Valuing Land Conservation in North Carolina

by

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Abstract:

In our current economic environment, decisions regarding financial resources have become progressively more difficult. This applies especially to environmental organizations that strive to protect our environment with limited funding. One such organization is the Clean Water Management Trust Fund (CWMTF), which works to protect and better North Carolina Water Resources. CWMTF funds 5 types of projects for water resource protection: acquisitions (conservation), restoration and storm water projects, wastewater infrastructure, planning, and mini-grants. The organization is now challenged to make funding decisions regarding these projects and has taken the first step towards basing these decisions on accurate and relevant information.

This masters project focuses on the benefits of conservation in order to provide CWMTF with information to aid their conservation funding decisions. This project estimates dollar values for two North Carolina sites: Ellerbe Creek Greenway and Cary Greenway. The estimation is generated using two economic research tools: a non-market valuation toolkit and on-site socioeconomic surveying. Using the data gathered on the characteristics of each site by the survey and from other source the toolkit provides an estimate of the economic value of the sites. The values of the sites are compared with each other as well as other research in the field of valuing conservation.

The results show that the Ellerbe Creek site has a higher overall economic value than the Cary Greenway site. The results suggest that this difference is due mainly to the higher population density of the area surrounding the Ellerbe Creek site in comparison to the area surrounding the Cary site. The data show that the economic value is greatly affected by the number of people who use the site and live nearby. These aspects seem to be more affected by the type of development rather than how well the site is known due to the heavy local use of the sites.

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I. Introduction:

1. *Problem Statement*

Conservation has long been a technique to protect our environment. Depending on location, conservation can lead to better water and air quality, protect animal and plant species, and conserve pristine environmental locations available for public use, as well as many other gains. However, there is still debate over whether conservation should occur and if so what should be conserved (Langat et al 2008). This debate poses a challenge for environmental organizations that provide conservation funding. Organizations with limited resources must decide among available conservation sites as they cannot conserve all sites of interest.

One such organization is Clean Water Management Trust Fund (CWMTF), a North Carolina organization that strives to protect and better North Carolina's water resources. A key approach to their goal is acquiring land for conservation in an effort to protect water resources on site and in surrounding areas. They are constantly addressing which locations should be targeted for conservation sites. In the recent economic downturn, prioritizing projects becomes even more critical to the organizations success. In order to successfully prioritize, the first step is to collect accurate and relevant information. Working with CWMTF, the first area which we strive to illuminate is the economic benefits of conservation.

2. *Objectives:*

The general research question that guides this project is:

What is the economic value of conservation in North Carolina?

Specifically, for this project the questions are:

What is the economic value of Ellerbe Creek (17 Acre Wood Preserve) in Durham, NC and

Cary Greenway(White Oak Creek Conservation Project plot 11) in Cary, NC?

How do the resulting economic estimates compare to each other and other North Carolina conservation research in terms of economic value and other conservation attributes?

The goal of this project is to compare and contrast two similar conservation sites that CWMTF acquired in order to assess their economic benefit to the state. By gathering data on these specific sites through the use of research and survey methods, we are able to create a clearer picture of the values gained through conservation of these sites. Specifically, working with CWMTF we create a toolkit which uses site characteristics such as size, location and expected development to generate dollar values of conservation sites. This project collects the specific inputs required by the toolkit for two sites partially funded by CWMTF: Ellerbe Creek in Durham, NC and the Cary Greenway in Cary, NC.

The main methods used are a survey created to determine the types of activities people participate in at conservation sites and a non-market valuation toolkit created in conjunction with CWMTF. Other necessary information will be gathered through additional research and use of CWMTF's database which contains profiles of the sites. Since CWMTF funded portions of each site, they have knowledge of site characteristics, making it easy to collect the information needed for this project.

By collecting the necessary information on the characteristics of these sites, we can determine rough estimates of economic value of each site through the use of the toolkit. The goal of the project is to compare these two sites based on their economic values and then compare these results with similar research within the field of conservation.

3. *Hypothesis*:

The hypothesis for this project is that the estimated economic value of Cary Greenway will exceed that of Ellerbe Creek Greenway. This result is expected due to the fact that Cary Greenway has more visitors

than Ellerbe Creek Greenway. Since the toolkit estimates an economic value and many of its categories estimate the locations value to the people who use the site, we expect that the site with more users to have a higher estimated value. In addition to this aspect, Cary Greenway is better known than Ellerbe Creek Greenway which also suggests that it will see more use, increasing its economic value.

II. Background:

1. Conservation

As urban sprawl continues to expand across the United States, many species that contribute to biodiversity are threatened due to habitat loss and fragmentation (Kong et al. 2006). One approach to combating this problem is to create green spaces that can provide protection for the environment and public access areas such as greenways and parks. However, it is not always the case that conservation is the best solution to the issue at hand. In certain areas, conservation has done little to affect deforestation and the financial resources could have been put to better use (Andam et al. 2008). In order to determine the best way to use conservation to protect the environment we must use a prioritization process to find the where the best locations to conserve are (Visconti et al. 2010). This project looks to test a toolkit designed to help with this prioritization process.

This case study observes two greenway locations and compares them based on economic values. While economic values are not the only characteristics that should be considered when deciding which sites to conserve, they are the main focus of this project as CWMTF receives funding from the state of North Carolina to protect water resources to improve the environment for the citizens of the state of North Carolina. This focus on people, leads us to use economic value as an initial means to compare the two sites at hand.

2. The Benefit Transfer Method

The toolkit used in this study determines the economic value of each site through the benefit transfer method[1]. Benefit transfer refers to "applying existing information and knowledge to new contexts" (Rosenberger et al. 2000). It is a research method that takes the results of previous research studies and applies them to a new situation. For example, results on research done on the value of water quality in one area could be applied to a different area with similar characteristics. Since no two research situations are exactly alike, the information that the benefit transfer method produces is not as accurate or in depth as primary research. Instead it allows for general information that can greatly aid management and policy decisions at a low cost. This is the most appropriate method for the project at hand as funds and time are limited.

There are two main types of benefit transfer: value transfer and function transfer. Value transfer refers to taking the values determined as the result of one study and directly applying them to the new context. For example if water quality at site A is valued at 10$ and site B is very similar to site A then we may use 10$ as a proxy for how much water quality at site B is valued. Another type of value transfer compiles many different studies on a subject and then takes the average value or the highest occurring value before applying it to the new site. This technique can help create a more accurate number by helping to control for some of the differences between the sites.

The most accurate type of benefit transfer is function transfer. When using function transfer, the functions used to evaluate the initial site are collected and then used to evaluate the new site by inputting attributes from the site under observation. This method best controls for differences since it requires the researcher to only apply the needed attributes of the site and the value adjusts accordingly. Similar to value transfer, functions can also be compiled to create an estimate valuation function from many previous studies. This technique is called meta-analysis.

[1] To receive access to the toolkit please contact charles.adair@duke.edu

For this case study, the toolkit uses value transfer which compiles the results of many different studies throughout North Carolina. While function transfer could have been more accurate, much of the information needed to perform a function transfer was not available during the creation of the toolkit. In order to create the initial assumptions, the value transfer technique was used to compile and find the lower bound or median of the compiled values (Champ et al 2008). Then CWMTF was consulted in order to decide which value was appropriate to be used within the toolkit.

3. The Sites:

A. Ellerbe Creek Greenway (17 acre Wood Preserve)

As noted from the segments name, this portion of Ellerbe Creek Greenway is approximately 17 acres in size. Located just south of Guess Road exit off of 85, this section has been preserved in order to protect the Ellerbe creek as well as provide a neighborhood park and trail to the local Durham residents. Total cost to CWMTF is approximately $3,588 per acre and $500 per year in monitoring costs. See map in appendix i.

B. Cary Greenway (White Oak Creek Conservation Project plot 11)

This portion of the Cary Greenway trails is 21.40 acres in size and part of a much larger (429 acre) conservation plan for the area. Located off of NC Highway 55 just south of Green Level West Rd, this section has been preserved to protect the Cape Fear River Basin in Wake County. The waters from this basin ultimately flow to the Jordan Reservoir which provides local water and recreation resources. Total cost to CWMTF is approximately $25,105 per acre. See map in appendix ii.

III. Methods:

1. The Toolkit:

A. Introduction

The toolkit used for this project was created in conjunction with CWMTF. It estimates economic values based on revenue and savings generated from direct income, direct savings, and environmental investment.

In the toolkit, direct income refers to money that is actual revenue for the region/state. Increased tax revenue is generally the main source of direct income; however, collective wealth such as increased property appreciation and tourism revenue also falls under this category.

Direct savings refers to the money that is saved by providing North Carolina residents with free services they would normally have to pay for including hiking trails, fishing areas, etc. Increased health falls under this category as it results in a savings in medical costs. The number of volunteer hours can also represent direct savings as people donate their labor to the state when they volunteer to work in state parks.

Finally, environmental investment refers to the value of environmental or ecosystem services such as clean air and water that are generated when we invest in conservation (generally referred to as environmental savings).

Using this framework, the toolkit attempts to address the two attributes that make land conservation projects especially difficult to analyze. The first attribute is that conservation tends to last "forever." Once land or easements have been purchased they are protected indefinitely. For this reason the toolkit produces an annual value and then allows the user to discount into the future to determine the value of the land over time. Discount value and payback period are determined by the user to allow easier comparisons between projects. The second attribute this toolkit addresses is that conservation contributes value to the state in many different ways. This toolkit recognizes seven basic ways in which land conservation has value: increase in property values, water quality, air quality, revenues and jobs,

use value, human health, and decreased stormwater runoff. The toolkit utilizes the benefit-transfer method discussed above to estimate economic values within each of these categories

The toolkit compiles the various methods of valuation for each category into one location. By making these methods easily accessible and adaptable the toolkit functions as an overarching model for determining a general estimated value of conserved land. The tool is meant to be purely informational as it estimates a general annual value, but its strength lies in its ability to compare land conservation projects on baseline assumptions which can be altered by the user. This flexibility allows for broader application of the tool and easy updating as research progresses on the topic of environmental valuation.

The toolkit is formatted in Excel and each of the categories is contained within its own spreadsheet. Each spreadsheet requires the user to input data on the characteristics of the observed site and then provides the user an estimated annual dollar value based on these characteristics. Some example characteristics include: location, size, type of expected development, tax rate, percent forest cover, on-site activities (hiking, picnicking, etc.), number of people who visit the site, etc. Each category contains assumptions set specifically for the state of North Carolina, created through the compilation of research within each category. Screenshots of the toolkit can be found in appendix iii.

The initial assumptions are put in place specifically for CWMTF. They are kept broad in order to create a tool that can be applied to all types of land conservation. However, because of the many uncertainties underlying environmental valuation these assumptions are also kept very conservative. Thus, even if the value is underestimated by a large amount, the toolkit will still provide an “at least” value.

B. The “At Least” Value

The “at least” value or ALV is a fundamental concept for CWMTF’s use of this toolkit. The basis for this concept is that whether or not we can pinpoint the specific value of environmental and other land use services provided by land conservation, they do have a positive value. The value is worth “at least” a certain amount and knowing the ALV will give a general conservative value. When compiling the research done on valuation, there is generally a range within which the results fall. In most cases the average result is used as a safe representative value. However, in many of these studies the results are not normally distributed leading the mean to overestimate the true value. The median serves a much better option due to the skewed distribution of most results.

The initial assumptions for CWMTF are represented by the median value of compiled results from previous studies, the median value of the most conservative study, or the lower bound of the range of results. The first value was used if there were many studies available that could be compiled. However, for certain topics only a few studies could be obtained. If this was the case either the second or third value was used depending on the reliability of the available studies. In some cases these values were further undercut to ensure an accurate ALV. This occurred if CWMTF decided that they were still too high to be accurately representative of true values.

By using these methods to determine the values of CWMTF’s initial assumptions we are able to confidently state that the output is an ALV. The purpose of these methods is to legitimize the results rather than inflate them. It is easy to make assumptions that inflate the value of land conservation but this goes against CWMTF’s goal of having a valuable informational tool for comparing potential projects.

C. Who can benefit from this toolkit?

Any organization that has trouble placing a dollar value on land conservation or the opportunity costs of land development will find this toolkit useful. However, it is strongly recommended that the party using the toolkit decides their initial assumed values based on their own research. The assumptions currently

used are conservative ALV developed specifically for CWMTF and are based on North Carolina statistics. Thus, these assumptions may not be appropriate for other organizations. That being said, these assumptions will give general values according to a conservative baseline and can be used for comparative purposes for any North Carolina land conservation projects. With basic knowledge of Microsoft Excel the user will be able to alter necessary variables to match the general location of the project being analyzed and a read through of the methods will indicate where each variable comes from and whether or not it is location specific.

This toolkit was developed in Excel with the intention of being straightforward and basic. Users are encouraged to develop an understanding of the basic assumptions and formulas and then add on to or alter the toolkit. This will support the creation and sharing of add-ons that are specific to different needs and areas. Making the toolkit an open source will allow users to continuously add on and update it appropriately to develop an overarching valuation tool for different services provided by our environment and land conservation.

2. Initial Assumptions and Methods for Gathering Data for the Toolkit

Within each of the categories listed below, there are initial assumptions put in place based on compilation of available research data. The section below lists the methods of developing the assumptions and collecting the data for the following categories:

- Increase in Property Values
- Water Quality
- Water Quantity
- Air Quality
- Health Value
- Use Value
- Revenues from Tourism & Associated Job Creation

A. Increase in Property Values (Direct Income)

In almost all circumstances parks and green space have a positive effect on surrounding residential property values. Parks and green space provide many services and aesthetic values and it is not surprising that people value having parks and green space close to their homes. Parks and green space changed the value of surrounding properties from -5 to 30% (Carleyolsen et al 2005). This value is negative if and only if the conserved property becomes problematic due to attracting crime, homeless persons, etc. For the land grants in question, each grant has a party responsible for maintaining the conserved land thus we will assume that these properties will not become problematic. Parks and green space affected surrounding properties up to a mile away, but the effects are stronger the closer the properties are. 500ft is the suggested conservative distance for calculating the effects. Also, CWMTF will use a conservative rate of 2.5% to measure the increase in collective wealth and tax revenues from increased property values.

In order to determine the increase in property values attributed to the conserved area, the number of houses within 500 ft of the conservation site was collected. A map of the conservation plot and surrounding properties was obtained and a 500 ft buffer was drawn around the conservation site. Then the number of properties within the buffer was counted and input into the Excel file. These steps were identical for both sites.

B. Water Quality (Environmental Investment)

Water quality is one of the most difficult attributes to measure. Since we do not have a market for water quality and most of us take clean water for granted, we must take a different approach to valuing changes in water quality due to shifts in land use. Here we try to get a general idea of how people value

water quality by combining the use of survey studies, expected change in water quality, and the predicted number of people affected.

Contingent valuation studies have been done in different locations to find out how much people value water quality (for example see Alliance 2008, Champ et al 2008, Qiu 2006, Schuler 1994). These studies survey people to find how much they value water quality and each uses a different type of survey to extrapolate how much someone is willing to pay to make the public water 1% cleaner. The results are stated as the dollar value of a 1% change in water quality. These figures vary across studies, but the median figures fall within a small range of $13-17 while the mean figures have a larger range of $23-63. In order to determine the value of water quality on the land acquisition it is best to use the lower bound for the median values as this will give a conservative "at least" value. CWMTF chooses to undercut this value further and use a value of 10$ per 1% improvement as there are only a few studies available to draw data from.

It is very difficult to predict how changes in land use will affect water quality. However, we can predict the future land use of the land acquisition if it is not conserved. Each of these types of land use alters the percent of the land that is pervious. Extensive research has been done on the effect of impervious land on water quality and gives us a percent of the land acquisition that would become impervious if development were allowed.

All of this research shows that there is a strong negative correlation between the amount of impervious land and water quality. This suggests that as the amount of impervious land increases, water quality in the area decreases due to the change in runoff patterns which leads to increased pollutants within this runoff and erosion. The majority of studies show that if impervious surfaces increase 10% there is a significant decrease in water quality. However, no studies place a direct percent change in water quality

affected by increase in impervious surfaces so we assume the minimum change occurs. We will assume that there will be at least a 1% decrease in water quality if impervious surfaces increase by 10%.

Determining the value of water quality requires the number of households in the area. The methods are identical to those above. The expected type of development which would occur without conservation was determined by observing the type of development surrounding the conservation site as well as speaking with CWMTF.

C. Water Quantity (Environmental Investment)

As impervious surfaces increase so does the amount of runoff. As discussed earlier this changes runoff patterns which can greatly affect water quality in the area by leading to increased pollutants and erosion. However, water quality is not the only issue associated with increased runoff. The quantity itself can greatly affect how local stormwater systems can handle runoff.

All municipalities in North Carolina must currently raise fees to cover the upkeep costs of their infrastructure, including stormwater infrastructure. Many counties and cities are considering implementing stormwater fees based on impervious surface cover because of its affect on runoff. Currently 6 counties have fees which charge an avg. of $2.50 for every 2500 sq ft of impervious surfaces or single family home. In order to estimate the effect of development on the increased costs of stormwater infrastructure maintenance we can use this figure to represent the cost of the effect of increased impervious surfaces. CWMTF chooses to undercut this value and use a value of 2$ for every expected single family home to be built as there are only a few studies available to draw data from.

Research has estimated the change in pervious surfaces for each type of development. These are given in percent of land cover. This will give us a percent of the land acquisition that would have become impervious had development been allowed. By inputting the number of acres to be conserved and the

type of expected development that would have occurred, the spreadsheet determines the associated number of houses that would have been built. This is used to calculate total stormwater infrastructure and maintenance costs for the area.

The area of the land conservation site was required for determining the economic benefits of water quantity. The expected type of development was also used as determined in the above section.

D. Air Quality (Environmental Investment)

Tree cover helps remove air pollutants by trapping and holding harmful pollutant particles and absorbing pollutant gases (Nowak et al. 2006). Manually calculating these values would be extremely difficult. Instead the US Forest Service has developed an air pollution reduction calculator available for public use that uses tree cover and location to determine the value of reduction of air pollutants. The calculator uses the externality values per ton for each individual pollutant. These values represent the median cost to society due to each ton of pollutant (UFORE 2002).

The inputs required include the number of acres and tree cover % of the land acquisition site. Location of the site must also be selected because the flux of air pollutants and forest type differ by area. In this model there are no NC sites to choose from so we will use the location closest in location to NC that generates the lowest value for an “at least” conservative value. This location is Charleston, WV.

Once all inputs are entered the calculator shows an annual dollar amount that the tree cover contributes in air pollution removal.

The size of the land conservation site was required for determining air quality benefits. Next, the percent of forest cover for the plot was estimated using satellite imagery.

E. Health Value (Direct Savings)

In the past 20 years obesity has climbed over 60% in America. Now over two thirds of Americans are overweight or obese and obesity-related deaths have reached over 400,000 a year (Medical News 2009). The negative health effects tied to obesity raises overall health costs for individuals, institutions, and insurance companies. Staying active is one of the keys to remaining healthy and preventing obesity and related health effects. In NC most parks and green space offer free admission and provide safe and accessible areas where people can be active. Research shows that 30 minutes of exercise three to four times a week can increase overall health and reduce health care costs. This reduction in health care cost is considered direct savings. This savings in health care costs ranges from $250-$2200 a year depending on the observed persons and the research study (Incorpore 2000). CWMTF chooses to use $250 as the lower bound for calculating the health benefits of being active on the land acquisition site.

In order to know the total value of the site's positive effects on health, the number of people who are physically active on that site for at least 90 minutes a week must be determined. Surveying is the preferred technique for finding this number. The spreadsheet calculates the total value of health savings once the number of active people and the value of health savings per person are input.

In order to calculate health value, the number of people active at the conservation site must be recorded. This was determined using the on-site survey (described in detail in the survey section).

F. Use Value (Direct Savings)

North Carolina Parks and Recreation supply the state with over 204,846 acres of public parkland (NC Govt. Parks and Recreation 2009). Access to most of these parks as well as the services they provide is generally free. These services are very diverse and include but are not limited to hiking and bicycle paths, camp grounds, and fishing/boating areas. Normally we can find how much someone values a service based on how much they are willing to pay for it. In this situation because the services are free, we are challenged us to place a value on these services when we cannot reference a market price. In

order to estimate how much these services are worth we can take a different approach and find how much people would be willing to pay for them if they were not available for free. This is called the "use value" method and was developed by the Army Corps of Engineers to estimate the value of recreational services.

The "use value" method places an average value on each service based on its quality. The Army Corps of Engineers lays out a rubric for valuing each activity, but this resource is over a decade old making it difficult to translate the numbers into present value (Core 2001). Many survey studies have been done to find how people value recreational activities (for example see Rosenberger et al. 2000, Kaval et al. 2003). From a meta-analysis of these studies and the Army Corps of Engineers rubric, we can determine conservative "at least" values to use in the toolkit. One goal of the toolkit is to remain flexible so that improvements can be made as research progresses in the area. Thus, the current values that have been input into the toolkit can be easily changed as more surveys are done in the field.

North Carolina Parks and Recreation tracks visitors in many of its parks as well as the activities they participate in. If this information is available for the land acquisition site or a site very similar it can be used in the toolkit. If this information is not available, then the best option is to conduct a survey to determine this information. If it is not possible to conduct a survey then a NC state park can be selected to estimate the number of people who visit and participate in each activity. Finally, because CWMTF wants to know the value of the site to NC, only NC resident visitors will be counted when calculating use value.

By inputting the number of people who participate in each activity and then aggregating the value each person gets from all activities they participate in, the spreadsheet calculates a general estimate of how the land acquisition contributes to use value.

Use Value requires three pieces of data to calculate economic benefit: number of visitors to the site, percent of visitors who are NC residents, and percent of visitors that participate in each activity. These data were also collected through the survey.

G. Revenues from Tourism & Associated Job Creation (Direct Income)

North Carolina's environment is one of the top attractions for tourists that visit our state. According to CWMTF, North Carolina state parks received over 3 million visitors last year and brought in over $120 million in revenue to local communities. Revenues from tourism benefit the local communities in the form of collective wealth and also benefit the state through increased sales tax revenues. This section focuses on valuing the revenues from non-NC residents who visit NC for the primary purpose of visiting parks or participating in other environmental activities. This "green tourism" has been a large source of tourism revenue to our state and will continue to grow as we protect and maintain more of NC's environment.

Visitors are split into two categories, day visitors and overnight visitors, as they spend different amounts during their trips. To find the number of visitors to the site, a survey can be administered. Data from the North Carolina Department of Commerce were used to represent the overnight value of expenditures and data from NC state parks were used to represent the day value in the spreadsheet.

The North Carolina Department of commerce shows that about 25% of visitors come to North Carolina as "green tourists," the main purpose of their trip being to visit parks and partake in environmental activities. Other studies show that generally 20% of visitors to areas with "green recreation" come as "green tourists." In addition, research shows that only 30-60% of revenues brought in by tourists stay in the local community. These values can be determined by the user and input into the spreadsheet. CWMTF chooses to use the lower bound of these ranges to calculate the effects of "green tourists" on tax revenues and collective wealth. By inputting the total number of non-NC residents who visit the site

and then weighting this according the amount of revenue that will stay within the community, the spreadsheet calculates collective wealth to the state of NC. The spreadsheet calculates the tax revenue from tourist expenditures using the tax rate input by the user.

The number of jobs generated from increases in tourism revenue can also be calculated. There is a great deal of research that focuses on the amount of revenue that is required to generate one job and the results vary. These studies suggest that when a certain amount of money enters a local community, new jobs are created. Because this toolkit focuses on total value, jobs created are extra information and provided within the spreadsheet for four different research values. Currently the values contained in the spreadsheet are $8879/job, $34910/job, $47500/job, and $86049/job and can be changed accordingly by the user.

Collecting the data for calculating revenues and associated job creation included: percent of tourists who are non-resident "green tourists", number of expected non-resident day visitors, and number of expected non-resident overnight visitors. These were all collected through the survey as well.

3. The Survey:

Most of the data used for this project comes from CWMTF's database profiles of the project sites. However, not all required data are provided within this framework so outside research was done as well. Specifically, both sites are designed for public access and in order to accurately value the sites the toolkit requires data on visitation patterns. A survey was created to collect the data and focuses on four areas of interest:

- Types of activities people partake in at the site
- Frequency that people partake in these activities
- Proportion of out of state visitors

- Travel time to the site

The survey process included four steps: writing the survey, seeking approval from Duke's Institutional Review Board (IRB) testing the survey using a focus group, implementing the survey, and recording the data.

The survey was designed to be concise and less than one double-sided page. This was crucial to the success of the survey as the survey was performed face to face at each site. By making the process visibly short people were less reluctant to stop and take the survey. In addition to being brief, the survey was formatted so none of the questions were site specific. This allowed the same survey to be used at both sites and will also allow for further use of the survey if CWMTF decides to evaluate other sites. Finally, a cover sheet describing this project, the survey requirements, data use, and confidentiality was attached to each survey to provide the taker with information regarding their participation.

Once the survey was written, an application for exemption was filed to the IRB. As the administrator of the survey, I had to complete an ethics module online. Once this was complete, the survey and application for exemption was filed electronically. Exemption was received within two weeks of filing.

To test the now approved survey and receive feedback before implementation, a focus group was formed from volunteers at CWMTF. Each person took the survey and then participated in a 40 minute discussion. During this discussion, it became clear that the survey questions were straight forward and easily understood. People suggested a few formatting and wording changes to make the survey more concise and also agreed with keeping the survey as short as possible. The largest complaint was made on the formatting of the activities box, which has been now been edited accordingly. The focus group preferred not to be recorded and instead compromised by writing down their comments anonymously on their individual surveys.

Immediately after the focus group, the comments were taken into account and used to edit the survey. The result was a slightly shorter survey found in appendix iv.

Implementation of the survey required travel to each site. At the site, the surveys were attached to clipboards and handed out to anyone at the site willing to offer a few minutes of their time. Any questions were answered immediately by one of the individuals administering the survey. Time and weather varied at each site.

Both sites that were selected for this project are local sites that are used almost solely by the neighborhoods around them. They are surrounded by densely populated neighborhoods that utilize them on a regular basis. The sites are not designed to attract tourists that come to the state to view North Carolina's state parks. Do to these characteristics the sites were surveyed with a combination of on-site and door to door surveying. The majority of the surveying was done door to door and the results give a good picture of overall use by the neighborhood as well as the types of activities that people enjoy at the site.

It took four days to complete a total of 83 surveys on site and in the neighborhood surrounding the Ellerbe Creek site. It took three days to complete a total of 72 surveys on site and in the neighborhood surrounding the Cary Greenway site. At both sites people were very receptive to taking the survey and those that were hesitant at first agreed to take the survey once the surveyor explained that it was very short. The surveying took place between 5:30pm and 7:30pm on weekdays in order to survey the most people since this time period captures people who work from nine to five. Approximately one out of every three households surveyed had someone home and only one person from each site refused to take the survey.

The data were collected and formatted within an excel spreadsheet. The answers for each individual survey were recorded within the spreadsheet and then totals were calculated. Using the data, graphs

were created to show the main trends for the four categories indicated above. These graphs can be found in appendix v & vi.

4. *Generating Estimated Economic Values*

Once the data were collected and recorded it was input in the toolkit one category at a time which allowed the value of each individual category to be recorded. Since the toolkit is an Excel tool, each site's results were also saved as individual Excel files. Inputting all of the data provided an estimated annual economic value for each site. These values are broken up into different categories to represent the different types of economic value that is received from each site.

In addition to finding the annual economic values for each site, the projected value over twenty years was also predicted. The value was calculated using a discount rate of 3%. This value proves very useful when making funding decisions as it represents a general payback period, a period of time during which you expect to be paid back for your investment. Payback periods can vary, here we use twenty years to get a good picture of whether these sites as much value to the state of North Carolina in twenty years as the initial funding investment. By comparing the funding investments made for each site to the value gained from conserving each site we are able to determine which site was a better environmental investment. The annual economic values as well as the twenty year discounted values are shown below.

Estimated Value	Ellerbe Creek Greenway	White Oak Creek Greenway
Estimated Annual Value	$191,313	$136,835
20 year Discounted Value	$2,384,184	$1,705,270

IV. Results, Observations and Discussion:

1. *Survey Results*

A. Ellerbe Creek Greenway – 17 acre Wood Preserve

The results show that there is heavy use of this section of Ellerbe Creek Greenway. Almost half of those surveyed used the site a few times a week or daily. A quarter used the site a few times a month and about ten percent had never used the site. Those who had never used the site either did not know it was there or did not have the time to visit the site. A graph of visitation patterns can be found in appendix v.

Almost everyone surveyed (85%) enjoyed walking on the site and about 30% used the site for jogging. One person noted that he had enjoyed cross-country skiing on the site thanks to the higher than average snowfall this winter. The trail was used by a quarter of those surveyed for bicycle riding. A graph of usage patterns can be found in appendix vi.

The average amount of time spent exercising on site by those surveyed was about 45 minutes a week and about 10% of respondents exercised at least 90 minutes a week at the site.

B. *Cary Greenway (White Oak Creek Conservation Project plot 11)*

Overall, the Cary Greenway site had similar use when compared with the Ellerbe Creek site. Over half of those surveyed used the site at least once a week, a slightly higher proportion than the Ellerbe site. About twenty percent of the respondents used visited the site a few times a month and ten percent of those surveyed did not use the greenway. A graph of visitation patterns can be found in appendix v.

The Cary site had a much higher number of respondents who rode their bicycles on the trail; about sixty percent compared to Ellerbe's twenty-six percent. The number of respondents who used the site for running was about thirty-five percent, only slightly higher than on the Ellerbe trail. Most people had used the trail for walking (70%) and a very small portion, about four percent, had picnicked on or around

the greenway. Finally, two respondents had used the trail for educational purposes. A graph of usage patterns can be found in appendix vi.

The average amount of time spent exercising on site by those surveyed was about 68 minutes a week and about 26% of respondents exercised at least 90 minutes a week at the site. This result shows that overall people tended to spend more time at the Cary site in comparison to the Durham site. This could be attributed to the fact that the Cary trail is longer than the Durham trail and also is part of a much larger greenway trail. However, from observation almost every household in the Cary neighborhood had one or more dogs, while it seemed that the half the Durham households had dogs. The Cary neighborhood also seemed to have many more families with young children compared to the Durham households. This seems to suggest that overall the Cary households might spend more time at the trail when they visited.

2. Toolkit Results

A. *Increase in Property Values*

The area surrounding Ellerbe Creek Greenway was much more densely populated then the area surrounding White Oak Creek Greenway. The total estimated number of houses within 500 ft of the Ellerbe Creek site was 179 compared to 88 houses for the Cary site. Even though the average house price in Cary is $75,000 more than the average house price in Durham, this was not enough to counterbalance the fact that Ellerbe had almost twice as many houses within its vicinity. Thus, the results show that the Ellerbe Creek site had a higher total initial property value which in turn led to a higher increase in value of properties in the area as well as tax increases as seen below. While the increase in property values gives a high estimate, we will use the annual increase in tax value to represent the value of increased property values since it is a more conservative estimate and direct income to the state.

Estimated Value	Ellerbe Creek Greenway	White Oak Creek Greenway
Increase in Property Value	$ 895,288	$ 613,274
Increase in Annual Tax Value	$ 7,464	$ 4,109

B. *Water Quality*

Similarly, water quality is also affected by the number of households within 500 ft of the conservation site resulting in a higher overall economic value of water quality at the Ellerbe site compared to the Cary site. In addition to the difference in number of households, the expected type of development to occur in each area differed as well. The type of development in the Ellerbe Creek area is highly dense with other 3 houses per acre, whereas the development in Cary was slightly less dense with 2 houses per acre. This further increased the difference between the values of water quality between the sites as seen below.

Estimated Value	Ellerbe Creek Greenway	White Oak Creek Greenway
Water Quality	$ 19,023	$ 6,573

C. *Water Quantity*

The economic value from controlling water quantity (storm water runoff) was very similar for both sites. This occurred because both sites were chosen to be approximately the same size in order to have an accurate comparison. However, even though the Cary site is slightly larger at 20.4 acres compared to the Durham site at 17 acres, this difference is countered by the fact that expected development at the Durham site is denser than at the Cary site. Thus impervious surfaces would be expected to increase more at the Ellerbe Creek site leading to higher economic values at preventing this runoff. We see that

this occurs and Ellerbe Creek Greenway has a higher economic value within the category of water quantity than the White Oak Creek Greenway.

Estimated Value	Ellerbe Creek Greenway	White Oak Creek Greenway
Water Quantity	$ 1,224	$ 1,027

D. *Air Quality*

Air quality is affected mainly by two land attributes: the size of the parcel and the amount of tree cover. Here we see that the Cary Greenway site has a higher economic value in terms of air quality compared to Ellerbe Creek Greenway. This is mainly due to the larger size of the Cary Greenway site compared to the Ellerbe Creek Greenway, 20 acres compared to 17 acres, and the similar tree covers of these sites, 90% compared to 95%.

Estimated Value	Ellerbe Creek Greenway	White Oak Creek Greenway
Air Quality	$ 2,283	$ 2,722

E. *Health Value*

Health value is determined by the number of people active at least 90 minutes a week at the site. The survey results indicate that there are a higher percentage of people who exercised at least 90 minutes a week at the Cary site compared to the Ellerbe site. This difference in percentage is large enough to overcome the difference in local populations and shows that overall more people exercise for greater periods of time at the Cary site. This leads to a higher health value for the Cary site as seen below.

Estimated Value	Ellerbe Creek Greenway	White Oak Creek Greenway

Health Value	$ 12,000	$14,250

One possible explanation for these results is that the Cary site is connected to a much longer greenway and thus people tend to associate their total amount of exercise on this greenway with the Cary site. In contrast the Ellerbe site is more detached from a longer trail and people then are more aware of the amount of time they spend on that specific trail.

F. *Use Value*

Use value was greater at the Ellerbe Creek site when compared to Whit Oak Creek due to the higher visitation patterns at the Ellerbe site. However, there were a higher proportion of visitors at the White Oak Creek site that participated in cycling and running, activities with higher values. Had the usage of the sites been similar then the difference in use value of the sites would have been much higher, but because of the differences in activities the difference was decreased.

Estimated Value	Ellerbe Creek Greenway	White Oak Creek Greenway
Use Value	$149,319	$108,154

G. *Revenue & Job Creation*

The surveys indicate that the sites where almost solely used by locals and those who were not locals did not visit the areas because of the sites. Thus this category has a value of zero for both sites and is included mostly to address sites that are designed to attract tourists who come to North Carolina as "green tourists."

V. Conclusion:

The results suggest that overall values of the sites are quite high compared to the amount of money invested into each site. For Ellerbe creek, approximately $3,588 was spent per acre and total monitoring costs are $500 per year. This places total initial costs at around $61,488. The annual value of the site to the community is approximately $191,313, well over the amount invested. Similarly, for the Cary site initial costs were $25,105 per acre or about $502,100. The annual value of the site to the community is approximately $136,385, which would give a payback period of about 4-5 years. These results suggest that both of these areas were very good investments in respect to conservation and business decisions.

When comparing the sites, we find that the Ellerbe site has a higher value than the Cary site. Upon further investigation, these results seem to be most affected by the difference in population density of the two areas. The area surrounding the Ellerbe site is about twice as densely populated than the Cary site due to the fact that the houses are on smaller plots of land and spaced more closely together. While people at the Cary site tend to be more active at the site and participate in more active activities such as bicycling and running, overall there are fewer visits to this particular section of the Cary site when compared to the Ellerbe site.

In addition to population density, the Cary site is also connected to a much longer greenway trail. While it is difficult to tease out the effects this has on the economic value of the site, this connection to a longer trail may be an explanation for why people tend to be active for longer periods of time at the Cary site and participate in more active activities. This increase the value of the site in respects to health and use value, but may also decrease the value since it leads to more substitutes for the site.

Finally, the results show that the economic value of conservation in densely populated areas may be significantly higher than conservation in less populated areas. This suggests that even though land values tend to be much higher in these areas, conserving land in these areas may still be a sound investment. However, these results are focused purely on the economic value of conservation and thus

are very heavily based on how people value the benefits and may miss many other types of value that the land has.

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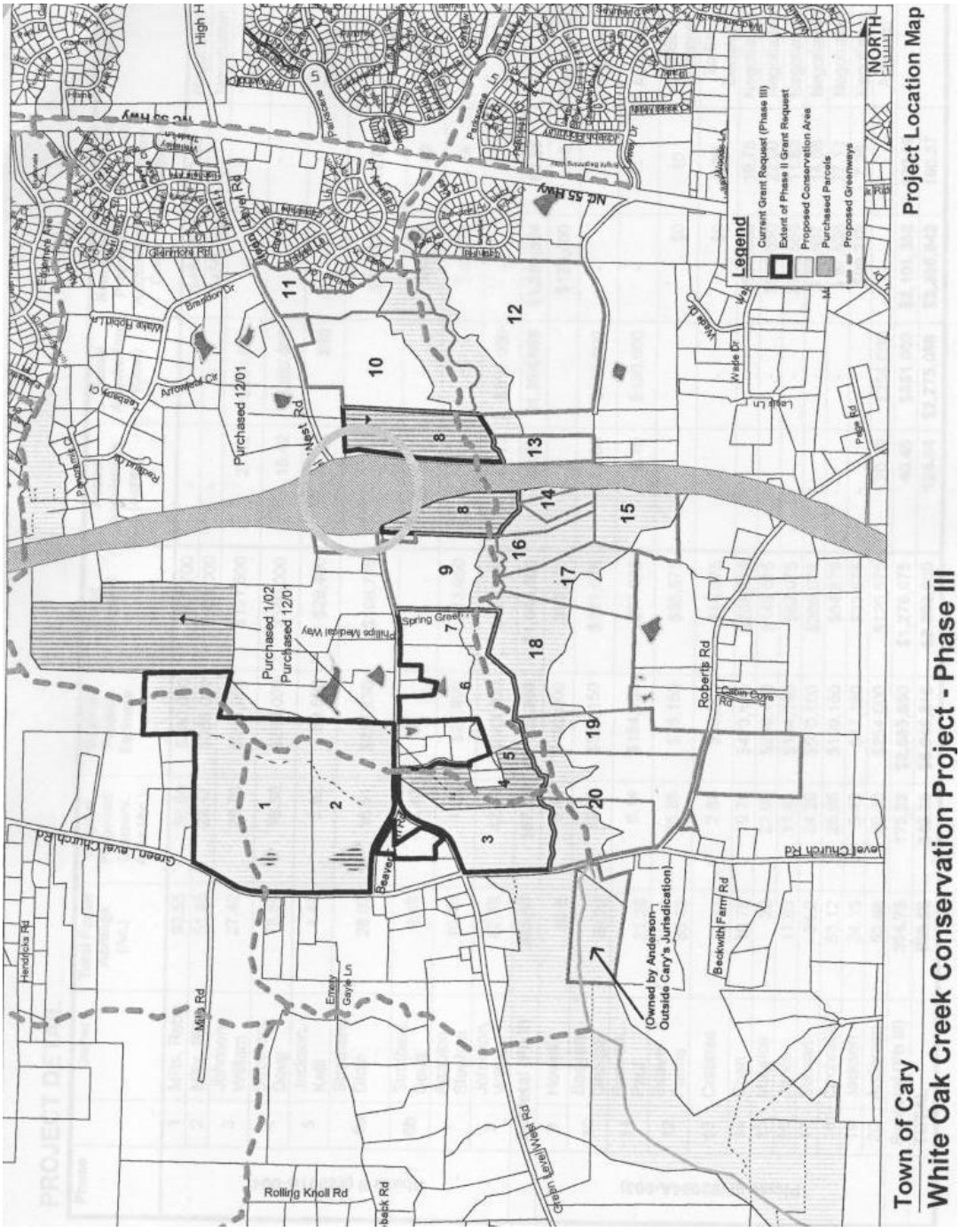
VII. Appendix

Appendix i: Map of Ellerbe Creek Greenway, Parcels 101183-87, 101303, 101277, 127846

Appendix ii: White Oak Creek Section of Cary Greenway Parcel 11



Appendix iii: Screenshots of the Toolkit (Water Quality)

Red indicates assumptions and inputs.

Water Quality
(Spreadsheet 1)

*If there **are** houses within 500ft of the land*
(if not proceed to the next spreadsheet)

1. Input the value of a 1% change in water quality

$10.00

2. Input the number of houses within 500 ft

191

3. Input the avg number of people per household

2.49

4. Select the type of future land development

Future Land Development (dwelling units/acre)	Total Value	% Impervious Surface
Click the cell above and then the arrow Medium Density 3	$19,023.60	30

5. Input the Total Value of water quality from above

19023

Appendix iv: Survey

Park Activities and

Visitation Patterns Survey

Dear Sir or Madame,

For my Master's Project at the Nicholas School of Environment at Duke, I am conducting a pilot survey of park visitors. In conjunction with my sponsor, Clean Water Management Trust Fund, I am trying to assess the value of conservation. The information you provide will help me determine who is visiting this park and estimate the total number of annual visitors. In addition, I am looking to identify the types of activities visitors participate in. The data collected from these surveys will help me complete my Master's Project *Valuing Land Conservation in North Carolina*.

This park has been selected as a case study and I am surveying visitors to _____ at this time _____. If you choose to participate, please take approximately three to five minutes to complete the attached questionnaire. There are no correct or incorrect responses, only your much needed opinions. All responses will be treated confidentially and will in no way be traceable to you.

Thank you for your assistance. I greatly appreciate your time.

Sincerely,

Charles Adair

Masters of Environmental Management Candidate, 2010

1. Are you a resident of North Carolina?

☐ yes
☐ no

2. What is your zip code? _____

3. How often have you visited this park in the past year?

☐ Daily
☐ A few times a week
☐ Once a week
☐ A few times a month
☐ Once a month
☐ A few times a year
☐ Once a year

4. On average, how many minutes do you spend exercising (hike, jog, run, etc.) at this park a week?

_____minutes

5. When visiting this park, which of the following activities have you participated in?

CHECK ALL THAT APPLY

Backpacking		Hiking	
Bicycling		Horseback Riding	
Boating		Off Road Vehicles	
Camping		Picnicking	
Canoeing/Kayaking		Running	
Educational Activities (nature tours, museums, informational stations, etc.)		Swimming	
Fishing		Walking	

Other_____

6. Do you live within 30 miles of this park?

- ☐ yes
- ☐ no

If you answered **no** to question 6 please complete the following:

---

7. Is this park or another environmental activity in the area (sightseeing, nature hike, etc.) the primary purpose of your trip to this area?

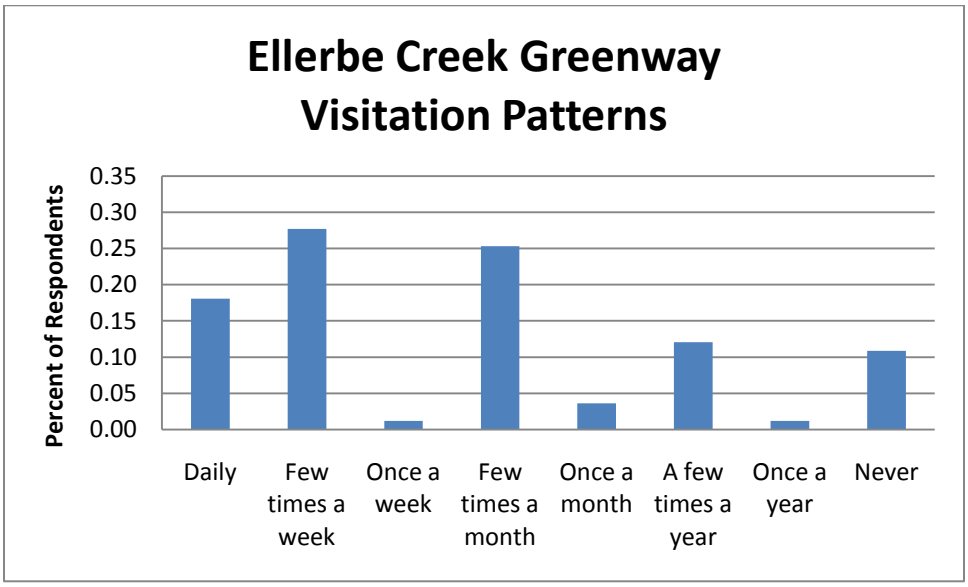
- ☐ yes
- ☐ no

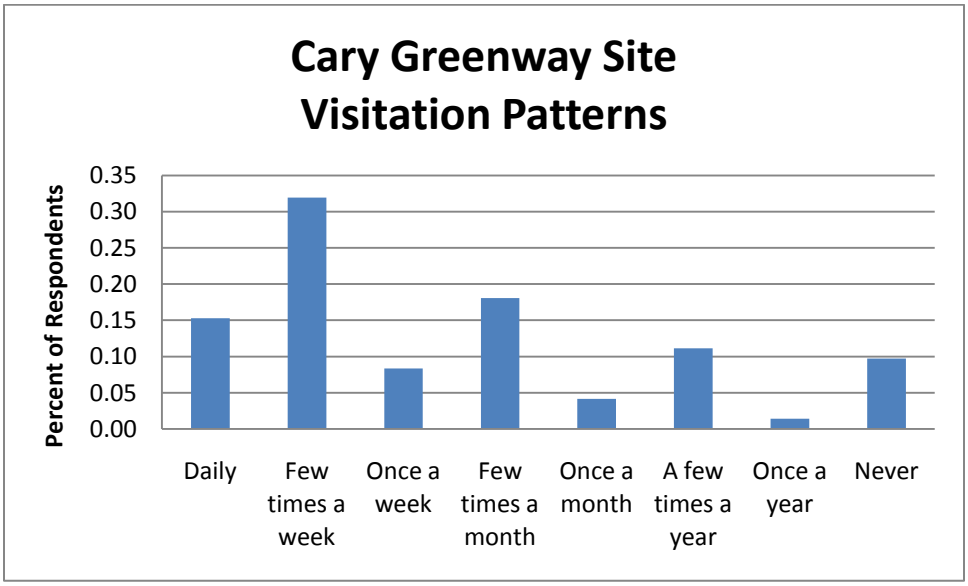
8. Is your trip to the area a

- ☐ day trip
- ☐ overnight trip _____ nights

Thank you for completing this survey.

Appendix v: Visitation Patterns





Appendix vi: Usage Patterns