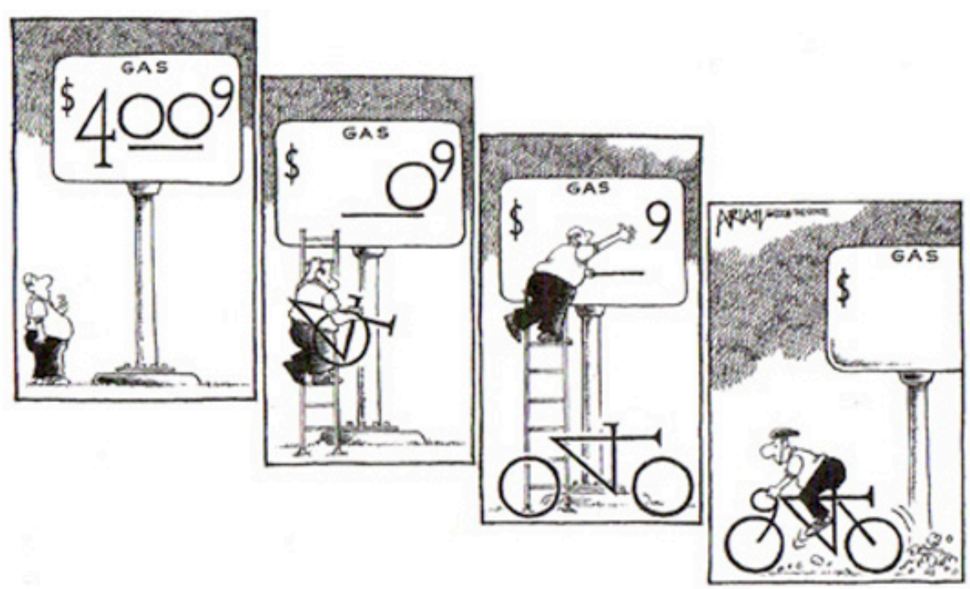
9.5 Economics

Duck, NC

Introduction

Bicycling and walking are important forms of transportation that hold substantial benefits over other modes in terms of cost, environmental sustainability, health impacts, and safety. The state of North Carolina (referred to henceforth as "the state") and the state of North Carolina Department of Transportation (NCDOT) recognize that creating a state that is more bicycle and pedestrian friendly is beneficial not just to individual residents, but to local communities and to the state as a whole as well.

Accordingly, NCDOT recently changed its mission statement to "Connecting people and places safely and efficiently, with accountability and environmental sensitivity to enhance the economy, health and well-being of North Carolina." By including health and well-being in its mission statement, NCDOT is recognizing that transportation is more than just getting from one place to another, but also has a measurable effect on quality of life.



Source: Robert Ariail (2009) ▲

In this Chapter

In this spirit, NCDOT has commissioned a Pedestrian and Bicycle Master Plan ("the Master Plan") for the state. The document will include both plans for improving current greenways and other bicycle and pedestrian infrastructure, and for creating and maintaining new bicycle and pedestrian facilities.

An important component of its Master Plan is the promotion of policies and investments that have a positive economic impact on the state. This appendix considers the following categories of economic impact:

1. The economic impact of upfront construction of the bicycle and pedestrian infrastructure, which translates into a one-time stimulus of economic activity and job creation during the construction period;
2. The economic impact of ongoing use of the bicycle and pedestrian infrastructure. This impact comes largely in the form of tourism that is attracted to the state by the existence of the infrastructure. Tourism attractions bring in purchasing power from outside the state to support economic activity and employment within it;
3. The direct use value enjoyed by users of the bicycle and pedestrian infrastructure;
4. The health care cost reduction from increased active living resulting from the newfound access to a recreational amenity;
5. The commuting gains that will occur as commuters opt for biking or walking to and from work or school, thereby reducing road congestion, including the safety impact of additional dedicated pathways that remove bicyclists and pedestrians from shared roads, thus lowering automobile accidents; and the personal cost savings from cheaper alternative transportation modes.

CASE STUDY

The Swamp Rabbit Trail

The Greenville Hospital System Swamp Rabbit Trail (SRT) is a 17.5 mile recreational trail running along the Reedy River in Greenville, South Carolina. The SRT, which opened in 2009, was created to provide residents with active recreation opportunities, offer a non-motorized commuting option, and promote economic activity.

An estimated 359,000 people use the SRT annually. Businesses near the trail reported increases in sales ranging from 30% to 85% as a result of increased business from visitors to the trail. One business decided to open as a result of the trail's construction, and another relocated to the site and saw a 30% increase in sales as a result. A third business reported that 75% of Saturday business and 40% of weekday business could be attributed to the trail (Reed 2012).

Economics

State of North Carolina Mode Shares for Walking and Bicycling as Compared to Top Five States and Neighboring States

Rank	State	Walk Commute Mode Share	Rank	State	Bike Commute Mode Share
1	Alaska	8.2%	1	Oregon	2.1%
2	New York	6.3%	2	Montana	1.3%
3	Vermont	6.2%	3	Colorado	1.2%
4	Montana	5.1%	4	Idaho	1.2%
5	Hawaii	4.7%	5	Wyoming	1.1%
-	United States	2.9%	-	United States	0.5%
32	Virginia	2.4%	34	Virginia	0.3%
42	South Carolina	1.9%	37	South Carolina	0.3%
44	North Carolina	1.8%	40	North Carolina	0.2%
49	Tennessee	1.4%	48	Tennessee	0.1%

Source: US Census Bureau (2011)

6. The property value impact associated with people's willingness to pay a premium to be located near such an outdoor amenity, which translates into wealth gains for property owners and increased property tax revenues for local governments.

The scale of these economic impacts can be estimated using a variety of industry standard techniques. As this approach is prospective rather than retrospective in nature, and as a number of impacts are difficult to quantify in precise terms, a number of predicted economic benefits must be made and results should be considered rough approximations. All predicted economic benefits are designed to be conservative so as not to overstate impacts.

For the purposes of this report, it is assumed that plans for the expansion of bicycle and pedestrian infrastructure will result in the construction of 300 miles of new greenway trails. Should plans result in more or less expansion,

The Virginia Creeper Trail

The Virginia Creeper Trail (VCT) is a 34.3 mile recreational trail in southwestern Virginia. The rail-to-trail project, completed in 1984, was developed through a public-private partnership and is maintained by federal, state, and local government agencies, as well as volunteers and private organizations.

One study found the individual net economic value for recreational use of the VCT to be between $23 to $38 per person per trip. All local and nonlocal visitors spend approximately $2.5 million in the region in per year.

Of this spending, tourists visiting the VCT from outside the study region (Washington and Greyson counties) spend about $1.2 million annually in direct spending, generating $1.6 million in total spending (Bowker 2004, Bowker 2007). An estimated 10,305 overnight visitors and 40,034 day visitors per¬ year come for the primary purpose of using the trail. Nonlocal users traveled an average of 260 miles.

When asked to rank the benefits they receive from using the VCT, users ranked "health and fitness" as the most important, followed by "opportunity impact estimates should be sized upward or downward accordingly.

We believe this is a reasonable estimate based on plans already in place, through which anticipated spending on bicycle and pedestrian infrastructure is far exceeding any previous investment levels.

Furthermore, as of the 2010 Census, the state ranks 40th among all states for bicycle commute share and 44th for walking mode share. Simply meeting national averages would mean more than a doubling of bicycle commuters and over a 50 percent increase in the number of walking commuters. In fact, over the long range, it is suggested that the state aspire to a walk mode share of 3 percent and a bicycle mode share of 2 percent. Meeting this goal would represent a significant increase in the amount of walking and bicycling taking place within the state, in excess of the example increases assumed throughout this report.

Suggested Future Goal Ranges for State of North Carolina Mode Shares for Walking and Bicycling

Commute Mode Share	Current (2010)	Low / Short-Term Goal	Med / Medium-Term Goal	High / Long-Term Goal
Walk	1.8%	2.0%	2.5%	3.0%
Bicycle	0.2%	0.5%	1.0%	2.0%

▲ *Source for current mode share: US Census Bureau (2010)*

Economic Impact from Upfront Construction of Bicycle and Pedestrian Infrastructure

Overview

There is a growing realization and appreciation of the significant economic stimulus that results from large-scale physical improvement projects such as the construction of pedestrian and bicycle infrastructure. These projects create immediate construction employment opportunities, resulting in large amounts of initial expenditures whose economic impact ripples through entire local and regional economies, creating jobs within a region and generating tax revenues for the local jurisdictions within that region. This is particularly helpful at a time of slack construction demand, high unemployment, and distressed fiscal conditions.

Predicted Economic Benefits

Project costs for the initial construction and renovation of greenways are not known at this juncture, since decisions have not yet been made as to how much and where such amenities will be built, and to what level of quality. Therefore, two sets of predicted economic benefits must be made:

1. How many new greenway miles will be built? It is assumed that this Plan will result in the construction of 300 new miles of trails.
2. How much will construction cost? Per mile construction costs were assumed to approximate those of other, similar projects. Based on a review of other trails, a cost estimate of approximately $280,000 per mile was used.[1]

Economic Impact

Three hundred miles of new greenways in the state, at $280,000 in construction costs per mile, results in about $84 million in new construction. To estimate the total economic impact associated with this amount of upfront construction, a standard input-output model was developed. Multiplier data provided by the US Department of Commerce were used to calculate the composition and scale of total expenditures, employment, and earnings resulting from the aggregate direct expenditures from trail construction.[2]

Based on this model, it appears that economic impact

Estimated Total One-Time Upfront Economic Impact Resulting from Construction of New Bicycle and Pedestrian Infrastructure within the State of North Carolina

	State of North Carolina
Direct Expenditures ($M)	*$84*
Indirect Expenditures ($M)	*$89*
Total Expenditures ($M)	*$174*
Total Employees	*1,600*
Total Earnings ($M)	*$55*
Total Tax Revenues ($M)	*$1.7*

◀ *Source: US Department of Commerce (2011), Econsult Corporation (2012)*

from construction within the state will be significant. It is estimated that construction spending will generate about $174 million in total expenditures, supporting about 1,600 jobs within the state and jobs and generating about $2 million in tax revenues for the state.[3]

Economic Impact from Ongoing Use of Bicycle and Pedestrian Infrastructure

Overview

In addition to upfront construction impacts, bicycle and pedestrian infrastructure will also create annual economic impacts through its continued operations, particularly as it draws in tourists to the state. Tourism is an important engine of economic growth: visitors spend money on hotels, transportation, dining, and entertainment, and therefore represent the use of outside purchasing power to support local businesses and governments. Therefore, it is important to consider the tourism impact of a major recreational amenity such as bicycle and pedestrian greenways.

Predicted Economic Benefits

Literature shows that additions and improvements to bicycle and pedestrian infrastructure will increase the number of outside tourists visiting a region. However, it is unknown at this time how much additional tourism activity will result from the additions to the state's inventory of bicycle and pedestrian infrastructure. For now, it is assumed that current tourism associated specifically with bicycle and pedestrian activity will increase by 40 percent: 20 percent from the addition of more greenways, and 20 percent from increased connectivity, improved activities, and enhanced promotion of existing greenways. Should actual tourism activity vary from this estimate, the results reported here can be adjusted upward or downward.

New Visitor Spending

A literature review was conducted in order to better understand the impact of bicycle and pedestrian infrastructure on tourism.[4] Of the approximately 23 million overnight visitors who came to the state in 2011[5], many participated in activities relating to biking or walking. Thus, biking and walking-related tourism represent an important sector of the state's tourism industry.

Estimated Number of Out-of-State Overnight Visitors Who Participated in Bicycle or Pedestrian Activities within the State of North Carolina in 2011

Activity	% of Out-of-State Tourists	# of Out-of-State Tourists (in M)
Rural sightseeing	12.9%	3.01
State/national park	8.6%	2.00
Urban sightseeing	7.4%	1.72
Wildlife viewing	5.8%	1.35
Hiking/ backpacking	3.9%	0.91
Bird watching	2.9%	0.68
Nature travel/ ecotouring	2.7%	0.63
Biking	2.0%	0.47

Source: VisitNC.com (2011), Econsult Corporation (2012); Bottom row: Considered in Estimating Aggregate Tourism Activity on Bicycle and Pedestrian Infrastructure.

To be conservative, and because it is difficult to determine which of the pedestrian-related activities occur as a result of specific pedestrian and bicycle infrastructure, it is assumed that 12 % of all out-of-state tourists participated in bicycle and pedestrian activities. This is lower than the sum of all pedestrian and bicycle activities. However, because survey respondents were permitted to select multiple activities, there is likely to be some overlap. Six percent of all out-of-state overnight visitors is equivalent to 2.76 million people.

How much new out-of-state visitor spending is generated by investment in pedestrian and bicycle infrastructure is a function of two additional variables, for which conservative predicted economic benefits are used to arrive at a preliminary estimate. First, it is assumed that investment in bicycle and pedestrian infrastructure increases the number of pedestrian and bicycle tourists by 40 percent, as stated above. Second, it is assumed that these tourists represent $60 per day in spending, based on data from prior studies.[6] This yields an additional $68 million in out-of-state visitor spending as a result of investment in bicycle and pedestrian infrastructure.

These estimates could very well end up being far too conservative. In 2011, the state saw 37 million overnight visitors, who spent an aggregate $17 billion. A $68 million increase in visitor spending therefore represents an increase of only 0.4 percent. As new bicycle and pedestrian infrastructure comes into existence, the state may have a better understanding of the new purchasing power it is able to attract as a result.

Estimated Increase in Out-of-State Spending Resulting from Investment in Bicycle and Pedestrian Infrastructure within the State of North Carolina

# Current Bicycle/ Pedestrian Tourists	% Increase in # Bicycle/ Pedestrian Tourists	# New Bicycle/ Pedestrian Tourists	Avg. Spending per Bicycle/ Pedestrian Tourist	Aggregate Spending by New Bicycle/ Pedestrian Tourists
2.8 million	40%	1,120,000	$60	$68 million

Source: North Carolina Division of Tourism, Film, and Sports Development (2011), Econsult Corporation (2012)

Economic Impact

The economic impact of this level of new spending can be modeled using the same methodology and model described in the previous section. Based on the predicted economic benefits used above, it is estimated that investment in pedestrian and bicycle infrastructure will result in about $128 million in new expenditures each year, supporting about 1,600 new jobs within the state and generating about $1 million in tax revenues for the state.

Additional Considerations

This estimate of tourism spending conservatively analyzes only out-of-state visitors. However, bicycle and pedestrian facilities will also attract in-state visitors who would otherwise have left the state for bicycling and walking activities. Additionally, pedestrian and bicycle facilities can cause economic activity to concentrate in certain areas rather than being distributed around the state, resulting in additional gains from agglomeration.

This analysis is also conservative in that it only considers net new expenditures from leisure visitors. This neglects the potential economic impact from new business activity that is attracted by bicycle and pedestrian infrastructure. Such outdoor amenities are increasingly considered by both employers and employees in their locational decisions, so investment in bicycle and pedestrian infrastructure could very well yield additional business attraction, retention, and expansion within the state. [7] Studies have also shown that bicycle and pedestrian infrastructure is economically beneficial to commercial corridors and retail centers, by increasing foot traffic and accessibility and by improving the aesthetics of a location. [8]

Estimated Annual Economic Impact Resulting from Increased Out-of-State Bicycle/Pedestrian Tourism within the State of North Carolina

	State of North Carolina
Direct Expenditures ($M)	$68
Indirect Expenditures ($M)	$60
Total Expenditures ($M)	$128
Total Employees	1600
Total Earnings ($M)	$36
Total Tax Revenues ($M)	$1.1

Source: US Department of Commerce (2011), Econsult Corporation (2012)

Economic Impact of Direct Use Value of Bicycle and Pedestrian Infrastructure

Overview

Recreational amenities like pedestrian and bicycle infrastructure are designed to facilitate enjoyable activities such as jogging, hiking, and bicycling. Little or no money exchanges hands when a person uses a greenway for recreation, but this person still derives significant personal benefits, which economists call "consumer utility" and which can be quantified using "willingness to pay" surveys. These surveys ask respondents how much they would be willing to pay to participate in an activity, thereby allowing an average direct use value to be assigned to that activity[9].

The most accepted "willingness to pay" estimates of direct use value are based on surveys conducted by the US Army Corps of Engineers, which publishes "Unit Day Values" of a variety of recreational activities. The implementation of pedestrian and bicycle infrastructure within the state is likely to lead to a significant increase in the number of recreational users and recreational uses, and therefore confers benefit to those users, on which an estimated aggregate value of their consumer utility can be placed.

Predicted Economic Benefits

It is unknown how much new recreational activity will be generated by investment in bicycle and pedestrian infrastructure, since decisions about how much and where to build have not yet been made. For now, it is assumed that recreational activity will increase by 40 percent. This is not inconsistent with increases in recreational use seen when other greenways were constructed[10].

Base Amount of Recreational Activity

Literature shows that an increase in bicycle and pedestrian infrastructure will lead to an increase in users in bicycle and pedestrian activities. It is unknown at this time how much additional recreational activity will result from the implementation of the bicycle and pedestrian facilities, but one way to forecast this amount is to estimate the current base of recreational activity, and then to assign some percentage increase in that recreational activity that results from the implementation of the trail.

Bicycle and walking activities are already popular among residents of the state, with 82 percent of the population reporting that they walk for pleasure. Multiplying through by the average number of uses per year and by Unit Day Values yields a very high aggregate amount of direct use value derived from various outdoor recreational activities: 2.65 billion uses per year, totaling $4.5 billion.

Of course, not all outdoor recreation activities involve walking or bicycling, and not all walking and bicycling occurs on pedestrian and bicycle infrastructure. It is assumed that walking for pleasure, bicycling, day hiking, and running or jogging are the only four activities that will increase with the addition of the state's improved bicycle and pedestrian infrastructure. Furthermore, it is estimated that of the total amount of these activities, only 25 percent of the total uses occur on pedestrian and bicycle infrastructure. Based on these predicted economic benefits, it is estimated that pedestrian and bicycle infrastructure is responsible for about 250 million uses and about $570 million in direct use value per year.

Estimated Aggregate Value Derived by Residents of the State of North Carolina per Year from Participation in Selected Outdoor Recreation Activities

Activity	% of Population that Participates	Total # Users (M)	Avg. # Uses/Yr	Total # Uses (M)	Unit Day Value	Total Unit Day Value ($M)
Walk for pleasure	82%	7.9	68.4	542	$1.47	$796
View/photo natural scenery	57%	5.5	45.9	253	$1.32	$334
Visit nature centers, etc.	53%	5.1	45.9	234	$1.47	$345
Sightseeing	53%	5.1	45.9	234	$1.32	$310
Visit historic Sites	43%	4.2	45.9	191	$1.32	$252
View/photo other wildlife	43%	4.2	45.9	191	$1.32	$252
View/photo wildflowers, trees	41%	4.0	45.9	182	$1.32	$240
View/photograph birds	34%	3.3	45.9	151	$1.32	$199
Bicycling	31%	3.0	35.3	106	$3.16	$334
Visit a primitive area	30%	2.9	45.9	132	$1.32	$174
Day hiking	30%	2.9	45.9	132	$3.16	$416
Running or jogging	28%	2.7	81.7	223	$3.25	$726
Visit archeological sites	18%	1.7	45.9	80	$1.32	$105
Total				**2,650**		**$4,482**

Source: North Carolina Division of Parks and Recreation (2009), Ohio Department of Natural Resources (2001), US Army Corps of Engineers (2010), Econsult Corporation (2012)

Economic Impact

Given this set of predicted economic benefits concerning base use of existing bicycle and pedestrian infrastructure, it is estimated that further investment will yield significant additional activity and therefore recreational benefit. A 40 percent increase in recreational activity would mean 100 million more uses and $230 million more in direct use value per year.

Health Care Cost Reduction from Increased Activity from Bicycle and Pedestrian Infrastructure

Overview

Walking and bicycling – whether for commuting or leisure – are physical activities that can have positive health effects on the bicyclists and pedestrians. This can in turn reduce the amount of money that is spent on health care by bicyclists and pedestrians, and by the health care pools of which they are a part. Health problems due to inactivity

Estimated Aggregate Value Derived by Residents of the State of North Carolina per Year from Participation in Selected Outdoor Recreation Activities Taking Place on Bicycle and Pedestrian Infrastructure

Source: North Carolina Division of Parks and Recreation (2009), Ohio Department of Natural Resources (2001), US Army Corps of Engineers (2010), Econsult Corporation (2012)

Activity	Total # Uses (M)	Total # Uses (M) Bicycle/ Pedestrian Infrastructure Only	Total Direct Use Value ($M)	Total Direct Use Value ($M) Bicycle/ Pedestrian Infrastructure Only
Walk for pleasure	542	135	$796	$199
Bicycling	106	26	$334	$83
Day hiking	132	33	$416	$104
Running or jogging	223	56	$726	$181
Total	**1,002**	**251**	**$2,272**	**$568**

Increase in Estimated Aggregate Value Derived by Residents of the State of North Carolina per Year from Participation in Selected Outdoor Recreation Activities as a Result of Investment in Bicycle and Pedestrian Infrastructure

Activity	Current # Uses (M)	Increase in # Uses (M)	Current Direct Use Value ($M)	Increase in Direct Use Value ($M)
Walk for pleasure	135	54	$199	$80
Bicycling	26	10	$83	$34
Day hiking	33	14	$104	$42
Running or jogging	56	22	$181	$72
Total	**251**	**100**	**$568**	**$228**

Source: North Carolina Division of Parks and Recreation (2009), Ohio Department of Natural Resources (2001), US Army Corps of Engineers (2010), Econsult Corporation (2012) are a common and growing problem in the US, and health care costs are expanding significantly. Outdoor amenities are helpful in promoting moderate physical activity. Even minor changes in daily habits can make a difference in health outcomes, with significant impacts on health care cost burdens. Preventative active living results in lower rates of hospital visits due to lower rates of obesity, chronic disease, and asthma.

Existing Literature

There is a substantial body of literature connecting access to recreational amenities to increased active living, and increased active living to improved health outcomes and to lower health care costs[11]. Health care cost reductions take place in at least five categories:

1. Direct health care costs – The amount spent immediately as a result of short-term health care needs.
2. Indirect health care costs – The amount spent over a lifetime as a result of reduced risk of chronic illness.
3. Direct worker's compensation costs – The direct amount spent on worker's compensation claims.
4. Indirect worker's compensation costs – The indirect administrative amount spent on worker's compensation claims.
5. Worker productivity – The cost of absenteeism (unhealthy and not at work) and "presenteeism" (unhealthy and present at work but not fully functioning).

A conservative aggregation of the existing literature on this issue suggests that the per person cost reduction associated with active living is about $3,000, when considering all of these health care cost reduction categories.

Predicted Economic Benefits

New pedestrian and bicycle infrastructure is particularly impactful in generating new exercisers from the population of people who live near the new infrastructure, since their barriers to active recreation have been lowered so dramatically as a result of the new amenities. However, since it is currently unknown how much new investment in pedestrian and bicycle infrastructure is being planned and where it will be located, it is difficult to predict the number of new exercisers that will result from such investments.

For now, one can make a preliminary assumption and then revise these results once actual increases in recreational activity can be measured. Consider first that 82 percent of residents of the state currently walk for pleasure. If one assumes that of the remaining 18 percent who do not, investment in bicycle and pedestrian infrastructure will result in just two percent of them taking up active recreation, this represents 26,000 new exercisers out of the state's adult population of 7.4 million people.

Conservative Estimate of Health Care Cost Savings Each Year within the State of North Carolina As a Result of Physical Activity

Health Care Cost Category	Per Person Health Care Cost Savings
Direct Health Care Cost Reductions	*$308*
Indirect Health Care Cost Reductions	*$924*
Direct Worker Compensation Cost Reductions	*$9*
Indirect Worker Compensation Cost Reductions	*$24*
Total	***$2,895***

▲ *Source: Pratt et al (2000), SMART BRFSS (2010), Chenoweth (2005), Chenoweth and Bortz (2005), Census Bureau (2009), Econsult Corporation (2012)*

Economic Impact

Multiplying this number by the low-end estimates of cost impacts for each of the five health care cost reduction categories conservatively yields an estimated health care cost reduction impact of about $76 million per year as a result of the expansion of North Carolina bicycle and pedestrian infrastructure. Should investment in bicycle and pedestrian infrastructure induce additional exercisers, or should health care costs rise higher, the health care cost reduction impacts would be even greater.

Commuting Gains from Bicycle and Pedestrian Infrastructure

Overview

Several studies have shown that the introduction of bicycle or pedestrian infrastructure can influence the commuting mode choice of local residents; this has also been shown to be effective for school-related trips, when safety is a particular priority[12]. There are many economic benefits, such as those achieved through environmental and personal health improvements, associated with replacing short car trips with other modes of transportation. More than 80 percent of North Carolina residents currently drive to work alone. Most others carpool or work from home. Only 1.8 percent of residents report walking to work, and less than 0.2 percent bicycle to work[13]. This equates to a total of approximately 81,000 residents who currently walk or bike to work, out of an adult worker population of 4.2 million.

The change to active commuting results in various benefits for those switching to the new mode of commuting, including improved health and safety. Additionally, this change leads to reduced fuel and automobile maintenance spending and can even aid other commuters by reducing road congestion.

Estimated Number of New Exercisers within the State of North Carolina as a Result of Investment in Bicycle and Pedestrian Infrastructure

Adult Population in the State of North Carolina	% Who Do Not Walk for Pleasure	% Who Begin to Exercise as a Result of Bicycle/ Pedestrian Infrastructure	# New Exercisers as a Result of Bicycle/Pedestrian Infrastructure
7.4 Million	18%	2%	26,000

Source: US Census Bureau (2012), North Carolina Division of Parks and Recreation (2009), Econsult Corporation (2012)

Estimated Number of New Exercisers within the State of North Carolina as a Result of Investment in Bicycle and Pedestrian Infrastructure

# New Exercisers as a Result of Bicycle/ Pedestrian Infrastructure	Per Person Health Care Cost Savings	Aggregate Health Care Cost Savings as a Result of Bicycle/Pedestrian Infrastructure
26,000	$2,895	$76 million

Source: US Census Bureau (2012), North Carolina Division of Parks and Recreation (2009), Econsult Corporation (2012)

Predicted Economic Benefits

This analysis assumes that statewide investments in bicycle and pedestrian facilities will result in a 40 percent increase in the number of residents walking or biking to work through improved accessibility and connectivity. This 40 percent increase is equivalent to roughly 32,000 people[14].

These mode shifts result in fewer car miles driven. It is assumed that half of these commuters would switch from driving (i.e. switching results in less car miles driven), while the other half would switch from some form of public transportation or else from carpooling (i.e. switching does not result in less car miles driven).

It is further assumed that the average new bicycle commuter is traveling 3.5 miles each way, and that the average new pedestrian commuter is traveling 0.7 miles each way, as per the state's current average distances traveled by mode of transportation. This equates to an aggregate 4.9 million fewer car miles not driven.

Economic Impacts – Lower Emissions, Decreased Gasoline Consumption, Reduced Congestion

There are three immediate positive economic impacts that result from reducing car miles driven[15]. First, reducing car miles driven reduces harmful emissions by cars. According to industry averages for emissions per car mile driven and externality costs per pollutant, reducing car miles driven by 4.9 million results in about $150,000 in total benefits per year.

Second, reducing car miles driven reduces the amount of gasoline consumed. According to industry averages, reducing car miles driven by 4.9 million results in about $800,000 less in gasoline purchased and about 12,000 fewer barrels of oil consumed.

Average Distance Traveled to Work within the State of North Carolina, by Mode of Transportation

Mode of Transportation	Distance from Home to Work
Automobile	17.2
Bus	19.8
Train/subway/trolley	11.4
Bicycle	3.5
Walk	0.7

Source: National Household Travel Survey (2009), Econsult Corporation (2012)

Third, reducing car miles driven reduces congestion for all other drivers. According to the Texas Transportation Institute, the Raleigh-Durham urban area, where about 6.3 billion car miles are driven each year, experienced 19 million hours of travel delay in 2011, wasting 6.6 million gallons of gasoline and resulting in $418 million in congestion costs. Applying these proportions to the state as a whole yields a total congestion costs avoided per year of about $325,000[16].

A reduction in car miles can also lead to economic benefits through reducing the amount of wear and tear on roads and thereby reducing government infrastructure repair spending, allowing these funds to be spent elsewhere. However, these gains are deemed too insubstantial to be included in this analysis. Road deterioration is caused primarily by weather patterns (i.e. the freeze-thaw cycle of seasons) and by heavy trucks, not passenger vehicles, which would not be affected by bicycle and pedestrian infrastructure expansion.

Estimated Reduction in Car Miles Driven as a Result of Increased Bicycle and Pedestrian Commuting in Response to Investment in Bicycle and Pedestrian Infrastructure within the State of North Carolina

	Bicycle Commuters	Pedestrian Commuters	Total
Current # Commuters	9,000	72,000	81,000
% Increase as a Result of Bicycle/Pedestrian Infrastructure	40%	40%	40%
New # Commuters	3,600	28,800	32,400
Avg Distance Traveled (miles)	3.5	0.7	
Aggregate Distance Traveled per Day by New Commuters	25,200	40,320	65,520
Work Days/Year	150	150	
Total Aggregate Distance Traveled per Year by New Commuters	3,780,000	6,048,000	9,828,000
% New Commuters Shifting from Driving	50%	50%	
Reduction in Car Miles Driven	**1.9 Million**	**3 Million**	**4.9 Million**

Source: National Household Travel Survey (2009), Econsult Corporation (2012), US Census Bureau (2011)

Economic Impacts – Increased Safety, Reduced Accidents

Investment in pedestrian and bicycle infrastructure has a threefold effect on commuter safety. First, current pedestrian and bicycle commuters will be safer using dedicated pedestrian and bicycle roadways: studies have shown that marked bike lanes can reduce crash rates by 50 percent when compared to unmarked roads[17], while separated walking infrastructure can also reduce the rate of non-intersection pedestrian accidents by 88 percent[18]. Second, current car commuters who switch to walking and bicycling will avoid the possibility of getting into car accidents. Third, the increased number of pedestrian and bicycle commuters will lead to greater awareness of pedestrians and bicyclists by car drivers on shared roadways.

A recent study found that each mile shifted from motorized transportation to non-motorized transportation resulted in 4 cents in safety benefits[19]. This means that 4.9 million miles shifted from car driving to bicycling or walking generates about $200,000 in annual safety benefits.

Estimated Externality Cost Avoided from Pollutants Not Emitted as a Result of Fewer Car Miles Driven Due to Increased Bicycle and Pedestrian Commuting in Response to Investment in Bicycle and Pedestrian Infrastructure within the State of North Carolina

Pollutant	Grams per Car Mile Driven	Total Pollution Avoided (Tons)	Externality Cost per Ton	Total Externality Cost ($000)
CO_2	365	1,977	$21	$42
SO_2	0.02	0.1	$2,370	$0
CO	9.5	51.5	$1,280	$66
NOX	0.8	4.3	$9,685	$42
VOC	0.28	1.5	$9,040	$14
PM10	0.11	0.6	$6,460	$4
Total				**$167**

▲ *Source: Bureau of Transportation Statistics (2009), Energy Information Agency (2010), University of California at Berkeley (2008), Air Pollution Modeling and Its Application XII (1998), Econsult Corporation (2012)*

Estimated Gasoline and Oil Not Consumed as a Result of Fewer Car Miles Driven Due to Increased Bicycle and Pedestrian Commuting in Response to Investment in Bicycle and Pedestrian Infrastructure

Car Miles Not Driven	**4.9 Million**
Average Fuel Efficiency (miles per gallon)	22.5
Gallons of Gasoline Not Used	**220,000**
Average Price of Gasoline (per gallon)	$3.71
Total Amount Not Spent on Gasoline ($M)	**$800,000**
Gallons of Gasoline Produced per Barrel of Oil	18.56
Total Barrels of Oils Not Consumed	**11,750**

▲ *Source: Bureau of Transportation Statistics (2009), Energy Information Agency (2010), University of California at Berkeley (2008), Air Pollution Modeling and Its Application XII (1998), Econsult Corporation (2012)*

Property Value Impact from Bicycle and Pedestrian Infrastructure

Overview

Pedestrian and bicycle infrastructure represents a desirable recreational amenity. Proximity to such infrastructure is increasingly characterized by increasing house values, as people are willing to pay a premium to be near such amenities, regardless of whether they plan to use them. Thus, recreational amenities such as bicycle and pedestrian infrastructure are seen as value-enhancing to nearby properties.

The economic benefit of investing in bicycle and pedestrian infrastructure, from a property value standpoint, is twofold. First, such investments tend to increase nearby property values, therefore generating household wealth. Second, to the extent that these increased property values are properly accounted for in property assessments, they then result in additional annual property tax revenues to municipalities and school districts.

Existing Literature

A more extensive and direct calculation of the property value impact of the introduction of the North Carolina bicycle and pedestrian infrastructure system on its immediate surroundings is beyond the scope of this report, especially since the exact location of new investments are not yet known. However, there is a growing body of literature, including numerous studies conducted by Econsult, that provides some guidance as to the magnitude of property value impact associated with investment in bicycle and pedestrian infrastructure, and off-street greenways in particular. The literature suggests that the property value impact of new greenways on nearby residential properties is something on the order of an additional 4 to 7 percent.

In contrast, investment in roadways for cars is often associated with lower property values, although one must be careful to necessarily assign causality, since the larger rights-of-way needed for roads for cars often means they are sited in lower-valued areas. At the very least, a subset of the studies that have looked at the property value impact of greenways in urban areas have accounted for situations in which bicycle and pedestrian infrastructure has come at the expense of reducing roadway space for cars. In other words, in such cases, any loss associated with decreased car mobility has been more than offset by the gains associated with increased bicycle and pedestrian mobility.

Predicted Economic Benefits

Since it is yet uncertain as to the existence and distribution of new greenway infrastructure such as access points, vista points, and other amenities that may have an influence on property values, we are only able to make a rough estimate of property value impact at this time. To be conservative, it is assumed that the implementation of the new state's bicycle and pedestrian facilities will result in a one-time 4 percent increase in the value of properties located within a ¼-mile of the new infrastructure[20].

To arrive at an estimate of the number of homes that will fall within a ¼-mile of new greenways, a number of conservative estimates were made. First, the statewide housing density of 80 houses per square mile was assumed[21]. Second, the smallest possible area within a ¼-mile radius of the assumed 300 miles of new greenways was assumed, which is an area of about 150 square miles[22]. This yields about 12,000 houses. At an average house value of about $130,000, there is about $1.6 billion in aggregate house value within a ¼-mile radius of the assumed 300 miles of new greenways.

Economic Impact

Investment in new bicycle and pedestrian infrastructure is likely to have a significant impact on property values and on property tax revenues. Based on the conservative predicted economic benefits above, and assuming a one-time 4 percent increase in the value of properties located within a ¼-mile of the new greenways proposed in this plan, the estimated one-time increase in property value would be on the order of about $64 million. Conservatively

Summary of Relevant Studies on the Property Value Impact of Trails, Parks, and Other Green Space[1]

See resources at the end of this appendix for a more detailed version of this table

Source	Estimated Property Value Impact
"A Dynamic Approach to Estimating Hedonic Prices for Environmental Goods: An Application to Open Space Purchase," Riddel (2001)	+3.75%
"Quantifying the Economic Value of Protected Open Space in Southeastern Pennsylvania," Econsult Corporation (2010)	+7%
"The Economic Impact of the Catawba Regional Trail," Campbell and Monroe (2004)	+4%
"The Potential Economic Impacts of the Proposed Carolina Thread Trail," Econsult Corporation (2007)	+4%
"Valuing the Conversion of Urban Green Space," Econsult Corporation (2010)	+7.2%

▲ Source: See above

assuming a real property tax rate of 1 percent, and assuming that property value increases are properly accounted for in property tax assessments, that magnitude of property value increase would generate about $640,000 per year in new property tax revenues to various municipalities and school districts.

Estimated Aggregate House Value within the State of North Carolina That Will Be within a Quarter-Mile of New Greenways

Houses/ Sq. Mi.	Sq. Mi. within ¼-Mile	# Houses within ¼-Mile	Average House Value	Aggregate House Value within ¼-Mile
80	150	12,000	$133,000	$1.6 Billion

▲ Source: US Census Bureau (2010), Zillow.com (2012), Econsult Corporation (2012)

Conclusion

This report has discussed the many forms of economic impact that may result from an increase in the rate of bicycling and walking activity across the state and associated new investments in bicycle and pedestrian infrastructure. Specific quantifications of economic impact from investment in bicycle and pedestrian infrastructure await the actual decisions on whether, where, and to what degree such infrastructure will be implemented throughout the state of North Carolina, and how people and organizations will respond to the existence of these amenities. Nevertheless, this first approximation of the type and magnitude of economic impact suggests that there are a number of ways in which investment in bicycle and pedestrian infrastructure generates very real and very large economic returns, to the state and to its residents and businesses.

Estimated Aggregate Increase in Property Value and in Property Tax Revenue within the State of North Carolina as a Result of Investment in Bicycle and Pedestrian Infrastructure

Aggregate House Value within ¼-Mile	One-Time % Increase in Property Value	Aggregate One-Time Increase in Property Value	Real Property Tax Rate	Aggregate Annual Increase in Property Tax Revenues
$3.2 Billion	4%	$124 Million	1%	$1,240,000

▲ Source: US Census Bureau (2010), Zillow.com (2012), Econsult Corporation (2012)

Summation of Estimated Economic Impacts Associated with Investment in Bicycle and Pedestrian Infrastructure within the State of North Carolina

Economic Impact Category	Estimated Economic Impact	Beneficiaries
Economic stimulus from upfront construction	$174M supporting 1,600 jobs	The entire state economy
Economic stimulus from increased tourism activity	$128M supporting 1,600 jobs	The entire state economy
Direct use value from usage of bicycle and pedestrian infrastructure	$228M in new direct use value	State residents who use the new bicycle and pedestrian infrastructure
Health care cost reduction from usage of bicycle and pedestrian infrastructure	$76M in health care cost reduction	State residents who use the new bicycle and pedestrian infrastructure, and the health care cost pools they are a part of
Commuting gains from increased usage of bicycle and pedestrian infrastructure	4.9M fewer car miles driven, $167,000 in emissions cost avoidance, $800,000 not spent on gasoline, $325,000 in congestion cost avoidance	Drivers within the state, as well as the state as a whole
Property value gains from proximity to bicycle and pedestrian infrastructure	$64M one-time increase in property value, $640,000 annual increase in property tax revenues	Property owners, municipalities and school districts

▲ Source: Econsult Corporation (2012)

Resources for Further Information

Additional Detail on Construction Costs Per Mile for Other, Similar Bicycle and Pedestrian Infrastructure Projects

Source: North Carolina Division of Parks and Recreation (2009), Ohio Department of Natural Resources (2001), US Army Corps of Engineers (2010), Econsult Corporation (2012)

Construction Costs per Mile for Other Similar Bicycle and Pedestrian Infrastructure Projects

Study	Author	Location	Year	# Miles	Construction Cost	Cost per Mile
Ecusta Rail-to-Trail Economic Impact Analysis	Econsult Corporation	Hendersonville, NC	2012	20.3	$13,000,000	$640,394
The Economic Impact of Investments in Bicycle Facilities: A Case Study of the Northern Outer Banks	Institute for Transportation Research and Education North Carolina State University	Outer Banks, NC	2004	55.75	$6,727,303	$120,669
The Potential Economic Impacts of the Proposed Catawba Thread Trail	Econsult Corporation	North Carolina	2007	500	$100,000,000	$200,000
Coastal Georgia Greenway Market Study and Projected Economic Impact	Armstrong Atlantic State University	Georgia	2003	150	$28,800,000	$192,000
The Piedmont Greenway	The Piedmont Land Conservancy	Greensboro, NC	2007	28	$7,200,000	$257,143
Average					**$31,145,461**	**$282,041**

Economics

Economic and Fiscal Impact Model Theory

History

The theory behind input-output modeling stretches as far back as the mid 17th century, when Sir William Petty described the interconnectedness of “production, distribution, and wealth disposal.” While Perry can be credited with noticing links between economies, input-output modeling did not begin to take true form until the mid 18th century, when French physician François Quesnay created the Tableau Économique. His work detailed how a landowner spends his earnings on goods from farms and merchants, who in turn spend their money on a host of goods and services. Over the course of the century, an algebraic framework was added by Achille-Nicholas Isnard. Robert Torrens and Léon Walras refined the model by establishing the connections between profits and production.

The modern input-output system can be attributed to Wassily Leontief. In his thesis, “The Economy as a Circular Flow” (1928), he outlined the economy as an integrated system of linear equations relating inputs and outputs. This framework soon gained popularity, and became a widely accepted analytical tool. In 1936, Leontief produced the first input-output analysis of the US. Leontief’s work became the US Department of Commerce’s Bureau of Economic Analysis’s (BEA) standard benchmark for US production in the 1950s. Leontief received a Nobel Prize for his work in 1973.

By the 1970s, the BEA had developed regional multipliers that could benchmark regional production throughout the US. Through extensive surveying, the impacts of each industry could be determined at the individual county level. These multipliers later became known as the Regional Input-Output Modeling System, RIMS. These multipliers would later be improved in the 1980s and reclassified as RIMS II multipliers. This new system soon became a trusted standard in economic impact studies. The updated RIMS II multipliers show the effect on the local economy that localized expenditures have in terms of employment, output, and earnings.

Application

The use and application of multipliers are fairly basic and intuitive. Multipliers, in their most basic form, are the result of an algebraic analysis expressing how two inputs are interconnected in the production of an output. The result of the equation generates a multiplier that is broken down into direct, indirect, and induced effects. In a generalized example: if the multiplier for good “X” to good “Y” is 3, then the direct of good “X” on “Y” is 1, with indirect and induced effects of 2. Essentially, every unit of good “X” supports 2 units of good “Y”.

When implemented on a large complex scale, such as that of the US economy or any subsection of it, multiplier effects across industries can be complicated. However, the same general concept comes into play. Each industry has largely different and varied inputs into other industries. The quantity of the output is largely decided by the scale and efficiency of the industries involved. As a result, the sum of those inputs equates to an output product plus a value added/component. By arranging these inputs and outputs by industry in a matrix, and performing some algebra to find the Leontief inverse matrix, each industry’s effect on final demand can be estimated. Additionally, the direct, indirect, and induced effects can also be determined. Direct effects include direct purchases for production, indirect effects include expenses during production, and induced effects concern the expenditures of employees directly involved with production. Using building construction as an example, the direct effects would include materials, brick, steel, and mortar, the indirect effects would involve the steel fabrication, concrete mixing, and the induced effects would consider the construction workers purchases from their wages. While impacts vary in size, each industry has rippling effects throughout the economy. By using an input-output model, these effects can be more accurately quantified and explained.

RIMS II is one of several popular choices for regional input-output modeling. Each system has its own nuances in establishing proper location coefficients. RIMS II uses a location quotient to determine its regional purchase coefficient (RPC). This represents the proportion of demand for a good that is filled locally; this assessment helps determine the multiplier for the localized region. RIMS II takes the multipliers and divides them into over 500 industry categories in accordance to the North American Industrial Classification System (NAICS) codes. A comprehensive breakdown of a region's multipliers by industry can be shown.

Despite the usefulness of input-output modeling, there are some shortcomings to the system. Notably, input-output models ignore economies of scale. Input-output models assume that costs and inputs remain proportionate through different levels of production. Further, multipliers are not generally updated on a timely basis; most multipliers are prone to be outdated with the current economy. If the multipliers are sourced from a year of a recession economy, the multipliers may not accurately represent the flows from an economic boom period. Additionally, the multipliers may not capture sudden legal or technological changes which may improve or decrease efficiency in the production process. Regardless, I-O models still serve as the standard in the estimation of local and regional impacts.

Economic Impact Model

The methodology and input-output model used in this economic impact analysis are considered standard for estimating such expenditure impacts, and the results are typically recognized as reasonable and plausible effects, based on the predicted economic benefits (including data) used to generate the impacts. In general, one can say that any economic activity can be described in terms of the total output generated from every dollar of direct expenditures. If an industry in a given region sells $1 million of its goods, there is a direct infusion of $1 million into the region. These are referred to as direct expenditures.

However, the economic impact on the region does not stop with that initial direct expenditure. Regional suppliers to that industry have also been called upon to increase their production to meet the needs of the industry to produce the $1 million in goods sold. Further, suppliers of these same suppliers must also increase production to meet their increased needs as well. These are referred to as indirect expenditures. In addition, these direct and indirect expenditures require workers, and these workers must be paid for their labor. These wages and salaries will, in turn, be spent in part on goods and services produced locally, engendering another round of impacts. These are referred to as induced expenditures.

Direct expenditures are fed into a model constructed by Econsult Corporation and based on RIMS II data. The model then produces a calculation of the total expenditure effect on the regional economy. This total effect includes the initial direct expenditure effect, as well as the ripple effects described, the indirect and induced expenditure effects.

Part of the total expenditure effect is actually the increase in total wages and salaries (usually referred to as earnings), which the model can separate from the expenditure estimates. Direct payroll estimates are fed into the "household' industry of the input-output model. Impacts of this industry are estimated using the personal consumption expenditure breakdown of the national input-output table and are adjusted to account for regional consumption spending and leakages from personal taxes and savings. The direct, indirect, and induced earnings represent a component of the total economic impact attributable to wages and salaries. Finally, the model calculates the total expenditures affecting the various industries and translates this estimate into an estimate of the total labor (or jobs) required to produce this output.

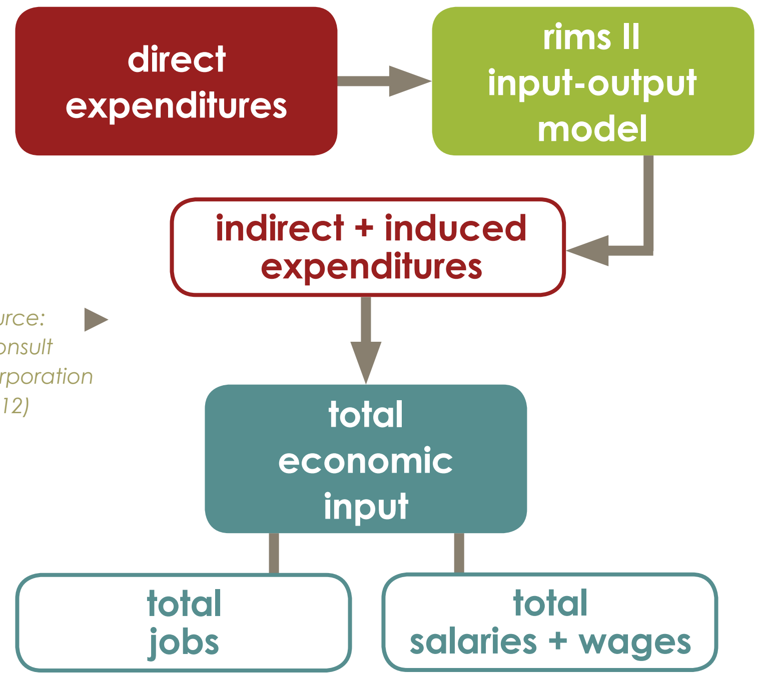
In short, the input-output model estimates the total economic activity in a region that can be attributed to the direct demand for the goods or services of various industries. This type of approach is used to estimate the total economic activity attributable to the expenditures associated with various types of spending in the region.

Fiscal Impact Model

The RIMS II model provides estimates of the economic impact of a new project or program on the regional economy. It does not, however, estimate the fiscal impact of the increased economic activity on state and local governments. Econsult has constructed a model that takes the output from the RIMS II model and generates detailed estimates of the increases in state and local tax collections that arise from the new project. Those revenues are in fact a part of the total economic impact of a new project that is often ignored in conventional economic impact analyses.

The RIMS II model provides estimates of direct, indirect, and induced expenditures, earnings, and employment within the defined region. The Econsult fiscal impact model combines the RIMS II output with the relevant tax types and tax bases associated with the jurisdiction or jurisdictions for which fiscal impact is being modeled. Specifically, the estimated earnings supported by the direct, indirect, and induced expenditures generated by the model are used to apportion the net increase in the relevant tax bases and therefore in those tax revenue categories. The resulting estimates represent the projected tax revenue gains to the jurisdiction or jurisdictions as a result of the increased business activity and its attendant indirect and induced effects.

Flowchart of Input-Output Methodology for Estimating Economic Impact



Source: Econsult Corporation (2012)

Sources

Miller, Ronald E., and Peter D. Blair. Input-output Analysis Foundations and Extensions. Cambridge, UK: Cambridge UP, 2009. Print.

Bess, Rebecca & Ambargis Zoë. "Input-Output models for Impact Analysis: Suggestions for Practitioners Using RIMS II Multipliers" Conference Proceeding, Southern Regional Science Association Conference March 2011

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Additional Detail on Estimated Tourism Impacts from Other, Similar Bicycle, and Pedestrian Infrastructure Projects

Estimated Outside Users per Mile per Year for Other, Similar Bicycle and Pedestrian Infrastructure Projects

Name	State	Length (mi)	Est. Outside Users/ Year	Est. Outside Users/ Mile/ Year	Source	Total Unit Day Value ($M)
Virginia Creeper	*Virginia*	*33.4*	*50,339*	*1,507*	*The University of Georgia*	*$796*
New River Trail	*Virginia*	*39*	*66,331*	*1,701*	*The University of Georgia*	*$334*
Little Miami Scenic Trail	*Ohio*	*72*	*150,000*	*2,083*	*OH/KY/IN Regional COG*	*$345*
Catawba	*North Carolina*	*150*	*62,000*	*143*	*Campbell & Munroe*	*$310*
The Great Allegheny Passage	*Maryland-Pennsylvania*	*141*	*500,000*	*3,546*	*Treadly. net*	*$252*

Source: various, Econsult Corporation (2012)

Literature Estimated Tourism Impacts From Other, Similar Bicycle and Pedestrian Infrastructure Projects

Title	Published By	Year	Findings
Bikeways to Prosperity: Assessing the Economic Impact of Bicycle Facilities	NCDOT	2006	4 million tourists visit the Outer Banks annually; 17% do some bicycling on their trip. This translates to approximately 680,000 annual visitors who bicycle, leading to an annual economic impact of $60 million and 1,407 jobs supported.
Economic Impact of Bicycling and Walking in Vermont	Vermont Agency of Transportation; Resource Systems Group, Inc.	2012	Visitor expenditures were obtained for over 40 major running and bicycling events in Vermont in 2009. These attracted over 16,000 participants, which supported 160 workers with $4.7 million in labor earnings.
Coastal Georgia Greenway Market Study and Projected Economic Impact	Armstrong Atlantic State University	2003	With the completion of the Georgia component of the East Coast Greenway, the Coastal Georgia Greenway (CGG), the CGG will annually add between $5 and $6.9 million to business revenue in 2015, rising to between $10.2 and $15 million in 2020.
Great Allegheny Passage Economic Impact Study	Allegheny Trail Alliance	2008	An estimated 800,000 trips are taken annually to the Passage, where the direct spending from trail users is estimated to be over $40 million, leading to $7.5 million in wages for 93 net new jobs, and a net gain of 47 new trail-related businesses.
The Outdoor Recreation Economy: Technical Report on Methods and Findings	Southwick Associates	2012	Active outdoor recreation (bicycling, trail activities, paddling, snow sports, camping, fishing, hunting, and wildlife viewing) contributes a total of $788 billion annually to the U.S. economy, supports 12.0 million jobs, and generates $197.4 billion in annual state, local, and national tax revenue.
Bicycling Means Business: The Economic Benefits of Bicycle Infrastructure	Advocacy Advance	2012	Maine's bicycle infrastructure has generated an estimated $66 million a year in tourism impacts since 2001.
Jackson Hole Trails Project Economic Impact Study	University of Wyoming	2011	Of a total of $18.1 million in economic activity generated in 2010 from the Teton County trail system, approximately $16.9 million was generated by non-local trail users.

Source: Various, Econsult Corporation (2012)

Glossary of Terms for Input-Output Models

Source: Econsult Corporation (2012)

Multiplier Effect the notion that initial outlays have a ripple effect on a local economy, to the extent that direct expenditures lead to indirect and induced expenditures.

Economic Impacts total expenditures, employment, and earnings generated.

Fiscal Impacts local and/or state tax revenues generated.

Direct Expenditures initial outlays usually associated with the project or activity being modeled; examples: one-time upfront construction and related expenditures associated with a new or renovated facility, annual expenditures associated with ongoing facility maintenance and/or operating activity.

Direct Employment the full time equivalent jobs associated with the direct expenditures.

Direct Earnings the salaries and wages earned by employees and contractors as part of the direct expenditures.

Indirect Expenditures indirect and induced outlays resulting from the direct expenditures; examples: vendors increasing production to meet new demand associated with the direct expenditures, workers spending direct earnings on various purchases within the local economy.

Indirect Employment the full time equivalent jobs associated with the indirect expenditures.

Indirect Earnings the salaries and wages earned by employees and contractors as part of the indirect expenditures.

Total Expenditures the sum total of direct expenditures and indirect expenditures.

Total Employment the sum total of direct employment and indirect employment.

Total Earnings the sum total of direct earnings and indirect earnings.

Partial Bibliography of Studies on the Connection Between Recreational Amenities, Increased Exercise, Improved Health, and Reduced Health Care Costs

"A Cost-Benefit Analysis of Physical Activity Using Bike/ Pedestrian Trails." Health Promotion Practice (2005).

"Active Commuting and Cardiovascular Disease Risk," Archives of Internal Medicine (2009).

"Cost Effectiveness of Community-Based Physical Activity Interventions," American Journal of Preventative Medicine (2008).

"Does the Outdoor Environment Matter for Psychological Restoration Gained through Running?" Psychology of Sports and Exercise (2003); "Restorative Effects of Natural Environment Experiences," Environment & Behavior (1991).

"Higher Direct Medical Costs Associated with Physical Inactivity," The Physician and Sportsmedicine (2000).

"Leisure-time Physical Activity Levels and Changes in Relation to Risk of Hip Fracture in Men and Women," American Journal of Epidemiology (2001).

"NCHS Data on Obesity," National Center for Health Statistics (2009).

"Occupational, Leisure Time, and Commuting Physical Activity in Relation to Cardiovascular Mortality among Finnish Subjects with Hypertension," American Journal of Hypertension (2007).

"Outdoor Recreation, Health, and Wellness: Understanding and Enhancing the Relationship," Resources for the Future (2009).

"Physical Inactivity Cost Calculator: How the Physical Inactivity Cost Calculator was Developed," College of Health and Human Performance (2005).

"Reduced Risk of Myocardial Infarction Related to Active Commuting: Inflammatory and Haemostatic Effects Are Potential Major Mediating Mechanisms," European Journal of Cardiovascular Prevention and Rehabilitation (2010).

"The Relative Influence of, and Interaction between, Environmental and Individual Determinants of Recreational Physical Activity in Sedentary Workers and Home Makers," University of Western Australia (1998).

"The Significance of Parks to Physical Activity and Public Health," American Journal of Preventive Medicine (2005).

"Transport and health: en route to a healthier Australia," Medical Journal of Australia (2000).

Additional Detail on the Impact of Other, Similar Bicycle and Pedestrian Infrastructure Projects on Commuting Mode Choice (following pages)

Recent Studies on the Property Value Impact of Recreational Facilities (following pages)

The Impact of Other, Similar Bicycle and Pedestrian Infrastructure Projects on Commuting Mode Choice

Title	Published By	Year	Findings
A Longitudinal Analysis of the Effect of Bicycle Facilities on Commute Mode Share	University of Minnesota	2005	Areas with facilities often already have very high bicycle commute shares compared to the other areas of Minneapolis-St. Paul. The construction of facilities led to a mode share increase from 1.7% to 2% while the rest of the region remained constant at .2%. All individual facilities studied were associated with a significant increase in bicycle mode share.
Active Transportation for America: The Case for Increased Federal Investment in Bicycling and Walking	Rails to Trails Conservancy	2008	Value of anticipated fuel savings from replacing short car trips alone = $3.5 billion under the status quo...The overall amount that could be saved on gasoline expenditure is in the range of $10 to $35 billion annually. Gives cost of bike lanes, bike racks, and sidewalks. During the course of a year, regular bicycle commuters that ride five miles to work, can save about $500 on fuel and more than $1,000 on other expenses related to driving.
If You Build Them, Commuters Will Use Them: Association between Bicycle Facilities and Bicycle Commuting	Transportation Research Record	1997	The study found that there is a positive association between miles of bicycle pathway per resident and percentage of population commuting by bicycle in 18 US cities.
Physically Active Commuting to Work – Testing Its Potential for Exercise Promotion"	Medicine and Science in Sports and Exercise	1994	The study found that people can be induced to actively commute to work. 10% of people who actively commute regularly are willing to increase their amount of active commuting, 6% of people who actively commute occasionally are willing to increase their amount of active commuting, 7% of people who do not active commute but for whom it is possible to actively commute (19% of total population) are willing to increase their level of active commuting. Programs to encourage active commuting were well received in the workplace test setting. Significant proportions of commuters were willing to switch to active commuting if provided safe passages for doing so.

▲ Source: Various, Econsult Corporation (2012)

Title	Published By	Year	Findings
The Impact of Bicycling Facilities on Commute Mode Share	*Minnesota DOT*	*2008*	*This study determines that several factors, including level of publicity, suitability of routes for commute purposes, and overall connectivity to the bicycle network, determine whether or not the creation of bicycle facilities leads to an increase in bicycle commuting.*
Barriers to Municipal Planning for Pedestrians and Bicyclists in North Carolina	*NCMJ- North Carolina Institute of Medicine and The Duke Endowment*	*2011*	*In 2009, 17% of North Carolina adults reported any walking or bicycling for transportation, and 26% reported no leisure activities or exercises during the past month, similar to the 2009 national average of 24%. North Carolina was 43rd among states for the percentage of adults who walked or bicycled for transportation, compared with the rest of the nation.*
Economic and Health Benefits of Bicycling in Iowa	*University of Northern Iowa, Iowa Bicycle Coalition*	*2011*	*There are an estimated 25,000 bicycle commuters in Iowa, who spend on average $1,160 per year for bicycle related activities. Commuter cyclist spending generates $51.9 million in direct and indirect impacts to Iowa and save Iowa $13.3 million in health care costs.*
The Social and Economic Benefits and Transportation Enhancements	*National Transportation Enhancements Clearinghouse*	*2005*	*The Marin County Bicycle Coalition began the Safe Routes to School program in 2000. In its first year, walking and biking trips to participating schools increased by 57%. In 2004, single student trips dropped by 13% among participating schools. This translates into more than 3,500 one-way trips saved every day, and an annual savings of nearly 2 million vehicle miles.*

Recent Studies on the Property Value Impact of Recreational Facilities

Amenity Being Analyzed	Estimated Effect	Source
Public greenbelt in Boulder CO	*3.75 percent increase in mean house prices resulting from preservation of open space.*	*"A Dynamic Approach to Estimating Hedonic Prices for Environmental Goods: An Application to Open Space Purchase," Riddel (2001).*
Protected open space larger than 5 acres in Philadelphia	*Homes within a quarter-mile of sites have a 7 percent premium in value, declining to 0 percent within 1 mile*	*"Quantifying the Economic Value of Protected Open Space in Southeastern Pennsylvania," Econsult Corporation (August 2010).*
Various trailways across the US	*Apex, NC: The Shepard's Vineyard housing development added $5,000 to the price of 40 homes adjacent to the regional greenway – and those homes were still the first to sell.* *Salem, OR: land adjacent to a greenbelt was found to be worth about $1,200 an acre more than land only 1000 feet away.* *Seattle, WA: Homes bordering the 12-mile Burke-Gilman trail sold for 6 percent more than other houses of comparable size.* *Brown County, WI: Lots adjacent to the Mountain Bay Trail sold faster for an average of 9 percent more than similar property not located next to the trail.* *Dayton, OH: Five percent of the selling price of homes near the Cox Arboretum and park was attributable to the proximity of that open space.*	*"The Economic Benefits of Parks and Open Space," The Trust for Public Land (2005) and "Economic Benefits of Trails and Greenways," The Rails-to-Trails Conservancy (2005).*

▲ *Source: Various, Econsult Corporation (2012)*

Amenity Being Analyzed	Estimated Effect	Source
Catawba Regional Trail in NC	*Being located within a quarter-mile of the trail conferred a 4 percent increase.*	*"The Economic Impact of the Catawba Regional Trail," Campbell and Monroe (2004).*
Pennypack Park in Philadelphia	*In the vicinity of Philadelphia's 1,300-acre Pennypack Park, property values correlate significantly with proximity to the park. In 1974, the park accounted for 33 percent of the value of land 40 feet away from the park, nine percent when located 1,000 feet away, and 4.2 percent at a distance of 2,500 feet.*	*"The Effect of a Large Urban Park on Real Estate Value," American Institute of Planning Journal (July 1974).*
Abandoned or vacant industrial sites that were converted to green space in Philadelphia	*Prior to conversion, homes within ¼ mile of an abandoned/vacant site were valued at 19.7 percent less than comparable homes that were not within a quarter-mile of an abandoned/vacant site. As a result of the announcement of conversion but prior to conversion, house prices near future converted sites had an appreciation rate that was 0.70 percent per year higher than the citywide average. Immediately following conversion to green space, homes within a ¼ mile increased in value by 7.2 percent on average, relative to comparable homes that were not proximate to such sites. In the years following conversion, homes within a ¼ mile of the site experienced an additional annual appreciation rate of 5.2 percent per year, relative to comparable homes that are not near such sites.*	*"Valuing the Conversion of Urban Green Space," Econsult Corporation (June 2010). (For Pennsylvania Horticultural Society.)*

Endnotes

1. See resources at the end of this appendix for additional detail on average construction costs per mile.

2. The economic impact model takes multiplier data from the US Department of Commerce's Regional Input-Output Modeling Systems (RIMS II) to produce estimates of the distribution of economic impact at the county and state level. See resources at the end of this appendix for a summary of Econsult's economic and fiscal impact methodology.

3. Since construction activity has a finite time period, these impacts are one-time and not ongoing in nature. This is contrasted against impacts from ongoing activities, which continue on into the future and therefore generate impacts that are ongoing and not one-time in nature.

4. See resources at the end of this appendix for additional detail on tourism impacts from other, similar bicycle and pedestrian infrastructure projects.

5. The North Carolina Department of Commerce reported 37 million visitors to the state in 2011, of which 63 percent came from outside the state.

6. "Ecusta Rail-to-Trail Economic Impact Analysis."Econsult Corporation (2012). By way of comparison, the 37 million overnight visitors to the state in 2011 represented an aggregate $17 billion in visitor spending, for a per-visitor average of $459. The lower estimate of $60 per day is used to account for the fact that many of the new out-of-state visitors generated by investment in bicycle and pedestrian infrastructure are not brand new to the state, but rather represent existing visitors spending additional time and making additional expenditures within the state as a result of the investment in bicycle and pedestrian infrastructure. Consider, for example, a family spending an extra night in order to enjoy a leisurely bicycle ride (and therefore incurring one more hotel night, one or two more meals, etc.), or a businessman staying in town a few extra hours in order to enjoy a run (and therefore spending additional amounts on food or souvenirs as a result of their longer stay).

7. "Active Transportation Beyond Urban Centers: Walking and Bicycling in Small Towns and Rural America," Rails to Trails Conservancy (2012).

8. "Bike Corrals: Local Business Impacts, Benefits, and Attitudes," Portland State University (2011).

9. While no money is changing hands when people use bicycle and pedestrian infrastructure, this direct use benefit is real and significant. And, in a sense, there are monetary consequences to this activity. People may choose from a variety of recreational options, and using the trail for free may substitute for other options that cost money, thus saving households money that can be diverted to other preferred uses.

10. For example, the addition of open space as a part of the Atlanta BeltLine greenway project was found to increase by 50 percent the likelihood of outdoor recreation among residents of neighborhoods within a half-mile of the open space parts of the BeltLine: "Atlanta BeltLine Health Impact Assessment," Georgia Institute of Technology (June 2007).

11. See resources at the end of this appendix for a detailed bibliography of studies on the connection between recreational

amenities, increased active living, improved health benefits, and reduced health care costs.

12. See resources at the end of this appendix for additional detail on the impact of other, similar bicycle and pedestrian infrastructure projects on commuting mode choice.
13. "American Community Survey." US Census Bureau (2010).
14. This may be too conservative. By way of comparison, in the City of Philadelphia, the introduction of a set of wider bicycle-only lanes (as opposed to just regular bicycle lanes) in the downtown area doubled bicycle ridership on those streets.
15. Over the long term, there are additional positive economic impacts from reducing car miles driven, as cities and regions adjust their land use patterns and transportation infrastructure investments to become more environmentally sustainable and economically efficient.
16. $418 million in congestion costs out of 6.3 billion car miles driven = 6.6 cents in congestion costs per mile driven multiplied by the 4.9 million car miles not driven, resulting in $325,000 in congestion costs avoided.
17. "The impact of transportation infrastructure on bicycling injuries and crashes: a review of the literature." Environmental Health (2009).
18. "Safety Benefits of Walkways, Sidewalks, and Paved Shoulders" Federal Highway Administration (2010).
19. "Evaluating Non-Motorized Transportation Benefits and Costs." Victoria Transport Policy Institute (2012).
20. What is meant by this assumption is that, all else equal, properties located within a quarter-mile of the new facilities will increase in value by 4 percent more than other, similar properties not located within a quarter-mile of the trail. Thus, if properties in the area increase in value by 3 percent, then properties located within a quarter-mile of the trail will increase by 7 percent (3 percent + 4 percent), while if properties in the area decrease in value by 3 percent, then properties located within a quarter-mile of the trail will increase by 1 percent (-3 percent + 4 percent). This may turn out to be conservative on one or more of three fronts. First, the one-time property value increase may be larger than 4 percent, as is suggested by the body of literature. Second, there may be a difference in the ongoing appreciation rate over time between properties located within a quarter-mile of the infrastructure and properties not located within a quarter-mile of the trail, such that the property value increase resulting from the implementation of the trail is not just the upfront 4 percent difference but also some ongoing difference that grows over time. Third, some upfront and/or ongoing difference in property value may apply to properties that are not located within a quarter-mile of the infrastructure but are still reasonably close to the trail; for example, properties located between a quarter-mile and a half-mile of the trail may sell for a premium, since such a distance from the trail may still be considered easily covered on foot.
21. There are about 4.3 million housing units within the state. The state's land area is about 54,000 square miles. Therefore, there are about 80 houses per square mile. This may be too conservative an estimate, since it is likely that new bicycle and pedestrian infrastructure will be located in areas that are more densely populated than the state as a whole, which contains significant proportions of rural and parkland space.
22. The smallest possible area within a ¼-mile radius of the assumed 300 miles of new bicycle and pedestrian infrastructure would be a single straight 300-mile segment of new bicycle and pedestrian infrastructure. This would have an area within a ¼-mile radius of 150 miles (a ¼-mile on each side of the straight line, plus a ¼-mile radius at both ends). If, more realistically, the new bicycle and pedestrian infrastructure was broken up into multiple segments throughout the state, the area within a ¼-mile radius would be larger.