1.0 Bikeway Masters Plan Purpose

The intent of this Bikeways Plan is to improve bicycling conditions for residents and visitors in the city of Clemson. In 2011, the City of Clemson and Clemson University received renewed interest from the community to update, improve and enhance the City's bikeways infrastructure and to make biking facilities safer and more comfortable for all of its users. This plan is an update to the City's previous bikeways plan, *Clemson Bikeways*, completed in 1997. *Clemson Bikeways Master Plan 2012* is a comprehensive survey of Clemson's existing bikeways infrastructure and a guide for future investments in bicycle infrastructure. The vision of this plan is to update and expand the existing bikeway network in order to provide greater connectivity throughout the city and seamless links to Clemson University's campus and experimental forest lands. This plan strives to create an efficient, safe, and comfortable bikeways network that is accessible to all residents and visitors regardless of age or ability and provides the foundation for systems that will educate and encourage bicyclists and motorists in the city of Clemson.

In October, 2011, the City was approached by the Clemson University Planning and design office about the University's intent to develop, adopt, and ultimately implement a bikeways plan for the core of the University and University property surrounding the city. In doing so, it is the University's goal to coordinate its planning, programming, and implementation efforts with that of the City's and to provide continuous and compatible connections from the University's core through the city to surrounding destinations, open spaces, and recreational areas. In response to this objective, Planning and Codes Administration staff agreed to pursue an update to the City's Bikeways Plan that would be synchronized with the University's and that would include major modifications to the 1997 Plan based on changes in the area's land uses, transportation network, community preferences, and bicycle travel demand as well as new developments in the methods by which bicycle facilities can be funded and implemented.

The focus of this plan is to direct the improvement and development of a bikeways network that serves utilitarian purposes, connecting citizens and visitors to routine destinations via safe, comfortable, and convenient facilities. Bikeways provide an alternative mode of transportation that is both reliable and affordable for many of Clemson's residents regardless of age, income, and ability levels. Investments in bikeway networks would likely also expand the number of people bicycling for recreation, which is currently a popular form of exercise and leisure in Clemson and nearby communities.

This plan was compiled and written over several months after numerous studies of the City's existing bikeway infrastructure, a city-wide survey and bicycle counts at targeted intersections. This plan is guided by the results of the following studies.

- 2011 Bikeways Survey developed and administered by Clemson University Landscape Architecture student: Jack Cebe;
- 2012 Bikeways Survey developed and administered by the City of Clemson planning staff;
- 2012 Bicycle Use Intersection Counts conducted by the City of Clemson planning staff;
- 2012 Bicycle Parking Facility Counts conducted by the City of Clemson planning staff;
- Inventory and Analysis of the existing bikeways network conducted by the City of Clemson planning staff;
- Bicycle Level of Service Survey conducted by the City of Clemson planning staff;
- Bicycle Compatibility Index Survey conducted by the City of Clemson planning staff;
- 2012 Clemson University Bikeways Master Plan prepared by Clemson University planning staff;
- SCDOT Maintenance and Resurfacing Schedule; and
- Bicycle Friendly Community Case Studies throughout the nation, reviewed by the City of Clemson planning staff.

Using the results of these studies, this plan provides detailed bikeway implementation recommendations to suit the current and future needs of the Clemson community. Existing conditions and recommendations are organized according to the five E's criteria set forth by the League of American Bicyclists, an advocacy group that works with communities in order to create more bicycle-friendly environments. The five E's criteria provide a valuable framework for evaluating the adequacy and efficiency of an environment as it relates to bicycle use.

1.1 **Setting and Environment**

1.1:1 Location

The city of Clemson is located in far northwestern South Carolina, also referred to as the Upstate, in the foothills of the Blue Ridge Mountains. The majority of Clemson lies in southwestern Pickens County with a small portion of the city falling in northern Anderson County. It is bordered to the west by Lake Hartwell, which forms the border between Pickens and Oconee Counties.

1.1:2 Connections

Clemson is connected to other areas of South Carolina, Georgia, and North Carolina by South Carolina Highway 93 (Old Greenville Highway), U.S. Highway 123, U.S. Highway 76 (Anderson Highway), and South Carolina Highway 133. It is located approximately 125 miles south of Charlotte, North Carolina, and 125 miles north of Atlanta, Georgia.

Clemson is bordered to the north and south by 17,500 acres of Clemson University's experimental forest. This land is managed as a self-sustaining, living laboratory and is primarily dedicated as an education and research tool for Clemson University and South Carolina. The experimental forest is host to approximately 105 miles of recreational trails. These trails are separated into

three primary areas: Fants Grove, Issaqueena, and Todds Creek. The experimental forest lands are accessed from the south by South Carolina Highway 133 and from the north by Cherry Road (State Rd S-29-195).

1.1:3 Climate

Clemson boasts a comfortable Southern climate with humid summer temperatures and cool dry winters. The average yearly high is 72 degrees Fahrenheit, while the average yearly low is 48.6 degrees Fahrenheit. Levels of precipitation remain similar throughout the year with an average of approximately 4.2 inches per month, totaling an average of 50.4 inches per year. Historically, Clemson receives 2-6 inches of snow annually.

Due to Clemson's proximity to large cities and the mountains, its welcoming climate, and crowd-drawing sporting events, the city functions much of the time as a major destination rather than just a place for year round residents to live, work, and learn. It offers a unique experience for those looking to escape urban and suburban environments while retaining recreational and cultural amenities.

1.2 Relevant Community Demographics

1.2:1 Population

According to the U.S. Census Bureau's 2010 Census, the city of Clemson has 13,905 permanent residents. Clemson is a unique city in South Carolina as it is home to Clemson University. Clemson University is one of the nation's top 25 public national universities as rated by "*U.S. News and World Report*" and educates approximately 19,000 students annually.[1] Approximately 40 percent of Clemson's students reside on campus during the academic year.

1.2:2 Age and Sex Distribution

According to the 2010 U.S. Census, there are 5,914 households in the city of Clemson. Of those, 2,485 are family households, 42 percent of which have children under the age of 18.

Relative to South Carolina and the United States as a whole, the city of Clemson has a young population. As per the 2010 Census, 68.9 percent of residents in Clemson are between the ages of 5-44 years of age, and the median age for all residents living in

[1] Top Public Schools: National Universities, www.usnews.com, accessed August 2, 2012, http://colleges.usnews.rankingsandreviews.com/best-colleges/rankings/national-universities/top-public.

Clemson is 24.3 years. The median age in South Carolina and the United States are 37.9 years and 37.2 years, respectfully. The City of Clemson and South Carolina also have a higher proportion of people over the age of 65 compared to the rest of the nation.

There are slightly more men living in the city of Clemson than woman. Men account for 52.8 percent of Clemson's population, while women account for 47.2 percent, which is important to note because historically men utilize bicycle transportation more often than women. Please see the following tables for a further breakdown of the demographic compositions involving age and sex for Clemson, South Carolina, and the United States.

Population by Age Group, 2010
City of Clemson, South Carolina and United States

Age Groups	Clemson		South Carolina		United States	
	Number	Percent	Number	Percent	Number	Percent
Total Population	13,905	100.00%	4,625,364	100.00%	308,745,538	100.00%
Under 5 yrs.	517	3.7%	302,297	6.5%	20,201,362	6.5%
5 to 19 yrs.	1,908	13.7%	922,128	19.9%	63,066,194	20.4%
20 to 24 yrs.	4,835	34.8%	332,494	7.2%	21,585,999	7.0%
25 to 44 yrs.	2,830	20.4%	1,193,348	25.8%	82,134,554	26.6%
45 to 64 yrs.	2,208	15.9%	1,243,223	26.9 %	81,489,445	26.4%
65 to 84 yrs.	1,262	9.1%	561,157	12.1%	34,774,551	11.3%
85+ yrs.	345	2.5%	70,717	1.5%	5,493,433	1.8%
Total 18+ yrs.	11,980	86.2%	3,544,890	76.6%	120,727,881	39.1%
Total 65+ yrs.	1,607	11.6%	631,874	13.7%	22,905,024	7.4%
Median Age	24.3 yrs.	---	37.9 yrs.	---	37.2 yrs.	---

Source: US Census Bureau, 2010 Census

Age and Sex of Residents, 2010
City of Clemson

Age	Total Persons	Males		Females	
		Number	Percent	Number	Percent
Under 5 yrs.	517	284	2.0%	233	1.7%
5 to 19 yrs.	1,908	982	7.1%	926	6.6%
20 to 64 yrs.	9,873	5,371	38.7%	4,502	32.4%
65+ yrs.	1,607	707	5.1%	900	6.5%
All Persons	**13,905**	**7,344**	**52.8%**	**6,561**	**47.2%**

Source: US Census Bureau, 2010 Census

1.2:3 Educational Attainment

The city of Clemson boasts a high percentage of educated residents compared to Pickens County and the state of South Carolina as a whole. As measured by the Census Bureau's 2006-2010 American Community Survey, over 66 percent of Clemson residents hold a bachelor's degree or higher.

Educational Attainment of Persons 25+ Years, 2006-2010
City of Clemson, Pickens County and South Carolina

Educational Attainment	Clemson		Pickens County		South Carolina	
	#	%	#	%	#	%
Population 25 Years and Over	5,426	100.0	71,984	100.0%	2,981,382	100.0%
Less Than 9th Grade	134	1.8%	4,751	6.6%	175,902	5.9%
9th to 12th Grade, No Diploma	216	2.9%	8,638	12.0%	330,933	11.1%
High School Graduate (Includes Equivalency)	854	11.5%	22,171	30.8%	930,191	31.2%
Some College, No Degree	906	12.2%	13,317	18.5%	581,369	19.5%
Associate Degree	379	5.1%	6,191	8.6%	247,455	8.3%
Bachelor's Degree	2,369	31.9%	9,862	13.7%	462,114	15.5%
Graduate/Professional Degree	2,569	34.6%	7,054	9.8%	250,436	8.4%

Source: Census Bureau, American Community Survey 2006-2010.

1.2:4 Income

The median household income for the city of Clemson is significantly less than the median household income for both South Carolina and the United States. Households in Clemson earn an estimated $33,935 per year according to the United States Census Bureau's 2006-2010 American Community Survey. Approximately 39.3 percent of residents in Clemson spend more than 30 percent of their household income on housing costs. It must be noted that many of Clemson's student residents have little to no earned income to report and sustain housing and living costs through alternate means such as grants, loans, and support from their families.

Yearly Income	Clemson	South Carolina	United States
Total Households	8,835	1,741,994	114,235,996
Less than $10,000	7.9%	5.3%	4.1%
$10,000 to $14,999	9.2%	6.5%	5.5%
$15,000 to $24,999	12.9%	12.8%	10.8%
$25,000 to $34,999	12.0%	12.0%	10.5%
$35,000 to $49,999	12.6%	15.1%	14.1%
$50,000 to $74,999	8.7%	18.4%	18.6%
$75,000 to $99,999	10.5%	11.4%	12.3%
$100,000 to $149,999	11.0%	9.5%	12.3%
$150,000 or greater	6.1%	5.1%	8.6%
Median Household Income	$33,935	$43,939	$51,914

Source: US Census American Community Survey 2006-2010 (5-Year Estimates)

1.2:5 Means of Transportation to Work

Means of Transportation to Work in City of Clemson 1990-2011

Mode	1990	2000	2007-2011	2000-2011 Percent Change
Drive Alone	78.4%	80.2%	85.20%	6.2%
Carpool	12.2%	10.7%	79.88%	646.5%
Public Transportation	0.0%	2.0%	4.08%	104.0%
Walk	4.4%	3.7%	5.06%	36.9%
Bicycle	2.7%	1.0%	1.51%	50.8%
Motorcycle	0.4%	0.3%	0.00%	-100.0%
Other Means	0.1%	1.2%	0.00%	-100.0%
Work at Home	1.8%	0.8%	4.15%	418.3%

Source: U.S. Census Bureau 1990, 2000 Census, and ACS 2007-2011 5-year Estimates

Means of Transportation to Work in South Carolina 1990-2011

Mode	1990	2000	2007-2011	2010	2000-2011 Percent Change
Drive Alone	75.5%	79.4%	81.8%	82.9%	3.0%
Carpool	16.9%	14.0%	10.2%	9.3%	-27.0%
Public Transportation	1.1%	0.8%	0.6%	1.1%	-19.5%
Walk	3.1%	2.3%	2.0%	1.9%	-12.5%
Bicycle	0.3%	0.2%	0.3%	0.4%	41.0%
Motorcycle	0.2%	0.1%	0.2%	0.2%	106.5%
Other Means	1.0%	1.0%	1.0%	1.0%	-0.4%
Work at Home	1.9%	2.1%	3.7%	3.7%	77.0%

Source: U.S. Census Bureau 1990, 2000 Census, and ACS 2007-2011 5-year Estimates

Means of Transportation to Work in U.S. 1990-2011

Mode	1990	2000	2007-2011	2010	2000-2011 Percent Change
Drive Alone	75.5%	79.4%	76.8%	82.9%	-3.3%
Carpool	16.9%	14.0%	10.2%	9.3%	-26.9%
Public Transportation	1.1%	0.8%	5.0%	1.1%	524.2%
Walk	3.1%	2.3%	2.9%	1.9%	24.0%
Bicycle	0.3%	0.2%	0.5%	0.4%	168.8%
Motorcycle	0.2%	0.1%	0.2%	0.2%	123.1%
Other Means	1.0%	1.0%	0.9%	1.0%	-13.1%
Work at Home	1.9%	2.1%	4.3%	3.7%	102.5%

Source: U.S. Census Bureau 1990, 2000 Census, and ACS 2007-2011 5-year Estimates

Means of Transportation to Work in Similar Sized University Cities 2007-2011

Mode	Auburn, AL Auburn University	Blacksburg, VA Virginia Tech	Pullman, WA Washington State	Clemson, SC Clemson University
Drive Alone	77.5%	63.0%	50.0%	79.9%
Carpool	9.3%	8.4%	9.8%	5.3%
Public Transportation	2.1%	7.5%	8.5%	4.1%
Walk	4.9%	10.0%	21.6%	5.1%
Bicycle	2.0%	3.0%	2.3%	1.5%
Motorcycle	0.3%	0.0%	0.9%	0.0%
Other Means	0.4%	0.1%	0.3%	0.0%
Work at Home	3.4%	8.0%	6.5%	4.1%

Source: U.S. Census Bureau ACS 2007-2011 5-year Estimates

Available Vehicles Per Household in City of Clemson 1990-2011

Number of Vehicles	1990	2000	2007-2011	2010	2000-2011 Percent Change
No Vehicle	5.9%	5.4%	5.3%		
One Vehicle	30.9%	33.7%	21.4%		
Two Vehicles	39.6%	38.7%	34.1%		
Three Vehicles	23.5%	22.2%	39.2%		

Source: U.S. Census Bureau 1990, 2000 Census, and ACS 2007-2011 5-year Estimates

Available Vehicles Per Household in South Carolina 1990-2011

Number of Vehicles	1990	2000	2007-2011	2010	2000-2011 Percent Change
No Vehicle		9.0%	2.8%		
One Vehicle		33.6%	21.0%		
Two Vehicles		39.1%	43.2%		
Three Vehicles		18.3%	33.0%		

Source: U.S. Census Bureau 1990, 2000 Census, and ACS 2007-2011 5-year Estimates

Available Vehicles Per Household in the U.S. 1990-2011

Number of Vehicles	1990	2000	2007-2011	2010	2000-2011 Percent Change
No Vehicle		10.3%	36.2%		
One Vehicle		34.2%	31.1%		
Two Vehicles		38.4%	21.9%		
Three Vehicles		17.1%	10.8%		

Source: U.S. Census Bureau 1990, 2000 Census, and ACS 2007-2011 5-year Estimates

1.3 Overview of Bikeways Plan

The Clemson Master Bikeways Plan is organized as followed:

Chapter 1- Introduction: Describes the location of the city of Clemson and its unique juxtaposition within the State of South Carolina. It also provides an overview of this plan and the City's bikeway vision statement, as well as demographic and transportation trends related to the characteristics of the population.

Chapter 2- Benefits: Highlights the important economic, health, and environmental benefits bicycling and the presence of bikeway infrastructure can have for a community.

Chapter 3- Existing Conditions: Inventories and examines the functionality of the existing bikeways network, programs, public and resident attitudes, and the Bicycle Level of Service, a measure of perceived bicyclist safety and comfort, in the city of Clemson.

Chapter 4: Recommendations and Implementation

Chapter 5: Education

Chapter 6: Conclusion

The city of Clemson is "*In Season, Every Season*" due to its relatively mild, Southern climate, an active and diverse population, and central location in the southeastern United States. Clemson is a community where people come to learn when they are young and relax and recreate while they age. This makes the city of Clemson an ideal location to invest in bicycle infrastructure to support the lifestyles of its diverse and active population.

This plan measures the physical existing bikeway network conditions present within the city and provides a guide for a future bikeways network designed to strengthen the community's economy, health, and levels of sustainability. This plan is supportive of a bikeway network that is accessible to every age, income, and ability level.

2.0 Benefits

The creation and use of bikeways has many positive effects on a community, including economic, health, and environmental benefits. Bicycling is the second most popular outdoor activity in the United States, and it is a form of transportation that is available to almost everyone regardless of age or income level.[2] It is also a cost-effective method of using transportation dollars to receive a generous return on investment. According to the United States Census Bureau, the percentage of bicycle commuters has increased 43 percent from 2000 to 2010. As a nation, we are slowly moving away from automobiles as the sole form of transportation, and more than 80 percent of Americans support maintaining or increasing funding for bicycling and walking infrastructure.[3] Between May and September 2008, gas prices reached average levels of over four dollars per gallon. During this time, Americans drove 57.8 billion fewer miles in the same months as they did in 2007.[4] A new analysis conducted by the League of American Bicyclists shows cyclists in the United States save an average total of 4.7 billion dollars per year.[5] Some of these savings result from fewer dollars spent on energy consumption, automobile maintenance and insurance, and healthcare. It also includes the value gained from less commuting time and greater work productivity. The U.S. Department of Transportation (USDOT) encourages local communities to go above and beyond minimum standards and requirements to create safe, sustainable, accessible, and attractive bicycling and walking networks. They also promote the utilization of universal design characteristics for bicycle and pedestrian facilities so they can be used by all ages and abilities.[6] This chapter highlights the benefits of biking with the intent to positively influence future infrastructure investments to help enhance the quality of life in the city of Clemson. Please see **Appendix A** for the complete USDOT walking and bicycling key statutes and regulations.

[2] "Outdoor Recreation Participation Topline Report 2011," Outdoor Industry Association, accessed July 9, 2012, http://www.outdoorindustry.org/participation-studies.php?action=detail&research_id=133.

[3] "National Poll: Americans Support Funding for Sidewalks and Bikeways," America Bikes, Princeton Survey Research Associates International, March 2012. accessed July 9, 2012, http://www.americabikes.org/2012survey.

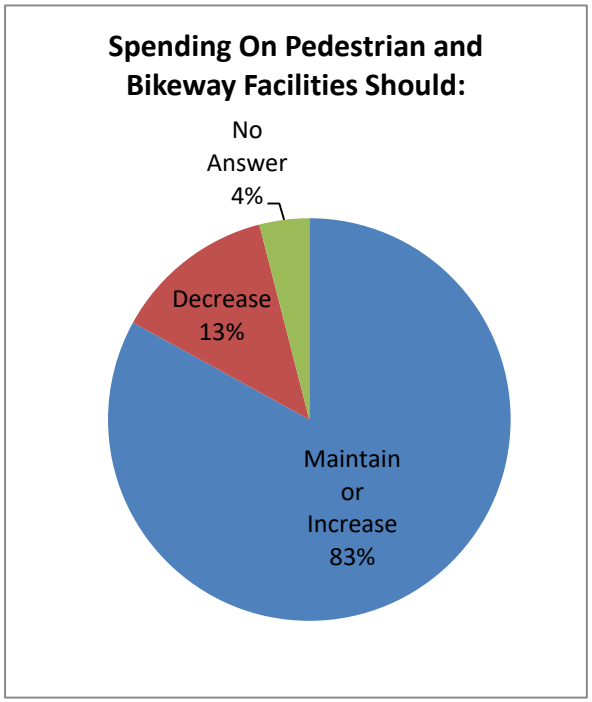
[4] "The Economic Benefits of Bicycle Infrastructure Investments," The League of American Bicyclists, June 2009, accessed July 10, 2012. http://www.bikeleague.org/resources/reports/pdfs/economic_benefits_bicycle_infrastructure_report.pdf.

[5] "U.S. Bicyclists Save $4.6 Billion Per Year by Riding, Instead of Driving," League of American Bicyclists, May 18, 2012, accessed July 26, 2012, http://archive.constantcontact.com/fs059/1102316596448/archive/1110016545074.html

[6] "Policy Statement on Bicycle and Pedestrian Accommodations: Regulations and Recommendations," United States Department of Transportation, March 2010, accessed July 10, 2012, http://www.fhwa.dot.gov/environment/bicycle_pedestrian/overview/policy_accom.cfm.

2.1 Economic Benefits

The economic benefits of bikeway networks have been studied throughout the United States, and the results have consistently demonstrated benefits to the communities they are in. A bikeways network not only makes an area a more attractive place to live, work and recreate, but it also boosts employment levels and economic activity. Communities that invest in bicycle transportation experience economic benefits by attracting more businesses and tourism dollars and encourage residents to become more active. Economic benefits associated with investments in bicycle transportation can be attributed to higher levels of disposable income spent in the community.



Source: 2012 Princeton University Survey

2.1:1 *Household and Transportation Costs*

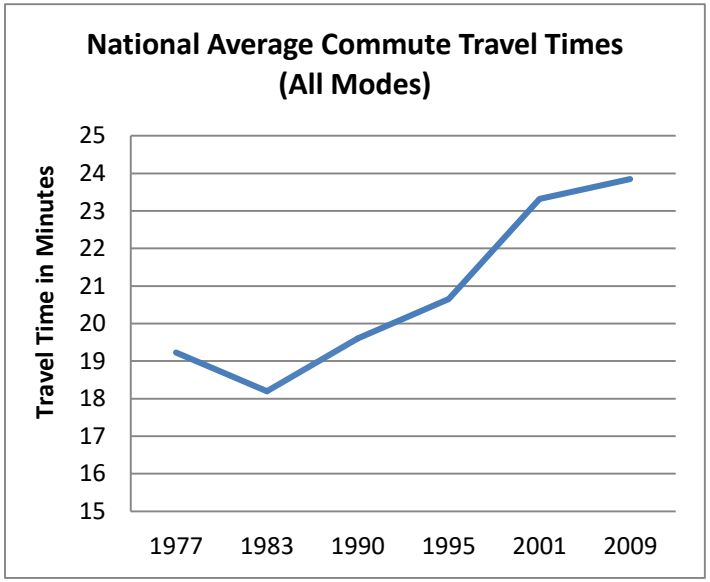
Today, the cost of transportation is the second largest expenditure for American households with medium income levels and is often the largest expense for lower income households. Low-income households can spend up to 55% of their household budget on transportation costs.[7] As gas prices continue to rise, more and more Americans are being forced to discover alternate modes of transportation. Enhancing bikeway networks provides more transportation options for users in which conventional single-occupancy motorized vehicular travel is becoming too costly. The most frequent function a transportation network serves is getting employees to work. With today's high cost of travel, workforce participation is suffering. Residents cannot afford to work if they have to spend a continually growing portion of their earning wage on transportation costs. This contributes to higher unemployment rates and creates barriers to workforce participation. Lack of adequate, affordable transportation also plays a role in higher employee turnover. The American Automobile Association estimates the cost of owning and operating a vehicle at more

[7] "House and Transportation Cost Trade-Offs and Burdens of Working Households in 28 Metro Areas," Center for Neighborhood Technology and Virginia Tech University, Center for Housing Policy, Washington D.C., 2006, accessed July 9, 2012, http://www.cnt.org/repository/H-T-Tradeoffs-for-Working-Families-n-28-Metros-FULL.pdf.

than $8,500 per year[8] while the average annual cost of owning and operating a bicycle is approximately $308.[9] It is much more expensive to own, drive, insure, and care for an automobile compared to the relatively low cost associated with owning, riding, and maintaining a bicycle. Therefore, bikeway network investments are essential in providing affordable transportation options.

A recent study by the Victoria Transport Policy Institute, an independent research organization dedicated to developing innovative and practical solutions to transportation problems,[10] looked at quantifying the benefits of switching from driving to bicycling for a trip. The findings indicated that by replacing an automobile trip with a bicycle trip, individuals and society save approximately $2.73 per mile.[11] Bicycling provides a cost-effective transportation option for all income levels.

Bicycling and walking also have a positive effect on the amount of local spending. Shifting short automobile-dependent trips to biking trips allows residents to have more disposable income, making the household budget stretch further.



Source: National Household Travel Survey 2009

High transportation and environmental costs can also be attributed to the amount of time people spend idling in their cars while stuck in daily traffic congestion. Employees are losing valuable billable hours stuck in traffic, and according to the Texas Transportation Institute, "Gridlock costs the average peak period traveler almost 40 hours a year in travel delay, and costs the United States more than $78 billion each year."[12]

[8] American Automobile Association. "Your Driving Costs," [online] 2011, accessed July 9, 2012, awww.aaaexchange.com/main/Default.sap?CategoryID=16&SubCategoryID=76&ContentID=353.

[9] "Bicycling and Walking in the United States: 2012 Benchmarking Report," Alliance for Biking and Walking, 2012. accessed July 9, 2012, http://www.peoplepoweredmovement.org/site/images/uploads/Media_Fact_Sheet_-_Benchmarking_2012.pdf.

[10] Victoria Transport Policy Institute, accessed July 18, 2012, http://www.vtpi.org/.

[11] "Quantifying the Benefits of Nonmotorized Transportation for Achieving Mobility Management Objectives," Victoria Transport Policy Institute, November 30, 2004. accessed July 9, 2012, http://vtpi.org/nmt-tdm.pdf.

[12] "Traffic Congestion and Urban Mobility," Texas Transportation Institute, accessed July 9, 2012, http://tti.tamu.edu/2011/03/01/improved-urban-mobility-report-distributed/.

Smaller communities have the most to gain by implementing bicycle and walking infrastructure. As per the U.S. Census Bureau's American Community Survey, half of all bicycle trips made by Americans are within 20 minutes. In rural America, nearly 40 percent of trips are shorter than three miles, and of those, half are shorter than one mile.[13] A study completed by the Rails-to-Trails Conservancy looked specifically at communities with less than 50,000 residents and found that walking and biking to destinations are part of everyday rural life. "Rural Americans walk at a rate between 58 and 80 percent of the overall national rate, depending on what type of community they live in; for biking, the numbers are even higher-between 74 and 104 percent." They also note that the share of work trips made by bicycle are nearly double that of urban centers.[14] Due to shorter trip lengths and the number of work trips, it is important and economically advantageous to invest in bicycle infrastructure in smaller communities.

2.1:2 *Transportation Equity*

It is essential to provide equal transportation opportunities for everyone, including those who cannot or choose not to drive a car. The 2009 National Household Travel Survey found that 33 percent of all Americans, including children, do not drive.[15] Some people are unable to drive for specific reasons, while others simply choose not to drive and do not have a license to operate motor vehicles. Children and elderly citizens are in need of safe, reliable transportation. Research shows that half of non-drivers age 65 and over, approximately 3.6 million Americans, do not leave home on a given day because they lack transportation.[16] When these potential consumers are unable to reach destinations where they can spend their money, it strains local economies because they are never able to reach their full economic potential.

[13] "Highlights from the National Household Travel Survey," League of American Bicyclists, January 2009, accessed July 9, 2012, www.bikeleague.org/resources/reports/pdfs/nhts09.pdf.

[14] "Active Transportation Beyond Urban Centers: Walking and Bicycling in Small Towns and Rural America," Rails-to-Trails Conservancy, accessed July9, 2012, http://www.railstotrails.org/resources/flipbooks/2012_bucreport/buc_report.html.

[15] "Dangerous by Design 2011: Solving the Epidemic of Preventable Pedestrian Deaths," Transportation for America, Washington D.C. 2011, accessed July 18, 2012, http://t4america.org/docs/dbd2011/Dangerous-by-Design-2011.pdf.

[16] "Economic Revitalization," Complete Streets, accessed July 11, 2012, http://www.completestreets.org/complete-streets-fundamentals/factsheets/economic-revitalization/.

2.1:3 *Infrastructure Costs*

Today in the United States, the bicycling industry supports nearly 1.1 million jobs and creates an estimated $17.7 billion in federal, state, and local taxes.[17] However, states are investing only 1.6 percent of their Federal transportation funds on bicycling and walking, amounting to only $2.17 per capita.[18]A study by the Political Economy Research Institute (PERI) found that for every $1 million spent on cycling projects, 11.4 jobs were created, while projects for motorized vehicles contributed only 7.8 jobs per $1 million.[19] Bicycle infrastructure's cost is modest compared to motorized vehicular infrastructure and maintenance costs. A recent cost benefit analysis shows that for every $1 invested in bicycling and walking, a community can benefit an additional $11.80.[20]

Depending on location, bikeways can cost as little as $5,000 per mile, whereas the price to add an additional lane for motorized travel is exponentially greater.[21] The implementation of bikeway networks lessens congestion on existing roadways and mitigates additional impacts on a region's motorized transportation network. Bicycles also have fewer negative impacts on bikeway infrastructure because it is able to withstand longer periods of time with minimal amounts of repair and maintenance compared to roadways designed for motorized travel.

2.1:4 *Parking Costs*

Even "*free parking"* is never free, and everyone pays for it whether they are using it or not. Parking costs are often unrecognized by the average citizen, because it is subsidized by governments, businesses, and residents. Many employers fund the cost of parking spaces for both employees and patrons through higher priced goods. Expensive, unused parking lots have become the norm on the American landscape. Bicycle parking facilities are an essential component of a bikeway network. People are more likely to travel by bicycle when there is a safe and secure parking location at their destination. Bicycle parking facilities require

[17] "The Economic Benefits of Bicycle Infrastructure Investments," The League of American Bicyclists, June 2009, accessed July 9, 2012, http://www.bikeleague.org/resources/reports/pdfs/economic_benefits_bicycle_infrastructure_report.pdf.

[18] "Bicycling and Walking in the United States: 2012 Benchmarking Report," Alliance for Biking and Walking, 2012. accessed July 9, 2012, http://www.peoplepoweredmovement.org/site/images/uploads/Media_Fact_Sheet_-_Benchmarking_2012.pdf.

[19] Garret-Peltier, Heidi. "Pedestrian and Bicycle Infrastructure: A National Study of Employment Impacts," Political Economy Research Institute, University of Massachusetts, June 20, 2011, accessed July 10, 2012, http://www.peri.umass.edu/236/hash/64a34bab6a183a2fc06fdc212875a3ad/publication/467/

[20] "Bicycling and Walking in the United States: 2012 Benchmarking Report," Alliance for Biking and Walking, 2012. accessed July 9, 2012, http://www.peoplepoweredmovement.org/site/images/uploads/Media_Fact_Sheet_-_Benchmarking_2012.pdf.

[21] "Bicycle Lanes," Pedestrian and Bicycle Information Center, accessed July 11, 2012, http://www.walkinginfo.org/engineering/roadway-bicycle.cfm.

far less space than traditional paved lots or ramps and can be located in otherwise unusable areas near developments. Between six and twenty bicycles can be parked in the space required for one motor vehicle.[22]

2.1:5 *Home Values*

A study near the Monon Trail in Indianapolis shows bicycling and pedestrian facilities can have positive statistically significant impacts on home values. Bob McNamara, a representative for the National Association of Realtors (NAR), emphasized the importance of selling choices at the 2009 National Bike Summit. He stated that more transportation options increase livability levels, thus increasing real estate values and the number of real property investments. A study by the Victoria Transport Policy Institute (VTPI) showed that by implementing bicycle and pedestrian infrastructure, traffic calms by speeds of 5- to 10-miles per hour (mph). Further, the study indicated that such traffic calming measures can cause residential property values to increase by about 20 percent.[23] In 1994, a study by American Lives, a company that seeks to quantify how values and lifestyles relate to consumer decisions, looked at 39 attributes used to select a home. Of these attributes, proximity to biking and walking paths ranked number three.[24]

A new tool by the Center for Neighborhood Technology (CNT), a leader in promoting urban sustainability working across multiple disciplines and issues, was created in order to determine true affordability by accounting for household transportation and housing costs depending on where people live.

> "The Index shows that transportation costs vary between and within regions depending on neighborhood characteristics. People who live in location-efficient neighborhoods—compact, mixed use, and with convenient access to jobs, services, transit, and amenities—tend to have lower transportation costs. People who live in location inefficient places that require automobiles for most trips are more likely to have high transportation costs."[25]

[22] "Ride for Economy," Leauge of American Bicyclists, accessed July 13, 2012, http://www.bikeleague.org/resources/why/economics.php
[23] "Evaluating Traffic Calming Benefits, Costs and Equity Impacts," Victoria Transport Policy Institute, 1999, accessed July 11, 2012, http://www.vtpi.org/calming.pdf.
[24] "The Economic Value of Active Transportation: A Factsheet," Ryan Snyder Associates, LLC., accessed July 12, 2012, http://www.rsa.cc/images/EconomicValueOfActiveTransportation.pdf.
[25] "True Affordability and Location Efficiency, H+T Affordability Index," Centers for Neighborhood Technology, accessed July 19, 2012, http://htaindex.cnt.org/about.php.

If people have access to more transportation options, they are able to lower their transportation costs, allowing for greater disposable income to purchase other necessary or desired goods and services.

2.1:6 *Local Businesses*

The local economy benefits most when money is spent in locally owned businesses. A dollar spent at an independent locally owned business generates about three times more benefit to a community than a dollar spent at a chain retailer, which sends this money back to its home office often in another region of the country, thus increasing the economic multiplier effect.[26] A study of merchants in Toronto showed a positive correlation between the number of patrons arriving by bicycle or foot and the amount of money spent in local businesses.[27] It was also found that people arriving by these modes visited local businesses more often. A 20-year study found that when streets are more accommodating of pedestrians and cyclists rather than just automobiles, nearby businesses exhibit stronger profit growth than auto-dominated shopping centers.[28]

2.1:7 *Complete Streets*

Complete streets aim to provide access to all users and modes of travel, including differing age groups and abilities by facilitating use by motor vehicle, public transportation, bicycle, or walking. When infrastructure is created for non-motorized transportation, automobile speeds are generally lowered and economic conditions improved. One example is Valencia Street in San Francisco where traffic lanes were narrowed. This encouraged motorists to slow down in order to accommodate other forms of traffic. Merchants in the area reported a 40 percent increase in sales and noticed approximately 60 percent more local residents shopping.[29]

2.1:8 *Tourism*

Bicycle infrastructure also positively influences tourism in a region. Numerous studies have shown that the bicycle retail industry and bicycle tourism can help boost local employment levels and economic activity. Communities are able to utilize additional sales tax revenue captured by people who visit an area to ride on a bicycle network. Investing in a bicycle network

[26] "Making Our Communities More Walkable," Walk Boston, accessed July 10, 2012, http://www.walkboston.org/resources/publications-products.

[27] "Bike Lanes, On-Street Parking and Business: A Study of Bloor Street in Toronto's Annex Neighborhood," The Clean Air Partnership, 2009, accessed July 10, 2012, http://www.cleanairpartnership.org/files/BikeLanes_Parking_Business_BloorWestVillage.pdf.

[28] Hass-Klas, C., "Impacts of Pedestrianization and Traffic Calming on Retailing," *Environmental and Transport Planning*, 1, 21-31.

[29] "Complete Streets Spark Economic Revitalization," National Complete Streets Coalition, accessed July 11, 2012, http://www.completestreets.org/webdocs/factsheets/cs-revitalize.pdf.

can help draw visitors who would otherwise spend their money elsewhere. Since 1991, Maine has made a significant effort to expand its bicycle infrastructure by widening shoulders and creating more shared-use paths. Today, bicycle tourism in Maine generates over $66 million dollars a year in revenue.[30] Other regions across the United States and Canada such as Colorado, Wisconsin, North Carolina, and Quebec have seen similar economic outcomes.[31]

2.2 Health Benefits

Obesity levels are at an all-time high for both adults and children in the United States. Between 1960 and 2009, bicycling levels fell 66% while obesity levels increased 156 percent.[32] Since the mid-1960s, the number of children bicycling or walking to school fell 75 percent while childhood obesity rose 276 percent.[33] The automobile has had a significantly negative impact on our health, from air and water pollution to increased risks of diabetes and other serious illnesses.

2.2.1 *Road Safety*

Safety levels are higher and fatal crashes are lower for motorists, cyclists, and pedestrians when there are more bicyclists on the road. A recent study focused on 24 cities in California, all with varying sizes and extents of bikeway networks and degrees of safety. Of those cities, researchers found that, "for a bicyclist, the fatality rate is more than 38 times greater in cities with poor safety records compared to those with significant biking, over 60 times greater for a severe injury, and over 7 times greater for all other bicyclist injuries."[34] The idea of "Safety in Numbers" is one in which the more people that participate in an activity, the more noticeable and safe they are. For cycling, it generally means that both drivers and cyclists are more likely to follow the rules of the road in instances or in locations where they coexist. Motorists change their driving behaviors and expectations when they begin to anticipate bicyclists on the road, usually by driving slower.

[30] "The Economic Benefits of Bicycle Infrastructure Investments," The League of American Bicyclists, June 2009, accessed July 9, 2012, http://www.bikeleague.org/resources/reports/pdfs/economic_benefits_bicycle_infrastructure_report.pdf.

[31] Ibid.

[32] "Bicycling and Walking in the United States: 2012 Benchmarking Report," Alliance for Biking and Walking, accessed July 19, 2012, http://www.peoplepoweredmovement.org/site/images/uploads/Media_Fact_Sheet_-_Benchmarking_2012.pdf

[33] Ibid.

[34] Marshall, Wesley E. and Norman W. Garrik, "Evidence on Why Bike-Friendly Cities Are Safer for All Road Users," *Environmental Practice* 13 (March 2011): 16-27.

According to the *Bicycling and Walking 2012 Benchmark Report*, prepared by the Alliance for Biking and Walking, 1.8 percent of all traffic fatalities are bicyclists, and 11.7 percent are pedestrians. Adults over 65 years of age are the most vulnerable bicyclists and pedestrians and comprise 10 percent of all bicycle fatalities in the U.S.

2.2:2 *Healthcare Cost*

There are continually rising healthcare costs due to levels of physical inactivity across the nation. "According to the Centers for Disease Control (CDC), 61 percent of adults in the U.S. are overweight or obese; 13 percent of kids ages 6 to 11 and 14 percent for kids 12 to 19 are overweight."[35] The research and knowledge of the health benefits that occur from physical activity have long been recognized by researchers and health care providers. Ten different studies examined captured the health savings affected by increased physical activity. These benefits ranged up to $1,175 per person, per year.[36] The National Highway Transportation Safety Administration (NHTSA) found in a 2002 survey that 84 percent of people either agree or strongly agree that bicycling is a "great form of exercise."[37] "States with the highest levels of bicycling and walking have the lowest levels of obesity, hypertension (high blood pressure), and diabetes and have the greatest percentage of adults who meet the recommended 30-plus minutes per day of physical activity."[38] These studies justify investments in bicycle infrastructure.

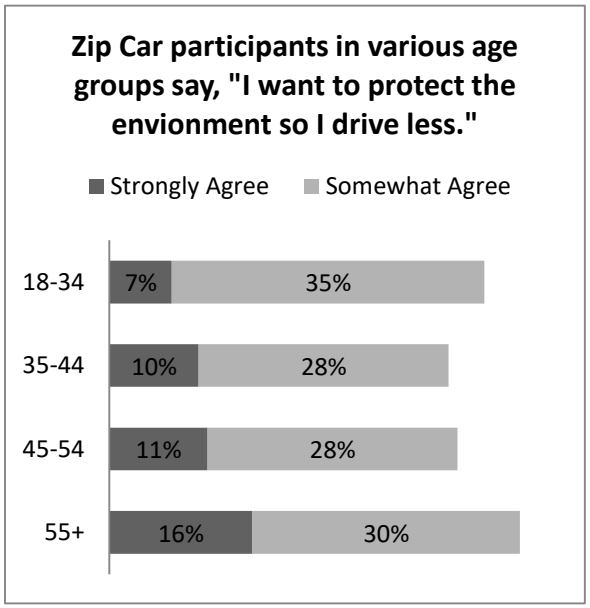
2.2:3 *Quality of Life*

Since the 1950s and 1960s, the amount of time Americans spend commuting has grown steadily. According to the United States Census Bureau's 2009 American Community Survey, the national average travel time to work was 23.85 minutes.[39] This is approximately 100 hours of commuting time per year. One way to increase quality of life is to discover opportunities to get people out of their vehicles and dramatically reduce travel time. Investing in bicycle and pedestrian infrastructure is one such solution. Often, bicycle commuters spend less of their day in transit. Bicycling raises physical activity levels, improves the household budget, and decreases travel times in some situations.

[35] "Ride for Your Health," League of American Bicyclists, accessed July 12, 2012, http://www.bikeleague.org/resources/why/health.php.
[36] "The Economic Benefits of Bicycle Infrastructure Investments," The League of American Bicyclists, June 2009, accessed July 10, 2012, http://www.bikeleague.org/resources/reports/pdfs/economic_benefits_bicycle_infrastructure_report.pdf.
[37] Ibid.
[38] "Bicycling and Walking in the United States: 2012 Benchmarking Report," Alliance for Biking and Walking, accessed July 19, 2012, http://www.peoplepoweredmovement.org/site/images/uploads/Media_Fact_Sheet_-_Benchmarking_2012.pdf
[39] "Commuting in the United States: 2009," American Community Survey Reports, accessed July 12, 2012, http://www.census.gov/prod/2011pubs/acs-15.pdf.

2.3 Environmental Benefits

Riding a bicycle and walking rather than driving a car has effects that are not always obvious. Often the costs and benefits are borne and accrued by society as a whole rather than by one individual. Millions of Americans spend hours a day in cars contributing to air quality issues, water pollution, and extensive natural resource consumption, thus altering the environment. Non-motorized transportation can provide a significant energy and resource savings, especially for short trips. Vehicle emission rates are highest during the first few minutes of a vehicle's operation and when a vehicle idles in traffic congestion.[40] Every one percent shift from an automobile trip to a non-motorized travel mode typically reduces fuel consumption two- to four percent.[41]



Source: Transportation and the New Generation

2.3:1 *Congestion*

Based on the current decline in driving levels, according to the Federal Highway Administration (FHWA), a relatively small shift from individual motorized vehicles to other modes can have a substantial impact on the amount of congestion on America's roadways. From 2007 to 2008, there was a 3 percent drop in traffic on "urban interstates," translating into a nearly 30 percent reduction in peak hour congestion.[42] The average national congestion levels were down 27 percent from 2010 to 2011.[43] This means that even one person changing his or her travel mode has a disproportionate impact on the congestion of a roadway network.[44]

[40] "Evaluating Non-Motorized Transportation Benefits and Costs," Victoria Transport Policy Institute, accessed July 19, 2012, http://www.vtpi.org/nmt-tdm.pdf
[41] Ibid.
[42] INRIX National Traffic Scorecard, accessed July 12, 2012, http://scorecard.inrix.com/scorecard/summary.asp
[43] Ibid.
[44] "The Economic Benefits of Bicycle Infrastructure Investments," The League of American Bicyclists, June 2009, accessed July 10, 2012, http://www.bikeleague.org/resources/reports/pdfs/economic_benefits_bicycle_infrastructure_report.pdf.

2.3:2 *Air, Water, and Noise Pollution*

The United States is home to only five percent of the world's population, yet it consumes 25 percent of worldwide energy consumption and produces 25 percent of worldwide greenhouse gas emissions.[45] On a community level, consumption by transportation accounts for 40 to 50 percent of total energy use.[46] "Some pollutants such as noise, carbon monoxide and particulates have local impacts, so their costs vary depending on where emissions occur, while others such as ozone, methane, and carbon dioxide have regional and global impacts."[47] Many studies have been conducted in order to quantify the monetary cost of motor vehicle pollution damages, but many of these estimates include only a limited portion of total pollution costs. Air, noise, and water pollution due to motorized vehicles has been estimated to cost an average of 2 to 15 cents per vehicle-mile.[48]

2.3:3 *Neighborhood Safety and Trust*

One considerable contributor to safe communities is neighborhood trust. Bikeway networks contribute to this level of trust. When people are out of their vehicles and interact with the built environment on a personal level, they have a greater ability to keep their "eyes on the street." Many parents hope to live in safe, family-friendly communities where children can learn to be resourceful and spend their days outdoors, but often parent reservations and safety risks control where children can go. Bikeway network implementation, such as Safe Routes to School, complete streets, and multi-use paths help create safe communities for everyone.[49]

2.3:4 *Current and Future Generations*

In April 2012, a study released by the Frontier Group, a research group focused on promoting a cleaner environment, and U.S. PIRG Education Fund, a research and public education entity working on behalf of consumers and the public interest, found that in 2011, Americans drove an average of six percent fewer miles than in 2004. This trend has been led by young people. "From 2001 to 2009, the average annual number of vehicle-miles traveled by young people (16 to 34 year olds) decreased from 10,000 miles to 7,900 miles per capita, a drop of 23 percent." There are numerous reasons for this trend, which is likely to be long-

[45] "Energy and Smart Growth: It's about How and Where We Build," Funder's Network for Smart Growth and Livable Communities, 2004, accessed July 12, 2012, http://www.issuelab.org/research/energy_and_smart_growth_its_about_how_and_where_we_build.
[46] Ibid.
[47] "Evaluating Non-Motorized Transportation Benefits and Costs," Victoria Transport Policy Institute, accessed July 19, 2012, http://www.vtpi.org/nmt-tdm.pdf
[48] Ibid.
[49] "Active Transportation Beyond Urban Centers: Walking and Bicycling in Small Towns and Rural America," Rails-to-Trails Conservancy, accessed July 11, 2012, http://www.railstotrails.org/resources/flipbooks/2012_bucreport/buc_report.html.

lasting. Some reasons include: tougher licensing laws, high gas prices, changes in Generation Y's values and preferences, and new technologies, such as social media sites, which make alternate transportation utilization more accessible. Also in 2009, 16- to 34-year olds took 24 percent more bike trips than they did in 2001, despite the age group actually shrinking in size by 2 percent.[50] Generation Y is also making a concerted effort to utilize alternate modes of transportation, and 16 percent of 16-to 24-year olds stated that it was to curb their environmental impact.[51] A study by the NAR found that young people are most likely to prefer to live in an area characterized by nearby shopping, restaurants, schools, and public transportation as opposed to sprawl.[52] From 2001 to 2009, young people aged 16 to 24 increased their use of biking by 122 percent, public transportation by 100 percent, and walking by 37 percent. Policymakers need to make sure they are keeping pace with the transportation patterns and behaviors practiced by a growing number of Americans.

As gas prices and travel times continue to increase, the demand for clean, healthy, and congestion-free transportation alternatives rises. Investments in bicycling infrastructure are imperative as bicycling has proven to meet these demands.

[50] "Transportation and the New Generation: Why Young People Are Driving Less and What It Means for Transportation Policy," Frontier Group, and U.S. PIRG Education Fund, April 2012, accessed July 11, 2012, http://www.uspirg.org/sites/pirg/files/reports/Transportation%20%26%20the%20New%20Generation%20vUS_0.pdf.

[51] Ibid.

[52] Ibid.

Existing Conditions

The League of American Bicyclists works with counties, communities, advocacy groups, and individuals across the country to help encourage bicycling as a major mode of transportation. They offer assistance with many services such as Bicycle Friendly America and Safe Routes to School. They also advocate for bicycle rights at the Federal level. Bicycle Friendly America ranks communities on their involvement in and progress with creating cycling as an alternate mode of travel. There are four levels for bicycle friendly communities: bronze, silver, gold, and platinum. Communities must apply to be considered, and applicants are scored according to "The Five Es:"

- Engineering
- Education
- Encouragement
- Enforcement
- Evaluation and Planning

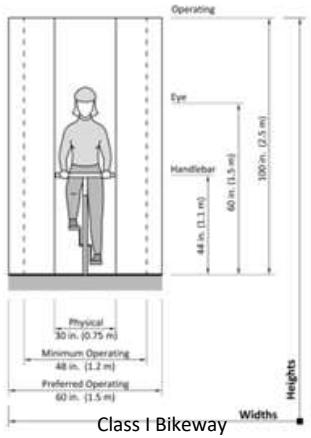
Communities that are part of Bicycle Friendly America boast a much higher bicycle mode share, and community members, both motorists and cyclists, are more knowledgeable on safe practices regarding "share the road" situations. This chapter examines the city of Clemson's existing facilities and cycling initiatives and works to highlight opportunities to make the city more bicycle friendly.

Engineering

As the City of Clemson works to enhance its 15.17-mile bikeway network, it is important to inventory existing bikeway facilities throughout the community. This plan categorizes bikeways into a three-tier classification:

- **Class I:** Paved, bike-only path physically separated from the roadway and visibly marked;
- **Class II:** Striped bike lane a minimum of 4 feet wide without curb and gutter or a recommended 5 feet wide with curb and gutter when not including a demarcating stripe; and
- **Class III:** Shared roadway clearly identified using road signs and/or pavement markings.

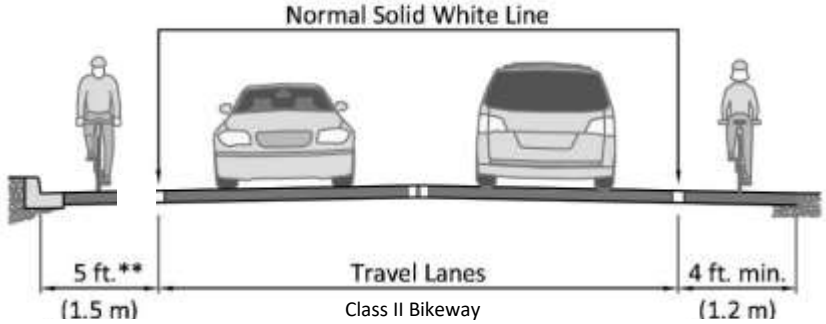
In addition to these three classes, the term multi-use path will refer to a separated, paved pathway that may be legally utilized by both pedestrians and non-motorized vehicles. Each of these classifications currently exists within the city limits, and the terms will be used to identify existing as well as proposed improvements to be listed throughout this plan.



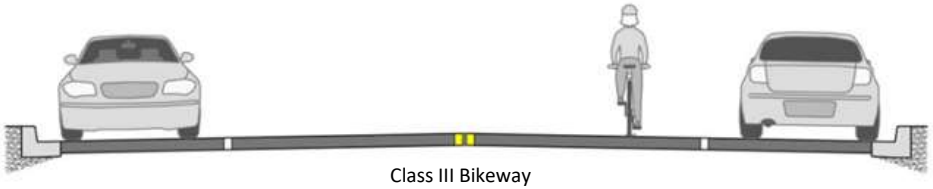
Class I Bikeway

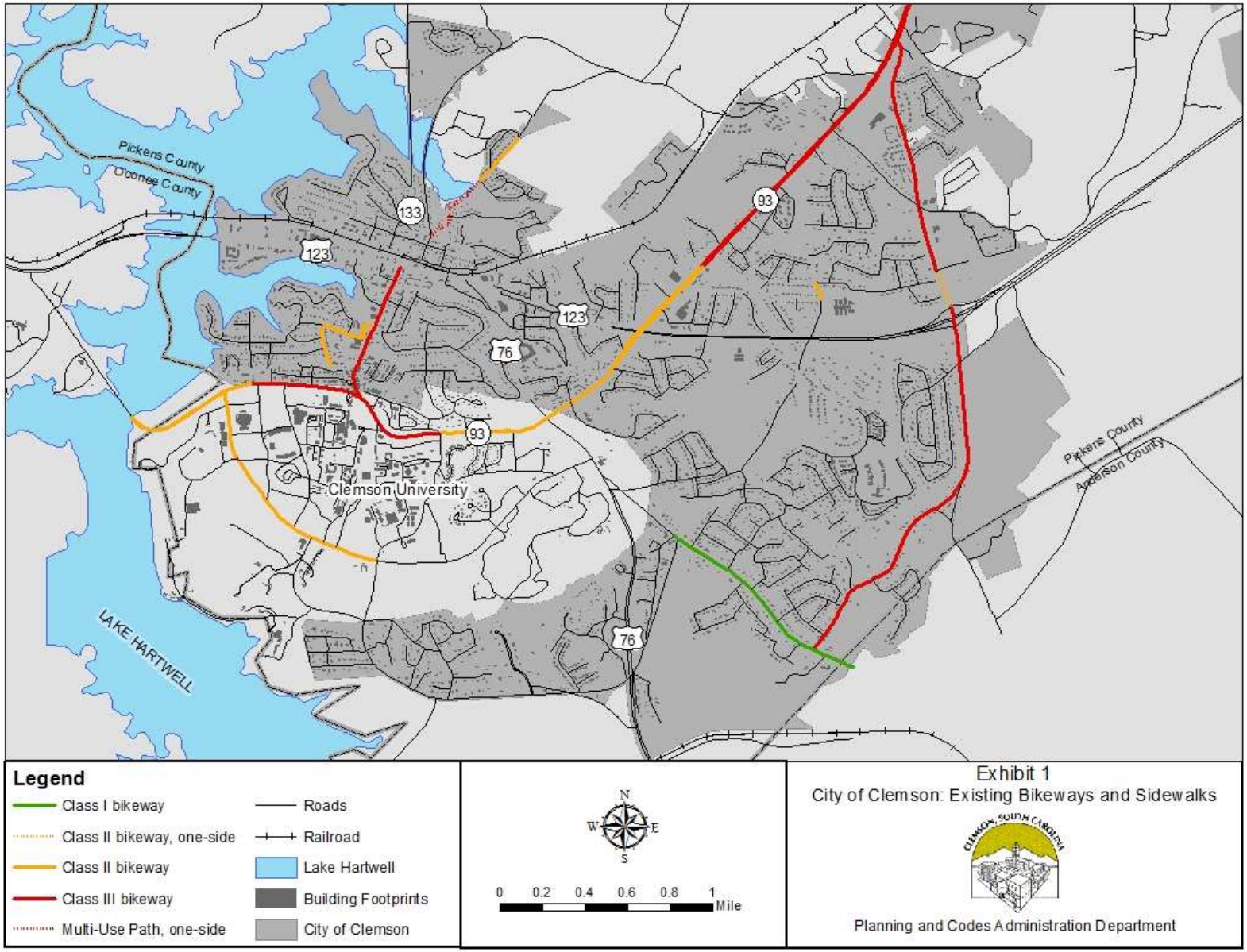
Inventory of Bikeways

With the exception of U.S. Highway 76 (Anderson Highway) and U.S. Highway 123, all major roads and corridors feature some level of bicycle facility within the city of Clemson. The majority of these improvements involve Class III bikeways. Many of the Class I and Class II facilities have maintenance issues, while many of each type of bikeway has subpar markings and/or signage indicating the presence of a designated facility for a certain type of use. **Exhibit 1** indicates existing facilities in the city by class.



Class II Bikeway


Class III Bikeway


Pickens County
Oconee County
133
123
93
123
76
93
Clemson University
Pickens County
Anderson County
LAKE HARTWELL
76
Legend
Class I bikeway
Class II bikeway, one-side
Class II bikeway
Class III bikeway
Multi-Use Path, one-side
Roads
Railroad
Lake Hartwell
Building Footprints
City of Clemson
N
W
E
S
0 0.2 0.4 0.6 0.8 1
Mile
Exhibit 1
City of Clemson: Existing Bikeways and Sidewalks
Planning and Codes Administration Department

S.C. 93 Class II Bikeway: Cherry Road to Bi-Lo

City of Clemson Bikeway Network Miles	
Class I Bikeway	1.06
Class II Bikeway	5.31
Class II Bikeway, one-sided	0.18
Class III Bikeway	8.25
Multi-Use Path, one-sided	0.37
Total Miles	15.17

S.C. 93 Class III Bikeway: Bi-Lo to Central

Highway 93

Highway 93 (Old Greenville Highway) is a major arterial with a 40 mile per hour (mph) speed limit and generally high traffic volume. It has both Class II and Class III bikeways. From the intersection of Cherry Road within the bounds of Clemson University to Skyview Drive, or the approximate location of the Super Bi-Lo shopping center and Clemson Plaza, is a Class II bikeway with the American Association of State Highway and Transportation Officials (AASHTO)-recommended 5-foot bike lane on both sides, including the paved gutter. North of Skyview Drive, several road signs exist on both sides of the road indicating the route is a Class III bikeway. There currently is intermittent signage indicating that the route continues into the Town of Central. South of the intersection with Cherry Road is a Class III bikeway with limited road width until Oak Street near the Esso Club, where a Class II bikeway begins. Within the Class II bikeways, maintenance is poor, and there is often debris present within the bike lane. Class III bikeways lack any pavement markings.

The referenced stretch of Class III bikeway is inadequate as a result of the narrow paved shoulder once the drainage area on the road is considered. Observations suggest a significant number of bicyclists utilize the sidewalks as a means of safer travel. Further, debris from trees and other plants and some garbage are not uncommon on both the paved shoulder and the drainage area, becoming a physical hazard for cyclists. The Class II bikeway on Highway 93 includes some potentially dangerous intersections, particularly at the Highway 76 and Highway 123 interchanges but also at Freedom Drive. Freedom Drive is likely to become a more significant hazard for cyclists after the planned Publix development is completed.

Highway 76

Highway 76 (Anderson Highway) features a narrow paved shoulder north of Stoney Creek Drive to Highway 123 and sidewalks from Highway 123 to the Clemson University property line. Current speeds of 45 mph make a Class III bikeway unattainable. A small stretch of Highway 76 is an important connection of Pendleton Road to Perimeter Road; however, this is within the bounds of Clemson University.

Highway 76 within the city of Clemson boundary lacks sufficient existing lane widths for a Class III bikeway and has no existing paved shoulders to establish such a bikeway. Within the bounds of Clemson University, Highway 76 includes a stretch of paved shoulder connecting Pendleton Road to Highway 93 that is utilized for bicycle traffic; however the shoulder is not marked for bicycle use.

Highway 123

U.S. Highway 123 (Tiger Boulevard) is the dominant vehicular thoroughfare in the City of Clemson and has sidewalks on both sides but no bikeway. Speed, traffic volume, and road width make biking on this stretch impractical and unsafe, thus many bicyclists ride on the sidewalks despite City ordinances and state law.

Highway 76: Intermittent paved shoulder

Highway 76: Fails to meet AASHTO standards regarding dedicated bike lanes.

Issaqueena Trail: Class III Bikeway

Issaqueena Trail: Class II Bikeway near Lowe's

Old Central Road: Multi-use paved path

Issaqueena Trail

Issaqueena Trail is an important connection between Highway 93, Berkeley Drive, and Pendleton Road. Intermittent road signage exists indicating the road is a Class III bikeway. Travel lanes are narrow, and navigating a bicycle along it can be perceived as dangerous.

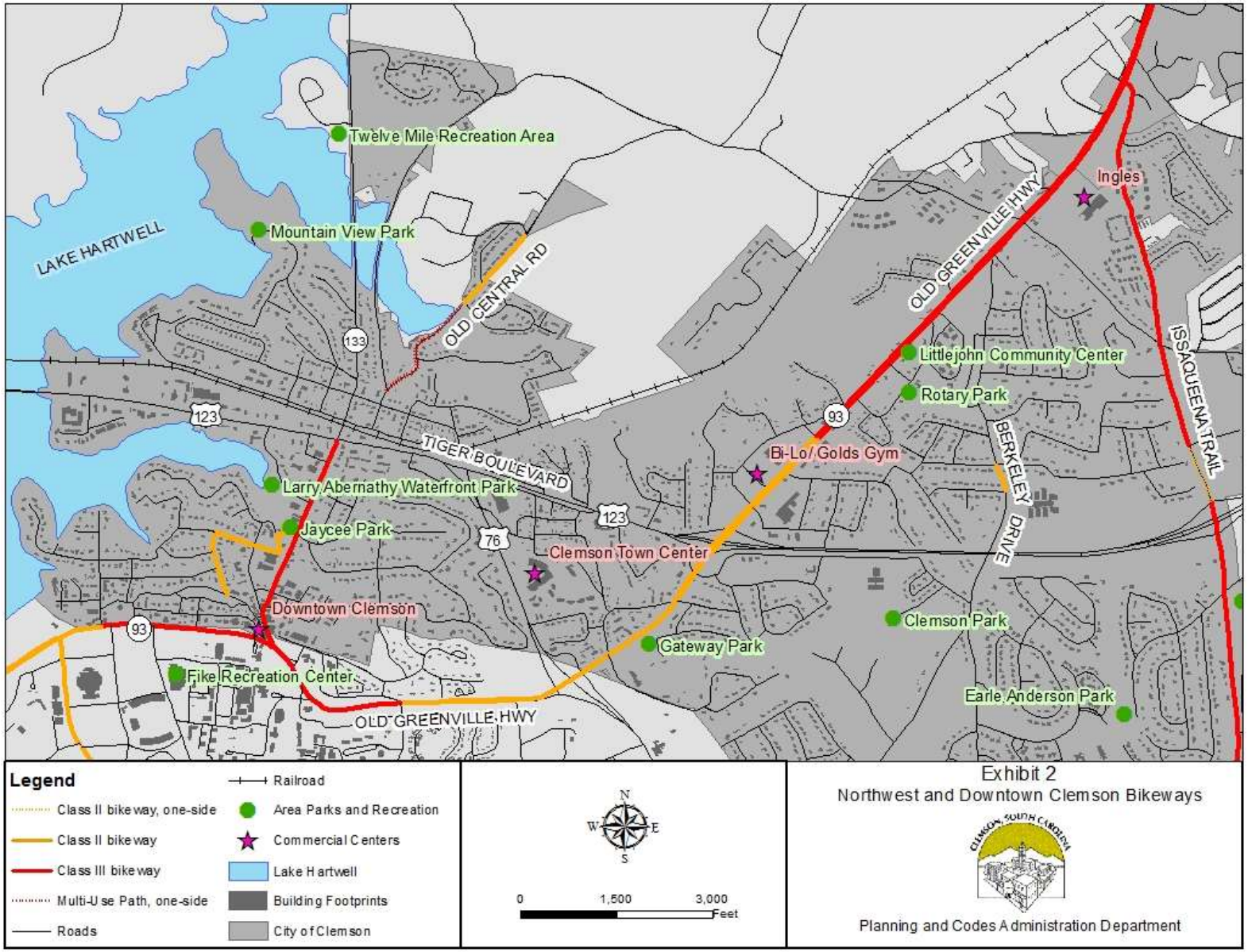
From Highway 123 to Tiliwa Court, there is a Class II bikeway on the north side of the road that was developed in conjunction with a planned development; however, it lacks connectivity to any major destinations.

Road signage is inadequate for motorists to be aware of the official classification as a Class III bikeway. Additionally, lane widths are insufficient for shared road usage, and there is no paved shoulder. This makes segments of Issaqueena Trail a severe hazard for bicyclists despite the road's significance as a connector to many existing and developing residential sections of the city.

Old Central Road

On the east side of Old Central Road beginning at Clemson Street is a paved multi-use path that continues to Creekside Drive. The path is predominately used by pedestrians and is poorly marked as a legal option for bicyclists. Additionally, the path only exists on one side, is unevenly graded, and abruptly ends with no paved shoulder or Class III bikeway beyond Creekside Drive.

The multi-use path on Old Central Road frequently has significant amounts of debris and numerous pedestrians on it. Lanes are not wide enough for pedestrian or bicycle travel on-road, thus the path is likely to remain used by both bicycles and pedestrians. The abrupt end of the path onto a roadway with many potholes and no bikeway signage also creates a substantial hazard at the path terminus.


Twelve Mile Recreation Area
LAKE HARTWELL
Mountain View Park
OLD CENTRAL RD
133
123
TIGER BOULEVARD
Larry Abernathy Waterfront Park
Jaycee Park
76
Clemson Town Center
Downtown Clemson
93
Fike Recreation Center
OLD GREENVILLE HWY
Gateway Park
Bi-Lo/ Golds Gym
Littlejohn Community Center
Rotary Park
OLD GREENVILLE HWY
Ingles
ISSAQUEENA TRAIL
BERKELEY DRIVE
Clemson Park
Earle Anderson Park
Legend
Class II bikeway, one-side
Class II bikeway
Class III bikeway
Multi-Use Path, one-side
Roads
Railroad
Area Parks and Recreation
Commercial Centers
Lake Hartwell
Building Footprints
City of Clemson
N
W
E
S
0
1,500
3,000
Feet
Exhibit 2
Northwest and Downtown Clemson Bikeways
Planning and Codes Administration Department

Edgewood Avenue: Class II Bikeway with minimal signage

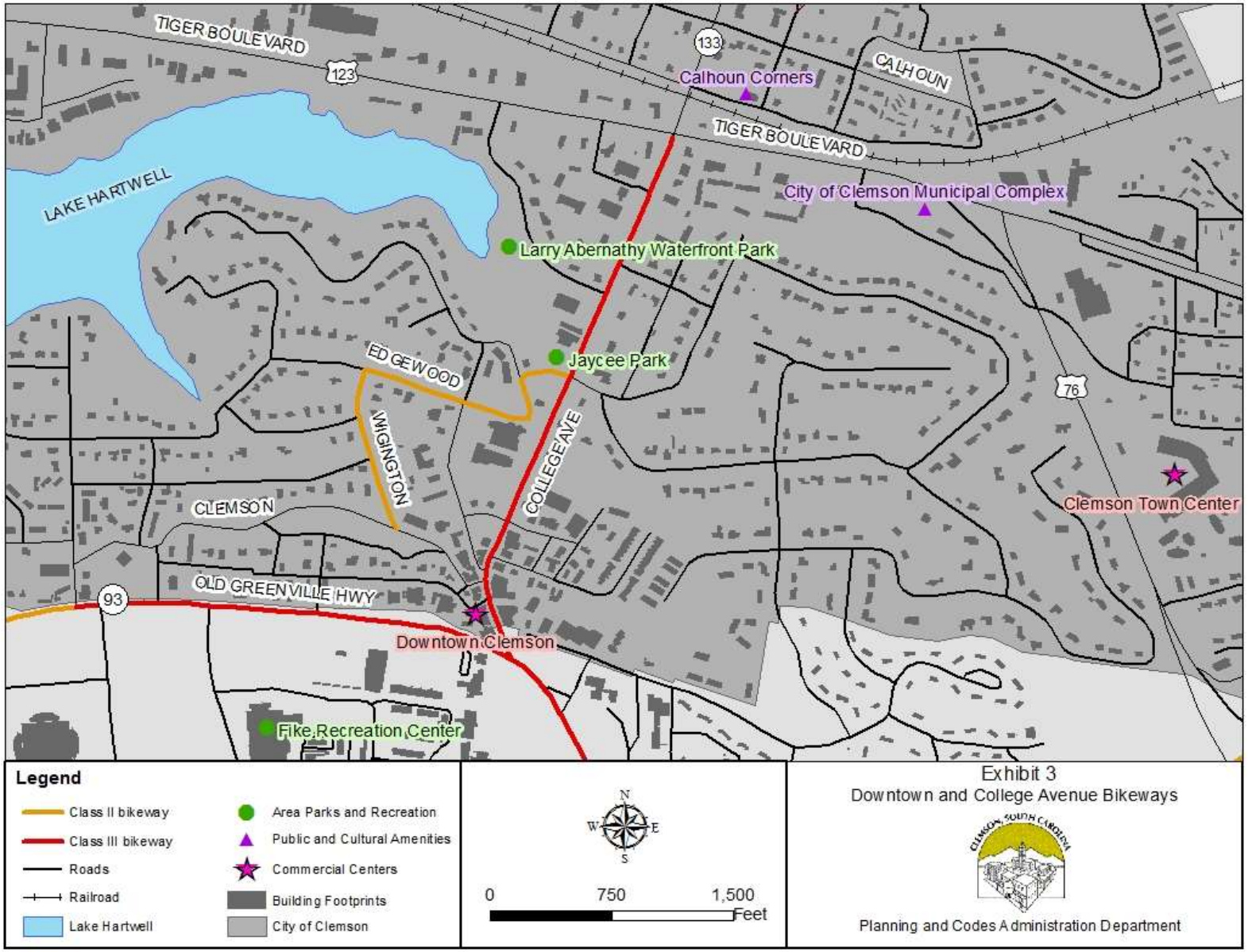
Edgewood Avenue: Class II Bikeway on the downtown Bypass

College Avenue Downtown: Class III Bikeway

College Avenue

South of U.S. Highway 123, College Avenue (SC Highway 133) features road signage on both sides of the road indicating the presence of a Class III bikeway. Many of the bicyclist's trips on this route originate from College Avenue north of Highway 123, but no bikeway exists along that segment of the roadway. Further, a Class II bikeway exists on Edgewood Avenue south of U.S. 123 but north of downtown on the west side of College Avenue. This particular bikeway was designed as a bypass of downtown and continues along Wigington Street to North Clemson Avenue. Segments of this bikeway fail to meet AASHTO standards for markings and lane width outside the street drainage area. Additionally, this route is not heavily traveled, as most cyclists prefer to ride directly through downtown on College Avenue as it is the more direct and gradually sloped route.

Lower College Avenue is a two-lane road with parking on either side. Traffic is very heavy, and the opening and closing of parked car doors is a substantial risk for bicyclists. This is the most direct route to campus for a significant number of students from their off-campus residences, thus it is likely to remain a heavily traveled roadway segment for both cars and bikes. Despite signage, people are seen bicycling on sidewalks, creating a hazard for both the bicyclist and pedestrians.


TIGER BOULEVARD
123
133
Calhoun Corners
CALHOUN
TIGER BOULEVARD
LAKE HARTWELL
City of Clemson Municipal Complex
Larry Abernathy Waterfront Park
Jaycee Park
EDGEWOOD
WIGINGTON
COLLEGE AVE
76
CLEMSON
Clemson Town Center
OLD GREENVILLE HWY
93
Downtown Clemson
Fike Recreation Center
Legend
Class II bikeway
Class III bikeway
Roads
Railroad
Lake Hartwell
Area Parks and Recreation
Public and Cultural Amenities
Commercial Centers
Building Footprints
City of Clemson
N
W
E
S
0
750
1,500
Feet
Exhibit 3
Downtown and College Avenue Bikeways
Planning and Codes Administration Department

Pendleton Road: Class I Bikeway with maintenance issues

Pendleton Road: Class I Bikeway

Berkeley Drive: Class II Bikeway with inconsistent grading

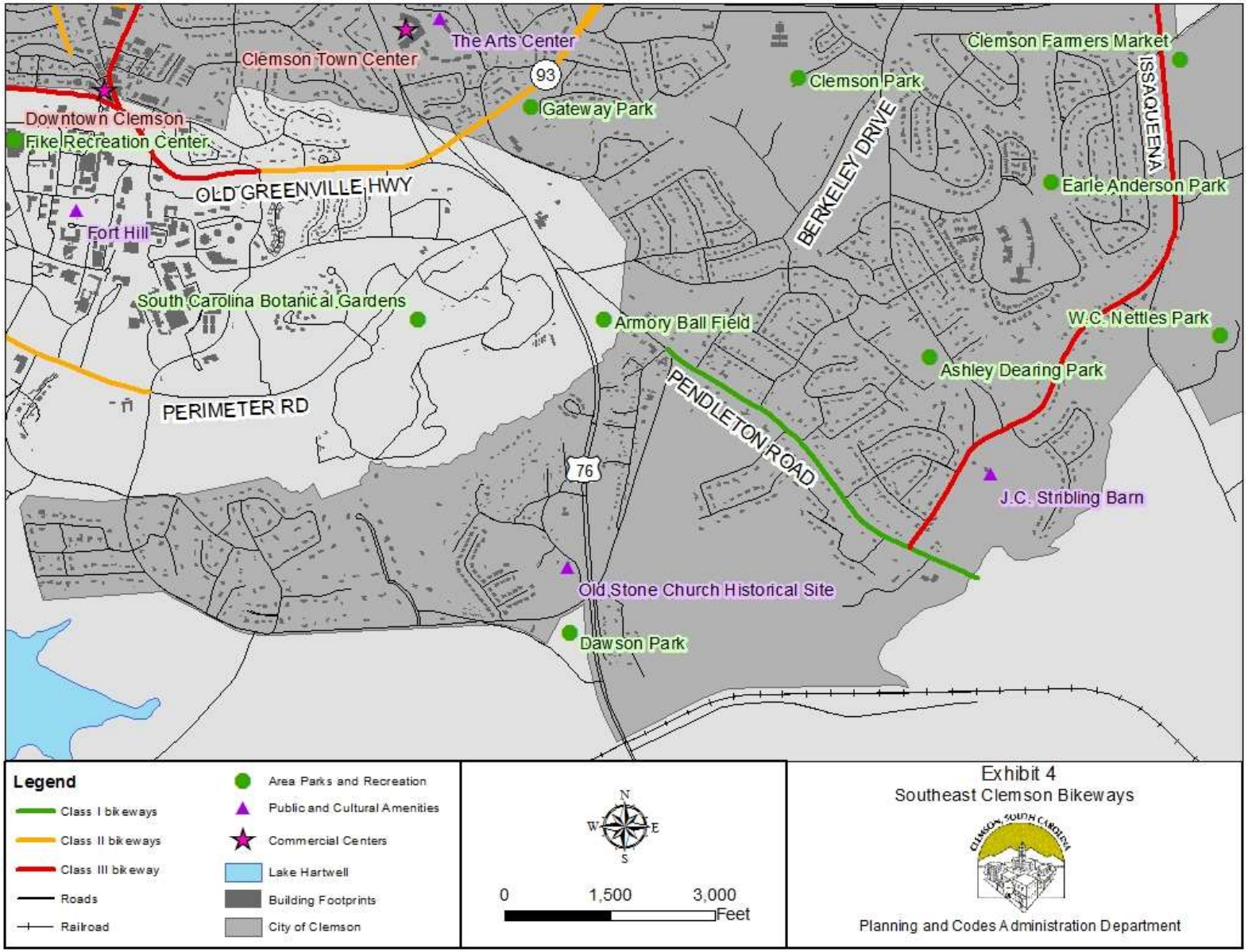
Pendleton Road

A Class I bikeway exists on both sides of the road from the Clemson municipal boundary with Pendleton to the City of Clemson's boundary with Clemson University. The paths feature heavily worn on-pavement markings indicating significant age and intermittent signage. Therefore, the paths are frequently mistaken as sidewalks, as no sidewalks exist on Pendleton Road. The paths are not wide enough to be considered multi-use by AASHTO standards. Tree roots have compromised the consistency of the paths creating many large potholes and areas covered by debris. This produces a hazard for bikes traveling at all but the slowest speeds. As a result of compromised path surface integrity and conflicting usage, bicyclists are sometimes inclined to use the roadway as a matter of safety or due to late knowledge that the path is a bicycling facility. Lane widths and posted speeds are such that on-road bicycle use creates a hazard for both vehicles and bicycles.

Berkeley Drive

Berkeley Drive is a mostly residential street that is considered one of the safer roads for bicycle travel. It features a paved shoulder on both sides of the road south of Highway 123. North of Highway 123, there is a Class II bikeway on both sides of the road to Ashley Drive. The block in front of Clemson Elementary School includes a Class II bikeway that helps to form a complete street, including sidewalks on both sides.

North of Ashley Drive, there are sidewalks separated from the roadway and a paved shoulder of varying widths. However, the paved shoulder on the north side has added grade challenges. The southern portion features a paved shoulder that provides an opportunity for bicyclists to safely travel on-road; however, the grading and surface integrity are inconsistent. Hazards on Berkeley Drive exist as a result of a lack of official bicycle infrastructure.


The Arts Center
Clemson Town Center
93
Clemson Farmers Market
Clemson Park
Gateway Park
ISSAQUEENA
Downtown Clemson
Fike Recreation Center
BERKELEY DRIVE
Earle Anderson Park
OLD GREENVILLE HWY
Fort Hill
South Carolina Botanical Gardens
Armory Ball Field
W.C. Nettles Park
Ashley Dearing Park
PERIMETER RD
PENDLETON ROAD
76
J.C. Stribling Barn
Old Stone Church Historical Site
Dawson Park
Legend
Class I bikeways
Class II bikeways
Class III bikeway
Roads
Railroad
Area Parks and Recreation
Public and Cultural Amenities
Commercial Centers
Lake Hartwell
Building Footprints
City of Clemson
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Feet
Exhibit 4
Southeast Clemson Bikeways
Planning and Codes Administration Department

Signage

The Manual on Uniform Traffic Control Devices (MUTCD) is provided by the Federal Highway Administration (FHWA) and sets the guideline standards for all roadway signage. Roadways signs are a very cost-effective method for administering more desired Class III bikeways. Such routes should include MUTCD-specified "*Share the Road*" signage. Signage is also very beneficial for bicycle way-finding and the branding of particular routes.

Currently, the City of Clemson utilizes signage on Class II and Class III bicycle routes, but there is room for positive improvement. Often the signage is lacking in number or is in need of maintenance. The City does not have any bicycle way-finding signage, and frequently bicycle routes such as the College Avenue bypass receive little, if any, use. In accordance with the City of Clemson's Land Development Rights (LDR), signage is to be installed at the developer's expense when a new bikeway is constructed.

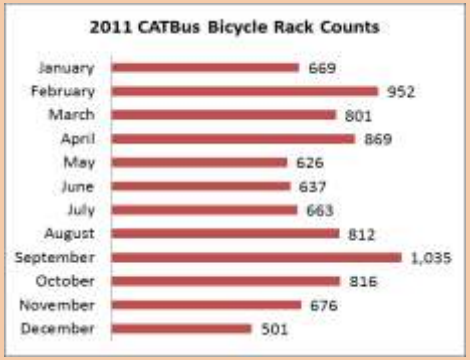
Bicycle Parking Facilities

This plan seeks to illustrate the importance of bicycle parking facilities. In the city of Clemson, there remains a significant opportunity to improve bicycle parking policies and facilities. Bicycle parking facilities consist of both short-and long-term parking, usually in the form of bicycle racks or long-term rentable lockers. There are also several other methods of bicycle parking such as parking corrals and covered parking areas that are meant to store bicycles for more than two hours. In June 2012, City staff conducted a bicycle parking facilities count and found there to be only fifteen (15) designated bicycle parking areas throughout the city, not including facilities located on the Clemson University campus, accounting for a total of 96 spaces. All of the fifteen parking facilities are short-term racks. Seven of these racks are located in the heart of downtown along College Avenue, where a Class III bikeway exists. Two bicycle parking facilities exist at the intersection of U.S. 123 and College Avenue, one at Rite Aid Pharmacy and another at CVS Pharmacy. The other six parking facilities are all near businesses or civic areas along S.C. Highway 93 where Class II and Class III bikeways exist.

According to the City of Portland's Bicycle Plan, a world class bicycling city, bicycle parking needs to be ubiquitous, convenient, and safe. Portland City code requires that short-and long-term parking requirements and developments that are not in compliance with the code must realize the short-term requirements when any moderate improvement is made to a

Stationary bicycle racks are provided at numerous locations in Downtown Clemson

Fast and easy solutions to bicycle parking are racks located near developments



Source: Clemson Area Transit, 2012

property.[53] In 2011, the City of Greenville, South Carolina, established a minimum number of bicycle parking facilities based on a percentage of required vehicle spaces for all new development. Greenville's Master Bicycle Plan ensures that all developments will include a minimum of two bicycle parking spaces.[54] The City of Greenville also provides a map on their website for users to know where bicycle racks are located.

The City of Clemson currently has no bicycle parking policy for any type of development, and bicycle parking facilities are intermittently placed in areas outside of downtown. Providing adequate, safe, and secure bicycle parking facilities is a vital part of developing a bicycle-friendly environment, and as a community that is home to a large university, it provides a cost-effective method of supplying alternate parking solutions.[55]

Multi-Modal Connections

Clemson Area Transit (CAT) is the major provider of public transportation in the city of Clemson. The combination of CAT buses and bicycling is an important and vital partnership. All CAT buses are equipped with front-loading bicycle racks with step-by-step user instructions posted at all stops, on route information pamphlets, and on the front page of its website.[56] Often riders will take their bicycles on CAT buses for use at their final destination. CAT estimates an average of 755 bicycles are transported by its buses per month. Bus utilization allows bicyclists to avoid certain hazardous or difficult areas on a route, such as steep

[53] *The Portland Bicycle Plan for 2030*

[54] *City of Greenville Bicycle Master Plan*

[55] Corbet, Sam, Joe Gilpin, and Rory Renfro, "Best Practices in Campus Bicycle Planning and Program Development," Perspectives in Planning. Volume 1.1, Alta Planning and Design

[56] www.catbus.com

grades, and helps to shorten long commute times; therefore, it encourages bicycling as the primary mode of transportation for more and more trips.

Complete Street on Berkeley Drive near Clemson Elementary

Tree roots create uneven surfaces on Edgewood Avenue, Pendleton Road, and Old Central Road

Large pothole creates hazard on Pendleton Road bike path

Bridges

Bridges also play an important role in bicycle infrastructure capabilities. They are long-term infrastructure and the majority of times are unable to be retrofitted for current bicycling needs. The city of Clemson has several narrow bridges that lack the right-of-way (ROW) for the addition of a Class II bicycle lane. As of 2012, a multi-use pedestrian bridge over U.S. 123 is proposed near Berkeley Drive in order to create a safer pedestrian and bicycling environment near Clemson Elementary and surrounding neighborhoods.

Complete Streets

Complete streets are those that are safer, more livable, and welcoming to everyone, compared to streets designed solely for use by automobiles. They are comprised of pedestrian infrastructure, traffic calming measures, and bicycle and mass transit accommodations. Complete street policies have been adopted by over 200 cities across the country, and in 2003, the South Carolina Department of Transportation (SCDOT) took a significant step forward when it declared its commitment to improve conditions for walking and bicycling. Please see Appendix A for South Carolina's complete street policy. The City of Clemson boasts one section of a complete street, which is located on the north side of Berkeley Drive near Clemson Elementary.

Maintenance

Bikeway maintenance is an integral part of a functioning bikeway system. Without clean bike lanes, routes become unsafe and cause bicyclists to ride in motorized traffic. The City of Clemson and the South Carolina Department of Transportation (SCDOT) are responsible for the cleanliness and maintenance of the existing bikeway system. The City of Clemson is responsible for cleaning College Avenue on a weekday basis. SCDOT is responsible for maintaining the remainder of the Class II and Class III bikeways on major highways through the city and uses a street sweeper approximately once a month to remove debris from the lanes. There is significant room for improvement on these major thoroughfares. Debris such as glass, garbage, and leaves collect quickly, posing substantial risks for cyclists; this requires the lanes to be serviced more frequently.

Intersections and Left Turn Lanes

Intersections pose some of the largest threats to bicyclists in the city of Clemson. Most intersections are poorly marked, and motorists and cyclists rarely follow proper safety etiquette. It is important to provide safe methods for crossing the street, such as bicycle signal detections or bike boxes. Bicycle signal detections indicate to the traffic signal that bikers are present, while bike boxes permit many cyclists to gather in front of vehicular traffic. These increase the time and lower the distance to cross an intersection once traffic lights change. Bike boxes also remove bicyclists from dangerous situations between vehicles while waiting for signal changes and may be used to create safer left turn conditions. In the city of Clemson, there are many opportunities to create safer left turn environments, especially on high traffic thoroughfares and intersections connecting with Clemson University.

Source: Jay Lawrence/Polara Studios, via Bike Portland

Encouragement

The City of Clemson in conjunction with Clemson University has a unique opportunity to spur bicycle use. They have the ability to combine their efforts to offer incentives and motivational programs to increase bicycling throughout the community.
Presently, both the City and the University have the chance to establish initiatives such as activities for Bike Month and Bike to Work Week. They also have the opportunity to provide route-finding signs in the city and on campus grounds in order to provide a cohesive and cofunctional bikeway network.

Some of the major attractions to the city of Clemson are University sporting events. The City has the ability to supply bicycling initiatives in and around downtown during major events. Not only does this increase alternative modes of travel during extremely congested periods, it also encourages people to visit downtown Clemson, boosting the local economy. As of 2012, no such initiatives exist, and the majority of visitors drive vehicles to their event destinations.

Community Outreach

At present, there is no singular place for the public to learn about or become familiar with bikeways in and around Clemson. There are ample opportunities to improve accessibility to existing bicycle facilities and occasions to increase knowledge and awareness of cycling in the city for all ages and ability levels. Neighboring Greenville, South Carolina, has recently created a website with a plethora of information regarding bicycling routes in that community.

There are also no registered bicycling groups affiliated with City of Clemson even though there is a growing cycling population. Clemson University does host the Clemson Cycling Club, which is involved in the few cycling events that do occur within the community.

Bicycle Friendly Businesses

Bicycle Friendly Businesses is a program established by the League of American Bicyclists that encourages business owners to promote bicycle use by employees and customers. Employers work to provide an environment that is more conducive to a bicycling friendly atmosphere. This includes bicycle parking facilities, lockers, and oftentimes showers at the workplace. The City of Clemson has no registered bicycle friendly businesses, and as of summer 2012, there is one bicycle retail and repair store near the intersection of S.C. Highway 93 and U.S. Highway 123.

Education

Bicycle education plays a pivotal role in the experiences both cyclists and motorists have when it comes to bicycling on both multi-use paths and congested streets. This education can and should be available to all ages and ability levels. The State of South Carolina passed the Bicycle Traffic Reform Law in January 2003. This law prescribes such things as safe distances between motorists and cyclists, bicycle lighting standards, bicycle signaling, and harassment convictions. A copy of the full law is provided in **Appendix A**.

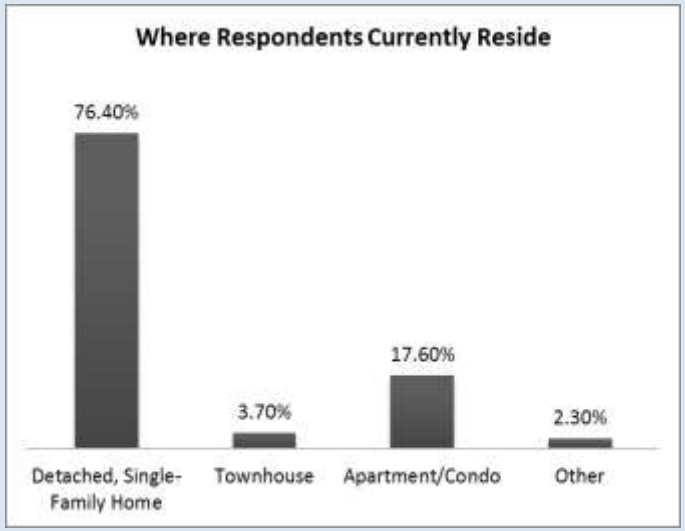
Safe Routes to School

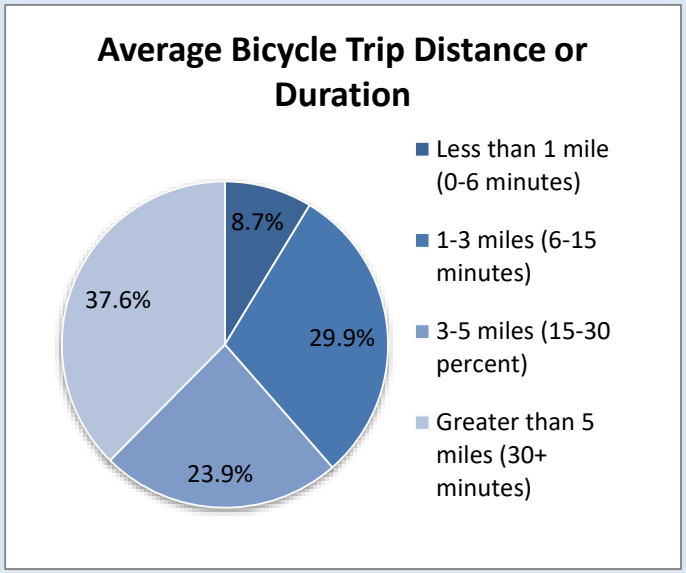
Safe Routes to School (SRTS) is a Federally funded initiative to involve parents, schools, and community leaders in educating and promoting students of all ability levels to walk and bike to school. This resource is growing in South Carolina, and the Upstate has a SRTS outreach coordinator trained to work individually with schools. In 2012, congress passed a transportation bill: Moving Ahead for Progress in the 21st Century (MAP-21) which does not grant specific funding for SRTS. Instead, SRTS programs are able to compete for funding though a program called Transportation Alternatives.[57] Each state is responsible for determining their course of action in order to receive these funds.

League of American Bicyclists

The League of American Bicyclists is a nationwide bicycling advocacy group that works to create bicycle friendly environments. They provide training to certify instructors of safe cycling techniques who can then share their knowledge with other community members. No instructors currently live within the Clemson city limits; however, there are six certified instructors within a 50-mile radius.

[57] www.saferoutesinfo.org, accessed July 30, 2012, http://www.saferoutesinfo.org/about-us/newsroom/response-map-21.





Enforcement

Enforcement plays a critical role in the actions of bicyclists and motorists. Bicyclists are to obey the rules of the road and yield to pedestrians while motorists yield to bicyclists. Presently, the City of Clemson has no bicycle police patrol; however, Clemson University adopted a mountain bike patrol in 2002. The University's patrol has proved to be an efficient and effective method of patrolling campus at all hours of the day. It has also been very beneficial during large sporting events when it is difficult to travel by motor vehicle.

In order to create a safe bikeway system, the City of Clemson should ensure cyclists are abiding by the law and will need to rely on their police force to make sure this happens.

Evaluation and Planning

The City of Clemson is very interested and concerned about its bikeway users and facilities. The City realizes the importance of facilitating mobility, access, and connectivity of various modes of transportation to all of its residents and visitors. Bicycling is a cost-effective, efficient, and sustainable form of transportation that can be utilized by users at all income and age levels. Therefore, the City of Clemson has spent significant time and resources collecting data regarding the current and future bikeway system needs and wants of its users.

Bikeway Survey Results

In March and April 2012, a City-administered online survey focusing on bicycle use was made available to anyone who wanted to participate regardless of whether they lived in Clemson. The survey captured a total of 572 respondents, and asked for participant zip code information to

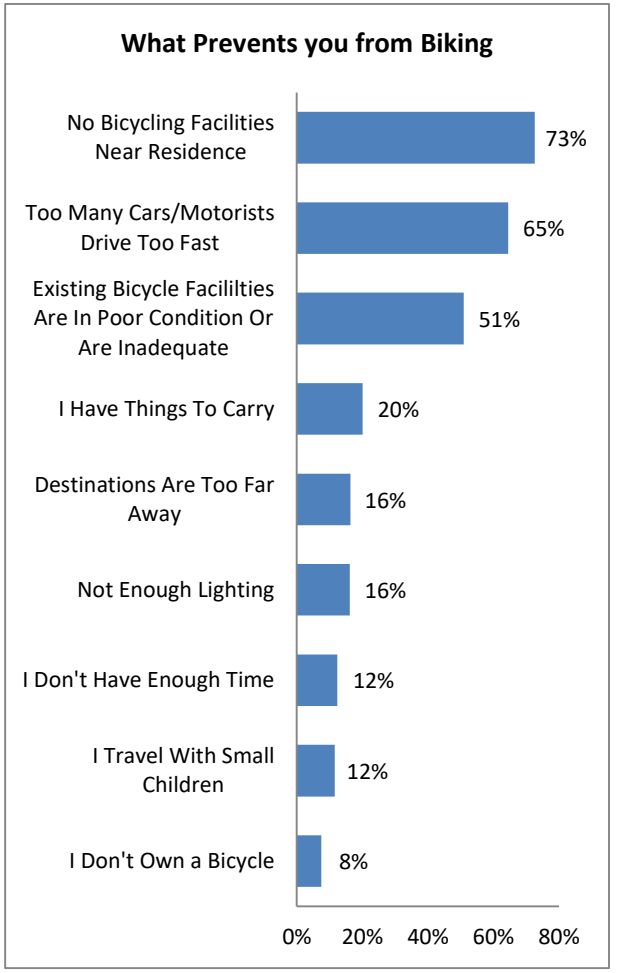
differentiate residents from non-residents. Over half of the survey respondents were between 40-64 years of age, and more than 40 percent were between the ages of 18 and 39 years of age. Of the total respondents, more than three-quarters reside in detached single-family homes.

Bicycle Ownership

When respondents were asked if they were more likely to own or ride a bicycle if they perceived bicycle facilities in Clemson to be more accommodating of bicyclists, 91 percent answered "*yes.*"

Trip Destination and Purpose

The survey also focused on trip destinations and trip purposes regardless of mode. The trip purpose with the highest average frequency, at 8.32 trips per week, was the school/work trip, followed by approximately 5.4 trips per week for shopping purposes and 5.5 trips per week for recreational purposes. A total of 3.09 trips were for other reasons not specified by the survey. Participants were then asked the number of weekly bicycle trips made by trip purpose. Of the total bicycle trips per week, 2.36 trips were for work or school, while 3.19 trips were for recreational or exercise purposes. In a recent study, the percentage of people commuting by bicycle is directly related to the number of bike lanes and paths in a city. This same study found that every one-mile increase in bike lanes is associated with an approximate one-percent rise in the share of bike-to-work trips.[58]



Source: 2012 Clemson Bicycle Survey

[58] Dill, Jennifer and Theresa Carr, "Bicycle Commuting and Facilities in major U.S. Cities: If you build them they will come – another look." Transportation Review Board. 2003 Annual Meeting. http://nexus.umn.edu/Courses/pa8202/Dill.pdf

Trip Distance

The National Survey of Pedestrian and Bicyclist Attitudes and Behavior indicated about 38.6 percent of bicycle trips taken in the U.S. are less than one mile in length; whereas the survey administered by the City of Clemson indicated only 8.7percent of trips taken by respondents were less than one mile. Instead, over half of the survey participants travel an average distance of one to five miles per bicycle trip, and 37.6 percent bicycle an average of five miles or more per trip.

Reasons that Prevent Biking

When respondents were asked to choose reasons that prevent them from biking, over 70 percent responded that there were no bicycling facilities near their homes, and 65 percent said vehicle speeds were too fast and create unsafe biking conditions. Over 50 percent of participants indicated that the condition of existing bicycle facilities is one of the main reasons that prevent them from biking.

Preferred Method of Bicycle Travel

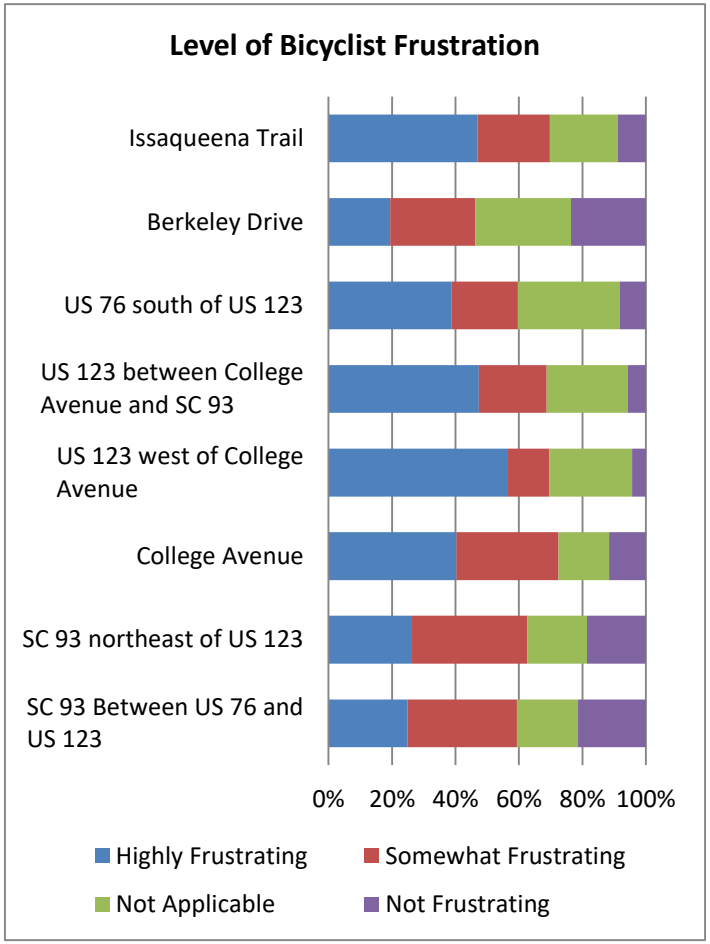
Almost all of Clemson's bikeways are either Class II on-road bikeways or Class III shared roadways. However, paved shared-use paths, separated from the road, were cited as the most preferred method of bicycle travel. The second most preferred type of bikeway facility as per survey respondents is on-road, Class II bike lanes differentiated with lane striping, bicycle on-pavement stencil markings, and roadway signage. The third and fourth most preferred facilities are natural surface trails and paved shoulders with on-road striping. Currently, Clemson lacks any appropriately marked, shared-use paths separate from the road, and portions of existing Class II bikeways fail to meet AASHTO bicycle lane width standards.

Bicyclists Behavior

Over 80 percent of participants strongly agree or agree that both motorists and bicyclists fare best when bicyclists act and are treated as drivers of motor vehicles. Approximately 15 percent of respondents disagreed or strongly disagreed with the question. Several comments were also made regarding rules of the road. Motorists find it disrespectful when they have to abide by the rules of the road when some cyclists do not. Respondents cited concerns about cyclists running red lights and biking in areas for vehicles when there is a clearly marked bicycle lane. Often bicyclists are found riding with vehicle traffic because there is debris in the designated bicycle lane or route. Mutual respect is needed for both modes in order to foster a safe environment for all users.

On-Road Facilities Versus Off-Road Facilities

When asked if bicyclists should stay off the road and ride on non-road facilities, 74.9 percent disagreed or strongly disagreed while 22.4 percent of participants agreed or strongly agreed. There are a number of reasons the majority of people prefer to use on-road facilities. Most of the time, on-road facilities provide the most direct and easily accessible route to destinations, thus decreasing travel times. There are also a number of reasons why some believe bicyclists should use separate off-road facilities. This could be due to skill level and perceptions of cyclists. Respondents who feel that some cyclists are not following the rules of the road may believe a better place for bicycles is on a completely separate path. Respondents with lower skill levels who are uncomfortable riding near traffic or those riding with small children also might find paths away from high traffic areas more accommodating.



Source: 2012 Clemson Bicycle Survey

Cyclist and Motorist Frustrations

Finally, respondents were asked to describe levels of frustration within the city of Clemson's existing street network. Participants found U.S. Highway 123 west of College Avenue to be the most frustrating road segment on which to travel as a cyclist and also as a motorist. This section of road is not classified as a bikeway, and its primary as designed purpose is to move motorized traffic east to west through the city of Clemson. It is unsafe for cyclists and motorists to share the road, as there is insufficient space to create a safe passing distance. The next two most frustrating roadway segments in the city as cited by survey respondents are U.S. Highway 123 east of College Avenue to S.C. Highway 93 and Issaqueena Trail. The section of U.S. 123 between College Avenue and S.C. 93 is not classified as a bikeway, and the predominant role of this facility is for motorized travel. Here, motorists are presented with the same challenges and frustrations as west U.S. 123 when passing bicycles in vehicular travel lanes. Issaqueena Trail near Lowe's is considered a Class II bikeway. The remainder of Issaqueena trail as currently paved is not very conducive to a share-the-road situation. Lane widths are narrow, and often there is little to no shoulder, high travel speeds, and insufficient signage. Respondents are also frustrated with College Avenue between U.S. 123

and downtown, which is a shared lane Class III bikeway. On this stretch of road, traffic is heavy, riding on sidewalks is prohibited, and on-street parking makes for dangerous bicycling conditions. To see all survey results, please refer to **Appendix A**.

Bicycle Counts

In order to determine the number of people bicycling on an average day in the city of Clemson, a bicycle count was conducted by City planning staff on specific days and times in March and April 2012. This plan illustrates those results and compares existing bicycle usage trends with those reported in the 1990 and 1997 Clemson Bikeway plans. This comparison is shown in **Table 3.1**: Clemson Bicycle Counts, 1990, 1996 and 2012.

The 2012 bicycle counts were conducted at the same intersections and at roughly the same time of day with comparable weather patterns as previous counts. The bicyclists were counted during the late afternoon hours, and as is expected, the majority of cyclists were traveling away from the University. The study area with the highest number of bicyclists was at the intersection of S.C. 93 and College Avenue, where observations revealed 30 riders from 4-5p.m. This is only one less rider than was observed in 1990 at the same intersection during the same time period. The intersection with the fewest number of cyclists was at the intersection of College Avenue and U.S. 123, with a recorded eight riders from 3:45-4:45p.m. The low number of riders could be due to the size of the intersection, the number of vehicles traveling at fast speeds, the lack of a bicycle lane or connecting sidewalk, and Clemson Area Transit (CAT). It must also be noted that portions of this intersection were under construction at the time of the 2012 study. The only intersection studied with a dedicated bicycle lane was that of S.C. 93 and U.S. 76. Here bicyclist numbers remained constant with what was recorded in 1996, with a total of 14 riders on Thursday, March 23, 2012, between 3:30-4:30p.m. The form used for the City-administered bicycle counts is located in **Appendix A**.

Although the extent of bicycle lanes in the city has increased significantly since 1990, the number of bicyclists has decreased according to the 2012 bicycle count. However, these numbers may not accurately represent the number of people bicycling in the city.

The most notable change from a transportation perspective in Clemson is the addition of the highly utilized CAT bus system. CAT services several of the highly traveled routes through town, such as S.C. 93, College Avenue, Perimeter Road, and sections of Issaqueena Trail as well as routes through Clemson University's campus. CAT ridership has experienced robust growth since its inception in 1996. It has also contributed to a general decrease in the volume of single-occupancy motorized travel that would otherwise create congestion on Clemson roadways, and lessens the strain on parking facilities throughout the city. It also affects the number of residents using their bicycles as a primary mode of travel, which is clearly observable in the 2012 bicycle counts. While the number of bikes observed at these intersections has decreased over the years, the number of bicycle mounts on the CAT bus has steadily increased. In 2011, CAT buses transported an average of 25 bicycles per day.

Table 3.1: Clemson Bicycle Counts, 1990, 1996 and 2012

Location and Date	Number of Cyclists Observed			Percent Change 1990-1996	Percent Change 1996-2012	Total Change 1990-2012
	1990	1996	2012			
	4-5 P.M.	4-5 P.M.	3:45-4:45 P.M.			
US. 123 and College Ave. 10/1/90,10/7/96, & 4/3/12	25	12	8	-52.0%	-33.3%	-68.0%
	4-5 P.M.	4-5 P.M.	3:30-4:30 P.M.			
S.C. 93 and U.S. 76 10/3/90, 10/9/96, & 3/29/12	21	14	14	-33.3%	0.0%	-33.3%
	4-5 P.M.	4-5 P.M.	4-5 P.M.			
S.C. 93 and College Ave. 10/5/90, 10/11/96, & 3/8/12	31	43	30	38.7%	-30.2%	-3.2%
Total	**77**	**69**	**52**	**-10.4%**	**-24.6%**	**-32.5%**

Source: Clemson Bikeways Plan 1990 & 1996; 2012 Clemson Planning and Codes Administration Staff

Suitability of Existing Network

A suitability analysis was conducted in January 2012 for major roadway segments throughout the city of Clemson in order to determine the Bicycle Level of Service (BLOS) and the Bicycle Compatibility Index (BCI). These metrics help to establish areas of high, medium, and low priority for improving bikeway facilities by measuring the level of comfort and safety for bicyclists.

BLOS and BCI

The BLOS method, developed by Landis, Vattikuti, and Brannick, seeks to quantify the perceived levels of safety for bicyclists on roadways.[59] This does not measure the bicycle capacity or traffic flow like other modes are measured to reflect level of service, but rather it seeks to capture the user's perceived level of safety based on inputs such as traffic volume, speed, pavement condition, and lane width. In 1998, the FHWA developed the BCI, which is another method for determining perceived safety using inputs such as traffic volume and speed, number of lanes in each direction, lane width, and types and characters of roadside development. The most influential BCI input is the average daily traffic (ADT) on a roadway segment. When ADT rises significantly, the level of service for bicycle use as calculated by BCI plummets. Both BLOS and BCI are measures stratified on a letter system A though F, with A being the most accommodating level of service and F being the least. Also included in this analysis are an inventory of Right of Way (ROW) widths and Cart Way (CW) widths. These help to determine the degree to which the level of service may be enhanced in the future and the ease at which it can be done. All results of this analysis are located in **Table 3.2**. Please refer to **Appendix A** for BLOS classification definitions.

The results of the BLOS and the BCI boast similar outcomes as the 2012 bicycle survey and as the inventory conducted by City staff. The only roadway segment considered to have a level of service A is Berkeley Drive between Clarendon Drive and Issaqueena Trail. This segment of roadway also would have space to increase the designated area available to bicyclists in the future. College Avenue is ranked C to D depending on the roadway segment. This is expected considering it is a Class III bikeway with abundant traffic and on-street parking. South Carolina Highway 93 is also ranked C to D with the majority of roadway segments classified as BLOS C and BCI C. The only segment of roadway classified as a D by both BLOS and BCI is between Cambridge Drive and Berkeley Drive, where the bicycle lane narrows to widths less than AASHTO standards. Issaqueena Trail is predominantly classified as level of service D by both BLOS and BCI except south of Nettles Drive and north of Berkeley Drive where the roadway is classified as BLOS C. Finally, U.S. Highway 123 is classified as BLOS D and BCI E for all segments.

Most roads with extremely low levels of service do have the capacity to be expanded in order to improve safety and comfort levels for bicyclists, bicycle mobility and access, and the overall functionality of Clemson's bikeways.

[59] Landis, Bruce, "Real-Time Human Perceptions: Toward a Bicycle Level of Service," Transportation Research Record 1578 (Washington DC, Transportation Research Board, 1997).

Table 3.2: Bicycle Level of Service and Bicycle Compatibility Index: Including Right of Way Width and Cart Way Width

Road Segment	Lanes per Direction	Outside lane Width	Paved shoulder/ bikelane width	Posted Speed Limit	BLOS	BCI	ROW	CW
Issaqueena Trail (N of 123, S of Cambridge Dr)	1	10	0	35mph	D	D	50	24
Issaqueena Trail (S of 123, N of Nettles Rd)	1	10	0	35mph	D	D	50	44
Issaqueena Trail (S of Nettles N of Berkeley)	1	10	0	35mph	C	D	65	23
SC 93 (Between Cambridge and Berkeley)	2	10-10.5	2.5-3	40mph	D	D	80	80
SC 93 (Between US 123 and Skyview Drive)	2	10	4.5	40mph	C	C	95	85
SC 93 (Between US76 and Kelly Rd)	1	10	4	40mph	C	C	na	na
Berkeley Drive (Between Princess Grace Ave and Sedgefield Dr)	1	10	3	30mph	B	B	65	50
Berkeley Drive (Between Clarendon Drive and Country Walk Lane)	1	10	8	35mph	A	A	50	35
Berkeley Drive (Between Rock Creek Rd and Issaqueena Trail)	1	10	8	35mph	A	A	50	35
US 123 (Between Keowee Trail and Holiday Avenue)	2	13	0	40mph	D	E	120	80
US 123 (Between College Avenue and Wall Street)	2	12	0	40mph	D	E	120	80
US 123 (Between College Avenue and Anderson Hwy)	2	13	0	40mph	D	E	120	85
US 123 (Between SC 93 and Anderson Hwy)	2	12	0	45mph	D	E	80	80
US 123 (Between SC 93 and Berkeley Drive)	2	12	0	55mph	D	E	80	80
Pendleton Road (south of Issaqueena)	1	12	0	35mph	D	D	65	45
Pendleton Road (Between Hunter Avenue and Old Stone Church Rd)	1	12	1	35mph	C	C	50	45
Rock Creek Rd (Between Riding Rd and Cedar Ln)	1	10	3	30mph	A	B	40	30
College Ave (Between SC 93 and Clemson Ave)	1	10	8	25mph	C	C	65	65
College Ave (Between Keowee Trail and Edgewood Ave)	2	14	0	35mph	C	D	85	65
College Ave (North of US 123)	2	12	0	35mph	D	D	85	65
Anderson Hwy (Between US 123 and Stoney Creek Drive)	2	11.5	3	40mph	C	C	100	80
Anderson Hwy (Between Perimeter Rd and Pendleton Rd)	2	11.5	7.5	45mph	A	C	100	80
Anderson Hwy (Between Pendleton Rd and Rose Circle)	2	12	7	45mph	A	C	na	na
Anderson Hwy (Between New Hope Rd and Old Stone Church Rd)	2	12	7	45mph	A	B	na	na
Anderson Hwy (Between Excelsior Mill Rd and New Hope Rd)	3	11.5	7.5	45mph	A	B	na	na

Current Policies

In order to create a functional bikeway system the City of Clemson's *Comprehensive Plan 2014,* Land Development Regulations, and Zoning Ordinances should encourage and prescribe a more accessible and better connected network of bikeway facilities.

The zoning ordinance requires Class II bikeways be implemented where possible on all new and reconstructed roadways as directed by the bikeways plan, and that they be implemented in conjunction with new major commercial, residential, or other land developments where it is practical and desirable. The City's current zoning ordinance also states that required landscape bufferyards can be used for bicycle paths. In the architectural overlay districts the City's zoning ordinance also states that connections are required for shared driveways if a public sidewalk or bikeway is adjacent to the property and if a public pedestrian walkway or bikeway exists that there must be pedestrian and bicycle connection to the primary building.

The City of Clemson's Land Development Regulations require bikeways in newly platted subdivisions as recommended by the 1997 Bikeways Plan.

Other policies the City of Clemson has adopted include prior authorization for use of hospitality fee fund for bicycle racks for downtown street improvements and a citywide ban of bicyclists on sidewalks and pedestrian walkways.

There are numerous opportunities to expand the scope of bicycling policies if the City wants to increase and enhance their bikeway system. These opportunities and suggestions are discussed in Chapter Five: Implementation.

Implementation

Proposed Bikeways

One of the primary goals of this bikeways plan is to focus on maximizing connectivity, mobility, and access through the City of Clemson and with Clemson University and other surrounding jurisdictions for utilitarian and recreational purposes. With this in mind, roadway segments have been identified that provide access to major commercial destinations, major employment centers, and residential neighborhoods as well as roadways that provide connectivity to implemented and proposed bikeways on university lands. Provided below is a map and list of the preferred roadway segments that were recognized as bikeway connections.

Type Proposed	Road Name	To	From	Total Distance	
Class I	Berkeley Drive	Karen Drive	Frontage Road	0.35	New Construction & Bridge over US123
Class I	Pendleton Road	Rice St	Booker Springs	1.06	Update and Maintenance
Class I	Tiger Boulevard	US123 Bridge	Anderson Highway	1.30	New Construction
Class I	18-Mile Creek	South Forest	Nettles Park		New Construction
				1.30	**Total Class I Miles**

Type Proposed	Road Name	To	From	Total Distance	
Class II	Berkeley Drive	Frontage Rd	Issaqueena Trail	1.10	widen shoulder add bike lane
Class II	Berkeley Drive	Old Greenville Hwy	Ashley Drive	0.63	widen shoulder add bike lane
Class II	Calhoun St	College Ave	Clemson St	0.09	widen shoulder add bike lane
Class II	Cambridge	Old Greenville Hwy	Issaqueena Trail	0.55	widen shoulder add bike lane
Class II	Cherry Rd/Old Stone Church	Crestwood	Hwy 76	1.47	widen shoulder add bike lane
Class II	Frontage Rd	Old Greenville Hwy	Berkeley Drive	0.90	widen shoulder add bike lane
Class II	Hwy 76 (Anderson Hwy)	US 123	Old Greenville Hwy 93	1.12	restripe/ road diet
Class II	Issaqueena Trail	Old Greenville Hwy	US 123	1.12	widen shoulder add bike lane
Class II	Issaqueena Trail	US 123	Berkeley Drive	1.38	widen shoulder add bike lane
Class II	Issaqueena Trail	Berkeley	Pendleton Road	0.42	widen shoulder add bike lane
Class II	Old Greenville Hwy	Abel	Old Central Rd	0.40	restripe/ road diet
Class II	Old Greenville Hwy	Abel	Abel	0.31	restripe/ road diet
Class II	Old Greenville Hwy	Skyview	Abel	0.30	restripe/ road diet
Class II	Pendleton Rd	Old Stone Church	Perimeter Road	0.44	widen shoulder add bike lane
Class II	Upper College Ave	Calhoun	Lakeview	0.25	widen shoulder add bike lane
Class II	Upper College Ave	Tiger Boulevard	Calhoun	0.31	widen shoulder add bike lane
Class II	Upper College Ave	Lakeview	Santee	0.79	widen shoulder add bike lane
Class II	US 123	Hwy 76	Old Greenville Hwy 93	0.96	restripe/ road diet
				9.69	**Total Class II Miles**

Type Proposed	Road Name	To	From	Total Distance	
Class III	Blue Ridge	Skyview	Karen	0.20	signage and stencils
Class III	Calhoun St	College Ave	Clemson Place	0.30	signage and stencils
Class III	Central Rd	Issaqueena Trail	Nettles Park	0.40	signage and stencils
Class III	Clarendon	Berkeley Drive	Shady	0.49	signage and stencils
Class III	Clemson St	Elm	Ford Rd	1.14	signage and stencils
Class III	Elm St	College Ave	College	0.18	signage and stencils
Class III	Elm St	River Point	College	0.44	signage and stencils
Class III	Ford Rd	Clemson St	Old Central Rd	0.60	signage and stencils
Class III	Hamilton West	Old Greenville Hwy	Old Central Rd	0.39	signage and stencils
Class III	Hedgerow	Wigington	Oak	0.35	signage and stencils
Class III	Highland	Rock Creek	Pendleton Rd	0.43	signage and stencils
Class III	Karen	Skyview	Berkeley	0.24	signage and stencils
Class III	Martin Street	Riggs	Daniel	0.17	signage and stencils
Class III	N. Clemson	Oak	College Ave	0.54	signage and stencils
Class III	Oak	Hedgerow	Old Greenville Hwy	0.14	signage and stencils
Class III	Old Central Old	Hamilton West	Lawrence	1.34	signage and stencils
Class III	Old Jewell Bridge	Clemson St	Pile	0.59	signage and stencils
Class III	Riggs Drive	Strode	Poole	0.26	signage and stencils
Class III	Rock Creek	Berkeley Drive	Pendleton Rd	0.96	signage and stencils
Class III	Shady	Clarendon	Rock Creek	0.09	signage and stencils
Class III	Skyview	Old Greenville	Blue Ridge	0.29	signage and stencils
Class III	Strode	College Ave	Riggs Drive	0.04	signage and stencils
Class III	Sunset	Oak		0.13	signage and stencils
				9.71	**Total Class III Miles**

Proposed bikeways focus and emphasis on maximizing connectivity, mobility, and access

Proposed Network Improvements

- Add each type of bikeway: Name of road, to – from, Length, Cost estimate?

Project planning and programming (BRET) (mat21/ TAP via MPO, SCDOT resurfacing/general maintenance, Hospitality Tax, MAP21, STP, and Fed Policy)

BIP Bikeway Improvement Program

- Explain model and inputs for each criteria, with methods and technique. Explain the score and the multiplier. Include treatments proposed to be applied to each segment
- Explain/show output of model using both map and discussion for each road segment assessed
- Add top priority bikeways and payment plan

Maintenance plan/program for existing and future bikeways

Clemson Project Prioritization Criteria				
Criteria	Score	Multiplier	Total	Description
Level of Frustration*	2	3.0	6	Highly Frustrating
	1		3	Somewhat Frustrating
	0		0	Not Frustrating
Bicycle Level of Service	3	3.0	9	BLOS Ranked "D"
	2		6	BLOS Ranked "C"
	1		3	BLOS Ranked "B"
	0		0	BLOS Ranked "A"
Ease of Physical Implementation	2	2.0	4	Little changes must be made to install a bikeway on the existing roadway.
	1		2	Minor changes must occur to install a bikeway on the existing roadway.
	0		0	Major changes must occur to install a bikeway on the existing roadway.
Cost	3	2.0	6	$0-$5000 to implement (share the road signs/posts, shared lane markings, way finding).
	2		4	$5000-$10,000 to implement (pavement marking and signage for bike lane).
	1		2	$10,000-$50,000 to implement (restriping, additional pavement).
	0		0	$50,000 or greater to implement (street widening, multi-use path).
Connections to Major Destinations	2	2.0	4	Directly connects to Clemson University, major commercial centers, schools.
	1		2	Directly connects to minor commercial centers, community and government facilities.
	0		0	Does not directly or indirectly connect to any significant destinations.
Connections to Residences	2	2.0	4	Directly connects to multi-family developments or areas with 7 or to 67 bedrooms per acre.
	1		2	Directly connects to single and/or multi-family developments with 4 to 6 bedrooms per acre.
	0		0	Directly connects to single family developments or areas with 0 to 3 bedrooms per acre.
Connecting Existing Gaps	2	2.0	4	Connects gaps between existing bikeways (Including those on University Lands).
	1		2	Connects gaps between existing and proposed bikeways (on University Lands).
	0		0	Does not directly connect to any existing or proposed bikeways on University Lands.
Transit Access	2	2.0	4	Bikeway is on a CAT bus route
	1		2	Bikeway leads to a CAT bus route
	0		0	Bikeway has no connection to a CAT bus route

*As indicated by survey respondents for the Bikeway Survey.

Encouragement, Safety, Education, Enforcement

Education, encouragement, enforcement, and promotional programs will help people of all ages and skill levels realize the full potential of Clemson's bicycle infruastructure. These types of programs help pedestrians, cyclists, and motorists learn how to use Clemson's roads safely.

A range of strategies and actions, from broad policy and outreach efforst to specific strategic support for people new to bicycling, will help the city meet the goals and objectives of this plan. The programmatic strategies in the plan aim to improve safety, strengthen wayfinding, increase access to bicycling, increase collaboration between nearby jurisdictions, and encourage community and economic development. Together these efforts can help make riding a bicycle in Clemson a safe, easy, and enjoyable experience for more people. The actions will increase the visibility of people who ride bicycles, communicate that all road users are expected to follow the rules of the road no matter hoe they travel, create safer streets, and develop a common understanding of traffic safety. The actions will also reach out to new audiences to help residents understand the rules of the road and shafe a vision of riding a bicycle as a fun, healthy, community-building activity.

The following programmatic strategies will help achieve higher levels of safety and connectivity of the bicycle infrastructure by encouraging people of all ages and abilities to ride a bicycle for any trip purpose.

Encouragement

Personal Travel Encouragement Program

Personal Travel Encouragement (PTE) programs (also known as individualized social marketing programs) are encouragement programs based on saturating a target geographic area with resources to help residents reduce drive-alone trips and increase biking, walking, transit, and carpool trips. These programs have demonstrated a lasting reduction in drive-alone trips; for example, in Portland, OR, target areas have experienced a 10% reduction in motor vehicle traffic.

Programs offer residents maps, brochures and other printed materials, classes, guided rides and walks, and other tools and programs that make bicycling, walking, and transit usage a more inviting travel option compared to drive-alone trips.

Compared to infrastructure improvements, these programs are scalable, flexible, inexpensive, and site-independent.

One of the strengths of the individualized marketing model is that it reaches every resident with an appealing invitation to participate, but then focuses the bulk of resources on those who identify themselves as interested. The many classes, rides, and activities continue to be publicized and open to all, so residents have multiple opportunities to opt into the program. This focus allows for both broad reach and strategic investment.

This model is most successful in areas that have made initial infrastructure investments sufficient to provide a functional bicycling, walking, and transit network. It is most effective as an approach that leverages investments in infrastructure, not one that replaces those investments. With Clemson's fast-increasing interest in a bicycle facilities network, PTE could build the user base for that network and evidence local demand for such facilities.

This Plan recommends that the City of Clemson implement a pilot Personal Travel Encouragement program for the bicycle network.

The program may include the following:

- Maps and brochures
- Classes, clinics, workshops
- Guided rides and walks
- Fun social events
- Giveaways (e.g., coupons, pedometers, etc.)
- Targeted outreach (e.g., Women on Bikes, Senior Strolls)
- Route planning help (bike, walking, or transit)

The exact program components and budget should be determined at time of program planning.

Education

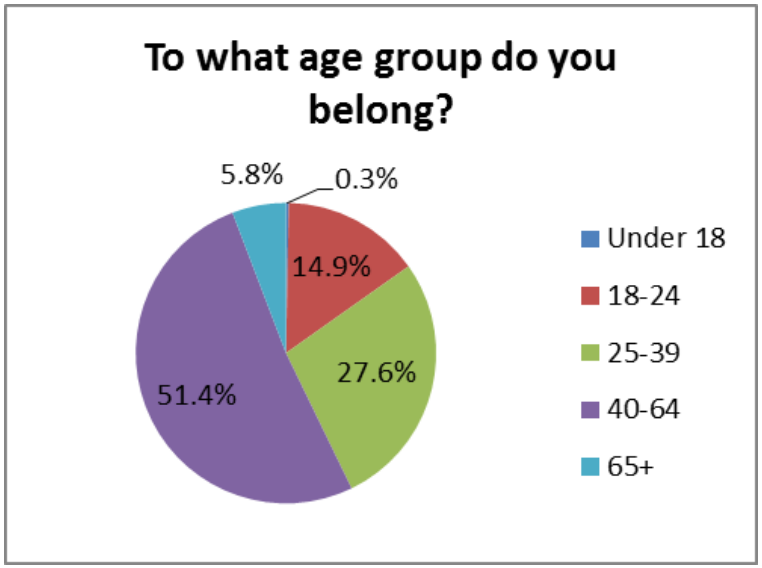
Education for pedestrians, cyclists, and motorists is a key component in ensuring a safe roadway network for all users. These educational programs should be geared specifically to target each age range and user.

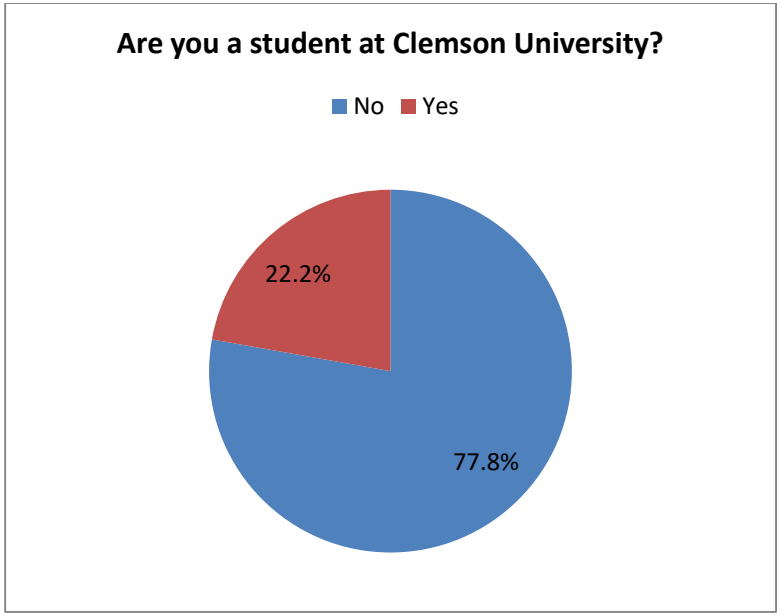
Safety education for all primary, middle, and high school-aged youth provides a unique opportunity to educate Clemson's youth in the formative moments when they create lifelong transportation habits. It is also important to educate adults about

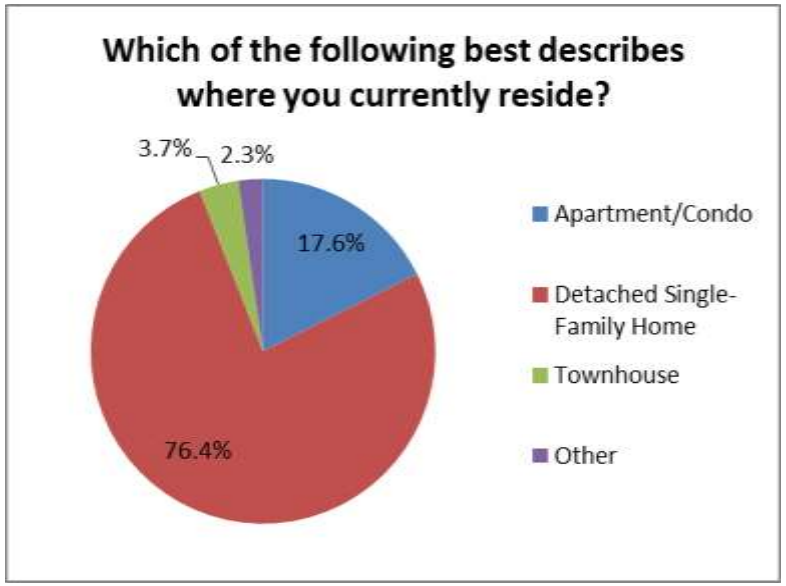
new bicycle facilities and how to interact with them regardless of which travel mode they prefer to ensure safe streets for all users of the roadway. Targeting wider audiesnce will build broad community knowledge about safety and bicycle riding opportunities. Changing individial behaviors is critical to accomplish the vision of this plan. The city will lead and support partners thorugh tailored direct outreach to people of all ages and abilites that encourages them to start and continue to ride a bicycle.

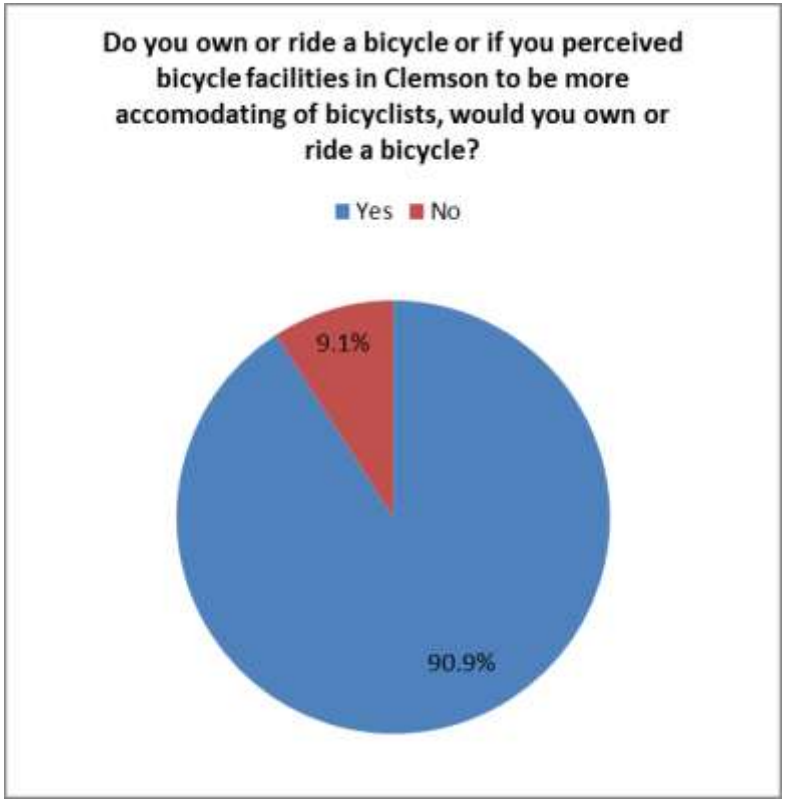
2012 Bikeway Survey Results

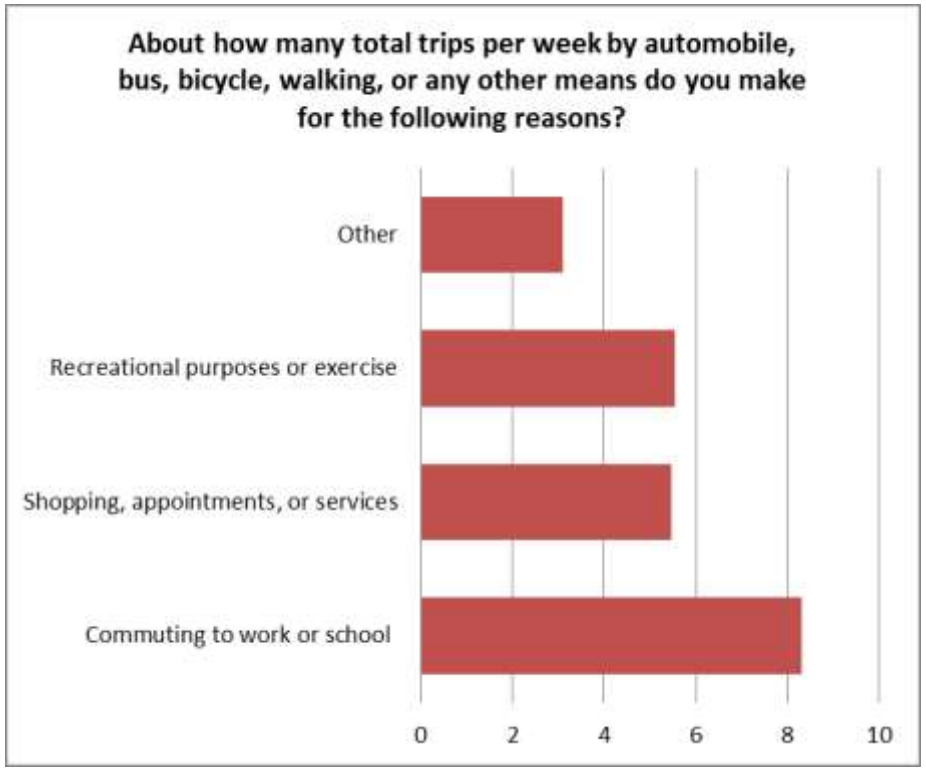
In Spring 2012, City of Clemson Planning Staff administered an online bikeways survey. The survey was advertised in *Community Connections*, a quarterly publication from the city, and notices were also sent to Clemosn households in the monthly ulitity bill. The following are the results of 572 survey participants:

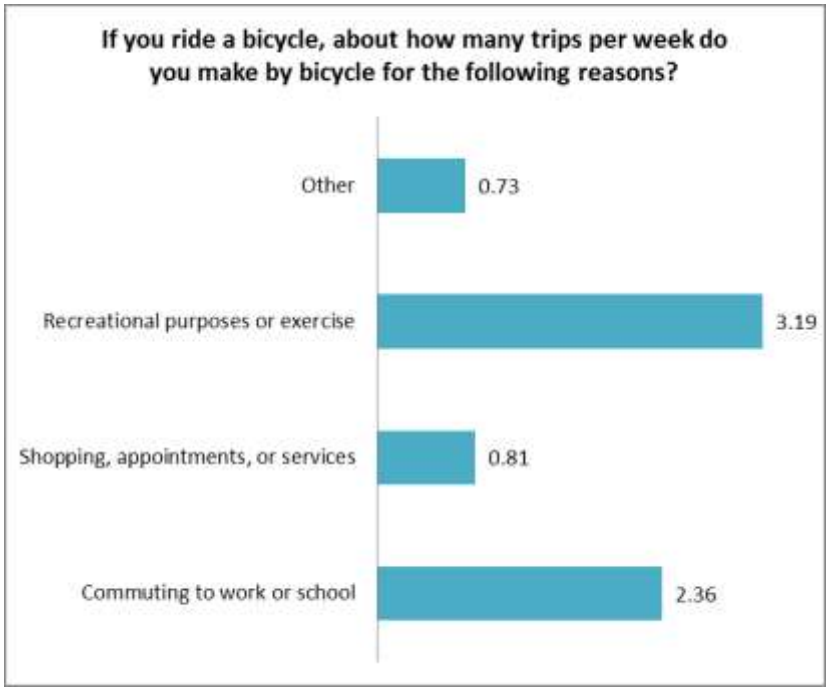

To what age group do you belong?
5.8%
0.3%
14.9%
27.6%
51.4%
Under 18
18-24
25-39
40-64
65+

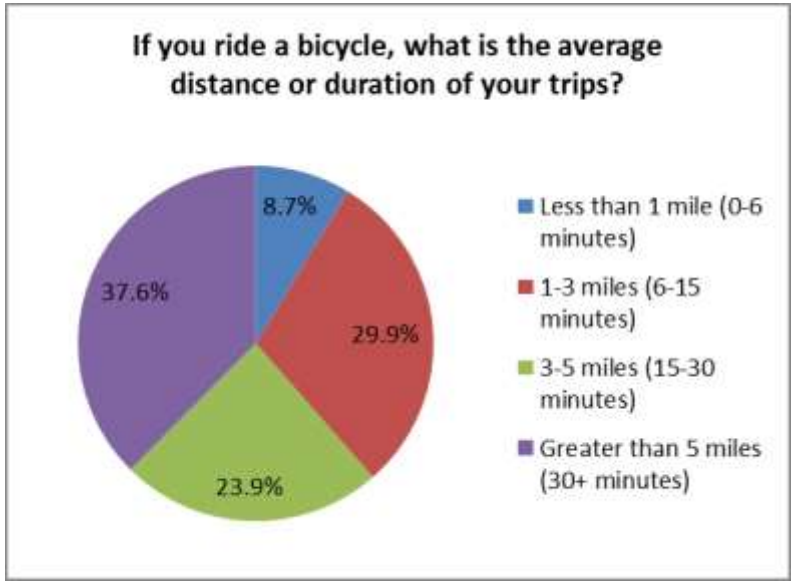

Are you a student at Clemson University?
No
Yes
22.2%
77.8%

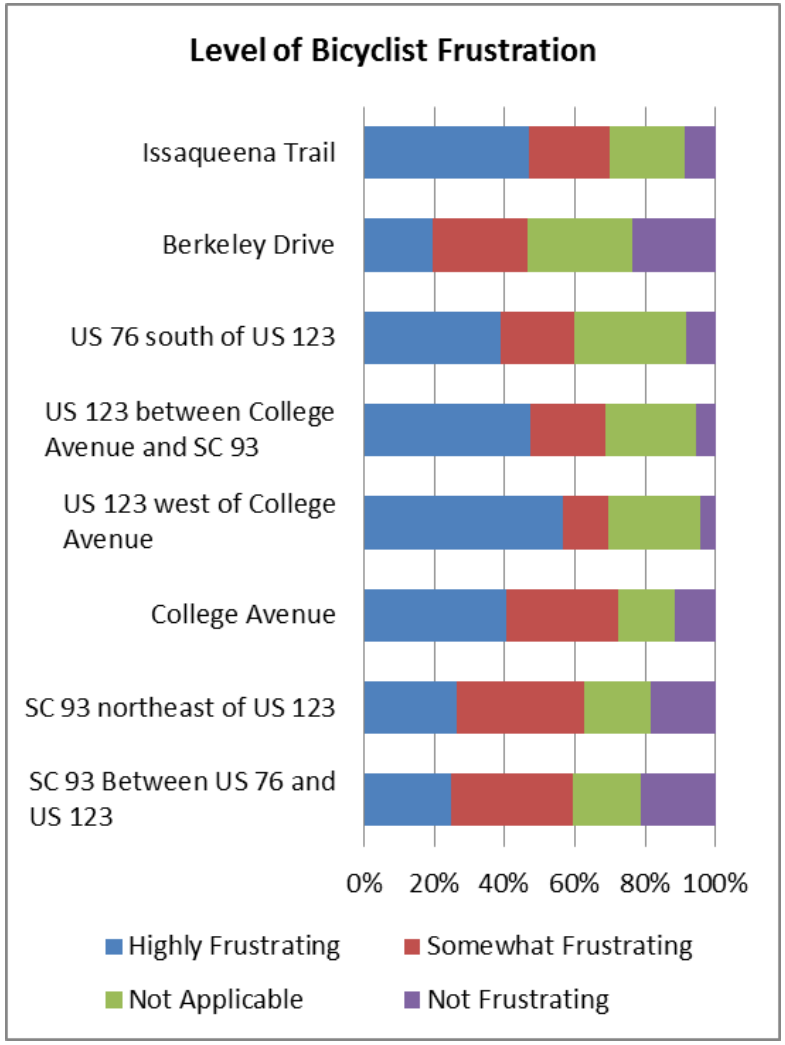

Which of the following best describes where you currently reside?
3.7%
2.3%
17.6%
76.4%
Apartment/Condo
Detached Single-Family Home
Townhouse
Other

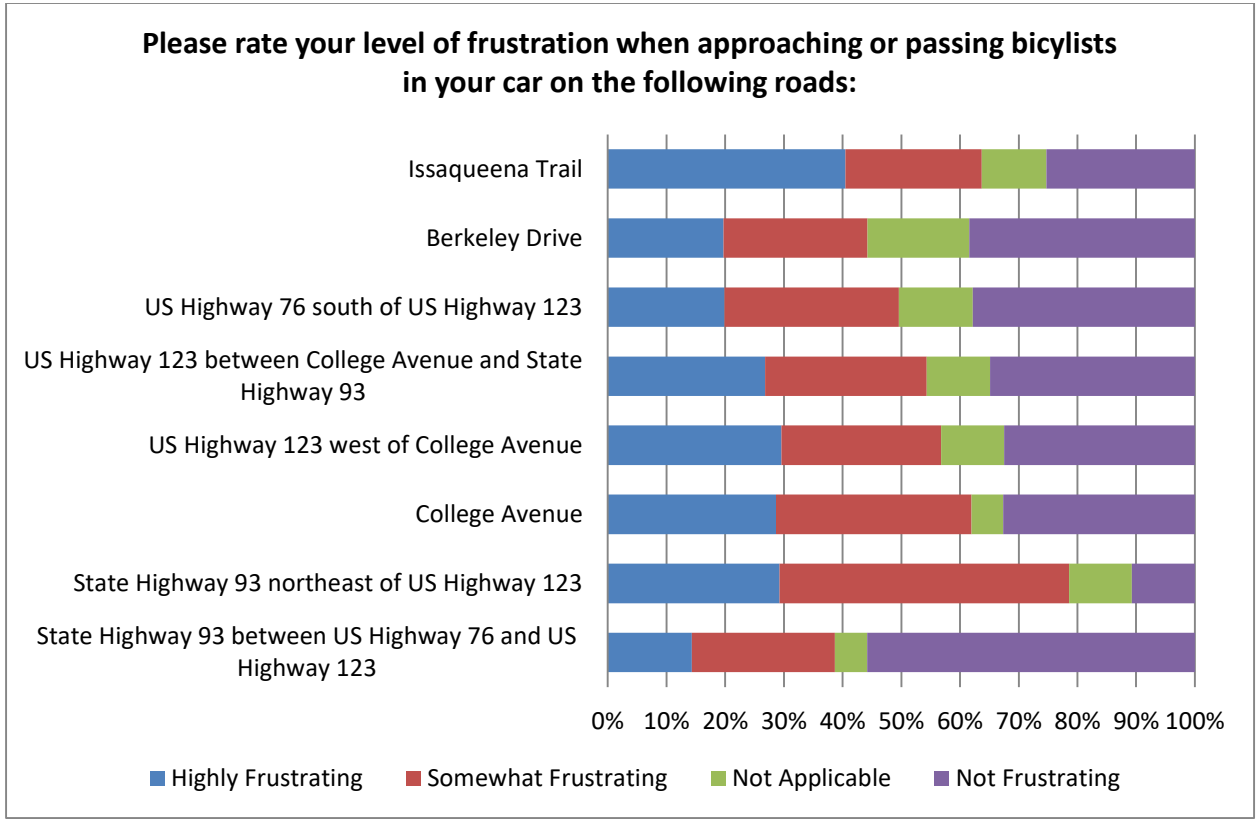

Do you own or ride a bicycle or if you perceived bicycle facilities in Clemson to be more accomodating of bicyclists, would you own or ride a bicycle?
Yes
No
9.1%
90.9%

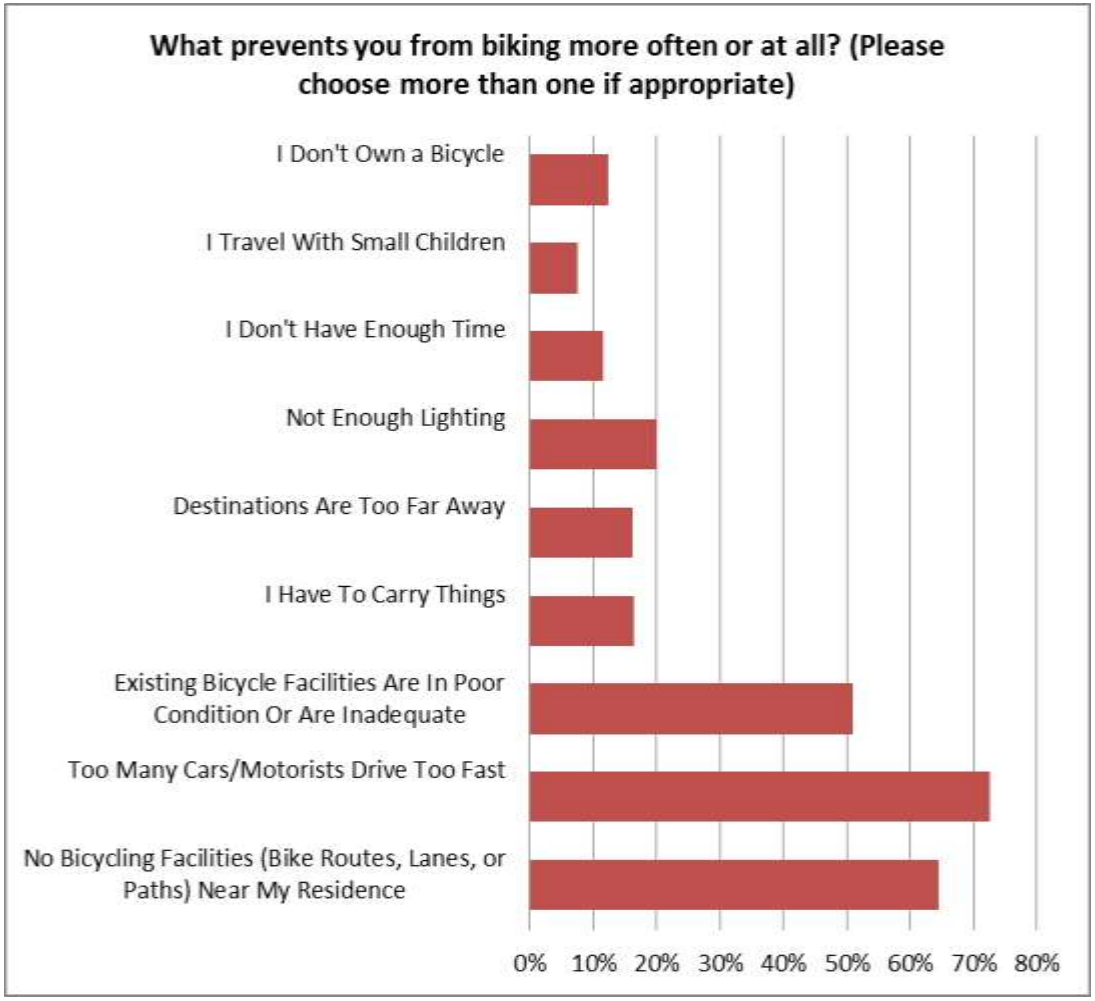

About how many total trips per week by automobile, bus, bicycle, walking, or any other means do you make for the following reasons?
Other
Recreational purposes or exercise
Shopping, appointments, or services
Commuting to work or school
0
2
4
6
8
10

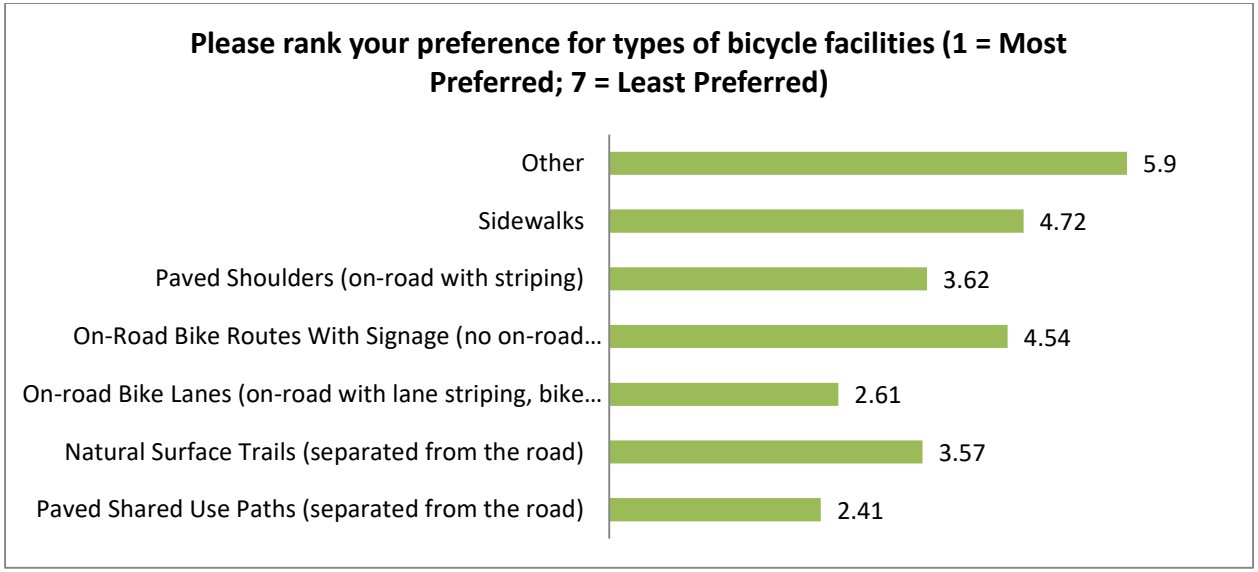

If you ride a bicycle, about how many trips per week do you make by bicycle for the following reasons?
Other
0.73
Recreational purposes or exercise
3.19
Shopping, appointments, or services
0.81
Commuting to work or school
2.36

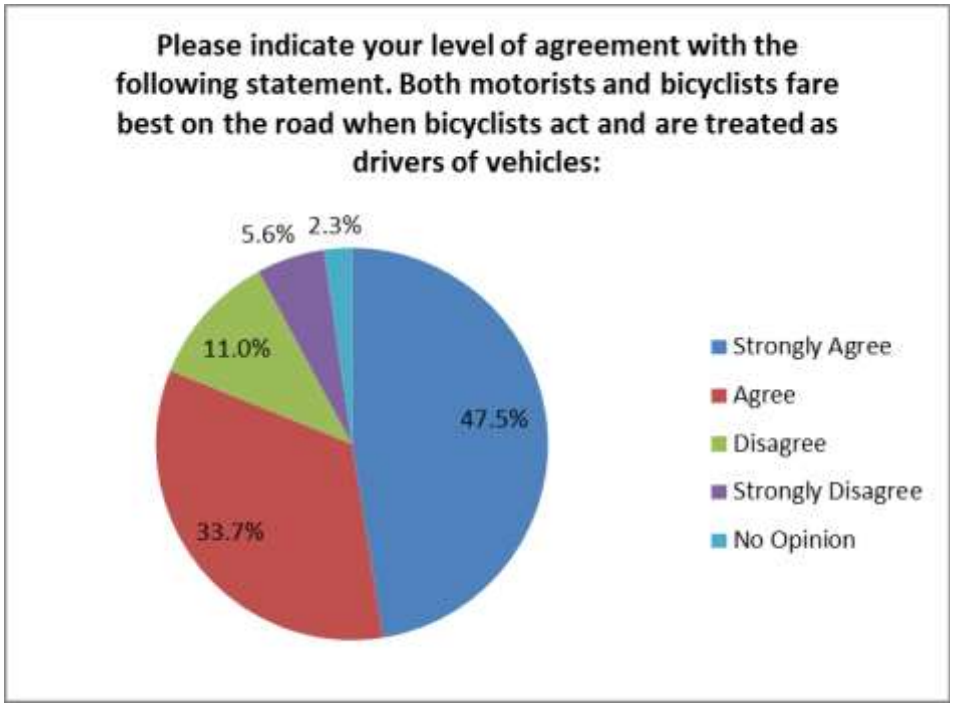

If you ride a bicycle, what is the average distance or duration of your trips?
8.7%
29.9%
23.9%
37.6%
Less than 1 mile (0-6 minutes)
1-3 miles (6-15 minutes)
3-5 miles (15-30 minutes)
Greater than 5 miles (30+ minutes)

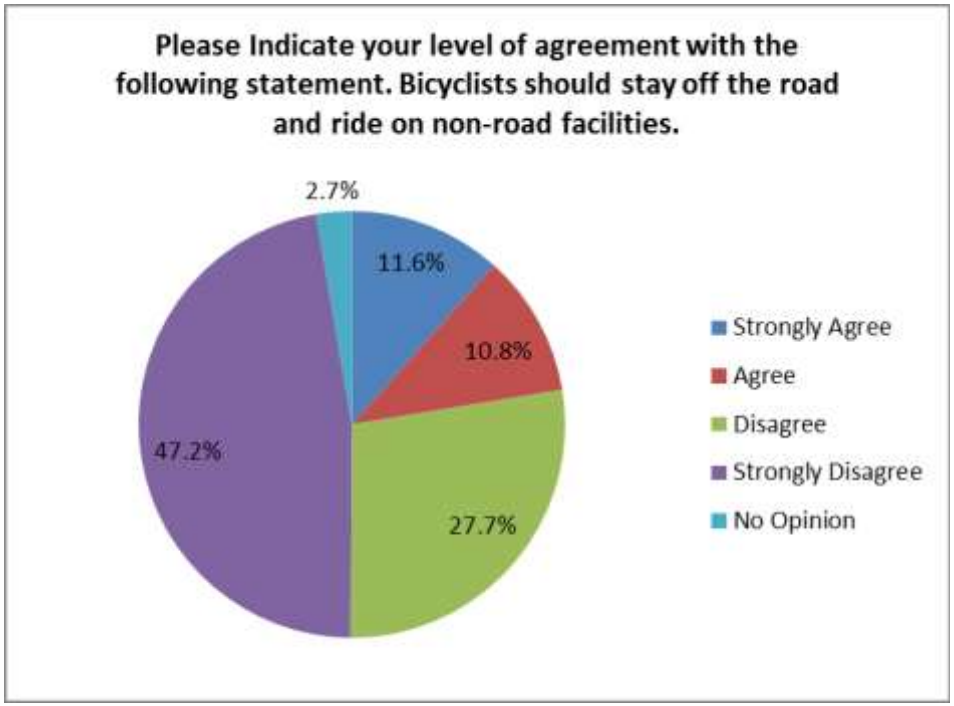

Level of Bicyclist Frustration
Issaqueena Trail
Berkeley Drive
US 76 south of US 123
US 123 between College Avenue and SC 93
US 123 west of College Avenue
College Avenue
SC 93 northeast of US 123
SC 93 Between US 76 and US 123
0%
20%
40%
60%
80%
100%
Highly Frustrating
Somewhat Frustrating
Not Applicable
Not Frustrating


Please rate your level of frustration when approaching or passing bicylists in your car on the following roads:
Issaqueena Trail
Berkeley Drive
US Highway 76 south of US Highway 123
US Highway 123 between College Avenue and State Highway 93
US Highway 123 west of College Avenue
College Avenue
State Highway 93 northeast of US Highway 123
State Highway 93 between US Highway 76 and US Highway 123
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Highly Frustrating
Somewhat Frustrating
Not Applicable
Not Frustrating


What prevents you from biking more often or at all? (Please choose more than one if appropriate)
I Don't Own a Bicycle
I Travel With Small Children
I Don't Have Enough Time
Not Enough Lighting
Destinations Are Too Far Away
I Have To Carry Things
Existing Bicycle Facilities Are In Poor Condition Or Are Inadequate
Too Many Cars/Motorists Drive Too Fast
No Bicycling Facilities (Bike Routes, Lanes, or Paths) Near My Residence
0%
10%
20%
30%
40%
50%
60%
70%
80%


Please rank your preference for types of bicycle facilities (1 = Most Preferred; 7 = Least Preferred)
Other
5.9
Sidewalks
4.72
Paved Shoulders (on-road with striping)
3.62
On-Road Bike Routes With Signage (no on-road…
4.54
On-road Bike Lanes (on-road with lane striping, bike…
2.61
Natural Surface Trails (separated from the road)
3.57
Paved Shared Use Paths (separated from the road)
2.41


Please indicate your level of agreement with the following statement. Both motorists and bicyclists fare best on the road when bicyclists act and are treated as drivers of vehicles:
5.6%
2.3%
11.0%
47.5%
33.7%
Strongly Agree
Agree
Disagree
Strongly Disagree
No Opinion


Please Indicate your level of agreement with the following statement. Bicyclists should stay off the road and ride on non-road facilities.
2.7%
11.6%
10.8%
47.2%
27.7%
Strongly Agree
Agree
Disagree
Strongly Disagree
No Opinion