# BASINWIDE ASSESSMENT REPORT

# FRENCH BROAD RIVER BASIN





NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES Division of Water Quality Environmental Sciences Section

April 2008



This page was intentionally left blank

# **TABLE OF CONTENTS**

#### LIST OF FIGURES INTRODUCTION TO PROGRAM METHODS......5 FRENCH BROAD RIVER HUC 06010105-FRENCH BROAD RIVER ......8 FRENCH BROAD RIVER HUC 06010106-PIGEON RIVER ......14 Description ......14 GLOSSARY

# LIST OF APPENDICIES

<u>Ap</u>	pend	<u>lix</u>	Page
I	B-1	Summary of benthic macroinvertebrate data, sampling methods, and criteria	23
l	F-1	Fish community sampling methods and criteria	36
l	F-2	A summary of fish community assessment data	42
l	F-3	Fish community data collected from the French Broad River basin, 1993-2007	46
	F-4	Fish community metric values from 44 wadeable streams in the French Broad River basin monitoring program 2004-2007	wide 48
	F-5	Fish distributional records for the French Broad River basin	48
	F-6	Habitat evaluations and stream and riparian habitats at 44 fish community monitoring sites in the French Broad River basin, 2004-2007	51
	F-7	Water quality at 44 fish community sites in the French Broad River basin, 2004-1007	58
	F-8	Fish Kills in the French Broad River basin, 2003-2007	61
	F-9	Web links	63
	F-10	Fish community references	64
	G-1	Flow measurement and flow conditions in the French Broad River basin	66

# LIST OF TABLES

<u>age</u>	<u>F</u>	<u>Table</u>
11	Waterbodies monitored in HUC 06010105 in the French Broad River basin for basinwide assessment, 2002 and 2007	FRB01
15	. Waterbodies monitored in HUC 06010106 in the French Broad River basin for basinwide assessment, 2002 and 2007	FRB02.
18	. Waterbodies monitored in HUC 06010108 in the French Broad River basin for basinwide assessment, 2002 and 2007	FRB03.

# LIST OF FIGURES

<u>Figure</u>		<u>Page</u>
1.	Geographical relationships of the French Broad River basin in North Carolina	6
2.	Level IV Ecoregions of the French Broad River basin	7
3.	Sampling sites in French Broad River HUC 06010105 in the French Broad River basin	9
4.	Sampling sites in Pigeon River HUC 06010106 in the French Broad River basin	16
5.	Sampling sites in Nolichucky River HUC 06010108 in the French Broad River basin	19

### INTRODUCTION TO PROGRAM METHODS

The Division of Water Quality uses a basinwide approach to water quality management. Activities within the Division, including permitting, monitoring, modeling, nonpoint source assessments, and planning are coordinated and integrated for each of the 17 major river basins within the state. All basins are reassessed every five years. The French Broad River basin has been sampled by the Environmental Sciences Section (ESS) four times for basinwide monitoring: 1992, 1997, 2002, and 2007.

The ESS collects a variety of biological, chemical, and physical data that can be used in a myriad of ways within the basinwide-planning program. In some program areas there may be adequate data to allow a fairly comprehensive analysis of ecological integrity or water quality. In other areas, data may be limited to one program area, such as only benthic macroinvertebrate data or only fisheries data, with no other information available. Such data may or may not be adequate to provide a definitive assessment of water quality, but can provide general indications of water quality. The primary program areas from which data were drawn for this assessment of the French Broad River basin include benthic macroinvertebrates and fish community for the period 2002 - 2007. Details of biological sampling methods (including habitat evaluation) and rating criteria can be found in the appendices of this report. Technical terms are defined in the Glossary.

The document is structured with physical, geographical, and biological data discussions presented by hydrologic units (HUCs). General water quality conditions are given in an upstream to downstream format. Lakes data, ambient chemistry data and aquatic toxicity data, with summaries, are presented in separate reports.

# **BASIN DESCRIPTION**

The French Broad River basin covers 2,842 square miles with approximately 4,113 miles of streams and is the ninth largest river basin in the state. This basin is located in the Blue Ridge Mountains and contains numerous level-IV ecoregions including the Southern Crystalline Ridges and Mountains, a tiny portion in each of the Southern Sedimentary Ridges and Southern Metasedimentary Mountains, High Mountains, and Broad Basins. The basin includes part or all of Transylvania, Buncombe, Henderson, Madison, Haywood, Yancey, Mitchell and Avery counties (Figure 1).





Much of the basin lies within the 1.2 million acre Pisgah National Forest or Pisgah Game Lands while the northwest corner of Haywood County is in the Great Smoky Mountains National Park. Over one-half of the basin is forested and the steep slopes limit the area suitable for development and crop production although valley areas generally support high concentrations of agricultural and urban uses. In most parts of this basin which are located near large towns, there is substantial activity associated with vacation home building. The basin is composed of three major drainages, the French Broad, Pigeon, and Nolichucky Rivers, which individually flow north into Tennessee. Streams found in valley areas tend to be of moderate (sometimes low) gradients with a good mix of substrates including rock, gravel, sand and silt. Conversely, streams found at higher elevations, above the valley streams, have much higher gradients and typically lack large amounts of silt and sand are proportionately more comprised of bedrock, boulder, and gravel.

The uppermost portions of this river basin (Subbasins 01, 02, 03, and 04, HUC 06010105) contain the headwaters of the French Broad River and originates at the confluence of the West and North Forks of the French Broad River near the Town of Rosman. This area of the basin includes the Broad Basins and Southern Crystalline Ridges and Mountains Level-IV ecoregions (Figure 2). Historically, NCDWQ maintains long-term benthic macroinvertebrate sampling points in Transylvania, Henderson, Buncombe, and Madison counties. Most of the landuse in this segment of the river basin is forest although in the valley areas there are large amounts of pasture and agricultural activity. The urban areas of Hendersonville, Brevard, Asheville, Weaverville, and Mars Hill are found here.

The largest single tributary of the French Broad River in North Carolina is the Pigeon River (Subbasin 05, HUC 0601006) and within this area NCDWQ maintains numerous historic benthic macroinvertebrate stations in Haywood County. Level-IV ecoregions found here include Southern Metasedimentary Mountains, Broad Basins, and Southern Crystalline Ridges and Mountains (Figure 2). With the exception of the urban area of Waynesville, Canton, and Maggie Valley, the majority of this portion of the basin is

forested and includes large tracts of protected lands associated with Great Smoky Mountains National Park as well as Pisgah National Forest.

The remaining portion of the French Broad basin that occurs within North Carolina can be found in HUC 06010108 (Subbasins 06, and 07) where NCDWQ maintains historic benthos monitoring stations in Avery, Mitchell, and Yancey counties. This area also includes the Southern Crystalline Ridges and Mountains Level-IV ecoregions. Much of the watershed is undeveloped and is encompassed within the Pisgah National Forest although high concentrations of agriculture and pasture can be found in some of the valley areas. The largest towns are Spruce Pine, Burnsville and Bakersville.



Figure 2. Level IV Ecoregions of French Broad River Basin

# FRENCH BROAD RIVER HUC 06010105 – FRENCH BROAD RIVER

### Description

The French Broad River basin HUC 06010105 contains DWQ's Subbasins from 04-03-01 to 04-03-04 and encompasses the 1,658 square mile French Broad River watershed from its headwaters in western Transylvania County to the North carolina-Tennessee state line northwest of the Town of Hot Springs in Madison County (Figure FRB05. Also included in this HUC are Henderson, Buncombe, and a very small portion of Haywood counties. Sizeable subwatersheds include the Davidson, Mills, and Swannanoa rivers and Ivy, Big Laurel, and Spring creeks.

The French Broad River originates near the Town of Rosman with the joining of the West Fork and North Fork of the French Broad River; just below the town is river's confluence with the East Fork of the French Broad River. These three streams generally drain minimally affected, Pisgah National Forest watersheds. The first major tributary to join the river below Rosman is the Davidson River which also drains a forested watershed. Downstream and below the Town of Brevard, is the confluence with the Little River. The headwaters of the Little River drain an area of Whiteside granite. This type of geology is associated with naturally sandy streams, although poor riparian buffers and nonpoint source runoff also contribute to the large amounts of sand and silt in the Little River. This portion of the French Broad River is low gradient and flows through a broad agricultural valley with row crops drained by the Mills River and Boylston Creek.

From the Mills River confluence to the City of Asheville, several medium size tributaries join the river – Mud Creek which drains the City of Hendersonville, Cane Creek, and Hominy Creek and the Swannanoa River which drain the southwest and the eastern portions of the Asheville metropolitan area, respectively. Northwest from the City of Asheville, smaller tributaries, such as Newfound, Reems, Flat, and Sandymush creeks drain forested areas and rural agricultural lands supporting dairy operations, apple orchards, corn, tomatoes, and burley tobacco. All of these areas are increasingly being encroached upon by the expansion of the Asheville metropolitan area. From the Buncombe-Madison County line to the state line, the river again flows through more rural and some very remote areas, especially many of the tributaries draining the high elevations along the Madison County borders. Major tributaries include Ivy, Big Laurel, Big Pine, and Spring creeks.

There are five Level IV ecoregions in this HUC of which the Southern Crystalline Ridges and Mountains and the Broad Basins encompass most of the area (Griffith, *et al* 2002). Three lesser ecoregions are at the periphery of the HUC – the Southern Metasedimentary Mountains and Southern Sedimentary Ridges near the state line and the High Mountains near the juncture of Haywood, Transylvania, Buncombe, and Henderson counties.

In this HUC, 16 watersheds, such as portions of the West Fork, North Fork, and East Fork French Broad River, North Fork and South Fork Mills River, and Ivy Creek, have been afforded additional water quality protection with supplemental water quality classifications such as High Quality Waters (HQW) or Outstanding Resource Waters (ORW) (Basinwide Information System query, February 01, 2008). Many of the watershed are also supplementally classified as Trout Waters. Priority watersheds for habitat conservation in this HUC include the Little River, Mills River, and upper French Broad River (in Transylvania County) (NCWRC 2005).

Public lands in this HUC include the North Carolina Division of Forest Resources' DuPont State Forest and the U.S. Forest Service's Pisgah National Forest. Portions of the Pisgah National Forest are managed by the North Carolina Wildlife Resources Commission as gamelands, including large tracts in each of the counties.



Figure FRB05. Sampling sites in HUC 06010105 in the French Broad River basin. Monitoring sites are listed in Table FRB05.

Major urban and metropolitan areas include the Town of Brevard, the City of Hendersonville, the City of Asheville, and the Interstate 40-Interstate 26 corridors. Smaller towns include Rosman, Mars Hill, Marshall, and Hot Springs. There are five major (> 0.5 MGD) permitted dischargers in this HUC discharging a total of 80.8 MGD: the Metropolitan Sewerage District of Buncombe County (40.5 MGD to the French Broad River), the Ecusta Business Development Center (27.5 MGD to the French Broad River), the City of Hendersonville (6.5 MGD) to Mud Creek, Progress Energy Carolinas, Inc. (4.8 MGD to the French Broad River), and the City of Brevard (2.5 MGD to the French Broad River) (Basinwide Information System query, February 01, 2008). There are 146 smaller facilities discharging a total of 4.472 MGD to the French Broad River and many of the smaller tributaries. One hundred seven miles of streams are on the 2006 impaired stream list (NCDENR 2007). Impaired waters that were monitored during the current basinwide cycle included Mud, Clear, Cane, Hominy, Newfound, and Little Ivy creeks and the Swannanoa River.

# **Overview of Water Quality**

Forty-six benthic macroinvertebrate and fish community samples, representing 43 different streams were collected from the French Broad River and its tributaries during the 2007 basinwide cycle (Table FRB05 and Figure FRB05). Six of the sites qualified as new fish community regional reference sites -- North Fork Mills River, South Fork Mills River, Bent Creek, Little Ivy Creek, Big Pine Creek, and Meadow Fork. In 2007, 57 percent of the sites were rated as either Good or Excellent; 33 percent as Good-Fair, 9 percent as Fair or Poor; and one site was Not Rated. Sites rating Fair or Poor -- Mud, Cane, lower Hominy, and upper Newfound creeks -- also rated Fair or Poor in 2002. Three sites on Hominy, South Hominy, and Little Ivy creeks were sampled for both benthic macroinvertebrates and fish. The two programs ratings for Hominy and South Hominy creeks were in agreement; the fish community rating for Little Ivy Creek was Good, whereas the benthic macroinvertebrate rating was Good-Fair.

Thirty-nine sites sampled in 2007 were sampled previously in 2002. The biological ratings of 59 percent of the sites did not change; 28 percent improved and in all cases increased by one rating; and 13 percent declined and in all cases decreased by one rating. For the 11 sites that improved (from Good to Excellent, or Good-Fair to Good, or Fair to Good-Fair, or Poor to Fair), the improvement was attributed to unknown causes at eight sites and to low flow conditions because of the drought lessening nonpoint source impacts at three sites. For the five sites that declined (from Excellent to Good, or Good to Good-Fair, or Fair to Poor), the decline was attributed to unknown cause at three sites; possible decline due to overall decline in water quality or seasonality factors at one site; and possible decline due to overall decline in water quality or flow at one site.

Based upon their consistent and long-term Excellent biological ratings, several basinwide watersheds qualify for supplemental reclassification to HQW or ORW, if so petitioned. These watersheds are: 1) Transylvania County -- the French Broad River at SR 1129, the North Fork French Broad River at SR 1322, the Middle Fork French Broad River at SR 1131, and the Davidson River at US 276 and 2) Madison County -- Big Laurel Creek at SR 1503 and at NC 208, Shelton Laurel Creek at NC 208, and Spring Creek at NC 209. [Note: some of these watersheds are in the process of being reclassified; please refer to the Special Studies section.]

Map # <sup>1</sup>	Waterbody	County	Location	2002	2007
B-1	French Broad R	Transylvania	SR 1129	Excellent	Excellent
B-2	French Broad R	Buncombe	NC 146	Good-Fair	Good
B-3	French Broad R	Buncombe	SR 1348	Good	Good-Fair
B-4	French Broad River	Buncombe	SR 1634	Fair	Good-Fair
B-5	French Broad R	Madison	NC 213	Good-Fair	Good-Fair
B-6	W Fk French Broad R	Transvlvania	US 64	Excellent	Good
B-7	N Fk French Broad R	Transvlvania	SR 1322	Excellent	Excellent
B-8	M Fk French Broad R	Transvlvania	SR 1131	Excellent	Excellent
B-9	Davidson R	Transvlvania	US 276	Excellent	Excellent
B-10	Little R	Transvlvania	SR 1560	Good	Excellent
B-11	Little R	Transvlvania	SR 1533	Good-Fair	Good-Fair
B-12	Boylston Cr	Henderson	SR 1314	Good-Fair	Good-Fair
B-13	Mills R	Henderson	SR 1337	Good	Good
B-14	Mills R	Henderson	SR 1353	Good-Fair	Good
B-15	Mud Cr	Henderson	US 25	Poor	Fair
B-16	Clear Cr	Henderson	SR 1513	Fair	Good-Fair
B-17	Cane Cr	Henderson	SR 1006	Fair	Poor
B-18	Hominy Cr	Buncombe	SR 1123	Good (NC 151)	Good-Fair
B-19	Hominy Cr	Buncombe	SR 3412	Fair	Fair
B-20	S Hominy Cr	Buncombe	NC 151	Good-Fair	Good
B-21	Swannanoa R	Buncombe	SR 2416	Fair	Good-Fair
B-22	Swannanoa R	Buncombe	US 25	Good-Fair	Good-Fair
B-23	Newfound Cr	Buncombe	SR 1622	Fair	Fair
B-24	Reems Cr	Buncombe	NC 251	Good-Fair	Good-Fair
B-25	Sandymush Cr	Madison	SR 1114	Good	Good-Fair
B-26	lvv Cr	Buncombe	SR 2150	Good	Good
B-27	lvv Cr	Madison	US 25/70	Good-Fair	Good
B-28	Little Ivv Cr	Madison	SR 1610	Good-Fair	Good-Fair
B-29	Big Laurel Cr	Madison	SR 1503	Excellent	Excellent (2006)
B-30	Big Laurel Cr	Madison	NC 208	Good	Excellent (2006)
B-31	Puncheon Fork	Madison	SR 1503	Excellent	Excellent
B-32	Shelton Laurel Cr	Madison	NC 208	Good	Excellent (2006)
B-33	Spring Cr	Madison	NC 209/SR 1172	Excellent	Excellent (2006)
	-1 3 -				
F-1	Crab Cr	Transylvania	SR 1532	Good	Good
F-2	N Fk Mills R	Henderson	SR 1341		Excellent
F-3	S Fk Mills R	Henderson	SR 1340		Good
F-4	Averv Cr	Buncombe	off SR 3498		Good-Fair
F-5	Bent Cr	Buncombe	off NC 191		Good
F-6	Hominy Cr	Buncombe	NC 151	Good-Fair	Good-Fair
F-7	S Hominy Cr	Buncombe	NC 151/SR 3449	Good	Good
F-8	Newfound Cr	Buncombe	SR 1641	Good	Good
F-9	Turkey Cr	Buncombe	SR 1629	Good	Good
F-10	Little Ivy Cr	Madison	SR 1547		Good
F-11	Bull Cr	Madison	SR 1574	Good-Fair	Good-Fair
F-12	Big Pine Cr	Madison	off SR 1151		Not Rated
F-13	Meadow Fk	Madison	NC 209		Good

# Table FRB05. Waterbodies monitored in HUC 06010105 in the French Broad River basin for basinwide assessment, 2002 and 2006/2007.

 $^{1}B$  = benthic macroinvertebrate monitoring sites; F = fish community monitoring sites.

# **River and Stream Assessment**

All benthic macroinvertebrate sites scheduled to be sampled were sampled in 2007. Four fish community sites scheduled to be sampled were not because of insufficient time or due to excessive turbidity resulting from late afternoon thunderstorms the previous day: 1) Buncombe County -- Newfound Creek at NC 63 and 2) Madison County -- Shelton Laurel Creek at NC 208, Big Laurel Creek at SR 1318, and Spillcorn Creek at SR 1330.

Specific site summaries of the 46 benthic macroinvertebrate and fish community samples may be found at this link: **06010105**.

# **Special Studies**

**Impacts from Trout Farm Discharge, West Fork French Broad River, Transylvania County** The Modeling/TMDL Unit requested that the fish communities at three sites along the West Fork French Broad River be evaluated in August 2003 to determine any impacts from the Whitewater Trout Farm discharge. One-half mile of the river from above to below the trout farm was on the 2002 303 (d) list of biologically impaired streams. The cause of impairment was given as "cause unknown" with "aquaculture" also given as the potential source. The impacts of a trout farm discharge upon the aquatic communities in the river had been documented since 1990. The discharge, along with degraded riparian habitats in the vicinity of the farm, affected the water chemistry, enriched periphytic growths, degraded the benthic community, and artificially stimulated the fish community. Enrichment and degradation of the stream by cattle wastes also could not be ruled out as a factor affecting the aquatic communities of the upper West Fork French Broad River (BAU Memorandum F-20031120).

# Wetlands Restoration Program Project, South Hominy Creek Watershed, Buncombe County

Four sites in the South Hominy Creek watershed were sampled in November 2003 for the purpose of evaluating the fish communities at the request of the Wetlands Restoration Program. Land alterations in the valleys in the middle portion of the watershed had lead to degraded stream riparian zones, embedded substrates, a general lack of pools, and open canopies. The fish communities in upper South Hominy Creek and Stony Fork were least impacted by watershed alterations. At Beaverdam and Warren Creeks the fish communities were impacted by nearby landuse practices. Nutrients did not seem to be an issue at any of the sites. Reproducing and multiple age class populations of trout were found in South Hominy Creek, Beaverdam Creek and Stony Fork. Select sites in this watershed would benefit from restoration efforts to reduce sediment inputs, increase canopy cover and riparian zones, and return the stream channels to a more functional state (BAU Memorandum F-20040326).

# Impacts from the 2004 Hurricanes

In late 2004, the impacts from the catastrophic flooding created by the remnants of the September 2004 hurricanes (Frances, Ivan, and Jeanne) on the benthic macroinvertebrate and fish communities in the French and Watauga River basins were investigated. Comparisons of habitat scores for pre- and post-hurricane sampling showed the biggest change in scores in the more developed watersheds, such as the Swannanoa River and South Hominy Creek. Water chemistry values showed little change. The eight benthic macroinvertebrate samples all declined one bioclassification following the hurricane flooding compared to the most recent sample (either 2002 or 2004). Mayfly taxa richness and abundance showed the largest declines and was the most consistent pattern across sites. Caddisflies generally were reduced, especially net spinning hydropsychids, but this pattern was not as consistent. Winter stoneflies and ephemerellid mayflies were the dominant taxa at all sites, and most likely hatched after the flooding. Where full scale samples were collected, the beetles and odonates were dramatically reduced, most likely because they are found most often on woody debris which was swept away in the floods.

The three fish community sites sampled showed a more varied pattern. Big Crabtree Creek (Mitchell County) maintained it's Excellent rating, while the benthos rating for Big Crabtree Creek declined from Excellent to Good. Cove Creek (Watauga River Basin) declined from Good-Fair to Fair (benthos changed from Good to Good-Fair). South Hominy Creek (Buncombe County) NCIBI scores decreased from 50 to 38 and the bioclassification changed from Good to Fair (benthos declined from Good-Fair to Fair). Overall, the benthos and fish communities showed a decline in bioclassification following the September 2004 hurricanes flooding. Before sampling, it was expected that the benthos, due to their inability to move far and their dependence on the bottom substrates, would show far greater impact than was found (BAU Memorandum F-20050404).

# Use Attainability/Reclassification Study, Upper Boylston Creek, Transylvania and Henderson counties

A Use Attainability/Reclassification Study was conducted to determine if there were wild, reproducing populations of trout in the upper Boylston Creek watershed. There was ample evidence collected by multiple researchers to document that two species of trout inhabit and reproduce within the Boylston Creek watershed. Brook Trout inhabit the higher elevation/upper reaches in Sutton Creek, Osborne

Branch, and Woody Branch. The lower elevations and reaches in Boylston Creek and Dog Creek are populated by Rainbow Trout. Based upon DWQ methods and criteria, reclassification of the Boylston Creek watershed from Class C to Class C, Tr (trout) waters was recommended (BAU Memorandum F-20060829).

# Ecosystem Enhancement Program Project, Lewis and Clear Creeks, Henderson County

In October 2006, four EPT samples were collected from two sites on Lewis Creek and two sites on Clear Creek. Both Lewis Creek sites were rated Fair (borderline Poor) with low EPT taxa richness and abundance values. The sparse fauna suggested toxicity, but the very poor habitat was also likely reducing the fauna. Clear Creek above Lewis Creek was rated Good-Fair and had some intolerant taxa, but the lack of stoneflies suggested chronic water quality rather than habitat problems. Below Lewis Creek, Clear Creek was rated Fair; but it had a more diverse and intolerant benthic community than either Lewis Creek site (BAU Memorandum B-20061116).

# Use Attainability/Reclassification Study, Big Laurel Creek Watershed, Madison County

A Use Attainability/Reclassification study was conducted at 15 sites in the Big Laurel Creek watershed in 2006 to determine if the watershed qualified as HQW or ORW. All sites, except one, were rated Excellent based upon the benthic macroinvertebrate community; Little Creek at SR 1318 was rated as Good. The entire Big Laurel Creek watershed qualified for reclassification to HQW (BAU Memorandum B-20061129).

# Use Attainability/Reclassification Study, Spring Creek Watershed, Madison County

A Use Attainability/Reclassification study was conducted at four sites in the Spring Creek watershed in 2006 to determine if the watershed qualified as HQW or ORW. All sites were rated Excellent based upon the benthic macroinvertebrate community. The entire Spring Creek watershed qualified for reclassification to HQW (BAU Memorandum B-20061129).

# Improper Use of Pesticides, South Fork Mills River, Transylvania County

A fish kill of at least 1,000 fish in the South Fork Mills River on or about July 26, 2007 was attributed to the misapplication of a pesticide (chlorothalonil) to tomato fields. Benthic macroinvertebrate samples showed a substantial impact from the pesticide. At an upstream sites, off SR 1338, the community was rated Excellent; downstream at SR 13340, the community was rated Fair (BAU Memorandum B-20070925).

# Use Attainability/Reclassification Study, Upper French Broad River Watershed, Transylvania County

A Use Attainability/Reclassification study was conducted at 11 sites in the upper French Broad River Basin in 2007 to determine if the watersheds qualified as HQW or ORW. Watersheds that qualified as HQW were: 1) Flat Creek, 2) North Fork French Broad River, Middle Fork French Broad River, 3) Gladys Fork, and 4) Cherryfield Creek. Watersheds that did not qualify as HQW were: 1) Parker Creek and 2) Diamond Creek (BAU Memorandum B-20080211).

# Use Attainability/Reclassification Study, Lower French Broad River Watershed, Madison County

A Use Attainability/Reclassification study was conducted at 5 sites in the lower French Broad River Basin in 2007 to determine if the watersheds qualified as HQW or ORW. Watersheds that qualified as HQW were: 1) the upper Bull Creek catchment; 2) Little Pine Creek, 3) Big Pine Creek, and 4) Doe Branch. Shut-in Creek qualified as ORW (BAU Memoranda B-20071203; B-20080211).

# FRENCH BROAD RIVER HUC 06010106—PIGEON RIVER

### Description

This HUC encompasses the Pigeon River watershed (Figure FRB06). Many of the undeveloped watersheds are in the Great Smoky Mountains National Park or the Pisgah National Forest. The Shining Rock and Middle Prong Wilderness areas are located in the watersheds of the Middle Fork, East Fork, and Little East Fork Pigeon Rivers and are also undeveloped.

In terms of ecoregions (Griffith *et al* 2002), this is among the most heterogeneous areas in the entire State with four Level-IV ecoregions present: Southern Crystalline Ridges and Mountains (elevations of between 1,200 and 4,500 feet with high precipitation rates and largely forested with some pasture, apple orchard, and Christmas tree farms), Broad Basins (lower elevation and relief, and therefore often have large concentrations of anthropogenic disturbances relative to the other three Level-IV ecoregions in this region), Southern Metasedimentary Mountains (steep relief and densely forested) and High Mountains (extremely steep, elevations in excess of 4,500 feet).

While most of this HUC remains forested, there are notable urban and suburban areas associated with Waynesville and the Towns of Clyde, Canton, and Maggie Valley. In addition, there are continued impacts associated with ongoing vacation home building in and around the suburban centers. In total, there are more than 20 dischargers in this subbasin. The major facilities include Waynesville's WWTP (6 MGD), Maggie Valley's WWTP (1 MGD), and Blue Ridge Paper Products, Inc. (29.9 MGD).

### **Overview of Water Quality**

The Blue Ridge Paper Products facility (the largest discharger in this HUC) has undergone many upgrades to its wastewater treatment process since 1990. However, recent sampling in 2006 indicates that the benthic macroinvertebrate community in the Pigeon River just downstream of the mill at SR 1642 (and slightly further downstream at SR 1519) continues to be comprised primarily of pollution tolerant organisms (Table FRB06). The SR 1519 location is likely impacted by the combined effluents of Blue Ridge Paper Products as well as the City of Waynesville's WWTP discharge. Specifically, the Pigeon River at SR 1642 (near Clyde) was rated Good-Fair rating in 1997, but decreased to Fair in 1999 and Poor in 2002 but improved slightly to Fair in 2006. The site near Hepco (SR 1338) continued to be rated Good-Fair in 2007 and the Waterville site (NC 215) improved to Good in 2007 from the 2002 Good-Fair collection.

Richland Creek near the City of Waynesville has shown signs of improving water quality in recent years based upon benthic macroinvertebrates and for 2007 this trend has also been documented in the fish community data. Recent work undertaken by the Asheville Regional Office (ARO) in the Richland Creek watershed during February and March 2007 has further contributed to improved benthic macroinvertebrate bioclassifications along some segments of Richland Creek. This improvement was most pronounced at the SR 1184 location, which improved from Good-Fair in 2002 to Good in 2007. Specifically, work undertaken by the ARO included the identification and subsequent repair of numerous leaking sewer lines adjacent to Richland Creek as well as those found on several tributaries (e.g., Hyatt Creek). Some degradation, usually from nonpoint sources such as dairy farms, also has been found in some of the smaller tributaries (e.g., Fines Creek).



# Figure FRB06. Sampling sites in HUC 06010106 in the French Broad River basin. Monitoring sites are listed in Table FRB06.

Overall, bioclassifications based on benthic macroinvertebrate data improved from 2002 to 2007 in this HUC at sites comprised primarily of non-point pollution inputs. In most instances, this was due to the record drought conditions and a subsequent decrease in run-off derived pollution. The most notable example of this occurred at Fines Creek, which improved from Good-Fair in 2002 to Good in 2007. Conversely, many sites that were below large point-source dischargers declined in bioclassification based on benthic macroinvertebrates due to a concentration of effluent due to the drought. The most noteworthy example of this occurred at Johnathans Creek at SR 1322, which declined from Excellent in 2002 to Good in 2007. Good in 2007. Generally speaking, benthic macroinvertebrate data suggest Good to Excellent water quality in most of the waterbodies contained in this HUC with the primary exceptions being noted at Richlands Creek (SR 1519) and the Pigeon River (SR 1642 and SR 1519). The most diverse and pollution intolerant benthic macroinvertebrate communities were found at Cataloochee Creek (designated ORW along with tributaries) and West Fork Pigeon River (which has been designated HQW as well as its

tributaries). Other waters designated as Native and Special Native Trout Waters (and thus also HQW) include the upper portion of the Little East Fork Pigeon River and tributaries, the upper portion of East Fork Pigeon River and tributaries, portions of Rough Creek, and Rocky Branch.

Fish community samples were collected from five sites during the 2007 assessment (Table XX). Three sites on Richland Creek ranged from Not Rated (Boyd Avenue) to Fair (SR 1184) to Good-Fair (Walnut Trail Road). The SR 1184 and Walnut Trail Road sites both improved from earlier collections (in 2001 and 2002 respectively), which received Poor bioclassifications. The remaining two fish samples in this HUC were collected at Crabtree Creek (Good-Fair; unchanged from 2002) and Fines Creek (Good-Fair, improved from Fair in 2002).

There was one fish kill reported between 2002 and 2007 in this HUC. The kill occurred on the Pigeon River, just below Canton, on September 27, 2007 as a combined effect of low flow, low dissolved oxygen and high water temperatures which was likely induced by the ongoing drought. Additional fish kill information can be found in Appendix XX.

# Table FRB06. Waterbodies monitored in HUC 06010106 in the French Broad River basin for basinwide assessment, 2002 and 2007.

Map # <sup>1</sup>	Waterbody	County	Location	2002	2007
B-1	Pigeon R	Haywood	NC 215	Good-Fair	Good <sup>2</sup>
B-2	W Fk Pigeon R	Haywood	SR 1216	Excellent	Excellent
B-3	E Fk Pigeon R	Haywood	US 276	Excellent	Excellent <sup>2</sup>
B-4	Pigeon R	Haywood	SR 1642	Poor	Fair <sup>2</sup>
B-5	Pigeon R	Haywood	SR 1338	Good-Fair	Good-Fair <sup>2</sup>
B-6	Pigeon R	Cocke Co, TN	At Browns Bridge	Good	Good
B-7	Richland Cr	Haywood	US 23	Good	Good-Fair
B-8	Richland Cr	Haywood	SR 1184	Good-Fair	Good
B-9	Richland Cr	Haywood	SR 1519	Good-Fair	Fair
B-10	Jonathans Cr	Haywood	SR 1306	Excellent	Excellent
B-11	Jonathans Cr	Haywood	SR 1322	Excellent	Good
B-12	Jonathans Cr	Haywood	SR 1349	Good	Good
B-13	Fines Cr	Haywood	SR 1355	Good-Fair	Good
B-14	Cataloochee Cr	Haywood	SR 1395	Excellent	Excellent
F-1	Richland Cr	Haywood	Boyd Ave.	Poor	Not Rated
F-2	Richland Cr	Haywood	SR 1184	Poor	Fair
F-3	Richland Cr	Haywood	Walnut Trail	Poor	Good-Fair
F-4	Crabtree Cr	Haywood	NC 209	Good-Fair	Good-Fair
F-5	Fines Cr	Haywood	SR 1355	Fair	Good-Fair

 $^{1}B$  = benthic macroinvertebrate monitoring sites; F = fish community monitoring sites.

<sup>2</sup>Data taken in 2006. <sup>3</sup>Data taken in 2001

#### **River and Stream Assessment**

Specific site summaries of the 19 benthic macroinvertebrate and fish community samples may be found at this link: **06010106**.

# **Pigeon River**

# **Special Studies**

Blue Ridge Paper Products (BRPP) NPDES No. NC0000272) operates a mill in Canton, NC . Among the decisions under consideration with permit renewal are whether to continue variances from the temperature and color standards. BRPP contracted biologists at the University of Tennessee at Knoxville to conduct a balanced and indigenous species study report and a temperature model for the Pigeon River (BRPP 2006). BRPP's balanced and indigenous species study found that the Pigeon River benthic community was impacted only directly below the mill as well as below the confluence of Richland Creek, which empties into the Pigeon River upstream of Waynesville's municipal wastewater discharge. A request was made by BRPP to consider the 2005 data in use support assessment of the Pigeon during the BRPP NPDES permit renewal process. Resampling by BAU biologists in July of 2006 was done as a special study to assess the Pigeon River during normal flow.

The rating of the Pigeon River at NC 215, Canton upstream of the BRPP mill received a bioclassification of Good. The rating given in 2002 for the location one-quarter mile upstream this site was Good-Fair, possible due to lower flows. Pigeon River at SR 1642 was given a rating of Fair. The community is dominated by tolerant taxa. This rating is an improvement from 2002 when this site was rated as Poor, possibly due to concentrated mill effluent and lack of habitat. Downstream of Clyde and Waynesville's wastewater effluent, the Pigeon River at SR 1519 also rated Fair. A similar tolerant community to that found at SR 1642 was found. The Pigeon River at SR 1338 was given a rating of Good-Fair, the same as found in 2002. It appears that distance from major dischargers and dilution of the Pigeon River by tributaries contributes to the higher classification than the two upstream sites. (BAU Memo-060914).

# **Richland Creek: Reclassification Study**

Numerous sites in the Richland Creek watershed were sampled for the presence of trout for purposes of reclassification to Trout (Tr) waters. As a result of this study, Shiny Creek, Old Bald Creek, Cherry Cove Creek, Winchester Creek, Medford Branch, Rocky Branch, Richland Creek (SR 1160/1168), Richland Creek (US 23 Business) and Richland Creek (Boyd Avenue) all met Trout Waters criteria and were recommended for reclassification to Tr waters. In addition, Rebank Branch, Nolen Creek, Drift Branch, Little Branch, Allen Creek Reservoir, Long Branch, Cold Spring Branch, Deep Gap Creek, Steestachee Branch, Bearpen Branch, and Rocky Branch (From source to dam at old Waynesville Reservoir) were also recommended for reclassification.

Streams not qualifying for reclassification included Factory Branch, Racoon Branch, Shelton Branch, Farmer Branch, Hyatt Creek, Richland Creek (SR 1184), Lake Junaluska, Shingle Cove Branch, Ratcliffe Branch, Mauney Cove Branch, and McElroy Branch.

### Fines Creek: Reclassification Study

A total of four sites in the Fines Creek watershed were sampled for the presence of trout for purposes of reclassification to Trout (Tr) waters. As a result of this study, all sites were found to be supporting a wild or naturalized and stocked trout population on a year-round basis. Moreover, it was determined that the entire Fines Creek watershed is also supporting a wild or naturalized and stocked trout population on a year-round basis and therefore the entire Fines Creek watershed should also be reclassified to Trout waters.

# FRENCH BROAD RIVER HUC 06010108 – NOLICHUCKY RIVER

# Description

HUC 06010108 is comprised of French Broad River Subbasins 06 and 07 and includes the Nolichucky River and its main tributaries, the Cane River and the North Toe River (Figure FRB08). The South Toe River, along with its tributary Big Crabtree Creek, flow into the North Toe River while the other major streams, Bald Mountain Creek and Big Rock Creek flow into the Cane and North Toe River respectively.

The majority of this hydrologic unit lies within the Southern Crystalline Ridges and Mountains ecoregion although sections of the High Mountain ecoregion are also present, particularly in the southwestern portion of the HUC. Much of the Nolichucky watershed is forested and contained within Pisgah National Forest. Agricultural land is generally located along the river corridors and is sparse in the northern portion of the watershed and more intense near the Towns of Spruce Pine and Burnesville. Additionally, small urban communities are scattered within this area of which Spruce Pine and Burnsville are the largest. Active industrial mining facilities are present on the North Toe River and are the largest permitted NPDES dischargers in the area. Various other minor NPDES permitted facilities exist in the watershed and are dominated by WWTPs from small community developments. In all, there are many point and non-point sources which can affect the water quality of streams in this area.



Figure FRB08. Sampling sites in HUC 06010108 in the French Broad River basin. Monitoring sites are listed in Table FRB08.

# Table FRB08. Waterbodies monitored in HUC 06010108 in the French Broad River basin for basinwide assessment, 2002 and 2007.

Map #1	Waterbody	County	Location	2002	2007
B-1	Nolichucky R	Mitchell	SR 1321	Good	Good
B-2	North Toe R	Avery	US 19E	Good	Good
B-3	North Toe R	Mitchell	SR 1162	Fair	Good (2006)
B-4	North Toe R	Yancey	SR 1314	Good	Good
B-5	Big Crabtree Cr	Mitchell	US 19E	Excellent	Excellent
B-6	South Toe R	Yancey	SR 1167	Excellent	Excellent
B-7	Big Rock Cr	Mitchell	NC 197	Excellent	Excellent
B-8	Cane R	Yancey	US 19W	Excellent	Excellent
B-9	Bald Mountain Cr	Yancey	SR 1408	Excellent	Excellent
F-1	N Toe R	Avery	SR 1121		Good-Fair
F-2	Big Crabtree Cr	Mitchell	SR 1002		Excellent
F-3	Cane Cr	Mitchell	SR 1211		Fair
F-4	Big Rock Cr	Mitchell	NC 226		Good
F-5	Pigeonroost Cr	Mitchell	SR 1349/NC 197	Excellent	Good
F-6	Big Cr	Yancey	SR 1444		Good
F-7	Hollow Poplar Cr	Mitchell	NC 197		Not Rated

 ${}^{1}B$  = benthic macroinvertebrate monitoring sites; F = fish community monitoring sites.

# **Overview of Water Quality**

Benthic macroinvertebrate samples have been collected at 36 sites in HUC 06010108 (25 in subbasin 06, 11 in subbasin 07) since 1983. Eight sites were sampled in 2007 and one in 2006 as part of the basin assessment program and rated Good or Excellent (Table FRB08). Although no serious habitat or physical-chemical problems, independent of exceptional drought, were prevalent throughout the basin, lack riparian vegetation was the most common deficiency shared by the majority of streams sampled. No streams in this HUC are listed on the NC impaired streams 303(d) list.

The Nolichucky River has consistently received a Good bioclassification since 1986. Small scale fluctuations in community composition and overall tolerance over the last 15 years have been documented but otherwise water quality remains stable.

Water quality in the North Toe River has remained relatively stable with a Good rating since basinwide monitoring began, with the exception of the sampling site at SR 1162 in Mitchell County. The latter site has historically varied between Fair (6 ratings) and Good (3 ratings). The most recent Fair rating, received during the last basinwide assessment, was attributed to a petroleum spill into the river a short time before sampling. The site returned to Good in 2007. This site is also downstream of 5 major NPDES dischargers and the Town of Spruce Pine which likely contribute to the variable ratings not seen at the other benthic stations on the North Toe River.

The South Toe River, classified as ORW, maintained its Excellent rating since it received a Good rating in 1983. Additionally, the secondary tributaries to the Nolichucky, Big Mountain Creek and Big Rock Creek, retained their Excellent bioclassifications indicating stable conditions within their catchments.

Benthic samples have been collected in the Cane River and its tributary Bald Mountain Creek since 1992. The Cane River has remained Excellent since 1992. Bald Mountain Creek has shown improvements in water quality as indicated by the bioclassification increase from Good-Fair (1992) to Good (1997) to Excellent (2002-2007).

Fish community samples were collected at seven streams (Table FRB08) within the Nolichucky watershed.

The North Toe River has maintained a Good-Fair rating since it was last sampled in 1997 though fewer fish species were collected in 2007. The moderately rich community was dominated by mottled sculpin and the river supported populations of both large wild and hatchery supported trout.

A regional reference site, Big Crabtree Creek has retained its Excellent bioclassification for over 10 years. Also, a hellbender (*Cryptobranchus alleganiensis*), a species of special concern in NC, was noted in this stream.

Cane Creek and Big Rock Creek, both tributaries to North Toe River, received a Fair and Good bioclassification, respectively. These ratings and the respective biotic indices have remained the same for each stream since they were last sampled (1997 for Cane Creek, 1998 for Big Rock Creek) indicating stable water conditions.

The rating for Pigeonroost Creek fell from the Excellent received in 2002, to Good for 2007. The Good rating for 2007, however, is borderline in that it may have scored an Excellent rating had one more intolerant fish species been collected.

Big Creek, a Cane River tributary, rated Good and Hollow Poplar Creek, a tributary to the Nolichucky River, received a Not Rated bioclassification. While Hollow Poplar Creek was Not Rated, the water quality is typical of a high elevation, high gradient trout stream. Both streams were sampled for the first time in 2007.

There was one fish kill reported between 2002 and 2007 in this HUC. The kill occurred on White Oak Creek, near Bakersfield, on May 1, 2007. This die-off is most likely attributed to pesticide use within the catchment. Additional fish kill information can be found in Appendix XX.

# **River and Stream Assessment**

Two basinwide streams sampled in 2002, Jacks Creek and Price Creek, were not sampled in 2007 due to insufficient manpower resources. Specific site summaries of the 16 benthic macroinvertebrate and fish community samples may be found at this link: **06010108**.

# **Special Studies**

# Post Hurricane Biological Sampling

The effect of catastrophic flooding caused by hurricanes on the fish and benthic macroinvertebrate community was assessed in the French Broad and Watauga River Basins in late 2004. Sampling was done on November 30 through December 2, 2004 on eight streams, of which two, Big Crabtree Creek and the South Toe River, are within the Nolichucky watershed.

Big Crabtree Creek maintained an Excellent rating for the fish community but dropped from Excellent to Good when based on the macroinvertebrate fauna. No fish sampling was performed in the South Toe River, but macroinvertebrate sampling resulted in a decrease from an Excellent to Good bioclassification. See the DQW memorandum BAU-04042005 for more information.

# Bald Creek Watershed Assessment

An assessment the macroinvertebrate community of the Bald Creek watershed was made at the request of the Ecosystem Enhancement Program. A total of 6 streams were sampled in this study (2 sites on Bald Creek, Elk Wallow Creek, Lickskillet Branch, Possumtrot Creek, Bowlens Creek and Bald Mountain Creek). Three streams, Bald Creek (at SR 1399), Lickskillet Branch, and Possumtrot Creek, were assigned Not Impaired ratings due to their small size. Bald Creek (at US 19W) and Elk Wallow Creek, a tributary to Bald Creek, both rated Good. The 2 reference sites, Bald Mountain Creek and the Bowlens Creek, both rated excellent. For more information see memorandum BAU-01202005.

# GLOSSARY

7Q <sub>10</sub>	A value which represents the lowest average flow for a seven day period that will recur on a ten year frequency. This value is applicable at any point on a stream. $7Q_{10}$ flow (in cfs) is used to allocate the discharge of toxic substances to streams.
Bioclass or Bioclassification	Criteria have been developed to assign bioclassifications ranging from Poor to Excellent to each benthic sample based on the number of taxa present in the intolerant groups (EPT) and the Biotic Index value.
cfs	Cubic feet per second, generally the unit in which stream flow is measured.
CHL a	Chlorophyll a.
Class C Waters	Freshwaters protected for secondary recreation, fishing, aquatic life including propagation and survival, and wildlife. All freshwaters shall be classified to protect these uses at a minimum.
Conductivity	In this report, synonymous with specific conductance and reported in the units of $\mu$ mhos/cm at 25 °C. Conductivity is a measure of the resistance of a solution to electrical flow. Resistance is reduced with increasing content of ionized salts.
Division	The North Carolina Division of Water Quality.
D.O.	Dissolved Oxygen.
Ecoregion	An area of relatively homogeneous environmental conditions, usually defined by elevation, geology, vegetation, and soil type. Examples include Mountains, Piedmont, Coastal Plain, Sand Hills, and Carolina Slate Belt.
EPT	The insect orders (Ephemeroptera, Plecoptera, Trichoptera); as a whole, the most intolerant insects present in the benthic community.
EPT N	The abundance of Ephemeroptera, Plecoptera, Trichoptera insects present, using values of 1 for Rare, 3 for Common and 10 for Abundant.
EPT S	Taxa richness of the insect orders Ephemeroptera, Plecoptera and Trichoptera. Higher taxa richness values are associated with better water quality.
HQW	High Quality Waters. Waters which are rated Excellent based on biological and physical/chemical characteristics through Division monitoring or special studies, primary nursery areas designated by the Marine Fisheries Commission, and all Class SA waters.
Major Discharger	Greater than or equal to one million gallons per day discharge ( $\geq$ 1 MGD)
MGD	Million Gallons per Day, generally the unit in which effluent discharge flow is measured.
Minor Discharger	Less than one million gallons per day discharge (< 1 MGD).
NPDES	National Pollutant Discharge Elimination System.

NCBI (EPT BI)	North Carolina Biotic Index, EPT Biotic Index. A summary measure of the tolerance values of organisms found in the sample, relative to their abundance. Sometimes noted as the NCBI or EPT BI.
NCIBI	North Carolina Index of Biotic Integrity (NCIBI); a summary measure of the effects of factors influencing the fish community.
NSW	Nutrient Sensitive Waters. Waters subject to growths of microscopic or macroscopic vegetation requiring limitations on nutrient inputs.
ORW	Outstanding Resource Waters. Unique and special waters of exceptional state or national recreational or ecological significance which require special protection to maintain existing uses.
SOC	A consent order between an NPDES permittee and the Environmental Management Commission that specifically modifies compliance responsibility of the permittee, requiring that specified actions are taken to resolve non- compliance with permit limits.
Total S (or S)	The number of different taxa present in a benthic macroinvertebrate sample.
UT	Unnamed tributary.
WWTP	Wastewater treatment plant

# Appendix B-1. Summary of benthic macroinvertebrate data, sampling methods and criteria.

# **Overall French Broad River Basin Summary:**

For 2007, 57 long-term benthic macroinvertebrate samples were sampled in the French Broad River Basin as part of the Basinwide Assessment program. Graphical representations of bioclassification trends from 2007-1992 among these long-term basinwide benthos sites for each of the HUCS (Figures XX-XX), subbasins (Figures XX-XX), as well as for the entire French Broad River basin (Figure XX) can be found below. As can be seen from this data, the 2007 benthic macroinvertebrate community bioclassifications have generally improved from previous levels. In many of these instances, the improvement is attributable to drought and this trend was most pronounced in areas of the basin where point source dischargers were rare and where the largest potential source of stress to aquatic invertebrate communities were due to non-point sources. In general, during droughts, invertebrate communities below large point source dischargers tend to become less diverse and more pollution tolerant in composition as effluent is concentrated as a result of lowered precipitation and groundwater inputs. Conversely, during drought conditions, less runoff from non-point sources is introduced from land into waterbodies and this typically results in the development of a more diverse, and less pollution tolerant invertebrate community.





### HUC 06010105 (French Broad River) Summary

The bioclassification trends for all of HUC 06010105 from 2007-1992 can be seen below (**Figure B-1.1**). This large HUC is comprised of a mix of forest, agriculture, and urban areas. Subbasins 01, 03, and 04 are largely forested with some agricultural uses. There are few large NPDES dischargers or large municipalities in these subbasins. Conversely, subbasin 02 is mostly a combination of agriculture and urban areas associated with the City of Asheville with several large NPDES dischargers present. In general, sites in subbasins 01, 03, and 04 that have largely forested watersheds maintained Excellent bioclassifications in 2007 from earlier Excellent samples. A few examples of this included West Fork French Broad River (US 64), Davidson River (US 276) and Big Laurel Creek (SR 1503). In addition, many sites in Subbasin 02 whose catchments are largely agriculture and suburban improved slightly in 2007 from earlier samples as a result of reduced impacts associated with non-point sources of pollution. Examples of this included French Broad River (SR 1634), Mud Creek (US 25), Clear Creek (SR 1513), South Hominy Creek (NC 151), and Swannanoa River (SR 2416). The one notable exception was Cane Creek (SR 1006), which received a Poor bioclassification in 2007 for the first time.



Figure B-1.1. French Broad River Basin HUC 06010105 (Subbasins 01, 02, 03, & 04) Bioclassification Trends (2007-1992)

# **Graphical Summaries by Subbasin**





Figure B-1.3. French Broad River Subbasin 02 (HUC 06010105): Bioclassification Trends (2007-1992)





Figure B-1.4. French Broad River Subbasin 03 (HUC 06010105): Bioclassification Trends (2007-1992)

Figure B-1.5. French Broad River Subbasin 04 (HUC 06010105): Bioclassification Trends (2007-1992)



# HUC 06010106 (Pigeon River) Summary

The bioclassification trends for all of HUC 06010106 from 2007-1992 can bee seen below in Figure B-1.6. As can be seen below, the number of Excellent bioclassifications declined slightly, but this was strongly offset by the large increase in the number of Good bioclassifications. With the exception of Canton and Waynesville, most of this HUC is comprised of forest and agriculture with few point source dischargers present. In general, streams in these areas of the HUC improved from earlier samples as a result of lessened non-point impacts due to drought. Examples of these streams include Fines Creek (SR 1355) and Pigeon River (NC 215). Conversely, some sites located below large NPDES dischargers decreased slightly in bioclassification as a result of effluent concentration due to drought and included Jonathans Creek (SR 1322). Streams with watershed comprised nearly entirely of forest maintained Excellent bioclassifications in 2007 from previous Excellent collections and included Cataloochee Creek (SR 1395), West Fork Pigeon River (SR 1216) and East Fork Pigeon River (US 276).





# HUC 06010108 (Nolichucky River) Summary

The bioclassification trends for all of HUC 06010108 from 2007-1992 can be seen below in Figure B-1.7. Most of the landuse in this HUC is a mix of forest and agriculture with few areas of suburbanization and few large NPDES dischargers. As can be seen below for 2007, bioclassifications have stayed largely unchanged in this HUC from previous samples. The one site that changed significantly from 2002 was the North Toe River (SR 1162), which improved to Good from Fair in 2002 as a result of continued recovery from a hydrocarbon spill in 2002.







Figure B-1.8. French Broad River Basin 06 (HUC 06010108): Bioclassification Trends (2007-1992)

Figure B-1.9. French Broad River Basin 07 (HUC 06010108): Bioclassification Trends (2007-1992)



There were numerous rare invertebrate taxa collected in the French Broad River basin in 2007 (Table 1).

Table 1. Rare invertebrate taxa:	French Broad River Basin, 2002-2007.
----------------------------------	--------------------------------------

Taxon	Number of DWQ Collections	Collection Location(s)	First Collection in FRB?
Mayfly: Litobrancha recurvata	37	Beaverdam Creek (SR 3449, Buncombe), Bad Fork (FSR 479, Henderson)	No
Mayfly: Serratella spiculosa	19	Carson Creek (SR 1103, <i>Transylvania</i> ), South Toe River (SR 1167, <i>Yancey</i> )	No
Mayfly: <b>Ameletus</b> <b>cryptosimulans</b>	8	Big Bearpen Branch (FSR 475B, <i>Transylvania</i> ), Lower Creek (FSR 472, <i>Yancey</i> ), Hollow Poplar Creek (SR 1321, <i>Mitchell</i> )	No
Mayfly: Drunella longicornis	18	Lower Creek (FSR 472, Yancey)	No
Stonefly: Rasvena terna	1	Log Hollow Branch (FSR 475B, <i>Transylvania</i> )	Yes
Stonefly: <i>Isoperla lata</i>	28	Big Laurel Creek (SR 1318, <i>Madison</i> ), Meadow Fork (NC 209, <i>Madison</i> ), Puncheon Fork (SR 1502, <i>Madison</i> ), Shelton Laurel Creek (NC 208, <i>Madison</i> ), Spring Creek (SR 1172, <i>Madison</i> )	
Stonefly: Agnetina flavescens	27	Sout Toe River (SR 1167, Yancey)	No
Stonefly: <i>Agnetina capitata</i>	29	Big Pine Creek (SR 1151, Madison), Bull Creek (SR 1370, Madison), Charley Branch (NC 209, Madison), Foster Creek (SR 1318, Madison), Little Laurel Creek (NC 208, Madison), Meadow Fork (NC 209, Madison), Mill Creek (SR 1313, Madison), Spillcorn Creek (SR 1330, Madison), Spring Creek (SR 1172, NC 209, Madison), Walnut Creek (SR 1395, Madison)	No
Stonefly: <i>Pteronarcys biloba</i>	34	Little River (SR 1560, <i>Transylvania</i> ), Hominy Creek (SR 1123, <i>Buncombe</i> ), Mud Creek (SR 1126, <i>Henderson</i> ), Big Laurel Creek (SR 1318, <i>Madison</i> ), Big Pine Creek (SR 1151, <i>Madison</i> )	No

Taxon	Total Number of DWQ Collections	Collection Location(s)	First Time Collected in Frenchbroad Basin?
Stonefly: Pteronarcys comstocki	4	North Toe River (SR 1314, Yancey), Ivy Creek (SR 2150, <i>Madison</i> )	Yes
Caddisfly: Ceratopsyche bifida	1	lvy Creek (US 25/70, Madison)	Yes
Caddisfly: Rhyacophila appalachia	3	Laurel Branch (NC 215, <i>Transylvania</i> , Little River (SR 1560, <i>Transylvania</i> )	Yes
Caddisfly: Rhyacophila amicus	8	West Fork Pigeon River (SR 1216, <i>Haywood</i> ), Big Crabtree Creek (US 19, <i>Mitchell</i> )	
Caddisfly: Platycentropus Sp	39	Hominy Creek (NC 112, Buncombe)	No
Caddisfly: Agarodes Sp	41	Tucker Creek (SR 1325, <i>Transylvania</i> ), Parker Creek (SR 1310, <i>Transylvania</i> )	No
Caddisfly: Parapsyche apicalis	15	Hollow Poplar Creek (SR 1321, <i>Mitchell</i> )	No
Caddisfly: <i>Psilotreta labida</i>	40	Bearwallow Branch (FSR 1206, <i>Transylvania</i> ), Big Bearpen Branch (FSR 475B, <i>Transylvania</i> ), Cold Spring Branch (NC 208, <i>Madison</i> ), East Prong Hickory Fork (SR 1310, <i>Madison</i> ), West Fork Pigeon River (SR 1216, <i>Haywood</i> )	No
Caddisfly: <i>Matrioptila jeanae</i>	18	Stony Fork (NC 151, <i>Buncombe</i> ), Beaverdam Creek (SR 3449, <i>Buncombe</i> ), Baldmountain Creek (SR 1408, <i>Yancey</i> )	
Caddisfly: Oecetis avara	30	Nolichucky River (NC 197, Mitchell)	Yes

# Table 1.Significantly Rare Invertebrate Taxa: Frenchbroad River Basin, 2002-2007<br/>(Continued).

# **Sampling Methods**

# Standard Qualitative (Full Scale) Method

Benthic macroinvertebrates can be collected from wadeable, freshwater, flowing waters using three sampling procedures. The Biological Assessment Unit's standard qualitative (Full Scale) sampling procedure includes 10 composite samples: two kick-net samples, three bank sweeps, two rock or log washes, one sand sample, one leafpack sample, and visual collections from large rocks and logs (NCDENR 2003). The samples are picked on-site. The purpose of these collections is to inventory the aquatic fauna and produce an indication of relative abundance for each taxon. Organisms are classified as Rare (1 - 2 specimens), Common (3 - 9 specimens), or Abundant ( $\geq$  10 specimens).

# **EPT Method**

Benthic macroinvertebrates can also be collected using the EPT sampling procedure. Four rather than 10 composite qualitative samples are taken at each site: 1 kick, 1 sweep, 1 leafpack and visual

collections (NCDENR 2006). Only EPT taxa are collected and identified and only EPT criteria are used to assign a bioclassification.

# **Habitat Evaluation**

An assessment form has been developed by the Biological Assessment Unit to better evaluate the physical habitat of a stream. The habitat score, which ranges between 1 and 100, is based on the evaluation of channel modification, amount of instream habitat, and type of bottom substrate, pool variety, bank stability, light penetration, and riparian zone width. Higher numbers suggest better habitat quality, but no criteria have been developed to assign impairment ratings.

# **Data Analysis**

Criteria for bioclassifications for standard qualitative samples in piedmont ecoregions are given below and are based on EPT S and the NCBI.

Tolerance values for individual species and biotic index values have a range of 0 - 10, with higher numbers indicating more tolerant species or more polluted conditions. Water quality scores (5 = Excellent, 4 = Good, 3 = Good-Fair, 2 = Fair and 1 = Poor) assigned with the biotic index numbers are averaged with EPT taxa richness scores to produce a final bioclassification. Criteria for piedmont and coastal plain streams are used for the Neuse River basin. EPT abundance and Total taxa richness calculations also are used to help examine between-site differences in water quality.

EPT S and BI values can be affected by seasonal changes. DWQ criteria for assigning bioclassification are based on summer sampling: June - September. For samples collected outside summer, EPT S can be adjusted by subtracting out winter/spring Plecoptera or other adjustment based on resampling of summer site. The BI values also are seasonally adjusted for samples outside the summer season.

	BI Values	BI Values
Score	Mountain	Piedmont
5	<4.00	<5.14
4.6	4.00-4.04	5.14—5.18
4.4	4.05-4.09	5.19—5.23
4	4.10—4.83	5.24—5.73
3.6	4.84—4.88	5.74—5.78
3.4	4.89—4.93	5.79—5.83
3	4.94—5.69	5.84—6.43
2.6	5.70—5.74	6.44—6.48
2.4	5.75—5.79	6.49—6.53
2	5.80—6.95	6.54—7.43
1.6	6.96—7.0	7.44—7.48
1.4	7.01-7.05	7.49—7.53
1	>7.05	> 7.53

#### Table 2. Biotic Index Criteria for Standard Qualitative (Full Scale) Samples.

#### Table 3.EPT Criteria for EPT samples.

	EPT Values	EPT Values
Score	Mountain	Piedmont
Excellent	>35	>27
Good	28-35	21-27
Good-Fair	19-27	14-20
Fair	11-18	7-13
Poor	0-10	0-6

# Table 4.Benthic macroinvertebrate data collected from French Broad River Basin, 2002-2007. Basinwide sites sampled in 2007 are in bold font.

HUC/Waterbody	Location	County	Index No	Date	ST	EPT	BI	EPT BI	BioClass
06010105									
French Broad R	SR 1129	Transylvania	6-(1)	8/16/2007 7/8/2002	105 96	46 54	4.2 3.6	3	Excellent Excellent
French Broad R	NC 146	Buncombe	6-(54.5)	8/15/2007	63 65	27	4.8 5.6	3.7	Good Foir
French Broad R	SR 1348	Buncombe	6-(54.5)	9/10/2002 8/16/2007	77	25 30	5.8	4.4	Good-Fair
French Broad R	SR 1634	Buncombe	6-(54.5)	7/10/2002 8/14/2007	73 77	30 28	4.7 5.6	3.9 4.1	Good Good-Fair
French Broad R	NC 213	Madison	6-(54.5)	7/10/2002 7/31/2007	57 79	18 32	5.7 4.9	4.8 3.7	Fair Good-Fair
Parker Cr	OFF SR 1310	Transylvania	6-2-4	6/26/2002 10/10/2007	81 35	26 35	5.8 2.2	4.5 2.2	Good-Fair Good
Flat Cr	UPS SP 1319	Transvlvania	6-2-10	10/0/2007	30	30	27	27	Excellent
	SR 1319	Transvlvania	0-2-10	7/8/2002	38	38	2.7	2.7	Excellent
N Fk French Broad B	SR 1322	Transylvania	6-3-(6.5)	8/17/2007	95	43	3.9	2.8	Excellent
Diodu IX	SR 1322	Transvlvania		7/9/2002	79	41	3.5	2.7	Excellent
Big Mountain Br	NC 215	Transylvania	6-3-13	10/10/2007	32	32	1.4	1.4	Excellent
Diamond Cr	off SR 1322	Transylvania	6-3-16	10/11/2007	24	24	1.6	1.6	Not Impaired
M Fk French Broad B	SR 1131	Transylvania	6-5	8/16/2007	43	43	2.2	2.2	Excellent
Broad IX				8/13/2007	41	41	3.1	3.1	Excellent
				7/8/2002	51	51	2.1	2.1	Excellent
Peter Weaver Cr	SR 1195	Transylvania	6-10	8/28/2007	61	27	5.2	4.5	Not Impaired
Morgan Mill Cr	OFF SR 1195	Transvlvania	6-10-1	8/28/2007	57	19	5.9	5	Not Impaired
Cherryfield Cr	SR 1128	Transvlvania	6-11	10/11/2007	46	46	3.2	3.2	Excellent
Glady Fk	OFF SR 1105	Transvlvania	6-16-3	10/10/2007	43	43	2.3	2.3	Excellent
Log Hollow Br	FSR 475B	Transvlvania	6-34-12-1-3	4/22/2005	71	44	1.9	1.2	Not Impaired
Big Bearpen Br	FR 475B	Transvlvania	6-34-12-3	4/22/2005	92	44	2.5	12	Not Impaired
Little R	SR 1560	Transvlvania	6-38-(1)	8/16/2007	45	45	3.3	3.3	Excellent
	SR 1560	Transvlvania	0 00 (1)	7/9/2002	35	35	3.5	3.5	Good
l ittle R	SR 1533	Transvlvania	6-38-(20)	8/16/2007	24	24	3.0	3.0	Good-Eair
	SR 1533	Transvivania	0-00-(20)	7/11/2002	24	24	42	42	Good-Fair
Mill Pond Cr	SP 1300	Henderson	6-51	8/20/2007	27	24	6.6	63	Not Rated
	511 1503	Tienderson	0-01	8/28/2007	21	6	5.6	5.1	Not Rated
Boylston Cr	SP 131/	Henderson	6-52-(0.5)	8/15/2002	22	22	3.0	3.0	Good-Eair
Doyiston of	0111014	Tienderson	0-52-(0.5)	7/22/2007	62	22	1.8	3.5	Good-Fair
Mille P	SP 1337	Henderson	6-54-(1)	8/15/2002	80	20	4.0	2.0	Good
	SK 1557	TIENGEISON	0-54-(1)	6/25/2007	74	20	4.4	2.1	Good
	CD 1252	Handaraan	6 FA (F)	0/25/2002	74	29	4.5	3.1	Good
	SK 1555	TIENGEISON	0-54-(5)	6/24/2002	7 Z 5 Q	20	4.4	20	Good Eair
Davidson B	118 276	Tranaulyania	6 FA (15 F)	0/24/2002	27	20	0.0 2.5	3.9	Guu-raii Evollopt
Daviuson R	03270	Transylvania	0-54-(15.5)	0/9/2007 8/16/2007	27	27	2.0	2.0	Excellent
				7/22/2002	27	27	2.0	2.0	Excellent
Rod Ek	ESD 470	Hondorson	651261	5/25/2002	57	37	3.Z 2.5	3.2	Excellent
S Fk Mills R	Off SR 1338	Henderson	6-54-3-	8/29/2007	46	40 46	2.5	2.5	Excellent
S Fk Mills R	SR 1340	Henderson	(17.5) 6-54-3- (17.5)	8/27/2007	17	17	4.1	4.1	Fair
				6/25/2002	73	38	4.5	3.2	Good
Mud Cr	SR 1126	Henderson	6-55	8/29/2007	50	18	5.9	5	Fair
Mud Cr	US 25	Henderson	6-55	8/15/2007	67	16	6.3	5	Fair
Bat Fk	SR 1803	Henderson	6-55-8-1	5/26/2006	47	9	5.7	5.7	Not Rated
King Cr	US 25	Henderson	6-55-8-1-2	5/26/2006	36	12	5.5	4.8	Not Impaired
Clear Cr	Bearwallow Rd	Henderson	6-55-11-(1)	10/31/2006	22	22	3.7	3.7	Good-Fair
Clear Cr	Gilliam Rd	Henderson	6-55-11-(1)	10/31/2006	17	17	4	4	Fair
Clear Cr	SR 1513	Henderson	6-55-11-(5)	8/13/2007	23	23	4.8	4.8	Good-Fair
Lewis Cr	Pilot Mt Rd	Henderson	6-55-11-è´	10/31/2006	11	11	4.2	4.2	Fair
Lewis Cr	Pryor Dr	Henderson	6-55-11-6	10/31/2006	11	11	4.7	4.7	Fair
Cane Cr	SŔ 1006	Henderson	6-57-(9)	8/13/2007	7	7	4.8	4.8	Poor
-			1-7	8/28/2003	15	15	5	5	Fair
				7/11/2002	11	11	4.2	4.2	Fair
Bent Cr	FSR 479	Henderson	6-67-(1)	8/29/2007	64	26	3.7	2.8	Good
			• •						

# Table 4 (continued).

HUC/Waterbody	Location	County	Index No	Date	ST	EPT	BI	EPT BI	BioClass
06010105									
Ledford Br	FSR 479	Buncombe	6-67-8	5/23/2006	58	30	2.4	1.7	Not Impaired
Hominy Cr	SR 1123	Buncombe	6-76	8/17/2007	81	31	5	4	Good-Fair
		<b>_</b> .		8/16/2007	72	21	5.8	4.3	Fair
S Hominy Cr	NC 151	Buncombe	6-76-5	8/17/2007	98	37	4.7	3	Good
				11/29/2004	18	18	2.6	2.6	Fair
O Liberations O	00 4405	Dura	0.70.5	8/28/2002	26	26	2.7	2.7	Good-Fair
S Hominy Cr	SK 1105	Buncombe	0-/0-5 6 76 5 5	7/8/2004	28	28	1.4	1.4	Good
Glady FK	SK 3452	Buncompe	0-70-0-0	7/9/2004	29	29	2.5	2.5	G000 Not Impoired
Smin Cove Br	SK 3449 ESP 170	Buncombe	0-70-0-0	1/3/2004 5/22/2006	23 52	∠3 22	3.Z	3.∠ 2.2	Not Impaired
Mooro Cr	CD 1221	Buncombo	6 76 9	5/23/2006	55 70	33	2.0	Z.Z	Not Impaired
Moore Br		Buncombe	6-77	5/23/2006	20	2	76	+.1 55	Not Rated
Swannanoa R	SR 2500	Buncombe	6-78	8/28/2003	51	ے 10	7.0 5	 3	Fair
owannanoa K	SR 2500	Buncombe	0-70	8/27/2002	62	19	54	4.0	Fair
Swannanoa R	SR 2416	Buncombe	6-78	8/16/2007	87	25	5.9	2	Good-Fair
Shannanou K	5112110	Bancombo	5.0	8/28/2003	73	25	5.3	4	Good-Fair
				8/27/2002	75	24	5.8	4.5	Fair
Swannanoa R	US 25	Buncombe	6-78	8/15/2007	82	30	5.6	4.1	Good-Fair
				11/29/2004	42	12	5.3	3.9	Fair
				8/28/2002	73	26	5.7	4.7	Good-Fair
Newfound Cr	SR 1622	Buncombe	6-84	8/14/2007	75	11	6.5	4.8	Fair
				7/12/2002	70	23	6.1	4.9	Fair
Reems Cr	NC 251	Buncombe	6-87-(10)	8/14/2007	23	23	3.7	3.7	Good-Fair
				7/10/2002	27	27	3.6	3.6	Good-Fair
Sandymush Cr	SR 1114	Madison	6-92-(9)	8/14/2007	22	22	3.9	3.9	Good-Fair
				11/30/2004	31	31	3.2	3.2	Good-Fair
				7/10/2002	32	32	3.5	3.5	Good
lvy Cr	SR 2150	Madison	6-96-(0.5)	8/6/2007	38	38	4.4	4.4	Excellent
				7/9/2002	32	32	4.1	4.1	Good
lvy Cr	US 25-70 BUS	Madison	6-96-(11.7)	8/6/2007	85	32	4.7	3.3	Good
	00 / 0/ -			6/26/2002	80	30	4.9	3.7	Good-Fair
L Ivy Cr	SR 1610	Madison	6-96-10	8/6/2007	26	26	4.3	4.3	Good-Fair
Ore also al Or	00 4500		0 00 40 4 0	5/29/2002	78	27	6.2	4.6	Good-Fair
	SK 1526	Wadison	6-96-10-1-8	7/30/2007	34	34	3.3	3.3	GOOD
	OFF SK 13/0	Madison	0-90-10	7/30/2007	37	37	3	3	Excellent
	OFF SK 1135 SP 1151	Madison	0-104 6-108	1/31/2007 8/1/2007	30 27	30 27	3.3 2 G	3.3 2 G	
	SR 1152	Madison	6-110	8/1/2007	20	31 20	∠.0 2.2	2.0	Excellent
Big Laurel Cr	SR 1503	Madison	6-112	9/18/2006	29 44	29 44	2.2	2.2	Excellent
	511 1005	Madison	0-112	7/8/2002	44	44	23	23	Excellent
Big Laurel Cr	OFF SR 1318	Madison	6-112	9/19/2006	40	40	3.3	3.3	Excellent
2.9 200101 01		maaloon	5112	7/8/2002	80	42	3.3	2.8	Excellent
Big Laurel Cr	NC 208	Madison	6-112	9/21/2006	47	47	3.3	3.3	Excellent
Puncheon Fk	SR 1502	Madison	6-112-5	9/18/2006	38	38	2.8	2.8	Excellent
Puncheon Fk	SR 1503	Madison	6-112-5	8/1/2007	40	40	2.4	2.4	Excellent
	-		-	7/8/2002	40	40	2.8	2.8	Excellent
Foster Cr	SR 1318	Madison	6-112-11	9/19/2006	36	36	3.1	3.1	Excellent
Spillcorn Cr	SR 1330	Madison	6-112-21	9/19/2006	38	38	2.7	2.7	Excellent
Shelton Laurel	NC 208	Madison	6-112-26	9/19/2006	44	44	3.4	3.4	Excellent
Cr									
				6/27/2002	32	32	3.6	3.6	Good
Shelton Laurel	Off NC 208	Madison	6-112-26	9/21/2006	51	51	3.5	3.5	Excellent
Cr							_		
Mill Cr	SR 1313	Madison	6-112-26-1	9/20/2006	42	42	2.1	2.1	Excellent
Big Cr	SR 1312	Madison	6-112-26-2	9/20/2006	42	42	1.7	1.7	Excellent
E Pr Hickory Fk	OFF SR 1310	Madison	6-112-26-7-	9/20/2006	41	41	1.9	1.9	Excellent
			2				-	-	
L Laurel Cr	NC 208	Madison	6-112-26-13	9/20/2006	42	42	3	3	Excellent
L Hurricane Cr	UId US 25-70	Madison	6-112-28	9/21/2006	36	36	2.2	2.2	Excellent
Bearwallow Br	FSR 1206	I ransylvania	6-118-1	4/21/2005	78	42	2.6	1.4	Not Impaired
	SK 1318	Madison	0-118-7	9/18/2006	35	35	2.5	2.5	G000 Execulerat
Friezeland Cr		Madison	0-118-10	11/1/2006	31	31	2.7	2.7	Excellent
IVIEAUUW FK	110 209	Mauson	0-110-19	11/1/2000	40	40	∠.4	∠.4	

Table 4 (continued).									
HUC/Waterbody	Location	County	Index No	Date	ST	EPT	BI	EPT	BioClass
06010105								ы	
Charley Br	NC 209	Madison	6-118-20	11/1/2006	39	39	2.2	2.2	Excellent
Spring Cr	NC 209	Madison	6-118-(27)	6/27/2002	37	37	3.3	3.3	Excellent
Spring Cr	SR 1172	Madison	6-118-(27)	11/1/2006	41	41	3	3	Excellent
Roaring Fk	SR 1343	Madison	6-112-9	9/19/2006	36	36	2.6	2.6	Excellent
Shut-In Cr	OFF SR 1183	Madison	6-125	7/31/2007	45	45	1.7	1.7	Excellent
Laurel Br	NC 215	Transylvania	6-6-6	10/11/2007	32	32	1.1	1.1	Excellent
	OFF SR 1325	I ransylvania	6-3-10	10/10/2007	47	47	2.5	2.5	Excellent
Broad R	SR 1314	Henderson	6-(54.5)	5/22/2007	59	1	6.2	6.7	Not Rated
Broad R	SR 1332	Buncombe	6-(54.5	5/23/2006	51	16	5.2	3.5	Not Rated
UT French Broad R	SR 3495	Buncombe	6-(54.5	5/25/2006	35	1	6.5	4.3	Not Rated
UT Mud Cr	US 25	Henderson	6-55	5/25/2006	52	11	6.2	5.4	Not Rated
UT Wash Cr	FSR 479	Henderson	6-55-7	5/25/2006	67	39	2.4	1.8	Not Impaired
	SR 1312	i ransyivania	6-2-(7.5)	10/9/2007	39	39	2.1	2.1	Excellent
W Fk French	US 64	Transylvania	6-2-(7.5)	8/28/2007	96	39	3.6	2.3	Good
DI Udu K				7/0/2002	01	51	3	23	Excellent
Walnut Cr	OFF SR 1395	Madison	6-106	7/31/2002	32	32	32	3.2	Good
Warren Cr	off NC 151	Buncombe	6-76-5-4	7/8/2004	27	27	2.4	2.4	Good-Fair
Youngs Cove Cr	SR 3452	Buncombe	6-76-6-3	7/8/2004	18	18	2.6	2.6	Not Rated
06010106									
W Fk Pigeon R	SR 1216	Haywood	5-2	8/8/07		46		1.9	Excellent
				11/29/04	69	42	2.5	2.0	Good
				7/25/02		37		2.4	Excellent
E Fk Pigeon R	Off US 276	Haywood	5-3-(0.5)	7/12/06	104	49	3.0	1.9	Excellent
D'anna D	011 40		<b>F</b> ( <b>7</b> )	7/22/02		41		2.5	Excellent
Pigeon R	Off 1-40	COCKE. CO.,	5-(7)	8/8/07	84	34	4.9	3.7	Good
		LIN.		7/22/02	76	20	5.0	2.0	Good
Pigeon R	NC 215	Haywood	5-(7)	7/12/06	86	34	5.0 4.6	3.9	Good
rigeonik	NC 215	Taywood	5-(7)	7/25/02	61	31	4.0	3.7	Good-Eair
Pigeon R	SR 1642	Haywood	5-(7)	7/13/06	71	16	6.3	4.7	Fair
			- (.)	9/10/02	49	9	6.8	5.2	Poor
Pigeon R	SR 1338	Haywood	5-(7)	7/13/06	94	30	5.4	4.2	Good-Fair
•				9/9/02	56	19	5.6	4.3	Good-Fair
Richland Cr	US 23	Haywood	5-16-(1)	8/7/07		27		2.8	Good-Fair
				7/29/02		31		2.9	Good
Richland Cr	SR 1184	Haywood	5-16-(11.5)	8/7/07		29		3.4	Good
<b>D</b> <sup>1</sup> 1 1 <b>D</b>	00.4540		<b>5</b> 40 (40)	7/24/02		19		4.3	Good-Fair
Richland Cr	SR 1519	Haywood	5-16-(16)	8/7/07		16		4.4	Fair Coord Toin
lonothone Cr	SP 1206	Howwood		7/25/02	45	20	5.4	4.4	Good-Fair
Juliatians G	SK 1500	Tlaywoou	5-20-(5.5)	7/24/02		37		1.7	Excellent
Jonathans Cr	SR 1322	Haywood	5-26-(7)	8/8/07		35		2.9	Good
	0111022	. laj li oca	0 =0 (.)	7/25/02		40		3.6	Excellent
Jonathans Cr	SR 1349	Haywood	5-26-(7)	8/8/07		33		2.9	Good
				9/9/02		34		3.8	Good
Fines Cr	SR 1355	Haywood	5-32	8/8/07		29		3.1	Good
Cotologahaa Cu	00 4005	L les sure e d	E 44	7/24/02		25		3.5	Good-Fair
Cataloochee Cr	SR 1395	Haywood	5-41	8/8/07	120	59	3.3	2.1	Excellent
06010108				7/24/02		42		1.5	Excellent
00010100									
Nolichucky R	SR 1321	Mitchell	7	8/14/07	88	37	4.51	3.52	Good
-				6/19/06	97	48	4.33	3.49	Excellent
				7/9/02	89	43	4.37	3.62	Good
Roaring Cr	US 19E	Avery	7-2-15	7/10/02		37		1.73	Excellent
Jones Cr	SR 1100	Avery	7-2-24	9/11/85	75	29	3.75	2.23	Good
N Toe R	US 19E	Avery	7-2-(27.3)	8/13/07	95	43	4.09	3.39	Good
	00 4400	N 414 - 14 - 14		7/10/02	89	39	4.92	3.86	Good
NIOEK	SR 1162	Mitchell	7-2-(27.7)	6/21/06	116	49	4.92	3.74	Good
				7/10/02	60	22	5.90	4.15	Fair

# Appendix F-1. Fish community sampling methods and criteria.

### **Sampling Methods**

At each sample site, a 600 ft. section of stream was selected and measured. Fish within the delineated stretch of stream were then collected using two backpack electrofishing units and usually, two persons netting the stunned fish. A seine was also used where there were substantial riffles. During the 2007 basinwide assessment BAU staff were assisted by staff from the DENR's Natural Heritage Program, DENR's Ecosystem Enhancement Program, DWQ's Asheville Regional Office, and a summer intern from North Carolina State University. After collection, all readily identifiable fish were examined for sores, lesions, fin damage, and skeletal anomalies, measured (total length to the nearest 1 mm), and then released. Those fish that were not readily identifiable were preserved and returned to the laboratory for identification, examination, and total length measurement. These fish have been deposited as voucher specimens with the North Carolina State Museum of Natural Sciences in Raleigh. All young-of-year were excluded from the analyses.

### **NCIBI Analysis**

The NCIBI is a modification of the Index of Biotic Integrity initially proposed by Karr (1981) and Karr, *et al.* (1986). The IBI method was developed for assessing a stream's biological integrity by examining the structure and health of its fish community. The scores derived from this index are a measure of the ecological health of the waterbody and may not directly correlate to water quality. For example, a stream with excellent water quality, but with poor or fair fish habitat, would not be rated excellent with this index. However, in many instances, a stream which rated excellent on the NCIBI should be expected to have excellent water quality.

The Index of Biological Integrity incorporates information about species richness and composition, trophic composition, fish abundance, and fish condition. The NCIBI summarizes the effects of all factors that influence aquatic faunal communities (water quality, energy source, habitat quality, flow regime, and biotic interactions). While change within a fish community can be caused by many factors, certain aspects of the community are generally more responsive to specific influences. Species composition measurements reflect habitat quality effects. Information on trophic composition reflects the effect of biotic interactions and energy supply. Fish abundance and condition information indicate additional water quality effects. It should be noted, however, that these responses may overlap. For example, a change in fish abundance may be due to decreased energy supply or a decline in habitat quality, not necessarily a change in water quality.

The assessment of biological integrity using the North Carolina Index of Biotic Integrity (NCIBI) is provided by the cumulative assessment of 12 parameters or metrics. The values provided by the metrics are converted into scores on a 1, 3, or 5 scale. A score of 5 represents conditions which would be expected for undisturbed reference streams in the specific river basin or ecoregion, while a score of 1 indicates that the conditions deviate greatly from those expected in undisturbed streams of the region. Each metric is designed to contribute unique information to the overall assessment. The scores for all metrics are then summed to obtain the overall NCIBI score. Finally, the score (an even number between 12 and 60) is then used to determine the ecological integrity class of the stream from which the sample was collected.

The NCIBI has been revised (NCDENR 2006). Currently, the focus of using and applying the NCIBI has been restricted to wadeable streams that can be sampled by a crew of four persons. In 2001, the bioclassifications and criteria were recalibrated against regional reference site data (Biological Assessment Unit Memorandum F-20010922) (Tables 1 - 5). To qualify as a reference site, the site had to satisfy all seven criteria in the order listed in Table 1. Reference sites represented the least impacted or the most minimally impacted streams and the overall biological conditions of the fish communities that could be attained (Table 2).
Table 1.
 Reference site selection hierarchy -- a watershed-based approach for streams.

Criterion	Qualification
1 Habitat	Total habitat score ≥ 65
2 – NPDES dischargers	No NPDES dischargers $\geq$ 0.01 MGD above the site or if there are small dischargers (~ $\leq$ 0.01
_	MGD), the dischargers are more than one mile upstream
3 – Percent urbanization	< 10% of the watershed is urban or residential areas
4 – Percent forested	$\ge$ 70% of the watershed is forested or in natural vegetation
5 – Channel incision	At the site, the stream is not incised beyond natural conditions
6 – Riparian zone integrity	No breaks in the riparian zones or, if there are breaks, the breaks are rare
7 – Riparian zone width	Mountain streams width of the riparian zone along both banks is $\geq$ 6m
Exception 1	If the site satisfied Criteria 1 - 6, except one of the two riparian widths was less than one unit
	optimal, then the site still qualified as a reference site
Exception 2	If the site satisfied Criteria 1 - 3 and 5 - 7, but the percentage of the watershed in forest or natural
	vegetations was $\ge$ 60% (rather than $\ge$ 70%), then the site still qualified as a reference site. [Note:
	in the New River Basin this last exception is ≥ 50%.]

### Table 2. Regional fish community reference sites in the French Broad River basin.

HUC/Waterbody	Station	County	Level IV Ecoregion
06010105 French Broad	River		
W Fk French Broad R	off NC 281	Transylvania	Southern Crystalline Ridges and Mountains
W Fk French Broad R	SR 1309	Transylvania	Southern Crystalline Ridges and Mountains
Mills R	SR 1337	Henderson	Broad Basins
N Fk Mills R	SR 1341	Henderson	Southern Crystalline Ridges and Mountains
S Fk Mills R	SR 1340	Henderson	Southern Crystalline Ridges and Mountains
S Hominy Cr	NC 151/SR 3449	Buncombe	Broad Basins
Big Ivy Cr	SR 2150	Buncombe	Broad Basins
Little Ivy Cr	SR 1547	Madison	Broad Basins
Big Pine Cr	off SR 1151	Madison	Southern Crystalline Ridges and Mountains
Shelton Laurel Cr	NC 208/212	Madison	Southern Metasedimentary Mountains
Little Laurel Cr	NC 208	Madison	Southern Metasedimentary Mountains
Meadow Fk	NC 209	Madison	Southern Crystalline Ridges and Mountains
06010106 Pigeon River			
Winchester Cr	off SR 1157	Haywood	Southern Crystalline Ridges and Mountains
Cherry Cove Cr	above reservoir	Haywood	Southern Crystalline Ridges and Mountains
Shiny Cr	above reservoir	Haywood	Southern Crystalline Ridges and Mountains
Old Bald Cr	above reservoir	Haywood	Southern Crystalline Ridges and Mountains
Medford Br	off SR 1140	Haywood	Southern Crystalline Ridges and Mountains
06010108 Nolichucky Riv	/er		
Big Crabtree Cr	SR 1002	Mitchell	Southern Crystalline Ridges and Mountains
Big Crabtree Cr	SR 1002	Mitchell	Southern Crystalline Ridges and Mountains
Big Rock Cr	NC 226	Mitchell	Southern Crystalline Ridges and Mountains
Pigeonroost Cr	SR 1349/NC 197	Mitchell	Southern Crystalline Ridges and Mountains
Bald Mountain Cr	SR 1408	Yancey	Southern Crystalline Ridges and Mountains
Hollow Poplar Cr	NC 197	Mitchell	Southern Crystalline Ridges and Mountains

Table 3Scoring criteria for the NCIBI for wadeable streams in the Western and Northern<br/>Mountains of the French Broad (including the Pigeon River), Hiwassee, Little<br/>Tennessee, New, and Watauga River basins with watersheds ranging between 3.1<br/>and 161 mi<sup>2</sup>.

No.	Metric		Score
1	No. of species		
-	> 16 species		5
	12-15 species		3
	< 12 species		1
2	No. of fish		
	320-1.000 fish		5
	205-319 fish		3
	< 205 fish		1
	> 1,000 fish		3
3	No. of species of darters		
	French Broad &	New River, Pigeon River, Watauga	
	Little Tennessee River Basins	& Hiwassee River Basins	
	≥ 4 species	≥ 3 species	5
	2 or 3 species	1 or 2 species	3
	0 or 1 species	0 species	1
4	No. of species of rock bass, smallmouth bass, and trout		
	≥ 2 species		5
	1 species		3
	0 species		1
5	No. of species of cyprinids		
	All basins, except Pigeon River Basin	Pigeon River Basin	
	≥ 8 species	$\geq$ 6 species	5
	6 or 7 species	4 or 5 species	3
	≤ 5 species	≤ <b>3</b>	1
6	No. of intolerant species		
	All basins, except New River Basin	New River Basin	
	$\geq$ 3 species	$\geq$ 5 species	5
	2 species	3 or 4 species	3
	0 or 1 species	0, 1, or 2 species	1
7	Percentage of tolerant individuals		
	≤ <b>2%</b>		5
	2-10%		3
	> 10%		1
8	Percentage of omnivorous + herbivorous individuals		
	10-36%		5
	37-50%		3
	> 50%		1
	< 10%		1
9	Percentage of insectivorous individuals		
	55-85%		5
	40-54%		3
	< 40%		1
	> 85%		1
10	Percentage of species with multiple age groups		_
	$\geq$ 65% of all species have multiple age groups		5
	45-64% all species have multiple age groups		3
	< 45% all species have multiple age groups		1

# Table 4.Tolerance ratings and adult trophic guild assignments for fish in the French Broad<br/>River basin. Species collected in 2007 are highlighted in blue. Common and<br/>scientific names follow Nelson, et al. (2004).

Family/Species	Common Name	Tolerance Rating	Trophic Guild of Adults
Petromyzontidae	Lamprevs		
Ichthvomvzon bdellium	Ohio Lamprev	Intermediate	Parasitic
I. castaneus	Chestnut Lamprev	Intermediate	Parasitic
I. greeleyi	Mountain Brook Lamprey	Intermediate	Non-feeding
Lampetra appendix	American Brook Lamprey	Intermediate	Non-feeding
Polyodontidae	Paddlefishes		C
Polyodon spathula	Paddlefish	Intermediate	Planktivore
Lepisosteidae	Gars		
Lepisosteus osseus	Longnose Gar	Tolerant	Piscivore
Hiodontidae	Mooneyes		
Hiodon tergisus	Mooneye	Intermediate	Insectivore
Clupeidae	Herrings		
Dorosoma cepedianum	Gizzard Shad	Intermediate	Omnivore
D. petenense	Threadfin Shad	Intermediate	Omnivore
Cyprinidae	Carps And Minnows		
Campostoma anomalum	Central Stoneroller	Intermediate	Herbivore
Carassius auratus	Goldfish	Tolerant	Omnivore
Clinostomus funduloides	Rosyside Dace	Intermediate	Insectivore
Ctenopharyngodon idella	Grass Carp	lolerant	Herbivore
Cyprinella galactura	Whitetail Shiner	Intermediate	Insectivore
C. spiloptera	Spottin Shiner	Intermediate	Insectivore
Cyprinus carpio	Common Carp	lolerant	Omnivore
Erimystax insignis	Nountain Blotched Chub	Intermediate	Omnivore
Hypopsis ampiops	Bigeye Chub	Intermediate	Insectivore
Luxilus chrysocephalus	Striped Sniner		Omnivore
L. coccogenis	Ruchand Chub	Intermediate	Ompivore
Nocomis iepiocephaius	Biver Chub	Intermediate	Omnivore
N. micropogon	Coldon Shinor	Tolorant	Omnivoro
Noternigonus crysoleucas	Tennessee Shiner	Intermediate	Insectivore
Nonopis reactodes	Highland Shiner	Intolerant	Insectivore
N photogenis	Silver Shiner	Intolerant	Insectivore
N. rubricroceus	Saffron Shiner	Intermediate	Insectivore
N spectrupculus	Mirror Shiner	Intermediate	Insectivore
N telescopus	Telescope Shiner	Intolerant	Insectivore
N. volucellus	Mimic Shiner	Intolerant	Insectivore
Phenacobius crassilabrum	Fatlips Minnow	Intermediate	Insectivore
Pimephales notatus	Bluntnose Minnow	Tolerant	Omnivore
P. promelas	Fathead Minnow	Tolerant	Omnivore
Rhinichthys cataractae	Longnose Dace	Intermediate	Insectivore
R. obtusus	Western Blacknose Dace	Intermediate	Insectivore
Semotilus atromaculatus	Creek Chub	Tolerant	Insectivore
Catostomidae	Suckers		
Carpiodes carpio	River Carpsucker	Intermediate	Omnivore
C. cyprinus	Quillback	Intermediate	Omnivore
Catostomus commersoni	White Sucker	Tolerant	Omnivore
Erimyzon oblongus	Creek Chubsucker	Intermediate	Omnivore
Hypentelium nigricans	Northern Hogsucker	Intermediate	Insectivore
lctiobus bubalus	Smallmouth Buffalo	Intermediate	Omnivore
I. niger	Black Buffalo	Intermediate	Omnivore
Moxostoma anisurum	Silver Redhorse	Intermediate	Insectivore
M. breviceps	Smallmouth Redhorse	Intermediate	Insectivore
M. carinatum	River Redhorse	Intermediate	Insectivore
M. duquesnei	Black Redhorse	Intermediate	Insectivore
M. erythrurum	Golden Redhorse	Intermediate	Insectivore
Ictaluridae		Talaway	Quality
Ameiurus catus		Tolerant	Omnivore
A. NEDUIOSUS	Brown Bullhead	Tolerant	Umnivore
A. piatycepnalus	Fial Bullnead	i olerant	
Ictaurus punctatus	Channel Cattish Mountain Madtam	Intermediate	Umrilvore
Noturus eleutherus	Stoppoot	Intermediate	
IN. IIdVUS Duladiatia alivaria	Stunetal Elathoad Catfieb	Intermediate	Discivero
ryiouicus olivaris	FIGUIEAU CAUISII	mennediate	FISCIVOIE

### Table 4 (continued).

Family/Species	Common Name	Tolerance Rating	Trophic Guild of Adults
Esocidae	Pikes	•	•
Esox masquinongy	Muskellunge	Intermediate	Piscivore
E. niger	Chain Pickerel	Intermediate	Piscivore
Salmonidae	Trouts And Chars		
Oncorhynchus mykiss	Rainbow Trout	Intolerant	Insectivore
Salmo trutta	Brown Trout	Intermediate	Piscivore
Salvelinus fontinalis	Brook Trout	Intolerant	Insectivore
Poeciliidae	Livebearers		
Gambusia affinis	Western Mosquitofish	Tolerant	Insectivore
G. holbrooki	Eastern Mosquitofish	Tolerant	Insectivore
Cottidae	Sculpins		
Cottus bairdi	Mottled Sculpin	Intermediate	Insectivore
C. carolinae	Banded Sculpin	Intermediate	Insectivore
Moronidae	Temperate Basses		
Morone chrysops	White Bass	Intermediate	Piscivore
Centrarchidae	Sunfishes		
Ambloplites rupestris	Rock Bass	Intolerant	Piscivore
Lepomis auritus	Redbreast Sunfish	Tolerant	Insectivore
L. cyanellus	Green Sunfish	Tolerant	Insectivore
L. gibbosus	Pumpkinseed	Intermediate	Insectivore
L. gulosus	Warmouth	Intermediate	Insectivore
L. macochirus	Bluegill	Intermediate	Insectivore
L. microlophus	Redear Sunfish	Intermediate	Insectivore
Lepomis sp.	Hybrid Sunfish	Tolerant	Insectivore
Micropterus dolomieu	Smallmouth Bass	Intolerant	Piscivore
M. punctulatus	Spotted Bass	Intermediate	Piscivore
M. salmoides	Largemouth Bass	Intermediate	Piscivore
Pomoxis annularis	White Crappie	Intermediate	Piscivore
P. nigromaculatus	Black Crappie	Intermediate	Piscivore
Percidae	Perches		
Etheostoma acuticeps	Sharphead Darter	Intolerant	Insectivore
E. blennioides	Greenside Darter	Intermediate	Insectivore
E. chlorobranchium	Greenfin Darter	Intolerant	Insectivore
E. flabellare	Fantail Darter	Intermediate	Insectivore
E. fusiforme	Swamp Darter	Intermediate	Insectivore
E. guttselli	Tuckasegee Darter	Intermediate	Insectivore
E. jessiae	Blueside Darter	Intolerant	Insectivore
E. rufilineatum	Redline Darter	Intermediate	Insectivore
E. swannanoa	Swannanoa Darter	Intermediate	Insectivore
E. vulneratum	Wounded Darter	Intolerant	Insectivore
E. zonale	Banded Darter	Intermediate	Insectivore
Perca flavescens	Yellow Perch	Intermediate	Piscivore
Percina aurantiaca	Tangerine Darter	Intolerant	Insectivore
P. burtoni	Blotchside Logperch	Intolerant	Insectivore
P. caprodes	Logperch	Intermediate	Insectivore
P. evides	Gilt Darter	Intolerant	Insectivore
P. sciera	Dusky Darter	Intermediate	Insectivore
P. squamata	Olive Darter	Intolerant	Insectivore
Stizostedion canadense	Sauger	Intermediate	Piscivore
S. vitreum	Walleye	Intermediate	Piscivore
Sciaenidae	Drums and Croakers		
Aplodinotus grunniens	Freshwater Drum	Intermediate	Insectivore

## Table 5.Scores and classes for evaluating the fish community of a wadeable stream using<br/>the North Carolina Index of Biotic Integrity in the French Broad, Hiwassee, Little<br/>Tennessee, New, and Watauga River basins.

NCIBI Scores	NCIBI Classes
58 or 60	Excellent
48, 50, 52, 54, or 56	Good
40, 42, 44, or 46	Good-Fair
34, 36, or 38	Fair
≤ 32	Poor

Criteria and ratings are applicable only to wadeable streams in the French Broad River basin. Metrics are the same as those for the Hiwassee, Little Tennessee, New, and Watauga River basins. Metrics and ratings should not be applied to non-wadeable streams nor to small, wadeable Southern Appalachian type trout streams in each of these basins. General characteristics of Southern Appalachian type trout streams include high gradient, certain visual aspects of the stream and riparian zones (e.g., *Rhododendron-, Leucothoe-*, and *Tsuga*-lined), presence of boulder and rock outcrop plunge pools, overall faunal characteristics (naturally low fish diversity), low specific conductance (often less than  $25\mu$ S/cm), temperature (often less than  $20^{\circ}$ C), clarity (gin-clear), elevation (which will vary from basin to basin and within a basin), and stream order ( $1^{st} - 3^{rd}$ ). These streams are currently not rated.

### Blackspot and Other Diseases

Blackspot and yellow grub diseases are naturally occurring, common infections of fish by an immature stage of flukes. The life cycle involves fish, snails, and piscivorous birds. Heavy, acute infections can be fatal, especially to small fish. However, fish can carry amazingly high worm burdens without any apparent ill effects (Noga 1996). The infections may often be disfiguring and render the fish aesthetically unpleasing (Figure 1).



### Figure 1. Heavy infestation of blackspot disease in creek chub (A) and yellow grub in bigeye chub (B).

Although some researchers incorporate the incidence of black spot and yellow grub into indices of biotic integrity (e.g., Steedman 1991), others, because of a lack of a consistent inverse relationship to environmental quality, do not (e.g., Sanders *et al.* 1999). The diseases are not considered in the NCIBI because it is widespread, affecting fish in all types of streams.

### Appendix F-2. A summary of fish community assessment data.

Monitoring efforts from 2003 to 2007 can be summarized as:

- Thirty-nine samples were collected as part of the basinwide monitoring cycle or as special studies.
- Twenty-five of the sites were considered to be basinwide sites and covered the period from June 11 to June 22, 2007.
- Nine of the 25 basinwide sites had not been previously sampled. Some of these sites were in rural watersheds where there were no NPDES dischargers and were selected as potential candidates for fish community regional reference sites (e.g. South Fork Mills River, North Fork Mills River, Bent Creek, *etc.*). Seven sites possessed the instream, riparian, and watershed characteristics of exceptionally high quality to qualify as new fish community regional reference sites (Appendices F-1 and F-6). These sites were North Fork Mills River, South Fork Mills River, Bent Creek, Big Pine Creek, Meadow Fork, and Hollow Poplar Creek.
- The remaining 16 sites had been sampled during the last basinwide cycle in 2002, during the first basinwide cycle in 1997, or as part of special studies conducted in 1998 and 2001 (Appendix F-3).
- Seven sites were scheduled to be sampled in 2006, but were not due to insufficient time or due to excessive turbidity resulting from late afternoon thunderstorms the previous day:
  - Buncombe County -- Newfound Creek at NC 63;
  - Haywood County -- Raccoon Creek at SR 1890;
  - Madison County -- Shelton Laurel Creek at NC 208, Big Laurel Creek at SR 1318, and Spillcorn Creek at SR 1330; and
  - Avery County -- Plumtree Creek at US 19 and Roaring Creek at US 19.
  - Three streams sampled in 2007 were on the impaired waters list (NCDENR 2007):
    - Little Ivy Creek from California Creek to SR 1547;
      - Fines Creek from source to Pigeon River; and
      - Richland Creek from source to Jones Cove Branch.
- From 2003 to 2007, 14 sites were sampled as part of special studies (Appendix F-3):
  - In 2003:
    - one site on Raccoon Creek (Haywood County) was sampled to verify results obtained in 2002;
    - three sites in the Bald Creek watershed (Yancey County) and four sites in the South Hominy Creek watershed (Buncombe county) were sampled in support of the Wetlands Restoration Program; and
    - three sites on the West Fork French Broad River (Transylvania County) were sampled as part of a study to determine the impacts from a trout farm discharge;
  - in 2004 two sites on South Hominy Creek and Big Crabtree Creek (Buncombe and Mitchell counties, respectively) were sampled as part of a regional study on the impacts from the 2004 hurricane-induced flooding; and
  - in 2006, one site on Boylston Creek (Henderson County) was sampled as part of a use attainability/trout supplemental re-classification study.
- The drainage areas of the assessed watersheds in 2007 ranged from 6.0 to 64.7 square miles (Appendix F-4).
- The most widely distributed species were the Central Stoneroller and Northern Hogsucker (Appendix F-5). The most abundant species was the Central Stoneroller; this species constituted almost one-fourth of all the fish collected.
- All sites, except three, were evaluated and rated using the North Carolina Index of Biotic Integrity (NCIBI) (Appendices F-1, F-3, and F-4). The NCIBI scores ranged from 36 to 60 and the NCIBI ratings ranged from Fair to Excellent (Figures 1 and 2).
- Two streams and their watersheds, Big Crabtree Creek and Pigeonroost Creek, may qualify as new High Quality Waters or Outstanding Resource Waters, if so petitioned.



### Figure 1. Distribution of the ratings of 25 fish community basinwide sites in the French Broad River basin, 2007.

- Of the 16 sites sampled previously, the ratings did not change appreciably at 12 of the sites since the last assessment; four sites improved since the last assessment (Figure 3). Three of these sites were in the Richland Creek watershed where watershed improvements projects have been implemented.
- The instream and riparian habitat assessment scores at the 25 sites ranged from 68 to 99 (Appendix F-6). Fish communities rated Excellent had the highest quality instream and riparian habitats contrasted to communities rated Good, Good-Fair, Fair, or Poor. Sites with minimal shading had a greater median percentage of omnivores+ herbivores than sites with partial or good shading. A more intact and wider riparian zone was also significantly correlated with a decrease in the percentage of omnivores+herbivores.
- No dissolved oxygen concentrations were less than the water quality standard of 5 mg/L.
- Specific conductance ranged from 13 µS/cm at South Fork Mills River to 151 µS/cm at Little Ivy Creek. The reading at Little Ivy Creek, a WS-II, HQW watershed, was the highest ever of any fish site in the basin and there are no known point source dischargers in this watershed. Elevated readings in the basin were associated with nonpoint source runoff from agricultural areas.
- The pH was less than 6.0 s.u. at four sites.



Figure 2. NCIBI scores and ratings of 25 fish community basinwide sites in the French Broad River basin, 2007. Blue = Excellent, Green = Good, Yellow = Good-Fair, and Rose = Fair sites.



Figure 3. NCIBI scores and ratings of 16 repeat fish community sites in the French Broad River basin, 1997 - 2007.

HUC/Waterbody	Station	County	Index No.	Date	NCIBI Score	NCIBI Rating
06010105 French Broa	d River					
W Fk French Broad R	off NC 281	Transylvania	6-2-(0.5)	08/28/03		Not Rated
W Fk French Broad R	SR 1306	Transvlvania	6-2-(0.5)	08/27/03		Not Rated
W Fk French Broad R	NC 281	Transvlvania	6-2-(0.5)	08/27/03		Not Rated
W Ek French Broad R	SR 1309	Transvlvania	6-2-(7.5)	10/23/97		Not Rated
Little P	SP 1533	Transylvania	6 28 (20)	06/02/02	40	Good Epir
Limer	SK 1999	Transylvania	0-30-(20)	10/03/02	40	Good Fair
Crah Cr	00 4500	Treneria	C 00 00	10/23/97	40	Good-Fall
	SR 1532	Transylvania	6-38-23	06/13/07	00	Good
	00 / 000		a =a (a =)	06/03/02	50	Good
Boylston Cr	SR 1328	Henderson	6-52-(6.5)	07/17/06		Not Rated
Boylston Cr	SR 1314	Henderson	6-52-(6.5)	06/04/02	52	Good
				09/15/97	56	Good
Mills R	SR 1337	Henderson	6-54-(1)	09/15/97	58	Excellent
Mills R	SR 1337	Henderson	6-54-(1)	10/19/94		Not Rated
Mills R	SR 1337	Henderson	6-54-(1)	06/29/93		Not Rated
N Fk Mills R	SR 1341	Henderson	6-54-2-(9)	06/13/07	60	Excellent
S Fk Mills R	SR 1340	Henderson	6-54-3-(17.5)	06/13/07	56	Good
Mud Cr	SR 1647	Henderson	6-55	06/04/02	22	Poor
				09/16/97	20	Poor
Bat Ek	SR 1770	Henderson	6-55-8-1	06/04/02	14	Poor
Datik	01(1115	richacison	0-00-0-1	00/04/02	24	Poor
Clear Cr	OD 1507	Llandaraan	C EE 11 (1)	10/02/01	24	Cood Foir
	SK 1307	Henderson	0-00-11-(1)	10/02/01	44	Good-Fair
Clear Cr	SR 1586	Henderson	6-55-11-(1)	10/02/01	36	Fair
Clear Cr	SR 1513	Henderson	6-55-11-(5)	10/02/01	44	Good-Fair
Cane Cr	US 25	Henderson	6-57-(9)	06/04/02	50	Good
				09/16/97	46	Good-Fair
Avery Cr	off SR 3498	Buncombe	6-60	06/12/07	40	Good-Fair
Bent Cr	off NC 191	Buncombe	6-67-(7)	06/12/07	56	Good
Hominy Cr	NC 151	Buncombe	6-76	06/12/07	46	Good-Fair
-				09/24/02	40	Good-Fair
				09/17/97	50	Good
S Hominy Cr	SR 1103	Buncombe	6-76-5	11/12/03		Not Rated
S Hominy Cr	NC 151/SR 3449	Buncombe	6-76-5	06/12/07	56	Good
		Banoombe	0100	11/30/04		Not Rated
				00/22/02	50	Good
				03/23/02	19	Good
Marran Cr	off NIC 151	Duncomho		11/12/02	40	Not Dated
Warren Cr		Buncombe	0-70-0-4	11/12/03		Not Rated
Stony FK	NC 151	Buncombe	6-76-5-6	11/14/03		Not Rated
Beaverdam Cr	SR 3446	Buncombe	6-76-5-8	11/14/03		Not Rated
Swannanoa R	SR 2435	Buncombe	6-78	06/18/02	48	Good
				09/19/97	40	Good-Fair
Swannanoa R	US 25	Buncombe	6-78	06/28/93	32	Poor
Beetree Cr	SR 2427	Buncombe	6-78-15-(6)	06/25/97	32	Poor
Newfound Cr	SR 1641	Buncombe	6-84	06/11/07	48	Good
				06/17/02	48	Good
				04/09/97	28	Poor
Reems Cr	NC 251	Buncombe	6-87-(10)	06/18/02	50	Good
			( )	09/17/97	52	Good
				11/17/93	44	Good-Fair
Flat Cr	SR 1742	Buncombe	6-88	06/18/02	50	Good
	0111142	Duncombe	0.00	04/10/02	56	Good
Sandymuch Cr	SD 1107	Madiaan	6.02 (0)	06/10/02	10	Cood
Sanuyinusii Ci	3K 1107	Madison	0-92-(9)	00/19/02	40	Good
				09/17/97	50	Good
		<b>_</b>		11/16/93	50	Good
Turkey Cr	SR 1629	Buncombe	6-92-13	06/11/07	52	Good
				06/17/02	48	Good
Big Ivy Cr	SR 2150	Buncombe	6-96-(0.5)	06/18/02	60	Excellent
				09/18/97	58	Excellent
				11/17/93	60	Excellent
Ivy R	US 25/70	Madison	6-96-(11.7)	11/16/93	52	Good
Little Ivy Cr	SR 1547	Madison	6-96-10	06/18/07	52	Good
Bull Cr	SR 1574	Madison	6-96-16	06/19/07	44	Good-Fair
			-	06/19/02	40	Good-Fair
Big Pine Cr	off SR 1151	Madison	6-108	06/19/07	32	Poor
Big Laurel Cr	NC 208	Madison	6-112	09/18/97	46	Good-Fair
		maaloon	0.1.2	00/10/01	-10	<b>2</b> 500 i aii

### Appendix F-3. Fish community data collected from the French Broad River basin, 1993 – 2007. Basinwide sites sampled in 2007 are in bold font.

### Appendix F-3 (continued).

Shelton Laurel Cr         NC 208/212         Madison         6-112-26         06/2002         58         Excellent           Little Laurel Cr         NC 208         Madison         6-112-26-13         05/04/99         58         Excellent           Meadow Fk         NC 209         Madison         6-118-19         06/19/07         48         Excellent           Meadow Fk         NC 209         Madison         6-118-19         06/19/07         48         Good           Meadow Fk         NC 208         SR 1160/1168         Haywood         5-16-(1)         07/17/01          Not Rated           Richland Cr         Buy US 23         Haywood         5-16-(1)         06/15/07          Not Rated           Richland Cr         Wainut Trail Rd         Haywood         5-16-10         06/14/07         40         Good-Fair           Winchester Cr         off SR 1157         Haywood         5-16-3         07/18/01          Not Rated           Cram Zove Cr         above reservoir         Haywood         5-16-7.8         07/18/01          Not Rated           Shirty Cr         above reservoir         Haywood         5-16-7.8         07/18/01          Not Rated      <	HUC/Waterbody	Station	County	Index No.	Date	NCIBI Score	NCIBI Rating
Little Laurel Cr. NC 208 Madison 6-112-26-13 05/04/99 58 Excellent Meadow Fk NC 209 Madison 6-118-19 06/19/07 48 Good 60/07/06 Pigeon River Richland Cr S R1160/1168 Haywood 5-16-(1) 07/17/01 Not Rated Richland Cr Boyd Ave Haywood 5-16-(1) 07/17/01 Not Rated Richland Cr Boyd Ave Haywood 5-16-(1) 07/17/01 Not Rated Richland Cr S R1184 Haywood 5-16-(1) 07/17/07 28 Poor Richland Cr S R1184 Haywood 5-16-(1) 07/17/07 20 Poor Richland Cr S R1185 Haywood 5-16-61 07/18/01 Not Rated Cherry Cove Cr above reservoir Haywood 5-16-7-3 07/18/01 Not Rated Shiny Cr above reservoir Haywood 5-16-7-3 07/19/01 Not Rated Shiny Cr above reservoir Haywood 5-16-7-3 07/19/01 Not Rated Rocky Br S R1147 & 1219 Haywood 5-16-7-3 07/19/01 Not Rated Brown & Georgia F Famer Br Ave Haywood 5-16-11 07/18/01 Not Rated Famer Br Ave Haywood 5-16-13 07/18/01 Not Rated Shelton Br Marshall St Haywood 5-16-13 07/18/01 Not Rated Shelton Br Marshall St Haywood 5-16-13 07/18/01 Not Rated Factory Br US 19 Haywood 5-16-13 07/18/01 Not Rated Factory Br US 19 Haywood 5-16-13 07/18/01 Not Rated Crabtree Cr NC 209 Haywood 5-16-13 07/18/01 Not Rated Crabtree Cr NC 209 Haywood 5-22 06/14/07 44 Good-Fair 06/03/97 28 Good-Fair 10/02/097 48 Good-Fair 06/03/97 28 Good-Fair 06/03/97 28 Good-Fair 12/01/04 SNeicheus/FWER N Toe R SR 1121 Avery 7-2-40.5 06/23/97 46 Good-Fair 06/04/97 58 Excellent 12/01/04 SNeicheus/FWER N Toe R SR 1121 Avery 7-2-40. 06/23/97 46 Good-Fair 09/30/98 58 Excellent 12/01/04 SNeicheus/FWER N Toe R SR 1121 Avery 7-2-40. 06/23/97 46 Good-Fair 09/30/98 58 Excellent 12/01/04 SNeicheus/FWER N Toe R SR 1120 Mitchell 7-2-48 06/24/107 40 Good-Fair 09/30/98 58 Excellent 12/01/04 SNeicheus/FWER N Toe R SR 1126/1136 Yancey 7-3-22 11/13/03 Not Rated Big Crabtree Cr SR 1002 Mitchell 7-2-48 06/24	Shelton Laurel Cr	NC 208/212	Madison	6-112-26	06/20/02	58	Excellent
Little Laurel Cr         NC 208         Madison         6-112-26-13         05/04/99         58         Excellent 09/29/98         60           Meadow FK         NC 209         Madison         6-118-19         06/19/07         48         Good           Bidhand Cr         SR 1160/1168         Haywood         5-16-(1)         07/17/01          Not Rated           Richland Cr         Buy US 23         Haywood         5-16-(1)         06/15/07          Not Rated           Richland Cr         SR 1184         Haywood         5-16-(1)         06/15/07          Not Rated           Richland Cr         SR 1184         Haywood         5-16-3         07/18/01          Not Rated           Minchester Cr         off SR 1157         Haywood         5-16-3         07/18/01          Not Rated           Charry Crve Cr         above reservoir         Haywood         5-16-7-3         07/18/01          Not Rated           Old Baid Cr         above reservoir         Haywood         5-16-7-3         07/18/01          Not Rated           Old Baid Cr         above reservoir         Haywood         5-16-7-3         07/18/01          Not Rated					06/03/97	58	Excellent
Meadow Fk         NC 209         Madison         6-118-19         09/19/07         48         Good           Medion Cr         SR 1160/1168         Haywood         5-16-(1)         07/17/01          Not Rated           Richland Cr         Bus US 23         Haywood         5-16-(1)         07/17/01          Not Rated           Richland Cr         Buy dve         Haywood         5-16-(1)         07/17/01         28         Poor           Richland Cr         SR 1184         Haywood         5-16-(1)         06/15/07         38         Fair           Richland Cr         Walnut Trail Rd         Haywood         5-16-(1)         06/15/07         40         Good-Fair           Winchester Cr         off SR 1157         Haywood         5-16-(7)         00/10/10          NoR Rated           Chary Cove Cr         above reservoir         Haywood         5-16-7-2         07/18/01          NoR Rated           Chyat Cove Cr         above reservoir         Haywood         5-16-7-2         07/18/01          NoR Rated           Chyat Cove Cr         above reservoir         Haywood         5-16-7-2         07/18/01          NoR Rated	Little Laurel Cr	NC 208	Madison	6-112-26-13	05/04/99	58	Excellent
Meadow Fk         NC 209         Madison         6-118-19         06/19/07         48         Godd           Richland Cr         SR 1160/1168         Haywood         5-16-(1)         07/17/01          Not Rated           Richland Cr         Boyd Ave         Haywood         5-16-(1)         06/15/07          Not Rated           Richland Cr         Boyd Ave         Haywood         5-16-(1)         06/15/07         36         Fair           Richland Cr         Walnut Trail Rd         Haywood         5-16-(1)         06/14/07         40         Good-Fair           Winchester Cr         of SR 1157         Haywood         5-16-3         07/18/01          Not Rated           Vinchester Cr         of SR 1157         Haywood         5-16-7-3         07/18/01          Not Rated           Cherry Cov Cr         above reservoir         Haywood         5-16-7-3         07/18/01          Not Rated           Old Ball Cr         above reservoir         Haywood         5-16-7-9/(2)         07/18/01          Not Rated           Rocky Br         SR 1140         Haywood         5-16-11         07/18/01          Not Rated         Selon					09/29/98	60	Excellent
06070100 Pigeon River         Haywood         5-16-(1)         07/17/01          Not Rated           Richland Cr         Bus US 23         Haywood         5-16-(1)         07/17/01          Not Rated           Richland Cr         Boyd Ave         Haywood         5-16-(1)         06/15/07          Not Rated           Richland Cr         Boyd Ave         Haywood         5-16-(1)         06/15/07         38         Poor           Richland Cr         Walnut Trail Rd         Haywood         5-16-(1)         06/13/07         40         Good-Fair           Winchester Cr         off SR 1157         Haywood         5-16-(1)         07/18/01          NoR Rated           Hyatt Cr         SR 1163         Haywood         5-16-7-2         07/18/01          NoR Rated           Cherry Cove Cr         above reservoir         Haywood         5-16-7-6         07/18/01          NoR Rated           Brown & Georgia         Haywood         5-16-7-6         07/18/01          NoR Rated           Brown & Georgia         Haywood         5-16-7-6         07/18/01          NoR Rated           Brown & Georgia         Haywood         5-16-7-6         <	Meadow Fk	NC 209	Madison	6-118-19	06/19/07	48	Good
Richland Cr Bus US 23 Haywood 5-16-(1) 07/1701 Not Rated Richland Cr Bus US 23 Haywood 5-16-(1) 07/1701 Not Rated Richland Cr Bus US 23 Haywood 5-16-(1) 06/1507 Not Rated 07/1701 28 Poor 77/1701 28 Poor 77/1701 28 Poor 77/1701 28 Poor 77/1701 28 Poor 70/2402 32 Poor 10/2297 38 Fair 70/2402 32 Poor 70/2402 30 Poor 70/2402 32 Poor 70/2402 30 Poor 70/2402 32 Poor 70/2402 30 Poor 70/2402 30 Poor 70/2402 30 Poor 70/2402 40 Not Rated 70/74801 Not R	06010106 Pigeon River						
Richland Cr         Buy US 23         Haywood         5-16-(1)         07/17/01	Richland Cr	SR 1160/1168	Haywood	5-16-(1)	07/17/01		Not Rated
Richland Cr         Boyd Ave         Haywood         5-16-(1)         06/15/07	Richland Cr	Bus US 23	Haywood	5-16-(1)	07/17/01		Not Rated
Richland Cr         SR 1184         Haywood         5-16-(1)         06/15/07         36         Fair           Richland Cr         Walnut Trail Rd         Haywood         5-16-(1)         06/14/07         40         Good-Fair           Winchester Cr         off SR 1157         Haywood         5-16-3         07/18/01	Richland Cr	Boyd Ave	Haywood	5-16-(1)	06/15/07		Not Rated
Richland Cr         SR 1184         Haywood         5-16-(1)         06/15/07         36         Fair           Richland Cr         Walnut Trail Rd         Haywood         5-16-(16)         06/14/07         40         Good-Fair           Winchester Cr         off SR 1157         Haywood         5-16-3         07/18/01				.,	07/17/01	28	Poor
Richland Cr         Walnut Trail Rd         Haywood         5-16-(16)         06/14/07         40         Good-Fair Poor           Winchester Cr         off SR 1157         Haywood         5-16-3         07/18/01          Not Rated           Hyatt Cr         SR 1165         Haywood         5-16-6         07/18/01          Not Rated           Old Bald Cr         above reservoir         Haywood         5-16-7-2         07/19/01          Not Rated           Old Bald Cr         above reservoir         Haywood         5-16-7-2         07/19/01          Not Rated           Old Bald Cr         above reservoir         Haywood         5-16-7-9         07/18/01          Not Rated           Rocky Br         SR 1147 X 1219         Haywood         5-16-11         07/18/01          Not Rated           Farmer Br         Ave         Haywood         5-16-13         07/18/01          Not Rated           Shelton Br         Marshall St         Haywood         5-16-13         07/18/01          Not Rated           Crabtree Cr         NC 209         Haywood         5-16-13         07/16/01          Not Rated           Cr	Richland Cr	SR 1184	Haywood	5-16-(1)	06/15/07	36	Fair
Richland Cr         Walnut Trail Rd         Haywood         5-16-(16)         06/14/07         40         Good-Fair           Winchester Cr         off SR 1157         Haywood         5-16-(16)         00/24/02         32         Poor           Hyatt Cr         SR 1165         Haywood         5-16-6         07/18/01          Not Rated           Cherry Cove Cr         above reservoir         Haywood         5-16-7.2         07/19/01          Not Rated           Old Bald Cr         above reservoir         Haywood         5-16-7.3         07/18/01          Not Rated           Medford Br         off SR 1147.8         1147.8         Haywood         5-16-7.4         07/18/01          Not Rated           Medford Br         off SR 1140         Haywood         5-16-13         07/18/01          Not Rated           Raccoon Cr         Bus US 23         Haywood         5-16-15         07/18/01          Not Rated           Ractory Br         US 19         Haywood         5-16-15         07/18/01          Not Rated           Ractory Br         US 29         Haywood         5-16-15         07/18/01          Not Rated					07/17/01	28	Poor
Winchester Cr         off SR 1167         Haywood         5-16-3         07/18/01	Richland Cr	Walnut Trail Rd	Havwood	5-16-(16)	06/14/07	40	Good-Fair
Minchester Cr         off SR 1157         Haywood         5-16-3         07/18/01          Not Rated           Hyatt Cr         SR 1165         Haywood         5-16-6         07/18/01          Not Rated           Cherry Cove Cr         above reservoir         Haywood         5-16-7-2         07/19/01          Not Rated           Old Bald Cr         above reservoir         Haywood         5-16-7-6         07/19/01          Not Rated           Medford Br         off SR 1157         Haywood         5-16-7-9(-2)         07/18/01          Not Rated           Medford Br         off SR 1147         11219         Haywood         5-16-13         07/18/01          Not Rated           Farmer Br         Ave         Haywood         5-16-13         07/16/01          Not Rated           Raccoon Cr         Bus US 23         Haywood         5-16-15         07/16/01          Not Rated           Raccoon Cr         NC 209         Haywood         5-16-15         07/16/01          Not Rated           Crabtree Cr         NC 209         Haywood         5-22         06/14/07         44         Good-Fair           Ogol397 </td <td></td> <td></td> <td>,</td> <td>( )</td> <td>09/24/02</td> <td>32</td> <td>Poor</td>			,	( )	09/24/02	32	Poor
Winchester Cr         off SR 1167         Haywood         5-16-3         07/18/01          Not Rated           Hyatt Cr         SR 1165         Haywood         5-16-6         07/18/01          Not Rated           Shiny Cr         above reservoir         Haywood         5-16-7-3         07/19/01          Not Rated           Old Bald Cr         above reservoir         Haywood         5-16-7-6         07/18/01          Not Rated           Rocky Br         SR 1147 & 1219         Haywood         5-16-7-6         07/18/01          Not Rated           Medford Br         SR 1140         Haywood         5-16-11         07/18/01          Not Rated           Farmer Br         Ave         Haywood         5-16-13         07/16/01          Not Rated           Raccoon Cr         Bus US 23         Haywood         5-16-15         07/16/01          Not Rated           Crabtree Cr         NC 209         Haywood         5-16-15         07/16/01          Not Rated           Crabtree Cr         US 19         Haywood         5-16-15         07/16/01          Not Rated           Crabtree Cr         NC 299					10/22/97	38	Fair
Hyatt Cr       SR 1165       Hajwood       5-16-6       07/18/01        Not Rated         Cherry Cove Cr       above reservoir       Hajwood       5-16-7-3       07/19/01        Not Rated         Old Baid Cr       above reservoir       Hajwood       5-16-7-6       07/19/01        Not Rated         Medford Br       off SR 1147 & 1219       Haywood       5-16-7-9-(2)       07/18/01        Not Rated         Medford Br       off SR 1140       Haywood       5-16-7-9-(2)       07/18/01        Not Rated         Farmer Br       Ave       Haywood       5-16-13       07/18/01        Not Rated         Factory Br       US 19       Haywood       5-16-14       08/26/03       24       Poor         Factory Br       US 19       Haywood       5-16-15       07/16/01        Not Rated         Crabtree Cr       NC 209       Haywood       5-22       06/14/07       44       Good-Fair         09/24/02       38       Fair       Fair       Fair       Fair       Fair         Fines Cr       SR 1355       Haywood       5-32       09/24/02       38       Fair         Jonathans Cr	Winchester Cr	off SR 1157	Haywood	5-16-3	07/18/01		Not Rated
Cherry Cove Cr         above reservoir         Haywood         5-16-7-2         07/19/01          Not Rated           Old Bald Cr         above reservoir         Haywood         5-16-7-6         07/19/01          Not Rated           Rocky Br         SR 1147 & 1219         Haywood         5-16-7-6         07/19/01          Not Rated           Medford Br         off SR 1140         Haywood         5-16-7-6         07/19/01          Not Rated           Farmer Br         Ave         Haywood         5-16-11         07/18/01          Not Rated           Raccoon Cr         Bus US 23         Haywood         5-16-13         07/16/01          Not Rated           Raccoon Cr         Bus US 23         Haywood         5-16-15         07/16/01          Not Rated           Crabtree Cr         NC 209         Haywood         5-16-15         07/16/01          Not Rated           Crabtree Cr         NC 209         Haywood         5-22         06/14/07         44         Good-Fair           Glog/39/7         28         Poor         09/24/02         38         Fair           Fines Cr         off SR 1355         Haywood <td>Hvatt Cr</td> <td>SR 1165</td> <td>Havwood</td> <td>5-16-6</td> <td>07/18/01</td> <td></td> <td>Not Rated</td>	Hvatt Cr	SR 1165	Havwood	5-16-6	07/18/01		Not Rated
Shiny Cr         above reservoir         Haywood         5-16-7-3         07/19/01          Not Rated           Old Bald Cr         above reservoir         Haywood         5-16-7-6         07/19/01          Not Rated           Medford Br         off SR 1147         1219         Haywood         5-16-7-9(2)         07/18/01          Not Rated           Brown & Georgia	Cherry Cove Cr	above reservoir	Havwood	5-16-7-2	07/19/01		Not Rated
Öld Bald Cr.         above reservoir         Haywood         5-16-7-6         07/19/01          Not Rated           Rocky Br         off SR 1147 & 1219         Haywood         5-16-7-9-(2)         07/18/01          Not Rated           Brown & Georgia         Brown & Georgia          Not Rated          Not Rated           Farmer Br         Ave         Haywood         5-16-11         07/18/01          Not Rated           Raccoon Cr         Bus US 23         Haywood         5-16-13         07/16/01          Not Rated           Raccoon Cr         Bus US 23         Haywood         5-16-15         07/16/01          Not Rated           Crabtree Cr         NC 209         Haywood         5-16-15         07/16/01          Not Rated           Crabtree Cr         NC 209         Haywood         5-26-(7)         10/22/97         46         Good-Fair           Jonathans Cr         US 276         Haywood         5-32         06/14/07         40         Good-Fair           Mof0108 Nolichucky River          10/22/97         34         Fair         Fair           N To R         SR 1121         Avery	Shiny Cr	above reservoir	Haywood	5-16-7-3	07/19/01		Not Rated
Rocky Br         SR 1147 & 1219         Haywood         5-16-7-9-(2)         07/18/01          Not Rated           Medford Br         off SR 1140         Haywood         5-16-8-1         07/18/01          Not Rated           Farmer Br         Ave         Haywood         5-16-11         07/18/01          Not Rated           Shelton Br         Marshall St         Haywood         5-16-13         07/18/01          Not Rated           Raccoon Cr         Bus US 23         Haywood         5-16-14         07/18/01          Not Rated           Factory Br         US 19         Haywood         5-16-15         07/18/01          Not Rated           Crabtree Cr         NC 209         Haywood         5-16-15         07/18/01          Not Rated           Jonathans Cr         US 276         Haywood         5-26-(7)         10/22/97         46         Good-Fair           Jonathans Cr         US 276         Haywood         5-32         06/14/07         40         Good-Fair           Modiola Molichucky River         Not Rated         10/22/97         46         Good-Fair           Not Ro R         SR 1022         Mitchell         7-2-40.5<	Old Bald Cr	above reservoir	Haywood	5-16-7-6	07/19/01		Not Rated
Medford Br         off SR 1140         Haywood         5-16-8-1         07/18/01          Not Rated           Farmer Br         Ave         Haywood         5-16-11         07/18/01          Not Rated           Shelton Br         Marshall St         Haywood         5-16-13         07/18/01          Not Rated           Raccoon Cr         Bus US 23         Haywood         5-16-13         07/18/01          Not Rated           Raccoon Cr         Bus US 23         Haywood         5-16-15         07/16/01          Not Rated           Crabtree Cr         NC 209         Haywood         5-26-(7)         10/22/97         24         Poor           Jonathans Cr         US 276         Haywood         5-32         09/24/02         38         Fair           Fines Cr         off SR 1355         Haywood         5-32         09/24/02         38         Fair           OffO100 Notichucky River         T         V         7-2-(0.5)         06/22/07         44         Good-Fair           OffO100 Notichucky River         T         V         7-2-48         06/14/07         58         Excellent           10/201/04         58         Excellent <t< td=""><td>Rocky Br</td><td>SR 1147 &amp; 1219</td><td>Haywood</td><td>5-16-7-9-(2)</td><td>07/18/01</td><td></td><td>Not Rated</td></t<>	Rocky Br	SR 1147 & 1219	Haywood	5-16-7-9-(2)	07/18/01		Not Rated
Brown & Georgia         Haywood         5-16-11         07/18/01          Not Rated           Farmer Br         Ave         Haywood         5-16-13         07/16/01          Not Rated           Raccoon Cr         Bus US 23         Haywood         5-16-14         08/28/03         24         Poor           Factory Br         US 19         Haywood         5-16-15         07/16/01          Not Rated           Crabtree Cr         NC 209         Haywood         5-22         06/14/07         44         Good-Fair           Jonathans Cr         US 276         Haywood         5-26-(7)         10/22/97         46         Good-Fair           Jonathans Cr         US 276         Haywood         5-32         09/24/02         38         Fair           Fines Cr         off SR 1355         Haywood         5-32         06/14/07         40         Good-Fair           6010108 Nolichucky River         T         V         7-2-(0.5)         06/23/97         46         Good-Fair           Big Crabtree Cr         SR 1002         Mitchell         7-2-48         06/23/97         48         Excellent           09/30/98         58         Excellent         09/30/98 <t< td=""><td>Medford Br</td><td>off SR 1140</td><td>Haywood</td><td>5-16-8-1</td><td>07/18/01</td><td></td><td>Not Rated</td></t<>	Medford Br	off SR 1140	Haywood	5-16-8-1	07/18/01		Not Rated
Farmer Br         Ave         Haywood         5-16-11         07/18/01          Not Rated           Shelton Br         Marshall St         Haywood         5-16-13         07/16/01          Not Rated           Raccoon Cr         Bus US 23         Haywood         5-16-13         07/16/01         34         Pair           Factory Br         US 19         Haywood         5-16-15         07/16/01          Not Rated           Crabtree Cr         NC 209         Haywood         5-26-(7)         10/22/97         44         Good-Fair           Jonathans Cr         US 276         Haywood         5-32         09/24/02         38         Fair           Fines Cr         off SR 1355         Haywood         5-32         09/24/02         38         Fair           60/03/97         28         Poor         10/22/97         34         Fair           Fines Cr         off SR 1355         Haywood         5-32         06/14/07         40         Good-Fair           60/01/016 Molichucky River         T         T         T         2-48         06/14/07         46         Good-Fair           Big Crabtree Cr         SR 1002         Mitchell         7-2-48         0		Brown & Georgia					
Shelton Br         Marshall St         Haywood         5-16-13         07/16/01          Not Rated           Raccoon Cr         Bus US 23         Haywood         5-16-14         00/26/03         24         Poor           Factory Br         US 19         Haywood         5-16-15         07/16/01          Not Rated           Crabtree Cr         NC 209         Haywood         5-16-15         07/16/01          Not Rated           Jonathans Cr         US 276         Haywood         5-22         06/14/07         44         Good-Fair           Jonathans Cr         US 276         Haywood         5-32         09/24/02         38         Fair           Fines Cr         off SR 1355         Haywood         5-32         09/24/02         38         Fair           Fines Cr         off SR 1355         Haywood         5-32         06/14/07         40         Good-Fair           06/01/08 Nolichucky River	Farmer Br	Ave	Havwood	5-16-11	07/18/01		Not Rated
Raccoon Cr         Bus US 23         Haywood         5-16-14         08/26/03         24         Poor           Factory Br         US 19         Haywood         5-16-15         07/16/01         34         Fair           Crabtree Cr         NC 209         Haywood         5-22         06/14/07         44         Good-Fair           Obj03/97         28         Poor         09/24/02         40         Good-Fair           Jonathans Cr         US 276         Haywood         5-26-(7)         10/22/97         46         Good-Fair           Jonathans Cr         US 276         Haywood         5-32         09/24/02         38         Fair           Fines Cr         off SR 1355         Haywood         5-32         06/14/07         40         Good-Fair           O6010108 Nolichucky River         Ver         7-2-(0.5)         06/22/07         44         Good-Fair           Obf040108 Nolichucky River         Ntoc R         SR 1121         Avery         7-2-40.5)         06/23/97         46         Good-Fair           Obf04049         58         Excellent         09/30/98         58         Excellent           Big Crabtree Cr         SR 1002         Mitchell         7-2-48         06/24/97	Shelton Br	Marshall St	Haywood	5-16-13	07/16/01		Not Rated
Factory Br         US 19         Haywood         5-16-15         07/16/01          Not Rated           Crabtree Cr         NC 209         Haywood         5-22         06/14/07         44         Good-Fair           Jonathans Cr         US 276         Haywood         5-26-(7)         10/22/97         46         Good-Fair           Jonathans Cr         US 276         Haywood         5-32         09/24/02         38         Fair           Fines Cr         off SR 1355         Haywood         5-32         09/24/02         38         Fair           Fines Cr         off SR 1355         Haywood         5-32         09/24/02         38         Fair           Fines Cr         off SR 1355         Haywood         5-32         06/23/97         46         Good-Fair           Ø610/108 Nolichucky River         V         V         7-2-(0.5)         06/22/07         44         Good-Fair           Big Crabtree Cr         SR 1002         Mitchell         7-2-48         06/18/07         58         Excellent           Big Crabtree Cr         SR 1002         Mitchell         7-2-48         06/21/07         36         Fair           Big Rock Cr         NC 226         Mitchell         7-2-69	Raccoon Cr	Bus US 23	Haywood	5-16-14	08/26/03	24	Poor
Factory Br Crabtree Cr         US 19 NC 209         Haywood Haywood         5-16-15 5-22         07/16/01 06/01/4/07 44         Not Rated Good-Fair 06/03/97           Jonathans Cr Fines Cr         US 276 SR 1355         Haywood         5-26-(7)         10/22/97         46         Good-Fair 06/03/97         28         Poor           Jonathans Cr         US 276 Fines Cr         Haywood         5-32         09/24/02         38         Fair           Fines Cr         off SR 1355         Haywood         5-32         06/14/07         40         Good-Fair           Motor R         SR 1121         Avery         7-2-(0.5)         06/23/97         44         Good-Fair           Big Crabtree Cr         SR 1002         Mitchell         7-2-48         06/18/07         58         Excellent           05/04/99         S8         Excellent         09/30/98         58         Excellent           09/30/98         S8         Excellent         09/30/98         58         Excellent           09/30/98         S8         Excellent         06/24/97         54         Fair           Jacks Cr         SR 1337         Yancey         7-2-63         06/21/07         56         Good           09/30/98         S0					07/16/01	34	Fair
Crabtree Cr         NC 209         Haywood         5-22         06/14/07         44         Good-Fair           09/24/02         40         Good-Fair         09/24/02         40         Good-Fair           Jonathans Cr         US 276         Haywood         5-26-(7)         10/22/97         46         Good-Fair           Fines Cr         SR 1355         Haywood         5-32         09/24/02         38         Fair           Fines Cr         off SR 1355         Haywood         5-32         06/14/07         40         Good-Fair           6001008 Nolichucky River         T         T         NToe R         SR 1121         Avery         7-2-(0.5)         06/23/97         46         Good-Fair           Big Crabtree Cr         SR 1002         Mitchell         7-2-48         06/18/07         58         Excellent           05/04/99         58         Excellent         09/30/98         58         Excellent           Crabtree Cr         SR 1002         Mitchell         7-2-48         06/24/97         58         Excellent           Cane Cr         SR 1337         Yancey         7-2-63         06/21/02         38         Fair           Jacks Cr         SR 1349/NC 197         Mitchell	Factory Br	US 19	Haywood	5-16-15	07/16/01		Not Rated
Institution         Institution <thinstitution< th=""> <thinstitution< th=""></thinstitution<></thinstitution<>	Crabtree Cr	NC 209	Haywood	5-22	06/14/07	44	Good-Fair
Jonathans Cr         US 276         Haywood         5-26-(7)         10/22/97         46         Good-Fair           Fines Cr         SR 1355         Haywood         5-32         09/24/02         38         Fair           Fines Cr         off SR 1355         Haywood         5-32         06//14/07         40         Good-Fair           Fines Cr         off SR 1355         Haywood         5-32         06//14/07         40         Good-Fair           060/0108 Nolichucky River         N         N Toe R         SR 1121         Avery         7-2-(0.5)         06/22/07         44         Good-Fair           Big Crabtree Cr         SR 1002         Mitchell         7-2-48         06/18/07         58         Excellent           09/30/98         58         Excellent         05/04/99         58         Excellent           Cane Cr         SR 1002         Mitchell         7-2-48         06/24/97         58         Excellent           Gaks Cr         SR 1337         Yancey         7-2-63         06/21/02         38         Fair           Jacks Cr         SR 1349/NC 197         Mitchell         7-2-69         06/20/07         50         Good           Price Cr         SR 1126/1136         Yanc			. laj li o o a	• ==	09/24/02	40	Good-Fair
Jonathans Cr         US 276         Haywood         5-26-(7)         10/22/97         46         Good-Fair           Fines Cr         SR 1355         Haywood         5-32         09/24/02         38         Fair           Fines Cr         off SR 1355         Haywood         5-32         06/14/07         40         Good-Fair           06010108 Nolichucky River         T         Very         7-2-(0.5)         06/22/07         44         Good-Fair           N Toe R         SR 1121         Avery         7-2-(0.5)         06/22/07         44         Good-Fair           Big Crabtree Cr         SR 1002         Mitchell         7-2-48         06/18/07         58         Excellent           12/01/04         58         Excellent         05/04/99         58         Excellent           Big Crabtree Cr         SR 1002         Mitchell         7-2-48         06/24/97         58         Excellent           Cane Cr         SR 1337         Yancey         7-2-63         06/24/07         36         Fair           Jacks Cr         SR 1349/NC 197         Mitchell         7-2-64         06/20/07         50         Good           9/30/98         50         Good         09/30/98         50					06/03/97	28	Poor
Fines Cr         SR 1355         Haywood         5-32         09/24/02         38         Fair           Fines Cr         off SR 1355         Haywood         5-32         09/24/02         38         Fair           Fines Cr         off SR 1355         Haywood         5-32         09/24/02         38         Fair           Fines Cr         off SR 1355         Haywood         5-32         09/24/02         38         Fair           Fines Cr         off SR 1355         Haywood         5-32         09/24/02         38         Fair           Ob6010108 Molichucky River           06/23/97         46         Good-Fair           Big Crabtree Cr         SR 1002         Mitchell         7-2-48         06/18/07         58         Excellent           09/30/98         58         Excellent         09/30/98         58         Excellent           Cane Cr         SR 1002         Mitchell         7-2-48         06/24/97         34         Fair           Jacks Cr         SR 1337         Yancey         7-2-63         06/21/02         38         Fair           Jacks Cr         NC 226         Mitchell         7-2-69         06/20/07         50         Good <t< td=""><td>Jonathans Cr</td><td>US 276</td><td>Haywood</td><td>5-26-(7)</td><td>10/22/97</td><td>46</td><td>Good-Fair</td></t<>	Jonathans Cr	US 276	Haywood	5-26-(7)	10/22/97	46	Good-Fair
Integration         Instruct         Occ	Fines Cr	SR 1355	Haywood	5-32	09/24/02	38	Fair
Fines Cr         off SR 1355         Haywood         5-32         06/14/07         40         Good-Fair           06010108 Nolichucky River         N Toe R         SR 1121         Avery         7-2-(0.5)         06/23/97         44         Good-Fair           Big Crabtree Cr         SR 1002         Mitchell         7-2-48         06/18/07         58         Excellent           12/01/04         58         Excellent         05/04/99         58         Excellent           09/30/98         58         Excellent         05/04/99         58         Excellent           09/30/98         58         Excellent         05/04/97         58         Excellent           Cane Cr         SR 1002         Mitchell         7-2-48         06/21/07         36         Fair           Jacks Cr         SR 1337         Yancey         7-2-63         06/21/02         38         Fair           Big Rock Cr         NC 226         Mitchell         7-2-69         06/20/07         50         Good           Price Cr         SR 1126/1136         Yancey         7-3-21         06/20/07         56         Good           Price Cr         SR 1126/1136         Yancey         7-3-22         11/1/30/3		0111000	naynood	0.05	10/22/97	34	Fair
Note of a second seco	Fines Cr	off SR 1355	Haywood	5-32	06/14/07	40	Good-Fair
N Toe R         SR 1121         Avery         7-2-(0.5)         06/22/07         44         Good-Fair           Big Crabtree Cr         SR 1002         Mitchell         7-2-(0.5)         06/23/97         46         Good-Fair           Big Crabtree Cr         SR 1002         Mitchell         7-2-48         06/18/07         58         Excellent           12/01/04         58         Excellent         05/04/99         58         Excellent           09/30/98         58         Excellent         09/30/98         58         Excellent           Cane Cr         SR 1211         Mitchell         7-2-48         06/24/97         58         Excellent           Jacks Cr         SR 1337         Yancey         7-2-63         06/21/02         38         Fair           Jacks Cr         SR 1337         Yancey         7-2-64         06/20/07         50         Good           Pigeonroost Cr         SR 1349/NC 197         Mitchell         7-2-69         06/20/07         56         Good           06/21/02         58         Excellent         10/20/97         60         Excellent           Di/20/97         60         Excellent         10/20/97         60         Excellent           Di/	06010108 Nolichucky F	River	na) noou	0.07	00,11,01		o o o o u i ull
Big Crabtree Cr       SR 1002       Mitchell       7-2-48       06/18/07       58       Excellent         Big Crabtree Cr       SR 1002       Mitchell       7-2-48       06/18/07       58       Excellent         Big Crabtree Cr       SR 1002       Mitchell       7-2-48       06/21/07       58       Excellent         Big Crabtree Cr       SR 1002       Mitchell       7-2-48       06/24/97       58       Excellent         Cane Cr       SR 1211       Mitchell       7-2-59       06/21/07       36       Fair         Jacks Cr       SR 1337       Yancey       7-2-63       06/21/02       38       Fair         Big Rock Cr       NC 226       Mitchell       7-2-64       06/20/07       50       Good         Pigeonroost Cr       SR 1349/NC 197       Mitchell       7-2-69       06/20/07       56       Good         Price Cr       SR 1126/1136       Yancey       7-3-21       06/20/02       52       Good         Price Cr       SR 1126/1136       Yancey       7-3-22       11/13/03        Not Rated         Bald Cr       US 19/SR 1399       Yancey       7-3-22       11/13/03        Not Rated         Bald Cr       <	N Toe R	SR 1121	Avery	7-2-(0.5)	06/22/07	44	Good-Fair
Big Crabtree Cr         SR 1002         Mitchell         7-2-48         06/18/07         58         Excellent           Big Crabtree Cr         SR 1002         Mitchell         7-2-48         06/18/07         58         Excellent           Big Crabtree Cr         SR 1002         Mitchell         7-2-48         06/18/07         58         Excellent           Big Crabtree Cr         SR 1002         Mitchell         7-2-48         06/24/97         58         Excellent           Cane Cr         SR 1211         Mitchell         7-2-59         06/21/07         36         Fair           Jacks Cr         SR 1337         Yancey         7-2-63         06/24/97         34         Fair           Big Rock Cr         NC 226         Mitchell         7-2-64         06/20/07         50         Good           Pigeonroost Cr         SR 1349/NC 197         Mitchell         7-2-69         06/20/07         56         Good           Price Cr         SR 1126/1136         Yancey         7-3-21         06/20/07         56         Good           Price Cr         SR 1126/1136         Yancey         7-3-22         11/13/03          Not Rated           Bald Cr         US 19/SR 1399         Yancey		••••	,	- ( ( ) )	06/23/97	46	Good-Fair
Big Crabtree Cr       SR 1002       Mitchell       7-2-48       06/24/97       58       Excellent         Big Crabtree Cr       SR 1002       Mitchell       7-2-48       06/24/97       58       Excellent         Cane Cr       SR 1211       Mitchell       7-2-59       06/21/07       36       Fair         Jacks Cr       SR 1337       Yancey       7-2-63       06/21/02       38       Fair         Big Rock Cr       NC 226       Mitchell       7-2-64       06/20/07       50       Good         Pigeonroost Cr       SR 1349/NC 197       Mitchell       7-2-69       06/20/07       56       Good         Price Cr       SR 1126/1136       Yancey       7-3-21       06/20/07       56       Good         Price Cr       SR 1126/1136       Yancey       7-3-21       06/20/07       56       Good-         Bald Cr       US 19/SR 1399       Yancey       7-3-22       11/13/03        Not Rated         Bald Cr       US 19W       Yancey       7-3-22       11/13/03        Not Rated         Bald Cr       US 19W       Yancey       7-3-22       11/13/03        Not Rated         Bald Cr       US 19W	Big Crabtree Cr	SR 1002	Mitchell	7-2-48	06/18/07	58	Excellent
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	3			-	12/01/04	58	Excellent
Big Crabtree Cr         SR 1002         Mitchell         7-2-48         06/24/97         58         Excellent           Cane Cr         SR 1211         Mitchell         7-2-59         06/21/07         36         Fair           Jacks Cr         SR 1337         Yancey         7-2-63         06/20/07         34         Fair           Big Rock Cr         NC 226         Mitchell         7-2-64         06/20/07         50         Good           Pigeonroost Cr         SR 1349/NC 197         Mitchell         7-2-69         06/20/07         56         Good           Price Cr         SR 1126/1136         Yancey         7-3-21         06/20/07         56         Good           Price Cr         SR 1126/1136         Yancey         7-3-21         06/20/07         56         Good           Bald Cr         US 19/SR 1399         Yancey         7-3-22         11/13/03          Not Rated           Bald Cr         US 19/SR 1399         Yancey         7-3-22         11/13/03          Not Rated           Bald Cr         US 19/SR 1488         Yancey         7-3-22         11/13/03          Not Rated           Bald Cr         US 19/SR 1488         Yancey         7-3					05/04/99	58	Excellent
Big Crabtree Cr         SR 1002         Mitchell         7-2-48         06/24/97         58         Excellent           Cane Cr         SR 1211         Mitchell         7-2-59         06/21/07         36         Fair           Jacks Cr         SR 1337         Yancey         7-2-63         06/24/97         34         Fair           Big Rock Cr         NC 226         Mitchell         7-2-64         06/20/07         50         Good           Pigeonroost Cr         SR 1349/NC 197         Mitchell         7-2-69         06/20/07         56         Good           Pigeonroost Cr         SR 1349/NC 197         Mitchell         7-2-69         06/20/07         56         Good           Price Cr         SR 1126/1136         Yancey         7-3-21         06/20/02         52         Good           Bald Cr         US 19/SR 1399         Yancey         7-3-22         11/13/03          Not Rated           Bald Cr         US 19/SR 1399         Yancey         7-3-22         11/13/03          Not Rated           Bald Cr         US 19/SR 1399         Yancey         7-3-22         11/13/03          Not Rated           Bald Cr         US 19/SR 1389         Yancey					09/30/98	58	Excellent
Cane Cr         SR 1211         Mitchell         7-2-59         06/21/07         36         Fair           Jacks Cr         SR 1337         Yancey         7-2-63         06/21/02         38         Fair           Jacks Cr         SR 1337         Yancey         7-2-63         06/21/02         38         Fair           Big Rock Cr         NC 226         Mitchell         7-2-64         06/20/07         50         Good           Pigeonroost Cr         SR 1349/NC 197         Mitchell         7-2-69         06/20/07         56         Good           Price Cr         SR 1126/1136         Yancey         7-3-21         06/20/02         52         Good           Price Cr         SR 1126/1136         Yancey         7-3-21         06/20/02         52         Good           Bald Cr         US 19/SR 1399         Yancey         7-3-22         11/13/03          Not Rated           Bald Cr         US 19/W         Yancey         7-3-22         11/13/03          Not Rated           Bald Cr         US 19/W         Yancey         7-3-22         11/13/03          Not Rated           Bald Mountain Cr         SR 1408         Yancey         7-3-32         10/21	Big Crabtree Cr	SR 1002	Mitchell	7-2-48	06/24/97	58	Excellent
Jacks Cr       SR 1337       Yancey       7-2-63       06/24/97       34       Fair         Jacks Cr       SR 1337       Yancey       7-2-63       06/21/02       38       Fair         Big Rock Cr       NC 226       Mitchell       7-2-64       06/20/07       50       Good         Pigeonroost Cr       SR 1349/NC 197       Mitchell       7-2-69       06/20/07       56       Good         Price Cr       SR 1126/1136       Yancey       7-3-21       06/20/02       52       Good         Price Cr       SR 1126/1136       Yancey       7-3-21       06/20/02       52       Good         Bald Cr       US 19/SR 1399       Yancey       7-3-22       11/13/03        Not Rated         Bald Cr       US 19/SR 1399       Yancey       7-3-22       11/13/03        Not Rated         Bald Cr       US 19/W       Yancey       7-3-22       11/13/03        Not Rated         Bald Cr       US 19/W       Yancey       7-3-22       11/13/03        Not Rated         Bald Mountain Cr       SR 1128       Yancey       7-3-32       10/21/97        Not Rated         Bald Mountain Cr       SR 1408 <td>Cane Cr</td> <td>SR 1211</td> <td>Mitchell</td> <td>7-2-59</td> <td>06/21/07</td> <td>36</td> <td>Fair</td>	Cane Cr	SR 1211	Mitchell	7-2-59	06/21/07	36	Fair
Jacks Cr         SR 1337         Yancey         7-2-63         06/21/02         38         Fair           Big Rock Cr         NC 226         Mitchell         7-2-64         06/20/07         50         Good           Pigeonroost Cr         SR 1349/NC 197         Mitchell         7-2-69         06/20/07         56         Good           Pigeonroost Cr         SR 1349/NC 197         Mitchell         7-2-69         06/20/07         56         Good           Price Cr         SR 1126/1136         Yancey         7-3-21         06/20/02         52         Good           Price Cr         SR 1126/1136         Yancey         7-3-21         06/20/02         52         Good           Bald Cr         US 19/SR 1399         Yancey         7-3-22         11/13/03          Not Rated           Bald Cr         US 19/SR 1399         Yancey         7-3-22         11/13/03          Not Rated           Bald Cr         US 19/W         Yancey         7-3-22         11/13/03          Not Rated           Bald Mountain Cr         SR 1408         Yancey         7-3-32         10/21/97          Not Rated           Big Cr         SR 1444         Yancey         7		••••			06/24/97	34	Fair
Big Rock Cr         NC 226         Mitchell         7-2-64         06/20/07         50         Good           Pigeonroost Cr         SR 1349/NC 197         Mitchell         7-2-69         06/20/07         56         Good           Pigeonroost Cr         SR 1349/NC 197         Mitchell         7-2-69         06/20/07         56         Good           Price Cr         SR 1126/1136         Yancey         7-3-21         06/20/02         52         Good           Price Cr         SR 1126/1136         Yancey         7-3-21         06/20/02         52         Good           Bald Cr         US 19/SR 1399         Yancey         7-3-22         11/13/03          Not Rated           Bald Cr         US 19/SR 1399         Yancey         7-3-22         11/13/03          Not Rated           Bald Cr         US 19/SR 1399         Yancey         7-3-22         11/13/03          Not Rated           Bald Cr         US 19/SR 144         Yancey         7-3-32         10/21/97          Not Rated           Bald Mountain Cr         SR 1408         Yancey         7-3-32         10/21/97          Not Rated           Big Cr         SR 1444         Yancey	Jacks Cr	SR 1337	Yancev	7-2-63	06/21/02	38	Fair
Big Rock Cr         NC 226         Mitchell         7-2-64         06/20/07         50         Good           Pigeonroost Cr         SR 1349/NC 197         Mitchell         7-2-64         06/20/07         56         Good           Pigeonroost Cr         SR 1349/NC 197         Mitchell         7-2-69         06/20/07         56         Good           Price Cr         SR 1126/1136         Yancey         7-3-21         06/20/02         52         Good           Price Cr         SR 1126/1136         Yancey         7-3-21         06/20/02         52         Good           Bald Cr         US 19/SR 1399         Yancey         7-3-22         11/13/03          Not Rated           Bald Cr         US 19/SR 1399         Yancey         7-3-22         11/13/03          Not Rated           Bald Cr         US 19/W         Yancey         7-3-22         11/13/03          Not Rated           Bald Mountain Cr         SR 1408         Yancey         7-3-32         10/21/97          Not Rated           Big Cr         SR 1444         Yancey         7-3-32         10/21/97          Not Rated           Big Cr         SR 1444         Yancey         7			,		10/20/97	34	Fair
Pigeonroost Cr         SR 1349/NC 197         Mitchell         7-2-69         06/20/07         56         Good           Prigeonroost Cr         SR 1349/NC 197         Mitchell         7-2-69         06/20/07         56         Good           Price Cr         SR 1126/1136         Yancey         7-3-21         06/20/02         52         Good           Price Cr         SR 1126/1136         Yancey         7-3-21         06/20/02         52         Good           Bald Cr         US 19/SR 1399         Yancey         7-3-22         11/13/03          Not Rated           Bald Cr         US 19/SR 1399         Yancey         7-3-22         11/13/03          Not Rated           Bald Cr         US 19/W         Yancey         7-3-22.7         11/13/03          Not Rated           Bald Mountain Cr         SR 1408         Yancey         7-3-32         10/21/97          Not Rated           Big Cr         SR 1444         Yancey         7-3-32         10/21/97          Not Rated           Hollow Poplar Cr         NC 197         Mitchell         7-10         06/21/07          Not Rated	Big Rock Cr	NC 226	Mitchell	7-2-64	06/20/07	50	Good
Pigeonroost Cr         SR 1349/NC 197         Mitchell         7-2-69         06/20/07         56         Good           Price Cr         SR 1126/1136         Yancey         7-3-21         06/20/02         52         Good           Price Cr         SR 1126/1136         Yancey         7-3-21         06/20/02         52         Good           Bald Cr         US 19/SR 1399         Yancey         7-3-22         11/13/03          Not Rated           Bald Cr         US 19/SR 1399         Yancey         7-3-22         11/13/03          Not Rated           Bald Cr         US 19W         Yancey         7-3-22         11/13/03         50         Good           Possumtrot Cr         SR 1128         Yancey         7-3-22-7         11/13/03          Not Rated           Bald Mountain Cr         SR 1408         Yancey         7-3-32         10/21/97          Not Rated           Big Cr         SR 1444         Yancey         7-3-32         10/21/97         56         Good           Hollow Poplar Cr         NC 197         Mitchell         7-10         06/21/07         56         Good	5			-	09/30/98	50	Good
Observe         Observe <t< td=""><td>Pigeonroost Cr</td><td>SR 1349/NC 197</td><td>Mitchell</td><td>7-2-69</td><td>06/20/07</td><td>56</td><td>Good</td></t<>	Pigeonroost Cr	SR 1349/NC 197	Mitchell	7-2-69	06/20/07	56	Good
Image: Price Cr         SR 1126/1136         Yancey         7-3-21         06/20/02         52         Good           Bald Cr         US 19/SR 1399         Yancey         7-3-22         11/13/03          Not Rated           Bald Cr         US 19/SR 1399         Yancey         7-3-22         11/13/03          Not Rated           Bald Cr         US 19/W         Yancey         7-3-22         11/13/03          Not Rated           Bald Mountain Cr         SR 1128         Yancey         7-3-22-7         11/13/03          Not Rated           Big Cr         SR 1408         Yancey         7-3-32         10/21/97          Not Rated           Hollow Poplar Cr         NC 197         Mitchell         7-10         06/21/07          Not Rated					06/21/02	58	Excellent
Price Cr         SR 1126/1136         Yancey         7-3-21         06/20/02         52         Good           Bald Cr         US 19/SR 1399         Yancey         7-3-22         11/13/03          Not Rated           Bald Cr         US 19/SR 1399         Yancey         7-3-22         11/13/03          Not Rated           Bald Cr         US 19W         Yancey         7-3-22         11/13/03          Not Rated           Bald Cr         US 19W         Yancey         7-3-22         11/13/03          Not Rated           Bald Mountain Cr         SR 1408         Yancey         7-3-32         10/21/97          Not Rated           Big Cr         SR 1444         Yancey         7-3-40-(2.5)         06/21/07         56         Good           Hollow Poplar Cr         NC 197         Mitchell         7-10         06/21/07          Not Rated					10/20/97	60	Excellent
Bald Cr         US 19/SR 1399         Yancey         7-3-22         11/13/03          Not Rated           Bald Cr         US 19/SR 1399         Yancey         7-3-22         11/13/03          Not Rated           Bald Cr         US 19W         Yancey         7-3-22         11/13/03          Not Rated           Bald Cr         US 19W         Yancey         7-3-22         11/13/03          Not Rated           Bald Mountain Cr         SR 1408         Yancey         7-3-32         10/21/97          Not Rated           Big Cr         SR 1444         Yancey         7-3-40-(2.5)         06/21/07         56         Good           Hollow Poplar Cr         NC 197         Mitchell         7-10         06/21/07          Not Rated	Price Cr	SR 1126/1136	Yancev	7-3-21	06/20/02	52	Good
Bald Cr         US 19/SR 1399         Yancey         7-3-22         11/13/03          Not Rated           Bald Cr         US 19W         Yancey         7-3-22         11/13/03          Not Rated           Bald Cr         US 19W         Yancey         7-3-22         11/13/03          Not Rated           Possumtrot Cr         SR 1128         Yancey         7-3-22-7         11/13/03          Not Rated           Bald Mountain Cr         SR 1408         Yancey         7-3-32         10/21/97          Not Rated           Big Cr         SR 1444         Yancey         7-3-40-(2.5)         06/21/07         56         Good           Hollow Poplar Cr         NC 197         Mitchell         7-10         06/21/07          Not Rated				-	10/21/97	46	Good-Fair
Bald Cr         US 19W         Yancey         7-3-22         11/13/03         50         Good           Possumtrot Cr         SR 1128         Yancey         7-3-22-7         11/13/03          Not Rated           Bald Mountain Cr         SR 1408         Yancey         7-3-32         10/21/97          Not Rated           Big Cr         SR 1444         Yancey         7-3-40-(2.5)         06/21/07         56         Good           Hollow Poplar Cr         NC 197         Mitchell         7-10         06/21/07          Not Rated	Bald Cr	US 19/SR 1399	Yancev	7-3-22	11/13/03		Not Rated
Possumtrot Cr         SR 1128         Yancey         7-3-22-7         11/13/03          Not Rated           Bald Mountain Cr         SR 1408         Yancey         7-3-32         10/21/97          Not Rated           Big Cr         SR 1444         Yancey         7-3-40-(2.5)         06/21/07         56         Good           Hollow Poplar Cr         NC 197         Mitchell         7-10         06/21/07          Not Rated	Bald Cr	US 19W	Yancev	7-3-22	11/13/03	50	Good
Bald Mountain Cr         SR 1408         Yancey         7-3-32         10/21/97          Not Rated           Big Cr         SR 1444         Yancey         7-3-40-(2.5)         06/21/07         56         Good           Hollow Poplar Cr         NC 197         Mitchell         7-10         06/21/07          Not Rated	Possumtrot Cr	SR 1128	Yancev	7-3-22-7	11/13/03		Not Rated
Big Cr         SR 1444         Yancey         7-3-40-(2.5)         06/21/07         56         Good           Hollow Poplar Cr         NC 197         Mitchell         7-10         06/21/07          Not Rated	Bald Mountain Cr	SR 1408	Yancev	7-3-32	10/21/97		Not Rated
Hollow Poplar Cr NC 197 Mitchell 7-10 06/21/07 Not Rated	Big Cr	SR 1444	Yancev	7-3-40-(2.5)	06/21/07	56	Good
	Hollow Poplar Cr	NC 197	Mitchell	7-10	06/21/07		Not Rated

Subbasin			d. a.		No.	No.	No. Sp.	No. Sp.	No. Sp.	No.	%	% Omni.	%	%
Waterbody	Location	County	(mi²)	Date	Species	Fish	Darters	RST	Cyprinids	Intol. Sp.	Tolerant	+Herb.	Insect.	MA
06010105 Frenc	h Broad River													
Crab Cr	SR 1532	Transylvania	7.0	06/13/07	600	21	4	3	8	3	11	18	79	86
N Fk Mills R	SR 1341	Henderson	23.1	06/13/07	642	21	6	2	8	3	1	19	79	67
S Fk Mills R	SR 1340	Henderson	39.6	06/13/07	562	19	5	2	8	3	1	10	88	84
Avery Cr	off SR 3498	Buncombe	8.1	06/12/07	296	23	7	0	9	1	17	22	69	57
Bent Cr	off NC 191	Buncombe	10.7	06/12/07	555	22	5	2	6	3	5	23	75	73
Hominy Cr	NC 151	Buncombe	30.2	06/12/07	1062	15	2	1	8	1	1	23	77	80
S Hominy Cr	NC 151/SR 3449	Buncombe	38.3	06/12/07	597	20	2	3	9	2	2	16	81	70
Newfound Cr	SR 1641	Buncombe	34.2	06/11/07	390	19	4	2	8	2	15	37	63	47
Turkey Cr	SR 1629	Buncombe	27.4	06/11/07	647	16	2	2	8	2	5	25	70	88
Little Ivy Cr	SR 1547	Madison	42.1	06/18/07	608	14	1	3	9	3	0	23	75	79
Bull Cr	SR 1574	Madison	20.7	06/19/07	1870	15	2	3	7	3	0	60	40	80
Big Pine Cr	off SR 1151	Madison	15.8	06/19/07	1749	9	0	2	6	1	0	63	36	67
Meadow Fk	NC 209	Madison	22.7	06/19/07	421	11	2	3	5	3	0	18	68	91
06010106 Pigeo	n River													
Richland Cr	Boyd Ave	Haywood	43.4	06/15/07	410	7	0	2	3	1	0	24	73	71
Richland Cr	SR 1184	Haywood	48.0	06/15/07	603	12	0	3	4	2	11	44	54	58
Richland Cr	Walnut Trail Rd	Haywood	64.7	06/14/07	224	10	1	2	3	2	4	29	59	80
Crabtree Cr	NC 209	Havwood	19.1	06/14/07	893	13	0	3	7	2	1	56	42	85

3

Big Crabtree Cr

Pigeonroost Cr

06010108 Nolichucky River

Hollow Poplar Cr NC 197

Fines Cr

N Toe R

Cane Cr

Big Cr

Big Rock Cr

SR 1121

SR 1002

SR 1211

SR 1349/NC 197

NC 226

SR 1444

off SR 1355

25.7

29.5

12.3

16.2

33.1

14.1

8.1

6.0

Haywood

Avery

Mitchell

Mitchell

Mitchell

Mitchell

Yancey

Mitchell

06/14/07

06/14/07

06/22/07

06/18/07

06/21/07

06/20/07

06/20/07

06/21/07

06/21/07

Appendix F-4. Fish community metric values from 25 wadeable streams in the French Broad River basinwide monitoring program, **2007**<sup>1</sup>.

<sup>1</sup>Abbreviations are d. a. = drainage area, No. = number, Sp. = species, RST = rockbass, smallmouth bass, and trout, Intol. = intolerants, Omni. + Herb. = omnivores+herbivores, Insect. = insectivores, and MA = species with multiple age groups.

#### Appendix F-5. Fish distributional records for the French Broad River basin.

Based upon Menhinick (1991), NC DWQ's data, and data from other researchers, approximately 98 species have been collected from the French Broad River basin (Table 5 in Appendix F-1). The known species assemblage now includes 27 species of minnows, 11 species of suckers, 7 species of catfish, 12 species of sunfish and bass, and 20 species of darters. Only three new county distributional records were recorded in 2007 from DWQ's fish community monitoring efforts (Table 1).

Family/Species	Common Name	County	
Cyprinidae	Carps and Minnows		
Clinostomus funduloides	Rosyside Dace	Transylvania	
Centrarchidae	Sunfishes	-	
Lepomis cyanellus	Green Sunfish	Avery	
Percidae	Perches	-	
Etheostoma fusiforme	Swamp Darter	Haywood	

#### Table 1. New distributional records for the French Broad River basin.

Twenty-one of the 98 species (21 percent of the total basin fauna) are nonindigenous (exotic) species and were introduced either as sportfish, forage fish, baitfish, or for reasons unknown (Table 2). In 2006, 10 of the 43 species collected were exotic species. The more commonly collected nonindigenous species included Rainbow Trout, Brown Trout, and Redbreast Sunfish. All of the streams had at least one nonindigenous species present. At Hollow Polar Creek, a trout stream, only two species were present, Western Blacknose Dace and Rainbow Trout; almost two-thirds of the fish collected were Rainbow Trout. At Cane Creek 43 percent of all the fish were Bluehead Chub.

### Table 2.Nonindigenous species in the French Broad River basin. Species collected in 2007<br/>are highlighted in blue.

Family/Species	Common Name	Family/Species	Common Name
Clupeidae	Herrings	Salmonidae	Trouts and Salmons
Dorosoma petenense	Threadfin Shad	Oncorhynchus mykiss	Rainbow Trout
Cyprinidae	Carps and Minnows	Salmo trutta	Brown Trout
Carassius auratus	Goldfish	Poeciliidae	Livebearers
Clinostomus funduloides	Rosyside Dace	Gambusia holbrooki	Eastern Mosquitofish
Ctenopharyngodon idella	Grass Carp	Moronidae	Temperate Basses
Cyprinus carpio	Common Carp	Morone chrysops	White Bass
Nocomis leptocephalus	Bluehead Chub	Centrarchidae	Sunfishes
Pimephales promelas	Fathead Minnow	Lepomis auritus	Redbreast Sunfish
Catostomidae	Suckers	L. cyanellus	Green Sunfish
Erimyzon oblongus	Creek Chubsucker	L. gibbosus	Pumpkinseed
Ictaluridae	North American Catfishes	L. microlophus	Redear Sunfish
Ameiurus catus	White Catfish	Percidae	Perches
A. platycephalus	Flat Bullhead	Etheostoma fusiforme	Swamp Darter
Esocidae	Pikes	Perca flavescens	Yellow Perch
Esox niger	Chain Pickerel		

Special protection status has been given to 17 of the 98 species by the U. S. Department of the Interior, the NC Wildlife Resources Commission, or the NC Natural Heritage Program under the NC State Endangered Species Act (G.S. 113-331 to 113-337) (LeGrand *et al.* 2006; Menhinick and Braswell 1997) (Table 3). None of these were collected in 2007.

### Table 3.Species of fish listed as state threatened (T), state endangered (E), or of special<br/>concern (SC) in the French Broad River basin.

Species	Common Name	State Rank	Comment
Lampetra appendix	American Brook Lamprey	T, S1	Madison Co.
Polyodon spathula	Paddlefish	E, SH	Madison Co.
Hiodon tergisus	Mooneye	SC, SH	Madison Co.
Luxilus chrysocephalus	Striped Shiner	T, S2	Buncombe & Yancey Cos.
Carpiodes carpio	River Carpsucker	SC, SH	Buncombe, Madison, & Yancey Cos.
Noturus eleutherus	Mountain Madtom	SC, SH	Extirpated in NC
Noturus flavus	Stonecat	E, S1	Madison & Yancey Cos.
Cottus carolinae	Banded Sculpin	T, S1	Madison Co.
Etheostoma acuticeps	Sharphead Darter	T, S1	Yancey Co.
E. jessiae	Blueside Darter	SC, SH	Extirpated in NC
E. simoterum	Snubnose Darter	SC, SH	Madison Co.
E. vulneratum	Wounded Darter	SC, S1	Haywood Co.
Percina burtoni	Blotchside Logperch	E, S1	Yancey Co.
P. caprodes	Logperch	T, S1	Madison & Haywood Cos.
P. sciera	Dusky Darter	E, SH	Extirpated in NC
P. squamata	Olive Darter	SC, S2	Haywood, Madison, Mitchell, & Yancey Cos.
Aplodinotus grunniens	Freshwater Drum	T, S1	Madison Co.

<sup>1</sup>S1 = critically imperiled in North Carolina because of extreme rarity or because of some factor(s) making it especially vulnerable to extirpation from North Carolina; S2 = imperiled in North Carolina because of rarity or because of some factor(s) making it very vulnerable to extirpation from North Carolina; and SH = of historical occurrence in North Carolina, perhaps not having been verified in the past 20 years and suspected to be still extant (LeGrand *et al.* 2006).

In 2007, 43 of the 98 species were collected. Species not collected included those with preferences for the larger rivers and mainstem portions of the rivers (e.g., French Broad, Toe, Cane, Nolichucky and Pigeon rivers) in Madison, Yancey, and Mitchell counties. The most widely distributed species, collected at 24 of the 25 sites, were the Central Stoneroller and Northern Hogsucker. Species less widely distributed and collected only at 1 or 2 sites included Rosyside Dace, Blotched Chub, Bluehead Chub, Telescope Shiner, Fatlips Minnow, Fathead Minnow, Brook Trout, Redear Sunfish, and Swamp Darter.

The most abundant species was the Central Stoneroller; this species constituted almost one-fourth of all the fish collected. At Bull Creek, 1,046 specimens of the Central Stoneroller were collected, the most fish of any species ever collected in DWQ's wadeable streams fish community assessment program. By contrast, some of the rarer species (less than five specimens collected) included Blotched Chub, Fatlips Minnow, Fathead Minnow, Brook Trout, Redear Sunfish, and Swamp Darter.

### Appendix F-6. Habitat evaluations and stream and riparian habitats at 25 fish community monitoring sites in the French Broad River basin, 2007.

#### Habitat Assessments

A method and scoring system has been developed to evaluate the physical habitats of a stream (NCDENR 2006). The narrative descriptions of eight habitat characteristics, including channel modification, amount of instream habitat, type of bottom substrate, pool variety, riffle frequency, bank stability, light penetration, and riparian zone width, are converted into numerical scores. The total habitat score ranges between 1 and 100. Higher numbers suggest better habitat quality, but criteria have not been developed to assign ratings. Scores greater than 65 generally represent moderate to high quality habitat site, whereas scores less than 65 generally represent low to poor quality habitat sites (DWQ unpublished data).

Fish community sampling was conducted in 2007 at 25 sites. All of the streams assessed had overall moderate to high quality habitats (score  $\geq$  65); none of the sites had overall low to poor quality habitats (score < 65) (Figure 1 and Tables 1 and 2). Habitat scores ranged from 68 at Crabtree Creek to 99 at Meadow Fork.



Figure 1. Distribution of the total habitat scores at 25 fish community sites in the French Broad River basin, 2007.

					Instream				Bank	Bank		Riparian	Riparian	Total
HUC	Waterbody	Location	County	Channel	Habitat	Substrate	Pools	Riffles	Stability-L	Stability-R	Shade	Zone-L	Zone-R	Score
06010105	5 French Broad Rive	er												
	Crab Cr	SR 1532	Transylvania	5	18	6	8	16	5	4	7	2	2	73
	N Fk Mills R	SR 341	Henderson	5	19	15	4	16	6	6	5	3	2	81
	S Fk Mills R	SR 1340	Henderson	5	19	15	6	16	6	6	8	3	3	87
	Avery Cr	SR 3498	Buncombe	5	18	8	4	15	7	7	10	4	5	83
	Bent Cr	off NC 191	Buncombe	5	19	12	4	14	7	7	10	5	5	88
	Hominy Cr	NC 151	Buncombe	5	16	6	4	14	7	6	9	5	3	75
	S Hominy Cr	NC 151/SR 3449	Buncombe	5	19	12	9	16	6	6	8	4	5	90
	Newfound Cr	SR 1641	Buncombe	5	16	12	4	14	6	6	7	5	4	79
	Turkey Cr	SR 1629	Buncombe	5	18	8	7	12	7	7	7	5	4	80
	Little Ivy Cr	SR 1547	Madison	5	16	8	6	14	6	6	7	3	2	73
	Bull Cr	SR 1574	Madison	5	18	12	6	15	6	6	9	4	5	86
	Big Pine Cr	off SR 1151	Madison	5	18	12	6	16	6	6	7	4	3	83
	Meadow Fk	NC 209	Madison	5	20	15	9	16	7	7	10	5	5	99
06010106	6 Pigeon River													
	Richland Cr	Boyd Ave	Haywood	5	18	13	6	16	6	6	8	2	3	83
	Richland Cr	SR 1184	Haywood	5	18	12	8	16	7	4	8	5	2	85
	Richland Cr	Walnut Trail Rd	Haywood	5	18	13	6	12	5	5	9	3	3	79
	Crabtree Cr	NC 209	Haywood	5	16	12	6	14	4	4	5	1	1	68
	Fines Cr	off SR 1355	Haywood	5	20	12	10	16	6	6	7	5	2	89
06010108	8 Nolichucky River													
	N Toe R	SR 1121	Avery	5	20	15	6	16	5	4	4	4	3	82
	Big Crabtree Cr	SR 1002	Mitchell	5	18	12	10	15	7	7	8	5	5	92
	Cane Cr	SR 1211	Mitchell	5	18	8	6	12	5	5	7	2	2	70
	Big Rock Cr	NC 226	Mitchell	5	18	12	7	16	6	6	10	4	3	87
	Pigeonroost Cr	SR 1349/NC 197	Mitchell	5	20	15	8	16	6	6	8	4	4	92
	Big Cr	SR 1444	Yancey	5	19	15	6	16	5	6	7	4	3	86
	Hollow Poplar Cr	NC 197	Mitchell	5	19	15	6	16	6	6	7	3	3	86
Maximun	n possible scores			5	20	15	10	16	7	7	10	5	5	100

### Table 1.Habitat evaluations at 25 basinwide fish community sites in the French Broad River basin, 2007. Red bold denotes less<br/>than optimal habitat conditions.

HUC	Waterbody	Location	County	Ecoregion	Score
		High	to Moderate Q	uality Habitats	
06010105	Meadow Fk	NC 209	Madison	Southern Crystalline Ridges & Mountains	99
06010108	Big Crabtree Cr	SR 1002	Mitchell	Southern Crystalline Ridges & Mountains	92
06010108	Pigeonroost Cr	SR 1349/NC 197	Mitchell	Southern Crystalline Ridges & Mountains	92
06010105	S Hominy Cr	NC 151/SR 3449	Buncombe	Broad Basins	90
06010106	Fines Cr	off SR 1355	Haywood	Broad Basins	89
06010105	Bent Cr	off NC 191	Buncombe	Broad Basins	88
06010108	Big Rock Cr	NC 226	Mitchell	Southern Crystalline Ridges & Mountains	87
06010105	S Fk Mills R	SR 1340	Henderson	Southern Crystalline Ridges & Mountains	87
06010108	Big Cr	SR 1444	Yancey	Southern Crystalline Ridges & Mountains	86
06010105	Bull Cr	SR 1574	Madison	Broad Basins	86
06010108	Hollow Poplar Cr	NC 197	Mitchell	Southern Crystalline Ridges & Mountains	86
06010106	Richland Cr	SR 1184	Haywood	Broad Basins	85
06010105	Avery Cr	SR 3498	Buncombe	Broad Basins	83
06010105	Big Pine Cr	off SR 1151	Madison	Southern Crystalline Ridges & Mountains	83
06010106	Richland Cr	Boyd Ave	Haywood	Broad Basins	83
06010108	N Toe R	SR 1121	Avery	Southern Crystalline Ridges & Mountains	82
06010105	N Fk Mills R	SR 341	Henderson	Southern Crystalline Ridges & Mountains	81
06010105	Turkey Cr	SR 1629	Buncombe	Broad Basins	80
06010105	Newfound Cr	SR 1641	Buncombe	Broad Basins	79
06010106	Richland Cr	Walnut Trail Rd	Haywood	Broad Basins	79
06010105	Hominy Cr	NC 151	Buncombe	Broad Basins	75
06010105	Crab Cr	SR 1532	Transylvania	Broad Basins	73
06010105	Little Ivy Cr	SR 1547	Madison	Broad Basins	73
06010108	Cane Cr	SR 1211	Mitchell	Southern Crystalline Ridges & Mountains	70
06010106	Crabtree Cr	NC 209	Haywood	Broad Basins	68
		Lo	w to Poor Qua	lity Habitats	
None					

### Table 2.Rankings of 25 waterbodies in French Broad River basin according to the total<br/>habitat scores, 2007.

Although all the sites in 2007 had moderate to high quality habitats (Table 2), in previous monitoring cycles (NCDENR 2003) major differences between the high to moderate and the low to poor quality habitat types were in the substrates, riffles, and bank stabilities (Table 3). Differences were not as pronounced in the instream habitat, abundance of pools, extent of canopy cover (shade), or width of riparian zones.

### Table 3.Mean habitat scores for 80 fish community sites in the French Broad River basin,<br/>2001 – 2007.

Habitat characteristics	Low - Poor Quality Habitat	Moderate - High Quality Habitat	Maximum score
Channel modification	3.9	4.7	5
Instream habitat	13.8	17.6	20
Substrate	6.6	11.2	15
Pools	4.9	7.1	10
Riffles	8.7	14.4	16
Bank stability (right & left)	7.1	11.1	14
Shade	5.9	8.0	10
Riparian zone width (right & left)	2.8	6.5	10
Sample size	17	63	80

Characteristics of moderate to high quality habitat streams are:

- instream habitats composed of rocks, sticks, leafpacks, snags and logs, and undercut banks and root mats;
- > a substrate of gravel, cobble, and boulders with low embeddedness;
- > frequent pools and riffles of varying depths and widths; and
- stable banks with a good tree canopy and a medium to wide riparian zone with no or rare breaks in the riparian zone (Figure 2).



### Figure 2. High quality instream habitats and wide riparian zones offering a good tree canopy, Meadow Fork, NC 209, Madison County.

Low to poor quality habitat characteristics include (Figures 3 - 5):

- livestock frequently having access to the stream causing bank erosion, trampling of riparian vegetation, fecal contamination, and nutrient deposition;
- an absence of cobble riffles; if present, they are usually caused by embedded, coarse woody debris in the current;
- an open canopy and the riparian zone has been cleared of native vegetation and replaced with a lawn; and
- > excessive turbidity following heavy downpours.



Figure 3. Fencing excluding cattle from mainstem channel but allowing wastes to enter the stream and the continuance of riparian degradation at Crab Creek at SR 1532, Transylvania County (left) and livestock with total access to the stream at Crabtree Creek at NC 209, Haywood County (right).



Figure 4. Grass covered riparian zones with eroding banks, Crabtree Creek at NC 209, Haywood County (left) and an absence of canopy and mowed banks at Big Creek at SR 1444, Yancey County (right).



Figure 5. Turbidity at the confluence of Shelton Laurel Creek and Big Laurel Creek at NC 208, Madison County (left) and at Spillcorn Creek at SR 1330, Madison County (right).

#### Habitat and NCIBI Relationships

Since 1997, 86 rateable fish community samples with associated habitat evaluations have been collected throughout the basin. [One data point – Beetree Creek (1997) was excluded from the data set because the site was below a reservoir with no minimum flow requirements.] This data set showed that communities rated Excellent had the highest quality instream and riparian habitats as contrasted to communities rated Good-Fair, Fair, or Poor (Figure 6). The median total habitat score for Excellent sites was 85; Good, Good-Fair, and Fair sites was approximately 75; and Poor sites had a median total habitat score of 62.

One of the fish community responses to the loss of tree canopy in the riparian zone and nutrient addition is an increase in the percentage of omnivores+herbivores (Metric No. 8). The 1997 – 2007 data set (n = 82) showed that sites with minimal shading (canopy scores of 2-4) had a greater median percentage of omnivores+ herbivores than sites with partial (canopy scores of 5-7) or good (canopy scores of 8-10) canopy (Figure 7). These median percentages (51.0, 27.5, and 23.0%, respectively) corresponded to NCIBI metric scores of 1, 5, and 5, respectively (Table 3 in Appendix F-1). A more intact and wider riparian zone was also significantly correlated with a decrease in the percentage of omnivores+herbivores (Figure 8).



Figure 6. Relationship between total habitat scores and NCIBI ratings in the French Broad River basin, 1997 - 2007.



Figure 7. Relationship between the percentage of omnivores+herbivores and streamside shading in the French Broad River basin, 1997 - 2007.



Figure 8. Relationship between the percentage of omnivores+herbivores and the riparian scores in the French Broad River basin, 1997 - 2007.

#### Appendix F-7. Water quality at 25 fish community sites in the French Broad River basin, 2007.

In 2007 water quality data (temperature, specific conductance, dissolved oxygen, and pH) were collected at every site during fish community assessments (Table 1). No dissolved oxygen concentrations were less than the water quality standard of 5 mg/L. Dissolved oxygen saturation ranged from 74 percent at Richland Creek at Walnut Trail Road (below Lake Junaluska) to 100 percent at Little Ivy Creek which was associated with the late afternoon photosynthesis by periphyton. Sixteen percent of the pH measurements (5 of the 25 measurements) were less than 6.0 s.u. The highest pH value, at Little Ivy Creek, similar to dissolved oxygen saturation, was associated with the late afternoon photosynthesis by the periphyton. Conductivity (specific conductance) ranged from 13  $\mu$ S/cm at South Fork Mills River to 151  $\mu$ S/cm at Little Ivy Creek (Table 1 and Figure 1). The reading at Little Ivy Creek, a WS-II HQW watershed, was the highest ever of any fish site in the basin and there are no known point source dischargers in this watershed. Elevated readings (e.g. at Newfound, Little Ivy, and Bull creeks) were associated with nonpoint source runoff from agricultural areas.

### Table 1.Water quality measurements at 25 fish community sites in the French Broad River<br/>basin, 2007. Red bold denotes less than the water quality standard.

				_	Specific	Dissolved		
HUC/		•		Temperature	conductance	oxygen	Saturation	pH
Waterbody	Location	County	Date	(°C)	(µS/cm)	(mg/L)	(%)	(s.u.)
06010105 French I	Broad River							
Crab Cr	SR 1532	Transylvania	06/13/07	15.4	27	8.8	88	5.5
N Fk Mills R	SR 1341	Henderson	06/13/07	17.4	16	8.9	93	5.6
S Fk Mills R	SR 1340	Henderson	06/13/07	16.1	13	9.3	94	6.3
Avery Cr	off SR 3498	Buncombe	06/12/07	20.8	38	8.3	93	5.9
Bent Cr	off NC 191	Buncombe	06/12/07	20.2	21	8.1	89	6.5
Hominy Cr	NC 151	Buncombe	06/12/07	17.5	91	8.7	91	6.7
S Hominy Cr	NC 151/SR 3449	Buncombe	06/12/07	17.5	33	9.1	95	6.2
Newfound Cr	SR 1641	Buncombe	06/11/07	22.7	108	7.9	92	7.4
Turkey Cr	SR 1629	Buncombe	06/11/07	20.5	97	8.2	91	7.3
Little Ivy Cr	SR 1547	Madison	06/18/07	24.6	151	8.3	100	8.4
Bull Cr	SR 1574	Madison	06/19/07	18.7	103	8.1	87	6.3
Big Pine Cr	off SR 1151	Madison	06/19/07	21.5	58	8.1	92	6.7
Meadow Fk	NC 209	Madison	06/19/07	18.8	41	8.5	91	6.2
06010106 Pigeon I	River							
Richland Cr	Boyd Ave	Haywood	06/15/07	16.6	50	9.0	92	6.9
Richland Cr	SR 1184	Haywood	06/15/07	16.5	56	8.3	85	6.2
Richland Cr	Walnut Trail Rd	Haywood	06/14/07	22.7	60	6.4	74	5.8
Crabtree Cr	NC 209	Haywood	06/14/07	17.1	65	8.7	90	7.6
Fines Cr	off SR 1355	Haywood	06/14/07	16.0	71	9.0	91	6.8
06010108 Nolichue	cky River							
N Toe R	SR 1121	Avery	06/22/07	14.0	64	9.3	90	7.0
Big Crabtree Cr	SR 1002	Mitchell	06/18/07	18.5	32	8.3	89	6.1
Cane Cr	SR 1211	Mitchell	06/21/07	14.7	68	9.1	90	6.9
Big Rock Cr	NC 226	Mitchell	06/20/07	20.2	65	9.0	99	6.9
Pigeonroost Cr	SR 1349/NC 197	Mitchell	06/20/07	17.4	39	9.0	94	6.8
Big Cr	SR 1444	Yancey	06/21/07	18.8	40	8.4	90	6.8
Hollow Poplar Cr	NC 197	Mitchell	06/21/07	17.1	41	8.8	91	6.9



### Figure 1. Specific conductance at 25 fish community sites in the French Broad River basin, 2007.

Since 1993, 92 rateable fish community samples with associated conductivity evaluations have been collected throughout the basin, primarily since 1997. [One data point – Beetree Creek (1997) was excluded from the data set because the site was below a reservoir with no minimum flow requirements.] This data set showed that communities rated Excellent had the lowest conductivity measurements (Figure 2). Median measurements for Excellent, Good, Good-Fair, Fair, and Poor sites were 33, 55, 61, 68, and

 $\mu$ S/cm, respectively. This data set also shows Little Laurel Creek (Excellent, conductivity = 84  $\mu$ S/cm) and Little Ivy Creek (Good, conductivity = 151 $\mu$ S/cm) as outliers and may indicate nonpoint source runoff or illegal discharges ("straight pipes").



Figure 2. Relationships between conductivity (µS/cm) and NCIBI ratings in the French Broad River basin, 1993 – 2007.



Appendix F-8. Fish kills in the French Broad River Basin, 2003- 2007.

Figure 1. Locations of fish kills in the French Broad River Basin, 2003 – 2007.

### Table 1.Fish kills in the French Broad River Basin, 2003 – 2007.

Date	Kill Number	Waterbody	Location	County	Subbasin	Species	Mortality
1/7/2003	AS03001	California Creek	north of Mars Hill	Madison	040304	Redhorse	83000
						Bass	
						Rockbass	
						Sunfish	
						Darters	
						Minnows	
						Trout	
						Stonerollers	
Notes: Kill ca	used by a tanke	er truck spill of propior	nic acid directly into Cali	fornia Creek. No	CWRC performed investigation a	nd assessed a fine of around \$1600	0 for time and cost of
fish. Fine forw	varded to DWQ	for collection.					
5/1/2007	AS07001	Whiteoak Creek	near Bakersville	Mitchell	040306	Chubs	250
Notes: Sedim	ent pesticide sa	ample (organochlorine	e, organophosphorus, ni	trogen) collected	at most upstream site on White	Oak Creek where dead fish observe	ed. Pesticide sample
collected due	to Christmas Tr	ee farm in the waters	hed.				
7/27/2007	AS07003	S Fork Mills River	near Mills River	Henderson	040303	Rainbow Trout	1000
						Sculpin	
						Darters	
						Redhorse Sucker	
						Chubs	
Notes: Investi	gators suspect	ed event was related	to pesticide application i	n adjacent toma	to fields. DWQ water samples s	howed the presence of Chlorothalor	il in field runoff and
samples collect	cted from the riv	ver. The event occuri	red after heavy rain follo	wing pesticide a	pplication. Majority of affected find	sh were identified as rainbow trout.	Event also had
significant effe	cts on the aqua	atic insect population.	This area of the South	Mills River supp	orts a documented population of	the federally listed Appalachian elkt	oe mussel (Alasmidonta
raveneliana), a	an endangered	species. A follow up	survey conducted on Ju	ly 29 indicated t	hat all located mussels were in g	ood condition.	
9/7/2007	AS07004	Pigeon River	below Canton	Haywood	040305	Darters	8000
						Suckers	
Notes: Kill eve	ent attributed to	low flow/DO and hig	h water temperatures br	ought on by ong	oing drought conditions. Investig	ators observed numerous live fish o	luring the investigation

### Appendix F-9. Web links.

NC Division of Water Quality, Stream Fish Community Assessment (including Habitat Assessment) Standard Operating Procedures http://www.esb.enr.state.nc.us/BAU.html

NC Division of Water Resources, Drought Monitoring <a href="http://www.ncwater.org/Drought\_Monitoring/">http://www.ncwater.org/Drought\_Monitoring/</a>

NC Division of Water Quality (native and exotic freshwater fish in North Carolina) <u>http://www.esb.enr.state.nc.us/www.esb.enr.state.nc.us/Native and Introduced Freshwater Fish in North</u> Carolina.2-1.htm

National Weather Service and North carolina State University's Marine, Earth, and Atmospheric Sciences Case Studies <a href="http://www.meas.ncsu.edu/nws/www/cases/">http://www.meas.ncsu.edu/nws/www/cases/</a>

US Geological Survey (real-time streamflow data for North Carolina) <u>http://waterdata.usgs.gov/nc/nwis/current?type=flow</u>

#### Appendix F-10. Fish community references.

- Fels, J. 1997. North Carolina watersheds map. North Carolina State University Cooperative Extension Service. Raleigh, NC.
- Griffith, G., Omernik, J. and J. Comstock. 2002. Ecoregions of North Carolina. United States Environmental Protection Agency. Research and Development. NHEERL. Western Ecology Division. Corvallis, OR.
- Karr, J. R. 1981. Assessment of biotic integrity using fish communities. Fisheries. 6: 21 27.

\_\_\_\_\_, Fausch, K. D., Angermeier, P. L., Yant, P. R., and I. J. Schlosser. 1986. Assessing biological integrity in running water: a method and its rationale. III. Nat. Hist. Surv. Spec. Publ. 5.

- LeGrand, H. E., Hall, S. P., McRae, S. E., and J. T. Finnegan. 2006. Natural Heritage Program list of the rare animal species of North Carolina. North Carolina Natural Heritage Program, Office of Conservation and Community Affairs, North Carolina Department of Environment and Natural Resources. Raleigh, NC.
- Menhinick, E. F. 1991. The freshwater fishes of North Carolina. North Carolina Wildlife Resources Commission. Raleigh, NC.
- and A. L. Braswell (eds). 1997. Endangered, threatened, and rare fauna of North Carolina. Part IV. A reevaluation of the freshwater fishes. Occas. Papers N.C. State Mus. Nat. Sci. and N.C. Biol. Surv. No. 11. Raleigh, NC.
- NCDENR. 2003. Basinwide assessment report. French Broad River basin. North Carolina Department of Environment and Natural Resources. Division of Water Quality. Water Quality Section. Environmental Sciences Branch. Raleigh, NC.
- \_\_\_\_\_. 2006a. Standard operating procedure. Biological monitoring. Stream fish community assessment program. Biological Assessment Unit. North Carolina Department of Environment and Natural Resources. Division of Water Quality. Environmental Sciences Section. Raleigh, NC.
- \_\_\_\_\_. 2007. North Carolina. Water quality assessment and impaired waters list (2006 integrated 305(b) and 303(d) report). Final. Approved May 17, 2007. North Carolina Department of Environment and Natural Resources. Division of Water Quality. Planning Section. Raleigh, NC.
- NCWRC. 2005. North Carolina wildlife action plan. North Carolina Wildlife Resources Commission. Raleigh, NC.
- Nelson, J. S., Crossman, E. J., Espinosa-Pérez, H., Findley, L. T., Gilbert, C. R., Lea, R. N., and J. D. Williams. 2004. Common and scientific names of fishes from the United States, Canada, and Mexico. American Fisheries Society, Special Publication 29, Bethesda, MD.
- Noga, E. J. 1996. Fish disease. Diagnosis and treatment. Mosby-Year Book, Inc. St. Louis, MO.
- Sanders, R. E., Miltner, R. J., Yoder, C. O., and E. T. Rankin. 1999. The use of external deformities, erosion, lesions, and tumors (DELT anomalies) in fish assemblages for characterizing aquatic resources: a case study of seven Ohio streams. pp. 25-246. *In* Simon, T. P. (ed.). Assessing the sustainability and biological integrity of water resources using fish communities. CRC Press. Boca Raton, FL.
- Steedman, R. J. 1991. Occurrence and environmental correlates of blackspot disease in stream fishes near Toronto, Ontario. Trans. American Fisheries Soc. 120: 494 - 499.

### Appendix F-10 (continued).

Weaver, J. C. 2005. The drought of 1998 – 2002 in North Carolina – precipitation and hydrologic conditions. U. S. Geological Survey. Scientific Investigations Report 2005-5053.

### Appendix G-1. Flow measurement and flow conditions in the French Broad River basin.

The onset of the 2007 drought began to be noticed in early February 2007 when portions of the basin were first described as being abnormally dry. The drought intensified throughout the spring, summer, and fall so that by early October the entire basin was in an exceptional drought. An extreme and exceptional level of drought has persisted into 2008.

During fish community sampling in mid June 2007 flows were well below the median daily flows at nearby USGS gauge sites (Figures 1 – 3). During benthic macroinvertebrate sampling from July through August water levels were often well below median flow. However, even before the last basinwide monitoring cycle was completed in 2002, the French Broad River basin had been experiencing a prolonged drought which started in 1998 and continued through 2002 (NCDENR 2003; Table 1; Figures 1- 3). The 1998 – 2002 drought was most severe during summer 2002 (Weaver 2002). The lowest daily mean discharges flows ever recorded occurred in August and September 2002 at several sites in the basin (Table 1). The drought was abruptly halted by above normal precipitation in late 2002 and into 2003.

### Table 1.Record-low daily mean discharges at select U. S. Geological Survey stream gaging<br/>stations. Data adopted from Weaver (2005).

			Lowest Daily Mean Discharge				
			Prio Wa	r to 1988 ter Year	During 1998-2002 Water Year		
Station, County	Drainage Area (mi <sup>2</sup> )	Annual 90% exceedances flow (ft <sup>3</sup> /s)	Min (ft <sup>3</sup> /s)	Date	Min (ft³/s)	Date	
French Broad River near Rosman, Transylvania	67.9	87	37	09/25/1954	47.6	08/12/2002	
Davidson River near Brevard, Transylvania	40.4	42	14	09/28/1954	16	09/16/1999	
Beetree Creek near Swannanoa, Buncombe	5.5	1.6	0.3	09/30/1954	0.37	09/12/2002	
Swannanoa River at Biltmore, Buncombe	130	36	1.2	10/14/1941	4.9	09/13/2002	
Pigeon River near Hepco, Haywood	350	205	95	09/30/1941	95	09/11/2002	
South Toe river near Celo, Yancey	43.3	36	12	07/21/1986	9.5	09/12/2002	

During a three week period in September 2004, the tropical storm remnants of three hurricanes (Frances, Ivan, and Jeanne) lead to wide-spread flooding throughout the central and northern mountains of western North Carolina in the Catawba, French Broad, and Watauga River basins. Rainfall estimates for the combined three storms totaled more than 20 - 30 inches in certain watersheds. Runoff from the storms produced flash-floods throughout the region with peak flows in excess of 10,000 cfs (approximately 500 times median flows) in upper tributary streams, peaks flows in some tributary rivers exceeded 50,000 cfs. Although several of the peak stream flows were within the 25 - 50 year recurrence interval (e.g., the Swannanoa River at Biltmore), others were within the 200 - 500 year recurrence interval (e.g., West Fork Pigeon River above Lake Logan) or greater than 500 year recurrence interval (e.g., Pigeon River near Canton). Flooding was particular acute in the watersheds of Hominy/South Hominy Creeks, the lower Swannanoa River at Biltmore Village, and the Pigeon River at Canton (Biological Assessment Unit Memorandum F-20050404).

Extremely high flows have been periodically recorded since then, until 2007 when the most recent drought commenced. In September 2007, the all time record low daily discharge, 10 cfs, was reached again at the gaging site on the West Fork Pigeon River above Lake Logan near Hazelwood (pers. comm. with Mr. J. Curtis Weaver, USGS North Carolina Water Science Center, Raleigh, NC, January 30, 2008).

Changes in the benthic macroinvertebrate community are often used to help assess between-year changes in water quality. However, some between-year changes in the communities may be due partly to changes in flow. High flows magnify the potential effects of nonpoint source runoff and in areas of high imperviousness, this can lead to scour, substrate instability, and reduced periphyton. Low flows may

accentuate the effect of point source dischargers by providing less dilution of wastes. Whether a change is flow-related is decided on a site-by-site basis, looking at:

- Flow. The daily flow patterns over a six to twelve month period prior to the collections are examined using the most comparable records from USGS gaging stations. Areas primarily affected by nonpoint source runoff are expected to have a decline in water quality after high flow, but may improve during low flow. The exception to this rule is the smaller headwater streams, which may cease flowing during extreme droughts. Streams affected primarily by point source dischargers may improve after high flow (with dilution of the effluent) and decline after low flows. These changes, however, occasionally produce a between-year change of only one bioclassification.
- Changes throughout the subbasin, especially at reference sites. Flow-related changes usually affect a whole group of sites, not just single sites.
- Changes in species composition. Real changes in water quality are usually reflected in a significant change in the composition of the invertebrate community.

Consequently, all between-year changes in the biological communities are considered in light of flow conditions. Daily flow information is obtained from the closest available USGS monitoring site and compared to the long-term median flows. High flow is defined by BUA Staff as a median flow greater than 140 percent of the long-term median for that time period, usually July or August. Low flow is defined as a median flow less than 60 percent of the long-term median, while normal flow is 60 - 140% of the median. Although broad scale regional patterns are often observed, there may be large geographical variation within the state and large variation within a single summer period.



Figure 1. Flows in the French Broad River at Rosman, January 01, 2007 – September 30, 2007 (top) and September 30, 2002 to September 30, 2007 (bottom).



Figure 2. Flows in the Pigeon River near Canton, January 01, 2007 – September 30, 2007 (top) and September 30, 2002 to September 30, 2007 (bottom).



Figure 3. Flows in the South Toe River near Celo, January 01, 2007 – September 30, 2007 (top) and September 30, 2002 to September 30, 2007 (bottom).

#### BENTHIC MACROINVERTEBRATE SAMPLE

Waterbo	dy	Locatio	Location				Date	Bioclassification	
FRENCH BR	ROAD R	SR 11	SR 1129		0	30	8/16/07	Excellent	
County	Subbasin	8 digit HUC	Latitude	Longitude	e AU I	Number	Le	vel IV Ecoregion	
Transylvania	1	06010105	350855	824759	6	6-(1)	Southern Crys	talline Ridges and Mountains	
Stream Classifica	ation	Drainage Area (mi <sup>2</sup> )	) Elev	vation (ft)	Strea	am Width	(m)	Stream Depth (m)	
B; Tr		102		2200		26		0.2	
Visible Landuse	orested/Wetland	Urban		Agricul	Agriculture		Other (describe)		
	(70)	50	0		0				
Upstream NPI	DES Discharg	gers (>1MGD or <1M	GD and withir	n 1 mile)	NF	PDES Nur	nber	Volume (MGD)	
Babcock Con	npany LLC, E	xcelsior Packaging Pl	lant / Rosman	WWTP	NC	0000108	/ NC0021946	0.015 / 0.25	
Water Quality Parameters Site Photograph									
Temperature (°C)		25.2	- 2				A Standard	Man Markata	
Dissolved Oxygen (mg	g/L)		1		19.14				
Specific Conductance	(µS/cm)	21	-	an.	C. Sel				
pH (s.u.)		7.7	the state		124	100	C. C. L		
Water Clarity		clear					1234		
Habitat Assessment	Scores (max	)	and the second second					A STATE OF THE STATE OF	
Channel Modification (	(5)	5							
Instream Habitat (20)		16					to the life	Contraction of the second	
Bottom Substrate (15)		8				State State		and the second states	
Pool Variety (10)		6		and the second	10 Sec. 1		A ANT		
Riffle Habitat (16)		10			ar in	100	A STATE OF		
Left Bank Stability (7)	1400		E Carl						
Right Bank Stability (7	·)	5				ALS S	a de la ca	and the stand of	
Light Penetration (10)		6			and a	16. M	A ST ST ST	- Aste	
Left Riparian Score (5	)	3	-			Tool and	122	A States	
Right Riparian Score (	5)	2							

				3	, a. e., eessie, a.	a eana
Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/16/07	10333	105	46	4.3	3.0	Excellent
07/08/02	8848	96	54	3.6	3.0	Excellent
07/08/97	7317	92	51	3.5	2.8	Excellent
07/06/92	5873	108	51	3.8	2.6	Excellent

gravel, cobble, and sand

Substrate

66

#### **Taxonomic Analysis**

Total Habitat Score (100)

A decrease in leptocerid caddisflies and ephemerellid mayflies from 2002 levels is primarily responsible for the decrease in EPT richness in 2007. The increase in the biotic index from 3.6 to 4.3 in 2007 is, in part, due to the increases in tolerant midges, such as *Polypedilum illinoense* gr. and *Tribelos jucundum*, as well as abundant lumbriculid oligochaetes. Despite this increase in the biotic index, many intolerant taxa were abundant such as *Serratella deficiens*, *S. serratoides*, *Acroneuria abnormis*, *Brachycentrus appalachia*, *Micrasema bennetti*, and *M. wataga*. This site is one of 5 locations within North Carolina where the rare mayfly *Barbaetis benfieldi* has historically been found. *Barbaetis benfieldi* was last collected in 1992.

#### Data Analysis

The sampling site lies on the edge of the Broad Basins ecoregion while the entire watershed upstream is contained within the Southern Crystalline Ridges and Mountains ecoregion. The headwaters of the French Broad River (North, West, East, and Middle Forks of the French Broad) all drain mostly undeveloped National Forest land. Regardless of being situated below Rosman and 2 minor dischargers, this site has maintained an Excellent rating. However, water quality does appear to be worsening slightly as indicated by the decrease in EPT and the substantial increase in the biotic index.

#### BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody			Location		Station ID		Date		Bioclassification
FRENCH BR	ROAD	R	NC 146		EB89		08/15/07		Good
County	Subbas	sin 8 digit	HUC	Latitude	Longitude	e AUI	Number	I	evel IV Ecoregion
BUNCOMBE	2	06010	0105	352853	823328	6-(	54.5)b	southern cr	ystaline ridges and mountains
Stream Classifica	ation	Drainage A	Area (mi2)	) Ele	vation (ft)	Stre	am Width	ı (m)	Stream Depth (m)
В		658	3.4	,	2043		50		0.5
		Forested/We	tland	Urbai	<b>1</b>	Agricul	ture		Other (describe)
Visible Landuse (%)		50		0	•	0			50 (I-26 corridor)
Upstream NP	DES Disch	hargers (>1MG	D or <1M	GD and withi	n 1 mile)	N	PDES Nui	nber	Volume (MGD)
·	ic Power	Plant	,		NC00003	96	4.8		
		RFS Ecusta	, Inc.				NC00000	78	27.5
	VTP				NC00605	34	2.5		
		Henderson W	/WTP				NC0025534 4.8		
Water Quality Param	neters						Site Pho	otograph	
Temperature (°C)			26.1	1.	AL			2. 199 2	· · · · · · · · · · · · · · · · · · ·
Dissolved Oxygen (me	g/L)		8.3		1	24		MARTIN	2. P. 41 4
Specific Conductance	e (µS/cm)		42	11		1		THE ALL OF	
pH (s.u.)	. ,		7.5	the second	the state	-	an war of	1.1 42	States and a state of the
					No. of Concession, Name				10 17 19 19 19 19 19 19 19 19 19 19 19 19 19
Water Clarity		turbid		<b>F</b> 356	The sea	HAD IN		19- Barris	
Habitat Assessment	Scores (n	nax)		The second	and por			A REAL PROPERTY	
Channel Modification	(5)		5		ACT STORE	-			AND DESCRIPTION OF THE OWNER OF T
Instream Habitat (20)	(0)		16	The second		Cit - Color	and the second	-	and the second s
Bottom Substrate (15)	)		12				The second	The sealthing	CONTRACTOR OF THE OWNER
Pool Variety (10)	/		10			States of the	***		Junior Aller a
Riffle Habitat (16)			7		-			4.20	
Left Bank Stability (7)			7					A Real	
Right Bank Stability (7	7)		7	and the second					
Light Penetration (10)			2						
Left Riparian Score (5	5)		5	-	1 2 2				
Right Riparian Score	(5)		5						
Total Habitat Score (	(100)		76	Substr	ate Mixt	ure of gra	re of gravel, cobble, and boulder		
Sample Date	)	Sample I	D	ST	EPT		BI	EPT BI	Bioclassification
08/15/07		10321		63	27		4.8	3.7	Good

08/15/07	10321	63	21	4.8	3.7	Good
09/10/02	8988	65	25	5.6	4.5	Good-Fair
07/08/97	7321	76	32	5.4	4.5	Good-Fair
07/08/92	5883	86	41	5.1	4.2	Good
07/26/90	5403	79	33	5.4	4.0	Good-Fair

#### **Taxonomic Analysis**

There were no stoneflies collected at this study location in 2007. Pollution intolerant, or "sensitive" taxa included the mayfly *Ephemera* sp., and the caddisfly *Brachycentrus numerosus*. Neither of these taxa have previously been collected at this site. Overall, the macroinvertebrate assemblage was dominated by facultative species.

#### Data Analysis

The bioclassification at NC 146 has improved slightly from Good-Fair in 2002 to Good in 2007. Although no stoneflies were collected at this location in either 2002 or 2007, their absence may be in part be attributable to adult emergence patterns rather than an effect of water quality. The infrequency of riffle habitats negatively affected the habitat score. However, due to the presence of abundant colonizable habitats at this location the bioclassification will likely remain Good unless water quality degrades.
Waterbody		Location	1	Station	ID	Date		Bioclassification	
FRENCH BROAD	R	SR 134	8	EB9	0	08	8/16/07	Good-Fair	
County Subt	basin 8 dig	jit HUC	Latitude	Longitude	AUN	Number	Lev	/el IV Ecoregion	
BUNCOMBE	2 060	10105	353632	823441	6-(	54.5)c		Broad Basins	
Stream Classification	Drainage	Area (mi2)	Elev	Elevation (ft) Stream Width (m)		(m)	Stream Depth (m)		
В		943		1960		50		0.4	
	Forested/V	/etland	Urban		Agricul	ture	0	ther (describe)	
Visible Landuse (%)	50		50		0			0	
Upstream NPDES Dis	chargers (>1M	GD or <1MG	D and within	1 mile)	NF	DES Nur	nber	Volume (MGD)	
Asheville Steam Electric Powe	er Plant					NC000039	96	4.8	
RFS Ecustra, Inc.						NC00000	78	27.5	
Brevard WWTP						NC00605	34	2.5	
Hendersonville WWTP						NC00255	34	4.8	
Water Quality Parameters						Site Pho	tograph		
<ul> <li>Dissolved Oxygen (mg/L)</li> <li>Specific Conductance (µS/cm pH (s.u.)</li> <li>Water Clarity</li> <li>Habitat Assessment Scores</li> <li>Channel Modification (5)</li> <li>Instream Habitat (20)</li> <li>Bottom Substrate (15)</li> </ul>	) slightly tr (max)	7.7 62 7.3 urbid 5 16 10							
Pool Variety (10) Riffle Habitat (16) Left Bank Stability (7) Right Bank Stability (7) Light Penetration (10) Left Riparian Score (5) Right Riparian Score (5)		10 10 7 7 2 4 3 74	Substra	te Mix o	f.bedroc	k boulder		nd sand	
Total Habitat Score (100)		74	Substic		n pearoci	k, boulder,	, rubble, gravel a		
Sample Date	Sample	e ID	ST	EPT		BI	EPT BI	Bioclassification	
08/16/07	1032	4	72	30		0.34	4.15	Good-Fair	
07/09/97	7323	3	72	30	2	5.03	4.02	Good-Fair	

### **Taxonomic Analysis**

07/23/92

08/03/87

5934

4190

No major changes in the benthic community were observed. Abundant taxa included Baetis intercalaris, Heterocloeon anoka, H. curiosum, Maccaffertium ithaca, M. modestum, Stenacron pallidum, Tricorythodes, Brachycentrus numerosus, Cheumatopsyche, Hydropsyche venularis, Triaenodes ignitus, Ancyronyx variegatus, Macronychus glabratus, Argia, Calopteryx, Macromia, Polypedilum flavum, Rheotanytarsus, Simulium and Crangonyx.

32

23

5.24

5.26

4.30

4.02

Good-Fair

Good-Fair

73

70

### Data Analysis

This site is located in the city of Asheville. EPT richness has been fairly stable (30 or 32) since 1992, but a slight decline in the NCBI occurred in 2002 resulting in a Good bioclassification. No major water quality problems are indicated by the benthic community.

Waterbody		Locat	Location		Station ID		Date	Bioclassification
FRENCH BR	ROAD R	SR 1	634	EB9	2	08/14/07		Good-Fair
County	Subbasin	8 digit HUC	Latitude	Longitude	AUN	lumber	Lev	el IV Ecoregion
BUNCOMBE	2	06010105	354230	823719	6-(	54.d)d	Southern Cryst	aline Ridges and Mountains
Stream Classifica	ation [	Drainage Area (mi	2) Elev	vation (ft)	Strea	Stream Width (m)		Stream Depth (m)
В		1049.3		1786		50		0.4
	Foi	ested/Wetland	Urban		Agricul	ture	Ot	ther (describe)
Visible Landuse	(%)	70	0		0		3	0 (Residential)
Upstream NPI	DES Discharge	rs (>1MGD or <1	MGD and withir	n 1 mile)	NF	DES Nur	nber	Volume (MGD)
	French	n Broad River WRF	-			NC00249	11	40
	Asheville Ste	am Electric Power	<sup>.</sup> Plant			NC00003	96	4.8
	RI	S Ecusta, Inc.				NC00000	78	27.5
	В	revard WWTP		NC0060534 2.5				
Henderson WWTP NC0025534 4.8						4.8		
Water Quality Parameters Site Photograph								
Temperature (°C)		27.1	-					
Dissolved Oxygen (mg	g/L)	7.4	1944-					
Specific Conductance	(µS/cm)	84	Marrie .					
pH (s.u.)		7.5	5 3					ALC: NO
Water Clarity		Turbid		Ries	(Creek		- Channel	A STREET
Habitat Assessment	Scores (max)		-					
Channel Modification (	(5)	5						-
Instream Habitat (20)		16			ATT	-	Table	
Bottom Substrate (15)	1	13	Statistics.			and a state of the	and the second s	
Pool Variety (10)		10			-			A CONTRACTOR OF THE OWNER
Riffle Habitat (16)		14	-					
Left Bank Stability (7)		7	100	10		-		
Right Bank Stability (7	")	7						
Light Penetration (10)		2		Story .			1000 - 100	
Left Riparian Score (5	)	3	and the second second	- States	-			and the second sec

Substrate

2

79

Mixture of gravel, cobble, and boulder

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/14/07	10317	77	28	5.7	4.1	Good-Fair
07/10/02	8869	57	18	5.8	4.9	Fair
07/09/97	7325	55	18	5.6	4.7	Good-Fair
07/23/92	5935	53	19	6.1	4.8	Fair
07/24/90	5399	61	19	5.7	4.3	Fair

## **Taxonomic Analysis**

Right Riparian Score (5)

**Total Habitat Score (100)** 

Intolerant or "sensitive" taxa identified from the 2007 sample included the mayflies *Heptagenia marginalis, Stenacron pallidum, and Serratella deficiens, and the caddisflies Brachycentrus numerosus and Protoptila* sp. No stoneflies were collected at this site.

### Data Analysis

The bioclassification of this study site has fluctuated between Fair and Good-Fair during the five sampling events between 1990 and 2007. The habitat score was negatively affected by an open stream canopy and by frequent gaps in the riparian zone. The operation of the French Broad River WRF was improved prior to 1997 sampling, and a trend of higher bioclassification at this location indicates a possible associated improvement in water quality. The recolonization of stoneflies would help this site in recieving a higher rating in the future.

Waterbody		Locatio	Location		Station ID		Date	Bioclassification
French Br	oad R	NC 2	13	EB	8194	07	7/31/07	Good-Fair
County	Subbasin	8 digit HUC	Latitude	Longitu	ude AU Number		Lev	vel IV Ecoregion
Madison	4	06010105	354710	82393	9 6-(	(54.5)f		Broad Basins
Stream Classifica	ition I	Drainage Area (mi2)	Elevation (ft)		Stre	Stream Width (m)		Stream Depth (m)
В		1,330	,	1,697		75		0.6
	Fo	rested/Wetland	Urban		Agricul	ture	0	ther (describe)
Visible Landuse	(%)	40	60		0			0
Upstream NPI	DES Discharge	ers (>1MGD or <1M	GD and withir	n 1 mile)	N	PDES Nur	nber	Volume (MGD)
		None						
Water Quality Param	eters					Site Pho	tograph	
Temperature (°C)		34.3		and the second	States 1	and a	A THE A	E States
Dissolved Oxvaen (mo	1/L)	5.7	and the second second	and a state of	T intel	Charles and	a star	
Specific Conductance	(µS/cm)	60.9	10	ALLER	ATT. TEAL		Contract's	
pH (s.u.)	u ,	6.7	March 1		Carst Prop		FR.	
Water Clarity	Ş	Slightly Turbid	21		家小学	Ser .	1 day	
Habitat Assessment	Scores (max)		and the second					and the second se
Channel Modification (	(5)	4	C. States				- The art of the	
Instream Habitat (20)		15	-					
Bottom Substrate (15)		12					- martin	A PART
Pool Variety (10)		4					the second	a share a first
Riffle Habitat (16)		10			-			action to the
Left Bank Stability (7)		6			-		top mile	
Right Bank Stability (7	)	5						0.4.0.3
Light Penetration (10)		4	6	A STATE	and the second		and the second	AN THE R
Left Riparian Score (5	)	1						
Right Riparian Score (	5)	1						
Total Habitat Score (	100)	62	Substra	ate S	and, rubble,	gravel, be	drock, and bould	ler.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/31/07	10270	79	32	4.98	3.73	Good-Fair
06/26/02	8840	81	26	5.80	4.50	Good-Fair
07/07/97	7336	52	25	4.70	3.70	Good-Fair
07/23/92	5929	66	24	5.30	4.50	Good-Fair
07/24/90	5398	49	18	5.50	4.70	Good-Fair

### **Taxonomic Analysis**

Although the bioclassification has been extremely stable at this location through time, the 2007 sample did produce the highest EPT taxa richness and lowest EPTBI suggesting slightly improved water quality here this year. Indeed, several EPT taxa were collected here for the first time in 2007 and included the mayflies *Plauditus punctiventris, Maccaffertium pudicum*, and the caddisflies *Agapetus* sp., *Brachycentrus numerosus*, *Brachycentrus spinae*, *Ceratopsyche bronta*, and *Polycentropus* sp.

### Data Analysis

Including the 2007 sample, this segment of the French Broad River has been sampled on 10 occasions with all but two samples (Fair in 1985 and 1988) resulting in Good-Fair bioclassifications. This data suggests stable water quality conditions through time at this location although the 2007 sample set a record high for EPT taxa richness and a record low EPTBI. This improvement in EPT community metrics is likely the result of lowered pollution inputs due to drought as much of this catchment is most influenced by non-point inputs. Indeed, conductivity in 2007 (61µS/cm) was much lower than the level measured in 2002 (100 µS/cm)

Waterbody		Locati	Location		Station ID		Date	Bioclassification
W FK FRENCH	BROAD R	US 6	64	EB4	15	30	8/28/07	GOOD
County	Subbasin	8 digit HUC	Latitude	Longitude	e AU I	AU Number		vel IV Ecoregion
Transylvania	1	06010105	350815	825105	6-2	2-(7.5)	Southern Cryst	alline Ridges and Mountains
Stream Classifica	ntion I	Drainage Area (mi <sup>2</sup>	<sup>2</sup> ) Elev	vation (ft)	Stre	am Width	(m)	Stream Depth (m)
B; Tr, HQW		27		2300		12		0.3
	Fo	rested/Wetland	Urban		Agricul	ture	0	ther (describe)
Visible Landuse	(%)	50	50		0			0
Upstream NPI	DES Discharge	ers (>1MGD or <1N	IGD and within	n 1 mile)	N	PDES Nur	nber	Volume (MGD)
	None							
Water Quality Param	eters					Site Pho	otograph	
Temperature (°C)		20.5		A MARKED BALL	Alle.		Set and	della della
Dissolved Oxygen (mg	g/L)	8.6	Sec. 1					
Specific Conductance	(µS/cm)	19	a the second		1000	Turner .	Contraction of the	
pH (s.u.)		6.5		A CALS AS				
Water Clarity		clear					St and	
Habitat Assessment	Scores (max)			- Alle				Standard Astronomic Park
Channel Modification (	(5)	5				and an and a second		
Instream Habitat (20)		14				1	A second second second	
Bottom Substrate (15)		12		112		P	T THE STATE	
Pool Variety (10)		8		and the second second second	art de la			
Riffle Habitat (16)		16				Contraction of the second		
Left Bank Stability (7)		7			and a second		and the second second	
Right Bank Stability (7	)	7	The second					A REAL PROPERTY AND ADDRESS OF ADDRE
Light Penetration (10)		7				and the set		
Left Riparian Score (5)	)	2			- Law			
Right Riparian Score (	5)	3						

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification		
08/28/07	10338	96	39	3.6	2.3	Good		
07/09/02	8851	91	51	3.0	2.3	Excellent		
07/07/97	7314	94	50	3.0	2.1	Excellent		
07/06/92	5871	87	47	3.5	2.4	Excellent		

cobble, sand, and boulder; silty

Substrate

81

#### **Taxonomic Analysis**

Total Habitat Score (100)

A dramatic drop in EPT richness occurred since 2002 driven mostly by the occurance of fewer mayfly taxa, of which five of the absent taxa belonged to the family Ephemerellidae. Also, 3 taxa species in the genus *Rhyacophila* (*R. atrata, R. formosa, R. fuscula*), an intolerant caddisfly group, were not collected in 2007. An increase in the biotic index is indicative of a slightly more tolerant benthic community with representatives like *Maccaffertium modestum*, abundant for the 1st time, and *Tribelos jucundum*, a tolerant midge, collected for the first time. EPT abundance values were also half those found in 2002 (157 vs. 329). Sensitve taxa of note included *Drunella allegheniensis*, *Paraleptophlebia* sp., *Paragnetina immarginata*, *Pteronarcys* sp., *Brachycentrus spinae*, *B. appalachia*, *Micrasema bennetti*, *M. rickeri* (63rd state record), *M. wataga*, and *Phylocentropus* sp.

### Data Analysis

A mostly undeveloped watershed, this river drains a portion of Pisgah National Forest. Trout farms exist in the upper watershed and have been documented to have a localized effect on stream water quality (see BAU memos 20000925 and 20020125). This site was sampled approximately 7 seasonal weeks after the prior basinwide samples were collected. Many of the taxa that did not occur may have already emerged. Also, the biotic index is well within the Excellent range while only one more EPT taxon collected would have produced an bioclassification rating of Excellent for 2007. It is possible that seasonal emergence of insects, along with increased impacts of the trout farms on the stream in a drought year, may have both contributed to lowering the bioclassification rating to Good in 2007.

Waterbody		Locatio	Location				Date	Bioclassification
N FK FRENCH	BROAD R	SR 13	22	EB2	28	30	8/17/07	EXCELLENT
County	Subbasin	8 digit HUC	Latitude	Longitude	AU	AU Number		vel IV Ecoregion
Transylvania	1	06010105	350916	825024	6-3	3-(6.5)	Southern Cryst	alline Ridges and Mountains
Stream Classifica	ition I	Drainage Area (mi <sup>2</sup> )	Elev	vation (ft)	Stre	am Width	(m)	Stream Depth (m)
B; Tr		35		2250		10		0.2
	Fo	rested/Wetland	Urban	1	Agricul	ture	0	ther (describe)
Visible Landuse	(%)	20	20		60			0
Upstream NPI	DES Discharge	ers (>1MGD or <1M	GD and withir	n 1 mile)	N	PDES Nur	nber	Volume (MGD)
		None						
Water Quality Param	eters					Site Pho	tograph	
Temperature (°C)		21.3			à la chi			- HOLE
Dissolved Oxygen (mg	g/L)		200					
Specific Conductance	(µS/cm)	20	Same -		TO NO			
pH (s.u.)		6.5					1-1	
Water Clarity		clear						
Habitat Assessment	Scores (max)			and the second second	11 500	100	- Carlos	
Channel Modification (	(5)	5		State State	and all	-		
Instream Habitat (20)		13			and the second second			
Bottom Substrate (15)		9		Tank St.				and the second
Pool Variety (10)		6			-			
Riffle Habitat (16)		14	-	1	and it	1 cm	CA	and the second s
Left Bank Stability (7)		6	and a state of the		and the second		0	Astronom a
Right Bank Stability (7	)	2	- +++		-			and the second second second
Light Penetration (10)		7	100			S.March		
Left Riparian Score (5)	)	4	and the second	C. Mart	-		Gt Barro	Children .
Right Riparian Score (	5)	3						

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification			
08/17/07	10335	95	43	3.9	2.9	Excellent			
07/09/02	8853	79	41	3.5	2.7	Excellent			
07/07/97	7315	76	41	3.3	2.5	Excellent			
07/06/92	5872	85	42	3.4	2.5	Excellent			

cobble, boulder, and sand

Substrate

69

#### **Taxonomic Analysis**

Total Habitat Score (100)

EPT richness in North Fork French Broad River has remained stable over the last 15 years. The biotic index, however, has risen since 1997 indicating that the benthos is slowly shifting towards a slightly more tolerant community (with increases in tolerant non-EPT taxa such as odonates and midges). Although intolerant taxa overwhelmingly dominated the community with *Epeorus vitreus*, *Paraleptophlebia* sp., *Acroneuria abnormis*, *Leuctra* sp., *Paragnetina immarginata*, *Brachycentrus appalachia* and *Dolophilodes* sp. being abundant, increases in the overall EPT biotic index also increased. Previously uncollected taxa were *Centroptilum* sp. *Molanna tryphena*, and *Rhyacophila carolina*. the caddisfly *Setodes* sp. and the stonefly *Perlesta* sp., as well as 3 ephemerellid mayflies, (Danella lita, Drunella lata, Serratella serrata) were not collected in 2007 as they were in years past.

### Data Analysis

Draining National Forest land in Transylvania County, the North Fork French Broad River has little development and no dischargers to impact water quality. Cattle access to the river just downstream of the sampling site has severely eroded the banks of the river and is cause for concern. The stream has maintained an Excellent bioclassification rating for the fourth consecutive basinwide cycle with no water quality issues noted.

Waterbody		Locati	Location		Station ID		Date	Bioclassification
M FK FRENCH	BROAD R	SR 11	131	EB2	21	30	8/16/07	EXCELLENT
County	Subbasin	8 digit HUC	Latitude	Longitude	e AU I	AU Number		vel IV Ecoregion
Transylvania	1	06010105	350716	824918		6-5	Southern Crys	stalline Ridges and Mountains
Stream Classification D		Drainage Area (mi <sup>2</sup>	) Elev	vation (ft)	Stream Wid		(m)	Stream Depth (m)
B; Tr		4.9		2240		4		0.1
	Fo	rested/Wetland	Urban	1	Agricul	ture		Other (describe)
Visible Landuse	(%)	0	75		0			25
Upstream NPD	DES Discharg	ers (>1MGD or <1N	IGD and withir	n 1 mile)	NF	DES Nur	nber	Volume (MGD)
		None						
Water Quality Parame	eters					Site Pho	tograph	
Temperature (°C)		22	1-16. A.		and the s		and the	
Dissolved Oxygen (mg	ı/L)		Sec. 2	Sec.			Contraction of the second	All Solder
Specific Conductance	(µS/cm)	26		1200		The second	STREET, PROVIDENT	and the second
pH (s.u.)		6.5		SAR	S. A. Car	and prove	E	A CARLER MAN
Water Clarity		clear	En la					
Habitat Assessment	Scores (max)		FINEE	State 1				The second
Channel Modification (	(5)	5	State -		in the			
Instream Habitat (20)		14			200		and the	
Bottom Substrate (15)		10				1	and the second	
Pool Variety (10)		6				The second second	A COM	
Riffle Habitat (16)		16		Star Shap		Townson and	MAR CO	and the start
Left Bank Stability (7)		5		and the second	100	A CALCULAR DE	and the second	
Right Bank Stability (7)	)	5	X		- Weller	Contraction of the		(D)
Light Penetration (10)		10	01		Sale -		Put Share	A Shine Star
Left Riparian Score (5)	)	1			2 and	-	- Alexan	ET CANA
Right Riparian Score (	5)	1						
Total Habitat Score (1	100)	73	Substra	ate		prima	rily cobble, grav	vel and sand

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/16/07	10334		43		2.3	Excellent
07/08/02	8849		51		2.2	Excellent

### **Taxonomic Analysis**

Eight fewer EPT were collected (5 mayflies, 1 stonefly, 1 caddisfly) in 2007 than were collected in 2002. In both sampling years almost all abundant taxa were sensitive species, although one third fewer taxa were abundant in 2007 (10 and 15 respectively). For 2007, intolerant taxa that were abundant included the mayfly *Epeorus vitreus* and the caddisflies *Micrasema wataga*, *Dolophilodes* sp., and *Brachycentrus spinae*. All 5 occuring taxa of stoneflies collected were abundant. Some new taxa in 2007 were *Neoephemera purpurea*, *Malirekus hastatus*, *Ceratopsyche slossonae*, *Micrasema bennetti*, *Neophylax mitchelli* and *Nyctiophylax celta*. Two of three species of *Rhyacophila* (*R. acutiloba* and *R. carolina*) collected in 2002 were not found in 2007.

## Data Analysis

A new basinwide site in 2002, the Middle Fork French Broad River drains a portion of the Pisgah National Forest. The sampling site lies within a heavily developed residential zone which leaves a large potion of the stream corridor without substantial riparian vegetation. Despite this, the stream has retained its Excellent rating from 2002 partially due to the lessened urban runoff during a low precipitation year. No water quality problems are noted at this site.

Waterbody		Locat	Location		Station ID		Date	Bioclassification
DAVIDSC	ON R	US 2	276	EB1	64	30	8/16/07	EXCELLENT
County	Subbasin	8 digit HUC	Latitude	Longitude	e AUI	AU Number		evel IV Ecoregion
Transylvania	3	06010105	351628	824251	6-34	4-(15.5)	Southern Cry	stalline Ridges and Mountains
Stream Classifica	tion	Drainage Area (mi	<sup>2</sup> ) Ele	vation (ft)	Strea	am Width	(m)	Stream Depth (m)
WS-IV, B; Tr		40		2195		15		0.1
	Fo	prested/Wetland	Urbai	1	Agricul	ture		Other (describe)
Visible Landuse	(%)	70	0		0			(30) campground
Upstream NPD	DES Discharg	ers (>1MGD or <1	MGD and withi	n 1 mile)	NF	PDES Nur	nber	Volume (MGD)
	None							
Water Quality Param	eters					Site Pho	otograph	
Temperature (°C)		19.6	a a s		Contraction of the second			
Dissolved Oxygen (mg	g/L)					A surger and		
Specific Conductance	(µS/cm)	22	14. H		35.44	and the second	2.0	
pH (s.u.)		6.8	- 10 M	A.	1012	Mar 18		
Water Clarity		clear		Testa ala				Sale
Habitat Assessment	Scores (max)			m	-	-		
Channel Modification (	(5)	5			-	100	and the second s	
Instream Habitat (20)		16		-	-			A STRATE OF THE OWNER
Bottom Substrate (15)		15						
Pool Variety (10)		6		and a state		1		
Riffle Habitat (16)		16		Cod.				and and -
Left Bank Stability (7)		5						
Right Bank Stability (7	)	6	500	1	Ser.	An-		and the second second
Light Penetration (10)		9			The second secon	L. N.	The state	San and Strain Sec.
Left Riparian Score (5)	)	3	Sec.				Contenta T	and the second second second
Right Riparian Score (	5)	3						

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/16/07	10330		37		2.6	Excellent
07/22/02	8883		37		3.2	Excellent
07/22/97	7333		52		2.7	Excellent
07/07/92	5875		45		1.8	Excellent

cobble, boulder, and gravel

Substrate

84

### **Taxonomic Analysis**

**Total Habitat Score (100)** 

EPT richness in Davidson River maintained it's 2002 level, although it has historically been higher. The reduction of ephemerellid mayflies from 1992 (8) to 2002 (3) and 2007 (1) is the primary reason for the difference in EPT richness values. Many intolerant taxa were were abundant in 2007 and included 3 mayflies (*Epeorus vitreus*, *Heptagenia marginalis*, and *Maccaffertium pudicum*), 3 stoneflies (*Acroneuria abnormis*, *Paragnetina immmarginata*, and *Tallaperla* sp.), as well as 5 caddisflies (*Brachycentrus spinae*, *Ceratopsyche sparna*, *Dolophilodes* sp., *Glossosoma* sp., and *Neophylax consimilis*). The previously collected taxa *Triaenodes ignitus*, *Polycentropus* sp. and *Perlesta* sp. were not collected in 2007. Also, an animal of special concern in North Carolina, the hellbender (*Cryptobranchus alleganiensis*), was found at this site.

### Data Analysis

The entire watershed of Davidson River lies within Pisgah National Forest and is completely undeveloped. This stream is a popular recreational stream and has undergone substantial habitat rearrangement by fishermman, although effects on the macroinvertebrate community are minimal. Davidson River has consistently maintained an Excellent rating and no water quality issues were identified.

Waterbody		Locati	Location			Date		Bioclassification
LITTLE	R	SR 15	SR 1560		18	30	8/16/07	EXCELLENT
County	Subbasin	8 digit HUC	Latitude	Longitude	e AUN	Number	Lev	vel IV Ecoregion
Transylvania	1	06010105	350918	823744	744 6-38-(1)		Southern Cryst	alline Ridges and Mountains
Stream Classification Draina		Drainage Area (mi <sup>2</sup> )	) Elev	vation (ft)	Strea	am Width	(m)	Stream Depth (m)
C; Tr		16		2200		5		0.2
	Fo	rested/Wetland	Urban	l	Agricul	ture	O	ther (describe)
Visible Landuse	(%)	40	20		0		4	0 (fallow field)
Upstream NPI	DES Discharge	ers (>1MGD or <1M	GD and withir	n 1 mile)	NF	DES Nur	nber	Volume (MGD)
	<u> </u>	None						
Water Quality Parame	eters					Site Pho	tograph	
Temperature (°C)		21.2				1.50		
Dissolved Oxygen (mg	g/L)						10 1	
Specific Conductance	(µS/cm)	21			a sea		1.2.7	
pH (s.u.)		6.6			1.20	and the	1. 1. 1. 1. 1.	a start of the second sec
Water Clarity		clear						
Habitat Assessment	Scores (max)						A share and	
Channel Modification (	(5)	5	a.			Sett 1	and setting on which the	A Distance of the local distance of the
Instream Habitat (20)		14	A second			1	N.	
Bottom Substrate (15)		3						CALL AND A DECK
Pool Variety (10)		7	. A. 1944	1.5				M. Som
Riffle Habitat (16)		4	N. Me		保全			Carp Carp
Left Bank Stability (7)		3	-		-		and the first of	A STATISTICS
Right Bank Stability (7	)	3	200	A STREET, STRE	-	-	and the second	
Light Penetration (10)		7	1	-fui			a state	
Left Riparian Score (5)	)	3					Contraction of the	and the second s
Right Riparian Score (	5)	4		_				
Total Habitat Score (	100)	53	Substra	ate			sand and woody	debris

( )							
Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification	
08/16/07	10332		45		3.3	Excellent	
07/09/02	8864		35		3.5	Good	

### **Taxonomic Analysis**

EPT richness increased by 10 taxa over the first basinwide sampling in 2002. This increase was due to more caddisflies being collected and, in turn, was responsible for lowering the EPT biotic index as the remainder of the 2007 benthic community was similar to that found in 2002. Caddisfly taxa not previously collected were *Dolophilodes* sp. (rare), *Glossosoma* sp. (abundant), *Hydroptila* sp. (rare), *Lype diversa* (common), *Micrasema wataga* (common), *Molanna tryphena* (rare), *Mystacides sepulchralis* (common), *Nyctiophylax moestus* (rare), *N. nephophilus* (common), *Rhyacophila appalachia* (rare), *R. fuscula* (common), and *Triaenodes ignitus* (abundant). Stoneflies were also diverse with 9 taxa of which *Acroneuria abnormis*, *Leuctra* sp. and *Tallaperla* sp. were abundant. Mayflies of note were *Baetisca* sp. (rare), *Drunella conestee* (common), *Hexagenia* sp. (common), and *Serratella deficiens* (abundant).

### Data Analysis

Upstream of any dischargers, this site on the Little River receives water from a mostly forested watershed. Some residential development (including golf courses) and agriculture also exist within the watershed, potential non-point sources of pollution. This site received an Excellent bioclassification up from a previous Good rating. The previous Good rating, however, was only one taxon away from scoring an Excellent suggesting that the Little River at this site has only been slightly impacted. Of note is that both samplings occured during drought years thereby lessening the impact of non-point source runoff on the benthos. Habitat in this stream was poor due to the homogeneous substrate and lack of riffles further supporting the fact that a diverse macroinvertebrate community benefits from excellent water quality.

Waterbody		Locatio	Statio	n ID		Date	Bioclassification	
LITTLE	R	SR 15	533	EB	16	08	8/16/07	GOOD-FAIR
County	Subbasin	8 digit HUC	Latitude	e Longitude	e AUI	Number	Lev	el IV Ecoregion
TRANSYLVANIA	1	06010105	351518	823835	6-3	8-(20)		Broad Basins
Stream Classifica	tion	Drainage Area (mi <sup>2</sup> )	) E	Elevation (ft)	Stre	am Width	(m)	Stream Depth (m)
С		44		2135		11		0.2
	Fo	rested/Wetland	Urt	ban	Agricul	ture	Ot	ther (describe)
Visible Landuse	(%)	0	3	30	50		2	20 (fallow field)
Upstream NPD	ES Discharge	ers (>1MGD or <1M	GD and wi	thin 1 mile)	NF	DES Num	nber	Volume (MGD)
	Eagle's N	lest Foundation - ca	mp			NC005102	21	0.008
Water Quality Parame	eters					Site Pho	tograph	
Temperature (°C)		21.3		And Section				
Dissolved Oxygen (mg	ı/L)		20			F. S.		A REAL PROPERTY
Specific Conductance	(µS/cm)	17	1000	and the second sec			and the second	
pH (s.u.)		6.4						
Water Clarity		slightly turbid				-	-	
		gj	-	- Par	$\prec$	-	A Distance	
Habitat Assessment	Scores (max)		to the	Fre		and the		A REAL PROPERTY OF
Channel Modification (	5)	5	-					and the second
Instream Habitat (20)		12				-		IT COME TO A
Bottom Substrate (15)		3		and a state	-	100		
Pool Variety (10)		8	The second			al a		Minister -
Riffle Habitat (16)		3	1000		1	2		and the second
Left Bank Stability (7)		3		Res and Andrews	ALL .	- 1	C. States	
Right Bank Stability (7)	)	3		AD F		4		A DECEMBER
Light Penetration (10)		10	1.50		2	1 E	T. Starting	
Left Riparian Score (5)	)	3		1	a circul	Carle -	The second	States and a state

Total Habitat Score (100)	52 Substrate		ate	sand and woody debris					
Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification			
08/16/07	10331		24		4.0	Good-Fair			
07/11/02	8870		24		4.2	Good-Fair			
07/08/97	7318		25		4.3	Good-Fair			
07/07/92	5874		26		4.2	Good-Fair			

2

### **Taxonomic Analysis**

Right Riparian Score (5)

EPT richness in the Little River has remained fairly constant since 1992. Pollution sensitive taxa in 2007 were represented by only one species of mayfly (*Serratella deficiens*), one species of stonefly (*Paragnetina fumosa*) and one species of caddisfly (*Brachycentrus nigrosoma*). Other abundant taxa were tolerant (*Cheumatopsyche* sp. and *Maccaffertium modestum*). Overall, fewer mayflies were collected in 2007 (4) as compared to other years (5-7). The previously collected stonefly, *Pteronarcys* sp., was not found in 2007. New taxa collected at this site were the burrowing mayfly *Hexagenia* sp. and the caddisfly *Polycentropus* sp.

### Data Analysis

This sampling site on the Little River lies in the Broad Basins ecoregion while the vast majority of the watershed lies within the Southern Crystaline Ridges and Mountains ecoregion. The Little River has consistlenly rated Good-Fair at SR 1533 since the monitoring of this waterbody began in 1992. A major discharger upstream (Sterling Diagnostic Imaging) became inactive since the last sampling in 2002, although the sampling site is downstream of a small discharger. Water quality has not improved at this site and is most likely affected by the high degree of urbanization and intense agriculture surrounding the stream. Additionally, the lack of good macroinvertebrate habitat impedes the streams ability to recover and contributes to the lack of benthic diversity.

Waterb	ody		Location			Date Station ID Bioclassification			tion	
CRAB	CR		SR 1532		06/13/	07	EF20		Good	
					1			- <u>1</u>		
County	Subbasir	n 8 digit HUC	Latitude	Long	itude	A	U Number	Le	Level IV Ecoregion	
TRANSYLVANIA	1	06010105	35.23444444	-82.6	6175		6-38-23		Broad Basi	ns
Stream Classifica	tion D	rainage Area (mi2)	Flevatio	on (ft)	Stream	n Widt	h (m)	Average Depth (	m) R	eference Site
C:Tr HOW		7	209						 	No
0,11,110,11		1	200	2000 0 0.0 1						110
	F	orested/Wetland	land Urban Agriculture Other (describ						be)	
Visible Landuse	(%)	15	0 85 0							
								_		
Upstream NPDES Di	schargers (>	1MGD or <1MGD a	ind within 1 mile	<del>)</del>			NPDES Nur	nber	Volun	ie (MGD)
		None								
Water Quality Param	eters						Site P	hotograph		
Temperature (°C)		15.4						E alte	5 - C - C - C - C - C - C - C - C - C -	的复数数字
Dissolved Oxygen (mg	g/L)	8.8						- Carlos		
Specific Conductance	e (µS/cm)	27	STR.			2		-		
pH (s.u.)		5.5	10.1	14-25	The party	1 provide	40.a.	- and the state		1.1.1
				1	St. IS	1.	adapted and a second second	Alexander		
Water Clarity		Clear	1000	and a			and the second	- SHERE		
			and the second	Sec.			The second			
Habitat Assessment	Scores (max	x)		Sec.					and the second	
Channel Modification	(5)	5	and the second			10				
Instream Habitat (20)		18								Mar Contract
Bottom Substrate (15)	)	6				the factor		antis topo		
Pool Variety (10)		8		- 30				A DAY		
Riffle Habitat (16)		16		一月里		The states				
Left Bank Stability (7)		5	10 million		a children		and and a			Salar and an
Right Bank Stability (7	7)	4			ALL ALL		- Andrew			and a
Light Penetration (10)		7		Catol S	5 10	-1-1-	A start of	Contract of the second	Car	
Left Riparian Score (5	5)	2			- Call		- a chi			
Right Riparian Score	(5)	2								
Total Habitat Score (	(100)	73	Sub	strate	Cobble, gr	avel, sa	and, and silt			
				-						
Sample Date	)	Sample	ID	Spe	cies Total	-	NC	BI	Bioclas	sification
06/13/07		2007-7	5		21		56	) }		bood
06/03/02		2002-6	2		20		50	J		1000
Most Abundant Spe	ecies	Mottled Sculpin	n and Central Sto	oneroller	Exotic \$	Specie	s Rosy and I	side Dace, Raint Redbreast Sunfis	oow Trout, E h.	rown Trout,
Species Change Sin	ce Last Cycle	Gains -	- Rosyside Dace	, Tennesse	ee Shiner, F	Rainbov	w Trout, and G	reenside Darter.	Losses I	Virror Shiner,

Bluegill, and Redline Darter.

#### Data Analysis

Watershed -- a small tributary to the Little River; drains eastern Transylvania County; no municipalities in the rural agricultural and forested watershed; site is ~ 1.4 miles above the creek's confluence with the river. Habitat -- eroding banks with narrow riparian zones; shallow riffles common, but embedded; snags and deadfalls; some quality deep snag pools where large trout and suckers were found; cattle with access to the stream on the left. 2007 -- low conductivity; low pH measurement was verified; percentage of tolerant fish (Creek Chub, White Sucker, and Redbreast Sunfish) was much greater than expected; a very diverse community for a stream of its size; large specimens of Golden Redhorse and wild Rainbow Trout and Brown Trout. 2002 & 2007 -- conductivity was low for an agricultural area; an abundant and very diverse community; 24 species known from the site including 9 species of cyprinids, 5 species of darters, and 3 intolerant species; slightly greater score in 2007 than in 2002; dominant species has been the Central Stoneroller and Saffron Shiner.

Waterbody		Locati	Location		Station ID		Date	Bioclassification
BOYLSTO	N CR	SR 13	814	EB1	59	80	8/15/07	GOOD-FAIR
County	Subbasin	8 digit HUC	Latitude	Longitud	e AUI	Number	L	evel IV Ecoregion
Henderson	3	06010105	352231	823301	6-5	2-(6.5)		Broad Basins
Stream Classifica	Stream Classification Drainage		) Elev	ation (ft)	Stre	Stream Width (m)		Stream Depth (m)
С		16		2072		8		0.1
	F	prested/Wetland	Urban		Agricul	ture		Other (describe)
Visible Landuse	(%)	10	30		60			0
Upstream NPI	DES Discharg	gers (>1MGD or <1M	GD and withir	n 1 mile)	N	DES Nun	nber	Volume (MGD)
		None						
Water Quality Parame	eters					Site Pho	tograph	
Temperature (°C) Dissolved Oxygen (mo	a/L)	22.4						
Specific Conductance	(µS/cm)	43				Start N		
pH (s.u.)		7				和此中		
Water Clarity		clear						The See
Habitat Assessment	Scores (max)	)		Call Call				State and the
Channel Modification (	(5)	5				100		
Instream Habitat (20)		16		WE ALL DE	a alter a	And the owner of the owner owner owner owner owner owner own		(s. 19.20)
Bottom Substrate (15)		6		Charles .		-		
Pool Variety (10)		8	100	Sec. 1				All and and a second se
Riffle Habitat (16)		12	and the second	the states	2.122	the second		
Left Bank Stability (7)		5		-18 MA	10 11 11	1.	and the	and the second s
Right Bank Stability (7	)	4	- STA			-	- Sub-sec	All the second second
Light Penetration (10)		10		And the second	- martin			
Left Riparian Score (5)	)	1	and the second	A starting	Star 1			
Right Riparian Score (	5)	2						

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification	
08/15/07	10329		22		4.0	Good-Fair	
07/22/02	8830	62	26	4.9	3.7	Good-Fair	
07/21/97	7332	71	23	5.5	4.4	Good-Fair	
07/07/92	5880		26		4.7	Good-Fair	

primarily sand and gravel, some cobble: silty

Substrate

69

### **Taxonomic Analysis**

Total Habitat Score (100)

EPT richness in Boylston Creek fell by 4 taxa in 2007. However, an abbreviated EPT collection was employed because of time constraints. Abundant taxa collected were moderately intolerant (the mayfly *Isonychia* sp. and the caddisfly *Triaenodes ignitus*) to tolerant (the mayfly *Maccaffertium modestum* and the hydropsychid caddisfly *Cheumatopsyche* sp.). Intolerant taxa were low in abundance and included the mayflies *Heptagenia marginalis*, *Serratella deficiens*, and *Stenacron pallidum*; the stonefly *Acroneuria abnormis* and the caddisflies *Brachycentrus nigrosoma* (1st site collection), *Glossosoma* sp., *Neophylax consimilis* and *Pycnopsyche lepida*.

### Data Analysis

The highly developed Boylston Creek catchment primarily drains agricultural fields and urban areas. Despite the abbreviated EPT method, this creek maintains its Good-Fair rating. The highly urban environment is likely responsible for the lower water quality in this stream as no NPDES permitted dischargers exist on this stream. Agricultural irrigation is prevalent in this area possibly allowing many pollutants to enter the stream even during low precipitation years. The lack of good riparian vegetation and erosion also contribute to the Good-Fair rating.

Waterboo	Waterbody		Location			Date		Bioclassification
MILLS	R	SR 13	337	EB1	67	30	8/15/07	GOOD
County	Subbasin	8 digit HUC	Latitude	Longitude	AUI	Number	Lev	vel IV Ecoregion
Henderson	3	06010105	352355	823542	6-5	54-(1)b	Southern Cryst	alline Ridges and Mountains
Stream Classifica	ition I	Drainage Area (mi <sup>2</sup>	) Elev	vation (ft)	Stre	am Width	(m)	Stream Depth (m)
WS-II; Tr, HQW	V	67		2130		23		0.2
	Fo	ested/Wetland	Urban	I	Agricul	ture	O	ther (describe)
Visible Landuse	(%)	50	50		0			0
Upstream NPE	DES Discharge	ers (>1MGD or <1M	IGD and withir	n 1 mile)	N	PDES Nur	nber	Volume (MGD)
		None						
Water Quality Parame	eters					Site Pho	otograph	
Temperature (°C)		21.5						A CARLER ST
Dissolved Oxygen (mg	g/L)						1. 1. 1. 1. 1.	
Specific Conductance	(µS/cm)	18			the sea	1.4		- a ferral to the
pH (s.u.)		7.2	-	* *			A. SIST	ALC: NO
Water Clarity		clear	1			- 42	Ant's	No. 2
Habitat Assessment	Scores (max)						1000 March 1000	
Channel Modification (	(5)	5		- 4- 4- 4-			A	
Instream Habitat (20)		16		State State				
Bottom Substrate (15)		13		1. 10	-04	2.	Har	
Pool Variety (10)		6		and the second			No. Company	the second
Riffle Habitat (16)		14			-	Bord &	Contraction of the local division of the loc	and the second second
Left Bank Stability (7)		7	-	2 200	1.00			
Right Bank Stability (7	)	6		1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-				
Light Penetration (10)		9	1000	or the	1.000	1	ARR CAL	
Left Riparian Score (5)	)	2		A state of	100		- Contra	SAME AND THE PARTY

Total Habitat Score (100)	82	82 Substrate			boulder, cobble, and gravel; silty				
Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification			
08/15/07	10294	89	34	4.4	2.8	Good			
06/25/02	8833	74	39	4.4	3.1	Good			
07/21/97	7330	115	53	3.5	2.4	Excellent			
07/08/92	5881	88	51	3.2	2.3	Excellent			

4

#### **Taxonomic Analysis**

Right Riparian Score (5)

Fewer EPT taxa were collected in 2007 than in any other year. The decrease in EPT richness was small since 2002 (5 EPT) but dramatc since 1997 (19 EPT). This decrease is due, in part, to the fewer number of mayflies and stoneflies collected in 2007. In fact, stoneflies have decreased in diversity and abundance since monitoring began, dropping from 9 taxa in 1992 to 3 in 2007 with no abundant species. Also, ephemerellid mayflies were almost completely absent, represented only by a single *Serratella serratoides* specimen. None of the 5 species of *Drunella* previously collected occured. Abundant intolerants that were found included *Neoephemera purpurea*, *Maccaffertium pudicum*, *Brachycentrus appalachia*, *Lepidostoma* sp. and *Neophylax oligius*. An increase of tolerant midge taxa occured concurrently with the drop in EPT and were represented by the abundant *Polypedilum aviceps*, *P. flavum*, *Tribelos jucundum*, and *Chironomus* sp.

#### **Data Analysis**

This site was sampled a little over a mile downstream of the confluence of the HQW waters of North Fork and South Fork Mills Rivers. Some intensive agriculture surrounds Mills River and may be contributing to the decrease of water quality seen over the past 10 years by contributing silt to the stream. A large fish kill attributed to pesticide runoff occurred in late July in the South Fork Mills River. The benthos was negatively affected (see BAU memo 20070925), particularly the stoneflies. Lingering effects of that toxic event are likely resposible for the decrease in EPT observed in 2007. Furthermore, indicative of worsening water quality is the increase in the biotic index which changed most dramatically between 1997 and 2002 when the bioclassification fell from Excellent to Good.

Waterbo	dy	Location		Station ID		Date		Bioclassification
MILLS	R	SR 13	353	EB1	68	30	8/15/07	GOOD
County	Subbasin	8 digit HUC	Latitude	Longitude	AU I	AU Number		vel IV Ecoregion
Henderson	3	06010105	352316	823246	6-	54-(5)		Broad Basins
Stream Classifica	ream Classification Drainage		) Elev	Elevation (ft)		Stream Width (m)		Stream Depth (m)
WS-III		73		2066		11		0.3
	Fo	rested/Wetland	Urban		Agricul	ture	0	ther (describe)
Visible Landuse	(%)	0	0		100			0
Upstream NPI	DES Discharge	ers (>1MGD or <1M	IGD and within	n 1 mile)	NF	DES Nur	nber	Volume (MGD)
	enderson WTP				NC00422	77	0.18	
Water Quality Param				Site Pho	tograph			
Temperature (°C)		24.9	10 m	and the second				
Dissolved Oxygen (mg	g/L)			Contraction of	A CAN	1 de		A DECK AND A DECK
Specific Conductance	(µS/cm)	22	1.40					
pH (s.u.)		8.2	and the second	ALCONT NO.		Bit in		
Water Clarity		clear		and and				
Habitat Assessment	Scores (max)		a second	S ST	100		The last	
Channel Modification	(5)	4	and the second	- Contractor	-		- Landar	1 A ANNES
Instream Habitat (20)		15			water in the second			
Bottom Substrate (15)		11					Service Service	
Pool Variety (10)		6		-	-	- and		
Riffle Habitat (16)		10			- Test	10.00		
Left Bank Stability (7)		6		1.1.1.1	1.2.5		and the second	A STATISTICS
Right Bank Stability (7	.)	6			12050	and the set	Care in	State State
Light Penetration (10)		7	1	The state	100	STAT O	All and	
Left Riparian Score (5	)	1		A Store	and a	and and		and the state of the
Right Riparian Score (	(5)	1						

Total Habitat Score (100)	67	67 Substrate			sand, gravel, and cobble; silty				
Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification			
08/15/07	10328	72	33	4.5	3.1	Good			
06/24/02	8831	58	28	5.5	4.0	Good-Fair			
07/01/98	7773	19	2	6.7	6.0	Poor			
07/21/97	7329	78	24	5.2	3.3	Good-Fair			
07/08/92	5882	81	24	4.2	3.1	Good			

### **Taxonomic Analysis**

The addition of 5 caddisfly taxa was responsible for the increase in EPT richness to 33 from the 2002 level of 28. Five intolerant taxa were abundant in 2007 (4 caddisflies, Brachycentrus appalachia, B. nigrosoma, Ceratopsyche sparna, Lepidostoma sp. and one mayfly, Neoephemera purpurea) compared to only one intolerant taxon in 2002 (Brachycentrus nigrosoma). Only one individual stonefly specimen (Pteronarcys sp.) was collected in 2007, the least amount since none were collected in 1998, a year Mills River at SR 1353 received a Poor bioclassification rating. New taxa collected in 2007 were Drunella allegheniensis, Heptagenia marginalis, and Oecetis persimilis.

### **Data Analysis**

Approximately 4 miles downstream of the Mills River sampling site at SR 1337, this site passes through an intensive agricultural area with active pesticide mixing stations. Mills River At SR 1353 has historically had extremely variable water quality with bioclasification ratings ranging from Poor to Good. Silty pools, a result of agricultural activity, were evident as they were in the upstream site. Pesticide runoff (late July 2007, see BAU memo 20070925) far upstream impacted this portion of Mills river less than at SR 1337, most likely due to increased dilution by various minor dischargers and additional tributaries. It appears that water quality has improved since 2002 based on the EPT richness and lower biotic index, although, because of the variable nature of this site, it will require further monitoring.

Waterbody			Location		Date	)	Station II	О Е	Bioclassifi	cation
N FK MILLS	R	5	SR 1341		06/13	/07	EF69		Excell	ent
				_						_
County S	ubbasin	8 digit HUC	Latitude	Long	itude		AU Number	L	evel IV Ec	oregion
HENDERSON	3	06010105	35.393889	-82.62	24444		6-54-2-9	Southern C	rystalline F	Ridges & Mountains
Stream Classification	Draina	ago Aros (mi2)	Elevatio	on (ft)	Stroa	m Wie	dth (m)	Average Depth	(m)	Poforonco Sito
	Draine	23.1	218	5	Juea	14				Ves
WO-II, II, IIQW		20.1	210	2100				0.4		163
	Fores	sted/Wetland	Url	oan		Ag	riculture	(	Other (des	cribe)
Visible Landuse (%)		35	15 (rural r	esidential)		50 (I	row crops)		0	
Unstream NDDES Disaba			al within 4 mile					lumb or	Val	
Opsilealli NPDES Discilai	gers (>nwc	None		;)			NFDE3 I		VO	
Water Quality Parameters							Site	e Photograph		
Temperature (°C)		17.4		alter	4				and the second	The set
Dissolved Oxygen (mg/L)		8.9					1. 1.	Contraction of the second	1	all the state
Specific Conductance (µS/d	cm)	16				80	S.V. Cale			C. M. C.
pH (s.u.)		5.6			diaman and			Section 200		a start of the
							the star	A LAND		
Water Clarity		Clear	- Philad				and the second	Strank?"	1.91	
			1		12			and the second s	17	
Habitat Assessment Score	es (max)		Section.		Re		-			State State
Channel Modification (5)		5			718			e totale		A Provide L
Instream Habitat (20)		19		-	- 4540	THE .	The state	1		The second second
Bottom Substrate (15)		15			1	- Care			1.1	and the second s
Pool Variety (10)		4		Long Hard			Contraction of the			THE THE
Riffle Habitat (16)		16						the state when		the to
Left Bank Stability (7)		6	5877 - C	-	and the second	1231	STATISTICS AND STATISTICS	and the second	- illing	Section of the sectio
Right Bank Stability (7)		6	e santis	BAR IN		74	6.9	2200	N PELLIN	a hard and the second
Light Penetration (10)		5		Ed. and		a de	ABA	All some side to	C. A. C.	and the second
Left Riparian Score (5)		3	2		F.A.F.	A.	AL SAN		S SAME	Statistics and statistics
Right Riparian Score (5)		2								
Total Habitat Score (100)		81	Sub	strate	Cobble ar	nd bou	ulder			
Sample Date		Sample I	D	Spe	cies Total		I	NCIBI	Biod	assification
06/13/07		2007-77			21			60		Excellent
Most Abundant Species		Mottled Sculpin			Exotic	Spec	ies R	ainbow Trout, Brov unfish	vn Trout, a	nd Redbreast
Species Change Since La Data Analysis	st Cycle	N/A								

This is the first fish community sample collected at this site. **Watershed** -- a large tributary to the Mills River and ultimately the French Broad River, drains northwest Henderson County, including the U.S. Forest Service's Pisgah National Forest; NCWRC Wild Trout Waters and Delayed Harvest Trout Waters in the headwaters; no municipalities in the watershed. **Habitat** -- primarily extensive, swift riffles; infrequent shallow pools; right riparian zone with tomato farms and other row crops (corn), left riparian zone with a residence; open canopy, but banks were stable. **2007** -- very low conductivity; low pH was a verified reading; a diverse and an abundant community, including 8 species of cyprinids and 6 species of darters; site is a popular local fishing stream.

S FK MILLS R     SR 1340     06/13/07     EF68     Good       County     Subbasin     8 digit HUC     Latitude     Longitude     AU Number     Level IV Ecoregion       HENDERSON     3     06010106     35.37555     -32.614167     6-54-3:(17.5)     Southern Crystalline Ridges & Mountaing       Stream Classification     Drainage Area (m2)     Elevation (t)     Stream Width (m)     Average Depth (m)     Reference Site       WS-II,Tr, HOW     39.6     2180     11     0.5     Yes       Visible Landuse (%)     Forested/Wetland     Urban     Agriculture     Other (describe)       Upstream NPDES Dischargers (>1MOD or <1MOD and within 1 mile)     NPDES Number     Volume (MGD)       Camp Highlander (-1.000 ft, upstream)     0.0074     0.0074       Water Quality Parameters     Eife 1     0.3     0.0074       Dissolved Oxygen (mg/L)     16.1     0.3     0.0074       Specific Conductance (µSCm)     15     19     0.0074       Habitat Assessment Scores (max)     5     19     15       Channel Modification (f)     6     19     5       Southards (f)     6     3     3     10       Lift Phantan Score (f)     3     3     10     10       Lift Phantan Score (f)     3     3<	Waterbo	ody			Location		Date	Statior	n ID	Bioclas	sification
County         Subbasin         8 digit HUC         Latitude         Longitude         AU Number         Level IV Eccregion           HENDERSON         3         06010106         35.375555         -42.614167         6-54-3:(17.5)         Southern Crystalline Ridges & Mountaing           Stream Classification         Drainage Area (mi2)         Elevation (tt)         Stream Width (m)         Average Depth (m)         Reference Site           WS-II,Tr, HOW         39.6         2180         11         0.5         Yes           Visible Landuse (%)         5         15 (rural residential)         50 (pasture)         0           Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	S FK MIL	LLS R		S	SR 1340		06/13/07	EF6	8	Go	bod
HENDERSON         3         06010105         35.375555         -82.614167         6-84-3-(17.5)         Southern Crystalline Ridges & Mountains           Stream Classification         Drainage Area (mi2)         Elevation (ft)         Stream Width (m)         Average Depth (m)         Reference Site           WS-II,Tr, HOW         39.6         2180         11         0.5         Yes           Forested/Wetland         Urban         Agriculture         Other (describe)         0           Visible Landuse (%)         35         15 (urail residential)         50 (pasture)         0         0           Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	County	Subb	asin	8 digit HUC	Latitude	Long	itude	AU Numb	er	Level IV	Ecoregion
Stream Classification         Drainage Area (mi2)         Elevation (ft)         Stream Width (m)         Average Depth (m)         Reference Site           WS-II,Tr, HOW         36         2180         11         0.5         Yes           Visible Landuse (%)         35         15 (rural residential)         50 (pasture)         0           Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	HENDERSON	3		06010105	35.375555	-82.61	4167	6-54-3-(17	.5) So	Southern Crystalline Ridges & Mountair	
WS-II,Tr, HQW       39.6       2180       11       0.5       Yes         Forested/Wetland       Urban       Agriculture       Other (describe)         Visible Landuse (%)       35       15 (rural residential)       50 (pasture)       0         Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	Stream Classifica	tion	Draina	ge Area (mi2)	Elevatio	n (ft)	Stream W	idth (m)	Avera	ge Depth (m)	Reference Site
Forested/Wetland       Urban       Agriculture       Other (describe)         Visible Landuse (%)       35       15 (rural residential)       50 (pasture)       0         Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	WS-II;Tr, HQW	'		39.6	2180	)	11			0.5	Yes
Visible Landuse (%)       35       15 (rural residential)       50 (pasture)       0         Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)			Fores	ted/Wetland	Urb	an	A	griculture		Other (o	lescribe)
Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile) NPDES Number Volume (MGD) Camp Highlander (-1.000 ft. upstream) NC003251 0.0074 Water Quality Parameters Site Photograph Temperature (°C) 16.1 Dissolved Oxygen (mg/L) Specific Conductance (µS/cm) 6.3 Water Clarity Clear Habitat Assessment Scores (max) Channel Modification (5) 5 Instream Habitat (20) 19 Bottom Substrate (15) 15 Pol Variey (10) 6 Riffle Habitat (16) 16 Riffle Habitat Score (100) 17 Riffle Habitat Score (100) 18 Riffle Riffle Habitat (16) 16 Riffle Habitat Score (100) 18 Riffle Riffle Riffle Riffle Hab	Visible Landuse	(%)		35	15 (rural re	esidential)	50	) (pasture)		•	0
Camp Highlander (~1,000 ft. upstream)         NC0033251         0.0074           Water Quality Parameters         Site Photograph           Temperature (*C)         16.1         9.3           Dissolved Oxygen (mg/L)         9.3         13           Specific Conductance (µS/cm)         16.3         13           Water Clarity         Clear         6.3           Habitat Assessment Scores (max)         5           Channel Modification (5)         5           Instream Habitat (20)         19           Bottom Substrate (15)         6           Pool Variety (10)         6           Riffe Habitat (16)         16           Left Bank Stability (7)         6           Right Bank Stability (7)         6           Right Reparian Score (5)         3           Right Reparian Score (5)         3           Right Reparian Score (5)         87           Stubstrate         Cobble and boulder           Sample Date         Sample D         Species Total         NCIBI           Matted Sculpin and Saffron Shiner         Exotic Species         Brown Trout and Redbreast Sunfish           Ok/13/07         2007-76         19         56         Good           Mottled Sculpin and Saffron Shiner	Upstream NPDES Dis	scharger	s (>1MG	D or <1MGD ar	nd within 1 mile	)		NPDE	S Number	,	Volume (MGD)
Site Photograph         Temperature (°C)       16.1         Dissolved Oxygen (mg/L)       9.3         Specific Conductance (µS/cm)       13         pH (s.u.)       6.3         Water Clarity       Clear         Habitat Assessment Scores (max)       5         Instream Habitat (20)       19         Bottom Substrate (15)       15         Pol Variey (10)       6         Riffle Habitat (16)       16         Light Panetration (10)       6         Right Riparian Score (5)       3         Total Habitat Score (100)       87         Sample Date       Sample ID       Species Total       NCIBI       Bioclassification         06/13/07       2007-76       19       56       Good         Most Abundant Species       Mottled Sculpin and Satfron Shiner       Exotic Species       Brown Trout and Redbreast Sunfish         Disc Change Since Last Cyce       Iv/A       Exotic Species       Brown Trout and Redbreast Sunfish		Camp	b Highlan	der (~1,000 ft. ι	ıpstream)			NCC	033251		0.0074
Temperature (°C)       16.1         Dissolved Oxygen (mg/L)       9.3         Specific Conductance (µS/cm)       13         PH (s.u.)       6.3         Water Clarity       Clear         Habitat Assessment Scores (max)       5         Channel Modification (5)       5         Instream Habitat (20)       19         Bottom Substrate (15)       15         Pool Variety (10)       6         Right Bank Stability (7)       6         Light Penetration (10)       8         Left Riparian Score (5)       3         Total Habitat Score (100)       87         Sample Date       Sample ID       Species Total       NCIBI       Bioclassification         06/13/07       2007-76       19       56       Good         Most Abundant Species       Mottled Sculpin and Saffron Shiner       Exotic Species       Brown Trout and Redbreast Sunfish         Species Change Since Last Cycle       NA       Data Analysis	Water Quality Param	eters						Ş	Site Photog	jraph	
Dissolved Oxygen (mg/L) Specific Conductance (µS/cm) pH (s.u.) Water Clarity Clear Habitat Assessment Scores (max) Channel Modification (5) Instream Habitat (20) Bottom Substrate (15) Pool Variety (10) Kiffle Habitat (16) Left Bank Stability (7) Kight Penetration (10) Left Riparian Score (5) Right Riparian Score (5) Sample Date Sample Dat	Temperature (°C)			16.1				12.12			
Specific Conductance (µS/cm)       13         pH (s.u.)       6.3         Water Clarity       Clear         Habitat Assessment Scores (max)	Dissolved Oxygen (mg	g/L)		9.3		1.10		152			
pH (s.u.)       6.3         Water Clarity       Clear         Habitat Assessment Scores (max)	Specific Conductance	(µS/cm)		13		1044					and a start
Water Clarity       Clear         Habitat Assessment Scores (max)       Image: Channel Modification (5)       5         Channel Modification (5)       5       19         Instream Habitat (20)       19       15       15         Pool Variety (10)       6       16       16       16       16         Left Bank Stability (7)       6       3       3       16       17       18         Right Bank Stability (7)       6       3       3       18	pH (s.u.)			6.3					E PAL		
Water Clarity       Clear         Habitat Assessment Scores (max)       5         Channel Modification (5)       5         Instream Habitat (20)       19         Bottom Substrate (15)       15         Pol Variety (10)       6         Riffhe Habitat (16)       16         Left Bank Stability (7)       6         Light Penetration (10)       8         Left Riparian Score (5)       3         Right Riparian Score (5)       3         Stability Core (100)       87         Substrate       Cobble and boulder         Sample Date       Sample ID       Species Total       NCIBI       Bioclassification         06/13/07       2007-76       19       56       Good         Most Abundant Species       Mottled Sculpin and Saffron Shiner       Exotic Species       Birown Trout and Redbreast Sunfish         Species Change Since Last Cycle       N/A       Data Analysis						2 44	Sector.	Sec.		and the states	A AL MARK
Habitat Assessment Scores (max)         Channel Modification (5)       5         Instream Habitat (20)       19         Bottom Substrate (15)       15         Pool Variety (10)       6         Riffle Habitat (16)       16         Left Bank Stability (7)       6         Light Penetration (10)       8         Left Riparian Score (5)       3         Total Habitat Score (100)       87         Sample Date       Sample ID         Sample Date       Sample ID         O6/13/07       2007-76       19         06/13/07       2007-76       19       56         Most Abundant Species       Mottled Sculpin and Saffron Shiner       Exotic Species       Brown Trout and Redbreast Sunfish         Species Change Since Last Cycle       N/A       Data Analysis       Data Analysis	Water Clarity			Clear		Sec.	and the second	A CAR		Allerer	
Habitat Assessment Scores (max)         Channel Modification (5)       5         Instream Habitat (20)       19         Bottom Substrate (15)       15         Pool Variety (10)       6         Riffle Habitat (16)       16         Left Bank Stability (7)       6         Light Penetration (10)       8         Left Riparian Score (5)       3         Total Habitat Score (100)       87         Sample Date       Sample ID         Sample Date       Sample ID         Most Abundant Species       Mottled Sculpin and Saffron Shiner         Kottel Sculpin and Saffron Shiner       Exotic Species         Brown Trout and Redbreast Sunfish         Species Change Since Last Cycle       Iv/A							ALL SAR	10			a la filler alte
Channel Modification (5)       5         Instream Habitat (20)       19         Bottom Substrate (15)       15         Pool Variety (10)       6         Riffle Habitat (16)       16         Left Bank Stability (7)       6         Light Penetration (10)       8         Left Riparian Score (5)       3         Total Habitat Score (100)       87         Sample Date       Sample ID         Sample Date       Sample ID         Of/13/07       2007-76       19         Most Abundant Species       Mottled Sculpin and Saffron Shiner       Exotic Species         Species Change Since Last Cycle       N/A         Data Analysis       N/A	Habitat Assessment	Scores (I	max)		14						and the second
Instream Habitat (20) 19 Bottom Substrate (15) 15 Pool Variety (10) 6 Riffle Habitat (16) 16 Left Bank Stability (7) 6 Right Bank Stability (7) 6 Light Penetration (10) 8 Left Riparian Score (5) 3 Right Riparian Score (5) 3 Total Habitat Score (100) 87 Sample Date Sample ID Species Total NCIBI Bioclassification 06/13/07 2007-76 19 56 Good Most Abundant Species Mottled Sculpin and Saffron Shiner Exotic Species Brown Trout and Redbreast Sunfish Species Change Since Last Cycle N/A	Channel Modification	(5)		5		ens 7	ANS P				State and
Bottom Substrate (15) 15 Pool Variety (10) 6 Riffle Habitat (16) 16 Left Bank Stability (7) 6 Right Bank Stability (7) 6 Light Penetration (10) 8 Left Riparian Score (5) 3 Right Riparian Score (5) 3 Right Riparian Score (5) 3 Total Habitat Score (100) 87 Sample Date Sample ID Species Total NCIBI Bioclassification 06/13/07 2007-76 19 56 Good Most Abundant Species Mottled Sculpin and Saffron Shiner Exotic Species Brown Trout and Redbreast Sunfish Species Change Since Last Cycle N/A	Instream Habitat (20)			19		august.	HANN N			and the second	and the second s
Pool Variety (10)       6         Riffle Habitat (16)       16         Left Bank Stability (7)       6         Light Penetration (10)       8         Left Riparian Score (5)       3         Right Riparian Score (5)       3         Total Habitat Score (100)       87         Sample Date       Sample ID         Sample Date       Sample ID         O6/13/07       2007-76         19       56         Good         Most Abundant Species       Mottled Sculpin and Saffron Shiner         Exotic Species Change Since Last Cycle       N/A	Bottom Substrate (15)	)		15		and the second	and the	and serve	All		Ser. March
Riffle Habitat (16)       16         Left Bank Stability (7)       6         Right Bank Stability (7)       6         Light Penetration (10)       8         Left Riparian Score (5)       3         Right Riparian Score (5)       3         Sample Date       Sample ID         Sample Date       Sample ID         06/13/07       2007-76         19       56         Good         Most Abundant Species       Mottled Sculpin and Saffron Shiner         Exotic Species       Brown Trout and Redbreast Sunfish	Pool Variety (10)			6		Ex S		E.			and the state
Left Bank Stability (7)       Image: Bank Stability (7)     6       Right Bank Stability (7)     6       Light Penetration (10)     8       Left Riparian Score (5)     3       Right Riparian Score (5)     3       Total Habitat Score (100)     87       Sample Date     Sample ID       Sample Date     Sample ID       O6/13/07     2007-76       19     56       Good       Most Abundant Species       Mottled Sculpin and Saffron Shiner       Exotic Species       Brown Trout and Redbreast Sunfish       Species Change Since Last Cycle       N/A	Riffle Habitat (16)			16	-> X412.	th-			and the		and the second second
Right Bank Stability (7)       6         Light Penetration (10)       8         Left Riparian Score (5)       3         Right Riparian Score (5)       3         Total Habitat Score (100)       87         Sample Date       Sample ID         Sample Date       Sample ID         Ob/13/07       2007-76         Most Abundant Species       Mottled Sculpin and Saffron Shiner         Exotic Species       Brown Trout and Redbreast Sunfish         Species Change Since Last Cycle       N/A	Left Bank Stability (7)			6	a same		- A	1 3 2 3	06/12	Aller Conner	the second second
Light Penetration (10)       8         Left Riparian Score (5)       3         Right Riparian Score (5)       3         Total Habitat Score (100)       87         Sample Date       Sample ID         Sample Date       Sample ID         O6/13/07       2007-76         Most Abundant Species       Mottled Sculpin and Saffron Shiner         Exotic Species       Brown Trout and Redbreast Sunfish         Species Change Since Last Cycle       N/A	Right Bank Stability (7	7)		6	" m			and the second		你不不是!	
Left Riparian Score (5)       3         Right Riparian Score (5)       3         Total Habitat Score (100)       87         Sample Date       Sample ID         Sample Date       Sample ID         O6/13/07       2007-76         Most Abundant Species       Mottled Sculpin and Saffron Shiner         Exotic Species       Brown Trout and Redbreast Sunfish         Species Change Since Last Cycle       N/A	Light Penetration (10)			8				- Party		H. Sa	
Bight Riparian Score (5)       3         Total Habitat Score (100)       87       Substrate       Cobble and boulder         Sample Date       Sample ID       Species Total       NCIBI       Bioclassification         06/13/07       2007-76       19       56       Good         Most Abundant Species       Mottled Sculpin and Saffron Shiner       Exotic Species       Brown Trout and Redbreast Sunfish         Species Change Since Last Cycle       N/A         Data Analysis       N/A	Left Riparian Score (5	)		3		100		2.20%		the state	States and
Start       Substrate       Cobble and boulder         Sample Date       Sample ID       Species Total       NCIBI       Bioclassification         06/13/07       2007-76       19       56       Good         Most Abundant Species       Mottled Sculpin and Saffron Shiner       Exotic Species       Brown Trout and Redbreast Sunfish         Species Change Since Last Cycle       N/A         Data Analysis       N/A	Right Riparian Score (	(5)		3	_						
Sample DateSample IDSpecies TotalNCIBIBioclassification06/13/072007-761956GoodMost Abundant SpeciesMottled Sculpin and Saffron ShinerExotic SpeciesBrown Trout and Redbreast SunfishSpecies Change Since Last CycleN/AV/AData AnalysisN/A	Total Habitat Score (	100)		87	Subs	strate	Cobble and bo	bulder			
06/13/07     2007-76     19     56     Good       Most Abundant Species     Mottled Sculpin and Saffron Shiner     Exotic Species     Brown Trout and Redbreast Sunfish       Species Change Since Last Cycle     N/A     V/A       Data Analysis     V/A	Sample Date	•		Sample II	D	Spe	cies Total	-	NCIBI	В	ioclassification
Most Abundant Species       Mottled Sculpin and Saffron Shiner       Exotic Species       Brown Trout and Redbreast Sunfish         Species Change Since Last Cycle       N/A       Image: Comparison of the second sec	06/13/07			2007-76			19		56		Good
Species Change Since Last Cycle     N/A       Data Analysis     Image: Comparison of the second sec	Most Abundant Spe	ecies		Mottled Sculpin	and Saffron Shi	ner	Exotic Spe	cies	Brown Tro	ut and Redbreast	Sunfish
Data Analysis	Species Change Sind	ce Last C	ycle	N/A							
	Data Analysis	_	-								

This is the first fish community sample collected at this site. **Watershed** -- a large tributary to the Mills River and ultimately the French Broad River; drains northwest Henderson County, including the U.S. Forest Service's Pisgah National Forest; no municipalities in the watershed; NCWRC Wild Trout Waters in the headwaters. **Habitat** -- very rocky with very swift deep runs, riffles, and chutes; open canopy at the bridge; residences being built within the riparian zones; overall, water was deep and fast considering the area was supposed to be in a drought. **2007** -- very low conductivity; a diverse and abundant community, including 8 species of cyprinids and 5 species of darters; percentage of insectivores slightly skewed (88%) and prevented the community from being rated Excellent; Rainbow Trout represented only by young-of-year; site was sampled six weeks prior to a fish kill caused by pesticide runoff from adjacent agricultural lands (Biological Assessment Unit Memorandum BAU B-20070925).

Waterbo	dy	Locati	on	Static	on ID		Date	Bioclassification
MUD (	CR	US 2	25	EB1	123	30	8/15/07	Fair
County	Subbasin	8 digit HUC	Latitude	Longitud	le AU	Number	Lev	el IV Ecoregion
HENDERSON	2	06010105	352315	823015	6	6-55d		Broad Basins
Stream Classifica	ation [	Drainage Area (mi2	2) Elev	vation (ft)	Stre	am Width	(m)	Stream Depth (m)
С		110		2040		16		1
	Fo	rested/Wetland	Urban		Agricul	ture	O	ther (describe)
Visible Landuse	(%)	50	50		0			0
Upstream NP	DES Discharge	ers (>1MGD or <1N	IGD and withir	n 1 mile)	N	PDES Nun	nber	Volume (MGD)
Hendersonville WWT	Ρ					NC002553	34	6.0
Mountain View WWTF	P					NC00741	10	0.005
Water Quality Param	eters					Site Pho	tograph	
Temperature (°C)		22.1	2		NS THE	11-2-10	and the fight	
Dissolved Oxygen (mg	g/L)	6.1	100	10		Sec. 4		
Specific Conductance	e (µS/cm)	97	28 1			्रिक्स्		
pH (s.u.)		6.6	2	a la la	***	S.A.		J the second second second
Water Clarity		slightly turbid		1. E		12		
Habitat Assessment	Scores (max)		- All	APA				
Channel Modification	(5)	5	all a	C. S. S.				
Instream Habitat (20)		14	100		$\leq 1.7$	100 - 117 - 117 - 117 - 117 - 117 - 117 - 117 - 117 - 117 - 117 - 117 - 117 - 117 - 117 - 117 - 117 - 117 - 117		TRACE AND A
Bottom Substrate (15)	)	3		States of States of States				
Pool Variety (10)		8	- 10 SM	not.		and the second	- 1. P	
Riffle Habitat (16)		7	and the second	14.3	The state	Real	2-1	
Left Bank Stability (7)		7	and the second	a set	Aler and			
Right Bank Stability (7	7)	6	-	- inge		1	- Contraction of	
Light Penetration (10)		10	100	A STREET	There	1	The state	and the second
Left Riparian Score (5	5)	3	1		200		and the set	the second second
Right Riparian Score	(5)	2	1 and	-	The state	1 mg mg	The states	Contraction of the local division of the loc
Total Habitat Score (	(100)	65	Substra	ate Aln	nost all sar	nd with sm	all amounts of ru	bble and gravel

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/15/07	10320	67	16	6.33	5.09	Fair
07/13/00	8178	57	10	7.06	5.71	Poor
09/09/97	7464	54	12	6.72	5.71	Fair

### **Taxonomic Analysis**

A slight decrease in the number of Baetid taxa occurred between 1997 and 2000. In 2007, the taxawere collected again along with two new Baetid taxa that had not been previously collected, *Plauditus punctiventris* and *Pseudocloeon propinquum*. In addition to new Baetid taxa, four new caddisfly taxa were also collected, *Brachycentrus nigrosoma*, *Oecetis persimilis*, *Ceratopsyche sparna* and *Triaenodes ignitus*.

## Data Analysis

Mud Creek is a tributary to the French Broad River and drains the city of Hendersonville and its metropolitan area. There are two major dischargers in the watershed above this monitoring site. This site was rated Fair in 1997, Poor in 2002, and Fair in 2007. Between year changes, however, were small and there was no evidence of any significant decline in water quality.

Waterbody		Locati	ion	Statio	n ID		Date	Bioclassification
CLEAR CF	२	SR 15	513	EB7	73	08	8/13/07	Good-Fair
County S	Subbasin	8 digit HUC	Latitude	Longitude	AU I	Number	Lev	vel IV Ecoregion
HENDERSON	2	06010105	352113	822640	6-55	5-11-(5)		Broad Basins
Stream Classificatior	n E	orainage Area (mi2	2) Elev	vation (ft)	Stre	am Width	(m)	Stream Depth (m)
С		42		2080		8		0.3
	For	ested/Wetland	Urban	1	Agricul	ture	Ot	ther (describe)
Visible Landuse (%)		25	0		75			0
Upstream NPDES	Discharge	rs (>1MGD or <1N	IGD and withir	n 1 mile)	NF	DES Nun	nber	Volume (MGD)
Greystone Subdivision					NC006879	99	0.02	
Pine Park Retirement Inn						NC006937	70	0.03
Water Quality Parameter	s					Site Pho	tograph	
Temperature (°C)		23.5					No lesso	100
Dissolved Oxygen (mg/L)		6.8	1.60		Part and	100 J	10 19 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	A STATISTICS OF A STATISTICS
Specific Conductance (µS	5/cm)	64					A CONTRACTOR	Carlos Carlos Antonio
pH (s.u.)		6.6			47-		S. Barry	or a Aller Care of
Water Clarity		turbid						N. Sac
Habitat Assessment Sco	ores (max)							
Channel Modification (5)		4	and the second se		a series		Frank Lat	and the second
Instream Habitat (20)		16						
Bottom Substrate (15)		10			A COMPANY	-	The state of the	
Pool Variety (10)		6				and the second		
Riffle Habitat (16)		16	A STREET	and a				and the second se
Left Bank Stability (7)		5				10		Charles and
Right Bank Stability (7)		3	Contraction of the second					11
Light Penetration (10)		7						
Left Riparian Score (5)		3						
Right Riparian Score (5)		2	-		Starter and	- Point	A PARA	a set of the
Total Habitat Score (100)	)	72	Substra	ate Mos	stly sand w	ith some l	ooulder, rubble, a	and gravel

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/13/07	10314		23		4.89	Good-Fair
07/12/00	8169	56	14	5.96	5.30	Fair
07/08/97	7319		8		5.11	Poor
07/07/92	5878		9		5.29	Poor

# **Taxonomic Analysis**

Taxa observed in 2007 sampling indicated an increase in mayfly and caddisfly taxa. Taxa that were common or abundant that had not been previously collected include the mayflies, Baetis pluto, Heterocloeon anoka, Pseudocloeon propinquum and Serratella deficiens; and the stonefly, Leuctra.

### **Data Analysis**

Clear Creek's watershed contains numerous apple orchards and tomato farms. Improper pesticide use was thought to be associated with water quality conditions of the creek and was intensively sampled in 2000 and 2001 as part of the Mud Creek WARP study. Data from sites that bracketed orchards suggested that orchard runoff was responsible for the change in the invertebrate communities. Since 2000, EPT taxa richness has increased indicating a slight improvement in water quality.

Waterbo	Waterbody		Location			Date		Bioclassification
CANE	CR	SR 10	06	EB6	66	80	8/13/07	Poor
County	Subbasin	8 digit HUC	Latitude	Longitude	AU I	Number	Lev	el IV Ecoregion
HENDERSON	2	06010105	352523	822958	6-5	57-(9)a		Broad Basins
Stream Classifica	ation I	Drainage Area (mi2)	) Elev	vation (ft)	Stre	am Width	(m)	Stream Depth (m)
С		80		2060		10		0.2
	Fo	rested/Wetland	Urban		Agricul	ture	Ot	ther (describe)
VISIBLE LANGUSE	(%)	20	0		0		00	(unving range)
Upstream NPI	DES Discharge	ers (>1MGD or <1M	GD and withir	n 1 mile)	NF	DES Nun	nber	Volume (MGD)
		None						
Water Quality Param	eters					Site Pho	tograph	
Temperature (°C) Dissolved Oxygen (mg	g/L)	25.6 7.7		- al				1. Al March
Specific Conductance	(µS/cm)	63		41 Ma 1 22	1.0	the starts		
pH (s.u.)		7.4	Sec.			1.1.1		
Water Clarity		turbid						
Habitat Assessment	Scores (max)				A C	11.00		
Channel Modification (	(5)	5		State State	all the second		1 1 1	
Instream Habitat (20)		16		and -				A CONTRACTOR OF
Bottom Substrate (15)		12						
Pool Variety (10)		8						and the second
Riffle Habitat (16)		10			1			
Left Bank Stability (7)		6		1	e de la		the state	
Right Bank Stability (7	.)	5	-		and the second	-	- Contraction	a freed
Light Penetration (10)		10					in the second	
Left Riparian Score (5	)	3	100				Star Contraction	
Right Riparian Score (	(5)	3	- 20 m			200		and the second

Mostly rubble and gravel with small amounts of boulder and sand **Total Habitat Score (100)** Sample Date EPT Bioclassification Sample ID ST BI EPT BI 08/13/07 10315 7 ----4.90 Poor ---08/28/03 9297 15 5.06 Fair -------07/11/02 8871 11 4.28 Fair -------07/08/97 7320 ---26 ---4.23 Good-Fair 07/07/92 5879 ----27 ----4.35 Good-Fair

Substrate

3 78

## **Taxonomic Analysis**

EPT taxa richness has declined since 1992. Mayfly taxa richness decreased from 17 taxa in 1992 to 14 taxa in 1997 to 6 taxa in 2002. In 2003, mayfly taxa richness had rebounded to 12 taxa but decreased again to 4 taxa in 2007. Stoneflies have disappeared from this site. No stoneflies were collected in 2003 or 2007 and only one taxon was collected in 2002; whereas, in previous years three (1997) or four (1992) taxa had been collected. Caddisfly taxa richness decreased from 6 taxa in 1992 to 3 taxa in 2007.

### Data Analysis

Cane Creek, a tributary to the French Broad River, drains northern Henderson and southeast Buncombe counties. Although there an no dischargers directly uspstream of this site, there are six NPDES facilities in the watershed. In addition, this site is located in a broad valley with agricultural and commercial land uses. Since 1992, the water quality has been declining. The site rated Good-Fair in 1997 and 1997, dropped to Fair in 2002 and 2003, and continued to drop in 2007 to Poor. This portion of the state experienced drought conditions in 2002 and in 2007 and could have contributed to the decline.

Waterb	ody			Location		Date	•	Station	ID	Biocla	ssification
AVERY	CR		off	SR 3498		06/12/	/07	EF6	6	Goo	od-Fair
County	Subl	basin	8 digit HUC	Latitude	Long	itude		AU Numbe	er	Level	IV Ecoregion
BUNCOMBE		2	06010105	35.456389	-82.56	68333		6-60		Bro	bad Basins
Stroom Classifica	tion	Draina	aa Araa (mi2)	Flovatio	n (ft)	Strop	m Wi	dth (m)	Avora	ao Donth (m)	Poforonco Sito
B		Diania	8 1	208	0	Silea	5		Avera		No No
			0.1	200	0		5			0.5	NU
		Fores	sted/Wetland	Url	ban		Ag	riculture		Other	(describe)
Visible Landuse	(%)		85	5 (rural re	esidential)			10			0
Upstream NPDES Di	scharge	rs (>1MO	GD or <1MGD ar	nd within 1 mile	e)			NPDES	Number		Volume (MGD)
			None								
Water Quality Param	eters							S	ite Photog	raph	
Temperature (°C)			20.8	1000	2	No. C. I	-1		a set	CONTRACT,	
Dissolved Oxygen (m	a/L)		8.3			States.					and the second
Specific Conductance	,, ∍ (uS/cm)	)	38	alt of			1-	Sec. 18	100	at 1	
pH (s.u.)	(		5.9	E H S					1000	A Sea	
							EE			and the	1 - tota
Water Clarity			Clear			a ch				1- 5	Martin and
Habitat Assessment	Scores	(max)						Sec.	A STREET	1	1 and the
Channel Modification	(5)	(,	5	4	352	)	24 -				COR.
Instream Habitat (20)	(3)		18	- second	E.A. La	)		COMPANY OF	THE REAL	Carrier 1	
Bottom Substrate (15)	)		8		- and	A. I	-				
Pool Variety (10)	/		4	a constant	100	Con 1		10-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-	and the second second	Canada and and a second	The sector
Riffle Habitat (16)			15			ELEPT		and the second	and the second	711-22	
Left Bank Stability (7)			7		1-34	「製作」 」		and and	Real Property	and and	
Right Bank Stability (7	7)		7				1	E TON	Mar .	Rame -	
Light Penetration (10)	,		10	1	CIUC	K			No. 1	and the state of	
Left Riparian Score (5	5)		4		all's !					-	
Right Riparian Score	(5)		5								
Total Habitat Score (	100)		83	Sub	strate	Sand, gra	vel, a	nd cobble.			
Sample Date	•		Sample I	D	Spe	cies Total			NCIBI		Bioclassification
06/12/07			2007-73		-	23			40		Good-Fair
Most Abundant Spe	ecies		Warpaint Shine	r and River Chu	b	Exotic	Spec	ies	Flat Bullhea Sunfish, an	ad, Redbreast d Swamp Dart	Sunfish, Green er
Species Change Sin	ce Last (	Cvcle	N/A								
Data Analysis		-,									
This is the first fish co	mmunity	sample o	collected at this	site. Watershee	d a smal	l tributary t	o the	French Broa	ad River, dr	ains the extrer	me south central portion
of Buncombe County:	rural/sul	hurbia: sti	ream is impound	ed ~ 1.6 miles i	instream h		Dam.	site is ~ 1.0	) mile above	e the creek's co	onfluence with the river

of Buncombe County; rural/suburbia; stream is impounded ~ 1.6 miles upstream by Dubose Dam; site is ~ 1.0 mile above the creek's confluence with the river. **Habitat** -- shallow and short runs and riffles; woody debris and undercut snags; some silt; stable banks and forested riparian zones. **2007** -- conductivity generally low; a very diverse community for a stream of its size, including 9 species of cyprinids and 7 species of darters, but no Rock Bass, Smallmouth Bass or trout were present; White Sucker represented by only young-of-year; fewer fish were collected than expected; the percentage of tolerant fish (Creek Chub, Flat Bullhead, Redbreast Sunfish, and Green Sunfish) was high; only one intolerant species was present.

Waterb	ody		Location		Date	Station	ID	Bioclassi	fication
BENT	CR	of	ff NC 191		06/12/07	EF6	7	Goo	bd
County	Subbasin	8 digit HUC	Latitude	Long	jitude	AU Numb	er	Level IV E	coregion
BUNCOMBE	2	06010105	35.5006616	-82.59	94464	6-67-(7)		Broad	Basins
		•					•		
Stream Classifica	tion Dra	inage Area (mi2)	Elevatio	on (ft)	Stream W	idth (m)	Average Dept	.h (m)	Reference Site
В		10.7	209	0	9		0.3		Yes
	Fo	rested/Wetland	Ur	ban	А	ariculture		Other (de	scribe)
Visible Landuse	(%)	100		0		0		0	
Unstream NPDES Di	ischargers (>1	MGD or <1MGD a	nd within 1 mile	2)		NPDES	Number	Ve	olume (MGD)
	isonargers (21	None		-)				T	
						_			
Water Quality Param	neters		10 Sec. 10.00	E.S.	CONTRACTOR A	S	ite Photograph		
Temperature (°C)		20.2			100 A		A Pine		21
Dissolved Oxygen (m	g/L)	8.1	Ser. 0	and the second	Andrea Contra		S AD LES 3	Nº1	
Specific Conductance	e (µS/cm)	21	Carls A	Paralle					all the last
pH (s.u.)		6.5							
			- New Street	2. 26 S			and the second	1.14	and the second
Water Clarity		Clear	2.4	New Contest	The second	10-100 -	- Parts		Set Bar
Habitat Assessment	Scores (max)			-k		and the set	State 122	C.S. C.S.	and the second
Channel Modification	(5)	5		A Card	风风大			- 992	
Instream Habitat (20)		19		CX-1	C. C	the fai	CONTRACTOR OF	-	
Bottom Substrate (15	)	12	Sec	N.K.	*		and the second		
Pool Variety (10)		4		3.3		AL ST		A STATE	CLAS -
Riffle Habitat (16)		14		T AN	2. 25	- M. M.			
Left Bank Stability (7)		7			1		1	- The second	
Right Bank Stability (7	7)	7		STA-					
Light Penetration (10)	1	10	200	1			AND A DESCRIPTION OF	-	
Left Riparian Score (5	5)	5			100		and the second	ALC: NOT THE OWNER	and the second
Right Riparian Score	(5)	5							
Total Habitat Score	(100)	88	Sub	strate	Cobble, bould	er, and grave	əl.		
Sample Date	•	Sample I	D	Spe	cies Total		NCIBI	Bio	classification
06/12/07		2007-74			22		56		Good
Most Abundant Spo	ecies	Mottled Sculpin	l		Exotic Spe	cies	Flat Bullhead and F	Redbreast	Sunfish
Species Change Sin	ce Last Cycle	N/A							
Data Analysis									
This is the first fish co	mmunity same	le collected at this	site. Watershe	d a sma	Il tributary to the	e French Bro	ad River: drains so	uthwestern	Buncombe

County, including the U.S. Forest Service's 9.4 square mile Bent Creek Experimental Forest; no municipalities in the watershed; NCWRC Hatchery Supported Trout Waters and Wild Trout Waters in the headwaters; site is within the UNC Arboretum property and is ~ 0.5 miles above the creek's confluence with the river. **Habitat** -- short, shallow riffles and runs; woody debris and snags; high quality instream and riparian habitats; one silty pool at the end of the reach. **2007** -- conductivity low; an abundant and diverse fish community for a stream of its size, including 5 species of darter and 4 species of suckers; however, the number of cyprinid species was slightly lower than expected and the percentage of tolerant fish (Creek Chub, White Sucker, Flat Bullhead, and Redbreast Sunfish) was slightly elevated.

Waterboo	dy	Locati	on	Stat	tion ID		Date	Bioclassification
HOMINY	CR	SR 11	123	EB	3327	30	3/17/07	Good-Fair
County	Subbasin	8 digit HUC	Latitude	Longitu	ude AU	Number	L	evel IV Ecoregion
BUNCOMBE	2	06010105	353204	82421	2	6-76b	southern cry	staline ridges and mountains
Stream Classifica	ition [	Drainage Area (mi2	2) Elev	ation (ft)	Str	eam Width	(m)	Stream Depth (m)
С	C			2131		6		0.2
	Forested				Agricu	llture		Other (describe)
Visible Landuse (%) 7		70	30		C			0
Upstream NPI	ers (>1MGD or <1N	IGD and withir	n 1 mile)	N	IPDES Nur	nber	Volume (MGD)	
		None		· · · ·				
Water Quality Parame	eters					Site Pho	tograph	
Temperature (°C)		22.3	-					
Dissolved Oxygen (mg	J/L)	8.1		1			and a second	
Specific Conductance	(µS/cm)	106		Service.		2.3		All and the second second
pH (s.u.)		7		14.1			100	and the search of the
Water Clarity		clear						
Habitat Assessment	Scores (max)		11/200					
Channel Modification (	(5)	5	1			Carlos P.	17-14 A	
Instream Habitat (20)		16				1-1-		and the second
Bottom Substrate (15)		11			Carry Cold-			- the second second
Pool Variety (10)		8					1000	
Riffle Habitat (16)		16		2420	and the second	and the second		
Left Bank Stability (7)		3			STERIO	and the		and the second se
Right Bank Stability (7	)	6			C.	Bage -		Company of the second
Light Penetration (10)		10			and the second	and the second	A MARTIN	and the second
Left Riparian Score (5)	)	2			the set	Beller In		and the second
Right Riparian Score (	5)	3						
Total Habitat Score (	100)	80	Substra	ate N	lostly grave	and cobbl	е	

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/17/07	10326	81	31	5.0	4.0	Good-Fair
05/14/02	8735	71	36	4.3	3.9	Good
09/10/97	7468	71	32	5.1	4.1	Good-Fair
07/09/92	5901	28	28	3.3	3.3	Good

### **Taxonomic Analysis**

Intolerant or "sensitive" taxa present at this study location included the mayflies Neoephemera purpurea and Serratella deficiens; the stoneflies Acroneuria abnormis, Paragnetina immarginata, and Pteronarcys biloba; and the caddisflies Brachycentrus spinae, and Nyctiophylax celta.

### **Data Analysis**

The study location previously at NC 151 was moved to SR 1123 in 2007. This location has received a bioclassification of either Good-Fair or Good in each of the four years of sampling. These similar ratings suggest relatively consistent water quality over the span of 15 years bracketed by sampling dates. This apparent stability is encouraging considering that much of the upsteam land use is either agricultural operations or residential and that the sediment load at this location is often quite high after rain events as was documented in the 2003 report for this basin. These sediments are problematic because they ultimately settle from the water column and blanket streambed substrates.

Waterbo	ody			Location		Date	•	Station II	D	Bioclassi	ication	
HOMIN	r CR			NC 151		06/12	/07	EF26		Good	Fair	
County	Subb	basin	8 digit HUC	Latitude	Long	itude		AU Number		Level IV E	coregion	
BUNCOMBE	2	2	06010105	35.53555556	-82.694	144444	4444 6-76b			Broad Basins		
Stream Classificat	ion	Draina	ige Area (mi2)	Elevatio	on (ft)	Strea	m Wid	lth (m)	Average Dept	:h (m)	Reference Site	
С			30.2	209	5		7		0.4	0.4 No		
		Fores	sted/Wetland	Urk	ban		Aar	riculture		Other (describe)		
Visible Landuse (	%)		40	60 (rual co	60 (rual commercial)			0		0		
				•		-						
Upstream NPDES Dis	scharge	rs (>1MG	iD or <1MGD a	nd within 1 mile	e)			NPDES N	Number	Vo	lume (MGD)	
			None						-			
Water Quality Parame	eters							Site	e Photograph			
Temperature (°C)			17.5				1			Pres -		
Dissolved Oxygen (mg	ı/L)		8.7						1	Free		
Specific Conductance	// (uS/cm)		91		1	Ches. He		Bellin Of			A State of the	
pH (s.u.)	(1,		6.7			California II	- Al	Service State		1	Sh	
							×.,		SAL			
Water Clarity			Clear							1		
Habitat Assessment	Scores (	max)		A Mar	2.34							
Channel Modification (	5)		5					See and	AN AN			
Instream Habitat (20)	,		16			The second		2	-	2. 134	ALC AND ALC	
Bottom Substrate (15)			6		Carlos and	P. Data			a total		2018年1月1日	
Pool Variety (10)			4	and the second second							Contraction of the second	
Riffle Habitat (16)			14						the second second			
Left Bank Stability (7)			7				-	Service and	Naples		Service and the service of the servi	
Right Bank Stability (7	)		6			and the	-		Contraction		1.10	
Light Penetration (10)			9			1000		And Calles	-			
Left Riparian Score (5)	)		5		-			and the second	1200		All and an and	
Right Riparian Score (	5)		3									
Total Habitat Score (	100)		75	Subs	strate	Cobble, g	ravel, a	and sand				
				_	-							
Sample Date			Sample	D	Spe	cies Total		I		Bio	classification	
06/12/07			2007-71			15			46		Good-Fair	
09/24/02			2002-84	•		16			40 50	+	Good	
09/17/97			97-00			10			50		9000	
Most Abundant Spe	cies		Saffron Shiner	and Mottled Scul	lpin	Exotic	Speci	es R	edear Sunfish			
Species Change Sinc	e Last C	Cycle	Gains - Redbrea	- Longnose Dace ast Sunfish.	and Rede	ear Sunfish	n. Los	ses Mount	ain Brook Lampre	∍y, Brown 1	Frout, and	
Data Analysis			_									
Watershed a tributa upstream with a combi pools; silts in the pools abundant community, i intolerant species pres classes increased from	ry to the ined flow ; housef almost fo ent; betw n 56% to	French E of 0.071 hold debr our times ween 200 80%. 19	Broad River; dra 4 MGD; site is is in the channe as many fish w 2 and 2007 the <b>997 - 2007</b> co	ins southwesterr - 500 ft. above it: I; right riparian z ere collected in 2 percentage of to nductivity has rai	n Buncomi s confluen one narrov 2007 than olerant fish nged form	be and a since with So w with com in 2002 (n declined f 78 to 98	mall pa outh Ho mercia = 1,06 rom 13	art of eastern ominy Creek. al land use. 2 22 vs. 266), d 3% to 1% and habitat score	Haywood countie Habitat riffles, 2007 conductivi iversity metrics lo d the percentage es have ranged fr	s, 4 small chutes, ar ty was elev wer than e of species om 69 to 7	dischargers ad shallow plunge vated; an extremely xpected; only 1 with multiple age 5: 18 species are	
upstream with a combi pools; silts in the pools abundant community, i intolerant species pres classes increased from	ined flow ined flow ; househ almost fo ent; betw n 56% to	of 0.071 oold debr our times ween 200 80%. <b>1</b> 9	4 MGD; site is - is in the channe as many fish w 2 and 2007 the <b>397 - 200</b> 7 co	<ul> <li>Southwesterr</li> <li>500 ft. above it: i; right riparian zu ere collected in 2 percentage of to nductivity has raised</li> </ul>	s confluen one narrov 2007 than lerant fish	w with com in 2002 (n declined f 78 to 98 µ	inali pa puth Ho imercia = 1,06 from 13 iS/cm;	an of eastern ominy Creek. al land use. 2 2 vs. 266), di 3% to 1% and habitat score	Habitat riffles, 2007 conductivi iversity metrics lo d the percentage es have ranged fr	chutes, ar ty was elev wer than e of species om 69 to 7	and shallow plu vated; an extre xpected; only with multiple a 5; 18 species	

known from the site, but only 2 species of darters; dominant species have been the Saffron Shiner and the Mottled Sculpin; 2002 was a drought year and in the intervening years were the 2004 hurricane-induced flash floods; community has recovered from the 2004 floods.

Waterbo	dy	Locatio	on	Statio	n ID		Date	Bioclassification
HOMINY	CR	SR 34	12	EB1	05	30	8/16/07	Fair
County	Subbasin	8 digit HUC	Latitude	Longitude	e AUI	Number	Le	vel IV Ecoregion
BUNCOMBE	2	06010202	353242	823806	6	-76d	southern crys	taline ridges and mountains
Stream Classifica	ition I	Drainage Area (mi2)	) Elev	vation (ft)	Strea	am Width	(m)	Stream Depth (m)
С		91.1		2070		10		0.4
	Fo	rested/Wetland	Urban	1	Agricul	ture	0	ther (describe)
Visible Landuse	(%)	80	20		0			0
Upstream NPDES Dischargers		ers (>1MGD or <1M	GD and within	n 1 mile)	NF	DES Nur	nber	Volume (MGD)
	1							
Water Quality Param	eters					Site Pho	otograph	
Temperature (°C)		25.9		and the set	No.	See and	1000	
Dissolved Oxygen (mg	g/L)	8				and the second	Ser les	Contraction of the second
Specific Conductance	(µS/cm)	93					States aller a	C. C. C. A.
pH (s.u.)		7.3		and the second			Part and a state of the	
Water Clarity		slightly turbid		1	X			AT MA
Habitat Assessment	Scores (max)						and the	100 11-1 3
Channel Modification (	(5)	5		T	>	K (2	States of the second	ALL ALLE
Instream Habitat (20)		10	11- T- 12-	John -			The second	A CONTRACTOR
Bottom Substrate (15)		3		2 Thene	100	-		
Pool Variety (10)		8	1 centre	al chan little		-		A DECEMBER OF THE OWNER
Riffle Habitat (16)		6						A CONTRACTOR
Left Bank Stability (7)		7				-		
Right Bank Stability (7	·)	7	1				and the second	A REAL PROVIDENCE
Light Penetration (10)		5	and the second					
Left Riparian Score (5	)	5	100	and the				ALS OTHER A
Right Riparian Score (	5)	4						

		-	-			
Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/16/07	10325	72	21	5.9	4.3	Fair
05/16/02	8744	65	21	5.6	5.0	Fair
09/09/97	7465	63	13	6.5	5.2	Fair
07/10/97	7328	13	13	4.1	4.1	Fair
07/09/92	5904	8	8	3.9	3.8	Poor

Mostly gravel and cobble

Substrate

60

### **Taxonomic Analysis**

Total Habitat Score (100)

The benthic macroinvertebrate community was dominated by species tolerant of water quality stressors. However, there were some sensitive taxa present including mayfly, stonefly, and caddisfly taxa (EPT taxa). Specifically, the mayfly *Stenacron pallidum*; the stoneflies *Pteronarcys proteus*, *P. dorsata*, and *Paragnetina immarginata*; and the caddisflies *Ceratopsyche morosa*. None of these taxa have previously been collected from this location. The number of EPT taxa have steadily increased during the 15 years of sampling SR 3412.

### **Data Analysis**

This sampling location was given a bioclassification of Poor in 1992, and improved to Fair in 1997-2007. The low quality habitat at this site continues to be an issue; with limited colonizable substrates, a streambed composed primarily of silt, extensive bank erosion, and scarce riffle habitats. In addition, the specific conductance at this site is considered high for the ecoregion, suggesting that poor water quality is also affecting the benthic community. The combined effects physical and chemical stressors may dictate a slow improvement of this location after the closing of the BASF Corporation Plant in Enka (NC0000299) which was until recently discharging just above SR 3412.

Waterb	ody			Location		Date	е	Station	ID	Biocla	ssification
S HOMIN	NY CI	R	NC <sup>·</sup>	151/SR 344	9	06/12	2/07	EF5	0	G	ood
County	Sub	obasin	8 digit HUC	Latitude	Long	itude		AU Numbe	ər	Level I	V Ecoregion
BUNCOMBE		2	06010105	35.53555556	-82.6	6925		6-76-5b		Broa	ad Basins
Stream Classifica	ation	Draina	ige Area (mi2)	Elevatio	on (ft)	Strea	am Wid	dth (m)	Ave	rage Depth (m)	Reference Site
C;Tr			38.3	209	5		14			0.4	Yes
		Fores	sted/Wetland	Ur	ban		Agriculture			Other (describe)	
Visible Landuse	(%)		85	15 (rural i	15 (rural residential)			0			0
Upstream NPDES Di	ischarg	ers (>1MG	iD or <1MGD a	and within 1 mile	thin 1 mile)			NPDES	S Numbe	r	Volume (MGD)
			None								
Water Quality Param	neters							s	ite Phot	ograph	
Temperature (°C)			17.5		-	1		- Nor	5	A market and	14
Dissolved Oxygen (me	a/L)		9.1	A1-9	week.	A. Part		- Laboration	Ren of		and and a
Specific Conductance	e (µS/cm	ר)	33		-			Electron .			
pH (s.u.)		,	6.2		1.1	Contra la			16 C	and the second	
					No. Aller			Buller	e n ii	C. Salar P.	Carl and the second
Water Clarity			Clear		AN AN		and a	and the second	The second		State State
				100	a start of	I test to				a start	Contraction and
Habitat Assessment	Scores	s (max)			a start	there -	13.00	Stores -	10		and a second
Channel Modification	(5)		5				1996				
Instream Habitat (20)			19		1.26						
Bottom Substrate (15)	)		12			11 -		Carlos Carlos	Contraction of the second	-	and the second second
Pool Variety (10)			9			-		A CONTRACTOR	1.1.1.1.1.2	And Ballinson	and the second se
Riffle Habitat (16)			16		See.		-	and the second	Ser an	at Same	
Left Bank Stability (7)	1		6	and the second							and the second
Right Bank Stability (7	7)		6	Sec.			10	The set	and the	and and and a state	Contraction of the
Light Penetration (10)	)		8		-	No.	-		-	ACT IN	
Left Riparian Score (5	5)		4	Stewart .		A ST	T. O.	the state	the start		and the second second
Right Riparian Score	(5)		5								
Total Habitat Score (	(100)		90	Sub	strate	Cobble, g	gravel,	sand, and b	oulder		
Comula Data	-		Commis		<b>C</b>	-: <b>T</b> -1-					Discloseffication

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
06/12/07	2007-72	20	56	Good
11/30/04	2004-140	14	38	Fair
09/23/02	2002-81	19	50	Good
04/09/97	97-16	16	48	Good
Most Abundant Species	Mottled Sculpin and Saffron Shin	er Exotic Spec	ies Rainbow Trout and	Brown Trout

Species Change Since Last Cycle

Gains -- Tennessee Shiner, Black Redhorse, Golden Redhorse, and Rainbow Trout. Losses -- Redbreast Sunfish. Gains and losses compared 2007 to 2002; not 2004.

### **Data Analysis**

**Watershed** -- tributary to Hominy Creek; drains southwest Buncombe County; no municipalities in the rural watershed; site is ~1,000 ft. above the creek's confluence. **Habitat** -- high quality instream habitats; swift riffles, runs, and chutes; *Podostemum* in the riffles; deep boulder pools; open canopy, but that is a function of stream width; areas healed over from the 2004 hurricane-induced flash floods **2007** -- conductivity low; all species gained were collected for the first time ever in 2007; number of intolerant species increased by one and the percentage of tolerant decreased from 6% to 1.5% between 2002 and 2007; the fish community has recovered from the 2004 flash floods. **1997 - 2007** -- conductivity has ranged from 25 to 35 µS/cm; habitat scores have ranged from 70 to 90; 24 species are known from the site, including 10 species of cyprinids, but only two species of darters; dominant species are the Mottled Sculpin, Saffron Shiner, and River Chub; NCIBI score has gradually improved from 48 to 50 to 56, the basinwide ratings have been consistently Good; sampled in 2004 as part of the post hurricane biological monitoring special study (BAU Memorandum F-20050404).

Waterboo	dy	Locati	on	Station	ID		Date	Bioclassification	
S HOMIN	Y CR	NC 1	51	EB13	35	08	8/17/07	Good	
County	Subbasin	8 digit HUC	Latitude	Longitude	AU Nu	umber	Lev	vel IV Ecoregion	
BUNCOMBE	2	06010105	353204	824132	6-7	'6-5		Broad Basins	
Stream Classifica	ition [	Drainage Area (mi2	?) Elev	vation (ft)	Strear	m Width	(m)	Stream Depth (m)	
C; Tr		39		2115		14		0.3	
	Fo	rested/Wetland	Urban		Agriculture		0	ther (describe)	
Visible Landuse (%)		70	0		30			0	
Upstream NPE	Upstream NPDES Dischargers		IGD and within	n 1 mile)	NPD	DES Nun	nber	Volume (MGD)	
			lone						
Water Quality Parameters					5	Site Pho	tograph		
Temperature (°C) Dissolved Oxygen (mg Specific Conductance pH (s.u.)	g/L) (µS/cm)	22.6 8.1 40 6.9				The state	No.		11
Water Clarity		slightly turbid					10gg		
Habitat Assessment	Scores (max)		and the		Stands -	a w	HER STR		
Channel Modification (	(5)	5	- 30-5			( Berlin	52 2	and the second	
Instream Habitat (20)		14			2. 4	-			
Bottom Substrate (15)		8				Tall Property of the	and the second s		
Pool Variety (10)		6		and the		1	15 and a stre	A REAL PROVIDENCE	
Riffle Habitat (16)		16			67 m	Presses.		and the second se	No.
Left Bank Stability (7)		7				-	de la composition		
Right Bank Stability (7	·)	7		-	E	1953	Phone pha		
Light Penetration (10)		5		Sec. Marin			a	and the second s	
Left Riparian Score (5)	)	2	To the second			COL COL	Card Man		
Right Riparian Score (	5)	2			Tanking Local				

Mostly boulder and rubble with small amounts of gravel and sand

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/17/07	10327	0327 96		4.77	3.00	Good
08/28/02	8991		26		2.73	Good-Fair
09/10/97	7467	38	8	6.35	5.32	Poor
07/09/92	5902		20		3.25	Good-Fair

Substrate

72

### **Taxonomic Analysis**

**Total Habitat Score (100)** 

Caddisfly taxa richness has increased three fold since 1992. Three taxa were collected in 1992 and 1997; 12 taxa were collected in 2002; and 14 taxa were collected in 2007. Taxa collected in 2007 that had not been previously collected include *Brachycercus*, *Drunella allegheniensis*, *Heterocloeon anoka*, *Neureclipsis*, *Oecetis persimilis*, *Rhyacophila fuscula* and *Ceratopsyche morosa*.

## Data Analysis

South Hominy Creek is a tributary to Hominy Creek and this site is located above the confluence with Hominy Creek. The water quality rating has fluctuated since 1992. In 1992, this site rated Good-Fair but dropped to Poor in 1997 due to an unknown toxic impact. It went back to Good-Fair in 2002 and rose to Good in 2007. With the exception of 2002, EPT taxa richness has increased suggesting that water quality is gradually improving.

Waterbo	dy	Locatio	on	Statio	n ID		Date	Bioclassification
SWANNAN	IOA R	SR 24	16	EB1	42	30	8/16/07	Good-Fair
County	Subbasin	8 digit HUC	Latitude	Longitude	e AU I	Number	L	evel IV Ecoregion
BUNCOMBE	2	06010105	353629	822641	6	-78c	southern cr	ystaline ridges and mountains
Stream Classifica	ition I	Drainage Area (mi2)	Elev	vation (ft)	Stre	am Width	(m)	Stream Depth (m)
С		80.7		2115		16		0.2
Foresto		rested/Wetland	Urban		Agricul	ture		Other (describe)
VISIBle Landuse	(%)	20	20		00	00		0
Upstream NPDES Dischargers (>		ers (>1MGD or <1M	GD and withir	n 1 mile)	N	PDES Nun	nber	Volume (MGD)
		None						
Water Quality Param	eters					Site Pho	tograph	
Temperature (°C) Dissolved Oxygen (mg	g/L)	22.4 6.9	-	<b>~</b>				A CONTRACTOR
Specific Conductance	(µS/cm)	73	1	Se 1.	No. Ha			
pH (s.u.)		6.5	t a s	A Barlan	Sec.	-No. 19		
Water Clarity		clear					97	HALL SHE
Habitat Assessment	Scores (max)			BAR TEN	And the second second	The Property		( ) to be
Channel Modification (	(5)	5		in the second	and star		and the second sec	
Instream Habitat (20)		16	1.255		been a			
Bottom Substrate (15)		12			Real of	117500	The second	The second and the second second
Pool Variety (10)		8		and the second	1		Suffrage Street	
Riffle Habitat (16)		7		Contraction of the second			and and the	
Left Bank Stability (7)		7	and some	1		and the second	And Shares	
Right Bank Stability (7	)	7	- indi		-		-	the second
Light Penetration (10)		7	-73	to day			+ -	
Left Riparian Score (5	)	2				Section 1	-	Man State
Right Riparian Score (	5)	3						

		-				
Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/16/07	10323	87	25	5.9	5.1	Good-Fair
08/28/03	9298	73	25	5.4	4.0	Good-Fair
08/27/02	8982	75	24	5.9	4.6	Fair
10/07/87	4433	60	22	5.2	4.3	Fair

Mixture of gravel, cobble, and boulder

Substrate

### **Taxonomic Analysis**

**Total Habitat Score (100)** 

There were several "sensitive" or pollution intolerant taxa collected at this study location; including the mayflies *Isonychia* sp. and *Serratella deficiens;* the stonefly *Acroneuria abnormis;* and the caddisflies *Ceratopsyche sparna* and *C. morosa.* The number of EPT taxa has increased slightly during the 20 years of sampling, but midges continue to be the dominant group. The mayflies *Pseudocloeon propinquum*, *Plauditus dubius* group, *Acentrella turbida* and the caddisfly *Triaenodes ignitus* were added to this site's taxa list in 2007.

### **Data Analysis**

The bioclassification of this study site improved from Fair in 1987 and 2002 to Good-Fair in both 2003 and 2007. Overall the habitat was relatively good, but the riparian zones had frequent breaks and riffle habitats were infrequent and small. There aren't any major dichargers upstream or minor dischargers within 1 mile of the study site. Because upstream land use is mostly agricultural and residential, non-point source pollution is likely the largest contributor to water quality degredation at SR 2416. However, the exceptional drought of 2007 should have miminized the impact of these stressors. Therefore, it is unclear why the bioclassification of this location is not greater than Good-Fair.

Waterboo	dy	Locati	ion	Statio	n ID		Date	Bioclassification
SWANNAN	IOA R	US 2	25	EB1	45	08	8/15/07	Good-Fair
County	Subbasin	8 digit HUC	Latitude	Longitude	e AU Nu	umber	Lev	vel IV Ecoregion
BUNCOMBE	2	06010105	353406	823242	6-7	6-78d		Broad Basins
Stream Classifica	ition [	Drainage Area (mi2	2) Elev	vation (ft)	Stream	n Width	(m)	Stream Depth (m)
С		124		1980		14		0.2
	Fo	rested/Wetland	Urban	1	Agriculture		0	ther (describe)
Visible Landuse	(%)	0	100		0			0
Upstream NPI	DES Discharge	ers (>1MGD or <1N	IGD and within	n 1 mile)	NPD	DES Nun	nber	Volume (MGD)
•		None						/
Water Quality Parame	Water Quality Parameters					Site Pho	tograph	
Temperature (°C)		26						
Dissolved Oxygen (mg	g/L)	8.6						
Specific Conductance	(µS/cm)	83	ale:	-		Here and		
pH (s.u.)		8.1	4	Mar Land			Mar .	A REAL
Water Clarity		clear	a lanka	145			1	
Habitat Assessment	Scores (max)						1 Bard	
Channel Modification (	(5)	5				a setti	CONCLUSION OF	
Instream Habitat (20)		14	A State	A CONTRACTOR	No. No.	LANS .	and the second second second	A CONTRACTOR
Bottom Substrate (15)		8					and the second	Call Callson
Pool Variety (10)		8	4					- Contraction
Riffle Habitat (16)		16		TRACK -		the state		Carl Carl Carl
Left Bank Stability (7)		7			and the second	-		and the second second
Right Bank Stability (7	·)	7				1.5	10025	
Light Penetration (10)		5		- in and			the start of	
Left Riparian Score (5)	)	1		132/2	atter	1 28	State of the second	and the set
Right Riparian Score (	5)	2		Concert of		- million		
Total Habitat Score (	100)	73	Substr	ate Goo	od mix of bou	ulder, rul	bble, gravel and	sand

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification	
08/15/07	10322	82	30	5.63	4.18	Good-Fair	
08/28/02	8990	73	26	5.80	4.71	Good-Fair	
07/09/97	7322	62	28	5.44	4.26	Good-Fair	
07/08/92	5884	72	27	5.74	4.44	Good-Fair	
07/27/89	5017	60	15	6.29	4.48	Fair	

### **Taxonomic Analysis**

No major changes in the benthic community were observed. Abundant taxa included Acentrella, Pseudocloeon propinguum, Maccaffertium mediopunctatum, Stenacron pallidum, Cheumatopsyche, Hydropsyche venularis, Micrasema wataga, Ceratopsyche sparna, Ancyronyx variegatus, Macronychus glabratus, Enallagma, Cricotopus vieriensis group, Polypedilum flavum, P. illinoense group, Phaenopsectra flavipes, Rheocricotopus robacki, Rheotanytarsus, Tanytarsus sp U, Simulium, Crangonyx, Corbicula fluminea, Helisoma anceps and Hydracarina.

# Data Analysis

The Swannanoa River, a tributary to the French Broad River, drains southeastern and eastern Buncombe County. This site, located in urban Asheville, has rated Good-Fair since 1992. Based on benthic data no major changes in water quality have been observed.



		-				
Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/14/07	10319	75	11	6.6	4.9	Fair
07/12/02	8873	70	23	6.2	5.0	Fair
05/18/99	7849	98	38	5.4	4.3	Good-Fair
07/09/97	7326	20	20	5.0	5.0	Good-Fair
07/27/89	5018	17	17	5.1	5.1	Fair

### **Taxonomic Analysis**

Of the 11 EPT taxa (mayflies, stoneflies, and caddisflies) collected in 2007, all but the stonefly *Paragnetina immarginata* (which was rare) and *Ceratopsyche sparna* are considered tolerant of poor water quality. The overall number of EPT taxa has declined considerably during the 18 years of sampling and the current sample had less than half the EPT taxa that were collected in 2002.

### Data Analysis

Newfound Creek SR 1622 has historically been heavily affected by nutrient loading and sedimentation from dairy farming. Despite past remediation efforts, the currently measured specific conductivity of 133 suggests that there are still pollution issues. In addition to water quality issues, the stream is negatively affected by marginal habitats. After improving to Good-Fair in 1997 and 1999, the bioclassification has dropped to Fair in both 2002 and 2007. Lastly, the habitat and water quality stressors described above may have been compounded by the exceptional drought occuring in 2007.

Waterbody		Location				Date Station ID			Bioclassification			
NEWFOU	ND CF	र	;	SR 1641		06/11	/07	EF37	,		Go	bd
County	Subb	asin	8 digit HUC	Latitude	Lonai	tude		AU Number		L	evel IV E	Ecoregion
BUNCOMBE	2	2	06010105	35.66611111	-82.634	16667		6-84e			Broad	Basins
L												
Stream Classificat	tion	Draina	ige Area (mi2)	Elevatio	n (ft)	) Stream Width (m) Average D			rage Depth	(m)	Reference Site	
С			34.2	1900	)	7				0.3 No		
		Fores	sted/Wetland	Urk	Urban			ariculture		c	Other (describe)	
Visible Landuse (	(%)		95	5 (rural re	sidential)	0				0	,	
				• •								
Upstream NPDES Dis	scharger	's (>1MG	D or <1MGD a	nd within 1 mile	)			NPDES	Numbe	r	Ve	olume (MGD)
			None						-			
Water Quality Param	eters							Sit	e Photo	ograph		
Temperature (°C)			22.7	and the second					Ser Au			-
Dissolved Oxygen (mg	g/L)		7.9	and the second	10	NAME AND A		C. S. Gall	1.91			CALIFICATION OF
Specific Conductance	(µS/cm)		108	Best	1.1	1					100	Carl Carl
pH (s.u.)			7.4		See .		12	Sales St.	a Per	Mar Hack	- And	and the second second
	_			1.00	S.m.	1.15	<b>*</b> - 2				-	
Water Clarity		Sli	ghtly turbid	1. S.								4.5
						de la		Contraction of the second	-		2.5	
Habitat Assessment	Scores (	max)		1.000		The Property in		100	A ANT	and the second		
Channel Modification (	(5)		5	Sec. Sec. Ast		W. Mary		and the second			-	and a second second
Instream Habitat (20)			16	Frankl	17		in the second	The second	STATE OF	AND THE OWNER	-	
Bottom Substrate (15)			12	The second	Con and		-			and the second		Same and
Pool Variety (10)			4	the second	A 1 8	-	2	also what	See. 1	-		States -
Riffle Habitat (16)			14	and the second		1	1	an internet	-	article.		and the second second
Left Bank Stability (7)			6		1 7			- and			and the second	
Right Bank Stability (7	.)		6			and a second	+ -	The Call	1		-	The second
Light Penetration (10)			7				ALC: N	A STORE		and a start	and the second	C TRei
Left Riparian Score (5)	)		5		Ton 22	1332	Carl	1000	and the second	-	THE S	
Right Riparian Score (	5)		4									
Total Habitat Score (	100)		79	Subs	strate	Cobble, g	gravel,	sand, and bo	oulder.			
Sample Date	1		Sample	D	Spec	cies Tota	ıl		NCIBI		Bio	oclassification
06/11/07			2007-70	)		19			48		Good	
06/17/02			2002-69	)		14			48			Good
04/09/97			97-17			10			28			Poor

**Most Abundant Species** 

Central Stoneroller

Exotic Species

Flat Bullhead and Redbreast Sunfish

Species Change Since Last Cycle

Gains -- Tennessee Shiner, White Sucker, Black Redhorse, Fantail Darter, and Banded Darter. Losses -- none.

### Data Analysis

Watershed -- tributary to the French Broad River; drains agricultural western Buncombe County; site is ~ 1.1 miles above the creek's confluence with the river. Habitat -- short, shallow riffles; gravel runs; vegetated banks; open canopy in places; shallow pools with *Elodea;* channel filled with sediment; became very turbid when walking downstream, but cleared up quickly. **2007** -- conductivity elevated; an abundant and diverse community, but only 2 intolerant species were present; percentage of omnivores+herbivores (Central Stoneroller, River Chub, and White Sucker) was slightly elevated and increased between 2002 and 2007; percentage of tolerant fish (Creek Chub, White Sucker, Flat Bullhead, and Redbreast Sunfish) was much greater than expected; large specimens of suckers present. **1997 - 2007** -- conductivity has ranged from 83 to 113 µS/cm; habitat scores have ranged from 61 to 79; 19 species are known from the site, including 4 species of darters; species diversity has steadily increased from 10 to 14 to 19 as has the diversity of darters from 0 to 2 to 4; dominant species has been the Central Stoneroller.

Waterboo	dy	Locati	ion	Station	n ID		Date	Bioclassification
REEMS	CR	NC 2	51	EB1	31	30	8/14/07	Good-Fair
County	Subbasin	8 digit HUC	Latitude	Longitude	AU N	Number	Lev	vel IV Ecoregion
BUNCOMBE	2	06010105	354140	823647	6-8	7-(10)		Broad Basins
Stream Classifica	ition I	Drainage Area (mi2	2) Elev	vation (ft)	Strea	am Width	(m)	Stream Depth (m)
С		37		1790		5		0.2
Fore		rested/Wetland	Urban		Agriculture		0	ther (describe)
Visible Landuse	(%)	100	0		0			0
Upstream NPDES Dischargers (>1MG			IGD and withir	n 1 mile)	NF	DES Nur	nber	Volume (MGD)
		None						
Water Quality Parame	eters					Site Pho	tograph	
Temperature (°C) Dissolved Oxygen (mg Specific Conductance pH (s.u.)	g/L) (μS/cm)	22.7 7.9 104 7.7				R.		
Water Clarity		slightly turbid			16			
Habitat Assessment	Scores (max)		1. 1.			1		
Channel Modification (	(5)	5				1		100 and a 1
Instream Habitat (20)		15			-	Service -	1.00	State of the state of the
Bottom Substrate (15)		14		Sec.	PRODUCT A	France -	and a state of the	Contraction of the
Pool Variety (10)		6		E H		-	A CONTRACTOR	Carlos Carlos
Riffle Habitat (16)		16		1 marie	The second	-		
Left Bank Stability (7)		7	100			Sei	5000	
Right Bank Stability (7	)	7		a for the second	A CONTRACTOR	No.	and the second	No. of Concession, Name
Light Penetration (10)		10	50.00	ALC: NO	e		and the second	
Left Riparian Score (5)	)	4	200		-12	- De	and the	CON END
Right Riparian Score (	5)	4	100	and the second second		-		

Mostly boulder and rubble with some gravel and sand

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/14/07	10318		23		3.74	Good-Fair
07/10/02	8865		27		3.69	Good-Fair
07/09/97	7324		30		3.33	Good
07/23/92	5936		20		3.37	Good-Fair

Substrate

89

### **Taxonomic Analysis**

**Total Habitat Score (100)** 

Gains in the number of mayfly species since 1992 have been offset by a decline in the abundance of stoneflies. Overall EPT taxa richness was down slightly in 2007 from previous years and may be due to drought conditions this portion of the state was experiencing at the time of sampling. Abundant taxa included Baetis flavistriga, B. intercalaris, Heptagenia marginalis, Maccaffertium ithaca, Acroneuria abnormis, Paragnetina immarginata, Leucotrichia pictipes and Ceratopsyche sparna.

## Data Analysis

Reems Creek drains the northwestern portion of Buncombe County including the town of Weaverville. There is no evidence of a long term change in water quality. This site has rated Good-Fair since 1992 with the anomalous exception of the Good rating it received in 1997.

Waterboo	dy	Locati	on	Stat	ion ID		Date	Bioclassification
SANDYMU	SH CR	SR 11	14	EB	137	30	3/14/07	Good-Fair
County	Subbasin	8 digit HUC	Latitude	Longitu	de AU	Number	Lev	el IV Ecoregion
MADISON	2	06010105	354405	82414	4 6-	92-(9)		Broad Basins
Stream Classifica	ition I	Drainage Area (mi2	) Elev	vation (ft)	Stre	am Width	(m)	Stream Depth (m)
С		47		1860		10 0		0.2
	Fo	rested/Wetland	Urbar	1	Agricul	ture	O	ther (describe)
Visible Landuse	(%)	95	5 (rural resid	lential)	0			0
Upstream NPI	DES Discharge	ers (>1MGD or <1M	GD and withi	n 1 mile)	N	PDES Nur	nber	Volume (MGD)
	J	None		-,				
Water Quality Param	eters					Site Pho	otograph	
Temperature (°C)		21	ALC: NO			Sic 1		Contraction of the state
Dissolved Oxygen (mg	g/L)	7.7	STATES I					
Specific Conductance	(µS/cm)	110						Part - Carlor
pH (s.u.)		7.5	1990 - 1990 1990 - 1990 1990 - 1990			Selles.	AND STORES	
Water Clarity		slightly turbid						a contraction
Habitat Assessment	Scores (max)				Contraction of the	and h		State of the state
Channel Modification (	(5)	5						
Instream Habitat (20)		16			- Call	5 / 1		A CARDON CONTRACTOR
Bottom Substrate (15)		12	See.				ALL HOLES	
Pool Variety (10)		6						and the second second
Riffle Habitat (16)		14					-	And the second
Left Bank Stability (7)		7	100	1		-		A State of the sta
Right Bank Stability (7	<i>'</i> )	6		A DE LA		-	at the second	The Terry The
Light Penetration (10)		7	A STATE				and the second	and the second sec
Left Riparian Score (5)	)	5	1	in 1			and the second second	
Right Riparian Score (	5)	5		000	The Party of the P			
Total Habitat Score (	100)	83	Substr	ate G	ood mix of b	oulder ru	bble gravel and	sand with some silt

Good mix of boulder, rubble, gravel, and sand with some silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/14/07	10316		22		3.98	Good-Fair
07/10/02	8868		32		3.51	Good
07/10/97	7327		30		4.03	Good
07/22/92	5933		36		4.32	Excellent

83

### **Taxonomic Analysis**

**Total Habitat Score (100)** 

EPT taxa richness has decreased since 1992. Taxa not collected in 2007 that were previously common or abundant include the mayflies, Pseudocloeon propinguum, Brachycercus, Epeorus rubidus, Heptagenia marginalis and Maccaffertium modestum; the stoneflies Leuctra and Perlesta, and the caddisfly Ceratopsyche bronta.

## Data Analysis

Sandymush Creek drains the extreme northwest corner of Buncombe County and a small portion of southwest Madison County before entering the French Broad River. Based on decreased EPT taxa richness, water quality appears to be declining. The site rated Excellent in 1992, dropped to Good in 1997 and 2002 and further dropped in 2007 to Good-Fair. This stream was one of many that experienced extreme flooding in September 2004 when the remnants of three hurricanes passed over western North Carolina.

Waterb	ody			Location		Date	)	Station I	Station ID Bioclassification		
TURKE	Y CR		;	SR 1629		06/11	/07	EF59		Goo	bd
County	Sut	obasin	8 digit HUC	Latitude	Long	itude		AU Number		Level IV E	coregion
BUNCOMBE		2	06010105	35.70472222	-82.668	88889		6-92-13		Broad I	Basins
Stream Classifica	tion	Draina	age Area (mi2)	Elevatio	on (ft)	Strea	m Wic	dth (m)	Average Dept	h (m)	Reference Site
С			27.4	188	5		8		0.4		No
		Fore	sted/Wetland	Url	ban		Ag	riculture		Other (de	scribe)
Visible Landuse	(%)		95		0	5	(SUCC	essional field	)	0	
Upstream NPDES Di	scharg	ers (>1M0	GD or <1MGD a	nd within 1 mile	e)			NPDES	Number	Vo	olume (MGD)
	J		None		,				-		
Water Quality Param	eters							Sit	e Photograph		
Temperature (°C)			20.5			Alter 1		A Part of		Ven	
Dissolved Oxygen (me	g/L)		8.2	- Ind			東山			12	See Space
Specific Conductance	e (µS/cm	ו)	97	Acres 1				- 1- 1 he		States -	2 757
pH (s.u.)			7.3			North	1	Part I			CARL STORES
Water Clarity			Turbid				A.C.				
Habitat Assessment	Scores	; (max)							and the second se		112
Channel Modification	(5)		5				-			120	
Instream Habitat (20)	( )		18			A MARINE	12-11		100	1 A	
Bottom Substrate (15)	)		8		C PARTY P	B.			and the second	- State	and the
Pool Variety (10)			7		All and a second						
Riffle Habitat (16)			12	and the second second						W. Lant	A ME LINE
Left Bank Stability (7)			7						the state of the s		
Right Bank Stability (7	7)		7					190	State State	A REAL	HE WEIGHT
Light Penetration (10)			7					1 Spatial	14.24.14	March 1	and and
Left Riparian Score (5	5)		5	and the second sec	1		- 3	and the second	the Laster of the		
Right Riparian Score	(5)		4								
Total Habitat Score (	(100)		80	Sub	strate	Cobble, b	oulde	r, and sand.			
Sample Date	)		Sample	ID	Spe	cies Total			NCIBI	Bio	classification
06/11/07			2007-69	9		16			52		Good
06/17/02			2002-68	3		14			48		Good
Most Abundant Spe	ecies		Bigeye Chub a	nd Central Stone	eroller	Exotic	Spec	ies F	edbreast Sunfish		
Species Change Sin	ce Last	Cycle	Gains -	- River Chub, Lo	ngnose Da	ice, and B	lack R	edhorse. Lo	sses Green Sur	nfish.	
Data Analysis											
<b>Vatershed</b> tributary to Sandymush Creek; no municipalities in the rural, agricultural watershed; site is now part of the NCWRC's Sandymush Gamelands. <b>Habitat</b> riffles with <i>Podostemum</i> , shallow pools with <i>Elodea</i> ; side boulder pools; good riparian zones with stable banks, especially at the end of the reach; vater easily silted, sediment from upstream sources; cattle no longer with access to the stream as in 2002. <b>2007</b> conductivity elevated; turbid even though lrought conditions prevailed; an abundant and diverse community, but the diversity of darters and the number of intolerant species was lower than expected; percentage of tolerant fish (Creek Chub, White Sucker, and Redbreast Sunfish) slightly elevated, large specimens of suckers, Rock Bass, and Smallmouth											

percentage of tolerant fish (Creek Chub, White Sucker, and Redbreast Sunfish) slightly elevated, large specimens of suckers, Rock Bass, and Smallmouth Bass were present. **2002 & 2007** -- conductivity elevated; has been ~ 90 µS/cm; habitat scores have been 67 and 80; 17 species known from the site, but only two species of darters; dominant species has been the Bigeye Chub; slight increase in the NCIBI score due to the collection of two additional species of cyprinids (River Chub and Longnose Dace); turbidity may be a chronic watershed problem.

Waterboo	dy	Locati	Location		Station ID		Date	Bioclassification
lvy C	r	SR 21	150	EB2	200	08	8/06/07	Excellent
County	Subbasin	8 digit HUC	Latitude	Longitud	e AUI	Number		Level IV Ecoregion
Madison	4	06010105	354728	823219	6-9	6-(0.5)		Broad Basins
Stream Classifica	ition	Drainage Area (mi2	2) Elev	vation (ft)	Stre	am Width	(m)	Stream Depth (m)
WS-II; HQW		60.6		1,972		13	13 0.3	
Fore: Visible Landuse (%)		orested/Wetland 40	Urban 50		Agriculture			Other (describe)
Upstream NPDES Discharge		gers (>1MGD or <1M	IGD and withir	n 1 mile)	NF	PDES Nur	nber	Volume (MGD)
		None						
Water Quality Parameters S						Site Pho	tograph	
Temperature (°C)		32.4	1 4.45			AN IN	1 1 A 4	
Dissolved Oxygen (mg	µ/L)	6.8	1	and the second		A CONTRACT		
Specific Conductance	(µS/cm)	40		Sec. 1		AL SA		REAL A CONTRACT
рН (s.u.)	. ,	8.3	2.4	STREET, ST	AN AL		1	
Water Clarity		Slightly Turbid			they are			
Habitat Assessment	Scores (max	)	1100	- Mart				
Channel Modification (	(5)	4	-	- And	and the second second	1.00	and the serve	
Instream Habitat (20)		15	and the second		and the second	-		
Bottom Substrate (15)		12		A Real Property in				and the second sec
Pool Variety (10)		7	-	and the second second				
Riffle Habitat (16)		14			100	-		
Left Bank Stability (7)		6		197		-	ALL AND	
Right Bank Stability (7	)	5			CONT.	-	and the second	
Light Penetration (10)		8				11		
Left Riparian Score (5)	)	3			A ST		Le Marine	and the second second
Right Riparian Score (	5)	1						

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/06/07	10295	38	38	4.41	4.41	Excellent
07/09/02	8768	32	32	4.10	4.10	Good
07/07/97	7335	27	27	2.80	2.70	Good-Fair
07/22/92	5931	38	38	3.40	3.40	Excellent

Rubble, boulder, gravel, sand, silt, and bedrock.

Substrate

75

### **Taxonomic Analysis**

**Total Habitat Score (100)** 

This site has exhibited large bioclassification oscillations ranging from Excellent to Good-Fair. The 2007 sample matched the previous high EPT species richness mark of 38 that was first set in 1992. EPT taxa collected for the first time in 2007 included the mayfly *Plauditus cestus*, *Acroneuria arenosa*, *Pteronarcys comstocki*, and *P. proteus*, and the caddisflies *Micrasema wataga*, *Neophylax oligius*, *Oecetis persimilis (edge taxon)*, *Pycnopsyche* sp.(edge taxon), and *Triaenodes ignitus (edge taxon)*. The presence of these edge taxa suggest that lower water levels due to the drought do not seem to be adversely affecting habitat at this location.

#### **Data Analysis**

The lvy Creek watershed upstream of this location is a mix of forest, residential, and agricultural uses and as a result non-point pollution is likely the greatest potential stressor here. As would be expected in watersheds where non-point pollution is prevalent and where significant NPDES point sources are largely absent, reduced run-off due to drought conditions typically results in improved community metrics. The improvement seen in 2002 (mild drought) and 2007 (severe drought) from the 1997 sample support this conclusion. Indeed, in 1997 the average discharge of Ivy Creek near Marshall (approximately 8 miles downstream of this location) was 156.8 cubic feet per second (cfs) and was 184 cfs and 172.6 cfs in 1996 and 1995 respectively. While in 2002, 2001, and 2000 the annual discharge was 100.5 cfs, 97.3 cfs, and 112.2 cfs respectively. Annual discharge data for 2007 data are not yet available.

Waterbo	dy	Locatio	on	Statio	n ID		Date	Bioclassification
lvy C	r	US 25-70	) Bus	EB2	201	30	8/06/07	Good
County	Subbasin	8 digit HUC	Latitude	Longitud	e AUI	Number	Lev	vel IV Ecoregion
Madison	4	06010105	354629	823843	6-9	6-(11.7)		Broad Basins
Stream Classifica	tion	Drainage Area (mi2)	) Elev	ation (ft)	Stre	am Width	(m)	Stream Depth (m)
С		160.7		1,750		20		0.6
	Fo	rested/Wetland	Urban	1	Agriculture		0	ther (describe)
Visible Landuse	(%)	90	10		0			0
Upstream NPI	DES Discharge	ers (>1MGD or <1M	GD and withir	n 1 mile)	N	PDES Nur	nber	Volume (MGD)
		None						
Water Quality Param	eters					Site Pho	otograph	
Temperature (°C)		30.9				-		and the second
Dissolved Oxygen (mg	g/L)	7.3			Star Star			AT AT AT
Specific Conductance	(µS/cm)	87.3	15- 5			and the second	See. 1	Carl Contraction
pH (s.u.)		7.2	4 - A - A				Man Maria	
Water Clarity		Turbid	the second	1				
Habitat Assessment	Scores (max)		1	COLUMN TO A COLUMN	and the second s	100	Sector Sector	
Channel Modification	(5)	4	and the second		and a	and the	- Phat	
Instream Habitat (20)		15			TO NO	C. C	Contraction of the local division of the loc	
Bottom Substrate (15)		12				10000	Contraction of the second	
Pool Variety (10)		7	- States				- Internet	Part and the second
Riffle Habitat (16)		14	Tarles and					
Left Bank Stability (7)		6	25.	Street P	1	in some states		
Right Bank Stability (7	)	6	2.74.5			1	al states and	and the second
Light Penetration (10)		7		are and	States of the local division of the	Services.	A CARLENCE	And and a second
Left Riparian Score (5	)	4					A STREET WAY	
Right Riparian Score (	5)	5						

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/06/07	10296	85	32	4.76	3.30	Good
06/26/02	8839	80	30	4.90	3.70	Good-Fair
07/07/97	7337	59	28	4.72	3.54	Good-Fair
09/02/93	6406	33	33	3.31	3.31	Good
07/22/92	5930	87	36	4.67	3.63	Good

Boulder, rubble, sand, gravel, and silt.

Substrate

80

## **Taxonomic Analysis**

**Total Habitat Score (100)** 

Consecutive samples in 1997 and 2002 were the two lowest rated collections at this location. However, community metrics observed in 2007 are much more comparable to those seen from samples in 1993 and 1992 and represents marked improvements from 1997 and 2002. EPT taxa collected for the first time in 2007 include the mayflies *Heterocloeon curiosum*, the stonefly *Pteronarcys dorsata*, and the caddisflies *Ceratopsyche bifida and Brachycentrus numerosus*. These taxa combined to narrowly produce the lowest EPTBI ever measured here.

### **Data Analysis**

The Ivy Creek watershed upstream of this road crossing is comprised of a mix of agriculture, forest, and suburban uses. As would be expected in a catchment where non-point pollution is the major stressor, reduced runoff due to the record 2007 drought has resulted is slightly improved community metrics relative to 2002 and 1997.

Waterb	ody			Location		Date		Statio	n ID	ID Bioclassification		
LITTLE I	VY CI	R		SR 1547		06/18/	/07	EF7	71		Goo	bd
County	Sub	basin	8 digit HUC	Latitude	Long	jitude		AU Numt	ber	Le	evel IV E	coregion
MADISON		4	06010105	35.8085416	-82.51	87343		6-96-10a	a		Broad I	Basins
Stream Classifica	tion	Draina	age Area (mi2)	Elevatio	on (ft)	Strear	m Wic	dth (m)	Ave	rage Depth	(m)	Reference Site
WS-II;HQW			42.1	206	5		9			0.4		Yes
		Fore	sted/Wetland	Ur	ban		Ag	riculture		C	)ther (de	scribe)
Visible Landuse	(%)		65	5 (rural re	esidential)			30			0	
Upstream NPDES Di	scharge	ers (>1MC	GD or <1MGD a	nd within 1 mile	<del>)</del> )			NPDE	S Numbei	r	Vc	olume (MGD)
			None									
Water Quality Param	eters							;	Site Photo	ograph		
Temperature (°C)			24.6	250	Sec. 3			131	Sec.			
Dissolved Oxygen (mg	g/L)		8.3		S. Same				and the second	alter a		
Specific Conductance	e (µS/cm	)	151				-	125	100			
pH (s.u.)			8.4		1. 1. A		9	-				
	Г					. Sina	the state	a second	2月1日			11.000
Water Clarity		Sli	ghtly turbid			S. AN		and the second				
Habitat Assessment	Scores	(max)								-	100	1/12
Channel Modification	(5)		5	and the second second	1			- AL		- de		
Instream Habitat (20)			16		24	-			-745			
Bottom Substrate (15)	)		8	100	1	1	1		Tanka -		- Andrews	
Pool Variety (10)			6		de la	Por Line	22	and the second second		-		4
Riffle Habitat (16)			14	and set of the set of		and the					the second	-
Left Bank Stability (7)			6	1111				and the second		Contraction of the second	A state	Equal to the
Right Bank Stability (7	7)		6				1	- martine		and the	Sec. 21	0.5
Light Penetration (10)			7				-	and the	and the second	STELL		A DOLLARS
Left Riparian Score (5	5)		3	0	10	Corr.	2	and and a second				the table
Right Riparian Score	(5)		2									
Total Habitat Score (	(100)		73	Sub	strate	boulder, s	lick be	edrock				
Sample Date	)		Sample	D	Spe	cies Total			NCIBI	<u>.</u>	Bio	classification
06/18/07			2007-84	1		14			52			Good
Most Abundant Spe	ecies		Whitetail Shine	r		Exotic	Spec	ies	Rainbow	Trout		
Species Change Sind	ce Last	Cycle	N/A									
Data Analysis												
This is the first fish co	mmunity	y sample	collected at this	site. Watershe	d a tribu	tary to Ivy 0	Creek	and ultima	ately the F	rench Broad	River; Ic	ocated almost 3
miles above its conflu	ence wit	th Ivy Cree	ek; drains the ea	stern corner of I	Madison C	ounty. Hat	tchery	Supported	d Trout Wa	aters. Habit	at prir	narily riffle-runs,

miles above its confluence with Ivy Creek; drains the eastern corner of Madison County. Hatchery Supported Trout Waters. **Habitat** -- primarily riffle-runs, with slick bedrock and *Podostemum*; the elevated conductivity and periphyton covered substrates are consistent with the non-point agricultural influences within this catchment. **2007** -- an abundant (n = 608) and moderately diverse fish community was collected, but with no tolerant species, and only one darter species (Fantail Darter); the fish fauna were dominated by intermediately tolerant species including Whitetail Shiner (31%), Northern Hogsucker (23%), and Central Stoneroller (22%); several fish species were also represented by young-of-year species count to 16. Notwithstanding the predominant agricultural land use, this watershed is maintaining good water quality.

Waterbo	dy	Locatio	on	Station ID			Date	Bioclassification
L Ivy C	Cr	SR 16	510	EB2	05	80	8/06/07	Good-Fair
County	Subbasin	8 digit HUC	Latitude	Longitude	AUI	Number	Le	vel IV Ecoregion
Madison	4	06010105	354732	823219	6-9	6-10b		Broad Basins
Stream Classifica	ition	Drainage Area (mi2)	) Elev	ation (ft)	Strea	am Width	(m)	Stream Depth (m)
WS-II; HQW		46.5		1,974		7		0.3
Visible Landuse	Fo (%)	rested/Wetland 40	Urban 30		Agricul 30	ture	С	ther (describe) 0
Upstream NPI	Upstream NPDES Dischargers		GD and withir	n 1 mile)	NF	DES Nur	nber	Volume (MGD)
·	Ŭ	None		,				
Water Quality Param	Nater Quality Parameters Site Photograph							
Temperature (°C) Dissolved Oxygen (mg Specific Conductance pH (s.u.) Water Clarity Habitat Assessment	g/L) (μS/cm) Scores (max)	32.1 7 130 8.3 Slightly Turbid		A.	マートン			
Channel Modification ( Instream Habitat (20) Bottom Substrate (15) Pool Variety (10) Riffle Habitat (16) Left Bank Stability (7) Right Bank Stability (7 Light Penetration (10) Left Riparian Score (5 Right Riparian Score (5)	(5) ) ) 5)	4 14 10 6 14 6 8 3 3					No.	

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/06/07	10258	26	26	4.34	4.34	Good-Fair
05/29/02	8755	78	27	6.10	4.60	Good-Fair
07/07/97	7334	16	16	3.90	3.90	Fair
07/22/92	5932	35	35	3.90	3.90	Good

Bedrock, rubble, boulder, gravel, snad, and silt.

Substrate

74

#### **Taxonomic Analysis**

**Total Habitat Score (100)** 

EPT taxa richness in 1997 was the lowest measured at this site and was likely related to increased non-point pollution run-off as USGS annual average discharge data from nearby Ivy Creek (near Marshall) indicate that 1997, 1996, and 1995 were fairly wet. Conversely, the 2002 and 2007 samples were taken during droughts, and the reduced run-off was likely the reason for the rebound in the EPT taxa richness metric. EPT taxa collected in 2002 and or 2007 but not found in 1997, included the mayflies *Leucrocuta* sp., *Acroneuria abnormis*, *Pteronarcys* sp., and the caddisflies *Neophylax mitchelli*, *Nyctiophylax celta*, *Oecetis persimilis*, and *Triaenodes ignitus*.

#### **Data Analysis**

The watershed upstream of this segment is a mix of agriculture, residential, and forest use with no NPDES dischargers. As would be expected in a watershed characterized by non-point pollution inputs, the drought years of 2007 and 2002 decreased runoff and therefore pollution inputs. This was reflected in the invertebrate community as EPT richness during the drought years of 2002 and 2007 were improved over the EPT richness measured in the wetter year of 1997. Although there are no permitted NPDES dischargers in the catchment, the conductivity was quite high in both 2002 and 2007 (131 µS/cm and 130 µS/cm respectively) which may suggest straight piping. Indeed, the 130 µS/cm was the second highest conductivity measured in this subbasin in 2007. Moreover, the pH was extremely high in 2002 (8.9) and 2007 (8.3) which suggest that excessive nutrient inputs are fueling high photosynthetic rates.
Waterb	ody		Location		Date	Statio	n ID	Bioclassification
BULL	CR		SR 1574		06/19/0	7 EF'	13	Good-Fair
				-		· · · · · ·		
County	Subbasi	in 8 digit HUC	Latitude	Long	itude	AU NUMber		Level IV Ecoregion
MADISON	4	06010105	35.80722222	-82.609	16667	6-96-16	)	Broad Basins
Stream Classifica	tion D	)rainage Area (mi2)	Elevatio	n (ft)	Stream	Width (m)	Average Dept	n (m) Reference Site
C		20.7	190	)	ourouni	7	0.3	No
, C				•			0.0	
		Forested/Wetland	Urk	ban		Agriculture		Other (describe)
Visible Landuse	(%)	80	20 (rural r	esidential)		0		0
				、		NDD	0 No	
Upstream NPDES DI	schargers (	>1MGD of <1MGD a	nd within 1 mile	<u>)</u>		NPDE	5 Number	Volume (MGD)
		None						
Water Quality Param	neters						Site Photograph	
Temperature (°C)		18.7	South Contraction		a tol			and a state of the
Dissolved Oxygen (m	g/L)	8.1		1000				Star 1
Specific Conductance	e (µS/cm)	103			× 15			and the state of a
pH (s.u.)	. ,	6.3					1946 C	and a line
			and the second second		2. 19 A	Ga	and the second	A Contractor
Water Clarity		Very slightly turbid	25-					SPARE OF STREET
-			1000		- Aller	17 7		
Habitat Assessment	Scores (ma	x)		-	- Althor			A STATE OF STATE
Channel Modification	(5)	5	4.7 - 1		and and the			Tal. Complete State
Instream Habitat (20)		18		1200	1			and the second se
Bottom Substrate (15	)	12		-	1000		- me	の原本
Pool Variety (10)		6		and the			the second second	
Riffle Habitat (16)		15		Sec.	Par	1000	There is a set	
Left Bank Stability (7)		6	-	104			and the	-
Right Bank Stability (7	7)	6	and a	100		3	An Frank	
Light Penetration (10)		9	State Bar	1-9	- state		and the second second	a company
Left Riparian Score (5	5)	4	1 4 To	-	int -	Stall -	all and	The second
Right Riparian Score	(5)	5						
Total Habitat Score	(100)	86	Subs	strate	cobble, boul	der, gravel, s	and, silt	
Sample Date	9	Sample I	D	Spe	cies Total		NCIBI	Bioclassification
06/19/07		2007-85	5		15		44	Good-Fair
06/19/02		2002-74	ł		14		40	Good-Fair
					1			
Most Abundant Spe	ecies	Central Stoner	oller		Exotic Sp	ecies	Redbreast Sunfish a	and Rainbow Trout
					l			
Species Change Sin	ce Last Cvc	le Gains -	Rainbow Trout	and Weste	ern Blacknose		es White Sucker	
openes change Sill	oo Last Oyu	Gails	Rambow Houl			. Date. <b>LUS</b>	Vinice Oucker.	
Data Analysis								

Watershed -- a tributary to Ivy Creek located about one mile above its confluence; drains part of central Madison County, west of Mars Hill. Habitat -- boulder runs, short riffles, chutes, and a few shallow pools; conductivity was high and the stream became very turbid when disturbed during sampling. 2007 -- an extremely abundant fish community (n = 1870) with moderate species richness; the Central Stoneroller (an herbivore that thrives in nutrient-rich mountain watersheds) comprised 56% of the total collection. 2002 - 2007 -- consistent NCIBI metric scores and ratings in two consecutive samples; this rural watershed continues to be influenced by non-point nutrient and sediment loading from agricultural practices.

Waterbody			Location			Date Station II		n ID	ID Bioclassification					
BIG PIN	IE CR	R	of	f SR 1151		06/19	/07	07 EF73			Not Ra	ated		
County	Sub	obasin	8 digit HUC	Latitude	Long	itude	AU	Number		Level	IV Ecore	gion		
MADISON		4	06010105	35.8384563	-82.77	24754	(	6-108	Sou	Southern Crystalline Ridges and		s and Mountains		
Stream Classifica	ition	Draina	age Area (mi2)	Elevatio	n (ft)	Strea	Stream Width (m)		Average Depth		Ith (m) Average Depth (m)		(m)	Reference Site
С			15.8	170	C		7			0.3		Yes		
		Fore	sted/Wetland	Urt	ban		Agriculture		C	Other (de	scribe)			
Visible Landuse	(%)		80	20 (rural r	esidential)			0			0			
Upstream NPDES Di	ischarg	ers (>1MC	GD or <1MGD a	nd within 1 mile	e)	-		NPDE	S Numl	per	Va	lume (MGD)		
			None											
Water Quality Param	neters							5	Site Ph	otograph				
Temperature (°C)			21.5			34						Summer Local		
Dissolved Oxygen (mg	g/L)		8.1			S				CARLES & G	4	A ALTER		
Specific Conductance	e (µS/cm	ר)	58			100	and the second		A CONTRACTOR		1.2	too		
pH (s.u.)			6.7	a solution		5 2	100	1063 L		North.				
				- m	20-22				1	ALC: NO		and the lot		
Water Clarity		Very	slightly turbid	100						the second		14		
Habitat Assessment	Scores	(max)										122		
Channel Modification	(5)	. ,	5		-		-		1 mil	-	-	and the second		
Instream Habitat (20)	(-)		18	and the second	of the		15	and the second			-			
Bottom Substrate (15)	)		12	100 2						-				
Pool Variety (10)	,		6		212	~	-					No. THE R.		
Riffle Habitat (16)			16			Terr	and the	A again and	and to	Contract Cont	The second	and the second		
Left Bank Stability (7)			6	-5-27	and a state of the	Ser.	1-1					* 1-		
Right Bank Stability (7	7)		6		2 Sale	State .	- And	and the second	A Carton	ALL	Car Car	and the second		
Light Penetration (10)	)		7	4.		Server.	The second	and a	a sip	Har Forthand	The .	- ANA-		
Left Riparian Score (5	5)		4	1-1-		- ABA		- States		at the for	The way of	A AND AND AND		
Right Riparian Score	(5)		3											
Total Habitat Score (	(100)		83	Sub	strate	cobble, b	oulder	, bedrock						

Sample Date	Sample ID	Species Total			NCIBI	Bioclassification
06/19/07	2007-87	9				Not Rated
Most Abundant Species	River Chub	er Chub		ies	Brown Trout	
Species Change Since Last Cyc	e N/A					

#### Data Analysis

This is the first fish community sample collected at this site. **Watershed** -- a tributary to the French Broad River located about one and a half miles above its confluence; drains part of west-central Madison County. Although largely forested, much of the stream runs parallel with the road corridor and is vegetated with the exotic Japanese knotweed (*Polygonum cuspidatum*); many residential lawns and gardens also exist along the stream. **Habitat** -- high gradient mountain stream with chutes, riffles, runs, and a few good pools; several sunlit areas (road and stream-side residences) and a moderately elevated conductivity are contributing to the slick periphyton found on the rocky substrates. **2007** -- a highly abundant (n = 1749) yet low diversity fish community was collected; River Chubs and herbivorous Central Stonerollers (n = 592 or 34%, and n = 515 or 29%, respectively) comprised more than half of the fish collected. Several species were anticipated but absent including Mountain Brook Lamprey, Greenfin Darter, Swannanoa Darter, Mottled Sculpin, and Rainbow Trout. Based on NCIBI metric scores at this site, the rating would be Poor; since the fish community in this mountain watershed has been substantially altered by loca

Waterbody		Locat	Location				Date	Bioclassification
Big Laure	el Cr	SR 1	503	EB1	84	09	9/18/06	Excellent
County	Subbasir	8 digit HUC	Latitude	Longitude	e AUI	Number	Le	evel IV Ecoregion
Madison	4	06010105	355436	823238	6	6-112 Southe		stalline Ridges and Mountains
Stream Classifica	tion	Drainage Area (mi	2) Ele <sup>v</sup>	vation (ft)	Stre	am Width	(m)	Stream Depth (m)
C; Tr		5		2,677		4		0.3
Foreste		Forested/Wetland	Urbar	1	Agricul	Agriculture		Other (describe)
Visible Landuse	(%)	50	40		10			0
Upstream NPE	DES Discha	gers (>1MGD or <1M	MGD and withi	n 1 mile)	NF	DES Nur	nber	Volume (MGD)
None						N/A		N/A
Water Quality Parame	eters					Site Pho	otograph	
Temperature (°C) Dissolved Oxygen (mg	ı/L)	18.7 7.7		A Maria	N		Vicini	
Specific Conductance	(µS/cm)	45	Ser. 1	1200			- date	
pH (s.u.)		6.1	2	A Car	Re Do	-		
Water Clarity		Clear					E H	
Habitat Assessment	Scores (ma	()		a police		Sea car		
Channel Modification (	5)	4	AL CO	and a		-	-	and the second second
Instream Habitat (20)		18			and the second		391 200	- Katal
Bottom Substrate (15)		12			marce			1000
Pool Variety (10)		4		1				
Riffle Habitat (16)		14			1000	-	-	A CONTRACTOR OF THE OWNER
Left Bank Stability (7)		7	1000		12		State and a lot	A CONTRACTOR
Right Bank Stability (7	)	7		ALC: NO		1		
Light Penetration (10)		9	1000	and a second second			A PROPERTY OF	and the second
Left Riparian Score (5)	)	3	and a	-			and the second	and the second
Right Riparian Score (	5)	5						

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
09/18/06	10088		44		2.72	Excellent
07/08/02	8843		45		2.30	Excellent
07/08/97	7341		33		2.30	Good

Rubble, gravel, sand, silt, and boulder.

Substrate

83

### **Taxonomic Analysis**

**Total Habitat Score (100)** 

EPT taxa richness has remained essentially unchanged between the 2002 and 2006 sampling events. Intolerant taxa common or abundant from both the 2002 and 2006 collections include the mayflies *Epeorus rubidus*, *Ephemera* sp., the stoneflies *Acroneuria abnormis*, *Paragnetina immarginata*, *Tallaperla* sp., and the caddisflies *Dolophilodes* sp., *Glossosoma* sp., and *Rhyacophila fuscula*. The slight increase in EPTBI measured from the 2006 sample was the result of a corresponding increase in abundances of several facultative taxa such as the mayflies *Baetis pluto*, *Plauditus dubius*, *Maccaffertium modestum*, *Maccaffertium pudicum* and the caddisflies *Cheumatopsyche* sp., and *Ceratopsyche bronta*.

### **Data Analysis**

Since the initial 1997 Good bioclassification, this site has improved to Excellent although the EPTBI did increase slightly in 2007 relative to the earlier samples. However, the 2007 sample also produced the highest EPT abundance (204) relative to the 2002 sample (196) and the 1997 sample (147). In general, the improvement seen in 2002 from the 1997 sample has been maintained through 2006 and indicates that water quality in this catchment remains stable. Indeed, conductivity values were nearly identical from 2002 (47µS/cm) and 2006 (45 µS/cm)

Waterbody		Locat	Location				Date	Bioclassification
Big Laur	el Cr	NC 2	08	EB18	31	09	/21/06	Excellent
County	Subbasin	8 digit HUC	Latitude	Longitude	AU I	AU Number		vel IV Ecoregion
Madison	4	06010105	355522	824505	6	6-112 So		etasedimentary Mountains
Stream Classifica	ation	Drainage Area (mi2	2) Elev	vation (ft)	Stream Wie		(m)	Stream Depth (m)
C; Tr		67.5	1	1,640		20		0.4
	F	prested/Wetland	Urban		Agricul	ture	0	ther (describe)
Visible Landuse	(%)	90	0		0			10-Residential
Upstream NPI	DES Discharg	gers (>1MGD or <1M	IGD and within	n 1 mile)	N	DES Nun	nber	Volume (MGD)
None						N/A		N/A
Water Quality Param	eters					Site Pho	tograph	
Temperature (°C)		14.6		North States				
Dissolved Oxygen (mo	a/L)	9.49		S. Sand S.				
Specific Conductance	(µS/cm)	78	and the second	APRIL AN	200	1.000		
pH (s.u.)	<b>u</b> ,	7	-	Section 1		A COLOR		The second second
Water Clarity		Clear					Sale and	
Habitat Assessment	Scores (max)	)	100	Star Land				States and a
Channel Modification	(5)	4		and a				The second second
Instream Habitat (20)		16	-		-		the same	and the second states
Bottom Substrate (15)		8				2	Total International	and the second states and
Pool Variety (10)		3	2.0		and the second		and the second	
Riffle Habitat (16)		12	-	and the second	ALC: NO	-		CIRCUSSION - CONTRACTOR
Left Bank Stability (7)		7		a state	-	and the state		
Right Bank Stability (7	.)	6		St. C.		10		
Light Penetration (10)		6	E. and E	- THE			and the second of	and the second second
Left Riparian Score (5	)	5		and the set	and the second	and the second	-x 229	and the second sec
Right Riparian Score (	(5)	2						

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
09/21/06	10074		47		3.37	Excellent
05/30/02	8767	90	46	4.60	3.50	Good
07/08/97	7340		36		2.70	Excellent
08/19/92	6004		38		3.00	Excellent

Rubble, sand, gravel, boulder and silt.

Substrate

69

#### **Taxonomic Analysis**

**Total Habitat Score (100)** 

Since 1997, overall EPT diversity has increased at this station. However, the 2002 Full-Scale sample produced the highest EPTBI recorded and was the result of first-time occurrence of several facultative mayfly taxa: *Plauditus dubius*, *Centrotilum* sp., *Pseudocloeon frondale*, and *Hexagenia* sp. The occurrence of these taxa contributed to the lowered bioclassification observed in 2002. These aforementioned taxa were not collected in 2006 and as a result the EPTBI lowered.

### Data Analysis

Although the 2002 sample received a Good bioclassification, it was on the borderline of receiving an Excellent bioclassification. While the EPTBI has increased since 1997, there has also been an increase in EPT abundance as it was 149 in 1992, 131 in 1997, 200 in 2002, and 262 in 2006. Overall, water quality at this location has remained generally stable since sampling commenced in 1992.

Waterbody		Locati	Location			Date		Bioclassification
Puncheo	n Fk	SR 15	603	EB2	217	30	3/01/07	Excellent
County	Subbasin	8 digit HUC	Latitude	Longitud	e AUN	Number	Lev	vel IV Ecoregion
Madison	4	06010105	355435	823239	6-	6-112-5 Sc		taline Ridges and Mountains
Stream Classifica	ation	Drainage Area (mi2	) Elev	vation (ft)	Strea	am Width	(m)	Stream Depth (m)
C; Tr		7.3	:	2,998		5		0.5
Forest		prested/Wetland	Urban	I	Agricult	Agriculture		ther (describe)
Visible Landuse	(%)	40	20		30		1	0 (Commercial)
Unstream NPDES Dischargers (>/		ers (>1MGD or <1M	GD and within	n 1 mile)	NF	DES Nur	nber	Volume (MGD)
		None		-7				
Water Quality Param	eters					Site Pho	otograph	
Temperature (°C)		23.3	No.		Seren a	No.		
Dissolved Oxygen (mg	g/L)	7.2	200	1. A.L.	36	ture of		The second second
Specific Conductance	(µS/cm)	41.4		. 25		-	and a start	and the second
pH (s.u.)		6.4	1	· ·	CAR S	A. TRANS		
Water Clarity		Slightly Turbid			Same Same	-		
Habitat Assessment	Scores (max)	)	The state	-	Contraction of the local division of the loc		and the second	
Channel Modification (	(5)	4	Sec.	-			The state	
Instream Habitat (20)		15		1-200		Rea -		
Bottom Substrate (15)		14	the second		- 15	4	a Burket	Jan
Pool Variety (10)		4	Real				Contractor of	Street and the
Riffle Habitat (16)		16	1				ALCONTRACTOR	
Left Bank Stability (7)		6	1000					and the second
Right Bank Stability (7	·)	6						
Light Penetration (10)		7						and the second
Left Riparian Score (5	)	1	Ser -					AND THE REAL PROPERTY AND
Right Riparian Score (	5)	1						
Total Habitat Score (	100)	74	Substra	ate Bo	ulder, rubbl	le, gravel,	and sand.	

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/01/07	10265	40	40	2.48	2.48	Excellent
07/08/02	8770	40	40	2.80	2.80	Excellent
07/08/97	7342	31	31	2.20	2.20	Good

### **Taxonomic Analysis**

This site has shown improved community metrics since the first sample in 1997. EPT taxa present in 2002 and 2007 but absent in 1997 included the mayflies *Acentrella* sp., *Serratella carolina*, the stonefly *Malirekus hastatus*, and the caddisflies *Lepidostoma* sp., *Polycentropus* sp., and *Pycnopsyche* sp. Moreover, there were several EPT taxa collected here for the first time and included the mayflies *Diphetor hageni, Ephemerella subvaria*, and the caddisflies *Diphetor hageni, Ephemerella subvaria*, and the caddisflies *Diphetor hageni, Ephemerella subvaria*, and the caddisflies *Diphetor na modesta, Leucotrichia pictipes, Lype diversa, Neophylax consimilis, and Neophylax mitchelli*.

### **Data Analysis**

Since 1997, the EPT taxa richness and EPT abundance have been trending higher. In fact, the 2007 sample had the highest EPT abundance (252) yet measured here and has increased steadily from 174 in 1997 and 219 in 2002. In addition to these three samples, a 2006 sample was taken about 1.5 miles upstream off SR 1502 as part of a High Quality Waters/Outstanding Resource Waters reclassification study which was requested prior to the installation of a large subdivision and WWTP which will discharge to Puncheon Fork. This sample also resulted in an Excellent bioclassification. These data currently suggest favorable water quality at this location.

Waterbody		Locati	Station ID		Date		Bioclassification	
Shelton Lau	urel Cr	NC 2	08	EB21	9	09	/19/06	Excellent
County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number		Lev	el IV Ecoregion
Madison	4	06010105	355607	824435	6-112-26 So		Southern Me	tasedimentary Mountains
Stream Classifica	tion [	)rainage Area (mi2	) Elev	ation (ft)	Strea	m Width	(m)	Stream Depth (m)
C; Tr	C; Tr		1	,712		10		0.4
	Fo	ested/Wetland	Urban		Agricult	ure	Ot	her (describe)
Visible Landuse	(%)	80	0		0		2	20-Residential
Upstream NPD	ES Discharge	ers (>1MGD or <1M	IGD and within	n 1 mile)	NP	DES Num	nber	Volume (MGD)
Madison Co., Boe/Lau	rel Elementary	School			NC	0034207	001	0.005
Water Quality Parame	eters					Site Pho	tograph	
Temperature (°C)		17.9	Star .			and the second		
Dissolved Oxygen (mg	/L)	8.5		是在东门	Set .	100		No in the
Specific Conductance	(µS/cm)	49		SHEP 1			Sale	ALE ALE
pH (s.u.)		5.9			1. 14	atter !		MARY LAND AND AND
Water Clarity		Clear						
Habitat Assessment S	Scores (max)		S. S. S.				Contraction of the second	
Channel Modification (	5)	4	14 10				the second	
Instream Habitat (20)		18		Carl Carl				
Bottom Substrate (15)		15			A BARLINE			
Pool Variety (10)		5		and the second second				
Riffle Habitat (16)		14			TY	-	and the second	and the second second
Left Bank Stability (7)		5				The second	A MARTIN	- The second
Right Bank Stability (7)	)	6	-					
Light Penetration (10)		7	5.5		and and		1655	and the states -
Left Riparian Score (5)		1	19.20				2	and the second

Right Riparian Score (5) Total Habitat Score (100)

Rubble, boulder, gravel, sand, bedrock, with a trace of silt.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
09/19/06	10101		44		3.40	Excellent
06/27/02	8841		32		3.60	Good
07/08/97	7339		31		3.10	Good
08/19/92	6003		32		2.90	Good
05/16/90	5267		44		2.50	Excellent

Substrate

78

### **Taxonomic Analysis**

The 2006 sample resulted in several EPT taxa collected at this location for the first time and included the mayfly *Maccaffertium pudicum*, the stoneflies *Eccoptura xanthenes*, *Paragnetina immarginata*, *Pteronarcys proteus*, and the caddislifes *Leucotrichia pictipes*, and *Paranyctiophylax moestus*. The addition of the long-lived and intolerant stoneflies *Paragnetina immarginata* and *Pteronarcys proteus* are particularly significant and suggest improved conditions at this location in 2006. In addition, the 2006 sample resulted in the most EPT specimens (203) ever collected here and represents a substantial increase from earlier samples; 142 in 1990, 144 in 1992, 163 in 1997, and 150 in 2002.

### **Data Analysis**

Although the EPTBI had been steadily increasing from the initial 1990 Excellent sample, this trend was reversed in 2006 as the EPTBI decreased slightly from the 2002 sample. In addition, the combination of the highest EPT abundance yet measured at this location, the highest EPT diversity measured sine 1990, and the first time presence of two long-lived and intolerant stoneflies suggest improved water quality along this reach of SHelton Laurel Creek. Although not conclusive, the limited conductivity data available here are supportive of this assertion as the conductivity was lower in 2006 (49 µS/cm) versus the 2002 measurement (56 µS/cm).

Waterbody		Locatio	Location				Date	Bioclassification
Spring	Cr	SR 11	72	EB2	222	11	/01/06	Excellent
County	Subbasin	8 digit HUC	Latitude	Longitud	e AU	Number	Lev	vel IV Ecoregion
Madison	4	06010105	354800	825110	6-1	6-118-(1) South		talline Ridges and Mountains
Stream Classifica	ition I	Drainage Area (mi2)	Elev	vation (ft)	Stre	am Width	(m)	Stream Depth (m)
C; Tr	C; Tr		2	2,437		6		0.3
Forested		rested/Wetland	Urban		Agricul	ture	0	ther (describe)
Visible Landuse	(%)	50	0		30			20-road
Upstream NPI	DES Discharge	ers (>1MGD or <1M	GD and withir	n 1 mile)	N	PDES Nur	nber	Volume (MGD)
None						N/A		N/A
Water Quality Param	eters					Site Pho	tograph	
Temperature (°C) Dissolved Oxygen (mg	ŋ/L)	10.6 10.2			CO.O.			SAVE
Specific Conductance	(µS/cm)	63		AN IN	-	-	dix .	Web Ve
pH (s.u.)		7.4			al worth	a fair	A dad	A LINA T MARKET
Water Clarity		Clear	and a				A.	
Habitat Assessment	Scores (max)				A	1.200		and the second second second
Channel Modification (	(5)	2	And South	and the second second	and the second		Sales Sales	
Instream Habitat (20)		18	alter -		105-		andra (	and the state of the
Bottom Substrate (15)		8			1000	Sector -		The second second
Pool Variety (10)		2	The second		-	- Summ	The later	
Riffle Habitat (16)		16	Star 1					and the start
Left Bank Stability (7)		2	1 400		a station		- Aller	
Right Bank Stability (7	)	3	and the second	200	and a	the state	and the state	19/12/ 19/12
Light Penetration (10)		2			- sul	1		
Left Riparian Score (5)	)	2	the state	T- AN	and the	18 K -	and the second	Carl Carl Carl Carl
Right Riparian Score (	5)	2						

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
11/01/06	10119		41		3.06	Excellent
06/27/02	8842		37		3.30	Excellent
07/08/97	7338		31		3.00	Good
08/19/92	6002		26		2.70	Good-Fair

Rubble, boulder, gravel, and sand.

Substrate

57

### **Taxonomic Analysis**

Total Habitat Score (100)

This site at SR 1172 is well upstream of the historic basinsite at NC 209. Although it is further upstream, and the sample was collected outside of the normal summer window, there were several non-seasonal intolerant EPT taxa collected from Spring Creek for the first time and included the mayflies *Baetisca carolina* and *Rhithrogena uhari*, the stoneflies *Agnetina capitata* and *Tallapera* sp, and the caddisflies *Diplectrona modesta*, and *Rhyacophila carolina*.

### Data Analysis

Based on the 2002 sample collected further downstream at NC 209, the 2006 sample obtained at SR 1172 provides further evidnece that water quality continues to improve throughout the Spring Creek watershed over levels measured in the early 1990's when biomonitoring initiated. Since 1992, EPT taxa richness and EPT abundnace have generally been on the increase. Sampling at the historic basinsite at NC 209 will resume in 2012.

Waterbody		Date Statio			on ID Bioclassification					
MEADOW F	K		NC 209		06/19/	07	EF7	2	G	ood
County Su	ıbbasin	8 digit HUC	Latitude	Long	itude	AU	Number		Level IV Ec	oregion
MADISON	4	06010105	35.8309149	-82.86	20598	6-′	118-19	Southe	ern Crystalline Ric	lges and Mountains
Stream Classification	Draina	age Area (mi2)	Elevatio	on (ft)	Strean	n Wic	dth (m)	Aver	age Depth (m)	Reference Site
C;Tr		22.7	190	0		7			0.4	Yes
						<b>A</b>		•	Other	(de e e rike)
Visible Landuse (%)	Fore	98	2 (rural re	esidential)		Ag			Other	
		50				Ū			0	
Upstream NPDES Discharg	gers (>1MC	GD or <1MGD a	nd within 1 mile	e)			NPDE	S Number		Volume (MGD)
		None								
Water Quality Parameters							5	Site Photo	graph	
Temperature (°C)		18.8		- 6	生活の	33	Parts -		100 3	
Dissolved Oxygen (mg/L)		8.5			1. a. a	1	and the second	a to all a	A CARLE	and the second
Specific Conductance (µS/c	m)	41				in the	dial and	A Cart	The state	Martin and
pH (s.u.)		6.2		100	A State		- Alter	1975		Contraction of the
			1			21.2		Con a		
Water Clarity		Clear	1	In	1.1	÷.	2	Long and		A A A
			July 1	923			ALC: NO		11/2	
Habitat Assessment Score	s (max)			and the					121122	and the N
Channel Modification (5)		5						and a		
Instream Habitat (20)		20	1 m				-	-	the second s	and the second
Bottom Substrate (15)		15			124.5	7.0	and a second		Sec.	C-
Pool Variety (10)		9		196	10 al	1 . A	-	-	and the second sec	a hard
Riffle Habitat (16)		16		C. N. PAR	100	2			and the second	
Left Bank Stability (7)		7	14	AL MAR	1	L.	Jan	- phase	a second	
Right Bank Stability (7)		7		- 5 Bas	- Contract	-	2.2			
Light Penetration (10)		10	SEL.	162			1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1		at the	a second second
Left Riparian Score (5)		5	16		in the	354	Charles -	N.M.		A Partie and
Right Riparian Score (5)		5								
Total Habitat Score (100)		99	Sub	strate	cobble, bo	ulder,	, gravel			
Sample Date		Sample	D	Spe	cies Total			NCIBI	E	Bioclassification
06/19/07		2007-86	6		11			48		Good
Most Abundant Species		Longnose Dace	9		Exotic \$	Speci	ies	Rainbow	Trout and Brown	Trout
Species Change Since Las	st Cycle	N/A								
Data Analysis										
This is the first fish commun	ity sample	collected here.	Watershed a	forested tri	ibutary to S	pring	Creek and	d ultimately	the French Broa	d River; this site
location is just above the Sp	ring Creek	confluence; drai	ns the westernm	lost tip of N	Madison Co	unty,	including s	some Pisga	ah National Fores	t lands; Hatchery

several sections of the 600' sample reach and has extensive forested riparian zones; this site earned the highest habitat score among all sites sampled in the basin in 2007. **2007** -- an abundant (n = 421) assemblage of cool and cold water fish species was collected; the fish community had low to moderate species richness (typical for high gradient mountain streams) and included 2 reproducing species of trout; there appears to be no water quality issues in this high gradient mountain watershed.

Waterbody		Locati	Statio	n ID	Date		Bioclassification	
Pigeon	R	I-40 at Brown	n's Bridge	EB2	250	30	8/08/07	Good
County	Subbasin	8 digit HUC	Latitude	Longitud	e AUN	Number	Lev	vel IV Ecoregion
Cocke Co., Tenn.	5	6010106	354707	830647	5	5-(7)f		Broad Basins
Stream Classifica	ition [	Drainage Area (mi2	:) Elev	vation (ft)	Strea	am Width	(m)	Stream Depth (m)
С	C			2,048		40		0.6
	rested/Wetland	Urban		Agricul	ture	0	Other (describe)	
Visible Landuse	(%)	100	0		0			0
Upstream NPI	DES Discharge	ers (>1MGD or <1N	IGD and withir	n 1 mile)	NF	PDES Nur	nber	Volume (MGD)
None	<u> </u>			,		N/A		N/A
Water Quality Parame	eters					Site Pho	tograph	
Temperature (°C) Dissolved Oxygen (mg Specific Conductance pH (s.u.) Water Clarity	g/L) (μS/cm)	22.6 N/A 220 6.4 Slightly Turbid						
Habitat Assessment	Scores (max)							
Channel Modification (	(5)	4	194	Contraction of the local distribution of the	120 ×			
Instream Habitat (20)		15	- Andrewson	- Territoria			attendige a late	
Bottom Substrate (15)		10	and the second		to the state		E and the second	
Pool Variety (10)		4	aller			12	-	
Riffle Habitat (16)		14	Cont and	T - F		Las Marca and		
Left Bank Stability (7)		7	-				- April -	
Right Bank Stability (7	<i>)</i>	5	and the second second	2- Jun			a man and the	
Light Penetration (10)		5	and the second	Here and		pour la la		the second se
Left Riparian Score (5)	)	5	and the second second	State of the second sec		and a	Contraction	
Right Riparian Score (	5)	1						
Total Habitat Score (	100)	70	Substra	ate Bou	ulder, rubbl	le, gravel,	and sand with a	trace of bedrock.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/08/07	10302	84	34	4.90	3.70	Good
07/23/02	8885	76	38	5.00	3.92	Good
07/24/97	7365	81	40	4.77	3.13	Good
08/03/94	6632	58	27	4.37	3.61	Good
07/25/90	5400	57	22	4.67	3.78	Good-Fair

### **Taxonomic Analysis**

Including the 2007 sample, this location has been sampled on 12 occasions with five samples resulting in Good bioclassifications, six Good-Fair ratings, and one Fair bioclassification in 1985. This site showed an improvement in bioclassification starting with the 1994 sample and this trend has continued (particularly as it pertains to the EPT community). Indeed, since the improvement noted in 1994, numerous EPT taxa have been present each year since 1994 and include the mayflies *Baetis intercalaris*, *Maccaffertium ithaca*, *M. modestum*, the stoneflies *Acroneuria abnormis*, *Leuctra sp., Paragnetina immarginata*, and the caddisflies *Cheumatopsyche* sp., *Hydropsyche venularis*, *Lepidostoma* sp., *Polycentropus* sp., *Ceratopsyche* 

### **Data Analysis**

With the exception of the 1985 sample, this site has always been either Good-Fair or Good and has been consistently been Good since 1994. Although there are large diurnal swings in discharge in this segment of the Pigeon River below Lake Waterville, it does not appear that this is an overwhelmingly negative influence on the invertebrate community as a whole. However, there may be some issues with low dissolved oxygen levels as the low dissolved oxygen indicating gastropod *Physella* sp has been common in the last three collections (previously *Physella* sp had only been collected once and was rare between 1989, 1990, and 1994).

Waterbody		Locati	on	Sta	tion ID	Date		Bioclassification
W Fk Pige	eon R	SR 12	216	EE	3273	08	3/08/07	Excellent
County	Subbasin	8 digit HUC	Latitude	Longit	ude Al	J Number	L	evel IV Ecoregion
Haywood	5	06010106	352346	8256	17	0	Southern Cr	ystaline Ridges and Mountains
Stream Classifica	ation I	Drainage Area (mi2	) Elev	vation (ft)	Sti	eam Width	(m)	Stream Depth (m)
WS-III; Tr	WS-III; Tr			2,998		15		0.5
	Forested			I	Agric	ulture		Other (describe)
Visible Landuse	Visible Landuse (%) 90				(	)		10 (SR 1216)
Upstream NP	Upstream NPDES Dischargers (>1			n 1 mile)		NPDES Nur	nber	Volume (MGD)
None		•				N/A		N/A
Water Quality Param	eters					Site Pho	otograph	
Temperature (°C)	- (1.)	22.3	5.94			NUMBER	Post And	
Dissolved Oxygen (m)	g/L)	10.9	THE					
	(µS/cm)	63				C. Provins		
рп (s.u.)		0.3				15 8	A STATE OF T	
Water Clarity		Clear		Jul.	2		- de	
Habitat Assessment	Scores (max)			= /	2	adama.		
Channel Modification	(5)	4	-	and the second second	-	-	And	
Instream Habitat (20)		17		-	-	-	A CONTRACTOR OF THE	the second se
Bottom Substrate (15)	)	15	Carton pre		Statistics in a	Manage	and and the still	
Pool Variety (10)		5		-		and the	-Aller Line	
Riffle Habitat (16)		15	and the second		Contraction of	De a	No and	A CONTRACTOR OF THE OWNER
Left Bank Stability (7)		6			Sec.		Sec.	and the second se
Right Bank Stability (7	7)	6	1	-		A State	2	
Light Penetration (10)	Penetration (10) 7		and the second	- Car	The second	and the second second	and a state of the second	
Left Riparian Score (5	Riparian Score (5) 5			Care Con		100 M	APR - Bar	
Right Riparian Score (5)					and the second second	Contraction of the American		
Total Habitat Score (	100)	82	Substra	ate F	Rubble, bou	lder, gravel	, sand.	

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/08/07	10306		46		1.93	Excellent
11/29/04	9528	69	42	2.50	2.00	Good
07/25/02	8896		37		2.40	Excellent
07/22/97	7358		50		1.50	Excellent
01/12/93	6044	81	47	2.50	1.70	Excellent

### **Taxonomic Analysis**

The upstream portion of the West Fork Pigeon River watershed is completely protected with only very minimal impacts from SR 1216 present. As would be expected from an undisturbed catchment such as this, all but one sample taken here has been Excellent. Several of the same pollution intolerant EPT taxa have been present at this station from every summer sample and include the mayflies *Acentrella* sp., *Drunella cornutella*, and *Rhithrogena exilis*, the stoneflies *Acroneuria abnormis*, *Leuctra* sp. and *Pteronarcys proteus*, and the caddisflies *Ceratopsyche alhedra*, *Dolophilodes* sp., *Glossosoma* sp., *Lepidostoma* sp., *Pycnopsyche* sp., and *Ceratopsyche sparna*.

### Data Analysis

With the exception of the post Hurricane Ivan, Francis, and Jeanne sampling conducted in 2004, every sample taken at this location using NCDWQ collection methodology (six samples since 1990) has resulted in an Excellent bioclassification. With the exception of the 2004 post Hurricane sampling, and the 2002 sample (which was conducted during a torrential downpour) EPT community metrics have been remarkably consistent at this location over time and reflects the highly protected nature of the West Fork Pigeon River catchment.

Waterbody		Locat	ion	Station ID			Date		Bioclassification	
Richland	d Cr	Business	, US 23	EB	262	30	3/07/07		Good-Fair	
County	Subbasin	8 digit HUC	Latitude	Longitud	le AU I	Number		Lev	el IV Ecoregion	
Haywood	5	06010106	5010106 352752 830040 5-16-(11.5)b Broad					Broad Basins		
Stream Classifica	ition I	Drainage Area (mi2	2) Elev	vation (ft)	Stre	am Width	(m)	) Stream Depth (m)		
B; Tr		11	2,759			5			0.3	
	Fo	rested/Wetland	Urban	1	Agriculture			Ot	her (describe)	
Visible Landuse	(%)	10	90	0	0			0		
Upstream NPI	DES Discharg	ers (>1MGD or <1M	IGD and withir	n 1 mile)	N	PDES Nur	nber		Volume (MGD)	
None		``		,		N/A			N/A	
Water Quality Parame	eters				•	Site Pho	tograph			
Temperature (°C)		27.9	1	51 11		200	Sec. 1		and the second second	
Dissolved Oxygen (mo	1/L)	6.6	123-		All sectors in		2006	S. 4		
Specific Conductance	(µS/cm)	24.5	1-1	1.10	Ser.	SIL	1	Ane	Charles Torres	
pH (s.u.)		6.8	1	121/2		1.1	Sec.			
Water Clarity		Clear	A		N.					
Habitat Assessment	Scores (max)			1		ALC: NO			A DE CONTRACT	
Channel Modification (	(5)	3	1.1	-		and the second second			1111	
Instream Habitat (20)		14	100.68	the se	Ser.	1000	100			
Bottom Substrate (15)		14	24	1	-	- Income	100			
Pool Variety (10)		4			and the second	a come		E.	the second second	
Riffle Habitat (16)		14				-				
Left Bank Stability (7)		6	- 27		1		Carlos -	14 -		
Right Bank Stability (7	)	6			-		1000			
Light Penetration (10)		9		-	and the	the second	-	The second	and the second second	
Left Riparian Score (5)	)	2	Gars.	-			1211		10 3 3 12	
Right Riparian Score (	5)	1								
Total Habitat Score (	100)	73	Substra	ate Ru	Rubble, gravel, sand, and boulder.					

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/07/07	10297		27		2.85	Good-Fair
07/29/02	8894		31		2.90	Good
07/25/97	7370		23		2.70	Good-Fair
08/18/92	5997		17		3.50	Fair

#### **Taxonomic Analysis**

Although the 2007 sample declined in bioclassification from the 2002 (Good) sample, the 2007 collection was just one EPT short of receiving a Good rating and the EPTBI was essentially identical between years. These data suggest that there has been no significant change in water quality at this location since 2002. In terms of EPT species richness, the 2007 and 2002 sample were both superior to the 1997 and 1992 samples. Intolerant EPT taxa collected either in 2002 and or 2007 but absent from the 1992 and 1997 samples include the mayflies *Drunella cornutella*, *Epeorus dispar*, *Habrophlebiodes* sp., *Stenacron pallidum*, the stoneflies *Isoperla holochlora*, *Malirekus hastatus*, *Pteronarcys* sp., and *Suwallia* sp., and the caddisflies *Brachycentrus spinae*, *Dolophilodes* sp.,

#### **Data Analysis**

The large increase in EPT species richness noted in 2002 and 2007 (relative to the 1992 and 1997 samples) is likely related to the decreased nonpoint runoff which is prevalent in this watershed as both of these samples were taken during droughts. The large increase in EPT taxa richness from the 1992 and 1997 samples noted in 2002 and 2007 was mostly concentrated in stonefly diversity. In 1992 and 1997 only one taxon of stonefly was collected. In 2002 four stonefly taxa were collected and in 2007 three taxa were present. In general, stoneflies are widely considered the most intolerant of all the aquatic insect orders and combined with the other improved metrics these data continue to suggest improved conditions in this segment of Richland Creek.

Waterbody				Date Station		n ID Bioclassification							
RICHLA	ND CF	ł	B	oyd Ave		06/15	/07	EF4	4		Not R	ated	
County	Sub	basin	8 digit HUC	Latitude	Long	itude		AU Numbe	er	L	evel IV E	coregion	
HAYWOOD		5	06010106	35.48916667	-82.999	916667		5-16-(11.5)	)a		Broad I	Basins	
Stream Classifica	tion	Draina	age Area (mi2)	Elevatio	on (ft)	Strea	m Wio	dth (m)	Ave	rage Depth	ı (m)	Reference Sit	e
B;Tr			42.9	266	5		12			0.4	<b>、</b>	No	
Visible Landuse	(%)	Fore	sted/Wetland	Url 75 (res	ban idential)		Agriculture			(	Other (de	scribe)	
VISIBLE Landuse	(70)		20	70 (103	lacitial)			U			0		
Upstream NPDES Di	ischarge	rs (>1MC	GD or <1MGD a	nd within 1 mile	e)			NPDES	S Numbe	r	Vo	lume (MGD)	
			None										
Water Quality Param	neters							s	ite Photo	ograph			
Temperature (°C)			16.6				160			NER	5 Cur		
Dissolved Oxygen (m	a/L)		9.0		1000		L.		P- 84	1 2 27	-	Sec. a	
Specific Conductance	9/-/ (uS/cm)	)	50		Sec. 2	1		P. Land	Service -		A second	Ann Anna ann	12
pH (s.u.)	(1)		6.9	Star and	1	1000		L.					
F (2.2.)					- 530	and the		ne al la	- Here		day 1	STATISTICS.	12
Water Clarity			Clear			R. AND							
Habitat Assessment	L Scores	(max)			2/15		1	-	1		E.	Ser you	1
Channel Modification	(5)		5	E Pak	*			- Internet			and the second	2001	
Instream Habitat (20)			18					the second			-		1
Bottom Substrate (15	)		13		-	600	-	a the second		1 100	1.00		-7
Pool Variety (10)			6	1		-	State of		the state		a dia	12	
Riffle Habitat (16)			16		No. of Concession, Name		1 YOUT	Ser Contra	the state	2	-		
Left Bank Stability (7)			6	A STATE	The star	and the same		The state	Stand Stand	A STATE	- Artisting		-
Right Bank Stability (7	7)		6	and the second	-		1	and the second	-		a spinster	and the second	
Light Penetration (10)			8	and the second second	CC-F	-	1	- Salar and	-	and the second	Re .		
Left Riparian Score (5	5)		2	PERMIT	and the second		all a	Carlos and	The second	2	and the second		
Right Riparian Score	(5)		3										
Total Habitat Score	(100)		83	Sub	strate	Cobble ar	nd bou	ulder					
Sample Date	)		Sample I	D	Spe	cies Total			NCIBI		Bio	classification	
06/15/07			2007-82	) -		7						Not Rated	
07/17/01			2001-78	8		11			28			Poor	
Most Abundant Spe	ecies		Longnose Dace	9		Exotic	Spec	ies	Rainbow	Trout, Brov	vn Trout,	and Green Sunfi	sh
Species Change Sin	ce Last	Cycle	Gains -	Western Blackr	nose Dace	Losses	Whi	itetail Shine	r, White S	Sucker, Bro	wn Bullhe	ad, Redbreast	
Data Analysis			Curinon,		r								
Watershed a tributa corridor. Habitat fa riparian zones. 2007	ary to the ist, shallo condu	e Pigeon I ow riffles a ctivity slig	River; drains sou and runs; under htly elevated; m	uthwestern Hayw cuts and snags; ore than twice a	vood Coun very clean s many fis	ty, includin substrate; h were col	ig the open lected	upper portio canopy nea in 2007 tha	on of the ar the bric an in 2001	City of Way dge, then sh I (n = 410 v	nesville a naded; res rs. 200); o	nd the US 23/74 sidences within th nly seven specie	ne es

corridor. **Habitat** -- fast, shallow riffles and runs; undercuts and snags; very clean substrate; open canopy near the bridge, then shaded; residences within the riparian zones. **2007** -- conductivity slightly elevated; more than twice as many fish were collected in 2007 than in 2001 (n = 410 vs. 200); only seven species were present, no darters, lampreys, or sculpins were present; excellent wild Rainbow Trout and Brown Trout populations; Rainbow Trout (n = 90) were 125-250 mm TL and Brown Trout (n = 11) were 150-270 mm TL; fish community is Not Rated because the community has characteristics of a trout stream which it did not have in 2001. **2001 & 2007** -- 12 species are known from the site, but no darters, sculpins, or lampreys; percentage of tolerant fish decreased from 13.5% in 2001 to 0.5% in 2007; dominant species have been the Northern Hogsucker and Longnose Dace; although Not Rated; community has greatly improved since 2001; sampled in 2001 as part of the Richland Creek Use Attainability Reclassification study (BAU Memorandum F-2001020906).

Waterbody		Locatio	Statio	on ID		Date	Bioclassification	
Richland	d Cr	SR 11	84	EB	260	30	3/07/07	Good
County	Subbasin	8 digit HUC	Latitude	Longitud	le AU	Number	Le	vel IV Ecoregion
Haywood	5	06010106	353031	825819	I	0		Broad Basins
Stream Classifica	ation	Drainage Area (mi2)	) Elev	vation (ft)	Stre	am Width	(m)	Stream Depth (m)
В		47.7	2	2,586		10		0.3
Visible Landuse	Fo	rested/Wetland	Urban		Agriculture		С	ther (describe)
VISIBle Landuse	(70)	00	00		0			v
Upstream NPI	DES Discharg	ers (>1MGD or <1M	GD and withir	n 1 mile)	N	PDES Nur	nber	Volume (MGD)
None						N/A		N/A
Water Quality Param	eters					Site Pho	otograph	
Temperature (°C)		N/A	11 12	A	P Star		and the second second	
Dissolved Oxygen (mg	g/L)	N/A					where the second	
Specific Conductance	(µS/cm)	N/A	2.19					
pH (s.u.)	. ,	7.2	1.	- De CV			and the second	
Water Clarity		Slightly Turbid	19 B. S.					No. No.
Habitat Assessment	Scores (max)		and the					
Channel Modification	(5)	4	State Ba			- COL		
Instream Habitat (20)	. ,	15	and the second	Con many			a second	
Bottom Substrate (15)		14	Sec. 1	5 . 1 M	and the		the second second	and the second
Pool Variety (10)		3	and	1		Strates	a company	
Riffle Habitat (16)		15	101	- 11 - C	a an the	- There	and the second	No. Committee
Left Bank Stability (7)		6		Carl Sugar	Ci not	1955	A. Martin	Contraction and a
Right Bank Stability (7	.)	5		y ger	CALCER	1.00		A TRU CAN
Light Penetration (10)		8	100					
Left Riparian Score (5	)	5	Sec. 20	29301	1000		STAR ST	A CARLER AND
Right Riparian Score (	(5)	2	50 JPT	and the second se		AL BURN		

Sample Date Sample ID ST EPT BI EPT BI Bioclassification 08/07/07 10299 29 ----3.41 Good ---07/24/02 8891 19 4.30 Good-Fair -------07/24/97 24 3.20 Good-Fair 7373 -------08/18/92 5998 26 ---3.30 Good-Fair ---08/10/88 4692 42 11 6.20 5.30 Fair

Rubble, gravel, sand, and boulder.

Substrate

77

## **Taxonomic Analysis**

**Total Habitat Score (100)** 

In addition to the six samples noted above, this location has also been sampled twice earlier (1985 and 1983) with both of these samples producing Poor bioclassifications. This segment of Richland Creek has been improving in bioclassification since 1983 and the 2007 sample set record high EPT species richness and abundance values. Notably intolerant EPT collected for the first time at this location included the mayflies *Serratella carolina*, *S. deficiens*, the stonefly *Malirekus hastatus*, and the caddisflies *Diplectrona modesta*, *Dolophilodes* sp., *Lepidostoma* sp., *Leucotrichia pictipes*, *Oecetis* sp., and *Triaenodes ignitus*.

### Data Analysis

The continued trend of improving EPT community metrics and bioclassification at this location since 1983 is primarily the result of the removal of the two upstream dischargers (Lee and Dayco) in 1998. Moreover, recent work (2006 and 2007) undertaken by Regional Office staff have resulted in the identification and subsequent repair of numerous sewer leaks and overflows upstream of this location (on Richland Creek proper as well as on several tributaries including Hyatt Creek and Shelton Branch). The record high EPT richness and EPT abundance measured in 2007 is likely related to a subsequent reduction in these inputs as well as a reduction in overall nonpoint runoff from Waynesville.

Waterbody			-	Date Station ID			Bioclassification				
RICHLAN	ND C	R		SR 1184		06/15/	/07	EF47		Fai	ir
County	Sut	obasin	8 digit HUC	Latitude	Long	litude		All Number		evel IV F	coregion
HAYWOOD	Uu	5	06010106	35.50833333	-82.97	194444		5-16-(11.5)c		Broad I	Basins
		<u> </u>	· · · · · · · · · · ·		(6)						
	tion	Draina	age Area (miz)	Elevatio		Strea		tn (m)	Average Deptr	1 (m)	Reference Site
D,11			40	239	0		9		0.4		NO
		Fore	sted/Wetland	Url	ban		Agr	iculture		Other (de	scribe)
Visible Landuse	(%)		70	5 (resi	dential)			0		25 (indu	strial)
Upstream NPDES Di	scharg	ers (>1MG	GD or <1MGD a	nd within 1 mile	<del>)</del>			NPDES Nu	umber	Vc	olume (MGD)
	J		None		,						
Water Quality Param	eters							Site	Photograph		
Temperature (°C)			16.5		~	- and	i ale	and a set	+3.5	SIR.	1 1 1 L L
Dissolved Oxygen (mg	g/L)		8.3		10 000	HAR S			1 Kinger		
Specific Conductance	e (µS/cm	n)	56		March 1	ALC: NO	Sec.	Constant P		A. 4. 4	1 / G.
pH (s.u.)			6.2			E. 12			14		1 20
				- 10	1 1 1	h	17	and the second	The second		- CR - 27-20
Water Clarity			Clear	810	Sec. 1			Sec.			and the second
Habitat Assessment	Scores	s (max)			1	-una - s	-				1 and the
Channel Modification	(5)	. ,	5		Ser 6	ALL READ	120.	Contraction of the			Series Social
Instream Habitat (20)	(-)		18				1 ST			Aleren a	
Bottom Substrate (15)	)		12	1			Se :		the second		
Pool Variety (10)			8	1. S. S. S.	N. Sam	And the second second	- ALAN	Carles Sal		-	and a state of the
Riffle Habitat (16)			16		1	12 22				100	
Left Bank Stability (7)			7	Sec.	E.	A SHOTE					and the se
Right Bank Stability (7	7)		4	an and		a a	-	the ball and the			
Light Penetration (10)			8			- Aller	-				a second
Left Riparian Score (5	5)		5	10 A.	and the second	and the second	El and		and the second s	and and	
Right Riparian Score	(5)		2								
Total Habitat Score (	(100)		85	Sub	strate	Cobble					
Sample Date	•		Sample	ID	Spe	ecies Total		N	CIBI	Bio	classification
06/15/07			2007-8	1		12			36	<u> </u>	Fair
07/17/01			2001-7	7		9			28		Poor
Most Abundant Spe	ecies		Central Stoner	oller		Exotic	Speci	es Rai and	inbow Trout, Bro d Green Sunfish	wn Trout, I	Redbreast Sunfish,
Species Change Sind	ce Last	Cycle	Gains - Bluegill	- Longnose Dace	e, Western	Blacknose	e Dace	, Smallmouth	Bass, and Large	mouth Ba	ss. Losses
Data Analysis											
Watershed a tributa Waters; site is ~ 1.3 n	ary to th niles ab	e Pigeon I ove Lake	River; drains so Junaluska. <b>Hal</b>	uthwestern Hayw <b>bitat</b> riffles, chu	rood Coun	nty, includin uns; deep j	ng the N pool in	Naynesville m	etropolitan area; reach; residence	Hatchery along the	Supported Trout right bank. 2007

Waters; site is ~ 1.3 miles above Lake Junaluska. **Habitat** -- riffles, chutes, and runs; deep pool in middle of the reach; residence along the right bank. **2007** -- conductivity slightly elevated; more than 15 times as many fish were collected in 2007 than in 2001 (n = 603 vs. 41); increases especially noted in the number of Central Stoneroller, Longnose Dace, and Northern Hogsucker; only 12 species were collected; percentage of tolerant fish (Redbreast Sunfish and Green Sunfish) was high, but decreased from 46% in 2001 to 11% in 2007; percentage of omnivores+herbivores was also high; wild Rainbow Trout and Brown Trout present, some stocked trout collected, including one Brook Trout 323 mm TL. **2001 & 2007** -- 13 species known from the site, but no darters, sculpins, or lampreys; although community was rated Fair in 2007, there was a dramatic improvement since 2001 in the abundance and diversity metrics; dominant species is the Central Stoneroller; sampled in 2001 as part of the Richland Creek Use Attainability Reclassification study (BAU Memorandum F-2001020906).

Waterbody			Location				Date Station ID			Bioclassification		
RICHLAN	ND CF	र	Wal	nut Trail R	d	06/14	/07	EF48		G	ood-F	air
					_				<u>_</u> ;			
County	Sub	basin	8 digit HUC		Long	itude		AU Number		Leve	el IV Ec	oregion
HAYWOOD		5	06010106	35.53/////8	-82.950	038889		5-16-(16)a		E	Broad Ba	asins
Stream Classifica	tion	Draina	age Area (mi2)	Elevatio	on (ft)	Strea	m Wio	dth (m)	Avera	ge Depth (n	n)	Reference Site
С			64.7	251	0		13			0.4		No
		Farra		11			<b>A</b>		Other (describe)			
Visible Landuse	(%)	FOIE	55	15 (rural r	esidential)		Ay	25			5 (NC 20	(9)
											- (	-)
Upstream NPDES Di	scharge	ers (>1MC	GD or <1MGD a	nd within 1 mile	e)			NPDES N	lumber		Volu	ume (MGD)
			None						•			
Water Quality Param	eters							Site	e Photog	raph		
Temperature (°C)			22.7		- and the	43. 3		1.2				
Dissolved Oxygen (mg	g/L)		6.4		(H. )			1.5		And States		The Last Last
Specific Conductance	(µS/cm	)	60		1	1						
pH (s.u.)			5.8	25	1	2.0	÷.,	N. Contraction		1000		
	-				1000			Sand?-		No and		Carlie
Water Clarity			Clear	and the second	K .		*	- 推行 。	Set S			
						and the second	-		- BE		Kaul	
Habitat Assessment	Scores	(max)				-		A DE				
Channel Modification	(5)		5	14	and the second		-	-	The second		-	and the second second
Instream Habitat (20)			18			Line and		and the second s	Standing of	1.4	-	AND STREET
Bottom Substrate (15)	)		13			100						Section 1
Pool Variety (10)			6			and the			A COLUMN			Contraction of the second
Riffle Habitat (16)			12	the second second				0-			- E.C.	
Left Bank Stability (7)			5	and the second					ALL ST	220	Sub Line and	
Right Bank Stability (7	7)		5				ARCH		A. F. S.	and the	1 miles	and the second
Light Penetration (10)			9		and the second	-		the state	and a		1	
Left Riparian Score (5	) 		3	100 20	a second		1		Carla A	- Carrier	24	
Right Riparian Score	(5)		3	Cub		Cabbla b	aulda	and group				
l otal Habitat Score (	100)		79	Sub	strate		ouidei	, and graver				
Sample Date	)		Sample	ID	Spe	cies Tota	I	Ν	NCIBI		Bioc	assification
06/14/07			2007-80	)		10			40		G	iood-Fair
09/24/02			2002-83	3		12			32			Poor
10/22/97			97-91			12			38			Fair
Most Abundant Spe	ecies		Central Stoner	oller		Exotic	Spec	ies Re	edbreast	Sunfish		
Species Change Sin	ce l ast	Cvcle	Gains -	- Tuckasegee Da	arter Los	ses Broy	wn Rul	lhead and Gr	een Sunfi	sh		
Data Analysis		_,	Canto		200	2.30 2.0						
Watershed a tributa	ary to the	e Pigeon I	River; drains so	uthwestern Hayw	ood Coun	ty, includir	ng the	City of Wayne	esville me	tropolitan ar	rea; site	is ~ 1.5 miles
above the creek's con	fluence	and ~ 1 m	nile below Lake	Junaluska. <b>Hab</b> i	tat riffle	s, chutes,	and ru	ins with a vari	ety of poo	ol sizes; exp	osed gra	avel bars. 2007
water clear and warm $2002 (n - 224) v_{0}$	er than e	expected,	conductivity slig	htly elevated, dis	solved ox	ygen satu	ration a	at 74%; twice	as many	fish were co	ollected i	n 2007 than in

2002 (n = 224 vs. 116), but the diversity metrics and abundance were still lower than expected for a stream of this size; only 10 species present, including just 2 species of cyprinids; percentage of tolerant fish (Redbreast Sunfish) decreased from 44% to 4% between 2002 and 2007; percentage of species with multiple age classes increased form 64% to 80%; first time a species of darter has been collected; large specimens of Northern Hogsucker and Rock Bass. **1997 - 2007** -- total habitat scores have ranged from 73 to 79; conductivity has ranged from 60 to 81 μS/cm; 15 species are known from the site, including 6 species of sunfish and 4 species of cyprinids, but no sculpins or lampreys; dominant species have been the Central Stoneroller and Northern Hogsucker.

Waterboo	dy	Locati	on	Stati	on ID		Date	Bioclassification
Richland	d Cr	SR 15	519	EB	261	30	3/07/07	Fair
County	Subbasin	8 digit HUC	Latitude	Longitue	de AUN	Number	Lev	vel IV Ecoregion
Haywood	5	06010106	353252	825645	5	0		Broad Basins
Stream Classifica	ation	Drainage Area (mi2	) Elev	vation (ft)	Strea	am Width	(m)	Stream Depth (m)
С		67.7	2	2,493		9		0.6
	Fo	rested/Wetland	Urban	l	Agriculture		о	ther (describe)
Visible Landuse	(%)	50	30		20			0
Upstream NPI	ers (>1MGD or <1M	IGD and withir	n 1 mile)	NF	PDES Nur	nber	Volume (MGD)	
None						N/A		N/A
Water Quality Param	eters					Site Pho	otograph	
Temperature (°C)		N/A	1					
Dissolved Oxygen (mg	g/L)	N/A	100	114	d the s	100	a starter	A STATISTICS
Specific Conductance	(µS/cm)	N/A		Sec.		Same	L LOBA	
pH (s.u.)		6.6	245.63			E. per	the market was	in the second second
Water Clarity		Slightly Turbid						
Habitat Assessment	Scores (max)			and a			and the second second	AND
Channel Modification (	(5)	4	1	- anticia	and the second		- Comment	Contraction of the
Instream Habitat (20)	( )	14		and the second	Ser al	All and a second	and the second	
Bottom Substrate (15)		12			1. 10	and the second		C. M. P. C. S. M.
Pool Variety (10)		4	and a second	the start	10	Ser.	2.2.	The second of the
Riffle Habitat (16)		14			-	-	and the second	老 一 行 人 新社
Left Bank Stability (7)		6	-	7 1	11 12 12		the second second	And
Right Bank Stability (7	.)	6	1000	s-nin	1 Colores		and the second	
Light Penetration (10)		7	-15	7.5.	40-	-	1000	A REAL PROPERTY OF THE PARTY OF
Left Riparian Score (5)	4 (5) 4			and?	12	- And	Constant of	
Right Riparian Score (	5)	5						
Total Habitat Score (	100)	76	Substra	ate Ru	ubble, sand,	gravel, be	oulder and bedro	ck.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification	
08/07/07	10300		16		4.46	Fair	
07/25/02	8893	45	20	5.40	4.40	Good-Fair	
07/25/97	7372		15		4.40	Fair	
08/18/92	5999		14		4.40	Fair	

#### **Taxonomic Analysis**

With the exception of the 2002 collection, this site has always maintained a Fair bioclassification. The 2007 sample lacked, for the first time ever, the flow dependent Heptageniid mayflies *Maccaffertium ithaca*, and *M. modestum* as well as the edge-dependent caddisflies *Triaenodes ignitus* and *Nectopsyche exquisita*. The lack of these taxa are likely related to the 2007 drought and corresponding decreased discharge from Lake Junaluska which would both reduce flow as well as available edge habitat.

## Data Analysis

This site is approximately 2.3 miles below Lake Junaluska. It is possible that the severe 2007 drought has resulted in reduced discharge from the lake. This hypothesis is supported by the absence (for the first time) of all Heptagennid mayflies and by a lack of several edge-dependent taxa. While the next closest upstream site (approximately 3.2 miles) on Richland Creek (SR 1184) improved drastically in 2007 due to reduced non-point pollution input, these effects were likely attenuated by the effects of the lake. Indeed, relative to the SR 1184 site, this location has always had much lower EPT diversity and is likely related to physical and chemical effects of Lake Junaluska.

Waterbo	dy	Locati	on	Static	on ID		Date	Bioclassification
Johnatha	ns Cr	SR 13	806	EB2	239	30	8/07/07	Excellent
County	Subbasin	8 digit HUC	Latitude	Longitud	e AU I	Number	Lev	el IV Ecoregion
Haywood	5	06010106	353107	830607		0	Southern Me	etasedimentary Mountains
Stream Classifica	tion	Drainage Area (mi2	) Elev	vation (ft)	Stre	am Width	(m)	Stream Depth (m)
WS-III; Tr, C	A	13.8	2	2,974		6		0.4
	Fo	rested/Wetland	Urban	<u> </u>	Agriculture		0	ther (describe)
Visible Landuse	(%)	70	30		0			0
Upstream NPI	ers (>1MGD or <1M	GD and withir	n 1 mile)	N	PDES Nur	nber	Volume (MGD)	
None				,		N/A		N/A
Water Quality Param	eters					Site Pho	tograph	
Temperature (°C)		N/A	and the second	* <u>_</u>	Contraction of the			
Dissolved Oxygen (mg	g/L)	N/A	1.1	The Contact	and an	ALC: NO	Contraction of the second	- In let
Specific Conductance	(µS/cm)	N/A	- W .		Contraction State	1	Leo I	
pH (s.u.)		N/A		1. 1.		ne se	And the first	
Water Clarity		Slightly Turbid						
Habitat Assessment	Scores (max)			Section -	and the	5.5		
Channel Modification	(5)	4	100		and the second	and the	- normal	the second second
Instream Habitat (20)		15		and the second second	Sent	-		an se
Bottom Substrate (15)		12						and the second second
Pool Variety (10)		4	1000	-			The second	
Riffle Habitat (16)		16				229	All designed in the local diversion of	
Left Bank Stability (7)		5	1.00				1 Starten	Survey and the
Right Bank Stability (7	·)	6				a serie	the state of the	- marine
Light Penetration (10)		8	5.00				an de	State of the state of the
Left Riparian Score (5	)	0	1.			A STATE		ALL REPORT OF
Right Riparian Score (	5)	3			10		All of the second second	Complete Registers and the second
Total Habitat Score (	100)	73	Substra	ate Bo	ulder, rubb	le, gravel,	and sand.	

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification	
08/07/07	10301		38		1.73	Excellent	
07/24/02	8890		37		1.50	Excellent	
07/24/97	7368		46		1.60	Excellent	
08/18/92	5996		41		2.00	Excellent	

#### **Taxonomic Analysis**

Although some of the watershed upstream of this location includes residential and commercial impacts, the majority of this catchment is still forested. As such, the EPT community here has largely been stable through time. However, the 2002 and 2007 samples both lacked several caddisfly taxa that had been collected here in 1992 and 1997. These taxa were *Goera* sp., *Neophylax mitchelli*, *Rhyacophila nigrita*, and *Ceratopsyche slossonae*. It is unclear why these highly pollution intolerant taxa were absent in 2002 and 2007 but present in 1992 and 1997.

### Data Analysis

With the exception of the four aforementioned intolerant caddisfly taxa absent in 2007 and 2002 but collected in 1997 and 1992, the EPTBI (and EPT taxa richness) has been largely stable at this location. However, the EPT abundance has continued a slightly downward trend with 193, 272, 150, and 191 EPT specimens being tallied from the 1992, 1997, 2002, and 2007 samples respectively. Conductivity was very low (24 µS/cm) from the 2002 sample generally indicating favorable water chemistry here but meters were malfunctioning in 2007 so no measurements were made.

Waterbo	dy	Locati	on	Statio	n ID		Date	Bioclassification
Johnatha	ns Cr	SR 13	322	EB2	40	30	8/08/07	Good
County	Subbasin	8 digit HUC	Latitude	Longitude	e AU I	Number	L	evel IV Ecoregion
Haywood	5	06010106	353433	830107		0		Broad Basins
Stream Classifica	ation	Drainage Area (mi2	) Elev	vation (ft)	Stream Widtl		(m)	Stream Depth (m)
C; Tr		50.9	2	2,564		11		0.4
Visible Lenduce	Fo	prested/Wetland	Urban		Agriculture			Other (describe)
VISIBle Landuse	(%)	30	50		20			U
Upstream NPI	DES Discharg	ers (>1MGD or <1M	IGD and withir	n 1 mile)	N	DES Nur	nber	Volume (MGD)
Maggie Valley WWTP					N	C0056561	1001	1.0
Water Quality Param	eters					Site Pho	otograph	
Temperature (°C)		21.2	100		11. 16			
Dissolved Oxygen (mg	g/L)	N/A	14 C					
Specific Conductance	(µS/cm)	N/A				AND AND		
pH (s.u.)		6					and the second	
Water Clarity		Clear						-
Habitat Assessment	Scores (max)			the second	1-			
Channel Modification	(5)	3	- 1	Carles Series	-		and the second second	and the second s
Instream Habitat (20)		15		and a state			- and	and the second second
Bottom Substrate (15)	)	12	and the second		-	1	A State of the sta	
Pool Variety (10)		3			2	SH	prover the and	A strange of the second second
Riffle Habitat (16)		15	Aller .		and the			
Left Bank Stability (7)		6	1990	The state	-	the set	AN STA	and the second second
Right Bank Stability (7	")	6			1		P	the states
Light Penetration (10)		8	1. S.	Con the	and the second		and the second second	The start of the
Left Riparian Score (5	)	2	1.16	CON .			Profile Party	State in the second
Right Riparian Score (	(5)	2						

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/08/07	10305		35		2.95	Good
07/25/02	8892		40		3.60	Excellent
07/24/97	7364		41		2.60	Excellent
08/18/92	5995		33		3.30	Good

Boulder, rubble, gravel, and sand.

Substrate

72

#### **Taxonomic Analysis**

**Total Habitat Score (100)** 

There were several EPT taxa that were present from the 1997 and 2002 samples that were absent for the first time in 2007 and included the mayflies *Baetis flavistriga*, *Heptagenia marginalis*, *Isonychia* sp., the stonefly, *Perlesta* sp., and the caddisfly *Pycnopsyche* sp. The decrease in EPT taxa for 2007 may be the result of less dilution of the upstream discharger due to the severe 2007 drought. Although 2002 was also a drought year that event was much less severe than the 2007 drought and may have provided more dilution and thereby explaining the 2002 Excellent rating.

### Data Analysis

This site is downstream from Maggie Valley and landuse is a mix of urban, forest and agriculture. This site is also approximately two miles downstream from the Maggie Valley WWTP (NC0056561001; 1.0 MGD). Streams that are downstream of large point dischargers often experience an increase in the instream waste concentration (IWC) during times of drought due to lessened dilution. This was likely the case in 2007 and the drop in EPT taxa measured in 2007 supports this conclusion. Unfortunately, water chemistry meters were not in operation at the time of sampling so a conductivity measurement was not possible. The one previous conductivity measurement made in 2002 (34 µS/cm) was still quite low despite the upstream discharger.

Waterbo	dy	Locatio	on	Stati	on ID		Date	Bioclassification	
Johnatha	ns Cr	SR 13	49	EB	241	30	8/08/07	Good	
County	Subbasin	8 digit HUC	Latitude	Longitu	de AU	J Number L		vel IV Ecoregion	
Haywood	5	06010106	353717	830018	3	0		Broad Basins	
Stream Classifica	ition	Drainage Area (mi2)	) Elev	ation (ft)	Stre	am Width	(m)	Stream Depth (m)	
C; Tr		65.4	2	2,410		17		0.5	
F Visible Landuse (%)		rested/Wetland 90	Urban 10		Agricu 0	lture	0	ther (describe)	
Upstream NPI	DES Discharge	ers (>1MGD or <1M	GD and within	n 1 mile)	N	PDES Nur	mber	Volume (MGD)	
none						IN/A		IN/A	
Water Quality Param	Vater Quality Parameters Site Photograph								
Temperature (°C)		21.9		100	2 [ ]	S SALE			
Dissolved Oxygen (mg	J/L)	N/A	- Friday Ser	-	2				
Specific Conductance	(µS/cm)	N/A			1		and a second		
pH (s.u.)		7.3	Y. de	- T-			3 - 12 A	and the first	
Water Clarity		Slightly Turbid			F			A CON	
Habitat Assessment	Scores (max)		1.8	and the second	a dia	-		a series of the series of the	
Channel Modification (	(5)	4				1000		and the state of the	
Instream Habitat (20)		15	Collaboration of		-	Pres .	and the second		
Bottom Substrate (15)		13		Start and			Mar have a start		
Pool Variety (10)		4		en an		3		and the second of the	
Riffle Habitat (16)		14		1	-	Patie		1	
Left Bank Stability (7)		6	and the second second	-		Carlos II	A STATE OF THE OWNER	diaman a	
Right Bank Stability (7	)	7	and the	1			The second		
Light Penetration (10)		7	- 10.17				State of the second		
Left Riparian Score (5	)	1	11/100					THE REAL PROPERTY OF	
Right Riparian Score (	5)	3							

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification	
08/08/07	10304		33		2.95	Good	
09/09/02	8986		34		3.80	Good	
07/24/97	7367		39		3.10	Excellent	
08/18/92	5994		23		3.70	Good-Fair	

Rubble, gravel, sand, boulder, and silt.

Substrate

74

#### **Taxonomic Analysis**

**Total Habitat Score (100)** 

EPT richness at this location continues a slight downward trend since the only Excellent sample was recorded here in 1997. EPT present in 1997 but absent in the drought years of 2002 and 2007 included the mayflies *Baetis tricaudatus*, *Caenis* sp., *Dannella simplex*, *Drunella conestee*, *Ephemerella catawba*, *Rhithrogena* sp., *Mccaffertium modestum*, *Serratella serratoides*, the stonefly *Perlesta* sp., and the caddisfly *Micrasema wataga*.

## Data Analysis

Declines in EPT taxa richness in 2002 and 2007 are likely attributed to the concentration of effluent from the upstream Maggie Valley WWTP discharge. The record high EPT richness noted in 1997 coincided with a year that had more rainfall than either the last two samples and this improvement in the EPT community was likely the result of dilution effects. Water chemistry meters were malfunctioning at the time of sampling so no conductivity measurements were available.

Waterb	ody			Location		Date		Station II	О Е	Bioclassi	fication
CRABTR	EE CF	R		NC 209		06/14/0	07	EF21		Good <sup>.</sup>	-Fair
County	Subb	basin	8 digit HUC	Latitude	Long	itude		AU Number	L	evel IV E	coregion
HAYWOOD	Ę	5	06010106	35.59805556	-82.933	388889		5-22		Broad I	Basins
Stroom Classifica	tion	Draina	ao Aroa (mi2)	Flovati	on (ft)	Stroom	Wid	lth (m)	Average Depth	(m)	Poforonco Sito
		Diailia	10.1	250	20	Stream	8				No No
C			19.1	2.52	.0		0		0.3		INO
		Fores	ted/Wetland	Ur	ban		Agr	riculture	C	Other (de	escribe)
Visible Landuse	(%)		25		0		65 (	(pasture)		10 (old s	school)
					-)				luurah an	V.	
Opstream NPDES DI	scharge	rs (>1MG	None		e)			NPDES I	Number	vc	
			None							·	
Water Quality Param	neters							Site	e Photograph		
Temperature (°C)			17.1			2		2	station of		104 S
Dissolved Oxygen (mg	g/L)		8.7					Series 1	and the second	and the second	
Specific Conductance	e (µS/cm)		65			1.0			a distant and	ALC: NOT	All and a second second
pH (s.u.)			7.6			Contraction of the					Ben alter
	_							and the second	Sector Sector	A REAL	
Water Clarity		Slig	ahtly turbid	Sec.	-	A SE			Carlos TI	100	
,			, , ,	1	ANUT -	-	A-6	ta L	and a second	10	
Habitat Assessment	Scores (	(max)		1-5		1 125 AT					
Channel Modification	(5)		5	10	the second	and the second		72.76		-	
Instream Habitat (20)			16			A STATEMENT	-	New York Contraction	Contraction of the local data	Not the	
Bottom Substrate (15)	)		12	1 7 - N	Mananta	Printle and		120	0		Contraction of the
Pool Variety (10)			6	A second				1	A COLUMN THE OWNER	AC -	
Riffle Habitat (16)			14		de la compañía de la comp		E.			10 000	
Left Bank Stability (7)			4	1000			Sec.		and the second of	Set in	1000
Right Bank Stability (7	7)		4	Sec.	教医一		-		in the		Hell .
Light Penetration (10)			5		gest.		100	CARLA STATE	antin and a start	14.50	
Left Riparian Score (5	5)		1			Saulty I will					
Right Riparian Score	(5)		1								
Total Habitat Score (	(100)		68	Sub	strate	Sand, cobb	ole, b	oulder, and b	edrock		
Sample Date	)		Sample	ID	Spe	cies Total			NCIBI	Bic	classification
06/14/07			2007-79	9	•	13			44		Good-Fair
09/24/02			2002-82	2		11			40		Good-Fair
06/03/97			97-52			8			28		Poor
Maat Abum daws 0	- alar	Г	Constral Of an	allan					Travit and D	alleneration	)fieh
wost Abundant Spe	ecies	L	Central Stoner	olier		Exotic S	ресі	es B	rown Trout and Re	upreast S	Sunfish
Species Change Sin	ce Last C	Cycle	Gains -	- River Chub, Fa	thead Min	now, and We	ester	n Blacknose	Dace. Losses L	argemou	ith Bass.
Data Analysis		-									
<b>7</b>											

Watershed -- a tributary to the Pigeon River; drains northeastern Haywood County; no municipalities in the rural watershed. Habitat -- riffles, chutes, runs, and plunge pools; a fairly open canopy with breaks in the riparian zones; eroded areas, especially at the end of the reach on the left bank; cattle continued to have access to the stream; water very easily silted. 2007 -- conductivity elevated; a very abundant community with a lot of biomass of most species; diversity lower than expected, no species of darters present; dominance by the Central Stoneroller and the very high percentage of omnivores+herbivores were indicative of nutrient enrichment; River Chub collected for the very first time. 1997 - 2007 -- conductivity has ranged from 57 to 75 µS/cm; total habitat scores have ranged from 64 to 68; 14 species are known from the site, but no species of darters, sculpins, or lampreys ever collected at the site; species diversity and NCIBI scores and ratings have steadily increased over time, but nutrients and bank erosion are still chronic problems at the site.

Waterbo	dy	Locatio	on	Statio	n ID		Date	Bioclassification	
Fines	Cr	SR 13	55	EB2	31	30	8/08/07	Good	
County	Subbasin	8 digit HUC	Latitude	Longitud	e AUI	Number	Lev	vel IV Ecoregion	
Haywood	5	06010106	354007	825938		0		Broad Basins	
Stream Classifica	ation	Drainage Area (mi2)	) Elev	vation (ft)	Stre	am Width	(m)	Stream Depth (m)	
С		25.6	2	2,295		7		0.6	
	Fo	orested/Wetland	Urban		Agriculture		0	ther (describe)	
Visible Landuse	(%)	80	10		10				
Upstream NP	DES Discharg	ers (>1MGD or <1M	GD and withir	n 1 mile)	N	PDES Nur	nber	Volume (MGD)	
None					N/A		N/A		
Water Quality Param	/ater Quality Parameters Site Photograph								
Temperature (°C)	~ // )	21.8		A Real					
Dissolved Oxygen (mo	y/L)	52.8			Provi -	Carl P	All China		
pH (s.u.)	(µ3/cm)	7.3		41 Hz	and the	-		100 4	
Water Clarity		Slightly Turbid							
Habitat Assessment	Scores (max)			5 M	AL.				
Channel Modification	(5)	5	Sec.	Des-21	12 UC		A Reality of the second s	1 2 2 2 2 2 2	
Instream Habitat (20)		15	and the second se	200	Contraction of the	A STATE A	and all		
Bottom Substrate (15)	)	12	the state of	1	10 Mar	A CONTRACTOR	N. Mary	All Notes	
Pool Variety (10)		10	Second /		The local dive	_	Contraction of the		
Riffle Habitat (16)		15		1 mar	-		-	and the second s	
Left Bank Stability (7)		7	1	T BREAK		1000	Carlo man	ALC AND	
Right Bank Stability (7	7)	7		2000	anteria c	P Barris	Xan Barris	a particular and	
Light Penetration (10)		9				and the second	a the second	NORMAN AND A DESIGNATION OF	
Left Riparian Score (5	5)	2	1 a	Contraction of the local division of the loc	100	Search .	South and	a distantion of the second	
Right Riparian Score	(5)	5							

Right Riparian Score (5) Total Habitat Score (100)

Boulder, rubble, gravel, sand, silt, and bedrock.

Sample Date	le Date Sample ID		EPT	BI	EPT BI	Bioclassification	
08/08/07	10303		29		3.13	Good	
07/24/02	8889		25		3.50	Good-Fair	
07/23/97	7362		27		2.60	Good-Fair	
08/17/92	5991		19		3.70	Good-Fair	

Substrate

87

## **Taxonomic Analysis**

The 2007 sample produced both the highest EPT species richness and the highest EPT abundance (132) ever measured at this location. Intolerant EPT taxa collected for the first time here included the mayflies *Acentrella* sp., *Baetisca* sp., the stoneflies *Malirekus hastatus*, *Perlesta* sp., and the caddisfly *Lepidostoma* sp.

## Data Analysis

The Fines Creek watershed is a mixture of residential, agricultural, and forest uses. As would be expected in a catchment where non-point pollution is the primary pollutant source, reduced pollution runoff due to the 2007 drought is likely the reason for the improvement in metrics and bioclassification seen this year.

Waterb	ody			Location		Date	e	Station I	D	E	Bioclassi	fication
FINES	CR		of	f SR 1355		06/14	/07	EF76	5		Good <sup>.</sup>	-Fair
County	Subb	basin	8 digit HUC	Latitude	Long	itude		AU Number	r	L	evel IV E	coregion
HAYWOOD	Ę	5	06010106	35.6669444	-82.99	91111		5-32			Broad	Basins
			L									
Stream Classifica	tion	Draina	ige Area (mi2)	Elevatio	n (ft)	Strea	ım Wio	dth (m)	Ave	rage Depth	(m)	Reference Site
С			25.7	2293	2293 12					0.4		No
		Fores	sted/Wetland	Urk	ban		Agriculture Other (describe)					scribe)
Visible Landuse	(%)		100	(	)			0			0	
					_							
Upstream NPDES Di	ischarge	rs (>1MG	D or <1MGD a	nd within 1 mile	e)			NPDES	Numbe	r	Vo	olume (MGD)
			None						-			
Water Quality Param	neters							Sit	te Photo	ograph		
Temperature (°C)			16.0		Not 18		and the	3035		10-		1 North
Dissolved Oxygen (mg	g/L)		9.0		ALC.P.	3.460			2.0		t to	VERY ST
Specific Conductance	e (µS/cm)		71		1250					and a	m \	
pH (s.u.)			6.8	1					14		Son A.	
Water Clarity		Sli	ghtly turbid			anal anal		and an		Vr.		
Habitat Assessment	Scores (	max)			The			A 8 4		and and a	24	ANT STATE
Channel Modification	(5)		5		Mar .	A TEL	-			-	× 11	1 1 1
Instream Habitat (20)			20		and Man					Free and		- Sales
Bottom Substrate (15)	)		12				-		-		-	State of
Pool Variety (10)			10		STREE.	100						
Riffle Habitat (16)			16	Case .			2.2		Die	an Si		100 100
Left Bank Stability (7)			6	The second		and the second			1		14 - 20	
Right Bank Stability (7	7)		6	and the second	Surf L	20		A THE	21	C-NC	The sea	
Light Penetration (10)			7	a la caracteria			-		FILT	Here .		
Left Riparian Score (5	5)		5							C. W.	1	The second second
Right Riparian Score	(5)		2									
Total Habitat Score (	(100)		89	Subs	strate	cobble, b	oulder					
Sample Date	)		Sample I	D	Spe	cies Tota	I		NCIBI		Bio	classification
06/14/07			2007-78			16			40			Good-Fair
09/24/02			2002-85			13			38			Fair
10/22/97			97-93			11			34			Fair

**Most Abundant Species** 

Redbreast Sunfish, Swamp Darter, Rainbow Central Stoneroller **Exotic Species** Trout, and Brown Trout Gains -- Swamp Darter, Smallmouth Bass, Largemouth Bass, Black Redhorse, and Western Blacknose Dace.

Species Change Since Last Cycle

Losses -- Whitetail Shiner and Green Sunfish.

#### **Data Analysis**

Watershed -- the last tributary to join the Pigeon River above Walters Lake; located about 200 meters above its confluence; drains part of northeast Haywood County; much of the lower valleys in this watershed are used for dairy production, and most tributaries are paralleled by roads; a use attainability study was conducted in 2006, which qualified this watershed for supplemental Tr reclassification (BAU Memo 20060906). Habitat -- high gradient mountain stream habitats with plunge pools, abundant riffles, and some large woody debris from storm events. 2007 -- a fairly diverse and abundant (n = 754) fish community was collected, half of which consisted of the herbivorous Central Stonerollers (n = 376); the slight improvement in rating is largely due to additional species and the increase in abundance since the 2002 sample; one introduced Swamp Darter was collected. 1997 - 2007 -- nonpoint agricultural runoff continues to impact the water quality in this catchment. However, species richness and abundance of the fish community has steadily increased over 3 samples.

Waterbo	dy	Locatio	on	Statio	on ID		Date	Bioclassification
Catalooch	ee Cr	SR 13	895	EB	227	30	8/08/07	Excellent
County	Subbasin	8 digit HUC	Latitude	Longitud	le AU I	Number	Lev	vel IV Ecoregion
Haywood	5	06010106	354002	830422		0	Southern Me	etasedimentary Mountains
Stream Classifica	ition I	Drainage Area (mi2	) Elev	vation (ft)	Stre	Stream Width (m)		Stream Depth (m)
C; Tr, ORW	C; Tr, ORW		2	2,499		18		0.3
Foreste		rested/Wetland	Urban		Agricul	Agriculture		ther (describe)
Visible Landuse	(%)	100	0		0			0
Upstream NPI	ers (>1MGD or <1M	GD and withir	n 1 mile)	N	PDES Nur	nber	Volume (MGD)	
None						N/A		N/A
Water Quality Parameters Site Photograph								
Temperature (°C)		N/A	115	1. 2. 1	1			
Dissolved Oxygen (mg	g/L)	N/A	and 11		行之之	i alla	Contraction of the	
Specific Conductance	(µS/cm)	N/A	A.S.			SE.	and the states	
pH (s.u.)		N/A		- Andrews	-			A SALL A SALL
Water Clarity		Clear					1 State	MAX X
Habitat Assessment	Scores (max)			North Land	No. of Lot	a winns a	and the second	
Channel Modification (	(5)	4		100	all and a second		-	the second
Instream Habitat (20)		20	S MAR			and the second division of the second divisio	and	Service States
Bottom Substrate (15)		15			-		Sales and the	
Pool Variety (10)		8		Sec. 12	and the	Owne -		and the second second
Riffle Habitat (16)		15		and the			and the second	- Alter
Left Bank Stability (7)		6		Variant 14				Sin as
Right Bank Stability (7)		6	+	1000	1 Star	ale of	The An	Constant and a second
Light Penetration (10)			- An and	and the second	400 3	a Maria		
Left Riparian Score (5	)	5	- 1 A.		ALC: NO			Contraction of the second
Right Riparian Score (	5)	5						

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/08/07	10310	120	59	3.33	2.10	Excellent
07/24/02	8888		42		1.50	Excellent
07/23/97	7363	102	50	2.70	1.60	Excellent
08/17/92	5992	84	42	2.90	1.80	Excellent
07/11/91	5660	80	48	2.70	2.00	Excellent

Boulder, rubble, gravel, sand, silt, and bedrock.

Substrate

92

### **Taxonomic Analysis**

**Total Habitat Score (100)** 

Including the 2007 sample, this segment of Cataloochee Creek has been sampled on 14 occasions with all collections resulting in Excellent bioclassifications. The 2007 sample resulted in the highest EPT species richness ever measured here with several taxa collected for the first time including the mayfly *Ephemera blanda*, the stoneflies *Helopicus* sp., and *Suwallia* sp., and the caddisflies *Goera calcarata*, and *Oligostomis pardalis*. This entire catchment is contained within Great Smokies National Park. This is reflected in the invertebrate community as many of the same highly intolerant taxa have been collected here during each summer sample and include the mayflies *Drunella conestee*, *D. cornutella*, the stoneflies *Isoperla holochlora*, *Malirekus hastatus*, and *Tallaperla* sp., and the caddisflies *Dolophilodes* sp., *Glossosoma* sp., and *Lepidostoma* 

#### Data Analysis

Although water chemistry meters were not functioning in 2007, previous water chemistry measurements reflect the highly protected nature of this catchment as measurements in 2002 and 1997 were 16µS/cm and 10 µS/cm respectively which are among the lowest conductivities measured in North Carolina. Predictably, this site has among the highest EPT species richness ever recorded by Division of Water Quality Biologists and ranks 6th overall from more than 6,500 samples. In addition, this location also ranks 2nd overall in terms of total EPT abundance with 356 EPT specimens collected.

Waterbo	dy	Locatio	on	Station	ID	Date		Bioclassification	
NOLICHU	CKY R	NC 197 (S	R1321)	EB28	9	08/14/0	7	GOOD	
County	Subbasin	8 digit HUC	Latitude	Longitude	AU Num	ber	Lev	el IV Ecoregion	
Mitchell	6	06010108	360429	822041	7	Southe	thern Crystalline Ridges and Mou		
Stream Classifica	ation	Drainage Area (mi <sup>2</sup> )	Elev	vation (ft)	Stream W	/idth (m)	Stream Depth (m)		
В		593		1960	30	)		0.4	
	Forested/		Urban	Urban Agricult			Ot	ther (describe)	
Visible Landuse	(%)	60	20		0			20	
Upstream NPI	ers (>1MGD or <1M	GD and withir	n 1 mile)	NPDES	Number		Volume (MGD)		
•		none		,					
Water Quality Param	eters				Site	Photograph			
Temperature (°C) Dissolved Oxygen (mg Specific Conductance pH (s.u.)	g/L) (µS/cm)	  106 8.5					No.	10-11-1	
Water Clarity		slightly turbid							
Habitat Assessment	Scores (max)			No. 1 Minutes and	and the second	and shares in the	-		
Channel Modification (	(5)	5	200		and the		No. 19	In the Association of the	
Instream Habitat (20)		18		The Street	- Majori	my all where y		State of the second second	
Bottom Substrate (15)	1	14			aller and an	- Charles	-	Continues of the second second	
Pool Variety (10)		7		and the second		HANNE PARTY	- Sector		
Riffle Habitat (16)		15	and s	2	Station and	1	1000	a set of the	
Left Bank Stability (7)		7			China La	and an	-		
Right Bank Stability (7	.)	7		Part of the second	Prove and	- untit	1	AL AN ALLE	
Light Penetration (10) 2				- and the	Thursday P	State of	the second	and the second second	
Left Riparian Score (5		in the second second	197 - MG		HE SHALL BE				
Right Riparian Score (	(5)	5							
Total Habitat Score (	100)	82	Substra	ate	(	cobble, boulde	er, grave	l, and sand	

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/14/07	10247	88	37	4.5	3.5	Good
07/09/02	8846	89	43	4.4	3.6	Good
07/09/97	7345	71	37	4.0	3.6	Good
07/21/92	5926	87	41	4.2	3.4	Good

#### **Taxonomic Analysis**

EPT richness in the Nolichucky River fell to 37 as 3 fewer mayfly taxa, 2 caddisfly taxa, and one stonefly taxon were collected than in 2002, which had the highest richness ever recorded for a basinwide sample at this site. The EPT community was dominated by moderately intolerant taxa like *Isonychia* sp, *Tricorythodes* sp., *Neureclipsis* sp. and *Oecetis persimilis*. Abundant intolerant taxa that occurred included *Acroneuria abnormis*, *Paragnetina ichusa*, and *Ceratopsyche morosa*. Previously collected taxa that were not found in 2007 included the intolerant species, *Mystacides sepulchralis*, *Goera* sp., *Glossosama* sp., *Anthopotamus distinctus*, *Leucrocuta* sp. and *Perlesta* sp.

### Data Analysis

This river integrates water from the Cane River and the North Toe River (Excellent and Good, respectively) and has no NPDES dischargers. This site has consistantly rated Good for the last 15 years. The biotic index has increased since 1997, suggesting slightly more tolerant benthic community which is supported by an increase in midges and oligochaetes. A relatively high specific conductance indicates dischargers upstream (mostly in the North Toe River) but seems to have little impact on the biota. The water quality, overall, remains good and appears to be relatively stable.

Waterbody			Location		Date Station ID			В	Bioclassification			
ΝΤΟ	ER			SR 1121		06/22/07	EF	36	(	Good-	Fair	
County	Sub	basin	8 digit HUC	Latitude	Long	itude A	U Number		Level	IV Ecore	gion	
AVERY		6	06010108	36.06583333	-82.000	027778	7-2-(0.5)	Southe	ern Crystalli	ne Ridges	and Mountains	
Stream Classifica	tion	Drain	age Area (mi2)	Elevatio	on (ft)	Stream V	vidth (m)	Aver	age Depth	(m)	Reference Site	
WS-V;Tr			29.5	326	2	1	4		0.4	) í	No	
										I		
Visible Lenduse	<i>(</i> 0/)	Fore	sted/Wetland	Ur 20 (rurol r	ban		griculture		0	ther (des	scribe)	
VISIBle Lanuuse	(%)		70	30 (Tutai 1	esiderillar)		0			0		
Upstream NPDES Di	ischarge	ers (>1M0	GD or <1MGD a	nd within 1 mile	e)		NPDE	ES Number		Vo	ume (MGD)	
			None									
Water Quality Param	neters							Site Photo	ograph			
Temperature (°C)			14.0	7940			16 - SI 12			1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		
Dissolved Oxygen (m	a/L)		9.3	and the second	Sec. 2	-			1 miles	-	12 - 23	
Specific Conductance	9/⊏/ • (uS/cm`	)	64			- Art		1 de	No.	A.C.	5 15° E.	
pH (s u )	( <b>µ0</b> /011)	/	7.0				and the		2 Page 1	Contra y	4/2 82	
pri (0.u.)			1.0	10.00		5 (- C		20		10	Participation and	
Water Clarity	Г		Clear	100	1 Carry	in the	A Starting	- All		1		
Water Clarity			Olean	States -				200		100		
Habitat Assessment	Scores	(max)		and st.	1		1200		ALC:		The second	
Channel Modification	(5)		5			-	and the second		the second	- and	and the second	
Instream Habitat (20)			20	Cheffe Barrier	and the second	-	a start in the				20-0010-	
Bottom Substrate (15	)		15			and a	The state of the	a weath				
Pool Variety (10)			6							- 4	-	
Riffle Habitat (16)			16					free a		the second	-	
Left Bank Stability (7)			5	1.57			1					
Right Bank Stability (7	7)		4	and the second		S OT HER	Section -	- And			and the second	
Light Penetration (10)			4		1	mathin	- ale	and the second	1.	A AL	and the	
Left Riparian Score (5	5)		4	100	2.2		-	E.		State at	in the second	
Right Riparian Score	(5)		3									
Total Habitat Score	(100)		82	Sub	strate	cobble, bould	er					
Sample Date	)		Sample	D	Spe	cies Total		NCIBI		Biod	assification	
06/22/07			2007-93	3		15		44		(	Good-Fair	
06/23/97			97-61			18		46		(	Good-Fair	
						1						
Most Abundant Spo	ecies		Mottled Sculpir	1		Exotic Sp	ecies	Green Su	infish, Raint	oow Trout	, and Brown Trout	
Species Change Since Last Cycle Gains Great and Brook Tr			- Green Sunfish. ok Trout	Losses -	- Mountain Br	ook Lampre	y, Redbreas	st Sunfish, V	Vestern B	lacknose Dace,		
Data Analysis												
Watershed the hea	dwaters	of the No	orth Toe River Io	cated in west-ce	ntral Averv	/ County: the M	lorth Toe Ri	ver eventua	ally joins the	Cane Riv	ver to form the	
Nolichucky River in Y	ancev Co	ounty bef	ore flowing into	Tennessee: land	use in this	s upper part of	the watersh	ned is a mix	of forest a	ariculture	and urban	

Nolichucky River in Yancey County before flowing into Tennessee; land use in this upper part of the watershed is a mix of forest, agriculture and urban (Newland and part of Sugar Mountain); Hatchery Supported Trout Waters. **Habitat** -- primarily riffles and runs with some boulder pools; the macrophyte *Podostemum* was thriving among the riffle habitats. **2007** -- an extremely abundant (n = 1242), and moderately diverse fish community was collected including several large wild specimens of Brown and Rainbow Trout; Mottled Sculpin represented 35% (n = 435) of the sample population. **1997 - 2007** -- relatively stable NCIBI metrics between sample years; although the rating did not change, the small drop in NCIBI score comes from 3 fewer species in the 2007 sample, including the intolerant Brook Trout. This watershed continues to receive non-point nutrient loading from agricultural practices.

Waterboo	dy	Locati	on	Statio	n ID		Date	Bioclassification	
N TOE	R	US 1	9E	EB2	88	30	3/13/07	GOOD	
County	Subbasin	8 digit HUC	Latitude	Longitude	e AU I	Number	Lev	vel IV Ecoregion	
Avery	6	06010108	355852	820058	7-2	-(21.5)	.5) Southern Crystalline Ridges and M		
Stream Classifica	ition I	Drainage Area (mi <sup>2</sup>	) Elev	Elevation (ft)		Stream Width (m)		Stream Depth (m)	
WS-IV; Tr, CA		74		2800		25		0.4	
Fores		rested/Wetland	Urban		Agricul	ture	0	ther (describe)	
Visible Landuse	(%)	40	40		0		20	J (campground)	
Upstream NPI	DES Discharge	ers (>1MGD or <1N	IGD and withir	n 1 mile)	N	DES Nur	nber	Volume (MGD)	
	none								
Water Quality Param	eters					Site Pho	otograph		
Temperature (°C) Dissolved Oxygen (mg Specific Conductance pH (s.u.)	g/L) (μS/cm)	22.6 9.1 58 7.7					-		
Water Clarity		slightly turbid		the Maria			e free		
Habitat Assessment	Scores (max)		1000						
Channel Modification (	(5)	5	and the second second	-	CHARACTER DE	PERSONAL PROPERTY.	- Harrison	State of the local division in which the local division in the loc	
Instream Habitat (20)		14					A STATISTICS	-	
Bottom Substrate (15)		12				-	ACC 1		
Pool Variety (10)		8							
Riffle Habitat (16)		14	1.0	and the second second	-	- Contract		1 1 1 2 2 2	
Left Bank Stability (7)		5	-	- 12	1	the second	1	10 m	
Right Bank Stability (7	and a second	1	in-	TAL					
Light Penetration (10) 4			the second second	To -	Contraction of the	Eter	A REAL	C. Later	
Left Riparian Score (5)	)	2	-2	-					
Right Riparian Score (	5)	4							

Total Habitat Score (100)	74	Substra	ate	cobble, boulder, and gravel; silty				
Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification		
08/13/07	10243	95	42	4.1	3.4	Good		
07/10/02	8805	89	39	4.9	3.8	Good		
07/10/97	7351	72	42	4.0	3.4	Excellent		
07/21/92	5923	99	41	4.3	3.2	Good		

#### **Taxonomic Analysis**

The North Toe River at US 19E has maintained a fairly stable EPT community since 1992. Additionally, the biotic index has dropped after a somewhat significant rise was observed in 2002. This drop can be attributed to a more intolerant EPT community and fewer oligochaete worms collected in 2007. The intolerant EPT community had 3 abundant stonefly taxa (*Acroneuria abnormis*, *Leuctra* sp., and *Paragnetina immarginata*), 2 abundant caddisfly taxa (*Brachycentrus spina* e and *Neophylax oligius*) and one abundant mayfly species (*Epeorus vitreus*). Other taxa included the intolerant but not abundant *Micrasema bennetti*, *M. wataga*, *Pteronarcys* sp., *Tallaperla* sp., *Baetisca* sp., *Brachycercus* sp., and *Serratella* serrata.

#### Data Analysis

This segment of the North Toe River is well developed along its length with small communities and active agricultural fields. Some small tributaries are undeveloped and drain portions of Pisgah National Forest in Avery County. This site was very silty, a symptom of agriculture and residential development. However, this stream rated Good but was borderline with Excellent. A slightly lower biotic index or 2 more EPT taxa would have given this site an Excellent bioclassification rating. As in 2002, there was a high abundance of diatomeceous growth on the rocks which may indicate nutrient enrichment. No serious habitat problems were noted.

Waterbody			Locatio	n	Stat	ion ID	)		Date		Bioclassification
ΝΤΟΕ	R	9	SR 116	62	EB	286	5	06	5/21/06		GOOD
County	Subbasir	n 8 digit I	IUC	Latitude	Longitu	de	AU Nu	umber		Lev	el IV Ecoregion
Mitchell	6	060102	08	355545	82065	5	7-2-(2	27.7)b	Souther	n Crysta	alline Ridges and Mountains
Stream Classifica	ation	Drainage A	ea (mi²)	Elev	ation (ft)		Stream	n Width	(m)		Stream Depth (m)
C; Tr		145			2473			30		0.6	
		<b>F</b>								0.	
Visible Landuse	(%)	Forested/wet	and	Urban 25		<u> </u>		re		Ot	ner (describe)
VISIBle Landuse	(70)	15		25			0				0
Upstream NPI	DES Discha	rgers (>1MGD	or <1MG	D and within	n 1 mile)		NPD	DES Nun	nber		Volume (MGD)
Uninem Corp - Quartz	c operation / I	Uninem Corp -	Schoolho	ouse Quarz fa	cility		NCC	0000175	/ NC0000	61	3.6 / 2.16
Feldspar Corp Spru	ce Pine Faci	lity / Spruce P	ine WWT	P			NC0	000353 /	/ NC00214	123	3.5 / 2.0
K-T Feldspar Corp S	Spruce Pine	Facility						NC00	00400		3.5
Water Quality Param	eters						5	Site Pho	tograph		
Temperature (°C) Dissolved Oxygen (mg Specific Conductance pH (s.u.) Water Clarity	g/L) - (μS/cm)	slightly turbi	24.3 8.9 98 6.9 d					and the second			
Habitat Assessment	Scores (ma	x)									
Channel Modification	(5)		5								
Instream Habitat (20)			16	1-2	and the	4-	-	-	and the second		
Bottom Substrate (15)	)		10		-	Contraction of the	un and			Call of the	
Pool Variety (10)			10	Law Calman	all and a second	-		Carlos a	a state of the	2	
Riffle Habitat (16)			14		C.A	100-				The second second	
Left Bank Stability (7)			7		P.S.S.	-	-			100	
Right Bank Stability (7	7)		7		to the second		1	60	-		
Light Penetration (10)			8	A TON				1		1	and the second
Left Riparian Score (5	5)		3	and the second	Frank Fr	-	- 2- 3			100	to the second second
Right Riparian Score (	(5)		3								
Total Habitat Score (	100)		83	Substra	ate	boulder, cobble, gravel and sand; silty				nd sand; silty	
Sample Date		Sample ID		ST	EPT		В	81	EPT	BI	Bioclassification
06/21/06		9965		116	49		4.	.9	3.7	,	Good
07/10/02		8806		60	22		5.9 4.2 Fa			Fair	
07/09/97		7348		70	34		4.	.7	3.7	,	Good

#### **Taxonomic Analysis**

07/20/92

EPT richness more than doubled since 2002 to achieve the highest number ever recorded at this site. Stoneflies, completely absent in 2002, have recovered with 7 taxa present of which 2 were abundant (Acroneuria abnormis and Perlesta sp.). The most caddisfly taxa ever collected were collected in 2006, almost 3 times the number of caddisfly taxa collected in 1997 (the last Good rating). However, abundant midge taxa and many oligochaete taxa kept the biotic index relatively high at 4.9. The number of abundant EPT taxa increased overall, but was evenly split between intolerant and tolerant groups. Never before collected taxa included Rhyacophila formosa, Micrasema wataga, Brachycentrus nigrosoma, Anthopotamus distinctus and Eurylophella aestiva (23rd state record).

23

5.2

3.1

Good-Fair

78

5922

### **Data Analysis**

Data from 2006 was used in lieu of sampling in 2007. Downstream of 5 major NPDES dischargers (four mining facilities and the town of Spruce Pine WWTP), the North Toe River has historically varied in bioclassification ratings. The Fair rating in 2002 occurred after a 1500 gallon petroleum spill which was remediated by the EPA. Since that event, the biota has recovered and surpassed prior levels to receive a Good bioclassification rating for 2007. Petroleum odors were noted during the 2006 sampling.

Waterbo	dy	Locati	ion	Statio	n ID		Date		Bioclassification
N TOE	R	SR 13	314	EB2	87	30	3/27/07		GOOD
County	Subbasin	8 digit HUC	Latitude	Longitude	e AUI	Number		Leve	el IV Ecoregion
Yancey	6	06010108	360018	821146	7-2	7-2-(58.5) Souther		Crysta	alline Ridges and Mountains
Stream Classifica	ation	Drainage Area (mi <sup>2</sup>	²) Elev	Elevation (ft)		am Width	(m)	Stream Depth (m)	
B; Tr		322		2278		35			0.4
Forested/		orested/Wetland	Urban		Agricul	ture		Ot	her (describe)
Visible Landuse	(%)	80	20		0				0
Upstream NPI	gers (>1MGD or <1M	IGD and withir	n 1 mile)	NF	PDES Nur	nber		Volume (MGD)	
n	one (below N	Toe R @ SR1162 dis	schargers)						
Water Quality Param	eters					Site Pho	tograph		
Temperature (°C)		27.3				Sec. 1		fin	AND THE REAL PROPERTY OF
Dissolved Oxygen (mg	g/L)	8.0			11-12		Constant and	13	
Specific Conductance	(µS/cm)	101	- Alle	10 C	100	120	2 10 10	5	
pH (s.u.)		8.1	and the second		Z la		ALCONT . ST	E.	
Water Clarity		slightly turbid				and the			
Habitat Assessment	Scores (max)					and the second second	444	a	And the Actual States of the second
Channel Modification	(5)	5		200				-	
Instream Habitat (20)		16						1	And the Andrews
Bottom Substrate (15)		11	-		Tister .		1.10	and a second	The second se
Pool Variety (10)		10	- State		Aug - F			0	And And And
Riffle Habitat (16)		14							and the second sec
Left Bank Stability (7)		6							The second second
Right Bank Stability (7	·)	7				and the	Contra all'a	1 miles	
Light Penetration (10)		2					and the second		
Left Riparian Score (5) 1						12 -	A Service		
Right Riparian Score (	5)	3							
Total Habitat Score (	100)	75	Substra	ate		be	edrock, grave	el, an	d sand

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/27/07	10336	73	35	5.3	4.6	Good
07/09/02	8802	75	36	4.9	3.8	Good
07/09/97	7347	74	40	4.7	4.2	Good
07/21/92	5924	94	42	4.8	4.1	Good

## **Taxonomic Analysis**

EPT richness continues to decline, although at a slow rate. The biota is dominated by semi-intolerant taxa such as *Neureclipsis* sp., *Tricorythodes* sp. and *Isonychia* sp. and by tolerant taxa such as *Baetis intercalaris*, *B. flavistriga*, *Caenis* sp. and *Cheumatopsyche* sp. Only one sensitve taxon, *Ceratopsyche morosa*, was abundant in 2007. Even though a few previously collected taxa were not found (*Eurylophella funeralis*, *Ephoron leukon*, *Serratella deficiens*, *S. serratoides*, *Nyctiophylax celta*, *Setodes* sp. and *Triaenodes ignitus*), some taxa were collected for the first time including the stonefly *Pteronarcys comstocki* (4th state record), *Oecetis nocturna*, *O. morsei*, and *Anthopotamus distinctus*. The stonefly *Perlesta* sp. was also missing, probably because of emergence.

## Data Analysis

Over 14 miles downstream of the last major NPDES discharger and 7 miles downstream from the confluence with the South Toe River, this site passes through agricultural and industrial (mining) areas. This site has maintained a Good rating since 1992. However, it appears that the macroinvertebrate community is becoming more tolerant as evidenced by an increasing biotic index. One caveat, however is that EPT richness in 2007 may be affected by seasonal emergence of some insects from the stream as this site was sampled late in August. The appalachian elktoe (*Alasmidonta raveneliana*), a federally endagered mussel, was found near this site in 2002.

Waterb	ody			Location		Date	е	Station	ID	Bi	oclassif	ication
BIG CRAB	<b>FREE</b>	CR		SR 1002		06/18	8/07	EF7	7	E	Excel	lent
County	Sul	bbasin	8 digit HUC	Latitude	Long	itude	AU	Number		Level I	V Ecore	gion
MITCHELL		6	06010108	35.8875	-82.146	638889	7	7-2-48	Sou	thern Crystallin	e Ridge	s and Mountains
Stream Classifica	tion	Drain	age Area (mi2)	Elevati	on (ft)	Strea	am Wi	dth (m)	۵۱	verage Depth (	(m)	Reference Site
C: Tr			12.3	259	90		9	utii (iii)	71	0.3		Yes
			.2.0	200			•			0.0		
		Fore	sted/Wetland	Ur	ban		Ag	riculture		Ot	ther (des	scribe)
Visible Landuse	(%)		100		0			0			0	
Upstream NPDES Di	scharg	iers (>1MC	GD or <1MGD a	and within 1 mil	e)			NPDES	S Numł	per	Vo	lume (MGD)
			None		-,							
									ito Ph	tograph		
water Quality Param	ieters					ALC: NO.	100	5 10 10 10 10 10 10 10 10 10 10 10 10 10	ite File	Jograph	AL MAN AND	and the second second
Temperature (°C)			18.5		E THE WAY			ter le	Sec. 1		Part of the	The second
Dissolved Oxygen (mg	g/L)		8.3			-					ate	
Specific Conductance	e (µS/cn	n)	32		Carlos and	and the second	- MA	Service Service	alla.	the Part of	200	
pH (s.u.)			6.1	*					147		and a	A Carto
				Siller Same		No.	- Darig			1.5	1	La Repair 8
Water Clarity			Clear					-				
Habitat Assessment	Scores	s (max)		1.00 m				1	. A	in the		
Channel Modification	(5)		5	- Bridge		No.	- n -	and the second second		and the second second		
Instream Habitat (20)	( )		18			-	-	-	-			States - Barr
Bottom Substrate (15)	)		12		2	se talen			1.5		-	the second
Pool Variety (10)	,		10		2	10		-	Ref. 1	A Me	-	- the
Riffle Habitat (16)			15	-	1	6				and the second		A
Left Bank Stability (7)			7					and and	-	and the second second	L'AL	
Right Bank Stability (7	7)		7	and the second second	and the second	the state		Sale -	17 - M	TURN THE REAL		
Light Penetration (10) 8				Strange Strange	and the	-			and the second	and the second	Sec. 1	
Left Riparian Score (5	5)		5	1000		and the second	del -	The states	Souls.		The second	
Right Riparian Score	(5)		5									
Total Habitat Score (	(100)		92	Sub	ostrate	cobble, b	oulder	•				

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
06/18/07	2007-83	20	58	Excellent
12/01/04	2004-141	17	58	Excellent
05/04/99	99-30	18	58	Excellent
09/30/98	98-77	17	58	Excellent
06/24/97	97-62	18	58	Excellent
Most Abundant Species	Mottled Sculpin	Exotic Spec	cies Redbreast Sunfish	

**Most Abundant Species** 

Species Change Since Last Cycle

Gains -- Rosyside Dace, Greenside Darter, Black Redhorse, Gilt Darter, and Creek Chub. Losses -- White Sucker and Whitetail Shiner.

**Exotic Species** 

#### **Data Analysis**

Watershed -- a tributary to the North Toe River located about 5.5 miles upstream of its confluence; drains the southernmost tip of Mitchell County and small part of southeastern Yancey County. Habitat -- high quality instream habitats including runs with fast chutes, cobble riffles, and boulder pools; low flow; good forested riparian zone widths. 2007 -- an abundant community of fish (n = 474) with good species richness (including 4 intolerant species) and good reproductive function; all species collected were represented by multiple age classes; a 7.5 inch Eastern Hellbender (a NC species of Special Concern and indicative of low siltation) was also collected and released. 1997 - 2007 -- a total of 22 species are known from this watershed including 10 species of minnows, 3 species of suckers, and 4 species of darters. This regional reference site has maintained the same NCIBI score and Excellent rating over a 10 year period and would qualify for HQW or ORW status if petitioned.

Waterbo	dy	Locati	ion	Statio	on ID		Date	Bioclassification
BIG CRABT	REE CR	US 19	9 E	EB2	274	30	8/15/07	EXCELLENT
County	Subbasin	8 digit HUC	Latitude	Longitud	le AU I	AU Number		evel IV Ecoregion
Mitchell	6	06010108	355409	820851	7.	-2-48	Southern Cry	stalline Ridges and Mountains
Stream Classifica	tion	Drainage Area (mi <sup>2</sup>	<sup>2</sup> ) Elev	vation (ft)	Stre	ream Width (m)		Stream Depth (m)
C; Tr	17		2600		7		0.1	
	F	orested/Wetland	Urban	1	Agricul	ture		Other (describe)
Visible Landuse	(%)	50	50		0			0
Upstream NPI	gers (>1MGD or <1M	IGD and withir	n 1 mile)	NF	PDES Nur	nber	Volume (MGD)	
		none						
Water Quality Param	eters					Site Pho	otograph	
Temperature (°C)		18.3					And the second sec	
Dissolved Oxygen (mg	g/L)		1. 1. 1			100	Contraction of the second	
Specific Conductance	(µS/cm)	42				AL.		
pH (s.u.)		6.7					TO LES	
Water Clarity		clear						2.
Habitat Assessment	Scores (max	)	1.00	a state of	- Frank	a just	a dela sa	Wanter
Channel Modification (	(5)	5	- 34	- 195	2-1	CAL.	a ling	
Instream Habitat (20)		14						Contraction of the second
Bottom Substrate (15)		12	15			-		and the second
Pool Variety (10)		10				and and a		
Riffle Habitat (16)		14	and the second second	and services		- 2-9	and the second second	And a state of the
Left Bank Stability (7)		7		THE .		100		
Right Bank Stability (7	)	7				-	Series -	and the second s
Light Penetration (10)		10	The second second			100	-	
Left Riparian Score (5	)	3						and the second second
Right Riparian Score (	5)	4						
Total Habitat Score (	fotal Habitat Score (5)			ate		cobble wit	h boulder and g	gravel, some sand

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/15/07	10293		37		2.9	Excellent
07/11/02	8809		37		3.0	Excellent
07/10/97	7350		40		2.2	Excellent

### **Taxonomic Analysis**

EPT diversity in Big Crabtree Creek has remained stable relative to other sampling years. However, abundant intolerants in 2007 decreased by a factor of 2 from previous years. Six taxa in 2002 were abundant while only 3 were abundant in 2007 (the mayfly *Epeorus vitreus* and the stoneflies *Leuctra* sp. and *Tallaperla* sp.). Only one baetid mayfly (*Baetis intercalaris*) was collected in 2007 in contrast to 4 in 2002 and 5 in 1997. Also, 2 species of the caddisfly *Rhyacophila (R. amicus and R. fuscula)*, present in previous years, were not collected. Collected taxa of note include the mayflies *Paraleptophlebia* sp. and *Serratella serratoides*; the stoneflies *Pteronarcys* sp. and *Paragnetina immarginata*; and the caddisflies *Brachycentrus spinae*, *Dolophilodes* sp., and *Mystacides sepulchralis*.

### Data Analysis

The catchment of Big Crabtree Creek is primarily forested with sparse pockets of residential development throughout and agricultural fields near US 19E. With no dischargers and low potential non-point source runoff (particularly during drought conditions), Big Crabtree Creek has few stressors on the macroinvertebrate community. This conclusion is supported by an Excellent rating for the last 3 basinwide cycles.

Waterboo	dy	Locatio	on	Statio	n ID		Date	Bioclassification
S TOE	R	SR 11	67	EB2	94	30	3/13/07	EXCELLENT
County	Subbasin	8 digit HUC	Latitude	Longitude	e AUI	Number	Lev	vel IV Ecoregion
Yancey	6	06010108	354952	821104	7-2	2-52-(1)	Southern Crys	alline Ridges and Mountains
Stream Classifica	ition	Drainage Area (mi <sup>2</sup> )	Elev	vation (ft)	Stream Width		(m)	Stream Depth (m)
B; Tr, ORW		43		2800		12		0.25
Forested/V		rested/Wetland	Urban		Agricul	ture	0	ther (describe)
Visible Landuse	(%)	70	30		0			0
Upstream NPI	ers (>1MGD or <1M	GD and withir	n 1 mile)	N	PDES Nur	nber	Volume (MGD)	
		none						
Water Quality Param	eters					Site Pho	otograph	
Temperature (°C)		25.2					752	
Dissolved Oxygen (mg	g/L)	6.7						Contraction of the second
Specific Conductance	(µS/cm)	21	Part of					A STATE
pH (s.u.)		6.6						199
Water Clarity		clear						
Habitat Assessment	Scores (max)		Sec. 1	and the second	and the	No. Ter	Sector and	Contraction of the local division of the loc
Channel Modification (	(5)	5	1.144				-	and the second s
Instream Habitat (20)		14		ALL DEPTH LINE	per- 2		the state	and the
Bottom Substrate (15)		15				-	the states	and the second s
Pool Variety (10)		8				To Mark	and a	State -
Riffle Habitat (16)		16		Lora-		AL	The second	- IT - HE
Left Bank Stability (7)		7		Sec. Salar		Y.		
Right Bank Stability (7	)	7		A State	-	and the second	Con-	
Light Penetration (10)		2			and the		-	
Left Riparian Score (5)	)	4	مر کم		Detter -	the state		The second second
Right Riparian Score (	5)	4						

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/13/07	10244	110	51	3.8	3.0	Excellent
07/11/02	8810	100	50	3.5	2.6	Excellent
07/10/97	7349	82	40	3.2	2.5	Excellent
07/20/92	5921	102	48	3.6	2.6	Excellent

cobble, boulder, and bedrock

Substrate

82

#### **Taxonomic Analysis**

**Total Habitat Score (100)** 

Very little change occurred in EPT richness from 2002 to 2007. Abundant taxa were mostly intolerant taxa such as Neoephemera purpurea, Paragnetina immarginata, Leuctra sp., Brachycentrus spinae, B. appalachia, Dolophilodes sp., and Mystacides sepulchralis. The increase in the biotic index can be partially attributed to a higher diverstiy of midges as well as an overall more tolerant EPT community. Agnetina flavescens, a perlid stonefly, was collected for only the 27th time in the entire state. Also, a hellbender (Cryptobranchus alleganiensis), a species of special concern in NC, was noted (and photographed).

### Data Analysis

Classified as Outstanding Resource Waters (ORW), the South Toe River drains a portion of Pisgah National Forest in Southeastern Yancy County. With no NPDES dischargers, the agricultural and residential development that exists along the river corridor in the lower watershed has little to no impact on the stream in low flow years such as 2002 and 2007. At SR 1167, South Toe River has consistantly rated Excellent. Even though the biotic index has increased during the last 2 cycles, suggesting a more tolerant community, it is still well within the excellent range. Of particular note, rootmats were out of the water reducing habitat for some groups of benthic insects although the instream habitat was very good.

Waterbody			Location			Date Station ID			n ID	D Bioclassification		
CANE	CR		:	SR 1211		06/21/	07 EF14			Fai	r	
County	Subb	asin	8 digit HUC	Latitude	Longi	itude	AUI	Number		Level IV Ecoregion		gion
MITCHELL	6	6	06010108	36.01166667	-82.1	475	7.	-2-59	9 Southern Crystallir		e Ridges	and Mountains
Stream Classifica	Classification Drainage Area (mi2)				Elevation (ft) Strea				am Width (m) Avera			Reference Site
C;Tr			16.3	2512	2		8			0.3		No
		Fores	sted/Wetland	Urk		Agr	iculture		Ot	ther (des	cribe)	
Visible Landuse	(%)		55	10 (rural r	esidential)			30			5 (city pa	ark)
Upstream NPDES Di	ischarger	s (>1MG	iD or <1MGD a	nd within 1 mile	:)			NPDE	S Num	ber	Vol	ume (MGD)
			None									
Water Quality Param						ę	Site Ph	otograph		ALC: CONTRACTOR		
Temperature (°C)			14.7	a state		19	are and		23	The second		140-2-2
Dissolved Oxygen (mg	g/L)		9.1			Contraction of			1			1
Specific Conductance	e (µS/cm)		68	CB6E .	-	*	-			A CONTRACTOR		
pH (s.u.)			6.9		the state				- Alexandre		eller.	
Water Clarity		Slig	ghtly turbid		A.			2				Mar I
Habitat Assessment	Scores (	max)		2.125.5			-	- San		A start	and the second	and and
Channel Modification	(5)		5			a second second				E hanne		- A/LA BARRE
Instream Habitat (20)			18			En la			the second	1-5-57	at 1	1-2-4
Bottom Substrate (15)	)		8		and a	1		- Ar	472	- There is	1	
Pool Variety (10)			6	34.00	7.4	12			-	1	0	4-4
Riffle Habitat (16)			12	the second second	- the	the second		~		1 mart		Section and
Left Bank Stability (7)			5	-	-	12 24		- Out	15th	-	Stat 1	the state of the s
Right Bank Stability (7	7)		5	and the second s	and and the	and and	-			a star	75	and and
Light Penetration (10)			7	10 - A.C.	1115	2.3	-1244			- ind	and the second	a contraction of the
Left Riparian Score (5	5)		2		AL DESCRIPTION	2010	Contra a	10000	CLA	at the second	and the second	and the second
Right Riparian Score	(5)		2									
Total Habitat Score (	(100)		70	Subs	strate	cobble, bo	ulder,	bedrock				
Sample Date	•		Sample	ID	Spe	cies Total			NCIE	I	Biod	lassification
06/21/07			2007-90	)		13			36			Fair
06/24/97 97-63			12			34			Fair			
Most Abundant Spe	ecies		Bluehead Chu	)		Exotic S	Speci	es	Redbr	east Sunfish, Bl	uehead (	Chub, and Brown

Species Change Since Last Cycle

Gains -- Rock Bass. Losses -- none

#### Data Analysis

**Watershed** -- a tributary to the North Toe River located about 4 miles above its confluence; drains central Mitchell County, just east of Bakersville; land use in this rural catchment is primarily agricultural; Hatchery Supported Trout Waters. **Habitat** -- cobble riffles, chutes, and one long shallow silty pool; thin but intact riparian zone widths on both sides of the sample reach; cattle have been fenced out of the stream. **2007** -- a moderately diverse, yet extremely abundant fish community (n = 1516) was collected; the non-indigenous Bluehead Chub (n = 636, 42%) and Central Stoneroller (n = 435, 29%) represented the majority; no darters were collected; only one intolerant species (Rock Bass) was collected. **1997 - 2007** -- there are 13 known species from this site including 8 species of minnows, 2 species of sunfish, 2 species of suckers, and 1 trout species. The NCIBI metrics have remained stable between sample cycles. However, this watershed continues to experience non-point runoff from rural agricultural practices, which is consistent with the high percentage of omnivores + herbivores collected in both samples.

Trout

Waterbody			Location				Date	Date Station ID			Bioclassification		
BIG ROC	CK CR	2		NC 2	26		06/20/	07	EF1	0		Go	od
County	Cub	haain	مالله المتعام ٥	L ati	4do	Long	ituda		Number		Lava		agion
	Subi	G	06010108	26.050	100e	22.21g	Ruue	7		Sout			egion
WITCHELL		0	00010108	30.030	)21110	-02.210		1	-2-04	3000	leni Ciysia		
Stream Classifica	tion	Draina	ige Area (mi2)	Elevation (f		n (ft)	Stream Wic		Width (m)		Average Depth (m)		Reference Site
C;Tr			33.3		2375	5		12			0.4		Yes
	_	Fores	sted/Wetland		Urt	ban		Agr	riculture			Other (de	escribe)
Visible Landuse	(%)		70		(	)			30			10	)
Upstream NPDES Di	scharge	rs (>1MG	D or <1MGD a	nd with	in 1 mile	)			NPDES	S Numbe	er	V	olume (MGD)
			None										
Water Quality Parameters Site Photograph													
Temperature (°C)			20.2					3.3	11		1.00	and the second s	and the second
Dissolved Oxygen (mg	g/L)		9.0		33.6				THE	Ser.	-	and the second	and the second
Specific Conductance	(µS/cm)	)	65		1	ALC: N		24	A sel				200
pH (s.u.)			6.9		R. H.	100	1 A Char	h	-				F
Water Clarity		(	Turbid		And the second			A.			-		
Habitat Assessment	Scores	(max)	_					-	Kart	and a		100	A CONTRACTOR
Channel Modification	(5)		5	_			C. Josef		and the second	2	-		
Instream Habitat (20)			18	_	Ster.			-		-	A MAR		
Bottom Substrate (15)	)		12	_	1911		Contraction of the						
Pool Variety (10)			(	_	and the second		No.		Telle Strate	C. S. H.			× 18 C ×
Riffle Habitat (16)			16	_	-	ALC: N			Ware -	CRC .	AL AREAL		
Left Bank Stability (7)	7)		6			No la	2 - 4	-		SAL.	and the second	-	
Right Bank Stability (7	()		6	_	1000	13			-		AL CONTRACT	10.00	
Light Penetration (10)	3		10			1000							No Sector
Pight Diporton Score (5	') (E)		4		ALC: NO	1000		100	ALC: NOT A			76	
Total Habitat Score (	(J) (100)		87		Sub	strate	cobble be	drock	•				
Samula Data			Samula		Cub	Eno	cico Total			NCIRI		Dia	alaasifiaation
	;		5ample	ט ג	]	Spe				NCIBI		BIG	Good
09/30/98			98-78	,			14			50			Good
Most Abundant Spe	ecies		Mottled Sculpir	l			Exotic	Speci	ies	Brown T	rout		
Spacios Chango Sin	needed Change Since Lost Cycle												

Species Change Since Last Cycle

**Gains** -- Bluegill and Smallmouth Bass. **Losses** -- Whitetail Shiner and Rainbow Trout.

#### **Data Analysis**

Watershed -- a tributary to the North Toe River located just over 5 miles above its confluence; drains a large portion of northern Mitchell County including some Pisgah National Forest lands within the outskirts of the catchment; Hatchery Supported Trout Waters. Habitat -- cobble and bedrock shelf riffles, boulder runs, and 1 long fast chute; thin riparian corridors that are flanked by pasture fields; slightly elevated conductivity. 2007 - a fairly diverse and abundant (n = 708) fish community was collected at this regional reference site; one very old Eastern Hellbender (NC Species of Special Concern and indicative of low siltation) measuring 21.5" long was also collected and released. 1998 - 2007 -- very stable NCIBI metric scores over the 9 year span between samples; this watershed is supporting a total of 17 known species including 8 species of minnows, 2 species of suckers, and 2 species of darters. Notwithstanding some non-point nutrient loading from agriculture, there appears to be no obvious water quality issues here.

Waterboo	dy	Locati	ion		Station I	D		Date		Bioclassification
BIG ROC	K CR	NC 1	97		EB27	5	30	8/14/07		EXCELLENT
County	Subbasin	8 digit HUC	Latit	ude Lo	ngitude	AUN	Number		Leve	I IV Ecoregion
Mitchell	6	06010108	360	128 8	21511	7-	2-64	Southern (	Crystal	line Ridges and Mountains
Stream Classifica	tion	Drainage Area (mi <sup>2</sup>	2)	Elevation	(ft)	Stream Width		(m)	(m) Stream Depth (m	
C; Tr		63		2135			9			0.3
	Fo	rested/Wetland		Urban		Agricul	ture		Oth	er (describe)
Visible Landuse (%)		20		20		60				0
Upstream NPI	ers (>1MGD or <1N	IGD and	d within 1 m	ile)	NF	DES Nun	nber		Volume (MGD)	
		none								
Water Quality Param	eters						Site Pho	tograph		
Temperature (°C)		25.5	200	Rand	then a	er de	122	THE WAR		St. Standard St.
Dissolved Oxygen (mg	g/L)			-	S.C.S		and an	A A	100	ALC MER MAN
Specific Conductance	(µS/cm)	66			AW	199		Thomas	1000	
pH (s.u.)		8.6	2.00				2 Partie	1	-	and the second second
Water Clarity		clear		-						
Habitat Assessment	Scores (max)			1. A.		1 see	and the second	2		AN A REAL BOOK
Channel Modification (	(5)	5	í.	R. C. Barris	Contraction of the second	CO.	Chan (Mr. )-	ANY MICHENS	1. 14	1- and the state
Instream Habitat (20)		14			300	12.0	-27		and the second	La state of the
Bottom Substrate (15)		10		100 200		-	the second	The start		The state of the
Pool Variety (10)		10	W/A			Souther a				Land and
Riffle Habitat (16)		15			E FE			1	-	and the second second
Left Bank Stability (7)		7	100	Contraction of the		1			7	「「いい」で、小山
Right Bank Stability (7	·)	6		and the second		-		TRAK	-	
Light Penetration (10)		3		E.S.	and the second	en en	302	S. S.	Ser.	
Left Riparian Score (5)	)	2		Participa	- de	A Designed and	- Free	and the second	1 and	and and the state
Right Riparian Score (	5)	1								

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/14/07	10292		38		3.3	Excellent
07/09/02	8801		36		3.0	Excellent
07/09/97	7346		34		2.4	Good
07/21/92	5925		43		2.7	Excellent

sand with equal amounts of boulder, cobble and gravel

Substrate

73

#### **Taxonomic Analysis**

**Total Habitat Score (100)** 

After a historically low EPT richness in 1997 (34), Big Rock Creek regained 2 EPT each basinwide cycle. Only 4 intolerant taxa were abundant; two stoneflies, *Acroneuria abnormis* and *Paragnetina immarginata*, as well as 2 caddisflies, *Brachycentrus spinae* and *Ceratopsyche morosa*. Other intolerant taxa were the mayflies *Epeorus vitreus*, *Heterocloeon anoka*, *Neoephemera purpurea* and *Anthopotamus distinctus* (1st collection at this site); and the caddisflies *Micrasema wataga* and *Setodes* sp. The caddisfly *Brachycentrus appalachia*, collected in previous years, was not found in 2007.

### Data Analysis

Big Rock Creek drains a portion of Pisgah National Forest and the Pisgah Gamelands. However, the river corridor in the lower watershed is well developed both residentially and agriculturally. Although this stream only rated Good in 1997, two more taxa would have resulted in an Excellent rating. This stream appears to have no water quality issues as evidenced by a stable and diverse macroinvertebrate community.

Waterbody		Location			Date		Station I	D	Bioclassification		
PIGEONRC	OST	CR	SR 1	349/NC 19	7	06/20/	07	EF39	)	Goo	bd
County	Subl	pasin	8 digit HUC	Latitude	Longi	itude	ΔU	Number	Leve	IV Ecore	aion
MITCHELL	64.51	5	06010108	36.04583333	-82,299	16667	7	7-2-69	Southern Crysta	lline Ridae	es and Mountains
		-			02.200		-	2 00		into radge	
Stream Classifica	Stream Classification Drainage Area (mi				n (ft)	Stream	n Wie	dth (m)	Average Dept	h (m)	Reference Site
C;Tr 14.1			14.1	213	)		9		0.4		Yes
Form			tod/Wotland	l lek	20		٨а	riculturo		Othor (do	scriba)
Visible Landuse (%)		10163	93	5 (rural re	sidential)		<u>~y</u>	0		2 (fire st	ation)
	(///			o (Faraire						2 (	
Upstream NPDES Di	scharge	rs (>1MG	iD or <1MGD a	nd within 1 mile	)			NPDES	Number	Vo	olume (MGD)
			None								
Water Quality Param						Sit	e Photograph				
Temperature (°C)			17.4					a starte		Car A	
Dissolved Oxvaen (me	a/L)		9.0					1. C. C. C.	THE STORE	- A	Par Internet
Specific Conductance	ο , (μS/cm)		39			· · · ·	12	2 2 2 2		1	E Charles
рН (s.u.)			6.8			1.1				1	
Water Clarity			Clear	ales -		1		-			
Habitat Assessment	Scores	(max)			(and			and the second second		and a	
Channel Modification	(5)		5	144 C	Sec. 1	SAL .		1			- Sector - Sector
Instream Habitat (20)			20	-	Section.				2 martin	Sec. 1	
Bottom Substrate (15)	)		15	200				-	and the second s	10.00	
Pool Variety (10)			8	and the second	-	1	-	- Maria			- Series
Riffle Habitat (16)			16	NV200	and the	and the second	Sales	A COLOR	and the second second		and the second
Left Bank Stability (7)			6	Sec. 1	- Bi	100-10		and here	- Bart		The second
Right Bank Stability (7	7)		6	10	200	-			- Andrew Color		the state of the state
Light Penetration (10)			8	20		And the state					30 - 30
Left Riparian Score (5	5)		4	and the second	1.50	a series of	(Care)	ALC: NOT		- Contraction	and the second
Right Riparian Score	(5)		4								
Total Habitat Score (	(100)		92	Subs	strate	cobble, bo	oulder	, gravel			
Sample Date	)		Sample	ID	Spee	cies Total			NCIBI	Bio	classification
06/20/07			2007-88	3		22			56		Good
06/21/02			2002-79	9		23			58		Excellent
10/20/97			97-87			21			60		Excellent

Most Abundant Species	Mottled Sculpin	Exotic Species	Redbreast Sunfish and Brown Trout	
Species Change Since Last Cycle	<b>Gains</b> Redbreast Sunfish, Fatlips Rainbow Trout, and Brook Trout.	Minnow, and Creek Chub	. Losses Rock Bass, Smallmouth Bass,	

#### Data Analysis

**Watershed** -- one of the last tributaries to the North Toe River before the North Toe joins the Cane River to form the Nolichucky River; drains part of the northwest corner of Mitchell County including portions of the Pisgah National Forest. **Habitat** -- high gradient forested mountain stream with abundant riffles, fast chutes, and boulder shelves. **2007** -- a very abundant fish population (n = 1553) with good species richness, including three intolerant species (Telescope Shiner, Greenfin Darter, and Gilt Darter); with the addition of just one more bass or trout species (see Losses), this site would have received its third consecutive rating of Excellent. **1997 - 2007** -- this site is supporting an incredibly abundant fishery of 27 known species including 13 species of minnows, 5 species of Darters, 3 species of trout, 2 species of bass, and 1 species of sucker. With stable NCIBI metrics, two Excellent ratings, and one Good rating, this watershed might qualify for reclassification to HQW or ORW if returns to Excellent.

Waterboo	dy	Locati	on	Statio	n ID		Date	Bioclassification
CANE	R	US 19	W	EB3	02	30	3/14/07	EXCELLENT
County	Subbasin	8 digit HUC	Latitude	Longitude	e AUI	J Number		Level IV Ecoregion
Yancey	7	06010108	360000	822126	7-3-	(13.7)a	Southern C	rystalline Ridges and Mountains
Stream Classification		Drainage Area (mi <sup>2</sup>	) Elev	vation (ft)	n (ft) Stre		(m)	Stream Depth (m)
C; Tr		145		2100		25		0.3
	Fo	rested/Wetland	Urban		Agricul	ture		Other (describe)
Visible Landuse	(%)	20	80		0			0
Upstream NPE	ers (>1MGD or <1M	GD and withir	n 1 mile)	N	PDES Nur	nber	Volume (MGD)	
		none						
Water Quality Parame	eters					Site Pho	otograph	
Temperature (°C) Dissolved Oxygen (mg Specific Conductance pH (s.u.)	g/L) (μS/cm)	24.7  68 8.7						
Water Clarity		slightly turbid						A
Habitat Assessment	Scores (max)			Lines.			Sec.	
Channel Modification (	(5)	5		State	-	And a	and a	
Instream Habitat (20)		16			1		-	
Bottom Substrate (15)		12		E - Loge		-	- The state	A set of the set of the set
Pool Variety (10)		6	1	2.5% 200	and the second	-		Transformer - P
Riffle Habitat (16)		14		1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 -	-		and a	
Left Bank Stability (7)		7			-	-		
Right Bank Stability (7	)	7	Contraction of the local division of the loc	and the second	and the second	1	Sec.	A Manual Con in
Light Penetration (10)		2	-	Sector Sector	2740	-	The second second	A de a la l
Left Riparian Score (5)	)	2	-			- And		and the second s
Right Riparian Score (	5)	3						

Total Habitat Score (100)	74	Substra	ate	cobble, boulder, and gravel				
Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification		
08/14/07	10246	99	45	4.4	3.5	Excellent		
07/09/02	8845	91	46	4.4	3.6	Excellent		
07/09/97	7344	84	46	4.4	3.5	Excellent		
07/21/92	5927	93	48	4.4	3.5	Excellent		

Cubatrata

#### **Taxonomic Analysis**

The EPT richness, as well as the biotic index, have remained stable over the last four basinwide cycles. Of note is that more intolerant taxa were abundant (10) than moderately intolerant (6) and tolerant taxa (2) combined. Three intolerant caddisfly taxa, Goera sp., Mystacides sepulchralis, and Nyctiophylax celta were not previously collected. Other taxa included the mayflies Ephoron leukon, Anthopotamus distinctus, Serratella deficiens; the stonefly Acroneuria abnormis; and the caddisflies Micrasema wataga and Neureclipsis sp. Heterocloeon petersi, Perlesta sp., Psychomia flavida, and Triaenodes perna, all found in 2002, were not collected in 2007.

### **Data Analysis**

Originating in Pisgah National Forest, the Cane River passes through many small communities and rural developments. Additionally, the river is closely followed by US 19 for much of its length eliminating riparian and adding potential road runoff. Despite this, the Cane River has consistently rated Excellent since 1992 indicating no water quality or serious habitat deficiencies, based upon the macroinvertebrate community. The addition of high quality waters from many of the Cane River tributatries is likely partially responsible for maintainig the excellent water of the Cane River.
# BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody		Locatio	Station ID		Date		Bioclassification		
BALD MTN CR		SR 14	SR 1408			08/14/07		EXCELLENT	
County	Subbasin	8 digit HUC	Latitude	Longitude	e <u>AU</u> I	Number	Lev	vel IV Ecoregion	
Yancey	7	06010108	355902	822432	7	-3-32	Southern Cryst	alline Ridges and Mountains	
Stream Classification		Drainage Area (mi <sup>2</sup> )	Elev	vation (ft)	Stre	am Width	(m)	Stream Depth (m)	
C; Tr		15		2380		7		0.2	
For		rested/Wetland	Urban		Agricul	ture	0	ther (describe)	
VISIBLE LANGUSE	(%)	30	30 70		0			0	
Upstream NPI	DES Discharge	ers (>1MGD or <1M	GD and withir	n 1 mile)	1 mile) NPC		nber	Volume (MGD)	
		none							
Water Quality Param	eters					Site Pho	tograph		
Temperature (°C)		17.1	Ser. Ser.					No. 2	
Dissolved Oxygen (mg	g/L)						(Postalan)	N PLE	
Specific Conductance	(µS/cm)	44			122	Sale -		A THE STATE	
pH (s.u.)		6.7	C			10.0	a second	1000	
Water Clarity		clear	and the		3		() = E		
Habitat Assessment	Scores (max)		10.10	1.2		Star Stat	and the second	and the second of	
Channel Modification (	(5)	5	alter to	T		NA TH	11	de Mathiation	
Instream Habitat (20)		16		Sec.	A LAND	and the second	The second	The states	
Bottom Substrate (15)		12		The Lot of the	Alex -	Torie -			
Pool Variety (10)		6	100	all all					
Riffle Habitat (16)					and the second		Ser AN		
Left Bank Stability (7)		A REAL PROPERTY AND A REAL							
Right Bank Stability (7)				-	-	-	A CARL		
Light Penetration (10)	7								
Left Riparian Score (5)	)	2		the second	and a second	2000	Carlo Sta		
Right Riparian Score (	5)	0							

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/14/07	10245		41		2.4	Excellent
07/09/02	8844		40		2.8	Excellent
07/08/97	7343		32		2.5	Good
07/21/92	5928		26		3.4	Good-Fair

Mostly cobble with gravel. Some boulder and sand.

Substrate

77

#### **Taxonomic Analysis**

**Total Habitat Score (100)** 

EPT richness was similar to 2002 levels but has increased substantially over the years prior to 2002. Abundant intolerant taxa dominate the fauna of Bald Mountain Creek. These taxa include the mayflies *Drunella conestee*, *Epeorus vitreus*, *Rithrogena* sp., and *Serratella carolina*; the stoneflies *Leuctra* sp., *Paragnetina immarginata*, and *Pteronarcys* sp.; and the caddisflies *Glossosoma* sp. and *Neophylax oligius*. Interestingly, previously abundant taxa such as the ubiquitous tolerant caddisfly *Cheumatopsyche* sp. and the moderately intolerant stonefly *Perlesta* sp. were not collected in 2007.

### **Data Analysis**

SR 1408 closely follows Bald Mountain Creek completely eliminating the riparian on one side of the stream. Additionally, the river corridor is moderately developed both residentially and agriculturally, although, overall, the watershed drains mostly forested land. Despite this, Bald Mountain Creek water quality has steadily improved to Excellent from its lowest rating of Good-Fair garnered in 1992. However, the potential non-point source impacts from agriculture and residential development is high. As 2007 (as well as 2002) was a severe drought year, little non-point source runoff entered the stream to impact the benthic fauna.

## FISH COMMUNITY SAMPLE

Waterbody		Location			Date		Station ID		Bioclassification				
BIG CR		SR 1444			06/21/0	)7	EF75		Good				
County Subbasin		e digit HUC Latituda Lan		Long	itudo	udo All Number							
YANCEY	Oub	7	06010108	36.0154299	-82.35	15462	7-3-	40-(2.5)	-(2.5) Southern Crystal			Iline Ridges and Mountains	
		•		0010101200	02.00			(2.0)			no raago		
Stream Classifica	tion	Draina	age Area (mi2)	2) Elevation (ft)		Stream	n Wid	ith (m)	A	verage Depth	(m)	Reference Site	
C;Tr			8.1	2230			5			0.4		No	
_		Forested/Wetland		Url	ban		Agr	riculture		C	other (des	scribe)	
Visible Landuse	(%)		90	10 (rural r	10 (rural residential)		0			0			
Unstream NPDES Di	scharge	ers (51MC	SD or <1MGD a	nd within 1 mile				NPDE	S Numl	her	Vo	lume (MGD)	
	Sonarge		None		•)								
			Nono										
Water Quality Param	eters							\$	Site Ph	otograph			
Temperature (°C)			18.8	1.1	LIP CONT	2 300	N. Ste	Street 15	and and the			1 7 - 1 - 1	
Dissolved Oxygen (mg	g/L)		8.4	Ser.				10.4		Mart 1		Sector and	
Specific Conductance	e (µS/cm	)	40	-5.0						NE BARK	6 m		
pH (s.u.)			6.8		Lunes	and a company						和大利是自己	
	F			1 204	1 4 6		12	AL DIR	2.211	THE PLAN		the Chickon	
Water Clarity			Clear		States .	一个国	and the second	A CONTRACTOR	-	a same			
Habitat Assessment	Scores	(max)					-					1.3-2	
Channel Modification	(5)		5		Kare			-41		and the second	also a	しているの語	
Instream Habitat (20)	(0)		19		1000	Non P	5	and a state of the	and the second			12 Hist	
Bottom Substrate (15)	)		15	Here Have	1 an	-	-		- 2000	-		The state of	
Pool Variety (10)	/		6		and a sente	-		(Catelores			-	ANS ALLE	
Riffle Habitat (16)			16		and the second second	1 40 - 18 a		A.m.	No.		200	~ * · · · · · ·	
Left Bank Stability (7)	Left Bank Stability (7)		5		TANGO - A	I I MARKET	and a	C. Starting P.	-	New 2			
Right Bank Stability (7	7)		6		and the second	All les	and the second		- star			- All All	
Light Penetration (10)			7	and the second	( martine	1000	and a	4 60	1	and the	and the	Contraction of the	
Left Riparian Score (5	5)		4		and a	Star and	Ny.	E. Frank	-		P Part		
Right Riparian Score	(5)		3										
Total Habitat Score (	(100)		86	Sub	strate	cobble, bou	ulder						
Sample Date	)		Sample I	D	Spe	cies Total			NCIB	I	Bio	classification	
06/21/07			2007-92			19			56			Good	
Most Abundant Spe	ecies		Mottled Sculpin			Exotic S	speci	ies	Rainbo	ow Trout and E	Brown Tro	ut	
Species Change Sin	ce Last	Cvcle	N/A										
Data Analysis													
I his is the first fish co	ommunity	y sample (	collected at this	site. watershed	a a tribul	tary to the C	ane	River (and	ultimat	ely the Nolichu	icky Rivei	) located just	

This is the first fish community sample collected at this site. Watershed -- a tributary to the Cane River (and ultimately the Nolichucky River) located just above its confluence; drains part of the northern tip of Yancey County. The upper 1/2 of this highlands watershed lies within Pisgah National Forest lands. Habitat -- typical instream habitats for a high gradient mountain stream; 100% riffle-runs with chutes; open canopy and full sunlight for part of the sample reach, which flows through a residential property. 2007 -- a diverse and abundant (n = 767) population of fish were collected including 6 intolerant species,

reach, which flows through a residential property. **2007** -- a diverse and abundant (n = 767) population of fish were collected including 6 intolerant species, 9 minnow species, 3 darter species, and all 3 trout species; with one more darter species collected, this site would have rated Excellent. There are no apparent water quality issues in this watershed.

## FISH COMMUNITY SAMPLE

Waterbody			Location			Date Sta		Station	tation ID		Bioclassification	
HOLLOW POPLAR CR		NC 197			06/21/	/07 EF7		'4	Not Rated			
County	Sub	hasin	8 digit HUC	Latitude	Long	iitude	۵.1	Number		Level IV Eco	region	
MITCHELL	Out	6	06010108	36.0875132	-82.33	69141	AU	7-10	Southe	ern Crystalline Ride	tes and Mountains	
		-									<u> </u>	
Stream Classifica	tion	Draina	age Area (mi2)	Elevation (ft)		Stream Width		dth (m)	Aver	age Depth (m)	Reference Site	
C;Tr			6	229	2290		4			0.3	Yes	
		Foro	stadMatland	Liel			٨а	riculturo		Othor (c	losoribo)	
Fore		FUIE	75	75 25 (rural residential)		)	Ay	0		0		
	(,,,,					,		-				
Upstream NPDES Di	scharge	ers (>1MC	GD or <1MGD a	nd within 1 mile	d within 1 mile)			NPDE	S Number	· · · ·	/olume (MGD)	
			None									
Water Quality Param	eters							5	Site Photo	graph		
Temperature (°C)			17.1	4	S.M.				1 - A.			
Dissolved Oxygen (mg	g/L)		8.8	AL THE			100		a de la		Station	
Specific Conductance	e (µS/cm	ı)	41	e shi	and the state			1		和基礎的構成。	Line and the	
pH (s.u.)			6.9	-	-	-		-	CONT.	The La		
	r		-		1.	E ASA T		· aller		Section .	C. Sharehow and	
Water Clarity			Clear		C. YEA	1 1 1	×.	-		A State in		
	L	()				A. 4	われ	N	-		Section Section	
Habitat Assessment Scores (max)					1.5.1			Contraction of the second	A get and	and the state		
Channel Modification	(5)		5	- 1	5 M .		1			and the second		
Instream Habitat (20)			19	1000	SP 2	AL AN		-		and the second	man Sel	
Bottom Substrate (15)	)		15	Card a			10		Contra -			
Pool Variety (10)			6		The state	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	1	ALC: NO		1		
Riffle Habitat (16)			16	- 10 M	1 A	C. Con			1-2-2			
Left Bank Stability (7)	7)		6		Sec.	SEA.		-	228	-		
Light Denotration (10)	()		0	-1-27			ALC: Y		The local diversion	Le alle		
Light Penetration (10)	:)		- 7		125	1 Line	1.10			1		
Leit Riparian Score (5	?) (こ)		3	and Alter		¥-1,999	SVI		100	and the second se	and the second sec	
Total Habitat Score (	(C) (100)		3 96	Sub	strato	cobble bo	ulder					
Total Habitat Scole (	100)		00	Cub	Strate		Juluer					
Sample Date	)		Sample	D	Spe	cies Total			NCIBI	В	ioclassification	
06/21/07			2007-91			2					Not Rated	
Most Abundant Spe	ecies		Rainbow Trout			Exotic	Spec	ies	Rainbow	Trout		
Species Change Since Last Cycle			N/A									
Data Analysis												
This is the first fish co	mmunit	y sample	collected at this	site. Watershe	d a tribu	tary to the	Nolich	nucky River	r located a	bout one mile abov	ve its confluence;	
urains a small neadwa	ater cato	inment in	me western cori	ier of witchell Co	ounty bord	lering renn	essee	e, the highe	stelevatio	ins or this watershe	eu lie within Pisgan	

National Forest lands. **Habitat** -- a highlands trout stream with 100% riffle-run habitats; an open canopy exists in sections of the stream along the road (see picture). **2007** -- only two species were collected (Rainbow Trout and Western Blacknose Dace), which is typical for the upper reaches of a high gradient Blue Ridge trout stream; this system probably used to support a reproducing population of Brook Trout, which were replaced with Rainbow Trout. Several dozen young-of-year wild Rainbow Trout were collected and or observed. No apparent water quality issues exist in this rural mountain watershed.