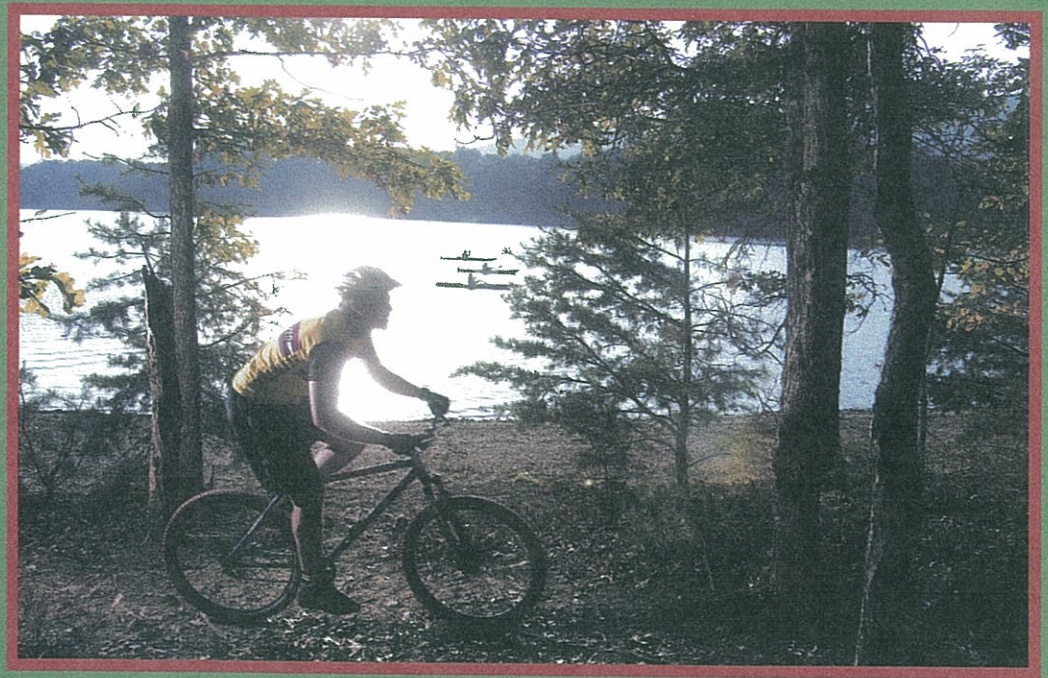
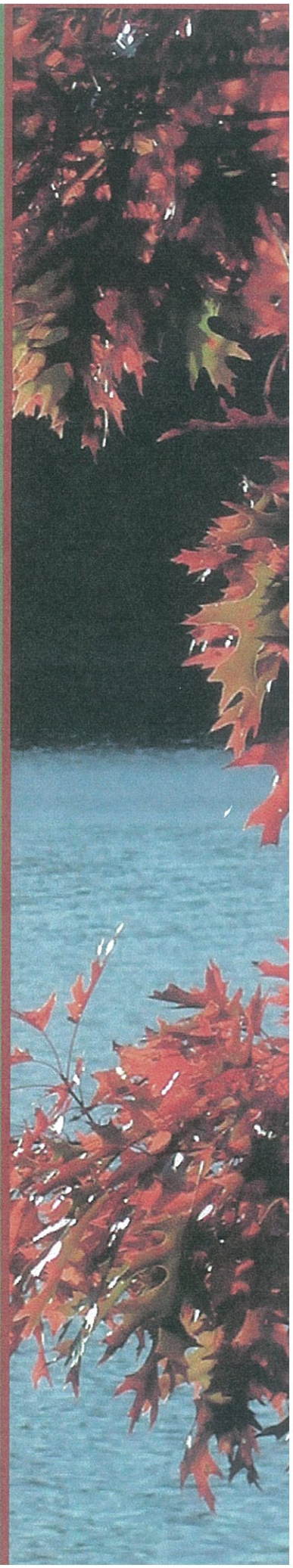
Carvins Cove Natural Reserve Park Management Plan





Western Virginia Water Authority

Roanoke Parks and Recreation

Carvins Cove Natural Reserve
Park Management Plan

Adopted
The Council of the City of Roanoke, Virginia

As Submitted by:
Roanoke Parks and Recreation

December 17, 2007

Executive Summary

This report is the result of a cooperative effort between the City of Roanoke Parks and Recreation Department, Western Virginia Water Authority, and the Carvins Cove Advisory Committee to update the 2000 Carvins Cove Land Use Plan and develop suitable policies for managing the unique natural and cultural resources of Carvins Cove Natural Reserve (the Cove). At 12,463 acres, the Cove is the second largest municipally owned and managed park in the United States, and the largest east of the Mississippi River. The 630-acre Carvins Cove Reservoir supplies approximately 45 percent of the drinking water used by the City of Roanoke and Roanoke County. Carvins Cove Natural Reserve is located north of the City of Roanoke, in Roanoke and Botetourt counties, just seven miles from Downtown Roanoke.

Staff from Roanoke Parks and Recreation and the Western Virginia Water Authority met periodically with an ad hoc Advisory Committee between March 2006 and November 2007 to determine future park planning needs and make recommendations for park management. The result of these efforts is a set of Resource Management Zones (RMZs) for the Cove and associated management goals, guidelines and actions, all of which are detailed in this report. Overall, recommendations call for expanded recreational facilities and programs at the Cove, executed in an environmentally sensitive manner that maintains water quality and the integrity of natural habitats found in the park.

Five RMZs have been designated at Carvins Cove Natural Reserve, based on physical, biological, and cultural resources found on the site (Figure 17). Management Zone 1, the Recreation Development Zone, lies closest to the Water Authority property (land below the 1200-foot contour) on the gentlest slopes found at the Cove. Future development of sustainable recreation facilities would take place in Management Zone 1. Conversely, the most sensitive resources for which the most stringent protection is recommended are found in Management Zone 2. Any additional recreation development in Management Zone 2 would have to be very carefully considered to minimize impacts to sensitive resources. Management Zone 2 occupies the ridges of Tinker and Brushy Mountains and abuts the Appalachian National Scenic Trail (AT). Management Zone 3 is the Low Impact Recreation Zone. Zone 3 serves as a transition between Zones 1 and 2. Two overlay zones that are aligned with certain linear features in the park are also delineated. Zone 4 is the Cultural Resources Zone, and it is represented as a 100-foot buffer along either side of the Fire Road on the northern edge of the reservoir. Old home sites and cemeteries are found in and alongside Management Zone 4. Finally, a riparian buffer, a minimum of 50 feet on either side of all tributaries, wetlands, and groundwater seeps in the park, comprises Management Zone 5, the Riparian Protection Zone. These RMZs serve as a framework for all future actions within the Cove.

Specific management goals, guidelines, and actions for park management have been developed and documented in this report. Parkwide management issues of water quality protection, forest management, wildlife resource management, compatible recreational opportunities, user amenities and infrastructure, and public education opportunities are the focus of the management goals, guidelines, and actions.

Together, the RMZs and management goals, guidelines, and actions move the City of Roanoke forward in its goal to create a sustainable, regional outdoor recreation destination at the Cove. Next steps for realizing this vision are also documented in this report. These include development of a Park Facilities Master Plan (to be added as an appendix to this document) that will include planning to address visitor experience and interpretation, site development, forest management, and trails. Ongoing planning and management by Roanoke Parks and Recreation, as detailed in the citywide Parks and Recreation Master Plan, addresses recreational programming, business planning, and capital development planning, and Carvins Cove Natural Reserve is currently included in this planning and budgeting process. As recreational facilities and programs are expanded at the Cove, Roanoke Parks and Recreation will continue to update its programming and budgeting to accommodate future changes.

The opportunities presented by Carvins Cove Natural Reserve for water supply protection, regional ecological conservation, and outdoor recreation are tremendous. The responsibility to manage it wisely is equally substantial. The City of Roanoke has owned all of the land in the Cove for over 60 years, but it has only recently begun to consider what active management of this resource entails. The multi-step planning process initiated with the 2000 Land Use Plan and this report move the City forward in its quest to responsibly steward this resource for all of the residents of the Roanoke region. Continued movement forward in the planning process and specific, direct management actions, like road and trail maintenance, are needed now as demands for the use of this resource rise. With careful decision making, as recommended in this plan, future generations of Roanoke residents will also sing the praises of this spectacular place.

Acknowledgements

The City of Roanoke would like to thank the following individuals for their contributions to the Carvins Cove Ad Hoc Advisory Committee. The commitment of an Advisory Committee and staff to the development of a sound management plan for Carvins Cove Natural Reserve is greatly appreciated. The Cove is a tremendous asset for the citizens of the City of Roanoke and surrounding jurisdictions, and this plan will serve to guide the future of the Cove for years to come.

Advisory Committee

Liz Belcher	Roanoke Valley Greenways
Bob Boeren	Virginia Department of Forestry
Jim Bowman	Virginia Department of Game and Inland Fisheries
Ted Coffman	USDA Forest Service
Rupert Cutler	Western Virginia Water Authority
Peter Givens	National Park Service
Roger Holnback	Western Virginia Land Trust
Dan Lovelace	Virginia Department of Game and Inland Fisheries
Robert Manetta	City of Roanoke Planning Commission
Teresa Martinez	Appalachian Trail Conservancy
Dennis McCarthy	Virginia Department of Forestry
Gary Robertson	Western Virginia Water Authority
Janet Scheid	Roanoke County Department of Community Development

Project Staff

Margaret Bryant	Virginia Polytechnic Institute and State University
Ursula Lemanski	National Park Service
Steve Buschor	City of Roanoke Parks and Recreation
Donnie Underwood	City of Roanoke Parks and Recreation

The mission of the Carvins Cove Advisory Committee has been to assist in the development of a multifaceted management plan for the protection and enhancement of Carvins Cove Natural Reserve. The Committee served as an advisory group, providing recommendations to the City of Roanoke Parks and Recreation Department, Western Virginia Water Authority, and ultimately to the Roanoke City Council and adjacent county Boards of Supervisors, in the development and implementation of the plan. The Committee also served as an open forum for sharing information, building networks, and increasing awareness and understanding of resource management issues.

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The 12,463-acre Carvins Cove Natural Reserve (also referred to as the Cove) would be a jewel in any city's park system. Roanoke, Virginia proudly claims this park as its own. It is the second largest municipally owned and managed park in the United States, and the largest east of the Mississippi River. The Cove contains the 630-acre Carvins Cove Reservoir which supplies approximately 45 percent of the drinking water for the City of Roanoke and Roanoke County. Hardwood and mixed pine-hardwood forests cover over 11,000 acres of the Cove. Carvins Cove Natural Reserve is located north of the City of Roanoke, in Roanoke and Botetourt counties, just seven miles from Downtown Roanoke (Figures 1 and 2).

A vital piece of Western Virginia's green infrastructure, Carvins Cove Natural Reserve is connected to national, state, and local trail systems. Four miles of the Appalachian National Scenic Trail (AT) are located on City-owned land (through an easement held by the National Park Service), and eleven additional miles are contiguous to the Carvins Cove property. Carvins Cove is in the viewshed of the AT for 15 miles, with critical viewpoints at McAfee's Knob (the second most photographed spot on the AT), Hay Rock, Angel's Gap, and Tinker Mountain. Over 40 miles of multi-use trails are located within the Cove itself. The partially complete Tinker Creek Greenway will connect Carvins Cove directly to the center of Roanoke and, through the City's greenway network, to Mill Mountain, the Blue Ridge Parkway, and the rest of the Roanoke Valley greenways. Clearly, Carvins Cove Natural Reserve is a park of regional significance and also significant as part of the Eastern United States ecological network. It is the intention of Roanoke Parks and Recreation to sustainably manage this unique park while also sensitively developing facilities that enhance its role as a nationally significant outdoor recreation destination.

The purpose of this Management Plan is to develop management goals, guidelines, and actions that will allow continued and enhanced recreational and educational use of Carvins Cove Natural Reserve. The Management Plan also seeks to create a framework that ensures protection of the natural and cultural resources that make this park so unique and critical to the long-term health of the region. The plan's development has been aided significantly by the work of the Carvins Cove Advisory Committee that met over the course of 1½ years between spring 2006 and fall 2007 to contribute their expertise on management issues and future compatible recreational development of the Cove. The Management Plan builds on the Carvins Cove Land Use Plan, prepared by Whitesell Orrison Inc. in 1999 and adopted by Roanoke City Council in 2000, by further developing the landscape inventory and by designating Management Zones and associated policies.

1.1 Ownership

Ownership of Carvins Cove by the City of Roanoke began in the 1930s. The Virginia Water Company began construction of a dam on Carvin Creek in 1926. Ten years later, the incomplete reservoir project became the responsibility of the Roanoke Water Works when it purchased the Virginia Water Company. In 1938, the City of Roanoke purchased all land held by Roanoke

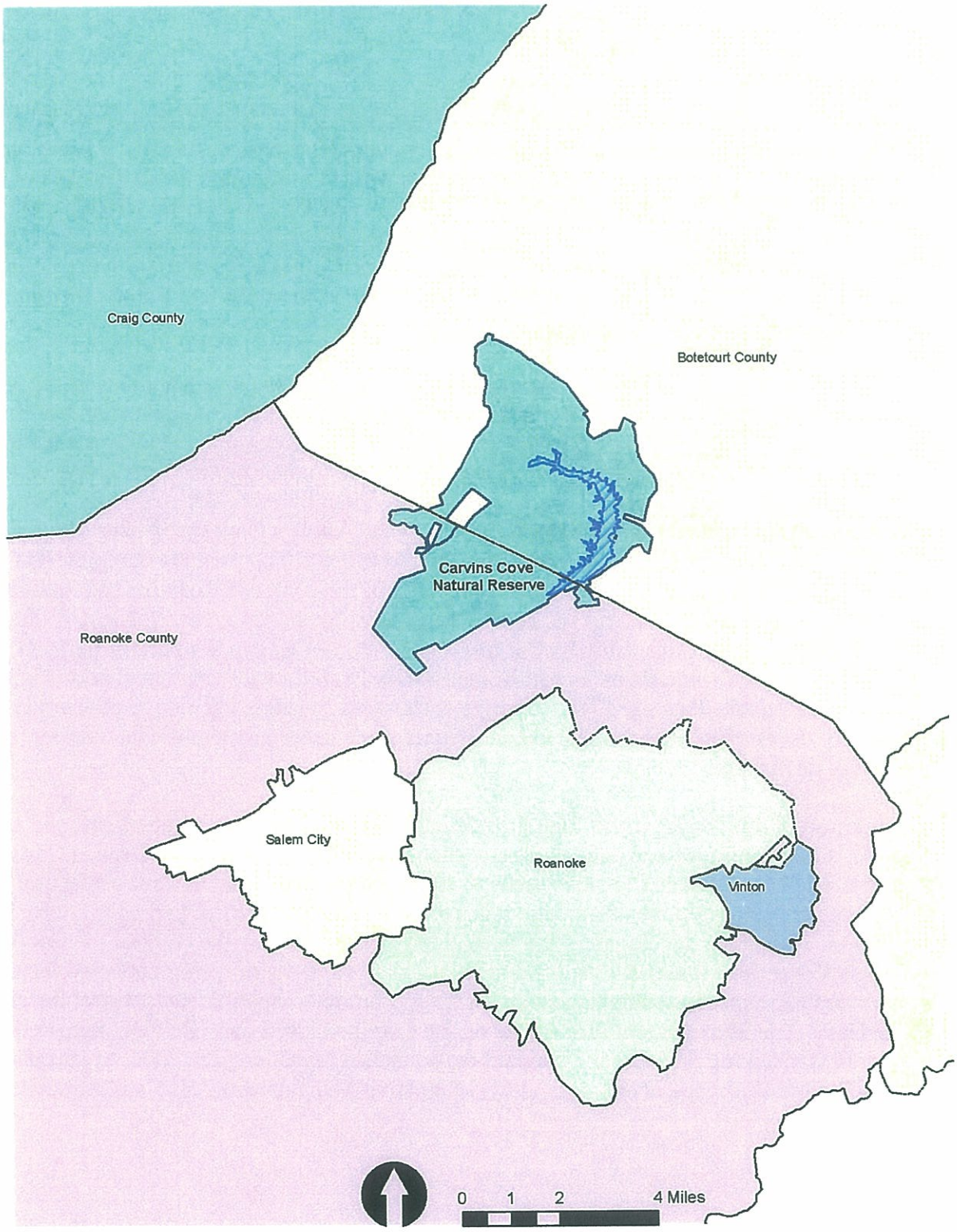

Figure 2. Local government jurisdictions

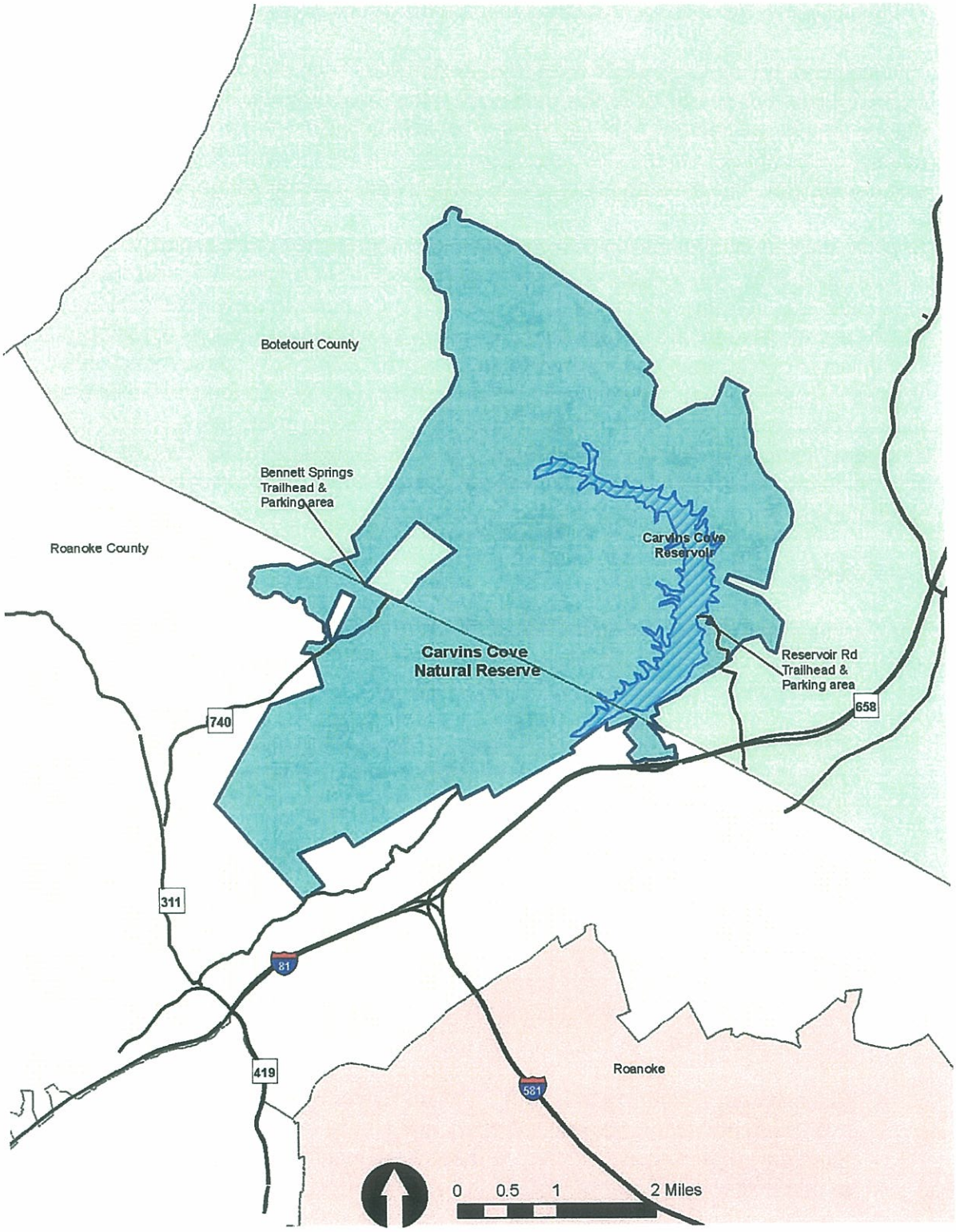

Figure 1. Location map

Water Works. By 1944, the City had secured all of the remaining private Carvin Creek land holdings needed for reservoir construction, and the reservoir project was completed in 1946.

The land comprising Carvins Cove Natural Reserve has been owned by the City of Roanoke for over 60 years. For nearly all of this time period, the Cove property has been managed for water quality almost exclusively, although limited recreation has been permitted. The custodial management approach to the Cove watershed has preserved a naturalized forested landscape and, at the same time, has not actively overseen the growing recreational use of this resource.

In 2004, the City of Roanoke and Roanoke County established the Western Virginia Water Authority, and the Water Authority assumed ownership of Carvins Cove Reservoir (the lake itself) and land holdings below the 1200-foot contour (approximately 1100 acres of the total 12,463 acres). Also in 2004, Roanoke Parks and Recreation was given responsibility for over 11,300 acres of Carvins Cove land, the land above the 1200-foot contour. Since 2004, the Western Virginia Water Authority and Roanoke Parks and Recreation have cooperatively managed the park land, with the Water Authority performing some management activities such as security patrols. This Management Plan will serve as a guide for the City as it seeks to actively manage multiple uses of this recreational and conservation resource of national significance.

1.2 Planning Principles

The Carvins Cove Advisory Committee drafted a set of guiding principles and/or planning assumptions that have been used as organizing concepts for the development of this plan. The guiding principles for plan development are as follows:

1. The primary purpose of the Carvins Cove Natural Reserve is protection of the municipal watershed to provide a safe, potable water supply to over 137,000 area residents and businesses.

2. Carvins Cove Natural Reserve contains a high level of biological diversity and will be managed in a manner that protects and enhances ecosystem benefits and functions.

3. Compatible outdoor recreation and educational uses and activities will be encouraged to promote the health and well being of area residents and visitors, and these uses and activities will be managed in a manner that supports ecosystem management and water quality objectives.

4. Management recommendations for Carvins Cove will be scientifically based using best available knowledge, proven standards, and advice of natural resource management and planning professionals, and they will be supplemented by additional research and study as outlined within the appendices.

5. The City of Roanoke and Western Virginia Water Authority will manage the resources of Carvins Cove using a collaborative process that fosters interjurisdictional cooperation and participation by the public.

1.3 Public Opinion Survey

In the spring of 2007, an update to the City of Roanoke Parks and Recreation Comprehensive Plan was completed by Leon Younger & PROS. As part of the update, National Service Research conducted a telephone survey of 500 randomly selected City of Roanoke residents in January 2007. Two of the questions in the survey pertain to the development of outdoor recreation at Carvins Cove. In one question, survey respondents were asked to rank the relative importance of eight different "actions" the City could take to "improve and expand Parks and Recreation facilities" (Comprehensive Plan Update 2007). Respondents ranked the following action as equal in importance to the other highest ranked action, developing walking and biking trails:

Develop Carvins Cove Natural Reserve as a signature park for the City.
41.3 percent of respondents ranked this action as "very important."

The survey also included a question about the types of recreational facilities that should be developed at Carvins Cove. Figure 3 shows a graph of the responses.

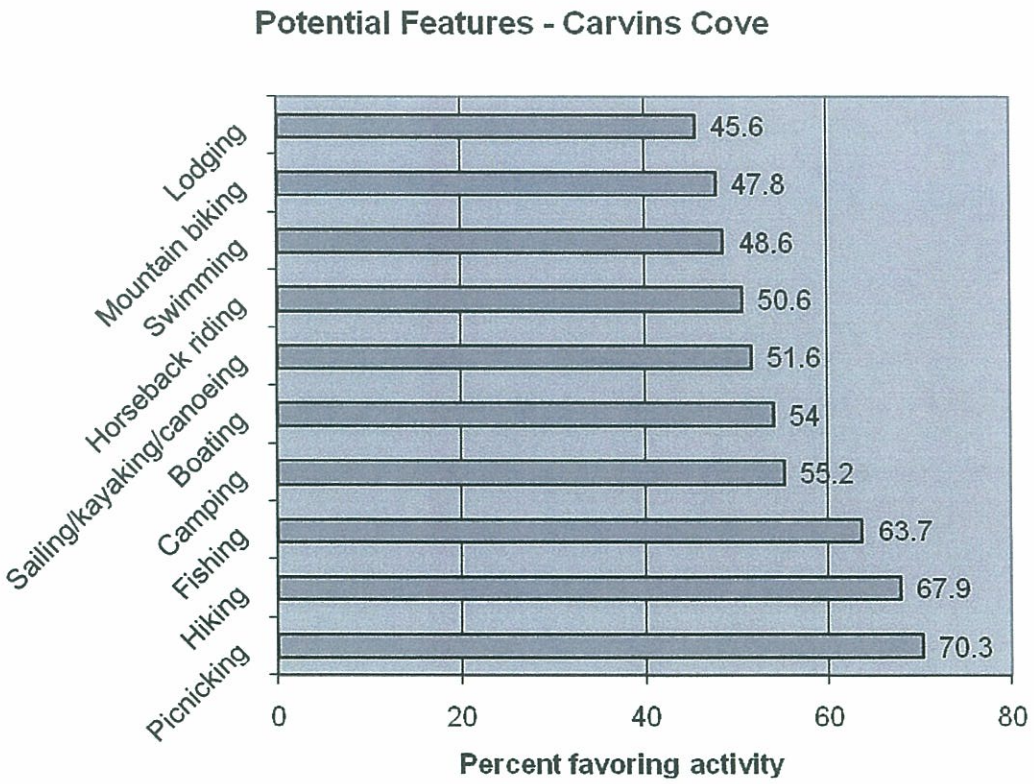

Figure 3. Telephone survey results for possible future recreational development at Carvins Cove

1.4 Organization of This Report

If Carvins Cove Natural Reserve is to become a major outdoor recreation destination for Roanoke and the surrounding region, what changes need to take place to accommodate increased use? How will Roanoke Parks and Recreation determine which of the many possible recreational activities suggested by the public can and should be offered at Carvins Cove? How should the park be managed to provide recreation while also protecting water quality and the forest ecosystem? This comprehensive planning tool begins to answer these questions by building on the information developed earlier in the 2000 Land Use Plan and extending the analysis further to identify specific management zones and corresponding management goals and guidelines. The report also identifies future studies, such as a Trails Plan and a Forest Stewardship Plan, that should be carried out before the park can truly become the sustainably managed park envisioned by the citizens of Roanoke. Another vital step in the planning process will be to develop a Park Facilities. This Management Plan provides the framework that will link more detailed plans and studies that will be conducted as needs arise and funding becomes available.

This Management Plan has four main sections: a resource inventory summary, a discussion of the main park management issues relevant to Carvins Cove, designation of resource management zones (RMZs), and a list of specific management goals, guidelines, and actions.

Section 2. Resource Description

The Carvins Cove landscape is strikingly beautiful. Two mountain ridges, Tinker Mountain and Brushy Mountain, provide dramatic sight lines rising above the crescent-shaped Carvins Cove Reservoir (Figure 4). Fifteen miles of the nation's premier footpath, the Appalachian Trail, skirts the western and northern boundaries of Carvins Cove Natural Reserve. According to the Appalachian Trail Conservancy, this section is consistently ranked by through-hikers as one of the favorite and most beautiful sections; therefore it is critical to protect and maintain the integrity and beauty of this national trail corridor as well as establish viewshed protection criteria to be incorporated into the future trails management plan and/or future conservation regulations for The Cove.

Carvins Cove is unique because it contains all aspects of a complete watershed system. The mountain slopes and ridges, perennial and intermittent streams, ephemeral wetlands, and the reservoir itself combine to create diverse wildlife habitats. In many ways, Carvins Cove exemplifies the best of the natural beauty of the region, combining both land and water resources. Some of its value lies in its size alone – over 12,000 acres of forest land and water in one contiguous block, serving as potential habitat for forest interior dwelling species. Current trends in land development mean that remaining intact habitat like this is becoming increasingly rare and therefore important. Parkland status could mean protection of this land for years to come, but that protection is only assured by adoption of specific land management policies by the City of Roanoke, as detailed in this report.

The most obvious legal and legislative purpose of Carvins Cove is protection of one of the main water sources for the City of Roanoke and Roanoke County. The value of the natural reserve goes beyond water quality, though, because of the park's overall benefit and significance to the region as a whole. It has the potential to become one of the Commonwealth's premier recreational resources, offering outstanding opportunities for hiking, birding, kayaking, biking, and picnicking. Creative and alternative outdoor recreation pursuits should be explored, either quiet and intuitive or dramatic experiences filled with excitement, are all possible here. The Cove is also a potential site for watershed research by faculty and students from local colleges and universities. Due to the low intensity of human activity at the site over the past 60 years, the watershed environment has developed into a healthy and diverse woodland ecosystem.

2.1 History of the Property

The Carvin Creek valley was inhabited by Native Americans long before Europeans settled there in the 1700s. The natives of this region in general were most likely Siouan Tribes comprised of the Tutelo, Saponi and, toward the New River, the Mohetan. Which particular tribespeople originally inhabited the Carvins Cove area is not known, but archaeological evidence of their life in the valley has been found and recorded by the Virginia Department of Historic Resources.

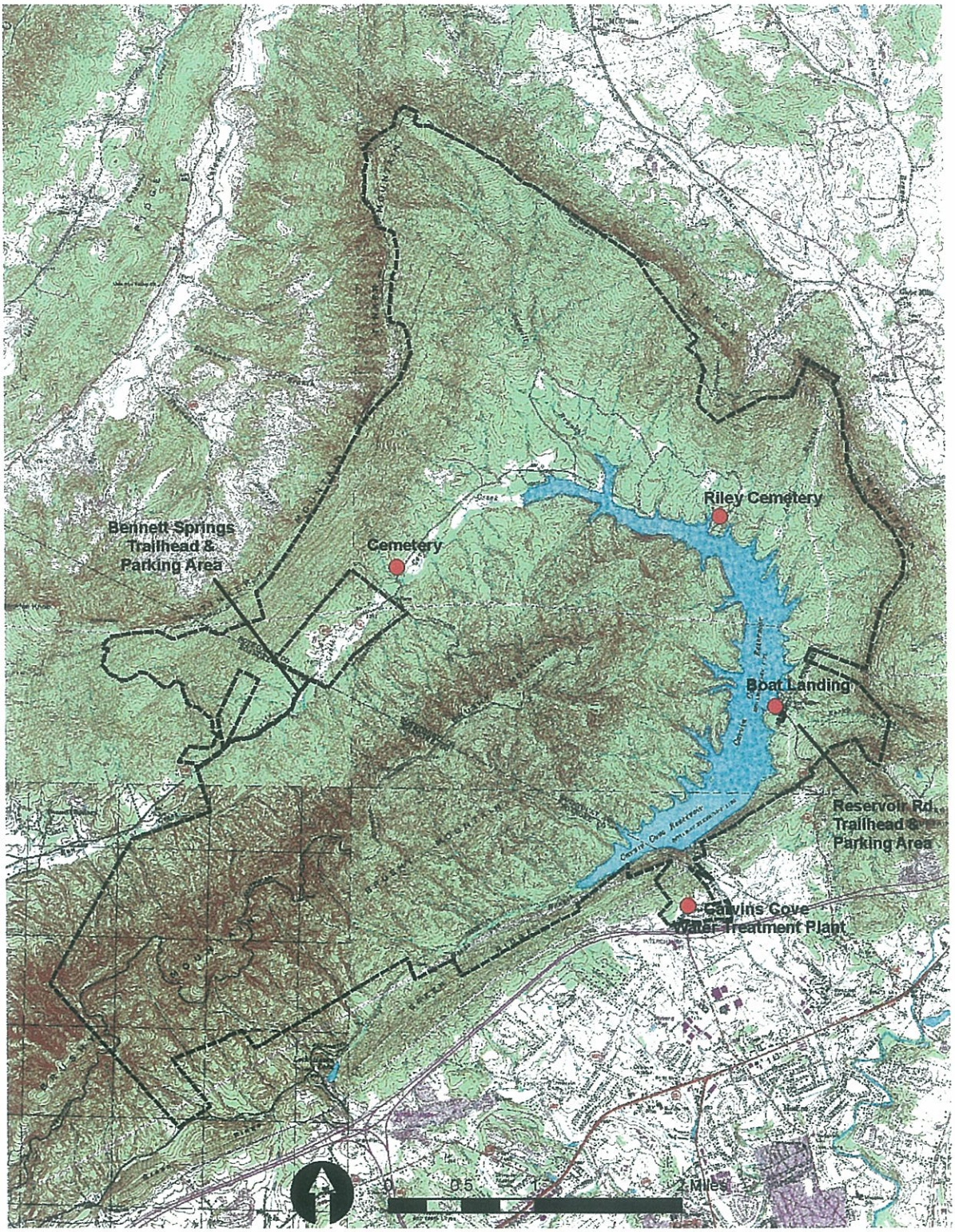

Figure 4. Existing site features – USGS quad map

Recorded history of Carvins Cove begins in 1746 when William Carvin settled on 150 acres of land along Carvin Creek. This land is currently owned by Hollins University. Carvin is remembered as a colorful character. One story tells of Carvin jumping from a cliff above a waterfall into a pool below (at the present location of the dam on Carvins Creek) to escape pursuing native tribesmen. William Carvin was a pioneer settler in the Roanoke Valley, and he acquired up to 1500 acres of land along the water bodies that now bear his name. In 1762, his land was willed to his son, William Jr., and was later divided into farms and sold. The area above the falls became known as Happy Valley. In the early 1800's James P. Riley built and operated a grist mill below the falls. Throughout the years, 35 to 40 families lived and worked in the Cove; the Rileys, Reedys, Laymans, Tinnells, Pollards, Guslers, Boards and Dogans are among those noted in local histories. The community grew to support a two-room schoolhouse, three cemeteries, and Cove Alum Church, established in 1867. Old Cove Road paralleled Carvin Creek; it was the spine along which most of the development in Happy Valley took place.

In 1926, the Virginia Water Company began construction of a dam across Carvin Creek at the falls with plans for a reservoir in the Cove. By 1928, a concrete dam had been constructed. Roanoke Water Works purchased the Virginia Water Company and, consequently, the incomplete reservoir project in 1936. Two years later, the City of Roanoke purchased all land held by Roanoke Water Works. By this time, some residents of Happy Valley had already sold their land to the water company, and others would later sell to the City, while reluctant residents like M.C. Dogan waited for the City to condemn their land in 1943. One resident, Cecil Riley, deconstructed his family's nine-room house to rebuild it on Peter's Creek Road. In February 1944, the last remaining buildings at Carvins Cove were auctioned off. On May 17, 1946, water spilled over the dam for the first time, indicating that the reservoir was full. (The reservoir stores 6.4 billion gallons of water at full pond.) The water treatment plant was completed in the same year. Many of the old home sites were submerged when the reservoir was filled.

To increase the water supply to Carvins Cove, the City cut two tunnels through Tinker Mountain to divert water from Tinker Creek and Catawba Creek to the reservoir. The tunnel from Tinker Creek opened in 1966 and is estimated to add, when open, approximately 5 million gallons of water daily (MGD) to the 10 MGD yield of Carvin Cove. The tunnel from Catawba Creek opened in 1973 and is estimated to provide another 5 MGD when open, making the total yield 20 MGD for all three watersheds that drain into the reservoir. The Carvins Cove Water Treatment Plant normally treats 11 to 18 MGD per day.

2.2 Regional Context

The significance of Carvins Cove Natural Reserve as a nature conservation area is established, in part, by its context (Figure 5). A large block of publicly owned land, the Jefferson National Forest, lies both to the northwest and to the east of Carvins Cove, following the southwest-to-northeast-trending ridgelines of the Ridge and Valley Province. The nearby National Forest land is part of the 1.8 million acre George Washington and Jefferson National Forests, one of the

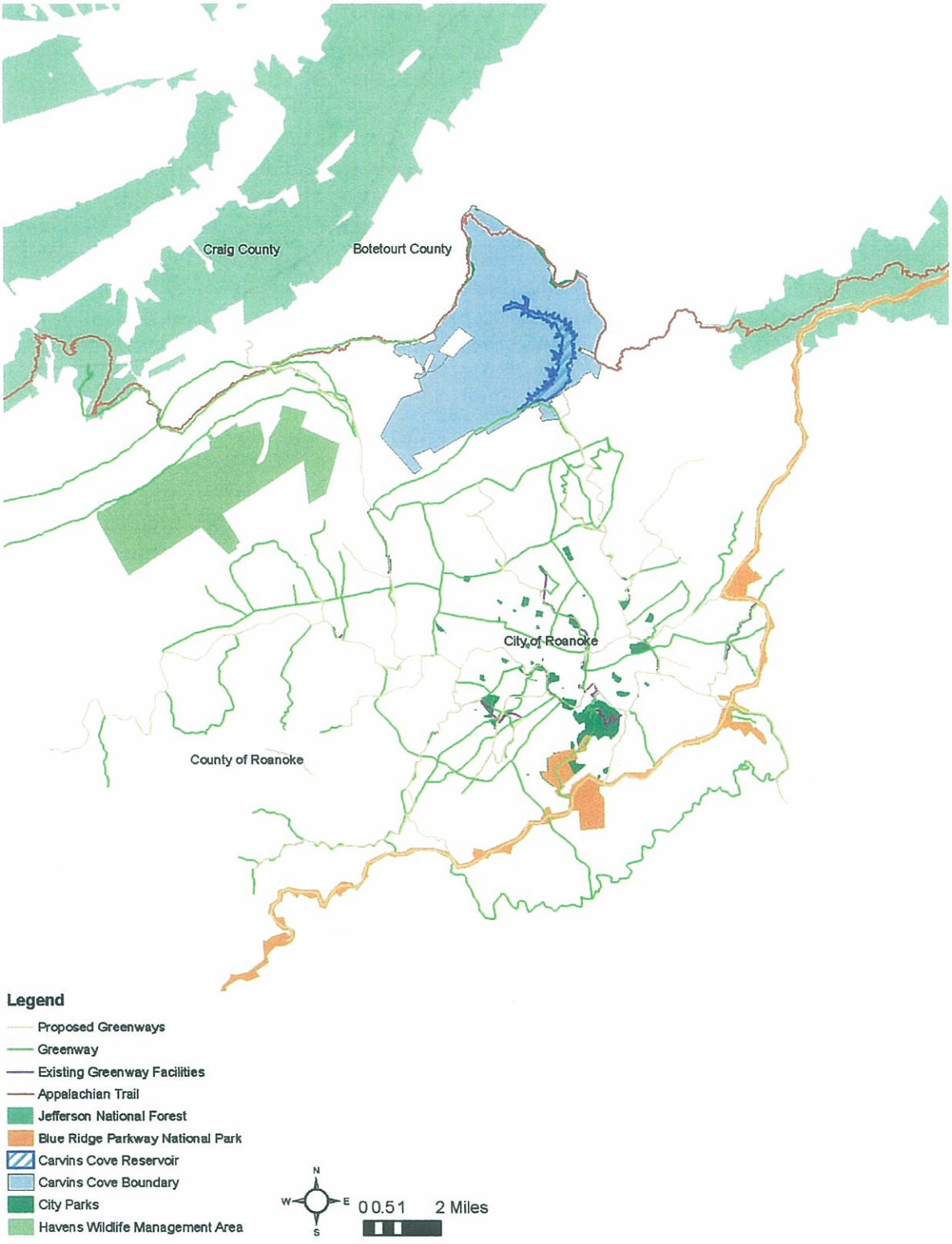

Figure 5. Regional conservation land

largest publicly held land holdings in the Eastern United States. Another large protected area, the state-owned 7190-acre Havens Wildlife Management Area, lies near the Cove's western edge. The Appalachian Trail lies along the western and northern edge of the park, and the Blue Ridge Parkway connects with Jefferson National Forest to the east.

From a landscape ecology perspective, The Cove serves as interior forest habitat, something that is in increasingly short supply given typically fragmented land development patterns and suburban sprawl. Carvins Cove functions as a habitat hub and potential link in a regional conservation land network. This role could be strengthened through additional land conservation efforts to create physical linkages of protected land (advocated by the Virginia Department of Conservation and Recreation) to bridge gaps between Havens Wildlife Management Area, Carvins Cove Natural Reserve, and the Jefferson National Forest, while also connecting the Tinker Creek Greenway corridor, Mill Mountain, and the Blue Ridge Parkway. Such connections facilitate the movement of large mammals, such as the black bear, from one protected area to another. Local land trusts, the Virginia Outdoors Foundation, and state agencies should make these linkages a priority for future easement acquisition.

Another aspect of the regional context is the existing role that Carvins Cove plays in terms of regional recreation. In particular, the Cove is widely recognized among mountain bike enthusiasts as having some of the best trails in Southwest Virginia. Mountain bikers travel from surrounding states to enjoy a weekend at Carvins Cove.

Regionally, the Cove serves as a major water supply source for the City of Roanoke and Roanoke County, as previously discussed. From the standpoint of public health, safety, and welfare, this is the predominant regionally significant characteristic of Carvins Cove Natural Reserve. Land areas that directly affect water quality in the Carvins Cove Reservoir extend well beyond the City-owned parcel, especially into the Catawba Creek and Tinker Creek watersheds (Figure 6). Water quality protection is a regional concern, and the Western Virginia Water Authority should consider developing a watershed protection plan to address water quality issues that affect Carvins Cove Reservoir. The recommendations contained in this Management Plan take water quality into consideration, but the main emphasis is on park management.

The Carvins Creek portion of the watershed that contributes to the reservoir is approximately 18 square miles in size. The portion of Tinker Creek that is diverted to Carvins Cove is 12 square miles, and the portion of Catawba Creek that contributes to the reservoir is 21 square miles. The spillway elevation is 1170 feet, and the reservoir holds 6.47 billion gallons of water at capacity (Howson 1946).

Figures 7 and 8 illustrate land use/land cover and the road network in the Tinker Creek and Catawba Creek contributing watersheds. Catawba Creek lies in an agricultural valley with limited residential development at the present time. Agricultural activities, like grazing, in the Catawba Creek watershed have the potential to adversely affect water quality in the reservoir. The Tinker Creek watershed presents a different set of concerns given the growing amount of residential development taking place there. Any proposals to limit and/or mitigate water quality impacts originating in the Catawba Creek and Tinker Creek watersheds are beyond the scope of this report.

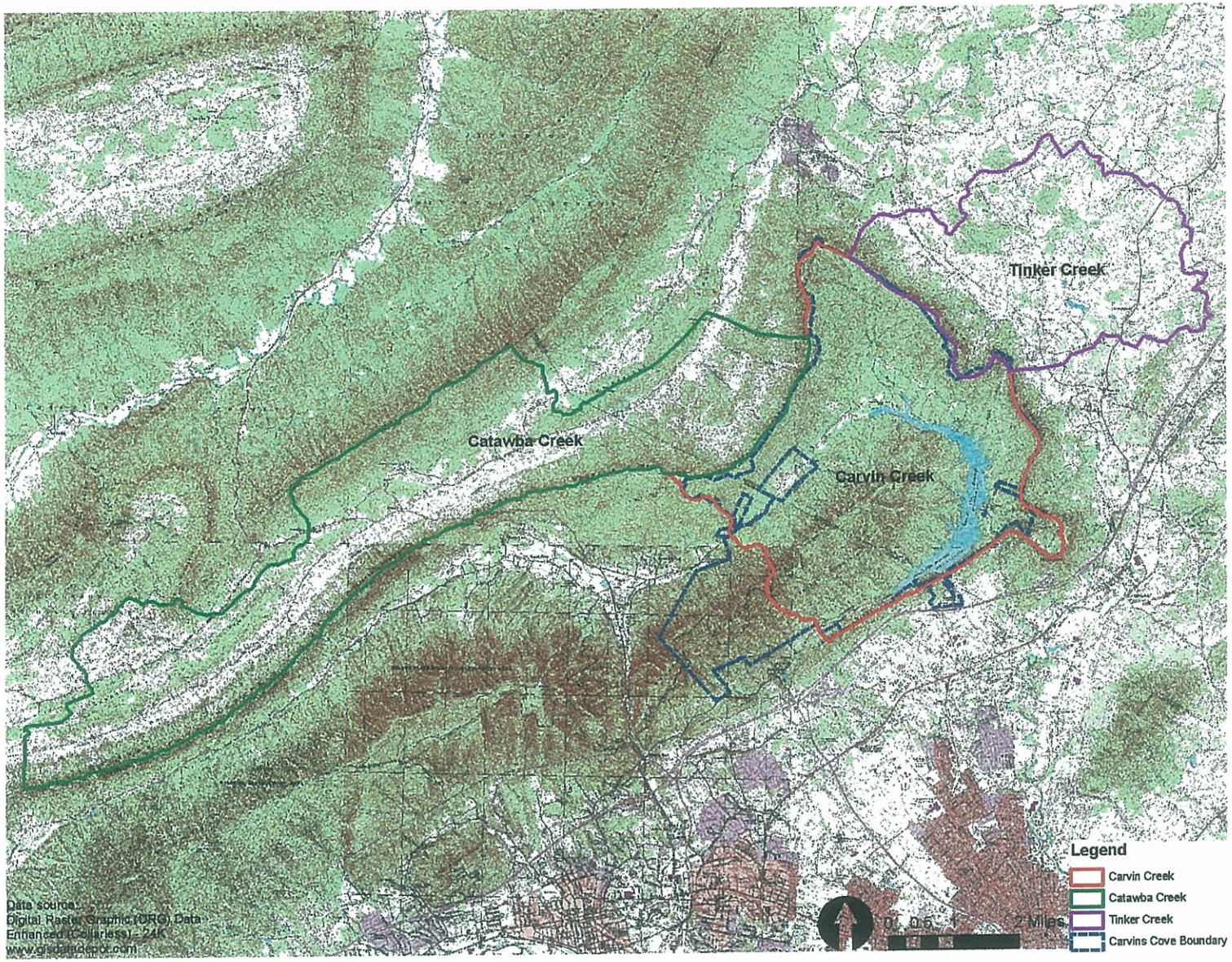

Figure 6. Watershed boundaries

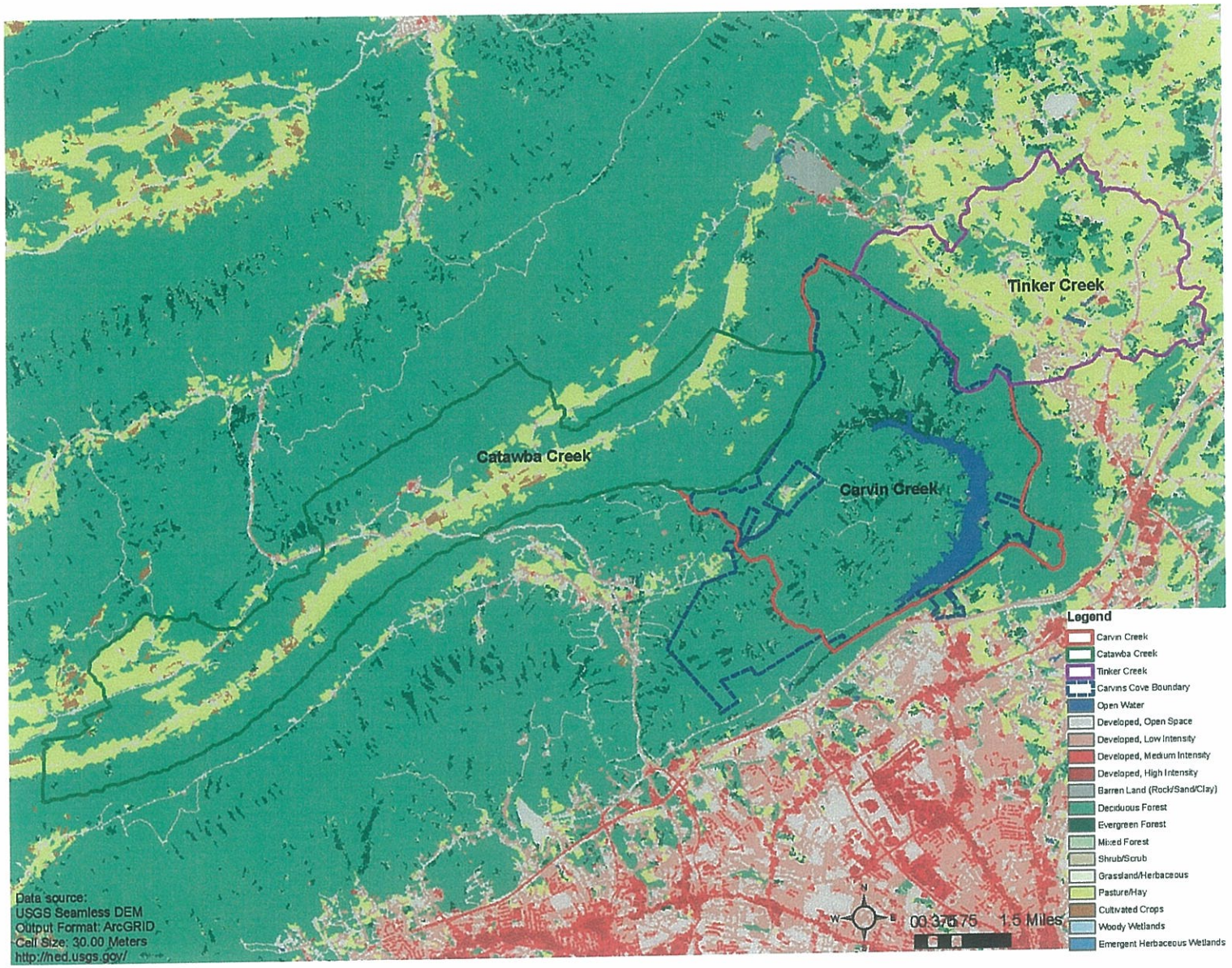

Figure 7. Watershed land use/land cover

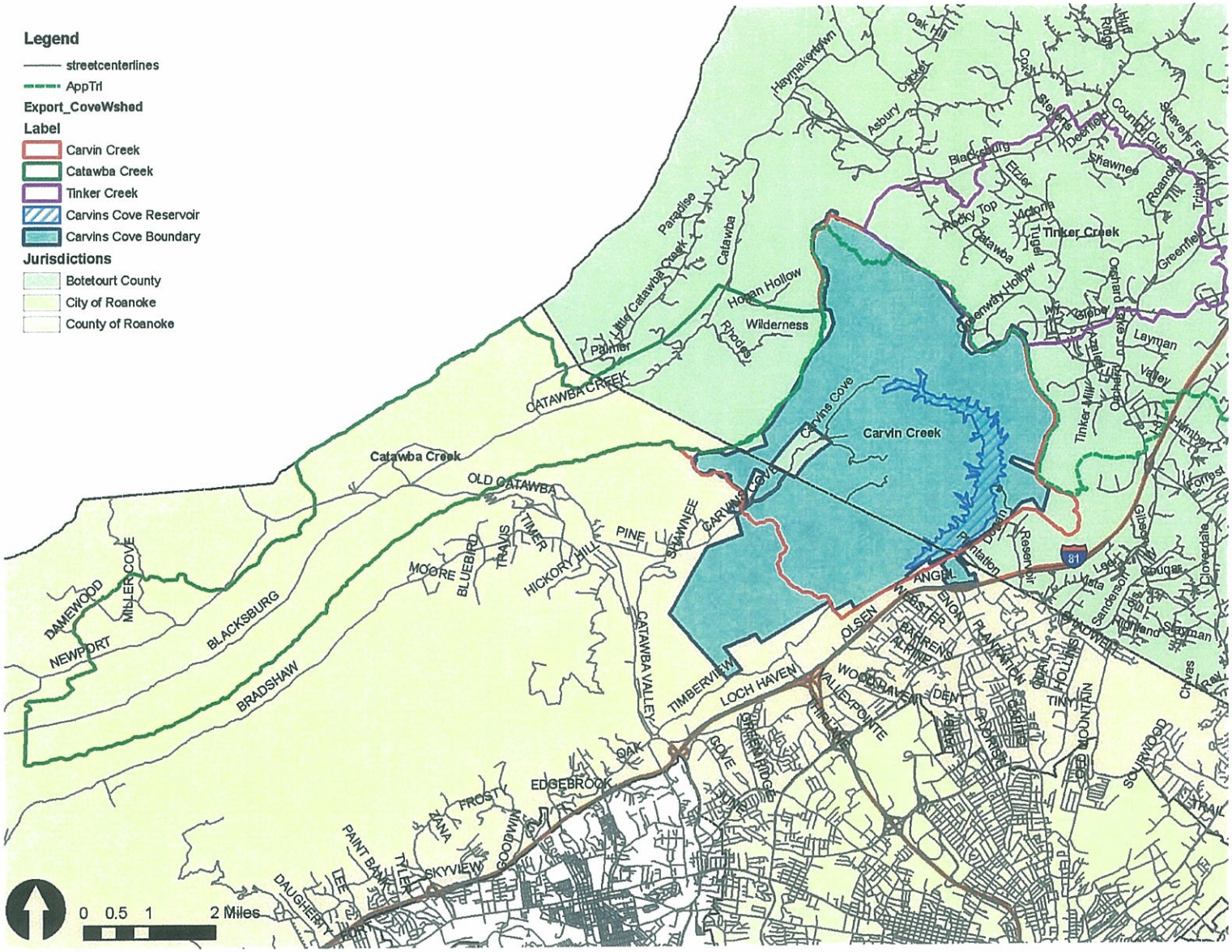

Figure 8. Watershed road network

2.3 Physical Conditions

Carvins Cove Natural Reserve lies in the mountainous terrain of the Ridge and Valley physiographic province. Figure 9 is an aerial photograph that clearly displays the ridgelines of Tinker and Brushy Mountains and the valley containing the reservoir. Important features such as the Fire Road and existing trails are identified on the aerial image. Figure 10 illustrates the elevation change at the park, from approximately 300 meters (990 feet) to over 900 meters (3000 feet). Figure 11 depicts degree of slope, with an emphasis on slopes greater than 30 percent. With a variety of trail activities being the current and likely future use of the mountainsides within the Cove, slope is obviously a critical consideration.

One of the main determinants of physiography is bedrock geology. The geological foundation of Carvins Cove Natural Reserve is characteristic of the Southern Appalachian foreland fold-thrust belt. Bedrock in the area includes sandstone, siltstone, mudstone, and quartz cobble to pebble conglomerate. Sandstone is the most resistant to weathering, and it forms the ridgelines of Tinker and Brushy Mountains.

Hydrology of the Carvins Cove Natural Reserve is shown in Figure 12. The main tributaries into the Cove are Carvin Creek, Horse Pen Branch, and Sawmill Branch. Angell Branch, Rocky Branch, and many unnamed tributaries flow into the main streams and the reservoir itself. The 1999 Team Environmental Quality Resources (EQR) report titled "Carvins Cove Natural Resource Assessment" (Appendix A) states the following about the main tributaries:

Carvin Creek Reach 1

Carvin Creek is the dominant fluvial feature in the Carvins Cove watershed. Above the reservoir, it is a third order stream that flows mainly from southwest to northeast, and drains the western-most third of the City's property. On City property, the stream is crossed once by the main access road, about 0.25 miles inside the Route 740 gate, and typically flows between 250 and 700 feet to the southeast of the road. Reach 1 extends upstream from the crossing approximately 650 feet. …The stream has been channelized for approximately 250 feet upstream of the crossing, with excavated material deposited on the floodplain [which blocks the stream's access to the floodplain]. Upstream of the channelized section, the stream traverses a broad alluvial valley and appears to be very stable. …The transition zone between the stable reach and the channelized segment is somewhat unstable. …The channel appears to have downcut in this transition section, and the cutbank on the south side of the channel is undermined. This area should be monitored, as remedial measures may be necessary to prevent degradation of the upstream reach. …The crossing and channelized stream retard the flood attenuation function of the riparian zones and severely degrade habitat (Team EQR 1999, 5).

Carvin Creek Reach 2

This reach runs downstream from the quad-corrugated metal pipes [road crossing] for a distance of approximately 4000 feet. This stretch of the river flows through a broad alluvial valley, where there is a great diversity of landforms. However, the relatively recent creation

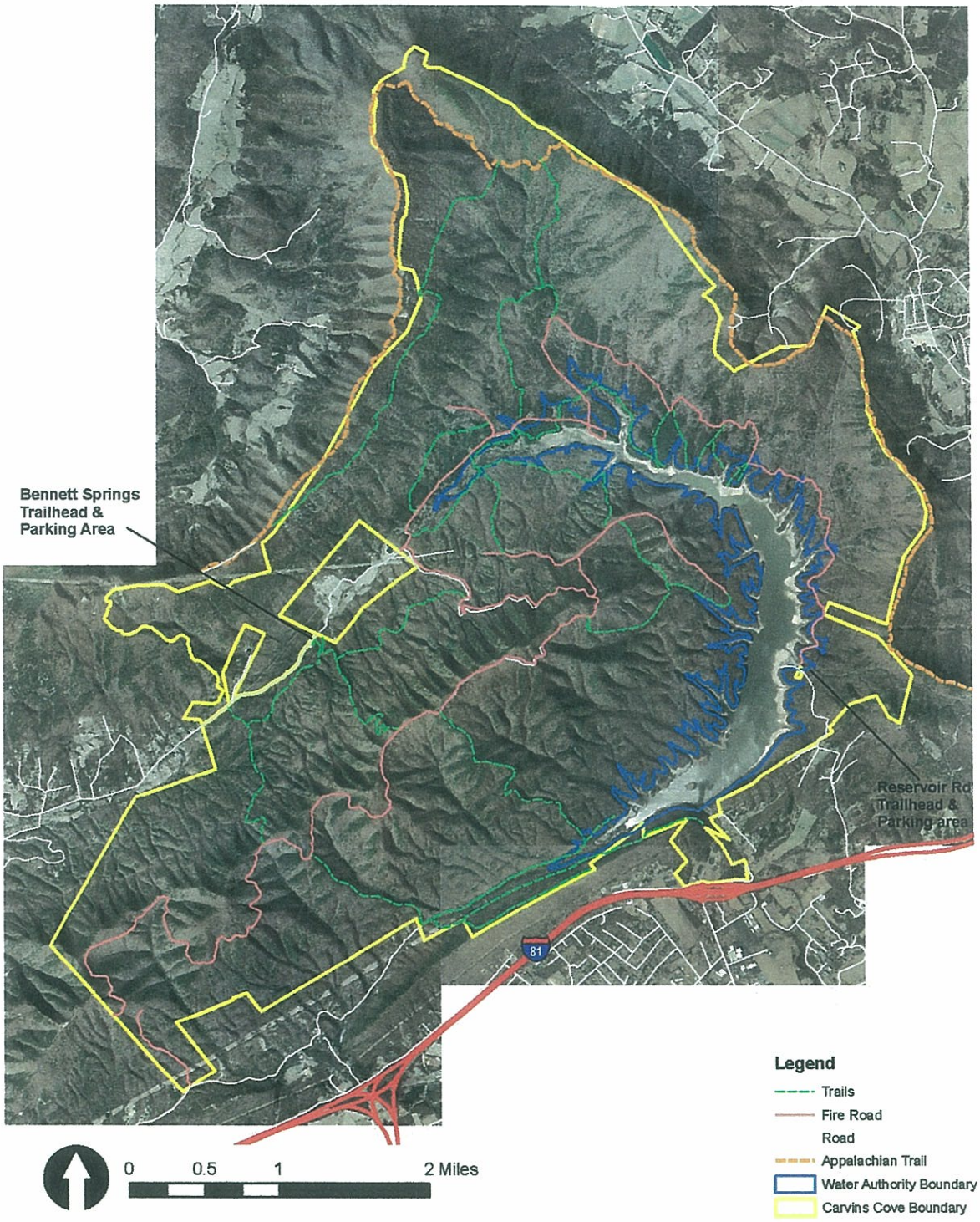

Figure 9. Aerial photograph

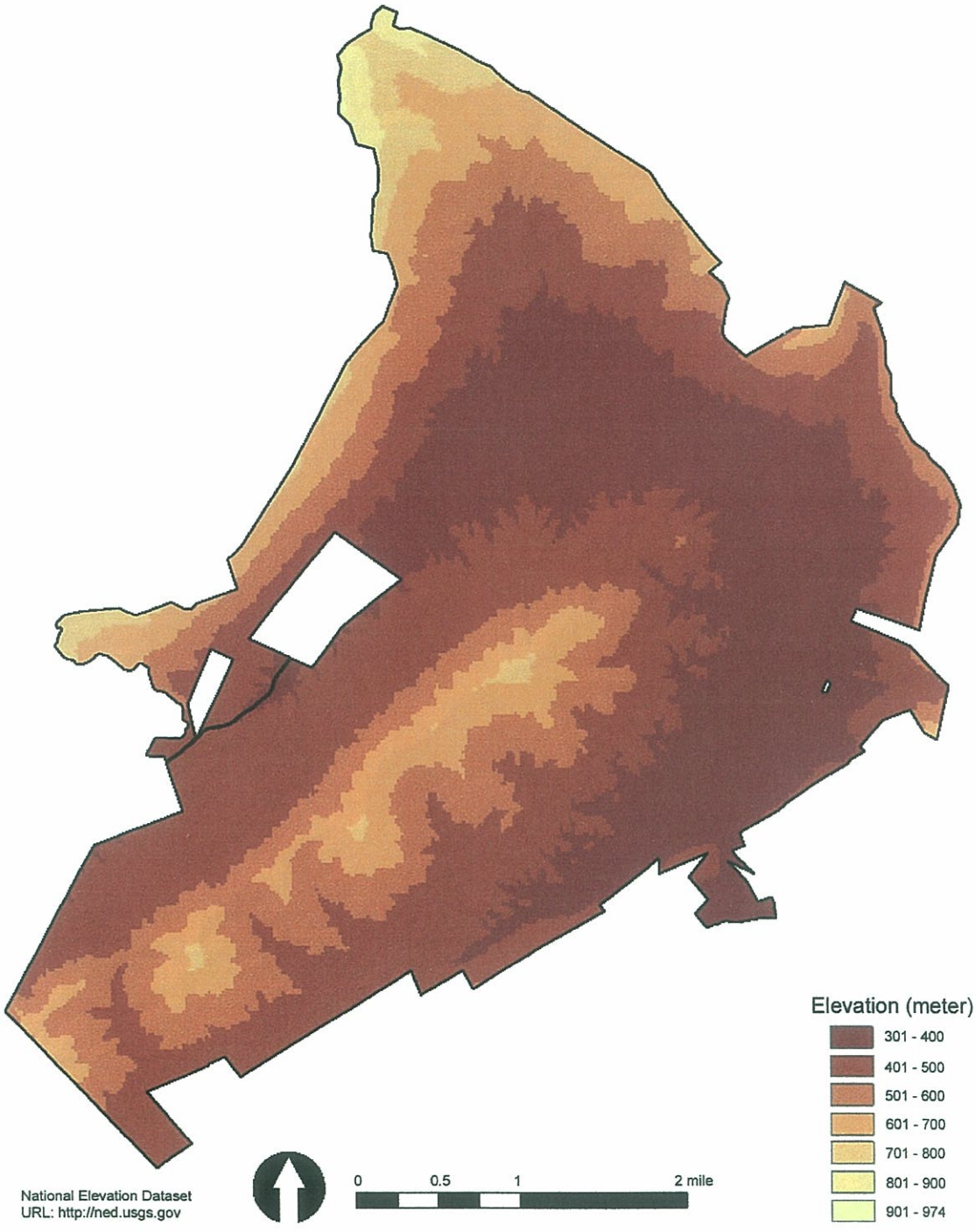

Figure 10. Elevation

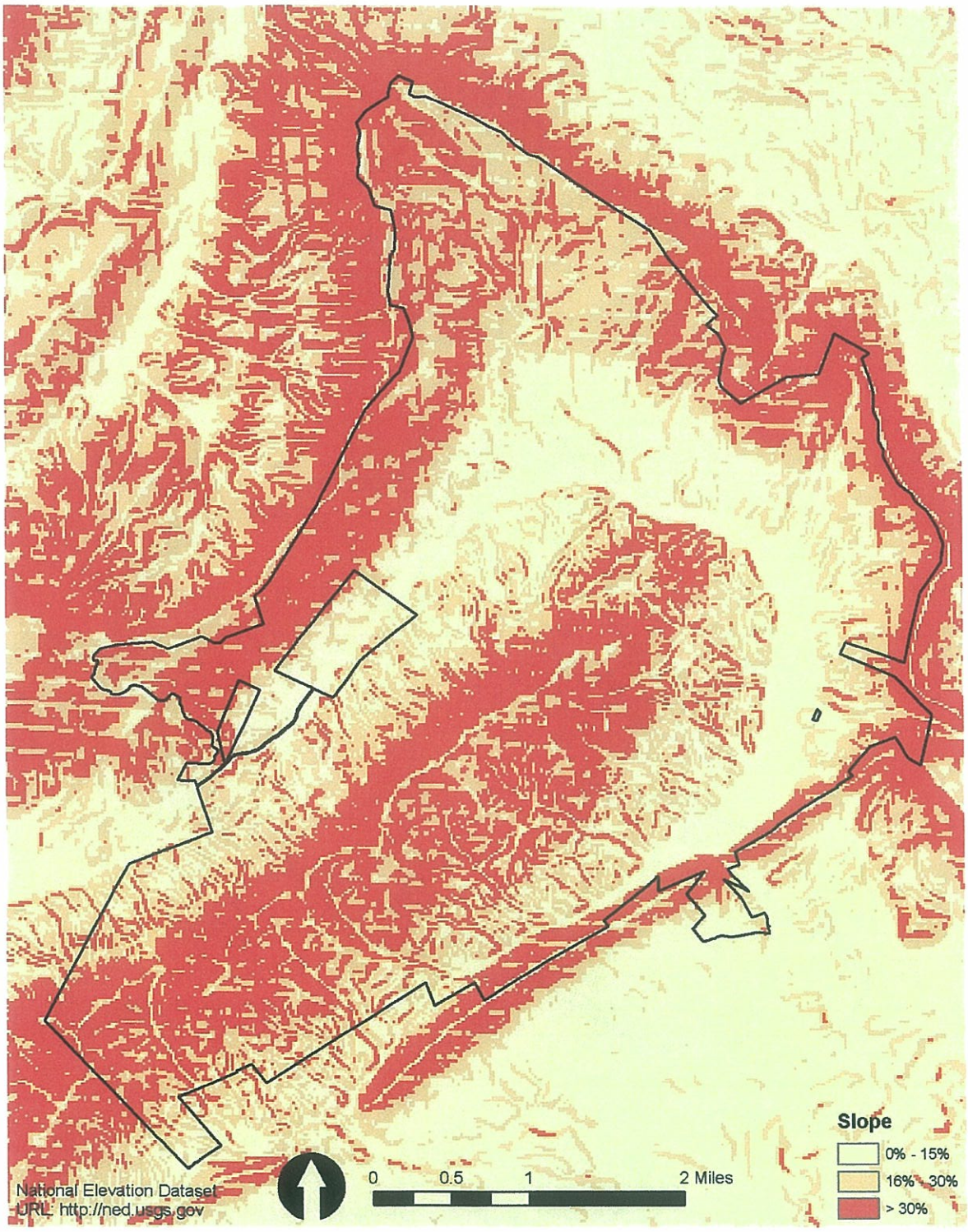

Figure 11. Slope

Figure 12. Hydrology

> of these [in-stream] features indicates that the reach is presently in the midst of substantial channel adjustments. …The absence of significant riffle sections is an indication of degraded habitat conditions.
>
> The causes of channel instability in this reach are complex and a thorough determination requires analysis of the road crossing with correlations to flow events. …Therefore, without human restoration efforts, many years will be required for the stream to re-establish an equilibrium condition. During that time, tons of sediment will be sent downstream, trees will be lost to failing stream banks, and additional aquatic habitat will be impaired (Team EQR 1999, 6).
>
> *Sawmill Branch*
>
> Sawmill Branch is a third order stream that flows into the north end of the reservoir. The catchment includes the northern quarter of the City property, and extends up Tinker Mountain to an elevation near 3000 feet. The basin is rugged and steep, and dissected by numerous first order tributaries. …The prevalence of bedrock and coarse, poorly sorted colluvium [make Sawmill Branch more resistant to erosion than Carvin Creek] (Team EQR 1999, 8). Team EQR studied the concrete box culvert located where the access road crosses the stream channel and determined that there were no indications of channel instability.
>
> *Horse Pen Branch*
>
> The stream flows through the valley between Brushy Mountain and Green Ridge, where the prevalence of bedrock exerts substantial influence on both channel and valley morphologies. Horse Pen Branch is very stable throughout nearly its entire length. …The road interrupts surface flow from Brushy Mountain, and a sizeable gully can be observed along portions of the road's northwest side. …Although no significant adverse impact to Horse Pen Branch could be discerned, this artificial stream could contribute to sedimentation in the lower reach of Horse Pen Branch by reducing stream power.

These excerpts from the Team EQR report are reproduced here to emphasize two main points. The first is the fact that Carvins Cove Natural Reserve cannot be managed in a sustainable manner without a detailed understanding of specific physical conditions on the property. Consultants' reports, like the Team EQR report, are valuable, but only if the detail contained within them is used to direct on-the-ground management, such as repair of the failing culverts identified by Team EQR in 1999. Adequate funding for park management is essential for both gathering such detailed information and acting on it. The condition of culverts throughout the park is one of the major concerns that must be addressed regardless of whether or not recreational use of the park increases.

The second point concerns the way in which physical conditions vary across the Cove property and the associated implications for recreation and increased use. Carvin Creek and its tributaries on the western side of the Carvins Cove property cut through alluvial fill and are prone to erosion and instability. Increased recreation activity on this side of the Cove – near the Bennett Springs entrance – should be designed carefully to mitigate against water quality impacts that

could adversely affect the reservoir. On the other hand, Sawmill Branch and Horse Pen Branch are much more stable stream systems with bedrock control. Even in instances where access roads cross these streams, little adverse impact was observed by Team EQR. More extensive recreational activities in these subwatersheds is unlikely to have adverse water quality impacts on the reservoir, although, of course, new facilities, including trails, in these areas would still need to be properly designed. In all cases, in all subwatersheds, stream crossings either by road or trail need special consideration and design to minimize water quality impacts. The Team EQR report lists specific guidelines for stream crossings (Appendix A, page 9).

Figure 13 identifies soils found on the Carvins Cove property. The main soil property studied in this report is erosion potential, illustrated in Figure 14. The soils are rated as either severe or very severe erosion potential based on classification by the Natural Resources Conservation Service (NRCS). Not surprisingly, the steep slopes, especially those 30 percent or greater, have the greatest erosion potential. Maintaining vegetation on the slopes is essential for keeping the soil in place. The map in Figure 13 also shows a distinct difference in how soils were mapped by NRCS in Roanoke County and how they were classified in Botetourt County. The finer texture of soil classes in Botetourt County is due to the differences in classification.

2.4 Biological Conditions

For management purposes, there are two main sources of information on the biological resources of Carvins Cove. The first is the 1999 Team EQR report (Appendix A) which defines forest cover types throughout the Cove. A written description of these cover types is found in Appendix 3, but the map of where these stands are located is unavailable. The second source of information is the 2008 Natural Heritage Inventory (Appendix B) which is based on field surveys conducted in spring and fall of 2007 by the Virginia Department of Conservation and Recreation. The focus of the Natural Heritage Inventory was threatened and endangered species and unique habitats. No threatened or endangered species were found on City property. Several unique habitats were located, all of which were located high on the ridges of Tinker and Brushy Mountain. (Information on wildlife species is found in Appendix B.)

Forested areas dominate the landscape of the Carvins Cove Natural Reserve and are generally defined by sharp changes in elevation, exposure, and various types of soils. The Team EQR report states that most of the watershed is a mixed oak-hickory-beech stand type with an understory of dogwood, beech, and saplings of oak and hickory. The upper slopes of ravines and some stream banks are comprised of mixed oaks, red maple, and yellow poplar. Bottomland sites, especially those near the upper reaches of the lake where flooding sometimes occurs, contain black willow, red maple, and sycamore. Significant stands of almost pure Virginia pine are located along stream banks at the upper end of the reservoir. The access road around the upper portion of the lake has a large stand of white pine planted by the Civilian Conservation Corps (CCC) in the late 1940s. The remaining stand type identified in the Team EQR report is scrub/shrub, open areas that are small in size and scattered throughout the site. The average size of trees throughout the property is 12-14" DBH.

Team EQR note that there is significant windthrow in the Virginia pine stands, resulting in deadfalls and hung-up snags. Many of the Virginia pine stands at Carvins Cove have high forest

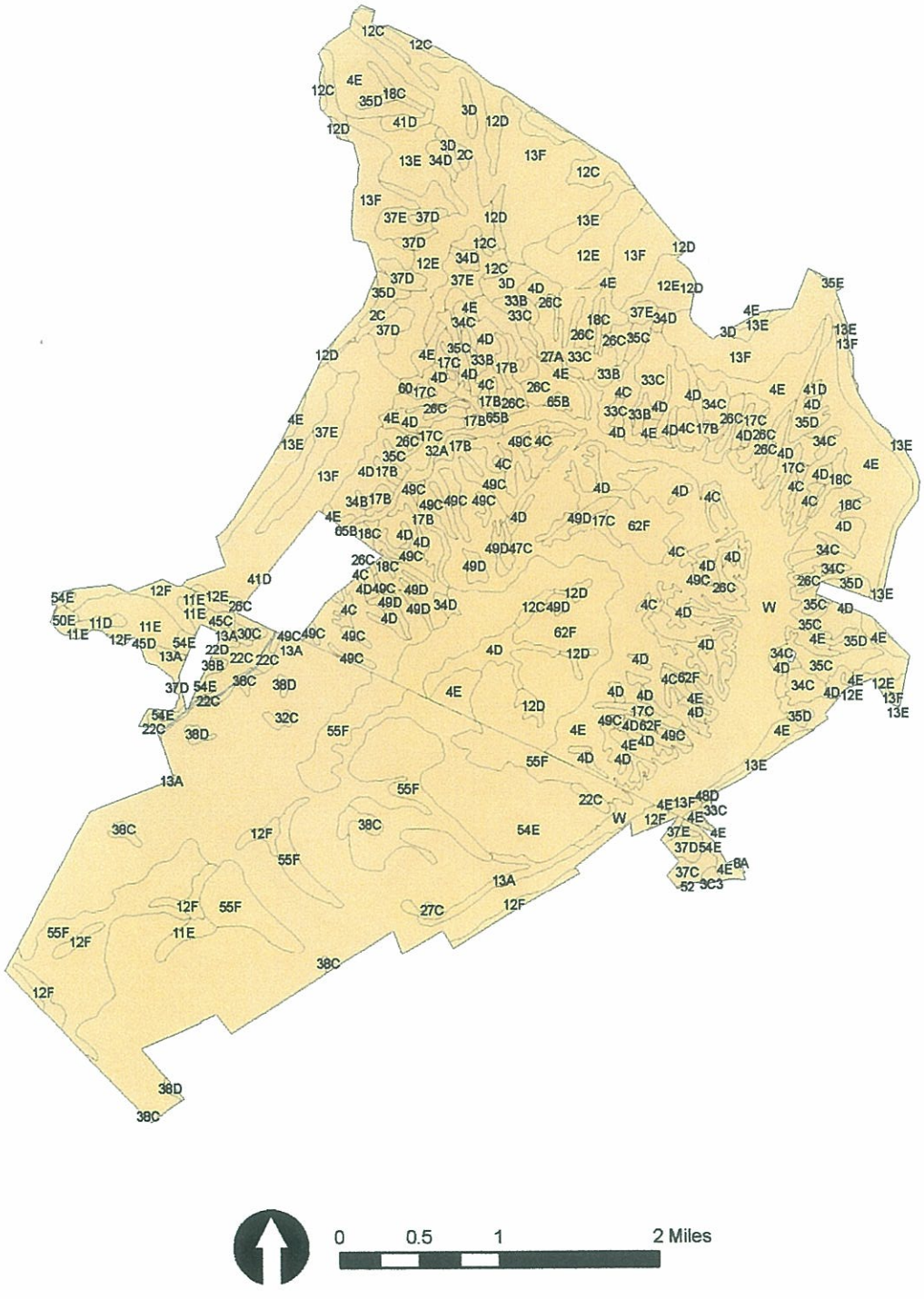

Figure 13. Soils

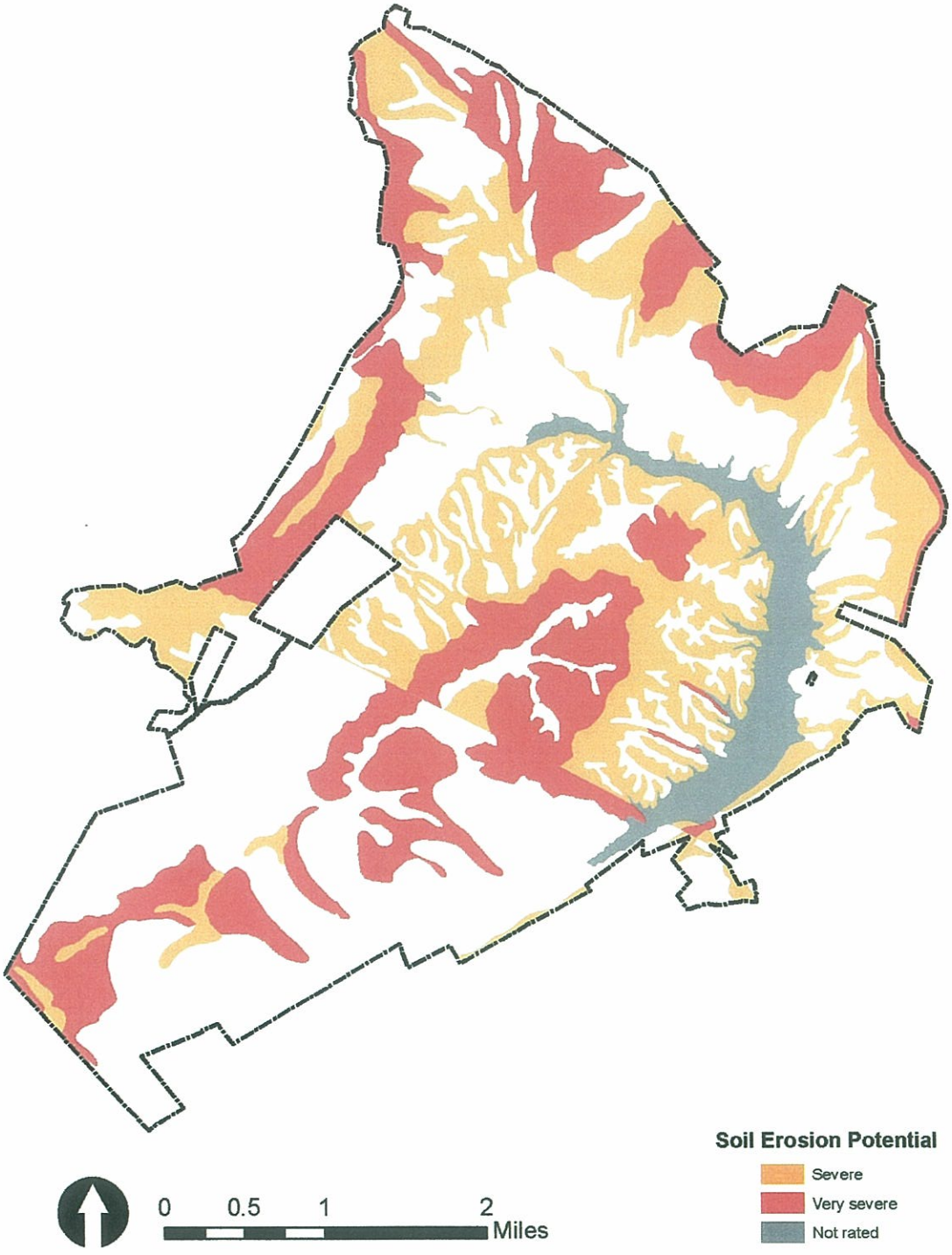

Figure 14. Soil erosion potential

fire fuel loading. Future management of Carvins Cove should address options for reducing fuel load in these stands. Team EQR also observed that the CCC-planted white pine is "grossly overstocked," and Team EQR recommended thinning of this stand to help ensure future stand health. (A recommendation of the Advisory Committee is to be very cautious about any timber harvesting in the park, limiting it to maintenance of forest health and public safety.)

2.5 Cultural Resources

Sixteen archaeological sites have been located at Carvins Cove, as described by Archaeological Reports from the Virginia Department of Historic Resources. These sites represent historic Euro-American sites from the 19th and 20th Centuries as well as prehistoric Native American sites from Early to Late Woodland Periods and Early to Late Archaic Periods. These sites are all normally submerged by the reservoir but were located during low water levels in 1991, 1997 and 1999. Each site was located by surface observation and collection, and no subsurface tests were completed. In many cases, the ground surface was severely eroded by inundation and waves, and therefore the artifacts on the surface were most likely moved from their original location. In a few cases, sites seemed to extend beyond the shores of the reservoir and up the adjacent ridge.

Five of the sixteen sites recorded by the Virginia Department of Historic Resources contain historic artifacts of Euro-Americans. These sites contained such artifacts as ceramic sherds, metal tools, iron, nails, wagon hardware, brick fragments, glass fragments and two burned foundations. Eleven sites contained prehistoric Native American artifacts. These artifacts include stone flakes, shatters, bifaces, hammer stones and projectile points. Also found were soapstone bowl fragments and ceramic sherds. On one site, lithic artifacts were scattered around clusters of fire crack rocks thought to be hearths.

None of the archaeological findings are surprising. Native Americans lived in the area at one time, but there is no evidence of any significant, large Native American community at this location. The Euro-American artifacts come from the known historical settlement that was displaced when the reservoir project was completed in the 1940s.

Reminders of the Happy Valley community are present and visible in the present-day Carvins Cove Natural Reserve. Some of the most obvious are the scattered ruins of early home sites, marked by large oaks and fruit trees. Even 50 years after the residents departed, many of the home sites that were not submerged are still marked by meadow vegetation with scattered trees. The grassy areas along the access road on the north side of the reservoir are some of the few non-forested habitat types found on the property. As reminders of the Happy Valley community and as needed habitat diversity, consideration should be given to maintaining the old home sites as open areas through mowing on an annual or bi-annual basis.

Cemeteries are the other reminder of the Happy Valley settlements. The following cemeteries remain in Carvins Cove Natural Reserve: the Riley cemetery, the NT Board cemetery, and the Reedy cemetery. Descendents of the people buried in these cemeteries have been given access to the grave sites by the City of Roanoke since the community's relocation in the 1940s.

Section 3. Park Management

The impetus for development of a Management Plan for the Carvins Cove Natural Reserve stems from the 2004 decision to create the Western Virginia Water Authority (the entity that then assumed ownership of the Carvins Cove Reservoir and reservoir lands below the 1200-foot contour) and the determination that the remainder of the City property at Carvins Cove would become a park. The summer of 2007 marked the official beginning of management of the park land by Roanoke Parks and Recreation. The Western Virginia Water Authority and Roanoke Parks and Recreation have developed a cooperative working relationship regarding the management of Carvins Cove, and it is recommended that both organizations continue this cooperation into the future and create joint use and/or operational procedures to quantify their respective roles.

Creation of an effective management framework for the park is a multi-staged process. This process began with the 2000 Land Use Plan, written prior to the creation of the "Natural Reserve," when the Cove was administered by the City Water Department. The 2000 plan focused on evaluation of water quality issues. In the spring of 2006, an ad hoc Carvins Cove Advisory Committee was tasked with providing Roanoke Parks and Recreation with guidance on future recreation uses in the park. The management goals, guidelines, and actions detailed in Section 4 of this report were derived from the discussions of the Advisory Committee. Another step in developing a management framework for the park is the Natural Heritage Inventory that will be completed in 2008. Preliminary conclusions were used to develop the Resource Management Zones mapped and discussed in Section 4. The draft Interpretive Plan contained in Appendix C is another important step in creating the management framework.

Appendix C was developed by Peter Givens of the National Park Service (NPS), using the NPS model of the "Interpretive Plan." Managing Carvins Cove requires consideration of the experience of the visitors. As Roanoke Parks and Recreation moves forward in planning for recreation at Carvins Cove, completion and implementation of the Interpretive Plan will be an important component of the overall management strategy.

This report documents the progress made to-date on planning the future of the Carvins Cove Natural Reserve. It also documents the specific recreation management activities and financial planning that still need to be done. Section 3 examines what is known and what needs to be determined about recreation management and facilities development at Carvins Cove.

3.1 Current Park Uses

Current approved park uses at Carvins Cove Natural Reserve are fishing, kayaking, boating, outdoor education, orienteering, team building, hiking, mountain biking, horseback riding, picnicking, bird watching, informal nature study, and other special activities approved by Roanoke Parks and Recreation. Users enter the park at the main entrance on Reservoir Road on the east side of the park, or through the Bennett Springs entrance on the west side of the park.

3.1.1 Fishing, Boating, Canoeing, Paddling, and Swimming

Fishing along the shoreline is permitted, and there are two fishing platforms available. In many locations, shoreline fishing has led to significant bank erosion; therefore, future site development planning should address the location of specific shoreline fishing areas and the mitigation and revegetation of eroded shoreline. Boats 10 HP or less are currently permitted on the lake and a boat landing area is located at the Reservoir Road entrance. Swimming is currently not permitted primarily due to perceived water quality risks and possible liability issues. Additional consideration is needed, and the issue will be addressed through future Recreational Program Planning efforts to better define the parameters of permitted swimming.

3.1.2 Picnicking

A picnic shelter, picnic tables, and grills are provided at the Reservoir Road entrance, uphill from the boat landing. Another picnic area is located on the northwest end of the lake, but it receives little use following the closure of the access road at the Bennett Springs entrance. The Bennett Springs area also has a retired restroom facility that should be investigated for possible reuse to include appropriate security, parking, and ADA compliance.

3.1.3 Trails

Various multi-use trail activities are the most popular recreational uses at Carvins Cove; activities include mountain biking, hiking, birding, and horseback riding. Figure 15 depicts existing trails. Over the years, trail use at Carvins Cove has not been directly managed. However, in 2003, Roanoke Parks and Recreation began an initial phase of redeveloping portions of the trail system to reach a level of sustainability both for the protection of the watershed as well as for the long-term lifecycle of the trail themselves. Initially, seven of the 40+ miles of trail were inventoried, assessed, and rehabilitated through the efforts of Parks and Recreation coupled with the International Mountain Bike Association. A recommendation of this plan is to implement a full trails management plan to inventory and assess the remaining trails (mirroring the process detailed in the Mill Mountain Management Plan), bring those to an environmentally sustainable level of service, and define a measurable action plan for ongoing maintenance and operational funding streams associated with trail management.

3.1.4 Outdoor Education

The Cove offers outstanding opportunities for nature study, education, and research. Currently, there are minimal program offerings as scheduled through Roanoke Parks and Recreation. To take full advantage of the potential offered by the resource, it is recommended that a more holistic approach to programming be researched. Future programming could be generated in cooperation with other local private and public agencies, as well as both state and federal organizations. There is great potential at the Cove to develop outdoor learning laboratory environments that are woven into the local public school system work plans, and these might be hosted and/or facilitated by neighboring institutions of higher learning.

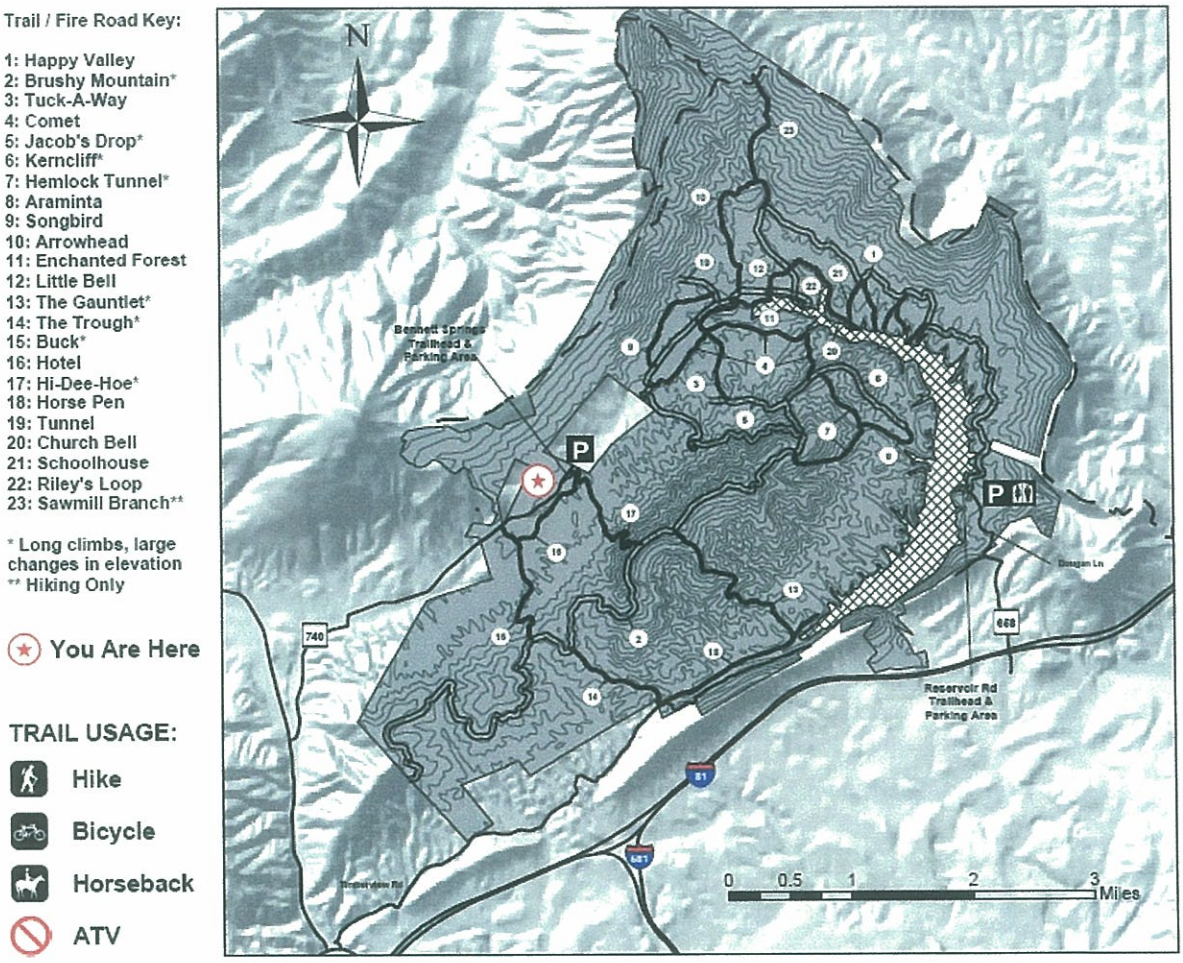

Figure 15. Trail map from Roanoke Parks & Recreation website

3.1.5 Organized Activities

Occasionally, special uses may be approved such as organized runs, trail events, races, biathlons, managed hunts, and so forth. It is incumbent upon the City of Roanoke to develop a special use permitting process that accurately controls how such activities are processed, allowed, or not allowed based upon the impact upon the resource, potential mitigation issues, and public as well as natural resource risk factors.

3.1.6 Undesirable Uses

The most significant undesired recreational use at the park is illegal motorized vehicles and all terrain vehicle (ATV) activities. ATVs are currently banned in the park, but enforcement of the ban is difficult. Future security related programming should address a multi-phased approach to the issue that would include public education, code and fine development, and appropriate levels of manned enforcement.

Unofficial motorized vehicles are only allowed by permit from either the Water Authority or Roanoke Parks and Recreation. With the exception of emergency management calls, only authorized staff from either the Water Authority or Parks and Recreation will be allowed motorized access onto the Fire Road. Motorized access into other areas of the Cove other than the Fire Road must have special permission granted by the Director of Parks and Recreation and/or the Water Authority.

Open hunting is unauthorized within the Cove; however, managed hunts in direct partnership with Virginia Game and Inland Fisheries are highly recommended to effectively manage the deer population.

3.2 Trends and Needs

The 2007 Virginia Outdoors Plan identifies some major demographic trends that are affecting and will affect outdoor recreation: population growth, ethnic diversity, and aging of the population. Population growth pressures result in greater demand for recreational facilities. More diverse ethnically and older populations demand services that differ from what many Parks and Recreation Departments have offered in the past. Management of Carvins Cove Natural Reserve must respond to these trends – first, by sensitively developing new facilities that are appropriate for the physical and biological conditions present and, second, by offering a broader range of options to people who are less mobile and physically fit than many of the current users of the park.

The 2007 Roanoke Parks and Recreation Master Plan identified the development of amenities at Carvins Cove as one of the primary objectives of Roanoke Parks and Recreation; however, the types of amenities were not identified. In order to determine what amenities need to be established, a facilities master plan would need to be created for the Cove to be included in the appendices. A facilities-based SWOT analysis (strengths, weaknesses, opportunities, and threats) would be a useful exercise to assist Roanoke Parks and Recreation in making decisions about what specific uses to allow and encourage at Carvins Cove.

It is the intent of Roanoke Parks and Recreation to respond to increasing demands for outdoor recreation at Carvins Cove without sacrificing the beauty, relative remoteness, ecological diversity, and environmental character that currently exists in the park. To achieve this goal, Carvins Cove Natural Reserve must be adequately staffed, funded, and maintained.

Carvins Cove Natural Reserve is described in the 2007 Parks and Recreation Master Plan as a regional attraction with potential to add significantly to the economic development potential of the Roanoke region. It is important to note that the economic benefit that is derived from park visitors is likely to be captured by jurisdictions other than the City of Roanoke, given the park's location. Shared benefits of future park development should lead to cooperative arrangements between local governments to supply the funds needed to adequately maintain this regional resource.

3.3 Recreation Management

The goal of managing recreation at Carvins Cove Natural Reserve is to balance resource protection with levels of recreational use that meet current and future demand for nature-based outdoor recreation within a sustainable framework. A Recreation Program Plan is needed to detail the kinds of recreational opportunities that will be offered at Carvins Cove, the kinds of facilities that need to be built, how programs will be evaluated and monitored, how the carrying capacity of the park will be monitored, and how the park's connectivity will benefit the surrounding region. Access to the park and evaluation of impacts on neighboring property holders need to be addressed through all levels of planning. These represent the next steps in detailing the development of Carvins Cove Natural Reserve for long-term sustainability. The Program Plan must be matched by a strategic business plan, a fiscal and financial operating plan, plus a multi-year, phased capital outlay for development. To achieve this, it is recommended that creative partnerships, both public and private, be developed to realize the potential at Carvins Cove.

3.4 Facility Development and Capital Program

In its current stage of minimal facilities development, the Cove will likely require future development to meet current and future needs of residents of the City and region. As stated in the 2007 Parks and Recreation Master Plan, citizens voiced their desire to create a special and unique experience at the Cove, and additional facilities planning will need to follow this resource-based Management Plan so that specific elements of a targeted recreational program and facilities can be identified and sited. Future facilities master plans should be included in Appendix D.

Section 4. Management Goals, Guidelines, and Actions

4.1 Designation of Management Zones

At first glance, the Carvins Cove Natural Reserve property looks fairly homogeneous in nature; it is almost entirely forested and consists largely of steep slopes. It takes a closer look to reveal subtleties in the landscape, and understanding those subtle distinctions between different places on the ground are what land planning and management is all about. A review of the physical, biological, and cultural characteristics tells a story about the evolution of the land and its use as habitat for living things, including humans in the recent past and long ago. The maps and resource descriptions contained in this report reveal the unique qualities and landscape variations of Carvins Cove. The composite analysis map in Figure 16 summarizes many of the prominent features and considerations in a graphic format.

How is the information about physical, biological, and cultural resources to be processed? In many cases, choices about what specific management action to take in a particular place or where to locate a new facility will require additional, on-the-ground investigation beyond what is offered in this Management Plan. The resolution of the data contained here is not fine enough to make site-level decisions. However, the broad trends and general characteristics of the Carvins Cove landscape are known, and many management decisions can be made with this knowledge.

Not to be overlooked is the fact that *not all* decisions about how to manage this property are going to be determined by scientific analysis. There are choices to be made that have to balance the physical and biological characteristics of the park with what the people of Roanoke want to have happen there, and the prevailing direction is toward conservation at the present time.

The Resource Management Zones (RMZs) described in this section (Figure 17) are delineated according to landscape conditions, and they are broad and limited in number to simplify their use. Fine-tuning can be accomplished with the addition of "Special Biological Zones" described in Appendix B and stream corridor buffers (Figure 12). The zones are designed to maximize conservation objectives while also accommodating an expansion of recreation to meet not just today's needs, but also future needs when questions over staffing and funding have been answered.

A calculation of the land area contained in each RMZ is shown in Table 1. A 100-foot buffer around the reservoir is included in the area measurement for the lake and its associated Riparian Protection Zone (Zone 5). The remainder of Zone 5 is the buffer along streams and other water features (50 feet on either side of streams), but the stream buffers are neither depicted in the figure, nor in the land area calculations. The land owned by the Western Virginia Water Authority, approximately 1100 acres, overlaps portions of all of the RMZs.

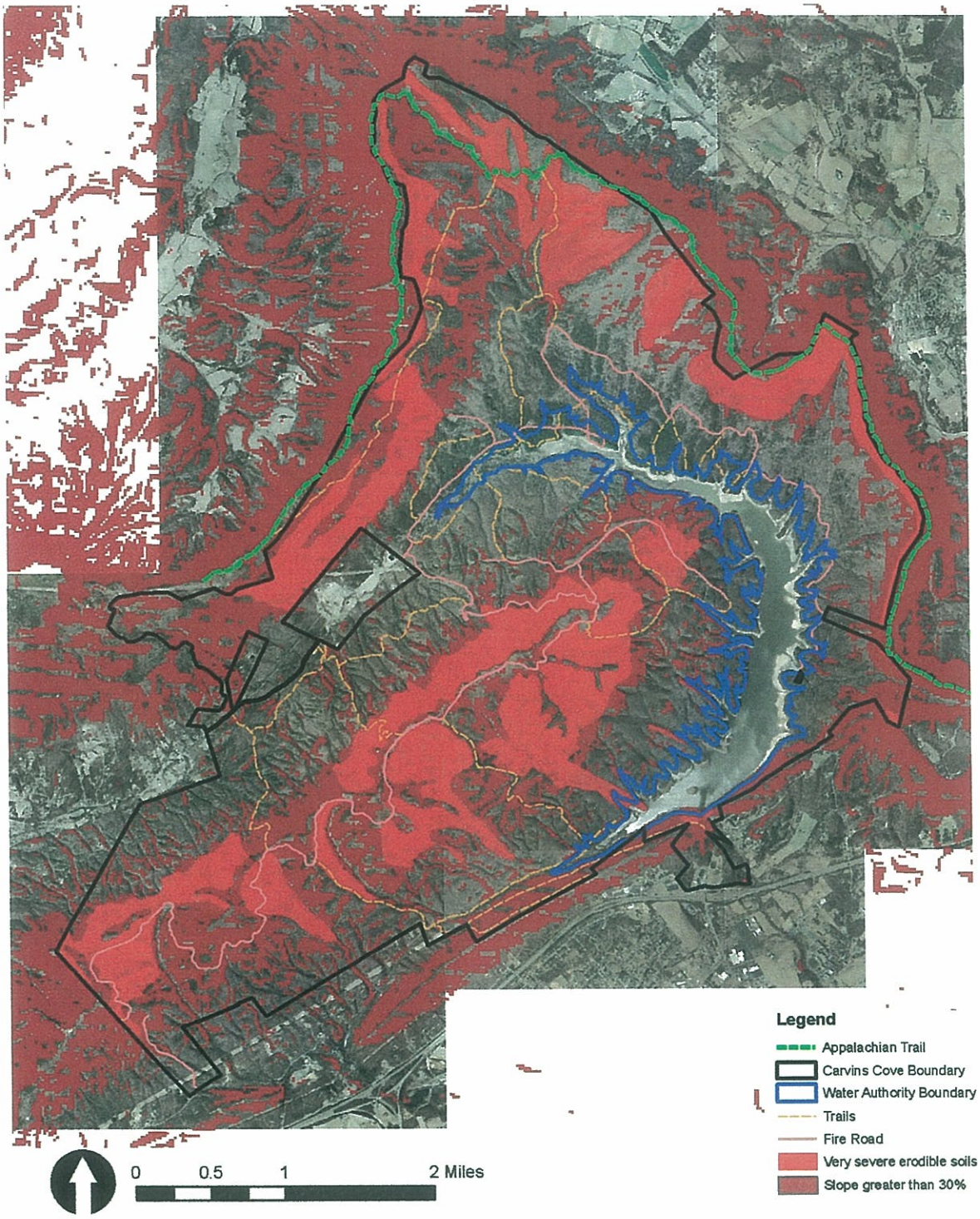

Figure 16. Composite analysis

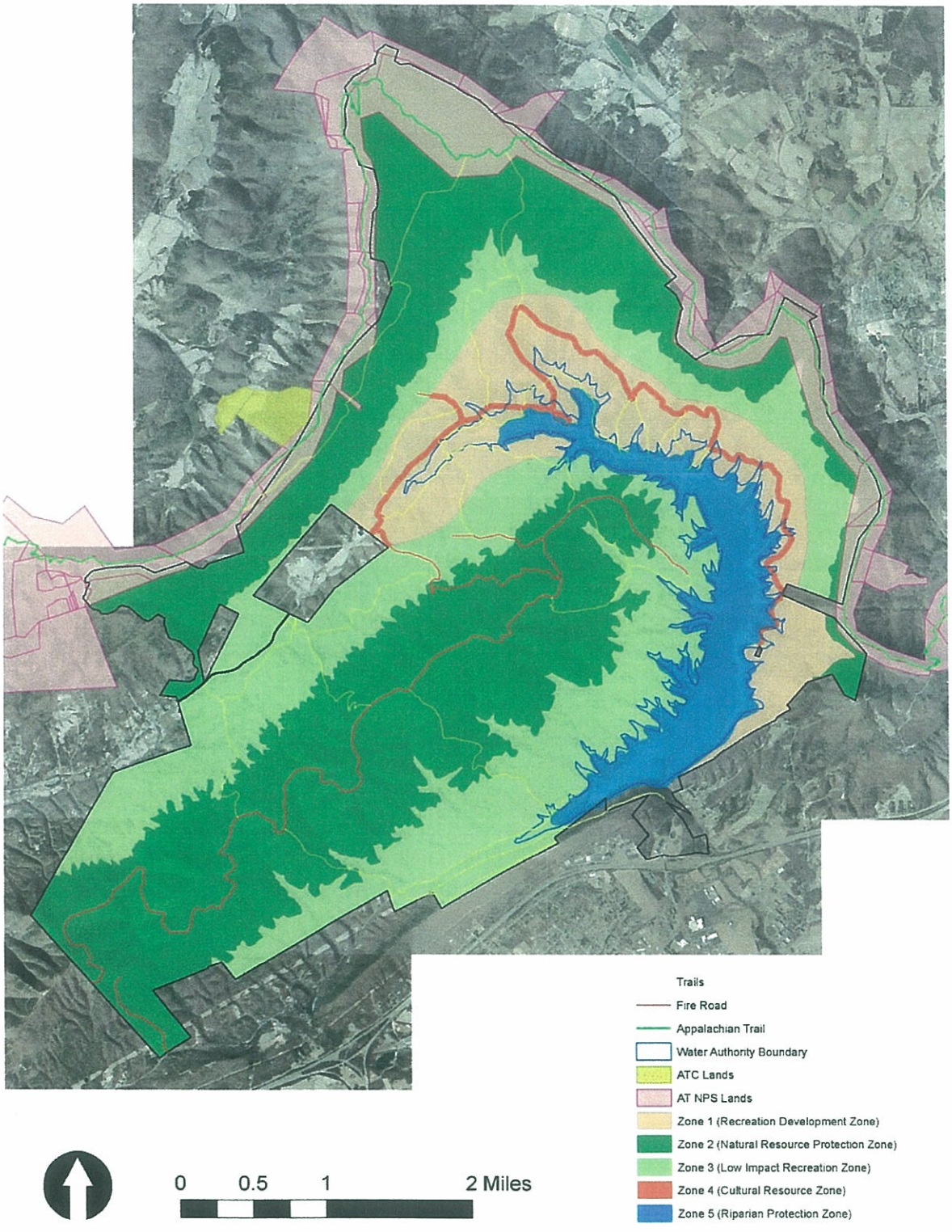

Figure 17. Resource Management Zones

Table 1. RMZ area calculations

RMZ	Acres
1	1540
2	6150
3	3520
4	175
5	960

* Approximately 118 acres of land is located in the vicinity of the Roanoke Water Treatment Plant, and that land is not included in the area calculations for the RMZs.

Zone 1. Recreation Development Zone

Management Zone 1 lies along the lowest slopes on the Cove property, primarily on the northern shore of the lake. The two currently developed recreation areas, one at the main entrance with the boat landing and picnic area and one near the northern end of the lake with a picnic area and currently closed restroom, are contained within this zone. The zone wraps around the narrow, northern end of the lake and provides access to both the north and south shores, although the southern section is truncated by the abrupt rise of Brushy Mountain. What is commonly referred to as the "Fire Road" is the only developed road within The Cove. While the roadway needs to be examined for erosion control, public safety and fire response suitability as well as trail functionality, it traverses across the northern part of Management Zone 1, linking the Bennett Springs entrance (currently closed to motorized vehicles) with the Reservoir Road entrance. This is the same road that is lined with remnants of old home sites and old family cemeteries.

Management Zone 1 has physical characteristics that make it the logical choice for more intensive recreational development such as additional picnic sites, stables, management and comfort facilities, fishing facilities, camping sites, formal transportation corridors, paddling facilities, and swimming areas. It is also the best location for both accessible recreational facilities for mobility-challenged populations because of its gentle slopes and existing road as well as potential future park offices and commercial services related to park use.

The main caution about future development of Management Zone 1 is that many small tributaries flow into the lake here, as shown in the aerial photo and indicated by the numerous small coves on the northern lake edge. The lowest-lying areas along the lake edge are frequently flooded and unsuitable for development. Close examination of soils would be necessary to determine development suitability before new facilities are planned in this area. The proposed 100-foot buffer of the reservoir edge and streams will make avoidance of sensitive areas easier, as will the fact that all land below the 1200-foot contour is owned and managed by the Western Virginia Water Authority. Any proposed recreational facility below the 1200-foot contour requires approval from the Western Virginia Water Authority.

Stream channel stability assessments conducted as part of the 1999 Natural Resource Assessment (Team EQR) indicate that erosion is a problem in the fine sediments of Carvin Creek, but that erosion is not as significant in bedrock-lined streams like Sawmill Branch. The broadest point of Management Zone 1 is where it is extended up into the Sawmill Branch subwatershed. When

recreation development suitability is considered in the future, this important distinction between Carvin Creek and Sawmill Branch should be considered. Both areas are in Management Zone 1.

Zone 2. Natural Resource Protection Zone

Management Zone 2 occupies the highest elevations of the Cove property and the steepest slopes of Brushy Mountain and Tinker Mountain. It is defined as the 1500-foot contour line throughout the site, with the exception of the northeast tip of Brushy Mountain, where the zone is defined as the 1345-foot contour (Figure 17). Steepness of slopes for the majority of land area in Management Zone 2 is over 30 percent. The majority of soils in the park that are rated "very severe" for erodibility by the Natural Resource Conservation Service (NRCS) are located in Management Zone 2. Like almost all of Carvins Cove Natural Reserve, the ridgelines and side slopes of Tinker and Brushy Mountains are forested, and the trees stabilize the slopes and thereby limit erosion. Social trails that are improperly conceived and executed in this part of the park are particularly damaging because of the fragile underlying conditions found here (steep slopes, thin, erodible soils, and deer-impacted shrub and ground layer vegetation).

Management Zone 2 also has the distinction of containing the Special Biological Areas identified by DCR (Appendix B), unique ecological communities found high on the slopes and ridgelines of the two mountains. Parts of Management Zone 2 abut the Appalachian Trail (AT) and thus serve as an important part of the AT's viewshed, the majority of which are foreground views of the first 500 feet or less of forest (personal communication, Teresa Martinez, Appalachian Trail Conference). At key points along the AT, however, the reservoir is visible. (Areas visible from the AT include a significant portion of Management Zone 1.)

For all of these reasons, Management Zone 2 has been designated as a Natural Resource Protection Zone. Recreational activities in this area should be strictly limited. Trails that currently exist in Management Zone 2 should be carefully reviewed to determine their sustainability. Consideration shall be given to determining if hiking-only trails are appropriate in this zone. Any existing authorized trail in this area that has significant environmental or cultural impact problems should be retired or rehabilitated as soon as possible as per recommendations of the trails assessment (when completed). Future trail development in Management Zone 2 shall be carefully considered.

There is interest in placing some or all of Carvins Cove Natural Reserve in a conservation easement. If the leadership of the City of Roanoke makes a decision to place land under easement, Management Zone 2 would form the "core" of the easement, given that the most critical conservation values on the property are found in this zone.

Zone 3. Low Impact Recreation Zone

Management Zone 3 is designated as the Low Impact Recreation Zone. The management intent is for this zone to serve as a buffer between more intensive recreational development in Zone 1 and conservation use/natural resource protection in Zone 2. Zone 3 covers the lower slopes of Brushy Mountain and the low- to mid-slope portion of Brushy Mountain above Carvin Creek. Zone 3 forms a thin transition zone between Zones 1 and 2 on the north side of the reservoir, but

broadens somewhat in the vicinity of Sawmill Branch. The recommendation is to promote the natural evolution of the natural, native forest canopy in this buffer while transitioning from hardscape infrastructure elements that may be in Zone 1. In all management zones, the use of more porous, eco-friendly, and sustainable materials is encouraged where built elements are needed.

Zone 4. Cultural Resource Zone

A 100-foot buffer along the main road (100 feet on either side) that links the Bennett Springs entrance to the Reservoir Road entrance marks **Management Zone 4**, the Cultural Resource Zone. The intent of this management zone is to call attention to the cultural resources that lie along this road, and, in a related way, to the water's edge and below. What cultural artifacts that remain in Carvins Cove, remnants of Happy Valley that are not submerged or long ago obliterated, lie along the road, mostly as early successional open areas that mark old home sites. Management Zone 4 would be the logical location for an interpretive trail and historical markers. Within this zone, serving as the main transportation artery as well as the most beneficial route for a multi-use recreational trail, the Fire Road should be rehabilitated for appropriate erosion and stability measures. Consideration should be given to re-surfacing this road with a more user-friendly stone base suitable for beginner recreational trail functionality.

Zone 5. Riparian Protection Zone

Management Zone 5 is the Riparian Protection Zone. All of the land below the 1200-foot contour is identified as part of Management Zone 5, although this land is owned and managed by the Western Virginia Water Authority. The parts of Management Zone 5 that are owned by the City of Roanoke and managed by Roanoke Parks and Recreation are the 50-foot buffer zones on either side of streams, wetlands, and other hydrological features such as seeps. Management Zone 5 serves as a kind of overlay zone that applies to all of the other Management Zones. The 50-foot buffers are not depicted on the map in an effort to maintain legibility, but they should be easily recognizable on the ground (also refer to Figure 12). Designation as a unique management zone is one way to convey the critical importance of water quality at Carvins Cove Natural Reserve.

4.2 Management Goals, Guidelines, and Actions

4.2.1 Protect Water Quality

Goals:

1. Maintain and protect water quality and potable water supply while providing for compatible recreational use of the reservoir and its watershed.
2. Protect the water quality of the reservoir by maintaining or improving the water quality of feeder stream corridors.

Guidelines:

1. Follow Virginia Department of Conservation and Recreation state standards for erosion and sedimentation in the construction and maintenance of facilities at Carvins Cove.

2. Use careful site selection procedures and appropriate design standards when locating new recreational facilities so that soil compaction and erosion are minimized.
3. Maintain a minimum 100-foot vegetated buffer around Carvins Cove Reservoir (excluding current developed areas) and along each side of perennial and intermittent streams, spring seeps and any other identified wetlands within the Carvins Cove watershed. Water-dependent structures, such as bridges, may be allowed within the buffers, but they should be carefully designed following best management practices for stream crossings.

Actions:

1. Formalize channels of communication between the Western Virginia Water Authority and Roanoke Parks and Recreation and develop standard protocols to ensure close coordination between the needs and activities of the two organizations regarding water quality management.
2. Conduct an inventory of all culverts and develop a plan to address culvert failures that are causing severe erosion and threaten both fire road/trail stability and reservoir water quality.

4.2.2 Protect the Natural Environment and Biodiversity

4.2.2.1 Forest Management

Goals:

1. Maintain the forest as the dominant ecosystem on the mountain slopes and valley floors to retain the existing character of the area.
2. Maintain forest health by providing for diversity in age and species composition of forest types and by retaining more historical ecosystem types that are currently threatened by the exclusion of natural fires and by invasive species.
3. Minimize loss of forest coverage due to development, and require facility designs that emphasize and enhance the aesthetic value of the forest.
4. Protect the habitat of fish and wildlife resources to maintain or enhance recreational uses and scientific values.

Guidelines:

1. Forest management practices should be considered within Carvins Cove Natural Reserve to provide sustainable habitat. Limited, specific, planned forest management is compatible with recreation, wildlife, and watershed management.
2. Manage the health of forest resources by monitoring disease and insect occurrences.
3. Establish guidelines for the use of pesticides, herbicides, and fertilizers to avoid harming non-target species.
4. Follow Virginia Department of Forestry Best Management Practice Guidelines for activities requiring soil disturbance.
5. Recognize that fire is a natural and valuable ecological phenomenon and that small "burns" may have positive ecological effects.

Actions:

1. Contract with a private forestry consultant to develop a Forest Stewardship Plan and make recommendations for forest management activities. The consultant should work

cooperatively with the Virginia Department of Conservation and Recreation (DCR), Division of Natural Heritage, to coordinate protection of significant natural communities.
2. Institute a program to monitor insect and disease impacts. Response to any occurrence will be developed as appropriate to maintain forest health as funding is available and regulations allow. Use volunteers to assist with pest monitoring.
3. Institute a program to monitor and control invasive plant species.
4. Develop a fire response plan for the Carvins Cove Natural Reserve that considers resources and values at risk. The resources are those agencies that would have responsibility for suppression efforts, and they should make recommendations for prevention tools that might be applied to Reserve users.
5. Consider a selective timber harvest focused on areas with high densities of conifers based on forest health considerations. This could provide a small amount of revenue that could be used for overall property management, and it would allow for diversification of habitat.
6. Improve existing fire roads with turn-around areas suitable for fire trucks and other emergency vehicles.

4.2.2.2 Wildlife Resource Management

Goal:

1. Manage wildlife to maintain desirable populations of native species to serve the needs of Carvins Cove Natural Reserve users.

Guidelines:

1. Follow DCR recommendations concerning any potential threatened and endangered species that might inhabit the Carvins Cove Natural Reserve.
2. Manage deer populations to prevent destruction of forest habitats through managed hunts in direct partnership with Virginia Department of Game and Inland Fisheries.
3. Identify opportunities to develop and maintain habitat for early successional stage species such as bobwhite quail, meadowlarks and rabbits.
4. Types of activities known to negatively affect fish and wildlife habitat that should be considered when evaluating any land use or development proposal include:

    - Reduction in the quantity, quality, or variety of food items available.
    - Introduction of animals (wild or domestic) that might lead to the transmission of diseases, increased predation, or harassment.
    - Creation of barriers to movement, either physical or behavioral.
    - Harassment or disturbance to animals causing: (a) movement from areas rich in food resources to less desirable habitat; (b) increased stress or energy expenditures that thereby reduce the survival ability of the animal; or (c) abandonment of young.
    - Reduction in the quality or availability of water supply.

Actions:

1. Allow recreational deer hunting during established archery season or for a portion of it. Allow deer hunting during the late muzzle loader season.
2. Re-establish a cooperative fisheries management agreement with the Virginia Department of Game and Inland Fisheries. DGIF staff could assist with fish population monitoring,

stocking and fishing regulations. Current fees and restrictions on who is allowed to use the Cove (open to citizens living in certain counties and cities) do not meet DGIF guidelines for assistance, but Roanoke Parks and Recreation can revisit these issues with DGIF and determine whether future assistance might be possible.

3. Explore potential partnerships with DGIF to identify stream restoration opportunities.

4.2.3 Provide Compatible Recreational Opportunities

Goals:

1. Develop the kinds of sustainable recreation facilities at Carvins Cove Natural Reserve that will make the park a premier outdoor recreation destination and will allow the park to serve as the kind of economic development generator that the second largest municipal park in the nation has the potential of becoming.
2. Enhance and strengthen recreational opportunities at Carvins Cove in a way that does not distract from the relatively pristine, naturalistic character that the park currently projects. New and expanded forms of recreation will be low impact in nature and sensitively sited.
3. Expand access and available recreational opportunities in at least one portion of the park for people with mobility limitations.
4. Carvins Cove Natural Reserve is a regional resource, attracting users from the region and beyond. Stewardship and care of this unique park must extend to the region as well, and partnerships need to be created to balance management responsibilities among the various jurisdictions that currently benefit from the park.
5. Activities which utilize trail systems, such as mountain biking, horseback riding, hiking and sightseeing/nature study are growing in popularity at Carvins Cove. These uses should be encouraged and facilities and management guidelines developed to minimize their impact on the watershed.
6. Rationing of public recreational use through a permit system to avoid over-use and degradation of trails, campgrounds, and other public-use sites should be considered if needed to protect the watershed.

Guidelines:

1. The recreational activities currently permitted at Carvins Cove Natural Reserve will continue to be permitted: fishing, boating (10 hp motor or less), picnicking, hiking, mountain biking, horseback riding, sightseeing and nature study.
2. Manage trail use in a manner that limits conflicts between various user groups: hikers, mountain bikers, and horseback riders.
3. ATV use, currently prohibited at the Cove, should continue to be banned in the future.
4. Programmed sports requiring ball fields are prohibited at Carvins Cove.
5. Provide adequate staffing for all permitted activities.
6. Fishing from the shore at designated locations and by boat is allowed.
7. Manage picnic facilities so that use impacts are minimized.
8. Prohibit user-created social trails.
9. Inform trail users of erosion hazards and encourage them to observe "Leave No Trace" guidelines.
10. Limit groups of equestrians to no more than 10 persons per group.
11. Suspend trail use during wet conditions and during periods of drought.

12. Swimming is not currently permitted at Carvins Cove. Before swimming would be considered an acceptable recreational use at the Cove, location, supervision, staffing, and public safety will be considered by Roanoke Parks and Recreation and coordinated with the Western Virginia Water Authority.
13. All recreational users should be required to purchase a permit for use of Carvins Cove facilities.

Actions:

1. Roanoke Parks and Recreation will study the feasibility of expanding recreational uses at Carvins Cove to include camping, swimming, cabins, concessions, a nature center, an outdoor laboratory, and/or interpretive trails.
2. Establish built environment character guidelines similar to those used by the National Park Service for the Blue Ridge Parkway.
3. Engage the user community and seek their preferences for future park amenities, their opinions about problems at the park, and their participation in park maintenance.
4. Provide designated fishing spots at easily accessible and stabilized areas along the bank. Stabilize soil in fishing areas with stone and/or geotextile materials to prevent erosion.
5. Create additional fishing platforms to decrease the amount of shore erosion taking place.
6. Provide hitching posts and at least one horse-unloading ramp.
7. Investigate options on a phased elimination of gasoline powered engines in boats on the reservoir. In particular, feasibility of electric motors and their potential horsepower limitations should be investigated.
8. Create several additional, smaller, less dense picnicking areas and rotate use so that use impacts are minimized. Some of these should be ADA accessible and located near parking and restrooms. Maintain a 100-foot buffer between all picnic areas and the shoreline.
9. Create well-defined pathways to picnic areas and table pads to reduce extensive soil compaction.
10. Designated grills should be provided in picnic areas. Fires and charcoal grills in locations other than those designated should be prohibited.
11. Refurbish the existing picnic areas and restrooms.
12. Conduct a trail assessment of all existing trails. For needed trail renovation, use the construction and design guidelines created for Mill Mountain.
13. Install a gate at the City of Roanoke property line on the Brushy Mountain fire road to discourage user trespass on adjacent private property.
14. Retain a buffer, where appropriate, free of recreational development, from all private properties located within the City-owned property.
15. User fee policies and related cost/revenue estimates to address joint-operations and maintenance of the Cove between the City and the WVWA should be evaluated in conjunction with future facility master planning and as facility development may occur.
16. Roanoke Parks and Recreation will work to build partnerships with other local governments in the vicinity of the Cove to further the management objectives of the park and build a broad constituency dedicated to the enhancement and protection of this significant regional resource.

4.2.4 Provide and Maintain User Amenities and Infrastructure

Goals:

1. Design, construct, and maintain user amenities and infrastructure in ways that serve the needs of the user while, at the same time, minimize potential danger to the public water supply.
2. Allow for increases in recreational use of the park in a manner that minimizes disturbance of water quality.
3. Create a safe experience for park users.

Guidelines:

1. Provide bike racks and hitching posts at all parking lots.
2. Provide environmentally friendly restroom facilities at all parking areas.
3. Establish inspection and maintenance guidelines for roads, parking lots, trails, and other types of infrastructure in the park.
4. Use minimally impactive construction methods to the extent feasible when new facilities are developed or existing ones are refurbished.
5. Provide conveniently located, covered, and anchored (wildlife-proof) trash containers in areas where recreational use is concentrated.

Actions:

1. Parking for cars at Timber View Road and a trailhead facility should be evaluated.
2. Evaluate existing toilet facilities at the Bennett Springs picnic area and consider re-opening them for use.
3. Redesign parking at the boat landing to allow the creation of a buffer strip along the reservoir edge. Remove sections of asphalt in the parking lot and replace with porous paving to reduce surface runoff into the water. This would have to be coordinated with the Western Virginia Water Authority.
4. Create a better separation of uses within the boat landing parking area to minimize bike/pedestrian/vehicle/horse/picnicking conflicts. Evaluate the possibility of segregating parking uses.
5. Evaluate opening up the Bennett Springs end of Carvins Cove as Roanoke Parks and Recreation staff capacity builds to manage this access.
6. Develop an Access and Road Management Plan. Evaluate the condition of existing roads.
7. Develop a Signage and Wayfinding Plan.
8. Develop a Visitor Safety Plan, which would include a mobilization plan in case of an accident, a communication plan, emergency procedures including location and type of supplies available.
9. Coordinate with the Western Virginia Water Authority on procedures for response to a hazardous material accident.

4.2.5 Provide Public Education Opportunities

Goals:

1. Effectively educate visitors about the role of the reservoir in providing clean drinking water to the region and the role visitors must play in protecting it.
2. Effectively educate visitors about forest and wildlife management within the watershed.

Guidelines:

1. Develop appropriate signage that identifies the reservoir as a source of drinking water and lists prohibited activities.
2. Establish a mechanism for delivering educational programming and/or events for local schools and organizations, possibly through community partners.

Action:

1. Develop interpretive trails, including displays explaining the history and resources of the park.

4.3 Priority Needs

4.3.1 Immediate and Short-Term Needs

Hire a Park Supervisor
Develop a Fire Response Plan
Assess current trail system
Inventory culverts and address culvert failures
Rehabilitate, as necessary, current picnic area
Upgrade Bennett Springs entrance
Create a single message board and educational message for each entrance
Create a public awareness campaign related to the value and importance of Carvins Cove
Upgrade signage throughout the park (Signage and Wayfinding Plan)
Manage deer populations through managed hunts developed in partnership with the Virginia Department of Game and Inland Fisheries (DGIF)
Develop a Visitor Safety Plan

4.3.2 Middle and Long-Term Needs

Definition of capital development needs based on resource management zones
Creation of Operations and Staffing Plan
Develop an Access and Road Management Plan
Develop a Forest Stewardship Plan
Re-establish a cooperative fisheries management agreement with DGIF
Full development of trail system

Section 5. Conclusions

Carvins Cove Natural Reserve is an exceptional resource for the City of Roanoke and, indeed, for the entire Roanoke region. As cities nationwide compete to attract young, active professionals, the so-called Creative Class that are thought to be drivers in the new global economy, the City of Roanoke cannot continue to ignore the outstanding outdoor recreation asset it has on its doorstep. Only one other city in the country can claim ownership of a municipal park this large, and it can be argued that the beauty of this city park is unrivaled. The location of Carvins Cove, on the nationally significant Appalachian Trail, near I-81 and only seven miles from Downtown Roanoke, soon to be physically connected to Downtown by the Tinker Creek Greenway, is another important factor in making this a premier outdoor recreation destination. The challenge is to more fully reap the recreational benefits of Carvins Cove Natural Reserve while keeping its utmost value foremost – its value as protector and locus of a major water supply for Roanoke City and County.

Analysis has shown that current levels of recreational activity at Carvins Cove do not negatively impact water quality in the reservoir. The most noteworthy impacts so far are not having major effects (compaction of the main picnic area, failing culverts and subsequent erosion of some trails and parts of the Fire Road, and so forth). This low level of impact could certainly change if recreational use were to sharply increase without careful planning and design of new facilities and upgrades to/maintenance of what is already there. Sustainable materials and techniques must be used to accommodate growth in use, and that starts with knowledge of the physical and biological condition of the land. The Management Plan takes this knowledge and specifies what kinds of uses are appropriate for what parts of the park, given physical conditions, desired aesthetic and ecological qualities, and user preferences for maintaining the natural quality of the place.

The Management Plan reviews the basic information on physical, biological, and cultural resources, adds new information in the form of a Natural Heritage Inventory, designates a series of Resource Management Zones (RMZs) on the property appropriate for different uses, and provides a detailed account of management goals, guidelines, and recommended actions.

The real challenge to the future of Carvins Cove may not be limited to how to accommodate recreation demand while protecting water quality. The challenge may lie in how the City of Roanoke acquires the resources to actively manage over 11,000 acres – its part of the 12,463-acre property it manages alongside the Western Virginia Water Authority. For the City of Roanoke to properly manage this park of regional significance, it must have a reliable revenue stream to cover significant capital and operating expenses. Regional partnerships and user fees may be part of the solution. Answering these fiscal and operational questions is a significant next step in charting the future of Carvins Cove.

Detailed park programming, including specific uses to be allowed and encouraged at the park, has not yet been determined. The RMZs designate land areas appropriate for a range of uses, but they are not specific enough to guide park development. Instead, the RMZs form the framework

within which the Park Facilities Master Plan can be placed. Exactly what facilities are appropriate for the park and where will they be located? How will the proposed projects and necessary maintenance be funded? How will capital projects be phased? These are the questions that a Facilities Master Plan must address.

The RMZs delineated in this Management Plan represent a landscape assessment of suitabilities for broad categories of use. Management Zone 1 is the area that is most suitable for new recreational facilities. Advisory Committee recommendations for the types of uses appropriate in Management Zone 1 include fishing, boating, kayaking, canoeing, picnicking, tent camping, horseback riding, mountain biking, hiking, interpretive trails, bird watching, educational uses, and a nature center. The master planning process will determine exactly what combination of uses will be pursued at Carvins Cove.

While Management Zone 1 is intended to be the primary location for enhanced recreation offerings at the Cove, Management Zone 2 is designed to be the primary natural resource preservation area. Apart from maintaining trails in Zone 2, minimal disturbance of the forest ecosystems and steep slopes is the management intent. As with Zone 1, the exact details of what will and will not be allowed in Zone 2 have not yet been determined. A Forest Stewardship Plan would inform the City of Roanoke about the options available for forest management throughout the site, but especially in Zone 2, the most fragile part of the Cove landscape. Following the historical pattern of simply leaving the forest alone may, or may not, be the best management response in Zone 2. The long-term health of the forest should be the primary consideration. Ecologists at the Virginia Department of Conservation and Recreation and foresters with the Virginia Department of Forestry can provide guidance to the City of Roanoke as it seeks to be a good steward of the Carvins Cove resources.

What is the best way to protect valued resources at Carvins Cove for future generations? A conservation easement is one way to ensure continuation of Carvins Cove Natural Reserve as a natural resource protection and low-impact recreation area. A conservation easement is a binding legal agreement, and that is what sets it apart from any other strategy to direct the future of the Cove. A master plan can be followed or not; restrictions written into a conservation easement must be followed in perpetuity. For that reason, any decision to enter into a conservation agreement must be made very carefully.

There is great flexibility in how a conservation easement may be written, and desired future uses may be included in the easement language. A conservation easement may be applied to all of a subject property, or just to a portion of it. If the City of Roanoke places an easement on the Carvins Cove property, it must determine whether or not to place the easement on the whole property, or place the easement on the land designated as Management Zone 2.

Determining all desired future uses of Management Zone 2, such as selective timber harvesting of diseased trees, so that these uses might be included in the easement language is a task that could be readily accomplished given the limited nature of uses appropriate for that zone. Much of the information necessary to make an informed decision about future uses of Management Zone 2 is contained within this report, and additional information could readily be gathered from the Virginia Department of Forestry, U.S. Forest Service, and Virginia Department of Game and

Inland Fisheries. Placing a conservation easement on the approximately 6150 acres designated as Management Zone 2 (54 percent of the total acreage controlled by the City of Roanoke in Carvins Cove Natural Reserve) is a recommendation of the Advisory Committee. Determining how easement restrictions will be enforced in Management Zone 2 is an important issue to address. The City of Roanoke and the potential easement holder should carefully consider how enforcement on such a large land holding will be managed.

Placing a conservation easement on the entire 11,363 acres owned by the City of Roanoke is a more difficult task because a Facilities Master Plan has not been done, and the details about what specific kinds of uses, facilities, and recreational programs will be developed at Carvins Cove Natural Reserve are not known. The City of Roanoke may wish to place an easement on the entire Carvins Cove property, but the wording of this part of the agreement must be especially well-considered, given the amount of uncertainty that exists over exactly what kinds of facilities and uses will be pursued in the less ecologically sensitive parts of the property.

On December 3, 2007, Roanoke City Council met to discuss this Management Plan, and they stated a desire to move forward with the conservation easement process and incorporate Management Zone 2 as the area needing the highest degree of protection. This is based on the understanding that the Council will incorporate language into the easement that addresses the future minimal amenities that may be built such as sustainable trails, interpretive and educational kiosks and signage, comfort stations, partially or fully opened shelters, and so forth. This will be the initial phase of the conservation easement process for the Cove.

Roanoke City Council also stated that the second phase of the easement process, addressing the remainder of the site, will be determined by the future recreational site development plan (previously referred to as the Facilities Master Plan in this document). This will allow for greater specificity of where each future recreational facility may reside, what its dimensions may be, its design, and its use of sustainable materials. When the Facilities Master Plan has been adopted by Roanoke City Council, the second phase of the conservation easement process will occur.

Current and future residents of the Roanoke region can thank Roanoke leaders of the early 20th century for having the foresight to protect the regional water supply by acquiring the Carvins Cove property and leaving it undeveloped. There is broad agreement among the citizens of Roanoke that Carvins Cove is an outstanding natural resource that must be protected for the long-term enjoyment of all. Fortunately, low impact, sustainably designed recreational opportunities can be offered at Carvins Cove without impairing water quality, but this balance requires the careful planning reflected in this Management Plan and in the subsequent planning efforts that will follow.

Section 6. References

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Carvins Cove
Natural Resource Assessment

Carvins Cove Watershed
Roanoke, Virginia

June 1999

Prepared by:
Team EQR
Frederick, Maryland

Prepared for:
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Roanoke, Virginia

CONTENTS

Water Quality Assessment

'EAM EQR is studying water quality through creation of monitoring stations and analysis of hysical and biological stream conditions. Four stations have been established for water uality monitoring. Two control stations have been established within the ownership of the ity of Roanoke:

Horsepen Branch

This stream drains a substantial area of the western edge of the Carvins Cove drainage and is essentially undisturbed. The watershed contains very steep topography and is a good example of an undisturbed watershed of high relief and is therefore representative of similar conditions elsewhere in the Cove. Sampling of this stream is ongoing and the final report of findings will be issued by Engineering Concepts, Inc.

Sawmill Branch

This is a perennial stream with a watershed that is an excellent example of a western aspect drainage. It contains many undisturbed areas and has the highest quality streams in the watershed. Sampling of this stream is ongoing and the final report of findings will be issued by Engineering Concepts, Inc.

n addition, two stations have been established outside of the watershed and ownership of Roanoke:

Catawba Creek

This perennial steam is outside the ownership of the City; however, it provides significant contribution to the reservoir through a cross-basin diversion. Sampling is occuring immediately above the trans-basin diversion intake structure in order to characterize water quality inputs that directly effect the water supply reservoir. Sampling of this stream is ongoing and the final report of findings will be issued by Engineering Concepts, Inc.

Tinker Creek

As with Catawba Creek and for the same reasons, this stream is being sampled immediately above the intake for the trans-basin diversion. Sampling of this stream is ongoing and the final report of findings will be issued by Engineering Concepts, Inc.

Stream Channel Stability Assesments

INTRODUCTION

Streams are physical systems that transport the water and sediment supplied by their watersheds. Over time, channels of all sizes naturally adjust their geometry to accommodate the quantitative, temporal, and spatial delivery patterns of the water and sediment received. Land development activities alter the water and sediment regimes of streams, and often cause an acceleration of natural geomorphic processes such as erosion and deposition. The response of stream channels to land use changes in a watershed can impair in-stream biological productivity, degrade adjacent riparian habitat, diminish aesthetic values, and threaten structures.

While most of the Carvins Cove watershed is covered by mature forest, the watershed is not pristine. The agricultural history of the area had localized impacts on watershed hydrology and related geomorphic processes, and even the limited public uses available today has affected the landscape. Additional development of the City property, whether for trails, parking areas, emergency access roads, comfort stations, and the like; has the potential to adversely impact the physical functions of streams. In addition, the biological components of aquatic resources develop over time to be compatible with the dynamic equilibrium of the physical environment. Perturbations to the physical stability of fluvial systems may significantly affect biological communities. Therefore, conservation and good stewardship of the natural resources in the watershed require consideration of the physical aspects of the natural systems: specifically, hydrology and geomorphic processes.

The most common cause of impacts to streams and riparian areas are stream crossings by ford, bridge or culvert. Because they frequently occur in the landscape, their attendant structures are often damaged by stream channel response to land use changes. Since crossings cost money to build and maintain, there would reasonably be some financial incentive to design and construct stream crossings that minimize impairment of fluvial processes. In addition, much of the excess sediment typically developed during any channel adjustments would ultimately make its way to the reservoir, with the potential of increasing operation and maintenance costs, as well as impacting lacustrine habitat and Carvin Creek downstream of the dam.

One of the dominant cultural features in the Carvins Cove watershed is the service road that runs from the boat ramp around the reservoir to Carvins Cove Road (State Route 740). Due to the dense drainage net to the Cove, this road crosses multifarious channels, ranging from ephemeral gullies to Carvin Creek, a third order perennial stream. Several types of crossing structures have been employed, and resultant stream impacts range from negligible at Sawmill Branch to severe at Carvin Creek. The responses of streams to these impacts provide valuable insights for developing a land use plan, especially since many of the options for additional recreational opportunities would most logically be tied directly to this access road.

Finally, it is important to note that disturbance to streams caused by road crossings and other development in a watershed are not always manifest in close proximity to the locations of the direct impacts. Due to the interconnected nature of drainage networks, many effects may not be fully observed near the point of impact. An unnamed tributary to Carvin Creek, referred to herein as the South Tributary, provides an example of this concept and is discussed below.

The objectives of the stream channel stability assessments in the Carvins Cove watershed were:

- Develop a preliminary understanding of the physical stability of streams under the

current hydrologic conditions; and,

- Identify specific stream reaches that may be particularly sensitive to the impacts that can be expected to accompany increased recreational use.

During the course of work pursued to accomplish these objectives, stream valley characteristics, including channel geometry, valley geology and morphology, and crossing types (e.g. box culvert, corrugated metal pipe) were studied. Trends were identified on some streams that related natural geomorphic characteristics and anthropogenic structures to negative channel stability impacts.

METHODS

An initial analysis of maps and aerial photographs of the watershed included the delineation of sub-watershed boundaries and determination of stream order. A sample of sub-basins comprised of various orders from around the property was further analyzed to determine drainage area, channel slope, valley slope, and valley floor width. Drainage direction/valley aspect and proximity to likely impacts were also evaluated. This work led to the preliminary selection of representative stream reaches for detailed field investigations. The selections were further refined after a field reconnaissance conducted in November of 1998. Field work was conducted in December of 1998 and March of 1999, and entailed measurements of hydraulic geometry, particle size distributions, and observations of channel stability criteria.

Due to the lack of available survey controls, arbitrary vertical elevation data were used. A semi-permanent benchmark was installed just off the main access road, on the west side of the Carvin Creek quad-CMP crossing, and designated BM-1. This benchmark consists of an 18 inch length of 1/2 inch diameter rebar driven flush with existing grade. BM-1 was assigned an arbitrary elevation of 200 feet, and all vertical measurements surveyed in Carvin Creek (cross sections and profiles) were tied to this datum. This information is presented in Appendix A. For data collected from the North Tributary to Carvin Creek, a temporary turning point, designated TP-1, was assigned and arbitrary elevation of 100 feet, and the profile and cross section elevations are relative to this datum.

All cross sections were marked in the field with wooden stakes driven near both endpoints and flagging tied onto nearby woody vegetation. Notes on cross section stakes identified the sections and precise locations of the stakes on the surveyed line (e.g. C/S 1, 0 + 5). The three cross sections measured on Carvin Creek also had 12 inch lengths of 1/2 inch diameter rebar driven flush with existing grades near the endpoints. This practice allows precise comparisons with any data that may be collected in the future to monitor the hydraulic geometry.

RESULTS AND DISCUSSION

During the November reconnaissance and subsequent data collection activities, eight stream segments were evaluated. These stream segments are approximately located on the enclosed map and briefly described below.

Horse Pen Branch

The stream segment observed begins at the crossing of the abandoned access road and extends downstream to the reservoir. The stream flows through the valley between Brushy Mountain and Green Ridge, where the prevalence of bedrock exerts substantial influence on both channel and valley morphologies. Horse Pen Branch is very stable throughout nearly its entire length, and the existing channel geometry is consistent with published regional relationships between hydraulic geometry and drainage area. Bed material varies locally between bedrock and a mix

of medium cobble and coarse gravel. A misalignment of the aforementioned road crossing has caused some minor bank erosion, but the prevalence of bedrock through most of the stream's course has prevented serious impacts.

The road interrupts surface flow from Brushy Mountain, and a sizable gully can be observed along portions of the road's northwest side. The gully has effectively captured flow from two first order tributaries. Although no significant adverse impact to Horse Pen Branch could be discerned, this artificial stream may contribute to sedimentation in the lower reach of Horse Pen Branch by reducing stream power.

The lower reach, extending a few hundred feet up from the reservoir, appears to reflect the influence of backwater from the lake on sediment transport. Coarse sediments have been deposited in the channel, and the width/depth ratio increases significantly compared to the adjacent upstream reach. Cutting in the lower bank region is also evident, as the channel seeks to regain the hydraulic capacity lost to the sediment deposition. The condition is not severe and the valley broadens along this lower reach, with ample area to accommodate lateral adjustment.

The old road appears frequently used by mountain bikers, and a few side trails veer off into the woods on both sides of the road. The geologic controls of the valley indicate this stream would be relatively insensitive to minor impacts. A small parking area or other increases in impervious area, for example, should not have detrimental impacts on the stream, provided an appropriate setback is used. Should repairs to the road be contemplated, it would be important to install proper crossings for the two tributaries presently impacted. In addition, two dilapidated crossings, the previously described bridge over Horse Pen Branch and another, similar structure over a tributary, presently pose public safety concerns. If significant increases in use are planned for this area, these structures will require substantial repairs or removal.

A benthic monitoring station has been installed near the upstream limit of the lower reach, which will provide water quality data.

Brushy Mountain Tributary

This stream is a second order tributary to Carvin Creek that drains approximately 0.3 square miles of the northwest side of Brushy Mountain. The subject reach begins near the Cove's western entrance gate at the end of Route 740, and extends approximately 400 feet downstream of the 60" corrugated metal pipe (CMP) crossing of the road up Brushy Mountain. The stream flows in a northerly direction parallel to the primary access road. The valley segment is influenced by both hillslope and fluvial processes. Colluvium from Brushy Mountain provides abundant material for transport, but because the subject reach is situated on a terrace of Carvin Creek, it is not confined.

In general, the channel is stable upstream of the culvert crossing, with good access to an incipient floodplain, a moderate width/depth ratio of about 12, and moderate sinuosity. No indications of abnormal erosion or deposition were observed upstream of the CMP. Immediately downstream of the 60" CMP, a four foot deep scour pool has been cut, and the stream channel is severely degraded. This segment is characterized by four to six foot bare vertical banks that appear to be actively eroding at accelerated process rates. At one place, approximately 200 feet downstream of the CMP, cutbank erosion has about reached the road. A small ephemeral tributary that comes down the north side of the road up Brushy Mountain enters the subject tributary near the CMP from the east-southeast. This tributary is also actively downcutting in response to the lowered elevation of the receiving stream's bed. In a few locations the receiving stream appears to be in the process of constructing a new floodplain appropriate for the lowered bed elevation, which suggests that channel adjustments are well

underway in response to perturbations caused by the culvert.

The accelerated erosional processes likely to occur will continue to provide excessive amounts of sediment to downstream reaches and, ultimately, the reservoir. Any development in this sub-basin should provide for quantity control of stormwater runoff because any significant alteration of the stream's hydrologic regime would probably instigate a new series of channel adjustments. In addition, water quality management should be included in the design of any parking areas under consideration, because petroleum based pollutants would be carried downstream via adsorption onto sediment particles.

A precise determination of the cause(s) of this stream's instability is beyond the scope of work. However, since the downcutting does not extend upstream of the CMP, it is evident that this structure is presently providing important grade control. Given the depth of the scour hole, the duration of any continued protection of upstream reaches by the CMP will have a limit. Since this reach has demonstrated sensitivity to impacts, any changes to this 60" CMP structure should be carefully designed, with particular attention to slope, capacities, and the distribution of capacities for various flow events.

Carvin Creek Reach 1

Carvin Creek is the dominant fluvial feature in the Carvins Cove watershed. Above the reservoir, it is a third order stream that flows mainly from southwest to northeast, and drains the western-most third of the City's property. On City property, the stream is crossed once by the main access road, about 0.25 miles inside the Route 740 gate, and typically flows between 250 and 700 feet to the southeast of the road. Reach 1 extends upstream from the crossing approximately 650 feet. The crossing utilizes four 48" corrugated metal squash pipes. Drainage area to the crossing is approximately 3 square miles.

The stream has been channelized for approximately 250 feet upstream of the crossing, with excavated material deposited on the floodplain. Upstream of the channelized section, the stream traverses a broad alluvial valley and appears to be very stable. The substrate is composed of very coarse pebble gravel (D50 = 42 mm), which provides good benthic habitat. The width of the bankfull channel is 23 feet, and the mean depth is about 2 feet (Appendix A, Figure 1), both of which are consistent with regional relationships to drainage area. The bedform is riffle-pool, with an average pool spacing of 150 feet, or about six channel widths (Appendix A, Figure 2). This stable segment of Carvin Creek appears to be transport limited, and allows for sediment storage.

The transition zone between the stable reach and the channelized segment is somewhat unstable. As indicated in the 0 to 60 foot portion of the profile shown in Figure 2, the riffle slope is significantly greater than the slopes of the two next riffles upstream (approximately 130 ft. to 210 ft., and 170 ft. to 395 ft. on the profile). The channel appears to have downcut in this transition section, and the cutbank on the south side of the channel is undermined. This area should be monitored, as remedial measures may be necessary to prevent degradation of the upstream reach.

Quantitative data were not collected in the channelized segment, although observations of copious backwater during the drought indicate an overly deep and flat channel. The excavated material was placed on the floodplain in riparian wetlands in such a manner that surface drainage to the channel is impeded and the stream's access to its floodplain is reduced. The crossing and channelized stream retard the flood attenuation function of the riparian zones and severely degrade habitat. Additional impacts from this crossing to downstream reaches are described below.

Given the sensitive nature of the resource, the design of any improvements to the road or crossing should include a thorough understanding of this stream's hydrology and sediment transport dynamics. In addition, if any parking lots or other structures that would create impervious surfaces are developed, adequate stormwater management should be provided.

Carvin Creek Reach 2

This reach runs downstream from the quad-CMP for a distance of approximately 4,000 feet. This stretch of river flows through a broad alluvial valley, where there is a great diversity of landforms. However, the relatively resent creation of these features indicates that the reach is presently in the midst of substantial channel adjustments.

Profiles measured from a representative portion of the reach are presented in Appendix A, Figure 4. In contrast to the thalweg profile for the stable reach shown in Figure 2, the data from Reach 2 describe an erratic stream bed. In addition, the absence of significant riffle sections is an indication of degraded habitat conditions. Cross Section 2 (Appendix A, Figure 3) depicts Carvin Creek about 65 feet downstream of the quad-CMP crossing. Both sides of the channel appear to have been altered to accommodate the road and crossing, although the extents of fill on the left side of the stream are not clearly discerned. The centerline of the access road is at about 47 feet of the abscissa shown in Figure 3.

Farther downstream, oxbows, avulsions (chute cut-offs), and high flow channels are abundant. Natural levees and terraces at two elevations are also present, if discontinuous. Some of these features are identified on the graph of Cross Section 3 (Appendix A, Figure 5). Limited colonization by vegetation on many of these features suggest they have been created in the recent past. This hypothesis further supported by spatial distributions of both coarse gravels and sands, the lack of significant organic material (humus) on depositional features, and the limited embeddedness of large woody debris. Large woody debris is excessively abundant, and many debris jams block the channel. While large woody debris can serve important functions for sediment storage, energy dissipation, and aquatic life, too much will greatly exacerbate channel stability problems.

The causes of channel instability in this reach are complex and a thorough determination requires analysis of the road crossing with correlations to flow events. It is important to understand that small frequent flows (those which occur on average about once a year) create the dimensions of stream channels and shape adjacent landforms. Therefore, without human restoration efforts, many years will be required for the stream to re-establish an equilibrium condition. During that time, tons of sediment will be sent downstream, trees will be lost to failed streambanks, and additional aquatic habitat will be impaired.

We believe some level of stream stabilization effort should be attempted. As exemplified by conditions at the South Tributary, the degradation of Reach 2 has instigated channel response in tributary streams. Failure to address channel stability issues in Carvin Creek will have ramifications throughout the drainage network.

South Tributary to Carvin Creek

This is an unnamed tributary that enters Carvin Creek Reach 2 about 4000 feet upstream of the reservoir. The subject reach extends upstream from the confluence with Carvin Creek and across a high terrace for 150 feet. This channel is actively eroding in response to changes in the receiving stream, and provides an illustrative example of how localized impacts can spread throughout a watershed. As stated above, the specific causes of instability in Carvin Creek have not been completely identified, and therefore a precise history of erosion and deposition at the confluence with the South Tributary is not known. However, Carvin Creek Reach 2 carries

a very high sediment load, is transport limited, and stores a large volume of sediment in the active channel. These factors imply that significant depositional features (bars, levees) are in flux, and therefore the channel is continually eroding to maintain hydraulic capacity.

The tributary enters Cravin Creek in the cutbank of a meander bend, where the receiving stream channel curves around from northeast to northwest. Fairly recent lateral adjustments in Carvin Creek are manifest by an oxbow upstream of the confluence and the over-extension of the point bar opposite the tributary. As the point bar grew into the stream, channel capacity was reduced and shear stresses on the opposite bank and streambed increased. As a result, a deep scour hole formed and a large sycamore tree that was undermined fell across the channel downstream of the confluence. At this location, Carvin Creek is now narrower and deeper than it had been for the period of time during which the tributary was stable and in contact with its floodplain.

The South Tributary is now eroding headward, both laterally and vertically. A knick point and a debris jam, located 67 feet and 78 feet upstream of the confluence, respectively, approximately define the transition zone between the stream segment currently undergoing major adjustments and apparently channel stability. Appendix A, Figure 6 depicts two cross sections measured 61 feet and 133 feet from the confluence. As described on the figure, the width of the tributary has more than doubled, and the mean channel depth has increased from less than 1 foot to more than 3 feet.

Much of the sediment removed by erosion has been deposited at the confluence in a delta shaped feature. This indicates that the debris jam associated with the big sycamore tree induces a backwater effect that impedes sediment transport in Carvin Creek. However, calculations from rough field measurements indicate that about 110 cubic yards of material have been eroded from the tributary channel, and about 32 cubic yards are present in the deposit. Therefore, Carvin Creek has moved about 78 cubic yards of material, or 70% of the excess sediment provided by the tributary.

Following the principle of headward erosion, we can predict that the perturbations manifest in the lower 70 feet of the South Tributary will migrate upstream until geologic or other controls arrest the process. It can also be postulated that similar degradation will occur on other tributary streams where receiving streams downcut rapidly through similar valley geology and base levels are lowered.

North Tributary to Carvin Creek

This first order tributary drains a small portion of Tinker Mountain, flowing intermittently from northwest to southeast, and entering Carvin Creek about 4800 feet upstream of the reservoir. The subject reach extends 300 feet up from the confluence to an old house place on the northwest side of the main access road. It appears that surface hydrology was impacted when the road was initially cut into the hillside. A small wetland area has developed on the slope between the road and the old foundation. The wetland includes a small outlet channel, approximately 3 feet in width, which is conveyed under the road by a 24 inch CMP.

The pipe appears to have been the subject of considerable maintenance, and the road continues to erode at the outfall. Approximately four linear feet of pipe are exposed. The road is presently undermined by a 5 foot deep scour hole at the outfall, as shown on the thalweg profile presented in Appendix A, Figure 7. Crossing failures of this type are commonly the result of inadequate considerations of channel capacity and slope. As seen in Figure 7, the slope of the pipe is not consistent with either the channel slope or the landform slope. The stream itself is relatively insignificant, as it is doubtful that sub-basin hydrology is sufficient to deliver a detrimental amount of sediment to Carvin Creek. From a land use perspective, this stream was

described to illustrate public safety and maintenance issues that can arise from poorly designed or constructed stream crossings.

Sawmill Branch

Sawmill Branch is a third order stream flows into the north end of the reservoir. The catchment includes the northern quarter of the City property, and extends up Tinker Mountain to an elevation near 3000 feet. The basin is rugged and steep, and dissected by numerous first order tributaries. Geologic structure and lithology influence channel geometry, as the streams are mostly steep, incised, and have low width/depth ratios.

The subject reach begins at the water quality monitoring station downstream of the access road, and extends upstream for a distance of about 150 feet. The valley segment is near the up-valley limit of alluvium, and both sediment supply and sediment storage are important processes. This implies that colluvium from up gradient hillslope processes is stored in this valley segment, and moves episodically down gradient, both by fluvial and hillslope processes. The sediment delivered to the channel by more frequent runoff events, while substantial, appears to be well accommodated by the stream. Bedforms include both step-pool and riffle-pool sequences, and the substrate ranges from coarse pebble gravel to cobble gravel.

The crossing consists of a concrete box culvert, which appears to be several decades old. This crossing appears well suited to the stream, as there are no indications channel instability. Channel stability can likely be attributed to adequate culvert capacity and the natural substrate. Bottomless culverts, like clear span bridges, do not force bed slopes on channels. In addition, when adequate capacity is provided, channel bedforms that are an integral component of sediment transport processes can be maintained.

Rocky Branch

An approximately 1200 foot reach upstream of the picnic area was walked. This second order stream flows from east to west, entering the Cove near the boat ramp. The substrate is almost entirely cobble, and the bedform is step-pool. Upstream of the road crossing the stream is very stable. Downstream the channel has eroded, and some fill material appears to have been placed on the south side of the stream. The road crossing appears to have been recently improved, and the affects of the repairs on downstream erosion cannot yet be determined. This area should be closely monitored. Given the high public use, stabilization of the reach downstream of the crossing may ultimately reduce maintenance costs.

CONCLUSIONS AND RECOMMENDATIONS

In the Carvins Cove watershed, the most conspicuous difference between apparently stable streams and those which appear to be actively adjusting, is the valley materials. The Carvin Creek valley is comprised of alluvial fills, which are less resistant to erosion. In addition, the broad valley floor allows Carvin Creek considerable freedom to adjust laterally, cutting through these fills and sending the sediment downstream. Because the South Tributary and the Brushy Mountain Tributary are cut on alluvial terrace deposits, they, too, have demonstrated a high susceptibility to disturbance. Conversely, the valleys containing Horse Pen Branch and Sawmill Branch have considerable influence from hillslope processes. The prevalence of bedrock and coarse, poorly sorted colluvium is more resistant to erosion.

If recreational opportunities on the property are to be expanded and better managed so as to reduce adverse environmental impacts, the geomorphic processes at work in the stream valleys should be considered. Common sense suggests that new facilities should be set back from streams, but the extent of the appropriate setback can be increased or decreased depending on

the stream and valley. Along Carvin Creek, for example, the setback for new facilities should be measured from the edge of the high terrace, with the distance determined by the proximity of the active channel to this landform. In addition, stormwater management should be a high priority for anything built in this drainage.

As described above, inadequately designed stream crossings can have far ranging impacts in the watershed. New access roads or improvements to the existing road can be designed to minimize impacts, but doing so requires site-specific evaluations of channel hydrology and morphology. In general, the following guidelines should be considered:

- crossings should be located at straight reaches, preferably at riffles;
- approaches and the crossing should be at right angles to the bankfull channel;
- bridges and other bottomless structures, such as concrete box or corrugated metal arch culverts, are best;
- the primary sizing criteria for CMP's should be the dominant discharge of the stream, with higher flows conveyed by additional pipe(s) installed at elevations consistent with geomorphically active floodplains;
- determining the appropriate slope for CMP's requires assessing the overall channel slope (measured along 10 to 20 channel widths assuming consistent channel geometry) and the slopes of impacted bedforms (e.g. riffles and pools); this is particularly important if the pool-pool spacing may be altered because of the required length of pipe;
- grade control structures, such as cross veins, should be included in outfall protection design;
- proposed distances to meanders, both upstream and downstream of crossings, should be measured to determine if bank stabilization measures are necessary.

In addition to reducing stream impacts, following these guidelines will reduce maintenance costs.

Forest Assessment

METHODS

The forest analysis began with a review of remotely sensed data including USGS topographic maps, recent aerial photography, nontidal wetland inventory maps, and soil surveys. A prelimnary stand assessment was performed to identify major forest stands and environmental features. A site constraints map showing the location of forest stands, steep slopes, streams, wetlands, and other areas sensitive to development was prepared from this reconnaissance. This map was used to focus attention of planners to areas where development/recreation would be least likely to degrade water quality. These areas were defined as the new project area.

Within the new project area, a more intensive sampling program was conducted. We utilized random and stratified random data sampling methods to fully characterize the forests of the new project area. Data collected on each cover type included dominant and co-dominant trees, understory type, range of sizes and average tree size, shrub layer, groundcover type and distribution, and basal area. General observations of past management, wildlife use and impacts, fuel loading, and exotic/invasive plants were noted. Vegetation was also examined for damage that was the result of existing recreation, such as limbs broken from trees protruding over trails, and tree roots damaged by horses' hooves. Erosion, loss of groundcover, soil compaction, and trunk and root damage were observed in the picnic area. This damage is from vehicles driving and parking in the area and concentrated foot traffic over the site, as well as vandalism and other sources.

FINDINGS

FOREST COVER TYPES AT CARVINS COVE

The following is a general description of forest cover types identified through remotely sensed data and field verification:

Stand Type 1. Mixed Oaks-Hickory-Beech

This stand type comprises most of the watershed. Oaks primarily include white, northern red, southern red, and chestnut and are approximately 50 - 60 % of dominant trees. Hickory account for an estimated 15 - 20% of dominant trees. Beech are scattered throughout the stands. Dominant trees vary from 10" to 18" DBH and average 14" DBH in most stands. There are some patches of smaller trees of this type, mostly on the north or northeast slopes near the crest of Brushy Mountain. The understory is mostly dogwood, beech, and saplings of oaks and hickory. Mountain laurel predominates at the higher elevations.

Stand Type 2. Red Maple-Yellow Poplar

This stand type is most often found in the lower elevation in ravines and stream bottoms where there is more moisture than on other parts of the site. Areas with little slope may have 50-60% poplar, but most are about 20-30% poplar and are dominant by maple. Dominant trees range from 10" to 16" DBH and average 12".

Stand Type 3. Mixed Oaks-Red Maple-Yellow Poplar

The upper slopes of ravines and some stream banks in very rocky/gravely areas often contain this type. The dominant trees are typically 10" - 16" DBH and average 14" DBH for maples and poplars and 12" DBH for oaks. At higher elevations, all species decrease in size and number with oaks becoming more numerous.

Stand Type 4. Mixed Oaks - Virginia Pine

Below about 1500 feet and especially around the fringe of the lake, oak stands contain significant numbers and sizes of Virginia Pine. The oak stand are similar to Stand Type 1 except the beech are replaced with pine.

Stand Type 5. Virginia Pine

There are several stands of almost pure Virginia pine within the watershed. These stands include planted stands along the fringe of the upper lake and stands that line the slopes of stream valleys throughout the site. The pine are typically 8" - 16" DBH and average 14" DBH for dominant trees. This pine species is very subject to windthrow, as demonstrated within virtually every stand. Those stands that receive higher and more frequent wind especially exhibit deadfalls and hung-up snags. This condition, in addition to the tendency of the trees to have persistent limbs, produces high forest wildfire fuel loading in several of the stands.

Stand Type 6. White Pine

White pine stands are located along the access road along the fringe of the upper lake. They were planted by the CCC in the late 1940's and are now overstocked. Dominant trees are 12" - 16" DBH and average 14" DBH with a basal area of about 250. This means the stand is grossly overstocked and should be thinned at least in order to provide less competition for the remaining trees and help ensure stand health.

Stand Type 7. Black Willow-Red Maple-Sycamore

The bottomland is subject to flooding, especially in the upper reaches of the lake, and contains moist-site species tolerant of fluctuating water conditions. These trees provide some water filtering, erosion control and wildlife habitat. Most of the trees are less than 8" DBH. Sycamore account for most of the trees larger than 8" DBH. Associates in these type are alders, sweetgum, and other typical bottomland species.

Stand Type 8. Scrub/Shrub

Areas that have been opened by wind, ice damage, or other natural occurrences have frequently become shrub/scrub area. These spots are small and scattered throughout the property. Some occupy old agricultural field, while others are remnants of understory trees that remain after the overstory was downed by a storm. In the latter, black cherry, dogwood, red maple, and sweetgum are often found. These trees are seldom over 6" DBH and average 4" DBH. Grasses, briars, greenbriar, and wild grape create brushy conditions. It was noted that deer prefer these areas during the mid-day and they are used by birds as feeding areas. The power line cuts in the eastern shore of the lake contain this habitat type when they have been left uncut for several years.

;TAND SAMPLING DATA

\s described in the Methods section of this report, more intensive sampling was conducted ıfter the inital study in areas rated as suitable for increased recreational development. The :omposition and diversity of these stands can be presented as follows:

Virginia Pine Stands

Virginia pine stands generally are either young sapling to pulpwood types or pulpwood to sawtimber types. In the former, average tree sizes range up to 8" DBH with basal areas in the 80 to 100 range. These young stands are often found on the fringe of older stands, in former openings that the pines have colonized, or on other areas that have been fairly recently disturbed. They occupy relatively little area on the tract. Because the trees are typically less than 50' high and the stands are dense, windthrow is not a serious problem.

The Virginia pine stands more typical of large areas of the site are 8" - 16" DBH, and average 12" DBH. These stands frequently have heavy fuel loading (downed debris) associated with them as their size is within the range at which Virginia pine begin to become susceptible to blowing over. Basal area in these stands is from 150 to 170 on sites with a site index of 70 - 80. Under usual conditions (i.e., on private property with routine forest management), these stands would be thinned to increase sawtimber volume, reduce windthrow losses, and recoup some costs of investment. On this property, these stands are the best candidates for development provided the entire stand is removed to avoid risk of damage or injury from windthrow from remaining trees.

White Pine Stands

Besides the Virginia pine stands, there are planted white pine between the lake and the gravel access road, near the northwest entry to the park. The pine are 10" - 16" DBH and average 14" DBH, with a basal area of 230 - 290. These very dense stands have minimal downed debris and a 1 " thick needle duff. White pine are not very susceptible to windthrow. The white pine stands, due to the relative safety and their location, would be excellent locations in which to establish campgrounds, picnic areas, interpretative centers, or other uses. The sheltering effect of the stands is attractive to visitors; wildlife habitat loss would be minimal, and the slight slopes plus maintenance of filter strips could control water quality impacts.

The pine stands offer less wildlife habitat and biodiversity than hardwood stands. They do provide excellent water control and quality benefits, especially on sites where hardwoods may not flourish (ex., rocky, dry sites with thin organic soil development).

Hardwood Stands

The hardwood stands can be classified into four basic types: yellow poplar and mixed oak stands, bottomland hardwood stands, mixed oak stands, and mixed hardwood with scattered Virginia pine.

The yellow poplar and mixed oak stands are most often found along intermittent streams on steep slopes. These stands provide water quality control as well as other environmental benefits. Trees range up to over 30" DBH, with average dominant trees in the 16" - 18" DBH class. Understory includes dogwood, red maple, oaks, and hickory.

Bottomland hardwood stands most often border lower-elevation streams where there is less slope and sometimes a floodplain. Sycamore dominate, with red maple, mixed oaks, and hickory throughout. The understory is usually dogwood, persimmon, maple, and redbud. Black

cherry are scattered. Trees range from 6" to 24" DBH, and dominant trees average 14" DBH. Some of these areas include spicebush, wild grape, foxtail grass, and yellow poplar. The stands have better structure development and more diverse species mix than most of the other stands on the property. Exotic invasive plants are usually less than 10% area coverage, although there is heavier coverage near roads and other openings.

Mixed hardwood stands are primarily white and red oaks with hickory, yellow poplar, and red maple appearing as scattered trees on dryer sites, or in clusters of up to 30% of the total tree cover on moist well-drained areas. The dominant trees range from 10" to over 30" DBH, and average 16" DBH. Dogwood, redbud, and mixed oaks form the understory. Groundcover is sparse in many areas. Greenbriar shows heavy browsing by deer throughout the site; hardwood sprouts are moderately to heavily browsed in most areas; highbush blueberry and other shrubs have low browse levels. Litter is approximately 1" deep, which is thin for a mid-successional stage hardwood forest of this density.

The mixed hardwood with scattered Virginia pine type accounts for most of the property. Hardwoods are mostly white, scarlet, and northern red oak with dominant trees averaging 16" DBH. There are pockets of white oak that show old, severe gypsy moth damage. Understory is the same species as well as hickory, dogwood, and redbud. Blueberry and greenbriar are the most common shrubs.

CONCLUSION

One of the goals of the Carvins Cove Watershed Management Plan will be to provide the City and affected area residents with land use alternatives that will preserve and protect the current water quality of the reservoir. Out of the virtually infinite alternatives that can be proposed for management of the property, only a few are expected to meet the expectations of the City managers (i.e., maintaining or improving potable water supply quality) and the public (i.e., providing increased recreational opportunities.

The alternative selected must meet these two basic criteria and, in addition, should (and is certainly expected to) be able to produce most recreation benefits without significantly reducing other reservoir benefits. Financing, public health and welfare, and logistics must also be considered.

The land adjacent to the lake and streams on the watershed serves not only to provide food, cover, and breeding habitat for fish, wildlife, plants, and organisms but is also important for its potential for recreation, tourism, and revenue.

A recreation management plan is being developed to address the most significant risks to the stability of the land, lake, and streams; to the habitat on the property; and to the reliability of a safe water source for Roanoke. A preliminary review of the property to identify the existing conditions and these risks has been completed. Several vegetation-related issues or elements were identified as needing further study in order to classify and rank their importance or significance to management of the property, and to help identify alternatives for risk management under a variety of (potential) recreational uses.

Threatened and Endangered Species

Rare, threatened, and endangered species have been either identified in the area, or habitat types that typically support these species have been identified, or both. The State and Federal listing of species as threatened or endangered gives them special status, and positive identification of these species or reasonable (science-based) suspicions they may occupy the site dictate an investigation as part of the site study. The preliminary study helped locate areas

where the "suspects" may be found, and further review of documentation, interviews with knowledgeable professionals, and other research will be followed by a focused search in the field. Seasonal variations will dictate when specific studies are conducted. Species confirmed to occupy the site will be documented, their locations mapped, and their requirements for protection considered as part of the development of the land use plan.

Biodiversity

The vegetative biodiversity of the site (the mix of species; the number of species types and variations, number of each species, and species distribution) is directly related to other site characteristics. The initial evaluation provided information that bolsters document reviews, aerial photo analysis, and other investigations. This evaluation identified three dominant habitat types and numerous smaller habitats. Eight different forest stands were identified. Therefore, the biodiversity of the site was high and the site itself contributed significantly to the biodiversity of the region (see Habitat Assessment). A possible management goal could be to maintain and/or increase the biodiversity through manipulation of the system. Any manipulation certainly should be compatible with naturally-occurring processes that could or would have increased the biodiversity. For example, the property contains planted conifer areas, old fields, gypsy moth mortality areas, and areas with heavy wildfire fuel loading that could be manipulated to provide increased habitat for certain plants and animals that are desirable on the property, but currently not found or in small numbers.

Timber Management

Admittedly, a timber harvest is not aesthetically pleasing for a period following logging. However, there are significant timber resources on the property, including planted conifer stands that were established primarily to provide revenue. Limited, specific, planned timber management is compatible with recreation and watershed management, and can increase biodiversity while reducing wildfire risk and insect and disease populations. Commercial forestry practices can promote recreational use, and be conducted in a manner that avoids significant water quality impacts. The revenue would help finance improvements and/or programs on the property or elsewhere. Professional forest management should be considered as an element of the City's overall management plan, as the entire tract is forested. This does not necessarily mean that there should be logging on the site, however, the monetary value of forest products should be considered. "Forest management" is more than logging; it encompasses the entire spectrum of natural resources management (trees and other vegetation, wildlife and wildlife habitat, water quality/hydrology, and recreation). On this property, timber revenue is not expected to be a primary consideration for management alternative selection. Tree harvesting could play a role in opening vistas; providing wildlife feeding, nesting, and/or viewing areas; reducing wildfire hazard; providing tree planting areas; clearing for recreational or other development; and other purposes. A coordinated, planned harvest could produce revenue sufficient to make the effort worthwhile as well as conserve the resource rather than waste it and create a disposal problem. It is important to have "recruits" for the existing trees: young trees that can take the place of older trees when they die or are removed. Forest structure also includes the shrub and herbaceous development within the stand.

Preliminary site sampling indicates most of the site has developed a recruit system and forest stands with moderate to good structure. Further analysis will be conducted to confirm this impression, and to map areas where the forest structure is poor. (The development of forest structure typically varies inversely with intensity of recreational use.) Additional investigation will be conducted to identify opportunities for forest management that enhance recreational use while providing other benefits, especially hazard reduction.

Wildfire

Fuel loading has developed to extreme danger levels in some areas of the watershed. Fuel sources include windthrown trees, limbs and other debris from ice storms and pest-killed trees, heavy leaf and needle litter buildup, dense growth of inflammable-leafed (waxy-coated, resinous, or similar) shrubs and saplings, and other sources. The property has no wildfire break system, although the primary access road could serve as a firebreak in some areas and under some circumstances. Risk of wildfire increases with greater public access. The property is crisscrossed with hiker/biker/equestrian trails that provide public access without being any use for access by almost any firefighting vehicle or powered equipment. There is no pressurized water (especially fire hydrants or stand pipes) except at developed areas (the dam and the boat ramp areas); water is not available to the property in general except at the lake. The investigators believe that there are no wildfire hand tool caches, or any wildfire suppression tools whatsoever, on the property. In any event, current staff is not trained in wildfire prevention and suppression, and has no knowledge of the use of suppression equipment. Reportedly, City firefighting crews would respond to a wildfire at the reservoir, but the gravel access road around and through the site will not allow turnaround of firetrucks except at a handful of points, and then only short (pumper) trucks of small capacity. Lack of proper equipment and training in wildfire suppression significantly reduces the probability of local efforts successfully and safely controlling and suppressing a wildfire here, and rules out using fire as a (habitat) management tool or to reduce the existing wildfire danger.

[In past cases of emergency response, security vehicles had to partially evacuate an injured biker because the ambulance could not travel the access road due to potholes, washouts, and other problems. Under these or even somewhat improved conditions, travel by a loaded firetruck would be impossible.]

The Virginia State Department of Forestry has indicated to the City that they would respond to a request for wildfire suppression assistance, most likely via helicopter and drop bucket. However, the City must consider the time involved for processing a request through proper channels, preparing a helicopter unit (assuming one were available), travel time to CC, and the logistics of delivery of water to a fire. In addition, helicopter or other air drops are not sufficient by themselves to extinguish a large wildfire; ground crews typically are used in coordination with air support.

Virginia pine is prone to windthrow, especially when in small stands and 10" DBH or larger, and exposure to wind on steep slopes increases the risk of tree loss. Stands "thinned" by wind become more susceptable as the stand opens up. Studies indicate that in some Virginia pine stands on Carvins Cove, downed tree trunks alone account for as much as 60 - 63% of the standing wood volume, which may be 18 - 20 cords per acre. Limbs and other woody material plus forest litter (pine needles and leaves) add to the fuel loading.

Forest Aesthetic/Educational Potential

This property provides many opportunities for natural resources interpretation and appreciation for citizens of all ages and backgrounds. The first phase of site study has revealed many potential interpretive sites and elements that can be used to increase knowledge of natural communities, their functions and values, and man's relationship to nature. Additional work on the site will encompass the review of these opportunities, and an increased focus on identification of specific interpretation/education goals and locations. The cost and impact of natural resources interpretation/education is typically very low, especially compared to the positive results from site visitors. These results include quantifiable benefits such as reduced litter and vandalism, and other benefits such as increased participation in conservation programs (recycling, water conservation, etc.).

Interdisciplinary Interaction and Coordination

Future studies will continue to be coordinated with other disciplines which are investigating the property in order to provide a clear and accurate assessment of the site. Consultation and teaming with other professionals provides opportunities to discuss and evaluate the elements of the site not only as individual components, but as an ecosystem. Joint studies have identified areas needing additional study and focus. An example is the relationship between stream stability, water quality, vegetative cover, land (recreational) use, and site design.

Habitat Asessment

INTRODUCTION

The City of Roanoke is responsible for the management of the Carvins Cove water supply reservoirs. The reservoir is surrounded by over 14,000 acres of forest that includes almost the entire watershed. Woodlands are dissected by numerous multiple-use trails, paved roads. parking areas, picnic shelters, a boat launch and miles of unpaved roads. These features are used by hikers, fishermen, mountain-bikes, horseback riders, all-terrain vehicles, law enforcement patrols, and fire prevention personnel. Roanoke has requested this study to analyze the potential impacts of recreational uses on the watershed. This section examines the effect of recreation on plant and animal habitat.

A study team consisting of Jim Cook (Licensed Professional Forester), Dennis LaBare (Aquatic Resource Specialist), and Rich Pais (Certified Wildlife Biologist) conducted several comprehensive tours of recreational paths at reservoirs during fall, winter and spring of 1998 - 1999. Visual inspections of erosion, vandalism, and habitat disturbance were made during each visit and findings were recorded according to the type and severity of disturbance. All species of terrestrial vertebrates seen, heard, or positively identified by prints or scats were noted. Following site inspections, a comprehensive literature search was conducted to determine the possible impacts of recreational use on habitats. This report provides background information and specific details on habitat impacts at Carvins Cove.

BACKGROUND

Carvins Cove is unique because it contains all the aspects and exposures of a complete watershed with considerable changes in elevation. In addition, the large number of perennial and intermittent streams, ephemeral wetlands, and the reservoir itself create a unique combination of wildlife habitat types. The watershed is also unusual because land management activities have been minimal for over 50 years and human visitation on the site is relatively infrequent although locally intense. These factors combine to produce a relatively high biological diversity compared with other large woodland tracts in the region.

Mountain bikes (Figure 1), horses, and all terrain vehicles can severely alter the vegetation structure and composition of natural forest communities. Trails and fire roads can serve as the entry point for aggressive and/or exotic plant and animal species that can displace native species (Brothes and Spingarn 1992). The ecosystem impact of these species can become severe if the area and frequency of disturbance is recurrent. For example, Drayton and Primack (1996) reported the decline of 38 percent of the original native plant species from a 400-ha woodland park in metropolitan Boston over a 100 year period. They believe that this decline was caused by several factors including an ". . . increasing number of trails and carriage roads". Adkison and Jackson (1996) reported significant changes in plant composition, decreases in organic matter, and increased soil compaction near foot trails in midwestern U. S. Forests. They also observed decreases in productivity as measured by vegetation characteristics such as cover, abundance, and height.

Floral habitat changes near trails are initiated by two primary factors: direct mechanical injury/removal and indirect mortality caused by soil changes (Kuss et al. 1990). We observed both conditions during our field visits (Figure 2 and Figure 3). Trampling and vehicle use causes soil compaction, increased soil density and penetration resistance, changes in soil structure and stability, losses in litter and humus layers, reduced infiltration rates, greater runoff, and increased erosion (Cole and Schreiner 1981). These changes can alter soil biology and chemistry

and cause the micro flora and fauna of the soils to change (Duffey 1975). The combination of these factors causes native plant mortality (Hartley 1976) and creates conditions suitable for exotic/invasive plant colonization.

The size of degraded habitats caused by recreational uses in forested situations, such as Carvins Cove, has been well documented. Early research indicated that the zone of trampling was limited within 2 to 3 meters of trails (Dale and Weaver 1974). However, more recent studies indicate that habitat changes extend well beyond the direct impact zone and in some cases the rate of species richness decline may be inversely proportional to the degree of disturbance (Cole 1982; Jones 1978; Merriam et al. 1973; Bell and Bliss 1973; Allcock 1973; Singer 1971). This means that light recreational use can cause greater habitat changes than heavy vehicular traffic. We believe that this may be due to the following:

1. The probability of the removal of rare plants increases with the time spent observing a habitat.

2. The opportunity for alien plant seed dispersal increases proportionally with the time spent in contact with each habitat.

3. Soil compaction spreads as recreational users diffuse from poorly defined trails.

4. Trail maintenance and soil erosion control measures are seldom instituted on trails which do not receive vehicular traffic.

The aerial extent of habitat changes is positively correlated with the amount and duration of use received by a trail (Bratton et al. 1977; Merriam et al. 1973). Most importantly, herbaceous forest cover is generally considered the most vulnerable vegetative type to trail impacts (Cole 1979).

Wildlife impacts of recreational trails are often correlated with changes in plant communities (Robbins 1984). For example, the loss of native herbaceous groundcovers can severely alter the habitat suitability of an area for ground nesting birds (Adams and Barret 1976). Further, direct impacts such as fright and harassment caused by humans and domestic animals will result in permanent shifts in wildlife populations. For example, the Eastern wild turkey (Meleagris gallopavo) is present throughout the property. It has been reported that turkeys make dramatic shifts in behavior patterns in response to frequent human interaction (Bailey et al. 1981). Turkey hens avoid nesting near open roads (Still and Baumann 1990) and reduce visitation to prime habitats in heavily used off-road vehicle areas (Wright and Speake 1975). By contrast, roads with controlled access and proper management can be positive for turkeys. They are used by turkeys for travel and are an important brood resource when properly revegetated (Bailey and Rinell 1968).

RESULTS

Unusual Species

In general, the more diverse the plant and animal life within a given region the greater the health of the ecological system. The most unusual species are usually located in the most restricted or sensitive habitats. At Carvins Cove, protecting these habitats - and the diversity of plant and animal life - is a logical first step towards protecting water quality for local residents. In order to understand the bio-diversity of Carvins Cove, TEAM EQR conducted visual surveys of all forest types and wetland and stream resources. However, it is very difficulty to accurately define the presence of mobile, seasonal, and/or nocturnal species. Therefore, data was collected from qualified local residents and the Virginia Department of Conservation and Recreation - Division of Natural Heritage. Local residents report observing the following species of interest:

Bradley's spleenwort	Asplenium bradleyi
Club Spur Rein Orchid	Platanthera clayellata
Hoary Puccoon	Lithospermum canescens
Pink Lady Slipper	Cyripedium acaule
Yellow Lady Slipper	Cyripedium calceolus
Bald Eagle	Haliapetus iepucocephalus
Golden Eagle	Aquila chrysaetos

Appendix B contains a correspondence prepared by the Natural Heritage Division in response to our request for information. They are particularly concerned with the possibility of unusual species being present in association with shale barren openings on steep high altitude southern and southeastern slopes.

Impacts to the Native Plant Community

The direct impacts of recreational usage on plant and wildlife habitats at Carvins Cove is difficult to quantify without intensive study of vegetation and wildlife before and after the development of a trail. We did not observe changes in the vegetation community directly adjacent to most trails.

In general, forests at Carvins Cove belong to the Oak-Hickory Forest Type as defined by the Society of American Foresters; however, there are approximately 8 different forest stands as described in the forest assessment portion of this report. Composition of forest stands varies according to the soil condition, aspect, slope, hydrology, previous land use, and current management activities. As noted above, the direct use of recreational trails probably exerts only a minimal influence on forest ecology. However, the indirect influence of frequent "non-consumptive" wildlife recreational activities - especially those of urban and suburban citizens - may have a greater impact on forest ecology by influencing forest management decisions. Specifically, the decision not to manage white-tailed deer is creating population levels above that considered desirable for maximum ecosystem diversity and forest health. For example, many mixed hardwood stands were observed with well developed canopy structure and a species richness typical for the association. Mid-story and understory structure however was extremely poor and in many instances missing altogether. The species richness of native

understory plants was very low. We would predict that herbaceous plant community may be equally impacted. This means that the habitat necessary for forest interior birds and many herpetofaunal species is being reduced. In addition, the elimination of herbaceous cover through overgrazing can increase erosion and sediment loading to surface waters.

The combination of no organized management plan, increasing recreational use, and overbrowsing by deer may have impacts on the biodiversity of the region. We observed over 12 species of FIDS at Carvins Cove including ground nesting species such as ovenbird, wild turkey, and ruffed grouse. These species nesting habits rely on native groundcover and infrequent human disturbance. Loss of groundcover vegetation through deer browsing or increasing human contact may reduce populations of these species. Further, we are aware of one endangered species that may be present on site. Table mountain pine (Pinus pungeons) is located with shale barrens at high elevations. Although there is very little recreation in this area, the species requires burning to persist. Development of a management plan for this species should be included in the development of comprehensive forest managment plans for Carvins Cove.

We recommend beginning deer harvests in order to protect the biodiversity of the watershed. Further, we believe that any educational campaigns directed at recreational users include specific information about this unique ecosystem and the reasons for instituting various management options. Strict fines should be implemented for the removal of any plant material from reservoir property.

Impacts to the Wildlife Community

The most important habitat attribute at the reservoirs is the presence of large blocks of mature deciduous forest. These forests provide habitat for over 60 species of resident birds and over 50 species of reptiles, amphibians, and mammals. There are two areas of concern regarding possible recreational impact to these wildlife communities:

Forest Interior Birds

Forest interior birds require large areas of unbroken canopy cover to successfully fulfill their life-cycle requirements. These birds are in a period of significant population decline (Robbins et al. 1989). When large areas of high quality forest experience fragmentation or transitions in plant community composition that mimic forest edges there is a decline in the abundance of forest interior birds (Lynch and Whigham. 1984). Nesting species at the reservoirs probably include highly vulnerable ground nesting species such as worm-eating warblers and ovenbirds. We strongly advise limiting recreational usage to woods roads to avoid disturbance and possible destruction of cryptic ground nests. We also recommend limiting the size and shape of any forest clearing activities to reduce the creation of edge habitat. Further, we recommend strict enforcement of leash laws during spring and early summer nesting seasons to prevent predation on ground nesting species from domestic pets.

Herpetofauna

There are numerous reptile and amphibian species located at Carvins Cove. Most of these species are secretive and undisturbed by recreational use. However, there are several species of salamanders and frogs which breed in ephemeral pools which form along woods roads in early spring. Frequent passage of vehicles through ephemeral pools can cause egg and juvenile mortality; however, there is little quantitative information which suggests this may cause changes in the populations of these species. We recommend avoiding the use of woods roads during very wet periods in late winter and early spring.

Impacts to the Soil

The greatest visible impact to the forest community caused by recreational activities on maintained and unmaintained trails and woods roads is erosion and compaction of surface soil. In places where bicycle and horse traffic passes up steep or highly erodible soils, considerable erosion is evident. These areas begin eroding from mechanical action of hoofs and tires but eventually become watercourses for rain that flows over the trail or woods roads. These areas are very limited in size and scope and do not appear to be causing any widespread siltation of streams or other ecological damage. However, we believe they should be repaired to prevent those conditions from developing.

More serious erosion is occuring near picnic areas; especially adjacent to the boat ramp (Figure 4 and 5). We recommend a 100 foot buffer be created and that portions of the picnic area should be moved to more inland locations.

MANAGEMENT RECOMMEDATIONS

1. Restrict vehicular and equestrian recreational access to well defined woods roads and trails.

2. Restrict vehicular, equestrian, and pedestrian access from remote portions of the Cove during the spring nesting season.

3. Institute deer harvests with the specific objective of restoring/enhancing the biological diversity of the forest.

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Appendix B. Natural Heritage Inventory

To be available in January 2008

Appendix C. Interpretive Plan

Introduction

This Interpretive Plan (IP) is about how to serve visitors to Carvins Cove Natural Reserve. Serving visitors means defining what stories and messages are communicated, who they are communicated to, and how they are told. The choices may be short-term or long-term, but either way, they become important factors in determining the use, enjoyment, and protection of the place.

Places like Carvins Cove have meaning and relevance – otherwise, why would we be taking care of them? Those who visit the place are seeking something of value – otherwise, why would they come? Interpretation, whether through exhibits, brochures, websites, or guided hikes, is the facilitator that connects the interests of the visitor and the meanings of the resource – otherwise, why would we do it?

This plan defines a variety of visitor experience opportunities for audiences, both inside and outside the park. Visitor experience is everything that visitors do, sense, and learn. In a broad and general way, this plan attempts to analyze those visitors' needs and determine a wide array of services and programs to communicate the purposes, significance, and themes associated with this special place. It reflects a balance between visitors' connections with the place and the protection and preservation of the place.

Themes

The communication of several significant ideas or important concepts will help visitors connect the tangible resources of Carvins Cove with larger ideas, processes, systems, or values of the site.

As part of their experience at Carvins Cove, visitors should understand that they are enjoying ***a unique regional resource that should be valued and protected by the citizens.*** As they enjoy any of a variety of passive or active recreational activities, visitors should also begin to see that ***responsible recreational activities and protection of water resources can work together.*** Conservation recreation can be combined with sustainable recreation amenities.

Carvins Cove is ***an important land-base for regional biodiversity*** and, perhaps over multiple visits and in sharing experiences with others, this idea will begin to permeate the communities and user-groups within the region. Another broad concept that should also extend beyond the boundaries of the preserve into communities of the region is that ***protection of drinking water is a shared responsibility, involving water suppliers, local and state governments, businesses, and individuals.***

As visitors encounter and experience cultural sites at Carvins Cove such as cemeteries and home places, they should begin to ***value the area's sense of place and how it connects to the early history of the Roanoke region.***

Management Goals
The management intent and expected outcome of interpretive or educational programs and services should be clearly articulated as a way to measure success or whether to add additional programming in the future.

All interpretive programming at Carvins Cove should have as a primary goal ***the protection of this primary regional water source.*** Hopefully over time, programs will succeed in ***building a long-term constituency that will appreciate and help in this protection.*** If visitors to the preserve and communities within the region understand these goals, then both the ***natural and cultural resources and associated values will be protected, restored, maintained in good condition and managed.***

Visitor safety and satisfaction are primary goals of an overall management philosophy. Visitors should have the opportunity for a ***safe experience and be satisfied with the availability, accessibility, diversity and quality of park facilities, services and appropriate recreational opportunities.***

Another overall management goal and objective in offering interpretive and educational programs should be a ***regional appreciation and understanding for the preservation of parks and their resources for this and future generations.***

Users of Carvins Cove and those who begin to hear about it should become ***stakeholders and sharers of the vision*** of protecting this natural resource, even if their past culture and experiences have made them apathetic to such issues. Having this as a goal will help generate a support base that will prompt city leaders to preserve and protect the place.

Desired Visitor Experiences
Effective interpretive and educational programming will facilitate visitor experiences and change the way the visitors and the public think, feel, or act as a result.

During a visit to Carvins Cove, visitors will ***enjoy a variety of quality recreational or educational activities while gaining insight, at their own level of interest, into regional water quality issues.*** Experiences at the preserve may include ***recreation or simply the opportunity for solitude and solace in a natural setting.*** Among the many land-based recreational experiences should be biking, hiking, horseback riding, and nature study. Water-based recreational experiences should include canoeing, kayaking, and rowing. Astronomy programs, night hikes, and history hikes are possible as well.
Regardless of the type of experience visitors have, it should be available ***without impairing the natural and cultural values of the site.***

A valuable experience for the visitors to Carvins Cove will ***allow them to understand something about the threats to this resource and learn about the importance of preserving natural systems.*** Sharing their enthusiasm and excitement for ***Carvins Cove as a profound, special, and unique place worth preserving*** should be a natural outcome of a visit.

Issues Affecting Interpretation
Resource-based or internal issues and laws may affect interpretation and/or education programming at Carvins Cove.

All education, interpretive, or recreational activity must be consistent with maintaining water quality of the reservoir. Activities should be designed to maintain a proper balance between visitor use and protection of the water quality. With this in mind, ***limited building or development of facilities should be the goal.***

Obviously, the ***cost of transportation of organized education groups*** and the ***availability of educational staff***, either paid or volunteer, will affect the amount of programming in the future.

Long-term weather conditions could affect visitor access or impact the site. ***Either excessive rain or snow that would increase erosion on trails*** or ***excessive drought*** may affect programming in the future.

Cooperation and a shared vision by all governments in the region need to take place in order for Carvins Cove Natural Preserve to succeed as a destination for visitors. All recreational and interpretive initiatives must gain the confidence of the Western Virginia Water Authority that protection of the water resources is the ultimate goal.

Visitor Profiles
Identifying various park audiences, including actual or potential visitor groups, along with their identified needs, helps determine the extent and type of interpretive or educational programs.

Currently, the vast majority of visitors to Carvins Cove are ***day-use visitors involved in a variety of recreational activities already identified in this plan.*** It seems apparent that this would continue to be the largest visitor use group coming to the site. There seems to be increased interest from ***day-use visitors outside the immediate area*** who find Carvins Cove Natural Preserve to be a unique resource.

The potential for ***educational groups, especially inner city schools where students have limited exposure to natural history,*** to learn the concepts of preservation and the importance of regional water resources, is a vital part of planning for future interpretive or educational programming. Students could attend a camp focusing on a variety of environmental or outdoor education activities. Likewise, ***college biology or hydrology classes*** could utilize the preserve and generate valuable research and baseline data for managers. ***An internship program with regional colleges and universities*** could also be a valuable utilization of the Carvins Cove resources.

The close proximity of ***local communities and the interests of local residents*** in the management and programs of Carvins Cove Natural Preserve suggest the need for ***special communications or proactive marketing effort to increase the awareness of the site within the region.***

Existing Interpretive Conditions
Future interpretive or educational services, development or proposals should begin small and utilize available conditions or facilities as a point of departure.

An "entrance experience" at Bennett Springs and Hollins should be provided with a ***message board that communicates one or more of the significant preservation themes identified above.*** Visitors should be ***encouraged to pack out trash*** and to ***avoid refueling of boat gas tanks while at the preserve.*** The ***boat landing site could be renovated*** to reflect sustainable development and conservation.

Initially, ***the current picnic shelter should be utilized*** rather than construction and disturbance at another site.

Horse ***trails should be inventoried and moved away from water sources*** if necessary. Visitors should have access to at least a portion of the ***cultural sites identified in order to communicate the sense of place and connection with the early history of the region.***
All-terrain vehicles should not be allowed or encouraged because of their potential for accidents and creating issues with erosion. Likewise, ***overnight camping increases the impact on the site and raises staffing and management issues*** that would be difficult to stop if allowed at this point.

Future Facilities
Future facility needs that will enhance interpretive and educational activities need to be considered. In order to reach a variety of educational groups, ***an environmental education facility near the Hollins entrance*** should be considered. This will provide a central site for interpretation, safety, and watershed management. Handicap accessible docks for fishing near the Hollins entrance and adequate, but low impact restroom facilities at both Hollins and Bennett Springs should be designed.

Outdoor equipment rental for mountain bikes, sea kayaks, row boats, or maps should be considered. A small retail sales area for items such as water bottles, bug spray, etc. would enhance the visitors' experience.

Any consideration of long-term construction such as campgrounds, cabins, or lodging should be carefully weighed in terms of sustainability, carrying capacity of the site, and the overall protection of water resources and other natural features.

Partnerships
Public or private-sector partnerships can often be utilized in the delivery of interpretive and educational services.

Partnerships with the ***Appalachian Trail Conservancy, multiple college and university biology or hydrology departments, and other federal, state, or local agencies*** could generate a cadre of staff to provide service to visitors. These partnerships may also extend to the Roanoke Valley Bird Club, the Virginia Native Plant Society, or Roanoke Valley Astronomical Society.

A non-profit Friends group could help generate a core work force for trail work, research purposes, or for educational and interpretive services.

Personal and Non-Personal Services
Staffing of educational or interpretive personnel or media such as exhibits, waysides, publications, audio-visual presentations, web sites, etc. should all be part of the long-range thinking of how to serve visitors at Carvins Cove Natural Preserve.

Wayside exhibit panels or message boards at each major entrance describing the relationship between health of the surrounding forest and water quality is an immediate need that would communicate a common message about the site.

Any exhibits and brochures should stress the relationship the Cove has on the surrounding region such as connected watersheds, similar issues in the Allegheny Highlands, or the various management issues of the Appalachian Trail. Cultural and natural history sites need to be identified by wayside exhibits or by brochure.

In the immediate future, one ***staff member, trained in environmental education, to conduct off-site programs*** is needed in order to make contact with schools and community or civic organizations on a regular basis. In addition, an ***established core of volunteers to meet, greet, and educate visitors*** is needed. ***To be fully functional for the long term, adequate maintenance, security, and customer service staff are imperative.***

A Traveler Information System AM radio station that could be easily changed would ***help educate visitors, and communicate safety and resource issues*** in a timely manner.

Appendix D. Park Facilities Master Plan