RIVER AND STREAM ASSESSMENTS

CAPE FEAR RIVER HUC 03030002– HAW RIVER
Specific site summaries of the 27 benthic macroinvertebrate and fish community sites may be found at this link: **03030002**.

CAPE FEAR RIVER HUC 03030003– DEEP RIVER
Specific site summaries of the 17 benthic macroinvertebrate and fish community sites may be found at this link: **03030003**.

CAPE FEAR RIVER HUC 03030004– LITTLE RIVER-CAPE FEAR RIVER
Specific site summaries of the 25 benthic macroinvertebrate and fish community sites may be found at this link: **03030004**.

CAPE FEAR RIVER HUC 0303005 – LOWER CAPE FEAR RIVER
Specific site summaries of the 6 benthic macroinvertebrate and fish community sites may be found at this link: **03030005**.

BLACK RIVER HUC 03030006 – BLACK RIVER
Specific site summaries of the 5 benthic macroinvertebrate and fish community sites may be found at this link: **03030006**.

CAPE FEAR RIVER HUC 03030007– NORTHEAST CAPE FEAR RIVER
Specific site summaries of the 11 benthic macroinvertebrate and fish community sites may be found at this link: **03030007**.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
HAW R	**NC 150**	**BB5**	**07/15/08**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
ROCKINGHAM	1	03030002	36.266667	-79.604167	16-(1)c	Northern Inner Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C;NSW	158	645	9	0.3

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	70	0	30	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Willow Oak Mobile Home Park	NC0060259	0.0175
Pleasant Ridge WWTP	NC0065412	0.0235

Water Quality Parameters

Temperature (°C)	25.3
Dissolved Oxygen (mg/L)	7.8
Specific Conductance (µS/cm)	115
pH (s.u.)	6.8

Water Clarity	turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	7
Bottom Substrate (15)	3
Pool Variety (10)	9
Riffle Habitat (16)	2
Left Bank Stability (7)	5
Right Bank Stability (7)	5
Light Penetration (10)	7
Left Riparian Score (5)	3
Right Riparian Score (5)	2
Total Habitat Score (100)	48

Site Photograph

Substrate primarily sand, some silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/15/08	10494	---	20	---	4.82	Good-Fair
07/06/98	7621	---	17	---	4.92	Good-Fair

Taxonomic Analysis

Two more mayfly taxa and one more caddisfly taxon were collected in 2008 than in 1998. Taxa common or abundant in 2008 and not collected in 1998 were *Pseudocloeon propinquum, Tricorythodes, Triaenodes perna/helo,* and *Polycentropus* . Both *Maccaffertium integrum* and *Hydropsyche venularis* were common in 1998 and uncollected in 2008.

Data Analysis

The site is seven miles SSE of Reidsville in the southeast corner of Rockingham County, and directly above the oufall for the City of Reidsville WWTP. A portion of Reidsville is within the catchment, as are portions of three suburban towns northwest of Greensboro (Summerfield, Oak Ridge, and Stokesdale).

There was little change in the EPT BI between the two basinwide sampling events at the site. Three more EPT taxa were collected during the most recent sampling event at the site; an additional taxon would have resulted in a classification of Good for 2008.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
HAW R	**NC 87**	**BB163**	**07/15/08**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
ALAMANCE	1	03030002	36.182500	-79.509444	16-(1)c	Southern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C;NSW	185	590	20	0.3

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

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
City of Reidsville WWTP	NC0024881	7.5
Altamahaw/Ossipee Elementary School	NC0045161	0.012

Water Quality Parameters

Temperature (°C)	25.5
Dissolved Oxygen (mg/L)	9.0
Specific Conductance (µS/cm)	211
pH (s.u.)	7.6

Water Clarity	turbid

Habitat Assessment Scores (max)

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

Site Photograph

Substrate primarily boulder and cobble; some gravel, silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/15/08	10491	59	14	6.31	5.79	Good-Fair
09/15/03	9319	57	15	6.29	5.40	Good-Fair
07/07/98	7623	57	17	6.69	5.98	Fair
07/13/93	6239	69	22	5.85	5.12	Good-Fair
07/09/90	5335	63	12	7.13	5.58	Fair

Taxonomic Analysis

The standard for EPT richness during summer sampling since 1987 was set in 1993 when 22 EPT taxa were collected. *Acroneuria abnormis, Leucotrichia pictipes* and *Triaenodes ignitus* were either common or abundant in that year but have been uncollected during subsequent sampling efforts. Several taxa that were rare in the 1993 sample have been since uncollected as well: *Ceratopsyche sparna, Ironoquia punctatissima,* and *Nyctiophylax moestus* .

Data Analysis

The site is 7.5 miles northwest of downtown Burlington in northwest Alamance County, and directly downstream of a low-head dam (Glen Raven Mills Dam). There are plans by the Alamance County Recreation and Parks Department to develop the area around the site as an access point for paddlers. A portion of Reidsville is within the catchment, as are portions of three suburban towns northwest of Greensboro (Summerfield, Oak Ridge, and Stokesdale).

Since 1993 the number of EPT taxa collected has declined with each successive sampling event. However, NCBI values have not shown such a clear trend, though all three values since 1993 are higher than the value for 1993. Agriculture and residential areas are sources for impact to the stream at the site.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
HAW R	NC 54	BB22	07/14/08	GOOD-FAIR

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Alamance	2	03030002	36.048611	-79.367222	16-(1)e	Southern Outer Piedmont

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; NSW	603.0	520	40	0.4

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	20	50	0	30 (fallow fields, parking)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Burlington East Side WWTP	NC0023868	12

Water Quality Parameters

Temperature (°C)	27.3
Dissolved Oxygen (mg/L)	8.5
Specific Conductance (µS/cm)	244
pH (s.u.)	7.1
Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	14
Bottom Substrate (15)	10
Pool Variety (10)	7
Riffle Habitat (16)	6
Left Bank Stability (7)	7
Right Bank Stability (7)	7
Light Penetration (10)	3
Left Riparian Score (5)	3
Right Riparian Score (5)	3
Total Habitat Score (100)	65

Site Photograph

Substrate Bedrock with equal mix of boulder, cobble, gravel and sand, silty

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/14/08	10489	68	18	6.30	5.48	Good-Fair
07/10/98	7663	73	21	6.10	5.34	Good-Fair
07/12/93	6233	64	19	6.12	5.39	Good-Fair
08/08/89	5051	58	14	6.16	5.56	Good-Fair
07/09/87	4089	74	20	6.29	5.50	Good-Fair

Taxonomic Analysis

The macroinvertebrate community has remained stable over the course of the last 15 years with all metrics staying virtually the same with only very small differences. Indeed, even the EPT community has remained mostly constant with a slight drop in richness and abundance from 1998 to 2008 (21 vs. 18 and 135 vs. 105, respectively). A few taxa previously collected were not found in 2008 such as the caddisflies *Nectopsyche exquisita* , *Leucotrichia pictipes* , and *Cyrnellus fraternus* and the mayfliy *Caenis* . No stoneflies have been collected in this portion of the Haw River since *Acroneuria abnormis* was collected in 1987.

Data Analysis

Sampling of benthos in 2003 was not performed due to continuous high flows. This middle segment of the Haw River has only one major NPDES permitted discharger upstream, although it drains the major urban areas of northern Greensboro and the entirety of Burlington. Despite growth of these cities, water quality has remained consistantly Good-Fair since 1987 suggesting some input of higher quality waters from the northern portion of the watershed. Habitat at this site was deficient particularly in regards to poor quality riffles with a high degree of embeddedness. Siltation was also of concern but is typical in urbanized rivers.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
HAW R	**SR 1005**	**BB220**	**07/23/08**	**GOOD**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Alamance	4	03030002	35.895000	-79.258333	16-(1)e	Carolina Slate Belt

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; NSW	1042.0	400	50	0.3

	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)
Burlington East Side WWTP; Graham WWTP	NC0023868; NC0021211	12; 3.5

Water Quality Parameters

Temperature (°C)	30.2
Dissolved Oxygen (mg/L)	7.0
Specific Conductance (µS/cm)	312
pH (s.u.)	7.4

Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	10
Pool Variety (10)	9
Riffle Habitat (16)	10
Left Bank Stability (7)	6
Right Bank Stability (7)	6
Light Penetration (10)	2
Left Riparian Score (5)	4
Right Riparian Score (5)	4
Total Habitat Score (100)	72

Site Photograph

Substrate Bedrock with boulder and cobble, some gravel and sand; silty

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/23/08	10516	72	25	5.49	4.81	Good
07/07/98	7642	65	20	6.17	4.77	Good-Fair
07/28/93	6318	60	18	5.92	5.28	Good-Fair
07/09/90	5334	71	20	6.12	5.02	Good-Fair
08/08/89	5052	60	18	6.23	5.43	Good-Fair

Taxonomic Analysis

EPT richness increased by 25 % in 2008 over the last sample collection made in 1998. This increase was driven by a substantial increase in mayfly species (8 in 1998 to 13 in 2008) particularly heptageniid mayflies with *Leucrocuta* and *Maccaffertium lenati* being collected at this site for the first time. The caddisflies *Protoptila* , *Oecetis nocturna* , and *Cyrnellus fraternus* were also collected for the first time at SR 1005. Despite a slight rise in the tolerance of the EPT community, the overall tolerance of the benthos decreased significantly due to lower richness and abundance of tolerant midges and oligochaetes.

Data Analysis

This site lies on the Alamance-Orange County line and drains all of Alamance County and the entirety of Burlington and Graham. Upstream dischargers contribute to the elevated specific conductance of the waters particularly in times of reduced flow. Sampling in 2008 resulted in an increase in the bioclassification from the historically consistant rating of Good-Fair to Good indicating a slight increase in water quality. Water levels were down from previous years and habitat score increased from a low of 56 in 1998 to the current score of 72. Also, siltation is a chronic problem in areas of slow flow and pools of this river.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
HAW R	**US 64**	**BB443**	**07/23/08**	**EXCELLENT**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Chatham	4	03030002	35.731111	-79.106111	16-(36.7)	Carolina Slate Belt

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-IV; NSW , CA	1296.0	250	50	0.3

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

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Burlington East Side WWTP; Graham WWTP	NC0023868; NC0021211	12; 3.5

Water Quality Parameters

Temperature (°C)	27.2
Dissolved Oxygen (mg/L)	5.8
Specific Conductance (µS/cm)	277
pH (s.u.)	7.0
Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	12
Pool Variety (10)	10
Riffle Habitat (16)	7
Left Bank Stability (7)	7
Right Bank Stability (7)	7
Light Penetration (10)	3
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	77

Site Photograph

Substrate Bedrock with boulder and cobble; silty

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/23/08	10515	82	32	5.22	4.25	Excellent
07/10/98	7651	65	25	5.41	4.40	Good
07/29/93	6319	63	24	5.19	4.43	Good
07/17/90	5382	60	24	5.47	4.30	Good
07/13/88	4625	81	28	6.02	4.71	Good

Taxonomic Analysis

The significant increase in EPT taxa in 2008 from 1998 was due to an increase in mayfly and caddisfly richness and led to a decrease in the Biotic Index. Three mayflies, *Callibaetis* , *Anthopotamus* , and *Serratella deficiens* , as well as two caddisflies *Neophylax oligius* and *Polycentropus* had never before been collected at this site until 2008. Tolerant taxa such as odonates, midges and oligochaetes either increased or remained essentially unchanged in richness and abundance providing evidence that the EPT community has become more intolerant over the past 10 years.

Data Analysis

US 64 is the last site on the Haw River before it enters Jordan Lake reservoir and is composed of multiple channels. Habitat is good at 77 with decent riparian and stable banks. However, siltation continues to be a problem in the Haw River. Water quality has improved to Excellent for the first time since sampling on the Haw River began in 1983 and is due, in part, to the highest EPT richness ever recorded at this site. The Haw River at US 64 was not sampled in 2003 due to high summer flows.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
TROUBLESOME CR	SR 2422	BB396	07/16/08	Good-Fair

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
ROCKINGHAM	1	03030002	36.307222	-79.738056	16-6-(0.3)	Northern Inner Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-III;NSW	31	695	6	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

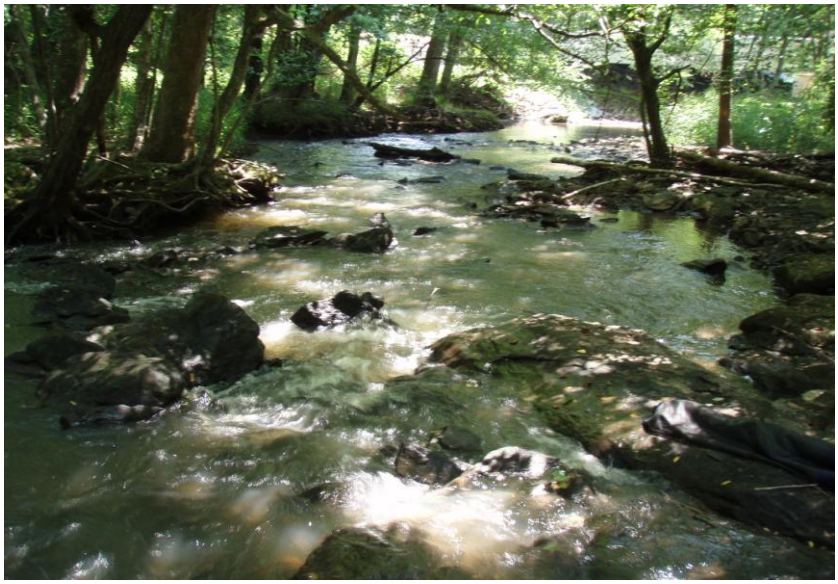
Temperature (°C)	23.0
Dissolved Oxygen (mg/L)	8.1
Specific Conductance (µS/cm)	100
pH (s.u.)	7.2

Water Clarity: slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	13
Bottom Substrate (15)	12
Pool Variety (10)	10
Riffle Habitat (16)	15
Left Bank Stability (7)	5
Right Bank Stability (7)	5
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	84

Site Photograph



Substrate: mix of bedrock, boulder, cobble; some sand, silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/16/08	10496	---	17	---	4.58	Good-Fair
04/09/02	8685	58	17*	5.89*	4.86	Good-Fair
07/06/98	7620	---	14	---	4.86	Good-Fair
07/14/93	6244	---	18	---	5.12	Good-Fair

* values corrected for seasonality

Taxonomic Analysis

EPT taxa collected at the site for the three summer EPT sampling events in 1993, 1998, and 2008 were similar. The only notable absence in 2008 was *Hexagenia* , which was abundant and common in 1993 and 1998 respectively. A few taxa were collected for the first time at the site in 2008 (all were rare in the sample): *Paragnetina kansesis, Triaenodes perna/helo,* and *Pycnopsyche.*

Data Analysis

The site is 5.5 miles southwest of downtown Reidsville in southern Rockingham County, and 1.2 stream-miles above Lake Reidsville. Sampling in July 2008 was done above the road crossing; the bridge was being rebuilt by DOT. Landcover includes forest, agriculture, and suburban residential areas.

No long-term trends in water quality are exhibited by the benthic community between 1993 and 2008.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
L TROUBLESOME CR	SR 2600	BB400	07/16/08	Good-Fair

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
ROCKINGHAM	1	03030002	36.282500	-79.611944	16-7b	Northern Inner Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C;NSW	12	655	4	0.2

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	30	20	50	0

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

Water Quality Parameters

Temperature (°C)	21.3
Dissolved Oxygen (mg/L)	8.2
Specific Conductance (µS/cm)	119
pH (s.u.)	6.8

Water Clarity: slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	12
Bottom Substrate (15)	3
Pool Variety (10)	4
Riffle Habitat (16)	5
Left Bank Stability (7)	6
Right Bank Stability (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	3
Right Riparian Score (5)	3
Total Habitat Score (100)	58

Site Photograph

Substrate: sand dominant; some silt, gravel

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/16/08	10495	77	20	6.47	5.59	Good-Fair
08/26/03	9280	---	12	---	5.83	Fair
07/09/01	8465	55	10	6.85	5.58	Fair
04/11/01	8407	62	12*	6.70*	4.66	Fair
08/22/00	8175	58	12	6.70	5.61	Fair
07/06/98	7618	42	3	7.60	7.02	Poor
07/14/93	6243	41	3	7.22	7.23	Poor

* values corrected for seasonality

Taxonomic Analysis

The most EPT taxa collected at the site by the BAU since 1993 was in 2008. All three insect orders were represented by the greatest number of taxa for summer sampling (i.e. excepting the April 2001 sample which is influenced by seasonality). EPT taxa collected for the first time at the site were: *Baetis flavistriga, Isonychia, Neoperla, Paragnetina fumosa, Phylocentropus, Hydroptila, Oecetis nocturna,* and *Triaenodes helo/perna.*

Data Analysis

The site is six miles SSE of downtown Reidsville in the southeast corner of Rockingham County. The stream segment is on the 303(d) list for fecal coliform and impaired biological integrity. The site is about three miles downstream of the former outfall for Reidsville WWTP, which was moved to discharge into Haw River in November 1998.

A comparison of EPT Richnes and NCBI values before and after removal of the WWTP discharge show clear improvements. In particular the high EPT richness value in 2008 relative to other sampling events is suggestive of improving conditions at the site, as is the lower NCBI value.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
STINKING QUARTER CR	SR 1136/1131	BB505	03/11/09	Good-Fair

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Orange	3	03030002	36.002630	-79.467680	16-9-8	Southern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; NSW	81.0/62.8	620	8	0.3

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	30	70	0	

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

Water Quality Parameters

Temperature (°C)	15.1
Dissolved Oxygen (mg/L)	11.7
Specific Conductance (µS/cm)	96
pH (s.u.)	6.7

Water Clarity: Clear.

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	16
Bottom Substrate (15)	3
Pool Variety (10)	4
Riffle Habitat (16)	5
Left Bank Stability (7)	4
Right Bank Stability (7)	4
Light Penetration (10)	10
Left Riparian Score (5)	1
Right Riparian Score (5)	4
Total Habitat Score (100)	55

Site Photograph

Substrate: Mostly sand with small amounts of cobble, gravel and silt.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/11/09	10643	---	20	---	4.46	Good-Fair
11/21/03	9312	---	21	---	4.86	Good-Fair
07/07/03	9159	---	13	---	5.59	Fair
07/10/98	7665	---	23	---	5.08	Good
07/12/93	6235	---	16	---	5.04	Good-Fair

Taxonomic Analysis

Baetis flavistriga , *B. intercalaris* and *B. pluto* were present in the November 2003 collection but not in the 2009 collection, whereas *Heterocloeon amplum* were present in the 2009 collection but not in the November 2003 collection. Other than this minor shift in Baetid taxa and the site being moved upstream, the November 2003 and 2009 benthological communities were similar.

Data Analysis

Stinking Quarter Creek is a large tributary to the Haw River. Due to deep water and no flow at the original basin site at SR 1136, this site was moved upstream to SR 1131. In order to find a site that was wadable and had sufficient flow, the site had to be moved several miles upstream and above the confluences of Little Alamance Creek and Rock Creek. This reduced the drainage area from 81.0 sq mi at the SR 1136 location to xx sq mi at the new location. This site received Good-Fair ratings in 2009, November 2003, and 1993. A Good rating in 1998 and a Fair rating in July 2003. The Fair rating in 2003 was most likely due to effects from the 2002 drought and is supported by the absence of edge species in the sample.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
REEDY FK	**SR 2128**	**BB362**	**07/16/08**	**GOOD-FAIR**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Guilford	2	03030002	36.172778	-79.953333	16-11-(1)a	Northern Inner Piedmont

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-III; NS 08/03/92: W	20.5	785	4	0.1

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	50	20	0	30 (fallow fields)

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

Water Quality Parameters

Temperature (°C)	22.8
Dissolved Oxygen (mg/L)	8.2
Specific Conductance (µS/cm)	111
pH (s.u.)	7.0

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	10
Bottom Substrate (15)	3
Pool Variety (10)	4
Riffle Habitat (16)	3
Left Bank Stability (7)	5
Right Bank Stability (7)	5
Light Penetration (10)	10
Left Riparian Score (5)	3
Right Riparian Score (5)	5
Total Habitat Score (100)	53

Site Photograph

Substrate	Sand; some silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/16/08	10497	---	16	---	4.29	Good-Fair
07/10/03	9189	---	15	---	4.68	Good-Fair
07/08/98	7631	---	19	---	4.07	Good-Fair
07/14/93	6247	---	19	---	4.88	Good-Fair

Taxonomic Analysis

The macroinvertebrate community at this site remains stable with only a small increase in EPT Richness. Also, EPT abundance increased from 54 in 2003 to 78 in 2008 indicating slightly higher benthic productivity. Along with *Seratella deficiens* , an ephemerelid mayfly collected again in 2008 after being absent in 2003, the perlid stoneflies, *Acroneuria* , *Neoperla* and *Perlesta* as well as the caddisfly *Chimarra* helped contribute to a lower BI value than was received in 2003. Overall, the benthic community present is relatively intolerant.

Data Analysis

Reedy Fork is a main feeder stream for Lake Brandt. This is the most upstream reach of Reedy Fork sampled for basinwide monitoring and is also the most urban as outward growth of Kernersville encroaches on much of the traditionally agricultural catchment. Reedy Fork at SR 2128 suffers from poor macroinvertebrate habitat reflective in the shifting sand substrate and lack of riffles. This site has maintained a Good-Fair water quality rating since 1993 despite these habitat deficiencies. Coupled with the presence of a relatively intolerant EPT community, this suggests that poor habitat may limit the benthic fauna more than urban runoff.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
REEDY FK	**SR 2728**	**BB404**	**07/15/08**	**GOOD-FAIR**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Guilford	2	03030002	36.179444	-79.647778	16-11-(9)a2	Southern Outer Piedmont

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; NSW	125.0	650	10	0.3

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	60	40	0	0

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

Water Quality Parameters

Temperature (°C)	24.4
Dissolved Oxygen (mg/L)	8.1
Specific Conductance (µS/cm)	98
pH (s.u.)	6.7

Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	16
Bottom Substrate (15)	12
Pool Variety (10)	6
Riffle Habitat (16)	6
Left Bank Stability (7)	6
Right Bank Stability (7)	6
Light Penetration (10)	10
Left Riparian Score (5)	3
Right Riparian Score (5)	2
Total Habitat Score (100)	71

Site Photograph

Substrate Equal mix of boulder, cobble, gravel, and sand; silty

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/15/08	10493	---	18	---	5.24	Good-Fair
07/11/03	9194	---	8	---	6.27	Fair
07/07/98	7624	---	18	---	5.64	Good-Fair
07/13/93	6241	---	16	---	5.99	Good-Fair

Taxonomic Analysis

A more than 2-fold increase in EPT taxa richness and abundance (75 in 2008 from 37 in 2003) occurred since the site's historic low in 2003. The primary taxa gained were moderately intolerant caddisflies such as the leptocerids *Oecetis cinerascens* , *O. nocturna* , *Triaenodes ignitus* , and *T. perna/helo* . These species helped to drive the Biotic Index significantly lower than in any previous sampling cycle. The addition of the silt loving mayflies *Caenis* and *Tricorythodes* to the benthos helped to mitigate the reduction of the BI.

Data Analysis

Located in northeastern Guilford County, this middle reach of Reedy Fork is the outflow of Townsend Lake and therefore indicative of the condition of Greensboro's drinking water supply. Entering more rural areas of the county, this station has much better habitat qualities than the site at SR 2128, the absence of wide riparian buffers being the most glaring deficiency. The bioclassification of this segment has historically been Good-Fair with the exception of a Fair rating in 2003 when the stream was sampled during high flow. Sampling in 2008 resulted in Reedy Fork once again rating Good-Fair.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
REEDY FK	NC 87	BB32	07/15/08	GOOD-FAIR

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Alamance	2	03030002	36.173056	-79.510556	16-11-(9)b	Southern Outer Piedmont

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; NSW	255.0	600	27	0.3

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	30	0	30	40 (20 fallow fields, 20 mill)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Horner's Mobile Home Park	NC0077968	0.04

Water Quality Parameters

Temperature (°C)	26.3
Dissolved Oxygen (mg/L)	9.0
Specific Conductance (µS/cm)	150
pH (s.u.)	7.0
Water Clarity	turbid

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	15
Bottom Substrate (15)	8
Pool Variety (10)	10
Riffle Habitat (16)	13
Left Bank Stability (7)	7
Right Bank Stability (7)	7
Light Penetration (10)	2
Left Riparian Score (5)	4
Right Riparian Score (5)	2
Total Habitat Score (100)	72

Site Photograph

Substrate Bedrock and boulder, with some cobble; silty

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/15/08	10492	56	16	6.34	5.81	Good-Fair
07/07/98	7622	53	11	7.11	6.16	Fair
07/13/93	6240	68	20	6.42	5.59	Good-Fair
08/08/89	5053	67	14	6.88	6.04	Fair
07/07/86	3825	59	10	6.78	6.03	Fair

Taxonomic Analysis

The increase in EPT from 1998 to 2008 as well as a significant drop in the Biotic Index can be primarily attributed to the addition of the caddisflies *Ceraclea enodis* , *Leucotrichia pictipes* (1st stream record), *Neureclipsis* (1st stream record), and *Oecetis persimilis* to the benthic community. Additionally, a decrease in midge taxa richness and abundance helped lower the BI to the lowest value in over 20 years despite an increase in oligochaetes.

Data Analysis

Reedy Fork flows primarily through rural and agricultural lands, although it originates from Kernersville. This site lies 1/4 mile below a low-head dam and 3/4 mile from the confluence with the Haw River. The increase in the bioclassifcation from Fair to Good-Fair indicates improving water quality. However, it is important to note that water quality has historically fluctuated between these two bioclassifications. This site was not sampled in 2003 due to continuous high flows.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
HORSEPEN CR	US 220	BB427	07/16/08	FAIR

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Guilford	2	03030002	36.136389	-79.860833	16-11-5-(2)	Northern Inner Piedmont

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-III; NS 08/03/92: W, CA	16.0	750	5	0.4

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	70	10	0	20 (commercial)

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)	7.4
Specific Conductance (µS/cm)	143
pH (s.u.)	7.2

Water Clarity	turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	6
Bottom Substrate (15)	2
Pool Variety (10)	4
Riffle Habitat (16)	7
Left Bank Stability (7)	2
Right Bank Stability (7)	2
Light Penetration (10)	10
Left Riparian Score (5)	4
Right Riparian Score (5)	4
Total Habitat Score (100)	46

Site Photograph

Substrate Mostly sand with some gravel, very silty

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/16/08	10498	---	10	---	6.34	Fair
07/10/03	9190	---	6	---	5.99	Poor
07/08/98	7630	---	7	---	6.46	Fair
07/14/93	3246	---	9	---	6.11	Fair

Taxonomic Analysis

EPT richness in 2008 was the highest ever recorded for a basinwide sample at this station. A total of 5 mayflies and 5 caddisflies were collected in 2008 with the mayfly *Stenacron interpunctatum* and caddisfly *Triaenodes perna/helo* being new records for this site. The EPT BI, contrary to the EPT richness, worsened due to the presence of more tolerant taxa which, although more tolerant, were not collected at all in 2003. This increase in richness helped nudge this site back to a Fair rating.

Data Analysis

A drinking water supply stream for Lake Brandt, Horsepen Creek is an exclusively urban stream. Draining the northeastern portion of Greensboro including PTI airport, this stream has very little catchment area that is not developed. Recent development pressures have been very heavy due to growth and has helped eliminate habitat for macroinvertebrates. Much of the poor habitat of Horsepen Creek is due to natural sandy substrates although high urban development has contributed to high water velocities after a rain event resulting from high percentages of impervious surfaces. High water velocities lead to severely eroded banks and stream incision which then loads the water with high amounts of silt thereby affecting the benthic fauna. It is clear that water quality of Horsepen creek is directly impacted by increasing urbanization. This stream may be a good candidate for a stream bank stabilization project.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
N BUFFALO CR	**SR 2832**	**BB407**	**07/23/08**	**Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
GUILFORD	2	03030002	36.120278	-79.708333	16-11-14-1b	Southern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; NSW	37.1	700	25	0.3

	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)
North Buffalo Cr WWTP	NC0024325	16.0

Water Quality Parameters

Temperature (°C)	24.9
Dissolved Oxygen (mg/L)	6.2
Specific Conductance (µS/cm)	377
pH (s.u.)	6.9

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	12
Pool Variety (10)	6
Riffle Habitat (16)	7
Left Bank Stability (7)	6
Right Bank Stability (7)	6
Light Penetration (10)	7
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	75

Site Photograph

Substrate Mostly sand with some bedrock, boulder, rubble and gravel.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/23/08	10510	43	6	7.37	6.77	Fair
07/10/03	9191	41	3	7.73	6.80	Poor
07/08/98	7627	37	3	8.00	7.00	Poor
07/13/93	6242	40	4	8.11	6.67	Poor

Taxonomic Analysis

No major changes in the benthic community were observed. New taxa collected in 2008 that were not previously collected include *Heterocloeon curiosum* and *Hydroptila*. Abundant taxa were *Baetis flavistriga*, *B. intercalaris*, *Cheumatopsyche*, *Hydropsyche betteni*, *Hydroptila*, *Argia*, *Enallagma*, *Ancyronyx variegatus*, *Ablabesmyia mallochi*, *Cricotopus bicinctus*, *Polypedilum halterale*, *P. illinoense* group, *Rheocricotopus robacki*, *Rheotanytarsus*, *Tanytarsus sp. A* and *T. sp. U*.

Data Analysis

This site is located in northwest Guilford County and downstream of the North Buffaloe Creek WWTP. It is also an ambient monitoring location. Since 1993, this site had consistently rated Poor. In 2008, EPT taxa richness doubled increasing the bioclassification to Fair.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
S BUFFALO CR	**SR 2821**	**BB406**	**07/23/08**	**Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
GUILFORD	2	03030002	36.059722	-79.725556	16-11-14-2a	Southern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; NSW	43.5	750	15	0.5

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	70	0	30	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
City of Greensboro WWTP	NC0047384	40.0

Water Quality Parameters

Temperature (°C)	26.5
Dissolved Oxygen (mg/L)	4.7
Specific Conductance (µS/cm)	815
pH (s.u.)	7.4

Water Clarity: slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	12
Bottom Substrate (15)	5
Pool Variety (10)	6
Riffle Habitat (16)	5
Left Bank Stability (7)	6
Right Bank Stability (7)	7
Light Penetration (10)	7
Left Riparian Score (5)	4
Right Riparian Score (5)	5
Total Habitat Score (100)	61

Site Photograph

Substrate: Mostly boulder with some rubble, sand and silt.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/23/08	10509	46	8	7.06	6.65	Fair
07/11/03	9193	38	4	7.13	7.00	Poor
07/07/98	7626	26	1	8.55	7.80	Poor
07/12/93	6237	50	2	8.23	6.20	Poor

Taxonomic Analysis

Eight EPT taxa were collected in 2008; the highest ever recorded for this site. Taxa collected for the first time include the mayfies, *Paracloeodes minutus* and *Tricorythodes* , and the caddisfly, *Hydropsyche venularis* .

Data Analysis

Most of the flow at this site, which is also an ambient monitoring site, is due to the 40 MGD discharge from the city of Greensboro's WWTP discharge. With the exception of the 1998 sample, which was taken immediately after a fish kill, EPT taxa richness has been gradually increasing since 1993 suggesting an improvement in water quality. The highest number of EPT taxa ever recorded from this site were collected in 2008, thereby increasing the bioclassification rating to Fair.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
STONY CR	**SR 1104**	**BB503**	**03/09/09**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Caswell	2	03030002	36.257309	-79.447130	16-14-(1)A	Southern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-II; HQW, NSW	23.9	600	5	0.8

	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)	13.4
Dissolved Oxygen (mg/L)	9.4
Specific Conductance (µS/cm)	100
pH (s.u.)	6.7

Water Clarity: Slightly turbid.

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	14
Bottom Substrate (15)	3
Pool Variety (10)	8
Riffle Habitat (16)	7
Left Bank Stability (7)	3
Right Bank Stability (7)	3
Light Penetration (10)	7
Left Riparian Score (5)	4
Right Riparian Score (5)	5
Total Habitat Score (100)	58

Site Photograph

Substrate: Mostly sand with a small amount of boulder and gravel

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/09/09	10634	---	23	---	4.85	Good-Fair
07/10/03	9188	---	11	---	6.34	Not Rated
07/06/98	7633	---	21	---	5.40	Good
07/13/93	6238	---	21	---	4.69	Good
02/10/93	6080	---	27	---	4.04	Good

Taxonomic Analysis

The decline in bioclassification from 1998 to 2009 is due to the absence of rare species that were present in the 1998 collection but absent in the 2003 and 2009 collections. Rare species are defined as taxa that are represented by one or two individuals. Those species include *Maccaffertium pudicum* , *Stenonema femoratum* , *Habrophlebiodes* spp., *Neoperla* spp., *Ceraclea ancylus* , *Oecetis persimilis* and *Polycentropus* spp.

Data Analysis

From 1993 to 2003, Stony Creek was sampled at SR 1100. It was suggested that in 2009, the site be moved to SR 1104 because the riffle located at SR 1100 was atypical for this reach of the stream. The bioclassification at this site was Good from 1993 to1998 then declined to Good-Fair in 2009. This part of the state experienced droughts in 2003 and 2008, thus the collection in 2003 was Not Rated. Although EPT richness in 2009 (23) was similar to those recorded in 1993 and 1998, whether the 2008 drought had any impact on Stony Creek is inconclusive.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
JORDAN CR	SR 1002	BB214	03/09/09	Not Rated

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
ALAMANCE	2	03030002	36.205000	-79.383889	16-14-6-(0.5)	Southern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-II; HQW, NSW	13.8	600	6	0.3

	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)	14.4
Dissolved Oxygen (mg/L)	9.3
Specific Conductance (µS/cm)	87
pH (s.u.)	6.5

Water Clarity: Clear.

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	7
Bottom Substrate (15)	3
Pool Variety (10)	8
Riffle Habitat (16)	5
Left Bank Stability (7)	6
Right Bank Stability (7)	6
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	60

Site Photograph

Substrate: mix of bedrock, boulder, rubble, gravel, sand and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/09/09	10635	---	13	---	4.34	Not Rated
08/26/03	9281	---	16	---	4.90	Good-Fair
07/06/98	7634	---	16	---	5.03	Good-Fair
02/10/93	6079	---	23	---	4.78	Good-Fair

Taxonomic Analysis

EPT richness, when corrected for season, decreased 50% from 2003 (16) to 2009 (8). The biotic index decreased, possibly due to the winter stonfly taxa present in the sample having lower tolerance values. Abundant taxa were *Ameletus lineatus* , *Prostoia* , *Clioperla clio* and *Isoperla transmarina* . All are considered winter taxa.

Data Analysis

Jordan Creek, which suffers from substantial bank erosion and habitat degradation, is a tributary to Stony Creek below Lake Burlington. It drains primarily rural, northern Alamance County. The site at SR 1002 is located three miles upstream of Lake Burlington. Taxa typically found in flowing water, such as Heptageniid mayflies, were absent from the 2009 sample suggesting the stream still has lingering impacts from the 2008 drought. Because of the low number of EPT taxa (eight, when corrected for seasonality) and the absence of flow dwelling species, Jordan Creek was Not Rated in 2009. Previously, the site has consistently received Good-Fair ratings.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
BIG ALAMANCE CR	**NC 49**	**BB130**	**07/14/08**	**Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
ALAMANCE	3	03030002	36.028056	-79.441389	16-19-(4.5)a	Southern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C;NSW	156	475	6	0.4

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	40	0	60	0

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

Water Quality Parameters

Temperature (°C)	24.5
Dissolved Oxygen (mg/L)	7.5
Specific Conductance (µS/cm)	185
pH (s.u.)	6.7

Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	12
Bottom Substrate (15)	4
Pool Variety (10)	10
Riffle Habitat (16)	7
Left Bank Stability (7)	6
Right Bank Stability (7)	6
Light Penetration (10)	5
Left Riparian Score (5)	4
Right Riparian Score (5)	4
Total Habitat Score (100)	62

Site Photograph

Substrate primarily sand; some cobble, silt, gravel

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/14/08	10487	---	9	---	6.11	Fair
08/26/03	9282	---	12	---	6.23	Fair
07/10/98	7666	---	18	---	5.82	Good-Fair
07/12/93	6234	---	19	---	5.24	Good-Fair

Taxonomic Analysis

There has been a decline in the number of EPT taxa collected after each summer sampling event from prior sampling events from 1993 through 2008. The loss of taxa is most pronounced in the stoneflies (two, one, one, and zero taxa collected in 1993, 1998, 2003, and 2008 respectively) and the caddiflies (ten, eight, six, and four taxa collected in subsequent sampling events).

Data Analysis

The site is 4.5 miles south of downtown Burlington in central Alamance County. The catchment includes a portion of Burlington and several small towns. The stream segment was added to the 303(d) list in 2006 for impaired biological integrity.

As in 2003, the stream shows degradation in 2008. A continued reduction in the number of EPT taxa collected suggests that water quality at the site continues to deteriorate, though the negligibly lower EPT BI value in 2008 over 2003 is somewhat confounding. Development and agriculture in the watershed are likely sources of impact to the benthic community.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
L ALAMANCE CR	SR 2309	BB388	07/14/08	Not Rated

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
ALAMANCE	3	03030002	36.034722	-79.408611	16-19-11	Southern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C;NSW	15	495	7	0.3

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	30	70	0	0

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)	8.1
Specific Conductance (µS/cm)	136
pH (s.u.)	6.6
Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	15
Bottom Substrate (15)	3
Pool Variety (10)	10
Riffle Habitat (16)	6
Left Bank Stability (7)	3
Right Bank Stability (7)	3
Light Penetration (10)	9
Left Riparian Score (5)	1
Right Riparian Score (5)	2
Total Habitat Score (100)	57

Site Photograph

Substrate mostly sand; some silt, cobble, gravel, detritus

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/14/08	10488	49	7	7.04	6.53	Not Rated
09/12/06	10111	46	5	6.79	6.19	Poor
06/23/03	9084	41	5	6.70	6.70	Fair
07/10/98	7667	---	6	---	6.86	Poor
07/29/85	3527	45	8	7.34	6.63	Fair

Taxonomic Analysis

The EPT portion of the benthic community has been similar for each sampling event. Over the five sampling events at the site a total of 11 taxa have been collected.

Data Analysis

The site is 2.5 miles south of downtown Graham in central Alamance County. Portions of Graham and Greensboro are within the catchment. The stream is on the 303(d) list for impaired biological integrity.

The site was not rated in 2008 due to low streamflow as the result of drought; the site would have rated as Fair otherwise.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
HAW CR	**SR 2158**	**BB374**	**07/14/08**	**FAIR**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Alamance	2	03030002	36.000278	-79.343889	16-20-(4)	Carolina Slate Belt

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; NSW	28.5	450	5	0.4

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

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

Water Quality Parameters

Temperature (°C)	23.5
Dissolved Oxygen (mg/L)	6.3
Specific Conductance (µS/cm)	112
pH (s.u.)	6.5

Water Clarity	turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	14
Bottom Substrate (15)	7
Pool Variety (10)	9
Riffle Habitat (16)	14
Left Bank Stability (7)	3
Right Bank Stability (7)	3
Light Penetration (10)	10
Left Riparian Score (5)	4
Right Riparian Score (5)	2
Total Habitat Score (100)	71

Site Photograph

Substrate Equal mix of gravel and sand, some cobble; very silty

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/14/08	10490	---	12	---	4.78	Fair
07/07/03	9187	---	14	---	5.47	Good-Fair
07/10/98	7664	---	22	---	4.79	Good

Taxonomic Analysis

A continuous loss of EPT taxa has occurred since 1998, noticibly with caddisfly larvae which dropped from 12 species in 1998 to only 5 in both 2003 and 2008, with only hydropsychid caddisflies remaining in 2008. A steady reduction in mayfly taxa has also occurred since 1998 (from 8 to 6 to 4) with the remaining taxa being silt tolerant species such as *Caenis* and *Maccaffertium modestum.* Only 2 perlid stonelfy taxa have been collected in each sampling year. Finally, the overall EPT abundance value has decreased each successive sampling from 92 in 1998 to 58 in 2008, although those taxa present are slightly less tolerant than those present in 2003.

Data Analysis

This site drains eastern Alamance and western Orange Counties, areas of high development pressures. Siltation of the waterway, coupled with the lack of any dischargers on the stream, is highly suggestive that watershed development is a primary cause of the reduction in the integrity of the macroinvertebrate community. Habitat deficiencies, which contribute to siltation and that are typical in areas of high development, were noted including moderate to severe bank erosion and lack of good riparian vegetation. The consistent drop in Bioclass from Good in 1998 to Fair in 2008 supports this hypothesis. However, it must be noted that a lack of community recovery from the extreme 2007 drought may also contribute to the Fair rating.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
MARYS CR	**SR 2174**	**BB377**	**03/09/09**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
ALAMANCE	4	03030002	35.915833	-79.308056	16-26	Carolina Slate Belt

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; NSW	12.0	485	10	0.4

	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)	16.4
Dissolved Oxygen (mg/L)	10.4
Specific Conductance (µS/cm)	91
pH (s.u.)	6.9

Water Clarity: Clear.

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	12
Pool Variety (10)	10
Riffle Habitat (16)	14
Left Bank Stability (7)	7
Right Bank Stability (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	93

Site Photograph

Substrate: Good mix of boulder, cobble and gravel.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/09/09	10636	---	27	---	4.03	Good
07/15/03	9195	---	18	---	5.03	Good-Fair
03/10/03	9069	---	18	---	4.05	Not Rated
10/19/00	8319	76	25	5.72	4.59	Good-Fair
02/10/98	7492	---	17	---	3.88	Fair

Taxonomic Analysis

Minor shifts in EPT taxa occurred between July 2003 and 2009. For example, *Baetis flavistriga* , *B. intercalaris* and *B. pluto* were present in the July 2003 collection but not in the 2009 collection, whereas *Heterocloeon amplum* and *Plauditis dubius* were present in the 2009 collection but not in the July 2003 collection. In addition stonefly richness increased from 3 taxa in July 2003 to eight taxa in 2009. Also, four species of Hydropsychid mayflies were present in the July 2003 collection versus one species in the 2009 collection. These shifts in the EPT community are partly due to cessation of flow during warmer drier months as well as seasonality.

Data Analysis

Marys Creek, a tributary of the Haw River, is located in eastern Alamance County. Water quality has improved to Good for the first time since sampling on Marys Creek began in 1998 and is due, in part, to the highest EPT richness ever recorded at this site. However, five of those taxa are winter stoneflies, thus removed from the analysis. Since Slate Belt streams often stop flow in the summer as well as in periods of drought, the fluctuation in the bioclassification is most likely due to the hydrologic regime of Marys Creek. Marys Creek was part of a drought recovery study (BAU memo B-20040823), that occurred after the 2002 drought to determine benthic community recovery times. The March 2003 sample was Not Rated

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
CANE CR	**SR 1114**	**BB241**	**03/11/09**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
ORANGE	4	03030002	35.986944	-79.206389	16-27-(2.5)a	Carolina Slate Belt

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-II; HQW, NSW, CA	13.7	675	7	0.3

	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)	14.0
Dissolved Oxygen (mg/L)	13.0
Specific Conductance (µS/cm)	83
pH (s.u.)	6.5
Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	12
Pool Variety (10)	10
Riffle Habitat (16)	14
Left Bank Stability (7)	5
Right Bank Stability (7)	5
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	87

Site Photograph

Substrate Good mix of boulder, cobble and gravel with little sand present.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/11/09	10642	---	18	5.19	---	Good-Fair
08/14/03	9279	---	15	4.94	---	Good-Fair
07/15/03	9196	---	18	5.19	---	Good-Fair
07/07/98	7656	---	27	4.36	---	Good
02/26/98	7506	77	37	4.89	3.79	Excellent

Taxonomic Analysis

No major changes in the benthic community were observed. Abundant taxa included *Plauditus dubius* , *Leucrocuta* , *Stenonema femoratum* and *Prostoia* . *Stenonema femoratum* is a Slate Belt indicator species that is tolerant of low dissolved oxygen and low flow conditions. Many of the small tributary streams in the Slate Belt are prone to extremely low flow conditions during the summer due to low base flows and may often dry up completely during prolonged low flow periods.

Data Analysis

Cane Creek drains rural southern Orange County and feeds into Cane Creek Reservoir. This site is located above the reservoir. Although down from the Excellent bioclassification in the winter of 1998 and the Good bioclassification in the summer of 1998, Cane Creek has exhibited a relatively stable macoinvertebrate community with all samples since July 2003 producing Good-Fair bioclassifications.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
COLLINS CR	**SR 1539**	**BB310**	**03/19/09**	**Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
CHATHAM	4	03030002	35.856944	-79.231944	16-30-(1.5)	Carolina Slate Belt

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-IV;NSW	19.5	435	12	0.5

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

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

Water Quality Parameters

Temperature (°C)	13.3
Dissolved Oxygen (mg/L)	12.8
Specific Conductance (µS/cm)	95
pH (s.u.)	6.3
Water Clarity	Slightly Turbid

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	17
Bottom Substrate (15)	13
Pool Variety (10)	7
Riffle Habitat (16)	16
Left Bank Stability (7)	5
Right Bank Stability (7)	7
Light Penetration (10)	9
Left Riparian Score (5)	5
Right Riparian Score (5)	4
Total Habitat Score (100)	87

Site Photograph

Substrate mix of bedrock, boulder, rubble, gravel, sand and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/19/09	10614	17	17	5.21	5.21	Fair
07/15/03	9197	14	14	5.33	5.33	Good-Fair
02/02/98	7477	19	19	4.53	4.53	Good-Fair
12/10/86	3971	44	4	7.16	4.12	Poor

Taxonomic Analysis

Collins Creek does not appear to have ceased flowing in 2008 since *Cheumatopsyche* spp were abundant and another hydropsychid caddisfly, *Hydropsyche betteni* was also present. The seasonal stonefly, *Amphineumura* sp, and the caddisfly *Ironoquia punctatissima* were the other abundant taxa collected here in 2009. EPT species composition differed little from the other spring sample collected here (1998). Differences between the 2009 sample and 2003 were largely the result of seasonality. There were no EPT taxa that suggested a water quality problem, nor any taxa that are particularly sensitive to aquatic pollution.

Data Analysis

Collins Creek declined from Good-Fair in 2003 to Fair in 2009. The EPT Biotic Index actually went down a little suggesting some water quality improvement but the absence of just one, non-seasonal, EPT taxa resulted in the drop in bioclassification. When compared to 1998, a small decline in EPT taxa and an increase in EPT Biotic Index suggest that conditions are not improving here. Though water levels may have dropped during the drought, there is ample evidence that flow was not interrupted here. Given this observation and a high habitat score, more EPT taxa should have been residing in this reach.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
TERRELLS CR	**NC 87**	**BB158**	**03/19/09**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
CHATHAM	4	03030002	35.821667	-79.255556	16-31-(2.5)	Carolina Slate Belt

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-IV;NSW	21.0	390	12	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	n/a	n/a

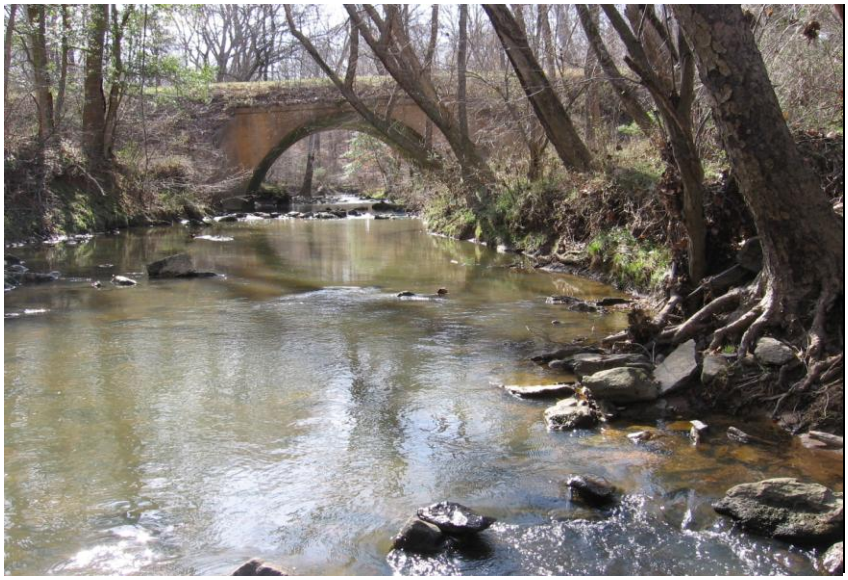
Water Quality Parameters

Temperature (°C)	13.3
Dissolved Oxygen (mg/L)	12.8
Specific Conductance (µS/cm)	95
pH (s.u.)	6.3
Water Clarity	Slightly Turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	17
Bottom Substrate (15)	13
Pool Variety (10)	7
Riffle Habitat (16)	14
Left Bank Stability (7)	4
Right Bank Stability (7)	7
Light Penetration (10)	9
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	86

Site Photograph



Substrate mix of bedrock, boulder, rubble, gravel, sand and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/19/09	10613	21	21	4.90	4.90	Good-Fair
03/10/09	10640	20	20	4.35	4.35	Good-Fair
03/12/08	10385	13	13	4.05	4.05	Fair
11/21/03	9313	18	18	4.42	4.42	Good-Fair
07/15/03	9200	12	12	5.26	5.26	Fair

Taxonomic Analysis

Abundant taxa collected here, such as the caddisfly *Cheumatopsyche* sp, suggest that Terrells Creek did not stop flowing in 2008 through spring of 2009. Though not as diverse as other streams, the taxa collected here are typical of the aquatic communities found in this part of North Carolina. Other abundant taxa included mayflies (*Heterocloeon amplum*, *Plauditus dubius* group) and stoneflies *(Amphinemura* sp, *Perlesta* sp, *Isoperla burksi, I. namata*).

Data Analysis

Terrells Creek rated Good-Fair in 2009. This was an improvement from 2008 and one of the 2003 samples. The number of EPT taxa collected here in 2009 was higher than in previous collections yet only placed Terrells Creek near the average in terms of macroinvertebrate diversity for other Slate Belt streams sampled in 2009 in this part of North Carolina.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
DRY CR	**SR 1520**	**BB307**	**03/19/09**	**Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
CHATHAM	4	03030002	35.803611	-79.211944	16-34-(0.7)	Carolina Slate Belt

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-IV;NSW	17.7	410	12	0.5

	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	n/a	n/a

Water Quality Parameters

Temperature (°C)	13.3
Dissolved Oxygen (mg/L)	12.8
Specific Conductance (µS/cm)	95
pH (s.u.)	6.3
Water Clarity	Turbid

Habitat Assessment Scores (max)

Channel Modification (5)	3
Instream Habitat (20)	15
Bottom Substrate (15)	11
Pool Variety (10)	3
Riffle Habitat (16)	7
Left Bank Stability (7)	4
Right Bank Stability (7)	7
Light Penetration (10)	9
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	69

Site Photograph

Substrate mix of bedrock, boulder, rubble, gravel, sand and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/19/09	10606	17	17	5.02	5.02	Fair
11/21/03	9314	13	13	5.06	5.06	Fair
07/15/03	9199	9	9	5.62	5.62	Fair
02/02/98	7478	21	21	3.98	3.98	Good-Fair
02/08/93	6072	31	31	4.62	4.62	Good

Taxonomic Analysis

There were 17 EPT taxa collected from this site in 2009, an increase from the 13 found in 2003. From the taxa collected it appears that this site may cease flowing. For example, the caddisfly *Cheumatopsyche* sp was rare here while being common or abundant at most other Slate Belt sites in 2009. These caddisflies require constant flow in order to feed. Another caddisfly, *Ironoquia punctatissima* was abundant in 2009. This taxon can withstand periods of intermittant stream flow. A commonly collected mayfly in Slate Belt streams is S*tenonema femoratum* . This taxon was absent here.

Data Analysis

Dry Creek received a Fair bioclassification in 2009. This stream rated Poor in 1986 and since then has been Fair, Good and Good-Fair. As its name implies, Dry Creek, appears to stop flowing in some years. Flow, or the lack thereof, would be the most obvious cause of lower biological diversity here since habitat features appear within normal ranges and there are no point sources upstream of the sampling location.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
POKEBERRY CR	**SR 1711**	**BB320**	**03/19/09**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
CHATHAM	4	03030002	35.774167	-79.120000	16-37	Carolina Slate Belt

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-IV;NSW	13.0	310	12	0.5

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

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

Water Quality Parameters

Temperature (°C)	10.5
Dissolved Oxygen (mg/L)	11.6
Specific Conductance (µS/cm)	71
pH (s.u.)	6.0

Water Clarity: Slightly Turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	17
Bottom Substrate (15)	12
Pool Variety (10)	5
Riffle Habitat (16)	16
Left Bank Stability (7)	2
Right Bank Stability (7)	6
Light Penetration (10)	7
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	80

Site Photograph

Substrate: mix of bedrock, boulder, rubble, gravel, sand and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/19/09	10592	27	27	4.24	4.24	Good-Fair
07/15/03	9198	19	19	5.28	5.28	Good-Fair
03/05/03	9061	21	21	4.66	4.66	Good-Fair
02/02/98	7479	30	30	3.92	3.92	Good
02/08/93	6071	23	23	4.68	4.68	Good-Fair

Taxonomic Analysis

Regardless of wet or dry years, Pokeberry Creek contains a greater diversity of EPT taxa than most other Slate Belt streams. A total of 27 EPT taxa were collected here including the mayflies *Diphetor hageni* and *Serratella deficiens*. These taxa were not collected at other streams in the area. Also, this stream contained high stonefly diversity (n=10) which included the only collections of *Eccoptura xanthesnes* and *Diploperla duplicata* in this part of the Cape Fear basin in 2009.

Data Analysis

Pokeberry Creek has been sampled seven times since 1985. The stream rated Good in 1986 and 1998. Recent samplings, including 2009, rated Good-Fair. Only one stream in this part of the Cape Fear River basin contained a greater number of EPT (Mill Creek). Previous reports noted the resilence of the benthic community at Pokeberry Creek through drought. The geology underlying Pokeberry Creek's watershed is mainly Granite rather than slate. This may account for the increase flows here compared with other nearby streams.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
NEW HOPE CR	**SR 1107**	**BB238**	**07/22/08**	**Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
DURHAM	5	03030002	35.884722	-78.966667	16-41-1-(11.5)c	Triassic Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-IV; NSW	74.4	250	8	0.4

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

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
South Durham Water Reclamation Facility	NC0047597	20.0

Water Quality Parameters

Temperature (°C)	25.8
Dissolved Oxygen (mg/L)	5.0
Specific Conductance (µS/cm)	340
pH (s.u.)	7.1
Water Clarity	turbid

Habitat Assessment Scores (max)

Channel Modification (5)	2
Instream Habitat (20)	11
Bottom Substrate (15)	1
Pool Variety (10)	4
Riffle Habitat (16)	3
Left Bank Stability (7)	5
Right Bank Stability (7)	5
Light Penetration (10)	10
Left Riparian Score (5)	3
Right Riparian Score (5)	5
Total Habitat Score (100)	49

Site Photograph

Substrate Clay and silt.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/22/08	10505	38	6	6.76	5.92	Fair
07/07/03	9167	32	6	6.64	6.32	Fair
07/07/98	7640	38	10	6.78	5.76	Fair

Taxonomic Analysis

Six EPT taxa were collected in both 2003 and 2008; however, there was a shift in the community composition. Mayfly taxa increased from two taxa in 2003 to four taxa in 2008 and caddisfly taxa decreased from four taxa in 2003 to two taxa in 2008. Two mayfly taxa not previously collected at this site, *Paracloeodes minutus* and *Tricorythodes* , were collected in 2008.

Data Analysis

New Hope Creek is located in the Triassic Basin. Streams in this ecoregion have silty clay soils and tend to dry up in the summer months. The site at SR 1107 is located below the City of Durham's South Water Reclamation Facility. The reach was a long, slow-flowing run. No riffles or pools were present. Banks were steep and eroding and instream habitat was limited to woody debris. This site has consistently rated Fair. Based on the Biotic Index values, water quality has not changed at this site.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
MORGAN CR	**NC 54**	**BB146**	**03/11/09**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
ORANGE	6	03030002	35.923611	-79.115556	16-41-2-(1)	Carolina Slate Belt

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-IV; NSW	9.0	500	6	0.3

	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)	13.7
Dissolved Oxygen (mg/L)	11.8
Specific Conductance (µS/cm)	108
pH (s.u.)	6.6

Water Clarity: Clear.

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	14
Bottom Substrate (15)	8
Pool Variety (10)	6
Riffle Habitat (16)	14
Left Bank Stability (7)	2
Right Bank Stability (7)	2
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	71

Site Photograph

Substrate: Mix of cobble, gravel, sand and bedrock.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/11/09	10641	---	26	---	4.36	Good
03/12/08	10387	---	12	---	3.55	Fair
06/02/04	9390	---	18	---	4.43	Good-Fair
10/01/03	9284	---	22	---	4.22	Good
07/07/03	9169	---	20	---	4.61	Good-Fair

Taxonomic Analysis

Increases occurred in the number of Mayfly and Caddisfly taxa collected from 2008 to 2009. Mayfly richness increased from 3 taxa in 2008 to 12 taxa in 2009 and Caddisfly richness increased from 3 taxa in 2008 to 8 taxa in 2009. Abundant taxa included *Heterocloeon amplum* , *Plauditus dubius* , *Stenacron interpunctatum* , *Amphinemura* , *Acroneuria abnormis* , *Isoperla namata* , *Cheumatopsyche* and *Ironoquia punctatissima* .

Data Analysis

The March 2008 sample was taken during the 2008 drought. It should not have been rated but was assigned a Fair bioclassification. A year later in 2009, the bioclassification increased from Fair to Good. The biological community was very similar to the 2003 collection and appears to have recovered from the drought. When corrected for season, the EPT richness (23) and the biotic index (4.36) recorded from the 2009 collection were similar to those recorded in November 2003 (EPT = 22, EPT BI = 4.22).

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
DEEP R	**SR 2615**	**BB452**	**07/22/08**	**GOOD**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Randolph	9	03030003	35.727778	-79.652778	17-(10.5)d2	Carolina Slate Belt

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	351.0	425	43	0.3

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	50	30	0	20 (sewer easement)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Randleman Lake WTP; Randleman WWTP	NC0087866; NC0025445	1.5; 1.75

Water Quality Parameters

Temperature (°C)	30.9
Dissolved Oxygen (mg/L)	6.2
Specific Conductance (µS/cm)	265
pH (s.u.)	7.0
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	12
Pool Variety (10)	7
Riffle Habitat (16)	7
Left Bank Stability (7)	6
Right Bank Stability (7)	6
Light Penetration (10)	3
Left Riparian Score (5)	5
Right Riparian Score (5)	4
Total Habitat Score (100)	71

Site Photograph

Substrate Mostly boulder and cobble with some gravel; silty

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/22/08	10501	72	26	5.72	4.52	Good
07/22/03	9180	57	19	5.72	5.24	Good
07/06/98	7636	71	20	5.92	4.77	Good-Fair
07/26/93	6306	67	17	6.22	5.13	Good-Fair
07/26/89	4996	73	18	6.11	5.44	Good-Fair

Taxonomic Analysis

EPT taxa richness increased significantly in 2008 in this segment of the Deep River from relatively stable values. An increase in heptageniid mayflies as well as leptocerid and net spinning caddisflies explains the difference between 2003 and 2008 EPT S. A few taxa not previously collected at this site included the mayflies *Serratella deficiens* and *Maccaffertium lenati* , the stoneflies *Acroneuria arenosa* and *Neoperla,* and the caddisflies *Lepidostoma* and *Oecetis sp. A* . Despite the increase in intolerant EPT taxa, the biotic index did not change from 2003 levels due to an increase in tolerant gastropod and oligochaete richness and abundance.

Data Analysis

This site passes through rural and agricultural land after exiting Randleman Lake which integrates water from both High Point and Greensboro. Also, two major NPDES permitted dischargers in the vicinity of Randleman and water from eastern Asheboro contribute to the high specific conductance measured at this Deep River site. Nutrient enrichment also appears to be a problem as high biomass of algae and aquatic macrophytes were noted in the river channel. Water quality of the Deep River at SR 2615 has remained Good over the last 5 years and may, in fact, be improving slightly based on the increased EPT richness and abundance seen in 2008.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
DEEP R	SR 1456	BB298	07/22/08	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MOORE	9	03030003	35.500278	-79.581111	17-(10.5)e2	Carolina Slate Belt

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	621.0	400	35	0.4

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

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

Water Quality Parameters

Temperature (°C)	31.1
Dissolved Oxygen (mg/L)	7.5
Specific Conductance (µS/cm)	219
pH (s.u.)	8.3

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	8
Pool Variety (10)	6
Riffle Habitat (16)	10
Left Bank Stability (7)	3
Right Bank Stability (7)	7
Light Penetration (10)	2
Left Riparian Score (5)	2
Right Riparian Score (5)	5
Total Habitat Score (100)	66

Site Photograph

Substrate Good mix of boulder, rubble, gravel, and sand.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/22/08	10508	67	25	5.39	4.12	Good
07/22/03	9181	66	26	5.03	4.40	Excellent
07/06/98	7639	82	33	5.27	4.54	Good
07/26/93	6304	80	32	5.04	4.23	Excellent

Taxonomic Analysis

The decrease in EPT from 1993 to 2008 can be attributed to the loss of mayflies from the benthic community. *Pseudocloeon propinquum* , *Serratella deficiens* and *Caenis* had been either Common or Rare in the past. Since 2002, they have been either Rare or absent from the community. Additionally, two species of hydropsychid caddisflies, *Hydropsyche demora* and *H. rossi* , abundant in previous samples were not present in 2008.

Data Analysis

This site is located in north central Moore County. Since 1993 this site has alternated between Excellent and Good. The bioclassification decreased from Excellent in 2003 to Good in 2008; however, this does not necessarily reflect a change in water quality. Since 1993, EPT taxa richness has decreased slightly and the Biotic Index has increased suggesting that the water quality may be declining.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
E FK DEEP R	SR 1541	BB312	07/22/08	GOOD-FAIR

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Guilford	8	03030003	36.037500	-79.945833	17-2-(0.3)b	Southern Outer Piedmont

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-IV: *	14.3	790	6	0.2

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

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

Water Quality Parameters

Temperature (°C)	25.4
Dissolved Oxygen (mg/L)	6.7
Specific Conductance (µS/cm)	133
pH (s.u.)	6.8

Water Clarity: slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	10
Bottom Substrate (15)	5
Pool Variety (10)	4
Riffle Habitat (16)	7
Left Bank Stability (7)	4
Right Bank Stability (7)	5
Light Penetration (10)	7
Left Riparian Score (5)	2
Right Riparian Score (5)	4
Total Habitat Score (100)	52

Site Photograph

Substrate: Primarily sand with some cobble (rip-rap), gravel and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/22/08	10500	---	14	---	5.92	Good-Fair
05/20/03	9137	48	8	6.94	6.52	Fair
07/09/98	7662	---	13	---	6.01	Fair

Taxonomic Analysis

The EPT richness rebounded in 2008 to 14 taxa from from the low of 8 recorded in 1998. Comprising the difference, baetid mayflies and leptocerid caddisflies reappeared, although no stoneflies were collected. The mayfly *Baetis pluto* and the caddisfly *Oecetis persimilis* were collected for the first time at this site in 2008. Taxonomically, the EPT community was very similar to that collected in 1998 as were the EPT metrics of richness and abundance (76 in 2008; 77 in 1998).

Data Analysis

As a source for High Point Lake, West Fork Deep River drains the highly urbanized western portion of Greensboro. The catchment has a high percentage of impervious surface resulting from increased residential and industrial development. This has also served to reduce riparian vegetation to narrow strips and further degrade the habitat (= 52) with sedimentation and erosion. A TMDL study performed in 2003 (full scale sampling) resulted in a Fair rating. The 2003 sampling was performed during high flows and turbid conditions which may have scoured much of the benthos away thereby reducing EPT richness and abundance. This site received a low Good-Fair rating in 2008 indicating increasingly better water quality.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
W FK DEEP R	**SR 1850 (SR 1818)**	**BB333**	**07/22/08**	**GOOD-FAIR**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Guilford	8	03030003	36.056389	-80.021667	17-3-(0.3)	Southern Outer Piedmont

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-IV: *	16.4	800	5	0.1

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

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

Water Quality Parameters

Temperature (°C)	22.7
Dissolved Oxygen (mg/L)	6.0
Specific Conductance (µS/cm)	103
pH (s.u.)	6.7
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	10
Bottom Substrate (15)	3
Pool Variety (10)	4
Riffle Habitat (16)	3
Left Bank Stability (7)	4
Right Bank Stability (7)	5
Light Penetration (10)	10
Left Riparian Score (5)	3
Right Riparian Score (5)	4
Total Habitat Score (100)	50

Site Photograph

Substrate Sand with some cobble (rip-rap) and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/22/08	10499	---	20	---	5.16	Good-Fair
07/07/03	9170	---	14	---	5.14	Good-Fair
07/09/98	7661	---	12	---	4.36	Fair
07/15/93	6280	---	15	---	4.67	Good-Fair

Taxonomic Analysis

EPT richness in 2008 was much higher than in previous collections with gains in each taxonomic order. New taxa, however, were not more intolerant as a group than in previous years. New taxa collected at West Fork Deep River were dominated by longhorned caddisflies and included *Nectopsyche exquisita* , *Oecetis nocturna* , and *O. persimilis* . Four stonelfy taxa were recorded in 2008 all of which are present in previous collections. Mayflies were dominated by heptageniid taxa with *Stenacron interpuntatum* collected here for the first time.

Data Analysis

The basinwide site at SR 1850 was moved 3/4 mile downstream to SR 1818 in 2008 due to presence of a beaverdam at SR 1850. This source stream for Oak Hollow Lake reservoir drains west central Guilford County and a moderately urbanized landscape. Despite the growth in residential development, the catchment area remains relatively forested thereby mitigating nonpoint source runoff. Water quality has remained relatively constant at Good-Fair with the exception of a Fair rating in 1998. However, a high stonefly richness in 1998 may suggest a higher bioclass than the Fair it received. A low habitat score of 50 in 2008 was due primarily to a homogeneous sandy substrate while the elevated specific conductance is typical of urban streams.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
HICKORY CR	SR 1131	BB247	03/09/09	Not Rated

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
GUILFORD	8	03030003	35.964167	-79.865833	17-8.5-(3)	Southern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-IV; CA	9.2	700	7	0.3

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	70	10	0	10

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

Water Quality Parameters

Temperature (°C)	11.3
Dissolved Oxygen (mg/L)	10.3
Specific Conductance (µS/cm)	188
pH (s.u.)	6.9

Water Clarity: Clear.

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	15
Bottom Substrate (15)	3
Pool Variety (10)	4
Riffle Habitat (16)	10
Left Bank Stability (7)	5
Right Bank Stability (7)	5
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	67

Site Photograph

Substrate: Mostly sand with a small amount of gravel.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/09/09	10633	---	19	---	4.78	Good-Fair
04/16/03	9096	35	17	5.01	4.09	Good-Fair
07/09/98	7660	---	12	---	5.31	Not Rated
02/17/93	6096	---	18	---	3.33	Fair

Taxonomic Analysis

With the exception of presence/absence of rare species, the benthic community changed very little from 2003 to 2009. Species that were not collected previously from this site include the mayfly *Leptophlebia* , the stonefly *Prostoia* and the caddisfly *Ptilostomis* . Abundant taxa were *Ameletus lineatus* , *Eurylophella doris* , *Prostoia* , *Clioperla clio* , *Isoperla namata* , *I. transmarina* , *Cheumatopsyche* and *Hydropsyche betteni* .

Data Analysis

Hickory Creek's watershed includes south-central Guilford County, south of Greensboro, south of I-85 and east of US 220. The lower portion of the watershed is rural. A TMDL stressor study, conducted in April 2003, identified sedimentation, habitat degradation, and urban runoff as the main impacts to this watershed. The Good-Fair bioclassifications in 2009 and 2003, up from the Fair bioclassification in 1993 suggest water qulaity may be improving. The site was Not Rated in July 1998 due to low flows.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
SANDY CR	**SR 2481**	**BB398**	**03/10/09**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
RANDOLPH	9	03030003	35.785000	-79.665833	17-16-(1)a	Carolina Slate Belt

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-III	45.3	500	18	0.3

	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)	13.2
Dissolved Oxygen (mg/L)	9.5
Specific Conductance (µS/cm)	106
pH (s.u.)	6.4

Water Clarity: Clear.

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	20
Bottom Substrate (15)	15
Pool Variety (10)	10
Riffle Habitat (16)	14
Left Bank Stability (7)	7
Right Bank Stability (7)	7
Light Penetration (10)	7
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	95

Site Photograph

Substrate: Mostly boulder and cobble with small amounts of gravel, sand, and silt.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/10/09	10637	---	35	---	4.04	Good
07/08/03	9172	---	20	---	4.92	Good-Fair
04/16/03	9083	71	27	4.98	3.81	Good
09/30/02	9025	---	21	---	4.73	Good
04/19/01	8417	124	43	5.33	4.26	Excellent

Taxonomic Analysis

The absence of edge species, *Triaenodes* and *Pycnopsyche* , in the 2002, April 2003 and July 2003 collections suggest the stream had lower than normal flows. *Triaenodes* and *Pycnopsyche* were present in the in 2001 and 2009 collections. After the 2002 drought, EPT richness had increased from 21 in 2002 to 27 in April 2003 but dropped to 20 in July 2003 and increased to 35 in 2009. Since Slate Belt streams typically have much lower flows during the summer, this decline in EPT taxa in July 2003 is due to the hydrologic nature of the stream.

Data Analysis

The Sandy Creek watershed drains northeastern Randolph County. After seasonal corrections were applied, Sandy Creek had a total of 27 EPT taxa (13 mayflies, 4 stoneflies,10 caddisflies) and a biotic index of 4.04. Due to the increase in EPT taxa and the lower biotic index, Sandy Creek received a Good rating in 2009, up from the Good-Fair rating in 2003. Previously the site rated Good or Excellent.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
RICHLAND CR	**SR 2873**	**BB409**	**03/10/09**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
RANDOLPH	9	03030003	35.608333	-79.619444	17-22	Carolina Slate Belt

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	64.8	410	15	0.4

	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)	14.9
Dissolved Oxygen (mg/L)	10.8
Specific Conductance (µS/cm)	82
pH (s.u.)	6.8

Water Clarity: Clear.

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	12
Pool Variety (10)	10
Riffle Habitat (16)	14
Left Bank Stability (7)	7
Right Bank Stability (7)	7
Light Penetration (10)	7
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	90

Site Photograph

Substrate: Mix of cobble and gravel with large areas of bedrock.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/10/09	10639	---	25	---	3.75	Good
07/08/03	9173	---	27	---	4.49	Good
07/06/98	7637	---	29	---	3.92	Excellent
07/26/93	6305	---	26	---	3.91	Good
02/18/93	6093	---	23	---	3.60	Good

Taxonomic Analysis

Although Richland Creek rated Good, several species of Hydropsychid mayflies (i.e. *Hydropsyche Betteni* , *H. venularis*) and edge taxa (*Oecetis* spp., *Triaenodes* spp.) that had been collected in previous years were absent from the 2009 sample and is likely the result of lingering drought effects. Abundant taxa included *Heterocloeon amplum* , *Eurylophella doris* , *E. enoensis* , *Maccaffertium modestum* , *Neoperla* , *Cheumatopsyche* and *Chimarra* .

Data Analysis

Richland Creek is located in southeast Randolph County. This location drains a forested watershed just upstream of the confluence with the Deep River. Water quality has remained relatively constant at Good with the exception of a borderline Excellent rating in 1998.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
BRUSH CR	**NC 22**	**BB113**	**03/10/09**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
RANDOLPH	9	03030003	35.601389	-79.583333	17-23b	Carolina Slate Belt

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	67.0	400	25	0.4

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

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

Water Quality Parameters

Temperature (°C)	13.1
Dissolved Oxygen (mg/L)	10.3
Specific Conductance (µS/cm)	26
pH (s.u.)	6.1

Water Clarity: Milky, slightly turbid.

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	12
Pool Variety (10)	10
Riffle Habitat (16)	7
Left Bank Stability (7)	7
Right Bank Stability (7)	7
Light Penetration (10)	7
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	83

Site Photograph

Substrate: Good mix of boulder, cobble and gravel.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/10/09	10638	---	22	---	4.81	Good-Fair
07/08/03	9174	---	19	---	5.30	Good-Fair
07/06/98	7638	---	26	---	4.27	Good
02/18/93	6092	---	23	---	3.58	Good
05/18/90	5288	---	28	---	4.29	Excellent

Taxonomic Analysis

Oecetis persimilis , *Triaenodes ignitus* , *T. perna/helo* and *Pycnopsyche* are edge species that were collected in 1998. Droughts ocurred in 2003 and 2008 suggesting that low flows reduced the amount of edge habitat prior to sampling in 2003 and 2009. This is supported by the absence of these species in the 2003 and 2009 collections. Taxa present in 2009 that had not been previously collected include the mayflies, *Eurylophella doris* and *E. enoensis* , the stoneflies *Prostoia* and *Isoperla transmarina* and the caddisfly *Ironoquia punctissima* .

Data Analysis

Brush Creek is a tributary of the Deep River in Randolph County. A total of 22 EPT taxa were collected. Five winter stoneflies were eliminated from the analysis because of seasonality, reducing the total richness to 17. This location rated Good-Fair in 2003 and 2009, down from the Good ratings received in 1993 and 1998.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
BEAR CR	**NC 705**	**BB152**	**07/24/08**	**Not Rated**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MOORE	10	03030003	35.440833	-79.589167	17-26-(6)	Carolina Slate Belt

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	139.0	400	8	0.2

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

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

Water Quality Parameters

Temperature (°C)	24.3
Dissolved Oxygen (mg/L)	3.4
Specific Conductance (µS/cm)	77
pH (s.u.)	6.2

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	20
Bottom Substrate (15)	12
Pool Variety (10)	4
Riffle Habitat (16)	10
Left Bank Stability (7)	6
Right Bank Stability (7)	5
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	4
Total Habitat Score (100)	81

Site Photograph

Substrate Rubble, silt, boulder and gravel

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/24/08	10512	75	11	6.90	5.95	Not Rated
07/09/03	9175	84	27	5.66	4.48	Good
07/21/98	7683	82	25	5.71	4.49	Good
08/09/93	6331	73	22	6.26	4.99	Good-Fair

Taxonomic Analysis

No major changes in the benthic community were observed, other than the loss of flow dependent taxa.

Data Analysis

Bear Creek is a large tributary of the Deep River in Moore County. This site is on the outskirts of Robbins with forest, commercial and residential development in the immediate watershed. The site was not rated in 2008 due to low streamflow as the result of drought. After the sample was collected, the lack of flow dependent taxa strongly suggested that flow had ceased or slowed to the point that the benthos was responding mainly to the drought. Another sample will be taken in 2009.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
MILL CR	**SR 1275**	**BB167**	**03/23/09**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MOORE	10	03030003	35.401667	-79.661111	17-26-5-4	Carolina Slate Belt

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-III	16.0		12	0.5

	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	n/a	n/a

Water Quality Parameters

Temperature (°C)	9.5
Dissolved Oxygen (mg/L)	12.3
Specific Conductance (µS/cm)	48
pH (s.u.)	5.9
Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	20
Bottom Substrate (15)	8
Pool Variety (10)	6
Riffle Habitat (16)	14
Left Bank Stability (7)	5
Right Bank Stability (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	85

Site Photograph

Substrate mix of bedrock, boulder, rubble, gravel, sand and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/23/09	10616	32	32	3.77	3.77	Excellent
02/05/08	10378	14	14	3.49	3.49	Not Rated
07/09/03	9177	26	26	3.76	3.76	Good
07/21/98	7684	20	20	4.17	4.17	Good-Fair
03/05/98	7509	76	31	4.79	4.09	Good

Taxonomic Analysis

In the six collections at this site since 1993, there have been a number of uncommonly collected taxa. In 2009 these inclued the mayflies *Ephemerella needhami* and *Rhithrogena uharia* and the caddisfly *Ceraclea neffi* . Also, there were several taxa that, though not uncommon in the North Carolian Piedmont, were less common in Slate Belt samples in 2009. Many more pollution-intolerant macroinvertebrates were collected here in 2009 than in nearby sites.

Data Analysis

Mill Creek rated Excellent in 2009, the same rating it recieved in winter of 1993. A sample collected in 2008 (during the drought) reflects the susceptability of the aquatic community here to hydrologic reductions. This is a possible reference site for Slate Belt streams as it rates Good or Excellent in recent years (with good flow) yet reduced flows have a suppressing effect on EPT taxa as evident by the winter 2008 sample. This site had a very low EPT Biotic index in 2009 similiar to prior years, reflecting the pollution-intolerant aquatic community that resides here.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
BUFFALO CR	**NC 22**	**BB159**	**03/23/09**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MOORE	10	03030003	35.470833	-79.516944	17-28	Carolina Slate Belt

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	22.0	270	12	0.5

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

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

Water Quality Parameters

Temperature (°C)	10.5
Dissolved Oxygen (mg/L)	11.8
Specific Conductance (µS/cm)	72
pH (s.u.)	6.2

Water Clarity: Slightly Turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	8
Pool Variety (10)	5
Riffle Habitat (16)	8
Left Bank Stability (7)	5
Right Bank Stability (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	76

Site Photograph

Substrate: mix of boulder, rubble, gravel, sand and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/23/09	10617	25	25	4.17	4.17	Good-Fair
07/09/03	9176	20	20	4.89	4.89	Good-Fair
02/16/98	7501	27	27	3.93	3.93	Not Rated
02/23/93	6101	20	20	3.51	3.51	Not Rated

Taxonomic Analysis

The EPT taxa collected in this reach of Buffalo Creek are similar to other Slate Belt sites in this part of the Cape Fear Basin. *Eurylophella* sp, *Amphinemura* sp, Perlesta sp and seasonal taxa such as *Leucrocuta* sp, and *Isoperla namata* were abundant here. Also, the mayfly Stenonema femoratum was abundant here. This species appears to be adapted to the low water bearing hydrology found in the Slate Belt ecoregion.

Data Analysis

Buffalo Creek rated Good-Fair in 2009, the same rating as in 2003. Two previous samples were Not Rated. The increase in the number of EPT from 2003 to 2009 reflects both seasonality and the higher flows compared to 2003, a drought year.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
GEORGES CR	SR 2142	BB368	03/23/09	Good-Fair

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
CHATHAM	11	03030003	35.602500	-79.258333	17-41	Triassic Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	3.2	270	12	0.5

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	85	10	5	

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

Water Quality Parameters

Temperature (°C)	14.0
Dissolved Oxygen (mg/L)	12.5
Specific Conductance (µS/cm)	75
pH (s.u.)	6.0

Water Clarity: Slightly Turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	19
Bottom Substrate (15)	12
Pool Variety (10)	6
Riffle Habitat (16)	16
Left Bank Stability (7)	6
Right Bank Stability (7)	6
Light Penetration (10)	10
Left Riparian Score (5)	4
Right Riparian Score (5)	4
Total Habitat Score (100)	88

Site Photograph

Substrate: mix of bedrock, boulder, rubble, gravel, sand and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/23/09	10618	19	19	4.07	4.07	Good-Fair
03/10/03	9056	17	17	4.52	4.52	Not Rated
02/25/93	6117	15	15	4.83	4.83	Not Rated

Taxonomic Analysis

Slightly more EPT taxa were collected here than in two previous sampling efforts. Most taxa were typical of nearby Slate Belt streams with some exceptions. The mayfly *Paraleptophlebia* sp, not found at most streams in this area was abundant here in 2009. Uncommonly collected caddisflies found here included *Leptidostoma, Wormaldia, Rhyacophila glaberrima/montana,* and *Neophylax oligius* . The fact that the net spinning caddisfly *Cheumatopsyche* sp was rare suggests that this stream likely ceased flowing in 2008.

Data Analysis

Georges Creek rated Good-Fair in 2009 after being Not Rated in 1993 and 2003. This site had a low EPT Biotic Index compared with other streams in this area suggesting an intolerant macroinvertebrate community here. A high habitat score balances out the fact that this site has a hydrology that includes flow stoppages in drier years.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
ROCKY R	SR 2170	BB376	07/23/08	Not Rated

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
CHATHAM	12	03030003	35.699167	-79.376389	17-43-(8)b	Carolina Slate Belt

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-III; CA	94.7	500	20	0.3

	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)	25.8
Dissolved Oxygen (mg/L)	5.3
Specific Conductance (µS/cm)	621
pH (s.u.)	6.8
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)	9
Left Bank Stability (7)	7
Right Bank Stability (7)	7
Light Penetration (10)	4
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	79

Site Photograph

Substrate Almost all rubble with small amounts of boulder and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/23/08	10511	70	13	6.75	5.73	Not Rated
07/22/03	9204	72	15	6.01	4.99	Good-Fair
09/30/02	9024	---	8	---	4.87	Not Rated
07/09/98	7649	66	18	6.28	5.07	Good-Fair
06/27/97	7312	80	19	6.44	5.50	Good-Fair

Taxonomic Analysis

No major changes in the benthic community were observed.

Data Analysis

This site is located three miles below its confluence with Loves Creek. Data from this site and the US 64 site (upstream of Loves Creek) are used to assess impacts from Siler City's WWTP. Droughts occurred in 2002 and in 2008. Both samples were clearly impacted by the drought because of the lower EPT richness and increased Biotic Index. As a result, the two samples were Not Rated. During non-drought years this site has consistently rated Good-Fair. This site will be resampled in 2009.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
ROCKY R	**US 15-501**	**BB422**	**07/22/08**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
CHATHAM	12	03030003	35.622222	-79.188056	17-43-(8)b	Carolina Slate Belt

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-III; CA	237.0	300	35	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)	30.2
Dissolved Oxygen (mg/L)	7.6
Specific Conductance (µS/cm)	289
pH (s.u.)	8.0
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)	10
Left Bank Stability (7)	7
Right Bank Stability (7)	7
Light Penetration (10)	4
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	80

Site Photograph

Substrate Mix of boulder, rubble, gravel and sand.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/22/08	10506	83	21	6.42	5.18	Good-Fair
07/21/03	9203	78	28	5.63	4.75	Good
07/09/98	7647	77	26	5.26	3.99	Good
07/27/93	6309	84	29	5.44	4.21	Good
07/03/90	5321	96	29	5.54	4.50	Good

Taxonomic Analysis

Although EPT taxa richness decreased from 28 taxa in 2003 to 21 taxa in 2008, there were no major shifts in the benthic community composition. The changes were mainly due to loss of rare taxa. Taxa that were Rare in 2003 but not collected in 2008 include *Plauditus punctiventris* , *Leucrocuta* , *Maccaffertium exiguum* , *Neoperla* , *Hydropsyche demora* , *H. rossi* and *Macrostemum* .

Data Analysis

This is the most downstream basin site on the Rocky River prior to its confluence with the Deep River in Chatham County. Water quality has remained stable at Good until 2008 when the site received a Good-Fair rating. A higher specific conductance and a lower EPT taxa richness were observed in 2008. EPT taxa richness as well as the specific conductance data had been relatively uniform until 2008: 1998 (26 EPT; 126 µS/cm), 2003 (28 EPT; 130 µS/cm), 2008 (21 EPT; 289 µS/cm). The lower EPT taxa richness value observed in 2008 could be attributed to decreased instream flows from the drought or to new development in the watershed. However, *Maccaffertium modestum* , a flow indicator taxa, was present and abundant and no new development was noted in the immediate watershed. Therefore, no definitive conclusions to the decrease in water quality could

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
TICK CR	SR 2120	BB360	03/24/09	Good-Fair

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
CHATHAM	12	03030003	35.665278	-79.385833	17-43-13b	Carolina Slate Belt

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	18.5	430	12	0.5

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

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

Water Quality Parameters

Temperature (°C)	11.6
Dissolved Oxygen (mg/L)	7.3
Specific Conductance (µS/cm)	115
pH (s.u.)	6.1
Water Clarity	Slightly Turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	17
Bottom Substrate (15)	8
Pool Variety (10)	7
Riffle Habitat (16)	14
Left Bank Stability (7)	5
Right Bank Stability (7)	5
Light Penetration (10)	9
Left Riparian Score (5)	3
Right Riparian Score (5)	3
Total Habitat Score (100)	76

Site Photograph

Substrate mix of bedrock, boulder, rubble, gravel, sand and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/24/09	10626	15	15	5.31	5.31	Good-Fair
07/22/03	9205	61	20	6.46	5.93	Good-Fair
07/09/98	7648	15	15	5.93	5.93	Good-Fair

Taxonomic Analysis

The caddisfly *Cheumatopsyche* sp. and the stonefly *Perlesta* sp. were the only abundant taxa of the 15 collected in 2009. Differences between 2009 and previous samples can be explained in the timing of the samples (2009 in spring and previous samples in summer). Tick Creek did not contain the mayfly *Heterocloeon amplum* nor *Stenacron interpunctatum* , two taxa that were frequently collected in other slate belt samples in 2009. This contributed to a lower EPT richness than most slate belt streams in this part of the Cape Fear River basin.

Data Analysis

Tick Creek rated Good-Fair in 2009, the same rating it received in 2003 and 1998. EPT diversity and EPT Biotic Index were similar to previous samples. Seasonal taxonomic differences were the only differences between the summer samplings in 2003 and 1998 and the spring sample in 2009. These small differences do not appear to be related to water quality and the benthic community at Tick Creek appears stable.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
HARLANDS CR	NC 902	BB166	03/19/09	Good-Fair

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
CHATHAM	12	03030003	35.691667	-79.244444	17-43-15	Carolina Slate Belt

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	16.0	393	12	0.5

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

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

Water Quality Parameters

Temperature (°C)	12.4
Dissolved Oxygen (mg/L)	11.3
Specific Conductance (µS/cm)	95
pH (s.u.)	6.5
Water Clarity	Turbid

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	16
Bottom Substrate (15)	12
Pool Variety (10)	5
Riffle Habitat (16)	13
Left Bank Stability (7)	5
Right Bank Stability (7)	7
Light Penetration (10)	9
Left Riparian Score (5)	3
Right Riparian Score (5)	5
Total Habitat Score (100)	79

Site Photograph

no picture available from 2003 or 2009

Substrate mix of bedrock, boulder, rubble, gravel, sand and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/19/09	10615	24	24	4.36	4.36	Good-Fair
07/21/03	9202	16	16	4.97	4.97	Good-Fair
07/10/98	7652	23	23	4.46	4.46	Good
02/03/98	7483	22	22	4.68	4.68	Good-Fair
07/03/90	5322	15	15	3.85	3.85	Good-Fair

Taxonomic Analysis

The number of EPT taxa collected here in 2009 was the highes to date, however spring time sampling was largely the reason for this. There were five seasonal taxa, the mayfly *Eurlophella enoensis* (common) and the stoneflies *Allocapnia* spp, *Amphinuemura sp, Isoperla bilineata* and *I. namata*. Only site where the caddisfly *Wormaldia* spp was abundant. Conversely, the tolerant mayfly *Caenis* sp was absent here but collected at nearly all other Slate Belt sites in 2009. *Cheumatopsyche* sp were abundant here indicating near year-round flow. in 2008

Data Analysis

Harlands Creek rated Good-Fair in 2009. Though more EPT taxa were collected here than in any of the previous samples, seasonal corrections resulting in the same rating as in 2003 and slightly lower than that of 1998. In 2009, there was a higher EPT abundance here than in most Slate Belt streams sampled and given the compostion of EPT taxa, it appears that this site remained flowing in 2008. Habitat scores from 2003 to 2009 were very similar further suggesting that this watershed remains stable.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
BEAR CR	**SR 2155**	**BB372**	**03/23/09**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
CHATHAM	12	03030003	35.631944	-79.236667	17-43-16c	Carolina Slate Belt

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	50.3	310	12	0.5

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	85	10	5	

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

Water Quality Parameters

Temperature (°C)	13.3
Dissolved Oxygen (mg/L)	12.8
Specific Conductance (µS/cm)	95
pH (s.u.)	6.3
Water Clarity	Slightly Turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	20
Bottom Substrate (15)	12
Pool Variety (10)	6
Riffle Habitat (16)	12
Left Bank Stability (7)	6
Right Bank Stability (7)	6
Light Penetration (10)	10
Left Riparian Score (5)	4
Right Riparian Score (5)	5
Total Habitat Score (100)	86

Site Photograph

Substrate mix of bedrock, boulder, rubble, gravel and sand

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/23/09	10625	20	20	4.62	4.62	Good-Fair
03/10/03	9063	16	16	5.05	5.05	Not Rated
07/03/90	5324	15	15	4.82	4.82	Not Rated

Taxonomic Analysis

Abundant EPT collected here in 2009 included the hydrosychid caddisfly *Cheumatopsyche* spp, two seasonal stoneflies (*Isoperla bilineata, I. namata*), the stonefly *Amphinemura* and three mayflies (*Caenis* spp, *Maccaffertum modestum*, *Eurylophella enoensis* - a slate belt specialist). The taxa found here in 2009 was similar to nearby slate belt streams that rated Good-Fair with two exceptions. The baetid mayfly *Plauditus dubius* and the stonefly *Perlesta* spp. were widely collected in slate belt samples but absent here. In 2009, taxa differed slightly from a spring collection in 2003 with the stonefly Strophopteryx spp abundant in 2003 but absent in 2009 and the caddiflies *Ceraclea ancylus* and *C. transversa* common in 2009 but absent in 2003.

Data Analysis

Bear Creek rated Good-Fair in 2009 where previously it was Not Rated due to low summer flows. This site did not have sufficient flow in 2008 to facilitate sampling. Slate Belt geology heavily influences hydrology here such that this stream is difficult to assign a bioclassification to, with its naturally reduced flows, particularly in years of drought (like 2008). The number of EPT taxa collected in 2009 was higher than 2003 (spring sample) and 1990 (summer sample). Reductions and increases in macroinvertebrate taxa are likely more influenced by hyrdology here than by any known anthropogenic factors. Additional samples should be collected at this location in wet (non-drought) years to aid in determining the potential future effects of water quality changes.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
PARKERS CR	SR 1450	BB297	07/21/08	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
HARNETT	7	03030004	35.539167	-78.919722	18-9	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; HQW	3.9	300	3	0.2

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	40	0	60	

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

Water Quality Parameters

Temperature (°C)	22.9
Dissolved Oxygen (mg/L)	6.9
Specific Conductance (µS/cm)	78
pH (s.u.)	6.7

Water Clarity: slightly turbid

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	15
Bottom Substrate (15)	15
Pool Variety (10)	4
Left Bank Stability (10)	8
Right Bank Stability (10)	8
Light Penetration (10)	10
Left Riparian Score (5)	4
Right Riparian Score (5)	4
Total Habitat Score (100)	83

Site Photograph

Substrate: Mixture of rubble, gravel and sand with some silt present.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/21/08	10502	---	18	---	4.59	Good
04/30/03	9105	---	26	---	4.54	Excellent
07/08/98	7644	---	19	---	5.44	Good
08/10/93	6339	83	25	5.45	4.51	Good

Taxonomic Analysis

A sharp decline in the number of mayfly and caddisfly taxa was observed in 2008. Baetid species which require flow were either absent or reduced in abundance from previous samples.

Data Analysis

Parkers Creek, which is classified as High Quality Waters, is a tributary of the Cape Fear River near Lillington. Land use at SR 1450 is primarily pasture and the riparian zone has been reduced to less than 18 meters. The site has rated Good since 1993 and had an Excellent rating in 2003 but dropped to Good again in 2008. EPT taxa richness decreased from 26 taxa in 2003 to 18 taxa in 2008; however, EPT biotic index was close to the value recorded in 2003. The decline in EPT taxa richness may be due to drought effects.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
NEILLS CR	SR 1441	BB294	04/24/07	Good-Fair

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
HARNETT	7	03030004	35.514167	-78.765278	18-16-(0.7)b	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-IV	4.0	270	3	0.3

	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	n/a	n/a

Water Quality Parameters

Temperature (°C)	17.5
Dissolved Oxygen (mg/L)	9.3
Specific Conductance (µS/cm)	70
pH (s.u.)	6.5
Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	15
Bottom Substrate (15)	15
Pool Variety (10)	9
Left Bank Stability (7)	10
Right Bank Stability (7)	9
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	83

Site Photograph

Substrate mix of bedrock, boulder, rubble, gravel, sand and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
04/24/07	10156	67	9	6.09	5.50	Good-Fair
03/12/03	9072	6	6	4.25	4.25	Poor
02/11/98	7494	19	19	5.10	5.10	Good-Fair
03/02/93	6122	18	18	4.64	4.64	Good-Fair

Taxonomic Analysis

In 2003, only six EPT taxa were collected; four were winter stoneflies, leaving a seasonally corrected EPT richness of two. No mayflies, of which many are flow dependent, were collected suggesting that the stream may have stopped flowing. In 2007, mayflies were again collected in the sample.

Data Analysis

This site is located above the confluence with Kenneth Creek. This upstream segment includes parts of the towns of Fuquay-Varina and Angier in its watershed. This site rated Good-Fair in 1993 and 1998. The bioclassification dropped to Poor in 2003. Because the benthic community was so sparse in 2003, there was some question to whether the stream may have stopped flowing during the 2002 drought. In 2007, the bioclassification returned to Good-Fair.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
KENNETH CR	**SR 1441**	**BB295**	**04/24/07**	**Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
HARNETT	7	03030004	35.514444	-78.786944	18-16-1-(2)	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-IV	16.6	200	6	0.3

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

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Fuquay-Varina WWTP	NC0028118	1.2

Water Quality Parameters

Temperature (°C)	15.9
Dissolved Oxygen (mg/L)	8.3
Specific Conductance (µS/cm)	110
pH (s.u.)	6.6
Water Clarity	turbid

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	10
Bottom Substrate (15)	14
Pool Variety (10)	4
Left Bank Stability (10)	9
Right Bank Stability (10)	5
Light Penetration (10)	5
Left Riparian Score (5)	5
Right Riparian Score (5)	0
Total Habitat Score (100)	67

Site Photograph

Substrate Mix of boulder, rubble, gravel, sand, silt and bedrock

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
04/24/07	10155	76	16	6.72	6.28	Fair
03/10/03	9071	4	4	5.60	5.60	Poor
02/11/98	7493	5	5	6.22	6.22	Poor
03/02/93	6121	43	7	6.22	5.28	Poor

Taxonomic Analysis

A far greater number of EPT taxa were found in 2007 than in previous years. However, these taxa are tolerant of aquatic pollution. Abundant EPT taxa here in 2007 include the mayflies *Baeits flavistriga* and *B. intercalaris* , and the caddisflies *Cheumatopsyche* spp and *Hydropsyche betteni.* Comparing Kenneth Creek at SR 1441 to an upstream site along the same waterbody (and also upstream of the Fuquay-Varina WWTP outfall) notable taxa differences occurred in the benthic communities. The mayfly *Stenacron interpunctatum* , common upstream site, was not collected at SR 1441. Also, three stoneflies collected upstream were not found here: *Eccoptura xanthenes, Haploperla brevis* and *Perlesta* spp. The absence of *Perlesta* spp is significant since this stonefly is the most tolerant of the three and was collected (Abundant) at nearby sites in 2007. There were two very pollution tolerant midges collected at SR 1441 in 2007, *Chironomus* spp and *Cricotopus bicinctus* . Both were abundant in the sample.

Data Analysis

This site rated Fair in 2007, a slight improvement from the Poor bioclassification received in 1993, 1998 and 2003. Taxa collected at sites upstream of the Fuquay-Varina WWTP outfall were not found at this SR 1441, yet habitats were similiar, suggesting that the WWTP continues to degrade water quality in Kenneth Creek. The Fuquay-Varina WWTP is scheduled to tie into a large Harnett County facility which may lead to an improvement in water quality in the Kenneth Creek watershed.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
UPPER LITTLE R	SR 1222	BB261	07/21/08	Good-Fair

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
HARNETT	13	03030004	35.406944	-79.063333	18-20-(8)a	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	54.0	300	12	0.3

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	60	10	0	30

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

Water Quality Parameters

Temperature (°C)	28.3
Dissolved Oxygen (mg/L)	7.7
Specific Conductance (µS/cm)	78
pH (s.u.)	6.7

Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	15
Bottom Substrate (15)	15
Pool Variety (10)	4
Left Bank Stability (10)	9
Right Bank Stability (10)	9
Light Penetration (10)	7
Left Riparian Score (5)	4
Right Riparian Score (5)	4
Total Habitat Score (100)	82

Site Photograph

Substrate Mostly sand with a small amount of rubble, gravel, and silt.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/21/08	10504	57	16	6.54	5.54	Good-Fair
07/22/03	9206	61	17	6.28	5.60	Good-Fair
07/13/98	7672	72	21	6.40	5.36	Good-Fair
08/10/93	6338	56	13	6.17	4.88	Good-Fair

Taxonomic Analysis

Although this site has rated Good-Fair since 1993, changes have occured in the EPT community compostion. No stoneflies have been collected since 1993. Five stonefly taxa were collected in 1993 and only one taxon was collected in 1998. In addition, some caddisfly species that were either common or abundant in past collections have either disappeared or only one or two individuals were collected in 2008.

Data Analysis

This Upper Little River site is located in the headwaters but only two miles downstream of Lake Trace, a 315 acre impoundment. The site has rated Good-Fair since 1993. However, the Biotic Index has been slowly increasing. Should this trend continue, the site will likely decline in rating.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
BARBEQUE CR	**SR 1285**	**04/16/08**	**BF125**	**Not Rated**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
HARNETT	13	03030004	35.3379652	-79.0455437	18-20-13	Sand Hills

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	47.2	298	9	0.6	Yes

	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)	13.2
Dissolved Oxygen (mg/L)	9.4
Specific Conductance (µS/cm)	32
pH (s.u.)	4.9

Water Clarity	Clear, tannin stained

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	19
Bottom Substrate (15)	13
Pool Variety (10)	8
Left Bank Stability (10)	10
Right Bank Stability (10)	10
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**95**

Site Photograph

Substrate Sand, gravel, and cobble

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/16/08	2008-17	10	---	Not Rated

Most Abundant Species Dusky Shiner

Exotic Species None

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

Data Analysis

This is the first fish community sample collected at this site. **Watershed** -- drains western Harnett County; tributary to the Little River; no municipalities within the watershed. **Habitat** -- very high quality instream and riparian habitats -- coarse woody debris; snags, undercuts, and aquatic plants. **Water Quality** -- typical for a Sand Hills stream -- clear, stained water of low pH and conductivity. **2008** -- a typical Sand Hills fauna, but lacking darters, American Eel, and intolerant species; Chain Pickerel were present, but represented only by young-of-year and not included in the total species count.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
LITTLE R	**NC 22**	**04/09/08**	**BF4**	**Not Rated**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MOORE	14	03030004	35.26944444	-79.41694444	18-23-(1)	Sand Hills

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
WS-III;HQW	27.3	400	7	0.6	No

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

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

Water Quality Parameters

Temperature (°C)	14.3
Dissolved Oxygen (mg/L)	8.9
Specific Conductance (µS/cm)	35
pH (s.u.)	4.7

Water Clarity	Clear, tannin stained

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	20
Bottom Substrate (15)	14
Pool Variety (10)	8
Left Bank Stability (10)	10
Right Bank Stability (10)	9
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	3
Total Habitat Score (100)	**94**

Site Photograph

Substrate Gravel and sand

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/09/08	2008-04	13	---	Not Rated
09/15/03	2003-54	13	---	Not Rated

Most Abundant Species Bluegill

Exotic Species Redear Sunfish

Species Change Since Last Cycle

Gains -- Golden Shiner, Redfin Pickerel, Bluespotted Sunfish, Redbreast Sunfish, Redear Sunfish, and Largemouth Bass. **Losses** -- American Eel, Margined Madtom, Pirate Perch, Chain Pickerel, Pumpkinseed, and Piedmont Darter.

Data Analysis

Watershed -- drains central Moore County; no municipalities within the watershed. **Habitat** -- site borders the Little River Golf and Resort along the right riparian zones, but still maintains high quality instream and riparian habitats including runs, riffles, pools, roots, and snags. **Water Quality** -- a typical Sand Hills stream with swift flow; clear, but stained water of low pH; conductivity has been 65 and 35 µS/cm, pH 6.2 and 4.7 s.u.. **2008** -- the number of fish collected was more than three times the number collected in 2003 (389 vs. 121; 2.6 vs. 9.4 fish/100 seconds); 72% (280/389) of all the fish were Age 1 and 2 Bluegill; proximity to or overflow from the golf course ponds may be the source of the Bluegill; Dusky Shiner and suckers were absent; number of species with multiple ages was low, only 4 of the 13 species were represented by multiple age classes; Chain Pickerel were present, but represented only by young-of-year and not included in the total species count. **2003 & 2008** -- 19 species are known from the site, including eight species of centrarchids.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
JAMES CR	**off SR 2026**	**04/10/08**	**BF17**	**Not Rated**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MOORE	14	03030004	35.18722222	-79.29333333	18-23-13	Sand Hills

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
WS-III	12.8	298	5	0.75	Yes

	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)	14.1
Dissolved Oxygen (mg/L)	7.9
Specific Conductance (µS/cm)	28
pH (s.u.)	4.5

Water Clarity	Clear, tannin stained

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	20
Bottom Substrate (15)	7
Pool Variety (10)	10
Left Bank Stability (10)	10
Right Bank Stability (10)	10
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**92**

Site Photograph

Substrate Sand and organic detritus

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/10/08	2008-07	13	---	Not Rated
09/16/03	2003-57	7	---	Not Rated

Most Abundant Species Dusky Shiner

Exotic Species None

Species Change Since Last Cycle

Gains -- Sandhills Chub, Yellow Bullhead, Flat Bullhead, Tadpole Madtom, Redfin Pickerel, Mud Sunfish, Dollar Sunfish, and Tessellated Darter. **Losses** -- Bluespotted Sunfish and Sawcheek Darter.

Data Analysis

Watershed -- begins near the Weymouth Woods Sandhills Nature Preserve in the southeastern area of Southern Pines and includes southeastern Moore and northwestern Hoke counties, including Fort Bragg; tributary to the Little River. **Habitat** -- high quality instream and riparian habitats including mature bottomland forest, snags, *Fissidens, Orontium aquaticum* (Golden Club), large coarse woody debris, and organic detritus matter. **Water Quality** -- a typical Sand Hills stream with low pH and conductivity; conductivity has been 26 and 28 µS/cm, pH 5.6 and 4.5 s.u. **2008** -- a typical Sand Hills fauna, two specimens of the Sandhills Chub, a species of Special Concern, were collected; almost twice as many fish (40 vs. 20 and 1.0 vs. 0.6 fish/100 seconds) and species (13 vs. 7) collected in 2008 than in 2003, only ~ one-fourth of the species were represented by multiple ages, 8 of the 13 species were represented by only 1 or 2 fish per species. **2003 & 2008** -- 15 species are known from the site, including four species of catfish; no exotic species have been collected at this site.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
FLAT CR	**Manchester Rd**	**04/10/08**	**BF1**	**Not Rated**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
HOKE	14	03030004	35.1825	-79.1775	18-23-15	Sand Hills

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
WS-III	7.6	209	4	0.5	Yes

	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)	14.7
Dissolved Oxygen (mg/L)	9.1
Specific Conductance (µS/cm)	17
pH (s.u.)	4.5

Water Clarity	Clear, tannin stained

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	20
Bottom Substrate (15)	13
Pool Variety (10)	10
Left Bank Stability (10)	10
Right Bank Stability (10)	10
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**98**

Site Photograph

Substrate Sand, gravel, cobble, and marl (clay)

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/10/08	2008-09	7	---	Not Rated
09/16/03	2003-58	12	---	Not Rated

Most Abundant Species Dusky Shiner **Exotic Species** None

Species Change Since Last Cycle **Gains** -- Creek Chubsucker. **Losses** -- American Eel, Eastern Mudminnow, Margined Madtom, Redfin Pickerel, Mud Sunfish, and Tessellated Darter.

Data Analysis

Watershed -- within the property of Fort Bragg draining northeastern Hoke County; site is ~ 0.5 mile above the creek's confluence with the Little River; no municipalities within the watershed. **Habitat** -- along with Crane and Muddy creeks, the highest scoring fish community site in 2008; habitats include coarse woody debris, snags, and undercuts; banks steep, may be entrenched from historical poor landuse practices. **Water Quality** -- a typical Sand Hills stream with very low conductivity (15 and 17 µS/cm) and pH (4.8 and 4.5 s.u.). **2008** -- a typical Sand Hills fauna with Dusky Shiner as the dominant species; darters absent; almost twice as many fish collected in 2008 than in 2003 (135 vs. 73 and 3.3 vs. 1.6 fish/100 seconds); seven specimens of the Sandhills Chub, a Species of Special Concern, were collected in 2008 representing three age groups. **2003 & 2008** -- 13 species are known from the site; Sandhills Chub was collected in 2003 and 2008; no exotic species have been collected at this site; dominant species in 2003 was the Margined Madtom which were common in the riffles below the culvert, in 2008 the creek was sampled upstream from the culvert where the riffles and the species were absent.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
CRANE CR	**SR 1810**	**04/09/08**	**BF48**	**Not Rated**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MOORE	14	03030004	35.31	-79.32444444	18-23-16a	Sand Hills

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
WS-III	16.8	400	6	0.8	Yes

	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)	13.7
Dissolved Oxygen (mg/L)	9.4
Specific Conductance (µS/cm)	52
pH (s.u.)	5.9

Water Clarity	Clear, tannin stained

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	20
Bottom Substrate (15)	13
Pool Variety (10)	10
Left Bank Stability (10)	10
Right Bank Stability (10)	10
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**98**

Site Photograph

Substrate Gravel, sand, and cobble

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/09/08	2008-05	4	---	Not Rated
04/23/02	2002-29	9	---	Not Rated

Most Abundant Species Spotted Sucker

Exotic Species None

Species Change Since Last Cycle

Gains -- Spotted Sucker. **Losses** -- Bluehead Chub, Highfin Shiner, Pirate Perch, Redfin Pickerel, Redbreast Sunfish, and Tessellated Darter.

Data Analysis

Watershed -- drains eastern Moore County; no municipalities within the watershed; tributary to the Little River. **Habitat** -- along with Muddy and Flat Creeks, the highest scoring fish community site in 2008; very high quality instream and riparian habitats -- runs, pools, snags, and undercuts, wide and forested riparian zones, stable banks, and swift, clear flow. **Water Quality** -- highest pH of any fish community site in the Sand Hills in 2008; conductivity has been 52 and 53 µS/cm, pH 6.3 and 5.9 s.u. **2008** -- fewest species and fish of any fish community site in the basin in 2008; only 7 fish of 4 species collected in 2008 contrasted to 281 fish of 9 species collected in 2002; the fish were 3 Spotted Sucker (383-470 mm TL), 1 Warmouth, 2 Bluegill, and 1 Creek Chub; catch per unit of effort was 0.3 fish/100 seconds shocking time vs. 8.3 in 2002; stream probably ceased flowing and dried-up during the 2007 drought. **2002 & 2008** -- both low flow years; 10 species are known from the site, including 3 species of cyprinids and centrarchids; no American Eels or exotic species have been collected at this site.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
BEAVER CR	**SR 1825**	**04/09/08**	**BF49**	**Not Rated**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MOORE	14	03030004	35.26916667	-79.22694444	18-23-16-8	Sand Hills

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
WS-III	13.5	252	8	0.6	Yes

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

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

Water Quality Parameters

Temperature (°C)	14.6
Dissolved Oxygen (mg/L)	8.9
Specific Conductance (µS/cm)	36
pH (s.u.)	4.6

Water Clarity	Clear, tannin stained

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	20
Bottom Substrate (15)	13
Pool Variety (10)	9
Left Bank Stability (10)	10
Right Bank Stability (10)	10
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**97**

Site Photograph

Substrate Cobble, gravel, sand, and boulder

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/09/08	2008-06	5	---	Not Rated
04/22/02	2002-26	12	---	Not Rated

Most Abundant Species Bluegill

Exotic Species None

Species Change Since Last Cycle

Gains -- American Eel. **Loses** -- Margined Madtom, Redfin Pickerel, Chain Pickerel, Bluespotted Sunfish, Redbreast Sunfish, Warmouth, Largemouth Bass, and Tessellated Darter.

Data Analysis

Watershed -- drains northeastern Moore, southeastern Lee, and southwestern Harnett counties; no municipalities within the watershed; tributary to Crane Creek. **Habitat** -- very high quality instream and riparian habitats, including dense riparian holly forests, and *Fissidens* on the logs and boulders. **Water Quality** -- very clear and swift flow; conductivity has been 27 and 36 µS/cm, pH 5.4 and 4.6 s.u. **2008** -- number of fish and the number of species collected in 2008 was ~ 40% and 25%, respectively, of the numbers collected in 2002; catch per unit effort was 3.2 and 1.0 fish/100 seconds, respectively in 2002 and 2008; declines suggested that the stream may have stopped flowing or dried-up during the 2007 drought; 20 of the 31 fish collected were Bluegill. **2002 & 2008** -- 13 species are known from the site, including 6 species of centrarchids, but no species of cyprinids; no exotic species have been collected at this site.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
BUFFALO CR	**SR 1001**	**04/10/08**	**BF21**	**Not Rated**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MOORE	14	03030004	35.18972222	-79.13666667	18-23-18	Sand Hills

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
WS-III	18.3	249	6	0.75	Yes

	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)	14.3
Dissolved Oxygen (mg/L)	7.7
Specific Conductance (µS/cm)	34
pH (s.u.)	4.3

Water Clarity	Clear, tannin stained

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	20
Bottom Substrate (15)	15
Pool Variety (10)	8
Left Bank Stability (10)	10
Right Bank Stability (10)	10
Light Penetration (10)	10
Left Riparian Score (5)	3
Right Riparian Score (5)	5
Total Habitat Score (100)	**96**

Site Photograph

Substrate Cobble, white gravel and sand

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/10/08	2008-08	11	---	Not Rated
09/15/03	2003-56	7	---	Not Rated
05/07/98	98-34	6	---	Not Rated

Most Abundant Species Sawcheek Darter and Pirate Perch

Exotic Species None

Species Change Since Last Cycle

Gains -- American Eel, Yellow Bullhead, Eastern Mosquitofish, Mud Sunfish, Warmouth, and Dollar Sunfish.
Losses -- Redfin Pickerel and Banded Sunfish.

Data Analysis

Watershed -- drains the south-central corner of Moore and southwestern Harnett counties; no municipalities with the watershed. **Habitat** -- high quality instream and riparian habitats, including runs, gravel riffles, deadfalls, snags, and roots; and open canopy at the bridge with *Juncus repens* and *Batrachospermum* abundant in the riffles at the bridge; left riparian zone was logged ~ 5 years ago, but a narrow buffer was kept intact. **Water Quality** -- swift clear flow, low pH and conductivity; conductivity has ranged from 21-34 µS/cm, pH from 4.3-4.9 s.u. **2008** -- very diverse, but no species was represented by multiple age classes; stream may have ceased flowing or gone dry in 2007; species collected for the first time were the Yellow Bullhead, Eastern Mosquitofish, Mud Sunfish, Warmouth, and Dollar Sunfish. **1998-2008** -- number of fish collected has always been very low, 14-29 fish/collection, 0.5-1.1 fish/100 seconds; 13 species are known from the site, including 5 species of centrarchids; no cyprinids or exotic species have ever been collected at this site.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
MUDDY CR	**SR 1001**	**04/18/08**	**BF22**	**Not Rated**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
CUMBERLAND	14	03030004	35.19666667	-78.99861111	18-23-26	Sand Hills

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	16.1	170	6	0.5	Yes

	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)	15.6
Dissolved Oxygen (mg/L)	8.8
Specific Conductance (µS/cm)	31
pH (s.u.)	4.3

Water Clarity	Clear, tannin stained

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	20
Bottom Substrate (15)	13
Pool Variety (10)	10
Left Bank Stability (10)	10
Right Bank Stability (10)	10
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**98**

Site Photograph

Substrate Sand and gravel

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/18/08	2008-20	16	---	Not Rated
09/16/03	2003-59	14	---	Not Rated

Most Abundant Species Dusky Shiner, Redbreast Sunfish, and Sawcheek Darter

Exotic Species None

Species Change Since Last Cycle

Gains -- Sandhills Chub, Lake Chubsucker, Redfin Pickerel, Mud Sunfish, Flier, and Tessellated Darter.
Losses -- Yellow Bullhead, Bluespotted Sunfish, Spotted Bass, and Banded Pygmy Sunfish.

Data Analysis

Watershed -- drains southern Harnett County and a small portion of northern Cumberland County; now part of the Fort Bragg property; tributary to the Little River, site was ~ 0.7 mile above its confluence with the river; no municipalities within the watershed. **Habitat** -- along with Crane and Flat Creeks, the highest scoring fish community site in 2008; coarse woody debris, undercuts, runs, snags, mature pine forest; and bluff on left bank. **Water Quality** -- a typical Sand Hills stream with low conductivity and pH; conductivity has been 22 and 31µS/cm, pH 4.4 and 4.3 s.u. **2008** -- a typical Sand Hills fauna; one specimen of the Sandhills Chub, a species of Special Concern, was collected; only Sand Hills site from which Lake Chubsucker (n=2) was collected; two intolerant species present (Sandhills Chub and Sawcheek Darter); 10 of 16 species represented by only 1 or 2 fish per species; only 5 of 16 species were represented by multiple age classes. **2003 & 2008** -- 20 species are known from the site, including seven species of centrarchids.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
TANK CR	**Manchester Rd**	**06/27/08**	**BF126**	**Not Rated**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
CUMBERLAND	14	03030004	35.18773	-79.00623	18-23-27	Sand Hills

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	5.8	155	4	0.3	No

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	75	0	0	25 (military base and WWTP)

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

Water Quality Parameters

Temperature (°C)	26.0
Dissolved Oxygen (mg/L)	5.0
Specific Conductance (µS/cm)	70
pH (s.u.)	5.9

Water Clarity	Clear, tannin stained

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	15
Bottom Substrate (15)	7
Pool Variety (10)	10
Left Bank Stability (10)	9
Right Bank Stability (10)	9
Light Penetration (10)	9
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**84**

Site Photograph

Substrate Sand and white gravel

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
06/27/08	2008-71	9	---	Not Rated

Most Abundant Species	Redbreast Sunfish	**Exotic Species**	Redear Sunfish

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

Data Analysis

This is the first fish community sample collected at this site. **Watershed** -- drains northwestern Cumberland County entirely within the Fort Bragg property; receives runoff from Pope AFB; immediate watershed is forested with large pine tress and Oriental privet; stream channel and mouth were altered, stream now flows into the Little River at the Fort Bragg WWTP. **Habitat** -- sandy runs, pools, a few short riffles; undercuts, some urban debris in the stream. **Water Quality** -- low flow; conductivity elevated for a Sand Hills stream; highest pH of any fish community site in the Sand Hills in 2008. **2008** -- a typical altered urban stream fauna; 97% of the fish and 7 of the 9 species were sunfish of which 75% were large, tolerant Redbreast Sunfish; cyprinids, suckers, and intolerant species were absent; and the greatest percentage of tolerant fish (76%) of any Sand Hills fish community site in 2008.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
ANDERSON CR	**SR 2031**	**04/16/08**	**BF52**	**Not Rated**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
HARNETT	14	03030004	35.26583333	-78.81944444	18-23-32	SE Floodplains and Low Terraces

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	34.7	98	10	0.8	Yes

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	95	5	0	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)	8.8
Specific Conductance (µS/cm)	54
pH (s.u.)	5.3

Water Clarity	Black water

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	19
Bottom Substrate (15)	14
Pool Variety (10)	9
Left Bank Stability (10)	9
Right Bank Stability (10)	9
Light Penetration (10)	10
Left Riparian Score (5)	4
Right Riparian Score (5)	5
Total Habitat Score (100)	**94**

Site Photograph

Substrate Cobble, marl (clay hardpan), gravel, and white sand

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/16/08	2008-16	8	---	Not Rated
10/02/03	2003-63	14	---	Not Rated
05/06/98	98-33	12	---	Not Rated

Most Abundant Species Tessellated Darter

Exotic Species None

Species Change Since Last Cycle

Gains -- Creek Chub and Largemouth Bass. **Losses** -- Bowfin, Spotted Sucker, Notchlip Redhorse, Yellow Bullhead, Flat Bullhead, Redfin Pickerel, Spotted Bass, Sawcheek Darter, and Piedmont Darter.

Data Analysis

Watershed -- drains southern Harnett County; is on the eastern edge of the Sandhills and borders the Southeastern Floodplains and Low Terraces and the Rolling Coastal Plain ecoregions; tributary to the Little River, site is ~ 1.3 miles above the confluence with the river; no municipalities within the watershed. **Habitat** -- very high quality instream and riparian habitats; very swift water; riffles, runs, side pools,and deep mid-channel runs/pools. **Water Quality** -- dark, tea colored water; conductivity has ranged from 35-54 µS/cm, pH from 5.0 to 5.6 s.u. **2008** -- stream may have ceased flowing during the 2007 drought; number of fish collected was one-half the total in 2003; intolerant species were absent; a typical Sand Hills fauna; species collected for the first time were Spotted Sucker and Largemouth Bass. **1998-2008** -- 19 species are known from the site; Sandhills Chub, a Species of Special Concern, and Green Sunfish were last collected at the site in 1998; catch per unit effort was 1.8, 1.5, and 1.3 fish/100 seconds in 1998, 2003, and 2008, respectively.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
ANDERSON CR	**SR 2031**	**BB353**	**07/21/08**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
HARNETT	14	03030004	35.266111	-78.819444	18-23-32	Southeastern Floodplains and Low Terraces

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	34.7	100	5	0.3

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

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

Water Quality Parameters

Temperature (°C)	23.0
Dissolved Oxygen (mg/L)	8.2
Specific Conductance (µS/cm)	80
pH (s.u.)	5.4
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	15
Instream Habitat (20)	15
Bottom Substrate (15)	15
Pool Variety (10)	10
Left Bank Stability (7)	9
Right Bank Stability (7)	9
Light Penetration (10)	9
Left Riparian Score (5)	4
Right Riparian Score (5)	4
Total Habitat Score (100)	90

Site Photograph

Substrate Gravel and sand with small amounts of silt and hardpan clay.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/21/08	10503	---	22	---	3.94	Good
07/23/03	9207	---	20	---	3.78	Good
09/19/00	8176	---	20	---	3.00	Good
07/14/98	7674	---	18	---	3.62	Good-Fair
08/24/93	6353	---	13	---	2.95	Good-Fair

Taxonomic Analysis

Other than presence/absence of Rare taxa, no major shifts in the benthic community were observed. Five taxa that were not previously collected were collected in 2008. Of which, three are tolerant, *Centroptilum* (T.V.=606), *Plauditus dubius* (T.V.=5.8), and *Pseudocloeon propinquum* (T.V.=5.8); one is moderately tolerant, *Heterocloeon anoka* (T.V.=3.5); and one is intolerant, *Psilotreta frontalis* (T.V.=0).

Data Analysis

Anderson Creek, located in southern Harnett County, is on the eastern edge of the Sand Hills and borders the Southeastern Floodplains and Low Terraces and the Rolling Coastal Plain ecoregions. The site rated Good-Fair in 1993 and 1998. It improved to Good in 2000 during a special study and has since rated Good. EPT taxa richness has been increasing and has nearly doubled since 1993. EPT BI has been increasing as well, suggesting a shift to a more tolerant community. Should this trend continue, the site will likely decline in rating.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
CROSS CR	**NC 87-210**	**BB75**	**08/14/08**	**Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
CUMBERLAND	15	3030004	35.05555556	-78.8725	18-27-(3)b	Southeastern Floodplains and Low Terraces

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	26.4	63	7	0.5

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

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
NONE	N/A	N/A

Water Quality Parameters

Temperature (°C)	22.6
Dissolved Oxygen (mg/L)	7.3
Specific Conductance (µS/cm)	43
pH (s.u.)	6

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (15)	10
Instream Habitat (20)	13
Bottom Substrate (15)	14
Pool Variety (10)	5
Left Bank Stability (10)	6
Right Bank Stability (10)	6
Light Penetration (10)	7
Left Riparian Score (5)	1
Right Riparian Score (5)	1
Total Habitat Score (100)	63

Site Photograph

Substrate	Rip-rap boulder, cobble, gravel and sand.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/14/08	10521	7	7	5.88	5.88	Fair
08/08/03	9270	38	9	6.33	5.95	Good-Fair
08/23/93	6348	10	10	6.16	6.16	Fair

Taxonomic Analysis

There have been two EPT samples and one Full-Scale sample taken at this station since 1993. Regardless of sampling effort, the EPT taxa richness and EPTBI has been quite stable. Indeed, there have been five EPT taxa collected at each sampling event and include the tolerant mayflies *Pseudocloeon propinquum* , *Maccaffertium modestum* and the tolerant caddisflies *Cheumatopsyche sp* ., *Hydropsyche betteni* , and the facultative caddisly *Nectopsyche exquisita* .

Data Analysis

As is demonstrated by the stable EPTBI and EPT taxa richness, the water quality at this site appears to have remained largely unchanged since sampling commenced in 1993. This conclusion is supported by the virtually identical specific conductance and pH data from 2003 (44 µS/cm; 6.3) and 2008 (43 µS/cm; 6.0). The only metric that varied significantly in 2008 relative to the other EPT collection was the EPT abundance. The 2008 sample resulted in the lowest EPT abundance (29) and represented a modest decrease from levels measured in 1993 (43). Given the virtually uniform EPT taxa richness, EPTBI, and water chemistry data, the decline in EPT abundance was possibly the result of high flows observed during the collection which may have limited access to some habitat types. This might have also accounted for the slightly lowered EPT taxa richness seen in 2008.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
L CROSS CR	WASHINGTON DR.	BB451	08/14/08	Poor

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
CUMBERLAND	15	3030004	35.06777778	-78.895	18-27-4-(2)	Atlantic Southern Loam Plains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	9.7	100	4	0.4

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	20	50	20	10

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
NONE	N/A	N/A

Water Quality Parameters

Temperature (°C)	24.7
Dissolved Oxygen (mg/L)	7.1
Specific Conductance (µS/cm)	37
pH (s.u.)	6.1

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (15)	14
Instream Habitat (20)	13
Bottom Substrate (15)	13
Pool Variety (10)	4
Left Bank Stability (10)	4
Right Bank Stability (10)	4
Light Penetration (10)	2
Left Riparian Score (5)	2
Right Riparian Score (5)	1
Total Habitat Score (100)	57

Site Photograph

Substrate Sand, gravel, and a trace of rip-rap boulder.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/14/08	10523	4	4	6.91	6.91	Poor
08/04/03	9266	41	7	7.37	6.82	Fair
03/03/98	7538	37	7	6.91	6.10	Fair

Taxonomic Analysis

Although Full-Scale samples have been collected here in the past, an EPT was employed in 2008 due to an extreme lack of instream habitat. While this discrepancy in sampling effort likely contributed to some of the reduction in EPT taxa present, it probably does not account for all of it as some of the reduction in EPT is suggestive of reduced flows and lessened in-stream edge habitat. For example, a strong indicator of flow (*Maccaffertium modestum)* was present in all previous collections but absent from the 2008 sample. In addition, many edge-dwelling caddisflies (*Oecetis cinerascens* , *Oecetis persimilis* , and *Pycnopsyche sp* .) were also absent in 2008 but collected from the 1998 and 2003 samples.

Data Analysis

This station is located approximately 600 meters downstream of Glenville Lake. The lower EPT taxa richness value obsereved in 2008 is most likely attributed to reduced instream flows from the drought and may have been further compounded by a corresponding reduction in water release from Glenville Lake. This conclusion is supported by the absence of flow indicator taxa (*Maccaffertium modestum*) as well as an absence of edge taxa (*Oecetis cinerascens, Oecetis persimilis,* and *Pycnopsyche sp* .). Moreover, the specific conductance data has been relatively uniform: 1998 (39 µS/cm), 2003 (48 µS/cm), 2008 (37 µS/cm) further indicating that the reduction in EPT taxa richness is likely not related to a change in water quality but may be more related to a reduction in flow and habitat availability.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
GUM LOG CANAL	**SR 1728**	**04/16/08**	**BF45**	**Not Rated**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
CUMBERLAND	15	03030004	35.06444444	-78.8425	18-28	SE Floodplains & Low Terraces

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	30.8	72	8	0.4	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	25	10	65	0

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

Water Quality Parameters

Temperature (°C)	11.2
Dissolved Oxygen (mg/L)	9.7
Specific Conductance (µS/cm)	89
pH (s.u.)	5.0

Water Clarity	Clear, tannin stained

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	17
Bottom Substrate (15)	15
Pool Variety (10)	8
Left Bank Stability (10)	3
Right Bank Stability (10)	3
Light Penetration (10)	4
Left Riparian Score (5)	1
Right Riparian Score (5)	1
Total Habitat Score (100)	**67**

Site Photograph

Substrate Cobble, gravel, and sand

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/16/08	2008-15	23	---	Not Rated
10/02/03	2003-65	22	---	Not Rated

Most Abundant Species Bluegill

Exotic Species Green Sunfish

Species Change Since Last Cycle

Gains --Golden Shiner, Sandbar Shiner, Flat Bullhead, Margined Madtom, Pirate Perch, Chain Pickerel, Warmouth, and Dollar Sunfish. **Losses** -- Spottail Shiner, Spotted Sucker, Snail Bullhead, Yellow Bullhead, Brown Bullhead, Bluespotted Sunfish, and Spotted Bass.

Data Analysis

Watershed -- includes eastern Cumberland County, east of the Cape Fear River and west of I-95; tributary to Locks Creek; straddles the Sand Hills and the Atlantic Southern Loam Plains; no municipalities within the watershed. **Habitat** -- riffles, runs, side snag pools; very narrow riparian zones; cattle with access to stream from both banks. **Water Quality** -- greatest conductivity of any fish community site in the Sand Hills in 2008; conductivity has been 75 and 89 µS/cm, pH 6.3 and 5.0 s.u. **2008** -- most species and fish collected (n=397, 13.0 fish/100 seconds) in 2008 from any Sand Hills site; seven species of sunfish; five species (White Shiner, Bluehead Chub, Sandbar Shiner, Notchlip Redhorse, and Green Sunfish) collected in 2008 were collected only at this site; community includes Coastal Plan and Piedmont species. **2003 & 2008** -- 30 species are known from the site, including 10 species of centrarchids, 6 species of cyprinids, and 5 species of catfish; community and site are very atypical for a Sand Hills stream, if rated with Piedmont criteria, NCIBI = 58 and NCIBI Rating = Excellent, in 2003 the score was 60 and the rating was also Excellent.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
ROCKFISH CR	SR 1432	BB293	09/04/08	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
HOKE	15	3030004	34.96805556	-79.10972222	18-31-(18)	Atlantic Southern Loam Plains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
B		140	9	1.3

	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)
City of Raeford	NC0026514001	3.0

Water Quality Parameters

Temperature (°C)	21.5
Dissolved Oxygen (mg/L)	6.7
Specific Conductance (µS/cm)	52
pH (s.u.)	5
Water Clarity	Clear, tannic

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	14
Bottom Substrate (15)	13
Pool Variety (10)	5
Left Bank Stability (10)	10
Right Bank Stability (10)	10
Light Penetration (10)	9
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	86

Site Photograph

Substrate Sand, detritus and a trace of silt.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
09/04/08	10525	21	21	3.43	3.43	Good
09/03/03	9301	23	23	3.73	3.73	Good
07/15/98	7679	60	25	5.44	3.90	Good
05/19/94	6495	23	23	3.67	3.67	Good
08/24/93	6354	61	25	4.86	3.54	Good

Taxonomic Analysis

Although EPT taxa richness values have been remarkably consistent at this location since sampling started in 1993, the 2008 EPT sample did result in the lowest EPT taxa richness value measured. EPT taxa absent from the 2008 collection but present in previous EPT samples (1994 and 2003) include the mayflies *Pseudocloeon propinquum* , *Attenella attenuata* , the stoneflies *Acroneuria abnormis* , *Neoperla sp* ., and *Perlesta sp* ., and the caddisflies *Oecetis georgia* , *Oecetis nocturna* , *Oecetis scala* GR, *Nyctiophylax moestus* , and *Lype diversa* .

Data Analysis

Although this site is approximately six stream miles below the Raeford WWTP, there seems to be no adverse impact due to increased instream waste concentration as a result of drought induced low flows. This conclusion is supported by the specific conductance data which has been relatively stable through time: 50 µS/cm (1994), 41 µS/cm (1998), 33 µS/cm (2003) and 52 µS/cm (2008) and is further supported by the fact that the 2008 sample produced the lowest EPTBI yet measured (3.43). Moreover, the Raeford WWTP has been compliant for nearly three years and has addressed industrial influent problems through aggressive pretreatment. The lower EPT taxa richness documented in 2008 was very likely the result of temporary high flows and reduced access to some habitat due to deep water.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
JUNIPER CR	**Plank Rd**	**04/15/08**	**BF20**	**Not Rated**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
HOKE	15	03030004	35.05833333	-79.25222222	18-31-10	Sand Hills

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	11.3	255	4	0.4	Yes

	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)	13.7
Dissolved Oxygen (mg/L)	8.3
Specific Conductance (µS/cm)	14
pH (s.u.)	3.8

Water Clarity	Clear, tannin stained

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	20
Bottom Substrate (15)	10
Pool Variety (10)	10
Left Bank Stability (10)	10
Right Bank Stability (10)	10
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**95**

Site Photograph

Substrate Sand and organic muck

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/15/08	2008-11	8	---	Not Rated
10/21/03	2003-70	10	---	Not Rated

Most Abundant Species Dusky Shiner

Exotic Species None

Species Change Since Last Cycle

Gains -- Sandhills Chub, Creek Chubsucker, and Chain Pickerel. **Losses** -- American Eel, Yellow Bullhead, Redfin Pickerel, Bluespotted Sunfish, and Warmouth.

Data Analysis

Watershed -- drains central Hoke County; within the property of Fort Bragg; tributary to Rockfish Creek; no municipalities within the watershed. **Habitat** -- very high quality instream and riparian habitats including aquatic plants, deadfalls, snags, and coarse woody debris. **Water Quality** -- a typical Sand Hills stream with clear and dark water of very low conductivity and pH, conductivity has been 13 and 14 µS/cm, pH 4.8 and 3.8 s.u, lowest pH of any Sand Hills fish community site in 2008. **2008** -- typical Sand Hills fauna; two specimens of the Sandhills Chub, a species of Special Concern, were collected; 5 of the 8 species represented by 1or 2 fish/species, only 3 of 8 species with multiple age classes; Redfin Pickerel were present, but represented only by young-of-year and not included in the total species count. **2003 & 2008** -- 13 species are known from the site; no exotic species have been collected at this site; dominant species is the Dusky Shiner.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
NICHOLSON CR	**SR 1301**	**04/15/08**	**BF34**	**Not Rated**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
HOKE	15	03030004	35.03083333	-79.21055556	18-31-14	Sand Hills

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	16.2	249	6	0.5	Yes

	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)	15.5
Dissolved Oxygen (mg/L)	8.1
Specific Conductance (µS/cm)	13
pH (s.u.)	5.0

Water Clarity	Clear, tannin stained

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	20
Bottom Substrate (15)	10
Pool Variety (10)	10
Left Bank Stability (10)	10
Right Bank Stability (10)	10
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**95**

Site Photograph

Substrate Sand and organic detritus

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/15/08	2008-12	11	---	Not Rated
10/20/03	2003-68	10	---	Not Rated

Most Abundant Species Dusky Shiner

Exotic Species None

Species Change Since Last Cycle

Gains -- Creek Chubsucker, Spotted Sucker, Margined Madtom, Largemouth Bass, and Piedmont Darter.
Losses -- American Eel, Tadpole Madtom, Dollar Sunfish, and Sawcheek Darter.

Data Analysis

Watershed -- drains central Hoke County; is adjacent to and east of the Juniper Creek watershed; within the property of Fort Bragg; tributary to Rockfish Creek; no municipalities within the watershed; site is ~ 2 miles downstream of Mott Lake. **Habitat** -- very high quality instream and riparian habitats including a tall open canopy, runs, snags, and deadfalls. **Water Quality** -- a typical Sand Hills stream; conductivity has been 14 and 13 µS/cm, pH 5.6 and 5.0 s.u. a typical Sand Hills fauna; almost twice as many fish collected in 2008 than in 2003 54 vs. 30; 1.5 vs. 0.6 fish/100 seconds); 8 of the 11 species represented by 1 or 2 fish/species; only 3 of 11 species represented by multiple age groups; two species of suckers and darters collected. **2003 & 2008** -- 15 species are known from the site; no exotic species have been collected at this site; Dusky Shiner is the dominant species.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
PUPPY CR	**SR 1406**	**04/15/08**	**BF39**	**Not Rated**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
HOKE	15	03030004	34.99083333	-79.11972222	18-31-19	Atlantic Southern Loam Plains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	26	183	8	0.4	Yes

	Forested/Wetland	Suburban	Agriculture	Other (describe)
Visible Landuse (%)	75	15	10	0

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

Water Quality Parameters

Temperature (°C)	14.7
Dissolved Oxygen (mg/L)	8.8
Specific Conductance (µS/cm)	20
pH (s.u.)	4.4

Water Clarity	Clear, tannin stained

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	18
Bottom Substrate (15)	13
Pool Variety (10)	10
Left Bank Stability (10)	10
Right Bank Stability (10)	10
Light Penetration (10)	10
Left Riparian Score (5)	4
Right Riparian Score (5)	5
Total Habitat Score (100)	**95**

Site Photograph

Substrate Sand and cobble

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/15/08	2008-14	8	---	Not Rated
10/21/03	2003-71	11	---	Not Rated
05/21/98	98-47	8	---	Not Rated

Most Abundant Species Tessellated Darter

Exotic Species None

Species Change Since Last Cycle

Gains -- Yellow Bullhead, Warmouth, and Piedmont Darter. **Losses** -- Creek Chubsucker, Margined Madtom, Redfin Pickerel, Bluegill, Largemouth Bass, and Banded Pygmy Sunfish.

Data Analysis

Watershed -- drains eastern Hoke County; transitions an area between the Sandhills and the Atlantic Southern Loam Plains; stream originates within the Fort Bragg property and then is dissected by US 401; golf course community upstream between US 401 and SR 1406; houses and subdivision built along the left bank in the past five years. **Habitat** -- very high quality instream and riparian habitats including coarse woody debris, snags, undercuts, and runs; American Holly forest along the banks. **Water Quality** -- a typical Sand Hills stream with low conductivity and pH; conductivity has ranged from 17-20 µS/cm, pH from 4.4-5.4 s.u. **2008** -- species collected for the first time were the Warmouth and Piedmont Darter; suckers and cyprinids absent; second fewest fish and lowest catch per unit effort of any Sand Hills fish community site in 2008, 21 fish and 0.8 fish/100 seconds, respectively. **1998-2008** -- 16 species are known from the site; Dusky Shiner and Spotted Sucker have not been collected since 1998; no exotic species have ever been collected at this site; catch per unit effort has ranged from 0.6 to 1.1 fish/100 seconds.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
L ROCKFISH CR	**Plank Rd**	**04/15/08**	**BF19**	**Not Rated**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
HOKE	15	03030004	35.05444444	-79.09083333	18-31-24-(1)	Sand Hills

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
B	11.2	214	6	0.5	Yes

	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)	15.2
Dissolved Oxygen (mg/L)	8.4
Specific Conductance (µS/cm)	12
pH (s.u.)	4.3

Water Clarity	Clear, tannin stained

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	20
Bottom Substrate (15)	7
Pool Variety (10)	10
Left Bank Stability (10)	10
Right Bank Stability (10)	10
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**92**

Site Photograph

Substrate Sand and organic muck

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/15/08	2008-13	11	---	Not Rated
10/20/03	2003-67	9	---	Not Rated

Most Abundant Species Dusky Shiner

Exotic Species None

Species Change Since Last Cycle

Gains -- Margined Madtom, Lined Topminnow, Bluespotted Sunfish, Redbreast Sunfish, and Tessellated Darter. **Losses** -- Yellow Bullhead, Redfin Pickerel, and Dollar Sunfish.

Data Analysis

Watershed -- drains eastern Hoke and western Cumberland counties; adjacent to and east of the Puppy Creek River watershed; site and the watershed are within Fort Bragg property; tributary to Rockfish Creek; no municipalities within the watershed. **Habitat** -- very high quality instream and riparian habitats including thick cane in the riparian zones; *Valisneria, Juncus, Batrachospermum,* and Golden Club; pools and runs; and abundant coarse woody debris. **Water Quality** -- a typical sand Hills stream with the lowest conductivity of any fish community site in 2008, pH also low; conductivity has been 11 and 12 µS/cm, pH 5.7 and 4.3 s.u. **2008** -- a typical Sand Hills fauna; almost three times as many fish collected in 2008 than in 2003 (80 vs. 29; 1.7 vs. 0.6 fish/100 seconds); 8 of the 11 species represented by 1 or 2 fish/species; only 3 of 11 species represented by multiple age groups. **2003 & 2008** -- 14 species are known from the site; no exotic species have been collected at this site; dominant species is the Dusky Shiner.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
L ROCKFISH CR	NC 59	BB151	09/04/08	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
CUMBERLAND	15	3030004	34.98722222	-78.96611111	18-31-24-(4)	Atlantic Southern Loam Plains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C		109	8	1.4

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

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
NONE	N/A	N/A

Water Quality Parameters

Temperature (°C)	24.2
Dissolved Oxygen (mg/L)	6.1
Specific Conductance (µS/cm)	40
pH (s.u.)	5.7

Water Clarity	Clear, tannic

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	13
Bottom Substrate (15)	13
Pool Variety (10)	5
Left Bank Stability (10)	10
Right Bank Stability (10)	10
Light Penetration (10)	9
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	85

Site Photograph

Substrate	Sand, silt and a trace of clay and detritus.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
09/04/08	10526	19	19	4.30	4.30	Good
09/03/03	9300	23	23	4.48	4.48	Good
07/20/98	7681	22	22	4.07	4.07	Good
08/25/93	6356	22	22	4.23	4.23	Good

Taxonomic Analysis

EPT taxa richness at this location has been remarkably stable since 1993. Indeed, eight EPT taxa have been collected here at every sampling event and an additional seven EPT taxa have been collected here on three of the four sampling events. The 2008 sample produced only one previously uncollected taxon, the stonefly *Acroneuria arenosa*.

Data Analysis

Although the EPTBI and EPT taxa richness has been consistent since 1993, the 2008 sample did produce slightly fewer EPT taxa relative to earlier samples. This sample also resulted in the lowest EPT abundance (78) and was down from 1993 (80), 1998 (101), and 2003 (100). These two metrics were likely suppressed as a result of temporary high flows and subsequent reduced access to some habitat due to deep water and not the result in a shift in water quality. This conclusion is supported by the water chemistry data as specific conductance has been very uniform: 1998 (46 µS/cm), 2003 (44 µS/cm), and 2008 (40 µS/cm).

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
BONES CR	**SR 1400**	**04/11/08**	**BF35**	**Not Rated**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
CUMBERLAND	15	03030004	35.06333333	-79.03888889	18-31-24-2	Atlantic Southern Loam Plains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	12.2	200	4	0.8	No

	Forested/Wetland	Suburban	Agriculture	Other (describe)
Visible Landuse (%)	60	40	0	0

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

Water Quality Parameters

Temperature (°C)	18.0
Dissolved Oxygen (mg/L)	6.2
Specific Conductance (µS/cm)	18
pH (s.u.)	4.8

Water Clarity	Clear, tannin stained

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	20
Bottom Substrate (15)	6
Pool Variety (10)	10
Left Bank Stability (10)	10
Right Bank Stability (10)	10
Light Penetration (10)	7
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**88**

Site Photograph

Substrate Sand and organic muck

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/11/08	2008-10	17	---	Not Rated
10/20/03	2003-66	13	---	Not Rated

Most Abundant Species Dusky Shiner

Exotic Species Redear Sunfish

Species Change Since Last Cycle

Gains -- Margined Madtom, Swampfish, Lined Topminnow, Chain Pickerel, Mud Sunfish, Redear Sunfish, and Largemouth Bass. **Losses** -- Flier, Banded Sunfish, and Pumpkinseed.

Data Analysis

Watershed -- drains western Cumberland County; the watershed above the site is on Fort Bragg; lower part is being encroached upon by subdivisions and apartment complexes from the Fayetteville metropolitan area; site straddles the Sand Hills and the Atlantic Southern Loam Plains; tributary to Little Rockfish Creek. **Habitat** -- high quality instream and riparian habitats including runs, deep pools, snags, aquatic macrophytes, *Batrachospermum,* and coarse woody debris; bottomland forest, but not with a dense canopy. **Water Quality** -- a typical Sand Hills stream with very low conductivity and pH; conductivity has been 14 and 18 µS/cm, pH 5.8 and 4.8 s.u. **2008** -- almost three times more fish collected in 2008 than in 2003 (139 vs. 49; 2.4 vs. 0.9 fish/100seconds), of which one-third were Dusky Shiner; only Sand Hills site from which the Swampfish was collected; suckers absent; 9 of 17 species represented by only 1 or 2 fish per species; only 6 of 17 species were represented by multiple age classes. **2003 & 2008** -- 20 species are known from the site, including 10 species of centrarchids, but no species of suckers have been collected.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
HARRISON CR	**SR 1318**	**04/04/08**	**BF91**	**Not Rated**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
BLADEN	16	03030005	34.747015	-78.709156	18-42a	Carolina Flatwoods

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;Sw	48.3	98	7	0.5	No

	Forested/Wetland	Residential/Commercial	Agriculture	Other (describe)
Visible Landuse (%)	75	25	0	0

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

Water Quality Parameters

Temperature (°C)	22.7
Dissolved Oxygen (mg/L)	6.2
Specific Conductance (µS/cm)	58
pH (s.u.)	3.7

Water Clarity	Black water

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	20
Bottom Substrate (15)	14
Pool Variety (10)	10
Left Bank Stability (10)	9
Right Bank Stability (10)	7
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	2
Total Habitat Score (100)	**92**

Site Photograph

Substrate gravel, sand, clay pan.

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/04/08	2008-58	11	--	Not Rated
05/20/98	98-44	9	--	Not Rated
05/03/94	94-13	10	--	Not Rated

Most Abundant Species Dusky Shiner.

Exotic Species None.

Species Change Since Last Cycle **Gains** - Bluespotted Sunfish, Redbreast Sunfish, Dollar Sunfish, Tadpole Madtom. **Losses** - Yellow Bullhead, Flier.

Data Analysis

Watershed -- A tributary to the Cape Fear River that drains the rural area of south-central Cumberland County and north-central Bladen County. **Habitats** -- high quality instream habitats including swift runs with root riffles and side pools with cypress knees. **2008** -- a fairly diverse fish community for a low pH, coastal watershed; as expected, low species abundances with a maximum of 15 individuals collected per species. 1**994-2008** -- a total of 15 species have been collected from this site, including seven species of sunfish and three species of catfish; although Not Rated, this stream is supporting a trophically rich community of fish, and is showing no clear signs of any water quality issues.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
BROWNS CR	**NC 87**	**04/21/08**	**BF77**	**Not Rated**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
BLADEN	16	03030005	34.613943	-78.58501	18-45	Carolina Flatwoods

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	15	77	8	0.3	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	75	10	15	0

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

Water Quality Parameters

Temperature (°C)	17.4
Dissolved Oxygen (mg/L)	8.2
Specific Conductance (µS/cm)	113
pH (s.u.)	6.3

Water Clarity: Clear, tannin stained

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	18
Bottom Substrate (15)	7
Pool Variety (10)	10
Left Bank Stability (10)	9
Right Bank Stability (10)	9
Light Penetration (10)	8
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**86**

Site Photograph

Substrate sand.

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/21/08	2008-21	25	--	Not Rated
05/20/98	98-42	11	--	Not Rated
08/11/92	92-36	12	--	Not Rated

Most Abundant Species Redbreast Sunfish.

Exotic Species Redear Sunfish, Spotted Bass.

Species Change Since Last Cycle

Gains -- Pirate Perch, Satinfin Shiner, Whitefin Shiner, Bluespotted Sunfish, Creek Chubsucker, Lake Chubsucker, Eastern Mosquitofish, Pumpkinseed, Warmouth, Dollar Sunfish, Redear Sunfish, Dusky Shiner, Spottail Shiner, Sandbar Shiner, Black Crappie. **Losses** -- Bowfin.

Data Analysis

Watershed -- a tributary to the Cape Fear River that drains central Bladen County and flows east through Elizabethtown. **Habitats** -- high quality instream habitats consisting of shifting sandy runs with good pool habitats where snags exist and along banks; good bank stablities, healthy vegetated riparian habitats, and good canopy coverage. **2008** -- an extremely diverse fish community for a sandy coastal plain stream, with twice as many species collected than either previous sample, and greater than five times the total fish abundance as in 1998 (n=232 vs. 43). Previously uncollected species include five minnow species, four sunfish species and two sucker species. Redbreast Sunfish represent 25% of the sample. **1992-2008** -- a total of 28 fish species are known from this watershed; although not rated, this creek is supporting a thriving fish community and shows no signs of water quality issues.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
BROWNS CR	**NC 87**	**BB155**	**02/07/08**	**MODERATE**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Bladen	16	03030005	34.613889	-78.584722	18-45	Carolina Flatwoods

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	15.7	40	6	0.3

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	70	0	0	30

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

Water Quality Parameters

Temperature (°C)	14.6
Dissolved Oxygen (mg/L)	9.2
Specific Conductance (µS/cm)	153
pH (s.u.)	6.1

Water Clarity	clear/tannic

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	14
Bottom Substrate (15)	11
Pool Variety (10)	6
Left Bank Stability (10)	9
Right Bank Stability (10)	7
Light Penetration (10)	10
Left Riparian Score (5)	4
Right Riparian Score (5)	3
Total Habitat Score (100)	79

Site Photograph

Substrate sand with some silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
02/07/08	10379	73	14	6.27	4.84	Moderate
02/20/03	8881	63	15	6.70	5.10	Moderate

Taxonomic Analysis

The benthic community in Browns Creek at NC 87 has remained stable over the past 5 years in both EPT richness and abundance (69 in 2008; 65 in 2003). The taxa composition in 2008 shifted to be slightly less tolerant both within the EPT and overall benthic community. While some previously collected taxa were lost such as *Acerpenna pygmaea*, *Taeniopteryx*, and *Phylocentropus*, others were collected for the first time and included *Centroptilum*, *Shipsa rotunda*, *Perlesta*, and *Oecetis persimilis*. In addition, higher numbers of collected taxa in 2008 were explained in part by greater odonate richness which almost doubled from 6 to 11. Also, fewer tolerant midge taxa were collected in 2008 which contributed to a lower biotic index.

Data Analysis

Browns Creek originates within an agricultural and forested landscape in central Bladen County and drains Elizabethtown, the largest munincipality in the area. Benthic habitat in Browns Creek was good although elevated specific conductance, typical of streams passing through munincipalities, was reported. Browns Creek has maintained a Moderate rating with a slightly more intolerant benthic community than that found in 2003.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
HAMMOND CR	**SR 1709**	**04/22/08**	**BF132**	**Not Rated**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
BLADEN	16	03030005	34.56974	-78.560731	18-50	Carolina Flatwoods

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	11.6	200	5	0.4	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	85	5	10	0

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

Water Quality Parameters

Temperature (°C)	15.6
Dissolved Oxygen (mg/L)	7.1
Specific Conductance (µS/cm)	134
pH (s.u.)	6.0

Water Clarity	Black water

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	18
Bottom Substrate (15)	8
Pool Variety (10)	10
Left Bank Stability (10)	9
Right Bank Stability (10)	9
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**89**

Site Photograph

Substrate sand.

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/22/08	2008-22	14	--	Not Rated

Most Abundant Species Bluegill.

Exotic Species None.

Species Change Since Last Cycle N/A

Data Analysis

New basinwide site. **Watershed** -- a tributary to the Cape Fear River that drains rural central Bladen County; located just south of the Browns Creek watershed. **Habitats** -- high quality instream habitats with sandy runs, pools with abundant coarse woody debris, and snags throughout. **2008** -- a blackwater stream with good fish diversity and relatively few individuals per species, which is common among coastal black water streams; sample included five species of sunfish, four species of minnow, and both pickerel species. Bluegill represent 33% (n=29) of the collection. The fish community of Hammond Creek appears healthy, and is showing no apparent signs of water quality issues.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
WHITES CR	**SR 1704**	**04/22/08**	**BF122**	**Not Rated**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
BLADEN	16	03030005	34.545834	-78.505894	18-50-5	Carolina Flatwoods

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	10.3	49	5.5	0.2	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	90	10	0	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)	8.5
Specific Conductance (µS/cm)	111
pH (s.u.)	6.1

Water Clarity: Clear, tannin stained

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	18
Bottom Substrate (15)	13
Pool Variety (10)	9
Left Bank Stability (10)	9
Right Bank Stability (10)	9
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**93**

Site Photograph

Substrate: sand.

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/22/08	2008-23	16	--	Not Rated
05/20/98	98-45	19	--	Not Rated

Most Abundant Species: Dusky Shiner.

Exotic Species: Redear Sunfish.

Species Change Since Last Cycle: **Gains** - Eastern Mosquitofish, Redear Sunfish, Creek Chub. **Losses** - Snail Bullhead, Flier, Sawcheek Darter, Spotted Sucker, Golden Shiner, Sandbar Shiner.

Data Analysis

Watershed -- a tributary to Hammond Creek that drains rural central Bladen County. **Habitats** -- high quality instream habitats including shallow sandy runs with long shallow side pools, course woody debris, and good root systems; good bank stabilities, extensive vegetated riparian widths, and a full canopy. **2008** -- a diverse community of fish was collected, with a species composition that is typical of Coastal Plain streams; Dusky Shiner (n=203) accounted for 60% of the sample, resulting in an increase in total abundance of the fish community (337 vs. 144). **1998-2008** -- a slight shift in trophic structure over a 10 year period to a higher percentage of insectivores (Dusky Shiner) and a lower percentage of piscivores. Although this stream is Not Rated with the NCIBI, the fish community appears healthy, and continues to exhibit good water quality.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
HOOD CR	US 74-76	BB447	02/07/08	MODERATE

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Brunswick	17	03030005	34.278333	-78.125833	18-66	Carolina Flatwoods

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Sw	23.0	15	7	0.6

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

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)	6.2
Specific Conductance (µS/cm)	120
pH (s.u.)	6.0

Water Clarity: clear/tannic

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	10
Bottom Substrate (15)	7
Pool Variety (10)	5
Left Bank Stability (10)	10
Right Bank Stability (10)	10
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	77

Site Photograph

Substrate: detritus and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
02/07/08	10380	47	12	6.94	5.58	Moderate
02/25/03	9050	42	12	6.16	5.13	Moderate
03/04/98	7522	69	20	6.00	4.78	Natural

Taxonomic Analysis

Although EPT richness remained the same as 2003 levels, overall taxa richness increased due in large part to higher numbers of tolerant midge and beetle taxa. Overall tolerance of the community also increased as intolerant species became much less abundant. EPT abundance values were less than half of 2003 levels (20 versus 56). The only abundant taxa collected were the amphipod *Gammarus* and the snail *Campeloma decisum*. Taxa lost from 2003 to 2008 were *Acerpenna pygmaea*, *Pseudocloeon frondale*, *Cheumatopsyche* and *Oecetis persimilis*. Newly collected taxa were *Callibaetis*, *Eurylophella doris*, and *Ironoquia punctatissima*.

Data Analysis

The catchment of Hood Creek is primarily composed of agricultural fields and forest. No major urban centers feed this creek although development is occuring throughout the watershed. Worsening water quality is indicated by a steadily increasing Biotic Index over the past ten years even though Hood Creek has maintained its Moderate rating from the previous basinwide cycle. Overall habitat was decent with the lack of good bottom substrate as the largest deficiency for colonizing macroinvertebrates.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
CRANE CR	SR 1146	04/23/08	BF134	Not Rated

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
SAMPSON	19	03030006	34.881454	-78.281467	18-68-2-12	Rolling Coastal Plain

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C; Sw	12	54	5	0.4	No

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	60	0	40	0

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

Water Quality Parameters

Temperature (°C)	18.1
Dissolved Oxygen (mg/L)	7.7
Specific Conductance (µS/cm)	96
pH (s.u.)	6.1

Water Clarity: Tannin stained

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	19
Bottom Substrate (15)	7
Pool Variety (10)	10
Left Bank Stability (10)	10
Right Bank Stability (10)	10
Light Penetration (10)	4
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**85**

Site Photograph

Substrate sand.

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/23/08	2008-25	18	--	Not Rated

Most Abundant Species Dusky Shiner.

Exotic Species None.

Species Change Since Last Cycle N/A

Data Analysis

New basinwide site. **Watershed** -- a tributary to Six Runs Creek, which drains the rural easternmost edge of Sampson County. **Habitats** -- good quality instream habitats consisting of sandy runs with course woody debris, side pools, undercut banks, and submerged vegetation; great riparian widths, but the sample reach is mostly sunlit (i.e. open canopy) due to the predominance of grasses and shrubs (vs. trees) on and outside of the stream's stable banks. **2008** -- very diverse fish community for a tanic Coastal Plain stream, with five species of both sunfish and minnows; a relatively balanced trophic structure; Dusky Shiner (n=112) made up about 39% of the total abundance; although Not Rated with the NCIBI, Crane Creek appears healthy with no obvious water quality problems.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
L COHARIE CR	**SR 1214**	**BB301**	**07/07/08**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
SAMPSON	19	3030006	34.88916667	-78.4425	18-68-12-(8.5)	Southeastern Floodplains and Low Terraces

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C, Sw		75	9	0.6

	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	N/A	N/A

Water Quality Parameters

Temperature (°C)	25.3
Dissolved Oxygen (mg/L)	4.5
Specific Conductance (µS/cm)	66
pH (s.u.)	5.8

Water Clarity	Clear, tannic

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	15
Bottom Substrate (15)	13
Pool Variety (10)	5
Left Bank Stability (10)	9
Right Bank Stability (10)	9
Light Penetration (10)	7
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	83

Site Photograph

Substrate Sand, gravel, and silt.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/07/08	10447	86	28	5.66	4.34	Good
09/17/03	9120	18	18	3.93	3.93	Good
08/05/98	7699	16	16	4.48	4.48	Good-Fair
08/23/93	6367	17	17	4.08	4.08	Good-Fair
10/17/89	5107	23	23	3.87	3.87	Good

Taxonomic Analysis

Although there has been very little change in the benthic macroinvertebrate community at this location since sampling started in 1989, there were several EPT taxa that were collected for the first time in 2008 and included the mayflies *Callibaetis sp*., *Centroptilum sp*., *Pseudocloeon ephippiatum*, *Tricorythodes sp*. the stonefly *Acroneuria arenosa*, and the caddisflies *Phylocentropus sp*. and *Oxyethira sp*.

Data Analysis

This site is approximately seven stream miles downstream of the Roseboro WWTP (NC0026816001, 0.7 MGD). Despite the persistent drought conditions in this area of the state and the low flows observed, it appears this station is far enough below the discharger that severe deleterious effects often associated with higher instream waste concentrations due to drought induced low flows were reduced. Although the EPT taxa richness value was unchanged in 2003 from 2008, there was a large drop in EPT abundance from 2003 (86) to 2008 (48) and a large increase in EPTBI from 2003 (3.93) to 2008 (4.84). Conversely, specific conductance dropped from 2003 (81 µS/cm) to 2008 (66 µS/cm) as did pH 2003 (6.4) to 2008 (5.8). These data suggest that the increase in EPTBI and decrease in EPTN may be more related to reduced habitat and reduced flows than to discharger effects.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
SOUTH R	**SR 1502**	**BB301**	**08/08/08**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
BLADEN	18	3030006	34.83666667	-78.48472222	18-68-12-(8.5)	Southeastern Floodplains and Low Terraces

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Sw, ORW:+		86	8	0.5

	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	N/A	N/A

Water Quality Parameters

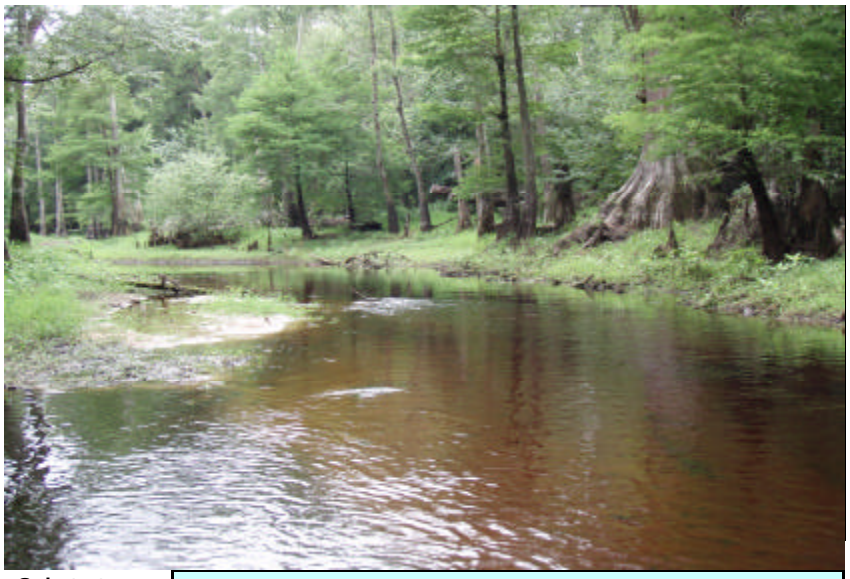
Temperature (°C)	26.1
Dissolved Oxygen (mg/L)	4.4
Specific Conductance (µS/cm)	77
pH (s.u.)	5.7

Water Clarity	Clear, tannic

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	16
Bottom Substrate (15)	13
Pool Variety (10)	4
Left Bank Stability (10)	9
Right Bank Stability 10)	10
Light Penetration (10)	7
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	84

Site Photograph



Substrate Sand, gravel, and silt.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/08/08	10476	86	28	5.66	4.34	Good
10/09/02	9032	12	12	4.40	4.40	Not Rated
08/04/98	7698	67	24	5.92	4.50	Good
08/25/93	6365	75	25	5.36	3.75	Good
06/07/87	4129	84	29	5.46	3.85	Excellent

Taxonomic Analysis

Although all of the Full-Scale samples collected here have resulted in very similar community metrics and bioclassifications, the 2008 sample did produce several new EPT records. These taxa included the mayfly *Isonychia sp* , the rare mayfly *Pseudocentroptiloides usa* , the stoneflies *Acroneuria arenosa* , *Perlesta sp* ., and the rare and intolerant taxon *Perlinella drymo.* The 2008 sample also produced many new caddisfly records for this station and included the intolerant *Oxyethira sp* ., as well as *Oecetis persimilis* , *Oecetis Sp F* , and *Molanna blenda* . The addition of these taxa suggest that there has been reduced nonpoint impacts as a result of the persistent drought.

Data Analysis

Primary landuse in this watershed is forest, swine operations, and row crops. Excluding the October 2002, less intensive EPT sample, the EPT taxa richness, BI, and EPTBI have been quite stable here through time. However, the 2008 sample did result in a somewhat higher EPT taxa richness relative to other Full-Scale samples collected in 1998 and 1993 and was only one EPT taxon short of the highest level measured here. This increase in EPT taxa richness is likely attributed to reduced levels of non-point pollution inputs associated with the drought. This hypothesis is supported by the lower specific conductance (77 µS/cm) and pH (5.7) measured in 2008 versus the specific conductance and pH measured in 1998 (121 µS/cm; 6.1) and 2002 (128 µS/cm; 6.8) respectively.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
COLLY CR	US 701	04/04/08	BF82	Not Rated

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
BLADEN	20	03030006	34.710853	-78.457305	18-68-17	Carolina Flatwoods

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;Sw	16.6	75	7	0.5	Yes

	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)	19.6
Dissolved Oxygen (mg/L)	4.8
Specific Conductance (µS/cm)	115
pH (s.u.)	3.2

Water Clarity	Black water

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	20
Bottom Substrate (15)	7
Pool Variety (10)	10
Left Bank Stability (10)	10
Right Bank Stability (10)	10
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**92**

Site Photograph

Substrate detritus, woody debris.

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/04/08	2008-57	5	--	Not Rated
05/19/98	98-41	7	--	Not Rated

Most Abundant Species Redfin Pickerel.

Exotic Species None.

Species Change Since Last Cycle **Gains** - Mud Sunfish. **Losses** - Yellow Bullhead, Swampfish, Yellow Perch.

Data Analysis

Watershed -- Colly Creek is a tributary to the Cape Fear River that drains most of eastern Bladen County; the fish site is located in the rural north-east corner of Bladen County, just downstream of its headwaters. **Habitats** -- high quality instream habitats in this slow moving black water stream with dense vegetation, abundant woody debris of all sizes, and abundant organic matter; site had been de-snagged prior to the 1998 sample, but not since; very low pH. **2008** -- as expected, the fish community is exhibiting low diversity and abundance in this slow moving coastal plain stream; the predatory Redfin Pickerel (n=17), made up almost 50% of the total catch. **1998-2008** -- a total of eight species have been collected from this low diversity site; although Not Rated, the fish community in this system appears healthy and is showing no obvious signs of water quality issues.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
DIVERSION CANAL	off SR 1536	04/22/08	BF133	Not Rated

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
BLADEN	20	03030006	34.490336	-78.332238	18-68-22-1	Mid-Atlantic Floodplains & Low Terraces

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;Sw	undetermined	29	10	0.3	No

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

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)	5.9
Specific Conductance (µS/cm)	79
pH (s.u.)	3.7

Water Clarity	Black water

Habitat Assessment Scores (max)

Channel Modification (15)	7
Instream Habitat (20)	18
Bottom Substrate (15)	6
Pool Variety (10)	8
Left Bank Stability (10)	10
Right Bank Stability (10)	10
Light Penetration (10)	7
Left Riparian Score (5)	4
Right Riparian Score (5)	5
Total Habitat Score (100)	**75**

Site Photograph

Substrate sand, detritus.

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/22/08	2008-24	10	--	Not Rated

Most Abundant Species Bluespotted Sunfish.

Exotic Species None.

Species Change Since Last Cycle N/A

Data Analysis

New basinwide site. **Watershed** -- a tributary to Colly Creek and ultimately the Black River that flows southeast, draining part of rural southeast Bladen County; diverts part of Frenchs Creek; Drainage Area is undetermined because GIS flow direction and accumulation layers do not exist for this canal. **Habitats** -- shallow sandy runs, shallow side pools lined with organics, and some coarse woody debris; there are obvious signs of historic channelization, but the stream meanders within its stable banks; riparian is good, but the right side has been logged in recent years and is in regrowth; very low pH. **2008** -- good diversity for a true blackwater stream, yet no minnows were collected. Otherwise, the fish community appears as expected, with three species of sunfish, two species of catfish, one species of sucker, one species of pickerel, and two darter species, including the intolerant Sawcheek Darter; Bluespotted Sunfish made up 63% of the individuals collected (n=77) and are thriving in this tannic system; although Not Rated with the NCIBI, this stream appears healthy and is showing no obvious signs of water quality issues.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
NE CAPE FEAR R	NC 41	BB126	08/05/08	Good-Fair

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
DUPLIN	22	03030007	34.827778	-77.833333	18-74-(25.5)	Carolina Flatwoods

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C;Sw;HQW	599.0	17	30	0.3

	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)
Town of Carolina Beach WWTP	NC 0023256	3.0
Guilfod Mills Guilford East Mill WWTP	NC 0002305	1.5

Water Quality Parameters

Temperature (°C)	29.4
Dissolved Oxygen (mg/L)	4.9
Specific Conductance (µS/cm)	302
pH (s.u.)	6.6
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	8
Bottom Substrate (15)	7
Pool Variety (10)	6
Left Bank Stability (10)	9
Right Bank Stability (10)	9
Light Penetration (10)	2
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	66

Site Photograph

Substrate sand

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/05/08	10409	92	25	6.16	4.42	Good-Fair
09/22/98	7767	40	3	7.00	4.40	Poor
08/05/98	7706	70	29	5.60	4.90	Good
08/24/93	6373	82	22	5.40	4.50	Good
08/09/89	5054	83	30	5.40	4.10	Excellent

Taxonomic Analysis

The benthic community in the Northeast Cape Fear River at NC 41 continues to be affected by drought. Hydropsychid caddisflies were represented in the August 2008 sample by only a single individual. In every sample prior to the 1998 Hurricane Bonnie sample, three taxa of Hydropsychid caddisflies were found to be abundant or common. These widely distributed caddisflies require near constant flow in which to feed. Given that the microhabitats where Hydropsychid caddisflies would be found are still present (e.g. snags and logs), there is no other apparent reason for their absence. A similar pattern was seen with black flies (*Simulium*). No black flies were found in the 2008 sample, though they were present in prior samples. Blackflies are another widespread group of aquatic macroinvertebrates that require minimal amounts of flow in which to filter feed, though some species can survive for a few days in stagnant water. The absence of this generally pollution tolerant group suggests that flow interruptions occurred here during 2007 and/or 2008.

Data Analysis

This site rated Good-Fair in 2008, an improvement from Poor in 1998. From 1985 through the summer of 1998, five benthic samples collected here rated Excellent (3) or Good (2). In 2003 and 2004 this site was not sampled due to high water levels. In spring 2008, high water levels postponed sampling. This site is still recovering from drought conditions seen throughout North Carolina in 2007 and 2008. Additional sampling should occur here to ascertain the non drought condition of this waterbody, in particular, if Good or Excellent water quality still remains (as seen prior to September 1998). Additional information can be found in BAU Memorandum B-20081020.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
GOSHEN SWP	**SR 1725**	**BB322**	**02/09/09**	**Severe**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
SAMPSON	22	03030007	35.197222	-78.210000	18-74-19a	Rolling Coastal Plain

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C;Sw	13.0	110	12	0.5

	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	n/a	n/a

Water Quality Parameters

Temperature (°C)	9.8
Dissolved Oxygen (mg/L)	10.1
Specific Conductance (µS/cm)	150
pH (s.u.)	6.0

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	15
Bottom Substrate (15)	6
Pool Variety (10)	6
Left Bank Stability (10)	10
Right Bank Stability (10)	10
Light Penetration (10)	7
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	79

Site Photograph

Substrate mostly silt with some sand

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
02/09/09	10607	39	4	7.91	7.49	Severe
02/19/03	8880	42	4	7.99	6.58	Severe

Taxonomic Analysis

Taxa collected in 2009 were similar to 2003. The only abundant EPT collected in either year was *Ironoquia puntatissima* (2009). The highly pollution tolerant chironomid *Chironomus* sp and the the dipteran *Bittacomorpha* sp were abundant in 2009. Chironomids, gastropods, segmented worms and leeches dominated the benthic community in Goshen Swamp.

Data Analysis

Goshen Swamp rated Severe in 2009, the same rating it received in 2003. The habitat scored 79 (80 in 2003) suggesting that water quality itself is degraded. The igh biotic index indicates that the aquatic community here is one that is very tolerant to pollution. Overall diversity is low. This site is located above the outfall of the pickle processing facility in an area dominated by agriculture including several hog operations.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
LIMESTONE CR	**SR 1702**	**06/03/08**	**BF127**	**Not Rated**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
DUPLIN	22	03030007	34.9083151	-77.8383869	18-74-23	Carolina Flatwoods

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C; Sw	59.7	35	7	0.3	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	65	5	30	0

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

Water Quality Parameters

Temperature (°C)	20.8
Dissolved Oxygen (mg/L)	7.4
Specific Conductance (µS/cm)	105
pH (s.u.)	6.1

Water Clarity	Clear, tannin stained

Habitat Assessment Scores (max)

Channel Modification (15)	10
Instream Habitat (20)	15
Bottom Substrate (15)	7
Pool Variety (10)	4
Left Bank Stability (10)	5
Right Bank Stability (10)	5
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**66**

Site Photograph

Substrate Sand with claypan outcrops

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
06/03/08	2008-55	11	---	Not Rated

Most Abundant Species Dusky Shiner

Exotic Species Channel Catfish

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

Data Analysis

This is the first fish community sample collected at this site. **Watershed** -- drains eastern Duplin County including the Town of Beulaville; tributary to the Northeast Cape Fear River; site is ~ 1,000 ft. above creek's confluence with the river. **Habitat** -- shallow and bare sandy runs; no large, coarse woody debris within the channel; deep pools were absent; old sand mining or de-snagging operation on right side of the creek; clay and sand banks stable, but sparsely vegetated; evidence of old channelization. **Water Quality** -- conductivity typical for a Coastal Plain stream. **2008** -- for its size (~ 60 square miles), total species diversity (n=11) and number of fish (n=245) collected seemed low; suckers were absent and only two species of sunfish, Redbreast and Bluegill, were present; and 3 species of cyprinids and 2 species of darters present.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
LIMESTONE CR	SR 1702	BB319	08/14/08	Good-Fair

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
DUPLIN	22	3030007	34.90833333	-77.83861111	18-74-23	Carolina Flatwoods

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C, Sw	0	39	8	0.2

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

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
NONE	N/A	N/A

Water Quality Parameters

Temperature (°C)	24.1
Dissolved Oxygen (mg/L)	8
Specific Conductance (µS/cm)	111
pH (s.u.)	6.1

Water Clarity: Clear

Habitat Assessment Scores (max)

Channel Modification (5)	14
Instream Habitat (20)	16
Bottom Substrate (15)	13
Pool Variety (10)	4
Riffle Habitat (16)	0
Left Bank Stability (7)	9
Right Bank Stability (7)	9
Light Penetration (10)	9
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	84

Site Photograph

Substrate: Sand.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/14/08	10524	17	17	4.63	4.63	Good-Fair
09/17/03	9321	12	12	4.79	4.79	Good-Fair
08/05/98	7704	14	14	4.86	4.86	Good-Fair
07/14/95	6870	4	4	5.48	5.48	Poor
08/25/93	6376	26	26	4.50	4.50	Excellent

Taxonomic Analysis

The 2008 sample produced the second highest EPT taxa richness value at this location since assessment initiated in 1993. This sample also resulted in two EPT taxa collected for the first time here and included the rare mayfly *Psaeudocentroptiloides usa* as well as *Tricorythodes sp* . In addition, the 2008 collection produced the second collection at this location of the caddisfly *Polycentropus sp* . which was found previously only from the 1993 (Excellent) sample. Aside from these additions, the 2008 benthic macroinvertebrate community structure has been largely unchanged from the 1998 and 2003 samples.

Data Analysis

The three major landuses present in this catchment are row crops, animal operations, and forest. The high EPT taxa richness measured in 2008 is likely the result of a reduction in non-point pollution inputs which corresponded to the record drought conditions that have persisted in this region of the state. The dramatic decline in bioclassification measured in 1995 was the result of a large discharge of chicken waste upstream of this station. Analysis of the substrate data from this location indicates that since 1993 boulder (25%) has disappeared and has been replaced with increasing estimates of sand: 1993 (65%), 1995 (75%), 1998 (100%), 2003 (90%), and 2008 (100%). This substrate transition is supported by the benthos community as taxa often associated with boulder habitat (*Neureclipsis sp* ., *Nyctiophylax moestus* , *Brachycentrus numerosus* , *Paragnetina kansensis* , *Acroneuria abnormis* , *Procloeon sp* ., and *Brachycercus sp.*) were collected only during the 1993 sample.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
STOCKINGHEAD CR	**NC 50**	**06/03/08**	**BF128**	**Not Rated**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
DUPLIN	22	03030004	34.8795866	-77.8942068	18-74-24	Carolina Flatwoods

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C; Sw	7.5	45	4	0.2	No

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	95	0	5	0

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

Water Quality Parameters

Temperature (°C)	20.8
Dissolved Oxygen (mg/L)	5.2
Specific Conductance (µS/cm)	239
pH (s.u.)	6.2

Water Clarity	Slightly turbid

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	18
Bottom Substrate (15)	7
Pool Variety (10)	10
Left Bank Stability (10)	9
Right Bank Stability (10)	9
Light Penetration (10)	9
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**87**

Site Photograph

Substrate Sand

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
06/03/08	2008-54	16	---	Not Rated

Most Abundant Species	Redbreast Sunfish	**Exotic Species**	None

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

Data Analysis

This is the first fish community sample collected at this site. **Watershed** -- drains south-central Duplin County; tributary to the Northeast Cape Fear River; no municipalities with the watershed. **Habitat** -- high quality instream and riparian habitats; dense canopy; snags, sand bars, runs, deadfalls, and water primrose. **Water Quality** -- dissolved oxygen less than 60% saturation; conductivity elevated for a Coastal Plain stream, the greatest conductivity of any fish community site in the basin in 2008. **2008** -- intolerant species and Dusky Shiner were absent; overall diversity was fairly high for a small stream with seven species of centrarchids present.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
MUDDY CR	**NC 41/NC 111**	**06/03/08**	**BF129**	**Not Rated**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
DUPLIN	22	03030007	34.842698	-77.7973039	18-74-25	Carolina Flatwoods

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C; Sw	40.8	35	5	0.8	No

	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)	21.3
Dissolved Oxygen (mg/L)	5.9
Specific Conductance (µS/cm)	136
pH (s.u.)	6.5

Water Clarity	Clear, tannin stained

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	20
Bottom Substrate (15)	7
Pool Variety (10)	10
Left Bank Stability (10)	10
Right Bank Stability (10)	10
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**92**

Site Photograph

Substrate Fine white sand

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
06/03/08	2008-56	14	---	Not Rated

Most Abundant Species	Dusky Shiner	**Exotic Species**	None

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

Data Analysis

This is the first fish community sample collected at this site. **Watershed** -- drains eastern Duplin County; tributary headwaters originate with the Town of Beulaville; tributary to the Northeast Cape Fear River. **Habitat** -- very high quality instream and riparian habitats with coarse woody debris, several species of aquatic plants, snags, deep pools at the bends and swift flow. **Water Quality** -- water very tannin stained, but pH was not low; conductivity moderately elevated for a Coastal Plain stream. **2008** -- only Coastal Plain site from which the Swampfish was collected; total number of fish (n=79) was low for a Coastal Plain stream but the species diversity was typical with 2 species of suckers, 3 species of sunfish, 2 species of cyprinids, and 2 species of darters; Redfin Pickerel and Eastern Mudminnow were present, but represented only by young-of-year and not included in the total species count.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
ISLAND CR	**NC 11**	**06/02/08**	**BF130**	**Not Rated**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
DUPLIN	22	03030007	34.8023657	-77.9419113	18-74-27	Carolina Flatwoods

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C; Sw	16.1	20	7	0.4	No

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	95	0	5	0

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

Water Quality Parameters

Temperature (°C)	26.2
Dissolved Oxygen (mg/L)	5.8
Specific Conductance (µS/cm)	156
pH (s.u.)	6.4
Water Clarity	Slightly turbid, tannin stained

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	19
Bottom Substrate (15)	7
Pool Variety (10)	10
Left Bank Stability (10)	9
Right Bank Stability (10)	9
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**89**

Site Photograph

Substrate Sand and mud

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
06/02/08	2008-53	13	---	Not Rated

Most Abundant Species Eastern Mosquitofish and Dusky Shiner

Exotic Species None

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

Data Analysis

This is the first fish community sample collected at this site. **Watershed** -- headwaters originate within the Town of Rose Hill; the town's WWTP discharge (Qw = 0.45 MGD) on Reedy Branch, a tributary, is ~ 5 miles upstream of the site; tributary to the Northeast Cape Fear River. **Habitat** -- high quality instream and riparian habitats including coarse woody debris, snags, and a dense canopy. **Water Quality** -- conductivity moderately elevated for a Coastal Plain stream. **2008** -- a typical, small Coastal Plain stream with 4 species of sunfish, 2 species of cyprinids, and 2 species of darters present, but suckers were absent; Chain Pickerel and Pirate Perch were present, but represented only by young-of-year and not included in the total species count.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
L ROCK FISH CR	NC 11	06/02/08	BF131	Not Rated

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
DUPLIN	22	03030007	34.72242	-77.981597	18-74-29-6	Carolina Flatwoods

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C; Sw	9.3	20	6	0.2	No

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	30	30	0	40 (mowed sewer & utility R-O-W)

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

Water Quality Parameters

Temperature (°C)	29.3
Dissolved Oxygen (mg/L)	6.8
Specific Conductance (µS/cm)	101
pH (s.u.)	6.6
Water Clarity	Clear, very slightly stained

Habitat Assessment Scores (max)

Channel Modification (15)	7
Instream Habitat (20)	15
Bottom Substrate (15)	10
Pool Variety (10)	2
Left Bank Stability (10)	3
Right Bank Stability (10)	3
Light Penetration (10)	5
Left Riparian Score (5)	3
Right Riparian Score (5)	2
Total Habitat Score (100)	**50**

Site Photograph

Substrate Sand

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
06/02/08	2008-52	12	---	Not Rated

Most Abundant Species Eastern Mosquitofish

Exotic Species None

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

Data Analysis

This is the first fish community sample collected at this site. **Watershed** -- drains southern Duplin County, including the Town of Wallace; tributary to Rockfish Creek. **Habitat** -- the lowest scoring fish community site in the basin in 2008; low quality instream and riparian habitats -- channelized, minimal canopy, grass covered eroding banks, very shallow, and of uniform depth throughout. **Water Quality** -- since at least 2003, the creek no longer receives the treated discharge from Wallace's WWTP; highest pH of any fish community site in 2008, but conductivity was typical for a Coastal Plain stream. **2008** -- most fish (n=314) collected from any Coastal Plain site in 2008; 72% of all the fish were the tolerant Eastern Mosquitofish; greatest percentage of tolerant fish (89%) of any fish community site in the basin in 2008; suckers and intolerant species were absent; 6 of the 12 species were represented by only 1 or 2 fish per species.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
LILLINGTON CR	**SR 1520**	**BB306**	**02/10/09**	**Moderate**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
PENDER	23	03030007	34.508611	-77.816389	18-74-42	Carolina Flatwoods

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C;Sw	6.9	3	7	0.5

	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	n/a	n/a

Water Quality Parameters

Temperature (°C)	12.9
Dissolved Oxygen (mg/L)	13.5
Specific Conductance (µS/cm)	110
pH (s.u.)	4.2

Water Clarity	Clear/tannic

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	15
Bottom Substrate (15)	4
Pool Variety (10)	10
Left Bank Stability (10)	10
Right Bank Stability (10)	10
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	84

Site Photograph

Substrate all detritus

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
02/10/09	10609	44	11	7.04	6.19	Moderate
02/10/03	9042	41	12	6.30	4.68	Natural
02/24/97	7246	33	7	6.01	4.74	Moderate

Taxonomic Analysis

The benthic community in Lillington Creek does not appear to have differed among the three samplings. Similar EPT taxa and overall taxa were collected in 2009 compared to previous samples. The recently described mayfly, *Eurylophella oviruptis,* was abundant here in the 2009 and 2003 samples. *Leptophlebia* sp, another mayfly, was abundant here in both years as were black flies *(Simulium* sp) and the crustacean *Lirceus* spp. The chironomid *Unniella multivirga* , which prefers low pH swamps, was collected here in all three sampling efforts.

Data Analysis

Lillington Creek declined in bioclassification form Natural in 2003 to Moderate in 2009, the same rating it received in 1997 . The change in bioclassification has more to do with slight differences in EPT and other taxa compositions and abundances as opposed to any change in water quality. Habitat scored well in both 2003 and 2009, in part influenced by the mostly forested catchement surrounding Lillington Creek. The pH is naturally low here, as Lillington Creek originates in Holly Shelter Swamp. In both 2003 and 2009 the naturally low pH did not appear to adversely affect the benthic macroinvertebrate communities here.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
ISLAND CR	SR 1336	BB272	02/11/09	Poor

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
NEW HANOVER	23	03030007	34.341944	-77.799444	18-74-50	Carolina Flatwoods

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C;Sw	3.2	20	3	0.3

	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	n/a	n/a

Water Quality Parameters

Temperature (°C)	13.6
Dissolved Oxygen (mg/L)	8.8
Specific Conductance (µS/cm)	155
pH (s.u.)	6.1

Water Clarity: clear/turbid

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	15
Bottom Substrate (15)	7
Pool Variety (10)	6
Left Bank Stability (10)	9
Right Bank Stability (10)	9
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	81

Site Photograph

Substrate: detritus with some sand

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
02/11/09	10611	49	4	6.90	6.87	Moderate
02/11/03	9044	24	4	6.78	6.55	Not Rated

Taxonomic Analysis

Though only four EPT were collected in both samples at Island Creek, the 2009 sample contained a large number of non EPT taxa compared with 2003. The majority of this difference were midges with 22 found in 2009 and only eight in 2003. There was a large shift in other aquatic groups from 2003 to 2009. Six crustacean taxa were collected in 2003 with only two in 2009. Gastropod taxa differed from 2003 (1) to 2009 (4). Overall, taxa were typical Coastal Plain species but the large differences in whole groups of aquatic organisms suggest larger scale process such as hydrology.

Data Analysis

Island Creek rated Moderate in 2009. There was a large increase in the total number of taxa here in 2009 compared with 2003. This site had good flow compared with other swamp streams in this part of the Coastal Plain, along with a good habitat score. The landowner made us aware of a horse operation upstream of the sampling location that may have a supressing effect on the benthic community here given that only four EPT have been found here. Future sampling efforts should consider investigating downstream on Island Creek at the crossing of Holly Shelter Road. This location could capture most of the Island Creek watershed and have the potential to have a more stable hydrology given the increased watershed size downstream.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
SMITH CR	**I-40**	**BB79**	**02/26/03**	**Severe**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
NEW HANOVER	23	03030007	34.278889	-77.867500	18-74-63	Carolina Flatwoods

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Sw	0.0	25	6	0.4

	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)	11.0
Dissolved Oxygen (mg/L)	10.3
Specific Conductance (µS/cm)	138
pH (s.u.)	6.3

Water Clarity	clear/tannic

Habitat Assessment Scores (max)

Channel Modification (5)	10
Instream Habitat (20)	10
Bottom Substrate (15)	7
Pool Variety (10)	2
Riffle Habitat (16)	0
Left Bank Stability (7)	4
Right Bank Stability (7)	4
Light Penetration (10)	7
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	54

Site Photograph

Substrate Almost all sand with small amount of detritus

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
02/26/08	10389	37	4	7.64	6.98	Moderate
02/26/03	9053	30	1	7.43	6.20	Severe

Taxonomic Analysis

Other than the increase in EPT taxa richness, the benthic community was similar among the two samples. The three new EPT taxa collected in 2008 include the tolerant mayflies, *Caenis* and *Pseudocloeon frondale* , and the tolerant caddisfly *Ptilostomis* .

Data Analysis

Smith Creek was sampled for the first time in 2003. A sample was taken at I-40 because a wadeable freshwater segment could not be located downstream. It received a Severe rating and placed on North Carolina's 2004 Impaired Streams list. In 2008 the site was moved upstream to SR 2165 due to low flows and salt infiltration at the I-40 location. EPT taxa richness increased from 1 in 2003 to 4 in 2008, most likely due to better instream habitat and bottom substrate than the I-40 location. This increase in EPT taxa richness resulted in a Moderate bioclassification.