Appendix 1B

Biological Assessment
Macroinvertebrate and Fish Site Sample Results

The full report is available on the DWQ Environmental Sciences Section website:
http://portal.ncdenr.org/web/wq/ess/reports

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
L TENNESSEE R	**OFF SR 1629**	**GB50**	**08/04/10**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	1	06010202	35.000000	-83.381667	2-(1)a	Broad Basins

Stream Classification			Stream Width (m)	Stream Depth (m)
C			25	0.6

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	25	0	25	0	50 (Fallow Fields)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None		

Water Quality Parameters

Temperature (°C)	21.4
Dissolved Oxygen (mg/L)	7.3
Specific Conductance (µS/cm)	27
pH (s.u.)	5.9

Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	16
Bottom Substrate (15)	8
Pool Variety (10)	10
Riffle Habitat (16)	7
Bank Erosion (7)	3
Bank Vegetation (7)	3
Light Penetration (10)	2
Left Riparian Score (5)	1
Right Riparian Score (5)	2
Total Habitat Score (100)	58

Site Photograph

Substrate Sand, gravel, cobble, silt with a trace of boulder

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/04/10	11014	72	24	5.72	4.61	Good-Fair
09/11/00	8303	67	15	6.35	4.08	Fair

Taxonomic Analysis

Numerous intolerant EPT taxa were collected in 2010 that were not present in 2000 and include the mayflies *Paraleptophlebia spp*., *Neoephemera purprea*, the stonefly *Leuctra spp*., and the caddisflies *Polycentropus spp*., *Lype diversa*, and *Neophylax consimilis*. In addition, many pollution tolerant chironomids which were abundant in 2000 were completely absent in 2010 and include *Cricotopus bicinctus*, *C. fugax*, *C. infuscatus*. These data suggest more favorable water quality conditions in 2010 relative to 2000.

Data Analysis

This sampling location is below Commissioner Creek. The large improvement in the benthic macroinvertebrate metrics at this location since the 2000 collection strongly suggests improved water quality at this location.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
L TENNESSEE R	SR 1113	GB24	08/05/10	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
SWAIN	2	06010202	35.326389	-83.523611	2-(26.5)b	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
B	375	1800	50	0.4

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	90	---	---	10	---

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Town of Franklin WWTP	NC0021547	1.65

Water Quality Parameters

Temperature (°C)	27.9
Dissolved Oxygen (mg/L)	7.4
Specific Conductance (µS/cm)	35
pH (s.u.)	6.5

Water Clarity: slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	19
Bottom Substrate (15)	12
Pool Variety (10)	4
Riffle Habitat (16)	14
Bank Erosion (7)	7
Bank Vegetation (7)	6
Light Penetration (10)	4
Left Riparian Score (5)	5
Right Riparian Score (5)	4
Total Habitat Score (100)	80

Site Photograph

Substrate: mostly cobble (50), boulder (20), and bedrock (20); some silt (10)

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/05/10	11090	89	39	4.19	3.36	Good
08/05/04	9461	95	42	4.04	3.03	Good
08/09/99	7957	75	31	4.59	3.44	Good
07/13/94	6587	82	39	4.46	3.81	Good

Taxonomic Analysis

The decrease in EPT richness (15 taxa) occurred as a result of a net loss of baetid mayflies including the intolerant Baetis pluto and Acentrella turbida as well as the rare Iswaeon davidi. However, the rarely collected Heterocloeon petersi has occurred at this site over the past 11 years. As expected in a large, productive river, flat-headed mayflies were abundant and were represented by 6 taxa and included the first basinwide site record of Epeorus vitreus. Caddisflies were rich with 22 taxa, the most this site has seen during basinwide sampling. Hydropsychids dominated and, along with other net-spinning caddisflies, were very abundant. First basinwide records for this site included Leucotrichia pictipes, a species typical of warm water, open-canopied rivers, Ceraclea ancylus, and two species of Pycnopsyche. Stonefly richness was half of that found in 2004 (2 vs. 4 taxa) and consisted entirely of riffle dwelling perlid stoneflies. Perlids are long-lived (2 years) as larvae so their presence over the last 16 years suggests overall stable habitat and water conditions.

Data Analysis

This most downstream site on the Little Tennessee River occurs in southeastern Swain county well below Franklin. The river at this point has two channels. The east channel was sampled in 2004 and the west channel sampled in 2010. These channels are very different as the east channel is primarily bedrock and the west has a good mix of substrates. Overall habitat in the west channel was good, particularly root mats and riffles, although pools were somewhat lacking. The specific conductance was low for a river downstream of a WWTP and the pH was also low for a large productive river. The BI was slightly elevated over the 2004 value (but remained lower than even earlier samples) and the EPT richness decreased, albeit only slightly. Water quality in the Little Tennessee at this site remains Good although it tends to fluctuate slightly, possibly contingent on the flow regime.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
L TENNESSEE R	**SR 1651**	**GB10**	**08/04/10**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	1	06010202	35.122222	-83.377778	2-(1)b	Broad Basins

Stream Classification			Stream Width (m)	Stream Depth (m)
C			40	0.7

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	30	10	50	10	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None		

Water Quality Parameters

Temperature (°C)	24.1
Dissolved Oxygen (mg/L)	8.8
Specific Conductance (µS/cm)	27
pH (s.u.)	6.9

Water Clarity: slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	9
Bottom Substrate (15)	8
Pool Variety (10)	4
Riffle Habitat (16)	7
Bank Erosion (7)	3
Bank Vegetation (7)	3
Light Penetration (10)	2
Left Riparian Score (5)	3
Right Riparian Score (5)	1
Total Habitat Score (100)	45

Site Photograph

Substrate: Sand, silt, gravel, cobble, trace of boulder

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/04/10	11015	93	35	5.03	4.12	Good
07/22/04	9435	93	37	5.30	3.62	Good
10/20/99	7993	62	29	4.16	3.27	Good-Fair
08/05/87	4196	64	20	5.59	4.73	Good-Fair
08/06/85	3536	52	18	5.48	4.66	Fair

Taxonomic Analysis

There were numerous pollution intolerant taxa present in the 2004 and 2010 samples that have not been present from the previous three samples. These taxa include the mayflies *Baetisca carolina* , *Drunella allegheniensis* , *Epeorus vitreus* , *Leucrocuta spp* . and the caddisflies *Brachycentrus spinae* , *Hydroptila spp* ., *Rhyacophila fuscula* , and *Neophylax consimilis* . The presence of these taxa suggest improved water quality at this site relative to the 1985-1999 monitoring period.

Data Analysis

Since the 1985 Fair bioclassification and the 1987 and 1999 Good-Fair ratings, invertebrate collections at this site in 2004 and 2010 have resulted in two consecutive Good bioclassifications. Since 2004, the EPT diversity has been stable and much higher than EPT data obtained in the previous three collections. The 2004 and 2010 data suggest improved water quality at this location relative to the 1985, 1987, and 1999 samples.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
L TENNESSEE R	**NC 28**	**GB35**	**08/05/09**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	1	06010202	35.235000	-83.395833	2-(26.5)a	Broad Basins

Stream Classification			Stream Width (m)	Stream Depth (m)
B			25	0.5

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	25	25	50	0	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none		

Water Quality Parameters

Temperature (°C)	22.5
Dissolved Oxygen (mg/L)	6.1
Specific Conductance (µS/cm)	35
pH (s.u.)	6.4

Water Clarity: slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	10
Bottom Substrate (15)	3
Pool Variety (10)	6
Riffle Habitat (16)	10
Bank Erosion (7)	5
Bank Vegetation (7)	5
Light Penetration (10)	8
Left Riparian Score (5)	1
Right Riparian Score (5)	5
Total Habitat Score (100)	58

Site Photograph

Substrate: bedrock, boulders, sand, gravel and sand

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/05/09	10791	85	37	4.66	3.55	Good
07/22/04	9448	71	32	5.07	4.13	Good-Fair
08/24/99	7978	86	32	5.27	3.65	Good-Fair
07/26/94	6621	57	27	4.88	4.07	Good-Fair
08/06/87	4197	75	28	5.37	4.29	Good-Fair

Taxonomic Analysis

Several EPT taxa were present for the first time in 2009 and included the mayflies *Iswaeon anoka* , *Plauditus dubius GR* , and the caddisfly *Brachycentrus spinae* . The addition of these intolerant taxa coupled with the simultaneous reduction of several pollution tolerant taxa (such as the chironomids *Ablabesmyia mallochi* , *Cricotopus bicinctus* , and *Cryptochironomus fulvus)* resulted in a the lowered BI (and EPTBI) in 2009. These trends may indicate improving water quality in this watershed.

Data Analysis

The EPTS, BI, and EPTBI have all been improving since 1987 . The 2009 sample resulted in the highest EPTs, the lowest BI and the lowest EPTBI observed at this location and also resulted in an improved bioclassification of Good. THe first non Good-Fair rating at this site. The improving invertebrate metrics indicate gradually improving water quality and is supported by the specific conductance data which has also been improving (128 µS/cm in 1999, 37 µS/cm in 2004, and 35 µS/cm in 2009). The 2005 assessment of this site noted that the drastic decline in conductivity from 2005 relative to 1999 may have been related to a reduction in local gem mining activities.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
MIDDLE CR	**SR 1635**	**GB49**	**08/03/10**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	1	06010202	35.052222	-83.374444	2-8	Broad Basins

Stream Classification		Elevation	Stream Width (m)	Stream Depth (m)
C; Tr		1930	7	0.3

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	25	0	50	0	25 (residential)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none		

Water Quality Parameters

Temperature (°C)	24.9
Dissolved Oxygen (mg/L)	7.7
Specific Conductance (µS/cm)	25
pH (s.u.)	6.7

Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	14
Bottom Substrate (15)	11
Pool Variety (10)	8
Riffle Habitat (16)	14
Bank Erosion (7)	5
Bank Vegetation (7)	3
Light Penetration (10)	7
Left Riparian Score (5)	1
Right Riparian Score (5)	1
Total Habitat Score (100)	68

Site Photograph

Substrate rubble, boulder, sand, silt and gravel

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/03/10	11013		38		2.77	Excellent
07/22/04	9427		43		2.37	Excellent
08/24/99	7979		25		3.94	Good-Fair

Taxonomic Analysis

The 1999 sample produced the lowest EPT taxa richness ever recorded at this location. Since the 1999 collection, several new records of intolerant taxa were present in both 2004 and 2010 and include the mayflies *Baetis tricaudatus* , *Serratella serrata* , *Paraleptophlebia spp* , the stonefly *Perlesta spp* and the caddisflies *Ceratopsyche bronta* , *Nectopsyche exquisita* , *Lype diversa* , *Rhyacophila fuscula* , and *Neophylax consimilis* .

Data Analysis

The new records of intolerant invertebrates collected in 2004 and 2010 suggest that water quality improved after the 1999 Good-Fair collection. The relatively stable EPTS and EPTBI from 2004 and 2010 suggest that the water quality is also generally stable.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
TESSENTEE CR	**SR 1684**	**GB46**	**07/30/09**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	1	06010202	35.066944	-83.368056	2-9	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
	14.4		7	0.3

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	25	25	50	0	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none		

Water Quality Parameters

Temperature (°C)	18.3
Dissolved Oxygen (mg/L)	7.5
Specific Conductance (µS/cm)	21
pH (s.u.)	6.1
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	15
Bottom Substrate (15)	8
Pool Variety (10)	4
Riffle Habitat (16)	16
Bank Erosion (7)	6
Bank Vegetation (7)	5
Light Penetration (10)	7
Left Riparian Score (5)	5
Right Riparian Score (5)	3
Total Habitat Score (100)	73

Site Photograph

Substrate Boulder, bedrock, cobble, gravel and sand with a trace of silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/30/09	10788		52		2.70	Excellent
07/22/04	9430		47		2.36	Excellent

Taxonomic Analysis

There are numerous intolerant taxa that have been present at this location since monitoring commenced in 2004 and included the mayflies *Drunella allegheniensis* , *Serratella serratoides* , *Epeorus vitreus* , the caddisflies *Micrasema wataga* , *Glossosoma spp* , *Dolophilodes spp* , *Nyctiophylax celta* and the long-lived stoneflies *Acroneuria abnormis* and *Paragnetina immarginata* .

Data Analysis

The consistent Excellent bioclassifications and persistent intolerant benthic macroinvertebrate community (and long lived stoneflies) suggests stable and favorable water quality in this catchment. This conclusion is further supported by the specific conductance data which has been low and quite similar through time at 18 µS/cm in 2004 and 21.3 µS/cm in 2010.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
COWEETA CR	**SR 1114**	**GB45**	**07/29/09**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	1	06010202	35.062778	-83.400556	2-10	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
B;Tr	12.1	2100	7	0.2

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	50	50	0	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

Water Quality Parameters

Temperature (°C)	19.1
Dissolved Oxygen (mg/L)	8.9
Specific Conductance (µS/cm)	16
pH (s.u.)	5.9
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	14
Pool Variety (10)	10
Riffle Habitat (16)	16
Bank Erosion (7)	6
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	3
Right Riparian Score (5)	5
Total Habitat Score (100)	92

Site Photograph

Substrate mostly cobble and gravel

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/29/09	10787	---	41	---	2.73	Excellent
07/22/04	9429	---	45	---	2.62	Excellent
08/21/99	7948	---	39	---	2.88	Excellent
07/27/94	6622	---	39	---	2.75	Excellent

Taxonomic Analysis

A stable, diverse, and pollution intolerant EPT fauna resides in Coweeta Creek. Abundant intolerant taxa collected in 2009 that characterize this site include the mayflies *Epeorus vitreus, Paraleptophlebia* spp, the stoneflies *Tallaperla* spp, *Perlesta* spp, and the caddisflies *Ceratopsyche bronta, C. sparna* , *Lepidostoma* spp and *Dolophilodes* spp.

Data Analysis

Coweeta Creek has been sampled here on four occasions with each sample producing an Excellent bioclassification. The majority of the watershed is undisturbed forest, in part, associated with Coweta Creek Hydrological Laboratory. A protected, forested watershed combined with a minimally disturbed riparian zone and instream habitat have resulted in a temporally stable, diverse, and pollution intolerant macrobenthic community.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
CARTOOGECHAYE CR	SR 1146	GB40	07/28/09	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	1	06010202	35.156389	-83.455556	2-19-(1)	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-III;Tr	57.0	2110	17	0.0

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	25	75	0	0	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none		

Water Quality Parameters

Temperature (°C)	18.5
Dissolved Oxygen (mg/L)	8.5
Specific Conductance (µS/cm)	33
pH (s.u.)	6.0

Water Clarity: clear/turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	14
Bottom Substrate (15)	12
Pool Variety (10)	8
Riffle Habitat (16)	12
Bank Erosion (7)	6
Bank Vegetation (7)	2
Light Penetration (10)	5
Left Riparian Score (5)	4
Right Riparian Score (5)	0
Total Habitat Score (100)	68

Site Photograph

Substrate: boulder, cobble, gravle, sand, and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/28/09	10784		30		3.24	Good
07/21/04	9446		31		3.03	Good
08/24/99	7977		41		2.81	Excellent
07/27/94	6623		30		2.91	Good

Taxonomic Analysis

With the exception of the 1999 sample, the invertebrate composition at this location is remarkably unifrom. In fact, 23 common EPT species have been collected at this site in at least three of the four total collection events and include the pollution intolerant mayfles *Drunella allegheniensis* , *Serratella serrata* , *Epeorus vitreus* , the stoneflies *Acroneuria abnormis* , *Leuctra spp* ., and the caddsiflies *Brachycentrus appalachia* , *Dolophilodes spp* , and *Neophylax consimilis* .

Data Analysis

With the exception of the Excellent rating from 1999, the water quality at this site has been very stable. Indeed, the specific conductance has also been very uniform through time with a measurement of 33 µS/cm in 1999, 31 µS/cm in 2004, and 33 µS/cm in 2009. The biological uniformity is further demonstrated in that 40% of all the taxa ever collected at this location have been collected in at least three of the four total collections.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
CULLASAJA R	**US 64**	**GB48**	**08/03/10**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	1	06010202	35.068889	-83.188889	2-21-(0.5)a	Southern Crystalline Ridges and Mountains

Stream Classification			Stream Width (m)	Stream Depth (m)
WS-III; Tr			5	0.3

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	45	0	0	30	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none		

Water Quality Parameters

Temperature (°C)	22.4
Dissolved Oxygen (mg/L)	6.2
Specific Conductance (µS/cm)	46
pH (s.u.)	5.4

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	16
Bottom Substrate (15)	6
Pool Variety (10)	10
Riffle Habitat (16)	7
Bank Erosion (7)	6
Bank Vegetation (7)	6
Light Penetration (10)	7
Left Riparian Score (5)	2
Right Riparian Score (5)	5
Total Habitat Score (100)	69

Site Photograph

Substrate sand, silt, gravel, and cobble with a trace of bedrock and boulder

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/03/10	11010	91	29	5.15	3.83	Good-Fair
07/21/04	9433	58	14	5.67	4.73	Fair
07/25/01	8537	41	10	6.67	6.04	Fair
08/28/00	8280	65	18	6.25	5.27	Fair
06/23/99	7869	47	14	5.63	4.88	Fair

Taxonomic Analysis

The EPT diversity at this site has more than doubled since the the most recent sample in 2004 and represents the highest EPT diversity ever observed here. EPT taxa collected here for the first time included the mayfly *Centroptilum spp* ., the intolerant and long-lived perlid stoneflies *Acroneuria abnormis* , *Paragnetina immarginata* , and the caddisflies *Micrasema wataga* , *Glossosoma spp* ., *Hydroptila spp* ., *Oxyethira spp* ., *Triaenodes marginatus* , *Neophylax consimilis* , and *N. mitchelli* . The addition of these taxa, and particularly of the long-lived perlid stoneflies, indicates that water quality at this location has improved relative to previous years.

Data Analysis

All four previous samples resulted in Fair bioclassifications. This site improved substantially from earlier samples with every benthic macroinvertebrate metric showing improvement. Of interest is the pH. The 2010 observations were substantially lower than the 2000 (6.7), 2001 (6.7) and 2004 (6.8) measurements and suggests a reduction in non-point pollution inputs which tend to have neutral to high pH characteristics. Indeed, many sites in this basin with minimal non-point pollution have very low pH values. Examples of this can be seen at Snowbird Creek (SR 1120) and Tellico Creek (SR 1367) with 2010 pH measurements of 5.6 and 4.9 respectively.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
CULLASAJA R	**SR 1678**	**GB79**	**08/03/10**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	1	06010202	35.125278	-83.285278	2-21-(5.5)	Southern Crystalline Ridges and Mountains

Stream Classification			Stream Width (m)	Stream Depth (m)
B; Tr			12	0.5

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	50	0	25	0	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none		

Water Quality Parameters

Temperature (°C)	24.2
Dissolved Oxygen (mg/L)	6.8
Specific Conductance (µS/cm)	29
pH (s.u.)	6.3

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	13
Pool Variety (10)	6
Riffle Habitat (16)	16
Bank Erosion (7)	6
Bank Vegetation (7)	3
Light Penetration (10)	10
Left Riparian Score (5)	3
Right Riparian Score (5)	1
Total Habitat Score (100)	81

Site Photograph

Substrate boulder, cobble, gravel, with a trace of sand and bedrock

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/03/10	11012	103	51	3.26	2.35	Excellent
06/22/99	7862	90	50	3.36	2.29	Excellent
10/15/96	7214	86	45	3.31	2.36	Excellent
07/26/94	6602	85	42	3.60	2.73	Excellent
10/15/91	5749	95	48	3.67	2.90	Excellent

Taxonomic Analysis

There are numerous pollution intolernat taxa that have been present at this location at each of the five collections and include the mayflies *Epeorus vitreus* , *Maccaffertium ithaca* , *M. pudicum* , *Neoephemera purprea* , the stoneflies, *Tallaperla spp* ., *Acroneuria abnormis* , *Paragnetina immarginata* , *Pteronarcys spp* ., and the caddisflies *Ceratopsyche morosa* , and *C. sparna* . In addition, several taxa were collected for the first time at this location in 2010 and included the intolerant mayflies *Heterocloeon curiosum* , *Procloeon spp* ., *Drunella allegheniensis* and the caddisfly *Triaenodes perna* . The new intolerant taxa collected in 2010 further support the trend of improving community metrics observed at this station since monitoring commenced in 1991.

Data Analysis

The consistent Excellent bioclassifications, high species diversity and low biotic indices are all indicative of a pollution intolerant invertebrate community typical of a largely undisturbed watershed. These conclusions are further supported by the low specific conductance values observed (20 µS/cm in 1999, 29 µS/cm in 2010). Overall, the benthic invertebrate community metrics (S, EPT, BI and EPTBI) have generally been improving since the first sample in 1991.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
CULLASAJA R	**SR 1668**	**GB39**	**08/03/10**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	1	06010202	35.164444	-83.325833	2-21-(5.5)	Broad Basins

Stream Classification		Elevation (ft)	Stream Width (m)	Stream Depth (m)
B; Tr		2100	20	0.4

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	50	25	25	0	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	N/A	N/AB; Tr

Water Quality Parameters

Temperature (°C)	24.6
Dissolved Oxygen (mg/L)	8.6
Specific Conductance (µS/cm)	33
pH (s.u.)	7.1

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	12
Bottom Substrate (15)	10
Pool Variety (10)	4
Riffle Habitat (16)	14
Bank Erosion (7)	6
Bank Vegetation (7)	5
Light Penetration (10)	2
Left Riparian Score (5)	4
Right Riparian Score (5)	1
Total Habitat Score (100)	63

Site Photograph

Substrate Sand, silt, gravel, cobble and bedrock.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/03/10	11011	116	50	4.30	3.08	Excellent
08/05/04	9462	86	42	4.27	3.42	Good
08/10/99	7961	99	51	3.74	3.09	Excellent

Data Analysis

The 1999 and 2010 samples were structurally quite similar. The slight decline in bioclassificaton seen in 2004 was largely due to the lack of certain taxa collected in 1999 and 2010. These taxa included the mayflies *Leucrocuta spp* , *Stenacron pallidum* , and the caddisflies *Micrasema bennetti* , *Hydropsyche venularis* , *Ceraclea ancylus* , *Neureclipsis spp* , *Nyctiophylax spp* and *Polycentropus spp* . With the ossible exception of *Hydropsyche venularis* and *Micrasema bennetti* , these taxa are generally restricted to slow pools along the stream margin. Their presence in 1999 and 2010 and absence in 2004 suggests that this habitat type was poorly developed or absent during the 2004 sample. Therefore, the slight decreased in bioclassification seen in 2004 was likely not related to a water quality change but may have been the result of reduced habitat availability, possibly related to low flow conditions. This assertion is supported by the water quality data as specific conductance was 22 µS/cm in 2004 and 33 µS/cm in 2010.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
TURTLE POND CR	**SR 1620**	**GB47**	**08/20/09**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	1	06010202	35.075278	-83.260278	2-21-8	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C;Tr	5.5	3320	10	0.2

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	100	0	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	17.8
Dissolved Oxygen (mg/L)	7.9
Specific Conductance (µS/cm)	13
pH (s.u.)	5.7
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	18
Bottom Substrate (15)	11
Pool Variety (10)	6
Riffle Habitat (16)	16
Bank Erosion (7)	5
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	2
Total Habitat Score (100)	84

Site Photograph

Substrate mix of cobble, sand, boulder, and gravel

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/20/09	10827	---	46	---	2.24	Excellent
07/23/04	9428	---	49	---	2.10	Excellent
06/22/99	7866	---	42	---	1.90	Excellent

Taxonomic Analysis

Several taxa were collected for the first time at the site in 2009. Most notable was *Micrasema sprulesi* , for which the BAU has fewer than 25 records. Other taxa collected for the first time included the stonefly *Sweltsa spp and the caddisflies Goera calcarata, Mystacides spp, Molanna blenda,* and *Rhyacophila minor.*

Data Analysis

Turtle Pond Creek is approximately three miles northwest of Highlands and about 0.5 stream-miles above the confluence with Cullasaja River. Though the site has a significant amount of sand, a diverse benthic community was supported. All benthic macroinvertebrate metrics have been stable at this location since monitoring commenced in 1999 and all bioclassifications have been Excellent.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
IOTLA CR	**SR 1372**	**GB33**	**08/04/09**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	1	06010202	35.234444	-83.398333	2-27	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
	10.0		5	0.3

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	50	25	25	0	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none		

Water Quality Parameters

Temperature (°C)	21.2
Dissolved Oxygen (mg/L)	7.5
Specific Conductance (µS/cm)	49
pH (s.u.)	6.6

Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	3
Instream Habitat (20)	16
Bottom Substrate (15)	8
Pool Variety (10)	0
Riffle Habitat (16)	10
Bank Erosion (7)	5
Bank Vegetation (7)	5
Light Penetration (10)	7
Left Riparian Score (5)	4
Right Riparian Score (5)	0
Total Habitat Score (100)	58

Site Photograph

Substrate boulder, silt, sand, and cobble

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/04/09	10790	83	32	4.63	3.92	Good
05/24/07	10188		31		3.62	Good
07/22/04	9449	73	32	4.66	3.86	Good
08/10/99	7960		35		3.50	Good
07/27/94	6624		21		4.28	Good-Fair

Taxonomic Analysis

Several intolerant taxa absent from the 1994 Good-Fair sample but present at each of the four subsequent Good collections included the mayflies *Telagonopsis deficiens* , *Heptagenia marginalis* , the stonefly *Perlesta spp* , and the caddisfly *Triaenodes ignitus* .

Data Analysis

With the exception of the 1994 Good-Fair sample, Iotla Creek at this location has rated Good on four separate occasions. There has been very little shift among the invertebrate community since the 1994 sample and suggests very stable and generaly favorable water quality in this catchment. This conclusion is further supported by the stable conductivity at each observation (49 µS/cm in 2009, 39 µS/cm in 2007 , 40 µS/cm in 2004, and 42 µS/cm in 1999).

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
COWEE CR	**NC 28**	**GB31**	**07/29/09**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	1	06010202	35.262500	-83.409444	2-29	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C;Tr	26.0	1980	6	0.2

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	25	50	25	0	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none		

Water Quality Parameters

Temperature (°C)	19.2
Dissolved Oxygen (mg/L)	8.5
Specific Conductance (µS/cm)	26
pH (s.u.)	5.9

Water Clarity	turbid

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	18
Bottom Substrate (15)	8
Pool Variety (10)	4
Riffle Habitat (16)	16
Bank Erosion (7)	5
Bank Vegetation (7)	5
Light Penetration (10)	6
Left Riparian Score (5)	0
Right Riparian Score (5)	4
Total Habitat Score (100)	70

Site Photograph

Substrate Boulder, cobble, gravel

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/29/09	10786		40		2.94	Excellent
05/23/07	10187		43		2.81	Excellent
07/22/04	9451		38		2.82	Excellent
08/10/99	7962		35		2.37	Good
07/26/94	6620		24		3.31	Good-Fair

Taxonomic Analysis

Several pollution intolerant taxa absent from the 1994 Good-Fair sample have been present in the subsequent samples and include the mayflies *Serratella serrata* , *Heptagenia marginalis* , *Leucrocuta spp* ., *Paraleptophlebia spp* ., the stonefly *Leuctra spp* ., and the caddisflies *Brachycentrus nigrosoma* , *Lepidostoma spp* ., and *Oecetis persimilis* .

Data Analysis

This site improved to Good in 1999 and then improved to Excellent in 2004 and has remained Excellent in both of the subsequent collections. The only small difference in the community noted at this location since 2004 was the very slight increase in the EPTBI. However, the data suggest no significant change in the water quality since 2004.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
BURNINGTOWN CR	**SR 1371**	**GB30**	**08/04/09**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	1	06010202	35.266389	-83.473056	2-38	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
B;Tr	24.8	1950	10	0.2

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	50	25	25	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

Water Quality Parameters

Temperature (°C)	20.5
Dissolved Oxygen (mg/L)	8.3
Specific Conductance (µS/cm)	20
pH (s.u.)	6.0

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	15
Bottom Substrate (15)	10
Pool Variety (10)	4
Riffle Habitat (16)	16
Bank Erosion (7)	6
Bank Vegetation (7)	6
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	1
Total Habitat Score (100)	77

Site Photograph

Substrate mix of bolder, rubble, gravel and sand

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/04/09	10789	---	37	---	3.41	Excellent
08/03/04	9477	---	43	---	3.12	Excellent
08/10/99	7959	---	39	---	3.06	Excellent
07/26/94	6619	---	30	---	2.89	Good

Taxonomic Analysis

Few differences existed with the common and abundant EPT taxa between the 2004 and 2009 samples. Although some changes in the benthic community in 2009 included the absence of the caddisfly *Micrasema watauga (* abundant in 2004 and common in 1999) and the stonefly *Pteronarcys* spp (common in 2004 and 1999, and abundant in 1994) but absent in 2009. The rest of the differences between 2004 and 2009 at Burningtown Creek involved the absence/presence of rare taxa. Despite the few differences the EPT community here appears diverse and generally pollution intolerant.

Data Analysis

Burningtown Creek rated Excellent in 2009, the same rating it received in 2004 and 1999. Though EPT diversity remains high here, the Biotic Index has steadily increased since first being sampled in 1994 suggesting that the benthic community is becoming slightly more pollution tolerant over time.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
TELLICO CR	**SR 1367**	**GB28**	**07/29/09**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	1	06010202	35.281944	-83.507500	2-40	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
	12.0		6	0.2

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	50	50	0	0	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none		

Water Quality Parameters

Temperature (°C)	17.7
Dissolved Oxygen (mg/L)	8.5
Specific Conductance (µS/cm)	23
pH (s.u.)	5.6

Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	15
Bottom Substrate (15)	12
Pool Variety (10)	6
Riffle Habitat (16)	16
Bank Erosion (7)	3
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	2
Right Riparian Score (5)	5
Total Habitat Score (100)	81

Site Photograph

Substrate Boulder, cobble, gravel, sand and a trace of silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/29/09	10785	93	40	3.07	2.35	Excellent
08/03/04	9476	93	44	3.29	2.33	Excellent
08/09/99	7958	108	54	3.30	2.24	Excellent
07/14/94	6586	84	43	3.24	2.37	Excellent

Taxonomic Analysis

Although several intolerant taxa were present in 2009 and included the mayflies *Drunella conestee* , *Epeorus vitreus and* the stoneflies *Tallaperla spp* , *Acroneuria abnormis* , *Paragnetina immarginata* , there were several edge-dwelling caddisflies that were absent or reduced in abundance in 2009 relative to previous collections. These taxa included *Brachycentrus spinae* , *Goera spp* and *Pycnopsyche spp* . The absence or reduction in these taxa may be related to a reduction in their favored habitat due to drought induced low flows. However, changes in water chemistry cannot be ruled out.

Data Analysis

Although there is a large trout farm approximately 1.8 miles upstream, there appears to be little impact to the benthic macroinvertebrate community as this site continues to rate Excellent and harbors many intolerant taxa. It is possible that dilution effects of several tributaries located between this location and the trout farm is having a positive influence on the invertebrate community. However, the EPTs in 2009 was the lowest on record and corresponded to a small increase in the specific conductance (23 µS/cm in 2009) which was elevated relative to the 1999 (16 µS/cm) and 2004 (17 µS/cm) observations. A reduction in flow in 2009 relative to earlier samples may support the elevated conductivity data due to a weakening in tributary dilution effects. Further, a reduction in flow also supports the lack of the edge-dwelling caddisfly taxa. Additional monitoring at this location is strongly recommended.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
NANTAHALA R	**FSR 437**	**GB42**	**07/21/04**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	3	06010202	35.126944	-83.619167	2-57-(0.5)	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
B; Tr, ORW	52	3065	22	0.4

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	80	10	0	10	---

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

Water Quality Parameters

Temperature (°C)	21.9
Dissolved Oxygen (mg/L)	9.2
Specific Conductance (µS/cm)	17
pH (s.u.)	6.3
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	19
Bottom Substrate (15)	15
Pool Variety (10)	4
Riffle Habitat (16)	16
Bank Erosion (7)	7
Bank Vegetation (7)	7
Light Penetration (10)	5
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	88

Site Photograph

Substrate mostly boulder, cobble and gravel with some sand and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/04/10	11016	108	56	3.01	1.93	Excellent
07/21/04	9445	92	49	2.90	1.60	Excellent
08/24/99	7976	100	49	3.11	2.02	Excellent
07/26/94	6627	77	48	2.40	1.95	Excellent
07/10/91	5655	94	54	2.34	1.48	Excellent

Taxonomic Analysis

Sampling in 2010 yielded the highest EPT richness yet in this upper reach of the Nantahala River. The EPT community at this site included some previously uncollected taxa including the rare mayfly *Litobrancha recurvata* as well as the mayflies *Procloeon* spp and *Epeorus subpallidus*. The stonefly community was very similar to that seen in previous samplings. Caddisflies previously uncollected included the silt-loving *Phylocentropus*, the uncommon long-horned *Triaenodes taenius* and the stone casemaker *Psilotreta frontalis.* Non-EPT benthos was rich, particularly in chironomids, but not abundant.

Data Analysis

The Nantahala River at FSR 437 straddles the Macon County-Clay County line and is upstream of Nantahala Lake. It's waters are derived from small mountain streams that reside within Nantahala National Forest, and thus has colder water than many other rivers of similar size. While both total and EPT richness increased, the respective biotic indices also increased over previous values although not dramatically. However, habitat and physico-chimical parameters were very supportive of a diverse macroinvertebrate fauna which was the productive and intolerant community one would expect from a stream supplementally classified as ORW. This site retains an Excellent bioclassification.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
NANTAHALA R	**OFF US 19-74 BE QUEENS CR**	**GB8**	**08/04/09**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
SWAIN	3	06010202	35.286111	-83.667500	2-57-(22.5)b	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
B;Tr	142.0	1960	20	0.3

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	66	33	0	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

Water Quality Parameters

Temperature (°C)	12.8
Dissolved Oxygen (mg/L)	9.6
Specific Conductance (µS/cm)	25
pH (s.u.)	6.3

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	20
Bottom Substrate (15)	12
Pool Variety (10)	6
Riffle Habitat (16)	16
Bank Erosion (7)	7
Bank Vegetation (7)	7
Light Penetration (10)	5
Left Riparian Score (5)	5
Right Riparian Score (5)	2
Total Habitat Score (100)	85

Site Photograph

Substrate mostly rubble with some boulder and gravel

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/04/09	10782	93	37	3.90	2.42	Good
07/20/04	9438	83	35	4.19	2.26	Good
08/23/99	7953	---	35	---	2.25	Good
07/26/94	6617	71	36	3.64	2.15	Good
11/15/93	6419	65	32	4.07	2.15	Good

Taxonomic Analysis

A diverse EPT community resides in this section of the Nantahala River although there is little difference among the taxa found in 2009 from previous collections. Among the dominant taxa that appear year after year include the mayflies *Serratella deficiens, Maccafffertium modestum, M. ithaca,* the stoneflies *Leuctra* spp and *Isoperla holochlora,* and the caddisflies *Micrasema watauga* and *Glossosoma* spp. Although more taxa were found in 2009 than any of the previous six collections, very few taxa new to this location were collected.

Data Analysis

This segment of the Nantahala River rated Good in 2009, the same rating it has received since 1993. It was first sampled in 1984, rating Good-Fair, followed by the same rating two years later. This portion of the Nantahala River is highly regulated with daily releases that greatly influence water chemistry, water depth and velocities. Though some edge taxa are limited here, overall, the macroinvertebrate community has adjusted to this artificial hydrologic regime and is currently stable.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
ALARKA CR	**SR 1185**	**GB17**	**07/29/09**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Swain	2	06010202	35.378611	-83.472222	2-69-(2.5)	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Tr	25.0	1952	9	0.2

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	20	80	---	---

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	19.6
Dissolved Oxygen (mg/L)	7.9
Specific Conductance (µS/cm)	28
pH (s.u.)	6.8

Water Clarity: slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	3
Instream Habitat (20)	18
Bottom Substrate (15)	10
Pool Variety (10)	4
Riffle Habitat (16)	16
Bank Erosion (7)	7
Bank Vegetation (7)	5
Light Penetration (10)	10
Left Riparian Score (5)	1
Right Riparian Score (5)	4
Total Habitat Score (100)	78

Site Photograph

Substrate: Cobble, boulder, and gravel with some bedrock, sand, and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/29/09	10769	110	53	3.59	2.66	Excellent
08/02/04	9453	101	46	3.88	2.67	Excellent
08/09/99	7956	86	51	3.62	3.03	Excellent
07/11/94	6580	91	48	3.70	2.99	Excellent

Taxonomic Analysis

Sampling resulted in the highest total taxa richness and EPT levels yet seen in this stream since it was added as a basinwide site. Approximately half of the EPT collected were mayflies (26 taxa) of which at least one third were abundant. Two intolerant mayflies (Ephemeroptera) not collected since 1994, *Baetisca spp* and *Brachycercus spp,* were collected in 2009. Stoneflies (Plecoptera) were rich and abundant as a group while the caddisflies were dominated by *Brachycentrus spinae* and hydropsychids. Additionally, five intolerant caddisflies were collected for the first time here and included*Ceraclea spp, Mystacides spp, Rhyacophila carolina,* and *Neophylax mitchelli.*

Data Analysis

While the watershed is primarily forested, the main stem of Alarka Creek is followed closely by a road resulting in mostly residential development along the stream channel. It was noted that since the last sampling event, native rock was removed from the channel downstream of the site (see photo above) by landowners adjacent to the stream to armor the immediate banks and to construct a gabion. This removed a significant amount of local habitat but did not affect the bioclassification. Sampling in 2009 resulted in the lowest biotic index ever measured in this stream. In fact, Alarka Creek has never rated lower than Excellent and maintains this rating in 2009 indicating that the water quality is very stable.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
WHITEOAK CR	**SR 1397**	**GB36**	**07/28/09**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	3	06010202	35.221944	-83.615278	2-57-45b	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C;Tr	7.1	3300	7	0.2

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	0	0	100	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

Water Quality Parameters

Temperature (°C)	18.2
Dissolved Oxygen (mg/L)	7.2
Specific Conductance (µS/cm)	28
pH (s.u.)	5.1

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	3
Instream Habitat (20)	19
Bottom Substrate (15)	8
Pool Variety (10)	6
Riffle Habitat (16)	16
Bank Erosion (7)	5
Bank Vegetation (7)	3
Light Penetration (10)	7
Left Riparian Score (5)	1
Right Riparian Score (5)	3
Total Habitat Score (100)	71

Site Photograph

Substrate mix of boulders, rubble, gravel and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/28/09	10783	57	21	4.84	1.73	Good-Fair
07/21/04	9443	63	26	4.53	2.34	Good-Fair
08/09/90	5426	60	20	5.83	2.20	Fair
05/15/90	5278	79	35	4.06	1.96	Good-Fair
01/23/90	5159	83	39	3.91	2.26	Good-Fair

Taxonomic Analysis

Only three EPT, all caddisflies, were abundant at this site on Whiteoak Creek in 2009 and included *Glossosom* spp, *Ceratopsyche sparna, and Lepidostoma* spp. Low EPT taxa richness combined with high numbers of pollution tolerant taxa such as oligocheates, leeches, chironomids, and other dipterans reflect an organically enriched aquatic environment. Large numbers of the filter feeding black fly, Simulium sp, were collected in summer 2009 and 2004, an increase from 1990 suggesting that additional organic particulates are entering Whiteoak Creek. This is the only site in the Little Tennessee Basin where the dipeteran Limnophora spp was collected in 2009. This taxa resides in the aquatic mosses that dominate the benthos in this enriched aquatic environment.

Data Analysis

Whiteoak Creek rated Good-Fair in 2009, the same rating it received in 2004. Since first being sampled in 1988, this waterbody has rated Fair twice and Good-Fair four times. This segment is located downstream of a trout farm, which appears to be adversely affecting the benthic community. Previous BAU investigations (B-, 881209, B-900220, B-900720, B-050218) clearly documented the effects of untreated wastewater here. Abnormally large and thick mats of aquatic plants have been a historic issue in Whiteoak Creek from 1998 to present. These mats consisted mostly of *Hylotheca mucosa* with some *Vaucheria* spp intermixed. *Hyloceca mucosa* is a widespread green alga usually occurring in acidic, oligotrophic aquatic environs. The degraded condition of this waterbody persists 1.5 miles downstream to Whiteoak Dam.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
PANTHER CR	**SR 1233**	**GB16**	**07/29/09**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Graham	2	06010202	35.390833	-83.624444	2-115	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Tr	9.2	1739	8	0.2

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	70	20	---	10 (road)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

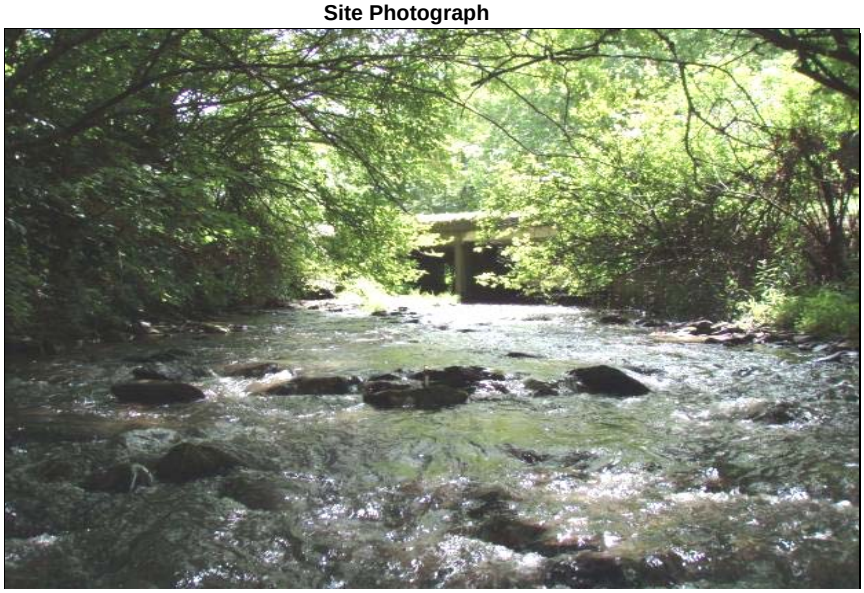
Water Quality Parameters

Temperature (°C)	17.9
Dissolved Oxygen (mg/L)	8.6
Specific Conductance (µS/cm)	24
pH (s.u.)	6.6
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	18
Bottom Substrate (15)	14
Pool Variety (10)	4
Riffle Habitat (16)	16
Bank Erosion (7)	6
Bank Vegetation (7)	6
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	3
Total Habitat Score (100)	86

Site Photograph



Substrate Cobble, gravel, and boulder with some bedrock

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/29/09	10701	---	45	---	2.13	Excellent
08/04/04	9457	---	35	---	2.07	Good
08/10/99	7963	---	39	---	2.15	Excellent
07/13/94	6585	---	37	---	1.93	Excellent

Taxonomic Analysis

The EPT richness in Panther Creek increased by more than 25% over 2004 levels to reach the highest richness yet measured in this waterbody. Although increases were seen in all three insect orders, it was primarily driven by increases in caddisfly taxa. Many taxa were new records for this stream and included the mayflies *Diphetor hageni* and *Epeorus dispar*, the stonefly *Beloneuria spp* and the caddisflies *Mystacides spp* and *Triaenodes perna/helo*.

Data Analysis

This site on Panther Creek is about 0.25 miles upstream of Fontana Lake. The high gradient stream follows a road and is impacted mostly by residential development and runoff, although the watershed is only lightly developed. In-stream habitat and physico-chemical parameters were good and no sediment problems or riparian issues (except for a road corridor) were noted. Previous observations of high periphyton biomass were not seen during 2009 sampling. The only non Excellent bioclassification observed at this site was in 2004 and that assessment was short of Excellent by just one EPT taxon. Overall, the water quality at this location has been quite stable through time.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
STECOAH CR	**SR 1237**	**GB14**	**07/29/09**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Graham	2	06010202	35.395556	-83.679167	2-130	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Tr	8.9	1801	5	0.3

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	20	60	20	---

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	18.6
Dissolved Oxygen (mg/L)	8.3
Specific Conductance (µS/cm)	54
pH (s.u.)	6.8

Water Clarity	turbid

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	15
Bottom Substrate (15)	12
Pool Variety (10)	6
Riffle Habitat (16)	16
Bank Erosion (7)	6
Bank Vegetation (7)	5
Light Penetration (10)	10
Left Riparian Score (5)	3
Right Riparian Score (5)	2
Total Habitat Score (100)	79

Site Photograph

Substrate Cobble and gravel with some boulder and gravel

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/29/09	10700	---	41	---	3.18	Excellent
08/04/04	9458	---	30	---	2.94	Good
08/11/99	7964	---	39	---	2.94	Excellent
07/13/94	6584	---	29	---	3.51	Good

Taxonomic Analysis

EPT richness increased by more than 33% from that measured in 2004 and was the highest observed here since sampling commenced. In addition, the stonefly community was the richest ever measured in Stecoah Creek with eight taxa collected while only five were collected in 2004.

Data Analysis

Stecoah Creek is a tributary to Fontana Lake and drains the northeastern portion of Graham County. Almost the entire stream corridor is developed for both residential and agricultural use leaving the forested landscape mostly around small tributaries to Stecoah Creek. At the time of sampling, flows were high and water was turbid making sampling difficult. Although benthic substrate was good, riparian vegetation was narrow or absent and some erosional areas were noted. Stecoah Creek has cycled between Good and Excellent since 1994 suggesting that water quality in this stream, though relatively stable, may be adversely affected by non-point source runoff during high flow years and positively affected during times of drought when non point pollution inputs are lower. This was likely the case in 2009.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
HAZEL CR	**NR MOUTH**	**GB3**	**07/28/09**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Swain	2	06010202	35.473611	-83.722778	2-146-(19)	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-IV; Tr, ORW, CA	44.8	1720	22	0.4

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	90	---	---	10 (gravel road)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	17.5
Dissolved Oxygen (mg/L)	8.6
Specific Conductance (µS/cm)	12
pH (s.u.)	6.4

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	20
Bottom Substrate (15)	13
Pool Variety (10)	6
Riffle Habitat (16)	16
Bank Erosion (7)	7
Bank Vegetation (7)	7
Light Penetration (10)	7
Left Riparian Score (5)	5
Right Riparian Score (5)	4
Total Habitat Score (100)	90

Site Photograph

Substrate Cobble and boulder with gravel and sand, some silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/28/09	10696	118	61	3.17	2.13	Excellent
08/03/05	9682	108	60	3.00	2.14	Excellent
08/03/04	9456	96	46	3.29	2.17	Excellent
08/11/99	7967	106	56	2.89	1.87	Excellent
07/12/94	6583	95	47	2.81	1.85	Excellent

Taxonomic Analysis

A very high total of 61 EPT were recorded in Hazel creek in 2009, similar to the 2005 EPT richness. The benthic community composition was very similar to previous years and was composed of many pollution sensitive taxa. While most of these taxa were previously collected, a few were collected for the first time in Hazel Creek including only the second NC record of the flatheaded mayfly *Epeorus subpallidus* and the third NC record of the baetid *Acentrella barbarae* which was described from Great Smoky Mountain National Park in 2006. Other newly collected taxa included the caddisflies *Phylocentropus spp* , *Molanna spp* , and *Oligostomis pardalis* .

Data Analysis

Hazel Creek drains a southeastern portion of Great Smoky Mountain National Park into Fontana Lake. Hazel Creek is paralleled by a gravel road for much of its length but otherwise has a completely forested watershed. While the sampling site is near the historic town of Proctor which was flooded to create Fontana Lake in 1944, very little evidence of the urbanization of Hazel Creek remains. Habitat was excellent and flows were normal creating a succession of riffles and pools for macroinvertebrate colonization. Historically high total taxa, EPT richness and EPT abundance (332) values were obtained in 2009. Although the biotic index did increase slightly in 2009, this was largely due to the collection of 11 beetle taxa (most of which are pollution tolerant species). Overall, the benthic macroinvertebrate metrics have remained remarkably stable at this location and is the result of the entirely protected and forested nature of the watershed.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
MIDDLE CR	**SR 1635**	**04/30/09**	**GF19**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	1	06010202	35.05194444	-83.36361111	2-8	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;Tr	12.2	2115	7	0.4	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	85	15	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	13.4
Dissolved Oxygen (mg/L)	9.1
Specific Conductance (µS/cm)	23
pH (s.u.)	5.8

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	8
Pool Variety (10)	10
Riffle Habitat (16)	7
Erosion (7)	4
Bank Vegetation (7)	4
Light Penetration (10)	7
Left Riparian Score (5)	3
Right Riparian Score (5)	1
Total Habitat Score (100)	**65**

Site Photograph

Substrate Cobble, gravel, sand, silt

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/30/09	2009-24	19	58	Excellent
05/17/04	2004-44	16	56	Good

Most Abundant Species 2009 Mottled Sculpin (36%)

Exotic Species 2009 Yellowfin Shiner, Mountain Redbelly Dace, Brown Trout, Redbreast Sunfish

Species Change Since Last Cycle

Gains -- Whitetail Shiner, Mountain Redbelly Dace, Western Blacknose Dace, Brown Trout, Greenfin Darter
Losses -- Rainbow Trout, Largemouth Bass. All species gained or lost were represented by 1-3 individuals/species; Rainbow Trout represented only by young-of-year and excluded from the sample.

Data Analysis

Watershed -- drains southern Macon County and a small portion of northern Rabun County, GA; tributary to the Little Tennessee River; site is ~ 1.1 miles above the creek's confluence with the river; no municipalities within the watershed. **Habitats** -- primarily runs, plunge pools, snags, narrow riparian zone along the right bank in residential use. **Water Quality** -- pH less than the water quality standard of 6.0 s.u. in 2004 and 2009. **2009** -- the collection of one individual of Greenfin Darter improved the rating from Good to Excellent; except for the darter metric, all other metric scores were comparable to reference site values (i.e., score = 5). **2004 & 2009** -- 21 species are known from the site, including 11 species of cyprinids, 5 exotic species, 4 intolerant species, 2 species of darters, and the Smoky Dace (Special Concern); dominant species has been the Mottled Sculpin (38% and 36%); no reproducing trout populations found at this lowermost site.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
TESSENTEE CR	**SR 1636**	**04/30/09**	**GF28**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	1	06010202	35.06527778	-83.37777778	2-9	Southern Crystaline Ridges & Mtns.

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;Tr	14.8	2040	7	0.4	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	60	15	0	25 (feedlot & cattle pasture)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	13.5
Dissolved Oxygen (mg/L)	9.4
Specific Conductance (µS/cm)	18
pH (s.u.)	6.1

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	8
Pool Variety (10)	10
Riffle Habitat (16)	10
Left Bank Stability (7)	2
Erosion (7)	4
Bank Vegetation (7)	7
Left Riparian Score (5)	5
Right Riparian Score (5)	1
Total Habitat Score (100)	**70**

Site Photograph

Substrate Cobble, gravel, sand, silt

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/30/09	2009-25	19	52	Good
05/18/04	2004-46	16	52	Good
05/03/95	95-38	16	56	Good

Most Abundant Species 2009 Mottled Sculpin (40%)

Exotic Species 2009 Snail Bullhead, Green Sunfish, Redbreast Sunfish

Species Change Since Last Cycle

Gains -- Fatlips Minnow, Creek Chub, Snail Bullhead, Green Sunfish, **Losses** -- Golden Redhorse. All species gained or lost were represented by 1individual/species, except for Creek Chub (n = 13) and Golden Redhorse (n = 10).

Data Analysis

Watershed -- drains southern Macon County; no municipalities within the watershed; tributary to the Little Tennessee River; site is ~ 0.6 miles above the creeks' confluence with the river. **Habitats** -- riffles, runs, silty shorelines, side snags, deep chutes; narrow riparian zone along the right shoreline in residential land use; unstable banks. **Water Quality** -- low specific conductance in 2004 and 2009. **2009** -- more fish collected than at any other site in 2009; 2.6 times more fish collected in 2009 than in 2004 (1,476 *vs.* 578), especially in the numbers of Mottled Sculpin (40%), Central Stoneroller (18%), River Chub (11%), Tennessee Shiner (7%), and Yellowfin Shiner (7%); Hatchery Supported Trout Waters, no trout collected except young-of-year Brown Trout. **1995-2009** -- 23 species known from the site, including 9 species of cyprinids, 6 exotic species, 4 intolerant species, 2 species of darters, and the Smoky Dace (Special Concern); dominant species has been the Mottled Sculpin (20, 39, and 40%); no reproducing trout populations found at this lowermost site; no substantial changes in this community among the three monitoring periods.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
ELLIJAY CR	**SR 1524**	**04/30/09**	**GF14**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	1	06010202	35.16611111	-83.3075	2-21-23	Southern Crystaline Ridges & Mtns.

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;Tr	20	2070	8	0.5	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	45	15	40	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	16.2
Dissolved Oxygen (mg/L)	9.1
Specific Conductance (µS/cm)	31
pH (s.u.)	6.9

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	18
Bottom Substrate (15)	10
Pool Variety (10)	9
Riffle Habitat (16)	16
Erosion (7)	7
Bank Vegetation (7)	4
Light Penetration (10)	5
Left Riparian Score (5)	2
Right Riparian Score (5)	2
Total Habitat Score (100)	**77**

Site Photograph

Substrate Cobble, bedrock, boulder, gravel, silt, sand

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/30/09	2009-26	19	50	Good
05/20/04	2004-51	20	56	Good

Most Abundant Species 2009 Central Stoneroller (31%), Mottled Sculpin (29%)

Exotic Species 2009 Rainbow Trout, Redbreast Sunfish

Species Change Since Last Cycle

Gains -- Fatlips Minnow and Gilt Darter. **Losses** -- Green Sunfish, Greenfin Darter, Tuckasegee Darter. All species gained or lost were represented by 1 or 2 individuals/species.

Data Analysis

Watershed -- drains the east-northeast region of Macon County; tributary to the Cullasaja River; site is ~ 0.6 mile above the creek's confluence with the river. **Habitats** -- swift flow; riffles, runs, plunge pools, side snags, narrow riparian zones (road and pasture) contributing to a fairly open canopy. **2009** -- almost twice as many fish collected in 2009 than in 2004 (1,132 *vs.* 590), especially the numbers of Central Stoneroller and Mottled Sculpin, but only one individual of one darter species; increase in the abundance of Central Stoneroller and River Chub are indicative of upstream nonpoint nutrient runoff and enrichment. **2004 & 2009** -- 22 species known from the site, including 10 species of cyprinids, 5 intolerant species, 3 species of darters, but all darter species represented only by one individual per species, and the Smoky Dace (Special Concern); Mottled Sculpin is the dominant species (44% and 29%); stream is supporting its supplemental designation as trout waters (Tr). Possible upstream nonpoint nutrient runoff and decline in the NCIBI score warrant continued monitoring in 2014.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
IOTLA CR	**off SR 1378**	**05/01/09**	**GF15**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	1	06010202	35.23444444	-83.39805556	2-27	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	10	1995	5	0.4	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	40	40	20	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	15.3
Dissolved Oxygen (mg/L)	8.9
Specific Conductance (µS/cm)	41
pH (s.u.)	5.7

Water Clarity	Slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	17
Bottom Substrate (15)	6
Pool Variety (10)	8
Riffle Habitat (16)	10
Erosion (7)	4
Bank Vegetation (7)	5
Light Penetration (10)	8
Left Riparian Score (5)	4
Right Riparian Score (5)	2
Total Habitat Score (100)	**69**

Site Photograph

Substrate Cobble, boulder, sand, silt

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/01/09	2009-27	22	48	Good
05/19/04	2004-48	18	44	Good-Fair

Most Abundant Species 2009 River Chub (26%)

Exotic Species 2009 Yellowfin Shiner, Brown Trout, Redbreast Sunfish, Green Sunfish

Species Change Since Last Cycle

Gains -- Spotfin Chub, Telescope Shiner, Fatlips Minnow, Creek Chub, Black Redhorse, Brown Trout, Tuckasegee Darter. **Losses** -- Mountain Brook Lamprey, White Sucker, Bluegill. All species gained or loss were represented by 1-34individuals/species, except for Telescope Shiner (n = 16).

Data Analysis

Watershed -- drains north-central Macon County, including the area around the Macon County airport; tributary to the Little Tennessee River; site is ~ 0.2 miles above the creek's confluence with the river. **Habitats** -- heterogeneous habitats (riffles, runs, sandy bottom pools, and snags, undercuts, boulder crevices, rip/rap); lower one-third of the reach had a higher gradient and better habitats than did the upper two-thirds of the reach. **Water Quality** -- in 2004 and 2009 pH less than the water quality standard of 6.0 s.u and conductivity elevated for a mountain stream. **2009** -- one specimen of the Federally Endangered Spotfin Chub was collected; site's proximity to the river may increase the diversity metrics and rate the community higher (Good) than what it should be (Good-Fair) more fish, total species, species of darters and cyprinids collected in 2009 than in 2004; abundance of River Chub and Central Stoneroller are indicative of upstream nonpoint nutrient runoff and enrichment. **2004 & 2009** -- 25 species known from the site, including 10 species of cyprinids and 4 species of darters; dominant species is the River Chub (23% and 26%).

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
BRUSH CR	**off SR 1129**	**04/29/09**	**GF2**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
SWAIN	2	06010202	35.31777778	-83.51555556	2-46	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	7.5	1830	6	0.3	Yes

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	100	0	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	16.7
Dissolved Oxygen (mg/L)	9.9
Specific Conductance (µS/cm)	29
pH (s.u.)	6.6

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	8
Pool Variety (10)	8
Riffle Habitat (16)	14
Erosion (7)	7
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**87**

Site Photograph

Substrate Cobble, boulder, silt, gravel, sand

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/29/09	2009-23	15	52	Good
05/19/04	2004-50	16	50	Good

Most Abundant Species 2009 Whitetail Shiner (18%), Warpaint Shiner (18%)

Exotic Species 2009 Rainbow Trout

Species Change Since Last Cycle

Gains -- Spotfin Chub, Telescope Shiner, Black Redhorse, Rainbow Trout. **Losses** -- Smoky Dace, Western Blacknose Dace, Redbreast Sunfish, Green Sunfish, Smallmouth Bass. All species gained or lost were represented by 1-4 individuals/species, except for Spotfin Chub (n = 38) and Telescope Shiner (n = 12).

Data Analysis

Watershed -- drains southern Swain County; tributary to the Little Tennessee River; site is ~ 0.2 miles above the creek's confluence with the river and within the state-owned Needmore Tract; no municipalities within the watershed. **Habitats** -- riffles, runs, plunge pools; wide riparian zones providing excellent canopy over the stream; silt-covered rocks contributing to the very turbid conditions when walking in the stream. **2009** -- total species richness and diversities of cyprinids and darters were slightly lower than expected, all other metric scores were comparable to reference site values (i.e., score = 5); 38 specimens of the Federally Endangered Spotfin Chub were collected. **2004 & 2009** -- 20 species known from the site, including 9 species of cyprinids, 6 intolerant species, and 2 species of darters; seasonal migrants from the river include Whitetail Shiner, Telescope Shiner, and Spotfin Chub; dominant species in 2004 were Mottled Sculpin (25%) and Warpaint Shiner (16%). Upstream nonpoint sediment runoff sources should be investigated.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
STECOAH CR	**SR 1237**	**04/28/09**	**GF26**	**Not Rated**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
GRAHAM	2	06010202	35.39527778	-83.67805556	2-130	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;Tr	9	1810	5	0.4	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	45	30	25	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

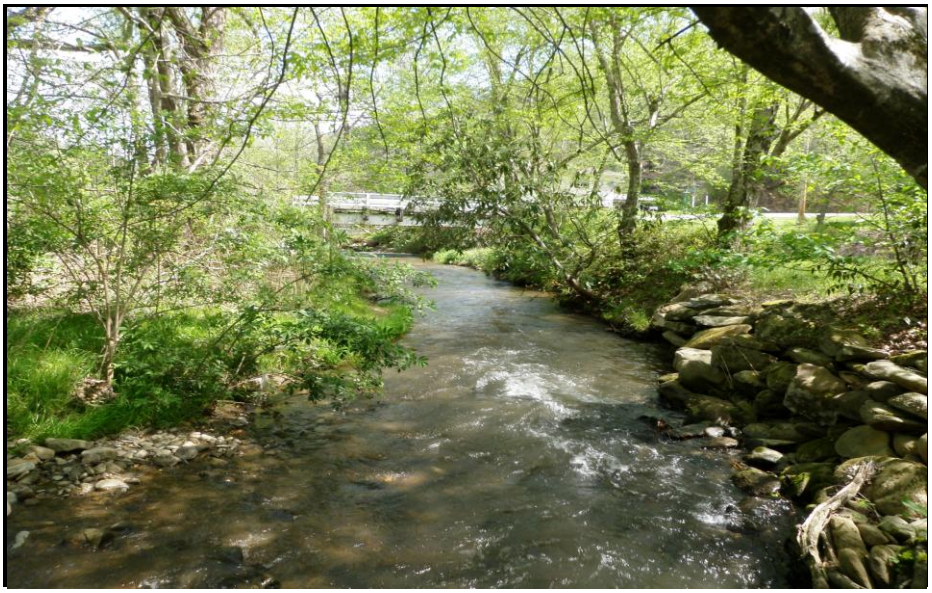
Temperature (°C)	15.4
Dissolved Oxygen (mg/L)	10.0
Specific Conductance (µS/cm)	39
pH (s.u.)	5.8

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	10
Pool Variety (10)	10
Riffle Habitat (16)	16
Erosion (7)	2
Bank Vegetation (7)	4
Light Penetration (10)	10
Left Riparian Score (5)	3
Right Riparian Score (5)	1
Total Habitat Score (100)	**79**

Site Photograph



Substrate Cobble, boulder

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/28/09	2009-19	12	---	Not Rated
06/03/04	2004-68	10	---	Not Rated

Most Abundant Species 2009 River Chub (33%)

Exotic Species 2009 Rainbow Trout, Green Sunfish

Species Change Since Last Cycle **Gains** -- Green Sunfish (n = 8), Smallmouth Bass (n = 1). **Losses** -- none.

Data Analysis

Watershed -- drains northeastern Graham County; tributary to Fontana Reservoir; site is ~ 1.5 miles above its mouth; no municipalities within the watershed. **Habitats** -- extensive riffles, chutes, plunge pools; degraded riparian zones and unstable banks; livestock with access to stream above the reach; more upstream development (i.e., campground and mobile homes) than in 2004. **Water Quality** -- conductivity elevated for a mountain stream in 2004 and 2009; pH less than the water quality standard of 6.0 s.u. in 2009. **2009** -- community is dominated by omnivores+herbivores (Central Stoneroller and River Chub); Mottled Sculpin, an indicator of cold-cool water, constituted only 3% of the fish; darters absent; Hatchery Supported Trout Waters, three stocked Brown Trout collected (236-313 mm TL). **2004 & 2009** -- 12 species known from the site, but no darters; site appeared to be degraded by straight-piping or nonpoint-source runoff which may be contributing nutrients to this stream; dominant species are River Chub (36% and 33%) and Central Stoneroller (14% and 19%). Stream is supporting its supplemental designation as trout waters (Tr), but the dominance by River Chub and Central Stoneroller, the silt on the substrate, and the widening of NC 28 in the Stecoah Valley warrants continued monitoring of this site in 2014.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
TUCKASEGEE R	**SR 1140**	**GB38**	**08/17/09**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Jackson	2	06010203	35.200110	-82.991800	2-79-(0.5)	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-III,B;Tr,ORW	11	3260	14	0.4

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	90	0	0	10 (road)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	20.2
Dissolved Oxygen (mg/L)	7.1
Specific Conductance (µS/cm)	10
pH (s.u.)	5.5
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	18
Bottom Substrate (15)	14
Pool Variety (10)	8
Riffle Habitat (16)	6
Bank Erosion (7)	7
Bank Vegetation (7)	6
Light Penetration (10)	9
Left Riparian Score (5)	2
Right Riparian Score (5)	5
Total Habitat Score (100)	79

Site Photograph

Substrate mostly boulder, cobble, sand; some gravel and silt also present

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/17/09	10818	---	35	---	2.42	Good
08/02/04	9473	---	36	---	1.83	Excellent
07/19/99	7906	---	46	---	1.86	Excellent
09/01/94	6696	---	39	---	2.26	Excellent
09/13/89	5077	101	47	3.50	1.79	Excellent

Taxonomic Analysis

Excluding the more intensive Full-Scale sample obtained in 1989, the number of Ephemeroptera collected in 2009 was generally within the range for the other EPT samples. However, both Plecoptera and Trichoptera were reduced in 2009, by 2-3 and 3-4 taxa respectively. The most conspicuous absence from the sample collected in 2009 is *Arctopsyche irrorata* --this stressor-sensitive species was common in each of the four prior samples. Another sensitive species, *Malirekus hastatus* , was also uncollected for the first time in 2009.

Data Analysis

This uppermost benthic basinwide site on the river is within five miles of the headwaters and about 15 miles west of Brevard. The site was sampled using Full-Scale methods in 1989, then with EPT methods during each of the following sampling events. If a single additional taxon had been collected at the site in 2009 the classification would have remained at Excellent and therefore, despite the Good bioclassification in 2009, it is evident that water quality in this catchment has remained stable since sampling commenced in 1989.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
TUCKASEGEE R	**SR 1378**	**GB19**	**07/30/09**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Jackson	2	06010203	35.368889	-83.263333	2-79-(40.5)	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
B	347.0	1952	50	0.5

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	---	90	---	10 (road)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Jackson County WWTP (Tuckasegee Water and Sewer Authority)	NC0039578	3.5

Water Quality Parameters

Temperature (°C)	17.5
Dissolved Oxygen (mg/L)	9.2
Specific Conductance (µS/cm)	27
pH (s.u.)	6.0

Water Clarity: slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	15
Bottom Substrate (15)	11
Pool Variety (10)	4
Riffle Habitat (16)	12
Bank Erosion (7)	6
Bank Vegetation (7)	3
Light Penetration (10)	2
Left Riparian Score (5)	1
Right Riparian Score (5)	4
Total Habitat Score (100)	63

Site Photograph

Substrate: Cobble and boulder with some bedrock, gravel, sand, and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/30/09	10770	75	43	4.29	3.52	Good
08/04/04	9484	84	44	4.27	3.44	Excellent
07/21/99	7932	75	40	4.34	3.73	Good
07/14/94	6591	100	47	4.38	3.32	Excellent
08/10/90	5366	86	43	4.10	3.20	Good

Taxonomic Analysis

A small reduction in both total and EPT richness occurred in 2009. Conspicuously absent in 2009, after being present since 1984, were the mayflies *Maccaffertium modestum* and *Neoephemera purpurea* . Only 13 Trichoptera were collected in 2009 as compared to 21 in 2004 although most missing taxa were rare in previous samples. The paucity of midge taxa was largely responsible for the reduction in the total taxa richness.

Data Analysis

This large river site receives effluent from the municipalities of Sylva, Webster, and Dillsboro and drains almost the entirety of Jackson County. A difficult site to sample in any year, this site was assessed during higher flows and was not completely wadeable. Habitat was typical for a large river and, except for the lack of sufficient riparian vegetation, had no significant deficiencies. Since the inception of sampling in 1984, the Tuckasegee River has improved from Good-Fair (1984) to the current rating of Good. Had sampling produced one more EPT, this site would have rated Excellent in 2009. This suggests that the water quality is not declining despite the slight drop to Good in 2009. This conclusion is further supported by the very stable biotic index and EPTBI measured here since 1990.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
CANEY FK	**SR 1740**	**GB27**	**08/02/04**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
JACKSON	2	06010203	35.305000	-83.126111	2-79-28-(2.5)	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-III; Tr	40	2200	14	0.3

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	40	20	30	10	---

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

Water Quality Parameters

Temperature (°C)	25.2
Dissolved Oxygen (mg/L)	7.2
Specific Conductance (µS/cm)	26
pH (s.u.)	7.5
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	14
Pool Variety (10)	7
Riffle Habitat (16)	14
Bank Erosion (7)	6
Bank Vegetation (7)	6
Light Penetration (10)	7
Left Riparian Score (5)	3
Right Riparian Score (5)	2
Total Habitat Score (100)	82

Site Photograph

Substrate good mix of cobble (40),gravel (30), boulder (20), and sand (10)

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/02/10	11088	107	52	3.13	2.20	Excellent
08/02/04	9474	107	54	3.39	2.33	Excellent
07/20/99	7912	97	53	3.26	2.50	Excellent
07/15/94	6593	93	56	3.01	2.38	Excellent

Taxonomic Analysis

The benthic community in Caney Fork has remained very speciose over the past 20 years. While EPT richness slowly decreases, total richness is trending up, due primarily to an increase in odonate and dipteran richness. These two groups contributed to the increase in the biotic index seen in the last 10 years (relative to the EPT BI), although this is partially offset by fewer Chironmidae larvae in 2010. The EPT fauna has consistently remained, over 4 basinwide cycles, both similar and productive (most likely due to the open canopy). Mayflies were dominated by baetids and included Caney Fork's first record of *Iswaeon anoka* as well as the flat-headed mayfly *Epeorus vitreus* . Intolerant species of hydropsychid net spinners, such as *Ceratopsyche morosa* , dominated, in terms of abundance, the caddisfly community suggesting slight enrichment. Finally, the stoneflies remained amazingly stable with the same 6 taxa recorded over the last 15 years.

Data Analysis

Caney Fork, along with its tributary Moses Creek, drains a small portion of east-central Jackson County, a mostly forested landscape, and ultimately feeds into the Tuckasegee River. Caney Fork, for most of it's length, is paralleled by roadway and is lined by agricultural fields and residences. It is therefore lacking any significant riparian vegetation and is often denuded on both sides of the stream. However, most of the watershed is forested thereby protecting the Excellent water quality that has persisted in Caney Fork over the last two decades. Other than loss of riparian vegetation (complete loss in some areas), no glaring problems were noted with either physico-chemical parameters or in-stream habitat. Small amounts of silt were recorded but appear to have a minimal effect on the benthos despite the occurrence of some substrate embeddedness.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
MOSES CR	**SR 1739**	**GB26**	**08/02/10**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
JACKSON	2	06010203	35.314722	-83.125556	2-79-28-8	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-III; Tr	8	2280	6	0.2

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	70	20	---	10	---

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

Water Quality Parameters

Temperature (°C)	21.5
Dissolved Oxygen (mg/L)	8.2
Specific Conductance (µS/cm)	26
pH (s.u.)	5.6

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	14
Pool Variety (10)	5
Riffle Habitat (16)	16
Bank Erosion (7)	6
Bank Vegetation (7)	5
Light Penetration (10)	7
Left Riparian Score (5)	2
Right Riparian Score (5)	3
Total Habitat Score (100)	81

Site Photograph

Substrate mostly cobble (50) and boulder (25), with some gravel (10)

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/02/10	11089	---	42	---	1.64	Excellent
08/02/04	9475	---	46	---	1.38	Excellent
07/20/99	7913	---	37	---	1.57	Excellent

Taxonomic Analysis

The decrease in EPT richness seen in Moses Creek in 2010 from the previous 2004 high was due to the net loss of 4 mayflies taxa largly represented in part by spiny crawlers (*Drunella cornutella*) and flat-headed mayflies (*Leucrocuta* spp, *Rhithrogena* spp, and *Stenacron pallidum*). Both stonefly and caddisfly richness remained stable (8 and 18 taxa, respectively). While the stonefly community was similar to the previous 2 samplings (with the addition of *Amphinemura* spp but the loss of *Isoperla holochlora*), a slight shift was seen in the caddisfly community. Filterers, particularly net-spinners such as hydropsychids, became more dominant in both richness (with the addition of *Ceratopsyche alhedra* and *C. morosa*) as well as abundance. Furthermore, brachcentrid caddisflies were much less common with 2 species, *Brachycentrus nigrosoma* and *Micrasema wataga*, disappearing altogether.

Data Analysis

Moses Creek is a tributary of Caney Fork which, in turn, drains into the Tuckasegee River. This stream has a catchment that is largely forested with only the lower segment paralleling a rural residential road. Moses Creek is one of the few streams in the LTN that saw a loss of EPT taxa from the previous sampling cycle, although this loss was relatively small. These losses were primarily seen among very intolerant taxa thus affecting the EPT BI which, while low, is the highest yet seen for this stream. While very little silt was seen, it was noted that riparian loss was occurring due to residential lawns, some upstream agriculture, and the nearby road. However, habitat was good overall and the specific conductance, while not exceedingly low like that of an undisturbed stream, was not problematic. Water quality in Moses Creek remains solidly Excellent.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
CULLOWHEE CR	SR 1001	GB29	07/30/09	Excellent

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Jackson	2	06010203	35.288333	-83.181667	2-79-31a	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Tr	18.9	2123	5	0.2

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	10	60	---	30 (park)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	19.8
Dissolved Oxygen (mg/L)	8.2
Specific Conductance (µS/cm)	32
pH (s.u.)	6.9

Water Clarity: slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	14
Bottom Substrate (15)	8
Pool Variety (10)	4
Riffle Habitat (16)	9
Bank Erosion (7)	7
Bank Vegetation (7)	4
Light Penetration (10)	7
Left Riparian Score (5)	1
Right Riparian Score (5)	3
Total Habitat Score (100)	61

Site Photograph

Substrate: Cobble and sand with some gravel and boulder, silty

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/30/09	10773	---	52	---	3.07	Excellent
08/04/04	9481	---	47	---	2.61	Excellent
07/20/99	7914	---	43	---	2.91	Excellent
08/31/94	6681	---	32	---	2.44	Good

Taxonomic Analysis

EPT richness values have steadily increased in Cullowhee Creek to the current levels of 52 taxa since the inception of sampling in 1994. However, the EPT biotic index has also increased leading to the conclusion that as more taxa are collected, a higher proportion of the total taxa are more tolerant to urban stressors. This is seen in both the presence of facultative taxa like the mayfly *Procloeon* as well as the absence or rarity of previously occurring intolerant taxa like the mayfly *Serratella carolina* and the caddisfly *Rhyacophila fuscula*. Some taxa recorded for the first time at Cullowhee Creek included the mayflies *Stenacron pallidum* and *Rhithrogena fuscifrons* and the caddisflies *Micrasema bennetti* and *Oligostomis pardalis*. Plecoptera were both taxa rich (8) and abundant. The rare mayfly, *Epeorus subpallidus,* was collected for only the 5th time in the state.

Data Analysis

Cullowhee Creek drains a small portion of western Jackson County and eventually drains into the Tuckasegee River. The sampling site lies above Cullowhee and Western Carolina University amid light urban development reflected by the lack of significant riparian vegetation and the high degree of embedded substrate in the stream. High levels of sand (25%) and silt (10%) have removed the interstitial spaces needed for some taxa to persist. High productivity was noted as evidenced by the presence of copious amounts of the macrophyte *Podostemum ceratophylum* (riverweed), which is known to increase macroinvertebrate abundance (high in this stream at 264) and provide substrate for epiphytic algae and rufugia for invertebrates. Although Cullowhee Creek was rated as Excellent in 2009, habitat degradation is a serious issue and may negatively affect the fauna in the future if watershed development continues unabated.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
SAVANNAH CR	**SR 1367**	**GB23**	**07/30/09**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Jackson	2	06010203	35.345833	-83.237500	2-79-36	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Tr	40.7	2004	12	0.2

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	60	30	---	10 (road)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	19.0
Dissolved Oxygen (mg/L)	8.6
Specific Conductance (µS/cm)	33
pH (s.u.)	6.1

Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	16
Bottom Substrate (15)	7
Pool Variety (10)	5
Riffle Habitat (16)	14
Bank Erosion (7)	5
Bank Vegetation (7)	4
Light Penetration (10)	10
Left Riparian Score (5)	1
Right Riparian Score (5)	4
Total Habitat Score (100)	70

Site Photograph

Substrate	Cobble and sand with some bedrock and gravel, extremely silty

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/30/09	10772	83	45	3.59	3.06	Excellent
08/04/04	9482	91	40	4.15	3.11	Good
07/21/99	7930	53	32	3.72	3.36	Good
07/26/94	6603	77	40	3.78	3.06	Excellent

Taxonomic Analysis

An increase in both mayfly and caddisfly taxa from 2004 levels brought the EPT richness to the highest level seen here. Many species absent in 2004 were collected in 2009 including many sensitive taxa like the mayflies *Brachycercus spp* , *Heterocloeon curiosum* , and *Serratella serrata* as well as the caddisflies *Brachycentrus spinae* and *Setodes spp* . Other sensitive species were collected for the first time such as the burrowing mayfly *Ephemera spp* (indicative of silt pools), and the caddisflies, *Nyctiophylax spp* , *Lype diversa* , and *Fattigia pele* . Fewer beetle and odonate taxa were collected in than in previous samplings which helped to reduce the biotic index.

Data Analysis

Savannah Creek, a tributary to the Tuckasegee River, drains a moderately developed landscape. Many segments of the stream are channelized and have had much of the riparian vegetation reduced or completely removed. The lower segment of the stream follows a road and has had most of the woody vegetation removed, consequently limiting habitat and resources for colonizing macroinvertebrates. Sedimentation was evident in the stream as embeddedness of bottom substrate was severe and large pools of silt and bank erosion were present. Slightly turbid water, normal in streams with development in the catchment, was also noted. Despite the habitat and watershed challenges, Savannah Creek rated Excellent for the first time in 10 years as evidenced by increased EPT richness and a significantly lower overall biotic index. This improvement was likely the result of reduced non point inputs of pollution due to drought effects.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
SCOTT CR	**UPS SR 1556**	**GB167**	**07/30/09**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Jackson	2	06010203	35.368889	-83.249444	2-79-39	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Tr	58.9	1968	9	0.3

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	---	90	---	10

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Sylva WWTP (Tuckaseigee Water and Sewer Authority)	NC0020214	0.5

Water Quality Parameters

Temperature (°C)	18.6
Dissolved Oxygen (mg/L)	8.9
Specific Conductance (µS/cm)	39
pH (s.u.)	6.1

Water Clarity: slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	3
Instream Habitat (20)	18
Bottom Substrate (15)	6
Pool Variety (10)	4
Riffle Habitat (16)	12
Bank Erosion (7)	6
Bank Vegetation (7)	4
Light Penetration (10)	9
Left Riparian Score (5)	1
Right Riparian Score (5)	1
Total Habitat Score (100)	64

Site Photograph

Substrate: Gravel and cobble with some boulder and sand, silty

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/30/09	10771	98	46	4.12	3.34	Excellent
08/09/07	10309	---	37	---	3.23	Excellent
08/04/04	9483	74	35	4.07	3.23	Good
07/21/99	7931	70	36	4.07	3.09	Good
07/14/94	6592	68	28	5.19	3.65	Good-Fair

Taxonomic Analysis

A significant increase in both total taxa and EPT richness has occurred since the last basinwide assessment in 2004. An almost 33% increase in EPT can be accounted for by additional mayflies and caddisflies occurring since 2004. In particular, the number of baetid mayfly species has more than doubled since monitoring began in 1994. Flat-headed mayflies were also abundant as a group with *Rhithrogena exilis* re-occurring for the first time in 15 years. Stonefly richness has remained relatively stable over time, varying between five and eight taxa (seven in 2009). In contrast, the caddisfly community was comprised of 16 taxa, almost double what was collected in 1994. Hydropsychids were the dominant caddisfly group and was represented by four species. Also, both beetle and midge richness increased in 2009, in part responsible for the increased total taxa richness and biotic index.

Data Analysis

Lying in northeastern Jackson County, many of Scotts Creek's tributaries drain unimpacted mountain slopes. However, the lower portion of this watershed is largely urbanized and passes through both downtown Sylva and Dillsboro before draining into the Tuckasegee River. Additionally, the stream is followed closely by major roads for much of it's length. The sampling site is on a reach that is channelized and stabilized with concrete riprap (see photo) and is next to the Great Smoky Mountain Railroad parking lot. The habitat score reflects the embeddedness and lack of riparian vegetation. Downstream of the Sylva WWTP, the specific conductance was low, although water levels were higher than normal due to recent rains. While the total taxa and EPT

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
CONNELLY CR	SR 1177	GB13	07/29/09	Excellent

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Swain	2	06010203	35.430556	-83.365278	2-79-52	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Tr	13.4	1869	7	0.2

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	50	50	---	---

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Smoky Mountain Country Club	NC0084441	0.12

Water Quality Parameters

Temperature (°C)	20.1
Dissolved Oxygen (mg/L)	7.9
Specific Conductance (µS/cm)	26
pH (s.u.)	6.7

Water Clarity: slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	18
Bottom Substrate (15)	14
Pool Variety (10)	5
Riffle Habitat (16)	16
Bank Erosion (7)	6
Bank Vegetation (7)	5
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	1
Total Habitat Score (100)	84

Site Photograph

Substrate: Mostly cobble mixed with gravel and boulder, some bedrock

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/29/09	10713	---	44	---	2.46	Excellent
08/03/04	9480	---	34	---	2.82	Good
07/21/99	7933	---	44	---	3.06	Excellent
07/14/94	6589	94	42	3.57	3.00	Excellent

Taxonomic Analysis

An EPT richness of 44 taxa collected in 2009 is the same as that obtained in 1999 but was significantly higher than that observed in 2004. This increase was driven in part by an additional 7 mayfly taxa (22) over 2004 levels (15) and is the same number of mayfly taxa that were collected in 1999. Coupled with this increase in richness is the decrease in the EPT biotic index to the lowest value recorded for this stream since sampling began in 1994. The absence of some tolerant baetid mayflies such as *Baetis flavistriga* and the addition of intolerant ephemerellid mayfly taxa, including *Drunella allegheniensis* , *Serratella carolina,* and *Serratella serratoides,* is responsible for the low EPT biotic index. Moreover, all but one taxa of the 7 Plecoptera taxa collected were abundant. The caddisfly community observed was similar to previous years with the first record of *Hydatophylax argus* at this site occurring in 2009.

Data Analysis

Connelly Creek is a small tributary to the Tuckasegee river and drains a small portion of southeastern Swain County. Only the lower portion of the watershed is developed, consisting mostly of residences and a golf course, leaving the vast majority of the upper watershed n forest. The stream follows a road for much of its length which has reduced or removed the riparian on one side for much of the segment. However, overall habitat was good and the stream banks were stable with little erosion. EPT richness levels rebounded to 1999 levels thereby increasing its bioclassification to Excellent after rating Good in 2004. Although this site was Good in 2004, that sample was only two EPT taxa short of receiving an Excellent bioclassification thus indicating temporally stable water quality in this catchment.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
BRADLEY FK	**US 441**	**GB1**	**07/29/09**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Swain	2	06010203	35.563333	-83.309722	2-79-55-12-(11)	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
B; Tr, HQW	19.6	2254	12	0.3

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	100	---	---	---

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	16.8
Dissolved Oxygen (mg/L)	6.1
Specific Conductance (µS/cm)	15
pH (s.u.)	6.0

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	20
Bottom Substrate (15)	15
Pool Variety (10)	8
Riffle Habitat (16)	16
Bank Erosion (7)	7
Bank Vegetation (7)	6
Light Penetration (10)	10
Left Riparian Score (5)	4
Right Riparian Score (5)	4
Total Habitat Score (100)	95

Site Photograph

Substrate a mix of boulder, cobble, and gravel with some bedrock and sand

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/29/09	10694	86	48	2.50	1.70	Excellent
08/03/04	9479	79	47	2.61	2.02	Excellent
07/22/99	7935	67	39	2.58	1.75	Excellent
10/12/95	6981	69	42	1.95	1.40	Excellent
09/01/94	6682	---	31	---	1.27	Good

Taxonomic Analysis

The highest EPT richness and total taxa richness (ST) ever measured in this stream occurred in 2009. Increases in Plecoptera and Trichoptera over previous samples were partly responsible for these increases and almost all taxa observed were intolerant or facultative species. One mayfly observed *Epeorus subpallidus* , has never before been identified from this stream and is in fact only the 4th record of this species in NC. Of the EPT collected during this sampling event, the mayfly *Leptophlebia spp* , the uncommon stonefly *Agnetina capitata* , and the caddisflies *Ceraclea flava* and *Fatiggia pele* were also not collected prior to 2009.

Data Analysis

Bradley Fork, a tributary to the Oconaluftee River, is located within Great Smoky Mountain National Park and as such has a completely undeveloped and forested watershed. This stream has high recreational usage among the public as it lies next to a campground just inside the park border. The 2009 sample produced a very low biotic index of 2.50, which is the lowest biotic index recorded for a basinwide sample at this site since sampling began in 1994. In addition, richness values for both total taxa and EPT have increased in the last ten years. These metrics indicate a stream with very high water quality and is consistent with an all forested and protected watershed. Bradley Fork received an Excellent bioclassification for the third straight basinwide cycle and the fourth straight sampling event.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
OCONALUFTEE R	**SR 1359**	**GB11**	**07/27/09**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Swain	2	06010203	35.461389	-83.353611	2-79-55-(16.5)	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Tr	284.0	1842	45	0.4

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	30	50	---	20 (road)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	23.2
Dissolved Oxygen (mg/L)	6.0
Specific Conductance (µS/cm)	21
pH (s.u.)	8.2
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	11
Pool Variety (10)	6
Riffle Habitat (16)	12
Bank Erosion (7)	7
Bank Vegetation (7)	6
Light Penetration (10)	4
Left Riparian Score (5)	2
Right Riparian Score (5)	2
Total Habitat Score (100)	73

Site Photograph

Substrate Cobble and gravel with some boulder and sand, silty at times

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/27/09	10695	98	47	4.07	3.11	Excellent
08/05/04	9485	106	51	3.95	2.97	Excellent
07/22/99	7934	104	53	3.93	3.20	Excellent
07/14/94	6590	86	46	4.05	2.99	Excellent
07/26/89	5029	88	47	4.13	3.22	Excellent

Taxonomic Analysis

A varied EPT community resides in this river although over the last ten years the fauna has become less rich. The reduction in EPT is exhibited in the loss of some baetid mayfly taxa such as *Acentrella* and *Plauditus* and in the loss of the hydropsychid caddisfly taxa *Diplectrona modesta* and *Hydropsyche morosa* although, overall, hydropsychids were the dominant group in the river. Both the stonefly community composition and richness were maintained from prior years with the exception of the loss of *Agnetina,* which was not found for the first time in 15 years of sampling. Taxa collected in 2009 that have never before been collected from this site included the mayfly *Heterocloeon anoka* and the caddisflies *Micrasema bennetti* and *Glossossoma nigrior* .

Data Analysis

The Oconaluftee River, a large tributary to the Tuckasegee River, drains the eastern portion of Great Smoky Mountain National Park. The lower segment of this river is tracked on both sides by roads (including US 19) and receives large amounts of urban runoff from Cherokee. High development pressures have introduced sediments into the river and removed large amounts of riparian vegetation. *Podostemum ceratophylum* was extremely abundant and retained sand and silt which were subsequently released during sampling resulting in large plumes of turbid water. Substrates were also partially embedded although not completely so. Despite a lower EPT richness relative to prior samplings, EPT abundance (282) was the highest ever recorded

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
DEEP CR	**W DEEP CR RD**	**GB5**	**08/06/10**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
SWAIN	2	06010203	35.466111	-83.431111	2-79-63-(16)	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-II, B; Tr, HQW	40	1815	14	0.2

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	80	---	---	---	20

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

Water Quality Parameters

Temperature (°C)	19.5
Dissolved Oxygen (mg/L)	7.8
Specific Conductance (µS/cm)	14
pH (s.u.)	4.8
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	19
Bottom Substrate (15)	13
Pool Variety (10)	5
Riffle Habitat (16)	16
Bank Erosion (7)	7
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	4
Right Riparian Score (5)	5
Total Habitat Score (100)	91

Site Photograph

Substrate mix of cobble (35), boulder (30), and gravel (25); some sand (10)

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/06/10	11093	---	45	---	2.33	Excellent
08/02/04	9410	---	43	---	1.79	Excellent
08/09/99	7954	---	47	---	2.09	Excellent
07/11/94	6579	---	41	---	1.93	Excellent

Taxonomic Analysis

The second highest EPT richness ever measured in this stream occurred in 2010. Increases in Ephemeroptera over previous samples were partly responsible and almost all taxa observed were intolerant or facultative species. One mayfly collected, *Acentrella barbarae,* originally described from GSMNP, has been recorded only seven times in NC, almost all of the records from park streams. EPT collected from this stream for the first time included the baetid mayfly *Pseudocloeon propinquum* , the uncommon stone *Agnetina capitata* , and *Triaenodes ignitus,* the only long-horned caddisfly found (other leptocerid taxa previously collected in Deep creek were absent in 2010).

Data Analysis

This site on Deep Creek, a tributary to the Little Tennessee River, is located at a campground within Great Smoky Mountain National Park and as such has a mostly forested watershed. This beautiful stream has high recreational usage among the public and is popular as a tubing spot. The very low EPT BI of 2.33, which is the highest yet recorded for a basinwide sample at this site, is indicative of a very intolerant EPT community. Also, EPT richness is second only to that recorded in 1999. Habitat was very good although the lack of large pools is characterized by the presence of one continuous riffle. These metrics indicate a stream with very high water quality. Deep Creek has maintained an Excellent rating for the last 20 years.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
DEEP CR	**SR 1340**	**GB7**	**08/06/10**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
SWAIN	2	06010203	35.442500	-83.440278	2-79-63-(21)	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
B; Tr	43	1750	13	0.4

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	---	70	30	---	---

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

Water Quality Parameters

Temperature (°C)	20.1
Dissolved Oxygen (mg/L)	7.7
Specific Conductance (µS/cm)	15
pH (s.u.)	5.5

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	19
Bottom Substrate (15)	12
Pool Variety (10)	6
Riffle Habitat (16)	16
Bank Erosion (7)	6
Bank Vegetation (7)	6
Light Penetration (10)	10
Left Riparian Score (5)	1
Right Riparian Score (5)	2
Total Habitat Score (100)	83

Site Photograph

Substrate mix of cobble (30), boulder (20), gravel (20), sand (20); silty (10)

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/06/10	11094	---	49	---	2.26	Excellent
08/02/04	9452	---	38	---	1.73	Excellent
08/09/99	7955	---	45	---	2.36	Excellent
07/11/94	6578	---	50	---	2.11	Excellent

Taxonomic Analysis

Gains seen in EPT richness between the 2004 and 2010 basinwide samplings were driven by increases in both mayflies (+7) and caddisflies (+4) while stoneflies remained stable. The increase in mayflies was driven by an surge in baetid richness and included the first Deep Creek record of *Heterocloeon* spp. and *Acentrella nadineae* . The appearance of the mayflies *Baetisca* spp and *Ephemera* spp in 2010 and the absence of both *Epeorus vitreus* and *Rhithrogena exilis* , after 15 years of abundance, may be attributable to additional sediment inputs into the stream. Stoneflies were dominated by perlids and the rare *Agnetina capitata* was collected. The caddisfly community was notable for the absence of *Brachycentrus spinae* which had been abundant in the three previous basinwide samples and the addition of *Hydatophylax argus* (1st Deep Cr. record) and *Oligostomis pardalis* (1st Deep Cr. record), two caddisflies that prefer slower, less turbulent waters.

Data Analysis

The SR 1340 sampling site on Deep Creek is approximately 3 miles below the site in GSMNP and drains the east-central portion of the park. EPT levels in 2010 rebounded from a twenty year low to the second highest richness recorded. Additionally, the EPT BI, while not the lowest recorded at this site, indicates a very intolerant EPT community resides here. As evidenced by the specific conductance measured, little impact can be seen from the 3 miles of commercial, agricultural, and residential properties between this reach and the upstream park reach. While less available habitat is present for colonization and more silt occurs in-stream than the park reach (most likely due to the agriculture), the additional sediment input and habitat deficiencies are not severe enough to affect the EPT fauna dramatically. Deep Creek at SR 1340 maintains it's excellent water quality for 2010. It is recommended that this site be dropped from Basinwide rotation as further upstream development seems unlikely.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
NOLAND CR	**NR MOUTH**	**GB6**	**07/28/10**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
SWAIN	2	06010203	35.454167	-83.527778	2-90	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Tr	20	1780	6	0.2

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	100	---	---	---	---

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

Water Quality Parameters

Temperature (°C)	21.2
Dissolved Oxygen (mg/L)	8.1
Specific Conductance (µS/cm)	12
pH (s.u.)	4.7

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	20
Bottom Substrate (15)	14
Pool Variety (10)	9
Riffle Habitat (16)	15
Bank Erosion (7)	7
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	4
Total Habitat Score (100)	96

Site Photograph

Substrate	mix of cobble (35), boulder (30), and gravel (25), some sand (10)

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/28/10	11092	45	45	1.31	1.31	Excellent
08/03/04	9454	35	35	1.57	1.57	Good
08/11/99	7966	40	40	1.63	1.63	Excellent

Taxonomic Analysis

Sampling in 2010 resulted in the highest yet recorded EPT richness in Noland Creek. An dramatic increase was seen in in caddisfly richness (+9) over that which was collected in 2004. Also, the EPT BI decreased for the second straight cycle time due in part to the presence of some very intolerant species of caddisflies that were not previously collected, including the uncommon *Rhyacophila acutiloba and Neophylax mitchelli.* The highest richness of Plecoptera was observed in 2010 with eight taxa collected with the majority of taxa abundant. New taxa occuring in 2010 included the rarely collected mayflies *Epeorus subpallidus* and *Acentrella barbarae,* which was described from GSMNP in 2006. The caddisfly *Molanna* spp was also previously unrecorded from Noland Creek.

Data Analysis

Noland Creek lies within the southcentral portion Great Smoky Mountain National Park and drains into Fontana Lake. It is an undeveloped and forested watershed. The habitat of Noland Creek is exceptional and consists of a series of cascades, riffles, and pools. The 2010 EPT BI is the lowest recorded in the entire LTN basin during the current basinwide cycle, even among other GSMNP sites. The EPT richness for 2010 is also the highest yet seen at this site. These metrics, coupled with the low specific conductance, indicate the very stable and intolerant benthic community one would expect from a stream with little to no anthropogenic disturbance. The low pH is partially attributable to the Anakeesta soils that are interspersed throughout the park. Noland Creek rates Excellent for the second time in 11 years.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
FORNEY CR	NR MOUTH	GB4	07/28/09	Excellent

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Swain	2	06010203	35.468611	-83.566111	2-97	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Tr, ORW	28.0	1788	10	0.5

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	100	---	---	---

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	18.5
Dissolved Oxygen (mg/L)	8.5
Specific Conductance (µS/cm)	10
pH (s.u.)	6.2

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	13
Pool Variety (10)	10
Riffle Habitat (16)	16
Bank Erosion (7)	7
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	4
Total Habitat Score (100)	95

Site Photograph

Substrate Boulder and cobble with some bedrock and gravel, very little silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/28/09	10697	81	52	2.47	1.64	Excellent
08/03/04	9455	78	44	2.62	1.80	Excellent
08/11/99	7965	81	46	2.59	1.58	Excellent
07/12/94	6581	79	46	2.43	1.49	Excellent

Taxonomic Analysis

Sampling in 2009 resulted in the highest yet recorded EPT richness in Forney Creek. An increase was seen in each EPT order over that which was collected in 2004. In addition, the EPTBI decreased to pre 2004 levels due in part to three species of the intolerant mayfly *Drunella* and four species of the intolerant caddisfly *Rhyacophila* . The highest richness of Plecoptera was observed in 2009 with 10 taxa collected with the majority of taxa either common or abundant, including the rarely collected stonefly *Agnetina capitata.* New taxa occurring in 2009 included only the 3rd NC record of the mayfly *Epeorus subpallidus* and the 4th NC record of mayfly *Acentrella barbarae,* which was described from Great Smoky Mountain National Park (GSMNP) in 2006. The caddisflies *Hetroplectron americanum* , *Phylocentropus spp* , and *Ceraclea flava* were also previously unrecorded from Forney Creek. Only 14 Chironomidae taxa were collected in 2009.

Data Analysis

Forney Creek lies within and drains the south-central portion of GSMNP into Fontana Lake. It is an entirely undeveloped and forested watershed. The habitat of this stream is as expected for a stream in a natural setting and consists of a series of riffles, cascades, and pools with excellent riparian zones. The biotic index and EPTBI has remained low with little variation and total taxa richness has likewise varied little over the last 15 years. These metrics, coupled with a high EPT richness, indicate the very stable benthic community one would expect for a stream whose catchment is completely encompassed within the GSMNP.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
CANEY FK	SR 1738	04/27/09	GF4	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
JACKSON	2	06010203	35.30472222	-83.13777778	2-79-28-(2.5)	Southern Crystaline Ridges & Mtns.

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
WS-III,Tr	50.2	2170	14	0.6	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	80	0	20	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	18.8
Dissolved Oxygen (mg/L)	8.5
Specific Conductance (µS/cm)	19
pH (s.u.)	5.9

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	19
Bottom Substrate (15)	13
Pool Variety (10)	6
Riffle Habitat (16)	16
Erosion (7)	7
Bank Vegetation (7)	3
Light Penetration (10)	4
Left Riparian Score (5)	3
Right Riparian Score (5)	2
Total Habitat Score (100)	**78**

Site Photograph

Substrate Cobble, boulder, bedrock

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/27/09	2009-17	15	52	Good
06/01/04	2004-62	16	56	Good

Most Abundant Species 2009 Mottled Sculpin (53%)

Exotic Species 2009 None

Species Change Since Last Cycle

Losses -- Tuckasegee Darter, Black Redhorse, Rainbow Trout. **Gains** -- Mirror Shiner, Western Blacknose Dace. All species gained or lost were represented by 1-4 individuals/species; Rainbow Trout represented only by young-of-year and excluded from the sample.

Data Analysis

Watershed -- located in east-central Jackson County where it drains the Great Balsam Mountains; tributary to the Tuckasegee River; no municipalities within the watershed. **Habitat** -- lower one-third of the reach has hay field and a road along its right and left shorelines, respectively, but is protected further upstream by a narrow forested buffer; narrow riparian zones provide minimal shading; instream habitats consist of riffles, runs, and chutes with good side pools. **Water Quality** -- pH in 2004 and 2009 slightly less than the water quality standard of 6.0 s.u.; specific conductance in 2004 and 2009 was 21 and 19 µS/cm, respectively. **2009** -- slightly lower total species and darter diversities than expected; all other metric scores were comparable to reference site values (i.e., score = 5). **2004 & 2009** -- 18 species known from the site, including 9 species of cyprinids, 4 intolerant species, but only 3 species of darters, and the Smoky Dace (Special Concern); dominant species is the Mottled Sculpin (37% and 53%); no tolerant species have ever been collected at the site; no evidence of reproducing populations of trout at this lowermost site; no appreciable change in the fish community, instream and riparian habitats, or water quality between assessment periods.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
CULLOWHEE CR	**SR 1545**	**04/27/09**	**GF13**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
JACKSON	2	06010203	35.29666667	-83.18111111	2-79-31a	Southern Crystaline Ridges & Mtns.

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;Tr	19.5	2110	10	0.4	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	75	0	0	25 (school yard)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	12.1
Dissolved Oxygen (mg/L)	8.9
Specific Conductance (µS/cm)	30
pH (s.u.)	6.2

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	11
Pool Variety (10)	10
Riffle Habitat (16)	16
Erosion (7)	7
Bank Vegetation (7)	5
Light Penetration (10)	5
Left Riparian Score (5)	3
Right Riparian Score (5)	5
Total Habitat Score (100)	**85**

Site Photograph

Substrate Cobble, gravel, silt

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/27/09	2009-16	17	50	Good
06/02/04	2004-63	16	46	Good-Fair

Most Abundant Species 2009 Mottled Sculpin (60%)

Exotic Species 2009 Brown Trout, Rainbow Trout

Species Change Since Last Cycle **Losses** -- none. **Gains** -- Tuckasegee Darter, 1 individual.

Data Analysis

Watershed -- drains southwestern Jackson County; tributary to the Tuckasegee River; no municipalities in the upstream watershed. **Water Quality** -- specific conductance in 2004 and 2009 was 33 and 30 µS/cm, respectively. **Habitat** -- higher quality riffles than in 2004; increased left bank stability and quality of the riparian zone has improved since 2004 by becoming more stable and densely vegetated; fairly open canopy; debris dams trapping much of the finer sediments in the upper one-third of the reach; instream habitats of riffles, runs, and deep snag pools. **2009** -- ~ 1.7 times more fish collected in 2009 than in 2004 (648 *vs.* 391), primarily Mottled Sculpin (387 *vs.* 190); very slight increase in darter diversity and a lower percentage of tolerant fish were the reasons for the slight increase in the NCIBI score and rating; Hatchery Supported Trout waters, one stocked Brook Trout collected (360 mm TL), all other Brown Trout and Rainbow Trout were wild; slightly lower cyprinid and darter diversities and percentage of omnivores+herbivores than expected; all other metric scores were comparable to reference site values (i.e., score = 5). **2004 & 2009** -- 17 species known from the site, including 7 species of cyprinids, but only 2 species of darters; dominant species is the cold-cool water indicator Mottled Sculpin (49% and 60%); stream is supporting its supplemental designation as trout waters (Tr). No appreciable change in fish community or water quality between assessment periods.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
SAVANNAH CR	**NC 116**	**04/28/09**	**GF23**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
JACKSON	2	06010203	35.3375	-83.23694444	2-79-36	Southern Crystaline Ridges & Mtns.

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;Tr	36.5	2025	11	0.6	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	50	25	25	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	12.1
Dissolved Oxygen (mg/L)	10.2
Specific Conductance (µS/cm)	29
pH (s.u.)	5.4

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	3
Instream Habitat (20)	18
Bottom Substrate (15)	12
Pool Variety (10)	6
Riffle Habitat (16)	15
Erosion (7)	4
Bank Vegetation (7)	3
Light Penetration (10)	4
Left Riparian Score (5)	1
Right Riparian Score (5)	2
Total Habitat Score (100)	**68**

Site Photograph

Substrate Cobble, boulder, rip/rap

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/28/09	2009-18	18	58	Excellent
06/02/04	2004-64	15	50	Good

Most Abundant Species 2009 Mottled Sculpin (36%)

Exotic Species 2009 Brown Trout, Rainbow Trout

Species Change Since Last Cycle

Losses -- none. **Gains** -- White Sucker, Brown Trout, Smallmouth Bass. All species gained were represented by 1 or 2 individuals/species.

Data Analysis

Watershed -- drains northwestern Jackson County, paralleling much of NC 116 and US 23/441 all the way to the creek's headwaters; no municipalities within the watershed; tributary to the Tuckasegee River. **Habitat** -- same as in 2004; minimal canopy; the riparian zones were in pasture, and an attempt had been made to stabilize portions of the banks with rip/rap and concrete slabs; swift & deep riffles, chutes, runs, and plunges. **Water Quality** -- pH in 2009 was less than the water quality standard of 6.0 s.u.; specific conductance in 2004 and 2009 was 28/29 µS/cm. **2009** -- although the creek is not Hatchery Supported Trout Waters in its lower reaches, one stocked Brown Trout (275 mm TL) was collected; all other Brown Trout and Rainbow Trout were wild; increased diversity and a slightly more balanced trophic structure in 2009 accounted for its Excellent rating. **2004 & 2009** -- 18 species known from the site, including 8 species of cyprinids and 4 intolerant species, but only 2 species of darters; dominant species is the Mottled Sculpin (39% and 36%); only one tolerant fish (White Sucker) has ever been collected at the site; no evidence of reproducing populations of trout at this lowermost site.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
TWENTY MILE CR	**NC 28**	**GB2**	**08/05/10**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
SWAIN	2	06010204	35.466944	-83.877500	2-178-(4)	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; TR, HQW	15	1300	9	0.2

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	100	---	---	---	---

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

Water Quality Parameters

Temperature (°C)	22.5
Dissolved Oxygen (mg/L)	7.8
Specific Conductance (µS/cm)	13
pH (s.u.)	5.3

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	20
Bottom Substrate (15)	14
Pool Variety (10)	9
Riffle Habitat (16)	15
Bank Erosion (7)	7
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	4
Right Riparian Score (5)	5
Total Habitat Score (100)	96

Site Photograph

Substrate mostly cobble (35), boulder (25) and gravel (25)

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/05/10	11091	---	41	---	2.06	Excellent
08/04/04	9459	---	29	---	1.82	Good

Taxonomic Analysis

A total increase of 12 EPT was recorded in 2010 over 2004 sampling results. All three orders saw an increase in richness but the caddisflies increased the most (E - 4, P - 2, T - 6). Additions to the caddisflies were 4 net-spinning species and included the relatively uncommon *Ceratopsyche macleodi.* Additional caddisfly taxa recorded included *Ceraclea ancylus* , *Rhyacophila atrata* , and *Goera* spp. Baetid mayflies help contribute to the increase seen in mayfly richness in 2010 and included only the fifth NC record of *Acentrella barbarae* , a mayfly originally described from GSMNP. An increase in the number of flat-headed mayflies was also see with both *Heptagenia marginalis* and *Leucrocuta* spp being collected. The stonefly fauna remained stable from 2009 and included *Perlesta* spp, a stonefly that typically emerges near the end of July.

Data Analysis

Twenty Mile Creek lies within and drains North Carolina's western portion of Great Smoky Mountain National Park (GSMNP) and ultimately joins the Little Tennessee River (Cheoah Reservoir) downstream of Fontana Dam. It has an undeveloped (hiking trails aside) and forested catchment. The habitat of this picturesque stream is as expected for a stream in a natural setting and consists of a series of cascades, riffles, and plunge pools. 2010 marks only the second sampling of this stream. Typical of undisturbed mountain streams, the specific conductance was very low. Also, while the EPT biotic index was higher than in 2004, it still indicates a very intolerant EPT community. Species richness was much higher than in 2004 and may be partially attributed to the presence of woody debris and microhabitat which was mostly absent in 2004. With such a high gradient it is likely that rain events would transport woody debris and further lead to increased scour which would reduce benthic populations. Twenty Mile Creek garnered its first Excellent rating.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
CHEOAH R	OFF SR 1138 UPS MOUNTAIN CR	GB133	07/27/09	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
GRAHAM	4	06010204	35.331944	-83.807778	2-190-(3.5)	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C;Tr	55.0	1960	12	0.3

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	80	0	0	20

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Town of Robbinsville WWTP	NC0025879	0.63

Water Quality Parameters

Temperature (°C)	20.8
Dissolved Oxygen (mg/L)	7.0
Specific Conductance (µS/cm)	40
pH (s.u.)	6.3
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	19
Bottom Substrate (15)	8
Pool Variety (10)	6
Riffle Habitat (16)	12
Bank Erosion (7)	6
Bank Vegetation (7)	6
Light Penetration (10)	7
Left Riparian Score (5)	4
Right Riparian Score (5)	4
Total Habitat Score (100)	77

Site Photograph

Substrate mixture of bedrock, boulder, rubble, gravel and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/27/09	10779	93	40	4.18	3.17	Good
07/19/04	9437	84	38	3.96	3.15	Good
08/12/99	7969	89	48	3.43	2.77	Excellent

Taxonomic Analysis

Both EPT and overall taxa lists from 1999, 2004 and 2009 were very consistent. Most of the abundant taxa found in 2009 were abundant in previous samples (e.g. the mayflies *Baetis flavistriga* , *B. intercalaris* and *Epeorus vitreus* ; the stoneflies *Lecutra* spp and *Paragnetina immarginata; a* nd the caddisflies *Glossosoma spp* , *Ceratopsyche sparna, Cheumatopsyche spp* and *Dolophilodes spp*).

Data Analysis

This section of the Cheoah River rated Good in 2009, the same rating as in 2004. This site is located in one of only two free-flowing sections of the Cheoah River. There is little evidence that the WWTP is significantly suppressing benthic macroinvertebrates in this reach as a sample upstream of the WWTP did not differ from a downstream sample in 1994. Moreover, approximately half a mile upstream of the 2009 sampling location are two historical sites spanning five samples. These data originate in 1983 and suggest water quality in this reach (both upstream and downstream of the WWTP) is Good and occasionally Excellent.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
TULULA CR	**SR 1275**	**GB22**	**07/28/09**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
GRAHAM	4	06010204	35.320556	-83.802500	2-190-2-(0.5)	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation	Stream Width (m)	Stream Depth (m)
WS-III; Tr	28.6	2000	9	0.2

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	25	50	25	0	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none		

Water Quality Parameters

Temperature (°C)	18.5
Dissolved Oxygen (mg/L)	7.8
Specific Conductance (µS/cm)	40
pH (s.u.)	6.2

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	19
Bottom Substrate (15)	8
Pool Variety (10)	4
Riffle Habitat (16)	16
Bank Erosion (7)	5
Bank Vegetation (7)	6
Light Penetration (10)	7
Left Riparian Score (5)	2
Right Riparian Score (5)	2
Total Habitat Score (100)	73

Site Photograph

Substrate Boulder, cobble, gravel and sand

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/28/09	10780	88	39	3.77	2.70	Good
07/19/04	9436	60	31	3.23	2.73	Good
08/12/99	7968	85	40	3.57	2.69	Excellent
07/25/94	6615	78	34	3.81	3.01	Good

Taxonomic Analysis

With the exception of the 1999 Excellent bioclassification, the overall trend in the invertebrate data suggest Good water quality in this catchment. Indeed, there are numerous intolerant taxa that have been present from each of the four collections and include the mayflies *Epeorus vitreus* , *Leucrocuta spp* , *Paraleptophlebia spp* , the caddisflies *Brachycentrus spinae* , *Lepidostoma spp* , *Rhyacophila fuscula* , as well as the long-lived stoneflies *Acroneuria abnormis* and *Paragnetina immarginata* .

Data Analysis

In general, the benthic macroinvertebrate data suggest stable and Good to Excellent water quality in this catchment since the initial 1994 collection although the 2009 sample was borderline Excellent and produced the second highest EPTs recorded. Indeed had just one more EPT taxa been collected this site would have received an Excellent bioclassification in 2009.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
SNOWBIRD CR	**SR 1120**	**GB25**	**07/28/09**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
GRAHAM	4	06010204	35.289167	-83.900278	2-190-9-(15.5)	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C;Tr	16.9	2220	7	0.2

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	100	0	0	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

Water Quality Parameters

Temperature (°C)	17.6
Dissolved Oxygen (mg/L)	6.9
Specific Conductance (µS/cm)	10
pH (s.u.)	4.9
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	19
Bottom Substrate (15)	13
Pool Variety (10)	9
Riffle Habitat (16)	16
Bank Erosion (7)	7
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	96

Site Photograph

Substrate mostly boulder and rubble with some gravel and sand

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/28/09	10781	---	52	---	2.13	Excellent
07/20/04	9442	---	48	---	2.06	Excellent
08/12/99	7970	---	52	---	2.57	Excellent
06/20/90	5320	---	49	---	1.80	Excellent

Taxonomic Analysis

A diverse and pollution intolerant EPT community continues to populate Snowbird Creek. Overall there has been little change in the benthic community composition from the first sample collected here, in 1990. However, two noticeable differences in this years sample were the absences of the caddisfly *Ceratopsyche sparna* (abundant in 1990, 1999 and 2004) and the mayfly *Maccaffertium ithaca* (abundant in 1990, common in 1999, 2004). Nevertheless, Snowbird Creek contains several highly pollution sensitive taxa such as the caddisflies *Apatania* spp, *Ceratopsyche alhedra* and the mayflies *Ephmerella crenula* and *Drunella allegheniensis* .

Data Analysis

Snowbird Creek rated Excellent in 2009, the same rating it received in each of its three prior samples. The very consistent Excellent bioclassifications are indicative of the minimally disturbed forested watershed present here.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
TULULA CR	**SR 1260**	**04/29/09**	**GF29**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
GRAHAM	4	06010204	35.30722222	-83.79444444	2-190-2-(0.5)	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
WS-III,Tr	27.4	2035	11	0.5	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	80	10	10	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	14.5
Dissolved Oxygen (mg/L)	10.1
Specific Conductance (µS/cm)	25
pH (s.u.)	5.6

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	13
Pool Variety (10)	8
Riffle Habitat (16)	16
Erosion (7)	4
Bank Vegetation (7)	6
Light Penetration (10)	7
Left Riparian Score (5)	5
Right Riparian Score (5)	3
Total Habitat Score (100)	**85**

Site Photograph

Substrate Cobble, boulder, bedrock

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/29/09	2009-22	15	48	Good
06/04/04	2004-69	14	46	Good-Fair

Most Abundant Species 2009 Central Stoneroller (36%)

Exotic Species 2009 Rainbow Trout, Redbreast Sunfish

Species Change Since Last Cycle

Gains -- Black Redhorse, Redbreast Sunfish, Bluegill. **Losses** -- Creek Chub, Tangerine Darter. All species gained or lost were represented by 1 or 2 individuals/species.

Data Analysis

Watershed -- drains the southeastern corner of Graham County; US 129 and a railroad parallel the creek throughout its length. **Habitats** -- slick rocks, plunge pools in mid-channel, bluegreen algal mats covering many of the rocks; most of the habitats were of high quality, except at the upper reach along the right shoreline where there was no canopy and the riparian zone was a manicured residential lawn. **Water Quality** -- pH less than the water quality standard of 6.0 s.u. in 2004 and 2009. **2009** -- total species richness was slightly lower than expected, especially among darters (n= 2) and minnows (n=6); very slight decline in the percentage of omnivores+herbivores from 51% to 49%) resulted in the very slight increase in NCIBI score and rating; Hatchery Supported Trout Waters, four stocked Brook Trout collected (200-291 mm TL); Rainbow Trout were all wild (n=28). **2004 & 2009** -- the presence of bluegreen algal mats and the percentages of omnivores+herbivores (i.e., Central Stoneroller and River Chub) which were much greater than expected continued to indicate possible upstream straight-piping or nonpoint-source erosion contributions of nutrients; 17 species known from the site including 7 species of minnows and 3 species of darters; dominant species have been Central Stoneroller (31% and 36%) and Mottled Sculpin (24% and 26%); stream is supporting its supplemental designation as trout waters (Tr).

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
SWEETWATER CR	**SR 1214**	**04/29/09**	**GF36**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
GRAHAM	4	06010204	35.324966	-83.79335	2-190-3-(0.5)	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
WS-III;Tr	13.6	1995	7	0.5	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	40	10	50	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	13.4
Dissolved Oxygen (mg/L)	10.0
Specific Conductance (µS/cm)	32
pH (s.u.)	5.8

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	19
Bottom Substrate (15)	10
Pool Variety (10)	8
Riffle Habitat (16)	16
Erosion (7)	7
Bank Vegetation (7)	6
Light Penetration (10)	9
Left Riparian Score (5)	5
Right Riparian Score (5)	4
Total Habitat Score (100)	**89**

Site Photograph

Substrate Bedrock shelves, cobble, boulder

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/29/09	2009-21	13	52	Good

Most Abundant Species 2009 Mottled Sculpin (34%)

Exotic Species 2009 Rainbow Trout

Species Change Since Last Cycle **N/A**

Data Analysis

This is the first fish community sample collected at this site. **Watershed** -- drains east-central Graham County; NC 143 parallels much of the creek; no municipalities within the watershed; tributary to the Cheoah River. **Habitats** -- ledges and plunge pools, riffles, runs, poor quality riparian zones in terms of invasive plants and trash from the highway; swift flow and slippery rocks. **Water Quality** -- pH less than the water quality standard of 6.0 s.u. **2009** -- total species richness was slightly lower than expected, especially among darters (n=2) and minnows (n=7); other abundant species included River Chub (20%) and Central Stoneroller (16%); very low percentage of tolerant fish (1%); intolerant species included Rainbow Trout, Rock Bass, and Greenfin Darter; stream is supporting its supplemental designation as trout waters (Tr); and water quality is generally Good.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
YELLOW CR	SR 1242	04/28/09	GF37	Not Rated

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
GRAHAM	4	06010204	35.417284	-83.874636	2-190-29	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;Tr	12.7	1830	6	0.4	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	100	0	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	16.2
Dissolved Oxygen (mg/L)	9.1
Specific Conductance (µS/cm)	19
pH (s.u.)	5.6

Water Clarity	Clear, tannin stained

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	8
Pool Variety (10)	6
Riffle Habitat (16)	10
Erosion (7)	7
Bank Vegetation (7)	6
Light Penetration (10)	10
Left Riparian Score (5)	4
Right Riparian Score (5)	5
Total Habitat Score (100)	**79**

Site Photograph

Substrate Sand, cobble, gravel, bedrock, silt

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/28/09	2009-20	6	---	Not Rated

Most Abundant Species 2009 Creek Chub (46%)

Exotic Species 2009 Rainbow Trout, Brown Trout

Species Change Since Last Cycle **N/A**

Data Analysis

This is the first fish community sample collected at this site. **Watershed** -- drains northern Graham County; no municipalities within the watershed; tributary to the by-passed reach of the Cheoah River between its confluence with Calderwood Lake and Lake Santeetlah. **Habitats** -- Sand Hills-like with tannin stained water, a substrate primarily of sand, wide forested riparian zones of American Holly and Mountain Laurel, and *Fissidens* common on coarse woody debris; side pools, runs, and riffles; gradient changes dramatically ~ 0.5 miles below the site with steeper gradients and waterfalls. **Water Quality** -- low conductivity; pH less than the water quality standard of 6.0 s.u. **2009** -- naturally depauperate (species diversity and abundance) community; fewest fish collected than at any other site in 2009 (n=186); Mottled Sculpin and darters absent; Hatchery Supported Trout Waters; no reproducing populations of trout were found, but no evidence of water quality impairment.