



# FEASIBILITY STUDY



## I-85 / US 321 Interchange Geometric Safety Improvements

Gastonia, Gaston County  
Division 12

FS-0212C

(I-5000)



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# **I-85 / US 321 Interchange Geometric Safety Improvements**

**Gastonia, Gaston County  
Division 12  
FS-0212C**

## **I. General Description**

This study addresses geometric safety improvements to the I-85 / US 321 interchange in Gastonia. Elements of concern are interchange capacity, geometry and safety. The existing interchange is a half-diamond with ramps and loops in the western quadrants. Existing features within the immediate vicinity of the interchange include a Norfolk Southern railroad parallel to US 321, Sims Legion Park, a Marietta Street grade separation over I-85, closely spaced intersections and urban development along US 321 and two Long Creek Tributary crossings. The **Project Location Map** shows the existing interchange location and its immediate vicinity.

This study is the initial step in the planning and design process for this project and is not the product of exhaustive environmental or design investigations. The purpose of this study is to describe the proposed project, including costs, and to identify possible impacts which may warrant more detailed study in the planning and design phases.

## **II. Need for Project**

The Gaston Urban Area Thoroughfare Plan classifies US 321 (N. Chester Street) as a Major Thoroughfare. The North Carolina Functional Classification of US 321 is a Principal Arterial (other than an Interstate). US 321 is the only major north-south route in Gaston County. Interstate 85 is the only major freeway traveling east-west through the county. This interchange being studied is the connection of these two routes and has significant regional importance. Local officials are very supportive of interchange improvements that will promote better safety and mobility in the area.

Several conditions of the existing interchange are undesirable. The weaving section between the interchange loops on US 321 is insufficient in length at only 500 feet. According to the American Association of State Highway and Transportation Officials' (AASHTO) 2004 Policy on Geometric Design of Highways and Streets (Exhibit 10-68 p.844) a more desirable and much safer length would be 1,000 feet. The traffic signal at the northern ramp terminal is over capacity. The base year 2005 traffic volumes result in a level of service (LOS) F. The traffic signal at the US 321 / Rankin Lake Road intersection, just to the north of the ramp terminals, is soon to be over capacity. Based on the traffic projections used in this study, this signal will be operating at an unacceptable LOS by the year 2010. There are also a large number of trucks using this interchange; approximately 20% of the traffic on I-85 and 7% of the traffic on US 321 are trucks. Growing traffic volumes, including the high

percentage of truck traffic, contribute to the general delay and congestion in peak hours. The most noticeable unsatisfactory condition is that traffic backs up onto southbound I-85 from the northern loop in peak hours. According to the local NCDOT division staff traffic typically backs up onto I-85 as much as a half mile prior to the loop ramp exit. Please see **Section V. Traffic Operations** of this report for a comprehensive analysis of traffic operations.

The interchange configuration and any proposed improvements are restricted by the location of the Norfolk Southern railway along the eastern side of US 321. Long range goals of the Gaston Urban Area Metropolitan Planning Organization (GUAMPO) include abandoning the railroad section adjacent to US 321 and converting it into a greenway trail or preserving it for passenger rail. Although there is a plan to abandon a section of railway north of this study area, there is no certain abandonment planned for the rail segment through the I-85 / US 321 interchange. This rail line is currently active with one train a day.

The study area is within the Gastonia City limits and is primarily urban in nature. There are hotels, restaurants, gas stations, and other commercial and industrial businesses located on the western side of US 321. There are a few small businesses located along the eastern side through the project area. There are residential neighborhoods just beyond the immediate vicinity of the interchange to the south and the west. The Highland School of Technology (a magnet high school) and Woodhill Elementary School are located within the vicinity of the project. Sims Legion Park is located adjacent to the railroad in the southeast quadrant of the interchange. This study identifies probable impacts to properties within the proposed footprint. More detailed impacts will be identified and evaluated in later planning and design stages.

The population of Gaston County has increased from approximately 180,000 to 192,000, a 7 percent increase, between 1994 and 2004. In addition to textiles, some of the major industries in Gastonia and Gaston County include truck manufacturing, automotive components, oil and air filters, power tools, Christmas ornaments and mining industries. Manufacturing in order of local employment are retail, service, government, construction and wholesale. Recent economic indicators from the Gaston County Economic Development Commission (EDC) point toward small growth through lower unemployment and increases in construction and retail sales.

### **III. Adjacent Projects**

There are a few NCDOT projects proposed near this study area; T.I.P. Projects B-4344, U-3321, R-2608 and a Moving Ahead project (on the northern I-85 / US 321 ramp terminal and along US 321). Please refer to **Figure 4** which shows the locations of the adjacent T.I.P. projects and their relationship to the Strategic Highway Corridors Metrolina Vision Plan.

T.I.P. project B-4344 proposes replacing Bridge No. 167 on Tulip Drive over Kaglor Branch. This bridge replacement project is scheduled for right-of-way and construction in 2006 and does not directly affect the interchange study.

The second T.I.P. project is U-3321, the Gaston and Mecklenburg Counties East-West Connector. This project recommends a multi-lane highway on new location from I-85 west of Gastonia in Gaston County to NC 160 in Mecklenburg County. This project is listed as a Strategic Highway Corridor as adopted by the North Carolina Board of Transportation. The North Carolina Turnpike Authority selected U-3321 in February of 2005 to be programmed for planning and environmental studies. The U-3321 and the R-2608 projects together make up the new roadway known locally as the Garden Parkway. The R-2608 project recommends a four-lane divided freeway on new location from I-85 west of Gastonia to US 321 north of Gastonia. The R-2608 project is also listed as a Strategic Highway Corridor but is unfunded at this time. Although these projects are near the I-85/US 321 interchange and may provide an alternative routing for US 321, the FS-0212C traffic projections based on the Gastonia Model are not greatly affected by the presence of the Garden Parkway.

Approximately 5 years ago the interchange ramp for the I-85 southbound to US 321 northbound movement was widened to provide dual left turn lanes. Last year in 2004, a "Moving Ahead" project was developed to widen the ramp to allow triple left turns. The project would also convert the Rankin Lake Road intersection with US 321 to a signalized directional crossover. The Regional Traffic Engineer has said that the Moving Ahead project is not a permanent solution but a good project for interim improvements. However, due to budget issues, this "Moving Ahead" project is on hold. The following studied alternatives propose improvements for more long-term solutions.

#### **IV. Studied Alternatives**

In the early stages of this study several interchange concepts were investigated. Because of the existing constraints of this particular location and prior to choosing feasible alternatives to study, input was collected from the NCDOT Roadway and Congestion Management Units and from Gaston MPO representatives. Traffic projections show a significant amount of traffic with high truck percentages traveling through the interchange; especially those traveling to Charlotte from Lincolnton and vice versa. With the railroad proximity and the heavy turning movements, there are limited ways that improvements can be made. However, the traffic distribution within the interchange helped develop the configuration of the studied alternatives. Refer to the traffic diagram on **Figures 1 and 2**. In addition, the railroad is located approximately 10 to 15 feet lower in elevation than US 321 in this area, allowing for the possibility of a grade separation. The topography also lends itself well toward construction of a flyover in the western quadrants. These factors led to the concept of adding directional ramps to accommodate the heaviest movements and allowing certain movements of the existing interchange to remain. With the proximity of the railroad to US 321, retaining walls and structures are needed to accomplish the directional ramp connections.

This Feasibility Study evaluates two alternatives, Alternatives 1 and 2, each of which provide directional ramps in the eastern quadrants over the existing railroad. Alternative 2 provides a flyover from southbound US 321 to northbound I-85 in addition to the directional ramps. Both alternatives propose improvements to US 321 to promote safety and mobility. Alternative 1 represents what could be considered the first phase of Alternative 2, with Alternative 2 being the ultimate long-term

improvement. Refer to **Figures 1 and 2** for maps of the studied alternatives and **Figure 3** for proposed typical sections. The following section describes each studied alternative and their proposed improvements in greater detail.

### Alternative 1

As mentioned previously, Alternative 1 provides directional ramps in the eastern quadrants of the interchange over the existing railroad. In the northeastern quadrant a two-lane directional ramp (Ramp A) provides a direct connection from I-85 southbound to US 321 northbound. An extension of an existing box culvert under I-85, a new structure over the railroad and retaining walls between the railroad and US 321 are needed to accomplish this ramp addition. This improvement removes the movement from Loop B and from the northern loop terminal traffic signal. This improvement does not, however, eliminate the need for the traffic signal, but it greatly improves traffic operations and safety. A standard length of deceleration lanes will be needed on I-85 for Ramp A. Ramp A was aligned between towers of the major overhead power lines in order to minimize utility impacts. The additional lanes on I-85 will require a longer bridge at the Marietta Street grade separation. Ramp A will also tie into the existing auxiliary lane on US 321 northbound which extends from Rankin Lake Road to just south of Long Creek.

In the southeastern quadrant a directional ramp (Ramp D) provides a direct connection from US 321 northbound to I-85 northbound. Retaining walls, a new structure over the railroad and a new box culvert are needed to accomplish this ramp addition. This removes the movement from Loop C and from the southern ramp terminal traffic signal. This improvement does not eliminate the need for the traffic signal, but it greatly improves traffic operations and safety. A standard length of acceleration lane is needed on I-85 for Ramp D. Ramp D was aligned between towers of the major overhead power lines in order to minimize utility impacts. The additional lane on I-85 will require a longer bridge at the Marietta Street grade separation. The Ramp A and Ramp D improvements will require the replacement of the Marietta Street bridge over I-85.

Ramp B and Ramp C will remain in place, unaltered by the proposed improvements of Alternative 1. Alternative 1 improvements eliminate the short weaving section between Loops B and C on US 321 in order to improve traffic safety and operation. The free-flowing right turn from Loop B onto US 321 will be moved under control of the Ramp B terminal traffic signal. If Alternative 1 is utilized as the first phase of Alternative 2 this change is unnecessary since traffic will be removed from Loop C under Alternative 2 improvements.

As described above, the installation of the directional ramps will improve the interchange operations. However, there are several other recommended measures that should be taken in conjunction with the addition of directional ramps to improve safety and operations on US 321. Control of access is needed at ramp junctions. Therefore, access restriction and proper junction spacing are needed along US 321 from south of Caldwell Street northward to the Tulip Drive/Bulb Avenue traffic signal. Sycamore Avenue should be extended from Caldwell Street to US 321 south of Ramp D and Caldwell Street cut off from US 321. Rankin Lake Road should be cut off from the east.

The potential for accidents at the at-grade railroad crossing on Rankin Lake Road will be greatly reduced as a result. The access to US 321 from the west along Rankin Lake Road will be restricted to right-in, right-out movements. The traffic signal at US 321 and Rankin Lake Road is then unnecessary and should be removed. As a result, additional enhancements to Tulip Drive and Bulb Avenue are needed in conjunction with the interchange improvements to provide sufficient access along US 321. Extending Bulb Avenue eastward on new location to Marietta Street will provide adequate access from Rankin Lake Road east of US 321. Traffic formerly accessing US 321 via Rankin Lake Road will have access via Tulip Drive and the Bulb Ave extension. The Tulip Drive and Bulb Avenue approaches to US 321 require improvements in order to accommodate the increases in traffic from projected growth and from traffic shifted north from Rankin Lake Road. An exclusive left-turn lane is needed on the Bulb Ave approach to US 321. Dual left-turn lanes on US 321 northbound and dual right-turn lanes on Tulip Drive eastbound are needed to accommodate increased traffic volumes. Tulip Drive requires widening to a 5-lane section from US 321 to Rankin Lake Road. Although shifting traffic north increases the traffic at the Tulip Drive/Bulb Avenue traffic signal and requires improvements along the approaches, it improves signal spacing and the overall safety and operations along US 321. A third southbound lane from Long Creek to the Ramp B entrance is the final measure that improves the traffic operations and safety of US 321.

Alternative 1 proposes constructing directional ramps in the eastern quadrants and access management improvements along US 321. Design criteria for the proposed improvements meet NCDOT standards. The ramps are full controlled access roadways. The proposed right-of-way varies along US 321 and is approximately 125' outside of ramps. Please refer to **Figure 3** for I-85, US 321 and ramp typical sections.

It is anticipated that **Alternative 1** will require the relocation of 1 residence and 9 businesses. The total cost, including construction and right-of-way, is estimated to be \$ 17,900,000.

Construction.....	\$ 15,100,000
<u>Right-of-way &amp; Utilities.....</u>	<u>\$ 2,800,000</u>
Total Cost.....	\$ 17,900,000

### Alternative 2

Alternative 2 includes almost all of the proposed improvements described in Alternative 1. The major difference between Alternative 1 and Alternative 2 is that Alternative 2 proposes the addition of a two-lane flyover ramp connection from US 321 southbound to I-85 northbound. Alternative 2 also proposes that Rankin Lake Road access to US 321 be cut off from the west as well as the east. Broadcast Street will also be removed with the flyover in place. Although Alternative 2 will result in significant impacts to existing commercial properties, the skew of the highways and the topography ideally lend themselves toward the construction of the proposed flyover. With Rankin Lake Road cut off from US 321, it will have remaining access to US 321 via Tulip Drive and the Bulb Avenue extension. Improvements to the Tulip Drive and Bulb Avenue approaches to US 321, as described in Alternative 1, are needed in order to accommodate the traffic shifted north from Rankin Lake Road.

Although this change increases the traffic at the Tulip Drive/Bulb Avenue traffic signal, it improves signal spacing and the overall safety and operations along US 321. The addition of a third southbound lane to US 321 from south of Long Creek to the flyover also improves traffic operations. The proposed flyover includes two structures; one spanning Ramp B, I-85 and Ramp C. The other structure is proposed over US 321 and the Norfolk Southern Railway. Ramp D merges with the flyover prior to entering onto I-85. In this area, the ramps were aligned between towers of the major overhead power lines in order to minimize utility impacts. A standard length of acceleration lanes is needed on I-85 for the flyover. The additional lanes for the Ramp A, Ramp D and flyover improvements will require the replacement of the Marietta Street bridge over I-85.

The Alternative 2 flyover eliminates the need for Loop C and removes the short weaving section from the interchange. This improves the overall operations of the interchange and the remaining free-flow Loop B movement. Ramp B and Ramp C will remain in place, unchanged by the proposed improvements.

Alternative 2 proposes constructing a flyover from US 321 southbound to I-85 northbound; directional ramps in the eastern quadrants; and access management improvements along US 321. Design criteria for the proposed improvements meet NCDOT standards. All ramps are full controlled access connections. The proposed right-of-way varies along US 321 and is approximately 125' outside of ramps. Please refer to **Figure 3** for I-85, US 321 and ramp typical sections.

It is anticipated that **Alternative 2** improvements will require the relocation of 1 residence and 13 businesses. The total cost, including construction and right-of-way, is estimated to be \$ 28,400,000.

Construction.....	\$ 23,700,000
<u>Right-of-way &amp; Utilities.....</u>	<u>\$ 4,700,000</u>
Total Cost.....	\$ 28,400,000

## V. Traffic Operations

Projected traffic volumes used in this study are based on the existing Gastonia Travel Forecast Model. Truck percentages in the forecast are based on turning movement counts from February 2003. The Metrolina Regional Model was not included in this forecast since it will not be available until after this study is completed.

The base year (BY) forecast for the Annual Average Daily Traffic (AADT) is year 2005 and the estimated design year (DY) forecast is for year 2030. The BY AADT on I-85 ranges from 75,100 to 93,100 vehicles per day (vpd). The estimated DY AADT projections for I-85 range from 77,000 to 97,200 vpd. The percentage of truck traffic on I-85 is 20% (5% Duals and 15% TTST's) for both BY and DY traffic. The BY AADT on US 321 ranges from 19,900 to 46,600 vpd. The estimated DY ADT projections for US 321 range from 25,800 to 56,200 vpd. The percentage of truck traffic on US 321 is 7% (4% Duals and 3% TTST's) for both BY and DY traffic. The heaviest volumes of traffic at this interchange occur in the northeastern quadrant of the interchange.

Traffic operation analysis is based on the Highway Capacity Manual (HCM) and on NCDOT Analysis Guidelines. Based on this, the signalized intersections on US 321 are closely spaced and should be analyzed as a coordinated system. Synchro software was used to analyze the coordinated signal system. HCS software was used to analyze all other components of traffic operations. The LOSs shown below reflect results of both BY and estimated DY traffic analyses. These analyses are preliminary and should be examined in greater detail in the subsequent stages of this project.

Based on analyses utilizing HCS software, for both the Build and No Build alternative conditions described below, US 321 within this project area will operate at a LOS D or better and Interstate 85 within this project area will operate at a LOS E or better. The following table shows these levels of service:

Table 1 – BUILD and NO BUILD Highway Segments				
Facility Type	Highway	From/To	Base Year 2005	Design Year 2030
Multi-lane	US 321	I-85/Lincolnton	C	D
Multi-lane	US 321	I-85/Gastonia	B	C
Freeway	I-85	US 321/Charlotte	E	E
Freeway	I-85	US 321/Spartanburg	D	D

**Existing Conditions**

There are four closely spaced existing traffic signals on US 321 in the proximity of the I-85 interchange; at the Ramp C Terminal, the Ramp B Terminal, Rankin Lake Road and at the Tulip Drive/Bulb Avenue intersections. Based on the Synchro analysis performed as a part of this study, both the Ramp B/Loop B and the Rankin Lake Road existing signalized intersections will operate at a LOS F by 2030. NCDOT Guidelines desire a LOS C for the design year for this type facility, with LOS D as the lowest passing level of service. The following table shows the results of the analyses of the existing intersections along US 321:

Table 2 – NO BUILD – Signalized Intersection LOS and Delay				
US 321 Intersection	Base Year 2005		Design Year 2030	
	AM LOS (delay)	PM LOS (delay)	AM LOS (delay)	PM LOS (delay)
Tulip Dr./Bulb Ave.	*	*	*	*
Rankin Lake Road	F (133.0 sec.)	E (73.3 sec.)	F (184.6 sec.)	F (186.2 sec.)
Ramp B/Loop B	F (150.8 sec.)	F (103.5 sec.)	F (163.7 sec.)	F (123.5 sec.)
Ramp C/Loop C	C (31.2 sec.)	B (17.1 sec.)	D (38.3 sec.)	B (17.2 sec.)

\* Traffic data was not available at the time of this study to analyze the existing signalized intersection at Tulip Drive/Bulb Avenue.

Components of the existing interchange have failing levels of service. Loop C is currently operating over capacity and has a short weaving section with Loop B. The BY traffic volumes show approximately 1500 cars traveling on Loop C in the AM peak hour. Loop capacity is approximately 1200 vehicles per hour according to AASHTO. In addition, a weave analysis reveals that the 500' section between Loops B and C operates at a LOS F in both BY and DY.

**Alternative 1**

Traffic operations will improve significantly over the existing conditions with the addition of directional ramps A and D, as proposed by Alternative 1. **Figure 1** shows an overview of these proposed improvements. The two most significant improvements of Alternative 1 are the removal of the heavy northbound left-turn from Loop B onto US 321 and the removal of the northbound left-turn from US 321 onto Loop C. The addition of the two-lane directional Ramp A replaces the left-turn movement from Loop B and eliminates the unsafe backups onto I-85. The addition of Ramp D replaces a northbound left-turn movement onto Loop C with a right-turn onto Ramp D. The additional ramps also improve operations by decreasing the user delays at the existing ramp terminal traffic signals as seen in **Table 3** below.

<b>Table 3 – ALTERNATIVE 1 – Signalized Intersection LOS and Delay</b>				
<b>US 321 Intersection</b>	<b>Base Year 2005</b>		<b>Design Year 2030</b>	
	<b>AM LOS (delay)</b>	<b>PM LOS (delay)</b>	<b>AM LOS (delay)</b>	<b>PM LOS (delay)</b>
Tulip Dr./Bulb Ave.	*	*	*	*
Rankin Lake Road	n/a	n/a	n/a	n/a
Ramp B/Loop B	B (16.4 sec.)	A (4.1 sec.)	E (60.0 sec.)	A (7.1 sec.)
Ramp C/Loop C	D (48.8 sec.)	B (12.3 sec.)	D (47.0 sec.)	B (13.2 sec.)

\* Traffic data was not available at the time of this study to evaluate the Tulip Drive/Bulb Avenue signalized intersection with US 321. Based on engineering judgment and available information this intersection will have failing operations in the future. Further study of this intersection in the subsequent stages of this project is needed.

Although Alternative 1 improves the traffic operations over the existing condition, there is a deficiency with this alternative. Alternative 1 leaves Loop C operating over capacity. The BY traffic volumes show approximately 1500 cars traveling on Loop C whereas loop capacity is only approximately 1200 vehicles per hour. Alternative 1 would best serve as the first phase for Alternative 2 improvements. Alternative 1 would produce immediate improvements, especially regarding Loop B back-ups onto I-85, until the Alternative 2 flyover could be constructed. If the Alternative 2 flyover is not constructed prior to the 2030 design year, traffic operations on Loop B will continue to degrade to an unacceptable LOS.

## Alternative 2

Traffic operations will show the most improvement with both the ramps and the flyover proposed under Alternative 2. **Figure 2** shows an overview of these proposed improvements. As shown in **Table 4**, the intersection levels of service are the same or better than those of Alternative 1. In addition to improved intersection operation on US 321, the interchange will operate more efficiently and safely with Alternative 2 improvements built. Based on analysis using HCS software, the interchange ramp merges and diverges will operate at a LOS A or better in BY and at a LOS B or better in DY.

<b>Table 4 – ALTERNATIVE 2 – Signalized Intersection LOS and Delay</b>				
<b>US 321 Intersection</b>	<b>Base Year 2005</b>		<b>Design Year 2030</b>	
	<b>AM LOS (delay)</b>	<b>PM LOS (delay)</b>	<b>AM LOS (delay)</b>	<b>PM LOS (delay)</b>
Tulip Dr./Bulb Ave.	*	*	*	*
Rankin Lake Road	n/a	n/a	n/a	n/a
Ramp B/Loop B	A (2.0 sec.)	A (4.6 sec.)	A (3.8 sec.)	A (6.0 sec.)
Ramp C/Loop C	B (16.5 sec.)	B (15.3 sec.)	B (13.8 sec.)	B (18.9 sec.)

\* Traffic data was not available at the time of this study to evaluate the Tulip Drive/Bulb Avenue signalized intersection with US 321. Based on engineering judgment and available information this intersection will have failing operations in the future. Further study of this intersection in the subsequent stages of this project is needed.

## Accident Analysis

This interchange study includes segments of urban US highway 321 and Interstate 85. Neither US 321 nor I-85 have experienced fatalities within the study area over the three-year period from October 1, 2001 through September 30, 2004. US 321 has experienced 363 crashes within the study area over the three-year period for a resultant crash rate of 1,321.86 crashes per 100 MVM (Million Vehicle Miles), almost four times that of the statewide average for urban US highways (346.74 per 100 MVM). More than half (56%) of these accidents were Rear End type accidents. I-85 has experienced 286 crashes within the study area over the three-year period resulting in a 139.69 crash rate per 100 MVM, which is slightly higher (8%) than the statewide average of 125.86 crashes per 100 MVM for interstates. The predominant accident type on I-85 was also Rear End accidents (26.92%). These high rear end crash rates are symptoms of the problems that are occurring at the existing interchange. Improved access management along US 321 and construction of controlled access directional ramps should reduce the potential for rear end accidents at the Interstate 85 and US 321 intersection.

## VI. Project Costs & Recommendations

There are two alternatives proposed for consideration in this study; **Alternative 1** and **Alternative 2**. Both alternatives in this study improve the capacity, geometry and safety of the I-85 / US 321 interchange. They each provide additional directional interchange ramps and access management improvements to US 321. The addition of the two-lane directional Ramp A will eliminate the unsafe backups onto I-85. The additional ramps also improve operations of existing ramp terminal traffic signals. Both will improve the interchange of I-85 and US 321, two regionally significant routes in Gastonia, Gaston County.

However, **Alternative 1** does not provide the best long-term solution to the capacity, geometry and safety issues. **Alternative 1** leaves Loop C operating over capacity. **Alternative 1** would best serve as the first phase of **Alternative 2** improvements. In addition to the improvements of **Alternative 1**, the interchange will operate more efficiently and safely with **Alternative 2** improvements built. There will be additional impacts to commercial properties on Broadcast Street with the construction of the flyover, but the over capacity on Loop C will be removed. The flyover and Ramp A accommodate the heaviest turning movements with free-flowing connections. Therefore, **Alternative 2** is the recommended alternative for the best long-term improvement to the I-85 / US 321 interchange capacity, geometry and safety.

The NCDOT Intelligent Transportation System (ITS) Section has recommended that an additional cost be included in the study to accommodate installation of ITS equipment, namely, two fiber-optic Closed Circuit Television (CCTV) cameras and three overhead Dynamic Message Signs (DMS). This equipment will be used for freeway management, incident management and detour routing on I-85 and US 321. The recommendations are in accordance with the Metrolina Regional ITS Strategic Deployment Plan. The estimated cost for this ITS deployment is \$ 1,400,000.00.

The following table shows the total project costs for each alternative studied in this report.

Table 5 - Project Costs				
Alternative	Construction Cost	Right-of-Way Cost	ITS Cost	Total Cost
<b>Alternative 1</b>	\$ 15,100,000	\$ 2,800,000	\$ 1,400,000	\$ 19,300,000
<b>Alternative 2</b>	\$ 23,700,000	\$ 4,700,000	\$ 1,400,000	\$ 29,800,000

The recommended alternative, Alternative 2, yields a total project cost of **\$ 29,800,000**. If Alternative 1 is utilized as the first construction phase, the approximate remaining cost to complete Alternative 2 would be **\$ 10,500,000** (current dollars).

## VII. Additional Comments

A detailed environmental study was not conducted for this feasibility study. However, an environmental screening did result in the following possible occurrences, which will need further evaluation in subsequent stages of the development of this project:

- Sims Legion Park, owned by the City of Gastonia and operated by the Gastonia Recreation Department will be impacted by this project. Proper Section 4(f) permitting should be acquired for the use of this publicly owned park for a transportation project. If it is determined in latter stages of planning and design that there is no feasible and prudent alternative to impacting the park, then all possible planning to minimize harm to the property should be taken. The proposed improvements of this study should not substantially diminish the use of the park.
- The National Wetland Inventory (NWI) mapping indicates that this project will have no impacts to wetlands.
- The Department of Natural Resources – Natural Heritage Section indicates that there are no occurrences of threatened or endangered species located along the study alternatives.

Other items or comments that should be noted from this study and considered during future planning and design phases of this project:

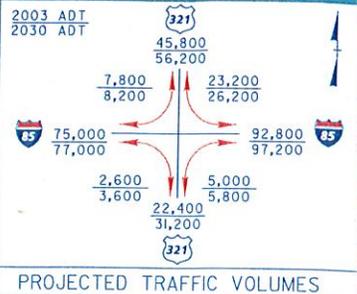
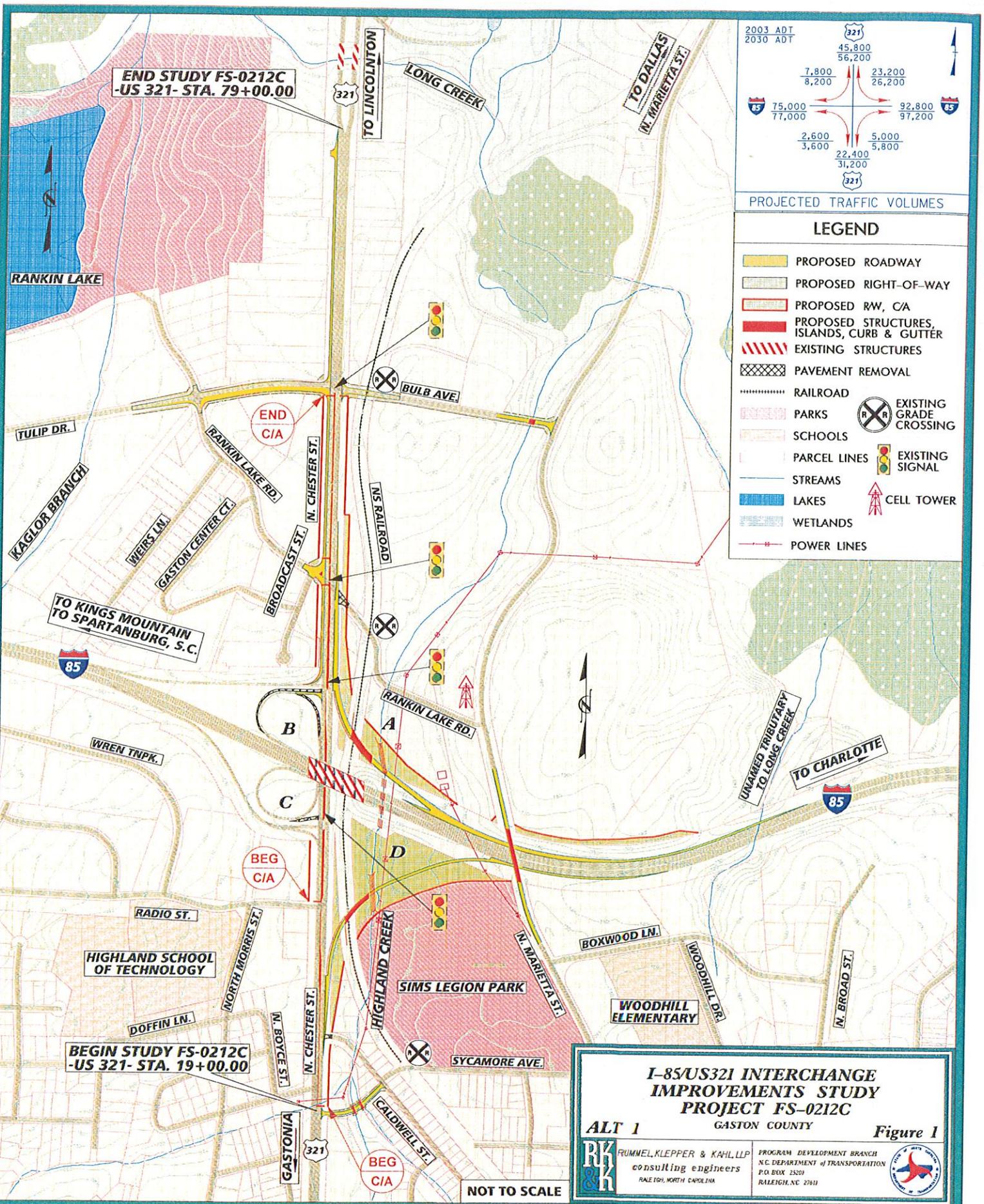
- Local government officials and NCDOT representatives have expressed strong support for safety improvements to this interchange and expediting the process.
- Coordination of the ramp alignments with the major overhead power lines should be examined in greater detail in future phases of this project.



### FS-0212C PROJECT LOCATION MAP

I-85/US 321 Interchange Geometric Safety Improvements  
Gastonia County





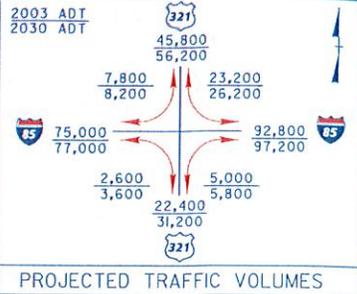
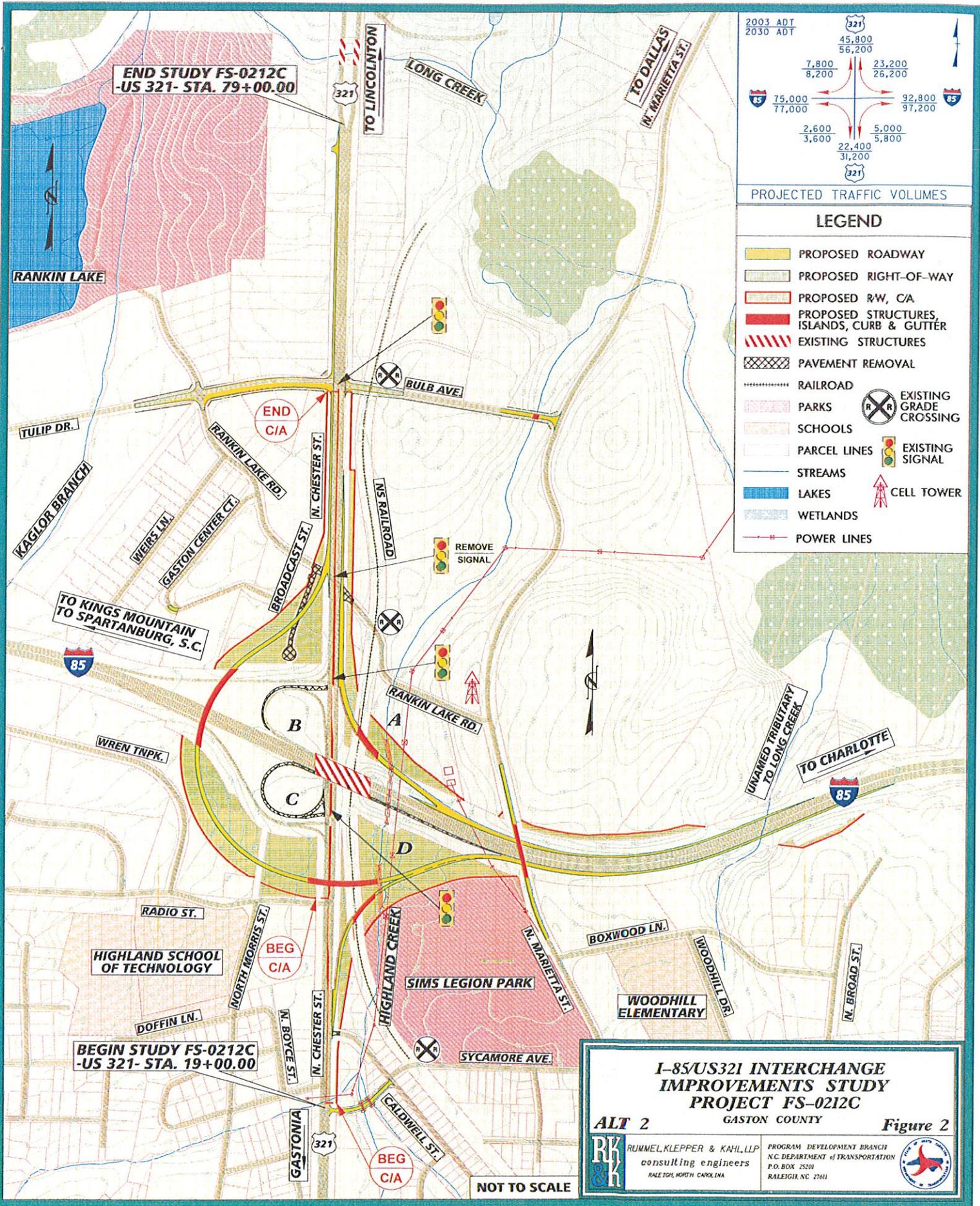
**LEGEND**

	PROPOSED ROADWAY		PAVEMENT REMOVAL
	PROPOSED RIGHT-OF-WAY		RAILROAD
	PROPOSED RW, CA		PARKS
	PROPOSED STRUCTURES, ISLANDS, CURB & GUTTER		EXISTING STRUCTURES
	EXISTING STRUCTURES		EXISTING GRADE CROSSING
	PAVEMENT REMOVAL		EXISTING SIGNAL
	RAILROAD		CELL TOWER
	PARKS		POWER LINES
	SCHOOLS		
	PARCEL LINES		
	STREAMS		
	LAKES		
	WETLANDS		

**I-85/US321 INTERCHANGE IMPROVEMENTS STUDY PROJECT FS-0212C**  
**ALT 1**  
 GASTON COUNTY Figure 1

	RUMMEL, KLEPPER & KAHL, LLP	PROGRAM DEVELOPMENT BRANCH
	consulting engineers	N.C. DEPARTMENT OF TRANSPORTATION
	RALEIGH, NORTH CAROLINA	P.O. BOX 25209
		RALEIGH, NC 27611

NOT TO SCALE



**LEGEND**

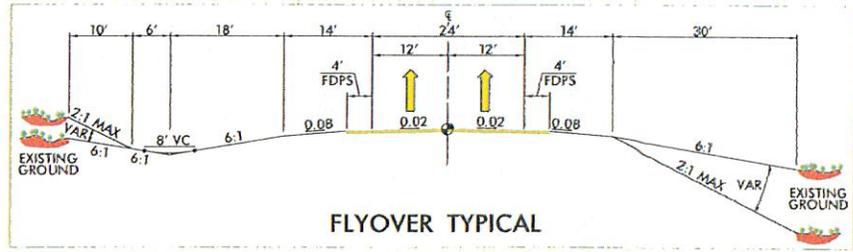
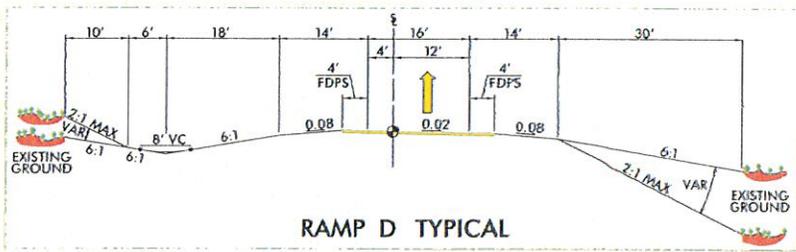
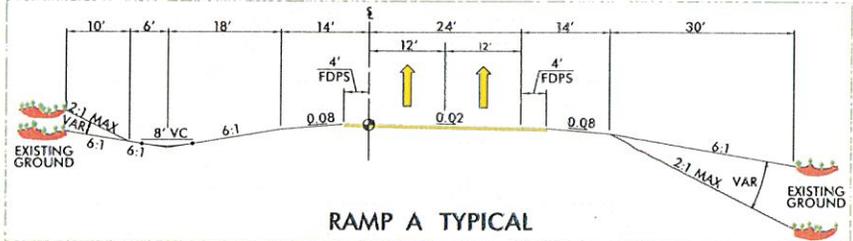
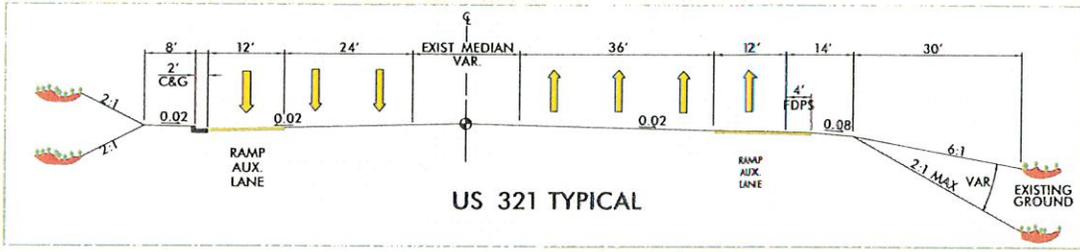
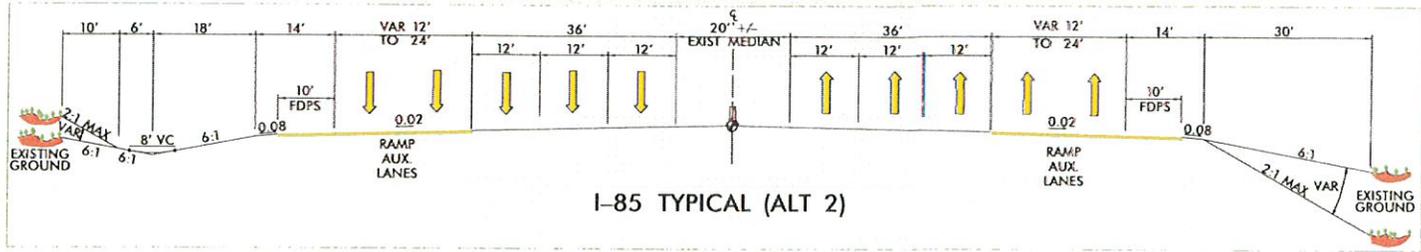
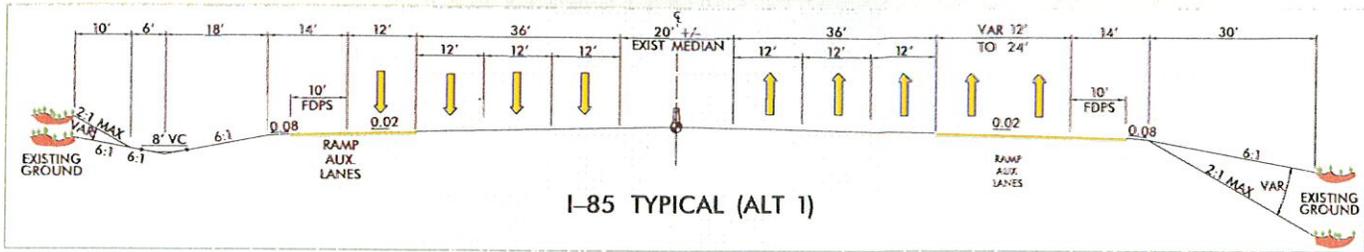
- PROPOSED ROADWAY
- PROPOSED RIGHT-OF-WAY
- PROPOSED R/W, CA
- PROPOSED STRUCTURES, ISLANDS, CURB & GUTTER
- EXISTING STRUCTURES
- PAVEMENT REMOVAL
- RAILROAD
- PARKS
- SCHOOLS
- PARCEL LINES
- STREAMS
- LAKES
- WETLANDS
- POWER LINES
- R  
R EXISTING GRADE CROSSING
- EXISTING SIGNAL
- CELL TOWER

**I-85/US321 INTERCHANGE IMPROVEMENTS STUDY PROJECT FS-0212C GASTON COUNTY**

**ALT 2** Figure 2

 <p>RUMMEL, KLEPPER &amp; KAHL, LLP consulting engineers RALEIGH, NORTH CAROLINA</p>	<p>PROGRAM DEVELOPMENT BRANCH N.C. DEPARTMENT OF TRANSPORTATION P.O. BOX 25201 RALEIGH, NC 27601</p> 
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NOT TO SCALE

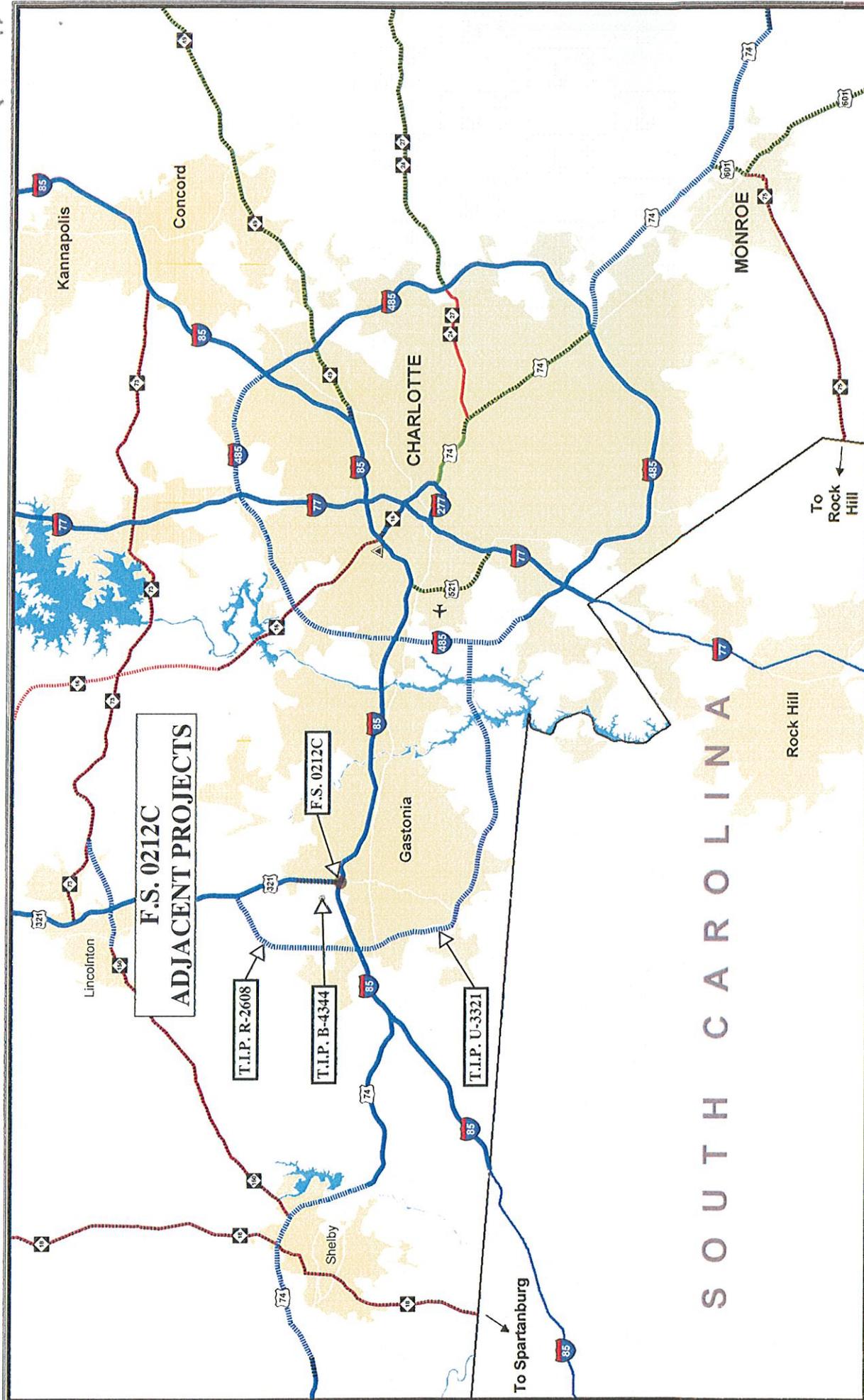


**I-85/US321 INTERCHANGE  
IMPROVEMENTS STUDY  
PROJECT FS-0212C  
GASTON COUNTY**

**Typicals** **Figure 3**

	RUMMELKLEPPER & KAHL, LLP	
	consulting engineers	
	RALEIGH, NORTH CAROLINA	

PROGRAM DEVELOPMENT BRANCH  
N.C. DEPARTMENT OF TRANSPORTATION  
P.O. BOX 25201  
RALEIGH, NC 27601



**F.S. 0212C  
ADJACENT PROJECTS**

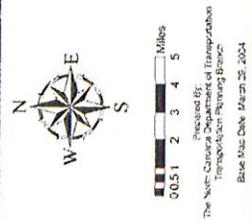
T.I.P. R-2608

T.I.P. B-4344

T.I.P. U-3321



**Vision Plan  
Metrolina Area**  
Adopted by The North Carolina  
Board of Transportation  
Plan Date: September 2, 2004



- Legend**
- |                 |                   |                      |                    |
|-----------------|-------------------|----------------------|--------------------|
| <b>Freeways</b> | <b>Boulevards</b> | <b>Thoroughfares</b> | <b>Expressways</b> |
| Existing        | Existing          | Existing             | Existing           |
| Needs Upgrade   | Needs Upgrade     | Needs Upgrade        | Needs Upgrade      |
| Recommended     | Recommended       | Recommended          | Recommended        |
- 
- |                |            |               |                      |                     |                     |            |                |
|----------------|------------|---------------|----------------------|---------------------|---------------------|------------|----------------|
| US/Other Route | State Port | Major Airport | Intermodal Connector | Coast Guard Station | Major Military Base | Urban Area | Water Features |
|                |            |               |                      |                     |                     |            |                |

**Figure 4**