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SR 400 Corridor Study
Final Report

March 20, 2009

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SR 400 Corridor Study
Final Report

Prepared for:

Georgia Department of Transportation

Prepared by:

ARCADIS

2849 Paces Ferry Road

Suite 400

Atlanta

Georgia 30339

Tel 770.431.8666

Fax 770.435.2666

Our Ref.:

GA063554/Rpt 2355

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Tables

Charts

Figures

Appendices

1. Executive Summary

The purpose of the Georgia State Route (SR) 400 corridor study is to:

- Analyze the existing transportation conditions, operations, and limited-access potential of the corridor
- Assess future transportation needs of the corridor
- Identify and prioritize projects in the study area that address safety and congestion, enhance mobility, and promote economic development

The SR 400 corridor study area extends from SR 306 (Keith Bridge Road) to SR 60 and encompasses portions of Forsyth, Dawson, and Lumpkin counties. Within the study area, SR 400 changes from a limited-access freeway to a controlled-access highway.

The study team relied on observable facts and measurable objectives related to existing and future traffic conditions, safety, land use, environmental conditions, and demographics to assess existing conditions and future travel demands and to develop a strategic implementation plan. Public, stakeholder, and agency involvement was conducted to assist the study team in identifying and incorporating the issues, needs, concerns, and desires of these groups into the study.

Forecasting future transportation needs was a vital part of the study. To identify these needs, economic development, measured in terms of population and employment, was converted into vehicle trips and travel patterns. Population and total employment growth estimates were developed based on recent trends as reported in Georgia Department of Community Affairs' data files. A future year planning horizon of 2030 was used to forecast demographic data and travel patterns. A base year of 2005 was used to benchmark the differences between current and future year 2030 travel patterns. The study findings and recommendations are summarized below.

1.1 Summary of Findings

The population of Dawson County, Forsyth County, and Lumpkin County combined is forecasted to almost triple from 2005 to 2030, increasing from 184,400 persons in 2005 to 534,000 in 2030. The rate of projected change in total employment is even higher. Base year 2005 employment of 47,000 workers is projected to increase to 221,000 by 2030, which is almost five times the number of base year employees.

Forecasted population and employment growth will result in traffic volumes on SR 400 that exceed available capacity. Future year 2030 traffic volumes are expected to more than double on SR 400. The number of total daily trips that end in the study area is expected to increase from 1.7 million to 6.2 million (an increase of 262 percent). In fact, the future year 2030 no-build analysis indicates that most existing side streets along SR 400 will not have the capacity to handle the projected growth in the study area. As a result, the impact on SR 400 could not be modeled or estimated. Based on future year 2030 traffic volumes, operating conditions through the entire corridor will provide a failing level of service (LOS F).

Safety is also a vital concern when assessing the transportation needs of the corridor. The study team analyzed historical crash data to compare SR 400 with similar highway facilities in Georgia. According to the data, SR 400 fares worse with regard to total accident rate, but better in terms of crash severity. The portion of the corridor from Browns Bridge Road/SR 369 to Settingdown Road in Forsyth County was identified by the study team as the most critical section in the corridor in terms of safety, based on the number of fatal accidents, the severity ratio, and the total accident rate.

Another important consideration when assessing the safety and future transportation needs of a corridor is the number of at-grade access points. At-grade intersections and driveways increase the number of potential vehicle conflict points, which reduce mobility, capacity, and safety in any corridor. Of the 119 access points in the SR 400 corridor, 52 percent are driveways, 47 percent are at-grade intersections, and 1 percent is at an interchange. In addition, a cursory aerial review of driveway spacing shows that most driveways on SR 400 are approximately 450 to 475 feet apart, which does not meet Georgia Department of Transportation access management requirements. The final determination of the study team is that the number of driveways and cross streets providing access must be limited to enhance corridor operations and improve safety in the study area.

1.2 Recommendations

The long-range recommendation is to upgrade SR 400 to an eight-lane, limited-access freeway with six general-purpose lanes throughout and two managed lanes south of SR 53. The corridor may include frontage roads and/or local roads as necessary to connect cross streets and provide access to existing developments. The new freeway would extend over the length of the study corridor, from SR 306 (Keith Bridge Road) in Forsyth County through Dawson County to SR 60 in Lumpkin County. Access to and from SR 400 would be provided via grade-separated interchanges at key crossroads.

Additional grade separations would provide for overpasses or underpasses to serve local travel. A corridor concept showing the potential locations of interchanges and cross streets is provided on Figure 19.

The total corridor plan is estimated to cost $1 billion. A preliminary phasing plan, along with recommended strategies for advancing project development activities, building project partners, and seeking project funding, is provided. The key strategies for advancing the project focus on establishing the concept design, purchasing necessary rights-of-way in advance of the project, and protecting access to the corridor.

2. Introduction

2.1 Background

Georgia State Route (SR) 400 is a major north-south highway, the primary purpose of which is to connect Atlanta's interstates with the metropolitan area's northern suburbs, including Roswell, Alpharetta, and Cumming. North of these suburbs, the road changes from a controlled-access highway to a divided arterial and continues to northeastern Georgia. Throughout the 1990s and early 2000s, both population and employment located along SR 400 increased substantially. Key drivers of population growth in the study area are the numerous subdivisions developed along the SR 400 corridor in northern Forsyth County that serve as bedroom communities to employment centers in Alpharetta, Sandy Springs, and Atlanta. Examples of developments creating jobs in the study area include the outlet mall located at the intersection of SR 400 and Dawson Forest Road, as well as strip commercial development at the intersection of SR 400 and SR 53. Current growth trends are expected to continue, with population and employment forecasted to increase in the future.

As a primary route to recreational opportunities in northern Georgia, such as Lake Lanier and the Chattahoochee National Forest, SR 400 serves a substantial number of recreational travelers from metropolitan Atlanta and other points south. As such, SR 400 routinely experiences higher daily traffic volumes on Saturdays than on an average weekday. However, the corridor also provides access for local and regional travel needs. These different functions are somewhat contradictory. For example, for a corridor to serve the local trip function, it must provide a relatively high level of access, while a corridor serving as a principal arterial must allow for higher speeds for longer distance trips, typically at the expense of additional local access. Improvement strategies may be warranted for the corridor to serve those who depend on its performance today and in the future.

The SR 400 study area extends for approximately 17 miles through Dawson, Forsyth, and Lumpkin counties. Its southern boundary is SR 306 (Keith Bridge Road), just north of the city of Cumming. Its northern boundary is SR 60, which extends into the city of Dahlonega.

2.2 Purpose

The purpose of the study is to analyze existing transportation conditions, operations, and limited-access potential and assess future transportation needs of SR 400, a vital

Georgia state highway corridor. This comprehensive study will result in the identification and prioritization of projects for the SR 400 corridor to address safety, congestion, mobility enhancement, and economic development potential through the proactive use of community involvement and technical analysis.

2.3 Approach

The study approach for the SR 400 corridor includes both technical and non-technical elements to identify and implement realistic transportation solutions. The technical elements of the approach rely on observable facts and measurable objectives related to existing and future traffic conditions, safety, land use, environmental conditions, and demographics.

Non-technical elements used in this approach rely on public, stakeholder, and agency input on relevant issues, needs, concerns, and desires. Although feedback from public involvement is used throughout the study, specific involvement efforts are detailed in Appendix A of this report.

2.4 Report Outline

The report includes the following sections:

- Existing Conditions Analysis – This section includes an overview of the current roadway network; bridge, traffic, and crash data; and current and future corridor land use, demographic data, and environmental/cultural features. Additionally, this section contains a review of previously conducted plans in the counties surrounding the study corridor. These findings serve as a baseline for assessing possible transportation improvements in the study area.

- Future Travel Demands – This section provides an assessment of future travel needs. Future travel demand is based on population and employment projections for the model area.

- Corridor Scenarios – This section describes each potential scenario analyzed. The analysis includes a summary of how each scenario performs relative to study goals and objectives.

- Strategic Improvement Plan – This section includes a summary of recommended actions as well as scheduling, prioritization, engineering, and policy considerations.

3. Existing Conditions Analysis

This section describes the existing conditions in the SR 400 study corridor. By establishing the current characteristics of the corridor, existing conditions allow for the identification of current challenges and opportunities, as well as create a baseline against which to compare future projections, stakeholder input, and potential improvement scenarios. This section provides the existing conditions for a variety of features of the SR 400 corridor, including the roadway network, traffic, level of service, safety, land use, physical environment, and socioeconomic data. It also summarizes current stakeholder input and previous studies conducted for the corridor. Various data sources are used to describe the existing conditions, including Census data, field observations, Georgia Department of Transportation (DOT) road network and safety data, and county comprehensive plans.

3.1 Roadway Network Conditions

3.1.1 Functional Classification

The functional classifications of the roads in the study area are used to analyze existing and future travel demand and levels of service. Acceptable levels of service can vary by area type and road functional classification, which categorizes roads based on the function they are designed to serve. Additionally, functional classification defines required rights-of-way, design standards, and design speeds. Appendix B provides definitions of standard roadway classifications.

The southernmost portion of SR 400 in the study area, from Keith Bridge Road to Browns Bridge Road, is classified as an urban principal arterial. North of this segment for the remainder of the study corridor, SR 400 is classified as a rural principal arterial. Most roads intersecting SR 400 are rural major collectors, the function of which is to serve intra-county travel at moderate speeds. Other intersecting roads are urban major collectors, rural principal arterials, rural minor arterials, and rural minor collectors (Table 1 displays the exact number of each). While these road types are similar in many ways, the presence of multiple functional classifications intersecting SR 400 indicates a variety of land uses and intensities along the corridor, varying trip types, and varying degrees of vehicle access to SR 400. Figure 1 displays the functional classification of the state routes in the SR 400 study area. Intersecting local roads are not included.

Table 1 Functional Classification of Intersecting State Routes

Functional Classification	No. of Intersecting Routes	Percent of Intersecting Routes
Urban Collector	1	8%
Rural Principal Arterial	2	17%
Rural Minor Arterial	1	8%
Rural Major Collector	5	42%
Rural Minor Collector	3	25%
Total	12	100%

Source: Georgia DOT Functional Classification Maps, Lumpkin, Dawson, and Forsyth Counties

3.1.2 Corridor Access

Corridor access points provide connections between SR 400 and the adjacent roadways and businesses. Examples of access points in the study area include interchanges, at-grade intersections, and driveway curb cuts. At-grade intersections and driveways increase the number of potential vehicle conflict points, which can reduce mobility, capacity, and safety.

Inclusive of the study corridor boundaries, SR 400 has a total of 119 access points. Of these, 61 (52 percent) are at driveways, 56 (47 percent) are at roads, and 2 (1 percent) are at an interchange. Roads and interchanges that provide access to/from both sides of SR 400 count as two points of access. Table 2 presents the number of access points to and from SR 400 by type and county jurisdiction. Figure 2 displays the locations of driveway and road access points to the SR 400 corridor.

Table 2 Access Type by County

County	Access Type			Total
	Driveway	Road	Interchange	
Forsyth	30	15	2	47
Dawson	28	30	0	58
Lumpkin	3	11	0	14
Total	61	56	2	119

Source: Field surveys (2006)

For a corridor such as SR 400 with a 65 mile per hour (mph) speed limit, Georgia DOT regulations require a minimum of 550 feet between driveways.[1] However, a cursory aerial review of driveway spacing shows that most driveways on SR 400 are only about 450 to 475 feet apart. This suggests that Georgia DOT access management requirements are not being met.

3.1.3 Pavement Condition

High-quality roads are vital for smooth and efficient travel, and pavement condition is the most important indicator of the quality of the roads in the study area. Georgia DOT updates and maintains the Pavement Condition Evaluation System (PACES), which scores state roads based on visual observation of the quality of roadway pavement. The maximum score a roadway can receive is 100. Roadways with a score below 70 are evaluated to determine the appropriate action (e.g., resurfacing or rehabilitation) to be taken.

All sections of SR 400 in the study area are currently rated over 70 and do not require remediation.

3.1.4 Bridge Conditions

The Bridge Sufficiency Ratings of all bridges in the corridor are identified for the purpose of assessing the status of existing bridge infrastructure. The Bridge Sufficiency Rating System is used by Georgia DOT to prioritize bridges for federal funding. Due to load limits, deficient bridges in a corridor can restrict traffic flow and commercial shipments.

With proper maintenance, any structure with a sufficiency rating above 75 should maintain an acceptable rating for the next 20 years. Bridges with a rating between 65 and 75 may or may not keep an acceptable rating over the next 20 years. Structures with a rating lower than 65 will likely require major rehabilitation or reconstruction during the next 20 years.

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[1] Georgia DOT “Regulations for Driveway and Encroachment Control,” 2004. Section 3A “Spacing of Driveways,” p. 3-1.

Sufficiency ratings of bridges on SR 400 in the study corridor range from 77.38 to 100.00. It is anticipated that existing bridges in the corridor will maintain an acceptable rating over the next 20 years.

Table 3 SR 400 Bridge Sufficiency Ratings

Description	Sufficiency Rating
SR 400 at SR 306 (Keith Bridge Road)	100.00
SR 400 at Baldridge Creek	94.08
SR 400 Southbound at Chestatee River	92.66
SR 400 at Settingdown Creek	84.74
SR 400 Northbound at Chestatee River	77.38

Source: Georgia DOT

3.2 Traffic Conditions

Traffic conditions in the study corridor provide an understanding of how the existing transportation system operates and provides a baseline against which to compare potential improvements. The following information describes the methodology used in the analysis, discusses traffic conditions in the study corridor, and details key findings. This section contains detailed tables including average annual daily traffic (AADT) volumes, intersection turning movement counts, a.m. and p.m. peak-hour delay for both signalized and unsignalized intersections, travel times between points on the study corridor, and speeds by segment of the study corridor.

Similar to most commuter routes, traffic conditions in the SR 400 corridor are heavily affected by the time of day. Based on the traffic analysis, conditions in the study corridor are worse during the afternoon peak hour than during the morning peak hour, with traffic volumes 16 percent higher during the afternoon peak hour. Congestion, measured in terms of average vehicular delay, is 32 percent higher in the afternoon peak hour than in the morning peak hour.

3.2.1 Methodology

Traffic volume data was gathered for 15 intersections between SR 306 (Keith Bridge Road) and SR 60 (South Chestatee Road) along SR 400. In addition, 24-hour traffic volume counts were gathered for 18 locations along the study corridor and the intersecting roadways (a list of these locations is provided in Appendix C). The 24-hour vehicle classification counts are used to estimate the percentage of trucks on SR 400. Additional information gathered includes number of lanes, lane assignments, intersection lane configuration, speed limit, and traffic signal phasing. This information is used to create a model of the entire study corridor for simulation and analysis. Additionally, field visits conducted during morning and afternoon peak periods provide key observations regarding traffic flow and the identification of critical intersections along SR 400.

The traffic count, traffic signal, and geometric data is used in combination with existing demographic data, roadway network files, and household travel behavior characteristics to create a travel demand model with study boundaries that exceed the region needed to study the SR 400 corridor only. Concurrently with its study of SR 400, Georgia DOT conducted a study of the SR 365 corridor, approximately 15 miles east and parallel to the SR 400 corridor. A brief description of the travel demand model is included later in this report. A full description of its development is presented in a separate technical memorandum. While the model was built and validated using existing data, its real value in the SR 400 and SR 365 corridor studies is its ability to evaluate future traffic conditions that result from testing assumed transportation improvement scenarios.

The cross-sectional design of SR 400 over the approximately 17-mile study corridor is generally homogeneous. From Keith Bridge Road to SR 60, SR 400's design includes the following cross-sectional characteristics:

- Two through lanes in each direction of travel
- A flush, grassy median, approximately 30 feet wide
- A paved, 10-foot shoulder adjacent to the outside travel lanes
- No shoulder adjacent to the inside travel lanes

The speed limit along SR 400 in the vicinity of North Georgia Premium Outlets in Dawsonville and SR 60 (South Chestatee Road) is 55 mph, while the rest of the corridor operates at a speed limit of 65 mph. In addition to signalized intersections, median openings are provided at various locations along SR 400 to provide access from and to the side streets.

Peak-hour traffic conditions for a typical weekday were benchmarked using level-of-service grades that were computed by means of a traffic simulation analysis. A CORSIM micro-simulation model was selected as the analysis tool to evaluate peak traffic operations. CORSIM is one of the traffic analysis programs in the Traffic Software Integrated System (TSIS) Version 5.1 suite of analysis tools. It was developed by the U.S. Federal Highway Administration (FHWA) to evaluate the relative effectiveness of different transportation system improvements. Traffic flow was analyzed for morning and afternoon peak-hour conditions, resulting in the determination of existing peak-hour delays and corresponding levels of service. Speed and travel time measurements for the corridor are additional measures obtained from the simulation model. These results are used as benchmarks for comparisons with future traffic conditions under various improvement scenarios.

3.2.2 Average Daily Traffic Volumes

The existing traffic data collected for SR 400 indicates that the study corridor is highly directional during peak hours. The peak-hour traffic is along the southbound direction during the morning peak hours and along the northbound direction during the afternoon peak hours.

The average daily traffic (ADT) along SR 400 varies significantly along the corridor and across counties. Based on existing traffic data, SR 400 in Forsyth County has the highest average daily volume compared to SR 400 roadway segments in Dawson and Lumpkin counties. The average daily traffic volume on SR 400 south of Browns Bridge Road is approximately 45,000 vehicles. The average daily traffic volume decreases to 37,000 vehicles at Settingdown Road and to approximately 31,000 vehicles at the Forsyth County boundary. The average daily traffic volume in Dawson County ranges from approximately 30,000 vehicles in the vicinity of Dawson Forest Road and SR 53 to 25,000 vehicles at Lumpkin Campground Road. SR 400 in Lumpkin County carries approximately 18,000 vehicles per day.

The average daily truck percentage along SR 400 ranges between 10 and 13 percent. The peak-hour truck percentage in the off-peak and peak directions is 7 and 14 percent, respectively.

3.2.3 Peak-Hour Traffic Volumes

Existing peak-hour traffic volumes were collected and are presented by segment and intersection. Traffic volumes are used in identifying potential issues and determining level of service along a facility or at intersections.

3.2.3.1 Freeway Segments

Table 4 provides traffic volumes for the peak travel direction for 14 segments of SR 400. As would be expected, traffic volumes are highest at the southern end of the corridor, where the majority of commute trips end in the morning and start in the evening. Traffic volumes tend to decrease incrementally at each intersection, moving from south to north. However, exceptions to this pattern in both the a.m. and p.m. peak periods are the segments to the north and south of the Dawsonville outlets, where traffic volumes increase rather than decrease. Another exception occurs in the p.m. peak period, when northbound traffic volumes increase on the segment between Settingdown Road and Hampton Park Drive.

Table 4 Peak-Hour Directional Volumes on SR 400

Segment		A.M.		P.M.	
Cross Street 1	Cross Street 2	Peak-Hour Traffic Volume	Peak Direction of Travel	Peak-Hour Traffic Volume	Peak Direction of Travel
GA 400 (just south of SR 306 ramps)	SR 306	2,307	southbound	3,049	northbound
SR 306	SR 369	1,987	southbound	2,367	northbound
SR 369	Settingdown Road	1,879	southbound	1,961	northbound
Settingdown Road	Hampton Park Drive	1,802	southbound	2,018	northbound
Hampton Park Drive	Hubbard Town Road	1,572	southbound	1,916	northbound
Hubbard Town Road	Jot Em Down Road	1,416	southbound	1,633	northbound
Jot Em Down Road	Dawson Forest Road	1,263	southbound	1,599	northbound
Dawson Forest Road	Dawsonville Outlets	1,454	southbound	1,549	northbound
Dawsonville Outlets	Industrial Park Road/ Beartooth Parkway	1,534	southbound	1,596	northbound
Industrial Park Road/ Beartooth Parkway	SR 53	1,326	southbound	1,477	northbound
SR 53	Lumpkin Campground Road	1,043	southbound	1,325	northbound

Table 4 Peak-Hour Directional Volumes on SR 400

Segment		A.M.		P.M.	
		Peak-Hour Traffic Volume	Peak Direction of Travel	Peak-Hour Traffic Volume	Peak Direction of Travel
Cross Street 1	**Cross Street 2**				
Lumpkin Campground Road	SR 136/Auraria Road	974	southbound	1,160	northbound
SR 136/Auraria Road	Burnt Stand Road	690	southbound	783	northbound
Burnt Stand Road	SR 60	393	southbound	790	northbound

Source: Field data collection (2006)

3.2.3.2 Intersections

Total intersection traffic volumes on the SR 400 corridor are greater during the p.m. peak hour (41,538) than during the a.m. peak hour (35,799). Based on the number of vehicles entering an intersection, the highest volume intersection in the SR 400 corridor is SR 369 (Browns Bridge Road) in Forsyth County. At this intersection, 4,403 vehicles were counted during the p.m. peak hour. The next highest volume was observed at SR 53, where 4,340 vehicles entered the intersection during the p.m. peak hour. These two intersections carry 28 percent and 39 percent more traffic than the third highest volume intersection in the a.m. and p.m. peak hours, respectively. The table below presents existing total a.m. and p.m. peak-hour intersection volumes for the SR 400 corridor.

Table 5 Peak-Hour Intersection Volumes

No.	Intersection	A.M.	P.M.
1.	SR 400 at SR 306 Northbound Ramp	2,050	2,590
2.	SR 400 at SR 306 Southbound Ramp	1,843	1,720
3.	SR 400 at SR 369	3,948	4,403
4.	SR 400 at Settingdown Road	2,778	3,129
5.	SR 400 at Hampton Park Drive	2,483	2,927
6.	SR 400 at Hubbard Town Road/Cross Roads Road	2,426	2,910
7.	SR 400 at Jot Em Down Road	2,563	2,938
8.	SR 400 at Dawson Forest Road	2,396	3,076
9.	SR 400 at Dawsonville Outlets	2,260	2,819
10.	SR 400 at Industrial Park Road/Beartooth Parkway	2,460	2,771

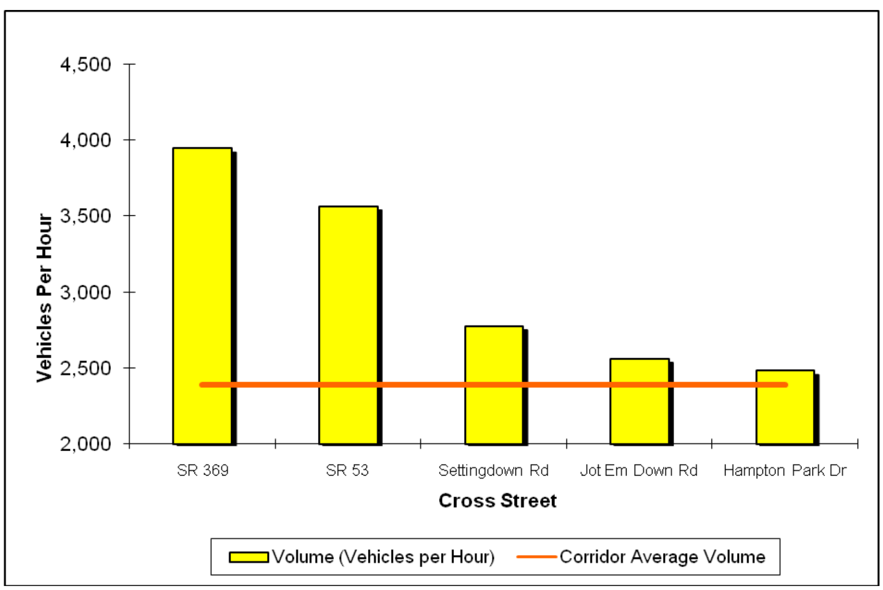
Table 5 Peak-Hour Intersection Volumes

No.	Intersection	A.M.	P.M.
11.	SR 400 at SR 53	3,568	4,340
12.	SR 400 at Lumpkin Campground Road	2,242	2,349
13.	SR 400 at SR 136/Auraria Road	1,764	2,023
14.	SR 400 at Burnt Stand Road/Lumpkin County Parkway	1,283	1,462
15.	SR 400 at SR 60	1,735	2,081
	Total	35,799	41,538

Source: Field data collection (2006)

Intersections were sorted by traffic volume in descending order to determine the five intersections with the highest traffic volumes during the a.m. peak hour, as shown on Chart 1. Although high volumes do not necessarily correspond to high levels of delay, SR 369 (Browns Bridge Road) and SR 53 (Dawsonville Highway), which account for significant delay during the a.m. peak hour, also happen to be the highest volume intersections during the a.m. peak hour. However, the intersection with the third highest volume, Settingdown Road, operates at an acceptable level of service despite carrying a higher volume than the corridor average.

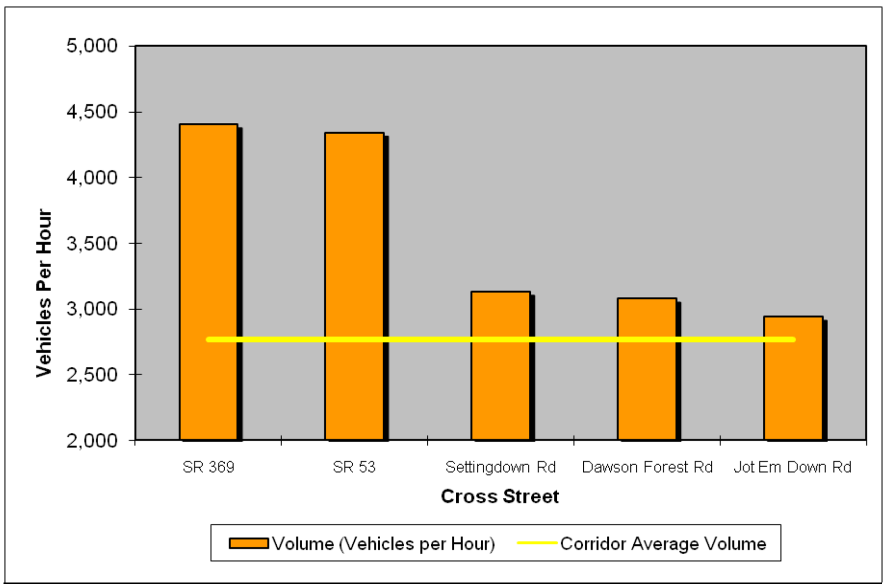
Chart 1 SR 400 Top Five Signalized Intersections by Volume (A.M. Peak Hour)



Source: Field data collection (2006)

The same sorting of intersections by traffic volume is used to determine the five intersections with the highest traffic volumes during the p.m. peak hour, as shown on Chart 2. Similar to the a.m. peak hour, SR 369 (Browns Bridge Road) and SR 53 (Dawsonville Highway), which account for the majority of delay during the a.m. peak hour, are also the highest volume intersections during the p.m. peak hour. Settingdown Road is again the intersection with the third highest volume and operates at an acceptable level of service despite carrying more vehicles than the corridor average. Although the five intersections with the highest traffic volumes are similar for the a.m. and p.m. peak hours, Dawson Forest Road is a top five intersection by volume and Hampton Park Drive is not during the p.m. peak hour.

Chart 2 **SR 400 Top Five Signalized Intersections by Volume (P.M. Peak Hour)**



Source: Field data collection (2006)

The a.m. and p.m. peak-hour turning movements and traffic volumes for all intersections evaluated are detailed in Tables 6 and 7.

Table 6 SR 400 Intersection Turning Movements and Traffic Volumes (A.M. Peak Hour)

	Northbound			Southbound			Eastbound			Westbound		
Intersection	**L**	**T**	**R**	**L**	**T**	**R**	**L**	**T**	**R**	**L**	**T**	**R**
SR 306 at SR 400 Northbound Ramp	34	0	423	0	0	0	29	405	0	0	1,064	95
SR 306 at SR 400 Southbound Ramp	0	0	0	100	0	145	0	367	164	675	392	0
SR 369 at SR 400	181	530	46	76	1,872	39	61	236	223	212	395	77
Settingdown Road at SR 400	14	641	20	4	1,789	86	47	7	21	113	31	5
Hampton Park Drive at SR 400	3	631	12	6	1,796	0	0	0	0	32	0	3
Hubbard Town Road/Cross Roads Road at SR 400	20	559	27	16	1,550	6	12	1	79	134	9	13
Jot Em Down Road at SR 400	66	502	39	33	1,340	43	36	60	99	184	87	74
Dawson Forest Road at SR 400	34	527	18	13	1,171	79	106	85	156	104	97	6
Dawsonville Outlet at SR 400	3	645	67	89	1,344	21	4	1	2	4	1	79
Industrial Park Road/Beartooth Parkway at SR 400	88	700	28	49	1,452	33	11	7	11	27	14	40
SR 53 at SR 400	299	449	81	191	1,018	117	191	339	266	168	341	108
Lumpkin Campground Road/Harmony Church Road at SR 400	6	530	158	5	924	114	33	60	2	306	101	3
SR 136/Auraria Road at SR 400	64	477	5	16	906	52	49	23	137	1	29	5
Burnt Stand Road/Lumpkin County Parkway	49	253	28	38	559	93	77	19	105	18	20	24
SR 60 at SR 400	178	123	104	41	310	42	18	231	155	228	273	32

Source: Field data collection (2006)

Table 7 SR 400 Intersection Turning Movements and Traffic Volumes (P.M. Peak Hour)

	Northbound			Southbound			Eastbound			Westbound		
Intersection	**L**	**T**	**R**	**L**	**T**	**R**	**L**	**T**	**R**	**L**	**T**	**R**
SR 306 at SR 400 Northbound Ramp	300	0	717	0	0	0	116	467	0	0	771	219
SR 306 at SR 400 Southbound Ramp	0	0	0	114	0	71	0	454	96	418	567	0
SR 369 at SR 400	240	1,785	342	115	800	58	52	283	218	96	299	115
Settingdown Road at SR 400	28	1,849	84	3	862	78	81	36	18	57	24	9
Hampton Park Drive at SR 400	4	1,980	34	14	869	0	0	0	0	11	0	15
Hubbard Town Road/Cross Roads Road at SR 400	81	1,670	165	42	812	5	23	4	28	50	4	26
Jot Em Down Road at SR 400	89	1,436	108	75	812	48	40	80	25	59	60	106
Dawson Forest Road at SR 400	246	1,300	53	64	705	116	148	112	110	79	114	29
Dawsonville Outlet at SR 400	61	1,420	68	67	881	56	80	4	97	0	0	85
Industrial Park Road/Beartooth Parkway at SR 400	180	1,372	44	71	1,000	15	12	4	5	17	7	44
SR 53 at SR 400	389	877	211	261	571	75	232	679	177	332	412	124
Lumpkin Campground Road/Harmony Church Road at SR 400	1	996	328	10	605	67	76	64	1	145	51	5
SR 136/Auraria Road at SR 400	167	978	15	15	620	40	21	17	106	8	16	20
Burnt Stand Road/Lumpkin County Parkway	138	617	28	18	416	43	50	22	45	33	18	34
SR 60 at SR 400	279	362	149	29	165	42	36	293	193	137	324	72

Source: Field data collection (2006)

3.2.4 Level of Service

Level of service (LOS) analysis is commonly used in transportation planning to measure the quality of service provided by transportation facilities in order to identify existing and future deficiencies. LOS ranges from A to F, with A corresponding to entirely uncongested conditions and F corresponding to severe congestion. Current Georgia DOT policy is to provide LOS C or better on all state roads in Georgia.

3.2.4.1 Freeway Segments

To determine LOS from traffic simulation model output, volume to capacity (V/C) ratios are calculated for each roadway segment by dividing the existing or predicted traffic volume (demand) by the theoretical capacity (supply) of the segment. A ratio greater than one indicates travel demand is higher than the supply of transportation infrastructure and corresponds to LOS F. Table 8 lists level of service grades and descriptions for basic freeway segments.

Table 8 Level of Service Grade Descriptions for Basic Freeway Segments

Grade	Description
A	Completely free-flow conditions. Operation of motor vehicles is virtually unaffected by the presence of other vehicles. Drivers are constrained only by the geometric features of the highway and personal driving preferences. Minor disruptions to traffic flow are easily absorbed without a change in travel speed. Vehicles are spaced at an average of 465 feet and the maximum density does not exceed 10 passenger cars per mile per lane.
B	Free-flow conditions but the presence of other vehicles begins to be noticeable. Average travel speeds should still be the same as LOS A but drivers have slightly less room to maneuver. Minor disruptions to traffic flow are still easily absorbed without a change in travel speed. Nevertheless, there could be some brief, localized deterioration in flow. Vehicles are spaced at an average of 260 feet and the maximum density does not exceed 16 passenger cars per mile per lane.
C	Represents a range of driving conditions where the influence of traffic density becomes very noticeable. Average travel speeds begin showing some reduction. Drivers' ability to maneuver is clearly affected by the presence of other vehicles. Minor disruptions can be expected to cause queuing and significant, localized deterioration in traffic flow. Vehicles are spaced at an average of 192 feet and the maximum density does not exceed 24 passenger cars per mile per lane.
D	Represents a range of driving conditions where the ability to maneuver is severely restricted because of traffic congestion. Average travel speeds are reduced due to increased volumes. Only minor disruptions can be absorbed without the formation of extensive queuing and deteriorating traffic flow. Vehicles are spaced at an average of 156 feet and the maximum density does not exceed 32 passenger cars per mile per lane.

Table 8 Level of Service Grade Descriptions for Basic Freeway Segments

Grade	Description
E	Represents driving conditions at or near capacity and is quite unstable. Vehicles can operate with minimum spacing at which uniform flow can be maintained. Disruptions cannot be readily dissipated. Disruptions will likely cause queues to form and service to deteriorate to LOS F. On most multi-lane highways, for which free-flow travel speeds are between 45 and 60 miles per hour, passenger car mean speeds at capacity range from 41 to 53 miles per hour. They are highly variable and unpredictable within that range.
F	Represents forced or breakdown flow. It occurs either at a point where vehicles arrive at a rate greater than the rate at which they are discharged or at a point on a planned facility where forecasted demand exceeds computed capacity. Although operations at such points and on sections immediately downstream will appear to be at capacity, queues will form behind these breakdowns. Operations within queues are highly unstable, with vehicles experiencing brief periods of movement followed by stoppages. Travel speeds within queues are generally less than 30 miles per hour.

Source: *Highway Capacity Manual 2000,* Transportation Research Board

Only two sections of SR 400, north and south of Keith Bridge Road/SR 306, are currently built to freeway standards in the study corridor. Existing (2005) levels of service for the a.m. and p.m. peak hours were computed for these sections using a methodology appropriate for long-range corridor planning. Peak-hour traffic counts and peak-hour volumes supplied by the SR 400 and SR 365 travel demand model were used to quantify existing travel demand. Freeway capacity and LOS grades were computed using the 1985 *Highway Capacity Manual* formula for basic freeway segments assuming ideal conditions and a 2 percent rate of heavy trucks in the traffic stream. Table 9 presents a.m. and p.m. peak-hour LOS grade estimates along with their associated volumes and capacities.

During the a.m. and p.m. peak hours, all freeway sections of SR 400 inside the corridor study area operate at a satisfactory LOS C or better. However, peak-hour volumes in the peak direction of travel on the section from Pilgrim Mill Road to Keith Bridge Road/ SR 306 are pushing the V/C ratio to exceed the LOS D threshold, which would result in operating conditions deteriorating to an unsatisfactory level of service. In the evening peak hour, operating conditions on SR 44 northbound between Keith Bridge Road/ SR 306 and Browns Bridge Road/SR 369 are associated with a satisfactory LOS C, which is misleading. The LOS on this section is actually controlled by operating conditions at the intersection between SR 400 and Browns Bridge Road/SR 369. In the off-peak direction of travel, a.m. and p.m. traffic conditions on all freeway sections are very good, which is denoted by the LOS A and B grades.

Table 9 Georgia 400 Freeway Segments – Existing (2005)

Segment			Direction of Travel	Analysis Type	A.M.					P.M.			
Cross Street 1		Cross Street 2			Modeled Volume (VPH)	Estimated Capacity (VPH)	V/C Ratio	LOS		Modeled Volume (VPH)	Estimated Capacity (VPH)	V/C Ratio	LOS
Forsyth County													
Pilgrim Mill Road	–	SR 306/Keith Bridge Road (off ramp)	Northbound	Basic Segment	1,330	3,900	0.34	A		3,000	3,900	0.77	C
SR 306/Keith Bridge Road (off ramp)	–	SR 306/Keith Bridge Road (on ramp)	Northbound	Basic Segment	960	3,900	0.25	A		2,400	3,900	0.62	C
SR 306/Keith Bridge Road (on ramp)	–	SR 369/Browns Bridge Road	Northbound	Basic Segment	1,030	3,900	0.26	A		2,500	3,900	0.64	C
SR 369/Browns Bridge Road	–	SR 306/Keith Bridge Road (off ramp)	Southbound	Basic Segment	2,400	3,900	0.62	C		1,100	3,900	0.28	A
SR 306/Keith Bridge Road (off ramp)	–	SR 306/Keith Bridge Road (on ramp)	Southbound	Basic Segment	2,200	3,900	0.56	C		950	3,900	0.24	A
SR 306/Keith Bridge Road (on ramp)	–	Pilgrim Mill Road	Southbound	Basic Segment	3,000	3,900	0.77	C		1,500	3,900	0.38	B
Dawson County													
(No Freeway Segments)													
Lumpkin County													
(No Freeway Segments)													

Source: *Highway Capacity Manual*, 1985, Special Report 209, Transportation Research Board

Traffic counts made in fall of 2006 by Georgia DOT's study team

Georgia 400 and SR 365 Travel Demand Model – PBS&J

3.2.4.1.1 Corridor Travel Speeds

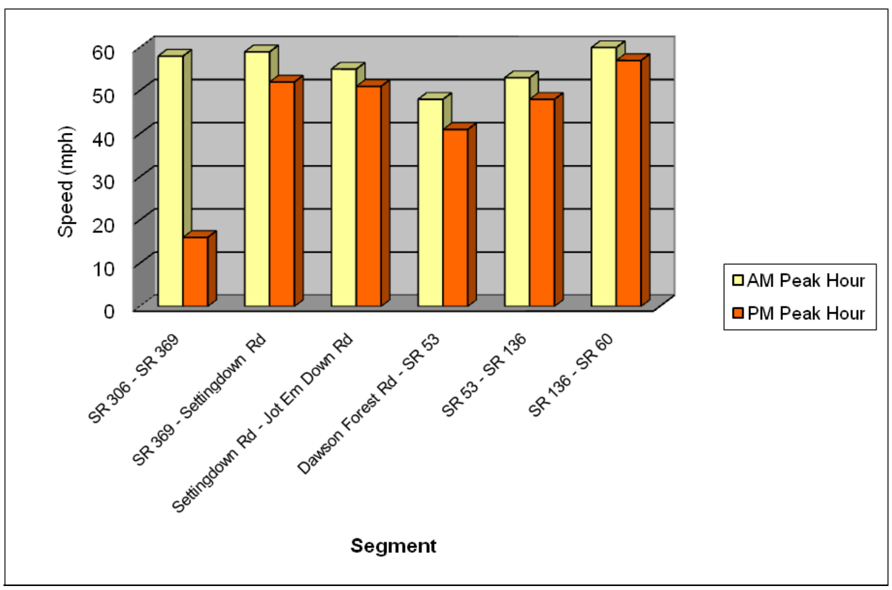
To gain an understanding of travel conditions throughout the study corridor as a whole, SR 400 was split into six segments, and the northbound and southbound speeds during both the a.m. and p.m. peak hours are reported.

Traffic flow on SR 400 northbound is directional, which is reflected in the speed differential between the a.m. and p.m. peak hours. Average speed is lowest and volume is heaviest during the p.m. peak hour. On SR 400 northbound in the p.m. peak hour, the average speed is 44 mph, or 21 percent slower than the a.m. peak-hour average speed of 56 mph.

Most segments of SR 400 northbound operate within 7 percent of the average speed during the p.m. peak hour, but the segment from SR 306 (Keith Bridge Road) to SR 369 (Browns Bridge Road) is significantly worse, at 16 mph. The segment with the second slowest speed is from Dawson Forest Road to SR 53 (Dawsonville Highway) at 41 mph, or 156 percent faster than the slowest section.

Chart 3 summarizes and compares speeds by segment on SR 400 northbound, while Table 10 provides a detailed breakdown of northbound speeds by segment.

Chart 3 SR 400 Northbound Speed by Segment



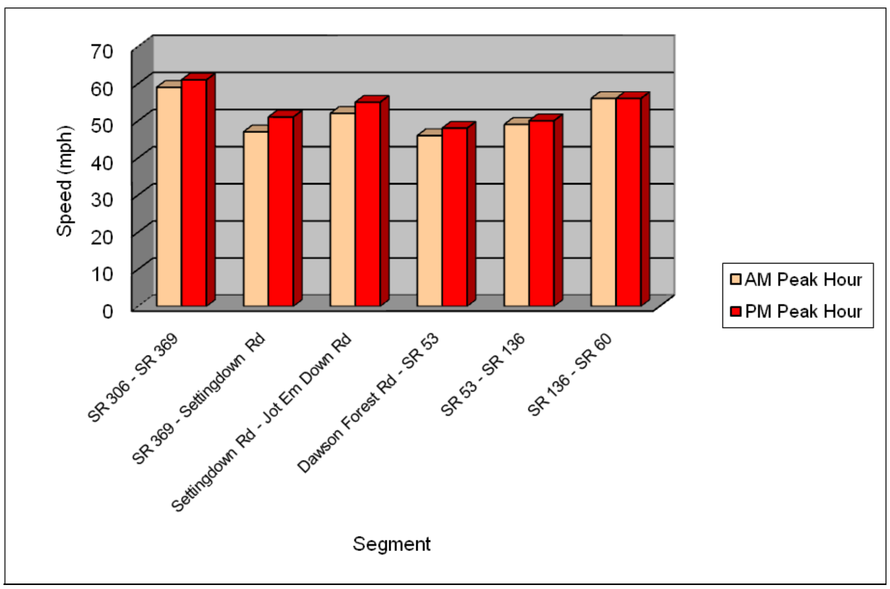
Source: CORSIM model

On SR 400 southbound, average speed is lowest and volume is heaviest during the a.m. peak hour as commuters head south to employment centers in Alpharetta, Sandy Springs, and the city of Atlanta. Average speed on SR 400 southbound in the a.m. peak hour is 52 mph, or 4 percent slower than the p.m. peak-hour average speed of 54 mph.

Most segments of SR 400 southbound operate within 6 percent of the average speed during the a.m. peak hour, but the segments from SR 369 (Browns Bridge Road) to Settingdown Road and from Dawson Forest Road to SR 53 (Dawsonville Highway) are slower than average at 47 mph and 46 mph, respectively.

Chart 4 summarizes and compares speeds by segment on SR 400 southbound, and Table 10 provides a detailed breakdown of southbound speeds by segment.

Chart 4 SR 400 Southbound Speed by Segment



Source: CORSIM model

Table 10 SR 400 Travel Speed Summary

	Speed (mph)			
	A.M. Peak Hour		P.M. Peak Hour	
Segment	**NB**	**SB**	**NB**	**SB**
SR 306 to SR 369	58	59	16	61
SR 369 to Settingdown Road	59	47	52	51
Settingdown Road to Jot Em Down Road	55	52	51	55
Dawson Forest Road to SR 53	48	46	41	48
SR 53 to SR 136	53	49	48	50
SR 136 to SR 60	60	56	57	56

Source: CORSIM model

The south end of the corridor from SR 306 (Keith Bridge Road) to SR 369 (Browns Bridge Road) is currently experiencing the highest levels of delay and lowest operating speeds. Additionally, the section of the study corridor near SR 53 (Dawsonville Highway) also experiences delays. Both SR 53 (Dawsonville Highway) and Industrial Park Road/Beartooth Parkway are experiencing significant levels of delay. Although not currently operating at a failing LOS, SR 318 (Dawson Forest Road) is among the five intersections with the highest a.m. and p.m. peak-hour delay. Additionally, the eastbound approach to North Georgia Premium Outlets is operating below the Georgia DOT statewide LOS standard at LOS D and E during the a.m. and p.m. peak hour, respectively.

3.2.4.2 Intersections

Level of service grades for intersections are described in Table 11. The descriptions presented in the table below are for signalized intersections. Level of service grades for unsignalized intersections are essentially the same but the threshold values for “Control Delay” are slightly different. Whether an intersection is signalized or unsignalized, it is assigned a LOS grade A through F with LOS A being the best and LOS F the worst. “Control Delay” in excess of 35 seconds at a signalized intersection produces an undesirable LOS grade of D.

Table 11 Level of Service Description for Intersections

Grade	Description
A	Low control delay on average, not exceeding 10 seconds per vehicle. Occurs when progression is extremely favorable and most vehicles arrive during the green phase. Most vehicles do not stop at all. Generally, all stopped vehicles clear the intersection during a cycle.
B	Relatively low average control delay, above 10 seconds and not more than 20 seconds per vehicle. Occurs when there is good progression and/or short cycle lengths. Generally, all stopped vehicles clear the intersection during a cycle. More vehicles stop in comparison with LOS A.
C	Control delay above 20 seconds and not more than 35 seconds per vehicle. Occurs when there is good progression and/or short cycle lengths. Cycle failures may begin to appear. A significant number of vehicles stop although many pass through the intersection without stopping.
D	Control delay above 35 seconds and not more than 55 seconds per vehicle. Influence of congestion becomes noticeable. Longer delays result from combination of unfavorable progression, long cycle lengths or high volume to capacity ratios. Cycle failures become apparent. Many vehicles stop and the proportion of vehicles not stopping declines.
E	Control delay above 55 seconds and not more than 80 seconds per vehicle. These long delay values can result from a combination of the following factors: poor progression, long cycle lengths, and high volume to capacity ratios. Cycle failures are frequent.
F	Control delay above 80 seconds per vehicle. These extremely long delay values can result from a combination of the following factors: poor progression, long cycle lengths, and excessive volume to capacity ratios.

Source: *Highway Capacity Manual 2000,* Transportation Research Board

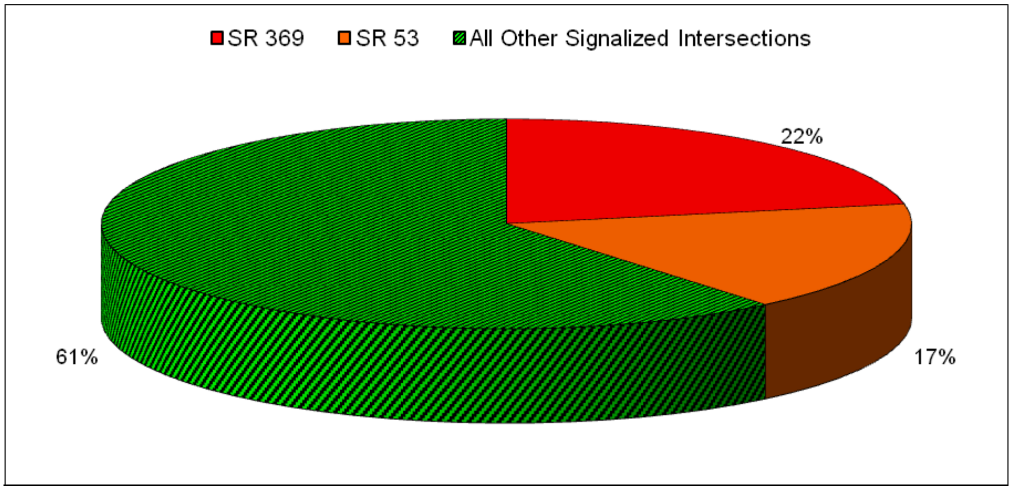
CORSIM, which models traffic and calculates delay, was used to identify intersections with existing deficiencies along the study corridor. Figure 3 displays a map of intersection level of service along the SR 400 corridor. Key findings include the following:

- Two of 15 signalized intersections operate at an unacceptable LOS of F during the p.m. peak hour:
  - SR 369 (Browns Bridge Road) at SR 400
  - SR 53 (Dawsonville Highway) at SR 400

- Two side street approaches at the unsignalized intersections operate at an unacceptable LOS of E and below during the a.m. peak hour:
  - Hampton Park Drive at SR 400
  - Industrial Park Road/Beartooth Parkway at SR 400
- Two of the side street approaches at the unsignalized intersections operate at an unacceptable LOS of E and below during the p.m. peak hour:
  - Dawsonville Outlet driveway at SR 400
  - Industrial Park Road/Beartooth Parkway at SR 400
- The intersections of SR 369 (Browns Bridge Road) and SR 53 (Dawsonville Highway) at SR 400 together account for 37 percent of the entire network delay during the a.m. peak hour.
- The intersections of SR 369 (Browns Bridge Road) and SR 53 (Dawsonville Highway) at SR 400 together account for 54 percent of the entire network delay during the p.m. peak hour.
- Field observation at the intersection of SR 369 (Browns Bridge Road) at SR 400 during the p.m. peak hour indicates long queues on the northbound approach of SR 400. These queues back up from the intersection of SR 369 (Browns Bridge Road) at SR 400 to the SR 306 (Keith Bridge Road) bridge, a distance of approximately 0.8 mile.

Intersection delay during the a.m. peak hour was calculated to identify intersections operating at LOS D. During the a.m. peak hour, SR 369 (Browns Bridge Road) and SR 53 (Dawsonville Highway) at SR 400 are the only two signalized intersections operating at LOS D. As shown on Chart 5, these two intersections alone account for 39 percent of the delay at signalized intersections in the SR 400 corridor during the a.m. peak hour. Improvements that reduce delay at these two intersections may maximize return on transportation investments.

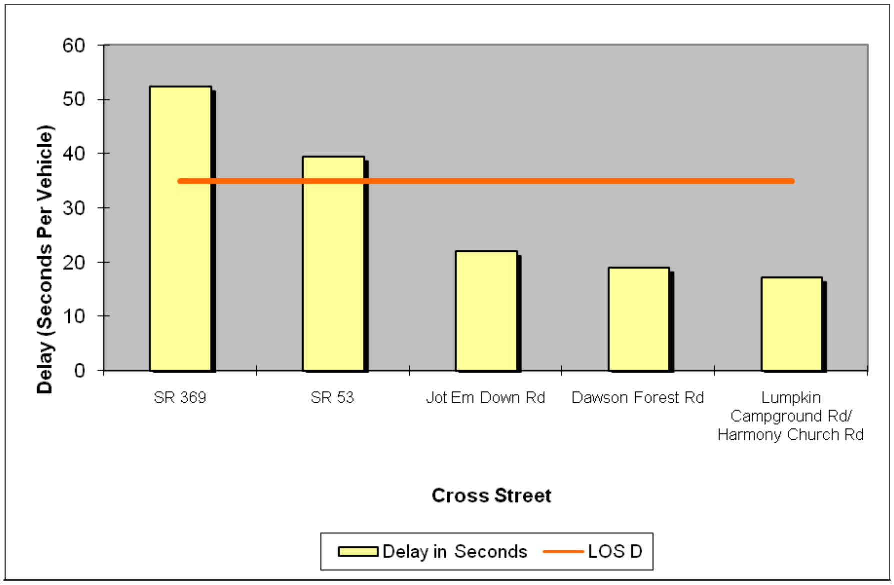
Chart 5 SR 400 Signalized Intersection Delay (A.M. Peak Hour)



Source: CORSIM model

Signalized intersections in the SR 400 corridor were sorted by delay during the morning peak hour in descending order to identify the five signalized intersections experiencing the highest level of delay, as shown on Chart 6. Additionally, the chart shows that the two signalized intersections with the highest level of delay, SR 369 (Browns Bridge Road) and SR 53 (Dawsonville Highway) at SR 400, have at least 80 percent more delay than the signalized intersection with the next highest level of delay, Jot Em Down Road at SR 400.

Chart 6 SR 400 Top Five Signalized Intersections by Delay (A.M. Peak Hour)



Source: CORSIM model

Table 12 summarizes the existing delay and LOS during the a.m. peak hour at the five intersections in the study corridor with the highest amount of delay. As shown, only two signalized intersections in the study corridor, SR 369 (Browns Bridge Road) and SR 53 (Dawsonville Highway), are currently operating below LOS C during the a.m. peak hour. Although Jot Em Down Road is currently operating at an acceptable LOS, it is approaching LOS D.

Table 12 SR 400 Top Five Signalized Intersections by Delay (A.M. Peak Hour)

Signalized Intersection	Average Delay (Seconds)	LOS
SR 369 (Browns Bridge Road)	52.2	D
SR 53 (Dawsonville Highway)	39.3	D
Jot Em Down Road	21.9	C
Dawson Forest Road	18.9	B
Lumpkin Campground Road/Harmony Church Road	17.1	B

Source: CORSIM Model

The intersection delay and the corresponding levels of service during the a.m. and p.m. peak hours at the signalized intersections are summarized in Table 13. The delays are defined in terms of average vehicular delay per vehicle at a particular intersection. The level of service provides a qualitative assessment of traffic conditions, based on the average delay.

Table 13 Capacity Analysis Summary – Signalized Intersections

	CORSIM Delay (Sec/Veh)		CORSIM LOS[1]	
Signalized Intersection	**A.M.**	**P.M.**	**A.M.**	**P.M.**
SR 306 at SR 400 Northbound Ramp	6.1	14.5	A	B
SR 306 at SR 400 Southbound Ramp	15.4	16.0	B	B
SR 369 at SR 400	52.2	94.3	D	F
Settingdown Road at SR 400	15.1	10.9	B	B
Hubbard Town Road/Cross Roads Road at SR 400	11.0	10.4	B	B
Jot Em Down Road at SR 400	21.9	14.3	C	B
Dawson Forest Road at SR 400	18.9	17.3	B	B
SR 53 at SR 400	39.3	83.0	D	F
Lumpkin Campground Road/Harmony Church Road at SR 400	17.1	12.0	B	B
SR 136/Auraria Road at SR 400	11.5	13.1	B	B
Burnt Stand Road/Lumpkin County Parkway	9.8	9.0	A	A
SR 60 at SR 400	17.1	17.0	B	B

Source: CORSIM model

[1]Represents Level of Service based on CORSIM delay

Vehicle delay during the a.m. peak hour based on turning movements for all intersections evaluated as part of the SR 400 corridor study is detailed in Table 14.

Table 14 SR 400 Vehicle Delay Based on Intersection Turn Movement (A.M. Peak Hour)

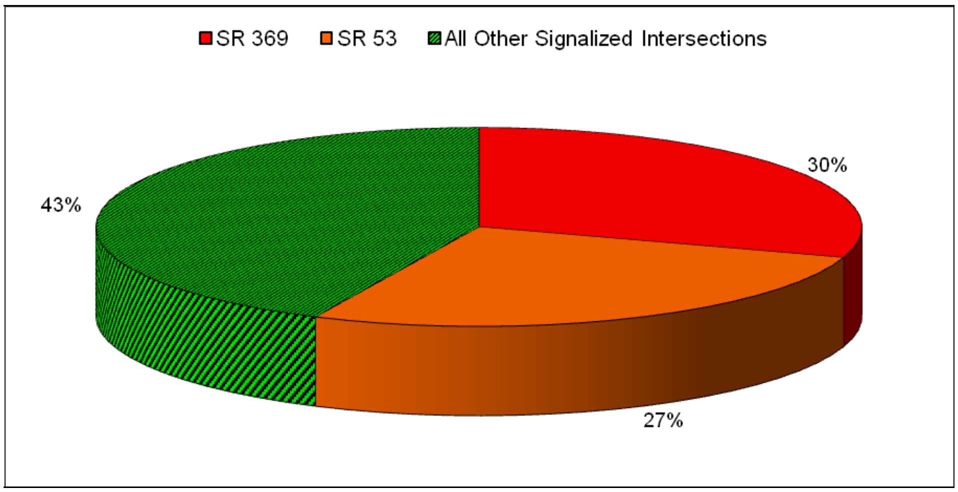
	A.M. Peak-Hour Delay (Sec/Veh)											
	Northbound			Southbound			Eastbound			Westbound		
Intersection	**L**	**T**	**R**	**L**	**T**	**R**	**L**	**T**	**R**	**L**	**T**	**R**
SR 306 at SR 400 Northbound Ramp	58.5	–	8.1	–	–	–	62.0	3.7	–	–	3.2	3.8
SR 306 at SR 400 Southbound Ramp	–	–	–	30.4	–	10.8	–	11.3	5.5	25.2	4.6	–
SR 369 at SR 400	124.6	10.8	8.2	30.0	31.0	19.0	134.9	210.6	88.4	88.1	46.5	10.8
Settingdown Road at SR 400	18.9	3.3	7.0	0.0	15.2	15.8	46.2	42.3	12.5	55.8	50.9	20.2
Hampton Park Drive at SR 400	–	0.4	3.8	0.0	1.4	–	–	–	–	47.4	–	5.5
Hubbard Town Road/Cross Roads Road at SR 400	19.2	5.0	5.8	17.9	8.4	0.0	40.8	18.5	14.0	54.4	48.5	41.3
Jot Em Down Road at SR 400	49.5	9.1	7.6	16.6	19.0	8.4	42.0	34.9	29.2	46.2	44.4	39.0
Dawson Forest Road at SR 400	41.1	7.5	10.9	44.1	20.3	12.5	31.0	23.0	13.8	35.3	32.2	24.2
Dawsonville Outlet at SR 400	0.0	4.0	10.5	10.0	1.5	6.0	38.2	34.5	4.8	–	–	7.2
Industrial Park Road/Beartooth Parkway at SR 400	16.0	0.8	7.1	17.9	7.3	12.3	72.2	117.1	26.5	71.0	70.6	30.7
SR 53 at SR 400	56.1	18.1	12.5	43.5	28.5	16.1	51.0	63.9	16.7	42.4	67.1	16.1
Lumpkin Campground Road/Harmony Church Road at SR 400	15.8	11.8	7.3	0.0	16.7	11.1	24.5	19.6	11.4	30.9	26.3	22.9
SR 136/Auraria Road at SR 400	19.3	5.4	7.7	15.9	11.8	9.8	28.5	23.4	16.9	12.9	25.6	5.7
Burnt Stand Road/Lumpkin County Parkway	13.5	6.06	7.9	10.4	6.5	7.6	27.0	26.9	15.5	25.7	26.3	7.3
SR 60 at SR 400	22.5	11.0	11.2	22.0	20.1	11.5	22.8	21.4	9.1	19.9	13.8	12.7

Source: CORSIM model

Intersections operating at LOS D or worse during the p.m. peak hour were determined based on the calculated delay.

During the afternoon peak hour, SR 369 (Browns Bridge Road) and SR 53 (Dawsonville Highway) at SR 400 are the only two signalized intersections operating at an unacceptable LOS. Both intersections operate at LOS F. As shown on Chart 7, these two intersections account for approximately 57 percent of the delay at signalized intersections in the SR 400 corridor during the afternoon peak hour. These two intersections also account for a substantial amount of a.m. peak-hour delay. Therefore, transportation projects that reduce delay at these two intersections may provide substantial benefits during both the a.m. and p.m. peak hours.

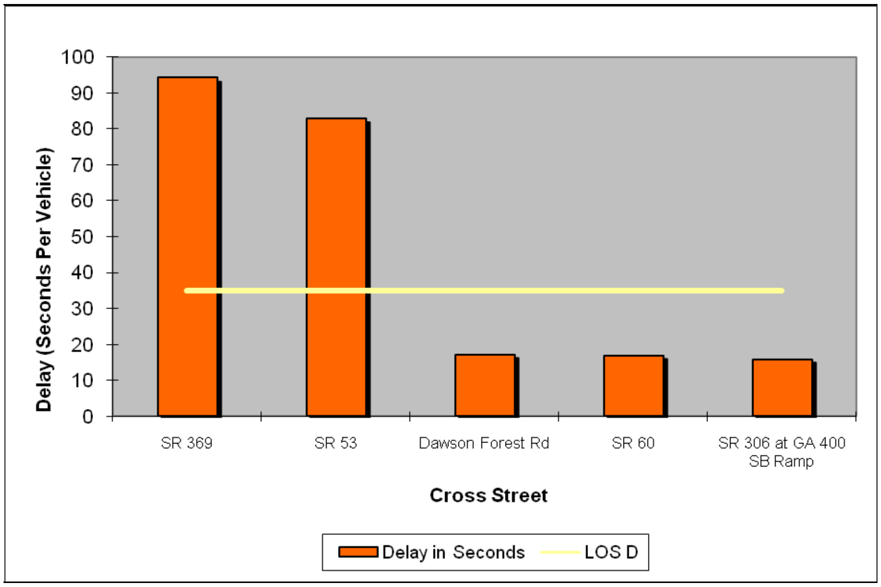
Chart 7 SR 400 Signalized Intersection Delay (P.M. Peak Hour)



Source: CORSIM model

Signalized intersections are sorted by p.m. peak-hour delay in descending order to identify the five intersections that experience the highest level of delay, which are shown on Chart 8. Two of the five intersections currently operate at an unacceptable LOS during the afternoon peak hour, while the other three operate at LOS B, which is acceptable. The gap in delay between failing intersections and other intersections in the top five is extremely large for the p.m. peak hour, in contrast to the a.m. peak hour. During the p.m. peak hour, SR 369 (Browns Bridge Road) and SR 53 (Dawsonville Highway) at SR 400 experience more than four times the delay of the next worst signalized intersection, Dawson Forest Road at SR 400.

Chart 8 SR 400 Top Five Intersections by Delay (P.M. Peak Hour)



Source: CORSIM model

Table 15 summarizes the existing delay and LOS at the five intersections in the study corridor with the highest amount of delay during the p.m. peak hour. As shown, only two signalized intersections in the study corridor, SR 369 (Browns Bridge Road) and SR 53 (Dawsonville Highway), are currently operating below LOS C, the Georgia DOT statewide service standard. The other three intersections are currently operating at LOS B. In contrast to the a.m. peak hour, during the p.m. peak hour, SR 369 (Browns Bridge Road) is experiencing 81 percent more delay and SR 53 (Dawsonville Highway) is experiencing 111 percent more delay.

Table 15 SR 400 Top Five Signalized Intersections by Delay (P.M. Peak Hour)

Signalized Intersection	Delay (Seconds)	LOS
SR 53 (Dawsonville Highway)	83.0	F
Dawson Forest Road	17.3	B
SR 60 (South Chestatee Road)	17.0	B
SR 306 (Keith Bridge Road) at SR 400 Southbound Ramp	16.0	B

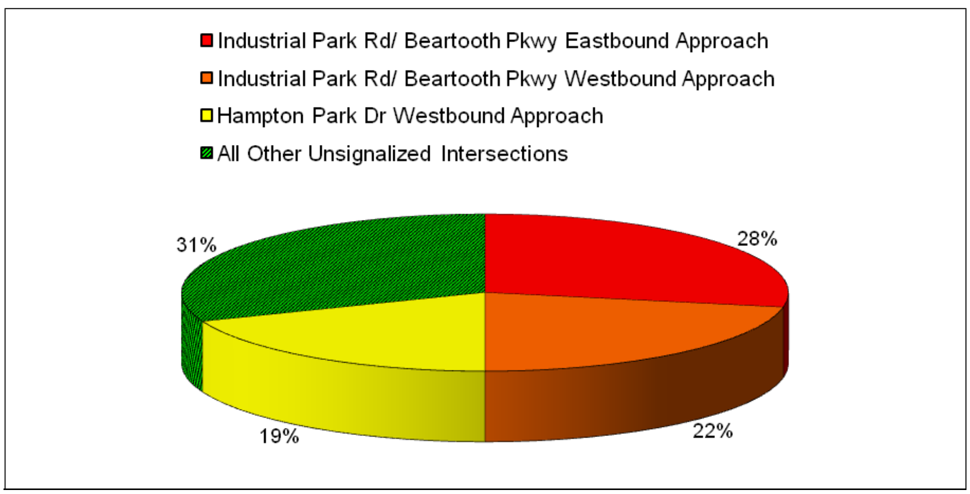
Source: CORSIM model

Vehicle delay during the p.m. peak hour based on turning movements for all intersections evaluated as part of the SR 400 corridor study is detailed in Table 16. Intersection delay and corresponding levels of service during the a.m. and p.m. peak hours at the signalized intersections are summarized in Table 9 presented previously in this section.

Several unsignalized intersections in the study corridor were also evaluated using CORSIM. Intersections operating at LOS D or worse during the a.m. peak hour were determined based on the calculated delay.

During the a.m. peak hour, the eastbound and westbound approaches of Industrial Park Road/Beartooth Parkway and the Hampton Park Drive westbound approach at SR 400 are operating at LOS E or worse. As shown on Chart 9, these three legs of unsignalized intersections account for 69 percent of the delay at unsignalized intersections in the SR 400 corridor during the a.m. peak hour. Improvements that reduce delay at these two intersections will provide a better return on transportation investments.

Chart 9 SR 400 Unsignalized Intersection Delay (A.M. Peak Hour)



Source: CORSIM model

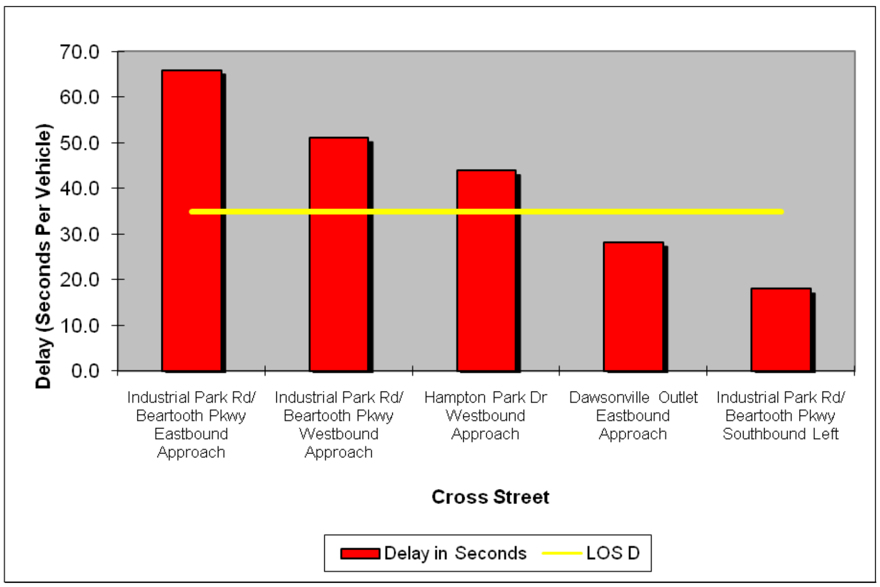
Table 16 SR 400 Vehicle Delay Based on Intersection Turn Movement (P.M. Peak Hour)

Intersection	P.M. Peak-Hour Delay (Sec/Veh)											
	Northbound			Southbound			Eastbound			Westbound		
	L	T	R	L	T	R	L	T	R	L	T	R
SR 306 at SR 400 Northbound Ramp	34.3	–	11.4	–	–	–	69.3	7.5	–	–	8.3	4.8
SR 306 at SR 400 Southbound Ramp	–	–	–	32.1	–	9.9	–	10.4	5.0	28.1	11.0	–
SR 369 at SR 400	62.6	181.4	47.5	75.8	16.0	12.7	34.5	62.2	10.8	35.3	33.7	22.3
Settingdown Road at SR 400	14.9	8.5	9.1	0.0	9.4	11.5	40.6	35.4	11.9	42.0	35.9	19.4
Hampton Park Drive at SR 400	–	1.82	5.9	15.7	0.9	–	–	–	–	31.8	–	15.5
Hubbard Town Road/Cross Roads Road at SR 400	14.1	9.3	9.4	26.5	9.5	9.7	30.5	26.3	7.5	35.4	35.0	15.6
Jot Em Down Road at SR 400	25.7	12.6	11.0	19.2	8.0	7.3	37.4	33.1	22.3	42.6	32.9	29.5
Dawson Forest Road at SR 400	30.6	14.6	16.1	32.7	15.8	7.6	24.3	18.0	8.8	26.3	21.7	19.5
Dawsonville Outlet at SR 400	15.5	5.6	11.3	16.8	1.1	6.3	78.1	59.3	13.9	–	–	11.3
Industrial Park Road/Beartooth Parkway at SR 400	15.0	1.8	7.6	28.4	6.8	13.2	118.2	56.3	15.6	79.8	114.3	37.4
SR 53 at SR 400	141.1	109.2	44.9	151.7	67.3	19.8	61.2	73.0	23.6	111.3	32.6	19.4
Lumpkin Campground Road/Harmony Church Road at SR 400	0.0	11.5	10.7	18.3	6.7	8.1	24.5	22.7	5.4	25.9	24.3	14.1
SR 136/Auraria Road at SR 400	19.7	12.3	8.1	20.4	13.4	8.9	21.4	15.8	10.1	8.0	8.6	6.8
Burnt Stand Road/Lumpkin County Parkway	12.3	5.6	7.6	11.1	6.9	7.3	32.6	21.4	12.5	30.1	19.9	11.7
SR 60 at SR 400	19.1	15.9	15.9	27.7	17.8	11.2	27.7	21.8	8.1	18.9	15.6	15.9

Source: CORSIM model

Unsignalized intersections in the SR 400 corridor are sorted by delay during the morning peak hour in descending order to identify the five unsignalized intersection approaches with the highest level of delay, as shown on Chart 10. Additionally, the chart shows that two unsignalized intersections, Industrial Park Road/Beartooth Parkway and Hampton Park Drive at SR 400, have 50 percent more delay than the unsignalized intersection with the next highest level of delay, Dawsonville Outlet at SR 400.

Chart 10 SR 400 Top Five Unsignalized Intersections by Delay (A.M. Peak Hour)



Source: CORSIM model

Table 17 summarizes the existing delay and LOS at the five unsignalized intersection approaches in the study corridor with the highest amount of delay. As shown, four of the top five unsignalized intersection approaches in the study corridor are operating at LOS D or worse during the a.m. peak hour, with two operating at LOS F. Both the eastbound and westbound approaches of Industrial Park Road/Beartooth Parkway are currently operating at a failing level of service during the a.m. peak hour, while the Hampton Park Drive westbound approach and the Dawsonville Outlet eastbound approach operate below LOS C, the Georgia DOT statewide service standard. Although the Industrial Park Road/Beartooth Parkway southbound left is currently operating at an acceptable LOS, it is approaching LOS D.

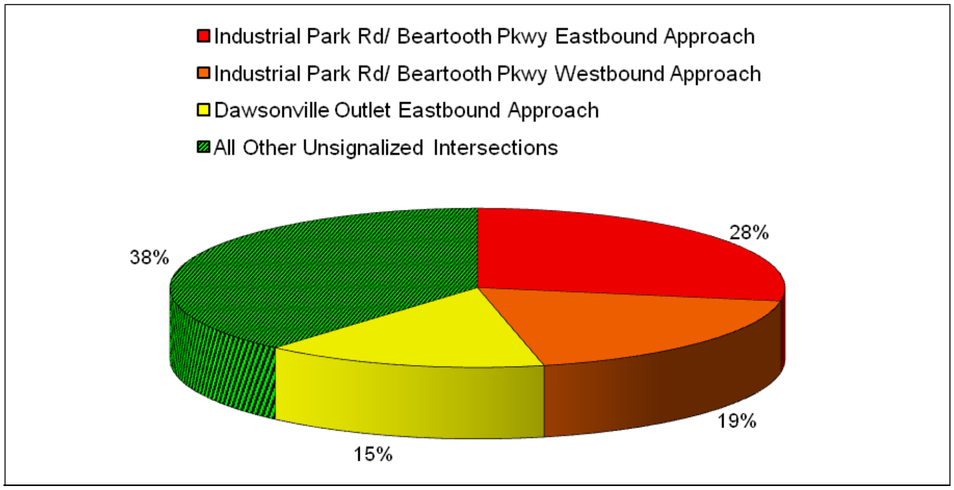
Table 17 SR 400 Top Five Unsignalized Approaches by Delay (A.M. Peak Hour)

Unsignalized Approach	Delay (Seconds)	LOS
Industrial Park Road/Beartooth Parkway Eastbound Approach	65.8	F
Industrial Park Road/Beartooth Parkway Westbound Approach	51.0	F
Hampton Park Drive Westbound Approach	43.8	E
Dawsonville Outlet Eastbound Approach	28.1	D
Industrial Park Road/Beartooth Parkway Southbound Left	17.9	C

Source: CORSIM model

Based on the calculated delay, intersections operating at LOS D or worse during the p.m. peak hour are identified. Additionally, the five unsignalized intersection approaches with the highest levels of delay were determined. During the p.m. peak hour, the eastbound and westbound approaches of Industrial Park Road/Beartooth Parkway and the Dawsonville Outlet eastbound approach at SR 400 are operating at LOS E or worse. As shown on Chart 11, these three legs of unsignalized intersections account for 62 percent of the delay at unsignalized intersections in the SR 400 corridor during the p.m. peak hour. Industrial Park Road/Beartooth Parkway also accounts for a significant amount of delay during the a.m. peak hour. Improvements that reduce delay at these two intersections will provide better returns on transportation investments.

Chart 11 SR 400 Unsignalized Intersection Delay (P.M. Peak Hour)



Source: CORSIM model

Unsignalized intersections in the SR 400 corridor are sorted by delay during the p.m. peak hour in descending order to identify the five unsignalized intersections with the highest level of delay, as shown on Chart 12. Additionally, the chart shows that the two unsignalized intersections, Industrial Park Road/Beartooth Parkway and Dawsonville Outlet at SR 400, have at least 52 percent more delay than the unsignalized intersection leg with the next highest level of delay, the Industrial Park Road/Beartooth Parkway southbound left at SR 400.

Chart 12 SR 400 Top Five Unsignalized Intersections by Delay (P.M. Peak Hour)

Source: CORSIM model

The existing delay and LOS at the five unsignalized intersection approaches with the most delay during the p.m. peak hour are presented in Table 18. As shown, four of the five intersection approaches are operating at LOS D or worse during the p.m. peak hour, with two operating at LOS F. Both the eastbound and westbound approaches of Industrial Park Road/Beartooth Parkway are currently operating at a failing level of service during the p.m. peak hour, while the Dawsonville Outlet eastbound approach and Industrial Park Road/Beartooth Parkway southbound left approach operate below LOS C. Although the Hampton Park Drive westbound approach is currently operating at an acceptable LOS, it is approaching LOS D. During the p.m. peak hour, the Industrial Park Road/Beartooth Parkway eastbound approach is experiencing 24 percent more delay and the Industrial Park Road/Beartooth Parkway westbound approach is experiencing 10 percent more delay than during the a.m. peak hour.

Table 18 Top Five Unsignalized Approaches by Delay (P.M. Peak Hour)

Unsignalized Approach	Delay (Seconds)	LOS
Industrial Park Road/Beartooth Parkway Eastbound Approach	81.9	F
Industrial Park Road/Beartooth Parkway Westbound Approach	55.9	F
Dawsonville Outlet Eastbound Approach	43.3	E
Industrial Park Road/Beartooth Parkway Southbound Left	28.4	D
Hampton Park Drive Westbound Approach	22.4	C

Source: CORSIM model

Vehicular delays and corresponding a.m. and p.m. peak-hour levels of service at all studied unsignalized intersections are detailed in Table 19.

Table 19 SR 400 Capacity Analysis Summary – Unsignalized Intersections

	CORSIM Delay (Sec/Veh)		CORSIM LOS[1]	
Unsignalized Intersections	**A.M.**	**P.M.**	**A.M.**	**P.M.**
Hampton Park Drive at SR 400				
• Southbound Left Turn	0.1	15.6	A	C
• Westbound Approach	43.8	22.4	E	C
Dawsonville Outlet at SR 400				
• Northbound Left	0.1	15.5	A	C
• Southbound Left	10.0	16.8	A	C
• Eastbound Approach	28.1	43.3	D	E
Industrial Park Road/Beartooth Parkway at SR 400				
• Northbound Left	16.0	15.0	C	B
• Southbound Left	17.9	28.4	C	D
• Eastbound Approach	65.8	81.9	F	F
• Westbound Approach	51.0	55.9	F	F

Source: CORSIM model

[1]Level of service based on CORSIM delay

3.3 Safety

Safety issues along SR 400 are of concern because of high traffic volumes, speeds, and at-grade intersections. The following analysis describes the conditions of the corridor with respect to safety and compares the corridor to other similar facilities throughout the state. Locations exhibiting substantially higher crash rates than the average are analyzed in more detail to isolate the types and potential causes of crashes.

A total of 1,141 crashes took place on SR 400 from 2000 to 2003. Of these, 331 were injury crashes and 10 resulted in one or more fatalities. While the absolute number of crashes that occur on a given corridor is one indicator of safety, crash rates are better for establishing relative levels of safety among similar facility types. Therefore, the analysis presented relies on crash rates to identify segments of SR 400 that appear most susceptible to crashes. Crash rates take traffic volume and road section length into consideration to create a ratio expressed as “number of crashes” per “100 million vehicle miles of travel.” As such, crash rates can highlight areas that may appear to have a low or average number of crashes but, when compared to other segments of the same functional class, actually exhibit a higher degree of crash danger.

Injury and fatal crashes have disproportionately higher monetary and social costs associated with them and are therefore highlighted independently in this analysis. Consideration of fatal, injury, and total crashes on a particular road segment is referred to in terms of the “*severity”* at a location. Road sections with especially high total crash rates or with high injury and/or fatal crash rates were identified and categorized as “*critical*” sections.

3.3.1 Methodology

For the purpose of establishing crash rates for individual segments of the SR 400 corridor, the corridor was subdivided into 13 sections ranging in length from 0.38 to 2.14 miles (see Figure 4). Segment labels were assigned in ascending order from south (northeastern edge of Cumming in Forsyth County) to north (SR 60 in Lumpkin County). A table of segment attributes, including segment lengths, is provided in Appendix D.

As might be expected, a disproportionate amount of crashes occur at or near intersections, as opposed to the mid-block area between intersections. Because intersection crashes can be assigned to one side of the intersection or another, a decision must be made when assigning these intersection crashes to a corridor segment in order to calculate a crash rate. For the purposes of this analysis, crashes located at or near an intersection were included in the calculation of the crash rates for the segment directly to the south of the intersection.

Each segment of the SR 400 corridor was assigned a relative score for three different crash statistics, and those with the highest relative scores are identified as “critical.” The three statistics are:

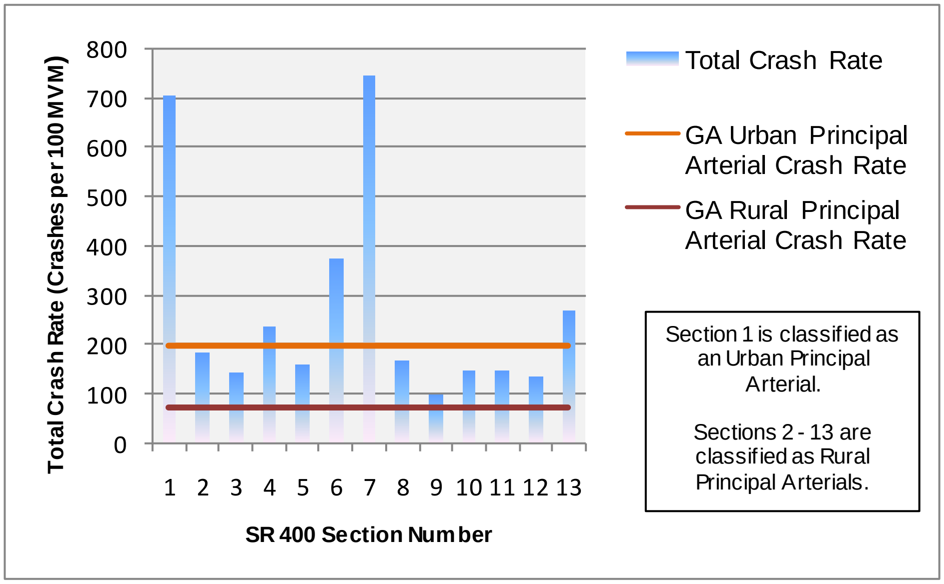
- Total crash rate
- Severe crash rate
- Fatal crash frequency

Additional detail regarding methodology and crash history is provided in Appendix D.

3.3.2 Total Crash Rate

Overall, the level of safety on SR 400 is substantially worse than levels experienced on roads of the same functional class located elsewhere in Georgia. Between 2000 and 2003, the corridor crash rate of 213 crashes per 100 million vehicle miles traveled (VMT) was well above the statewide average total crash rate of 142 crashes per 100 million VMT. Chart 13 displays the total crash rate for each of the 13 segments of SR 400. The chart also displays the corridor and statewide average crash rates for facilities of the same functional class. These rates are 200 crashes per 100 million VMT on urban principal arterials and 73 crashes per 100 million VMT on rural principal arterials.

Chart 13 Crash Rates for Total Crashes (SR 400)



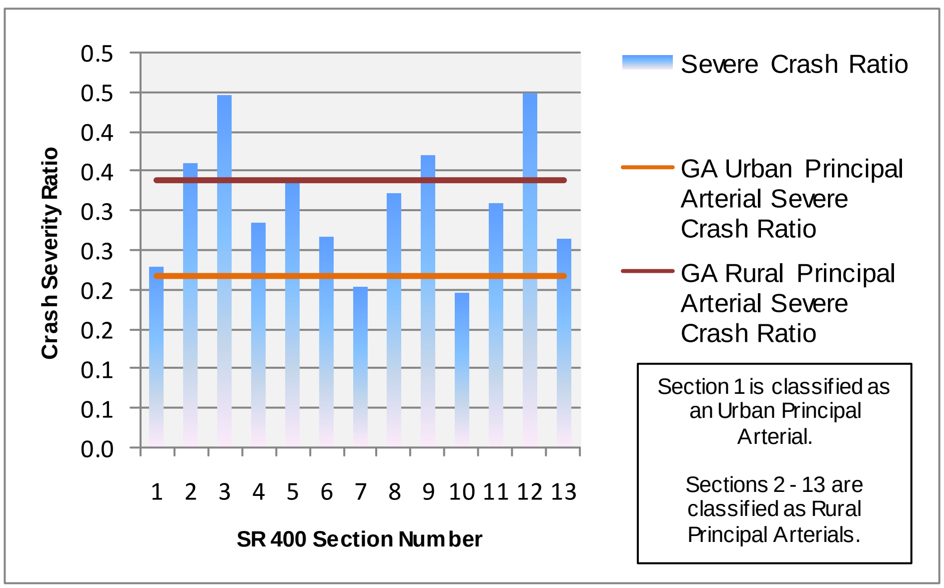
Source: Raw data from Georgia DOT

Total crash rates computed for individual sections varied widely. Every section experienced crash rates higher than the statewide average for roads of the same functional class, with several sections experiencing crash rates significantly above the statewide average. The highest total crash rate from 2000 to 2003 occurred on Section 7 in Dawson County, which includes the Dawsonville Highway/SR 53 intersection. There were 746 crashes per 100 million VMT on this section, which is approximately 10 times the statewide average for rural principal arterials. Section 1, from Keith Bridge Road/SR 306 to Browns Bridge Road/SR 369 in Forsyth County, also exhibited a very high rate for total crashes. The Section 1 rate was 707 total crashes per 100 million VMT, which is three-and-a-half times the statewide average for urban principal arterials. The causes of these high total crash rates were the relatively short section lengths and the high numbers of total crashes. In both cases, the influence from high-volume, at-grade cross streets at the northern end of each section had a significant impact on collisions on SR 400. The third highest section was Section 6 with a crash rate of 376 crashes per 100 million VMT, which is roughly five times the statewide average for rural principal arterials. All other sections experienced higher crash rates than the statewide average corresponding to their functional classification.

3.3.3 Severe Crash Ratio

Severe crashes are those that result in an injury or fatality. The severe crash ratio was computed by dividing the sum of injury and fatal crashes by the total number of crashes. Based on corridor crash characteristics from 2000 to 2003, the overall severity of crashes on the SR 400 corridor is slightly below the statewide severity for roads of the same functional class. Overall, the corridor severe crash ratio of 0.30 injury or fatal crashes per crash is under the statewide average of 0.34. Chart 14 displays the relative crash severity of each roadway segment, along with the statewide ratio computed for roads of the same functional class.

Chart 14 Severe Crash Ratio



Source: Raw data from Georgia DOT

Four roadway sections have computed severe crash ratios above 0.34, the statewide average for rural principal arterials. The highest severe crash ratio, 0.45, is for Section 12 in Lumpkin County between Whelchel Road and Burnt Stand Road/Lumpkin County Parkway. Section 3 in Forsyth County, from Settingdown Road to Hubbard Farm Road/Cross Roads Road, has a slightly lower severity ratio of 0.44. Other sections with high severity ratios above the statewide average for rural principal arterials are Section 9 in Dawson County at 0.37 (Lumpkin Campground Road/Harmony Church Road to SR 136) and Section 2 in Forsyth County with a ratio of 0.36 (Browns Bridge Road/SR 369 to Settingdown Road). Section 5 in Dawson

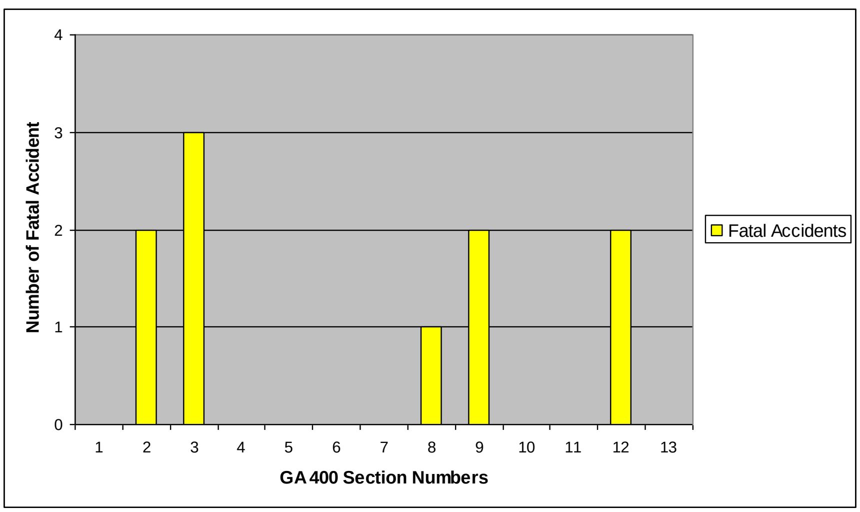
County (Jot Em Down Road to Dawson Forest Road) has a severe crash ratio of 0.34, identical to the statewide average for rural principal arterials.

Section 1, which is classified as an urban principal arterial, has a severe crash ratio of 0.23, which is only marginally higher than the statewide severe crash ratio average of 0.22 for urban principal arterials.

3.3.4 Fatal Crash Frequency

The third screening statistic used to identify critical sections is called the "Fatal Crash Frequency," which is the number of fatal crashes that occurred on a particular roadway section from 2000 to 2003. Overall, the SR 400 corridor fatal crash rate of 1.90 crashes per 100 million VMT is slightly higher than the 1.78 crashes per 100 million VMT statewide average fatal crash rate. Chart 15 displays the number of fatal crashes per section.

Chart 15 SR 400 Fatal Crash Frequency



Source: Raw data from Georgia DOT

Fatal crashes occurred on five of the 13 crash analysis sections. The section with the greatest number of fatal crashes between 2000 and 2003 was Section 3 (Settingdown Road to Hubbard Farm Road/Cross Roads Road) in Forsyth County, where three fatal crashes occurred. Two fatal crashes took place on three sections: Section 2 (Browns Bridge Road/SR 369 to Settingdown Road) in Forsyth County; Section 9 (Lumpkin Campground Road to SR 136) in Dawson County; and Section 12 (Whelchel Road to

Burnt Stand Road/ Lumpkin County Parkway) in Lumpkin County. One fatal crash occurred on Section 8 in Dawson County (SR 53 to Lumpkin Campground Road).

3.3.5 Section Rankings

The three crash statistics presented above were combined to create a composite safety score for each of the 13 analysis sections of SR 400. The composite safety score of each section was computed as the sum of the rankings that were assigned for each vital safety statistic; the lower the sum of the three rankings for a given segment, the greater the severity of the crash characteristics observed there. Because more than half of the sections did not have any fatal crashes between 2000 and 2003, the same fatal crash rank was assigned to these eight sections. For these eight sections, a ranking of “6” was applied.

The section-level rankings and composite safety score for each section in the SR 400 corridor are presented in Table 20. The section from Browns Bridge Road/SR 369 to Settingdown Road in Forsyth County (Section 2) is ranked as the most critical section in the corridor. It is ranked at the top because it has the second highest number of fatal crashes, the fourth highest severity ratio, and the sixth highest total crash rate. The next section north in Forsyth County, Section 3, is deemed the second most critical portion of the corridor in terms of safety. Section 3, from Settingdown Road to Hubbard Farm Road/Cross Roads Road, received its ranking because it has the highest number of fatal crashes, is second in severity ratio, and is 11th in total crash rate.

Table 20 Crash Severity Scores by Segment

Section No.	Description	Ranks			
		Total Crash Rate	Severe Crash Rate	Fatal Crash Frequency	Composite Total
1	Keith Bridge Road/SR 306 – Browns Bridge Road/SR 369	2	11	6	19
2	Browns Bridge Road/SR 369 – Settingdown Road	6	4	2	12
3	Settingdown Road – Hubbard Farm Road/Cross Roads Road	11	2	1	14
4	Hubbard Farm Road/Cross Roads Road – Jot Em Down Road	5	8	6	19
5	Jot Em Down Road – Dawson Forest Road	8	5	6	19
6	Dawson Forest Road – Industrial Park Road/Green Forest Road	3	9	6	18
7	Industrial Park Road/Green Forest Road – SR 53	1	12	6	19
8	SR 53 – Lumpkin Campground Road/Harmony Church Road	7	6	5	18
9	Lumpkin Campground Road/Harmony Church Road – SR 136	13	3	4	20
10	SR 136 – Heath Road	11	13	6	30
11	Heath Road – Whelchel Road	10	7	6	23
12	Whelchel Road – Burnt Stand Road/Lumpkin Co. Parkway	12	1	3	16
13	Burnt Stand Road/Lumpkin Co. Parkway – SR 60	4	10	6	20

Most critical rank
2nd most critical rank
3rd most critical rank
4th most critical rank

The five sections with the lowest composite total scores had total scores of less than 19. Each of these sections has one or more crash statistic associated with it that merits consideration in the formulation of short-term and long-range road improvement strategies. These sections are highlighted on Figure 5.

3.3.6 Crash Type and Location

Crash type is an additional characteristic to consider when assessing the safety of a corridor. Crash type indicates the nature of the crash with respect to the physical positions of the cars involved (e.g., rear end, head on, etc.).

Crash type as a proportion of total crashes varies significantly between the crash analysis sections of SR 400 (see Table 21). Crash types can be suggestive of the physical characteristics of a given segment, being that road configuration may have an effect on crash occurrences. The crash types that account for the highest proportion of crashes on individual crash analysis sections are rear-end crashes, angle crashes, and crashes with objects other than motor vehicles.

Angle crashes suggest the presence of unsignalized intersections where vehicles turning left, entering, or crossing the mainline have potential to make contact with moving vehicles traveling on the mainline. The segments with the highest relative proportion of angle crashes are Sections 3, 6, 8, and 12. Three unsignalized intersections on SR 400 are located in Sections 3 and 6, which may help explain the relatively high proportion of angle crashes there. However, Sections 8 and 12 do not have any unsignalized intersections, and it is not clear why a relatively high proportion of angle accidents occur in these sections.

Head-on crashes suggest a roadway that does not adequately separate bidirectional traffic. Given that SR 400 is median-separated, the head-on crashes that occurred in Sections 3, 4, 5, 7, and 13 likely resulted from random occurrences of extreme driver error, such as crossing the grass median or traveling in the wrong direction.

Crashes with objects other than motor vehicles are probably crashes with wildlife such as deer. These types of crashes are more likely in areas of undeveloped land, which may serve as deer habitat. The segments with the highest relative proportion of crashes with objects other than motor vehicles are Sections 9, 10, and 11. Although there is a significant amount of undeveloped land adjacent to this portion of SR 400 (especially on the west side), this type of adjacent land use is common to much of the SR 400 study corridor. Without knowing exactly what the objects were, a determination cannot be made as to why these sections feature relatively high proportions of crashes with objects other than motor vehicles.

Rear-end crashes may occur in relatively higher proportions on sections of SR 400 that feature signalized intersections. This is because drivers at a complete stop at red lights are vulnerable to a conflict with vehicles potentially traveling at high speeds behind them. Rear-end crashes represent the highest proportion of crashes on analysis sections, occurring more frequently than any other crash type. Sections 1, 4, and 7 feature very high proportions (greater than 70 percent) of rear-end crashes, while Sections 2, 5, 6, and 13 feature high proportions of rear-end crashes. All of these sections include signalized intersections, which likely contributes to the relatively high proportion of rear-end crashes. These intersections may be more prone than other signalized intersections in the corridor as a result of shorter sight distances, longer intersection queues, and/or higher vehicle speeds.

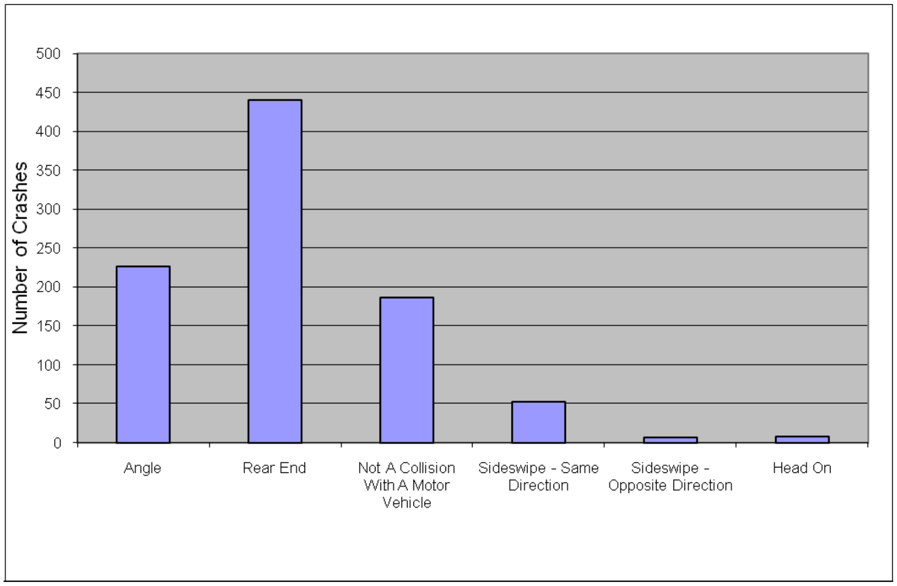
Sideswipe accidents may occur in relatively higher proportions on sections of SR 400 that have a higher number of access points, particularly driveways, right-only road intersections, or interchanges. These features require entering and exiting drivers to perform merging and weaving maneuvers, thereby increasing the likelihood of same-direction sideswipes. Because SR 400 is median-separated, it is likely that opposite direction sideswipe crashes are a result of extreme driver error. Sections 10 and 11 feature the highest relative proportions of same-direction sideswipe crashes. However, neither segment contains an interchange or a particularly high number of access points. Given that other crash analysis sections with more access points have a relatively low proportion of same-direction sideswipe crashes, it is likely that these types of crashes are generally caused by driver error when merging and changing lanes rather than the physical characteristics of SR 400.

Table 21 SR 400 Crash Types by Section

Section ID	Total No. of Crashes	Angle	Head-On	Not a Collision with Motor Vehicle	Rear-End	Sideswipe (Opp. Dir.)	Sideswipe (Same Dir.)
1	227	7% (15)	0% (0)	4% (9)	82% (188)	0% (0)	7% (15)
2	100	30% (30)	0% (0)	11% (11)	50% (50)	1% (1)	8% (8)
3	110	45% (49)	2% (2)	21% (23)	25% (28)	2% (2)	5% (6)
4	102	12% (12)	2% (2)	8% (8)	74% (76)	1% (1)	3% (3)
5	103	22% (23)	2% (2)	10% (10)	61% (63)	0% (0)	5% (5)
6	71	39% (28)	0% (0)	9% (6)	48% (34)	1% (1)	3% (2)
7	89	7% (6)	1% (1)	3% (3)	83% (74)	0% (0)	6% (5)
8	68	38% (26)	0% (0)	24% (16)	32% (22)	0% (0)	6% (4)
9	35	17% (6)	0% (0)	60% (21)	23% (8)	0% (0)	0% (0)
10	46	22% (10)	0% (0)	50% (23)	15% (7)	2% (1)	11% (5)
11	29	14% (4)	0% (0)	45% (13)	31% (9)	0% (0)	10% (3)
12	40	42% (17)	0% (0)	32% (13)	18% (7)	3% (1)	5% (2)
13	121	22% (27)	1% (1)	15% (18)	55% (67)	1% (1)	6% (7)

As shown on Chart 16, rear-end type crashes are by far the most frequent along the SR 400 study corridor. The next most frequent crash type is angle, followed by crashes that involve collisions with something other than a motor vehicle. By comparison, sideswipe and head-on crashes are relatively infrequent.

Chart 16 Crash Type Frequency



Source: Raw data from Georgia DOT

Locations in the SR 400 corridor with the highest concentration of crashes were also identified and are as follows:

- SR 400 at Browns Bridge Road
- SR 400 at SR 53
- SR 400 between SR 136 and Auraria Road
- SR 400 at SR 60
- SR 400 at Jot Em Down Road

It is important to note that the locations of crash concentrations cannot be described in precise terms. All that can be said of a cluster of crashes is that they are in the general vicinity of a particular location. Therefore, although the locations listed above are precise, it is not necessarily true that the crashes occurred precisely in the middle of the intersection. Figure 6 displays the spatial distribution of crashes along the SR 400 corridor, as well as areas of high crash concentration.

3.4 Land Use, Environment, and Economic Development

It is important to assess current and future land use in the study corridor not only to plan for the future but to understand how existing land use patterns interact with the transportation network to create the observed transportation conditions. Environmental and economic development resources must also be assessed to identify potential issues or opportunities with infrastructure improvements.

3.4.1 Existing Land Use

The southern portion of the SR 400 study area in Forsyth County is primarily undeveloped land with scattered areas of residential, commercial, and agricultural use adjacent to the corridor. Several retail establishments are located on the east side of the Keith Bridge Road interchange, at the project corridor's southern terminus. Other scattered commercial/retail developments along the southern portion of the project corridor primarily include household goods retailers, flea markets, antique stores, and self-storage facilities.

The central portion of the SR 400 project corridor, located in Dawson County, consists of the same land use classifications as the southern portion of the corridor; however, areas of commercial and residential use are much larger along this portion and more concentrated. Commercial/retail use along the portion of SR 400 in Dawson County is primarily concentrated between the Carlisle Road/Whitmire Drive and SR 53 intersections. Located within this area is North Georgia Premium Outlets, as well as outlying retailers and restaurants. After this predominantly commercial area, the corridor transitions into undeveloped and residential use, with scattered institutional (church) use.

The northern portion of the SR 400 project corridor is located in Lumpkin County. Undeveloped land with small, scattered residential use surrounds the majority of this portion of SR 400. Most commercial use along the corridor is concentrated around the SR 400/Whelchel Road intersection, with some commercial use around the SR 400/ SR 60 intersection.

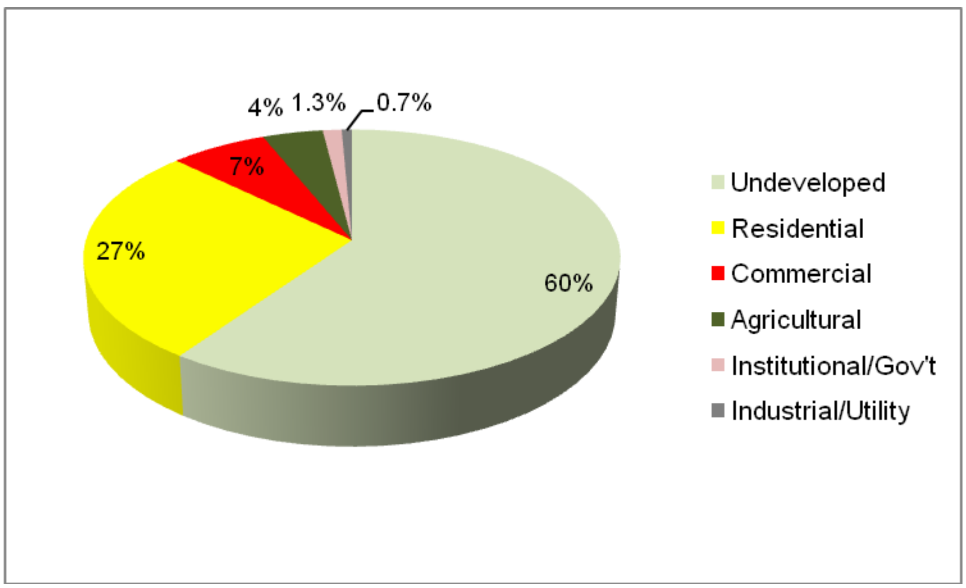
Table 22 and Chart 17 display the distribution of existing land uses in the SR 400 corridor area. Figure 7 displays the spatial distribution of existing land use.

Table 22 Existing Land Use Distribution

Existing Land Use	Total Acres	Percent
Undeveloped	8,798	60%
Residential	4,035	27%
Commercial	985	7%
Agricultural	612	4%
Institutional/Government	171	1.3%
Industrial/Utility	112	0.7%
Total	14,713	100%

Source: Forsyth, Dawson, Lumpkin County Land Use Plans

Chart 17 SR 400 Corridor – Existing Land Use Distribution



Source: Field survey (2006)

3.4.1.1 Churches and Institutions

Several land uses are considered more sensitive land uses, and include such uses as churches or other religious institutions, schools, and public facilities. These uses are usually closely associated with the quality of life within a community. A windshield survey for churches and other institutions was conducted along the SR 400 project corridor. Figure 9 includes general locations of churches and institutions. A list is also included in Appendix E.

3.4.1.2 Cemeteries

No cemeteries were noticed within the SR 400 project corridor during the windshield survey. However, if any cemeteries are identified within the project corridor during more detailed field investigations, it is recommended that they be avoided during project design.

3.4.1.3 Park Lands

Coal Mountain Park, a 26-acre Forsyth County public park, is located at 3560 Settingdown Road, to the west of SR 400. This park is not anticipated to be affected by improvements to the SR 400 corridor, given its distance (more than 1,000 feet) from the existing SR 400 corridor. No other public parks are located in the vicinity of the SR 400 project corridor. While several golf courses exist along the SR 400 project corridor, these recreation areas are not publicly owned, and right-of-way acquisition from these areas would not require a Section 4(f) evaluation.

3.4.1.4 Farmland

Agricultural land use occurs in scattered areas throughout the SR 400 project corridor, on both sides of the existing roadway. The National Farmland Protection Policy Act of 1081 (7 CFR 658) requires that all federal or federally assisted agencies consider the potential impacts of proposed action to prime, statewide, and locally important farmland. In accordance with the National Farmland Protection Policy Act, criteria need to be applied during project development to determine the effects of project implementation to farmland, and to determine whether the proposed farmland conversion is consistent with the Farmland Protection Policy Act. Form AD-1006, “Farmland Conversion Impact Rating,” or Form NRCS-CPA-106, “Farmland Conversion Impact Rating for Corridor Type Projects,” must be completed for the project and submitted to the Natural Resources Conservation Service (NRCS) for review and concurrence.

3.4.1.5 Potential Environmental Justice Concerns

In accordance with Executive Order 12898, improvements to the project corridor need to be analyzed to avoid disproportionate adverse effects to minority and low-income populations and communities. Minority persons include citizens or lawful, permanent residents of the United States who are African-American, Hispanic, Asian-American, American Indian, or Alaskan Native. Low-income persons are those whose median household income is below the United States Department of Health and Human Services poverty guidelines. Minority or low-income communities are groups of minority or low-income persons who live in reasonably close proximity to one another.

Year 2000 Census data was evaluated to assess the project corridor for the locations of environmental justice populations. According to the data, the entire SR 400 project corridor could potentially raise environmental justice concerns due to lower-than-average income levels (southern portion of the project corridor, in Forsyth County), higher-than-average minority populations (central portion of the project corridor, in Dawson County), or lower-than-average education levels (northern portion of the project corridor, in Lumpkin County, as well as some portions of the project corridor in Forsyth County).

Potential environmental justice communities, and the potential for disproportionate adverse impacts on any such communities, should be more fully identified during project development. If it is determined that there may be a disproportionately high and adverse impact to an environmental justice community, additional public involvement should be conducted. Such public involvement should further define the community, identify the needs and wishes of the community, determine project scenarios, and identify mitigation efforts.

3.4.1.6 Historic Structures and Archaeology

Section 106 of the National Historic Preservation Act of 1966 requires federal agencies to take into account the effects of their undertakings on historic properties and afford the Advisory Council on Historic Preservation (ACHP) a reasonable opportunity to comment on such undertakings.

No historic markers were noted along the corridor during a windshield survey. Georgia's Natural, Archaeological, and Historic Resources Geographic Information System (NAHRGIS) database was queried to determine if there are any known or listed resources eligible for the National Register of Historic Places (NRHP) within the vicinity of the SR 400 corridor. According to this data, potentially eligible properties exist within the vicinity of the SR 400 corridor, all of which are residential properties. These properties should be taken into consideration during the design of this project. However, it should be noted that some of the properties listed in the NAHRGIS database may not be considered eligible for the NRHP, or may no longer exist (a few of these properties could not be verified in the field). In addition, the NAHRGIS database does not contain a complete listing of all potential historic properties within the project area. During a windshield survey, several additional potential historic properties (not listed in the NAHRGIS database) were identified in the vicinity of the SR 400 corridor. Additional historic properties may exist within the project corridor and would require an assessment by a qualified architectural historian. Exact locations and descriptions of potential historic structures should be identified during preliminary engineering activities. Figure 9 displays the approximate locations of potential historic structures identified through field observation. Appendix E contains data on the potential historic structures, including NAHRGIS ID (if applicable), street location, county, and structure type.

Several Indian archaeological sites have been documented within Forsyth County, one of which is located on Settingdown Creek near the mouth of the Etowah River. While this is outside the area of potential effect for SR 400 improvements, given its proximity to the study area, the project corridor could contain eligible NRHP archaeological sites. In addition, because Lumpkin County was part of the last remaining Indian land in Georgia, the archaeological potential in this area is high. The Chestatee and Etowah rivers, as well as other water courses in the county, exhibit a high potential for containing both prehistoric and historic archaeological resources. Based on previous roadway construction and residential and commercial construction in some areas, it is not likely that any intact archaeological sites would remain within the SR 400 corridor; however, an assessment by a qualified archaeologist should be completed. In addition, this project may require tribal coordination as necessary through guidance by Georgia DOT.

3.4.2 Future Land Use

The SR 400 corridor study area spans Forsyth, Dawson, and Lumpkin counties, and in all of these counties, commercial land use dominates the projections in the areas adjacent to the roadway. In these locations of projected commercial development, other land uses tend to be set back from the roadway by approximately 300 to 1,500 feet. In Forsyth County, the predominant projected non-commercial land uses are high- and medium-density residential. Additionally, Forsyth County is projected to have significant areas of conservation land in irregular snaking patterns, presumably following the organic shape of creeks or other natural features. There is very little projected institutional or office land use in Forsyth County.

The projected land uses in Dawson and Lumpkin counties are much less diverse than those in Forsyth County, likely a result of being located farther north of Atlanta and its encroaching development. The land adjacent to the roadway is particularly less diverse, and is projected to be primarily commercial. Additionally, these projected commercial strips are usually wider than the commercial strips in Forsyth County.

In addition to commercial land use, Dawson County's other projections of significant sizes include rural, low-density residential, and office land uses. Projected rural land is located to the east of SR 400 in central Dawson County. Projected low-density residential is scattered throughout the study area with concentrations to the north near the Lumpkin County border. Projected office land use is also scattered through the county but is more predominant to the west of SR 400. Additionally, there are pockets of projected high-density residential, institutional, industrial, and conservation land throughout the county.

Lumpkin County is projected to have the least diverse land uses in the SR 400 study area. Similar to Forsyth and Dawson counties, commercial land uses dominate the land adjacent to the roadway. Aside from the commercial land use, there are irregularly shaped conservation areas and blocks of low-density residential or rural areas. In Lumpkin County, there are some locations where conservation land use is directly adjacent to the highway.

Overall, future land use projections along the SR 400 corridor represent significant changes compared to current land use. Undeveloped land is projected to decrease from 60 percent to 15 percent, while commercial land uses are expected to increase from 7 percent to 46 percent. Residential land uses are not expected to change significantly. While industrial land use is not projected to constitute a large percentage of the study area, it is nevertheless expected to increase significantly from 0.7 percent to 3 percent.

As shown in the following table and chart, almost half (46 percent) of the projected future land use in the SR 400 corridor study area is commercial. Residential areas account for a quarter of the future land use, evenly split between high-density and low-density development. Rural and conservation land use accounts for another 15 percent of land uses. The remaining 14 percent is comprised of office, medium residential, industrial, and institutional uses. Of these, institutional uses account for the smallest percentage by far, at only 1 percent of the study area. Chart 18 displays future land use along the SR 400 corridor. Figure 8 displays the spatial distribution of projected future land use.

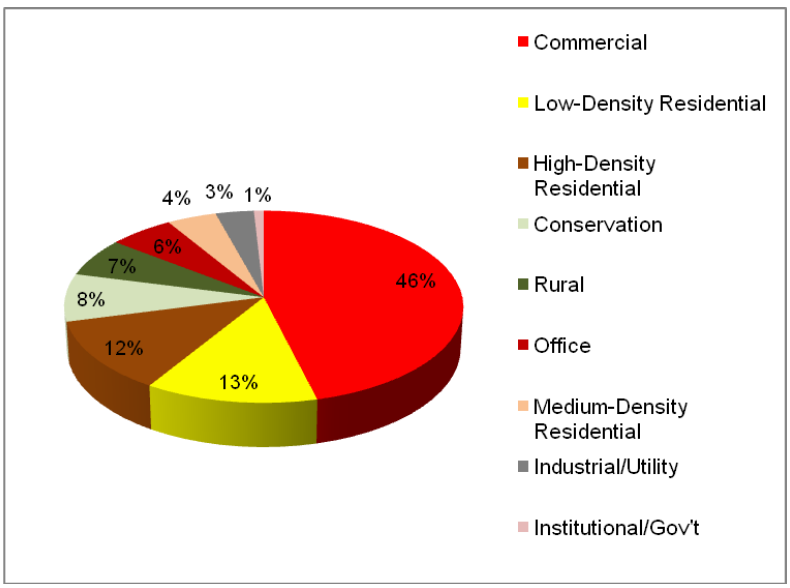
Table 23 SR 400 Corridor – Projected Future Land Use Distribution

Projected Land Use	Total Acres	Percent
Commercial	5,320	46%
Low-Density Residential	1,471	13%
High-Density Residential	1,400	12%
Conservation	927	8%
Rural	752	7%
Office	669	6%
Medium-Density Residential	510	4%
Industrial	394	3%
Institutional	101	1%
Total	11,544*	100%

Source: Forsyth, Dawson, Lumpkin counties; compiled by ARCADIS

*Note: This future land use total acreage is larger than the existing land use total acreage due to larger corridor boundaries used for data analysis.

Chart 18 SR 400 Corridor – Projected Future Land Use Distribution



Source: Forsyth, Dawson, and Lumpkin County Comprehensive Plans

3.4.3 Physical Environment

3.4.3.1 Water Quality and Streams

A review of the State of Georgia Hydrologic Map Cataloging Unit (HUC) indicates that the SR 400 corridor is located within the Upper Chattahoochee River (HUC 03130001) and Etowah River (HUC 03150104) watersheds. The SR 400 corridor crosses three named streams, Bald Ridge Creek, Settingdown Creek, and the Chestatee River. Neither the portion of these streams crossed by SR 400 nor their downstream segments are designated trout streams. The Draft Georgia 2006 305(b)/303(d) List Documents indicate that portions of three water bodies do not support their designated uses. Toto Creek does not fully support its designated use for fishing because of excessive fecal coliform levels from non-point pollutant sources. The Chestatee River does not support its designated use for fishing because of excessive fecal coliform levels from non-point pollutant sources. Settingdown Creek does not support its designated use for fishing because of excessive biota and sedimentation from non-point pollutant sources.

In its *Guidelines for Eating Fish from Georgia Waters, 2006 Update*, the Georgia Department of Natural Resources (DNR) did not issue fish consumption guidance for any of the listed streams. The guidelines prescribe safe human consumption limits of certain fish species, as well as information about the handling and preparation of all fish from listed waters.

There are no known drinking water intakes on the Chestatee River or any waterways that transect SR 400. The closest water intake is for the city of Cumming located downgradient of the project area at Lake Sidney Lanier.

3.4.3.2 Wetlands/Waters of the United States

Federal jurisdictional authority over jurisdictional Waters of the United States is derived from Section 404 of the Clean Water Act of 1972, as amended in 1979. Section 404 relates to the discharge of fill material in “Waters of the U.S.,” including wetlands, and establishes the U.S. Army Corps of Engineers (USACE) as the federal agency responsible for permitting wetland impacts, with oversight by the U.S. Environmental Protection Agency (EPA). Executive Order 11990, Protection of Wetlands, establishes a national policy to “avoid to the extent possible the long-term and short-term adverse impacts associated with the destruction or modification of wetlands and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative."

A preliminary and informal investigation for areas that are likely to contain wetlands and/or non-wetland waters (i.e., streams, rivers, and areas of open water) was conducted within an approximately 1,000-foot study corridor along each side of SR 400. The initial inspection identified the occurrence of aquatic resources associated with and in the vicinity of crossings at Bald Ridge Creek, Settingdown Creek, Mill Creek, Thompson Creek, Toto Creek, and the Chestatee River.

Additional and potential aquatic resources, including unnamed streams, branches, and discharges of groundwater and/or stormwater runoff, were also observed within the Upper Chattahoochee and Etowah watersheds.

Any improvements to the SR 400 corridor that would involve construction activities in these aquatic environments would require authorization of an impact permit pursuant to Section 404 of the Clean Water Act. Throughout Georgia, the Section 404 program is administered by the USACE, Savannah Regulatory District.

In Georgia, there are three levels of permitting under the USACE program: Regional, Nationwide, and Individual Permits. The type of permit coordination and authorization involved depends on the extent of proposed impacts on wetlands/waters of the United States.

A Regional Permit for Minor Discharges for the Construction of Roads and Bridges within the Geographic Limits of Georgia (RGP No. 001) authorizes a maximum impact resulting in the cumulative loss of less than 1 acre of waters of the United States, including wetlands, and/or 300 linear feet of intermittent or perennial stream for a single road project with logical termini. Following submittal of a completed Pre-Construction Notification (PCN) to the USACE, use of RGP 001 can be authorized after as little as a 25-day review by cooperating resource agencies.

Nationwide Permit 14 (NWP 14), Linear Transportation Projects, is regionally conditioned by the USACE to authorize individual roadway projects in Georgia with cumulative impacts to a maximum of 10 acres of wetland and/or 1,500 linear feet of stream within each HUC. However, these regional conditions also limit impacts at each individual crossing not to exceed 0.5 acre of wetlands or 300 linear feet of perennial stream. NWP 14 is generally authorized after a 45-day review, following submittal of a completed PCN to the USACE.

For all other impacts, authorization of an Individual Permit (IP) must be sought. An IP is only issued following a full public interest review that may be conducted concurrently with other public involvement procedures. Anticipated time to authorization of impacts under an IP generally ranges upward from 180 days.

Whichever permit level is deemed appropriate, cumulative project impacts to greater than 1/10 acre of wetlands and/or 100 linear feet of stream within each HUC require compensatory mitigation for all impacts to wetlands and streams within that HUC. Permit applications are not considered complete, and therefore not subject to prescribed review time frames, without inclusion of a compensatory mitigation plan.

3.4.3.3 Endangered/Threatened Species

Under the provisions of the Endangered Species Act of 1973, as amended, federal law requires that any action likely to adversely affect a species or designated critical habitat classified as federally protected be subject to review by the U.S. Fish and Wildlife Service (USFWS) and/or National Marine Fisheries Service (NMFS), as appropriate. Current lists of threatened and endangered species potentially occurring in Forsyth, Dawson, and Lumpkin counties were obtained from Georgia DNR and USFWS. Based on background research and a preliminary survey of the project corridor, the potential occurrence of each federally listed or candidate species and their associated habitats was identified within the study corridor. Results of this analysis are included in Table 24. As this project progresses through concept planning and preliminary design, field investigations for biological resources will be necessary to ensure that the entire project corridor is carefully surveyed and documented for potential impacts to these and other natural resources. If proposed improvements to SR 400 involve alignment changes that veer away from the existing corridor onto new locations, the chances of encountering threatened and endangered species and/or suitable habitat may increase.

Table 24 lists the federal threatened and endangered species with distributional ranges including Forsyth, Dawson, and Lumpkin counties, their associated habitats, and their potential to occur within the project area.

Table 24 Federally Listed Species and Their Habitats in Forsyth, Dawson, and Lumpkin Counties and Their Potential to Occur Within the Project Area

Common Name	Scientific Name	Federal Status	State Status	Habitat	County	Potential to Occur in Project Area?
Bald eagle	*Haliaeetus leucocephalus*	T	E	Inland waterways and estuarine areas; edges of lakes and large rivers; seacoasts.	F, D, L	No
Amber darter	*Percina antesella*	E	E	Gentle riffle areas over sand and gravel substrate that become vegetated (primarily with *Podostemum*) during summer; last taken in Etowah River in 1980; historic population in Shoal Creek probably extirpated by construction of Allatoona Reservoir in 1950.	F, D	No
Cherokee darter	*Etheostoma scotti*	T	T	Shallow water (0.1 – 0.5 meter [m]) in small to medium warm water creeks (1– 15 m wide) with predominantly rocky bottoms. Usually found in sections with reduced current, typically run above and below riffles and at ecotones of riffles and backwaters.	F, D, L	No
Etowah darter	*Etheostoma etowahae*	E	E	Shallow riffle habitat, with large gravel, cobble, and small boulder substrates. Usually found in medium and large cool water creeks or small rivers (15 – 30 m wide) with moderate or high gradients and rocky bottoms.	F, D, L	No

Table 24 Federally Listed Species and Their Habitats in Forsyth, Dawson, and Lumpkin Counties and Their Potential to Occur Within the Project Area

Common Name	Scientific Name	Federal Status	State Status	Habitat	County	Potential to Occur in Project Area?
White fringeless orchid	*Platanthera integrilabia*	C	T	Red maple-blackgum swamps; also sandy damp stream margins; on seepy, rocky, thinly vegetated slopes. Also known as Monkey-face Orchid.	F	No
Georgia aster	*Aster georgianus*	C	SC	Upland oak-hickory-pine forests and openings; sometimes with *Echinacea laevigata* or over amphibolites.	F, D	Yes

E = Endangered; T = Threatened; C = Candidate; SC = Species of Concern; F = Forsyth County; D = Dawson County; L = Lumpkin County

Source: USFWS Listed Species in Forsyth, Dawson, and Lumpkin Counties, updated May 2004; Georgia DNR Locations of Special Concern Animals, Plants, and Natural Communities in Forsyth, Dawson, and Lumpkin Counties, Georgia, 10/22/04

In addition to the information presented above, the study corridor also includes distributional ranges for several state-protected species listed in Forsyth, Dawson, and Lumpkin counties that could occur in the vicinity of the project corridor. It is Georgia DOT policy to notify the Georgia DNR Freshwater Wetlands and Heritage Inventory Program of any possible impacts to these species.

3.4.3.4 Floodplains

A review of the National Flood Insurance Program's Flood Insurance Rate Maps for Forsyth, Dawson, and Lumpkin counties (Panel Nos. 13117C0050D, 1303040125A, 1303040175A, and 1303540225A) indicate that the study corridor encounters Flood Hazard Areas subject to inundation by 100-year flood events at three locations: Bald Ridge Creek, Settingdown Creek, and the Chestatee River. Additionally, five regulatory floodways are crossed by SR 400 at the three named waterways, while one encounter with the eastern bank of Bald Ridge Creek occurs adjacent to the stream's regulatory floodway. Figure 9 provides an overview of the 100-year and 500-year floodplains.

Depending on the level of proposed involvement in floodplains and regulatory floodways, appropriate coordination may be required between the project proponent and the Federal Emergency Management Agency in compliance with relevant federal statutes and Executive Order 11988 for Floodplain Management and to avoid increased impacts from flooding that would be attributed to a reconstructed roadway and/or its secondary and cumulative impacts.

3.4.3.5 Invasive Species

Executive Order 13112, Invasive Pest Species, requires that federal actions not contribute to the spread of invasive species. Georgia DOT identifies the following 16 species as being invasive pest species: tree of heaven (*Ailanthus altissima*), mimosa (*Albizia julibrissin*), water hyacinth (*Eichhornia crassipes*), autumn olive (*Elaeagnus umbellata*), cogongrass (*Imperata cylindrical*), Chinese privet (*Ligustrum sinense*), Japanese honeysuckle (*Lonicera japonica*), amur honeysuckle (*Lonicera maakii*), princess tree (*Paulownia tomentosa*), common reed (*Phragmites australis*), kudzu (*Pueraria montana*), multiflora rose (*Rosa multiflora*), Chinese tallowtree (*Sapium sebiferum*), johnsongrass (*Sorghum halepense*), Japanese wisteria (*Wisteria floribunda*), and Chinese wisteria (*Wisteria sinensis*).

In accordance with Executive Order 13112, if this project receives federal aid, a survey for populations of invasive species that may be spread during construction should be conducted. It was noted during a preliminary investigation that several invasive species, including kudzu, johnsongrass, and Chinese privet, occur along several portions of the project corridor.

During the construction process, measures to prevent or minimize the spread of invasive species as appropriate for the time of year should be followed. These measures include removing and disposing of vegetative parts in the soil that may reproduce by root raking, burning on site any such parts and aboveground parts that bear fruit, controlling or eradicating infestations prior to construction, and cleaning of vehicles and other equipment prior to leaving the infested site. The measures used would be appropriate for the particular species and conditions that exist on the project site, as described in Georgia Standard Specifications Section 201, Clearing and Grubbing of Right-of-Way.

3.4.3.6 Migratory Bird Habitat

The Migratory Bird Treaty Act (MBTA) of 1918 decreed that all migratory birds and their parts (including eggs, nests, and feathers) are fully protected under this act. Approximately 850 species of birds are covered under the MBTA, except the house sparrow, starling, feral pigeon, and resident game birds such as pheasant, grouse, quail, dove, and wild turkey.

Because no formal guidance has been developed on how to carry out the MBTA, Georgia DOT has adopted a policy of identifying tracts of contiguous habitat of 100 or more acres that would be impacted by roadway construction. The 100-acre threshold is considered a minimum sufficient size to allow for sensitive species to avoid predation and parasitism from species that will only penetrate a certain distance within a given habitat.

While suburban residential, commercial, and industrial development continues to occur throughout the SR 400 corridor, numerous areas containing greater than 100 contiguous acres of undeveloped habitat and/or mature forested canopy were identified from areas adjacent to the existing SR 400 corridor. Potential migratory bird habitat exists adjacent to SR 400 along nearly the entire project corridor. Exceptions include areas in the immediate vicinity of SR 400 from its intersection with Keith Bridge Road north to Settingdown Road, from Bottoms Road north to Cross Roads Road, from Carlisle Road north to Kilough Church Road, and areas in the immediate vicinity of the Henry Grady Highway, Whelchel Road, and SR 60 intersections.

In addition, Georgia DOT protocol indicates surveying under bridges and in large culverts that would be subject to reconstruction or removal as part of any proposed construction activity. If birds, such as the barn swallow (*Hirundo rustica*), are observed nesting under bridges or in culverts, exclusionary devices such as bird-netting should be installed and/or demolition or reconstruction of these structures should be scheduled to take place at a time when nests are not being used between August 31 and April 1, pursuant to Georgia DOT's special construction contract provision 107.23G. Along SR 400, the only two existing bridge structures of potential migratory bird habitat concern include the Keith Bridge Road overpass on the southern end and the Chestatee River bridge on the northern end. In addition, potential migratory bird habitat could exist in each named stream crossing within the SR 400 project corridor. Bald Ridge, Settingdown, Mill, Thompson, and Toto creeks all pass beneath the existing roadway through culvert structures. Furthermore, should they be subject to removal as a result of corridor improvements, any open buildings, including barns, sheds, and similar structures, should be inspected for the presence of migratory birds, as well as raptors such as barn owls, and roosting bats.

3.4.3.7 Essential Fish Habitat

The Sustainable Fisheries Act (Public Law 104-297) became law on October 11, 1996, and amended the habitat provisions of the Magnuson Fishery Conservation and Management Act. The renamed Magnuson-Stevens Fishery Conservation and Management Act calls for direct action to stop or reverse the continued loss of fish habitats. The act requires cooperation among National Marine Fisheries Service (NMFS), South-Atlantic Fisheries Management Council Site and Mid-Atlantic Fisheries Management Council Site (the Councils), fishing participants, and federal and state agencies to protect, conserve, and enhance essential fish habitat. Essential fish habitat is defined as habitat for federally managed fish species as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.” The conservation of essential fish habitat is an important component of building and maintaining sustainable fisheries. Essential fish habitat can be found in the following Georgia counties: Camden, Glynn, McIntosh, Liberty, Bryan, and Chatham. The proposed project would not impact any essential fish habitat, since essential fish habitat is not found within Forsyth, Dawson, or Lumpkin counties.

3.4.3.8 Air Quality

The Clean Air Act (CAA), Section 176 (c), requires that federal transportation projects be consistent with state air quality goals, found in the State Implementation Plan (SIP). The process to ensure this consistency is called Transportation Conformity. Conformity to the SIP means that transportation activities will not cause new violations of the National Ambient Air Quality Standards (NAAQS), worsen existing violations of the standards, or delay timely attainment of the relevant standard.

Transportation conformity is required for federal transportation projects in areas that have been designated by the U.S. EPA as not meeting the NAAQS. These areas are called nonattainment areas if they currently do not meet air quality standards or maintenance areas if they have previously violated air quality standards, but currently meet them and have an approved maintenance plan. Dawson and Lumpkin counties are currently in attainment for air quality standards. However, Forsyth County is located within the Atlanta metropolitan region’s nonattainment area for ozone and particulate matter (PM) 2.5. The proposed project needs to be evaluated for its consistency with state and federal air quality goals and compliance with air quality standards.

3.4.3.9 Construction/Utilities

A Forsyth Water and Waste Distribution Center is located along County Way to the west of SR 400. Aboveground utility poles exist along the SR 400 project corridor. Along the west side of SR 400 just north of its intersection with Chesterra Drive, aboveground utility poles parallel SR 400 in proximity to the existing road. Underground (buried) utilities also likely exist along the SR 400 project corridor, particularly in areas of residential and commercial developments. In addition, a single large utility pole (potentially a cell phone tower) exists on the west side of SR 400, north of its intersection with Henry Grady Highway. This pole is situated several hundred feet from the existing roadway, and may not be affected by improvements to SR 400. Coordination with utility companies should occur early during project development. During construction, every effort should be made to avoid relocation of utilities.

The roadway should remain open to traffic during construction; however, should this not be possible, a temporary detour plan should be developed.

3.4.3.10 Railroads

There are no rail lines found within the SR 400 study area.

3.4.3.11 Energy/Mineral Resources

No energy or mineral resources were found within the SR 400 study area.

3.4.3.12 Underground Storage Tanks/Hazmat Sites

A windshield survey for sites that may contain hazardous materials, including soil and/or water contaminated by leaking underground storage tanks (USTs), was conducted along the SR 400 project corridor. Numerous gas stations containing USTs were identified along the project corridor.

An extensive database search for sites known to contain leaking USTs should be completed prior to any right-of-way acquisition. No other facilities that could potentially contain USTs or hazardous materials were identified along the corridor during the windshield survey. Figure 9 displays known physical features in the SR 400 study area. Appendix E includes a full list of known USTs in the study corridor.

3.4.4 Socioeconomic Conditions

An understanding of study area demographics, economic activity, and employment is critical for comprehending current and forecasting future travel demand. Current and future population and employment are vital inputs to the travel demand model, because commute patterns are based on the locations of population and employment.

3.4.4.1 Current Demographic Profile of Study Area

Forsyth County dominates the study area in terms of population, housing, income, and employment. Located on the northern fringe of metropolitan Atlanta, the southern portion of the study area is approximately 45 miles from downtown Atlanta, 30 miles from Perimeter Center, and just north of Alpharetta. Over the past 25 years, population and job growth in the study area have been driven by the growth of metropolitan Atlanta north along SR 400.

Demographic data at the county level was disaggregated to an intermediate level referred to as “districts.” Districts are unique areas within the study area that are differentiated from each other based on the presence of population or employment centers (for example, “Dahlonega” and “Lumpkin” are unique districts in the SR 400 study area). Assessing demographic data at the district level improves precision to more thoroughly characterize unique portions of the study area.

The total estimated study area population in 2005 was 167,981 persons, an increase of 38.2 percent over 2000 numbers. During this same time period, the statewide population increased more slowly, at 11.6 percent. Study area population is concentrated in Forsyth County, with the slight majority in the South Forsyth district. Population density is highest in the two districts that include cities, the Dahlonega and Cumming districts. The Cumming district is over twice as dense as the study area average. Of the districts that do not include cities, only the South Forsyth district is denser than the study area average. Population density of the study area is low, at 0.7 persons per acre, but higher than the average population density statewide (0.2 persons per acre). Figure 10 displays population density in the SR 400 study area. Table 25 summarizes population and density by district.

Table 25 SR 400 Corridor Population (2005) by District

District	Population	Persons per Acre	Percent of Total Population
Dahlonega	4,148	1.3	2.5%
Lumpkin	7,054	0.2	4.2%
Lumpkin 400	4,042	0.3	2.4%
Dawson	8,328	0.3	5.0%
Dawson 400	4,016	0.4	2.4%
North Forsyth	38,416	0.6	22.8%
Cumming	13,900	1.8	8.3%
South Forsyth	88,077	1.2	52.4%
Study Area Total	167,981	0.7	100.0%

Source: U.S. Census Population Estimates Program (2005)

In 2005, total estimated households in the study area numbered 59,727, an increase of 39.1 percent since 2000. Similar to the population numbers, most of the study area households are located in Forsyth County, with the slight majority in the South Forsyth district. Household size is relatively constant across the study area, ranging from a low of 2.5 persons per household to a high of 2.9. The study area average is 2.8 persons per household. In comparison, the average household size for the state of Georgia is 2.6 persons.

Average household income in the study area ranges from a low of $40,145 per year in the Dahlonega district to a high of $89,901 per year in the South Forsyth district. In comparison, the average annual household income in the state of Georgia is $61,540. Similar to the population and household data, 63 percent of all income in the study area is concentrated in the South Forsyth district. Table 26 summarizes the number of households and household size by district.

Table 26 SR 400 Corridor Households (2005) by District

District	No. of Households	Average Household Size	Percent of Total Households
Dahlonega	1,642	2.5	2.7%
Lumpkin	2,667	2.6	4.5%
Lumpkin 400	1,452	2.8	2.4%
Dawson	3,050	2.7	5.1%
Dawson 400	1,592	2.5	2.7%
North Forsyth	13,625	2.8	22.8%
Cumming	5,092	2.7	8.6%
South Forsyth	30,607	2.9	51.2%
Study Area Total	59,727	2.8	100.0%

Source: U.S. Census (2000), U.S. Census Population Estimates Program (2005)

The following housing occupancy statistics are based on 2000 Census data. The vacancy rate of the study area, 6.5 percent, is lower than the state of Georgia at 8.4 percent. Vacancy rates in the study area are highest in the middle of the SR 400 corridor, where the Dawson and Dawson 400 districts are both more than double the study area average. Those districts and the Dahlonega district are the only three in the study area that exceed the statewide rate. Table 27 summarizes occupancy status by district.

Table 27 SR 400 Corridor Housing Occupancy Status by District (2000)

District	Housing Units	Occupied Housing Units	Vacant Housing Units	Vacancy Rate
Dahlonega	1,152	1,039	113	9.8%
Lumpkin	2,490	2,289	201	8.1%
Lumpkin 400	1,364	1,275	89	6.5%
Dawson	2,980	2,541	439	14.7%
Dawson 400	1,434	1,232	202	14.1%
North Forsyth	10,188	9,535	653	6.4%
Cumming	3,832	3,571	261	6.8%
South Forsyth	22,485	21,459	1,026	4.6%
Study Area Total	45,925	42,941	2,984	6.5%

Source: U.S. Census (2000)

3.4.4.2 Economy and Employment

The economy and employment play a significant role in generating travel demand. This section details historic trends in industry and employment at the county level, as well as current estimates in the study area.

An understanding of regional trends is required to provide context for current study area employment estimates and to inform future predictions. Historical employment data for Forsyth, Dawson, and Lumpkin counties from 1990 to 2005, made available by the Georgia Department of Labor (DOL), is used in this analysis.

From 1990 to 2005, employment in the three counties increased significantly faster than in the state of Georgia as a whole. However, variations in the growth rate of the three counties reflect statewide trends. Between 1990 and 1995, employment in the three counties increased 56.8 percent, while statewide growth was 12.6 percent. Employment growth accelerated between 1995 and 2000, with the three counties increasing 76.5 percent and the state increasing 16.2 percent. This trend reversed between 2000 and 2005, with growth in the three counties dropping to 31.5 percent and 6.1 percent statewide.

Employment growth from 1990 to 2005 was not evenly distributed in the three counties, increasing faster in Forsyth and Dawson counties than in Lumpkin County.

From 1990 to 1995, Forsyth County grew fastest in percentage terms and number of employees added. In the 1995 to 2000 and 2000 to 2005 periods, Dawson County grew the fastest of the three in percentage terms, while Forsyth County added the highest number of employees. Lumpkin County grew the slowest in percentage terms during all three periods and added the least number of employees during the two most recent periods.

Employment increased in all three counties from 1990 to 2005. During this same period, employment share by industry sector changed significantly as the three counties shifted toward a service-oriented economy. Some sectors grew slower than others, accounting for the shift in share. Wholesale and retail trade added the fewest number of jobs, manufacturing added a medium amount of jobs, and services added the most jobs. Industry mix is important, because some industry types generate more trips than others, impacting the transportation system differently.

Table 28 shows the industry mix by sector for Lumpkin, Dawson, and Forsyth counties combined.

Table 28 SR 400 Corridor Three-County Industry Mix by Sector (1990 – 2005)

	Share of Total Jobs			
Sector	**1990**	**1995**	**2000**	**2005**
Wholesale	6.1	8.3	8.5	7.9
Manufacturing	38.1	36.2	35.1	29.6
Retail	18.3	19.3	18.4	11.9
Services	37.5	36.2	38.0	50.6
Total	100.0	100.0	100.0	100.0

Source: U.S. Department of State: InfoUSA

The SR 400 study area includes all of Forsyth County and parts of Dawson and Lumpkin counties. Total estimated study area employment in 2005 was 42,360 persons. Similar to population and households, study area employment is concentrated in Forsyth County. In contrast to population and households, while the South Forsyth district accounts for a larger share of jobs than any other district, it does not contain the majority of study area employment.

Employment density is substantially higher in the two districts that include cities, the Cumming and Dahlonega districts, than in the other districts. The Cumming district has an employment density over six times higher than the study area average, while the

Dahlonega district is over four times as dense as the study area average. Figure 10 displays employment density in the SR 400 study area.

The jobs-to-housing ratio provides insight as to the flow of workers into and out of the study area. The jobs-to-housing ratio is calculated by dividing the number of jobs in a geographic area by the number of households in the same area.

Statewide, an average of 1.3 persons per household have jobs, so when the jobs-to-housing ratio is below 1.3, on balance commuters are leaving an area. Conversely, when the ratio is above 1.3, the area has a surplus of jobs and commuters are entering the area.

The ratio of jobs to households for the study area is 0.7, significantly lower than the statewide ratio. Based on the low ratio of jobs to households in the study area, on average commuters are leaving the study area during the morning peak period and returning to the study area in the afternoon peak period. Most are likely headed south of the study area to employment centers in Alpharetta, the Central Perimeter area, Buckhead, Midtown, downtown Atlanta, and other locations in metropolitan Atlanta. Commuters living and working in the study area are likely commuting to districts that include cities and the Dawson 400 district. Cumming, Dahlonega, and the Dawson 400 districts are the only districts with a jobs-to-households ratio over the study area average, at 2.0, 1.5, and 1.2 jobs to households, respectively.

Table 29 SR 400 Corridor Employment (2005) by District

District	Jobs	Jobs per Acre	Percent of Total Jobs	Jobs to Households
Dahlonega	2,406	0.8	5.7%	1.5
Lumpkin	2,424	0.1	5.7%	0.9
Lumpkin 400	697	0.1	1.6%	0.5
Dawson	1,647	0.1	3.9%	0.5
Dawson 400	1,943	0.2	4.6%	1.2
North Forsyth	9,358	0.1	22.1%	0.7
Cumming	10,171	1.3	24.0%	2.0
South Forsyth	13,714	0.2	32.4%	0.4
Study Area Total	42,360	0.2	100.0%	0.7

Source: U.S. Department of State: InfoUSA

3.5 Stakeholder Input

The public was given the opportunity to convey what they believed were the key issues and concerns for the study area. The most common challenges and issues expressed by meeting attendees for intersections throughout the corridor are traffic congestion and safety on the roadway. Safe access to businesses is an issue, specifically in locations where businesses front SR 400 and have access points that are not at signalized intersections. Participants expressed the need for improvements for bicyclist and pedestrian safety on SR 400 near North Georgia Premium Outlets and the Home Depot/Wal-Mart shopping center, as well as along Lumpkin Campground Road.

The issues and concerns expressed for the SR 400 corridor were used in the development of goals/objectives and performance measures, and are summarized by location in the table below.

Table 30 SR 400 Major and Minor Transportation Issues

Corridor Intersection SR 400 at:	Challenges and Issues	
	Major Issue(s)	**Minor Issue(s)**
Keith Bridge Road	Roadway signage/informational devices	None
Matt Highway	Traffic congestion	Roadway signage/informational devices Safety on roadway
Martin Road	Safety on roadway	None
Heard's Circle	Traffic congestion Safe access to businesses	None
Reservoir Six	Traffic congestion	Safety on roadway
Reservoir 59	Safety on roadway	Safe access to businesses
Hubbard Town Road	Traffic congestion	Safety on roadway
Reservoir 36	Safety on roadway Safe access to businesses	None
Jot Em Down Road	Traffic congestion	Safety on roadway
Lumpkin Campground Road (south of Dawson Forest Road)	Bicyclist and pedestrian safety	Safety on roadway Traffic congestion
Whitmire Drive	Traffic congestion	None

Table 30 SR 400 Major and Minor Transportation Issues

Corridor Intersection SR 400 at:	Challenges and Issues	
	Major Issue(s)	**Minor Issue(s)**
Carlisle Drive	Roadway signage/informational devices	Safe access to businesses
Dawson Forest Road to SR 53	Traffic congestion Safe access to businesses Safety on roadway	Bicyclist and pedestrian safety
Dawson Forest Road at SR 53 (west of SR 400)	Traffic congestion Roadway signage/informational devices Safety on roadway	Bicyclist and pedestrian safety
Harmony Church Road	Traffic congestion Safety on roadway	Roadway signage/informational devices Condition of pavement
East Grant Road	Condition of pavement	Roadway signage/informational devices
SR 226 at SR 9E	Roadway signage/informational devices	None
Gold Creek Highway	Traffic congestion	Safety on roadway Roadway signage/informational devices
Auraria Road	Safety on roadway	Traffic congestion Safe access to businesses
Cain Branch Creek	Condition of pavement	None
Whelchel Road	Safety on roadway	None
Cain Bridge Road	Condition of pavement	None
Lumpkin County Park Road at Mountain Brook Drive	Bicyclist and pedestrian safety	None
SR 60	Traffic congestion	Safe access to businesses Safety on roadway

Source: Public Information Open House (2006)

Stakeholders also identified preferred roadway treatments, favoring the freeway followed by the access road options. The least popular treatments are signalized intersections and bicycle/pedestrian connectivity.

3.6 Review of Previous Studies and Plans

Within Forsyth, Dawson, and Lumpkin counties, the SR 400 corridor has been included in several prior and ongoing planning studies. A review of these studies was undertaken to determine recommended improvements, issues, and opportunities identified previously. Key findings are summarized by county.

3.6.1 Forsyth County

Forsyth County comprehensive and transportation plans were reviewed for information relevant to the SR 400 corridor. Studies reviewed included the Forsyth County Comprehensive Plan 2004 – 2025, Forsyth County Major Transportation Plan Update, and Forsyth County Transportation Plan Update.

3.6.1.1 Key Findings

- SR 400 has been the favored corridor in Forsyth County for growth and development and this trend is expected to continue.
- Widening SR 400 from four to six lanes beginning at SR 20 and ending at the Dawson County line is recommended.
- In 2030, the entire SR 400 corridor will be operating at LOS E or F, which is below the adopted service standard of LOS D.
- There are two high crash locations in the corridor at Settingdown Road and Hubbard Town Road/Cross Roads Road.

3.6.2 Dawson County

The Dawson County Comprehensive Plan 2006 – 2026 and the Dawson County Long Range Transportation Plan (LRTP) were reviewed and information relevant to the SR 400 corridor is summarized below.

3.6.2.1 Key Findings

- Both population and employment have been growing rapidly during the past decade and this trend is projected to continue into the future.

- Population projections range from a low of 66 percent to a high of 166 percent by 2030.

- Employment is projected to increase 151 percent between 2005 and 2030.

- Traffic volumes have doubled on SR 400 from 1992 to 2002 and are projected to continue increasing in the future.

- Level of service along SR 400 is C or better with the LRTP projects in place.

- Several projects in the LRTP address the SR 400 corridor.

3.6.3 Lumpkin County

Of the three counties in the study area, only Lumpkin County does not have a long-range transportation plan. However, a transportation element is included in the Lumpkin County Comprehensive Plan.

3.6.3.1 Key Findings

- Increasing population will drive travel demand in the SR 400 corridor.

- The level of service on SR 400 will decline from LOS A in 2000 to LOS C in 2020.

- SR 400 from the Dawson County line to the project limit is not a high-crash facility.

4. Assessment of Future Travel Demands

Forecasts of future travel demand are used to approximate the performance of the transportation network over the next 25 years, based on expected changes in the study area. Future travel demand is calculated using the CORSIM model, which uses future population and employment figures, projected land uses, planned transportation projects, and trip-making behavior on the network to predict levels of service. The model results are used to prioritize the transportation policies and projects that can best mitigate the likely challenges on the network. This section explains the methodology used to develop the travel demand model and its future inputs, and discusses the future travel demand results.

Because travel sheds for the SR 365 and SR 400 corridors partially overlap, one travel demand model including both corridors was developed. Additionally, because both corridors were studied at the same time, creating one model resulted in cost reductions compared to building two separate travel demand models. The travel demand model, including a description of the model study area, is discussed later in this section.

4.1 Growth Outlook

The study team made projections of population and employment growth at the traffic analysis zone (TAZ) level in five-year increments from 2010 to the horizon year 2030 for use in the travel demand model. Assignments of future year 2030 traffic onto the baseline future year road network were used to formulate alternate road improvement scenarios that would adequately address future travel demand. Subsequently, travel demand output from model runs of the improvement scenarios was summarized in combination with other performance measures in the strategies evaluation process to identify which improvement strategy would most likely maximize Georgia DOT's investment in the SR 400 corridor.

4.1.1 Data Sources

The model inputs were developed from Georgia Department of Community Affairs (DCA) population and employment projections in five-year increments to 2030. This data source was selected for several reasons. First, the DCA projection methodology is the same for each county in the study area, providing consistent population and employment forecasts. Additionally, DCA projections are readily available for all counties in the study area. Finally, DCA is the state agency providing comprehensive planning, technical, and research assistance to local governments and is the expert at producing population and employment projections.

A methodology based on the average rate of population change for each five-year period between 1980 and 2005 was used to project the future countywide population. Data sources used include:

- U.S. Census
- Existing land use maps from adopted county comprehensive plans
- Future land use plans from adopted county comprehensive plans
- Existing year 2005 population and employment estimates previously produced as part of this study

Population and employment control totals used for each county are shown in the following table.

Table 31 Forecast Population and Employment Control Totals

			2010	2015	2020	2025	2030
SR 365	Habersham	Population	46,458	54,500	63,934	75,001	87,984
		Employment	19,937	21,516	23,096	24,676	26,256
	Hall	Population	205,842	255,599	317,383	394,102	489,106
		Employment	139,558	180,910	220,732	253,885	280,792
SR 400	Dawson	Population	24,225	29,743	36,518	44,836	55,049
		Employment	9,729	11,808	14,170	16,827	19,982
	Forsyth	Population	172,537	212,041	260,590	320,255	393,581
		Employment	76,459	94,985	117,999	146,589	182,393
	Lumpkin	Population	31,296	40,267	51,810	66,661	85,769
		Employment	13,094	14,576	16,058	17,540	19,022
	White	Population	30,724	39,241	50,120	64,014	81,760
		Employment	12,336	13,670	15,004	16,338	17,672

Source: Raw data from U.S. Census (2000), calculations by ARCADIS

4.1.2 Disaggregation Methodology

Because Georgia DCA projections are available only at the county level and because the travel demand modeling process requires socioeconomic data for a much smaller geography, the following two-part strategy was developed to disaggregate the countywide projections to the individual TAZ level based on existing conditions and future land use plans. Using 2005 estimates reviewed by the technical advisory committee, the share of existing population for each TAZ was calculated by dividing 2005 estimates for the TAZ by the total county estimate in 2005.

The share of future land use growth for each TAZ was calculated using the following steps. First, the expected percentage future land use maps for each county were overlaid with the TAZ structure. Next, based on the planned land uses and knowledge of existing conditions and development trends in the study area, a growth rating of 1 through 5 (1 representing no change or limited growth and 5 representing explosive growth) was manually assigned to each TAZ. Population and employment were rated separately. Finally, for each county, the ratings were summed. For each TAZ within the county, the rating was divided by the total to determine percentage of population and employment growth relative to the entire county.

The existing share of population and employment and the expected share of population and employment growth were then averaged to determine a composite future share percentage for each TAZ. Population and employment forecasts for each TAZ were then determined by multiplying the countywide population total for each year by the composite future share percentage to determine the population and employment forecast for each TAZ for each forecast year.

A limitation of the above-described procedure is the inability to account for projects currently in the planning process or in the development pipeline since the procedure relies exclusively on general countywide forecasts. To mitigate this, a manual adjustment step is built into the forecast methodology that relies on the local knowledge of technical advisory committee members and key stakeholders.

The results of the disaggregation procedure outlined above were compared to development information gathered at previous technical advisory committee meetings and stakeholder interviews to incorporate development projects and trends not yet available through conventional sources.

4.1.2.1 Households

Average household size is very close to 2.0. For the purpose of the travel demand model, household sizes are assumed to remain relatively constant over time. For each TAZ, the number of households in 2005 was divided by the estimated 2005 population. This factor was then multiplied by the projected population for each of the forecast years to determine the number of households for individual TAZs.

4.1.3 Issues and Solutions

Because the Forsyth County Comprehensive Plan appeared to underestimate population and employment projections, Georgia DOT and the study team used population and employment projections for Forsyth County from the Forsyth County Major Transportation Plan – 2006 Update. The Forsyth County Comprehensive Plan predicts 227,819 persons in 2025, which is the horizon year of the plan. Based on Census data and recent trends, the 2025 forecast would be exceeded between 2010 and 2015.

No comprehensive plan was available for Habersham County, so the Georgia DOT Multimodal Transportation Study: Habersham, Stephens, Rabun, and White Counties (2003) was used as a source of population projections. The Georgia DOT study was used because it was the most recent countywide study available. However, that study did not include employment projections; therefore, Georgia DCA data was used.

The Lumpkin County Comprehensive Plan included population projections only. Because no other source of data was available, Georgia DCA employment projections were used.

Part of White County falls within the travel demand model area. However, none of the county falls within the SR 400 or SR 365 corridors, and a comprehensive plan for the county was not available. Therefore, Georgia DCA projections were used for both forecast population and employment.

4.1.4 Exceptions

A portion of White County falls in the travel demand model boundary. However, no part of White County falls within the SR 400 or SR 365 corridors. Therefore, a simplified disaggregation methodology was used. Additionally, a comprehensive plan for White

County was not available. For TAZs in White County, the disaggregation is based on the 2005 population and employment share only.

4.1.5 County Comprehensive Plan Population and Employment Projections

For comparison purposes, population and employment projections from county comprehensive plans, except where noted otherwise, are included in Tables 32 and 33. The base year for all plans is 2000.

Table 32 SR 400 Comprehensive Plan Population Projections

County	SR 400 Population						
	1980	1990	2000	2010	2020	2025	2030
Dawson	4,774	9,429	15,999	25,753	42,941	57,271	71,600
Forsyth	27,958	44,083	98,407	160,219	206,419	227,819	n/a
Lumpkin	10,762	14,573	21,016	34,925	52,410	66,661	n/a
Total	43,494	68,085	135,422	220,897	301,770	351,751	n/a

Source: Historic and current population figures are from the Census. Future projections are from the Dawson County LRTP (2004), Forsyth County Comprehensive Plan (2004), and Lumpkin County Comprehensive Plan (2005).

Table 33 SR 400 Comprehensive Plan Employment Projections

County	SR 400 Employment						
	1980	1990	2000	2010	2020	2025	2030
Dawson	n/a	1,151	4,220	9,599	14,137	16,407	18,886
Forsyth	7,815	18,094	42,942	60,053	76,234	83,167	n/a
Lumpkin	4,202	6,838	10,130	13,094	16,058	17,540	19,022
Total	n/a	26,083	57,292	82,746	106,429	117,114	n/a

Source: Historic and current employment figures are from the Census. Projected figures are from the Dawson County LRTP (2004), the Forsyth County Comprehensive Plan (2004), and the DCA for Lumpkin County.

4.2 Travel Demand Model

The travel demand model integrates land use and zonal socioeconomic data with household travel behavior. A brief description of the travel demand model used to study SR 400 is provided below. A full description of the model's development, calibration, and validation is provided in documentation supplementary to this report, a technical memorandum titled “SR 400 and SR 365 Travel Demand Model.” The model employed for the SR 400 corridor study was also used in the SR 365 corridor study.

The model study area includes all of Forsyth and Hall counties but only the southern portions of Lumpkin, White, and Habersham counties. Figure 11 shows the geographic area used for travel demand modeling, as well as the two study corridors and the highway network links for which current and future traffic volumes were computed by the model. For Dawson County, only the eastern third of the county falls inside the model’s study area. The SR 365 corridor runs northeasterly from Gainesville in Hall County to the Cornelia-Demorest area of Habersham County. The SR 400 corridor is oriented northeasterly from north of Cumming in Forsyth County to SR 60 southeast of Dahlonega in Lumpkin County.

4.2.1 Base Year Travel Patterns

The final product of the SR 400 and SR 365 travel demand model is the assignment of daily traffic volumes onto a model road network. Along with the assignment of daily traffic onto the highway network, the model computes daily trip tables by trip purpose, interzonal free-flow travel time matrices, and interzonal travel time matrices that reflect lower travel speeds from capacity limitations that exist on specific network links during peak hours of a typical weekday.

Some of the most prominent travel behavior data and patterns input to the base year (2005) model are presented in the following sections.

4.2.2 External Station Traffic

In addition to daily traffic generated within the 445 TAZs inside the study area, there is a significant amount of traffic that comes in and out of the study area by way of external stations. Within the model, external stations are represented by those network links located on the edge of the SR 400 and SR 365 travel sheds. There are 51 external stations in the SR 400 and SR 365 travel demand model. A list of modeled external stations and their corresponding 2005-level ADT volume estimates is provided in Table 34.

Table 34 External Stations

External Station No.	Route Name	County	Est. 2005-Level Daily Traffic	External Station No.	Route Name	County	Est. 2005-Level Daily Traffic
446	Yonah Homer	Hall	2,320	472	SR 9/Cumming Hwy.	Forsyth	21,980
447	SR 51	Hall	2,610	473	Midway	Forsyth	1,530
448	SR 323	Hall	1,100	474	Drew Campground	Forsyth	1,530
449	SR 52	Hall	3,580	475	SR 20	Forsyth	15,800
450	SR 82	Hall	1,140	476	SR 369	Forsyth	8,230
451	U.S. 129	Hall	10,040	477	Dawson Forest	Dawson	390
452	SR 332	Hall	1,070	478	SR 53	Dawson	6,760
453	SR 60	Hall	2,100	479	SR 136	Dawson	1,400
454	SR 53	Hall	7,910	480	SR 52	Lumpkin	2,860
455	SR 211	Hall	4,910	481	SR 9/U.S. 19/SR 60	Lumpkin	3,730
456	Spout Springs/Thompson Mill	Hall	5,250	482	SR 11/U.S. 129	White	6,050
457	Ridge	Hall	290	483	SR 75	White	8,090
458	N Bogan	Hall	980	484	SR 384	White	2,940
459	I-985	Hall	58,950	485	SR 17	Habersham	2,910
460	SR 13	Hall	8,440	486	SR 197	Habersham	4,530
461	Peachtree Industrial	Hall	12,170	487	SR 385	Habersham	7,000
462	Buford Dam	Hall	1,210	488	SR 365/U.S. 23	Habersham	9,240
463	Buford Dam	Forsyth	11,630	489	Glade Creek	Habersham	390
464	SR 20	Forsyth	23,920	490	SR 17	Habersham	8,930
465	Old Atlanta	Forsyth	5,870	491	SR 13	Habersham	1,270
466	SR 141	Forsyth	34,000	492	Lake Russell	Habersham	200
467	Jones Bridge	Forsyth	3,920	493	U.S. 441	Habersham	8,400
468	Old Alpharetta	Forsyth	7,545	494	Apple Pie Ridge	Habersham	4,590
469	McFarland	Forsyth	10,830	495	SR 347	Hall	4,250
470	Georgia 400	Forsyth	74,400	496	Bald Ridge Marina	Forsyth	3,350
471	Union Hill	Forsyth	1,530				

Source: SR 400 and SR 365 travel demand model

The external station with the highest volume is SR 400 in Forsyth County with an ADT of 74,400 vehicles per day (vpd) in both directions of travel. I-985 in Hall County is also a high-volume entry/exit point with an estimated 2005 ADT of 58,950 vpd. On the northern fringe of the SR 365 corridor travel shed, SR 365 splits into two highways before exiting the study area. U.S. 23/SR 365, with an external station ADT of 9,240 vpd, continues north through Habersham County toward Tallulah Falls. The other branch of SR 365 becomes SR 17 and is oriented in an eastward direction toward Toccoa, Georgia. The external station volume at the Toccoa branch of SR 17 is 8,930 vpd.

4.2.3 Census 2000 Journey to Work Data

The United States Bureau of Census collects “Place of Residence” and “Place of Work” data on the decennial Census’ long form, which is distributed to approximately 15 percent of the nation’s households. It is referred to as the Census Journey to Work Sample (JTW Sample). The Census 2000 JTW Sample reported herein captures the “Place of Residence” and “Place of Work” patterns of residents who live in counties inside the model study area. The major limitation of this data set is that it only accounts for work trips, to the exclusion of trips made for any other purpose. This is significant because work trips only account for approximately 15 percent to 20 percent of total daily household travel, so several other trip type patterns are left unrepresented.

Forsyth County residents dominate the composition of commuters in the SR 400 corridor north of Fulton County, although they may not dominate on the section of SR 400 being studied north of Cumming. “Place of Residence” to “Place of Work” tabulations are shown in Table 35 for Forsyth County residents as well as for residents of Dawson County and Lumpkin County.

Table 35 Journey to Work Sample (2000)

Workplace Locations	Place of Residence		
	Forsyth	**Dawson**	**Lumpkin**
Metro Atlanta	26,175	5,835	2,050
Forsyth County	20,965	1,630	735
Dawson County	740	2,765	700
Lumpkin County	200	355	4,960
Hall County	1,265	480	1,615
Habersham County	30	20	30
White County	4	30	250

Source: U.S. Census Bureau – Census 2000

The most dominant combination of "Residences" and "Workplaces" in 2000 was Forsyth County residents who work in metropolitan Atlanta. There were 26,175 Forsyth County residents whose workplace was located in metropolitan Atlanta. The second highest residence-workplace combination was the 20,965 Forsyth County residents who also work in Forsyth County. Only 740 Forsyth County residents drive to work in Dawson County. In Dawson County, a majority of resident workers commute to work in metropolitan Atlanta as well. Approximately twice as many Dawson County residents work in metropolitan Atlanta (5,835) than commuted or telecommuted to or from a workplace in Dawson County. More than twice as many Dawson County residents work in Forsyth County (1,630) in comparison with the number of Forsyth County residents who work in Dawson County. The commute pattern for Lumpkin County residents is different than for Forsyth County and Dawson County. Lumpkin County residents commute mostly to workplaces inside Lumpkin County (4,960). A significant number of Lumpkin County workers also commute to metropolitan Atlanta (2,050) and Hall County (1,615).

4.2.4 Trip Generation

The travel demand model uses seven trip purposes to generate trip ends. These are listed below.

No.	Purpose Name	No.	Purpose Name
1.	Home-Based Work (HBW)	5.	Commercial Vehicles
2.	Home-Based Other (HBO)	6.	Internal-External Passenger Cars (IEPC)
3.	Home-Based Shopping (HBSh)	7.	Internal-External Trucks
4.	Non-Home-Based (NHB)		

Vehicle trips traveling from outside the model study area to outside the model study area (e.g., from Atlanta to Asheville, North Carolina) are referred to as External-External (E-E) trips. E-E trips were estimated for both passenger cars and trucks in separate data files, outside of the trip generation process. Origin-destination survey data from roadside surveys provided the study team with a basis for these data sets. The Atlanta Regional Commission (ARC) conducted an external station survey in 1994 to update travel patterns in its travel demand model. ARC's origin-destination survey included taking samples of motorists on Interstate 985 at the Gwinnett County-Hall County border as well as at the Forsyth County-Dawson County border. In addition, Census 2000 JTW data provided background into splitting total external station trips between E-E type trips and Internal-External (I-E) trips.

The relative share of 2005-level modeled trip ends for each county is closely related to the level of human activity within that county's boundary. Modeled production and attraction trip ends by county for the base year 2005 are presented in Table 36. In the SR 400 study area, Forsyth County has the highest number of production and attraction trip ends with 349,849 and 286,418, respectively. Forsyth County's relative share of productions is 37.5 percent for the entire model study area and 30.7 percent for attractions. The number of trips attracted to Hall County denotes a high concentration of workplaces there. In contrast, there are 150,000 fewer attraction trip ends in Forsyth County because employment-related developments there are not as well developed as in Hall County.

Table 36 Modeled Total Trip Ends by County (2005)

County	Productions	Percent of Total	Attractions	Percent of Total
Dawson	39,964	4.3%	50,516	5.4%
Forsyth	349,849	37.5%	286,418	30.7%
Habersham	94,836	10.2%	87,667	9.4%
Hall	365,882	39.3%	429,863	46.1%
Lumpkin	39,370	4.2%	42,119	4.5%
White	42,181	4.5%	35,485	3.8%
Study Area	932,082	100.0%	932,068	100.0%

Source: SR 400 and SR 365 trip generation application

Notes: Forsyth County and Hall County include trips generated for the entire county. Dawson, Habersham, Lumpkin, and White include trips generated for parts of the county.

North of Forsyth County, the distribution of trip ends in SR 400 corridor counties drops significantly. Lumpkin County, Dawson County, and White County together comprise 13 percent of the study area production trip ends and nearly 14 percent of the model study area's attraction trip ends. Long-distance trips produced in or attracted to White County will be oriented to and from the SR 400 and SR 365 corridors.

4.2.5 Trip Distribution Patterns

Table 37 Travel Time and Trip Length by Trip Purpose

Trip Purpose	Mean Travel Time (Minutes)	Mean Trip Length (Miles)
HBW	20.6	10.3
HBO	10.8	5.0
HBSh	15.6	7.7
NHB	10.7	4.9
COMMERCIAL	10.0	4.3
I-E Passenger Cars	22.8	14.2
I-E Trucks	25.2	17.0

Source: SR 400 and SR 365 daily trip tables, congested time, free-flow time, and distance skim files from loaded network

Of all seven trip purposes, the longest trips computed in the travel demand model were I-E passenger car trips and I-E truck trips. These patterns are not unexpected, since trips entering a model study area from outside the study area are work-related and have relatively long trip lengths in comparison with the other common trip purposes or trip types. For the five internal to internal (I-I) trip purposes, HBW trips had the longest computed trip lengths as expected. Average travel times (in minutes) and average trip lengths (in miles) by trip purpose are displayed in Table 37.

I-E truck trip lengths for time and distance were 25.2 minutes and 17.0 miles. The I-E passenger car pattern was slightly shorter, having a computed average time of 22.8 minutes and average distance of 14.2 miles. Average trip times and trip distances were lower for HBW trips than for I-E trip types. The average trip time was 20.6 minutes and the average trip distance was 10.3 miles for HBW trips. Average trip distances and travel times for home-based shopping trips were relatively long (15.6 minutes and 7.7 miles). In contrast, home-based other, commercial, and non-home-based trip purposes exhibited relatively low trip lengths.

4.2.6 Daily Traffic Assignment

The SR 400 and SR 365 travel demand model was built and subsequently calibrated to produce accurate weekday ADT volumes for calendar year 2005. ADT numbers represent the two-way volume of 24-hour traffic on a section of road for an average weekday. Base year 2005-level ADT output by the travel demand model for the SR 400 corridor is displayed using bandwidth sizes on Figure 12.

Base year 2005 ADT estimates for the SR 400 corridor range from a high of 53,200 vehicles per day south of Keith Bridge Road (SR 306) north of Cumming to a low of 19,200 vehicles per day south of SR 60 in Lumpkin County. There is a secondary concentration of traffic in Dawson County by North Georgia Premium Outlets, but daily traffic volumes drop steadily as one travels from north to south in the SR 400 corridor. The distribution of 2005-level ADT volumes, indicated by varying thicknesses of the band overlaying sections of SR 400, closely matches the observed daily traffic volumes measured for this study.

Another important design objective of the SR 400 and SR 365 travel demand model was to identify major intersecting cross streets that contribute a significant amount of daily traffic onto and off of SR 400. Presently, the major intersecting cross streets contributing a significant level of traffic to SR 400 are Keith Bridge Road (SR 306) in Forsyth County, Browns Bridge Road (SR 369) in Forsyth County, Settingdown Road in Forsyth County, Dawson Forest Road in Dawson County, SR 53 in Dawson County, Long Branch Road (SR 115) in Lumpkin County, and SR 60 in Lumpkin County. On the bandwidth map, only Keith Bridge Road (SR 306), Browns Bridge Road (SR 369), SR 53 in Dawson County, and SR 60 in Lumpkin County are shown with thick bandwidths associated with an ADT range between 10,001 and 20,000 vehicles per day.

4.3 Future Corridor Travel Demands

Basic elements of the SR 400 and SR 365 travel demand model were assembled, calibrated, and tested during development of the base year 2005 modeling scenario. To project travel demand to the future planning horizon of 2030, several new data files were prepared to replace their counterparts in the 2005 version of the model. These files are:

- 2030 zonal socioeconomic data file
- 2030 estimates of external station volumes
- Baseline Existing plus Committed (E+C) highway network

Once the new files were input to the calibrated base year travel demand model, future year travel demand for the baseline 2030 modeling scenario was forecasted. Each data file is described later in this section with a summary of the traffic assignment output by the future year 2030 baseline model run.

4.3.1 Socioeconomic Data

The SR 400 and SR 365 travel demand model study area is located immediately north of metropolitan Atlanta's fast-growing suburban areas. The SR 400 corridor is situated immediately north of northern Fulton County, southern Forsyth County, and the city of Cumming. Northeast of the SR 400 corridor, the SR 365 corridor lies north of northern Gwinnett County, southern Hall County, and the city of Gainesville. As a result of the residential and commercial development patterns that have occurred in these areas over the past 20 years, the level of new construction, redevelopment, and overall human activity is anticipated to increase substantially between 2005 and 2030. Increased levels of human activity directly translate into additional travel demand.

Table 38 displays the county-level projections of population and total employment that were incorporated in the travel demand model to forecast travel demand in the SR 400 and SR 365 corridors. To get a sense of the amount of growth projected, population and total employment were projected to increase to nearly 1.1 million persons and 508,000 employees, respectively, throughout the entire SR 400 and SR 365 corridor study areas. The 2030 population projection is nearly three times more than the 378,000 persons residing in the study area in 2005. The rate of growth is even higher for commercial development, with 2030 total employment forecasted to be almost four times more than in 2005.

Table 38 2030 Population and Total Employment by County

County	Population	Percent of Total	Total Employment	Percent of Total
Dawson[1]	34,439	3.2%	13,462	2.6%
Forsyth	393,581	36.2%	182,393	35.8%
Habersham[1]	67,164	6.2%	25,190	4.9%
Hall	487,826	44.9%	260,389	51.2%
Lumpkin[1]	53,755	4.9%	15,513	3.0%
White[1]	49,919	4.6%	11,944	2.3%
Total	1,086,684	100.0%	508,891	100.0%

[1]Population and total employment figures only for that portion of county inside the model study area.

Source: Raw data from U.S. Census (2000)

The relative distribution of socioeconomic data by county in 2030 does not change much in comparison with 2005. The highest concentrations of population and total employment are expected to remain in Forsyth County and Hall County in the future. Hall County currently has approximately 50 percent of the study area's total employment and 44 percent of the study area's population. Those shares are essentially the same in the 2030 projections. Forsyth County's share of population remains virtually the same between 2005 and 2030, but its proportion of total employment increases from 25 percent in 2005 to 35 percent in 2030.

While this amount of growth may seem large, the projected socioeconomic numbers used to forecast 2030 travel demand are similar to planning demographics on record with Georgia DCA and those being used by Forsyth, Hall, Habersham, Dawson, Lumpkin, and White counties in their comprehensive planning processes.

Projected growth from 2005 to 2030 was not allocated uniformly throughout the study area or within county boundaries. The spatial allocation of 2005–2030 increases in population and total employment for 17 subareas inside the model study area are shown on Figures 13 and 14, respectively. The South Forsyth and South Hall subareas received the largest increases in population growth, with more than 100,000 new persons expected to reside in each of these subareas by 2030. Several subareas in North Forsyth and North Hall were expected to gain between 50,000 additional persons and 100,000 additional persons. The SR 365 corridor in North Hall is forecasted to receive 30,000 new persons to 50,000 new persons by the horizon year 2030.In terms of the total employment forecast, Figure 14 indicates that the Gainesville subarea in Hall County is projected to experience the highest concentration of employment-related growth between 2005 and 2030. Subareas in South Forsyth, North Forsyth, and South Hall are projected to receive 50,000 to 100,000 new employees, including the SR 400 corridor subarea of northern Forsyth County. The area along the SR 365 corridor in northern Hall County is forecasted to receive 10,000 to 20,000 new employees by the horizon year 2030.

4.3.2 External Station Data

Overall, external traffic coming into, out of, and through the SR 400 and SR 365 travel demand model study area is forecasted to increase by 119 percent from 2005 to 2030. This rate of traffic growth was considered to be consistent with the amount of forecasted growth in human activity inside the study area. Forecast year 2030 external station traffic volumes are listed in Table 39. Not surprisingly, the two highway facilities with the highest daily 2030 volumes are the same roadway facilities as in 2005. SR 400, at the border between North Fulton and South Forsyth, was projected to have the highest 2030 volume with 175,800 vpd, which represents 136 percent of cumulative growth over 2005 numbers. I-985, where North Gwinnett meets South Hall, has the second-highest volume of 2030 traffic entering and leaving the study area at 139,300 vpd, which also represents 136 percent growth over 2005-level traffic.

Table 39 2005 and 2030 Daily Traffic at External Stations

Model External Station No.	Road Name	County	Est. 2005 Daily Volume	Est. 2030 Daily Volume	Daily Traffic Change (2005–2030)
446	Yonah Homer	Hall	2,320	4,600	98%
447	SR 51	Hall	2,610	5,100	95%
448	SR 323	Hall	1,100	2,200	100%
449	SR 52	Hall	3,580	7,100	98%
450	SR 82	Hall	1,140	2,200	93%
451	U.S. 129	Hall	10,040	23,700	136%
452	SR 332	Hall	1,070	2,100	96%
453	SR 60	Hall	2,100	4,400	110%
454	SR 53	Hall	7,910	18,700	136%
455	SR 211	Hall	4,910	11,600	136%
456	Spout Springs/Thompson Mill	Hall	5,250	17,800	239%
457	Ridge	Hall	290	500	72%
458	N Bogan	Hall	980	1,600	63%
459	I-985	Hall	58,950	139,300	136%
460	SR 13	Hall	8,440	19,900	136%
461	Peachtree Industrial	Hall	12,170	32,400	166%
462	Buford Dam	Hall	1,210	2,500	107%
463	Buford Dam	Forsyth	11,630	16,900	45%
464	SR 20	Forsyth	23,920	56,500	136%
465	Old Atlanta	Forsyth	5,870	11,700	99%
466	SR 141	Forsyth	34,000	71,200	109%
467	Jones Bridge	Forsyth	3,920	8,200	109%
468	Old Alpharetta	Forsyth	7,545	14,000	86%
469	McFarland	Forsyth	10,830	22,700	110%
470	Georgia 400	Forsyth	74,400	175,800	136%
471	Union Hill	Forsyth	1,530	9,300	508%
472	SR 9/Cumming Highway	Forsyth	21,980	46,000	109%
473	Midway	Forsyth	1,530	5,200	240%

Table 39 2005 and 2030 Daily Traffic at External Stations

Model External Station No.	Road Name	County	Est. 2005 Daily Volume	Est. 2030 Daily Volume	Daily Traffic Change (2005–2030)
474	Drew Campground	Forsyth	1,530	5,200	240%
475	SR 20	Forsyth	15,800	37,300	136%
476	SR 369	Forsyth	8,230	17,200	109%
477	Dawson Forest	Dawson	390	4,200	977%
478	SR 53	Dawson	6,760	11,100	64%
479	SR 136	Dawson	1,400	2,300	64%
480	SR 52	Lumpkin	2,860	4,700	64%
481	SR 9/U.S. 19/SR 60	Lumpkin	3,730	6,100	64%
482	U.S. 129	White	6,050	9,900	64%
483	SR 75	White	8,090	13,300	64%
484	SR 384	White	2,940	4,800	63%
485	SR 17	Habersham	2,910	4,800	65%
486	SR 197	Habersham	4,530	7,400	63%
487	SR 385	Habersham	7,000	11,500	64%
488	SR 365/U.S. 23	Habersham	9,240	19,300	109%
489	Glade Creek	Habersham	390	600	54%
490	SR 17	Habersham	8,930	17,800	99%
491	SR 13	Habersham	1,270	2,100	65%
492	Lake Russell	Habersham	200	300	50%
493	U.S. 441	Habersham	8,400	15,600	86%
494	Apple Pie Ridge	Habersham	4,590	7,500	63%
495	SR 347	Hall	4,250	7,000	65%
496	Bald Ridge Marina	Forsyth	3,350	6,200	85%
Total			434,065	949,400	119%

Source: SR 400 and SR 365 travel demand model

Traffic growth from 2005 to 2030 at other stations on the perimeter of the model's study area was generally consistent with differences in human activity that were represented by the 2005 to 2030 changes in socioeconomic data by subarea. Two external stations were projected to have an unusually high percentage of growth change between 2005 and 2030. Station no. 471 in Forsyth County (Union Hill Road) had a forecasted 508 percent growth, which represents growth in daily traffic from a base of 1,530 vpd in 2005 to 9,300 vpd in 2030. In absolute terms, that is an increase of 7,770 vpd over 25 years, which is consistent with the level of residential and commercial growth anticipated in that portion of the model study area. Moreover, most road facilities parallel to Union Hill Road are already nearing their design capacity during peak hours of typical weekdays.

Farther north in Dawson County, station no. 477 (Dawson Forest Road) was projected to experience 977 percent growth. That percentage represents growth in daily traffic from a base of 390 vpd in 2005 to 4,200 vpd in 2030, which is 3,810 vpd in absolute terms. Once again, this traffic growth is consistent with the level of residential and commercial growth anticipated in that portion of southern Dawson County around the intersection of Dahlonega Highway/SR 9 at Dawson Forest Road.

4.3.3 E+C Network Assumptions

A new, updated highway network was built from the base year 2005 network file to better reflect “committed” improvements that are assumed will be built over the next 10 years. In the travel demand modeling environment, as well as the real world environment, any capacity or accessibility changes in the highway network could trigger significant shifts in the routing decisions of vehicles traveling between certain origin-destination zone pairs. These routing shifts are particularly sensitive for motorists who travel in highway networks where congestion is present.

Committed roadway improvements were defined by the study team as those planned highway improvements that will be under construction or at least in the right-of-way acquisition stage of project implementation within the 2007–2011 time frame. The list of “committed” projects assembled by the study team was obtained from the following sources: Gainesville-Hall Metropolitan Planning Organization (GHMPO) 2006–2011 Transportation Improvement Program (TIP); ARC 2006–2011 TIP; Georgia DOT’s Construction Work Program (CWP) (June 2006); Georgia DOT’s CWP (April 2007); and Georgia DOT’s 2007–2009 State Transportation Improvement Program (STIP). Projects selected to be coded into the future year E+C network were those that could significantly improve capacity or accessibility or change motorist routings. Figure 15 displays a network map of the study area, highlighting sections of the road system where “committed” projects were identified. Brief descriptions of individual projects are included in Appendix F of this report, according to the label numbers shown on the figure.

The “committed” projects map highlights only those planned improvements meeting the criteria specified previously. County public works departments and Georgia DOT have many more improvements in various stages of the project development process. However, because of existing funding constraints and the possibility of prioritization shifts, only these planned projects were coded into the future year highway network to represent a reasonable baseline condition.

Capacity and accessibility improvements were coded into the base year highway network file to provide infrastructure where current and projected levels of human activity are greatest. Most of the roads highlighted on Figure 15 are located in southern Forsyth County, Cumming, southern Hall County, and Gainesville. Not many “committed” improvements are situated directly in the SR 400 study corridor, except for the three listed below:

- Interchange improvement at SR 369/Browns Bridge Road in Forsyth County
- Interchange improvement at Dawsonville Highway/SR 53 in Dawson County
- Operational and safety improvement with some added capacity on Cannon Bridge Road/SR 105 at SR 365 in Habersham County

4.3.4 Traffic Assignment

The future year 2030 traffic assignment for the baseline scenario is composed from a loading of 2030 travel demand onto the E+C highway network. Forecasted 2030 travel demand was much greater than base year 2005 traffic, as would be expected, considering the escalation in socioeconomic data between 2005 and 2030. A comparison of 2005 and 2030 total trip ends

Table 40 2005 and 2030 Total Trip Ends by County

County	Total Trip Ends 2005	Total Trip Ends 2030	Percent Change
Dawson[1]	75,467	212,798	182%
Forsyth	708,204	2,524,704	256%
Habersham[1]	169,134	490,379	190%
Hall	648,171	2,517,692	288%
Lumpkin[1]	63,778	274,137	330%
White[1]	69,540	249,957	259%
Total	1,734,294	6,269,667	262%

[1]Trip ends for only those portions of the county inside the model study area.

Source: SR 400 and SR 365 travel demand model produced and attracted to zones inside the study area is presented by county in Table 40. More than 6.2 million daily trip ends are forecasted in the future year 2030. This number is 262 percent more than the 1.7 million total trip ends estimated for the base year 2005. In Hall County, the increase in trip ends is from 648,000 in 2005 to 2.5 million in 2030. At the north end of the SR 365 corridor, Habersham County's total trip ends are forecasted to increase by 190 percent, from 169,000 in 2005 to 490,000 in 2030. Forsyth County also shows a prolific change in travel demand, growing from 708,000 in 2005 to 2.5 million in 2030.

Future year 2030 traffic volumes on SR 400 are projected to at least double. Year 2030-level traffic volumes projected for SR 400 would be much greater if the bottlenecks that cause severe congestion on sections of SR 400 located south of Keith Bridge Road/SR 306 were eliminated. A colored bandwidth map displaying 2005 and 2030 modeled daily volumes on roadways in the SR 400 corridor is presented as Figure 16.

The highest load section of SR 400 within the corridor study area is between Keith Bridge Road/SR 306 and Browns Bridge Road/SR 369, for which the projected 2030 daily volume is 84,000 vehicles per day. This projection is 105 percent higher than the 41,000 vehicles per day estimated in the base year 2005. The lowest volume section of SR 400 in Forsyth County is the northernmost section above Jot Em Down Road, where future year traffic is 67,000 vehicles per day.

Moving northward into Dawson County, modeled 2030 daily traffic exhibits a modest spike as it increases to 70,000 vehicles per day around Dawsonville Highway/SR 53 and the North Georgia Premium Outlets commercial district. The travel demand model forecasts traffic growth of 133 percent on SR 400 in this area, with the base year 2005 estimate being 31,000 vehicles per day. In northern Dawson County near the Lumpkin County border, future year 2030 daily traffic is 62,000 vehicles per day.

In Lumpkin County, the highest load section of SR 400 is between Burnt Stand Road/Lumpkin County Parkway and Dahlonega Highway/SR 60 in the model's 2030 baseline scenario. The forecasted 2030 volume for this section is 56,000 vehicles per day, which is 192 percent more than the 19,200 vehicles per day estimated for 2005. Dahlonega Highway/SR 60 is the northern border of the SR 400 corridor study area, but not for the SR 400 and SR 365 travel demand model study area. Moving from south to north on SR 400, most of the 56,000 vehicles per day are either coming from or traveling to Dahlonega or northern Hall County on SR 60 as opposed to coming from or traveling toward Cleveland on SR 115/Long Branch Road.

4.3.5 Projected Traffic Conditions

Only two sections of SR 400, north and south of Keith Bridge Road/SR 306, are currently built to freeway standards in the study corridor. However, the future no-build/E+C model scenario assumes that a short section of SR 400 at Dawsonville Highway/SR 53 is expected to be built to freeway standards. Therefore, the future year no-build/E+C model scenario assumes a freeway design in two sections of the corridor:

- From south of Browns Bridge Road/SR 369 to Pilgrim Mill Road
- From south of Lumpkin Campground Road to north of Dawson Forest Road

A level-of-service methodology appropriate for long-range corridor planning was employed for the future year 2030 no-build/E+C scenario. Forecasts of future year 2030 traffic volumes were output by the study team using the SR 400 and SR 365 travel demand model. Freeway capacity and level-of-service grades were computed using the 1985 *Highway Capacity Manual* formula for basic freeway segments assuming ideal conditions and a 2 percent rate of heavy trucks in the traffic stream. Table 41 presents a.m. and p.m. peak-hour LOS grade estimates, along with their corresponding traffic volumes and capacities.

During the a.m. and p.m. peak hours in the future no-build/E+C condition, both freeway segments north and south of Keith Bridge Road/SR 306 are forecasted to operate at LOS F in the peak direction of travel. In the a.m. peak hour, for example, 4,380 vehicles are forecasted to travel southbound between Browns Bridge Road/SR 369 and Keith Bridge Road/SR 306. Two southbound through lanes are assumed for this section of SR 400 in the no-build/E+C scenario, resulting in a capacity of 3,900 vehicles per hour. Values for the volume and capacity produce a V/C ratio of 1.12 for this section, which is equivalent to LOS F. With only two through lanes in each direction of travel, future year congestion on SR 400 is expected to worsen south of Keith Bridge Road/SR 306. The a.m. V/C ratio increases to 1.40 southbound from Keith Bridge Road/SR 306 to Pilgrim Mill Road. In the p.m. peak hour, similar traffic conditions, LOS F, are expected for motorists traveling northbound on SR 400 between Pilgrim Mill Road and Browns Bridge Road/SR 369. In the northbound direction of travel, however, the level of service on the segment from Keith Bridge Road/SR 306 to Browns Bridge Road/SR 369 would be dictated by how well SR 400 traffic passes through the at-grade intersection between Browns Bridge Road/SR 369 and SR 400. Northbound SR 400 traffic is not expected to move through Browns Bridge Road/ SR 369 in the p.m. peak hour without very long delays, equivalent to LOS F conditions.

In defining the future year no-build/E+C highway network for future baseline conditions, the existing at-grade intersections on SR 400 between Lumpkin Campground Road and Dawson Forest Road were removed from the travel demand model network. In the model, replacement access was provided by a split-diamond interchange linked by frontage roads along SR 400. At the southern end of the freeway design, a new road that would connect Industrial Park Road to Beartooth Parkway was assumed to provide SR 400 access to and from the south. At the north end, ramps to and from the north at Dawsonville Highway/SR 53 were assumed to provide access to SR 400. Forecasted traffic conditions on the freeway section north of Dawsonville Highway/ SR 53 and on the freeway section south of the Industrial Park Road/Beartooth Parkway connector are unsatisfactory in the peak direction of travel. It is forecasted that motorists traveling southbound on SR 400, from Lumpkin Campground Road to Dawsonville Highway/SR 53, will experience LOS E operating conditions in the a.m. peak hour. On the section of SR 400 between the Industrial Park Road/Beartooth Parkway connector and Dawson Forest Road, it is forecasted that southbound motorists will operate in LOS D conditions. The future year no-build/E+C scenario level-of-service analysis revealed that a two-lane freeway cross section will not provide satisfactory capacity in much of the SR 400 corridor.

Table 41 Freeway Section Level of Service (A.M. and P.M.)

Segment					A.M.					P.M.			
Cross Street 1		Cross Street 2	Direction of Travel	Analysis Type	Modeled Volume (PCPH)	Estimated Capacity (PCPH)	V/C Ratio	LOS		Modeled Volume (PCPH)	Estimated Capacity (PCPH)	V/C Ratio	LOS
Forsyth County													
Pilgrim Mill Road	–	SR 306/Keith Bridge Road	Northbound	Basic Segment	3,300	3,900	0.85	D		5,450	3,900	1.40	F
SR 306/Keith Bridge Road	–	SR 306/Keith Bridge Road	Northbound	Basic Segment	2,230	3,900	0.57	C		3,400	3,900	0.87	D
SR 306/Keith Bridge Road	–	SR 369/Browns Bridge Road	Northbound	Basic Segment	2,560	3,900	0.66	C		4,380	3,900	1.12	F
SR 369/Browns Bridge Road	–	SR 306/Keith Bridge Road	Southbound	Basic Segment	4,380	3,900	1.12	F		3,010	3,900	0.77	D
SR 306/Keith Bridge Road	–	SR 306/Keith Bridge Road	Southbound	Basic Segment	3,400	3,900	0.87	D		2,620	3,900	0.67	C
SR 306/Keith Bridge Road	–	Pilgrim Mill Road	Southbound	Basic Segment	5,450	3,900	1.40	F		3,880	3,900	0.99	E
Dawson County													
Dawson Forest Road	–	Industrial Park/ Beartooth Parkway	Northbound	Basic Segment	2,500	3,900	0.64	C		3,620	3,900	0.93	D
Industrial Park/ Beartooth Parkway	–	Dawsonville Highway/SR 53	Northbound	Basic Segment	1,780	3,900	0.46	B		2,800	3,900	0.72	C
Dawsonville Highway/ SR 53	–	Lumpkin Campground Road	Northbound	Basic Segment	2,520	3,900	0.65	C		3,810	3,900	0.98	E
Lumpkin Campground Road	–	Dawsonville Highway/SR 53	Southbound	Basic Segment	3,810	3,900	0.98	E		2,960	3,900	0.76	C
Dawsonville Highway/ SR 53	–	Industrial Park/ Beartooth Parkway	Southbound	Basic Segment	2,800	3,900	0.72	C		2,090	3,900	0.54	B
Industrial Park/ Beartooth Parkway	–	Dawson Forest Road	Southbound	Basic Segment	3,620	3,900	0.93	D		2,940	3,900	0.75	C
Lumpkin County													
(No Freeway Segments)													

Source: *Highway Capacity Manual*, 1985, Special Report 209, Transportation Research Board; Georgia 400 and SR 365 Travel Demand Model – PBS&J

5. Corridor Expansion Scenarios

This section presents the identified corridor goals and objectives, identifies potential corridor expansion scenarios, and describes how each potential expansion scenario is anticipated to perform relative to those goals and objectives.

5.1 Goals and Objectives

The previous sections of this report discuss existing travel conditions, anticipated future growth and development, and the likely future travel conditions in the study corridor as it exists today. Based on the results of that analysis and input from the study team, stakeholders, and the general public, specific corridor goals and objectives were identified. Simply stated, these goals and objectives identify the purposes of improvements to the corridor. They include goals such as “improve safety” and “increase mobility” and are listed in Table 42. As shown, the goals are fairly broad statements about the purpose of improvements to the corridor. The objectives, listed below each goal, more specifically define each corridor goal.

These goals and objectives guided the identification and evaluation of potential corridor expansion strategies. The project team identified corridor expansion scenarios expected to address the goals and objectives. Corridor strategies that were not expected to address the goals and objectives were not developed for detailed evaluation.

Table 42 Corridor Goals and Objectives

1. **Improve Safety**
   a. Reduce potential for vehicular conflicts
   b. Increase safe crossings for bicyclists and pedestrians
2. **Increase Mobility**
   a. Reduce corridor trip times
   b. Reduce system-wide hours of delay
   c. Decrease corridor mileage operating at unacceptable levels of service
3. **Better Manage Access**
   a. Reduce corridor access points
   b. Increase connectivity
   c. Increase average speed in congested conditions
4. **Encourage Transportation Best Practices**
   a. Minimize environmental impacts
   b. Maximize benefit/cost relationship
   c. Promote appropriate land use decision making

To further assist Georgia DOT's study team with identifying and evaluating appropriate improvement strategies, SR 400 stakeholders were asked to prioritize the list of objectives associated with each goal. Stakeholders' opinions are reported below.

Under the broadly defined goal *Improve Safety,* stakeholders unanimously decided that "reducing the potential for vehicular accidents" is the most important objective. For the goal *Increase Mobility,* there was no unanimous decision. Instead, stakeholders equally favor each of the objectives and added a fourth, "better access and turn lanes to businesses." For *Better Manage Access*, the stakeholders indicated they unanimously prefer the "increase connectivity" objective. For the goal *Encourage Transportation Best Practices,* stakeholders indicated that two objectives are most important. Their choices were split between "maximize benefit-cost value" and "promote appropriate land use decision making."

5.2 Scenario Development

5.2.1 Guidelines

As mentioned above, the project team considered the above goals and objectives in identifying potential corridor improvement strategies. The team also considered the following additional guidelines and data:

Georgia Department of Transportation design guidelines
Year 2030 daily traffic forecast by the SR 400 travel demand model
Findings from the crash rate analysis
Existing and future land use maps

Specific planning criteria used in defining overall strategic plans for the corridor are listed below.

- Future traffic volumes were forecast using travel demand modeling software. Additional travel lanes were proposed to handle future travel demand where volumes exceed capacity using the following thresholds:
  - Up to 40,000 vpd: four-lane freeway
  - Up to and exceeding 60,000 vpd: six-lane freeway
  - Up to 30,000 vpd: four-lane at grade
  - Up to 45,000 vpd: six-lane at grade
- Interchange spacing standards: Georgia DOT interchange spacing guidelines were used when determining interchange locations. Spacing guidelines are as follows, according to Department policy (these are also consistent with FHWA guidelines):
  - 1 mile minimum spacing in urban areas with an average of 2 miles
  - 2 miles minimum spacing in suburban areas with an average spacing of 4 miles
  - 2 miles minimum spacing in rural areas with an average spacing of 8 miles
- Existing and future land use: Development pressure is immediate along the SR 400 corridor. Existing and future land use maps were obtained from the counties in the study area to determine appropriate intersection or interchange locations in concert with access, connectivity, and interchange spacing criteria.

- Travel patterns: Travel patterns along the corridor are through trips versus commuter trips. Treatments serving commuter trips may include managed lanes, such as high-occupancy vehicle (HOV) lanes, while additional general-purpose lanes and a smaller number of interchanges favor through trips. Additionally, SR 400 carries a large amount of seasonal travel.

- Network access: Access points provide connections to adjacent land uses from the corridor but can deteriorate safety, capacity, and efficiency if not managed. Treatments may include frontage roads or an access management plan.

- Safety: Because the number of accidents is reduced with interchanges compared to at-grade intersections, this treatment is recommended in segments of the corridor with a crash rate above the statewide average of 142 total accidents per 100 million VMT and 1.78 fatal accidents per 100 million VMT.

- System connectivity: This includes two components: cross-corridor connections and interfaces with major roads serving as key links in the regional transportation system. Cross-corridor connections provide opportunities for motorists, bicyclists, and pedestrians to travel from one side of the corridor to the other. Interfaces between the corridor and major roads provide connections linking the corridor with destinations such as shopping, employment, and residential neighborhoods.

- Stakeholder input: The public input received favors the construction of a controlled-access freeway, followed by creating a limited-access road and a multi-lane divided road; technical advisory committee members (TAC) provided suggestions on access/interchange locations and off-corridor solutions, and expressed concern about feasibility and cost.

5.3 Scenarios

Based on the guidelines defined above, and on input received from the public, stakeholders, and TAC, the project team developed three scenarios for detailed testing and evaluation. These are listed and described below.

It is important to note that none of the scenarios tested included only an upgrade to the existing controlled-access configuration (meaning that at-grade intersections and driveways are permitted). The overwhelming majority of professional opinion, as well as input from involved parties, agreed that the predicted travel demands cannot be safely accommodated in an arterial environment. Therefore, the three scenarios tested represent different configurations of a limited-access corridor (meaning that at-grade intersections and driveways would be eliminated). These scenarios, described below, will be compared to the no-build or E+C scenario discussed previously in this report and below.

5.3.1 Cross Street Treatments

A limited-access roadway limits vehicular access only to grade-separated interchanges, with no direct driveway or street intersections on the roadway. Therefore, to adequately define and evaluate potential limited-access scenarios, it was necessary to identify an assumed treatment of each existing connection to the study segment of SR 400. A set of access rules was applied to each of the cross streets that intersect SR 400. The frequency of access and exact locations of access onto and off of SR 400 that were assumed in this study are consistent with the Department of Transportation’s interchange spacing guidelines as well as with the application of access management principles that attempt to balance the needs of local governments, property owners, and users of the roadway system.

Cross streets intersecting SR 400 were placed into one of three access treatment categories, as follows:

1. Freeway interchange – Grade-separated access onto and off of SR 400, such as the existing Keith Bridge Road interchange in Forsyth County.

2. Overpass/Underpass – Provides access between the eastern and western sides of SR 400, but not onto and off of SR 400 itself.

3. Cul-de-sac – The local road’s access onto and off of SR 400 is removed. There is not an overpass/underpass connecting to the other side of SR 400.

In the limited-access scenarios described below, no local road access onto and off of SR 400 is assumed using at-grade intersections as is the current practice. In each scenario, the potential treatment of each existing cross street is categorized and identified by symbols on the scenario maps.

5.3.2 Six-Lane Freeway

The first corridor expansion scenario included a conventional six-lane freeway. In this scenario, all driveways and at-grade intersections would be removed from the corridor.

Grade-separated interchanges would be located at key crossroads, and driveways would be relocated to other surface streets or would be removed. Scenario cost estimates, presented later, include costs associated with modifications to connecting streets and driveways.

Based on the analysis of likely future travel demands (discussed previously), the corridor likely warrants eight lanes at the southern end of the study area and six lanes at the northern end of the study area. The project team tested both a six-lane and an eight-lane (discussed below) scenario to more accurately test this finding and to locate the most probable location where the corridor would be reduced by two lanes.

5.3.2.1 Conceptual Schematics

The six-lane freeway scenario is illustrated on Figure 17. As shown, this scenario provides 10 new interchanges connecting to the corridor and nine overpasses/ underpasses to cross the corridor. It is also envisioned that parallel-access roadways may be necessary in certain locations as a means to replace access to existing developments.

5.3.2.2 Roadway Typical Sections

The general configuration and dimensions of the six-lane freeway scenario are illustrated on typical sections shown on Figure 19.

5.3.3 Eight-Lane Freeway

The second corridor expansion scenario included a conventional eight-lane freeway. In this scenario, all driveways and at-grade intersections would be removed from the corridor. Grade-separated interchanges would be located at key crossroads, and driveways would be relocated to other surface streets or would be removed. Scenario cost estimates, presented later, include costs associated with modifications to connecting streets and driveways.

5.3.3.1 Conceptual Schematics

The eight-lane freeway scenario is illustrated on Figure 18. As shown, this scenario provides 10 new interchanges connecting to the corridor and nine overpasses/ underpasses to cross the corridor. It is also envisioned that parallel-access roadways may be necessary in certain locations as a means to replace access to existing developments.

5.3.3.2 Roadway Typical Sections

The general configuration and dimensions of the eight-lane freeway scenario are illustrated on typical sections shown on Figure 19.

5.3.4 Managed Lanes

The third scenario tested includes an eight-lane freeway from SR 369 to Lumpkin Campground Road, where two of those lanes are designated for managed-lane operation. North of Lumpkin Campground Road the scenario includes a six-lane freeway. In this scenario, the eligibility to use the managed lanes includes automobiles with two or more occupants and buses. Any additional capacity within the managed lanes could also be sold via a toll option.

5.3.4.1 Conceptual Schematics

The managed-lane freeway scenario is illustrated on Figure 19. As shown, this scenario provides 10 new interchanges connecting to the general-purpose lanes, four new interchanges connecting to the managed lanes, and five overpasses/underpasses to cross the corridor. It is also envisioned that parallel-access roadways may be necessary in certain locations as a means to replace access to existing developments.

5.3.4.2 Roadway Typical Sections

The general configuration and dimensions of the managed-lane freeway scenario are illustrated on typical sections shown on Figure 19.

5.4 Evaluation

Each corridor scenario was evaluated for its anticipated ability to satisfy the identified corridor goals and objectives. This evaluation included a detailed evaluation of future travel conditions and the resulting traffic operations. The costs to implement each scenario were also estimated. Each scenario was evaluated in relation to the future year 2030 no-build or baseline model scenario. The aim of the evaluation was to identify which scenario best addresses the study’s goals and objectives, in light of the project’s cost-effectiveness.

The quantitative evaluation was based on traffic assignment output from the SR 400 and SR 365 travel demand model, the crash analysis, estimated project costs, and an environmental screening assessment. A summary comparing the performance measures of each scenario is provided in Appendix G. The resulting performance measures are discussed below relative to each of the study corridor's goals.

5.4.1 Improve Safety

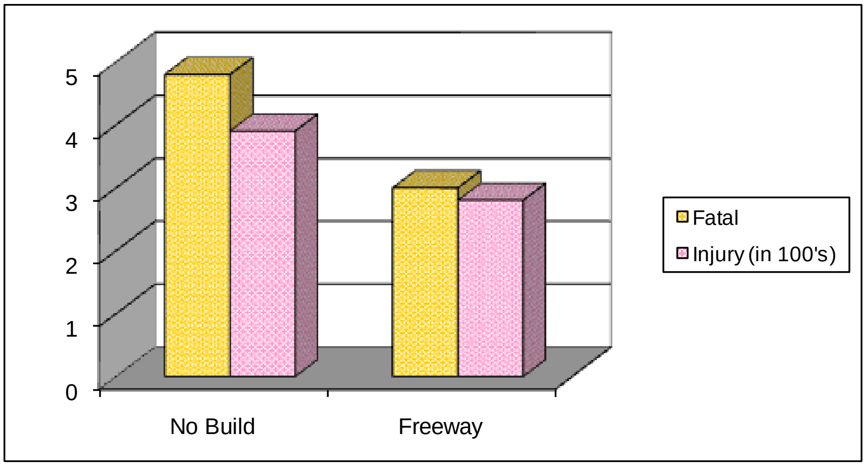
Historic crash frequency along the corridor was addressed previously in the Existing Conditions Analysis section of this report. As noted, some segments of SR 400 exhibit crash frequency rates higher than the statewide average for comparable roadways. As traffic volumes continue to increase on the corridor, the crash rates will likely increase correspondingly. Statewide average crash data indicates that as traffic volumes continue to increase, limited-access facilities (freeways) typically experience lower crash rates than arterial facilities of similar traffic volumes.

Statewide crash rates were used to estimate the potential future crash rates for both the no-build scenario and the build scenarios. The data does not allow for a fair comparison between the build scenarios – since all three build scenarios are limited-access control – but does allow for a comparison of the no-build scenario to any limited-access build scenario. Chart 19 illustrates the predicted future fatal and injury crashes for the no-build scenario and any of the build scenarios.

As shown, any of the three build scenarios (freeway facilities) are anticipated to result in lower crash rates than with the corridor's current arterial configuration. The limited-access or freeway facility is anticipated to reduce fatal and injury crashes by approximately 38 percent and 28 percent, respectively.

Bicycle and pedestrian safety on the corridor will be improved because crossings will be grade-separated.

Chart 19 Estimated Number of Annual Fatal and Injury Crashes by Scenario



Source: GDOT crash data and SR 400/SR 365 travel demand model

5.4.2 Increase Mobility

Using travel demand model output, the study team computed effectiveness measures for several study objectives associated with this goal:

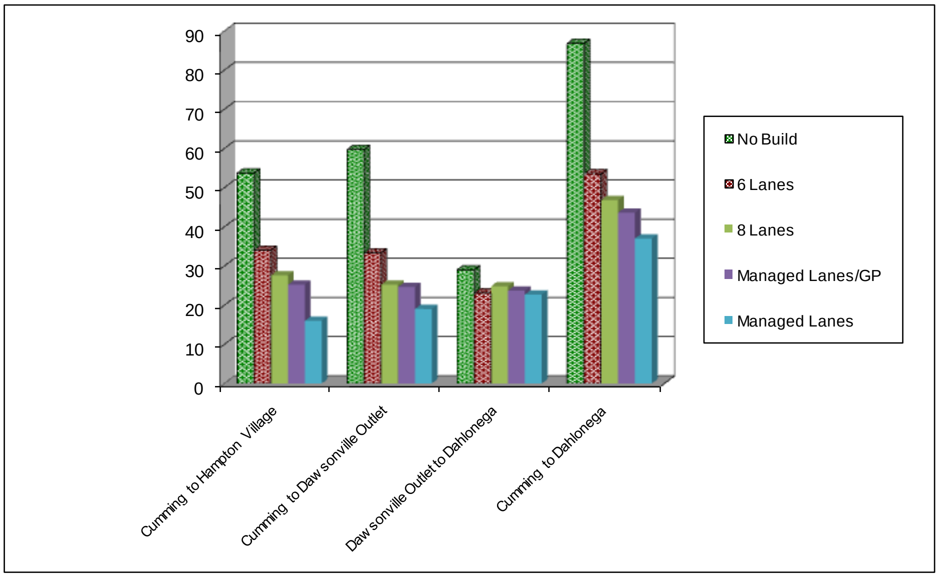
- Reduce corridor trip times
- Reduce system-wide hours of delay
- Reduce corridor route mileage operating at an unacceptable level of service

The relative performance of each improvement scenario is explained below for the effectiveness measures listed above.

5.4.2.1 Reduce Corridor Trip Times

Because the study corridor is approximately 17 miles long, four different origin-destination pairs were used to gauge the relative difference in trip times between the scenarios. These are Cumming to Hampton Village, Cumming to the Dawsonville outlets, the Dawsonville outlets to Dahlonega, and Cumming to Dahlonega. In Cumming, the specific origin was the Forsyth County courthouse. In Dahlonega, the specific origin was the square in downtown. Average peak-period travel times from 2030 travel demand model runs provided the benchmark statistics.

Chart 20 Travel Times for Selected Trip Interchanges



Source: CORSIM model

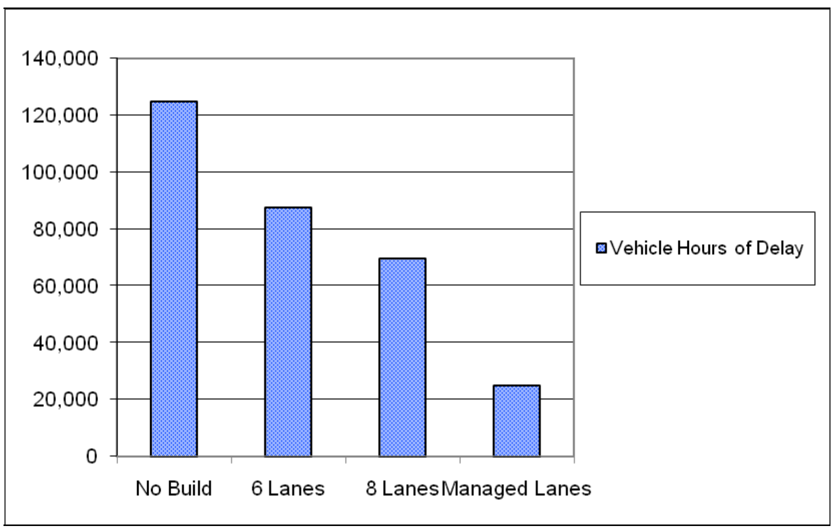
The future no-build scenario results in significant increases in travel times over existing conditions. For example, the travel time from Cumming to Dahlonega is predicted to increase from approximately 37 minutes to approximately 87 minutes, an increase of 50 minutes, or 235 percent. The travel time from Cumming to the Dawsonville outlets is expected to increase from 20 minutes to approximately 60 minutes, an increase of 200 percent. Each of the build scenarios results in significant improvements to the no-build travel times, but still increases travel time over existing conditions. The managed-lane scenario provides the best overall future travel times, particularly for those vehicles eligible to use the managed lanes, for which future travel times are very close to current conditions.

5.4.2.2 Reduce System-Wide Hours of Delay

Currently, travel delays along this segment of SR 400 are limited to isolated locations and peak periods. This is expected to change in the future unless investments are made to improve capacity in the study corridor. While the study area including and surrounding the SR 400 corridor currently experiences about 1,050 total hours of delay per day, the year 2030 model run of the no-build scenario estimated 124,930 total hours of delay per day in the SR 400 study corridor. This study area includes SR 400 and the major roads in the model network within a 4-mile-wide buffer around SR 400. It is important to note that the following discussion of delay applies to the entire study area, including not only SR 400 but all roads within this buffer. Therefore, delay figures presented refer to total combined delay experienced on all facilities in the study area on a given day, under a given scenario.

The predicted vehicular hours of delay for the build scenarios are significantly reduced as compared to the no-build scenario and are illustrated on Chart 21. As shown, the six-lane freeway scenario results in approximately 88,000 hours of delay; the eight-lane freeway scenario results in approximately 70,000 hours of delay; and the managed-lane scenario results in approximately 25,000 hours of delay in the study corridor. While none of these scenarios reduces total delay to today's levels, it is important to note that the measure includes other major roadways within a 4-mile buffer surrounding the SR 400 corridor, suggesting that some of the remaining delay is a result of capacity deficiencies on parallel or crossing roadways.

Chart 21 Vehicle Hours of Delay

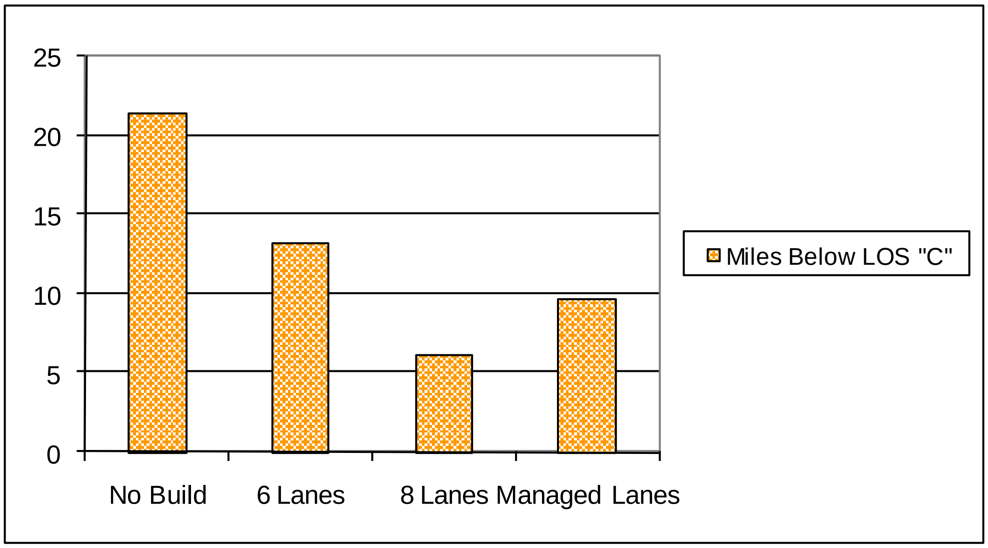


Source: CORSIM model

5.4.2.3 Reduce Corridor Route Mileage Operating at Unacceptable Level of Service

Currently, approximately 2 route miles of SR 400 experience traffic volumes in excess of the corridor's designed capacity. (A route mile is a mile in a single direction; therefore, the study corridor of 17.3 miles includes 34.6 route miles.) By year 2030, the existing corridor is expected to experience more than 21 route miles operating over capacity – that is 60 percent of the corridor operating over its intended capacity. The additional capacity provided by the build scenarios improves this measure considerably. The six-lane freeway scenario reduces the measure to 13 route miles and the eight-lane freeway scenario reduces the measure to 6 route miles. The managed-lane scenario reduces the measure to approximately 10 route miles, all of which are in the general-purpose lanes and none of which involve the managed lanes.

Chart 22 SR 400 Route Miles Operating Below LOS C



Source: CORSIM model

The future year 2030 no-build analysis indicates that most of the existing side streets along SR 400 will not have capacity to handle the projected traffic growth in the study area; therefore, the impact on SR 400 could not be estimated.

ARCADIS performed traffic analyses for three defined scenarios along SR 400:

- Scenario 1: Six-lane freeway system between Keith Bridge Road (SR 306) and SR 60
- Scenario 2: Eight-lane freeway system between Keith Bridge Road (SR 306) and SR 60
- Scenario 3: Eight-lane freeway system, including one HOV/managed lane between Keith Bridge Road (SR 306) and Lumpkin Campground Road/Harmony Church Road, transitioning to a six-lane freeway system between Lumpkin Campground Road/Harmony Church Road and SR 60

Detailed level-of-service results for each scenario are available in Appendix G.

5.4.3 Better Manage Access

Access management has different meanings; some of them are at cross purposes, so their measured values may have opposite meanings to different people. Considering the SR 400 corridor travel conditions and the goals and objectives described previously, improved access management in the SR 400 corridor would include a higher level of access control to better facilitate the types of trips demanded by the users. Three effectiveness measures were evaluated by the study team to assess how well each improvement strategy responds to the general goal of managing access. The three effectiveness measures are:

- Reduce corridor access points
- Increase connectivity
- Increase average speed in congested conditions

While the first two of these measures are contrary to each other, they provide meaningful information to help understand the differences between the no-build and the build scenarios. The third measure identifies the resulting effect to vehicular travel.

5.4.3.1 Reduce Corridor Access Points

The existing study segment of SR 400 has approximately 117 access points. These include at-grade driveways, at-grade street intersections, and ramp connections from the interchange at Keith Bridge Road. The two freeway scenarios reduce those direct connections to 22 access points. The managed-lane scenario adds special-use interchanges to/from the managed lanes, and therefore includes 30 access points.

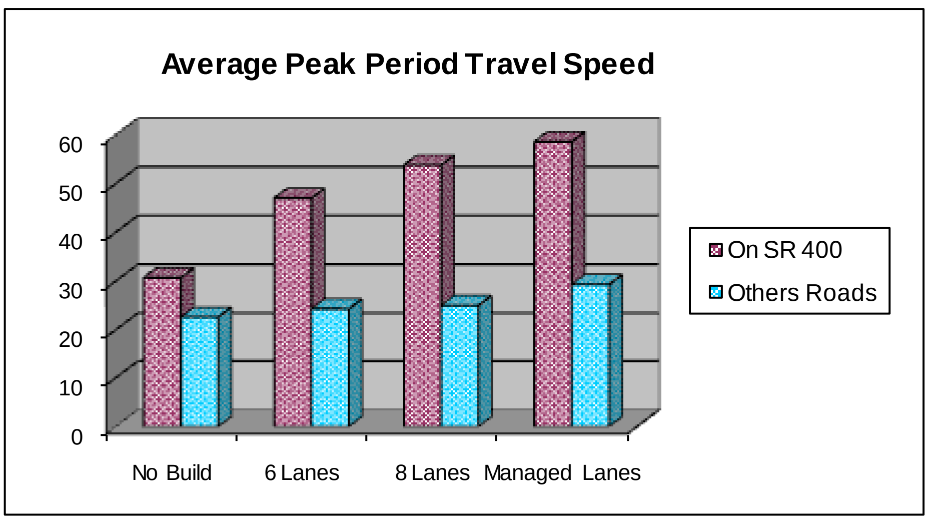
5.4.3.2 Increase Connectivity

Connectivity is a measure of how many connections exist within a system of roadways. A decrease in connectivity usually causes short, local trips to become longer in order to reach the desired destination. A decrease in connectivity usually has less impact to longer trips. Each of the build scenarios offers less connectivity than the no-build, because the scenarios are reducing the number of connections on SR 400. There is not a measurable difference in connectivity between the six-lane scenario and the eight-lane scenario. The managed-lane scenario would have slightly more connectivity as a result of the addition of several managed-lane access points to SR 400. In all the build scenarios, connectivity has been slightly improved over a basic freeway design through the inclusion of access roads or frontage roads in select locations – namely between SR 53 and Dawson Forest Road near Dawsonville.

5.4.3.3 Increase Average Speed in Congested Conditions

Average travel speeds are anticipated to drop significantly by year 2030 without improvements in the SR 400 corridor. The SR 400 average speed during peak periods is expected to drop from 57 mph today to 31 mph in the 2030 no-build scenario. The six-lane freeway scenario is predicted to achieve 47 mph, while the eight-lane freeway scenario is expected to achieve approximately 54 mph. The managed-lane scenario is expected to achieve average speeds of 58 mph on the general-purpose lanes and 63 mph on the managed lanes. This results in a combined average speed of approximately 59 mph, an increase of 2 mph over existing conditions.

Chart 23 Average Peak-Period Travel Speeds



Source: CORSIM model

The increased congested speeds associated with each build scenario are good indicators of the effect of reducing the number of connections on SR 400. Reduced access will result in improved mobility, less congestion, and improved travel speeds. Considering the goals and objectives for travel in the SR 400 corridor, these predicted changes suggest that each of the build scenarios presents a favorable condition over the existing design.

5.4.4 Support Transportation Best Practices

5.4.4.1 Potential Environmental Impacts

In evaluating the scenarios for SR 400, “environmental” includes both social and physical environmental considerations. Environmental impacts are assessed by the study team based on findings of a planning-level analysis, which was described previously in this report. This analysis identifies known resources that are potentially impacted by each scenario. More detailed project development activities will be necessary to more accurately assess specific impacts. This planning-level analysis, however, allows for an order-of-magnitude comparison between scenarios. The most important factor revealed by the preliminary assessment of potential environmental considerations is that there does not appear to be any fatal flaws that would tend to eliminate any of the potential scenarios from further consideration. The relative impact that each scenario may have on society and the environment is reported below.

There are currently 11 known sites with hazardous materials that potentially would be impacted by the six-lane or eight-lane scenarios. The managed-lane scenario potentially impacts 14 hazardous material sites. Most of these sites are gas stations with underground storage tanks. It is not yet known how many of these sites would in fact be impacted. If directly impacted by a build scenario, these tanks would likely require removal and assessment of the surrounding area to determine if additional mitigation would be required. The no-build scenario has no known impacts to hazardous material sites.

Similarly, there are currently four potentially historic properties, one church, one agricultural property, four residences, and 35 commercial uses potentially directly impacted by the six-lane and eight-lane scenarios. The managed-lane scenario potentially affects five potentially historic properties, one church, one agricultural property, seven residences, and 43 commercial uses.

The six-lane and eight-lane scenarios present similar potential impacts. The managed-lane scenario, because of the addition of special access to the managed lanes, slightly increases the potential for environmental impacts. Most importantly, none of the build scenarios appears to have a serious environmental issue that would prevent it from being developed in further detail.

With regard to social environmental considerations, any of the build scenarios offers a more favorable report than the no-build scenario. The primary reason for this conclusion has to do with the amount of future growth that is anticipated along the corridor and the resulting traffic growth and congestion that will occur. The worsening traffic congestion will negatively impact both the quality of life and commerce along the corridor. (Increased congestion will also result in increased crash rates as mentioned previously.)

5.4.4.2 Cost-Effectiveness

Cost estimates were prepared to construct each build scenario. These estimates are summarized in the following table.

Table 43 Scenario Cost Estimates

Scenario	Construction Cost (millions)	Right-of-Way Cost (millions)	Total Cost (millions)
Six-Lane Freeway	$438	$300–$500	$738–$938
Eight-Lane Freeway	$525	$350–$550	$875–$1,075
Managed-Lane Freeway	$558	$400–$600	$958–$1,158

The study team used a methodology reported in an American Association of State Highway and Transportation Officials (AASHTO) publication (*Manual on User Benefits Analysis of Highway and Bus Improvements)* for calculating benefit-cost ratios. Estimated costs included right-of-way, construction, and maintenance. User benefits were determined primarily by computing cumulative travel times and operating costs from link-level operational analyses performed for each scenario. A safety component was also incorporated into user benefits. The detailed data and calculations are provided in Appendix H.

Although the need for travel improvements to the SR 400 corridor has been clearly identified, the cost of improvements is likely to exceed the benefits for both the six-lane and eight-lane freeway scenario. Only the managed-lane scenario provides a long-term benefit-cost ratio greater than 1.0. This suggests that while additional capacity is needed, the cost of providing traditional general-purpose lanes alone outweighs the benefits realized. (Note that this analysis did not attempt to include other potential project benefits such as economic development or quality of life.) Based on this analysis, a combination of general-purpose lanes and managed lanes provides the most cost-effective solution.

5.4.4.3 Others

Each build scenario supports a number of other best transportation practices. These include a strategy to make freight movement more safe and efficient; providing local governments with a major transportation artery from which to revise and update their future land uses and infrastructure needs; and opportunities to enhance alternate forms of transportation/recreation (i.e., carpooling, bicycle, and pedestrian).

5.4.5 Qualitative Corridor Characteristics

Qualitative information was also considered by the study team, including:

- Survey origin-destination data
- Comments from public safety departments
- Exchanges of ideas through the public involvement process

Travel behavior patterns, crash characteristics, and corridor development circumstances were considered by the study team in the evaluation process but were not directly reflected in effectiveness measurements. In terms of travel behavior, origin-destination surveys indicate that SR 400 is heavily used as a commuter corridor and used heavily throughout the day for regional commerce. In addition, seasonal and weekend spikes in traffic volume on SR 400 are commonplace. And, while the majority of the trips in this study segment extend beyond the study area, most of these trips are oriented to/from the Atlanta region and are not interstate trips.

The crash analysis portion of this report highlights sections of SR 400 where the severity of crashes is more critical than on other sections. It does not explicitly state that most of the accidents occurred at at-grade intersections, but the general locations of crashes suggest that most are related to major at-grade intersections. Also, public involvement meetings allowed stakeholders and the public to express growing concerns about specific intersections along SR 400. These data and accounts support the finding that the preferred scenario should be some form of limited-access configuration.

Similar to other areas of northern Georgia, residential and commercial development has been and will continue to influence traffic and safety through the study area. Georgia DOT has been besieged with requests from local governments and property owners for permits to access SR 400. Relatively large-scale developments being planned along the corridor have the potential to increase the number of at-grade intersections and significantly add to daily traffic levels on SR 400. The public indicated a preference that SR 400 be reconstructed as a freeway-type roadway facility. At the same time, provisions for access to existing development are also necessary.

6. Strategic Improvement Plan

The results of the analysis of existing and anticipated future conditions described in the preceding sections of this report clearly demonstrate the need to make significant improvements to the SR 400 study corridor to satisfy the corridor goals for safety and mobility. The results discussed above indicate the expected future conditions without investment in the SR 400 corridor, along with three investment scenarios. The following sections describe the resulting recommended corridor plan, including the recommended corridor design; supporting policies, programs, and projects; and implementation steps.

6.1 Recommended Expansion

Based on analyses by the study team, in combination with collaboration from stakeholders and the public, the long-range recommendation is to upgrade the SR 400 corridor to a limited-access freeway. The corridor would include six general-purpose lanes from SR 306 (Keith Bridge Road) to SR 60 and two managed lanes from SR 306 to Lumpkin Campground Road. In addition, frontage roads and/or local roads would be provided where appropriate to connect local streets and provide access to existing development.

Although the freeway scenarios without managed lanes have lower benefit-cost ratios, it is likely that the improvements in this study section of SR 400 will be phased in such a way that the freeway upgrade will occur first, with managed lanes added at a later date. The timing of future corridor improvements must also take into account consistency with the rest of the SR 400 corridor south of the study area. For these reasons, a detailed recommended phasing plan is presented below to address sequencing of improvements that will ultimately result in complete build-out of the recommended long-term concept.

The total project cost for the recommended improvement plan is approximately $1 billion. Construction cost is estimated at $560 million and right-of-way costs are estimated at $400 to $600 million.

6.2 Implementation Strategies

To minimize obstacles that could prevent or impose significant delays to implementation of the recommended long-range plan, a number of potential strategies have been identified to help advance the project. There are many detailed action steps that will be necessary to advance the recommended corridor concept. A specific Action Plan is provided later in this section. The overall implementation strategy is described below.

6.2.1 Project Development

6.2.1.1 Concept Design

Based on the planning-level analysis documented in this report, a limited-access type of facility with provisions for future managed lanes is recommended for the SR 400 corridor. However, there are many specific conceptual design options that must be explored and a final concept must be identified before Georgia DOT can begin protecting necessary rights-of-way and purchasing access rights to accommodate additional development abutting the corridor.

It is anticipated that mitigating the loss of existing direct property access (or providing alternate access) will be the most complicated and expensive element of upgrading the SR 400 corridor. Therefore, it is suggested that the concept design phase consider unconventional design concepts as necessary along the corridor as either interim solutions or the most cost-effective solutions for the ultimate design. Some unconventional design elements that should be considered include:

- Continuous flow intersections
- Paired intersections
- Median U-turn
- Superstreet
- Jughandle
- Continuous T-flow intersections

A brief description of each concept is included in Appendix I. It is suggested that this appendix serve as a guide to the future design phases.

6.2.1.2 Project Phasing

The recommended corridor concept is estimated to cost a total of $1 billion, and will likely be implemented in many phases over many years. This phasing should be revisited periodically as conditions along the corridor continue to change and as more detailed information becomes available from concept design and other future project development activities. It is likely that opportunities for additional potential phases will be possible, allowing for earlier construction of component projects.

The study length of SR 400 is logically subdivided into two segments as listed in Table 44. A second layer of phasing is also listed within those two main segments.

Table 44 Possible Phasing Plan

Section I: SR 306 to SR 53		**8.6 miles**
(Forsyth and Dawson Counties)		**Length**
Dawson Forest Road to SR 53	Construct interchange with frontage roads	1.0 mile
SR 306 to SR 53	Reconstruct to six-lane freeway	7.6 miles
SR 306 to SR 53	Construct managed lanes	7.6 miles
Section II: SR 53 to SR 60		**8.7 miles**
(Dawson and Lumpkin Counties)		**Length**
SR 53 to SR 60	Construct interchanges	8.7 miles
SR 53 to SR 60	Reconstruct to six-lane freeway	8.7 miles
SR 60	Widen to four-lane arterial	5.5 miles

As shown in the table, the planned interchange at SR 400/SR 53 is recommended as a priority. Also, by widening the corridor to the outside of the existing lanes, space is left in the median for the final phase – the addition of two managed lanes in the median. Segment II, north of SR 53, includes two major projects.

In addition to these major project phases, it is possible that individual intersections may be upgraded to grade-separated interchanges as standalone projects. For example, the existing at-grade intersection at SR 306 or at Hubbard Town Road may be upgraded to a grade-separated interchange as a “spot” improvement. The need to advance individual interchange projects should be more thoroughly studied as part of the necessary concept development activities.

Implementation of the recommended scenario will not bring about changes to currently programmed capacity and accessibility improvements as reported in Appendix F.

6.2.2 Access Management

The first substantial step toward implementing the recommended scenario is the preservation of right-of-way. This should be accomplished through two primary steps: access management planning and purchase of access rights.

6.2.2.1 Access Management Program

Approximately 50 feet of additional right-of-way may be necessary along SR 400 from SR 306 to SR 53 to accommodate the proposed typical section. This dimension assumes similar outside shoulders and drainage features, and may be reduced as future concept design is completed. Additional rights-of-way will also be required at interchanges and where frontage roads are needed. Estimates of these areas are assumed for the purpose of cost estimates; however, more specific concept design work is necessary to more accurately locate these rights-of-way.

Approximately 30 feet of additional right-of-way may be necessary from SR 53 north to SR 60 to accommodate the proposed typical section, as well as additional right-of-way at interchange locations. Estimates of these areas are assumed for the purpose of cost estimates; however, more specific concept design work is necessary to more accurately locate these rights-of-way.

New developments, driveways, and cross streets will make right-of-way acquisition for the limited-access facility more difficult and expensive in the future. To minimize the costs and complexity associated with implementing the project, it would be judicious for Georgia DOT to prepare an access management plan to preserve the corridor for expansion.

An access management program is needed to assist in the implementation of frontage roads and the development of land use guidelines to support a phased implementation of the full set of road improvements recommended for SR 400. The program should be comprised of individuals representing Georgia DOT, local governments, and stakeholders in the corridor. Furnishing access to local properties from the public road system will be a key element in being able to acquire right-of-way and in restricting direct access on and off SR 400 to a limited number of cross street locations – ideally only those cross streets that will ultimately receive either an interchange or a bridge crossing of SR 400. Greater detail on access management programs, including recommendations specific to the SR 400 corridor, is provided in Appendix J.

6.2.2.2 Access Rights

In addition to managing future access, Georgia DOT must purchase access rights even where additional rights-of-way are not needed. These rights ensure that future driveways will not further impact travel on the corridor, and reduce the number of drives that must be relocated or removed in order to upgrade the corridor to limited access.

6.2.3 Adjacent Infrastructure Improvements

Travel forecasts conducted as part of this study indicate that SR 400 south of the study area will require significant expansion – and that expansion is not yet planned nor programmed by Georgia DOT or the Atlanta Regional Commission. Working with ARC, Georgia DOT needs to plan this expansion in ARC's Regional Transportation Plan (RTP) and Transportation Improvement Program (TIP) and in the Department's Construction Work Program (CWP) prior to programming the addition of lanes to SR 400 in the study area. Upgrading of SR 400 to limited access, however, may logically be implemented before corridor expansion south of the study area.

At the northern limit of the study area, SR 400 terminates at an intersection with SR 60 and Long Branch Road. Long Branch Road is a local, rural major collector that continues north to SR 52. New developments and driveway access have recently been constructed on Long Branch Road near the intersection with SR 400 and SR 60. Management and control of future vehicular access to Long Branch Road should be considered to protect against degradation of traffic operations near this important intersection.

At the request of Lumpkin County, a recommendation for SR 60 from SR 400 to the City of Dahlonega is included. SR 60 provides continuing access west and north from SR 400 to Dahlonega as a rural principal arterial. Because of the connectivity it provides between Gainesville, SR 400, and Dahlonega, SR 60 is an important adjacent roadway facility to consider.

The intersection of SR 60 and SR 400 operates at acceptable levels of service under current conditions as well as in each potential scenario. Currently, the intersection operates at LOS B in the a.m. and p.m. periods. Under the recommended scenario, the interchange at SR 60 operates at LOS A/B.

The SR 400/365 travel demand model included SR 60 in its model network from north of Dahlonega to east of Gainesville and, therefore, modeled future travel demands along SR 60. The travel forecasting results suggest that future travel demands on

SR 60 will continue to increase as upgrades are made to SR 400. During the a.m. peak hour, modeled volumes for the recommended scenario include 1,320 vehicles eastbound on SR 60 approaching SR 400 and 1,000 vehicles westbound on SR 60 leaving the intersection with SR 400. During the p.m. peak hour, modeled volumes for the recommended scenario include 1,170 vehicles eastbound on SR 60 approaching SR 400 and 1,710 vehicles westbound on SR 60 leaving the intersection with SR 400.

Daily traffic volumes on SR 60 are forecasted to increase significantly by the year 2030. Between SR 400 and the City of Dahlonega, volumes are forecasted to approximately double from 11,000 to 12,000 vehicles per day to 22,000 to 23,000 vehicles per day. In downtown Dahlonega, between SR 9 and Morrison Moore Parkway, volumes will increase by roughly 2.5 times, from 5,000 to 13,000 vehicles per day. The following table displays existing and forecasted daily traffic volumes on SR 60 through the travel demand model area.

Table 45 SR 60 Daily Traffic Estimates/Forecasts – SR 400/SR 365 Corridor Studies

	Segment Boundaries			Daily Traffic Estimate	
				2005	2030
Lumpkin County	SR 9	-	Morrison Moore Parkway	5,000	13,000
	Morrison Moore Parkway	-	Golden Avenue	12,000	23,000
	Golden Avenue	-	SR 400/SR 115/ Long Branch Road	11,000	22,000
	SR 400/SR 115/Long Branch Road	-	Seven Mile Hill	11,000	25,000
	Seven Mile Hill	-	Hall County	7,000	16,000
Hall County	Hall County	-	Old Dahlonega Highway	7,000	18,000
	Old Dahlonega Highway	-	SR 136/Price Road	11,000	22,000
	SR 136/Price Road	-	SR 283/Mt. Vernon Road	14,000	24,000
	SR 283/Mt. Vernon Road	-	BUS 11/Riverside Drive	30,000	53,000
	BUS 11/Riverside Drive	-	Downtown Gainesville/SR 369	40,000	66,000
	Downtown Gainesville/SR 369	-	Pearl Nix Parkway	18,000	42,000
	Pearl Nix Parkway	-	Industrial Boulevard	20,000	60,000
	Industrial Boulevard	-	I-985	26,000	54,000
	I-985	-	Fullenwider Road	11,000	24,000
	Fullenwider Road	-	Poplar Springs Road	6,000	20,000
	Poplar Springs Road	-	SR 211/Tanner Mill Road	4,000	14,000
	SR 211/Tanner Mill Road	-	Jackson County	2,500	10,000

Source: SR 400 and SR 365 Travel Demand Model; Georgia DOT Traffic Counts

Volume/capacity ratios and corresponding levels of service were also calculated for SR 60 north and south of SR 400 within the study model area. Table 46 displays these results for existing conditions, the 2030 no-build scenario, and the 2030 recommended managed-lane scenario.

Table 46 Volume/Capacity Ratios and Level of Service for SR 60

Segment	Direction	2005		2030 No-Build		2030 Build – Interchange at SR 60	
		V/C	LOS	V/C	LOS	V/C	LOS
North of SR 400	Northbound	0.63	C	1.24	F	1.17	F
	Southbound	0.64	C	1.29	F	1.31	F
South of SR 400	Northbound	0.65	C	1.75	F	1.75	F
	Southbound	0.69	C	1.81	F	1.85	F

The V/C ratios summarized in the table above are based on projected traffic demand in the SR 365 and SR 400 travel demand model and modeled roadway capacities consistent with the Atlanta Regional Commission travel demand model. The modeled roadway capacity depends on the area type and facility type and corresponds to capacity at LOS E for the purposes of analysis. Therefore, this approach likely provides a macro-level “worst case” assessment of V/C on SR 60. A more detailed traffic operational analysis approach, which may be appropriate in the future, could potentially yield lower V/C ratios and better levels of service.

Additionally, the CORSIM analysis of future conditions at the intersection of SR 400 and SR 60 demonstrated significant queues for vehicles turning onto southbound SR 400 from both eastbound and westbound SR 60. Therefore, additional turn-lane storage will likely be necessary on SR 60 at this location regardless of whether SR 60 is widened. The future scenarios involve a grade-separated interchange at this intersection and, as such, the addition of turning lanes is sufficient to achieve acceptable levels of service at the interchange alone if SR 60 is not improved in conjunction with SR 400 improvements.

This analysis confirms a need to increase the number of through lanes on SR 60 to the north between SR 400 and the City of Dahlonega and to the south between SR 400 and SR 136, especially as upgrades to SR 400 are advanced. Because improvements to SR 400 will contribute to increased travel demand on SR 60, potential future improvements to SR 60 should be considered subsequent to, or in conjunction with, any improvements to SR 400.

6.2.4 Intelligent Transportation Systems

Intelligent transportation system (ITS) features were not explicitly studied in the full build-out plan for the SR 400 corridor in this study. However, they may contribute to the operation of the corridor and should be considered in subsequent phases of preliminary engineering. ITS elements that could be implemented in designing the SR 400 corridor improvements include:

- State-of-the art traffic signalization at intersections controlling turning movements at freeway ramp termini
- Ramp metering
- Traveler information through Georgia DOT's prototype NaviGAtor system

The prototype NaviGAtor system is a network of interconnected fiber optic cable, variable message signs, vehicle detectors, and cameras that provide the Department of Transportation with the capability to:

- Operate a state-of-the-art incident management program
- Provide real-time traveler and traffic information to motorists
- Influence motorist routings when conditions warrant such action

Greater detail on intelligent transportation systems, including recommendations specific to the SR 400 corridor, is provided in Appendix J.

6.2.5 Travel Demand Management

Travel demand management (TDM) techniques for managing and mitigating traffic congestion were not studied in detail in developing the 2030 vision for the SR 400 corridor. However, TDM strategies may be incorporated in subsequent preliminary engineering and design studies to support phased implementation of the plan's improvements and to provide motorists with options. Potential TDM strategies may include park-and-ride lots to encourage ridesharing and facilitate express bus service. Greater detail on TDM, including recommendations specific to the SR 400 corridor, is included in Appendix J.

6.2.6 Local Partnerships

Local partnerships will be needed to (1) coordinate and monitor progress in implementing the 2030 vision for SR 400; (2) implement effective access management; and (3) modify land use policies and ordinances in local governments' comprehensive planning processes to support access management and travel demand management initiatives. Local partnerships must include participation from a variety of individuals representing a cross section of government, institutional, business, and residential interests. In addition, Georgia DOT and local governments must try to inform and engage the public as project development activities proceed.

Examples of land use and development policies that may be applicable to the SR 400 corridor are listed below.

- Local governments, in collaboration with Georgia DOT, should consider expanding their local street network parallel to SR 400 where there is commercial, institutional, or dense residential development to aid in converting SR 400 into a limited-access highway.

- Capital improvement elements of local government comprehensive plans should be modified to include a budget for new or improved local roads that will serve property owners whose access to and from the public road system is significantly lessened by the conversion of SR 400 to a limited-access highway.

- Zoning regulation changes administered by local governments that could aid in implementing the improvements to SR 400 include creating an overlay district for special zoning regulations in the SR 400 corridor pertaining to property access, formulating a new process for local governments to grant driveway permits for properties inside the SR 400 overlay district that are being developed or redeveloped, considering benefits of interparcel access in zoning ordinances for dense residential and commercial land uses, and considering benefits from shared parking in zoning ordinances.

6.3 Action Plan

Following is a step-by-step action plan outlining specific steps for each implementation strategy discussed above. Each step has an associated phase for delivery.

Table 47 Action Plan

Actions	Task Duration (years)	Cost*	Year	Considerations
Project Development				
Prepare concept plan for recommended scenario	1	$3,000,000	2	
Add project to statewide long-range plan	.1	Staff Time	3	This needs to be coordinated with the MPO planning process.
Construct interchange with frontage roads between Dawson Forest Road and SR 53	5	$124,919,476	3	PE – 1 year, ROW – 2 years, CST – 2 years
Reconstruct SR 400 to six-lane freeway from SR 306 to SR 53	6	$332,003,367	4	PE – 1 year, ROW – 2 years, CST – 3 years
Reconstruct to six-lane freeway between SR 53 and SR 60	5	$289,028,960	4	PE – 1 year, ROW – 2 years, CST – 2 years
Construct interchanges between SR 53 and SR 60	4	$121,387,800	5	PE – 1 year, ROW – 2 years, CST – 4 years
Construct managed lanes between SR 306 and SR 53	5	$200,065,804	5	PE – 1 year, ROW – 2 years, CST – 2 years
Access Management				
Prepare corridor access management plan	1	$100,000	1	This could be coordinated with a statewide effort to develop access management guidelines for roadways based on functional classification.
Purchase access rights	5	$107,812,800	1	This is recommended as an early step as access rights are anticipated to increase in cost over time.
Implement any additional action items from access management plan	TBD	TBD	2	
Adjacent Infrastructure Improvements				
Conduct study of SR 400 south of study area	1.5	$1,200,000	1	
Widen SR 60 from two lanes to four lanes (SR 9 to SR 136)	5	$130,000,000^	5	PE – 1 year, ROW – 2 years, CST – 2 years
Implement recommendations from studies	TBD	TBD	3	

Table 47 Action Plan

Actions	Task Duration (years)	Cost*	Year	Considerations
ITS				
Short Term – Prepare ITS/advanced transportation management system (ATMS) plan for an intersection collision warning system at unsignalized rural intersections in the corridor, where sight line issues exist	.5		1	
Long Term – Prepare ITS/ATMS plan that addresses state-of-the-art traffic signalization at intersections controlling turning movements at freeway ramp termini; ramp metering and traveler information through Georgia DOT's prototype NaviGAtor system	.75	$240,000	2	Coordinate with concept plan and PE efforts for each project phase.
TDM				
Prepare a TDM plan for the corridor	.75	$100,000	2	Should include identifying/ assessing feasibility of local transportation management associations (TMAs).
Local Partnerships				
Coordinate with county government to establish development restrictions along corridor	1	Staff Time	1	Several previous studies/plans have already been conducted that highlight potential development regulations.
Expand local street network parallel to SR 400 where development intensity is highest	1–10	TBD	2	This should be primarily a local responsibility.
Coordinate with county and local capital improvement plans	1	Staff Time	2	Coordination will occur periodically according to the county schedules.

* Costs associated with PE, ROW, CST, and access rights are described in more detail in Appendix H.

^ Source: ARC Transportation Project Costing Tool; details in Appendix H.

6.4 Implementation Considerations

There are funding regulations and allocation guidelines to which Georgia DOT must adhere. In addition, local consent, environmental approvals, and environmental justice must be considered in accordance with federal and state transportation statutes.

Funding for the project is anticipated to come from a combination of sources, including federal, state, and local funding capital improvement programs. By federal and state statutes governing the allocation of transportation funds, money to implement the SR 400 improvements needs to come from multiple sources for all practical purposes. (Exceptions could occur if a local government or privately controlled enterprise were to finance the improvements.)

The study team anticipates that the project will be paid for by means of federal, state, and local capital needs programs. Typical federal funding for a National Highway System (NHS) project requires a 20 percent minimum match from state and local sources. Moreover, Georgia DOT policy requires transportation funding to be spent equally across the congressional districts over a five-year period. In this case, for example, 80 percent, or $800 million, of the $1 billion total project cost could come from federal funds. That would leave $200 million from Georgia DOT and local government programs for capital improvements.

6.4.1 State Process

Georgia DOT has two important interrelated processes dictating the implementation schedule of a large-scale project such as the SR 400 corridor improvement plan. The primary focus of one process is designing the project. The other process is geared to financing, scheduling, and construction of the project, which is also known as programming.

Design of the project is done in two major sequential steps. Generally, these are:

1. Preliminary Design, which includes a concept study, environmental studies, preliminary engineering, and a right-of-way plan

2. Final Design, which includes environmental approval and location and design approval, final design, and right-of-way acquisition as well as modifications to final design and the right-of-way plan

These two phases of project design are not mutually exclusive. They could be thought of as an engineering-based econometric convergence process that concludes when the utilities for transportation function improvements and minimization of environmental impacts are maximized in relation to cost.

On a different, but related, implementation track, there are administrative matters pertaining to the projects that need to be programmed. Chiefly, programming includes funding and implementation schedules. A project is considered programmed for implementation when elements of the project are programmed into the Construction Work Program (CWP) and State Transportation Improvement Program (STIP). While the Department of Transportation, primarily, is responsible for programming projects in Georgia, metropolitan planning organizations (MPOs), such as the Atlanta Regional Commission, also have a responsibility in programming projects within their planning boundary. Outside of metropolitan areas, regional development centers (RDCs), county commissioners, and municipal administrators also have avenues to collaborate with Georgia DOT on programming transportation improvement projects. A project of this scale will need to be programmed over several years.

6.4.2 Metropolitan Planning Process

The Atlanta Regional Commission has responsibility for identifying transportation improvement projects in Forsyth County. Georgia DOT has to coordinate with ARC in the planning and programming of improvements to SR 400 within ARC's planning boundary. These requirements include planning for corridor expansion in the region's RTP and TIP. These are federally required planning and programming elements. As part of that required planning, the Atlanta Regional Commission must include projects in the regional air quality conformity analyses to ensure that the Atlanta region will meet its future targets for improving the region's air quality.

There is no MPO planning process for the Dawson County and Lumpkin County portions of the SR 400 corridor. Therefore, elements of the 2030 vision programmed for the northern portion of the corridor will be done by Georgia DOT in consultation with county and city officials.

6.4.3 NEPA Process

The National Environmental Policy Act (NEPA) of 1969 provides a framework for environmental planning and decision-making by federal agencies. NEPA directs federal agencies to consider the potential environmental consequences of their proposals, document the analysis, and make this information available to the public for comment prior to implementation. The NEPA process includes input from the public as well as from state and federal agencies so that all environmental issues, such as impacts to the natural, social, cultural, and economic environments, as well as other issues, are addressed. In addition to evaluating the potential environmental effects, the transportation needs of the public are taken into account in reaching a decision that is in the best overall public interest. There are three levels of environmental analysis and documentation that may be undertaken to satisfy the NEPA process for a proposed project or action:

- Categorical Exclusion (CE): A Categorical Exclusion is the lowest level of environmental documentation. A CE is typically prepared for a project that is expected to have little or no impact on the human environment. A project being cleared under a CE typically does not require public involvement. Project types that are typically cleared with a CE include intersection improvements, addition of turn lanes, signal upgrades, striping, safety, and most multiuse trails or sidewalks. The approval time for CEs ranges from six to nine months.

- Environmental Assessment (EA): An EA is the appropriate level of documentation when the impacts of a project may be significant or it is difficult to determine the potential impacts. An EA requires public involvement at the minimum of one public information open house and a public hearing. Project types that typically qualify for an EA are those that propose more than 1 mile of roadway on new location, major road widenings, those with potential for public controversy, and those with combined impacts to waters of the United States, cultural resources impacts, community impacts, noise impacts, air quality impacts, and other aspects of the human environment. An EA will often consider multiple alternatives including a no-build alternative. Preparation of an EA is a two-step process in which an EA is approved and, based on the findings, a Finding of No Significant Impact is generated. The approval time for EAs ranges from 12 to 24 months.

- Environmental Impact Statement (EIS): An EIS is the highest level of environmental analysis and is generally the appropriate document type for large transportation corridors such as bypasses or interstates. Preparing an EIS is a three-step process, with initial preparation of the Draft EIS, progressing to a Final EIS and concluding with a Record of Decision. Public outreach is significant for an EIS, usually consisting of several public information meetings and a hearing, as well as the creation of a citizens' advisory group and a technical advisory group. An EIS carries several alternatives through analysis, including the no-build, in which potential alternatives are analyzed to the same level for environmental impacts. The time period for preparation and approval of an EIS can range from three to five years or more.

This project will likely require an EA or an EIS. The study limits along the SR 365 and SR 400 corridors each encompass approximately 22 miles. The first step in determining the appropriate level of environmental documentation is to examine specific project areas that demonstrate logical termini that would have little to no impact on the environment and could possibly be cleared with a CE. Should the Department choose to clear the entire 22 miles of each corridor under one environmental document, the first level of analysis should start at the EA stage. The EA is selected when the significance of a project's impact on the environment is not known. If it is determined early in the process that the project would have significant adverse impacts along each corridor, it would then be appropriate to elevate the environmental analysis to an EIS.

6.4.3.1 Commercial/Residential Relocations

The number of residential and/or commercial displacements that may occur as a result of the proposed project cannot be determined at this time. However, commercial and residential development in proximity to the existing roadway was identified in several locations along SR 400. It may be possible to relocate residences and businesses within the same area, or potentially farther back on the same parcels, instead of relocating them to a new area. Once project development progresses, a conceptual stage study, which includes the relocation impacts of the proposed project, should be conducted to ensure compliance with the Uniform Relocation Assistance and Real Properties Acquisition Act of 1970.

6.4.3.2 Historic Properties

Section 106 of the National Historic Preservation Act of 1966 requires federal agencies to take into account the effects of their undertakings on historic properties and to afford the Advisory Council on Historic Preservation a reasonable opportunity to comment on such undertakings. It is unlikely that historic properties will be impacted by the proposed project.

6.4.3.3 Wetlands

Any construction related to the SR 400 corridor that involves activities in the aquatic environments identified in the Existing Conditions Analysis section will require authorization of an impact permit pursuant to Section 404 of the Clean Water Act. Throughout Georgia, the Section 404 program is administered by the USACE, Savannah Regulatory District.

In Georgia, there are three levels of permitting under the USACE program: Regional, Nationwide, and Individual Permits. The type of permit coordination and authorization involved depends on the extent of proposed impacts on wetlands/waters of the United States.

6.4.4 Short-Term Improvements

In recent years, Georgia DOT has upgraded intersections along SR 400 to provide improved turning lanes and traffic signal operations. However, several of the existing signalized intersections are now operating at or above their design capacity. Certain intersections, such as SR 400/SR 53, would benefit from dual left-turning lanes. However, SR 53 does not presently have two receiving lanes to accept two left-turning lanes. (As noted previously, a planned improvement will construct an interchange at the current SR 400/SR 53 intersection.) Therefore, in most cases, a significant widening of the cross street will be necessary to add intersection turning lanes on SR 400. As a result, there are not easily implementable, traditional opportunities for low-cost capacity improvements; significant cross street improvements or grade separations are necessary to increase intersection capacities.

While supportive of long-term improvements, the access management, ITS, and TDM strategies are effective in their own right and can be implemented without capacity improvements to streets intersecting the corridor.

Implementing access management or purchasing access rights and removing driveways provide both safety and mobility in a corridor. By reducing conflict points, specifically left turns in and out of driveways, access management increases safety by reducing the number of crashes. According to the *Access Management Toolkit*, produced by the Center for Transportation Research and Education at Iowa State University, case studies of 11 cities in Iowa showed that crash rate reductions as a result of implementation of access management ranged from 10 to 70 percent, with 40 percent being a typical reduction.

Mobility benefits from access management include a roadway capacity increase of 40 percent according to the Florida Department of Transportation and the *Highway Capacity Manual*. In the Iowa case studies mentioned above, level of service remained the same in 36 percent of the case studies and improved one letter grade or more in 64 percent.

Intelligent transportation systems have a proven track record of improving safety and mobility. Short-term ITS improvements focus on enhancing safety in the corridor and include the following:

- Implement Advanced Warning for End of Green Signal (AWEGS) at rural signalized intersections in the SR 400 corridor
- Install intersection collision warning system at unsignalized rural intersections in the corridor, where sight line issues exist
- Tie all ITS technologies deployed into existing Georgia NaviGAtor

Travel demand management strategies are low cost and can be implemented in the short term to reduce demand in the SR 400 corridor. Coordinating with existing TMAs and building new or expanding existing park-and-ride facilities, such as the one located at Lumpkin Campground Road, are appropriate TDM solutions for the SR 400 corridor. This would allow commuters to take better advantage of existing or future transit, carpool, and vanpool strategies.

In addition to the short-term improvements recommended above, some level of additional analysis will be needed to coordinate improvements in the study corridor with facilities at either end of the study corridor. For example, a study of SR 400 from SR 369 south to I-285 or I-85 may be needed to address the continuation of managed lanes and additional through lanes southward.

ARCADIS

Appendix A

Public Involvement

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Appendix B

Roadway Classifications

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Appendix C

Traffic Count Locations

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Appendix D

Crash History and Methodology

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Appendix E

Churches, Institutions,
Hazardous Materials, and
Potential Historic Structures

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Appendix F

Planned and Programmed Projects

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Appendix G

Scenario Comparisons

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Appendix H

Scenario Cost Estimates

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Appendix I

Unconventional Arterial
Intersection Designs

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Appendix J

Details on Access Management, ITS, and TDM