchased is anticipated to be a minimum of 300 feet.

For the 1994 functional design plans for the Detailed Study Alternatives, the 300-foot right-of-way width was located in the center of the 1,200-foot corridor. This right of way was shifted slightly as necessary within the corridors to avoid identified resources such as natural features, historic resources, or large communities. The exact location of the proposed highway within the

1,200-foot-wide corridor was refined during preliminary design, and the construction limits of the refined design were used to determine impacts of the Preferred Alternative for this document.

Western Alternative (see **Figure 2-17(a-c)**) — The Project U-2579 Western Alternative is approximately 12.7 miles in length. It begins at the NC 66 Connector, just east of US 52. The Western Alternative extends on new location crossing University Parkway in an easterly direction, generally paralleling Old Hollow Road (NC 66) about one-half mile to its north. It crosses Stanleyville Drive and NC 8 (Germanton Road) about 0.3 miles north of the intersection of NC 66 and NC 8 (Germanton Road). The Western Alternative crosses NC 66 just east of Old Rural Hall Road and proceeds southeast, generally paralleling NC 66 to the south.

The Western Alternative crosses Baux Mountain Road and Davis Road, before crossing Dippen Road south of the intersection of Dippen Road and Day Road. It crosses Old Walkertown Road near Northampton Drive and New Walkertown Road (US 311) south of Williston Road. Continuing in a southeast direction, the alternative crosses Williston Road, Old Belews Creek Road, and Reidsville Road (US 158) about 0.4 mile south of its middle intersection with Old Belews Creek Road. It also crosses Walkertown-Guthrie Road. The Western Alternative crosses West Mountain Street just east of the intersection of Hastings Hill Road and West Mountain Street. It continues to US 421/I-40 Business and ends at a proposed interchange 0.5 mile east of the grade-separation structure at Hastings Hill Road.

The Project U-2579 Western Alternative includes potential interchanges at the following intersecting roads:

- NC 66 (University Parkway)
- NC 8 (Germanton Road)
- Baux Mountain Road
- US 311 (New Walkertown Road)
- US 158 (Reidsville Road)
- US 421/I-40 Business (NC 150)

Eastern Alternative (see **Figure 2-17(a-c)**) — The Project U-2579 Eastern Alternative is approximately 13.5 miles in length. It begins at the NC 66 Connector just east of US 52. The Eastern Alternative extends on new location in a northeast direction, crossing University Parkway, Stanleyville Drive, and NC 8 (Germanton Road) about one mile north of the intersection of NC 8 (Germanton Road) and NC 66. The Eastern Alternative turns to a southeasterly direction, crossing Providence Church Road, Baux Mountain Road, and Davis Road about 0.5 mile north of the intersection of NC 66 and Davis Road. Continuing just east of Davis Road, the Eastern Alternative turns to the south crossing NC 66 midway between McGee Road

and Dippen Road. It crosses Day Road before turning southeast and crossing Old Walkertown Road and US 311 about 0.2 miles north of the intersection of US 311 and Williston Road. It passes through the auto/rail distribution complex (Allied Terminal Systems, Ltd.) located on Old Walkertown Road.

The Eastern Alternative continues in a southeast direction and crosses US 158 about 0.9 miles south of the intersection of Darrow Road and US 158. Continuing in the same direction, it crosses Old Belews Creek Road, Walkertown-Guthrie Road, and West Mountain Street about one mile west of its intersection with NC 66. The Eastern Alternative extends to a proposed interchange with US 421/I-40 Business about 0.8 miles east of the Hastings Hill Road grade-separation structure.

The Project U-2579 Eastern Alternative includes potential interchanges located at the following intersecting roads:

- NC 66 (University Parkway)
- NC 8 (Germanton Road)
- Baux Mountain Road
- US 311 (New Walkertown Road)
- US 158 (Reidsville Road)
- US 421/I-40 Business (NC 150)

The Eastern Alternative could include an additional interchange at NC 66 (Old Hollow Road). The five crossover corridors include:

Crossover 1 — Crossover 1 is approximately two miles in length. It provides a transition from the portion of the Eastern Alternative west of Providence Church Road to the portion of the Western Alternative that crosses and extends east of Baux Mountain Road. Crossover 1 would cross NC 66 about 0.3 miles east of its intersection with Providence Church Road. No additional potential interchanges are located on Crossover 1.

Crossover 2 — Crossover 2 is approximately 2.4 miles in length. It provides a transition from the portion of the Western Alternative that crosses and extends west of NC 8 (Germanton Road) to the portion of the Eastern Alternative just west of Baux Mountain Road. No additional potential interchanges are located on Crossover 2.

Crossover 3 — Crossover 3 is approximately 1.4 miles in length. It provides a transition from the Eastern Alternative near Day Road to the Western Alternative near US 311. No additional potential interchanges are located on Crossover 3.

Crossover 4 — Crossover 4 is approximately 1.5 miles in length. It provides a transition from the Western Alternative near US 311 to the Eastern Alternative near US 158. No additional potential interchanges are located on Crossover 4.

Crossover 5 — Crossover 5 is approximately 1.6 miles in length. It provides a transition from the Eastern Alternative near US 158 to the Western Alternative near West Mountain Street. No additional potential interchanges are located on Crossover 5.

2.10.2 Project U-2579A

2.10.2.1 Preliminary Alternative Segments

The original limits of Project U-2579 were US 52 and US 421/I-40 Business. A proposal was made in January 1994 at a Project U-2579 interagency meeting to extend those limits to US 311.

Once Project U-2579 was identified as a potential route for I-74, FHWA recognized that US 311 would be a more logical endpoint for Project U-2579. NCDOT had designated that I-74 would use the portion of US 311 from Winston-Salem to US 220 to carry the route toward its destination in South Carolina. Because of that designation, it was logical for NCDOT to extend Project U-2579 to US 311, an existing freeway that will require little modification to be signed as I-74. The extension was designated as Project U-2579A, the Northern Beltway Eastern Section Extension.

Meanwhile, the DEIS for Project U-2579 was approved in September 1995 and the Preferred Alternative was selected in May 1996. The first meeting to discuss the purpose and need for Project U-2579A was held in February 2000, after which preliminary alternative segments were developed. A supplemental DEIS for Project U-2579A was underway when the decision was made to combine the environmental document for the Eastern and Western Sections of the Beltway in November 2001.

The termini of the proposed Project U-2579A alternatives are US 311 on the south and US 421/I-40 Business on the north. Ultimately, Projects U-2579 and U-2579A together will extend from US 52 to US 311. Since a preferred alternative had already been selected for Project U-2579 prior to the decision to extend the project to US 311, alternatives for Project U-2579A were developed to tie into the southern terminus of the Project U-2579 Preferred Alternative at US 421/I-40 Business. A review of other potential northern termini included impacts both north and south of US 421/I-40 Business and determined that there would be more impact at other locations. A detailed discussion of this review of the northern terminus for Project U-2579A is in **Section 2.111.2.1**. The location of the southern terminus at US 311 was flexible.

To develop preliminary alternatives, the Project U-2579A study area was divided into two parts: one from US 421/I-40 Business to I-40 and one from I-40 to US 311. The preliminary alternatives between US 421/I-40 Business and I-40 are N1, N2, N3, and N4 ("N" standing for north of I-40). The alternatives between I-40 and US 311 are S1, S1A, and S2 ("S" standing for south of I-40).

Major physical features were identified within the study area to determine how to most effectively minimize impacts. Preliminary corridors account for these features and are strategically located to help minimize impacts within the area. The feasibility of each corridor was reviewed on the basis of providing acceptable design, geometrics, costs, and limits to adverse social and environmental impacts.

Segments were developed into continuous alternatives between the studied termini. Several preliminary alternatives for Project U-2579A were investigated as a result of planning studies. They were discussed with the Section 404/NEPA Merger Team (NCDOT, FHWA, and state and federal regulatory and resource agencies) on February 8, 2001 at a meeting to discuss Concurrence Points 1 (Purpose and Need) and 2 (Alternatives). They were also discussed with the Metropolitan Planning Organization (MPO) on March 23, 2001. Preliminary alternative segments are shown on **Figure 2-18**.

On February 8, 2001, it was agreed to perform a screening of the preliminary alternative segments based on the following criteria:

- Major adverse impact to existing residential communities, including relocations and impact on community cohesion;
- Major adverse impact to businesses, including relocations or adverse impact to accessibility;
- Inconsistency with project purpose and need;
- Undesirable traffic operational or safety conditions;
- Adverse impacts to known archaeological sites and historic properties, and to existing or planned parks and greenways, including Section 4(f) impacts and major Section 106 effects;
- Major adverse impacts to wetlands or other sensitive natural areas; and
- Higher cost of construction.

These criteria are relative rather than absolute (i.e., if most of the alternatives would result in 100 to 150 residential displacements, 300 would probably be considered unacceptable; but if the range was 200 to 400, 300 would be acceptable). The same holds true for the other criteria — the alternative segments are judged in relation to one another, rather than by an absolute standard. In general, alternative segments with greater negative impacts in most or all categories or

substantially greater impacts in at least one category without corresponding benefits were eliminated from consideration.

The four northern alternative segments (N1, N2, N3, and N4) start at the planned interchange of US 421/I-40 Business and Project U-2579. The alternatives continue south to four separate interchange locations at Kernersville Road and meet again at I-40. All alternatives use the same interchange location at I-40, which was chosen to minimize the impacts to natural resources and neighborhoods along I-40. In addition, the location options for a new interchange between US 311 and Union Cross Road were limited due to the spacing between those two existing interchanges. At I-40, three alternative segments are routed southward to two interchange locations at US 311 (S1, S1A, and S2).

Several other potential alternative segments were investigated but discarded because of readily apparent feasibility issues. Moving the southern terminus of Segment S1 further west to minimize impacts to Muddy Creek was investigated, as suggested at the February 8, 2001 agency meeting, but was determined not to qualify for further study for several reasons. The alternative would intersect with US 311 too close to the existing Ridgewood Road interchange, also resulting in a substantial amount of out-of-direction travel. It would not be possible to construct this alternative without violating design criteria for an Interstate roadway or creating massive neighborhood disruption and relocations.

An alternative further east was discussed, but it would not be compatible with the Union Cross Road interchange at I-40, which provides access to a fairly large area and a shopping center at the interchange. This alternative also would impact Glenn High School and result in substantial wetland and floodplain impacts in the Abbott's Creek/Pine Tree Branch area.

2.10.2.2 Project U-2579A - Evaluation of Preliminary Alternatives

Each of the preliminary alternative segments for Project U-2579A (**Figure 2-18**) was evaluated based on criteria listed in the previous section. Of the seven alternative segments, two (Segments N4 and S1A) were determined not to warrant further study. **Table 2-21** summarizes the impacts of the preliminary alternatives segments based on right-of-way width. **Table 2-22** summarizes the impacts of preliminary alternatives created by combining various segments.

Segment N4 – In comparison with the other northern segments, Segment N4 would relocate the largest number of residences. Although the wetland impacts by this segment would be lower than the other northern segments, it crosses the same number of major streams and floodplains, and would have higher stream impacts (12,900 feet versus the next-highest impact of 8,000 feet by Segment N3). It would have a higher impact on natural communities, and increase the noise levels at the most number of residences. In addition, the northwest ramps of the I-40 interchange for Segment N4 would substantially impact Fiddler Creek. Shifting Segment N4 to the east to

avoid the impacts to Fiddler Creek would result in a longitudinal impact on a tributary of Fiddler Creek to the east of the interchange.

Segment S1A – This segment was originally discussed as an alternative to Segment S1, and was designed to be used only in combination with N4. Although the impacts to residences, streams and wetlands, and natural communities are similar for Segments S1 and S1A, Segment S1A was eliminated when Segment N4 was eliminated. In addition, when combined with Segment N4, the northwest ramps of the I-40 interchange would substantially impact Fiddler Creek.

Elimination of Preliminary Alternatives. At the Concurrence Point 2 (Alternatives) meeting on April 18, 2001, the Section 404/NEPA Merger Team agreed to the preliminary alternative segments to be carried forward for detailed study. Based on the above evaluation, Segments N4 and S1A were eliminated from further consideration.

Table 2-21: Project U-2579A - Environmental Comparison of Preliminary Alternative Segments

Factor	Preliminary Alternative Segment					
	Northern				Southern	
	N1	N2	N3	N4	S1 (S1A)*	S2
Length (Miles)	2.69	**2.65**	2.59	2.74	**1.74** (1.70)	1.95
Displacements						
Residences	112	**88**	82	122	**19** (24)	62
Businesses	6	**7**	7	0	**0**	0
Other (Schools, Churches, etc.)	0	**0**	1	0	**0**	0
Park and Greenway Impacts						
Existing Greenway Crossings	0	**0**	0	0	**0**	0
Proposed Greenway Crossings	1	**1**	1	1	**0**	0
Parks Impacted	0	**0**	0	0	**0**	0
Historic Impacts						
National Register Sites/Study List Sites	0	**0**	0	0	**0**	0
Stream and Wetland Impacts						
Wetland Impacts (acres)	3.9	**5.2**	4.6	2.2	**5.1** (4.9)	0.0
Major Stream/Floodplain Crossings	4	**4**	4	4	**2**	2
Minor Stream Crossings (Not Included Above)	3	**3**	4	4	**2 (3)**	3
Stream Impact (feet)	6,900	**7,300**	8,000	12,900	**7,400** (6,000)	8,400
Natural Communities Impact						
Relative Impact (L=Low, M=Medium, H=High)	L	**L**	L	M	**M**	L
Noise Impacts (Residences)	32	**34**	19	35	**20** (19)	19
Potential Hazardous Material Sites/USTs In Corridors	0	**0**	2	0	**0**	0
Construction Cost ($ millions, 2001)	88.9	**91.6**	94	92.1	**59.5**	49

*Numbers in parentheses are for Segment S1A if different than for Segment S1.
Impacts are based on estimated right-of-way width.
Bold indicates Preferred Alternative.

Table 2-22: Project U-2579A - Environmental Comparison of Preliminary Alternatives

Factor	Preliminary Alternative							
	N1-S1	N1-S2	N2-S1 (Pref.)	N2-S2	N3-S1	N3-S2	N4-S1	N4-S2
Length (Miles)	4.43	4.64	**4.39**	4.6	4.33	4.54	4.44	4.69
Displacements								
Residences	131	174	**107**	150	101	144	146	184
Businesses	6	6	**7**	7	7	7	0	0
Other (Schools, Churches, etc.)	0	0	**0**	0	1	1	0	0
Park and Greenway Impacts								
Existing Greenway Crossings	0	0	**0**	0	0	0	0	0
Proposed Greenway Crossings	1	1	**1**	1	1	1	1	1
Parks Impacted	0	0	**0**	0	0	0	0	0
Historic Impacts								
National Register Sites/Study List Sites	0	0	**0**	0	0	0	0	0
Stream and Wetland Impacts								
Wetland Impacts (acres)	9	3.9	**10.28**	5.18	9.7	4.6	7.1	2.2
Floodplain and Major Stream Crossings	6	6	**6**	6	6	6	6	6
Minor Stream Crossings (Not Included Above)	5	6	**5**	6	6	7	7	7
Stream Impact (feet)	14,300	15,300	**14,700**	15,700	15,400	16,800	18,900	20,300
Natural Communities Impact								
Relative Impact (L=Low, M=Medium, H=High)	M	L	**M**	L	M	L	M	M
Noise Impacts (Residences)	52	51	**54**	53	39	38	54	54
Potential Hazardous Material Sites/USTs In Corridors	0	0	**0**	0	2	2	0	0
Construction Cost ($ millions, 2001)	148.4	137.9	**151.1**	140.6	153.5	143	151.6	141.1

Impacts are based on estimated right-of-way width.
Bold indicates Preferred Alternative.

2.10.2.3 Project U-2579A Detailed Study Alternatives

Following the evaluation presented in **Section 2.10.2.2**, three northern preliminary alternative segments and two southern preliminary alternative segments were retained for detailed study (shown in **Figure 2-19**). As with Project U-2579, the width of each of the alternative corridors is 1,200 feet, with additional width at the proposed interchange locations. The actual right-of-way width is anticipated to be a minimum of 300 feet. The exact location of the proposed highway within the 1,200-foot-wide preferred corridor will be determined during final design, following the Record of Decision. However, preliminary designs within the corridors for the Detailed Study Alternatives were developed to minimize impacts to resources. **Figure 2-19** shows the Detailed Study Alternative segments. These figures assist in comparing the alternatives with respect to their impacts on the social and natural environment.

At the request of the Section 404/NEPA Merger Team at the April 18, 2001 meeting, the Project U-2579A Detailed Study Alternatives have been evaluated both with and without an interchange at Kernersville Road. The following discussion refers to Detailed Study Alternatives with and without the Kernersville Road interchange. Also, for clarity, the northern and southern portions of the Detailed Study Alternatives are described separately.

The Project U-2579A Detailed Study Alternatives all share a common northern terminus at US 421/I-40 Business. From this point, the two westernmost segments (N1 and N2) curve to the southwest and the eastern segment (N3) follows a route due south. At Sedge Garden Road, Segment N2 diverges slightly to the east of Segment N1. Segments N1, N2, and N3 all have the option of an interchange at Kernersville Road. South of Kernersville Road, Segment N2 continues southeast along Oak Grove Road until it meets Segment N3. From here, Segments N2 and N3 continue southward together to an interchange at I-40. Segment N1 curves southeast from Kernersville Road to meet Segments N2 and N3 at a common interchange location at I-40 about 1,000 feet west of Oak Grove Road.

The Detailed Study Alternatives continue south from the I-40 interchange as Segments S1 and S2. South of the I-40, Segment S1 curves to the southwest and terminates in an interchange at US 311. Segment S2 heads in a southeastern direction from I-40. Thus, the interchange of Segment S2 at US 311 is east of the interchange location of Segment S1. The location of the Segment S2 interchange requires the removal of the interchange at Union Cross Road. No interchanges are planned between I-40 and US 311.

Six alternatives were retained for detailed study, each with and without an interchange at Kernersville Road, as listed below and documented in the concurrence form dated April 18, 2001 (**Appendix D.4**).

- N1-S1
- N1-S2
- N2-S1
- N2-S2
- N3-S1
- N3-S2

2.10.3 Projects U-2579 and U-2579A - Traffic Operations and Levels of Service

Traffic operations, including levels of service, were evaluated for the Project U-2579 Preferred Alternative and the U-2579A Detailed Study Alternatives based on year 2025 traffic projections developed from the Piedmont Triad Regional Travel Demand Model. These analyses are documented in the *Traffic Technical Memoranda for the Eastern Section* and *Eastern Section Extension* (December 2003 and February 2002, respectively), which are appended by reference. **Figure 2-20(a-b)** shows the projected year 2025 traffic volumes and turning movements at the interchanges for Projects U-2579 and U-2579A.

Capacity analyses were performed for selected major arterials in the project study area for both Build and No Build conditions. Results of these analyses are summarized in **Table 2-22-1**. Traffic for the Build condition assumes completion of both the Western Section (from US 158 southwest of Winston-Salem to US 52 on the north) and the Eastern Section (from US 52 on the north to US 311 on the southeast) of the Northern Beltway. The No Build condition assumes that the Western Section of the Northern Beltway, from US 158 to US 52 North, is constructed but that the Eastern Section of the Northern Beltway, from US 52 North to US 311, is not constructed.

The Northern Beltway, Eastern Section Extension will provide substantial traffic relief for already congested sections of US 52, thereby improving travel conditions along the corridor. For the section of US 52 between University Parkway and where the Northern Beltway would tie into US 52, overall traffic volumes for 2025 on US 52 would decrease from over 113,000 vehicles per day (vpd) in the No Build scenario to just over 63,000 vpd in the Build scenario. This traffic reduction would enable US 52 to be constructed as a 6-lane facility (three lanes per direction) rather than an 8-lane facility (four lanes per direction) in this section. Similarly, as shown in **Table 2-22-1**, the Build alternative provides further decreases in traffic in the section of US 52 between University Parkway and I-40 Business and on several sections of I-40 Business.

Table 2-22-1: Traffic and Capacity Analysis of Major Arterials in the Eastern Section

Roadway	Section	1998 Conditions					2025 No Build Conditions					2025 Build Conditions				
		Lanes	ADT	Capacity	V/C	LOS	Lanes	ADT	Capacity	V/C	LOS	Lanes	ADT	Capacity	V/C	LOS
I-40 Business	US 52 to US 158	4	62,000	61,400	1.01	F	4	75,300	61,400	1.23	F	4	53,900	61,400	0.88	D
	US 158 to Linville Road	4	47,000	61,400	0.77	D	4	53,700	61,400	0.87	D	4	34,200	61,400	0.56	C
	Linville Road to S. Main Street	4	33,000	61,400	0.54	C	4	41,400	61,400	0.67	C	4	41,800	61,400	0.68	C
I-40 Bypass	US 52 to NC 109	6	86,000	95,900	0.90	D	6	138,700	95,900	1.45	F	6	136,000	95,900	1.42	F
	NC 109 to US 311	6	72,000	95,900	0.75	D	6	116,700	95,900	1.22	F	6	116,700	95,900	1.22	F
	US 311 to NC 66	4	51,000	63,600	0.80	D	4	108,600	63,600	1.71	F	4	88,300	63,600	1.39	F
US 52	Beltway to University Parkway	4	46,000	61,400	0.75	C	6	113,100	87,600	1.29	F	6	63,300	87,600	0.72	C
	University Parkway to Germanton Road	4	47,000	61,400	0.77	D	4	42,500	61,400	0.69	C	4	29,000	61,400	0.47	B
	Germanton Road to Akron Drive	4	52,000	61,400	0.85	D	4	48,800	61,400	0.79	D	4	33,100	61,400	0.54	C
	Akron Drive to 25th Street/Liberty Street	4	56,000	61,400	0.91	D	4	52,000	61,400	0.85	D	4	29,500	61,400	0.48	B
	25th St/Liberty St to 12th St/Liberty St	4	69,000	61,400	1.12	F	4	58,600	61,400	0.95	E	4	27,700	61,400	0.45	B
	12th St/Liberty St to I-40 Business	4	65,000	61,400	1.06	F	4	69,200	61,400	1.13	F	4	34,000	61,400	0.55	C
	I-40 Business to I-40	4	55,000	61,400	0.90	D	4	32,800	61,400	0.53	C	4	37,400	61,400	0.61	C
University Parkway	US 52 to Oak Summit Road	4	33,000	32,200	1.02	F	4	52,100	32,200	1.62	F	4	50,300	32,200	1.56	F
	Oak Summit Road to North Point Blvd	4	35,000	32,200	1.09	F	4	50,000	32,200	1.55	F	4	47,200	32,200	1.47	F
	North Point Blvd to N Cherry Street	4	19,500	32,200	0.61	C	4	34,200	32,200	1.06	F	4	31,300	32,200	0.97	E
	N Cherry St to I-40 Business	4	31,000	32,200	0.96	E	4	53,600	32,200	1.66	F	4	42,000	32,200	1.30	F

Source: 1998 ADT and 2025 traffic projections provided by Statewide Planning Branch, NCDOT
Levels of Service based on the 1994 Highway Capacity Manual
ADT = Average Daily Traffic, V/C = Volume/Capacity, N/A = No Data Available

There are opportunity, sustainability, timesaving, and community benefits to providing an alternative for faster-moving traffic that is away from more congested neighborhood communities. There is a reduction in VHT (Vehicle Hours of Travel) by constructing the Western Section (Project R-2247) exclusively – approximately 292 VHT/day, and a greater reduction by constructing both Western and Eastern Sections – 4,539 VHT/day. This yields an annual time savings of 106,580 hours and 1,656,735 vehicles hours, respectively for 2025. Using a national wage average of $16/hr (assumed wages lost or gained in travel time), this equates to a travel time savings of $1,705,280 and $26,507,760 per year, respectively. The Triad Region, in the near-term and future, is experiencing growth, and the analyzed roadway segments are experiencing this growth with or without the beltway.

2.10.3.1 Project U-2579

Analyses of anticipated traffic operating conditions included LOS evaluations for the following: basic lane sections; merge, diverge, and weave operations for freeway ramps; and intersection analyses for ramp termini at interchanges. Projected 2025 traffic volumes along Project U-2579 range from a low of 60,900 vehicles per day (VPD) at the western terminus with US 52 to a high of 76,600 VPD between US 311 (New Walkertown Road) and US 158 (Reidsville Road).

Projected 2025 traffic volumes along Project U-2579A range from a high of 36,000 VPD between Kernersville Road and I-40 to a low of 30,600 VPD between I-40 and US 311.

Capacity analyses performed using the *2000 Highway Capacity Manual* indicate that in the design year 2025, a six-lane basic freeway section would be needed to provide LOS D or better for Project U-2579. A four-lane basic freeway section would be needed to provide LOS D or better for Project U-2579A in the design year 2025.

For each segment of Project U-2579, freeway analyses were conducted for projected 2025 PM peak hour traffic volumes assuming three travel lanes per direction. As shown in **Table 2-23**, all freeway segments are projected to operate at acceptable levels of service with the proposed lane geometry; all sections operate at LOS D or better.

Merge and diverge analyses with the appropriate use of auxiliary lanes indicated LOS D or better at all interchanges. Weave analyses were performed at all proposed interchanges with the proposed Beltway. The interchanges provided a minimum LOS D for weaving. Planning-level intersection capacity analyses were performed where proposed ramps tie into existing surface arterials. By providing three to seven lanes through these intersections, the cross roads are expected to operate at LOS D or better. Analyses were done on interchanges with the following roads:

- US 158 (Reidsville Road)
- New Walkertown Road (US 311)
- Baux Mountain Road
- NC 8 (Germanton Road)
- NC 66 (University Parkway)

Table 2-23: Project U-2579 - Projected 2025 PM Peak-Hour Operation Freeway Segment Levels of Service

Section Name	Direction of Travel	Level of Service (density in pc/mi/ln)
I-40 Business to Reidsville Rd	Northbound	D (28.9)
	Southbound	C (18.8)
US 158 (Reidsville Rd) to New Walkertown Rd	Northbound	D (30.7)
	Southbound	C (19.6)
New Walkertown Road to Baux Mountain Rd	Northbound	D (28.7)
	Southbound	C (18.7)
Baux Mountain Rd to NC 8 (Germanton Rd)	Northbound	D (29.2)
	Southbound	C (18.9)
NC 8 (Germanton Rd) to NC 66 (University Pkwy)	Northbound	C (24.2)
	Southbound	B (16.1)
NC 66 (University Pkwy) to US 52	Northbound	C (23.4)
	Southbound	B (15.6)

2.10.3.2 Project U-2579A

For each segment of Project U-2579A, freeway analyses were conducted for projected 2025 PM peak hour traffic volumes assuming two travel lanes per direction. Scenario 1 includes a new interchange at Kernersville Road, and Scenario 2 assumes that there is no interchange at Kernersville Road. As shown in **Table 2-24**, all freeway segments are projected to operate at acceptable levels of service with the proposed laneage; all sections operate at LOS C or better for both alternatives.

Table 2-24: Project U-2579A - Projected 2025 PM Peak-Hour Operation Freeway Segment Level-of-Service

Section Name	Direction of Travel	PM Peak Hour Level of Service and density (pc/mi/ln)*	
		Scenario 1 (With Kernersville Road Interchange)	Scenario 2 (Without Kernersville Road Interchange)
US 311 to I-40	Northbound	C 18.1	B 17.5)
	Southbound	B 12.1	B 11.6)
I-40 to Kernersville Road	Northbound	B 14.2	-
	Southbound	C 21.3	-
Kernersville Road to I-40 Business/US 421	Northbound	C 20.1	-
	Southbound	B 13.4	-
I-40 to I-40 Business/US 421	Northbound	-	C 18.9)
	Southbound	-	B 12.6)

*LOS	Density Range (pc/mi/ln)	LOS	Density Range (pc/mi/ln)
A	0 to 11	D	27 to 35
B	12 to 18	E	36 to 45
C	19 to 26	F	46+

Merge and diverge analyses with the appropriate use of auxiliary lanes indicated LOS D or better at all interchanges. The proposed interchange at US 421/I-40 Business would require substantial use of multi-lane ramps and auxiliary lanes to accommodate heavy merging and diverging traffic. Weave analyses were performed at all proposed interchanges with the proposed Project U-2579A. The interchanges provided a minimum LOS D for weaving. Planning-level intersection capacity analyses were performed where proposed ramps tie into existing surface arterials. By providing three to seven lanes through these intersections, the cross roads are expected to operate at LOS D or better. The following interchanges of Project U-2579A were analyzed:

- US 421/I-40 Business
- Kernersville Road
- I-40
- US 311

2.10.4 Projects U-2579 and U-2579A - Cost Estimates

2.10.4.1 Project U-2579

For Project U-2579, construction costs were estimated in 1994 dollars for each of the Detailed Study Alternatives based on the 1994 functional design plans that included horizontal and vertical alignments of the proposed highway. The costs were developed using the design criteria and typical sections described in **Section 2.7.1.2**, and shown in **Figure 2-7**. Construction costs estimated included the following elements:

- Mobilization
- Clearing and grubbing
- Earthwork (excavation and embankment)
- Drainage
- Stabilization and pavement
- Structures
- Guardrail
- Erosion control
- Traffic control
- Signing and marking
- Widening cross-streets at interchanges
- Engineering and contingencies
- Noise barriers

Right-of-way cost estimates were prepared based on the following elements:

- Value of the land and improvements that would be acquired
- Damage to parcels
- Relocated homes and businesses
- Utility relocations
- Acquisition costs

By combining the construction and right-of-way costs, the estimated total costs were obtained. The total costs for the Project U-2579 Detailed Study Alternatives range from $163.4 million to $196.9 million (1994 dollars). **Table 2-25** shows the 1994 construction costs, right-of-way costs, and total costs for the Detailed Study Alternatives.

Costs estimates for the Project U-2579 Preferred Alternative were updated in October 2005 through January 2006. The total estimated cost for construction and right of way is $445.2 million dollars. Of this amount, $291.1 million is for construction, $4.0 million is for utility relocations, and $150.1 million is for right of way. The large increase in the project cost was due primarily to the following reasons:

- Increases in unit construction cost
- Increases in right-of-way cost
- Changes in design due to increases in traffic projections, environmental mitigation, and changes in design standards
- Change in project limits (see **Section 2.10.4.2**)

Table 2-25: Project U-2579 – Comparison of Estimated Costs of Alternatives (1994 dollars)

Detailed Study Alternative	Construction Costs (millions $)	Right-of-Way Costs (millions $)	Total Costs (millions $)
Western	130.3	33.1	163.4
Eastern	165.1	31.8	196.9
1	143.9	32.7	176.6
2	155.8	34.1	189.9
3	145.4	35.6	181.0
4	136.1	37.9	174.0
5	150.7	36.7	187.4
6	133.4	33.8	167.2
7*	147.8	28.9	176.7
8	141.4	39.0	180.4

* Preferred Alternative

2.10.4.2 Project U-2579A

Construction costs were estimated for the Project U-2579A Detailed Study Alternatives in 2003 dollars, as shown in **Table 2-26**.

Table 2-26: Project U-2579A – Comparison of Estimated Costs of Alternatives (2003 dollars)

Detailed Study Alternative	Construction Costs (millions $)*	Right-of-Way Costs (millions $)*	Total Costs (millions $)*
N1-S1	177.0 (174.0)	70.3 (61.9)	247.3 (235.9)
N1-S2	165.0 (161.0)	82.4 (74.0)	247.4 (235.0)
N2-S1 (Preferred Alternative)	181.0 (178.0)	64.1 (61.9)	245.1 (239.9)
N2-S2	172.0 (172.0)	80.0 (77.8)	252.0 (249.8)
N3-S1	162.0 (158.0)	65.3 (58.7)	227.3 (216.7)
N3-S2	164.0 (163.0)	81.3 (74.6)	245.3 (237.6)

*Values inside () are for each Alternative without Kernersville Road Interchange

Costs estimates for the Project U-2579A Preferred Alternative were updated in September through December 2005. The total estimated cost for construction and right of way is $215.8 million dollars. Of this amount, $154.2 million is for construction, $1.5 million is for utility relocations, and $60.1 million is for right of way. The decrease in costs from 2003 was due to a change in project limits. The earlier cost estimates for Project U-2579A included the interchange with US 421/I-40 Business up to north of West Mountain Street, while the 2005 estimate stopped south of US 421/I-40 Business.

2.10.5 Projects U-2579 and U-2579A - Safety

Acceptable methodologies for predicting long-range future numbers of crashes and crash rates are not available at this time. These types of analyses are currently not standard practice for NCDOT's Traffic Engineering and Safety Systems Branch. Therefore, this section focuses instead on the general safety benefits of the type of facility being proposed and the specific safety benefits the project is expected to provide.

Modern interstate-standard facilities are the safest facility NCDOT can provide to the public. These facilities have the highest design-standards to minimize the potential for crashes, and built-in protections to lessen the severity of crashes that do occur. Crash rates and injury and fatality statistics demonstrate that modern interstate-standard facilities are indeed the safest type of highway facility. The Eastern Section of the Beltway (a modern interstate-standard facility) would provide the motoring public a safer choice than many of the existing routes available today.

US 52 between US 421/I-40 Business and Akron Drive has a crash rate above the critical crash rate (257.71 and 168.33 crashes per million vehicle-miles, respectively) which points to a safety problem along that route. Because the Eastern Section of the Beltway is projected to reduce volumes along this stretch of US 52 by diverting them to a safer facility, it is expected that the number of crashes on this stretch of US 52 would decrease as a result of the project. NCDOT is also addressing the safety issue along this stretch of US 52 by constructing some safety improvements as part of TIP Project U-2826B.

2.11 PROJECTS U-2579 & U-2579A – PREFERRED ALTERNATIVE

2.11.1 Project U-2579

The DEIS for Project U-2579 was completed in September 1995. Following a corridor public hearing on December 7, 1995, the Preferred Alternative for Project U-2579 was chosen in May 1996. Since land uses have changed and environmental conditions might have changed in the past seven years, the selection of Alternative 7 as the Preferred Alternative was selected in light of current conditions.

2.11.1.1 Original Selection of the Project U-2579 Preferred Alternative

The Project U-2579 Preferred Alternative is shown in **Figure 2-21**. The Preferred Alternative is Detailed Study Alternative 7, which is a combination of the Western and Eastern Alternatives using Crossover 4.

The Preferred Alternative begins at the NC 66 Connector just east of US 52. It extends on a new location crossing University Parkway in an easterly direction, generally paralleling Old Hollow Road (NC 66) about one-half mile to the north of NC 66. It then crosses Stanleyville Drive and NC 8 (Germanton Road) about 0.3 miles north of the intersection of NC 66 and NC 8 (Germanton Road). The Preferred Alternative crosses NC 66 just east of Old Rural Hall Road and proceeds in a southeast direction, generally paralleling NC 66 on its south side. It then crosses Baux Mountain Road and Davis Road before intersecting with Dippen Road south of the intersection of Dippen Road and Day Road. It intersects Old Walkertown Road near Northampton Drive and New Walkertown Road (US 311) south of Williston Road.

The Preferred Alternative transitions from the Western Alternative near US 311 to the Eastern Alternative near US 158 using Crossover 4. The Preferred Alternative follows the Eastern Alternative in a southeast direction and intersects US 158 about 0.9 miles south of the intersection of Darrow Road and US 158. Continuing in the same direction, it intersects Old Belews Creek Road, Walkertown-Guthrie Road, and West Mountain Street about one mile west of its

intersection with NC 66. The Preferred Alternative extends to a proposed interchange with US 421/I-40 Business located 0.8 mile east of the Hastings Hill Road grade separation structure.

Detailed Study Alternative 7 was selected as the Preferred Alternative for the following reasons:

- Involves fewest residential relocations
- Requires the least amount of cultivated/field, woodland, open water, and developed acreage
- Has least impact on established neighborhoods
- Has least impact on the Salem Lake watershed

Figure 2-22(a-i) shows the proposed right of way and travel lanes for the Project U-2579 Preferred Alternative. These maps label specific environmental and community resources in the vicinity of the Preferred Alternative. **Table 2-28** compares anticipated impacts of Alternative 7 with the other Detailed Study Alternatives, and **Table 2-29** compares Alternative 7 with the other Detailed Study Alternatives using engineering criteria. Unless otherwise noted, results are based on the 1994 functional design plans presented in the 1995 Project U-2579 DEIS.

The advantages of the Preferred Alternative are detailed below:

Relocations — The Preferred Alternative would relocate 217 residences, while the other Detailed Study Alternatives would relocate between 231 and 285 residences. Largely as a result of having the least number of residential relocations, the Preferred Alternative also has the lowest right-of-way cost.

Required Acreage — The Preferred Alternative would require a total of 680.5 acres, including cultivated and field, woodland, developed, and open water. The other Detailed Study Alternatives would require from 741.5 to 857.3 acres.

Table 2-28: Project U-2579 - Environmental Comparison of Detailed Study Alternatives

Resource	Preferred (Alt 7)	Western	Eastern	Detailed Study Alternative Combinations With Crossovers						
				1	2	3	4	5	6	8
Length (miles)	**12.7**	12.7	13.5	13.7	13.1	13.9	13.5	14	13.2	13.6
Displacements (minority)	**220 (19)**	262 (25)	235 (27)	262 (26)	240 (26)	282 (32)	287 (31)	262 (33)	247 (25)	267 (32)
Residences (minority)	**217 (19)**	260 (25)	231 (27)	258 (26)	236 (26)	280 (32)	285 (31)	259 (33)	245 (25)	264 (32)
Businesses	**3**	2	4	4	4	2	2	3	2	3
Churches	**0**	0	0	0	0	0	0	0	0	0
Acreage Required										
Cultivated/Field	**105.3**	101.2	102.9	147	62.6	136.8	96.5	127.8	130.2	87.5
Woodland	**302.8**	344.4	386.5	362	375	412.4	400.9	420.8	337.1	409.3
Developed	**271.1**	295.4	292	286	311	289.3	308.3	306.9	286	325.9
Total (includes open water)	**680.5**	741.5	783.2	796	750.9	840.1	807.8	857.3	754.6	825
Acres of Prime, and Statewide and Local Important Farmland	**N/A[1]**	532	500	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]
Acres of Wetland	**7.1**	7.1	7.7	6.2	7.7	8.2	8.2	7.5	6.9	7.5
Acres of Water Resources Impacted										
Open Water	**1.3**	0.5	1.8	0.8	2.3	1.6	2.1	1.8	1.3	2.3
Bank to Bank	**4.0**	3.2	4.0	3.6	3.9	3.7	3.6	3.8	3.8	3.7
Acres of Floodplain	**27.1**	21.0	23.7	20	23.7	17.7	17.7	23.2	26.6	23.2
Major Stream Crossings	**15**	15	15	16	13	15	13	16	16	14

Table 2-28: Project U-2579 - Environmental Comparison of Detailed Study Alternatives

Resource	Preferred (Alt 7)	Western	Eastern	Detailed Study Alternative Combinations With Crossovers						
				1	2	3	4	5	6	8
Impacted Length of Major Streams*	**6,930**	6,324	8,352	7,584	6,822	8,676	5,094	8,052	6,630	6,522
Stream Relocation Length (feet)	**0**	0	0	0	0	0	0	0	0	0
Receptors Exceeding Noise Abatement Criteria	**189**	200	138	182	139	209	210	174	225	175
Receptors with Substantial Noise Increase	**137**	118	129	125	118	131	120	132	140	121
Potential Hazardous Material Sites In or Near Corridor	**1**	1	1	1	1	1	1	1	1	1
Underground Storage Tank Sites In or Near Corridor	**0**	0	0	0	0	0	0	0	0	0
Potentially Eligible Historic Architectural Properties in or near corridor	**1**	1	0	0	1	0	1	0	1	1
Potentially Eligible Archaeological Sites In or Near Corridor	**1**	1	3	2	2	3	2	3	1	2

N/A[1]: Acres of farmland were determined for the Eastern and Western Alternatives and for the five crossovers, but were not calculated for the other Detailed Study Alternatives. Based on land use in the study area, the other alternatives would be expected to have similar acreages of prime and important farmland.
All impacts based on 1994 functional design plans.

Table 2-29: Engineering Comparison of Project U-2579 Detailed Study Alternatives

Resource	Preferred (7)	Western	Eastern	Possible Detailed Study Alternative Combinations With Crossovers						
				1	**2**	**3**	**4**	**5**	**6**	**8**
Length (miles)	**12.7**	12.7	13.5	13.7	13.1	13.9	13.5	14	13.2	13.6
Interchanges	**6**	6	6	6	6	6	6	6	6	6
Other Structures										
Railroad	**4**	3	4	3	4	3	3	3	3	3
Drainage	**13**	14	14	12	16	16	18	16	15	18
Grade Separation	**9**	9	8	9	9	10	11	8	9	9
2020 Projected Traffic (thousands)										
High	**57.9**	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9
Low	**37.3**	37.3	37.3	37.3	37.3	37.3	37.3	37.3	37.3	37.3
2020 Level-of-Service	**C**	C	C	C	C	C	C	C	C	C
Construction Cost (millions, 1994)	**147.8**	130.3	165.1	143.9	156	145.4	136.1	150.7	133.4	141.4
Right-of-Way Cost (millions, 1994)	**28.9**	33.1	31.8	32.7	34.1	35.6	37.9	36.7	33.8	39
Total Cost (millions, 1994)	**176.7**	163.4	196.9	176.6	190	181	174	187.4	167.2	180.4

* Impacted stream lengths calculated by multiplying the length of major drainage structures based on the 1994 functional design plans (Section 4.4.2.1 in the 1995 DEIS) by 1.2 to account for non-linear streams.

Neighborhoods —The Preferred Alternative would be within 500 feet of Temora Lakes Estates and Creekwood Acres. It would directly impact High Meadows, and would impact residences and the community pool in the Doe Run neighborhood. The Western Alternative would have a greater impact to Doe Run, and would impact those same neighborhoods in addition to Twin Oak Estates. The Preferred Alternative and other alternatives using Route Segment E5 would disrupt only the tip of the Windsor Park subdivision near the interchange with US 421/I-40 Business. The Preferred Alternative would affect approximately 8 homes that would be lost and 2 homes that would be separated from the rest of Windsor Park. The Western Alternative and other alternatives using Route Segment W5 would split the Doe Run neighborhood in the vicinity of US 421/I-40 Business and involve the loss of approximately 17 homes with 9 homes separated from the rest of that subdivision, as well as taking the community pool. The Eastern Alternative would be within 500 feet of Pinebrook Valley, Remington Ridge, Scarlet Acres, and a mobile home park near Windsor Park.

Salem Lake — The Project U-2579 Preferred Alternative would have the least impact on the Salem Lake watershed as compared to the Western Alternative or other Detailed Study Alternatives using Route Segment W5 and the same impact as the Eastern Alternative or other Detailed Study Alternatives using Route Segment E5. Salem Lake is a recreational area and a secondary water supply for Winston-Salem.

Other – The Project U-2579 Preferred Alternative was determined by the US Army Corps of Engineers and NC Department of Environment and Natural Resources - Division of Water Quality to be the least environmentally damaging practicable alternative (LEDPA) based on both amount and quality of impacted wetlands (see correspondence in **Appendix D.2**.). Those agencies originally designated the Western Alternative as their preferred, but after field visits and further discussions, the agencies concurred in the selection of Alternative 7 as the LEDPA. The Preferred Alternative also impacts the lowest number of potentially eligible archaeological sites.

2.11.1.2 Selection of the Project U-2579 Preferred Alternative Based on Current Conditions

The Preferred Alternative for Project U-2579 was selected in 1996. As part of this supplemental document, the selection of Alternative 7 as the Preferred Alternative was reviewed in light of current conditions to determine if changes have occurred that could impact the section of Alternative 7.

The original reasons for selection of the Preferred Alternative were reviewed, and any changes that have occurred since 1996 were identified. Those changes were analyzed to determine whether or not they would influence the original reasons for the selection of the Preferred Alternative.

In general, the features and resources that would be expected to change noticeably since 1996 are those relating to the human environment. New additions to the human environment within the project vicinity could include residential neighborhoods and commercial development, construction of new community facilities, and creation of new parkland. **Figure 2-17(d-e)** indicates that several new subdivisions have been built in the Eastern Alternative and in Segment W5 of the Western Alternative, and shows the locations of community facilities within the Preferred Alternative corridor. No new community facilities have been constructed within the Preferred Alternative, although impacts have changed slightly due to revised designs.

No existing greenways or parkland would be impacted by the Preferred Alternative and no new greenways or parklands have been created within the Preferred Alternative corridor. Some proposed greenways in the Project U-2579 study area have changed since the 1995 DEIS. **Figure 3-6** shows existing and proposed greenway trails in the study area.

A new survey for historic architectural resources in the eastern portion of the study area also was conducted in 2002; it identified two historic properties eligible for listing in the National Register of Historic Places in addition to the two properties originally identified. All these properties are shown in **Figure 2-17(d-e)**.

US Census Data from 1990 and 2000 were reviewed to identify trends in overall population in the block groups traversed by the Detailed Study Corridors. A comparison of population densities from 1990 and 2000 show that Forsyth County grew increasingly suburban, with a shift from rural to suburban densities occurring primarily in census block groups located in the southern, western, and northeastern portions of the County.

Aerial photography and mapping were reviewed to confirm that streams have not changed substantially since the original selection of the Preferred Alternative. Natural features such as streams and floodplains have not changed substantially, if at all, since the 1996 evaluation and the relative values of these resources within each Detailed Study Alternative are not substantially different.

The most recent flood insurance rate (FIRM) maps for Forsyth County, dated October 1998, were compared with the floodplain information used in the 1995 DEIS. Based on a review of the figures showing the floodplains, there were no significant differences between the two maps that would result in new encroachment locations not previously reported in the 1995 Project U-2579 DEIS.

The Preferred Alternative for Project U-2579 was selected even though it did not have the lowest estimated impacts to wetlands (7.1 acres compared with other alternatives with impacts ranging from 6.2 acres to 8.2 acres). Since 1996, subsequent Preferred Alternative engineering design refinements combined with detailed wetland delineations resulted in reducing wetland impacts to

6.7 acres within the construction limits. This 6.7-acre impact is based on 1998 wetland surveys and 2005 preliminary engineering designs. It is expected that similar reductions in wetland impacts would result if the same procedures were applied to the non-preferred Detailed Study Alternatives. However, even if the wetland impact of the other alternatives were reduced substantially, this amount would not change the selection in favor of any other Detailed Study Alternative, particularly since quantity of wetland impacts was not the major consideration in the selection of the Project U-2579 Preferred Alternative.

Residential Relocations – Relocations were updated in May 2003 and again in December 2005 (see relocation reports in **Appendix G**). The most recent update count shows an increase in the number of residential relocations, from 217 to 452. This increase is primarily due to refinement of the Preferred Alternative to a more detailed level of design, particularly at interchanges, which indicated larger construction limits and access control. To a lesser extent, the increase reflects additional homes that have been built in the corridor since 1995. Development has also continued to occur in all non-preferred Detailed Study Alternative corridors, as indicated in **Figure 2-17(d-e)**. A comparison of 2003 and 2006 aerial photography, using the functional plans for the Detailed Study Alternatives, confirmed that the Preferred Alternative would still have among the lowest number of residential relocations.

Acreage Required – Because of its shorter length, Alternative 7 would require substantially less acreage than the other alternatives, 680.5 acres versus a range of 742 acres to 857.3 acres for the other alternatives. With the refined 2005 preliminary design plans, the acreage needed was further reduced to 518 acres. While it is anticipated that refined design would also reduce the acreage needed to construct the other alternatives, the Preferred Alternative would still require the least acreage to construct. Within the acreage requirements, the Preferred Alternative also had the lowest impact on forested land (woodland), which was still lower for the refined preliminary design plans.

Impact on Communities – The impact on communities of the Preferred Alternative is essentially the same as was identified previously, although additional residences would be relocated as discussed above. Based on field investigation as well as review of mapping, one new subdivision has been developed in the vicinity of the Preferred Alternative. A shift in the alignment to avoid the Mill Creek floodplain would take approximately six homes at the end of Oakmont Ridge Drive in a newly developed subdivision. As indicated in **Figure 2-17(d-e)**, several new or expanded subdivisions have developed in or near the other Detailed Study Alternatives. In particular, a large residential subdivision (Ashley Woods) has been built south of West Mountain Street that would be heavily impacted and divided by all of the alternatives except the Eastern Alternative and Alternatives 1 and 7 (Preferred). Even with the additional impacts on Oakmont Ridge Drive, the Preferred Alternative still would impact fewer homes and communities than would the Eastern Alternative and Alternative 1. Therefore, it can be concluded that the Preferred Alternative still has the least impact on communities.

One church, Mount Pleasant Christian Church (formerly Mount Pleasant Holiness Church), within the proposed right of way of the Preferred Alternative, was not identified in the 1995 Project U-2579 DEIS. Although the property for the church was purchased in 1992 and the church was open before 1995, the church is located in a small building behind a house, and was not identified as a church during the Project U-2579 DEIS relocation survey. Therefore, this church is not a new impact but an impact that had not been identified in the previous study. Mount Pleasant Christian Church is across from Northampton Road on Old Walkertown Road.

Salem Lake – The impact on Salem Lake and its critical watershed area has not changed. The Preferred Alternative still has the lowest impact on Salem Lake.

Wetland Quality – No increases in the extent or value of wetlands or natural areas have occurred within the proposed right of way of the Preferred Alternative, according to the *Natural Resources Technical Memorandum* (2004). In fact, one wetland area that had been identified previously was determined to have changed such that it is no longer a wetland. As discussed previously, wetlands within other alternatives did not increase in quantity or quality, based on review of mapping and photography.

Extension south of US 421/I-40 Business as the Eastern Section Extension – The preferred terminus of Project U-2579 at US 421/I-40 Business had already been identified when Project U-2579A was proposed. Therefore, the impacts south of the US 421/I-40 Business interchange were not taken into consideration when the Project U-2579 Preferred Alternative was identified. According to the analysis presented in the 1995 Project U-2579 DEIS, using the western terminus (0.5 miles east of Hastings Hill Road) rather than the preferred eastern terminus would require the relocation of an additional 40 families north of US 421/I-40 Business (see **Figure 2-17e** and **Figure 2-22h**). The majority of these homes would be in the Doe Run neighborhood, where developers have continued to build homes. If the western terminus rather than the eastern terminus had been selected, the number of homes in the Hastings Hill Farms subdivision south of US 421/I-40 Business that are affected would decrease slightly but additional homes would be impacted on Amersham Court and in the Woodbridge Drive neighborhood. The western interchange location also would impact homes and property along Sedge Garden Road.

Thus, there would not be a decrease in overall impact to communities by shifting to the western alternative location. Further, the recently approved Stone Forest subdivision south of US 421 would be in the path of a western interchange location (see **Figure 2-22h**). Fishers Branch would be crossed the same number of times, although the western interchange would be closer to Salem Lake. According to preliminary studies, there would be no substantial benefits in the Project U-2579A area to crossing US 421/I-40 Business at the western terminus rather than the eastern terminus, and there are substantial advantages for the eastern terminus in the Project U-2579 area.

Conclusion. Based on the findings of the SFEIS/SDEIS, the comments of the citizens at the public meetings and hearings, and the discussions with the NEPA/Section 404 Merger Team, Detailed Study Alternative 7 is selected as the Project U-2579 Preferred Alternative because it is among those with the fewest residential relocations, has the shortest length and requires the least amount of land, impacts the fewest high quality wetlands, minimizes impacts to neighborhoods, minimizes impacts to Salem Lake, and has the southern terminus that minimizes impacts to homes and subdivisions when the Eastern Section Extension is taken into account. The selection of Alternative 7 as the Preferred Alternative by NCDOT is documented in a letter dated September 14, 2006.

2.11.1.3 Updates to the Project U-2579 Preferred Alternative Engineering Design Since the 2004 SFEIS/SDEIS

The Concurrence Point 2A (Bridging Decisions and Alignment Review) Section 404/NEPA merger meeting for Project U-2579 took place after the 2004 SFEIS/SDEIS. As a result of that meeting, it was decided that bridges would be installed rather than culverts at three stream crossings to protect water quality and stream habitat. These crossings, described in more detail in **Section 4.14.1.5**, include the following locations:

- Structure ES 4, Mill Creek
- Structure ES 8, Lowery Mill Creek
- Structure ES 10, Martin Mill Creek

In addition, NCDOT has determined that it is feasible to provide a grade separation at Dippen Road, as was requested by a number of citizens, and has modified the plans to include that structure, which will provide access across the Beltway between Davis Road and Old Walkertown Road. Citizens also requested that Northampton Road remain open to Old Walkertown Road. NCDOT intends to maintain this connection. The final design will be developed based on design constraints and cost considerations.

2.11.2 Project U-2579A

2.11.2.1 Selection of the Project U-2579A Preferred Alternative

Alternative N2-S1 with an interchange at Kernersville Road is the Preferred Alternative for Project U-2579A.

The 2004 SFEIS/SDEIS evaluated six detailed study alternatives (each with and without an interchange at Kernersville Road) for Project U-2579A. These six alternatives represent the combination of five alternative segments – N1, N2, and N3 north I-40 and S1 and S2 south of I-40, as described in the 2004 SFEIS/SDEIS and in this SFEIS/FEIS (**Section 2.10.2**). The approved 2004 SFEIS/SDEIS was distributed to federal and state environmental regulatory and resource agencies and to the general public for comment in October 2004.

Based on the findings of the 2004 SFEIS/SDEIS, the comments of the citizens at the public meetings and hearings, and the identification of Alternative N2-S1 with an interchange at Kernersville Road as the least environmentally damaging practicable alternative (LEDPA) by the Section 404/NEPA Merger Team, NCDOT endorsed Alternative N2-S1 with an interchange at Kernersville Road as the NCDOT Preferred Alternative. This decision was based primarily on residential relocations, economic impacts, stream impacts, and the support of local officials.

On January 25 and February 10, 2005, the Section 404/NEPA Merger Team met to discuss the identification of the LEDPA (Concurrence Point 3). At these meetings, the Team discussed the northern segments, southern segments, and the interchange at Kernersville Road separately. The Team agreed to N2-S1 with an interchange at Kernersville Road as the LEDPA based on the following discussion (see the signed concurrence form dated March 14, 2005 in **Appendix D.4**).

Northern Alternative Segments. Alternative Segment N1 was dismissed because it involved 37 to 43 more relocations than either of the other alternatives (284 vs 241 for N2, 284 vs 247 for N3), the greatest amount of disruption to neighborhoods, and in general no discernable benefit over N2, which is similar but has fewer impacts. Regarding the issue of neighborhood disruption, it was noted that N1 would relocate residences largely in the center of neighborhoods rather than on fringes, as would be the case with N2 or N3.

Segments N2 and N3 each had advantages relative to each other. N2 would keep Sedge Garden Road open, would allow a single-point urban interchange (SPUI) at the Kernersville Road interchange, would impact approximately 4,100 fewer feet of streams, and would impact fewer potentially hazardous material sites (2 vs 7 with N3). Being able to accommodate a SPUI interchange is important because that type of interchange typically has a smaller footprint and thus fewer impacts than most other interchange designs, and also optimizes traffic operations.

On the other hand, it would be more feasible to keep Oak Grove Church Road open with Alternative Segment N3, it would not impact Sedge Garden Elementary School, avoids the Salem Lake protection area, is slightly preferred by the public (19 supported vs. 12 opposed of preferences stated), and would take fewer businesses (18 vs. 23). Other impacts were approximately the same for these northern segments.

Overall, Alternative Segment N2 is preferred because it provides better connectivity in Kernersville and has less stream impact. N2 would retain connectivity on Sedge Garden Road and N3 would be more likely to retain connectivity on Oak Grove Church Road. Although the Town of Kernersville did not state a preference other than to try to keep both roads open, retaining Sedge Garden Road would provide better overall service and would also have less access impact to the Sedge Garden Elementary School.

A SPUI would be feasible at the proposed interchange at Kernersville Road for N2, but not for N3. Although a SPUI would not reduce impacts greatly over the compressed diamond used to calculate impacts in the DEIS, it would improve traffic operations along Kernersville Road.

N2 would have temporary construction impacts to Sedge Garden Elementary School, but N3 would have a higher access impact due to the closing of Sedge Garden Road.

Kernersville Road Interchange. The U-2579A alternatives included a potential interchange at Kernersville Road. The interchange option with Alternative N2 offered several advantages. The public supported an interchange at Kernersville Road (24 supported vs 6 opposed). In addition agencies commenting on the DEIS (including local government agencies) supported the interchange (4 supported vs 1 opposed). (EPA had originally opposed the interchange, but later concurred with the Preferred Alternative including an interchange at Kernersville Road.) Because the Beltway is already severing several roads in Kernersville, this interchange would provide access to Kernersville, providing some mitigation. **Section 2.11.2.2** discusses additional mitigation in the form of grade separations at major roads in Kernersville. On a similar note, this interchange would provide the only access to surface streets (non-freeway) south of Reidsville Road (US 158). The interchange would not impact any additional streams, nor increase the length of impact.

Based on the above stated advantages, the team agreed on a SPUI interchange at Kernersville Road with Alternative Segment N2.

Southern Alternative Segments. Alternative Segment S1 would offer several important advantages. It would have substantially fewer relocations than Alternative Segment S2 (241 vs. 308). The difference in relocations is expected to increase substantially due to new development occurring in the S2 corridor. The majority of the public stated a preference for S1 (15 supported S1 vs 3 supported S2). Alternative Segment S1 would have less negative economic impact, in

that it would not close the US 311/Union Cross Road interchange, which is the primary access to existing business parks and the Alliance Business Park, which is now the Dell Computers site.

Alternative Segment S2 would impact connectivity and access to Kernersville. At the public hearings, local governments strongly opposed closing the US 311/Union Cross Road interchange (necessary with S2) because of economic impacts.

A revised design developed between the two meetings on the selection of the LEDPA would mitigate/reduce impact to streams. The interchange at US 311 was modified and a retaining wall was added to avoid longitudinal impact to Muddy Creek. Other impacts of the two alternative segments were approximately the same.

Therefore, based on the reasons described above, the Merger Team, including NCDOT, FHWA, the US Army Corps of Engineers, the NC Division of Water Quality, the US Fish and Wildlife Service, the NC Wildlife Resource Commission, and the HPO concurred on March 14, 2005 that Alternative N2-S1 with an interchange at Kernersville Road is the LEDPA.
Following the identification of the LEDPA, NCDOT formally selected N2-S1 with a single point interchange at Kernersville Road as the Preferred Alternative. Reasons for selecting N2-S1 as the Preferred Alternative include the following:

- This alternative has the fewest residential relocations and the least impact on neighborhoods.
- This alternative keeps the Union Cross interchange open, which is critical to the success of the area's economic development, especially Union Cross Business Park and Alliance Business Park, which was selected in December 2004 as the home of a Dell Computer distribution facility. (Dell Computers has recently constructed the first phase of their manufacturing facility.)
- The Town of Kernersville strongly desires an interchange at Kernersville Road.
- A single-point interchange at Kernersville Road is feasible for this alternative. This type of interchange would have the least impact and also would improve traffic operations.
- This alternative has close to the least impact to streams north of I-40 and was modified in the vicinity of US 311 to substantially reduce stream impacts.
- This alternative preserves the continuity of Sedge Garden Road.
- This alternative was preferred by both the City of Winston-Salem and the Town of Kernersville.

2.11.2.2 Updates to the Project U-2579A Preferred Alternative Engineering Design Since Selection of the Preferred

Based on requests from the Town of Kernersville, the City of Winston-Salem, and concerned citizens, the Project U-2579A Preferred Alternative was modified to include additional grade separations at Pisgah Church Road, Hastings Hill Road, and High Point Road. The purpose of the additional crossings is to maintain continuity of major surface streets and to mitigate for the divisions created to the transportation network of the Beltway. Other changes to the Preferred Alternative included service roads to provide access to properties, modifications to interchange and road geometry to provide a better design, incorporation of changes to avoid portions of Muddy Creek near US 311, and refinement of drainage structures. Changes needed to accommodate the revised interchange at US 421/I-40 Business included modification to Smith Creek and the ponds north of US 421 and realignment of Hastings Hill Road and replacement of the bridge over US 421. Other changes were refinements of the plans developed for the corridor public hearing maps and displays, including more detail on control of access and intersection geometry.

The impacts described in this document are based on the preferred alternative as identified by NCDOT following selection of the LEDPA. Minor changes in design are anticipated throughout the design process and into right-of-way acquisition and construction.

2.12 Selection of the Northern Beltway Preferred Alternative

NCDOT has selected Alternative C3-WEST-B/Alternative 7/Alternative N2-S1 with an interchange at Kernersville Road as the Preferred Alternative for the Winston-Salem Northern Beltway. The Preferred Alternative was selected for the reasons listed below, by section and as a whole:

From US 158 to US 52 (Project R-2247 – Western Section), Alternative C3-WEST-B was selected because it:

- Avoids impacts to community facilities (two schools and parkland);
- Avoids direct impacts to historic sites (Pfafftown Historic District and John Henry Kapp Farm);
- Has a more desirable interchange design and location with US 52
- Avoids potential impacts to Rural Hall associated with extending the roadway east of US 52
- Avoids crossing the confluence of the Muddy Creek and Silas Creek floodplains (a notable wildlife habitat);
- Is one of the least expensive alternatives;

- Is one of two alternatives with the fewest residential relocations; and
- Is one of two alternatives with the least floodplain impact.

From US 52 to US 421/I-40 Business (Project U-2579 – Eastern Section), Alternative 7 was selected because it:

- Is one of the alternatives with the fewest residential relocations;
- Has the shortest length and requires the least amount of land;
- Impacts the fewest high quality wetlands;
- Is one of the alternatives with the least impact to the Salem Lake Watershed;
- Has the least impact on neighborhoods;
- Was agreed to as the Least Environmentally Damaging Practicable Alternative by regulatory agencies (DWQ and USACE); and
- The southern terminus minimizes impacts when Project U-2579A is taken into account.

From US 421/I-40 Business (Project U-2579A – Eastern Section Extension), Alternative N2-S1 with an interchange at Kernersville Road was selected because it:

- Has fewest relocations and the least impact on neighborhoods;
- Would have less negative economic impact by keeping US 311/Union Cross Road interchange open;
- Is preferred by the Town of Kernersville and the City of Winston-Salem;
- Would allow for a single-point urban interchange (SPUI) to be constructed at the Kernersville Road interchange;
- Has close to the least impact to streams;
- Provides best connectivity in Kernersville by keeping Sedge Garden Road open; and
- Was selected as the least environmentally damaging practicable alternative (LEDPA) by the Section 404/NEPA Merger Team.

As part of the selections of the Preferred Alternatives for Projects R-2247, U-2579, and U-2579A, the junctions or termini where these sections meet were examined. It was determined that:

- The location where the Western and Eastern Section Preferred Alternatives cross US 52 is preferred because it provides acceptable interchange spacing on US 52 and minimizes impacts on Rural Hall; and
- The location where the Eastern Section and Eastern Section Extension Preferred Alternatives cross US 421/I-40 Business is preferred because it provided acceptable interchange spacing

on US 421/I-40 Business and minimizes impact to streams and to neighborhoods on both sides of US 421/I-40 Business.

The Preferred Alternative for Project U-2579A was formally selected by NCDOT on March 16, 2005, and the Preferred Alternative for Projects R-2247 and U-2579 were formally selected by NCDOT on September 14, 2006.

Further documentation of the Preferred Alternative selection by project section is found in **Section 2.9** (Project R-2247) and **Section 2.11** (Projects U-2579 and U-2579A). The estimated costs for the Northern Beltway Preferred Alternative are shown in **Table 2-30**, and other impacts of the Preferred Alternative are shown in **Table S-1** in the Summary. The Preferred Alternative for the Northern Beltway is shown in **Figure S-2**.,

Table 2-30: Summary of Estimated Costs (2005-2006 dollars)

Northern Beltway Project	Estimated Costs (in millions of dollars)			Total
	Right of Way	Utilities	Construction	
Project R-2247	$ 59.2	$ 15.0	$ 340.4	**$ 414.6**
Project U-2579	$ 150.1	$ 4.0	$ 291.1	**$ 445.2**
Project U-2579A	$ 60.1	$ 1.5	$ 154.2	**$ 215.8**
Total	**$ 269.4**	**$ 20.5**	**$ 785.7**	**$ 1,075.6**

CHAPTER 3

Chapter 3 AFFECTED ENVIRONMENT

3.1 APPROACH TAKEN TO ADDRESS PROJECTS R-2247, U-2579, AND U-2579A IN CHAPTERS 3 AND 4

Information from the 1996 Project R-2247 FEIS, 1992 Project R-2247 DEIS, and 1995 Project U-2579 DEIS was used where appropriate.

The following describes the use of previous and new data in Chapter 3 to describe existing conditions and in Chapter 4 to evaluate the impacts of Projects R-2247 and U-2579. All existing conditions and impacts reported for the Project U-2579A study area and Project U-2579A Detailed Study Alternatives are current, and are therefore not discussed specifically below, except where studies have been updated since the 2004 SFEIS/SDEIS. There were no previously published NEPA documents for Project U-2579A. Information regarding the Project U-2579A Preferred Alternative has only been included where updates to studies have been preformed since the 2004 SFEIS/SDEIS.

Land Use and Zoning
All conditions and impacts for all Detailed Study Alternatives and Preferred Alternatives are based on current information.

Consistency with Transportation Plans and Local Land Use Plans
All conditions and impacts for all Detailed Study Alternatives and Preferred Alternatives are based on current information.

Relocations
Project R-2247 Detailed Study Alternatives - The relocation impacts reported in the 1992 Project R-2247 DEIS are included in the document. There is a qualitative discussion that the relocation impacts would be expected to increase for all Detailed Study Alternatives except the Preferred Alternative due to increased development in the area. This conclusion is based on review of aerial photographs, current parcel data from Forsyth County's on-line GIS system (INFOrsyth), and site visits to the area. Also, no new development has occurred in the Preferred Alternative due to a moratorium enforced by the City of Winston-Salem and Forsyth County. The recent development occurring in the project study area is specifically indicated on **Figure 2-10(a-e)**, which provides the reader a visual aid of the magnitude of the change.

Project R-2247 Preferred Alternative – Development in the Preferred Alternative corridor is being restricted by the City of Winston-Salem and Forsyth County based on the Corridor Protection Map, so there have been no changes in the numbers of relocations resulting from this alternative. The availability of suitable replacement business sites and residences was updated in

September 2003 and again in December 2005 for anticipated relocations and supplies were found to still be sufficient.

Project U-2579 Detailed Study Alternatives - The impacts reported in the 1995 Project U-2579 DEIS for all Detailed Study Alternatives are included in the document. There is a qualitative discussion that the impacts would be expected to increase for all Detailed Study Alternatives due to increased development in the area. This conclusion is based on review of aerial photographs, current parcel data from Forsyth County's on-line GIS system (INFOrsyth), and site visits to the area. The recent development occurring in the project study area is indicated on **Figure 2-17(d-e)**, which provides the reader a visual aid of the magnitude of the change.

Project U-2579 Preferred Alternative – Relocation impacts and availability of replacement housing and business sites for the Preferred Alternative were updated in May 2003 and again in December 2005.

Project U-2579A Preferred Alternative – Relocation impacts and availability of replacement housing and business sites for the U-2579A Preferred Alternative were updated in December 2005.

Community Services and Facilities

Project R-2247 Detailed Study Alternatives – The impacts reported in the 1992 Project R-2247 DEIS are included in this document and were updated based on a review of aerial photography, mapping, and INFOrsyth.

Project R-2247 Preferred Alternative – The corridor has been protected, and there are no impacts to community facilities.

Project U-2579 Detailed Study Alternatives - The impacts reported in the 1995 Project U-2579 DEIS are included in the document and were updated based on a review of aerial photography, mapping, and INFOrsyth.

Project U-2579 Preferred Alternative – Impacts were updated based on review of the alignment in the field in addition to a review of aerial photography, mapping, and INFOrsyth.

Community Cohesion

All conditions and impacts for all Detailed Study Alternatives and Preferred Alternatives are based on current information.

Environmental Justice

The analyses for all Detailed Study Alternatives and Preferred Alternatives are based on 2000 US Census data.

Utilities and Infrastructure

All conditions and impacts for all Detailed Study Alternatives and Preferred Alternatives are based on current information.

Archaeological Resources

The archaeological sample surveys conducted for the Project R-2247 Detailed Study Alternatives in 1991, for Project U-2579 Detailed Study Alternatives in 1994, and for the Project U-2579A study area in 1994 are still valid. Archaeological resources in any of the Detailed Study Alternatives for any project would not have changed since the early 1990s.

Intensive archaeological surveys were conducted for the Project R-2247 Preferred Alternative in 1996, for the Project U-2579 Preferred Alternative in 1998, and for Project U-2579A in December 2004. No sites worthy of preservation in place were identified.

Historic Architectural Resources

An update to the 1991 Phase II historic architectural survey for Project R-2247 was conducted in 2002. This updated survey covered the entire Area of Potential Effects (APE) for the Project R-2247 Detailed Study Alternatives.

A Phase II historic architectural survey of the Project U-2579 Detailed Study Alternatives was conducted in 1995. An update for Project U-2579 covering the APE for the Detailed Study Alternatives was conducted in 2003. An update for Project U-2579A Detailed Study Alternatives was conducted in 2004.

Air Quality – Microscale Carbon Monoxide Analyses

Updated microscale air quality analyses were conducted for the Project R-2247 Preferred Alternative and the Project U-2579 Preferred Alternative using the latest traffic projections, the latest dispersion model CAL3QHC, and the emissions factor model MOBILE 6.2.

The results of the three analyses indicate projected maximum CO concentrations well below the 1-hour and 8-hour standards in 2005, 2010, and 2025. It can be estimated that because the results for these alternatives are well below the National Ambient Air Quality Standards (NAAQS), that none of the other Detailed Study Alternatives would cause exceedances of the NAAQS since traffic volumes would be similar and the interchange locations would be the same.

Air Quality – Ozone and Tree Removal.

This section was included in the 2004 SFEIS/SDEIS in response to commentary from the lawsuit filed regarding Project R-2247. In this SFEIS/FEIS, the section was deleted because it was determined to be confusing to the general reader.

Noise

Noise Model Information - Currently, there are two traffic noise prediction models FHWA and NCDOT allow to be used on federally-funded transportation projects, depending on the project situation. These two models are STAMINA 2.0 (1987) and a newer model called TNM 2.5 (2004). It is NCDOT's policy that any new projects entering the planning process should use TNM. Projects that used STAMINA for studies prior to the release of TNM can continue through the planning process using STAMINA or can switch to TNM. However, once the planning process is complete through the Record of Decision (ROD) and the project enters the final design phase, the design noise reports should then use TNM.

In September 2004, the NC Board of Transportation adopted a new Traffic Noise Abatement Policy. Updated noise studies for Project R-2247, U-2579, and U-2579A Preferred Alternatives have been performed based on the new policy, as described in the following sections.

Project R-2247 Detailed Study Alternatives – The noise barriers presented in the 1996 Project R-2247 FEIS and 1993 Project R-2247 DEIS are shown in this document, along with the year 2015 noise contour information developed based on the traffic projections available at that time.

Updated noise contour information was developed based on the updated traffic projections for 2025 (See **Figure 2-14a**), the most current typical cross-sections (See **Figure 2-6**), and the noise prediction model (TNM). As discussed in **Section 4.8.2.2**, the new TNM model runs with the 2025 traffic projections show the 2025 future noise contours would generally be about the same or slightly narrower than the 2015 future noise contours reported for the Detailed Study Alternatives in the 1996 Project R-2247 FEIS.

A decision was made to not prepare an updated traffic noise mitigation study for the Project R-2247 Detailed Study Alternatives for the following reasons:

- Updated noise contours indicate the noise levels are similar under the new traffic projections, so the conclusions reached regarding noise barriers for the older neighborhoods present when the original noise study was prepared should still be valid.
- STAMINA, which was used in the original noise study, is still an appropriate model to use.
- For new neighborhoods, an accurate noise mitigation evaluation could not be conducted because new planimetric survey information was not prepared for the non-preferred Detailed Study Alternatives. New planimetric surveys were not conducted for the non-preferred

Detailed Study Alternatives because they were not needed to reverify the selection of the Preferred Alternative (**Section 2.9**).

- Noise impacts were not a factor in the original selection of the Preferred Alternative, nor would they be a factor now. Noise impacts would increase for the non-preferred Detailed Study Alternatives due to the new development in the area, as they would for the Preferred Alternative.
- Design noise studies would still need to be conducted during the final design phase and noise barriers could still change no matter which Detailed Study Alternative is selected.

Project R-2247 Preferred Alternative – The noise barriers shown on the 1996 Design Public Hearing Map are presented in **Figure 4-3(a-d)**. As discussed in **Section 4.8.2.2**, updated noise contours based on 2025 traffic projections (August 2003) were overlain on aerial photography with the 1995 Project R-2247 Preferred Alternative preliminary engineering designs. Five new neighborhoods and one school were identified that had parcels abutting the proposed right of way that were within the year 2025 66 dBA Leq noise contour. The identification was accomplished through review of the 2002 aerial photography and Forsyth County's GIS system (INFOrsyth) and comparison to the 1991 aerial photography used as a base for the Project R-2247 Corridor Public Hearing Map.

A noise study was prepared in July 2004 for the five new neighborhoods using the updated traffic information, 2005 preliminary engineering designs, and recent planimetric mapping. The updated noise study found walls to be potentially reasonable and feasible near two of the subdivisions based on NCDOT Noise Abatement Guidelines. Results of this noise study were reported in the 2004 SFEIS/SDEIS. The Ronald Reagan High School opened in August 2005, and there was insufficient information regarding topography and site design to perform a noise study at the time. Additional analysis will be performed at this location as part of the final design.

In May 2005, an updated design noise study for the entire length of the Preferred Alternative for Project R-2247 was prepared based on the 2004 NCDOT Traffic Noise Abatement Policy. The May 2005 updated noise study found walls to be potentially reasonable and feasible at two of the eight evaluated subdivisions in addition to the previously recommended noise barriers (**Figures 4-3a and c**). The results of the May 2005 updated noise study are reported in **Section 4.8.2.2** of this SFEIS/FEIS.

Project U-2579 Detailed Study Alternatives – Noise studies were not updated for the Detailed Study Alternatives. The previous studies documented in the 1995 Project U-2579 DEIS evaluated the impacts of the alternatives using consistent, approved methodology. Noise impact was not among the reasons for selection of the Preferred Alternative. Therefore, it was not necessary to re-evaluate the noise impacts for all of the Detailed Study Alternatives, but only to

determine the noise impact of the Preferred Alternative based on the latest data and using current procedures.

Project U-2579 Preferred Alternative – Noise studies were updated in 2003, including new noise monitoring as well as modeling future noise levels using TNM. This update was needed because of higher projected traffic volumes and some increased development in the vicinity of the Preferred Alternative. An updated noise study for the U-2579 Preferred Alternative was prepared in April 2006 based on revised preliminary design and the 2004 NCDOT Traffic Noise Abatement Policy.

Project U-2579A Preferred Alternative – An updated noise study for the U-2579A Preferred Alternative was prepared in April 2006 based on revised preliminary design and the 2004 NCDOT Traffic Noise Abatement Policy.

Hazardous Materials

Surveys for hazardous materials were updated only for the Preferred Alternatives for Projects R-2247 and U-2579.

The survey for Project R-2247 did not identify any new hazardous materials sites that would preclude construction of the Preferred Alternative.

The updated survey for the Project U-2579 Preferred Alternative identified several small hazardous material sites not previously identified. One large site, Reynolds Auto Junkyard on University Parkway, had been identified previously and would be affected by all the Detailed Study Alternatives since they are close together in this area.

Updated surveys for all the Detailed Study Alternatives would only result in increased impacts, not decreased impacts. Increased impacts to hazardous materials sites would not cause a change in the decision on the preferred alternatives for Project R-2247 and Project U-2579. Therefore, surveys for the other Project R-2247 and Project U-2579 Detailed Study Alternatives were not necessary.

Farmland

Project R-2247 Detailed Study Alternatives and Preferred Alternative - An AD 1006 form was submitted to the Natural Resource Conservation Service (NRCS) for the Project R-2247 Preferred Alternative in August 2003. The assessment for the Preferred Alternative did not result in a total site assessment score greater than 160 points and mitigation for farmland loss is not required under the Farmland Protection Policy Act (FPPA). Based on this result, it is not expected that any of the other Detailed Study Alternatives would result in significant impacts to farmland. The other seven Detailed Study Alternatives either include most of the segments used by the Project R-2247 Preferred Alternative, or use the segments to the east that are more urbanized.

Project U-2579 Detailed Study Alternatives and Preferred Alternative – An AD 1006 form was submitted to the NRCS for the Project U-2579 Detailed Study Alternatives in May 1994. The assessment for the Detailed Study Alternatives resulted in a total site assessment score of less than 160 points and mitigation for farmland loss was not required under the FPPA. In September 2003, an AD 1006 form was submitted to the NRCS for the Project U-2579 Preferred Alternative. The assessment for the Preferred Alternative resulted in a total site assessment score of less than 160 points and mitigation for farmland loss is not required under the FPPA.

Water Quality

The most recent water quality information was obtained from the North Carolina Department of Environment and Natural Resources (NCDENR) Division of Water Quality (DWQ) in March 2003. Streams included on the current Section 303(d) list also are discussed.

Floodways and Floodplains

The most recent flood insurance rate (FIRM) maps for Forsyth County are dated October 1998 and are shown on the figures in the document.

The floodplains shown in the 1996 Project R-2247 FEIS were dated 1983 (page 4-53). Based on a review of the figures showing the floodplains, there were no significant differences between the two maps that would result in new encroachment locations not previously reported in the FEIS. One reason the Preferred Alternative was selected was minimization of floodplain impacts. This is still valid based on a review and comparison of the new FIRM maps with those used in the previous NEPA documentation.

The floodplains and floodways shown in the 1995 Project U-2579 DEIS were designated using mapping available from FEMA in 1994. Based on a review of the figures showing the floodplains, there were no significant differences between the two maps that would result in new encroachment locations not previously reported in the DEIS.

Mitigation would be the same for all alternatives. Bridges and culverts would be designed and constructed in accordance with flood impact regulations.

Streams

Updated surveys for streams were conducted in 2003 for the Project R-2247 Preferred Alternative and in 1998 and 2002/2003 for the Project U-2579 Preferred Alternative. Streams are not expected to have disappeared or been created over the time period since the original surveys, even if development has occurred. Relative impacts between the alternatives are expected to be the same. The new surveys provided updated electronic delineations and classification information for the streams.

Wetlands

Updated surveys for wetlands were conducted in 2003 for the Project R-2247 Preferred Alternative and in 1998 and 2002/2003 for the Project U-2579 Preferred Alternative.

As discussed below, updating the wetland information for all the Detailed Study Alternatives will not aid in the decision-making process.

The Preferred Alternative for Project R-2247 was selected regardless of the fact that it originally had the highest estimated impacts to wetlands (originally estimated at 13.2 acres in the right of way). For the Preferred Alternative, engineering design refinements subsequently resulted in reduced wetland impacts of 5.8 acres within the construction limits based on 1995 wetland surveys and the 1995 preliminary engineering designs. Further refinement of the designs and updated wetland surveys conducted in 2003 resulted in the current estimate of 3.6 acres of wetland impacts. It is expected that similar reductions in wetland impacts would result if the same procedures were applied to the non-preferred Detailed Study Alternatives. In the non-preferred Detailed Study Alternatives, it is possible that wetlands have been filled by recent development or have changed based on long-term weather patterns. However, even if new surveys and impact calculations showed wetland impacts less than 3.6 acres, this amount would not "tip the scales" in favor of any other Detailed Study Alternative, particularly since wetlands was not a consideration in the selection of the Project R-2247 Preferred Alternative and other factors, as described in **Section 2.9**, weigh heavily in favor of the current Preferred Alternative.

While wetland impact was not one of the specific reasons identified for selecting the Preferred Alternative for Project U-2579, the Preferred Alternative was identified as the least environmentally damaging practicable alternative (LEDPA) based on both amount and quality of impacted wetlands. As was the case with Project R-2247, wetland impacts of this alternative have been further reduced in preliminary design. The same reductions may have been possible for the non-preferred Detailed Study Alternatives. However, no new construction has been identified in the non-preferred Detailed Study Alternatives that would have impacted the previously identified wetlands and no changes to these areas were observed through reviewing aerial photography. Therefore, the relative impact on wetlands of the alternatives would be similar to that previously determined and no new wetlands determinations were needed for the non-preferred Detailed Study Alternatives.

Biotic Communities

Impacts to biotic communities were updated for the Preferred Alternatives for Project R-2247 and Project U-2579 in 2003.

The original biotic community surveys were completed in 1991 for the Project R-2247 Detailed Study Alternatives and in 1994 for the Project U-2579 Detailed Study Alternatives. Since that time, the naming conventions for some of the specific communities changed, and the

communities themselves may have changed. It is likely there are more maintained/disturbed communities along the non-preferred Detailed Study Alternatives due to increased development in these corridors. However, knowing an exact updated acreage of biotic communities would not aid in the decision-making process. Biotic communities did not play a role in the selections of the Preferred Alternatives and there are no regulatory issues associated with these impacts.

Protected Species

Previous protected species surveys for the Project R-2247 (1991) and Project U-2579 Detailed Study Alternatives (1994) did not find any protected species. The list of protected species for Forsyth County has not changed since these previous surveys were conducted. Updated protected species surveys were conducted for the Project R-2247 and Project U-2579 Preferred Alternatives in 2005. The Preferred Alternatives had biological conclusions of No Effect to the listed species.

Updated surveys for the non-preferred Detailed Study Alternatives for Project R-2247 and Project U-2579 were not necessary. Since no impacts were identified in the original surveys and no impacts were identified in the updated surveys for the preferred alternatives, it is not likely there would be new impacts for the non-preferred detailed study alternatives. Also, any impacts that might be identified would only further support the selections of the Preferred Alternatives.

Indirect and Cumulative Impacts

Indirect and cumulative impacts were updated in 2003/2004 and considered the following scenarios:

1. Build-West scenario
2. Build-East scenario
3. Full-Build scenario

Updates regarding new commercial development (e.g. Dell Computers) were added in this SFEIS/FEIS in **Section 4.20**. Also, **Section 4.20** was reformatted and rewritten for improved readability. The conclusions reported in the SFEIS/SDEIS regarding indirect and cumulative impacts have not changed.

3.2 EXISTING LAND USE AND ZONING

3.2.1 Existing Land Use

3.2.1.1 Western Portion of the Study Area

Existing land uses in western Forsyth County consist primarily of single-family residential uses in suburban and rural settings, and rural land uses with a limited scattering of commercial and industrial uses.

Commercial and industrial land uses in western Forsyth County include a broad range of structures and uses. Commercial uses are most prevalent at the intersections of major roadways, while industrial uses are concentrated along the highways. Commercial uses include locally-oriented small service establishments (food stores, convenience stores, gas stations, personal services, and plant nurseries), while the industrial uses (primarily large manufacturing, warehouse, and distribution operations) are regionally or nationally oriented and are concentrated near the intersections of US 52 with Bethania-Rural Hall Road (NC 65) and with Tobaccoville Road.

Agricultural land uses include land used to grow small grain crops, primarily corn and soybeans. In addition, several agri-business farms, horse-riding stables, and plant nurseries are in the area. There are about 850 farms (average size is 65 acres) in Forsyth County, of which approximately one-third are located in the western portion of the County.

Changes to land use in the area since the early 1990s include development of new residential neighborhoods and commercial areas, construction of new community facilities, and creation of new parkland. This new development is shown in **Figure 2-10(a-e)**.

3.2.1.2 Eastern Portion of the Study Area

Existing land use in the study area is rural-residential in nature, interspersed with scattered commercial and industrial development along the major traffic arteries, and a mix of agricultural and public land use.

Single-family subdivisions, mobile home parks, and clusters of single-family residences are distributed throughout the eastern portion of the study area. Residential development is concentrated along the following major roadway corridors: University Parkway, Stanleyville Drive, Germanton Road, Old Rural Hall Road, Baux Mountain Road, NC 66, Old Walkertown Road, Northampton Drive, US 158, High Point Road, Glenn Hi Road, Sedge Garden Road, Kernersville Road, Walkertown-Guthrie Road, and West Mountain Street.

Commercial and industrial development is greatest in the US 421/I-40 Business, West Mountain Street, and Kernersville Road areas. There are numerous industries in the vicinity of the existing interchanges with US 421/I-40 Business and US 311 at the southern fringe of the study area. The Dell Computers facility is located north of US 311 and west of Union Cross Road. Other substantial industrial and commercial development is located on NC 66 near Walkertown, on University Parkway near NC 66, and on US 52 in the northwest corner of the study area.

Agricultural land and undeveloped open-space are evenly distributed throughout the study area, primarily around residential areas.

3.2.2 Existing Zoning

Figure 3-1 shows the current zoning in Forsyth County. Current zoning in Forsyth County follows a policy that strives to contain industrial zones within defined corridors or pockets. Industrial, institutional and commercial strips extend outward from downtown Winston-Salem along major transportation routes.

US 52 is the predominant industrial corridor, stretching from just south of I-40 Business to just north of Rural Hall. Similarly, NC 66 stretching from I-40 Business through Kernersville is zoned primarily for commercial, industrial, and institutional uses.

Commercial corridors include sections of US 52 extending north from downtown Winston-Salem, US 421/I-40 Business extending west to Lewisville, and Kernersville Road southwest of US 421/I-40 Business. A less developed commercial corridor extends along Reynolda Road, from Wake Forest University to Bethania.

3.3 TRANSPORTATION AND LAND USE PLANNING

3.3.1 Land Use Planning

In order to update the County's land use plan, *Vision 2005-A Comprehensive Plan for Forsyth County*, the Winston-Salem/Forsyth County City-County Planning Board initiated a community-wide planning process in 1995 to begin work on the *Legacy Development Guide*. Public involvement was critical in the development of the plan. The Planning Board appointed a 21-member Legacy Citizens Steering Committee, which represented a wide range of positions in the community, including realtors, educators, farmers, and attorneys.

The Legacy Citizens Steering Committee's first step was "visioning" or describing the future of the community they wanted. After several public visioning workshops, the Citizens Steering Committee appointed more than 100 volunteers from across the county to participate in focus

groups. These groups developed vision statements for the year 2015 on topics including Managing Growth and Development, Transportation Options, and Environmental Quality. Work on the community vision, called *Forsyth County Tomorrow*, was completed in 1997 and was subsequently adopted by Forsyth County and its eight municipalities. The goals in this vision served as the basis of *The Legacy Development Guide* (*The Legacy Comprehensive Plan Summary* pg. 2).

The Legacy Development Guide (2001) is the centerpiece of the local planning program and a key component of future community development. The primary function of the general comprehensive plan is to outline, in writing, the policy that the community intends to pursue with respect to growth and development issues and to determine the steps needed to put the policy into effect. The major component of the comprehensive plan is the land use plan, which is based on projections of population growth and land development patterns that have impacts on public facilities, transportation and economic development, housing, cultural resources, natural resources and amenities.

The City-County Planning Board's *Growth Management Plan* was developed as part of the *Legacy Development Guide*. **Figure 3-2** shows the areas planned for municipal services, future growth, and rural uses in the *Growth Management Plan*. Growth management is defined as the utilization by government of a variety of plans and activities to guide patterns of land use, and the type, location, and nature of development.

The City-County Planning Board realized the need to manage growth through curbing urban sprawl by creating more compact and efficient development patterns that still accommodate growth, while maintaining environmental quality, making more efficient use of the land that has already been developed, encouraging reuse, and preserving open space and rural character (*Legacy Development Guide*, pg. 25).

The vision for 2015, as indicated in the *Growth Management Plan,* includes the following patterns of land development:

- Concentrating highest densities and mixed-use development in the Municipal Services Area at Metro Activity Centers, Urban Boulevards and City/Town Centers.
- Increasing the intensity of development in the urban areas of the County where there is already large public investment in roads, sewers and infrastructure, helping to reduce sprawl and concentrate development in these areas.
- Increasing infill development in the urban areas. Infill development occurs on vacant or underused lands within areas that are already urbanized or developed.

The *Growth Management Plan* divides Forsyth County into three broad areas for planning purposes: the Municipal Services Area, Future Growth Areas, and Rural Areas.

Forsyth County is composed of 55 percent Municipal Services Area, 15 percent Future Growth Areas, and 30 percent Rural Areas. The western portion of the project study area is primarily within the Municipal Services Area and Future Growth Areas. Remaining parts of the western portion of the study area are along the boundaries between the Municipal Services Area and Rural Areas. The eastern portion of the study area is primarily within the Municipal Services Area and Future Growth Areas.

Municipal Services Area. The Municipal Services Area is the area within the Muddy Creek drainage basin and includes areas served by infrastructure and services. The majority of the proposed Northern Beltway is included in this area. Within this area are more specialized land uses, including the following:

- Center City - The Winston-Salem Commercial District where the most urban development would take place. It is a major employment center and is intended to be a hub for government services, banking, medical research and other services, including arts and cultural activities. The vitality of this center contributes to the County's regional and national image.
- Urban Boulevards - Surround the city center where there would be higher residential densities as well as neighborhood retail and community services. Certain of the Urban Boulevards would link planned Metro Activity Centers at the Northern Beltway with the City Center. Planned Urban Boulevards intersecting with or near the proposed Northern Beltway include Robinhood Road on the west side, and Old Walkertown Road, New Walkertown Road (US 311), and Ridgewood Road on the east side.
- Town Centers - Small compact centers of mixed-use commercial, residential, and community services located in the seven smaller municipalities in the County. These centers would encourage pedestrian access and use.
- Metro Activity Centers (MAC) - Comprised of intense, compact development where they would serve as hubs for the surrounding less intensely developed neighborhoods. These centers would be mixed-use – consisting of residential, commercial, and employment uses. They also would encourage walking and support transit services. As shown in **Figure 3-2**, there are a total of nine Metro Activity Centers proposed in Forsyth County. Five of these centers are located in the project study area and are listed from west to east:

    - West Activity Center – Country Club Road and the Northern Beltway;
    - North Summit Square - near US 52 and University Parkway;
    - Liberty Street/Airport Activity Center – Liberty Street and Old Rural Hall Road

- US 311 Northeast Winston-Salem Walkertown Activity Center - US 311 and the Northern Beltway; and
- US 311 South Activity Center - US 311 and Ridgewood Road (near the Northern Beltway terminus at US 311).

Future Growth Area. Areas for future growth do not currently have sewer or other facilities and services to support urban development. However, because of their potential to be served efficiently in the future and/or their proximity to towns, major roads and other public investments, these areas are planned to eventually become urban (*Growth Management Plan*, page 34).

One special Future Growth Area is the Union Cross Road Area at the southeastern terminus of the Northern Beltway at US 311. Currently, the area is largely undeveloped due to environmental constraints. However, there are opportunities for future residential, commercial, and industrial development. Conservation development would be encouraged, which could include clustering residential and nonresidential building development, incorporating open space requirements, and watershed regulations to conserve the open rural character of the area.

Rural Area. The Rural Area is located outside of the Future Growth Area and beyond the area that can be provided with public sewer and other services in a cost-efficient manner. The County plans to institute provisions for the protection of farmland, natural areas, and rural character. The County intends this area to remain in very low-density residential and agricultural uses (*Growth Management Plan*, page 35).

3.3.2 Transportation Planning

The Northern Beltway was first proposed in 1965 as part of the Master Transportation Plan for the County (City-County Planning Board, 1989). The original purpose of the roadway was to provide adequate circumferential routes around the most densely populated areas of the county and to connect the system's radial roadways. A version of the proposed Northern Beltway has been included in every City-County Planning Board roadway plan since 1965. The original route for the Western Section of the Northern Beltway followed Muddy Creek north from I-40 and Mill Creek through Old Town before intersecting US 52 in the vicinity of Shattalon Drive. Due to prohibitive costs and development in the corridor, the original route, as first proposed, was discarded and other alternatives were sought.

The *Winston-Salem Urban Area 2030 Multi-Modal Long Range Transportation Plan (LRTP)* (see **Figure 1-6**) is a comprehensive transportation plan that encompasses every mode: transit, rail, bicycle, pedestrian, airport, and streets and highways. The Winston-Salem Northern Beltway is shown in the *2030 LRTP*. The alignment follows the Preferred Alternatives for Projects R-2247 and U-2579 and traverses through the center of the study area for Project U-2579A.

The *2005 Thoroughfare Plan* is the street and highway system component of the *2030 LRTP* for the planning horizon beyond *2030*. The *Thoroughfare Plan* makes area-wide recommendations for new streets and highways as well as improvements to existing roads based on traffic modeling data (City of Winston-Salem Department of Transportation, *http://www.ci.winston-salem.nc.us/Home/Departments/Transportation/Planning/Articles/ThoroughfarePlan*, accessed January 9, 2007).

The first thoroughfare plan for the Winston-Salem/Forsyth County Urban Area was adopted in 1968. The Thoroughfare Plan for all of Forsyth County was updated in 1987 in conjunction with *Vision 2005 – A Comprehensive Plan for Forsyth County*. The Thoroughfare Plan was reviewed during the *Legacy Development Guide* process and LRTP update, and major revisions were completed in 2002 and June 2005. The *2002 Thoroughfare Plan* has been replaced with an updated *2005 Thoroughfare Plan* (see **Figure 1-7**).

The City of Kernersville updated their street *Thoroughfare Plan* in 2002. The new plan is consistent with the *Winston-Salem/Forsyth County 2030 Thoroughfare Plan*. Walkertown and Rural Hall have not developed individual thoroughfare plans.

3.4 SOCIOECONOMIC CONDITIONS

3.4.1 Population Projections and Characteristics

3.4.1.1 Population

Population Trends. During the 1990s, the population of North Carolina increased by 21 percent, adding over 1.4 million people. On a percentage basis, both the Greensboro/Winston-Salem/High Point Metropolitan Statistical Area (MSA) and Forsyth County experienced population growth comparable to that of the State of North Carolina during the 1990s. **Table 3-1** shows the population change for these areas.

Table 3-1: Population Change

Area	1980	1990	2000	Change 1990 to 2000	Percent Change 1990 to 2000	Share of State Growth
North Carolina	5,881,766	6,628,637	8,049,313	1,420,670	21.4	100%
MSA*	--	1,050,304	1,251,509	201,205	19.2	14%
Forsyth County	243,683	265,878	306,067	40,189	15.1	3%
Winston-Salem	131,885	143,485	185,776	42,291	29.5	3%

Source: *Census 2000 PHC-T-3. Ranking Tables for Metropolitan Areas: 1990 and 2000*
*MSA = Greensboro-Winston-Salem-High Point Metropolitan Statistical Area

Population Density. Population density is a measure of the number of people located within an area, typically square miles or acres. **Figure 3-3(a-b)** shows the persons-per-square-mile density for the Forsyth County census block groups based on US Census general definitions for urban, suburban, and rural densities (defined on the figures). Comparison of 1990 versus 2000 population densities reveals that Forsyth County grew increasingly suburban over the ten-year span. A shift from rural to suburban densities occurred primarily in census block groups located in the southern, western, and northeastern portions of the County. Approximately 38.6 percent of the County is rural, 59.0 percent is suburban, and 2.4 percent is urban (compared with 44.8 percent, 53.0 percent, and 2.1 percent, respectively, in 1990).

Population Projections. The population of Forsyth County is projected to grow steadily from April 2000 to July 2025 as seen in **Table 3-2**. Every five years the population of Forsyth County is projected to grow by approximately 6 percent.

Table 3-2. Population Projections

Area	April 2000	July 2005	April 2010	July 2015	April 2020	July 2025
Forsyth County	306,067	327,170	347,165	368,164	390,124	411,887
Increase	--	21,103	19,995	20,999	21,960	21,763
Percent Increase	--	7%	6%	6%	6%	6%

Source: North Carolina State Data Center, *http://www.census.state.nc.us*
Population Overview: 2000-2030

3.4.1.2 Population Characteristics

Race. In 2000, Forsyth County and the MSA had similar racial profiles. The majority of the populations for both Forsyth County and the MSA were White (68.47 percent and 72.2 percent, respectively). Forsyth County and the MSA are both more racially diverse now than they were in 1990, when 74.1 percent and 79.6 percent of the population was White.

In Forsyth County, the greatest concentration of minority populations is located in the eastern portion of downtown Winston-Salem. The City of Winston-Salem's racial mix remained relatively unchanged between 1990 and 2000 (at approximately 56 percent White and 37 percent Black). **Figure 3-4** shows the percentages of minority population in the county by census block group in 2000.

As shown in **Table 3-3**, the percent of White residents in the eastern portion of the study area (including Projects U-2579 and U-2579A) was higher than the county average in 2000 (80 percent versus 68 percent). The Project U-2579 Preferred Alternative right of way passes through two block groups with a lower White population when compared to the county average of 68

percent: Block Group 3002.2 (56 percent White) and Block Group 3002.1 (13 percent White). The Project U-2579 Preferred Alternative passes through a large portion of Block Group 3002.2, but passes through a small portion (approximately 0.30 acres) of Block Group 3002.1. **Figure 3-5 (a-d)** shows the block groups (2000) crossed by the Detailed Study Alternatives for Projects R-2247, U-2579, and U-2579A.

Age. As shown in **Table 3-3**, Forsyth County and Winston-Salem had approximately the same percentage of people 65 years and older (13 percent and 14 percent, respectively) in the year 2000. The study area also had a similar percentage of people 65 years and older, with 10 percent in the western portion and 12 percent in the eastern portion. One block group in the eastern portion of the study area has 26 percent of its population aged 65 years and older (Block Group 2902.3).

Poverty. The most recent poverty census data available is for 1999 and is listed in **Table 3-3**. The percentage of people in poverty for Forsyth County and Winston-Salem are 11 percent and 15 percent, respectively.

Table 3-3: 2000 Study Area Populations

Area	Total Population	Percent White	Percent Black	Percent Other	Percent 65 Years and Over	Percent In Poverty (1999)
Forsyth County	306,067	68%	26%	6%	13%	11%
Winston-Salem	185,776	56%	37%	7%	14%	15%
Study Area	67,458	83%	13%	4%	11%	5%
Western Portion	32,061	86%	10%	4%	10%	4%
Eastern Portion	35,397	80%	16%	4%	12%	6%
*Western Portion Census Block Groups**						
3802.3	1,020	92%	5%	3%	12%	3%
4004.1	2,152	88%	3%	9%	17%	5%
3802.2	2,828	66%	28%	6%	11%	5%
4006.2	1,214	78%	12%	10%	7%	13%
4006.1	3,143	88%	8%	4%	6%	3%
3904.1	1,792	90%	7%	3%	18%	2%
3904.2	2,434	82%	11%	7%	16%	11%
4008.3	4,158	91%	5%	4%	6%	3%
4008.2	1,586	92%	6%	2%	9%	1%
4008.1	1,034	92%	5%	3%	11%	7%
4101.4	1,413	94%	4%	2%	10%	3%
4101.3	1,674	85%	12%	3%	9%	4%
4101.2	751	88%	10%	2%	10%	1%

Table 3-3: 2000 Study Area Populations

Area	Total Population	Percent White	Percent Black	Percent Other	Percent 65 Years and Over	Percent In Poverty (1999)
4101.5	1,310	88%	10%	2%	12%	4%
4101.1	744	98%	1%	1%	20%	1%
2801.3	1,872	92%	6%	2%	13%	3%
2804.1	1,105	82%	15%	3%	13%	5%
2805.3	891	95%	4%	1%	13%	4%
2805.4	940	78%	20%	2%	18%	4%
*Eastern Portion Census Block Groups**						
2805.2	1,472	73%	15%	12%	14%	11%
2806.2	1,914	69%	26%	5%	19%	9%
2807.1	1,670	65%	31%	4%	13%	4%
2807.3	1,846	91%	4%	4%	17%	9%
2901.1	1,679	79%	18%	3%	13%	12%
2901.2	1,514	85%	12%	4%	13%	6%
2902.1	1,907	75%	22%	3%	13%	7%
2902.3	628	91%	9%	0%	26%	8%
2902.4	685	89%	10%	1%	17%	5%
2902.5	1,500	87%	7%	7%	14%	6%
3001.1	1,277	77%	17%	6%	9%	3%
3001.2	3,241	93%	3%	3%	9%	4%
3001.3	1,491	91%	5%	4%	7%	1%
3002.1	1,336	13%	85%	2%	10%	14%
3002.2	1,424	56%	41%	3%	13%	4%
3002.3	878	86%	14%	0%	19%	4%
3303.3	1,844	87%	9%	4%	13%	5%
3306.1	1,129	92%	8%	0%	6%	2%
3307.1	2,249	88%	9%	3%	12%	4%
3308.1	3,350	88%	6%	6%	8%	2%
3308.2	1,413	89%	10%	0%	12%	2%
3402.1	950	84%	2%	14%	12%	12%

Source: 2000 Census, Summary Files 1 and 3

*####.# = first four numbers are the Census Tract, the last number is the Block Group number.

Overall, the Project R-2247 study area has a much lower percentage of people in poverty than the Project U-2579 and Project U-2579A study areas (4 percent and 8 percent, respectively). All of the census blocks in the Project R-2247 study area have a percentage of people in poverty ranging from 1 percent to 7 percent, with the exception of Block Groups 4006.2 and 3904.2, which are located in the vicinity of I-40 and Peace Haven Road. Block Group 4006.2 has 13 percent and Block Group 3904.2 has 11 percent of their populations in poverty, which are closer to the Forsyth County and Winston-Salem poverty percentages.

The eastern portion of the study area has an average of 6 percent of people in poverty, which is lower than Forsyth County, but slightly higher than the western portion of the study area. There are seven block groups in the eastern portion with over 10 percent of their population in poverty.

3.4.2 Economic Characteristics

3.4.2.1 Economic Trends

The economy of Winston-Salem and Forsyth County has changed dramatically over the last two decades. Traditional industries such as tobacco and textiles have declined largely due to changes in respective markets. Meanwhile, other local businesses have become increasingly linked to national and global economic trends. As a result, the area has shifted from dependence on a manufacturing-based economy to a more diversified services-based economy.

Traditionally, the strength of the local economy was the manufacturing sector. The mainstay of the manufacturing base was tobacco, together with textiles. Winston-Salem was the world headquarters of the R.J. Reynolds-Nabisco Company until 1987, when the corporate headquarters moved to Atlanta, Georgia. A new boost to manufacturing occurred recently when Dell opened a plant in the vicinity of the Union Cross Road/US 311 intersection and I-40.

Since about 1970, the economy has changed from predominantly manufacturing to non-manufacturing. This trend is in accord with similar trends taking place in many regions nationwide. The sectors exhibiting the most growth include trade, services, finance, and real estate. In 1970, manufacturing accounted for about 45 percent of the jobs in the area. By 2001, manufacturing accounted for only about 18 percent of the jobs (NC Department of Commerce website: *cmedis.commerce.state.nc.us/countyprofiles*, accessed December 19, 2002).

Since 1970, Forsyth County has experienced considerable economic growth and development, paralleling the MSA and North Carolina. Overall, there was growth in jobs and earnings for some sectors, and an increase in per capita and household income. The following sections highlight key socioeconomic indicators for the study area.

Employment. According to the 1990 US Census, the highest percentage of blue collar jobs was located within the eastern section of downtown Winston-Salem. The highest percentage of white collar jobs was located within the western part of Winston-Salem. The set of tables below (**Tables 3-4, 3-5, and 3-6**) highlights the growth in the amount and types of jobs available. The percentage of wage and salary employment has stayed approximately the same (between 85 percent and 91 percent) from 1970 to 2000 in North Carolina, the MSA, and Forsyth County. Likewise, the percentage of proprietors' employment (self-employment) has remained the same (between 9 percent and 15 percent) from 1970 to 2000 in North Carolina, the MSA, and Forsyth

County. The percentage of farming employment has seen a steady decrease, while non-farming employment has steadily increased.

Earnings. Forsyth County experienced just over a 17 percent decline in manufacturing as a share of overall industry earnings over the last several decades. However, this decline in manufacturing was offset by growth in the service industry, which increased by almost 18 percent. This trend also is true for the MSA and North Carolina. For the MSA and Forsyth County, basic industries were created or expanded in a variety of sectors, most notably within the service industry, such as health services.

Table 3-4: Employment for North Carolina (Full-Time Jobs)

Type	1970	Percent of Total	1980	Percent of Total	1990	Percent of Total	2000	Percent of Total
Wage and salary employment	2,107,633	85%	2,634,944	86%	3,371,825	86%	4,189,603	85%
Proprietors' employment*	360,886	15%	424,857	14%	557,296	14%	753,117	15%
Farm	125,354	5%	95,774	3%	64,703	2%	58,049	1%
Nonfarm	235,532	10%	329,083	11%	492,593	12%	695,068	14%
Total	**2,468,519**	**100%**	**3,059,801**	**100%**	**3,929,121**	**100%**	**4,942,720**	**100%**

*Proprietors' employment refers to self-employment
Source: Bureau of Economic Analysis, *Regional Economic Profile*

Table 3-5: Employment for MSA (Full-Time Jobs)

Type	1970	Percent of Total	1980	Percent of Total	1990	Percent of Total	2000	Percent of Total
Wage and salary employment	385,776	88%	467,734	87%	596,075	86%	701,211	85%
Proprietors' employment	54,018	12%	67,897	13%	97,500	14%	120,175	15%
Farm	13,650	3%	12,107	2%	8,775	1%	8,185	1%
Nonfarm	40,368	9%	55,790	11%	88,725	13%	111,990	14%
Total	**439,794**	**100%**	**535,631**	**100%**	**693,575**	**100%**	**821,386**	**100%**

Source: Bureau of Economic Analysis, *Regional Economic Profile*

Table 3-6: Employment for Forsyth County (Full-Time Jobs)

Type	1970	Percent of Total	1980	Percent of Total	1990	Percent of Total	2000	Percent of Total
Wage and salary employment	104,271	90%	134,507	91%	167,223	87%	194,295	87%
Proprietors' employment	10,980	10%	13,979	9%	24,850	13%	29,606	13%
Farm	1,275	1%	1,115	1%	788	<1%	691	<1%
Nonfarm	9,705	9%	12,864	8%	24,062	13%	28,915	13%
Total	**115,251**	**100%**	**148,486**	**100%**	**192,073**	**100%**	**223,901**	**100%**

Source: Bureau of Economic Analysis, *Regional Economic Profile*

3.4.2.2 Income

Per Capita Income. In terms of per capita income, Forsyth County was higher than both the MSA and North Carolina, with an annual income of $32,291 per person in 2000. This compares to $28,522 and $26,882 for the MSA and North Carolina, respectively. While average annual incomes in Forsyth County were higher than in the MSA and the State of North Carolina, the percent population growth for all three geographic units was similar.

Per capita income grew rapidly between 1970 and 2000 within the study areas. The per capita income increased at between 12 and 14 percent for Forsyth County, the MSA and the State of North Carolina (see **Table 3-7**).

Table 3-7: Per Capita Income

Area	1970	1980	1990	2000	Percent Growth over 30 year span
North Carolina	$3,285	$8,247	$17,367	$26,882	12%
MSA	$3,856	$9,436	$19,612	$28,522	14%
Forsyth County	$4,211	$10,521	$22,218	$32,291	13%

Source: Bureau of Economic Analysis, *Regional Economic Profile*

Household Income. **Table 3-8** shows household income for Forsyth County, the MSA, and the City of Winston-Salem. Forsyth County, the MSA, and Winston-Salem had approximately the same distribution of household incomes in 1999. The highest percentages of households earned between $15,000 and $74,999.

Table 3-8: 1999 Household Income Percent Distribution

Income	Winston-Salem	Forsyth County	MSA
Less than $10,000	12%	10%	9%
$10,000 to $14,999	7%	6%	6%
$15,000 to $24,999	14%	13%	14%
$25,000 to $34,999	14%	13%	14%
$35,000 to $49,999	16%	17%	18%
$50,000 to $74,999	18%	20%	20%
$75,000 to $99,999	8%	10%	9%
$100,000 to $149,999	6%	7%	6%
$150,000 to $199,999	2%	2%	2%
$200,000 or more	3%	2%	2%
Total	**100%**	**100%**	**100%**

Source: 2000 US Census, DP-3. *Profile of Selected Economic Characteristics*

3.4.3 Community Facilities

3.4.3.1 Western Portion of Study Area

Schools. As shown in **Figure 2-10(a-e),** eleven schools are located near the Project R-2247 Detailed Study Alternatives in the western portion of the study area. Five of these schools are public elementary schools: Ward Elementary (**Figure 2-10a**), Southwest Elementary (**Figure 2-10a**), Jefferson Elementary (**Figure 2-10b**), Meadowlark Elementary (**Figure 2-10b**), and Gibson Elementary (**Figure 2-10e**). Three are public middle schools: Clemmons Middle (**Figure 2-10a**), Meadowlark Middle (**Figure 2-10b**), and Northwest Middle (**Figure 2-10e**). There are two public high schools, West Forsyth High (**Figure 2-10a**) and Ronald Reagan High (**Figure 2-10c**) and a private school, Forsyth Country Day School (**Figure 2-10b**).

Meadowlark Elementary and Meadowlark Middle were built in the late 1990s. Ronald Reagan High School opened in the 2005/2006 school year. These three schools were not included in the 1996 Project R-2247 FEIS discussion of schools within the western portion of the study area because they did not exist at the time.

Churches and Cemeteries. Many churches, cemeteries, and memorial parks are located in the study area. Those near the Detailed Study Alternatives are shown in **Figure 2-10(a-e)** and **Figure 2-12(a-k)**. A large memorial park (cemetery) is located in the Village of Clemmons, west of the project. East of US 52, beyond the study area, is Crestview Memorial Park (cemetery) on the west side of University Parkway in Rural Hall.

Fire Stations. In unincorporated areas, fire protection is provided by volunteer fire departments. There is one fire station in the vicinity of the Project R-2247 Detailed Study Alternatives. Mt. Tabor fire station (Station No. 20), built in the mid 1990s, is located at the intersection of Robinhood Road and Meadowlark Drive (see **Figure 2-10c**).

Other Public Facilities. There are no libraries or hospitals in the vicinity of the Project R-2247 Detailed Study Alternatives. There is one post office, the Pfafftown Post Office, located at the northeast corner of Yadkinville Road and Transou Road near the Pfafftown Historic District (see **Figure 2-10d**).

Parks and Recreation. Parks and recreation facilities near the Project R-2247 Detailed Study Alternatives in the western portion of the study area include three golf courses, one golf driving range, one publicly-owned park, one undeveloped publicly-owned park, a National Little League park, and several community centers, neighborhood pools, tennis courts, and greenways. These facilities are described below.

Hillcrest Golf Club is a publicly-owned facility located between South Stratford Road and Little Creek, approximately one mile north of the project's southern terminus. The Grandview Golf Club is located along Muddy Creek, immediately north of Yadkinville Road, in the Pfafftown community. Bethania Golf Course (also known as Long Creek Club) is located along Muddy Creek and the Wedgewood development northwest of the town of Bethania. Both the Grandview Golf Club and Bethania Golf Club are privately owned but open to the public for play. A golf driving range is located along Bethania-Tobaccoville Road (NC 65) between Muddy Creek and Reynolda Road (NC 67).

The City of Winston-Salem acquired parkland on Meadowlark Drive in the late 1990s, adjacent to the new Meadowlark Elementary and Middle schools. Over the next six to eight years, depending on funding levels, the City plans to develop the area into a multi-use park, which will include soccer fields, ball fields, tennis courts, volleyball courts, restroom facilities, and covered picnic shelters (Personal Communication, Mark Serosky, Forsyth County Parks Director, April 21, 2003).

Forsyth County owns the 72-acre CG Hill Park located on Balsom Road. CG Hill Park increased in size from ten acres to 72 acres in the late 1990s when the City of Winston-Salem purchased landfill property from Forsyth County. Amenities include a small fishing lake, a walking path around the lake, benches, bridges, picnic tables, grills, and washroom facilities. A large 500 year-old yellow poplar tree is a major attraction in the park.

A National Little League park is a privately-owned baseball park located in the southern portion of the study area on Phillips Bridge Road on the east bank of Muddy Creek.

A number of private and association-owned pools, tennis courts, and recreation centers are located throughout the study area. A community center is located on Jonestown Road just north of McGregor Road, and ball fields and a community center are located in the Vienna community just east of Lewisville-Vienna Road.

The *Greenway Plan Winston-Salem and Forsyth County 2015 (*June 2003*)* makes recommendations for expansion of the existing greenway system to the year 2015. **Figure 3-6a** shows the *2015 Greenway Plan*, which includes all existing and proposed greenways. As of January 2002, sixteen miles of trails had been built along six greenway corridors within the City of Winston-Salem.

There are three types of proposed greenways shown in the *Greenway Plan*: proposed priority trails, other proposed trails, and potential greenway connectors. Proposed priority trails are greenways planned for construction between 2002 and 2015. Other proposed trails consist of "other greenway trails proposed in area plans and other studies for long-term implementation" (*Greenway Plan*, page 10). Greenway connectors link major greenway trails to other trails or destinations (*Greenway Plan*, page 9).

3.4.3.2 Eastern Portion of Study Area

Schools. There are eighteen public schools in the eastern portion of the study area. These are shown on **Figures 2-17(d-e) and Figure 2-22(a–i) for** Project U-2579, and **Figure 2-19 and Figure 2-23(a-d)** for Project U-2579A. Nine of these schools are public elementary schools: Cash Elementary (**Figure 2-17e**), North Hills Elementary (**Figure 2-17d),** Mineral Springs Elementary (**Figure 2-17d),** Walkertown Elementary (**Figure 2-17e**), Petree Elementary (**Figure 2-17e**), Ibraham Elementary (**Figure 2-17e**), Sedge Garden Elementary (**Figure 2-19**), Hall-Woodward Elementary (**Figure 2-19**), and Union Cross Elementary (**Figure 2-19**). Three of these are public middle schools: Mineral Springs Middle (**Figure 2-17d**), Walkertown Middle (**Figure 2-17e**), and Southeast Middle (**Figure 2-19**). There are four high schools: East Forsyth High (**Figure 2-17e**), North Forsyth High (**Figure 2-17d**), Carver High (**Figure 2-17e**), and Glenn High (**Figure 2-19**), and three private schools in the eastern portion of the study area: Gospel Light Baptist School (**Figure 2-17e**), Kerwin Baptist Christian School (**Figure 2-17e**), and Quality Education Institute (**Figure 2-17d**).

North Hills Elementary and Petree Elementary were built in the late 1990s. They are not included in the 1995 Project U-2579 DEIS discussion of schools within the study area, and therefore were not considered in the original selection of the Preferred Alternative.

Churches and Cemeteries. The locations of churches, cemeteries, and memorial parks in the eastern portion of the study area are shown on **Figure 2-17(d-e)** and **Figure 2-22(a–i)** for Project U-2579, and **Figure 2-19 and Figure 2-23(a-d)** for Project U-2579A. There are several churches

and cemeteries located within the study area, including two memorial parks, Piedmont Memorial Gardens and Oaklawn Memorial Gardens.

Fire Stations. In unincorporated areas, fire protection is provided by volunteer fire departments. Each city or town within the study area (Winston-Salem, Kernersville, and Walkertown) provides fire protection in their respective incorporated portions. The thirteen fire stations in the eastern portion of the study area are shown on **Figure 2-17(d-e)** and **Figure 2-22(a–i)** for Project U-2579, and **Figure 2-19 and Figure 2-23(a-d)** for Project U-2579A.

Other Public Facilities. As shown on **Figure 2-17(d-e)** and **Figure 2-22(a–i)** for Project U-2579, and **Figure 2-19 and Figure 2-23(a-d)** for Project U-2579A, there are a number of public facilities in the eastern portion of the project study area. These include three Forsyth County public library branches: Rural Hall, Carver School Road, and Walkertown; the Walkertown Post Office; and the Walkertown Town Hall.

Parks and Recreation. There are five public parks and one public golf course in the immediate vicinity of the Projects U-2579 and U-2579A Detailed Study Alternatives. These areas are shown in **Figure 2-17(d-e)** and **Figure 2-22(a–i)** for Project U-2579, and **Figure 2-19 and Figure 2-23(a-d)** for Project U-2579A, which also include parks and recreational areas outside of the immediate vicinity that are not discussed below. Three of the publicly-owned parks and the golf course are owned by the City of Winston-Salem, and include the following:

- Salem Lake Park and Trail (Salem Lake Road) – amenities include paved and unpaved trails, restrooms, picnic areas, a boat launch, fishing pier, and boat rentals.
- Sedge Garden Park and Recreation Center (401 Robbins Road) – amenities include meeting rooms, shelter, playground, softball field, tennis courts, and a fitness trail.
- Winston Lake Park (2801 New Walkertown Road) – amenities include picnic shelters, softball fields, a football field, a fitness trail, access to the lake, and playgrounds.
- Winston Lake Golf Course (3535 Winston Lake Road) – this golf course, located in Winston Lake Park, has a pro shop, full-service grill, practice greens, driving range, cart and club rentals, and lockers.

Two of the publicly-owned parks are owned by Forsyth County, including:

- Walkertown Community Park (2701 Darrow Road) – amenities include a picnic shelter, picnic tables, grills, restrooms, softball and baseball fields, a soccer field, a sand volleyball court, horse-shoe pits, a playground, a hiking trail, a walking path, and three tennis courts.

- Union Cross Park (1925 Union Cross Road) – amenities include picnic shelters, restrooms, sand volleyball court, horseshoe pits, picnic tables with grills, lighted softball fields, basketball court and tennis courts, playground, concessions, and an asphalt path.

Figure 3-6a shows the existing and proposed greenways located in the eastern portion of the study area. The only existing greenway in the eastern portion of the study area is Salem Lake Trail located along the periphery of Salem Lake. There is one proposed priority trail, the Piedmont Greenway Trail, along Kerners Mill Creek. This trail is proposed to link the existing Salem Lake Trail to Triad Park, at the Guilford County line. All of the other proposed greenways in the study area are defined as other proposed trails. These greenways are located along the following creeks: Brushy Fork Creek, Mill Creek, Five Mile Branch (tributary to Mill Creek), Harmon Mill Creek, and Kerners Mill Creek.

3.5 INFRASTRUCTURE AND UTILITIES

3.5.1 Electrical Power Transmission

3.5.1.1 Western Portion of Study Area

As shown in **Figure 3-7,** there are three existing electrical substations and two 100/230-kV transmission line easements owned by Duke Power Company within the Western portion of the study area.

3.5.1.2 Eastern Portion of Study Area

There are three existing electrical substations and several 100/230-kV transmission line easements owned by Duke Power Company within the eastern portion of the study area, as shown on **Figure 3-7**.

3.5.2 Water and Sewer

3.5.2.1 Water

Sewer and water service for the majority of Forsyth County are provided by the Winston-Salem and Forsyth County City-County Utilities. The City-County Utilities Division provides potable water to residential, commercial and industrial customers. The water distribution system roughly covers the entire county with the exception of the northeastern portion. As of August 2004, the distribution system consists of approximately 1,944 miles of water lines (City-County Consolidated System, 2004). Rural Hall and Walkertown have their own water systems supplied

from deep wells. Areas not served by these water systems maintain private wells or are connected to community systems.

The City-County Utilities Division operates three conventional water treatment plants: the Thomas Water Treatment Plant, the Neilson Water Treatment Plant, and the Northwest Water Treatment Plant. These plants, located outside the study area, provide treated water to most areas in the County, including the study area, at an average daily demand of 43.2 million gallons (City-County Utilities Division, 2003). Supply sources are Salem Lake, the Yadkin River, and Idols Pond (an impoundment on the Yadkin River in the southwestern corner of Forsyth County). **Section 3.15.2** provides additional information on water supply resources.

3.5.2.2 Sewer

Centralized wastewater collection is provided by one primary system in Forsyth County, the City-County Consolidated System. This includes Kernersville, Rural Hall, and Winston-Salem. Walkertown is currently installing public sewer lines, which also will be tied into the Consolidated System.

The City-County Utilities Division provides wastewater collection to residential, commercial, and industrial customers. As of August 2004, the sewer system serves approximately 64 percent of the occupied dwellings/businesses within the county. The wastewater collection system consists of approximately 1,413 miles of sewer mains (City-County Consolidated System, 2004).

The City-County Utilities Division manages two wastewater treatment plants and fifty-two wastewater pump stations. The Archie Elledge plant is located on Salem Creek on the southwestern side of Winston-Salem and has a capacity of 30 million gallons per day. The Muddy Creek Wastewater Treatment Plant is located on the southern border of Forsyth County and is permitted for 21 million gallons per day (City-County Utilities Division, 2003).

The centralized sewage/wastewater collection system follows the Muddy Creek Basin, with lines along Muddy Creek, Mill Creek, and Grassy Creek. A 54-inch interceptor parallels the Muddy Creek floodway and carries sewage to the Lower Muddy Creek Treatment Plant above the Davidson County line. In addition to several pump stations located within the western portion of the study area, there are two metering stations, three package treatment plants, and the one wastewater treatment plant.

3.5.3 Natural Gas

3.5.3.1 Western Portion of Study Area

Piedmont Natural Gas Company provides gas services to the western portion of the study area, as shown in **Figure 3-7**. Based on information provided by Piedmont Natural Gas (2003), one major gas main runs generally northeast-southwest through the study area north of Robinhood Road. None of the Detailed Study Alternatives cross this line.

Other gas mains noted in the 1996 Project R-2247 FEIS south of Robinhood Road are not considered major lines by Piedmont Natural Gas (*Piedmont Natural Gas Company, North Carolina Atlas – Winston Salem District,* revised September 2002).

3.5.3.2 Eastern Portion of Study Area

There are three main gas transmission lines in the eastern portion of the study area. One runs generally from east to west, crossing US 52 near Germanton Road, arcing slightly northward, then running southeast to cross New Walkertown Road before proceeding east through Walkertown. The second extends from near the intersection of US 311 and Thomasville Road southeast, paralleling Thomasville Road. The third crosses the county from Old Greensboro Road southwest to Hastings Road. The natural gas main rights of way are shown on **Figure 3-7**.

3.5.4 Railroads

3.5.4.1 Western Portion of Study Area

Railroad lines operated by the Norfolk Southern Railroad Company (headquartered in Norfolk, Virginia) are located at the north and south ends of the western portion of the study area. The southern railroad line is located south of and parallel to South Stratford Road. These tracks extend into downtown Winston-Salem (see **Figure 3-1**).

One northern railroad line runs east/west through Tobaccoville and Rural Hall, north of the study area. Another railroad line runs south from Rural Hall to Winston-Salem, following Grassy Creek until it crosses US 52 near the NC 66 Connector. This rail line intersects the area encompassed by a proposed interchange between the Eastern and Western Sections of the Winston-Salem Northern Beltway and US 52 at the NC 66 Connector.

3.5.4.2 Eastern Portion of Study Area

Two railroad lines operated by the Norfolk Southern Railroad Company are located in the eastern portion of the study area (see **Figure 3-1**). One railroad line connects to the north/south tracks

located in the western portion of the study area near the interchange of US 421/I-40 Business and US 52. This line then follows US 421 and West Mountain Street through downtown Kernersville. The other railroad line follows Old Walkertown Road northeast into Walkertown, and continues north along US 311 (Walnut Cove Road) toward Walnut Cove. The NCDOT Rail Division proposes to close three crossings of Norfolk Southern Railroad between West Mountain Street and Pisgah Church Road in the vicinity of the Northern Beltway. One new crossing is proposed in this area that will provide access to a new school.

3.5.5 Radio Transmission Towers

3.5.5.1 Western Portion of Study Area

A directional radio antenna array for station WSJS is located on the west side of Muddy Creek south of Robinhood Road. The location of the WSJS radio antenna array is shown on **Figure 3-7**. WSJS is a directional station that operates under severe restrictions imposed by the FCC. Any alteration to or relocation of the array could threaten the continued operation of the station. Four towers and associated radial grounding wires and guy wires run in an east-west direction from the Muddy Creek floodplain, up the hillside to the west. The grounding wires extend in a 300-foot radius from each of the four towers.

3.5.5.2 Eastern Portion of Study Area

There are no known radio transmission towers within the eastern portion of the study area.

3.6 CULTURAL RESOURCES

3.6.1 Prehistoric and Historic Cultural Setting

The following **Sections 3.6.1.1 and 3.6.1.2** are summarized from the 1996 Project R-2247 Final Environmental Impact Statement (Section 3.4.4). This history has not changed since 1996 and does not require updating.

3.6.1.1 Prehistoric Cultural Setting

The project study area has a high density of archaeological sites spanning a lengthy prehistoric period. The major prehistoric stages recognized in the cultural sequence of the North Carolina Piedmont are Paleo-Indian (ca. 10,000 to 8,000 years B.C.), Archaic (8,000 to 500 B.C.), and Woodland (500 B.C. to A.D. 1500). Sites from all of these cultural stages occur in the Forsyth County area. Woodland subsistence patterns persisted in the region until historic times. The Historic period began with the advent of European traders from coastal areas.

Paleo-Indian. As the climate began to warm around 10,000 B.C., temperate deciduous forests gradually replaced the spruce/pine boreal forests covering much of North Carolina. In North Carolina, the lanceolate, usually fluted, *Clovis*-like spear points diagnostic of this period most often indicate evidence of Paleo-Indian occupation. Few sites containing Paleo-Indian components have been reported in the vicinity.

Archaic. The Archaic stage is traditionally viewed as a period of adaptation to Holocene environments. Characteristics of this stage include a general trend from highly mobile bands to more sedentary and specialized groups, more intensive utilization of woodland resources, and increasing regional variation (Caldwell, 1958; Claggett and Cable 1982). There is a strong preference for ridge tops and ridge toes as the location of Archaic stage sites (Coe, 1964; Hargrove et al., n.d.).

Woodland. Woodland component sites are common to Forsyth County. A frequently used definition of the Woodland stage includes three characteristics: ceramics, the use of cultigens, and the appearance of burial mounds (Griffin, 1967). The Woodland settlement pattern included seasonal campsites of varying sizes. By the Late Woodland, some villages were occupied year-round. As cultivated crops increased in importance, villages moved from upland locations and clustered near fields on fertile bottomland soils (Woodall, 1984).

Mississippian. Sometime around A.D. 1450, an intrusive group, known archaeologically as the Pee Dee Complex, appeared among the indigenous Woodland Tradition population along the Yadkin River northwest of the study area. The South Appalachian Mississippian tradition practiced by the prehistoric Pee Dee people was a variant of the Mississippian pattern of maize-based agricultural economy, complex social organization, and temple mound ceremonialism (Ferguson, 1971). Town Creek Indian Mound on the Little River in western Montgomery County is the reconstructed ceremonial center of the Pee Dee phase (Coe, 1252a; Ferguson, 1971). Outside of the area encompassed by the Pee Dee Complex, Woodland Stage material culture continued uninterrupted until the Historic period. There are no known sites associated with the Pee Dee complex in the project vicinity.

3.6.1.2 Late Prehistoric and Historic Cultural Setting (to the 1930s)

A considerable body of archaeological and ethnological data supports the consensus that the North Carolina Piedmont was occupied by several Siouan-speaking tribes during the late prehistoric and early historic periods (Coe, 1937, 1952a, 1952b; Cumming, 1958; Dickens et al., 1987; Lefler, 1967; Lewis, 1951; Mooney, 1894; Swanton, 1946).

By the mid-seventeenth century, Siouan-speaking Indians of the southern North Carolina Piedmont were in regular contact with European traders (Alvord and Bidgood, 1912; Cumming,

1958; Lefler, 1967). Historic Indian villages in the North Carolina Piedmont were stockaded for defense.

The religious group known as the Moravians traces its origins to 1457 with the formation of the original *Unitas Fratrum* in Lititz, Germany (formerly Moravia). Stemming from missionary efforts in the New World, the Moravians reached the Yadkin River near present-day Wilkesboro. They heard of a tract of land along Muddy Creek and in the 1750s established the Wachovia Tract (Fries, 1922).

A group of Single Brothers, one of the Moravian's social groups or "Choirs", left Pennsylvania to develop settlements in Wachovia in 1753. The Brethren began laying out a town, which they called Bethabara, the House of Passage. It was to serve as a center for colonization of the Wachovia Tract. The settlement contained at least 16 structures.

The settlement was positioned along the Great Wagon Road. The road became an avenue of war during the French and Indian War, and Cherokees frequently came into Bethabara (Hartley, 1987). Because of a stockade at Bethabara, the settlement became a place of safety, with settlers and refugees numbering about 300 in 1760 (Willis and Marshall, 1988).

In 1759, the lots and streets of Bethania were laid out by Christian G. Reuter, surveyor of Wachovia. The settlement was designed as an agricultural town utilizing designs from the Middle Ages. The Bethania Town Lot was originally defined as 2,000 acres divided into four categories of land use: residential lots, orchard lots, bottomland lots, and upland lots (Hartley et al., 1990).

In 1769, the Bethania Town Lot was expanded to 2,500 acres by extending the boundaries to the north, east, and south. The Bethania and Bethabara town lots now touched, with Bethania to the northwest and Bethabara to the southeast. The Great Wagon Road passed between the Bethania and Bethabara town lots and continued southwest through the Wachovia Tract to the Yadkin River (Hartley et al., 1990).

As the Wachovia Tract was settled and served as an anchor for the frontier, a number of communities were founded around its boundaries, including Clemmons and Pfafftown.

Following the Civil War, agriculture in Forsyth did not undergo significant changes. The County was never an area of large farms and few farmers held slaves. The breakup of the large plantations and the loss of a free labor force did not have the same impacts in the region as it did in the areas of plantation economies further east. The rise of tenancy and sharecropping did, however, occur in the County to an extent, and agriculture entered a very non-productive stage after the war. One observer noted in 1877 that one of the chief agricultural exports from the County was dried blackberries (Fries et al., 1976).

During the recovery period, Forsyth County farms generally grew smaller, and the farmers were barely feeding themselves, with little surplus for sale in the growing towns. Most of the farms were between 20 and 100 acres (Fries et al., 1976).

Of increasing importance was the rise in tobacco manufacturing, with a demand for tobacco products increasing after the Civil War. In 1865, Washington Duke began manufacturing tobacco on his Orange County farm, moving the operation to Durham a few years later. While Durham had the early entry into the field, Winston quickly followed with the opening of TJ Brown's warehouse in 1872 (Lefler, 1943).

Also in 1872, PH Hanes moved to Winston and opened PH Hanes and Company, joining three firms which had already opened. In 1875, RJ Reynolds opened a Winston factory, and by 1878, these early pioneers had been joined by 19 other concerns. By the end of the 1880s, 30 factories were in operation, most in newly built four- and five-story structures. By 1896, this number had increased to 49 (Fries et al., 1976).

This boom period lasted until around 1912. In addition to the surge in tobacco manufacturing, rail connections improved, electric streetlights were installed and an electric street railway operated. In 1910, two smaller banks had merged into Wachovia Bank and Trust, moving into a new building, the first "skyscraper" in Winston (Taylor and Phillips, 1989).

A second boom period, extending from 1913 to 1930, has been termed Winston-Salem's era of success. The new era was signaled by a legislative act uniting the towns of Winston and Salem into one unit upon the vote of the population of the new towns. During these same years, RJ Reynolds Tobacco Company introduced the first modern-blend cigarette, Camel (Taylor and Phillips, 1989).

3.6.2 Section 106 of the Historic Preservation Act

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 Regulations for Compliance with Section 106, codified as 36 CFR Part 800. Section 106 requires Federal agencies to take into account the effects of their undertaking (federally-funding, licensed, or permitted) on properties on or eligible for inclusion in the National Register of Historic Places (NRHP) and to afford the Advisory Council a reasonable opportunity to comment on such undertakings.

Districts, sites, buildings, structures, and objects associated with American history, architecture, archaeology, engineering, and culture are considered eligible for the NRHP if they possess integrity of location, design, setting, materials, workmanship, feeling, and association and meet one or more of the following criteria established by the US Department of the Interior:

Criterion A: *Resources associated with events that have made a significant contribution to the broad patterns of our history.*

Criterion B*:* *Resources associated with the lives of persons significant in our past.*

Criterion C*:* *Resources that embody the distinctive characteristics of a type, period, or method of construction, or that represents the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction.*

Criterion D**:** *Resources that have yielded or may be likely to yield information important in prehistory or history.*

3.6.3 Archaeological Resources

3.6.3.1 Archaeological Resources for Project R-2247

A staged archaeological investigation of Project R-2247 was conducted in 1990 and 1991 due to the large size of the study area and the high potential for both prehistoric and historic archaeological resources. The first stage was a reconnaissance level sample survey of the Detailed Study Alternatives. This type of survey provides a general understanding of the types of archaeological resources within the study area. It assists planning decisions regarding the archaeological sensitivity and preservation concerns in the area.

Objectives of the reconnaissance survey included evaluating the potential of the Detailed Study Alternatives to contain archaeological sites and establishing a foundation for developing a field strategy for the intensive survey of the Project R-2247 Preferred Alternative. The intensive survey of the Project R-2247 Preferred Alternative was the second stage of the archaeological investigation (see **Section 4.4.2.3**).

The reconnaissance sample survey began with the background research on the prehistory and history of the entire study area. Based on this background research, a field survey strategy was developed. The sampling strategy involved surveys of representative portions of each of the Detailed Study Alternatives.

Previous archaeological research in the region indicates archaeological sites occur within certain landform types (e.g., ridge tops, gaps, floodplains, confluences, etc). Therefore, these landforms in the alternative corridors were included in the sample units surveyed during the first part of the archaeological project. All work conducted during the sample survey was performed pursuant to the National Historic Preservation Act of 1966, as amended; the regulations of the Advisory Council on Historic Preservation 36 CFR 800; and the regulations and procedures of FHWA (23

CFR 771 and Technical Advisory T 6640.8a). Fieldwork was conducted in February 1991. The sample areas were examined through surface inspection and/or shovel testing, depending upon the ground cover.

The survey included 25 sample units comprising 602 acres, which equaled ten percent of the total corridor area. Seventeen archaeological sites were discovered (Nash et al. 1991).

Four potentially eligible sites (31FY626, 31FY818, 32FY828, and 31FY830) were recommended for additional work should they be located within the Project R-2247 Preferred Alternative right of way. The State Historic Preservation Officer (SHPO) concurred with these site assessments in a letter dated July 10, 1991 (see **Appendix D.1)**.

The reconnaissance sample survey demonstrated that all of the Project R-2247 Detailed Study Alternatives could potentially impact archaeological sites. Because of this potential, none of the alternatives were excluded from the need for additional archaeological surveys.

Subsequent to the selection of Detailed Study Alternative C3-WEST-B as the Project R-2247 Preferred Alternative, an Intensive Archaeological Survey (1996) was conducted along a 500-foot-wide corridor defined by the 1995 preliminary engineering designs for the project. The Intensive Archaeological Survey reported that 102 of the 115 sites found within the preferred corridor were assessed as ineligible for inclusion on the National Register of Historic Places. Twelve sites were assessed as eligible for inclusion on the National Register of Historic Places. None of these sites are considered to warrant preservation in place. The impacts to Project R-2247 archaeological resources are discussed in **Section 4.4.2.3** of this document.

3.6.3.2 Archaeological Resources for Projects U-2579 and U-2579A

Project U-2579. An archaeological sample survey was conducted within the corridors for the Project U-2579 Detailed Study Alternatives between April 1994 and July 1994 (*Archaeological Resources Technical Memorandum for Winston-Salem Northern Beltway Eastern Section*, October 1995, appended by reference). The survey was conducted in accordance with Section 106 of the National Historic Preservation Act of 1966; the regulations of the Advisory Council on Historic Preservation 36 CFR 800; and the regulations and procedures of FHWA (23 CFR 771 and Technical Advisory T 6640.8a). The survey sampled the corridors for prehistoric and historic archaeological sites, made recommendations regarding eligibility of identified sites, and discussed the probability of additional archaeological resources occurring within unsurveyed portions of the corridors.

The survey covered 3,717 acres and included 420 acres selected from among the Detailed Study Alternatives (approximately 11.31 percent of the proposed rights of way). Thirty-one sample

units were systematically surveyed, with shovel tests excavated along transects (Abbott and Davis 1995:i).

The sample survey investigated 49 sites: two previously recorded archaeological sites (31FY4 and 31FY64), 33 previously unrecorded archaeological sites, and 14 isolated artifact finds. No archaeological sites listed in the NRHP were identified within the corridors for the Detailed Study Alternatives. However, three of the previously unrecorded sites, 31FY975**; 31FY994/994**; and 31FY1008, were determined eligible for listing in the NRHP. The report recommends consulting the State Historic Preservation Office (HPO) regarding additional work at the sites if any of the three sites are within the right of way for the Preferred Alternative.

The landowner of archaeological site 31FY64 denied access to the field archaeologists. Consequently, it was concluded that assessment of site 31FY64 would be undertaken if it is located within the right of way of the Preferred Alternative and after it is acquired by NCDOT. Archaeological site 31FY1020 was discovered en route to a sample area, but not assessed. Site 31FY1020 will be assessed if it is located within the right of way of the Preferred Alternative. A cemetery with unmarked graves and a headstone with the date 1821 (reported to represent members of the Frazier family) was recorded as archaeological site 31FY996**. The cemetery will be addressed in accordance with North Carolina General Statutes Chapter 70 if it is located within the right of way of the Preferred Alternative. In a letter dated September 6, l995 (included in **Appendix D.1**), the Deputy SHPO agreed to these recommendations.

The determination of "not eligible" for site 31FY998** was questioned by the Deputy SHPO. This site is the Robbins farmstead, which reportedly dates to 1850, although no artifacts from that time period were discovered. Site 31FY998** will be reassessed if it is located within the right of way of the Preferred Alternative. The assessment will be in the form of shovel tests that may be accompanied by larger units.

Project U-2579A. A preliminary archaeological background research study and field reconnaissance of the study area for Project U-2579A was conducted in November 1994 (*Archaeological Resources Technical Memorandum for Winston-Salem Northern Beltway Eastern Section Extension*, November 1994, appended by reference). The survey examined the project area for prehistoric or historic archaeological sites with significant remains that might be eligible for inclusion in the NRHP. The background research study consisted of reviewing the holdings of the Division of Archives and History, Office of State Archaeology and Historic Sites section, in Raleigh. The field survey involved a drive-through of the project area.

The Area of Potential Effect (APE) for the Project U-2579A archaeological survey was defined as a corridor approximately 4.5 miles long, between 4,000 and 10,000 feet wide. The APE included all Detailed Study Alternatives.

The preliminary survey identified a total of 18 sites within or immediately adjacent to the APE. Eleven of the previously recorded sites were recommended for further assessment to determine their status. Four sites were recommended for no further work, two were destroyed, and one was determined not eligible.

Five of the 18 previously recorded archeological sites were located within the 1,200-foot corridors for the preliminary alternatives, which in 1994 were described as the Eastern, Middle, and Western Alternatives. However, only one site (31FY258) is within the corridors for the Detailed Study Alternatives, and this site was recommended for no further work.

An additional archaeological survey and evaluation was performed for the Project U-2579A study area during November and December 2004. This study examined nine of the 16 sites recorded in the earlier study and encountered five additional sites. The nine sites were determined to be not eligible for the NRHP and no further work is required. The five new sites identified were determined to be ineligible for the NRHP. It is unlikely that further archaeological work will be required in conjunction with this project.

3.6.4 Historic Architectural Resources

3.6.4.1 Historic Architectural Resources for Project R-2247

Two Historic Architectural Resource Surveys were prepared for the western portion of the project study area. The first survey was completed in 1990-1991 (*Phase I and Phase II Historic Architectural Resource Survey Reports for Project R-2247*, appended by reference). The second study was completed in 2002-2003 (*Historic Architectural Resource Survey Report Phase II Intensive for Project R-2247*, appended by reference).

1990-1991 Architectural Resources Survey. The 1990-1991 architectural resources survey was conducted in two phases between June 1990 and June 1991. The first phase recorded all properties 50 years of age or older within the 72 square-mile APE. The second phase evaluated those properties within the APE that are listed in or were determined eligible for listing in the NRHP. The APE is defined as the geographic area or areas within which a project may cause changes in the character or use of historic properties.

Background research was conducted at state and local archives to locate primary and secondary sources of information pertaining to the history of particular properties and the greater survey region. Numerous oral interviews were conducted with local citizens who were knowledgeable about particular properties. Using the previous survey reports and the 1950 USGS quad maps, all roads within the 72 square-mile survey area were driven and all pre-1950 buildings were mapped and photographed.

Of over 500 architectural properties mapped and photographed within the western portion of the study area, 37 were intensely investigated and a survey report was produced in 1991 that documents the results of the investigations. Nine individual properties and two districts were determined to be eligible for listing in the NRHP. **Table 3-9** lists the properties determined eligible for the NRHP during the 1990-1991 Historic Architectural Resources Survey.

2002-2003 Architectural Resources Survey. The APE defined in 1990-1991 remained valid for the project; therefore, updated fieldwork was conducted in the western portion of the APE in July 2002.

Table 3-9 includes the properties listed in or determined eligible for listing in the NRHP as a result of the 2002-2003 survey. **Figure 2-12(a-k)** shows the locations of these historic architectural resources. Four properties were determined eligible for the National Register in the 2002-2003 study that were determined not eligible during the 1990-1991 study. In addition, three properties were determined eligible for the NRHP in the 2002-2003 study that had not been identified in the 1990-1991 study.

The following section describes the properties within the Project R-2247 APE listed in or determined eligible for listing in the NRHP during the 2002-2003 survey.

Doub-Yarbrough House (see Figure 2-12e)

The Doub-Yarbrough House, located at the northwest corner of SR 1427 and SR 1348, is a mid-nineteenth century log dwelling with later frame additions located on a 1.03 acre tract that originally served as part of the family's surrounding farmland. The house is eligible for listing in the NRHP under Criterion C (see **Section 3.6.2**) as an excellent example of turn-of-the-century piedmont farmhouse construction and Criterion B for its association with Methodist circuit rider David Doub, who built the original log portion of the house. The setting for this property remains intact.

John Jacob Schaub House (see Figure 2-12g)

The John Jacob Schaub House, located immediately west of CG Hill Memorial Park, is listed in the NRHP under Criterion C as an exceptionally rare example of early nineteenth century brick Moravian architecture. The house is isolated within an 8.6-acre tract without any associated outbuildings. The site remains relatively unaltered.

Ploughboy Jarvis Farm (see Figure 2-12a)

The Ploughboy Jarvis Farm, located at 1532 Jonestown Road, is a late nineteenth century agricultural complex centered about an L-shaped farmhouse. The complex includes an intact array of typical agricultural outbuildings and is located within a 33-acre parcel that remains from the original farm. Nine acres of the farm is eligible under Criteria A and B for its association

with Forsyth County's broad patterns of rural agrarian development and for its association with James Monroe "Ploughboy" Jarvis.

Table 3-9: Properties Listed in or Eligible for Listing in the National Register of Historic Places in Project R-2247 Study Area

Name of Historic Resource	Status per 1990/1991 Survey	Status per 2002/2003 Survey
Doub-Yarbrough House	Eligible	Eligible
John Jacob Schaub House	Listed in 1984	Listed in 1984
Ploughboy Jarvis Farm	Eligible	Eligible
Samuel Stauber House and Barn	Listed in 1988	Listed in 1988
Jeremiah Bahnson Conrad House	Eligible	Eligible
Constantine C. Stoltz House	Eligible	Demolished in 1995
Columbus Kapp House and Barn	Eligible	Eligible
John Henry Kapp Farm	Listed in 1992	Listed in 1992
Thomas Jefferson Kapp House	Eligible	Eligible
Pfafftown Historic District	Eligible	Eligible
Bethania Historic District	Listed in 1976 boundary increase in 1991	Listed in 1976 boundary increase in 1991
Brookberry Farm*	Not Eligible	Eligible
Harmony Grove United Methodist Church Cemetery	Not identified	Eligible
Alexander Hege House	Not eligible	Eligible
John S. Shore Farm	Not identified	Eligible
Todd House	Not identified	Eligible
Kapp's Mill Miller's House	Not Eligible	Eligible
Eugene Thomas Kapp House	Not Eligible	Eligible

* The Brookberry Farm is currently being redeveloped.

Samuel Stauber House and Barn (see Figure 2-12h)

The Samuel Stauber House and Barn, located at 6085 Bethania-Tobaccoville Road, is a main house and a complex of associated agricultural outbuildings set within a 6.9-acre tract, which remains from the family's original farm of several hundred acres. The property is listed in the NRHP under Criteria A and C as an excellent representative of a mid-nineteenth century farmstead in rural Forsyth County.

Jeremiah Bahnson Conrad House (see Figure 2-10c)

The Jeremiah Bahnson Conrad House is located on Spicewood Drive, just north of Oil Mill Branch. The brick I-house with Greek Revival and Italianate details is located on one acre of land that remains from the original large farm. The property is eligible for the NRHP under Criterion A for its association with Forsyth County's broad patterns of rural agrarian development

in the mid- to-late-nineteenth century. The house is eligible under Criterion C also for its architectural qualities.

Columbus Kapp House and Barn (see Figure 2-12k)

The Columbus Kapp House and Barn, located on Kapp Road, is a late nineteenth century brick-nogged Queen Anne-style I-house with four agricultural outbuildings set within a 13-acre tract of the Kapp family's 130-acre farm. The property is eligible for the NRHP under Criterion A for association with Forsyth County's broad patterns of agrarian development and Criterion C for its architectural qualities.

John Henry Kapp Farm (see Figure 2-12g)

The John Henry Kapp Farm is located at 6055 Bethania-Tobaccoville Road. The fine mid-nineteenth century brick-nogged Queen Anne-style I-house and its associated agricultural outbuildings are set within a 35-acre parcel on the family's original farm. The property was placed on the NRHP in 1992 under Criterion C for its architectural qualities.

Thomas Jefferson Kapp House (see Figure 2-12h)

The Thomas Jefferson Kapp House is an unusually fine two-story mid-nineteenth century Greek-Revival farmhouse and barn set within a 1.13-acre tract. The main house is eligible for the NRHP under Criterion C for its architectural qualities.

Pfafftown Historic District (see Figure 2-10d)

The Pfafftown Historic District is a linear array of ten mid-to late-nineteenth century residential homes. The district is eligible for listing in the NRHP under Criterion A for its association with broad patterns of settlement in Forsyth County by the Moravian cultural group. The district is eligible under Criterion B also for its association with Peter Pfaff and later generations of Pfaffs and Transous. The individual properties also are eligible under Criterion C for their representation of Greek-Revival and Queen Anne architectural style trends which prevailed prior to the twentieth century. The historic district boundaries largely follow the rear property lines linking the individual properties. One archaeological site, Site 31FY626, is located within the eastern section of the district.

Bethania Historic District (see Figure 2-10d)

The Bethania Historic District was listed in the National Register in 1976. Its boundaries were increased in 1991. The district includes buildings in the original town center and outlying areas that were historically farm lots corresponding to residential lots in town. A majority of the district's outlying areas are located in the floodplains of Muddy Creek and its tributary streams.

Brookberry Farm (see Figure 2-12d)

The Brookberry Farm includes the circa 1910 Conrad house (a two-story I-house), the Gray House (a two-story T-shaped block house), three small bungalow cottages, and associated agricultural outbuildings set within 185 acres of a 1,000-acre parcel. The Brookberry Farm boundary follows ridgelines and natural contours.

Brookberry Farm is eligible for the NRHP under Criteria A and C. The house, grounds, pastures, and dairy-related buildings survive as important examples of the country house movement and the Colonial Revival style during the post-World War II period.

The Brookberry Farm's eligibility for the National Register of Historic Places changed from "not eligible" based on the 1990/1991 surveys to "eligible" based on the 2002/2003 surveys. The reason this property was cited as "not eligible" in the 1990/1991 surveys was it was not at least 50 years old at the time of the 1990/1991 surveys (see letter from the SHPO dated January 2, 1992 in **Appendix D.1**). By the time of the 2002/2003 surveys, it was at least 50 years old and could then be eligible for the National Register of Historic Places (see letter from the SHPO dated October 9, 2003 in **Appendix D.1**).

Since the 2004 SFEIS/SDEIS, the Brookberry Farm has been identified for redevelopment.

Harmony Grove United Methodist Church Cemetery (see Figure 2-10a)

The Harmony Grove United Methodist Church Cemetery is located on the north side of Marty Lane (SR 1261) about 0.3 miles east of Lake Cottage Road (SR 1103). The cemetery contains approximately 60 marked graves, all of which are more than fifty years old and the majority of which are from the nineteenth century. The Harmony Grove cemetery is on a 0.83-acre parcel and is bound by a fence. The property is eligible for the NRHP under Criterion C and Criterion Consideration D for its outstanding non-Moravian Germanic funerary art.

Alexander Hege House (see Figure 2-12d)

The Alexander Hege House, located at 5340 Shallowford Road, is a one-and-a-half-story, side-gable log house with a frame barn situated on a one-acre parcel of land. This property's eligibility for the NRHP changed from "not eligible" based on the 1990/1991 surveys to "eligible" based on the 2002/2003 surveys. The reason this property was cited as "not eligible" was it had undergone "character-altering changes" (see letter from Langdon Edmunds Oppermann dated September 23, 1992 in **Appendix D.1**). However, the house was determined eligible for the NRHP under Criterion A in the 2002/2003 survey for its association with the broad pattern of western Forsyth County's rural agrarian development in the mid- and late nineteenth century and Criterion C as a well-preserved example of a log house, once very common in Forsyth County (see letter from SHPO dated October 9, 2003 in **Appendix D.1**).

John S. Shore Farm (See Figure 2-12h)

The John S. Shore Farm, located at 6010 Bethania-Tobaccoville Road, consists of a gabled-roof I-house with a rear ell and shed additions. A smokehouse and a smaller barn or granary are included on the 3.89 acre farm also. The house is eligible for listing in the NRHP under Criterion A for its association with the broad pattern of western Forsyth County's rural agrarian development in the early nineteenth century. It is also eligible under Criterion C as a typical I-house with an unadulterated exterior and a compliment of well-preserved outbuildings.

Todd House (see Figure 2-10a)

The Todd House is located at 2510 Clemmonsville Road southeast of US 158 (Stratford Road). It is a one-story plank and log house probably constructed in the late nineteenth century. The Todd House is eligible for listing in the NRHP under Criterion C for its rare and distinctive plank construction.

Kapp's Mill Miller's House (see Figure 2-12h)

The Kapp's Mill Miller's house, located at 5611 Kapp Road, is a small one-and-one-half story gable-sided house with board-and-batten siding. The house has been vacant since about 1970 and is in deteriorated condition. This house is said to have been the Miller's house for the Thomas Jefferson Kapp gristmill located down the hill on Mill Creek and run by TJ Kapp. This was the fourth mill in the Bethabara and Bethania area. Remains of the mill, which ceased operation by 1920, are still evident in the creek. The Miller's house was likely built in the mid- to late-nineteenth century.

The property is eligible for listing in the National Register under Criterion A for its association with rural industry and commerce in nineteenth century Forsyth County.

This property's eligibility for the National Register of Historic Places changed from "not eligible" based on the 1990/1991 surveys to "eligible" based on the 2002/2003 surveys. The reason this property was cited as "not eligible" was it had undergone "numerous character-altering changes" (see letter from the SHPO dated January 2, 1992 in **Appendix D.1**). However, the 2002/2003 surveys found that even though the interior of the house had been altered, the exterior of the building was a good representation of a 19th century miller's house, which is rarely found. Therefore, the property was determined "eligible" for the NRHP based on the findings of the 2002/2003 surveys.

Eugene Thomas Kapp House (see Figure 2-12h)

The Eugene Thomas Kapp House is located at 5631 Kapp Road. This I-house of heavy frame construction with brick nogging is three bays wide and one room deep with brick exterior end chimneys, cornice returns and sawn Italianate ornamentation. Eugene Thomas Kapp, who was a member of a large family of which several members became successful millers, built the house in

1882. Alterations to the house, including the addition of full-height, classical revival portico with fluted columns, and a broken pediment over the front door, were made after Kapp's death in 1941. These additions were removed recently and the current owner is undertaking a restoration.

The property is eligible for listing in the National Register under Criterion C for its architecture, including interior woodwork and heavy frame construction with brick nogging. It is an excellent example of an unaltered, rural I-house with Queen Anne and Italianate-style detailing.

This site's eligibility for the National Register of Historic Places changed from "not eligible" based on the 1990/1991 surveys to "eligible" based on the 2002/2003 surveys. The reason this property was cited as "not eligible" was it had undergone "numerous character-altering changes" (see letter from the SHPO dated January 2, 1992 in **Appendix D.1**). However, as described above, these changes have been removed and a restoration is being performed (see letter from the SHPO dated October 9, 2003 in **Appendix D.1**).

3.6.4.2 Historic Architectural Resources for Project U-2579

Three Historic Architectural Resource Surveys were prepared for Project U-2579. The first survey, completed in April 1993, was for the Project U-2579 Detailed Study Alternatives (*Phase I: Historic Architectural Reconnaissance Survey – Eastern Section*). A Phase II survey was completed in late 1994 for the Detailed Study Alternatives (*Historic Structures, Survey and Evaluation Report – Eastern Section*, January 1995, revised June 1995). The third study was completed in April 2003 for the Project U-2579 Preferred Alternative (*Historic Architectural Resources Survey Report, Phase II Intensive – Eastern Section*). All three reports are appended by reference.

1993 Architectural Resources Survey. The 1993 Phase I Historic Architectural Reconnaissance Survey identified ten properties considered potentially eligible for inclusion in the NRHP, including five properties listed on the HPO's State Study List of potentially eligible properties. These sites are described in Section 3.1.7.1 of the 1995 Project U-2579 DEIS.

1995 Architectural Resources Survey. The 1995 Phase II Intensive Survey identified two properties in the APE eligible for the NRHP: the John and Matthew Clayton Farm and the John and Charles Fries Day Farm.

The John and Matthew Clayton Farm, also known by its historic name, the Clayton Family Farm, is located at the northeast corner of SR 1920 and NC 66. This property was listed in the NRHP in 2001. The John and Charles Fries Day Farm is located at 4995 Dippen Road.

2002-2003 Architectural Resources Survey. A Phase II historic architectural survey was conducted in June and July 2002 within the APE of the Project U-2579 Preferred Alternative and was completed in April 2003. Every property over 50 years of age was photographed and mapped. Those properties considered potentially eligible for the NRHP were evaluated.

In addition to the field survey, the files at the North Carolina HPO were reviewed. The deeds and tax records at the Forsyth County courthouse and records in the Forsyth County library were researched and local sources interviewed.

The APE for Project U-2579 was established as a band 2,000 feet wide and 4,000 feet wide, centered on the Preferred Alternative. Topography and the character of adjacent land use determined the width of the APE at any given point. The survey also included properties located within approximately 750 feet of the APE boundary, or where the proposed highway would be visible from a potentially eligible property.

Of the 335 properties identified during the 2002-2003 Phase II survey, 324 were determined ineligible by NCDOT, HPO, and FHWA based on the photographic inventory and background research. One property (Clayton Family Farm) listed in the NRHP, and one property previously determined eligible (John and Charles Fries Day Farm) were evaluated to insure they maintained their status. Nine additional properties identified by the survey were evaluated for eligibility, two of which were determined eligible for listing in the NRHP.

Table 3-10 includes the properties within the Project U-2579 APE that are listed in or eligible for listing in the NRHP. **Figure 2-17(d-e)** shows the location of these properties.

Table 3-10: Properties Listed in or Eligible for Listing in the National Register of Historic Places in Project U-2579 Preferred Alternative APE

Name of Property	Status per 1995 Survey	Status per 2002-2003 Survey
Clayton Family Farm	Eligible	Listed in 2001
John and Charles Fries Day Farm	Eligible	Eligible
Seaver's Gulf Station	Not identified	Eligible
Hammock Family Farm	Not identified	Eligible

Clayton Family Farm

The Clayton Family Farm (near the intersection of Stanleyville Drive and NC 66) consists of a house site with lawn and woodlands on approximately 25 acres in a modern residential setting north of the City of Winston-Salem. Fifteen structures are situated on the property, twelve of which contribute to the historic significance of the property. The Clayton Family Farm is listed in the NRHP under Criterion A for its association with early transportation in the area; Criterion B for its integrity of design, material, setting, and feeling; and Criterion C for its intact collection of nineteenth and twentieth century domestic, commercial, and agricultural buildings and

structures. The farm presents one of the most intact and historically significant complexes in rural Forsyth County.
In addition to the buildings on the Clayton Family Farm, a section of the roadbed of Old Hollow Road, an important early trade and travel corridor, extends across the lawn in front of the Matthew Clayton House. In 1953 Old Hollow Road was realigned to the south leaving an approximately 550 foot section abandoned in the yard of the Clayton Farm. The family took over part of the old road to use as a driveway. An "open pond," so called because it was open for all to use, is located northeast of the house. Historically used as a watering hole for livestock traveling the Old Wagon Road, the "open pond" has been overgrown with trees since the mid twentieth century. It was cited on the *Great Map of Wachovia, Part I* begun in 1758 by Christian Gottlieb Reuter.

John and Charles Fries Day Farm

The John and Charles Day Farm (on Dippen Road near the intersection of Day Road) is a medium-sized complex of frame and log buildings situated on approximately eleven acres in a rural area northeast of Winston-Salem. The John Day House is recognized as an important example of log construction. The Charles Fries Day house and seven outbuildings remain, and are a remarkably intact late nineteenth century small farmstead.

The John and Charles Day Farm is a rare example of the small subsistence post-Civil War farm. The farm is eligible for the National Register under Criterion C for the collection of well-preserved domestic and agricultural buildings that remain on the property. The farmhouse represents a common building technique of the nineteenth century where a log dwelling was built and later incorporated as the rear ell of a more substantial frame house. The outbuildings represent construction methods and patterns of arrangement practiced on farms in the county in the late nineteenth and early twentieth centuries.

The farm is also eligible under Criterion A for the ensemble of outbuildings that retain their integrity as a group and represent common agricultural practices of this section of Forsyth County in the post Civil War period. The property is one of a few farm complexes from the late nineteenth century that survive in Forsyth County.

Seaver's Gulf Station

Seaver's Gulf Station is a well-preserved representation of early automobile history in rural Forsyth County, and is eligible for the National Register under Criterion A for its association with early rural transportation history in Forsyth County.

Small gasoline stations from the period before World War II not only supplied customers with gasoline, they also functioned as community gathering places, especially in rural areas where such institutions were rare. The rural gas station helped to nurture and expand the automobile culture in areas outside cities and towns.

The Seaver Gulf station is also eligible under Criterion C as a well-preserved example of a standardized gasoline station built with rusticated concrete blocks made in a hand-operated block-making machine. Concrete block was an especially popular material for garages and other automobile-related buildings because of its fireproof qualities.

Hammock Family Farm

The Hammock Family Farm is a large complex of domestic and agricultural buildings from the early to mid-twentieth century set on approximately one hundred acres in a rural area northeast of Winston-Salem.

The farm, representing three generations of the Hammock family's tenure, is eligible under Criterion A in the area of agriculture for its collection of well-preserved outbuildings associated with cattle farming, hay cultivation, and domestic farm activities in Forsyth County. The farm is also eligible under Criterion C for the ensemble of twentieth century farm buildings and the dwelling that make the property one of the most outstanding complexes from the period after World War I.

3.6.4.3 Historic Architectural Resources for Project U-2579A

Three Historic Architectural Resource Surveys were conducted for Project U-2579A, all appended by reference. The first survey (Phase I) was conducted in 1995 as part of a Feasibility Study prepared by NCDOT (*Phase I Historic Structures, Survey and Evaluation Report – Eastern Section Extension*). The second survey, an update of the first survey, was prepared in September 2001 (*Historic Architectural Resources Survey Report, Preliminary Identification – Eastern Section Extension*). The third survey was a Phase II survey and was completed in April 2003 (*Historic Architectural Resources Survey Report, Phase II Intensive – Eastern Section Extension*). In addition, Phase II surveys were completed in February 2004 at the John and Catherine Bodenhamer House (*Historic Architectural Resources Survey Report, Phase II Intensive – Eastern Section Extension, John and Catherine Bodenhamer House*) and in March 2005 at the Disher Retreat (Hart Farm). All reports are appended by reference, and SHPO concurrence letters are in **Appendix D.1**.

1995 Preliminary Identification Survey. The first survey (Phase I) was conducted in 1995 as part of a Feasibility Study prepared by NCDOT. The 1995 survey identified one property that appeared to be eligible for the NRHP. That potentially eligible property was the Wilson-Stockton House, located at the north side of Kernersville Road, 0.5 miles northeast of SR 2675 and built in the early 1800s.

2001 Preliminary Identification Survey. This second survey was an update of the first survey conducted in 1995. The study area for Project U-2579A was redrawn around the Detailed Study Alternatives in 2001. The new eastern boundary was extended farther east and the northern boundary was made slightly larger than the original study area. A Phase I survey was conducted within the revised APE. Only newly identified properties and previously identified properties whose status had changed were discussed in the 2001 survey report. No properties located within the APE were identified that are listed on the NRHP or State Study List, or that appeared to be definitely eligible. The corridor location that affected the Wilson-Stockton House (identified in the original Preliminary Identification Study as being potentially eligible for the NRHP) had been moved, and thus no potential impact is anticipated.

2003 Preliminary Identification Survey. A Phase II survey of historic architectural properties within the APE was conducted to identify all structures over fifty years of age. Every structure over fifty years of age was photographed and mapped. Those properties considered worthy of further analysis were evaluated.

In addition to the field survey, the files at the North Carolina HPO were reviewed, the deeds and tax records at the Forsyth County courthouse and at the Forsyth County library were researched, and local sources interviewed.

Seventy-three properties over fifty years of age were identified during the field survey. Two additional properties were identified just outside the APE and were not evaluated. No properties listed on the NRHP occur within the APE. No properties previously determined eligible through the environmental review process are located within the APE. Seventy-two properties were determined not eligible by FHWA based on the photographic inventory. The SHPO concurred with this determination in correspondence dated January 20, 2004 (see **Appendix D.1**). The remaining property—the Motsinger Family Farm—was evaluated and determined not to be eligible for the NRHP by FHWA. The SHPO concurred with this determination in correspondence dated February 5, 2004.

2004 and 2005 Phase II Surveys. A Phase II survey of the John and Catherine Bodenhamer House was conducted in February 2004. The John and Catherine Bodenhamer House, located on High Point Road between I-40 and Union Cross Road, was determined not eligible for listing on the NRHP. A Phase II survey of the E.J. Disher Retreat (Hart Farm) was conducted in March 2005. The farm, located near Sedge Garden Road, was determined not eligible for listing on the NRHP. Concurrence forms for eligibility of these properties are included in **Appendix D.1**.

3.7 SECTION 4(f) AND SECTION 6(f) RESOURCES

3.7.1 Background

In accordance with Section 4(f) of the Department of Transportation Act of 1966 (49 USC § 303) and 23 CFR § 771.135, FHWA "may not approve the use of land from a significant publicly owned park, recreation area, or wildlife and waterfowl refuge, or any significant historic site unless a determination is made that: (i) there is no feasible and prudent alternative to the use of land from the property; and (ii) 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 (FHWA, 1987: pg 44).

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. Information on Section 6(f) resources in Forsyth County were obtained by contacting the Division of Parks and Recreation (personal communication, April 28, 2003).

3.7.2 Resources in Study Area

Section 4(f) and Section 6(f) resources near the Detailed Study Alternatives for Projects R-2247, U-2579, and U-2579A are listed in **Table 3-11**. Of the 25 Section 4(f) and/or Section 6(f) resources, eighteen are located in the western portion of the project study area. Fifteen of these resources are properties listed in or eligible for listing in the NRHP. Three resources are publicly-owned recreation areas.

Of the seven Section 4(f) and/or Section 6(f) resources in the eastern portion of the study area, four are historic and three are publicly-owned recreation areas.

Table 3-11: Section 4(f) and Section 6(f) Resources Within Project Study Area

Resource Name	Project Study Area Where Resource is Located	Section 4(f) or 6(f)
PUBLICLY-OWNED RECREATION AREAS		
Hillcrest Golf Club	R-2247	4(f)
C.G. Hill Park	R-2247	4(f)
Meadowlark Park	R-2247	4(f)
Sedge Garden Park	U-2579A	4(f)
Union Cross Park	U-2579A	4(f) and 6(f)
Salem Lake Park	U-2579 and U-2579A	4(f)
PROPERTIES LISTED IN OR ELIGIBLE FOR LISTING IN THE NRHP		
Doub-Yarbrough House	R-2247	4(f)
John Jacob Schaub House	R-2247	4(f)
Ploughboy Jarvis Farm	R-2247	4(f)
Samuel Stauber House and Barn	R-2247	4(f)
Jeremiah Bahnson Conrad House	R-2247	4(f)
Columbus Kapp House and Barn	R-2247	4(f)
John Henry Kapp House	R-2247	4(f)
Thomas Jefferson Kapp House	R-2247	4(f)
Pfafftown Historic District	R-2247	4(f)
Bethania Historic District	R-2247	4(f)
Brookberry Farm*	R-2247	4(f)
Harmony Grove United Methodist Church Cemetery	R-2247	4(f)
Alexander Hege House	R-2247	4(f)
John S. Shore Farm	R-2247	4(f)
Todd House	R-2247	4(f)
Clayton Family Farm	U-2579	4(f)
John and Charles Fries Day Farm	U-2579	4(f)
Seaver's Gulf Station	U-2579	4(f)
Hammock Family Farm	U-2579	4(f)

* The Brookberry Farm is currently being redeveloped.

3.8 VISUAL RESOURCES AND AESTHETICS

3.8.1 Western Portion of the Study Area

The western portion of the study area reflects the agricultural and farming traditions of the region, and is characterized by a gently rolling topography, pockets of wooded areas, and numerous streams. With the exception of areas near major roads and intersections, the study area population density is low. Occupied rural residences range from older established farmsteads to new permanent residences and mobile homes. Considerable variation exists in the general conditions of rural development, ranging from abandonment to modern, well-maintained farming operations and new contemporary subdivisions. The study area contains no natural or man-made features that were identified as having unique visual or aesthetic values for which some public scenic protection or designation is required.

Publicly-accessible views of the study area's landscape are confined primarily to roadways and public lands. In addition, non-public views of the landscape are available from developed (primarily residential) and undeveloped portions of the study area. Actual viewsheds and potential viewers to be affected by the proposed project are discussed in **Section 4.6**.

3.8.2 Eastern Portion of the Study Area

The general visual character of the eastern portion of the study area is rural residential, interspersed with large undeveloped tracts having wooded, gently sloping terrain with numerous streams and a few small lakes. There are no unusually scenic views from the roadways, although the mixture of woods and cropland offers a tranquil backdrop for the traveler. Commercial development is more evident between New Walkertown Road (US 311) and US 421/I-40 Business and along Kernersville Road. Residential development recently constructed between US 421/I-40 Business and I-40 reduced the natural scenic views.

The proposed project would cross major streams, potentially including Grassy Creek, Buffalo Creek, Frazier Creek, Mill Creek, Lowery Mill Creek, Martin Mill Creek, Kerners Mill Creek, and Smith Creek. The natural settings of these streams within wooded lands characterize the visual quality of much of the area. **Section 4.6** describes viewsheds and potential viewers that would be affected by the proposed project.

3.9 AIR QUALITY

The following section generally is extracted from the *Air Quality Technical Memorandum for the Winston-Salem Northern Beltway, Eastern Section Extension* prepared in October 2002 and appended by reference. This discussion of existing air quality applies to both the eastern and western portions of the project study area. The 8-hour ozone standard discussion is updated information.

The federal Clean Air Act of 1970, as amended (42 USC 750(c)), was enacted for the purposes of protecting and enhancing the quality of the nation's air resources to benefit public health, welfare, and productivity.

The US Environmental Protection Agency (EPA) has established primary and secondary National Ambient Air Quality Standards (NAAQS) for six criteria air pollutants: carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), ozone (O_3), particulate matter, and lead (Pb). For ozone, North Carolina adopted the 8-hour standard on April 1, 1999.

Air pollution originates from various sources, with emissions from industrial processes and internal combustion engines the most prevalent sources. Other sources of outdoor air pollution are solid waste disposal and combustion and any form of fire. The impact resulting from highway construction can range from intensifying existing air pollution problems to improving the ambient air conditions.

Traffic exhaust is the central concern when determining the air quality impacts of a new roadway facility or the improvement of an existing roadway facility. Motor vehicles emit carbon monoxide (CO), nitrogen oxides (NOx), hydrocarbons (HC), particulate matter, sulfur dioxide (SO_2), and lead (Pb) (listed in order of decreasing emission rate). Automobiles are considered to be the major source of CO in the project area. For this reason, most of the analysis presented is concerned with determining expected CO levels in the vicinity of the project due to traffic flow.

Carbon monoxide concentrations are generally higher in urbanized areas and are affected by daily and seasonal events. Daily variations in carbon monoxide concentrations are caused by atmospheric heating/cooling patterns. In the morning, cooler, dirtier air can get trapped below warmer, cleaner air in a temperature inversion. As the earth heats up, air near the surface gets warmer and mixes with the air above, promoting better dispersion of air pollutants later in the day. Temperature inversions occur more frequently in late autumn and early winter. Therefore, carbon monoxide concentrations tend to be higher during these months (NCDENR, 1999).

Table 3-12 lists National Ambient Air Quality Standards. The primary standards are set at a limit intended to "protect the public health with an adequate margin of safety," and the secondary standards are set at a limit intended to "protect the public welfare from known or anticipated

adverse effects (effects to aesthetics, crops, architecture, etc.)" (Federal Clean Air Act 1990: Section 109). The primary standards are established with a margin of safety, and consider long-term exposures for the most sensitive groups in the general population (i.e., children, senior citizens, and people with breathing difficulties).

Table 3-12: National Ambient Air Quality Standards

Criteria Pollutant	Averaging Time	Standard	Standard Type
Carbon Monoxide	8-hour Average	9 ppm	Primary
	1-hour Average	35 ppm	Primary
Nitrogen Dioxide	Annual Arithmetic Mean	0.053 ppm	Primary and Secondary
Ozone	1-hour Average	0.12 ppm	Primary and Secondary
	8-hour Average	0.08 ppm	Primary and Secondary
Lead	Quarterly Average	1.5 $\mu g/m^3$	Primary and Secondary
Particulate < 10 micrometers (PM_{10})	Annual Arithmetic Mean	50 $\mu g/m^3$	Primary and Secondary
	24-hour Average	150 $\mu g/m^3$	Primary and Secondary
Particulate < 2.5 micrometers ($PM_{2.5}$)	Annual Arithmetic Mean	15 $\mu g/m^3$	Primary and Secondary
	24-hour Average	65 $\mu g/m^3$	Primary and Secondary
Sulfur Dioxide	Annual Arithmetic Mean	0.03 ppm	Primary
	24-hour Average	0.14 ppm	Primary
	3-hour Average	0.50 ppm	Secondary

Source: US EPA Website*: http://www.epa.gov/oar/oaqps/greenbk/*

The Triad area, including Forsyth County, does not meet the 8-hour ozone standard. The Triad area (counties include Surry, Stokes, Rockingham, Caswell, Yadkin, Forsyth, Guilford, Alamance, Davie, Davidson, and Randolph) has entered into an Early Action Compact (EAC) with the EPA. The EPA is working with communities like the Triad to achieve the 8-hour ozone standard as soon as possible by entering into EAC that will reduce ground-level ozone, commonly known as smog (*http://www.epa.gov/ttn/naaqs/ozone/eac/,* accessed January 9, 2007). Communities close to or exceeding the 8-hour ozone standard that have elected to enter into an EAC will start reducing air pollution at least two years sooner than required by the Clean Air Act. Communities participating in the EACs must submit plans in 2004 for meeting the national 8-hour ozone air quality standard, rather than waiting until 2007, which is the plan submittal deadline for other areas not meeting the 8-hour ozone standard. EACs require communities to:

- Develop and implement air pollution control strategies.
- Account for emissions growth.
- Achieve and maintain the national 8-hour ozone standard.

EPA designated these areas as "non-attainment" in April 2004. However, as long as EAC areas meet agreed upon milestones, the impact of non-attainment designation for the 8-hour ozone standard will be deferred. As of June 2005, the Triad EAC has met the milestones thus far and the non-attainment designation is deferred.
During 1988, there were two recorded exceedances of the CO standard within Forsyth County. As a result, the county also was designated as a moderate non-attainment area for CO. Two additional exceedances for the CO standard were recorded in 1989. Subsequently, there were no further CO exceedances and the county was designated 'maintenance' for CO on November 7, 1994, and remains listed as such (US EPA website, *http://www.epa.gov/NSR/live/nc.html,* accessed January 9, 2007).

On December 17, 2004, EPA took final action to designate attainment and nonattainment areas under the national air quality standards for fine particulate matter (PM2.5). The final designations include only Davidson and Guilford Counties in the Greensboro/Winston-Salem/High Point area (EPA website: *http://www.epa.gov/pmdesignations/finaltable.htm*, accessed January 9, 2007).

Hydrocarbon and nitrogen oxides emitted from vehicles are carried into the atmosphere where they react with sunlight to form ozone and nitrogen dioxide. Automotive emissions of HC and NOx are expected to decrease in the future due to the continued installation and maintenance of pollution control devices on new vehicles. However, in regard to area-wide emissions, these technological improvements may be offset by the increasing number of vehicles on the transportation facilities in the area.

Ozone is the main component of smog. Since ozone is formed by chemical interactions with the sunlight, ozone concentrations are generally higher during the daytime and in late spring through early fall when temperatures are above 60 degrees Fahrenheit (F) and sunlight is more intense. In North Carolina, the ozone 'season' is April through October (NCDENR, 1999). The photochemical reactions that form ozone and nitrogen dioxide require several hours to occur. For this reason, the peak levels of ozone generally occur six to 12 miles downwind of a hydrocarbon or nitrogen oxide source. Urban areas as a whole are regarded as sources of ozone precursors, not individual streets and highways. The emissions of all sources in an urban area mix together in the atmosphere, and in the presence of sunlight, the mixture reacts to form ozone, nitrogen dioxide, and other photochemical oxidants.

Particulate matter and sulfur dioxide emissions are predominantly the result of non-highway sources such as industrial processes and commercial and agricultural activities. Because emissions of particulate matter and sulfur dioxide from automobiles are very low relative to other sources, there is no reason to suspect that traffic on the project would cause air quality standards for particulate matter and sulfur dioxide to be exceeded.

Automobiles without catalytic converters can burn regular gasoline. The burning of regular gasoline emits lead because regular gasoline contains tetraethyl lead, which was added by refineries to increase the octane rating of the fuel. Cars with catalytic converters burn unleaded gasoline, eliminating lead emissions. The 1990 Clean Air Act Amendments make the sale, supply, or transport of leaded gasoline or lead additives unlawful after December 31, 1995. Therefore, it is not expected that traffic on the proposed project would cause the NAAQS for lead to be exceeded.

In addition to the criteria air pollutants for which there are National Ambient Air Quality Standards (NAAQS), 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).

3.10 EXISTING NOISE LEVELS

3.10.1 Characteristics of Noise

Noise is defined as unwanted sound. It is emitted from many sources, including motor vehicles, airplanes, railroads, power generation plants, and factories. **Table 3-13** lists noise levels for common indoor and outdoor noises. Motor vehicle noise, or traffic noise, is usually a composite of noise from engine exhaust, drive trains, and tire-roadway interaction.

The magnitude of noise is typically described by its sound pressure. As shown in **Table 3-13**, the range of sound pressures humans can hear varies greatly. To reduce the range, a logarithmic scale is used to relate sound pressure to some common reference level, usually the decibel (dB). Sound pressures described in decibels are called sound pressure levels and are often defined in terms of frequency-weighted scales (A, B, C, and D).

The A-weighted scale is used almost exclusively to describe traffic noise because A-weighted sound quantities often correlate well with the subjective response of people to the magnitude of a sound level. For example, A-weighting takes into account the fact that humans are more sensitive to higher frequency sounds than lower frequency sounds. Sound levels measured using an A-weighted decibel scale are often expressed as dBA.

In this document, all sound pressure levels are expressed as dBA Leq(h). The hourly average sound level (Leq(h)), or equivalent sound level, is the level of constant sound which in an hour would contain the same acoustic energy as the time-varying sound. In other words, the fluctuating sound levels of traffic noise are represented in terms of steady noise levels with the same energy content.

Table 3-13 shows that most individuals in urbanized areas are exposed to noise from many sources as they go about their daily activities. The degree of disturbance or annoyance from these noises depends on three factors: 1) the amount and nature of the intruding noise, 2) the relationship between the background noise and the intruding noise, and 3) the type of activity occurring when the intruding noise is heard (Bolt, Beranek, and Newman, Inc., 1973:1-19).

Table 3-13: Common Indoor and Outdoor Noises

Common Outdoor Noises	Sound Pressure (μPa)	Sound Pressure Level (dBA)	Common Indoor Noises
	6,324,555	110	Rock band at 15 feet
Jet Flyover at 1,000 feet			
	2,000,000	100	
Gas lawn mower at 3 feet			Inside NY Subway train
	632,456	90	
Diesel truck at 50 feet			Food blender at 3 feet
	200,000	80	Garbage disposal at 3 feet
Noise urban daytime			Shouting at 3 feet
Gas lawn mower at 100 feet	63,246	70	Vacuum cleaner at 10 feet
Commercial area			Normal speech at 3 feet
	20,000	60	Large business office
Quiet urban daytime	6,325	50	Dishwasher in next room
Quiet urban nighttime	2,000	40	Small theatre
Quiet suburban nighttime			Library
	632	30	Bedroom at night
Quiet rural nighttime			Concert hall
	200	20	Broadcast/recording studio
	63	10	
			Threshold of hearing
	20	0	

Source: Highway Noise Fundamentals, Federal Highway Administration, September 1980, Page 29.

3.10.2 Noise Measurements

3.10.2.1 Western Portion of Study Area

As reported in the 1996 Project R-2247 FEIS (Section 3.5.8.1), noise levels were measured at 33 noise-sensitive sites in the vicinity of the Detailed Study Alternatives during February 1991 using a GenRad 1988 Precision Integrating Sound-Level Meter and Analyzer. These sites are representative of noise-sensitive land uses that are most likely to be affected by project noise from the Detailed Study Alternatives.

Noise measurement locations and measured noise levels are presented in **Table 3-14** and the locations are shown in **Figure 3-8a**. Short-term measurements (20 minutes in duration) were made at each of the 33 sites. Simultaneous traffic counts were taken during the measurement periods at sites located near existing roadways.

Average measured noise levels varied from a high of 68 dBA Leq at existing US 52 (site #3) to a low of 44 dBA Leq on Birchdale Drive (site #17). Dominant noise sources in the Project R-2247 study area included traffic on existing roads, various kinds of local activity, and animal sounds. These ambient measurements characterized existing noise levels, but are not necessarily representative of peak-hour conditions.

Updated measurements were not performed as part of the development of this supplemental document for the reasons described below.

Development has occurred in the Project R-2247 study area (shown in **Figure 2-10(a-k)**) since the noise analysis was prepared in support of the 1996 Project R-2247 FEIS. This development brought additional traffic and activity to the area. As a result, the general noise levels, on average, have likely increased.

The ambient noise level measurements are the basis for determining if predicted future noise levels would represent a "substantial increase" over existing noise levels. New measurements in the same locations as the previous measurements likely would show the same or higher ambient noise levels, which could in turn lower the number of noise-impacted receptors who would qualify for noise abatement. This could happen because fewer receptors would experience a substantial increase in noise levels.

Table 3-14: Noise Level Measurements – Project R-2247 Study Area

Site Number	Noise Measurement Location	Land Use Description	Ambient Noise Level (dBA Leq)
1	Shore Road, 0.3 mile south of Griffin Road (at approx. Project Crossing)	SFR*	54
2	Mizpah Church Road, 1.1 mile east of Bethania-Tobaccoville Road	SFR	55
3	Bethania-Rural Hall Road (NC 65) at US 52	SFR	68
4	Bethania-Rural Hall Road (NC 65) at Ziglar Road	SFR	62
5	North end of Eagle Crest Drive	SFR	46
6	Bethania-Tobaccoville Road at Myers Road	SFR	60
7	West end of Poplar Lane	SFR	49
8	NC 67 at Bethania-Tobaccoville Road	SFR	64
9	C.G. Hill Memorial Park on Balsom Road	SFR	50
10	Transou Road at Balsom Road	SFR	60
11	Lockhurst Drive at Waterway Drive	SFR	45
12	Pinehill Drive, 0.2 mile west of Spicewood Road (at approx. Project Crossing)	SFR	51
13	Wessex Road at Anglia Drive	SFR	45
14	Kecougtan Road, 0.1 mile north of Yadkinville Road	SFR	61
15	Chickasha Road, 0.1 mile south of Yadkinville Road at Vienna Elementary School Road	Elementary School	56
16	Storm Canyon Drive at Windmill Circle	SFR	53
17	Birchdale Drive, 0.5 mile west of Olivet Church Road	SFR	44
18	Robinhood Road, 0.7 mile west of Muddy Creek	SFR	67
19	Ashlyn Drive, 0.2 mile east of Meadowlark Road	SFR	53
20	Ketner Road, 0.7 mile north of Shallowford Road	SFR	51
21	Meadowlark Drive at Hundley Road	SFR	62
22	Shallowford Road at Sharon Methodist Church 0.5 mile west of Styers Ferry Road	Church	53
23	Country Club Road, 0.1 mile west of Muddy Creek	SFR	65
24	Phillips Bridge Road at Horncastle Drive	SFR	58
25	Phillips Bridge Road at Styers Ferry Road	SFR	58
26	Oak Creek Court at Marty Lane	Elementary School	58
27	Southwest School Road, 0.2 mile south of Holder Road	Elementary School	58
28	Woodwind Drive at Crestview Way	SFR	50
29	Peace Haven Road, 1.0 mile east of Lewisville-Clemmons Road	Church	66
30	McTavish Lane at Cutty Sark Road	SFR	63
31	Ploughboy Lane at Buddy Street	SFR	48
32	Lockwood Drive at Brian Lake Drive	SFR	53
33	South Stratford Road (US 158) at West Clemmonsville Road	SFR	64

* SFR = Single Family Residence

Using the 1991 levels to determine impacts due to a 'substantial increase' in noise levels would result in a conservative estimate of the number of impacts (i.e. a greater number of impacts would be reported). Since the proposed noise wall locations shown to the public at the Design Public Hearing held on September 5, 1996, were based on the 1991 measurements, NCDOT and FHWA decided to continue to use these 1991 measurements.

3.10.2.2 Eastern Portion of Study Area

As reported in the 1995 Project U-2579 DEIS (Section 3.3.15), noise levels were measured at 33 noise-sensitive sites in the vicinity of the Detailed Study Alternatives. Recommended noise wall locations were discussed in the 1995 DEIS, although they were not presented to the public.

Additional field measurements were taken in 2002 at 24 locations in the vicinity of the Project U-2579 Preferred Alternative and 24 locations in the vicinity of the Project U-2579A Detailed Study Alternatives to determine existing noise levels at receptors along the proposed project.

Noise impacts were updated based on revised traffic volume projections and the preliminary engineering design for the Project U-2579 Preferred Alternative. The noise measurements were made for the Preferred Alternative only because, based on review of land use patterns in the study area, the noise impacts of the alternatives studied in detail relative to one another would not change substantially.

Measurements were taken on August 6 and 7, 2002 for the Project U-2579 Preferred Alternative and on February 12 and 13, 2002 for the Project U-2579A Detailed Study Alternatives. The monitoring was conducted using a Norsonic Integrating-Averaging Sound Level Meter, type 116. These sites are representative of noise sensitive land uses that are most likely to be affected by noise from the projects.

The 1995 and 2002 noise measurement locations and the measured noise levels are listed in **Table 3-15** (Project U-2579) and **Table 3-16** (Project U-2579A). Site Numbers that include an "A" in **Table 3-15** are sites where noise levels were measured in 1995. The locations are shown in **Figure 3-8b** (Project U-2579) and **Figure 3-8c** (Project U-2579A).

Table 3-15: Noise Level Measurements – Project U-2579 Study Area

Site Number	Noise Measurement Location	Land Use Description	Ambient Noise Level (dBA Leq)
1	Tickle Road (far western end)	SFR*	53
2	Intersection of University Parkway and NC 66	SFR	66
3	Intersection of Stanleyville Drive and NC 66	Church	67
4	Intersection of Armindale Avenue and Shell Harbor Avenue	SFR	48
5	Germanton Road (at Hickory Ridge United Methodist Church)	Church	60
6	Intersection of Old Hollow Road and Grubbs Street	SFR	62
7	Intersection of McCuiston Street and Green Acres Street	SFR	47
8	Intersection of Baux Mountain Road and Westmoreland Drive	SFR	60
9	South End of Phelps Drive	SFR	45
10	Intersection of Sandusky Street and Westmoreland Drive	SFR	52
11	End of Northwest Drive	SFR	48
12	End of Manning Street	Church	43
13	Intersection of Dippen Road and Woodsboro Lane	SFR	55
14	Intersection of Old Walkertown Road and SW Hammock Farm Road	Other (previous church site)	69
15	Intersection of Huff Circle and Winnabow Street	SFR	44
16	Location along Dillon Farm Road	SFR	45
17	Corner of Imperial Drive and Sudsbee Lane	SFR	46
18	Intersection of Esther Lane and Reidsville Road	SFR	69
19	Intersection of Old Belews Creek Road and Gospel Light Church Road	Church	49
20	Walkertown-Guthrie Road (230 feet south of Carbine Court)	SFR	50
21	Location along Morris Drive (north of Wrangler Drive)	SFR	43
22	Pisgah Church Road (600 feet east of intersection with West Mountain Street)	Church	45
23	Intersection of Timber Ridge Road and Timber Ridge Court	SFR	43
24	Bluff School Road (far western end north of US 421/I-40 Business)	Undeveloped Land	51
1A	Tickle Road (far western end)	SFR	49
2A	Intersection of University Parkway and NC 66	SFR	65
3A	Intersection of Stanleyville Drive and NC 66	Church	58
4A	Intersection of Lacock Avenue and Stephany Circle	SFR	46
5A	Armindale Avenue (far southern end)	SFR	45
6A	Germanton Road (at Hickory Ridge United Methodist Church)	Church	60
7A	NC 66 (900 feet east of Old Rural Hall Road)	SFR	63
8A	Intersection of McCuiston Street and Green Acres Street	SFR	47
9A	Providence Church Road (at Northside Baptist Church)	Church	50

Table 3-15: Noise Level Measurements – Project U-2579 Study Area

Site Number	Noise Measurement Location	Land Use Description	Ambient Noise Level (dBA Leq)
10A	Intersection of Baux Mountain Road and Westmoreland Drive	SFR	61
11A	Baux Mountain Road (900 feet south of Mountain Brook Trail)	SFR	59
12A	Davis Road (600 feet north of NC 66)	SFR	57
13A	Davis Road (3,500 feet south of NC 66)	SFR	57
14A	Intersection of Dippen Road and Day Road	Historic Property	54
15A	Intersection of NC 66 and Melvin Lane	SFR	60
16A	Old Walkertown Road (at Pellcare Nursing Facility)	Nursing Facility	69
17A	Intersection of Allison Avenue and Winnabow Street	SFR	44
18A	US 311 (at Union Tabernacle Church)	Church	62
19A	Willison Road (300 feet south of Parnell Ridge Drive)	SFR	63
20A	Beeson Dairy Road (300 feet east of Frazier Creek bridge)	SFR	61
21A	Old Greensboro Road (southwest of Petree School)	School	58
22A	West Mountain Street (600 feet west of Hastings Hill Road)	SFR	63
23A	US 158 (1,300 feet south of Esther Lane)	SFR	71
24A	Intersection of Old Belews Creek Road and Gospel Light Church Road	Church	53
25A	Walkertown-Guthrie Road (230 feet south of Carbine Court)	SFR	54
26A	Intersection of Churchland Drive and Lakeland Avenue	Church	61
27A	US 158 (south of AMP, Inc.)	Industry	66
28A	Goler Street (at Forest Ridge Apartments)	Apartment Complex	58
29A	Pisgah Church Road (600 feet east of intersection with West Mountain Street)	SFR	50
30A	NC 66 (at Cash Elementary School)	SFR	62
31A	Bluff School Road (far western end north of US 421/I-40 Business)	Undeveloped Land	51
32A	Gerry Drive (far northern end)	SFR	45
33A	Bluff School Road (far northern end south of US 421/I-40 Business	SFR	66

* SFR = Single Family Residence

A: Indicates sites that were measured in 1995.

Table 3-16: Noise Level Measurements – Project U-2579A Study Area

Site Number	Location	Description	Ambient Noise Level (dBA Leq)
1	Intersection of Gerry Drive and Buck Run Drive	SFR*	64
2	Doe Run Drive and Hunters Lane area	SFR	42
3	Regent's Park Road	SFR	43
4	Intersection of Bluff School Road and Montcrest Drive	SFR	58
5	Intersection of Hastings Hill Road and Sedge Garden Road	SFR	49
6	Sedge Garden Road North of Old Winston Road	School	46
7	End of Norcross Road	SFR	40
8	Intersection of Prince Charles Drive and Weavil Road	SFR	42
9	Cul-de-sac at School View Drive off Sedge Garden Road	SFR	42
10	Intersection of Pope Lane and Sedge Garden Road	SFR	45
11	Kernersville Road and Motsinger Drive area	Church	45
12	Kernersville Road and Maynard Drive area	SFR	42
13	End of Old Hunt Trail	SFR	44
14	Embark Drive and Embark Court area	SFR	46
15	Intersection of Oak Grove Road and Thomas Park Drive	Church	55
16	Intersection of Brookmont Drive and Hampton Way Drive	SFR	53
17	Intersection of Parnell Road and Vicar Lane	SFR	52
18	Yeaton Glen Circle and Wood Glen Court area	SFR	45
19	Intersection of Patsy Drive and Glen Landing Drive	Church	47
20	Intersection of Winter Hue Street and Horn of Plenty Lane	SFR	49
21	Swaim Road and Meadow Lane area	SFR	47
22	Intersection of High Point Road and Forest Trails Drive	SFR	51
23	Intersection of High Point Road and Union Cross Road	School	60
24	US 311 and Cole Road area	Church	55

* SFR = Single Family Residence

At the start of each day that measurements were recorded, the sound level meter was calibrated. The microphone was mounted approximately five feet above the ground to simulate the height of a typical human ear. Measurement duration ranged from 10 to 20 minutes. Traffic counts were taken at some of the roadside sites during the sampling periods.

Principal noise sources included vehicular traffic and animal sounds. Measured noise levels for the Project U-2579 Preferred Alternative varied from a high of 69 dBA Leq at the intersection of Old Walkertown Road and SW Hammock Farm Road (site #14) to a low of 43 dBA Leq at David Road, Old Greensboro Road, and West Mountain Street (sites #12, 21, and 23). These noise

measurements were taken during the afternoon peak period. Measured noise levels for Project U-2579A varied from a high of 64 dBA Leq at the intersection of Gerry Drive and Buck Run Drive (site #1), near US 421/I-40 Business, to a low of 40 dBA Leq at the end of Norcross Road (site #7).

3.11 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, and lagoons. Hazardous materials take the form of gas, liquid, sludge, or solids, and can be radioactive, corrosive, flammable, explosive, infectious, toxic, or reactive.

3.11.1 Western Portion of Study Area

Two hazardous materials surveys were conducted in the western portion of the project study area. The first survey was conducted in the early 1990s in support of the 1992 Project R-2247 DEIS. The second survey was conducted in December 2002 for the area in the immediate vicinity of the Preferred Alternative. **Figure 3-9a** shows the locations of the facilities reported in the 1996 Project R-2247 FEIS and in the updated December 2002 field reconnaissance survey. The two surveys are described below.

1991 Survey. In the early 1990s, the North Carolina Department of Environment and Natural Resources (NCDENR) provided information concerning closed dumps and permitted sanitary landfills, and other known potentially hazardous materials sites. The CERCLIS (Comprehensive Environmental Response Compensation and Liability Information System) and the North Carolina National Priority List (NPL) were reviewed for sites located in Forsyth County.

The NCDENR also provided information concerning underground storage tanks in the western portion of the study area. An inquiry to the Forsyth County Health Department also provided information on the location of hazardous materials sites, landfills, and underground storage tanks. Documentation concerning hazardous materials sites was supplemented by field inspections, an evaluation of existing land uses, and an analysis of topographic maps and aerial photography of the study area.

A review of the NCDENR file revealed that no state-permitted solid waste sites were located in the western portion of the study area. However, field reconnaissance and information from the County Health Department revealed two privately owned and County-permitted demolition landfills and three auto salvage yards. A demolition landfill is a facility permitted by the County for storage of leaves, stumps, untreated wood, rock, and brick.

The worst hazardous material sites in the state are included on the NPL and are designated for cleanup using Superfund money. No sites listed on the National Priorities List (dated 6/3/91) are located in the western portion of the study area. A review of CERCLIS (dated 11/14/90) revealed five potential hazardous materials generators in the study area. Street addresses of the potential hazardous materials generators noted in the 1996 Project R-2247 FEIS are listed in **Table 3-17**. Using INFOrsyth, Forsyth County's GIS database, research was conducted to determine if the companies listed below still exist at the noted addresses. As shown in the table, company names have changed for three of the listings.

Table 3-17: Hazardous Materials Generators from the 1996 Project R-2247 FEIS

Site Name	Address
American Inks & Coating Company	3755 Kimwell Drive, Winston-Salem (Stratford Industrial Park)
AMP Inc.	4798 Kinnamon Road, Winston-Salem
Beaunit Corp/Dying & Finishing (now Microfibres)	3801 Kimwell Drive, Winston-Salem (Stratford Industrial Park)
Hayes-Albion Corp/Briggs Schaffer (now Microfibres)	3706 Kimwell Drive, Winston-Salem (Stratford Industrial Park)
Westinghouse Electric/Winston-Salem (now Siemens Westinghouse)	3050 Westinghouse Road, Winston-Salem

The three sites on Kimwell Drive are located in the Stratford Industrial Park, just outside the southern end of the western portion of the study area. The site on Kinnamon Road is located just west of the Detailed Study Alternatives, south of I-40. The site on Westinghouse Road is located near US 52, at the northern interchange option.

2002 Survey. An updated field reconnaissance survey for hazardous materials sites was conducted in December 2002 along existing roadways in the area of the Project R-2247 Preferred Alternative. In addition to the field survey, a file search of appropriate environmental agencies was conducted to identify any known problem sites along the proposed project.

Based on the field reconnaissance survey, six (6) facilities with regulated underground storage tanks (USTs) were identified along the Project R-2247 Preferred Alternative. These six sites are shown on **Figure 3-9a** and listed in **Table 3-18**. Two were located on Reynolda Road (NC 67) and one each on Shallowford Road, Robinhood Road, Bethania Road, and Bethania-Rural Hall Road.

Database research conducted as part of the survey did not uncover any regulated or unregulated landfills or dumpsites within the western portion of the study area. No Superfund sites or sites listed in CERCLIS or RCRIS (Resource Conservation and Recovery Information System) databases were identified in the vicinity of the project.

Table 3-18: Underground Storage Tank Facilities - 2002 Survey for Project R-2247

Site Name[1]	Address/Location	Status
Hutchin Country Store	6915 Shallowford Rd, Lewisville	Abandoned country store, USTs removed in 1994. Leaks discovered. Monitoring well observed on site. NCDENR[2] Incident #14199. Facility ID 0-033936
Henley Bait & Tackle	5500 block Robinhood Rd, Lewisville	Appears to have been a gas station in the past.
Summer Afternoons	6390 Reynolda Rd, Winston-Salem	A former gas station now operating as a gift shop.
Old Richmond Grill	6425 Reynolda Rd, Winston-Salem	May have been a former gas station. Now operating as a restaurant.
Rural Hall Amoco	1105 Bethania Rd, Bethania	Former gas station that was razed. Concrete pads remain. USTs removed in 1994. Leaks discovered. Monitoring wells observed on site. NCDENR[2] Incident #13688. Facility ID 0-015028
Pantry 3188	1065 Bethania-Rural Hall Road, Bethania	Active gas station near US 52. Facility ID #0-012996. Four active USTs registered with NCDENR.

1. Based on a GeoEnvironmental Impact Evaluation, December 12, 2002
2. NC Department of Environment and Natural Resources

3.11.2 Eastern Portion of Study Area

3.11.2.1 Project U-2579 Study Area

Two surveys for hazardous material sites were conducted for Project U-2579. The first survey was conducted in April 1994 for the 1995 Project U-2579 DEIS, and included contacting appropriate environmental agencies responsible for controlling hazardous materials in the eastern portion of the study area.

An updated survey for the Project U-2579 Preferred Alternative was conducted in October 2002.

1994 Survey. The 1994 survey identified nine small generators, twenty solid waste sites, three generator/Superfund sites (one low priority, one past site, and one current), and four special incident sites (consists of leaks or spills or potentially hazardous liquids or chemicals), all of which are shown on **Figure 3-9b**. Of these sites, there were eighteen demolition landfills and two auto junkyards. There were no Comprehensive Environmental Response Compensation and Liability Act (CERCLA) hazardous material sites located, and no service stations or other businesses likely to have underground storage tanks (UST) were observed. **Table 3-19** lists the three generator/Superfund sites, four special incident sites, and two auto junkyards. The remaining 27 sites are not anticipated to pose environmental issues. Additional information about

the sites identified in the 1994 survey can be found in the 1995 Project U-2579 DEIS (Section 3.2.5).

Table 3-19: Hazardous Materials Sites from the 1995 Project U-2579 DEIS

Site Number[1]	Site Name	Address/Location	Status
A	Walkertown Gant Oil Station	NC 66 at Main Street, Walkertown	Special incident
B	Sadolin Paint Products	3950 New Walkertown Road	Generator/low priority Superfund site
C	AMP, Inc.	3900 Reidsville Road	Generator/past Superfund site
D	Johnson Controls Globe Battery Division	Old Greensboro Road	Small generator/Superfund site
E	Reynolds Auto Junkyard	University Parkway	Solid waste site
F	Auto Junkyard	Stanley Drive	Solid waste site
G	Gant Oil Co. Station	5000 Old Walkertown Road	Special incident
H	Sanderson Nissan	3475 Myer Lee Drive	Special incident
I	Sharon Kroth Residence	207 Byerly Road	Special incident

[1] Site numbers refer to **Figure 3-9b**.
Source: 1995 Project U-2579 DEIS

2002 Survey. The results of the 2002 survey for the Project U-2579 Preferred Alternative varied from the 1994 survey for two primary reasons. First, the 2002 survey focused on regulated (commercial) USTs, and did not investigate all sites with unregulated USTs (such as farm tanks or home heating oil tanks). Second, the 2002 survey was conducted within or adjacent to the corridor for the Project U-2579 Preferred Alternative.

A field search to identify possible UST locations included driving along all major roadways (non-subdivision roads) in the areas proposed to be crossed by the Project U-2579 Preferred Alternative.

Table 3-20 lists the potential hazardous material sites identified within the vicinity of the Project U-2579 Preferred Alternative. The corresponding locations of these sites are shown on **Figure 3-9b**.

Table 3-20: Hazardous Materials Sites for Project U-2579 Preferred Alternative 2002 Survey

Site Number[1]	Site Name	Address/Location	Status
1	Quality Mart #3	6444 University Parkway	Active gas station
2	TJ Automotive	6435 University Parkway	Former gas station
3	Stanleyville Square	University Parkway	History unknown
4	Abandoned Block Business	Old Hollow Road	History unknown
5	Guy Cloud RVs	6401 University Parkway	History unknown
6	Wilco Foodmart #12	566 Old Hollow Road	Active gas station
7	Pinebrook Grocery	5713 Germanton Road	Active gas station
8	Gina's #1 Food Mart	675 Old Hollow Road	Inactive gas station
9	Reynolds Automotive	6505 University Parkway	Active auto salvage yard

[1] Site numbers refer to **Figure 3-9b**.
Source: Based on a GeoEnvironmental Impact Evaluation, October 1, 2002

All of the identified sites are located in the northwest corner of the eastern portion of the study area, near US 52. Eight UST sites and one potentially contaminated site (Reynolds Automotive) were identified within the Project U-2579 Preferred Alternative proposed right of way.

Database research conducted as part of the 2002 survey shows no regulated or unregulated landfills or dumpsites occurring within the project limits. No Superfund sites or sites listed in Stet CERCLIS or Resource Conservation and Recovery Information System (RCRIS) databases were identified in the vicinity of the project.

3.11.2.2 Project U-2579A Study Area

Two surveys for hazardous materials sites were conducted for Project U-2579A. The first survey was conducted for the *Eastern Section Extension Feasibility Study* (January 1996). This survey primarily consisted of examining files maintained by appropriate environmental agencies responsible for regulating hazardous materials in the eastern portion of the study area. In addition, a field search to identify possible UST locations within the proposed alternative corridors was conducted.

An updated survey for the Project U-2579A was conducted in September 2001.

1996 Survey. The 1996 survey identified one small generator, three special incident sites (consists of leaks or spills or potentially hazardous liquids or chemicals), and one debris landfill. No hazardous material sites listed in CERCLIS were identified. Two service stations or other businesses likely to have USTs were observed. **Table 3-21** lists the potential hazardous materials sites identified in the first survey and are shown on **Figure 3-9c**.

Table 3-21: Hazardous Materials Sites from the 1996 Project U-2579A Feasibility Study

Site Number[1]	Name	Status
A	Francis L. Manuel Solid Waste Landfill	Land clearing and inert debris landfill
B	Coleman Residence	Pollutants suspected but not confirmed
C	Glenn View Baptist Church	Contamination from previous UST
D	Cummings Residence	Contamination confirmed
E	Joe Whicker's Body Shop	Small quantity generator

[1] Site numbers refer to **Figure 3-9c**.
Source: 1996 Project U-2579A Feasibility Study

2001 Survey. None of the potential hazardous materials sites identified in the *1996 Project U-2579A Feasibility Study* were located during the 2001 survey, primarily due to the change in the study boundaries of the Project U-2579A alternatives. **Table 3-22** lists the potential hazardous materials sites within or adjacent to the Project U-2579A Detailed Study Alternatives. All of the identified sites are located on Kernersville Road, as shown on **Figure 3-9c**.

Table 3-22: Hazardous Materials Sites for Project U-2579A Detailed Study Alternatives – 2001 Survey

Site Number[1]	Name/Description	Street Address/Location	Status
1	Vacant Brick Building	Kernersville Rd at Corbin St	Former gas station
2	3D Furniture Outlet	4255 Kernersville Road	Possible former gas station
3	Dean's Service Center	4260 Kernersville Road	Former gas station
4	Stock Exchange Consignment	4308 Kernersville Road	Former gas station
5	Pegram Oil Company	4314 Kernersville Road	Active gas station
6	Pentecostal Lighthouse Church	4349 Kernersville Road	Former gas station
7	Sedge Garden Florist	4400 Kernersville Road	Former gas station
8	Pantry 3191 (Etna 321)	4401 Kernersville Road	Active gas station

[1] Site numbers refer to **Figure 3-9c**.
Source: GeoEnvironmental Impact Evaluation, September 18, 2001

There were no apparent regulated or unregulated landfills or dumpsites identified within the eastern portion of the study area. No CERCLA or RCRA sites were identified in either study area. There were eight UST sites identified within the vicinity of Project U-2579A.

3.12 CLIMATE, TOPOGRAPHY AND SOILS

3.12.1 Climate

The climate of the study area is mild, with zero-degree Fahrenheit (° F) temperatures rare and snowfall infrequent. Temperatures of 100° F can occur in June through September. The county's average temperature in January is 37° F and the average temperature in July is 77° F. The average rainfall is 45 inches (*http://cmedis.commerce.state.nc.us/ countyprofiles*, accessed January 8, 2003).

3.12.2 Topography

Forsyth County lies within the Piedmont physiographic province of North Carolina (Braun, 1950). The study area is generally characterized by gently rolling to steep hills and the inter-stream areas are fairly broad (Soil Conservation Service, 1976). Forsyth County has altitudes predominantly in excess of 800 feet, ranging from 700 to 988 feet above sea level (City-County Planning Board, 1968).

3.12.3 Geology

The project study area lies in a geologically complex region, bounded to the north by the major litho-tectonic feature known as the Milton belt and to the south by the Charlotte Belt. Generally, the two major units of bedrock within Forsyth County are gneiss and porphyritic granite (City-County Planning Board, 1968).

The majority of Forsyth County is underlain by biotite gneiss and schist. These crystalline metamorphic rocks consist of potassic feldspar and garnet, calc-silicate rock, sillimanite-mica schist, mica schist, amphibolite, and small masses of granite rock. Bedrock south of US 421, in the southern portion of the project study area, is comprised of intrusive granitic rock formed during the late Paleozoic period, and is younger in age than the metamorphic gneisses to the north (City-County Planning Board, 1968). Metamorphosed mafic rock, consisting of metagabbro, metadiorite, and mafic plutonic-volcanic complexes, also makes up the bedrock in the southern portion of the study area (Geologic Map of North Carolina, 1985).

3.12.4 Soils

Based upon information obtained from the Soil Conservation Service, *Soil Survey of Forsyth County* (SCS [now the Natural Resources Conservation Service] 1976), the soils within the study area are composed of four main associations: Pacolet-Cecil, Madison-Pacolet, Chewacla-Wehadkee-Congaree, and Wedowee-Louisburg. The following is a brief description of each soil

series located in the study area. **Table 3-23** lists the specific soil types that occur within the vicinity of the western and eastern portions of the study area.

Table 3-23: Soil Types in Project Study Area

Farmland Type Code[1]	Mapping Unit	Present in Western Portion of Study Area[2]	Present in Eastern Portion of Study Area[2]
P	Altavista fine sandy loan, 1 to 6% slopes	*	
P	Appling sandy loam, 2 to 6% slopes	*	*
P	Appling sandy loam, 6 to 10% slopes	*	*
P	Cecil sandy loam, 2 to 6% slopes	*	*
F	Cecil sandy loam, 6 to 10% slopes	*	*
F	Cecil sandy loam, 10 to 15% slopes	*	
F	Cecil clay loam, 2 to 6% slopes, eroded	*	*
F	Cecil clay loam, 6 to 10% slopes	*	*
F	Chewacla loam	*	*
F	Congaree complex	*	*
-	Cut and fill land	*	*
F	Enon fine sandy loam, 2 to 6% slopes	*	*
-	Enon fine sandy loam, 6 to 10% slopes	*	*
-	Enon fine sandy loam, 10 to 15% slopes	*	*
-	Gullied land	*	*
P	Hiwassee loam, 2 to 6% slopes	*	*
F	Hiwassee loam, 6 to 10% slopes	*	*
-	Hiwassee loam, 10 to 15% slopes	*	*
-	Hiwassee loam, 15 to 25% slopes	*	*
P	Hiwassee clay loam, 2 to 6% slopes eroded	*	*
F	Hiwassee clay loam, 6 to 10% slopes, eroded	*	*
-	Hiwassee clay loam, 10 to 15% slopes, eroded	*	*
F	Iredell fine sandy loam, 2 to 6% slopes	*	
-	Louisburg loamy sand, 6 to 15% slopes	*	
-	Louisburg loamy sand, 15 to 45% slopes	*	
-	Louisburg-Wedowee complex, 15 to 25% slopes	*	*
P	Madison fine sandy loam, 2 to 6% slopes	*	*
F	Madison fine sandy loam, 6 to 10% slopes	*	*
-	Madison fine sandy loam, 10 to 15% slopes	*	*
-	Madison fine sandy loam, 15 to 45% slopes	*	*
F	Madison clay loam, 6 to 10% slopes, eroded		*
-	Madison clay loam, 10 to 15% slopes, eroded		*
P	Mecklenburg loam, dark surface variant, 2 to 6% slopes	*	
F	Mecklenburg loam, dark surface variant, 6 to 10% slopes	*	

Table 3-23: Soil Types in Project Study Area

Farmland Type Code[1]	Mapping Unit	Present in Western Portion of Study Area[2]	Present in Eastern Portion of Study Area[2]
F	Mecklenburg loam, dark surface variant, 10 to 15% slopes	*	
P	Pacolet fine sandy loam, 2 to 6% slopes	*	*
F	Pacolet fine sandy loam, 6 to 10% slopes	*	*
-	Pacolet fine sandy loam, 10 to 15% slopes	*	*
-	Pacolet fine sandy loam, 15 to 45% slopes	*	*
F	Pacolet clay loam, 2 to 6% slopes, eroded	*	*
-	Pacolet clay loam, 6 to 10% slopes, eroded	*	*
-	Pacolet clay loam, 6 to 10% slopes, severely eroded	*	*
-	Pacolet clay loam, 10 to 15% slopes, eroded	*	*
-	Pacolet clay loam, 15 to 45% slopes, eroded	*	*
-	Pacolet complex, 10 to 25% slopes, severely eroded	*	*
-	Pacolet-urban land complex, 2 to 10% slopes	*	
-	Pacolet-urban land complex, 10 to 25% slopes	*	
-	Tallapoosa fine sandy loam, 6 to 15% slopes	*	
-	Tallapoosa fine sandy loam, 15 to 45% slopes	*	*
P	Vance sandy loam, 2 to 6% slopes	*	
F	Vance sandy loam, 6 to 10% slopes	*	
F	Vance sandy loam 10 to 15% slopes	*	
P	Wedowee sandy loam, 2 to 6% slopes	*	*
-	Wedowee sandy loam, 6 to 10% slopes	*	*
-	Wedowee sandy loam, 10 to 15% slopes	*	*
H	Wehadkee	*	*
P	Wickham fine sandy loam, 2 to 6% slopes	*	*
F	Wickham fine sandy loam, 6 to 10% slopes	*	
F	Wickham fine sandy loam, 10 to 15% slopes	*	
-	Wilkes soils, 6 to 10% slopes	*	*
-	Wilkes soils, 10 to 15% slopes	*	*
-	Wilkes soils, 15 to 45% slopes	*	*

1. P = Soils considered prime farmland
F = Soils considered farmland of statewide importance
H = Soils considered hydric
Source: Important Farmlands of North Carolina, NRCS, May 1998
*2. * = Yes*

Pacolet-Cecil - This association comprises approximately 65 percent of the soils in Forsyth County and is the most common association within the study area. Pacolet-Cecil soils are usually found on uplands and are well-drained, loamy, and brownish with a reddish clay subsoil. These soils are well suited for small grain, corn, soybeans, lespedeza, tobacco, and pasture. Slope, moderate shrink-swell potential, and moderate permeability are the most important limitations for both farm and non-farm uses of these soils.

Madison-Pacolet - The soils in this association comprise 13 percent of the soils in Forsyth County. These soils are typically found on uplands and are characterized by well-drained, reddish and brownish, loamy soils with a reddish clay subsoil. Most of the acreage comprising this association is in non-farm uses, while the remaining is cultivated or in pasture. These soils are suited for small grain, corn, soybeans, lespedeza, tobacco, and pasture. The major limitations of this association for both farm and non-farm uses include slope, moderate permeability, and depth to bedrock.

Chewacla-Wehadkee-Congaree - These poorly drained soils are typically found along floodplains and are characterized as grayish and brownish loam with a grayish and yellowish loamy subsoil. This association comprises approximately six percent of the soils in Forsyth County. Most of the acreage within this association is cultivated or pastured, and the rest is in forest. The Congaree soils are well suited for most crops, while the Chewacla and Wehadkee soils are suited to pasture and water tolerant trees. Very frequent flooding and a seasonal high water table are the most important limitations for most farm and non-farm uses of these soils.

Wedowee-Louisburg - These well-drained, upland soils are brownish loamy and sandy with a yellowish clay and reddish sandy subsoil. This soil association comprises seven percent of the soils in Forsyth County. Most of the acreage within this association is forested, with the remaining being cultivated or pastured. These soils are fairly well suited for small grain, corn, soybeans, lespedeza, tobacco, and pasture. Slope and depth to bedrock are important limitations for both farm and non-farm uses of these soils.

3.12.5 Hydric Soils

The Natural Resources Conservation Service defines a hydric soil as one that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part of the soil. Such soils usually support hydrophytic vegetation.

Wehadkee soils are the only hydric soils known to occur in Forsyth County. In addition, Chewacla loam soils, which are classified as farmlands of statewide importance, have possible hydric soil inclusions. These soils are located within the study area along the floodplains of all the creeks in the project study area.

3.13 MINERAL RESOURCES

Within Forsyth County, the main mineral resources are crushed stone, gravel, and sand. Stone is mined in a few quarries in the County. These resources are mainly used for local construction.

Communication with the City-County Planning Board identified no mining activities for mineral resources in the County, and no quarry operations in the study area (Personal Communication, April 28, 2003).

Although no active quarries were identified in the immediate vicinity of the eastern portion of the study area, a large rock quarry operated by Vulcan Materials Company (North Quarry) is located adjacent to the study area at 4401 North Patterson Avenue (on the north side of Patterson Avenue just east of University Parkway). This quarry is shown on **Figure 2-17b**. None of the Detailed Study Alternatives for Project R-2247, Project U-2579 or Project U-2579A would impact this quarry. No other mines or quarries are known to exist within or adjacent to the study area.

3.14 PRIME AND IMPORTANT FARMLAND

The Farmland Protection Policy Act of 1981 (7 CFR Part 658) requires all federal agencies to consider the impact of their activities on prime, unique, statewide and locally important farmland soils, as defined by the US Department of Agriculture (USDA), NRCS (Public Law 97-98, Subtitle 1, Section 1540). The NRCS (formerly the Soil Conservation Service [SCS]), in cooperation with state and local agencies, developed a listing of *Prime and Statewide Important Farmland of North Carolina* (USDA, 1998).

Prime Farmland is defined as soils best suited for producing food, feed, fiber, forage, and oil seed crops. These soils are favorable for all major crops common to the county, have a favorable growing season, and receive the available moisture needed to produce high yields on an average of eight out of every ten years. Land already in or committed to urban development or water storage is not included.

Unique Farmlands are used for production and specific high-value food or fiber crops. It has the special combinations of soil quality, location, growing season, and moisture supply needed to economically produce sustained high quality or high yields of specific crops when treated and managed.

State and Locally Important is defined by the appropriate state or local government agency as soils important in the agriculture of an individual county. These definitions are based on measures of the soil's capacity to support productive farm activity, not of current cultivation.

There are 62,005 acres of prime farmland, 72,285 acres of state and locally important farmland and 137,070 acres of other land in Forsyth County (SCS, n.d.). **Table 3-23** identifies prime farmland, and state and locally important farmland. Note that these are areas with proper soil conditions for farmlands, not areas that are currently or even recently cultivated. A considerable portion of the identified areas currently are forested.

Forsyth County has established a Farmland Preservation Program with a primary goal "to protect and conserve those soils in Forsyth County best suited to agricultural uses." The tracts participating in this program are shown on **Figure 3-6**.

3.15 WATER RESOURCES

Water resources are described in detail in the *Supplemental Natural Resources Technical Memorandum* (2003) for Project R-2247 and the *Natural Resources Technical Memorandum* (2004) for Projects U-2579 and U-2579A, both of which are appended by reference.

3.15.1 Drainage Basins and Streams

The project study area primarily is within the Yadkin-Pee Dee River Basin, in the northern part of sub-basin 03-07-04. The northeastern portion of Forsyth County north of NC 66 is within the Roanoke River Basin, sub-basin 03-02-01.

None of the streams in the western or eastern portions of the study area are classified as C-Tr (Trout). Forsyth County is not one of the twenty-five mountain counties designated by the North Carolina Wildlife Resources Commission (NCWRC) as containing Mountain Trout Waters (MTWs). None of the streams in the western or eastern portions of the project study area support trout, anadromous fish, or significant warm water fish species.

3.15.1.1 Western Portion of Study Area

The streams in the western portion of the project study area generally have moderate bed slopes with well-defined drainage systems. The larger creeks are perennial. **Figure 3-10a** shows the major streams in the western portion of the study area and the sub-basin boundaries.

The major stream, Muddy Creek, drains to the south. All of the minor creeks within the western portion of the project study area are tributaries of Muddy Creek within sub-basin 03-07-04, with the exception of Bashavia Creek, which is within sub-basin 03-07-02.

The named tributaries to Muddy Creek include, from south to north, Little Creek, Silas Creek, Reynolds Creek, Tomahawk Creek, James Branch, Mill Creek, Oil Mill Branch, Bill Branch, Mill

Creek No. 3, and Hoffman Branch. Grassy Creek, which crosses US 52 north of the NC 66 intersection, is a named tributary to Mill Creek.

Minor streams flow into Muddy Creek from both the east and west. Those east of Muddy Creek drain areas of predominantly urban and dense development on the west side of Winston-Salem; those entering Muddy Creek from the west drain mostly rural areas. Some of these streams are experiencing noticeable increases in peak flows, which is likely due to localized subdivision development (Abbott, 1991). Bashavia Creek is a direct tributary of the Yadkin River and flows westward out of the project area towards the Yadkin River.

The western portion of the study area encompasses the middle reaches of Muddy Creek. The drainage area of Muddy Creek at the southern end of the western portion of the study area is approximately 87 square miles. At the upper end of the western portion of the study area, Muddy Creek drains an area of approximately 13 square miles.

Drainages in the western portion of the study area have scoured deep channels ranging from two to ten feet deep. Channels associated with the larger floodplains, such as Muddy Creek, are generally at least ten feet deep and ten to 30 feet wide. These larger streams tend to have substrates that are predominantly sands and silt with some gravel. The smaller perennial and intermittent streams in the area tend to flow down a steeper gradient, and, although narrower than the larger systems, tend to have more habitats for aquatic organisms (rock and gravel substrate with runs of riffles and pools).

Figure 3-11(a-ee) shows streams in relation to the Project R-2247 Preferred Alternative right of way. More details about these streams and impacts to them are discussed in **Section 4.14.2**.

Best Usage Classifications. DWQ classifies stream segments according to their highest supportable use. Unless otherwise stated, unnamed tributaries with no designated best usage classification share the classification of their respective receiving waters. All streams in the western portion of the study area have a Best Usage Classification of C.

Best Usage Classification C denotes waters appropriate for aquatic life propagation and survival, fishing, wildlife, secondary recreation and agriculture. Secondary recreation refers to any activity involving human body contact with water on an infrequent or incidental basis. Class C waters are the lowest classification of non-degraded waters and are typical of urban watersheds with point and non-point sources, and unrestricted rural watersheds with livestock production.

No water resources classified as High Quality Waters (HQW's), Water Supply Watersheds (WS-I's), or Outstanding Resource Waters (ORW's) occur within the western portion of the project study area (shown in **Figure 3-10d**).

NPDES Permitted Dischargers. Point source dischargers located throughout North Carolina are permitted through the National Pollutant Discharge Elimination System (NPDES) program administered by the North Carolina Department of Environment and Natural Resources. Any discharger is required to register for a NPDES permit.

There are 40 NPDES permitted dischargers in Yadkin-Pee Dee sub-basin 03-07-04. The larger dischargers in Forsyth County include Archie Elledge Wastewater Treatment Plant on Salem Creek (WWTP) (30 MGD) and Winston-Salem Muddy Creek WWTP (21 MGD), located to the south of the western portion of the study area, and RJ Reynolds (0.8 MGD), located to the north of the western portion of the study area (DWQ 2002).

3.15.1.2 Eastern Portion of Project Study Area

The streams located within the eastern portion of the project study area are shown in **Figure 3-10b** (Project U-2579) and **Figure 3-10c** (Project U-2579A), and **Figure 3-12(a-jj)**. Salem Lake, which serves as a water supply reservoir for the City of Winston-Salem, is located in the southwest corner of the eastern portion of the study area.

The northeastern region, north of NC 66, is drained by Rough Fork Creek, Trick-Um Creek, Buffalo Creek, and Mill Creek. These creeks generally flow to the northeast, eventually draining into the Dan River in the Roanoke River basin in Stokes County.

Fivemile Branch, Grassy Creek, Mill Creek, Lowery Mill Creek, Martin Mill Creek, Kerners Mill Creek, Smith Creek, South Fork Muddy Creek, Fiddlers Creek, Swaim Creek, and Smith Creek (Harmon Mill Creek) drain the northwestern and southern regions of the eastern portion of the study area, generally flowing to the southwest into the Yadkin River.

Figure 3-12(a-jj) shows streams in relation to the Project U-2579 Preferred Alternative and Project U-25769A Detailed Study Alternatives. More details about these streams and impacts to them are discussed in **Section 4.14.2**.

Best Usage Classifications. Salem Lake, Martin Mill Creek, Lowery Mill Creek, Smith Creek, Fishers Branch, and their associated tributaries are classified by DWQ as Water Supply Watershed III (WS-III) streams. WS-III streams are protected as water supplies in generally low to moderately developed watersheds. They require general permits for point source discharge, and local programs to control non-point source and stormwater discharges. They are suitable for all uses specified under Class C. Water supply watersheds are shown in **Figure 3-10d**.

Lowery Mill Creek discharges directly into the north arm of Salem Lake. Kerners Mill Creek discharges into the south arm of the lake. Kerners Mill Creek has a best usage classification of WS-II and is designated as a critical area within the watershed. Critical areas are defined as those

areas within the watershed where water supply intakes or reservoirs are at the greatest risk for pollution.

Martin Mill Creek flows into Lowery Mill Creek approximately one mile to the northeast of the upper arm of Salem Lake. Smith Creek converges with Kerners Mill Creek at approximately 1.5 miles northeast of the lower arm of Salem Lake. Both Martin Mill Creek and Smith Creek are assigned best usage classifications of WS-III. Salem Lake also is classified as WS-III and designated as a critical area. The remaining streams in the study area are assigned best usage classifications of C. The Salem Lake critical area is shown on **Figure 3-10(b-c)**.

The City-County Planning Board has created a series of Water Quality Sensitive Areas (WQSA) within the Salem Lake watershed to protect water quality and monitor development within these water quality sensitive areas. Regulations for each of these areas are listed below.

- *Water Quality Sensitive Area I (WQSA I)* - consists of all land within 500 feet of the lake. No development is permitted here except necessary roads, utilities, and recreation facilities.
- *Water Quality Sensitive Area II (WQSA II)* - consists of all land outside of WQSA I but within a defined reservoir buffer area. WQSA II consists of: 1) all land that either drains directly into the lake or is within 1000 feet of the lake, whichever is greater; and 2) certain other parcels deemed sensitive due to topography or location.
- *Water Quality Sensitive Area III (WQSA III)* - consists of the remainder of the land within the watershed. WQSA III is an overlay district requiring all proposed development to obtain a special use permit from the City Council.
- *Water Quality Sensitive Area IV (WQSA IV)* - consists of a system of stream buffers designated along all streams flowing into Salem Lake. For the major streams with designated floodplains, the buffer is defined as the area within the floodplain or 100 feet from the stream bank on either side, whichever is greater. For smaller streams with no designated floodplain, the stream buffer is 50 feet from the stream bank on either side. Stream buffers are to remain in their natural state and the only uses permitted are road crossings, utility lines, and greenway facilities.

Although the project study area is located outside of WQSA I and II, the Project U-2579 Detailed Study Alternatives in the area south of US 158 (Reidsville Road) are located within a WSQA III zone. In addition, the stream buffers along Lowery Mill Creek, Martin Mill Creek, Kerners Mill Creek, and Smith Creek, along with their associated tributaries, are considered WQSA-IV zones.

NPDES Permitted Dischargers. Ten NPDES permits are known to have been issued in the project vicinity. **Table 3-24** lists the registered NPDES permits for point source discharges located within a half-mile of the eastern portion of the study area.

Table 3-24: National Pollutant Discharge Elimination System Permits within One Half-Mile of the Eastern Portion of the Study Area

Facility	Stream	Permit number
R.H. Johnson Construction Company	Rough Fork	NC0079049
Stephen B. Culler Residence	UT Mill Creek	NCG550168
Gant Oil Company / Site #31	UT Mill Creek	NCG510061
Prince Ibraham Elementary School	UT Mill Creek	NC0035572
Norman G. Mabe, Jr. Residence	UT Mill Creek	NCG550383
Pell Care Nursing Home	UT Mill Creek	NC0034533
Richard R. Sexton Residence	Lowery Mill Creek	NCG550056
Frank Soper Residence	Lowery Mill Creek	NCG550057
Tracy R. Morgan Residence	South Fork Muddy Creek	NCG550462
Sedge Garden Elementary School	UT Fiddlers Creek	NC0035084

Source: *Projects U-2579 and U-2579A Natural Resources Technical Memorandum,* Table 3 (2004)

3.15.2 Water Supply Resources

There are no water supply resources in the western portion of the study area. The Yadkin River is outside the project study area for direct impacts, but forms the western boundary of the study area for indirect and cumulative impacts (**Section 4.20**).

The Forsyth County Water System has two intakes on the Yadkin River. One, located in the extreme southwest corner of the county, supplies the Neilson Water Treatment Plan. The second is on the Yadkin River near its confluence with Beshavia Creek, near the center of the western edge of the county, and supplies the Northwest Water Treatment Plant.

The City of Winston-Salem constructed Salem Lake for a water supply in 1919. The lake is located in the eastern portion of the study area. In 1966, the City began using the Yadkin River as an additional source of raw water supply. Currently, Salem Lake supplies approximately 20 percent of the water needs of Winston-Salem and Forsyth County. This percentage is anticipated to continue to decrease as the total water consumption increases (approximately 3 percent annually) and the water available from Salem Lake remains relatively constant.

The watershed of Salem Lake encompasses approximately 25 square miles and is under the planning jurisdiction of the City of Winston-Salem, Forsyth County, and the Towns of Kernersville and Walkertown. The critical area for Salem Lake, shown on **Figure 3-10c**, is

bounded by Kernersville Road on the south and Old Greensboro Road on the north, and encompasses an area of approximately 5,300 acres. The Salem Lake water supply intake that supplies the Thomas Water Treatment Plant is at the dam on the west side of the lake.

Salem Lake is also used for fishing and boating, although no swimming is allowed. A seven-mile multi-use path around the lake and a picnic/activity shelter area provide other recreational opportunities.

Water sampling conducted in 1989 indicated that Salem Lake was fully supporting all of its designated uses. However, the lake received a eutrophic nutrient status indicating high nutrient levels (DENR 1990 and 1992) and was listed by the State as threatened. Threatened lakes are those that are currently supporting their designated uses but may not fully support these uses in the future unless pollution is controlled and action is taken (DENR, 1992).

3.15.3 Water Quality

Basinwide water quality plans are prepared by DWQ for each of the seventeen major river basins in the state. Basinwide water quality planning is a non-regulatory, watershed-based approach to restoring and protecting the quality of North Carolina's surface waters. While these plans are prepared by the DWQ, their implementation and the protection of water quality requires the coordinated efforts of many state and local agencies, and stakeholder groups (DWQ website, *http://h2o.enr.state.nc.us/*). The latest basinwide plan for the Yadkin-Pee Dee River basin was completed in March 2003. The latest basin wide plan for the Roanoke River basin was completed in July 2001.

The DWQ collects a variety of data from a number of sources to assess water quality in each basin. Monitoring programs in the Yadkin-Pee Dee River Basin include benthic macroinvertebrate monitoring, fish assessments, aquatic toxicity monitoring, lakes assessment, and ambient monitoring (DWQ, March 2003, page 60). Benthic macroinvertebrates are organisms, primarily aquatic insect larvae that live in and on the bottom substrates of rivers and streams. Since some macroinvertebrates are sensitive to very subtle changes in water quality, the species richness and overall biomass of these organisms reflect water quality.

The Benthic Macroinvertebrate Ambient Network (BMAN) is managed by the DWQ and is part of an ongoing ambient water quality monitoring program that addresses long-term trends in water quality. The program assesses water quality by sampling for selected benthic macroinvertebrate organisms at fixed monitoring sites. Some macroinvertebrates are sensitive to very subtle changes in water quality; thus, the species richness and overall biomass of these organisms reflect water quality. Benthic macroinvertebrates are organisms, primarily aquatic insect larvae that live in and on the bottom substrates of rivers and streams.

The DWQ uses the water quality data it collects to rate surface waters as "Supporting" or "Impaired." These ratings refer to whether the classified uses of the water are being met. For example, waters classified for aquatic life protection and secondary recreation (Class C for freshwater) are rated "Supporting" if data used to determine use support meet certain criteria. If the criteria are not met, then the waters are rated as Impaired. Waters with inconclusive data are listed as Not Rated and waters lacking data are listed as No Data (DWQ, March 2003, pages 78-79).

Based on information obtained from the *Yadkin-Pee Dee Basinwide Water Quality Management Plan* (DWQ, March 2003), the majority of the waters within sub-basin 03-07-04 exhibit some level of impacts to water quality. Forsyth County streams in sub-basin 03-07-04 with Use Support Ratings of Impaired include Muddy Creek and Salem Creek. These streams are Impaired by a combination of nonpoint and point source pollution. (DWQ, March 2003, page 146).

Based on information obtained from the Roanoke River Basinwide Water Quality Management Plan (DWQ, July 2001), the majority of the waters within sub-basin 03-02-01 exhibit low level of impacts to water quality. Forsyth County streams in sub-basin 03-02-01 have a Support Ratings of Fully Supporting. (DWQ, July 2001, page 96).

3.15.3.1 Western Portion of Project Study Area

According to the *Yadkin-Pee Dee Basinwide Water Quality Management Plan* (DWQ, March 2003), the western portion of the study area has two BMAN stations and a fish community monitoring station in Muddy Creek and a fish community monitoring station in Silas Creek.

As indicated below, Muddy Creek was rated as Impaired in the DWQ's *Yadkin-Pee Dee Basinwide Water Quality Management Plan:*

> *"The impairment of Muddy Creek primarily is attributed to nonpoint source pollution from stormwater runoff from construction sites and developed areas. The input of heavily developed and/or Impaired tributaries also contributes: Mill Creek, Silas Creek, Reynolds Creek and Salem Creek." (DWQ, March 2003, page 154).*

In that document, Silas Creek, along with Mill Creek, are mentioned as streams with "notable impacts" (page 156-157):

> *"These streams are likely being impacted by stormwater runoff from the City of Winston-Salem. Mill Creek has not been sampled by DWQ, but the lower two-thirds of the watershed contain moderate road coverage indicating large amounts of developed area, similar to the watershed of Silas Creek. The fish*

community of Silas Creek was sampled by DWQ for the first time in 2001. Severe habitat degradation was observed and the data indicated impairment. However, the stream was resampled in 2002 and received a "Good-Fair" bioclassification. This score is likely due to the reduction in nonpoint source pollution that accompanies an extended drought."

3.15.3.2 Eastern Portion of Project Study Area

Grassy Creek, the only stream in the eastern portion of the study area with established biological monitoring, has a sampling station located to the south near SR 1669 (Ziglar Road). The most recent reported sampling of the creek occurred in 1984. At that time, the creek received a bioclassification of "Fair" with some toxicity reported (DENR 1988 and 1991). All streams in the eastern portion of the study area are rated as "Supporting" their classified uses (DWQ, March 2003).

3.15.4 303(d) Listed Streams

Section 303(d) of the Clean Water Act requires states to identify waters not meeting standards set by the US Environmental Protection Agency (EPA) (described on the DWQ website, *http://h2o.enr.state.nc.us/tmdl/General_303d.htm*). A list of waters not meeting these standards is submitted to the EPA every two years. The EPA reviews and approves the listed waters. Waters placed on this list require the establishment of total maximum daily loads (TMDLs) intended to guide the restoration of water quality. (DWQ, March 2003, page 79).

There are three stream segments in subbasin 03-07-04 (Yadkin-Pee Dee River Basin) included on the Section 303(d) list. Grants Creek (17.9 miles from source to Yadkin River) and Salem Creek (11.7 miles from Winston-Salem water supply dam (Salem Lake) to Muddy Creek) are listed primarily due to agricultural sources, municipal pretreatment and urban runoff. Problems include turbidity and fecal coliform bacteria. There is also an unnamed tributary to Grants Creek (from source to Grants Creek) that is on the Section 303(d) list whose cause of impairment is unknown.

There is one stream segment in subbasin 03-02-01 (Roanoke River Basin) included on the Section 303(d) list, the Town Fork Creek (8.0 miles from source to Timmons Creek), whose cause of impairment is unknown (DWQ website, *http://h2o.enr.state.nc.us/*).

3.15.5 Floodways and Floodplains

The Federal Emergency Management Administration (FEMA), in cooperation with Federal, State and local governments, developed floodway boundaries and Flood Insurance Rate Maps (FIRM) for Forsyth County in October 1998. Forsyth County is a participant in the National Flood Insurance Program (NFIP). As part of the NFIP, FEMA determines floodway boundaries as a

tool for floodplain management. Based on FEMA's definition, the floodplain 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 is equaled on the average of once every one hundred years. The area between the floodway boundary and the 100-year floodplain boundary is known as the floodway fringe or the 100-year floodplain. 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.

3.15.5.1 Western Portion of Study Area

Figure 2-10(a-d) shows the floodplains and floodways in the western portion of the study area. Delineated floodplain and floodway boundaries were accessed from maps located on the Forsyth County Geographic Information System (GIS) website. The study area crosses the floodways and 100-year floodplains of Little Creek, Silas Creek, Muddy Creek, Reynolds Creek, Tomahawk Creek, Bashavia Creek, Mill Creek No. 3, and Grassy Creek.

3.15.5.2 Eastern Portion of Study Area

The floodplains and floodways in the eastern portion of the study area are shown on **Figure 3-10b** (Project U-2579) and **Figure 3-10c** (Project U-2579A). Delineated floodplain and floodway boundaries are from maps located on the Forsyth County Geographic Information System (GIS) website (*http://maps.co.forsyth.nc.us*). The eastern portion of the study area includes the floodways and 100-year floodplains of Grassy Creek, Mill Creek, Smith Creek (Harmon Mill Creek), Kerners Mill Creek, Martin Mill Creek, Lowery Mill Creek, Fishers Branch, Fiddlers Creek, Swaim Creek, and South Fork Muddy Creek.

3.15.6 Wild and Scenic Rivers

The Wild and Scenic Rivers Act (Public Law 90-542) calls for a continuing evaluation of outdoor recreation needs and resources of the United States and identification of potential wild, scenic, and recreational river areas within the nation. No stream systems in Forsyth County are listed as a wild and scenic river system, nor do any qualify for inclusion under this system. (National Parks Service Website, *http://www.nps.gov*, accessed January 9, 2007).

3.16 TERRESTRIAL BIOTIC COMMUNITIES

3.16.1 Regional Overview

The study area generally is located within the Atlantic Slope portion of the Oak-Pine Forest Region as described by Braun (1950). This area lies within the Piedmont physiographic province. Within this region, the upland plant communities are typified by a predominance of white oak (*Quercus alba*), black oak (*Quercus velutina*), post oak (*Quercus stellata*), red oak (*Quercus rubra var. rubra*), southern red oak (*Quercus falcate var. falcata*), mockernut hickory (*Carya tomentosa*), pignut hickory (*Carya glabra*), and loblolly pine (*Pinus taeda*). Bottomland forests are of limited extent and dominated by floodplain species such as sweetgum (*Liquidambar styraciflua*), willow oak (*Quercus phellos*), water oak (*Quercus nigra*), and red maple (*Acer rubrum*). Steep banks or ravine bluffs rise above the bottomlands and support mixed hardwood communities in which beech (*Fagus grandifolia*) is an important species, and white oak and tulip tree (*Liriodendron tulipifera*) are common associates (Braun, 1950).

The Piedmont has historically been subjected to extensive clearing of the original forests and to poor agricultural practices, resulting in erosion of the topsoil. Much agricultural land has been abandoned due to a lack of productivity. Today, vegetation of the Piedmont exists primarily as second-growth forests of various ages, patchworks of agricultural fields, young pine stands, and culled hardwood stands of varying composition. Only a few remnant forests situated on ridges, knolls, and stream bluffs have escaped clear cutting and serve to represent the original vegetation (Braun, 1950).

3.16.2 Biotic Communities in Western Portion of the Study Area

In 1991, a natural resources survey was conducted in support of the Project R-2247 Detailed Study Alternatives. A second survey was conducted in 2002-2003 to update natural resource information for the Project R-2247 Preferred Alternative. The results of these surveys are described in the following sections.

3.16.2.1 1991 Survey of Project R-2247 Detailed Study Alternatives

Plant communities within the Project R-2247 Detailed Study Alternatives were described from field data collected during a reconnaissance survey in March 1991. **Appendix E** includes Figure 3.6-1 from the 1996 Project R-2247 FEIS that shows the biotic communities within the Detailed Study Alternatives. These communities included pine forests, upland mixed pine/deciduous and deciduous hardwood forests, bottomland hardwood forests associated with floodplains, agricultural fields, aquatic habitat, and disturbed areas.

These communities, except for aquatic habitat, were described in the 1996 Project R-2247 FEIS (Section 3.6.1) as follows. Aquatic habitats (wetlands) are described in **Section 3.17.**

Pine Forests. Historically, most pine forests within the study area have been replaced by urban landscapes. The few that remain are relatively small second-growth stands. The pine forests are characterized by a composition of greater than 75 percent pine. Scrub pine (*Pinus virginiana*) predominates, although scattered loblolly pine and white pine (*Pinus strobus*) were occasionally observed. Hardwoods make up less than or equal to 25 percent of the composition and species vary widely between pine stands, depending on the age of the stand and management practices.

The structure of these forests varies greatly, depending on historical factors, successional status, and management practices. Generally, the pine forests are composed of even-aged stands of scrub pine. These pines inhabit old abandoned fields or disturbed areas. Pine stands that have been left undisturbed encourage a regeneration of hardwoods. Occasionally, old field areas were observed to be revegetated by nearly pure young stands of red cedar (*Juniperus virginiana*).

An understory stratum is often lacking in the pine forests, but when present, is typically dominated by saplings of the overstory. The shrub and herbaceous strata, where they exist, are generally sparse. The shrub layer, if any, is typically composed of flowering dogwood (*Cornus florida*), beech, sweetgum, red maple, and American holly (*Ilex opaca*). The herbaceous stratum is generally sparse, but can include young black cherry (*Prunus serotina*), clubmoss (*Lycopodium* sp.), partridge berry (*Mitchella repens*), and strawberry bush (*Euonymus americanus*). Vines, such as Japanese honeysuckle (*Lonicera japonica*), grapes (*Vitis* spp.), greenbriars (*Smilax* spp.), yellow jessamine (*Gelsemium sempervirens*), and cross vine (*Anisostichus capreolata*), may occasionally be found throughout a pine forest.

Mixed Pine/Deciduous Forest. Upland mixed forests of the study area vary in composition from stands that are composed almost exclusively of hardwoods and that occur primarily as ridge-top forests where sites are dry and soils are very poor, to stands that are composed of a hardwood/pine mix. Hardwood/pine mixed stands occur primarily as higher slope forests where slightly more moisture is available and soils are somewhat more productive than on the ridgetops. In these mixed stands, pine may represent up to, but not exceed, 75 percent of the overstory community. Dominant overstory hardwood species in these upland forests include red oak, tulip tree, and beech.

Understory composition includes saplings of the overstory, as well as ironwood (*Carpinus caroliniana*), flowering dogwood, white oak, and red cedar. The shrub layer is composed of such species as strawberry bush, red cedar, ironwood, beech, flowering dogwood, and rose (*Rosa* sp.). Vines, such as Japanese honeysuckle and cross vine, occasionally occur. The sparse herbaceous layer may contain spotted wintergreen (*Chimpaphila maculata*), strawberry bush, ebony spleenwort (*Asplenium platyneuron*), and partridge berry.

Deciduous Hardwood Forest. The deciduous hardwood forest is one of the least extensive upland biotic communities in the Detailed Study Alternatives. In general, the deciduous hardwood forests tend to be located on the less steep side slopes of the study area. Canopies in the area tend to be dominated by either white oak or beech. Other canopy species observed include tulip tree, red maple, red oak, and scrub pine. The dominant species in the subcanopy is red maple. Ironwood, beech, and red cedar also are in the subcanopy. The shrub layer is dominated by beech saplings. Flowering dogwood is common and red maple is scattered throughout this layer. The herbaceous layer, which is very sparse, is dominated by the woody seedlings of overstory species. Also present are strawberry bush, arrow-woods (*Viburnum* spp), and Christmas fern (*Polystichum acrostichoides*). Vines are typically absent.

Lowland Forest. Lowland forests are non-wetland communities occupying the floodplains of creeks and tributaries and the lower slope forests on the steep banks and ravine bluffs immediately adjacent to these drainages. Such forests are not extensive within the study area due to steep topography.

Lowland forests within the study area typically have a canopy dominated by red maple, sycamore (*Platanus occidentalis*), box elder (*Acer negundo*), and ash (*Fraxinus* sp). The understory of these lower slope forests is composed of red maple and ash, with scattered tulip tree, white oak, and flowering dogwood. The shrub layer is moderate to very dense, with rose (*Rosa multiflora*), ash, red maple, arrow-wood, privet (*Ligustrum sinense*), and cane (*Arundinaria gigantea*) commonly occurring. Avens (*Geum* sp.), goldenrod (*Solidago* sp), chickweed (*Stellaria* sp.), field garlic (*Allium vineale*), blue grass (*Poa* sp.), and violets (*Viola* spp.) were observed in the herbaceous layer. Grapes and greenbriars are common vines of these forests.

Agricultural Fields. Agricultural fields are open fields where there is evidence of recent active management. The extent of this category was first interpreted from black and white aerial photography of the study area. Field reconnaissance provided additional information about the specific land use practices occurring within this category, including pastureland, cropland, and recently abandoned fields. Pastureland makes up the largest portion of this category. A typical pasture has only an herbaceous layer composed of fescue (*Festuca* sp.), allium (*Allium* sp.), brambles (*Rubus* sp.), goldenrod, and trumpet vine (*Campsis radicans*).

Disturbed Areas. Disturbed areas occur where the majority of the vegetation has been removed by human activities. Examples include residential and industrial developments, dirt roads, mowed-over areas under power lines, etc. Vegetation in many disturbed areas most frequently consists of herbaceous species with a few shrubs and trees.

3.16.2.2 2002-2003 Natural Resources Survey Methodology - Project R-2247 Preferred Alternative

Natural resources surveys were conducted in 2002-2003 by qualified biologists from PBS&J for biotic communities (see **Section 3.16.1**), wetlands (see **Sections 3.17.1 and 3.19.1**), streams (see **Section 4.14.2**), and threatened and endangered species (see **Section 3.21.1**) within the right of way for the Project R-2247 Preferred Alternative. The results of these surveys are documented in the *Supplemental Natural Resources Technical Memorandum* (2003) and appended by reference.

Sources consulted in the survey include the following:

- US Geological Survey (USGS) quadrangle maps (Winston Salem West, Rural Hall, Vienna, and Clemmons).
- Natural Resources Conservation Service (NRCS, formerly the Soil Conservation Service) soil maps.
- NCDOT aerial photographs of project area.

Water resource information was obtained from the following source:

- NCDENR Division of Water Quality (DWQ website http://h2o.enr.state.nc.us/)).

Information concerning the occurrence of federal and state protected species in the study area was gathered from the following sources:

- US Fish and Wildlife Service (USFWS) list of Forsyth County Endangered Species, Threatened Species, and Federal Species of Concern website (http://nc-es.fws.gov/es/countyfr.html)
- NCDENR Natural Heritage Program (NHP) database of rare species and unique habitats.

Field surveys were conducted on the following dates for the stated purposes:

- April 22-26, and May 10 and 14, 2002 – Threatened/endangered species (T/E) surveys and biotic communities investigations.
- June 27, 2002 – Biotic community investigations and T/E surveys.
- July 24, and August 6, 2002 - Delineate wetlands in Bethania-Tobaccoville interchange area and T/E surveys.
- October 25 2002 – USACE verification of wetlands in Bethania-Tobaccoville interchange area. Concurrence letter received from USACE on November 12, 2002.

- January 27 and 28, February 3, 24 and 25, March 11, and April 2, 2003 – Re-inspect wetlands from 1995 delineation and T/E surveys.
- April 29, 2003 – USACE verification of wetlands from 1995 re-inspection.

Surface waters within the western portion of the study area were evaluated in the field to document their physical characteristics and jurisdictional status. The top of bank and/or centerline of streams, depending on channel widths, were surveyed and recorded using Global Positioning System (GPS) survey methods.

All wetlands identified in 1995 within or adjacent to the Project R-2247 Preferred Alternative were re-inspected to determine their current jurisdictional status. Wetlands identified in 1995 that were outside of the Project R-2247 Preferred Alternative corridor were not investigated in 2003. In **Figure 3-11(a-ee)**, these wetlands are coded as "1995 wetland, not investigated 2003." Wetlands and streams were re-surveyed along the Preferred Alternative since the Section 404 permit previously issued by the US Army Corps of Engineers (USACE) and the Section 401 Certification previously issued by the DWQ expired in December 2002. New permits will be required to construct the project.

Field review of streams were conducted to determine if the streams were jurisdictional and if mitigation would be required for impacts to the stream based upon the current regulatory permitting requirements of the USACE and DWQ. Stream delineations were conducted using the *1987 Corps of Engineers Wetland Delineation Manual* and the criteria established in a guidance memorandum entitled "Delineation of 'Other Waters' for the Purpose of Section 404" developed by the USACE (March 6, 1995) to assist Natural Resource Conservation Service representatives.

Jurisdictional wetlands were identified and delineated based upon the methodology outlined in the *1987 Corps of Engineers Wetlands Delineation Manual*. Wetland systems were classified based upon the US Fish and Wildlife Service *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin, et al., 1979). Wetland boundaries were located in the field using GPS methods with sub-meter accuracy.

3.16.2.3 Biotic Communities Recorded in 2002-2003 Survey - Project R-2247 Preferred Alternative

To the extent possible, natural communities were classified based on the North Carolina Natural Heritage Program's *Classification of the Natural Communities of North Carolina* (Schafale & Weakley, 1990). Many areas have been disturbed by human activities so much that they do not fit into any of the categories described by Schafale & Weakley. The predominant community types along the Project R-2247 Preferred Alternative are Piedmont/Low Mountain Alluvial Forest and Dry Mesic Oak-Hickory Forest. Other communities include: Pine Plantation, Cut-over,

Agriculture, and Maintained/Disturbed (Commercial, Institutional, and Residential developments).
These communities are shown in **Figure 3-11(a-ee)** and described below. The abbreviations given for each community type are used in **Figure 3-11(a-ee)**. The communities from the 1991 survey that most closely match the classifications determined during the 2002-2003 survey are noted.

Piedmont/Low Mountain Alluvial Forest [AF] (Similar to Lowland Forest in 1991 Survey). The areas along the streams are Piedmont/Low Mountain Alluvial Forest community type. The nutrients in this community type are provided by flood-carried sediment. Flooding also creates regular natural disturbances. The canopy of this community type is dominated by box elder, tulip poplar, red maple, sweet gum, sycamore, and river birch (*Betula nigra*), with the shrub layer made up of saplings of the canopy species. Near the edge of the stream, jewelweed (*Impatiens capensis*) dominates, while further back from the banks, the herb and vine layer is primarily composed of poison ivy (*Toxicodendron radicans*), pokeweed (*Phytolacca americana*), Chinese privet, and may-apple (*Podophyllum peltatum*).

Dry Mesic Oak-Hickory Forest [D O/H] (Similar to Mixed Pine/Deciduous Forest and Deciduous Hardwood Forest in 1991 survey). The Dry Mesic Oak-Hickory forest type was once dominant in the piedmont region, but human disturbance has transformed much of this community type to agriculture, urban uses, or an earlier successional stage on abandoned agricultural fields (Schafale and Weakley, 1990). The dominant tree species in these areas are white oak, pignut hickory, red maple, sweet gum, short-leaf pine (*Pinus echinata*), southern red oak, and occasional blackjack oak (*Quercus marilandica*). Shrubs include saplings of the tree species as well as eastern redbud (*Cercis canadensis*), smooth sumac (*Rhus glabra*), red cedar, flowering dogwood, and highbush blueberry. The vine and herb layer consists of poison ivy, grape, Jack-in-the-pulpit (*Arisaema triphyllum*), Solomon's seal (*Polygonatum biflorum),* and annual phlox (*Phlox drummondii*) at the forest margins.

Agriculture [AGR] (Similar to Agricultural Fields in 1991 survey). Much of the corridor for the Preferred Alternative is in agricultural use, primarily for hay production. These areas are often a meadow habitat, with a few scattered trees. Some areas have cattle. Generally, the cattle have access to streams, so streambanks in areas with cattle tend to be muddy, with very little vegetation.

Cut-Over [CUT] (Similar to Pine Forests in 1991 survey). The cut-over areas (also called successional pine) appear to have been used for agriculture in the past, but have not been maintained for some time, or the forest was recently logged. Early successional species are beginning to establish in these areas, which are often still meadow-like, with grasses and asters (*Aster* spp.) prevalent. Tree species colonizing these areas include short-leaf pine, sycamore, red cedar, white oak, cherry (*Prunus* sp.), smooth sumac, tulip poplar, and sweet gum saplings.

Shrub and vine species common in these areas include blackberry (*Rubus* sp.), grape, greenbrier, and Japanese honeysuckle.

Communities under the powerlines in the area are similar in composition to those in the Cutover community type, as these areas are mowed every few years, but are not otherwise maintained.

Pine Plantation [PINE] (Similar to Pine Forests in 1991 survey). The pine plantation area has a monoculture of short-leaf pine trees planted in rows. These trees are of the same age class. The vine/shrub and herb layer is composed of greenbrier and poison ivy.

Maintained/Disturbed [COMM & RES] (Similar to Disturbed Areas in 1991 survey). Maintained/Disturbed communities consist of institutional, commercial [COMM] and residential [RES] areas, as well as roads. An "institutional" property, a church, is located near the intersection of Reynolda Road and Transou Road. Areas with commercial businesses are generally covered with impermeable surfaces, with very little vegetation. These areas generally provide little habitat for wildlife. Residential areas are primarily vegetated with turf grasses, and have often been planted with a variety of non-native plants.

3.16.3 Biotic Communities in the Eastern Portion of the Study Area

A natural resources survey of the Project U-2579 Detailed Study Alternatives was conducted in the fall of 1993 and spring of 1994 in support of the 1995 Project U-2579 Draft EIS. A second survey was conducted in April 2000 to update the natural resource information for the Project U-2579 Preferred Alternative and to include the Project U-2579A Detailed Study Alternatives. Additional updates were completed in June 2004. The results of these surveys are described in the following sections.

3.16.3.1 1994 Survey for Project U-2579 Detailed Study Alternatives

Seven vegetative communities within the Project U-2579 Detailed Study Alternatives were identified during the 1994 survey. They include mixed pine/deciduous forests, deciduous hardwood forests, pine forests, agricultural land, and urban/disturbed lands. Bottomland forests occur in floodplain areas adjacent to creeks and their tributaries. The aquatic habitat category, which may or may not contain a vegetative component, includes lakes and ponds. Wetland habitats, which comprise a small percentage of the vegetative communities within the Detailed Study Alternatives, are described in detail in **Section 3.17**. **Appendix F** includes a comprehensive list of the common plant species found in the vicinity of Project U-2579 Detailed Study Alternatives that were obtained from literature review and site observations.

The following is a description of the vegetative communities identified, with the exception of aquatic habitats. The aquatic habitats are described in **Section 3.17**. The text was obtained from the 1995 Project U-2579 DEIS (Section 3.3.9).

Mixed Pine/Deciduous Forests - Upland mixed forests are the dominant forested community within the corridors for the Project U-2579 Detailed Study Alternatives. These successional forests occur primarily along the steeply sloping, ridge-top areas with drier, well-drained soils. These forest types are very similar to deciduous hardwood forest which they typically precede in development. Loblolly pine and shortleaf pine are present in various amounts and share canopy dominance with such hardwood species as white oak, post oak, yellow poplar (*Liriodendron tulipifera*), sweetgum, mockernut hickory, and pignut hickory.

Understory composition includes saplings of the overstory, as well as flowering dogwood, red maple, beech, and ironwood. Shrub and herbaceous species include red cedar, dogwood, and blackberry. Vines common to this community include poison ivy, Virginia creeper (*Parthnocissus quinquefolia*), muscadine (*Vitis rotundifolia*), and Japanese honeysuckle.

Deciduous Hardwood Forests - Deciduous hardwood forests tend to be located on less steep side slopes, often adjacent to the mixed pine/deciduous forests. White oak, red oak, post oak, sweetgum, yellow poplar, and red maple dominate the canopy. Understory species include beech, American elm (*Ulmus americana*), flowering dogwood, mockernut hickory, and ironwood. The shrub and herbaceous species are much the same as those occurring in the mixed pine/deciduous forest.

Pine Forests - Pine forests are the least abundant forested community within the corridors for the Project U-2579 Detailed Study Alternatives. The nature of this community type varies depending on successional status and land management practices. Generally, the pine forests are composed of even-aged stands of loblolly and short leaf pine. This forest type appears to inhabit old abandoned fields or previously disturbed areas. The subcanopy is typically dominated by saplings of the overstory species. The shrub and herbaceous strata is typically sparse but may include American holly, greenbrier, Japanese honeysuckle, and various lichens and mosses.

Bottomland Forests - Bottomland (alluvial) forests are found along the floodplains of creeks and tributaries. The species within this ecosystem are typically dependent on the increased moisture levels caused by the periodic inundation of the floodplain. Although this habitat is not extensive within the Project U-2579 Detailed Study Alternatives, rich alluvial soils found along the stream banks provide habitat for woody and herbaceous vegetation that is sufficiently distinct from other vegetative communities.

Common canopy species include sycamore, silver maple (*A. saccharinum*), green ash (*Fraxinus pennsylvanica*), box elder, sweetgum, red maple, yellow poplar, and river birch. The subcanopy

stratum is composed of saplings of overstory species, as well as blackwillow (*Salix nigra*), American elm, and loblolly pine. Herbaceous and shrub species that have adapted to bottomland forests include blackberry, Virginia creeper, geenbrier, multiflora rose (*Rosa multiflora)*, poison ivy, and cane.

Agricultural Land - Agricultural lands are defined by the evidence of recent, active management of open fields. These areas include actively farmed cropland and pasture lands used primarily for cattle forage and hay production. In most agricultural areas, the canopy, subcanopy, and shrub vegetation have been cleared.

Urban/Disturbed Land - Disturbed lands support residential, commercial, and industrial development. Maintained roadside right of ways are also included in this category. The majority of vegetation within these areas has been altered or removed by human activity. This is the largest habitat identified within the Project U-2579 Detailed Study Alternatives.

3.16.3.2 2000 and 2003 Natural Resources Survey Methodology – Project U-2579 Preferred Alternative and Project U-2579A Detailed Study Alternatives

Field investigations were conducted within the eastern portion of the study area during April 2000, with updates completed in May 2003. Pedestrian surveys were undertaken to determine natural resource conditions and to document natural communities, wildlife, and the presence of protected species or their habitats.

Published information regarding the eastern portion of the study area was derived from the same sources as described in **Section 3.16.2.2**.

Surface waters within the eastern portion of the study area were evaluated in the field to document their physical characteristics and jurisdictional status. The top of bank and/or centerline of streams, depending on channel widths, were surveyed and recorded in the field using GPS survey methods. Water resources information was obtained from publications of DWQ.

Wildlife occurrences were determined through visual field observations, evaluation of habitat-types, secondary indicators of species (tracks, scat, and burrows), and as a review of supporting literature (Coe, 1994, Martof, *et al* 1980, and Webster, 1985). Field observations and literature reviews (Bogan, 2002, Jenkins and Burkhead, 1993) were used to assess aquatic life.

Information concerning the potential occurrence of federal and state protected species within the eastern portion of the study area was obtained from the USFWS list of protected species (updated January 29, 2003) and the NCDENR Natural Heritage Program (NHP) database of rare species and unique habitats (updated July, 2002). Field evaluations were conducted to identify suitable

habitat for protected species. If suitable habitat was identified, field surveys were conducted for federally listed endangered or threatened species if the field investigation corresponded to the appropriate survey season for the species. Otherwise, a separate site visit was made during the appropriate survey season to look for the protected species.

Field review of streams were conducted to determine if the streams were jurisdictional and if mitigation would be required for impacts to the stream based upon the current regulatory permitting requirements of the USACE and DWQ. Stream delineations were conducted using the *1987 Corps of Engineers Wetland Delineation Manual* and the criteria established in a guidance memorandum entitled "Delineation of 'Other Waters' for the Purpose of Section 404" developed by the USACE (March 6, 1995) to assist Natural Resource Conservation Service representatives.

Jurisdictional wetlands were identified and delineated based upon the methodology outlined in the *1987 Corps of Engineers Wetlands Delineation Manual*. Wetland systems were classified based upon the U.S. Fish and Wildlife Service *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin, et al., 1979). Wetland boundaries were located in the field using GPS methods with sub-meter accuracy. Ponds also were identified.

3.16.3.3 Biotic Communities Recorded in 2000 and 2003 Survey – Project U-2579 Preferred Alternative and Project U-2579A Detailed Study Alternatives

Seven biotic communities were identified within the eastern portion of the study area through aerial interpretation and field reconnaissance conducted in April 2000 and May 2003. These communities are shown in **Figure 3-13 (a-d)**.

Approximate boundaries of plant communities were mapped in the field utilizing aerial photography. Dominant plant species were identified in each stratum for each plant community. Plant community descriptions are based on the classifications utilized by Schafale and Weakley (1990). Plant names follow the nomenclature found in Radford *et al.* (1968).

The forest communities identified include Dry Oak-Hickory Forest, Dry Mesic Oak-Hickory Forest, Mesic Mixed Hardwood Forest, Successional Pine, Piedmont Bottomland Forest, Piedmont/Low Mountain Alluvial Forests, and Agricultural Areas. Also located within the eastern portion of the study area are Maintained/Disturbed areas that include the grassed shoulders or existing roads, utility corridors, and residential lawns. These communities are described below. The communities from the 1994 survey that most closely match the new classifications are noted.

The nomenclature for these communities is the same nomenclature used in the 2003 surveys for the Project R-2247 Preferred Alternative.

Dry Oak-Hickory Forest (Similar to Mixed Pine/Deciduous Forests in 1994 survey). Dry oak-hickory forests are found in acidic soils on the upper slopes, ridge tops, and other relatively dry upland areas. These forests are located predominantly around residential communities. These areas are dominated by white oak, southern red oak, post oak, mockernut hickory, pig nut hickory, sourwood (*Oxydendrum arboretum*), red maple, flowering dogwood, and sweetgum. Common herbaceous species include wild ginger (*Hexastylis arifolia*), spotted wintergreen, and crane fly orchid (*Tipularia discolor*).

Dry Mesic Oak-Hickory Forest (Similar to Deciduous Hardwood Forests [mid-slope] in 1994 survey). Dry mesic oak-hickory forests are found on the mid slope, low ridges, and other dry mesic upland areas. This community is typically found down slope of dry oak hickory forest and grades into mesic mixed hardwood. Many of these areas were once used for agriculture and have since reverted back to forest cover. These areas are dominated by white oak, southern red oak, mockernut hickory, yellow poplar, sourwood, red maple, flowering dogwood, and sweetgum. In some areas these stands are dominated by Virginia pine (*Pinus virginiana*) and shortleaf pine.

Mesic Mixed Hardwood Forest (Similar to Deciduous Hardwood Forests [low-slope] in 1994 survey). Mesic mixed hardwood forests are located on the lower slopes adjacent to the floodplain of major stream systems. They also are found in relic floodplains. This community grades into dry-mesic oak hickory forest in better drained locations and alluvial to bottomland forest when an active floodplain exists. These forests are dominated by similar species as the dry mesic oak hickory forest, but typically contain more sweetgum and red maple. The herbaceous layer commonly consisted of Japanese honeysuckle and multiflora rose.

Successional Pine Forest (Similar to Pine Forests in 1994 survey). These forests are dominated by early successional species such as Virginia pine and shortleaf pine with scattered sweetgum. The areas were recently (within the last 5 years) in agriculture and have since been abandoned. Broomsedge (*Andropogon virginicus*) and blackberry are common species within these communities.

Piedmont Bottomland Forest (Similar to Bottomland Forests [adjacent to floodplains] in 1994 survey). These forests are located adjacent to alluvial forest and mesic mixed hardwoods on the active floodplains of the larger creeks including Fiddlers Creek, Muddy Creek, and Swaim Creek. Jurisdictional wetland areas also are associated with this community where shallow depressions occur. Sycamore, yellow poplar, sweetgum, sugar berry (*Celtis laevigata*), green ash, loblolly pine, and bitternut hickory (*C. cordiformis*) are common dominate trees.

Piedmont/Low Mountain Alluvial Forest (Similar to Bottomland Forests [within floodplains] in 1994 survey). These areas are located within the active floodplain of the major stream systems with alluvial deposition common. Early successional bottomland species tend to dominate, including yellow poplar, sycamore, sweetgum, red maple, and black willow. The understory typically contains Chinese privet with scattered spice bush (*Lindera benzoin*).

Maintained-Disturbed (Similar to Urban/Disturbed Land in 1994 survey). Residential areas contain maintained properties with fescue (*Festuca* sp.), crab grass (*Digitaria* sp.), dandelion (*Taraxacum officinale*), and asters (*Aster* spp.).

Agriculture (Similar to Agricultural Land in 1994 survey). Agricultural areas vary greatly within the eastern portion of the study area, from areas that are intensively managed for row crop production to less intensively managed pastures. The row crop areas contain little herbaceous vegetation and no woody component. Typical herbaceous "weedy" species found in these areas include Carolina geranium (*Geranium carolinianum*), chickweed (*Stellaria* sp.), wild onion (*Allium canadens.*), asters, and henbit (*Lamium amplexicaule*). The pasture area with recent maintenance and grazing are dominated by fescue.

3.17 AQUATIC BIOTIC COMMUNITIES

3.17.1 Western Portion of the Study Area

Aquatic habitats within the western portion of the study area range from open water and riverine systems associated with farm ponds, to numerous intermittent and perennial streams, to vegetated palustrine systems as defined by Cowardin et al. (1979). Characteristics of the streams in the western portion of the study area are presented in **Section 3.15.1**. Non-riverine aquatic habitats include wetlands, ponds and borrow pits with varying temporal hydrology, as well as ephemeral pools.

A survey of wetlands was conducted in 1990-1991 for the Project R-2247 Detailed Study Alternatives. An update to this survey was conducted in 1995 for the Project R-2247 Preferred Alternative. A second update to the wetland survey of the Project R-2247 Preferred Alternative was conducted in 2003. The results from these surveys are described below.

1990-1991 Survey. This section is a summary of wetland information included in the *1996 Project R-2247 FEIS* (Section 3.6.2) for the Project R-2247 Detailed Study Alternatives. A routine on-site determination of areas subject to jurisdiction by the USACE under Section 404 of the Clean Water Act was conducted in 1990 and 1991 using the methodology set forth in the *Federal Manual for Identifying and Delineating Jurisdictional Wetlands* (1989). The analysis

was conducted to determine the location and approximate extent of non-tidal wetlands along each of the Detailed Study Alternatives.

The 1989 *Manual* was the applicable manual at the time the 1990-1991 wetlands surveys were conducted. The 1987 Corps of Engineers *Wetland Delineation Manual* (Technical Report Y-87-1) is the method by which wetlands are currently identified. Since the 1987 *Manual* requires strong indicators of all three technical criteria (hydric soils, hydrophytic vegetation, and positive signs of hydrology), the 1989 delineations presented herein represent an overstated scenario of wetlands impacts consistent across all the Project R-2247 Detailed Study Alternatives.

Color infrared aerial photography, USGS topographic maps, and site-specific soil maps provided by the NRCS were used to produce an initial map of the wetland boundaries within the Project R-2247 Detailed Study Alternatives. Field reconnaissance was used to verify and supplement the preliminary mapping. All low-lying areas, stream crossings, and soils listed as "poorly drained" were examined as part of this wetland determination. Areas with vegetation that indicated the presence of potential wetlands were further investigated. Edaphic (soils) characteristics such as soil color, chroma, and evidence of mottling within the top 25 centimeters of soil were recorded for representative areas within wetland habitats along the corridors for the detailed study alternatives.

Wetland communities within the Project R-2247 Detailed Study Alternatives include largely non-vegetated open water and riverine systems associated with farm ponds, numerous intermittent and perennial streams; and vegetated palustrine systems as defined by Cowardin et al. (1979). The vegetated wetlands are predominantly palustrine systems on floodplains adjacent to streams, and are typically narrow as defined by the topography of the area. Wetland habitats within Project R-2247 Detailed Study Alternatives are described in detail below.

Emergent palustrine wetlands are composed typically of erect, rooted, herbaceous hydrophytes. These plants are predominantly perennials. Therefore, they are present most of the growing season, with above-ground tissues usually persisting throughout the winter months. Vegetation species found in emergent wetlands in the study area include: gerardia (*Agalinis sp*.), sedge (*Carex sp.*), woodreed (*Cinna arundinacea*), spike-rush, soft rush (*Juncus effuses*), and knotweed (*Polygonum sp*.). Emergent wetlands within the Project R-2247 Detailed Study Alternatives were classified as narrow-leaved persistent (Cowardin et al., 1979). These types of habitats are associated with the shallow fringe areas of farm ponds and disturbed areas along sewer lines, where compaction of soils has altered drainage patterns.

Scrub-shrub palustrine wetland includes areas dominated by woody species of shrubs, young trees, or trees whose growth has been inhibited due to environmental conditions. The dominant species in the Project R-2247 Detailed Study Alternatives are tag alder and willows. Scrub-shrub wetlands may be part of a successional stage toward forested wetlands, or may be relatively stable

communities as in the gradient of an impoundment fringe. All scrub-shrub habitats within the Project R-2247 Detailed Study Alternatives were in the subclass broad-leaved deciduous (Cowardin et al., 1979).

Forested palustrine wetlands were the predominant wetland type found in the Project R-2247 Detailed Study Alternatives. These habitats, which are characterized by woody species 20 feet or taller, are common in the eastern United States (Cowardin et al., 1979). These systems are associated with the broad-leaved deciduous riparian habitats along streams and floodplains in the Project R-2247 Detailed Study Alternatives.

A representative palustrine habitat possesses a dominant canopy of red maple, sycamore, and American elm. Common associates in this stratum are ash, river birch, and black willow. The subcanopy is dominated by much of the same, with red maple and American elm being the most common. The shrub stratum usually is dense with privet, rose, red maple, sycamore, arrow-woods, and dogwood. Other species encountered, to a lesser degree include ash, swamp rose (*Rosa palustris*), brambles, sweet-gum, strawberry bush, river birch, willow oak, cane, and spice bush.

1995 Update Survey for the Project R-2247 Preferred Alternative. This section is a summary of information included in the 1996 Project R-2247 FEIS (Section 4.6.2.1) for the Project R-2247 Preferred Alternative.

Wetland delineations were conducted in March and April 1995 within a 1,200-foot wide corridor for the Project R-2247 Preferred Alternative. The survey corridor was expanded at proposed interchanges and other areas where the right of way was anticipated to extend beyond the 1,200-foot wide corridor. The USACE's *1987 Wetland Delineation Manual* was the method by which the wetlands were delineated. On May 2, 1995, a representative of the USACE reviewed a representative sample of the wetland delineation areas. The USACE concurred with all wetland boundaries and the method of delineation. The delineated limits of the wetlands were recorded using GPS techniques.

A total of 68 wetlands were delineated within the 1,200-foot wide corridor for the Preferred Alternative, with a total area of 43 acres. Individual wetlands ranged in size from 0.001 acre to 5.73 acres. These wetlands are shown in an exhibit in the *Supplemental Natural Resources Technical Memorandum for Project R-2247* (2003).

2002-2003 Update Survey for the Project R-2247 Preferred Alternative. The Project R-2247 Preferred Alternative was surveyed in 2002-2003. As part of this survey, wetlands delineated in 1995 were resurveyed to determine their current jurisdictional status. Wetland communities were investigated pursuant to the 1987 *Corps of Engineers Wetland Delineation Manual* as discussed in **Section 3.16.2.2**. Jurisdictional status can change over time due to long-term weather

conditions, development, or habitat succession. Generally, the larger wetlands previously identified in the 1995 survey remained the same, while many of the previously identified smaller wetlands no longer met the criteria for wetland classification.

Figure 3-11(a-ee) shows the wetlands and ponds within the Project R-2247 Preferred Alternative identified during the 2002-2003 surveys. Wetlands range in size from 0.01 acre to 1.34 acres and range in quality from low to high. The descriptions of plants within these wetlands are the same as those described in the 1995 survey. There were eight ponds identified within or partially within the Project R-2247 Preferred Alternative right of way.

Wetland types were classified according to DWQ's Rating System. Three wetland types were identified, Bottomland Hardwood, Headwater Forest, and Ephemeral Wetland. The predominant wetland type was the Bottomland Hardwood forest. These wetlands were found close to medium to large streams. Dominant vegetation included sweetgum, tulip poplar, sycamore, river birch, black willow, red maple, ironwood, and privet. These systems are highly diverse.

Headwater Forest wetlands are located at the top of intermittent streams and other linear depressions. These wetlands are irregularly inundated or flooded by surface water. The typical vegetation found in a Headwater Forest is red maple, sweetgum, tulip poplar, and ironwood. Occasionally blackberry, sphagnum moss and Japanese honeysuckle were encountered.

Ephemeral wetlands are typically found in depressions in uplands or on interstream divides. Typical vegetation encountered along the project included red maple, sweetgum, sycamore, needle rush, and river birch.

3.17.2 Eastern Portion of the Study Area

Aquatic habitats within the eastern portion of the study area include streams, wetlands, and water bodies that may or may not include a vegetative component. Grassy Creek, Mill Creek, Frazier Creek, Lower Mill Creek, Martin Mill Creek, Kerners Mill Creek, Smith Creek, Fishers Branch, Fiddlers Creek, Swaim Creek, Muddy Creek, and numerous unnamed associated tributaries flow within the eastern portion of the study area. In addition, numerous ponds are located within the eastern portion of the study area.

Locations of these streams, wetlands and ponds are shown on **Figure 3-12(a-jj)**. The streams' physical characteristics are described in detail in **Section 3.15.1**. A detailed description of each wetland and stream segment labeled in the figures is included in the *Natural Resources Technical Memorandum* (2004, appended by reference).

1993-1994 Survey of the Project U-2579 Detailed Study Alternatives. This section is a summary of information found in the 1995 Project U-2579 DEIS (Section 3.3.10).

Initial field reconnaissance of the wetlands for Project U-2579 was performed in November 1993. Additional field reconnaissance was performed with the USACE in April 1994. The location, extent, and quality of potential wetlands along each Project U-2579 Detailed Study Alternative were determined by:

- Stereoscopic interpretation (by an environmental scientist with more than 30 years of experience in the interpretation and analysis of aerial photography) of black-and-white aerial photography (scale 1 inch=2,000 feet) flown in February 1993 with leaf-off conditions.
- Review of US Geological Survey topographic maps (Kernersville, Walkertown, Belews Creek, Winston-Salem East, and Winston-Salem West, NC quadrangles). No National Wetland Inventory (NWI) maps were available for the study area.
- Review of the Soil Conservation Service, *Soil Survey of Forsyth County*.
- Field reconnaissance of the study area.

A preliminary assessment was made based on the methodology outlined in the 1987 *Corps of Engineers Wetlands Delineation Manual*. This assessment was conducted to evaluate the impacts of the Project U-2579 Detailed Study Alternatives. No official verifications of the delineations by USACE have been conducted.

The majority of the wetlands identified in the study area are associated with the alluvial floodplain valleys of Grassy Creek, Trick-um Creek, Buffalo Creek, Mill Creek, Frazier Creek, Lowery Mill Creek, Martin Mill Creek, and Kerners Mill Creek and their tributaries. The valleys are generally flat lying to gently sloping, and are characterized mainly by bottomland hardwoods interspersed with enclaves of shrub/scrub vegetation. A few marsh systems also were identified along the outer periphery of Salem Lake, Kerners Mill Creek, and pond sites. Bottomland (alluvial) forests are the most frequently encountered wetlands, followed by shrub/scrub, and marsh wetlands.

Bottomland (alluvial) forests typically occur in the low-lying floodplain areas parallel to creeks and their tributaries. These forests usually occur as an ecotone between the aquatic and upland ecosystems; however, they have distinct vegetation and soil characteristics. The extent of these alluvial systems is usually defined by topographic gradient and disturbances in the area. Many of the bottomland forests along the creeks in the study area have been cleared for agricultural or residential purposes.

The canopy of the bottomland forest is dominated by sweetgum, red maple, sycamore, yellow poplar, and river birch. Subcanopy species include American elm, ironwood, red maple, green

ash, and flowering dogwood. The shrub stratum is composed of multiflora rose, poison ivy, blackberry, and virginia creeper. Herbaceous species include false nettle (*Boehmeria cylindrica*), sedges, and Japanese honeysuckle.

The shrub/scrub wetland areas consist of woody species of shrubs and young hardwood species. These areas may be an early successional stage of a forested wetland system. Dominant vegetation in these shrub/scrub wetlands includes green ash, black willow, red maple, American elm, sweetgum, and a number of woody vines.

Marsh wetlands occur in the low-lying areas adjacent to Salem Lake, Kerners Mill Creek, and a pond site near US 421/I-40 Business. These areas are dominated by herbaceous vegetation including juncus (*Juncus spp.*), sedges (*Scirpus* spp.), and cattail (*Typha latifolia*), and are often interspersed with willows and alders.

Aquatic habitat includes Grassy Creek, Trick-um Creek, Buffalo Creek, Mill Creek, Lowery Mill Creek, Martin Mill Creek, Kerners Mill Creek, and Smith Creek. Also included are numerous unnamed first and second order tributaries that feed the major drainages. Salem Lake is located in the southwest corner of the eastern portion of the study area. Numerous small farm ponds are located in the vicinity of the Project U-2579 Detailed Study Alternatives. Several large ponds are located immediately to the north of US 421/I-40 Business.

2002 Survey of the Project U-2579 Preferred Alternative and Project U-2579A Detailed Study Alternatives. Wetlands within the Project U-2579 Preferred Alternative were originally delineated in the fall of 1993 and the spring of 1994. Wetlands within the Project U-2579A Detailed Study Alternatives were delineated in the fall of 2001 and spring of 2002. All wetland community investigations were conducted pursuant to the *1987 Corps of Engineers Wetland Delineation Manual* as discussed in **Section 3.16.3.2**.

The USACE conducted a field review and jurisdictional verification of the wetland delineations for the Project U-2579 Preferred Alternative and Project U-24579A Detailed Study Alternatives in March and April, 2002. Detailed wetland analysis including USACE data forms and DWQ Wetland Rating Worksheets are included in the *Section 404/401 Jurisdictional Areas Report* (April 2004), appended by reference.

Figure 3-12(a-jj) shows the wetlands and ponds completely or partially within the Project U-2579 Preferred Alternative and Project U-2579A Detailed Study Alternatives identified during the 2002 survey. Thirteen jurisdictional wetlands and seven jurisdictional open waters/ponds were identified within the Project U-2579 Preferred Alternative, including one additional wetland area created following the installation of two new culverts since the 1993 survey. An additional review of aerial maps revealed a fourteenth wetland within the Project U-2579 Preferred

Alternative right of way, but outside of the construction limits. There are 2.55 acres of impacted wetlands, and 17.92 acres of ponds.

Fourteen jurisdictional wetlands and nine jurisdictional open waters/ponds were identified within the Project U-2579A Detailed Study Alternatives. The descriptions of plants within these wetlands are the same as those described in the 1993-1994 survey. Details and impacts are described in **Section 4.17.1.5** (Project U-2579) and **Section 4.17.1.6** (Project U-2579A).

3.18 IMPORTANT NATURAL AREAS

The North Carolina Natural Heritage Program (NHP) records do not document any rare or unique natural areas within the project study area (NHP website, *http://www.ncsparks.net/nhp/quad.html,* accessed January 9, 2007).

3.19 JURISDICTIONAL ISSUES

Section 404 of the Clean Water Act (CWA) requires regulation of discharges into "Waters of the United States." The term Waters of the United States has broad meaning and incorporates both wetlands and surface waters. Although the principal administrative agency of the CWA is the EPA, the USACE has major responsibility for implementation, permitting, and enforcement of provisions of the Act. The USACE regulatory program is defined in 33 CFR 320-330. Executive Order 11990 requires that new construction in wetlands be avoided to the extent possible, and that all practical measures be taken to minimize or mitigate impacts to wetlands.

Water bodies such as rivers, lakes, ponds and streams are subject to jurisdictional consideration under the Section 404 program. A discussion of streams is presented in **Section 3.15**. Ponds are discussed in **Section 3.17.**

By regulation, wetlands also are considered "Waters of the United States." Wetlands are described 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." [33 CFR 328.3(b) (1986)]*

The USACE requires the presence of three parameters (hydrophytic vegetation, hydric soils, and evidence of hydrology) in support of a jurisdictional determination. The types of jurisdictional wetlands present in the study area are discussed in **Section 3.17**.

The jurisdictional streams and wetlands for the Bethania-Tobaccoville Road interchange area for the Project R-2247 Preferred Alternative were verified on October 25, 2002. The verification letter from the USACE dated November 12, 2002 is included in **Appendix D.2**. The streams and wetlands for the remaining portion of the Project R-2247 Preferred Alternative were verified on April 29, 2003. The verification letter from the USACE dated August 28, 2003 is included in **Appendix D.2**.

The preliminary wetland determinations for the Project U-2579 Detailed Study Alternatives were verified with the USACE on April 25, 1994. The wetlands and streams for the Project U-2579 Preferred Alternative and the Project U-2579A Detailed Study Alternatives were verified with the USACE on March 5 and April 4, 2002 respectively. The USACE concurred with the wetland determinations for the Project U-2579 Preferred Alternative and Project U-2579A Detailed Study Alternatives in a letter dated March 31, 2006 (see **Appendix D.2**).

3.20 WILDLIFE

3.20.1 Aquatic Wildlife

The following discussion is summarized from the 1996 Project R-2247 FEIS (Section 3.6.3) and from the *Projects U-2579 and U-2579A Natural Resources Technical Memorandum (*2004). The findings included in both sources apply to aquatic communities in the western and eastern portions of the study area.

Several streams were examined for the presence of aquatic organisms during the field reconnaissance of the Project R-2247 Detailed Study Alternatives conducted in March 1991. Streams were examined by turning over rocks and logs and examining detritus, such as leaves, within the stream. Smaller first and second order streams were examined, as well as Silas Creek (1996 Project R-2247 FEIS, Section 3.6.3, page 3-81). Wildlife identification involved active searching of known or suspected species and incidental visual observations. These species are identified with an asterisk.

The qualitative survey conducted in March 1991 found mayfly nymphs of the family Heptageniida and saddle case caddisfly larvae of the family Glossosomatidae in all streams examined. Both of these organisms are well-suited to inhabit flowing water. They were more common in the smaller first and second order streams due to an abundance of rocks and gravel on

which they cling. Many larger streams had a predominantly sand/silt substrate, limiting the available habitat (1996 Project R-2247 FEIS, Section 3.6.3, page 3-81).

Other organisms observed within the smaller creeks include crayfish (Cambaridae), midges (Chironomidae), freshwater snails (Pleuroceridae) and worms (Oligochaeta). No fish were observed in the smaller tributaries. Small fish were observed in Silas Creek, most likely minnows from the Cyprinidae family. Also observed in a number of streams was the two-lined salamander (*Eurycea bislineata*) (1996 Project R-2247 FEIS, Section 3.6.3, page 3-82).

Other organisms likely to be found in or near streams within the project study area include insects such as backswimmers (Notonectidae), water striders (Gerridae), stoneflies (Plecoptera), dragonflies (Odonata), scuds (Gammaridae), and a variety of fly larvae (Diptera) and beetles (Coleoptera). Amphibians such as the marbled salamander (*Ambystoma opacum*), northern dusky salamander (*Desmognathus fuscus*) and the pickerel frog (*Rana palustris*) also may occur (1996 Project R-2247 FEIS, Section 3.6.3, page 3-82).

No updated fish or aquatic organism qualitative surveys were performed on streams or ponds in the western portion of the study area, nor were any of these types of surveys conducted for the eastern portion of the study area. It is expected that organisms observed and typical in 1991 would be the same today.

According to the NCWRC, typical fish species likely to inhabit streams and ponds in the study area include creek chub (*Semotilus atromaculatus*), common sucker (*Catostomus commersoni*), longnose dace (*Rhinichthys cataractae*), blacknose dace (*Rhinichthys atratulus*), mosquitofish (*Gambusia affinis*), fantail darter (*Etheostoma flabellare*), and various shiners (*Notropis* spp.). Farm ponds are often stocked with game fish such as blue gill (*Lepomis macrochirus*), large mouth bass* (*Micropterus salmoides*), catfish (*Pylodictis olivaris*), and green sunfish (*Lepomis cyanellus*).

Freshwater mussels that may occur include spike (*Elliptio* spp.), Carolina slabshell (*E. congaraea*), and pond horn (*Uniomerus* sp.). Common benthic invertebrates found in such communities would include stoneflies (*Plecoptera*) and caddisflies (*Trichoptera*).

In addition to these invertebrate species, several different species of amphibians and reptiles inhabit the study area and are likely to occur within the streams or ponds. Amphibious species such as the slimy salamander, spotted salamander (*Ambystoma maculation*), eastern newt (*Notophthalmus viridescens*), green frog (*Rana clamitans*), pickerel frog* (*Rana palustris*), and bullfrog* (*Rana catesbeiana*) depend on waters of streams, ponds, and pools for resident or breeding habitats.

Reptiles, such as the snapping turtle, brown water snake (*Nerodia taxispilota*), northern water snake (*Nerodia sipedon*), and crustaceans such as crayfish (*Cambarus* spp.) are semi-aquatic species that rely upon aquatic habitat for food and shelter. Open water in the area also provides resting places for migrating waterfowl.

3.20.2 Terrestrial Wildlife

The following discussion of terrestrial wildlife is from the *Natural Resources Technical Memorandum* (2004) prepared for the eastern portion of the study area. This discussion is similar to the discussion of wildlife found in the 1996 Project R-2247 FEIS (Section 3.6.3) and also would apply to the western portion of the study area.

Wildlife species of the project study area varied greatly due to the diverse habitats available. Certain species can be expected throughout the study area while others are limited to a specific habitat. Wildlife identification involved active searching of known or suspected species, incidental visual observations, incidental auditory indicators (such as bird song and other sounds), and secondary indicators of species presence or site utilization (such as scat, tracks, and burrow). These species are identified with an asterisk.

Upland forests provide food, shelter, and nesting resources for a relatively diverse population of wildlife. These areas may be particularly suited to wildlife diversity when located adjacent to successional and maintained/disturbed areas, as they provide corridors for movement of wildlife as well as a variety of food and other resources. Canopy species common in such areas, hickory and oak forests in particular, provide valuable materials for browser forage as well as materials for nesting, shelter, and cover.

Wildlife species typically found in forested habitats include white-tailed deer* (*Odocoileus virginianus*), Virginia opossum* (*Didelphis virginiana*), gray squirrel* (*Sciurus carolinensis*), eastern cottontail rabbit* (*Sylvilagus floridanus*), gray fox (*Urocyon cinereoargenteus*), white-footed mouse (*Peromyscus leucopus*), and eastern chipmunk (*Tamias striatus*).

Common reptiles and amphibians found in these upland forested communities include the eastern box turtle* (*Terrapene carolina*), ground skink (*Scincella lateralis*), American toad* (*Bufo americanus*), upland chorus frog, (*Pseudacris triseriata*), rat snake* (*Elaphe obsoleta*), eastern garter snake (*Thamnophis sirtalis*), and eastern kingsnake (*Lampropeltis getula*).

Common bird species found within the forested communities include the northern cardinal (*Cardinalis cardinalis*), American robin* (*Turdus migratorius*), common crow* (*Corvus brachyrhynchos*), blue jay* (*Cyanocitta cristata*), tufted titmouse* (*Baeolophus bicolor*), and the red bellied woodpecker (*Melanerpes carolinus*). Species such as the pinewarbler (*Dendroica*

pinus) and nuthatches (*Sitta* spp.), while not limited to pine forest habitat, would more commonly occur in these areas.

Bottomland communities, including forests and shrub/scrub areas, provide prime habitat for wildlife due to their food, cover, and proximity to a water source. Species diversity and wildlife populations are often high in these communities. Mammals such as raccoon* (*Procyon lotor*), beaver* (*Castor canadensis*), and muskrat (*Ondatra zibethicus*) are known to occur in these habitats. Other mammals typically found in upland forested communities also may use these riparian areas as part of their home range.

A variety of reptiles and amphibians populate these bottomland communities, including the common snapping turtle (*Chelydra serpentina*), slimy salamander (*Plethodon glutinosus*), five-lined skink* (*Eumeces fasciatus*), common garter snake, watersnakes (*Nerodia* spp), and numerous species of frogs (*Hyla* spp).

Avian species within the bottomland communities are numerous and include the red-tailed hawk* (*Buteo jamaicensis*), wood thrush* (*Hylocichla mustelina*), red-eyed vireo (*Vireo olivaceus*), and the red-bellied woodpecker.

Disturbed areas and agricultural fields provide "edges" or "breaks" along forested communities. These open areas may be important feeding grounds for transient and migrant birds and for wildlife in adjoining vegetative communities. The ecotone between the different communities is considered optimum habitat for game species such as white-tailed deer and northern bobwhite (*Colinus virginianus*).

Characteristic species typical of open, herbaceous habitats include the eastern cottontail rabbit, gray squirrel, house mouse (*Mus musculus*), eastern box turtle, American toad, northern black racer (*Coluber constrictor*), killdeer* (*Charadrius vociferus*), song sparrow (*Melospiza melodia*), and mourning dove* (*Zenaida macroura*).

3.21 PROTECTED SPECIES

Species with the federal status Endangered (E), Threatened (T), Proposed Endangered (PE), and Proposed Threatened (PT) are protected under provisions of the Endangered Species Act. Any activity permitted, funded or conducted by a federal agency that may affect a listed species or designated critical habitat requires a consultation with the USFWS.

3.21.1 Federally Threatened and Endangered Species and Species of Concern

Federally Threatened and Endangered Species

The three federally listed species in Forsyth County are shown in **Table 3-25**. A description of the species follows.

Table 3-25: Federal Listed Species in Forsyth County

Common Name	Scientific Name	Federal Status	State Status
Vertebrates			
Bog Turtle	*Clemmys muhlenbergii*	T(S/A)	T
Red-Cockaded Woodpecker	*Picoides borealis*	E	E
Vascular Plants			
Small-Anthered Bittercress	*Cardamine micranthera*	E	E

Protection Status
E: Listed Endangered - A taxon in danger of extinction through all of a significant portion of its range.
T: Listed Threatened - A taxon likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.
T(S/A): Threatened due to Similarity of Appearance – A taxon not threatened or endangered itself, but listed due to its similarity to a species that is listed.

Source: USFWS Website, Accessed July 1, 2005. http://nc-es.fws.gov/es/es.html.

Bog Turtle (*Clemmys muhlenbergii*), T(S/A)

The bog turtle is a small turtle growing only to approximately 4.5 inches (11.43 cm) in diameter. It can be identified by the bright orange spots on either side of the head. It prefers wet meadows, bogs, marshes, and other wetland environments where the ground is soft and light penetrates. Because these habitats tend to be early successional stage areas that are encroached over time by woody material, bog turtle habitat locations change over time. Bog turtles prefer a mosaic habitat including both dry and wet microhabitat such as a wetland area within a meadow (*Bog Turtles Slipping Away* website, *http://sites.state.pa.us/PA_Exec/Fish_Boat/sepoct98/bogturtl.htm*).

The species is threatened from collection for the pet trade, as well as from alteration of the wetland habitat the species requires (USFWS website, *http://nc-es.fws.gov/es/es.html,* accessed July 6, 2004).

The southern population of bog turtle is not threatened, but is listed because of the difficulty of differentiating between the northern and southern populations.

Red-Cockaded Woodpecker (*Picoides borealis*), Endangered

The red-cockaded woodpecker lives in open stands of southern pines that are a minimum age of 80 to 120 years. They most commonly nest in longleaf pine (*Pinus palustris*), but will also use other southern pine species. The birds lay eggs from April through June, with 38 days from egg laying to fledging and several additional weeks before the young become independent. Red-cockaded woodpeckers feed primarily on insects, supplemented by seasonal wild fruit (USFWS website, *http://nc-es.fws.gov/es/es.html,* accessed July 6, 2004).

The species' decline is attributed to the loss of pine forests with trees 80 years old or older. Fire suppression has led to the intrusion of hardwood species, further reducing the specialized habitat the species requires (USFWS Endangered Species Program Website, *http://endangered.fws.gov /i/b/sab4a.html*, accessed July 6, 2004).

Small-Anthered Bittercress (*Cardamine micranthera*), Endangered

The small-anthered bittercress is a small plant 8 to 16 inches (20 to 41 cm) tall, with small white flowers that bloom in April to May. The leaves are almost square and non-clasping. The plant lives in seepages, wet rock crevices, streambanks, sandbars, and wet woods along small streams. Historically it is known in the Dan River drainage in the northern Roanoke River Basin.

Threats to the small-anthered bittercress include agricultural and residential development, impoundment, channelization, exotic weeds, and toxic chemical spills (USFWS website, *http://nc-es.fws.gov/es/es.html,* accessed July 6, 2004).

Federal Species of Concern

There is one federal species of concern, the brook floater (Alasmidonta varicose), listed by the USFWS for Forsyth County. Federal species of concern are not afforded federal protection under the ESA and are not subject to any of its provisions, including Section 7, until they are formally proposed or listed as Threatened or Endangered. Federal species of concern are defined as species under consideration for listing for which there is insufficient information to support listing as Threatened or Endangered. The status of this species may be upgraded at any time, thus it is included here for consideration.

3.21.2 State Listed Species

State Listed Species

Species with state designations Endangered, Threatened or Special Concern are granted protection by the State Endangered Species Act and the State of North Carolina Plant Protection and Conservation Act of 1979. Legal protection under North Carolina state law regulates the possession, propagation or sale of protected species. However, those Acts do not "limit the rights of a landholder in the management of his lands for agriculture, forestry, development or any other lawful purpose." (NCGS §113-332; see also NCGS § 106-202.13). There are five state listed species in Forsyth County. These species are shown in **Table 3-26**.

Table 3-26: State Listed Species in Forsyth County

Common Name	Scientific Name	State Status
Vertebrates		
Loggerhead Shrike	*Lanius ludovicianus ludovicianus*	SC
Bigeye Jumprock	*Scartomyzon ariommus*	T
Vascular Plants		
Bog Rose	*Arethusa bulbosa*	E
Yellow Fringeless Orchid	*Platanthera integra*	T
Small's Portulaca	*Portulaca smallii*	T

E: Endangered - A taxon in danger of extinction through all of a significant portion of its range.
T: Listed Threatened - A taxon likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.
SC: Special Concern - A taxon which requires monitoring, but which, if not threatened or endangered, may be collected or sold from wild populations under the provision of the Plant Protection and Conservation Act (GS 19B 106:202.12). If the species is threatened or endangered, propagated individuals may be traded or sold under specific regulations.
Source: NC NHP website. Accessed September 17, 2002. *http://www.ncsparks.net/nhp/county.html*

CHAPTER 4

Chapter 4 ENVIRONMENTAL CONSEQUENCES

This SFEIS/FEIS combines three projects from the *North Carolina Department of Transportation (NCDOT) 2006-2012 Transportation Improvement Program (TIP);* Projects R-2247, U-2579, and U-2579A. These projects, collectively, are commonly known as the Winston-Salem Northern Beltway. These projects completed varying stages of the NEPA process in different years (see **Preface** and **Section 1.6**), and Preferred Alternatives have been identified for all three projects.

Section 3.1 describes the use of previous and new data in evaluating the impacts of Projects R-2247 and U-2579 that are presented in this chapter. All existing conditions and impacts reported for the Project U-2579A study area and Project U-2579A Detailed Study Alternatives are current, and are therefore not discussed in **Section 3.1**, except where studies have been updated since the 2004 SFEIS/SDEIS. There were no previously published NEPA documents for Project U-2579A.

The information for the Detailed Study Alternatives as well as the Preferred Alternatives is available at different levels of detail. Information from the 1996 Project R-2247 FEIS, 1992 Project R-2247 DEIS, and 1995 Project U-2579 DEIS is used where appropriate. Information is updated for the Project R-2247, U-2579, and U-2579A Preferred Alternatives where practicable and/or necessary for adequate comparison of alternatives. A discussion is provided under each issue describing the status of the information and analysis and the types of updates performed.

For resources or topics discussed in this chapter, sections generally begin by presenting any applicable regulatory background, impact criteria, and/or analysis methodology. Impact information in this chapter is presented for Detailed Study Alternatives and Preferred Alternatives. Discussions of the environmental consequences of the three projects are generally organized as follows:

- Combined direct effects of the R-2247 Preferred Alternative and U-2579 Preferred Alternative with each of the U-2579A Detailed Study Alternatives, including the U-2579A Preferred Alternative
- Project R-2247 - Detailed Study Alternatives
- Project R-2247 - Preferred Alternative
- Project U-2579 - Detailed Study Alternatives
- Project U-2579 - Preferred Alternative
- Project U-2579A - Detailed Study Alternatives
- Project U-2579A - Preferred Alternative

Sections in this chapter that, due to their nature, do not follow the format described above cover the following topics:

- Land Use and Transportation Planning
- Environmental Justice
- Visual Impacts
- Mineral Resources
- Soils
- Water Quality
- Aquatic Biotic Communities
- Indirect and Cumulative Impacts
- Construction Impacts
- Irreversible and Irretrievable Commitment of Resources
- Relationship Between Short-Term Impacts and Long-Term Benefits
- Summary of Environmental Consequences
- Required Permits and Actions

For some impacts, information is available by Segments for the Detailed Study Alternatives. This information is presented in **Appendix I of the SFEIS/SDEIS**, and includes the following impacts for individual segments comprising the Detailed Study Alternatives:

- relocations
- community facilities impacts
- utilities impacts
- traffic noise impacts
- prime and important farmland soils impacts
- major drainage structures
- stream impacts
- floodway and floodplain impacts

The following impacts for individual segments are shown only for Project R-2247:

- major floodplain encroachments
- biotic communities impacts

- wetland and pond impacts
- hazardous material/waste sites

4.1 LAND USE AND TRANSPORTATION PLANNING

4.1.1 Consistency With Transportation Plans

Projects R-2247, U-2579, and U-2579A, together known as the Northern Beltway, are consistent with the state and local transportation plans for the area.

The *2005 Thoroughfare Plan* was adopted in January 2005, and the *Winston-Salem Urban Area 2030 Multi-Modal Long Range Transportation Plan* (*LRTP*) was adopted May 28, 2005. In accordance with the Clean Air Act, the *LRTP* must be fiscally constrained and meet air quality conformity standards. **Figure 1-6** shows the *Long Range Transportation Plan* for 2030. The *2005 Thoroughfare Plan* (see **Figure 1-7**) is the street and highway system component of the *2030 Long Range Transportation Plan* that goes beyond the planning horizon of 2030.

The *2030 LRTP* and *2005 Thoroughfare Plan* show the conceptual location of the Winston-Salem Northern Beltway in a location corresponding to the Preferred Alternatives for Project R-2247 (Western Section), Project U-2579 (Eastern Section), and Project U-2579A (Eastern Section Extension). The other Detailed Study Alternatives, also controlled access facilities with interchanges at the same roadways, would be consistent with the concepts shown on the *2030 LRTP* and *2005 Thoroughfare Plan*.

4.1.2 Consistency With Land Use Plans and Policies

This section addresses the proposed alternatives' general consistency with the following local land use and comprehensive plans and policies:

- *Legacy Development Guide*
- *Winston-Salem Urban Area 2030 Multi-Modal Long Range Transportation Plan*
- *Growth Management Plan*
- *Salem Lake Watershed Protection Ordinance*
- *Winston-Salem/Forsyth County Bicycle Map*

The Northern Beltway is an integral part of the County's land use planning. All the Detailed Study Alternatives would be consistent with the concepts and policies in the *Legacy Development*

Guide. Detailed discussions on development trends and potential indirect and cumulative impacts as they relate to land use are included in **Section 4.20 - Indirect and Cumulative Impacts**.

Forsyth County's comprehensive plan (*Legacy Development Guide*) and transportation plan (*2030 Multi-Modal Long Range Transportation Plan*) incorporate and support the construction of the Northern Beltway. Currently, most of the study area is zoned suburban residential and single-family residential, with pockets of agricultural, industrial, multi-family, and mobile-home zoning. Since the mid-1960s, the Northern Beltway has been included in County master transportation plans. More recent updates of the plan state that traffic problems in the vicinity of the proposed project need much attention due to rapid development in the area.

The *Legacy Development Guide* is the current general, long-range policy guide for decisions concerning the overall growth and development of Forsyth County and its eight municipalities. The *Legacy Development Guide* is a general guide to managing and promoting smarter growth for Forsyth County by building at higher densities and in activity centers, by promoting transit-oriented development that reduces auto-dependency and air pollution, and by protecting and enhancing community values. The plan also stresses the importance of protecting open space, farmland, and historic resources, and of revitalizing downtown and older neighborhoods (*2030 Multi-Modal Long Range Transportation Plan,* Forsyth County Tomorrow, p.4).

One of the Action Agenda items in the *Legacy Development Guide* is implementation of the *Multi-Modal Long Range Transportation Plan*. The Northern Beltway is the major new road proposed in the *Multi-Modal Long Range Transportation Plan* (*Legacy Development Guide, Transportation Alternatives*, pgs. 53-55).

Included in the *Legacy Development Guide* is a *Growth Management Plan* (Chapter 3 of the *Legacy Development Guide*) for Forsyth County. The overall goal of the *Growth Management Plan* is to reduce sprawl, create a more compact and balanced urban development pattern and preserve open space and rural character (*Legacy Development Guide*, *Growth Management Plan*, pg. 28). As a means of achieving this goal, nine Metro Activity Centers are proposed for Forsyth County.

As shown in **Figure 3-2**, the *Growth Management Plan* for Forsyth County shows the conceptual location of the Winston-Salem Northern Beltway in a location corresponding to the Preferred Alternatives for Projects R-2247, Project U-2579, and Project U-2579A. Two of the nine proposed Metro Activity Centers are located at proposed interchanges of the Northern Beltway (see **Figure 3-2**).

Section 4.1.1 of the 1996 Project U-2579 DEIS describes the impacts of the Detailed Study Alternatives to the Salem Lake Watershed according to the *Salem Lake Watershed Area Plan*. Since 1996, the *Salem Lake Watershed Area Plan* has been superseded by the *City-County*

Planning Board's Unified Development Ordinances (UDO). The *UDO* consists of all regulations that regulate land use, including the Zoning Ordinance, the Environmental Ordinance, and the Subdivision Ordinance/Regulations. The Salem Lake Watershed Protection Ordinance is described in Chapter C, Article III of the UDO document, which is located at *http://cityofws.org/Home/Departments/Planning/ZoningAndSubdivision/Articles/UDO*.

The Salem Lake Watershed is located in the eastern portion of the study area, and is bounded by Old Greensboro Road and Williston Road on the west, Kernersville Road and Sedge Garden Road on the south, Old Hollow Road and West Mountain Street on the north, and Salisbury Street and Union Cross Road on the east. All Project U-2579 and U-2579A Detailed Study Alternatives (including the Preferred Alternatives) cross through the Salem Lake Watershed. None of the Preferred Alternatives would impact Salem Lake's critical area, although the U-2579A Preferred Alternative would impact the Resource Protection Area (RPA).

The *Winston-Salem/Forsyth County Bicycle Map* corresponds with the routes in Winston-Salem and Forsyth County that are identified by the City-County Planning Board as official bicycle routes. These routes are designated by signs that include the picture of a racing bicyclist, the route with major intersecting streets, and the route name and number. Currently, there are 25 signed routes along 64 miles in Winston-Salem and 113 miles in Forsyth County. The routes were developed to connect residential areas with major attractors, and were designed to facilitate both commuters and recreational riders. The Bicycle Map identifies the bicycle routes, major thoroughfares, schools, greenways, recreational facilities, and governmental buildings. The Winston-Salem/Forsyth County Planning Board has published a pamphlet including the map and basic biking instructions (*http://www.ncdot.org/transit/bicycle/maps/maps_urban.html)*.

All Project R-2247 Detailed Study Alternatives, including the Preferred Alternative, cross one Winston-Salem/Forsyth County Bicycle Route – Route #2. Bicycle Route 2 is a route along Shallowford Road/Country Club Road (SR 1001). All Project R-2247 Detailed Study Alternatives propose an interchange with Shallowford Road, allowing Bicycle Route 2 to maintain continuity.

The Project U-2579 Detailed Study Alternatives, including the Preferred Alternative, cross four county Bicycle Routes at five total crossings. The Detailed Study Alternatives cross at University Parkway (Route #20), Stanleyville Drive (Route #20), Baux Mountain Road (Route #19), Old Walkertown Road (Route #18), and West Mountain Street (Route #15). All Project U-2579 Detailed Study Alternatives propose interchanges at University Parkway and Baux Mountain Road and grade separations at Stanleyville Drive, Old Walkertown Road, and West Mountain Road. Continuity of the bicycle routes would be maintained along these roads.

The Project U-2579A Detailed Study Alternatives cross two Bicycle Routes, Route #16 at Sedge Garden Road and Route #24 at High Point Road. Both these roads would be grade-separated

from the Project U-2579A Detailed Study Alternatives, including the Preferred Alternative. Two of the non-preferred Detailed Study Alternatives (N3-S1 and N3-S2 with the Kernersville Road interchange) would cut off Sedge Garden Road north and south of Kernersville Road. Therefore, continuity of the bicycle routes would be maintained for all Project U-2579A Detailed Study Alternatives except for N3-S1 and N3-S2, which cut off Sedge Garden Road at Kernersville Road.

By not disrupting any of the bicycle routes, this project maintains consistency with the county bicycle map.

4.2 SOCIAL IMPACTS

Social impacts of the Northern Beltway include residential and business relocations, impacts to community services and facilities, public safety, community cohesion, and environmental justice. These topics are addressed in the following sections.

4.2.1 Relocations

4.2.1.1 NCDOT Relocation Policies

It is the policy of NCDOT to ensure that comparable replacement housing is available for relocatees prior to construction of state and/or federally assisted projects. Furthermore, NCDOT has three programs to minimize the inconvenience of relocation: relocation assistance, relocation moving payments, and relocation replacement housing payments or rent supplements.

With the Relocation Assistance Program, experienced NCDOT staff would be available to assist displacees with information such as: availability and prices of homes, apartments, or businesses for sale or rent, and financing or other housing programs. The Relocation Moving Payment Program, in general, provides for payment of actual moving expenses encountered in relocation. Where displacement would force an owner or tenant to purchase or rent property at higher cost or to lose a favorable financing arrangement (in case of ownership), the Relocation Replacement Housing Payments or Rent Supplement Program would compensate up to $22,500 to owners who are eligible and qualify, and up to $5,250 to tenants who are eligible and qualify.

The relocation program for the proposed action would be conducted in accordance with the Federal Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646) and the North Carolina Relocation Assistance Act (GS-133-5 through 133-18). This program is designed to provide assistance to displaced persons in relocating to a

replacement site in which to live or do business. At least one relocation officer is assigned to each highway project for this purpose.

The relocation officer would determine the needs of displaced families, individuals, businesses, non-profit organizations, and farm operations without regard to race, color, religion, sex, or national origin. NCDOT would schedule its work to allow ample time, prior to displacement, for negotiation and possession of replacement housing that meets decent, safe, and sanitary standards. The relocatees are given a 90-day written notice after NCDOT purchases the property.

Relocation of displaced persons would be offered in areas not generally less desirable in regard to public utilities and commercial facilities. Rent and sale prices of replacement housing would be within the financial budget of the families and individuals displaced and would be reasonably accessible to their places of employment. The relocation officer also would assist owners of displaced businesses, non-profit organizations, and farm operations in searching for and moving to replacement property.

All tenant and owner residential occupants who may be displaced would receive an explanation regarding all available options, including: 1) purchases of replacement housing; 2) rental of replacement housing, either private or public; and 3) moving existing owner-occupied housing to another site (if practicable). The relocation officer also would supply information concerning other state or federal programs offering assistance to displaced persons and would provide other advisory services as needed in order to minimize hardships to displaced persons in adjusting to a new location.

Last Resort Housing is a program used when comparable replacement housing is not available, or is unavailable within the displacee's financial means, and the replacement payment exceeds the federal and state legal limitation. The purpose of the program is to allow broad latitudes in methods of implementation by the state so that decent, safe, and sanitary replacement housing can be provided. Since opportunities for replacement housing appear adequate within the study area, it is not likely that the Last Resort Housing Program would be necessary for the proposed project. However, this program would still be considered, as mandated by State law.

4.2.1.2 Combined Direct Relocation Impacts

Table 4-1 combines the Preferred Alternatives for Projects R-2247 and U-2579 with each Detailed Study Alternative for Project U-2579A to show the total relocations for the Winston-Salem Northern Beltway.

Table 4-1: Combined Direct Relocation Impacts – Projects R-2247, U-2579, and U-2579A

Project	Alternative	Residences				Businesses
		Total	Owner-Occupied	Tenant-Occupied[1]	Minority	
R-2247 and **U-2579 Preferred Alternatives** **plus** **U-2579A Detailed Study Alternatives** With (Without) Kernersville Road Interchange	N1-S1	988 (965)	891 (870)	97 (96)	171 (171)	50 (36)
	N1-S2	1,024 (1,002)	925 (904)	99 (98)	173 (168)	47 (34)
	N2-S1 (Preferred Alternative)	**1,019** (942)	**894** (847)	**125** (95)	**155** (169)	**60** (42)
	N2-S2	1,012 (1,009)	914 (912)	98 (97)	182 (172)	49 (40)
	N3-S1	951 (941)	852 (842)	99 (99)	170 (169)	46 (35)
	N3-S2	1,018 (1,008)	917 (907)	101 (101)	191 (170)	44 (33)

Based on 2005 Relocation Reports for Projects U-2579, and U-2579A Preferred Alternatives and 2003 Relocation Reports for Project R-2247 Preferred Alternative and Project U-2579A non-preferred Detailed Study Alternatives.
() Alternative without Kernersville Road Interchange. The Project U-2579A Preferred Alternative includes an interchange at Kernersville Road.
'Bold' indicates Preferred Alternative.
[1] A number of tenant-occupied residences are privately-owned mobile homes. The owners rent space in a mobile-home park, and are thereby considered to be tenants.

4.2.1.3 Relocations - Project R-2247 Detailed Study Alternatives

The following section is summarized from the 1996 Project R-2247 FEIS (Sections 4.1.2 and 4.1.3), and updated where applicable.

Relocations are grouped as residences (owner-occupied, tenant-occupied, minority) and businesses.

Table 4-2 provides a summary of relocations by type for the Project R-2247 Detailed Study Alternatives. Relocations are grouped by Detailed Study Alternatives.

Table 4-2: Residential and Business Relocations – Project R-2247 Detailed Study Alternatives

Detailed Study Alternative	Length (mi)	Residences				Businesses
		Total	Owner-Occupied	Tenant-Occupied*	Minority	
WEST-A	17.22	385	221	164	81	22
EAST-A	16.31	276	229	47	43	5
WEST-B	17.59	408	234	174	82	25
EAST-B	16.68	299	242	57	44	8
C3-WEST-A	16.97	266	246	20	43	7
C2-EAST-A	17.05	340	240	100	54	15
C2-EAST-B	17.43	363	253	110	55	18
Preferred Alternative						
C3-WEST-B – 1992 Functional Design		**289**	**259**	**30**	**44**	**10**
C3-WEST-B – 1995 Preliminary Engineering Design		**258**	**229**	**29**	**37**	**10**
C3-WEST-B - 2002 Preliminary Engineering Design		**252**	**223**	**29**	**37**	**10**

* A number of tenant-occupied residences are privately-owned mobile homes. The owners rent space in a mobile-home park, and are thereby considered to be tenants.
'Bold' indicates Preferred Alternative.
Source: NCDOT Relocation Reports

Residential Relocations. Residential relocations for the Detailed Study Alternatives vary from a low of 266 for Detailed Study Alternative C3-WEST-A, to a high of 408 for Detailed Study Alternative WEST-B based on the 1992 functional engineering design.

Approximately 65 percent of the relocations for the WEST Detailed Study Alternatives (WEST-A, WEST-B, C3-WEST-A, and C3-WEST-B) would occur south of Phillips Bridge Road. Most of these are found in the vicinity of the I-40 and US 421 interchanges. About 65 percent of relocations for the EAST Detailed Study Alternatives (EAST-A, EAST-B, C2-EAST-A, and C2-EAST-B) also would occur south of Phillips Bridge Road. As with the WEST Detailed Study Alternatives, most of these are associated with the major interchanges at I-40 and US 421.

Forsyth County and Winston-Salem are limiting new development within the Preferred Alternative and have been since the identification of the Project R-2247 Preferred Alternative in 1993. Therefore, development since then has occurred primarily within the non-preferred Detailed Study Alternatives. Specifically, as shown on **Figures 2-10(b-c)**, large new residential subdivisions have developed along Segments A3, C2 (same subdivision), B6, and B7. These large subdivisions could not be avoided with minor shifts in segment alignments. All the

Detailed Study Alternatives except C3-WEST-A and the Preferred Alternative use one or more of these segments.

Business Relocations. **Table 4-2** identifies the businesses that may be relocated by the Project R-2247 Detailed Study Alternatives. As shown in **Table 4-2**, the WEST Detailed Study Alternatives (WEST-A. WEST-B, C3-WEST-A, and C3-WEST-B (Preferred)) would affect from 7 to 25 businesses. The EAST Detailed Study Alternatives (EAST-A, EAST-B, C2-EAST-A, C2-EAST-B) would affect from 5 to 15 businesses. These businesses are within right-of-way limits or are denied access in the 1992 functional engineering designs for the Detailed Study Alternatives. This data was considered in the 1993 selection of the Preferred Alternative.

Any changes in business relocations that may have occurred since the 1996 Project R-2247 FEIS likely would involve increases in the number of businesses in the non-preferred Detailed Study Alternatives. No changes in the numbers of businesses impacted by the Preferred Alternative are anticipated since the Preferred Alternative is being protected by the County and Winston-Salem. This conclusion is based on a review of 2002 aerial photography.

4.2.1.4 Relocations - Project R-2247 Preferred Alternative

The NCDOT Relocation Reports were updated for the Preferred Alternative based on the 1995 preliminary engineering design. The updates are shown in **Table 4-2**.

Based on the 1995 preliminary engineering design documented in the 1996 Project R-2247 FEIS, the Preferred Alternative would relocate a total of 258 families and 10 businesses. Of the residential relocations, 229 are owners (89%), 29 are tenants (11%), and 37 are minorities (14%). Copies of the NCDOT Relocation Reports are in **Appendix G**.

The NCDOT Relocation Reports indicated that suitable replacement business sites and residences were available based upon discussions with area realtors, newspaper listings, and visual survey. The availability of suitable business sites and residences was updated on September 9, 2003 and the supplies were found to still be sufficient.

Since the 1996 Project R-2247 FEIS, four changes were made to the Preferred Alternative preliminary engineering design. These changes are described in **Section 2.9.3.4**. Only one of these four changes, a modification to the interchange at Bethania-Tobaccoville Road, affected the number of residential relocations. The Northern Beltway interchange with Bethania-Tobaccoville Road was modified to avoid an adverse effect on the Samuel Stauber House and Barn, a property listed on the National Register of Historic Places (NRHP). Two alternatives to the original design were presented in the *Bethania-Tobaccoville Road Interchange Alternatives Evaluation* (2003) and are summarized in **Section 2.9.3.4.4.**

Design Alternative 2 is the preferred alternative for the Bethania-Tobaccoville Road interchange (see **Section 2.9.3.4.4**). The Design Alternative 2 interchange reduced the residential relocations for the Project R-2247 Preferred Alternative by six for a total of 252 residences (see C3-WEST-B – 2002 in **Table 4-2**). The number of business relocations would remain the same.

4.2.1.5 Relocations – Projects U-2579 and U-2579A

Relocation reports were conducted by NCDOT at the following times:

- September 1994: Project U-2579 Detailed Study Alternatives (relocation reports are in the 1995 DEIS Appendix)
- May 2003: Project U-2579 Preferred Alternative and Project U-2579A Detailed Study Alternatives (see relocation reports in **Appendix G**)
- December 2005: Project U-2579 Preferred Alternative and Project U-2579A Preferred Alternative (see relocation reports in **Appendix G**)

Between 1994 and 2003, the project limits of Project U-2579 (for purposes of the relocation reports) were modified. In 1994, the project limits were from US 52 on the north to south of US 421. In 2003, the project limits were shortened, from US 52 to north of West Mountain Street. The project limits for Project U-2579 in 2005 were extended to the originl limits of US 52 to south of US 421. The project limits for Project U-2579A were changed correspondingly; in 2003 they were from north of West Mountain Street to US 311, and in 2005 they were from south of US 421 to US 311. In other words, the US 421 interchange has moved back and forth between the two projects. The project limits of the Eastern Section and Extension taken together have not changed, and a valid comparison can be made between the 2003 and 2005 values for total relocation impacts associated with the Eastern Section plus Extension.

The total number of residential relocations in Projects U-2579 and U-2579A increased from 479 in 2003 to 761 in 2005. Business relocations increased from 32 in 2003 to 50 in 2005. This increase is primarily due to refinement of the Preferred Alternatives to a more detailed level of design, particularly at interchanges, which indicated larger construction limits and access control. To a lesser extent, the increase reflects additional homes that have been built in the corridor recently. The following sections provide more detail for each of the individual projects.

4.2.1.6 Relocations - Project U-2579 Detailed Study Alternatives

The impacts on residences and businesses by the Project U-2579 Detailed Study Alternatives, including the Preferred Alternative, were originally based on the 1994 functional engineering designs. In May 2003 and December 2005, relocation impacts were updated for the Project U-2579 Preferred Alternative based on the updated preliminary engineering design. The following section is based on the 1995 Project U-2579 DEIS (Sections 4.2.1 and 4.2.2) with revised information as appropriate from the 2003 relocation survey.

Table 4-3 provides a summary of relocations, by type, for the Project U-2579 Detailed Study Alternatives. Residences were identified as either owner-occupied or tenant-occupied, and minorities were distinguished. Relocations were determined for the Eastern and Western Detailed Study Alternatives, as well for the five crossovers. Copies of the original Relocation Reports for each Detailed Study Alternative and the updated Relocation Report for the Preferred Alternative are included in **Appendix G**.

Residential Relocations. Based on the 1994 functional engineering designs, the Detailed Study Alternatives would relocate between 217 and 285 residences. Approximately 40 percent of the relocations occur south of Reidsville Road with 94 relocations near Old Hollow Road south of US 158 and 107 relocations near Hastings Hill Road. The number of relocations for the Preferred Alternative increased from the 217 indicated in the 1995 Project U-2579 DEIS to 452 based on the 2005 survey. This increase is primarily due to refinement of the Preferred Alternative to a more detailed level of design, including detours and interchanges, and to a lesser extent, to the number of homes that have been built in the corridor since 1995.

As a part of the preparation of this document, the Project U-2579 Preferred Alternative was reviewed in the field to determine whether any factors had changed substantially. The Preferred Alternative study area was field-checked for new homes, subdivisions, and public facilities. Detailed Study Alternatives not selected would not have become more desirable, and may have become less desirable, since 1996 due to increased development. Subdivisions and other facilities that existed in 1996 still exist, and more new houses and subdivisions have been constructed. A comparison of 2003 and 2006 aerial photography, using the functional plans for the Detailed Study Alternatives, confirmed that the Preferred Alternative would still have among the lowest number of residential relocations.

Table 4-3: Residential and Business Relocations – Project U-2579 Detailed Study Alternatives

Detailed Study Alternative	Length (mi)	Residences				Businesses
		Total	Owner-Occupied	Tenant-Occupied[1]	Minority	
Western	11.8	260	243	17	25	2
Eastern	13.2	231	184	47	27	4
Alternative 1	12.7	258	205	53	26	4
Alternative 2	12.8	236	218	18	26	4
Alternative 3	13.5	280	225	55	32	2
Alternative 4	13.2	285	259	26	31	2
Alternative 5	13.1	259	209	50	33	3
Alternative 6	12.9	245	227	18	25	2
Alternative 7	**12.4**	**217**	**202**	**15**	**19**	**3**
Alternative 8	12.8	264	243	21	32	3
Preferred Alternative						
W1-W2-W3-C4-E5 (Alternative 7) 1994 Functional Engineering Design	**12.4**	**217**	**202**	**15**	**19**	**3**
W1-W2-W3-C4-E5 (Alternative 7) 2005 Preliminary Engineering Design[2]	**12.4**	**452**	**390**	**62**	**93**	**18**

Impacts based upon the right of way limits for the 1994 functional engineering designs unless otherwise noted.
Source: NCDOT Relocation Reports.
[1] A number of tenant-occupied residences are privately-owned mobile homes. The owners rent space in a mobile-home park, and are thereby considered to be tenants.
[2] Relocations were updated for the Preferred Alternative in December 2005.
'Bold' indicates Preferred Alternative.

No new subdivisions have been constructed within the proposed right of way of the Project U-2579 Preferred Alternative. However, a shift in the alignment to avoid the Mill Creek flood plain would impact several homes on Oakmont Ridge Drive in a newly developed subdivision. Additional detail about the evaluation of the Project U-2579 Preferred Alternative based on current conditions is in **Section 2.11.1.2**. **Figure 2-17(d-e)** show subdivisions and other development in the vicinity of the Project U-2579 Detailed Study Alternatives.

Business Relocations. According to the 1995 Project U-2579 DEIS, the Detailed Study Alternatives would relocate between two and four businesses, depending on the alternative chosen. The Eastern Detailed Study Alternative would take four businesses (Perfection Exhaust, Reynolds Garage, Allied Terminal Systems, Ltd., and a small in-home business); whereas the Western Detailed Study Alternative would take two businesses (Hemrick's Garage and Whitney's Used Cars II). Businesses identified as requiring relocation include those that are within the

right-of-way limits of the Detailed Study Alternatives or those that are denied access. **Table 4-3** lists the number of businesses that would be relocated for each Detailed Study Alternative.

Allied Systems, Ltd. (located on Williston Road between US 311 and Old Walkertown Road) was included as a relocation for the Eastern Detailed Study Alternative and Detailed Study Alternatives 2, 5, and 8. However, it is anticipated that impacts to this business would be limited to the taking of some of the site's parking facilities. At this time, it is unknown if the business can continue operations on the remaining parcel. The facility operates as a rail/trucking distribution center, and is Norfolk Southern's largest auto distribution facility. In 2003, it employed 165 people and handled over 237,000 autos.

Since the 1994 relocation study, the number of businesses that would be relocated by the Preferred Alternative has grown from three to 18. As was the case with residential relocations, the increase is attributable largely to the more detailed level of design, particularly in the area of interchanges. The numbers of relocations for the other alternatives were not updated but it is anticipated that similar growth has occurred in the other Detailed Study Alternatives as well. All of the businesses impacted by the Preferred Alternative have no more than four full- and part-time employees. Details on displaced businesses are in **Appendix G.**

None of the other businesses requiring relocation are critical for overall service and none have more than 50 employees. There also would be ample areas to relocate. Furthermore, there would be a beneficial effect of the Northern Beltway Eastern Section for businesses in the study area due to the ability to serve increased traffic and the improved access to northeastern Forsyth County.

Non-Profit Relocations. Other relocations include the Mount Pleasant Christian Church (formerly Mount Pleasant Holiness Church), which is located on Old Walkertown Road across from Northampton Drive. This church would be relocated by the Western Detailed Study Alternative and Detailed Study Alternatives 1, 6, and 7.

4.2.1.7 Relocations - Project U-2579 Preferred Alternative

The NCDOT Relocation Reports included in the 1995 Project U-2579 DEIS were updated in May 2003 and again in December 2005 for the Preferred Alternative based on the updated preliminary engineering design. **Table 4-3** shows the original relocation results for the Detailed Study Alternatives, and both the original and updated results for the Preferred Alternative. The original and updated Relocation Reports are in **Appendix G**.

Based on the 2005 relocation reports, a total of 18 businesses and one church would be impacted by the Preferred Alternative. In addition, 452 residences and one farm would be displaced. Of the residential relocations, 390 are owners (86 percent), 62 are tenants (14 percent), and 93 are minorities (21 percent). The NCDOT Relocation Report suggested that suitable replacement

business sites and housing are available based on information from the Winston-Salem Journal, realtor.com website, and the MLS realtor service. According to the report, adequate housing would be available if the project is split into phases, although rental housing may present a problem for low income tenants.

4.2.1.8 Relocations - Project U-2579A Detailed Study Alternatives

The impacts of Project U-2579A on residences (owner-occupied, tenant-occupied, minority) and businesses were determined by a relocation survey conducted by NCDOT in May 2003. Relocations were determined for each of the Detailed Study Alternatives. Copies of the Relocation Reports are included in **Appendix G**. **Table 4-4** lists the number of relocations based on the Project U-2579A Detailed Study Alternatives preliminary engineering designs. Relocation impacts were updated in December 2005 for the Preferred Alternative (see **Section 4.2.1.8**), and are also shown in **Table 4-4**.

Table 4-4: Residential and Business Relocations – Project U-2579A Detailed Study Alternatives

Detailed Study Alternative	Length (mi)	Residences				Businesses
		Total	Owner-Occupied	Tenant-Occupied[1]	Minority	
N1-S1	4.4	284 (262)	278 (257)	6 (5)	41 (41)	22 (8)
N1-S2	4.6	320 (298)	312 (291)	8 (7)	43 (38)	19 (6)
N2-S1	4.4	241 (238)	236 (234)	5 (4)	40 (39)	23 (14)
N2-S2	4.6	308 (305)	301 (299)	7 (6)	52 (42)	21 (12)
N3-S1	4.3	247 (237)	239 (229)	8 (8)	40 (39)	18 (7)
N3-S2	4.5	314 (304)	304 (294)	10 (10)	61 (40)	16 (5)
N2-S1 (Preferred Alternative)[2]	**4.4**	**309**	**275**	**34**	**25**	**32**

() Alternative without Kernersville Road interchange. The Project U-2579A Preferred Alternative includes an interchange at Kernersville Road.
'Bold' indicates Preferred Alternative.
Impacts based upon right-of-way limits for the 2002 preliminary engineering designs except where noted.
Source: NCDOT Relocation Reports.
[1] A number of tenant-occupied residences are privately-owned mobile homes. The owners rent space in a mobile-home park, and are thereby considered to be tenants.
[2] Impacts based on 2005 preliminary engineering design and the 2005 Relocation Reports.

Residential Relocations. Based on the 2003 Relocation Reports, the Project U-2579A Detailed Study Alternatives would relocate between 238 and 305 residences without an interchange at Kernersville Road, and between 241 and 320 residences with the interchange. Between approximately 40 percent and 50 percent of the relocations for each alternative are located at the I-40 interchange. The alternatives with the Kernersville Road interchange relocate between 3 and 22 additional residences. The number of relocations for the Preferred Alternative increased from the 241 indicated in the 2003 reports to 309 based on the 2005 survey. This increase, despite the

difference in project limits discussed in **Section 4.2.1.5**, is primarily due to refinement of the Preferred Alternative to a more detailed level of design, including service roads, detours, and interchanges, and to the number of homes that have been built in the corridor since 2003.

Business Relocations. Business relocations include those that are within the right-of-way limits or are denied access according to the 2002 preliminary engineering designs for the Detailed Study Alternatives. Based on the 2003 Relocation Reports, between 5 and 14 businesses would be relocated for Detailed Study Alternatives without an interchange at Kernersville Road. Between 16 and 23 businesses would be relocated for Project U-2579A Detailed Study Alternatives with an interchange at Kernersville Road.

Based on the 2005 reports, 32 businesses would be displaced by Alternative N2-S1, the Preferred Alternative. The numbers of relocations for the other alternatives were not updated but it is anticipated that similar growth has occurred in the other Detailed Study Alternatives as well. The largest impacted business has 10 full-time employees (AC Delco), and most of the other businesses impacted by the Preferred Alternative have no more than three full- and part-time employees. Details on displaced businesses are included in **Appendix G**.

4.2.1.9 Relocations - Project U-2579A Preferred Alternative

The impacts of the Project U-2579A Preferred Alternative on residences (owner-occupied, tenant-occupied, minority) and businesses were estimated by a relocation survey conducted by NCDOT in December 2005. Copies of the Relocation Reports are included in **Appendix G**.

A total of 32 businesses would be impacted by the Preferred Alternative. Of the 309 residential relocations, 275 are owners (89 percent), 34 are tenants (11 percent), and 25 are minorities (8 percent). The NCDOT Relocation Reports conclude that suitable replacement business sites and housing are available. According to the reports, adequate housing would be available if the project is split into phases, although rental housing may present a problem for low income tenants.

4.2.2 Community Services and Facilities

Community services and facilities include schools, churches, cemeteries, fire stations, community centers, libraries, hospitals, parks, and recreation areas.

4.2.2.1 Combined Direct Impacts to Community Services and Facilities

Table 4-5 combines the Preferred Alternatives for Projects R-2247 and U-2579 with each Detailed Study Alternative for Project U-2579A to show the total number of impacted community services and facilities for the Winston-Salem Northern Beltway.

Table 4-5: Combined Direct Impacts to Community Services and Facilities – Projects R-2247, U-2579, and U-2579A

Project	Alternative	Schools	Parks & Recreational Facilities	Churches and Cemeteries	Other Community Facilities
R-2247 and **U-2579 Preferred Alternatives plus U-2579A Detailed Study Alternatives**[1]	N1-S1	1[2]	0	7[4,5,6,7]	0
	N1-S2	1[2]	0	7[3,4,5,7]	0
	N2-S1 (Preferred Alternative)	**1[2]**	**0**	**7[4,5,6,7]**	**0**
	N2-S2	1[2]	0	7[3,4,5,7]	0
	N3-S1	0	0	7[4,5,6,7]	0
	N3-S2	0	0	7[3,4,5,7]	0

Impacts are based on 2005 preliminary engineering designs for the Project R-2247, U-2579, and U-2579A Preferred Alternatives, and are based on the 2002 preliminary engineering designs for the Project U-259A non-preferred alternatives.

[1] Results are the same for Project U-2579A alternatives with or without the Kernersville Road interchange.

[2] Sedge Garden Elementary School; temporary impact from Sedge Garden Road detour.

[3] Piedmont Memorial Gardens; impact to property, but not to existing graves.

[4] Impact to the Gospel Light Christian School and Church property does not impact school or church facilities.

[5] Mount Pleasant Christian Church.

[6] Impact to Christ Temple Church does not impact church facilities.

[7] Impact to the Oak Grove Moravian Church includes relocation of the parsonage, but no impact to church facilities.

'Bold' indicates Preferred Alternative.

4.2.2.2 Community Facilities - Project R-2247 Detailed Study Alternatives

Table 4-6 shows the estimated impacts to schools, parks and recreational facilities, churches, cemeteries, and other facilities such as fire stations and community centers. There are no hospitals or libraries in the vicinity of the Project R-2247 Detailed Study Alternatives. The table lists impacts to facilities that were reported in the 1996 Project R-2247 FEIS and also impacts to facilities that have been built since that time.

Schools. At the time the 1996 Project R-2247 FEIS was prepared, no school properties were located within the right of way of any of the Detailed Study Alternatives. Since then, three public schools have been built in the vicinity of the Detailed Study Alternatives: Meadowlark Elementary, Meadowlark Middle, and Clemmons Middle. One public school, Ronald Reagan High School, opened in August 2005.

Meadowlark Elementary School and Meadowlark Middle School are located within the alignment of the EAST Detailed Study Alternatives (EAST-A, EAST-B, C2-EAST-A, and C2-EAST-B) and would be directly impacted by these alternatives (see **Figure 2-10b**). Clemmons Middle School is near the southern terminus of Project R-2247 (see **Figure 2-10a**). However, Clemmons Middle School is outside of the right of way for all Detailed Study Alternatives and would not be directly impacted.

Table 4-6: Impacts to Community Facilities – Project R-2247 Detailed Study Alternatives

Detailed Study Alternative	Schools		Parks & Recreational Facilities		Churches and Cemeteries		Other Community Facilities	
	Reported in 1996 FEIS	Built after mid-1990s	Reported in 1996 FEIS	Built after mid-1990s	Reported in 1996 FEIS	Built after mid-1990s	Reported in 1996 FEIS	Built after mid-1990s
WEST-A	0	0	1*	0	0	0	1**	0
EAST-A	0	2	0	1	0	0	0	0
WEST-B	0	0	1*	0	0	0	1**	0
EAST-B	0	2	0	1	0	0	0	0
C3-WEST-A	0	0	0	0	0	0	0	0
C2-EAST-A	0	2	1*	1	0	0	0	0
C2-EAST-B	0	2	1*	1	0	0	0	0
Preferred Alternative								
C3-WEST-B	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Impacts are based upon the right-of-way limits from the functional engineering designs.
* City of Winston-Salem Police Department Firing Range on Gun Club Road.
** Community Center at Stoney Bridge Mobile Home Park.
'**Bold**' Indicates the Preferred Alternative.

Ronald Reagan High School is located on the northwest corner of Balsom Road and Transou Road. A portion of the property acquired for Ronald Reagan High School is located within the right of way of the WEST Detailed Study Alternatives (WEST-A, WEST-B, C3-WEST-A, and C3-WEST-B (Preferred)) (see **Figure 2-12g**) However, the developers are aware of the location of the right of way and are keeping the portion of the property within the right of way vacant. As a result, none of the Detailed Study Alternatives would impact the Ronald Reagan High School buildings or function.

Potential indirect impacts to the schools also were evaluated in the 1996 Project R-2247 FEIS. These include the effects of potential additional traffic volumes on local roads, safety issues related to the disruption of pedestrian routes, and traffic-generated noise from the high-speed facility. Potential indirect impacts related to additional traffic on local roads and traffic--generated noise are discussed below. Further discussion of pedestrians can be found in

Section 4.2.3 – Public Safety.

In the 1996 Project R-2247 FEIS (Section 4.4.1), 2015 traffic volumes for the Build and No-Build conditions were compared for roadways adjacent to West Forsyth High School, Southwest Elementary School, Forsyth Country Day School, and Vienna Elementary School, all of which are located in the vicinity of the Detailed Study Alternatives (see **Figure 2-10** for school locations in the Project R-2247 Study Area).

The Detailed Study Alternatives WEST-A, WEST-B, C2-EAST-A, and C2-EAST-B pass east of Southwest Elementary School and West Forsyth High School. The Northern Beltway would decrease, rather than increase, traffic volumes on Lewisville-Clemmons Road in the vicinity of these schools in comparison with the 2015 No-Build conditions.

The WEST Detailed Study Alternatives (WEST-A, WEST-B, C3-WEST-A, C3-WEST-B) pass just east of Forsyth Country Day School and Vienna Elementary School. With interchanges at both Shallowford Road and Yadkinville Road, traffic volumes in front of the schools would increase in comparison with the 2015 No-Build conditions. The remaining four Detailed Study Alternatives would have no adverse effect on these two schools.

As part of the 1996 Project R-2247 FEIS, indirect noise impacts were analyzed for West Forsyth High School, Southwest Elementary School, Forsyth Country Day School, and Vienna Elementary School, all of which are located in the vicinity of the Detailed Study Alternatives.

As discussed in the 1996 Project R-2247 FEIS (Section 4.4.1), the Detailed Study Alternatives' centerlines are a substantial distance from any of these schools. The closest school is Vienna Elementary School, at 1,000 feet from the centerline of the WEST Detailed Study Alternatives (WEST-A, WEST-B, C3-WEST-A, C3-WEST-B (Preferred)). Traffic-generated noise at the schools from these Detailed Study Alternatives would not reach the 67 dBA Leq impact criterion at which noise abatement must be considered. Therefore, none of the Detailed Study Alternatives would have an adverse effect on these four schools.

Since the 1996 FEIS, 2025 traffic volumes have been obtained from the latest traffic model for the Build and No-Build conditions. The 2025 traffic volume on Yadkinville Road in the vicinity of Vienna Elementary School would experience a decrease in traffic volume due to the Northern Beltway. As a result, no indirect noise impacts are expected from Project R-2247 (Western Section) to Vienna Elementary School. The 2025 traffic volumes for roads near the three schools farther from the Detailed Study Alternatives (West Forsyth High School, Southwest Elementary School and Forsyth Country Day School) would remain the same or slightly increase due to the Northern Beltway (see **Section 4.8.2**). Because of the distance from the Northern Beltway and the minimal change in traffic volumes, no indirect noise impacts are expected from Project R-2247 on the three schools.

Parks and Recreational Facilities. The 1996 Project R-2247 FEIS identified one recreational facility that would be impacted by the Detailed Study Alternatives. A weapons firing range on Gun Club Road would be impacted by Detailed Study Alternatives WEST-A, WEST-B, C2-EAST-A, and C2-EAST-B. Bethania Golf Course (privately owned) would be impacted by Segment B9; however, Segment B9 was not used in any of the Detailed Study Alternatives.

Since the time of the 1996 Project R-2247 FEIS, one area of new park land has been purchased that would be impacted by some of the Detailed Study Alternatives. The park is located just south of Meadowlark Elementary and Middle Schools (see **Figure 2-10b**) and would be bisected by the EAST Detailed Study Alternatives (EAST-A, EAST-B, C2-EAST-A, and C2-EAST-B).

No existing greenways or potential greenways are located near the Detailed Study Alternatives in the western portion of the study area. One proposed priority trail, the Tomahawk Creek Greenway Trail, is crossed by all the Detailed Study Alternatives. All other proposed greenways crossed by the Detailed Study Alternatives are considered other proposed trails and include greenways along Reynolds Creek, Muddy Creek, Silas Creek, Grassy Creek, and Little Creek. The Forsyth County Greenway Plan (see **Figure 3-6a**) shows proposed greenways in Forsyth County.

The *Forsyth County Greenway Plan* (Winston-Salem Forsyth County Planning Board, June 2003) distinguishes proposed priority trails as greenways that are planned for development between 2002 and 2015 (*www.cityofws.org/Home/Departments/Transportation/Biking/Articles/BikePlan*) One of the greenways that would be crossed by all the Detailed Study Alternatives is a proposed priority trail located just south of Shallowford Road.

The development of this project would be further coordinated with the City of Winston-Salem and Forsyth County Parks and Recreation Departments to minimize any conflicts with future parks and greenways planning. Following the selection of a Preferred Alternative, provisions would be considered to maintain the future viability of any impacted proposed greenways.

Churches and Cemeteries. The 1996 Project R-2247 FEIS identified no churches or cemeteries within the right of way of the Detailed Study Alternatives. However, according to the 2005 preliminary engineering designs for the Project R-2247 Preferred Alternative, the Pfafftown Baptist Church owns property located within the right of way of the WEST Detailed Study Alternatives (WEST-A, WEST-B, C3-WEST-A, and C3-WEST-B (Preferred Alternative)) (see **Figure 2-12g**) .

Pfafftown Baptist Church owns two parcels that would be impacted by the WEST Detailed Study Alternatives; a four-acre parcel fronting Transou Road and a 15-acre parcel abutting the smaller

parcel to the north and west. Pfafftown Baptist Church is located on the four-acre parcel fronting Transou Road. The 15-acre parcel is mostly vacant, but does have two outbuildings on it. These outbuildings are located at the back of the church parking lot.

The right of way limits of the WEST Detailed Study Alternatives impact 10.7 acres of the 15-acre parcel, and would impact one of the buildings located on the parcel. The right of way limits of the WEST Detailed Study Alternatives impact 0.13 acres of the four-acre parcel, impacting approximately six parking spaces and an area of the parking lot painted as a basketball half-court at the northwest corner of the parking lot, but would not impact the church itself. The nearest right-of-way limits pass approximately 150 feet from the church.

Because the WEST Detailed Study Alternatives would pass behind the church, impacts to traffic operations and church access are not anticipated.

Other Community Facilities. The 1996 Project R-2247 FEIS identified one community facility in Detailed Study Alternatives WEST-A, WEST-B, C2-EAST-A, and C2-EAST-B. The community center is located off Peace Haven Road on the north side of I-40 within the Stoney Brook Mobile Home Park. The interchange of these Detailed Study Alternatives with I-40 would displace the community center, along with a large number of residences at Stoney Brook.

The 1996 Project R-2247 FEIS identified no fire stations within the right of way of the Detailed Study Alternatives. Since the time of the 1996 Project R-2247 FEIS, one fire station has been built. The Mt. Tabor Fire Station would not be impacted by any of the Detailed Study Alternatives.

4.2.2.3 Community Facilities - Project R-2247 Preferred Alternative

The 2005 preliminary engineering design for the Project R-2247 Preferred Alternative would impact the property of one community facility; Pfafftown Baptist Church. The Project R-2247 Preferred Alternative right of way would impact an outbuilding and a portion of the parking lot owned by Pfafftown Baptist Church, but would not impact the church itself or access to the church. The Project R-2247 Preferred Alternative also would impact one proposed priority greenway trail south of Shallowford Road.

The development of this project has been coordinated with the City of Winston-Salem and Forsyth County Parks and Recreation Departments to minimize any conflicts with future parks and greenways planning. During final design, provisions will be considered to maintain the future viability of any impacted proposed greenways.

4.2.2.4 Community Facilities- Project U-2579 Detailed Study Alternatives

Table 4-7 summarizes the estimated impacts to schools, park and recreational facilities, churches and cemeteries, and other facilities such as fire stations, community centers, and libraries by the Project U-2579 Detailed Study Alternatives. There are no hospitals or clinics in the vicinity of the Project U-2579 Detailed Study Alternatives. The table lists impacts to facilities that were reported in the 1995 Project U-2579 DEIS, as well as impacts to facilities that have been built since that time. Community facilities are shown on **Figures 2-17d and e**. Community facilities that would be impacted by both Project U-2579 and Project U-2579A are described under Project U-2579A (**Section 4.2.2.6**).

Schools. No school facilities would be taken by any of the Project U-2579 Detailed Study Alternatives (see **Figures 2-17d and e**).

At the time of the 1995 Project U-2579 DEIS, based on the 1994 functional engineering designs, the Eastern Section Detailed Study Alternatives and Detailed Study Alternatives 2 and 7 passed approximately 200 feet from the property line of the Gospel Light Christian School, located on Gospel Light Church Road between Old Belews Creek Road and Walkertown-Guthrie Road (S12 on **Figure 2-17e**). However, based on the 2005 preliminary engineering designs, Alternative 7 (Preferred Alternative) would cross 3.3 acres of property. The right of way would pass approximately 850 feet from school buildings and would not impact any playground facilities. It is anticipated that similar design changes would have been made for the non-preferred Detailed Study Alternatives.

The Western Detailed Study Alternative and Detailed Study Alternatives 1, 6, and 7, would pass approximately 550 feet from the edge of the Ibraham Elementary School property. Ibraham Elementary School is located at the intersection of Old Walkertown Road and Davis Road (S6 on **Figure 2-17e**).

Since the Detailed Study Alternatives pass behind Gospel Light Christian School and Ibraham Elementary School, school traffic operations would not be impacted. In addition, there are no proposed interchanges in the vicinity of the schools, so there should be no substantial increase in traffic in the vicinity of the schools as a result of the proposed project.

Table 4-7: Impacts to Community Facilities – Project U-2579 Detailed Study Alternatives

Detailed Study Alternative	Schools		Parks & Recreational Facilities		Churches and Cemeteries		Other Community Facilities	
	Reported in 1995 DEIS	Impacts identified since mid-1990s	Reported in 1995 DEIS	Impacts identified since mid-1990s	Reported in 1995 DEIS	Impacts identified since mid-1990s	Reported in 1995 DEIS	Impacts identified since mid-1990s
Western	0	0	0	0	0	3[1,2]	0	0
Eastern	0	0	0	0	0	1[1]	0	0
Alternative 1	0	0	0	0	0	1[2]	0	0
Alternative 2	0	0	0	0	0	3[1]	0	0
Alternative 3	0	0	0	0	0	0	0	0
Alternative 4	0	0	0	0	0	2[1]	0	0
Alternative 5	0	0	0	0	0	0	0	0
Alternative 6	0	0	0	0	0	3[1,2]	0	0
Alternative 7	**0**	**0**	**0**	**0**	**0**	**4[1,2]**	**0**	**0**
Alternative 8	0	0	0	0	0	2[1]	0	0
Preferred Alternative								
W1-W2-W3-C4-E5 (Alternative 7) 1994 Functional Engineering Design	**0**	**0**	**0**	**0**	**0**	**4[1,2]**	**0**	**0**

Impacts are based upon the right-of-way limits for the 1994 functional engineering designs.
Source: NCDOT Relocation Reports.
[1] Impact to property but no impact to school or church buildings or cemetery.
[2] Mount Pleasant Christian Church; built in 1992, but not identified during the Project U-2579 DEIS relocation survey.
'**Bold**' Indicates the Preferred Alternative.

Parks and Recreational Facilities. No land from any public park, wildlife refuge, or existing greenway would be taken by any of the Project U-2579 Detailed Study Alternatives (see **Figures 2-17d and e**).

No existing greenways would be impacted by the Detailed Study Alternatives. The 2015 Greenway Plan (see **Figure 3-6a**) shows several proposed greenways. The Eastern Detailed Study Alternative would cross the least (three) proposed greenways (located along Kerners Mill Creek north of US 421/I-40 Business, along Lowery Mill Creek northwest of US 158, and along Mill Creek north of Day Road). The Western Detailed Study Alternative would cross the most (four) proposed greenways (located along Kerners Mill Creek north of US 421/I-40 Business, along Lowery Mill Creek southeast of US 158, along an unnamed tributary to Mill Creek west of Dippen Road, and along Mill Creek south of NC 66). Crossover 4 also would cross one proposed greenway (located along Lowery Mill Creek northwest of US 158).

The *Forsyth County Greenway Plan* (Winston-Salem Forsyth County Planning Board, June 2003) distinguishes proposed priority trails as greenways that are planned for development between 2002 and 2015 (*www.cityofws.org/Assets/CityOfWS//Documents/Planning/Publications/GreenwayPlan.pdf*) One of the proposed greenways that would be crossed by all of the alternatives is a proposed priority trail near US 421/I-40 Business.

The development of this project would be further coordinated with the City of Winston-Salem and Forsyth County Parks and Recreation Departments to minimize any conflicts with future parks and greenways planning.

Churches and Cemeteries. At the time the 1995 Project U-2579 DEIS was prepared, no churches were located within the right of way of any of the Detailed Study Alternatives (see **Figure 2-17(d-e**). Although the property for Mount Pleasant Christian Church (formerly Mount Pleasant Holiness Church) was purchased in 1992 and the church was open before 1995, the church is located in a small building behind a house, and was not identified as a church during the Project U-2579 DEIS relocation survey. The Mount Pleasant Christian Church is located on Old Walkertown Road across from Northampton Drive (C44 on **Figure 2-17e**). The Western Detailed Study Alternative and Detailed Study Alternatives 1, 6, and 7 would require relocation of Mount Pleasant Christian Church.

A number of churches and cemeteries located near the Detailed Study Alternatives were described in Section 4.1.4 of the 1995 Project U-2579 DEIS. The churches that were adjacent to non-preferred Detailed Study Alternatives but would not be impacted by the Preferred Alternative include Hickory Ridge United Methodist Church (C16 on **Figure 2-17d**), Northside Baptist Church (C20 on **Figure 2-17d**), Crusade for Christ Baptist Church (C40 on **Figure 2-17e**), Mt. Olive United Methodist Church and Cemetery (C41 on **Figure 2-17e**), Harvest Baptist Church (C54 on **Figure 2-17e**), and an unnamed cemetery (C9 on **Figure 2-17d**) on Stanleyville Drive between Broad Street and Germanton Road. Impacts on churches by the Preferred Alternative right of way are described in the following paragraphs.

At the time of the 1995 Project U-2579 DEIS, based on the 1994 functional engineering designs, the Eastern Section Detailed Study Alternatives and Detailed Study Alternatives 2 and 7 passed approximately 200 feet from the property line of the Gospel Light Christian School, located on Gospel Light Church Road between Old Belews Creek Road and Walkertown-Guthrie Road (C52 on **Figure 2-17e**). However, based on the 2005 preliminary engineering designs, Alternative 7 (Preferred Alternative) would cross 3.3 acres of property. The right of way would impact two houses owned by the church, is 750 feet from the cemetery, and is 850 feet from any church buildings. It is anticipated that similar design changes would have been made for the non-preferred Detailed Study Alternatives. This property impact is counted in the Churches and Cemeteries column of **Tables 4-7 and 4-5** and not in the Schools column of those tables.

First Baptist Church of Stanleyville on Ziglar Road east of University Parkway (C12 on **Figure 2-17d**) is 600 feet from Segment W1 (Western Detailed Study Alternative and Detailed Study Alternatives 2, 4, 6, 7, and 8). Based on the 1994 functional engineering design in the 1995 Project U-2579 DEIS, these Detailed Study Alternatives would not impact this property. However, based on the Project U-2579 Preferred Alternative 2005 preliminary engineering designs, Virginia Lake Road would be widened to provide access to residents, impacting 0.21 acres of church property and passing 250 feet from the church buildings. It is anticipated that similar design changes would have been made to the non-preferred Detailed Study Alternatives.

Widening of NC 66 and Germanton Road associated with Segment W1 (Western Detailed Study Alternative and Detailed Study Alternatives 2, 4, 6, 7, and 8) would cross 1.5 acres of property of Bethany Baptist Church, located on Germanton Road at NC 66 (C18 on **Figure 2-17d**). The right of way limits for the widening of NC 66 and Germanton Road would pass approximately 50 feet from the church buildings. Based on the 1994 functional engineering design in the 1995 Project U-2579 DEIS, these Detailed Study Alternatives would not impact this property. However, based on the Project U-2579 Preferred Alternative 2005 preliminary engineering designs, the widening of NC 66 would result in 1.5 acres of impacts to the Bethany Baptist Church property. It is anticipated that similar changes would have been made to the non-preferred Detailed Study Alternatives.

Oak Grove Moravian Church on Old Walkertown Road near Northampton Drive (C45 on **Figure 2-17e**) is 200 feet from Segment W3 (Western Detailed Study Alternative and Detailed Study Alternatives 1, 6, and 7).

Old Fashion Baptist Church on Stanleyville Road north of Old Hollow Road (C10 on **Figure 2-17d**) is 450 feet from Segment W1 (Western Detailed Study Alternative and Detailed Study Alternatives 2, 4, 6, 7, and 8).

Holy Ghost Miracle Church on Old Walkertown Road west of Northampton Road (C43 on **Figure 2-17e**) is 600 feet from Segment W3 (Detailed Study Alternatives 1, 7, and the Western Detailed Study Alternative).

The Mecum Cemetery (C53 on **Figure 2-17e**) is located on Old Belews Creek Road south of Reidsville Road. The Segment E5 right of way (Eastern Detailed Study Alternative and Detailed Study Alternatives 2 and 7) passes 300 feet from the edge of the parcel containing the cemetery.

The Ogburn Cemetery (C17 on **Figure 2-17d**) is located on Germanton Road south of NC 66. The Segment W1 right of way (Western Detailed Study Alternative and Detailed Study Alternatives 2, 4, 6, 7, and 8) passes 50 feet from the edge of the parcel containing the cemetery.

Other Community Facilities. All the Project U-2579 Detailed Study Alternatives, including the Preferred Alternative, would provide a positive impact on police and fire protection, emergency vehicle access, and school transportation in the form of improved traffic service. **Figure 2-17(d-e)** shows community facilities for the Detailed Study Alternatives. Segment W4 (Detailed Study Alternatives 1, 3, 4, and the Western Detailed Study Alternative) would pass approximately 500 feet from the City View Fire District #17 Fire Station located on Old Belews Creek Road just east of US 158 (F7 on **Figure 2-17e**). At this location, Old Belews Creek Road is not proposed to have a grade-separation, which would cut off the fire station's access to the east. However, the proposed interchange between the Beltway and US 158 is approximately 1,600 feet away from the fire station which may improve access to other areas.

4.2.2.5 Community Facilities - Project U-2579 Preferred Alternative

All community facilities for the Preferred Alternative are shown on **Figure 2-22(a-i)**.
The Project U-2579 Preferred Alternative would require the relocation of the Mount Pleasant Christian Church, located on Old Walkertown Road across from Northampton Drive (**Figure 2-22e**). This church is in a minority neighborhood and its attendance consists primarily of minorities.

While the Preferred Alternative would require a small amount of property from the Gospel Light Baptist Church and School (see **Figure 2-22f**), no impacts to the school or church buildings would occur, although two houses owned by the church would be impacted by the right of way. This was confirmed by a conversation with the maintenance supervisor of the church and school in August 2004. Since it passes behind the schools, school traffic operations would not be impacted. In addition, there are no proposed interchanges in the vicinity, so there should be no substantial increase in traffic in the vicinity of the schools as a result of the proposed project. The impact to the Gospel Light Baptist Church and School property is counted in the Churches and Cemeteries column of **Tables 4-7 and 4-5** and not in the Schools column of those tables.

First Baptist Church of Stanleyville on Ziglar Road east of University Parkway (**Figure 2-22a**) is 600 feet from Segment W1 (Western Detailed Study Alternative and Detailed Study Alternatives 2, 4, 6, 7, and 8). With these alternatives, Virginia Lake Road would be widened to provide access to residents, impacting 0.21 acres of church property and passing 250 feet from the church buildings.

Widening of NC 66 and Germanton Road would cross 1.5 acres of property of Bethany Baptist Church, located on Germanton Road at NC 66 (**Figure 2-22b**). The right-of-way limits for the widening of NC 66 and Germanton Road would pass approximately 50 feet from the church buildings.

The Oak Grove Moravian Church parsonage is within the right of way of the Project U-2579 Preferred Alternative but not within the construction limits. The specific impacts will be

minimized if possible during final design. It may be possible to relocate the parsonage to a different area on the same property.

The Preferred Alternative would cross one proposed priority trail (greenway), located near US 421/I-40 Business.

4.2.2.6 Community Facilities - Project U-2579A Detailed Study Alternatives

Table 4-8 summarizes the estimated impacts to schools, park and recreational facilities, churches and cemeteries, and other community facilities. There are no hospitals, clinics, police stations, or fire stations in the vicinity of the Project U-2579A Detailed Study Alternatives. **Figure 2-19** shows community facilities in the Project U-2579A study area. Impacts are the same for alternatives with or without the Kernersville Road interchange.

Table 4-8: Impacts to Community Facilities – Project U-2579A Detailed Study Alternatives

Detailed Study Alternative	Schools	Parks & Recreational Facilities	Churches and Cemeteries	Other Community Facilities
N1-S1	1[1]	0	2[2,4]	0
N1-S2	1[1]	0	2[2,3]	0
N2-S1 (Preferred Alternative)	**1[1]**	**0**	**2[2,4]**	**0**
N2-S2	1[1]	0	2[2,3]	0
N3-S1	0	0	2[2,4]	0
N3-S2	0	0	2[2,3]	0

Impacts are based upon right-of-way limits for the 2002 preliminary engineering designs.
Source: NCDOT Relocation Reports.
Results are the same for alternatives with or without the Kernersville Road interchange.
[1]Sedge Garden Elementary School; temporary impact to property but no impact to school buildings.
[2]Pisgah United Methodist Church; impact to property but no impact to church or cemetery.
[3]Piedmont Memorial Gardens; impact to property, but not to existing graves.
[4] Impact to Christ Temple Church does not impact church facilities.
'Bold' indicates Preferred Alternative.

Schools. The Project U-2579A Detailed Study Alternatives would not impact any schools. Sedge Garden Elementary School is located along Sedge Garden Road near Kernersville Road between the N1 and N2 Detailed Study Alternatives and the N3 Detailed Study Alternatives. However, the proposed construction limits for the Sedge Garden Road detour for Segments N1 and N2 (with and without the Kernersville Road interchange) would impact approximately 0.35 acres of school property, but would be approximately 60 feet from any buildings and would not impact any playground facilities.

All of the northern alternative segments would cross approximately 2,800 feet from the property line of East Forsyth High School, which is also in the vicinity of the Project U-2579 Segment W5 (Western Detailed Study Alternative and Detailed Study Alternatives 1, 3, 4, 5, 6, and 8) (S9 on

Figure 2-17e). The alternatives would pass over West Mountain Street, which currently serves East Forsyth High School, so school traffic operations would not be impacted.

Parks and Recreational Facilities. No land from any public park, wildlife refuge, or existing greenway would be taken by any of the Detailed Study Alternatives, including the Preferred Alternative (see **Figure 2-19**).

The Project U-2579A Detailed Study Alternatives would not impact any existing or proposed greenways shown in the 2015 Greenway Plan (see **Figure 3-6a**). The *Forsyth County Greenway Plan* (Winston-Salem Forsyth County Planning Board, June 2003) distinguishes proposed priority trails as greenways that are planned for development between 2002 and 2015 (Forsyth County website,
www.cityofws.org/Assets/CityOfWS//Documents/Planning/Publications/GreenwayPlan.pdf).
None of the proposed priority trails (greenways) would be crossed by any of the Detailed Study Alternatives.

Sedge Garden Park is located approximately 65 feet from the 2002 preliminary engineering designs of all Detailed Study Alternatives near the project's southern terminus.

The development of this project has been coordinated with the City of Winston-Salem and Forsyth County Parks and Recreation Departments to minimize any conflicts with future parks and greenways planning. During final design, provisions will be considered to maintain the future viability of any impacted proposed greenways.

Churches and Cemeteries. There are no impacts to churches from the Project U-2579A Detailed Study Alternatives. All of the northern alternative segments would impact approximately 0.01 acres of property of Pisgah United Methodist Church and Cemetery, which is also within the vicinity of the Project U-2579 Segment E5 (Eastern Detailed Study Alternative and Detailed Study Alternatives 2 and 7) (C60 on **Figure 2-17e**). The church is located approximately 275 feet from the northern segments' rights of way, and the cemetery is located approximately 100 feet from the edge of the right of way.
Glenview Baptist Church is located on Oak Grove Road at Glenn Hi Road, and is approximately 825 feet from the Segment S2 right of way. Segment S2 impacts approximately 1.9 acres of Piedmont Memorial Gardens, a cemetery located on US 311 at Piedmont Memorial Drive. There are currently no graves within the proposed right of way.

Christ Temple Church is located south of US 311 on Cole Road at Thamer Road. Segment S1 impacts approximately 1.61 acres of the church property, and is approximately 280 feet from the nearest church building.

4.2.2.7 Community Facilities - Project U-2579A Detailed Study Alternatives

All community facilities for the Preferred Alternative are shown on **Figure 2-23(a-d)**.

The Project U-2579A Detailed Study Alternatives would not impact any schools. Sedge Garden Elementary School is located along Sedge Garden Road near Kernersville Road. The proposed construction limits for the Sedge Garden Road detour would impact approximately 0.35 acres of Sedge Garden Elementary School property, but would be approximately 60 feet from any buildings and would not impact any playground facilities. The Preferred Alternative would cross approximately 2,800 feet from the property line of East Forsyth High School. It would pass over West Mountain Street, which currently serves East Forsyth High School, so school traffic operations would not be impacted.

No land from any public park, wildlife refuge, or existing greenway would be taken by any of the Detailed Study Alternatives, including the Preferred Alternative. The Preferred Alternative would not impact any existing or proposed greenways shown in the 2015 Greenway Plan (see **Figure 3-6a**). Sedge Garden Park is located approximately 65 feet from the 2002 preliminary engineering designs of all Detailed Study Alternatives near the project's southern terminus.

There are no impacts to churches from the Preferred Alternative. It would impact approximately 0.01 acres of property of Pisgah United Methodist Church and Cemetery. The church is located approximately 275 feet from the rights of way, and the cemetery is located approximately 100 feet from the edge of the right of way. Christ Temple Church is located south of US 311 on Cole Road at Thamer Road. The Preferred Alternative impacts approximately 1.61 acres of the church property, and is approximately 280 feet from the nearest church building.

4.2.3 Public Safety

4.2.3.1 Public Safety - Project R-2247 Detailed Study Alternatives

Fog. Dense fog can occur at certain times of the year along the major drainages in western Forsyth County, including the Yadkin River, Muddy Creek, Silas Creek, and Peters Creek. However, the frequency of foggy conditions is low. In the Winston-Salem/Greensboro/High Point Triad Area, the National Climatic Data Center recorded an average of 32.4 foggy days per year between 1927 and 1999 at the Greensboro Airport (State Climate Office of North Carolina Website, *http://www.nc-climate.ncsu.edu/climate/greensboro.html,* accessed July 7, 2004).

In the 1996 Project R-2247 FEIS, it was stated "if operations on the Northern Beltway are found to be adversely affected by fog, NCDOT would consider the use of an automatic detection and warning system. A decision to use such a system for this project likely would occur during the final design of the roadway or after operations commence on the facility."

This statement from the 1996 Project R-2247 FEIS is consistent with NCDOT's normal operating procedures. NCDOT does not have a written policy regarding procedures for designing projects in fog-prone areas. Projects are studied on a case-by-case basis, typically after a project has been constructed. For example, NCDOT evaluated the conditions on the I-95 bridge over the Roanoke River near Roanoke Rapids. In this location, NCDOT installed a weather station to assess weather conditions, such as fog, and to prompt a variable message sign warning travelers of thick fog and limited visibility. Additional devices used to enhance safety in fog-prone areas can include flat grades, reflective pavement markers, and lighting (Steve Smallwood, NCDOT Roadway Design, Personal Communication, March 29, 2001).

Existing freeway facilities that cross major drainages and could be affected by area fog include I-40, US 421, US 52, and Silas Creek Parkway. None of these facilities, nor any other State-maintained roadways in the Piedmont Triad, has fog safety devices installed (Steve Smallwood, NCDOT Roadway Design, Personal Communication, March 29, 2001).

Because there are no major facilities in the region with fog-safety devices, there is no reason to conclude these devices should be incorporated into the design of the Project R-2247 Detailed Study Alternatives or the Preferred Alternative at this time. In accordance with NCDOT normal operating procedures, fog-related safety issues are evaluated on a case-by-case basis and installed where warranted.

4.2.3.2 Public Safety - Project R-2247 Preferred Alternative

Fog. The above discussions regarding fog also apply to the Project R-2247 Preferred Alternative.
Schools. In the 1996 Project R-2247 FEIS, it was stated "Mitigation options to reduce the effects of the project on schools include the design of interchange ramps to maintain unbroken pedestrian access along one side of the road (a half-clover interchange), the use of signalized intersections with pedestrian controls at the interchange ramps, the construction of pedestrian overpasses across the facility, and the construction of noise and visual barriers between the school grounds and the highway." Because of the mitigation issue addressed in the 1996 Project R-2247 FEIS regarding school pedestrians and the close proximity of Forsyth Country Day School and Vienna Elementary School to the Preferred Alternative, further research was conducted on the Preferred Alternative's potential safety impact on children walking to and from school.

Two schools, Vienna Elementary School (1975 Chickasha Road, Pfafftown, NC 27040) and Forsyth Country Day School (5501 Shallowford Road, Lewisville, NC 27023-0549) are near the Project R-2247 Preferred Alternative. **Figure 2-10** shows the locations of the schools and the adjacent neighborhoods. In order to determine if pedestrians at these schools would be impacted by the Preferred Alternative, Steve McGinnis, the principal of the Vienna Elementary School was

contacted on April 20, 2006 and Andrea Matney, Chief Financial Officer at Forsyth Country Day School was contacted on April 6, 2006.

Principal McGinnis stated there is one student currently walking to school. This student will be attending Vienna Elementary for two more years, but walks from Chickasha Drive and would not cross the Winston-Salem Northern Beltway. Vienna Elementary is in a rural setting with most of the students living more than 1½ miles from school. Winston-Salem/Forsyth County Board of Education Policy 3541 states bus transportation would be provided for students who live more than 1½ miles from their school. However, there is a neighborhood under construction on Yadkinville Road across from the school that may have students who would walk to school. Pedestrian access from this neighborhood to the school would not be affected by the Project R-2247 Preferred Alternative because pedestrians from this neighborhood would not have to cross the interchange of Yadkinville Road and the proposed Northern Beltway to access the school. Additionally, a reduction of traffic volumes is expected on Yadkinville Road, which may increase pedestrian safety on Yadkinville Road. If pedestrian safety is an issue for these students, the Winston-Salem/Forsyth County Board of Education Policy 3541 states bus transportation may be routed to pick up students who live closer than 1½ miles if they face hazardous walking conditions, such as traffic.

Ms. Andrea Matney, Chief Financial Officer at Forsyth Country Day School, stated there are currently no students walking to the school. There are neighborhoods within walking distance off of Shamrock Trail and Shady Brook Lane near the school where potential students could possibly live in the future, but pedestrians from these neighborhoods would not have to cross the interchange of Shallowford Road and the proposed Beltway. Ms. Matney mentioned that students may attend the school from a new neighborhood under construction, the Brookberry Farm development. Although students coming from this neighborhood would have to cross the Shallowford Road interchange to get to the school, it is unlikely that students will walk because the development is over two miles from the school.

4.2.3.3 Public Safety - Project U-2579 Detailed Study Alternatives

Fog. Public safety issues related to fog discussed in the previous section (**Section 4.2.3.1**) for Project R-2247 also would apply to Project U-2579. Because there are no major facilities in the region with fog-safety devices, there is no reason to conclude these devices should be incorporated into the design of the Project U-2579 Detailed Study Alternatives or the Preferred Alternative at this time. In accordance with NCDOT normal operating procedures, fog-related safety issues are evaluated on a case-by-case basis and installed where warranted.

Schools. Detailed Study Alternatives 2, 7, and the Eastern Detailed Study Alternative would cross 4.4 acres of property from the Gospel Light Baptist Church and Christian School. All access for the church and school is onto Walkertown-Guthrie Road to the east and Snyder Road

to the north. No impacts are anticipated for pedestrians or drivers accessing the church and school site.

4.2.3.4 Public Safety - Project U-2579 Preferred Alternative

Fog. The above discussions regarding fog also apply to the Project U-2579 Preferred Alternative.

Schools. The Gospel Light Baptist Church and School is the primary facility in the vicinity of the Preferred Alternative with potential public safety concerns. Issues related to Gospel Light are discussed above in **Section 4.2.3.3**.

4.2.3.5 Public Safety - Project U-2579A Detailed Study Alternatives and Preferred Alternative

Fog. Public safety issues related to fog discussed in the previous section for Project R-2247 (**Section 4.2.3.1**) also would apply to Project U-2579A. Because there are no major facilities in the region with fog-safety devices, there is no reason to conclude these devices should be incorporated into the design of the Project U-2579A Detailed Study Alternatives (including the Preferred Alternative) at this time. In accordance with NCDOT normal operating procedures, fog-related safety issues are evaluated on a case-by-case basis and installed where warranted.

Schools. As a part of Segments N1 and N2 (with and without the Kernersville Road interchange), Sedge Garden Road would be temporarily detoured during construction of an overpass at the intersection of the Northern Beltway and Sedge Garden Road. The southern end of the detour merges into the existing street alignment between the existing access points of the circular driveway in front of Sedge Garden Elementary School (S3 on **Figure 2-19**), crossing the north exit. This may result in a minor temporary impact to drivers utilizing the circular driveway, and pedestrians crossing Sedge Garden Road in front of the school. Alternative N2-S1, the Preferred Alternative, would have this temporary impact on drivers and pedestrians accessing Sedge Garden Elementary School.

4.2.4 Community Cohesion

4.2.4.1 Community Cohesion - Project R-2247 Detailed Study Alternatives

The following section is from the 1996 Project R-2247 FEIS (Sections 4.2.1.1 and 4.2.1.2).

Incorporated Communities. Shaded areas on **Figure 1-2** indicate the incorporated limits of the City of Winston-Salem, the Village of Clemmons, and the communities of Lewisville, Rural Hall, Tobaccoville, and Bethania.

Winston-Salem's city limits are crossed by all Project R-2247 Detailed Study Alternatives near the project terminus at South Stratford Road, by the EAST Detailed Study Alternatives (EAST-A, EAST-B, C2-EAST-A, and C2-EAST-B) at I-40, and by the southernmost interchange at US 52 (Detailed Study Alternatives WEST-B, EAST-B, C3-WEST-B and C2-EASt-B), where the interchange ramps south of the NC 66 Connector would be located within the city limits.

The interchange at I-40 used by Detailed Study Alternatives WEST-A, WEST-B, C2-EAST-A, and C2-EAST-B would require the use of land within the Village of Clemmons near Gun Club Road.

The Town of Lewisville limits are crossed by the interchange ramps at Shallowford Road and the westward relocation of Ketner Road due to this interchange. The city limits of Rural Hall would be crossed by the northernmost interchange at US 52 (Detailed Study Alternatives WEST-A, EAST-A, C3-WEST-A, and C2-EAST-A) and the routing of the Eastern Section of the Northern Beltway from US 52 to beyond University Parkway (NC 66). At the southernmost interchange with US 52 (Detailed Study Alternatives WEST-B, EAST-B, C3-WEST-B, and C2-EAST-B), interchange ramps north of the NC 66 Connector would be located within the limits for Rural Hall.

Neighborhoods. The alternative route planning process, environmental planning process, and environmental impact study have given high priority to the avoidance and minimization of neighborhood disruption during the definition, evaluation, and selection of the project corridors and alternative routes. The initial land suitability mapping process identified residential areas and natural and historic resources in the study area. Alternatives were laid out to achieve a balance between impacts to residential developments and sensitive, regulated natural and cultural features, such as wetlands, floodplains, schools, and historic resources. Substantial impacts to neighborhoods could not be avoided by the Detailed Study Alternatives because of the density of existing development in proximity to sensitive natural and historic resources in key geographic areas, such as along I-40 and US 421, and in Pfafftown.

The neighborhoods affected by the Detailed Study Alternatives are listed in **Table 4-9** and are based on the 1992 functional designs. The number of neighborhoods impacted by the Detailed Study Alternatives range from nineteen for Detailed Study Alternative EAST-A to twenty-six for Detailed Study Alternative WEST-B. The type of effect ranges from the total displacement of a neighborhood (listed as category 'F' in **Table 4-9**) to the relocation of homes along the edge of a neighborhood (listed as category 'A' in **Table 4-9**).

Since the 1996 Project R-2247 FEIS, several subdivisions have developed along the non-preferred Detailed Study Alternatives. These are included in **Table 4-9** and discussed below.

Springfield Farm Road. This recent development is located between US 421 and Peace Haven Road, just northwest of Muddy Creek and east of West Forsyth High School (see **Figure 2-10a**). This new neighborhood would be impacted by Detailed Study Alternatives WEST-A, WEST-B, C2-EAST-A, and C2-EAST-B. These four Detailed Study Alternatives would have a severe impact to this neighborhood, resulting in numerous relocations, neighborhood isolation impacts, and access impacts. It is likely Springfield Farm Road would be grade-separated from the Beltway, providing access to the adjacent schools for the homes in the neighborhood east of the Detailed Study Alternatives.

Ashlyn Drive and Century Oaks Lane. These recent developments are located off of Meadowlark Drive just south of Robinhood Road (SR 1348) and north of Meadowlark Middle School (see **Figure 2-10b**). Homes in the southern neighborhood are accessed by Ashlyn Drive. Homes in the northern neighborhood are accessed by Century Oaks Lane. Detailed Study Alternatives EAST-A, EAST-B, C2-EAST-A, and C2-EAST-B, traverse these neighborhoods. These four Detailed Study Alternatives would severely impact the two neighborhoods, resulting in relocations, neighborhood isolation impacts, and potential access impacts.

Lochurst Drive Neighborhood Expansion. This newly developed area, accessed by Waterway Drive and Peter Pfaff Drive, is an extension of the Lochurst neighborhood. It is within the Pfafftown Historic District boundaries (**Figure 2-10c**). The same types of impacts would apply as noted in **Table 4-9** for the Lochurst neighborhood. The numbers of relocations would be greater now that the development has expanded.

Table 4-9: Affected Neighborhoods – Project R-2247 Detailed Study Alternatives

Segment	Description of Affected Neighborhood	Type of Effect (Updated Effect)*	Detailed Study Alternative							
			WEST -A	EAST-A	WEST -B	EAST-B	C3-WEST -A	C2-EAST-A	C3-WEST-B (Preferred Alternative)	C2-EAST-B
A1	West Park – mobile homes on Stratford Road (US 158) *This mobile home park no longer exists, so no impacts would occur under any Detailed Study Alternative*	--								
	Edgewood Farms – Lockwood Drive south of Rockingham Drive	D (D)	●	●	●	●	●	●	●	●
A2	Ploughboy Lane (SR 1136)	E	●		●			●		●
	Buddy Lane (Jonestown Manor)	A	●		●			●		●
	Silas Creek Road (SR 1211)	A	●		●			●		●
	Stoney Brook – mobile home park on Peace Haven Rd	A	●		●			●		●
A3	Holder Road (SR 1145)	E	●		●					
	Moravian Heights – Moravian Heights Lane	D	●		●					
	Lewisburg Point Drive	A	●		●					
	Southwest Acres, south – Marty Lane (SR 1261)	D	●		●					
	Southwest Acres, north – Kinney Road (SR 1146)	D	●		●					
	Phillips Bridge Road (SR 1152)	E	●		●					
	Springfield Farm Road - *new neighborhood since 1996 Project R-2247 FEIS*	(E)	●		●					
A4	Bradford Place – Bradford Place Lane	A (A)	●		●		●		●	
	Ketner Road (SR 1316)	D (D)	●		●		●		●	
	Allgood Road (SR 1431)	F (F)	●		●		●		●	
	Tomahawk Road (SR 1552)	A (B)	●		●		●		●	
	Lake Forest - Floral Lane	A (D)	●		●		●		●	
	Grenada Estates - El Camino Dr	D (B)	●		●		●		●	
	Dorchester – Millstone Lane (SR 3275)	D (E)	●		●		●		●	
	Roberts Road	D (D)	●		●		●		●	
B2	McGregor Park - McGregor Park Dr	D (D)		●		●	●		●	
	McGregor Manor – McGregor Downs Lane	D (D)		●		●	●		●	

Table 4-9: Affected Neighborhoods – Project R-2247 Detailed Study Alternatives

Segment	Description of Affected Neighborhood	Type of Effect (Updated Effect)*	Detailed Study Alternative							
			WEST-A	EAST-A	WEST-B	EAST-B	C3-WEST-A	C2-EAST-A	C3-WEST-B (Preferred Alternative)	C2-EAST-B
	Moravian Heights – Moravian Heights Lane	A (A)		●		●	●		●	
	Southwest Acres, south – Marty Lane (SR 1261)	A (A)		●		●	●		●	
B3	Ridings Road (SR 1146)	A		●		●		●		●
	Valleystream Farms, Applecross – Valleystream Road, Buckhorn Road (SR 3592)	D		●		●		●		●
B6	Glenbrook Estates – Ashlyn Drive (SR 1572)	A		●		●		●		●
	Fleetwood Circle (SR 1427)	D		●		●		●		●
	Meadowlark Drive and Century Oaks Lane - *new neighborhood since 1996 Project R-2247 FEIS*	(A)		●		●		●		●
B7	Buckingham Park – Wessex Road (SR 1862)	A		●		●		●		●
	Pinehill Drive (SR 1522)	D		●		●		●		●
	Lochurst – Lochurst Drive	A		●		●		●		●
	Grandview Estates – Rock Hill Road	A		●		●		●		●
	Simpson Forest – Poplar Lane	C		●		●		●		●
	Walker Mobile Home Park – Bethania-Tobaccoville Road (SR 1611)	F		●		●		●		●
B8	Myers Road (SR 1629)	C (C)			●	●			●	●
	Forest Village – Village Oak Drive (SR 3949)	A (A)			●	●			●	●
	Creekview – Vestal Road (SR 1774)	A (A)			●	●			●	●
B10	Northwest Acres – Nylon Drive (SR 1815)	A (none)			●	●			●	●
	Winsville Heights – Stanleyville Manor Ave (SR 1666)	A (A)			●	●			●	●
C1	Ploughboy Lane (SR 1136)	E (E)		●		●	●		●	
	McGregor Road south of I-40 (SR 1137)	D (D)		●		●	●		●	

Table 4-9: Affected Neighborhoods – Project R-2247 Detailed Study Alternatives

Segment	Description of Affected Neighborhood	Type of Effect (Updated Effect)*	Detailed Study Alternative							
			WEST-A	EAST-A	WEST-B	EAST-B	C3-WEST-A	C2-EAST-A	C3-WEST-B (Preferred Alternative)	C2-EAST-B
C2	Holder Road (SR 1145)	C						●		●
	Moravian Heights	A						●		●
	Southwest Acres, south – Marty Lane (SR 1261)	A						●		●
	Springfield Farm Road - *new neighborhood since 1996 Project R-2247 FEIS*	(E)						●		●
C3	Ridings Road (SR 1146)	A (C)					●		●	
	Phillips Bridge Road (SR 1152)	D (E)					●		●	
	Nottingham – Ellington Drive (SR 3552)	D (A)					●		●	
C4	Walker Mobile Home Park – Bethania-Tobaccoville Road (SR 1611)	F (F)	●		●		●		●	
C5	Myers Road (SR 1629)	C	●	●			●	●		
ESNB-A	Falconbridge	A								

EFFECT: A – Relocation of homes on end of road or at edge of neighborhood. No access beyond Beltway.
B – Similar to Effect A, but bridge provided across Beltway.
C – Relocation in midst of neighborhood. Isolation of homes and no access across Beltway.
D – Similar to Effect C, but new access routes provided to neighborhood. No local access across Beltway.
E – Similar to Effect C, but bridge provided across Beltway.
F – Total displacement of a neighborhood.

Note: In the 1996 Project R-2247 FEIS, these neighborhoods were identified as affected by the project based upon the DEIS functional designs for all Detailed Study Alternatives, including the Preferred Alternative.

*Effects for the Preferred Alternative were updated based on the 2005 preliminary design and also the new development that has occurred after the 1996 Project R-2247 FEIS. Effects for the non-preferred Detailed Study Alternatives were updated based on the new development that has occurred after the 1996 Project R-2247 FEIS.

4.2.4.2 Community Cohesion - Project R-2247 Preferred Alternative

The Preferred Alternative passes within the incorporated limits of Winston-Salem, Lewisville, and Rural Hall. It would not impact any community facilities or bus routes.

A total of twenty-four neighborhoods would be affected by the Project R-2247 Preferred Alternative. **Table 4-9** shows impacts disclosed in the 1996 Project R-2247 FEIS and the updated impacts. Updates are based on the 2005 preliminary engineering design and include development occurring after the 1996 Project R-2247 FEIS. The types of effect range from the total displacement of a neighborhood (Category 'F'), to the relocation of homes along the edge of a neighborhood (Category 'A').

Impacts to the Walker Mobile Home Park would be unavoidable. The Walker Mobile Home Park is located on the west side of Bethania-Tobaccoville Road, north of Kapp Road and south of Wide Country Road (see **Figure 2-12**). The redesign of the Bethania-Tobaccoville Road interchange reduced the residential impacts in this community from all of them (nine) to seven. Moving the Beltway alignment south would impact the historic Samuel Stauber House and Barn. Shifting the Beltway alignment north would result in higher numbers of residential impacts since the alignment would pass through the Wide County Road development.

The owner of the mobile home park attended the public workshop held on February 25, 2002, and inquired about relocating the homes in the park to another area of the parcel. The parcel of land where the mobile home park is located may be large enough to accommodate the mobile homes in another area. If an alternative is selected that impacts the Walker Mobile Home Park, NCDOT would implement its relocation policies (see **Section 4.2.1.1**) to determine the feasibility of relocating the homes to another area of the parcel.

4.2.4.3 Community Cohesion - Project U-2579 Detailed Study Alternatives

The following section is from Section 4.1.3 of the *1995 Project U-2579 DEIS*. **Figure 4-1a** shows the general location of subdivisions referenced throughout the text for the Project U-2579 study area. **Table 4-10** summarizes the impacts on neighborhoods by the Project U-2579 Detailed Study Alternatives.

Much of the study area through which the alternatives pass is currently rural, with scattered suburban development. The alternatives were selected in part to minimize impacts to subdivisions and neighborhoods by using undeveloped land and skirting the borders of developed areas wherever possible.

The primary impacts to subdivisions would be in the area immediately adjacent to US 421/I-40 Business. This area is relatively heavily developed, and designing an alternative that would not impact existing development was not possible.
The Western Detailed Study Alternative is located about 1,500 feet southwest of Dogwood Trails Subdivision and passes within 150 feet southeast of Temora Lakes Estates Subdivision. It is located about 700 feet northeast of Northchester Subdivision and about 600 feet southeast of Oakwood Estates Subdivision. The Western Detailed Study Alternative is located about 400 feet southeast of Creekwood Acres Subdivision and about 850 feet east of Williston Subdivision. It passes about 750 feet southeast of Wildwood Estates Subdivision. It would directly impact Twin Oak Estates Subdivision. The Western Detailed Study Alternative would impact residences in the Doe Run Subdivision and would require the taking of the community pool facilities. It also would impact the mobile home park just north of US 421/I-40 Business. The Western Detailed Study Alternative is about 1,100 feet southeast of the Windsor Park Subdivision.

The Eastern Detailed Study Alternative would directly impact a mobile home park located at University Parkway. It is located about 200 feet north of Pinebrook Valley Subdivision and about 100 feet north of Remington Ridge Subdivision. This alternative also would directly impact the southern edge of Scarlet Acres Subdivision. The Eastern Detailed Study Alternative would pass through the Willowbrook Subdivision, impacting the northeast edge of the subdivision. It is located about 900 feet northeast of Wildwood Estates Subdivision and directly impacts Martin Acres, passing through the edge of the subdivision. The Eastern Detailed Study Alternative is located about 1,000 feet southwest of Kings Court Subdivision. Near the terminus at US 421/I-40 Business, a mobile home park would be directly impacted approximately 400 feet from the Willowbend Subdivision. This alternative goes through the western edge of the Windsor Park Subdivision, directly impacting this expanding development. The Eastern Detailed Study Alternative is located approximately 2,400 feet east of Doe Run Subdivision. The proposed interchange at I-40 Business would substantially impact High Meadows Subdivision located south of US 421/I-40 Business.

Crossover 1 directly impacts Eastwood Subdivision and passes approximately 1,500 feet south of Oakwood Estates Subdivision. Crossover 2 does not involve any subdivisions. Crossover 3 is located about 700 feet west of Scarlet Acres Subdivision. Crossover 4 is located about 400 feet north of Wildwood Estates Subdivision and 300 feet southwest of Martin Acres Subdivision. Crossover 5 is located about 900 feet east of Twin Oak Estates Subdivision.

In evaluating the impact on community cohesion, changes in travel patterns and accessibility were examined. All intersecting roads would be grade separated, or alternative means of access would be provided. All construction alternatives would increase overall southeast-northwest accessibility within the study area.

Table 4-10: Affected Neighborhoods – Project U-2579 Detailed Study Alternatives

Segment	Description of Affected Neighborhood	Type of Effect (Updated Effect)*	Detailed Study Alternative						
			Western Alt.	Eastern Alt.	Crossover 1	Crossover 2	Crossover 3	Crossover 4	Crossover 5
E1	Dogwood Trails Subdivision	--	●						
E1	Temora Lakes Estates Subdivision	--	●						
W2	Northchester Subdivision	--	●						
W3, C1	Oakwood Estates Subdivision	--	●		●				
W3	Creekwood Acres Subdivision	--	●						
W4	Williston Subdivision	--	●						
W4 C5	Twin Oak Subdivision	A --	●						●
W5	Doe Run Subdivision	A	●						
E5, W5	Mobile home park north of US 421/I-40 Business	A	●	●					
E5, W5	Windsor Park Subdivision	-- (A)	●	●					
E1	Mobile Home Park – University Parkway	A		●					
E1	Pinebrook Valley Subdivision	--		●					
E3	Remington Ridge Subdivision	--		●					
E4	Willowbrook Subdivision	A		●					
E5, C4	Wildwood Estates Subdivision	--		●				●	
E4 C4	Martin Acres	A --		●				●	
E5	Kings Court Subdivision	--		●					
E5	High Meadows Subdivision	--		●					
C1	Eastwood Subdivision	A			●				
C3	Scarlet Acres Subdivision	--					●		
W5	New development – south of West Mountain Street near Hastings Hill Road	-- (A)	●						
E1	New development on Stanleyville Road north of Old Hollow Road	-- (A)		●					

EFFECT: A – Relocation of homes on end of road or at edge of neighborhood. No access beyond Beltway.
-- No relocations necessary.

Note: Originally, these neighborhoods were identified as affected by the project based upon the 1994 functional engineering designs. The designs would be revised a number of times for the Preferred Alternative prior to construction, and impacts to specific neighborhoods may change. This listing is provided only to assist in the selection of a preferred alternative. All intersecting roads impacting affected neighborhoods would be grade separated, or alternative means of access would be provided.

*Updated Effects were identified based on the ***2005*** preliminary design for the Preferred Alternative.

Since the 1995 Project U-2579 DEIS, several subdivisions have developed in the study area. Two of these new subdivisions are impacted by some of the Detailed Study Alternatives. One-third (approximately 30 lots) of a new development located south of West Mountain Street near Hastings Hill Road would be impacted by Detailed Study Alternatives 1, 3, 4, 5, 6, 8, and the Western Detailed Study Alternative. One-third (approximately 30 lots) of a second new development, located along Stanleyville Road north of Old Hollow Road, would be impacted by Detailed Study Alternatives 1, 3, 5, and the Eastern Detailed Study Alternative.

4.2.4.4 Community Cohesion - Project U-2579 Preferred Alternative

Subdivisions in the Project U-2579 study area are shown on **Figure 4-1a**. The Preferred Alternative is located about 1,500 feet southwest of Dogwood Trails Subdivision and passes within 150 feet southeast of Temora Lakes Estates Subdivision. The Preferred Alternative is located about 700 feet northeast of Northchester Subdivision and about 600 feet southeast of Oakwood Estates Subdivision. The Preferred Alternative is located about 400 feet southeast of Creekwood Acres Subdivision and about 850 feet east of Williston Subdivision and about 400 feet north of Wildwood Estates Subdivision.

The Project U-2579 Preferred Alternative directly impacts Martin Acres, passing through the edge of the subdivision. It is located about 1,000 feet southwest of Kings Court Subdivision. Near the terminus at US 421/I-40 Business, a mobile home park is directly impacted approximately 400 feet from the Willowbend Subdivision. Also at the US 421/I-40 Business terminus, the Project U-2579 Preferred Alternative disrupts the tip of the Windsor Park Subdivision and would result in approximately eight homes lost and two homes separated from the rest of the subdivision. The Project U-2579 Preferred Alternative would impact residences and the pool facilities on the edge of Doe Run Subdivision and would substantially impact High Meadows Subdivision located south of US 421/I-40 Business. The Project U-2579 Preferred Alternative would not impact any of the new subdivisions that have been developed since the 1995 Project U-2579 DEIS. However, a shift in the alignment to avoid the Mill Creek flood plain would impact several homes on Oakmont Ridge Drive in a newly developed subdivision.

The Beltway would affect the connectivity of roads serving residential and commercial developments. North of the University Parkway interchange, Tickle Road would become a cul-de-sac because of its proximity to the interchange. A new connector road would provide access from Tickle Road to Webster Road, with Webster Road realigned to line up with Bray Street. Similarly, the entrance to a mobile home park north of the interchange would be cut off. The mobile home park would be connected to Bray Street with a new road. South of the interchange, both Stanleyville Manor Court and Mathbus Drive would become cul-de-sacs, but the subdivisions would be connected to Ziglar Road by Virginia Lake Road, which would be extended to Stanleyville Manor. Old Hollow Road would be relocated to tie to University

Parkway south of the interchange. East of Baux Mountain Road, Phelps Drive would be severed, with a cul-de-sac on each side of the Beltway. Based on 2005 preliminary engineering designs, Northampton Drive would be severed at Old Walkertown Road. With that design, residents would have access to Old Walkertown Road either via existing residential streets or via New Walkertown Road to either Carver School Road or Williston Road. NCDOT has reassessed the design of this intersection since the preliminary engineering designs and intends to maintain a connection from Northampton Road to Old Walkertown Road. The final design will be developed based on design constraints and cost considerations. Morris Road would be severed just north of the Winchester subdivision, which would continue to have access at Walkertown Guthrie Road.

No bus routes would be impacted by the Preferred Alternative.

4.2.4.5 Community Cohesion - Project U-2579A Detailed Study Alternatives

Subdivisions in the Project U-2579A study area are shown on **Figure 4-1b**, and are summarized in **Table 4-11**. All three northern segments of the Detailed Study Alternatives would slightly impact the Amersham Subdivision, which currently abuts US 421/I-40 Business. The northern segments also would all directly impact the High Meadows Subdivision, which is located on Hastings Hill Road at Bluff School Road. Segment N3 is located 700 feet west of the proposed Hastings Hill Farms Subdivision and 800 feet west of King's Forest Subdivision. The Oak Ridge Place Subdivision is located south of Kernersville Road, and is impacted by Segments N2 and N3. Meredith Subdivision and Oakhill Place Subdivision would both be impacted by all of the Detailed Study Alternatives (northern segments N1, N2, N3).

The Glenn Village Subdivision, which is currently under construction, would be impacted by Segment S2. The Glenn Meadow Subdivision is located 500 feet from Segment S2. Yeaton Glen Subdivision is 500 feet east of Segment S1 and 700 feet west of Segment S2. Segment S2 is 1,100 feet west of the Glenn Acres Subdivision. Glenn Landing Subdivision abuts Segment S1 on the west, and is slightly impacted by Segment S2 on the east. A mobile home park is located approximately 500 feet west of Segment S1. Forest Trails Subdivision and Hickory Creek Subdivision are adjacent to US 311, and are within approximately 200 feet of the southern segments (S1, S2).

With the new Beltway interchange at US 311, the adjacent interchanges would require modification to provide adequate spacing between ramps. With Alternatives N1-S1, N2-S1 (Preferred Alternative), and N3-S1, the Ridgewood Road interchange would be modified from a diamond interchange to a half-clover interchange, with all ramps on the west side of Ridgewood Road. All existing movements would be provided, although some would use loops and would therefore be slightly less direct. A more substantial change would occur with Alternatives N1-S2,

N2-S2, and N3-S2. Because the interchange with US 311 would be very close to the existing interchange at Union Cross Road, that interchange would be closed and traffic for Union Cross Road would have to use the High Point Road interchange, approximately 1.4 miles to the southeast. Thus, traffic destined to Union Cross Road from the Beltway or from central Winston-Salem would have to travel almost three additional miles. Traffic from the direction of High Point on US 311 would have much less of a diversion.

The Beltway also would impact the connectivity of several roads within the study area. As a freeway, no direct access would be provided and access would only be provided at the designated interchanges. Further, not all roads crossed would be provided with grade separations. Some roads that are currently continuous would be severed and alternative routes would be needed. The major roads (other than subdivision streets) that would be severed by the Project U-2579A include Hastings Hill Road (all alternatives), Old Winston Road (Alternatives N2-S1 (Preferred Alternative), N2-S2, N3-S1, N3-S2), Sedge Garden Road (N3-S1 and N3-S2), and High Point Road (all alternatives). Oak Grove Road would be severed near I-40 by all interchanges, as well as between I-40 and Kernersville Road by Alternatives N2-S1 (Preferred Alternative), N2-S2, N3-S1, and N3-S2. In addition, the southern portion of Linville Road would be relocated by Alternatives N1-S1 and N1-S2, but access would continue to be provided.

Severing roads would result in longer travel times and distances for some local residents. The alternatives to using Hastings Hill Road would either be Kernersville Road and US 421/I-40 Business or Sedge Garden Road. The alternative to Old Winston Road would be Kernersville Road. The alternative to Oak Grove Road across I-40 would be Union Cross Road or High Point Road. The alternative to High Point Road would be Glenn Hi Road or US 311 via Union Cross Road or Ridgewood Road.

4.2.4.6 Community Cohesion – Project U-2579A Preferred Alternative

One of the reasons for selecting the Preferred Alternative for Project U-2579A was that it had less of a community cohesion impact than other alternatives (see **Section 2.11.2**). Following selection of the Preferred Alternative, NCDOT developed and evaluated mitigation strategies for community impacts. Mitigation options for lessening community cohesion impacts included bridging for access across the Northern Beltway and providing new access routes if bridging is not practical. The Preferred Alternative was modified to include grade separations at Pisgah Church Road, Hastings Hill Road, and High Point Road. It was not feasible to include a grade separation at Oak Grove Church Road; however, the widening of Union Cross Road across I-40 as part of TIP Project U-4909 has been extended to Sedge Garden Road to provide additional capacity crossing I-40 to help mitigate the loss of crossing at Oak Grove Church Road.

Table 4-11: Affected Neighborhoods – Project U-2579A Detailed Study Alternatives

Segment(s)	Description of Affected Neighborhood	Type of Effect	Detailed Study Alternative					
			N1-S1	N1-S2	N2-S1 *(Preferred Alternative)*	N2-S2	N3-S1	N3-S2
N1, N2, N3	Amersham Subdivision	A	●	●	●	●	●	●
N1, N2, N3	High Meadows Subdivision	A	●	●	●	●	●	●
N3	Hastings Hill Farms Subdivision	--					●	●
N3	King's Forest Subdivision	--					●	●
N2, N3	Oak Ridge Place Subdivision	A			●	●	●	●
N1, N2, N3	Meredith Subdivision	A	●	●	●	●	●	●
N1, N2, N3	Oakhill Place Subdivision	A	●	●	●	●	●	●
S2	Glenn Village Subdivision	A		●		●		●
S2	Glenn Meadow Subdivision	--		●		●		●
N1, N2, N3	Yeaton Glen Subdivision	--	●	●	●	●	●	●
S2	Glenn Acres Subdivision	--		●		●		●
N1, N2, N3	Glenn Landing Subdivision		●	●	●	●	●	●
N1, N2	Mobile Home Park	--	●	●	●	●		
S1, S2	Forest Trails Subdivision	--	●	●	●	●	●	●
S1, S2	Hickory Creek Subdivision	--	●	●	●	●	●	●

EFFECT: A – Relocation of homes on end of road or at edge of neighborhood. No access beyond Beltway.
-- No relocations necessary.

Results are the same with or without the Kernersville Road interchange.

4.2.4.7 Community Cohesion Mitigation

Mitigation has also been incorporated into the Preferred Alternatives for Projects R-2247 and U-2579. Examples of access provisions already included in the 2005 preliminary engineering designs include providing reconnection of Millstone Lane to Skylark Road (see **Figure 2-12f**). Further mitigation for community impacts will be included in final design.

4.2.5 Environmental Justice

Legislative Background. Federal laws and regulations require the evaluation of effects of transportation actions on minority and low-income groups. These groups traditionally have not actively participated in the decision-making process.

Impacts to individuals are covered through Title VI of the 1964 Civil Rights Act, which requires that Federal agencies ensure that no person is excluded from participation in, denied the benefit of, or subjected to discrimination under any program or activity that receives federal financial assistance on the basis of his/her race, color, national origin, age, sex, disability, or religion.

This protection is expanded to communities through the Federal-aid Highway Act of 1970 (23 CFR Section 109 (h)), which emphasizes the equitable treatment of communities being affected by transportation projects. This act requires the consideration of the anticipated effect of proposed transportation projects on residences, businesses, accessibility of public facilities, tax base, and other community resources.

The need to identify low-income and minority populations and include them in the project's decision-making process gained greater emphasis as a result of Executive Order 12898, Federal Actions to Address Environmental Justice in Minority and Low Income Populations (February 11, 1994). This order directs all federal agencies to determine whether a proposed action would have an adverse or disproportionate impact on minority and/or low-income populations.

Federal Highway Administration (FHWA) guidelines regarding environmental justice are contained in *FHWA Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (December, 1998). This publication serves as guidance for analysis in compliance with Executive Order 12898 and defines Low-Income/Minority Population as:

> "any readily identifiable group of low-income/minority persons who live in geographic proximity, and, if circumstances warrant, geographically dispersed/transient persons (such as migrant workers or Native Americans) who would be similarly affected by a proposed FHWA program, policy, or activity."

Analysis. Based on the 2000 Census Data, the percentages of non-white population in the western portion of the study area (13 percent), eastern portion of the study area (29 percent), and entire study area (23 percent) are less than in Forsyth County (32 percent) (see **Table 3-3**).

The highest concentration of minority population within the entire study area occurs in the eastern portion of the study area. The percent of white residents in the eastern portion of the study area is slightly higher than the county average (74 percent versus 68 percent). Three block groups with approximately 60 percent black or other minority populations are located along the west side of the Project U-2579A Detailed Study Alternatives. The Project U-2579 Preferred Alternative, as well as the Western Detailed Study Alternative and Detailed Study Alternatives 1 and 6, intersects with approximately 0.30 acres of Block Group 3002.1, whose population is 13 percent white.

Overall, the project study area has a lower percentage of population living in poverty (6 percent) compared to the County as a whole (11 percent). The highest concentration of population living in poverty is located in the eastern portion of the study area (Census Tract 3401 Block Group 1). Approximately 50 acres of this block is located within the right of way of one of the Project U-2579A Detailed Study Alternatives.

The construction of Project R-2247, Project U-2579, and Project U-2579A along any of the Detailed Study Alternatives would result in the displacement of some minority residents. The degree to which this displacement would take place is addressed in **Section 4.2.1.2**. As summarized in **Table 4-4**, between 17.4 percent and 19.6 percent of residential relocations are estimated to be minority for Project U-2579A Detailed Study Alternatives with an interchange at Kernersville Road, and between 17.2 percent and 18.7 percent are estimated to be minority for Detailed Study Alternatives without the Kernersville Road interchange. These values are below the county-wide averages for these populations.

A review of the 2000 Census Data was conducted for neighborhoods where some relocations would occur within the Project R-2247 and Project U-2579 Preferred Alternatives and within the right of way for the U-2579A Detailed Study Alternatives. This review supports the finding of no disproportionate adverse impacts to minority and low-income communities. These neighborhoods are listed in **Table 4-12,** along with the population characteristics of the 2000 Census block(s) that most closely correspond to the neighborhood/subdivision boundaries. As shown in **Table 4-12**, none of the neighborhoods affected by the Project R-2247 Preferred Alternative are disproportionately minority or in poverty when compared to the County-wide population. Due to the relative homogeneity in the population in the western portion of the study, it is expected that none of the Detailed Study Alternatives would disproportionately impact minority or low-income communities.

The three neighborhoods (Grubbs Street, Northchester, and Eastwood) impacted by the Project U-2579 Preferred Alternative that have a slightly higher percent of low-income residents are all within the same block group (29.01-1), which is located south of Old Hollow Road (NC 66) between Old Rural Hall Road and Baux Mountain Road. The Project U-2579 Preferred Alternative impacts a total of 130 acres within Tract 29.01, including approximately 60 residential lots that are a part of one of the three neighborhoods listed. **Figure 2-22(a-i)** shows the locations of the streets referenced in **Table 4-12**.

The three neighborhoods (Presley Drive, Piedmont Memorial Drive, and Swaim Road) impacted by the Project U-2579A Detailed Study Alternatives that have a higher percent of low-income residents than the county as a whole are a part of Block Group 34.02-1, which is bounded by Ridgewood Road and High Point Road near US 311. Approximately 110 acres of Tract 34.02 would be impacted by either of the southern segments, including seven residential lots for Segment S1 and 14 residential lots for Segment S2. **Figure 2-19** shows the locations of the streets referenced by **Table 4-12**.

There is one potentially impacted neighborhood with a significantly higher percent of non-white residents (North Oaks). The Project U-2579 Preferred Alternative would affect less than ten lots in the North Oaks subdivision, located in the southeast corner of Northampton Drive and Old Walkertown Road (see **Figure 2-22e**). In addition, two neighborhoods have a slightly higher proportion of non-white residents than the county as a whole: White Oak Drive and Shellharbour Boulevard, which are both part of Block Group 2807.1. The White Oak Drive subdivision has a population that is 33.3 percent non-whites, and the Shellharbour Boulevard subdivision has a population that is 36.4 percent non-white.

Table 4-12: Characteristics of Neighborhoods Affected by Preferred Alternatives for Project R-2247 or Project U-2579 or the Detailed Study Alternatives for Project U-2579A

Neighborhood Description	Census Tract	Census Blocks	Total Population	Neighborhood Characteristics	
				% Non-White	% Below Poverty*
Forsyth County	--	--	**306,607**	**32%**	**11%**
Project R-2247 Preferred Alternative					
Edgewood Farms – Lockwood Drive south of Rockingham Drive	38.02	3011, 3012, 3013, 3018	63	1.6%	2.7%
Bradford Place – Bradford Place Lane	40.08	3000, 3001, 3002, 3018, 3019, 3020, 3021	788	8.8%	3.3%
Ketner Road (SR 1316)	40.08	1002, 1010, 1011	71	1.4%	6.9%
Allgood Road (SR 1431)	40.08	1000	101	10.9%	6.9%
Tomahawk Road (SR 1552)	41.01	4000, 4007	407	7.9%	3.3%
Lake Forest - Floral Lane	41.01	4000	278	8.3%	3.3%

Table 4-12: Characteristics of Neighborhoods Affected by Preferred Alternatives for Project R-2247 or Project U-2579 or the Detailed Study Alternatives for Project U-2579A

Neighborhood Description	Census Tract	Census Blocks	Total Population	Neighborhood Characteristics	
				% Non-White	% Below Poverty*
Grenada Estates	41.01	2006	297	11.8%	.75%
Dorchester – Millstone Lane (SR 3275)	41.01	2001	242	8.3%	.75%
Roberts Road	41.01	1001, 1002, 1003, 1006, 1007	110	0%	2.5%
	28.01	3018			
McGregor Park	39.04	2026, 2028, 2029	220	10.9%	10.9%
McGregor Manor	38.02	2021, 2023	187	20.8%	4.8%
Moravian Heights	40.06	1000, 1006, 1007, 1008, 1009	1018	14.2%	3.3%
Southwest Acres, south – Marty Lane (SR 1261)	40.06	1000, 1006, 1007, 1008, 1009	1018	14.2%	3.3%
Myers Road (SR 1629)	28.05	3048, 3049, 3054, 3055, 3056, 3057, 3058, 3059, 3065, 3066, 3067, 3068	20	0%	4.2%
Forest Village – Village Oak Drive (SR 3949)	28.05	4000, 4001, 4002	195	23.6%	4.2%
Creekview – Vestal Road (SR 1774)	28.05	4000, 4001, 4002	195	23.6%	4.2%
Northwest Acres – Nylon Drive (SR 1815)	28.06	2006, 2009, 2013	320	33.7%	9.3%
Winsville Heights – Stanleyville Manor Avenue (SR 1666)	28.06	2007, 2010, 2011	100	3.0%	9.3%
Ploughboy Lane (SR 1136)	38.02	2024, 2025, 2026, 2027, 2031, 2033	93	12.9%	4.8%
McGregor Road south of I-40 (SR 1137)	38.02	2009, 2017, 2018, 2022, 2030	404	27%	4.8%
Ridings Road (SR 1146)	40.08	2027, 2028	316	3.5%	1.1%
Phillips Bridge Road (SR 1152)	40.08	2021, 2022, 2023, 2025, 2026	388	9.3%	1.1%
Nottingham – Ellington Drive (SR 3552)	40.08	2021, 2026	127	4.7%	1.1%
Walker Mobile Home Park – Bethania-Tobaccoville Road (SR 1611)	28.01	3007, 3008, 3023, 3024, 3025, 3026	336	5.1%	2.9%
Project U-2579 Preferred Alternative					
Stanleyville Manor Avenue (SR 1666)	28.06	2006, 2007, 2009, 2010	177	13.6%	9.3%
Clayton Acres – Stanleyville Drive (SR 1920)	28.06	2001, 2003, 2004, 2005, 2018	615	28.1%	9.3%
Phelps Circle (SR 1925)	28.07	1002, 1009, 1010, 1013, 1014, 1015, 1016, 1017, 1018	735	29.8%	4.0%

Table 4-12: Characteristics of Neighborhoods Affected by Preferred Alternatives for Project R-2247 or Project U-2579 or the Detailed Study Alternatives for Project U-2579A

Neighborhood Description	Census Tract	Census Blocks	Total Population	Neighborhood Characteristics	
				% Non-White	% Below Poverty*
Shellharbour Boulevard (SR 2175)	28.07	1002, 1005, 1006, 1007, 1008, 1021	828	36.4%	4.0%
R.M. Cox Subdivision - Rock Springs Drive (SR 2202)	28.06	2000, 2019, 2020, 2021, 2022	234	8.5%	9.3%
Pinebrook Manor - Twin Oak Drive (SR 2055)	29.01	2031, 2032, 3033, 3000, 3001	297	19.5%	8.8%
White Oak Drive (SR 1928)	28.07	1002, 1019, 1020	624	33.3%	4.0%
Grubbs Street	29.01	1000, 1001, 2028	347	15.9%	11.1%
Northchester – Karen Circle (SR 2208)	29.01	1002, 1003, 1004, 100	120	28.3%	12.4%
Eastwood - Dolphin Drive (SR 2527)	29.01	1000, 1010, 1011, 1012, 1013	368	16.3%	12.4%
Phelps Drive (SR 2085)	29.02	4017, 4018, 4019, 4020, 4021	336	13.1%	5.1%
Creekwood Acres - Webster Street (SR 1665)	29.02	1076, 1077, 1078, 1079, 1080, 1083, 1084, 1090, 1091, 1092	468	26.9%	8.1%
North Oaks - Northampton Drive (SR 1605)	30.02	1000, 1001, 2007, 2008, 2009	462	74.5%	3.6%
West Road (SR 2413)	30.01	3041, 3042, 3045, 3046, 3048	482	6.2%	0.9%
Regents Park Road (SR 4214)	30.01	2006, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2020, 2021	836	5.1%	4.1%
Willowbend - Doe Run Drive (SR 4290)	30.01	2025, 2026, 2027, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2055, 2088	766	19.7%	4.1%
Doe Run - Doe Run Drive (SR 4290)	30.01	2042, 2057, 2058, 2059, 2060, 2066, 2067, 2069, 2072	146	6.2%	4.1%
Gerry Drive (SR 2825)	30.01	2061, 2062, 2063, 2065	145	0.7%	4.1%
Hastings Hill Road (SR 2667)	33.07	1011, 1014, 1019	187	10.2%	4.1%
Bluff School Road (SR 4280)	30.01	2005, 2006, 2008, 2009, 2010, 2011, 2089, 2090, 2091, 2093	695	11.7%	4.1%
Project U-2579A Detailed Study Alternatives					
School View Drive (SR 4217)	33.08	2050, 2055, 2057	124	12.9%	1.6%
Motsinger Drive (SR 2833)	33.03	3001	291	12.7%	4.7%

Table 4-12: Characteristics of Neighborhoods Affected by Preferred Alternatives for Project R-2247 or Project U-2579 or the Detailed Study Alternatives for Project U-2579A

Neighborhood Description	Census Tract	Census Blocks	Total Population	Neighborhood Characteristics	
				% Non-White	% Below Poverty*
Oak Ridge Place – Oak Grove Road (SR 2678)	33.03	3003	63	14.3%	4.7%
Oakhill Place – Oak Grove Road (SR 2678)	33.03	3005	10	0.0%	4.7%
Meredith – Oak Grove Road (SR 2678)	33.08	1018, 1032	226	27.0%	1.8%
Glenn Hi Road (SR 2679)	33.08	1052, 1053, 1054, 1055, 1056, 1057, 1058, 1059, 1060, 1061, 1062, 1063	838	11.3%	1.8%
Yeaton Glen Drive (SR 4342)	33.06	1001, 1003	538	11.9%	2.2%
Glenn Village – Glenn Hi Road (SR 2679)	33.06	1001	476	12.2%	2.2%
Glenn Meadow – Glenn Hi Road (SR 2679)	33.06	1001	476	12.2%	2.2%
Glenn Landing Drive	34.06	1000, 1006, 1007, 1008, 1009	342	8.2%	2.2%
Piedmont Memorial Drive (SR 2695)	34.02	1009, 1011, 1012, 1013, 1017, 1018, 1019, 1020, 1021, 1029	220	10.0%	11.7%
Swaim Road (SR 2692)	34.02	1033	115	11.3%	11.7%
Forest Trails Drive (SR 4302)	33.06	1012, 1013, 1016, 1017	216	9.3%	2.2%

Source: US Bureau of Census, 2000.
* Poverty data available at block group level only.

Avoidance and Minimization Efforts. The Detailed Study Alternatives for Projects R-2247, U-2579, and U-2579A were located to avoid passing through the centers of all neighborhoods and subdivisions wherever possible, regardless of demographic characteristics. Mitigation options for lessening the impacts on any neighborhood include: bridging for access across the Northern Beltway, providing new access routes if bridging is not practical, constructing noise abatement barriers, and providing visual barriers or vegetative screens. These types of options have been incorporated into the Preferred Alternatives for Project R-2247 and Project U-2579, and the Project U-2579A Detailed Study Alternatives. As discussed in **Section 4.2.4.6**, several additional crossings were provided as part of the U-2579A Preferred Alternative. Additional mitigation options will be further considered during final design.

Public Involvement Opportunities. Through the project's public involvement strategy, NCDOT has attempted to include all residents and property owners in the project study area in the decision-making process. Additional outreach to discuss opportunities for mitigation were made to members of the Mount Pleasant Christian Church, a minority church, and residents of North Oaks, a minority community, both impacted by the Project U-2579 Preferred Alternative. Efforts to include the residents of communities within the study area in the decision-making process for this project are discussed in **Chapter 6 – Coordination and Public Involvement**. Outreach to affected minorities included a meeting with residents of the North Oaks community and continuing communication with community representatives. NCDOT staff also met with the pastor and board members of Mount Pleasant Christian Church during one of the public meetings in November 2004. Additional information about these meetings is in Section 6.2.2.3.

4.3 UTILITIES AND INFRASTRUCTURE

Major existing utilities within the study area include electrical transmission lines, natural gas lines, water mains, and sanitary sewer lines (see **Figure 3-7**). During final design, all utility providers would be contacted and coordinated with to ensure that the proposed design and construction of the project would not substantially disrupt service.

4.3.1 Combined Direct Impacts to Utilities and Infrastructure

Table 4-13 combines the Preferred Alternative for Projects R-2247 and U-2579 with each Detailed Study Alternative for Project U-2579A to show the total number of utility and infrastructure impacts for the Winston-Salem Northern Beltway. Since specific counts of water main crossings and sewer main crossings were not included in the analyses for Projects R-2247, U-2579, and U-2579A, they have not been incorporated into the summary. Results are the same for Project U-2579A with or without the Kernersville Road interchange.

Table 4-13: Combined Direct Impacts to Utilities and Infrastructure – Projects R-2247, U-2579, and U-2579A

Project	Alternative	Electrical Easement Crossing	Electrical Substations	Major Gas Mains	Directional Radio Antenna Arrays	Railroad Crossings
R-2247 and **U-2579 Preferred Alternatives plus U-2579A Detailed Study Alternatives***	N1-S1	9**	0	2**	0	3**
	N1-S2	8**	0	2**	0	3**
	N2-S1 (Preferred Alternative)	**9****	**0**	**2****	**0**	**3****
	N2-S2	8**	0	2**	0	3**
	N3-S1	9**	0	2**	0	3**
	N3-S2	8**	0	2**	0	3**

Impacts are based on 2005 preliminary engineering designs for the Project R-2247, U-2579, and U-2579A Preferred Alternatives, and are based on the 2002 preliminary engineering designs for the Project U-259A non-preferred alternatives.
* Results are the same for Project U-2579 alternatives with or without Kernersville Road interchange.
** Interchange ramp design may cause multiple crossings of the utility corridor at locations of planned interchanges. Only one crossing is noted in the table for each of these locations.

4.3.2 Western Portion of Study Area - Project R-2247

4.3.2.1 Utilities - Project R-2247 Detailed Study Alternatives

All construction alternatives would require some adjustment, relocation, or modification to existing public utilities in the study area. Although the amount of modification required varies between the alternatives and the specific utility service, the impacts would be short-term and restricted to the construction period.

The numbers of major utility crossings by Detailed Study Alternatives are listed in **Table 4-14**, which was originally included in the 1996 Project R-2247 FEIS as Table 4.3-1. **Table 4-14** provides impacts based on current information on utility locations. The impact of alternatives on area utilities is contained in the construction cost and right-of-way estimates (see **Section 2.8.5.6)**.

Electric Power Transmission. Based on information provided by Duke Power (2003), three 130/230-kilovolt (kV) electrical transmission lines and five electrical substations are located within the study area (see **Figure 3-7**). The transmission lines run generally north-south through the study area and cross the Detailed Study Alternatives at several locations. The crossings may require the relocation of transmission lines and towers to maintain adequate vertical and horizontal clearances. NCDOT would coordinate closely with Duke Power to relocate power utilities where necessary and to avoid/minimize service disruptions.

Table 4-14: Utility Impacts - Project R-2447 Detailed Study Alternatives

Detailed Study Alternative	Electrical Easement Crossing	Electrical Substations	Major Gas Mains	Directional Radio Antenna Arrays	Railroads Crossings
WEST-A	5**	0	0	0	0
EAST-A	2	0	0	0*	0
WEST-B	6**	0	0	0*	1**
EAST-B	3**	0	0	0	1**
C3-WEST-A	5**	0	0	0	0
C2-EAST-A	2	0	0	0*	0
C2-EAST-B	3**	0	0	0*	1**
Preferred Alternative					
C3-WEST-B 1992 Functional Design	**6****	**0**	**0**	**0***	**1****

* The right of way passes just west of the grounding cables for the radio antenna array. No impacts are expected.
** Interchange ramp design may cause multiple crossings of the utility corridor at locations of planned interchanges. Only one crossing is noted in the chart for each of these locations.
'Bold' indicates the Preferred Alternative; impacts are based upon the 1992 DEIS Functional Design.

North of Shallowford Road, the WEST Detailed Study Alternatives (WEST-A, WEST-B, C2-WEST-A, and C3-WEST-B (Preferred)) generally run along the east side of the power transmission corridor to Yadkinville Road, where some relocation of transmission towers may be required for an interchange. North of Yadkinville Road, these alternatives cross under the power lines and stay east of the power transmission corridor from Skylark Road to just south of Reynolda Road (NC 67), then cross over to the west of the power transmission corridor until the vicinity of Bethania-Tobaccoville Road.

The EAST Detailed Study Alternatives (EAST-A, EAST-B, C2-EAST-A, and C2-EAST-B) approach the east side of the same power transmission corridor, south of Reynolda Road (NC 67). They stay to the east of this corridor until the Bethania-Tobaccoville Road area, where two crossings of the power transmission corridor are made.

The interchange with US 52, in the vicinity of the NC 66 Connector (Detailed Study Alternatives EAST-B, WEST-B, C2-EAST-B, and C3-WEST-B (Preferred)), is traversed by another power transmission corridor. Multiple crossings of the power transmission corridor would be made by the Beltway and the many ramps involved with this major interchange.

Sewer and Water Services. Water and wastewater services in the study area are primarily provided by the consolidated City-County water supply and wastewater collection system. Throughout the study area, a relatively limited system of water lines service the developed areas. A water metering and pump station is located in the vicinity of the Ziglar Road intersection with Bethania-Rural Hall Road (NC 65). It would be displaced by Detailed Study Alternatives

EAST-B, WEST-B, C2-EAST-B, and C3-WEST-B (Preferred), based on the 1992 functional designs.

Each of the Detailed Study Alternatives cross sewer interceptors located along the Muddy Creek floodway. The two major interchanges at I-40 and US 421, located in the vicinity of the Muddy Creek floodplain, would require extensive reconstruction of the interceptors at these sites due to the multitude of interchange ramps and loops.

NCDOT would coordinate closely with the City-County Utilities Division to relocate water and sewer utilities where necessary and to avoid/minimize service disruptions.

Railroads. There is an active rail line east of US 52 that would be impacted by the US 52 interchange with Detailed Study Alternatives EAST-B, WEST-B, C2-EAST-B, and C3-WEST-B (Preferred). Adequate bridging of the railroad would be provided to ensure no interruption of service. The extension of Detailed Study Alternatives EAST-A, WEST-A, C2-EAST-A and C3-WEST-A through south Rural Hall, as a part of the Eastern Section of the Northern Beltway (Project U-2579), would result in similar impacts to the rail lines.

Natural Gas Service. Based on information provided by Piedmont Natural Gas (2003), there is one major gas main within the study area (see **Figure 3-7**). The line runs generally northeast-southwest through the study area north of Robinhood Road. None of the Detailed Study Alternatives cross this line. Other gas mains noted in the 1996 Project R-2247 FEIS south of Robinhood Road are not considered major lines by Piedmont Natural Gas (*Piedmont Natural Gas Company, North Carolina Atlas – Winston Salem District, revised September 2002*). NCDOT would coordinate closely with Piedmont Natural Gas to relocate natural gas utilities where necessary and to avoid/minimize service disruptions.

Other Utilities. The directional radio antenna array for station WSJS is located on the south side of Robinhood Road, just west of Muddy Creek. The right of way for Detailed Study Alternatives EAST-A, EAST-B, C2-EAST-A, and C2-EAST-B passes just to the west of the WSJS property and grounding cables for the array. No long-term impacts are expected to the array from the Detailed Study Alternatives, but special precautions may be required to mitigate disruption to transmissions from tall construction equipment during peak transmission hours.

4.3.2.2 Utilities - Project R-2247 Preferred Alternative

Electric Power Transmission. The 1996 Project R-2247 FEIS stated that "the Preferred Alternative would result in the relocation of three transmission towers in the vicinity of Robinhood Road, one transmission tower near Yadkinville Road, one transmission tower between Reynolda Road and Bethania-Tobaccoville Road, and three transmission towers near US 52. There are no other transmission towers or electrical substations affected by the project." Based on the 2005 preliminary engineering design, the Project R-2247 Preferred Alternative would result in the relocation of two transmission towers in the vicinity of Robinhood Road, four transmission towers near Yadkinville Road, one transmission tower near Skylark Road, one transmission tower near Bethania-Tobaccoville Road, and six transmission towers near US 52.

Under the 2005 preliminary engineering design, Bethania-Tobaccoville Road would be relocated in the vicinity of the Project R-2247 Preferred Alternative mainline. Relocated Bethania-Tobaccoville Road would cross a major electric power easement. There may be vertical clearance issues associated with the power lines where realigned Bethania-Tobaccoville Road would cross the power transmission line easement. The elevations of the proposed roadway where it would cross the easement are higher than the existing ground.

The Preferred Alternative would cross six electrical easements, including the one at Bethania-Tobaccoville Road. Any necessary modifications to high-voltage transmission lines in order to accommodate the proposed project are not expected to adversely impact electrical service in the area. Any impacts and relocations of power lines or towers would be coordinated with Duke Power during final design.

Sanitary Sewer and Water Service. The Project R-2247 Preferred Alternative would cross several water and sewer mains. The water metering and pump station located in the vicinity of the Ziglar Road/Bethania-Rural Hall Road intersection would not be impacted.

The main sewer lines located along the Muddy Creek floodway would be crossed by the Project R-2247 Preferred Alternative. The two major interchanges at I-40 and US 421, located in the vicinity of the Muddy Creek floodplain, would require extensive reconstruction of the sewer interceptors at these sites due to the multitude of interchange ramps and loops.

NCDOT would coordinate closely with the City-County Utilities Division to relocate water and sewer utilities where necessary and to avoid/minimize service disruptions.

Railroads. The Project R-2247 Preferred Alternative would bridge the railroad within the interchange at US 52 and the NC 66 Connector. No impacts would occur to the active rail lines.

Natural Gas. The Project R-2247 Preferred Alternative would not impact the major gas main in the study area. NCDOT would coordinate closely with Piedmont Natural Gas to relocate any minor natural gas mains where necessary, and to avoid/minimize service disruptions.

Other Utilities. The 2005 preliminary engineering design for the Project R-2247 Preferred Alternative would not affect the WSJS antenna array.

4.3.3 Eastern Portion of Study Area - Projects U-2579/U-2579A

4.3.3.1 Utilities - Project U-2579 Detailed Study Alternatives

The number of major utility crossings by Detailed Study Alternative are listed in **Table 4-15**, including electrical and gas easements and electrical substations. Impacts are based on the 1994 functional engineering designs. Conditions have not changed since completion of the 1995 Project U-2579 DEIS. The costs of crossing these lines were evaluated, and the results are included in the economic comparison of the construction alternatives (see **Section 2.10.4.1**).

Electric Power Transmission. Based on information provided by Duke Power (2003), there are three primary 130/230-kilovolt (kV) electrical transmission lines and two electrical substations within the Project U-2579 study area (see **Figure 3-7**). There is no impact to either of the substations. The transmission lines run generally north-south and cross the Detailed Study Alternatives once at Reidsville Road (US 158). The crossing may require the relocation of transmission lines and towers to maintain adequate vertical and horizontal clearances. NCDOT would coordinate closely with Duke Power to relocate power utilities where necessary and to avoid/minimize service disruptions. The construction alternatives are not anticipated to adversely affect any electric transmission facilities, and no disruption in service is anticipated.

Sewer and Water Services. Water and wastewater services in the study area are primarily provided by the Winston-Salem and Forsyth County City-County Utilities, which maintains the water supply and the wastewater collection system. The location of existing major sanitary sewer and water lines was considered to avoid any significant disruption to utilities. NCDOT would coordinate closely with the City-County Utilities Division to relocate water and sewer utilities where necessary and to avoid or minimize service disruptions.

Railroads. As seen on **Figure 3-1**, there are two active railroads in the eastern portion of the study area, both operated by the Norfolk Southern Railroad Company. The Project U-2579 Detailed Study Alternatives cross both railroads, which run parallel to Old Walkertown Road and

West Mountain Street. The Beltway would cross over the railroad at Old Walkertown Road, which would minimize the potential impacts on rail and roadway service facilities. However, the crossing at West Mountain Street is expected to pass under the Norfolk Southern Railroad, requiring the temporary relocation of the railroad tracks to provide a grade-separated underpass structure. Design of railroad crossings would be coordinated with Norfolk Southern Railroad, NCDOT Rail Division, and Piedmont Area Rapid Transit (PART), which may provide rail transit service in the future.

Table 4-15: Utility Impacts – Project U-2579 Detailed Study Alternatives

Detailed Study Alternative	Electrical Easement Crossing	Electrical Substations	Major Gas Mains	Railroad Crossings
Western	1	0	2*	2
Eastern	1	0	1	2
Alternative 1	1	0	2*	2
Alternative 2	1	0	1	2
Alternative 3	1	0	2*	2
Alternative 4	1	0	2*	2
Alternative 5	1	0	1	2
Alternative 6	1	0	2*	2
Alternative 7	**1**	**0**	**2***	**2**
Alternative 8	1	0	1	2
Preferred Alternative				
W1-W2-W3-C4-E5 (Alternative 7) 1994 Functional Engineering Design	**1**	**0**	**2***	**2**

Impacts are based upon right-of-way limits for the 1994 functional engineering designs.
*Interchange ramp design may cause multiple crossings of the utility corridor. Only one crossing is noted in the chart for each of these locations.
'Bold' indicates the Preferred Alternative.

Natural Gas Service. Based on information provided by Piedmont Natural Gas (*Piedmont Natural Gas Company, North Carolina Atlas – Winston Salem District, revised September 2002*), there is one major gas main within the Project U-2579 study area (see **Figure 3-7**). The line runs generally east-west, and crosses the Project U-2579 Detailed Study Alternatives between Baux Mountain Road and Davis Road along Segment W3 and at New Walkertown Road (US 311) at the intersection of Segments W3 and W4 and crossovers C3 and C4. NCDOT would coordinate closely with Piedmont Natural Gas to relocate natural gas utilities where necessary and to avoid/minimize service disruptions.

4.3.3.2 Utilities - Project U-2579 Preferred Alternative

Electric Power Transmission. The Project U-2579 Preferred Alternative would cross one major power transmission easement at Reidsville Road (US 158) (see **Figure 3-7**). NCDOT would coordinate closely with Duke Power to relocate power utilities where necessary and to avoid/minimize service disruptions. The Project U-2579 Preferred Alternative is not anticipated to adversely affect any electric transmission facilities, and no disruption in service is anticipated.

Sewer and Water Services. The Project U-2579 Preferred Alternative would cross several water and sewer mains. Specific locations of water and sewer mains would be determined prior to construction, and NCDOT would coordinate closely with the City-County Utilities Division to relocate water and sewer utilities where necessary and to avoid/minimize service disruptions.

Railroads. As seen on **Figure 3-1**, the Project U-2579 Preferred Alternative would bridge the railroad line at Old Walkertown Road with no impact to the active rail line. The Preferred Alternative also would require the temporary relocation of the railroad tracks along West Mountain Street during the construction of an underpass for the Northern Beltway. Design of railroad crossings would be coordinated with Norfolk Southern Railroad, NCDOT Rail Division, and Piedmont Area Rapid Transit (PART), which may provide rail transit service in the future. A rail crossing just east of the US 52 interchange is addressed as a part of Project R-2247.

Natural Gas Service. The Project U-2579 Preferred Alternative would cross a major gas main between Baux Mountain Road and Davis Road and at New Walkertown Road (US 311) (see **Figure 3-7**). NCDOT would coordinate closely with Piedmont Natural Gas to relocate natural gas utilities where necessary and to avoid/minimize service disruptions.

4.3.3.3 Utilities - Project U-2579A Detailed Study Alternatives and Preferred Alternative

The numbers of major utility crossings by Project U-2579A Detailed Study Alternative are listed in **Table 4-16**, including electrical and gas easements and electrical substations. The costs of crossing these lines were evaluated, and the results are included in the construction costs of the Detailed Study Alternatives (**Section 2.10.4.2**). Results are the same for alternatives with or without the Kernersville Road interchange. The Preferred Alternative would cross two electrical easements.

Table 4-16: Utility Impacts – Project U-2579A Detailed Study Alternatives

Detailed Study Alternative	Electrical Easement Crossing	Electrical Substations	Major Gas Mains	Number of Railroad Crossings
N1-S1	2	0	0	0
N1-S2	1	0	0	0
N2-S1 (Preferred Alternative)	**2**	**0**	**0**	**0**
N2-S2	1	0	0	0
N3-S1	2	0	0	0
N3-S2	1	0	0	0

Impacts are based upon right-of-way limits for the 2002 preliminary engineering alignments.
Results are the same for alternatives with or without the Kernersville Road interchange.
'Bold' indicates Preferred Alternative.

Electric Power Transmission. Based on information provided by Duke Power (2003), there are two 130/230-kilovolt (kV) electrical transmission lines and two electrical substations within the Project U-2579A study area (see **Figure 3-7**). There would be no impacts to either of the substations.

One transmission line runs generally north-south and crosses Segment S1 near Ridgewood Road. The other transmission line runs southwest-northeast, and crosses the northern segments (N1, N2, and N3). Alternative N2-S1, the Preferred Alternative, would cross both of these lines. The crossing may require the relocation of transmission lines and towers to maintain adequate vertical and horizontal clearances. NCDOT would coordinate closely with Duke Power to relocate power utilities where necessary and to avoid/minimize service disruptions. The construction alternatives are not anticipated to adversely affect any electric transmission facilities, and no disruption in service is anticipated.

Sewer and Water Services. Water and wastewater services in the study area are primarily provided by the Winston-Salem/Forsyth County City-County Utilities, which maintains the water supply and the wastewater collection system. The location of existing major sanitary sewer and water lines was considered to avoid any significant disruption to utilities. NCDOT would coordinate closely with the City-County Utilities Division to locate water and sewer utilities where necessary and to avoid/minimize service disruptions.

Railroads. The only railroad within the Project U-2579A study area is along West Mountain Street, which is impacted by the Project U-2579 Preferred Alternative as described previously.

Natural Gas Service. Based on information provided by Piedmont Natural Gas (2003), there are two major gas mains within the study area (see **Figure 3-7**), both south of the Project U-2579A Detailed Study Alternatives. One line runs northwest-southeast, and the Transco Pipeline runs northeast to southwest. Since none of the alternatives cross any natural gas utilities, no service disruptions are anticipated.

4.4 CULTURAL RESOURCES

4.4.1 Combined Direct Impacts to Archaeological and Historic Architectural Resources

Table 4-17 combines the Preferred Alternative for Projects R-2247 and U-2579 with each Detailed Study Alternative for Project U-2579A to show the total number of archaeological and historic architectural resources impacted by the project. Results are the same for Project U-2579A with or without the Kernersville Road interchange.

Table 4-17: Combined Direct Impacts to Archaeological and Historic Architectural Resources – Projects R-2247, U-2579, and U-2579A

Project	Alternative	# of Archaeological Sites Requiring Preservation in Place	# of Historic Resources with No Adverse Effect	# of Historic Resources with Adverse Effect
R-2247 and **U-2579 Preferred Alternatives plus U-2579A Detailed Study Alternatives**[1]	N1-S1	0	4	1
	N1-S2	0	4	1
	N2-S1 (Preferred Alternative)	**0**	**4**	**1**
	N2-S2	0	4	1
	N3-S1	0	4	1
	N3-S2	0	4	1

Impacts are based on 2005 preliminary engineering designs for the Project R-2247, U-2579, and U-2579A Preferred Alternatives, and are based on the 2002 preliminary engineering designs for the Project U-259A non-preferred alternatives.

[1] Results are the same for Project U-2579A alternatives with or without Kernersville Road interchange.

4.4.2 Archaeological Resources

4.4.2.1 Section 106 Compliance for Archaeological Resources

Archaeological studies were conducted pursuant to Section 106 of the National Historic Preservation Act of 1966 and the *Advisory Council on Historic Preservation Regulations for Compliance with Section 106*, codified in 36 CFR Part 800. **Appendix D.1** includes the correspondence from the State Historic Preservation Office (HPO), as described below.

Western Portion of Study Area. An Archaeological Sample Survey was conducted over portions of the Project R-2247 Detailed Study Alternatives. Field work was conducted in February 1991 and a draft report on the investigation was completed in April 1991.

In a letter dated July 10, 1991, the HPO concurred with the findings and recommendations of the Archaeological Sample Survey. In a letter dated February 25, 1992, the HPO concurred with the FHWA's findings that sites 31 FY626, 31FY818, and 31FY830 are important for data recovery potential and do not warrant preservation in place.

In a letter dated August 1, 1995, the HPO concurred with the extent of the Archaeological Intensive Survey of the Preferred Alternative.

In a letter dated March 13, 1996, the HPO concurred with the recommendations for National Register eligibility for twelve additional sites located in the Preferred Alternative. SHPO did not consider preservation in place for these twelve sites a necessary or feasible option. The intensive survey of the Project R-2247 Preferred Alternative led to the execution of a Memorandum of Agreement (MOA) on April 26, 1996 regarding the twelve archaeological sites located in the Preferred Alternative. A copy of the MOA is included in **Appendix D.1**.

Eastern Portion of Study Area. An Archaeological Sample Survey was conducted for a sample of all Project U-2579 Detailed Study Alternatives. Field work took place between April and July 1994, and a draft report was completed in October 1995.

An Intensive Archaeological Survey was conducted for the Project U-2579 Preferred Alternative between July 7 and 27, 1998. A report was prepared in December 2000. In a letter dated September 6, 1995, the Deputy State Historic Preservation Officer (SHPO) agreed in principle with the recommendations from the sample survey, stating that six archaeological sites are potentially eligible for the National Register of Historic Places (NRHP) and would be subjected to archaeological data recovery if they are within the Preferred Alternative.

An Archaeological Sample Survey was conducted for a sample of all Project U-2579A preliminary alternatives in early November 1994, and a report was completed November 28,

1994. An additional archaeological survey and evaluation was performed for the Project U-2579A study area during November and December 2004.

4.4.2.2 Archaeology - Project R-2247 Detailed Study Alternatives

Section 3.6.3.1 describes the archaeological resources in the western portion of the study area. Based on the 1991 Archaeological Sample Survey, Detailed Study Alternative EAST-B, the easternmost corridor, was predicted to have a higher potential for impacting archaeological sites than Detailed Study Alternative WEST-A, the westernmost corridor. The Detailed Study Alternative WEST-A had the lowest potential based on the following observations: 1) fewer previously recorded sites are present than in Detailed Study Alternative EAST-B, 2) only one site recorded during the sample survey was recommended as eligible for the National Register, 3) fewer sites on the state's Study List are in the alignment, and 4) the alignment is the farthest from the Bethania National Register Historic District and Town Lot and the Pfafftown Historic District (1996 Project R-2247 FEIS, page 4-35).

Five crossover segments are used by the Detailed Study Alternatives (C1 through C5). Segment C1 is used by Detailed Study Alternatives EAST-A, EAST-B, C3-WEST-A, and C3-WEST-B (Preferred). Segment C4 is part of Detailed Study Alternatives WEST-A, WEST-B, C3-WEST-A, and C3-WEST-B (Preferred). Segment C5 is part of Detailed Study Alternatives WEST-A, EAST-A, C3-WEST-A, and C2-EAST-A. Two previously recorded archaeological sites are found in these segments: one impacted by Segment C1 and one impacted by both Segment C4 and Segment C5. During the 1991 Archaeological Sample Survey, one additional site (31FY828) was recorded in Segment C1. This prehistoric site was recommended for further investigation. The remaining crossover segments near US 421 (Segments C2 and C3) are thought to have a high probability for site occurrence due to topographic setting and proximity to reliable water sources.

The Archaeological Sample Survey demonstrated that all of the alternatives had some potential to contain archaeological sites, requiring an intensive survey of the selected alternative.

At the time of the sample survey, two archaeological properties were on the North Carolina Professional Review State Study List in Forsyth County (Hall, 1990). The first is the John Doub Complex (31FY801), the site of an abandoned tannery, an eighteenth-century dwelling; a later eighteenth- to mid nineteenth-century cemetery; and an aboriginal occupation. The site has not been placed on the NRHP and would not be affected by any alternative, including the Preferred Alternative.

The second property represents the proposed Yadkin River Archaeological District. It is located west of the proposed project along the Forsyth County side of the Yadkin River floodplain. The

District consists of 25 prehistoric sites and six fish weirs. The District would not be affected by any alternative, including the Preferred Alternative.

4.4.2.3 Archaeology - Project R-2247 Preferred Alternative

Subsequent to the selection of Detailed Study Alternative C3-WEST-B as the Project R-2247 Preferred Alternative, an Intensive Archaeological Survey (1996) was conducted along a 500-foot-wide corridor defined by the 1995 preliminary engineering design for the project. This survey corridor included minor and major interchanges.

The Intensive Survey reported that one hundred and two sites of the one hundred fifteen found within the preferred corridor were assessed as ineligible for inclusion on the NRHP.

One additional site, 31FY570** (Flynt cemetery), although ineligible for inclusion on the NRHP, falls under the provisions of GS Chapter 70. Flynt cemetery was found on the edge of the preferred corridor during the 1996 Intensive Survey. This site consists of 32 graves containing ancestors of the Flynt family. The Flynt family has a long history in Forsyth County. The area surrounding the cemetery has been maintained by the William Piatt family of Winston-Salem. Avoidance or compliance with the regulations outlined in GS Chapter 70 was recommended in the Intensive Survey. The 2005 preliminary engineering design for the Project R-2247 Preferred Alternative was reviewed to determine if this site was within the Preferred Alternative right of way. Flynt cemetery is located within the right of way for the Preferred Alternative and must, therefore, be relocated. The relocation of this site will be in compliance with GS Chapter 70.

Twelve sites were assessed as eligible for inclusion on the NRHP. These sites include 31FY888, 31FY893**, 31FY901, 31FY902, 31FY903, 31FY910**, 31FY911**, 31FY912**, 31FY921, 31FY925**, 31FY944, and 31FY947.

These twelve sites are listed in the HPO letter dated March 13, 1996 contained in **Appendix D.1.** None of these sites are considered to warrant preservation in place. The SHPO and FHWA agreed that the Preferred Alternative would have no adverse effect on the twelve archaeological sites with the enactment of testing and data recovery plans as stipulated in a Memorandum of Agreement between the SHPO, FHWA, and NCDOT (see letter and Memorandum of Agreement (MOA) dated April 26, 1996 in **Appendix D.1**).

The 2005 preliminary engineering design for the Project R-2247 Preferred Alternative was reviewed to determine if the twelve sites found in the Intensive Survey as eligible for listing on the NRHP would be within the Preferred Alternative right of way. One of the twelve sites (31FY947) would be outside the Project R-2247 Preferred Alternative right of way. A new Memorandum of Agreement, included in **Appendix D.1**, was executed in March 2006 and supersedes the 1996 MOA. The new MOA describes the data recovery process for the sites.

4.4.2.4 Archaeology - Project U-2579 Detailed Study Alternatives

The archaeological sites in the Project U-2579 study area for the Detailed Study Alternatives were identified and documented in the 1995 Project U-2579 DEIS. The following discussion is from Section 4.1.7.2 of the 1995 Project U-2579 DEIS.

Three archaeological sites 31FY975**, 31FY994(**), and 31FY1008 were assessed as eligible for the NRHP. The ** indicates the site contains historic components, and (**) indicates the site contains both prehistoric and historic components. Should any of these sites be impacted by the Preferred Alternative, FHWA and NCDOT would make a decision, in consultation with the SHPO, regarding the testing strategy. If testing results warrant additional work in the form of data recovery or mitigation, such work would be conducted in consultation with the SHPO.

In addition, access was denied to the property upon which 31FY64 is located. Eligibility of this site is unknown, and if the site falls within the Preferred Alternative after final design, an assessment would be conducted prior to construction after it is acquired by NCDOT.

Archaeological sites 31FY998** and 31FY1020** were located outside of the sample areas. Should these sites be located within the Preferred Alternative after final design, they would be assessed after they are acquired by NCDOT.

A cemetery with unmarked graves and a headstone dated 1821 reported to represent members of the Frazier family. This site was recorded as archaeological site 31FY996**. Should the cemetery be located within the Preferred Alternative after final design, the cemetery would be addressed in accordance with North Carolina General Statutes Chapter 70.

The archaeological report recommends that the archaeological survey of the Preferred Alternative concentrate on areas where archaeological sites are likely to retain integrity. These locations consist of soils that have not been eroded.

4.4.2.5 Archaeology - Project U-2579 Preferred Alternative

Following the selection of the Project U-2579 Preferred Alternative, an Intensive Archaeological Survey was conducted for the proposed right of way, using the preliminary engineering design.

Among the 27 sites identified or revisited during the Intensive Survey, one site (31FY1053(**)) is recommended as potentially eligible for inclusion in the NRHP. The remaining 26 sites are recommended as not eligible for the NRHP. Site 31FY1053(**) is located north of Old Walkertown Road between Davis Road and Dippen Road, and is recommended as eligible for inclusion on the NRHP for its potential to yield information on a mid nineteenth to early

twentieth century owner-operated farmstead. Site 31FY1053(**) is included in the MOA, which calls for data recovery for this site.

A portion of the preferred alignment from Northwest Drive across Phelps Road to Baux Mountain Road remains to be assessed due to denial of access by landowners or residents of these properties. Some of the properties were fenced, heavily posted, and were patrolled by guard dogs. This area encompasses approximately 6,000 feet (~1.1 mi) of the preferred corridor. There are two previously recorded sites in this section of denied access, 31FY4 and 31FY1003, both of which were examined during the sample survey (Abbott and Davis 1995). Site 31FY4 was recommended as not eligible for inclusion on the NRHP. Site 31FY1003 was an isolated find and also was assessed as not eligible for the NRHP.

4.4.2.6 Archaeology - Project U-2579A Detailed Study Alternatives

The Sample Survey completed for Project U-2579A was conducted for the 1,200-foot preliminary alternative corridors, described as the Eastern, Middle, and Western Alternatives.

According to the Sample Survey, the areas of highest probability for potentially eligible prehistoric sites are along the drainages within the floodplain of a creek valley, particularly at the confluence of streams. Since almost all of the stream valleys are undeveloped, site probability is high in those areas. There are also several third order stream valleys within the study area with site potential, including Fiddlers Creek, Fishers Branch, Kerners Mill Creek, and Swaim Creek (see **Figure 3-10c**).

Five of the eighteen archaeological sites identified as potentially eligible for the NRHP were located within the 1,200-foot corridors for the preliminary alternatives. Of the five sites that were potentially impacted, four were recommended for additional testing to determine whether or not they are eligible for the NRHP, and one site was recommended for no further work. The site recommended for no further work (31FY258) is adjacent to the Segment N3. All four of the sites recommended for further testing (31FY79, 31FY80, 31FY242, and 31FY280) are located outside of the Detailed Study Alternatives' rights of way, and therefore outside the right of way for the Preferred Alternative.

An additional archaeological survey and evaluation was performed for the Project U-2579A study area during November and December 2004. This study examined nine of the 16 sites recorded in the earlier study and encountered five additional sites. The nine sites were determined to be not eligible for the NRHP and no further work is required. The five new sites identified were determined to be ineligible for the NRHP. It is unlikely that further archaeological work will be required in conjunction with this project.

4.4.3 Historic Architectural Resources

4.4.3.1 Section 106 Compliance for Historic Architectural Resources

Historic architectural studies were conducted pursuant to Section 106 of the National Historic Preservation Act of 1966 and the *Advisory Council on Historic Preservation Regulations for Compliance with Section 106*, codified as 36 CFR Part 800.

Western Portion of Study Area. Historic architectural surveys were conducted in the area of potential effect for the Detailed Study Alternatives in 1990-1991 (Opperman) and updated in 2002-2003 (Edwards-Pitman Environmental, Inc.).

Based on the State Historic Preservation Office's (HPO) review of the 1990-1991 architectural resources survey report and subsequent addenda, concurrence was reached concerning the eligibility of nine historic properties and the Pfafftown Historic District (Brook, January 2, 1992, and April 7, 1992). In a May 1, 1992 letter, the State Historic Preservation Officer (SHPO) concurred with NCDOT's determinations of effects to architectural properties for the ten historic resources on or eligible for the National Register that were identified in the early studies.

Based on the APE determined in 1990-1991, historians conducted updated fieldwork in the western portion of the study area in July of 2002 and identified seventeen properties on or eligible for the National Register. The HPO concurred with the Determinations of Eligibility in its October 9, 2003 letter (see **Appendix D.1**). The SHPO also concurred with the Determinations of Effect from the Project R-2247 Preferred Alternative in a concurrence form dated March 1, 2004 (see **Appendix D.1**).

The project would have an adverse effect on one of the eligible properties, the Alexander Hege House, as documented in the concurrence for referenced above. Therefore, a Memorandum of Agreement (MOA) was executed on March 29, 2006, describing conditions needed to mitigate the adverse effect. A copy of the MOA is included in Appendix D.1.

Eastern Portion of Study Area. Three historic architectural resource surveys were completed for the Project U-2579 portion of the study area. The first survey, completed in April 1993 (*Phase I: Historic Architectural Reconnaissance Survey – Eastern Section*), was for the Project U-2579 study area. A Phase II survey was completed in late 1994 for the Detailed Study Alternatives (*Historic Structures, Survey and Evaluation Report – Eastern Section*, January 1995, revised June 1995). Based on HPO's review of the 1993 architectural resources survey report, concurrence was reached regarding the eligibility of 18 properties. In an August 2, 1995 letter, the SHPO agreed that two properties within the Detailed Study Alternative APE were eligible for the NRHP. In the 1995 Project U-2579 DEIS, it was determined that the Detailed Study Alternatives would have no effect on these two properties.

The third study was completed in April 2003 for the Project U-2579 Preferred Alternative (*Historic Architectural Resources Survey Report, Phase II Intensive – Eastern Section*). In a January 20, 2004 letter, the SHPO agreed that the previously identified Clayton Family Farm (with an expanded historic boundary from that indicated in the 1995 Project U-2579 DEIS) is listed on the NRHP, and that the other previously identified property (John and Charles Fries Day Farm) is still eligible for listing on the NRHP and is listed on the North Carolina State Study List. Two properties that were not previously identified (Seaver's Gulf Station and the Hammock Family Farm) were also determined eligible for listing on the NRHP.

In a March 1, 2004 concurrence form, the SHPO agreed that the Project U-2579 Preferred Alternative would have no adverse effect on the Clayton Family Farm with the condition that any trees that would be removed during construction will be replaced with a similar species. The SHPO agreed that there would be no adverse effect to the Hammock Family Farm provided that no construction occurs within the historic boundary and no effect to Seaver's Gulf Station. In an April 21, 2004 concurrence form, the SHPO agreed that since there were no design changes in the Preferred Alternative near the John and Charles Fries Day Farm, the previous determination of no effect is still applicable.

Three historic architectural surveys have been completed for Project U-2579A. The first Preliminary Identification Study was completed in January 1995 (*Phase I Historic Structures, Survey and Evaluation Report – Eastern Section Extension*, January 1995). The second Preliminary Identification Study, an update of the first survey, was completed in 2001 (*Historic Architectural Resources Survey Report, Preliminary Identification – Eastern Section Extension,* September 2001). The third report was a final consolidation and update of the previous surveys, and was completed in 2003 (*Historic Architectural Resources Survey Report, Phase II Intensive – Eastern Section Extension*).

A Phase II survey was completed in February 2004 at the John and Catherine Bodenhamer House (*Historic Architectural Resources Survey Report, Phase II Intensive – Eastern Section Extension, John and Catherine Bodenhamer House*). (The Bodenhamer House is also referred to in some correspondence as the Dempsey McDaniel House.) Based on the preliminary identification surveys and correspondence with the HPO, there are no properties within the APE that were listed on or identified as eligible for the NRHP. The SHPO concurred with this conclusion in letters dated February 5 and March 5, 2004.

A second Phase II survey was completed in March 2005 at the E. J. Disher Retreat (Hart Farm). Based on this report on coordination with the HPO, this property is not eligible for the NRHP. The SHPO concurred with this conclusion in a letter dated March 3, 2005.

4.4.3.2 Historic Resources - Project R-2247 Detailed Study Alternatives

Table 3-9 lists seventeen existing properties on or eligible for the NRHP located in the Project R-2247 study area. Their locations with respect to the Detailed Study Alternatives are shown in **Figure 2-10**. As discussed in **Section 3.6.4**, ten of these properties were identified as on or eligible for the NRHP in the 1990-1991 historic architectural resources survey. These ten properties, plus seven other resources, were identified in the updated 2002-2003 historic architectural resources survey.

Impacts to historic architectural resources were reported in the 1996 Project R-2247 FEIS based on the 1992 Detailed Study Alternatives functional designs and on the 1995 Preferred Alternative preliminary engineering design. As discussed in the 1996 Project R-2247 FEIS *(*Section 4.4.5.1), determinations of Adverse Effect or No Adverse Effect from one or more Detailed Study Alternatives were noted for the John Henry Kapp Farm, Columbus Kapp House and Barn, Pfafftown Historic District, and Samuel Stauber House and Barn.

The designs for the non-preferred Detailed Study Alternatives have not been modified since the 1992 functional designs. As discussed below, it is assumed that the effects on the ten historic architectural resources reported in the 1996 Project R-2247 FEIS are still valid. (See May 1992 letter from the HPO in **Appendix D.1**). The HPO agreed with this conclusion in a meeting on March 1, 2004.

In the updated 2002 historic architectural survey, which is documented in the *Historic Architectural Resources Survey Report Phase II* seven additional historic resources on or eligible for the NRHP were identified. These are Todd House, Harmony Grove United Methodist Church Cemetery, Brookberry Farm, Alexander Hege House, Eugene Thomas Kapp House, Kapp's Mill Miller's House, and John S. Shore Farm.

Determinations of No Effect to six of these seven resources were made for the Project R-2247 Preferred Alternative 2002 preliminary engineering design in consultation with the HPO in a concurrence form dated March 1, 2004 (see **Appendix D.1**). One of the seven historic resources newly identified in 2002, the Alexander Hege House, was given a determination of Adverse Effect for the Project R-2247 Preferred Alternative (see concurrence form dated March 1, 2004 in **Appendix D.1**). The effects the other Detailed Study Alternatives would have were inferred based on the determinations of the Preferred Alternative and discussions at the 2004 concurrence meetings with the HPO.

Table 4-18 lists the effects of the Detailed Study Alternatives on the seventeen existing properties on or eligible for the NRHP located in the Project R-2247 study area.

Table 4-18: Effects on Historic Architectural Resources - Project R-2247 Detailed Study Alternatives

Historic Resources	Detailed Study Alternative							
	WEST-A	WEST-B	EAST-A	EAST-B	C2-EAST-A	C2-EAST-B	C3-WEST-A	C3-WEST-B (Preferred)
Todd House*	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect
Ploughboy Jarvis Farm	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect
Harmony Grove United Methodist Church Cemetery*	Adverse Effect	Adverse Effect	No Effect	No Effect	Adverse Effect	Adverse Effect	No Effect	No Effect
Alexander Hege House*	Adverse Effect	Adverse Effect	No Effect	No Effect	No Effect	No Effect	Adverse Effect	Adverse Effect
Brookberry Farm*[a]	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect
Doub-Yarbrough House	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect
Jeremiah Bahnson Conrad House	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect
Pfafftown Historic District	No Effect	No Effect	Adverse Effect	Adverse Effect	Adverse Effect	Adverse Effect	No Effect	No Effect
John Jacob Schaub House	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect
Bethania Historic District	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect
John Henry Kapp Farm	No Adverse Effect	No Adverse Effect	Adverse Effect	Adverse Effect	Adverse Effect	Adverse Effect	No Adverse Effect	No Adverse Effect
Eugene Thomas Kapp House and Kapp's Mill Miller's House*	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect
Thomas Jefferson Kapp House	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect
John S. Shore Farm*	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect
Samuel Stauber House and Barn	No Adverse Effect	No Adverse Effect	No Adverse Effect	No Adverse Effect	No Adverse Effect	No Adverse Effect	No Adverse Effect	No Adverse Effect
Columbus Kapp House and Barn	Adverse Effect	No Effect	Adverse Effect	No Effect	Adverse Effect	No Effect	Adverse Effect	No Effect

*Historic resource newly identified in 2002 as on or eligible for the NRHP.
[a] The Brookberry Farm is currently being redeveloped.

The following is a discussion of the effects of the Detailed Study Alternatives on the properties that are on or eligible for the NRHP. The historic resources are listed from south to north.

Todd House (Figure 2-10a). This site is located on Clemmonsville Road, outside the limits of the Detailed Study Alternatives. There would be no effect to the Todd House from any of the Detailed Study Alternatives.

Ploughboy Jarvis Farm (Figure 2-10a). None of the Detailed Study Alternatives would impact this resource, which is located on Ploughboy Lane off of Jonestown Road. Detailed Study Alternatives EAST-A, EAST-B, C3-WEST-A, and C3-WEST-B (Preferred) have right-of-way limits approximately 600 feet from the edge of the historic property. The remaining Detailed Study Alternatives are farther away from the Ploughboy Jarvis Farm. In a concurrence form dated May 1, 1992, the SHPO determined that all the Detailed Study Alternatives would have No Effect on the Ploughboy Jarvis Farm (see **Appendix D.1**).

Harmony Grove United Methodist Church Cemetery (Figure 2-10b). This cemetery is located on Marty Lane, about 0.3 mile west of Cottage Lake Road. Detailed Study Alternatives WEST-A, WEST-B, C2-EAST-A, and C2-EAST-B could have an adverse effect on the Harmony Grove United Methodist Church Cemetery due to the large area that would be required for the interchange at I-40.

Alexander Hege House (Figure 2-10b). This site is located on the south side of Shallowford Road, just east of Bradford Place. It is near Detailed Study Alternatives WEST-A, WEST-B, C3-WEST-A, and C3-WEST-B (Preferred). The HPO in a concurrence form dated March 1, 2004 (**Appendix D.1**), determined that the Project R-2247 Preferred Alternative would have an adverse effect on this historic resource. It was assumed that Detailed Study Alternatives WEST-A, WEST-B, and C3-WEST-A also would have an adverse effect on the historic resource since they would have a similar design in this location.

Brookberry Farm (Figure 2-10b). Right of way along Detailed Study Alternatives WEST-A, WEST-B, C3-WEST-A, and C3-WEST-B (Preferred) would be about 400 feet from the historic site boundaries (see **Figure 2-12d**) and would have No Effect on the site. The other four Detailed Study Alternatives are farther away and also would have no effect on the site. Since the 2004 SFEIS/SDEIS, the Brookberry Farm has been identified for redevelopment.

Doub-Yarbrough House (Figure 2-10b). None of the Detailed Study Alternatives would impact this resource, which is located on Fleetwood Circle. The EAST Detailed Study Alternatives (EAST-A, EAST-B, C2-EAST-A, C2-EAST-B) would introduce a new highway and interchange on Robinhood Road, approximately 1,200 feet from the historic property. The WEST Detailed Study Alternatives (WEST-A, WEST-B, C3-WEST-A, C3-WEST-B (Preferred)) are much farther away than the EAST Detailed Study Alternatives. In a concurrence form dated

May 1, 1992, the SHPO determined that all the Detailed Study Alternatives would have No Effect on the Doub-Yarbrough House (see **Appendix D.1**).

Jeremiah Bahnson Conrad House (Figure 2-10c). None of the Detailed Study Alternatives would impact this resource, which is located on Spicewood Drive, just north of Oil Mill Branch. The EAST Detailed Study Alternatives (EAST-A, EAST-B, C2-EAST-A, and C2-EAST-B)) would pass approximately 650 feet west of the historic property. The WEST Detailed Study Alternatives (WEST-A, WEST-B, C3-WEST-A, C3-WEST-B (Preferred)) are much farther away than the EAST Detailed Study Alternatives. In a concurrence form dated May 1, 1992, the SHPO determined that all the Detailed Study Alternatives would have No Effect on the Jeremiah Bahnson Conrad House (see **Appendix D.1**).

Pfafftown Historic District (Figure 2-10c). This historic district is located north of Yadkinville Road and west of Grandview Club Road. Detailed Study Alternatives EAST-A, EAST-B, C2-EAST-A, and C2-EAST-B would require the use of some land from properties in the district. Additionally, they would have an adverse effect on the district through the introduction of a major road near and adjacent to the rear property lines of several of the eastern properties in this significant linear historic district. In a concurrence form dated May 1, 1992, the SHPO determined that Detailed Study Alternatives EAST-A, EAST-B, C2-EAST-A, and C2-EAST-B would have an adverse effect on the Pfafftown Historic District (see **Appendix D.1**).

Detailed Study Alternatives EAST-A, EAST-B, C2-EAST-A, and C2-EAST-B would alter the character of the rural district and the district's setting, diminishing its integrity of rural, agrarian feeling, and would introduce visual elements that are out of character with the district. The other four Detailed Study Alternatives (WEST-A, WEST-B, C3-WEST-A and C3-WEST-B (Preferred)) would have No Effect on the historic district (see May 1, 1992 concurrence form in **Appendix D.1**).

John Jacob Schaub House (Figure 2-10c). None of the Detailed Study Alternatives would impact this resource, which is located on the southeast side of CG Hill Memorial Park, south of Balsom Road. In a concurrence form dated May 1, 1992, the HPO determined that all the Detailed Study Alternatives would have No Effect on the John Jacob Schaub House (see **Appendix D.1**).

Bethania Historic District (Figure 2-10d). None of the Detailed Study Alternatives would impact the Bethania Historic District. The selection of the Detailed Study Alternatives from among the preliminary alternatives eliminated those routes that passed through the historic district.

John Henry Kapp Farm (Figure 2-10d). Based on the 1992 functional designs, Detailed Study Alternatives EAST-A, EAST-B, C2-EAST-A, and C2-EAST-B would have an adverse effect on the John Henry Kapp Farm (see May 1, 1992 concurrence form in **Appendix D.1**). This historic site is located on Bethania-Tobaccoville Road (NC 65). These four Detailed Study Alternatives would take land from the historic site for a southbound interchange exit ramp. The right of way extends just into the east property boundary. The other four Detailed Study Alternatives, WEST-A, WEST-B, C3-WEST-A, and C3-WEST-B (Preferred) would have no adverse effect on the John Henry Kapp Farm (see May 1, 1992 concurrence form in **Appendix D.1**).

In a concurrence form dated April 21, 2004 (**Appendix D.1**), the SHPO determined that the Project R-2247 Preferred Alternative would have no adverse effect on this historic resource. The no adverse effect determination comes with the condition that NCDOT shall not approve any new driveway permits along the property of the John Henry Kapp Farm within the right of way for the Preferred Alternative. This condition shall be filed in NCDOT Division office responsible for driveway permits. It is assumed that Detailed Study Alternatives WEST-A, WEST-B, and C3-WEST-A also would have no adverse effect on the historic resource with the same condition since their designs would be similar to the Preferred Alternative's design in this location.

Eugene Thomas Kapp House and Kapp's Mill Miller's House (Figure 2-10d). These two resources are adjacent to the Thomas Jefferson Kapp House, described below. None of the Detailed Study Alternatives would impact these resources. The nearest Detailed Study Alternatives are EAST-A, EAST-B, C2-EAST-A, and C2-EAST-B, which are about 1,400 feet west of the properties.

Thomas Jefferson Kapp House (Figure 2-10d). None of the Detailed Study Alternatives would impact this resource, which is located on Kapp Road just north of Mill Creek No. 3. The nearest Detailed Study Alternatives are EAST-A, EAST-B, C2-EAST-A, and C2-EAST-B, which is about 1,400 feet west of the property. In a concurrence form dated May 1, 1992, the SHPO determined that all the Detailed Study Alternatives would have No Effect on the Thomas Jefferson Kapp House (see **Appendix D.1**).

John S. Shore Farm (Figure 2-10d). This resource is located on Bethania-Tobaccoville Road south of the Samuel Stauber House and Barn. None of the Detailed Study Alternatives would directly impact the site.

Samuel Stauber House and Barn (Figure 2-10d). Based on the 1992 functional designs, all of the Project R-2247 Detailed Study Alternatives would have an adverse effect on the Samuel Stauber House and Barn (see May 1, 1992 concurrence form in **Appendix D.1**). All Detailed Study Alternatives would each introduce a new highway and interchange at Bethania-Tobaccoville Road, in close proximity to the historic property. No land would be taken for the project, but the project would alter the character of the property's setting, diminishing its

integrity, and would introduce visual elements that are out of character with the property. The use of vegetative screening and/or earthen embankments within the right of way may be used to lessen the visual, and to some extent, the audible impacts of the project on the historic property. Modifications made to the Preferred Alternative in the 1995 preliminary engineering design moved the Bethania-Tobaccoville Road interchange 300 feet north, which resulted in a change in determination to no adverse effect. During final design in the mid-1990s, a service road proposed at the Bethania-Tobaccoville Road interchange resulted in a second determination of Adverse Effect. In the 2002 preliminary engineering design, the Bethania-Tobaccoville Road interchange was moved northeast and Bethania-Tobaccoville Road relocated. This change resulted in a no adverse effect determination for the Project R-2247 Preferred Alternative by the HPO in a concurrence form dated March 1, 2004 (see **Section 4.4.3.3** for more details).

All of the Detailed Study Alternatives are similar in the vicinity of the Samuel Stauber House and Barn. Therefore, it is assumed that the 1992 functional designs for the non-preferred Detailed Study Alternatives could be modified to have no adverse effect on the Samuel Stauber House and Barn much like the modification to the 2002 preliminary engineering design for the Project R-2247 Preferred Alternative.

Columbus Kapp House and Barn (Figure 2-10e). Based on the 1992 functional designs, Detailed Study Alternatives WEST-A, EAST-A, C3-WEST-A, and C2-EAST-A would have an adverse effect on the Columbus Kapp House and Barn (see May 1, 1992 concurrence form in **Appendix D.1**). The project would not take land from the historic site, but would introduce a major interchange immediately adjacent to the northern boundary of the historic property. The project would alter the character of the property's setting, diminishing its integrity. The use of vegetative screening and/or earthen embankments within the right of way may be used to lessen the visual, and to some extent, the audible impacts of the project on the historic property. Detailed Study Alternatives WEST-B, EAST-B, C2-EAST-B, and C3-WEST-B (Preferred) would have No Effect on this property (see May 1, 1992 concurrence form in **Appendix D.1**).

4.4.3.3 Historic Resources - Project R-2247 Preferred Alternative

As shown in **Table 4-18**, the Preferred Alternative's 2002 preliminary engineering design was determined to have No Effect on six of the seven additional historic architectural resources identified in the updated 2002-2003 historic architectural resources survey. One of the seven historic resources newly identified in 2002, the Alexander Hege House, was given a determination of Adverse Effect for the Project R-2247 Preferred Alternative (see concurrence form from the HPO dated March 1, 2004 in **Appendix D.1**).

Because of the determination of Adverse Effect, the Hege House was included in a Memorandum of Agreement (MOA) executed by FHWA and SHPO, and concurred in by NCDOT and the owner of the Hege House (see copy of MOA in **Appendix D.1**). The MOA specifies that

NCDOT would photographically record the existing conditions of the Hege House and its surroundings prior to construction, that the driveway would be aligned opposite the proposed ramp and would be under signal control, that access control fencing be designed in consultation with SHPO prior to its installation by NCDOT, and that NCDOT would provide tree protection and limit disturbance of plantings along the National Register boundary. The owner may pursue a preservation easement for the house.

Originally, based on the 1992 functional designs, the effect on the Samuel Stauber House and Barn was "adverse effect." In the 1996 Project R-2247 FEIS, the Preferred Alternative was considered to have no adverse effect on two properties, the John Henry Kapp Farm and the Samuel Stauber House and Barn. These determinations of effect were based on the 1995 preliminary engineering design. The revised determination of no adverse effect to the Samual Stauber House and Barn resulted from the relocation of the alignment in the preliminary design approximately 300 feet farther away from the property.

During the service road studies for the Bethania-Tobaccoville Road area conducted during final design activities after the 1996 Project R-2247 FEIS, the determination of effect to the Samuel Stauber House and Barn was changed again to "adverse effect" based on concern that a service road's fill would adversely effect the historic site's setting (see **Section 2.9.3.4**). In response, Bethania-Tobaccoville Road and the interchange were relocated about 860 feet east. Based on this new design, which was incorporated into the 2002 preliminary engineering design, the Preferred Alternative would have no adverse effect on the Samuel Stauber House and Barn (see concurrence form from the HPO dated March 1, 2004 in **Appendix D.1**).

In the 1996 Project R-2247 FEIS, the Preferred Alternative was considered to have "No Adverse Effect" on both the John Henry Kapp Farm and the Samuel Stauber House and Barn. In a concurrence form dated April 21, 2004 (see **Appendix D.1**), the SHPO agreed with the previous determination of "No Adverse Effect" on the John Henry Kapp Farm with the condition that NCDOT shall not approve any more driveway permits along the property of the John Henry Kapp Farm within the right of way of the Preferred Alternative.

4.4.3.4 Historic Resources - Project U-2579 Detailed Study Alternatives

Two properties were identified during the 1995 architectural resources survey of the Detailed Study Alternatives that were considered to be potentially eligible for the NRHP. The [Clayton Family Farm] site includes the Matthew Clayton House (FY 563) and the John Clayton House (FY 579), and is near the intersection of Stanleyville Drive and NC 66. The second site consists of the [Charles and John Fries Day Farm] (FY 507), and is located on Dippen Road near the intersection of Day Road. The following section is taken from the 1995 Project U-2579 DEIS (Section 4.1.7.1), which discusses the impacts of the Detailed Study Alternatives on the identified sites.

Neither of these two properties would be adversely impacted by any of the Detailed Study Alternatives. A brief discussion of the reasons why the two properties were determined not to be adversely affected by the proposed project is given below. Unless the property is situated between the two primary alternatives, only the closest alternative to each property is discussed. At the time of the study, both properties were included on the SHPO State Study List of potentially eligible properties. Current status of the properties is described in **Section 4.4.3.5**. Correspondence from the HPO is included in **Appendix D.1**.

John Clayton House (FY563) and Matthew Clayton House (FY 579) [Clayton Family Farm]. The original conclusion in the 1995 Project U-2579 DEIS was that the Western Detailed Study Alternative as well as Alternatives 2, 4, 6, 7, and 8 would have no effect as it passes north of the northernmost boundary of the historic property. These alternatives are located 1,000 feet north of the historic structures and include intervening woodlands. In addition, no interchange is planned between the proposed project and Stanleyville Drive; therefore, traffic would not increase on Stanleyville Drive adjacent to the property as a result of the proposed project. Since completion of the 1995 Project U-2579 DEIS, the Clayton Family Farm was listed on the National Register of Historic Places, with a larger site boundary than had been anticipated previously. **Section 4.4.3.5** updates this conclusion based on more recent information. The non-preferred alternatives as well as the Preferred Alternative could also be revised to miss the property. The Eastern Detailed Study Alternative as well as Alternatives 1, 3, and 5 are located approximately 2,500 feet from the historic site with the revised boundaries and no impacts are anticipated.

Charles and John Frieze Day Farm (FY 507) [Charles and John Fries Day Farm]. The property is located 1,900 feet from the point at which the Eastern Detailed Study Alternative joins with Crossover 3. These proposed alternatives would have no effect on the property due to this distance between them and the property, as well as intervening trees. In addition, no interchange is planned between the proposed project and Day Road, so traffic would not increase on Day Road adjacent to the property as a result of the proposed project. The Western Detailed Study Alternative would have no impact due to its location 3,000 feet from the property, an intervening subdivision and woods, and no traffic impact.

No changes to the historic properties are expected to be caused by the proposed alternatives. No noise impacts to the historic resources are expected to be caused by the proposed alternatives that would detract from their eligibility to the National Register. A "no-effect" is appropriate because the proposed project would not change existing conditions.

It is concluded that proximity impacts of the proposed alternatives are not severe and would not substantially impair the protected activities, features, or attributes that qualify these two resources for eligibility on the NRHP.

4.4.3.5 Historic Resources - Project U-2579 Preferred Alternative

Table 3-10 lists the four properties on or eligible for the NRHP located in the Project U-2579 Preferred Alternative study area. These properties were identified during the 2003 architectural resources survey of the Preferred Alternative APE.

In a March 1, 2004 concurrence form, the SHPO concurred that the Preferred Alternative has no adverse effect with commitment (no net effect) on the Clayton Family Farm, no effect on Seaver's Gulf Station, and no adverse effect on the Hammock Family Farm. In an April 21, 2004 concurrence form, the SHPO concurred that the Preferred Alternative has no effect on the John and Charles Fries Day Farm.

The Preferred Alternative construction limits are adjacent to the Clayton Family Farm, approximately 180 feet from the Hammock Family Farm property; 2,200 feet from Seaver's Gulf Station; and 2,800 feet from the John and Charles Fries Day Farm. In a March 1, 2004 concurrence form, the HPO agreed that the Project U-2579 Preferred Alternative would have no adverse effect on the Clayton Family Farm with the condition that any trees that would be removed during construction will be replaced with a similar species. The SHPO agreed that there would be no adverse effect to the Hammock Family Farm provided that no construction occurs within the historic boundary and no effect to Seaver's Gulf Station. In an April 21, 2004 concurrence form, the SHPO agreed that since there were no design changes in the Preferred Alternative near the John and Charles Fries Day Farm, the previous determination of no effect is still applicable.

The historic property boundary of the Clayton Family Farm was expanded when the site was listed on the NRHP in 2001. Due to the revised boundary, the original location of the Preferred Alternative in that location would have impacted the Clayton Family Farm. As a result, the Preferred Alternative has been shifted to avoid impact to the site. Stanleyville Drive would be closed during construction of the grade separation to avoid impact to the Clayton Family Farm. Minor temporary construction easements would be needed during construction, but there would be no permanent encroachment, and the impacted portion of the property would be restored to its original condition.

4.4.3.6 Historic Resources - Project U-2579A Detailed Study Alternatives

Based on the architectural resources survey, there are no properties that are on or eligible for the NRHP in the Project U-2579A Detailed Study Alternative APE. The Wilson-Stockton House is located along Kernersville Road west of the Detailed Study Alternatives (see **Figure 2-19**), and was identified in the *U-2579A Feasibility Study* (January 1996). The preliminary alternatives were designed to avoid impacting the Wilson-Stockton House, which is currently 2,200 feet from the right of way of Segment N1. As indicated in their February 5, 2004 letter (in **Appendix D.1**),

the SHPO concurred that the Motsinger Family Farm is not eligible for listing on the NRHP. In a letter dated March 5, 2004, the SHPO concurred that the John and Catherine Bodenhamer House is also not eligible for listing on the NRHP (see **Appendix D.1**). In a memorandum dated March 3, 2005, the SHPO concurred that the E.J. Disher Retreat (Hart Farm) is not eligible for listing on the NRHP (see **Appendix D.1**).

4.5 SECTION 4(f) AND 6(f) RESOURCES

4.5.1 Background Information

If land from a Section 4(f) resource (a significantly publicly owned park, recreation area, or wildlife and waterfowl refuge, or any significant historic site) would be used due to a proposed United States Department of Transportation (USDOT) action, a separate document called a Section 4(f) Evaluation would need to be prepared. This study would evaluate whether there is a feasible and prudent alternative to the use of land from a Section 4(f) resource and whether the proposed action includes all possible planning to minimize harm to the resource resulting from its use.

A Section 4(f) use occurs when there is a permanent incorporation of land into a transportation facility, an adverse temporary occupancy, or a "constructive use."

Constructive use is defined in 23 CFR Section 771.135(p)(2), as follows:

> "Constructive use occurs when the transportation project does not incorporate land from a Section 4(f) resource but the project's impacts due to proximity are so severe that the activities, features, or attributes that qualify a resource for protection under Section 4(f) are substantially impaired. Substantial impairment would only occur when the utility of the resource in terms of its prior significance is substantially diminished or destroyed, amounting to an indirect taking of such activities, features or attributes."

For historic resources, a determination of "Adverse Effect" under 36 CFR Part 800 does not necessarily mean there is a 'constructive use' of the site (FHWA, 1989, Chapter 3). The adverse effect would have to be a direct taking or determined to be an indirect taking as defined above.

4.5.2 Combined Direct Impacts to Section 4(f)/6(f) Resources

Table 4-19 combines the Preferred Alternatives for Projects R-2247 and U-2579 with each Detailed Study Alternative for Project U-2579A to show the total number of impacts to Section 4(f) and Section 6(f) resources.

Table 4-19: Combined Direct Impacts to Section 4(f)/6(f) Resources – Projects R-2247, U-2579, and U-2579A

Project	Alternative	Section 4(f) Resources Impacted	Section 6(f) Resources Impacted
R-2247 and **U-2579 Preferred Alternatives plus U-2579A Detailed Study Alternatives***	N1-S1	0	0
	N1-S2	0	0
	N2-S1 (Preferred Alternative)	**0**	**0**
	N2-S2	0	0
	N3-S1	0	0
	N3-S2	0	0

Impacts are based on 2005 preliminary engineering designs for the Project R-2247, U-2579, and U-2579A Preferred Alternatives, and are based on the 2002 preliminary engineering designs for the Project U-259A non-preferred alternatives.
*Results are the same for Project U-2579A alternatives with or without Kernersville Road interchange.

4.5.3 Western Portion of the Study Area - Project R-2247

4.5.3.1 Section 4(f) and 6(f) Resources - Project R-2247 Detailed Study Alternatives

There are no resources in the western portion of the study area protected under Section 6(f) of the Land and Water Conservation Fund Act.

No archaeological properties recorded from the Sample Survey have been identified as requiring preservation in place, so consequently no Section 4(f) evaluations for archaeological resources are known to be necessary.

There are resources protected under Section 4(f) in, or affected by, one or more of the Project R-2247 Detailed Study Alternatives. These include the new Meadowlark Road Park and five historic resources: Pfafftown Historic District, John Henry Kapp Farm, Columbus Kapp House and Barn, Samuel Stauber House and Barn, and the recently identified Alexander Hege House (identified in the 2002-2003 historic resources surveys).

The Section 106 Adverse Effect determinations for Columbus Kapp House and Barn, Samuel Stauber House and Barn and Alexander Hege House from one or more Project R-2247 Detailed

Study Alternatives did not involve direct taking of property from these sites. Rather, the adverse effects were based on proximity to the property and alteration of the character and setting of the property. For these properties, further evaluation was conducted to determine if the indirect impacts that triggered the Adverse Effect determination constituted 'constructive use.'

Meadowlark Park. This land, near Meadowlark Elementary and Middle Schools, was acquired after the *1996 Project R-2247 FEIS*. It would be directly impacted by Detailed Study Alternatives EAST-A, EAST-B, C2-EAST-A, and C2-EAST-B (see **Figure 2-10b**). A Section 4(f) Evaluation would have been required for the Meadowlark Park if one of these four Detailed Study Alternatives were selected.

Pfafftown Historic District. The eastern portion of this historic district would be directly impacted by Detailed Study Alternatives EAST-A, EAST-B, C2-EAST-A, and C2-EAST-B (see **Figure 2-10c**). A Draft 4(f) evaluation for this property, which includes a study of possible avoidance alternatives, was conducted for the original 1996 Project R-2247 FEIS, and would have needed to be updated if one of these four Detailed Study Alternatives were selected.

John Henry Kapp Farm. Based on the 1992 functional designs, Detailed Study Alternatives EAST-A, EAST-B, C2-EAST-A, and C2-EAST-B would use land from the John Henry Kapp Farm for a southbound interchange exit ramp. The taking of land from the NRHP property would require a Section 4(f) Evaluation showing that no feasible and prudent alternative to the taking of historic property exists if Detailed Study Alternative EAST-A, EAST-B, C2-EAST-A, or C2-EAST-B was selected. The other four Detailed Study Alternatives, WEST-A, WEST-B, C3-WEST-A, and C3-WEST-B (Preferred) would not have a constructive use of the John Henry Kapp Farm based on the reasons listed below. Therefore, further evaluations under Section 4(f) are not required if Detailed Study Alternative WEST-A, WEST-B, C3-WEST-A, or C3-WEST-B (Preferred) is selected.

1. Detailed Study Alternatives WEST-A, WEST-B, C3-WEST-A, and C3-WEST-B (Preferred) would not have noise impacts on the property since the predicted levels are below the FHWA noise abatement criteria (67 dBA). Detailed Study Alternatives WEST-A, WEST-B, C3-WEST-A, and C3-WEST-B (Preferred) would not use any land from the John Henry Kapp Farm.
2. Access to the property would be maintained due to an interchange at NC 67 (Reynolda Road).
3. The primary view of the buildings, from Transou Road, would not be obstructed or eliminated.
4. In a concurrence form dated April 21, 2004 (see Appendix D.1), the SHPO determined the Preferred Alternative has no adverse effect on the John Henry Kapp Farm with the condition that NCDOT shall not approve any more driveway permits along the property of the John Henry Kapp Farm within the right of way for the Preferred Alternative.

Samuel Stauber House and Barn. None of the Detailed Study Alternatives would cause a direct use or a constructive use of this historic property based on the reasons listed below. Therefore, further evaluations under Section 4(f) are not required.

1. None of the Detailed Study Alternatives would have noise impacts on the property since the predicted levels are below the FHWA noise abatement criteria (67 dBA). None of the Detailed Study Alternatives would use land from the Samuel Stauber House and Barn.
2. Access to the property would be maintained due to an interchange at Bethania-Tobaccoville Road.
3. The primary view of the buildings, from Bethania-Tobaccoville Road, would not be obstructed or eliminated.
4. The setting of the area has already been compromised by the introduction of a new subdivision to the west of the site, as well as an existing mobile home park. The introduction of this facility would neither substantially impair nor substantially diminish the integrity of the resource.
5. The 2002 preliminary engineering design for Detailed Study Alternative C3-WEST-B, the Preferred Alternative, relocated Bethania-Tobaccoville Road and moved the interchange 860 feet east, resulting in a determination of no adverse effect for the Preferred Alternative as currently proposed.

Columbus Kapp House and Barn. Based on the 1992 functional designs, Detailed Study Alternatives WEST-A, EAST-A, C2-WEST-A, and C2-EAST-A would have an adverse effect on the Columbus Kapp House and Barn. They would take no land from the site, but would introduce an interchange immediately adjacent to the northern boundary of the site, thereby altering the character of the property's setting and diminishing its integrity. However, this indirect effect would not constitute a constructive use of this historic property based on the reasons listed below. Therefore, further evaluations under Section 4(f) are not required.

1. The Detailed Study Alternatives have no noise impact on the property since the predicted levels are below the FHWA noise abatement criteria (67 dBA).
2. Access to the property would be maintained.
3. The primary view of the buildings, from the dirt road, would not be obstructed or eliminated. The surrounding area is wooded, and would remain so after completion of the project.
4. The rural setting of the resource has already been impaired by the presence of US 52. The introduction of a new facility would neither substantially impair nor substantially diminish the integrity of the resource.

Alexander Hege House. This site was newly identified in 2002 as listed in or eligible for listing in the NRHP. This site is located on the south side of Shallowford Road, just east of Bradford Place. It is near Detailed Study Alternatives WEST-A, WEST-B, C3-WEST-A, and C3-WEST-B (Preferred). The HPO, in a concurrence form dated March 1, 2004 (**Appendix D.1**), determined that the Project R-2247 Preferred Alternative would have an adverse effect on this historic resource. A Memorandum of Agreement (MOA) was executed in March 2006 to take into account the effects of the undertaking on the Alexander Hege House (see **Section 4.4.3.4** and **Appendix D.1**). It is assumed that Detailed Study Alternatives WEST-A, WEST-B, and C3-WEST-A also would have an adverse effect on the historic resource since they would have a common alignment in this location.

Detailed Study Alternatives WEST-A, WEST-B, C3-WEST-A, and C3-WEST-B (Preferred) would take no land from the site, but would introduce an interchange immediately adjacent to the northern boundary of the site altering the character of the property's setting and diminishing its integrity. However, this indirect effect would not constitute a constructive use of this historic property based on the reasons listed below. Therefore, further evaluations under Section 4(f) are not required.

1. The Detailed Study Alternatives have no noise impact on the on the property since the predicted levels are below the FHWA noise abatement criteria (67 dBA).
2. Access to the property would be maintained due to an interchange at Shallowford Road.
3. The setting of the area has already been compromised by the introduction of a new subdivision adjacent to the western parcel boundary (Bradford Place). The introduction of the proposed roadway would neither substantially impair nor substantially diminish the integrity of the resource.
4. The primary view of the buildings, which is from Shallowford Road, would not be obstructed or eliminated.

4.5.3.2 Section 4(f) and 6(f) Resources - Project R-2247 Preferred Alternative

Based on the 2005 preliminary engineering design for the Project R-2247 Preferred Alternative, no Section 6(f) or Section 4(f) resources would be impacted. As discussed in **Section 4.5.3.1**, the Preferred Alternative would make no constructive use of Samuel Stauber House and Barn, John Henry Kapp Farm, or the Alexander Hege House, and no 4(f) evaluations are necessary.

4.5.4 Eastern Portion of Study Area - Projects U-2579/U-2579A

4.5.4.1 Section 4(f) and 6(f) Resources - Project U-2579 Detailed Study Alternatives

There are no Section 6(f) resources that would be impacted by Project U-2579 Detailed Study Alternatives. Of the five resources protected by Section 4(f) in the eastern portion of the study area, one (the Clayton Family Farm) could have been impacted by one or more of the Detailed Study Alternatives prior to alignment shifts.

The nearest Detailed Study Alternative right of way is approximately 1,900 feet from the John and Charles Fries Day Farm (Detailed Study Alternatives 2, 3, 4, 5, 8, and the Eastern Detailed Study Alternative).

Salem Lake Park is 450 feet from Detailed Study Alternatives 2, 7, and the Eastern Detailed Study Alternative, and abuts Detailed Study Alternatives 1, 3, 4, 5, 6, 8, and the Western Detailed Study Alternative.

The Clayton Family Farm is located at the northeast corner of the intersection of Old Hollow Road (NC 66) and Stanleyville Drive. Although the original Detailed Study Alternatives 2, 4, 6, 7 (Preferred), 8, and the Western Detailed Study Alternative would have impacted the property, the alignment of the Preferred Alternative was adjusted to avoid the site. Because the Western Alternative as well as Alternatives 2, 4, 6, and 8 have similar alignments to the Preferred Alternative in this area, they could also avoid this site and a Section 4(f) evaluation would not be required.

4.5.4.2 Section 4(f) and 6(f) Resources - Project U-2579 Preferred Alternative

Based on the preliminary engineering design for the Project U-2579 Preferred Alternative from the 1995 Project U-2579 DEIS, there would be no use of Section 4(f) resources. The Preferred Alternative was redesigned to avoid permanent impacts to the Clayton Family Farm. There would be temporary construction easements on the property, but the impacted property would be restored to its original condition. The Section 4(f) regulations discuss temporary impacts under 49 USC 303 Section 771.135(p)(7):

> A temporary occupancy of land is so minimal that it does not constitute a use within the meaning of Section 4(f) when the following conditions are satisfied:
>
> (i) Duration must be temporary, i.e., less than the time needed for construction of the project, and there should be no change in ownership of the land;

(ii) Scope of the work must be minor, i.e., both the nature and the magnitude of the changes to the Section 4(f) resource are minimal;

(iii) There are no anticipated permanent adverse physical impacts, nor will there be interference with the activities or purpose of the resource, on either a temporary or permanent basis;

(iv) The land being used must be fully restored, i.e., the resource must be returned to a condition which is at least as good as that which exited prior to the project; and

(v) There must be documented agreement of the appropriate Federal, State, or local officials having jurisdiction over the resource regarding the above conditions.

All of the above conditions will be satisfied under the terms of the proposed temporary construction easements.

4.5.4.3 Section 4(f) and 6(f) Resources - Project U-2579A Detailed Study Alternatives

There are no Section 4(f) or Section 6(f) resources that would be affected by the Project U-2579A Detailed Study Alternatives, including the Preferred Alternative. Union Cross Park, which is a Section 4(f) and a Section 6(f) resource, is 1,450 feet from the southern segments (S1 and S2). Salem Lake Park, a 4(f) resource, is located 1,750 feet from the northern segments (N1, N2, and N3).

4.6 VISUAL IMPACTS

Although the study area contains many structures of historic significance, no natural features in the study area have been identified as having unique visual or aesthetic values for which some public scenic protection or designation has been made. This analysis of visual and aesthetic impacts is limited to addressing publicly-accessible views of the landscape, which are confined primarily to roadways and public lands. Viewer groups include those with views from the project and those with views of the project.

The roadway would diminish the rural, pastoral atmosphere of the area local to the project. However, due to the natural change in elevation, the extensive areas of cut in areas out of the floodplain, and tall trees in the area, much of the roadway would probably not be visible from areas other than its immediate vicinity. Given the growth plan described in *The Legacy Plan*, residential development in the area will convert much of the study area, changing the existing rural, pastoral atmosphere to one of a more developed, suburban character.

The alternative routes for Project R-2247 increase in elevation from roughly 700 feet at the southern end to 800-850 feet at the middle segments, and 900-950 feet at the northern terminus. The proposed roadway, characterized by gentle turns and changes in elevation, would probably provide scenic views of the area's valleys, hills, wooded areas, streams, and cultural features (farmhouses and agricultural operations, fences, and developed areas).

Groups with a view of the road would include adjacent property owners, some recreational area users, single-family residential and suburban residents, as well as commercial and industrial areas. The EAST Detailed Study Alternatives (EAST-A, EAST-B, C2-EAST-A, C2-EAST-B) pass adjacent to the Grandview Golf Course.

Future development of linear greenways along Silas Creek, Muddy Creek, and Grassy Creek would bring recreational users in close proximity to portions of all Project R-2247 Detailed Study Alternatives south of I-40 (Silas Creek and Muddy Creek), to portions of the EAST Detailed Study Alternatives from I-40 to Robinhood Road (Muddy Creek), and the southernmost interchange at US 52 (Grassy Creek).

The Project U-2579 and Project U-2579A study area is characterized by gently rolling to steep hills with fairly broad interstream divides. Elevations, above sea level, generally range from about 800 feet at Salem Lake to around 1,000 feet at Walkertown Road. The land uses surrounding and within the project study area primarily consist of residential development with some extensive forested areas. Commercial and retail development is located along the major roads within the project study area. The area is experiencing growth, including the development of several new housing developments and is slowly shifting toward a more urban environment.

All of the Detailed Study Alternatives for Projects U-2579 and U-2579A have the potential to offer opportunities for creating visually pleasing views from the highway, such as views of valleys, hills, wooded areas, streams, and cultural features (farmhouses and agricultural operations, fences, and developed areas). Conversely, the Detailed Study Alternatives have the potential to detract from the existing views of rural areas. Visually pleasing aspects of the highway and views from the highway were explored during the selection of alternatives and will be further studied and developed in the design phase.

Between US 52 and New Walkertown Road (US 311), portions of the Project U-2579 Preferred Alternative are near existing residential developments and could have a range of visual impacts on residents and others. Those whose views would be impacted by the road would include adjacent property owners, some recreational area users, and rural and suburban residents. Some areas affected by the route in this area are generally not as rural or scenic; therefore, the degree of visual impact would be less. These less rural areas include the scattered commercial development that occurs between New Walkertown Road (US 311) and US 421/I-40 Business, particularly

along West Mountain Street. This commercial development is generally along the major roads that would be served by interchanges.

Businesses and residences are interspersed along the U-2579A project study area. In general, the land between I-40 and US 311 is more rural than the area between US 421/I-40 Business and I-40. Recent development has reduced the natural scenic views, and the degree of visual impact has in turn lessened, although more residents would experience visual impacts. This is especially noticeable in Segment S2 (not part of the Preferred Alternative), where new residential subdivisions have been constructed since 2001. The three northern alternatives are located through similar land uses, and therefore have similar visual impacts.

The aesthetic quality of the adversely affected areas would be improved by the following measures, which will be considered during final design:

- Curvilinear design of the roadway to blend with landscape.
- Landscape including trees, shrubs, and ground cover and/or revegetation with indigenous species of the cut and fill slopes.
- Structural design (such as drainage structures and bridges) consideration to enhance visual appearance.
- Bifurcated roadways (opposing lanes on roadways on different grades) to blend better with existing topographical features.
- Natural earth berms for mitigation of noise and visual impacts.

4.7 AIR QUALITY

4.7.1 Combined Direct Microscale Air Quality Impacts

Based on the microscale modeling described in subsequent sections, none of the Detailed Study Alternatives for Projects R-2247, U-2579, or U-2579A are predicted to cause exceedances of the National Ambient Air Quality Standard for carbon monoxide in 2005, 2010, or 2025.

Analysis of the Preferred Alternatives used recent (2000-2002) background concentrations and persistence factors available from the NC Division of Air Quality at their website (*www.daq.state.nc.us/permits/mets/alerts.shtml*). The background concentration for the Forsyth County/Winston-Salem region is 2.7 (ppm) and the persistence factor is 0.80.

4.7.2 Microscale Analyses in Western Portion of Study Area

4.7.2.1 Air Quality - Project R-2247 Detailed Study Alternatives

The following discussion is from Section 4.5.1 of the 1996 Project R-2247 FEIS (page 4-48).

A microscale air quality analysis was performed to determine future carbon monoxide (CO) concentrations resulting from the proposed Detailed Study Alternatives. *Caline 3 – A Versatile Dispersion Model for Predicting Air Pollutant Levels Near Highways and Arterial Streets* was used to predict the carbon monoxide concentrations at the project right-of-way limits.

The following inputs were included in the mathematical model to estimate hourly carbon monoxide concentrations: a level roadway under normal conditions with predicted traffic volumes, vehicle emission factors, and meteorological parameters. The traffic volumes are based on the annual average daily traffic projections. The modeling analysis was performed for a worst case condition using winds blowing parallel to the roadway. Carbon monoxide vehicle emission factors were calculated for the year 2005 and 2015 using the US Environmental Protection Agency (EPA) publication *Mobile Source Emission Factors* and the accompanying Mobile 4 computer program.

The minimum proposed right-of-way line was determined to be the closest point to the Beltway and was used in the analysis as the worst-case scenario. The 2005 and 2015 traffic volumes with parallel wind conditions were predicted to result in a maximum one-hour CO concentration of 3.2 ppm [parts per million] for 2005 and 3.6 ppm for 2015. Comparison of the predicted CO concentrations with the National and North Carolina Ambient Air Quality Standards (maximum one hour, 35 ppm; 8-hour average, 9 ppm) indicates no violation of these standards.

As described in the next section (**Section 4.7.2.2**), updated microscale air quality analyses were conducted for the Project R-2247 Preferred Alternative using the latest traffic projections, the latest dispersion model CAL3QHC, and the emissions factor model MOBILE6.2. The results for the Project R-2247 Preferred Alternative indicate projected maximum CO concentrations well below the 1-hour and 8-hour standards in 2005, 2010, and 2025. It can be estimated that because the results for the Project R-2247 Preferred Alternative are well below the National Ambient Air Quality Standards (NAAQS), none of the other Detailed Study Alternatives would cause exceedances of the NAAQS since traffic volumes would be similar and the interchange locations would be the same.

4.7.2.2 Air Quality - Project R-2247 Preferred Alternative

Methodology. The microscale air quality analysis for the Project R-2247 Preferred Alternative is documented in the *Air Quality Assessment for the Winston-Salem Northern Beltway Western Section Technical Memorandum* (February 2004), *Addendum #1* (May 2004), and *Addendum #2* (June 2006) appended by reference. A summary of the methodology, procedures, and results is provided below. The background concentration and persistence factor are updated as described in **Section 4.7.1**.

The guidance contained in the North Carolina Department of Environment and Natural Resources Division of Air Quality's G*uidelines for Evaluating the Air Quality Impacts of Transportation Facilities* (1999) and the Environmental Protection Agency's *Guideline For Modeling Carbon Monoxide From Roadway Intersections* (1992) were used in this analysis.

Carbon monoxide concentrations at a receiver near a roadway are comprised of two components: local and background concentrations. The local concentration is the carbon monoxide emissions from motor vehicles on roadways in proximity to a receiver. The background concentration is the concentration at a receiver that is the result of emissions outside the local vicinity.

The background, or ambient, concentrations vary by region and are based on air quality monitoring data and regional modeling. For the project area, the background hourly average carbon monoxide concentration is estimated to be 2.7 ppm (NC DENR, March 2003, model alert documented at *www.daq.state.nc.us/permits/mets/alerts.shtml*). Estimates of 8-hour average concentrations are calculated by multiplying the 1-hour average levels by the persistence factor, which accounts for variations in traffic and meteorological conditions over time. For the project area, the persistence factor is 0.80 (NC DENR, 2003).

The local microscale carbon monoxide concentrations were estimated using the EPA line source dispersion model CAL3QHC (1992), with input from the EPA's emission factor model MOBILE6.2 (2004). The model results were added to the background concentration to determine the total 1-hour and 8-hour carbon monoxide concentrations at a receiver near a roadway. These total values were then compared to the NAAQS to determine whether the receiver would experience air quality impacts.

The 2005, 2010, and 2025 project peak-hour traffic at selected project interchanges were modeled. To model the year 2005, the projected 2025 traffic volumes were used with the 2005 emission factors from MOBILE6.2. These assumptions will result in conservative (higher) values for 2005.

The intersection with the lowest level of service and highest delay was selected for modeling. This intersection is the Northern Beltway at Stratford Road (US 158). Receivers were modeled in all quadrants of the intersection and at nearby existing residences.

Analysis Results. Table 4-20 lists the predicted maximum 1-hour average CO concentrations for receivers modeled at the intersection. As shown in the table, model results indicate that microscale exceedances of state and federal ambient CO standards, 35 ppm for a 1-hour average and 9 ppm for an 8-hour average, would not occur along the Project R-2247 Preferred Alternative.

Table 4-20: Predicted Maximum Carbon Monoxide Concentrations – Project R-2247 Preferred Alternative

Interchange	Year	AM/ PM	Receiver Location	Maximum 1-Hour Avg. CO Concentration (ppm)*	Maximum 8-Hour Avg. CO Concentration (ppm)
US 158 (Stratford Road)	2005	AM	NE corner of intersection	4.2	3.4
		PM	NE corner of intersection	4.1	3.3
	2010	AM	NE corner of intersection	3.8	3.0
		PM	SE corner of intersection	3.8	3.0
	2025	AM	SE corner of intersection	3.7	3.0
		PM	NE corner of intersection	3.6	2.9

*ppm = parts per million CO = Carbon Monoxide. Updated to include 2000-2002 background concentrations and persistence factors from NC Division of Air Quality (March 2003).

4.7.3 Microscale Analyses in Eastern Portion of Study Area

4.7.3.1 Air Quality - Project U-2579 Detailed Study Alternatives

Air quality was analyzed in the *1995 Project U-2579 DEIS* for the Detailed Study Alternatives, and updated in February 2003 for the Preferred Alternative. The following discussion is from Section 4.5 of the 1995 Project U-2579 DEIS.

The effect of the various construction alternatives on ambient air quality was estimated using the CAL3QHC air dispersion computer model, emission factors computed from the Mobile 5a computer model, and the traffic volumes for Year 2020. These emission factors are put into the CAL3QHC model, which considers traffic volume, roadway geometry, and atmospheric conditions to project concentrations of CO at receptor sites near the modeled roadway.

This procedure was applied to year 2020 projected traffic volumes at two proposed interchange locations: the proposed interchange between the Eastern Detailed Study Alternative and US 421/I-40 Business and the proposed interchange between the Western Detailed Study Alternative

and US 421/I-40 Business. These locations were judged to be worst-case due to heavy traffic volumes, as well as nearby residential areas. The receptors were located at either the closest structures to the roadway in each quadrant of the interchange, or at the right-of-way line. One-hour concentrations for each receptor are summarized in **Table 4-21** and described in the *Technical Memorandum on Air Quality* (June 1995), which is appended by reference.

The maximum one-hour CO concentration is 3.9 ppm for the Eastern Detailed Study Alternative and 4.2 ppm for the Western Detailed Study Alternative. Comparison of the predicted CO concentrations with the NAAQS (maximum 1 hour = 35 ppm) indicates no violation of this standard. Because the maximum 1-hour concentration does not exceed the 8-hour standard of 9.0 ppm, no 8-hour analysis was required.

As described in the next section (**Section 4.7.3.2**), updated microscale air quality analyses were conducted for the Project U-2579 Preferred Alternative using the latest traffic projections, the latest dispersion model CAL3QHC, and the emissions factor model MOBILE6.2.

Table 4-21: Predicted Maximum Carbon Monoxide Concentrations – Project U-2579 Detailed Study Alternatives

Location	CO Concentration (parts per million)	
	Western Detailed Study Alternative	Eastern Detailed Study Alternative
Receptor 1	2.7	2.3
Receptor 2	2.8	2.8
Receptor 3	3.1	2.9
Receptor 4	3.5	2.7
Receptor 5	4.2	3.9
Receptor 6	3.0	3.5
Receptor 7	2.7	2.8
Receptor 8	3.2	3.1
Receptor 9	2.9	3.4
Receptor 10	2.9	2.8
Receptor 11	2.9	2.7
Receptor 12	3.2	3.0
Receptor 13	3.2	3.1
Receptor 14	3.0	2.9
Receptor 15	2.8	2.7
Receptor 16	2.8	3.0

Note: NAAQS maximum allowable 1 hour CO concentration = 35 ppm.
Source: Table 4-9 from 1995 Project U-2579 DEIS

4.7.3.2 Air Quality - Project U-2579 Preferred Alternative

The microscale air quality analysis for the Project U-2579 Preferred Alternative is documented in *Air Quality Analysis, Winston-Salem Northern Beltway, Eastern Section Technical Memorandum* (February 2003) and in the *Air Quality Technical Memorandum Addendum* (June 2006), appended by reference. A summary of the methodology, results, and conclusions is provided below. The background concentration and persistence factor are updated as described in **Section 4.7.1**.

Methodology. The same methodology described in **Section 4.7.2.2** was used for the analysis of the Project U-2579 Preferred Alternative, except that traffic volumes were projected for each analysis year. The "worst case" intersection, in terms of level of service, was selected for the 2003 air quality analysis. A traffic analysis was developed in November 2002 that evaluates the entire section of Project U-2579 between US 52 and Reidsville Road (US 158). Based on the traffic analysis, the signalized intersection of Northern Beltway Northbound Exit Ramp and US 158/Reidsville Road was selected for the air quality analysis.

The analysis was revised in the 2006 Adendum because of changes to the geometry of the interchange from a diamond interchange to a partial cloverleaf interchange. With the new interchange configuration, the worst case location was the intersection of the southbound ramps and Reidsville Road. A total of 32 receptors were selected at the proposed intersection, most located near the right-of-way line in each quadrant of the intersection.

Analysis Results. The modeling results shown in **Table 4-22** indicate the maximum predicted one-hour CO concentration at the Northern Beltway Northbound Exit Ramp and Reidsville Road (US 158) intersection would occur in the year 2005 and is predicted to be 5.30 ppm. Applying a 0.80 persistence factor, the eight-hour CO concentration is 4.24 ppm.

Comparing these results to the 1-hour standard of 35 ppm and 8-hour standard of 9 ppm indicates that the maximum predicted CO concentration for the design years of 2005, 2010, and 2025 would be less than the standard for each case (**Table 4-22**). Therefore, the CO emissions attributable to the proposed signalized intersection of Northern Beltway Northbound Exit Ramp and Reidsville Road (US 158) would not cause a violation of the state or NAAQS for CO.

Table 4-22: Predicted Maximum Carbon Monoxide Concentrations – Project U-2579 Preferred Alternative

Interchange	Year	Receiver Location	Maximum 1-Hour Avg. CO Concentration (ppm)	Maximum 8-Hour Avg. CO Concentration (ppm)
Northern Beltway NB Exit Ramp and Reidsville Rd (US 158)	2005	SW corner of Beltway and Reidsville Road	5.3	4.2
	2010	SE corner of Beltway and Reidsville Road	4.7	3.8
	2025	SE of Reidsville Road, SW of northbound exit ramp	3.0	2.4

Source: Table 1 from *Air Quality Analysis, Winston-Salem Northern Beltway, Eastern Section and Eastern Section Extension Technical Memorandum* (Addendum) (June 2006).

4.7.3.3 Air Quality - Project U-2579A Detailed Study Alternatives and Preferred Alternative

An air quality analysis for the Project U-2579A Detailed Study Alternatives was conducted in July 2002. The microscale air quality analysis is documented in *Air Quality Analysis, Winston-Salem Northern Beltway, Eastern Section Extension Technical Memorandum* (October 2002), appended by reference. The analysis for the Preferred Alternative is documented in the *Air Quality Technical Memorandum Addendum* (June 2006), appended by reference. A summary of the methodology, results, and conclusions is provided below. The background concentration and persistence factor are updated as described in **Section 4.7.1**.

Methodology. The same methodology described in **Section 4.7.2.2** was used for the analysis of the Project U-2579A Detailed Study Alternatives, except that traffic volumes were projected for each analysis year. The "worst case" intersection, in terms of level of service, was selected for the 2003 air quality analysis. A traffic analysis was developed in May 2002 that evaluates the entire section of Project U-2579A between US 421/I-40 Business and US 311. Based on the traffic analysis, the signalized intersection of Northern Beltway Northbound Exit Ramp and US 158/Kernersville Road (Segment N1) was selected for the air quality analysis. The analysis was revised in the 2006 Addendum because of changes to the geometry of the interchange from a diamond interchange to a single point urban interchange.

A total of 33 receptors were selected at the proposed intersection. Most of the receptors were located near the right-of-way line in each quadrant of the intersection.

Analysis Results. The modeling results shown in **Table 4-23** indicate the maximum predicted 1-hour CO concentration at the Northern Beltway ramps and Kernersville Road intersection

would occur in the year 2005 and is predicted to be 4.00 ppm. Applying a 0.80 persistence factor, the 8-hour CO concentration is 3.20 ppm.

Comparing these results to the 1-hour standard of 35 ppm and 8-hour standard of 9 ppm indicates that the maximum predicted CO concentration for the design years of 2005, 2010, and 2025 would be less than the standard for each case (**Table 4-23**). Therefore, the CO emissions attributable to the proposed signalized intersection of Northern Beltway Exit Ramps and Kernersville Road would not cause a violation of the state or NAAQS for CO.

Based on these results, it can be concluded that the Project U-2579A Preferred Alternative would not cause a localized exceedance of the CO ambient air quality standards.

Table 4-23: Predicted Maximum Carbon Monoxide Concentrations – Project U-2579A Detailed Study Alternatives and Preferred Alternative

Interchange	Year	Receiver Location	Maximum 1-Hour Avg. CO Concentration (ppm)	Maximum 8-Hour Avg. CO Concentration (ppm)
Northern Beltway NB Exit Ramp and US 158/ Kernersville Rd	2005	SE corner of interchange east of exit ramp	4.0	3.2
	2010	North side of Kernersville Rd between soutbound exit ramp and the Beltway	3.8	3.0
	2025	North side of Kernersville Rd between soutbound exit ramp and the Beltway	3.9	3.1

Source: Table 2 from *Air Quality Analysis, Winston-Salem Northern Beltway, Eastern Section and Eastern Section Extension Technical Memorandum* (June 2006).

4.7.4 State Implementation Plan (SIP) Consistency

Both the Clean Air Act and TEA-21 (Transportation Equity Act for the 21st Century) require conformity between a proposed transportation system and the State Implementation Plan (SIP). The transportation conformity regulations are intended to ensure that a state does not undertake federally funded or approved transportation projects, programs, or plans that are inconsistent with the state's obligation to meet and maintain the NAAQS. Metropolitan Planning Organizations (MPOs) must show that expected emissions from their transportation system are within the mobile source emission budgets in the applicable SIP. Transportation projects must come from conforming transportation plans/programs, and transportation plans/programs must conform to the SIPs.

The project is located in Forsyth County, which is within the Greensboro-Winston-Salem-High Point maintenance area for one hour ozone (O3) and the Winston-Salem nonattainment area for carbon monoxide (CO) as defined by the EPA The 1990 Clean Air Act Amendments (CAAA) designated these areas as moderate non-attainment area for O3 and CO. However, due to improved monitoring data, these areas were redesignated as maintenance for O3 on November 8, 1993 and for CO on November 7, 1994. Section 176(c) of the CAAA requires that transportation plans, programs, and projects conform to the intent of the state air quality implementation plan (SIP). The current SIP does not contain any transportation control measures for Forsyth County. The *Winston-Salem Urban Area 2030 Long Range Transportation Plan (LRTP)*, the *High Point MPO 2030 LRTP* and the 2006-2012 Metropolitan Transportation Improvement Programs (MTIPs) conform to the intent of the SIP. The USDOT made a conformity determination on the *Winston-Salem Urban Area 2030 LRTP* on October 1, 2005, the *High Point MPO LRTP* on October 1, 2004, the Winston Salem/Forsyth MPO MTIP on October 1, 2005 and the High Point MPO MTIP on October 1, 2005. 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.

Forsyth County was designated as a moderate nonattainment for O3 under the eight-hour ozone standard on April 15, 2004. Effective on November 22, 2004, EPA reclassified Forsyth County from a moderate nonattainment area to a marginal nonattainment area. Forsyth County is under an Early Action Compact and the effective date of the nonattainment designation has been deferred until December 31, 2006. 40 CFR Parts 51 and 93 is not applicable until December 31, 2007 (one year after the nonattainment designation becomes effective).

4.7.5 Other Air Quality Issues

Ozone is an item of concern related to air quality raised in the lawsuit against FHWA and NCDOT regarding Project R-2247. As discussed below, ozone pollution is addressed on a systems-wide or region-wide level, as it has been for the Triad area.

According to the FHWA's *Discussion Paper on the Appropriate Level of Highway Air Quality Analysis for a CE, EA/FONSI, and EIS* (April 7, 1986), "Ozone is not a concern at the project level, because it is an areawide pollutant which is analyzed in system-level planning as part of the SIP development process."

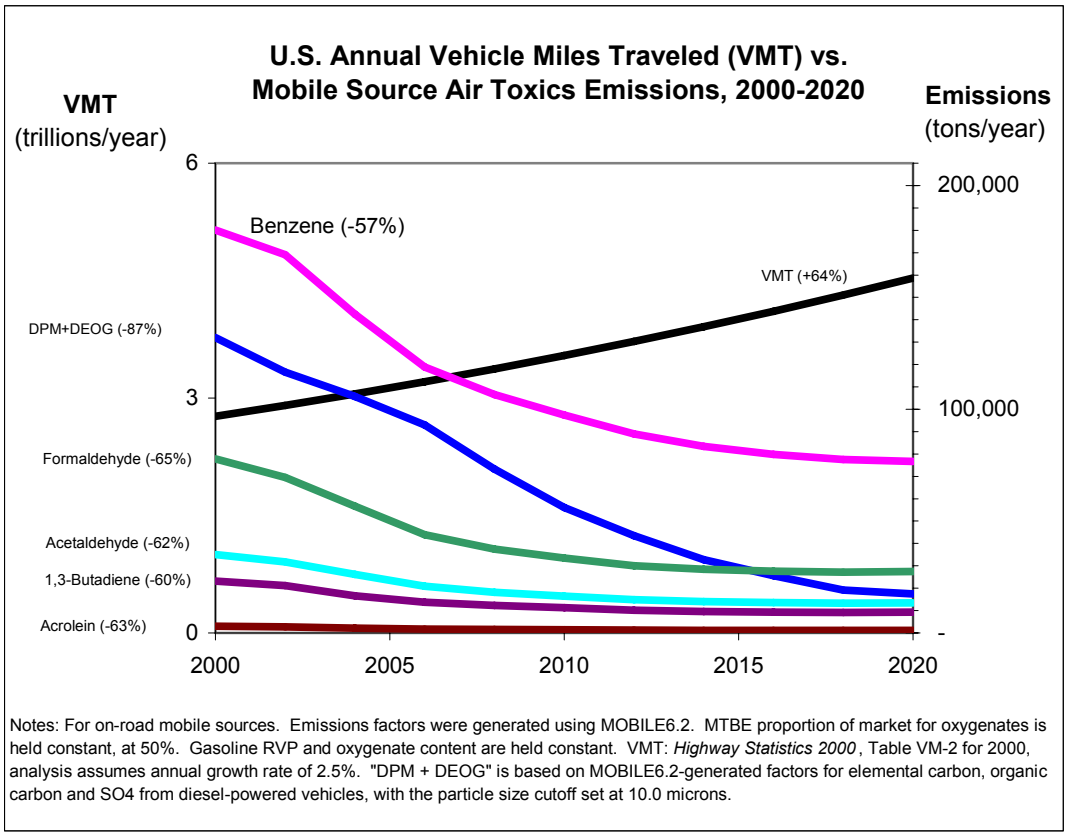
Also, the FHWA's *Technical Advisory* (T 6640.8A October 30, 1987) states, "Ozone (O_3), Hydrocarbons (HC), and Nitrogen Oxide (NOx) air quality concerns are regional in nature and, as such, meaningful evaluation on a project-by-project basis is not possible. Where these pollutants are an issue, the air quality emissions inventories in the State Implementation Plan (SIP) should be referenced and briefly summarized in the draft EIS." Based on FHWA guidelines, it is not necessary or feasible to determine how the Winston-Salem Northern Beltway would impact O_3, HC or NOx levels at the microscale level. However, one requirement of transportation conformity is that motor vehicle emissions be less than or equal to emissions budgets or caps set in the SIP. Emissions budgets are discussed below.

The emissions budget for the Triad area are set by the North Carolina Division of Air Quality (NCDAQ) at levels intended to ensure compliance with the relevant NAAQS. The emissions budget takes into account future growth in the area and vehicle miles traveled. The proposed Northern Beltway is incorporated in the latest emissions budget for the Triad.

This section also includes a basic analysis of the likely MSAT emission impacts of this project. Mobile Source Air Toxics (MSATs) are a subset of the 188 air toxics defined by the Clean Air Act. 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 and has certain responsibilities regarding the health effects of MSATs. The EPA issued a Final Rule on Controlling Emissions of Hazardous Air Pollutants from Mobile Sources. 66 FR 17229 (March 29, 2001). This rule was issued under the authority in Section 202 of the Clean Air Act. In its 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 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 PM emissions by 87 percent, as shown in the following graph:



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.

As a result, EPA concluded that no further motor vehicle emissions standards or fuel standards were necessary to further control MSATs. The agency is preparing another rule under authority of CAA Section 202(l) that will address these issues and could make adjustments to the full 21 and the primary six MSATs.

Available technical tools do not enable predictions of the project-specific health impacts of the emission changes associated with the alternatives in this EIS. 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, including emissions modeling, dispersion modeling in order to estimate ambient concentrations

resulting from the estimated emissions, exposure modeling in order to estimate human exposure to the estimated concentrations, and then final determination of health impacts based on the estimated exposure. Each of these steps is encumbered by technical shortcomings or uncertain science that prevents a more complete determination of the MSAT health impacts of this project.

1. Emissions: The EPA tools to estimate MSAT emissions from motor vehicles are not sensitive to key variables determining emissions of MSATs in the context of highway projects. While MOBILE 6.2 is used to predict emissions at a regional level, it has limited applicability at the project level. MOBILE 6.2 is a trip-based model--emission factors are projected based on a typical trip of 7.5 miles, and on average speeds for this typical trip. This means that MOBILE 6.2 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 limitation, MOBILE 6.2 can only approximate the operating speeds and levels of congestion likely to be present on the largest-scale projects, and cannot adequately capture emissions effects of smaller projects. For particulate matter, the model results are not sensitive to average trip speed, although the other MSAT emission rates do change with changes in trip speed. Also, the emissions rates used in MOBILE 6.2 for both particulate matter and MSATs are based on a limited number of tests of mostly older-technology vehicles. Lastly, in its discussions of PM under the conformity rule, EPA has identified problems with MOBILE6.2 as an obstacle to quantitative analysis.

   These deficiencies compromise the capability of MOBILE 6.2 to estimate MSAT emissions. MOBILE6.2 is an adequate tool for projecting emissions trends, and performing relative analyses between alternatives for very large projects, but it is not sensitive enough to capture the effects of travel changes tied to smaller projects or to predict emissions near specific roadside locations.

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 more than a decade ago for the purpose of predicting episodic concentrations of carbon monoxide to determine compliance with the NAAQS**.** The performance of dispersion models is more accurate for predicting maximum concentrations that can occur at some time at some location within a geographic area. This limitation makes it difficult to predict accurate exposure patterns at specific times at specific highway project locations across an urban area to assess potential health risk. The NCHRP is conducting research on best practices in applying models and other technical methods in the analysis of MSATs. This work also will focus on identifying appropriate methods of documenting and communicating MSAT impacts in the NEPA process and to the general public. Along with these general limitations of dispersion models, FHWA is also faced

with a lack of monitoring data in most areas for use in establishing project-specific MSAT background concentrations.

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 accurately calculate annual concentrations of MSATs near roadways, and to determine the portion of a year that people are actually exposed to those concentrations at a specific location. These difficulties are magnified for 70-year cancer assessments, particularly because unsupportable assumptions would have to be made regarding changes in travel patterns and vehicle technology (which affects emissions rates) over a 70-year period. 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. 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 other project impacts 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 noncancer 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.

There have been other studies that address MSAT health impacts in proximity to roadways. 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 final summary of the series is not expected for several years.

Some recent studies have reported that proximity to roadways is related to adverse health outcomes – particularly respiratory problems[1]. Much of this research is not specific to MSATs, instead surveying the full spectrum of both criteria and other pollutants. The FHWA cannot evaluate the validity of these studies, but more importantly, they do not provide information that would be useful to alleviate the uncertainties listed above and enable us to perform a more comprehensive evaluation of the health impacts specific to this project.

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[1] South Coast Air Quality Management District, Multiple Air Toxic Exposure Study-II (2000); 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.

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. Because of the uncertainties outlined above, a quantitative assessment of the effects of air toxic emissions impacts on human health cannot be 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 document, FHWA has provided a qualitative analysis of MSAT emissions relative to the various alternatives, and has acknowledged that all the project alternatives 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 estimated.

As discussed above, technical shortcomings of emissions and dispersion models and uncertain science with respect to health effects prevent meaningful or reliable estimates of MSAT emissions and effects of this project. However, even though reliable methods do not exist to accurately estimate the health impacts of MSATs at the project level, it is possible to qualitatively assess the levels of future MSAT emissions under the project. Although a qualitative analysis cannot identify and measure health impacts from MSATs, it can give a basis for identifying and comparing the potential differences among MSAT emissions – if any – from the various alternatives. The qualitative 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*.

For each alternative in this EIS, the amount of MSATs emitted would be proportional to the vehicle miles traveled, or VMT, assuming that other variables such as fleet mix are the same for each alternative. The VMT estimated for each of the Build Alternatives is slightly higher than that for the No Build Alternative, because the additional capacity increases the efficiency of the roadway and attracts rerouted trips from elsewhere in the transportation network. This increase in VMT would lead to higher MSAT emissions for the action alternative along the highway corridor, along with a corresponding decrease in MSAT emissions along the parallel routes. The emissions increase is offset somewhat by lower MSAT emission rates due to increased speeds; according to EPA's MOBILE6 emissions model, emissions of all of the priority MSATs except

for diesel particulate matter decrease as speed increases. The extent to which these speed-related emissions decreases will offset VMT-related emissions increases cannot be reliably projected due to the inherent deficiencies of technical models.

Because the estimated VMT under each of the Alternatives are expected to be nearly the same due to similar lengths, speeds, and access, it is expected there would be no appreciable difference in overall MSAT emissions among the various alternatives. Also, regardless of the alternative chosen, emissions will likely be lower than present levels in the design year as a result of EPA's national control programs that are projected to reduce MSAT emissions by 57 to 87 percent between 2000 and 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 in the study area are likely to be lower in the future in nearly all cases.

The alignments contemplated as part of the project alternatives will have the effect of moving some traffic closer to nearby homes, schools and businesses; therefore, under each alternative there may be localized areas where ambient concentrations of MSATs could be higher under certain Build Alternatives than the No Build Alternative. The localized increases in MSAT concentrations would likely be most pronounced along the new location roadway sections as well as the widening of existing routes at interchange locations for all alternatives. The greatest amount of widening would be at the interchanges with major highways such as I-40, US 52, and US 421/ I-40 Business. However, as discussed above, the magnitude and the duration of these potential increases compared to the No-build alternative cannot be accurately quantified due to the inherent deficiencies of current models. In sum, when new portions of highway are constructed or when a highway is widened and, as a result, moves closer to receptors, the localized level of MSAT emissions for the Build Alternative could be higher relative to the No Build Alternative, but this could be offset due to increases in speeds and reductions in congestion (which are associated with lower MSAT emissions). Also, MSATs will be lower in other locations when traffic shifts away from them. However, on a regional basis, EPA's vehicle and fuel regulations, coupled with fleet turnover, will over time cause substantial reductions that, in almost all cases, will cause region-wide MSAT levels to be significantly lower than today.

Lessening the effects of mobile source air toxics should be considered for projects with substantial construction-related MSAT emissions that are likely to occur over an extended building period, and for post-construction scenarios where the NEPA analysis indicates potentially meaningful MSAT levels. Such mitigation efforts should be evaluated based on the circumstances associated with individual projects, and they may not be appropriate in all cases. However, there are a number of available mitigation strategies and solutions for countering the effects of MSAT emissions.

Mitigating for Construction MSAT Emissions. Construction activity may generate a temporary increase in MSAT emissions. Project-level assessments that render a decision to pursue construction emission mitigation will benefit from a number of technologies and operational practices that should help lower short-term MSATs. In addition, the SAFETEA-LU has emphasized a host of diesel retrofit technologies in the law's CMAQ provisions - technologies that are designed to lessen a number of MSATs.[2]

Construction mitigation includes strategies that reduce engine activity or reduce emissions per unit of operating time. Operational agreements that reduce or redirect work or shift times to avoid community exposures can have positive benefits when sites are near vulnerable populations. For example, agreements that stress work activity outside normal hours of an adjacent school campus would be operations-oriented mitigation. Also on the construction emissions front, technological adjustments to equipment, such as off-road dump trucks and bulldozers, could be appropriate strategies. These technological fixes could include particulate matter traps, oxidation catalysts, and other devices that provide an after-treatment of exhaust emissions. The use of clean fuels, such as ultra-low sulfur diesel, also can be a very cost-beneficial strategy.

The EPA has listed a number of approved diesel retrofit technologies; many of these can be deployed as emissions mitigation measures for equipment used in construction. This listing can be found at: *www.epa.gov/otaq/retrofit/retroverifiedlist.htm*.

Post-Construction Mitigation for Projects with Potentially Significant MSAT Levels. Longer-term MSAT emissions can be more difficult to control, as variables such as daily traffic and vehicle mix are elusive. Operational strategies that focus on speed limit enforcement or traffic management policies may help reduce MSAT emissions even beyond the benefits of fleet turnover. Well-traveled highways with high proportions of heavy-duty diesel truck activity may benefit from active Intelligent Transportation System programs, such as traffic management centers or incident management systems. Similarly, anti-idling strategies, such as truck-stop electrification can complement projects that focus on new or increased freight activity.

Planners also may want to consider the benefits of establishing buffer zones between new or expanded highway alignments and areas of vulnerable populations. Modifications of local zoning or the development of guidelines that are more protective also may be useful in separating emissions and receptors.

The initial decision to pursue MSAT emissions mitigation should be the result of interagency consultation at the earliest juncture. Options available to project sponsors should be identified

[2] SAFETEA-LU, Public Law 109-59, August 10, 2005

through careful information gathering and the required level of deliberation to assure an effective course of action.

4.8 NOISE

4.8.1 Noise Impact Criteria and Noise Prediction Models

4.8.1.1 Noise Impact Criteria

Noise analyses were conducted in accordance with FHWA requirements as detailed in Part 772 of Title 23 of the Code of Federal Regulations (23 CFR 772), as well as the NCDOT guidelines outlined in the NCDOT Traffic Noise Abatement Policy (1992, 1996, and 2004) on highway noise.

Traffic noise impacts are defined in the FHWA regulations as project-generated noise levels that approach or exceed the FHWA Noise Abatement Criteria (NAC) or noise levels that are a substantial increase over existing noise levels. Noise abatement must be considered for impacted receivers in either case.

Table 4-24 lists the FHWA Noise Abatement Criteria. Approach values are defined by NCDOT as being 1 decibel (dB) less than the NAC shown in this table.

Table 4-24: FHWA Noise Abatement Criteria

Activity Category	Leq (h)*	L_{10} (h)*	Description of Activity Category
A	57 (Exterior)	60 (Exterior)	Land for 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 area is to continue to serve its intended purpose and need.
B	67 (Exterior)	70 (Exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals.
C	72 (Exterior)	75 (Exterior)	Developed lands, properties, or activities not included in Categories A or B above.
D	-	-	Undeveloped lands.
E	52 (Interior)	55 (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals and auditoriums.

* Either L_{10}(h) or L_{eq}(h), but not both, may be used on a project.

Prior to September 2004, a substantial increase impact was defined by NCDOT as follows:

- If the existing noise level is less than or equal to 50 dBA Leq, an increase of 15 dBA or more is considered substantial.
- If the existing noise level is greater than 50 dBA Leq, an increase of 10 dBA is considered substantial.

In September 2004, the NC Board of Transportation adopted a new Traffic Noise Abatement Policy. The September 2004 NCDOT Traffic Noise Abatement Policy included changes to the definition of "substantial increase" and a revision in how barrier cost-effectiveness is calculated.

NCDOT uses a 10 dBA to 15 dBA increase of future predicted noise levels above existing noise levels to define "substantial increase" in exterior noise levels. **Table 4-24-1** presents the new definition of a substantial increase and the sliding scale used to allow greater increase at a lower existing noise level before a "substantial" increase is defined.

Table 4-24-1: NCDOT Definition of Substantial Increase in Noise Levels

Existing Average Noise Level dBA Leq(hour)	Increase (in decibels) from Existing Noise Levels to Future Noise Levels
≤50	≥15
51	≥14
52	≥13
53	≥12
54	≥11
≥55	≥10

Source: North Carolina Department of Transportation Traffic Noise Abatement Policy (September 2004).

The sensitivity of an area to additional noise is a function of land use and background noise level. Some types of land use are more sensitive to noise than others, especially those associated with rest, relaxation, concentration, and communication. Examples of noise sensitive areas include residences, schools, churches, hospitals, libraries, public assembly halls, lodgings, and parks. Land use types that are less sensitive to noise include commercial, industrial, and agricultural uses.

4.8.1.2 Noise Prediction Models

Currently, there are two traffic noise prediction models FHWA and NCDOT allow to be used on federally-funded transportation projects, depending on the project situation. These two models are STAMINA 2.0 (1987) and the more recent TNM 2.5 (2004). It is NCDOT's policy that any new projects entering the planning process should use TNM, as detailed in a memo dated Apil 14, 2004 (in **Appendix I**). Projects that used STAMINA for studies prior to the release of TNM can continue through the planning process using STAMINA or can switch to TNM. However, once the planning process is complete through the Record of Decision (ROD) and the project enters the final design phase, the design noise reports should then use TNM.

4.8.2 Western Portion of Study Area

4.8.2.1 Noise - Project R-2247 Detailed Study Alternatives

This section is a summary of the noise analysis undertaken as part of the 1996 Project R-2247 FEIS (Section 4.5.8).

Analysis Methodology. The prediction of highway traffic noise is a complicated procedure. In general, the traffic situation is composed of a large number of variables that describe different cars driving at different speeds through a continually changing highway configuration and surrounding terrain. To assess the problem, certain assumptions and simplifications must be made.

The procedure used to predict future noise levels for the 1996 Project R-2247 FEIS was the STAMINA 2.0 and OPTIMA (revised March 1983) programs, based on the FHWA Highway Traffic Noise Prediction Model (FHWA-RD-77-108). These were the programs current at the time the analysis was prepared.

Design hour and level-of-service (LOS) C volumes were compared for the proposed project. The volumes that resulted in the "noisiest" conditions were used with posted speeds to predict future noise levels.

The STAMINA 2.0 computer model was used to estimate the number of land uses (by type), which during the peak hour in the design year 2015, would be exposed to noise levels approaching or exceeding the FHWA's Noise Abatement Criteria and those land uses predicted to expect a substantial noise increase.

Projected Impacts. **Table 4-25** is a summary of the projected number of receptors that would approach or exceed the FHWA Noise Abatement Criteria and/or substantially exceed the existing noise levels in 2015, as reported in the 1996 Project R-2247 FEIS (Section 4.5.8.3). The number of impacted residences predicted for the 2015 design year ranged from a low of 55 for Detailed Study Alternative WEST-A to a high of 122 for Detailed Study Alternative C2-EAST-B.

As shown in **Figure 2-10(a-e)**, there have been numerous new residential neighborhoods developed within and adjacent to the alignments since the mid-1990s, especially along the non-preferred Detailed Study Alternatives (see **Figure 2-10(a-e)**). It is likely additional receptors beyond those reported in the table below would be impacted in these new neighborhoods.

Table 4-26 (Table 4.5-8 from the 1996 Project R-2247 FEIS) contains the maximum predicted 2015 Leq noise levels in dBA for a given section of roadway at 100-, 200-, and 400-foot

distances measured from the center of the nearest travel lane. In addition, this table shows the contour distances measured from the center of the proposed highway to a point where the 67 dBA and 72 dBA noise levels can be expected.

Table 4-25: Traffic Noise Impact Summary – Project R-2247 Detailed Study Alternatives

Detailed Study Alternative	Number of Impacted Receivers Without Barrier[a]	Number of Impacted Receivers With Barrier[b]	Number of Proposed Feasible Barriers	Number of Homes Protected by Feasible Barriers[c]	Total Length of Feasible Barriers (feet)	Barrier Cost (Millions of Dollars)
WEST-A	55	21	2	53	4,200	0.987
EAST-A	92	66	2	76	5,600	1.131
WEST-B	78	21	4	93	8,600	1.573
EAST-B	115	66	4	116	10,000	1.717
C3-WEST-A	75	44	3	86	7,700	1.556
C2-EAST-A	99	50	3	122	7,700	1.543
C2-EAST-B	122	50	5	162	12,100	2.130
Preferred Alternative – Functional Design						
C3-WEST-B	**98**	**44**	**5**	**126**	**12,100**	**2.143**

a. Total receptors exceeding FHWA Noise Abatement Criteria.
b. Total impacted receptors remaining with proposed barriers in place.
c. Number of receptors that would experience >4 decibels of noise reduction. This includes some receptors that did not meet the criteria for item a.
d. **Bold** indicates the Preferred Alternative.
Source: Table 4.5-7 of the 1996 Project R-2247 FEIS.

The following paragraph is not from the 1996 Project R-2247 FEIS. It describes updated noise contour information that was developed in 2003.

Updated noise contour information was developed based on the updated traffic projections for 2025 (see **Figure 2-14a**), the most current typical cross-sections (see **Figure 2-6**), and a more current noise prediction model (TNM 2.0). As discussed in **Section 4.8.2.2**, the more recent model and 2025 traffic projections show the 2025 future noise levels would generally be about the same or slightly lower than those reported for the Detailed Study Alternatives in the 1996 Project R-2247 FEIS.

Noise Abatement Measures. Noise abatement measures must be considered for receptors that are predicted to approach or exceed the FHWA Noise Abatement Criteria or experience a substantial noise increase. Abatement measures can include alteration of the roadway alignment, purchase of land for use as a buffer zone, restrictions on vehicles, and noise barriers.

Alteration of the roadway alignment for noise purposes is not feasible. Moving the alignment away from one area would move is closer to another. Purchasing land for use as a buffer zone would cause the displacement of residences and, therefore, is not considered practical.

Table 4-26: 2015 Noise Contour Information from 1996 Project R-2247 FEIS

Location along Western Section of the Beltway	Maximum Predicted[1] Hourly Noise Levels (dBA Leq) for 2015 WEST-A/EAST-B			Contour[2] Distances (maximum feet) WEST-A/EAST-B	
	100 feet	200 feet	400 feet	67 dBA	72 dBA
US 158 to I-40	72/72	68/68	64/64	326/438	183/287
I-40 to US 421	72/72	68/68	64/64	303/462	177/305
US 421 to Country Club Road	72/74	68/70	64/64	376/488	207/343
Country Club Road to Robinhood Road	73/73	69/69	65/66	405/525	216/316
Robinhood Road to Yadkinville Road	72/72	68/69	64/65	376/495	207/309
Yadkinville Road to NC 67	72/72	68/68	64/64	386/454	229/300
NC 67 to Bethania-Tobaccoville Road	72/72	68/68	64/64	326/449	183/295
Bethania-Tobaccoville Road to US 52	70/70	6767	63/63	264/293	121/160

1. 100-foot, 200-foot, and 400-foot distances are measured from center of nearest traffic lane.
2. 67 dBA and 72 dBA contour distances are measured from center of proposed roadway.
3. Noise contours based on 2015 traffic projections using the traffic model that was available in the early 1990s.

Modeling has shown a reduction in the speed limit of 10 mph would result in a noise level reduction of approximately 1 to 2 decibels. Because most people cannot detect a noise reduction of 3 decibels (Bolt, Beranek, and Newman, Inc., 1972:1-20), and because reducing the speed limit would reduce roadway capacity, it is not considered a viable noise abatement measure. This and other traffic system management measures, including the prohibition of truck operations, are not considered to be consistent with the proposed project's purpose and need.

Solid noise barriers reduce noise levels by blocking the sound path between the noise source and noise sensitive areas. This measure is most often used on high-speed, limited access facilities where noise levels are high and there is adequate space for continuous barriers. Noise barriers may be constructed of a variety of materials either individually or combined, including concrete, wood, metal, earth, and vegetation.

For a noise barrier to provide sufficient noise reduction it must be high enough and long enough to shield the receptor from significant sections of the roadway. The barrier must also be feasible to construct as well as economically reasonable. The NCDOT *Noise Abatement Guidelines* (1992) provided guidance on determining the reasonableness and feasibility of providing noise barriers for impacted receivers identified in the 1996 noise analysis. Feasibility considers source/receiver relationships and the engineering aspects of constructing a barrier at impacted sites. Determination of feasibility includes consideration of whether a barrier can be built on the site topography and whether other noise sources are present in the area. Noise reductions of up to 10 decibels are usually attainable and should be at least 6 decibels. Access openings in barriers severely reduce the noise reduction provided by barriers, making barriers along roadways that lack access control generally unreasonable to construct.

An evaluation of reasonableness includes the following criteria: barrier cost, decibel reduction achieved, public support, the degree of noise impact, required sound barrier height, and consideration of potential safety and/or drainage problems. The barrier height should be no more than 25 feet. A reasonable barrier must be cost effective. At the time of the 1996 noise analysis, the NCDOT considered a cost-effective barrier as one that is no more than $25,000 per effectively protected site (a site having 5 decibel or more reduction), based on a cost of $15.00 per square foot of barrier. In general, barriers are not considered reasonable for businesses or isolated residences (NCDOT, 1992).

Thirteen noise barriers were evaluated in the *1996 Project R-2247 FEIS* for the segments used by the Detailed Study Alternatives. **Table 4-27** presents these thirteen barriers. Eight of these barriers, which are shown in **Figure 4-2**, were determined to be cost-effective and feasible based on the 1992 functional designs. **Table 4-28** lists which barriers would apply to each Detailed Study Alternative. **Table 4-25** lists the resultant reductions in numbers of impacted receptors.

Additional modeling of traffic noise and noise barriers would be accomplished after the final design plans are completed for the selected alternative, using the latest noise prediction model. Changes in design, the development in the area, and the volume of traffic predicted for the design year may result in changes in the outcome of the traffic noise prediction and barrier analysis. Also, it is possible additional barriers would be found feasible and cost-effective along any of the Detailed Study Alternatives at the locations where they pass by or through large new subdivisions developed after the mid-1990s (see **Figure 2-10(a-e)**).

In areas of impacted receptors where abatement measures have been considered and found not to be reasonable, a vegetative barrier would be considered during final design for psychological and aesthetic screening.

Table 4-27: Noise Barrier Descriptions – Project R-2247 Detailed Study Alternatives

Barrier Study Area	Description	Benefited Receptors	Barrier Length (ft)	Barrier Height (ft)	Approximate Cost	Cost per Receptor
Cost-Effective and Feasible Barriers						
Barrier A4-1 Lake Forest Subdivision	Near Yadkinville Road, east side of project	29	2,000	18	$469,800	$16,200
Barrier A4-2 Dorchester Subdivision	Near Skylark Road, east side of project	24	2,200	18	$516,780	$21,532
Barrier B6-1 Attanook Rd and Storm Canyon Rd	East sides of roadways, north of Robinhood Rd	36	2,400	18	$563,760	$15,660
Barrier B7-1 Grandview Estates Subdivision	Near intersection of Reynolda Road and Transou Road on east side of project	40	3,200	15	$567,040	$14,176
Barrier B8-1 Creekview Subdivision, Vestal Road	Near Bethania-Rural Hall Road, north side of project	29	2,400	12	$319,920	$11,031
Barrier B8-2 Forest Village Subdivision along Village Oak Drive	At Bethania-Rural Hall Road, south side of project	11	2,000	12	$266,600	$24,236
Barrier C2-1 Moravian Heights Subdivision	Near US 421 at western side of project.	46	2,100	16	$412,440	$8,966
Barrier C3-1 Nottingham Subdivision	Near Styers Ferry Road, northeastern side of project	33	3,500	14	$569,100	$17,245
Other Barriers Evaluated						
Homes along Rockingham Drive	Segments A2 and C1 - South side of Rockingham Drive	8	1,900 (2 sections)	24	$448,000	$56,000
Birchdale Drive	Segment A4 -End of Birchdale Drive, east side of project	4	2,000 (2 sections)	18	$336,300	$84,300
Dorchester Subdivision	Segment A4 - Near Skylark Road, west side of project	13	2,200	18	$516,780	$39,752
Glenbrook Estates Subdivision	Segment B6 – End of Ashlyn Drive	18	2,600	24	$543,400	$30,188
Buckingham Park Subdivision	Segment B7 – Wessex Road on east side of project	12	2,500	16	$491,000	$40,838

Table 4-28: Recommended Barriers – Project R-2247 Detailed Study Alternatives

Detailed Study Alternatives	Noise Barrier[1]							
	Barrier A4-1 Lake Forest SD	**Barrier A4-2** Dorchester SD	**Barrier B6-1** Attanook Rd and Storm Canyon Rd	**Barrier B7-1** Grandview Estates SD	**Barrier B8-1** Creekview SD, Vestal Road	**Barrier B8-2** Forest Village SD along Village Oak Drive	**Barrier C2-1** Moravian Heights SD	**Barrier C3-1** Nottingham SD
WEST-A	X	X						
EAST-A			X	X				
WEST-B	X	X			X	X		
EAST-B			X	X	X	X		
C3-WEST-A	X	X						X
C2-EAST-A			X	X			X	
C2-EAST-B			X	X	X	X	X	
C3-WEST-B Preferred	X	X			X	X	X	X

1. See **Table 4-27** for descriptions of each barrier.
SD=Subdivision

Vegetation, if it is high enough and dense enough that it cannot be seen through, can decrease highway traffic noise. Studies have shown that a 200-foot (61-meter) width of dense vegetation can reduce noise levels by 10 dBA Leq. However, it is usually impractical to plant this quantity of vegetation to achieve such reductions, particularly in urban situations.

Earthen berms may be effective in reducing noise impacts in many areas, especially where parallel barriers may be necessary to protect impacted areas on both sides of the proposed roadway. Earthen berms generally provide more noise attenuation for less cost than other barrier materials, but are limited by right of way and other engineering considerations. Earthen berms would be considered during final design in areas where barriers predicted to be reasonable and feasible.

4.8.2.2 Noise - Project R-2247 Preferred Alternative

The following sections describe the updates to potential noise impacts for the Project R-2247 Preferred Alternative. This discussion includes updates completed in July 2004 and May 2005.

Previous Noise Barrier Recommendations. **Figure 4-2** shows the noise barriers recommended for the Project R-2247 Detailed Study Alternatives, including the Preferred Alternative. The 1996 Project R-2247 FEIS did not include additional noise analyses for the Preferred Alternative's 1995 preliminary engineering design.

Two noise barriers changed between the publication of the 1996 Project R-2247 FEIS on March 13, 1996 and the Design Public Hearing on September 5, 1996. **Figure 4-3 (b-d)** shows the noise barriers presented on the Design Public Hearing Map. Noise Barrier A4-2, which was included in the 1996 Project R-2247 FEIS, was not shown on the Design Public Hearing Map, and a new barrier, not included in the 1996 FEIS, was included in the southeast quadrant of the Shallowford Road interchange (**Figure 4-3b**) on the Design Public Hearing Map. Due to the age of the information, the reasons for the differences in noise barrier locations could not be determined. The public has seen the noise barriers included in the 1996 Project R-2247 FEIS, as well as those included on the Design Public Hearing Map. As a result, the NCDOT will provide noise barriers at the locations shown in the 1996 Project R-2247 FEIS and on the Design Public Hearing Map.

Methodology for the July 2004 Updated Noise Analysis. The updated noise study, *Limited Noise Impact Assessment for the Winston-Salem Northern Beltway TIP Project R-2247* (July 2004) is appended by reference.

Noise contour information was updated based on the August 2003 projected 2025 peak hour traffic and the typical section consistent with the 2002 preliminary engineering design. The projected 2025 peak hour traffic volumes for the Preferred Alternative (see **Figure 2-14a**), along with the current typical sections (see **Figure 2-6**), were used in the analysis.

The current computer model used to predict future noise levels is the TNM computer model (FHWA, 2000). For the noise contour update, the TNM model was used to determine the distances at which the predicted hourly noise levels would be at or approaching 67 dBA Leq and 72 dBA Leq. Activity Category B (which includes residences) has a noise abatement criterion of 67 dBA Leq and Activity Category C (which includes businesses) has a noise abatement criterion of 72 dBA Leq. Terrain features and shielding were not included in the noise contour model runs to achieve results that reported the maximum predicted distances. The projected 2025 peak hour traffic volumes along the Preferred Alternative were used (see **Figure 2-14a**), along with the current typical sections (see **Figure 2-6**).

The noise contours were then overlain on 2002 aerial photography with the Project R-2247 Preferred Alternative 2002 preliminary engineering design to determine if any new neighborhoods or noise sensitive sites that did not exist at the time of the 1996 Project R-2247 FEIS could potentially be impacted by noise. The identification was accomplished through review of the 2002 aerial photography and Forsyth County's GIS system (INFOrsyth) and comparison to the 1991 aerial photography used as a base for the Project R-2247 Corridor Public Hearing Map. Five new residential subdivisions and one school (described under the results section) were identified that had parcels abutting the proposed right of way that were within the year 2025 66 dBA Leq noise contour. The five subdivisions were evaluated in more detail. The one school, Ronald Reagan High School (see **Figure 2-12g**), is under construction (scheduled to be opened in 2005) and there was insufficient information regarding topography and site design

to perform a detailed noise study at this location for inclusion in this document. An evaluation of Ronald Reagan High School will be performed as part of the design noise study that will be prepared for the Project R-2247 Preferred Alternative following the publication of this document.

For the evaluation of the five new neighborhoods, the TNM 2.0 model was used with updated traffic information, the 2002 preliminary engineering design, and recent planimetric mapping that provided parcel and structure locations as well as topographic information. Individual receivers were input to the model, representing individual residences. Terrain features, roadway location and elevation, and barriers also were included.

Noise Contour Results. **Table 4-29** presents the maximum predicted 2025 dBA Leq noise levels for a given section of roadway at 100-, 200-, and 400-foot distances measured from the center of the nearest travel lane. In addition, this table shows the contour distances measured from the center of the proposed roadway.

Table 4-29: 2025 Noise Contour Information – Project R-2247 Preferred Alternative

Location along Western Section of the Beltway	Maximum Predicted[1] Hourly Noise Levels (dBA Leq) for 2025			Contour[2] Distances (maximum feet)	
	100 feet	200 feet	400 feet	67 dBA	72 dBa
US 158 to I-40	73	68	62	270	165
I-40 to US 421	73	68	62	270	165
US 421 to Country Club Road	75	69	63	315	190
Country Club Road to Robinhood Road	75	69	63	315	190
Robinhood Road to Yadkinville Road	74	69	63	295	180
Yadkinville Road to NC 67	74	69	63	295	180
NC 67 to Bethania-Tobaccoville Road	74	69	63	295	180
Bethania-Tobaccoville Road to US 52	74	69	63	295	180

1 100-foot, 200-foot, and 400-foot distances are measured from center of nearest traffic lane.
2 67 dBA and 72 dBA contour distances are measured from center of proposed roadway.
3 Noise contours based on 2025 traffic projections using TNM 2.0 traffic model.

A comparison of **Table 4-29** with **Table 4-26** shows that the updated noise contours are similar to, and sometimes closer to the roadway, than those used in the original analysis. Since the new model and new traffic projections result in similar values to the original analysis, new barrier analyses were not run for the barriers previously shown in the 1996 Project R-2247 FEIS and the 1996 Project R-2247 Design Public Hearing Map.

Noise Mitigation Evaluation Results for the Five New Subdivisions (July 2004). The five new neighborhoods for which detailed noise mitigation studies were performed are listed below from south to north:

- Subdivision #1: West of I-40, west of the Preferred Alternative. Roads in the subdivision include Wynbrook Drive, Wynbrook Court, and Sparks Court (see **Figure 2-12b**).
- Subdivision #2: Off of Holder Road west of the Preferred Alternative and south of US 421. Roads in the subdivision include Valley Oak Drive, Springfield Farm Road, Harper Spring Drive, and Highland Brook Drive (see **Figure 2-12c**).
- Subdivision #3: Off of Peace Haven Road, east of the Preferred Alternative and south of US 421. Roads in the subdivision include Regents Village Drive, Cameron Way Circle, Charlotte Court, and Bristol View Court (see **Figure 2-12c**).
- Subdivision #4: West of US 52 and south of the Preferred Alternative. Roads in the subdivision include Ferntree Court, Ferncrest Court, and Crestlawn Trail (see **Figure 2-12i**).
- Subdivision #5: East of US 52 and south of the Preferred Alternative. Roads in the subdivision include Mossgreen Drive, Summer Trace Lane, and Grainwood Court (see **Figure 2-12j**).

A noise wall was modeled for each subdivision. The walls generally were located along the tops of cuts or fills within the Preferred Alternative right of way directly adjacent to the subdivision. The feasibility and cost-effectiveness of each barrier was determined based on NCDOT's Noise Abatement Guidelines (1996). These guidelines are the same as those described in **Section 4.8.2.1**, except the noise reduction achieved by the barrier must be a minimum of 5 decibels, and preferably 8 decibels or more.

The modeled noise walls are described below.

Subdivision 1 – The barrier would be about 2,080 feet long and vary in height from 8 to 18 feet. Seventeen residences would benefit from the barrier at a cost of $24,911 per benefited receiver.

Subdivision 2 – The barrier would be about 1,399 feet long and vary in height from 10 to 23 feet. Five residences would benefit from the barrier at a cost of $88,520 per benefited receiver.

Subdivision 3 - The barrier would be about 1,650 feet long and 13 feet high. Twenty-one residences would benefit from the barrier at a cost of $15,276 per benefited receiver.

Subdivision 4 - The barrier would be about 2,610 feet long and vary in height from 8 to 18 feet high. Eight residences would benefit from the barrier at a cost of $61,275 per benefited receiver.

Subdivision 5 - The barrier would be about 1,710 feet long and vary in height from 12 to 23 feet. Two residences would benefit from the barrier at a cost of $239,500 per benefited receiver.

Based on NCDOT Guidelines (1996), noise walls were found to be feasible and cost-effective for Subdivisions 1 and 3. These walls are shown on **Figure 4-3(a-b)**. As discussed in the previous section, additional modeling of traffic noise and noise barriers would be accomplished after the final design plans are completed for the selected alternative, using the latest noise prediction model.

Revised NCDOT Traffic Noise Abatement Policy. In September 2004, the NCDOT Board adopted a new Traffic Noise Abatement Policy, as described in **Section 4.8.1.1**. This new policy was adopted too late for incorporation into the 2004 SFEIS/SDEIS. As a result of this new policy, additional updates to the noise analysis were undertaken for the Project R-2247 Preferred Alternative.

May 2005 Updated Noise Analysis. The updated noise study, Updated Noise Impact Assessment for the Winston-Salem Northern Beltway TIP Project R-2247 (May 2005), is appended by reference.

Re-evaluation of Subdivisions 2, 4, and 5 from July 2004 Limited Noise Impact Assessment. The July 2004 Limited Noise Impact Assessment (previously described) was prepared prior to the adoption of the new NCDOT Traffic Noise Abatement Policy (September 2004). The July 2004 report recommended noise barriers at two of the five evaluated subdivisions and determined barriers were not cost-effective at the remaining three (Subdivisions 2, 4, and 5).

The May 2005 noise analysis reevaluated the results of the noise mitigation studies at the three subdivisions in light of the new Traffic Noise Abatement Policy to determine if the change in substantial impact definitions or change in cost-effectiveness determinations would result in a barrier becoming cost-effective. The model output published in the July 2004 study was used in the recalculation.

None of the barrier systems for the three subdivisions is considered cost-effective under the new (September 2004) Traffic Noise Abatement Policy.

Detailed Noise Mitigation Studies for Five Subdivisions (May 2005). In addition to the three reevaluations described above, projected noise contours along the entire Project R-2247 Preferred Alternative were reviewed to identify other areas for detailed noise mitigation studies. New noise mitigation studies were conducted for five subdivisions, two of which were previously determined to be not cost-effective in the 1996 Project R-2247 FEIS (subdivisions A and C). The locations of these five subdivisions are as follows:

- *Subdivision A: North of the Preferred Alternative and north of Rockingham Drive between US 158 and Ploughboy Lane (south of I-40) (see **Figure 2-12a**). (*Subdivision previously evaluated in the 1996 FEIS and determined not cost-effective).
- Subdivision B: Northeast quadrant of the I-40 interchange with the Preferred Alternative south of Peace Haven Road. Roads in the subdivision include Hunters Ridge Road and Wexham Road (see **Figure 2-12b**).
- *Subdivision C: North of Yadkinville Road interchange with the Preferred Alternative west of the Preferred Alternative and south of Skylark Road. Roads in the subdivision include El Camino Drive, La Sierra Drive (across from Millstone Lane area east of the Preferred Alternative) (see **Figure 2-12f**). (*Subdivision previously evaluated in the 1996 FEIS and determined not cost-effective).
- Subdivision D: West of the Reynolda Road interchange with the Preferred Alternative south of Reynolda Road. Roads in the subdivision include Ellen Avenue and Hauser Drive (see **Figure 2-12g**).
- Subdivision E: Between the Reynolda Road and Bethania-Tobaccoville Road interchanges with the Preferred Alternative east of the Preferred Alternative. Roads in the subdivision include Meadow Lane (see **Figure 2-12h**).

Methodology for the May 2005 Updated Noise Analysis. Updated existing noise level measurements were not performed as part of this noise impact assessment. Existing noise level measurements were obtained from Table 3-14 of the Winston-Salem Northern Beltway SFEIS/SDEIS (October 2004).

The noise contours used were reported in the *Technical Memorandum – Limited Noise Impact Assessment for the Winston-Salem Northern Beltway (Western Section) TIP Project R-2247* (July 2004). Five subdivisions requiring detailed noise mitigation studies were identified within the updated 66 dBA Leq noise contours for the Project R-2247 Preferred Alternative. The computer model used to predict future noise levels in this study was the TNM 2.5 computer model (FHWA, 2004).

The traffic noise level increase summary for the five neighborhoods is as follows:

For Subdivision A, one residence is predicted to experience future traffic noise levels that approach or exceed the FHWA Noise Abatement Criteria and six residences are predicted to experience substantial increases in noise levels.

For Subdivision B, zero residences are predicted to experience future traffic noise levels that approach or exceed the FHWA Noise Abatement Criteria and zero residences are predicted to experience substantial increases in noise levels.

For Subdivision C, zero residences are predicted to experience future traffic noise levels that approach or exceed the FHWA Noise Abatement Criteria and six residences are predicted to experience substantial increases in noise levels.

For Subdivision D, one residence is predicted to experience future traffic noise levels that approach or exceed the FHWA Noise Abatement Criteria and five residences are predicted to experience substantial increases in noise levels.

For Subdivision E, zero residences are predicted to experience future traffic noise levels that approach or exceed the FHWA Noise Abatement Criteria and zero residences are predicted to experience substantial increases in noise levels.

Noise Barrier Analysis. The noise sensitive sites (Neighborhoods A, C, and D) predicted to be impacted directly (i.e., experience noise levels that approach or exceed FHWA criteria or show a substantial increase over existing levels) were further evaluated in terms of the feasibility and reasonableness of providing noise barriers.

The feasibility and cost-effectiveness of each barrier was determined based on the current NCDOT Traffic Noise Abatement Policy (September 2004).

NCDOT considers a barrier cost–effective if the abatement measure has a "reasonable" allowable cost per benefited receiver. Based on the new policy guidelines, the reasonable cost-effective amount for an impacted area is identified as $35,000 per benefited receiver plus an incremental increase of $500 per dBA average increase (I) in the predicted exterior noise levels of the impacted receptors of the area.

The cost per benefited receiver (a site having 5 dB or more reduction) should be less than or equal to the value (V) determined by dividing the number (N) of benefited receivers into the total cost (C) of the barrier system, which is based on a cost of $15.00 per square foot ($160 per square meter) of barrier. The new policy still considers barriers not reasonable for businesses or isolated residences (NCDOT, 2004).

The updated noise study found walls to be potentially reasonable and feasible near two of the five modeled subdivisions (A and C) (see Figures 4-3a and c). The modeled noise walls are described below:

Subdivision A would have fourteen receivers (of which seven were initially impacted) benefiting from the barrier at a cost of $41,490 per benefited receiver. The barrier length would be 2,130 feet long and vary in height from 14.8 to 19.7 feet. This barrier was found to be cost-effective.

Subdivision C would have eighteen receivers (of which six were initially impacted) benefiting from the barrier at a cost of $40,363. The barrier length would be 2,665 feet long and vary in height from 13.1 to 21.3 feet. This barrier was found to be cost-effective.

Subdivision D would have twelve receivers (of which three were initially impacted) benefiting from the barrier at a cost of $47,750. The barrier length would be 2,005 feet long and vary in height from 16.4 to 21.3 feet. This barrier was found to be not cost-effective.

In summary, eleven noise barriers are proposed for the Project R-2247 Preferred Alternative as described in **Table 4-29-1** below:

Table 4-29-1: Recommended Noise Barriers for Project R-2247 Preferred Alternative

Noise Analysis	Barrier or Subdivision Name	Description	Figure Reference
1996 Project R-2247 FEIS	A4-1	Lake Forest Subdivision	4-3c
	A4-2*	Dorchester Subdivision	4-3c
	B8-1	Creekview Subdivision, Vestal Road	4-3d
	B8-2	Forest Village Subdivision, along Village Oak Drive	4-3d
	C2-1	Moravian Heights Subdivision	4-3b
	C3-1	Nottingham Subdivision	4-3b
1996 Design Public Hearing Map	no name given	Southeast quadrant of Shallowford Road interchange	4-3b
July 2004 Noise Update	Subdivision #1	West of I-40, west of the Preferred Alternative. Roads in the subdivision include Wynbrook Drive, Wynbrook Court, and Sparks Court	4-3a
	Subdivision #3	Off of Peace Haven Road, east of the Preferred Alternative and south of US 421. Roads in the subdivision include Regents Village Drive, Cameron Way Circle, Charlotte Court, and Bristol View Court	4-3b
May 2005 Noise Update	Subdivision A	North of the Preferred Alternative and north of Rockingham Drive between US 158 and Ploughboy Lane (south of I-40)	4-3a
	Subdivision C	North of Yadkinville Road interchange with the Preferred Alternative west of the Preferred Alternative and south of Skylark Road. Roads in the subdivision include El Camino Drive, La Sierra Drive (across from Millstone Lane area east of the Preferred Alternative)	4-3c

**Barrier not shown on the1996 Design Public Hearing Map*

4.8.3 Eastern Portion of the Study Area

A noise analysis was conducted for the 1995 Project U-2579 DEIS, where all Project U-2579 Detailed Study Alternatives were analyzed for future noise impacts. An updated noise analysis was completed for the Project U-2579 Preferred Alternative in March 2003. A noise analysis of the Project U-2579A Detailed Study Alternatives was completed in June 2003. An updated noise analysis was completed for the Project U-2579 and U-2579A Preferred Alternatives in August 2005. This analysis incorporated the new Traffic Noise Abatement Policy, adopted in September 2004, and was based on the 2005 preliminary engineering designs for this project.

4.8.3.1 Noise - Project U-2579 Detailed Study Alternatives

The following discussion was taken from the 1995 Project U-2579 DEIS (Sections 4.6.4, 4.6.5, and 4.6.6).

Future Noise Levels and Noise Impacts. Future highway noise levels were estimated using the FHWA computer program STAMINA 2.0.

Assumptions for the proposed alternatives included the following:

- Projected 2020 ADT volumes
- 10 percent of ADT during peak-hour
- 60/40 directional split for autos and trucks
- All traffic on center-line of lanes for each direction
- High traffic volume on receptor side
- 8 percent heavy trucks, 4 percent medium trucks in the peak-hour
- 55 MPH operating speed (free-flow) and 60 MPH design speed
- Variable alpha (attenuation) factor depending on receptor distance

The peak-hour or one-hour equivalent (Leq) noise level is used for highway noise analysis. In accordance with NCDOT procedures, if the design hour volume exceeds the volume for LOS C, the LOS C volume is used for noise analysis.

Year 2020 noise levels were projected for 876 receptor locations, including residences and businesses. The Eastern Detailed Study Alternative was predicted to have 129 receptors with a substantial noise increase and the Western Detailed Study Alternative was predicted to have 118 such receptors. **Table 4-30** compares the number of receptors with a substantial noise increase

for each of the other alternative combinations. Many of the receptors that exceed the FHWA NAC also experience a substantial noise increase.

Locations approaching or exceeding the noise abatement criteria included all residences with a predicted noise level of 66 dBA or more. Based on 2020 traffic volumes, the Eastern Detailed Study Alternative would have more receptors exceeding the substantial increase criteria than the Western Detailed Study Alternative. The Western Detailed Study Alternative would, however, have more receptors approaching or exceeding the FHWA NAC.

Table 4-30: Receptor Comparison by Alternative – Project U-2579 Detailed Study Alternatives

Detailed Study Alternative	Receptors Approaching/Exceeding Noise Abatement Criteria	Receptors with Substantial Noise Increase
Western	200	118
Eastern	138	129
1	182	125
2	139	118
3	209	131
4	210	120
5	174	132
6	225	140
7	189	137
8	175	121

Table 4-31 summarizes the number of receptors approaching or exceeding the FHWA NAC for the Western and Eastern Detailed Study Alternatives, as well as the five crossovers. The number of receptors approaching or exceeding the FHWA NAC with proposed noise barriers in place is shown in parentheses.

Table 4-31: Number of Receptors that Approach/Exceed FHWA NAC – Project U-2579 Detailed Study Alternatives

Location along Eastern Section of the Beltway	Western	Eastern	C1	C2	C3	C4	C5
US 52 to University Parkway	6	7	0	0	0	0	0
University Parkway to NC 8/Germanton Road	5	9	0	0	0	0	0
NC 8/Germanton Road to Baux Mountain Road	39	2	16 (16)	8	0	0	0
Baux Mountain Road to US 311	77	70	0	0	48 (40)	0	0
US 311 to US 158	20	14	0	0	0	26	0
US 158 to US 421/I-40 Business	53 (44)	36 (33)	0	0	0	0	19
Total	**200 (191)**	**138 (135)**	**16 (16)**	**8**	**48 (40)**	**26**	**19**

() Numbers in parentheses indicate the number of receptors approaching or exceeding the FHWA NAC with proposed noise barriers in place.
Source: Table 4-12 from the 1995 Project U-2579 DEIS

Noise Barrier Analysis. Twenty-five possible barrier locations were examined. Noise reduction goals were developed for the barrier evaluation based on NCDOT Guidelines (1996). For a barrier to be recommended, it must be feasible and reasonable, as described in **Section 4.8.2.1**.

Because of the low population density in portions of the study area, most barriers of suitable height and length to provide substantial noise reduction have a high cost per dwelling unit and are therefore not reasonable. Of the 25 barriers evaluated, only five barriers were estimated to provide substantial noise reduction for less than $25,000 per dwelling unit. These potential barriers are summarized in **Table 4-32** and are shown on **Figure 4-4**.

Table 4-32: Evaluation of Barrier Locations – Project U-2579 Detailed Study Alternatives

Barrier	Alternative/ Segment	Length (ft)	Height (ft)	Cost	Benefited Receptors	Cost/Receptor
13	Eastern	2,000	15	$354,400	17	$20,847
16	Crossover 1	900	13	$133,110	9	$14,790
18	Crossover 3	1,150	16	$225,860	10	$22,586
22	Western	700	12	$ 93,310	5	$18,662
23	Western	1,450	14	$235,770	11	$21,434

Source: Table 4-13 from the 1995 Project U-2579 DEIS

The preliminary conclusions regarding likely barrier abatement measures for this project are based on preliminary studies and cost data. A final decision on the installation of noise abatement measures would be made at the completion of the project design.

Other Noise Abatement Measures. When the noise levels of a proposed roadway approach or exceed Noise Abatement Criteria, FHWA requires that various noise abatement measures be considered. The discussion of measures other than noise barriers included in **Section 4.8.2.1** for Project R-2247 is applicable to Project U-2579. Other non-barrier abatement measures would not be reasonable and feasible.

4.8.3.2 Noise - Project U-2579 Preferred Alternative

The noise analysis for the Preferred Alternative was updated in April 2006 in the *Noise Technical Memorandum for the Winston-Salem Northern Beltway, Eastern Section and Extension*, appended by reference. The noise evaluation procedure and results are described below.

Analysis Methodology. As a part of the noise evaluation for the Project U-2579 Preferred Alternative, existing background noise levels were measured in the vicinity of the project. The FHWA approved noise model TNM Traffic Noise Prediction Model was used to generate all computer modeled equivalent sound levels (Leq).

Input parameters were obtained at each monitoring site for the purpose of validating the TNM model. Those parameters included: number of cars, medium trucks, and heavy trucks; traffic speeds; community noises; general topographic data; and existing physical features (i.e., walls, berms, water bodies, etc.). Design year (2025) peak-hour traffic noise levels were predicted for receptors within 600 feet of the highway centerline.

Future Noise Levels. The traffic parameters for this study include:

- projected 2025 peak-hour volumes
- 10 percent of ADT during peak-hour
- 60/40 directional split for autos and trucks
- 65 MPH operating speed (free-flow)

The noise predictions reflect highway-related noise for the PM peak-hour traffic conditions during the design year (2025). Peak-hour volumes were used with anticipated posted speed limits to predict future noise levels, which results in the greatest traffic noise generation. During all other time periods, the noise levels would be less than that achieved during the peak hour. The volumes used in the analysis are listed in **Table 4-33**. The heavier directional traffic from the PM peak hour was applied to both directions of travel to account for both AM and PM peak hour conditions.

Noise sensitive receptors within 600 feet of the highway centerline were modeled and evaluated. As shown in **Table 4-33**, the proposed facility was reported in six location segments (based on

proposed interchange locations) with eastbound and westbound traffic contributing to the predicted Leq calculation for the various receptors located along their relative location.

Receptor coordinates for 779 existing receptor locations were obtained from the 2003 preliminary engineering design. Receptor locations are not necessarily identified as individual sensitive receivers. Some receptor locations represent areas of concern and account for multiple sensitive receivers at various locations along the 1,200-foot corridor limits. With future growth and expansion, more receptors could be identified by the time construction begins. During that analysis, the areas to be considered for noise abatement will include only those that were either existing or determined to have a building permit at the time that the Record of Decision (ROD) was approved for this project. It is the responsibility of local governments and private landowners to ensure that noise-compatible designs are used for development permitted after the Date of Public Knowledge.

Future noise levels were projected at the 779 existing receptor locations. **Tables 4-34 and 4-36** summarize the noise impacts that would result from the proposed Project U-2579 Preferred Alternative. **Table 4-34** shows the predicted noise levels at distances of 100, 200, and 400 feet, as well as the distance to the 67 dBA Leq noise contour, each referenced from the project centerline.

Table 4-33: Design Year (2025) Traffic Volumes, PM Peak Hour – Project U-2579 Preferred Alternative

Location along Eastern Section of the Beltway	Total Vehicles	Autos	Medium Trucks	Heavy Trucks
US 52 to University Parkway	6,028	2,217 (EB) 2,368 (WB)	73 108	146 216
University Parkway to NC 8/Germanton Road	6,306	2,326 (EB) 3,412 (WB)	77 113	153 225
NC 8/Germanton Road to Baux Mountain Road	7,446	2,772 (EB) 4,004 (WB)	91 132	183 264
Baux Mountain Road to US 311	7,314	2,683 (EB) 3,973 (WB)	88 131	177 262
US 311 to US 158	7,649	2,831 (EB) 4,132 (WB)	93 136	185 272
US 158 to US 421/I-40 Business	7,283	2,721 (EB) 3,906 (WB)	90 129	179 258

Source: Table 5 from the *Project U-2579 and U-2579A Noise Technical Memorandum* (2006)

The extent of the 67 dBA contour line is used to assess the exposure impacts of land uses since receptors located within the contour line could be expected to experience traffic noise levels above the FHWA NAC. Furthermore, this information is provided to assist local authorities in exercising land use control over the remaining undeveloped lands adjacent to the roadway and to prevent further development of incompatible activities and land uses. **Table 4-35** from the SFEIS/SDEIS has been deleted from this SFEIS/FEIS based on the revised noise analysis.

Table 4-34: 2025 Noise Contour Information – Project U-2579 Preferred Alternative

Location Along Eastern Section of the Beltway	Distance to 67 dBA Contour (feet)	Maximum Predicted[1] Hourly Noise Levels (dBA Leq) for 2025		
		100 feet (dBA)	200 feet (dBA)	400 feet (dBA)
US 52 to University Parkway	350	76	74	65
University Parkway to NC 8/Germanton Road	220	76	68	60
NC 8/Germanton Road to Baux Mountain Road	255	73	70	63
Baux Mountain Road to US 311	310	74	70	65
US 311 to US 158	250	78	72	60
US 158 to US 421/I-40 Business	416	77	72	66

[1]100-foot, 200-foot, and 400-foot distances are measure from center of nearest traffic lane.
Source: Table 6 from the *Project U-2579 and U-2579A Noise Technical Memorandum* (2006)

On the Project U-2579 Preferred Alternative, 149 of the 779 identified receptors approach (within one dBA) or exceed the FHWA NAC and 204 of the 779 receptors experience a substantial noise increase. 242 receptors exceed or approach the NAC or experience a substantial increase. **Table 4-36** shows the number of receptors by segment expected to approach or exceed the FHWA NAC, the number of receptors expected to experience a substantial noise level increase, and the total number of impacted receptors within each section of the proposed corridor.

Table 4-36: Number of Receptors Impacted By Noise – Project U-2579 Preferred Alternative

Location along Eastern Section of the Beltway	Exceed/Approach FHWA NAC	Substantial Increase	Total # of Impacted Receptors
US 52 to University Parkway	16	17	19
University Parkway to NC 8/Germanton Road	14	8	15
NC 8/Germanton Road to Baux Mountain Road	24	17	25
Baux Mountain Road to US 311	36	56	70
US 311 to US 158	20	23	28
US 158 to US 421/I-40 Business	39	83	85
Total	149	204	242

Source: Table 7 from the *Project U-2579 and U-2579A Noise Technical Memorandum* (2006)

Noise Barrier Analysis and Recommendations. Several barriers are deemed reasonable and feasible pursuant to the NCDOT noise abatement criteria, based on an updated noise barrier analysis that was conducted for the Project U-2579 Preferred Alternative in 2006. The preliminary analysis involved a survey review of the receptor locations that exceeded the 66 dBA criteria or had substantial increases as specified by NCDOT. This exercise involved quantifying

the receivers in questionable areas and conservatively determining the height and length of the potential noise barrier. Assuming that all receivers would be benefited, a probable cost for the wall was estimated based on the NCDOT specified barrier cost of $15 per square foot. The walls that fell within reasonable limits of the NCDOT guidelines for reasonableness and feasibility were included in a detailed barrier analysis.

The NCDOT feasibility criteria are directed toward the design and engineering considerations of a barrier. Such factors include such items as the topography of the proposed location, a minimum of a 5 dBA noise reduction, access, drainage, safety, and maintenance.

The matter of reasonableness is a more subjective matter that deals with the cost of the barrier. NCDOT defines the unit cost of modeled barriers at $15 per square foot. It further states that a benefited receiver is one that experiences a 5 dBA or greater noise reduction from the insertion of a noise wall. An excerpt taken from the NCDOT Traffic Noise Abatement Policy states that "the reasonable cost effective amount for an impacted area will be $35,000 per benefited receptor plus an incremental increase of $500 per dBA average increase (I) in the predicted exterior noise levels of the impacted receptors of the area." In other words the total cost of the effective wall is divided by the number of benefited receptors. If that individual cost is less than $35,000 plus $500*(I), then the wall is considered reasonable.

The preliminary analysis identified 43 possible wall locations. Through the cost-to-benefit screening, 22 of those 43 walls met the criteria for inclusion in the TNM model analysis. The roadway design plans and geometry were utilized to obtain the input coordinates for the proposed wall locations. The coordinates provided project stationing, centerline offset, and ground elevation at each wall.

A noise barrier analysis was performed on the 22 TNM modeled walls in order to evaluate the feasibility of the barriers. Each wall was evaluated at varying heights in order to obtain optimum attenuation and minimum cost, per impacted receptor. **Table 4-37** provides a summary of each evaluated barrier, and was revised from the table in the SFEIS/SDEIS based on the 2005 analysis. The barriers are shown in **Figure 4-5(a-b)**. Of the 22 barriers evaluated, four are considered reasonable and feasible by NCDOT guidelines. Asterisks in **Table 4-37** and **Figure 4-5(a-b)** indicate those noise barriers that met all the NCDOT criteria.

Barriers 11 and 12 behave as a single barrier, but are divided by the Davis Road overpass. Barrier 11 is located on the north side of Davis Road and Barrier 12 is located south of Davis Road. In total, the barriers extend along the north side of the proposed alignment for 3,412 feet and range in height from 18 to 22 feet. Benefiting 42 receptors, the $1,069,872 cost breaks down to $25,473 per benefited receptor. The reasonable cost based on the incremental increase of $500 for the average noise increase equates to $42,800.

Barrier 13 is located just northwest of the US 311 interchange and extends along the south side of the proposed alignment through Old Walkertown Road. The barrier is split at Old Walkertown, so it is actually two barriers functioning as one to benefit the impacted receivers in the area. The total length of the barrier is 4,022 feet and ranges in height from 10 to 20 feet. Benefiting 45 receptors, the $1,089,277 cost breaks down to $24,206 per benefited receptor. The reasonable cost based on the incremental increase of $500 for the average noise increase equates to $42,700.

Barrier 18 is located just north of West Mountain Road on the north side of the proposed alignment. The barrier extends along the shoulder of the proposed alignment for 1,247 feet and at a height of 16 feet. Benefiting 7 receptors, the $299,434 cost breaks down to $42,776 per benefited receptor. The reasonable cost based on the incremental increase of $500 for the average noise increase equates to $44,550.

Barrier 10 was analyzed as a 2,200 foot wall, shielding a larger area of impacted receivers. However, the process of determining the optimum cost per benefited receiver reduced the barrier into 2 short barriers. Evaluating the two portions separately reveals that only one is actually cost reasonable. As such, Barrier 10A is shown to be cost reasonable in **Table 4-37**, while Barrier 10B is not. Each portion is shielding the traffic noise solely for the one receiver. As stated in the NCDOT traffic noise abatement policy, it is not considered reasonable to provide noise abatement for isolated receptors, and therefore the walls are not recommended.

The barrier previously recommended in the *1995 Project U-2579 DEIS* that was located along the Preferred Alternative (Barrier # 13 in the 1995 Project U-2579 DEIS) was not considered reasonable and feasible in the April 2006 study for the following reasons: 1) the lack of sufficient traffic noise impacted receptors, 2) the alignment of the Preferred Alternative (Alternative 7) changed slightly from the 1994 functional engineering design to the preliminary engineering design, 3) the cost of a noise barrier per foot increased from 1995 to 2005 from approximately $12 per square foot to $15 per square foot, and 4) the analysis for the Detailed Study Alternatives assumed that a noise barrier must have a 4 dBA minimum noise reduction (insertion loss), while the 2005 study used the current higher value of 5 dBA.

Two barriers recommended in the 2004 SFEIS/SDEIS, labeled in that document as Barriers 18 and 31, did not meet NCDOT criteria for noise barriers. However, since they met the criteria using the previous standards and because they were shown to the public at the public hearings in November and December 2004, they are recommended to remain as part of this project, pending further studies and public involvement. The two barriers are indicated in **Table 4-37** and **Figure 4-5(a-b)** as Barriers 22 and 23.

Other Noise Abatement Measures. When the noise levels of a proposed roadway approach or exceed NAC, FHWA requires that various noise abatement measures be considered. The discussion of measures other than noise barriers included in **Section 4.8.2.1** for Project R-2247 is applicable to Project U-2579. Other non-barrier abatement measures would not be reasonable and feasible.

Table 4-37: Evaluation of Barrier Locations – Project U-2579 Preferred Alternative

Barrier	Length (ft)	Evaluated Height (ft)	Cost	Number of Benefited Receptors	Average Increase (I)	Reasonable Cost Effective Amount	Actual Cost per Benefited Receptor
1	1,873	12-24	$465,601	10	14.4	$42,200	$46,560
2	836	12-24	$196,140	2	7.7	$38,850	$98,070
3	558	16-20	$163,702	2	21.9	$45,950	$81,851
4	417	12	$75,313	1	7.5	$39,350	$75,313
5	328	24	$11,8472	0	8.1	$39,050	N/A
6	1,591	24	$572,867	0	11.6	$40,800	N/A
7	276	24	$98,746	1	17.7	$43,850	$98,746
8	1,132	14-16	$258,571	4	14.7	$42,350	$64,643
9	499	22	$164,251	2	19.5	$44,750	$82,126
10A	65	14	$13,766	1	22.7	$46,350	$13,766
10B	262	12-20	$66,930	1	22.7	$46,350	$66,930
11 & 12*	3,412	18-22	$1,069,872	42	15.6	$42,800	$25,473
13*	4,022	10-20	$1,089,277	45	15.4	$42,700	$24,206
14	1,739	20-24	$572,165	3	18.8	$44,400	$190,722
14A	876	12-20	$249,954	5	14.5	$42,250	$49,991
15	1,519	12-16	$338,682	2	18.2	$44,100	$169,341
16 & 17	2,996	12-18	$771,002	8	19.4	$44,700	$96,375
18*	1,246	16	$299,434	7	19.1	$44,550	$42,776
19	1,178	22	$389,455	0	16.3	$43,150	N/A
20	1,978	10-20	$572,979	3	16.6	$43,300	$190,993
21	1,965	16-20	$568,189	7	19.3	$44,650	$81,170
22**	400	6-8	$42,000	2	–	$25,000	$21,000
23**	850	6-22	$199,800	9	–	$25,000	$22,200

* Recommended noise barrier.
** Recommended in 2004 SFEIS/SDEIS; data shown is from that document.
N/A: No benefited receptor for barrier.
Source: Table 11 from the Noise Technical Memorandum for Project U-2579 and U-2579A (2006)

4.8.3.3 Noise - Project U-2579A Detailed Study Alternatives

Analysis Methodology. As a part of the noise evaluation for the Project U-2579A Detailed Study Alternatives, existing background noise levels were measured in the vicinity of the project. The FHWA approved noise model TNM Traffic Noise Prediction Model was used to generate all computer modeled equivalent sound levels (Leq).

Design year (2025) peak-hour traffic noise levels were predicted for receptors within a minimum of 600 feet of the project centerline. Further analysis is recommended once a final alignment is chosen.

Future Noise Levels. The traffic parameters for this study are:

- projected 2025 ADT volumes
- 10 percent of ADT during peak-hour
- 60/40 directional split for autos and trucks
- 65 MPH operating speed (free-flow)

The noise predictions reflect highway-related noise for the PM peak-hour traffic conditions during the design year (2025). Peak-hour volumes were used with anticipated posted speed limits to predict future noise levels. The volumes used in the analysis are listed in **Table 4-38** (with an interchange at Kernersville Road).

Noise sensitive receptors within 600 feet of the centerlines of the various alternatives were modeled and evaluated. As shown in **Table 4-38**, the proposed facility was segmented into five sections (based on proposed interchange locations) with peak-hour traffic contributing to the predicted Leq calculation for the various receptors located along their relative segment. The noise model was run for both AM and PM peak hours, so that receptors on both sides of the highway would be tested equally.

Coordinates for 1,201 receptor locations were obtained from the roadway functional design map. The number of receptors impacted by each alignment varies based on the shift of the centerline. Receptor locations are not necessarily identified at individual sensitive receivers. Some receptor locations represent areas of concern and account for multiple sensitive receivers at various locations along the 1,200-foot corridor limits. With future growth and expansion, more receptors could be identified by the time construction begins. Coordination with City and County officials would be necessary to track any new development in the vicinity of the proposed project.

Table 4-38: Design Year (2025) Traffic Volumes, PM Peak Hour – Project U-2579A Detailed Study Alternatives

Location along Eastern Section of the Beltway	Total Vehicles	Autos	Medium Trucks	Heavy Trucks
Detailed Study Alternative – with Kernersville Road Interchange				
US 421/I-40 Business to NC 150	3,390	1,851 (NB) 1,234 (SB)	61 41	122 81
NC 150 to I-40	4,318	1,966 (NB) 1,964 (SB)	65 65	129 129
I-40 to US 311 Junction	3,060	1,671 (NB) 1,114 (SB)	55 37	110 73
US 311 Junction	1,696	772 (NB) 772 (SB)	25 25	51 51
US 311	3,266	1,629 (EB) 1,343 (WB)	54 44	107 89
Detailed Study Alternative – without Kernersville Road Interchange				
US 421/I-40 Business to NC 150	3,250	1,775 (NB) 1,183 (SB)	59 39	117 78
NC 150 to I-40	3,900	1,775 (NB) 1,775 (SB)	59 59	116 116
I-40 to US 311 Junction	3,000	1,638 (NB) 1,092 (SB)	54 36	106 72
US 311 Junction	1,648	750 (NB) 750 (SB)	25 25	49 49
US 311	3,278	1,640 (EB) 1,343 (WB)	54 44	108 89

Source: Table 4 from the *Noise Technical Memorandum, Winston-Salem Northern Beltway, Eastern Section Extension*, June 2003

Future noise levels were projected at the 1,201 receptor locations. **Tables 4-39 through 4-41** summarize the noise impacts that would result for of each proposed project's alternatives. **Table 4-39** shows the noise contour information. This information is provided to assist local authorities in exercising land use control over the remaining undeveloped lands adjacent to the roadway and to prevent further development of incompatible activities and land uses.

Table 4-39: 2025 Noise Contour Information – Project U-2579A Detailed Study Alternatives

Segment	Distance to 67 dBA Contour (feet)	Maximum Predicted Hourly Noise Levels (dBA Leq) for 2025		
		100 feet (dBA)	200 feet (dBA)	400 feet (dBA)
N1	384 (260)	74 (73)	70 (68)	66 (65)
N2	347 (275)	74 (73)	70 (68)	66 (66)
N3	290 (290)	74 (73)	70 (68)	64 (64)
S1	375 (384)	74 (74)	69 (71)	63 (65)
S2	357 (389)	74 (74)	71 (69)	67 (67)

() Alternatives without the Kernersville Road interchange. The Project U-2579A Preferred Alternative includes an interchange at Kernersville Road.
Source: Table 6 from the *Project U-2579A Noise Technical Memorandum* (June 2003)

A distribution summary of the predicted noise level increases for the proposed project is shown in **Table 4-40**. As previously noted, receptors with an existing noise level of 50 dBA or less are considered to experience a substantial noise increase if the increase due to the project is 15 dBA or more. For those receptors with an existing noise level greater than 50 dBA, the substantial increase threshold is 10 dBA.

For each of the Project U-2579A Detailed Study Alternatives, there are receptors that are expected to exceed or approach the NAC and experience a substantial increase. **Table 4-41** shows the number of receptors by alternative expected to approach or exceed the FHWA NAC, the number of receptors expected to experience a substantial noise level increase, and the total number of impacted receptors within each proposed alignment.

Table 4-40: Receptor Distribution Summary of Noise Level Increases With (Without) Kernersville Road Ramps – Project U-2579A Detailed Study Alternatives

Detailed Study Alternative	Location along Eastern Section of the Beltway	Existing Noise (Leq)	Noise Level Increase (decibels)					Substantial Noise Increases
			+ 0 - <5 dB	+ 5 - <10 dB	+ 10 - <15 dB	+ 15 - <20 dB	+ ≥20 dB	
N1-S1	I-40 Business to I-40	less <=50 greater >50	12(13) 4(6)	48(54) 11(9)	85(81) 5(9)	81(85) 12(8)	53(56) 7(7)	134(141) 24(24)
	I-40 to US 311	less <=50 greater >50	59(59) 103(107)	44(56) 90(91)	218(197) 7(3)	67(72) 2(2)	3(6) 0(0)	70(78) 9(5)
N1-S2	I-40 Business to I-40	less <=50 greater >50	3(3) 0(1)	32(37) 6(4)	87(85) 11(14)	91(95) 13(11)	57(59) 7(7)	148(154) 31(32)
	I-40 to US 311	less <=50 greater >50	23(23) 26(26)	162(159) 109(108)	92(94) 67(68)	23(24) 9(9)	1(1) 0(0)	24(25) 76(77)
N2-S1 (Preferred Alternative)	I-40 Business to I-40	less <=50 greater >50	**0**(0) **0**(0)	**24**(28) **4**(5)	**72**(80) **14**(19)	**89**(82) **19**(15)	**72**(67) **8**(7)	**161**(149) **41**(41)
	I-40 to US 311	less <=50 greater >50	60(60) 83(83)	27(27) 83(83)	214(214) 13(13)	82(82) 0(0)	5(5) 0(0)	87(87) 13(13)
N2-S2	I-40 Business to I-40	less <=50 greater >50	0(0) 0(0)	24(28) 4(5)	72(80) 14(19)	89(82) 19(15)	72(67) 8(7)	161(149) 41(41)
	I-40 to US 311	less <=50 greater >50	28(28) 17(17)	167(167) 114(114)	92(92) 67(67)	20(20) 9(9)	1(1) 0(0)	21(21) 76(76)
N3-S1	I-40 Business to I-40	less <=50 greater >50	12(19) 0(0)	55(53) 15(17)	87(94) 4(3)	116(110) 9(10)	43(40) 1(4)	159(150) 14(17)
	I-40 to US 311	less <=50 greater >50	60(60) 83(83)	27(27) 83(83)	214(214) 13(13)	82(82) 0(0)	5(5) 0(0)	87(87) 13(13)
N3-S2	I-40 Business to I-40	less <=50 greater >50	12(19) 0(0)	55(53) 15(17)	87(94) 4(3)	116(110) 9(10)	43(40) 1(4)	159(150) 14(17)
	I-40 to US 311	less <=50 greater >50	28(28) 17(17)	167(167) 114(114)	92(92) 67(67)	20(20) 9(9)	1(1) 0(0)	21(21) 76(76)

() Alternatives without Kernersville Road interchange. The Project U-2579A Preferred Alternative includes an interchange at Kernersville Road.
Source: Table 7 from the *Project U-2579A Noise Technical Memorandum* (June 2003)
'Bold' indicates Preferred Alternative.

Table 4-41: Impacted Receptors – Project U-2579A Detailed Study Alternatives

Detailed Study Alternative	Exceed/Approach FHWA NAC	Substantial Increase	Total Impacted Receptors
N1-S1	69 (67)	237 (248)	243 (256)
N1-S2	115 (116)	279 (288)	280 (289)
N2-S1 (Preferred Alternative)	**113** (81)	**213** (290)	**218** (297)
N2-S2	126 (111)	299 (287)	301 (289)
N3-S1	69 (70)	273 (267)	280 (274)
N3-S2	100 (100)	270 (264)	272 (266)

() Alternatives without the Kernersville Road interchange. The Project U-2579A Preferred Alternative includes an interchange at Kernersville Road.
Source: Table 8 from the Project U-2579A Noise Technical Memorandum (June 2003) for non-preferred Detailed Study Alternatives. Impacts were updated in 2005 for the Preferred Alternative.
'Bold' indicates Preferred Alternative.

Noise Barrier Analysis and Recommendations. Noise barriers reduce noise levels by blocking the sound path between a roadway and noise-sensitive areas. This measure is typically used on high-speed, limited-access facilities where noise levels are high and adequate space for barriers is available. Noise barriers may be constructed from a variety of materials including concrete, wood, metal, earth, and vegetation.

A noise barrier analysis was conducted for each Project U-2579A Detailed Study Alternative. The preliminary analysis involved a survey review of the receptor locations whose future predicted noise levels exceeded the 66 dBA criteria or had substantial increases as specified by NCDOT. This exercise involved quantifying the receptors in impacted areas and conservatively determining the height and length of the potential noise barrier. Assuming that all receptors would be benefited, a probable cost for the wall was estimated based on a cost of $15 per square foot. The walls that fell within reasonable limits of the NCDOT Guidelines ($25,000/Benefited Receptor) were then included in the TNM modeling for a more detailed analysis.

The preliminary analysis identified 38 possible wall locations for the studied alignments. Through the cost-to-benefit screening, 29 of those 38 walls met the criteria for inclusion in the TNM model analysis. Those walls are shown in **Figure 4-6(a-c)**. The roadway design plans and geometry were utilized to obtain the input coordinates for the proposed wall locations. The coordinates provided project stationing, centerline offset, and base elevation for each wall.

As each alignment shares a mutual segment with another alignment, many of the modeled barriers apply to more than one alternative. For example, the walls that apply to Segment N1 of Detailed Study Alternative N1-S2 were reviewed and found to benefit the same impacted receptors as N1-S1. The same logic applied for the other alignments as well.

A noise barrier analysis using TNM was performed on the 29 walls in order to evaluate the feasibility of the barrier. For a barrier to be considered as a viable option, it must provide the aforementioned 5 dBA minimum noise reduction (insertion loss) for an adequate number of receptors. Each wall was evaluated at varying heights in order to obtain optimum attenuation and minimum cost per impacted receptor. **Table 4-42** provides a summary of the following information for each evaluated barrier: location (station), dimensions, cost estimates, the number of receptors with at least a 5 dBA insertion loss, and the cost per benefited receptor. Of the 29 barriers evaluated, one is considered reasonable and feasible by NCDOT guidelines. Asterisks in **Table 4-42** and **Figure 4-6(a-c)** indicate the noise barrier that meets all the NCDOT criteria.

The only area for which a noise barrier is recommended is located in the southeast quadrant of the I-40 interchange. The area is impacted by the predicted noise generated from the traffic assigned to Segment S2. Consequently, all of the alternatives that include Segment S2 (N1-S2, N2-S2, N3-S2) would warrant this barrier. It runs 3,074 feet along the proposed right-of-way line of the northbound Beltway off ramp. It varies in height from 22 to 25 feet and is expected to benefit 71 receptors at a cost of $15,500 per benefited receptor.

Other Noise Abatement Measures. When the noise levels of a proposed roadway approach or exceed Noise Abatement Criteria, the FHWA requires that various noise abatement measures be considered. The discussion of measures other than noise barriers included in **Section 4.8.2.1** for Project R-2247 is applicable to Project U-2579A. Other non-barrier abatement measures would not be reasonable and feasible.

Table 4-42: Evaluation of Barrier Locations – Project U-2579A Detailed Study Alternatives

Barrier	Detailed Study Alternative Segment(s)	Length (ft)	Evaluated Height (ft)	Cost	Number of Benefited Receptors	Cost/Receptor
N1-1, N2-1	N1, N2	1,165	25	$384,400	0	N/A
N1-2, N2-2	N1, N2	2,204	12-24	$711,800	10	$71,180
N1-3	N1	1,555	16-24	$507,700	12	$42,308
N1-3a	N1*	1,600	16-25	$501,900	8	$62,738
N1-4	N1	531	14-20	$150,300	2	$75,150
N1-5	N1	2,385	12-22	$637,500	7	$91,071
N1-5a	N1*	2,565	12-24	$746,700	11	$67,881
N1-6	N1	1,601	14-22	$471,700	4	$117,925
N1-6a	N1*	2,487	16-22	$740,700	5	$148,140
N1-7	N1	912	12	$164,400	4	$41,100
N2-3	N2	650	12-22	$188,900	2	$94,450
N2-4	N2	1,253	14-24	$398,500	8	$49,813
N2-5	N2	2,201	25	$793,600	3	$264,533
N2-6	N2	951	14-24	$270,000	4	$67,600
N3-1	N3	1,194	14-20	$313,800	5	$62,760
N3-2	N3	1,279	18	$345,500	0	N/A
N3-3	N3	2,486	12-25	$851,300	14	$60,807
N3-3a	N3*	2,204	18-25	$732,300	12	$61,025
N3-4	N3	1,328	18	$358,800	0	N/A
N3-5	N3	879	12-18	$193,600	4	$48,400
S1-1	S1	1,742	16-24	$544,900	15	$32,053
S1-2	S1	2,038	16-24	$576,200	2	$288,100
S1-3	S1	1,125	18	$304,500	0	N/A
S1-4	S1	3,579	20	$1,074,700	0	N/A
S2-1**	S2	3,074	22-25	$1,100,800	71	$15,504
S2-2	S2	2,854	12-24	$939,800	18	$52,211
S2-3	S2	1,552	12-18	$368,000	5	$73,600
S2-4	S1	2,125	20-24	$728,300	4	$182,075

* Alternative without Kernersville Road interchange.
** Recommended noise barrier.
N/A: No benefited receptor for barrier.
Source: Table 9 from the *Noise Technical Memorandum, Winston-Salem Northern Beltway, Eastern Section Extension*, June 2003

4.8.3.4 Noise - Project U-2579A Preferred Alternative

Analysis Methodology. As a part of the noise evaluation for the update to the Project U-2579A Preferred Alternative, the alignment was updated to include revisions that had been made since the detailed study alternatives were evaluated. The receptor database also was updated. The FHWA approved noise model TNM Traffic Noise Prediction Model was used to generate all computer modeled equivalent sound levels (Leq). The detailed results of the analyses are included in the Noise Technical Memorandum dated April 2006, appended by reference.

Design year (2025) peak-hour traffic noise levels were predicted for receptors within 600 feet of the highway centerlines. This update was conducted due to the most recent 2004 adoption of NCDOT's Traffic Noise Abatement Policy and changes in the project alignment. Previous analysis was used wherever possible to aide in the update of this noise analysis. Further analysis is recommended once a final design is completed.

Future Noise Levels. The traffic parameters for this study are:

- projected 2025 ADT volumes
- 10 percent of ADT during peak-hour
- 60/40 directional split for autos and trucks
- 65 MPH operating speed (free-flow)

The noise predictions reflect highway-related noise for the PM peak-hour traffic conditions during the design year (2025). Peak-hour volumes were used with anticipated posted speed limits to predict future noise levels. The volumes used in the analysis are listed in **Table 4-38** (with an interchange at Kernersville Road).

Noise sensitive receptors within 600 feet of the highway centerlines were modeled and evaluated. As shown in **Table 4-38**, the proposed facility was segmented into three sections (based on proposed interchange locations and the resultant changes in traffic volumes) with peak-hour traffic contributing to the predicted Leq calculation for the various receptors located along their relative segment. The noise model was run for both AM and PM peak hours, so that receptors on both sides of the highway would be tested equally.

Coordinates for 985 receptor locations were obtained from the roadway functional design map. The number of receptors impacted by each alignment varies based on the shift of the centerline. Receptor locations are not necessarily identified at individual sensitive receivers. Some receptor locations represent areas of concern and account for multiple sensitive receivers at various locations along the 1,200-foot corridor limits. With future growth and expansion, more receptors

could be identified by the time construction begins. During that analysis, the areas to be considered for noise abatement will include only those that were either existing or determined to have a building permit at the time that the Record of Decision (ROD) was approved for this project. It is the responsibility of local governments and private landowners to ensure that noise-compatible designs are used for development permitted after the Date of Public Knowledge.

Future noise levels were projected at the 985 receptor locations. **Tables 4-42-1 and 4-42-1** summarize the noise impacts that would result for the Preferred Alternative. **Table 4-42-1** shows the noise contour information. This information is provided to assist local authorities in exercising land use control over the remaining undeveloped lands adjacent to the roadway and to prevent further development of incompatible activities and land uses.

Table 4-42-1: 2025 Noise Contour Information – Project U-2579A Preferred Alternative

Segment	Distance to 67 dBA Contour (feet)	Maximum Predicted Hourly Noise Levels (dBA Leq) for 2025		
		100 feet (dBA)	200 feet (dBA)	400 feet (dBA)
US 421/I-40 Business to I-40	384	74	70	66
I-49 to US 311	357	74	71	67

Source: Table 9 from the *Project U-2579 and U-2579A Noise Technical Memorandum* (2006)

For the Project U-2579A Preferred Alternative, there are 218 receptors that are expected to approach or exceed the NAC and receptors expected to experience a substantial increase. **Table 4-42-2** shows the number of receptors expected to approach or exceed the FHWA NAC, the number of receptors expected to experience a substantial noise level increase, and the total number of impacted receptors within the proposed alignment. As previously noted in **Section 4.8.1**, a "substantial increase" is now defined based on a sliding scale as shown in **Table 4-24-1**.

Table 4-42-2: Impacted Receptors – Project U-2579A Preferred Alternative

Location along Eastern Section of the Beltway	Exceed/Approach FHWA NAC	Substantial Increase	Total Impacted Receptors
US 421/I-40 Business to I-40	77	152	154
I-40 to US 311	36	61	64
Total	113	213	218

Source: Table 10 from the *Project U-2579 and U-2579A Noise Technical Memorandum* (2006)

Noise Barrier Analysis and Recommendations. Noise barriers reduce noise levels by blocking the sound path between a roadway and noise-sensitive areas. This measure is typically used on high-speed, limited-access facilities where noise levels are high and adequate space for barriers is available. Noise barriers may be constructed from a variety of materials including concrete, wood, metal, earth, and vegetation.

A noise barrier analysis was conducted for the Project U-2579A Preferred Alternative. The preliminary analysis involved a survey review of the receptor locations whose future predicted noise levels exceeded the 66 dBA criteria or had substantial increases as specified by NCDOT. This exercise involved quantifying the receptors in impacted areas and conservatively determining the height and length of the potential noise barrier. Assuming that all receptors would be benefited, a probable cost for the wall was estimated based on a cost of $15 per square foot. The walls that fell within reasonable limits of the NCDOT Guidelines ($35,000/Benefited Receptor plus an incremental increase of $500 per dBA average attenuation) were then included in the TNM modeling for a more detailed analysis.

The preliminary analysis identified eight possible wall locations for the studied alignments. Those walls are shown in **Figure 4-7**. The roadway design plans and geometry were utilized to obtain the input coordinates for the proposed wall locations. The coordinates provided project stationing, centerline offset, and base elevation at each wall.

The analysis previously completed for the Project U-2579A Detailed Study Alternatives was used to eliminate barriers that were considered but were determined not to be feasible.

A noise barrier analysis using TNM was performed on the eight walls in order to evaluate the feasibility of the barrier. For a barrier to be considered as a viable option, it must provide the aforementioned 5 dBA minimum noise reduction (insertion loss) for an adequate number of receptors. Each wall was evaluated at varying heights in order to obtain optimum attenuation and minimum cost per impacted receptor. **Table 4-42-3** provides a summary of the following information for each evaluated barrier: dimensions, cost estimates, the number of receptors with at least a 5 dBA insertion loss, and the cost per benefited receptor. Of the eight barriers evaluated, four are considered reasonable and feasible by NCDOT guidelines. Asterisks in **Table 4-42-3** and **Figure 4-7** indicate the noise barriers that meet all the NCDOT criteria.

Table 4-42-3: Evaluation of Barrier Locations – Project U-2579A Preferred Alternative

Barrier	Length (ft)	Evaluated Height (ft)	Cost	Number of Benefited Receptors	Average Increase (I)	Reasonable Cost Effective Amount	Actual Cost per Benefited Receptor
ESE-NB1	2140	18	$577,500	3	21.6	$45,800	$192,500
ESE-NB2	1980	18	$533,740	6	18.4	$44,200	$88,960
ESE-NB3	720	18	$194,100	0	20.6	$45,300	N/A
ESE-NB4*	3210	12 - 24	$1,011,790	59	21.7	$45,850	$17,150
ESE-NB5	1330	18	$360,240	0	19.2	$44,600	N/A
ESE-NB6*	2750	14 - 22	$840,400	49	18	$44,000	$17,150
ESE-NB7*	3210	16 - 24	$1,020,990	31	13.9	$41,950	$32,940
ESE-NB8*	1770	14 - 18	$450,150	12	15.2	$42,600	$37,510

* Recommended noise barrier.
N/A: No benefited receptor for barrier.
Source: Table 12 from the *Project U-2579 and U-2579A Noise Technical Memorandum* (2006)

Barrier ESE-NB4 extends along the west side of the proposed alignment between I-40 and Kernersville Road. The proposed barrier is projected to be 3,210 feet and ranges in height from 12 to 24 feet. The barrier is expected to benefit 59 receivers at a total cost of $1,001,790, for a cost of $17,150 per benefited receiver.

Barrier ESE-NB6 extends along the northwest quadrant of the I-40 interchange. The proposed barrier is projected to be 2,750 feet in length and ranges from 14 to 22 feet in height. The barrier is expected to benefit 49 receivers at a total cost of $840,400, for a cost of $17,150 per benefited receiver.

Barrier ESE-NB7 extends along the southeast quadrant of the I-40 interchange. The proposed barrier is projected to be 3,210 feet in length and range from 16 to 24 feet in height. The barrier is expected to benefit 31 receivers at a total cost of $1,020,990, for a cost of $32,940 per benefited receiver.

Barrier ESE-NB8 extends along the southern portion just to the east of the US 311 interchange. The proposed barrier is projected to be 1,770 feet in length and ranges from 14 to 18 feet in height. The barrier is expected to benefit 12 receivers at a total cost of $450,150, for a cost of $37,510 per benefited receiver.

Other Noise Abatement Measures. When the noise levels of a proposed roadway approach or exceed Noise Abatement Criteria, the FHWA requires that various noise abatement measures be

considered. The discussion of measures other than noise barriers included in **Section 4.8.2.1** for Project R-2247 is applicable to Project U-2579A. Other non-barrier abatement measures would not be reasonable and feasible.

4.8.4 Information on Noise for Local Officials

It is the policy of NCDOT that the type of material used in the construction of noise abatement measures be an engineering decision based on economics, effectiveness, and to a limited degree, visual impact. Visual impact considerations assure the barrier meets a basic aesthetic level and a basic durability level such that excessive deterioration or corrosion would not occur.

It is also a part of this policy to have traditional highway resources pay for the required noise abatement. Should a local jurisdiction request that a material be used for the noise barrier that is more costly than that proposed by NCDOT, the requesting body must assume 100 percent of the additional cost.

If a local jurisdiction insists on the provision of a noise abatement measure deemed feasible but not reasonable by NCDOT, a noise barrier may be installed, provided the locality is willing to assume 100 percent of the cost of the abatement measure, including but not limited to preliminary engineering, construction, maintenance, and that NCDOT's material, design and construction specifications are met.

In an effort to prevent future noise impacts on currently undeveloped lands, NCDOT uses the following criteria:

- The "Date of Public Knowledge" is the approval date of Categorical Exclusions (CE), Findings of No Significant Impact (FONSI), Records of Decision (ROD), or the Design Public Hearing, whichever comes later. After the Date of Public Knowledge, Federal/State governments are no longer responsible for providing noise abatement measures for new development for which building permits are issued within the noise impact area of the proposed highway project.
- For development occurring after this public knowledge date, it is the responsibility of the local governing bodies to ensure that noise compatible designs are utilized.
- The date for determining when undeveloped land is "…planned, designed and programmed…" for development will be the issuance of a building permit for an individual site.

The information on projected noise level contours is included in **Tables 4-29** (Project R-2247), **4-34** (Project U-2579) **and 4-39** (Project U-2579A). The information in these tables should assist local authorities in exercising land use control over the remaining undeveloped lands adjacent to

the roadway segments within the local jurisdiction. For example, with the proper information on noise, the local authorities can prevent development of incompatible activities and land uses with the predicted noise levels of an adjacent highway.

4.9 HAZARDOUS MATERIALS

4.9.1 Combined Direct Hazardous Materials Impacts

Table 4-43 combines the Preferred Alternative for Projects R-2247 and U-2579 with each Detailed Study Alternative for Project U-2579A to show the total number of hazardous materials sites potentially impacted by the Winston-Salem Northern Beltway.

Table 4-43: Combined Direct Hazardous Materials Impacts – Projects R-2247, U-2579, and U-2579A

Project	Detailed Study Alternative	Potentially Impacted Hazardous Materials Sites
R-2247 and **U-2579 Preferred Alternatives plus U-2579A Detailed Study Alternatives** [1]	N1-S1	19 (16)
	N1-S2	19 (16)
	N2-S1 (Preferred Alternative)	**19** (15)
	N2-S2	19 (15)
	N3-S1	22 (17)
	N3-S2	22 (17)

Impacts are based on 2005 preliminary engineering designs for the Project R-2247, U-2579, and U-2579A Preferred Alternatives, and are based on the 2002 preliminary engineering designs for the Project U-259A non-preferred alternatives.
[1] Numbers in () are without Kernersville Road interchange in Project U-2579A. The Project U-2579A Preferred Alternative includes an interchange at Kernersville Road.
'Bold' indicates Preferred Alternative.

4.9.2 Hazardous Materials - Project R-2247 Detailed Study Alternatives

The following section is from Section 4.5.7 of the 1996 Project R-2247 FEIS.

As discussed in **Section 3.11.1**, a site assessment for potential hazardous waste sites was conducted for the Northern Beltway (Western Section) study area. Based on the assessment, underground storage tanks (USTs), landfills, auto salvage yards, and five hazardous waste producers were identified within the study area. Five of the identified UST sites are located at operating gas stations. Two USTs are located within the right of way of Segment A6 at a trucking firm. None of the known abandoned USTs are affected by Detailed Study Alternatives.

Table 4-44: Potentially Impacted Hazardous Materials/Waste Sites – Project R-2247 Detailed Study Alternatives

Detailed Study Alternative	Potentially Impacted Hazardous Materials/ Waste Sites*
WEST-A	3
EAST-A	2
WEST-B	3
EAST-B	2
C3-WEST-A	1
C2-EAST-A	2
C2-EAST-B	2
Preferred Alternative	
C3-WEST-B	**1**

Note: Impacts are estimated based upon the right-of-way limits from the DEIS functional designs and are from Table 4.5-4 in the 1996 Project R-2247 FEIS.

* This includes hazardous waste generators, auto salvage yards, landfills, and underground storage tanks (UST).

Table 4-44 lists the number of hazardous materials sites (including underground storage tanks) within the proposed right of way of the 1992 functional designs for the Detailed Study Alternatives.

4.9.3 Hazardous Materials - Project R-2247 Preferred Alternative

In December 2002, the NCDOT Geotechnical Unit conducted an updated survey of hazardous materials and waste sites. The survey included field reconnaissance along existing roadways in the area of the Project R-2247 Preferred Alternative. In addition to the field survey, a file search of appropriate environmental agencies was conducted to identify any known problem sites along the proposed project alignment.

Based on the 2002 field reconnaissance survey, approximately six facilities with the potential for Underground Storage Tanks (USTs) were identified along the proposed project corridor. Two were located on Reynolda Road (NC 67) and one each on Shallowford Road, Robinhood Road, Bethania Road, and Bethania-Rural Hall Road. The locations of these sites are shown in **Figure 3-9a**.

Database research conducted as part of the survey shows no regulated or unregulated landfills or dumpsites occurring within the project limits. No Superfund sites are in the vicinity of the project.

If any of the potential hazardous materials/waste sites cannot be avoided by the Project R-2247 Preferred Alternative, further assessments of the properties would be conducted during final design. These assessments would evaluate the properties for specific types and amounts of hazardous materials and would include right-of-way acquisition recommendations.

4.9.4 Hazardous Materials - Project U-2579 Detailed Study Alternatives

The following discussion is from Section 4.2.4 of the 1995 Project U-2579 DEIS.

State regulatory agencies were consulted, and lists of potential hazardous material sites scheduled for cleanup by the EPA and other regulatory agencies were reviewed. This review includes EPA's National Priorities List (NPL) of heavily contaminated sites and the sites scheduled for priority cleanup with Superfund money. No potential hazardous material sites in Forsyth County are listed on the NPL.

The North Carolina Department of Environment and Natural Resources (NCDENR) is responsible for issuing permits to hazardous waste facilities. Categories for those facilities include exempt small quantity generators, small quantity generators (generators of 100 kilograms (kg) to 1,000 kg per month), generators (generators of more than 1,000 kg per month), transporters, treatment facilities, storage facilities, and disposal facilities. None of the twelve generators identified as being within or adjacent to the study area are crossed by any of the proposed alternatives.

One solid waste site, Reynolds Auto Junkyard on University Parkway (NC 66), is located within the 1,200-foot corridor of the Eastern and Western Detailed Study Alternatives and would be impacted by all the Detailed Study Alternatives. This approximately 10-acre site operates as a disposal facility for wrecked automobiles and may have automobile fluid (i.e., oil and coolant) contamination. All of the Detailed Study Alternatives cross this site. Therefore, further investigation would be required to determine the exact extent of any possible contamination.

In addition, four solid waste sites were identified that may be close enough to the corridors of some alternatives to present possible problems. These sites are all demolition landfills permitted by Forsyth County to receive stumps, limbs, leaves, concrete, brick, wood, and uncontaminated soils. For the most part, these sites can be expected to contain these materials. However, the Forsyth County Division of Environmental Health and Laboratory makes periodic field inspections of such sites and is aware of occasional deviations from these materials being allowed by various owner operators. Based on mapping provided by the County, the approximate locations of these sites puts them at distances ranging from 400 to 700 feet from the corridor for the Eastern Detailed Study Alternative and Detailed Study Alternatives 1, 2, 3, 4, 5, and 8.

Based on mapping provided by the County, the approximate locations of these sites range from 400 to 700 feet from the corridor for the Eastern Detailed Study Alternative. However, due to the scale of the mapping provided, it is difficult to determine the exact locations. Upon selection of a preferred alternative, further research may be required to determine the exact locations of these sites.

None of the four special incident sites or the three current or past Superfund sites identified as being within or adjacent to the project study area are crossed by any of the proposed alternatives.

As discussed in **Section 3.11.2**, no service stations or other businesses likely to have USTs were identified within the corridors for any of the proposed alternatives. **Table 4-45** compares the number of potential hazardous material and underground storage tank sites impacted for each of the alternative combinations.

Table 4-45: Potentially Impacted Hazardous Materials Sites – Project U-2579 Detailed Study Alternatives

Detailed Study Alternative	Potentially Impacted Hazardous Material Sites in or near 1,200-foot Corridor	Potentially Impacted Underground Storage Tank Sites in or near 1,200-foot Corridor
Western	1	0
Eastern	1	0
1	1	0
2	1	0
3	1	0
4	1	0
5	1	0
6	1	0
7 (Preferred)	**1**	**0**
8	1	0

Impacts are based upon the 1200-foot corridors used in the 1995 Project U-2579 DEIS for the Detailed Study Alternatives.
'Bold' indicates Preferred Alternative.

4.9.5 Hazardous Materials - Project U-2579 Preferred Alternative

An updated survey for hazardous materials and waste sites was completed in October 2002 by the NCDOT Geotechnical Unit along existing roadways in the area of the Project U-2579 Preferred Alternative.

In the Preferred Alternative preliminary design right of way, eight underground storage tank (UST) sites were identified (see **Figure 3-9b**). In addition, one solid waste site, Reynolds Auto Junkyard on University Parkway (NC 66), is located within the right of way of the Preferred Alternatives. This approximately 10-acre site operates as a disposal facility for wrecked automobiles and may have automobile fluid (i.e., oil and coolant) contamination. Differences in the number of sites between the original survey for the 1995 Project U-2579 DEIS and the updated 2002 survey may have been the result of the criteria used for the survey and the revised design plans.

Because the Preferred Alternative cannot avoid crossing this site, further investigation would be required to determine the exact extent of any possible contamination. Six of the sites identified as potential hazardous material sites were located at University Parkway, and the remaining three were in the vicinity of Germanton Road (NC 8). **Table 3-20** describes the nine potentially hazardous sites, which would all be impacted by the Preferred Alternative, requiring the facilities to be taken and remediated.

4.9.6 Hazardous Materials - Project U-2579A Detailed Study Alternatives and Preferred Alternative

Two surveys of known hazardous materials sites were conducted within the Project U-2579A study area. The survey in 1996 identified one exempt small generator, three special incident sites, and one debris landfill. These sites are described in **Table 3-21** and shown in **Figure 3-9c**.

None of the seven previously identified sites were included in the September 2001 survey, primarily due to a change in alternative design. Differences in location of sites may have also been the result of the criteria used for the survey. Eight UST sites were observed within the revised study area for Project U-2579A (see **Figure 3-9c**). All eight sites are located on Kernersville Road, and are described in **Table 4-46**. Of the eight sites, seven would potentially be impacted. Dean's Service Center is within the right of way for Segment N1, and the Pentecostal Lighthouse and Pantry 3191 are within the right of way for Segment N3. The impacted sites would be taken and remediated.

The hazardous materials sites that would be potentially impacted by the Preferred Alternative are shown in bold in **Table 4-46**. Four UST sites are within the Preferred Alternative right of way.

Table 4-46: Potentially Impacted Hazardous Materials Sites – Project U-2579A Detailed Study Alternatives

Site Number[1]	Detailed Study Alternative Segment(s)	Name/Description	Street Address/Location	Status
1	-	Vacant Brick Building	Kernersville Rd at Corbin St	Former gas station
2	**N1, N1*, N2, N3**	**3D Furniture Outlet**	**4255 Kernersville Road**	**Possible former gas station**
3	**N1, N2, N3**	**Dean's Service Center**	**4260 Kernersville Road**	**Former gas station**
4	**N1, N2, N3**	**Stock Exchange Consignment**	**4308 Kernersville Road**	**Former gas station**
5	**N1, N2, N3**	**Pegram Oil Company**	**4314 Kernersville Road**	**Active gas station**
6	N3, N3*	Pentecostal Lighthouse Church	4349 Kernersville Road	Former gas station
7	N3	Sedge Garden Florist	4400 Kernersville Road	Former gas station
8	N3, N3*	Pantry 3191 (Etna 321)	4401 Kernersville Road	Active gas station

[1] Site numbers refer to **Figure 3-9c**.
* Detailed Study Alternative without the Kernersville Road interchange.
Source: Based on a GeoEnvironmental Impact Evaluation, September 18, 2001
'Bold' indicates Preferred Alternative

4.10 MINERAL RESOURCES

Although Forsyth County contains potential sources of materials for use as construction materials for this project (i.e. rock, sand, and gravel), no known mines or quarries are located in the immediate vicinity of the study area. Therefore, the project would not adversely impact such resources through conversion of their existing land use.

During construction, local resources would be used for construction of the roadbed and bridge structures. In many cases, material removed from road cuts would be used for fill elsewhere along the project.

Two Forsyth County quarries are available as a source of aggregate for the project. The largest, the Martin Marietta North Quarry, is located just east of US 52, a few miles south of the northern terminus of the proposed Northern Beltway. A second quarry is located in eastern Forsyth County near the intersection of NC 66 and US 311.

There are numerous concrete plants located throughout the county, and sand is excavated along the Yadkin River.

With the ready source of materials described above, the construction of Projects R-2247, U-2579, and U-2579A is not expected to cause a local shortage of construction materials. No other known mineral resources would be impacted as a result of the proposed projects.

4.11 SOILS

The properties of soils can affect the engineering design of a roadway. Soil limitations may include shrink-swell potential, erosion hazard, risk of corrosion, differential settlement, low strength, and flood hazard. **Table 3-23** lists the soils in the project study area. Their properties and limitations for roadway construction are discussed in **Section 3.12.4**.

Soil limitations can be overcome through proper engineering design, including the incorporation of techniques such as soil modification, appropriate choice of fill material, use of non-corrosive subgrade materials, and design of drainage structures capable of conveying estimated peak flows. Decisions regarding soil limitations and methods to overcome them would be determined during final design of the selected alternatives.

4.12 FARMLAND

4.12.1 Regulatory Background

In accordance with the Farmland Protection Policy Act (FPPA) of 1981 (7 CFR Part 658) and State Executive Order Number 96, an assessment was undertaken of the potential impacts of land acquisition and construction activities in prime, unique, and local or statewide important farmland soils, as defined by the US Natural Resource Conservation Service (NRCS).

The FPPA defines "farmland" as either "prime farmland," "state and locally important farmland," or other farmland. All three types of "farmland" are defined by Section 1540(c)(1) of the Act. These definitions refer to areas where the soils are conducive to agricultural production, not just areas currently or historically used as farmland. According to the Act, prime farmland does not include land already in or committed to urban development or water storage.

Coordination with the NRCS for the proposed projects was conducted. Form AD-1006, *Farmland Conversion Impact Rating*, was submitted to the NRCS for the Project R-2247 Preferred Alternative, the Project U-2579 Detailed Study Alternatives and Preferred Alternative, and the Project U-2579A Detailed Study Alternatives. The NRCS responded by completing their

portions of this form and providing a relative value of farmland that may be affected (converted) by the proposed project.

The NRCS assigns ratings to potential farmland impacts in order to determine the level of significance of impacts. The ratings are comprised of two parts. The Land Evaluation Criterion Value represents the relative value of the farmland to be converted and is determined by the NRCS on a scale from 0 to 100 points. The Corridor Assessment, which is rated on a scale of 0 to 160 points, evaluates farmland soil based on its use in relation to the other land uses and resources in the immediate area. The two ratings are added together for a possible total rating of 260 points. Sites receiving a total score of less than 160 should be given a minimal level of protection, and sites receiving a total score of 160 or more are given increasingly higher levels of consideration for protection (7 CFR Section 658.4).

As described in **Section 3.14,** some soils in the project area are considered as prime farmland and state important land as defined by the Natural Resources Conservation Service (formerly Soil Conservation Service (SCS)).

4.12.2 Combined Direct Farmland Impacts

No significant impacts to farmland would occur under any of the Detailed Study Alternatives for Projects R-2247, U-2579, or U-2579A, whether constructed in whole or in part.

4.12.3 Farmland - Project R-2247 Detailed Study Alternatives

This section is based on Section 4.6.5 of the 1996 Project R-2247 FEIS.

As described in **Section 3.14,** some soils in the project area are considered as prime farmland or state/locally important farmland as defined by the Natural Resources Conservation Service (formerly Soil Conservation Service (SCS)).

Table 4-47 presents the estimates of prime and important farmland soils present in the Detailed Study Alternatives, based on the 1992 functional designs rights of way. These estimates of prime and state and locally important farmland were calculated by multiplying the linear length of the alignment traversing the farmland category by the ratio of right of way acreage to total segment length (farmland linear length * [right-of-way acreage/segment length]). The resulting number is an estimate based on the average ratio of right-of-way acreage to segment length and provides a relative measure for use in comparing segment impacts to farmland soils.

Table 4-47: Prime and Important Farmland Soils Impacts – Project R-2247 Detailed Study Alternatives

Detailed Study Alternative	Length (miles)	Right-of-way Area (acres)	Prime Farmland Soils (acres)	State/Locally Important Farmland Soils (acres)
WEST-A	17.22	1,273	202	335
EAST-A	16.31	1,163	155	295
WEST-B	17.59	1,259	182	325
EAST-B	16.68	1,149	135	286
C3-WEST-A	16.97	1,215	213	300
C2-EAST-A	17.05	1,222	183	312
C2-EAST-B	17.43	1,208	162	302
Preferred Alternative				
C3-WEST-B	**17.35**	**1,201**	**193**	**291**

Source: Table 4.5-3 of the 1996 Project R-2247 FEIS.
Estimates of acreage based on 1992 functional designs right of way.
'Bold' indicates Preferred Alternative.

For the 1996 Project R-2247 FEIS, coordination with the SCS (phone conversation with Mr. P. Tant, SCS, July 23, 1991) confirmed that the lands within the study area did not meet the Farmland Protection Policy Act's definition of prime farmland, as all land within the study area was zoned by the City-County Planning Board and Forsyth County for either residential, commercial, or industrial use. The preparation of Form AD 1006 (Farmland Conservation Impact Rating) was, therefore, not required for these lands.

As discussed in the next section, an AD 1006 form was submitted to the NRCS for the Preferred Alternative in August 2003. The assessment for the Preferred Alternative did not result in a total site assessment score greater than 160 points and mitigation for farmland loss is not required under the FPPA. Based on this result, it is not expected that any of the other Detailed Study Alternatives would result in significant impacts to farmland. The other seven Detailed Study Alternatives either include most of the segments used by the Project R-2247 Preferred Alternative, or use the segments to the east that are more urbanized.

4.12.4 Farmland - Project R-2247 Preferred Alternative

There are about 498 acres of prime farmland soils and 602 acres of statewide/locally important farmland soils within the 1,559 acres of right of way of the Preferred Alternative's 2002 preliminary engineering design. Estimates of prime and important farmland soils present in the right of way were calculated using the Arc/Info GIS program and overlaying the soils with the right of way. The soils data layer was provided by Forsyth County. The most recent list of Important Farmlands of North Carolina (dated May 1998) was downloaded from the NRCS

website in August 2003 and used to identify prime and locally/state important farmland soils within the Preferred Alternative right of way.

Although there are about 498 acres of prime farmland soils within the Preferred Alternative right of way, the majority of these soils do not meet the Farmland Protection Policy Act's definition of "prime farmland" because they are already in or committed to urban development as can be seen on the current zoning map (see **Figure 3-1**).

The current zoning map shows that the majority of the land within the Project R-2247 Preferred Alternative right of way is zoned single-family residential with pockets of land zoned for business, industrial, multi-family residential, office, institutional and mixed use (see **Figure 3-1**). However, a small amount of the land crossed by the Preferred Alternative currently is zoned agriculture. Also, the *Growth Management Plan* shows that the Preferred Alternative skirts the Rural Area designation north of Yadkinville Road (see **Figure 3-2**).

As required by the FPPA, coordination with the NRCS was initiated by submittal of Form AD-1006, *Farmland Conversion Impact Rating*. The NRCS responded by completing their portions of this form and providing a relative value of farmland that may be affected (converted) by the proposed project.

The completed AD-1006 Farmland Conversion Rating Form is provided in **Appendix H**. The relative value of farmland included in the Project R-2247 Preferred Alternative received a score of 29 points (out of a possible 100 points) and the total site assessment received a score of 66 points (out of a possible 160 points), for a total score of 95 points. The Project R-2247 Preferred Alternative received less than the minimum level (160 points) at which the United States Department of Agriculture (USDA) recommends that a proposed alternative be considered for farmland protection. Therefore, in accordance with the Farmland Protection Policy Act, no mitigation for farmland loss is required for the project.

4.12.5 Farmland - Project U-2579 Detailed Study Alternatives

The following discussion is from Section 4.4.8 of the 1995 Project U-2579 DEIS. The impact to farmland was determined for areas that were designated as rural in the 1990 census.

All the proposed alternatives would involve the use of prime, statewide, and local important farmland within the proposed right of way. This project was coordinated with the Soil Conservation Service (SCS) as required by the Farmland Protection Policy Act (FPPA).

The Forsyth County Growth Management Plan included in *Vision 2005* indicates that the areas to the south of NC 66 and to the west of University Parkway are planned as "Growth Area." *Vision 2005* states that areas planned as "Rural Area" attempt to "retain farming activities." The Growth Management Plan also indicates that the only planned Rural Area in the study area is to the north of NC 66. Most of the study area is planned for future urbanization. Portions of the Eastern and Western Detailed Study Alternatives, as well as Crossovers 1 and 2, located north of NC 66 and east of University Parkway are located within the designated Rural Area. Since the 1995 Project U-2579 DEIS, the Growth Management Plan, the *Legacy Plan*, has been updated, and is discussed in **Section 1.10.3**.

The Farmland Conversion Impact Rating form (Form AD-1006) was completed by the appropriate agencies and is included in **Appendix H**. **Table 4-48** summarizes the amount of prime, as well as statewide and local important farmland, included in the Western and Eastern Detailed Study Alternatives and the five crossovers.

Table 4-48 indicates that the Western Detailed Study Alternative includes 532 acres of specially designated farmland, whereas the Eastern Detailed Study Alternative includes 500 acres. Crossover 2 includes the greatest amount of specially designated farmland of any of the crossovers (58 acres), whereas Crossover 3 has the least (41 acres).

Table 4-48: Prime and Important Farmland Impacts – Project U-2579 Detailed Study Alternatives

Alternative/ Segment	Prime Farmland Soils (acres)	State/Locally Important Farmland Soils (acres)	Total Prime and Important (acres)	Total Site Assessment Score
Western	303	229	532	140.4
Eastern	239	261	500	130.2
C1	10	39	49	129.2
C2	7	51	58	120.0
C3	21	20	41	150.4
C4	28	23	51	157.3
C5	10	40	50	134.2

Impacts are based upon right-of-way limits for the 1994 functional engineering designs. Source: Table 4-8 from the 1995 Project U-2579 DEIS

All of the proposed alternatives received less than the minimum level (160 points) at which the United States Department of Agriculture (USDA) recommends that a proposed alternative be considered for farmland protection. Based on these relatively low scores, the proposed Detailed Study Alternatives for Project U-2579 require a minimal level of farmland protection, and no mitigation for farmland loss is required for the project.

4.12.6 Farmland - Project U-2579 Preferred Alternative

The impact to farmland was determined for land that was designated as rural in the 2000 census. Acres of soils impacted were determined using ArcView to calculate the amount of each type of soil impacted by the construction limits of the Preferred Alternative. The Farmland Conversion Impact Rating Form (Form AD-1006) was completed by the Natural Resources Conservation Service, and is included in **Appendix H**. For the Preferred Alternative, there are 76.9 acres of prime and unique farmland and 116.0 acres of statewide and locally important farmland, for a total of 192.9 acres. The total site assessment score was 114. Since this is less than 160, according to the Farmland Protection Policy Act, no mitigation for farmland loss is required for this project.

4.12.7 Farmland - Project U-2579A Detailed Study Alternatives and Preferred Alternative

The impact to farmland was determined for land that was designated as rural in the 2000 census. Acres of soils impacted were determined using ArcView to calculate the amount of each type of soil impacted by the construction limits of each Detailed Study Alternative. The completed Farmland Conversion Impact Rating Form (Form AD-1006) is provided in **Appendix H**. **Table 4-49** lists the acres of prime farmland soils, the acres of state and locally important

farmland soils, and the total site assessment score. Since none of the alternatives resulted in a total site assessment score greater than 160 points (including the Preferred Alternative), no mitigation for farmland loss is required for the project.

Table 4-49: Prime and Important Farmland Impacts – Project U-2579A Detailed Study Alternatives

Alternative[1]	Prime Farmland Soils (acres)	State/Locally Important Farmland Soils (acres)	Total Prime and Important (acres)	Total Site Assessment Score
N1-S1	35.2	51.5	86.7	110
N1-S2	53.3	46.0	99.3	138
N2-S1 (Preferred Alternative)	**35.2**	**51.5**	**86.7**	**110**
N2-S2	53.3	46.0	99.3	138
N3-S1	36.2	51.9	88.1	119
N3-S2	54.9	44.5	99.4	141

[1] Results are the same for alternatives with and without the Kernersville Road interchange.
'Bold' indicates Preferred Alternative.

4.12.8 Local Farmland Policies

None of the Detailed Study Alternatives for Projects R-2247, U-2579, or U-2579A would impact parcels participating in the Forsyth County Farmland Preservation Program. The nearest participating farmland tract is located approximately 0.5 miles north of the Project U-2579 Detailed Study Alternatives.

4.13 WATER QUALITY

The following discussion of combined direct impacts on water quality applies to all Detailed Study Alternatives for all three projects, R-2247, U-2579, and U-2579A.

Based on information obtained from the *Yadkin-Pee Dee Basinwide Water Quality Management Plan* (DWQ 1998), sub-basin 03-07-04 has one of the highest number of impaired streams within the Yadkin-Pee Dee basin. Muddy Creek, in particular, is a support threatened stream and is impaired by both urban runoff and wastewater discharges. The DWQ has initiated a whole basin approach to water quality management for the 17 river basins in the state.

The primary sources of water-quality degradation in urban areas are non-point-source discharges and stormwater runoff. Non-point source discharge refers to runoff that enters surface waters through stormwater, snowmelt, or atmospheric deposition. In urban settings, land use activities such as land development, construction, landfills, roads, and parking lots are the major

contributors of non-point source pollutants. Precautions should be taken to minimize these types of impacts to water sources in the project vicinity.

Sediment is the most widespread cause of non-point source pollution in North Carolina. The greatest impacts to water resources in the project study area would be at stream crossings, which would require vegetation clearing and fill placement in and/or around channels and floodplains.

Stormwater runoff from roadways carries quantities of silt, heavy metals, petroleum products, nitrogen, and phosphorous. These materials can potentially degrade water quality and aquatic habitat integrity. The effects on water quality depend on the size of the waterways crossed, the number of such crossings and the season of construction. Streams with low flow are more severely affected since they have less volume to dilute the runoff. However, construction during periods of low precipitation can result in reduced impacts since stormwater does not carry the pollutants downstream. Because aquatic organisms are very sensitive to discharges and inputs from construction, appropriate measures must be taken to avoid petroleum spillage and control runoff. Stormwater runoff rates likely would increase slightly due to the increase in impervious surface area. This is an unavoidable, long-term impact resulting from construction of Projects R-2247, U-2579, and U-2579A in whole or in part.

Short-term impacts include erosion and sedimentation of the streambed, which may occur during construction activities. Other adverse effects may include degradation of water quality, disturbance of the stream bottom, and increased turbidity during construction. Highly turbid waters can result in oxygen depletion, coating of gills on fish, siltation of filter feeding structures, reduced solar radiation, and interference with spawning activities. The installation of box culverts can significantly diminish fish and other aquatic animal movements, and can be especially detrimental to less mobile benthic organisms. Many fish would exhibit an avoidance response and leave the immediate area. Uncontrolled erosion and sedimentation can potentially destroy aquatic algae, eliminate benthic macroinvertebrate habitat, eradicate fish spawning habitat and remove food resources for many stream species.

Temporary construction impacts due to erosion and sedimentation would be minimized through implementation of stringent erosion control schedules and use of best management practices. The contractor would be required to follow contract specifications pertaining to erosion control measures (as outlined in 23 CFR 650, Subpart B and Article 107-13) entitled *Control of Erosion, Siltation, and Pollution* (NCDOT, Specification for Roads and Structures). These measures include the following:

- Use of dikes, berms, silt basins, and other containment measures to control runoff during construction. Regular maintenance and inspection of these structures is recommended to insure effectiveness.

- Elimination of construction staging areas in floodplains or adjacent to streams and tributaries would help reduce the potential for petroleum contamination or discharges of other hazardous materials into receiving waters.
- Rapid re-seeding of disturbed sites to help alleviate sediment loading and reduce runoff. Increased runoff from new highway surfaces can be partially mitigated by providing for grassed road shoulders and limited use of ditching.
- Careful management and use of herbicides, pesticides, de-icing compounds, or other chemical constituents would minimize potential negative impacts on water quality. Roadside maintenance crews should be well versed in the use of these chemicals.
- Avoid direct discharges into streams whenever feasible. Runoff effluent should be allowed to filter through roadside vegetation in order to remove contaminants and to minimize runoff velocities.

Long-term impacts on water quality can occur due to particulates, heavy metals, organic matter, pesticides, herbicides, nutrients, and bacteria that are often found in highway runoff. Much of the non-point pollution associated with an urbanizing watershed comes from the aggregate total of paved and roofed areas. The direct impacts of a specific highway project are expected to be less severe than the overall impact from the area's development.

Winston Salem adopted varying measures to protect public water supplies. Two principal types of protections are provided by Winston-Salem/Forsyth County and/or North Carolina: minimum lot size requirements for private septic systems; and the local watershed protection regulations, which are further refined into two categories applied either to the Salem Lake Watershed or the six remaining watersheds in Forsyth County. All jurisdictions in Forsyth County (Winston-Salem, Forsyth County, Kernersville, Clemmons, Walkertown, and Lewisville) have adopted standards that meet – but do not exceed and are not identical in each jurisdiction – the state regulations for development intensity and design. The City-County Planning Board still actively reviews and makes adjustments to the Unified Development Ordinance (UDO), where the local stormwater and WSW protection regulations are codified. Forsyth County has also proved to be responsive to the State's concerns about adding new infrastructure that could indirectly contribute to increased development potential. On November 10, 2005, the Forsyth County Board of Commissioners approved a zoning text amendment to the UDO to add riparian buffers in the Abbots Creek watershed, effectively increasing the buffer width from 30' to 50', adding protections for intermittent streams, and increasing development restrictions.[3] The City-County is also planning to partition the UDO into separate documents for each jurisdiction this year, although the documents will still be coordinated between jurisdictions as before.

The proposed action also has the potential to temporarily degrade the quality of water in the surrounding streams as a result of soil erosion and sedimentation during construction. There are

[3] Norby, Paul A., Staff Report: UDO-147. November 17, 2005.

four streams in Forsyth County that the North Carolina Department of Environment and Natural Resources - Division of Water Quality (DWQ) classifies as impaired waters (Section 303(d) streams). Three of these four streams, Muddy Creek, Salem Creek, and Reynolds Creek, may face additional development pressure if the Northern Beltway is built. The likely additional pressure is somewhat dependent upon the Beltway scenario that is built. For example, if only the Eastern section is built, then it is likely that there will be less development pressure along Muddy Creek. In order to address water quality issues, NCDOT is preparing a water quality analysis in support of the Section 401 Water Quality Certification application. The results of this analysis could be used to assist NCDOT, NCDENR and local governments evaluate alternative methodologies to mitigate the direct and the indirect impacts of projects.

Cumulative direct impacts to water quality from the proposed projects would be minimized through adherence to NCDOT's *Best Management Practices for the Protection of Surface Waters (June 1991)*. In addition, a detailed sediment and erosion control plan consisting of best management practices would be developed for the proposed project. The following mitigation measures to eliminate or reduce short-term and long-term water quality impacts would be incorporated wherever practicable:

- Development of roadway alignments that avoid streams and ponds to the extent possible.
- Use of design measures, including avoiding stormwater discharge into public water supplies, minimizing steam crossings, and minimizing segments of roadway that closely parallel streams, to protect water quality.
- Use of grass shoulders, grass lined ditches, and vegetative buffers to intercept highway runoff.
- Implementation of construction practices that protect stream bottom habitat from siltation by sedimentation control, retention of riparian vegetation buffers, and restoration of stream bottom habitat taken by construction.
- Restricting the use of scuppers (weep holes) in bridges.
- Hazardous spill containment basins also would be considered during the final designs, and implemented where appropriate.

The indirect impacts to water quality are qualitatively discussed in **Section 4.20** – Indirect and Cumulative Impacts.

Water quality is monitored and regulated by the NC Division of Water Quality. The proposed projects would require a Section 401 Water Quality Certification prior to construction (see **Section 4.25** for a discussion of permits). A quantitative analysis of the changes in stormwater runoff and nutrient loading in the project vicinity as a result of projected growth would be

prepared for the selected alternatives for Project R-2247, Project U-2579, and Project U-2579A in support of the Section 401Water Quality Certification.

Hazardous spills are another item of concern relating to water quality. Currently, the City of Winston-Salem's Fire Department employs firefighters who have undergone specialized training in hazardous material spills. The Hazardous Material Response Team (HMRT) is funded by the City of Winston-Salem and Forsyth County. The team operates out of the City Fire Department station located on Old Greensboro Road, about two miles from Salem Lake. They respond to hazardous material spills throughout Forsyth County. In the event of large spill, the HMRT has a back-up unit on US 311, about seven miles from Salem Lake. Response reports for all hazardous spills are sent to the NC Division of Emergency Management within 48 hours of the incident.

4.14 HYDROLOGY AND DRAINAGE

Construction of the proposed project would not have significant impacts on existing large-scale drainage patterns. Local changes would be experienced in small drainage basins as: 1) areas are cut off, reducing flow in a section of the existing channel; 2) flow is redirected into an adjoining, larger drainage; or 3) flow in the channel is increased by the addition of waters from the roadway storm water system. These actions would cause localized changes to the existing stream channels, in some instances resulting in siltation due to lessened flow, and in others, increased erosion and cutting of the channel. The effects would quickly dampen out as distance downstream from the roadway increases.

4.14.1 Major Drainage Structures

4.14.1.1 Major Drainage Structures – Projects R-2247, U-2579, and U-2579A

Table 4-50 combines the Preferred Alternatives for Projects R-2247 and U-2579 with each Detailed Study Alternative for Project U-2579A to show the total number of major drainage structures required for the Northern Beltway. Results are the same for Project U-2579A with or without the Kernersville Road interchange. Major drainage structures have been updated for all three Preferred Alternatives since the 2004 SFEIS/SDEIS as described in **Sections 4.14.1.3** (R-2247), **4.14.1.5** (U-2579), and **4.14.1.7** (U-2579A).

Table 4-50: Major Drainage Structures – Projects R-2247, U-2579, and U-2579A

Project	Alternative	Number of Bridges over Streams	Number of Crossings with Major Culverts or Pipes (> 72 inches in diameter)
R-2247 and **U-2579 Preferred Alternatives plus U-2579A Detailed Study Alternatives** [1]	N1-S1	17	32
	N1-S2	17	34
	N2-S1 **(Preferred Alternative)**	**18**	**37**
	N2-S2	17	34
	N3-S1	17	31
	N3-S2	17	33

[1] Results are the same for alternatives with and without the Kernersville Road interchange. The Project U-2579A Preferred Alternative includes an interchange at Kernersville Road.

4.14.1.2 Major Drainage Structures – Project R-2247 Detailed Study Alternatives

Table 4-51 lists the major drainage structures (all bridges and those culverts greater than 72 inches in diameter) proposed along each Detailed Study Alternative based on the Project R-2247 1992 functional designs. The number of box culverts for the segments in **Table 4-51** does not match those listed in the 1996 Project R-2247 FEIS, which reported incorrect numbers for the box culverts in each segment. The number of major stream crossings for each segment was inadvertently copied into the column for box culverts for each segment. The numbers reported below in **Table 4-51** are correct based on the information available at the time.

Table 4-51: Major Drainage Structures – Project R-2247 Detailed Study Alternatives

Detailed Study Alternative	Length (miles)	Number of Bridge Structures	Number of Box Culverts
WEST-A	17.22	10	20
EAST-A	16.31	9	14
WEST-B	17.59	13	22
EAST-B	16.68	12	16
C3-WEST-A	16.97	9	15
C2-EAST-A	17.05	13	19
C2-EAST-B	17.43	16	21
Preferred Alternative			
C3-WEST-B	**17.35**	**12**	**17**

Note: Impacts are estimates based upon the right-of-way limits from the 1992 Project R-2247 DEIS functional designs.
'Bold' indicates Preferred Alternative.

4.14.1.3 Major Drainage Structures – Project R-2247 Preferred Alternative

The Preferred Alternative crosses numerous streams for which bridges and box culverts would be required (see **Figure 2-12**). **Table 4-52** lists the major drainage structures (all bridges and those culverts greater than 72 inches in diameter) associated with the Preferred Alternative. The information listed in **Table 4-52** was obtained using previous hydraulic designs (1998 and 2001), current preliminary engineering design plans, and the 2004 Project R-2247 Public Hearing Map.

Table 4-52: Major Drainage Structures – Project R-2247 Preferred Alternative

Segment	Location on Figure 2-12(a-k)	Crossing Number	Stream	Roadway	Recommended Major Drainage Structure[1]
C1	2-12a	1	Little Creek	Northern Beltway	2@ 140' x 38'
C1	2-12a	2	Silas Creek	Northern Beltway – northbound	1@ 1024' x 38'
C1	2-12a	2	Silas Creek	Northern Beltway - southbound	1@ 1063' x 45'
C1	2-12a	2a	Silas Creek	McGregor Road	1@ 69' x 30'
C1	2-12b	3	Silas Creek	I-40	Extend RCBC 3@ 12' x 14' (36' upstream and 96' downstream)
B2	2-12b	4	Muddy Creek	Northern Beltway	1@ 902' x 38' and 1@ 928' x 38'
B2	2-12c	5	Muddy Creek tributary	Northern Beltway	1@ 8' x 8' RCBC (242' long)
C3	2-12c	6	Muddy Creek	US 421 – ramp AC	1@ 692' x 34'
C3	2-12c	6	Muddy Creek	US 421 – ramp C	1@ 408' x 25'
C3	2-12c	6	Muddy Creek	US 421 – northbound	1@ 213' x 59'
C3	2-12c	6	Muddy Creek	US 421 – southbound	1@ 213' x 52'
C3	2-12c	7	Silas Creek	Kester Mill Road	1@ 70' x 27'
A4	2-12d	8	Reynolds Creek	Northern Beltway	2@ 305' x 38'
A4	2-12e	9	Unnamed Tributary to Tomahawk Creek	Northern Beltway	2@ 341' x 38'
A4	2-12e	10	Unnamed Tributary to Tomahawk Creek	Robinhood Road	2@ 6' x 7' RCBC (214' long)
A4	2-12e	11	Unnamed Tributary to Tomahawk Creek	Northern Beltway	2@ 6' x 5' RCBC (312' long)
C4	2-12h	12	Mill Creek Number 3	Northern Beltway	2@ 350' x 38'
C4	2-12h	13	Unnamed Tributary to Mill Creek Number 3	Northern Beltway	1@ 8' x 8' RCBC (394' long)
B8	2-12i	14	Unnamed Tributary to Muddy Creek	Northern Beltway	1@ 9' x 9' RCBC (344' long)
B8	2-12i	15	Muddy Creek	Northern Beltway	2@ 370' x 38'

Table 4-52: Major Drainage Structures – Project R-2247 Preferred Alternative

Segment	Location on Figure 2-12(a-k)	Crossing Number	Stream	Roadway	Recommended Major Drainage Structure[1]
B10**	2-12j	16	Unnamed Tributary to Grassy Creek	Northern Beltway and US 52 Interchange	1 @ 7' x 6' x 1185' long
B10**	2-12j	17	Unnamed Tributary to Grassy Creek	Northern Beltway and US 52 Interchange	1 @ 8' x 6' x 1673' long
B10**	2-12j	18	Grassy Creek	Northern Beltway and US 52 Interchange	Replace Existing 2 @ 8' x 8', with 2 @ 9' x 9' x 555' long
B10**	2-12j	19	Grassy Creek	US 52 North Ramp DA1 to eastbound Northern Beltway	300x30
B10**	2-12j	20	Grassy Creek	US 52 Northbound and Southbound	Extend Existing 2 @ 9' x 9', 163' upstream & 41' downstream
B10**	2-12k	21	Unnamed Tributary to Beaver Dam Creek	US 52 – north of the Northern Beltway	Extend 60" cmp 77' upstream & 80' downstream and supplement with 48" pipe 403' long
B10**	2-12k	22	Unnamed Tributary to Beaver Dam Creek	US 52 – north of the Northern Beltway	Extend existing 1 @ 8' x 7', 37' upstream & 30' downstream and supplement with 66" pipe 327' long
B10**	2-12k	23	Beaver Dam Creek	US 52 – north of the Northern Beltway	Extend existing 2 @ 7' x 7', 30' upstream & 16' downstream
B10**	2-12j	24	Grassy Creek	US 52 North Ramp DBA1 to Westbound Northern Beltway	311x40

* Perennial stream that is not present on USGS quadrangle. These streams could be intermittent on the USGS maps.
**Updated based on 2006 preliminary engineering designs for this location.
[1]RCBC = Reinforced Concrete Box Culvert
Example: 2@ 978' x 38' means a bridge with 2 spans each 978 feet long and 38 feet wide
3@ 12' x 10' RCBC (260' long) means 3 rectangular openings, each 12' wide, 10' deep, and 260' long

Note: Where RCBC is not specified, the structure is a bridge.

It should be noted that the number of structures listed in **Table 4-51** for the Project R-2247 Preferred Alternative is different than the number of structures listed in **Table 4-52** for the Project R-2247 Preferred Alternative. This difference in the number of structures is a result of changes in design from the 1992 DEIS functional design (used for **Table 4-51**) to the current preliminary engineering design, previous hydraulic designs (1998 and 2001), and 2004 Public Hearing Map (used for **Table 4-52**). The information in **Table 4-52** reflects the most recent design for the Preferred Alternative and is used in the Summary of Major Drainage Structures – Projects R-2247, U-2579, and U-2579A (**Table 4-50**).

All hydraulic structures would be designed such that the proposed structures would not significantly increase upstream flooding and would not increase the flood hazard potential of the existing floodplain. The structure types were presented to and agreed upon by the Merger Team members at meetings on June 9, 2005; July 13, 2005, and March 21, 2006 (see discussion in **Section 6.1.1.2**).

4.14.1.4 Major Drainage Structures – Project U-2579 Detailed Study Alternatives

A hydrological analysis of major stream crossings for the Detailed Study Alternatives was prepared for the 1995 Project U-2579 DEIS. **Table 4-53** lists the major drainage structures proposed along each alternative, including box culverts and cross pipes 72 inches or greater in diameter. There are no bridges proposed for the Detailed Study Alternatives. **Table 4-53** lists the correct number of structures for each segment and alternative based on the 1994 functional engineering designs.

Table 4-53: Major Drainage Structures – Project U-2579 Detailed Study Alternatives

Detailed Study Alternative	Length (miles)	Number of Pipes	Number of Box Culverts	Number of Bridge Structures
Western	11.8	3	11	0
Eastern	13.2	1	14	0
Alternative 1	12.7	2	14	0
Alternative 2	12.8	2	10	0
Alternative 3	13.5	0	15	0
Alternative 4	13.2	1	11	0
Alternative 5	13.1	1	15	0
Alternative 6	12.9	3	12	0
Alternative 8	12.8	2	11	0
Preferred Alternative				
W1-W2-W3-C4-E5 (Alternative 7) 1994 Functional Engineering Design	**12.4**	**3**	**11**	**0**

Quantities are based upon the right-of-way limits for the 1994 functional engineering designs.
'Bold' indicates Preferred Alternative.

4.14.1.5 Major Drainage Structures – Project U-2579 Preferred Alternative

An updated hydraulic analysis of major stream crossings was prepared for the Project U-2579 Preferred Alternative based on the 2005 preliminary engineering designs. Based on this analysis, the Preferred Alternative would cross 12 streams using box culverts, and would cross three streams using bridges. **Table 4-54** has been revised from the SFEIS/SDEIS, and lists the major drainage structures (box culverts and bridges) recommended for the Project U-2579 Preferred

Alternative, based on construction limits from the 2005 functional engineering design. The structure types were presented to the Merger Team members at meetings on May 10 and June 9, 2005 and the concurrence form was signed on June, 2005 (see discussion in **Section 6.1.2.3**).

Table 4-54: Major Drainage Structures – Project U-2579 Preferred Alternative

Structure Number	Segment	Stream	Roadway	Recommended Major Drainage Structure[1] (WxL, feet)	Stream Impact (feet)
ES 1	W2	UT to Mill Creek	Northern Beltway	7' x 7' x 300' long RCBC	355
ES 2	W2	UT to Mill Creek	Northern Beltway	7' x 7' x 310' long RCBC	374
ES 3A	W3	UT to Mill Creek	Northern Beltway – Ramp A	7' x 7' x 215' long RCBC	225
ES 3B	W3	UT to Mill Creek	Northern Beltway	7' x 7' x 235' long RCBC	290
ES 3C	W3	UT to Mill Creek	Northern Beltway – Ramp D	7' x 7' x 195' long RCBC	240
ES 4	W3	Mill Creek	Northern Beltway	2 @ 65' x 285'	0
ES 5	W3	UT to Mill Creek	Northern Beltway	7' x 7' x 330' long RCBC	510
ES 6	W3	UT to Frazier Creek	US 311 – west ramps	6' x 6' x 1,000' long RCBC	1,560
ES 7	C4	Frazier Creek	Northern Beltway	7' x 7' x 330' long RCBC	365
ES 8	C4	Lowery Mill Creek	Northern Beltway	2 @ 65' x 275'	0
ES 9	C4	UT to Lowery Mill Creek	US 158	7' x 7' x 230' long RCBC	285
ES 10	E5	Martin Mill Creek	Northern Beltway	2 @ 65' x 330'	0
ES 11	E5	UT to Martin Mill Creek	Northern Beltway	8' x 8' x 265' long RCBC	405 + 700 relocated
ES 12	W3	Mill Creek	Baux Mountain Road	Extend existing 3 @ 10' x 8' RCBC with 25' extension and add 1 @ 1' x 10' RCBC	45
ES 13	W3	UT to Mill Creek	Northern Beltway	7' x 7' x 330' long RCBC	360

Quantities are based upon the construction limits for the 2004 functional engineering design.
UT = Unnamed Tributary
[1]RCBC = Reinforced Concrete Box Culvert
Example: 2@ 65' x 275' means a bridge with 2 spans each 65' wide and 275' long
3@ 12' x 10' x 265' long RCBC means 3 rectangular openings, each 12' wide, 10' deep, and 265' long
Note: Where RCBC is not specified, the structure is a bridge.

4.14.1.6 Major Drainage Structures – Project U-2579A Detailed Study Alternatives

A hydraulics analysis was completed in December 2002 for the Detailed Study Alternatives. Major drainage areas were delineated on United States Geological Survey (USGS) quadrangle maps. Since there are no stream crossings near the proposed Kernersville Road interchange, the drainage structures are the same for each alternative with or without the additional interchange.

Pipe sizes are calculated based on the flows produced by a 50-year or 100-year storm event, referred to as Q50 or Q100, respectively. Although 50-year design is the minimum for all crossings, the crossings for Fishers Branch, Fiddlers Creek, Swaim Creek, and South Fork Muddy Creek are governed by a 100-yr design based on FEMA requirements because they are located in National Flood Insurance Program (NFIP) flood hazard areas. There are Detailed Flood Studies for these areas at nearby crossings. Design discharges for crossings in flood hazard areas are Q100, as published in the Detailed Flood Studies or estimated using the NCDOT hydrologic design methods taking into account the probable urbanization of the drainage basins. A prorated value was applied in cases where drainage areas for the proposed crossings were different than the sections for which data is given.

In accordance with the NCDOT design procedures for crossings not located in a flood hazard area, the design discharge is Q50 based on the drainage area and the NCDOT hydrologic design methods (USGS Regression and C200 charts). Approximate structure sizes were developed using FHWA hydraulic design charts for inlet control (FHWA Hydraulic Engineering Circular No. 5) based on headwater depths and design discharges. Gauge data was not applicable for this project site.

Only box culverts and cross pipes 72 inches or greater in diameter are specifically addressed in this section. No bridges are recommended for the Detailed Study Alternatives. **Table 4-55** lists the major drainage structures for the Detailed Study Alternatives by structure, which are based on the 2002 preliminary engineering designs. Modifications and/or additional structures may be considered due to changes in the final design. **Table 4-56** summarizes the major drainage structures for each Detailed Study Alternative.

Table 4-55: Major Drainage Structures – Project U-2579A Detailed Study Alternatives

Structure Number	Detailed Study Alternative Segment(s)	Stream	Approximate Design Size	Approximate Length (feet)
1A	N1, **N2**	Fishers Branch	2 @ 9' x 9' RCBC	285
1B	N3	Fishers Branch	2 @ 9' x 9' RCBC	308
2	N1, **N2**	UT to Fishers Branch	6' x 6' RCBC	213
3A	N1	Fiddlers Creek	2 @ 10' x 10' RCBC	407
3B	**N2**	Fiddlers Creek	2 @ 10' x 10' RCBC	367
3C	N3	Fiddlers Creek	2 @ 10' x 10' RCBC	236
3D	N1	Fiddlers Creek	2 @ 10' x 10' RCBC	266
3E	**N2**	Fiddlers Creek	2 @ 10' x 10' RCBC	233
3F	N3	Fiddlers Creek	2 @ 10' x 10' RCBC	171
3G	N1	Fiddlers Creek	2 @ 10' x 10' RCBC	249
3H	**N2**	Fiddlers Creek	2 @ 10' x 10' RCBC	236
3I	N3	Fiddlers Creek	2 @ 10' x 10' RCBC	164
4A	S2	Swaim Creek	2 @ 9' x 9' RCBC	233
4B	**S1**	Swaim Creek	2 @ 9' x 9' RCBC	207
5A	S2	South Fork Muddy Creek	2 @ 10' x 10' RCBC	171
5B	S2	South Fork Muddy Creek	2 @ 10' x 10' RCBC	151
5C	S2	South Fork Muddy Creek	Extend Existing 3 @ 7' x 7' RCBC by 200'	174
5D	**S1**	South Fork Muddy Creek	2 @ 10' x 10' RCBC	233

UT = Unnamed Tributary
Quantities are based on the construction limits for the 2002 preliminary engineering designs.
Quantities are the same for alternatives with or without the Kernersville Road interchange.
'Bold' indicates Preferred Alternative.

Table 4-56: Summary of Major Drainage Structures – Project U-2579A Detailed Study Alternatives

Detailed Study Alternative	Number of Structures	Total Structure Length (ft)
N1-S1	7	1,860
N1-S2	9	2,149
N2-S1 (Preferred Alternative)	**7**	**1,774**
N2-S2	9	2,063
N3-S1	6	1,319
N3-S2	8	1,608

Quantities are based on the construction limits from 2002 preliminary engineering designs.
Results are the same with and without the Kernersville Road interchange.
'Bold' indicates Preferred Alternative.

4.14.1.7 Major Drainage Structures – Project U-2579A Preferred Alternative

Major drainage structures were updated for the U-2579A Preferred Alternative based on the 2005 preliminary engineering designs, and were approved by the Merger Team on June 9, 2005. Based on the 2005 preliminary engineering designs, the Preferred Alternative would include two bridges and ten RCBCs. **Table 4-56-1** lists the major drainage structures for the U-2579A Preferred Alternative.

Table 4-56-1 Major Drainage Structures – Project U-2579A Preferred Alternative

Structure Number	Segment	Stream	Roadway	Recommended Major Drainage Structure[1] (WxL, feet)	Stream Impact (feet)
ESE 1	N2	Kerners Mill Creek	Northern Beltway, Ramp BD	2 @ 12' x 10' x 480' long RCBC	472
ESE 2	N2	Smith Creek (Harmon Mill Creek)	Northern Beltway, C/D Road, Ramp A, Ramp BD	2 @ 130' x 45', 1 @ 130' x 40', 2 @ 130' x 60'	0
ESE 3	N2	Fiddler's Creek	Meredith Way Ext.	2 @ 10' x 10' x 60' long RCBC	118
ESE 4	N2	Fisher's Branch	Northern Beltway, C/D Road	2 @ 9’ x 9’ x 330' long RCBC	344
ESE 5	N2	UT to Fisher's Branch	Northern Beltway	6’ x 6’ x 226' long RCBC	100
ESE 6A	N2	Fiddler's Creek	Ramp B, Ramp BD	2 @ 10' x 10' x 410' long RCBC	824
ESE 6B	N2	Fiddler’s Creek	Northern Beltway	2 @ 10' x 10' x 233' long RCBC	234
ESE 6C	N2	Fiddler’s Creek	Ramp A, Ramp AC	2 @ 10' x 10' x 200' long RCBC	210
ESE 7	S1	Swaim Creek	Ramp AC	(Part of interchange bridge)	0
ESE 8	S1	Muddy Creek	Northern Beltway	2 @ 10’ x 10’ x 256' long RCBC	298
ESE 9	S1	Muddy Creek	Ramp AC	Extend existing 3 @ 8' x 8' RCBC with 220' extension	250
ESE 10	N2	Smith Creek (Harmon Mill Creek)	I-40 Business	Extend existing 3 @ 8’ x 9’ RCBC with 60’ extension	75 + 2,083 relocation
Totals				**11 Major Drainage Structures**	**2,925 + 2,083 relocation**

UT = Unnamed Tributary
Quantities are based upon the construction limits for the 2005 preliminary engineering designs.
Quantities are the same for alternatives with or without the Kernersville Road interchange.
[1]RCBC = Reinforced Concrete Box Culvert
Example: 2@ 65’ x 275’ means a bridge with 2 spans each 65’ wide and 275’ long
3@ 12’ x 10’ x 265’ long RCBC means 3 rectangular openings, each 12’ wide, 10’ deep, and 265’ long
Note: Where RCBC is not specified, the structure is a bridge.

4.14.2 Stream Impacts

4.14.2.1 Background Information

The following sections report the impacts on perennial, intermittent, and ephemeral streams associated with Projects R-2247, U-2579, and U-2579A.

Perennial streams are those meeting the criteria set forth by the NCDWQ. The perennial streams are generally considered to be significant, in that they usually possess the consistent hydrology to support aquatic populations year round. Some intermittent streams are considered to be important because they also support aquatic populations during portions of the year. Important streams are classified based on guidance from the US Army Corps of Engineers (USACE). The USACE is responsible for making the final importance determination and compensatory mitigation requirements. Compensatory mitigation is usually required for important perennial and intermittent stream channel impacts.

Streams crossed by the proposed alignments for Projects R-2247, U-2579 and U-2579A may be temporarily impacted by road construction. Potential short-term impacts include temporarily increased sedimentation and turbidity levels. Long-term impacts to streams as a result of road construction are expected to be negligible. An increase in impervious road surface area would result in increased runoff with the potential for carrying higher pollutant loads. Adherence to the NCDOT's *Best Management Practices for the Protection of Surface Waters* during design and construction of the proposed projects are expected to minimize impacts.

Other potential impacts from stream crossings and channel relocations include disturbance of the natural stream channel habitat and associated aquatic and terrestrial wildlife populations (see **Section 4.18**).

Through the Section 404 Permit and Section 401 Water Quality Certification, all stream channel impacts and relocations would be coordinated with the US Army Corps of Engineers, US Fish and Wildlife Service, NC Division of Water Quality, and NC Wildlife Resources Commission (see **Section 4.25 - Permits**).

4.14.2.2 Combined Direct Stream Impacts

Table 4-57 lists the combined stream impacts for the Northern Beltway. Impacts have been updated for all the Preferred Alternatives based on the 2005 preliminary engineering designs.

Table 4-57: Combined Direct Stream Impacts – Projects R-2247, U-2579, and U-2579A

Project	Alternative	Impacted Length – USACE Mitigatable[2] (ft)	Impacted Length - Not Mitigatable (ft)	Total Length of Impacted Stream[3] (ft)	Total Length of Relocated Stream[3] (ft)	Number of Stream Crossings
R-2247 and **U-2579 Preferred Alternatives -plus U-2579A Detailed Study Alternatives**[1]	N1-S1	39,304	16,523	55,827	3,914	116
	N1-S2	37,906	17,137	55,043	3,914	116
	N2-S1 (Preferred Alternative)	**36,445**	**16,907**	**53,352**	**6,189**	**120**
	N2-S2	38,441	17,137	55,578	3,914	118
	N3-S1	42,283 (41,614)	16,523	58,806 (58,137)	3,914	119
	N3-S2	40,885 (40,216)	17,137	58,022 (57,353)	3,914	119

Impacts are based on 2005 preliminary engineering designs for the Project R-2247, U-2579, and U-2579A Preferred Alternatives, and are based on the 2002 preliminary engineering designs for the Project U-259A non-preferred alternatives.
[1]Unless designated by () as without Kernersville Road interchange, Project U-2579A Detailed Study Alternatives are the same with or without the interchange. The Project U-2579A Preferred Alternative includes an interchange at Kernersville Road.
[2]USACE mitigatable streams are considered as such based on guidance from the USACE. Mitigatable streams must be mitigated for.
[3] Stream relocations are considered mitigated impacts.

4.14.2.3 Streams - Project R-2247 Detailed Study Alternatives

Table 4-58 lists the number of stream crossings and length of estimated stream channel relocation from Table 4.5-1 of the 1996 Project R-2247 FEIS. These values are based on the 1992 functional designs. Streams are not expected to have disappeared or been created over the time period since the functional designs, and relative impacts between the alternatives are expected to be the same.

Table 4-58: Stream Impacts - Project R-2247 Detailed Study Alternatives

Detailed Study Alternative	Length (miles)	Number of Stream Crossings	Stream Channel Relocations (ft)
WEST-A	17.22	41	3,600
EAST-A	16.31	43	1,200
WEST-B	17.59	49	3,800
EAST-B	16.68	51	1,400
C3-WEST-A	16.97	39	2,300
C2-EAST-A	17.05	45	1,200
C2-EAST-B	17.43	53	1,400
Preferred Alternative			
C3-WEST-B	**17.35**	**47**	**2,500**

Values are based upon the DEIS functional designs.
'Bold' indicates Preferred Alternative.

As shown in the table above, Detailed Study Alternative C3-WEST-A would have the fewest stream crossings, and Detailed Study Alternatives EAST-A and C2-EAST-A would have the least stream channel relocation. The Preferred Alternative is in the middle of the ranges for both stream crossings and length of channel relocation.

4.14.2.4 Streams - Project R-2247 Preferred Alternative

Updated surveys for streams were conducted in 2002/2003, as described in **Section 3.16.2.2**. There are 52 streams crossed by the Preferred Alternative right of way. These streams are shown in **Figure 3-11(a–ee)** and listed in **Table 4-59**, along with the impacted length, number of crossings, mitigation category (USACE mitigatable or not), length of relocated stream, stream name, type, stream classification, and NCDWQ index #. Known bridge locations based on the 2005 preliminary engineering design and the Public Hearing Map are noted, with no impacts to streams included in these locations. USACE mitigatable (important) streams are considered as such based on guidance from the USACE.

DWQ mitigatable streams are perennial streams (named or unnamed) present on the USGS quadrangle maps or perennial streams containing aquatic life. Based on preliminary observations, it is not expected that there will be more DWQ mitigatable streams than there are USACE mitigatable streams, which are presented in **Table 4-59**. It is expected that the USACE mitigatable streams will also be mitigatable for DWQ.

Table 4-59: Streams Within the Preferred Alternative Right of Way for Project R-2247

Stream Label[1]	Stream Type	Width (ft)	Depth (ft)	Primary Substrate	Aquatic Organisms Observed	USACE Mitigatable[2]	Stream Name	Stream Class.	NC DWQ Index #	Impacted Length[3] (ft)	Number of Crossings[5]	Length of Relocated Stream[6] (ft)
A	Ephemeral	3.5	0	Sand	None	No	*	C	12-94-11	261	1	0
Ba	Intermittent	5.0	2.5	Gravel	None	No	UT to Little Creek	C	12-94-11	1,055	1	0
Bb	Perennial	5.0	2.5	Gravel	None	Yes	UT to Little Creek	C	12-94-11	261	1	0
C	Intermittent	1.5	0.4	Gravel	None	No	**	C	12-94-11	214	1	0
D	Intermittent	1.0	0.3	Sand	None	No	**	C	12-94-11	129	1	0
E	Perennial	15.0	1.5	Sand	None	Yes	Little Creek	C	12-94-11	0	1 bridge	0
F	Ephemeral	1.5	0	Clay	None	No	*	C	12-94-10	313	1	0
G	Ephemeral	1.0	0	Clay	None	No	*	C	12-94-10	210	1	0
H	Perennial	20.0	2.0	Sand	None	Yes	Silas Creek	C	12-94-10	173	4 (3 bridges & 1 other)	0
I	Perennial	3.0	0.3	Sand	None	Yes	***	C	12-94-10	69	1	0
J	Perennial	38.0	2.5	Gravel	Snails	Yes	Muddy Creek	C	12-94-(0.5)	0	5 bridges	0
K	Perennial	6.0	0.5	Gravel	Snails	Yes	UT to Muddy Creek	C	12-94-(0.5)	OUTSIDE ROW	0	0
L	Perennial	2.5	0.3	Sand	None	Yes	UT to Muddy Creek	C	12-94-(0.5)	OUTSIDE ROW	***0***	0
M	Perennial	4.0	0.5	Gravel	Snails	Yes	UT to Muddy Creek	C	12-94-(0.5)	257	1	0
N	Intermittent	3.0	0.4	Silt	None	No	**	C	12-94-(0.5)	1,188	1	330
O	Intermittent	2.0	0.3	Sand	None	No	**	C	12-94-(0.5)	311	1	0
P	Perennial	6.0	0.3	Gravel	Snails	Yes	Reynolds Creek	C	12-94-9	0	1 bridge	0
Q	Perennial	5.0	0.3	Gravel	Snails	Yes	UT to Tomahawk Creek	C	12-94-9-1	830	1	0
R	Perennial	11.0	0.9	Sand	None	Yes	UT to Tomahawk Creek	C	12-94-9-1	0	1 bridge	0
S	Perennial	4.0	0.2	Gravel	Snails	Yes	UT to Tomahawk Creek	C	12-94-9-1	310	1	547
T	Intermittent	2.0	0.1	Silt	None	No	**	C	12-94-9-1	464	2	0
U	Perennial	5.0	0.3	Sand	None	Yes	UT to Tomahawk Creek	C	12-94-9-1	1,224	2	1,528
U1	Intermittent	1.0	0.3	Gravel	None	No	UT to Tomahawk Creek	C	12-94-9-1	647	1	0
V	Perennial	6.0	0.3	Gravel	None	Yes	UT to Tomahawk Creek	C	12-94-9-1	522	4	0

Table 4-59: Streams Within the Preferred Alternative Right of Way for Project R-2247

Stream Label[1]	Stream Type	Width (ft)	Depth (ft)	Primary Substrate	Aquatic Organisms Observed	USACE Mitigatable[2]	Stream Name	Stream Class.	NC DWQ Index #	Impacted Length[3] (ft)	Number of Crossings[5]	Length of Relocated Stream[6] (ft)
W	Perennial	4.0	0.2	Sand	None	No	***	C	12-94-9-1	224	1	0
X	Perennial	3.0	0.4	Gravel	Snails	Yes	UT to Tomahawk Creek	C	12-94-9-3	92	1	0
Y	Intermittent	2.0	0.1	Clay	None	No	**	C	12-81-(0.5)	849	1	0
Z North	Intermittent	1.5	0.3	Clay	None	No	UT to Bill Branch	C	12-94-5	305	1	0
Z South	Intermittent	1.5	0.3	Clay	None	No	UT to Bill Branch	C	12-94-5	293	1	0
AA	Intermittent	2.0	0.2	Sand	None	No	UT to Bashavia Creek	C	12-81-(0.5)	335	1	0
BB	Perennial	4.0	0.9	Sand	None	Yes	Bashavia Creek	C	12-81-(0.5)	0	1 (ex. culvert)	0
CC	Perennial	2.0	0.2	Sand	Snails	Yes	UT to Bashavia Creek	C	12-81-(0.5)	489	1	0
DD	Perennial	2.0	0.2	Gravel	None	Yes	UT to Bashavia Creek	C	12-81-(0.5)	442	1	0
EE	Intermittent	1.0	0.1	Sand	None	No	UT to Bashavia Creek	C	12-81-(0.5)	548	1	0
FF	Intermittent	1.0	0.1	Sand	None	No	**	C	12-81-(0.5)	714	1	0
GG	Intermittent	0.5	0.1	Clay	None	No	**	C	12-94-4	776	1	0
HH	Perennial	5.0	0.8	Sand	None	Yes	Mill Creek No. 3	C	12-94-4	0	1 bridge	0
II	Intermittent	1.5	0.2	Sand	None	No	**	C	12-94-4	357	1	0
JJ	Intermittent	1.5	0.2	Silt	None	No	UT to Mill Creek No. 3	C	12-94-4	147	1	0
KK	Intermittent Perennial	6.0	0.3	Gravel	Snails	No Yes	***	C	12-94-4	813 292	1	0
LL	Intermittent	2.5	0	Sand/silt	None	No	UT to Muddy Creek	C	12-94-(0.5)	620	1	0
	Perennial	2.5	0	Sand/silt	None	Yes	UT to Muddy Creek	C	12-94-(0.5)	647	1	0
MM	Ephemeral	1.0	0	Vegetation/ Silt	None	No	*	C	12-94-(0.5)	102	1	0
NN	Perennial	7.0	2.0	Silt	Fish, Frogs, Water Striders	Yes	UT to Muddy Creek	C	12-94-(0.5)	391	1	0
OO	Perennial	3.5	0.3	Sand	None	Yes	Muddy Creek	C	12-95-(0.5)	0	1 bridge	0
PP	Perennial	1.5	0.1	Sand	None	Yes	***	C	12-95-(0.5)	361	1	0
QQ	Perennial	2.0	0.2	Gravel	None	Yes	UT to Muddy Creek	C	12-94-(0.5)	616	1	0

Table 4-59: Streams Within the Preferred Alternative Right of Way for Project R-2247

Stream Label[1]	Stream Type	Width (ft)	Depth (ft)	Primary Substrate	Aquatic Organisms Observed	USACE Mitigatable[2]	Stream Name	Stream Class.	NC DWQ Index #	Impacted Length[3] (ft)	Number of Crossings[5]	Length of Relocated Stream[6] (ft)
RR	Perennial	2.0	0.1	Gravel	Snails	Yes	UT to Grassy Creek	C	12-94-7-3	OUTSIDE SLOPES	1	0
SS	Intermittent	3.0	0.1	Gravel	None	No	**	C	12-94-2	394	1	0
TT	Perennial	3.0	0.1	Cobble	None	Yes	***	C	12-94-2	312	1	0
UU	Perennial	6.0	0.2	Gravel	None	Yes	UT to Beaver Dam Creek	C	12-94-2	117	1	0
VV	Perennial	Braided	0.3	Sand	None- impacted by fungus from chip pile runoff	No[4]	UT to Grassy Creek	C	12-94-7-3	1,825	1	0
WW	Perennial	8.0	0.3	Sand	None	Yes	UT to Grassy Creek	C	12-94-7-4	1,185	1	0
XX	Perennial	9.0	0.5	Sand	None	Yes	Grassy Creek	C	12-94-7-3	1,287	2 and 2 bridges	604
YY	Intermittent	2.5	0.1	Sand	None	No	**	C	12-94-5	232	1	0
ZZ	Intermittent	1.5	0.1	Sand	None	No	**	C	12-94-7-3	251	1	0
AAA	Intermittent	3.5	0.3	Sand	None	Yes	UT to Grassy Creek	C	12-94-7-3	OUTSIDE SLOPES	0	0
BBB	Perennial	8	0.6	Sand	Mayflies, stoneflies, caddisflies	Yes	Beaver Dam Creek	C	12-94-2	100	1	0
CCC	Perennial	9	0.2	Cobble	Mayflies	Yes	UT to Beaver Dam Creek	C	12-94-2	206	1	0
USACE Mitigatable (linear feet)										**10,183**	**--**	**2,679**
Not Mitigatable (linear feet)										**13,577**	**--**	**330**
Total Linear Feet of Stream Channel										**23,760**	**--**	**3,009**

UT = Unnamed Tributary

[1] Stream numbers refer to **Figure 3-11(a-ee)**.

[2] USACE mitigatable streams are considered as such based on guidance from the USACE.

[3] Total Impacted Length was calculated based on the length of stream within the estimated construction limits of the 2005 preliminary engineering design.

[4] The perennial stream has been significantly impacted by runoff from a chip/mulch pile. The stream has a white fungal growth preventing a "USACE Mitigatable" classification. The USACE concurs with this determination

[5] Bridge crossings are specified as such. All other crossings are culverts or pipes and have impacts associated with them.

[6] Length of stream relocations is based on the 2005 preliminary engineering design. Stream relocations are considered mitigated impacts.

* Ephemeral stream not present on USGS quadrangle. No stream name. The stream classification and index number relate to closest tributary stream.

** Intermittent stream not present on USGS quadrangle. No stream name. The stream classification and index number relate to closest tributary stream.

*** Perennial stream that is not present on USGS quadrangle. These streams could be intermittent on the USGS maps.

Stream impacts were calculated based on the length of each stream within the estimated construction limits of the 2005 preliminary engineering design. The *Supplemental Natural Systems Technical Memorandum* (2003), appended by reference, includes additional details about each stream. Relocated stream lengths are based on the 2005 preliminary engineering design. Stream relocations are considered mitigated impacts.

As shown in the table, all of the streams have a best usage classification of C assigned by the North Carolina Division of Water Quality (NCDWQ). The C listing indicates that the water uses include aquatic life propagation and survival, fishing, wildlife, secondary recreation, and agriculture.

Of the fifty-two streams crossed by the Project R-2247 Preferred Alternative, four are ephemeral, seventeen are intermittent, twenty-nine are perennial, and three (Streams B, KK, and LL) change from intermittent to perennial within the Project R-2247 Preferred Alternative right of way. Stream Z is crossed twice.

Mitigation must be provided for cumulative important stream channel impacts. Complete bridging of the stream channel would not require mitigation, but construction of standard concrete or metallic culverts would require mitigation for the disturbed stream channel. The 2005 preliminary engineering design for the Project R-2247 Preferred Alternative currently proposes bridges over Little Creek, Silas Creek, Muddy Creek, Reynolds Creek, and Tomahawk Creek tributary. A conceptual mitigation plan would be developed during final design and included in the final environmental document. **Section 4.17** provides further discussion of jurisdictional issues and mitigation.

In addition to transverse crossings using culverts and bridges, the 2005 preliminary engineering design for the Project R-2247 Preferred Alternative would relocate approximately 2,405 feet of stream channel along Tomahawk Branch and tributaries of Muddy Creek, Reynolds Creek, and Tomahawk Creek. These crossings are listed in **Table 4-59** and shown in **Figure 3-10a**. Stream channel relocation also may be necessary along Grassy Creek at the US 52 interchange, south of the NC 66 connector. However, current preliminary drainage designs have not been completed for that portion of the project.

4.14.2.5 Streams - Project U-2579 Detailed Study Alternatives

The 1995 Project U-2579 DEIS (**Section 4.4.2.1**) described the stream crossings and length of estimated stream channel relocation for the Detailed Study Alternatives. **Table 4-60** summarizes the number of major stream crossings for each Detailed Study Alternative. There are no major stream relocations or channelization proposed for any of the alternatives. The number of major stream crossings for three of the alternatives (Alternatives 2, 4, and 8) are different from those

listed in the 1995 Project U-2579 DEIS. Although all of the stream crossings were described correctly, the total number of crossings for those three alternatives was incorrectly summed. Results are based on the 1994 functional engineering designs.

As shown below, Detailed Study Alternatives 2 and 4 would have the fewest number of stream crossings, and Alternatives 1 and 6 would have the most crossings. As stated previously, there were no stream channel relocations proposed for any of the alternatives.

Figure 3-10b shows the streams in the study area. Lowery Mill Creek, Martin Mill Creek, and Kerners Mill Creek are located within a water quality sensitive area (WQSA-IV), based on the Salem Lake watershed. Special consideration would be given during design to minimize erosion and prevent sedimentation from entering these streams.

Table 4-60: Stream Impacts – Project U-2579 Detailed Study Alternatives

Detailed Study Alternative	Length (miles)	Number of Major Stream Crossings
Western	11.8	14
Eastern	13.2	15
Alternative 1	12.7	16
Alternative 2	12.8	12
Alternative 3	13.5	15
Alternative 4	13.2	12
Alternative 5	13.1	16
Alternative 6	12.9	15
Alternative 8	12.8	13
Preferred Alternative		
W1-W2-W3-C4-E5 (Alternative 7) 1994 Functional Engineering Design	**12.4**	**14**

Impacts are based upon right-of-way limits for the 1994 functional engineering designs.
'Bold' indicates Preferred Alternative.

4.14.2.6 Streams - Project U-2579 Preferred Alternative

Streams were identified in September 1998 within the Preferred Alternative right of way and construction limits. Streams impacts were calculated by overlaying NCDOT's preliminary roadway design plans onto topographic base mapping of the project area. A field review was conducted in 2002 and 2003 to determine a Rosgen classification for each stream segment. There are 51 streams crossed by the Preferred Alternative, six of which are described under Project

U-2579A impacts (**Section 4.14.2.7**), and one of which is described under Project R-2247 impacts (**Section 4.14.2.4**).

The remaining 44 streams are described in **Table 4-61** and shown in **Figure 3-12(a-jj)**. Impacts were based on the length of each stream within the estimated construction limits of the 2005 preliminary engineering design.

Based on the 2005 preliminary engineering design, there are 905 feet of stream relocations or stream channelization proposed for the Preferred Alternative. Stream relocations have been agreed to by the NEPA/Section 404 Merger Team (see **Section 6.1.2.3** for more detail on the merger process). If channel relocations are required in the right of way, they will be designed using natural channel design techniques and will be self mitigating. The table gives the total stream lengths within the construction limits of the Project U-2579 Preferred Alternative.

USACE mitigation status is given in **Table 4-61**. USACE mitigatable (important) streams are considered as such based on guidance by the USACE. No water resources classified as High Quality Waters (HQW's), Water Supply Watersheds (WS-I), or Outstanding Resource Waters (ORW's) are located within the project vicinity. There are no streams on the DWQ 2003 Draft 303 (d) list of impaired waters located within the project study area.

No water resources classified as High Quality Waters (HQW's), Water Supply Watersheds (WS-I), or Outstanding Resource Waters (ORW's) are located within the project vicinity. There are no streams on the DWQ 2003 Draft 303 (d) list of impaired waters located within the project study area.

Lowery Mill Creek and Martin Mill Creek and their associated tributaries are classified by DWQ as Water Supply Watershed III (WS-III) streams. WS-III streams are protected as water supplies in generally low to moderately developed watersheds, require general permits for point source discharge, and local programs to control non-point source and stormwater discharges, and are suitable for all Class C uses. Class C denotes waters suitable for all general uses including: aquatic life propagation and survival, fishing, wildlife, secondary recreation, and agriculture.

Lowery Mill Creek discharges directly into the north arm of Salem Lake. It has been assigned a best usage classification of WS-II and has been designated a critical area within the watershed. Critical areas are defined as those areas within the watershed where water supply intakes or reservoirs are at the greatest risk for pollution. Martin Mill Creek, classified as WS-III, flows into Lowery Mill Creek approximately one mile to the northeast of the upper arm of Salem Lake.

Table 4-61: Streams Within the Project U-2579 Preferred Alternative Right of Way

Stream Label[1]	Stream Type	Stream Name	Stream Class.	14-Digit Hydrologic Unit Code	NCDWQ Index #	USACE Mitigatable	Width (ft)	Depth (ft)	Impacted Length[2] (ft)	Relocated Length[2] (ft)	Data Label[3]
ES-S1	Perennial	UT to Rough Fork	C	3010103190010	22-25-5-2	Yes	10-12	4-6	1,554	0	ES-S2
ES-S2	Perennial	UT to Rough Fork	C	3010103190010	22-25-5-2	Yes	4-6	2-3	106	0	ES-S2
ES-S3	Perennial	UT to Rough Fork	C	3010103190010	22-25-5-2	Yes	4-6	2-3	547	0	ES-S3
ES-S4	Perennial	UT to Trick-um Creek	C	3010103190010	22-25-5-1	Yes	10	2	697	0	ES-S4
ES-S5	Perennial	UT to Trick-um Creek	C	3010103190010	22-25-5-1	Yes	6	4	299	0	ES-S5
ES-S6	Perennial	UT to Trick-um Creek	C	3010103190010	22-25-5-1	Yes	8	6	564	0	ES-S6
ES-S7	Perennial	UT to Buffalo Creek	C	3010103190010	22-25-5	Yes	4	2	1,209	0	ES-S7
ES-S8	Perennial	UT to Buffalo Creek	C	3010103190010	22-25-5	Yes	10-25	2-3	525	0	ES-S8
ES-S9	Perennial	UT to Buffalo Creek	C	3010103190010	22-25-5	Yes	15-20	6-8	371	0	ES-S9
ES-S10	Perennial	UT to Mill Creek	C	3040101170020	22-25-11-1	Yes	6	4-5	355	0	-
ES-S11	Intermittent	UT to Mill Creek	C	3040101170020	22-25-11-1	No	10-12	4	281	0	-
ES-S12	Perennial	UT to Mill Creek	C	3040101170020	22-25-11-1	Yes	3-4	2	66	0	-
ES-S13	Perennial	UT to Mill Creek	C	3040101170020	22-25-11-1	Yes	3-4	2	7	0	ES-S11
ES-S14	Perennial	UT to Mill Creek	C	3040101170020	22-25-11-1	Yes	6-8	3	374	0	ES-S12
ES-S15	Perennial	UT to Mill Creek	C	3040101170020	22-25-11-1	Yes	8-12	3-4	812	0	ES-S14
ES-S16	Perennial	UT to Mill Creek	C	3040101170020	22-25-11-1	Yes	4	3	775	0	ES-S15
ES-S17	Perennial	Mill Creek	C	3040101170020	22-25-11-1	Yes	20	6-8	45	0	-
ES-S18	Perennial	UT to Mill Creek	C	3040101170020	22-25-11-1	Yes	8	6	369	115	ES-S16
ES-S19	Intermittent	UT to Mill Creek	C	3040101170020	22-25-11-1	No	6	2	150	0	ES-S18
ES-S20	Perennial	Mill Creek	C	3040101170020	22-25-11-1	Yes	20	6-8	410	0	ES-S20
ES-S21	Perennial	UT to Mill Creek	C	3040101170020	22-25-11-1	Yes	7-10	5-8	323	0	ES-S22
ES-S22	Perennial	UT to Mill Creek	C	3040101170020	22-25-11-1	Yes	7-10	5-8	52	0	ES-S22
ES-S23	Perennial	UT to Mill Creek	C	3040101170020	22-25-11-1	Yes	7-9	5-6	279	0	ES-S23
ES-S24	Perennial	UT to Mill Creek	C	3040101170020	22-25-11-1	Yes	10-15	6-8	512	0	ES-S24
ES-S25	Perennial	UT to Mill Creek	C	3040101170020	22-25-11-1	Yes	6-8	4-6	440	90	ES-S25
ES-S26	Perennial	UT to Mill Creek	C	3040101170020	22-25-11-1	Yes	6-8	4-6	70	0	ES-S25
ES-S27	Perennial	UT to Frazier Creek	C	3040101170060	12-94-12-6-1	Yes	4-6	3	486	0	ES-S26

Table 4-61: Streams Within the Project U-2579 Preferred Alternative Right of Way

Stream Label[1]	Stream Type	Stream Name	Stream Class.	14-Digit Hydrologic Unit Code	NCDWQ Index #	USACE Mitigatable	Width (ft)	Depth (ft)	Impacted Length[2] (ft)	Relocated Length[2] (ft)	Data Label[3]
ES-S28	Perennial	UT to Frazier Creek	C	3040101170060	12-94-12-6-1	Yes	4-6	3	1,049	0	ES-S27
ES-S29	Perennial	UT to Frazier Creek	C	3040101170060	12-94-12-6-1	Yes	8-10	3-4	484	0	ES-S28
ES-S30	Perennial	UT to Frazier Creek	C	3040101170060	12-94-12-6-1	Yes	6-10	3	46	0	ES-S29
ES-S31	Perennial	UT to Frazier Creek	C	3040101170060	12-94-12-6-1	Yes	6-10	3	829	0	-
ES-S32	Perennial	Frazier Creek	C	3040101170060	12-94-12-6-1	Yes	10-15	4	365	0	ES-S30
ES-S33	Perennial	Lowery Mill Creek	WS III	3040101170060	12-94-12-3-(0.5)	Yes	15-20	6-8	354	0	ES-S31
ES-S34	Perennial	Lowery Mill Creek	WS III	3040101170060	12-94-12-3-(0.5)	Yes	15-20	6-8	66	0	ES-S31
ES-S35	Perennial	UT to Lowery Mill Creek	WS III	3040101170060	12-94-12-3-(0.5)	Yes	6	4	285	0	-
ES-S36	Perennial	UT to Lowery Mill Creek	WS III	3040101170060	12-94-12-3-(0.5)	Yes	15-20	6-8	312	0	-
ES-S37	Perennial	UT to Lowery Mill Creek	WS III	3040101170060	12-94-12-3-(0.5)	Yes	6-10	4-8	464	0	ES-S33
ES-S38	Perennial	UT to Lowery Mill Creek	WS III	3040101170060	12-94-12-3-(0.5)	Yes	5-8	2-4	602	0	ES-S34
ES-S39	Perennial	UT to Lowery Mill Creek	WS III	3040101170060	12-94-12-3-(0.5)	Yes	8-12	2-8	518	0	ES-S35
ES-S40	Perennial	UT to Martin Mill Creek	WS III	3040101170060	12-94-12-3-1	Yes	4-12	1-4	311	0	ES-S36
ES-S41	Perennial	Martin Mill Creek	WS III	3040101170060	12-94-12-3-1	Yes	10-12	4-6	263	0	ES-S37
ES-S42	Perennial	UT to Martin Mill Creek	WS III	3040101170060	12-94-12-3-1	Yes	6-8	3-5	405	700	ES-S38
ES-S43	Perennial	UT to Martin Mill Creek	WS III	3040101170060	12-94-12-3-1	Yes	6-8	3-5	106	0	ES-S38
ES-S44	Perennial	UT to Martin Mill Creek	WS III	3040101170060	12-94-12-3-1	Yes	6-8	1-3	419	0	ES-S39
USACE Mitigatable (linear feet)									**18,125**	**790**	
Not Mitigatable (linear feet)									**431**	**115**	
Total Linear Feet of Stream Channel									**18,556**	**905**	

Source: Table 3 of *Wetlands/Streams Delineation and Function Analysis; Protected Species Biological Opinion*, 1998)
UT = Unnamed Tributary
[1] Stream numbers refer to **Figure 3-12(a-jj)**.
[2] Total Impacted Length and Relocated Length were calculated based on the length of stream within the estimated construction limits of the 2005 preliminary engineering design.
[3] Data labels refer to original field collection maps.

Of the 44 streams, two are intermittent and the remainder is perennial. Mitigation must be provided for cumulative important stream channel impacts. NCDWQ mitigation status will be determined for the Project U-2579 Preferred Alternative prior to completion of the next environmental document. Construction of standard concrete or metallic culverts would require mitigation for the disturbed stream channel. Channel crossings and relocations were not addressed in the 2002-2003 stream analysis.

Some stream impacts would be mitigated on-site; that is, within the project's right of way. To date, the Merger Team has agreed to examine possible on-site mitigation opportunities. Relocated streams are considered mitigated impacts.

Stream impacts that are not mitigated on-site will be mitigated through the Ecosystem Enhancement Program (EEP) in accordance with the 2003 Memorandum of Agreement signed by the US Army Corps of Engineers, the NC Department of Environment and Natural Resources, and NCDOT. **Section 4.17** provides further discussion of jurisdictional issues and mitigation.

4.14.2.7 Streams - Project U-2579A Detailed Study Alternatives

A survey for streams was conducted in 2001, as described in **Section 3.16.3.2**. A hydraulics analysis completed in December 2002 described the type of drainage structure recommended for each crossing. Based on 2002 preliminary designs, there are no stream relocations or stream channelization proposed for any of the alternatives. However, based on the 2005 preliminary engineering design, the Preferred Alternative would include two stream relocations for a total of 1,827 feet. If channel relocations are required in the right of way they will be designed using natural channel design techniques and will be self mitigating. Results are the same for each alternative with and without the Kernersville Road interchange.

The 2002 stream analysis also provided information on each of the 27 stream crossings by the Project U-2579A Detailed Study Alternatives, listed in **Table 4-62** and shown in **Figure 3-12(a-jj)**. Stream impacts are based on the Detailed Study Alternatives construction limits for the 2002 preliminary engineering designs.

In **Table 4-62**, streams are categorized as USACE mitigatable or not mitigatable. USACE mitigatable (important) streams are considered as such based on guidance from the USACE. DWQ mitigatable streams are perennial streams (named or unnamed) present on the USGS quadrangle maps or perennial streams containing aquatic life. Based on preliminary observations, it is not expected that there will be more DWQ mitigatable streams than there are USACE mitigatable streams, which are presented in **Table 4-62**. It is expected that the USACE mitigatable streams will also be mitigatable for DWQ**.**

Table 4-62: Streams Within the Detailed Study Alternatives Right of Way for Project U-2579A

Stream Label[1]	Width (ft)	Depth (ft)	Stream Type	Alternative Segment(s)	USACE Mitigatable[3]	Total Impacted Length[4] (ft)	Stream Name	Stream Class.	NC DWQ Index #	14-Digit Hydrologic Unit Code	Data Label[2]
ESE-S1	20	4-6	Perennial	N1, N2 N3	Yes	472 485	Kerners Mill Creek	WS III	12-94-12-2-(0.3)	3040101170060	ESE-1
ESE-S2	20	6-8	Perennial	N1, N2 N3	Yes	1,158 1,112	Smith Creek (Harmon Mill Creek)	WS III	12-94-12-2-1	3040101170060	ESE-2
ESE-S3	8	1-3	Intermittent	N1, N2, N3	No	591	UT to Smith Creek (Harmon Mill Creek)	WS III	12-94-12-2-1	3040101170060	ESE-3
ESE-S4	12	6-8	Perennial	N1, N2 N3	Yes	308 354	Fishers Branch	WS III	12-94-12-2-2-(1)	3040101170060	ESE-4
ESE-S5	12	3-4	Intermittent	N1, N2 N3	Yes	538 557	UT to Fishers Branch	WS III	12-94-12-2-2-(1)	3040101170060	ESE-5
ESE-S6	9-10	2-4	Intermittent	N3	Yes	523	UT to Fishers Branch	WS III	12-94-12-2-2-(1)	3040101170060	ESE-7
ESE-S7	10-14	2-4	Perennial	N1 N2	Yes	161 172	UT to Fishers Branch	WS III	12-94-12-2-2-(1)	3040101170060	ESE-8
ESE-S8	14-16	4-6	Perennial	N3	Yes	1,961 (1,292)	UT to Fiddlers Creek	C	12-94-13-3	3040101170070	ESE-9
ESE-S9	6-8	2-4	Intermittent	N3	Yes	278	UT to Fiddlers Creek	C	12-94-13-3	3040101170070	ESE-10
ESE-S10	4-6	2-3	Perennial	N1 N2 N3	Yes	123 275 81	UT to Fiddlers Creek	C	12-94-13-3	3040101170070	ESE-14
ESE-S11	25-40	6-9	Perennial	N1 N2 N3	Yes	1,338 1,661 1,677	Fiddlers Creek	C	12-94-13-3	3040101170070	ESE-15
ESE-S12	10-15	4-6	Perennial/ Intermittent	S1 S2	Yes / No[5]	1,457 / 1,543[5] 1,457 / 1,787[5]	UT to Fiddlers Creek	C	12-94-13-3	3040101170070	ESE-16
ESE-S13	8-10	5-8	Intermittent	S1, S2	Yes	650	UT to Fiddlers Creek	C	12-94-13-3	3040101170070	ESE-17
ESE-S14	4-7	3	Intermittent	S1, S2	No	84	UT to Fiddlers Creek	C	12-94-13-3	3040101170070	ESE-18

Table 4-62: Streams Within the Detailed Study Alternatives Right of Way for Project U-2579A

Stream Label[1]	Width (ft)	Depth (ft)	Stream Type	Alternative Segment(s)	USACE Mitigatable[3]	Total Impacted Length[4] (ft)	Stream Name	Stream Class.	NC DWQ Index #	14-Digit Hydrologic Unit Code	Data Label[2]
ESE-S15	2-3	1	Intermittent	S1, S2	No	297	UT to Fiddlers Creek	C	12-94-13-3	3040101170070	ESE-19
ESE-S16	6-8	3-5	Intermittent	S1	Yes	227	UT to Fiddlers Creek	C	12-94-13-3	3040101170070	ESE-20
ESE-S17	18-22	5-8	Perennial	S2	Yes	293	Swaim Creek	C	12-94-13-1	3040101170070	ESE-21
ESE-S18	15-20	6-8	Perennial	S1	Yes	883	Swaim Creek	C	12-94-13-1	3040101170070	ESE-22
ESE-S19	6-10	1-4	Intermittent	S1	Yes	442	UT to Swaim Creek	C	12-94-13-1	3040101170070	ESE-23
ESE-S20	18-26	6-8	Perennial	S1	Yes	2,766	Muddy Creek	C	12-94-(0.5)	3040101170060	ESE-24
ESE-S21	8-16	2-3	Intermittent	S2	No	370	UT to Muddy Creek	C	12-94-(0.5)	3040101170060	ESE-25
ESE-S22	8-16	2-4	Intermittent	S2	Yes	1,045	UT to Muddy Creek	C	12-94-(0.5)	3040101170060	ESE-26
ESE-S23	12-16	4-6	Perennial	S2	Yes	1,582	Muddy Creek	C	12-94-(0.5)	3040101170060	ESE-24
ESE-S24	6-8	2-3	Perennial	N1, N2, N3	Yes	28	UT to Kerners Mill Creek	WS III	12-94-12-2	3040101170060	-
ESE-S25	10-12	6-8	Perennial	N2, N3	Yes	24	Fiddlers Creek	C	12-94-13-3	3040101170070	-
ESE-S26	8-10	3	Perennial	N2, N3	Yes	25	UT to Fiddlers Creek	C	12-94-13-3	3040101170070	-
ESE-S27	20-30	6-8	Perennial	N1, N2, N3	Yes	445	Smith Creek (Harmon Mill Creek)	WS III	12-94-12-2	3040101170060	-

Unless designated by () as without Kernersville Road interchange, Project U-2579A Detailed Study Alternatives are the same with or without the interchange.
UT = Unnamed Tributary
[1] Stream labels refer to **Figure 3-12(a–jj)**
[2] Data labels refer to original field collection maps
[3]USACE mitigatable streams are considered as such based on guidance from the USACE.
[4]Total Impacted Length was calculated based on the length of stream within the estimated construction limits of the 2005 preliminary engineering designs.
[5]Stream includes both USACE mitigatable and non-mitigatable portions.

Table 4-63 shows the stream impacts for each Detailed Study Alternative.

Table 4-63: Stream Impacts by Alternative – Project U-2579A Detailed Study Alternatives

Detailed Study Alternative	Impacted Length - USACE Mitigatable Streams[1] (ft)	Impacted Length - Not Mitigatable Streams (ft)	Total Impacted Length (ft)	Number of Stream Crossings
N1-S1	10,996	2,515	13,511	18
N1-S2	9,598	3,129	12,727	18
N2-S1 (Preferred Alternative	**8,137**	**2,899**	**11,036**	**22**
N2-S2	10,133	3,129	13,262	20
N3-S1	13,975 (13,306)	2,515	16,490 (15,821)	21
N3-S2	12,577 (11,908)	3,129	15,706 (15,037)	21

Impacts are based on 2002 preliminary engineering designs, except for N2-S1 (Preferred Alternative), which are based on 2005 preliminary engineering designs.
Unless designated by () as without Kernersville Road interchange, Project U-2579A Detailed Study Alternatives are the same with or without the interchange. The Project U-2579A Preferred Alternative includes an interchange at Kernersville Road.
[1]USACE mitigatable streams are considered as such based on field verification by the USACE.

No water resources classified as High Quality Waters (HQW's), Water Supply Watersheds (WS-I), or Outstanding Resource Waters (ORW's) are located within the project vicinity. There are no streams on the DWQ 2003 Draft 303 (d) list of impaired waters located within the project study area. Salem Lake, Martin Mill Creek, Kerners Mill Creek, Smith Creek (Harmon Mill Creek), Fishers Branch, and their associated tributaries are classified by DWQ as Water Supply Watershed III (WS-III) streams. WS-III streams are protected as water supplies in generally low to moderately developed watersheds, require general permits for point source discharge, and local programs to control non-point source and stormwater discharges, and are suitable for all Class C uses. Class C denotes waters suitable for all general uses including: aquatic life propagation and survival, fishing, wildlife, secondary recreation, and agriculture.

Kerners Mill Creek discharges directly into the south arm of Salem Lake. It has been assigned a best usage classification of WS-III and has been designated a critical area within the watershed. Critical areas are defined as those areas within the watershed where water supply intakes or reservoirs are at the greatest risk for pollution. However, the streams designated as critical areas are not located within the Detailed Study Alternatives' rights of way. Smith Creek (Harmon Mill Creek) converges with Kerners Mill Creek approximately 1.5 miles northeast of the southern arm of Salem Lake.

Alternatives N1 and N2 impact the critical area around Salem Lake near the intersection of the Beltway with Kernersville Road between Linville Road and Sedge Garden Road (see **Figure 3-12**). Of the 27 streams, 11 are intermittent, 15 are perennial, and one changes from intermittent to perennial within the 2002 preliminary engineering design construction limits. Mitigation must be provided for cumulative important stream channel impacts. Construction of standard concrete or metallic culverts would require mitigation for the disturbed stream channel. **Section 4.17** provides further discussion of jurisdictional issues and mitigation.

4.14.2.8 Streams - Project U-2579A Preferred Alternative

Stream impacts for the Project U-2579A Preferred Alternative were updated based on the 2005 preliminary engineering design. **Table 4-63-1** shows the impact to streams for the U-2579A Preferred Alternative.

Some stream impacts would be mitigated on-site; that is, within the project's right of way. To date, the Merger Team has agreed to examine possible on-site mitigation opportunities. The two streams to be relocated are considered to be mitigated.

Stream impacts that are not mitigated on-site will be mitigated through the Ecosystem Enhancement Program (EEP) in accordance with the 2003 Memorandum of Agreement signed by the US Army Corps of Engineers, the NC Department of Environment and Natural Resources, and NCDOT.

Table 4-63-1: Streams Within the Project U-2579A Preferred Alternative Right of Way

Stream Label[1]	Stream Name	Stream Type	Total Impacted Length (ft)	Relocated Length	USACE Mitigatable[2]	Stream Class.	Width (ft)	Depth (ft)	NC DWQ Index #	14-Digit Hydrologic Unit Code
ESE-S1	Kerners Mill Creek	Perennial	472	0	Yes	WS III	20	4-6	12-94-12-2-(0.3)	3040101170060
ESE-S2	Smith Creek (Harmon Mill Creek)	Perennial	0	0	Yes	WS III	20	6-8	12-94-12-2-1	3040101170060
ESE-S3	UT to Smith Creek (Harmon Mill Creek)	Intermittent	591	0	No	WS III	8	1-3	12-94-12-2-1	3040101170060
ESE-S4	Fishers Branch	Perennial	344	0	Yes	WS III	12	6-8	12-94-12-2-2-(1)	3040101170060
ESE-S5	UT to Fishers Branch	Intermittent	538	0	Yes	WS III	12	3-4	12-94-12-2-2-(1)	3040101170060
ESE-S7	UT to Fishers Branch	Perennial	100	0	Yes	WS III	10-14	2-4	12-94-12-2-2-(1)	3040101170060
ESE-S10	UT to Fiddlers Creek	Perennial	102	0	Yes	C	4-6	2-3	12-94-13-3	3040101170070
ESE-S11	Fiddlers Creek	Perennial	1,268	0	Yes	C	25-40	6-9	12-94-13-3	3040101170070
ESE-S12	UT to Fiddlers Creek	Perennial/ Intermittent	1,457 / 1,927[3]	0	Yes / No[3]	C	10-15	4-6	12-94-13-3	3040101170070
ESE-S13	UT to Fiddlers Creek	Intermittent	650	0	Yes	C	8-10	5-8	12-94-13-3	3040101170070
ESE-S14	UT to Fiddlers Creek	Intermittent	84	0	No	C	4-7	3	12-94-13-3	3040101170070
ESE-S15	UT to Fiddlers Creek	Intermittent	297	0	No	C	2-3	1	12-94-13-3	3040101170070
ESE-S16	UT to Fiddlers Creek	Intermittent	167	0	Yes	C	6-8	3-5	12-94-13-3	3040101170070
ESE-S18	Swaim Creek	Perennial	0	192	Yes	C	15-20	6-8	12-94-13-1	3040101170070
ESE-S19	UT to Swaim Creek	Intermittent	490	0	Yes	C	6-10	1-4	12-94-13-1	3040101170070

Table 4-63-1: Streams Within the Project U-2579A Preferred Alternative Right of Way

Stream Label[1]	Stream Name	Stream Type	Total Impacted Length (ft)	Relocated Length	USACE Mitigatable[2]	Stream Class.	Width (ft)	Depth (ft)	NC DWQ Index #	14-Digit Hydrologic Unit Code
ESE-S20	Muddy Creek	Perennial	548	0	Yes	C	18-26	6-8	12-94-(0.5)	3040101170060
ESE-S24	UT to Kerners Mill Creek	Perennial	378	0	Yes	WS III	6-8	2-3	12-94-12-2	3040101170060
ESE-S25	Fiddlers Creek	Perennial	118	0	Yes	C	10-12	6-8	12-94-13-3	3040101170070
ESE-S26	UT to Fiddlers Creek	Perennial	101	0	Yes	C	8-10	3	12-94-13-3	3040101170070
ESE-S27	Smith Creek (Harmon Mill Creek)	Perennial	303	0	Yes	WS III	20-30	6-8	12-94-12-2	3040101170060
ESE-S28[4]	Smith Creek (Harmon Mill Creek)	Perennial	246	0	Yes	WS III	20-30	6-8	12-94-12-2	3040101170060
ESE-S29	Smith Creek (Harmon Mill Creek)	Perennial	75	2,083	Yes	WS III	20	6-8	12-94-12-2-1	3040101170060
USACE Mitigatable (linear feet)			**7,357**	**2,275**						
Not Mitigatable (linear feet)			**2,899**	**0**						
Total Linear Feet of Stream Channel			**10,256**	**2,275**						

Impacts are based on 2005 preliminary engineering designs.
UT = Unnamed Tributary
[1] Stream numbers refer to **Figure 3-12(a-jj)**.
[2] USACE mitigatable streams are considered as such based on guidance from the USACE
[3] Stream includes both USACE mitigatable and non-mitigatable portions.
[4] Stream was included with ESE-20 in the 2004 SFEIS/SDEIS

4.14.3 Floodways and Floodplains

4.14.3.1 Regulatory Background and Design Requirements

Increased impervious cover associated with highway construction would have only minimal impact with respect to increasing runoff volumes and peak flow rates in Muddy Creek and its major tributaries. Larger changes may be experienced within small drainage areas crossed by the alignment where the roadway storm drainage system discharges into existing drainageways.

Forsyth County is a participant in the regular program of the National Flood Insurance Program (NFIP). Where a detailed flood study has been made, the discharge and frequency information would be used in the design of hydraulic structures.

The floodplains in the study area were identified using the Federal Emergency Management Agency's (FEMA) Flood Insurance Rate Map information for Forsyth County. For the updates to the Preferred Alternative conducted in 2002/2003, this floodplain/floodway information was available electronically on the Forsyth County Geographic Information System (GIS) website (http://maps.co.forsyth.nc.us).

Floodplain evaluations were conducted for the proposed projects in accordance with Executive Order 11988, *Floodplain Management* and 23 CFR 650, Subpart A – *Location and Hydraulic Design of Encroachments on Floodplains*. The objectives of these regulations are to avoid adverse impacts due to occupancy and alteration of the 100-year floodplain unless that location is the only practicable alternative. In such circumstances, every effort must be made to minimize the potential risks to human safety and to property, and to minimize the negative effects on natural and beneficial floodplains.

All bridges and culverts along the proposed projects (Projects R-2247, U-2579, and U-2579A) would be designed and constructed in accordance with the FHWA's floodplain impact requirements, which require the minimization of upstream headwater elevations due to roadway construction across floodplains. In NFIP flood hazard areas, the final hydraulic designs of the selected alternatives would be such that the floodway would carry the 100-year flood without a substantial increase in flood elevation. In Forsyth County, this increase cannot exceed 0.5 foot for the 100-year flood event or the elevation needed to protect structures, whichever is less. Non-perpendicular crossings of streams and their associated floodplains and floodways are difficult to avoid for linear projects like the Northern Beltway. The effect of the project on floodwaters can be mitigated effectively through proper sizing and design of hydraulic structures (culverts, bridges, and channel stabilization). Longitudinal or parallel siting of projects within the floodplains and/or floodways of streams can create greater impacts than simple transverse crossings.

The Detailed Study Alternatives for all three proposed projects have been located in floodplains and/or floodways only in locations where existing residential and business development have left no feasible alternatives to the use of floodplains. The alignments in these locations strike a balance between the human and floodplain impacts.

Each of the major encroachments occurring under the selected alternatives would require a floodway modification. A Conditional Letter of Map Revision would need to be submitted and approved by the Flood Zone Administrator for the community in accordance with the Forsyth County Flood Damage Control Ordinance and National Flood Insurance Program Rules and Regulations, and coordinated with the Federal Emergency Management Agency (FEMA).

4.14.3.2 Combined Direct Impacts to Floodplains and Floodways

Table 4-64 lists the combined floodplain and floodway impacts of the Northern Beltway projects.

Table 4-64: Combined Direct Impacts to Floodplains and Floodways – Projects R-2247, U-2579, and U-2579A

Project	Alternative	Number of Floodplain/Floodway Crossings	Number of Crossings Requiring Floodway Modification
R-2247 and U-2579 Preferred Alternatives plus U-2579A Detailed Study Alternatives [1]	N1-S1	22	13
	N1-S2	22	13
	N2-S1 (Preferred Alternative)	**22**	**13**
	N2-S2	22	13
	N3-S1	22	13
	N3-S2	22	13

Impacts are based on 2005 preliminary engineering designs for the Project R-2247, U-2579, and U-2579A Preferred Alternatives, and are based on the 2002 preliminary engineering designs for the Project U-259A non-preferred alternatives.

[1] Results are the same for Project U-2579A alternatives with or without the Kernersville Road interchange.

4.14.3.3 Floodways and Floodplains - Project R-2247 Detailed Study Alternatives

The following discussions are based on Section 4.5.3 of the 1996 Project R-2247 FEIS. The floodplains shown in the 1996 Project R-2247 FEIS were dated 1983. Based on a review of the figures showing the floodplains, there were no significant differences between the two maps that would result in new encroachment locations not previously reported in the FEIS. Mitigation would be the same for all Detailed Study Alternatives. Bridges and culverts would be designed and constructed in accordance with flood impact regulations.

Figure 3-10a shows the Detailed Study Alternatives in relation to streams, 100-year floodplains, and floodways. **Table 4-65** lists the acreages of the major floodplain encroachments for the Detailed Study Alternatives. Detailed Study Alternatives C3-EAST-A and C3-WEST-B (Preferred) would encroach on the least acreage of floodplain at 78 acres and 94 acres, respectively. Detailed Study Alternatives C2-EAST-A and C2-EAST-B would encroach on the most floodplains at 161 acres and 177 acres, respectively.

The southern region of Project R-2247, generally south of Country Club Road, has large areas of floodplain encroachment regardless of the alternative chosen. These encroachments are due to the large system interchanges at I-40 and US 421 and the dense residential development adjacent to the floodplains that influenced the routing of the alternatives along the western edges of the floodplains of Silas Creek and Muddy Creek. The two largest areas of impact are along Detailed Study Alternatives WEST-A, WEST-B, C2-EAST-A, and C2-EAST-B south of I-40 at Silas Creek/Muddy Creek and along Detailed Study Alternatives EAST-A, EAST-B, C3-WEST-A, C2-EAST-A, C3-WEST-B, and C2-EAST-B south of US 421 at Muddy Creek.

Minor Encroachments. There are 18 total minor encroachments into the base floodplains from the Detailed Study Alternatives. Minor encroachments are transverse crossings of narrow floodplains, with either culvert or bridge structures designed to minimize floodplain effects. These minor encroachments are, from south to north, across the floodplains of Little Creek, Silas creek, Reynolds Creek, Tomahawk Creek, Oil Mill Branch, Bill Branch, Beshavia Creek, Mill Creek No. 3, and Muddy Creek.

Major Encroachments. Major encroachments are longitudinal or parallel encroachments into a floodplains or areas where an interchange is proposed with all or portions of ramps in the floodplain. There are a total of eight major encroachments along the Detailed Study Alternatives. **Table 4-65** (Table 4.5-3 from the 1996 Project R-2247 FEIS) lists the major encroachments into the 100-year floodplains, beginning at Little Creek at the southern end of the project. For these encroachments, floodway modifications would be required. Additional details about the encroachments are provided below.

Table 4-65: Major Floodplain Encroachments – Project R-2247 Detailed Study Alternatives

No.	Detailed Study Alts.	Stream	Encroach. Type[1]	100-Year Floodplain Encroachment (acres)[2]	Regulatory Floodplain Encroachment (acres)[2]	Floodway Mod. Required?
1	EAST-A EAST-B C3-WEST-B C3-WEST-A	Silas Creek	Interchange @ I-40	18	11	Yes
2	WEST-A WEST-B C2-EAST-A C2-EAST-B	Silas/Muddy Creeks	Longitudinal	21	11	Yes
3	WEST-A WEST-B C2-EAST-A C2-EAST-B	Muddy Creek	Interchange @ I-40	49	18	Yes
4	EAST-A EAST-B	Muddy Creek	Interchange @ US 421	68	27	Yes
5	C3-WEST-A C3-WEST-B	Muddy Creek	Interchange @ US 421	67	28	Yes
6	C2-EAST-A C2-EAST-B	Muddy Creek	Interchange @ US 421	50	22	Yes
7	EAST-A EAST-B C2-EAST-A C2-EAST-B	Reynolds Creek	Longitudinal	8	4	Yes
8	WEST-B EAST-B C3-WEST-B C2-EAST-B	Grassy Creek	Longitudinal-Interchange @ US 52	21	10	Yes

1. Longitudinal describes the alignment running parallel to the floodway/floodplain boundaries. Interchange describes impacts of numerous ramps and loops that cross/impinge on floodway/floodplain. Individually, these may be minor, but their cumulative effect is, in essence, a longitudinal encroachment. The acreages listed are to the right-of-way limits of the interchange. Actual area of fill in the floodway/floodplain would be less than these values.
   The interchanges are locations where the floodway has been previously constrained to flow through a channel at a bridge crossing at I-40 or US 421. The effect of this project on the floodway in these location would be to lengthen the existing channel with its higher water velocities
2. Impacts are based on the 1992 DEIS Functional Designs

Source: Table 4.5-3 of the 1996 Project R-2247 FEIS

Major Encroachment 1. The proposed interchange at I-40 under Detailed Study Alternatives EAST-A, EAST-B, C3-WEST-B (Preferred), and C3-WEST-A would impact the floodway/floodplain at Silas Creek. The floodway/floodplain at this location already is constrained by embankment along I-40 and an existing culvert that carries Silas Creek under I-40. There would be a long, 30-degree crossing of the floodway/floodplain at the existing crossing of McGregor Road, placing fill in the floodway and 100-year floodplain. Existing development on both sides of Silas Creek constrains the roadway alignment through this area, providing no practicable alternative to the floodplain encroachments (see **Figure 2-10a**).

Major Encroachment 2. This longitudinal encroachment into the Silas Creek/Muddy floodway/floodplain about ½ mile south of I-40 would occur under Detailed Study Alternatives WEST-A, WEST-B, C2-EAST-A, and C2-EAST-B (see **Figure 2-10a**). The proposed alignment would make a transverse crossing of Silas Creek about 600 feet north of the confluence with Muddy Creek. There would be a 45-degree crossing of Muddy Creek. There is no practicable way to avoid the floodplain encroachment for this particular alignment since there is existing residential development along the ridge separating Silas Creek and Muddy Creek and there are wetlands along the west side of Muddy Creek just north of the proposed alignment.

Major Encroachment 3. The proposed interchange at I-40 under Detailed Study Alternatives WEST-A, WEST-B, C2-EAST-A, and C2-EAST-B would impact the floodway/floodplain at Muddy Creek (see **Figure 2-10a**). Muddy Creek currently is impacted at this location by a bridge carrying I-40 over Muddy Creek. The Detailed Study Alternatives listed above would further impact the floodway and floodplain due to placement of fill and construction of bridges across Muddy Creek. Constraints in this location include commercial development along the western floodplain margin, residential development along the eastern floodplain edge south of I-40, and residential development on both side of the floodplain north of I-40.

Major Encroachment 4. The proposed interchange at US 421 under Detailed Study Alternatives EAST-A and EAST-B would further impact the floodway/ floodplain at Muddy Creek (see **Figure 2-10b**). Muddy Creek currently is impacted at this location by a bridge carrying US 421 over Muddy Creek. The proposed interchange would add additional bridges, constricting the floodway north and south of US 421. Dense residential development occurs along both sides of the floodplain in the vicinity of US 421, constraining alignment options.

Major Encroachment 5. This encroachment at US 421 occurs under Detailed Study Alternatives C3-WEST-A and C3-WEST-B (Preferred) and is similar to Major Encroachment 4 (see **Figure 2-10b**). The widening of US 421 and the location of interchange roadways in the southeast quadrant of the proposed interchange would impact the floodplain/floodway, as would the new crossing of Muddy Creek about 4,200 feet downstream of US 421. Dense residential development occurs along both sides of the floodplain in the vicinity of US 421, constraining alignment options.

Major Encroachment 6. This encroachment at US 421 occurs under Detailed Study Alternatives C2-EAST-A and C2-EAST-B. This encroachment is similar to Major Encroachments 4 and 5 (see **Figure 2-10b**). The northeast and southeast quadrants of the interchange would impact the floodplain/floodway of Muddy Creek.

Major Encroachment 7. This longitudinal encroachment would be about 1,200 feet in length at Reynolds Creek under Detailed Study Alternatives EAST-A, EAST-B, C2-EAST-A, and

C2-EAST-B (see **Figure 2-10b**). The encroachment would be about 1,800 feet south of Country Club Road. Dense residential development along both sides of the floodplain in the vicinity of US 421 resulted in alignment constraints farther north at Reynolds Creek.

Major Encroachment 8. The proposed interchange at US 52 under Detailed Study Alternatives EAST-B, WEST-B, C2-EAST-B, and C3-WEST-B (Preferred) would impact the floodplain/floodway of Grassy Creek. The floodplain/floodway at Grassy Creek already is impacted by bridges, railroad embankment, US 52 and the NC 66 Connector. The existing US 52/NC 66 Connector interchange location and layout, along with commercial development north of NC 66 and residential development south of NC 66 constrain the options for an interchange at US 52.

4.14.3.4 Floodways and Floodplains - Project R-2247 Preferred Alternative

The most recent flood insurance rate (FIRM) maps for Forsyth County are dated October 1998 and are shown on **Figures 2-10 and 2-12**.

The floodplains shown in the 1996 Project R-2247 FEIS were dated 1983. Based on a review of the figures showing the floodplains, there were no significant differences between the two maps that would result in new encroachment locations not previously reported in the FEIS. One reason the Preferred Alternative was selected was minimization of floodplain impacts. This is still valid based on a review and comparison of the new FIRM maps with those used in the previous NEPA documentation.

Table 4-66 contains floodplain/floodway encroachment data for the Preferred Alternative based on the 2004 Project R-2247 Public Hearing Map and ***2005*** preliminary engineering design. These encroachment measurements are based on the estimated construction limits of the design for mainline sections and interchange components (loops, ramps, and connector roadways).

There are eleven crossings of floodplains/floodways. Eight crossings are along the mainline of the Preferred Alternative, two are on I-40, and one is on Robinhood Road. Three of the mainline crossings are longitudinal and are considered major encroachments. As shown in **Table 4-66**, the Preferred Alternative as currently designed would encroach on approximately 11.4 acres of floodway and 40.3 acres of 100-year floodplain.

As discussed in **Section 4.14.3.1**, detailed hydraulic studies for the selected alternative would be completed during final design. For all major encroachments, a Conditional Letter of Map Revision would be required to be submitted to the County's floodzone administrator and coordinated with FEMA in compliance with the Forsyth County Flood Damage Prevention Ordinance and the National Flood Insurance Program Rules and Regulations.

Table 4-66: Floodway and Floodplain Impacts – Project R-2247 Preferred Alternative

Location	Type[1]	Impacts to Floodway (acres)		Impacts to 100-Year Floodplain (acres)		2005 Hydraulic Structure	Floodway Modification Required?
		1995 Prelim. Design	2005 Prelim Design	1995 Prelim. Design	2005 Prelim Design		
Little Creek Mainline Crossing	T	<1	0.4	1.2	1.8	Bridge	No
Silas Creek Mainline crossing near McGregor Rd	L	2.5	0.4	7.8	1.9	Bridge	Yes
Silas Creek I-40 Crossing	T	--	0.4	--	1.9	Existing I-40 Culvert Area	No
Muddy Creek I-40 Crossing	T	--	0	--	0.2	Existing I-40 Bridge Area	No
Muddy Creek Mainline crossing near/including US 421 interchange	L	16.5	5.7	35.9	24.9	Various Bridges For Mainline/ Ramps	Yes
Reynolds Creek Mainline Crossing	T	1	0.01	3	0.5	Bridge	No
Tomahawk Creek Mainline Crossing	T	2	0.0	5	1.6	Bridge	No
Tomahawk Creek Robinhood Rd Interchange	T	--	0.3	--	0.8	Culvert	No
Mill Creek No. 3 Mainline Crossing	T	1	0	4	1.0	Bridge	No
Muddy Creek Mainline Crossing	T	0.2	0	1.3	0.7	Bridge	No
Grassy Creek at US 52 interchange[2]	L	4	4.6	10	4.6	Various Bridges and RCBCs For Mainline/ Ramps	Yes
Total Acreage from Longitudinal Crossings		**23**	**10.7**	**44**	**31.4**	--	--
Total All Floodway/Floodplain Impacts (acres)		**27**	**11.8**	**69**	**39.9**	--	--

1. T = Transverse, L = Longitudinal
2. Based on 2006 preliminary engineering designs at this location

The following paragraphs describe details of each of the eleven floodplain/floodway encroachments listed in **Table 4-66**.

Little Creek –Segment C1 (see Figure 2-12a). This encroachment on the Little Creek floodway/floodplain is a minor, transverse encroachment. At this location, Little Creek drains approximately 4,650 acres. It has a floodway approximately 95 feet in width, a 100-year floodplain from 380 feet to 600 feet in width, and a regulatory water surface elevation of 707 feet. The lowest habitable structures west of the creek, off Jonestown Road and Ploughboy Lane are located along the 720-foot and 732-foot elevation contours, and those east of the creek are along the 758-foot contour on Rockingham Drive. All of these are far above the 707-foot base flood elevations (1996 Project R-2247 FEIS, Section 4.5.3.4).

Silas Creek –Segment C1 and I-40 Interchange (see Figure 2-12b). The mainline encroachment at Silas Creek constitutes a major longitudinal encroachment into the regulatory floodway and floodplain of Silas Creek. Also, the interchange roadways connecting the Beltway and I-40 would impact Silas Creek. Silas Creek drains approximately 7,500 acres at this location (1996 Project R-2247 FEIS, Section 4.5.3.4). The existing I-40 box culverts would be widened, and the associated embankment for roadway elements would result in fill within portions of the floodway and floodplain of Silas Creek.

The Beltway mainlines would cross Silas Creek at a 30-degree skew, at the point where McGregor Road currently crosses the creek. Within this area, the floodway varies from 275 feet to 315 feet wide, with the base flood elevation controlled by backwater from Muddy Creek. The 100-year elevation is approximately 710 feet (1996 Project R-2247 FEIS, Section 4.5.3.4).

Property along the creek is not expected to be endangered by construction of the project. The lowest habitable structures along the stretch of Silas Creek between McGregor Road and I-40 are at an elevation of 720 feet, well above the regulatory elevations, which range from 710 feet to 714 feet for this reach of Silas Creek. West of the creek, two homes along McGregor Road are located between the 720-foot and 722-foot elevation contours. East of the creek, one home along McGregor Road is on the 730-foot contour, apartment buildings are at the 734-foot contour, and homes along Beaverton Trail are along the 740-foot and 742-foot contours (1996 Project R-2247 FEIS, Section 4.5.3.4).

Realignment of the project to provide a more perpendicular crossing of Silas Creek to reduce impacts to the floodway and floodplain is not feasible due to the location of the existing McGregor Road crossing of the creek, and the existing residential development along McGregor Road both north and south of I-40.

The fact that the Silas Creek floodway is already constrained by the I-40 culverts minimizes the effects of the new bridges, located 3,400 feet downstream of I-40. There should be no adverse effects either upstream or downstream of I-40 due to the project.

Muddy Creek – I-40 Interchange (see Figure 2-12b). The existing I-40 bridges over Muddy Creek would remain the same. A small amount of additional fill is proposed in the 100-year floodplain to accommodate the merging of the I-40 on-ramp from southbound Northern Beltway.

Muddy Creek –Segment B2 (see Figure 2-12c). During the previous design activities for the Project R-2247 Preferred Alternative, a Conditional Letter of Map Revision (CLOMR) was submitted for the Muddy Creek floodway/floodplain encroachments of the mainline and US 421 interchange ramps on October 20, 1998. **Appendix D.3** includes a copy of the August 13, 1999 FEMA approval letter for this CLOMR.

The mainline and US 421 interchange area would create a major longitudinal encroachment into the regulatory floodway and floodplain of Muddy Creek for a distance of approximately 4,200 feet downstream of the existing embankment and bridges at US 421. Muddy Creek drains approximately 54,000 acres at this location.

The 100-year floodplain elevation is approximately 733 feet for the length of the Beltway encroachment. The existing US 421 bridges across Muddy Creek provide a restriction to the flow, with a resultant headwater-tailwater drop from 737 feet to 733 feet. (1996 Project R-2247 FEIS, Section 4.5.3.4).

Reynolds Creek –Segment A4 (see Figure 2-12d). The mainline encroachment on the Reynolds Creek floodway/floodplain is a minor transverse encroachment. At this location, Reynolds Creek drains approximately 1,175 acres and has a floodway about 100 feet in width. The 100-year floodplain is about 230 to 320 feet in width, with a base flood water surface elevation of 746 feet. The lowest habitable structures in the vicinity are located along the 756-foot elevation contour, along Hollow Wood Court about 800 feet downstream of the crossing. The lowest upstream house is along the 780-foot contour, 2,800 feet from the crossing (1996 Project R-2247 FEIS, Section 4.5.3.4).

Tomahawk Creek –Segment A4 (see Figure 2-12e). There are two minor transverse encroachments of the Tomahawk Creek floodway/floodplain. One is the mainline and one is on Robinhood Road at the western ramps. The mainline would bridge Tomahawk Creek. A stream relocation is proposed in the ramp area.

At this location, Tomahawk Creek drains approximately 2,080 acres and has a floodway about 190 feet in width. The 100-year floodplain is about 650 to 1,100 feet in width, with a base flood water surface elevation of 768 feet. There are no habitable structures in the vicinity (1996 Project R-2247 FEIS, Section 4.5.3.4).

Mill Creek No. 3 –Segment C4 (see Figure 2-12h). The mainline encroachment on the Mill Creek No. 3 floodway/floodplain is a minor transverse encroachment. Mill Creek No. 3 is proposed to be bridged. At this location, Mill Creek No. 3 drains approximately 2,800 acres and has a floodway about 180 feet in width. The 100-year floodplain is about 600-700 feet in width, with a base flood water surface elevation of 829 feet. The lowest habitable structure in the vicinity is located along the 752-foot elevation contour, about 1,500 feet upstream. (1996 Project R-2247 FEIS, Section 4.5.3.4).

Muddy Creek –Segment B8 (see Figure 2-12i). The mainline encroachment on the Muddy Creek floodway/floodplain is a minor transverse encroachment. Muddy Creek is proposed to be bridged. At this location, Muddy Creek drains approximately 15,000 acres and has a floodway about 250 feet in width. The 100-year floodplain is about 380-520 feet in width, with a base flood water surface elevation of 812 feet. The lowest habitable structure in the vicinity is located along the 828-foot elevation contour, more than 0.5 miles from the crossing. (1996 Project R-2247 FEIS, Section 4.5.3.4).

Grassy Creek –Segment B10 and US 52 Interchange (see Figure 2-12j). The encroachment at Grassy Creek constitutes a major longitudinal encroachment into the regulatory floodway and floodplain of Grassy Creek. At this location, Grassy Creek and its floodway have been previously constrained by bridges and embankments for the NC 66 connector (one bridge), the Southern Railway (three bridges), and US 52 (two bridges). To this existing complex of bridges, the project would add about three to five major structures and would relocate about 1,500 feet of stream channel.

Of all the areas of encroachment within this interchange, the area immediately south of the existing NC 66 connector is the only one in the vicinity of habitable structures. In this location, the 100-year floodplain elevation is about 838 feet (Project R-2247 FEIS, Section 4.5.3.4). The encroachment from the embankment for the ramp roadway connecting US 52 northbound with the Beltway eastbound lies close to existing development along Nylon Drive, Shumate Road, and Stanleyville Manor Avenue. There also has been some new development in this area along Summer Trace Lane and Averlan Court. The lowest habitable structure is at 860 feet elevation.

4.14.3.5 Floodways and Floodplains - Project U-2579 Detailed Study Alternatives

The following discussion is based on Section 4.4.2.1 of the 1995 Project U-2579 DEIS. It is not anticipated that floodplains and floodways have changed substantially since the original evaluations were prepared.

The location of streams, floodplains, and floodways are shown on **Figure 3-10b**. Alternatives 3 and 4 would encroach on the least acreage of floodplains (17.0 acres), and Alternatives 6 and 7 would encroach on the largest acreage of floodplains (26.6 and 27.1 acres, respectively).

Involvement of the project alternatives with the 100-year floodplain was identified based on the Flood Insurance Rate Maps. Smith Creek (Harmon Mill Creek), Kerners Mill Creek, Frazier Creek, Buffalo Creek, Martin Mill Creek, Lowery Mill Creek, Mill Creek, and Grassy Creek are part of the designated floodplain areas. All of the build alternatives cross regulated floodways of these creeks and their tributaries. Floodplain crossings would be as close to 90 degrees as practical to minimize floodplain encroachments.

Minor encroachments are transverse crossings of narrow floodplains, with either culvert or bridge structures designed to minimize floodplain effects. Major encroachments are longitudinal or parallel encroachments into a floodplains or areas where an interchange is proposed with all or portions of ramps in the floodplain. In the 1995 Project U-2579 DEIS, it was reported that there was potential for longitudinal encroachment along Mill Creek near Baux Mountain Road with the Western Detailed Study Alternative, but that there was room within the 1,200-foot corridor for an alignment to be located outside the 100-year floodplain limit. The 2005 preliminary engineering plans for the Preferred Alternative have been revised to locate the alignment outside the floodplain.

4.14.3.6 Floodways and Floodplains - Project U-2579 Preferred Alternative

The Project U-2579 Preferred Alternative crosses floodplains/floodways eight times, based on the 2005 preliminary engineering design. **Table 4-67** has been revised from the SFEIS/SDEIS, and describes the crossings for the Preferred Alternative, which impacts a total of 15.75 acres of 100-year floodplain. Floodplains, floodways, and streams are shown on **Figure 3-10b** and **Figure 2-22(a-i)**. The two major (longitudinal) encroachments are along Mill Creek floodplain near Baux Mountain Road, and along Smith Creek (Harmon Mill Creek), also tabulated under Project U-2579A. Based on the 2005 preliminary design, it is anticipated that eight floodway modifications may be required for the Preferred Alternative (including three also listed under Project U-2579A). A flood study will be completed if necessary based on the final engineering designs.

Acres of floodplain and floodway were quantified by using geographic information systems data overlays to measure those areas within the construction limits that would be impacted as a result of the proposed construction.

Table 4-67: Floodway and Floodplain Impacts – Project U-2579 Preferred Alternative							
Stream	**Location**	**Type of Crossing**	**Length of Crossing (ft)**	**Structure Number**	**Acres of Floodplain**	**Acres of Floodway**	**Floodway Modification Required?**
Mill Creek	0.6 mi. west of Baux Mountain Rd.	Box Culvert	310	ES 2	0.0	0.0	Yes
Mill Creek	0.5 mi. east of Baux Mountain Rd.	Bridge	285	ES 4	2.2	1.0	Yes
Lowery Mill Creek	0.3 mi. west of US 158	Bridge	275	ES 8	1.8	0.2	Yes
Martin Mill Creek	0.6 mi. north of West Mountain St.	Bridge	330	ES 10	1.0	0.3	Yes
Mill Creek	0.8 mi. south of Old Hollow Rd.	Box Culvert	25	ES 12	0.25	0.05	Yes
UT to Mill Creek	0.5 mi. east of Baux Mountain Rd.	Box Culvert	330	ES 13	N/A[3]	N/A[3]	No
Kerners Mill Creek[1]	0.6 mi. south of West Mountain St.	Box Culvert	480	ESE 1	2.0	1.2	Yes
Smith Creek (Harmon Mill Creek)[1]	0.9 mi. south of West Mountain St.	Box Culvert	930	ESE 2	6.5	2.3	Yes
Fishers Branch[1]	0.3 mi. south of Hastings Hill Rd.	Box Culvert	330	ESE 4	2.0	0.6	Yes
			3,295		**15.75**	**5.65**	**8[2]**

Impacts are based on construction limits for the 2005 preliminary engineering design.
[1] Also listed under Project U-2579A Detailed Study Alternative impacts.
[2] Includes the three floodplain/floodway crossings shared by Projects U-2579 Preferred Alternative and U-2579A Detailed Study Alternatives.
[3] Included in ES 4 impacts. This crossing is not a detailed study but is within the floodplain of Mill Creek.

4.14.3.7 Floodways and Floodplains - Project U-2579A Detailed Study Alternatives and Preferred Alternative

A hydrological survey was completed for the Project U-2579A Detailed Study Alternatives in December 2002. **Table 4-68** describes the floodplain impacts for the Project U-2579A Detailed Study Alternatives by segment and **Table 4-69** summarizes the floodplain impacts for each Detailed Study Alternative. One major (longitudinal) encroachment is along Segment S1, which impacts 22 acres of the floodplain at the junction of Swaim Creek and South Fork Muddy Creek. The other longitudinal encroachment is along Smith Creek (Harmon Hill Creek), as mentioned previously. Impacts are the same for each alternative with or without the Kernersville Road interchange.

Based on preliminary engineering designs, it is anticipated that two floodway modifications may be required for each of the Detailed Study Alternatives (including the Preferred Alternative), in

addition to those required for the Project U-2579 Preferred Alternative. If necessary, a flood study will be completed based on the final engineering designs.

Table 4-68: Floodway and Floodplain Impacts – Project U-2579A Detailed Study Alternatives

Stream	Location	Segment	Floodway Modification Required?
Kerners Mill Creek[1]	0.6 mi. south of West Mountain St.	N1	Yes
		N2	Yes
		N3	Yes
Smith Creek (Harmon Mill Creek)[1]	0.9 mi. south of West Mountain St.	N1	Yes
		N2	Yes
		N3	Yes
Fishers Branch[1]	0.3 mi. south of Hastings Hill Rd.	N1	Yes
		N2	Yes
		N3	Yes
Fiddlers Creek	0.3 mi. north of I-40	N1	Yes
		N2	Yes
		N3	Yes
		S1	Yes
		S2	Yes
Swaim Creek/South Fork Muddy Creek	High Point Rd.	S1	Yes
	Between High Point Rd. and US 311	S2	Yes
	0.6 mi. north of High Point Rd.		Yes

Results are the same for alternatives with and without the Kernersville Road interchange.
[1] Also listed under Project U-2579 Preferred Alternative impacts
[2] Includes the three floodplain/floodway crossings shared by Project U-2579 Preferred Alternative and Project U-2579A Detailed Study Alternatives.

Table 4-69: Floodway and Floodplain Impacts by Alternative – Project U-2579A Detailed Study Alternatives

Detailed Study Alternative	Number of Floodplain/Floodway Crossings	Number of Crossings Requiring Floodway Modification
N1-S1	5[1]	5[1]
N1-S2	5[1]	5[1]
N2-S1 (Preferred Alternative)	**5[1]**	**5[1]**
N2-S2	5[1]	5[1]
N3-S1	5[1]	5[1]
N3-S2	5[1]	5[1]

Results are the same for alternatives with and without the Kernersville Road interchange.
[1]Includes the three floodplain/floodway crossings shared by Project U-2579 Preferred Alternative and Project U-2579A Detailed Study Alternatives.
'Bold' indicates Preferred Alternative.

4.14.3.8 Floodplain Finding

Regulatory floodplains within the study area were identified in accordance with Executive Order 11988: Floodplain Management, which prohibits floodplain infringements when uneconomical, hazardous, or incompatible land use of floodplain results. Any action within the limits of the floodplains that would involve critical interruption of a necessary transportation facility, a substantial flood risk, or a sizeable impact on the natural values of the floodplain would be considered as such an encroachment. The proposed project will be developed to comply with this order.

The Preferred Alternatives for Projects R-2247, U-2579, and U-2579A cross the 100-year floodplain/floodway at 21 locations, including 11 by Project R-2247 (eight minor and three major crossings), eight by Project U-2579 (seven minor and one major crossings), and two by Project U-2579A (one major and one minor crossing). (Three of the five crossings by Project U-2579A are shared with Project U-2579). It is anticipated that 13 of these crossings will require floodway modification.

Hydraulic design techniques described in 23 CFR 650, Subpart A, A Location and Hydraulic Design of Encroachment on Floodplains, would be utilized to determine the impact of roadway drainage structures on the 100-year floodplain. Structures would be sized to ensure that no increase to the extent and level of flood hazard risk would result from such encroachments. Concurrence Point 4B (30 Percent Hydraulic Design) and Concurrence Point 4C (100 Percent Hydraulic Design) of the NEPA/404 Merger Process focuses on this aspect of the project design. The hydraulic analysis would examine drainage patterns near flood overflow pipes to ensure that the passageway does not become inundated with roadway drainage.

The long-term, indirect impacts on flood hazard zones from future development were considered during project development. As a freeway, the proposed action will not support probable incompatible floodplain development. Where floodplain impacts are unavoidable, methods to minimize harm and restore and preserve the floodplains could include minimizing fill and grading requirements, preserving the free natural drainage whenever possible, maintaining vegetation buffers, controlling urban run-off using best management practices, and minimizing erosion and sedimentation during construction.

In conclusion, with the proper sizing and location of drainage structures, no substantial constraints to flow will be placed in floodways, the flood stage elevations upstream and downstream of the project will not be increased by more than one foot, and habitable structures will not be adversely affected as a result of the project. As previously documented, all other feasible alternatives for these projects involve floodplain encroachments of similar magnitude. Therefore, the proposed action is the only practical alternative for this project.

4.15 TERRESTRIAL BIOTIC COMMUNITIES

4.15.1 Combined Direct Impacts to Terrestrial Biotic Communities

Table 4-70 summarizes the biotic community impacts of Projects R-2247, U-2579, and U-2579A.

4.15.2 Biotic Communities - Project R-2247 Detailed Study Alternatives

In 1991, a natural resources survey was completed as part of the original EIS process. A second survey was completed in 2002-2003 to update natural resource information for the Project R-2247 Preferred Alternative (see **Section 3.16.2.2**).

The following text was taken from Section 4.6.1 of the 1996 Project R-2247 FEIS.

The primary direct impacts to vegetation from the proposed construction of Project R-2247 would result from the removal of existing vegetation within the right of way. Impacts to the biotic communities described in **Section 3.16** were quantified by using a polar planimeter to measure those areas within the right of way that would be impacted as a result of the proposed construction. Although the measurements represent the total area that would be impacted from construction and clearing, much of this area would not actually be paved, but would quickly return as ruderal-type vegetation, grasses, and weeds that would provide limited habitat value for some wildlife species. Resources used in this analysis included aerial photography flown in 1980, and black-and-white aerial photography from 1987, 1990, and 1991.

Table 4-71 lists the acreages of biotic communities within the rights of way of the Detailed Study Alternatives based on the 1992 functional designs.

Table 4-70: Combined Direct Biotic Community Impacts – Projects R-2247, U-2579, and U-2579A

Project	Detailed Study Alternative	Piedmont/ Low Mountain Alluvial Forest (acres)	Dry Oak-Hickory Forest (acres)	Dry Mesic Oak-Hickory Forest (acres)	Mesic Mixed Hardwood Forest (acres)	Successional Pine Forest (acres)	Piedmont Bottomland Forest (acres)	Maintained/ Disturbed (acres)	Agriculture (acres)	Cut-over (acres)	Pine Plantation (acres)
R-2247 and **U-2579 Preferred Alternatives <u>plus</u> U-2579A Detailed Study Alternatives** With (Without) Kernersville Road Interchange	N1-S1	106	61	582	172	1	13 (12)	1,146 (1,123)	376	59	77
	N1-S2	80	60	577	141	10	13 (12)	1,149 (1,127)	383	59	77
	N2-S1 (Preferred Alternative)	**106**	**63**	**581**	**174**	**1**	**12** (11)	**1,160** (1,145)	**369**	**59**	**77**
	N2-S2	82	61	576	146	10	12 (11)	1,165 (1,149)	380	59	77
	N3-S1	108 (107)	59	572	195 (189)	1	10	1,157 (1,137)	378 (375)	59	77
	N3-S2	83 (82)	58	577	166 (160)	10	10	1,156 (1,136)	389 (385)	59	77

Impacts are based on a 2002-2003 survey for the Project R-2247 Preferred Alternative, a 2000 survey for the Project U-2579 Preferred Alternative, and a 2003 survey for the U-2579A Detailed Study Alternatives.
() Alternative without Kernersville Road interchange. The Project U-2579A Preferred Alternative includes an interchange at Kernersville Road.

Table 4-71: Biotic Community Impacts – Project R-2247 Detailed Study Alternatives

Detailed Study Alternative	Pine Forest (acres)	Mixed Deciduous/ Pine Forest (acres)	Forest Total (acres)	Maintained/ Disturbed Lands (acres)	Agricultural Lands (acres)
WEST-A	104	386	490	304	281
EAST-A	112	426	538	217	238
WEST-B	119	465	584	310	239
EAST-B	126	505	632	223	196
C3-WEST-A	110	372	482	239	294
C2-EAST-A	124	460	584	233	238
C2-EAST-B	138	540	678	239	196
Preferred Alternative					
C3-WEST-B	**124**	**451**	**575**	**245**	**252**

Source: Table 4.6-1 from the 1996 Project R-2247 FEIS.
'Bold' indicates Preferred Alternative.

4.15.3 Biotic Communities - Project R-2247 Preferred Alternative

The following information is based upon the updated natural resources survey conducted in 2002-2003 for the Project R-2247 Preferred Alternative (see **Section 3.16.2.2**).

Figure 3-11(a-ee) shows the biotic communities within proposed right-of-way limits for the Project R-2247 Preferred Alternative. The impacts the project would have on each community type are listed in **Table 4-72**. Impacts to the biotic communities were quantified by using geographic information systems data overlays to measure those areas within the construction limits that would be impacted as a result of the proposed construction.

The biotic communities that account for the majority of the area in the Preferred Alternative construction limits are maintained/disturbed (about 39 percent) and forested (about 35 percent). The upland community types are described in detail in **Section 3.16.2.3.**

Plant communities found within the Project R-2247 Preferred Alternative serve as nesting and sheltering habitat for wildlife. Impacts to wildlife are discussed in **Section 4.18.**

Table 4-72: Biotic Community Impacts – Project R-2247 Preferred Alternative

Community	Acres	Percent of Total
Total Forested	442	34.9
-Piedmont/Low Mountain Alluvial Forest	*31*	*2.5*
-Dry Mesic Oak-Hickory Forest	*411*	*32.4*
Maintained/Disturbed	495	38.9
-Commercial/Institutional	*11*	*0.8*
-Residential	*205*	*16.2*
-Powerline/Sewerline/Gas Line	*16*	*1.2*
-Road	*263*	*20.7*
Agriculture	196	15.4
Cut-over	59	4.7
Pine Plantation	77	6.1
Total	**1,269**	**100.0**

4.15.4 Biotic Communities - Project U-2579 Detailed Study Alternatives

The following discussion is based on the original natural resources survey, which was conducted for the 1995 Project U-2579 DEIS. Impacts to plant communities associated with the construction of widening of a highway through natural ecosystems would consist largely of community modification resulting from clearing, filling, paving, and creation of borrow areas. Impacts to plant communities were quantified using a digital planimeter to approximate acreage impacts within a 300-foot right-of-way limit within the 1,200-foot corridor of each alternative, including interchanges where applicable.

Table 4-73 shows the approximate impact acreage for each vegetative community type for the Western and Eastern Detailed Study Alternatives, as well as for the five crossovers. The degree of impact on vegetation is dependent on the extent of the construction area. However, the complete removal of vegetation within these limits may not be necessary. The limits of construction will be posted and enforced to minimize impacts. Bare soil will be promptly seeded with grass species to minimize erosion. Long-term impacts to vegetation from highway runoff would be minimized by using retention/detention basins and grassed swales in the construction design.

Table 4-73: Biotic Community Impacts – Project U-2579 Detailed Study Alternatives

Alternative/ Segment	Deciduous Forest (acres)	Mixed Pine/ Deciduous Forest (acres)	Pine Forest (acres)	Riparian Forest (acres)	Agricultural Land (acres)	Urban/ Disturbed Land (acres)
Eastern	79.2	242.9	46.0	18.3	103.0	292.0
Western	88.8	163.4	77.4	14.8	101.1	295.5
Crossover 1	14.0	25.3	7.0	0	8.5	20.0
Crossover 2	30.2	40.1	7.9	0	4.2	30.9
Crossover 3	3.5	12.6	0	0	16.5	17.1
Crossover 4	1.8	12.2	0.6	2.6	39.6	6.7
Crossover 5	2.9	32.2	0	0	15.0	14.5

Impacts are based upon right-of-way limits for the 1994 functional engineering designs.
Source: Table 4-5 from the 1995 Project U-2579 DEIS

4.15.5 Biotic Communities - Project U-2579 Preferred Alternative

An updated survey of biotic communities was completed in May 2003 for the Project U-2579 Preferred Alternative, based on the 1994 functional engineering designs *(*see **Section 3.16.3.2**). **Figure 3-13(a-d)** shows the biotic communities impacted by the Preferred Alternative based on the 2004 preliminary engineering designs. The maximum impacts the project would have on each community type are listed in **Table 4-74,** and are based on 1994 functional engineering designs. Updated impacts to biotic communities were quantified by using geographic information systems data overlays to measure those areas within the right of way that would be impacted as a result of the proposed construction.

Table 4-74: Biotic Community Impacts – Project U-2579 Preferred Alternative

Community	Acres	Percent of Total
Total Forested	260	46.0
-Dry Oak-Hickory Forest	*33*	*5.8*
-Dry Mesic Oak-Hickory Forest	*118*	*20.8*
-Mesic Mixed Hardwood Forest	*77*	*13.6*
-Successional Pine Forest	*0*	*0*
-Piedmont Bottomland Forest	*6*	*1.0*
-Piedmont/Low Mountain Alluvial Forest	*26*	*4.7*
Maintained/Disturbed	244	43.0
Agricultural	62	11.0
Total	**566**	**100.0**

Impacts are based on construction limits for the 1994 functional engineering design.

4.15.6 Biotic Communities - Project U-2579A Detailed Study Alternatives and Preferred Alternative

A survey of biotic communities was completed in May 2003 for the Detailed Study Alternatives (see **Section 3.16.3.2**). **Figure 3-13(a-d)** shows the biotic communities for the alternatives. Mapping of biotic communities was updated for the 2005 Preferred Alternative preliminary engineering designs based on an aerial review. **Figure 3-13(a-d)** shows biotic communities within the 2005 preliminary engineering designs for the Preferred Alternative, and biotic communities within the 2000 preliminary engineering designs for the non-preferred Detailed Study Alternatives.

Impacts to biotic communities were quantified by using geographic information systems data overlays to measure those areas within the construction limits that would be impacted as a result of the proposed construction. Impacts were calculated for all alternatives based on the 2000 preliminary engineering designs. **Table 4-75** shows the approximate impact acreage for each vegetative community type for each alternative. The degree of impact on vegetation is dependent on the extent of the construction area. However, the complete removal of vegetation within these limits may not be necessary.

The limits of construction will be posted and enforced to minimize impacts. Bare soil will be promptly seeded with grass species to minimize erosion. Long-term impacts to vegetation from highway runoff will be minimized by using retention/detention basins and grassed swales in the construction design.

All alternatives have approximately the same impact on agricultural and previously disturbed lands (525 to 548 acres with the Kernersville Road interchange, and 502 to 532 acres without the interchange). Alternatives including Segment S1 have a higher impact on forested communities than those including Segment S2.

Table 4-75: Biotic Community Impacts – Project U-2579A Detailed Study Alternatives

Detailed Study Alternative	Maintained/ Disturbed (acres)	Agricultural (acres)	Dry Oak-Hickory Forest (acres)	Dry Mesic Oak-Hickory Forest (acres)	Mesic Mixed Hardwood Forest (acres)	Successional Pine Forest (acres)	Piedmont Bottomland Forest (acres)	Piedmont/Low Mountain Alluvial Forest (acres)
N1-S1	407 (384)	118 (118)	28 (28)	53 (53)	95 (95)	1 (1)	7 (6)	48 (48)
N1-S2	410 (388)	125 (125)	27 (27)	48 (48)	64 (64)	10 (10)	7 (6)	22 (22)
N2-S1 (Preferred Alternative)	**421 (406)**	**111 (111)**	**30 (30)**	**52 (52)**	**97 (97)**	**1 (1)**	**6 (5)**	**48 (48)**
N2-S2	426 (410)	122 (122)	28 (28)	47 (47)	69 (69)	10 (10)	6 (5)	24 (24)
N3-S1	418 (398)	120 (117)	26 (26)	43 (43)	118 (112)	1 (1)	4 (4)	50 (49)
N3-S2	417 (397)	131 (127)	25 (25)	38 (38)	89 (83)	10 (10)	4 (4)	25 (24)

() Results without the Kernersville Road interchange. The Project U-2579A Preferred Alternative includes an interchange at Kernersville Road.
Impacts are based upon construction limits for the 2000 preliminary engineering designs.
'Bold' indicates Preferred Alternative.

4.16 AQUATIC BIOTIC COMMUNITIES

Impacts to stream channels are discussed in **Section 4.14**. Impacts to wetland communities are discussed in **Section 4.17.1**. Aquatic communities are sensitive to even small changes in their environment. Stream channelization, scouring, siltation, sedimentation and erosion from construction-related work temporarily may affect water quality and biological constituents. In-stream construction alters the stream substrate and may remove streamside vegetation at the site. Invasive species such as Japanese honeysuckle are already prevalent in the area. To avoid further spread of these species, a hardy groundcover would be established as soon as possible after disturbance.

The removal of streamside vegetation and placement of fill material at the construction site alters the terrain. Alterations of the streambank increase the likelihood of erosion and sedimentation. Erosion and sedimentation carry soils, toxic compounds and other materials into aquatic communities at the construction site. These processes magnify turbidity and can cause the formation of sandbars at the site and downstream, thereby altering water flow and the growth of vegetation. Streamside alterations also lead to more direct sunlight penetration and to elevations of water temperatures that may impact many species. Revegetating the banks stabilizes and holds the soil, thus mitigating these processes. Measures outlined in **Section 4.13** to maximize sediment and erosion control during construction would protect water quality for aquatic communities.

4.17 JURISDICTIONAL ISSUES

4.17.1 Impacts to Waters of the United States

4.17.1.1 Combined Direct Impacts to Jurisdictional Resources

Wetlands, streams, and open waters are regulated by the USACE pursuant to Section 404 of the Clean Water Act. The North Carolina DENR-DWQ also has regulatory input through Section 401 Water Quality Certification. Wetlands, defined in 33 CFR 328.3, are those areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Any action that proposes to place fill into these areas falls under the jurisdiction of the USACE under Section 404 of the Clean Water Act (33 USC 1344).

Table 4-76 summarizes impacts to jurisdictional resources including wetlands and streams. The total impacts to USACE mitigatable streams do not include stream channel relocations. For Project U-2579, stream impacts reported as USACE mitigatable are perennial streams.

Table 4-76: Summary of Jurisdictional Resources Impacts – Projects R-2247, U-2579, and U-2579A

Project	Alternative	Low Quality Wetlands (acres)	Medium Quality Wetlands (acres)	High Quality Wetlands (acres)	Total Wetland Impacts (acres)	Number of Wetland Crossings	Total Pond Impacts (acres)	Number of Pond Crossings	Total Impact to USACE Mitigatable Streams (Linear Ft)
U-2579A Detailed Study Alternatives [1] plus R-2247 and U-2579 Preferred Alternatives	N1-S1	1.65	2.92	2.93	7.50	44	26.91	20	39,304
	N1-S2	1.65	2.54	2.93	7.12	42	21.92	18	37,906
	N2-S1 (Preferred Alternative)	**1.65**	**2.92**	**2.91**	**7.48**	**45**	**24.71**	**23**	**36,445**
	N2-S2	1.65	2.54	3.06	7.25	43	22.65	19	38,441
	N3-S1	1.57	3.11	3.06	7.74	47	27.52	19	42,283 (41,614)
	N3-S2	1.57	2.73	3.06	7.36	45	22.53	17	40,885 (40,216)

Impacts are based on 2005 preliminary engineering designs for the Project R-2247, U-2579, and U-2579A Preferred Alternatives, and are based on the 2002 preliminary engineering designs for the Project U-259A non-preferred alternatives.

[1] Unless designated by () as without Kernersville Road interchange, Project U-2579A Detailed Study Alternatives are the same with or without the interchange. The Project U-2579A Preferred Alternative includes an interchange at Kernersville Road.

4.17.1.2 Jurisdictional Resources - Project R-2247 Detailed Study Alternatives

Pursuant to Executive Order 11990, *Protection of Wetlands*, and Section 404 (b)(1) guidelines of the Federal Clean Water Act, the proposed Detailed Study Alternatives were evaluated to determine impacts to wetlands and ponds along each study corridor. Survey methodology is described in **Section 3.17.1**.

Table 4-77 identifies specific impacts to vegetated wetlands and ponds for each Detailed Study Alternative based on the right-of-way limits from the Project R-2247 1992 Functional Designs. Stream impacts are discussed in **Section 4.14.2.3**. Results reflect the "worst case," as some areas within the right-of-way limits may not be impacted.

As shown in **Table 4-77**, the wetland impacts for the Detailed Study Alternatives range from 7.0 acres for Detailed Study Alternative EAST-A to 13.2 acres for the Preferred Alternative (C3-WEST-B). Pond impacts range from no impacts for Detailed Study Alternatives WEST-A and C3-WEST-A, to 4.3 acres for EAST-B and C2-EAST-B.

Table 4-77: Summary of Wetland and Pond Impacts for Project R-2247 Detailed Study Alternatives

Detailed Study Alternative	Impacted Wetland Acreage	Impacted Pond Acreage
WEST-A	12.1	0.0
EAST-A	7.0	3.7
WEST-B	12.2	0.6
EAST-B	7.1	4.3
C3-WEST-A	13.0	0.0
C2-EAST-A	8.0	3.7
C2-EAST-B	8.2	4.3
Preferred Alternative		
C3-WEST-B	**13.2**	**0.6**

All impacts are based on the right-of-way limits of the DEIS 1992 functional designs.
Source: Tables 4.6-1 and 4.6-2 in the 1996 Project R-2247 FEIS.
'Bold' indicates Preferred Alternative.

Most wetland impacts cannot be avoided, as they are linear systems along streams that are crossed by the Detailed Study Alternatives. In other areas, the impacts have been minimized to the extent practicable, yet complete avoidance of the wetlands would result in greater impacts to residential communities. This is particularly the case for larger wetland sites within the floodplain of Muddy Creek.

4.17.1.3 Jurisdictional Resources - Project R-2247 Preferred Alternative

Section 3.17.1 discusses the methodology for the wetland, pond, and stream surveys. For the 1996 Project R-2247 FEIS, wetland delineations were conducted in March and April 1995 within a 1,200-foot wide corridor for the Preferred Alternative.

All wetlands, ponds, and streams identified in 1995 within the Preferred Alternative right of way were re-inspected in 2002-2003 to determine their current jurisdictional status. Potential wetland communities were investigated pursuant to the 1987 *Corps of Engineers Wetland Delineation Manual* (USACE, 1987).

Figure 3-11(a-ee) shows the jurisdictional wetlands, streams and ponds delineated within right-of-way limits of the Preferred Alternative.

Section 4.14.2 and **Table 4-57** discuss stream impacts in detail. **Tables 4-78 and 4-79** are detailed listings of potential direct impacts to wetlands and ponds, respectively, based on the estimated construction limits shown on the 2005 preliminary engineering design. Wetland impacts are identified as "high quality," "medium quality," or "low quality." Further details regarding wetland types and impacts are contained in **Section 3.17** and the *Supplemental Natural Systems Technical Memorandum* (2003).

Table 4-78: Wetland Impacts – Project R-2247 Preferred Alternative

Wetland[1]	Wetland Impacts[2] (acres)	NCDWQ Rating	Wetland Quality
1	0.02	62	High
2	0.70	77	High
3	0.13	68	High
4	0.32	25	Low
5	0.04	52	Medium
6	0.52	80	High
7	0.05	70	High
8	Outside Slope Stake and ROW	89	High
9	0.27	25	Low
10	Outside Slope Stake and ROW	60	High
11	0.12	34	Low
12	0.74	49	Medium
13	0.08	44	Medium
14	Outside Slope Stake	56	High
15	0.12	63	High
16	0.02	84	High
17	0.03	41	Medium
18	0.02	41	Medium
19	0.06	21	Low
20	0.04	63	High
21	0.10	31	Low
22	Outside Slope Stake and ROW	39	Medium
23	0.01	43	Medium
24	Outside Slope Stake and Row	64	High
26	0.01	42	Medium
27	0.05	68	High
	0.87	**Total Acreage – Low Quality Wetland**	
	0.93	**Total Acreage – Med. Quality Wetland**	
	1.65	**Total Acreage – High Quality Wetland**	
TOTAL	**3.45**		

[1] Wetland numbers refer to **Figure 3-11(a–ee)**.
[2] Construction limits (slope stakes) of the Preferred Alternative 2005 preliminary engineering design was used to calculate impacts

Some wetlands were so small that they do not show up on the mapping or are immediately adjacent to the corridor and were included in case the corridor shifted slightly.

As shown in **Table 4-78**, the Preferred Alternative would impact 21 wetlands. Five of the wetlands are considered to be low quality, seven are medium quality wetlands, and high quality wetlands were found at nine locations.

As shown in **Table 4-79**, the Preferred Alternative would impact six ponds for a total of 1.26 acres of pond impacts.

4-79: Pond Impacts – Project R-2247 Preferred Alternative

Pond[1]	Pond Impacts[2] (acres)	Total Pond Size (acres)
1	Outside Slope Stakes	0.19
2	0.21	0.41
3	0.18	0.51
4	0.49	0.73
5	0.06	0.54
6	0.02	0.07
7	0.30	0.80
8	Outside Slope Stakes	0.04
Total	**1.26**	**3.29**

[1] Pond numbers refer to **Figure 3-11(a-ee)**.
[2] Construction limits (slope stakes) of the Preferred Alternative 2005 preliminary engineering design was used to calculate impacts

4.17.1.4 Jurisdictional Resources - Project U-2579 Detailed Study Alternatives

Pursuant to Executive Order 11990, *Protection of Wetlands*, and Section 404 (b)(1) guidelines of the Federal Clean Water Act, the proposed Detailed Study Alternatives were evaluated to determine impacts to wetlands and ponds along each study corridor. Survey methodology is described in **Section 3.17.2**.

Table 4-80 identifies wetlands impacted by the Detailed Study Alternatives based on a 300-foot right of way for each alternative plus interchange areas. **Table 4-81** summarizes the impacts on wetlands and ponds by Detailed Study Alternative. Results reflect the "worst case," as some areas within the right-of-way limits may not be impacted.

Table 4-80: Wetland Impacts – Project U-2579 Detailed Study Alternatives

Site	Wetland	Type	Impacts (acres)						
			Western	Eastern	C1	C2	C3	C4	C5
W-1	Grassy Creek	F	0.3	0.3	0	0	0	0	0
W-2	Grassy Creek	M	0.2	0.1	0	0	0	0	0
W-3	UT to Trick-um Creek	F	0	0.5	0	0	0	0	0
W-4	Trick-um Creek	F	0	0.4	0	0	0	0	0
W-5	Buffalo Creeks	F	0	0.3	0	0	0	0	0
W-6	Buffalo Creeks	F	0.4	0	0	0.9	0	0	0
W-7	UT to Buffalo Creeks	F	0	0	0	0.5	0	0	0
W-8	UT to Mill Creek[1]	F	1.2	0	0	0	0	0	0
W-9	UT to Buffalo Creeks	F	0	0.5	0	0	0	0	0
W-10	UT to Buffalo Creeks	F	0	0	0.5	0	0	0	0
W-11	UT to Buffalo Creeks	F	0	0	0	0.2	0	0	0
W-12	UT to Mill Creek[1]	F	0.9	0	0	0	0	0	0
W-13	UT to Mill Creek[2]	F	0	0.6	0	0	0	0	0
W-14	UT to Mill Creek[2]	F	0	0.2	0	0	0	0	0
W-15	UT to Mill Creek[1]	F	0	0.7	0	0	0	0	0
W-16	UT to Mill Creek[1]	F	0	0	0	0	0.5	0	0
W-17	UT to Mill Creek[1]	M	0	0.4	0	0	0	0	0
W-18	Frazier Creek	S	0	0	0	0	0	0.5	0
W-19	Frazier Creek	S	0.6	0	0	0	0	0	0
W-20	Lowery Mill Creek	F	0	0.7	0	0	0	0	0
W-21	Lowery Mill Creek	F	0	0	00	0	0	0.6	0
W-22	Lowery Mill Creek	S	0.8	0	0	0	0	0	0
W-23	Martin Mill Creek	F	1.5	0	0	0	0	0	0
W-24	Martin Mill Creek	F	0	0	0	0	0	0	1.6
W-25	Martin Mill Creek	F	0	1.1	0	0	0	0	0
W-26	Kerners Mill Creek	M	0.3	0	0	0	0	0	0
W-27	Kerners Mill Creek	M	0.9	0	0	0	0	0	0
W-28	Kerners Mill Creek	F	0	0.9	0	0	0	0	0
W-29	Smith Creek (Harmon Mill Creek)	F	0	1.0	0	0	0	0	0
Subtotals:		**F**	**4.3**	**7.2**	**0.5**	**1.6**	**0.5**	**0.6**	**1.6**
		S	**1.4**	**0**	**0**	**0**	**0**	**0.5**	**0**
		M	**1.4**	**0.5**	**0**	**0**	**0**	**0**	**0**
Total:			**7.1**	**7.7**	**0.5**	**1.6**	**0.5**	**1.1**	**1.6**

UT = Unnamed Tributary
[1] Mill Creek South of NC 66
[2] Mill Creek North of NC 66
Wetland Codes: F – Hardwood Forested Wetland, S – Scrub/Shrub, M -– Marsh
Source: Table 4-6 in the 1995 Project U-2579 DEIS
Site numbers refer to Figure III-8 in the 1995 Project U-2579 DEIS.

Table 4-81: Open Water and Wetland Impacts – Project U-2579 Detailed Study Alternatives

Detailed Study Alternative	Pond Impacts (acres)	Wetland Impacts (acres)
Alternative 1	4.4	6.2
Alternative 2	6.2	7.7
Alternative 3	5.3	8.2
Alternative 4	5.7	8.2
Alternative 5	5.6	7.5
Alternative 6	5.1	6.9
Alternative 7 (Preferred)	**5.3**	**7.1**
Alternative 8	6.0	7.5

Impacts are based upon right-of-way limits for the 1994 functional engineering designs.
'Bold' indicates Preferred Alternative.

4.17.1.5 Jurisdictional Resources - Project U-2579 Preferred Alternative

Section 3.17.2 discusses the methodology for the wetland surveys. For the 1995 Project U-2579 DEIS, wetland delineations were conducted in 1993 and updated in 1994. Wetlands, ponds, and streams within the Preferred Alternative study area were verified and identified in March and April, 2002. Additional field surveys were completed in June 2004. Potential wetland communities were investigated pursuant to the 1987 *Corps of Engineers Wetland Delineation Manual*.

According to the three-parameter approach outlined in the manual, hydric soils, hydrophytic vegetation and prescribed hydrologic characteristics must all be present for an area to be considered a wetland. **Figure 3-12(a-jj)** shows the jurisdictional streams, jurisdictional wetlands, and ponds delineated within right-of-way limits of the Preferred Alternative.

Tables 4-82 and 4-83 are detailed listings of potential total direct impacts to wetlands and ponds, respectively, based on the estimated construction limits shown on the 2005 preliminary engineering designs. Wetland impacts are identified as "high quality," "medium quality," or "low quality." Further details regarding wetland types and impacts are contained in **Section 3.17** and the *Natural Resources Technical Memorandum* (2004).

As shown on **Table 4-82**, the Preferred Alternative would impact 13 wetlands. Of these, seven are considered low quality, three are medium quality, and three are high quality. An additional wetland is within the right of way but is outside the construction limits.

In addition to the estimated direct impacts within the construction limits of the Project U-2579 Preferred Alternative 2005 preliminary engineering design, other adverse impacts to wetlands and aquatic sites associated with project construction could include direct or indirect hydrologic impacts resulting from the alteration of drainage patterns. The concentration of overland flow into pipes and the potential increases in stormwater runoff could lead to downstream channel incision and consequent wetland hydrology alterations. In addition to permanent alterations, temporary adverse impacts also may occur, such as temporary pond dewatering and stream diversion during the construction of bridges and culverts, and temporary clearing and filling associated with underground utility relocation and construction access.

Table 4-82: Wetland Impacts – Project U-2579 Preferred Alternative

Wetland[1]	Wetland Impacts (acres)	NCDWQ Rating	Wetland Quality	Stream Name	Data Label[2]
ES-W1	0.06	29	Low	UT of Rough Fork	-
ES-W2	0.02	25	Low	UT of Rough Fork	-
ES-W3	0.17	29	Low	Trick-Um Creek	WI
ES-W4	0.52	72	High	UT of Mill Creek	WVI
ES-W5	0.03	33	Medium	Mill Creek	WVIII
ES-W6	0.28	75	High	UT of Frazier Creek	WX
ES-W7	0.01	24	High	UT of Frazier Creek	WXIA
ES-W8	0.32	69	High	UT of Frazier Creek	WXIB
ES-W9	0.01	24	Low	UT of Frazier Creek	WXIIIB
ES-W10	0.28	24	Low	UT of Frazier Creek	WXIIIA
ES-W11	0.11	41	Medium	UT of Frazier Creek	WXII
ES-W12	0.67	32	Medium	Lowery Creek	WXVIII
ES-W13	0.07	28	Low	UT of Martin Mill Creek	WXXIA
ES-W14	Outside Slope Stakes	72	High	UT of Mill Creek	WXIX
	0.61	**Total Acreage - Low Quality Wetland**			
	0.81	**Total Acreage – Medium Quality Wetland**			
	1.13	**Total Acreage - High Quality Wetland**			
TOTAL	**2.55**				

UT = Unnamed Tributary
Impacts are based upon construction limits for the 2005 preliminary engineering designs.
[1] Wetland numbers refer to **Figure 3-12(a-jj)**.
[2] Data label refers to original data collection maps. "-" indicates identified during 2004 survey.

4-83: Pond Impacts – Project U-2579 Preferred Alternative

Pond[1]	Pond Impacts (acres)	Total Pond Size (acres)
ES-P1	2.13	2.40
ES-P2	5.98	36.48
ES-P3	0.63	0.63
ES-P4	0.08	2.17
ES-P5	2.41	2.41
ES-P6	Outside Slope Stakes	0.56
ES-P7	6.69	31.86
Total	**17.92**	**76.51**

Impacts are based upon construction limits for the 2005 preliminary engineering design.
[1] Pond numbers refer to **Figure 3-12(a-jj)**.

4.17.1.6 Jurisdictional Resources - Project U-2579A Detailed Study Alternatives

Pursuant to Executive Order 11990, *Protection of Wetlands*, and Section 404 (b)(1) guidelines of the Federal Clean Water Act, the proposed Detailed Study Alternatives were evaluated to determine wetland impacts along each study corridor. Survey methodology is described in **Section 3.17.2**.

There were 14 wetlands and nine ponds impacted by Project U-2579A Detailed Study Alternatives. **Section 4.14.2** and **Table 4-61** discuss stream impacts in detail. **Table 4-84** describes each impacted wetland for the Detailed Study Alternatives, and **Table 4-85** describes each impacted pond (see **Figure 3-12(a-jj)**). Impacts are based on construction limits for the 2002 preliminary engineering designs.

Table 4-84: Wetland Impacts – Project U-2579A Detailed Study Alternatives

Wetland[1]	Segment(s)	Wetland Impacts (acres)	NCDWQ Rating	Wetland Quality	Associated Stream	Data Label[2]
ESE-W1	N1, N2, N3	0.22	34	Medium	Kerners Mill Creek	W-A
ESE-W2	N1, N2, N3	0.04	41	Medium	Smith Creek (Harmon Mill Creek)	W-B
ESE-W3	N1, N2, N3	0.20	39	Medium	Smith Creek (Harmon Mill Creek)	W-C
ESE-W4	N1, N2 N3	0.24 0.36	44	Medium	Fishers Branch	W-D
ESE-W5	N3	0.02	42	Medium	Fishers Branch	W-F
ESE-W6	N3	0.05	34	Medium	Fishers Branch	W-G
ESE-W7	N3	0.01	22	Low	UT to Fishers Branch	W-H
ESE-W8	N2, N3	0.13	54	High	UT to Fiddlers Creek	W-I
ESE-W9	S1, S2	0.06	42	Medium	Fiddlers Creek	W-J
ESE-W10	S1, S2	0.09	26	Low	Fiddlers Creek	W-K
ESE-W11	S1, S2	0.04	40	Medium	Fiddlers Creek	W-L
ESE-W12	S1	0.34	35	Medium	Fiddlers Creek	W-M
ESE-W13	S1	0.04	39	Medium	Swaim Creek	W-N
ESE-W14	N1, N2	0.08	27	Low	UT of Kerners Mill Creek	-

Impacts are based upon construction limits for the 2002 preliminary engineering designs.
[1] Wetland numbers refer to **Figure 3-12(a-jj)**.
[2] Data label refers to original data collection maps.

4-85: Pond Impacts – Project U-2579A Detailed Study Alternatives

Pond[1]	Segment(s)	Pond Impacts (Acres)	Total Pond Size (Acres)
ESE-P1	N1, N2, N3	2.33	2.33
ESE-P2	N1, N2, N3	0.12	0.12
ESE-P3	N1, N2 N3	0.03 0.09	0.35
ESE-P4	N1 N2	0.12 0.13	0.83
ESE-P5	N1, N2	0.01	0.79
ESE-P6	N2 N3	0.72 0.68	0.84
ESE-P7	S1 S2	2.36 0.13	2.36
ESE-P8	S1	0.39	0.67
ESE-P9	S1	2.37	2.37

Impacts are based upon construction limits for the 2002 preliminary engineering designs.
[1] Pond numbers refer to **Figure 3-12(a-jj)**.

Table 4-86 lists the total wetland and pond impacts by Detailed Study Alternative. The impacts to wetlands vary from 0.97 acres for Alternative N1-S2 to 1.59 acres for Alternative N3-S1. The impacts to ponds vary from 2.74 acres for Alternative N1-S2 to 14.09 acres for Alternative N2-S1 (Preferred Alternative). In general, alternatives containing Segment S2 have fewer wetland and ponds impacts than alternatives containing Segment S1.

Table 4-86: Wetland and Pond Impacts by Alternative – Project U-2579A Detailed Study Alternatives

Detailed Study Alternative	Low Quality Wetlands (acres)	Medium Quality Wetlands (acres)	High Quality Wetlands (acres)	Total Wetlands Impacted (acres)	Number of Wetland Crossings	Total Ponds Impacted (acres)	Number of Pond Crossings
N1-S1	0.17	1.18	0	1.35	10	7.73	8
N1-S2	0.17	0.80	0	0.97	8	2.74	6
N2-S1 *(Preferred Alternative)*	**0.17**	**1.18**	**0.13**	**1.48**	**11**	**14.09**	**11**
N2-S2	0.17	0.80	0.13	1.10	9	3.47	7
N3-S1	0.09	1.37	0.13	1.59	13	8.34	7
N3-S2	0.09	0.99	0.13	1.21	11	3.35	5

Results are the same for alternatives with and without the Kernersville Road interchange.
Impacts are based upon construction limits for the 2002 preliminary engineering designs. Impacts for the Preferred Alternative have been updated for the 2005 preliminary engineering designs.
'Bold' indicates Preferred Alternative.

4.17.1.7 Jurisdictional Resources - Project U-2579A Preferred Alternative

Wetland impacts were recalculated for the Project U-2579A Preferred Alternative based on the 2005 preliminary engineering design. **Table 4-86-1** shows the impact to wetlands by the U-2579A Preferred Alternative. Wetland impacts for Alternative N2-S1 (Preferred Alternative) have not changed since the 2004 SFEIS/SDEIS. **Table 4-86-2** summarizes the impact to ponds by the Preferred Alternative. Three additional ponds were found within the revised Project U-2579A Preferred Alternative construction limits based on the 2005 preliminary engineering design.

Table 4-86-1: Wetland Impacts – Project U-2579A Preferred Alternative

Wetland[1]	Wetland Impacts (acres)	NCDWQ Rating	Wetland Quality	Stream Name
ESE-W1	0.22	34	Medium	Kerners Mill Creek
ESE-W2	0.04	41	Medium	Smith Creek (Harmon Mill Creek)
ESE-W3	0.20	39	Medium	Smith Creek (Harmon Mill Creek)
ESE-W4	0.24	44	Medium	Fishers Branch
ESE-W8	0.13	54	High	UT to Fiddlers Creek
ESE-W9	0.06	42	Medium	Fiddlers Creek
ESE-W10	0.09	26	Low	Fiddlers Creek
ESE-W11	0.04	40	Medium	Fiddlers Creek
ESE-W12	0.34	35	Medium	Fiddlers Creek
ESE-W13	0.04	39	Medium	Swaim Creek
ESE-W14	0.08	27	Low	UT to Kerners Mill Creek
	0.17	**Total Acreage - Low Quality Wetland**		
	1.18	**Total Acreage – Medium Quality Wetland**		
	0.13	**Total Acreage - High Quality Wetland**		
Total	**1.48**			

Wetland numbers are not consecutive because wetlands only crossed by non-preferred detailed study alternatives have been deleted.
UT = Unnamed Tributary
Impacts are based upon construction limits for the 2005 preliminary engineering designs.
[1] Wetland numbers refer to **Figure 3-12(a-jj)**.

4-86-2: Pond Impacts – Project U-2579A Preferred Alternative

Pond[1]	Pond Impacts (Acres)	Total Pond Size (Acres)
ESE-P1	2.33	2.33
ESE-P2	0.12	0.12
ESE-P3	0.03	0.35
ESE-P4	0.13	0.83
ESE-P5	0.01	0.79
ESE-P6	0.72	0.84
ESE-P7	2.36	2.36
ESE-P8	0.39	0.67
ESE-P9	2.37	2.37
ESE-P10	0.10	0.10
ESE-P11	5.53	5.53
Total	**14.09**	**16.29**

Impacts are based upon construction limits for the 2005 preliminary engineering designs.
[1] Pond numbers refer to **Figure 3-12(a-jj)**.

4.17.2 Avoidance and Minimization Measures and Compensatory Mitigation

The avoidance and minimization measures discussed below are applicable to Projects R-2247, U-2579 and U-2579A.

Through the CEQ, the USACE has adopted, a wetland mitigation policy that embraces the concepts of "no net loss of wetlands" and sequencing. The purpose of this policy is to restore and maintain the chemical, biological and physical integrity of Waters of the United States, including wetlands. Mitigation of wetland impacts has been defined by the CEQ to include avoiding impacts, minimizing impacts, rectifying impacts, reducing impacts over time, and compensating for impacts (40 CFR 1508.20). Each of these three aspects (avoidance, minimization and compensatory mitigation), which are discussed below, must be considered sequentially.

Avoidance. The avoidance step examines all appropriate and practicable possibilities of avoiding impacts to Waters of the United States. According to a 1990 Memorandum of Agreement (MOA) between the EPA and the USACE, in determining "appropriate and practicable" measures to offset unavoidable impacts, such measures should be appropriate to the scope and degree of those impacts and practicable in terms of cost, existing technology and logistics in light of overall project purposes. Since this is a linear project it would not be possible to completely avoid impacts to Waters of the United States. However, bridges that avoid placing bents in creeks would be constructed wherever practicable.

Minimization. Minimization includes the examination of appropriate and practicable steps to reduce unavoidable impacts to Waters of the United States. Implementation of these steps would be required through project designs and permit conditions. Strict adherence to Best Management Practices (BMPs) would help to minimize the impacts from the project. Minimization typically includes:

- decreasing the footprint of the proposed project by reducing right-of-way widths, fill slopes and/or road shoulder widths
- installing temporary silt fences, earth berms, and temporary ground cover during construction
- minimizing clearing and grubbing activity
- re-establishing vegetation on exposed areas with judicious pesticides and herbicide management
- bridge lengthening in environmentally sensitive areas
- strictly enforcing sedimentation and erosion BMPs to protect waters
- minimizing in-stream activities

NCDOT has already worked with the USACE and NCDWQ, and will continue to do so as appropriate, to determine the appropriate minimization measures for the Preferred Alternatives for R-2247, U-2579**,** and U-2579A.

Compensatory Mitigation. Compensatory mitigation is not normally considered until anticipated impacts to Waters of the United States have been avoided and minimized to the maximum extent possible. Compensatory actions often include restoration, creation and enhancement of Waters of the United States. Such actions should be undertaken in areas adjacent to or contiguous to the discharge site where possible.

Compensatory mitigation for Project R-2247 was undertaken in 1998, during the original permitting process for the project. Wetland impacts from the project were mitigated at the Friedberg Site. This site is constructed, planted and has been monitored for about ***5*** years. The site is successful and no significant problems have been encountered. Approximately 2,000 linear feet of stream mitigation was completed for Project R-2247 in October 2000 by the Wetland Restoration Program (WRP) at Stone Mountain State Park in Wilkes County. Additional on-site stream mitigation was completed for approximately 7,000 linear feet. A full analysis of the impacts and the existing mitigation will be included in the 404/401 permitting process.

Avoidance and minimization measures were agreed to by the NEPA/404 Merger Team during the meetings for Concurrence Point 4A (Avoidance and Minimization) on May 10, 2005; June 9, 2005; July 13, 2005; and March 21, 2006. **Appendix D.4** contains the Concurrence Point 4A signature forms. Efforts include designing bridges instead of culverts, flood overflow pipes under the road at key locations, and steeper fill slopes where feasible.

4.17.3 Section 401/404 Permits

Temporary and permanent impacts to jurisdictional surface waters (including wetlands) are anticipated. In accordance with provisions of Section 404 of the Clean Water Act (33 USC 1344), a permit is required from the USACE for the discharge of dredged or fill material into "Waters of the United States."

A NCDWQ Section 401 Water Quality Individual Certification is required prior to the issuance of the Section 404 Individual Permit. The Section 401 Certification allows surface waters to be impacted for activities that would not violate water quality standards.

A Section 404 Individual Permit is applicable for project impacts to Waters of the United States. An Individual Section 404 Permit (Action ID No. 199820670) and Section 401 Water Quality Certification (WQC No. 3204) were previously issued for Project R-2247. These permits expired in December 2002.

A new permit, or permits, would be needed for Projects R-2247, U-2579, and U-2579A. The appropriate permits required for Projects R-2247, U-2579, and U-2579A would be determined by the USACE and NCDWQ in coordination with NCDOT.

4.17.4 Wetland Finding

In accordance with Executive Order 11990, impacts to wetlands are to be avoided where practicable. If avoidance is not practicable, then impacts should be minimized and, finally, mitigated. For the Detailed Study Alternatives, the wetland areas were avoided where possible. For the Project R-2247 final engineering designs and the U-2579/U-2579A 2005 preliminary engineering designs for the Preferred Alternatives, impacts were minimized to the fullest extent practicable when avoidance was not possible. This minimization was documented in the Merger Meetings for Concurrence Points 2A (Bridging Decisions and Alignment Review), 3 (Identification of the Least Environmentally Damaging Practicable Alternative), and 4A (Avoidance and Minimization), as discussed previously in this document.

The wetland impacts within the construction limits of the Preferred Alternatives are shown in **Tables 4-76** (summary), **4-78** (Project R-2247 detail), **4-82** (Project U-2579 detail), and **4-86-1** (Project U-2579A detail). The proposed Northern Beltway will cross a total of 47 wetlands, with a total impact of 9.05 acres. Impacted wetlands are shown on **Figures 3-11(a-ee) and 3-14(a-d)**.

Avoidance, minimization, and compensatory mitigation are described in more detail in **Section 4.17.2**.

4.18 WILDLIFE

4.18.1 Terrestrial Wildlife

A new roadway has the potential to eliminate or displace animals in a manner proportionate to the type and quality of habitat lost. Individuals of some less mobile species may be eliminated during construction, as they may not be able to leave the project site during construction activities. Clearing of vegetation during the breeding season could reduce breeding habitat and may destroy broods of many animals. Those species that move from the project corridor may crowd adjacent populations and alter species composition and community dynamics. Noise from construction and operation of a new roadway may also impact wildlife, and operation of a new roadway would invariably result in increased mortality from road kills.

The impact to wildlife resources in the study area is proportional to the habitats converted to new roadway and the value of the converted habitats to terrestrial species. Lands that are already disturbed from human impacts (i.e. urban or industrial areas) tend to be of lesser value to wildlife, while wetlands and forested communities are of higher value in terms of species diversity and abundance. Woodlands, both riparian and upland, provide nesting, escape, and feeding habitat for a large variety of animals. Single-age or monotypic woodlands (as is found in the young pine stands in the study area) provide poor quality habitat, as do grazed wood-lots. Large tracts of woodlands are superior to small ones for maintenance of species diversity (Janzen, 1983; Diamond and May, 1976; Robbins, 1979). Therefore, the placement of new roadway through large undisturbed forested tracts would not only replace high quality habitat with poor habitat, but would also degrade, through fragmentation, the high quality habitat that remains.

Small patches of agricultural land, interspersed with escape and shelter habitats, can be of exceptional value for wildlife. The agricultural land provides food, while other nearby habitats provide protection. Deer and turkey are two species for which this arrangement is ideal. However, large tracts of agricultural land are of limited value, except to a select few species (i.e. meadowlarks) and are frequently only of seasonal importance for migratory species, such as Canada geese.

4.18.1.1 Wildlife - Project R-2247 Detailed Study Alternatives

The following information was taken from Section 4.6.3 of the 1996 Project R-2247 FEIS.

Generally, the study area is a fragmented mosaic forested, agricultural, and man-dominated lands. The largest undisturbed tracts of forested lands that remain are associated with floodplains and some upland areas in the north end of the project area. As such, the EAST Detailed Study Alternatives (EAST-A, EAST-B, C2-EAST-A, C2-EAST-B) would have the greatest impact, through habitat fragmentation, due to the impacts to the floodplains of Little Creek, Silas Creek, and Muddy Creek. However, the WEST Detailed Study Alternatives (WEST-A, WEST-B, C3-WEST-A, and C3-WEST-B (Preferred) would have the greatest single impact on habitat fragmentation due to crossing the floodplains of Silas Creek and Muddy Creek a few hundred feet upstream of their confluence.

The US 52 interchange option at the NC 66 Connector under Detailed Study Alternatives EAST-B, WEST-B, C3-WEST-B (Preferred), and C2-EAST-B also would have greater impacts to forested communities than the Detailed Study Alternatives that would construct an interchange at US 52 at Shore Road/Westinghouse Road (EAST-A, WEST-A, C2-EAST-A, C3-WEST-A), mainly due to the difference in length between the two routes.

4.18.1.2 Wildlife - Project R-2247 Preferred Alternative

The right of way for the Preferred Alternative is comprised of about 41 percent forested area, 22 percent agricultural and pine plantation, and 37 percent maintained/disturbed (see **Table 4-72**). Conversion of wetlands and mixed pine/deciduous hardwood forests would have the greatest impact on terrestrial wildlife. The conversion of even-age pine stands and agricultural areas would have a moderate impact, while the conversion of already disturbed lands and open-water habitats would have the least impacts.

4.18.1.3 Wildlife - Project U-2579 Detailed Study Alternatives

The following discussion is from Section 4.4.3.2 of the 1995 Project U-2579 DEIS.

Habitat modification would occur with any of the Detailed Study Alternatives, and would result in the displacement or loss of wildlife in these areas due to clearing of the upland within the right of way. Each habitat community described in Chapter 3 supports wildlife species that are dependent on the resources in that given area. Those species that have greater mobility would be displaced to other areas. Displacement could potentially lead to increased competition for the available resources, resulting in a net loss of wildlife. Less mobile species, including several species of amphibians, reptiles, and mammals, may be lost. Human activities and elevated noise levels during construction also may disturb breeding or other activities of nearby species. However, these impacts would be temporary and only within the immediate vicinity of the project construction area.

Certain species, such as rabbits, squirrels, raccoons, and opossums, more easily adapt to the increased open spaces. In addition, disturbed areas can provide edges along forested communities in which long-term species diversity may be enhanced. Regularly mowed grass medians and shoulders may provide habitat for transient species including several birds, white-tailed deer, raccoons, and opossums.

In general, forested communities that are less disturbed provide greater habitat value for wildlife as opposed to highly altered or maintained areas. Detailed Study Alternative 5 had the largest area of disturbed woodland (420.8 acres) and Alternative 7 had the smallest area of disturbed woodland (302.8 acres). Overall, Alternative 5 also had the largest total area of disturbed vegetative habitat (857.3 acres), and Alternative 7 had the smallest total area of disturbed vegetative habitat (680.5 acres).

Habitat fragmentation occurs when parcels of otherwise suitable habitat are isolated and rendered less suitable for wildlife, adversely affecting faunal diversity and richness. The degree of impact on wildlife and species diversity depends on the size and isolation of the parcels being fragmented and the sensitivity of the species. Roadway improvements through large undisturbed

forested tracts not only replaces valuable wildlife habitat, but also may reduce the value of the remaining forested habitat through fragmentation.

The study area is primarily suburban and composed of a patchwork of forested, agricultural, and urban/disturbed habitats. The largest undisturbed tracts of forested lands that remain are associated with the floodplains of Lowery Mill, Martin Mill, Kerners Mill, and Smith (Harmon Mill) Creeks in the southern portion of the study area. As such, the Western Detailed Study Alternative would have the greatest impact through fragmentation, due to the floodplain crossings of Kerners Mill, Martin Mill, and Lowery Mill Creeks. However, the Eastern Detailed Study Alternative would also have fragmentation impacts as a result of its floodplain crossings of Smith Creek (Harmon Mill Creek) and Kerners Mill Creek. Also, Crossover 5 would cause fragmentation impacts at its crossing of Martin Mill Creek.

4.18.1.4 Wildlife - Project U-2579 Preferred Alternative

The Preferred Alternative right of way is comprised of approximately 46 percent forested area, 11 percent agricultural and successional pine, and 43 percent maintained/disturbed (see **Table 4-74**). Conversion of wetlands and mixed pine/deciduous forests would have the greatest impact on terrestrial wildlife. The conversion of even-age pine stands and agricultural areas would have a moderate impact, while the conversion of already disturbed lands and open-water habitats would have the least impacts. As part of the Concurrence Point 4A (Avoidance and Minimization) discussions, the Merger Team agreed to include wildlife crossings where appropriate and possible (see May 10, 2005 meeting minutes and signed concurrence form in **Appendix D.4**).

4.18.1.5 Wildlife - Project U-2579A Detailed Study Alternatives and Preferred Alternative

According to **Table 4-75**, alternatives containing Segment S1 (including the Preferred Alternative) impact approximately 40 more acres of biotic communities than alternatives containing Segment S2. In general, Segment S1 alternatives impact an additional 50 acres of forested communities and 10 fewer acres of agricultural and maintained/disturbed lands. Conversion of wetlands and mixed pine/deciduous forests would have the greatest impact on terrestrial wildlife. The conversion of even-age pine stands and agricultural areas would have a moderate impact, while the conversion of already disturbed lands and open-water habitats would have the least impacts. As part of the Concurrence Point 4A (Avoidance and Minimization) discussions, the Merger Team agreed to include wildlife crossings where appropriate and possible (see May 10, 2005 meeting minutes and signed concurrence form in **Appendix D.4**).

4.18.2 Aquatic Wildlife

Aquatic communities are sensitive to even small changes in their environment. Under all the detailed study alternatives for Projects R-2247, U-2579, and U-2579A, short-term impacts can occur during construction and long-term impact can occur as a result of highway operation and maintenance.

The most significant short-term impacts to aquatic biota result from erosion and associated sedimentation. Erosion can result from excavation activities, such as clearing and grubbing, rechannelization, stream relocation, removal of riparian vegetation, bridging, and movement of equipment. After entering the aquatic environment, eroded material would increase turbidity levels and sedimentation downstream. Excessive quantities of suspended solids can harm fish and other aquatic life by coating gills, smothering benthic organisms, reducing solar radiation intensity, and thus, affecting the aquatic food chain. Deposition of suspended solid materials can alter substrate composition of streambeds, which can interfere with primary production and spawning activities of freshwater fishes. Such impacts can be greatly reduced and mitigated through the use of approved erosion and sedimentation control structures, and by phasing construction activities and revegetation of exposed surfaces.

Long-term impacts to the aquatic environment result from the physical alteration of aquatic habitats (i.e. stream channel relocation) and from potential contamination associated with storm water runoff. These impacts can also be reduced and mitigated through construction design that filters storm water before it enters the aquatic environment (such as the use of flush shoulders and grassed swales instead of curb and gutter), and by ensuring that relocated stream channels would have comparable habitats (i.e. riffles and pools) to what is displaced.

Best management practices for standard road and bridge construction and proper project planning would minimize impacts to the aquatic organisms and their habitats in the study area.

4.19 PROTECTED SPECIES

Species with federal status of Endangered (E), Threatened (T), Proposed Endangered (PE), and Proposed Threatened (PT) are protected under provisions of the Endangered Species Act. Any activity permitted, funded, or conducted by a federal agency that may affect a listed species or designated critical habitat requires a consultation with the US Fish and Wildlife Service (USFWS). The result of the consultation is a written biological opinion of whether the proposed action is likely to result in jeopardy to a listed species or adverse modification of designated critical habitat. Federal Species of Concern (FSC) are not afforded protection under the

Endangered Species Act and are not subject to any of its provisions, including Section 7, until they are formally proposed or listed as Threatened or Endangered.

Species with State designations of Endangered, Threatened, or Special Concern (see **Table 3-26**) are granted protection by the State Endangered Species Act and the State of North Carolina Plant Protection and Conservation Act of 1979. Legal protection under North Carolina state law regulates the possession, propagation, or sale of protected species. However, those Acts do not "limit the rights of a landholder in the management of his lands for agriculture, forestry, development or any other lawful purpose" (N.C.G.S. § 113-332; see also N.C.G.S. § 106-202.13). As such, the protections given to state-listed species does not apply to NCDOT activities, and NCDOT does not typically conduct surveys for state-listed species. Consequently, impacts to state-listed species are not quantified here.

As discussed in **Section 3.21,** there are three federally-protected species with habitat ranges in Forsyth County: red-cockaded woodpecker (*Picoides borealis*), bog turtle (*Clemmys muhlenburgii*), and small-anthered bittercress (*Cardamine micranthera*).

4.19.1 Combined Direct Impacts to Protected Species

None of the alternatives would impact the red-cockaded woodpecker or the small-anthered bittercress.

A biological conclusion was not drawn for the bog turtle since the species is not biologically endangered or threatened and therefore is not subject to Section 7 consultation. However, no impacts to bog turtle are anticipated from any of the project alternatives.

4.19.2 Protected Species - Project R-2247 Detailed Study Alternatives

The following information was taken from the 1996 Project R-2247 FEIS.

No impacts to federal or state-listed threatened or endangered species are expected under any of the Project R-2247 Detailed Study Alternatives. Generally, there is no suitable habitat in the study corridors to support the species listed by the USFWS.

4.19.3 Protected Species - Project R-2247 Preferred Alternative

The 1996 Project R-2247 FEIS reported no impacts to federally protected species from the Preferred Alternative. **Appendix D.8** includes a letter from USFWS dated October 3, 1995 concurring with these determinations.

Updated surveys were performed along the Project R-2247 Preferred Alternative for the three federal threatened and endangered species listed in Forsyth County during field visits on April 22, 23, and 25; May 10 and 14; and June 27, July 24, and August 6, 2002, and on January 27 and 28; February 3, 24, and 25; March 11; and April 2 and 29, 2003 (see **Section 3.16.2.2** for a discussion on survey methodology). Some of these dates are out of the normal survey period for the small-anthered bittercress. However, all small-anthered bittercress habitats were inspected during the appropriate flowering period. Results of the surveys and biological conclusions of the impacts on each species from the Preferred Alternative are listed below.

Bog Turtle (*Clemmys muhlenbergii*)

The bog turtle is listed due to similarity of appearance to the northern populations of the species. Species listed as threatened due to similarity are not biologically endangered or threatened, and are not subject to Section 7 consultation. Therefore, no surveys or Biological Conclusions are required for this species. Some areas with suitable habitat were located during the updated surveys, but no bog turtles were found. The 1996 FEIS for Project R-2247 also notes there is suitable habitat for the bog turtle along the Preferred Alternative. No individuals were located during the field studies conducted in support of this finding in the 1996 Project R-2247 FEIS. Therefore, the Project R-2247 Preferred Alternative would not impact the bog turtle.

Red-Cockaded Woodpecker *(Picoides borealis)*

BIOLOGICAL CONCLUSION **NO EFFECT**

The 2002-2003 surveys were conducted according to the *Guidelines for Preparation of Biological Assessments and Evaluations for the Red-cockaded Woodpecker* (Henry, 1989). No suitable nesting habitat in the form of large pine tree stands 30 years or older is present within the project vicinity. The 1996 Project R-2247 FEIS also concluded there is no appropriate habitat for the red-cockaded-woodpecker along the Preferred Alternative. Therefore, construction of the Project R-2247 Preferred Alternative would not impact the red-cockaded woodpecker.

Small-Anthered Bittercress *(Cardamine micranthera)*

BIOLOGICAL CONCLUSION **NO EFFECT**

Surveys for the small-anthered bittercress were conducted during 2002-2003 by qualified PBS&J biologists, but no individuals were observed. Surveys for the small-anthered bittercress also were conducted in support of the 1996 Project R-2247 FEIS. No bittercress populations were located at that time either. No individuals have been observed in Forsyth County for more than 40 years.

Additionally, since the project is exclusively in the Yadkin River Basin, a basin in which the small-anthered bittercress is not known to occur, it is very unlikely that populations of the plant occur along the project corridor. The 1996 Project R-2247 FEIS also concluded that the small-

anthered bittercress is unlikely to be present along the Preferred Alternative. Surveys documented in the 1996 Project R-2247 FEIS did not locate any small-anthered bittercress populations. The additional surveys conducted in 2002 and 2003 support this conclusion.

4.19.4 Protected Species - Project U-2579 Detailed Study Alternatives

The following discussion is taken from Section 4.4.4 of the 1995 Project U-2579 DEIS.

Two federally protected species potentially occur in the study area (red-cockaded woodpecker and small-anthered bittercress). The pine forests observed in the study area consisted of younger pines with a fairly dense shrub and herbaceous understory. No prime red-cockaded woodpecker foraging or nesting habitat was identified in the study area (NCNHP, 1990 and Hopper, et. al., 1980). Therefore, no survey for this species will be necessary.

Although no recorded populations of the federally endangered small-anthered bittercress are known to occur in Forsyth County, its presence cannot be ruled out due to potential habitat in the study area. Upon selection of the Preferred Alternative, surveys for this species will be conducted at stream crossings during the spring when the species bears flowers and fruit. Because the Eastern and Western Detailed Study Alternatives have nearly the same number of stream crossings (20 and 22, respectively), the amount of potential habitat for each alternative is relatively equal.

The bog turtle, a federal candidate species and state listed threatened species (protected by State law), has been reported to occur in areas around the project corridor. Although no records for the species have been reported within the study area, its presence cannot be ruled out due to potential habitat. Potential habitat for the bog turtle may be associated with wetlands. The Eastern Detailed Study Alternative impacts approximately 7.7 acres of wetlands and the Western Detailed Study Alternative impacts approximately 7.1 acres.

4.19.5 Protected Species - Project U-2579 Preferred Alternative and Project U-2579A Preferred Alternative

Updated surveys were performed along the Project U-2579 Preferred Alternative and the Project U-2579A Detailed Study Alternatives (including the Preferred Alternative) for the three federal threatened and endangered species listed in Forsyth County. These species were also discussed in the 1995 Project U-2579 DEIS (see **Section 4.19.4**).

According to the February 18, 2003 USFWS internet listing (which is the most recent list published by USFWS), two federally listed endangered species, the red-cockaded woodpecker (*Picoides borealis*) and small anthered bittercress (*Cardamine micranthera*), and one federally listed threatened species, the bog turtle (*Clemmys muhlenbergii*), are listed for Forsyth County.

The southern population of bog turtle is listed due to similarity of appearance to the northern populations of the species. Species listed as threatened due to similarity are not biologically endangered or threatened and are not subject to Section 7 consultation. Therefore, no surveys or Biological Conclusions are required for this species. Listing of the red cockaded woodpecker results from a historic record. Field surveys were conducted by biologists in January 2003. The survey included an assessment of suitable habitat within the proposed project study area for the listed species. A description of the species and their habitat requirements are discussed below.

Bog Turtle (*Clemmys muhlenbergii*)

Habitat for the bog turtle consists of wetland seeps and bogs with a mosaic of dry pockets and pockets that are periodically flooded (USFWS 1997). There are no suitable seeps or bogs located in the project study area. No habitat is present for this species within the project study area. Based on the information above and field reconnaissance, no impacts to this species are anticipated as a result of the proposed project construction.

Red-Cockaded Woodpecker *(Picoides borealis)*
BIOLOGICAL CONCLUSION **NO EFFECT**

No suitable habitat was found within the project study area for the red-cockaded woodpecker. The forested areas have been cutover or are young pine in fallow agricultural fields. Based on the information above and field reconnaissance, no impacts to this species are anticipated as a result of the proposed project construction. No known populations are known for the project study area.

Small-Anthered Bittercress *(Cardamine micranthera)*
BIOLOGICAL CONCLUSION **NO EFFECT**

On June 3, 2002, biologists from Kimley-Horn and Associates conducted a field review with Marj Boyer, NC Department of Agriculture, Plant Protection Division at areas of suspected small anthered bittercress. Everything within the channel that had potential habitat along Kerners Mill Creek was reviewed. Numerous plants were viewed and it was concluded that the plants in question were *Cardamine pennsylvanica* based on the leaf arrangement. The project area did not contain small-anthered bittercress at the time of the survey.

4.20 INDIRECT AND CUMULATIVE IMPACTS

This section summarizes the analysis and conclusions documented in the *Winston-Salem Northern Beltway Indirect and Cumulative Impacts Analysis* (June 2005), which is appended by reference. This section has been revised since the 2004 SFEIS/SDEIS. Changes include reorganization, more information from the technical memorandum, and updates to the analysis.

For additional information about this report or any other report referenced in this document, or to view a copy of a report, please contact NCDOT.

4.20.1 Purpose and Organization

This section of the SFEIS/FEIS discusses the analyses of indirect and cumulative impacts for the Winston-Salem Northern Beltway. The purpose of analyzing indirect and cumulative impacts is to assess the degree to which various human and natural resources within the sphere of influence of the project may be affected by the project either indirectly (as a result of the proposed project but occurring later in time or farther removed in distance) or cumulatively (as a result of past, present, and reasonably foreseeable future actions). Those terms are further defined below. The time frame of the indirect and cumulative impacts analysis is 2025, which is the design year of the Northern Beltway. In contrast, the majority of the Environmental Impact Statement principally discusses direct impacts, which are caused by the action and occur at the same time and place as the action.

Part of the indirect and cumulative impacts analysis involves estimating the effect the project will have on future (2025) housing density and job growth. As described below, small shifts in the location of housing and job growth in Forsyth County are expected as an indirect impact of the project. These shifts have not been reintroduced into the analysis of direct impacts summarized elsewhere in the document. Indirect and cumulative impact studies are attempting to estimate complex, dynamic systems created by private markets, changes in public policy, and other forces external to and largely beyond the control of any individual public agency. Regional, system-level travel demand models are not sensitive to the size of shifts implied by the ICI analysis in this section. Since the regional model is not sensitive to changes of this scale, they were not reintroduced into the model or direct impact analyses.

Nevertheless, indirect and cumulative impact analyses fulfill a required and important role in assessing the impacts of major infrastructure projects. This type of analysis seeks to answer questions about potential changes to and effects on important resources across a study area and time frame that are much larger in scale than their direct impact analysis counterparts. Therefore,

it is the combination of direct and indirect/cumulative effect analyses that permits a thorough examination of a project and its alternatives. The Winston-Salem Northern Beltway Indirect and Cumulative Impacts analysis utilizes multiple methods of analysis to reinforce conclusions, and goes further to make suggestions about the methods that state and local governing agencies can apply to manage possible changes created by the Winston-Salem Northern Beltway and other projects.

The following summary of the indirect and cumulative impacts analysis is organized in the following manner. First a discussion of key definitions, the analysis scenarios, and the analysis performed is presented. Second, a brief discussion of general factors influencing growth patterns is included as a precursor to the indirect and cumulative effects analysis that follows. Finally, overall conclusions and mitigation options are identified. Specific issues may be highlighted for longer discussion, although generally the reader will need to refer to the complete report for additional details.

4.20.2 Objective and Terminology

4.20.2.1 Objective

The objective of the indirect and cumulative impact assessment is to identify how the various scenarios might affect the natural and human environment in Forsyth County.

4.20.2.2 Definitions

- **Cumulative Impacts**. Cumulative impacts are impacts on the environment which result from the incremental impact of a project when added to other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR Part 1508.7).
- **Indirect Impacts**. Indirect impacts are caused by the project and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect impacts may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems (40 CFR Part 1508.8). Indirect impacts also include encroachment-alteration effects, which are alterations of the behavior and functioning of the affected environment caused by project encroachment (physical, chemical, or biological) on the environment.
- **Induced Travel**. Induced travel is increases in total vehicle miles of travel on a roadway network resulting from increased roadway capacity beyond the vehicles miles of travel

that results from population growth, changes in income, and other outside variables (demographics, etc.). Induced travel is difficult to measure in part because it is has three components, only two of which are actually 'new' travel. Diverted trips, lengthened trips, and new trips have been considered part of induced travel according to various researchers. Strictly speaking, only new travel that would not have occurred if a facility (new capacity) had not been constructed meets the definition of induced travel. Due to this uncertainty, the analysis and discussion of this topic should not be construed as a broad acceptance of the theories or effects of induced travel, but is simply an attempt to quantify potential induced travel impacts based on the limited, state-of-the-practice understanding of this topic.

4.20.3 Analysis Scenarios

The two Northern Beltway projects (Western Section and Eastern Section/Eastern Section Extension) have separate and distinct purposes and needs. Therefore, the North Carolina Department of Transportation considers them two separate projects for the purposes of funding, design, and construction. The Western Section ("Build-West" Scenario) is designated as R-2247 in the *NCDOT 2006-2012 TIP*. The Eastern Section ("Build-East" Scenario) is designated as U-2579 and U-2579A in the *NCDOT 2006-2012 TIP*.

In order to reflect all of the scenarios in the analysis and to provide a baseline for comparing them against a no-build condition, four scenarios were examined during this analysis:

- **No-Build Scenario** – Known transportation improvements are included in this scenario, but no section of the Northern Beltway.
- **East-Build Scenario** – The Eastern Section of the Northern Beltway extends approximately 17 miles from US 52 north of Winston-Salem to US 311 southeast of Winston-Salem. The Eastern Section of the Northern Beltway will be a six-lane, freeway facility from US 52 to I-40 Business (U-2579); the remaining section between I-40 Business to US 311 is proposed to be a four-lane freeway facility (U-2579A).
- **West-Build Scenario** – The Western Section consists of a four-lane freeway that extends approximately 17 miles from a southern terminus along Stratford Road (US 158) to a northern terminus along US 52, just north of an intersection with University Parkway.
- **Full-Build Scenario** – As the name implies, the Full-Build Scenario assumes that the Eastern and Western Sections of the Northern Beltway will be constructed. It is the summation of both the East- and West-Build Scenarios.

4.20.3.1 Study Boundaries

The time frame for the analysis is the year 2025, which corresponds with the design year for the project and the horizon dates for long-range planning documents and demographic forecasts there

were made available for this study. The overall study area for the indirect and cumulative impacts evaluation is Forsyth County, with details provided on subunits of geography inside the study area where potential growth-related pressures may be anticipated. This boundary was defined through use of the *Guidance for Assessing Indirect and Cumulative Impacts of Transportation Projects in North Carolina. Volume II: Practioner's Handbook (NCDOT ICI Guidance)*, as well as an investigation of the natural, built, and political geography of Winston-Salem and Forsyth County; review of relevant case studies and current literature; and interviews with local planning officials. The boundary encompasses areas within which indirect and cumulative impacts can be reasonably assessed with a degree of specificity. Development effects are most often found up to one mile around a freeway interchange, and from two to five miles along major feeder roadways to the interchange. One reason for identifying the entire County as the study area was that it allows examination of both the corridor itself as well as a buffer area around the corridor where indirect and cumulative impacts may occur.

Potential changes to general land use, accessibility, and development potential/attractiveness were evaluated in this study area. Traffic Analysis Zones (TAZs) used in the Piedmont Triad Regional Traffic Model were the units for most of the quantitative analyses.

4.20.4 Characteristics of Study Area

The NCDOT ICI Guidance recognizes the importance of establishing the existing and anticipated forces guiding new growth and development that may impact important natural or man-made resources in the study area.

4.20.4.1 Land Use Trends

Forsyth County shares many of the same characteristics as other counties in the Southeastern part of the United States. A trend towards suburbanization coupled with an increasing attraction to metropolitan areas has placed pressure on North Carolina's municipalities to provide critical infrastructure such as schools, transportation facilities, and water/sewer service. While Forsyth County has not grown at quite the same pace as North Carolina generally (1.1 percent annual growth for the county compared to 1.6 percent annual growth for the state between 1980 and 2000), Forsyth County has seen increased congestion levels and longer commute times (12 percent increase in commute travel times since 1992). Winston-Salem has incorporated significant acreage into its boundaries through annexation (35 square miles in recent years) to ensure that consistent planning and services are provided to urban and suburban residents and businesses. The following tables indicate the population and employment changes between 1980 and 2000 in the study area.

Table 4-86-3. Population 1980-2000

	1980	2000	Percent Change 1980-2000	Annual Growth 1980-2000
North Carolina	5,880,095	8,046,485	37%	1.6%
Forsyth County	243,704	306,067	26%	1.1%

Source: North Carolina State Data Center.

Table 4-86-4. Total Employment 1980-2000

	1980	2000	Change 1980-2000	Percent Change 1980-2000	Annual Growth 1980-2000
North Carolina	3,059,801	4,942,549	1,882,748	62%	2.4%
Forsyth County	148,486	220,947	72,461	49%	2.0%

Source: North Carolina State Data Center.

Partially in response to these changes, the Forsyth County government has sought to implement measures to manage growth and development in the urban fringe. The *Growth Management Plan* outlines a number of relevant goals for 2015, including the curtailment of sprawling growth, providing more convenient shopping opportunities, and a reduced dependence on the private automobile for travel.

4.20.5 Resources and Environmental Features

Forsyth County and its central city, Winston-Salem, have a number of historic, archaeological, and natural resources that collectively represent the notable features inventory described in the NCDOT ICI Guidance. The preservation and conservation of these features are important not only to the health of Forsyth County residents, but are also integral elements to their quality of life and that of the natural environment. The following is a brief summary of various categories of notable features in the study area.

4.20.5.1 Parks and Recreational Facilities

Eight large public parks (over 100 acres in size) and several public golf courses, as well as smaller neighborhood parks, community centers, and trails, are within the study area. Sixteen miles of trails on six greenways are located in Forsyth County. More information on public parks, golf courses, and community facilities is in the Draft Winston-Salem/Forsyth County 2015 Parks and Open Space Plan (February 2006) (*http://www.co.forsyth.nc.us/Documents/ParksPlanDraft2006.pdf*), appended by reference.

4.20.5.2 Cultural Resources

Forsyth County and Winston-Salem are rich in features of archaeological and historical significance. The most famous among these includes the Old Salem historic district in downtown Winston-Salem and the Bethania community on the west side of the City. The Northern Beltway crosses an area characterized with a high density of archaeological sites spanning a considerable prehistoric period. Forsyth County contains sites from numerous cultural stages dating back to the Paleo-Indian era (ca. 10,000 to 8,000 years BC) up until the early European settlements by Moravians in the 18th century. A total of 66 archaeological sites were discovered during investigations conducted by NCDOT. Similarly, numerous independent historic resource surveys were conducted between 1991 and 2003; a total of 76 buildings and districts of historical interest have been cataloged as a result.

4.20.5.3 Water Resources

The project study area primarily is located within the Yadkin-Pee Dee River Basin, although a portion of northeastern Forsyth County north of NC 66 is within the Roanoke River Basin. None of the streams in the western or eastern portions of the study area are classified as Trout Streams (C-Tr). None of the streams in the western or eastern portions of the study area support trout, anadromous fish, or significant warm water fish species. No High Quality Waters or Outstanding Resource Waters are located in the study area. The most notable water supply resource is Salem Lake, a man-made lake that supplies about 20 percent of the drinking water to the study area. The City-County Planning Board has created a series of Water Quality Sensitive Areas (WQSA) within the Salem Lake watershed to protect water quality and monitor development within these water quality sensitive areas.

Section 303(d) of the Clean Water Act requires states to identify waters not meeting standards set by the EPA. There are three stream segments in subbasin 03-07-04 included on the 303(d) list. Grants Creek (17.9 miles from source to Yadkin River) and Salem Creek (11.7 miles from Winston-Salem water supply dam to Muddy Creek) are listed primarily due to agricultural sources, municipal pretreatment and urban runoff. There is also an unnamed tributary to Grants Creek (from source to Grants Creek) that is listed but whose impairment is unknown. There is one stream segment in subbasin 03-02-01 on the 303(d) list, Town Fork Creek (8 miles from source to Timmons Creek) whose cause of impairment is unknown.

4.20.5.4 Species and Habitat

Before the first planned settlement in November 1753, virtually all of the land area that is now Forsyth County was covered by virgin forest. Except for a few large tracts in steep, rugged terrain, mostly in the northeastern and northwestern portions of the County and along the Yadkin River, most of the original forest has been subjected to repeated disturbance since 1753. Nearly all of the tillable area has been cleared at one time or another and some areas have been cleared more than once. As a result of repeated disturbances, most of the original forest has been converted to stands of pine and mixed pine and hardwoods or is in farm, industrial, commercial, residential or other uses (USDA, 1976).

Of the various habitats in the County, woodlands, in particular those associated with wetland or floodplains, and wetland and aquatic habitats, tend to be of highest diversity and therefore of greatest value ecologically. The habitats in the study area support a diverse range of terrestrial and aquatic species. Of these, two are federally protected and nine are state listed. The FWS, under the Endangered Species Act (1972) lists federally threatened and endangered species. The three federally protected species that have the potential for habitat in the study area are: small-anthered bittercress, red-cockaded woodpecker, and bog turtle. Five more state-listed species are also listed as having habitat in the study area. It is not known for certain how many of these species still survive in Forsyth County.

4.20.6 General Factors Influencing Cumulative and Indirect Impacts

In examining the potential indirect and cumulative impacts for the Winston-Salem Northern Beltway, it is necessary to understand how transportation improvements can influence long-term regional development and what other factors also play a role in determining future land use patterns. Although numerous research activities and empirical studies have been conducted in order to understand the numerous interactions between land use, transportation, and other economic and social factors, no single solution has been identified.

4.20.6.1 Location Decisions

Many factors influence the location decisions of individual households, businesses and developers. Research indicates that transportation accessibility is one factor, but not necessarily the most important. Other factors include:

- Cost of housing or office space;
- Distance from heavily urbanized areas;
- Access to amenities;
- Quality of schools and public services;
- Community characteristics; and
- Governmental regulations and incentives.

4.20.6.2 Beltway Impacts on Land Use

The construction of Beltway facilities introduces additional factors that influence land use development in a region. Typically, the regional impact of a highway project on overall commercial activity is small. However, the localized effect of such projects on land use can be substantial, particularly in the presence of features sensitive to growth-related impacts. If the conditions for development are generally favorable in a region (i.e., the region is urbanizing), then highway and transit projects can become one of the major factors influencing where development will occur. General circumstances influencing the likelihood of induced development shifts include:

- **Extent and maturity of existing transportation infrastructure.** The influence of highway projects diminishes with successive improvements because each new improvement brings a successively smaller increase in accessibility.
- **Land availability and price.** Development cannot take place without the availability of land of a quality and price suitable for development. Land prices are likely to reflect a parcel's suitability for development (favorable topography, water and sewer availability), the availability of other suitable parcels in the area, the attractiveness of the location and many of the other factors listed below.
- **State of the regional economy.** Even if changes in accessibility are great, development is not likely to occur if the regional economy will not support new jobs and households; if credit or financing is not readily available; or if firms conclude that the availability of labor, suppliers, or local markets for goods are not sufficient.
- **Area vacancy rates.** High local vacancy rates in housing or commercial space of good quality may be absorbed before any shift in development to the project area is seen.
- **Location attractiveness.** The quality of existing development, local politics, and growth history are all factors in addition to transportation availability and cost.
- **Local political/regulatory conditions.** Low business, property and sales tax rates, the availability of incentives for development such as tax abatements, and a regulatory

environment that is favorable to business are factors favorable to development. The speed, ease, or predictability of the development review process can also impact development costs.

- **Land use controls.** Development is shaped by zoning ordinances and other land use controls. These controls influence the amount of land available for various uses, the densities permitted, and the costs of development. Pressures for development can prompt communities to alter land use controls, however an assessment should be made which considers the likelihood that changes in land use controls will occur. Such an assessment can consider the historical record of zoning enforcement and granting of variances, whether the controls are rooted in long range comprehensive plans, and the existing amount of undeveloped land for each use.

4.20.6.3 Interstate Signage (I-74)

NCDOT expects the Eastern Section of Winston-Salem's Northern Beltway will be part of the Interstate 74 corridor. Originally identified as part of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), the I-74 corridor, if and when it is ultimately completed, would provide a continuously signed Interstate link from Michigan to South Carolina through Ohio, West Virginia, Virginia, and North Carolina. Although some sections of new alignment are planned, in many areas I-74 will follow existing roadways that will be either upgraded to Interstate standards or existing freeways that will be re-signed with an Interstate shield.

Within North Carolina, I-74 is composed of numerous segments in various stages of operation, construction, and planning. Significant portions are not yet in the planning stages with actual construction and funding not identified. Other sections, such as north of Winston-Salem on US 52, include existing freeways that NCDOT expects to upgrade and then redesignate as I-74. In Winston-Salem, the Eastern Section of the Northern Beltway and the extension of the Eastern Section between I-40 and US 311 is the planned route for I-74 (See Figure 5-1 of the *Winston-Salem Northern Beltway Indirect and Cumulative Impacts Analysis*).

It should be noted that the I-74 corridor has independent utility from the Eastern Section and Eastern Section Extension and could be provided separately on a different alignment. In addition, the Western Section of the Northern Beltway project has been envisioned since 1965 and the Eastern Section since 1968, more than 25 years before the I-74 corridor was established by ISTEA.

To determine the potential impacts of signing the Eastern Section and Eastern Section Extension of the Northern Beltway as I-74, a review of available reports and a series of telephone interviews

were conducted. The findings related to the potential effects of signing the eastern half of the Northern Beltway as I-74 are:

- Regardless of whether the Eastern Section and Eastern Section Extension of the Northern Beltway are signed as I-74, the design criteria for the roadway will meet modern Interstate standards and provide the same level of access and mobility.
- If the Eastern Section and Eastern Section Extension of the Northern Beltway were not signed as I-74, it is assumed that US 52 to US 311 would be signed as I-74. No change in total I-74 traffic routed through Winston-Salem would be anticipated, although the specific roadways designated as Interstate would change.
- I-74 through traffic would take approximately 15 minutes to travel on US 52 from the Northern Beltway interchange north of Winston-Salem to the US 311/I-40 interchange southeast of Winston-Salem. Traveling on US 52 through downtown is projected to take approximately 19 minutes. The new routing would save 4 minutes, representing an approximate 20 percent savings in travel time through the region.
- Although Interstate signing is a screening factor used in the initial stages of industrial recruitment, it is typically less important in the final stages of site selection. In an urbanized area such as Winston-Salem with existing Interstate routes, however, the region already meets the screening criterion of local Interstate access and would not be prematurely eliminated from consideration. In the later stages of site selection, transportation issues focus more on the roadway network and roadway congestion – the issue of whether a particular freeway is signed as an Interstate is no longer a primary criterion.
- The most critical element to truckers is time since reducing travel time is critical to meeting schedules and following regulations restricting amount of driving time per day. Therefore, the presence of Interstate signing on the Northern Beltway would not impact preferred routes substantially or significantly impact truck volumes.
- A telephone interview with the American Automobile Association (AAA) indicated that AAA trip maps would tend to use circumferential freeways around large cities irrespective of Interstate signing. Tourist destination cities are a potential exception to this statement.

There is some discussion among the long-range planners at NCDOT and FHWA about possibly designating the Western Section, when built, as a three-digit interstate. (Three-digit interstates are either loops or spurs. A loop (a three-digit interstate with an even first digit) is a connecting route or a full or partial circumferential beltway around and within urban areas. A loop usually connects to an interstate on both ends. A spur (a three-digit interstate with an odd first digit) is a supplemental radial route that connects with the main interstate only on one end.) Should this designation occur, it would not be expected to influence the route most drivers choose for the reasons given in the last three bullets above. In fact, the three-digit interstate-signage on the Western Section might be expected to have even less influence on route choice, since loops and

spurs do not provide new cross-state routes, but rather provide urban areas with additional access to the Interstate System.

4.20.7 Analysis of Indirect and Cumulative Impacts

The NCDOT ICI Guidance recommends that multiple techniques be used to analyze the potential for indirect and cumulative impacts, especially if that project is complex, controversial, and large in scope. The following summarize the qualitative and quantitative methods used to analyze the potential indirect and cumulative impacts of the Northern Beltway.

4.20.7.1 Analysis of Indirect Impacts

To determine the potential indirect impacts and land use pressures resulting from the construction of the Northern Beltway, a detailed accessibility analysis was performed. This analysis technique, which utilizes land use data and travel times to determine changes in land use, served as one of the primary tools used in identifying those areas with potential land use growth pressures. One of the assumptions of this analysis is that there is no net change in land use for Forsyth County as a result of construction of the Northern Beltway. Increases in housing and employment growth related to a new facility result from redistribution of growth that is already occurring in a region to areas within that region experiencing improved accessibility. For purposes of this analysis, the study area was divided into Traffic Analysis Zones (TAZs). TAZs are units of geography that typically consist of fairly homogeneous land uses and are comprised of smaller units of U.S. Census geography, such as blocks, block groups, or tracts. These analysis units were chosen for the more detailed aspects of the study since they are the most detailed units of geography that have demographic forecasts provided and approved by local governments in the study area.

General Growth Patterns. Under all future scenarios, Forsyth County's housing density is just under one dwelling unit (du) per acre. A more detailed analysis of housing density was also conducted for each TAZ in the study area to identify specific regions of Forsyth County that would encounter increased housing density as a result of building sections of the Northern Beltway. The analysis conducted was a variation of the Hansen gravity model, which empirically determines the effects of various effects, including vacant land and accessibility, on the location decisions of future households and employers based upon changes in accessibility. The general form of these models and a literature review indicates that these models are capable of helping determine areas of increased development pressures, but cannot be used to predict specific development actions. If the Beltway were appreciably redirecting suburban growth to rural areas, one would anticipate that large numbers of TAZs would move from very low density levels (i.e., one dwelling unit/acre) to higher density levels (i.e., two or three dwelling units/acre). The analysis determined that there was very little change in density levels for individual TAZs

indicating that the Northern Beltway has minimal effects on housing location. While overall changes were small, the following potential shifts in housing location from the No-build scenario were observed:

Build-East: Shifted growth in this scenario clusters in zones around the Eastern Section of the Beltway, or in other zones whose access to other parts of the Piedmont Triad is improved. In addition, there is the effect of preserving housing in the downtown area.

Build-West: Shifted growth in this scenario clusters in zones around the Western Section of the Beltway. No additional growth in housing is anticipated downtown beyond what is already included in the No-Build data.

Full-Build: The projected growth for the Full Build scenario is more than is anticipated for the Western and Eastern section separately, but is still expected to be minimal, affecting only 3.3% of the housing locations for the study forecast period. Additional growth is projected for this alternative along the alignment of the Western and Eastern corridors of the Northern Beltway. In this scenario there is the effect of preserving housing in the downtown area. Other growth areas include the southwest portion of the County near the US 158 terminus of the project.

Similarly, overall shifts in employment growth from the No-build scenario are expected to be small. The following potential shifts were observed:

Build-East: Shifted job growth in this scenario clusters in zones around the Eastern Section of the Beltway. Focused growth, however, is noted near the proposed US 52 and University Parkway interchanges, the proposed New Walkertown Road interchange, and just west of the proposed US 311 interchange. Each of these three locations is near a planned Metro Activity Center as included in the County's Legacy Plan.

Build-West: Shifted growth in this scenario clusters in zones around the Western Section of the Beltway. Development is concentrated near the planned Metro Activity Center at the Robinhood Road interchange. In addition, additional job growth is projected near Bethania and the southern terminus of the western alignment at US 158.

Full-Build: The projected growth for the Full Build scenario is more than is anticipated for the Western and Eastern sections separately. Like the Build-West and Build-East alternatives, growth along the Beltway is focused at Metro Activity Centers near the Robinhood Road, University Parkway, and the New Walkertown Road interchanges. In addition, Bethania continues to be subject to increased growth pressure. Note however that the amount of growth in zones adjacent to the Beltway is actually forecast to be less than either the Build-West or Build-East scenario. Also note that no additional growth is

projected near US 311. In the Full-Build Scenario, the largest increase in growth is focused in the downtown. In addition, a large increase in growth is noted near the regional industrial park on US 158 west of I-40.

Interchange-Development Potential. **Table 4-86-6** summarizes the results of the qualitative interchange specific analysis. Each of the interchanges is rated as having a low, medium, or a high potential for commercial development based upon a review of five criteria. The five criteria used to estimate the development potential for each interchange and the metrics used to measure the criteria were:

Table 4-86-5. Interchange Criteria

Interchange Criteria	Low	Medium	High
Amount of existing commercial development	Less then 50 jobs in ½-mile radius	Between 50 and 200 jobs in a ½-mile radius	More than 200 jobs in a ½-mile radius
Potential for future development as identified in zoning and land use plans	Within protected or residential area	Zoning is medium density commercial or industrial use	Zoning is high density commercial use or is designated as a future activity center
Improved accessibility to workers or shoppers (as measured by the accessibility analysis)	Change in accessibility of four nearest traffic analysis zones is less than one standard deviation from the mean of all TAZs	Change in accessibility of four nearest traffic analysis zones is between one and two standard deviations from the mean of all TAZs	Change in accessibility of four nearest traffic analysis zones is more than two standard deviations from the mean of all TAZs
Existing traffic volumes on cross streets	Cross-street has less than 12,000 vehicles per day	Cross-street has between 12,000 and 20,000 vehicles per day	Cross-street has more than 20,000 vehicles per day
Interchange type and spacing *Note: Service interchanges interchange with surface streets; System interchanges interchange with another full-control of access facility*	A system interchange with one or fewer service interchanges within 1.5 miles	A service interchange with another service interchange within 1.5 miles OR a system interchange with two or more service interchanges within 1.5 miles	A service interchange with two or more additional service interchanges within 1.5 miles

In the No-Build scenario, most of the proposed interchange sites have a low potential for commercial development. Note that in the No-Build case, interchanges with planned Metro Activity Centers (a term used to denote future concentrated development areas in the Winston-Salem/Forsyth County comprehensive land use plan) are projected to have a low relative potential for growth as a result of the composite analysis.

In the Build scenarios, most of the interchange sites have moved up one category to medium potential for commercial development as a result of improved accessibility due to the interchange. Some exceptions to this are the I-40 West, I-40 East, and US 311 interchanges which have low commercial development potential under all four scenarios. The reason for this result is that these highway to highway interchanges will not provide direct access to adjacent properties. With the entire Northern Beltway in place, interchange development potential is considered high at four interchanges, medium at six interchanges, and low at eight interchanges. Since the effects on natural systems from induced growth are small, and since the impacts from indirect growth are generally similar in type to those experienced by the cumulative impacts of other development actions, the indirect impacts on natural systems are included in the cumulative impact analysis, which is discussed in **Section 4.20.7.2, Analysis of Cumulative Impacts**.

The results in **Table 4-86-6** are consistent with the results of the stakeholder survey conducted to cross-check the assumptions made in the qualitative analysis. The survey was sent to 21 stakeholders; including representatives of local government, the private sector, and environmental groups. The respondents indicated that the Northern Beltway would encourage development at nearby interchanges. The respondents also indicated that the biggest factor in determining the type and timing of development is the zoning near the interchanges.

Table 4-86-6. Development Potential at Interchanges

Interchange	No-Build	Build-East	Build-West	Full-Build
Stratford Rd (US 158)	Medium	-	High	High
I-40 West	Low	-	Low	Low
US 421	Low	-	Medium	Low
Shallowford Rd.	Low	-	Medium	Medium
Robinhood Rd.	Low	-	High	Medium
Yadkinville Rd.	Low	-	Medium	Low
Reynolda Rd. (NC 67)	Low	-	Medium	Low
Bethania-Tobaccoville Rd.	Low	-	Medium	Low
US 52 North	Medium	High	Medium	High
University Parkway (NC 66)	Medium	High	-	High
Germanton Rd (NC 8)	Low	Medium	-	Medium
Baux Mountain Rd.	Low	Medium	-	Medium
New Walkertown Rd (US 311)	Low	High	-	High
Reidsville Rd (US 158)	Low	Medium	-	Medium
US 421/I40 Business	Low	Low	-	Low
Kernersville Rd	Low	Medium	-	Medium
I-40 Bypass	Low	Low	-	Low
US 311	Low	Low	-	Low

Induced Travel. The FHWA's SMITE (Spreadsheet Model for Induced Travel Estimation) model, with modifications made to better represent the study area, was used to provide an estimate of induced travel that may occur related to the Winston-Salem Northern Beltway. The SMITE model estimates both diverted travel and induced travel; the travel demand model should account for variations in trip lengths and diverted travel that are not associated with additional induced trips. As such, SMITE is not intended to be used alone, but should be used to supplement a traditional travel demand model.

Using an initial estimate of system travel, system capacity, change in system capacity, and elasticity of demand, SMITE estimates speeds on each class of roadway, delay to travelers, travel diverted from one roadway class to another, and new travel. SMITE provided a liberal estimate of induced travel in this analysis because the travel demand model automatically handles diversion of traffic from old facilities to new facilities, and because the trip distribution portion of the travel demand model was run to develop the project traffic forecasts for each of the four evaluated scenarios. By running the gravity allocation model for each scenario, the model accounted for people taking longer trips.

In 2025, induced travel for all reasonably foreseeable projects in the study area is approximately 1.80 percent of total travel. Induced travel with only the entire Northern Beltway and no other anticipated projects is approximately 1.05 percent. Since the largest figure for vehicle miles of travel (VMT) is 12.1 million VMT/day countywide, this equals about 218,000 additional vehicle miles of travel each day countywide. Furthermore, the SMITE models indicate that this increase is being absorbed largely by the additional freeway components of the roadway system and shifted off of the other roadway types. Based on this analysis it can be concluded that the amount of induced travel resulting from construction of the Northern Beltway is not appreciable when examined as a portion of vehicle miles traveled throughout the region, and that traffic is being shifted to roadways with less-frequent acceleration events which contribute substantially to negative air quality impacts for ozone precursors and carbon monoxide.

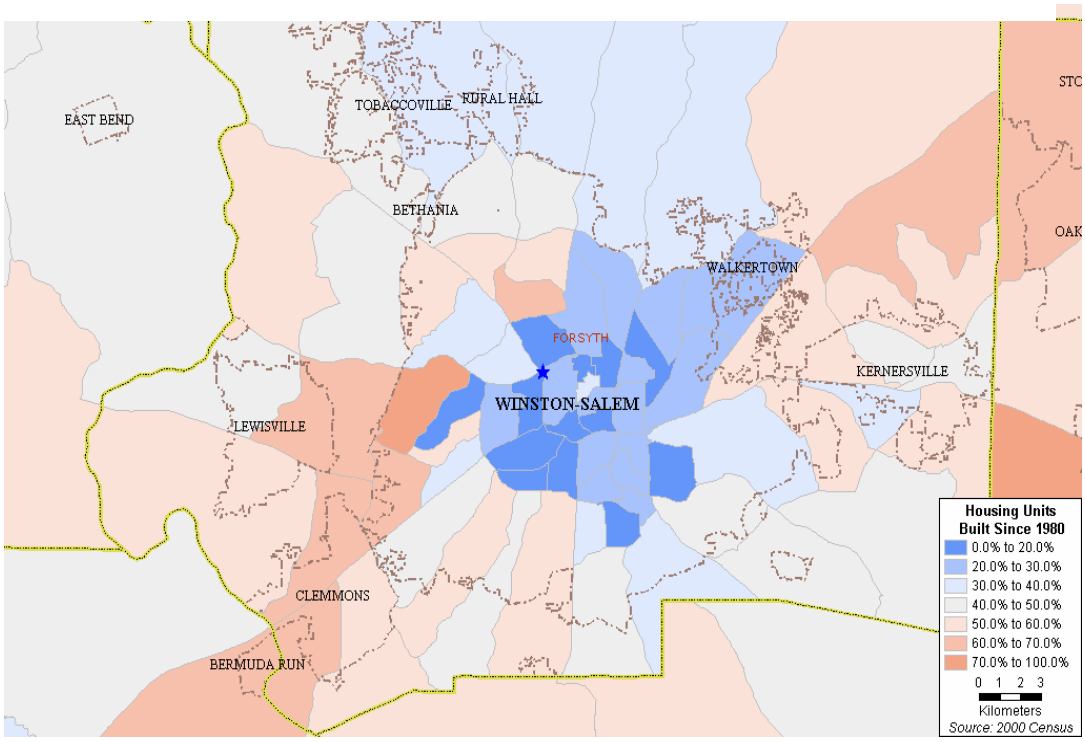
4.20.7.2 Analysis of Cumulative Effects

The growth expected to occur in Forsyth County between now and the year 2025, in conjunction with the improved access provided by the Northern Beltway and the construction of other anticipated transportation improvements, would result in additional pressure on several resource categories. Broadly described, these categories are communities, natural habitat, historic sites, water quality, and air quality. For the analysis of cumulative impacts, two general methodologies were employed. First, a countywide assessment was conducted comparing county-wide features and resources to the anticipated areas of high growth in the region under the East, West, and Full-Build Scenarios. A secondary analysis was conducted by focusing on those zones identified as having the highest increase in housing under each of the three scenarios. Those zones are depicted in **Figure 4-8** (Figure 7-1 from the *Indirect and Cumulative Impacts Analysis*, June 2005). Within each of these zones, specific resources are identified as being potentially impacted by the cumulative effects. Additional analysis was completed on the Dell Computer Manufacturing site located in the vicinity of the Union Cross Road/US 311 intersection and Interstate 40.

Communities. Forsyth County, like many of North Carolina's urban counties, is rapidly growing, and the pattern of growth can be categorized as low density suburban. In **Figure 4-9** below, the census tracts shaded blue indicate where more than 50 percent of the housing was built before 1980.

In the census tracts shaded in orange hues, more than 50 percent of the housing has been built since 1980. This figure shows a clear axis of growth west of Winston-Salem, north of I-40, and roughly parallel to Muddy Creek. This figure also shows that growth has begun to move northward along Muddy Creek as well as eastwards from Kernersville. As this growth occurs, existing rural farming communities will be converted to bedroom communities oriented towards Winston-Salem and newer development centers. All of the build scenarios for the Northern Beltway add incrementally to this change in neighborhood characteristics.

Figure 4-9. Forsyth County Housing Age
(Source: 2000 Census)



Also, in the Full-Build scenario, downtown Winston-Salem becomes more attractive for both jobs and housing, possibly due to the diversion of some traffic away from the city center and hence increasing roadway capacity and accessibility. At the same time, it should be noted that in no future case is growth forecasted to occur in these downtown zones; rather, the losses that are expected to occur in the future are less under the Build cases than the No-Build case. In this particular case there is potential that existing minority and disadvantaged communities in downtown Winston-Salem could be disrupted as older neighborhoods gentrify. To some degree this is happening now. Field reviews and interviews with local planning staff have indicated that there is a renewed interest in constructing residential units in the central business district of Winston-Salem.

Natural Habitat. As discussed in the Communities section, growth in Forsyth County has been most rapid along Muddy Creek and along I-40 to the west of town. Additionally, there is some growth along NC 66 running from US 52 through Walkertown and into Kernersville. In addition to converting farming communities to suburban bedroom communities this growth is changing the habitat from woodlands, fields, and pastures into suburban landscapes, office complexes, and shopping centers. These changes are reducing the natural habitat available to other species. However, each of the Build scenarios will fragment the habitat in the area by introducing an additional barrier to animal migration. This barrier will be most evident in western Forsyth

County, where the Beltway will divide the habitat along the Yadkin River from Muddy Creek. It will also be evident in northeastern Forsyth County, where the Beltway separates the Yadkin River Basin from the Dan River Basin.

Historic Sites. Forsyth County has a number of historic sites and districts either on or potentially eligible for the National Register of Historic Places. Many of these features are in the downtown area and will not face much additional development pressure that is out of character with existing land uses as a result of the construction of the Northern Beltway. The features most likely to face additional development pressure as identified by the accessibility analysis are: Bethania Historic District, the Dr. Beverly Jones House, and the John Jacob Schaub House. Additional historic areas located near interchanges with projected medium or high potential for growth development are:

- Todd House;
- Ploughboy Jarvis Farm;
- Alexander Hege House;
- Brookberry Farm;
- Doub Yarborough House;
- Community United Church of Christ;
- Pfafftown Historic District;
- John Henry Kapp Farm;
- Bethania Historic District;
- Kapp's Mill Miller's House;
- Thomas Jefferson Kapp House;
- Eugene Thomas Kapp House;
- John S. Shore Farm;
- Samuel B. Stauber House and Farm;
- Columbus Kapp House and Barn;
- Clayton Family Farm and Cemetery;
- Hammock Family Farm;
- Seaver's Gulf Station; and
- Wilson-Stockton House

Water Quality. There are several water supply watersheds in Forsyth County classified as either Water Supply Watershed III or Water Supply Watershed IV. Portions of the Eastern Section pass through a Water Supply Watershed III associated with Salem Lake. The Eastern Section Extension is on the border of a Water Supply Watershed III area associated with Abbott's Creek. The Western Section is located to the east of the Yadkin River Water Supply Watershed III area. Of these water supply watersheds, increased development pressure may occur within the Yadkin River watershed and the Salem Creek watershed on the western and eastern sides of Forsyth County, respectively. Various state and local regulations govern development within the different Water Supply Watersheds. These regulations typically limit the amount of allowable built-upon

area, require buffers around streams, and may require stormwater management controls depending upon their location in relationship to different watershed management areas.

There are four streams in Forsyth County that the North Carolina Department of Environment and Natural Resources - Division of Water Quality (DWQ) classifies as impaired waters (Section 303(d) streams). Three of these four streams, Muddy Creek, Salem Creek, and Reynolds Creek, may face additional development pressure if the Northern Beltway is built. The likely additional pressure is somewhat dependent upon the Beltway scenario that is built. For example, if only the Eastern section is built, then it is likely that there will be less development pressure along Muddy Creek.

In order to address water quality issues, NCDOT is preparing a water quality analysis in support of the Section 401 Water Quality Certification application. The results of this analysis could be used to assist NCDOT, NCDENR and local governments evaluate alternative methodologies to mitigate the direct and the indirect impacts of projects. Generally, increased impervious surface area increases runoff and sedimentation because of the reduced opportunity for infiltration.

Air Quality. The EPA agency lists Forsyth County as one of the North Carolina counties with air quality problems (nonattainment or maintenance areas for the National Ambient Air Quality Standards (NAAQS)). Specifically, Forsyth County is currently a maintenance area for the one-hour ozone standard[4] and for the carbon monoxide standard. The EPA has also declared Forsyth County nonattainment for the eight-hour ozone standard. For the one-hour ozone standard and for the CO standard, Forsyth County has valid transportation conformity determinations that show the transportation sector meeting established emission budgets until at least 2025. The Northern Beltway is included in the analysis supporting this determination.

Forsyth County is part of an Early Action Compact for the eight-hour ozone standard. Currently, Forsyth County is on track to comply with the eight-hour ozone standard in 2007. If Forsyth County meets these goals, then EPA will declare that the County is in attainment for both ozone standards.

The travel demand model used for the air quality conformity determination accounts for the cumulative effect of all transportation projects in the region. Therefore, the Northern Beltway, together with other projects in the region, is not expected to have an adverse cumulative impact on air quality.

[4] The one-hour ozone standard will apply in Forsyth County until the legal status of Early Action Compacts is determined.

DELL Computer Manufacturing and Related Projects. In September of 2005, DELL Computing completed construction on the first phase of a 189-acre site in the Alliance Science and Technology Park near the confluence of Interstate 40, US 311, and Union Cross Road. This 750,000-square-foot facility currently employs over 1,000 and is projected to employ 1,500 people within five years of its completion. The State of North Carolina and Winston-Salem/Forsyth County governments aggressively campaigned for the DELL facility to come to this site. Although the final location decision was an amalgam of factors that stressed the importance of in-kind and direct financial incentives, the siting of the facility was deemed worthy of additional analysis to ensure a complete assessment of the cumulative impacts that might potentially be attributable to the Northern Beltway projects.

To achieve a balanced and thorough economic impact assessment of the DELL siting, Karnes, a North Carolina-based consulting firm that typically performs economic analyses for private companies wishing to locate or expand operations in North Carolina, was contracted to conduct the assessment. Karnes produced four comparative case studies (three DELL plants and one BMW auto manufacturing/assembly plant) as well as conducting research into the DELL facility proposed in Forsyth County.

Karnes estimated that the DELL facility would have an additional job multiplier of 0.5, meaning that for every 10 employees hired by DELL, another five employees would be required to provide services and support. This translates into approximately 2,250 housing units; 39,260 square feet of retail space; 751,400 square feet of industrial space; and 39,600 square feet of office space for DELL and its suppliers.

Related issues include a large, proposed residential development being constructed in the same vicinity. Caleb's Creek is expected to have 3,000 units when completed. However, these homes are priced well outside of the price range of the average worker at the DELL facility, who is expected to earn an annual salary of about $28,000. Infrastructure projects that directly support the facility, such as the construction of DELL Boulevard from Union Cross Road to the facility and other minor roadway improvements, will service the anticipated truck and vehicle traffic expected due to the facility and additional jobs created by it.

The TAZ in which the DELL facility and Caleb's Creek are located were not predicted to be high growth areas in the original forecast for the year 2025. Given their proximity to the Eastern Section of the Northern Beltway (U-2579A), and the differences in housing or employment from the forecasts it was determined that a prudent course of action would be to treat the traffic analysis zones containing the DELL facility and the Caleb's Creek development as high impact traffic analysis zones for the purposes of the cumulative impacts analysis. Both zones are outside the municipal service area; however, both municipal water and municipal sewer service are available in these two zones. The closest known historic structure is the Wilson Stockton House near Kernersville Road. The TAZ in which Caleb's Creek is located is within a water supply

watershed; however, it is not within the critical area of the watershed. The most likely environmental impact of the two projects is habit fragmentation associated with converting vacant land to commercial or residential uses.

4.20.7.3 Mitigation Options

The responsibility for mitigating the effects of the Northern Beltway will fall primarily on local and state governments, with the participation of private sector developers. Ideally, there will be a concerted effort of local and state governments to partner with one another and with non-governmental stakeholders to minimize the negative aspects of growth.

Mitigation measures recommended for the stakeholders in this area include the following, and are not intended to be a comprehensive listing:

- Develop small area and interchange plans to assist communities in planning for growth and development in those areas that the Indirect and Cumulative Impacts analysis indicates may have the greatest potential for increased pressures to develop.
- Revise site design standards to minimize the effects of stormwater runoff, particularly in the area of parking and buffer requirements. Foster more cluster development by modifying local development ordinances to allow and encourage higher densities of development inside the parcel.
- Continue to assess and monitor the effects on air and water quality. Forsyth County is already part of an Early Action Compact, a policy-level attempt to coordinate efforts to voluntarily reduce emissions controlled under the Clean Air Act and amendments. In addition, additional quantitative water quality analysis is being performed in compliance with the requirements of Section 401 of the Clean Water Act.

4.20.7.4 Conclusions Regarding Indirect and Cumulative Impact Analyses

After evaluating the information available and conducting the analysis of the indirect and cumulative impacts, a number of conclusions were formulated. These must be tempered by the inherent uncertainty associated with future economic and policy conditions.

1. The underlying land-use pattern in Forsyth County is, and has been for several decades, a low-density suburban growth pattern characteristic of many urban areas in the Southeast. Winston-Salem/Forsyth County has made notable strides in managing this growth, particularly with consideration of preserving open space in outlying areas of the county.
2. The traffic analysis zones (TAZ) that are expected to face the greatest development pressures over the next 20 years (i.e. with the greatest projected increase in housing and employment)

do not vary regardless of whether the Northern Beltway or any of its segments are constructed. However, the pace of development may be slightly accelerated and the nature of the development may partially change as a result of the construction of the Northern Beltway at these high growth TAZs.

3. Building the Northern Beltway, or any of its individual segments, does not appreciably increase the amount of suburban type development in Forsyth County, although a greater variety of land uses will be attracted to future interchange locations. The greatest increase in land use in any TAZ that is attributable to the implementation of any build scenario is between three and five percent over the No-Build scenario. In some cases, these growth areas are being actively planned for by the community and are considered desirable changes over the No-Build case.
4. The Northern Beltway, in whole or in part, would have a small effect on the desirability of given tracts of land over other, similar tracts of land (tracts near the Beltway tend to have slight gains in total employment or housing relative to the No-Build Scenario).
5. Development, particularly commercial development, near the proposed interchanges is more likely in the Build cases than in the No-Build case. This is evident from the results of the gravity allocation model, research findings, and comparative case studies of other interchange areas across the State.
6. The FHWA's SMITE model, as modified, was used to provide an estimate of induced travel that may occur related to the Winston-Salem Northern Beltway. In 2025, induced travel for all reasonably foreseeable projects is estimated to be approximately 2.45 percent of total travel. Induced travel with only the Northern Beltway is approximately 1.05 percent. Based on this analysis, it can generally be concluded that the amount of induced travel resulting from construction of the Northern Beltway is not appreciable when examined as a portion of vehicle miles traveled throughout the region.

In summary, the effects attributable solely to the Northern Beltway projects are relatively small, but should be placed in an appropriate context with public policy, land available for conversion to higher-intensity uses, other public infrastructure projects, and market conditions. Cumulatively, the Northern Beltway in conjunction with other public and private projects places some additional pressures from induced development, induced travel, and encroachment-alteration effects on communities, natural habitat, and water quality. While the magnitude of these changes is difficult to quantify with certainty, the nature of the land use changes, the features that may be sensitive to change, and the locations most susceptible to indirect/cumulative effects have been identified. Local governments and stakeholder groups should be prepared for these changes, and be proactive in mitigating for their negative effects while maximizing positive benefits from the proposed Beltway projects.

4.21 CONSTRUCTION IMPACTS

Construction of any of the Detailed Study Alternatives may cause temporary adverse impacts to the local environment, including impacts to air quality, water quality, noise, and biotic communities. Construction impacts are generally short-term in nature and can be controlled, minimized, or mitigated through the use of *Best Management Practices* and standard NCDOT procedures. The No-Build Alternative would not generate any construction impacts.

Short-term impacts to adjacent land uses during construction, especially in built-up areas, would occur due to the movement of workers and materials through the area and construction activities. Construction noise and dust, as well as temporary disruption of traffic flow on local roads, may also affect residences, businesses, and farming operations in the vicinity of the project. Coordination between NCDOT and landowners regarding construction scheduling and access to the construction site and right of way would minimize any such disruptions.

Potential construction-related impacts are briefly summarized below.

Air Quality. Temporary degradation of the air quality in the project area would result from the construction of the project within any of the Detailed Study Alternatives. Initial clearing and grubbing would produce dust and exhaust emissions. Open burning, if allowed, also would contribute to local air pollution. The contractor would be responsible for controlling dust at the project site and at areas affected by the construction, including unpaved secondary roads, haul roads, access roads, disposal site, borrowed material sources, and production sites. 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
- Using covered haul trucks

Emissions from construction equipment are regulated by federal standards. Any burning of cleared materials would be conducted in accordance with applicable state and local laws, regulations and ordinances and the regulations of the North Carolina SIP for air quality, in compliance with 15 NCAC 2D.0520. Care would be taken to ensure burning occurs under constant supervision, at the greatest practical distance from homes, and not when weather conditions could create hazards.

Mitigating for Construction MSAT Emissions. Construction activity may generate a temporary increase in MSAT emissions. Project-level assessments that render a decision to pursue construction emission mitigation will benefit from a number of technologies and operational practices that should help lower short-term MSATs. In addition, the SAFETEA-LU has emphasized a host of diesel retrofit technologies in the law's CMAQ provisions - technologies that are designed to lessen a number of MSATs.[5]

Construction mitigation includes strategies that reduce engine activity or reduce emissions per unit of operating time. Operational agreements that reduce or redirect work or shift times to avoid community exposures can have positive benefits when sites are near vulnerable populations. For example, agreements that stress work activity outside normal hours of an adjacent school campus would be operations-oriented mitigation. Also on the construction emissions front, technological adjustments to equipment, such as off-road dump trucks and bulldozers, could be appropriate strategies. These technological fixes could include particulate matter traps, oxidation catalysts, and other devices that provide an after-treatment of exhaust emissions. The use of clean fuels, such as ultra-low sulfur diesel, also can be a very cost-beneficial strategy.

The EPA has listed a number of approved diesel retrofit technologies; many of these can be deployed as emissions mitigation measures for equipment used in construction. This listing can be found at *www.epa.gov/otaq/retrofit/retroverifiedlist.htm*.

Noise. Heavy construction equipment and blasting operations would generate noise and vibration. Although the Detailed Study Alternatives traverse primarily low density residential areas, neighboring communities would be temporarily impacted. The duration and level of noise differs with each phase of construction. Typically the first two phases, ground clearing and excavation, generate the highest noise levels. Noise generated by construction equipment, including trucks, graders, bulldozers, concrete mixers, and portable generators can reach noise levels of 67 dBA to 98 dBA at a distance of 50 ft.

The NCDOT specifications require the contractor to limit noise levels to 80 dBA Leq in noise sensitive areas adjacent to the project. NCDOT may also monitor construction noise and require abatement where limits are exceeded. NCDOT also can limit work that produces objectionable noise during normal sleeping hours.

Water Quality. Erosion and sedimentation caused by construction activities could effect drainage patterns and water quality. In accordance with the North Carolina Sedimentation Pollution Control Act (15A NCAC 4B.0001-.0027), an erosion and sedimentation control plan

5 SAFETEA-LU, Public Law 109-59, August 10, 2005

must be prepared for land-disturbing activities that cover one or more acres to protect against runoff from a ten-year storm.

Prior to construction, an erosion and sedimentation plan would be developed for the selected alternative in accordance with the NCDENR publication *Erosion and Sediment Control Planning and Design* and the NCDOT's *Best Management Practices for Protection of Surface Waters*. These Best Management Practices include, but are not limited to the following activities:

- Using berms, dikes, silt barriers, and catch basins
- Vegetating or covering disturbed areas
- Conforming with proper clean-up practices

NCDOT also has *Standard Specifications* that require proper handling and use of construction materials. The contractor would be responsible for taking every reasonable precaution throughout construction of the project to prevent pollution of any body of water. Pollutants such as chemicals, fuels, lubricants, bitumens, raw sewage, and other harmful wastes shall not be discharged into any body of water. The contractor also shall be responsible for preventing soil erosion and stream siltation. Contractors shall not ford streams with mechanical equipment unless construction is required in the stream bed, including stream rerouting, channel improvements, and culvert construction.
Excavated materials would not be stockpiled or disposed of adjacent to or in areas where stormwater runoff may cause erosions of the material into surface waters. If material storage in these areas is unavoidable, the contractor must implement measures to prevent runoff. Contractors also must provide sanitary facilities for employees during project construction.

Biotic Communities. Construction, staging, and stockpiling operations may result in the temporary disruption of the resident wildlife population. The clearing of habitats, human activity, and noise from construction operations may result in the displacement of mobile wildlife. Non-mobile species would be lost as habitat is converted to construction areas.

Impacts to biotic communities would be minimized as much as possible by restricting land clearing and construction operations within the project's right of way. NCDOT would encourage the contractor to locate off-site staging and stockpiling to disrupt the least amount of natural habitat area. These areas would be revegetated once construction activities are complete, thus replacing habitat for some species.

Construction Waste. All construction waste material generated during clearing, grubbing, and other construction phases would 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 would be collected and disposed of at local landfill locations.

Utility Service. The proposed project would require some adjustment, relocation, or modification to existing utilities. Any disruption to utility service during construction would be minimized by phased adjustments to the utility line. All modifications, adjustments, or relocations would be coordinated with the affected utility company.

Maintenance of Traffic. Maintenance of traffic and sequencing of construction would be planned and scheduled so as to minimize traffic delays within the project corridor. Maintenance and protection of traffic in conjunction with construction activities associated with this project would be prepared in accordance with the latest edition of the *Manual of Uniform Traffic Control Devices* and roadway standards of NCDOT. Signs would be used as appropriate to provide notice of road closures and other pertinent information to the traveling public. Advance notice through the local news media would be made to alert the public of traffic restrictions and construction related activities.

Truck traffic in the project area would increase during construction. Access to construction staging areas and the construction sites may require temporary access roadways. The traffic plan developed during the final engineering design phase will define designated truck routes and parking areas for construction vehicles.

4.22 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Irreversible and irretrievable commitments are those impacts resulting from the construction and maintenance of a Build alternative that cannot be mitigated or replaced in the future. Construction of any of the proposed Build alternatives would require certain irreversible and irretrievable commitment of resources, including the following:

- Lands within the selected right of way would be converted from their present use to that of a transportation use. Natural resources committed include portions of wetlands and stream drainages lost to culvert construction and/or filling for the Build alternative. Soils also would be permanently disturbed at construction sites. Other resources that would be required to construct a Build alternative include asphalt, aggregate, sand, cement, and steel.
- Other resources, including considerable amounts of non-renewable resources (fossil fuels) would be expended to construct and maintain the proposed project.
- Economic and fiscal resources, including a large commitment of labor during the construction phases, also would be committed for the Build Alternatives. Construction would require a substantial one-time expenditure of both State and Federal funds that are not retrievable. These commitments also would be required for maintenance of the facility in the long-term.

4.23 RELATIONSHIP BETWEEN SHORT-TERM IMPACTS AND LONG-TERM BENEFITS

The most disruptive local short-term impacts associated with the proposed Projects R-2247, U-2579, and U-2579A would occur during land acquisition and project construction. The short-term use of the human environment and of human, socioeconomic, cultural, and natural resources contributes to the long-term productivity of the study area. Most short-term construction-related impacts would occur within or in proximity to the proposed right of way.

Existing homes, farms, and businesses within the selected alternatives' right of way would be displaced. However, adequate replacement housing, land, and space are available for homeowners, tenants, and business owners within the study area (see **Section 4.2.1**). Improved access within the study area would contribute to long-term residential and business growth.

Construction activities would create short-term air quality impacts, such as dust due to earthwork, road improvements, and exhaust from construction vehicles. Short-term noise impacts would be unavoidable due to use of heavy equipment. Air and noise abatement measures would be used by NCDOT to minimize these short-term impacts during construction.

The construction phase also would result in beneficial impacts to the study area, including a temporary increase in employment, income, and tax base in the study area. This would be followed by the long-term supplement to the job market from additional maintenance crews and better access to the economic resources in the area.

Short-term visual impacts would occur in the vicinity of the construction corridor. The NCDOT mitigation measures, such as reducing slope cuts outside necessary road widths, reducing vegetation removal, leaving native vegetation screens in place, and minimizing alteration of scenic ridge lines and slopes, would be used to reduce long-term visual resources impacts.

The local, short-term impacts and use of resources by the proposed action would be consistent with the maintenance and enhancement of long-term productivity. Construction of the proposed Winston-Salem Northern Beltway would add a vital link to the long-range transportation system for the region. The project is consistent with the long-range transportation goals and objectives of the *NCDOT Transportation Improvement Program*, the *2025 Multi-Modal Long Range Transportation Plan*, and the *Legacy Plan*. It is anticipated that the roadway would enhance long-term access opportunities in Forsyth County and would support local and regional commitments to transportation improvement and economic vitality.

4.24 SUMMARY OF ENVIRONMENTAL CONSEQUENCES

This section summarizes the combined direct environmental consequences for Projects R-2247, U-2579, and U-2579A discussed in **Sections 4.1 through 4.23.**

Table 4-88 summarizes the various quantitative impacts to the environment for the Project R-2247 Preferred Alternative, U-2579 Preferred Alternative, and U-2579A Detailed Study Alternatives. **Table 4-89** summarizes the various quantitative impacts to the environment for the Preferred Alternatives for Projects R-2247, U-2579, and U-2579A.

Issues that were not quantified in the **Table 4-88** are summarized below.

Land Use and Transportation Planning (Section 4.1). Projects R-2247, U-2579, and U-2579A are consistent with state and local transportation plans in the area.

Public Safety (Section 4.2.3). Projects R-2247, U-2579, and U-2579A would have an overall beneficial impact on the level of public safety in the study area. Project U-2579 crosses the southern corner of Gospel Light Baptist Church and Christian School, but is not expected to have any impact on pedestrians or drivers accessing the church and school site. Project U-2579A would temporarily detour Sedge Garden Road, which would have a minor, temporary impact on Sedge Garden Elementary School. This detour would impact approximately 0.35 acres of school property, but is not anticipated to negatively affect school operations. The southern end of the realigned road is located between the existing access points of the circular driveway in front of the school, crossing the north exit, which would temporarily impact drivers utilizing that driveway during construction of the new road.

Environmental Justice (Section 4.2.5). None of the Detailed Study Alternatives for Projects R-2247, U-2579, or U-2579A are expected to have an adverse or disproportionate impact on minority and/or low-income populations.

Visual Impacts (Section 4.6). Projects R-2247, U-2579, and U-2579A are expected to have minimal visual impacts to the area. Although the roadway would diminish the rural, pastoral atmosphere of the area, the growth plan described in *The Legacy Plan* indicates that much of the Project R-2247 study area will be changing from the existing rural atmosphere to one of a more developed, suburban character due to anticipated residential development. The roadway probably would not be visible from areas other than the immediate vicinity due to the natural change in elevation, the extensive areas of cut in areas out of the floodplain, and tall trees in the area.

Table 4-88: Combined Direct Environmental Consequences – Projects R-2247, U-2579, and U-2579A

Environmental Issue	Project R-2247 and Project U-2579 Preferred Alternatives PLUS Project U-2579A Detailed Study Alternatives						
	N2-S1 (Preferred Alternative)	**N1-S1**	**N1-S2**	**N2-S1 (Without Interchange)**	**N2-S2**	**N3-S1**	**N3-S2**
		With (Without) Kernersville Road Interchange			**With (Without) Kernersville Road Interchange**		
Length (miles)	**34.2**	34.2	34.4	34.2	34.4	34.1	34.3
Estimated Costs[7]							
Construction Costs (millions $)	**785.7**	808.5 (805.5)	796.5 (792.5)	809.5	803.5 (803.5)	793.5 (789.5)	795.5 (794.5)
Right-of-Way and Utility Costs (millions $)	**289.9**	298.6 (290.2)	310.7 (302.3)	290.2	308.3 (306.1)	293.6 (287.0)	309.6 (302.9)
Total Costs (millions $)	**1,075.6**	1,107.1 (1,095.7)	1,107.2 (1,094.8)	1,099.7	1,111.8 (1,109.6)	1,087.1 (1,076.5)	1,105.1 (1,097.4)
Relocation Impact Summary[8]							
Residences (total)	**1,019**	985 (963)	1,021 (999)	939	1,009 (1,006)	948 (938)	1,105 (1,005)
Owner-occupied	**894**	888 (867)	922 (901)	844	911 (909)	849 (839)	914 (904)
Tenant-occupied	**125**	97 (96)	99 (98)	95	98 (97)	99 (99)	101 (101)
Minority	**155**	171 (171)	173 (168)	169	182 (172)	170 (169)	191 (170)
Businesses	**60**	50 (36)	47 (34)	42	49 (40)	46 (35)	44 (33)
Community Services and Facilities Impact Summary							
Schools	**1**[4,5]	1[4,5]	1[4,5]	1[4,5]	1[4,5]	0	0
Parks & Recreational Facilities	**0**	0	0	0	0	0	0
Churches & Cemeteries	**8**[5,9]	8[5,9]	8[5,6,9]	8[5,9]	8[5,6,9]	8[5,9]	8[5,6,9]
Other Community Facilities	**0**	0	0	0	0	0	0
Utilities[1]							
Electrical Easement Crossings	**9**	9	8	9	8	9	8
Electrical Substations	**0**	0	0	0	0	0	0
Major Gas Mains	**2**	2	2	2	2	2	2
Directional Radio Antenna Arrays	**0**	0	0	0	0	0	0

Table 4-88: Combined Direct Environmental Consequences – Projects R-2247, U-2579, and U-2579A

Environmental Issue	Project R-2247 and Project U-2579 Preferred Alternatives PLUS Project U-2579A Detailed Study Alternatives						
	N2-S1 (Preferred Alternative)	N1-S1	N1-S2	N2-S1 (Without Interchange)	N2-S2	N3-S1	N3-S2
		With (Without) Kernersville Road Interchange			With (Without) Kernersville Road Interchange		
Railroad Crossings	**3**	3	3	3	3	3	3
Historic Architectural and Archaeological Resources Impact Summary							
# of Archaeological sites requiring preservation in place[2]	**0**	0	0	0	0	0	0
# of Historic Resources with No Adverse Effect	**4**	4	4	4	4	4	4
# of Historic Resources with Adverse Effect	**1**	1	1	1	1	1	1
Section 4(f)/6(f) Resources Impact Summary							
Section 4(f) Resources	**0**	0	0	0	0	0	0
Section 6(f) Resources	**0**	0	0	0	0	0	0
Air Quality Impact Summary							
Intersections Exceeding Carbon Monoxide NAAQS	**0**	0	0	0	0	0	0
Noise Impact Summary							
# of Impacted Receptors – with mitigation in place	**269**	755 (768)	721 (730)	809	742 (730)	792 (786)	713 (707)
Hazardous Materials Impact Summary							
Number of Potentially Impacted Hazardous Materials Sites	**19**	19 (16)	19 (16)	15	19 (15)	22 (17)	22 (17)
Major Drainage Structure Summary							
Number of Bridges over Streams	**18**	17	17	18	18	17	17
Number of Crossings with Major Culverts (> 72 inches in diameter)	**37**	32	34	37	37	31	33
Floodways and Floodplains Impact Summary							
Floodplains/Floodways (# of crossings)	**22**	22	22	22	22	22	22
Number of Crossings Requiring Floodway Modification	**13**	13	13	13	13	13	13
Biotic Communities Impact Summary (acres)							
Piedmont/Low Mountain Alluvial Forest	**106**	106	80	106	82	108 (107)	83 (82)

Table 4-88: Combined Direct Environmental Consequences – Projects R-2247, U-2579, and U-2579A

Environmental Issue	Project R-2247 and Project U-2579 Preferred Alternatives PLUS Project U-2579A Detailed Study Alternatives						
	N2-S1 (Preferred Alternative)	N1-S1	N1-S2	N2-S1 (Without Interchange)	N2-S2	N3-S1	N3-S2
		With (Without) Kernersville Road Interchange			With (Without) Kernersville Road Interchange		
Piedmont Bottomland Forest	**12**	13 (12)	13 (12)	11	12 (11)	10	10
Dry Oak-Hickory Forest	**63**	61	60	63	61	59	58
Dry Mesic Oak-Hickory Forest	**581**	582	577	581	576	572	577
Mesic Mixed Hardwood Forest	**174**	172	141	174	146	195 (189)	166 (160)
Maintained/Disturbed	**1,160**	1,146 (1,123)	1,149 (1,127)	1,145	1,165 (1,149)	1,157 (1,137)	1,156 (1,136)
Agriculture	**369**	376	383	369	380	378 (375)	389 (385)
Cut-Over	**59**	59	59	59	59	59	59
Successional Pine Forest	**1**	1	10	1	10	1	10
Pine Plantation	**77**	77	77	77	77	77	77
Acres of Prime, Statewide, and Local Important Farmland	**1,380**	1,380	1,392	1,380	1,392	1,381	1,392
Jurisdictional Issues Summary							
Acres of Wetlands Impacted	**7.48**	7.50	7.12	7.48	7.25	7.74	7.36
Number of Wetland Crossings	**45**	44	42	45	43	47	45
Acres of Ponds Impacted	**24.71**	26.91	21.92	24.71	22.65	27.52	22.53
Number of Pond Crossings	**23**	20	18	23	19	19	17
Total Linear Feet of Impacted USACE Mitigatable Streams	**35,665**	39,304	37,906	35,665	38,441	42,283 (41,614)	40,885 (40,216)
Total Linear Feet of Relocated Streams	**6,189**	3,914	3,914	6,189	3,914	3,914	3,914
Number of Stream Crossings	**120**	116	116	120	118	119	119
Protected Species Impact Summary							
Bog Turtle (*Clemmys muhlenbergii*)[3]	**N/A**	N/A	N/A	N/A	N/A	N/A	N/A
Red-Cockaded Woodpecker (*Picoides borealis*)	**No Effect**	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect
Small-Anthered Bittercress (*Cardamine micrantha)*	**No Effect**	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect

Table 4-88: Combined Direct Environmental Consequences – Projects R-2247, U-2579, and U-2579A

Environmental Issue	Project R-2247 and Project U-2579 Preferred Alternatives PLUS Project U-2579A Detailed Study Alternatives						
	N2-S1 (Preferred Alternative)	N1-S1	N1-S2	N2-S1 (Without Interchange)	N2-S2	N3-S1	N3-S2
		With (Without) Kernersville Road Interchange			With (Without) Kernersville Road Interchange		

Unless designated by () as without Kernersville Road interchange, Project U-2579A Detailed Study Alternatives are the same with or without the interchange. The Project U-2579A Preferred Alternative includes an interchange at Kernersville Road.

Construction limits (slope stakes) of the preliminary engineering design for the R-2247 Preferred Alternative, the U-2579 Preferred Alternative, and the Project U-2579A Detailed Study Alternatives were used to calculate impacts except for relocations, which were based on right-of-way limits. Impacts were updated based on revised preliminary engineering designs for the Project R-2247, U-2579, and U-2579A Preferred Alternatives. Non-preferred Detailed Study Alternatives for Project U-2579A were not updated since the 2004 SFEIS/SDEIS.

[1] Interchange ramp design may cause multiple crossings of the utility corridor at locations of planned interchanges. Only one crossing is noted in the table for each of these locations.
[2] Site 31FY1053(**) in the Project U-2579 study area requires further study.
[3] This species is not biologically endangered or threatened and is not subject to Section 7 consultation.
[4] Sedge Garden Elementary School; temporary impact from Sedge Garden Road detour.
[5] Impact to property does not impact school or church facilities.
[6] Piedmont Memorial Gardens; impact to property, but not to existing graves.
[7] Based on 2005-2006 costs for Projects R-2247, U-2579, and U-2579A Preferred Alternatives; and 2003 costs for Project U-2579A non-preferred Detailed Study Alternatives.
[8] Based on 2005 relocation reports for U-2579 and U-2579A Preferred Alternative, and 2003 relocation reports for R-2247 Preferred Alternative and U-2579A non-preferred Detailed Study Alternatives.
[9] Pfafftown Baptist Church - impacts to parking lot and one outbuilding, but no impact to the church itself.

Mineral Resources (Section 4.10). No known mines or quarries are located in the immediate vicinity of the project study area. Therefore, the project would not adversely impact such resources through conversion of their existing land uses.

There are two Forsyth County rock quarries and numerous concrete plants located throughout the county. With a ready source for these materials, construction of Projects R-2247, U-2579, and U-2579A is not expected to cause a local shortage of construction materials. No other known mineral resources would be impacted as a result of the proposed projects.

Soils (Section 4.11). The soils within the project study area are composed of four main associations: Pacolet-Cecil, Madison-Pacolet, Chewacla-Wehadkee-Congaree, and Wedowee-Louisburg. Soil limitations can be overcome through proper engineering design, including the incorporation of techniques such as soil modification, appropriate choice of fill material, use of non-corrosive subgrade materials, and design of drainage structures capable of conveying estimated peak flows. Decisions regarding soil limitations and methods to overcome them would be determined during final design.

Farmland (Section 4.12). No significant impacts to farmland would occur under any of the Detailed Study Alternatives for Projects R-2247, U-2579, or U-2579A, whether constructed in whole or in part.

Water Quality (Section 4.13). Stormwater runoff rates likely would increase slightly due to the increase in impervious surface area. This is an unavoidable, long-term impact resulting from construction of Projects R-2247, U-2579, and U-2579A in whole or in part. The proposed action also has the potential to temporarily degrade the quality of water in the surrounding streams as a result of soil erosion and sedimentation during construction. Implementation of NCDOT's *Best Management Practices for the Protection of Surface Waters* would minimize these impacts. Quantitative water quality modeling would be conducted for the selected alternatives as part of the Section 401 Water Quality Certification process.

Indirect and Cumulative Impacts (Section 4.20). The methods described in the *NCDOT Indirect and Cumulative Impact Guidance Manuals (Volumes I and II)* were followed to assess the indirect and cumulative impacts of the Winston-Salem Northern Beltway. Four analysis scenarios were chosen for the indirect and cumulative impacts assessment of the Winston-Salem Northern Beltway. These are listed below:

- No-Build
- Build West scenario (Western Section only)
- Build East scenario (Eastern Section and Eastern Section Extension only)
- Full Build Northern Beltway (Projects R-2247, U-2579, and U-2579A).

The time frame for the analysis is the year 2025. The overall study area for the indirect and cumulative impact evaluation is Forsyth County. Potential changes to general land use, accessibility, and development potential/attractiveness were evaluated in this study area. Traffic Analysis Zones (TAZs) used in the Piedmont Triad Regional Traffic Model were used as the scale for analysis.

Overall conclusions of the indirect and cumulative impacts assessments are summarized below.

- The underlying land use pattern in Forsyth County is a low-density pattern characteristic of many urban areas in the Southeast. Winston-Salem/Forsyth County has made notable strides in managing this growth, particularly with consideration of protecting open space in outlying areas of the county.
- The TAZs that are expected to face the greatest development pressures over the next 20 years do not vary regardless of whether the Northern Beltway or any of its segments are constructed. However, the pace of development may be accelerated and the nature of the development may change partially as a result of the construction of the Northern Beltway, in whole or in part.
- The greatest change in growth in any traffic analysis zone attributable to the implementation of any build scenario is between three and five percent over the No-Build scenario. In some cases, these growth areas are being actively planned for by the community and are considered desirable changes over the No-Build scenario.
- The Northern Beltway, in whole or in part, would have a small effect on the desirability of some tracts of land over other, similar tracts of land. Tracts near the Northern Beltway would tend to have slight gains in total employment or housing relative to the No-Build scenario.
- Development, particularly commercial development, near the proposed Northern Beltway interchanges is more likely to occur in the Build scenarios than in the No-Build scenario.
- FHWA's SMITE model was used to provide an estimate of induced travel that may occur related to the Winston-Salem Northern Beltway**.** In 2025, induced travel for all reasonably foreseeable projects in the study area is approximately 5.6 percent of total travel. Induced travel with only the Northern Beltway is approximately 1.3 percent. Based on this analysis, it can generally be concluded that the amount of induced travel resulting from the Northern Beltway is not appreciable when examined as a portion of the vehicle miles traveled throughout the region.

In summary, the effects attributable solely to the Northern Beltway projects (Projects R-2247, U-2579, and U-2579A) are relatively small, but should be placed in an appropriate context with public policy, available land for conversion to higher-intensity uses, other public infrastructure projects, and market conditions.

Cumulatively, the Northern Beltway, in conjunction with other public and private projects, places some additional pressures from induced development, induced travel, and encroachment-alternation effects on communities, natural habitat, and water quality. While the magnitude of these changes is difficult to quantify with certainty, the nature of the land use changes, the features that may be sensitive to change, and the locations most susceptible to indirect/cumulative effects have been be identified. Local governments and stakeholder groups should be prepared for these changes, and be proactive in mitigating for their negative effects while maximizing positive benefits from the proposed Beltway projects.

4.25 REQUIRED PERMITS AND ACTIONS

Construction of all or part of the Winston-Salem Northern Beltway would result in several activities requiring environmental regulatory permits from state and federal agencies. A list of these permits, organized by issuing agency, is provided below. NCDOT would obtain all necessary permits prior to construction.

4.25.1 Required Permits

United States Army Corps of Engineers

Section 404 Permit. A permit from the US Army Corps of Engineers (USACE) is required for any activity in water or wetlands that would discharge dredged or fill materials into Waters of the United States and adjacent wetlands. To obtain permit approval, impacts to wetlands must be mitigated through avoidance, minimization, and compensation measures in accordance with the *Memorandum of Agreement Between the Environmental Protection Agency and the Department of the Army Concerning the Determination of Mitigation Under the Clean Water Act Section 404(b)(1) Guidelines* (February 1990). Additional policy and guidance has been established through *An Interagency Agreement Integrating Section 404/NEPA* (May 1997) which is usually referred to as the NEPA/404 Merger Agreement.

Authority. Federal Pollution Control Act Amendments of 1972 and Section 404 of the Clean Water Act of 1977. Regulations promulgated in 33 CFR Part 323.

United States Fish and Wildlife Service

Section 404 Permit Review. The US Fish and Wildlife Service's (USFWS) responsibilities include review of Section 404 permits. The USFWS provides recommendations to the USACE on how impacts to fish and wildlife resources and habitats can be minimized.

Authority. Endangered Species Act of 1973, Section 7.

North Carolina Department of Environment and Natural Resources – Division of Water Quality

Section 401 Water Quality Certification. Any activity which may result in discharge to Waters of the United States requires a certification that the discharge will be in compliance with applicable state water quality standards. A US Army Corps of Engineers Section 404 permit and a water quality certification may be applied for simultaneously.

Authority. North Carolina General Statute 143, Article 21, Part 1. Regulations promulgated in 15A NCAC 2H and 2B.

National Pollutant Discharge Elimination System (NPDES) Permit. A permit is required for projects involving sewer systems, treatment works, disposal systems, and certain stormwater runoff that could result in a discharge to surface waters. The State has the authority to administer the national NPDES program for projects in North Carolina.

Authority. North Carolina General Statute 143, Article 21, Part 1. Regulations promulgated in 15A NCAC 2H.0100.

North Carolina Department of Environment and Natural Resources – Division of Land Quality

Soil and Erosion Control Plan. Persons conducting land-disturbing activity shall take all reasonable measures to protect all public and private property from damage caused by such activities. Pursuant to GS 112A-57(4) and 113A-54(d)(4), an erosion and sedimentation control plan must be both filed and approved by the agency having jurisdiction.

Authority. North Carolina Administrative Code, Title 15A. Department of Environment and Natural Resources Chapter 4. 15A NCAC 04B .0101

North Carolina Department of Environment and Natural Resources – Division of Air Quality

Burn Permit. Any burning done during the construction of the proposed project would be done in accordance with applicable local laws and ordinances and regulations of the North Carolina State Implementation Plan for air quality in accordance with 15 NCAC 2D.0520.

Authority. Regulations promulgated in 15 NCAC 2D.0520.

4.25.2 Subsequent Actions

The approval of this Supplemental FEIS/FEIS does not complete the project implementation process. The following is a summary of actions, events, and studies to be completed prior to project construction. Coordination with resource agencies will be maintained throughout the entire process. Items indicated as subsequent actions in the SFEIS/SDEIS that have been performed include the public hearing, review and evaluation of comments, and selection of the Least Environmentally Damaging Practicable Alternative/Preferred Alternative. In addition, preliminary designs have been refined to minimize environmental impacts, particularly to streams and wetlands. Some service road studies have been performed, and others will be performed during final design.

This document will be circulated to environmental agencies and the public for review and comment. Then, the following studies and actions will be completed to advance the project through Concurrence Points 4B (30 Percent Hydraulic Design) and 4C (100 Percent Hydraulic Design) of the NEPA/Section 404 merger process.

After approval of this environmental document, a Record of Decision (ROD) will be published. Following the ROD, a Design Public Hearing will be held to receive public comments on the refined preliminary design for the selected alternative.

The final roadway design plans will be prepared, taking into consideration all public and agency comments received on the preliminary designs and the next environmental document. The following studies will be conducted as a part of the final design process.

- During the permitting phase of the project, NCDOT will investigate on-site mitigation opportunities throughout the area. Off-site mitigation for the project is being implemented by the Ecosystem Enhancement Program
- Hazardous materials will be conducted to further review sites which would be impacted.

- Drainage and hydrological studies to identify and design major drainage structures and coordination with FEMA and the Forsyth County Flood Administrator.
- Traffic control plans will be developed to facilitate access during the construction phase.
- Surveys for wells within and adjacent to the proposed right-of-way limits will be conducted.
- Noise analyses based on updated traffic and detailed design plans will be conducted to evaluate whether or not potential noise barriers are feasible and reasonable.
- Geotechnical investigations will be conducted to recommend techniques and materials to overcome any soil limitations along the selected alternative.
- Project right-of-way limits will be finalized.

Other actions which must be completed prior to the start of project construction include, but are not limited to the following:

- Preparation of an erosion control plan incorporating the NCDOT *Best Management Practices for Protection of Surface Waters*.
- Coordination with municipalities and utilities for relocation and reconfiguration of utility systems.
- Implementation of the Relocation Assistance Program.
- Approval of all required permits and certifications as outlined in **Section 4.25.1**.

CHAPTER 5

Chapter 5 LIST OF AGENCIES, ORGANIZATIONS, AND PERSONS TO WHOM COPIES OF THE STATEMENT ARE SENT

Federal Agencies

US Environmental Protection Agency
US Department of Transportation
US Department of the Interior
US Department of Agriculture
US Department of Health and Human Service, Office of Environmental Affairs
Federal Railroad Administration
Federal Emergency Management Agency
Federal Aviation Administration Advisory Council on Historic Preservation
Ecology and Environmental Conservation Office
US Geological Survey

Regional Offices

US Environmental Protection Agency
Department of Housing and Urban Development
US Army Corps of Engineers
US Fish and Wildlife Service
Federal Emergency Management Agency
Federal Energy Regulatory Commission
General Services Administration

State Agencies

North Carolina Department of Human Resources
North Carolina Department of Environment and Natural Resources
North Carolina Wildlife Resources Commission
North Carolina Department of Cultural Resources
North Carolina Department of Public Instruction
North Carolina Department of Commerce – Travel and Tourism Division
North Carolina Department of Economic and Community Development
State Clearinghouse

Local Governments and Agencies

Chairman, Forsyth County Commissioners
Manager, Forsyth County
Mayor, Winston-Salem City Council
City of Winston-Salem Department of Transportation
Winston-Salem/Forsyth County Urban Area Metropolitan Planning Organization
City-County Planning Board (Winston-Salem/Forsyth County)
Manager, City of Winston-Salem
Town of Kernersville
Town of Bethania
Town of Walkertown
Town of Rural Hall
Village of Tobaccoville
Town of Lewisville
Village of Clemmons

Other

Piedmont Area Regional Transit
Norfolk Southern Corporation
North Carolina Alliance for Transportation Reform
Friends of Forsyth
Terris, Pravlik & Millian, LLP

CHAPTER 6

Chapter 6 COORDINATION AND PUBLIC INVOLVEMENT

This chapter provides a summary of the inter-agency coordination and public involvement efforts for Projects R-2247, U-2579, and U-2579A of the Winston-Salem Northern Beltway project.

6.1 AGENCY COORDINATION

6.1.1 Project R-2247

6.1.1.1 Agency Coordination on Project R-2247 Occurring Before or at the Time of the 1996 Project R-2247 FEIS Publication and Record of Decision

In accordance with the implementation procedures of the National Environmental Policy Act (NEPA) and North Carolina Department of Transportation policy, which require early coordination with and comment from appropriate federal, state, and local agencies, the Federal Highway Administration published a Notice of Intent (NOI) in the Federal Register on August 22, 1991 (1996 Project R-2247 FEIS Section 7.0, page 7-1).

After the project team selected alternatives for detailed environmental and engineering analyses for Project R-2247, coordination with appropriate agencies continued with a formal request for comments on impacts of the project. A project scoping letter, which described the detailed study alternatives for Project R-2247, was circulated in January 1991 to the federal, state, and local agencies officials listed below. Agencies identified below with an asterisk responded to the scoping letter. Those identified with a pound sign (#) attended the Interagency Coordination Meeting in April 1992.

- FEDERAL AGENCIES
  - US Advisory Council on Historic Preservation
  - US Army Corps of Engineers, Wilmington District
  - * US Department of Agriculture, Soil Conservation Service
  - US Department of Health and Human Services
  - US Department of the Interior
  - * # Fish and Wildlife Service
  - Fish and Wildlife Enhancement
  - Endangered Species Field Station, Asheville, NC
  - * Bureau of Mines
  - US Environmental Protection Agency, Region IV
  - US Geological Survey

- STATE AGENCIES

	NC Department of Administration
	State Clearinghouse
	NC Department of Cultural Resources
* #	Division of Archives and History
	NC Department of Public Instruction
	Division of School Planning
*	Winston-Salem/Forsyth County Schools
	NC Department of Environment, Health, & Natural Resources (now NC Department of Environment and Natural Resources)
*	Division of Environmental Health
* #	Division of Environmental Management (now Division of Water Quality)
*	Division of Land Resources
* #	Division of Forest Resources
*	Division of Water Resources
* #	Wildlife Resources Commission
*	Natural Heritage Program

- LOCAL AGENCIES OR OFFICIALS

	Forsyth County Board of Commissioners
*	Historic Properties Commission of Winston-Salem
	Mayor of Winston-Salem
*	Northwest Piedmont Council of Governments
	Winston-Salem Board of Aldermen

- SPECIAL INTEREST GROUPS

*	Sierra Club

6.1.1.2 Agency Coordination on Project R-2247 Occurring after the 1996 Project R-2247 FEIS and Record of Decision

A new NOI was published for this combined supplemental document on March 17, 2004 (see **Appendix D.7**). A revised NOI for this document was published on September 13, 2004 in the Federal Register (see **Appendix D.7**).

Agency coordination regarding Project R-2247 occurring after the 1996 Project R-2247 FEIS and Record of Decision included Section 106 coordination with the Historic Preservation Office (HPO) (see **Appendix D.1**), coordination with the US Army Corps of Engineers and the N.C. Division of Water Quality leading to the issuance of the 1998 Section 404 and 401 (of the Clean Water Act) permits,2002-2003 verification of wetlands and streams along the Project R-2247

Preferred Alternative with the USACE (see **Appendix D.2**), and Section 404/NEPA Merger Team coordination (see **Appendix D.4**).

The Section 404/NEPA merger process was developed to integrate NEPA and Section 404 of the Clean Water Act in order to streamline the project development and permitting processes. The objective of the process is to include the regulatory requirements of Section 404 into the NEPA decision-making process for transportation projects. The process is conducted using a series of key decision points which are brought to interagency meetings for concurrence. These meetings are known as concurrence or merger team meetings. Once an item is agreed upon at a concurrence meeting and a concurrence form is signed, that decision stands unless substantive new information is found that would warrant a re-evaluation.

Agencies participating in the merger team meetings include:

- US Army Corps of Engineers
- Federal Highway Administration
- NC Department of Transportation
- US Environmental Protection Agency
- US Fish and Wildlife Service
- NC Department of Environment and Natural Resources, Division of Water Quality
- NC Wildlife Resources Commission
- NC Department of Cultural Resources

Other agencies may participate when a project is within their geographic area. In the case of the Winston-Salem Northern Beltway, the Winston-Salem Metropolitan Planning Organization participated in merger team meetings.

The concurrence points for NCDOT for projects on new location include the following items:

- Concurrence Point 1: Purpose and Need and Study Area
- Concurrence Point 2: Detailed Study Alternatives Carried Forward
- Concurrence Point 2A: Bridging Decisions and Alignment Review
- Concurrence Point 3: LEDPA/Preferred Alternative Selection
- Concurrence Point 4A: Avoidance and Minimization
- Concurrence Point 4B: 30 Percent Hydraulic Review
- Concurrence Point 4C: Permit Drawings Review

Typically only the concurrence points through 4A take place during the NEPA process; 4B takes place during preparation of right of way plans and 4C takes place after completion of right of way

plans. Signed concurrence forms for Projects R-2247, U-2579, and U-2579A are included in **Appendix D.4**.

Project R-2247 pre-dated the merger process when it was originally developed and designed in the 1990s. However, the combination of Projects R-2247, U-2579, and U-2579A into one environmental impact statement and the subsequent choice to process all three projects under one Section 404 permit brought Project R-2247 under the Section 404/NEPA merger process with regards to Concurrence Point 2A (bridging decisions and alignment review) and Concurrence Point 4A (avoidance and minimization).

Concurrence Point 2A: Bridging Decisions and Alignment Review

The Merger Team met to discuss Project R-2247 on June 9 and July 13, 2005, and met and signed the concurrence form for Concurrence Point 2A (bridging decisions and alignment review) on March 21, 2006. During this process, agreement was reached on opportunities for minor design revisions that would reduce impacts on streams and wetlands in the study area. The concurrence forms, included in **Appendix D.4**, document the consensus of the Merger Team regarding bridging decisions and alignment review.

Concurrence Point 4A: Avoidance and Minimization

The Merger Team met to discuss Project R-2247 on June 9 and July 13, 2005, and met and signed the concurrence form for Concurrence Point 4A (avoidance and minimization) on March 21, 2006. The concurrence forms, included in Appendix D.4, document the consensus of the Merger Team regarding avoidance and minimization of wetlands and streams.

6.1.2 Projects U-2579 and U-2579A

6.1.2.1 Agency Coordination on Project U-2579 Occurring Before or at the Time of the 1995 Project U-2579 DEIS

The following text was taken directly from the 1995 Project U-2579 DEIS (Section VI, page VI-2).

The North Carolina Department of Transportation, through the scoping process and the filing of a Notice of Intent in the March 19, 1993 Federal Register, informed a number of federal, state, and local agencies of the existence of this project and its scope. The NCDOT initiated early project coordination on March 10, 1993, by distribution of a scoping letter soliciting comments related to this project. The scoping letter was sent to the following agencies (an asterisk (*) indicates those agencies that have responded to the scoping letter; copies of their letters are included in the Appendix of the 1995 DEIS). Consideration of these comments was incorporated into the 1995

Draft Environmental Impact Statement. Also, a letter from the Federal Transit Administration is attached.

- FEDERAL AGENCIES
  - * US Department of Interior Bureau of Mines
  - * US Army Corps of Engineers
  - US Department of Housing and Urban Development
  - US Environmental Protection Agency
  - Federal Emergency Management Administration
  - Federal Energy Regulatory Commission
  - US Fish and Wildlife Service
  - US Geological Survey
  - * Soil Conservation Service (Now Natural Resources Conservation Service)

- STATE AGENCIES
  - * North Carolina State Clearinghouse
  - * North Carolina Department of Environment, Health, and Natural Resources (Now NC Department of Environment and Natural Resources)
    - * Division of Environmental Management Water Quality Section (Now NCDWQ)
    - * Division of Parks and Recreation
    - * Division of Soil and Water Conservation
    - Division of Environmental Health
    - * Division of Forest Resources
    - Division of Water Resources
    - * Division of Land Resources
  - North Carolina Department of Crime Control and Public Safety
    - Division of Emergency Management
  - * North Carolina Wildlife Resources Commission
  - North Carolina Department of Cultural Resources
    - * Division of Archives and History
  - North Carolina Department of Public Instruction
    - Division of School Planning

- REGIONAL AGENCIES
  - Piedmont Triad Council of Governments

- LOCAL AGENCIES
  - Forsyth County School System
  - Forsyth County Commissioners
  - City-County Planning Board (Winston-Salem/Forsyth County)
  - City of Winston-Salem

Town of Rural Hall
Town of Walkertown
Town of Kernersville

The following utilities also were contacted to provide locations of their lines and facilities:

- UTILITIES

  Duke Power Company
  AT&T
  Piedmont Natural Gas Company
  Norfolk Southern Railway
  Winston-Salem and Kernersville Utility Departments
  Southern Bell
  Summit Cable Services

A steering committee of technical personnel was formed at the initiation of the project study to provide assistance and ensure coordination. Representatives from the following organizations attended steering committee meetings:

- STEERING COMMITTEE

  City-County Planning Board (Winston-Salem/Forsyth County)
  Winston-Salem Department of Transportation
  Town of Kernersville
  City of Winston-Salem
  North Carolina Department of Transportation
  Federal Highway Administration
  Kimley-Horn and Associates, Inc.

Interagency Coordination

Two interagency meetings were held. Representatives from the following agencies were requested to attend:

- NC Department of Cultural Resources
- NC Division of Environmental Management
- US Fish and Wildlife Service
- NC Wildlife Commission
- US Army Corps of Engineers

Attendees and summaries of both meetings are included in the 1995 Project U-2579 DEIS. The first meeting was held on April 13, 1993, and was a combination scoping, interagency, and

technical steering committee meeting. The reasonable and feasible alternatives were shown at the second interagency meeting (January 26, 1994) and no objections were expressed by the agencies.

6.1.2.2 Agency Coordination on Project U-2579A Occurring Before or at the Time of the 1995 Project U-2579 DEIS

Scoping Letter

As part of the development of the Feasibility Study, a scoping letter was mailed on November 28, 1994 requesting information regarding potential environmental impacts that could result from Project U-2579A. The following agencies responded with comments to the letter:

- US Fish and Wildlife Service
- NC Department of Environment, Health and Natural Resources (Now NC DENR)
- NC Division of Parks and Recreation
- NC Wildlife Resource Commission
- NC Department of Cultural Resources
- Northwest Piedmont Council of Governments
- City of Winston-Salem

These comments were addressed in the Feasibility Study, and copies of the letters were included in appendices to that document.

Joint Interagency and Steering Committee Meeting

A joint interagency and steering committee meeting was held on January 4, 1995 in the Board Room of the NCDOT Transportation Building in Raleigh, North Carolina. The history of the project, preliminary alternatives, and key environmental concerns were discussed. A summary of the meeting is included in the *Project U-2579A Feasibility Study* (January 1996), appended by reference. Representatives from the following agencies attended the meeting:

- Winston-Salem/Forsyth County City-County Planning Board
- Town of Kernersville
- NC Division of Environmental Management – Water Quality (Now NCDWQ)
- City of Winston-Salem
- Department of Cultural Resources/State Historic Preservation Officer
- NCDOT Planning and Environmental Branch (Now Project Development and Environmental Analysis Branch)
- NCDOT Division 9
- NCDOT Roadway Design

- NCDOT Location Surveys
- NCDOT Statewide Planning
- Kimley-Horn and Associates

6.1.2.3 Agency Coordination on Projects U-2579 and U-2579A Occurring After the 1995 Project U-2579 DEIS

A new NOI was published for this combined supplemental document on March 17, 2004 (see **Appendix D.7**). A revised NOI for this document was published on September 13, 2004 for publication in the Federal Register (see **Appendix D.7**).

Project U-2579

Following the December, 1995 Public Hearing on Project U-2579, Alternative 7 was identified as the Preferred Alternative for the Eastern Section of the Northern Beltway in March, 1996.

NCDOT discussed the selection of Alternative 7 at an interagency coordination meeting held on August 15, 1996. NCDWQ and the USACE expressed concern over Alternative 7's eastern segment (Segment E5 on **Figure 2-17e**) impacts to wetlands W-25, W-28, and W-29. These wetlands were identified in the 1995 Project U-2579 DEIS as 3.0 acres of forested wetland. The corresponding non-preferred western segment (Segment W5 on **Figure 2-17e**) had impacts to wetlands W-23, W-26, and W-27, which were identified as 1.5 acres of forested wetlands and 1.2 acres of marsh wetland. For the 1995 Project U-2579 DEIS, the wetland areas had not been delineated, but rather had been approximated based on aerial photography, topographic mapping, and limited field review, which was the standard at the time. NCDWQ and the USACE were concerned that although the quantity of wetland impact was relatively the same for these two segments, the selected eastern segment would impact higher quality forested wetlands. It was decided that a field review of the wetlands in question would be conducted and assessed using the DEM wetlands rating system to better determine the quality of impacted wetlands.

A field review of these wetlands areas was conducted on December 11, 1996 with NCDWQ representative Eric Galamb, USACE representative Eric Alsmeyer, and NCDOT consultant representatives Beth Reed and Keith Markland. Based on this field review, Wetlands 26 and 27 (western segment along Kerners Mill Creek) received a DEM score of 78 (Mr. Galamb noted this score was probably high and a ranking of 45-50 was more accurate). Wetland 28 (eastern segment along Kerners Mill Creek) received a ranking of 15. Wetland 29 (eastern segment along Smith Creek) was impacted by a sewer line. Smith Creek was deeply incised and provided limited overbank flooding. Wetland 23 (western segment along Martin Mill Creek) was determined to consist of primarily braided stream channels and was not a wetland. Wetland 25 (eastern segment along Martin Mill Creek) also was determined to be primarily stream channel and not wetland. It was noted that farming had occurred within the floodplain of this area.

Based upon the results of this field evaluation, it was determined that the eastern segment actually impacted the lower quality systems, and, therefore, Alternative 7 was the least environmentally damaging alternative. Copies of the concurrence letters from the USACE dated September 19, 1997, and from the NCDWQ dated December 1, 2003 are included in **Appendix D.2**.

An agency field review of the Preferred Alternative was conducted on February 12, 1999 to evaluate the wetland and stream impacts associated with the alternative and determine if there were opportunities to further avoid and minimize impacts to these resources. An interagency meeting was held on January 20, 2000 as a follow-up to the field review to discuss roadway design measures that had been taken to further avoid wetland and stream impacts.

Project U-2579's 1995 DEIS and the 1996 identification of the Preferred Alternative pre-dated the 1997 Section 404/merger process, although inter-agency coordination did occur as described in the preceding paragraphs. Since there was documented concurrence from the regulatory agencies on LEDPA, the Eastern Section was dropped into the merger process post-Concurrence Point 3. However, Concurrence Point 2A (bridging decisions and alignment review) and Concurrence Point 4A (avoidance and minimization) had not formally occurred with the regulatory agencies. Therefore, these concurrence points were discussed and achieved with the entire Merger Team, as discussed below.

Concurrence Point 2A: Bridging Decisions and Alignment Review

The Merger Team met to discuss Concurrence Point 2A for Project U-2579 on May 10 and June 9, 2005, and signed the concurrence form on June 9, 2005. During this process, proposed major drainage structures were discussed, both with respect to their type and their size. The concurrence forms, included in **Appendix D.4**, document the consensus of the Merger Team regarding bridging decisions.

Concurrence Point 4A: Avoidance and Minimization

The Merger Team met to discuss Concurrence Point 4A for Projects U-2579 on May 10 and June 9, 2005, and signed the concurrence form on June 9, 2005. During this process, opportunities for minor design revisions for reducing impacts on streams and wetlands were identified. The concurrence forms, included in **Appendix D.4**, document the consensus of the Merger Team regarding avoidance and minimization measures.

The Eastern Section Extension (Project U-2579A) was developed from its beginning in 2000 under the merger process, as discussed below.

Project U-2579A

With the initiation of planning for Project U-2579A, a Notice of Intent was published in the August 8, 2000 Federal Register and a scoping letter was sent in July 2001 to the following agencies. An asterisk (*) indicates those agencies that responded to the scoping letter. Copies of their letters are included in **Appendix D.6**.

US Army Corps of Engineers
US Environmental Protection Agency
Federal Emergency Management Agency
US Fish and Wildlife Service
US Geological Survey
* NC State Clearinghouse
NC Department of Cultural Resources
Department of Public Instruction
* NC Division of Water Quality - Wetlands
* NC Department of Environment and Natural Resources
NC Wildlife Resources Commission
Region I Planning Agency
Chairman County Commissioner, Forsyth County
* Northwest Piedmont Council of Governments
Mayor of Winston-Salem

Because of the railroad grade separations planned as part of this project, additional scoping letters were sent to the following agencies in July 2003:

* Piedmont Authority for Regional Transportation (PART)
* Norfolk Southern Railroad.

Because this project was to be conducted using the Section 404/NEPA merger process, several Merger Team (interagency) meetings were held. The following agencies as well as NCDOT were represented on the Merger Team for Project U-2579A:

- US Fish and Wildlife Service (USFWS)
- US Environmental Protection Agency (USEPA)
- US Army Corps of Engineers (USACE)
- Federal Highway Administration (FHWA)
- NC Wildlife Resources Commission (NCWRC)
- NC Division of Water Quality (DWQ)
- NC Department of Cultural Resources (NCDCR)
- Winston-Salem Metropolitan Planning Organization

Concurrence Point 1: Purpose and Need

The Merger Team met to discuss Concurrence Point 1 (purpose and need) for Project U-2579A on July 19, 2000 and February 8, 2001. Consensus on purpose and need was achieved on February 8, 2001. The signed concurrence form is included in **Appendix D.4**.

Concurrence Point 2: Detailed Study Alternatives

The Merger Team met to discuss Concurrence Point 2 (alternatives to study in detail) for Project U-2579A on February 8 and April 18, 2001. Consensus on which alternatives to study in detail was achieved on April 18, 2001. The signed concurrence form is included in **Appendix D.4**.

Concurrence Point 2A: Bridging Decisions and Alignment Review

The Merger Team met to discuss Concurrence Point 2A (bridging decisions and alignment review) for Project U-2579A on March 16, 2004 and signed the concurrence form on the same day. During this process, proposed major drainage structures were discussed, both respect to their type and their size. The concurrence forms, included in **Appendix D.4**, document the consensus of the Merger Team regarding bridging decisions and alignment review.

Concurrence Point 3: Least Environmentally Damaging Preferred Alternative (LEDPA)

The Merger Team met to discuss the LEDPA for Project U-2579A on January 25, 2005 and February 10, 2005, and agreed on Alternative N2-S1 with a single point urban interchange at Kernersville Road. The Merger Team finished signing the concurrence form on March 14, 2005 (the meeting took place on March 4, 2005, which is the date on the form, but the concurrence form was signed by the final Merger Team member on March 14, 2005). NCDOT approved the selection of N2-S1 with a single point urban interchange at Kernersville Road as the project's Preferred Alternative on March 17, 2005.

Alternative N2-S1 was chosen as the LEDPA and as the NCDOT Preferred Alternative based on residential relocations, economic impacts, stream impacts, and support of local officials. Additional information about the selection of Alternative N2-S1 as the Preferred Alternative is in **Section 2.11.2.1**. The merger document and NCDOT approval letter are in **Appendix D.4**.

Concurrence Point 4A: Avoidance and Minimization

The Merger Team met to discuss Concurrence Point 2A (avoidance and minimization) for Project U-2579A on May 10, 2005 and June 9, 2005 and signed the concurrence form on June 9, 2005. The concurrence forms, included in **Appendix D.4**, document the consensus of the Merger Team regarding avoidance and minimization measures.

6.2 PUBLIC INVOLVEMENT

Public involvement is an integral aspect of the EIS process. The Federal Highway Administration's regulations implementing NEPA state that public involvement and a systematic interdisciplinary approach must be essential parts of the development process for proposed actions.

6.2.1 Project R-2247

6.2.1.1 Public Involvement Activities Occurring Before or at the Time of the 1996 Project R-2247 FEIS and Record of Decision

The following text is taken directly from the 1996 Project R-2247 FEIS (Section 7.2, page 7-26).

In response to the requirements set out by NEPA, the project team conducted an active public involvement program during the entire Project R-2247 EIS process to ensure maximum public participation. The project team strived to receive input from all interested and potentially-affected parties during the environmental studies and the decision-making process.

Goals of the Project R-2247 Public Involvement Program

The final selection of an alternative for Project R-2247 required a continual and ongoing flow of information to and from the public. The public involvement program for this project was developed to meet three following objectives:

- Promote a better understanding of the transportation facility, including its needs, benefits, and constraints

- Inform and communicate with the public regarding the environmental planning process, project schedule, project description, decision process, and possible impacts and effects on the environment

- Ensure that the decision-making process accurately identifies and considers the values and concerns of the public and affected agencies

Approach Used to Develop the Public Involvement Program

The first step in developing the public involvement program for Project R-2247 involved identifying specific community issues and determining the community's level of concern. This was accomplished by conducting the following reconnaissance activities:

- Reviewing existing written materials, including newspaper articles and letters to the editor dating back to 1986; petitions, documents, and letters submitted to the City and the County; and comment forms submitted by the public during the EIS consultant selection process;

- Conducting Public Availability Sessions where more than 200 residents, business people, landowners, and local officials presented comments and concerns on the proposed project; and

- Reviewing comment forms completed by individuals attending the Availability Sessions.

In addition to these activities, the project team conducted meetings with the Project R-2247 Northern Beltway Steering Committee to discuss previous public involvement efforts and future EIS public involvement activities. The Steering Committee consisted of representatives from the City of Winston-Salem, Forsyth County, the North Carolina Department of Transportation, and the Federal Highway Administration.

The next step in developing the program involved analyzing the information gathered during the reconnaissance activities listed above. This information, coupled with the overall public involvement objectives, was then used to determine specific public involvement activities and their timing and format.

Description of Project R-2247 Public Involvement Activities

The public involvement program consisted of the following components, all of which were developed to meet the project's overall public involvement objectives, identify citizen concerns, and meet state and federal guidelines for preparing an EIS:

- Availability sessions
- Mailing list
- Newsletters
- Public meetings
- Information repositories

Availability Sessions

Informal "drop in " sessions were held over two nights in late February 1989 to allow citizens to meet and talk with City and County officials and members of the project team concerning the proposed project. More than 200 citizens attended these meetings. Key community concerns expressed during the sessions are summarized in the following questions:

- Is the Beltway really needed? Exactly what needs will it serve?
- How will the community's quality of life be affected?
- Will the environmental and engineering studies be objective?
- Can the quality of local creeks and lakes be preserved?
- What will be the effects on the environment? Air quality? Noise levels? Plant life? Wildlife?
- Will the Beltway enhance or reduce recreational opportunities?
- Will the Beltway have controlled access?
- To what extent will property values be affected?
- How much attention will be given to landscaping?
- How will the engineers address the potential for fog and flooding?
- Will local historical and cultural resources be preserved?

Summaries of all public comments concerning the project are included in Part II of Appendix A of the 1996 Project R-2247 FEIS.

Mailing List

A comprehensive mailing list consisting of 2,250 names was compiled from sign-in sheets from past City public involvement activities in the study area, along with the names of citizens who either participated in the Project R-2247 availability sessions, contacted the study team, responded to newsletter comment forms, or attended project meetings. The mailing list was used to distribute the project newsletter and notify the public of meeting dates, times, and locations.

Newsletters

Three newsletters were prepared and distributed to all citizens and agencies on the mailing list. Copies were also made available at public places, such as the libraries housing the information repositories, City and County office buildings, and local community centers. Each newsletter included a solicitation for input on any aspect of the project.

The first newsletter, published in the winter of 1989-90, contained information on the EIS process, the project schedule, public involvement opportunities, and a summary of key community concerns identified at the February 1989 availability sessions. The newsletter also announced the first public workshops that took place January 23 and 24, 1990.

The second newsletter was published in the summer of 1990 following identification of preliminary corridor routes. This edition included information on activities leading to corridor selection and a brief discussion of how the corridors were selected. The newsletter also highlighted public comments received from the first newsletter, workshop comment sheets,

letters, discussions, and phone calls, and announced details for the upcoming Open Houses held July 24 and 25, 1990.

The third newsletter announced the selection of alternative corridors for detailed analysis. The newsletter also outlined key factors used in selecting the major corridors and an explanation of the final phases in the EIS process. Copies of the newsletters were included in the Appendix A of the 1996 Project R-2247 FEIS.

Citizens Informational Workshop; January 23-24, 1990

Two nights of informal citizens workshops were held to share information on the EIS study, highlight the study schedule and phases, and solicit community comments and concerns. More than 250 residents attended the first night, and over 300 came to the second. At each workshop, rooms were set up with six displays that covered the following areas:

- Population, housing, and employment projections and road improvements for the year 2015;
- Traffic projections for the year 2015;
- Broad corridors where a facility could be located to address future traffic conditions;
- Subjects studied and evaluated as part of an EIS;
- Steps taken in selecting potential routes; and
- Study phases and key decision-making points.

Attendees also received comment sheets on which to express their concerns about the Northern Beltway Project R-2247. Summaries of these and all public comments concerning the project are included in the 1996 Project R-2247 FEIS.

Citizens Informational Workshop; July 24-25, 1990

On July 24 and 25, 1990, approximately 425 people attended each of the open-house workshops where residents had the opportunity to view maps displaying the preliminary corridors and talk with the project team and City and County staff about the corridors. Exhibits included the following:

- Western Forsyth County maps showing all the preliminary route corridor segments;
- The land suitability map, which highlighted the environmental features investigated;
- 1990 aerial photographs, with the preliminary corridors identified, to illustrate how the routes might affect areas of special interest; and
- Display boards, including examples of different roadway designs and right-of-way (ROW) widths; relationships between corridors and the ultimate ROW needed for the facility; and an updated project schedule.

Attendees also had a chance to express their concerns about the Northern Beltway project. Summaries of these and all public comments concerning the project are included in the 1996 Project R-2247 FEIS.

Pre-Public Hearing Open House, August 27 and 28, 1992

Two evenings of Pre-Public Hearing Open Houses were held on August 27 and 28, 1992. The Corridor Public Hearing Map and half-size reproductions were available for viewing along with copies of the Draft EIS. Announcement of these meetings included the mailing of a fourth project newsletter to approximately 2,250 households on the mailing list.

Corridor Public Hearing, September 1, 1992

A Corridor Public Hearing was conducted on September 1, 1992 at the Southwest Elementary School Auditorium. Approximately 750 people attended the Public Hearing, and 45 people provided spoken comments. Over 500 comment forms were received, with an additional 800 signatures on petitions received during the extended comment period on the Draft EIS.

Information Repositories

In order to ensure that the community had easy access to project documents and maps, information repositories were set up at the main Forsyth County Library, the Clemmons Branch Library, and the Reynolda Branch Library. The repositories included newspaper articles, available background documents, project newsletters, technical documents, and project maps, and were updated throughout the EIS process.

Design Public Hearing

A Design Public Hearing was held to present the engineering designs for the Project R-2247 Preferred Alternative. The Public Hearing was held on September 5, 1996 beginning at 7:30 pm at the Southwest Elementary School. Approximately 180 people attended the hearing. A Pre-Hearing Workshop was held on August 15, 1996 at the same location to provide people an opportunity to review the project designs and to ask questions one-on-one with NCDOT representatives.

6.2.1.2 Public Involvement Occurring After the 1996 Project R-2247 FEIS and Record of Decision

Winston-Salem Northern Beltway Western Section Reevaluation Citizens Informational Workshop

A Citizens Informational Workshop was held from 4:00 pm to 8:00 pm on Tuesday, November 27, 2001 at Calvary Baptist Church in Winston-Salem to present two Improve Existing Roadways

Alternatives (see **Section 2.6**) to the public. A newsletter (see **Appendix C.1**) was mailed to approximately 3,000 recipients in November 2001 to inform the public of this workshop. The mailing list included property owners along the roadways included in the Improve Existing Roadways Alternatives (RV-A and RV-B), and people already on the mailing list for the Western Section of the Northern Beltway (Project R-2247). At this open house workshop, citizens received a handout (see **Appendix C.1**), watched a slideshow, and viewed project display maps showing functional designs for Alternatives RV-A and RV-B on aerial photography. The slideshow provided an overview (see **Appendix C.1**), including a description of the project history, status of current studies, the next steps in the process and explained how citizens could participate.

The NCDOT Study Team was present to answer questions and to discuss the project one-on-one. Approximately 670 people attended the workshop. Three-hundred sixteen comments from individuals were received at the Citizens Informational Workshop or by email or mail after the meeting. More than 275 (87%) of the comments either expressed opposition to the Improve Existing Alternatives or stated a preference for the Preferred Alternative for Project R-2247.

Local Officials

Several local governments and organizations sent letters or comment sheets expressing their support of the Preferred Alternative for Project R-2247. These organizations include the City of Winston-Salem Department of Transportation, the Town of Bethania, the Town of Lewisville, NCDOT Board Member, and the Winston-Salem Chamber of Commerce.

Bethania-Tobaccoville Road Interchange – Property Owners Meeting

A property owner coordination meeting was held on February 25, 2003 at the Alpha Chapel Community Center from 6:00 pm to 8:00 pm in Bethania. The purpose of this meeting was to provide project and design concepts information, and to solicit comments from property owners who could be directly affected by potential interchange alternatives. These interchange alternatives were developed to find a way to minimize effects on the historic Samuel Stauber House and Barn (see **Section 2.9.3.4.4**). Invitations to this meeting were mailed to property owners whose property or access could be potentially impacted by any of these alternatives. Approximately forty-two invitations were mailed, and thirty-one citizens attended this meeting.

6.2.2 Projects U-2579 and U-2579A

6.2.2.1 Public Involvement Activities for Project U-2579 Occurring Before or at the Time of the 1995 Project U-2579 DEIS

The following text is taken directly from the 1995 Project U-2579 DEIS (Section VI, page VI-4).

A public involvement plan was developed at the initiation of the study process with the following primary objectives:

- To educate and inform the public on a timely basis regarding the study scope, schedule, findings, and recommendations.

- To obtain public comments regarding the study process, data, conclusions, and recommendations.

The public involvement plan included use of several communications media as well as meetings scheduled at various points during the study. These communications media and meetings are described in the following sections.

Newsletters and Mailing List

Three newsletters were distributed to interested citizens, groups, and officials during the study informing them of the study process and progress. The newsletters are included in the Appendix of the 1995 DEIS. A database of citizen names was compiled, including persons attending Citizens Informational Workshops, persons requesting information, and neighborhood groups as provided by the City of Winston-Salem. This list has been updated and expanded throughout the study period and now includes approximately 8,800 names and addresses of citizens interested in this portion of the Northern Beltway.

Telephone Contact

A toll-free telephone number for project information was distributed through the newsletter and at public meetings. The number was set up in response to public comments requesting a local number at which to contact NCDOT planning staff. An engineer was available during regular office hours to answer questions and provide information regarding the study progress and results. If a question could not be answered immediately, the caller's telephone number or address was recorded and a response made within two business days. Since January 2005, approximately 120 calls (not including those who called NCDOT directly to inquire about the project) were received from the public, mostly seeking information about the project.

Mail Contact

A mailing address was distributed through the newsletters and at public meetings. All incoming mail (not including Citizen Informational Workshop comments) was responded to by mail (or by telephone, if requested) within two days. Approximately 55 letters (47 form letters) were received from groups or individuals. The form letters, which resulted from the second Citizens Informational Workshop (March 1994), stated strong preference for the Project U-2579 Western Alternative over the Eastern Alternative. The other letters were essentially opposed to the proposed project, or preferred the Western Alternative over the Eastern Alternative.

Citizens Informational Workshops

The first Citizens Informational Workshop, which was advertised in a project newsletter, was held in the Cash Elementary School on April 29, 1993. The workshop lasted from 4:00 pm until 8:00 pm. Approximately 200 citizens attended. Representatives from the NCDOT, the City of Winston-Salem, towns of Kernersville, Rural Hall, and Walkertown, and Forsyth County also were present.

Exhibits for the workshop included: maps of the alignments overlain with potential hazardous waste sites, Salem Lake Management Area, streams and floodways, historic and archaeological sites, land use, average annual daily traffic volumes (1992), schools, churches, and proposed parks and open space. An aerial photo base map with the previous alternatives displayed on an overlay was made available. Another aerial photo base map with a blank overlay was provided for citizens to indicate preferred routes or to make other comments. Citizens also had the opportunity to be added to the mailing list or to make comments on forms that were provided. A handout was provided which included printed maps of the study area.

The second Citizens Informational Workshop, also advertised in a project newsletter, was held in the Cash Elementary School March 8, 1994. The workshop lasted from 4:00 pm until after 7:00 pm. Approximately 450 citizens attended, including 355 citizens who signed the meeting attendance register. Representatives from the NCDOT, the City of Winston-Salem, the towns of Kernersville, Rural Hall, and Walkertown, and Forsyth County were also present. Exhibits for the workshop included maps of the Eastern and Western Alternatives, as well as the five crossovers. Two duplicate aerial photo base maps with overlays (scale 1"=800') were used to display the alternatives. Handouts included a map showing the two alternatives and cross-overs and a self-addressed comment sheet.

Small Group Meetings

Civic groups and neighborhood organizations were contacted by mail early in the study process to inform them that NCDOT and consultant staff was available to meet with them during the course of the study for informal presentations and to answer questions.

Public Officials Meetings

The first public officials meeting was held on April 29, 1993 at Cash Elementary School. The meeting was held just prior to the first Citizens Informational Workshop. Representatives from the following agencies were at the meeting: City of Winston-Salem, Town of Kernersville, Town of Rural Hall, NCDOT, and Kimley-Horn and Associates. The project status, previous alternative alignments studied, and the project study area were discussed.

The second public officials meeting was held on March 8, 1994 at Cash Elementary School. Representatives from the following agencies were in attendance: City of Winston-Salem Department of Transportation, Town of Kernersville, Town of Walkertown, Town of Rural Hall, City-County Planning Board, NCDOT, Kimley-Horn and Associates, Inc., and New South Associates. New South Associates was an archaeological sub-consultant for the proposed project. Key environmental issues were discussed. The alignments for the alternatives selected for further detail studies were presented and discussed. No objections were voiced for the proposed alternatives.

6.2.2.2 Public Involvement Activities for Project U-2579A Occurring Before or at the Time of the 1995 Project U-2579 DEIS

Newsletters

A newsletter published in January 1995 for Project U-2579A announced the initiation of a Feasibility Study for the project to the public, describing the proposed schedule of the project and opportunities for the public to be involved. It announced the first Feasibility Study informational meeting for Project U-2579A (February 7, 1995).

A second newsletter for Project U-2579A was published in July 1996, and identified the Feasibility Study's recommended alternative. It described the alternative, and listed the advantages and preliminary impacts.

Citizens Informational Workshop

A Citizens Informational Workshop was held on February 7, 1995 at Sedge Garden Elementary School for Project U-2579A. Approximately 500 people attended this workshop, which presented three alternative corridors identified by the NCDOT for examination in the Feasibility Study. The 1,200-foot corridors, shown on an aerial map, identified the areas to be examined in detail as well as potential interchange locations. No written comments were received at the meeting, and four comment forms were received following the meeting. Most of the citizens in attendance at the meeting were primarily concerned with determining the proposed project in relationship to their individual residences. A summary of the meeting is included in the *Project U-2579A Feasibility Study* (January 1996), appended by reference.

6.2.2.3 Public Involvement Activities for Projects U-2579 and U-2579A Occurring After the 1995 Project U-2579 DEIS

Project U-2579 Public Hearing - 1995

A Corridor Public Hearing on the Winston-Salem Northern Beltway (Eastern Section) was held on December 7, 1995 at the Cash Elementary School. The Eastern and Western Alternatives, along with Alternatives 1-8, were presented for public comments. It was explained that once the specific corridor is selected, a preliminary design would be prepared along with the Final Environmental Impact Statement. These would then be presented at a design public hearing in the future. Thirty-four citizens made public comments and/or statements at the meeting and 22 citizens forwarded letters to the Public Hearing Officer during the Public Hearing comment period. Of those citizens who made a public statement/comment, 25 were opposed, three supported the project, and six had general comments. The issues and concerns addressed are summarized below:

- Six residents felt that the project should be directed to the Piedmont Triad International Airport.
- Eight residents felt that the money could better be spent for local improvements such as bridge repair, existing road repair, schools, law enforcement, and health care.
- Two residents were not opposed to the project, but felt that it should go north of Walkertown to alleviate downtown traffic and eliminate the need for a bypass of Walkertown.
- A representative of the Joint Government Affairs for Realtors supported the project. He felt that the project would attract business.
- Three citizens voiced their concern on falling home property values in the vicinity of the project and how the fair market value is determined.
- A Vice President of the Wellington Way-Windsor Park Homeowners' Association opposed the project and preferred the No Build Option. He voiced his concern about the project's impact on the watershed and increased traffic on I-40 Business. He also wanted to know why the alternate north of Walkertown was dropped.
- The Vice Chairman of the Winston-Salem Chamber of Commerce was in favor of the project because it will encourage growth in business and industry.
- One resident was concerned with additional runoff and flooding in the project area.

Written Comments Received During the Public Hearing Comment Period

Of the 22 written comments received following the public hearing, including comment forms from the public hearing, two letters supported the Beltway in general, eight opposed the Beltway in general, and the remaining 15 cited specific preferences. Two comments favored moving the

Beltway as far out as possible. Comments regarding specific alternatives included one favoring Alternate 6 and one favoring Alternate 7. Comments regarding specific segments included one opposing W1 segment and one opposing W5 and favoring E5. Two citizens expressed concerns regarding the Beltway's impact on Doe Run. One citizen supported the Beltway west of US 158 but opposed the section from US 158 to Business 40, and favored an interchange on West Mountain Street. One citizen favored the Walkertown proposal and noted that the western corridor would take family property.

Comments on the Eastern corridor included a citizen favoring the eastern corridor in general, one favoring E-1, and another concerned with impacts of E-3 on a trailer park and favoring an interchange on Old Walkertown Road. One citizen was concerned about the impact of Crossover 4 on family property. Finally, one citizen requested that the project schedule be accelerated in order to reduce the period of uncertainty for homeowners.

Other Correspondence Received Following the Public Hearing Comment Period

Two letters opposed the Beltway in general. One letter opposed Alternatives 2 and 7, as well as the eastern alternative. One citizen opposed the easternmost alternative through Sedge Garden because of its impact on a fish hatchery business, while another citizen who opposed the Beltway favored the eastern alternative because it is closest to Winston-Salem. A petition with 73 households represented opposed the Walkertown proposal for a beltway north of Walkertown. Three letters supported the Beltway, including one from Stokes County Economic Development, one from the Stokes County Manager, and one from the King Chamber of Commerce.

Newsletters

A newsletter (see **Appendix C.2**) published in May 1996 for Project U-2579 presented the Preferred Alternative selected, and discussed the reasons for selecting that alternative. The newsletter also summarized the results of the public hearing on December 7, 1995, and described the upcoming FEIS process. Approximately 800 newsletters were mailed.

A newsletter (see **Appendix C.2**) was published in October 2001 for Project U-2579A. The newsletter included general project information such as project background, study area, and contacts. The newsletter also presented the Project U-2579A alternative corridors and told of an upcoming Citizens Informational Workshop (held on November 1, 2001). Approximately 1,500 newsletters were mailed.

Project U-2579A Citizens Informational Workshop

The workshop was held on November 1, 2001 at Sedge Garden Elementary School for Project U-2579A. Approximately 340 people attended this meeting. The project study corridors and a typical section of the proposed project were available for public review. The October 2001 newsletter referred to above was provided as a handout. A total of 37 comments were received

from citizens and public officials. Concerns included questions about the project need, project scheduling and funding, community impacts, land use and property impacts, traffic and design issues, and environmental impacts.

Project U-2579A Public Officials Meeting

A Public Officials meeting was held on November 1, 2001 for Project U-2579A. The same displays shown at the public information workshop described above were shown at the public official's meeting. Sixteen public officials attended the meeting and had the opportunity to comment on the project. Comments from citizens and public officials are described above.

Small Group Meetings

Citizens were informed in the study newsletter that NCDOT and consultant staff was available to meet with neighborhood organizations during the course of the study for informal presentations and to answer questions. NCDOT and consultant staff met as requested with members of the Doe Run neighborhood on January 10, 2002. Approximately 25 citizens attended the meeting, which was held at the Doe Run clubhouse. NCDOT staff described the project's history, and, using a large corridor map on aerial photography, generally described the impact of the alternatives on the Doe Run area. It was explained that the Preferred Alternative for Project U-2579 had the least impact to the neighborhood, and that all of the U-2579A alternatives would have similar impacts. Citizens were primarily concerned with the physical impacts to the neighborhood, including changes in access, and the noise impact of the highway.

NCDOT and consultant staff also met the with North Oaks community on November 15, 2004. The meeting took place at the Carl Russert Recreation Center, and included 40 citizens. NCDOT staff explained the background of the project, and addressed citizens' concerns regarding the impacts of the project on the community. Citizens were concerned about loss of access, relocations, and noise impacts.

NCDOT staff met with the pastor and board members of Mount Pleasant Christian Church during one of the public meetings in November 2004. The NCDOT staff indicated on a display map that the Beltway would require relocation of the church building. They also explained the schedule and right-of-way acquisition procedures to the church group, and offered to meet with them at a time and place convenient to them. Church representatives said that they had received all the information they needed, and declined an invitation for an additional small group meeting.

6.2.3 Joint Public Involvement Activities for Projects R-2247, U-2579, and U-2579A

6.2.3.1 Public Information Materials

Project Website

A project website for the Winston-Salem Northern Beltway (Projects R-2247, U-2579 and U-2579A) was posted in December 2002 at *www.ncdot.org/projects/wsnb* and regularly updated in order to provide project-related information to interested citizens. The site provides an overview of the overall project history, alternatives information for the Western and Eastern Sections, the proposed schedule, contact information, and past newsletters. The site also posts information on past and upcoming workshops and hearings.

Newsletters

A newsletter was published in March 2003 for the Winston-Salem Northern Beltway (Projects R-2247, U-2579, and U-2579A). It was mailed to approximately 4,300 homes, businesses, and local and state government agencies. The newsletter explained that all three projects were now being addressed in one environmental document and included general project information such as project background, study area, and contacts. The newsletter also included a project schedule and current project news. A copy of the newsletter is included in **Appendix C.3**.

A second newsletter for the Northern Beltway was published in October 2004. It was mailed to approximately 5,000 homes, businesses, and local and state government agencies. The newsletter announced the availability of SFEIS/SDEIS and the public hearing maps, gave the dates and locations for public workshops and hearings, and summarized the impacts of the Beltway. A copy of the newsletter is included in **Appendix C.3**.

A third newsletter for the Northern Beltway was published in May 2005. It was mailed to approximately 8,800 homes, businesses, and local and state government agencies. The newsletter announced the selection of the Project U-2579A Preferred Alternative, gave current project news, and announced the availability on the project website of the project maps shown at the hearing. A copy of the newsletter is included in **Appendix C.3**.

Public Review

The SFEIS/SDEIS was posted for review on the project website *http://www.ncdot.org/projects/wsnb* and at the following locations:

NCDOT Division 9
375 Silas Creek Parkway, Winston-Salem

Winston-Salem Department of Transportation
City Hall South
101 East First St, Room 307, Winston-Salem

Forsyth County Library Branches:
Central Library, 660 West Fifth St, Winston-Salem
Kernersville Branch, 130 E. Mountain St, Kernersville
Carver School Road Branch, 4915 Lansing Drive, Winston-Salem
Lewisville Branch, Lewisville Plaza Shopping Center, Lewisville
Reynolda Manor Branch, 2839 Fairlawn Drive, Winston-Salem
Rural Hall Branch, 7125 Broad St, Rural Hall
Walkertown Branch, 2969 Main St, Walkertown

6.2.3.2. Public Meetings

Table 6-1 summarizes information from the November and December 2004 combined project public meetings. While three of the meetings were focused on specific projects, maps on all projects were displayed at all meetings, and questions and comments on all projects were welcomed at all meetings. Handouts were provided at each meeting, and a copy of each handout is found in **Appendix C.3**. During the open houses, citizens examined the maps and asked questions of project staff one-on-one. During the formal hearings, the NCDOT public hearing officer introduced key members of the project team, gave a brief project history and overall project description, presented information on the featured project, explained the maps, and presented information on the right of way acquisition and relocation process.

Table 6-1: Pre-Hearing Open House and Hearing Summary

Project	Entire Northern Beltway	Entire Northern Beltway	R-2247	U-2579	U-2579A
Type of Meeting	Pre-hearing open house	Pre-hearing open house	Open house public hearing	Formal public hearing	Formal corridor public hearing
Components	Workshop and slide presentation	Workshop and slide presentation	Workshop and slide presentation	Workshop, live presentation, and formal comment period	Workshop, live presentation, and formal comment period
Date	Nov 8, 2004	Nov 9, 2004	Nov 16, 2004	Nov 17, 2004	Dec 2, 2004
Time	4-8 PM	4-8 PM	4-8 PM	4-6 PM open house; 7:00 presentation and comments	4-6 PM open house; 7:00 presentation and comments
Location*	Anderson Conference Center	Dixie Classic Fairgrounds	Anderson Conference Center	Anderson Conference Center	Benton Convention Center
Maps Displayed	Full-size colored maps of R-2247, U-2579, and U-2579A preliminary designs and U-2579A Corridor Map	Full-size colored maps of R-2247, U-2579, and U-2579A preliminary designs and U-2579A Corridor Map	Full-size colored maps of R-2247 preliminary designs and ½ size colored maps of U-2579 and U-2579A preliminary designs and U-2579A Corridor Map	Full-size colored maps of U-2579 preliminary designs and ½ size colored maps of R-2247 and U-2579A preliminary designs and U-2579A Corridor Map	Full-size colored maps of U-2579A preliminary designs and ½ size colored maps of U-2579 and R-2247 preliminary design and U-2579A Corridor Map
Number of Attendees**	118	239	44	153	245
Number of speakers (verbal comments)	N/A	N/A	N/A	24	28
Number of written comments received at workshop/hearing***	8	17	2	14	19 and a petition including 276 names

* Location addresses are in Appendix C.3.

** Not including NCDOT staff and other members of the project team attending.

*** This number includes information requests made by citizens at the meetings. It does not include the 218 written comments (including 25 resolutions and 1 petition) received in the mail during the comment period.

6.2.3.3. General Summary of Comments Received

Total Number of Comments Received

The comment period originally was from November 16, 2004 to January 5, 2005. The law firm of Terris, Pravlik and Millian, LLC requested an extension of the comment period to January 18th, 2005, which was granted.

As of January 18, 2005, a total of 281 written and verbal comments were received from agencies and citizens. Comments are in **Appendix C.4**. Comments included:

- 187 comment forms, emails, and letters from citizens
- 15 comment letters from federal, state, and local agencies
- 52 verbal comments from the two formal public hearings (November 17 and December 2, 2004)
- 25 resolutions from municipalities and organizations
- 2 petitions

General Support of and Opposition to the Northern Beltway

Of the total number of written and verbal comments received from both citizens and agencies (excluding resolutions and petitions), 94 comments supported the entire Northern Beltway and 18 comments objected to the entire Northern Beltway.

Comments received supporting the Northern Beltway stated reasons such as:
The Winston-Salem Northern Beltway would:

- Relieve traffic congestion
- Encourage economic development
- Prevent widening of existing roads
- Support future growth
- Provide safety
- Attract companies (ex. FedEx and Dell)
- Serve as the I-74 corridor

Those comments received against the Northern Beltway felt that the Northern Beltway would:

- Encourage urban sprawl
- Promote unwanted development
- Cost too much
- Have too many environmental impacts
- Diminish the rural character of the county

Project R-2247

Eighteen comments (including agency comments) were related to the preliminary design of Project R-2247.

Project U-2579

Eighteen comments (including agency comments) were related to the preliminary design of Project U-2579.

Project U-2579A

Seventy-eight of the comments received supported a particular Project U-2579A alternative or were otherwise related to Project U-2579A. Table 6-2 summarizes the preferences given for the Project U-2579A Alternatives. Nine comments had general questions or issues related to Project U-2579A.

The number of citizens with a preference for an alternative on Project U-2579A was tallied, and is summarized in **Table 6-2**. Fifty-five citizens responded with an alternative preference, and 30 had a preference regarding the additional Kernersville Road interchange. Most citizen comments specifically mention alternative segments (N1, N2, etc.), while some had preferences on alternatives (N1-S1, N2-S2, etc). Citizens that stated preferences either spoke for themselves or for a non-governmental agency, such as a business or a chamber of commerce. The list of citizen comments in Appendix C.4 lists any organization representation stated by the citizen.

Table 6-2: Project U-2579A Preferences

Alternative	Individuals Supporting Alternative
N1-S1	3
N1-S2	0
N2-S1	2
N2-S2	2
N3-S1	6
N3-S2	1
Alternative Segment	Individuals Supporting Alternative Segment
N1	10
N2	8
N3	12
S1	15
S2	3

In addition, 24 citizens stated they would like an interchange at Kernersville Road, while six citizens stated they do not want an interchange at Kernersville Road.

Agencies that had a preference regarding U-2579A alternatives or an interchange at Kernersville Road either submitted written comments, formal resolutions, and/or made verbal comments at the public hearings. The following local governmental agencies stated preferences:

- City of Winston-Salem: Alternative N2-S1, with Kernersville Road interchange
- Winston-Salem/Forsyth County Board of Education: Alternative N2-S1, with Kernersville Road interchange
- Winston-Salem/Forsyth County Utility Commission: Alternative Segment S1
- Town of Kernersville: Include Kernersville Road interchange
- Kernersville Fire Department: Include Kernersville Road interchange

In addition, the EPA stated a preference for Alternative N3-S2 with no interchange at Kernersville Road.

Petitions

Two petitions on the Winston-Salem Northern Beltway were signed and submitted: one from the First Baptist Church of Stanleyville and one from the North Oaks neighborhood and surrounding communities.

The petition from the congregation of the First Baptist Church of Stanleyville included 300 signatures and was in regards to the widening of Virginia Lake Road on Project U-2579. The petitioners requested that instead of widening Virginia Lake Road to provide access from the Stanleyville Manor area to the connecting point of Ziglar Road, which would impact the church property, the DOT "consider moving the access east of Virginia Lake Road and allowing the road to go directly to University Parkway or use Nylon Drive as the access road to Ziglar Road for the Stanleyville Manor area."

The petition from the North Oaks Community included 276 signatures, and was in regards to the design of Project U-2579 at New Walkertown Road and Northampton Road. Petitioners requested to have access to Old Walkertown Road from Northampton Drive, instead of the design which would cul-de-sac Northampton Drive. The petitioners also noted a concern about air quality due to excess traffic. The petition included questions which are listed below. Answers to these questions and others from citizens are found in Table 6-5.

- What has been done or will be done to contact others in the Eastern Section that will be affected by the Beltway?
- Will anything be done to reduce the noise level for the homes closest to the Beltway that are on the northern end of Winnabow Road?

- What will be done about any damage that may be done by vibrations (or other causes) from blasting and digging during construction? Who will be responsible for any structural damage and how will we contact them?
- What is the elevation of the bypass from street level to the bridge that's going to be built?

Resolutions

Twenty-five municipalities and organizations submitted resolutions. **Table 6-3** summarizes these resolutions.

Table 6-3: Resolutions

Resolution Number	Municipality/Organization	Date	Content of Resolution
1	High Point Urban Area Metropolitan Planning Organization (HPMPO)	10-26-04	Supports the Beltway
2	High Point City Council	7-8-04	Supports the Beltway
3	Winston-Salem/Forsyth County Board of Education	12-14-04	Requests selection of Alternative N2-S1 with an interchange at Kernersville Road, and that Hastings Hill Road not be severed.
4A	Piedmont Authority for Regional Transportation (PART)	10-13-04	Supports the Beltway
4B	Piedmont Authority for Regional Transportation (PART)	5-12-04	Supports the Beltway
4C	Piedmont Authority for Regional Transportation (PART)	12-6-04	Includes copies of Resolutions from PART communities.
5	High Point Chamber of Commerce	11-24-04	Supports the Beltway
6	Winston-Salem/Forsyth County Utility Commission	12-2-04	Requests selection of Alternative Segment S1
7	Winston-Salem Chamber of Commerce	5-19-04	Supports the Beltway
8A	Winston-Salem Business Inc.	12-2-04	Requests selection of Alternative Segment S1
8B	Winston-Salem Business Inc.	5-24-04	Supports the Beltway
9A	King City Council	9-7-04	Supports the Beltway
9B	King City Council	7-6-04	Supports the Beltway
10	Town of Elkin Board of Commissioners	10-11-04	Supports Project U-2579
11	Town of Rural Hall	5-10-04	Supports the Beltway
12	Archdale-Trinity Chamber of Commerce	5-19-04	Supports the Beltway
13	Surry County Board of Commissioners	7-19-04	Supports Project U-2579
14A	Stokes County Board of Commissioners	9-13-04	Supports Project U-2579
14B	Stokes County Board of Commissioners	6-14-04	Supports the Beltway
15A	Winston-Salem City Council	12-20-04	Requests selection of Alternative N2-S1 with an interchange at Kernersville Road. Also, construction of new major roads

			and/or connections to replace thoroughfares severed or eliminated by the Beltway; construction of new collector and local roads to provide access to areas isolated by construction; and incorporation of the provision of the planned bicycle, pedestrian, and greenway facilities into the design.
15B	Winston-Salem City Council	6-7-04	Supports the Beltway
16	Winston-Salem Urban Area Transportation Advisory Committee (TAC)	7-15-04	Supports the Beltway
17	Idealliance/Piedmont Triad Research Park	12-2-04	Requests selection of Alternative Segment S1
18	Hillsville Town Council	11-11-04	Supports the Beltway
19	Pilot Mountain Town Council	9-27-04	Supports the Beltway
20	Dobson Town Board	9-23-04	Supports the Beltway
21	Galax City Council	11-8-04	Supports the Beltway
22	Carroll County	11-13-04	Supports the Beltway
23	City of Mount Airy Board of Commissioners	9-16-04	Supports Project U-2579
24	Danbury Town Council	9-15-04	Supports the Beltway
25	Town of Kernersville	1-3-05	Provide an interchange between US 158 and US 421/I-40 Business and/or provide indirect access onto the Beltway via the proposed Big Mill Farm Road interchange with US 421/I-40 Business. Construct grade separations at Hastings Hill Road and Pisgah Church Road. Reconstruct and/or realign Oak Grove Church Road to retain the connection.

6.2.4 Conclusion

Public involvement activities throughout the EIS process provide citizens with an opportunity to comment and provide input before project decisions were made. The activities included conducting workshops and hearings and soliciting information from the public on the selection criteria and the individual alignments as they were being evaluated. In addition, a combination of newsletters, toll-free telephone numbers, website, small group meetings, and information repositories was used to give citizens easy access to timely information about the technical aspects of the project.

6.3 RESPONSES TO COMMENTS ON THE 1995 PROJECT U-2579 DEIS

The Draft Environmental Impact Statement for Project U-2579 was coordinated with federal, state, and local agencies and organizations, as well as with the public through an extensive public involvement program (see **Section 6.2.2.1**).

Below is a list of specific agencies and organizations to which a 1995 Project U-2579 DEIS was sent with an asterisk (*) indicating those commenting:

- FEDERAL AGENCIES
  - * US Environmental Protection Agency
  - * US Department of Transportation
  - * US Department of the Interior
  - * US Department of Commerce
  - * US Department of Agriculture
  - US Department of Energy
  - Federal Railroad Administration
  - * Federal Emergency Management Agency
  - Office of Management and Budget
  - Interstate Commerce Commission
  - Federal Aviation Administration

- REGIONAL OFFICES
  - Regional Representative of the Secretary of Transportation
  - Department of Housing and Urban Development
  - Environmental Protection Agency
  - * US Army Corps of Engineers
  - US Fish and Wildlife Service
  - Federal Emergency Management Agency
  - General Services Administration

- STATE AGENCIES
  - North Carolina Department of Human Resources (Now NCDHHS)
  - North Carolina Department of Environment, Health, and Natural Resources (Now NCDENR)
  - North Carolina Wildlife Resources Commission
  - * North Carolina Department of Cultural Resources
  - North Carolina Department of Public Instruction
  - State Clearinghouse

- LOCAL GOVERNMENTS
  - Piedmont-Triad Council of Governments
  - Chairman, Forsyth County Commissioners
  - Mayor of Winston-Salem
  - Mayor of Rural Hall
  - Mayor of Kernersville
  - Mayor of Walkertown

- LOCAL AGENCIES
  - Piedmont-Triad International Airport
  - * City-County Planning Board
  - Winston-Salem-Forsyth County Schools
  - * Greater Winston-Salem Chamber of Commerce
  - Winston-Salem Police Department
  - Winston-Salem Fire Department
  - Winston-Salem Department of Transportation

Written responses received from agencies commenting on the Project U-2579 DEIS are summarized below with responses as appropriate. The letters are reproduced in full in **Appendix D.5**. Each response follows the comment and is printed in italics.

United States Department of Transportation, Federal Transit Administration

Letter dated: August 23, 1995

Comment: We concur with the assessment that the requirements for a major investment study have substantially been met.

Response: *None required.*

Federal Emergency Management Agency

Letter dated: October 11, 1995

Comment: The waterways listed in the DEIS have regulatory floodways delineated and 100-year floodplains. Any encroachment into these areas must be in compliance with the National Flood Insurance Program (NFIP) regulations. The Agency in charge must comply with the floodplain management measures enacted by the State of North Carolina. It is imperative that the Agency coordinates closely with the appropriate staff in the Floodplain Management Section of the Division of Emergency Management.

Response: *The project will be designed to comply with all federal and state floodplain regulations and requirements. Design of drainage structures will be coordinated with appropriate staff in the Division of Emergency Management.*

United States Department of Interior

Letter dated: October 13, 1995

Comment: Cooperation and coordination with the State Historic Preservation Officer is recommended to ensure that no historic and archaeological resources are being impacted after the selection of the Preferred Alternative. If any of these resources are affected, a Memorandum of Agreement (MOA) should be prepared to include measures to avoid or minimize harm to historic and archaeological resources in compliance with Section 106 of the National Historic Preservation Act of 1966, as amended. Also, a signed copy of the MOA should be included in the final statement.

Response: *The project design will be designed to avoid historic and archaeological resources where possible. The project's development and preliminary design has been closely coordinated with the State Historic Preservation Officer. Project U-2579 will have an adverse effect on one eligible archaeological site. A Memorandum of Agreement has been prepared in accordance with Section 106 of the National Historic Preservation Act of 1966, as amended, and is found in Appendix D.1. The MOA addresses this archaeological site, as well as several archaeological sites and one historic structure adversely affected by Project R-2247. It provides for data recovery for the archaeological sites and for data recordation and preservation of the Hege House.*

United States Department of Commerce, Office of the Under Secretary for Oceans and Atmosphere

Letter dated: October 23, 1995

Comment: The location and designation of any horizontal and vertical geodetic control monuments in the proposed project should be identified.

Response: *The project design will identify any horizontal and vertical geodetic control monuments within the proposed right-of-way.*

Comment: If there are any planned activities which will disturb or destroy these monuments, the National Geodetic Survey (NGS) requires not less than 90 days prior notification in order to plan for relocation. NGS recommends that funding for this project include the cost of any relocation(s) required.

Response: *National Geodetic Survey will be notified at least 90 days prior to construction regarding the relocation of any monuments. The funding for the project will provide for the relocation of such markers.*

North Carolina Department of Cultural Resources

Letter dated: November 3, 1995

Comment: The description of the John and Matthew Clayton Houses in the DEIS states that the historic property consists of approximately fifteen (15) acres. There is a discrepancy between that figure, the eleven (11) acres that the survey report proposed, and the approximately twenty-five (25) acres that we believe should be included within eligible boundaries. Please resolve this discrepancy in the Final Environmental Impact Statement.

Response: *The Historic Architectural Resources Phase II Intensive Survey Report for Project U-2579 (Section VI.A., April 2003) indicates that the Clayton Family Farm, which includes the John and Matthew Clayton Houses, consists of approximately 25 acres, which is consistent with the boundaries included on the National Register of Historic Places.*

Comment: We have not been consulted about the effects of the project on the Clayton Farm or the John and Charles Fries Day Farm, properties eligible for the National Register of Historic Places. We cannot concur with the findings of effect in the DEIS at this time.

Response: *Following a meeting on March 1, 2004 with NCDOT, HPO, and Kimley-Horn and Associates, the FHWA, the HPO, and the NCDOT concurred that Project U-2579 would have no adverse effect on the Clayton Family Farm under the condition that any trees that are removed during construction are replaced with trees of a similar species. Following a meeting on April 21, 2004, the FHWA, the HPO, and the NCDOT also concurred that Project U-2579 would have no effect on the John and Charles Fries Day Farm (see signed concurrence forms in Appendix D.4).*

Department of the Army, Wilmington District, Corps of Engineers

Letter dated: November 17, 1995

Comment: We agree to accept cooperating agency status and will conduct normal review and consultation as requested by your agency. This will include providing comments concerning effects on Corps of Engineers' projects and flood plains, as well as Section 404 permit requirements.

Response: *None required.*

United States Environmental Protection Agency

Letter dated: November 30, 1995

Comment: We are concerned about limiting the scope of the Draft Environmental Impact Statement to the eastern segment of the Northern Bypass. It is appropriate for the environmental review of large highway projects to evaluate the entire proposed project. Defining the western terminus of the eastern segment would compromise the subsequent consideration of the routing for the western segment. If phasing of the implementation of project segments is appropriate, that should proceed only after a comprehensive evaluation of the bypass. The DEIS should have at a minimum described the alternative connecting points to the future western segment.

Response: *As discussed in Chapter 1, the eastern and western sections of the Northern Beltway have independent utility, have different purposes, and serve different needs. The termini of the projects at US 52 were developed in coordination with each other, and the location was determined to be appropriate for both projects. Since the Western Section (Project R-2247) came first in time, the eastern terminus of the Western Section was studied and selected taking into account the connection to the Eastern Section (see Section 2.6.2). This environmental document includes both the eastern and western sections of the Beltway, discusses the reasons for selection of the termini, and addresses the impacts of the individual sections and of the entire Northern Beltway.*

Comment: There should have been a consideration of widening NC 66 with small bypasses of Kernersville and Walkertown. This alternative could improve traffic capacity, minimize the amount of new alignment and minimize relocations. It seems logical that traffic management could be instituted to exclude heavy trucks passing through Kernersville and Walkertown.

Response: *The widening of NC 66 was discussed in Chapter 2. This widening was determined not to meet one key component of the purpose and need of this project, which is to serve as part of I-74 and thus needs to be a freeway with full control of access. In addition, widening of existing NC 66 would result in prohibitive cost and disruption, particularly to the portion of NC 66 from west of Kernersville to US 421/I-40 Business.*

Comment: We are not sure that the Salem Lake Watershed Area Plan has received adequate consideration relative to secondary impacts. The greatest concern is controlling future development within this water supply watershed. One of the best ways to control development is to limit freeway interchanges. We think NCDOT should consider deleting an interchange from the Salem Lake Watershed.

Response: *The Salem Lake Watershed Plan and watershed protection measures are discussed in depth in this document. The impacts of the alternatives on the watershed, both direct and indirect, are discussed in Chapter 4. One of the preliminary alternatives was eliminated largely because of its impact on the watershed. No interchanges or roadway segments are within the WS III critical area for Salem Lake. Two interchanges are within the Salem Lake watershed: Reidsville Road (US 158) and US 421/Business I-40. The US 421/Business I-40 interchange is a freeway-to-freeway interchange, with no access to property, so its impact on development would be minimal..*

Comment: We note that the bypass project is proposed to cross future segments of the greenway system. The highway project plans should include provisions for assisting the implementation of these greenways for the designated recreational use specified in the Greenway Plan. The Federal Highway Administration could insure such implementation by a condition on the award of the highway funds to the State.

Response: *Design of the highway will consider the proposed greenways and will, where feasible, provide for crossings that will accommodate the greenways. There are no existing greenways crossing the proposed Beltway alignment. In the merger meetings, NCDOT agreed to design culverts large enough accommodate proposed greenways on the Winston-Salem and Forsyth County greenway plans in locations where a bridge would not be used. This includes culverts at Mill Creek and Frazier Creek (see concurrence forms in Appendix D.4).*

Comment: We did not identify any one alternative as being clearly superior. We are rating all project alternatives EC-2, meaning we have identified potential impacts to a water supply reservoir which should be avoided. We believe the DEIS does not contain sufficient information about the western segment connection to fully define the project impacts.

Response: *Impacts to the Salem Lake water supply watershed are included in the analysis of alternatives in this document. Connectivity issues as well as cumulative impacts are fully addressed in this combined SFEIS on Project R-2247/FEIS on Projects U-2579 and U-2579A..*

United States Department of Agriculture

Letter dated: December 15, 1995

Comment: There are no National Forest System lands in the project area.

Response: *None required.*

Winston-Salem/Forsyth County City-County Planning Board

Letter dated: January 26, 1996

Comment: *Vision 2005, The Comprehensive Plan for Forsyth County and Winston-Salem, North Carolina* supports the concept of building the Northern Beltway. However, as a preferred alternative is chosen, we ask that you carefully consider and act judiciously upon the following issues and concerns:

Preserve the integrity of the Salem Lake watershed by minimizing the impacts upon sensitive environmental areas and limit, to the greatest extent possible, areas disturbed by construction.

Response: *The Salem Lake Watershed Plan and watershed protection measures are discussed in depth in this document. The impacts of the alternatives on the watershed, both direct and indirect, are discussed in Chapter 4. One of the preliminary alternatives was eliminated largely because of its impact on the watershed. No interchanges or roadway segments are within the WS III critical area for Salem Lake. The Preferred Alternative has three interchanges within the Salem Lake watershed: Reidsville Road (US 158), US 421/Business I-40, and Kernersville Road. The US 421/Business I-40 interchange is a freeway-to-freeway interchange, with no access to property, so its impact on development would be minimal.*

Comment: Locate the Beltway inside the sewer service area of the Muddy Creek Basin which generally lies southwest of NC 66.

Response: *The Preferred Alternative remains within the Muddy Creek Basin except between University Parkway and Old Rural Hall Road. However, the route segment that was chosen in that area is closer to the Basin boundary than the other alternatives.*

Comment: Accommodate the emerging industrial corridor along US 52 and the growing transportation needs of US 52/I-74 by designing the Beltway (especially bridges) to accommodate a minimum of six lanes.

Response: *The Northern Beltway from US 52 to US 421/I-40 Business is designed as a six-lane section with the ability to widen to eight lanes.*

Comment: Design the interchange at Business I-40 to facilitate the Beltway extension to I-40 and US 311 South.

Response: *The interchange of the Northern Beltway with I-40 Business accommodates Project U-2579A, which is the Northern Beltway Eastern Section Extension from I-40 Business to US 311, also addressed in this document.*

Comment: Provide a location along the beltway for an interchange to connect a future controlled access highway to Piedmont Triad International Airport at NC 68.

Response: *The distance between the proposed interchanges at Reidsville Road and US 421/I-40 Bypass is approximately 3.5 miles. This provides adequate interchange spacing for a future connector to the airport, as shown in the Thoroughfare Plan.*

Comment: Design beltway and beltway interchanges to facilitate traffic movement and not to promote commercial development.

Response: *Interchanges will be designed to accommodate projected future traffic volumes based on an adopted land use plan. The interchanges will be designed to interstate standards, and control of access along interchanging surface streets will generally extend about 1000 feet from the interchange ramp terminals, consistent with NCDOT design standards for this type of facility.*

Comment: Work closely with local economic development officials to accommodate potential new industrial sites near the beltway and provide frontage roads or other means of vehicular access to them.

Response: *The design hearing will provide an opportunity for the public and local officials to review preliminary design plans and to provide input on access near interchanges.*

Comment: Build brick noise barriers with attractive landscaping.

Response: *Noise barriers may be provided based on the results of design noise studies and public input. As stated in NCDOT's 2004 Traffic Noise Abatement Policy, noise barrier materials will be selected based on economics, effectiveness, and, to a limited degree, visual impact. Should a local jurisdiction request that a material be used for the noise barrier that is more costly than that proposed by NCDOT, the requesting body must assume 100 percent of the additional cost (see* ***Section 4.8.4****)*

Comment: Design bridges at interchanges to accommodate bicycle crossings.

Response: *Bicycle accommodations may be provided based on local bicycle plans and NCDOT policies.*

Comment: Retain natural areas along the beltway and design new naturalized landscape areas in medians, interchanges, and other locations using wild flowers and native plant materials.

Response: *During design and construction, efforts will be made to minimize the impact to existing vegetative buffers and natural areas. A post construction landscape design/corridor plan*

will be completed to mitigate construction impacts and integrate enhancements, while remaining sensitive to the environment and to the safety of the traveling public.

6.4 RESPONSES TO COMMENTS ON THE 2004 SFEIS/SDEIS

The SFEIS/SDEIS for Projects R-2247, U-2579, and U-2579A was coordinated with federal, state, and local agencies and organizations, as well as with the public through a public involvement program. **Section 6.4** summarizes the comments and responses to comments received on the October 2004 SFEIS/SDEIS. None of the comments received require an extensive response or change to the EIS.

Listed below are the specific agencies and organizations to which a 2004 SFEIS/SDEIS was sent, with an asterisk (*) indicating those commenting:

- FEDERAL AGENCIES
  - * US Environmental Protection Agency
  - US Department of the Interior
  - US Department of Commerce
  - US Department of Agriculture
  - US Department of Energy
  - US Department of Health and Human Services, Office of Environmental Affairs
  - Federal Railroad Administration
  - Federal Emergency Management Agency
  - Office of Management and Budget
  - Interstate Commerce Commission
  - Department of Housing and Urban Development
  - US Army Corps of Engineers
  - US Fish and Wildlife Service
  - Federal Emergency Management Agency
  - General Services Administration
  - Federal Transit Administration

- STATE AGENCIES
  - North Carolina Department of Health and Human Resources
  - * North Carolina Department of Environment and Natural Resources
  - * North Carolina Wildlife Resources Commission
  - * North Carolina Department of Cultural Resources
  - North Carolina Department of Public Instruction
  - North Carolina Department of Commerce – Travel and Tourism Division

North Carolina Department of Economic and Community Development
State Clearinghouse

- LOCAL GOVERNMENTS
  - Chairman, Forsyth County Commissioners
  - * Mayor, Winston-Salem City Council
  - City of Winston-Salem Planning Department
  - * City of Winston-Salem Engineering Department
  - * Town of Kernersville
  - Town of Bethania
  - Town of Walkertown
  - * Town of Rural Hall
  - * Village of Tobaccoville
  - Town of Lewisville
  - Village of Clemmons

- LOCAL AGENCIES
  - Winston-Salem/Forsyth County Urban Area Metropolitan Planning Organization
  - * City-County Planning Board (Winston-Salem/Forsyth County)
  - * Winston-Salem-Forsyth County Schools
  - * Winston-Salem Department of Transportation

Written responses that were received from agencies commenting on the SFEIS/SDEIS are summarized below, with responses as appropriate. **Table 6-4** summarizes comments from federal and state agencies, and **Table 6-5** summarizes citizen comments. The letters are numbered and are reproduced in full in **Appendix C.4** (citizen comments) and **Appendix D.9** (agency comments).

Table 6-4: Comments from Federal and State Agencies

Project	Agency	Letter-Comment Number	Comment	Response
R-2247	HPO	A9-1	Project R-2247 has the potential to impact the Bethania National Landmark Historic District.	The map of the historic district boundaries included in the comment letter was reviewed, and found to be consistent with the boundaries recorded in the Phase II Historic Architecture Survey that supports the SFEIS/FEIS. It was determined that Project R-2247 would not directly impact the Bethania National Landmark Historic District. Also, according to the Town of Bethania *Comprehensive Transportation & Land Use Study* completed in 2001, traffic on Main Street "is projected to increase to 12,200 vpd in 2025, and significantly more (21,200 vpd) if a proposed Winston-Salem beltway is not constructed. Almost all traffic on Main Street is through traffic. Without significant traffic reduction, the Town's efforts to generate tourism with the new Visitors Center will be hindered, and historic structures on Main Street will continue to be adversely affected." More discussion on the effects of the proposed Northern Beltway on traffic is found in Section 2.9.4. Section 2.9.3.4.4 describes the agency coordination related to the Bethania-Tobaccoville Road interchange.
All	NC Dept of Environ-ment and Natural Resources (NCDENR),	A21-1	DENR does not wish to delay this document by requesting additional documentation at this time. However, these concerns [comments from DENR Divisions] will need to be resolved prior to the applicant applying for the Section 401 Water Quality Certification. The applicant is encouraged to continue to work with the Division of Water Quality and the NC Wildlife Resources	The NCDOT will provide the Division of Water Quality and the NC Wildlife Resources Commission all documentation needed for a complete Section 401 Water Quality Certification permit application.

Table 6-4: Comments from Federal and State Agencies

Project	Agency	Letter-Comment Number	Comment	Response
	Environ-mental Review Coordinator		commission prior to finalizing project plans. It is also recommended that the applicant make the necessary information readily available to these agencies in order to avoid unnecessary delays in the permit process.	
All	NCDENR Division of Water Quality (NCDWQ)	A22-1	DWQ agrees with the purpose and need of the projects.	Comment noted.
All	NCDWQ	A22-2	DWQ agrees with the preferred alternatives for TIP Project Nos. R-2247 and U-2579. DWQ will not provide comments regarding our preferred alternatives for TIP Project U-2579A at this time.	Subsequent to this letter, on March 14, 2005, the NCDWQ concurred with the selection of Project U-2579A Detailed Study Alternative N2-S1 as the Least Environmentally Damaging Practicable Alternative (see the signed concurrence form in **Appendix D.4**). This alternative was then selected as the Preferred Alternative on March 16, 2005.
U-2579A	NCDWQ	A22-3	The stream labels in Table 4-62 on pages 4-148 and 4-149 do not match the stream labels on maps 3-12c and 3-12d.	Table 4-62 has been corrected. An "S" was inserted just prior to each number in the Stream Label column. For example, Stream Label ESE-1 in Table 4-62 was revised to be Stream Label ESE-S1 to correspond to the correct stream labels on Figures 3-12c and 3-12d.
U-2579A	NCDWQ	A22-4	DWQ is very concerned about alternatives that would impact stream ESE-S20, Muddy Creek (12-94-(0.5)). DWQ considers a segment of Muddy Creek to be unique. The stream bed and bank	As originally developed, the Preferred Alternative N2-S1 would not directly impact Muddy Creek in the vicinity of the bedrock formation, as was confirmed during the interagency

Table 6-4: Comments from Federal and State Agencies

Project	Agency	Letter-Comment Number	Comment	Response
			for this segment consists of a solid bedrock formation for an approximate length of 150 linear feet. This segment of Muddy Creek would be directly in the impact corridor of the proposed S1 Alternative Segment.	field visit on November 3, 2004. The creek would be impacted several hundred feet downstream of this area. Based on agency concerns, the design was modified to totally avoid impacts to Muddy Creek both upstream and downstream of the rock outcrop area. The only impact to Muddy Creek would be a two-barrel box culvert approximately 2000 feet downstream of this area, near the confluence of Muddy Creek with Swaim Creek.
All	NCDWQ	A22-5	Prior to issuance of the 401Water Quality Certification, NCDOT will need to demonstrate the avoidance and minimization of impacts to wetlands (and streams) to the maximum extent practical. Based on the impacts described in this document, wetland mitigation will be required for this project in accordance with Environmental Management Commission's Wetland Rules (15A NCAC 2H.0506(h)(2)).	NCDOT has coordinated with NCDWQ and USACE to avoid and minimize impacts to wetlands and streams through Concurrence Points 2A (avoidance and minimization) and 4A (bridging decisions and alignment review). NCDOT will continue work with these agencies for Concurrence Points 4B (review of conceptual drainage design with 30 percent hydraulic design) and 4C (review surface drainage design and permit drawings with 100 percent hydraulic design) and to obtain a Section 401 Water Quality Certification and a Section 404 Permit prior to project construction.
All	NCDWQ	A22-6	…mitigation will be required for impacts of greater than 150 linear feet to any single perennial stream. In the event that mitigation is required, the mitigation plan should be designed to replace appropriate lost functions and values. In accordance with the Environmental Management Commission's Rules (15A NCAC 2H.0506(h)(3)), the NC Ecosystem Enhancement Program may be available for use as stream mitigation.	During the Section 401 Water Quality Certification and Section 401 Permit application process, NCDOT will work with NCDWQ and the US Army Corps of Engineers to determine appropriate mitigation.

Table 6-4: Comments from Federal and State Agencies

Project	Agency	Letter-Comment Number	Comment	Response
All	NCDWQ	A22-7	Any new culverts must be countersunk to allow unimpeded fish and other aquatic organisms passage through the crossing.	For new culverts constructed in streams, the inverts will be buried at least one foot below the bed of the stream for culverts greater than 48 inches in diameter. For culverts 48 inches in diameter or smaller the inverts will be buried below the bed of the stream to a depth equal to or greater than 20 percent of the diameter of the culvert.
All	NCDWQ	A22-8	The 401 Water Quality Certification application will need to specifically address the proposed methods for storm water management. More specifically, storm water will not be permitted to discharge directly into the creek. Instead, storm water should be designed to drain to a properly designed storm water detention facility/apparatus.	The Section 401 Water Quality Certification application will specify storm water management methods. NCDOT will develop a storm water management plan and use appropriate storm water Best Management Practices to control and/or treat storm water runoff.
All	NCDWQ	A22-9	If applicable, NCDOT should not install the bridge bents in the creek, to the maximum extent practicable.	NCDOT will avoid installing bridge bents in creeks to the maximum extent practicable.
All	NCDWQ	A22-10	If foundation test borings are necessary, it should be noted in the document. Geotechnical work is approved under General 401 Certification Number 3027/Nationwide Permit No. 6 for Survey Activities.	It is anticipated that foundation test borings will be necessary. NCDOT will obtain any required permits for this work.
All	NCDWQ	A22-11	Sediment and erosion control measures should not be placed in wetlands.	Sediment and erosion control measures should not be placed in wetlands or waters to the maximum extent practicable. If placement of sediment and erosion control devices in wetlands or waters is unavoidable, they shall be removed and

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				the natural grade restored once the project is complete and fill slopes have been stabilized.
All	NCDWQ	A22-12	Borrow/waste areas should avoid wetlands to the maximum extent practicable. Impacts to wetlands in borrow/waste areas could precipitate compensatory mitigation.	Contract standard specifications prohibit a contractor from selecting borrow/waste sites that are in wetland areas.
All	NCDWQ	A22-13	While the use of National Wetland Inventory (NWI) maps and soil surveys is a useful office tool, their inherent inaccuracies require that qualified personnel perform onsite wetland delineations prior to permit approval.	Wetlands in the study area were identified by qualified personnel performing onsite surveys and delineation.
U-2579, U-2579A	NC Wildlife Resources Commission (NCWRC)	A23-1	Sediment and erosion control measures should adhere to the design standards for sensitive watersheds in portions of the project that drain to Water Supply waters. (Salem Lake, Martin Mill Creek, Lowery Mill Creek, Smith Creek, Fishers Branch, and associated tributaries are WS-III streams, Kerners Mill Creek is a WS-II stream. The eastern extension area is on the border of a WS-III area associated with Abbotts Creek).	NCDOT will incorporate sediment and erosion control measures according to the Design Standards in Sensitive Watersheds for all construction in high quality water (HQW) zones. See the table at http://h2o.enr.state.nc.us/csu/freshwater.pdf for more information.
All	NCWRC	A23-2	The project is expected to further fragment wildlife habitat. Measures, such as longer bridges and use of floodplain drains (pipes or culverts), will provide some additional habitat connectivity, as well as spread out flood flows, which reduces flood damage. NCDOT should continue to work closely with the proper authorities to protect the floodplains and floodways and provide habitat connectivity.	As discussed in Section 4.14.3.1 of the SFEIS/FEIS, all bridges and culverts will be designed and constructed in accordance with the FHWA's floodplain impact requirements, which require the minimization of upstream headwater elevations due to roadway construction across floodplains. In National Flood Insurance Program (NFIP) flood hazard areas, the final hydraulic designs of the selected alternatives will be

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				such that the floodway would carry the 100-year flood without a substantial increase in flood elevation. In addition, the Merger Team agreed to include wildlife crossings where appropriate in the vicinity of stream crossings, which provide opportunities for animals to cross under the Beltway.
All	NCWRC	A23-3	NCDOT should work with local officials to accommodate both existing and proposed greenways that cross the project.	There are no existing greenways crossed by the Preferred Alternatives for Projects R-2247, U-2579, and U-2579A. However, there are several proposed greenways that cross the alignments. In the merger meetings, NCDOT agreed to design culverts large enough to accommodate any proposed greenways on the Winston-Salem and Forsyth County greenway plans in locations where a bridge would not be used. These locations include culverts at Mill Creek and Frazier Creek.
All	NCWRC	A23-4	The US Environmental Protection Agency has also recommended the county be designated nonattainment for the fine particulate matter standard.	On December 17, 2004, EPA took final action to designate attainment and nonattainment areas under the more protective national air quality standards for fine particulate matter ($PM_{2.5}$). The final designations included only Davidson and Guilford Counties in the Greensboro/Winston-Salem/High Point area. Forsyth County was not included in the final designations. EPA website: http://www.epa.gov/pmdesignations/regions/region4desig.htm, accessed January 9, 2007).

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All	NCWRC	A23-5	We recommend that air quality be monitored in the project study areas before, during, and after construction and that mitigating measures be employed as appropriate.	Forsyth County operates eight air quality monitoring stations located throughout the county. Each station measures one or more criteria pollutants, and this data is used to help determine attainment status regarding the National Ambient Air Quality Standards (NAAQS). 1. Pollirosa – Ozone 7635 Hollyberry Lane (NW Forsyth Co.) 2. Shiloh Church – Ozone Shiloh Ch. Rd near Baux Mtn Rd 3. North Forsyth – $PM_{2.5}$ Behind North Forsyth High School 4. Five Points – Carbon Monoxide Intersection of Country Club Rd and Stratford Rd 5. Hattie Ave A & B – All pollutants except lead Corner of 13th and Hattie Ave 6. Hanes Mall – Carbon Monoxide Corner of Hanes Mall Blvd and Stratford Rd 7. Peters Creek – PM_{10} and Carbon Monoxide Corner of Peters Creek Pkwy/Silas Creek Pkwy 8. Union Cross – Ozone Across from Piedmont Memorial Gardens Cemetery off of US 311 Detailed information on Forsyth County's air quality monitoring activities can be found at the Forsyth County Environmental Affairs Department website http://www.co.forsyth.nc.us/EnvAffairs/.

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Project	Agency	Letter-Comment Number	Comment	Response
				The proposed project is not expected to cause localized (microscale) or regional exceedances of the NAAQS. Therefore, additional air quality monitoring stations will not be set up specifically for the proposed project.
All	NCWRC	A23-6	We applaud the County's efforts to manage growth and protect natural areas, which will benefit wildlife, water quality, and the quality of life for residents. However, we are concerned with the extent these measures and guidelines are being implemented, as we understand that violations of environmental regulations, stream degradation, failure to acquire proper Clean Water Act permits, and loss of farmlands/open spaces are on-going problems in Forsyth County.	Issues cited in this comment are not related to the NCDOT's actions on Projects R-2247, U-2579, and U-2579A. No response is required in this document.
All	NCWRC	A23-7	A summary of the Draft Winston-Salem Northern Beltway Indirect and Cumulative Effects Assessment was provided, however we would like to request a copy of the full report.	The WRC was provided a copy of the full final technical memorandum in August, 2005.
All	NC WRC	A23-8	Secondary and cumulative impacts are a major concern for the project. A detailed assessment of secondary and cumulative impacts to water quality and natural areas was not presented and no details were given about existing regulations and to what extent growth will be limited and water quality will be protected.	Section 4.20.7.2 of the SFEIS/FEIS states "NCDOT is preparing water quality modeling in support of a Section 401 Water Quality Certification application to the NCDWQ." The results of the analysis will be used to support the Section 401 Water Quality Certification requirements, and may also be used to address concerns related to indirect and cumulative effects, since development shifts are incorporated into the water quality analysis.

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Project	Agency	Letter-Comment Number	Comment	Response
All	NCWRC	A23-9	No estimation of impervious surface coverage currently existing or expected at build-out was provided, nor when built-out is likely to occur.	See Responses to Comments A23-7 and A23-8.
All	NCWRC	A23-10	Additional regulations or ordinances may be necessary to adequately protect water quality and preserve wildlife habitat and open space, which is very important to the health of the area.	Regulations and ordinances related to water quality and preservation of habitat/open space are outside the scope of this project and outside the authority of NCDOT and FHWA. Local governments or other state agencies may address these issues.
All	NCWRC	A23-11	We believe the land surrounding the project corridor will become much more attractive to industrial, commercial and residential development and that secondary and cumulative impacts will be substantial, much more so than the document indicated.	The *Indirect and Cumulative Impacts Analysis* was performed by the Louis Berger Group, using staff nationally recognized as experts in indirect and cumulative effects assessments. The study was performed in accordance with the NCDOT's *Indirect and Cumulative Impact Guidance Manuals Volumes I and II*, which also were prepared with the assistance of the Louis Berger Group. Berger's analysis reports that the expected percentage of housing shifting locations due to the addition of the Northern Beltway ranges from 0.6 percent to 3.3 percent while the percentage of jobs changing locations ranges from 0.4 percent to 4.4 percent. The absolute magnitude of change at the zonal level is small. Also, see Response to Comment 225-30/65.
All	NCWRC	A23-12	The Northern Beltway, combined with other public and private	This project's SFEIS/SDEIS and SFEIS/FEIS can be a useful

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Project	Agency	Letter-Comment Number	Comment	Response
			projects, places additional pressures from induced development, induced travel, and impacts on communities, natural habitat, and water quality. Governments and stakeholders groups should be prepared for these changes and be proactive in mitigating for their negative effects.	tool for local governments and stakeholder groups in understanding the environmental and social impacts (both beneficial and adverse) of the proposed projects, as well as the indirect and cumulative impact of these projects and other reasonable foreseeable projects in the area.
All	NCWRC	A23-13	We strongly encourage NCDOT and local authorities to work together to adopt and implement regulations and measures that would provide significant protection to the area's natural resources. Measures can be found in the *Guidance Memorandum to Address and Mitigate Secondary and Cumulative Impacts to Aquatic and Terrestrial Wildlife Resources and Water Quality* (NCWRC 2002).	The Forsyth County Environmental Affairs Department (EAD) has implemented a stream monitoring program that, since 1996, has been actively monitoring 12 stream locations annually across Forsyth County. The EAD, through partnership with the NC Department of Environment and Natural Resources (DENR), reacts to pollution problems and turns over evidence of concerns to the appropriate authority.
All	NCWRC	A23-14	We strongly encourage NCDOT and local authorities to use low impact development techniques to manage stormwater quantity and quality (see www.lowimpactdevelopment.org for information).	It is not within the authority of the NCDOT to limit how development occurs apart from controlling access to its highways. The proposed Beltway will have full control of access. This project's Indirect and Cumulative Impact Analysis and the downstream water quality analysis that will be prepared in support of the Section 401 Water Quality Certification can be useful tools for local governments and stakeholder groups in understanding the environmental and social impacts (both beneficial and adverse) of the proposed projects, as well as the indirect and cumulative impact of these projects and other reasonably foreseeable projects in the area.

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Project	Agency	Letter-Comment Number	Comment	Response
All	NCWRC	A23-15	We encourage the use of non-impervious materials to construct sidewalks, parking lots, and other facilities, particularly in developed watersheds with a high percentage of impervious surfaces.	NCDOT will use concrete for sidewalks constructed as part of this project. No parking lots will be constructed as part of this project.
All	NCWRC	A23-16	It may be appropriate for NCDOT to coordinate with local planning authorities and park authorities to offset aquatic and terrestrial impacts and diminished habitats and open spaces in the Abbotts Creek water supply drainage through purchase of parklands or development rights or farmland preservation as described south of US 311 on Abbotts Creek and Idlewild Road Creeks in the Union Cross/Southeast Forsyth County Area Plan Future Land Use Plan.	The FHWA and NCDOT do not have the legal authority to regulate local land use nor purchase land for uses unrelated to transportation projects. Off-site mitigation will be done by Ecosystem Enhancement Program. NCDOT will inform EEP of NCWRC's comment, in the event EEP desires to use local parkland for mitigation.
All	NCWRC	A23-17	Substantial stream restoration potential exists on the Abbotts Creek drainage. These opportunities should be fully evaluated.	During the permitting phase of the project, the NCDOT will be investigating on-site mitigation opportunities throughout the area. Off-site mitigation for the project is being implemented by the Ecosystem Enhancement Program.
General	US Environ-mental Protection Agency (USEPA)	A24-1	Beltways are usually proposed in part to divert traffic and avoid adverse impacts of expanding older routes through city centers. Project U-2826 is a separate project identified in the Long Range Transportation Plan that would upgrade US 52 to a 6-lane freeway from I-40 northward to the proposed Northern Beltway. Since both the western and eastern portions of the Northern Beltway would provide new north-south freeway travel alternatives, it appears that U-2826 would be less needed. Improving and widening US 52 to	TIP Project U-2826 calls for upgrading and widening of US 52 from I-40 to the proposed Beltway interchange. It includes the replacement of two bridges, TSM-type improvements, and interchange improvements. The proposed cross-section is basically a six-lane facility, not including auxiliary lanes. This project is included in the *2006-2012 Transportation Improvement Program (TIP)* and in the *2030 LRTP*, which shows US 52 widened to six lanes through the downtown area

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			8-lanes was considered but rejected as an alternative to the Northern Beltway because of costs and environmental impacts, so it is unclear why this project remains in the Long Range Transportation Plan.	by 2014. (The LRTP includes a financial plan.) Project U-2826 will improve safety as well as adding to capacity on US 52. Projected traffic volumes show that the Northern Beltway is needed even taking into account Project U-2826, and vice versa. This is well-documented in Chapter 1 (see Section 1.11) of this document. Traffic volumes show that if the Northern Beltway were not built, an eight-lane cross-section, not including any auxiliary lanes, would need to be provided on US 52 to adequately serve design year traffic (see Tables 1-6 and 1-9). This eight-lane facility also would need to be built to Interstate standards in order to carry I-74 in the absence of Project U-2579. An eight-lane interstate facility is neither in the TIP nor in the *2030 LRTP*. This unplanned, unprogrammed eight-lane interstate facility is what was considered as an alternative to the Beltway in Chapter 2 of this document (see Section 2.6.3.2).
R-2247	USEPA	A24-2	Documenting changes in the man-made environment is the primary reason mentioned in Section 2.9.2 for the re-evaluation of the western section (R-2247) alternatives. In all but a few cases, the impacts to the natural environment are spoken of in relative terms as not significant factors in the selection of the alternatives. Apparently the quality of the streams, wetlands, and other natural	The primary reason for the re-evaluation of the Western Section was to review the Preferred Alternative "in light of current conditions to determine if changes have occurred that could impact the selection of C3-WEST-B" as the Preferred Alternative (Section 2.9.2). Current conditions included both the natural and human environment. The SFEIS/FEIS simply

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			areas of the project area have not been surveyed to determine whether there have been changes since the 1993 analyses. Although there has been a development moratorium with the preferred alternative alignment, it cannot be assumed that the quality of the natural resources have not changed within or beyond the preferred corridor.	notes that the human environment would be the most likely to have experienced the greatest changes since 1993. In Section 2.9.2, changes in impacts since 1993 are discussed in relative terms for all issues (human and natural environments). It was not necessary for the decision-making process to quantitatively update impacts for all resources in all Detailed Study Alternatives. As stated in Section P5 of the SFEIS/FEIS, "In the NEPA regulations, it is stated NEPA documents should 'concentrate on the issues that are truly significant to the action in question [40 CFR Part 1500.1(b)]'. Following this policy, information in this document is updated where practicable and/or necessary for an adequate comparison of alternatives; to provide a clear understanding of the potential consequences of the proposed actions; and for effective decision-making by public officials." Section 2.9.2 describes how each issue that was a factor in the previous 1996 selection of a Project R-2247Preferred Alternative has likely changed. Surveys of the streams, wetlands, and natural areas for the Project R-2247 and Project U-2579 Preferred Alternatives all were updated for the SFEIS/SDEIS. The surveys within the Project R-2247 Preferred Alternative were updated in 2002-2003. Section 2.9.2 recognizes that "In the non-preferred Detailed Study Alternatives, reductions in wetland impact

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				also could have occurred due to long-term drier weather patterns since the early 1990s and/or to wetlands being filled by recent development. Changes due to weather patterns would be similar for all Detailed Study Alternatives (including the Preferred Alternative). Filling of wetlands is more likely to have occurred in the non-preferred Detailed Study Alternatives". Section 2.9.2 also states the relative values of streams and floodplain within each Detailed Study Alternative are not expected to be substantially different. Aerial photography and mapping were reviewed to confirm that streams have not changed since the original selection of the Preferred Alternative. The most recent flood insurance rate (FIRM) maps for Forsyth County were compared to those available in 1996 and there were no significant difference between the two maps that would result in new encroachment locations not previously reported in the 1996 Project R-2247 FEIS. Section 3.1 describes the use of previous data (information from the 1996 Project R-2247 FEIS, 1992 Project R-2247 DEIS, and 1995 Project U-2579 DEIS) and new data in Chapter 3 to describe existing conditions and in Chapter 4 to evaluate the impacts of Projects R-2247 and U-2579. Water quality, floodways/floodplains, streams, wetlands, biotic communities, and protected species are all addressed separately in this section of the SFEIS/FEIS.

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Project	Agency	Letter-Comment Number	Comment	Response
All	USEPA	A24-3	The need for comprehensive resource mitigation is still essential to reach project completion.	FHWA and NCDOT will continue to work with the US Army Corps of Engineers, US Fish and Wildlife Service, NC Division of Water Quality, the Environmental Protection Agency, NC Wildlife Resources Commission and the State Historic Preservation Office to fulfill all consultation requirements and to obtain all necessary permits.
R-2247 & U-2579	USEPA	A24-4	EPA is participating in the Merger process for Projects R-2247 and U-2579 and will continue to address the 'Least Environmentally Damaging Practicable Alternative' and mitigation through this team process.	Comment noted. FHWA and NCDOT are coordinating with state and federal resource agencies, including the EPA, throughout the Section 404/NEPA merger process.
U-2579A	USEPA	A24-5	EPA prefers Eastern Section Extension Alternative N3-S2 without the Kernersville Road interchange.	After additional coordination subsequent to this letter, on March 14, 2005, the US EPA concurred with the selection of Project U-2579A Detailed Study Alternative N2-S1 (with the Kernersville Road interchange) as the Least Environmentally Damaging Practicable Alternative (see the signed concurrence form in **Appendix D.4**). This alternative was then selected by FHWA and NCDOT as the Preferred Alternative on March 16, 2005.
All	USEPA	A24-6	A 2025 Multi-Modal Long Range Transportation Plan is mentioned, but nowhere is there mention of High Occupancy Vehicle (HOV) lanes as components in the transportation solution. The Northern Beltway does not include HOV lanes. This is puzzling given the traffic congestion and air quality non-attainment	The Congestion Management System (CMS) of the *2030 LRTP* includes HOV lanes as one of a list of TDM strategies. The plan states that HOV lanes and congestion pricing may have applicability if congestion and air pollution problems grow worse. However, no HOV lane improvements are

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			status of the area. EPA recommends that HOV be further considered for the presently proposed general use lanes and that the next capacity improvements envisioned for the beltway be limited to HOV use.	proposed as specific projects in the LRTP. HOV lanes were discussed in Chapter 2 of the SFEIS/SDEIS and determined not to meet the purpose and need of this project.
General	USEPA	A24-7	In general, the alternatives all have high but similar degrees of impacts to the environment. The decision to be made for each beltway section, is whether to proceed with the project more so than which alternative to select.	Comment noted. The direct, indirect and cumulative impacts of the Northern Beltway, in whole and in part, are described in the SFEIS/SDEIS.
R-2247	USEPA	A24-8	It is unclear whether any farms would be lost for the more rural western section.	According to the Relocation Reports in Appendix G, no farms would be entirely relocated by the Project R-2247 Preferred Alternative. As shown in Table 4-72 in the SFEIS/SDEIS, land in agricultural use accounts for about 196 acres (15.4%) of the total right of way needed for the Project R-2247 Preferred Alternative.
U-2579A	USEPA	A24-9	The Eastern Section Extension greatly exceeds the relocation impacts per mile of the other beltway section. While there is transportation merit for this section extension, every possible configuration and positioning should be considered to lessen impacts.	Section 2.10.2 of the SFEIS/SDEIS describes the development and evaluation of the Project U-2579A preliminary alternatives and the identification of the detailed study corridors. To help develop preliminary alternatives, major physical features were identified within the study area to determine how to most effectively minimize impacts. Project U-2579A passes through rapidly suburbanizing areas. Several subdivisions have been developed since the alternatives were identified, substantially increasing the

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				number of relocations. The three major directional interchanges with existing freeways limit the opportunity to avoid impacts to communities. The one surface street interchange, at Kernersville Road, would be configured as a single point urban interchange (SPUI), which would minimize impact to the adjacent homes and businesses as well as improve traffic operations. One of the factors in the selection of the Preferred Alternative was minimizing both relocations and impact on community cohesion. Other corridors were investigated and eliminated during the development of preliminary alternatives. Alternatives to the west would involve out of direction travel, increased community impact, and would not provide appropriate interchange spacing at I-40 and at US 311. Alternatives to the east would be close to the existing Union Cross Road interchange with I-40, would impact Glenn High School, or would impact the high quality Abbotts Creek and Pine Tree Branch area. Factors in eliminating some of the preliminary alternative segments included major adverse impacts to existing residential communities (including relocations and community cohesion) and major adverse impacts to businesses (Section 2.10.2 of the SFEIS/FEIS). Since Project U-2579A was added to Project U-2579 after a preferred alternative was selected for Project U-2579, all preliminary alternatives for Project U-2579A began at the

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Project	Agency	Letter-Comment Number	Comment	Response
				southern terminus of the Project U-2579 Preferred Alternative. An analysis of whether the selection of the Project U-2579 Preferred Alternative would change if Project U-2579A were taken into consideration is included in Section 2.11.1.2 of the SFEIS/FEIS. The conclusion of the analysis is there would not be a decrease in overall impact to communities by shifting to the western terminus (non-preferred terminus for Project U-2579).
U-2579A	USEPA	A24-10	When relocations are considered relative to length of the section, the 4.5 mile U-2579A Eastern Section Extension greatly exceeds the impacts per mile of the other beltway sections. Although there is documentation of the public participation process starting back in 1991, it is difficult to gauge how the citizens within the affected areas reacted to this degree of relocation impact.	Public involvement was included as a part of Project U-2579A since the initial planning phase was begun in 1995. The fact that 500 citizens attended the feasibility study public workshop in February 1997 indicates both a high degree of awareness and a high degree of interest in the project, particularly since it was not even programmed in the state TIP at that time. The meeting summary notes that most of the citizens were interested in the impact of the project on their individual properties. When the project became programmed and was included in the NEPA process along with Project U-2579, over 300 citizens attended a public information meeting. At that meeting, several citizens expressed concern regarding impact on established communities.
All	USEPA	A24-11	EPA notes the total relocation impacts would be 728 to 807 residential relocations, 35 to 42 businesses, a church, and a farm. EPA is unaware of any federal guidelines that define acceptable/unacceptable relocation impacts, but we suggest that the	In accordance with NEPA and other environmental rules and regulations, NCDOT and FHWA strive to minimize and mitigate the impacts of projects on both the human and natural environments. To help develop preliminary

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			Federal Highway Administration comment on this point.	alternatives, major physical features were identified within the study area to determine how to most effectively minimize impacts. One of the factors in the selection of the Preferred Alternatives was minimizing both relocations and impact on community cohesion. Other corridors were investigated and eliminated during the development of preliminary alternatives. Factors in eliminating some of the preliminary alternative segments included major adverse impacts to existing residential communities (including relocations and community cohesion) and major adverse impacts to businesses. Although the R-2247 Preferred Alternative corridor has been protected, several subdivisions have been developed within the U-2579A Preferred Alternative corridor since inception of the project, and individual homes have been constructed within the U-2579 Preferred Alternative corridor. All three Preferred Alternatives were originally chosen in part due to their lower number of relocations; the Preferred Alternatives for Projects U-2579 (Alternative 7) and U-2579A (Alternative N2-S1) had fewest relocations of any Detailed Study Alternatives, and the Project R-2247 Preferred Alternative (C3-WEST-B) was among the lowest. During final design, all Preferred Alternatives will be revised to further reduce impacts to homes and businesses.

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All	USEPA	A24-12	Protection of water supply resources must be a priority consideration in the decisions on the Northern Beltway.	The Preferred Alternative avoids the watershed critical zone for Salem Lake, the nearest water supply resource. Best Management Practices (BMPs) will be used to minimize construction impact in the Salem Lake watershed. Please see response to Comment A23-1.
U-2579A	USEPA	A24-13 A24-28 A24-29	A24-13. EPA is very concerned about the protection of Salem Lake, which supplies a substantial amount of Winston-Salem's water needs. Development pressure induced by the project within the lake's watershed, including the Water Supply Critical Area, potentially will adversely impact this reservoir. A24-28. EPA is very concerned over the potential direct and indirect and cumulative impacts to the Salem Lake Critical Water Supply Area. The lake has been defined as eutrophic due to high nutrient levels, and was listed as "threatened" by the state DWQ. A24-29. EPA strongly encourages NCDOT and FHWA to avoid any direct impacts to the Salem Lake Critical Water Supply Area and seek measures with local officials on minimizing indirect and cumulative impacts from the Northern Beltway project on this critical resource	See response to Comment A24-12 above. The critical watershed area is to the west of the proposed Winston-Salem Northern Beltway interchange at Business I-40. This interchange is categorized as "low" with regard to potential for future growth and development changes due to the proposed Beltway. No traffic analysis zone in this area is noted as being in the top ten impacted zones under any future year scenario evaluated in the indirect and cumulative effects analysis (reference Figures 6-5 and 7-1 in the *Indirect and Cumulative Impacts Analysis*).
General	USEPA	A24-14	It is unclear to EPA whether the two land use/growth management plans in existence have appropriate compliance provisions to correct presently degraded streams. Without such provisions, the	Section 303(d) of the Clean Water Act (CWA) requires states to develop a list of waters not meeting water quality standards or which have impaired uses. Listed waters must be

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			Northern Beltway could promote increased pollutant runoff and contribute to more degraded surface water quality.	prioritized, and a management strategy or total maximum daily load (TMDL) must subsequently be developed by NCDWQ for all listed waters. There are several streams in Yadkin River subbasin 03-07-04 on the State's 303(d) list, including Little Creek, Grants Creek, Town Creek, Muddy Creek, Salem Creek, and Reynolds Creek (http://h2o.enr.state.nc.us/tmdl/General_303d.htm#Download). After a TMDL is established by NCDWQ, an implementation plan is developed. Implementation plans are the basis for initiating local, regional, and state actions that reduce pollutant loads to levels established in TMDLs. Also, see response to Comment A23-10.
R-2247 & U-2579	USEPA	A24-15	EPA is concerned that Forsyth County has allowed development to proceed within alternative corridors, other than NCDOT's preferred alternatives, prior to the completion of the NEPA review and final corridor selection. This situation greatly biases the present reconsideration of the beltway alternatives.	A corridor protection map for the Western Section of the Northern Beltway 1996 Preferred Alternative was filed with the Forsyth County Registrar of Deeds on October 6, 1997, after the issuance of the original Record of Decision on that project. Under North Carolina law, a corridor protection map delays development activity (subdivision or construction) for up to three years from the date of application by the developer. NCDOT must either acquire the right of way by that time or allow development to occur. Because most developers work within a much shorter time frame, the map is effective at discouraging development within the protected

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				corridor. This corridor protection map is still valid and in use by the local governments (Winston-Salem Department of Transportation, personal communication, April 21, 2005). Forsyth County /Winston-Salem does not have any ordinances, regulations, or corridor protection maps in place that prohibit development within NCDOT's Preferred Alternative for Project U-2579. Development proposals consistent with current zoning are not being prohibited. Whether or not a property is within the Project U-2579 preferred corridor is a factor in recommendations from the City-County Planning Board staff regarding rezoning requests (personal communication, City-County Planning Board staff, April 19, 2005).
All	USEPA	A24-16 A24-25	A24-16. EPA is concerned that compensating for 7-8 linear miles of stream habitat may not be possible considering the deficit of mitigation credits within the Piedmont zone of the state. A24-25. EPA is very concerned regarding the magnitude of potential stream and wetland impacts. Compensatory mitigation for jurisdictional losses is proposed to be obtained through the EEP. However, recent reports from other agencies and direct comments from the EEP Transition Manager would indicate that mitigation (stream restoration) projects in the Piedmont are difficult to find and may not be available under the current program. This area of the state (i.e., Northern Piedmont) is also	NCDOT's preference and first option is to use the DENR-EEP program to satisfy all NCDOT's required compensatory mitigation requirements for the federal and state permits, pursuant to the terms of the NCDENR/NCDOT 2004 Memorandum of Agreement Governing EEP Operations. On-site mitigation would be the first option, with off-site mitigation used if sufficient suitable on-site mitigation sites are not available. If DENR-EEP is unable to identify adequate compensatory mitigation opportunities, NCDOT may propose to the appropriate NCDENR permitting agency to use alternate mitigation options to satisfy the mitigation requirement. The NCDENR permitting agencies will allow

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Project	Agency	Letter-Comment Number	Comment	Response
			understood to be in a critical 'deficit' for stream mitigation credits due to numerous other large TIP projects (e.g., Greensboro Western Loop).	the alternate option, provided all applicable rules are met.

All	USEPA	A24-17 A24-32	A24-17. While there are no requirements for mitigating the direct loss of forestland, this loss coupled with indirect losses due to development will substantially alter the county's landcover and the habitat for dependant terrestrial wildlife. A24-32. Forsyth County is approximately 408 square miles. The irreversible loss of forested lands would represent approximately 0.4% of the total land area of Forsyth County.	According to *the Indirect and Cumulative Impacts Analysis*, there would be minimal additional development indirectly attributable to (induced by) the Northern Beltway. However, the loss of forestland from construction of the Northern Beltway, cumulatively added to other past, present, and reasonably foreseeable future developments will alter the county's landcover and wildlife habitat. The County's vision for urban and rural areas is contained in the Growth Management Plan portion of the *Legacy Plan*. Additional "small area" plans address localized concerns under the general framework provided by the Legacy Plan. The Winston-Salem Planning Department notes that in 84 percent of the rezoning cases where an action is taken, it is in agreement with the *Legacy Plan*. It is also worthwhile to note that Forsyth County has recently adopted ordinance revisions requiring many new development actions to include tree preservation on open sites. Preferences for Tree Save Areas (5%-10% of the total lot size) are given to those trees that are healthy and mature.
All	USEPA	A24-18 A24-33 A24-34 A24-35	A24-18. EPA wishes to mention the requirement of the federal Migratory Bird Treaty Act. Compliance with this act could place additional constraints on the construction of the beltway. A24-33. With the possible exception of the Bobwhite, EPA believes that all of the other species identified in the SFEIS are specifically listed under Title 50 Code of Federal Regulations Section 10.13 as migratory birds. EPA recommends that NCDOT consult with the USFWS for compliance with the Migratory Bird Treaty Act.	NCDOT is coordinating with the USFWS to ensure this project's compliance with all applicable laws.

			A24-34. NCDOT may wish to consult with the active chapter of the Audubon Society of Forsyth County for a complete listing of terrestrial forest migratory bird species which will be impacted by the project. A24-35. Future environmental studies and documents for this project should address the coordination and consultation recommendations with the USFWS under the Migratory Bird Treaty Act and any environmental commitments required.	
All	USEPA	A24-19 A24-36 A24-37	A24-19. EPA expects the bisection of animal habitat to result in substantial mortality from collisions with vehicles unless there is adequate mitigation incorporated into the design of the beltway. The US Fish and Wildlife Service and the NC Wildlife Resources Commission should be consulted. A24-36. NCDOT and FHWA propose no wildlife crossings for the project. While posting signs for 'Deer Crossings' is helpful for the motorist, they appear to provide no actual reduction in the number of conflicts between vehicles and deer. From a safety standpoint, EPA is concerned that NCDOT has not fully identified this safety conflict and sought more input from the USFWS and NCWRC on large mammal crossings. A24-37. The NEPA analysis should document and discuss the fact that high-speed freeways result in the deaths of hundreds of thousands of animals every year. Efforts (such as wildlife passages) to minimize this mortality are not specifically required by Federal or state law but would represent a substantial gesture of environmental stewardship.	During the Concurrence Point 2A (bridging decisions and alignment review)/4A (avoidance and minimization) meetings, NCDOT agreed to bridge several streams that had been proposed to be crossed by culverts (see Section 4.14.1). NCDOT agreed to shorten culvert lengths where possible and daylight systems between culverts where possible in interchange areas. In addition, NCDOT will include wildlife crossings where appropriate in the vicinity of stream crossings, which will allow animals to cross under the Beltway (see concurrence form in Appendix D.4).
General	USEPA	A24-20 A24-44 A24-45	A24-20. The SEIS addresses another issue raised about the loss of forests related to air quality. By focusing on pollutant emitted by trees, NCDOT is inferring that trees are detrimental to air quality	The NCDOT and FHWA agree that the important air quality situation to consider is Forsyth County's status as non-attainment for the 8-hour ozone standard and maintenance for

		A24-46 A24-47 A24-48	and therefore land clearing for the project and other development will not result in negative effects. EPA views this discussion as extremely unscientific and misleading to the public. The important air quality situation to consider is that Forsyth County is in non-attainment for the 8-hour ozone standard and is a maintenance area for carbon monoxide. A24-44. The discussion in the SFEIS of the effects of tree removal is centered on the known scientific fact that tree emit Volatile Organic Compounds (VOCs) which can aid in the formation of ozone. While the information in this Section is not incorrect, it provides the public with no real information on the fact that trees also help in the removal of pollutants from the atmosphere. Trees are just one input to the airshed with the emissions from continual VOC emissions from numerous asphalt-paved surfaces. The proposed beltway would add significantly to this emissions budget. A24-45. The effects of tree removal discussion does not support the conclusion that the removal of trees will not adversely impact ozone and carbon monoxide formation in the Triad area. A24-46. NCDOT is encouraged to refer to EPA's website dealing with air quality and mobile emission sources. This website will provide the public with an objective view of the significant sources of air pollutants. A24-47. One of the most important technical elements missing in the analysis is that trees provide excellent shade and greatly help to reduce surface temperatures. A24-48. Efforts to portray trees as 'air polluters' in the hope that it justifies more than 1,000 acres of impacts to terrestrial forests is extremely biased and in EPA's opinion does not constitute good science.	carbon monoxide. An updated 2030 Long Range Transportation Plan (LRTP) for the Winston Salem Forsyth MPO and the USDOT Conformity Determination was completed on May 28, 2005. This latest LRTP update/conformity determination for the region used the latest planning assumptions and emissions model (Mobile 6.2) to demonstrate attainment of the ozone and carbon monoxide ambient air quality standards. The discussion in Section 4.7.5 on the literature search regarding effects of tree removal on air quality has been removed in this SFEIS/FEIS. The NCDOT and FHWA agree that the discussion could be confusing to the general reader. The intent of the discussion was to show that it was not practicable to effectively quantify on a project-specific level the air quality impacts of the removal of trees for construction of the Northern Beltway, nor was it required by FHWA guidance. It was not the intent of the section to infer that trees are detrimental to air quality.

R-2247	USEPA	A24-21	Based on our analysis of this reconsideration of Project R-2247, EPA does not have a preferred alternative, but it maintains its concerns about the extent of the impacts to the man-made and natural environments.	The extent of direct, indirect, and cumulative impacts of the Northern Beltway, in whole or in part, is documented in the SFEIS/SDEIS. Reasons for the original selection of the Preferred Alternative in 1993 and the re-selection of the Preferred Alternative are well documented in Section 2.9.2 (Re-evaluation of the 1993 Project R-2247 Preferred Alternative Selection) of the SFEIS/SDEIS. In Section 2.9.2, the reasons for selecting the Preferred Alternative in 1993 were reviewed. Any changes that have occurred since 1993 were identified and whether these changes would influence the reasons for selecting the Preferred Alternative in 1993 are discussed in detail. Based on evaluations discussed in this section of the SFEIS/SDEIS, conditions in the project study area have either not changed substantially since 1992, or have changed in such as way that further supports the selection of the Preferred Alternative.
R-2247	USEPA	A24-22	The document generally lacks detail on mitigation for Project R-2247 despite it being in the design stage. Therefore considerable work must be done in order to adequately mitigate identified adverse impacts.	NCDOT will obtain all required permits and implement all required mitigation measures that are conditions of those permits. Also, NCDOT will fulfill all commitments listed on the "Green Sheet" of Project Commitments, located toward the beginning of this SFEIS/FEIS. Mitigation is also discussed in this SFEIS/FEIS in Sections 4.2.4.7 (community cohesion), 4.8.2.2 (noise), 4.13 (water quality), 4.17.2 (jurisdictional resources), and 4.20.7.3 (indirect and cumulative effects).
U-2579 & U-2579A	USEPA	A24-23	NCDOT states the benefits to through travelers of the Eastern Section and Eastern Section Extension (and its designation as I-74) in the project area would be a 20% savings in travel time, or a total of 4 minutes, versus traveling on existing US 52 through downtown Winston-Salem to the same endpoints. Although the other benefits of the projects are to improve the traffic congestion	The extent of direct, indirect, and cumulative impacts of the Northern Beltway, in whole and in part, is documented in the SFEIS/SDEIS and now in this SFEIS/FEIS. The degree of environmental impact associated with alternatives to the Eastern Section and Eastern Section Extension would also be high. This SFEIS/FEIS also discusses the impacts of widening

			of the local north-south roadways of this eastern section, the degree of community and environmental impact is high.	US 52 to eight lanes. This widening would have substantial impact on minority communities as well as have other serious environmental justice concerns.
U-2579 & U-2579A	USEPA	A24-24	Deleting an interchange from the water supply watershed would greatly improve the acceptability of the Eastern Section. EPA has a strong preference for Alternative N3-S2 for the Extension. Alternative N3-S2 would avoid direct impact to the water supply critical area, and the bedrock outcrop, and we recommend the deletion of the Kernersville Road interchange to accomplish the avoidance. Otherwise, a far more robust mitigation plan would be necessary. Further consideration is required defining appropriate avoidance and minimization of selecting alternatives during the Merger Process (Concurrence Points 3 and 4). This process should result in additional protection for the water supply, surface streams and wildlife habitat.	After additional coordination subsequent to this letter, on March 14, 2005, the US EPA concurred with the selection of Project U-2579A Detailed Study Alternative N2-S1 (with the Kernersville Road interchange) as the Least Environmentally Damaging Practicable Alternative (see the signed concurrence form in **Appendix D.4**). This alternative was then selected by the NCDOT as the Preferred Alternative on March 16, 2005. Alternative N2-S1 does not impact the bedrock outcropping referred to in the letter (please see response to NCDWQ comment 22-4). During the merger process, it was agreed that the Kernersville Road interchange would be designed as a single-point urban interchange (SPUI), which would minimize the impact area. It was also agreed that the design in the Muddy Creek area would be modified to avoid impacting the creek. It was determined that Project U-2579A Alternative N2-S1 does not impact the water supply critical area. The boundary shown in the SFEIS/SDEIS (Figures 3-10c, 3-12c, and 3-14c) was found to be in error, and has been corrected. These figures have been corrected in this SFEIS/FEIS.
R-2247	USEPA	A24-26 A24-30 A24-31	A24-26. Protection of water supply resources is a priority concern for EPA. The county and city are increasingly relying on a direct withdrawal from the Yadkin River. This river is within the roadway study area but the supply intake is not located or addressed in the document relative to potential impacts of the development that would occur within the western section (R-2247). A24-30. Because Forsyth County and the city are increasingly relying on a direct water intake from the Yadkin River, this intake	The Yadkin River is outside the project study area for direct impacts and it forms the western boundary of the study area for indirect and cumulative effects. The Forsyth County Water System has one intake on the western end of Salem Lake that supplied the Thomas Water Treatment Plan. There are two intakes on the Yadkin River. One is located at the extreme southwest corner of the County and it supplies the Neilson Plant. The second is on the River

			should receive more discussion in the document. The critical area for this intake should be located on a map and the land use and cover within this area should be defined. A24-31. The proposed western section project would likely stimulate development closer to the Yadkin River.	near the center of the western edge of the County near the confluence with Beshavia Creek. This intake supplies the Northwest Plant. A description of the Yadkin River water intakes has been included in Section 3.15.2 of this SFEIS/FEIS. The indirect and cumulative impacts analysis completed for this project showed only minor housing and employment changes overall, and no increases along the western border of the study area (Forsyth County and Yadkin River). The area immediately bordering the Yadkin River is categorized as rural protected under the existing zoning ordinance employed by Winston-Salem/Forsyth County (refer to Figure 7-4B of the *Indirect and Cumulative Impacts Analysis*). One zone (2712) that immediately borders US 52 on the north side of the County, is one of the zones projected to have the highest housing increases. However, this zone is approximately 1.5 miles away from the Yadkin River. Conversations with the Planning and Stormwater Control staff of Winston-Salem/Forsyth County (Keith Huff, January 9, 2007) indicate that Winston-Salem has permitting authority county-wide for sedimentation. In areas where there is a water supply watershed (such as the WSWIII area around Salem Lake), additional controls are applied for development setbacks, buffer requirements, and impervious surface thresholds to maintain the integrity of these water supplies. Further, the City of Winston-Salem recently annexed a large portion of unincorporated of Forsyth County, which extended the controls for stormwater to a larger area. Finally, the City of Winston-Salem is pursuing a Phase II Stormwater Control permit, which will further enhance the City's ability to implement stormwater controls within the City and extra-territorial jurisdiction.

All	USEPA	A24-27	The EIS lacks sufficient detail about the status of water resources and the management requirements stipulated in the 2003 update of the Yadkin-Pee Dee Basinwide Water Quality Plan.	The Yadkin-Pee Dee Basinwide Water Quality Plan and the status of relevant water resources are described in Sections 3.15.3 and 3.15.4 in the SFEIS/SDEIS. Water resources are also shown in Figure 3-10 (a-c). The NCDWQ website where the basin plan can be accessed is provided in Section 3.15.3.
General	USEPA	A24-38	EPA would recommend that NCDOT refer the public and reviewing agencies to the Auto Emissions Fact Sheet from the National Safety Council's Environmental Health Center. It provides an excellent technical reference for motor vehicle operators, including tips on what motorists can do to reduce emissions.	NCDOT and FHWA also encourage the reader, and the public in general, to review the Auto Emissions Fact Sheet and to take actions to reduce emissions whenever possible.
General	USEPA	A24-39	In a full and objective NEPA analysis, NCDOT should address the environmental and socio-economic benefits to be missed by the selection of a particular alternative over others and assist the public in making more environmentally-friendly and technically accurate and informed decisions.	The SFEIS/SDEIS fully discusses the beneficial and adverse impacts of each alternative considered. The SFEIS/SDEIS identifies the preferred alternatives for Project R-2247 and Project U-2579 and the reasons for their previous selections. It reevaluates the previous selections in light of current conditions and explains NCDOT's continued preference for these selections. This SFEIS/FEIS identifies the Preferred Alternatives for Project R-2247, Project U-2579, and Project U-2579A and the reasons for their selections. In accordance with FHWA guidelines (Technical Advisory T6640.8A), the Record of Decision will explain the balancing of values which formed the basis for the decision on the alternative(s) to implement. "The values (social, economic, environmental, cost-effectiveness, safety, traffic, service, community planning, etc) which were important factors in the decision making process should be clearly identified along with the reasons some values were considered more important

				than others."
General	USEPA	A24-40	Winston-Salem is in the process of updating to a 2030 LRTP which will include a new emissions analysis and conformity determination. That plan should be in place by May 28, 2005 (at the latest) so it would be appropriate for the SFEIS to be updated in the future to reflect that new analysis.	Section 1.10.2 and Figures 1-6 and 1-7 were updated in this SFEIS/FEIS to show the *2030 LRTP* and the updated *2005 Thoroughfare Plan*. Section 4.7.4 also was updated to describe the new emissions analysis and conformity determination.
General	USEPA	A24-41	A new regional emissions analysis will also be conducted using MOBILE6, whereas the hot-spot analysis was for the SFEIS using MOBILE5b.	An updated *2030 Long Range Transportation Plan (LRTP)* for the Winston Salem Urban Area and the USDOT Conformity Determination was completed on May 28, 2005. This latest LRTP update/conformity determination for the region used the latest planning assumptions and emissions model (MOBILE 6.2, which is the latest version of MOBILE6). As described in Sections 4.7.2.2, 4.7.3.2, and 4.7.3.3 of this document, MOBILE6.2 was used in the updated microscale analyses conducted for the preferred alternatives for R-2247, U-2579, and U-2579A.
General	USEPA	A24-42	Although EPA did not designate Forsyth County non-attainment for Particulate Matter 2.5 designations, both Davidson County and Guilford County are non-attainment and it would be appropriate for projects within Forsyth County to adopt mitigation to help preclude a similar designation.	There are no regulatory requirements for Forsyth County related to the PM2.5 standard.
All	USEPA	A24-43	If a photochemical modeling analysis is used to support a regulatory application, documentation is required showing that the modeling was developed consistent with EPA modeling guidance. A brief discussion on photochemical grid modeling using "UAMs" was presented in Section 4.7.5.	No photochemical modeling was conducted for the project or to support a regulatory application, and therefore, further documentation is not required. Also, see response to comment A24-20.
All	USEPA	A24-49	NCDOT and FHWA will need to develop very specific and	The project will be designed and constructed in compliance

			comprehensive staging and construction plans to minimize potentially years of construction impacts to both natural resources and the human environment. A simple reference to the Best Management Practices (BMPs) manual does not fully address EPA's concerns.	with applicable federal, state, and local law and according to NCDOT standards and policy. The project(s) will be staged in such a way as to cost-effectively and safely minimize disruption to the human and natural environments.
All	USEPA	A24-50	EPA would strongly urge NCDOT to access the Forsyth County Environmental Affairs website for specific requirements for future land clearing activities. Open burning of vegetative and other construction debris in an area which is not in compliance with the Clean Air Act 8-hour ozone standard is EPA's least preferred method of disposal.	Any burning of cleared materials would be conducted in accordance with state and local laws (including Forsyth County's Open Burning Regulations, Chapter 3 of the Forsyth County Code, Section 1900), regulations and ordinances and the regulations of the North Carolina SIP for air quality, in compliance with 15 NCAC 2D.0520. More information is in Section 4.21 of the SFEIS/SDEIS and this SFEIS/FEIS.
All	USEPA	A24-51	EPA has for several years recommended to NCDOT and FHWA in dozens of NEPA review letters to consider recycling efforts by shredding and mulching vegetative debris and making it available to the public. EPA strongly requests NCDOT and FHWA to adopt a position requiring an "environmentally friendly" recycling option for the thousands of tons of vegetative debris which will be generated from this project.	It is left to the contractor's discretion on how best to dispose of vegetative debris according to local, state, and federal law.
U-2579	USEPA	A24-52	Table 2-28 shows **N/A**[1] for the Preferred (Alt. 7). There is no explanation in the table or text for the footnote.	Table 2-28 is a summary of the impacts of the Project U-2579 Detailed Study Alternatives from the Project U-2579 DEIS. The acres of impacts to prime and statewide and locally important farmland were not available for some alternatives. The acreages would be similar to those for the Project U-2579 Eastern Alternative and Western Alternative, which range from 500-532 acres. A footnote has been added to the table in this SFEIS/FEIS.
All	USEPA	A24-53	Table 4-88 (Combined Direct Impacts for all three segments) indicates a range of impacts to agriculture between 369 and 389 acres. This table includes no heading or category for Prime	A row has been added to Table 4-88 for listing impacts to prime, statewide, and locally important farmland.

			Farmland or farmland of Statewide or Local Importance.	
R-2247	USEPA	A24-54	The discussion/coordination with the Soil Conservation Service (now the Natural Resources Conservation Service or NRCS) back in 1991 regarding Prime Farmland covered in Section 4.12.3 is not relevant or timely to the current NEPA analysis.	This information was included to provide a history of this issue from previous NEPA documents. The paragraph following this information (the last paragraph in Section 4.12.3) describes the more recent coordination with the NRCS on Project R-2247 that occurred in August 2003.
All	USEPA	A24-55	The discussion regarding zoning all of the lands within the project corridors to residential, commercial or industrial by City-County Planning Boards appears to be contradictory to the agricultural lands identified in Table 4-88 (several hundred acres).	The zoning is not contradictory to the agricultural uses identified in Table 4-88 under the heading "Biotic Communities Impact Summary". The agricultural uses identified in Table 4-88 are existing uses observed during field surveys. Zoning indicates the existing allowable highest or densest use of the land. Land zoned residential or agricultural can have a variety of uses. The Unified Development Ordinance is the regulation governing zoning and allowable uses in all jurisdictions in Forsyth County (*www.cityofws.org/Home/Departments/Planning/ZoningAndSubdivision/Articles/UDO*). Table 2.6 of the UDO (Permitted Uses Table) lists the allowable uses in each zoning designation. For example, land zoned AG (Agriculture) can have a single-family dwelling, a Family Group Home A, agricultural uses, public recreation facilities, adult day care, etc., as listed in the UDO's table. Land zoned residential can also have agricultural crop or livestock production.
All	USEPA	A24-56	EPA urges NCDOT and FHWA to provide the potentially impacted acreage to all Prime and Statewide or Locally Important soil types within the corridors for R-2247, U-2579, and U-2579A projects regardless of current local zoning or projected land use status. EPA would prefer to see a consistent and relevant analysis	A row has been added to Table 4-88 for listing impacts to prime, statewide, and locally important farmland soils. Section 4.12 of the SFEIS/SDEIS and SFEIS/FEIS discusses the acreages of prime, statewide, and locally important farmland present in the project alternatives.

			of impacts based on current land uses, or in this case, soil types and classifications.	Coordination with the NRCS in 2003 for the Project R-2247 Preferred Alternative, Project U-2579 Preferred Alternative and Project U-2579A Detailed Study Alternatives resulted in the conclusion that no mitigation for farmland loss is required in accordance with the Farmland Protection Policy Act.
All	USEPA	A24-57	NCDOT and FHWA specifically identified the acres of impacts to 'maintained/disturbed' lands and 'cut-over' areas. There is no legal or technically required basis for identifying the potential impacts to these areas. NCDOT or FHWA could have just placed a "N/A" in these categories with a footnote. The NEPA analysis must disclose and discuss information in a manner that the general public can understand.	Reporting on all the biotic community types found within alternatives is a standard procedure and allows the reader to form an understanding of the overall mix of biotic community types within an alternative. The only area where N/A (not available) was listed in a table is in Table 2-28, which is a summary of the impacts of the Project U-2579 Detailed Study Alternatives from the Project U-2579 DEIS. The acres of impacts to prime and statewide and locally important farmland were not available for some alternatives. The acreages would be similar to those for the Project U-2579 Eastern Alternative and Western Alternative, which range from 500-532 acres. Section 4.12 describes the acreages of impacts to farmland soils.
All	USEPA	A24-58	Apparently, there are impacts to Prime Farmland soils for the R-2247 segment of the project, but not for the others, except for the Western and Eastern alternatives for U-2579. There are no Prime Farmland soils for NCDOT's preferred alternative for U-2579. There apparently are no Prime Farmland soils for any of the alternatives for the U-2579A segment. The EPA senior technical EIS review staff had difficulty deciphering the tables and information and are concerned that the public would have trouble, too.	Section 4.12 of the SFEIS/FEIS reports on the acreages of impacts to farmland soils. Section 4.12.4 describes the Project R-2247 Preferred Alternative. Section 4.12.6 describes the Project U-2579 Preferred Alternative, and Section 4.12.7 describes the Project U-2579A Detailed Study Alternatives and Preferred Alternative. As discussed in these sections, the Project R-2247 Preferred Alternative has approximately 498 acres of prime farmland soils and 602 acres of statewide/locally important farmland soils. The Project U-2579 Preferred Alternative has

				approximately 77 acres of prime farmland soils and 116 acres of statewide/locally important farmland soils. The Project U-2579A Detailed Study Alternatives have impacts to prime farmland soils that range from 35-55 acres and impacts to statewide/locally important farmland soils that range from 44-52 acres. The Project U-2579A Preferred Alternative (N2-S1) has approximately 35 acres of primary farmland soils and 52 acres of state/locally important farmland soils.
All	USEPA	A24-59	EPA would greatly encourage NCDOT and FHWA to update, clarify and revise the information on Prime Farmlands and agricultural lands to be impacted by the projects in future Merger meetings and NEPA documents.	A row has been added to Table 4-88 for listing impacts to prime, statewide, and locally important farmland soils. Coordination with the NRCS in 2003 for the Project R-2247 Preferred Alternative, Project U-2579 Preferred Alternative and Project U-2579A Detailed Study Alternatives resulted in the conclusion that no mitigation for farmland loss is required in accordance with the Farmland Protection Policy Act.
General	USEPA	A24-60	There appears to be a great deal of currently zoned rural and open space land that will be in conflict with the Growth Management Plan. EPA has noted numerous conflicts between current zoning and future growth management. Future growth areas shown in Figure 3-2 do not appear to match the zoning 'plans' very closely.	The Growth Management Plan and current zoning are fairly consistent. Almost all the land currently zoned agricultural is located in the area designated Rural Area on the Growth Management Plan. Most of the remaining land in the Rural Area is zone residential. According to the Growth Management Plan, the Rural Area "is intended to remain in very low density residential and agricultural uses for the 15-year time horizon of the plan" (Legacy Development Guide Growth Management Plan, page 35). According to the 2004 update to the *Legacy Plan*, the "decision was made this year by the Planning Board to shift the emphasis in *Legacy's* implementation from the preparation of guidelines to the preparation of ordinance amendments that would apply *Legacy's* recommendations to development." One ordinance developed was a draft Voluntary Agricultural

				District Ordinance. This ordinance will allow the voluntary establishment of special areas where commercial agriculture is encouraged, farm practices are protected and farmers may receive protection from private nuisance lawsuits. The update also states, "Statistics on rezonings for the period 2003-2004 reveal that, in cases where *Legacy* principles were relevant, decisions made by planning boards and elected officials showed a high rate of compliance with those principles. Elected bodies, planning boards and staff were in agreement on decisions in 54 of 64 cases or 84.4% of cases."
General	USEPA	A24-61	The Open Space System map contains a great deal of detail, but it is very difficult for EPA to 'overlay' this figure with the Growth Management Plan.	If the Growth Management Plan (Figure 3-2) is overlain on the Open Space System (Figure 3-6), the majority of open space system facilities are located within the Municipal Services Area and the Future Growth Area. Open Space system items in the Rural Area include Horizon Park, Tanglewood Park, CG Hill Memorial Park, most natural heritage sites, and all but one farmland preservation program site.
All	USEPA	A24-62	EPA is concerned with the proposed Northern Beltway's potential noise receptor impacts. EPA requests that NCDOT and FHWA pursue all reasonable mitigation alternatives (not just noise walls but also vegetative barriers with earthen berms) to reduce increased noise levels to the extent practicable for the significant number of impacted receptors.	The NCDOT adopted a new Traffic Noise Abatement Policy in September 2004. The new policy increases the allowable cost per benefited receptor, which will result in more barriers being determined cost-effective. In support of this SFEIS/FEIS, a noise study update was conducted for the Northern Beltway to review noise issues in relation to NCDOT's new policy. The results of the noise study update are reported in this SFEIS/FEIS. Other changes in the noise policy relating to mitigation are noted below. "NCDOT uses this policy to determine the need for noise

				abatement and the feasibility and reasonableness of abatement measures. Requests for vegetative screening for aesthetic purposes may be considered under the Highway Landscaping Planting Policy." "The steel pile and concrete panel wall is NCDOT's standard noise wall however, NCDOT will consider Context Sensitive Solutions (CSS) as long as other criteria are met. Consideration should be given to providing earth berms for noise abatement purposes on projects that have earth waste and where sufficient right-of-way exists to construct the berm."
All	USEPA	A24-63	The NCDOT and FHWA have not identified which, if any, of the minimization measures listed on page 4-182 would be specifically proposed for R-2247, U-2579, or U-2579A. To EPA's knowledge, NCDOT and FHWA are not proposing any bridge lengthening in environmentally sensitive areas and have not specifically proposed any standard minimization measures such as decreasing the footprint of the proposed project by reducing right of way widths, fill slopes and/or shoulder widths. Another standard minimization measure is to reduce median widths, particularly important at stream and wetland crossings. This has not been identified as a minimization measure in the SFEIS/SDEIS.	During the Concurrence Point 2A (bridging decisions and alignment review)/4A (avoidance and minimization) meetings, NCDOT agreed to bridge several streams that had been proposed to be crossed by culverts (see Section 4.14.1). Generally, 2:1 slopes will be used where possible to minimize culvert length, and NCDOT agreed to shorten culvert lengths where possible and daylighting systems between culverts where possible in interchange areas (see concurrence form in Appendix D.4). At the LEDPA merger meeting, it was agreed to narrow the median width for Project U-2579A from 70 feet to 46 feet where practicable. However, because of the need to add and drop lanes at interchanges and to maintain consistency with existing US 311 near that interchange, it was not practicable to reduce the median width for the entire project.

Table 6-5: Comments from Citizens

Project	Letter/ Comment Number	Comments & Questions	Response
General	60-1	Wants to know when and how will real estate values be determined for properties acquired for right of way.	NCDOT pays fair market value for all property purchased. Licensed real estate appraisers determine a fair market value. This is the same type of appraisal that is required when selling, buying, or refinancing a house.
General	61-1	Would like a right lane between 110B and 110A (south bound) on existing US 52. Hopes this modification could be done prior to constructing the Northern Beltway.	Widening and upgrading the roadway and interchanges along US 52 from the I-40 Bypass to the proposed Beltway is included in the TIP as Project U-2826. US 52 in the area of Exit 110A and 110B is included in Project U-2826. Project U-2826 includes adding auxiliary lanes and revising ramp configurations along US 52. Planning and design are in progress for U-2826. Right of way and construction are scheduled to begin in 2008.
R-2247	64-1	Traffic noise from the westbound lanes of I-40 is a problem for the Five Oaks neighborhood.	NCDOT adopted a new Traffic Noise Abatement Policy in September 2004. As a result, a noise study update was conducted for the Northern Beltway to review noise issues in relation to NCDOT's new noise policy. The results of the noise study update are reported in this SFEIS/FEIS.
General	65-1	Respond feature of the website was not operational.	Respond feature is now operational.
General	65-2	Meetings were held in Winston-Salem, making it difficult for citizens in the county to attend.	Locations were chosen based on their ability to provide adequate space for the large maps and the large expected attendance and on availability. Locations large enough simply were not available outside of central Winston-Salem.
General	65-3	Did not like the fact that all contact people were in Raleigh and having to call long distance to reach them.	A toll-free phone number is now available. (866-223-0862)

Table 6-5: Comments from Citizens

Project	Letter/ Comment Number	Comments & Questions	Response
*R-2247	68-1	Concerned about noise. Wants to request a sound wall. (5631 Whippoorwill Drive, Pfafftown)	Noise studies were conducted for the Preferred Alternative for Project R-2247 to determine where noise walls would be feasible and cost-effective. An update to the evaluation was conducted for this SFEIS/FEIS. Areas along the Project R-2247 Preferred Alternative that have recommended noise barriers are identified in this SFEIS/FEIS. The commenter's area of concern did not qualify for a noise wall according to regulations set by the Federal Highway Administration (FHWA) and NCDOT's *Traffic Noise Abatement Policy*.
*General	69-2	Has the DOT studied effects of a tax relief for those who carpool or don't own a car? What is being done to control the traffic?	NCDOT Public Transportation Division and PART (Piedmont Area Regional Transit) are working to offer more transit services as a means of providing mobility and enabling people to drive less. Use of transit was considered in the SFEIS/SDEIS and while it is a desirable goal, it would not eliminate the need for the beltway.
*General	69-3	Will fences be placed to protect animals? Will any animal population controls be implemented before construction? Has lots of wildlife in backyard and wants to know who to call to help with this problem.	As with other controlled access roads, fences will be built along the right-of-way. NCDOT does not have responsibility for controlling animal populations.
*General	69-5	Asks why NC tax payers are footing the burden of new roads when NC has more roads per land mass than any other state.	Roads in North Carolina are funded through a combination of local, state, and federal funding, with the proportion based on the type of road and its funding category. Road needs are identified by a long range transportation plan prepared by the local metropolitan planning organization (MPO), with funding and priorities set in both the local and state Transportation Improvement Program (TIP). North Carolina has experienced considerable growth in recent years, which creates need for more roadways. North

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Project	Letter/ Comment Number	Comments & Questions	Response
			Carolina and the Triad Region have no county roads, which is the reason that it has one of the largest state maintained highway system in the US.
*General	69-6	Wants to know if tolls will be used to offset the burden to out of state travelers.	No tolls are currently planned to fund the Northern Beltway.
*General	69-7	Houses are having trouble selling for fair market value due to the uncertainty of this plan. Will there be a reduction in taxes until the DOT makes a decision?	Property taxes are set by local governments based on assessed value. NCDOT has no input into local taxing decisions. NCDOT will begin to purchase right of way when the designs have been completed sufficiently to determine actual property that will be needed for construction and when the funds are available to purchase the property. Purchase price is based on fair appraised value, and is subject to negotiation with the property owner. NCDOT may purchase some properties on an accelerated basis if it is determined that a hardship exists. Such purchases may be made after the Record of Decision is complete, anticipated in early 2007. In addition to purchasing property, NCDOT will also pay for relocation of the family.
General	69-9	When will the public get another chance to state their opinions?	Additional public meetings will be held after the Record of Decision to show and collect comments on the most current preliminary designs. The public can comment on the projects at any time via the project website contact page, standard email, regular postal service mail, or telephone, and can request NCDOT staff to attend small group meetings.
General	69-10	Would like to have the opportunity to look at project maps without having to go to a library and then present comments. Concerned that her neighborhood did not have a chance to	NCDOT has made the project maps available on the web site in pdf format (http://www.ncdot.org/projects/wsnb/). The formal comment period lasted approximately 96 days. Comments and questions can be submitted to the

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Project	Letter/ Comment Number	Comments & Questions	Response
		collect their thoughts prior to the meetings to have a combined voice.	NCDOT at any time.
*General	69-11	Will DOT make road improvement to those roads receiving more traffic due to cutting off other roads for the project?	NCDOT has received comments from the Town of Kernersville and others related to road connectivity, and proposes to provide additional connections to mitigate the impact to local traffic. NCDOT proposes to provide a grade separations at Pisgah Church Road, Hastings Hill Road, Sedge Garden Road, and High Point Road, which would facilitate travel to the US 311 area. These connections are also addressed in Section 2.12.7 of this SFEIS/FEIS. In addition, the study of the widening of Union Cross Road from north of I-40 to Sedge Garden Road (TIP Project U-4759) is currently underway. This project would help to mitigate the closing of Oak Grove Church Road.
General	69-12	What are the impacts to schools?	One school, Sedge Garden Elementary School, would be temporarily impacted by the Sedge Garden Road detour that is needed for N2-S1, which is the Preferred Alternative for the Eastern Section Extension (TIP Project U-2579A). This is the only impact to schools as a result of the Winston-Salem Northern Beltway. See Section 4.2.2 of the SFEIS/SDEIS for more detail regarding impacts to schools.
General	69-13, 100-5	69-13. This road was to help the stress of US 52. The original study indicated that it was too expensive to widen US 52. Should widening existing US 52 be evaluated again because of the high cost associated with the Beltway? 100-5. Upgrading US 52 is a viable alternative to constructing	A study of widening existing US 52 from four lanes to six is being done as a separate project (TIP Project U-2826). Widening to six lanes would improve traffic operations and safety but, without the Beltway, would not meet anticipated traffic demand. As part of the SFEIS/SDEIS, a new study of widening existing US 52 to eight lanes was performed to determine cost and feasibility. Based on major community impacts and the fact that widening

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Project	Letter/ Comment Number	Comments & Questions	Response
		the Beltway. US 52 could serve as the I-74 corridor if it was improved. Work on US 52 has been delayed because of the Beltway, and as a result US 52 is in poor condition.	existing US 52 would not serve developing areas in northern and eastern Forsyth County, widening US 52 to eight lanes is not considered to be a viable alternative and was eliminated from further study. The cost and impacts of widening existing US 52 are included in the discussion of alternatives in the SFEIS/SDEIS (Section 2.6.3.2).
U-2579A	69-14	Concerned about increased travel time to get to place of worship in the area of US 311.	NCDOT proposes to provide a grade separations at Pisgah Church Road, Hastings Hill Road, Sedge Garden Road, and High Point Road, which would facilitate travel to the US 311 area.
*General	69-15	Wants to know when summary of comments will be posted. Sent comments previously via email a few years ago. Did not see them on the last published notes. Wants to know where these comments were logged.	All comments on the 2004 SFEIS/SDEIS for Projects R-2247, U-2579, and U-2579A from citizens, local, and federal agencies are summarized in this document (SFEIS/FEIS). Comments on the 1995 Project U-2579 DEIS were summarized and included in Appendix D.5 of the 2004 SFEIS/SDEIS.
General	70-1	Concerned about noise. Wants to know if a noise wall is not warranted, will the DOT consider a heavy landscape border to block the view and help reduce noise.	According to NCDOT's noise policy, requests for vegetative screening for aesthetic purposes may be considered under the Highway Landscaping Planting Policy. Landscaping to block the view or reduce noise is a part of the overall landscaping budget, which will be 0.75% of the total construction budget. Municipalities can pay for any additional landscaping wanted.
U-2579A	164-4	Halt development as soon as route is chosen.	NCDOT will consider if a Transportation Corridor Official Map is appropriate for this project. Without a Transportation Corridor Official Map, NCDOT does not have the authority to stop people from developing their property. Even in the absence of a Transportation Corridor Official Map, once a Record of Decision is issued, NCDOT can make appropriate

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Project	Letter/ Comment Number	Comments & Questions	Response
			advanced protective purchases of properties that are about to be developed.
General	164-5	Make sure that all ramps are long enough to provide safe driving (many in Winston-Salem are too short).	All ramps will be designed according to the latest NCDOT standards, which are different from the standards in place when US 52 and US 421 were constructed.
General	164-7 153-3	Make sure there are enough rural areas versus populated areas to retain the balance of nature. Concerned about lost habitats.	This issue is addressed in the comprehensive plan (*Legacy Comprehensive Plan,* www.cityofws.org/Home/Departments/Planning/Publications/Articles/Publications) for Forsyth County.
General	153-4	Believe that wetland study needs to be re-evaluated, since the original evaluation was done during drought conditions.	Wetlands surveys for the Project R-2247 Preferred Alternative were performed in January and February 2003. For the eastern side (Projects U-2579 and U-2579A), surveys were performed in March and April 2002. Average annual precipitation in the Winston-Salem area is 42.5 inches. Total precipitation for Forsyth County by year is listed below (source: www.wunderground.com): 2001 – 30.35 inches 2002 – 39.67 inches 2003 – 56.3 inches 2004 – 43.4 inches Dry years occurred in 2001 and 2002. Surveys on the eastern side were done during a dry cycle. Surveys on the western side were done in a wet cycle (normal precipitation in December is 3.38 inches, the December before the western surveys was 4.93 inches).

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			Drought conditions will not affect the jurisdictional status of wetlands unless they occur over a period of many years. In addition, wetlands were verified in October 2004 (a normal precipitation year).
General	153-5	Additional asphalt will contribute to loss of water resources because water goes down storm drains rather than being absorbed into the underground water supply.	Water from storm drains is recycled into the underground water supply.
General	100-2	The Southern Loop should be included in this project. A southern loop is shown on the 2002 Thoroughfare Plan.	The Southern Loop is not a funded project, is not in the TIP, and is not included in the *2030 Long Range Transportation Plan*. Therefore, it is not a reasonably foreseeable project and is not included in this study.
General	100-3, 169-1	This project is longer, more expensive, and has a longer schedule than originally planned in the 1989 Highway Trust Fund Act.	The current Highway Trust Fund law describes the Winston Salem urban loop as extending from I-40 west of Winston-Salem northerly to US 311/Future I-74 in eastern Forsyth County. The N.C. General Assembly has modified the urban loop descriptions in the law somewhat since 1989. TIP Project R-2247A (the --- mile segment from US 158 to I-40 southwest of Winston-Salem) is the only section of the Winston-Salem Northern Beltway not included in the Highway Trust Fund's urban loop for Winston-Salem. The Highway Trust Fund is a funding mechanism. It does not dictate the limits of a project, but establishes a revenue stream and specifies the roadways that are eligible to receive funds from that revenue stream. TIP Project R-2247A will not be funded with Trust Fund revenue, but with National Highway Systems funds. The longer schedule is attributable in part to lawsuit-related delays and the

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			need for additional environmental studies that ensued subsequently. The higher cost is related to increased construction costs, increased property values, greater development within the corridors, higher design standards, and increased avoidance and mitigation of environmental impacts.
General	100-7, 100-8	One stated purpose of the Beltway is improved connectivity across US 52 in northern Forsyth County, but traffic maps show traffic dropping off before it reaches US 52.	Improved connectivity is only one of the purposes of the proposed Northern Beltway. There are other purposes, including individual purposes of the Eastern Section (including the Extension) and the Western Section. Traffic forecasts show higher traffic volumes in the middle segments of both the Eastern and Western Sections. This indicates that in addition to the regional traffic traveling to US 52, US 421, and I-40, there is a notable amount of local traffic taking advantage of increased accessibility within the Western Section study area. Traffic forecasts show that 9,200 vehicles per day are projected to travel across US 52 on the Beltway in 2025 should the entire Northern Beltway be constructed.
General	100-12	The Piedmont Triad area is growing slower than the state average. Why is the state spending money on a beltway in this area?	During the 1990s, the population of North Carolina increased by 21 percent. The population of the Greensboro-Winston-Salem-High Point Metropolitan Statistical Area (MSA) increased by 19 percent and Forsyth County population increased by 15 percent; both growth rates are comparable to the state growth in the 1990s. Section 1.4 of the SFEIS/SDEIS is a summary of the needs for the proposed actions and Section 1.5 discusses the purposes of the proposed actions.
General	100-13	"The Winston-Salem Northern Beltway Indirect and Cumulative Effects Analysis (2004) concluded that except for localized	The indirect and cumulative effects analysis (summarized in Section 4.20 of the SFEIS/SDEIS) was prepared in accordance with the NCDOT's *Indirect*

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		impacts, each of the Beltway Build alternatives would have minimal effect on the spatial allocation and amount of growth and development within the County compared to the No-Build Scenario." The Northern Beltway will only encourage sprawl.	*and Cumulative Impact Guidance Manuals (Volumes I and II)*. The conclusions reached in the indirect and cumulative effects evaluation are the result of an extensive modeling and evaluation effort, as described in the Indirect and Cumulative Effects technical memorandum and the updates described in this SFEIS/FEIS.
General	100-14	Metro centers and urban boulevards can be relocated and the Legacy Plan altered whenever developers discuss and decide what is best for their developments. The Northern Beltway will be a target for new development.	The Northern Beltway is in the *2030 Long Range Transportation Plan (LRTP)* approved by the City-County Planning Board. The Northern Beltway's influence on development is discussed in the Indirect and Cumulative Impacts section (Section 4.20) of the SFEIS/SDEIS. Development potential at interchanges is discussed in Section 4.20.4.2. Section 3.3.2 of the Final Winston-Salem Northern Beltway Indirect and Cumulative Effects Analysis states, "As part of the review of Forsyth County zoning, an examination of rezoning requests for 2001, 2002, and 2003 was conducted. Over the period examined, it was determined that approximately 68 percent of rezoning requests presented to Forsyth County were approved. The vast majority of these involved "upzoning," designating the land use to a more valuable or dense type of development. Regardless, the review generally indicates that the approved rezonings were in accordance with the *Legacy Plan*. In fact, a reason cited in not approving several rezonings was that there was a conflict with the *Legacy Plan*." The local government is responsible for all decisions regarding land use. In an update to the *Legacy Plan*, the Legacy Oversight Committee evaluated rezonings and compliance with the *Legacy Plan* in 2003-2004. Their brochure states "Statistics on rezonings for the period 2003-2004 reveal that,

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			in cases where *Legacy* principles were relevant, decisions made by planning boards and elected officials showed a high rate of compliance with those principles. Elected bodies, planning boards and staff were in agreement on decisions in 54 of 64 cases or 84.4% of cases." (www.cityofws.org/Home/Departments/Planning/Publications/Articles/Publications)
General	100-15	The Triad is ranked the 7th most dangerous place for pedestrians out of more than 330 major metropolitan areas nationwide. Why isn't NCDOT concentrating on making local streets safer?	Local street problems would be addressed as part of other local or NCDOT Transportation Improvement Program (TIP) projects. The SFEIS/SDEIS (Section 1.10.1) describes the various Forsyth County projects included in the 2006-2012 NCDOT TIP. It includes seven interstate projects, ten rural projects, twenty-three urban projects, twenty-one bridge replacement projects, four bicycle and pedestrian projects, two enhancement projects, two hazard elimination projects, two passenger rail projects, and over twenty transit projects. In addition, the City of Winston-Salem has an ongoing sidewalk construction program to improve pedestrian safety.
General	100-16	The Triad area has notably poor air quality based on national studies. Road construction and increased traffic contribute to poor air quality.	Based on microscale modeling, the Northern Beltway is not predicted to contribute to localized exceedances of the National Ambient Air Quality Standard for carbon monoxide in 2005, 2010, or 2025. The SFEIS/SDEIS discusses air quality in Sections 3.9 and 4.7. The NCDOT and FHWA agree that the important air quality situation to consider is Forsyth County's status as non-attainment for the 8-hour ozone standard and maintenance for carbon monoxide. An updated *2030 Long Range Transportation Plan (LRTP)* for the Winston Salem Urban Area and the USDOT Conformity Determination was completed on May 28, 2005.

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Project	Letter/ Comment Number	Comments & Questions	Response
			This latest LRTP update/conformity determination for the region used the latest planning assumptions and emissions model (Mobile 6.2) to demonstrate attainment of the ozone and carbon monoxide ambient air quality standards.
General	100-17	The SFEIS/SDEIS figures estimate that the total vehicle miles traveled will increase with the construction of the Beltway. Why would NCDOT encourage more traffic?	The SFEIS/SDEIS figures do not mention total vehicle miles traveled. However, several figures in Chapter 2 show the average daily traffic volumes that would be attracted to the three sections of the Northern Beltway by 2025. Figure 2-14 shows Project R-2247, Figures 2-20a and 2-20b show Project U-2579 and Project U-2579A. Some additional travel would be attributed to the Beltway, estimated to be a maximum of only 1.59 percent of total travel.
General	100-18	If we cannot maintain existing roads, why would we add more miles to maintain? Why didn't the SFEIS/SDEIS address the need for maintaining existing roads rather than building a new loop?	The SFEIS/SDEIS discusses Improve Existing Roadways Alternatives, which were eliminated from further study because they did not meet the projects' purposes and needs (see Section 2.6). The Northern Beltway does not claim to solve every transportation problem in Forsyth County, and its construction does not preclude other projects to address other problems.
General	100-21	Since more road projects are being planned than there is money for, the reasons for building or not building this project should be taken very seriously. Priorities should be on maintaining the existing road system rather than building a road to benefit developers and the Chamber of Commerce.	Section 1.4 of the SFEIS/SDEIS is a summary of the needs for the proposed actions and Section 1.5 discusses the purposes of the proposed actions. The Winston-Salem Urban Area Metropolitan Planning Organization (MPO) (whose members include the local governments of the area) sets roadway improvement priorities for the area and develops the *Long Range Transportation Plan (LRTP)*. The Northern Beltway is included as a major project in the *2030 LRTP*.

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Project	Letter/ Comment Number	Comments & Questions	Response
			Statewide transportation spending priorities (e.g., maintenance v. new construction) are set by the N.C. General Assembly. The budget passed by the General Assembly in 2005 includes several Division Motor Vehicle fee increases that will generate approximately $141 million in additional revenue annually for maintenance of NC highways.
General	169-2	Based on traffic and accidents, Project U-2579 should be built before Project R-2247. Project R-2247 is being built first because of developers and planners who want to make money from creating urban sprawl on the western side.	NCDOT's Transportation Improvement Program (TIP), which schedules the funding for right of way acquisition and construction for transportation projects, reflects the decision by the NC Board of Transportation to reverse the priorities of TIP Projects U-2579 and R-2247. Project U-2579 is now scheduled to be constructed before Project R-2247. According to the 2006-2012 TIP, construction of Project U-2579 is scheduled to start in 2010 and construction of Project R-2247 is not within the 7-year programming period.
General	169-3	The money allocated to the Beltway should be invested in resolving existing traffic problems.	The Northern Beltway would help to resolve traffic problems. Section 2.6 discusses the Improve Existing Roadways Alternative, including the reasons it was not carried forward for further study. Section 2.11 (Project R-2247) and Section 2.12.3 (Projects U-2579 and U-2579A) discuss traffic projections for the Northern Beltway Preferred Alternatives.
General	187-1	Concerned about accuracy of endangered species survey; there is a red-cockaded woodpecker on the property.	Surveys were conducted for the red-cockaded woodpecker (RCW) in 2002 and 2003. No suitable nesting habitat is present within the project vicinity. The RCW's habitat requirements are very specific – see Section 3.21.1 of this SFEIS/FEIS. A biological conclusion of No Effect was reported in the SFEIS/SDEIS and this SFEIS/FEIS. To the untrained eye, hairy woodpeckers and downy woodpeckers resemble the RCW.

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Project	Letter/ Comment Number	Comments & Questions	Response
General	189-1, 190-1	Move highway further east to better serve the Triad.	The corridor study evaluated several potential locations for the Beltway, including some further east, but those were eliminated from further consideration for reasons described in Section 2.12.1.2 of this document.
General	193-1	The Beltway needs more sound barriers to help with the environment and help with the quality of life for the citizens.	Barriers will be provided in areas determined to be reasonable and cost-effective in accordance with FHWA regulations and NCDOT guidelines. Barriers are proposed at several locations along the Preferred Alternatives for Projects R-2247, U-2579, and U-2579A.
General	157-1	Why is it so difficult to design an east bound I-40 to west bound US 421 and vice versa?	This interchange is located outside the project corridor. The existing interchange with US 421 and I-40 in western Forsyth County provides for all movements except from eastbound I-40 to westbound US 421 and from eastbound US 421 to westbound I-40. Those movements were not included in the interchange because of limited demand and restricted geometric conditions. Motorists desiring to make that movement can either use Stratford Road and Silas Creek Parkway east of the I-40/US 421 interchange or use Lewisville/Clemmons Road west of the interchange. The Western Section of the Northern Beltway has interchanges at both I-40 and US 421, which would allow those traveling on eastbound I-40 to access the Northern Beltway, traveling north, and exit onto westbound US 421 at the next interchange.
General	219-1	The Beltway needs to be built with sufficient capacity so that it is not over-capacity by the time it is completed.	The Northern Beltway will be built to serve projected 2025 traffic volumes.

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Project	Letter/ Comment Number	Comments & Questions	Response
General	173-1	How many trees are going to be destroyed by this Beltway?	It is anticipated that the impacts of the Preferred Alternative of the Northern Beltway to forested land will be approximately 868 acres. More information is available in the SFEIS/SDEIS (Section 4.15).
General	185-1	What is the status of the lawsuit?	In 1999, the North Carolina Alliance for Transportation Reform and Friends of Forsyth County filed a lawsuit in federal court challenging the ROD issued for the Western Section of the beltway in 1996. FHWA and NCDOT agreed to reopen the NEPA process, and the lawsuit was dismissed. By order of the court, FHWA may "not grant any further approvals, enter into any contracts, or provide any funds relating to the acquisition of property or construction of the Western Section of the Winston-Salem Beltway" and NCDOT may not take any "irrevocable actions relating to construction, right of way acquisition, or negotiations for right of way acquisitions" until a "new environmental analysis and documentation process has been completed, a conforming Long Range Transportation Plan and Transportation Improvement Program for the Winston-Salem metropolitan area have been approved, and [FHWA and NCDOT] issue a new Record of Decision."
R-2247	67-1, 73-1 74-1	Concerned with plan to build median on Route 67 from west of the Route 65/Route 67 intersection to Seward Road. Currently, it is dangerous to turn left onto Hauser Drive or Seward Road off Route 67 due to vertical sight distance. A median would force more traffic to make these movements, which is a major concern.	The NCDOT will check the traffic operations in this area and will design accordingly. The median length will be considered as well as improving sight distance and providing adequate opportunity for U-turns. A design public hearing, planned to be held in 2006, will provide citizens with additional opportunities to comment on design features such as this.
R-2247	67-2, 73-2	If median is built on Route 67, widening will impact property on	Symmetric widening is currently proposed to minimize impacts. NCDOT

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	74-2	south side of Route 67. The DOT already owns property on the north side of Route 67, so please consider widening on north side rather than south side.	owns one property on the north side of the road. Impacts to houses also would occur if widened to the north.
R-2247	72-1	Concerned if Wide Country Road is closed to Bethania-Tobaccoville Road, then all traffic will be diverted to Bethania Ridge Road. Bethania Ridge development is not designed to handle this traffic. Suggest flattening the curve on Bethania-Tobaccoville Road (Doral Drive) and extending Bethania Ridge a little further, which will allow residents on Doral Drive to intersect Bethania Ridge nearer the intersection of Doral Drive.	Approximately 95 to 100 residential parcels use Bethania Ridge Rd and Wide County Rd. It is estimated that 75 outgoing trips are made during the morning peak hour in the Bethania Ridge Road/Wide Country Road area. If all of these trips were restricted to one access road, this traffic volume would not warrant a signal. Bethania Ridge road is appropriately designed for this volume of traffic. The NCDOT plans to proceed with the current design.
R-2247	75-1	The eastward turn of Beltway just south of Reynolda Road takes property. Moving the Beltway a bit more eastward would miss the property and would go through open land.	Moving the Beltway to the east in this location cannot be done because of Beshavia Creek in the area.
R-2247	100-4	The projected traffic volumes for 2025 do not justify building the Western Section. According to traffic volumes, Project U-2579 should be built before Project R-2247. Because of the new Dell facility planned for next fall, Project U-2579A should be built first.	NCDOT's Transportation Improvement Program (TIP) reflects the decision by the NC Board of Transportation to reverse the priorities of TIP Projects U-2579 and R-2247. Project U-2579 is now scheduled to be constructed before Project R-2247. According to the 2006-2012 TIP, construction of Project U-2579 is scheduled to start in 2010 and construction of Project R-2247 is scheduled for Post Year (which means some time after 2012).
R-2247	100-6	One stated purpose of Project R-2247 is to improve north/south connectivity in western Forsyth County. However, most of western Forsyth County is residential, with nothing important to	Improving north/south connectivity by constructing Project R-2247 would allow the residents in western Forsyth County to get to areas both north and south without having to travel towards the city or weave through a series of

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		connect.	north/south roadways that generally are not continuous across radial routes (see Section 1.4.1 of the SFEIS/SDEIS).
R-2247	100-9	One stated purpose of Project R-2247 is to provide congestion relief for area roadways, but developers will try to build around the new interchanges. This will bring more congestion to the area. There are a number of congested roads that, according to the SFEIS/SDEIS, the Beltway will not improve with construction of the Beltway.	The local government is responsible for decisions regarding land use planning and development. The Indirect and Cumulative Effects section of the SFEIS/SDEIS assesses the potential for development around the Northern Beltway interchanges (see Section 4.20). With the entire Northern Beltway in place, interchange development potential is considered high at 4 interchanges, medium at 6 interchanges, and low at 8 interchanges (Table 4-87, Section 4.20.4.2). The effects on area roads due to the Western Section of the Northern Beltway are discussed in Section 2.11.3 of the SFEIS/SDEIS. Table 2-19 shows the local roadway network traffic volumes and level of service for roadways in the western section area under the Build and No-Build Alternatives. Table 2-20 summarizes and compares the information from Table 2-19. As reported in Table 2-20, with the Build Alternative in place, 9 percent of roadway segments analyzed would experience an improved level of service and 41 percent would experience reduced traffic volumes, compared with 5 percent experiencing a degraded LOS and 12 percent experiencing increased traffic volumes.
R-2247	100-11	The Alternatives workshop for Project R-2247 that was held right after 9-11-01 was ridiculous. The Alternatives were designed in such a way to include many roads to be widened	The workshop to present the Improve Existing Roadways (IER) Alternatives held on November 27, 2001 was attended by over 670 people. Written comments were received by 184 citizens, with 177 of these comments

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		and taking many citizens' yards. The workshop did not include a cost comparison between the Beltway and the Alternatives. Information on the Thoroughfare Plan was not provided at the workshops. The workshop did not include information on non-construction alternatives.	expressing opposition to the IER Alternatives. The Improve Existing Roadways Alternatives (IER) RV-A and RV-B were developed to focus on the same benefits provided by the Western Section Preferred Alternative that could be provided by improving existing roadways. Most roadways included in the IER Alternatives are two-lane roadways. Improving these roads required widening them for increased capacity and improved alignment, and this would require additional right of way from adjacent parcels. The large-scale aerial photographs of Alternatives RV-A and RV-B shown at the meeting indicated areas where right of way was needed. In addition to the aerial photographs showing the IER Alternatives, two poster-sized maps showing Alternatives RV-A and RV-B in relation to the Preferred Alternative alignment for the Western Section of the Northern Beltway were displayed, as well as a poster-sized map showing the *Winston-Salem Thoroughfare Plan*. The handout provided at the workshop presented a comparison of the impacts of the IER Alternatives to the Preferred Alternative. Costs were not available at the time, but were provided in the SFEIS/SDEIS (Section 2.6). The handout also stated that other non-new location alternatives that were included in the original 1996 Project R-2247 FEIS were being reviewed and updated in coordination with the local Metropolitan Planning Organization, including: Transportation Demand Management (TDM) Alternatives, Transportation System Management (TSM) Alternatives, and mass transit

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			alternatives. The handout also states "These alternatives are not presented at this workshop tonight. However, updated research and discussions of these types of alternatives will be included in the documentation of the reevaluation [the SFEIS/SDEIS]".
R-2247	100-19	The graveyard of Sharon Methodist Church should be eligible for the National Register and was left off of the Survey of Historic Properties. George McKnight II (member of the family which sponsored Methodism in Forsyth County) and Leanard Conrad (member of the first Board of County Commissioners of Forsyth County) are buried there.	There are no direct impacts to this church property. NCDOT's Phase II Historic Architectural Resources Survey Report (April 2003) evaluated the Sharon Methodist Church and cemetery and it was recommended as not eligible for the National Register of Historic Places. A letter from the State Historic Preservation Office dated April 7, 1992 stated that the Sharon Methodist Church is not eligible. On July 25, 1995, the Federal Highway Administration, the State Historic Preservation Office, and the NCDOT agreed that church and cemetery are not eligible. The letter and concurrence form are in Appendix D.1.
R-2247	100-20	The main reason given for not selecting the less costly route for Project R-2247 was the preservation of Historic Pfafftown. Historic Pfafftown is being developed daily.	There were other reasons for selecting the Project R-2247 Preferred Alternative, which include: fewer relocations, fewer impacts to water resources and wildlife habitat, and better design and location of the US 52 interchange. This is discussed in the SFEIS/SDEIS (Section 2.9.2). Whether or not historic Pfafftown is being developed by other entities, as long as it remains eligible for or listed on the National Register of Historic Places, it is protected by federal law (Section 106 of the National Historic Preservation Act and Section 4(f) of the USDOT Act) from federal actions.
R-2247	194-1	Lives on Ellen Avenue. There are about 70 homes in this development. Putting a median in Reynolda Road (NC 67) in	The NCDOT will check the traffic operations in this area and will design the roadway accordingly. Medians that restrict left turns are safer than

Table 6-5: Comments from Citizens

Project	Letter/ Comment Number	Comments & Questions	Response
		this area is going to make it really dangerous for people coming out of Davbon Park. Traffic is heavy on NC 67. Sounds like people will have to take a right on NC 67 and then a U-turn to go left. Sounds dangerous. Don't understand why NC 67 will not be widened on the other side. State has already purchased and removed houses on that side. To widen on Davbon Park side will take half of the yards of about six homes. Why ruin these homes, the road will be so close to their front doors. Someone needs to do more studies on this.	unrestricted left-turns across traffic. Intersections will be designed to be wide enough for U-turns to be made safely. The median length will be considered, as well as improving sight distance and providing adequate opportunity for U-turns. Symmetric widening is currently proposed to minimize impacts. NCDOT owns one property on the north side of the road. Impacts to houses also would occur if widened to the north.
U-2579	76-1, 80-1 83-4, 85-1, 98-1, 171-2, 182-1	The closing of Northampton Road would be a great inconvenience, and the only detours would be too long. Business would be negatively affected by closing Northampton without a shorter detour, and citizens who frequently use Old Walkertown Road would be affected. This would affect citizens living on Winnabow Road, Wakeman Drive, Tory Pines, and Huff Circle. It would place heavy traffic on Northampton Drive. The cul-de-sac proposed for the north end of Northampton Drive limits access to important businesses, including post office, grocery store, and drug store.	NCDOT intends to maintain a connection from Northampton Road to Old Walkertown Road. The final design will be developed based on design constraints and cost considerations.
U-2579	77-1	Existing drainage is poor at the intersection of Willow Bend and West Mountain Street. Can the landscaping at this location be improved?	These issues are not within the scope of the proposed projects. However, NCDOT Division 9 has been made aware of these concerns.
U-2579	77-2	Existing curve from West Mountain Street to Willow Bend is a	These issues are not within the scope of the proposed projects. However,

Table 6-5: Comments from Citizens

Project	Letter/ Comment Number	Comments & Questions	Response
		blind curve, which vehicles speed around. Would like a lower speed limit around that curve.	NCDOT Division 9 has been made aware of these concerns.
U-2579	78-1	If Dippen Road is closed, the detour using NC 66 and Davis Road to get to Old Walkertown Road is too long.	NCDOT has studied this issue further and currently plans to have a grade-separation at Dippen Road.
U-2579	79-1	Concerned that noise and visual impacts would be great on the neighborhood (5026 Woodsboro Lane, Winston-Salem). Suggest NCDOT purchases the entire properties of Edwin Craig Snow and Curtis R. Cox, as opposed to just the limited area of the right of way, and use this property to plant trees to shield the neighborhood from the Beltway. If this is not possible, any barrier would be appreciated.	The noise analysis reported in Section 4.8.3.2 of the SFEIS/SDEIS found that a noise barrier in this area was not reasonable and feasible. NCDOT adopted a new Traffic Noise Abatement Policy in September 2004. As a result, a noise study update was conducted for the Northern Beltway to review noise issues in relation to NCDOT's new noise policy. The results of this analysis indicate that a noise barrier is reasonable and feasible in the area from about 900 feet west of Davis Road to Dippen Road. These results are reported in Chapter 4 of this SFEIS/FEIS.
U-2579	80-2	The maps did not accurately show the location of the Moravian Church in relation to the property.	Staff have double-checked, and, according to aerial photography and available mapping, the location of the church is correct on the maps.
U-2579	80-3, 98-2 168-3	Noise is a concern. Need more information about where the Beltway will be in relation to the house (4241 Church Hill Road, Winston-Salem). There are no noise walls proposed. If there were any noise walls, they would detract from the look of the neighborhood (4291 Winnabow Road).	Church Hill Road is about 800 feet from the U-2579 Preferred Alternative. It is too far from the Northern Beltway to be substantially impacted by traffic noise due to the Beltway. The City may choose to upgrade the material/design of a NCDOT noise wall. NCDOT adopted a new Traffic Noise Abatement Policy in September 2004. As a result, a noise study update was conducted for the Northern Beltway to review noise issues in relation to NCDOT's new policy. The results of this

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Project	Letter/ Comment Number	Comments & Questions	Response
		No noise barriers have been projected for the North Oaks community. The citizens feel that one is necessary due to the increase in noise from the nearby Beltway.	analysis indicate that a noise barrier on the south side of the Beltway is reasonable and feasible in the area from about 650 feet east of Old Walkertown Road for approximately 2,000 feet to the east. The results are reported in Chapter 4 of this SFEIS/FEIS.
U-2579	81-1	Wish to be informed at all times. The map shows that 95 percent of the property will be taken, and that the guardrails are proposed to be in front of the house. Suggest that NCDOT purchase the entire property (5862 Stanleyville Drive, Rural Hall).	The NCDOT Right of Way Branch will address each property on an individual basis, including uneconomic remnants and removal of access.
U-2579	82-1	The preferred route destroys the neighborhood of elder homes. There must be a better route (5762 Germanton Road, Winston-Salem).	Several routes were previously evaluated, and the Preferred Alternative was chosen based on a number of reasons, such as fewest residential relocations, least impact to established neighborhoods, and least impact to the Salem Lake watershed. The SFEIS/SDEIS discusses the selection of the Preferred Alternative for Project U-2579 in Section 2.12.6.
U-2579	83-1	Concerned with traffic, noise, and unfamiliar people in the neighborhood (4366 Winnabow Road, Winston-Salem).	The right of way limits of the Beltway will be fenced. Since there is no interchange proposed at Old Walkertown Road, no additional traffic is expected on Northampton Road or within the North Oaks community. NCDOT adopted a new noise policy in September 2004. As a result, a noise study update was conducted for the Northern Beltway to review noise issues in relation to NCDOT's new policy. The results of the noise study update indicate that a noise barrier on the south side of the Beltway is reasonable and feasible in the area from about 650 feet east of Old Walkertown Road for approximately 2,000 feet to the east. The results are reported in Chapter 4 of this SFEIS/FEIS.

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Project	Letter/ Comment Number	Comments & Questions	Response
U-2579	83-2	Exit ramps are an issue (4366 Winnabow Road, Winston-Salem).	The closest major road to the community at which an interchange could be placed would be Davis Road, which is about 1.4 miles from US 311. The US 311 and US 158 interchanges are 1.1 miles apart. Old Walkertown Road is only 0.6 mile from US 311, too close for an interchange. An interchange at Davis Road would impact a community, a church, and would not justify an interchange based on projected traffic.
U-2579	83-3	Is interested in noise walls (4366 Winnabow Road, Winston-Salem).	The NCDOT adopted a new Traffic Noise Abatement Policy in September 2004. The new policy increases the allowable cost per benefited receptor, which will result in more barriers being determined cost-effective. In support of this SFEIS/FEIS, a noise study update was conducted for the Northern Beltway to review noise issues in relation to NCDOT's new policy. The results of the noise study update indicate that a noise barrier on the south side of the Beltway is reasonable and feasible in the area from about 650 feet east of Old Walkertown Road for approximately 2,000 feet to the east. The results are reported in Chapter 4 of this SFEIS/FEIS.
U-2579	84-1	The Beltway must go north of Walkertown in order to serve traffic from north of Walkertown, which is what is needed. A traffic study should be made to verify this.	When considering build alternatives for Project U-2579, the study area was defined to locate the Northern Beltway outside much of the urbanized portion of Forsyth County in order to reduce impacts to communities, while keeping the route close enough to travel destinations to serve Forsyth County traffic in addition to traffic from outside the region. Extending the study area farther to the north and east would have required an expansion of several miles in order to extend beyond central Rural Hall, Walkertown, and Kernersville. A route in this outer area would be considerably longer and would result in substantially greater natural resource impacts as well as increased cost

Table 6-5: Comments from Citizens

Project	Letter/ Comment Number	Comments & Questions	Response
			(SFEIS/SDEIS, Section 2.12.1.1)
U-2579	98-3 171-1	The interchanges for the Beltway are far away and inconvenient. Was told that interchanges could not be placed close together. The ones for US 311 and US 158 show that one could be placed at a more convenient location for the neighborhood. (98-3: 4291 Winnabow Road; 171-1: North Oaks community)	The closest major road to the community at which an interchange could be placed would be Davis Road, which is about 1.4 miles from US 311. The US 311 and US 158 interchanges are 1.1 miles apart. Old Walkertown Road is only 0.6 mile from US 311, too close for an interchange. An interchange at Davis Road would impact a community and a church, and would not justify an interchange based on projected traffic.
U-2579	120-1	The Oak Grove Moravian Church parsonage would be affected by the Beltway. Request consideration to minimize impact to the parsonage (459 South Church Street, Winston-Salem).	The parsonage is within the right of way but not within the construction limits. The specific impacts will be minimized if possible during final design. It may be possible to relocate the parsonage to a different area on the same property.
U-2579	156-1	By closing the road to the trailer park of US 311, tenants will have to use private driveway (3380 Dillon Farm Road, Winston-Salem).	The Right of Way Branch and the Roadway Design Unit will determine whether it will be more feasible to provide a new access road to the tenants or to purchase the properties.
U-2579	156-2	Appears that well for the trailer park will have to be relocated (very expensive) (3380 Dillon Farm Road, Winston-Salem).	The Right of Way Branch will address this issue during right of way acquisition.
U-2579	156-3	The 12-inch gas line across property will have to be moved (3380 Dillon Farm Road, Winston-Salem).	Utility issues will be addressed during final design.
U-2579	156-4	Spring-fed pond may be impacted (3380 Dillon Farm Road, Winston-Salem).	This issue will be addressed during final design.

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Project	Letter/ Comment Number	Comments & Questions	Response
U-2579	156-5	Many hardwood and large pine trees will be impacted. Do owners have option to cut and sell trees prior to construction?	Owners may cut and sell trees prior to the appraisal by NCDOT, which will take into account the value the trees add to the property's fair market value. If trees are cut after the appraisal, the appraised value may be reduced.
U-2579	156-6	Disabled citizens will be land-locked, and will have difficulty moving (3380 Dillon Farm Road, Winston-Salem).	The Right of Way Branch will work with these citizens as needed. Access will be provided to land-locked parcels, or NCDOT will acquire the property based on fair market value, and will aid in the relocation of citizens.
U-2579	168-1	Object to making Northampton Road a cul-de-sac. It will adversely affect access by school buses, emergency vehicles, residents to the respective churches, shopping centers, grocery stores, and jobs. It will more than double traffic on Northampton Drive, causing a safety hazard to children where there are not sidewalks and only providing one exit from the North Oaks community and Northampton Drive. To place a cul-de-sac would provide equal limitations to residents who travel Walkertown Road as well as other roads.	NCDOT intends to maintain a connection from Northampton Road to Old Walkertown Road. The final design will be developed based on design constraints and cost considerations.
U-2579	168-2	What has been done to adequately inform other residents in the Eastern Section who will be affected by the Beltway? Some residents have not been informed, and others have only been partially informed.	A mailing list was created based on the most current owner-information available, and is regularly updated. Public meetings were advertised in the local newspaper and in newsletters. Newsletters also provided citizens information about the project. The NCDOT has a project website to inform the public (www.ncdot.org/projects/wsnb) and a toll-free number was established in 2004 to facilitate contacting the project team about the project. The county website has the beltway corridor shown as a layer on their Geo-

Table 6-5: Comments from Citizens

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			Data Explorer page (http://www.co.forsyth.nc.us/tax/geodata.aspx) where the beltway can be seen in relation to tax parcels. After this group expressed this concern, NCDOT posted variable message boards in the neighborhood to announce the November 17, 2004, public hearing to passers-by.
U-2579	168-4	Concerned about the decrease in air quality, especially to elderly residents on oxygen. Many sick residents will not be able to walk outdoors any more.	Based on microscale modeling, the Beltway is not predicted to cause exceedances of the National Ambient Air Quality Standard for carbon monoxide in 2005, 2010, or 2025. The SFEIS/SDEIS discusses air quality in Sections 3.9 and 4.7.
U-2579	168-5	Concerned about possible damage to homes due to blasting, vibrations, and digging during road construction. Who will be primarily responsible for damage, how should damage be reported, and will a contact person be identified?	In case of damage, the resident may contact the Resident Engineer for the project. A pre-construction survey will be done in areas of possible concern to assess a pre-construction condition. Construction impacts are discussed in the SFEIS/SDEIS.
U-2579	168-6	What is the elevation of the bypass from street level to the bridge relative to North Oaks community? Will any homes or property be overshadowed by the Beltway?	The pavement elevation just east of the bridge over Old Walkertown Road and the railroad is approximately 23 feet higher than the closest property to the south on Northampton Drive. As the ground drops, the pavement is approximately 75 feet above the property at the north end of Winabow Road. In this "worst case" location, the roadway is about 365 feet away from the property, which would equate to a slope of about 20 percent. Also, since the Beltway would be to the north of the North Oaks Community, there would be no shadowing effect in terms of blocking sunlight.
U-2579	171-3	School buses in the Northampton Road area will need to use narrow detour roads because of road closings.	NCDOT intends to maintain a connection from Northampton Road to Old Walkertown Road. The final design will be developed based on design

Table 6-5: Comments from Citizens

Project	Letter/ Comment Number	Comments & Questions	Response
			constraints and cost considerations.
U-2579	171-4	Concerned about emergency vehicle access with Old Walkertown Road closing.	NCDOT intends to maintain a connection from Northampton Road to Old Walkertown Road. The final design will be developed based on design constraints and cost considerations.
U-2579	171-5	Concerned about noise pollution, and do not know how well noise barriers would protect neighborhood residents.	The NCDOT adopted a new Traffic Noise Abatement Policy in September 2004. The new policy increases the allowable cost per benefited receptor, which will result in more barriers being determined cost-effective. In support of this SFEIS/FEIS, a noise study update was conducted for the Northern Beltway to review noise issues in relation to NCDOT's new policy. The results of the noise study update indicate that a noise barrier is reasonable and feasible on the south side of the Beltway in the area from about 650 feet east of Old Walkertown Road for approximately 2,000 feet to the east. The results are reported in Chapter 4 of this SFEIS/FEIS.
U-2579	211-1	Wants to know how far project is from Lane Street.	Lane Street is approximately 1.3 miles from the Project U-2579 right of way.
U-2579	202-1	Has looked through website and the environmental impact report and could not ascertain if his home (508 Buck Run Drive in Kernersville) will be affected by the beltway. Wants to know if his home will be affected, and if not, how close will the Business 40 interchange be to his property.	The Project U-2579 right of way impacts approximately 500 square feet of the southwest corner of this property.
U-2579	217-2	Lives in Brookmont Subdivision off Glen Hi Road and wants to know exactly how the project affects this neighborhood.	The southern alternative segments (S1 and S2) will affect between 5 and 10 properties in this subdivision. Access to the north on Oak Grove Church Road will also be eliminated.

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Project	Letter/ Comment Number	Comments & Questions	Response
U-2579	221-2	Would like NCDOT to slide the right of way over 10' to take him (no address available).	Design changes such as this would be addressed in the final roadway design.
U-2579/ U-2579A	100-10	One stated purpose of Projects U-2579/U-2579A is to enhance safety. If safety is a factor, why has the state pushed the Western Section of the Beltway to be constructed first? Also, the design of the Beltway is guaranteed to cause more accidents.	NCDOT's Transportation Improvement Program (TIP) reflects the decision by the NC Board of Transportation to reverse the priorities of TIP Projects U-2579 and R-2247. Project U-2579 is now scheduled to be constructed before Project R-2247. According to the 2006-2012 TIP, construction of Project U-2579 is scheduled to start in 2010` and construction of Project R-2247 is scheduled for Post Year (which means some time after 2012). The Beltway is being designed to meet modern standards for safety. As discussed in Section 2.12.5, the accident rate on modern freeways such as the Beltway is substantially lower than a surface street with multiple access points.
U-2579/ U-2579A	192-1	Concerned about narrowing from 6-lane section to 4-lane section from Project U-2579 to Project U-2579A.	With auxiliary lanes, approximately two-thirds of Project U-2579A will be 6-lanes wide. The major movement between Project U-2579 and U-2579A is from the Beltway to US 421/I-40 Business. Transitions between different numbers of lanes will be designed in accordance with NCDOT standards.
U-2579A	62-2, 177-3 179-2	The Piedmont Greenway Plan is a greenway trail that will run from Salem Lake through Kernersville to Triad Park to Lake Brandt. Wants DOT to keep this trail in mind when the Beltway is built so access can be provided under the Beltway for those using the greenway trail.	The Project Commitments section of the SFEIS/SDEIS includes the following: The development of this project will be further coordinated with the City of Winston-Salem and Forsyth County Parks and Recreation Departments to minimize any conflicts with future parks and greenways planning. Stream crossings will be designed to maintain the future viability of any impacted proposed greenways.

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Project	Letter/ Comment Number	Comments & Questions	Response
U-2579A	66-1	Asks DOT to make provisions for pedestrians in support of the planned Piedmont Regional Greenway (PRG) along Kerners Mill Creek and along West Mountain Street in plans for the Northern Beltway.	NCDOT will coordinate the Beltway design with local greenway plans.
U-2579A	69-1	Noise barriers should be implemented at on and off ramps where communities will be affected by the change in elevation of roads. On/off ramps are proposed in a low area at I-40 and Gerry Drive.	Noise impacts were evaluated for this area in accordance with federal and state policy and it was determined that this area would not qualify for a noise barrier.
U-2579A	69-4	Concerned about impacts to the Sedge Garden neighborhood. It was affected by the I-40 Bypass and will be affected again by this project.	NCDOT proposes to provide overpasses at Sedge Garden Road and Hastings Hill Road to maintain continuity.
U-2579A	69-8	Concerned about parents in poor health needing to move to an assisted living facility in the near future and having difficulty selling their home. They have already received a note from the department of engineering. Wants to know what the DOT will do in this situation. Parents live on Hastings Hill Road near the proposed new road.	The Right of Way Branch will address each property on an individual basis. There are provisions for advanced acquisition in hardship situations when criteria are met.
U-2579A	86-1, 111-3, 132-2, 138-1, 139-1, 146-1,	Concerned about increased highway noise. Requests an evaluation for a sound barrier.	The NCDOT adopted a new Traffic Noise Abatement Policy in September 2004. The new policy increases the allowable cost per benefited receptor, which will result in more barriers being determined cost-effective. In support of this SFEIS/FEIS, a noise study update was conducted for the Northern Beltway to review noise issues in relation to NCDOT's new policy. The

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Project	Letter/ Comment Number	Comments & Questions	Response
	149-3, 160-1		results of the noise study update are reported in this SFEIS/FEIS.
U-2579A	3-2, 86-2, 87-2, 88-2, 92-3, 93-2, 95-3, 97-4, 104-3, 109-3, 115-3, 116-1, 118-3, 137-1, 138-2, 150-1, 155-2, 158-4, 162-1, 165-3, 153-1, 163-5 177-5, 206-2	Include grade separation at Hastings Hill Road (do not sever Hastings Hill Road). This road provides access to the busiest retail area of town and many churches. Detour on Sedge Garden Road to S. Main Street would increase traffic by Sedge Garden Elementary School, creating a bottleneck.	NCDOT has revised the project design to include a grade separation at Hastings Hill Road. The detour on Sedge Garden Road is necessary to keep the road open and to provide access to the elementary school and nearby neighborhoods.
U-2579A	138-4, 140-3	If Hastings Hill Road is severed, need to improve the intersection of Kernersville Road and Hastings Hill Road.	Intersection improvements at Kernersville Road and Hastings Hill Road would be done as a separate TIP project. Division 9 is currently addressing this issue. NCDOT has revised the project design to include a grade separation at Hastings Hill Road.
U-2579A	3-1, 87-3,	Include grade separation at Pisgah Church Road (do not sever	NCDOT has revised the design to include a grade separation at Pisgah

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Project	Letter/ Comment Number	Comments & Questions	Response
	95-2, 96-1, 97-3, 104-4, 115-2, 116-2, 158-3, 162-2, 53-2, 177-2, 179-1, 206-1	Pisgah Church Road).	Church Road.
U-2579A	88-1, 89-1	Include grade separation at Oak Grove Church Road (do not sever Oak Grove Church Road).	NCDOT has studied the feasibility of bridging or realigning Oak Grove Church Road. While this does not appear to be feasible, Union Cross Road will be widened from I-40 to Sedge Garden Road to provide additional capacity crossing I-40.
U-2579A	91-2, 92-2, 109-1, 97-2	Include an interchange at West Mountain Street.	NCDOT met with the Town of Kernersville and determined an interchange is not feasible at West Mountain Street due to the proximity of the railroad and spacing of other interchanges. It was noted that Kernersville needs better access to the Beltway and the NCDOT will consider that issue. The future airport connector was mentioned as a potential interchange location. Current proposed spacing of proposed interchanges does not preclude a future interchange with the airport connector, although adding an interchange at West Mountain Street would. The airport connector is on the local thoroughfare plan and the long-range transportation plan, but it is not funded in the TIP.
U-2579A	92-1, 104-1, 138-5, 158-1	Include an interchange at Big Mill Farm Road with US 421 (do not sever Big Mill Farm Road).	Big Mill Farm Road is outside the study area for this project, but could be studied as a separate project. Current plans for the Beltway design do not

Table 6-5: Comments from Citizens

Project	Letter/ Comment Number	Comments & Questions	Response
	177-4, 96-2 97-2, 206-4 87-1		preclude an interchange here.
U-2579A	93-1, 104-5, 107-2, 165-2	Include more grade separations (sever fewer roads).	NCDOT, after discussions with Winston-Salem and Kernersville and additional design studies, has revised the project design to include grade separations at Pisgah Church Road, Hastings Hill Road, and High Point Road.
U-2579A	93-3, 104-2, 105-3, 106-1, 109-2, 134-2, 135-2, 140-2, 141-2, 142-1, 152-1, 155-1, 158-2, 173-2	Include an interchange at Kernersville Road. This will reduce traffic on Linville Road due to traffic going to Business 40 or I-40 to access the Beltway.	The Preferred Alternative selected for Project U-2579A is N2-S1 and includes an interchange at Kernersville Road.
U-2579A	95-1, 96-3, 97-1, 107-1, 115-1, 117-1, 165-1	Include more interchanges in Kernersville.	An interchange is proposed at Kernersville Road (the Preferred Alternative for the Eastern Section Extension is N2-S1 with an interchange at Kernersville Road). There will exist adequate spacing for a future interchange with the future Airport Connector, should that project be funded and built. NCDOT is designing the Beltway in such a way as not to preclude an interchange at Big Mill Farm Road.

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U-2579A	97-5, 177-1 206-3	Consider a future interchange for the proposed Airport Connector.	An interchange at this location is not included at this time since the Airport Connector is not a funded project. That project is currently on the 2006-2012 TIP as Project I-4924, which is programmed for planning and environmental study only by the Turnpike Authority. The proposed interchange spacing does allow room for this interchange in the future, should that project become funded and built.
U-2579A	99-1	Would like to see Project U-2579A portion of the Beltway accelerated.	NCDOT's Transportation Improvement Program (TIP) reflects the decision by the NC Board of Transportation to reverse the priorities of TIP Projects U-2579 and R-2247. Project U-2579 is now scheduled to be constructed before Project R-2247. According to the 2006-2012 TIP, construction of Project U-2579 is scheduled to start in 2010 and construction of Project R-2247 is scheduled for Post Year (which means some time after 2012).
U-2579A	99-3	If N1 is chosen, mother must be relocated as well due to situation (4211 and 4224 Orvil Lane).	The Preferred Alternative selected for Project U-2579A is N2-S1.
U-2579A	100-1	Do not choose the S2 alternative segment, which impacts the Alliance Science and Technology Park and closes the Union Cross interchange with US 311. The Park should be on Figure 2-19 of the SFEIS/SDEIS. Also consider the potential impact to the future Dell facility.	The Preferred Alternative selected for Project U-2579A is N2-S1. This alternative does not impact Alliance Science and Technology Park, does not close the Union Cross Road interchange on US 311, and does not impact the Dell site.
U-2579A	151-1	Shift alignment to Glenn High Road, where there are open fields.	Shifting the alignment is not feasible due to the location of the interchange in the area and the skew of the road.

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U-2579A	101-1, 131-2, 145-1, 149-2	Take entire property rather than a portion of it. (101-1: 930 Bluff School Road, Kernersville; 131-2: 202 Oak Grove Church Road, Winston-Salem; 145-1: 414 Sedge Garden Road; 149-2: 4384 Monica Court, Winston-Salem)	The Right of Way Branch will address each property on an individual basis.
U-2579A	102-1	Property will be taken with all alternatives, and hopes NCDOT will be fair.	NCDOT Right of Way Branch will buy property based on fair market value. Licensed real estate appraisers determine a fair market value. This is the same type of appraisal that is required when selling, buying, or refinancing a house.
U-2579A	103-2	If N2 is chosen, realign proposed access road from School View Drive to Linville Road to connect across from Saint's Delight Church Road (see figure).	NCDOT has reviewed this alignment, but it does not appear to offer an advantage over the current plan.
U-2579A	103-4	If N1 is chosen, please take house (644 Linville Road, Kernersville).	The Preferred Alternative selected for Project U-2579A is N2-S1.
U-2579A	111-2	Take into consideration Sedge Garden Elementary School; keep project as far away as possible so as not to impact or distract the children.	Fencing will be provided along the highway right of way near the school, including the detour. NCDOT will coordinate with Forsyth County Schools to ensure the safety of students bicycling or walking to Sedge Garden Elementary School.
U-2579A	112-1, 125-1, 162-3,	Do not include an interchange at Kernersville Road.	The Preferred Alternative selected for Project U-2579A is N2-S1 and includes an interchange at Kernersville Road. The Town of Kernersville strongly supports the inclusion of this interchange.

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	164-1, 163-1		
U-2579A	113-1, 138-3, 149-4, 160-2	Feel that Beltway is lowering property values. How will this be compensated?	The NCDOT cannot compensate where there are no right of way claims. .
U-2579A	113-2, 139-3	If Beltway will impact Meredith subdivision, NCDOT should purchase the entire development.	NCDOT will either provide an access route for the remaining properties in Meredith or will purchase the properties.
U-2579A	113-3	The tax value of the property is increasing by $20,000. How can this be?	Contact Forsyth County for tax value information.
U-2579A	118-1	The Doe Run community will be destroyed because of the Gerry Drive realignment.	Based on the current preliminary plans, a portion of Gerry Drive would be relocated to provide for a new ramp and to provide access to remaining properties at the north end of Gerry Drive. During final design, the relative costs of relocating this road versus buying access to the property to be cut off would be evaluated and a final decision made on whether or not to relocate Gerry Drive.
U-2579A	118-2	There is a ramp ¾ of a mile long with no sound walls through Croyden, Windsor Park, and Doe Run.	The NCDOT adopted a new Traffic Noise Abatement Policy in September 2004. As a result, a noise study update was conducted for the Northern Beltway to review noise issues in relation to NCDOT's new policy. Some areas to the immediate west of the southbound access ramp to US 421 are predicted to experience noise impacts. Two barriers were analyzed for this area and neither was found to be cost-effective based on NCDOT and FHWA guidelines.
U-2579A	119-1, 186-1	Close Pisgah Church Road.	Based on comments from several citizens and the Town of Kernersville,

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Project	Letter/ Comment Number	Comments & Questions	Response
	191-1		NCDOT has revised the designs to include a grade separation at Pisgah Church Road
U-2579A	130-2, 224-2	Do not close High Point Road.	NCDOT has revised the designs to include a grade separation at High Point Road.
U-2579A	130-4	Plan legal action against the state if S1 alternative segment is chosen.	The Preferred Alternative selected for Project U-2579A is N2-S1. The selection of this alternative is discussed in this SFEIS/FEIS.
U-2579A	132-1	Move Gerry Road realignment slightly north so that it would not take part of lot (2516 Deer Rack Circle, Kernersville).	Based on the current preliminary plans, a portion of Gerry Drive would be relocated to provide for a new ramp and to provide access to remaining properties at the north end of Gerry Drive. During final design, the relative costs of relocating this road versus buying access to the property to be cut off would be evaluated and a final decision made on whether or not to relocate Gerry Drive.
U-2579A	132-3	Consider a slight movement of the proposed ramp at interchange at Business 40 to eliminate noise issues in neighborhood and issue at Gerry Road.	Based on the location of the property to the Beltway, moving the ramp slightly would not change noise issues.
U-2579A	133-1	Consider adding an additional loop onto the clover in N3-S1 to eliminate the ramp connecting the Beltway with US 421.	The Preferred Alternative selected for Project U-2579A is N2-S1.
U-2579A	133-2	Are more sound walls being constructed on northwest quadrant of proposed interchange of Beltway with US 421?	The NCDOT adopted a new Traffic Noise Abatement Policy in September 2004. As a result, a noise study update was conducted for the Northern Beltway to review noise issues in relation to NCDOT's new noise policy.

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Project	Letter/ Comment Number	Comments & Questions	Response
			Some areas to the immediate west of the southbound access ramp to US 421 are predicted to experience noise impacts. Two barriers were analyzed for this area and neither was found to be cost effective based on NCDOT and FHWA guidelines.
U-2579	134-1	Do not close Walkertown-Guthrie Road to get to West Mountain Street.	The detour for Walkertown-Guthrie Road is not permanent. During final design of the Beltway, the Division will determine if an on-site detour is possible, leaving Walkertown-Guthrie Road open. Elementary school traffic will be a factor in scheduling construction.
U-2579A	139-2	There is not a viable egress from the neighborhood (4439 Meredith Way, Winston-Salem).	NCDOT will purchase any landlocked properties or provide access.
U-2579A	139-5	Increased noise will cause structural damage to house (4439 Meredith Way, Winston-Salem).	Noise will not cause structural damage to homes. Construction impacts are discussed in the SFEIS/SDEIS.
U-2579A	139-6	Proximity to house increases risk of hazardous material spills (4439 Meredith Way, Winston-Salem).	Winston-Salem has an emergency response team trained to handle hazardous material spills. All drainage will be on the highway right of way, which would be contained in the event of a hazardous material spill.
U-2579A	139-7	Increased traffic and proximity of ramp increases the danger of injury/death to neighborhood children if a truck should jump the ramp; a truck has already jumped from I-40 and landed in the property across the street (4439 Meredith Way, Winston-Salem).	Guardrail will be provided for safety according to NCDOT design standards.
U-2579A	154-1	Move the crossing at West Mountain Street to the east or west to	Moving the crossing to the east would impact a cemetery. The Right of Way

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Project	Letter/ Comment Number	Comments & Questions	Response
		align with property line of farm.	Branch will work with property owners affected by the Beltway as necessary. Access will be provided to the property, it will be bought by the NCDOT, or damages will be paid.
U-2579A	154-2	Choose the No Build option – Widen and upgrade US 52	This comment was included in the "against the Beltway" tally.
U-2579A	159-1	Church will lose parking area and recreation facilities (Christ Temple Church; 2935 Cole Road, Winston-Salem).	NCDOT Right of Way Branch will work with the church and will provide compensation for any property taken.
U-2579A	55-1	Do not construct Project U-2579A. Use NC 66 or other points east.	Section 2.6.3.1 of the SFEIS/SDEIS discusses an Improve Existing Roadways Alternative that would improve NC 66/US 158/Union Cross Road and the reasons why it was eliminated from further study.
U-2579A	164-3	If N1 is chosen, NCDOT should purchase one home on Sedgeview Lane and create an outlet for the other 4 rather than purchasing all homes.	N2-S1 has been chosen as the Preferred Alternative for Project U-2579A.
U-2579A	164-6	Consider moving all north corridors so that some water access to the Motsinger land would be provided.	The current preliminary plan shows the stream crossing the ramp just south of the Motsinger property. These designs are approximate and will be refined during final design. The designs must meet state and federal design standards. NCDOT has met with regulatory and resource agencies regarding stream crossings and has obtained approval regarding the general locations of crossings and the use of culverts where needed. During final design, permit application drawings will be prepared that will need to show the exact location of crossings. Therefore, NCDOT cannot commit to moving a crossing until the impact on the interchange and on the crossing is known.

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Project	Letter/ Comment Number	Comments & Questions	Response
			NCDOT will examine that crossing in final design to see if it is feasible to adjust the crossing so the Motsingers retain access to the stream.
U-2579A	163-2	An interchange at Kernersville Road would be within the 1-mile recommended interchange spacing recommended by NCDOT.	The interchange is located more than one mile from both US 421/Business 40 and I-40 for all new location alternatives.
U-2579A	163-4	Project U-2579A will destroy the Sedge Garden community. Road to help Kernersville should be moved closer to Kernersville.	NCDOT is working with Kernersville to minimize the impacts to the Sedge Garden neighborhood. The Preferred Alternative selected by the NCDOT for Project U-2579A is N2-S1. One of the reasons this alternative was selected is because it preserves the continuity of Sedge Garden Road. Alternatives further to the east were studied for Project U-2579 but were eliminated due to impact on schools, residential development, and wetlands, as well as constraints posed by existing interchanges on US 421 and on I-40. The location of the southern terminus of Project U-2579 was chosen because it had fewer impacts to residential communities, one of which is the Sedge Garden Road area, when compared to the more western alternative that was studied (see SFEIS/SDEIS, Section 2.12.6.2). Information regarding the preliminary alternatives studied for Project U-2579 can be found in the SFEIS/SDEIS, Section 2.12.
U-2579A	166-1	The Beltway is a poor use of the land, which includes many open spaces which are future growth areas of Forsyth County.	The Northern Beltway is consistent with the *Legacy Comprehensive Plan*, the comprehensive plan for Forsyth County.
U-2579A	166-2	The Beltway will ruin the culture of Kernersville.	The Preferred Alternative selected for Project U-2579A is N2-S1. This alternative is preferred by the Town of Kernersville. Anticipated social

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Project	Letter/ Comment Number	Comments & Questions	Response
			cultural (human environment) impacts are discussed in Sections 4.2 and 4.4.
U-2579A	166-3	The Beltway will have too many impacts on the natural springs and streams that feed Salem Lake, the primary source of drinking water for the Winston-Salem and Kernersville area.	See Chapter 4 of the SFEIS/SDEIS for impacts to streams and jurisdictional areas. NCDOT is working with the US Army Corps of Engineers and the NC Division of Water Quality to minimize and mitigate impacts to streams and water quality.
U-2579A	166-4	The recent shifts in the local economy result in a poor placement of the Beltway. It should be shifted to the east to better serve Kernersville and the Fed-Ex hub.	Numerous studies have resulted in the current location of the Beltway. Moving it to the east would either have more of an impact on Kernersville or would create conflicts with High Point and Greensboro communities, natural and historic resources, and thoroughfares.
U-2579A	166-5	The existing roads need to be repaired and widened, including NC 66, US 158, US 52, NC 150, and NC 68. If they are not improved before the Beltway is constructed, the transportation system will have more problems than there are now.	Repairing and widening other state-maintained roadways would be done by NCDOT Division 9 or as other TIP projects. Local street improvements would be done by Winston-Salem or other municipalities. This concern has been passed along to NCDOT Division 9 and to the City of Winston-Salem.
U-2579A	179-3	Provide better access, particularly from the northwest side of Kernersville.	The Preferred Alternative for Project U-2579A (N2-S1) includes an interchange with Kernersville Road. NCDOT will coordinate with the Town of Kernersville to be sure that the Beltway would be designed in such a way as not to preclude an interchange at Big Mill Farm Road.
U-2579A	186-1, 191-1	Close Pisgah Church Road.	Based on comments from several citizens and the Town of Kernersville, NCDOT has revised the designs to include a grade separation at Pisgah Church Road.

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Project	Letter/ Comment Number	Comments & Questions	Response
U-2579A	201-1	Maps appear to take neighborhood on Swaim Road. Citizen lives on 3214 Swaim Road (runs parallel to US 311 South). Have formal plans been made to take the neighborhood? If neighborhood is relocated, how long before notification and how much time would be given for relocation?	This neighborhood would be impacted by the S2 alternative. The NCDOT Preferred Alternative selected for Project U-2579A is N2-S1, which would not impact Swaim Road. Based on current preliminary plans, all construction in this area would occur within the existing right of way.
U-2579A	208-1	The N3 alternative segment places the road above Sedge Garden Elementary School.	Because a portion of the Preferred Alternative is close to Sedge Garden Elementary School, NCDOT will coordinate with Forsyth County Schools to ensure the safety of students bicycling or walking to Sedge Garden Elementary School.
U-2579A	223-1, 224-1	Opposes N1-S1 due to impacts to property. Supports N1-S2.	The Preferred Alternative selected for Project U-2579A is N2-S1. Twenty-five of 55 individuals that stated a preference chose this alternative. See Section 6.2.3 for a more detailed tally of responses.
U-2579A	224-3	Access to Temple School Road from property at 4000 High Point Road is essential.	NCDOT proposes to provide a grade separation at High Point Road.
U-2579A	226-1	Supports the N2 route because it has the least impact on the property (Motsinger Farm, at the end of Motsinger Road)	The Preferred Alternative selected for Project U-2579A is N2-S1. Twenty-five of 55 individuals that stated a preference chose this alternative. See Section 6.2.3 for a more detailed tally of responses.
U-2579A	227-1	Requests that NCDOT not disconnect the Robbins Road community by cutting off Old High Point Road/Old 311. Please allow passage on Old 311 to continue.	NCDOT has revised the designs to include a grade separation at High Point Road.
All	225-1	"The 2002 Thoroughfare Plan 'shows a potential future southern	The future southern loop shown on the *2005 Thoroughfare Plan* is not in the

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Project	Letter/ Comment Number	Comments & Questions	Response
		loop connecting the Northern Beltway from US 158 to US 311' and resulting in the formation of a complete loop….Considering the geographic proximity of the southern loop to the Winston-Salem Northern Beltway, the SFEIS/SDEIS should have analyzed the environmental impacts of constructing the southern loop together with its analysis of the three projects that constitute the Winston-Salem Northern Beltway."	NCDOT's 2006-2012 Transportation Improvement Program, nor is it on the *Winston-Salem Urban Area 2030 Long Range Transportation Plan(LRTP).*This LRTP includes a financial plan that demonstrates current or projected revenues to support the proposed transportation projects. Therefore it is not considered a reasonably foreseeable project that needs to be considered in this EIS.
All	225-2, 225-56	2. "The SFEIS/SDEIS fails to document specific needs. For example, there is no enumeration of how many trips would be served or how much time would be saved as a benefit of constructing any of the three projects." 56. "The SFEIS/SDEIS fails to document more specific needs but instead just makes assertions such as "does not address current travel patterns" (1-7) without providing evidence. Similarly, needs for continuous freeways are suggested without any enumeration of how many trips would be served or how much time would be saved…Quantitative analysis is needed to demonstrate a need."	Section 1.4 of the SFEIS/SDEIS is a summary of the needs for the proposed actions and Section 1.5 discusses the purposes of the proposed actions. Several figures in Chapter 2 show the average daily traffic volumes that would be attracted to the three sections of the Northern Beltway by 2025. Figure 2-14a shows Project R-2247, Figures 2-20a and 2-20b show Project U-2579 and Project U-2579A. Section 2.6.2.3 includes a quantitative evaluation of the travel time savings achieved by the Project R-2247 Preferred Alternative compared to improving existing roadways in the western portion of the county. The evaluation concludes improving existing roadways could reduce travel times by up to 18 percent, while the Project R-2247 Preferred Alternative would reduce travel times by about 46 percent. Section 2.6.2.3, with Figure 2-5, also includes a quantitative evaluation of traffic service and attraction of the Project R-2247 Preferred Alternative and the Improve Existing Roadways Alternative RV-A. While similar analyses were not performed for U-2579 and U-2579A (see Section 4.20.4.1), the volumes of traffic projected to use this facility clearly

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			demonstrates the savings in travel time. The needs and purposes of the proposed actions are adequately supported by the data in Sections 1.4 through 1.12 and associated exhibits in this document. For example, the statement in Section 1.4.2 that "the need for better north/south connectivity within and through western Forsyth County is a reflection of the growing suburban population and its changing travel patterns" is supported by the information in Section 1.9.2. "There are a substantial number of employment centers and services located in areas of Forsyth County beyond the central city area. These areas do not have direct road connections to the growing residential areas of the County." The text continues by listing specific areas. The needs and purposes stated for Project R-2247 do not specify a freeway as the solution. Improved north/south connectivity, improved direct connections to major routes, and congestion relief are the purposes for Project R-2247 listed in Section 1.5.2. Projects U-2579 and U-2579A do include a freeway as part of the purpose and need, in order to improve mobility, reduce congestion on US 52 and I-40 Business, and provide a corridor for I-74.
All	225-3, 225-46, 225-55	3. "…construction of a highway is not an effective way to improve connectivity." 46, 55 Several of the needs identified in the Purpose and Need	The purposes of Projects R-2247, U-2579, and U-2579A that relate to connectivity refer to regional connectivity – meaning connectivity across the county and between major Interstate and US routes. Highways with some control of access are often the best way to provide connectivity across regions

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		section are for 'connectivity' or 'linkage'. This discussion is so general that it could apply to any roadway project proposed anywhere. More specific data are needed to justify these connections and linkages. Limited access highways often are relatively poor ways to improve connectivity as they require expensive bridging by local roads, and therefore limit cross points.	and between controlled-access facilities. The needs and purposes of the proposed actions are adequately supported by the data in Sections 1.4 through 1.12 and associated exhibits in this document. For example, the statement in Section 1.4.2 that "the need for better north/south connectivity within and through western Forsyth County is a reflection of the growing suburban population and its changing travel patterns" is supported by the information in Section 1.9.2. "There are a substantial number of employment centers and services located in areas of Forsyth County beyond the central city area. These areas do not have direct road connections to the growing residential area of the County." The text continues by listing specific areas. Review of the maps in Figures 1-2 and 1-3 show a lack of north/south continuous routes. For the Preferred Alternatives for Projects R-2247, U-2579, and U-2579A, grade separations and realignments and/or reconnections of roadways crossed by the proposed projects are provided where needed to maintain local connectivity.
All	225-4, 225-48, 225-59, 225-60	4. "The SFEIS/SDEIS uses a transportation modeling approach known as the all-or-nothing assignment method that has been considered to be unreliable for many years….the all-or-nothing model substantially over predicted congestion. Therefore, the SFEIS/SDEIS should have based its analysis on the equilibrium method."	The original model was tested for calibration in 1994 for both All-or-Nothing and Equilibrium loading methods. It was determined that All-or-Nothing yielded slightly better calibration results overall for major facilities than the equilibrium loading method. A series of applied "manual" capacity constraint adjustments were performed using relative speed sensitivity in an effort to simulate the observed travel patterns on radials and parallel routes in the modeled All-or-Nothing network. After the All-or-Nothing calibration with

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Project	Letter/ Comment Number	Comments & Questions	Response
		48. "The all or nothing assignment approach used is invalid for congested roadway networks, and therefore can not be used to reach conclusions about levels of future congestion." 59. "The all-or-nothing assignment method relied on in the EIS substantially over-predicts traffic on congested links, and cannot be relied on for any analyses of congestion." 60. "The transportation modeling that provides the basis for the alternatives analysis is based on the obsolete "all-or-nothing" assignment algorithm."	applied manual capacity constraints yielded the best results, it was determined that the use of the combined All-or-Nothing with capacity adjustment method was the best choice to clearly analyze and define travel pattern tendencies when performing traffic forecasts for local and regional projects. These analyses and results are documented in the Piedmont Triad Regional Travel Demand Model, *Technical Report No. 1: Model Development and Calibration* (NCDOT, 1999) and *Technical Report No. 2: Development and Evaluation of Alternative Land Use Scenarios* (NCDOT, 2000).
All	225-5	"First, the SFEIS/SDEIS merely compares the statewide average accident rate with the accident rate at specific roadways in the study areas, while failing to demonstrate the significance of these rates."	A new critical crash rate analysis is included in this SFEIS/FEIS. Crash rates on an individual road that are higher than the critical crash rate for similar roads indicate the road may have some safety concerns, as described in Section 1.12. Critical crash rates were calculated for roads in the eastern study area and are presented in Table 1-12. Table 1-11 shows crash rates for roads in the western study area and statewide average crash rates for similar roads. Critical crash rates were not calculated for roads in the western study area, since safety is not a part of the western project's purpose and need.
All	225-6	"Second, the SFEIS/SDEIS's discussion of accident rates fails to consider how the construction of these three projects, or any one or combination of them, will effectively address the problem."	Section 2.10.5 of the SFEIS/FEIS describes how the construction of the Eastern Section and Eastern Section Extension is expected to help safety in the study area. A similar analysis for the western side of the study area was not conducted because safety was not a part of the purpose and need for Project R-2247.

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All	225-7	"Third, the SFEIS/SDEIS also fails to evaluate whether there are any alternatives to constructing these projects that could have a positive impact on accident rates."	As described in Section 1.5.3 of the SFEIS/FEIS, enhancing safety is only one purpose of Projects U-2579 and U-2579A. Other purposes include improving intrastate and interstate mobility, improving roadway system linkage and continuity, reducing traffic congestion, and providing a corridor for I-74. The range of alternatives for Projects U-2579 and U-2579A described in the SFEIS/FEIS were developed to fulfill as many of these purposes as possible. Alternatives for Projects U-2579 and U-2579A that were evaluated and eliminated from detailed study are described in Chapter 2. They include transportation management alternatives, mast transit/multi-modal alternatives, and improving existing US 52.
All	225-8	"Fourth, the SFEIS/SDEIS fails to consider the effect that induced travel resulting from construction of the Northern Beltway will have on the current accident rate."	As discussed in Section 4.20.7.1 of the SFEIS/FEIS, the amount of induced travel resulting from the Northern Beltway is expected to be approximately 1.05 percent of total travel. Changes in traffic volumes on individual roadways of 1.05 percent would not have a significant effect on accident rates.
All	225-9, 225-49, 225-61	9. "Fifth, the SFEIS/SDEIS is misleading in stating the accident rates are lower on interstate facilities than on arterial roadways." 49. "The accident analysis similarly is inconclusive as it is based on counting roadway segments with accident rates that are 'above average'. By definition, it would be expected that roughly half of roadway segments would have rates above average, and that is true here. No evidence is presented that	Statewide, average accident rates are lower on interstate facilities than on all types of primary and secondary roads analyzed for this project. This is based on 2000-2002 NCDOT *Three Year Crash Rates (Standard)*, the years corresponding with Projects U-2579 and U-2579A accident data. The following statewide average accident rates were applicable for 1999-2002 for the facility types included in the crash analysis: • Rural interstate: 67.62 accidents per million vehicle miles traveled (MVMT)

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		there are statistically significant high accident rates in the study area." 61. "It would be expected that roughly half of the segments would have rates above the state average and about half would be below average. Similarly, it would be expected that any collection of segments would have more than half above average about half the time. No analysis is presented whether the differences in accident rates are statistically significant. Given the small sample, it appears that the differences are not statistically significant. The SFEIS/SDEIS also mentions that accident rates are lower on Interstate facilities than on arterial roadways (p1-9), but this is misleading. No trip begins or ends on an Interstate facility. Travelers using Interstate roadways must also use other roads, often traveling through congested arterial sections near interchanges. Travel often becomes less direct to access the Interstates, and vehicle miles go up. Accident rates are given in terms of accidents per mile, so the rates per person do not decline as much as might be expected."	• Urban interstate: 125.86 accidents per MVMT • 4-lane divided full access control urban US route: 155.81 MVMT • 2-lane undivided urban US route: 170.47 MVMT • 2-lane undivided rural NC route: 182.95 accidents per MVMT • 2-lane undivided urban route: 334.95 accidents per MVMT It is true that a random sample, or a very large sample, of roadways would show that roughly half would have rates above average. However, for the accident reporting in Section 1.12, the roadway selection was not random. Data was listed for major roadways in each study area whose traffic volumes could be influenced by the Northern Beltway. The purpose of the analysis was to evaluate accident rates on these specific roadways, not to draw conclusions about the regional rate of accidents. Therefore, consideration of sample size was not a part of the analysis. A critical crash rate analysis was conducted for this SFEIS/FEIS in accordance with NCDOT's "Guidelines for Utilizing NC Statewide Crash Rates" and is found in Section 1.12. The critical crash rate method addresses the commenter's concerns about using average crash rates. As part of this project, all roads with interchanges will be improved in the vicinity of those interchanges, including control of access to reduce conflicts. The combination of improved geometry and control of access should help minimize any increase in accident potential.

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All	225-10	"The SFEIS/SDEIS fails to provide any evidence that construction of the Northern Beltway would not spur new growth in the area. Nonetheless, it continues to use the same population and employment inputs for all scenarios in its analysis of alternatives."	A final *Winston-Salem Northern Beltway Indirect and Cumulative Impacts Analysis* (June 2005) was prepared for the proposed projects and the study is summarized in Section 4.20 of the SFEIS/SDEIS. Updates to this study area are included in Section 4.20 of this SFEIS/FEIS. The indirect and cumulative impacts assessment was performed in accordance with NCDOT's Indirect and Cumulative Impact Guidance Manuals (Volumes I and II). This study concludes that the Northern Beltway has minimal effects on housing location and very little change in residential densities (Section 4.20.7.1 of the SFEIS/FEIS). The percentage of housing shifting locations ranges from 0.6 percent to 3.3 percent, while the percentage of jobs changing locations ranges from 0.4 percent to 4.4 percent (see Sections 6.2 and 6.3, respectively, in the *Indirect and Cumulative Impacts Analysis*, June 2005). The percent changes of *individual* zones can be greater, with selected zones sometimes experiencing increases or decreases of 4.5 to 23.5 percent between the full-build and no-build scenarios, for example. The absolute magnitude of the total changes in both housing and jobs are generally small. Also, SFEIS/FEIS Sections 1.11.1.2, 1.11.1.3, and 1.11.1.4 describe the selection and validity of scenarios used to estimate traffic volumes.
All	225-11, 225-57	11. "First, an LOS analysis comparing construction of a project to not building it at all was conducted only for the Western Section, not the Eastern Section or the Eastern Section Extension. See SFEIS/SDEIS, pp. 2-85 to 2-87. ("Table 2-19") 57. "No level-of-service results are presented for the other roadway alternatives supposedly considered in the	The difference in analysis for the two sections of the Beltway arises from the purpose and need for the two independent projects. Project R-2247 is aimed much more at local connectivity and reduction of congestion, while Project U-2579 and U-2579A is aimed more at regional mobility. For completeness of information, a new table (Table 2-22-1) is provided in this SFEIS/FEIS to illustrate the reduction in congestion with the Eastern Section and Eastern Section Extension in place.

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		SFEIS/SDEIS – the east project only, the full Northern Beltway, or the "Improve Existing Roadways Alternatives."	The No-Build LOS analysis presented in Table 2-19 for roadways in the Western Section study area would apply to two cases: the no-build case and building only Projects U-2579 and U-2579A. The Build LOS analysis for western section area roadways likewise applies to building the Western Section only and building the entire Northern Beltway. (See Sections 1.11.1.3, and 1.11.1.4.) A level of service analysis was not necessary for the western section Improve Existing Roadways Alternatives to show these alternatives would not meet the project purpose and need. Section 2.6.2.5 describes the reasons why these alternatives were eliminated from further consideration. By their nature, the widening of specific roadways would improve their levels of service. It is acknowledged in the SFEIS/FEIS that Alternatives RV-A and RV-B would provide congestion relief for the roadways widened under that alternative (Section 2.6.2.2 of the SFEIS/FEIS). Likewise, a level of service analysis was not necessary for the eastern section Improve Existing Roadways Alternatives to show they would not meet the project purpose and need. Section 2.6.2.5 describes the reasons why these alternatives were eliminated from further consideration.
R-2247	225-12, 225-47 225-58	12. "Second, although the SFEIS/SDEIS does compare the LOS of the No-Build Alternative to the Build Western Section Only Alternative (pp 2-85 to 2-87), it fails to demonstrate significant traffic benefits from constructing the Western	Table 2-19 shows the local roadway network traffic volumes and levels of service for roadways in the western section area under the Build and No-Build Alternatives. Table 2-20 summarizes and compares the information from Table 2-19.

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		Section…Improvement of the LOS at merely two interchanges is not am(sic) impressive feat for a multi-million dollar project." 47. "The SFEIS/SDEIS fails to demonstrate significant traffic benefits. The Northern Beltway is justified, in part, by an analysis showing that the western project improves the level of service for more roadway segments than it makes worse. This is a very weak justification. The difference is only 2 roadway segments out of 74. Furthermore, the analysis shows that some segments with level of service F in both the No Build and Build scenarios are much worse in the build scenario. No traffic analysis is provided for other roadway alternatives. The SFEIS/SDEIS lack comprehensive summaries of vehicle hours of travel that are standard in roadway EIS documentation"." 58. "The results that are given for the western project fail to show significant traffic benefits for the project. Compared to the No Build scenario, "more roadway segments would experience improved levels of service and/or reduced traffic volumes than roadway segments that would experience worse levels of service and higher traffic volumes." (p. 2-88) This is a low standard to justify the expenditure of hundreds of millions of dollars. Of the 74 roadway segment analyzed, 62 would have undesirable levels of service in 2025…which would be cut by 2 to 60 in the Build scenario. It seems probable that targeted local projects could cut the number by more than 2 at much lower	Each category in the level of service designations A through F includes a range of traffic volumes. Sometimes, a roadway can experience decreased delays and decreased traffic volumes (which is a reduction in congestion), but still show the same LOS value. Therefore, the overall picture of congestion used the level of service values reported in Table 2-19 and the changes in traffic volumes. As reported in Table 2-20, with the Build Alternative in place, 9 percent of roadway segments analyzed would experience an improved level of service and 41 percent would experience reduced traffic volumes, compared with 5 percent experiencing a degraded LOS and 12 percent experiencing increased traffic volumes. Providing congestion relief is only one element of the purpose and need for Project R-2247. The other purposes for Project R-2247 are to improve north/south connectivity in western Forsyth County and provide improved direct connections to US 52, US 421, and I-40. The Project R-2247 Preferred Alternative would achieve these elements of the purpose and need. As shown in Section 2.6 of the SFEIS/FEIS, Improve Existing Roadways Alternatives (which would be local projects) would not meet the purposes and needs for Project R-2247. There are opportunity, sustainability, timesaving, and community benefits to providing an alternative for faster-moving traffic that is away from more congested neighborhood communities. There is a reduction in VHT (Vehicle Hours of Travel) by constructing the Western Section (Project R-2247) exclusively – approximately 292 VHT/day, and a greater reduction by

Table 6-5: Comments from Citizens

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		cost. "	constructing both Western and Eastern Sections – 4,539 VHT/day. This yields an annual time savings of 106,580 hours and 1,656,735 vehicles hours, respectively for 2025. Using a national wage average of $16/hr (assumed wages lost or gained in travel time), this equates to a travel time savings of $1,705,280 and $26,507,760 per year, respectively. The Triad Region, in the near-term and future, is experiencing growth, and the analyzed roadway segments are experiencing this growth with or without the beltway.
All	225-13, 225-26, 225-35, 225-51, 225-53, 225-59, 225-69, 225-74	13&59. The LOS studies are incomplete in that they fail to account for the effects of additional commercial development near interchanges, or for regional measures of congestion, such as total vehicle hours of travel. 26&69. "…the SFEIS/SDEIS's analysis of interchange development fails to analyze the effects of the added development on traffic on the crossroads and whether that additional traffic could "undermine the very weak benefits attributed to the project." 51. "The interchange analysis fails to quantify the effects on commercial development around the proposed interchanges, or what effects the traffic from this development will have on area roadways." 35, 53, & 74. The SFEIS/SDEIS fails to account for the effects of induced travel in other sections, specifically in its discussion	The analysis uses the demographic projections adopted by the Metropolitan Planning Organization for its *2025 Long Range Transportation Plan*. A gravity model analysis of potential redistribution of housing and employment associated with the various alternatives did not find large shifts in housing or employment that would indicate large changes in the development pattern that could be attributable to building the Northern Beltway. The effects of commercial development are included in land use input in the Winston-Salem MPO long-range transportation plans and the latest planning assumptions in accordance with applicable regulations. When land use plans are updated or new planning assumptions are determined, land use data are included in transportation modeling work after being officially approved by the MPO. Although not a necessary part of this SFEIS/FEIS, a system-wide VHT analysis was conducted to provide information in response to a comment. It clearly showed the benefits to this area from this project. (See response to comment 225-12/47/58.) NCDOT's conservative access management standards at new interchanges

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		on traffic impacts of the Northern Beltway in the alternatives analysis and in the discussion on increased traffic around interchanges in evaluating alternatives.	help to reduce congestion and preserve the design level of service. For example, NCDOT's policy is not to allow access within 1,000 feet of an interchange ramp, whenever possible. As discussed in Section 4.20.7.1 of the SFEIS/FEIS, the amount of induced travel resulting from the Northern Beltway is expected to be approximately 1.05 percent of total travel.
U-2579A	225-14	"Finally, the SFEIS/DEIS's consideration of the alternatives for the Eastern Section Extension should be updated to account for…Dell, inc. in the Alliance Science and Technology Park."	Governor Easley's office announced the Dell Computer assembly facility in November 2004, after the Draft Winston-Salem Northern Beltway *Indirect and Cumulative Impacts Analysis* was completed and after the SFEIS/SDEIS was completed. A review of the Dell plan indicates a small impact of this project at the county level. An addendum discussing the review has been added to the *Indirect and Cumulative Impacts Analysis* (Section 4.20), and the Summary in this SFEIS/FEIS has been updated.
All	225-15	"'[A]n impact statement is incomplete without an analysis of the effect [a road] will have on the production of ozone in the region.' Sierra Club v. United States Dep't of Transportation, 962 F. Supp. 1037, 1045 (N.D. Ill. 1997), The SFEIS/SDEIS fails to do this."	Section 4.7.5 of the SFEIS/FEIS includes a discussion of ozone and how it should be addressed in a project level transportation facility EIS. FHWA guidance states ozone is not a concern at the project level because it is an area wide pollutant which is analyzed in system-level planning as part of the SIP development process. The FHWA's Technical Advisory (T 6640.8A, October 30, 1987) states, "Ozone (O3), Hydrocarbons (HC), and Nitrogen Oxide (NOX) air quality concerns are regional in nature and, as such, meaningful evaluation on a project-by-project basis is not possible. Where these pollutants are an issue, the air quality emissions inventories in the State Implementation Plan (SIP) should be referenced and briefly summarized in

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			the draft EIS." Since the publication of the SFEIS/SDEIS, the SIP and conformity determination for Forsyth County have been updated and these updates are included in Section 4.7.4 of this SFEIS/FEIS. Under 40 CFR Part 93.109 and 93.115, the analysis conducted for the conformity determination suffices for ozone at the project level.
All	225-16, 225-17, 225-77	16. "First, the SFEIS/SDEIS only considers the effect on carbon monoxide (CO) emission from each of the three proposed projects individually and fails to consider the effect on CO emissions if all three of the proposed projects, or any combination of them, is built." 17. "Mr. Marshall and Mr. Grady explain that the microscale air quality analyses failed to evaluate the CO effects of the whole Northern Beltway but merely evaluated the CO effects at one specific interchange in each of the three projects." 77. "The microscale air quality impacts were only evaluated for each individual segment of the Northern Beltway. No analysis was performed using traffic volumes that reflect a full build out of the eastern and western sections of the beltway."	The regional effects of the entire Northern Beltway on carbon monoxide concentrations are included in the previous and current conformity determinations for the area. The conformity determination of October 2005 is included in Section 4.7.4 of this SFEIS/FEIS. Since the Build Alternative is the Preferred alternative for all three projects, and together, these three projects are included in the conformity determination that demonstrates attainment of the National Ambient Air Quality Standards, there is no reason to model other regional scenarios. The microscale carbon monoxide analyses were performed for the interchange ramp intersections projected to have the worst level of service and highest delays in accordance with the Environmental Protection Agency's Guidelines for Modeling Carbon Monoxide From Roadway Intersections (1992). All microscale analyses were run using traffic volumes projected for building the entire beltway.
All	225-18, 225-19,	18. "….a fair comparison of the Detailed Study Alternatives is not possible due to the use of outdated MOBILE4 technology."	Updated microscale air quality analyses using Mobile 6.2 were conducted for the R-2247 Preferred Alternative, the U-2579 Preferred Alternative, and the

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	225-54, 225-75, 225-76	19. "Because different MOBILE technology and different dates are used for the Western and Eastern Sections' Detailed Study Alternatives and Preferred Alternatives, there is no basis on which to compare these alternatives with each other." 54. "The alternatives can not be fully evaluated until the air impacts are quantified using the same version of MOBILE." 75. "However, the microscale CO hot spot analyses for the Detailed Study Alternatives for Projects R-2247 and U-2579 are still based on outdated models….The SFEIS/SDEIS should be considered incomplete until the analysis has also been updated for the Detailed Study Alternatives." 76. "…comparison of the air impacts associated with the R-2247 Detailed Study Alternatives and the Preferred Alternative are impossible because these two different MOBILE versions, which produce very different results, were used to derive the carbon monoxide emission factors. ….the microscale air quality impact analysis for the R-2247 and U-2579 Detailed Study Alternatives should also be updated using MOBILE5b."	U-2579A Detailed Study Alternatives and the Preferred Alternative. Regarding the comparison of Detailed Study Alternatives, as explained in Section 3-1 of the SFEIS/FEIS, "The results of the three analyses [Project R-2247, Project U-2579, and Project U-2579A] indicate projected maximum CO concentrations well below the 1-hour and 8-hour standards in 2005, 2010, and 2025. It can be estimated that because the results for these alternatives are well below the National Ambient Air Quality Standards (NAAQS), that none of the other Detailed Study Alternatives would cause exceedances of the NAAQS since traffic volumes would be similar and the interchange locations would be the same [as the Preferred Alternatives]". The 1-hour CO National Ambient Air Quality Standard (NAAQS) is 35 ppm and the 8-hour standard is 9 ppm. The maximum projected CO concentration for all modeled intersections along all three projects is 5.3 ppm for the 1-hour maximum and 4.2 ppm for the 8-hour maximum. These values occur at the Northern Beltway exit ramps at US 158/Reidsville Road (Table 4-22 of the SFEIS/FEIS). The background concentration and persistence factor included in the projected maximum have been updated for this SFEIS/FEIS. The background concentration has been updated to 2.7 ppm from 1.5 ppm (NC Division of Air Quality) and the persistence factor has been updated to 0.8 from 0.57. Accounting for these updated values results in projected maximum CO concentrations reported above. These values are still well below the NAAQS.

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			Since all the Detailed Study Alternatives for Project R-2247 are relatively close in geographic location and all would interchange with the same roadways, there would be little difference in projected traffic volumes or patterns. This is also true for Project U-2579/U-2579A Since the other Detailed Study Alternatives for Projects R-2247 and U-2579 would have similar intersections with similar traffic as the Preferred Alternatives for Projects R-2247 and U-2579, it is reasonable to conclude, without going through the actual modeling exercise, that microscale air quality analyses (using updated CAL3QHC and MOBILE models) for these alternatives also would result in similar maximum carbon monoxide concentrations well below the NAAQS and below a significant impact. Therefore, these updated models for every Detailed Study Alternatives were not necessary in order to provide a clear understanding of the potential consequences of the proposed actions and for effective decision making by public officials.
All	225-20	"…the SFEIS/SDEIS's discussion entitled "Indirect Effects" that follows the definition fails to mention "related effects on air and water and other natural systems."	Cumulative impacts include the direct impacts associated with the project, the indirect impacts caused by the project, and the reasonably foreseeable impacts of others' actions. Since air and water effects are generated primarily by cumulative actions and not as much by project-specific influences, they are therefore discussed in a single section of the report devoted to cumulative impacts. Since the effects on natural systems from induced growth are small, and since the impacts from indirect growth are generally similar in type to those experienced by the cumulative impacts of other development actions, the indirect impacts on natural systems are included in the cumulative impact

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			analysis, which is discussed in Section 4.20.7.2, Analysis of Cumulative Impacts.
All	225-21	"It [SFEIS/SDEIS] therefore fails to evaluate the "[reasonably foreseeable effects that] are caused by the project and are later in time or farther removed in distance", as the regulations specifically require.	See the response to comment 225-20.
All	225-22, 225-23	22. "The SFEIS/SDEIS again fails to discuss the indirect effects on resident and migratory wildlife with any specificity." 23. "Although the SFEIS/SDEIS explains that current growth is "reducing the natural habitat available to wildlife" and that "each of the Build scenarios would additionally fragment habitat in the area by introducing a large barrier to animal migration," it bases these conclusions on the premise that "[n]one of the Build scenarios significant change the pace of development in Forsyth County." SFEIS/SDEIS, p. 4-200. This is the same argument put forth in defense of the 1996 FEIS's failure to address the Fish and Wildlife Service's concerns…..Yet, the SFEIS/SDEIS relies upon this position again in its analysis of the Northern Beltway's anticipated effects on Natural Habitat."	Overall, the habitat in Forsyth County is shifting from pasture and cropland to woodland and low density suburban landscapes. Similar shifts are occurring in much of North Carolina, the Southeast, and the United States as landscapes rebound from the intensive agriculture practiced until the 1920's (or later). This change favors species that inhabit woodlands but is detrimental to species that prefer grasslands. The clearing and forest boundary regimes associated with the Northern Beltway will likely benefit species that prefer grasslands. As discussed in the response to Comment 225-10, the percentage of housing shifting locations and the percentage of jobs changing locations are generally small in absolute magnitude. This clarification is now reflected in the SFEIS/FEIS.
All	225-63	"The gravity model is not explained in the SFEIS/SDEIS. Nor is it explained in the main body of the Indirect and Cumulative Impacts Analysis report, but only in Appendix A-1."	The SFEIS/SDEIS and this SFEIS/FEIS include summaries of the technical memoranda. The reader is appropriately referred to the following documents for additional details on analysis methods and procedures: Piedmont Triad Regional Travel Demand Model ,*Technical Report No. 1: Model*

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			Development and Calibration (NCDOT, 1999) and *Technical Report No. 2: Development and Evaluation of Alternative Land Use Scenarios* (NCDOT, 2000).
All	225-24, 225-50	24. "The gravity model in the SFEIS/SDEIS only considers the growth of Forsyth County and fails to account for the growth rates of surrounding counties, which had higher growth rates in the 1990s than Forsyth County…..By failing to account for anticipated growth in surrounding counties, the SFEIS/SDEIS fails to consider how construction of the Northern Beltway could encourage commuting to and from Forsyth County and the growth effects of such commuting on Forsyth County." 50. "The gravity model applied in the indirect and cumulative impacts analysis is incorrect because it includes only Forsyth County…This failure…causes the effects of the Northern Beltway on future land use to be underestimated."	The study area boundaries were defined according to NCDOT's Guidance for Assessing Indirect and Cumulative Impacts of Transportation Projects in North Carolina. Volume II: Practitioner's Handbook. The shifts in population and employment in Forsyth County were so small that any shifts outside Forsyth County were considered too small to include. In addition there are major transportation infrastructure projects in Guilford, Randolph, and Davidson Counties that would tend to maintain the existing equilibrium of jobs and housing.
All	225-25, 225-66, 225-67	25. "The SFEIS/SDEIS's discussion entitled "Interchange-Specific Analysis" is inadequate….three of the criteria used to rate the development potential at an interchange – existing traffic volumes, existing commercial development, and potential for future development as identified in zoning and land use plans – are backward looking and are a poor basis for forecasting conditions in 2025."	This analysis follows NCDOT's guidance on assessing indirect and cumulative impacts. The text defines the interchange specific analysis as qualitative in nature. The primary purpose of this analysis was to assess which of the Northern Beltway alternatives will increase the development potential near the proposed interchanges. This analysis is in addition to the gravity model analysis that provides redistributions at the traffic analysis zone level, and the stakeholder survey that assesses what local experts believe will happen. The results of the three analyses provide a clearer sense of a possible

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		66. "These subjective ratings are based on five criteria. Three of these criteria are backward looking and are a poor basis for forecasting conditions in 2025." 67. "The interchange development potential analysis framework is too weak to be of any real value…Rather than forecast numerical shifts in employment to the high and medium employment areas, it simply discusses whether such changes are consistent with local zoning and land use plans."	future. Also note that the criteria used are among the measures that the private sector uses to make location decisions. The five criteria assess whether both existing and future conditions will support development. If both existing and proposed conditions support development it is likely that more development will occur. Appendix A-3 of the *Indirect and Cumulative Impacts Analysis* discusses the input criteria and their development. This analysis was not an attempt to forecast growth. Its purpose is to assess the potential for growth based on existing conditions and qualitative assessment of the potential for growth. Development potential is based on the average of five criteria that influence development. Appendix A-3 of the *Indirect and Cumulative Impacts Analysis* discusses each of these criteria in detail and assigns numerical ranges to them. In addition to the qualitative analysis of the interchanges, the results of a survey of stakeholders are included in Appendix A-3. The survey's results are similar to the results of the qualitative interchange analysis. Job and housing totals specific to each traffic analysis zone and alternative are included in Appendix B of the *Indirect and Cumulative Impacts Analysis*.
All	225-26, 225-51, 225-69	26&69. "…the SFEIS/SDEIS's analysis of interchange development fails to analyze the effects of the added development on traffic on the crossroads and whether that additional traffic could "undermine the very weak benefits attributed to the project."	See Response to Comment 225-25 above. Specific numbers of houses and jobs are available at the traffic analysis zone level in the gravity model analysis. This information is included in the *Indirect and Cumulative Impacts Analysis*.

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		51. "The interchange analysis fails to quantify the effects on commercial development around the proposed interchanges, or what effects the traffic from this development will have on area roadways."	Traffic from projected commercial development around the interchanges has been included in the traffic forecast for this project. All interchange areas have been designed to operate at acceptable levels of service with the forecast traffic volumes, as described in Sections 2.9.4 and 2.10.3.
All	225-27	"The SFEIS/SDEIS's evaluation of interchange development potential also fails to quantify anticipated growth. The analysis categorizes potential growth at interchanges as either "Low," "Medium," or "High" without quantifying what these categories represent."	This evaluation was performed according to the NCDOT's Indirect and Cumulative Impact Guidance Manuals (Volumes I and II). Zone-specific estimates of growth are included in the *Indirect and Cumulative Impacts Analysis*. A low accessibility value is given to any interchange location whose percent change in accessibility is less than one standard deviation above the average change in accessibility for all zones. A medium accessibility value is given to any interchange location whose percent change in accessibility is between one and two standard deviations above the average change in accessibility for all zones. A high accessibility value is given to any interchange location whose percent change in accessibility is more than two standard deviations above the average change in accessibility for all zones. Statistically, 84.13 percent of observed values should be less than one standard deviation above the mean, while 97.72 percent of observed values should be less than two standard deviations above the mean.
All	225-68	"However, just calling an area a "Metro Activity Center" on the map doesn't create one. The build out of these areas will be very different if the Northern Beltway is constructed than if it is	As noted in the response to Comment 225-10, the analysis used the socio-economic data projections approved by the MPO for its *2025 Long Range Transportation Plan*. The Metro Activity Center locations are identified in

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		not."	The *Legacy Plan*, the local comprehensive plan. It is the responsibility of the local governments to implement the vision they have created. Forsyth County is actively implementing the *Legacy Plan*. According to the Legacy Development Guide Update 2004, "significant progress has been made this year in the planning/design of four [activity] centers."
All	225-28	"The discussion entitled "General Growth Patterns" is deficient in at least three ways…First, the analysis merely discusses the possible effects of constructing the Northern Beltway on housing density in Forsyth County, without adequately considering commercial development….Thus, a discussion of land use patterns outside of housing patterns and interchanges, such as commercial development outside of the interchanges, is missing."	The *Indirect and Cumulative Impacts Analysis* includes substantial quantitative information on both housing and employment shifts (e.g., Figures 6-4A through 6-4D for housing and Figures 6-7A through 6-7D for employment in the technical memorandum). Changes in growth patterns throughout the region as well as at interchanges are discussed.
All	225-29	"Second, the evaluation of growth is not quantified. For example, it states that "[t]he analysis determined that there was very little change in density levels for individual TAZ's…..Without explanation of what "very little change' or "minimal effects" means, this discussion is of little value.	The *Indirect and Cumulative Impacts Analysis* includes substantial quantitative information on both housing and employment shifts. For example Figures 6-4A through 6-4D in the technical memorandum show housing densities. Section 4.20 of the SFEIS/FEIS has been revised to include much of this information.
All	225-30, 225-65	30. "Third, the conclusion that "the Northern Beltway [will have] minimal effects on housing location" (SFEIS/SDEIS, p. 4-196), is questionable in light of the potential interchange development identified by the SFEIS/SDEIS in its discussion of Indirect Effects."	The percentage of housing shifting locations ranges from 0.6 percent to 3.3 percent while the percentage of jobs changing locations ranges from 0.4 percent to 4.4 percent. The absolute magnitude of change at the zonal level is small.

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		65. New highways cause shifts in population and employment. The SFEIS/SDEIS fails to account for the impacts of these shifts. Instead, it uses the same population and employment inputs for all scenarios."	As noted in Section 1.11.1.3 of this document, the presence or absence of the Northern Beltway is expected to have only a minor influence on spatial allocation of growth across the County, Therefore, the Draft Land Use growth scenario used in the travel demand model is a reasonable model condition to use under any of the build, partial build, and no-build project scenarios.
All	225-31, 225-70	31. "…the model used in the SFEIS/SDEIS is "greatly modified" from the FHWA's SMITE model…This fact is not mentioned in the SFEIS/SDEIS. It is only referred to in Appendix A-2 of the Winston-Salem Northern Beltway Indirect and Cumulative Impacts Analysis, Draft, dated October 2004, a document merely referenced in the SFEIS/SDEIS." 70. "These changes are not acknowledged at all in the SFEIS/SDEIS. Neither are they acknowledged in the main body of the Indirect and Cumulative Impacts Report. The changes are mentioned only in Appendix A-2 of the report…"	The discussion in Section 4.20.7.1 of the SFEIS/FEIS notes that the version of the SMITE model used in the induced travel analysis was modified. These modifications add functional classifications, simplify data input, provide some graphical output, and eliminate cost calculations. The speed formulas and diversion formulas are the same as in the FHWA version. The speed formulas are those described in Improved Speed Estimation Procedures for Use in STEAM and Air Quality Planning, Margiotta, Richard et.al. and in Economic Implications of Transportation and Land Development Patterns, Metropolitan Planning Technical Report No. 11. FHWA, June 1998. The diversion formulas are fully described in Chapter 9 of NCHRP Report 365 Travel Estimation Techniques for Urban Planning (pp 96-100).
All	225-32, 225-71	32. Regarding SMITE: "…the model assumes that the Northern Beltway will shift traffic equally from all other freeways to itself, regardless of whether one freeway is more congested or closer to the Northern Beltway than another….Mr. Marshall and Mr. Grady's report describe the use of the model as "unrealistic and invalid".	The SMITE model assumes that travelers will make facility choices based on available capacity which leads to travel time savings. Before using SMITE in this analysis both the speed and diversion formulas were thoroughly researched. The diversion algorithm used in SMITE is fully described in Chapter 9 of NCHRP Report 365 Travel Estimation Techniques for Urban Planning (pp 96-100). This diversion algorithm is discussed in a regional context and is clearly appropriate for a regional analysis.

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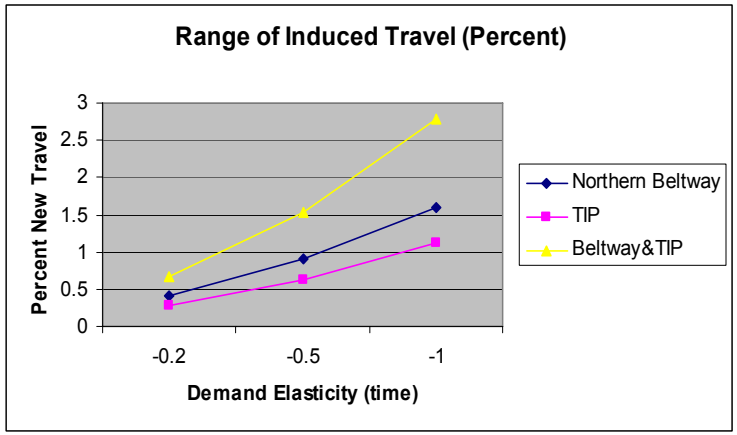
		71. "In the reformulation, the SMITE model is inappropriately shifted from a corridor to an entire region….Rather than analyzing parallel roadways, the analysis is shifted to classes of roadways….This use of the model is unrealistic and invalid."	As stated in Section 4.20.7.1 of this document, SMITE is not intended to be used alone, but should be used to supplement a traditional travel demand model. SMITE was used to estimate induced travel along with NCDOT's travel demand model.
All	225-33, 225-52, 225-73	33. "Second, by creating a model that assumes that the Northern Beltway will shift traffic equally from all other freeways, the reformulated model overestimates the reduction in traffic volume on some freeways and thus underestimates the effects of induced traffic caused by constructing the Northern Beltway…Mr. Marshall and Mr. Grady conclude that the reformulation of the FHWA's SMITE model resulted in an estimate of induced travel that is less than half as what would be expected based on authoritative research on induced travel." 52. "The induced travel estimates are based on an inappropriate application of the FHWA SMITE model…and is less than what would be expected from the technical literature on induced travel." 73. "The spreadsheets in Appendix A-2 show that the Northern Beltway would add 92.4 lane miles to 2475.2 lane miles in the region. This is an increase of 3.7%. With an elasticity of 0.7, an increase in VMT would be expected of 2.6%. This is twice the number of 1.3% reported in the SFEIS/SDEIS, p. 4-	Figure A2-1 of the *Indirect and Cumulative Impacts Analysis* (reproduced below) is a sensitivity analysis that addresses this issue. It shows that induced travel could range from a low of 0.4 percent to a high of 1.59 percent if only the Northern Beltway is considered.  Many estimates of induced travel are based on a simple relationship between lane miles and induced traffic. This relationship tends to overestimate induced travel because they are unable to separately account for trips diverted from one facility to another. Robert Cervero Ph.D. notes in "Road

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		198…..we attribute the low estimated of induced travel in the SFEIS/SDEIS to a combination of inappropriate use of the modified spreadsheet and errors in the spreadsheet."	Expansion, Urban Growth, and Induced Travel: A Path Analysis" Journal of the American Planning Association, Vol. 69 No. 2, Spring 2003, that his most recent estimate of elasticity based on speed is 0.238, which tends to support the argument that lane-mile elasticities tend to overstate induced-travel effects.
All	225-34, 225-72	34. "The reformulation of the FHWA's SMITE model resulted in at least four other errors identified in Mr. Marshall and Mr. Grady's report." 72. The errors in the spreadsheet include: 1) inconsistent capacity inputs between alternatives, 2) inconsistent travel time functions between alternatives, 3) undocumented equations that essentially replace the SMITE model with an alternative model, and 4) extremely low modeled speeds that are unrealistic and skew the analysis results.	After correcting the errors pointed out by Terris, Pravlik & Millian, induced travel falls from 1.27 percent to 1.05 percent. The summary in this SFEIS/FEIS has been corrected to match these new estimates. The concerns noted in this comment are discussed in order: 1) Inconsistent capacity inputs between alternatives- this data input error has been corrected. The error affected four functional classes. Using the lower capacity values would change estimated induced travel from 1.8 percent to 2.45 percent in the case where the beltway and the TIP are both analyzed. Using the lower capacity values also lowers speeds in the no-build case. 2) Inconsistent travel time functions between alternatives- The travel time functions are the same in all alternatives and are the same as originally specified in FHWA's version of SMITE. 3) Undocumented equations that essentially replace those in the SMITE model. As has been stated, the speed/delay equations and the diversion equations are the same as those used in the FHWA version of SMITE. The equations have been reformatted to make comprehension and checking easier but have not been changed otherwise. Complete documentation can be found in: Margiotta, Richard et.al. Improved Speed Estimation Procedures of Use in STEAM and Air Quality Planning. Economic Implications of Transportation and Land Development Patterns. Metropolitan Planning Technical Report No. 11. FHWA, June 1998

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			4) Low modeled speeds. There was a coding error affecting signalized streets with high levels of congestion. The coding error multiplied delays instead of adding them. This error has been corrected for all signalized streets. Correcting this error changed speeds on Urban Principal Arterials from ~1.6 mph to ~16 mph in the no build case.
All	225-62	"The SFEIS/SDEIS addresses "induced travel" as a component of indirect and cumulative effects. In its definition of induced travel, it starts out correctly…However, the concluding sentence of the paragraph suggests that only the third component, new travel, "strictly speaking….meets the definition." This is wrong and the sentence should be removed."	The definition of induced travel used in the *Indirect and Cumulative Impacts Analysis* is that portion of travel not accounted for in the travel demand model. The travel demand model accounts for both diverted trips and longer trips, but not totally new trips.
All	225-36, 225-64	36. "The geographic scope of the entire Cumulative Effects discussion is too narrow…the impact of the Northern Beltway will be felt beyond Forsyth County... However, the study area for the indirect and cumulative impact evaluation is limited to Forsyth County…and the discussion entitled "Communities' is limited to the Winston-Salem area…Due to commuting patterns into and out of Forsyth County, the Cumulative Effects discussion's scope should be broadened to include relevant portions of surrounding counties." 64. "However, there is a serious flaw in the application of the gravity model in the Northern Beltway analysis. The gravity model is applied only within Forsyth County."	The study area boundaries were defined according to the guidance set forth in *Guidance for Assessing Indirect and Cumulative Impacts of Transportation Projects in North Carolina. Volume II: Practitioner's Handbook.* See response to Comment Number 225-50 above. In addition, the commenters use the I-270 widening in Maryland as a case study for their contention that the gravity model should have included a broader area. The Montgomery County Maryland Study (I-270) is not comparable to Forsyth County. The urban areas are different sizes, have different demographics, and different land values. In addition, I-270 is a radial facility crossing one state and two county lines connecting Washington, DC with Frederick Maryland. Widening I-270 confers a significant time advantage to commuters in Montgomery and Frederick Maryland. In contrast, the Winston-Salem Northern Beltway is a circumferential freeway entirely within

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			Forsyth County, North Carolina. It should not provide a significant travel time savings for intercounty commuters (e.g., Davidson, Davie, Guilford and Stokes county residents) who have to drive into Forsyth County to use it.
All	225-37	"The Cumulative Effects Section's discussion entitled "Air Quality" discusses the effect of this project and other projects on the one-hour ozone standard and the carbon monoxide standard…However, it fails to discuss the effects of future projects, including the Northern Beltway, on the eight-hour ozone level and the particulate matter standard."	Because Forsyth County is part of an Early Action Compact (EAC) for the eight-hour ozone standard, the eight-hour ozone standard does not apply in Forsyth County. Additionally, USEPA considers Forsyth County Attainment for the PM2.5 standard; therefore transportation conformity is not necessary for PM2.5.
All	225-38	"The SFEIS/SDEIS does describe the travel demand model used for the conformity determination, but it fails to state what those determinations were for the eight-hour ozone level and the particulate matter standards."	These conformity determinations are for the one-hour ozone and the carbon monoxide standards. Forsyth County is currently in attainment for the PM2.5 standard, and implementation of the 8-hour ozone standard is deferred under the Ozone Early Action Compact.
All	225-39	""The SFEIS/SDEIS states that Forsyth County is part of an Early Action Compact for the eight-hour ozone standard and at the time of publication was "on track to comply with the eight-hour ozone standard in 2007," but it does not explain how constructing the Northern Beltway along with other development would effect this determination in the future…The SFEIS/SDEIS should explain the effect of all transportation projects on the eight-hour ozone level standard."	The Northern Beltway is part of the *Winston-Salem Urban Area 2030 Long Range Transportation Plan*, which is the plan used for conformity determinations. In ozone early action compacts, USEPA defers implementation of the eight-hour ozone standard until 2007, or until the area fails to meet an implementation milestone. Thus, the eight-hour ozone standard does not currently apply. If the early action compact area meets USEPA's requirements for attainment of the eight-hour ozone standard in 2007, then the area USEPA re-designates the area directly to attainment and no further

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Project	Letter/ Comment Number	Comments & Questions	Response
			action will be needed. The Division of Air Quality performed extensive photochemical dispersion modeling to assess the likelihood of achieving and maintaining the eight-hour ozone standard. This modeling included assessing the contribution of the transportation sector and evaluated attainment through 2017. (Sheila Holman, NC Division of Air Quality, personal communication, March 28, 2005.)
All	225-40	"The SFEIS/SDEIS also says that, at the time of publication, EPA had recommended that Forsyth County be designated nonattainment under the fine particulate standard, but it does not explain how development will affect this determination in the future...The SFEIS/SDEIS should explain the effect of all transportation projects on the fine particulate standard."	USEPA has not designated Forsyth County as nonattainment for PM2.5 . Transportation Conformity for the PM2.5 standard does not apply to Forsyth County. References to the attainment status for PM2.5 have been updated.
All	225-41	"There are at least three deficiencies in the discussion entitled "Water Quality" See SFEIS/SDEIS, p. 4-201. First, the SFEIS/SDEIS addresses the effects that the Northern Beltway would have on water quality, but it does not indicate that it considers the effects that other projects may have on water quality."	Section 4.20.7.2 of the SFEIS/FEIS states "NCDOT is preparing water quality modeling in support of a Section 401 Water Quality Certification application to the NCDWQ." This section also addresses the water quality analysis performed since the SFEIS/SDEIS was published, and addresses the cumulative effect on water quality in the region.
All	225-42	"Second, the discussion states that "increased development pressure may occur within the Yadkin River water supply watershed and the Salem Creek water supply watershed on the western and eastern sides of Forsyth County" due to the Eastern Section Extension, but fails to quantify, or even clearly indicate,	See response to Comment 225-41 above.

Table 6-5: Comments from Citizens

Project	Letter/ Comment Number	Comments & Questions	Response
		the amount of "pressure" or how significant its effects will be."	
All	225-43	"Third, the SFEIS/SDEIS identifies four streams in Forsyth County that are classified by NCDWQ as impaired waters….but again fails to quantify the amount of "pressure" or how significant its effects will be."	See response to Comment 225-41 above.
U-2579 & U-2579A	225-44	"The discussion entitled "Potential Impacts of the Interstate 74 Corridor" fails to discuss the possibility of additional traffic being pulled into the Eastern Section…..For example, the SFEIS/SDEIS determines the I-74 "would not impact preferred routes [of truckers] substantially or significantly impact truck volumes.", but fails to address other vehicles. The failure to address other vehicles is significant since common sense indicates that designating the Eastern Section and Eastern Section Extension…as part of I-74 will pull drivers from I-74…onto the Eastern Section and the Eastern Section Extension.	The body of the *Indirect and Cumulative Impacts Analysis* includes a more complete discussion of how I-74 may affect passenger car travel. Parts of this discussion have been added to the summary in this SFEIS/FEIS.
All	225-45	"These comments, together with the report of Mr. Marshall and Mr. Grady, show that the SFEIS/SDEIS is seriously deficient and therefore does not comply with the requirements of the National Environmental Policy Act….we submit that a new SFEIS/SDEIS must be issued, which should be subject to a new period of public comment. We believe that a supplemental SFEIS/SDEIS will not be adequate to comply with the requirements of the Act."	The FHWA and NCDOT believe the SFEIS/SDEIS sufficiently fulfills the requirements of the National Environmental Policy Act.

CHAPTER 7

Chapter 7 LIST OF PREPARERS

7.1 1996 PROJECT R-2247 FEIS PREPARERS

All information about preparers listed in this section was taken from the 1996 Project R-2247 FEIS, Section 5.0.

A listing of the principal participants in the preparation of the 1996 Project R-2247 FEIS is presented below. The status of the people listed below was current at the time of the 1996 Project R-2247 FEIS.

FEDERAL HIGHWAY ADMINISTRATION

Roy C. Shelton	BS in Civil Engineering. 24 years of experience in transportation. Responsible for administration of the Federal Aid Highway Program for the western NC District.
Daniel Hinton, PE Area Engineer	BS in Civil Engineering. 5 years of experience in transportation engineering. Responsible for administration of the Federal Aid Highway Program in Divisions 9 and 12 in NC.
Shelley Lynch, PE Area Engineer	8 years of experience in transportation. Responsible for Federal Aid Highway Programs for Divisions 8 and 9.
Brent Dather Assistant Area Engineer	4 years of experience in transportation.
Susan Mooney Highway Engineer Trainee	2 years of experience in transportation.

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

L. Jack Ward, PE Manager, Planning & Environmental Branch	BS in Civil Engineering. 30 years of experience in the Planning and Environmental Branch.
H. Franklin Vick, PE Assistant Manager, Planning & Environmental Branch	BS in Civil Engineering. 20 years of experience in the Planning and Environmental Branch.

Robert P. Hanson, PE Project Planning Engineer, Planning & Environmental Branch	BS in Civil Engineering. 7 years of experience in transportation.
A.H. Lassiter, PE Project Engineer, Roadway Design Unit	23 years of experience in highway design.

ESPEY, HUSTON & ASSOCIATES

Tracy L. Hill, PE Project Manager	BS in Civil Engineering B.A. in History. 12 years of related experience.
Roy Highberg, PE Assistant Project Manager	BS in Ocean Engineering. 2 ½ years of related experience.
Rob Reid Environmental Manager	BS in Wildlife and Fisheries Sciences. M.S. in Wildlife and Fisheries Sciences. 15 years of related experience.
Myron George, PE Project Manager	BS in Civil Engineering. 9 years of related experience. Responsible for functional design and cost estimates.
Charlie Darling Senior Designer	S.E.T. 32 years of related experience. Responsible for functional design and cost estimates.
Roe O'Donnell, PE Project Manager	BS in Civil Engineering. 13 years of related experience. Responsible for hydraulics.
Richard Reed, PE Project Engineer	BS in Civil Engineering. M.S. in Civil Engineering. 12 years of related experience. Responsible for hydraulics.
Ryan Hill Environmental Planner	AS in Ecology. BS in Forestry. 8 years of related experience. Responsible for traffic noise and air quality.
Sherry Cordry Urban/Regional Planner	BA in Geography. MS in Community & Regional Planning. 6 years of related experience. Responsible for socioeconomics, utilities, and hazardous materials.

Wayne Glander	BA in Sociology. MA in Anthropology. 20 years of related experience. Responsible for cultural resources and archaeology.
Alain C. Outlaw Senior Staff Archaeologist	BA in Anthropology. MA in Anthropology. 20 years of related experience. Responsible for cultural resources.
Michael Nash Staff Archaeologist	AA in History. BA in Anthropology. MA in Anthropology. 11 years of related experience. Responsible for cultural resources.
Loretta Lautzenheizer Historic Archaeologist	BS in Anthropology. MA in Anthropology. 15 years of related experience. Responsible for cultural resources.
Langdon Edmunds Opperman Architectural Historian	BA in Historic Preservation and City Planning. MA in City Planning and Historic Preservation. 19 years of related experience. Responsible for cultural resources and historic architecture.
Eugene Foster Architectural Historian	MS in Architectural Studies. 6 years of related experience. Responsible for cultural resources and historic architecture.
W. Bruce Aitkenhead	BS in Fisheries Biology. MS in Oceanography. 17 years of related experience. Responsible natural systems quality control and quality assurance.
Thomas A. Stierhoff Senior Staff Ecologist	BS in Ecology. MS candidate in Ecology. 8 years of related experience. Responsible for natural systems.

WHM TRANSPORTATION ENGINEERING CONSULTANTS

David Millar, PE Engineer	BS in Civil Engineering. 7 years of related experience. Responsible for traffic modeling and capacity analysis.

Gordon Derr, PE Engineer	BS in Civil Engineering. MS in Civil Engineering. 16 years of related experience. Responsible for traffic modeling and capacity analysis.
Randy Machemehl, PE Senior Consultant	AA in Engineering. BS in Civil Engineering. MS in Civil Engineering. PhD in Civil Engineering. 22 years of related experience. Responsible for traffic modeling and capacity analysis.

ICF INCORPORATED

Betsy Marcotte	BA in Economics. 18 years of related experience. Responsible for public involvement.
Alison Orr	BS in Environmental Education. 6 years of related experience. Responsible for public involvement.
Susan Reynolds	BA 6 years of related experience. Responsible for public involvement.

7.2 1995 PROJECT U-2579 DEIS PREPARERS

A listing of the principal participants in the preparation of the 1995 Project U-2579 DEIS is presented below, taken from Chapter VI of the 1995 Project U-2579 DEIS. The status of the people listed below was current at the time of the 1995 Project U-2579 DEIS.

FEDERAL HIGHWAY ADMINISTRATION

Roy C. Shelton Operations Engineer	BS in Civil Engineering. 29 years of experience in transportation engineering. Responsible for administration of the Federal Aid Highway Program.
Wady Williams Area Engineer	BS in Architectural Engineering. 24 years of experience in transportation engineering. Responsible for administration of the Federal Aid Highway Program in Divisions 3, 6, and 9 in N.C.
Daniel Hinton, PE Area Engineer	BS in Civil Engineering. 5 years of experience in transportation engineering. Responsible for administration of the Federal Aid Highway Program in Divisions 9 and 12 in N.C.

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

H. Franklin Vick, PE Manager, Planning and Environmental Branch	BS in Civil Engineering. 21 years of experience in transportation engineering. Responsible for highway planning and environmental impact analysis.
Richard Davis, PE Assistant Manager, Planning and Environmental Branch	BS in Civil Engineering. 21 years of experience in transportation and environmental studies. Responsible for coordinating consultant projects.
J. A. Bissett, Jr., PE Unit Head, Consultant Engineering Unit	BS in Civil Engineering. 10 years of experience in transportation engineering and planning. Responsible for coordinating environmental impact studies.
Byron Brady, PE Project Planning Engineer, Consultant Engineering Unit	BS in Civil Engineering. 9 years of experience in transportation and planning. Responsible for coordination.

KIMLEY-HORN AND ASSOCIATES, INC.

Barton J. Barham, PE Senior Transportation Engineer	BS and MS in Civil Engineering. 20 years of experience in transportation planning and environmental studies. Responsible for quality control/quality assurance.
Nathan B. Benson, PE Project Manager	BS in Civil Engineering. 34 years of experience in transportation planning and environmental studies. Responsible for overall management and development of the EIS.
Mark E. Atkinson, PE Assistant Project Manager	BS in Civil Engineering. 8 years of experience in transportation planning and environmental studies. Responsible for preparation of noise and air quality studies.
Angelo D. Beccasio, PG Senior Geologist	BS in Geology. MS in Geology. 36 years of experience in environmental studies relating to transportation planning, site selection, feasibility, and natural resource inventory and development. Responsible for preparation of natural system studies.
Beth Reed Environmental Analyst	BS in Biology. MS in Biology. 5 years of experience in environmental planning and natural resources. Responsible for field surveys and natural system studies.
John D. Walker, PE Transportation Analyst	BS in Civil Engineering. 3 years of experience in transportation planning. Responsible for highway capacity analysis.
Robert E. Norburn, EI Transportation Analyst	BS in Civil Engineering. 2 years of experience in transportation planning. Responsible for data collection and environmental preparations.
Richard Rohrbaugh, PE Design Engineer	BS in Civil Engineering. 13 years of experience in highway engineering. Responsible for the hydraulic design studies.

Ed Holzapfel, CET Highway Design	20 years of experience in highway design construction. Responsible for preparation of hydraulic studies.
Tom Goodwin, PE Design Engineer	BS in Civil Engineering. 11 years of experience in highway design. Responsible for development of functional designs.
Ahad A. Sadat Design Engineer	BS in Civil Engineering. 9 years of experience in highway design. Responsible for preparation of functional design plans.

LONGLEAF HISTORIC RESOURCES

M. Ruth Little, PhD Architectural Historian	BS in Arts, History, and French. MA in History. PhD in History. 20 years of experience of historic preservation; former survey specialist; experience in various programs of State Historic Preservation Offices. Responsible for the preparation of the architectural historic survey.

NEW SOUTH ASSOCIATES, INC.

Lawrence E. Abbott, Jr. Archaeologist	BS in Business Administration. BA in Anthropology. MA in Anthropology. 10 years of experience in archeological surveys. Responsible for the archeological survey and studies.

7.3 WINSTON-SALEM NORTHERN BELTWAY COMBINED SFEIS/SDEIS and SFEIS/FEIS PREPARERS (PROJECTS R-2247, U-2579, AND U-2579A)

A listing of the principal participants in the preparation of this document, the Winston-Salem Northern Beltway SFEIS/FEIS for Projects R-2247, U-2579, and U-2579A (and the preceeding SFEIS/SDEIS), is presented below.

FEDERAL HIGHWAY ADMINISTRATION

Emily Lawton, PE Operations Engineer	BS Civil Engineering 13 years of experience. FHWA oversight - NC Division. Responsible for Federal-aid projects within North Carolina.
Clarence Coleman, PE Operations Engineer	BS in Civil Engineering 14 years of experience. FHWA oversight – NC Division. Responsible for Federal-aid projects within North Carolina.
Felix Davila, PE Area Engineer	BS Civil Engineering Area Engineer, FHWA oversight - NC Division. 15 years of experience. Responsible for Federal-aid projects in Divisions 7, 8, and 9 in North Carolina.

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

Gail Grimes, PE Assistant Branch Manager	BS in Civil Engineering. 30 years of experience. Responsible for project development and environmental analysis conducted by consultants for NCDOT.
Derrick Weaver, PE Project Engineer	BS in Civil Engineering. 13 years of experience. Responsible for supervising four Project Managers.
Missy Dickens, PE Project Manager	BS in Civil Engineering. 15 years of experience. Responsible for overseeing development of the SFEIS/SDEIS.
Eric Midkiff, PE Central Region Unit Head	BS in Civil Engineering. 17 years of experience. Responsible for project development and environmental analysis for projects in the Central Region

PBS&J

PBS&J was responsible for updating the Winston-Salem Northern Beltway - Western Section (R-2247) and for overall management and preparation of the Combined Winston-Salem Northern Beltway SFEIS/SDEIS.

Jill S. Gurak, PE, AICP Project Manager	BS in Mechanical Engineering. 14 years of experience in NEPA studies. Responsible for overall management and development of the EIS and quality control for air quality and noise impact assessments.
Gina Gilgo, PE Former Project Manager	BS in Civil Engineering 12 years of experience. Previous project manager.
Virginia Schaar, PE Roadway Design Engineer	BS in Civil Engineering. 8 years of experience. Responsible for conceptual layouts of widening improvements and right-of-way impact evaluation.
Steve Drum, PE Project Manager, Roadway Design	BS in Civil Engineering. 16 years of experience. Responsible for roadway improvements alternatives analysis.
John Adams, PE Program Manager, Transportation Planning	BS in Civil Engineering. 10 years of experience. Responsible for traffic operations analysis.
Melissa Cooney, PE Traffic Engineer	BS in Civil Engineering. 11 years of experience. Responsible for traffic analysis for the traffic technical memorandum.
David Bass. PE Project Manager, Roadway Design	BS in Civil Engineering. 13 years of experience. Responsible forInvestigation and design of multiple alternatives for Bethania-Tobaccoville Road.
Lauren Wolfe, EI Project Engineer	BS Environmental Engineering. 3 years of experience. Responsible for development of DEIS including research, data collection and analysis.
Suzanna Rea, PE Project Engineer	BS in Civil Engineering. 4 years of experience. Responsible for traffic capacity analysis, development of the DEIS, air quality impact assessment.

Kimberly Bereis, AICP Project Planner	BS in Environmental Studies. MSP in Urban & Regional Planning. 7 years experience. Responsible for demographic and neighborhood impact data collection and analysis, farmland impact assessment, updated noise impact assessment, and development of the SFEIS/SDEIS.
Eric Galamb Senior Biologist	BS in Environmental Management and Biogeography. 15 years of experience. Responsible for wetlands delineation, T&E species surveys, and stream determinations.
Jeremy Huckeba Web Site Developer	7 years of experience. Responsible for project website development.
Craig Mesimer GIS Analyst	BS Geography & Planning. 4 years of experience. Responsible for data collection and maintenance; wetland, stream, and biotic community impact analysis; and graphic support.
James Lawson GIS Analyst/Graphics Coordinator	Associates Degree in Civil Engineering. BA in Psychology 16 years of experience. Responsible for graphics coordination, preparation of graphics and exhibits, and impact calculations.
Jamie Blackwell GIS Analyst/Graphics Coordinator	Associates Degree in Specialized Technology. 5 years of experience. Responsible for preparation of graphics and exhibits, and impact calculations.

KIMLEY-HORN AND ASSOCIATES, INC.

Kimley-Horn and Associates was responsible for updating the Winston-Salem Northern Beltway Eastern Section (Project U-2579) and preparing new material for the Winston-Salem Northern Beltway Eastern Section Extension (Project U-2579A), and for providing Quality Control/Quality Assurance for the Winston-Salem Northern Beltway Combined SFEIS/SDEIS.

Laurence J. Meisner, PE, AICP Project Manager	BS in Industrial Engineering. MS in Regional Planning. 34 years of experience. Responsible for overall management and development of the EIS.
Elizabeth A. Reed, PWS Senior Biologist	BS in Marine Biology. MS in Coastal Zone Management and Oceanography. 18 years of experience. Responsible for quality control for natural resources and impacts.

Teresa Gresham, PE Transportation Analyst	BS in Civil Engineering. MS in Civil Engineering. 3 years of experience. Responsible for development of SFEIS/SDEIS including research, data collection and analysis; impact analysis; and preparation of graphics and exhibits.
D. Norton Webster Biologist	BS in Business. MS in Forestry. 12 years of experience. Responsible for data collection and maintenance; wetland, stream, and biotic community impact analysis; and graphic support.
Andrew R. Kiley Biologist	BS in Biology. MS in Environmental Resource Management. 7 years of experience. Responsible for preparation of graphics and exhibits, and impact analysis for natural systems.
Jeffrey W. Moore, PE Senior Design Engineer	BS in Civil Engineering. 11 years of experience. Responsible for development of preliminary roadway plans.
Benjamin Brandstetter, EI Highway Designer	BS in Civil Engineering. 5 years of experience. Responsible for development of preliminary roadway plans.
Christopher Mroczka, PE Transportation Engineer	BS in Civil Engineering. MS in Civil Engineering. 7 years of experience. Responsible for performing traffic analysis.
Jennifer M. Haynie Transportation Analyst	BS in Physics. ME in Environmental Management. 5 years of experience. Responsible for data collection and analysis, and graphic support.
Michael M. Rutkowski, PE, AICP Transportation Engineer	BS in Civil Engineering. MS in Civil Engineering. 16 years of experience. Responsible for air quality analysis.
Jeff B. Mullis, PE Senior Engineer	AS in Electronic Engineering Technology. BS in Civil Engineering. 16 years of experience. Responsible for quality control for noise impact analysis.
Jeffrey B. Palmquist, EI Transportation Analyst	BS in Civil Engineering. MS in Civil Engineering. 5 years of experience. Responsible for noise impact analysis.

Jennifer L. Steed, PE Transportation Engineer	BS in Civil Engineering. MS in Civil Engineering. 5 years of experience. Responsible for air quality analysis.
Russell H. Dalton, PE Transportation Engineer	BS in Civil Engineering. MS in Civil Engineering. 6 years of experience. Responsible for traffic impact analysis.
Peter J. Nicholas IV, EI Transportation Analyst	BS in Civil Engineering. 3 years of experience. Assisted in traffic impact analysis.
R. David Whyte, PE Transportation Engineer	BS in Civil Engineering. 10 years of experience in GIS/Information Technology. Responsible for preparation of graphics and exhibits.
Lucie N. Maguire, EI Civil Analyst	BS in Civil Engineering. 3 years of experience. Responsible for hydology analysis.
Colleen A. Kiley Environmental Analyst	BS in Geology. MS in Coastal Zone Management. 4 years of experience. Responsible for preparation of graphics and exhibits, and impact analysis.
Jason A. Yakimowich, PE Transportation Engineer	BS in Civil Engineering. MS in Civil Engineering. 6 years of experience. Responsible for noise monitoring, traffic analysis.
Kelly D. VanPatten Technician	AS in Architectural Technology. 6 years of experience. Responsible for preparation of graphics and exhibits.
Pramoda Gode Transportation Analyst	BS in Civil Engineering. MS in Civil Engineering 2 years of experience. Responsible for preparation of graphics and exhibits.
Ahad Sadat Design Engineer	BS in Civil Engineering. 13 years of experience. Responsible for development of preliminary roadway plans, and for preparation of graphics and exhibits.
Natalie Mengelkoch Transportation Analyst	BS in Civil Engineering. 4 years of experience. Responsible for noise analysis.

LOUIS BERGER GROUP, INC.

The Louis Berger Group, Inc. was responsible for the Indirect and Cumulative Impact Analysis.

Lawrence Pesesky, AICP Senior Vice President	BS in Agricultural Economics. MS in Geography. 19 years of experience. Responsible for Indirect and Cumulative Impact Assessment.
Albert Racciatti, AICP Analyst	BS in Industrial and Labor Relations. MA in International Relations. MCRP in City & Regional Planning. 6 years of experience. Responsible for Indirect and Cumulative Impact Assessment.
Stacey Barron Analyst	BA in Geography. MA in Geography. 6 years of experience. Responsible for Indirect and Cumulative Impact Assessment.
Rachel E. Conaty Planner	BS in Applied Mathematics (Physics). Masters of Urban Planning. Two years of experience. Responsible for Indirect and Cumulative Impact Assessment (2001).
Scott Lane, AICP Transportation Planning Manager	BS in Geography. MA in Geography. 14 years of experience. Responsible for Indirect and Cumulative Impact Assessment (2004).
David Hyder, PE Principal Transportation Engineer	BS in Civil Engineering. MS in Civil Engineering. 20 years of experience. Responsible for Indirect and Cumulative Impact Assessment (2004).
Michael J. Fendrick, PE, PTOE Transportation Engineer	BS in Civil Engineering Masters in Civil Engineering 17 years of experience. Responsible for Indirect and Cumulative Impact Assessment (2004).

EDWARDS PITMAN ENVIRONMENTAL, INC.

Edwards Pitman Environmental was responsible for updating Historic Architectural Resources for Projects R-2247,U-2579, and U-2579A.

Jennifer Martin Architectural Historian	BA in History. BA in Sociology. MA in History with Emphasis in Historic Preservation. 13 years of experience. Responsible for Phase II intensive historic architectural resources identification and documentation for the Eastern Section and Eastern Section Extension.
Heather Fearnbach Architectural Historian	BA in English. MA in History with Emphasis in Public History. 11 years of experience. Responsible for additional property surveys.
Sara Woodard Historian	BA in History. MHP in Historic Preservation. 5 years of experience. Responsible for Phase II intensive historic architectural resources identification and documentation.
Clay W. Griffith Historian	BS in Architecture. MA in Architectural History. 10 years of experience. Responsible for Phase II intensive historic architectural resources identification and documentation for the Western Section.

LONGLEAF HISTORIC RESOURCES

Longleaf Historic Resources was responsible for updating Historic Architectural Resources for Project U-2579.

M. Ruth Little, PhD Historian	BS in Arts, History, French. MA in History. PhD in History. 20 years of experience. Responsible for the update of the architectural historic survey for Project U-2579.

RS&H

RS&H was responsible for the US 52 widening analysis for Projects U-2579 and U-2579A.

Janice K. Anderson, PE Project Manager	MRP in Transportation Planning. MCE in Traffic Engineering. BS in Mechanical Engineering 25 years of experience. Responsible for management of the US 52 Corridor Study.
Veronica S. McGriff Wallace, PE Transportation Engineer	BS in Civil Engineering. 12 years of experience. Responsible for project management, roadway, permitting, and drainage design.
Deborah A. Porter Analyst	BA Geography. 20 years of experience. Responsible for technical coordination of transportation planning studies and coordination of project deliverables and quality control and quality assurance tasks.
Kimberly Boik, EI Transportation Engineer	BS Civil Engineering. 3 years of experience. Responsible for roadway design and transportation planning.
Radha Krishna Swayampakala Analyst	BT Civil Engineering. 1 year of experience. Responsible for transportation planning and traffic engineering studies.

CHAPTER 8

Chapter 8 REFERENCES

8.1 Supporting Documentation

Project R-2247 (Western Section)

Project R-2247. *Alternative Comparison/Selection Report for the Winston-Salem Northern Beltway (West) Project R-2247.* 1990. Prepared by Espey, Huston & Associates.

Project R-2247. *Natural Systems Technical Memorandum*. December 1991. Prepared by Espey, Huston & Associates.

Project R-2247. *Historic Architectural Resources Survey Report.* 1990-1991. Prepared by Langdon E. Opperman.

Project R-2247. *A Sample Survey of the Proposed Final Alternatives for the Winston-Salem Northern Beltway (Western Section), Forsyth County, North Carolina*. 1991. Prepared by Nash, Michael; L. Lautzenheiser, R. Rogers, P. McCoy and W. Glander.

Project R-2247. *Draft Environmental Impact Statement (DEIS).* June 1992. Prepared by Espey, Huston, & Associates.

Project R-2247. *Alternative Comparison Summary for Selection of a Preferred Alternative.* January 1993. Prepared by Espey, Huston & Associates.

Project R-2247. *Wetland Delineation Report for Winston-Salem Northern Beltway (West) in Forsyth County, North Carolina*. August, 1995. Prepared by Espey, Huston & Associates, Inc.

Project R-2247. *Final Environmental Impact Statement (FEIS)*. March 14, 1996. Prepared by Espey, Huston & Associates.

Project R-2247. *Improve Existing Roadways Alternatives Evaluation Report.* 2002. Prepared by PBS&J.

Project R-2247. *GeoEnvironmental Impact Evaluation.* December 12, 2002. Prepared by NCDOT Geotechnical Unit.

Project R-2247. *Historic Architectural Resources Survey Report Phase II Intensive*. April, 2003. Prepared by Edwards-Pitman Environmental, Inc.

Project R-2247. *Supplemental Natural Resources Technical Memorandum (2003) for Project R-2247.* 2003. Prepared by PBS&J.

Project R-2247. *Bethania-Tobaccoville Road Interchange Alternatives Evaluation*. June 2003. Prepared by PBS&J.

Project R-2247. *Traffic Technical Memorandum for Project R-2247.* August 2003. Prepared by PBS&J.

Project R-2247. *Air Quality Assessment for the Winston-Salem Northern Beltway Western Section Technical Memorandum*. 2003. Prepared by PBS&J.

Project R-2247. *Technical Memorandum for a Limited Noise Impact Assessment (Western Section).* July 2004. Prepared by PBS&J.

Project R-2247. Updated Noise Impact Assessment (Western Section). July 2005. Prepared by PBS&J.

Project U-2579 (Eastern Section)

Project U-2579. *Historic Architectural Resources Survey Report: Phase I.* April 1993. Prepared by Longleaf Historic Resources.

Project U-2579. *Natural Resources Technical Memorandum*. 1994. Prepared by Kimley-Horn and Associates, Inc.

Project U-2579. *Draft Environmental Impact Statement (DEIS)*. September 1995. Prepared by Kimley-Horn and Associates, Inc.

Project U-2579. *Archaeological Resources Technical Memorandum*. October 1995. Prepared by New South Associates.

Project U-2579. *Archaeological Survey for the Eastern Section Preferred Alternative*. February 2001. Prepared by New South Associates.

Project U-2579. *Air Quality Technical Memorandum*. October 2002. Prepared by Kimley-Horn and Associates, Inc.

Project U-2579. *Hydraulics Technical Memorandum*. December 2002. Prepared by Kimley-Horn and Associates, Inc.

Project U-2579. *Traffic Technical Memorandum*. February 2003. Prepared by Kimley-Horn and Associates, Inc.

Project U-2579. *Noise Technical Memorandum*. March 2003. Prepared by Kimley-Horn and Associates, Inc.

Project U-2579. *Historic Architectural Resources Survey Report: Phase II Intensive*. April 2003. Prepared by Edwards-Pitman Environmental, Inc.

Project U-2579. *Section 404/401 Jurisdictional Areas Report*. 2004. Prepared by Kimley-Horn and Associates, Inc.

Project U-2579 and U-2579A. Natural Resources Technical Memorandum. 2004. Prepared by Kimley-Horn and Associates, Inc.

Project U-2579 and U-2579A . Noise Technical Memorandum. August 2005. Prepared by Kimley-Horn and Associates, Inc.

Project U-2579A (Eastern Section Extension)

Project U-2579A. *Archeological Resources*. November 1994. Prepared by New South Associates.

Project U-2579A. *Historic Architectural Resources Survey Report: Phase I*. January 1995. Prepared by Longleaf Historic Resources.

Project U-2579A. *Feasibility Study*. January 1996. Prepared by Kimley-Horn and Associates, Inc .

Project U-2579A. *Purpose and Need Technical Memorandum*. February 2001. Prepared by Kimley-Horn and Associates, Inc.

Project U-2579A. *Alternatives Technical Memorandum*. June 2001. Prepared by Kimley-Horn and Associates, Inc.

Project U-2579A. *GeoEnvironmental Impact Evaluation*. September 2001. Prepared by NCDOT Geotechnical Unit.

Project U-2579A. *Historic Architectural Resources Survey Report: Phase I Update*. September 2001. Prepared by Longleaf Historic Resources.

Project U-2579A. *Traffic Technical Memorandum*. December 2002. Prepared by Kimley-Horn and Associates, Inc.

Project U-2579A. *Air Quality Technical Memorandum.* February 2003. Prepared by Kimley-Horn and Associates, Inc.

Project U-2579A. *Historic Architectural Resources Survey Report: Phase II Intensive*. April 2003. Prepared by Edwards-Pitman Environmental, Inc.

Project U-2579A. *Noise Technical Memorandum* for U-2579A. June 2003. Prepared by Kimley-Horn and Associates, Inc.

Project U-2579A. *Historic Architectural Resources Survey Report: Phase II Intensive Final Identification and Evaluation, John and Catherine Bodenhamer House*. February 2004. Prepared by Edwards-Pitman Environmental, Inc.

Project U-2579 and U-2579A. Natural Resources Technical Memorandum. 2004. Prepared by Kimley-Horn and Associates, Inc.

Project U-2579 and U-2579A . Noise Technical Memorandum. August 2005. Prepared by Kimley-Horn and Associates, Inc.

Project U-2579A. Archaeological Survey and Evaluation, Proposed Corridor for the Winston-Salem Northern Beltway Eastern Section Extension. December 2004. Prepared by URS Corporation.

All Projects

US 52 Corridor Study. 2003. Prepared by Reynold, Smith, and Hills (RS&H).

Winston-Salem Northern Beltway Indirect and Cumulative Impacts Analysis. June 2005. Prepared by The Louis Berger Group, Inc.

8.2 References

Documents

American Association of State Highway and Transportation Officials (AASHTO)
2001 A Policy on Geometric Design of Highways and Streets. Fourth Edition.

Amoroso, JL
1999 Natural Heritage Program List of the Rare Plant Species of North Carolina. North Carolina Natural Heritage Program, Division of Parks and Recreation; North Carolina Department of Environment, Health, and Natural Resources; Raleigh. 88 pp.

Clarke, AH
1985 The Tribe Alasmidontini (Unionidae: Anodontidae), Part II: *Lasmigona* and *Simpsonaias.* Smithsonian Institution Press, Washington, D.C. 75 pp.

Cowardin, LM, V. Carter, FC Goblet, and ET Laroe
1979 Classification of Wetland and Deepwater Habitats of the United States. U.S. Fish and Wildlife Service, FWS/OBS 79/31. U.S. Department of the Interior.

Department of Environment, Health, and Natural Resources (DEHNR)
1989 Benthic Macroinvertebrate Ambient Network (BMAN): Water Quality Review 1983-1988. Rpt. 89-08, North Carolina DEHNR, Division of Environmental Management, Water Quality Section; Raleigh. 193 pp.

1991 Biological Assessment of Water Quality in North Carolina Streams: Benthic Macroinvertebrate Data Base and Long Term Changes in Water Quality, 1983-1990. North Carolina DEHNR, Division of Environmental Management, Water Quality Section; Raleigh.

1994 Draft Basinwide Assessment Report Support Document: Catawba River Basin. North Carolina DEHNR, Division of Water Quality, Water Quality Section; Raleigh. 234 pp.

1995 Fourth Version, Guidance for Rating the Values of Wetlands in North Carolina. North Carolina DEHNR, Division of Environmental Management, Water Quality Section; Raleigh.

1997 Draft Basinwide Assessment Report Support Document: Yadkin-Pee Dee River Basin. North Carolina DEHNR, Division of Water Quality, Water Quality Section; Raleigh. 338 pp.

2003 Yadkin-Pee Dee Basinwide Water Quality Management Plan: Yadkin-Pee Dee River Basin. North Carolina DEHNR, Division of Water Quality, Water Quality Section; Raleigh. 146 pp.

Department of the Army (DOA)

1987 Corps of Engineers Wetlands Delineation Manual. Tech. Rpt. Y-87-1. Waterways Experiment Station, Corps of Engineers, Vicksburg, Mississippi. 100 pp.

Division of Planning and Assessment (DPA)

1991 North Carolina Environmental Permit Directory. North Carolina Department of Environment, Health, and Natural Resources, Raleigh. 91 pp.

Federal Highway Administration

2001 Traffic Noise Model, Version 1.1.

1993 The Development of Logical Termini. Memorandum. November 5.

1989 Section 4(f) Policy Paper. Originally published September 24, 1987. Revised June 7, 1989. Available for download at http://www.fhwa.dot.gov/environment/guidebook/chapters/v2ch15.htm

1987 Guidance for Preparing and Processing Environmental and Section 4(f) Documents. Technical Advisory T6640.8A.

Hamel, PB

1992 Land Manager's Guide to the Birds of the South. The Nature Conservancy, Southeastern Region, Chapel Hill, NC. 437 pp.

Kral, RA

1983 A Report on Some Rare, Threatened, or Endangered Forest-related Vascular Plants of the South. Technical Publication R8-TP 2. U.S. Department of Agriculture, Forest Service, Southern Region, Atlanta, GA. 1305 pp.

Lee, DS, JF Funderburg, Jr., and MK Clark
1982 A Distributional Survey of North Carolina Mammals. Occasional Papers of the North Carolina Biological Survey 1982-10.

LeGrand, HE Jr. and SP Hall
1999 Natural Heritage Program List of the Rare Animal Species of North Carolina. North Carolina Natural Heritage Program, Divisions of Parks and Recreation; Department of Environment, Health, and Natural Resources; Raleigh. 82 pp.

Martof, BS, W.M. Palmer, JR Bailey, and JR Harrison III
1980 Amphibians and Reptiles of the Carolinas and Virginia. The University of North Carolina Press, Chapel Hill NC. 264 pp.

Menhinick, EF
1991 The Freshwater Fishes of North Carolina. North Carolina Wildlife Resources Commission, Raleigh. 227 pp.

National Geographic
1999 Field Guide to the Birds of North America, Third Edition. National Geographic Society, Washington, D.C. 480 pp.

North Carolina Geological Survey (NCGS)
1985 Geologic Map of North Carolina. Division of Land Resources, Department of Natural Resources and Community Development.

North Carolina Department of Environment, Health and Natural Resources (NCDEHNR) – Division of Environmental Management
1995 1990 Ambient Air Quality Report. September. Prepared by the Air Quality Section.
1999 Guidelines for Evaluating the Air Quality Impacts of Transportation Facilities. Prepared by the Air Quality Section.

North Carolina Department of Transportation
2001 NCDOT Traffic Count Maps
2002, 2003 2025 ADT Volumes, NCDOT Transportation Planning Branch
2004 Noise Abatement Policy. September.
2006-2012 Transportation Improvement Program
2001 Guidance for Assessing Indirect and Cumulative Impacts of Transportation Projects in North Carolina. Volume I: Guidance Policy Report, Prepared by The Louis Berger Group, Inc.
2001 Guidance for Assessing Indirect and Cumulative Impacts of Transportation Projects in North Carolina. Volume II: Practioner's Handbook, Prepared by The Louis Berger Group, Inc.

Palmer, WM and AL Braswell
1995 Reptiles of North Carolina. The University of North Carolina Press, Chapel Hill, NC. 412 pp.

Piedmont Authority for Regional Transportation (PART)
2002 Triad Major Investment Study Preliminary Draft Report. November.

Piedmont Natural Gas Company,
2002 North Carolina Atlas – Winston Salem District, revised September 2002.

Potter, EF, JF Parnell, and RP Teulings
1980 Birds of the Carolinas. The University of North Carolina Press, Chapel Hill, NC. 408 pp.

Radford, AE, HE Ahles, and CR Bell
1968 Manual of the Vascular Flora of the Carolinas. The University of North Carolina Press, Chapel Hill, NC. 1183 pp.

Rohde, FC, RG Arndt, DG Lindquist, and JF Parnell
1994 Freshwater Fishes of the Carolinas, Virginia, Maryland, and Delaware. The University of North Carolina Press, Chapel Hill, NC. 222 pp.

Rosgen, D
1996 Applied River Geomorphology. Printed Media Companies, Minneapolis Minnesota.

Schafale, MP and AS Weakley
1990 Classification of the Natural Communities of North Carolina: Third Approximation. North Carolina Natural Heritage Program, Division of Parks and Recreation; N.C. Dept. of Environment, Health, and Natural Resources; Raleigh NC. 325 pp.

Transportation Research Board
2000 Highway Capacity Manual. Special Report.

US Army Corp of Engineers (USACE)
1987 Corps of Engineers Wetlands Delineation Manual

US Department of Agriculture (USDA)
1976 Soil Survey of Forsyth County, North Carolina. USDA Soil Conservation Service. 159 pp + maps.

1991 Hydric Soils of the United States. In Cooperation with the National Technical Committee for Hydric Soils, USDA Soil Conservation Service.

US Environmental Protection Agency
1992 User's Guide to CAL3QHC Version 2.0: A Modeling Methodology for Predicting Pollutant Concentrations Near Roadway Intersections. EPA Report Number EPA-454/R-92-006.

US Fish and Wildlife Service (USFWS)
1987 Habitat Management Guidelines for the Bald Eagle in the Southeast Region. U.S. Department of the Interior. 8 pp.
2000 Endangered, Threatened, and Candidate Species and Federal Species of Concern by County, in North Carolina. June 16, 2000 Update. 51 pp.
2000 Endangered, Threatened, and Candidate Species and Federal Species of Concern by County, in North Carolina. February 26, 2001 Update. 51 pp.

Weakley, AS
1993 Guide to the Flora of the Carolinas and Virginia. Working Draft of November 1993. North Carolina Natural Heritage Program, Division of Parks and Recreation, Department of Environment, Health, and Natural Resources. 575 pp.

Webster, WD, JF Parnell, and WC Biggs, Jr.
1985 Mammals of the Carolinas, Virginia, and Maryland. The University of North Carolina Press, Chapel Hill, NC. 255 pp.

Winston-Salem, City of
2002 US 52 Corridor Study. Prepared by RS&H.
2003 US 52 Land Use and Transportation Plan. Prepared by RS&H.

Winston-Salem/Forsyth County City-County
1988 (Adopted) Vision 2005 (Comprehensive Plan)
1987 Winston-Salem/Forsyth County Thoroughfare Plan
1999 Winston-Salem/Forsyth County 2025 Multi-Modal Long Range Transportation Plan
2000; 2001 (Adopted) Legacy Comprehensive Plan/Growth Management Plan
2002 Greenway Plan Winston-Salem/Forsyth County 2015
2002 Thoroughfare Plan
2005 Thoroughfare Plan
2005 Winston-Salem/Forsyth County 2030 Multi-Modal Long Range Transportation Plan

Winston-Salem/Forsyth County City-County Utilities Division
2003 2002-2003 Wastewater Report.
2003 2003 Water Quality Report

Internet Sites

2005 Thoroughfare Plan	www.ci.winston-salem.nc.us/Home/Departments/Transportation/Planning/Articles/ThoroughfarePlan
City of Winston-Salem	www.cityofws.org
City of Winston-Salem's *US 52 Corridor Study*	www.us52study.com
Environmental Protection Agency	www.epa.gov
FHWA, *A Methodology for Evaluating Mobile Source Air Toxic Emissions Among Transportation Project Alternatives*	www.fhwa.dot.gov/environment/airtoxic/msatcompare/msatemissions.htm
Forsyth County Environmental Affairs Department	www.co.forsyth.nc.us/EnvAffairs/
GeoData Explorer	http://www.co.forsyth.nc.us/tax/geodata.aspx
Legacy Comprehensive Plan	http://www.cityofws.org/Home/

	Departments/Planning/Publications/Articles/Publications
Parks and Open Space Plan (Draft, February 2006)	http://www.co.forsyth.nc.us/Documents/ParksPlanDraft2006.pdf
Piedmont Authority for Regional Transportation	www.partnc.org
Piedmont Triad Council of Governments	www.ptcog.org/ files/eacstrategies.pdf
Piedmont Triad International Airport	www.flyfrompti.com
NC Department of Commerce	cmedis.commerce.state.nc.us
NC State Data Center – State Demographics	demog.state.nc.us
National Park Service	www.nps.gov
North Carolina Natural Heritage Program	www.ncsparks.net/nhp/quad.html
NC Division of Water Quality 303(d) List	http://h2o.enr.state.nc.us/tmdl/General_303d.htm
NC Department of Environment and Natural Resources, Division of Air Quality	www.daq.state.nc.us/permits/mets/alerts.shtml
Salem Lake Watershed Protection Ordinance	www.cityofws.org/Home/Departments/Planning/zoningandsubdivision/Articles/UDO
State Climate Office of North Carolina	www.nc-climate.ncsu.edu/
US Census Bureau	www.census.gov
US Census Transportation Planning Package	http://transportation.org/ctpp/home/nc
Winston-Salem Chamber of Commerce	http://www.winstonsalem.com/winstonsalem/www.nsf
Winston-Salem Transit Authority	http://www.cityofws.org/DOT/wsta.html
Winston-Salem/Forsyth County *2015 Parks and Open Space Plan* (Draft)	www.co.forsyth.nc.us/Documents/ParksPlanDraft2006.pdf
Winston-Salem/Forsyth County Planning Board Bicycle Plan	www.cityofws.org/Home/Departments/Transportation/Biking/Articles/BikePlan
Winston-Salem/Forsyth County Greenway Plan	www.cityofws.org/Assets/CityOfWS//Documents/Planning/Publications/GreenwayPlan.pdf

CHAPTER 9

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CHAPTER 10

Chapter 10 GLOSSARY

abatement	to lessen negative impacts on noise levels, air quality, etc.
access-controlled	allowing intersections (with driveways or other roadways) only at certain locations. Full control of access is one type of access control and means that access to and from the roadway is provided only at interchanges, with no access to adjacent land. Partial control means that intersections with roadways and/or driveways may be allowed at certain locations.
adverse impact	negative effect
alignment	a possible road location within a corridor
arterial	major road that is primarily intended to serve through traffic, although it may provide some access to adjacent land and therefore also serve local traffic.
circuitous	curvy, indirect
circumferential	bypassing, encircling
confluence	point where two or more streams meet
corridor	a general location within which a road might be located; a corridor usually defines the limits of environmental study; in this case is about 1,200 feet wide for a 300-foot right of way
displacement	process by which a business or residence is relocated because its existing location is needed for a transportation project
effluent	discharge, normally from water/sewage treatment plants
expressway	high-speed, multi-lane road with access partially or fully controlled
floodplain	area that floods an average once during a 100-year period
freeway	multi-lane road designed for through movement with access limited to interchanges (fully-controlled access)
level-of-service	Six levels-of-service are defined for each type of facility for which analysis procedures are available. They are given letter designations, from A to F, with level-of-service A representing the best operating conditions and level-of-service F the worst. In general, the various levels-of-service are defined as follows for uninterrupted flow facilities:

Level-of-service A represents free flow. Individual users are virtually unaffected by the presence of others in the traffic stream. Freedom to select desired speeds and to maneuver within the traffic stream is extremely high. The general level of comfort and convenience provided to the motorist, passenger, or pedestrian is excellent.

Level-of-service B is in the range of stable flow, but the presence of other users in the traffic stream begins to be noticeable. Freedom to select desired speeds is relatively unaffected, but there is a slight decline in the freedom to maneuver within the traffic stream from LOS A. The level of comfort and convenience provided is somewhat less than at LOS A, because the presence of others in the traffic stream begins to affect individual behavior.

Level-of-service C is in the range of stable flow, but marks the beginning of the range of flow in which the operation of individual users becomes significantly affected by interactions with others in the traffic stream. The selection of speed is now affected by the presence of others, and maneuvering within the traffic stream requires substantial vigilance on the part of the user. The general level of comfort and convenience declines noticeably at this level.

Level-of-service D represents high-density, but stable, flow. Speed and freedom to maneuver are severely restricted, and the driver or pedestrian experiences a generally poor level of comfort and convenience. Small increases in traffic flow will generally cause operational problems at this level.

Level-of-service E represents operating conditions at or near the capacity level. All speeds are reduced to a low, but relatively uniform value. Freedom to maneuver within the traffic stream is extremely difficult, and it is generally accomplished by forcing a vehicle or pedestrian to "give way" to accommodate such maneuvers. Comfort and convenience levels are extremely poor, and driver or pedestrian frustration is generally high. Operations at this level are usually unstable, because small increases in flow or minor perturbations within the traffic stream will cause breakdowns.

Level-of-service F is used to define forced or breakdown flow. This condition exists wherever the amount of traffic approaching a point exceeds the amount which can traverse the point. Queues form behind such locations. Operations within the queue are characterized by stop-and-go waves, and they are extremely unstable. Vehicles may progress at reasonable speeds for several hundred feet or more, then be required to stop in a cyclic fashion. Level-of-service F is used to describe the operating conditions

	within the queue, as well as the point of the breakdown. It should be noted, however, that in many cases operating conditions of vehicles or pedestrians discharged from the queue may be quite good. Nevertheless, it is the point at which arrival flow exceeds discharge flow which causes the queue to form, and level-of-service F is an appropriate designation for such points.
mainline volume	volume of through traffic on a main road
master plan	general long-range plan for growth in a certain area, developed by local government entities and covering land use, transportation needs, and other elements
merge	to combine two traffic lanes into one
mitigation	measures taken to compensate for negative effects of construction and constructed facilities
multi-modal	combination of transportation types such as air, rail, bus, auto, etc.
overlay	a new layer of pavement
plat	registration with authorities of a parcel of land designated for development
radial	direct route to and from a central location
ridgeline	highest point between two watersheds where runoff water could head either direction
runoff	rainwater that is not absorbed into the ground and runs across the ground surface, carrying particles with it
Section 4(f)	a section of a Federal law (USDOT Act of 1966) requiring that land may be taken from public parks, recreation areas, refuges, or historic sites only if it can be shown that there is no feasible and prudent alternative to using that land; such lands are sometimes referred to as "4(f) lands"
siltation	process by which sediment from erosion is deposited and accumulates in a water body (such as a lake), reducing the volume of water that can be stored
terminus (termini)	end point(s)
thoroughfare plan	a comprehensive system of existing and needed roads designed to collectively meet the current and long-range future travel demands of an area in a safe and efficient manner

transportation system management (TSM)	system of low-cost techniques to maximize the capacity of existing transportation facilities (such as adding turn lanes, designating existing lanes as high occupancy vehicle lanes, improvements to signals, etc.)
watershed	the entire area of land that drains runoff into a tributary or stream
weaving	crossing of two or more traffic streams traveling in the same general direction
wetlands	areas saturated with ground or surface water often enough and long enough to maintain certain vegetation which is adapted to saturated soil conditions (such as swamp, marsh, or bog)