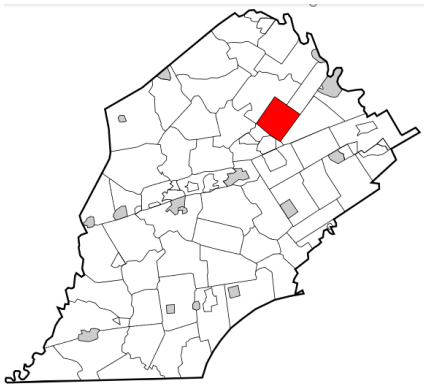
Return on Environment Study

An Approach to Develop a Sustainable Environment and Economy

DRAFT Keystone Conservation Trust, October 2019

ACKNOWLEDGEMENTS:

Our thanks to the West Pikeland Township Environmental Advisory Council for its interest, participation and support. And to others who attended the ROE Workshop. Finally, to Jeanne Ortiz, Audubon Pennsylvania who provided leadership and support.



It is extremely difficult to have a strong economy without a healthy environment, clean water, quality habitat and plenty of open space.

This project was funded by the William Penn Foundation through the Delaware River Watershed Initiative.

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01. SUMMARY

West Pikeland Township's rural character, values and time-honored traditions are facing the winds of change.

Nature has been part of West Pikeland Township's heritage, culture, economy and sense of place ever since it was founded in the mid-1700s. Green, rolling hills and streams create beautiful vistas and reflect the township's rural character and values. However, the loss of farmland and scenic views, fragmentation of forests, and increasing traffic are harbingers of change.

The purpose of this report is to explain the financial value of nature in West Pikeland Township. We call this "Return on Environment." This Return on Environment Study (ROE) can help policymakers, businesses and residents make informed choices about growth, economic development, infrastructure, tourism, recreation and stewardship investments while protecting the environment.

Nature is the lifeblood of West Pikeland Township's culture and economy. Today, open spaces are where nature thrives. This area's quiet, rolling, forests and streams provide many recreational opportunities from hunting and fishing to hiking trails, bicycling and horseback riding. Wildlife is visible and abundant.

Nature is serious business, ROE is real, significant and impacts a wide range of stakeholders. Placing a dollar value on nature helps policymakers, businesses and residents see nature as a portfolio of financial assets rather than a commodity or added expense.

Nature provides clean water, stormwater management and flood protection, pollination, nutrient absorption, aquatic and terrestrial habitat, carbon sequestration, air pollutant removal, erosion control, and biological control, free of charge. Once disrupted or destroyed, nature's services must be replaced at the taxpayers' expense.

Nature is an invisible economy. More than just pretty places, nature provides nearly $20 million dollars each year to West Pikeland Township in the form of avoided costs for natural system services, decreased health care costs, and revenues from outdoor recreation (See *Figure 1*).

The ROE estimates in the study are not about intrinsic value, but rather an explanation of what governments and people have been willing to pay for nature's services once nature has been disrupted or destroyed. As an example, avoided costs mean taxpayers won't have to pay to construct new infrastructure to manage and treat more stormwater and drinking water and, as long as nature is intact, won't incur greater clean-up costs from natural disasters.

Figure 1. **The financial benefits of ROE.**

West Pikeland Township's Annual Return on Environment

$10.6 million
Natural system services

$3.59 million
Value of existing riparian buffers

$2.3-7.8 million
Outdoor recreation annual revenues

$3.3 million
Health care cost savings attributed to open space and exercise

It is extremely difficult to have a strong economy without a healthy environment and plenty of open space. Unfortunately, because Mother Nature doesn't write receipts, nature's economy is often overlooked or undervalued in policy debates, business and land use decisions, and personal choices.

A major challenge for West Pikeland Township is how to balance the pattern of growth with the community's existing quality of life, health, low cost of living, sense of place and the economic value provided by open space.

A second, and possibly more important and difficult challenge, is how to balance the health of natural systems to support a sustainable economy. The most effective way to realize the full value of natural system services is to connect larger, native forest and grassland habitats with riparian areas as green corridors. These are called Green Ribbon Landscapes.

ROE can help businesses, policy makers and residents make informed decisions on land use, infrastructure, economic development, recreation and tourism. Every resource-based decision process should begin with a clear understanding of West Pikeland Township's ROE**.**

How land is used has the greatest impact on water quality and a healthy environment. Unfortunately, Pennsylvania has consumed more land per person than any other state, over the past 30 years. Sprawl has been accelerating the fragmentation and depletion of forests, wetlands and other open areas where natural system services occur. [1]

Commercial and industrial development, farms, and open land generate more revenue than they require back in services. However, for every dollar received from residential development, a township pays $1.11 to provide services like roads and schools. The real value of development is the revenue provided minus the cost of services and the loss of ROE to the township. [2]

Another impact from sprawl and climate change is the loss of critical habitat. Bird populations in North America are in a freefall. A study published in the journal *Science* found that North America has lost nearly 3 billion birds, or 29% of its avian population since 1970 and many species are in "conservation need," meaning they lack adequate habitat. [3]

The National Audubon Society just released *Survival by Degrees: 389 Bird Species on the Brink* stating, "The fate of birds and humans are deeply connected. If an ecosystem is broken for birds, it is—or soon will be—for people as well. And right now, in no uncertain terms, we're facing a bird emergency… science shows that a majority of North American bird species—even familiar and beloved birds like the Wood Thrush and American Robin—are at risk of extinction from climate change." [4]

Birds are a good biological indicator. The authors of this recent research say, "The best time to plant a tree was 20 years ago. The next best time is now." [5]

Research shows that the most efficient way to avoid excessive future costs is to increase the flexibility of ecosystems now so that they may function and retain resiliency under a wider range of climatic conditions. Increases in temperature will impact birds and animal populations, which can increase insect populations and defoliate trees. Infestations of insects, snakes and rodents are likely due to the loss of birds. [6]

Clearly, conservation decisions are strategic to today and to the future. While nature can replace itself, once disrupted or destroyed, natural system services will be diminished for 50-120 years until they reach full capacity. It can take 400 years for a non-native plant to

naturalize. [7] In the meantime, residents assume the tax burden of replacing the services once provided by nature, free of charge. That's why conservation and protecting nature are good business strategies.

The careful protection, management, and use of natural resources are essential to the long-term sustainability of nature and the local and regional economies. Also, the U.S. Environmental Protection Agency (EPA) recommends that townships protect riparian corridors and connections between large forests, to be more resilient to the anticipated effects of climate change. [8]

Map 1 shows the ROE values for West Pikeland Township. The ROE map is the base map for the ROE Interactive Map Series. The purpose of the ROE Interactive Map Series is to show the relationship between different financial data layers related to the use of land and natural system services.

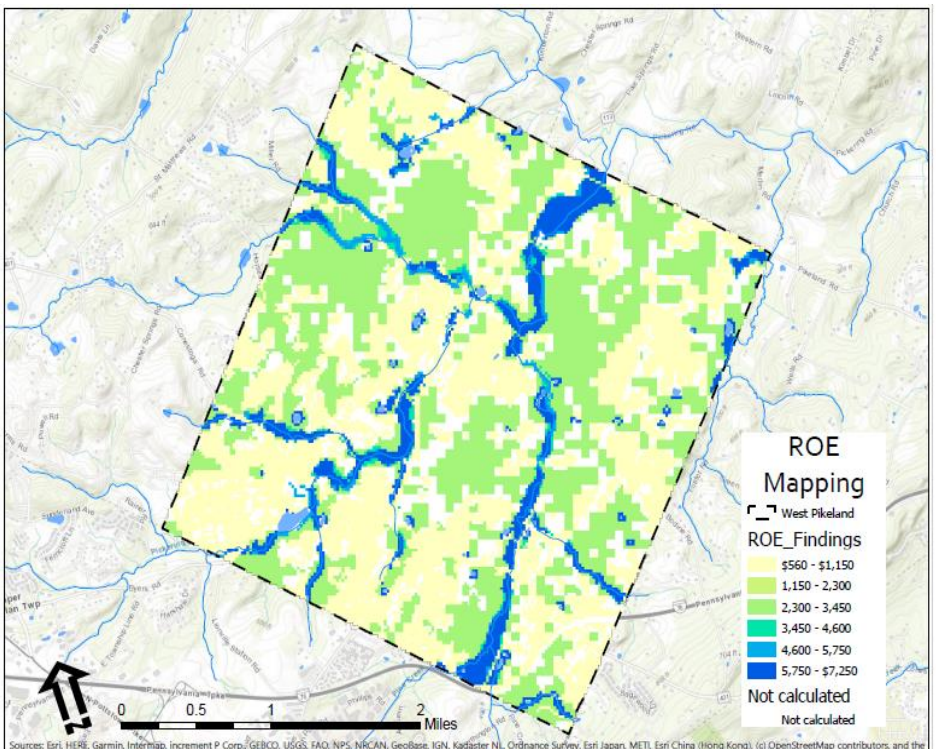
The link to the ROE Interactive Map Series is: https://wplan.maps.arcgis.com/apps/webappviewer/index.html?id=4574dd3d500849f5b47a74c3b85d8306

The highest value land cover types are wetlands and riparian forests, floodplains and large forests.

If West Pikeland Township expects to have a sustainable economy, a connected pattern of forests and wetlands needs to be protected and managed. This includes at a minimum:

1. Map the relative financial values of natural system services and develop strategies to maintain, restore and enhance them.
2. Restore riparian areas where necessary. 100-foot wide buffers are the most effective. Headwater protection is critical.
3. Retain as much pre-existing, natural landscape as possible during any new construction. Pass a native plant ordinance to ensure all future development primarily uses native plant species.
4. Protect highly valued ROE areas that are vulnerable to disruption.
5. Protect and restore riparian buffers and wetlands from disturbance and connect and restore open space corridors.
6. Connect larger forests where possible, with riparian corridors or upland wooded corridors.
7. Expand natural habitat by developing Green Ribbon Landscapes along riparian areas and around parks, trails and natural preserves.

Map 1. ROE Values for West Pikeland Township



02. WHY ROE?

ROE informs decisions on land use, tourism, infrastructure, economic development, and recreation.

Article I, Section 27 of the Pennsylvania Constitution provides as follows:
"The people have a right to clean air, pure water, and to the preservation of the natural, scenic, historic and aesthetic values of the environment. Pennsylvania's public natural resources are the common property of all the people, including generations yet to come. As trustee of these resources, the Commonwealth shall conserve and maintain them for the benefit of all the people."

Sprawl, forest fragmentation, stormwater and flooding, water pollution, and invasive plants have been consistent, unsolved problems for more than 60 years.

Just as return on investment tools are important to assess the value of investment decisions, we now have a way to estimate the Return on Environment.

ROE explains conservation in a language that is easy to understand, and which can immediately be used in decision making. It also connects nature to a community's quality of life and welfare, while expressing nature's significant benefits**.**

To ensure responsible stewardship of the environment, every resource-based decision process should begin with a clear understanding of West Pikeland Township's Return on Environment.

The steering committees for the ROE studies in Carbon, Perry and Dauphin Counties noted that placing a dollar value on natural system services would help solve 70% to 100% of short and long-term environmental problems associated with sprawl, stormwater, flooding, water quality, and habitat loss.

The Benefits of Return on Environment Valuations

1. Explain nature's complex system in a simple, easy-to-understand concept, accessible to a wide range of audiences.
2. Dollars convey a level of significance or priority to allow for better trade-off analysis.
3. Dollars, as a financial measure, underscore nature's connection to our quality of life, health, cost of living, economy, and sense of place.
4. Monetary estimates of the value of natural system services can be applied within decision frameworks related to land use, tourism, and economic development.
5. Discussion of natural system services and their values engages key stakeholders in an educational process that can help organizations execute their missions.

While any numeric model will engender healthy skepticism, the discussion about nature's value puts this issue on the table in full view, so policy makers and citizens are aware of nature's relative significance and its connection to our quality of life, health, cost of living, sense of place, and the economy.

"We can't solve problems by using the same kind of thinking we used when we created them."
Albert Einstein

03. PLACE

A quiet, rural place with beautiful vistas and natural areas is experiencing the pressures of growth.

The original township was known as Pikeland because the original grant of land was given by William Penn to Joseph Pike, of Cork, Ireland, 1705. The township was divided into East and West Pikeland in 1838. This township was established in 1849 and derived its name from the creek which flows through it.

Situated in northern Chester County, West Pikeland Township offers an abundance of outdoor activities from hunting to horseback riding.

Pine Creek Park was the former Palmer Farm where horses were trained for racing. The farm was acquired by the township in 1996 and designated as a community park.

West Pikeland is a small township comprising about 9.96 square miles. The township lies within the Pickering Creek Watershed and drains to the Schuylkill River.

The township is proud of its rich history. The Chester Springs Historic District, Clinger-Moses Mill Complex, Fagley House, Ker-Feal, Lightfoot Mill, and Rice-Pennebecker Farm are listed on the National Register of Historic Places.

According to the 2018 census estimates, the township has a population of 4,083, people, with 1,554 housing units. Median family income is $142,574. 98.9% of residents are high school graduates or higher. [9]

West Pikeland Township's forests, streams and scenic vistas provide greenery and beauty. The area's rural character reflects its rural values and interest in preserving nature. The township provides areas for many outdoor activities, from walking and jogging to hunting and fishing and horseback riding. It also has an inclusive and engaged community of residents. The township is an easy commute to Pottsville, Collegeville and King of Prussia.

Nature's value-added amenities like greenery, outdoor recreation opportunities, and abundant open space elevate community pride and appreciation and make communities like this "preferred destinations."

Legacy problems such as sprawl, flooding, stormwater, water pollution, and traffic are significant and important issues with fiscal consequences that affect the township. Identifying areas with the highest ROE can show the significance of nature's financial role in the economy both now and into the future.

Looking forward, the township plans to continue to focus on open space preservation, fiscal growth and infrastructure while protecting water quality, woodlands, streams and the agricultural economy.

Lightfoot Hill National Historic Landmark.

04. BIOLOGICAL DIVERSITY IS CRITICAL TO OUR SURVIVAL

Biological diversity is central to maximizing nature's ecological and financial value.

We live in the Eastern Deciduous Forest Biome. The soils and climate of this region have been growing trees for 14,000 years, since the last Ice Age. In Pennsylvania, biological diversity is the sum of all plants, animals, and insects that live in a forest environment. Native plants are the foundation for all life and control local biodiversity.

Nature helps drive natural system services like photosynthesis, pest control, pollination, erosion control, soil formation, water purification, and the generation of oxygen and clean air. Additionally, native plants support 29 times more biodiversity than non-native plants. [10]

Natural system services work 24 hours a day, 365 days a year. Forests provide source water protection to keep groundwater and streams clean. Every dollar spent on planting and caring for a community tree yields benefits that are seven times that investment. [11] In many instances, nature can outperform engineered solutions. [12]

Louisiana Water Thrush

Figure 2 shows the benefits West Pikeland Township annually receives from forests.

FIGURE 2.

West Pikeland Township's Annual Benefits From Forests (millions)

$3.3
Habitat

$.24
Pollination

$.25
Biological Control

$.14
Carbon Sequestration

$.19
Air Pollutant Removal

Forests over 500 acres provide the habitat size necessary for breeding populations of songbirds like Scarlet Tanager, Wood Thrush and Louisiana Water Thrush.[13,14] Forests over 250 acres are breeding sites for some songbirds. [15] Small forests under 250 acres are nesting sites for many species.

Forests over 750 acres provide the habitat size necessary for breeding populations of raptors like eagles and hawks. [16]

The major causes of biodiversity loss are forest fragmentation and non-native, invasive plants. Habitat size, shape, and topography all play a role in sustaining biodiversity. [17] Connecting and expanding habitat size creates healthy and resilient biological systems that boost the performance of natural system services. [18]

West Pikeland Township's primary habitats are outside the township in Marsh Creek State Park, Hopewell Big Woods and Valley Forge. These are the breeding grounds for birds and wildlife that frequent West Pikeland Township.

Tips for managing forests:

1. Protect forests. The larger the forest, the better.

2. Protect round forests versus linear forests. This provides habitat for indigenous species in the forest core.

3. Connect forests with riparian or upland corridors, allowing for movement of species and genetic drift.

4. Leave dead trees for habitat.

Table 1 explains The Pennsylvania Wildlife Action Plan's list of species in conservation need in West Pikeland Township. [19]

TABLE 1.

Species in Conservation Need in West Pikeland Township

Willow Flycatcher
(Empidonax traillii)
Purple Martin
(Progne subis)
Wood Thrush
(Hylocichla mustelina)
Gray Catbird
(Dumetella carolinensis)
Louisiana Waterthrush
(Parkesia motacilla)
Scarlet Tanager
(Piranga olivacea)
Northern
Field Sparrow
(Spizella pusilla)
Grasshopper Sparrow
(Ammodramus savannarum)

05. WE NEED TO KEEP WATER CLEAN AT THE SOURCE

Every 10% increase in forest cover in a watershed decreases water treatment costs by 20%. [20]

FIGURE 3.

West Pikeland Township's Annual Water Resource Benefits (millions)

$3.3
Stormwater & flood control
$.24
Water supply
$1.3
Nutrient absorption
$.73
Aquatic Resources

Riparian Buffers

The land adjacent to streams is called a riparian buffer. Scientific research has established the harm to water quality, increased flooding and the damage to the ecosystem that results from failure to protect riparian buffers. Riparian buffers, particularly when forested, effectively prevent non-source pollutants from degrading these resources. Scientific research documents that undisturbed, vegetated buffers provide extensive water quality and other environmental benefits.

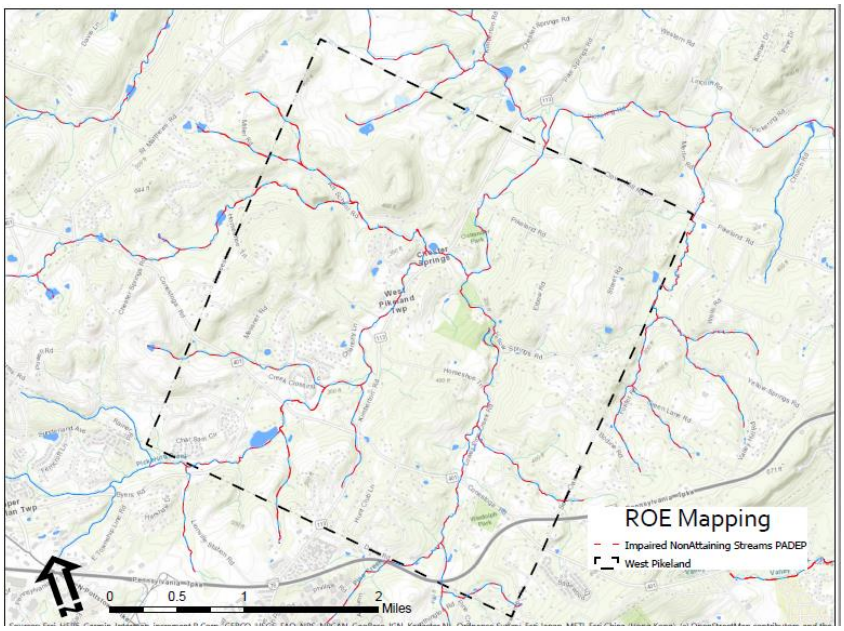
West Pikeland Township lies within the boundaries of the Pickering Creek Watershed, which is part of the larger Schuylkill Watershed. This watershed and its smaller tributaries, Pine Creek and Pigeon Run, are composed of "High-Quality" streams. High Quality and Exceptional Value streams are given special protection in the Commonwealth of Pennsylvania in recognition of their ability to support a diversity of aquatic life. As such, they are an important natural resource to the community, providing superior recreation and, a public water supply via the Pickering Creek Reservoir in Schuylkill Township. [21]

How we manage the land around streams directly affects their health for better or worse. New research shows an even higher ecological value for riparian buffers in headwaters, or first-order streams, that should be protected from disturbance or degradation. Headwater streams are primary food/fuel production areas and have been found to be essential to the health of the entire aquatic system. [22]

Riparian buffers, particularly forested buffers, provide the following documented conservation benefits:

- Prevent stream bank erosion;
- Protect natural stream morphology (i.e., broad meanders with maximum stream bottom habitat);
- Remove excess nitrogen, phosphorus and sediment from surface water runoff;
- Reduce downstream flooding;
- Provide thermal protection to adjoining streams, wetlands, and water bodies;
- Infiltration of rainwater helps prevent flooding and provides clean water to streams at a consistent temperature of 55 degrees Fahrenheit, the temperature most suitable for aquatic life;
- Provide food and habitat for wildlife;
- Provide food and habitat for fish and amphibians;
- Form corridors for habitat conservation and greenways and protect associated wetlands. [23]

MAP 2. Stream Classification



Map 2 shows the stream classification of West Pikeland Township. Streams shown in red are considered impaired by the Pennsylvania Department of Environmental Protection. Streams are impaired due to a variety of sources and causes, such as "agriculture" (source) and "nutrients" (cause) or "urban runoff/storm sewers" (source) with "siltation" (cause). The same stream segment may be impaired by more than one cause, so a stream segment may be listed by PADEP multiple times.

An impaired aquatic life use of a waterbody means that the overall aquatic community (fish, macroinvertebrates, plants, and algae) is not healthy and there are pollutants or pollution needs to be minimized or eliminated to return the waterbody to a healthy condition. [26]

Headwater streams are critical repositories of biodiversity, especially aquatic insects (macro invertebrates), which play such a vital role in aquatic eco-systems and in the in-stream processing discussed above.

Forested riparian buffers in headwaters (first-order streams) generate high levels of organic matter which inputs directly from land into the water. This, in turn, maximizes in-stream processing functions providing the "fuel" needed for downstream energy and nutrient processing.

Stroud research has demonstrated that the aquatic insect community is remarkably abundant in headwaters zones, which contributes greatly to downstream stream energy and nutrient processing. In-stream processing needs "fuel." It turns out that maximum fuel is provided in a variety of ways in

these headwater streams, from algae, aquatic mosses, rooted aquatic plants, trees, understory shrubs, and other herbaceous vegetation. [24]

They also provide important habitat and wildlife corridors for mammals and birds. Trees and shrubs with deep root systems hold the soil and resist stream bank erosion.

Riparian buffers also act as shock absorbers that diffuse the energy of floodwaters, thus reducing damage downstream. Trees cast a shade that cools the water, reduces the growth of algae, and improves fish habitat. [25]

When crafting effective riparian buffer ordinances, buffer width is important. Recommended minimum width depends, to some extent, on what benefits or eco-services are deemed important to protect, although virtually all sources acknowledge that the wider the buffer, the better the eco-services performance. Functions and recommended width studies have been summarized for riparian zones in *Table 2.* [26]

Many of the riparian buffers in the township need to be restored to maintain a healthy environment and protect these important streams.

Map 3 shows the current protected parcels in West Pikeland Township and the Green Ribbon Landscape pattern. Many of the remaining forests have been protected, but there is much to do regarding restoring headwaters and riparian areas.

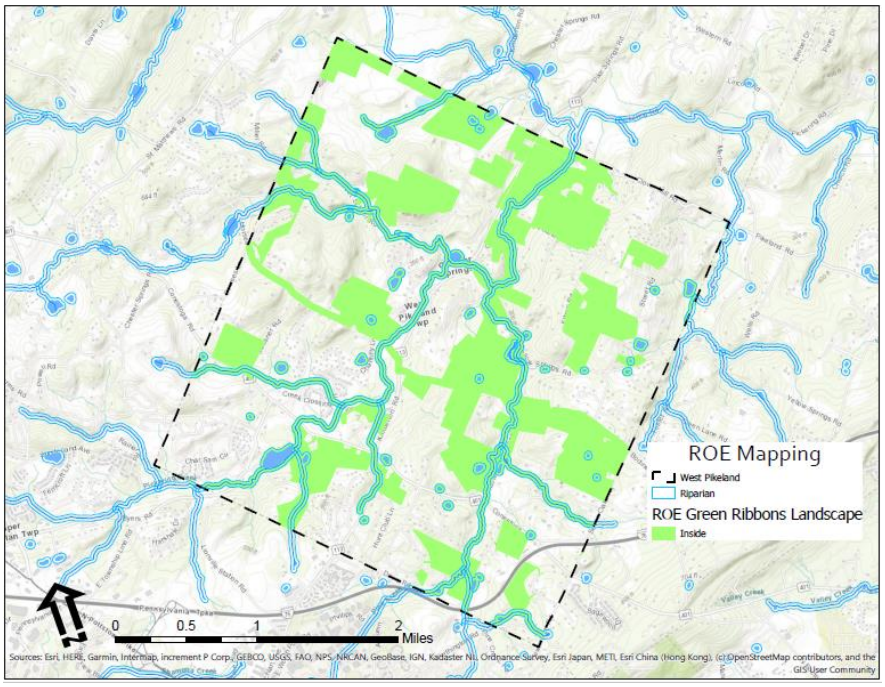
TABLE 2.

Erosion/Sediment Control:	30 to 98 feet
Water Quality:	
Nutrients	49 to 164 feet
Pesticides	49 to 328 feet
Bio-contaminants (fecal, etc.)	30 feet or more
Aquatic Habitat:	
Wildlife	33 to 164 feet
Litter/Debris	50 to 100 feet
Temperature	30 to 230 feet
Terrestrial Habitat:	150 to 330 feet

$3.59 million per year

ROE values currently provided by West Pikeland Township's existing 100-foot-wide riparian buffer.

MAP 3. Riparian areas and Green Ribbon Landscapes



Tips for a Riparian Buffer:

1. Begin a "no mow or no graze zone" along stream banks. An ideal buffer is 100 feet wide. The wider, the better.
2. Plant trees and shrubs in your buffer zone. They provide many long-lasting benefits and can be inexpensive to establish and maintain.
3. Maintained slopes of streambanks should approach 1-foot of rise over a 4-foot length where possible, to eliminate bank erosion and increase surface area.
4. Start with shrubs. They give a buffer a quick start and many reach full size in just a few years.
5. Limit lawns near the water. Set mower blades at least 3 inches high. Taller grass slows runoff, resists drought and needs less fertilizer. Do not use herbicides in the buffer zone.
6. Stop animals from grazing in the streams. Fencing is sometimes needed.

Green Ribbon Landscapes

The most effective way to realize the full value of natural system services is to connect larger, native forests and grassland habitats with green corridors. These landscape patterns are called Green Ribbon Landscapes (GRL). GRLs are the highest value ROE areas and are the backbone for biological diversity and a healthy environment and sustainable economy. This connectivity can potentially moderate some of the worst effects of habitat fragmentation and severe weather effects by promoting connectivity of habitats and wide-ranging biodiversity. [27] *Map 4,* shows West Pikeland Township's Green Ribbon Landscapes.

Restoring and maintaining connected, healthy riparian areas, headwaters, wetlands, and larger upland habitats expands ROE and biological diversity. GRL is a voluntary approach to help residents understand how important these areas are. A GRL is a linear, 300-foot setback that expands ROE along parks, trails, preserves, riparian areas, and large forests (over 200 acres). The 300-foot distance protects the core forest from light that enables invasive species. Invasive species often out compete native species and destroy native habitat. 300 feet is the distance that light can penetrate a forest edge do to sun angles. Planting 60% canopy cover and 60% native plants within the 300-foot setback helps protect the core forest and biological diversity. These plantings can be done in parks, trails, preserves, riparian areas and private land.

84% of land in Pennsylvania is privately owned. To be able to have an impact, particularly in high ROE areas, homeowners need to practice good stewardship on their property and plant 60% in canopy cover and 60% in native plants (refer to the Green Ribbon Map to note priority areas for backyard stewardship). [28]

06. ECO-PRICING

What have governments and people been willing to pay for the services that nature provides free of charge?

The value placed on nature's services is not intrinsic, but rather a value that government, businesses, and individuals have been willing to pay for these services once nature has been disrupted or destroyed. In this way, the full cost of habitat loss or retention is understood, and communities can begin to see nature's services as financial assets to be managed.

Eco-pricing is the process used to determine what price people and government have been willing to pay to maintain or restore services.

The eco-price method documents instances where society has paid for an increase in nature's services, avoided their loss, or restored damages to those services. For example, many restoration practices are focused on reducing the amount of nitrogen entering waterways. The cost of paying for this can be expressed in terms of $/pound of nitrogen removed.

Natural systems, such as wetlands, forests, and riparian areas, remove nitrogen naturally at varying rates on an annual basis. Using the average cost of nitrogen reduction practices, an annual eco-price benefit can be calculated for each natural system. [29]

Building on previous valuation studies and using standard economic analysis techniques, our study estimated the financial value of natural system services. Data for these estimates were provided by the Pennsylvania Fish and Boat Commission, Pennsylvania Game Commission, Pennsylvania Bureau of Forestry, PA DCNR and the Maryland Department of Natural Resources. For more information on eco-pricing see https://kittatinnyridge.org/explore/roe/

07. OUTDOOR RECREATION AND REDUCED HEALTH CARE COSTS

Demand for outdoor recreation is increasing.

The outdoor recreation industry is strong and growing, generating $646 billion annually in the United States. By comparison, gasoline and other fuels yield $354 billion annually.[30]

According to the Outdoor Industry's *Pennsylvania Fact Sheet*, Pennsylvania residents spend over $29.1 billion annually on outdoor recreation. [31] This includes many sports events, driving for pleasure, and golf. Outdoor recreation sustains as many jobs in Pennsylvania as the natural gas industry. [32]

This study only focuses on outdoor recreation activities of residents to enhance their quality of life without disturbing or destroying the environment.

31% of Pennsylvanians surveyed during the DCNR *2014 Outdoor Recreation Participation Survey of Pennsylvania* said they planned to spend more time outdoors.[33]

About half of the region's baby boomers plan to increase their outdoor activity, compared to 25% of their older counterparts. By 2025, millennials will make up 75% of the workforce, and these young professionals enjoy the outdoors and seek healthy and adventurous lifestyles. [34]

Nature provides the venues for outdoor activities, free-of-charge. *Table 3* shows the direct recreation economic impacts for West Pikeland Township in two scenarios.

$2.3 to 7.8 million

Outdoor recreation annual revenues

TABLE 3.

West Pikeland Township

Recreation Direct Economic Impact

Activity	Low Scenario	Expected Scenario
Walking	$235,181	$456,888
Fishing	$183,694	$416,466
Hunting	$196,923	$599,209
Birding/Bird Watching	$67,165	$476,874
Wildlife Watching	$176,059	$310,618
Camping	$146,988	$284,177
Kayaking/Paddle Sports	$61,245	$259,066
Bicycling	$293,976	$521,807
Mountain Biking	$166,586	$1,156,673
Cross-Country Skiing	$106,158	$452,233
Horseback Riding	$39,197	$1,469,880
Hiking	$114,324	$181,285
Jogging/Running	$53,079	$753,314
Nature Study	$488,735	$431,981
Total*	$2,329,311	$7,770,472

*These estimates are based on the 75% outdoor recreation participation.

The Low Scenario is the lowest possible participation and spending on recreation in the township. The Expected Scenario is based on participation and spending rates from the opinions of regional vendors and recreation enthusiasts.

The trend for current residents is to spend more time outdoors, and this is expected to continue with future growth.

A 2015 report by the Outdoor Industry Association found that the following outdoor activities have been increasing:

- paddle sports
- mountain biking
- cross-country skiing
- day hiking
- bird watching
- bicycling

Local outdoor recreation experts add fishing, running, and nature study to the list. [35]

Many people participate in more than one outdoor activity. They also participate on different lands, from farmers' fields, to trout streams, roads, white water areas and so on. *The Chester County ROE Study* estimated that people spend $656 per household, per year recreating on protected lands. [36]

Numerous studies have shown that easy access to outdoor recreation inspires more people to exercise. The more they exercise, the healthier they are, with less money spent on health care costs. [37]

West Pikeland Township's health care savings were derived by applying DCNR outdoor exercise participation rates to the conclusions of four recent studies.

$3.3 million annually

Dollars saved each year from reduced health care costs by men and women over 19 years of age in West Pikeland Township.

The EPA and other public health organizations have long acknowledged the link between water and air quality, and human health. There are social and health benefits related to the proximity of people to nature, parks, walking trails and biking trails—both in the form of physical exercise and mental stress relief. [38]

Forests outside of urban areas significantly contribute to improved human health in urban areas. These health benefits have the potential to provide significant cost savings in health expenditures. People who exercise regularly and seek stress relief are generally healthier, have fewer insurance claims and spend less time in hospitals, thus their societal health care costs are lower. [39]

While paid fitness clubs and prescription exercise are valuable, individuals generally remain actively involved for just a short period of time, often three to six months. [40]

People over 19 years of age who exercise two or more times a week save $1,425 per year in health care costs annually. [41,42] Adults who exercise one day per week save $713 dollars each year on health care costs. [43,44]

08. PROPERTY VALUE

Homeowners are willing to pay a premium to live near protected open space.

Chester County, Pennsylvania's Return on Environment Study: *The Economic Value of Protected Open Space in Chester, County Pennsylvania* clearly shows that homeowners are willing to pay a premium to live near protected open space.

Results indicate that proximity to protected open space contributes a significant positive impact to residential property values. [45] As a result, the existing protected open space in Chester County adds to the overall value of its housing stock. This increased wealth is captured by citizens through higher sale values of homes near protected open space. This generates increased government revenues via larger property tax collections and greater transfer taxes at time of sale.

The Chester County report analyzed approximately 98,000 home sales in Chester County from 1981-2017 to estimate the effect of protected open space on residential property values and the attendant fiscal impacts.

The closer a home is to protected open space, the more value it captures. Approximately 3.6% of the value of a home located between 0 and ¼ mile of protected open space can be attributed to its proximity to that protected open space. [46]

The increase in value for homes ¼ mile to ½ mile away is about 2.3%. When added together, the increments of value that homes within ½ mile of Chester County's protected open space captured as a result of their proximity to protected open space totaled $1.65 billion. [47]

In other words, if all the protected open space in Chester County were eliminated, the total value of the housing stock would decrease by $1.65 billion. For homes within ½ mile of protected open space, this represents an average property value increase of almost $11,380 and nearly $13,120 for homes within ¼ mile of protected open space. [48]

The increased value of homes within a ½ mile radius of protected open space also increases the amount of property and transfer taxes paid to county and municipal governments and to school districts. County-wide, the additional property tax revenues total $27.4 million per year for homes within ½ mile of protected open space. [49]

A similar, but less rigorous approach was used for Dauphin, Lehigh, and Northumberland Counties and showed that the value of homes within a ¼ mile of open space varied, depending on the land use setting. [50]

- Lakes - 22% increase
- Urban areas - 15% increase
- Suburban areas - 10% increase
- Rural areas - less than 1% increase

09. NATURE PROVIDES A COMPETITIVE ADVANTAGE

ROE financial data supports a businesslike approach to economic development, infrastructure, water management, tourism, and land use planning.

West Pikeland Township's open spaces supply clean water, critical wildlife habitat, flood protection, stormwater management, and significant recreation and tourism opportunities. By understanding nature's financial value, West Pikeland Township is better equipped to strike an effective balance between protection of natural systems and supporting smart growth.

Nature's Competitive Advantages:

- Every company with a discharge permit is dependent on clean water;
- Pure, naturally filtered water is critical to bottling, pharmaceutical, and technology companies in their business processes;
- Many businesses today want employees to have healthy lifestyles because active employees are happier, more creative, more productive, and miss less work. [51]

Two of the fastest-growing sectors of the economy are retirees and people working in knowledge-based industries. Increasingly, they are selecting communities with protected land and natural amenities when determining where to make their home. [52]

Since 1990, 90% of new jobs with good salaries are in the service sector. Many of these are flexible, able to locate anywhere. [53]

The quality of the environment impacts business location, attracts investment, stimulates tourism and recreation sectors, and attracts wealth. [54]

10. CREATING A SUSTAINABLE ENVIRONMENT AND ECONOMY

The first rule of ecology is that everything is connected to everything else. Whatever we do to natural habitats—good or bad, big or small—ripples through the economy.

The *2014 National Climate Assessment* notes the effects of climate change in regions around the United States. Depending on the region, effects can include more and stronger storms, more drought, more frequent, extreme-heat events, rising sea levels, and more flooding. Townships that protect riparian corridors are expected to be more resilient to the anticipated effects of climate change.

Expenses associated with recovery from extreme weather impacts increased by a factor of six between 1997 and 2007. The most efficient way to avoid excessive future costs is to increase the flexibility of ecosystems now so that they may function and retain resiliency under a wider range of climatic conditions. [55] It is essential to understand the changes projected for Pennsylvania when planning land use.

Land use decisions are, by far, the greatest opportunity to create ecological and financial change. Preventing impairments to natural systems protects the services that they provide. This has economic benefits for communities and prevents expensive replacement and restoration costs.

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. 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 biological sustainability and better enables a community's ability to adapt to climate change, and provides long-term financial benefits.

This connectivity can potentially moderate some of the worst effects of habitat fragmentation and promote wide-ranging biodiversity. [56]

Map 4, West Pikeland Township's ROE, provides a landscape pattern that can be used to restore connectivity. The Green Ribbon Landscape map shows the patterns needed to have a sustainable environment and economy by connecting riparian areas and forests.

Tips for creating a sustainable environment and economy

1. Protect water quality at its source in headwaters and wetlands, and along riparian areas.
2. Protect regional, sub-regional, and local wildlife corridors.
3. Remove invasive plants and minimize disturbance on edges and clearings.
4. Remove obsolete dams to improve water quality and aquatic habitats.
5. Minimize impervious surfaces and limit turf grass to areas essential for recreation.
6. Practice good stewardship and incentivize the use of native plants in the landscape areas surrounding parks, preserves, riparian areas, and trails.

11. WE CAN' T AFFORD NOT TO PROTECT OPEN SPACE

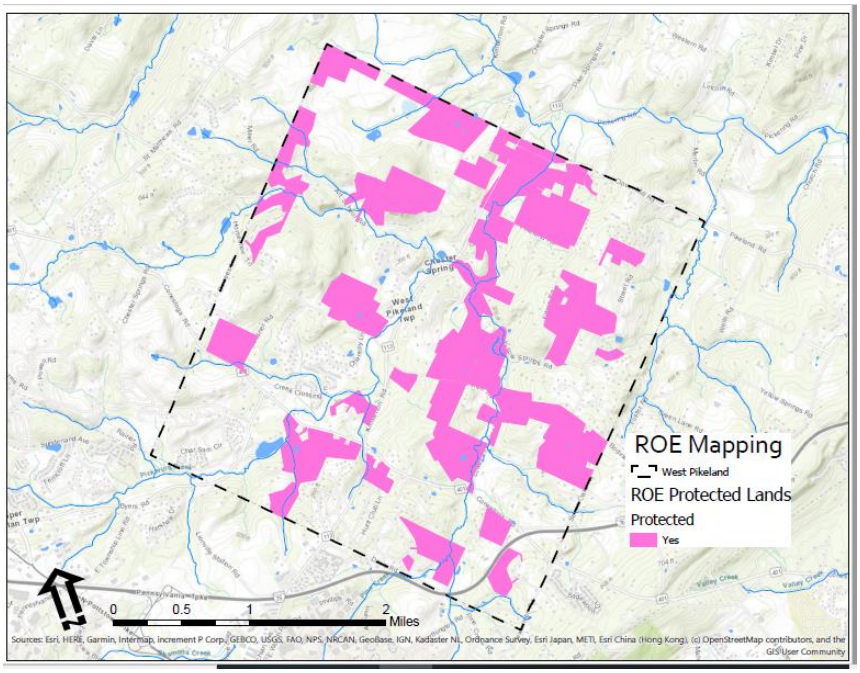
The loss of open space costs us more than we know. We are only beginning to understand the significance of nature's financial values.

A strong regional economy requires a healthy natural environment and plenty of open space combined with sound land-use planning. Many communities are a patchwork of small open space areas and stream corridors.

If the economy of West Pikeland Township is to remain strong, environmental stewardship must become a community responsibility. Municipal officials, policymakers, business leaders, and local citizens need to work together to examine current policies and ensure sustainable environmental practices. Only then can West Pikeland Township build the foundation for a vibrant, balanced economy and a healthy, desirable community for current residents and future generations.

Today, West Pikeland Township must do more to quantify the financial benefits provided by nature and link those values directly to the community's well-being. For example, a natural resource inventory does not explain the financial consequences of losing a habitat or species. Development proposals might not estimate the cumulative impact on stormwater, flooding or loss of wetland functions.

Map 4. West Pikeland Township's Protected Land and Green Ribbon Landscapes.



Communities that understand the value of nature have a better chance of striking an effective balance between maintaining connected, resilient open spaces and supporting smart growth. This includes arresting the decline in habitats and species and the degradation of landscapes. The strategy will help improve the quality of the natural environment and sustain the economy in West Pikeland Township, moving to a net gain in the value of both.

12. PUTTING RETURN ON ENVIRONMENT STUDIES TO WORK

A blueprint for action

Growth can fragment habitat and impact natural systems by causing water pollution, flooding, and stream bank erosion. With less open space remaining, the size, quality, location, and connectivity of that remaining open space becomes critical in determining residents' future quality of life, health, and cost of living.

The first step in putting ROE studies to work is articulating the ways in which open space provides natural system services. Placing a dollar value on different land covers helps decision makers understand what is critical to the environment and the economy and what lands can be developed. Mapping the pattern of connected habitat identifies what is needed to sustain the environmental and economic benefits.

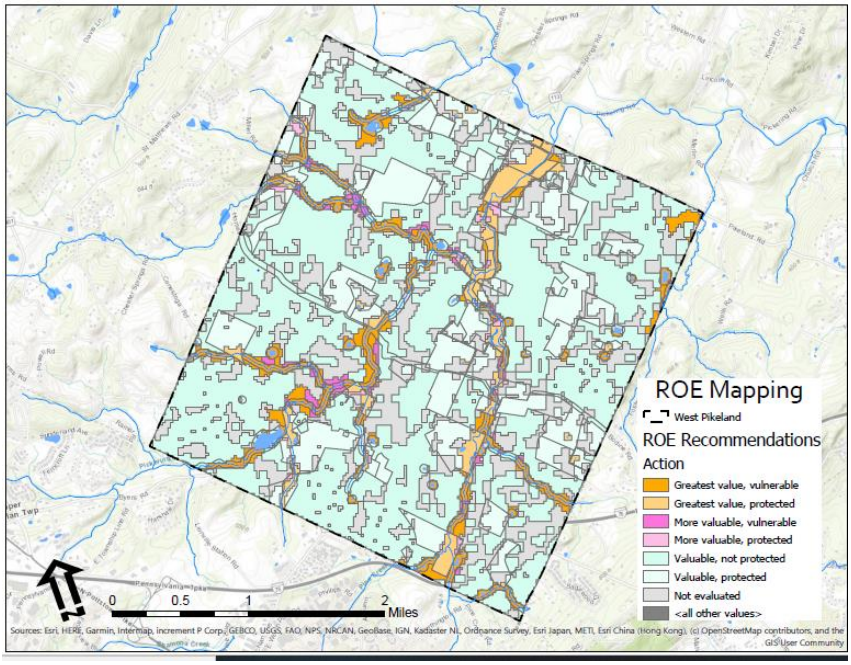
All Stakeholders Play a Part

Environmental stewardship must become part of West Pikeland Township's everyday culture. Strong alignment between residents, planners, nonprofits, land trusts, businesses, and policy makers is essential for the township to continue to thrive. Utilizing the ROE process can help ensure this commitment to collective responsibility.

- Include ROE in decision-making. Begin every land-use, economic development, tourism and recreation-planning process with a clear understanding of the financial value of nature's current assets;
- Include ROE data in your comprehensive plan, zoning and site-plan review;
- Map the relative financial values of natural system services and develop strategies to maintain, restore and enhance them;
- Expand natural habitat by developing Green Ribbon Landscapes along riparian areas and around parks, trails and natural preserves;
- Restore riparian areas where necessary;
- Determine if highly valued areas are vulnerable to disruption;
- Protect and restore riparian buffers and wetlands from disturbance and connect and restore open space corridors;
- Retain as much pre-existing, natural landscape as possible during any new construction;
- Estimate the financial savings each year when Riparian Buffer and Official Map are in place;
- Teach the principles of good stewardship to landowners. Create good habitat and use native plants in your own backyard;
- Teach your park maintenance staff how to naturalize parks; and Involve schools. Initiate environmental education programs with multidisciplinary applications that will help students appreciate the value of nature.

Maintaining connected, healthy riparian areas, headwaters, wetlands, larger uplands and habitats provides for a sustainable environment and local economy.

MAP 5. West Pikeland Township's ROE Recommended Actions



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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.

Avoided cost *(AC)* Dollars that do not need to be spent on the provision of environmental services, such as improving water quality and removing air pollution.

Biological connectivity The ability of individual plants and animals to move across complex landscapes, maintaining regional populations in the short term and allowing species to shift their geographic range in response to habitat needs and climate change.

Biological control The dynamic regulation of species populations, including the control of invasive species and unwanted species—such as pests, weeds, and disease vectors (e.g., mosquitoes)—by beneficial insects.

Carbon sequestration The process of carbon capture and long-term storage of atmospheric carbon dioxide (CO2) through photosynthesis. Carbon sequestration describes long-term storage of carbon dioxide or other forms of carbon to either mitigate or defer global warming and avoid dangerous climate change.

Carbon storage The estimate of the total amount of carbon currently stored in the above- and below-ground biomass of a forest.

Climate change Regional or local climate patterns, particularly a change apparent from the mid-20th century onward, attributed largely to the increased levels of atmospheric carbon dioxide produced by the use of fossil fuels.

Conservation design A planning process that rearranges the development on each parcel as it is being planned so that half (or more) of the buildable land is set aside for open space.

Contingent valuation *(CV)* A survey-based economic technique for the valuation of non-market resources, such as environmental preservation or the impact of contamination.

Cost of damage *(CD)* An estimate of monetized damages associated with the release of carbon or other pollutants.

Cost of regulation (CR) Fines and procedures.

Direct market valuation *(DM)* Obtaining values for the provision of services.

Direct investment in a resource *(DI)* Investment in water supply facilities or the protection of land.

Ecosystem function The habitat, biological, or system properties or processes of ecosystems.

First Order streams Stream order is a measure of the relative size of streams. The smallest tributaries are referred to as first-order streams. These are headwater streams.

Flood mitigation The management and control of flood water movement, such as redirecting flood runoff through the use of floodwalls and floodgates, rather than trying to prevent floods altogether.

Green Ribbon Landscape A voluntary 300-foot setback that expands ROE and supports a sustainable economy.

Groundwater **Water** found underground in the cracks and spaces in soil, sand, and rock. It is stored in and moves slowly through geologic formations of soil, sand, and rock called aquifers. Groundwater is the source of water for streams and supplies water through wells.

Habitat The area or environment where an organism or ecological community normally lives or occurs.

Habitat loss Loss and degradation of the natural conditions that animals and plants need to survive.

Market valuation *(MV)* The amount of money paid to purchase credits in a trading market, for example, the price of a carbon credit for air quality, the purchase of a nutrient credit for water quality, or the purchase of potable water.

National Pollutant Discharge Elimination System (NPDES) permit The NPDES permit program addresses water pollution by regulating point sources that discharge pollutants to waters of the United States.

Natural capital A portfolio of natural assets, such as geology, soil, air, water, and all living things.

Natural habitat regeneration The process by which vegetation and habitat grow back without human intervention.

Natural system services The flow of goods and services that benefits people, directly or indirectly, from ecosystem functions; also called ecosystem services.
Open space Land that is valued for aesthetic beauty, recreation, natural process, agriculture, and other public benefits.
Outdoor recreation Activities that can be performed in natural settings, without causing harm.
Pollination The process by which pollen is transferred from the anther (male part) to the stigma (female part) of a plant, thereby enabling fertilization and reproduction.
Replacement cost *(RC)* Cost to replace services 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 cost of replacing the natural waste assimilation service with chemical or mechanical alternatives.

Water supply A source, means, or process of supplying water, including groundwater aquifers, reservoirs, streams, rivers, and pipelines.
Waste assimilation The method by which forests and wetlands provide a natural protective buffer between natural system activities and water supplies.
Riparian buffer A vegetated area ("buffer strip") near a stream, 100 feet wide and usually forested, which helps shade and partially protect a stream from the impact of adjacent land uses. It plays a key role in increasing water quality in associated streams, rivers, and lakes, thus providing environmental benefits.
Soil retention A system that creates and enriches soil through weathering and decomposition, preventing it from being washed away. ***Tax benefits (TB)*** **Adjustment benefiting a taxpayer's** tax liability.
Travel cost *(TC)* Cost of travel and its reflection on the implied value of a service.
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 quality A measure of the suitability of water for a particular use (drinking, fishing, or swimming), based on selected physical, chemical, and biological characteristics.

APPENDIX A. Pennsylvania Wildlife Action Plan, 2019

Wildlife Action Plan, Conservation Opportunity Area Tool Results West Pikeland Township.

Species of Greatest Conservation Concern	SGCN Season	Priority Score	Occurrence	Habitat Macrogroup(s)	Specific Habitat Requirements
Blue-winged Warbler	Breeding	1	Likely	Agricultural	Early-mid successional forests and thickets with openings; areas marked by patches of herbs, shrubs, and trees and often located near a forest edge.
Willow Flycatcher *(Empidonax traillii)*	Breeding	1	Likely	Wet Meadow / Shrub Marsh	Low-elevation shrub swamp, wet meadow, and brushy habitats along streams and the edges of ponds and marshes. Sometimes dry upland sites.
Purple Martin *(Progne subis)*	Breeding	2	Likely	Agricultural	Having nearby water sources is not necessary in a Purple Martins habitat, however it can be helpful as a food source. Martin housing should be placed in the most open spot available (at least 40 feet, but preferably 60 feet from trees or buildings) and within 100 feet of human housing or activity. Proximity to humans and a wide-open location and flight area will help protect the martins from predators.
Wood Thrush *(Hylocichla mustelina)*	Breeding	1	Likely	Northern Hardwood & Conifer	Second-growth deciduous forest and forest-edge habitats often with available fruit. 500 acres and larger.
Gray Catbird *(Dumetella carolinensis)*	Breeding	4	Likely	Urban/Suburban Built	Dense, shrubby vegetation, including thickets, hedgerows, woodland edges, and regenerating clear-cuts.
Louisiana Waterthrush *(Parkesia motacilla)*	Breeding	1	Likely	Hardwood & Conifer	Mature, forested watersheds with med-high gradient. 250 acres and larger. Headwater (1st-3rd order) streams, with well-developed banks

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					(ravines) and/or plentiful overturned trees with exposed root masses. High-quality stream indicator.
Scarlet Tanager *(Piranga olivacea)*	Breeding	1	Likely	Northern Hardwood & Conifer	A wide variety of mature deciduous and mixed-deciduous forest types. 500 acres and larger.
Northern Field Sparrow *(Spizella pusilla)*	Breeding	1	Likely	Agricultural	Mixture of grasses and shrubs.
Grasshopper Sparrow *(Ammodramus savannarum)*	Breeding	1	Likely	Agricultural	Indicator for large-scale grasslands; grassland obligate species.

Action Impact Score: Recommended Conservation Actions Benefiting Species of Greatest Conservation Concern. The PA Game Commission can help with more information.

High

Land use planning	Action	Priority Score	Species
	Develop landscape-level planning agreements across ownerships in areas where species occur. Cluster development, utilities, and associated infrastructure to reduce impacts to species. Implement land use best management practices (e.g., riparian buffers) and erosion and sedimentation plans to protect water quality.	1	Black-and-White Warbler, Hooded Warbler Grasshopper Sparrow, Field Sparrow
	Implement land use best management practices (e.g., riparian buffers) and erosion and sedimentation plans to protect water quality.	1	Louisiana Waterthrush

Wildlife damage management	Manage deer for healthy and sustainable forest habitat.	1	Willow Flycatcher
Fire management	Create or maintain grassland habitat, particularly warm season grasses.	1	Field Sparrow
Conservation area designation	Conserve trees along streams and rivers, and around wetlands.	1	Louisiana Water Thrush
	Reduce impacts of Brown Trout in areas managed for native Eastern Brook Trout	!	Brook Trout
	Identify and conserve unprotected large >247 acres (>100 hectares) forest blocks.	1	Scarlet Tanager
Species and habitat management planning	Conduct species distribution and population surveys to support management decisions and conservation strategies. Manage deer for healthy and sustainable forest habitat.	1	Scarlet Tanager, Sensitive Species
Create new habitat or natural processes	Identify areas of unnaturally acidified soils and restore using terrestrial lime application. Actively manage habitat (e.g., controlled burns) to promote presence of the species.	1	Wood Thrush, Kentucky Wood Thrush Black-and-White Warbler
Vegetation management	Conserve, create, or restore habitat for this species.	1	Willow Flycatcher
Private sector standards and codes	Reduce straight, 'hard edges' between field and forest by creating a young forest transition between the habitats.	1	Willow Flycatcher
Water management	Determine the impact of pesticide use and contaminant bioaccumulation.	2	Purple Martin
Vegetation management	Create patches of forest openings and young forest habitat (i.e., multiple age stands) through best management practices (e.g., controlled burns or timber harvest).	4	Gray Catbird
	Create or maintain grassland habitat, particularly warm season grasses.	1	Field Sparrow
Land use planning	Cluster development, utilities, and associated infrastructure to reduce impacts to species.	1	Wood Thrush
State Regulations	Cluster development, utilities, and associated infrastructure to reduce impacts to species.	1	Scarlet Tanager

Fire management	Conserve grassland habitat using best management practices (e.g., controlled burns) to prevent conversion to non-grassland habitat.	1	Grasshopper Sparrow
	Maintain or create habitat mosaics, including shrubs, with fire.	1	Field Sparrow
Coordination and Administration	Coordinate planning of new roads, pipelines, and powerlines to avoid large forest blocks, or use existing corridors.	1	Black-and-white Warbler, Hooded Warbler
Partner/stakeholder engagement	Develop education curriculum about the species and threats facing the species.	2	Purple Martin
Legislation	Monitor climate change indicators, such as water temperature and prey populations.	1	Louisiana Water Thrush