

Chapter 4 - Water Quality Issues Related to the Multiple Watersheds in the Watauga River Basin

4.1 Overview

The 1997 Watauga River Basinwide Water Quality Management Plan included several recommendations to address water quality issues in the basin. Most of these recommendations were for specific stream segments and are discussed separately in the individual subbasin chapter in Section B. This chapter discusses water quality issues that relate to the entire Watauga River basin. Habitat degradation, including sedimentation (resulting primarily from land clearing activities, loss of riparian vegetation, rural roads and livestock grazing on streambanks) and urban runoff, is the main water quality issue in the basin.

4.2 Habitat Degradation

Instream habitat degradation is identified in the use support summary (Appendix III) where there is a notable reduction in habitat diversity or a negative change in habitat. This term includes sedimentation, bank erosion, channelization, lack of riparian vegetation, loss of pools or riffles, loss of woody habitat, and streambed scour. Good instream habitat is necessary for aquatic life to survive and reproduce. Streams that typically show signs of habitat degradation are in watersheds that have a large amount of land-disturbing activities (construction, mining, timber harvest and agricultural activities) or a large percentage of impervious surfaces. A watershed in which most of the riparian vegetation has been removed from streams or channelization has occurred also exhibits instream habitat degradation. Streams that receive a discharge quantity that is much greater than the natural flow in the stream often have degraded habitat as well.

Determining the cause and quantifying amounts of habitat degradation are very difficult in most cases. To assess instream habitat degradation in most streams would require extensive technical and monetary resources and perhaps even more resources to restore the stream. DWQ is working to develop a reliable habitat assessment methodology.

Although DWQ and other agencies are starting to address this issue, local efforts are needed to prevent further instream habitat degradation and to restore streams that have been impaired by activities that cause habitat degradation. As point sources become less of a source of water quality impairment, nonpoint sources that pollute water and cause habitat degradation need to be addressed to further improve water quality in North Carolina's streams and rivers.

4.2.1 Sedimentation

Introduction

Soil erosion, transport and redeposition are among the most essential natural processes occurring in watersheds. However, land-disturbing activities such as the construction of roads and buildings, crop production, livestock grazing and timber harvesting can accelerate erosion rates by causing more soil than usual to be detached and moved by water. If best management practices (BMPs) are not used effectively, accelerated erosion can strip the land of its topsoil, decreasing soil productivity and causing sedimentation in streams and rivers (NCDENR-DLR, 1998).

Sedimentation is the process by which eroded soil is deposited into waters. Sediment that accumulates on the bottom of streams and rivers smothers aquatic insects that fish feed upon and buries fish habitat that is vital to reproduction. Sediment filling rivers and streams decreases their storage volume and increases the frequency of floods (NCDENR-DLR, 1998).

Major Causes of Sedimentation in the Watauga River Basin

- Land clearing activities (construction and preparing land for planting and crops)
- Streambank erosion
- Runoff from unpaved rural roads and eroding road grades

Suspended sediment can decrease primary productivity (photosynthesis) by shading sunlight from aquatic plants, affecting the overall productivity of a stream system. Suspended sediment also has several effects on various fish species including avoidance and redistribution, reduced feeding efficiency, and therefore, reduced growth by some species, respiratory impairment, reduced tolerance to diseases and toxicants, and increased physiological stress (Roell, June 1999). Suspended sediment also increases the cost of treating municipal drinking water.

During 1999 basinwide monitoring, DWQ aquatic biologists reported sedimentation throughout the Watauga River basin. Although no stream is listed as impaired, lower bioclassification ratings and decreases in EPT taxa richness in several streams are attributed to sedimentation; bottom substrate is embedded by silt and/or pools are partially filled with sediment (NCDENR-DWQ, April 2000).

The Wildlife Resources Commission's *Fisheries Management Direction for the Watauga River Basin* also lists sedimentation of the Watauga River and tributary streams as one of two major concerns in the basin (NCDENR-WRC, July 1998). Sedimentation was also identified by participants at the public workshop as the major threat to water quality in the Watauga River basin.

Land Clearing Activities

Erosion and sedimentation can be controlled during most land-disturbing activities by using appropriate BMPs. In fact, substantial amounts of erosion can be prevented by planning to minimize the (1) amount and (2) time the land is exposed. Land clearing activities that contribute to sedimentation in the Watauga River basin include: construction of homes and

subdivisions; plowing of soil to plant crops; site preparation and harvest on Christmas tree farms; and road projects.

DWQ's role in sediment control is to work cooperatively with those agencies that administer sediment control programs in order to maximize the effectiveness of the programs and to protect water quality. Where programs are not effective, as evidenced by a violation of instream water quality standards, and where DWQ can identify a source, then appropriate enforcement action can be taken. Generally, this entails requiring the landowner or responsible party to install acceptable BMPs.

As a result of new stormwater rules enacted by EPA in 1999, construction or land development activities that disturb one acre or more are required to obtain a NPDES stormwater permit (refer to Part 2.7.2 of this section for more information). An erosion and sediment control plan must also be developed for these sites under the state's Sedimentation Pollution Control Act (SPCA) administered by the NC Division of Land Resources. Site disturbances of less than one acre are required to use BMPs, but a plan is not required.

Forestry activities in North Carolina are subject to regulation under the SPCA. However, a forestry operation in the Watauga River basin may be exempt from the permitting requirements if compliance with performance standards outlined in *Forest Practice Guidelines Related to Water Quality* (15NCAC 11 .201-.209) and General Statutes regarding stream obstruction (77-13 and 77-14) are maintained. Extensive information regarding these performance standards and rules as they apply to forestry operations can be found on the NC Division of Forest Resources website at http://www.dfr.state.nc.us/managing/water_qual.htm.

For agricultural activities which are not subject to the SPCA, sediment controls are carried out on a voluntary basis through programs administered by several different agencies (see Appendix VI for further information).

New Rules Regarding Sediment Control

The Division of Land Resources (DLR) has the primary responsibility for assuring that erosion is minimized and sedimentation is reduced. In February 1999, the NC Sedimentation Control Commission adopted significant changes for strengthening the Erosion and Sedimentation Control Program. The following rule changes were filed as temporary rules, subject to approval by the Rules Review Commission and the NC General Assembly:

Some Best Management Practices

Agriculture

- Using no till or conservation tillage practices
- Fencing livestock out of streams and rivers
- Leaving natural buffer areas around small streams and rivers

Construction

- Using phased grading/seeding plans
- Limiting time of exposure
- Planting temporary ground cover
- Using sediment basins and traps

Forestry

- Controlling runoff from logging roads
- Replanting vegetation on disturbed areas
- Leaving natural buffer areas around small streams and rivers

- Allows state and local erosion and sediment control programs to require a pre-construction conference when one is deemed necessary.
- Reduces the number of days allowed for establishment of ground cover from 30 working days to 15 working days and from 120 calendar days to 90 calendar days. (Stabilization must now be complete in 15 working days or 90 calendar days, whichever period is shorter.)
- Provides that no person may initiate a land-disturbing activity until notifying the agency that issued the plan approval of the date the activity will begin.
- Allows assessment penalties for significant violations upon initial issuance of a Notice of Violation (NOV).

Additionally, during its 1999 session, the NC General Assembly passed House Bill 1098 to strengthen the Sediment Pollution Control Act of 1973 (SPCA). The bill made the following changes to the Act:

- Increases the maximum civil penalty for violating the SPCA from \$500 to \$5000 per day.
- Provides that a person may be assessed a civil penalty from the date a violation is detected if the deadline stated in the Notice of Violation is not met.
- Provides that approval of an erosion control plan is conditioned on compliance with federal and state water quality laws, regulations and rules.
- Provides that any erosion control plan that involves using ditches for the purpose of de-watering or lowering the water table must be forwarded to the Director of DWQ.
- Amends the General Statutes governing licensing of general contractors to provide that the State Licensing Board for General Contractors shall test applicants' knowledge of requirements of the SPCA and rules adopted pursuant to the Act.
- Removes a cap on the percentage of administrative costs that may be recovered through plan review fees.

For information on North Carolina's Erosion and Sedimentation Control Program or to report erosion and sedimentation problems, visit the new website at <http://www.dlr.enr.state.nc.us/> or you may call the NC Division of Land Resources, Land Quality Section at (919) 733-4574.

4.2.2 Streambank Erosion and Loss of Riparian Vegetation

During 1999 basinwide sampling, DWQ biologists reported degradation of benthic habitat at several sites throughout the Watauga River basin in association with narrow or nonexistent zones of native riparian vegetation. Riparian vegetation loss was common in both agricultural and residential areas (NCDENR-DWQ, April 2000).

The Wildlife Resources Commission's *Fisheries Management Direction for the Watauga River Basin* also reports that loss of riparian vegetation along the Watauga River and its tributaries is of major concern (NCDENR-WRC, July 1998).

Removing trees, shrubs and other vegetation to plant grass or to place rock (also known as riprap) along the bank of a river or stream degrades water quality. Removing riparian vegetation eliminates habitat for aquatic macroinvertebrates that are food for trout and other fish. Rocks lining a bank absorb the sun's heat and warm the water. Some fish require cooler water temperatures as well as the higher levels of dissolved oxygen cooler water provides. Trees,

shrubs and other native vegetation cool the water by shading it. Straightening a stream, clearing streambank vegetation, and lining the banks with grass or rock severely impact the habitat that aquatic insects and fish need to survive (WNCT, 1999).

Livestock grazing with unlimited access to the stream channel and banks can cause severe streambank erosion resulting in degraded water quality. Although they often make up a small percentage of grazing areas by surface area, riparian zones (vegetated stream corridors) are particularly attractive to cattle that prefer the cooler environment and lush vegetation found beside rivers and streams. This concentration of livestock can result in increased sedimentation of streams due to "hoof shear", trampling of bank vegetation, and down-cutting by the destabilized stream. Despite livestock's preference for frequent water access, farm veterinarians have reported that cows are healthier when stream access is limited (EPA, 1999).

Preserving the natural streamside vegetation (riparian buffer) is one of the most economical and efficient BMPs. Forested buffers in particular provide a variety of benefits including filtering runoff and taking up nutrients, moderating water temperature, preventing erosion and loss of land, providing flood control and helping to moderate streamflow, and providing food and habitat for both aquatic and terrestrial wildlife (NCDENR-DWQ, October 2001). To obtain a free copy of DWQ's *Buffers for Clean Water* brochure, call (919) 733-5083, ext. 558.

4.2.3 Unpaved Rural Roads and Eroding Road Grades

As is typical of settlement in mountainous areas, many roads in the Watauga River basin follow streams. The roads are often constructed on the streambank with very little (if any) vegetated buffer to filter sediment and other pollutants from surface runoff. Many of the steep road grades are actively eroding because of a lack of stabilization. Road grades of 12 percent or less are desirable. Unpaved roads with grades in excess of 12 percent erode easily and are difficult to maintain (WNCT, 1999). Additionally, when road maintenance activities are conducted, there is often inadequate space for structural BMPs to be installed to control erosion from the land-disturbing activity.

Roads built to accommodate vehicles and equipment used for forestry activities in the Watauga River basin also contribute to sediment runoff. These roads are generally unpaved and accelerate erosion unless they are maintained with stable drainage structures and foundations. In the mountainous areas of North Carolina, ordinary forest roads are known to lose as much as 200 tons of soil per acre of roadway during the first year following disturbance (NRCD-DFR, September 1989).

4.2.4 Channelization

Channelization refers to the physical alteration of naturally occurring streams and riverbeds. Typical modifications are described in the text box. Although increased flooding, bank erosion and channel instability often occur in downstream areas after channelization has occurred, flood control, reduce erosion, increase usable land area, increase navigability and more efficient drainage are frequently cited as the objectives of channelization projects (McGarvey, 1996).

Direct or immediate biological effects of channelization include injury and mortality of benthic macroinvertebrates, fish, shellfish/mussels and other wildlife populations, as well as habitat loss. Indirect biological effects include changes in benthic macroinvertebrate, fish and wildlife community structures, favoring species that are more tolerant of or better adapted to the altered habitat (McGarvey, 1996).

Restoration or recovery of channelized streams may occur through processes, both naturally and artificially induced. In general, streams that have not been excessively stressed by the channelization process can be expected to return to their original forms. However, streams that have been extensively altered may establish a new, artificial equilibrium (especially when the channelized streambed has been hardened). In such cases, the stream may enter a vicious cycle of erosion and continuous entrenchment. Once the benefits of a channelization project become outweighed by the costs, both in money and environmental integrity, channel restoration efforts are likely to be taken (McGarvey, 1996).

Channelization of streams within the continental United States is extensive and promises to become even more so as urban development continues. Overall estimates of lost or altered riparian habitats within US streams are as high as 70 percent. Unfortunately, the dynamic nature of stream ecosystems makes it difficult (if not impossible) to quantitatively predict the effects of channelization (McGarvey, 1996). Channelization has occurred historically throughout the Watauga River basin and continues to occur in some watersheds, especially in small headwater streams.

4.2.5 Recommendations for Reducing Habitat Degradation

DWQ will continue to work cooperatively with DLR and other agencies that administer sediment control in order to maximize the effectiveness of the programs and to take appropriate enforcement action when necessary to protect or restore water quality. However, more voluntary implementation of BMPs is needed for activities that are not subject to these rules in order to substantially reduce the amount of widespread sedimentation present in the Watauga River basin. Public education is needed basinwide to educate landowners about the value of riparian vegetation along small tributaries and the impacts of sedimentation to aquatic life.

It is recommended that the Department of Transportation, as well as county highway departments, take special care of riparian zones when constructing and maintaining (including mowing) roads along streams in the Watauga River basin. The lack of riparian vegetation and streambank erosion is well documented and will lead to increased instream habitat degradation if these problems remain unchecked. Vegetation along streams should remain as undisturbed as possible when conducting these construction and maintenance activities, keeping in mind that most of these streams are to be managed in a manner similar to HQWs pursuant to Administrative Code Section: 15A NCAC 2B .0225 e(4).

Funding is available for cost sharing with local governments that set up new erosion and sedimentation control programs or conduct their own training workshops. The Sediment Control Commission will provide 40 percent of the cost of starting a new local erosion and sedimentation control program for up to 18 months. Two municipalities or a municipality and county can develop a program together and split the match. Avery County, Watauga County, the Town of

Banner Elk and the Town of Boone currently have locally-delegated erosion and sediment control programs (refer to Section C for further details). It is recommended that other local governments draft and implement local erosion and sedimentation control programs.

Funding is also available through numerous federal and state programs for farmers to restore and/or protect riparian buffer zones along fields or pastures, develop alternative watering sources for livestock, and fence animals out of streams (refer to Section C, Part 1.4.3). EPA's *Catalog of Federal Funding Sources for Watershed Protection* (Document 841-B-99-003) outlines some of these and other programs aimed at protecting water quality. A copy may be obtained by calling the National Center for Environmental Publications and Information at (800) 490-9198 or by visiting the website at <http://www.epa.gov/OWOW/watershed/wacademy/fund.html>. Local contacts for various state and local agencies are listed in Appendix VI.

4.3 Urban Runoff

Runoff from built-upon (developed) areas carries a wide variety of contaminants to streams including sediment, oil and grease from roads and parking lots, street litter, and pollutants from the atmosphere. The volume and speed of runoff are greatly increased in these areas as well, causing streambank erosion, temperature and salinity alterations, and scouring of the streambed. Generally, there are also a larger number of point source discharges in these areas. Cumulative impacts from habitat and floodplain alterations, point and nonpoint source pollution can cause severe impairment to streams.

Projected population growth over the 25-year period from 2000 to 2020 for the Watauga River basin shows an approximate 16 percent increase in Avery County and a 21 percent increase in Watauga County. As populations expand, so do developed areas. Development was identified by participants at the public workshop as a significant threat to water quality in the Watauga River basin. Proactive planning efforts at the local level are needed in the basin in order to assure that development is done in a manner that minimizes impacts to water quality.

4.3.1 Rural Development

More than three-quarters of the land in western North Carolina has a slope in excess of 30 percent. Building site preparation and access are complicated by shallow bedrock, high erosion rates, soils that are subject to sliding, and lack of adequate sites for septic systems. Additionally, road grades of 12 percent or less are desirable. Unpaved roads with grades in excess of 12 percent erode easily and are difficult to maintain (WNCT, 1999). This terrain presents a challenge for environmentally sensitive development. Development could occur in the relatively flat stream and river valleys, placing pressure on floodplains and riparian zones and displacing agricultural land uses. Alternatively, it could occur on the steep slopes accelerating erosion during construction. In addition, chronic problems with failing septic systems and eroding road grades are more likely. Development occurs in both places in different portions of the Watauga River basin.

4.3.2 Urbanization

Urbanization often has greater hydrologic effects than any other land use, as native watershed vegetation is replaced with impervious surfaces in the form of paved roads, buildings, parking lots, and residential homes and yards. Urbanization results in increased surface runoff and correspondingly earlier and higher peak flows after storms. Flooding frequency is also increased. These effects are compounded when small streams are channelized (straightened) or piped and storm sewer systems are installed to increase transport of drainage waters downstream. Bank scour from these frequent high flow events tends to enlarge streams and increase suspended sediment. Scouring also destroys the variety of habitat in streams leading to degradation of benthic macroinvertebrate populations and loss of fisheries (EPA, 1999).

In and around municipalities in the Watauga River basin, 1999 DWQ biological assessments revealed that streams are being impacted by urban stormwater runoff. Most of the impacts are in terms of habitat degradation (see Part 4.2 of this section), but runoff from developed and developing areas can also carry toxic pollutants to a stream.

The presence of intact riparian buffers and/or wetlands in urban areas can lessen these impacts, and restoration of these watershed features should be considered where feasible; however, the amount of impervious cover should be limited as much as possible. Wide streets, huge cul-de-sacs, long driveways and sidewalks lining both sides of the street are all features of urban development that create excess impervious cover and consume natural areas.

4.3.3 Stormwater Regulations

DWQ administers a number of programs aimed at controlling stormwater runoff in the Watauga River basin. These include: 1) programs for the control of development activities near High Quality Waters (HQW) and Outstanding Resource Waters (ORW) and activities within designated water supply (WS) watersheds; 2) NPDES stormwater permit requirements for industrial activities and municipalities; and 3) NPDES stormwater permit requirements for construction or land development activities on five acres of land or more.

Amendments were made to the Clean Water Act in 1990 (Phase I) and most recently in 1999 (Phase II) pertaining to permit requirements for stormwater discharges associated with storm sewer systems. Part of Phase II required some municipal storm sewer systems serving populations under 100,000 which are located in larger urbanized areas and/or that have a high population density to obtain an NPDES stormwater permit. The municipal permitting requirements are designed to lead to the formation of comprehensive stormwater management programs for municipal areas.

Planning Recommendations for Watauga Development

- Minimize number and width of residential streets.
- Minimize size of parking areas (angled parking and narrower slots).
- Place sidewalks on only one side of residential streets.
- Vegetate road right-of-ways, parking lot islands and highway dividers to increase infiltration.
- Plant and protect natural buffer zones along streams and tributaries.
- Minimize floodplain development.
- Protect and restore wetland/bog areas.

Boone will be considered for inclusion under the Phase II rules because of a population greater than 10,000 and/or a population density greater than 1,000 persons per square mile. DWQ is currently developing criteria that will be used to determine whether this and other municipalities will be required to obtain a NPDES permit. Refer to Section A, Part 2.7.2 for further information.

4.3.4 Recommendations

Proactive planning efforts at the local level are needed to assure that development is done in a manner that minimizes impacts to water quality. These planning efforts must find a balance between water quality protection, natural resource management and economic growth. Growth management requires planning for the needs of future population increases as well as developing and enforcing environmental protection measures. These actions are critical to water quality management and the quality of life for the residents of the basin. These actions should include, but not be limited to:

- preservation of open spaces;
- provisions for controlled growth;
- development and enforcement of buffer ordinances and water supply watershed protection ordinances more stringent than state requirements;
- halt on floodplain development and protection of wetland areas;
- examination of zoning ordinances to ensure that they limit large, unnecessary parking lots; allow for vegetation and soil drainage systems; and build in green spaces in parking lots to limit and absorb runoff; and
- sustainable land use planning that considers long-term effects of development.

Public education is needed in the Watauga River basin in order for citizens to understand the value of urban planning and stormwater management. Action should be taken by county governments and municipalities to plan for new development in urban and rural areas. For more detailed information regarding recommendations for new development found in the text box, refer to EPA's website at www.epa.gov/owow/watershed/wacademy/acad2000/protection. DWQ recently developed a booklet that discusses actions individuals can take to reduce stormwater runoff and improve stormwater quality entitled *Improving Water Quality In Your Own Backyard*. To obtain a free copy, call (919) 733-5083, Ext. 558.

4.4 Golf Courses

There were 17,108 golf courses in the United States in 2000; and in that year, 524 new courses were built, 707 were under construction, and 1,049 were being planned (NGF, 2001). In North Carolina, 150,000 acres of new turf areas, including athletic fields, recreational areas, home lawns and golf courses, are developed each year and the rate of development continues to grow (NCCES, 1995). Without proper site design, construction practices and maintenance, all turf areas can serve as source of sediment, nutrients and other contaminants that can impact water quality. Golf courses, because of their size, location and historical design practices, can cause significant impacts to small streams. In order to insure water quality protection, BMPs should be implemented throughout the life of a golf course from design to construction to daily maintenance.

Proper site design works with the landscape. The design should designate environmentally sensitive areas throughout the course and strive to protect them with minimal disturbance. The design can prevent or minimize erosion and stormwater runoff by maintaining natural vegetated riparian areas near streams, wetlands and lake shorelines as much as possible. Good design also minimizes the development of gullies, avoids channelization (straightening) of streams, and prohibits the unnecessary disruption of stream banks and lake shorelines (NCCES, 1995).

During golf course construction, the exposed soils and steep slopes are highly susceptible to erosion and sedimentation. In order to reduce erosion and sedimentation from the site, strategies to effectively control sediment, minimize the loss of topsoil and protect water resources need to be implemented throughout the construction of the course (CRM, 1996). A very effective BMP to use during construction activities on large sites is to minimize the duration of exposed soils and to establish ground cover as soon as possible after soil disturbance (NCCES, 1995).

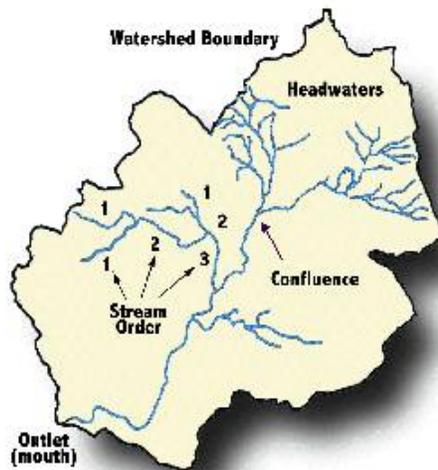
Golf course maintenance also has the potential to impact water quality through improper fertilization, mowing and irrigation. Fertilizer applications should be based on a soil test to determine the appropriate timing, level and type of fertilizer necessary for the type of grass on particular areas of the course. Fertilizers should not be applied on steep slopes near surface waters or directly to lakes, streams and drainage areas. It is a good practice to maintain a buffer of low-maintenance grasses or natural vegetation between areas of the highly maintained portions of the golf course and surface waters (NCCES, 1995).

The appropriate level of irrigation for a golf course is vital to the health of the grasses and the preservation of water quality. Under-watering may harm the grasses while over-watering increases the potential for leaching fertilizers and nutrients from the soil and increasing runoff. A properly designed irrigation system will apply a uniform level of water at the desired rate and time. The amount and frequency of watering should be based on the type of grass, soil and weather conditions (NCCES, 1995).

Golfers can also play a role in protecting water quality on the golf course. Players should respect designated environmentally sensitive areas within the course and recognize that golf courses are managed areas that can complement the natural environment. Golfers should support and encourage maintenance practices that protect and enhance the environment and encourage the development of environmental conservation plans for the course. In addition, golfers can choose to patronize courses that are designed, constructed and maintained with protection of natural resources in mind (CRM, 1996).

4.5 Protecting Headwaters

Many streams in a given river basin are only small trickles of water that emerge from the ground. A larger stream is formed at the confluence of these trickles. This constant merging eventually forms a large stream or river. Most monitoring of fresh surface waters evaluates these larger streams. The many miles of small trickles, collectively known as headwaters, are not directly monitored and in many instances are not even indicated on maps. However, degradation of headwater streams can (and does) impact the larger stream or river.



In smaller headwater streams, fish communities are not well developed and benthic macroinvertebrates dominate aquatic life. Benthic macroinvertebrates are often thought of as "fish food" and, in mid-sized streams and rivers, they are critical to a healthy fish community. However, these insects, both in larval and adult stages, are also food for small mammals, such as river otter and raccoons, birds and amphibians (Erman, 1996). Benthic macroinvertebrates in headwater streams also perform the important function of breaking down coarse organic matter, such as leaves and twigs, and releasing fine organic matter. In larger rivers, where coarse organic matter is not as abundant, this fine organic matter is a primary food source for benthic macroinvertebrates and other organisms in the system (CALFED, 1999). When the benthic macroinvertebrate community is changed or extinguished in an area, even temporarily, it can have repercussions in many parts of both the terrestrial and aquatic food web.

Headwaters also provide a source of insects for repopulating downstream waters where benthic macroinvertebrate communities have been eliminated due to human alterations and pollution. Adult insects have short life spans and generally live in the riparian areas surrounding the streams from which they emerge (Erman, 1996). Because there is little upstream or stream-to-stream migration of benthic macroinvertebrates, once headwater populations are eliminated, there is little hope for restoring a functioning aquatic community.

Recommendations

Because of the small size of headwater streams, they are often overlooked during land use activities that impact water quality. All landowners can participate in the protection of headwaters by keeping small tributaries in mind when making land use management decisions on the areas they control. This includes activities such as retaining vegetated stream buffers, minimizing stream channel alterations, and excluding cattle from streams. Local rural and urban planning initiatives should also consider impacts to headwater streams when land is being developed.

All streams in the North Carolina portion of this basin are the headwaters of the Tennessee River. For a more detailed description of watershed hydrology, refer to EPA's Watershed Academy website at <http://www.epa.gov/OWOW/watershed/wacademy/acad2000/watershedmgt/principle1.html>.

4.6 Priority Issues for the Next Five Years

Clean water is crucial to the health, economic and ecological well-being of the state. Tourism, water supplies, recreation and a high quality of life for residents are dependent on the water resources within any given river basin. Water quality problems are varied and complex. Inevitably, water quality impairment is due to human activities within the watershed. Solving these problems and protecting the surface water quality of the basin in the face of continued growth and development will be a major challenge. Looking to the future, water quality in this basin will depend on the manner in which growth and development occur.

The long-range mission of basinwide management is to provide a means of addressing the complex problem of planning for increased development and economic growth while protecting and/or restoring the quality and intended uses of the Watauga River basin's surface waters. In striving towards its mission, DWQ's highest priority near-term goals are to:

- identify and restore impaired waters in the basin;
- identify and protect high value resource waters and biological communities of special importance; and
- protect unimpaired waters while allowing for reasonable economic growth.

Strategies for Addressing Notable Water Quality Concerns in Unimpaired Waters

Often during DWQ's use support assessment, water quality concerns are documented for waters that are fully supporting designated uses. While these waters are not considered impaired, attention and resources should be focused on these waters over the next basinwide planning cycle to prevent additional degradation or facilitate water quality improvement. Waters with notable water quality concerns are discussed individually in the subbasin chapter in Section B.

Water quality problems in the Watauga River basin are varied and complex. Inevitably, many of the water quality impacts noted are associated with human activities within the watershed. Solving these problems and protecting the surface water quality of the basin in the face of continued growth and development will be a major challenge. Voluntary implementation of BMPs is encouraged and continued monitoring is recommended. DWQ will notify local agencies and others of water quality concerns for the waters discussed below and work with them to conduct further monitoring and to locate sources of water quality protection funding. Additionally, education on local water quality issues is always a useful tool to prevent water quality problems and to promote restoration efforts.