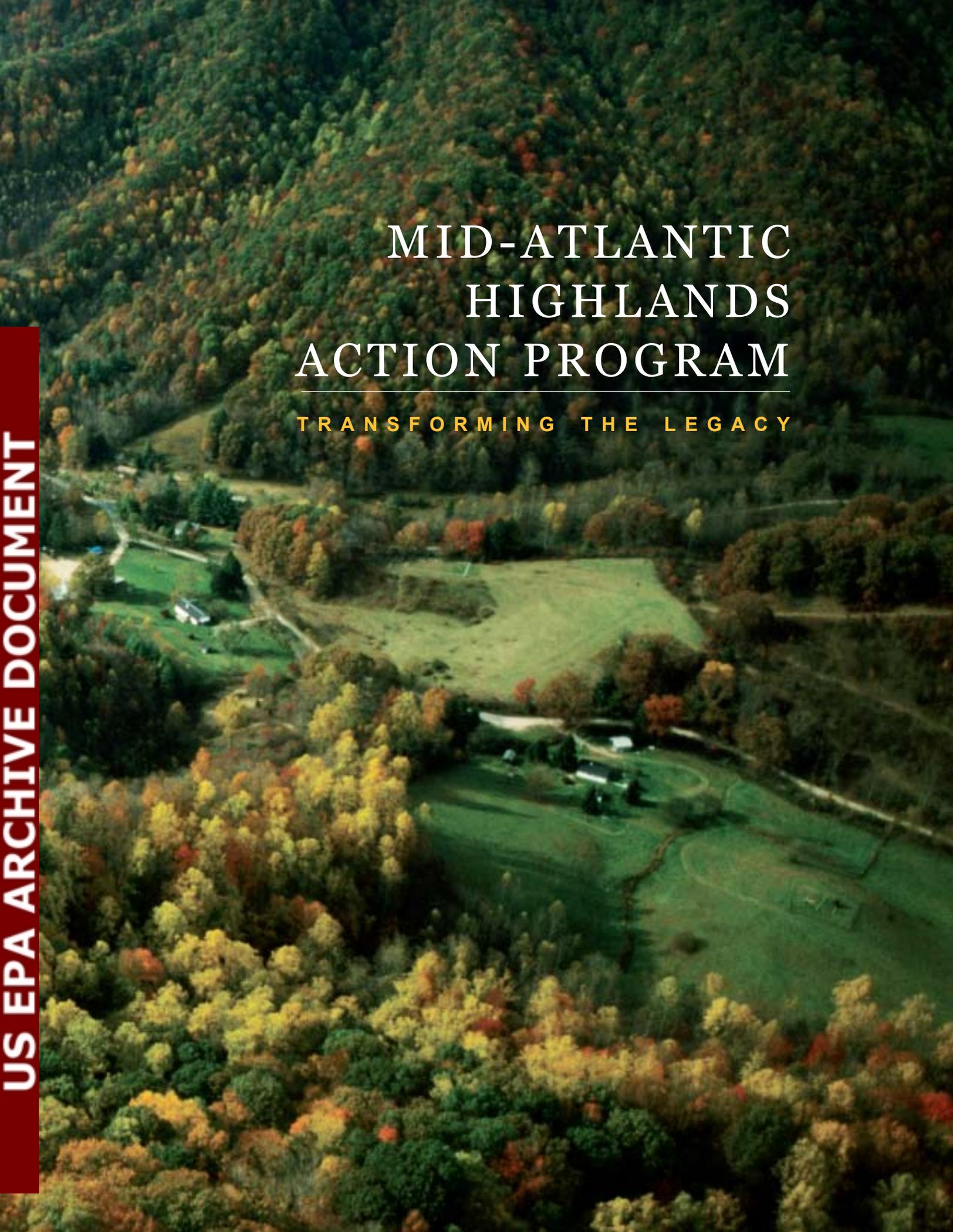


US EPA ARCHIVE DOCUMENT

MID-ATLANTIC HIGHLANDS ACTION PROGRAM

TRANSFORMING THE LEGACY



ACKNOWLEDGMENTS

This report was prepared by Canaan Valley Institute with the assistance of FTN Associates. It could not have been written without information provided by many agencies and institutions. These sources are listed in the reference section at the end of the report.

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Cover photograph: Rock Creek, WV by Lyntha Scott Eiler.

The Mid-Atlantic Highlands region extends from New York in the north to the North Carolina/Tennessee border in the south, and from the Blue Ridge Mountains in the east to the Ohio River in the west.



Mid-Atlantic Highlands

T R A N S F O R M I N G T H E L E G A C Y

Action Program

prepared by
Canaan Valley Institute

July 2002

EXECUTIVE SUMMARY

In the Joint Explanatory Statement of the Committee of the Conference, accompanying Public Law 107-73, making Fiscal Year 2002 Appropriations for the Department of Veterans Affairs and Housing and Urban Development, and Independent Agencies (including the Environmental Protection Agency (EPA)), Congress expressed an expectation that the Administrator of the EPA will carry out the goals of the Mid-Atlantic Highlands Program. It calls for EPA to enter into agreements with state and federal agencies, as well as nongovernmental organizations like Canaan Valley Institute (CVI) to assist the Agency in carrying out those goals. CVI has prepared this report for Congress and EPA for two reasons:

1. to document the need for a Highlands Action Program and
2. to recommend an approach to implement a Highlands Action Program.

Created to foster local decision making in support of sustainable Highlands communities, the Institute is committed to empowering stakeholders and increasing their ability to improve their quality of life.

The Mid-Atlantic Highlands is a complex and evol-

ving region, where the environment is an important part of the community, quality of life, and economy. The region hosts some of the most diverse and globally important ecological resources on Earth. Its forests are the most diverse in North America and contain the largest interior temperate hardwood forests in the world. Highlands streams also contain as many types of fish, mussel and crayfish species as any temperate streams in the world. In a 2000 report by the Nature Conservancy, the Highlands region was identified as one of its top six priorities because of the high diversity in total species richness of plants and animals, and the presence of unique species not found in other parts of the United States.

The Highlands region has a remarkable history forged by past environmental and economic decisions. These decisions left a legacy of problems – remnants of past exploitation that fueled an economy outside the region. Over the past ten years, a wealth of scientific information has been generated about the Highlands by scientific institutions. This information is being used to help solve some of the region's environmental problems and support

the need for a Highlands Action Program.

Some of the major environmental problems identified through research and CVI-stakeholder interactions are habitat loss; stream sedimentation; forest fragmentation; acid rain; acid mine drainage; flooding; and invasive, non-native species. These are just some of the stressors that result from human activities such as urban infringement, timber, agriculture and mining practices, and stream alterations. In addition there are also economic concerns in the Highlands. In some counties in the Highlands, up to 50% of the children are living in poverty. Parts of the region also struggle with high unemployment rates, low labor force participation rates, and some of the lowest per capita incomes in the nation (Table 1).

With problems, however, come opportunities. There are opportunities to take advantage of the skills and resources within the region that cannot be duplicated anywhere else – its people, history and cultural heritage, institutions, climate, scenic beauty, open space, biological diversity, and globally significant forests. Some key opportunities include

Table 1. Environmental and socioeconomic indicators suggest that all is not well in the Highlands.

<i>Indicator</i>	<i>Environmental Condition (% Fair/Poor)</i>	<i>Socioeconomic Condition (% Counties Below National Average)</i>
Forest Fragmentation	47	
Bird Index	57	
Fish Index	67	
Insect Index	75	
High School Graduation Rates		86
Unemployment Rates		83
Per Capita Income		88

1. the creation of a natural resource restoration industry;
2. amenity-based development;
3. value-added natural resources products; and
4. the foundation of a solid base for environmental stewardship and sustainable development through partnerships.

Those who live here and those who visit realize that the Highlands region must be cared for through partnerships and with methods that intertwine the economic concerns and values of local communities with environmental stewardship. The Canaan Valley Institute has demonstrated that this model for the Highlands works. Now, the model needs to be expanded through a Highlands Action Program to sustain this special place and nurture the emerging approach to environmental stewardship. This will

require broad political and citizen support.

Sound environmental stewardship can be achieved through a Highlands Action Program that

1. takes action on the problems identified in this report;
2. uses environmental indicators, good science, and partnerships to identify the causes of these problems;
3. develops solutions and management actions to resolve these problems;
4. develops a management governance for the Program that includes local communities, states, nongovernmental organizations, research institutions, and the private sector in partnerships; and
5. periodically assesses its status, emerging issues and trends, and reports to Congress and local stakeholders on its findings.

An approach for implementing a Highlands Action Program to achieve the objectives cited above is recommended in this report. This report describes how a Highlands Action Program can, indeed, help transform a legacy of scarred landscapes and underserved people into a promising future of sound environmental and socioeconomic stewardship. The Program relies upon Highlands stakeholders to work together to resolve Highlands issues.

Mid-Atlantic Highlands
 TRANSFORMING THE LEGACY
Action Program

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“Our duty is to use the land well, and sometimes, not to use it at all. This is our responsibility as citizens; but, more than that, it is our calling as stewards of the Earth. Good stewardship of the environment is not just a personal responsibility, it is a public value. Americans are united in the belief that we must preserve our natural heritage and safeguard the land around us.”

– George W. Bush, President, United States

INTRODUCTION

PURPOSE

This report, developed by the Canaan Valley Institute,

- identifies the values and needs of Mid-Atlantic Highlands stakeholders;
- defines the environmental pulse or condition of the Mid-Atlantic Highlands;
- evaluates the stressors affecting this condition;
- identifies the human activities contributing to the stressors;
- highlights the factors affecting economic conditions;
- proposes opportunities for sustainable environmental stewardship; and
- presents an approach for implementing and evaluating a Highlands Action Program.

BACKGROUND

In the Joint Explanatory Statement of the Committee of the Conference, accompanying Public Law 107-73, making Fiscal Year 2002 Appropriations for the Department of Veterans Affairs and

Housing and Urban Development, and Independent Agencies (including the Environmental Protection Agency (EPA)), Congress expressed an expectation that the Administrator of the EPA will carry out the goals of the Mid-Atlantic Highlands Program. It calls for EPA to enter into agreements with state and federal agencies, as well as nongovernmental organizations like Canaan Valley Institute (CVI) to assist the Agency in carrying out those goals. Congress indicated that a federal program is needed in this region for collaborative monitoring, research, management, and restoration activities. CVI is specifically mentioned in the Congressional Report because of its extensive experience working with Mid-Atlantic Highlands stakeholders.

CVI has prepared this report for Congress and the EPA for two reasons: 1) to document the need for a Highlands Action Program and 2) to recommend an approach to implement a Highlands Action Program. Created to foster local decision making in

support of sustainable Mid-Atlantic Highlands communities, the Institute is committed to empowering stakeholders and increasing their ability to improve their quality of life.

Congress and the EPA have long recognized the environmental importance of watersheds. In addition, there is a growing recognition of the importance of collaboration among all levels of stakeholders to ensure responsible environmental stewardship. Because the Mid-Atlantic Highlands is comprised of three major watersheds on over 79,000 square miles, which affect water quality from the Potomac Highlands to the Gulf of Mexico, there is a need to establish a federal program that involves collaborative monitoring, research, management, and restoration activities throughout the Mid-Atlantic Highlands.

This report describes why a Mid-Atlantic Highlands Action Program is needed, and how it could be implemented to assist government agencies and citizens to

- tightly intertwine economics and cultural heri-

“We must improve the relationships among the federal government, states, and localities so that we are more often working together, rather than at cross-purposes, as we pursue responsible environmental stewardship.”

– Christine Whitman, Administrator, US Environmental Protection Agency

- tag with the environment;
- revitalize damaged ecosystems;
- sustainably practice environmental stewardship;
- protect special places;
- create long-term employment opportunities and improve the quality of life for those who live in and visit the region; and

- leverage funds for an underserved region.
- The Canaan Valley Institute has a successful history of building partnerships that are locally driven, but that include stakeholders from all levels of government as well as from the nonprofit, private, and academic sectors. These partnerships employ sound scientific methods to creatively and effectively manage natural re-

sources, improve communities, and develop economic opportunities.

CVI has benefited from the experience of established place-based programs, and the organization has incorporated lessons learned from successful federal efforts such as the EPA’s Chesapeake Bay Program, the National Estuaries Program, and the Great Lakes Program. Based on its experience and that of others, CVI has concluded that a science-stewardship approach combining top-down program policies and goal setting (a strength of EPA geographic-based programs) with the momentum of locally driven values, opinions, and needs is the desired approach for implementing the congressionally mandated Mid-Atlantic Highlands Action Program. The color themes distinguishing each section of this report relate to each element of this approach as illustrated in Figure 1.

The information and recommendations presented in this report are intended to help Congress, EPA, and other federal agencies as they decide on programs and priorities to guide the Mid-Atlantic Highlands in the 21st century.



Figure 1. This diagram illustrates the process by which the Highlands Action Program will operate. The Program is locally driven and incorporates government, private sector, nonprofit, and academic partners. Sound science and local stewardship go hand in hand. The color themes of each section of this report relate to the elements of this process.

“The circle of people who understand the significance of this resource is growing. More and more are becoming familiar with the rich resources and rare habitats of the Mid-Atlantic Highlands. We’ve been hard at work spreading the word because we know that this is a unique region. And we believe that it deserves careful study, and thoughtful solutions to the problems which exist.”

– Alan Mollohan, US Representative, West Virginia (D)

THE HIGHLANDS—A SPECIAL PLACE

LAND

The Mid-Atlantic Highlands is a complex and evolving region, where the environment is an important part of the community, quality of life, and economy.

The region encompasses about 79,000 square miles. It extends from the Blue Ridge Mountains in the east to the Ohio River in the west, and from New York on the north to North Carolina and Tennessee in the south. (See inside front cover).

The region hosts some of the most diverse and globally important ecological resources on Earth. Of the three world forest zones—boreal at high latitudes, temperate at mid-latitudes, and tropical at low latitudes—the Mid-Atlantic Highlands contains the most extensive interior hardwood forests in the world at the temperate latitudes. These forests are also the most diverse in North America—they contain an unusually rich mix of ferns, fungi, groundcover plants, shrubs, and trees. Sala-

The Mid-Atlantic Highlands region is a special place, where the environment is an important part of the community, quality of life, and economics of the region.

manders, frogs, and songbirds abound.

In a 2000 report by the Nature Conservancy, the Mid-Atlantic Highlands region was identified as one of its top six priorities because of the high diversity in total species, richness of plants and animals, and the presence of unique species not found in other parts of the US (Figure 2). These results have implications not just for conservation but also for tourism, recreation, and other economic activities.

The hardwood forests of the region are the most highly evolved in the eastern US, and provided the seed base from which all other forests in the east were spawned. As the glaciers moved down from the north tens of thousands of years ago, forests in their path were destroyed. The glaciers stopped just north of Central Appalachia, and this area became a refuge for the remaining temperate forest in the East—a mother forest that nurtured its trees, and sent them out to reforest the eastern US as the glaciers retreated. It is because of their unique evolutionary history that these forests are the most diverse in North America.

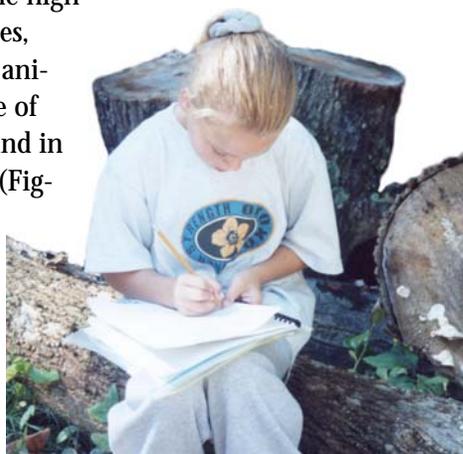


Photo: Dave Clark

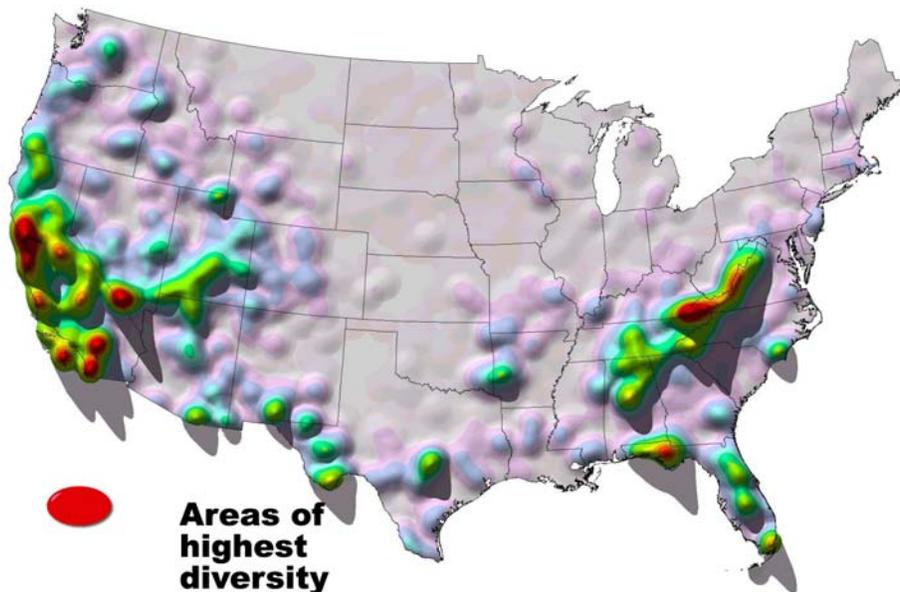


Figure 2. In 2000, The Nature Conservancy identified the Highlands as one of the most significant areas in the country due to its high amount of biological diversity. Areas of importance are shown in red.

The Mid-Atlantic Highlands forested watersheds are home to turkey, bobcat, black bear, and other species. This region is an important part of the migratory flyway not only for geese and ducks, but also for songbirds, many of which are suffering severe losses due to diminishing habitat. Several unique natural features—such as the boreal ecosystem of Canaan Valley, the geologically ancient New River Gorge, and Shenandoah National Park—draw millions of visitors a year.

These forests, which contribute so much to ecological diversity, are just as important economically. In 1999, the Mid-Atlantic Highlands forests contributed to an \$11 billion timber industry that provided over 186,000 jobs to the area. From 1982 to 1999, the timber industry grew 184%

in West Virginia alone, while across the region the timber industry's portion of the Gross State Product increased by 67% during this same period. Other opportunities, such as



Collection of ginseng is an important non-timber forest industry. Ginseng is just one example of an important forest plant that has contributed to the region's cultural heritage. [Photo: Lyntha Scott Eiler]

recreation and restoration, have yet to be fully developed, making the potential economic value of the forests even greater.

Forests are also a vital part of the cultural heritage of the region. Many of the forested mountains, such as Bloodroot Mountain in West Virginia and Chestnut Ridge in Pennsylvania, are named for important plants that have contributed to the region's remarkable culture. Herbs such as ginseng are used globally for medicinal purposes, and are harvested to support an important local non-timber forest industry.

Approximately one-quarter of all forested land in the Mid-Atlantic Highlands is managed as public land. National forests include the Monongahela National Forest of West Virginia, the Allegheny National Forest of Pennsylvania, and the George Washington and Jefferson National Forests of Virginia (Table 2). Mid-Atlantic Highlands states also manage significant areas of forest land. In total, 39 state forests in the Mid-Atlantic Highlands cover almost 3,600 square miles.

THE WATER

A rich interconnected mosaic of forests and aquatic ecosystems exists within the region. Streams weave through forests interspersed with wet-

GLOBALLY SIGNIFICANT FORESTS

THE MID-ATLANTIC HIGHLANDS REGION has globally significant, interior forests, but what exactly does that mean? The photo to the right shows an example of an extensive interior forest. Notice there are no breaks or patches in the forest coverage. Everything in the photo is considered interior forest. Many species require interior forest habitats to live. The Mid-Atlantic Highlands region has the largest interior, temperate hardwood forests in the world!



Photo: Lyntha Scott Eiler

AS THE FOREST BECOMES FRAGMENTED, or broken into small patches like the graphic below, the amount of interior forest decreases significantly. This is what is happening worldwide, including in the Highlands. Interior forest and the species that need interior forest habitats to survive are being lost. For some animals, these open areas form barriers to their movement. Greater forest patchiness also makes it easier for invasive species to get a foothold and outcompete native species, contributing to the loss of some Highlands species that are already rare, endangered, or of special concern.



Photo: Charlie Yuill, West Virginia University

The Highlands region contains globally important and exceptional natural resources.



Highlands streams flow through forests interspersed with wetlands, fields, and towns, contributing to the natural beauty of the region. [Photo: Lyntha Scott Eiler]

lands, towns, and farms. Mid-Atlantic Highlands streams contain as many types of fish, mussel, and crayfish species as any temperate streams in the world. Over 150 fish species, 75 mussel species, and about 20 crayfish species are found in these streams, including a number that are endangered, threatened, or of special concern.

Mid-Atlantic Highlands streams have such rich species diversity, in part, because the rugged landscape created many isolated hollows and ridges where this rich diversity could evolve. Over geologic time, many species were exchanged between the headwaters of the Ohio River and the Atlantic slope. The Mid-Atlantic Highlands is the birthplace of sev-

eral nationally important rivers—the Ohio, Tennessee, Potomac and the James. The region is also home to the New, Susquehanna, Monongahela, Allegheny, and Shenandoah Rivers (Figure 3). All of these rivers are part of the economic and cultural heritage of the region and still serve as major transportation corridors. In addition, many of

Table 2. National Forests and National Parks in the Highlands

<i>Name</i>	<i>State</i>	<i>Area (square miles)</i>
Allegheny National Forest	PA	870
George Washington & Jefferson Nation Forests	VA&WV	5200
Monongahela National Forest	WV	1420
Shenandoah National Park	VA	320



Figure 3. The Highlands is the birthplace and home to several nationally important and well-known rivers.

these rivers supply water to areas outside the region, both to the East Coast and the Ohio Valley.

BELOW GROUND

Although known for its mountainous terrain, not all of the Mid-Atlantic Highlands habitats are above ground. There are over 6,200 caves in the Mid-Atlantic Highlands, with over 3,800 caves in southwest Virginia alone. These caves support a rich biodiversity, with cave crickets, albino spiders, blind salamanders, and several endangered bat species. Organ Cave, located in southeastern West Virginia, is a Natural National Landmark. Over 40 miles long, it is one of the

longest caves in the United States and has been a tourist attraction since 1837.

Groundwater is also an important Mid-Atlantic Highlands resource. Emerging from stream beds and banks, groundwater sustains most of the Highland streams during the summer and fall months. Springs, arising from groundwater, also provided many homesteads with drinking water, and were an im-

portant part of the tourism economy for places like Berkeley Springs, WV. Groundwater provides about 15% of the public water supply and industrial uses in the Mid-Atlantic Highlands and over 67% of the water used for commercial purposes.

THE PEOPLE

The Mid-Atlantic Highlands has a remarkable history forged by past environmental and economic decisions, particularly the legacy and history of farming, coal mining, and timbering. Mid-Atlantic Highlands mountain music echoes



The legacy of coal mining contributed to the rich cultural diversity of the Highlands. [Photo courtesy of West Virginia and Regional History Collection, West Virginia University Libraries]



*The Civil War is part of the history and cultural heritage of the region and is a major source of tourism dollars.
[Photo courtesy of Rich Mountain Battlefield Foundation, Beverly, WV]*

the Scottish, Irish, and English refrains of its early agricultural settlers. The construction of railroads after the Civil War opened more of the area to coal mining and timbering, creating additional jobs and bringing more settlers to the Mid-Atlantic Highlands. These settlers were the children of many nations. These immigrants mined the coal, forged the steel, harvested the timber, and drilled the oil and natural gas that fueled the American industrial revolution and heated millions of homes in America. Pennsylvania, Virginia, and West Vir-

ginia have historically been among the top coal producing states in the United States. Of the 65 billion short tons of coal produced in the US from 1890 to 2001, 45% came from Pennsylvania, Virginia, and West Virginia.

Just as isolated mountain hollows fostered the evolution of rich species diversity, they helped to preserve cultural heritage and create a sense of self-reliance and independence within the people. Self-reliance was needed for survival, yet the sense of being part of an extended family was not lost. Even today, family net-

works strengthen rural Appalachian families.

The Mid-Atlantic Highlands features some of the most historic landscapes in the country. Many major battles of the Civil War were fought in the beautiful countryside of Virginia, West Virginia, Pennsylvania, and Maryland. Museums, railroad stations, historic homes, battlefields, and state parks are dedicated to the memory of hundreds of thousands of soldiers who shed their blood.

One of the first land battles of the Civil War was fought in Philippi, West Vir-

ginia. Antietam, Maryland saw one of the bloodiest days of the Civil War. In Pennsylvania, over 1.8 million people a year make the pilgrimage to Gettysburg, the largest battlefield shrine in America. Today, Civil War tourism thrives in the region, and is a major source of tourism dollars. Festivals celebrate the culture and crafts of the Mid-Atlantic Highlands throughout the year. Various heritage trails and parks exist throughout the Mid-Atlantic Highlands region, as well as former rail beds that have been converted to recreational trails for hiking, biking, and horseback riding.

Photo: Pamela Kemlage



The Mid-Atlantic Highlands environment offers diverse, economically significant opportunities for recreation and tourism (Table 3). Over one-third of the population of the United States lives within a day's drive of the Mid-Atlantic Highlands. It is no wonder that the tourism industry, which includes hiking, birding, whitewater rafting, skiing, and other outdoor recreational activities, generates \$26 billion/year in direct revenue. In addition, hunting and fishing license sales bring in more than \$88 million/year to state economies.

SCIENTIFIC INFORMATION

Over the past ten years, a wealth of scientific informa-

tion has been generated about the Mid-Atlantic Highlands by scientific institutions. There are over 85 colleges and universities in the Mid-Atlantic Highlands conducting environmental, socioeconomic, historical, and cultural research in the region. EPA Region 3, through a partnership with the EPA Office of Research and Development, has three major research efforts in the Mid-Atlantic Highlands—Environmental Monitoring and Assessment Program (EMAP), Regional Vulnerability Assessment (ReVA), and the Mid-Atlantic Integrated Assessment (MAIA). These three research efforts, in turn, have partnered with other federal and state agencies such as the US Geological Survey, US

Table 3. The diverse recreational opportunities in the Highlands mirror the diverse ecological resources of the region

<i>Activity</i>	<i>Opportunity</i>
Hunting	414 Wildlife Management Areas cover 1,886,606 acres
Fishing	Over 39,000 miles of streams with sport fish
Biking	173 Rail Trails with almost 1,700 miles of maintained trails
Heritage Tourism	9 National Historical Parks, 4 National Heritage Areas, and numerous battlefields
Hiking	24 Wilderness Areas cover 267,095 acres
Birding	4 National Forests including 3,220,000 acres
Whitewater Rafting	3,354 miles of whitewater streams
Skiing	25 ski areas with 691 downhill ski trails



Recreation activities, like whitewater rafting contribute to a \$26 billion/year tourism industry in the Highlands. [Photo: Whitewater Photography, Fayetteville, WV]

Forest Health Monitoring Program, Maryland Department of Natural Resources, West Virginia Division of Environmental Protection, as well as with local and state academic institutions. These research efforts range from determining the vulnerability of regional groundwater aquifers to contaminants, to finding ways of assessing the dollar value of the region's ecological goods and services, to creating new business opportunities through ecological restoration and

value-added natural resource products.

A wealth of scientific information and applied research has been carried out by other programs on both a regional and local level. For example, researchers at the School of Forest Resources at The Pennsylvania State University are studying the effects of increasing soil acidity on the growth of valuable timber species across the state. At the local level, a citizen water quality monitoring program in Virginia involves residents in as-

sessing and monitoring the health of their local aquatic ecosystems.

This scientific information is being used to help solve some of the region's environmental problems and to support the need for a Highlands Action Program. Over the past seven years, the Canaan Valley Institute has helped develop watershed associations and partnerships, so that stakeholders can use all of this valuable information to more effectively address issues within their communities.

“Where we once viewed West Virginia’s stunning natural resources mainly in the context of generating energy through mining for coal, drilling for natural gas and oil or harnessing the power of our raging rivers, now we have come to see them as a treasure trove of beauty and wildlife to be carefully preserved.”

– Robert C. Byrd, US Senator, West Virginia (D)

VALUES AND DESIRES

The work of the Canaan Valley Institute over the past seven years has revealed that the values and desires of people and communities in the Mid-Atlantic Highlands are no different from those of people across the country:

- a good economy, with jobs so people can earn a living and stay in the Mid-Atlantic Highlands they love;
- a good education for everyone;
- fishable, swimmable, and drinkable water;
- natural beauty for recreation, spiritual renewal, and aesthetics;
- protection from loss of life and property due to flooding;
- preservation of a culture that creates a sense of family and a “coming home” atmosphere for all; and
- sustainable development and environmental stewardship that will ensure these values and desires can be attained.

“Wanting” and “having,” however, are two different things. Currently, EPA place-based efforts in the Mid-Atlantic Highlands focus on protecting these values and desires in estuaries. Work in the upper watersheds is performed primarily to benefit the downstream estuarine systems.

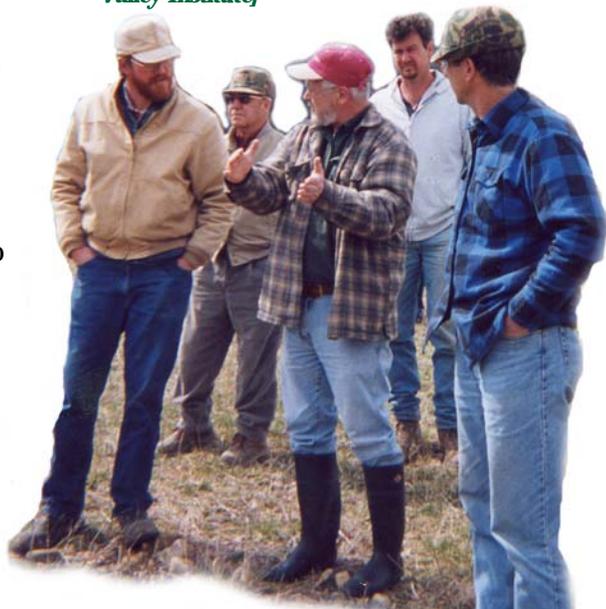
The Mid-Atlantic Highlands is the only geographic area in the Mid-Atlantic not managed by EPA as a distinct region. The Chesapeake Bay, Delaware Bay, and Maryland Coastal Bays are all managed through distinct, place-based programs.

There is an opportunity to take environmental stewardship a step further in the Mid-Atlantic region by developing, funding, and implementing a Highlands Action Program. To do this, some indication of the health or condition of the Mid-Atlantic Highlands is needed. Communities need to know if they can have their wants and desires fulfilled based on this condition. The pulse of the region can be taken and the question “What

is the condition of the environment in the Mid-Atlantic Highlands?” can be answered because of the scientific studies, environmental monitoring, and community development that have occurred over the last ten years.

The Highlands is the only geographic area in the Mid-Atlantic that is not managed by EPA as a distinct region.

Stakeholders discuss their values and needs with Canaan Valley Institute staff. [Photo: Dave Clark, Canaan Valley Institute]



“We believe that access to valid information on environmental trends and priorities enables all of us—whether at EPA, our partnering state and local agencies, environmental organizations, industry, or the general public—to develop the right policies and make the right investments to best protect our environment.”

– Donald Welsh, Regional Administrator US EPA Region 3

THE PULSE OF THE HIGHLANDS

While the Mid-Atlantic Highlands region enjoys rich natural and cultural resources, all is not well. The region suffers from past and current environmental and socioeconomic impacts at scales ranging from the local community to the entire region. Programs established to measure the region's condition have been enhanced over the past decade. Traditional federal and state monitoring programs

Biological organisms—fish, birds, insects—all indicate that, in general, anywhere from 50% to 75% of the Highlands landscapes and streams are in fair to poor condition.

have been augmented by initiatives such as the EPA MAIA, a partnership between EPA Region 3 and the EPA Office of Research and Development. MAIA is a scientific effort to measure the condition of the living resources of the Region. Together with ongoing programs, these monitoring results point to past, present, and future threats to the Mid-Atlantic Highlands. More information on MAIA, including reports and assessments results, can be found on the Internet at www.epa.gov/maia.

ENVIRONMENTAL CONDITION OF THE MID-ATLANTIC HIGHLANDS

When there is no life in a stream, or the land has nothing growing on it, it is easy to assess environmental condition. The condition is bad! Because of the progress that has been made over the past 30 years, however, these extreme environmental situations are rare today. So, how can the condition of the environment

in the Mid-Atlantic Highlands be assessed?

One of the best ways to assess the overall health of the environment is to assess the condition of the biological organisms such as fish, insects, birds, and trees living in these areas. These organisms integrate the physical and chemical factors in the environment, so that not every aspect of the physical habitat or every chemical in the air, water, and soil has to be measured to adequately assess environmental condition. Biological organisms provide a more complete picture of the condition of the place in which they live.

The organisms that are measured, called biological indicators, also represent desired ecological endpoints, the things individuals and communities care about and want—reproducing trout fisheries, diverse and productive forest communities, and songbirds. In addition, good environmental stewardship protects the health of humans, other animals, and plants. Measuring the health of organisms pro-

vides a direct measure of how well environmental stewardship programs are working.

LANDSCAPE

The patterns of land types that compose the regional landscape influence ecosystem condition. At the regional scale, measures that characterize changes in land use, forest fragmentation, the intensity of human impacts, changes in water quality, and air pollution serve to differentiate relatively undisturbed ecosystems from those impacted by human activities. The EPA has used such measures to characterize the health of landscapes in the Mid-Atlantic States. Their maps show that relative to other areas in the Mid-Atlantic, the Mid-Atlantic Highlands region generally contains large tracts of interior hardwood forest, low human population, high levels of acid rain, high numbers of roads crisscrossing streams, and low levels of nutrient or fertilizer runoff into streams. These measures provide a means to identify relatively undisturbed ecosystems as well as areas affected by stressors and human activities. To further explore the quality and integrity of the Mid-Atlantic Highlands landscape, biological indicators are

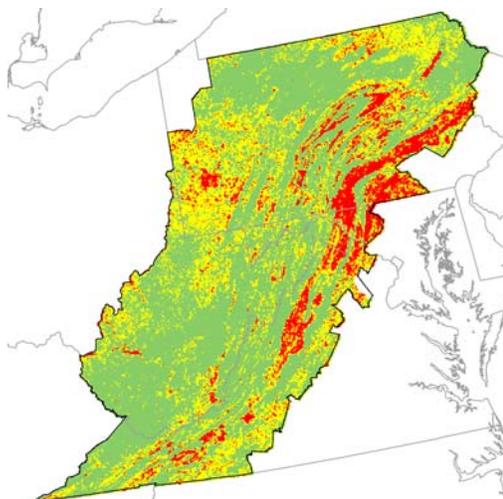


Figure 4. Bird communities give us an indication of the health of the landscape. They are telling us that 57% of the Highlands landscape is in fair or poor condition, indicated on the map by yellow or red areas.

needed. Birds, trees, fish, and insects provide a clearer indication of ecosystem health in the Mid-Atlantic Highlands.

BIRDS

Researchers at The Pennsylvania State University have found that bird communities in the Mid-Atlantic Highlands reflect the overall ecological condition of the landscape. As birds fly, they evaluate the landscape below them, choosing to nest, breed, or feed in areas they judge suitable. Birds not only evaluate the composition, but also the patterns of the landscape. Where the landscape is highly fragmented or dominated by agricultural or urban development, bird communities are impoverished. Where the landscape is composed of large tracts of in-

terior forest, bird communities are diverse, including an array of species that use different parts of the habitat.

Based on these observations, scientists developed a Bird Community Index (BCI) to describe the overall

ecological condition of the landscape. The BCI tells us that 43% of the Mid-Atlantic Highlands landscape is in good to excellent condition, 36% is fair, and 21% is in poor condition (Figure 4).

The BCI can also be used to evaluate the condition of the landscape within individual watersheds. Relative to other areas in the Mid-Atlantic Highlands, the landscape in southwestern West Virginia and north-central Pennsylvania is in better overall condition.

TREES

One indicator of forest health is the condition of the tree crown or canopy. The US Forest Service, in conjunction with Mid-Atlantic Highlands states, has been monitoring a suite of indicators of forest health, including indicators of tree crown dieback. Healthy tree crowns indicate good productivity and growth of the trees; poor tree crown condition means poor growth and

productivity and that the trees are being affected by one or more stressors. Poor growth and productivity, as indicated by poor tree crown condition, has both economic and environmental consequences. In general, tree crown measurements indicate the forests across the Mid-Atlantic region are in good condition. While there are no apparent regional problems that are affecting all the tree species, localized problems do occur in different forest stands. Invasive species, forest fragmentation, acid rain, and high ozone concentrations are all affecting the health of trees in Mid-Atlantic Highlands forests. Even though the tree crown might indicate the forest is in good condition, other indicators show that all might not be well.

FISH

Assessing the condition of a Mid-Atlantic Highlands stream provides information not only about the health of the stream, but also the upstream watershed. Streams, wetlands, lakes, and other aquatic ecosystems integrate what is happening in the watershed with what is happening in the water. Aquatic organisms integrate the physical, chemical, and other biological stressors arising in the watershed with processes that are occurring within the



Fish communities indicate that 31% of Highlands streams are in poor condition, 36% are in fair condition, and 17% are in good condition. In 16% of Highlands streams no fish were found.

stream itself. Scientists have developed an Index of Biotic Integrity (IBI) to indicate the condition of fish communities. This index considers multiple factors contributing to the health of fish communities in streams, just like the BCI did for the watershed. Estimates of the health of fish communities in over 72,000 miles of Mid-Atlantic Highlands streams indicated that there were almost twice as many miles of streams in poor condition (31%) as in good condition. The IBI indicated that over 67% of the stream miles in the Mid-Atlantic Highlands were in fair to poor condition. The total number of stream miles were estimated based on

USGS 1:100,000 scale maps and include 1st, 2nd, and 3rd order streams identified at that scale.

INSECTS

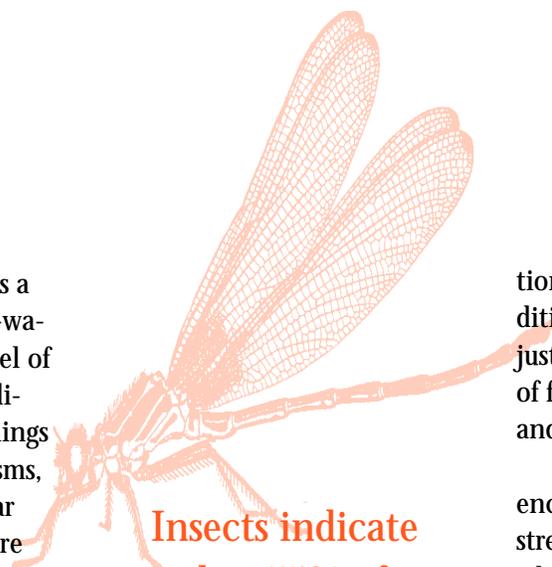
Stream insects are another group of organisms that have traditionally been used to assess the condition of streams. Stream insect assemblages are easier to sample than fish, serve as food for fish and other wildlife, and are also sensitive to pollutants and habitat damage. An insect index, called the EPT, was used by EPA scientists, along with scientists from the Mid-Atlantic Highlands states, to assess the health or condition of Mid-Atlantic Highlands streams. This stream insect index indicated that about one quarter of Mid-Atlantic Highlands streams are in good condition (25%) while about 27% are in poor condition. Seventy-five percent of Mid-Atlantic Highlands streams were estimated to be in fair to poor condition, which is similar to the condition estimated by the fish index.

BIOLOGICAL CONDITION

Biological organisms are stressed throughout the region (Table 4). Stream bottom animals, stream fishes, and birds all show signs of stress. It does not matter if the Mid-Atlantic

Highlands are examined as a whole, on a watershed-by-watershed basis, or at the level of individual states, the condition is the same. Living things are stressed. These organisms, like trout, honeybees, sugar maple, and black cherry, are important to us both environmentally and economically. When they are in poor condition, the things Mid-Atlantic Highlands residents and visitors value and desire—jobs, fishing, hunting, recreational and tourism revenue, and even flowers that need bees to pollinate them—are affected.

The current reality, then, is that many of the values and desires of local communities are not being attained. Previous regulatory and environmental management programs



Insects indicate that 75% of Highlands stream miles are in fair or poor condition. Only 25% of stream miles are in good condition.

have made progress, but it is not enough. Why is the environment in fair to poor condi-

tion? What is causing this condition? Unfortunately, it is not just one thing. A combination of factors is stressing humans and other biological organisms.

The conditions are influenced by factors, also called stressors, in the environment, which are often a result of human activities. For example, a stream may be devoid of fish because of highly acidic conditions. The acidic conditions might have been caused by improperly managed mining practices or by atmospheric deposition of man-induced pollutants like acid rain. What are some of these stressors affecting the condition of the environment?

Table 4. Biological indicators show that the majority of the Highlands region is in fair or poor condition.

Biological Indicator	Condition		
	Good	Fair	Poor
Landscape (fragmentation)*	53	39	8
Birds (BCI)*	43	36	21
Fish (IBI)+^	17	36	31
Aquatic Insects (EPT)+	25	48	27

* Percent of area

+ Percent of stream miles

^ In 16% of stream miles no fish were found

“We are working on far more complex environmental problems than we did 20 or 30 years ago. Today, the definitions of environmental problems are often far less certain, possible solutions are more difficult to identify, and the costs of dealing with them are likely to be much greater.”

– Christine Whitman, Administrator, US Environmental Protection Agency

STRESSORS AFFECTING ENVIRONMENTAL CONDITIONS

Stressors are the byproduct of human activities and natural processes that cause undesirable impacts. Some of these stressors and their effects have been scientifically studied and documented, and their effects can be solved through sound management. Other stressors and their effects are not as well understood and require additional research. Research from EPA’s MAIA program has given us estimates of the extent of some Mid-Atlantic Highlands stressors. Other stressors have been identified through research and CVI’s

work with stakeholders, but estimates of the extent of these problems are not yet available (Table 5).

RIPARIAN AND AQUATIC HABITAT LOSS

Habitat is the place where a plant or animal lives and grows. Aquatic organisms need both good riparian and instream habitats to survive, live, and reproduce. Riparian or streamside habitat includes the grasses, ground cover, vines, shrubs, and trees growing along the stream. Riparian vegetation shades streams, par-

ticularly small streams, maintaining cool water temperatures required by many organisms, like trout and smallmouth bass, for growth and reproduction. It also stabilizes streambanks and helps prevent silt and associated contaminants from entering the stream. EPA and US Forest Service studies have shown that poor riparian and aquatic habitat is a major problem in many Highland streams. Almost 25% of Mid-Atlantic Highlands streams (over 17,000 stream miles) have poor riparian habitat (Figure 5). In addition, about

28% of Mid-Atlantic Highlands streams, or over 18,000 stream miles, are only in fair condition. Poor riparian habitat contributes to stream sedimentation, lack of cover, limited filtering of sediment and pollutant inputs

Table 5. Highlands Stressors

EPA Estimates Available

- Riparian and aquatic habitat loss
- Sedimentation
- Acidic deposition (acid rain)
- Acid mine drainage
- Forest fragmentation

Estimates Not Available

- Flooding
- Ozone damage
- Waterborne pathogens
- Invasive species
- Persistent pollutants
- Climate change

from the watershed, and loss of good fishing areas. Healthy streams can not be sustained without good riparian habitat.

SEDIMENTATION

In addition to riparian habitat, instream habitat is also important. Woody debris from riparian trees that fall or wash into the stream creates complex habitat structure and pools for fish and aquatic insects. Habitat created by boulders, cobble stones, and gravel in streams provides areas where fish and aquatic organisms can reproduce, feed, and hide from predators. Good instream habitat is as important as good riparian habitat for healthy streams, but it can be covered over or smothered by soil and sediments washing into the stream from the upstream watershed or from streambank erosion. Poor instream habitat affects fish and other aquatic organisms by eliminating areas in which organisms can live, feed, and lay their eggs. It also results in the loss of good fishing areas. Healthy streams need both good riparian and instream habitat.

Unfortunately, excess sedimentation is a major problem for Mid-Atlantic Highlands streams. Research has shown that about 25% of Mid-Atlantic Highlands streams, or over 18,000 stream miles, have



Healthy streams require good riparian habitat. Stream bank erosion creates bad riparian habitat.

poor habitat because of stream sedimentation and 40%, or almost 29,000 miles, have only fair habitat (Figure 5).

ACID RAIN

Acid rain has been a regional problem for over four decades. During the 1980s, the Mid-Atlantic Highlands was extensively studied by the EPA, US Geological Survey, and US Forest Service through the National Acid Precipitation Assessment Program. Acid rain forms when emissions of nitrogen and sulfur compounds from combustion of fossil fuels combine with water vapor in the atmosphere and become acidic. These acids can be transported long distances before they fall to

the earth and acidify the watersheds and streams into which they fall. In most instances, the acid rain falling on watersheds in the region comes from the Ohio Valley. Many aquatic organisms are sensitive to acidic waters and cannot survive or reproduce under these conditions. Acid rain is a particular problem for smaller streams that provide nursery and spawning areas for aquatic organisms. Even though larger streams might not become acidic,

Not all problems in the Highlands are understood. Applied research is needed to develop science-based, cost-effective solutions.

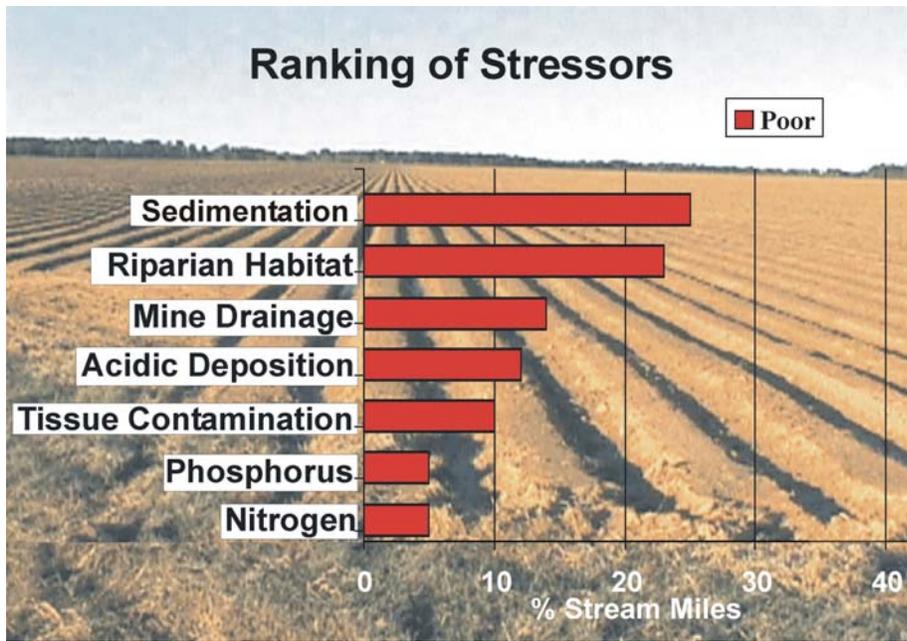


Figure 5. The greatest stressors on streams in the Highlands are sedimentation of instream habitat and destruction of riparian habitat.

these larger streams depend on their smaller tributaries for a continual supply of fish and other aquatic organisms. While the 1990 Clean Air Act Amendments helped reduce emissions that contribute to acid rain, there is still a “bull’s eye” of low pH or acid rain over parts of the Mid-Atlantic Highlands region (Figure 6). The EPA initiative found over 7,500 miles of Mid-Atlantic Highlands streams are susceptible or in poor condition due to acid rain.

ACID MINE DRAINAGE

During mining, overburden and spoil are discarded, piled around the mine, or pushed into a valley. This overburden and spoil contain sulfur compounds that are converted into sulfuric acid just by exposure to the air. Many people think the effects of acid mine drainage (AMD)

are primarily due to this sulfuric acid leaching or running into a stream. When it rains, however, not only is this sulfuric acid washed into the streams, but so are toxic concentrations of heavy metals and high loads of sediment. Sulfuric acid makes the stream acidic and unsuitable for life. Metals can poison the aquatic organisms living in the streams, and sediment can smother the bottom and ruin habitat for fish and other living organisms. The effects of acid mine drainage, then, are greater than just the acid load to the streams. Over

10,000 stream miles in the Mid-Atlantic Highlands have been degraded by AMD (Figure 5) and, as a result, many affected streams contain no fish. Pennsylvania has estimated it loses over \$65 million a year due to the elimination of sport fishing in these AMD-affected streams.

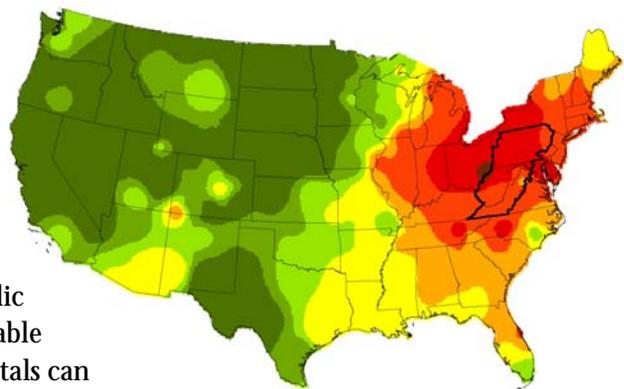


Figure 6. The dark red colors show the bulls eye of acid rain over parts of the Highlands. The darkest red areas have a pH of less than 4.25, the orange areas have a pH of 4.6 to 4.7, and the green areas have a pH of 4.9 or higher. Natural rain has a pH of 5.0 to 5.5.

The effects of mining are not just limited to surface waters. There are many abandoned deep mines throughout the Mid-Atlantic Highlands, a legacy of coal production that fueled the US economy. Many of these mines are filling, or are already filled, with water that is acidic because sulfur in the coal and overburden has been converted to sulfuric acid. Scientists and regulators don't understand the full extent of the problem yet, but the potential seepage of acidic underground water is a looming problem in the Mid-Atlantic Highlands. For example, there is a 42 square mile area of underground abandoned mine shafts and tunnels in and around Fairmont, WV that is full of acidic water. This water is currently being pumped and treated to keep the underground pool from overflowing. However, if this pumping and treating ever stops, the acid water will contaminate nearby streams like Buffalo and Paw Paw Creeks and the Monongahela River. If this water eventually blows out of several "seeps," the fish in these streams will be killed for long stretches downstream. Better scientific information about this problem is needed to determine how extensive it is, and what the potential risks are to Mid-Atlantic Highlands streams.

FOREST FRAGMENTATION

As stated earlier, the forests in the Mid-Atlantic region are a globally important resource. No other place in the world has as much temperate, contiguous hardwood forest as the Mid-Atlantic. But it is rapidly being reduced from large, contiguous stands to smaller pieces. This is known as fragmentation. Many human activities and land uses, such as unconstrained development or sprawl, urbanization, building utility lines and roads, timber harvesting, and mountaintop mining all contribute to habitat loss and degradation. Almost half (47%) of the Mid-Atlantic Highlands landscape is considered to be in poor or fair condition because of forest fragmentation (Figure 7). Many living organisms, from migratory birds to black bears, require large blocks of contiguous forest to sustain their populations.

Over the past 20 years, people have learned a lot about how the arrangement of the landscape affects living organisms. The US Forest Service and EPA Office of Research and Development have been actively studying how landscape patterns affect

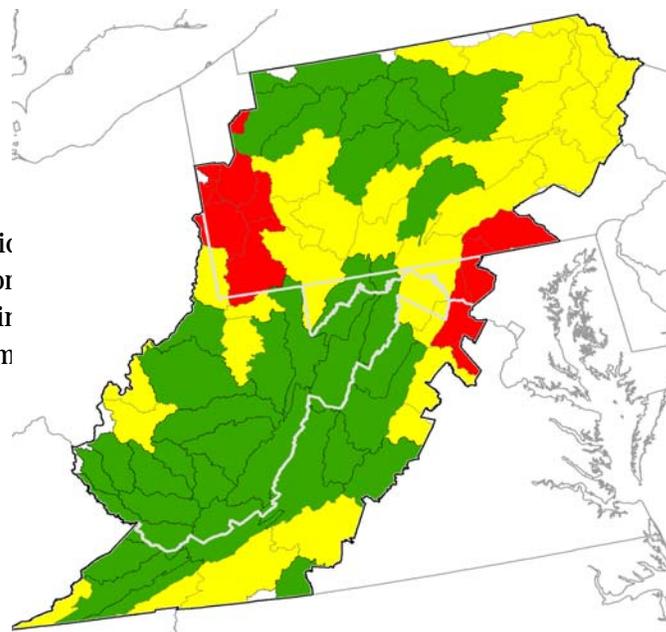


Figure 7. Based on landscape fragmentation indicators, like population density and amount of steamlength with adjacent forest, the areas in dark green (53%) on this map are in good condition, the areas in yellow are in fair condition (39%), and the red areas are in poor (8%) condition.

the quality of the habitat for living organisms. By looking at these patterns throughout the world, they were able to determine how unique the Mid-Atlantic Highlands forests are, and how susceptible they are to fragmentation and habitat destruction and loss. Forests are an integral part of the environment, economy, culture, and lore of the Mid-Atlantic Highlands, and there is a continuing need for additional research into ways to protect and manage this valuable resource as residents in the Mid-Atlantic Highlands move toward sustainable development.

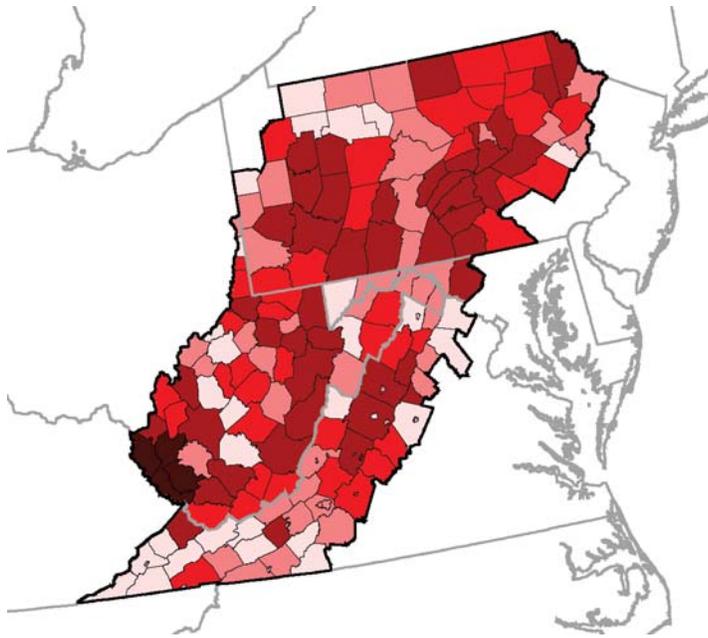


Figure 8. All Highlands counties have been affected by at least one federally declared flood disaster. Counties in the darkest color have been affected by 7 or 8 federal flood disasters from 1965 to 2000. Counties in the lightest color have been affected by 1 or 2 flood disasters, and the rest of the counties have experienced 3 to 6 flood disasters in the same period.

FLOODING

People may experience increased flooding as upstream areas and the floodplain are developed. Increased development, floodplain development, and changes in land cover, like forest fragmentation and forest loss, contribute to flooding. Roads, parking lots, and cleared lots all contribute to increased runoff and downstream flooding. Streambank erosion from higher flows eats away land, putting homes in danger of being lost or damaged. While Mid-Atlantic Highlands residents recognize flooding as one of their major concerns, the extent to which land use changes have contributed to increased flooding is not known.

During the 35-year period from 1965 to 2000, 54 flooding events were declared federal disasters in the Mid-Atlantic

Highlands. Unfortunately for some counties, flooding has become a recurring event. Over this 35-year period, 50 of the 174 Highland counties have had 5 to 8 federally declared flood disasters and 93 counties have had 4 or more federally declared flood disasters (Figure 8). While the Federal Emergency Management Agency provided over \$600 million in flood assistance just since 1985, these dollars can't compensate for the loss of lives, family homes and heirlooms, or the constant fear of future floods.

OZONE DAMAGE

Ozone is formed through a series of complex chemical reactions of nitrogen compounds, organic mixtures, and sunlight in the atmosphere. Ozone is highly reactive and is used in some water treatment plants to kill bacteria or other organisms that might be living in the wa-

ter. Because it is so reactive, it can also cause damage to plants with which it comes into contact.

Ozone damage is often thought of as just a big city problem, but US Forest Service studies have found that Mid-Atlantic Highlands forests are being affected by ozone damage. Ozone damage creates a distinct mark on tree leaves (as seen in the photo at right), so it is easy to distinguish from the effects of disease or insect damage. Ozone not only damages leaves, it makes the trees more susceptible to disease and other pollutants. Overlapping regional problems such as acid rain and ozone can aggravate the severity and extent of local problems. Loss of forest productivity translates directly into lost dollars to the timber industry. The full extent of ozone damage is unknown, and more scientific studies need to be conducted to understand the effects of ozone on the environment, the economy, and local communities.



PATHOGENS

Pathogens are organisms such as bacteria and viruses that can cause diseases. Human waste can contain pathogens that make people sick if they drink water or come into contact with water in which sewage was discharged. The discharge of raw sewage into streams occurs throughout the region. This raw sewage is typically discharged by local residents directly from their house into the stream through pipes because many rural communities in the Mid-Atlantic Highlands aren't served by wastewater treatment plants. Unfortunately, the full extent of the problem is unknown. Studies are needed to determine the extent of raw sewage discharge and pathogens associated with these discharges.

INVASIVE SPECIES

The Mid-Atlantic Highlands has rich species diversity because of its unique geological history. Several Mid-Atlantic Highlands species are considered rare, endangered or of special concern because they aren't found in other places. Forest fragmentation, acid rain, acid mine drainage, habitat loss and other problems create stresses on native species and make it easier for non-native species to outcompete them and move

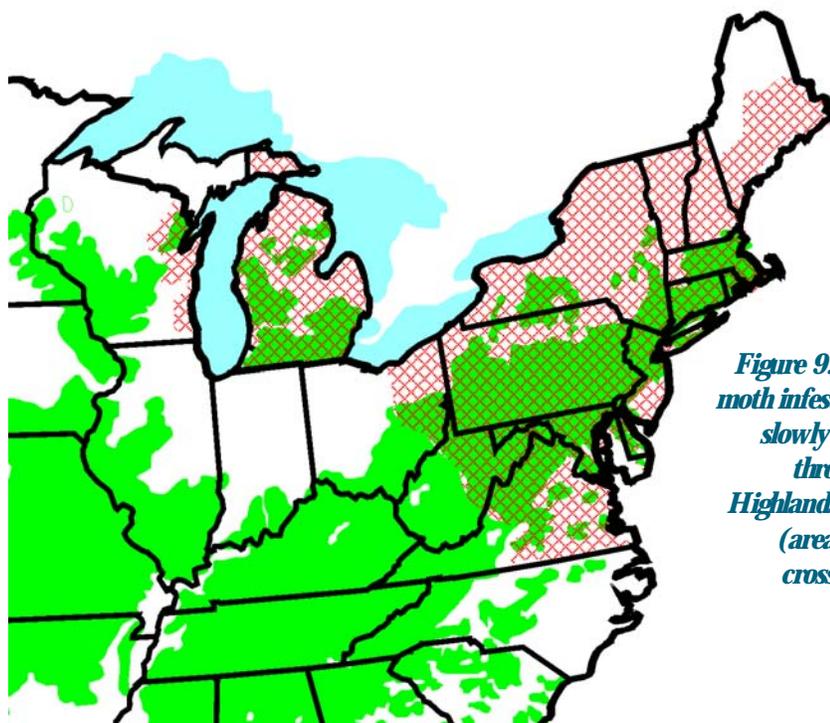


Figure 9. Gypsy moth infestation is slowly moving through the Highlands forests (areas in red crosshatch).

into the area. Researchers from the US Forest Service, The Nature Conservancy, and similar organizations point out that non-native species have invaded the Mid-Atlantic region and are a major problem. These non-native species range from pathogens (Nile virus) to plants (purple loosestrife) to insects (gypsy moth, Figure 9) to birds (starlings). These non-native species can outcompete native species because their natural enemies are not present in the Mid-Atlantic region. Combining habitat loss with invasive species introductions results in the loss—in many cases permanent loss—of native species. Eliminating pest species once they get a foothold in a region is almost impossible, and very expensive. Preventing these

species from entering is much more cost effective.

PERSISTENT BIOACCUMULATIVE TOXINS

Some pollutants, such as mercury, are persistent and do not go away. Even worse, mercury concentration increases at each step up the food chain, from the water to microscopic plants in the stream, to insects that feed on plants, to small fish that feed on insects, to largemouth bass that feed on the small fish. This is called bioaccumulation and biomagnification. Many streams in the Mid-Atlantic Highlands region are under fish consumption advisories because the mercury concentration in top predator fish, like largemouth bass, exceeds

safe levels for human consumption as determined by the Food and Drug Administration and EPA. Mercury enters the atmosphere naturally because it is a naturally occurring element, and also through human activities such as coal combustion, the burning of municipal or medical waste, and other uses like mercury switches for electric lights. The extent of mercury contamination, as well as other persistent, bioaccumulative toxins, such as lead and dioxin, is not well known in the Mid-Atlantic Highlands.

CLIMATE CHANGE

Although a hotly debated issue, most scientists agree that human-influenced climate change is occurring. Increased carbon dioxide, nitrogen oxide, methane, sulfur dioxide, water vapor and other “greenhouse” gases are contributing to heat retention within the atmosphere, which

results in the warming of the earth. This warming may contribute to significant changes in the climate over much shorter periods of time than have occurred in the past. With climate change, floods and droughts could be more frequent and severe in the Mid-Atlantic Highlands. Increased runoff from heavy rains can carry more sediments, pesticides, fertilizers, and germs into the streams.

These pollutants can affect fish and other aquatic life living in these streams. Increased temperatures can change the composition of the forests, making some important hardwood species less abundant. Trout and other cold-water fish would become less abundant and warm-water fish more abundant. The rate, magnitude, and effects of climate change are not well-un-

derstood. Without more research and understanding, it will be impossible to develop effective management and mitigation practices to deal with both the causes and effects of climate change.

These are just some of the stressors affecting the Mid-Atlantic Highlands environment. In most cases, these stressors result from human activities. What activities are causing or contributing to these effects in the Mid-Atlantic Highlands?

“By being aware that what occurs on land also affects stream quality, residents become advocates for responsible land use, as well as volunteer stream guardians.”

– Downstream Alliance trainer, Chain-Wen Wang, who teaches volunteers to monitor stream health

HUMAN ACTIVITIES

Scientific studies and public insight suggest that some of the activities within the Mid-Atlantic Highlands that are contributing to environmental stress include the following:

- Urban infringement and rural sprawl;
- Timbering and agriculture;
- Mining;
- Raw sewage discharges; and
- Stream alteration.

URBAN INFRINGEMENT AND RURAL SPRAWL

Urban infringement and sprawl are not just issues in large metropolitan areas. Although the majority of the Mid-Atlantic Highlands is rural, the land is not immune to the effects of sprawl and infringement. As the population in urban areas both within and surrounding the Mid-Atlantic Highlands continues to grow, the rural landscape, including valuable agricultural land and family farms, is slowly being

transformed. Of great concern is the eastern expansion of Pittsburgh and the western expansion of the Baltimore-Washington corridor, which are slowly cutting the Mid-Atlantic Highlands in half from east to west (Figure 10).

With this infringement comes more roads, more houses, and more supporting infrastructure like pipelines and utility lines. These changes in land use and land cover contribute to flooding, forest fragmentation, invasive species introduction, riparian habitat loss, air pollution, and sources of persistent pollutants. With an increase in impervious surface area from roads, parking lots, driveways, and roofs comes greater runoff. Increased development also contributes to the loss of riparian habitat, which further aggravates flooding. In addition, because rainfall no longer soaks into the ground, base flow from groundwater needed to sus-

tain streams during dry periods also decreases.

Unconstrained development or sprawl in rural areas also chops up or fragments the forest into smaller and smaller patches, with the resultant loss of wildlife habitat and natural areas that previously permitted the rain to soak into the ground. As the number of

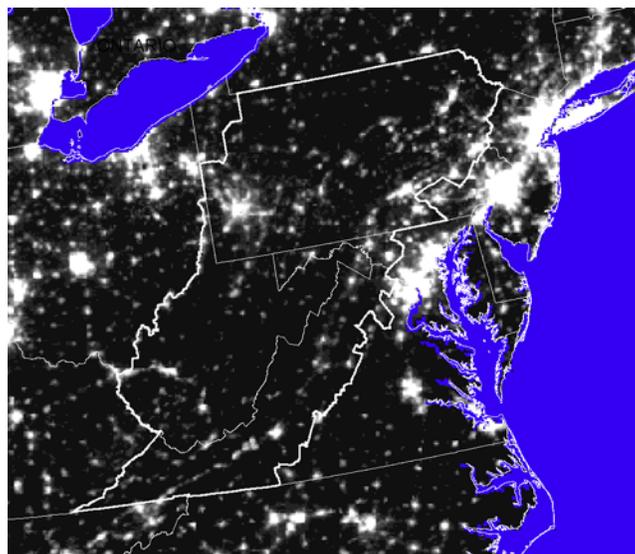


Figure 10. Lights in the night sky (white areas) show urban areas encroaching on the Highlands.

patches increases, so does the likelihood that non-native, invasive species will be introduced. More traffic and housing development brings more pollutants from automobile exhaust, and runoff from fertilizer and pesticide applications to home yards and commercial properties.

Second-home development is increasing in the Mid-Atlantic Highlands. In several counties, second homes represent 25% or more of the housing development. Forest County, Pennsylvania, leads the nation with 75% of its housing development in second homes. The type of second home varies, as does its impact. For example, if it lacks a proper sewage system, or if forest cover is entirely removed to build the house, a second home development can aggravate existing problems as much as other commercial and residential development.

As with most land use changes, there are a series of

cascading effects that arise with these human activities. Some of the attendant problems of sprawl —traffic, congestion, unplanned development and clearing, and associated stressors—are changing the Mid-Atlantic Highlands environment.

TIMBERING AND AGRICULTURE

Land use practices such as timbering and agriculture also can affect aquatic organisms and terrestrial wildlife. Increases in erosion from timber removal are generally short-lived if proper timbering practices are followed. The construction of skid and haul roads, however, can have longer lasting effects because of the creation of forest patches. Compaction from harvest related activities can slow or eliminate the regrowth of trees in these areas. In addition,

improper road construction can contribute significant sediment loads to nearby streams.

The removal of forest for agriculture generally has greater effects on both aquatic and terrestrial organisms than



Photo: Dave Clark

other forest practices. Both the loss of forest cover and forest fragmentation affect wildlife and bird species.

Agricultural land use is the largest contributor of sediment to streams in the US. Increased agricultural fertilizer and pesticide concentrations are also associated with current farming practices. Large confined animal operations can significantly concentrate waste in one area of the watershed and, if improperly handled, runoff or discharge of this waste can affect the fish and other aquatic organisms in the receiving streams. Conservation tillage, fertilizer and pesticide management programs, treatment of confined animal waste and similar agricultural management practices can significantly reduce these problems. Improper management can yield sedimentation, persistent pollutants, or permanent habitat destruction.



Photo: Dave Clark

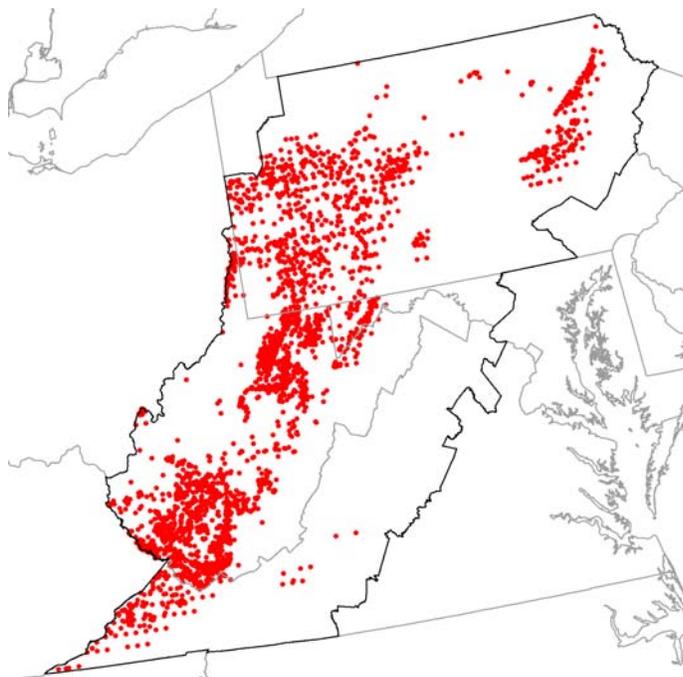


Figure 11. Abandoned mine lands (red dots) are pervasive in the Highlands and have a cumulative effect on the environment.

MINING

While coal mining has contributed to economic development and national prosperity, it has left behind a legacy of abandoned mines, acid mine drainage, persistent pollutants, and riparian habitat loss in the Mid-Atlantic Highlands (Figure 11). Abandoned mines can contribute acidity, toxic metals, and stream sedimentation for many years after mining activities have ended. Mining reclamation usually returns the land to grasses, which significantly improves runoff water quality, but does not reclaim the land back to forest.

Current mining practices, such as mountaintop mining, can eliminate entire headwater stream reaches needed to support downstream fisheries

and aquatic life. Mountaintop mining involves the removal of large quantities of soil and parent material from the tops of mountains to expose underlying coal seams. While some of the overburden material is retained for reclamation purposes, large quantities are deposited in adjacent hollows and coves. Current mountaintop mining activities in West Virginia affect over 100,000 acres. Based on current government projections, over the next twenty years the total area of forests affected is likely to triple.

RAW SEWAGE DISCHARGE

In some places, raw sewage is still discharged into streams from individual homes and small communities, negatively

affecting water quality. These discharges destroy fisheries and release pathogens that create public health problems. Many of the local problems arise either because existing state and federal wastewater programs do not cover these small communities with fewer than 10,000 residents, or because small communities lack the resources to do detailed technical studies to document their needs. Based on a national 1996 EPA Clean Water Needs Survey, Pennsylvania and West Virginia were among the top three states with the greatest financial needs for small community wastewater treatment facilities. The full extent of this problem is unknown, but is expected to be extensive, given the small size of many of the towns throughout the Mid-Atlantic Highlands. These communities need additional resources and support to correct this problem and not only improve their quality of life, but also the water quality of the receiving streams.

STREAM ALTERATION

Stream alterations include stream channelization, dredging, damming, or similar changes in the streams. Stream channelization has been used in the past to help reduce flooding in localized areas. This simply moves the water more quickly downstream to

another area where flooding might occur, and as more areas develop, channelization becomes less effective in reducing flooding. In addition, stream channelization destroys stream habitat for fish and other aquatic organisms. Dredging is used to deepen a stream or river. Dredging is often used to remove instream sediment, which in many cases is sediment that has washed in to the stream because of inappropriate watershed or riparian area management practices. More often, dredging removes natural instream habitat, which affects the fish and other organisms that need this natural habitat.

A more permanent change in streams and rivers occurs when the stream is dammed. Over 50% of the rivers in the US have been dammed and are no longer free-flowing. These dams serve as obstacles to the movement of fish upstream to spawn or repopulate areas that might have been previously damaged. They also change the entire system from a stream ecosystem to a pond or lake ecosystem. The region still has a number of free-flowing streams, but with increased concern about flooding and increased demand for water supply, the idea of constructing dams is gaining popularity again.

Human activities typically have multiple, not single ef-

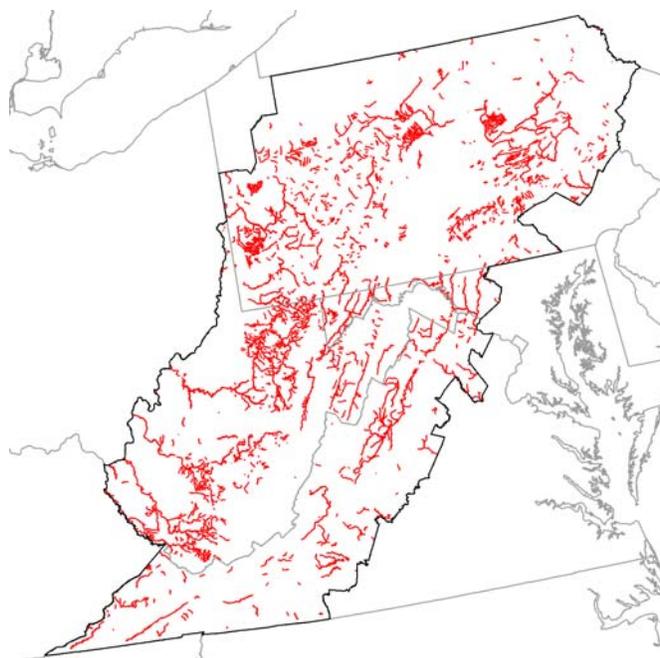


Figure 12. Each red line represents a stream segment that is not meeting water quality standards.

fects, and introduce multiple stressors that have a cascading effect on the environment. For example, constructing a new road can lead to forest fragmentation, which contributes to loss of riparian habitat and affects instream habitat. This contributes to the loss of sport fish, which impacts fishing and other recreation activities, and results in economic consequences for the local community. When the individual streams affected by the stressors and pollutants are listed together, a clear picture of the total effects can be seen across the region (Figure 12). Many Mid-Atlantic Highlands streams are not attaining water quality standards established to protect them. To meet these standards, stressors and pollut-

ants need to be removed and the habitat restored.

The data indicate that, even though the Mid-Atlantic Highlands region is a special place, it is a place with existing and emerging problems. A Highlands Action Program with strong environmental stewardship is needed to solve these problems. This Program must also protect the special places and restore damaged ecosystems in the region. These efforts must work in concert with economic and cultural realities of the Mid-Atlantic Highlands.

“We’ve found that public lands are no longer the only places to protect species. We have come to realize that we must work in partnership with people who farm, ranch and log on private land. While countless species depend on the land to sustain life, families depend on the land for economic survival.” —Gale Norton, Secretary, United States Department of Interior

FACTORS AFFECTING ECONOMIC CONDITIONS

Environmental issues are not isolated from socioeconomic issues. Our lifestyles affect the environment, and the environment affects our quality of life. There are many economic opportunities associated with good environmental stewardship (as described in the next chapter). However, until the basic necessities of life, like food, clothing, and shelter are met, it is difficult for people to recognize these opportunities. The economic benefits of protecting, restoring, and being good environmental stewards are often unclear to people struggling to meet the basic needs of their families. And many communities in the Mid-Atlantic Highlands are struggling with serious economic problems:

- High rates of children in poverty;
- Low educational attainment;
- High unemployment rates;
- Low labor force participation rates;

- Outmigration of the working-age population; and
- Low per capita income.

For the United States as a whole, virtually all socioeconomic indicators show a higher standard of living for metropolitan (urban) areas as opposed to nonmetropolitan (rural) areas, with the more isolated rural areas having the lowest standards of living.

In the Mid-Atlantic Highlands as a whole, 33% of the population lives in rural areas, compared with 19.7% for the nation. Within large parts of the Mid-Atlantic Highlands, especially in West Virginia and southwest Virginia, there is a high proportion of isolated rural counties. In West Virginia, 58% of the population resides in rural areas, as does 53% in the Virginia portion of the Mid-Atlantic Highlands.

The most economically distressed parts of the Mid-Atlantic Highlands are the rural areas. These areas generally have high poverty rates, low educational attainment, high

unemployment, and low labor force participation.

CHILDREN IN POVERTY

There are several counties within the Mid-Atlantic Highlands where over a third of the children are living in poverty (as defined by the US Census Bureau), and county poverty rates range up to 50%. While high poverty rates are not uniform throughout the Mid-Atlantic Highlands, they are significant in many areas (Figure 13).

LOW EDUCATIONAL ATTAINMENT

Educational attainment in the Mid-Atlantic Highlands lags behind that for the United States as a whole. Perceived local job opportunities influence the value people place on education. Areas that have a

Eighty-eight percent of counties in the Highlands have lower per capita income than the rest of the country.

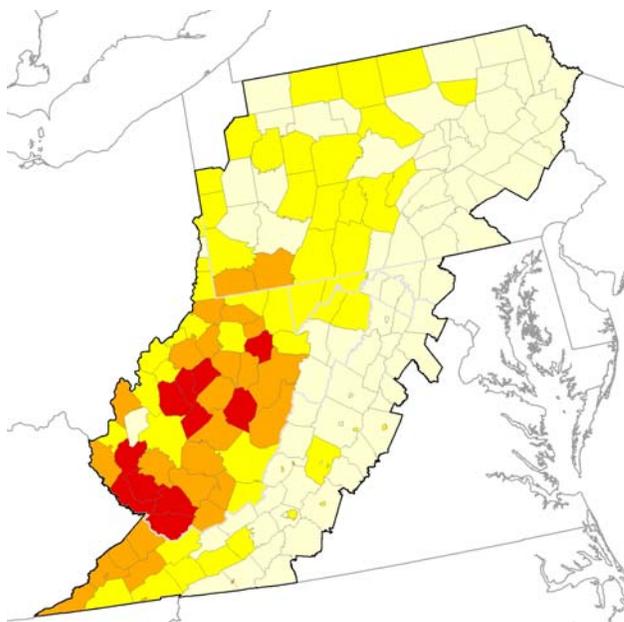


Figure 13. In some Highlands counties between one-third and one-half of the children live below the national poverty level (counties in red). In many counties, over 20% of children live in poverty (counties in orange). Counties in red, orange, and yellow all have child poverty rates above the national average.

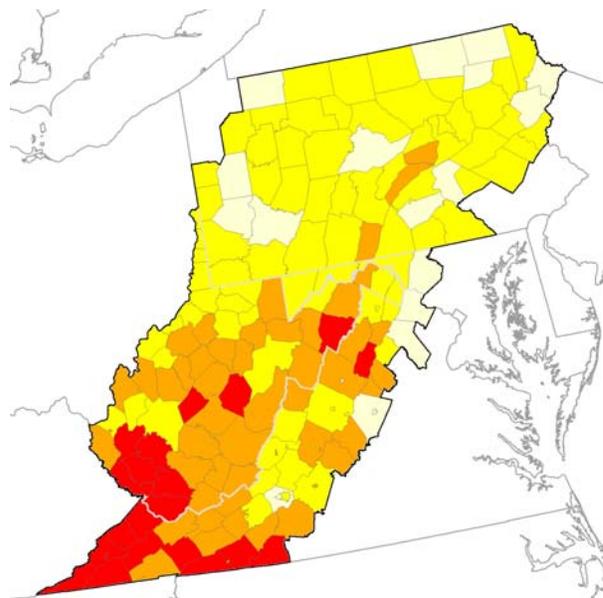
high concentration of employment in blue-collar occupations are less likely to stress the value of higher education. In 1990, 86% of Mid-Atlantic Highlands counties fell below the national average for adult high school graduation rates. Low educational attainment is most serious in rural areas, such as southern West Virginia and southwestern Virginia (Figure 14).

HIGH UNEMPLOYMENT AND LOW LABOR FORCE PARTICIPATION

Traditionally, many employment opportunities in the Mid-Atlantic Highlands have been in the blue-collar mining, forestry, and agriculture sectors—industries requiring neither major urban centers nor knowledge in areas such as advanced computer technology.

These industries have now declined, or have phased out workers through increased mechanization and operational efficiency. In 1980, over 100,000 coal miners were employed in the Mid-Atlantic Highlands. By 1999, there were 30,000—a decline of 70%. The persistence of high unemployment in the more isolated areas suggests that

Figure 14. In many Highlands counties (those in red), 40-55% of adults do not have high school diplomas; in many other counties (orange), one-third of adults don't have high school diplomas. Counties in red, orange, and yellow all have high school graduation rates below the national average.



new and growing industries are not being attracted to take advantage of the available labor force.

In the Mid-Atlantic Highlands, 83% of counties have higher unemployment rates than the rest of the United States, and 81% have lower labor force participation rates. Low labor force participation and high unemployment rates are usually the result of these factors:

- Insufficient number of jobs to employ all potential seekers;
- Low wages; and
- Existence of barriers that inhibit the ability of an individual to accept a job (lack of transportation or daycare, lack of skills).

Such socioeconomic conditions are interrelated. For example, without a high school degree, it is difficult for an individual to obtain a good-

paying job, especially given the decline in manufacturing and mining entry-level jobs across the region.

LOW PER CAPITA INCOME

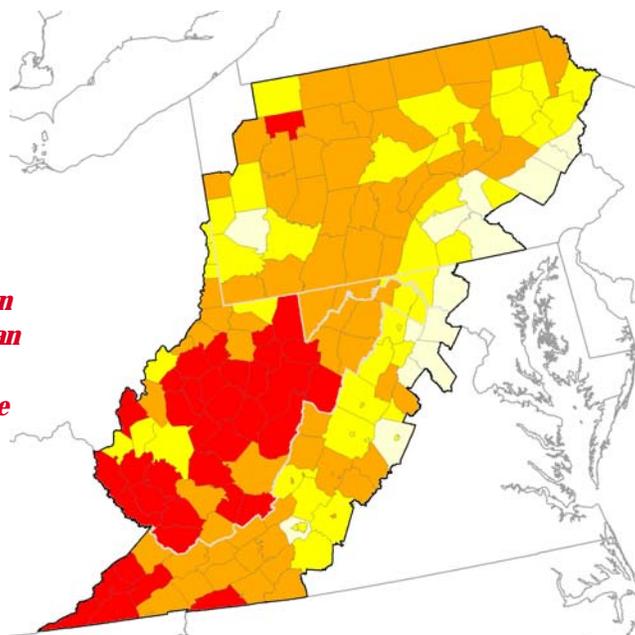
Per capita income is low throughout the Mid-Atlantic Highlands. In 1989, 88% of the region's counties had a per capita income below the national average (Figure 15). Even metropolitan counties in the Mid-Atlantic Highlands lagged behind the nation, with 78% of the counties below the national average for per capita income.

OUTMIGRATION OF WORKING-AGE POPULATION

Although there have been population increases in several counties through-

out the Mid-Atlantic Highlands, the area overall has experienced a population decline or slow population growth relative to the rest of the country. Population growth between 1970 and 2000 in the Mid-Atlantic Highlands was only 10.6%, compared to 38.4% for the nation. Much of this slow growth is explained by a history of reliance on the manufacturing and coal mining industries, which are employing fewer and fewer people. Few industries have emerged to fill these voids. This problem is exacerbated by a lack of technology. For example, relatively few high-speed Internet access lines exist within the Mid-Atlantic Highlands (Figure 16). Poor Internet access is indicative of the lack of a strong Mid-At-

Figure 15. Per capita income in many Highlands counties falls well below the national average of \$14,420. Per capita income in counties shown in red is less than \$9,500; for counties in orange it is less than \$11,500. Counties in red, orange, and yellow all have per capita income below the national average.



lantic Highlands technology base.

Because of such voids, outmigration of the working-age population is prevalent, particularly in distressed areas, where younger people move out of the area in search of economic opportunity elsewhere. At the same time, the percentage of children in the area has decreased, a direct consequence of this out-migration of the younger working-age population (Figure 17). In West Virginia, for instance, all of the population growth in the 1990s occurred in the 45 and older age group; the working-age population is being replaced by an influx of older people. Just as the working-age population is leaving due to a lack of opportunities, retirees are returning or migrating to the area due to low property

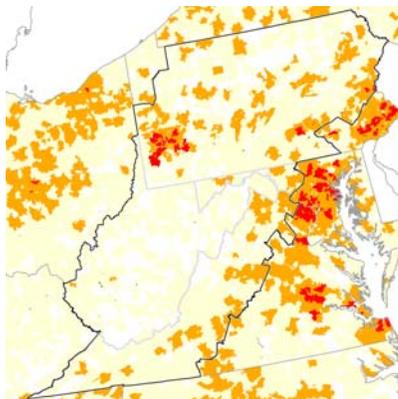


Figure 16. High speed internet access is nonexistent (white areas) or sparse (lightest yellow areas) throughout much of the Highlands. Red and orange areas have many high speed internet access options.

taxes and the lower cost of housing and land. Thus, the median age, currently the highest in the nation, is increasing, causing a greater tax

burden for the remaining working-age class.

Over the past seven years, CVI has become increasingly aware of changes affecting local communities. More importantly, this awareness has driven home the point that community, economy, and environment are all inexorably linked. Any time there are problems, there are also opportunities. As CVI has worked with local communities to solve their problems, some opportunities for sustainable environmental stewardship and sustainable development have emerged.

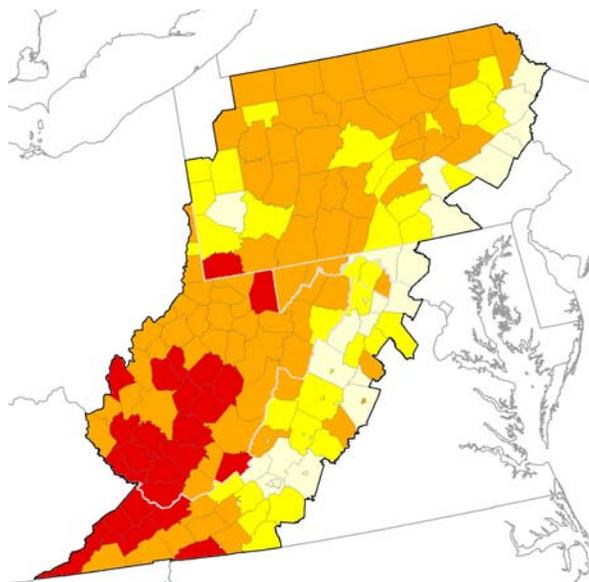


Figure 17. The percentage of the population younger than 18 years old declined in the Highlands between 1990-2000. In counties shown in red, the percent of children decreased between 3-6%. (The percentage of children in the population decreased in counties in red, orange, and yellow between 1990-2000.)

“The fact of the matter is these watershed associations aren’t only doing environmental projects, they are enhancing their communities. Agencies are realizing that if they put money into these communities where residents are involved, they are going to get a major return in their investments.” – Jennifer Pauer, WV Department of Environmental Protection, Coordinator for Stream Partners

OPPORTUNITIES FOR SUSTAINABLE ENVIRONMENTAL STEWARDSHIP

While the Mid-Atlantic Highlands is challenged by legacies of poverty, under-employment, and natural resource exploitation, it is rich with assets and opportunities. Open space and natural beauty, energy and renewable forest resources, a relaxed pace, extended family support systems, close contact with the natural world, opportunities for fishing and other recreational activities are just a few of these assets. Such assets can be the foundation of an improved quality of life for all that live and visit the region.

The historical economic base of the Mid-Atlantic Highlands (agriculture, forest products, mining, and manufacturing) has shrunk. Prosperity will require the creation of new economic bases: new products and resources that can be traded on the global market, for which demand is growing. But first, each community must determine for itself what prosperity means, taking into account both traditional measures of wealth

and less easily measured “quality of life” factors.

Opportunity for the Mid-Atlantic Highlands means taking advantage of resources and skills within the region that cannot be duplicated anywhere else: its people, history and cultural heritage, scientific and governmental institutions, climate, natural scenic beauty, open space, biological diversity, and natural resources. Just as important, it is an opportunity to intertwine economics with sustainable environmental stewardship through innovative partnerships. In fact, this is already happening in local communities throughout the Mid-Atlantic Highlands.

Six examples are provided to show that people working together can, and are, capturing these opportunities to get more value from natural assets through environmental stewardship.

- 1. Coordinate existing stewardship efforts to maximize opportunities for partnerships***

The people and institutions of the Mid-Atlantic Highlands offer unsurpassed opportunities to build partnerships, teach and learn about the region, and develop complementary environmental and socioeconomic goals. Experience has shown us that partnerships among government, research institutions, nonprofit organizations, citizens, and business create more innovative, workable solutions to environmental and socioeconomic problems than those constructed by any one group alone.

There is already a high level of public interest in local watersheds. Within the Mid-Atlantic Highlands there are

Opportunities exist in the Highlands to create jobs, generate revenue, and promote environmental stewardship through innovative and sustainable use of natural resources.

269 watershed groups, and CVI has worked with almost half (125) of these. Despite limited resources, these groups are doing some amazing things (see sidebar here and next page). Agencies and academic institutions with strengths in environmental science have much to offer these watershed groups. Organizational expertise, like that offered by CVI, already exists to facilitate stakeholder-science partnerships. The current situation however, can be improved. Many more local residents could become involved in improving conditions in their communities.

“From that initial brainstorming session about how to get more citizens involved in our watershed activities, Lower Paint Creek Association has moved to a full-fledged, countywide teaching effort that includes partnerships with other watershed organizations, local schools, and various programs with the WV Division of Environmental Protection. We have also worked with the US Environmental Protection Agency Region III, the West Virginia Department of Natural Resources, and other organizations.”—Marty Prichard, Lower Paint Creek Association

Environmental Stewardship in Action

PAINT CREEK: ORDINARY PEOPLE DOING EXTRAORDINARY THINGS

The Lower Paint Creek Association was formed by four people sitting around a living room, deciding to take on the challenge of cleaning up their community and restoring trout to their watershed. To achieve its goal, the newly-formed watershed group enlisted the help of many other organizations, from the local school board and a coal company to the West Virginia Division of Environmental Protection. Their efforts at improving water quality and habitat paid off, and trout have returned to Paint Creek. The Lower Paint Creek Association continues to grow and gain organizational skills, and continues to develop recreational opportunities in the community. They are now embarking on an ambitious county-wide youth education program, involving students of all ages in a watershed awareness curriculum. Their success shows what can be accomplished when a local watershed group receives encouragement and technical assistance from partners who share the same vision.



Photo: Dave Clark

2. Create a restoration industry to add value to the environment and to boost the economy

A priority of the Highlands Action Program is to restore damaged ecosystems. Doing so will add value to the natural environment, draw more visitors, and add more recreational revenues to the area's economic base. Recreation is a rapidly growing industry across the US, presenting economic opportunities for the region, which is within a day's drive for over a third of the US population.

Not only will the environment be improved, but restoration is also likely to establish a new growth industry for the region that will create jobs with global marketing potential (Table 6). Many residents already possess the skills and experience to perform the natural landscape work that is required to restore a stream or forest. They enjoy outdoor

***SHENANDOAH BASIN PROJECT:
STRENGTHENING CITIZEN WATERSHED GROUPS***

Citizens in the Shenandoah Basin in Virginia are protective of their river. Many belong to citizen watershed organizations, which are committed to improving water quality in the Basin. However, these groups are often staffed by volunteers and many times lack the organizational skills, technical expertise, and networking opportunities to be as effective as possible. The Shenandoah Basin Project helps to bridge these gaps. By providing training opportunities, small grants, and other organizational support, the project helps to empower watershed groups so that they can become more effective organizations, and so that they can better address the complex issues that surround water quality improvement. To date, the Project has helped ten citizen watershed organizations.

Table 6. Direct and indirect number of jobs per million dollars of spending for different industrial sectors. Aquatic ecosystem restoration can create as many or more jobs than other industrial sectors.

<i>Industrial Sector</i>	<i>Direct jobs/\$million</i>	<i>Indirect jobs/\$million</i>	<i>Total jobs/\$million</i>
Aquatic Ecosystem Restoration	13.0	17.0	30.0
Road Construction	9.5	14.8	24.3
Utility Maintenance and Construction	6.1	19.7	25.8
Defense Contractors	10.2	10.5	20.7

work and heavy machinery operation. They already have a close connection to the land (see sidebars, this page). According to the Association of General Contractors, for every \$1 million spent on restoring acid mine drainage-impaired streams, 59 jobs are created. Economists have a range of estimates for job creation, from 30 to 59. Restoration projects spawn growth in related industries such as nurseries to provide the native plants required in many restoration projects, and heavy equipment maintenance and repair facilities.

Restored ecosystems enhance tourism and recreational expenditures. The expertise and experience in habitat restoration gained by

photo: Bill Worobec, Dunwoody Fish & Game Club



FROM MINING TO RECLAMATION

After 100 years of mining bauxite in Arkansas, Alcoa closed the mines and started planning for reclamation. To Alcoa's delight, the union miners, who were heavy equipment operators, stepped up and said, "We helped mess this site up and we want to help fix it." Not only are almost 1000 acres being restored to wildlife habitat, but because of the miners' experience, the project is ahead of schedule.

Restoration & Retraining

those in the Mid-Atlantic Highlands can be exported. A global economy presents opportunities to pursue international markets for restoration work.

Community leaders, elected officials, and public agencies all need information, technical assistance, and financial support to fully realize the potential of a restoration industry. All levels of government must make a commitment to restoration, and sources of long-term, stable funding must be developed. Local contractors would be able to compete for agency contracts, with contractor assistance programs and business development support.

RESTORATION WORKSHOPS: HELPING TO TRAIN A NEW GENERATION

In the eastern US, there is a shortage of companies and workers trained in stream restoration techniques. For engineers and contractors who want to get in on this untapped market, Canaan Valley Institute sponsors training in natural stream channel design. Workshops bring together engineers, contractors, and permittees and agency workers to learn about this new technology and how to assess the success of their current and future projects.

3. Obtain more value from natural resources

Partnerships with agencies such as the Small Business Administration are needed to foster businesses that will support the restoration industry (such as native plant nurseries), and to promote entrepreneurship in value-added industries that use agricultural or timber products (see sidebar). In West Virginia, MountainMade.com uses the Internet to market the works of West Virginia artists and craftspeople to a worldwide audience.

Similar endeavors are being developed using telecommunications to manage networks of small-scale but high-value furniture manufacturers. And the West Virginia E-Business program is assisting wood products companies to develop an export component to their business by facilitating relationships with key government agencies, and helping with the development of promotional materials.

High-value nursery and greenhouse products and agriculture-derived products such as beeswax candles are just a few examples - investment must continue to move away from low-priced, globally produced commodities into high-value, regionally specialized products.



Value-added products from forest resources generate more revenue than shipping raw material, especially logs, out of the region. [Photo: Karl Badgley, MountainMade.com]

Transforming Liabilities into Assets

MORRISON COVE SMALL ENTERPRISE AGRICULTURAL BUSINESS INITIATIVE

Agricultural areas with nutrient-related problems due to high concentrations of livestock and manure are also “opportunity zones” for the creation of valuable manure-derived products such as compost, energy pellets, and methane/electricity. In Morrison Cove, Pennsylvania, a locally-based partnership has secured a Rural Business Enterprise grant from the USDA to develop a business plan for a regional composting facility as well as a methane digestion system to supply a nearby town with electrical power.

4. Obtain full value from the restored natural environment by fostering amenity-based development

Amenity-based development occurs when a region's natural and cultural assets (its amenities) attract and retain people and businesses. Individuals no longer value just salary, but also value quality of life components such as climate, recreational opportunities, low crime, lack of crowding, clean air and water, good schools, and cultural resources. Amenity-based development respects and safeguards the natural and cultural assets on which it is based, even as more people move to the area (see sidebar).

A priority of the Highlands Action Program is to protect special places. The preservation of the character, diversity, and function of the ecosystems and special places within the Mid-Atlantic Highlands is in and of itself an opportunity that may be offered only once. Failure to act as good stewards of these resources may result in irreversible impacts to the area and the irretrievable loss of the region's natural legacy.

Special area protection and restoration have economic return implications as well. The Mid-Atlantic Highlands already contains many public lands that are attractive to urban visitors, but 75% of the rich forested lands remain in the private sector. Government incentives such as the wetlands Conservation and Reserve Program of the US Department of Agriculture should be used to reward private landowners for allowing environmental stewardship of their lands to take priority over short-term private gain. Federal mine reclamation funds should be used to reforest systems and reignite recreational uses of these areas.

An enhanced natural environment means enhanced opportunities for tourism of all kinds: ecotourism, outdoor recreation,

KIDS ARE FISHING AGAIN ON GEORGES CREEK!

In western Maryland, Georges Creek Watershed Association catalyzed the installation of an innovative treatment system for acid mine drainage. Since the treatment system was installed on a tributary of Georges Creek, a reproducing brook trout population has been reestablished. Now the stream is a youth-oriented catch-and-release fishing area. Because of this success, Georges Creek Watershed Association was inspired to continue improving fish habitat and water quality in their watershed. The successes of Georges Creek Watershed Association have created a groundswell of local interest in improving economic and environmental conditions throughout the watershed.

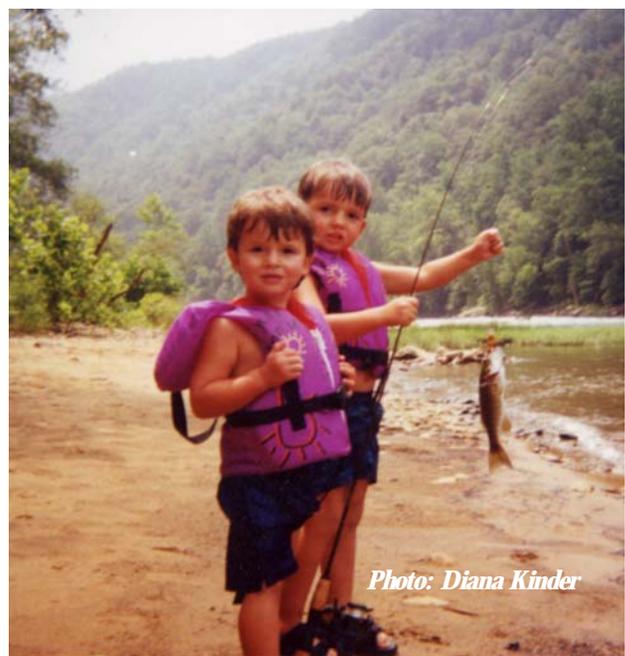


Photo: Diana Kinder

hunting and fishing, and heritage tourism. Coordination on a regional level could strengthen the power of promotional products and packages and improve wages and benefit levels for tourism workers. Historic landscapes, scenic vistas, rivers and streams, mountain trails - much of the "natural infrastructure" is already in place in the Mid-Atlantic Highlands, and demand for these products is growing (Table 7). In addition, land trusts, conservation easements, and comprehensive planning will continue to protect even more special places (see sidebar.)

Using Science to Protect Special Places

CACAPON AND LOST RIVERS LAND TRUST

A major four-lane highway is being built near the Cacapon and Lost Rivers watersheds and will connect this formerly remote rural location to the Washington, DC area. Sales of farms and forested land to developers are already intensifying in the area, and open space is being subdivided at a rapid rate.

Due to the lack of a comprehensive land use plan in this region, the founders of the Cacapon and Lost Rivers Land Trust (CLRLT) in West Virginia sought private sector tools, such as conservation and agricultural easements, for landowners to voluntarily and permanently prevent unwanted subdivision and development on their property, while retaining ownership and the right to sell or transfer the property to heirs.

Table 7. Increasing demand for outdoor recreation in the United States

Activity	Millions of Participants	Millions of Participants	Percent Change
	1994-1995	2000-2001	1994-2001
Kayaking	2.6	7.3	182.6
Photographing Wildlife	26.8	53.1	97.8
Viewing Wildlife	61.1	95.3	55.9
Backpacking	14.8	22.8	53.8
Day Hiking	46.7	70.6	51.3
Bicycling	56.1	84.6	50.8
Canoeing	13.8	20.6	49.8

Public Complaints Inspire an Innovative Solution

5. Develop opportunities to manage the environment using innovative technology

The Highlands Action Program will promote work to achieve sustainable environmental stewardship. Local environmental problems, including flooding and small sewage discharges into streams, offer challenges to develop new technologies - such as better methods of flood control and flood management. Individualized onsite wastewater treatment systems and “cluster” systems could be designed to provide more efficient and effective treatment, to be managed by qualified third parties, and to provide affordable sewerage options for rural residents (see sidebar).

Partnerships with state and federal water management agencies must be formed to correct the misperception that innovative local solutions to problems are too expensive or technologically infeasible. Partnerships with research firms and institutions should provide incentives for technology development.

Large-scale issues such as mountaintop mining and timber operations represent a challenge to the goals of economic prosperity and environmental protection. Advances in science and technology should help locate and manage these activities to prevent un-

TWIN LAKES

Heavily used, the outdated pit toilets at Twin Lakes County Park in southwest Pennsylvania were a problem. The public had serious odor complaints and health concerns. To make matters worse, the park was investing a lot of time, labor, and money just trying to keep up with the maintenance of this inefficient system.

So in 1999, the Penns Corner Resource Conservation and Development Council convened an Alternative Wastewater Management Committee to work with local elected officials on this and other rural wastewater issues. Canaan Valley Institute provided information about alternative sewage systems and sought technical advice from the National Small Flows Clearinghouse and the Freshwater Institute. A new peat-based biofilter technology was chosen as a demonstration project. Initial test results indicate that effluent levels are meeting state standards, and an official year-long monitoring of the system began in April 2002.

acceptable impacts, to minimize disturbances, and mitigate unavoidable damage while achieving fair economic returns.

6. Create opportunities for science, teaching, and learning

The Mid-Atlantic Highlands is a data-rich and diverse environment that could be attractive to research institutions. It is an irreplaceable natural laboratory for scientific study-not only to establish baseline values for relatively pristine natural environments, but also to develop and test better tools and management techniques for

stewardship and restoration of degraded areas to a healthier condition (see sidebar, page 39). This information and these tools and management techniques can be taught to those outside the Mid-Atlantic Highlands.

Not only is the region a natural laboratory for scientific study, but it's also a natural classroom for teaching children and young people about environmental stewardship in their watersheds. The Randolph County Outdoor Education Program provides over 300 fifth-graders in West Virginia each year with a three-day residency grounded in the county's rich natural

environment and its cultural heritage. The program is designed to increase children's awareness and appreciation, with input from local teachers, administrators, and community partners. Similar programs are in place throughout the region, but these can be strengthened – younger generations are the future partners in the Mid-Atlantic Highlands.

Environment-economy-community working together

is the model for sustainable development and environmental management. However, for this approach to work, it must be built on the collaborative and cooperative efforts of all the stakeholders. Partnerships among government agencies, nonprofit orga-

nizations, the private sector, and the local community create sustainable environmental stewardship.

Using Flood Models to Educate Homeowners

SMITHFIELD, WEST VIRGINIA

Residents of Smithfield, WV needed help to deal with repeated flooding events. A triad of public agencies, private companies, and nonprofit organizations has developed a flood model for the town (Figure 18). An airborne technology known as LiDAR was the first used in the state. The model includes easy-to-understand computer graphic movies of flooding events. Residents will be able to watch and see when a house is likely to be flooded, and how deep the water will be. Residents can more carefully evaluate the pros and cons of FEMA buy-out offers, identify constricting structures along their streams, and create a safer, more secure future for the community.

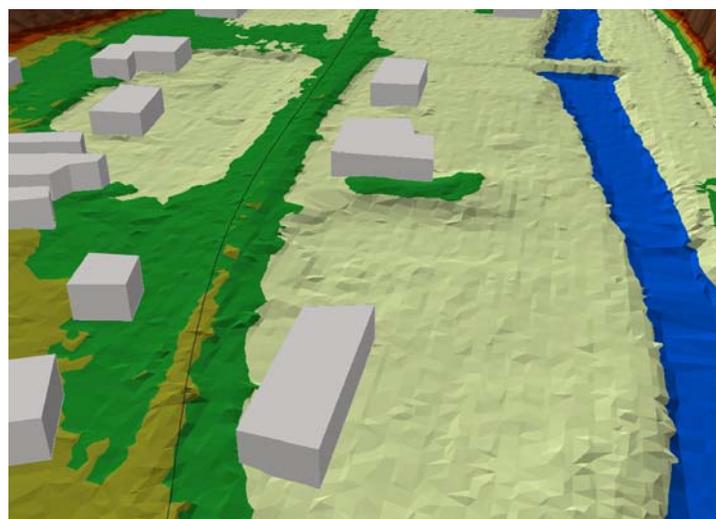
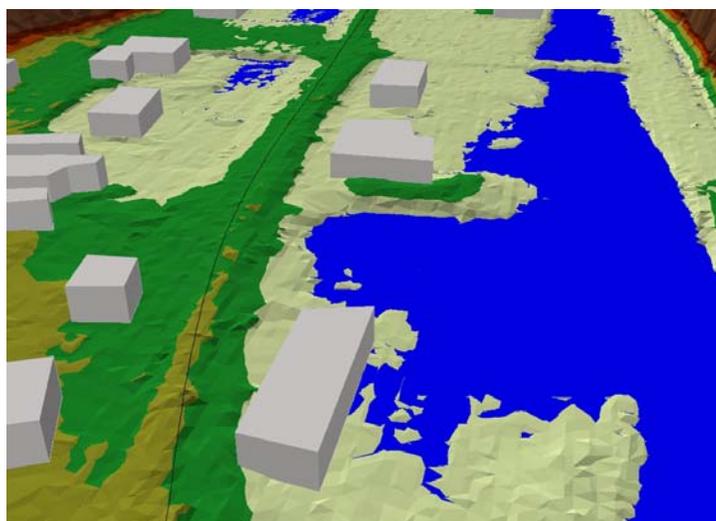


Figure 18. Two scenes generated by a computer model show Smithfield, WV residents which areas are likely to flood (blue areas) during periods of high flows. A low flow is shown above and a high flow below.



“Much work remains to be done and the path to continued environmental improvements will require a new emphasis on partnerships. Some of the most creative solutions to our problems are generated at the local level by citizens, business, state and local government, and other interested organizations, and we all need to work together to achieve the next generation of environmental progress.”—Christine Whitman, Administrator, US Environmental Protection Agency

COMMITMENT TO ENVIRONMENTAL STEWARDSHIP

Over the past thirty years, the EPA and others have made considerable strides in addressing environmental problems in the United States. Yet environmental degradation continues, and many ecological services—such as regulating the flow of streams and rivers and maintaining air quality—are impaired or inadequately managed.

The traditional approach to environmental management

has been sector-based. Government, nongovernmental, and private organizations alike have focused energy, dollars, and people based on the media with which they were concerned, like air, water, or wildlife. The desired approach to environmental stewardship (Figure 19) reflects the idea that natural, economic, and human resources must be managed in a way that is inclusive in nature, balances ecological and economic values, and en-

courages proactive involvement by all stakeholders.

A review of other programs has indicated that successful ones have learned the following lessons:

1. Encourage the participation of a broad spectrum of participants;
2. Focus on the integration of government agencies;
3. Involve and inform the public;
4. Embrace clear, strong, specific, comprehensive, and measurable goals;
5. Use sound science, and combine theory, detailed knowledge, monitoring and modeling;
6. Provide incentives and methods for institutional cooperation; and
7. Demonstrate and communicate results.

Canaan Valley Institute has taken the best of the lessons learned and used them to create an innovative process for improved environmental stewardship. This process for

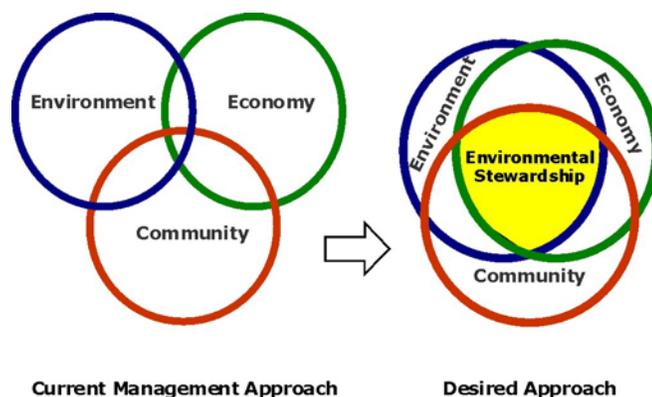


Figure 19. Sustainable environmental stewardship requires that we move from our current approach to the desired approach where environment, economy, and community are considered together:

environmental stewardship has been illustrated throughout this document (Figure 20). First, the process seeks out and involves local citizens, commerce, and government groups. Next, it emphasizes knowing and understanding the ecological and socioeconomic character of an area, and using sound science leads to the development of creative actions to solve problems. Finally, the process should include mechanisms to measure success, share knowledge, and learn from the past. Through-

out this process, economic growth, maintaining a quality environment, and wise use of resources go hand in hand to ensure a rising standard of living for all Americans.

In order to integrate the economy, environment, and community, several principles are clear. The approach must foster local decision making in support of sustainable communities. It must develop or inspire partnerships between local communities, government agencies, nongovernmental organizations,

research institutions, and the private sector to develop creative solutions. And, it must integrate environmental science, social science, and knowledge of sound management practices.

That brings the discussion back to the diagram of an environmental stewardship process: a process that involves all stakeholders in the identification of concerns, the characterization of their environment, the discovery of stressors and causes of these stressors, and the development, implementation, and measurement of solutions (Figure 20).

The process enables both region-wide and local watershed problem solving, with its goals to protect, enhance, and restore entire watersheds throughout the Mid-Atlantic Highlands while creating jobs and opportunities for local citizens. This process is not new. It is already working at the local level, as the example projects in the preceding section demonstrate.

Existing place-based environmental stewardship programs are successful and need to be replicated throughout the Highlands.



Figure 20. An approach for environmental stewardship founded on the scientific method, modified based on lesson learned from other federal programs, and which has proven successful over the past 7 years.

I would like to see a formal, focused, structured approach to environmental restoration in the Highlands. It would bring together local, state, and federal government agencies, as well as non-government groups like Canaan Valley Institute...It would lead to a 'Highlands Action Plan,' driven by sound science and solid partnerships—and delivering real results.”

—Alan Mollohan, US Representative (D)

THE HIGHLANDS ACTION PROGRAM

In July 2001, Congress took the first step toward establishing the Mid-Atlantic Highlands Action Program. It recognized the need to establish a federal program for collaborative monitoring, research, management, and restoration activities within the Mid-Atlantic Highlands. Congress expressed an expectation that EPA would partner with local communities, state and local governments, other federal agencies, nongovernmental organizations, research institutions, and the private sector to carry out the goals of the Mid-Atlantic Highlands Program. Congress also recommended these program goals:

- Improve water quality, living resources, and habitat of the Mid-Atlantic Highlands, and
- Foster stewardship of resources through an outreach program for public information and education in the Mid-Atlantic Highlands.

Within the Congressional language, the Canaan Valley Institute (CVI) is referenced as a logical partner for EPA. It was the intent of Congress to blend the strengths and experiences of both EPA and nongovernment organizations (NGO's) to establish a new model for geographic-based partnerships: a model based upon government service to locally embraced, scientifically informed socioeconomic and environmental goals.

Indeed, the goals and objectives of government agencies such as EPA and nongovernmental institutions are similar. An examination of those goals reveals that both entities are pursuing watershed protection and restoration, sound science, pollution prevention, environmental stewardship, and partnerships. These goals reflect the needs and desires of people and communities in the Mid-Atlantic Highlands.

EPA's goals, formally expressed through the Government Performance and Results Act (GPRA), reflect the

Agency's commitment to partnerships, science, and solutions to real water quality, habitat, and quality of life issues. Similarly, the strategic goals and guiding principles of CVI and other NGO's place a premium on stakeholder participation, science and information, and action to resolve known water quality, habitat, and quality of life issues. All these goals reinforce each other and highlight the need for collaborative partnerships.

The ability to address the goals and objectives of all stakeholders within the region can be improved and enhanced collaboratively through the Highlands Action Program. This is not just conjecture—the examples in this report show that improvements are already occurring in local communities across the Mid-Atlantic Highlands.

With these common goals in mind, CVI recommends that the Highlands Action Program be a joint effort between EPA, NGO's, local communities, state and local governments, other federal

agencies, research institutions, and the private sector (Figure 21). EPA should implement the program with independent funding, leadership, and resources comparable to the Chesapeake Bay Program, including additional support for select federal agencies to enhance their participation in the program.

Two steps seem apparent to progress towards a long-term program. Initial funding should be considered to enhance Highlands-wide participation in the program and to improve the quantity, quality, and utility of data and information across the region. It should also be used to encourage actions to resolve on-the-

ground Highlands issues as described in this report.

As part of this initial effort, EPA and CVI should organize three work groups with representatives from all cooperating partners to oversee and review Program implementation. Based upon initial but thorough understanding of the region, three work groups should be established to carry out the following activities:

1. Revitalizing damaged places;
2. Protecting special places;
3. Promoting environmental stewardship.

The program, however, should maintain flexibility to

change focus as information and experience dictates. The work groups should be chaired by regional and local stakeholders and should provide feedback to the Highlands Action Program leadership on program goals, objectives, and activities.

Secondly, EPA and CVI should be responsible for a report to Congress from the Highlands Action Program on long-term strategies, resource needs, and plans for each focus area. Recommendations

Sustainable environmental stewardship must be intertwined with the economy and local communities.

Highlands Action Program Formed

Figure 21. EPA and CVI should take the lead to bring together local communities, government agencies, NGOs, research institutions, and the private sector to form an effective management structure for the Highlands Action Program.



should focus on how existing resources could be more efficiently used to address these needs, as well as detailing estimates for additional initiatives and resources.

Recommendations

Over the last decade, a growing list of federal agencies such as EPA, NOAA, and NRCS and nongovernmental organizations such as Canaan Valley Institute have recognized the need for addressing the region’s economic and environmental problems. It makes sense for these organizations and others to pull together and work toward common goals. The Institute recommends using the ap-

proach described above for implementing a Highlands Action Program as set forth by Congress. This Highlands Action Program should

- Take action on the problems identified in this report;
- Use environmental indicators, good science, and partnerships to identify the causes of these problems;
- Develop solutions and management actions to resolve these problems;
- Develop a management governance for the Program that includes states, nongovernmental organizations, local communi-

ties, and the private sector in partnership;

- Periodically assess its status, emerging issues and trends, and report to Congress and local stakeholders on its findings and successes.

This proposed Highlands Action Program captures the Congressional vision — a locally driven partnership, where all levels of stakeholders work to creatively and effectively manage the very special resources and socioeconomic opportunities within this special place — the Mid-Atlantic Highlands.



Photo: Dave Clark



Photo: Todd Schroeder



Photo: Dave Clark

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Figure and Table Notes

Map Graphic on Inside Front Cover by Corey Anderson, Canaan Valley Institute.

Figure 1. Graphic by Joe Adkins, Emily Clifton, and Ellen Voss, Canaan Valley Institute.

Figure 2. Map Graphic by Dan Morse, The Nature Conservancy.
Adapted from *Precious Heritage: The Status of Biodiversity in the United States*, Data from State Natural Heritage Programs.

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Figure 3. Map graphic by Corey Anderson, Canaan Valley Institute.

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Skiiing

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Figure 4. Map Graphic by Corey Anderson and Peter Claggett, Canaan Valley Institute. Created with data from: O'Connell, T.J., L.E. Jackson, and R.P. Brooks. (2000). A Bird Community Index of Biotic Integrity for the Mid-Atlantic Highlands. *Environmental Monitoring and Assessment*, 51, 145-156.

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Figure 5. Graphic Modified from: US Environmental Protection Agency. (2000). *Mid-Atlantic Highlands Streams Assessment*. US Environmental Protection Agency, Washington, DC. EPA/903/R-00/015.

Figure 6. Map Graphic by Corey Anderson, Canaan Valley Institute. Created with data from: National Atmospheric Deposition Program. (1999). National Atmospheric Deposition Program/National Trends Network. <http://nadp.sws.uiuc.edu>

Figure 7. Map Graphic by Corey Anderson and Emily Clifton, Canaan Valley Institute. Adapted from: US Environmental Protection Agency. (1997). *An Ecological Assessment of the United States Mid-Atlantic Region: A Landscape Atlas*. US Environmental Protection Agency, Washington, DC. EPA/600/R-97/130.

Figure 8. Map Graphic by Corey Anderson and Matt Sherald, Canaan Valley Institute. Created with data from: US Federal Emergency Management Agency. NEMIS Database, 1965-2000.

Figure 9. Map Graphic From: Stolte, K.W., B.L. Conkling, and S. Fulton. *Draft. State of the Forests in the Mid-Atlantic Region*. US Department of Agriculture Forest Service.

Figure 10. Map Graphic by Corey Anderson, Canaan Valley Institute. Created with data from: National Geophysical Data Center, US Geological Survey. (1997). National Atlas of the United States of America: Night Lights. US Geological Survey.

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Figure 12. Map Graphic by Corey Anderson, Canaan Valley Institute. Created with data from: US Environmental Protection Agency. (2002). Most Current Section 303(d) Listed Waters.

Figure 13. Map Graphic by Corey Anderson, Canaan Valley Institute. Created with data from: US Department of Commerce, Census Bureau. 1990 Decennial Census.

Figure 14. Map Graphic by Corey Anderson, Canaan Valley Institute. Created with data from: US Department of Commerce, Census Bureau. 1990 Decennial Census.

Figure 15. Map Graphic by Corey Anderson, Canaan Valley Institute. Created with data from: US Department of Commerce, Census Bureau. 1990 Decennial Census.

Figure 16. Map Graphic by Corey Anderson, Canaan Valley Institute. Created with data from: US Department of Commerce, Census Bureau. 1990 Decennial Census and 2000 Decennial Census.

Figure 17. Map Graphic by Corey Anderson and Matt Sherald, Canaan Valley Institute. Created with data from: Federal Communications Commission, Industry Analysis Division, Common Carrier Bureau. High-Speed Services for Internet Access: Subscribership as of June 30, 2001.

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King, Dennis. (1992). Preliminary Analysis of Wetland Restoration Cost. Data collected through EPA Cooperative Agreement No. 075-25151 with University of Maryland, Center for Estuarine and Environmental Studies.

Source for Table 7.

Cordell, K. (n.d./2002). Outdoor Recreation: Segmenting Americans and markets to better see the trees. [www presentation]. URL <http://www.srs.fs.fed.us/trends/OIAAZ.pdf>

Figure 18. Graphics by Ed Watson, Canaan Valley Institute.

Figure 19. Graphics by Emily Clifton, Canaan Valley Institute. Adapted from: Flint, R. Warren and Willow Lisa Houser. (2001). *Living a Sustainable Lifestyle for Our Children's Children*. Authors Choice Press, Lincoln, NE.

Figure 20. Graphic by Joe Adkins, Emily Clifton, and Ellen Voss, Canaan Valley Institute.

Figure 21. Graphic by Joe Adkins, Canaan Valley Institute.

Photo Sources

Cover photograph of Rock Creek, WV by Lyntha Scott Eiler, reference number AFC 1999/008 CRF-LE-C047-02. (filename = aerial rock creek.tif) From: US Library of Congress, American Folklife Center. Tending the Commons: Folklife and Landscape in Southern West Virginia. <http://memory.loc.gov/ammem/cmnshtml/cmnshtml.html>

Girl Studying Photograph by Dave Clark, Canaan Valley Institute

Ginsenger Photograph by Lyntha Scott Eiler, reference number AFC 1999/008 CRF-LE-C011-16. From: US Library of Congress, American Folklife Center. Tending the

Commons: Folklife and Landscape in Southern West Virginia. <http://memory.loc.gov/ammem/cmnshtml/cmnshtml.html>

Photograph of unfragmented forest, Kanawha County, WV by Lyntha Scott Eiler, Reference number AFC 1999/008 CRF-LE-C034-08. From US Library of Congress, American Folklife Center.

Photograph of fragmented forest, Hampshire County, WV by Charlie Yuill, West Virginia University, National Resource Analysis Center

Historic Coal Miners Photograph from West Virginia and Regional History Collection. West Virginia University Libraries

Civil War Re-enactors Photograph from Rich Mountain Battlefield Foundation. Beverly, WV

Rail Trail Photograph by Pamela Kemplage

Whitewater Rafters Photograph by Whitewater Photography. Fayetteville, WV

Stream Erosion Photograph by Dave Clark, Canaan Valley Institute

Ozone Damaged Leaves Photograph by Jenny Hager/Alpine Images, reference number AFC 1999/008 n/a. From: US Library of Congress, American Folklife Center. Tending the Commons: Folklife and Landscape in Southern West Virginia. <http://memory.loc.gov/ammem/cmnshtml/cmnshtml.html>

Cow Photograph by Dave Clark, Canaan Valley Institute

Lots for Sale Photograph by Dave Clark, Canaan Valley Institute

Stakeholder Discussion Photograph by Dave Clark, Canaan Valley Institute

Miners photograph by Lyntha Scott Eiler, reference number AFC 1999/008 CRF-LE-C128-08. From US Library of Congress, American Folklife Center.

Restoration Operator Photograph by Bill Worobec, Dunwoody Fish & Game Club

Bowl Maker Photograph by Karl Badgley

Boys Fishing Photograph by Diana Kinder

Photograph of Men with Map by Dave Clark, Canaan Valley Institute

Photograph of Kids with Butterfly Net by Dave Clark, Canaan Valley Institute

Photograph of Stream in Fall by Todd Schroeder, Canaan Valley Institute



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