

Cumberland County Return on Environment Report:

The Economic Benefits of Protecting and Restoring Natural Systems

2015



Keystone Conservation Trust, ECONSULT, and 4WARD Planning

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Cumberland County Return on Environment Report

Executive Summary

“The wooded ridges of [the Kittatinny Ridge] and South Mountain, the natural stream corridors of the Yellow Breeches Creek and Conodoguinet Creek, and the Susquehanna River along the eastern boundary are natural resources that define Cumberland County. The valley land between the ridges with rich agricultural soils, wetlands, and riparian areas adds to the diversity of the County’s natural resources.”¹

These features, along with the opportunities provided by growth, are the foundation for a strong economy and quality of life. A strong economy is not an "either/or" choice. This report explains why a balanced, strong economy requires plenty of connected, accessible open space and an environment that supports good health.

A top priority of local residents is open space, according to a Cumberland County 2012 Land Partnerships Public Opinion Survey.² **When asked, "How important are the following to you?"**

- Natural Resource Protection: Very Important or Important - 90%
- Farmland Preservation: Very Important or Important - 84%
- Parks, Trails & Greenways: Very Important or Important - 83%
- Livable Communities: Very Important or Important - 71%

Open spaces provide substantial economic, environmental, and public health benefits to communities. These benefits, however, are generally not well-understood and are often undervalued in policy debates and investment decisions. Beyond their intrinsic benefits, open space and nature (i.e., forests, wetlands, meadows, and farmland) provide these vital services cost-free. Once lost, natural system services are costly and difficult, if not impossible, to replace.

To provide a better understanding of these benefits, this study estimates the economic value generated by natural system services and open space in Cumberland County. This analysis indicates that open space adds significant value to the regional economy with benefits accruing to businesses, governments, and households.

Building from previous valuation studies published by economist Robert Costanza and using

Cumberland County’s Annual Return on Environment

Avoided Costs

- **Natural System Services: \$269.6 – \$739.1 Million**
- **Air Pollution Removal: \$131.1 – \$146.8 Million**

Outdoor Recreation Revenue

- **Outdoor Recreation: \$204.7 – \$521.5 Million**
- **Jobs: 2,539 – 6,656**
- **State and Local Taxes: \$15.3 – \$38.9 Million**

¹ Cumberland County. (2013). *Land Partnerships Plan: A Countywide Strategy*. 6-3.

² Ibid, Appendix 3-2: Combined Survey – “How important are the following to you?” (User Selected and Random Sample Surveys).

standard economic analysis techniques, this study estimates the value of protected and undeveloped open space in Cumberland County by measuring impacts across three areas: (1) the avoided costs associated with natural system services; (2) the avoided costs associated with air quality; and (3) the value of recreational activity on open space.³ With 30% forest cover present in Cumberland County, large forested mountains, and clean streams, the economic value is expected to be closer to the higher end of the range.

Cumberland County faces many challenges. Among them may be how people value the environment in relation to other factors. Over the past 30 years, polls conducted by Gallup, Inc., have shown a changing attitude. For 23 years, there was a clear preference for the environment, but since 2008, opinions have wavered with economic development favored during the last recession, particularly by people over 65.⁴

In 2014, Act 162 was enacted in Pennsylvania, amending the Clean Streams Law to make buffer requirements for development along high quality and exceptional value streams more flexible.⁵ The Stroud Water Research Center determined that forested streams remove 200% - 800% more nitrogen pollution than non-forested streams.⁶ Developers and landowners are still required to prove that they are protecting waterways through other means. However, the change in regulations indicates that we are willing to risk impacting water quality of pristine streams rather than impacting development.

The Knight Foundation's three-year *Soul of the Community Study*, published in 2011, surveyed nearly 43,000 people in 26 communities across the US. The survey determined that real emotional attachment to where people live comes from a region's welcoming attitude to diverse populations, aesthetics (physical beauty of area and availability of playgrounds, trails, and parks), and social offerings. These criteria were significantly more important than the usual suspects of safety, jobs, schools, and services. Communities that exhibited these three criteria also had higher economic growth.⁷ Just as residents love where they live for the reasons stated above, prospective residents are likely attracted to Cumberland County because of its wooded hills, scenic stream corridors, agricultural landscapes, and recreational opportunities.

Going forward, a major challenge will be to change people's perception that they must choose between environmental protection and economic development. The reality is that the environment is a driver for strong economic development.

As in other studied counties in Pennsylvania, the biggest challenge facing Cumberland County related to open space may be promoting sustainable growth while maintaining a high quality of life, a low cost of living, and good health for all residents.

³ Costanza, R., Wilson, M., Troy, A., Voinov, A., Liu, S., and D'Agostino, J. (2006). *The Value of New Jersey's Ecosystem Services and Natural Capital*. New Jersey Department of Environmental Protection Division of Science, Research and Technology. Report Number: SR04-075.

⁴ Swift, A. (2013). Americans Again Pick Environment Over Economic Growth. *Gallup Poll Social Series*. Retrieved from www.gallup.com/poll/168017/Americans-again-pick-environment-economic-growth.aspx.

⁵ <http://pecpa.org/policy/pec-statement-on-act-162-of-2014/>

⁶ Stroud Water Research Center. (2004). Forested Buffers: The Key to Clean Streams. Abstract published by Chesapeake Bay Foundation, 1. Retrieved from <http://www.stroudcenter.org/press/pnassumarychbayfdn06.pdf>.

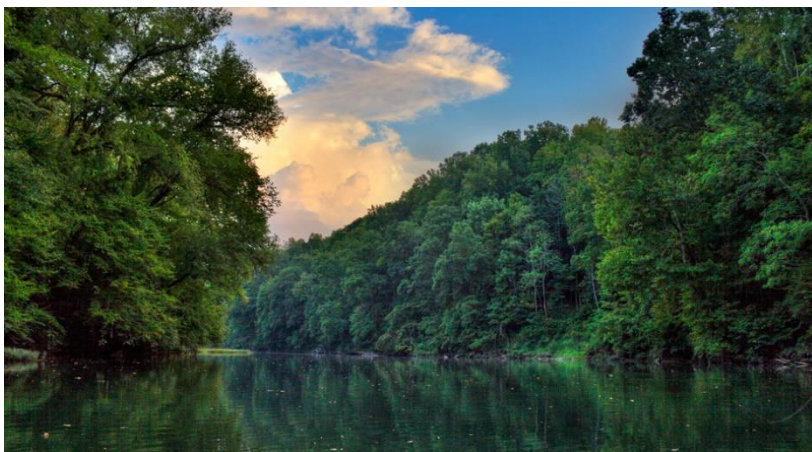
⁷ Gallup, Inc., and the John S. and James L. Knight Foundation. *Knight Soul of the Community 2010*, 10-12. Retrieved from <http://knightfoundation.org/sotc/overall-findings/>.

It is important to note that economic data presented in this study *approximates* the value of open space in Cumberland County, taking into account the broad variety of land cover, economic activities, recreational activities, natural system services, and other factors that exist or occur on open space.

This study is intended to heighten awareness of the economic benefits of open space to residents, municipalities and businesses in Cumberland County. Its purpose is to help further the dialogue about the role of open space in the Cumberland County economy, quality of life, cost of living and good health and well-being of its residents.

Natural System Services

When we consider the importance of Cumberland County's open space, it is essential that we recognize the role that trees, fields, meadows, and wetlands play in filtering water, cleaning air, controlling flooding, and providing environmental services.



The Susquehanna River. Credit HCP

Open space provides value in the form of naturally-occurring environmental processes. When open lands are developed in critical areas, Cumberland County needs to replicate vital and costly services such as water supply and treatment, flood control, pollination and biological control, and habitat through alternative methods.

Open spaces are where the majority of natural systems function. By relying on nature's ability to provide these valuable services, Cumberland County avoids significant expenses. The US Environmental Protection Agency's (EPA) *Healthy Watersheds Program* explains that in some cases, decision-makers have found that the environment creates infrastructure solutions that are less expensive and more reliable.⁸ The natural environment can help keep the cost of living low.

Nature provides a form of insurance to Cumberland County residents because natural systems function on a continuous basis and they have been doing so for at least 10,000 years. This study estimates the avoided costs associated with several environmental services that naturally occur in Cumberland County's open spaces. Costanza et al (2006) compiled and summarized over 100 academic studies comprising 210 individual value estimates for the types of ecosystems present in the state of New Jersey. Due to similarity between the climate, land cover, and ecosystems of New Jersey and Cumberland County, the studies compiled by Costanza et al (2006) for Cumberland County were used.

Key findings include:

The County's open spaces provide natural system services that support quality of life, cost of living, health, and well-being at an estimated \$269.64 – \$739.13 million in annual cost savings and economic

⁸ US Environmental Protection Agency, (2012). *The Economic Benefits of Protecting Healthy Watersheds.*, EPA 841-N-12-004, 1. Retrieved from http://water.epa.gov/polwaste/nps/watershed/upload/economic_benefits_factsheet3.pdf.

benefits. Given the fact that the Kittatinny Ridge provides habitat and water resources, that 30% of Cumberland County is forested and that healthy streams exist, the expected value should be at the higher end of the range—between the mean and maximum value.⁹ This represents costs avoided by not having to artificially replace vital ecosystem services currently provided by open space within Cumberland County. According to the data shown in Table 5 on page 34, the current green infrastructure along streams in Cumberland County reduces tax burdens by avoiding annual expenditures of more than:

- \$45.03 – \$174.79 million for water supply;
- \$23.86 – \$35.15 million for flood control; and
- \$11.4 – \$11.5 million for water quality.

Natural areas also provide annual benefits of (see Table 5):

- \$20.76 – \$32.72 million for pollination services;
- \$2.1 million for biological control services in agriculture, backyards, and the natural landscape;
- \$165.69 – \$481.77 million in habitat for insects, birds, animals, and plants; and
- \$0.82 – \$1 million in soil formation.¹⁰

Preventing impairments to natural systems protects the services that they provide, which in turn provide economic benefits to society and prevent expensive replacement and restoration costs. Maintaining connected habitats and corridors allows the full value of open space to be realized. These precious benefits provide a more resilient environment during changing climatic conditions.

Air Quality Services

Cumberland County faces substantial air quality problems due to its location, topography, and economy. Currently it does not meet air quality standards and has some long-term air quality problems.¹¹ Poor air quality is a common problem in many urban and suburban areas and can lead to a variety of human health problems, including asthma and other respiratory ailments. Additionally, air pollution can also damage buildings and plants,



Woodlands. Credit John Rogers

⁹ 2004 FIA Database, 2007 Penn State Timber Market Report; 2004 USDA Forest Service, Northeast Forest Experimental Station GTR NE-126; 2004 USDA Northeastern Forest Experimental Station GTR NE-136; USDA Census of Agriculture 2002; 2007 PA Department of Labor; Minnesota IMPLAN group, Inc. 2004 data.

¹⁰ Costanza et al. (2006).

¹¹ Cumberland County | Clean Air Board of Central PA.

disrupt many ecosystem services, and can cause reduced visibility and smog.

According to Nowak et al (2006), trees remove significant amounts of air pollution and consequently improve environmental quality and human health. In particular, trees remove significant amounts of nitrogen dioxide (NO₂), sulfur dioxide (SO₂), carbon monoxide (CO), ozone (O₃), and particulate matter (PM₁₀). Trees remove gaseous air pollution primarily by uptake via leaf stomata, though some gases are removed by the plant surface. “Trees also remove pollution by intercepting airborne particles.”¹²

Urban and suburban trees help mitigate climate change by sequestering atmospheric carbon (from carbon dioxide [CO₂]) in new biomass each year. Carbon storage is another way that trees can influence climate change. As trees grow, they store more carbon by holding it in their accumulated tissue. As trees die and decay, they release much of the stored carbon back to the atmosphere. Carbon storage is an estimate of the total amount of carbon that is currently stored in the above- and below-ground biomass of the forest, while *carbon sequestration* is a measure of how much new carbon dioxide is taken up by the forest each year through new growth.

The incidence of childhood asthma worldwide has paralleled the sharp increase in carbon dioxide (CO₂) emissions over at least the last two decades, in part due to climate-related factors. In a report released by the Harvard Medical School and the Center for Health and the Global Environment, it was noted that there was an increase in asthma incidence of 160% from 1980 – 1994 among preschool children in the United States. Using the i-Tree Vue Model, developed by the US Forest Service, the following estimates were determined for Cumberland County.¹³

Key findings include:

- In Cumberland County, the total annual avoided health care costs for greenhouse gases is between \$38.5 million and \$53.4 million.
- Currently, tree-covered open space in Cumberland County stores 4,350,717 tons of carbon over the life of a tree.
- Photosynthesis by trees adds 137,832 tons of carbon sequestration each year.
- If the carbon currently stored in trees—both above and below ground—on open space were released into the air, it would cause damage due to increased carbon emissions that would cost \$92.6 million to mitigate in Cumberland County (Table 11).

Outdoor Recreation

Open space generates value via the consumer benefit that residents enjoy by engaging in recreation and exercise for free or at below-market rates, instead of turning to private markets for the same activities.

Table 1. is a list of recreational uses in Cumberland County. According to data in Table 1, between \$204.7 million and \$521.5 million is spent on outdoor recreation each year in Cumberland County. As a result, 2,539 – 6,656 jobs have been created both inside and outside Cumberland County, and \$15.3 –

¹² Nowak, D. J., Crane, D. E., & Stevens, J. C. (2006). Air Pollution Removal by Urban Trees and Shrubs in the United States. *Urban Forestry & Urban Greening* 4, 115-116.

¹³ United States Forest Service. (2010). i-Tree Vue User’s Manual, Version 3.0.

\$38.9 million has been generated in state and local taxes. These numbers include the 2014 DCNR participation survey data.¹⁴

Table 1. Outdoor Recreation Economic Contribution

Activity	Low Total Output	Expected Total Output
Walking	\$20,658,192	\$21,725,532
Fishing	\$16,135,626	\$18,922,689
Hunting	\$12,319,599	\$54,111,193
Bird Watching	\$3,676,466	\$35,656,142
Wildlife Watching	\$8,264,554	\$38,961,470
Camping	\$88,445,373	\$111,338,153
Kayaking/Canoeing	\$4,840,329	\$22,991,564
Bicycling	\$26,644,765	\$86,646,772
Hiking	\$12,050,612	\$116,369,105
Jogging/Running	\$9,419,561	\$11,438,039
Nature Study	\$2,195,425	\$3,293,137
TOTAL	\$204,650,502	\$521,453,796

Source: IMPlan Model, 2015.

Key findings include:

- Residents of all ages frequent parks, trails, natural areas, and waterways to get outside and exercise, get in shape, relax, recreate as a family, and have contact with nature. Every year, 71% of people in Pennsylvania enjoy some form of outdoor recreation.¹⁵
- Every year, 39.1% of residents in South Central Pennsylvania participate in outdoor recreation two or more times each week.¹⁶
- Physically active people are typically healthier, having a lower incidence of cardiovascular diseases, diabetes, depression,



Family Recreation. Credit John Rogers

¹⁴ Pennsylvania Department of Conservation and Natural Resources (DCNR), (2014). Outdoor Recreation Participation Survey

¹⁵ Department of Conservation and Natural Resources (DCNR), (2014). Outdoor Recreation Participation Survey

¹⁶ Department of Conservation and Natural Resources (DCNR), (2014). Outdoor Recreation Participation Survey. South Central Region Topline Results.

certain cancers, and obesity. DCNR's *2014 Outdoor Recreation Participation Survey of Pennsylvania Residents* showed that 30% of residents undergo moderate and strenuous activity that takes place on protected open space.¹⁷ They do this by running, walking, bicycling, kayaking, and hiking.

- The outdoor recreation economy grew approximately five percent annually in the US between 2005 and 2011, during an economic recession during which many sectors contracted.¹⁸
- 31% of people surveyed in Pennsylvania plan to spend more time outdoors.¹⁹ And, about half of the region's baby boomers (ages 44-62) expect to increase their outdoor activity, compared to 25% of their older counterparts. Given the aging population of Cumberland County, outdoor activities are expected to grow. .²⁰
- The fastest growing activities nationally are kayaking, birding, wildlife watching, outdoor photography, running, and bicycling. The popularity of these activities is replacing more traditional activities like hunting and fishing.²¹



An Overlook on the Appalachian Trail.

“America needs her forests and her wild spaces quite as much as her cities and her settled places.”

Benton MacKaye, Founder of the Appalachian National Scenic Trail

Introduction

People expect an unending supply of clean air, water, and open space, but what is it worth and how do we determine its value? What happens to our quality of life if we continue to lose forests and wetlands? The loss of open space can change everything, including recreation, health, water supply, water and air quality, and economic development.

The trees, stream valleys, farms, and forests of Cumberland County account for millions of dollars each year in savings, avoided costs, and attraction of economic development. This report describes how

¹⁷ IBID.

¹⁸ Outdoor Industry Association, (2012). Economic Outlook

¹⁹ Department of Conservation and Natural Resources (DCNR), (2009). Outdoor Recreation Participation Survey. Note: this question was not asked in the 2014 SCORP survey.

²⁰ Department of Conservation and Natural Resources (DCNR), (2014). Outdoor Recreation Participation Survey

²¹ Cordell, K. (2012). *Outdoor recreation trends and futures: A technical document supporting the Forest Service 2010 RPA assessment*. USFS Southern Research Station: Asheville, NC.

open space is an integral part of Cumberland County's economy, quality of life, health, and lower cost of living. Open space can be as big as the Kittatinny Ridge or as small as the setback on a tree-lined street.

More than just pretty places that contribute to our quality of life and cost of living, the region's open spaces are productive assets that generate significant economic value for Cumberland County. Open spaces positively affect everything from scenic views, tourism, property values, health, and economic development to reduced costs for healthcare, stormwater management, and flood mitigation. Open space also increases revenues from recreation and naturally improves air and water quality. Open space has a broad influence on life from supplying basic needs to enhancing health and well-being, jobs, and the economy while supporting plant and animal diversity. Simply stated, open space affects everything (Figure 1).

Cumberland County, along with the region's municipalities and other organizations, has been active in acquiring and preserving farmland and open space, as well as providing recreational opportunities. What has been lacking, however, is an economic valuation of the benefits provided by natural systems and open space to fortify these efforts. This is the purpose of the Cumberland County Return on Environment Report. Communities that have a more complete understanding of the fiscal implications of open space will be better equipped to set priorities and to strike a balance between open space and other objectives. Open space can be public or private land. Open space is not just a place to play; it is an asset that supports the majority of natural system services.

The impetus for this project came from the recognition of the real and hidden value of the Kittatinny Ridge. The Kittatinny Ridge is a Globally Important Bird Area (IBA) and one of the largest IBAs in Pennsylvania. (Figure 2, see following page).

In 2009, the Kittatinny Coalition (a partnership of land trusts, environmental non-profits, government agencies, and academic institutions) decided to undertake a pilot study for Berks County to assess how much conservation was contributing to the local residents' quality of life and local economy.

The premise of the study was that protecting and restoring our best remaining natural areas would make significant economic sense and the value could be quantified. Monetizing natural system services would help us understand the value or loss of "quality of life," as well as the multiple benefits created by monetizing natural resource value. An example of a major benefit is the cost reduction in infrastructure spending for stormwater, drinking water, and wastewater treatment. The attraction of high-quality natural areas to sportsmen and tourists also should be a major incentive for conservation.

Figure 1. Open Space Affects Everything

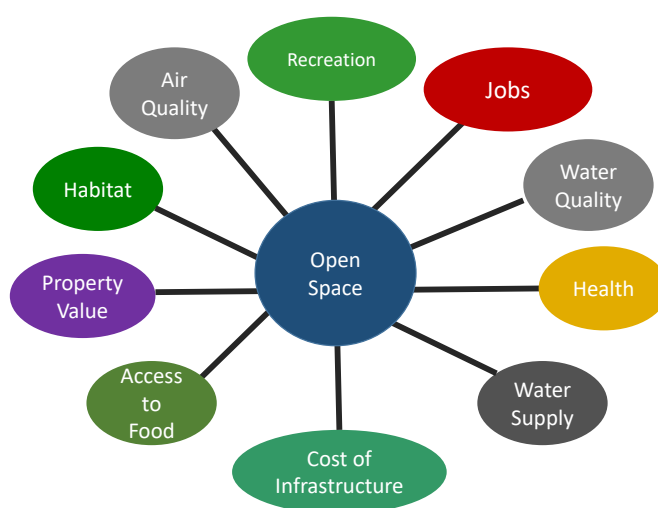
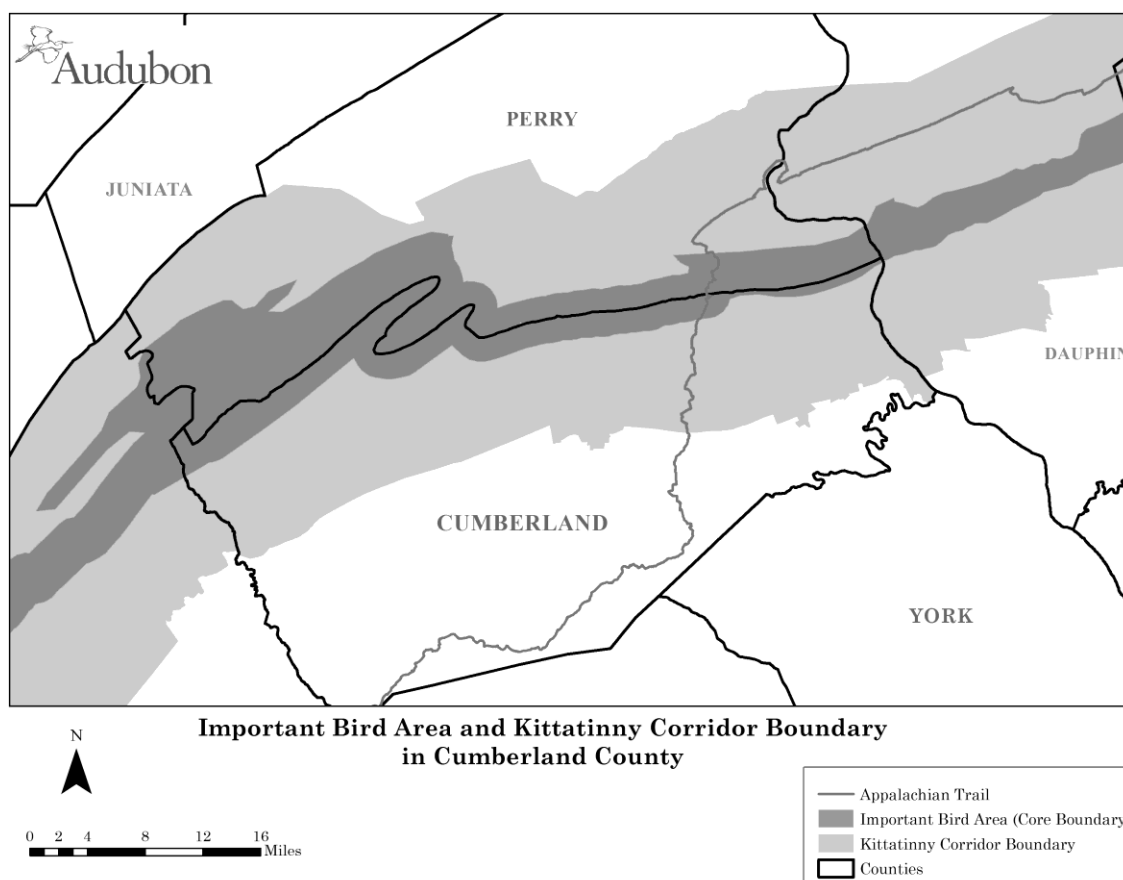


Figure 2. Important Bird Area and Kittatinny Corridor Boundary in Cumberland County



Source: Audubon Pennsylvania

The objectives of this study are to determine the following:

1. The monetary value of natural system services to families, local communities and businesses.
2. The monetary value of improved air quality due to forest resources and reduced health care costs.
3. The monetary value of outdoor recreation and the number of people who participate in it.

Different valuation approaches were used to express the economic significance of natural systems services, air quality, and outdoor recreation. Each methodology is explained, and detailed information and results are provided.

It is important to note that economic data presented in this study *approximates* the value of open space in Cumberland County, taking into account the broad variety of land cover, economic activities, recreational activities, natural system services, and other factors that exist or occur on open space.

This study is intended to heighten awareness of the economic benefits of open space to residents, municipalities and businesses in Cumberland County. Its purpose is to help further the dialogue about the role of open space in the Cumberland County economy, quality of life, cost of living and good health and well-being of its residents.

The Place

The wooded ridges of Cumberland County are a scenic and natural resource that are valued by citizens and visitors to the area. Approximately 30% of the County is covered by woodlands and the wooded areas are primarily located along the County's northern and southern ridge lines.²² The Kittatinny Ridge aligns with the northern boundary of the county, and the South Mountain ridge aligns with a portion of the southern boundary of the county. The central valley of the county and the lower portion of the northern ridge have small wooded lots, primarily associated with areas of steep slopes and streams.

Both the Kittatinny Ridge (also known locally as Blue Mountain or North Mountain) and South Mountain provide internationally-recognized Important Bird Areas that play a major role in bird migration in the Atlantic Flyway (Figure 2). These resources are essential to migrating and resident birds, as well as the ecology of both North and South America.

According to Audubon Pennsylvania, over 40% of migrating birds are in conservation need.²³ This means more of the right habitats are needed. The goal is to maintain critical open space and natural systems while allowing for sustainable development.



Part of Cumberland County's attraction for growth is the region's scenic mountains and farmland views, river corridors, pristine groundwater, large forest habitat, and a variety of recreation opportunities. All this is provided by open spaces.

A View from the Appalachian Trail. Credit unknown

Here are some statistics about natural resources in Cumberland County:

Agricultural Lands²⁴

- Approximately 16,850 acres of prime farmland are permanently preserved through the County Farmland Preservation Program²⁵

²² 2004 FIA Database, 2007 Penn State Timber Market Report; 2004 USDA Forest Service, Northeast Forest Experimental Station GTR NE-126; 2004 USDA Northeastern Forest Experimental Station GTR NE-136; USDA Census of Agriculture 2002; 2007 PA Department of Labor; Minnesota IMPLAN group, Inc. 2004 data.

²³ National Audubon Society. (2011). Annual Report of the National Audubon Society, Conservation Flyways.

²⁴ Retrieved from

http://www.agcensus.usda.gov/Publications/2012/Online_Resources/County_Profiles/Pennsylvania/cp42041.pdf

²⁵ This statistic is current as of December 2014.

- Land in farmland = 155,000 acres, 1,415 farms
- Approximately 11% of county farmland is permanently protected²⁶
- \$195M = market value of Cumberland County Agricultural Products
⇒ 30% crops / 70% livestock, livestock products

Natural Resources²⁷

- 39% of Cumberland County has “prime soils,” the most productive soils in the country for crop production
- Letort Spring Run & Yellow Breeches Creek are designated PA Scenic Rivers. There are two scenic rivers in the county out of 13 waterways so designated in the Commonwealth. The federal government designated six scenic rivers in Pennsylvania.
- Sensitive Environmental Features:
 - ⇒ Woodlands, 30% of county
 - ⇒ 15+% Slopes, 12% of county
 - ⇒ Floodplains, 5% of county
 - ⇒ Wetlands, 2% of county

Parks, Trails & Greenways²⁸

- Cumberland County has approximately 55,000 acres (15% of County) of protected parks and natural areas including:
 - ⇒ 2 state forests
 - ⇒ 3 state parks
 - ⇒ 4 state game lands
 - ⇒ 140+ municipal parks
 - ⇒ 355,000 acres of federal park lands
- Cumberland County has 220+ miles of trails
- Cumberland County has three official water trails – Yellow Breeches Creek, Conodoguinet Creek, and Susquehanna River
- Cumberland County is home to more than 45 miles of the Appalachian National Scenic Trail (A.T.).



Fun on the A.T. Credit unknown

The A.T. is the most famous hiking trail in the United States, extending 2,189 miles from Georgia to Maine. More than 45 miles of the A.T. meander through the Cumberland Valley, including a 13-mile section that is the longest and flattest section on the entire trail and one of the most accessible portions to park and take a short day trip. Pine Grove Furnace State Park is the midway point of the A.T.²⁹

Even the most casual review of Cumberland County’s growth and consequent loss of open space reveals the potential for added environmental risk. Damage to natural systems is caused by forest

²⁶ This statistic is current as of December 2014.

²⁷ Cumberland County. (2013). *Land Partnerships Plan: A Countywide Strategy*.

²⁸ Ibid.

²⁹ Cumberland Valley Visitors Bureau. (2012). *Appalachian Trail*. Retrieved from <http://www.visitcumberlandvalley.com/listings/Appalachian-Trail/1252/>.

fragmentation, loss of habitat, clearing of land near streams, introducing invasive species, and over-grazing by deer.

As open space continues to be lost to development each year – four percent from 2004-2011 – what is left will need to provide more services in less available space. A hopscotch landscape pattern of small patches of open space will not provide for sustainable populations of wildlife and native plants.

Cumberland County is in a position to sustain its economy, quality of life, and health of its residents while maintaining a low cost of living. With less open space remaining, the size, quality, location, and



Green corridors.

connectivity of open space will determine the future quality of life and cost of living in Cumberland County. The large forests and stream corridors are like veins of biological diversity, which drive natural system services and recreational opportunities.

Without connected habitats and corridors, the full value of open space may not be realized, and these precious benefits may be significantly diminished or lost forever.

There has been a lot of great conservation work done in Cumberland County. Perceptions about the value of the environment and conservation continue to change. With this positive trend and commitment of government and residents, this work can continue and ensure a foundation for a vibrant, balanced economy; high quality of life; low cost of living; and good health and well-being for future generations.

Open Space Consumers

The 2013 estimated population for Cumberland County is 241,212.³⁰ The population is expected to grow by 20,000 people over the next 30 years. In Cumberland County, 5.2% of residents are younger than five years old. 20.3% are younger than 18 years old, and 16.6% are older than 65 years. While the ranks of the young and middle-aged may rise and fall over the next 25 years, the population of senior citizens, as a percentage of the total population, will steadily increase over the next 30 years.³¹

Households

³⁰ Census Bureau, US Department of Commerce. *2013 Population Estimates.*

³¹ Census Bureau, US Department of Commerce. *2013 Population Estimates.*

Cumberland County has 96,667 households with approximately 2.36 persons in each.³² These are homeowners and renters who use Cumberland County's natural resources. Approximately 88% are Caucasian (non-Hispanic), 3.4% African-American, 3.3% Hispanic, 3.5% Asian, 0.1% Native American, and 1.6% two or more races.³³

Government

The 11 boroughs and 22 townships, having a more complete understanding of the fiscal implications of open space, will be better equipped to set priorities and strike a balance between open space and other objectives. Government policies that favor greenery and outdoor opportunities will also benefit from better opportunities for economic development.³⁴

Businesses

Taken together, Cumberland County's location and natural resources make the region very business-friendly. The quality and quantity of resources available to businesses are critical to business function. The recreational opportunities available on open spaces contribute to the health of the region's workforce, translating into avoided medical and workers' compensation costs, as well as lost productivity costs.

Change

The choices made about the environment today will have a dramatic impact on the future of Cumberland County. New development increases the demand for recreation, water supply, stormwater management, clean air and water, and many other nature-based services. Consequently, businesses, governments, and households have to work together to manage the remaining open space in ways that result in the highest return on the environment.

Business managers, policy makers, and residents need better information about the value of natural systems in order to make informed choices. Land use decisions often require a choice between preserving the land in its existing state or converting it to developed uses. Businesses need to take a broader look at their processes and practices to become more environmentally aware and households should learn more about stewardship at home and in their own backyards.

Trends and Emerging Awareness about Open Space

While every facet of the economy has emerging trends, several trends relate directly to natural systems, open space, and economic development. These help us explain the world in which the trends exist, why different trends have not emerged, what new trends and patterns might arise, and how designing new outcomes can have a positive influence on our culture and future.

We don't want to just see trends, we want to use them to understand our future quality of life, economy, and cost of living. We want to decide which trends will reinforce the desired future of Cumberland County. In this report, 10 primary, interrelated changes that relate to the role of the

³² Census Bureau, US Department of Commerce. *2013 American Community Survey 1-year Estimate*.

³³ Census Bureau, US Department of Commerce. *2013 Population Estimates*.

³⁴ Gallup, Inc., and the John S. and James L. Knight Foundation. *Knight Soul of the Community 2010*. Retrieved from <http://knightfoundation.org/sotc/overall-findings/>.

environment in Cumberland County's future are examined. Awareness of these changes can help decision-making to be guided by a combined understanding and similar goals.

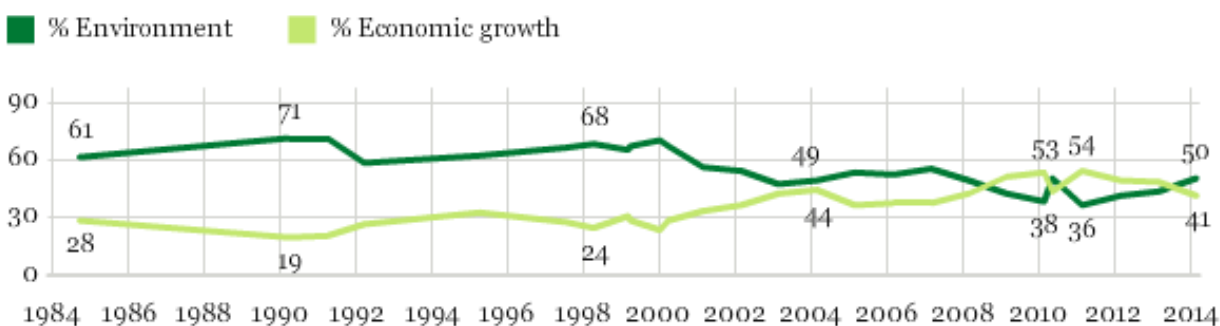
1. The attitudes of different age groups toward the environment are changing.

For more than 30 years, Gallup, Inc., has done surveys about people's attitudes toward the environment and economic growth.³⁵ The Gallup Poll posed the question as a choice between protecting the environment or economic growth (Figure 3). From 1985 until the early 2000s, there was a significant favoring of environmental protection with mixed results in more recent polls.

Figure 3.

Prioritizing Environmental Protection vs. Economic Growth, 1984-2014

With which one of these statements about the environment and the economy do you most agree -- [ROTATED: protection of the environment should be given priority, even at the risk of curbing economic growth (or) economic growth should be given priority, even if the environment suffers to some extent]?



GALLUP

Americans from age 18 – 29, are most likely to say the environment should be given priority over economic growth, by a 60% to 30% margin. Americans 65 and older say that economic growth should be prioritized, by a margin of 50% to 39%. Both 30 – 49-year-olds and 50 – 64-year-olds prioritize the environment over economic growth, but the gap between the two topics narrows as the cohort ages.³⁶

Without better public understanding of the extent to which a healthy, protected environment contributes to the economy, it may be difficult to convince people that the protection and restoration of open space is extremely important. Local decision-makers need educational tools to stay informed and so they can make sound decisions on development, environmental protection, and investment issues.

2. Attachment to where people live and their quality of life is impacting economic development.

While “quality of life” has long been a traditional public policy goal, there is no commonly-understood definition. The concept exists in a wide range of contexts, including standard of living and employment

³⁵ Swift, A. (2014). Americans Again Pick Environment Over Economic Growth. *Gallup Poll Social Series*. Retrieved from www.gallup.com/poll/168017/Americans-again-pick-environment-economic-growth.aspx.

³⁶ Ibid.

but also the built environment, physical and mental health, education, recreation, leisure time, and social belonging.

“What makes a community a desirable place to live? What draws people to stake their future in it? Are communities with more attached residents better off? Gallup and the John S. and James L. Knight Foundation launched the Knight *Soul of the Community* project in 2008 with these questions in mind. [Interestingly, a]fter interviewing almost 43,000 people in 26 communities over three years, the study found that three main qualities attach people to place.”³⁷

- Social Offerings - Places for people to meet each other and a strong feeling that the community cares about its residents.
- Openness - How welcoming the community is to different types of people, including families with children, minorities, and talented college graduates.
- Aesthetics - The physical beauty of the community, including the availability of parks and green spaces.

The main drivers of attachment show little difference across communities. In addition, the same drivers rose to the top in every year of the study. Open spaces with scenic views, tree-lined streets, parks, trails, and other recreation opportunities create a sense of place and attachment of people to a town or region. Attachment to place is an important metric for communities, since it links to key outcomes like local economic growth (Gross Domestic Product).

3. The “green business” trend is tied to open space.

What do Air Products, Coca Cola, Waste Management Corporation, Knoll Furniture, and Chipotle restaurants all have in common? They all want to be the “greenest” provider in their respective market sector for two reasons. First, because being “green” increasingly follows the trends in their customers' values. Second, because it saves money. At the corporate level, the green light is beginning to shine bright. Even during the recession, “going green” increased rather than decreased.³⁸

PricewaterhouseCoopers expects this “will continue to abound for years to come” and notes that “companies reporting sustainability efforts have a greater return on assets than companies that do not. For example, it may cost more to install solar panels, but monthly savings on energy bills add up fast.”³⁹

Many sustainable companies have a longer-term vision and have committed to both natural and social capital. *Social capital* is networking between people and organizations that leads to accomplishing a goal of mutual social benefit. Many green corporations are looking for places to share their social capital.

³⁷ John S. and James L. Knight Foundation. (2006-2015). Retrieved from knightfoundation.org/subcategories/soul-community/.

³⁸ Haanaes, K., Arthur, D., Balagopal, B., Kong, M. T., Reeves, M., Velken, I., Hopkins, M., & Kruschwitz, N. (2011). Sustainability: The Embracers' Seize Advantage. *MIT Sloan Management Review*. Retrieved from <http://sloanreview.mit.edu/reports/sustainability-advantage/>.

³⁹ FranchiseHelp Holdings, LLC. (2012). *Green Industry Analysis 2015 – Costs and Trends*. Retrieved from <https://www.franchisehelp.com/industry-reports/green-industry-report/>.

Consumer goods giant, Unilever, demonstrates how to progress past tracking sustainability trends to improve company culture. CEO Paul Polman, has established a vision to double growth and cut environmental impact in half over the next eight years.⁴⁰ Some regions, such as the Tennessee Valley, are actually certifying regions as “sustainable” using independent consultants to make them more competitive as part of their economic development strategy.⁴¹

4. Knowledge about nature’s impact on stress management, healthy lifestyles and breathing is expanding.

Access to open space improves not just “the bottom line,” but our waistlines, general health, and breathing. Nature impacts our health in important ways—it provides opportunities for exercise, contact with nature, and gives us cleaner air. Open space provides the venue for healthy lifestyles and inspires people to get outdoors.

Exercise is medicine, according to the American College of Sports Medicine. Open space inspires people to get outside and exercise and have contact with nature. The benefits are significant. Research has shown that adequate exercise can reduce rates of heart disease, diabetes, colon cancer, and Alzheimer’s by at least 40%, saving on healthcare costs.⁴²

Our children may be the first generation at risk of having shorter lifespan than their parents. Sedentary lifestyles and physical inactivity have contributed greatly to the numerous health problems plaguing today’s children and adults. Chronic conditions such as childhood obesity, asthma, attention-deficit disorder, and vitamin D deficiency have all increased over the past few decades. Outdoor activity in natural environments can help to provide healthy solutions to these alarming trends.

Sources: Ludwig, D. S (2007). Perrin, et.al. (2007) Committee of Environmental Health (2009)

“Being physically active is one of the most important things people of all ages can do for their health,” according to Joan Dorn of the Centers for Disease Control and Prevention (CDC).⁴³ She noted “that walking is rated as American adults’ favorite physical activity. As little as 30 minutes every day is one way to achieve significant health benefits.”⁴⁴

One of the top 10 reasons people participate in outdoor recreation is to exercise and stay fit. The two most popular ways to exercise are walking on streets or walking on trails.⁴⁵

⁴⁰ Unilever. (2012). Unilever Sustainable Living Plan: Progress Report 2012, 2-3. Retrieved from http://www.unilever.co.uk/Images/USLP-Progress-Report-2012-FI_tcm28-352007.pdf.

⁴¹ Tennessee Valley Authority Economic Development. (2015). Sustainable Development, Valley Sustainable Communities Program. Retrieved from www.tvaed.com/sustainability.htm.

⁴² American College of Sports Medicine. (2014). Exercise is Medicine. Retrieved from exerciseismedicine.org.

⁴³ Walljasper, J. (2013). *Talking ‘Bout a Revolution? It’s Simpler Than You Might Think*. Rails to Trails Conservancy. Retrieved from www.railstotrails.org/trailblog/2013/april/19/talking-bout-a-revolution-its-simpler-than-you-might-think/.

⁴⁴ Walljasper, J. (2013). *A Walking Revolution: The Movement Makes Americans Happier*. Every Body Walk! Retrieved from www.peoplepoweredmovement.org/site/images/uploads/Walking_revolution_smaller.pdf, 1.

⁴⁵ Outdoor Foundation. (2012). Participation Survey.

In his book *The Nature Principle*, Richard Louv explains that there is a growing body of evidence that contact with nature reduces stress and depression; reduces blood pressure; increases concentration, creativity and learning, and connects people to their community. Other studies have made similar conclusions.⁴⁶

- Nature can increase or reduce stress which, in turn, impacts our bodies. What you are seeing, hearing, or experiencing at any moment is changing not only your moods and attitude, but also how your nervous, endocrine, and immune systems are working.⁴⁷
- Exposure to nature not only makes you feel better emotionally, it contributes to your physical wellbeing, reducing blood pressure, heart rate, muscle tension, and the production of stress hormones within three to four minutes of having contact with nature. It may even reduce mortality rates, according to public health researcher Stamatakis.⁴⁸

Time in and experiences of the natural world are associated with psychological wellbeing, meaningfulness, and vitality.⁴⁹ Time in nature or viewing nature scenes increases our ability to pay attention. As humans find nature inherently interesting, they can naturally focus on what they are experiencing out in nature.⁵⁰

Research points to the fact that it is important to get outside. Residents in Chicago public housing who had trees and green space around their building reported knowing more people, having stronger feelings of unity with neighbors, being more concerned with helping and supporting each other, and having stronger feelings of belonging than did tenants in buildings without trees.⁵¹ In addition to this greater sense of community, they had a reduced risk of street crime, lower levels of violence and aggression between domestic partners, and a better capacity to cope with life's demands, especially the stresses of living in poverty.⁵²

5. People are increasingly interested in outdoor recreation.

⁴⁶ Louv, R. (2011). *The Nature Principle*. Chapel Hill, North Carolina: Algonquin Press.

⁴⁷ Bowler, D. E., Buyung-Ali, L. M., Knight, T. M., & Pullin, A. S. (2010). A systematic review of evidence for the added benefits to health of exposure to natural environments. *BMC Public Health*, 10, 456.

⁴⁸ Stamatakis, E., Hamer, M., & Dunstan, D. W. (2011). Screen-Based Entertainment Time, All Cause Mortality, and Cardiovascular Events: Population-Based Study with Ongoing Mortality and Hospital Events Follow-Up. *Journal of American College of Cardiology* 57:3. Retrieved from <http://www.sciencedirect.com/science/article/pii/S0735109710044657>.

⁴⁹ Kim, T. (2010). Human brain activation in response to visual stimulation with rural and urban scenery pictures: A functional magnetic resonance imaging study *Science of the Total Environment*, 408(12), 2600.

⁵⁰ Cervinka, R., Röderer, K., & Hefler, E. (2012). Are nature lovers happy? On various indicators of well-being and connectedness with nature. *Journal of Health Psychology*, 17(3), 379-388.

⁵¹ Ulrich, Rogers S. 1984. "View through a Window May Influence Recovery From Surgery". *Science* 224.4647 (1984) <http://www.sciencemag>.

⁵² Ulrich, R. S, Simmons, R., Lostio, B., Fiorito, E., Miles, M. A. Miles, & Zelson, M., (1999). Stress Recovery During Exposure to Natural and Urban Environments. *Journal of Psychology* 11, 201-230.

⁵⁰ Ulrich et al, XX.

⁵¹ Coley, R., Kuo, F. E., & Sullivan, W. C. (1997). Where does community grow? The social context created by nature in urban public housing. *Environment and Behavior*, 29(4), 468.

⁵² Kuo, F. E. & Sullivan, W. C. (2001). Environment and Crime in the Inner City Does Vegetation Reduce Crime? *Environment and Behavior*, 33, 343.

⁵²: Bowler, D. E., Buyung-Ali, L. M., Knight, T. M., & Pullin, A. S. (2010). A systematic review of evidence for the added benefits to health of exposure to natural environments. *BMC Public Health*, 10, 456.

Outdoor recreation is a larger and more critical sector of the American economy than most people realize. An analysis of comparable activities demonstrates that the outdoor recreation economy grew approximately 5% annually between 2005-2011 during the economic recession when many industries contracted.⁵³

Residents value outdoor recreation and open space with good reason. They recognize that outdoor recreation and open spaces are key ingredients to healthy communities, contribute to a high quality of life, and attract and sustain businesses and families.⁵⁴

At the core of the outdoor recreation economy is the outdoor consumer, whose diverse interests fuel a robust and innovative local economy. Today's outdoor lovers seek meaningful outdoor experiences in their backyards, on trails and roads, and in the backcountry. They are all genders, ages, shapes, sizes, ethnicities, and income levels. They live throughout Cumberland County, and they view outdoor recreation as an essential part of their daily lives. They purchase bicycles, dirt bikes, backpacks, tents, hunting rifles, and fishing gear. The Outdoor Industry Association states "outdoor recreation is no longer a 'nice to have,' it is now a 'must have' as leaders recognize the economic, social and health benefits of outdoor recreation."⁵⁵

Trend data from the US Forest Service's National Survey on Recreation and the Environment (NSRE) shows that several activities are growing: viewing birds (22.8%), other wildlife besides birds (25.4%), wildflowers/trees (29.4%), natural scenery (17.9%), and fish (21.4%).⁵⁶ NSRE explains that while "traditional" forms of outdoor recreation such as hunting and fishing have been declining or are experiencing very slow growth, other viewing and photographing of nature activities have increased dramatically.⁵⁷

The Pennsylvania Department of Conservation and Natural Resources (DCNR) did a study in 2009 to determine participation rates and levels of spending on outdoor recreation in Pennsylvania. 31% of the respondents said they planned to increase their outdoor activity over the next five years. Younger people (ages 6 – 16) and those with higher incomes said they were more likely to increase their outdoor recreation. About half of Baby Boomers (ages 44 – 62) expected to increase their outdoor activity, compared to 25% of their older counterparts.⁵⁸ The reasons why people participate in outdoor recreation vary; however, nature and health are the primary reasons.⁵⁹

Cumberland County has a wonderful variety of trail experiences, such as the A.T., Cumberland Valley Rail Trail, Darlington Trail, Tuscarora Trail, and others. Walking, running, and bicycling on trails are the top crossover activities, demonstrating that people who do these activities are most likely to try other

⁵³ Cordell, K. (2012). *Outdoor recreation trends and futures: A technical document supporting the Forest Service 2010 RPA assessment*. USFS Southern Research Station: Asheville, NC.

⁵⁴ Outdoor Industry Association. (2013). *The Economic Contributions of Outdoor Recreation: Technical Report on Methods and Findings*.

⁵⁵ Ibid.

⁵⁶

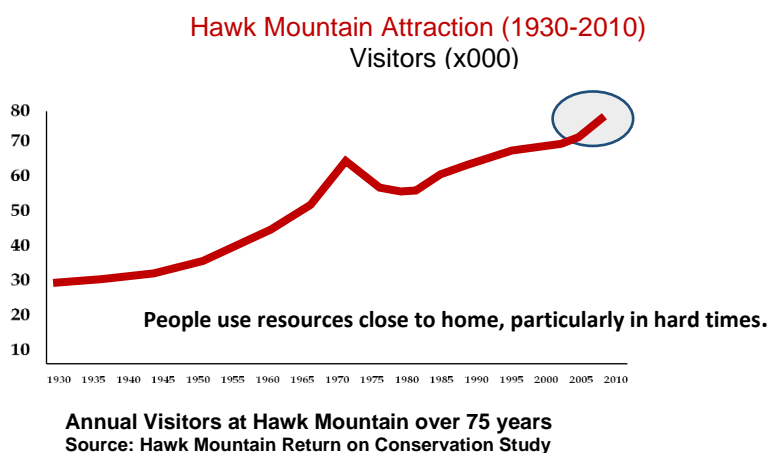
⁵⁷ Cordell, K. (2012). *Outdoor recreation trends and futures: A technical document supporting the Forest Service 2010 RPA assessment*. USFS Southern Research Station: Asheville, NC.

⁵⁸ Department of Conservation and Natural Resources (DCNR), (2009). *Outdoor Recreation Participation Survey*. Note: this question was not asked in 2014.

⁵⁹ Department of Conservation and Natural Resources (DCNR), (2014). *Outdoor Recreation Participation Survey*. Outdoor Foundation. (2013). *Outdoor Participation Survey*.

activities.⁶⁰ Demand for high-quality recreation remains high even in difficult times. The participation rate at Berks County's Hawk Mountain increased during the recent recession. Visitor numbers increased at a faster rate during the last recession than at any time in the last 30 years, as shown in Figure 4.⁶¹ While no studies have been done in Cumberland County, similar results are expected.

Figure 4. Visitors to Hawk Mountain



Local resident participation in outdoor recreation and ecotourism will likely increase due to population growth, a growing interest in exercise and getting outdoors, the region's environmental quality and close proximity to millions of people. Available local open space is also particularly important in volatile economic times.

6. Investing in green infrastructure can be very cost-effective.

Numerous examples exist of how local decision-makers have elected to restore the environment instead of spending more money on traditional gray infrastructure (e.g., pipes, roads, and treatment plants). In some cases, decision-makers have found that the environment creates infrastructure solutions that are less expensive and more reliable.⁶² The natural environment can help keep the cost of living low. In Figure 5, the World Resources Institute shows comparisons between green and gray infrastructure.

Many gray infrastructure projects are very expensive to engineer. An engineered natural system service like stormwater management or flood control may only provide a fraction of the services provided by natural system services.⁶³

In a study of 27 US water suppliers, researchers found that protecting forested watersheds used for drinking water sources can reduce capital, operational, and maintenance costs for drinking water treatment.⁶⁴ Researchers found that watersheds with greater percentages of protected forest correlate

⁶⁰ Cumberland County Department of Tourism. 2014

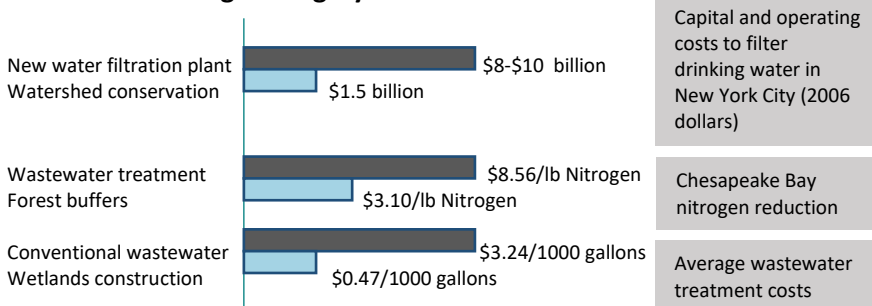
⁶¹ Hawk Mountain. 2012. Return on Conservation Study. Keystone Conservation Trust.

⁶² Hanson, C., Talberth, J., & Yonaviak, L. (2011). Forests for Water: Exploring Payments for Watershed Services in the US South. *World Resources Institute Brief 2*.

⁶³ US Environmental Protection Agency. 2012. The Economic Benefits of Protecting Healthy Watersheds. EPA 841-N-12-004

⁶⁴ Ernst, C., Gullick, R., Nixon, K. (2004). Conserving Forest to Protect Water. *Opflow 30:1,4-7*

Figure 5. Watershed Protection is less expensive than building new “gray infrastructure”



Source: Hanson, Craig et al. (2011). *Forests for water: exploring payments for watershed services in the US South.* World Resources Institute Issue Brief, Issue 2, 15.

to fewer water treatment expenditures: an increase in 10% of a watershed forest decreases treatment costs by 20% - 60% forest cover of the watershed.⁶⁵ The study documents what many people already know—that keeping a watershed forested reduces water treatment costs (Table 2).⁶⁶ An Environmental Protection Agency (EPA) study of drinking water source protection efforts concluded that every \$1 spent on source-water protection saved an average of \$27 in water treatment costs.⁶⁷

Headwater protection is essential to control surface water treatment costs and to maintain basic water quality and the health of aquatic organisms. Wetlands, riparian forests, and headwaters provide some

Share of forested watershed	Treatment Share of forested costs/ 3,000 m2	Average annual treatment cost	Cost increase over 60% forest cover
60%	\$29	\$297,110	-----
50%	\$36	\$369,380	24%
40%	\$46	\$465,740	57%
30%	\$58	\$586,190	97%
20%	\$74	\$746,790	151%
10%	\$91	\$923,450	211%

Source: Ernst et al (2004).

of the highest value to the local economy based on Robert Costanza's work on natural capital.⁶⁸

In Pennsylvania, there are several examples in which improvements in green infrastructure ultimately led to reduced wastewater treatment costs:

1. In 2007, Mount Joy Borough in Lancaster County became the first municipality in Pennsylvania to implement nutrient trading as part of its

overall permit compliance plan. The borough invested \$2.9 million in treatment plant improvements and partnered with a local farmer who generated credits by converting more than 900 acres from traditional cultivation to continuous no-till agriculture. The borough paid the farmer for the credits. Mount Joy reduced its annual projected cost for nutrient treatment using the trading option from \$382,500 per year to \$248,000 per year—a 35% reduction.⁶⁹

⁶⁵ Ernst et al (2004).

⁶⁶ Ernst et al (2004).

⁶⁷ Hanson, C., Talberth, J., & Yonaviak, L. (2011). *Forests for Water: Exploring Payments for Watershed Services in the US South.* World Resources Institute Brief 2.

⁶⁸ US Environmental Protection Agency. 2012. *The Economic Benefits of Protecting Healthy Watersheds.* EPA 841-N-12-004

⁶⁹ Pennsylvania Environmental Council, *Nutrient Trading.* 2008 (Communication on case studies)

2. Fairview Township, York County, has agreed to purchase 20,000 nitrogen credits per year for the next 15 years from the Red Barn Trading Company of Lancaster. The municipality estimated that the cost to upgrade its sewer facility and sewage treatment plant would be \$6.2 million, which would have required a rate increase of \$22 per quarter for each resident. Under the nutrient trading agreement, residents will only see a \$9 increase per quarter—a 41% reduction.⁷⁰

Maintaining “green infrastructure” in riparian areas provides a supporting network for ecological integrity, ensuring the sustainable and cost-effective provision of clean water over time. Watersheds that maintain protected riparian corridors are expected to be more resilient to the anticipated effects of climate change. Riparian areas that are connected by groundwater to their landscape can maintain their functionality, are more adaptable to change, and are better equipped to handle large storm events.⁷¹ It is very cost-effective to invest in green infrastructure. Natural system restoration has shown investment returns in Pennsylvania of \$7 – \$12 for every \$1 spent.⁷²

There is a growing movement to reduce infrastructure costs and maintain a low cost of living by protecting wetlands, forests, and wooded areas along streams. Using natural systems effectively can expand natural system services at little to no cost. Green infrastructure is often the least-cost and most-reliable solution to watershed protection. The greatest return on investment is the leverage created by maintaining and restoring headwaters.

7. The pattern, size, and connectivity of open space and native habitat is increasingly important.

Mountains, forests, and streams are the historic, natural hallmarks in any regional landscape in Pennsylvania, including Cumberland County. Existing open space serves as habitat for a diverse array of native plants and animals. Habitat is the place in which an organism or population normally lives. It is made up of abiotic factors such as soil, moisture, range of temperature, and availability of light, as well as biotic factors such as the availability of food and the presence of predators. A substantial amount of scientific literature about the requirements of individual species as well as groups of species, patterns, and consistencies have begun to emerge. Habitat size, shape, and location matters in developing sustainable populations of wildlife, and corridors provide connectivity for many species. More than just “green infrastructure,” the approach to habitat management requires knowledge on how large forests and how wide corridors should be and what patterns of forests of varying sizes will sustain healthy wildlife populations.⁷³

Riparian forests—forests found adjacent to streams—offer a tremendous diversity of habitat. The layers of habitat provided by trees, shrubs, and grasses and the transition of habitats from aquatic to upland make these areas critical to the life stages of more than one-half of all native species. Protecting stream

⁷⁰ Ibid.

⁷¹ US Environmental Protection Agency. 2012. The Economic Benefits of Protecting Healthy Watersheds. EPA 841-N-12-004

⁷² Department of Recreation, Park, and Tourism Management, The Pennsylvania State University Keystone Fund Report; www.tpl.org/Pennsylvania; (2012). *The Economic Significance and Impact of Pennsylvania State Parks: An Updated Assessment of 2010 Park Visitor Spending on the State and Local Economy, 2012*.

Trust for Public Land. (2013). *Pennsylvania’s Return on Investment in the Keystone Recreation, Park, and Conservation Fund*, DCNR.

⁷³ Audubon Pennsylvania. (2012). *Planning for Forest Birds*. Blue Ridge Mountains, Kittatinny Ridge Conservation Project.

corridors is very important in maintaining habitat.⁷⁴ The enactment of Act 162 in 2014, which altered mandatory riparian buffer requirements, has ramifications that will present challenges to the preservation and maintenance of riparian buffers.

Streams that travel through woodlands provide spawning habitats for fish. Trees and woody debris provide valuable cover for small fish and other aquatic organisms along the water's edge. Degradation of any portion of a stream can have profound effects on living resources downstream. While the overall impact of these riparian forest corridors is greatest in headwaters and smaller order streams, there is a clear link all the way downstream. Riparian buffers can absorb 200% - 800% more nitrogen than non-wooded buffers.⁷⁵

The size, quality, shape, location, and connectivity of open space will determine how well the economy, quality of life, health, and cost of living will be maintained. The full value of open spaces cannot be realized unless the open space system of large habitat areas and riparian and upland corridors are intact.

8. Conservation on private property is becoming increasingly critical.

Over 85% of land in Pennsylvania is privately owned.⁷⁶ Finding ways to improve environmental stewardship on private land helps to significantly expand open space and natural system services. Conservation design focuses on creating higher-quality developments by clustering home sites to preserve open space and environmentally-sensitive areas and maintaining landscape connectivity. These practices often save money and increase home values when compared to traditional development.

There are an increasing number of programs available to help landowners become better stewards of developed properties, including Audubon's *Bird Town* and *Important Bird Areas* program, the Fish and Wildlife Service's *Backyard Habitat Program*, *Urban and Community Forestry-USDA*, and EPA's *Healthy Watershed Program*.

Best Practices for Backyard Conservation:

- Plant native trees, shrubs, grasses and flowers.
- Reduce the size of your manicured lawn.
- Reduce mowing frequency.
- Create flowerbeds on the perimeter of the lowest areas of your property and consider rain gardens.
- Avoid using toxic chemicals.
- Use slow-release fertilizer (1/4 dose).
- Create three-inch berms on slopes to slow runoff.
- Plant trees and grasses in riparian zones.

Source: John Rogers. (2012). *Designing With Natives*, Conservation Strategies Inc.

The annual value of natural systems in these areas ranges from \$3,000 – \$10,000 per acre.⁷⁷ The closer to top quality streams, the higher the value. Increasing the size and connectivity of these open space areas with conservation design and stewardship improves natural systems, increases the tax base, reduces infrastructure costs, and helps maintain the community's "sense of place."

⁷⁴ Newbold, J. D., Herbert, S., Sweeney, B. W., Kiry, P., & Alberts, S. J. (2010). Water quality functions of a 15-year-old riparian forest buffer system. *Journal of the American Water Resources Association*. 1-12. DOI: 10.1111/j.1752-1688.2010.00421.

⁷⁵ Stroud Water Research Lab. 2004. *Forested Buffers: The Key to Clean Streams*. Chesapeake Bay Foundation

⁷⁶ US Census, 2012. <http://www.summitpost.org/public-and-private-land-percentages-by-us-states/186111>

⁷⁷ Costanza et al. (2006).

Where properties abut natural areas, planting native plants and implementing best management practices will also substantially increase natural system services. This is an important consideration when compared to traditional development.

Many private landowners are opting to place conservation easements on their prime farmland, woodland, forested slopes, and riparian buffers, whereby certain land use rights are permanently restricted (primarily development rights) for purposes of protecting the conservation values and natural resources on their properties. Local land trusts offer conservation easement donation programs and easement purchase programs, both of which may provide significant tax benefits and/or fair market value compensation for the value of the easement. The PA Fish and Boat Commission offers a riparian buffer easement purchase program on designated stream corridors and the Natural Resource Conservation Service and the PA Game Commission offer funding to private landowners for habitat improvement programs on eligible properties. The Alliance for the Chesapeake Bay has a cost-share program to help landowners with native plant landscape design www.stormwater.allianceforthebay.org/yard-design.

Creating private property stewardship areas (green corridors) along open space areas can significantly increase natural system services at a very low cost. Conservation design is less expensive and provides greater ecological benefits than traditional patterns of development. Stewardship of public and private properties adjacent to open space areas increases the size and connectivity of natural systems and the critical services they provide.⁷⁸

9. Property values are positively impacted by open space.

Square footage, quality of schools, landscaping, and structural condition can raise or lower the value of a home. So can proximity to open space. Whether it's a trail, park, scenic area, or waterfront – people will pay a premium to be near open space. As a result, Cumberland County's existing open space should add to the overall value of its housing stock.

Beginning in the 1970s, studies that focused on the role of more traditional forms of open space, such as parks, determined positive impacts on property values, urban aesthetics, and the environment and established that natural amenities tended to have a positive impact on property values. In these studies, green space can be defined as trees, urban forestry, parks, wetlands, community gardens, water, or other natural amenities. Most of this work has focused on the impact of green space on residential properties, rather than commercial or industrial properties. Park and open space studies have established the positive impacts on property values based on proximity. Properties

The Value of Proximity to Open Space is Positive and Significant

According to a detailed analysis conducted by the Delaware Valley Regional Planning Commission (2011), homes in southeastern Pennsylvania located near protected open space captured a measurable increase in their value because of their proximity.

Suburban properties located less than one mile from protected open space captured an average measurable increase in their value of up to \$10,000.

Delaware Valley Regional Planning Commission and Green Space Alliance, 2011, *The Economic Value of Protected Open Space in Southeastern Pennsylvania*. Publication No. 11033-C, A.7.

⁷⁸ Rogers, J. (2011). *Designing With Natives: a Road Map to Environmental Stewardship Using Native Plants*. Conservation Strategies, Inc.

that abut parks or open spaces tend to see, on average, a 20% premium or increase in value over similar properties.⁷⁹

Recent studies have shown increased property values and tax revenues from properties near open space, green space, walking/biking trails, or riparian areas. Even in tight economic times, a relatively higher premium is placed on properties with access to nature. Clean and healthy waterfronts boost property values and demand for adjacent retail and commercial businesses as well.

People value living near healthy, clean water. Studies show that home values decline by tens of thousands of dollars with declines in water quality.⁸⁰ Preserving healthy watersheds and protecting open space while providing access to people have the potential to boost local revenues while providing attractive amenities.⁸¹

This increased wealth is captured by citizens through higher sale values of homes near open space, and generates increased government revenues via larger property tax collections and transfer taxes at time of sale. While homes that are closer to open space have been shown in other studies to generate a 5.5% - 10% increase in value, all homes in the region are worth more when open space is near. Studies that focus on trees or forested areas demonstrate that proximity to wooded areas or more densely forested areas has a positive impact on property values, particularly if they are available.⁸² In the Lehigh Valley, the average open space premium afforded each home within a ¼ mile distance from open space was \$14,600.⁸³ The total real estate premium attributed to their proximity to protected open space for all single family homes located within ¼ mile of protected open space in the Lehigh Valley was more than \$1.8 billion.⁸⁴

The Costs Related to Traditional Development Compared to Conservation Development

Traditional development requires intensive and costly additions of gray infrastructure to connect new neighborhood road and utility networks. In a review of 98 communities across 21 states, researchers found that, for every dollar received from residential development revenues, an average of \$1.16 was spent on providing services to the new community by the local government. Conservation design provides economic benefits to communities because it consumes less land, needs fewer roads, resources, and utility infrastructure. Additionally, studies have shown that people are willing to pay a premium to live in conservation developments; these premiums provide for greater revenues to local communities.

Source: Crompton, J. L. (2007). *The Impact of Parks and Open Spaces on Property Taxes. The Economic Benefits of Land Conservation*. Ed. Constance T.F. de Brun. The Trust for Public Land, 1-12.

⁷⁹ Crompton, J. L. (2007). The impact of parks and open spaces on property taxes. *The Economic Benefits of Land Conservation*. Ed. Constance T.F. de Brun. The Trust for Public Land, 1-12.

⁸⁰ Crompton, J. L. (2007).

⁸¹ US Environmental Protection Agency. 2012. The Economic Benefits of Protecting Healthy Watersheds. EPA 841-N-12-004.

⁸² Ibid.

⁸³ Lehigh Valley Planning Commission. (2014). *Lehigh Valley Return on Environment: The Economic Value of Open Space in the Lehigh Valley*.

⁸⁴ Ibid.

10. Americans are showing a growing interest in organic, locally grown food, and open space is playing a role.

Native forests and meadows provide pollinators essential to the reproduction of agriculture, landscape, and native plant populations at no cost. Elizabeth Grossman states, “one of every three bites of food eaten depends on pollinators, especially bees, for a successful harvest.”⁸⁵ However, honeybee numbers in Pennsylvania have been declining over the past several years. Beekeepers recorded over-winter losses of 26% – 48% in Pennsylvania between 2006 and 2013.⁸⁶ These losses are much higher than seen in previous years. A rebounding bee population will be important for sustaining local agriculture, landscaping, and native plants. It is essential to actively conserve a diversity of pollinators and sustain natural ecosystems in order to preserve local plant populations. Without a broad effort to protect them, pollinating species could irrevocably decline. Protecting open space protects native plants and pollinators.⁸⁷

Insect populations are suppressed by naturally-occurring organisms and environmental factors. Beneficial insects and birds act as control agents along with predators, parasites, and pathogens. For example, many migrating birds eat over half their weight each day they are migrating. Their diet is mostly protein in the form of insects and rodents. Keeping natural, biological controls in place is imperative to managing pest populations.

Economic Value Analysis

The economic value of Cumberland County’s open spaces is estimated by measuring impact in three areas:

1. The avoided costs associated with natural system services provided by Cumberland County's open spaces;
2. The avoided costs associated with air pollution removal on health, agricultural, and building impacts of trees and natural vegetation;
3. The value of open space related to recreational activity.

The process of estimating the value of natural system services begins by defining natural capital. Natural capital can be defined as Cumberland County’s portfolio of natural assets. This collection of natural assets includes geology, soil, air, water, and all living things. The most obvious natural system services include the food we eat; the water we drink; and the plant materials we use for fuel, building materials, and medicines.

There are also many less-visible natural system services such as climate regulation and natural flood defense provided by forests. Over time, billions of tons of carbon are stored in forests. Forests and

⁸⁵ Grossman, E. (2013). Honeybee populations are collapsing.

⁸⁶ IBID.

⁸⁷ Bryn Mawr College and Rutgers University. (2009). Native bee benefits.

meadows also support natural pollination and biological control of insects and rodents. Less obvious benefits are cultural and natural system services such as awe-inspiring scenic views and increased property values.

Open space creates economic value in four ways:

1. Revenue generation (e.g., sale of goods and services);
2. Wealth generation (e.g., higher property values and earnings from open space-related activities);
3. Increased tax revenues (e.g., increased property tax collections due to higher property values); and
4. Avoided costs (e.g., dollars that would be spent on the provision of environmental services such as improving water quality and removing air pollution in the absence of protected open space).

Conservative approaches were used to estimate monetary values. For example, not all recreational activities were included, nor were all natural system services. Even with this conservative approach, however, the analysis is subject to caveats common to any economic valuation or impact analysis. These caveats include substitution effects, double counting, and value estimation.

Substitution Effects is important to keep in mind when considering the benefits that residents enjoy by recreating and exercising on public parks as opposed to in a private facility. If all open space were to be developed, it is unlikely that residents would altogether stop participating in the recreational activities they now enjoy on parkland. Instead, it is likely that residents would go elsewhere to recreate and thereby replace some of the value they currently derive from recreational activity on public parks. Because of this substitution effect, estimates of recreational value in this study should only be understood to represent the benefit that existing open space in the County provides.

Double Counting occurs when a value is overstated due to it being accounted for in two separate analyses. While this study aims to minimize any double counting, it is expected that some double counting exists in the evaluation of property values. It is expected that smaller double counting may occur between the natural system services and property value impacts and the recreational cost savings.⁸⁸

Value Transfer methods are utilized where data collection proves too costly or time consuming. In surveying existing studies for benefit transfer values (e.g., how much is a ton of carbon dioxide worth when it is removed from the atmosphere or how much is a run on a trail worth to the average individual), there are a range of plausible values to choose from within the research literature. This study draws upon leading researchers that have evaluated a large number of studies and, in most cases, uses an average value among the existing research to apply to the Cumberland County analysis. The values calculated in this economic research are based on the average consumer's activity.⁸⁹

It is important to note that the economic benefits presented in this study are meant to serve as estimates, not exact values. While approximates, they are based on defensible estimation methods and represent a vast improvement over attempting to make economic judgments regarding open space preservation or protection without good data.

⁸⁸ Costanza et al. (2006).

⁸⁹ Delaware Valley Regional Planning Commission and Green Space Alliance (2011) Return on Environment: The Economic Value of Protected Open Space in Southeastern Pennsylvania.

Natural System Service Benefits

Natural system services represent the benefits that human populations derive, directly or indirectly, from ecosystem functions. “Because natural system services are not fully ‘captured’ in commercial markets or adequately quantified in terms comparable with economic services and manufactured capital, they are often given too little weight in policy decisions.”⁹⁰

The natural landscapes of open space provide many environmental benefits to Cumberland County. This study estimates the avoided costs associated with seven natural system services that naturally occur in Cumberland County’s open space including water supply, flood mitigation, provisions for wildlife habitat, pollination, biological control, waste treatment, and soil formation. These represent natural system functions that, if lost, would require costly measures to replicate. The following analysis estimates the value of these services.

The natural system services provided by the natural land cover of Cumberland County vary depending on the type of land cover, with substantial differences in natural system service values based on the type of land cover considered.

The United Nation’s Millennium Ecosystem Assessment (MEA) groups natural system services into the following main categories:⁹¹

- Provisioning Services: the products obtained from ecosystems, such as food and water.
 - ⇒ Hydrologic Services
 - ⇒ Natural protective buffer for water supplies helping to filter out pathogens, excess nutrients, metals, and sediments.
- Regulating Services: the benefits obtained from the regulation of ecosystem and abiotic processes.
 - ⇒ Disturbance mitigation from flooding and biological control and regulation of species including pests, invasive species, and disease vectors.
- Cultural Services: the non-material benefits that people obtain from nature, such as aesthetic experiences.
- Supporting Services: those that are necessary for the production of all other natural system services. These services differ from provisioning, regulating, and cultural services in that their impacts on people are either indirect or occur over a very long time.
 - ⇒ Wildlife Habitat
 - ⇒ Soil Formation/Retention
 - ⇒ Pollination⁹²

⁹⁰ Costanza, R.; d’Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O’Neill, R. V., Paruelo, J., Raskin, R. G., Sutton, P., & van den Belt, M. (1997). The Value of the World’s Ecosystem Services and Natural Capital. *Nature* 387, 253-260.

⁹¹ United Nations. (2001). Millennium Ecosystem Assessment. Retrieved from <http://www.unep.org/maweb/en/index.aspx>.

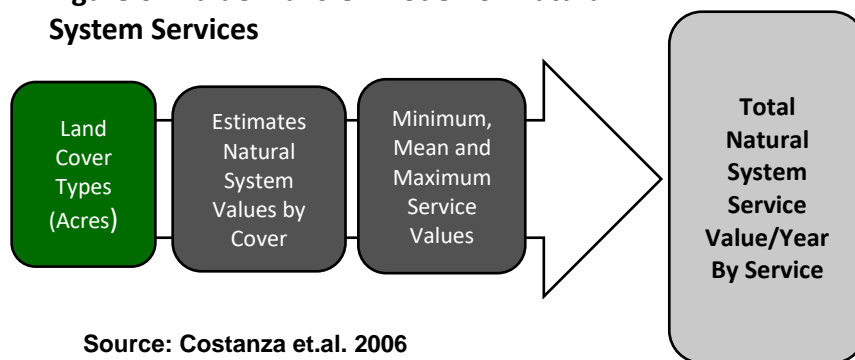
⁹² Costanza et al. (2006).

Methodology

In this analysis, value transfer is used to estimate the ecosystem services discussed above. Value transfer essentially involves the adaptation of existing valuation or data from one location to a similar location. Value transfer is typically used as an alternative strategy when primary research is not possible or justified because of limited time or budget constraints. While value transfer is the alternative strategy, it is much better than the alternative of not accounting for natural system services in the analysis and thereby implying that the value of those services is zero. Value transfer has become a very important tool for policy makers since it can be used to reliably estimate the economic values associated with a particular landscape, based on existing research, for considerably less time and expense than a new primary study (Figure 6).⁹³ The data came from the 2011 (the most recent year available) satellite-derived land cover data from the Multi-Resolution Land Characteristics (MRLC) Consortium.

Costanza et al (2006) compiled and summarized over 100 academic studies comprising 210 individual value estimates for the types of ecosystem present in the state of New Jersey. Due to similarity between the climate, land cover, and ecosystems of New Jersey and our study area, we decided to

Figure 6. Value Transfer Model for Natural System Services



Source: Costanza et.al. 2006

use the studies compiled by Costanza et al (2006) for their study of ecosystem values in New Jersey. The similarities should allow the values used by Costanza to easily “transfer” to our study area. Table 3 (see page 32) includes data on the number of studies reviewed by Costanza – as well as the minimum, mean, and maximum willingness to pay values for each activity. Please note that per-acre values for the different ecosystem services vary by the type of land cover, and Table 4 (see page 33) is an aggregate of all of the land cover values for a given ecosystem service. The natural system service benefits by service area are as follows:

Water Supply

Many land cover types (e.g., forests and wetlands) and their underlying soils help ensure that rainwater is stored and released gradually rather than being allowed to immediately flow downstream as runoff. About 130,000 people in Cumberland County get their water from wells. As Cumberland County grows, the value of water to future residents is very high.

Water Quality

Forests and wetlands also provide a natural protective buffer between anthropogenic activities and water supplies, helping to filter out pathogens, excess nutrients, metals, and sediments. The waste assimilation benefits will primarily be driven by the amount of forest, wetland, and riparian buffer cover.

⁹³ Costanza et al. (2006).

Disturbance (Flood) Mitigation

Many natural landscapes help provide a buffering function that protects humans from destructive perturbations. Forests, wetlands, and floodplains help mitigate the effects of floods by trapping and containing stormwater.

Biological Control

Biological control refers to the dynamic regulation of species populations by native birds and insects including the control of invasive species and unwanted species, such as pest predators, weeds, and disease vectors (e.g., mosquitoes).

Wildlife Habitat

Contiguous patches of land cover with sufficient area to hold naturally-functioning ecosystems support a diversity of plant and animal life. Intact forests and wetlands function as critical population sources for plant and animal species that humans value for both aesthetic value and functional reasons. Native vegetation supports 29 times the biological diversity as non-native plants.⁹⁴

Soil Formation/Retention

Soils provide many of the services mentioned above, including water storage/filtration, waste assimilation, and a medium for plant growth. Natural systems create and enrich soil through weathering and decomposition and retain soil by preventing it from being washed away by precipitation.

Pollination

Pollination is essential for many agricultural crops and substitutes for local pollinators are increasingly expensive. Pennsylvania has been experiencing a severe “bee collapse.” Forests and meadows provide pollination service benefits that are a form of insurance for farmers and nature, should the collapse continue for an extended period of time.

Caveats

The estimates presented in Table 5 (see page 34) are likely a conservative estimate of the value of the services provided by the ecosystems of Cumberland County. As illustrated in Table 4, not all land cover types have been well-studied, and there exist some gaps in the valuation literature. More complete coverage would almost certainly increase the values. Additionally, since most estimates are based on an individual’s estimate of their willingness to pay, which are limited by their perceptions and knowledge base, increasing their knowledge of the contribution that various ecosystem services make to their welfare would almost certainly increase their willingness to pay values. Furthermore, this analysis uses a static framework that ignores interdependencies and dynamics. More elaborate studies of ecosystem services have shown that including interdependencies and dynamics leads to significantly higher values, as changes in ecosystem service levels ripple through the natural systems and the economy.

Since most services are natural functions, well-functioning markets for these services do not exist. When there are no explicit markets for the services, more indirect means of assessing values must be utilized. The studies analyzed by Costanza et al (2006) utilized a variety of non-market techniques (the list of techniques used for each natural system service is included in Table 3). The techniques are defined as follows:

⁹⁴ Tallamy, D., (2007). *Bringing Nature Home*. Algonquin Books.

- **Avoided Cost (AC):** some of the ecosystem services allow society to avoid costs that would have been incurred in the absence of those services. An example is flood control provided by intact riparian buffers helping to avoid property damage downstream.
- **Replacement Cost (RC):** some of the ecosystem services could be replaced with man-made systems. For example the waste assimilation service provided by wetlands could be replaced with chemical or mechanical alternatives (such as wastewater treatment plants). The replacement cost would be the estimated costs of replacing the natural waste assimilation service with chemical or mechanical alternatives.
- **Travel Cost (TC):** service demand may require travel, the cost of which can reflect the implied value of the service.
- **Hedonic Pricing (HP):** service demand may be reflected in the prices people will pay for the associated goods.
- **Contingent Valuation (CV):** service demand may be elicited by posing hypothetical scenarios that involve some valuation of the alternatives.
- Some of the value estimates of various natural system services included in Costanza, et al. (2006) were obtained from studies that also used Value Transfer (VT) techniques and Direct Market (DM) valuations.

Table 3. Studies Reviewed by Costanza et al (2006)

Natural System Service	Number of Studies	Min	Mean	Max	Valuation Methods
Water Supply	23	\$3	\$1,102	\$3,839	AC (2), CV (12), HP (1), RC (1), TC (5), VT (2)
Waste Assimilation	3	\$44	\$309	\$838	VT (3)
Disturbance Prevention	5	\$6	\$768	\$3,657	AC (3), VT (2)
Biological Control	3	\$2	\$9	\$12	VT (3)
Habitat	12	\$1	\$772	\$3,883	CV (11), VT (1)
Soil Formation	3	\$1	\$3	\$6	DM (1), VT (2)
Pollination	4	\$2	\$56	\$265	AC (1), DM (1), RC (1), VT (1)

Source: Costanza, et al. (2006)

The numbers in parentheses indicates the number of studied reviewed for data.

Table 4 lists the different land covers that have been found to provide various natural system services. To estimate the amount of natural system services provided by the natural areas of Cumberland County, we needed to estimate the amount of various land cover types. We obtained 2011 (the most recent year available) satellite-derived land cover data from the Multi-Resolution Land Characteristics (MRLC) Consortium and used ArcGIS to calculate the acres of 7 different land cover types.

Once specific land cover types were identified, ecosystem flow values for the various land cover types were calculated by multiplying areas of each land cover type, in acres, by the minimum, mean, and maximum annualized dollar value per acre for that cover type as reported by Costanza et al (2006). The total natural system service value of a given type of preserved and undeveloped open space was

determined by aggregating the individual natural system service values associated with each land cover type.

Table 4. Natural System Provided by Different Land Cover Types

Natural System Service	Land Cover(s) Associated with the Ecosystem Service
Water Supply	Forests, Freshwater Wetlands, Open Freshwater, Riparian Buffers
Waste Assimilation	Forests, Freshwater Wetlands, Pasture, Riparian Buffer
Disturbance Prevention	Freshwater Wetlands, Riparian Buffers, Urban Green Space
Biological Control	Cropland, Forests, Pasture
Habitat	Cropland, Forests, Freshwater Wetlands
Soil Formation	Forests, Pasture
Pollination	Cropland, Forests, Pasture

Results

Table 5 presents the natural system service estimates for Cumberland County calculated using the mean, minimum, and maximum values from Costanza et al (2006). The natural systems of Cumberland County currently generate a likely benefit range between \$269.64 million – \$739.13 million.

Table 5. Natural System Service Benefits Calculated Using the Minimum, Mean, and Maximum Values (\$millions/year)

Natural System Service	Min	Mean	Max
Habitat	\$29.14	\$165.69	\$481.77
Water Supply	\$1.10	\$45.03	\$174.79
Flood Protection	\$12.90	\$23.86	\$35.15
Pollination	\$7.90	\$20.76	\$32.72
Water Quality	\$8.10	\$11.40	\$11.50
Biological Control	\$2.10	\$2.10	\$2.10
Soil Formation	\$0.66	\$0.80	\$1.10
Total	\$61.90	\$269.64	\$739.13

Source: Costanza et al (2006)

Air Quality Benefits

Cumberland County faces substantial air quality challenges.⁹⁵ Poor air quality is a common problem in many urban and suburban areas and can lead to a variety of human health problems, including asthma and other respiratory ailments. Additionally, air pollution can also damage buildings and plants, disrupt many natural system services, and can cause reduced visibility and smog. Trees remove significant

⁹⁵ Cumberland County | Clean Air Board of Central PA

amounts of air pollution and consequently improve environmental quality and human health. In particular, trees remove significant amounts of nitrogen dioxide (NO₂), sulfur dioxide (SO₂), carbon monoxide (CO), ozone (O₃), and particulate matter (PM₁₀) from the atmosphere.⁹⁶

Urban and suburban trees also help mitigate climate change by sequestering atmospheric carbon (from carbon dioxide [CO₂]) in new biomass each year. Carbon storage by trees is another way that trees can influence climate change. As trees grow, they store carbon by holding it in their accumulated tissue. Carbon storage is an estimate of the total amount of carbon that is currently stored in the above and below ground biomass of the forest, while carbon sequestration is a measure of how much new CO₂ is taken up by the forest each year through new growth.

Key findings include:

- In Cumberland County, the total annual avoided health care costs for greenhouse gases is between \$38.5 million and \$53.4 million.
- Currently, tree-covered open space in Cumberland County stores 4,350,717 tons of carbon over the life of a tree.
- Photosynthesis by trees adds 137,832 tons of carbon sequestration each year.
- If the carbon currently stored in trees—both above and below ground—on open space were released into the air, it would cause damage due to increased carbon emissions that would cost \$92.6 million to mitigate in Cumberland County (Table 11).

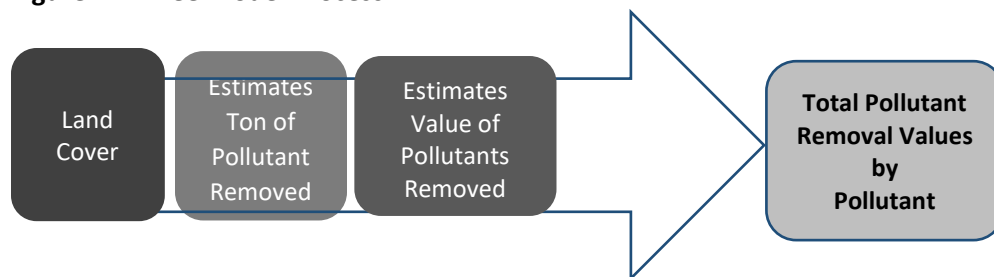
Methodology

The i-Tree Vue model developed by the US Forest Service was used to estimate the air pollution removal and carbon sequestration and storage benefits of the tree cover of Cumberland County (Figure 7).⁹⁷ The model uses National Land Cover Datasets (NLCD) to estimate the amount of tree canopy and then uses pollution removal rates to estimate the total amount of pollutant removal. The i-Tree Vue model has the advantage of allowing for the adjustment of the per acre pollutant removal values. For the purposes of this analysis, a range of pollutant removal values from the academic literature was used. Table 7 reports the total pollutant removal amounts in tons, calculated using the values in Table 6. Pollution removal values were estimated using national median externality values. The values were based on the median monetized dollar per ton externality values used in energy decision-making from various studies. These values in dollars per metric ton are: NO₂ = \$10,200 t-1, PM₁₀ = \$6,820 t-1, SO₂ = \$2,500 t-1, and CO = \$1,450 t-1. The externality values for O₃ were set to equal the value for NO₂.

⁹⁶ Nowak, David J.; Crane, Daniel E.; and Stevens, Jack C. (2006). "Air Pollution Removal by Urban Trees and Shrubs in the United States." *Urban Forestry and Greening*, Vol. 4: 115-123.

⁹⁷ US Forest Service. 2010. *i-Tree Vue User's Manual*, version 3.0. The United States Forest Service.

Figure 7. i-Tree Model Process



Source: adapted from Nowak (2006).

Table 6. Pollutant Removal Rates (pounds/acre of tree canopy/year)

Pollutant	Min	Mean	Max
Carbon Sequestration	2,434.00	2,555.20	2,676.50
Carbon Storage	80,123.80	80,656.10	81,188.30
O ₃	8.17	30.83	39.83
PM ₁₀	12.66	32.33	50.33
NO ₂	7.67	15.50	20.50
SO ₂	3.67	6.83	11.33
CO	1.67	1.67	1.67

Source: Nowak et al (2006).

Results

Table 7. Cumberland County Pollutant Removal (total tons/year)

Pollutant	Min	Mean	Max
O ₃	441	1,663	2,148
PM ₁₀	683	1,744	2,715
NO ₂	414	836	1,106
SO ₂	198	368	611
CO	90	90	90
Total	1,826	4,701	6,670

Source: ESI (2014) and i-Tree (2014)

The total pollutant removal values for each pollutant will vary depending on the amount of tree canopy cover; increased tree cover leads to greater total removal and greater pollutant removal values.⁹⁸ Table 8 shows the carbon storage and sequestration rates.

Table 8. Carbon Storage and Sequestration Rates (pounds/acre of tree canopy)

Pollutant	Min Nowak et al (2006)	Mean Author Calculations	Max USDA (2010)
Carbon Sequestration	2,434.0	2,555.2	2,676.5
Carbon Storage	80,123.8	80,656.1	81,188.3

⁹⁸ Nowak, David J.; Crane, Daniel E.; and Stevens, Jack C. (2006). "Air Pollution Removal by Urban Trees and Shrubs in the United States." *Urban Forestry and Greening*, Vol. 4: 115-123.

Table 9 includes the low, average, and high value of the pollutant removal benefits. We found that the pollutant removal benefits generated by the tree cover of Cumberland County ranges between \$14.0 and \$53.4 million per year.

Table 9. Cumberland County Air Pollution Benefit Values (\$millions/year)

Pollutant	Min	Mean	Max
O ₃	\$4.5	\$17.0	\$21.9
PM ₁₀	\$4.7	\$11.9	\$18.5
NO ₂	\$4.2	\$8.5	\$11.3
SO ₂	\$0.5	\$0.9	\$1.5
CO	\$0.1	\$0.1	\$0.1
Total	\$14.0	\$38.5	\$53.4

Source: ESI (2014)

Table 10 reports the total carbon storage and sequestration, in tons. Table 11 reports the total storage and carbon sequestration benefits. On average, the tree cover of Cumberland County sequesters over 137,832 tons of carbon each year and generates \$2.8 million in annual benefits. The tree cover of Cumberland County stores nearly 4,350,717 million tons of carbon worth \$89.8 million annually.

Table 10. Cumberland County Carbon Storage and Sequestration (total tons)

Pollutant	Min	Mean	Max
Carbon Sequestration	131,294	137,832	144,375
Carbon Storage	4,322,004	4,350,717	4,379,425

Source: ESI (2014) and iTree (2014)

Table 11. Cumberland County Carbon Storage and Sequestration Benefits (millions/year)

Pollutant	Min	Mean	Max
Carbon Sequestration	\$2.7	\$2.8	\$3.0
Carbon Storage	\$89.2	\$89.8	\$90.4
Total	\$91.9	\$92.6	\$93.4

Source: https://www.itreetools.org/resources/manuals/Vue_Manual_v5.pdf, <http://www.epa.gov/climatechange/EPAactivities/economics/scc.html>. The dollar value estimates were derived using the social cost of carbon.

Caveats

Please note that NLCD provides tree cover estimates with a 30-meter pixel resolution for the contiguous United States. The national database provides important information on our national tree resources, but has limitations, particularly at the local scale. Tree cover estimates from the NLCD cover maps are believed to underestimate tree cover by an average of about 10%⁹⁹. Thus, the tree cover and consequently the ecosystem service estimates at the local level are likely conservative, but the exact degree of underestimation in specific areas is not currently known.

⁹⁹ US Forest Service. 2010. i-Tree Vue User's Manual, version 3.0. The United States Forest Ser

Outdoor Recreation

Open space in Cumberland County provides a desirable place for many free and low-cost recreational activities that enhance the quality of life and health for area residents and visitors. Levels of participation and direct annual spending by residents were tracked across 11 recreation activity categories. This list does not include every activity that could be recognized as outdoor recreation. Based on published information, those activities with the highest participation rates were included. Also included were the activities associated with Cumberland County's residents recreating on Cumberland County open space. Some residents may enjoy horseback riding, but the numbers are small relative to other activities. Further, motorized activities like motorcycling, snowmobiling, and driving for pleasure were not included, as these are long distance activities more associated with tourism. The working definition for tourism activities is that they involve a 50-mile one-way trip and or an overnight stay.¹⁰⁰ The major recreational activities developed for Cumberland County include:

- Fishing (freshwater)
- Hunting (all types)
- Walking (on trails, in parks and on streets)
- Running (on and off-road)
- Bicycle-based recreation (on paved roads or off-road)
- Camp-based recreation (in a tent)
- Water-based recreation (kayaking, recreational/sea/whitewater, rafting and canoeing)
- Trail-based recreation (hiking on an unpaved trail, backpacking and climbing natural rock)
- Wildlife viewing (wildlife watching and photography, except birds)
- Birding (near home and away from home bird feeding, watching and photography)
- Outdoor education (nature study)

This list was compiled by reviewing the major activities in the Department of Conservation and Natural Resources 2014 Outdoor Recreation Participation Survey by the consultant.

Tourism

The state's travel industry directly accounted for \$14 billion (2.4%) of Pennsylvania's 2011 GDP.¹⁰¹ Cumberland County is in the Dutch County Roads Region for tourism data analysis. This region is third in the state behind Philadelphia and Pittsburgh. In 2011, Cumberland County tourism spending was up by \$48.3 million from 2010, totaling \$726.1 million. Tourism survey data showed 8% in nature/eco-tourism, or roughly \$58 million in spending from overnight tourists. This number is typically all that is included for nature-based tourism contributions to the county's GDP.

Travelers within Pennsylvania who were on overnight trips to Cumberland County between 2010 and 2011, showed that camping preference increased from 7% - 18%, hiking increased from 6% - 12% and

¹⁰⁰ Department of Economic and Community Development, 2014

¹⁰¹ Tourism Economics, (2012). *The Economic Impact of Travel and Tourism in PA. Calendar year 2012*

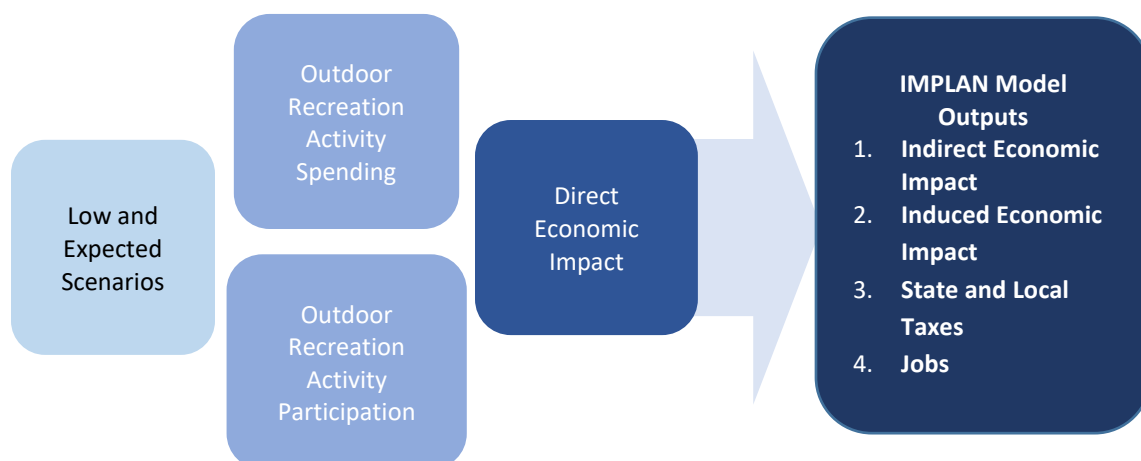
fishing increased from 5% - 11%. This demonstrates that parts of the outdoor recreation economy are improving after the recession.¹⁰²

Methodology

Economic impact analysis is an assessment of the change in overall economic activity as a result of change in one or several specific economic activities. Economic activity can be either from outside the region or reflected in transactions between people and businesses within Cumberland County. This form of economic activity is often referred to as “economic contributions.”

Economic contributions are usually expressed as jobs, income, retail sales (expenditures) and tax revenues. Economic contributions and impacts, for the purpose of economic modeling, can be divided into three standard components: direct, indirect, and induced effects. The indirect and induced effects are the two components of the “multiplier” or “ripple” effect. Each of these is considered when estimating the overall effects of any activity on the economy (Figure 8).

Figure 8. IMPLAN Economic Impact Assessment Tool



Direct impacts are initial purchases made by the consumer and are found by multiplying the number of participants by the participant’s average annual spending for particular activities. Participation is the number of people who engage in a given activity at least once a year. Outdoor recreation activity spending includes on recreational trips, clothing, equipment, and fees such as entry fees for events.

Indirect effects measure how sales in one industry affect the various other industries providing supplies and support. For example, an angler buys fishing rods, hats, hip boots, gasoline, and food. These items may be manufactured in other parts of the state, country, or elsewhere.

¹⁰² IBID.

Induced effects result from the wages and salaries paid by the directly and indirectly-impacted industries. The employees of these industries then spend their incomes. These expenditures are induced effects that, in turn, create a continual cycle of indirect and induced effects. The sum of the direct, indirect and induced effects is the **total economic impact** or contribution. The IMPLAN economic model analyzes economic and demographic data filed for Cumberland County. Indirect and induced economic impacts, plus employment and state and local taxes, were analyzed for the 11 outdoor recreation activities.¹⁰³

Data Collection

The first phase of this analysis was focused on data gathering that included:

1. Research of existing published surveys gathering information on regional, state and national participation and spending estimates.
2. Estimates of the total annual expenditures made by recreationists at the local, regional and national levels for each category examined from existing sources.
3. Interviews with local experts in each activity to validate the survey data for participation and spending for Cumberland County.
4. Creation of a set of expected estimates for participation and spending.

Not all surveys collect information in the same data categories; however, there are consistencies among the surveys. Most surveys have information on a majority of activities, provide participation rates, and in some cases – provide information on spending.

The rate of participation and levels of spending depend on the recreational activity. Statistics on the different activities are difficult to collect. Transaction receipts are very impractical, if not impossible, to collect. Therefore, the primary sources of information are surveys. Recreation surveys generally accept respondents' estimates without validation, and since outdoor recreation is considered a desirable activity, respondents may overestimate their participation.

Most surveys ask people about their activities over the previous seven days, two weeks, or even a year. A natural inability to recall behavior over periods of time, combined with a tendency to remember recent events more accurately, can lead to overestimates. Nevertheless, surveys do indicate trends, several surveys have similar outcomes, and local experts and users can help validate survey results. Creating scenarios allows us to bracket the results and present an accurate range of economic impacts.

Figure 9 compares the participation rates from five surveys (please see following page).

¹⁰³ Department of Conservation and Natural Resources (DCNR), 2014. Outdoor Recreation Participation Survey
Cumberland County Return on Environment Report 2015

Table 12. Cumberland County Participation Rate Analysis					
	Outdoor Foundation 2013 Participation Survey [1]	US Fish and Wildlife Service 2011 [2]	Pennsylvania Outdoor Recreation Participation Survey 2014 [3]	Pennsylvania Resident Outdoor Recreation Survey, South Central Region 2014 [3]	Center for Disease Control, 2012 [4]
Walking			0.691	0.631	0.6
Fishing	0.136	0.11	0.183	0.129	
Hunting	0.051	0.07	0.145	0.125	
Birding/Bird Watching	0.05	0.27	0.309	0.311	
Wildlife Watching	0.077	0.36	0.35	0.363	
Camping	0.133		0.155	0.112	
Kayaking/Canoeing	0.028		0.174	0.133	
Bicycling	0.164		0.216	0.202	
Hiking/Backpacking	0.12		0.136	0.291	
Jogging/Running	0.185		0.174	0.134	
Nature Study	0.21		0.042	0.063	

[1] Outdoor Foundation, 2013. Participation Survey

[2] U.S Fish & Wildlife Service. 2011 National Survey of Fishing, Hunting and Wildlife –Associated Recreation— Pennsylvania

[3] Department of Conservation and Natural Resources (DCNR), 2014. Outdoor Recreation Participation Survey

[4] Center for Disease Control and Prevention, 2012. More People Walk for Better Health, CDC Vitalsigns

Financial data is less available than participation rates and is usually derived from surveys and national studies. For example, the US Fish and Wildlife Service conducts a *National Survey of Fishing, Hunting and Wildlife-Associated Recreation* every five years. The survey breaks down spending, demographic and participation information. In addition, it also provides information on a state-by-state basis. This survey is a well-established reference for fishing, hunting and wildlife watching.

Very few studies give spending ranges. One study on running asked the question "How much do you spend on running in a lifetime?" Using reasonable assumptions, the following categories were identified — Cheapest, Average, and Most Expensive; and results were totaled by four expense categories (Table 13). The costs on a per day basis range from \$.069 – \$10.22, which corresponds to the annual expenditure ranging from \$196 – \$3,734. Spending can vary by region. As an example, the 2009 DCNR statewide *Outdoor Recreation Resident Survey* estimated annual spending for an individual to be \$238 per year.

Table 13. How Much Runners Spend in a Lifetime

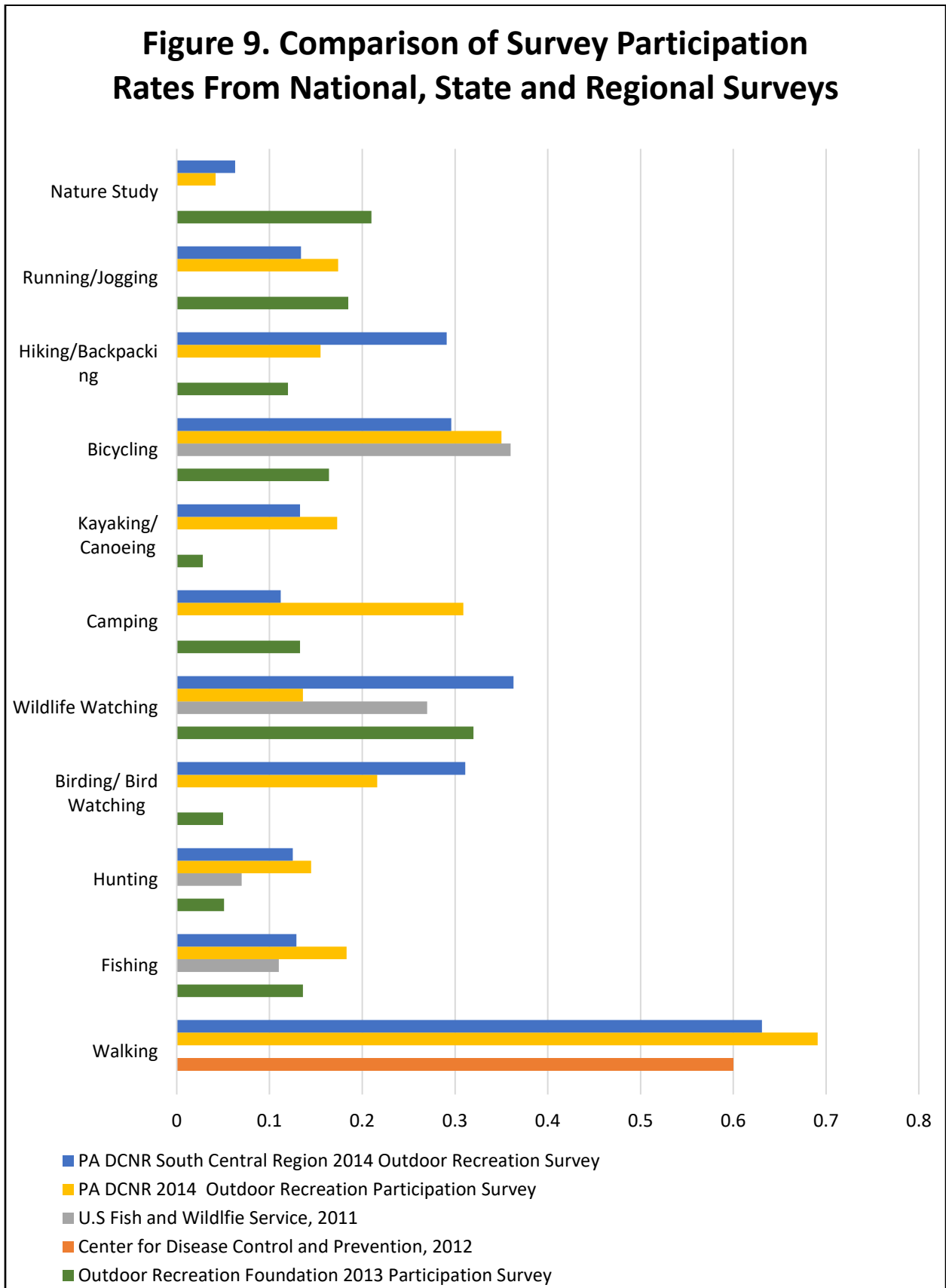
	Least Expensive	Average	Most Expensive
Clothing	\$11,196.43	\$22,392.86	\$50,485.71
Races	\$0.00	\$17,670.00	\$51,642.00
Food	\$3,145.12	\$11,145.54	\$88,838.75
Fluid	\$15.70	\$3,834.06	\$16,205.63
Total Lifetime Expenditures	\$14,357	\$55,042	\$207,172
Yearly Average	\$196	\$393	\$3,734

Source: Jim Warrenfeltz, Runners World, July 22, 2013

Table 14 shows several spending estimates, some with ranges and some without. Light blue indicates lowest annual spending estimate per person. Green indicates the expected annual spending rate per person. Dark blue estimates spending rates used in both scenarios.

Table 15 shows the direct costs for Cumberland County. Table 16 shows the results of the IMPLAN model for both the Low and Table 17 shows the final economic impact summary in terms of jobs and state and local taxes. Expected Direct Economic Impact was calculated for all 11 recreation activities. These numbers are based on the 2013 estimated population of 241,212 people.¹⁰⁴

¹⁰⁴ Census Bureau, US Department of Commerce. *2013 Population Estimates*.



Results

According to this analysis, the \$132.7 million low economic direct contribution scenario for Cumberland County would result in over 2,539 jobs, over \$204.7 million in economic output and approximately \$15.3 million in state and local taxes. The expected value is based on local expert input. The \$345.7 million expected direct economic contributions scenario would result in over 6,656 jobs and nearly \$521.5 million in total output, and \$38.9 million in state and local taxes.

	US Fish and Wildlife Service, 2011 Recommended by Game Commission[1]	DCNR 2009 Outdoor Recreation Resident participation Survey[2]	Outdoor Industry Association, 2013[3]	Jim Warrentfeltz, 2013 [4]	
Walking		\$96			
Fishing	\$409	\$831			
Hunting	\$1,207	\$687			
Birding/Bird Watching	\$329	\$211			
Wildlife Watching	\$308				
Camping		\$2,529	\$2,009		
Kayaking/ Canoeing			\$482		
Bicycling		\$453	\$1,196		
Hiking/Backpacking		\$280	\$1,115		
Jogging/ Running		\$238		\$196	\$3,734
Nature Study		\$150			

[1] U.S Fish & Wildlife Service. (2011) National Survey of Fishing, Hunting and Wildlife Associated Recreation, Pennsylvania

[2] Department of Conservation and Natural Resources (DCNR), (2009). Outdoor Recreation Participation Survey

[3] Outdoor Industry Association Outdoor Recreation Survey, 2013

[4] Jim Warrentfeltz, Runners World, July 22, 2013

Table 15. Cumberland County Direct Economic Impact

Activity	Participation Rate Minimum	Number of Participants	Minimum Spending	Minimum Direct Economic Impact	Participation Rate Expected	Number of Participants	Expected Spending	Expected Direct Economic Impact
	Low Economic Contribution Scenario				Expected Economic Contribution Scenario			
Walking	0.6	144,727	\$96	\$13,893,811.20	0.631	152,205	\$96	\$14,611,658
Fishing	0.11	26,533	\$409	\$10,852,127.88	0.129	31,116	\$409	\$12,726,586
Hunting	0.05	12,061	\$687	\$8,285,632.20	0.125	30,152	\$1,207	\$36,392,861
Birding-watching	0.05	12,061	\$211	\$2,544,786.60	0.311	75,017	\$329	\$24,680,571
Wildlife Watching	0.077	18,573	\$308	\$5,720,583.79	0.363	87,560	\$308	\$26,968,466
Camping	0.112	27,016	\$2,009	\$54,274,629.70	0.112	27,016	\$2,529	\$68,322,817
Kayaking/Canoeing	0.028	6,754	\$482	\$3,255,397.15	0.133	32,081	\$482	\$15,463,136
Bicycling	0.164	39,559	\$453	\$17,920,121.90	0.202	48,725	\$1,196	\$58,274,890
Hiking	0.12	28,945	\$280	\$8,104,723.20	0.291	70,193	\$1,115	\$78,264,852
Jogging/ Running	0.134	32,322	\$196	\$6,335,191.97	0.134	32,322	\$238	\$7,692,733
Nature Study	0.042	10,131	\$150	\$1,519,635.60	0.063	15,196	\$150	\$2,279,453
Totals				\$132,706,641				\$345,678,022.66

Table 16. Cumberland County IMPLAN Summary Economic Impact

LOW				
Activity	Direct Impact	Indirect Output	Induced Output	Total Output
Walking	\$13,893,811	\$2,506,395	\$4,257,986.24	\$20,658,192
Fishing	\$10,852,128	\$1,957,686	\$3,325,812.30	\$16,135,626
Hunting	\$8,285,632	\$1,494,699	\$2,539,267.93	\$12,319,599
Bird Watching	\$2,544,787	\$690,196	\$441,483.44	\$3,676,466
Wildlife Watching	\$5,720,584	\$1,551,533	\$992,437.64	\$8,264,554
Camping	\$54,274,630	\$17,894,536	\$16,276,208.00	\$88,445,373
Kayaking/Canoeing	\$3,255,397	\$587,263	\$997,669.44	\$4,840,329
Bicycling	\$17,920,122	\$3,232,728	\$5,491,915.12	\$26,644,765
Hiking	\$8,104,723	\$1,462,064	\$2,483,825.41	\$12,050,612
Jogging/Running	\$6,335,192	\$1,142,846	\$1,941,523.18	\$9,419,561
Nature Study	\$1,519,636	\$412,155	\$263,634.20	\$2,195,425
Totals	\$132,706,641	\$32,932,099	\$39,011,763	\$204,650,503
EXPECTED				
Activity	Direct Impact	Indirect Output	Induced Output	Total Output
Walking	\$14,611,658	\$2,635,892	\$4,477,982.20	\$21,725,532
Fishing	\$12,726,586	\$2,295,832	\$3,900,270.79	\$18,922,689
Hunting	\$36,392,861	\$6,565,143	\$11,153,189.21	\$54,111,193
Bird Watching	\$24,680,571	\$6,693,851	\$4,281,719.78	\$35,656,142
Wildlife Watching	\$26,968,466	\$7,314,369	\$4,678,634.60	\$38,961,470
Camping	\$68,322,817	\$22,526,272	\$20,489,064.23	\$111,338,153
Kayaking/Canoeing	\$15,463,136	\$2,789,497	\$4,738,929.82	\$22,991,564
Bicycling	\$58,274,890	\$10,512,587	\$17,859,295.17	\$86,646,772
Hiking	\$78,264,852	\$14,118,706	\$23,985,547.93	\$116,369,105
Jogging/Running	\$7,692,733	\$1,387,742	\$2,357,563.86	\$11,438,039
Nature Study	\$2,279,453	\$618,232	\$395,451.30	\$3,293,137
Totals	\$345,678,023	\$77,458,124	\$98,317,649	\$521,453,796

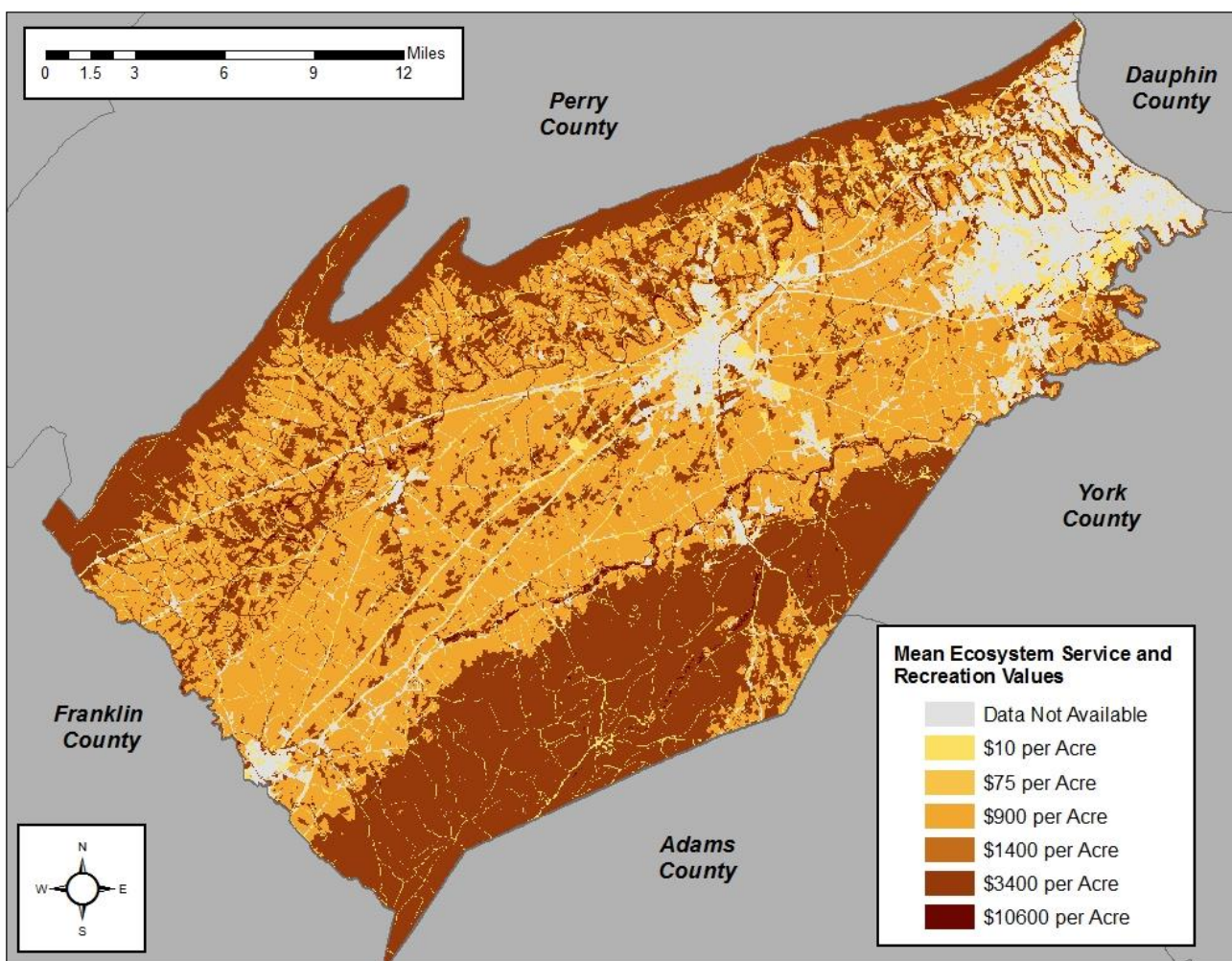
Table 17. Economic Impact Summary in Terms of Jobs and State and Local Taxes.

LOW				
Activity	Direct Impact	Output	Employment	State and Local Taxes
Walking	\$13,893,811	\$20,658,192	303	\$1,631,069
Fishing	\$10,852,128	\$16,135,626	237	\$1,273,989
Hunting	\$8,285,632	\$12,319,599	181	\$972,695
Bird Watching	\$2,544,787	\$3,676,466	29	\$270,570
Wildlife Watching	\$5,720,584	\$8,264,554	65	\$608,232
Camping	\$54,274,630	\$88,445,373	930	\$6,509,579
Kayaking/Canoeing	\$3,255,397	\$4,840,329	71	\$356,248
Bicycling	\$17,920,122	\$26,644,765	391	\$1,961,055
Hiking	\$8,104,723	\$12,050,612	177	\$886,925
Jogging/Running	\$6,335,192	\$9,419,561	138	\$693,280
Nature Study	\$1,519,636	\$2,195,425	18	\$161,583
Totals	\$132,706,641	\$204,650,503	2,539	\$15,325,225
EXPECTED				
Activity	Direct Impact	Output	Employment	State and Local Taxes
Walking	\$14,611,658	\$21,725,532	319	\$1,715,341
Fishing	\$12,726,586	\$18,922,689	277	\$1,494,042
Hunting	\$36,392,861	\$54,111,193	794	\$4,272,353
Bird Watching	\$24,680,571	\$35,656,142	279	\$2,624,119
Wildlife Watching	\$26,968,466	\$38,961,470	307	\$2,867,378
Camping	\$68,322,817	\$111,338,153	1170	\$8,194,488
Kayaking/Canoeing	\$15,463,136	\$22,991,564	337	\$1,692,179
Bicycling	\$58,274,890	\$86,646,772	1273	\$6,377,202
Hiking	\$78,264,852	\$116,369,105	1705	\$8,564,766
Jogging/Running	\$7,692,733	\$11,438,039	168	\$841,840
Nature Study	\$2,279,453	\$3,293,137	27	\$242,375
Totals	\$345,678,023	\$521,453,796	6,656	\$38,886,083

Cumberland County Return on Environment Map

Tourists and residents want to experience nature at its best. Areas in need of protection within Cumberland County have the highest economic value from a natural capital standpoint. They also provide the highest quality natural system services and help define Cumberland County residents' quality of life and sense of place. The highest return on conservation is in green corridors along streams and creeks, and second are the ridges and slopes. Taking all the values listed in this report for natural resources in the county, a map can be created showing higher values for more natural, undeveloped acres (darker brown) that return a higher level of value to the local economy than the more developed (or lighter colored) acres. We obtained 2011 (the most recent year available) satellite-derived land cover data from the Multi-Resolution Land Characteristics (MRLC) Consortium and used ArcGIS to calculate the acres of 7 different land cover types.

Figure 10. Cumberland County Return on Environment Map



For the local economy, we can see that conservation of these resources can yield more than \$10,600 per acre annually. This map helps us flip our open space paradigm from “only valuable if developed” to “only develop if there is clear value.” The darker the areas, the more ecological and economic value there is. For many people who enjoy the environment, these darker areas also depict places that provide wonderful fun and excitement.

Creating Conservation Leverage: What should we do?

This study has shown that a strong economy requires a healthy environment and plenty of open space. The estimates in this study were very conservative and total more than \$1 billion. Even if you consider the low estimate or take 20% off the top, the natural environment provides significant economic value to Cumberland County.

Most communities are a patchwork of small open space areas and stream corridors. Growth often fragments habitat and impacts natural systems through erosion, water pollution flooding, and stream bank erosion. With less open space remaining, the size, quality, location, and connectivity of remaining open space will be critical in determining the future quality of life, health, and cost of living for residents.

We can't afford not to protect Cumberland County's open spaces. These are valuable assets that are essential to our everyday life.

The most effective way to realize the full value of natural system services is to connect larger native forest and grassland habitats with green corridors of riparian land. The wider the corridor, the higher the return to the local economy. Without connected systems, these valued benefits may be significantly diminished or lost forever. Maintaining connected, healthy riparian areas, headwaters, wetlands, and larger upland habitats; as well as parks, trails, wooded public property, and areas protected as open space; creates a supporting network of sustainable biological integrity. This ensures long-term financial benefits and resilience to changes in climate.¹⁰⁵

It is simple, really. When we protect our natural resources and open space, residents and businesses save money, the local economy benefits, and our quality of life is preserved.

We can't afford not to protect Cumberland County's open spaces. These are valuable assets that are essential to our everyday life. If the economy of Cumberland County is to remain strong, environmental stewardship cannot be the responsibility of a few dedicated people. Environmental stewardship must become part of Cumberland County's everyday culture. Only then can the residents and policy makers of Cumberland County ensure a foundation for a vibrant, balanced economy, high quality of life, low cost of living, good health, and well-being for current residents and future generations.

¹⁰⁵ US Environmental Protection Agency, (2012). *The Economic Benefits of Protecting Healthy Watersheds.*, EPA 841-N-12-004, 1. Retrieved from http://water.epa.gov/polwaste/nps/watershed/upload/economic_benefits_factsheet3.pdf.

The biggest challenge related to Cumberland County's open space is to promote sustainable growth while maintaining high quality of life, low cost of living, and good health for all residents and visitors. At the same time, we need to understand the value of the environment to quality of life, health, and cost of living. Municipal officials, business leaders, and local citizens need to examine current policies and practices. Below is a list of strategic actions Cumberland County can take to enhance its environment, economy, and sense of place.

Recommended Strategic Actions:

1. Fund critical projects to protect high-quality areas (mature woodlands and rare resources), as well as critical resources like headwaters, riparian, and wetland areas. See Cumberland County Return on Environment Map.
2. Use natural system services before spending more money on infrastructure.
3. Create a social network and communication strategy among the dozens of nature-based user groups, and form new partnerships and alliances to focus on resource management and protection.
4. Maintain large contiguous forests, particularly along the ridges and stream valleys.
5. Consider creating annual impact fee for any clearing of areas with high economic value (An **impact fee** is a fee that is imposed by a local government within the United States on a new or proposed development project to pay for all or a portion of the costs of providing public services to the new development). Base the fee on the annual economic return of the existing cover types on site. Stormwater fees are based on a similar approach.
6. Practice and require sustainable forestry; ensure invasive plants and forest regeneration are effectively managed.
7. Restore riparian buffers and wetland areas to get the highest return on environment. Plant native trees, shrubs, grasses, and wildflowers. Support the repeal of legislation like Act 162 of 2014 so that the importance of these buffers is recognized in state policy.
8. Act creatively to protect lands with highest conservation value. When protecting open space, the first priority is "buy the best." Unfortunately municipalities and land trusts can't begin to afford direct purchase of all the areas in need of protection and management. Conservation easements also require sources of revenue and willing property owners.
9. Create an "official map" which expresses an interest in acquiring specific land (or easements thereon) for trails, streets, parks, open space networks, and other public purposes. If a landowner seeks to develop lands designated as "reserved" on this map, the municipality has a year to pursue acquisition of the land from the owner before the owner may freely build or subdivide.¹⁰⁶
10. Update Comprehensive Plans and Zoning Ordinances to reflect best land use methods.
Conservation design is one technique that helps municipalities and developers build new housing

¹⁰⁶ <http://conservationtools.org/>

and businesses while protecting important natural and critical resources. With straightforward changes to municipal ordinances, new subdivisions can leave half (or more) of buildable land as open space while being fair to those seeking to develop their land. These practices apply to new development and can save money and increase home values when compared to traditional development.¹⁰⁷

11. Actively provide educational tools to landowners about good land stewardship. In Pennsylvania, many acres are already developed and over 85% of the land is privately held.¹⁰⁸ Many land owners don't understand what they can and should do to be good environmental stewards. Strategies are available that help teach homeowners, municipalities and businesses how to become good stewards in their own back yards while making their properties beautiful.
12. Teach private property owners low impact or restorative approaches along the borders of forests and riparian buffer areas. These strategies have significant financial benefits. As backyards become connected to stream corridors, parks, and natural areas; neighborhoods expand wildlife and create larger, self-sustaining habitats. These voluntary buffers and habitats are called "green corridors."
13. Help municipalities partner with and participate in conservation and watershed stewardship programs like Audubon's *Bird Town* to involve private property owners and businesses in better nature stewardship on private property.
14. Conduct a survey of recreational users to increase local knowledge of how significant natural capital value really is. This also becomes a tool for forecasting future needs at the local level.

¹⁰⁷ IBID

¹⁰⁸ U.S Department of Commerce, Census Bureau, 2013. American Fact-Finder. Profile of General Population and Housing Statistics

Glossary

Air Pollution

The release of harmful matter, particulates and gases such as sulfur dioxide, nitrogen oxides, carbon monoxide and volatile organic compounds into the air. Ozone, a harmful air pollutant, is created by sunlight interacting with other air pollutants.

Avoided Cost (AC)

Some of the natural system services allow society to avoid costs that would have been incurred in the absence of those services. An example is flood control, provided by intact riparian buffers, helps avoid property damage downstream.

Biological Connectivity

The ability of individual plants and animals to move across complex landscapes is critical for maintaining regional populations in the short-term and allowing species to shift their geographic range in response to climate change¹⁰⁹. As organisms move through spatially complex landscapes, they respond to multiple biotic and a-biotic factors to maximize access to resources and mates while minimizing mortality risks.

Biological Control

Refers to the dynamic regulation of species populations, including the control of invasive species and unwanted species, such as pest predators, weeds, and disease vectors (i.e. mosquitoes).

Contingent Valuation (CV)

Service demand may be elicited by posing hypothetical scenarios that involve some valuation of the alternatives.

Direct Market Valuation (DM)

Actual market data is used in study. Most often used to obtain values for provisioning services – Consumer preferences and marginal cost of production are reflected in market price. In well-functioning markets, price provides accurate information on value

Ecosystem Function

Refers to the habitat, biological, or system properties or processes of ecosystems. Ecosystem functions add value to natural capital. Several ecosystem functions may combine to provide a natural system service.

Externalities

A side effect or consequence of an industrial or commercial activity that affects other parties without this being reflected in the cost of the goods or services involved, such as the pollination of surrounding crops by native bees, insects, and birds.

¹⁰⁹ Heller, N. E., and E. S. Zavaleta. 2009. Biodiversity management in the face of climate change: A review of 22 years of recommendations. *Biological Conservation* 142:14-32. doi: 10.1016/j.biocon.2008.10.006.

Flood Mitigation

Many natural landscapes help provide a buffering function that protects humans from destructive perturbations. Forest, wetlands, and floodplains help mitigate the effects of floods by trapping and containing stormwater.

Greenhouse Gas Emissions (GHG)

The release of heat-trapping gases such as carbon dioxide, methane, and nitrous oxide into the air. Greenhouse gases keep the earth warm, but increased concentrations contribute to climate change.

Habitat

The area or environment where an organism or ecological community normally lives or occurs. Sustainable habitat provides food, water, and shelter for plants and animals that are of sufficient area to enable natural systems to function and support a diversity of plant and animal life.

Habitat Loss

Loss and degradation of the natural conditions that animals and plants need to survive. It is caused by activities like development, deforestation, and contamination from stormwater runoff and other pollution. It can occur directly from activities like road building, or indirectly, such as contamination from vehicle exhaust.

Hedonic Pricing (HP)

Service demand may be reflected in the prices people will pay for the associated goods.

Natural Capital

Defined as Cumberland County's portfolio of natural assets. This collection of natural assets includes geology, soil, air, water, and all living things.

Natural System Services (or ecosystem services)

The benefits people derive, directly or indirectly, from ecosystem functions. The food we eat, the water we drink and the plant materials we use for fuel, building materials and medicines are all natural system services. Other less visible natural system services are climate regulation and natural flood control provided by forests, and carbon stored by trees, or the pollination of crops by insects. Even less visible are cultural natural system services such as the inspiration people get from wildlife viewing and photography and simple contact with nature.

Open Space

Refers to land that is valued for aesthetic beauty, active and passive recreation, natural process, agriculture, and other public benefits. Such lands include parks, stream and river corridors, grassland, farms, trails, streetscapes, or other natural lands within rural, suburban, and urban areas. Open space may be public or private, protected, or unprotected.

Pollination

Refers to the process by which pollen is transferred from the anther (male part) to the stigma (female part) of the plant, thereby enabling fertilization and reproduction. Pollination is essential for many agricultural crops and substitutes for local pollinators are increasingly expensive.

Replacement Cost (RC)

Some ecosystem services could be replaced with man-made systems. For example, the waste assimilation service provided by wetlands could be replaced with chemical or mechanical alternatives

(such as wastewater treatment plants). The replacement cost would be the estimated costs of replacing the natural waste assimilation service with the chemical or mechanical alternatives.

Resource Use

Using extracting or harvesting natural and manufactured resources can deplete ecosystems and destroy habitat. Associated activities like transportation and processing can cause air and water pollution. Excessive withdrawal of water from lakes, rivers, or aquifers can damage habitats by drying wetlands, creating low flow rivers, and stopping natural springs.

Return on Environment

The economic value created from the flow of goods and services into the economy from natural resources and natural systems.

Soil Formation/Retention

Soils provide many services including water storage/filtration, waste assimilation, and a medium for plant growth. Natural systems create and enrich soil through weathering and decomposition and retain soil by preventing it from being washed away by precipitation.

Travel Cost (TC)

Service demand may require travel, the cost of which can reflect the implied value of the service.

Value Transfer (VT)

A method used to estimate economic values for ecosystem services by transferring available information from studies already completed in another location and/or context. For example, values for recreational fishing in a particular state may be estimated by applying measures of recreational fishing values from a study conducted in another state.

Water Pollution

Sewage, fertilizers, pesticides, oil, silt, and other pollutants that are discharged, spilled or washed into water, including contaminants from air pollution that settle onto land and are washed into water bodies.

Water Supply

A source, means, or process of supplying *water* (as for a community) usually including groundwater aquifers, reservoirs, streams, rivers, and pipelines.

Waste Assimilation

Forests and wetlands provide a natural protective buffer between natural system activities and water supplies by helping to filter out pathogens, excess nutrients, metals, and sediments.

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