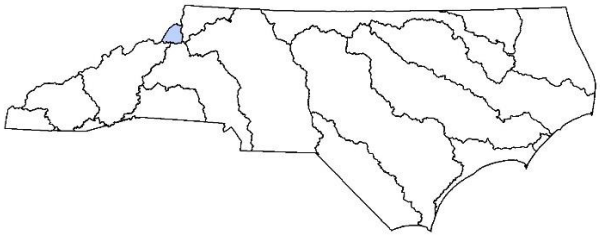
Executive Summary



The Watauga River basin is situated in the far northwest corner of the state between the French Broad and Catawba River basins to the south and the New River basin to the north. The entire watershed drains northwest into Tennessee where it flows into the Watauga River Reservoir. The Watauga River Gorge, where the river drops sharply as it enters Tennessee, is one of the most beautiful stretches of river. The river is a major tributary to the Holston River which flows to the Tennessee River. Water from the Watauga River basin eventually makes its way to the Gulf of Mexico. Parts of the basin in North Carolina are traversed by the scenic Blue Ridge Parkway and contained within the Pisgah National Forest. The basin is the second smallest in the state, containing nearly 280 stream miles and encompassing only 205 square miles. The Watauga River basin contains one 8-digit hydrologic unit code (HUC).

The North Carolina portion of the Watauga River basin is located entirely in the Blue Ridge Province of the Appalachian Mountains. Major tributaries to the Watauga River include Boone Fork, Cove Creek, Beech Creek, Beaverdam Creek, and the Elk River. Most of the watersheds are made up of high-gradient, cool water streams that can support a variety of habitats (terrestrial and aquatic) and biodiversity.

The 2018 Watauga River Basin Water Resources Plan is the fourth document to be developed for the Watauga River basin by the Division of Water Resources (DWR) in the North Carolina Department of Environmental Quality (DEQ). The plan includes six sections covering water quality and water quantity issues in the basin. Because a hydrologic (or water supply) model has not been developed for the Watauga River basin, national and local water use information reported by the US Geological Survey (USGS), public water supply (PWS) systems through their local water supply plans (LWSP), and entities required to register with the state's Water Withdrawal and Transfer Registration (WWATR) program was used to provide an overview of water use in the basin. Water quantity information was also obtained from the Census of Agriculture published by the US Department of Agriculture (USDA).

The 2018 Watauga River Basinwide Water Resources Plan includes the following information:

Section 1: Overview

Basic information about land use and population, nonpoint source pollution (agriculture, forestry, stormwater), programs to protect water resources and stream flow.

Section 2: Monitoring Data and Water Quality Assessment

Reviews how chemical, physical and biological parameters are used to assess water quality in North Carolina and overall results for the Watauga River basin.

Section 3: Watershed Chapters

Provide detailed information at the watershed scale. Individual stream assessments, special studies, information related to water use, and specific projects in the watershed are included.

Section 4: Permitted and Registered Activities in the Watauga River Basin

General information about existing programs that protect water resources. Examples include wastewater management, stormwater programs, public water supply systems, and underground storage tanks.

Section 5: Water Use and Availability in the Watauga River Basin

Provides a summary of water use in the basin. Information related to water use was obtained from LWSPs, information housed in the WWATR database, and national databases available through USGS and USDA. A one-page summary is also available for this section.

Section 6: Local Initiatives and Funding Opportunities

This section explores various options for protecting water resources and includes general information as it relates to local initiatives, watershed planning and funding opportunities.

The plan also includes interactive components. Using online tools available through ESRI, a Story Map and a Web Application were developed specifically for the Watauga River basin. Because the interactive components provide a better view of where monitoring locations, permits and streams are located in the basin, only a few locational maps are included in this basin plan.

Population, Land Use Changes and Nonpoint Sources of Pollution

Urbanization poses one of the greatest threats to water resources. Not only is more water needed to meet water demands, but urbanization can also impact aquatic habitats if stormwater runoff is not controlled. Small towns and communities are usually not considered urban centers, but even small concentrations of urbanization can have significant impacts on local waterways. Topography also plays a role. Improper grading on existing and new construction sites can disrupt natural stormwater runoff patterns and result in poor drainage, high runoff velocities and increased peak flows during storm events. These changes can increase the chances of flooding. When combined with a faster flow, stormwater can cause severe erosion along streambanks, remove vegetation, deliver large amounts of sediment to the streambed, and impact aquatic habitats. Stormwater captured on site with rain gardens, stormwater ponds, constructed wetlands or bioretention cells allows stormwater to drain into the soil, decrease the amount of water that reaches the stream, and potentially prevent pollutants and excess nutrients from reaching surface water.

Land cover information can assist local, state and federal managers and officials assess ecosystem status and health, model nutrient and pesticide runoff, understand spatial patterns in biodiversity, develop land use management policies, and evaluate the effects of land use changes on water quality. North Carolina uses land cover datasets available from the National Land Cover Database (NLCD). Based on the most recent land cover dataset, over 77 percent of basin is identified as forest. Just over 10 percent is identified

as agriculture with most of the land being used for pasture. Biologists identified several stream segments throughout the basin that had some level of impact from adjacent agricultural land use with loss of riparian vegetation, streambank erosion and sedimentation identified as potential causes of habitat degradation. Based on data available through the USDA Census of Agriculture, the number of farms and the land area utilized for farming operations in Avery and Watauga counties has remained relatively unchanged since 2002, but the number of animals for cattle and calf operations, as well as the number of chickens, have increased in both counties. The census also includes five trout farms in the basin. Much of the agricultural operations in the basin are in the valleys along the stream and river banks where they can have a direct impact on water resources. Several voluntary, agricultural best management practices (BMPs) have been installed throughout the basin. The BMPs are designed to reduce sediment, erosion and nutrients. DWR encourages the agricultural community continue installing BMPs. Owners and operators of aquaculture facilities are encouraged to contact their local Cooperative Extension office and/or research institutions to identify best ways to manage impacts to water resources.

Portions of two counties (Avery and Watauga) are in the basin along with the municipalities of Banner Elk, Beech Mountain, Elk Park, Seven Devils and Sugar Mountain. The outskirts of Boone are also located in the basin. Population has seen a steady increase over the past 20 years with a 16 percent increase since 2000 and 25 percent increase since 1990. Population is expected to continue increasing in both counties over the next several years. Proper land use planning can assist local leaders in establishing long-range goals, help control the rate of development and growth patterns, and ensure open space is conserved throughout the basin.

Biological Monitoring

Biological (benthic and fish community) samples are given a bioclassification based on the data collected at the site by DWR biologists in the Water Sciences Section (WSS) Biological Assessment Branch (BAB). The bioclassifications (also referred to as ratings) are Excellent, Good, Good-Fair, Not Impaired, Not Rated, Fair, or Poor and include measurements for diversity, abundance and the number of pollution tolerant or intolerant species found within a particular waterbody. Each biological parameter (benthic and fish) and each ambient parameter is assessed independently and determined to be either meeting criteria, exceeding criteria, or data inconclusive based on its rating or percent exceedance.

Biological samples are collected on a five-year rotating schedule with some sites being assessed as part of a special study. Biological samples for this plan were collected between September 2004 and August 2009 (cycle 4) and September 2009 and August 2014 (cycle 5) (Table 1).

Table 1: Biological Monitoring Cycles in the Watauga River Basin

Cycle Number	Dates	Benthic Samples Collected	Fish Samples Collected
4	September 2004 – August 2009	30	13
5	September 2009 – August 2014	22	14

A total of 43 biological samples were collected during cycle 4, and 36 were collected during cycle 5 (Table 1). Most of the sites sampled for fish community were Not Rated because criteria and metrics have not been developed for small, Southern Appalachian trout streams. Samples that were rated, however, used methodology found in the Fish Community Standard Operating Procedures (SOP) developed by DWR.

Overall, biological monitoring indicates that water quality remains good throughout the basin except for one fish community site on Beaverdam Creek. Any changes in species abundance, diversity and tolerance noted by biologists were likely due to extreme weather conditions (i.e., low stream flow due to drought conditions, higher than normal stream flow due to heavy precipitation) prior to sampling events.

Figure 1: Biological Monitoring – Benthic Macroinvertebrates

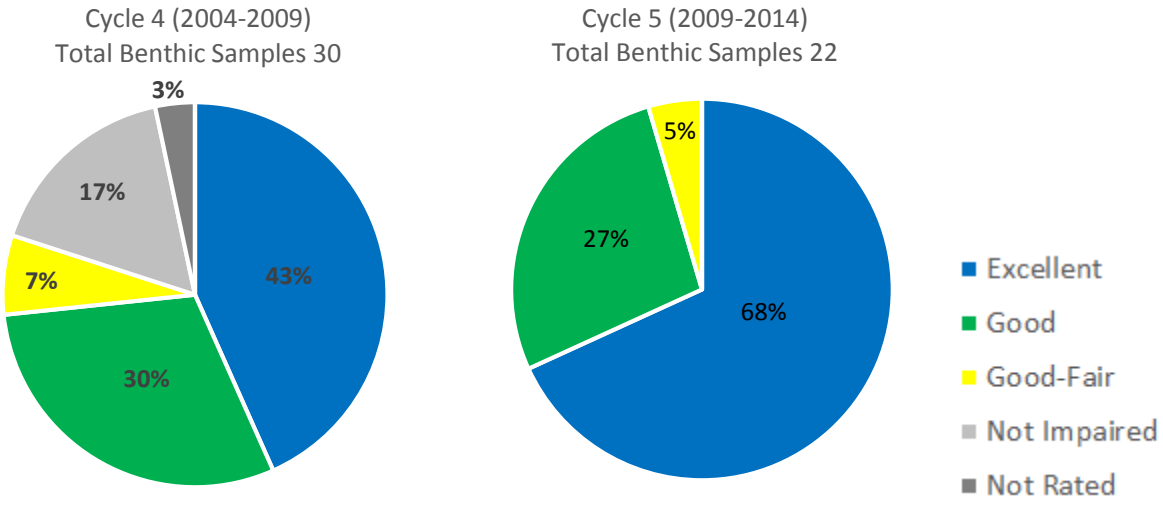
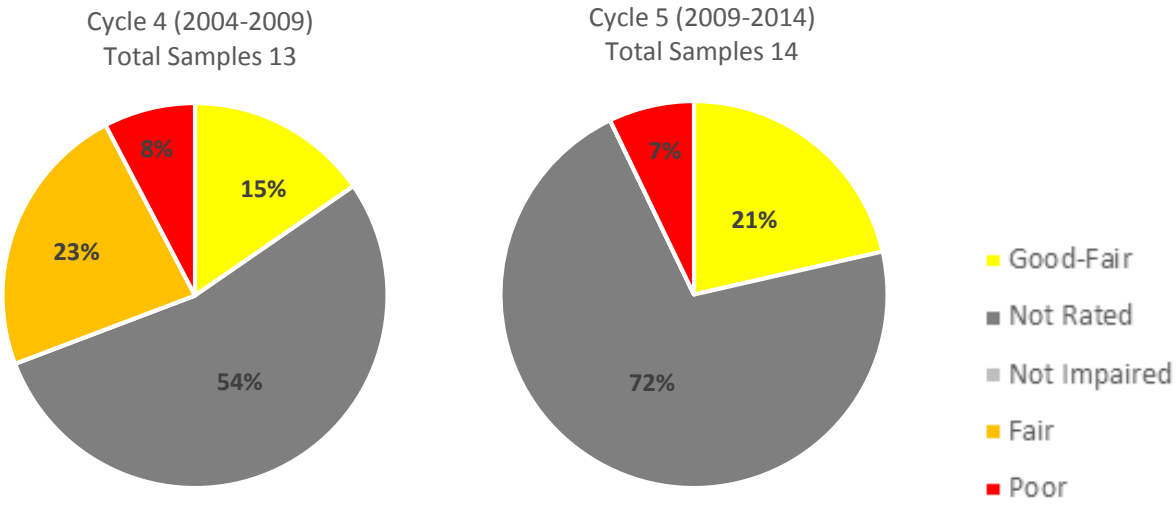


Figure 2: Biological Monitoring – Fish Community



Special Study: Supplemental Classification – Trout (Tr)

Several streams throughout the basin were sampled as part of special study requested by the North Carolina Chapter of the American Fisheries Society (AFS). The special study was requested to determine if the streams are eligible for the supplemental classification of Trout (Tr). The streams were sampled by DWR's Biological Assessment Branch (BAB) in 2009, and supporting documentation was provided by the North Carolina Wildlife Resources Commission (WRC). Benthic macroinvertebrates were also sampled as part of the study to determine if the streams are also eligible for the supplemental classification of High

Quality Waters (HQW). The results of the special study are included in the total number of benthic and fish communities sampled in cycle 4 and cycle 5.

Table 2: Biological Monitoring Special Study – Trout (Tr)

Station ID	Date Sampled	Stream Index Number	Stream Name	Bioclassification*
LF14	10/13/2009	8-7-6	Bee Tree Creek	Not Rated
LF15	10/12/2009	8-7-5	Cannon Branch	Not Rated
LF22	10/12/2009	8-22-11	Clear Branch	Not Rated
LF16	10/13/2009	8-10-1	Harrison Branch	Not Rated
LF17	10/12/2009	8-22-9	Leroy Creek	Not Rated
LF18	10/13/2009	8-15-2	North Fork Cove Creek	Not Rated
LF19	10/13/2009	8-19-3	Rube Creek	Not Rated
LF20	10/12/2009	8-2	Shanty Spring Branch	Not Rated
LF21	10/13/2009	8-15-6	Sharp Creek	Not Rated
LF23	10/13/2009	8-19-3-2	West Fork Rube Creek	Not Rated

* Not Rated because criteria and metrics have not been developed by the Biological Assessment Branch (BAB) for Southern Appalachian trout streams.

Based on data submitted by WRC and because data collected by the BAB showed evidence of multiple age classes and trout species, all the streams sampled and their unnamed tributaries may be eligible for the supplemental classification Tr. Additional information related to land use changes in the watersheds may be necessary to pursue the supplemental classification for these streams.

Ambient Monitoring

Chemical and physical samples were collected monthly at two ambient monitoring stations (AMS) on the Watauga River. Parameters collected at each station, or site, depend on the waterbody's classification but typically include conductivity, dissolved oxygen (DO), pH, temperature, turbidity, nutrients and fecal coliform bacteria. Between January 2007 and December 2008, two stations (Cold Prong and Cove Creek) were also monitored as part of the Random Ambient Monitoring System (RAMS). RAMS is a component of the AMS and is a probabilistic monitoring initiative in which sampling locations are randomly selected and located on freshwater streams throughout the state. The stations are sampled once a month for two years and then "retired." RAMS focuses on smaller streams and allows the division to collect data on water quality parameters that are not evaluated through AMS and allows the division to answer broad questions about water quality in North Carolina's smaller streams.

Water quality standards are currently meeting criteria as established by the State of North Carolina in the Watauga River basin. Turbidity and temperature, however, have been identified as concerns throughout the basin by local resource agencies. Turbidity is a measure of cloudiness in water and is often accompanied with excessive sediment deposits in the streambed. Excessive sediment deposited on stream and lake bottoms can choke spawning beds (reducing fish survival and growth rates), harm fish food sources, fill in pools (reducing cover from prey and high temperature refuges), and reduce habitat complexity in stream channels. Excessive suspended sediments can also make it difficult for fish to find

prey and at high levels can cause direct physical harm, such as clogged gills. Sediments can also cause taste and odor problems, block water supply intakes, foul treatment systems, and fill reservoirs.

Soil erosion is the most common source of turbidity. Some erosion is a natural phenonmenon, but human actions and land use practices can accelerate the process to unhealthy levels. Construction sites, mining operations, agricultural opertions, logging operations, and excessive stormwater flow off of impervious surfaces are all potential sources of erosion and turbidiy in a stream channel.

In order to be healthy and reproduce, all aquatic species require specific temperature ranges. An aquatic species becomes stressed when water temperatures exceed the ideal temperature range, often making them more susceptible to injury and disease. Trout, for example, prefer temperatures below 20°C (68°F) and cannot survive in the water reservoirs of the piedmont and coastal plain where temperatures can exceed 30°C (86°F). Changes to natural conditions or weather patterns can often change the ambient water temperature. For example, higher ambient water temperatures are expected during years with severe drought in areas where there is little shade. Higher ambient water temperatures can also be expected when air temperatures are high during summer months. Stormwater can also impact surface water temperature as well as recreational activities.

Special Studies: Temperature

Because trout fishing represents a significant portion of angling opportunities in North Carolina's mountains, the North Carolina Wildlife Resources Commission (WRC) continually strives to protect, identify and preserve streams that support self-sustaining populations of wild trout. Between May 2015 and March 2016, WRC conducted a temperature study in the mainstem of the Watauga River from NC 194 to US 321. Along this stretch of river, there are several areas where the river is wide, riparian areas are sparse, and agricultural land is directly adjacent to the river.

Temperature was automatically collected from five stations every two hours and recorded in degrees Fahrenheit (°F). The 2015-2016 study found that temperatures exceeded 68°F (20°C) for most of the days in June, July and August of 2015. The wide, open areas along the river are likely contributing to the high temperatures during the summer months by allowing sunlight to directly warm the water in the river. This in turn decreases the level of dissolved oxygen, which can impact aquatic life especially naturally sustaining trout populations.

A second special study was conducted by WRC during the summer of 2017. The second study was in response to some unusually high temperature readings between the Avery County line and the Shulls Mill area, the headwaters of the Watauga River. WRC identified an area in the Watauga River near the confluence with Moody Mill Creek where there is an abrupt change in water temperature. In addition to elevated temperature, WRC biologists also noted that the fish habitat changes from a cold-water fishery to a cool/warm water fishery habitat. Moody Mill Creek and its tributaries are characterized by a lack of woody riparian vegetation and little shade with pastures located along the streambanks. Several ponds are located throughout the catchment. Any water released from these ponds could contribute to increased temperatures downstream.

Watersheds in the Watauga River Basin

Watauga River Headwaters HUC 060101030301

As the name indicates, several headwater streams are located in this watershed and include Moody Mill Creek, Boone Fork, Cannon Branch and Bee Tree Branch. Water quality for biological integrity in the watershed remains good and even excellent in some places, but changes in land use and stream flow are evident in the upper most section of the river where benthic communities have fluctuated between Good-Fair, Good and Excellent over the past three monitoring cycles.

Watauga River LB14 (Good)
2013

Land Use	
Forest	83.9%
Developed	10.6%
Agriculture	4.0%

Biological Sampling Sites		
Cycle 4	5 Benthic	0 Fish
Cycle 5	5 Benthic	4 Fish

Permits	
NPDES Wastewater Permit	15
Non-Discharge Permits	1
Stormwater Permits	0

Water Supply	
Public Water Supply System	29
Local Water Supply Plans	1
Registered to Withdraw Water	0

Cove Creek HUC 060101030302

Covering just under 30 square miles, Cove Creek is a mix of forest, agriculture and rural development. Cove Creek has the highest number of acres dedicated to agricultural use, and the second highest number of developed acres when compared to other watersheds in the basin. Overall, water quality in the Cove Creek watershed is good, but the entire watershed continues to be impacted by historic and existing land use. Long lengths of the creek and its tributaries lack a canopy, portions are deeply entrenched with very little aquatic habitat, and forested riparian areas are non-existent in many areas. Cove Creek has been targeted by the local Soil and Water Conservation District (SWCD) and NC Cooperative Extension Service (NCCES) for educational workshops related to keeping and maintaining riparian areas. Initial work has already started in identifying areas of concern and where streambanks are heavily eroded. In addition, several BMPs have already been installed in the watershed. BMPs include measures to reduce sediment, nutrient and erosion and exclude livestock from streams.

Cove Creek LB5 (Good)
2013

Land Use	
Forest	70.8%
Developed	9.2%
Agriculture	17.3%

Biological Samples Collected		
Cycle 4	6 Benthic	2 Fish
Cycle 5	2 Benthic	3 Fish

Permits	
NPDES Wastewater Permit	3
Non-Discharge Permits	1
Stormwater Permits	0

Water Supply	
Public Water Supply Systems	12
Local Water Supply Plans	0
Registered to Withdraw Water	0

Dutch Creek HUC 060101030303

Watauga River between Laurel Fork and Cove Creek is in the Dutch Creek watershed along with Dutch Creek itself. Running through a more urban part of the basin, Laurel Fork has historically been impacted by stormwater runoff, but over the years, the Winston-Salem Regional Office (WSRO) has worked with several of the stormwater permittees to identify discharge locations and ways to reduce the amount of stormwater leaving their properties. Dutch Creek is more rural, but biologists noted that forestland continues to decrease in the catchment area and development (single-residential family homes) has increased. Overall, water quality in the Dutch Creek watershed is good, but historic and current agricultural land use as well as development along Laurel Fork has created extremely narrow riparian zones and unstable streambanks throughout the watershed.

Dutch Creek LF7 (Good-Fair)
2013

Land Use	
Forest	84.7%
Developed	5.5%
Agriculture	8.1%

Biological Samples Collected		
Cycle 4	4 Benthic	2 Fish
Cycle 5	3 Benthic	2 Fish

Permits	
NPDES Wastewater Permit	5
Non-Discharge Permits	1
Stormwater Permits	5

Water Supply	
Public Water Supply Systems	30
Local Water Supply Plans	0
Registered to Withdraw Water	1

Beaverdam Creek HUC 060101030304

Beaverdam Creek encompasses approximately 20 square miles and is the least populated of all the watersheds. Land use is mostly forested with agricultural and rural residential properties. Overall, water quality in the watershed continues to be good, but Beaverdam Creek remains impaired for aquatic life – fish community. The stream was first listed in 2008 due to a Poor fish bioclassification. The same site was given a Fair bioclassification during cycle 4 but received a Poor bioclassification again during cycle 5. Despite the poor fish community ratings, the benthic community received an Excellent bioclassification during the two most recent monitoring cycles (cycle 4 and cycle 5). Working with the local community and funds provided by grants through EPA Section 319, several best management practices

Beaverdam Creek LF5 (Poor)
2013

Land Use	
Forest	78.8%
Developed	3.3%
Agriculture	15.9%

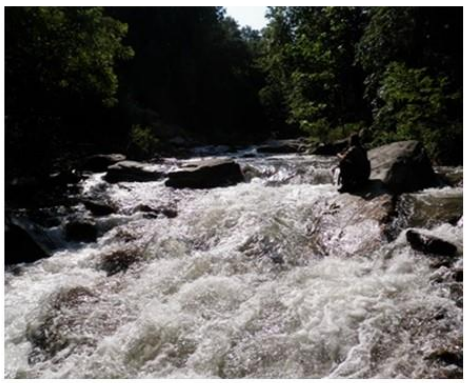
Biological Sampling Sites		
Cycle 4	2 Benthic	2 Fish
Cycle 5	3 Benthic	3 Fish

Permits	
NPDES Wastewater Permit	1
Non-Discharge Permits	0
Stormwater Permits	0

Water Supply	
Public Water Supply Systems	1
Local Water Supply Plans	0
Registered to Withdraw Water	0

(BMPs) have been constructed throughout the watershed with several more planned by the Watauga River Partners (WRP).

Beech Creek HUC 060101030305



Beech Creek LB2 (Good)
2013

Land Use	
Forest	81.4%
Developed	7.7%
Agriculture	7.4%

Biological Sampling Sites		
Cycle 4	5 Benthic	2 Fish
Cycle 5	3 Benthic	0 Fish

Permits	
NPDES Wastewater Permits	2
Non-Discharge Permits	1
Stormwater Permits	0

Water Supply	
Public Water Supply Systems	3
Local Water Supply Plans	1
Registered to Withdraw Water	2

Covering approximately 40 square miles with development centered around the Town of Beech Mountain, the Beech Creek watershed is a popular destination for winter and summer enthusiasts. The town itself spans across portions of both Watauga and Avery Counties, includes a small portion of the Elk River watershed and is the highest (5,506 feet) incorporated community east of the Mississippi River. Overall, water quality in the watershed remains good with Beech Creek (AU 8-20) seeing a slight decrease in the benthic community between 2008 and 2013. The decrease is likely due to increased nonpoint source runoff from upstream residential and agricultural areas and increased scour due to high flow events prior to sampling.

Residents in the Town of Beech Mountain rely on surface water for their drinking water supply while the remaining population relies on groundwater through a community well or individual private wells. In 2012, the Division of Water Resources (DWR) determined that the town's LWSP could not be approved because the PWS could not meet the current or long-term water supply needs of its customer base. Working with the town, DWR issued a Water Supply Availability report in September 2015 identifying needs and challenges associated with the town's current water supply. DWR's Water Supply Development program will continue to work with the town to identify how to address water supply demands now and into the future.

Elk River HUC 0601010302

Elk River LB6 (Excellent)
2013

Land Use	
Forest	82%
Developed	9%
Agriculture	5%

Biological Samples Collected		
Cycle 4	5 Benthic	3 Fish
Cycle 5	5 Benthic	2 Fish

Permits	
NPDES Wastewater Permit	5
Non-Discharge Permits	2
Stormwater Permits	0

Water Supply	
Public Water Supply Systems	18
Local Water Supply Plans	3
Registered to Withdraw Water	6

Elk River begins on the northwestern slope of Peak Mountain in Avery County. It flows west/northwest through the Towns of Banner Elk and Elk Park. Just before the river crosses into Tennessee, it drops 40-feet over Big Falls (also known as Elk Falls). Tributaries include Cranberry Creek and Little Elk Creek.

Covering 52.1 square miles in North Carolina, the watershed consists of high peaks, forests, rural residential properties, and scattered agricultural land. Because of its natural beauty, portions of the Elk River watershed have become popular destinations for nature and recreational enthusiasts. Overall, water quality remains good in the watershed but new development and its potential impact to streambanks and streambeds was noted as a concern by local resource agencies. Several streams may be eligible for the Trout (Tr) classification based on a special study requested by the North Carolina Chapter of the American Fisheries Society (NCAFS). Additional information related to land use changes in the watershed may be necessary to pursue the supplemental classification for these streams.

On-Site Wastewater Treatment Systems (Septic Systems)

Poorly planned and/or maintained septic systems can fail and contribute to nonpoint source pollution. Wastewater from failing septic systems can contaminate ground and surface water. Failing septic systems are also health hazards and are considered illegal discharges when surface water is impacted. The On-Site Water Protection Branch (OSWP) in the Environmental Health Section (EHS) of the Division of Public Health (DPH) in the Department of Public Health and Human Services (DHHS) is responsible for providing regulatory oversight of sub-surface on-site wastewater and dispersal systems. OSWP is also responsible for inspecting and testing the construction, repair or abandonment of a private drinking water well on or after July 1, 2008. OSWP provides statewide regulatory and consultative services related to both wastewater and private drinking water wells to local health departments as well as number of other clients including: builders, developers, landowners, system installers, well drillers, system operators, engineers, soil scientists, geologists, and environmental health consultants.

Information about the proper installation and maintenance of septic tanks can be obtained by contacting OSWB or county health departments. OSWP also has a Non-Point Source (NPS) Pollution Program that identifies potential NPS pollution from on-site systems as well as best management practices to ensure an on-site system is functioning properly. The program also has county statistics on the number of households using septic systems. The facts and figures are based off of the 1990 Census. In the Watauga River basin, it was determined that 62 percent of the residents in Avery County were using septic systems to dispose of domestic waste and 63 percent in Watauga County.

Underground Storage Tanks

In North Carolina, the Underground Storage Tanks (UST) Section is in the Division of Waste Management (DWM). The section manages the UST program, the non-UST release program (petroleum aboveground storage tank (AST) releases), and the Ex-Situ Petroleum Contaminated Soil Remediation Permit program. The section also oversees permanent closure activities, administers several trust funds for the reimbursement of cleanup costs associated with releases, and ensures compliance with all relevant state and federal laws, policies, rules and regulations by assisting owners and operators in complying with operation standards.

A petrochemical seep in the Watauga River in the Town of Foscoe was reported to DEQ's Winston-Salem Regional Office (WSRO) and the Watauga County Emergency Response Team in July 2017. It was located between Church Road and Riverside Farm Road and was first reported by a local angler to the Watauga Riverkeeper who then contacted the proper agencies to investigate the source of the seep. Soon after the seep was confirmed, a recreational use advisory was issued by Appalachian District Health Department (AppHealthCare), and the UST Section collected water from water supply wells to ensure the contaminant was below detection limits for drinking water standards. Catch booms were installed to absorb the petrochemical in an effort to prevent the contaminant from moving further downstream.

In September 2017, DWM worked with an environmental consulting firm to stabilize the seeps. Petroleum covered vegetation was removed from the streambank; absorbent pads along with a vacuum truck was used to remove any free product that was present; and more than 100 feet of booms were placed along the streambanks where seeps were observed. An additional boom was placed down river as an added precaution (Sherrill, October 5, 2017; AppHealthCare, October 5, 2017). Comments received by the Watauga Riverkeeper note that the cleanup improved conditions without impacting the flora and fauna but the seeps remain. An investigation over the past several months (October 2017 through June 2018) eliminated one potential source of the seeps. The investigation for the source of the seeps continues and a recreational water advisory remained intact for the Watauga River between Church Road and Riverside Farm Road (AppHealthCare, July 3, 2018). An advisory will remain in effect until DHHS and AppHealthCare determine that the seeps are no longer impacting recreational use of the river. Watauga County, AppHealthCare, DEQ, DHHS and DWM continue to investigate the source of the contamination.

Water Use and Availability

Based on the information available through the LWSPs and the WWATR database, total water use in the basin in 2015 was an estimated 2.029 million gallons per day (MGD) with 1.045 MGD (51%) being used by public water supply (PWS) systems or community wells, 0.457 MGD (23%) being used for snow making, and 0.333 MGD (16%) being used for golf course irrigation. Snow making and golf course irrigation accounted for 71% of the total surface water withdrawn. PWS systems accounted for 78% of the total groundwater withdrawn. These numbers do not account for the amount of water withdrawn by private groundwater wells, small agricultural operations, or aquaculture facilities.

Five PWS systems are required to submit a LWSP. LWSPs are required for all units of local government that provide or plan to provide public water service as defined under North Carolina General Statute G.S. 143-355(l). One of the five systems, the Town of Beech Mountain, relies on surface water for its water supply. The remaining four systems rely on groundwater.

Based on information presented in the Town of Beech Mountain's LWSP, the PWS system is unable to meet current or long-term water supply needs for its customer base. The town has taken steps to reduce the lost or unaccounted-for water in their system by replacing water meters and strategically replacing water lines to relieve flow restrictions. The town is also constructing a new water treatment plant (WTP) which will also help reduce the amount of water lost from the system. DWR continues to work with the town to identify how best to meet current and future water supply needs. All other systems are currently meeting current and projected water demands.

Currently, there are no interbasin transfers, interconnections or emergency connections between PWS systems. Each system is independent of the other due to terrain, elevation and location in the basin. No DWR groundwater monitoring wells are located in the basin.

Residential water demand (as reported by the LWSPs) is expected to increase from 0.285 MGD in 2015 to 0.460 by 2060. Total water use is expected to increase from 0.823 MGD in 2015 to 1.126 MGD by 2060. Managing and identifying current and future water use demand and availability will be critical for meeting current and future water needs in the basin. A regional water resource plan was developed by the High Country Council of Governments (COG). It includes information pertaining to water resource planning, development and protection. The plan is intended to be a guide to assist local governments in managing their own water resource needs while also protecting water quality. In addition, conservation education and measures are encouraged, and PWS systems that submit LWSPs are required to submit water shortage response plans.

To understand how surface water withdraws can change water availability in the basin, a hydrologic computer model is being developed. The model can also assist with planning for increased water uses due to continuous growth, regulatory decisions on waste assimilative capacity, and managing resources during drought conditions. DWR is working with HydroLogics to develop a model for the Watauga, New and French Broad River basins using OASIS. The model will use historic and current data as it relates to stream flow, water supply planning (LWSP and WWATR), and water supply shortage response plans to develop a tool to assist with future planning endeavors.

Recommendations

Balancing economic growth with water resources protection is challenging. Point source impacts on surface waters can be measured and addressed through voluntary and regulatory actions, but the accumulative effects of nonpoint source pollution are diffuse. Nonpoint source pollution is the primary threat to water quality and habitat degradation in the Watauga River basin. While streams impacted by nonpoint source pollution can be identified through the basin planning process, actions to address the issues are needed at the local level.

In the Watauga River basin, sparse or non-existent riparian areas and stormwater were identified as major concerns throughout the basin along with the need to understand water use and availability. Working in tandem with local resource agencies and stakeholders, DWR has the following recommendations:

- Best management practices (BMPs), urban and agricultural, are needed throughout the basin to protect, improve or enhance existing conditions. Protective measures should include practices that protect streambanks, prevent or reduce solar radiation, and reduce overland flow. Overhanging trees and shrubs naturally keep flowing water cool by providing adequate shade during summer months and protecting aquatic organisms from elevated temperatures.

Vegetation along the streambanks also help retain soils during high flow events, reducing streambank erosion and sedimentation and preserving habitat and pools for aquatic organisms to escape direct sunlight and increasing water temperature.

- Continue supporting and promoting voluntary BMPs throughout the basin. Several voluntary programs exist for the agricultural community through the local Soil and Water Conservation District (SWCD) and Natural Resource Conservation Service (NRCS). The SWCD, NRCS and the Cooperative Extension Offices (CES) can also provide guidance on managing agricultural lands, forests, riparian buffers and stormwater runoff.

- Efforts should be made to assess and understand stormwater runoff throughout the basin and municipalities are encouraged to establish stormwater management programs. Municipalities are also encouraged to evaluate floodplains and their function throughout the basin. Floodplains allow water to move out of the river or streambed during heavy rain or rapid snowmelt events, dissipating energy, reducing erosion and protecting downstream property owners. Floodplains also act as natural filters, protecting water quality by removing excess nutrients and sediment and recharging groundwater supplies. When considering recreational opportunities (i.e., fishing, boating, camping, wildlife watching, hiking) throughout the basin, floodplains can play a major role in land use or conservation planning.

- Efforts to identify areas in the basin where USTs and/or on-site wastewater management systems may be impacting water quality should also be made. Both could have a significant impact to sensitive waters located throughout the basin should they fail.

- Elevated stream temperatures were noted as a major water quality and aquatic habitat concern by several resource agencies. Retrofitting in-line ponds or impoundments with cold water releases could lessen temperature impacts on the cold-water fisheries throughout the basin. Ponds used for snow-making and/or irrigating golf courses should be constructed off-line to reduce potential impacts to stream flow.

- Education and management measures are needed to prevent the introduction or spread of invasive, nonnative species. Whirling disease and gill lice have both been found throughout the basin. WRC is asking the public to help prevent the spread of the disease by cleaning and drying equipment, clothing or anything else that comes into contact with freshwater streams where trout are located and dispose of fish parts carefully by either sealing them in a garbage bag, burning them completely or burying deeply. Permits are required to move fish or aquatic life from one waterbody to another. This allows biologists an opportunity to review the potential negative impacts to the environment before any species is introduced to another body of water.

- Several streams throughout the basin were sampled as part of special study to determine if the streams are eligible for the supplemental classification of Trout (Tr). The study was requested by the North Carolina Chapter of the American Fisheries Society (AFS). Streams were sampled by DWR's Biological Assessment Branch (BAB) in 2009, and supporting documentation was provided by the North Carolina Wildlife Resources Commission (WRC). Based on data submitted by WRC

and because data collected by the BAB showed evidence of multiple age classes and trout species, all the streams sampled, and their unnamed tributaries, may be eligible for the supplemental classification Tr. Additional information related to land use changes in the watersheds may be necessary to pursue the supplemental classification for these streams.

- WRC recommends surveys to identify the distribution of brook trout. Surveys should also be conducted to identify three additional aquatic species (banded sculpin, Grandfather Mountain crayfish, Green Floater) identified as species of greatest conservation need (SGCN) in the basin. Long-term monitoring is needed to assess species and ecosystem health over time and understand species resiliency to changing water quality conditions.

- No DWR ambient groundwater monitoring wells are currently located in the basin, and there is only one active stream gauge. Existing groundwater wells, or sites for new wells that could be incorporated into DWR's groundwater monitoring network, should continue to be investigated by DWR and the Ground Water Management Branch (GWMB). Adding groundwater wells in the basin can fill in geographic data gaps and allow for monitoring of groundwater quality and drought conditions in the basin. Baseflow separation from the steam flow data can be used to estimate groundwater availability as well. With only one active stream gauge, however, baseflow separation from stream gauge data provides limited information. The installation of more stream gauges could improve DWR's ability to determine if the groundwater supply can support current and future demands.

- Based on information presented in the Town of Beech Mountain's LWSP, the PWS system is unable to meet current or long-term water supply needs for its customer base. The town has taken steps to reduce the lost or unaccounted-for water in their system by replacing water meters and strategically replacing water lines to relieve flow restrictions. The town is also constructing a new water treatment plant (WTP) which will also help reduce the amount of water lost from the system. DWR's Water Supply Development Program continues to work with the town to identify how best to meet current and future water supply needs. All other systems are currently meeting current and projected water demands.

- To understand how surface water withdrawals can change water availability in the basin, a hydrologic computer model is being developed. The model can be used to assist with planning for increased water uses due to continuous growth, regulatory decisions on waste assimilative capacity and managing resources during drought conditions. Updates on model development will be provided as they become available.

More information about each of these recommendations can be found in the Watauga River Basin Water Resources Plan.