Little River

Riparian Corridor Conservation Plan

Summary Report

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Riparian Corridor Conservation Plan

Prepared by:

Upper Neuse River Basin Association
and Triangle J Council of Governments

Prepared for:

Eno River Association

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Summary Report
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Table of Contents

Figures

Tables

Executive Summary

The Little River is an irreplaceable natural resource to Orange and Durham Counties and one of the two water supplies serving over 176,000 residents in Durham, North Carolina. The Little River's watershed is a relatively rural area bordering some of the fastest development in the State of North Carolina. North Carolina's Department of Environment and Natural Resources designates the Little River Watershed as a "Water Supply II" watershed, which provides the greatest protection, outside of prohibiting development, that a watershed can receive in the state.

The Little River Riparian Corridor Conservation Plan identifies the most valuable places for protecting water quality, aquatic habitat, and riparian habitat in the watershed. The Upper Neuse River Basin Association (UNRBA) and the Triangle J Council of Governments (TJCOG) prepared this report on behalf of the Eno River Association (ERA) for the Conservation Trust for North Carolina (CTNC). The UNRBA and TJCOG worked with Eno River Association Staff to identify protection goals, establish criteria to guide the analysis, and execute a geographic information systems analysis to meet those criteria. CTNC provided funding for this project through a Clean Water Management Trust Fund grant to the Eno River Association.

The products of the analysis are 1) a prioritization of 181 tracts for land protection that best meet the ERA and other ecological criteria and 2) an identification of 56 potential stream, wetland, and buffer restoration sites that meet NC Ecosystem Enhancement Program minimum restoration criteria. The land protection priorities allow the ERA to further prioritize land protection efforts to match the management approach, whether the approach is acquisition, easement, or outreach and education.

The analysis uses a landscape ecology approach for protecting riparian lands in the Little River Watershed. Highly-ranked 'reserves' would provide large areas of critical habitat while the remaining riparian lands would connect habitat in the larger reserves and maintain water quality. The analysis helps the ERA envision the corridor and focus management efforts.

I. Introduction

The Little River Riparian Corridor Conservation Plan prioritizes 181 tracts in the 105 square-mile Little River Watershed for conservation and 56 sites for potential restoration. The purpose for prioritizing lands is to help the Eno River Association identify the most ecologically valuable properties and serve as a scoping tool to help the Association prioritize its landowner outreach work. The conservation analysis is based on the Eno River Association's Land Protection Policy and additional ecosystem criteria recommended by the Upper Neuse River Basin Association. The restoration analysis is a GIS analysis identifying areas meeting North Carolina Ecosystem Enhancement Program minimum criteria for stream, riparian buffer, and wetland restoration projects.

From September 2004 until August 2005, the Eno River Association (ERA), Upper Neuse River Basin Association (UNRBA), and the Triangle J Council of Governments (TJCOG) developed five technical memoranda to familiarize readers with the watershed, describe the riparian corridor conservation planning approach, and provide results of the analyses. These memoranda are listed below.

Little River Riparian Corridor Conservation Plan Memorandum #1: Overview of natural, water quality, and cultural resources in the Little River Watershed

Little River Riparian Corridor Conservation Plan Memorandum #2: Suggested approach for 'hot spots' analysis

Little River Riparian Corridor Conservation Plan Memorandum #3: Protection Hot Spots Analysis and Priority Parcels

Little River Riparian Corridor Conservation Plan Memorandum #4: Priority Parcels for Land Protection

Little River Riparian Corridor Conservation Plan Memorandum #5: Restoration Hot Spots Analysis and Priority Parcels

The plan summarizes the results and recommendations from these technical memoranda.

Project Area: The Little River Watershed

The Little River is located in the North Carolina Piedmont in the headwaters of the Neuse River Basin. Figure 1 shows the location of the Little River Watershed, the total area that flows to the river. The Little River Watershed is a part of the greater Eno River Watershed, and together these form about one-third of the entire Falls Lake Basin.

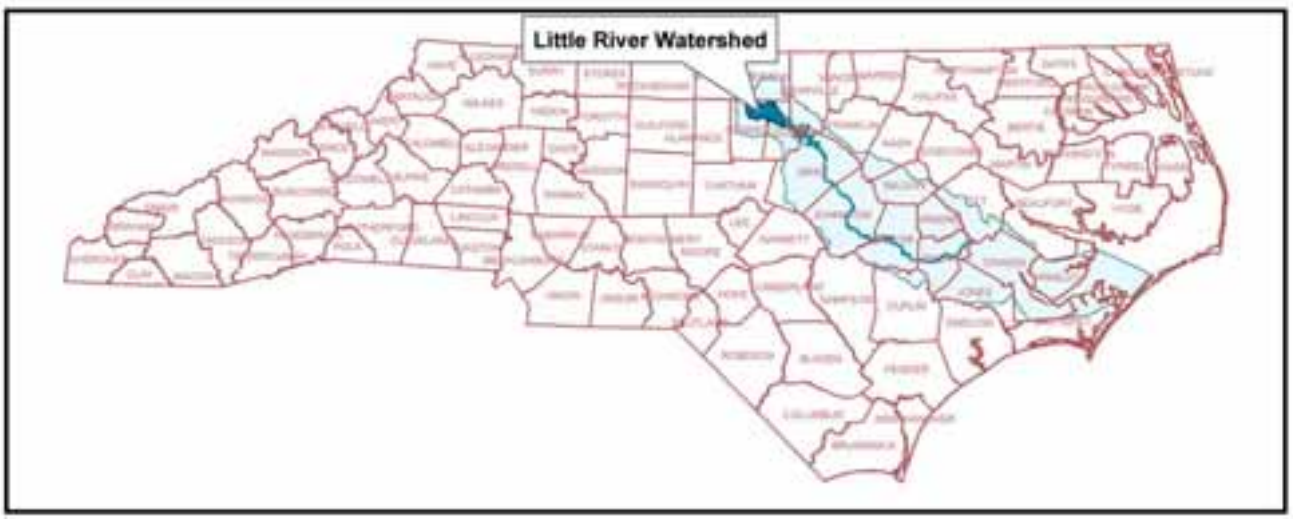

Figure 1. Little River's Location in the Neuse River Basin.

The Little River Watershed covers 105 square miles of northern Durham and Orange Counties. The river is one of the premier examples of aquatic habitat in the state, and its reservoir provides half of urban Durham's water supply. The Little River makes up about one-seventh of the total land area in the Falls Lake Basin and is therefore an important source of water for the 350,000 people who get their water from Falls Lake. For these reasons, the Little River Watershed is a regionally important and precious resource. Figure 2 is a map of the Little River Watershed

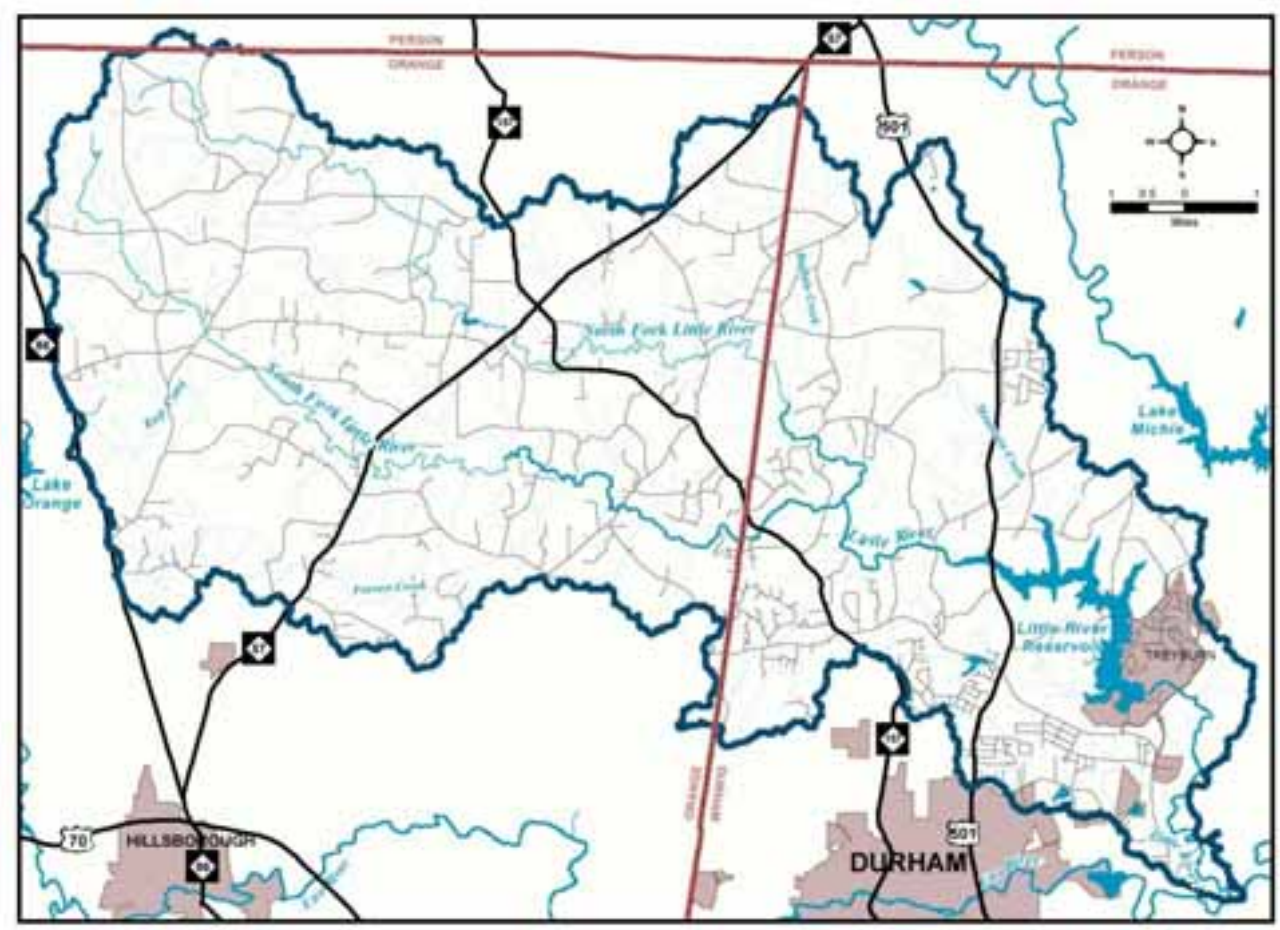

Figure 2. The Little River Watershed

Why Does the Little River need a Riparian Corridor Conservation Plan?

The Little River is one of the premier water bodies in the State of North Carolina. The NC Natural Heritage Program rates the river's aquatic habitat as "of state significance". Rare species, rare or high quality natural communities, or other important ecological features rank the Little River among the five most important aquatic habitats in the state (Ratcliff and McRae 2004).

In a region of explosive population growth, the Little River Watershed presents a wonderful but ephemeral opportunity to preserve a unique and rare resource. Only three percent of the watershed is formally protected. Compare this to almost 12% of lands in the remainder of the Eno River Watershed and 12% of those in the Falls Lake Basin, and the risk to the Little River is clear. As stated in the *Durham County Natural Heritage Inventory* (Hall and Sutter 1999), "the function of this valley as a movement corridor for wildlife is, in fact, highly imperiled."

Future development in the Little River Watershed is also expected to have significant and negative impacts on the Little River Reservoir. The *Upper Neuse Watershed Management Plan* (Tetra Tech 2003) predicts that by the Year 2025, the algae levels in the reservoir will be at management targets set by the Durham Department of Water Management. Under a buildout scenario, the nutrient levels will exceed those management targets and threaten water quality in the reservoir. High algae levels in rivers and lakes reduces the oxygen available to aquatic insects and fish, harming the entire aquatic ecosystem. Algae growth in water supply reservoirs lowers oxygen levels and can significantly complicate water treatment, degrade water taste and odor, and raise treatment costs. It is particularly concerning that these impacts will occur under relatively strong county Water Supply Watershed Protection ordinances that require minimum lot sizes of at least two acres for all new development.

As development pressures grow, the Little River Watershed is in an increasingly precarious situation. With very little protected land and regulations that may prove inadequate to protect it, will the river's habitat be reduced from rare and special to just another impacted resource? Will the high level of water quality degrade to levels that concern water supply managers and cost consumers more money and effort to treat? These are crucial questions that must be answered soon. The *Little River Riparian Corridor Conservation Plan* provides the land protection strategy that is a necessary part of the effective management of the Little River Watershed.

Figure 3. Jewel-weed (Photo by Alvin Braswell)

II. Overview of Natural, Water Quality, and Cultural Resources

The Little River Watershed ranks among the most important aquatic habitats in the State of North Carolina (Ratcliff and McRae 2004). This section of the plan describes some of the natural, water quality, and cultural resources that make the Little River special. *The Little River Riparian Corridor Conservation Plan Technical Memorandum #1: Overview of Natural, Water Quality, and Cultural Resources in the Little River Watershed* provides greater detail about the geography, geology and topology, soils, hydrology, forest ecology, riparian forests, water quality conditions, aquatic habitat, land uses, watershed regulations and future land use predictions in the Little River Watershed.

Natural and Water Quality Conditions and Features

Figure 4. Little River in Durham County

The Little River is born from scores of small, piedmont streams in northeastern Orange County, about 800 feet above sea level. These streams join together to form two larger, parallel streams, the North and South Forks of the Little River. The North and South Forks flow to the southeast through gently rolling forests and farmlands and cross the Durham County line before joining to form the Little River. There, the river forms what is undoubtedly one of the region's most scenic and ecologically precious areas, the Little River Gorge. Below the 100 foot-high walls of the gorge, the river is backed up behind the Little River dam to form the Little River Reservoir, the source for half of urban Durham's drinking water (Newell 2005).

Geology and Topography

From the headwaters to the reservoir dam, the Little River Watershed overlays a 600 million year-old, crystalline metamorphic geologic unit called the Carolina Slate Belt (Godfrey 1997). As the north and south forks of the river flow eastward, they reach a transition between the hard, dense metamorphic rock of the Carolina Slate Belt and the more erodable sedimentary soils of the Durham Triassic Basin. Where this tongue of newer sedimentary material overlies the Slate Belt rock, streams have formed deeper, steeper valleys, and the river has carved out the impressive Little River Gorge. The steep slopes in this area provide unique habitat for rhododendron and other communities typical of mountain areas. Because people traditionally have not farmed or lived on steep slopes, the area contains good examples of mature habitat.

The area downstream of the Little River Reservoir dam to the Eno River is part of the Durham Triassic Basin. Here, the river flattens out and begins to meander, creating broad floodplains.

Soils

Most of the soils in the Upper Little River Watershed have a low potential for runoff, meaning that they infiltrate water moderately well when thoroughly wetted. The Triassic Basin soils (downstream of the reservoir, around the reservoir and main stem of the river to the Orange County line, in Buffalo Creek, and in the headwaters of the North Fork Little River) have a higher potential for runoff if disturbed.

Hydrology

The Little River's hydrology is typical of central piedmont watersheds. The watershed receives about 44 inches of rainfall per year. Probably two-thirds (over 30 inches) of this water evaporates or is transpired by plants back into the atmosphere (Schafer et al 2002). About 28% of this rain (or 12 inches) runs over land or into shallow groundwater that eventually flows into the river (Camp, Dresser & McKee 1989). The remaining water is likely recharged deeper into groundwater.

The Little River is a small, low-order system feeding the Eno and Neuse Rivers. Seventy percent (70%) of the watershed flows to the North and South Forks of the river, which are both fourth order streams. Headwater (first and second order) streams on rocky, sloping terrain are a very important part of the Little River system (see box).

Over 90% of the watershed lies upstream of the Reservoir. For this reason, the fate of the entire river and the reservoir are intertwined, and much of what affects the Little River Watershed also affects the reservoir.

Floating downstream from the headwaters toward larger, higher-order streams, one encounters broader floodplains. The North Fork Little River, South Fork Little River, Forrest Creek in Orange County and Mountain and Buffalo Creeks in Durham County have floodplains of up to 500 feet. Further downstream on the North and South Forks, floodplains begin to widen, regularly achieving widths of around 1000 feet. One large floodplain area along the South Fork northwest of New Sharon Church Road has a width of about 2000 feet.

Headwater Streams

The scientific literature demonstrates that headwater streams, defined as zero-order (ephemeral) to second-order streams, make up at least 80% of the nation's overall stream network (Meyer et al 2003). Headwater streams provide most of a river ecosystem's nutrients in the form of leaves and other materials deposited by trees. Headwater streams harbor aquatic insects that are a crucial part of the river's food web. Although no studies have been done in the Little River, examination of GIS data from Forrest Creek, a tributary of the South Fork Little River, show that about 56% of the subwatershed's land drains to second-order streams.

Below the reservoir, the floodplains widen to approximately 2000 feet. Here, the river meanders through the low gradient and sedimentary parent material of the Triassic Basin. Over time, the process of river migration leaves wide floodplains, deep alluvial soils, and wetlands. The damming of the river has changed this hydrologic pattern because the river no longer peaks and floods. This undoubtedly has changed the nature of these soils and the local ecology.

Riparian Forests

Riparian forests are the forests that lie immediately adjacent to water bodies and in low, wet areas such as floodplains and wetlands. Riparian forests are the most productive and diverse ecosystems in the Piedmont (Godfrey 1997). Although they occupy only a small amount of the total land in the Little River Watershed (Godfrey estimates 5% in southern Piedmont areas), they support life systems in flowing (lotic) and standing (lentic) water, on islands, levees, in wetlands, and in bottomland hardwood forests.

Our best science indicates that riparian buffers of at least 330 feet from the edge of a stream are necessary to maintain biodiversity in riparian and terrestrial communities (McNaught et al 2003). In the Little River Watershed, there are several opportunities to protect such corridors within floodplains and areas of steep slopes, which lie almost entirely along larger (3rd order and greater) streams.

The great majority of riparian corridors, in terms of length, lie along headwater streams. Headwater riparian areas serve many important watershed functions. Tree roots hold stream banks in place and process nutrients and other elements. At the same time, vegetation makes nutrients and carbon available for subsurface life. When tree trunks fall into streams, they provide important hydrologic controls, reducing the power of flowing water, causing localized flooding and sediment deposition, and creating aquatic habitat. Riparian vegetation provide a canopy that intercepts rain and protects the soils below from its strong erosive power. Tree canopies also shade streams and maintain the cool temperatures important for aquatic life.

Since headwater streams have the greatest collective amount of riparian corridor, they are also the most abundant source of organic matter for the natural river system (Naiman & Bilby 1998). Many of the innumerable leaves in a riparian forest eventually find their way into a stream. Once there, each leaf floats slowly downstream, impeded by the numerous fallen trunks or snags in a headwater stream. Fungi and bacteria quickly colonize the leaf and begin to break it down, making it more palatable for aquatic insects. Next, groups of small aquatic insects disassemble the leaf using mouthparts made specifically for shredding detritus. Smaller shredding and grazing insects further decompose the leaf until, over months and downstream, all that remains of the original leaf are fine particles. There an array of insects collect and filter out the floating particles; some, such as caddisflies, even spin underwater webs for this task! Through this elegant process, the forest feeds the insects that form the base of the food chain for predatory insects, fish, and mammals.

The Little River's riparian corridor is largely intact and serving the important functions already described. A Triangle J Council of Governments study (TJCOG 2000) conducted for the NC Clean Water Management Trust rated subwatersheds of the upper Neuse for their potential for both riparian corridor restoration and protection. This scoping-level study rated Mountain Creek and Little River Reservoir among the five highest priority riparian corridor protection areas in the Upper Neuse. A similar 2002 study by the Upper Neuse River Basin Association-Triangle J Council of Governments analyzed non-forested riparian areas in the basin (UNRBA 2002). This study defines non-forested riparian areas as 100-foot wide and 3,000-foot long stretches of stream or river with no riparian forest. This study found that 17.3 miles, or 5%, of stream in the Little River qualify as "non-forested". (For comparative purposes, the same study found that 47.3 miles, or 9.5%, of the Eno River's riparian corridors qualify as non-forested)

Beaver Dams: Nature's Water Quality Management

The Natural Heritage Program has identified two impoundments (described below) created by beavers as Natural Heritage Sites. Beaver impoundments are particularly important because they support a great diversity of aquatic life and have a very positive effect on overall water quality in the river. Before the fur trapping industry brought by early European settlers, it is very possible that beaver impoundments covered the tributaries of the Little River. Outwater (1996) estimates that perhaps 200 million beavers once lived in North America, compared to only 10 million now. If there were 20 times the number of beaver ponds in the Little River, imagine the difference in the watershed's hydrology and wetlands.

1) The South Fork Little River Marsh, located upstream from Rays Creek, provides excellent habitat for water-loving species. American elm, white ash, sycamore, sweet gum, black willow and willow oak are the dominant trees. Underneath them grow buttonbush, swamp dogwood, tag alder, elderberry, swamp rose, and bladdernut (Sather and Hall 1988). Sather and Hall also observed wood ducks, great blue herons, kingfishers, green frogs, and bluegill at this site. And where there are beavers, there are likely otters and mink.

2) The Forrest Creek Beaver Pond is located on the creek near the New Sharon Church Road and Walker Road junction. Although not ranked as highly as the South Fork Marsh, this site is located along a braided section of stream and is the older of the two sites. The site supports tag alder, red maple, willow, sweet gum, buttonbush, elderberry, and ironwood. Vegetation includes numerous grasses, sedges, and rushes and many other open marsh herbs (Sather and Hall 1988).

Water Quality Conditions

Because of the Little River's rural character, the North Carolina Department of Environment and Natural Resources classifies the reservoir's watershed as a "predominantly undeveloped watershed". This classification (WS-II) is for sources of water supply that should be given the "maximum protection where a WS-I classification (of no development) is not feasible".

The state also classifies all waters of the Neuse River Basin, including the Little River, as Nutrient Sensitive waters. Nutrient Sensitive waters are defined as "waters subject to growths of microscopic or macroscopic vegetation requiring limitations on nutrient inputs" [NC Administrative Code 15A NCAC 02B.0101(e)(3)]. Under the "Neuse Rules" for nitrogen reduction, Orange and Durham Counties require that all developments use state approved stormwater management practices for reducing nitrogen loading. In addition, all land must protect a minimum 50-foot riparian stream buffer, the first 30 feet of which must be left undisturbed and 20 feet that may be disturbed but must be re-vegetated. Land uses that existed before 1997 are exempt from the rule.

Due to the watershed's WS-II regulatory status, no major wastewater discharges are allowed in the Little River. This eliminates one major source of pollutants in the watershed; however, stormwater is a major management concern. Runoff from impervious areas (roads, rooftops, and parking lots) and agricultural operations increase storm flows that are destructive to streams. These flows greatly increase erosion of stream banks, which increases sediment flows. The runoff from impacted upland areas can also contain various pollutants, and the main pollutants of concern are nutrients like nitrogen and phosphorous, pesticides and herbicides, waste from septic spills and animal operations, and metals. For this reason, land use is the key factor affecting water quality upstream of the reservoir.

Downstream of the reservoir, there are at least 8 “package plants” (small wastewater treatments plants) discharging wastewater to the Little River (Korest 2001). Although these plants are required to treat wastewater, they add nutrients and other pollutants to the river that have negative effects on the aquatic system. In this part of the watershed, both wastewater discharges and diffuse sources of urban runoff are concerns.

Several studies have modeled water quality in the Little River Reservoir’s watershed. Both Durham’s Watershed Management Study (Camp, Dresser & McKee 1989) and the Upper Neuse Watershed Management Plan (Tetra Tech 2003) estimate low levels of nutrients in the watershed. Algae growth in reservoirs in this area is limited mainly by phosphorous (Camp, Dresser & McKee), which most often enters streams and rivers bound to sediment. Since riparian areas can limit the amount of sediment entering streams, the protection of intact riparian corridors is a very important component of watershed management for the City of Durham.

The Triangle Area Water Supply Monitoring Project, a joint effort of the local governments and the US Geological Survey, has been monitoring two sites in the Little River since 1988. One site is where Johnson Mill Road crosses the river in Durham County. The second site is at the reservoir dam. A 1997 study of the water quality data at these sites revealed some important improvements in water quality during the period of 1988 to 1995. The study found that levels of total nitrogen and phosphorous decreased during that period (Childress & Bathala 1997). However, the same report finds that at the same time nutrients levels were declining, chlorophyll a levels, indicating algae growth, were increasing. The report did not speculate on the cause.

Aquatic Habitat

The NC Natural Heritage Program rates the Little River as aquatic habitat “of state significance” upstream of the Little River Reservoir along both forks to around NC Highway 57. This rating means that rare species, rare or high quality natural communities, or other important ecological features are present in the river. In fact, the Natural Heritage Program sees the Little River as one of the most important aquatic habitat in the State of North Carolina (Ratcliff and McRae 2004).

This stretch of the river supports a variety of fresh water mollusks that is “nearly as rich as that of the Eno and Flat” Rivers (Hall and Sutter 1999). A total of 8 species has been recorded, and 4 of these are listed by the state as Endangered, Threatened, or Significantly Rare (NC Natural Heritage Program 2004). The mussels include two species of elliptios, the triangle floater (*Alasmidonta undulatus*), and the:
Yellow lampmussel (*Lampsillis cariosa*)—State status Endangered, candidate for Federal Endangered Species List;
Atlantic pigtoe (*Fusconaia masoni*)—State status Endangered, candidate for Federal Endangered Species List;
Squawfoot (or Creeper) (*Strophitus undulatus*)—State status Threatened; and
Notched Rainbow (*Villosa constricta*)—State status Significantly Rare.

In addition, the Natural Heritage Program staff knows of an undescribed species of *Lampsillis* (mussel) in the Little River that they believe to exist only in the Upper Tar and Upper Neuse watersheds (Ratcliff and McRae 2004).

In addition to the freshwater mussels, 36 species of fish have been recorded in the Little River (Menhinick 1991). Of these, a few are considered rare. They are the:
Mimic shiner (*Notropis volucellus*), which has been recorded from only a few sites in the Piedmont;
Roanoke bass (*Ambloplites roanokensis*), state status of Significantly Rare;
Pinewoods shiner (*Lythrurus matutinus*), found at several locations along the river.

Several other species of note have been observed in the Little River. The Neuse River Waterdog (*Necturus Lewisi*), a salamander, is one of only three species of mudpuppies in the state. It lives its entire life among the bottoms of quiet waters in rivers or larger streams in the Neuse and Tar River systems, and is found nowhere else on earth (Beane 1996).

The Natural Heritage Program has also found species of aquatic insects that are considered Significantly Rare, including a stonefly (*Shipsa rotunda*) and a caddisfly (*Dibusa angata*) (Ratcliff and McRae 2004). The stonefly is extremely intolerant of pollution, and the N.C. Division of Water Quality has not found enough of the caddisfly to classify its pollution tolerance. The existence of insects that are extremely intolerant to pollution is considered an indicator of excellent water quality and habitat.

In general, we do not know much about the aquatic insects of the watershed. More knowledge of these species is important because their role as indicator species helps us to better understand water quality and aquatic habitat conditions. In one 15-year study of water quality trends in the Treyburn area (Oblinger et al 2002), the USGS has collected aquatic insects and graded sites using the North Carolina Biotic Index. This study found that diversity of aquatic insects is higher at the mid-size streams and in the river than in smaller streams. Most of the scores in the river were excellent. The study found examples of insect species that are indicators of excellent habitat and water quality, including species of mayflies, caddisflies, and stoneflies. This information may serve as a valuable reference that can help us to understand what conditions ought to be like in the watershed.

The aquatic habitat of the Little River also supports a host of special animals such as beaver, otter (*Lutra canadensis*), Mink (*Mustela vison*), queen snakes (Regina septemvittata) and red-bellied watersnakes (*Nerodia erythrogaster*) (Hall and Sutter 1999).

Human Influence in the Little River Watershed

The Little River has likely been a home to human inhabitants for around 10,000 years (Korest 2001). Our knowledge of Native American history in the Little River is limited. Archaeologists have found one site used for quarrying rhyolite and chert to make stone tools in Durham County. The site dates from the Paleo-Indian and Archaic Periods (10,000 -1,000 B.C.). Several scattered and isolated sites exist throughout the Durham County portion of the watershed, and some of these are believed to be encampments. One archaeological site in Durham County is eligible for the National Register of Historic Places.

Rivers and European Settlers

The river was an integral part of life for the early Irish and Scottish settlers in the watershed, providing water for people, livestock, and power to run mills. The location of fords dictated where the roads would be built. Mills were the social and economic centers of settler life, and these sites are thus important from a cultural perspective. Mill sites like Lowell Mill, Orange Factory, McMannen's Mill, Johnson Mill, and Berry's Mill are located along the main stem and larger tributaries. One mill site of interest, as much for its natural setting as for historical value, is Saw Mill Hole Bluffs. This former mill site is located among the steep slopes of the Little River Gorge with numerous little waterfalls and pools. Chestnut oak (*Quercus montana*), sourwood (*Oxydendron arboretum*), shortleaf pine (*Pinus echinata*), red oak (*Quercus rubra*) and beech (*Fagus grandifolia*) dominate the overstory at this site. The understory contains mountain laurel (*Kalmia latifolia*), witch hazel (*Hamamelis virgiiniana*) and red maple (*Acer rubrum*). The gorge and Saw Mill Hole Bluffs are privately-owned.

By the time European settlers arrived in the Piedmont in the mid-1600's, the Occaneechi, Adshusheer, Shakori, Tuscarora, and Catawba Tribes

were living in loose alliance. These groups traded surplus goods along the Native American Trading Path (Korest 2001). Settlers continued to use the path for 200 years, long after they had displaced the native people. The main route of this path, which covered almost 500 miles from central Georgia to southern Virginia, runs through the Little River Watershed. Today, St. Mary's, Mason, and Snowhill Roads in the southeastern part of the watershed cover the ancient path. Portions of the Trading Path are being protected in Treyburn, and several spur trails dating to that time are found nearby. One such trail exists in the Little River Gorge Area.

In his *Field Guide to the Piedmont*, Godfrey (1997) describes a "primal piedmont" with an ecosystem dominated by "deciduous giants". Native Americans living more than 300 years ago would have walked under a one-hundred foot high canopy of chestnuts, white oaks, mocker nut hickories, and tulip trees.

The Little River's watershed has been greatly transformed from the primal piedmont. Godfrey (1997) says that today's Piedmont "is either plowed, paved, or in succession". To see how this description applies to the Little River, examine the land cover of today. At one time or another, most of the watershed has been under cultivation, and about 25% of it is still farmed (Tetra Tech 2002).

Watershed Land Uses

Today, about 13,698 people live in the watershed (Year 2000 census data). The population density of the watershed is about 130 people per square mile. The Little River is one of the most rural watersheds in the Triangle Area. Figure 5 shows the land uses in the watershed. Over 60% of the Little River Watershed's land is covered by forest, 25% of the land is in agriculture, and residential development occupies 6% of the land.

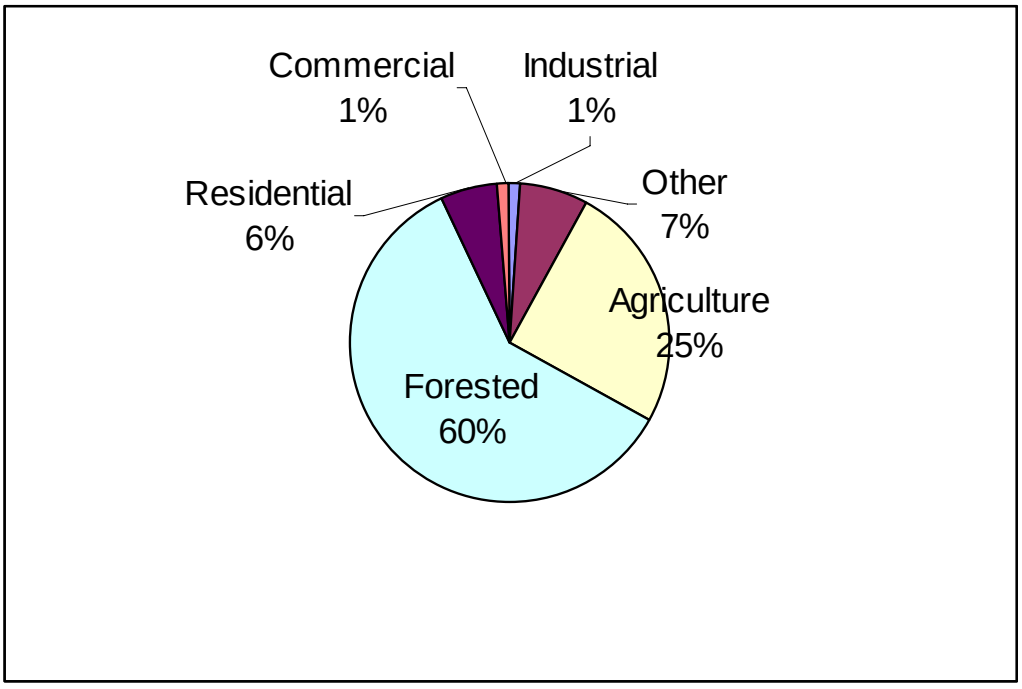

Figure 5: Land use in the Little River Watershed (Tetra Tech 2003)

Of the almost two-thirds of the watershed that is forested, about 25% is relatively young pine forest. Secondary succession trees like pine, winged elm, and sweet gum have taken over abandoned farmlands and are beginning to regenerate the forest. According to Godfrey, "by their thirtieth year,

the pines have thinned and pruned themselves sufficiently to accommodate a vigorous under-story of sweet gum, tulip, and red maple. These…spend the next three to five decades invading the canopy and slowly wrestling control from the pines, which eventually all succumb to competitive pressures and disease."

Godfrey estimates that the climax hardwood forest in the North Carolina Piedmont typically occurs after 90 years of succession. The 75% of forests in the Little River Watershed that are classified as deciduous (Tetra Tech 2002) are somewhere in this range, between 30 and 90 years of non-disturbance. "During this time, flowering dogwoods and red mulberry dominate the under-story…as the canopy becomes more predominantly deciduous, redbud and sourwood arrive in the understory. The secondary layer under the tulips, ashes, and maples will likely contain some winged elm and sassafras, residuals from the initial woody invasion that was overgrown by the pine canopy." (Godfrey 1997)

Some form of agriculture or forestry is practiced on almost half the lands in the watershed. Although the land use/land cover data show that only 25% of the watershed is agricultural, 43% of the land (almost 45 square miles) qualifies for the present use value program, which gives tax breaks on lands with farm-related uses such as timber and pasture. Besides tax breaks and a few Voluntary Agricultural Districts in Durham and Orange County, farmlands receive no other real protection, such as agricultural zoning, from conversion to suburban development.

Protected Lands

Although the Little River is similar in geography, hydrology, and biology to the Eno River, it has relatively few protected lands. While almost 12% of the Eno River watershed's lands are protected from development, only 3% of the land in the Little River is protected (Tetra Tech 2003).

Figure 6 is a map of the protected lands in the Little River Watershed. The figure includes Natural Heritage Sites, although these sites are not afforded the level of protection given to parks and conservation easements. This figure shows that most of the protected land lies at the downstream end of the watershed. The Durham City-owned lands around the reservoir (almost 1100 acres) and the Durham- and Orange-County owned Little River Regional Park (378 acres) comprise the great majority of the protected land area in the entire watershed.

Another important tool for the protection of lands is the conservation easement, a written agreement between a landowner and a qualified conservation organization or public agency in which the landowner promises to keep the land in its natural condition without extensive disturbance. Under this agreement, the organization granted the easement has the right to enforce it and the responsibility to monitor the property in the future. The conservation easement is a very important tool for land protection in a watershed like the Little River with so much privately held property.

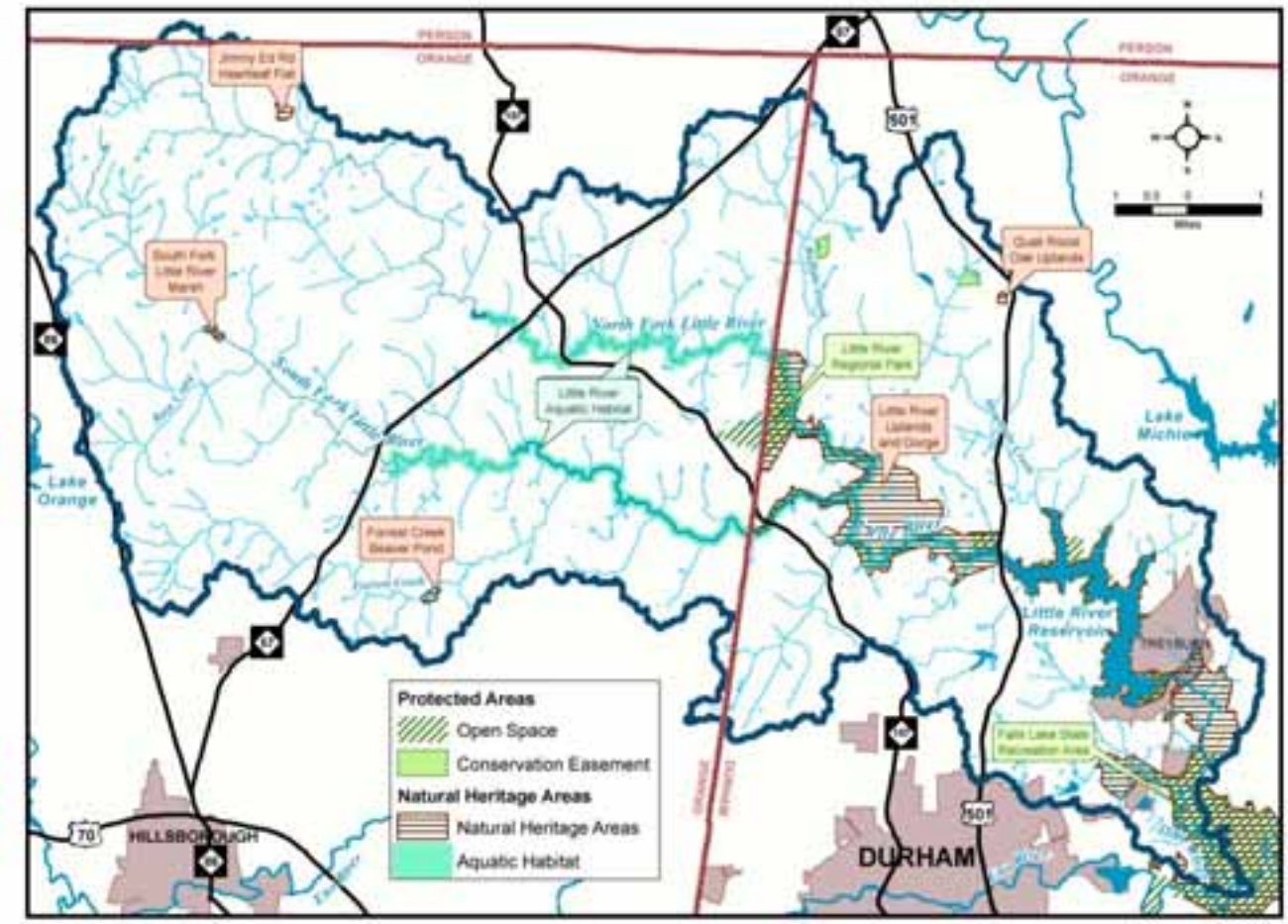

Figure 6. Protected Lands and Natural Heritage Sites in the Little River Watershed

In the Little River, there are only two properties in the entire watershed under conservation easement. These easements, shown in Figure 6, are located in Buffalo and Mountain Creeks and total approximately 58 acres.

The Little River Uplands Natural Heritage Site

According to the NC Natural Heritage Program, large upland sites of 400 acres or greater are necessary for species of wildlife that are intolerant to human disturbance (Korest 2001), for example the bobcat. The Little River Regional Park has protected one such place, and the Little River Uplands is another. The Little River Uplands is considered one of the largest and most significant blocks of upland habitat and wildlife refuge area remaining in Durham County (Hall and Sutter 1999). Some sections have a medium-aged dry-mesic oak-hickory forest community (Schafale and Weakley 1985 quoted in Hall & Sutter 1999) with a canopy of red oak, white oak, mocker nut hickory, pignut hickory, red maple, and tulip poplar. The understory consists of red maple, white ash, hop hornbeam, and sourwood. On the lower slopes closer to the river, beech, red maple, and red oak become dominant.

Where the river plunges through the fall line between Slate Belt and Triassic Basin in Durham County, the Little River Gorge constricts the river from the Johnson Mill Road area to Roxboro Road. The gorge's walls are reminiscent of more mountainous areas to the west, rising between 60 and 140 feet high in places (Korest 2001). "At several points, massive rock cliffs stand immediately above deep pools and cascades formed as the river courses over wide exposures of bedrock and extensive areas choked with boulders" (Hall & Sutter 1999) Here, the south-facing slopes are extremely dry and open, supporting thickets of blueberries and stands dominated by chestnut oaks, post oaks, shortleaf pine, and other xeric species. The north-facing slopes support tangles of mountain laurel and some montane species such as galax and wintergreen. Hall and Sutter (1999) recorded 11 species of forest interior, Neotropical migranting birds and expect that more exist in the forest along the Little River Gorge Slopes.

Several other special species also inhabit this area, including barred owls, piliated woodpeckers , possibly long-tailed weasel , black vulture (a state species of concern), and striped skunk , considered rare in this area.

Land Use and Watershed Regulations

Because the State of North Carolina classifies the Little River as WS-II to maintain water quality in the reservoir, the reservoir's watershed has a relatively high level of land use protection. On the other hand, lands below the reservoir, especially in Treyburn and Durham, have lesser protection. Figure 7 divides the watershed into five zones:

1. The headwaters in Orange County;
2. The headwaters in Durham County;
3. The "Critical Area" within a 1-mile buffer of the reservoir;
4. The area draining to the river downstream of the reservoir; and
5. The area downstream of Little River but within Falls Lake Critical Area

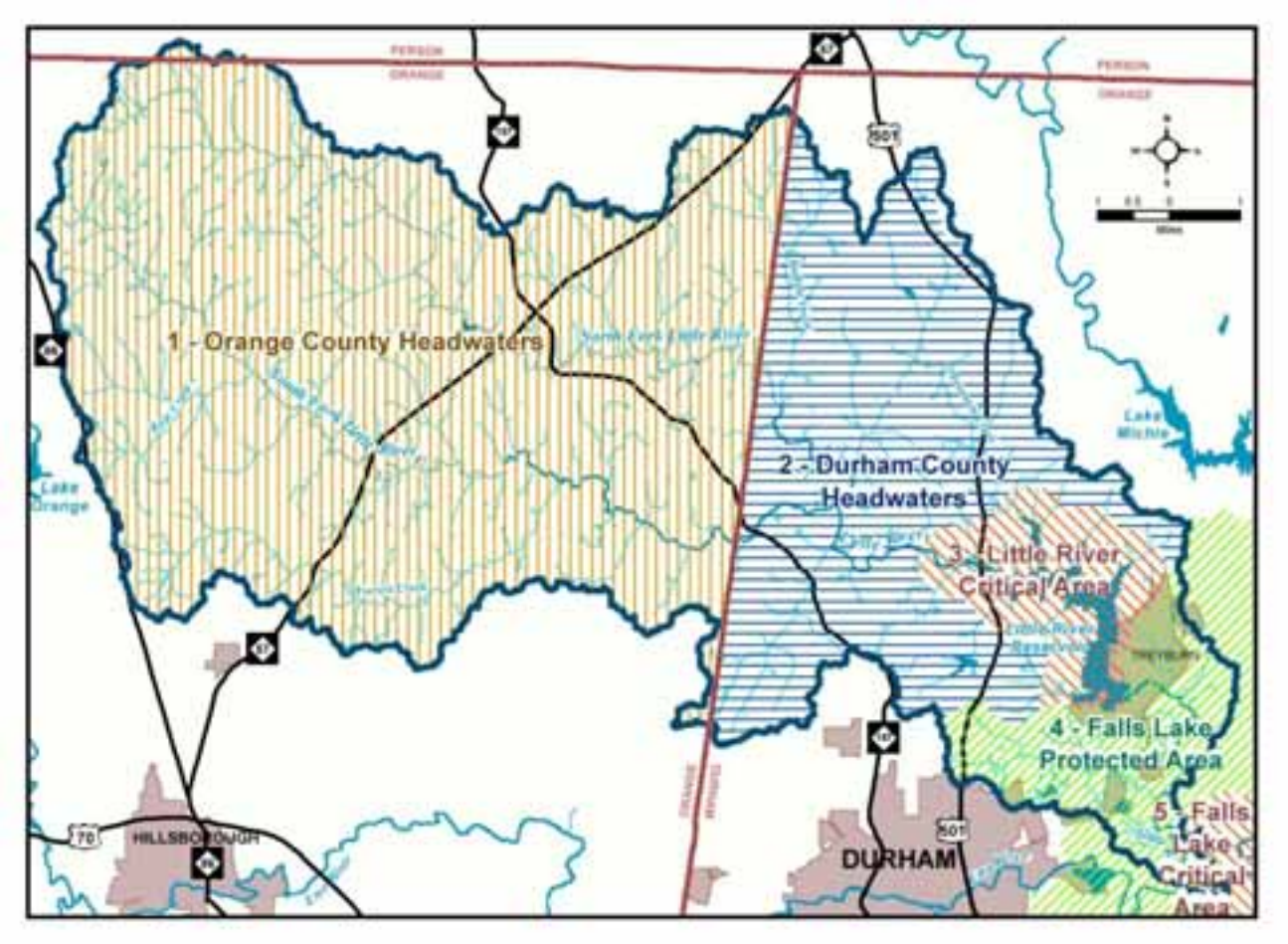

Figure 7. Watershed Management Zones in the Little River Watershed

Table 1 details the permitted land uses in the Little River Watershed (adapted from two more detailed tables in Technical Memorandum #1). Both Durham and Orange County limit land uses in the majority of the watershed to residential and limited commercial uses, prohibiting Industrial uses and landfills. Commercial and office centers are permitted only with a special use permit. Downstream of the reservoir, industrial uses are prohibited outside Durham's Urban Growth Area (UGA).

Zone	Land Uses	Density Limits*
1. Orange County headwaters	Primarily residential. Limited commercial and office. Industrial and solid waste disposal sites prohibited.	Residential: 2-acre & 6% impervious cover
2. Durham County headwaters	Primarily residential. Limited commercial and office. Industrial and solid waste disposal sites prohibited.	2-acre & 6% imp. cover
3. Little River Critical Area	Primarily residential. Limited commercial and office. Industrial and solid waste disposal sites prohibited.	2-acre & 6% imp. cover (some additional restrictions)
4. Downstream of Reservoir	Inside Urban Growth Area (UGA), commercial, office, and industrial are permitted subject to performance standards	20,000 sq. ft. & 24%- 70% imp. cover with stormwater controls
5. Downstream of Reservoir in Falls Lake Critical Area	Inside and outside UGA, commercial, office, light industrial, and research uses are subject to additional restrictions. Industrial is not permitted outside the UGA.	Within ½-mile of Lake: 2 acre & 6% imp. cover ½–1 mile of Lake: 2 acre min. & 9% imp. cover

Table 1: Land uses permitted in the Little River Watershed

Table 2 details the regulations currently in place to protect the Little River's riparian corridors. The table divides the watershed into the same five zones used to describe development densities. In general, Durham and Orange Counties have stronger riparian buffer protection rules than surrounding counties. Each local government bases the minimum required buffer widths on a stream's classification as intermittent (only flowing part of the year) or perennial (constantly flowing). In Orange County, all intermittent and perennial streams and floodplains in the Little River must have a buffer of at least 65 feet on either side. This buffer can be up to 150 feet depending upon the slope of the surrounding lands. In Durham County, streams in the area upstream of the reservoir must have buffers of 50 to 150 feet on either side, and the reservoir itself has a buffer of 250 feet.

Zone	Required Riparian Buffer Widths	Floodplain Protections
1. Orange County headwaters	Floodplain width plus 65 or 80 feet (depending on slope); not to exceed 150 ft.	Development is restricted in the floodplains by virtue of the buffer requirements.
2. Durham County headwaters	Perennial stream: 150 feet Intermittent stream: 50 feet	Land in floodway fringe counts toward min lot sizes 100%. Land in floodway counts toward min lot sizes 75%.
3. Little River Critical Area	Perennial stream: 150 feet Intermittent stream: 50 feet Reservoir: 250 feet	Land in floodway fringe counts toward min lot sizes 100%. Land in floodway counts toward min lot sizes 75%.
4. Downstream of Reservoir	Perennial stream: City: 100 feet County: 100 feet (or floodplain if greater) UDO proposes 100 feet for both Intermittent stream: County: 50-100 ft. or floodplain if greater City: 50 or 100 ft.	minimum buffer width shall be the width of the 100-year floodplain on that side of the stream (ZO 5.5.8.1)
5. Downstream of Reservoir in Falls Lake Critical Area	Perennial stream: City: 150 feet County: 150 ft or floodplain if greater Intermittent stream: County: greater of floodplain or 100 ft. (outside UGA) or 150 ft. (inside UGA) City: 50 ft. (inside UGA) or 100 ft. (out) Reservoir: 250 feet	Minimum buffer width shall be at least the width of the 100-year floodplain on either side of the stream (ZO 5.5.8.1)

Table 2: Riparian buffer protection requirements

Downstream of the reservoir, the required buffer distances are based on the stream's classification (perennial or intermittent), its location in Falls Lake's Critical or Protected area, and its location in the city or urban growth area. The minimum requirements in the city are 50 feet for intermittent streams and 100 -150 feet for perennial streams. In the county, the requirements are 50 – 150 feet for intermittent streams, and perennial streams receive buffers of 100 -150 feet or the floodplain, whichever distance is greater.

Land Use Projections

The Little River Watershed is slowly converting to residential uses. The majority of the development is to the south of the South Fork Little River in Orange County and south of the main stem in Durham County. The areas adjacent to the watershed and downstream of the reservoir are developing most rapidly, especially in and around Treyburn.

The *Upper Neuse Watershed Management Plan* (Tetra Tech 2003) predicts that the entire Falls Lake Watershed will experience a 53 percent increase in population by 2025 and that 70,000 acres of forest and agricultural lands will be converted into residential and urban development. The same plan predicts that growth in the Little River will follow a similar, if slower trend as that of the larger Falls Lake Basin. Currently, the watershed is very rural, with a population of about 13, 700 people (Tetra Tech 2003). The population density of the watershed is about 130 people per square mile, much less than that of the more urbanized Eno River (328 people per square mile). There are no

major wastewater discharges upstream of the reservoir, and the watershed's WS-II regulatory status prohibits the development of any new major discharges. However, as the Little River Watershed becomes "built-out" to the extent allowable under current regulations, the level of impervious cover (roads, rooftops, driveways) will increase from 5% to near 10%, and higher in the Durham County areas around the reservoir.

What will happen to riparian areas if the same rural, forested conditions that support exceptional aquatic habitat and water quality attract urbanites to build new homes as near to the river as possible? To answer this question, consider the amount of "potentially developable" riparian corridor in the Little River Watershed. Assuming the current 2-acre minimum lot size and Orange County floodplain protections, and forgetting about soil limitations, any parcel over 4 acres in size and not entirely inside a protected area (floodplain, protected green space, or private easement) is more likely to be subdivided and developed. Fifty-six percent (56%) the watershed's riparian corridor is "potentially developable" under these assumptions. Eleven percent (11%) of these developable riparian parcels is completely or partially within NC Natural Heritage Sites.

Current efforts by Durham and Orange could increase the level of protection in the reservoir's watershed. Both the Durham Comprehensive Plan and the draft Orange County Comprehensive Plan recommend reducing the allowable development densities in the Little River watershed to one unit per 3 acres. Additionally, Durham's draft Unified Development Ordinance, which codifies the visions of the Comprehensive Plan, currently recommends the 3-acre lot size. If adopted, this would significantly decrease development potential in the watershed. Current analyses, however, cannot assume that Durham or Orange will adopt the 3-acre lot size requirement.

III. Little River Riparian Corridor Conservation Analysis

The major objective of the Little River Riparian Corridor Conservation Plan is to recommend tracts with the greatest potential for protecting valuable watershed functions such as water quality and aquatic habitat. A challenge of the plan is to integrate numerous sources of information over an area of 105 square miles with 345 stream miles and almost 9,000 parcels. The Eno River Association (ERA), the Upper Neuse River Basin Association (UNRBA), and the Triangle J Council of Governments (TJCOG) used geographic information systems (GIS) analysis verified through fieldwork. This section describes the goals, criteria, and analytical approach.

Little River Riparian Corridor Conservation Goals and Criteria

The ERA's Land Protection Policy provides the major guidance for the Little River Riparian Corridor Conservation Plan. The box below shows the ERA's land protection criteria.

Eno River Association Criteria for Land Protection
(from Final Draft, ERA Land Protection Policy)

Natural Features
High priority—1) endangered, threatened or rare species or natural communities; 2) NC Natural Heritage Areas; 3) Ecosystems of special educational, scientific, and wildlife habitat value; 4) wetlands, floodplains or lakeshores necessary for the protection of water quality; 5) steep slopes near streams or rivers; or 6) a significant amount of river or stream frontage.
Medium priority—1) outstanding geologic characteristics, or 2) recognized historical or cultural features.
Low priority—1) significant forest cover; 2) farmlands that are designated as prime agricultural lands or part of a designated agricultural preservation district; or 3) significant public scenic views.

Other Qualities
High priority—1) tract is desired by the Eno State Park (not applicable in this study); 2) tract is in close proximity to other properties that are currently protected; 3) development of tract poses significant threat to water quality or other significant ecological features; 4) tract has high potential for funding for acquisition; or 5) tract has important conservation values and is large (e.g., greater than 300 acres).
Medium priority—1) tract is on major or minor tributary of the river; 2) tract is under imminent threat; 3) tract is one for which the ERA has secured or identified stewardship endowments; or 4) tract has high potential for partnerships.
Low priority—1) tract is within 1000 feet of a stream or river bank.

The Association's criteria combine environmental features and other considerations that make lands suitable for protection. The environmental criteria focus largely on protecting the functions necessary for maintaining a healthy watershed, while the suitability criteria reflect other values that would make an individual tract more interesting to the Association.

The ERA, UNRBA, and TJCOG compared these criteria with other potential criteria from the scientific literature on the ecosystem services and specific functions provided by riparian corridors.

In order to reflect important hydrologic, water quality, and habitat functions of riparian areas, especially in the headwaters, the analysis augments the Eno River Association Criteria with functional criteria such as larger buffers around the river, reservoirs and major tributaries and areas within 50 feet of first or second-order streams. Table 3 shows these functional criteria, and Technical Memorandum #1 offers greater detail about the selection of these criteria.

Functional Criteria	Priority Level
Area within 330 feet of the river or reservoir*	High
Area within 330 feet of a major tributary *	Medium
Area within 50 feet of 1st or 2nd order stream **	Medium

Table 3: Functional criteria used in the Little River landscape analysis

* McNaught et al 2003 and Keller et al 1993.

** Widely identified standard which is the basis for the Neuse nitrogen removal buffer standard, also referenced in McNaught et al 2003 and Gilliam 1997.

A second objective of the plan is to identify potential restoration sites in the watershed. The UNRBA and TJCOG used stream, wetland, and buffer restoration site selection criteria from the NC Ecosystem Enhancement Program to guide this analysis (NC EEP 2003, NC EEP 2004).

The General Analytical Approach details the analytical criteria and how the analysis was conducted.

General Analytical Approach

The Riparian Corridor Conservation Analysis is a five-step process.

Step 1 translates Eno River Association and functional goals into criteria for guiding the analysis using available data.

Step 2 performs a landscape analysis for identifying key areas with strong resource conservation value.

Step 3 identifies potential “hot spots” for restoration.

Step 4 scores all parcels in the watershed based on ERA’s parcels-specific criteria and ”flags” parcels for additional non-scored criteria (e.g. historic sites or prime farmland).

Step 5 combines the scored and flagged parcels with the priority protection and potential restoration areas, resulting in the identification of priority tracts.

Technical Memoranda #3-#4 describe the analysis in detail

Step 1: Establish Criteria

Step 1 separates criteria into three categories: 1) environmental criteria to guide the landscape (protection hot spots) analysis; 2) restoration criteria to guide the restoration hot spots analysis; and 3) parcels-level criteria to assess opportunities associated with any given tract in the watershed.

Some of the ERA-defined “other qualities” criteria are not appropriate for a GIS-based analysis because there are no detailed data sources for the information. These include tracts with high potential for funding or acquisition, tracts under imminent threat, tracts for which the ERA has secured or identified stewardship endowments, and tracts with high potential for partnerships. ERA staff will best determine the existence of such during follow-up outreach and fieldwork.

Step 2: Perform Landscape Analysis and Identify Protection "Hot Spots"

The landscape-level analysis assesses the value of any given location in the Little River Watershed for protecting the functions necessary for maintaining a healthy watershed. The landscape analysis is based on the environmental criteria shown in Table 4 using a geographic information system (GIS). The product of the landscape analysis is a set of weighted watershed protection values for all areas in the Little River Watershed. Little River RCCP Technical Memoranda #3 and #4 describe the landscape analysis in detail.

Little River RCCP Landscape Analysis Criteria	ERA Priority Level	Data Sets Used in Analysis
Endangered, threatened or rare species or natural communities	High	Natural Heritage Element Occurrences (buffered), Little River Aquatic Habitat
NC Natural Heritage Areas	High	Orange and Durham County Natural Heritage Inventory Areas
Wetlands necessary for the protection of water quality	High	Falls Lake Functional Wetlands data (NC Wetlands Restoration Program)
Floodplains	High	Flood Hazard Areas (from NC Flood mapping program's high-res. LIDAR data)
Steep slopes over 15%	High	20-foot resolution Upper Neuse Digital Elevation Model (derived by USGS from NC Flood mapping Program's LIDAR data)
Highly erosive soils: ▪ Extreme Erosion Potential ▪ Very High Erosion Potential ▪ High Erosion Potential	High-Low	Durham & Orange Co. Soils data
Area in proximity of river or reservoir: ▪ Within 300 feet* ▪ Within 1000 feet	High-Medium	TJCOG 330-foot and 1000-foot stream buffer data (derived from NCDWQ streams and ponds data)
Area within 300 feet of a major tributary *	Medium	NC DWQ streams and ponds data
Area within 50 feet of 1st or 2nd order stream **	Medium	TJCOG 50-foot stream buffer data (derived from NCDWQ streams and ponds data)
Outstanding geologic characteristics ▪ Diabase Areas ▪ Carolina Slate Belt	Medium-Low	NC Eco-Regions data (geologic regions of the state)
Forested cover: ▪ Deciduous ▪ Mixed deciduous/pine ▪ Woody pine	High-Low	EPA 15-meter res. Land Use/Land Cover data, Durham and Orange Co. Aerial Photos

Table 4: Criteria, priorities and data used in the Little River landscape analysis

* McNaught et al 2003 and Keller et al 1993.

** Widely identified standard which is the basis for the Neuse nitrogen removal buffer standard, also referenced in McNaught et al 2003 and Gilliam 1997.

Figure 8 is a map of the general results of the landscape analysis.

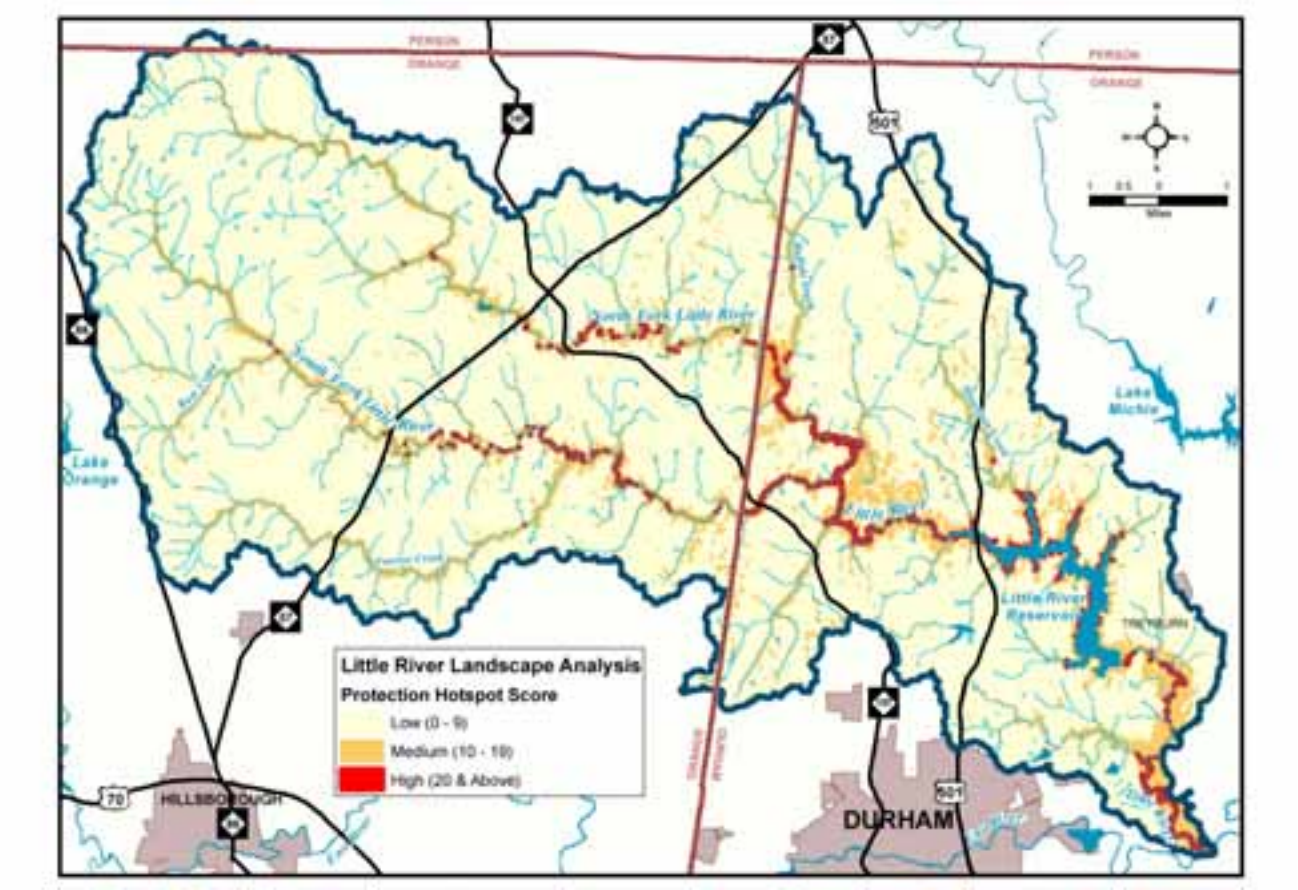

Figure 8. General Results of the Little River Landscape Analysis

The landscape analysis results in a score for any given 20 by 20-foot (400 square-foot) area in the watershed. The scores range from zero (areas that do not meet any environmental criteria) to 28 (the spot in the watershed that met the greatest number of criteria). For viewing ease, Figure 8 color-codes the results. Yellow represents low (0-9), orange is medium (10-19), and red is high (over 20).

Step 3: Perform Restoration "Hot Spots" Analysis

The landscape analysis in step 2 identifies "hot spots" with high conservation value. Step 3 adds an analysis of potential restoration "hot spots". The restoration hot spots analysis uses the most recent land use/land cover data and aerial photography publicly available to identify areas that have the greatest potential to meet NC Ecosystem Enhancement Program criteria for stream, buffer, and wetland restoration. Table 5 summarizes the minimum criteria, and Little River RCCP Technical Memorandum #5 describes the restoration hot spots analysis in detail.

	Little River Restoration Criteria	Data Sets Used in Analysis
Wetlands	Hydric soils are present	Falls Lake Functional Wetlands - Disturbed Wetlands data (NC Wetlands Restoration Program)
	Hydrology has been removed or modified	Falls Lake Functional Wetlands - Disturbed Wetlands data (NC Wetlands Restoration Program)
	There is evidence that hydrophytic vegetation existed at some point and has since been removed.	Falls Lake Functional Wetlands - Disturbed Wetlands data (NC Wetlands Restoration Program)
	Potential wetland restoration site is greater than 5 acres	Falls Lake Functional Wetlands - Disturbed Wetlands data (NC Wetlands Restoration Program)
Streams	Perennial streams only	1:24K hydrology streams (lines) in the Little River Watershed
	Stream with more than a 20 square mile drainage area	Little River Perennial Streams, selected from 1:24K hydrology streams (lines)
	Lies within a 50ft buffer along either side of the stream	Little River Perennial Streams in 3rd order or lower subwatersheds, selected from 1:24K hydrology streams (lines)
	Non-forested segment greater than or equal to 1500 ft in length	Buffer of Little River Perennial Streams in 3rd order subwatersheds, selected from 1:24K hydrology streams (lines); EPA landcover classes, 15 meter dataset; Orange County 2003 Ortho Photography; Durham County 1999 Orthophotography
Stream Buffer	All 1st-3rd order streams	1:24K hydrology streams (lines) in the Little River Watershed
	Lies within a 50ft buffer along either side of the stream	Little River Streams in 3rd order or lower subwatersheds, selected from 1:24K hydrology streams (lines)
	Non-forested segment greater than or equal to 1000 ft in length	Buffer of Little River Streams in 3rd order subwatersheds, selected from 1:24K hydrology streams (lines); EPA landcover classes, 15 meter dataset; Orange County 2003 Ortho Photography; Durham County 1999 Orthophotography
	Would be adjacent to croplands/ sources of nutrients (Note: valuable information, but not mandatory to be considered a restoration site)	Potential Restoration Areas; Agricultural Parcels in the Use Value Program

Table 5: Minimum criteria and data for conducting Little River Restoration analysis

The analysis identifies the areas meeting the minimum restoration criteria. The result is a set of potential restoration sites that the ERA should explore for their potential to receive NC Ecosystem Enhancement Program or other restoration project funding.

Step 4: Perform Parcels-Level Analysis

The fourth step in the Little River Riparian Corridor Conservation Plan is the parcels-level analysis. This analysis assesses all parcels in the Little River Watershed for their conservation suitability and feasibility. The parcels-level analysis uses the criteria shown in Table 6. Little River RCCP Technical Memoranda #3 and #4 describe the parcels-level analysis in detail.

The product of the parcels-level analysis is a set of almost 9,000 scored and flagged parcels, all the parcels in the Little River Watershed. Each parcel received a score for key ERA conservation-related criteria such as large size, significant river frontage, or adjacency to protected lands. In addition, other types of criteria that do not add to a tract's environmental value (such as farmlands or historic sites) were "flagged". Flagging parcels for such features identifies opportunities that might make a project more attractive to various partners or funding sources.

Little River RCCP Parcels-level Analysis Criteria	Priority Level	Data Sets Used in Analysis
Proximity to protected lands: ▪ Adjacent to protected property ▪ Within ¼-mile of protected property	High-Medium	Triangle Green space Database, Orange and Durham County protected open space, conservation easements
Parcel size: ▪ Over 300 acres ▪ 100-300 acres ▪ 50-100 acres	High-Low	Durham and Orange County parcels data
Significant amt. of river or stream frontage: ▪ Over ½-mile river or reservoir ▪ Over ¼-mile river or reservoir ▪ Over ¼-mile major tributary	High-Medium	NC Division of Water Quality (DWQ) streams and ponds data (hy24k-l and hy24k-p)
Farmlands designated as prime agricultural lands	Low	Durham & Orange Co. Use Value data, prime soils data, Durham and Orange County Voluntary Agricultural Districts
Presence of recognized historical or cultural features	Medium	TJCOG historic districts and sites, Archaeological sites, Trading Path

Table 6: Criteria, priorities and data used in the Little River Parcels-level analysis

Step 5: Conduct Final Prioritization and Mapping

The final step in the analysis is to combine priority protection and restoration "hot spots" with the weighted and flagged parcels to identify priority tracts for restoration and protection in the Little River Watershed. The result is a set of scored and flagged tracts for potential protection or restoration that the Eno River Association could use for guiding land protection and restoration priorities. Little River RCCP Technical Memoranda #4 and #5 describe the final prioritization and mapping process, and this section includes the results of the analysis.

The analysis identifies the 181 tracts in the Little River Watershed with the highest scores. These tracts include the lands that best meet the Eno River Association's (ERA's) criteria. Each of the tracts is selected because it scores above 20 in the analysis (the highest score was 34). Tracts that did not intersect a high scoring hot spot did not make the final list of 181 parcels.

The analysis identifies all lands that best meet the environmental criteria for protecting water quality and aquatic habitat. Therefore, all tracts with high scores except public lands are included in the results. This includes tracts with and without existing structures.

The restoration hot spots analysis identifies 56 restoration sites that reflect NC Ecosystem Enhancement Program's minimum restoration criteria. These results are presented in *Little River Riparian Corridor Conservation Plan Memorandum #5: Restoration Hot Spots Analysis and Priority Parcels*. A total of ten of the potential restoration sites are located on priority protection parcels. Thirty-four of the 56 restoration tracts are potential buffer restoration sites. The length of buffer restoration sites range from 1,030 to 4,980 ft, with an average length of 2552 ft. Six potential buffer

restoration sites are located on priority protection parcels, while eight sites are located within a single parcel each. Twenty-three of the buffer restoration sites are adjacent to agricultural land.

Four of the 56 potential restoration sites identified are potential stream restoration sites. The length of stream restoration sites range from 1,605 to 4,980 ft, with an average length of 3987 ft. Two potential stream restoration sites are located on priority protection parcels, while only one site is located within a single parcel.

Eighteen of the 56 potential restoration sites are potential wetland restoration projects. The size ranged from 5 to 14 acres, with an average size of 8 acres. Sites 50 and 58 were the only two restoration sites to occur on protected parcels, and site 50 is also located on a priority protection parcel. In all, 3 potential wetland restoration sites are located on priority protection parcels, and 4 are located within a single parcel each.

IV. Conclusion

The Little River Riparian Corridor Conservation Analysis benefits the Eno River Association by translating the ERA's land protection criteria into a GIS-based analysis to meet water quality and aquatic habitat protection goals. The products of the analysis are:

- A prioritization of tracts for land protection that best meet the ERA and other ecological criteria. The top 181 priority tracts have been identified;
- Several methods that enable ERA land protection staff to further prioritize land protection efforts to match the management approach, whether the approach is acquisition, easement, or outreach and education; and
- An identification of potential stream, wetland, and buffer restoration sites that meet NC Ecosystem Enhancement Program minimum restoration criteria. A set of 56 potential restoration sites are identified.

The plan provides two methods for analyzing and ranking the priority protection tracts to assist decision-making, prioritize field work, and justify protection efforts. The plan also provides the ERA with valuable information to help staff determine an individual tract's suitability for protection, including size, existence of over ½-mile of stream frontage, prime agricultural soils, historic sites, or potential restoration sites.

Conservation Priorities

As the Eno River Association considers funding outright acquisition, conservation easements, or landowner outreach and education, it can use the results of this study to prioritize landowner contacts. This analysis prioritizes key tracts, helps the Association envision the corridor, and helps focus outreach and education toward ecologically valuable but already inhabited lands. The analysis can also inform the ERA where there is potential to seek partnerships or funding sources that emphasize farmlands or historic sites.

The analysis identifies a potential landscape ecology approach for protecting riparian lands in the Little River Watershed. This would consist of high-quality reserves and connecting corridors. Highly-ranked 'reserves', especially large tracts with large areas of high scoring land, provide large areas of critical habitat. The remaining lands connect the larger reserves and provide a movement corridor for aquatic and riparian species. In addition, long stretches of unimpacted riparian corridors allow river systems the space they need to flood, dissipate energy, and generally conduct the processes necessary for maintaining water quality.

Potential Restoration Areas

The restoration hot spots analysis identifies 56 potential restoration sites that reflect NC Ecosystem Enhancement Program's key restoration criteria. These results are presented in *Little River Riparian Corridor Conservation Plan Memorandum #5: Restoration Hot Spots Analysis and Priority Parcels*. A total of 10 of the potential restoration sites are located on priority protection parcels. Thirty-four are potential buffer restoration sites, 4 are potential stream sites, and 18 are potential wetland restoration sites. The ERA should work with the NC EEP to field verify these results and identify sites with the greatest potential for restoration. Since the NC EEP requires, as a minimum, the acquisition of a conservation easement on any restoration property, the ERA can work together with the program to improve negotiations. In places where ERA and NC EEP have common interests, the ERA may be able to facilitate restoration efforts.

Watershed Management

The reality of riparian corridor conservation is that protecting tracts is only one part of the challenge of protecting the overall system. Only a small portion of the entire watershed, and even of the overall stream miles, is prioritized for protection. The Eno River Association's criteria weight riverfront properties more heavily than lower order streams. For that reason, headwater tracts generally receive moderate scores in this analysis (see Figure 7). However, riparian areas along headwater streams, although not individually crucial to the functioning of the watershed, collectively comprise a fundamental part of the Little River system's capacity to maintain clean water and aquatic habitat.

How should the Eno River Association address this fundamental challenge? One way is to advocate a management strategy to match the river system. A comprehensive watershed management approach emphasizes land protection to safeguard the most ecologically rich areas, sound management to prevent impacts from development in headwaters and uplands, and watershed restoration to restore habitat and water quality to degraded areas.

The management strategy should use high-impact, high-cost approaches, like land protection and restoration, on the highest priority tracts. Without these areas, the system will lose key habitat, hydrology and water quality protection functions. In these priority areas (reserves), the ERA is likely to play a central role in watershed management through land acquisition, easements, or partnering on restoration projects.

It is difficult to fully protect the over 50% of the watershed area that drains directly to headwater streams using acquisition or conservation easements. Many of these areas are likely to become suburban. Therefore, the ERA should advocate a comprehensive watershed management approach like the one recommended to Durham and Orange Counties in the *Upper Neuse Watershed Management Plan* (Tetra Tech 2003). That plan recommends minimum buffer requirements for all streams in the watershed, innovative stormwater standards for new development, improved erosion and sediment control, improved enforcement of existing laws, and improved stewardship in the form of stream monitoring and education programs. Protection of these tributaries through comprehensive management will help protect the investment that the Association makes in land protection in the remainder of the watershed.

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