

### An Environmental Plan for the Middle Nolichucky River Area

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This article presents an environmental plan for the area surrounding the Middle Nolichucky River in northeastern Tennessee, developed for a nonprofit group called the Friends of the Nolichucky River, by the University of Tennessee, Knoxville. The plan is broadly conceived because stakeholders' concepts of the environment include the natural environment and the river/air/water quality, as well as the traditional agricultural landscape, local culture, and historic structures. Numerous problems, such as agricultural runoff, soil erosion, flooding, habitat fragmentation, and impending climate change combine to affect human and ecological health, aesthetics and culture, and environmental economic services. The plan integrates several themes, including the built and natural environments, 21st-century agriculture, sustainable technologies, climate change mitigation, and land conservation techniques. The plan is novel in that it is decidedly multi-faceted, more so than what is found in typical comprehensive plans or more classical environmental plans that focus only on natural amenities.

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Environmental practice is inherently interdisciplinary. Understanding environmental problems and their solutions requires the application of numerous knowledge bases, including environmental science, atmospheric science, economics, law, human health, psychology, and risk assessment and management. Understanding environmental issues in a community context is also an interdisciplinary exercise, for the word “environment” has taken on a broad meaning for many communities.

For the stakeholders in the area surrounding the middle portion of the Nolichucky River in northeastern Tennessee, the environment is understood not only to include the natural environment of the river but also the agricultural

landscape, local culture and historic structures, and local air and water quality. The environmental plan developed for this area, the Middle Nolichucky River area (MNRA), is novel because it is correspondingly broad and integrated, much more so than is typically found in plans that focus mainly on natural amenities such as parks and forests.

The next section of this article describes the study area. Following that, we present our approach to the development of an environmental plan for the MNRA, and then summarize the environmental problems plaguing the MNRA. In addition, we discuss how, in aggregate, these problems impact human health, ecological health, aesthetics and culture, and environmental economic services. The last major section presents the elements of an environmental plan for the MNRA. The paper concludes with a lessons learned section.

### The Middle Nolichucky River Area

The headwaters of the Nolichucky River are in the mountains of western North Carolina. The middle part of the Nolichucky River runs from near the Tennessee–North Carolina border southwest to the Nolichucky River Dam, which created the Davy Crockett Lake. The study area covers a more limited portion of the middle part of the river, from around Jonesborough in Washington County into the eastern edge of Greene County (around Tusculum). Stakeholders consider the Cherokee National Forest to be the southern boundary of the area. A relatively new highway, 11E, represents the northern boundary. For centuries, this area has been dominated by the agricultural sector. Greene County is the top agricultural county in Tennessee, ranking number one in milk cows, second in alfalfa production, and first in other hay production.<sup>1</sup> Washington County also ranks high agriculturally in the state.<sup>2</sup> The Nolichucky River provides substantial economic services to the agricultural sector.

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The study area is located within the United Nations' designated Southern Appalachians Man and the Biosphere Region;<sup>3</sup> in addition to the Cherokee National Forest, the Great Smoky Mountains National Park and the Appalachian Trail are nearby. Its natural environment is quite diverse. According to the Tennessee Valley Authority (TVA), grasslands, upland hardwood forests, and floodplain hardwood forests make up 72% of the 500-year floodplain boundary of the Nolichucky River, with the remaining 28% being aquatic.<sup>4</sup> The grasslands of the area are typically made up of crops and successional herbs due to disturbance. Living in the area are numerous animals, including toads, box turtles, garter snakes, copperhead snakes, salamanders, songbirds, herons, vultures, brown bats, moles, shrews, squirrels, woodchucks, opossums, otters, raccoons, rabbits, coyotes, foxes, deer, and one of the world's most diverse collection of mussels. The forest areas are composed of red oak, maple, beech, buckeye, spruce fir, basswood, pine, cedar, hemlock, sycamore, box elder, river birch, willow, and tulip trees. A number of rare and endangered species are also found in the area, including the Appalachian rose gentian (*Sabatia capitata*), pink lady's slipper (*Cypripedium acaule*), and greater purple fringed orchid (*Platanthera grandiflora*).<sup>5</sup>

The Nolichucky River is a defining characteristic for many small and historic communities of the area, including Chuckey (the most prominent community), Limestone, and Telford. It is believed that Davy Crockett was born in this area next to the river; the Davy Crockett Birthplace State Park commemorates this historical event. The area was settled by Henry Earnest and his descendants in the 18th century. It has the oldest operating family farm in the state, the Earnest family farm, established in 1777. Numerous attractive historical structures dot the landscape, from the Earnest Log Fort House to the Salem Presbyterian Church (circa 1780), to the beautiful buildings and the railroad station in the Chuckey Community.<sup>6</sup>

The MNRA is representative of rural areas struggling to protect their environment and cultural heritage.<sup>7</sup> The most tangible threats to the area are the growth in Greene and Washington counties, which increased in population 12.6% and 16.1%, respectively, from 1990 to 2000, and in those counties' two main cities, Greeneville in Greene County and Johnson City in Washington County, which bracket the study area. It is forecast that population in these cities will grow another 30% by 2030. Growth from these two areas is beginning to spill over into the study area, most visibly in the form of new subdivisions. Additionally, this growth had spurred discussions of the

location of a new wastewater treatment plant, which was originally slated to be sited in the study area until public outcry halted those plans.

## Approach to Developing the Environmental Plan

In response to these threats to the area, a group of local citizens formed the not-for-profit Friends of the Nolichucky River Valley (hereinafter referred to as Friends). According to their brochure, the mission of the group is to "conserve the environment and promote the agricultural, ecological, historical and cultural integrity of the Nolichucky River Valley." The Friends approached the Department of Urban and Regional Planning, University of Tennessee, Knoxville (UTK), in the fall of 2001 for help in developing an environmental plan for the study area. It was mutually decided to focus the class project for UTK's graduate-level environmental planning class (Spring 2002) on the issues being confronted in the study area.

The approach taken in developing the environmental plan can be described as collaborative learning.<sup>8</sup> This is a process whereby stakeholders and professionals work together to define problems and develop solutions to the problems. To this end, the authors and class members spent time with the stakeholders, listening to their views of the issues facing the study area. The lead author of this article made several trips to the study area, and the entire class spent a Saturday in the study area, first listening to presentations by several very knowledgeable stakeholders about the area's environment and history, and then touring the area in four separate groups, with each tour focusing on a particular theme for the environmental plan.

The UTK team also accepted the responsibility for educating the Friends about a wide range of environmental issues facing the study area and how these issues are interrelated. It was learned early on that different members of the Friends used the word "environment" in different ways. For the two leaders of the group, the word is interpreted to mean the historical agricultural landscape and associated culture. For others in the group, the word was more related to water and air quality and the protection of local species. We interpreted the word very broadly to encompass all these viewpoints, as well as a few others that stakeholders had not mentioned. The most prominent issue added to the mix was climate change. A major flood in the area triggered by an extreme weather event had recently threatened several historic structures. Because most scientists believe that climate change will

increase the frequency and severity of such events, we felt it was important to educate the stakeholders about the potential consequences of climate change for their area, even though major uncertainties surround the magnitude and timing of such events. Admittedly, the lead author was also curious about the extent to which the Friends could incorporate climate change into their agenda.

Because the Friends was a relatively new organization and because of the semester limitations of the class, it was decided that the environmental plan would include the following: a comprehensive assessment of environmental issues facing the study area; an analysis of how these issues affect four thematic areas—human health, ecological health, aesthetics and culture, and environmental economic services (i.e., natural capital); and ideas for the Friends to consider for dealing with the environmental threats to the thematic areas. Knowing that the Friends group does not have extensive financial resources, a section was added to the plan that addressed potential sources of funding for elements of the plan. The Friends were provided with interim reports—the assessment of environmental problems in the area and the impacts of those problems on the four thematic areas mentioned above. At the end of the project, a presentation was made to the Friends and they were provided with multiple copies of a CD containing the presentation. It was expected that the Friends would review and prioritize the ideas and pursue those that made the best sense to them. It was anticipated that UTK, as possible and appropriate, would help the Friends develop approaches for implementing specific ideas contained in the plan.

## **Environmental Issues in the Middle Nolichucky River Area**

According to our analysis of existing data, interviews with stakeholders, and personal observation, the four most significant environmental problems afflicting the study area are agricultural runoff, soil erosion, flooding, and habitat fragmentation. The first three problems are highly interrelated. Agricultural runoff refers to water, in the form of rain or irrigation, that drains from farmland into nearby streams and rivers. Carried from the farmland in the runoff are insecticides, herbicides, fertilizers, animal wastes, and topsoil (which leads to soil erosion). Livestock are permitted to enter the Nolichucky River, resulting in sedimentation erosion and direct manure impact with its associated problems (e.g., bacteria, viruses, parasites, and

fungi). In part because Greene and Washington counties are leading agricultural communities, and in part because of current agricultural practices and soil types, agricultural runoff is a significant problem; the Nolichucky River and its tributaries are degraded with excess nutrients and salts, possibly dangerous levels of pathogens (from animal wastes),<sup>9</sup> and agricultural chemicals.<sup>10</sup> Aquatic ecosystems are at risk from nutrient overload, and human health is at risk because of contaminated water.

Sediments from soil erosion of agricultural lands and construction sites, as well as from mining and logging operations upstream, also foul the waters. Siltation is the top pollutant of Tennessee rivers; all of the Nolichucky River, Big Limestone Creek and several of its tributaries, and Sinking Creek are listed as impaired because of this cause.<sup>11</sup> Overall, the water quality in the Nolichucky River watershed is quite poor.<sup>12</sup> In Washington County, there are 32 impaired water bodies and 13 exist in Greene County.<sup>13</sup>

Because sediments have substantially filled in the reservoir next to the Nolichucky Dam, built in 1913, soil erosion is also a major cause of flooding. In fact, the Tennessee Valley Authority stopped production of power by the dam in 1972 because of siltation. Instead of filling up the reservoir, rainwater now backs up and floods land upstream as far away as the study area, which begins approximately five miles from the dam.<sup>14</sup> Without action to change the situation around the dam and action to reduce soil erosion, and given expected increased frequency of extreme weather events due to climate change (see below), more frequent and even more extreme flooding can be expected.

Habitat fragmentation refers to the reduction of natural habitat for wildlife into smaller pieces and the increased isolation of these fragments from other similar fragments. Habitat fragmentation leads to a loss of biodiversity and could even threaten some species with extinction, as smaller habitats lose their ability to support larger mammals and various types of birds and other animals. Fences, roads, powerlines, farms, subdivisions, and recreational facilities are some of the man-made causes of habitat fragmentation. Even though the study area is essentially rural, the establishment of farms at the expense of natural habitat and the subsequent building of roads, fences, and communities have long since fragmented the area's natural habitat. Even farmlands, however, are habitat-friendly compared with the intensive suburban development that many stakeholders see in the future for the study area. Thus, potential development poses even more threats to the area's natural habitat.

The next four most significant environmental issues plaguing the study area are acid precipitation, tropospheric ozone, groundwater contamination, and invasive species. Acid precipitation is caused by the interaction of normal precipitation with acidifying compounds, such as sulfur dioxide (SO<sub>2</sub>), that have been emitted into the atmosphere. Acid rain can kill fish in lakes and streams, cause damage to trees and crops, and eat away at building materials, statues, and automobile finishes, among other things. Seven emitters in Washington and Greene counties pumped 862 tons of sulfur dioxide into the atmosphere in 1999.<sup>15</sup> According to a recent article in *Science* magazine, “Current research estimates that SO<sub>2</sub> emissions must be cut by another 80% beyond current Clean Air Act provisions for trees and fish to recover by 2050.”<sup>16</sup>

Tropospheric ozone is caused by the interaction between nitrogen oxides, volatile organic compounds, and sunlight. Ozone can cause permanent damage to the lungs and lead to chest pains, coughing, heart disease, emphysema, and asthma. The burning of fossil fuels (e.g., at TVA coal plants, in automobiles, and by industry) is the major cause of both acid rain and ozone. Even though the study area is rural, it and its inhabitants (human and other species) are at risk from acid rain and ozone because of nearby TVA coal plants that have not been equipped with modern emission sulfur dioxide control technology and because complex wind patterns can bring in ozone-causing chemicals (e.g., from as far away as Nashville, as is indicated by ozone simulations on a United States Environmental Protection Agency [USEPA] Web site<sup>17</sup>). Eleven emitters in Washington and Greene counties pumped 325 tons of nitrogen oxides into the atmosphere in 1999.<sup>18</sup> Additionally, animal wastes in Washington and Greene Counties, approximately 960,000 tons worth, released a total of 2,600 tons of nitrogen oxides into the atmosphere.

Groundwater has been an important source of drinking water for inhabitants of the study area. The quality of the water has degraded, however, from the seeping of contaminated waters from agricultural land and mining operations upstream, as well as from some urban runoff. All the local drinking water wells are now closed.<sup>19</sup> The amount of water in aquifer systems in the area is also decreasing as demands for water exceed recharge rates.

Invasive species are defined as flora and fauna that have been “introduced into new areas in which they are not among native [inhabitants], and because they no longer face the natural enemies or competition from their place of origin, they spread or reproduce prolifically.”<sup>20</sup> Over 75

invasive species pose severe or significant threats in areas of Tennessee. Kudzu (*Pueraria montana* var. *lobata*) and Japanese honeysuckle (*Lonicera japonica*) are only two of the most well known. Invasive species are threatening freshwater mussels, trees, and other species in the study area, and could be imposing heavy economic burdens as well. Zebra mussels (*Dreissena polymorpha*) and Asian clams (*Corbicula fluminea*) are threatening the area’s large number of indigenous mussels. Balsam woolly adelgid (*Adelges piceae*) and hemlock woolly adelgid (*Adelges tsugae*) are destroying spruce fir and hemlock forests in the mountains of east Tennessee. An even greater threat is the gypsy moth (*Lymantria dispar*), which “is expected to seriously impact rare old growth and virgin oak forests in the Smoky Mountains and oak forests throughout the state.”<sup>21</sup> Southern pine beetles (*Dendroctonus frontalis*) and fire ants (*Solenopsis invicta*) are two other invasive species that are causing major worries in the area.

Urban runoff, point source pollution, and solid waste disposal are not substantial problems in the study area. Nevertheless, they should not be ignored. *Urban runoff* is a term used to describe the water (usually in the form of rainfall) that flows across impervious man-made surfaces and into local streams and rivers. Because the study area is largely rural, urban runoff is not a major problem; the USEPA has listed the entire Nolichucky River watershed as minimally impervious (having less than 1% of land area above 25% imperviousness).<sup>22</sup> This issue could become a problem, however, if the area becomes more developed.

*Point source pollution* refers to water bodies receiving effluent from an identifiable, stationary source, such as an industrial plant or municipal sewage system. The Clean Water Act has done a relatively good job of regulating and reducing point source pollution, such that it does not appear to be a major issue in the study area. In Washington County, for example, Environmental Defense attributes only 3% of overall water quality impairment in the county to municipal point sources.<sup>23</sup> This assumes that point source emitters are complying with the law, which studies indicate is not the case in a significant percentage of cases around the country;<sup>24</sup> eventually, therefore, similar problems could arise in the study area.

Solid waste disposal, including the disposal of municipal, construction, and industrial wastes, appears well managed in the study area. The only concern is pollution of groundwater under two closed landfills: one, in Greeneville, was closed in 1994, and the other, in Johnson City, was closed in 1997.<sup>25</sup> Local officials report that both are

polluting the groundwater. A system has been put in place to monitor this problem, which appears limited in scope and beyond the boundary of our study area.

Two problems loom large on the horizon, global climate change and endocrine disrupters. In a recent report, the International Panel on Climate Change estimated that the earth's mean surface temperature may rise between 2.5° and 10.4°F over the next 100 years.<sup>26</sup> With respect to the southeastern United States, temperatures could increase by as much as 3°F in the next 30 years. The area's heat index would thus soar by as much as 15°F in this time period.<sup>27</sup> It is also predicted that this region will experience a greater number of even more extreme weather events.<sup>28</sup> It is unclear what the impact on precipitation will be—one model predicts a 20% increase by 2030; another model predicts a 10% decrease.<sup>29</sup> In any case, water supplies are destined to change, and increases in temperature and carbon dioxide in the atmosphere could have decided and potentially devastating impacts on agriculture, local flora and fauna, and human health in the next 30 years.

Endocrine disrupters are chemical compounds that alter hormonal functions.<sup>30</sup> Scientists have identified more than 60 such compounds, including dioxins, polychlorinated biphenyls, and pesticides such as DDT and atrazine. These types of compounds persist in the environment and bioaccumulate upward through the food chain. Potential impacts of endocrine disrupters on humans include infertility, cancer, thyroid system disorders, compromised immune systems, and abnormal development. Assessment of polluting activities in the study area indicates the likely presence of endocrine disrupters in the food and water. At least five substances suspected to be endocrine toxins are emitted into the air from local industries: lead, styrene, cadmium, chlorodifluoromethane, and dichloromethane.<sup>31</sup> In Tennessee, almost 3,000,000 pounds of dichloromethane are emitted annually (the fourth highest ranking in the US); annual emissions in Washington County are approximately 16,000 pounds. One company in Greenville emits 32,000 pounds of chlorodifluoromethane annually. Tennessee ranks first nationally in emissions of styrene, at over 7,000,000 pounds annually, with much of the emissions coming from the Tennessee Eastman plant in Kingsport, which is northeast of the study area.<sup>32</sup> Environmental Defense's *Scorecard*, which draws upon over 400 scientific and government databases, ranks Tennessee as the tenth worst state for the release of developmental toxins (i.e., chemicals that affect fertility and healthy development of fetuses).<sup>33</sup> Because most endocrine-disrupting compounds are not monitored in

food and drinking water, and because endocrine disrupter science is still in its infancy, it is not possible at this time to provide a reliable assessment of the risk to human health (or other species) from endocrine disrupters in the study area. It is easily imaginable, however, that this issue is currently a problem and could quickly become a truly major concern for the inhabitants of the region in the next several years.

Other potentially important environmental issues in the study area include visibility, endangered species, wetlands preservation, particulate matter (e.g., PM<sub>10</sub>, PM<sub>2.5</sub>), hazardous waste disposal, and noise. With respect to visibility, the Southern Appalachian Mountain Initiative notes, "In the Southern Appalachian Mountain Area, visibility has declined from an estimated 100 miles in the summer to just 20 miles."<sup>34</sup> This loss of visibility has affected the aesthetic values of the study area.

Unfortunately, there are already numerous endangered species in the region of this study area.<sup>35</sup> These include the Appalachian elktoe (*Alasmidonta raveneliana*), a freshwater mussel found only in mountain streams in western North Carolina and in the main stem of the Nolichucky River, which is threatened by contaminated water.<sup>36</sup> Other endangered mussels in the area include birdwing pearly-mussel (*Conradilla caelata*), Cumberland bean pearly-mussel (*Villosa trabalis*), finereyed pigtoe (*Fusconaia cuneolus*), green blossom (*Epioblasma torulosa gubernaculum*), oyster mussel (*E. capsaeformis*), and pink mucket (*Lampsilis abrupta*). Other endangered species include the gray bat (*Myotis grisescens*) and the Chucky madtom fish (*Norturus [Rabida] spp.*).

The topography of the region is not conducive for wetlands, being dominated by sharp ridges and mountains. The largest wetland in the area was created by the siltation of the Nolichucky Dam and is now rich in biodiversity.<sup>37</sup> A small wetland near the river is famous locally for being the stopover place for an endangered whooping crane.

The authors believe that particulate matter is a problem in the area, because of the proximity of the TVA coal-fired power plants and as a result of dust aroused during mining, logging, and agricultural activities. A national map available from the United States Environmental Protection Agency (USEPA), showing that a high number of PM<sub>2.5</sub> monitors in the general vicinity of the study area exceed National Ambient Air Quality Standards, supports our contention.<sup>38</sup> Hazardous waste and noise are not problems in the study area at the present time.

## Cross-Cutting Impacts of the Environmental Problems

This section assesses the environmental problems described above for their cumulative impacts in the following four areas:

- human health;
- ecological health;
- aesthetics and culture; and
- environmental economic services.

The cumulative effects on human health of the environmental problems listed above could be quite substantial. As explained earlier, risks to the health of residents are posed by several types of air pollution and contamination of drinking water. Substantial increases in the heat index arising from climate change could affect the health of older persons and children, in particular. As conditions become more tropical, diseases currently largely confined to tropical areas (such as malaria and dengue fever) may migrate to this area, potentially causing major public health problems.<sup>39</sup> In summary, we assume that the area's environment is negatively affecting human health, although a more comprehensive comparative risk analysis would need to be conducted to support a less qualitative and more quantitative statement of the degree to which human health is actually threatened.

The general environment is also under siege. Centuries of development, although mostly agricultural, have converted most of the land in the MNRA from wilderness to human use. This development, along with roads, fences, and bridges, has fragmented the remaining ecological areas. Agricultural development up to the edge of the Nolichucky River has also damaged riparian ecosystems. Agricultural runoff and soil erosion have had negative effects on aquatic life. Invasive species, such as those mentioned above, are threatening indigenous species in the river and forests. Climate change threatens to completely destroy existing ecosystems.

The residents of the MNRA are cognizant of the human health and ecological impacts of the environmental issues mentioned above, but also of very high concern is the protection of their area's aesthetic and cultural characteristics. Uncontrolled development, spreading from the two major cities in the area, Greeneville and Johnson City, threatens the attractive agricultural landscape. Predicted climate changes promise more frequent and more severe storms and increased flooding, which imperil many low-lying historic structures. Additionally, acid precipitation has been eating away at many historical structures. Agricultural

runoff and soil erosion have degraded the aesthetic qualities of the river. Invasive species, especially kudzu, are interfering with aesthetics as they cover trees, fences, telephone poles, and other structures with dense vine formations.

Economic services derivable from the MNRA environment are also at risk. Increased development has amplified demand for water. The closing of wells has cut off one source of drinking water. Climate change may actually result in a drier climate, thereby reducing water for human use, and agricultural uses as well. Even if precipitation increases, rain may occur in more concentrated periods of time, thereby having less than optimal impacts on river water levels and the groundwater tables. Soil erosion continues to degrade the quality of the agricultural lands. Climate change may actually result in decreases in agricultural productivity for some crops (such as soybeans, if the dry scenario comes to pass).<sup>40</sup> Uncontrolled development, invasive species, inability to save historical structures, and substantial increases in daily heat indices may also have a negative effect on tourism in the area.

In summary, the various environmental problems listed previously are posing major threats to human health and the environment. Threats to the area's cultural heritage and economic well-being are also real and related to environmental issues.

## Environmental Plan for the Middle Nolichucky River Area

The project team based its approach to the creation of a comprehensive environmental plan for the area on the three major guidelines:

- **Build a Sustainable Economic Base:** The Friends were clear in their belief that the area's character could not be maintained without a strong economic base. The agricultural base has been suffering for many years. Losing that base would lead to a string of undesirable consequences, such as conversion to subdivisions and dirty industry, which would then lead to irreversible changes in the area. Thus, innovative thinking was needed to improve the economic base in the face of tough agricultural times without damaging the traditional agricultural landscapes of the area.
- **Respect the Area's Aesthetics and Culture:** The Friends' top desires were to maintain the area's traditional agricultural landscapes and rural, east Tennessee culture. That they have articulated this desire through the need for an environmental plan is interesting and telling;

there are no other types of plans that take into account the broad needs of this community.

**Respect the Area's Environment:** The concept of "environment" is broad in this context. The environment encompasses local viewsheds and agricultural landscapes. It encompasses the Nolichucky River and its riparian boundaries. It encompasses the small wetland where a migrating whooping crane landed in the not too distant past. It encompasses forested housing lots and the nearby Cherokee National Forest. It also encompasses concerns for terrestrial and aquatic species.

There is no simple approach to meeting the principles set out above while addressing the many environmental problems described earlier in this article. The plan outlined below is decidedly multi-faceted, more so than is found in typical comprehensive plans or more classical environmental plans that focus only on forests or parks. The plan's elements are designed to be as integrated as possible.

#### Built Environment

One main element of the environmental plan for the MNRA relates to the built environment. Structures and infrastructures need to harmonize with the environment, culture, and other aspects of the plan. An obvious major goal in this regard is the preservation of key historical structures. In the Chuckey area in particular, there are several houses, inns, a railroad station, and a bank building that are all deserving of preservation. It is recommended that these structures be renovated with cultural tourism in mind. For example, the houses and inns could be renovated as bed-and-breakfasts. The other buildings could house historical artifacts and educational centers. It is further recommended that information, nature, and agricultural centers be built in this area and that all the centers be connected via a greenway system. In this way, visitors could enjoy the area's natural beauty by walking from center to center. It is recommended that this area be automobile free, with frequent tram service for those unable to walk the "circuit."

It is recommended that a festival center be established near the river and on the greenway system. The area could draw upon the fame of one of its illustrious ancestors to establish "Davy Crockett Days," a month-long series of events and activities paying tribute to the frontier history of the area. A more ambitious plan would be to establish a "Crockettville Initiative" to support the development of permanent attractions and programs associated with the

life and times of Davy Crockett. Activities such as concerts celebrating the rich musical heritage of the area, horseback riding tours creating linkages to the United Methodist "circuit riders" of the early nineteenth century, and reenactments of historic events in locations such as Chuckey, Greeneville, and Rheatown would provide links to the area's rich cultural past while increasing the tourism base. Efforts should be made to integrate green building designs (discussed below) and minimize the increase of traffic into historic areas through the use of park-and-ride facilities with free or minimally priced tram or trolley service.

#### Natural Environment

It is recommended that various natural environment amenities be integrated along with the built environment and greenway system. For example, wildlife corridors should crisscross the area. Wildlife corridors "preserve rare landscape elements and associated species" and "retain large contiguous or connected areas that contain critical habitats."<sup>41</sup> As a first priority, the riparian areas adjacent to the Nolichucky River need to be rehabilitated to suit the movements of local wildlife and act as a corridor to the Cherokee National Forest. Over the longer term, the wildlife corridors need to be integrated into a regional system of corridors linking the region's main protected areas.

It is also recommended that a new, multi-hundred-acre wetland be constructed near the river on converted agricultural land. The wetland would be home to numerous species of birds, native grasses, fish, shellfish, and other life forms. The wetland would be a major attraction in its own right along the greenway system. Bird-related activities alone are a \$20 billion industry in the US, with over 60 million participants.<sup>42</sup> The wetland would also provide economic benefits. Wetlands create new natural habitat for waterfowl, fish, and shellfish.<sup>43</sup> Finally, the wetland could also serve as the area's natural wastewater treatment system, as is the case in several municipalities in Kentucky.<sup>44</sup> An example of a community designed around a natural amenity like a wetland is Prairie Crossing, Illinois.<sup>45</sup>

An extensive program is needed to promote native species. Natural landscaping needs to be the rule rather than the exception. Natural grasses could be planted in fallow areas to increase land suitable for wildlife habitats. Additionally, efforts dealing with invasive species such as kudzu and Japanese honeysuckle need to redouble. The planting of

grasses and plants native to northeastern Tennessee, such as upland bent grass, flattened oak grass, red and sugar maples, and various native ferns, may serve the dual purposes of inhibiting the spread of exotic and invasive species as well as reflecting and encouraging regional natural resource heritage.<sup>46</sup>

### 21st Century Agriculture

Agriculture is central to this community's heritage. The picturesque farms are the foundation for the area's aesthetic qualities. Thus, much attention needs to focus on preserving this aspect of the community. As discussed in detail below, agriculture should be integrated into the tourism business. One or more agricultural education centers should be built in the area and located on the greenway circuit. Also on the circuit should be several working farms, each with its own agricultural focus. Visitors could stay in the local inns or even in rooms on the farms. Their days would consist of lectures and hands-on farm work.

It is also clear that agricultural practices are having a negative impact on the area's water, air, and soil quality. Each working farm needs to adopt best practices to reduce agricultural runoff, use of pesticides and herbicides, and the impacts of animal wastes. It can be assumed that organic farms would be attractive to visitors. Consideration could be given to expanding the wetland to facilitate rice farming.

When traditional agricultural products face heavy international competition, one strategy is to search for new products and markets. The MNRA is actually well suited to several alternatives to traditional beef cattle. For example, ranchers could raise elk, which consume only about one-third as much grain as beef and dairy animals.<sup>47</sup> Another potential substitute for beef cattle is bison, which can adapt to hot and cold climates and the inhospitable weather of the Southeast, and which have a longer reproductive life than cattle. Yet another alternative is beefalo, a hybrid species that is three-eighths American Buffalo and five-eighths domestic cattle. Beefalo are lower in fat, cholesterol, and calories than traditional beef.<sup>48</sup> Markets for these alternative products are growing and would also be attractive to working farm visitors.

### Sustainable Technologies

One key to creating an environmentally sustainable community will be the incorporation of green building

designs<sup>49</sup> and sustainable technologies. As sustainability becomes an increasingly important element in community design, a myriad of ecologically friendly elements are being designed for incorporation into new and existing development. Ranging from green elements for buildings to environmentally friendly paving materials and vehicle fuel sources, a number of green design elements may be incorporated into the MNRA plan.

Starting at the top, the various proposed centers may incorporate "greenroofs."<sup>50</sup> Greenroofs are similar to roof gardens but do not require as much maintenance. The primary function of any roof is to provide shelter from the elements, specifically water. Greenroofs are just as functional as conventional roofs, but are more economically efficient and ecologically responsible. Having greenroofs on buildings helps to reduce energy and maintenance costs. They also provide a natural form of insulation that can cut cooling costs by up to 30%. This, in itself, is an incentive given both the forecast temperature increases and the relatively warm climate of northeastern Tennessee that requires homes and businesses to spend more per year on cooling than on heating. Although the initial cost of greenroofs is higher than conventional roofs, they will pay for themselves in the long run by significantly reducing energy expenditures. Such roofs may be incorporated into the proposed integrated information, agricultural, and cultural centers and can be integrated into the wildlife corridor concept.

Ecologically, greenroofs provide responsible stormwater management, remove pollutants from rainwater, and reduce heat-reflecting surfaces that contribute to urban heat island effects. Additionally, any water that runs off of a greenroof can be harvested and stored in aboveground cisterns (this technology can be used with or without greenroofs). Water that is stored in cisterns can then be pumped into a house or building and used for flushing toilets, watering plants, or any other water needs that do not require potable water. If it is not feasible to pump the water into a home or building, the water stored in cisterns can be used for irrigation purposes. This facet of greenroofs would effectively address many of the problems faced, given either of the precipitation scenarios associated with climate change.

With an increased number of tourists flocking to the area to experience the sights and sounds of "Crockettsville," a considerable amount of parking will be needed. If a conventional route (i.e., using impermeable surfaces such as asphalt or concrete) is chosen to meet parking needs, some unwanted consequences may be faced in the



future. Given the projected climatic changes in the Southeast, coupled with an increase of impermeable parking surfaces, more negative effects such as erosion of river banks due to fiercely flowing floods, increased loss of topsoil, and higher concentrations of pollution running into the waterways from an increased number of cars visiting the area may be experienced.

New “green parking” technologies should be integrated into the MNRA to mitigate the negative environmental effects caused by traditional parking measures while providing adequate parking for the increase in visitors. Such technologies as Grasspave or TurfGrid<sup>21</sup> provide environmentally sound forms of parking, as their structures are designed to allow for stormwater infiltration, as well as the planting of various grasses to help reduce the heat island effect associated with traditional blacktop parking lots. Any new parking facilities should be located at the outer edges of the MNRA to encourage walking or the use of public transportation and to minimize the amount of traffic near the river. The extension of walking and horse trails to hub locations such as parking lots and tourist centers will provide additional means of transportation in the MNRA.

The provision of public transportation alternatives will prevent the MNRA from suffering traffic congestion problems similar to those experienced in east Tennessee’s Gatlinburg/Pigeon Forge area. Such problems could even be worse in our study area because the narrow, winding roads that lend character to the area are not designed for high volumes of traffic. Public transportation in the area should be fuel-efficient and as clean as possible to reduce locally the emission of air pollutants.

#### Climate Change Mitigation

Climate change has the potential to devastate this community. More and more severe weather events promise even more extensive flooding. Global warming could significantly harm local flora and fauna and make the area more hospitable to tropical diseases. Also, as mentioned above, rising heat indices could have a significant impact on older persons and children in particular. Plans need to be developed now to deal with all these problems.

With respect to flooding, the community should consider moving historical structures now sited in the flood plain to safer locations. Also, the community needs to become

more actively involved in discussions about the future of the Nolichucky River Dam. Because the dam is so silted up, the river now backs up more frequently and is causing flooding farther and farther upstream. An increase in frequency and magnitude of extreme weather events will only exacerbate flooding associated with the dam. Actions to lower or even remove the dam, as considered in a recent environmental impact statement,<sup>52</sup> need to be considered and strongly advocated by the community. A program to help low-income older persons afford air-conditioning in the summer months needs to be considered. Finally, local, state, and federal public health officials need to monitor the area to identify the invasion of tropical diseases and deal with them before they become epidemics.

In-depth ecological studies are needed to assess the impact of global warming and changes in precipitation on the area’s environment. Does it make sense to try to maintain the existing local flora and fauna? If not, will residents be able to conceptualize that the aesthetics of their area will change and visualize a new aesthetic character for the area? Will certain crops that are attuned to today’s climate fail in the future? Which crops are more likely to succeed? These questions and others that arise will require further examination as more becomes known about the consequences of rapid climate change, especially as it affects precipitation. In the meantime, measures should be taken to assess various decision alternatives and their abilities to function under different climate change scenarios.

#### Land Use Controls

The success of the integrated environmental plan described above is greatly dependent on the community’s ability to control the uses of land. It has been implicitly assumed that landowners do not want to sell their land to developers or firms wishing to locate new (and most likely polluting) manufacturing facilities in the area. It has also been assumed that the farmers would cooperate in the development of the greenway system, the new wetland, and the working farms. These are a large number of assumptions, probably too many; over the long term, without some more formal means of controlling land uses, there is little hope that land uses will conform to the vision set out above.

There are numerous methods used to control land use. Zoning is the most frequently implemented method. Other methods include land trusts, conservation easements, transfer development rights, and outright purchases of land by municipalities to prevent development.

It is suggested that the MNRA community focus on developing a land trust for the most aesthetically important agricultural lands and on obtaining conservation easements for the greenway system and wildlife corridors. The trust could hold the easements. Additionally, the trust or another community nonprofit group should purchase the historical structures and land for the various centers. Firms could be given contracts to manage all these facilities.

The above approach does not rely on zoning, chiefly because zoning is not as effective in the long run as are these other methods. The history of zoning in the US has seen zoning ordinances crumble in the face of political considerations, and history could repeat itself in this community. Another reason is that neither Washington nor Greene counties currently have zoning ordinances. A substantial, multi-year, problematic effort would be needed to enact two countywide zoning ordinances with the hope that the results would be favorable to the MNRA. The community's efforts probably could be better spent on building the land trust, gaining conservation easements, and raising money for key purchases of open land and historical structures.

#### Political Activism

It is unfortunate that the community cannot tackle all of its environmental problems on its own. But such is the case with air pollution, in particular. The already serious problem of acid precipitation and the growing problem of tropospheric ozone are problems largely beyond the jurisdictions of Washington and Greene counties. Reducing acid precipitation requires better enforcement of existing Clean Air Act regulations, which is the responsibility of the federal and state governments. Reducing ozone requires the reduction of emissions of nitrogen oxides from the transportation sector and volatile organic compounds from industry, again the responsibilities of the federal and state governments. Thus, communities like the MNRA must become active lobbyists for better enforcement of existing regulations and promulgation of more stringent environmental regulations if they hope to protect their local environment.

#### Funding

The proposed tourism and sustainable building design initiatives advocated for the MNRA will require a substantial amount of fiscal outlay. Though many of the centers and designs will eventually pay for themselves through increased revenues from tourist dollars and mitigation of negative environmental impacts, the initial costs may appear somewhat overwhelming. There are, however, a

number of grants and loans available that may be applied for to offset the costs of various phases of implementation.

Given the cultural nature of the proposed tourism initiative, one possible grant that may be applied for is the National Endowment for the Arts (NEA) "Partners in Tourism: Culture and Commerce" grant. The grant is made through a partnership of the National Endowment for the Arts, the Institute of Museum and Library Services, and the President's Committee on Arts and the Humanities. The purpose of the grant is to fund cultural tourism initiatives that are sustainable, promote cultural integrity, and involve the community's citizens. A grant of this nature could assist with the opening and running of the community's cultural center, as well as help with the revitalization and renovation of Chuckey and other areas.<sup>53</sup>

A grant-making program that is specifically directed toward agricultural tourism is the US Department of Agriculture Rural Development Program.<sup>54</sup> This program is designed to improve economic development in rural areas, and funds may be targeted toward programs that enhance research, education, and extension initiatives. In some cases, money from this program has been used to educate farmers about agricultural tourism activities, as well as to help set up and implement tourism plans. Because of the nature of agritourism, it will most likely be necessary for workshops and other practical educational methods to be offered to help inform area farmers of the opportunities available.

In terms of ecotourism, the North American Commission for Environmental Cooperation provides a fund designed to carry out the broad goals of this multinational organization, including the linkage of environmental, social, and economic issues, as well as the involvement of community members in bringing funded projects to completion and fruition. A number of ecotourism projects have been funded through this program, including education and infrastructure work to help rural communities connect to a broader network of ecotourism efforts.<sup>55</sup>

Another program to consider is the National Resource Conservation Service Environmental Quality Incentives Program (EQIP), which is designed to provide information and technical and financial assistance to farmers and ranchers in order to promote the effective and sustainable use of water, soil, and other natural resources. Such information will be vital for any ecotourism or agritourism initiatives.<sup>56</sup>

A number of grants may be applied for to provide information and assistance on the construction of greenways. One such fund is the Kodak American Greenways Award, which concentrates primarily on greenways that link natural areas, historic sites, parks, and open spaces. Given the connected nature of the "Crockettville" initiative, such a grant, providing awards in the range from \$500 to \$2500 per project, would be most effective in the commencement of such a system. Another grant that falls within this area is made through the Tennessee Parks and Greenways Foundation.<sup>57</sup>

Finally, a general grant that may be used for a number of different areas is the US Department of Agriculture Rural Community Development Initiative. Funds are granted to rural areas for use in undertaking housing, community facility, and community and economic development projects. Grants are awarded for a minimum of \$50,000 and a maximum of \$1 million.<sup>58</sup>

## Lessons Learned and Conclusions

Integrated environmental, community-based planning will become more common in the future and may come to dominate environmental practice. This is so because many people see "the environment" as an organizing principle for a broad range of quality-of-life issues, especially in rural and lightly developed suburban areas. We found that the Middle Nolichucky River area suffers from myriad environmentally based problems, more numerous and more pernicious than we had expected. Additionally, the community's cultural heritage and aesthetics are also under siege. The environmental plan presented above attacks these problems in many ways. The central theme is the environment; protecting the environment can preserve the area's aesthetics and be a source of sustainable economic development.

Overall, the Friends of the Nolichucky River were pleased with the process and results of this project. The plan includes many ideas they had not considered and it offers an integrated approach to dealing with the area's environmental issues. The process appears readily transferable to other contexts.

Other than some progress in the area of conservation easements on farms and consideration of the "circuit rider" idea, it cannot be said that this project has led to many positive outcomes in the area. Several reasons underlie this conclusion. First, the Friends organization does not have extensive political power and operates in

two different counties. Prominent politicians do not belong to the group. As a nonprofit group, the organization does not have ready access to governmental financial resources. Thus, it has been hard for the group to achieve political objectives and acquire financial resources to implement aspects of the plan.

Second, the group has had to fight another "environmental crisis," this time the proposed siting of a nuclear fuel reprocessing facility in an adjacent community. Dealing with this issue diverted attention away from the plan. Finally, it should be mentioned that the plan's discussions and elements dealing with climate change have not had much traction with the group, at least so far. This is not an unexpected outcome, given the group's crisis focus and current limited abilities to drive local public policy, which itself may not be amenable to the consideration of longer-term issues.

In retrospect, the project team could have been more aggressive in distributing the plan to elected officials, planners, federal employees, and other prominent people in the area. The University of Tennessee, Knoxville, could also have been more aggressive in attempting to help the Friends implement ideas found in the plan. On balance, though, it was not our responsibility to do either of these things without being asked. The lesson we have learned is that working with nonprofit, activist groups may take time, patience, and a long-term perspective.

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