BASINWIDE ASSESSMENT REPORT
WHITE OAK RIVER BASIN

NCDENR

NORTH CAROLINA
DEPARTMENT OF ENVIRONMENT
AND NATURAL RESOURCES
Division of Water Quality
Environmental Sciences Section
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DIVISION OF WATER QUALITY
DWQ

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INTRODUCTION TO PROGRAM METHODS

The Division of Water Quality uses a basinwide approach to water quality management. Activities within the Division, including permitting, monitoring, modeling, nonpoint source assessments, and planning are coordinated and integrated for each of the 17 major river basins within the state. All basins are reassessed every five years. The White Oak River basin has been sampled by the Environmental Sciences Section (ESS) four times for basinwide monitoring: 1999, 2004, and 2009.

The ESS collects a variety of biological, chemical, and physical data that can be used in a myriad of ways within the basinwide-planning program. In some program areas there may be adequate data from several program areas to allow a fairly comprehensive analysis of ecological integrity or water quality. In other areas, data may be limited to one program area, such as only benthic macroinvertebrate data. Such data may or may not be adequate to provide a definitive assessment of water quality, but can provide general indications of water quality. The primary program areas from which data were drawn for this assessment of the White Oak River basin include benthic macroinvertebrates and fish community. Details of biological sampling methods (including habitat evaluation) and rating criteria can be found in the appendices of this report. Technical terms are defined in the Glossary.

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

BASIN DESCRIPTION

The White Oak River basin lies entirely within the southern outer coastal plain ecoregion, and is divided into two eight-digit hydrologic units or HUCs (Figure 1). Approximately 1,264 square miles of watershed in Onslow, Jones, Craven, and Carteret Counties drain into four separate river systems (New, White Oak, Newport, and North rivers), and ultimately into Bogue or Core sounds. There are 267 miles of freshwater streams and rivers, and about 192 square miles of saltwater in the basin.

The largest cities in the White Oak basin are Jacksonville on the New River, and the area of Morehead City and Beaufort on Bogue Sound and the Newport River. Other urban areas include Richlands, Swansboro, Cape Carteret, Newport, Atlantic Beach, and Bogue Banks. Large portions of the basin are publicly owned areas such as Croatan National Forest, Hoffman State Forest, Cape Lookout National Seashore, and Camp Lejeune.

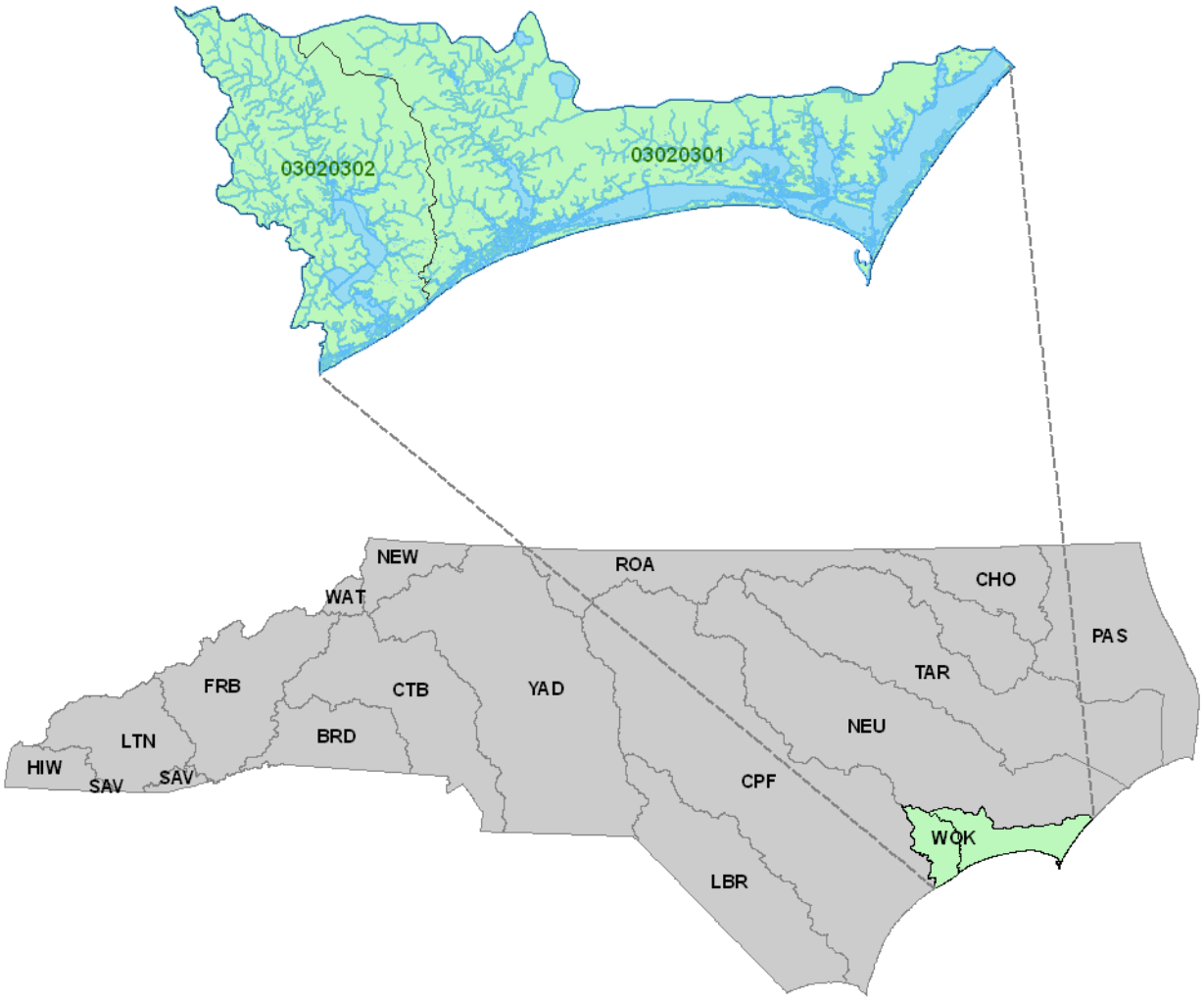


Figure 1. Geographic Relationships and eight-digit hydrologic units of the White Oak River Basin.

White Oak River Basin HU 03020301—White Oak River

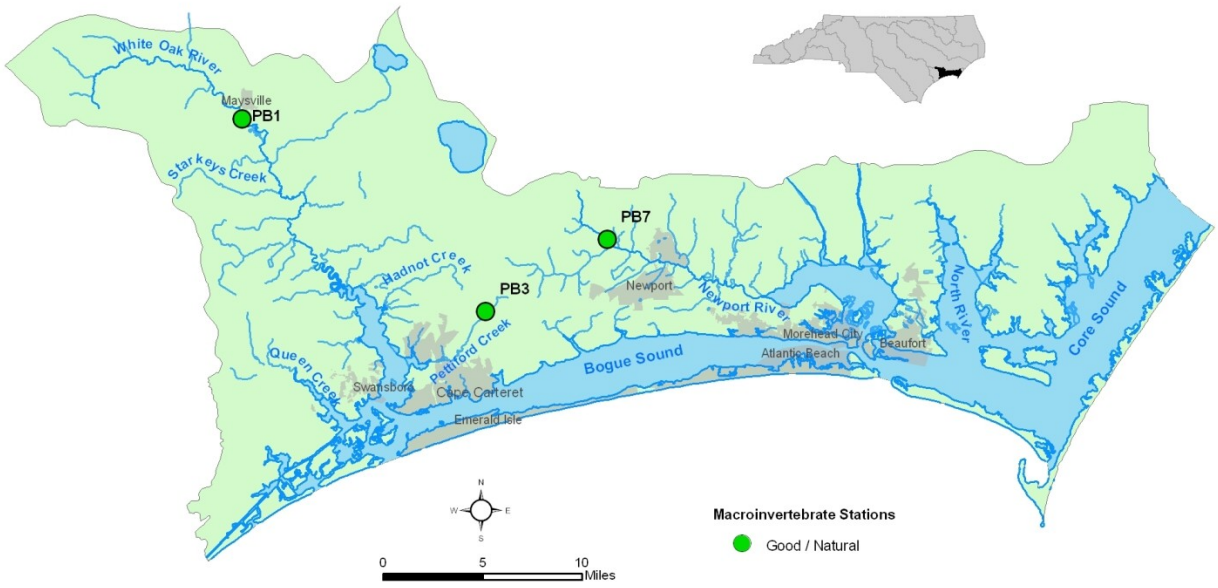


Figure 2. Sampling sites in HU 03020301 (2008-2010).

River and Stream Assessment

Specific summaries of the three benthic macroinvertebrate basinwide sampling cycles may be found in Appendix B-1. A list of all benthic macroinvertebrate samples taken in the White Oak River Basin can be found in Table 4. There have been no special studies in this HU since the prior basinwide cycle. Three basinwide collections were made for this HU (Table 1, Figure 2). However, due to unfavorable discharges, the White Oak River was sampled in 2010 while both Pettiford Creek and the NW Prong Newport River were sampled in 2008.

Table 1. Waterbodies monitored in HU 03020301 (2004 and 2009).

SiteID	Waterbody	County	Location	2004	2009
PB1	White Oak R	Onslow	US 17	Good-Fair	Good[1]
PB3	Pettiford Cr	Carteret	FSR 128	Natural	Natural[2]
PB7	NW Pr Newport R	Carteret	SR 1124	Natural	Natural[2]

[1]Sample was collected in 2010. [2]Sample was collected in 2008.

White Oak River Basin HU 03020302—New River

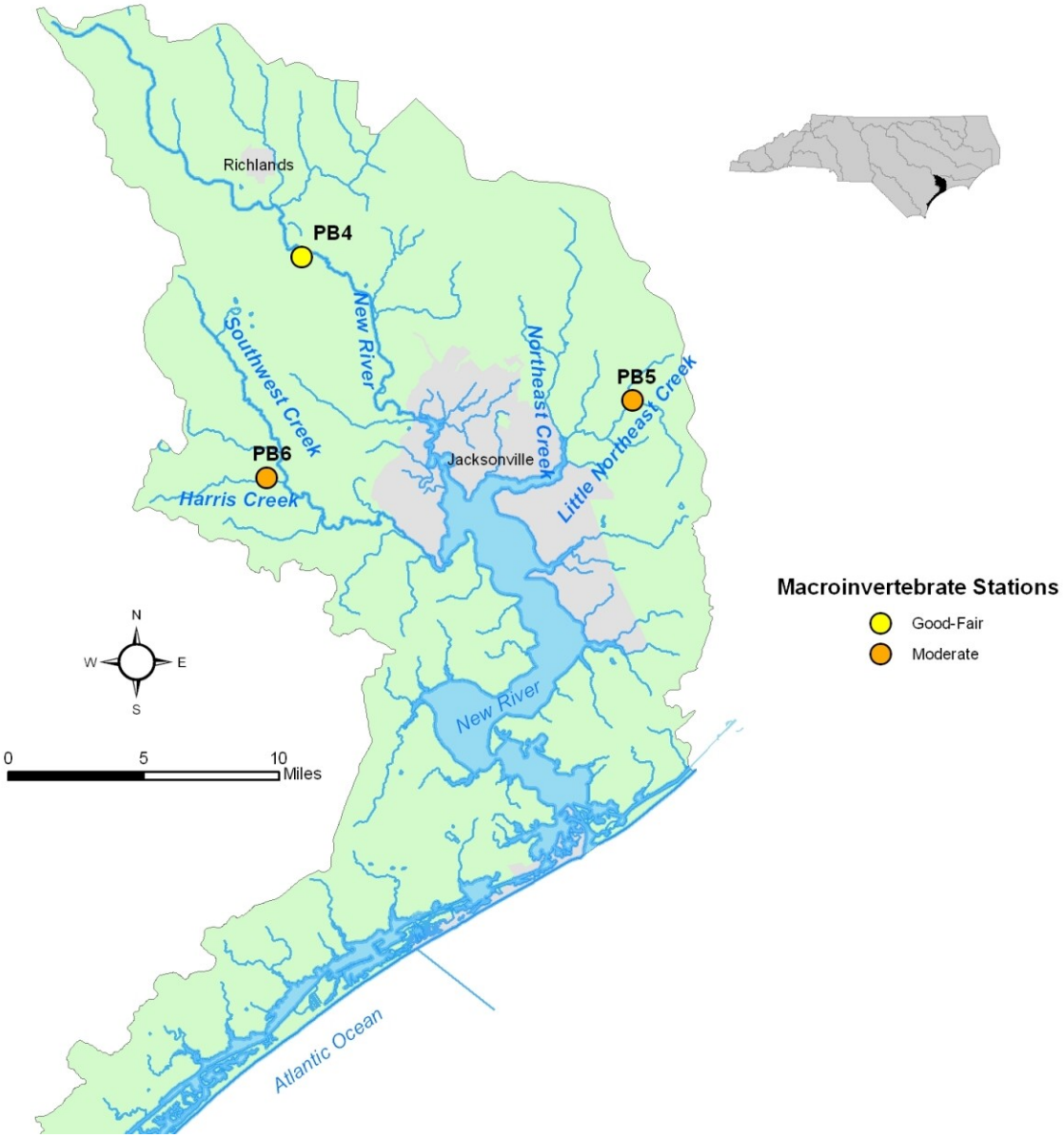


Figure 3. Sampling sites in HU 03020302 (2008-2010).

River and Stream Assessment

Specific summaries of the three benthic macroinvertebrate basinwide sampling cycles may be found in Appendix B-1. A list of all benthic macroinvertebrate samples taken in the White Oak River Basin can be found in Table 4. There have been no special studies in this HU since the prior basinwide cycle and there have been three basinwide collections (Table 2, Figure 3). However, due to unfavorable discharges, the New River was sampled in 2010 while both L Northeast Creek and Harris Creek were sampled in 2008.

Table 2. Waterbodies monitored in HU 03020302 (2004 and 2009).

SiteID	Waterbody	County	Location	2004	2009
PB4	New R	Onslow	SR 1314	Good-Fair	Good-Fair[1]
PB5	L Northeast Cr	Onslow	SR 1423	Moderate	Moderate[2]
PB6	Harris Cr	Onslow	SR 1109	Moderate	Moderate[2]

[1]Sample was collected in 2010. [2]Sample was collected in 2008.

GLOSSARY

Assessment Unit	A stream or a segment of a stream. Assessment Unit designations are used to uniquely identify streams or stream segments for the purpose of classifying waters for protection by use (such as for drinking water supply or trout waters).
BI or NCBI	North Carolina Biotic Index. This is one of two metrics used extensively to evaluate the results of benthic sampling, and is the weighted sum of tolerance values for taxa found in the sample relative to their abundance.
Bioclassification	A classification assigned to a stream site following biological sampling of either fish or macroinvertebrates. Criteria have been developed to assign bioclassifications ranging from Poor to Excellent to each sample. For invertebrates the bioclassification is based on the number of taxa present in the intolerant groups (EPT) and the North Carolina Biotic Index (BI or NCBI) value. For fish the classification is based on abundance, condition of specimens, species richness, composition, pollution-tolerance, trophic composition, and reproductive function.
Ecoregion	An area of relatively homogeneous environmental conditions, usually defined by elevation, geology, vegetation, and soil type. Examples include Mountains, Piedmont, Coastal Plain, Sand Hills, and Carolina Slate Belt.
EPT	The insect orders Ephemeroptera, Plecoptera, and Trichoptera. As a whole, these are the most intolerant insects present in the benthic community. EPT also refers to taxa richness within the three insect orders, a metric used extensively to derive bioclassifications. Higher EPT taxa richness values are associated with better water quality.
EPT BI	North Carolina Biotic Index for the EPT portion of the benthic community. This is the weighted sum of the tolerance values of taxa in the insect orders Ephemeroptera, Plecoptera, and Trichoptera found in the sample, relative to their abundance.
HQW	High Quality Waters. Such waters are rated Excellent based on biological and physical/chemical characteristics through Division monitoring or special studies and have been approved for such designation by the state Environmental Management Commission; also, primary nursery areas designated by the Marine Fisheries Commission and all Class SA waters.
MGD	Million gallons per day. This is generally the unit in which effluent discharge flow is measured.
NPDES	National Pollutant Discharge Elimination System.
NCIBI	North Carolina Index of Biotic Integrity (NCIBI); a summary measure of the effects of factors influencing the fish community.

ORW	Outstanding Resource Waters. These are unique and special waters of exceptional state or national recreational or ecological significance that require special protection to maintain existing uses and have been approved for such designation by the Environmental Management Commission.
Specific Conductance	The measure of the resistance of a solution to electrical flow. Resistance is reduced with increasing content of ionized salts. Reported in the units of µmhos/cm at 25 ^{o}C.
ST	Total invertebrate richness. The total number of different taxa present in a Full Scale benthic macroinvertebrate sample.
UT	Unnamed tributary.
WTP	Water treatment plant.
WWTP	Wastewater treatment plant

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

White Oak River Basin Summary:

As can be seen in Figure 4 there has been very little variation in bioclassifications since basinwide monitoring started in the White Oak Basin in 1999. However, a 2010 sample on the White Oak River at US 17 resulted in the first Good bioclassification ever recorded in the basin (Table 1). The lack of variation in bioclassifications in the White Oak River Basin also extended to the swamp samples (Figure 5) as the only noticeable change among these sites from 1999 included a reduction from three (3) swamps receiving a Natural bioclassification in 1999 to two (2) Natural bioclassifications at each subsequent monitoring event. Overall, water quality based on benthic macroinvertebrate samples has been stable in the White Oak Basin since 1999.

Figure 4. Bioclassification Trends in the White Oak River Basin: 1999-2009[1]. Stream and River Samples. **[1]Some 2009 samples were taken in 2010 due to unfavorable discharge conditions at some basin locations in 2009.**

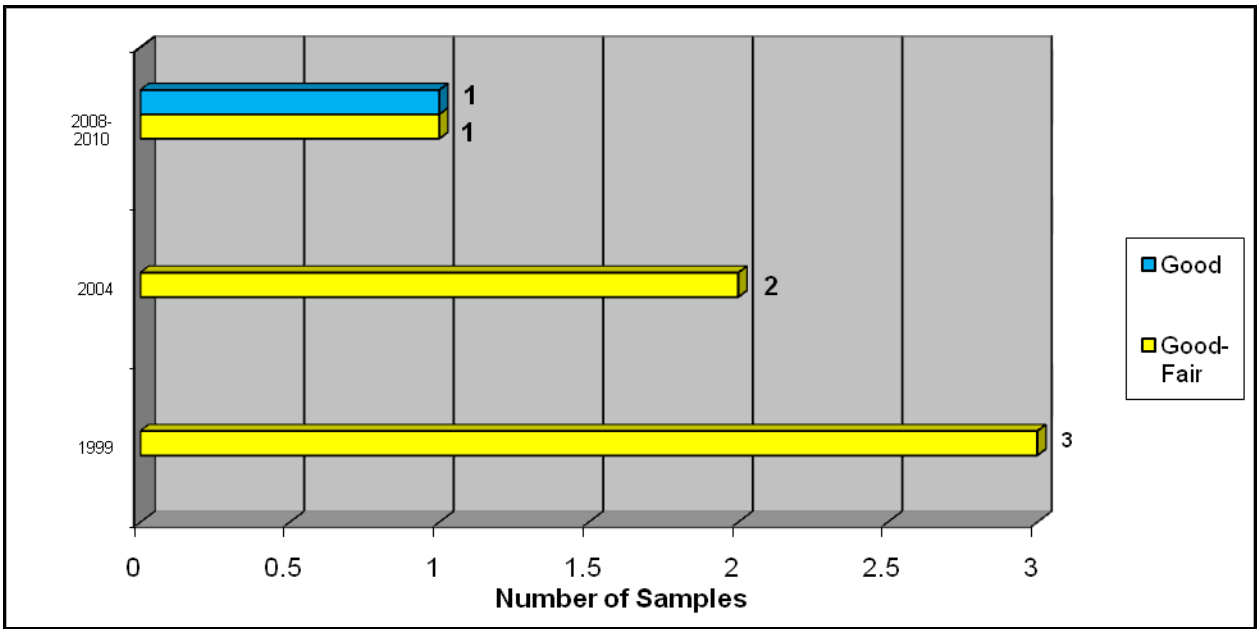
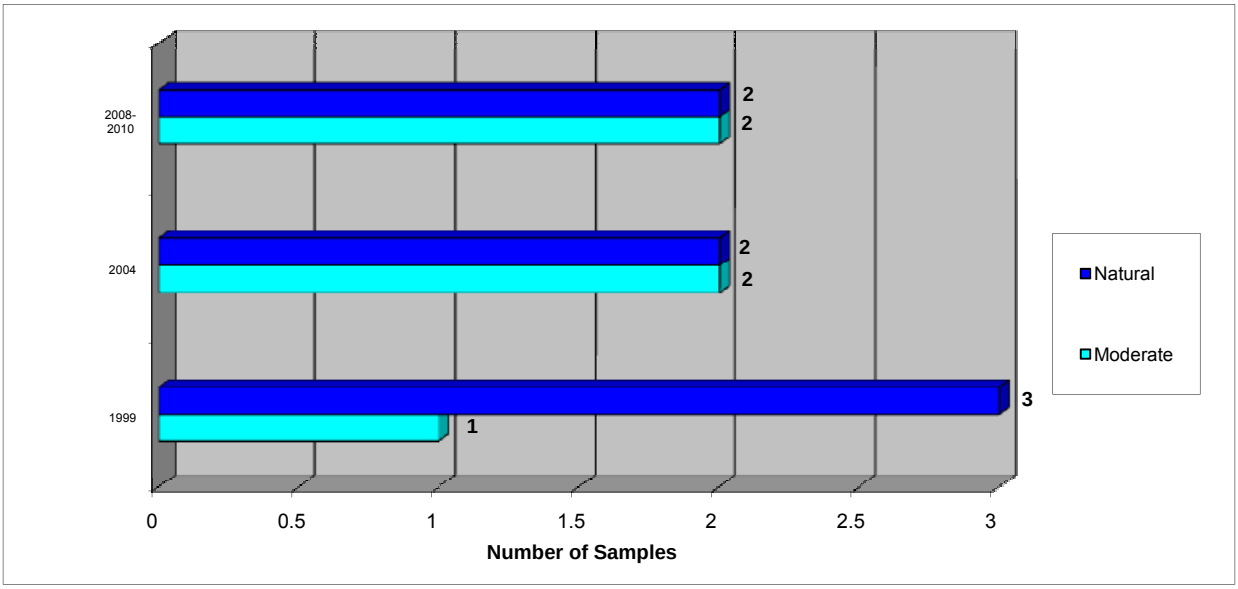


Figure 5. Bioclassification Trends in the White Oak River Basin: 1999-2009[1]. Swamp Samples. [1]**Some 2009 samples were taken in 2010 due to unfavorable discharge conditions at some basin locations in 2009.**



Numerous rare invertebrate taxa were collected in the Roanoke River basin in 2009. These data are presented below in Table 3.

Table 3. Rare Taxa Collected in the White Oak River Basin (Rare Taxa are Defined as Those Taxa Which Occur Less Than or Equal to 0.5% of Approximately 6,500 NCDWQ Benthic Collections).

CC Num	Date	Waterbody	Location	County	Subbasin	Huc_8Digit	Scientific Name
10982	6/9/10	WHITE OAK R	US 17	ONSLOW	1	03020301	ABLABESMYIA SIMPSONI
10982	6/9/10	WHITE OAK R	US 17	ONSLOW	1	03020301	OXYETHIRA SPP
10982	6/9/10	WHITE OAK R	US 17	ONSLOW	1	03020301	ARGIA TIBIALIS
10982	6/9/10	WHITE OAK R	US 17	ONSLOW	1	03020301	UVARUS LACUSTRIS
10982	6/9/10	WHITE OAK R	US 17	ONSLOW	1	03020301	STENELMIS CONVEXULA
10982	6/9/10	WHITE OAK R	US 17	ONSLOW	1	03020301	NILOTANYPUS AMERICANUS
10982	6/9/10	WHITE OAK R	US 17	ONSLOW	1	03020301	PROBEZZIA SPP
10982	6/9/10	WHITE OAK R	US 17	ONSLOW	1	03020301	ACRONEURIA EVOLUTA
10382	2/20/08	PETTIFORD CR	FSR 128	CARTERET	1	03020301	HYDROMETRA SPP
10382	2/20/08	PETTIFORD CR	FSR 128	CARTERET	1	03020301	TRIAENODES OCHRACEUS
10382	2/20/08	PETTIFORD CR	FSR 128	CARTERET	1	03020301	CHAETOCLADIUS SPP
10382	2/20/08	PETTIFORD CR	FSR 128	CARTERET	1	03020301	TANYTARSUS SP G
10382	2/20/08	PETTIFORD CR	FSR 128	CARTERET	1	03020301	BIDESSONOTUS SPP
10382	2/20/08	PETTIFORD CR	FSR 128	CARTERET	1	03020301	EURYLOPHELLA PRUDENTALIS
10382	2/20/08	PETTIFORD CR	FSR 128	CARTERET	1	03020301	STENELMIS CONVEXULA
10383	2/20/08	NW PR NEWPORT R	SR 1124	CARTERET	1	03020301	TRIAENODES OCHRACEUS
10383	2/20/08	NW PR NEWPORT R	SR 1124	CARTERET	1	03020301	STENELMIS CONVEXULA
10383	2/20/08	NW PR NEWPORT R	SR 1124	CARTERET	1	03020301	CERATOPOGON SPP
10981	6/9/10	NEW R	SR 1314	ONSLOW	2	03020302	SPARBARUS MACULATUS
10981	6/9/10	NEW R	SR 1314	ONSLOW	2	03020302	BELOSTOMATIDAE
10981	6/9/10	NEW R	SR 1314	ONSLOW	2	03020302	DROMOGOMPHUS SPINOSUS
10981	6/9/10	NEW R	SR 1314	ONSLOW	2	03020302	NILOTANYPUS AMERICANUS
10981	6/9/10	NEW R	SR 1314	ONSLOW	2	03020302	SUPHISELLUS SPP
10981	6/9/10	NEW R	SR 1314	ONSLOW	2	03020302	PARACYMUS SPP
10981	6/9/10	NEW R	SR 1314	ONSLOW	2	03020302	ORTHOCLADIUS CARLATUS
10391	2/11/08	HARRIS CR	SR 1109	ONSLOW	2	03020302	PARAKIEFFERIELLA SP 1 (dubious)
10391	2/11/08	HARRIS CR	SR 1109	ONSLOW	2	03020302	STEMPELLINA SPP
10391	2/11/08	HARRIS CR	SR 1109	ONSLOW	2	03020302	HYDROMETRA SPP
10390	2/11/08	L NORTHEAST CR	SR 1423	ONSLOW	2	03020302	ALBOGLOSSIPHONIA HETEROCLITA
10383	2/20/08	NW PR NEWPORT R	SR 1124	CARTERET	3	03020301	PROBEZZIA SPP
10383	2/20/08	NW PR NEWPORT R	SR 1124	CARTERET	3	03020301	LIMNOPHILA SPP

SAMPLING METHODS

Standard Qualitative (Full Scale) Method

Benthic macroinvertebrates can be collected from wadeable, freshwater, flowing waters using three sampling procedures. The Biological Assessment Unit's standard qualitative (Full Scale) sampling procedure includes 10 composite samples: two kick-net samples, three bank sweeps, two rock or log washes, one sand sample, one leafpack sample, and three visual collections from large rocks and logs (NCDWQ 2006).

EPT Method

Benthic macroinvertebrates can also be collected using the EPT sampling procedure. Four rather than 10 composite qualitative samples are taken at each site: one kick, one sweep, one leafpack and three visual collections (NCDWQ 2006). Only EPT taxa are collected and identified and only EPT criteria are used to assign a bioclassification.

Swamp Stream Method

The swamp sampling method utilizes nine sweep samples collected from each of the following habitats: macrophytes, root mats/undercut banks, and detritus deposits. If one of these habitat types is not present, a sweep from one of the other habitats is substituted. Three log/debris washes are also collected as are three visual collections.

Habitat Evaluation

The habitat evaluation, which ranges between 1 and 100, is based on the evaluation of several instream and riparian habitat parameters. Higher numbers suggest better habitat quality.

Data Analysis

Bioclassification criteria for all sampling procedures are provided in NCDWQ 2006. Tolerance values for individual species and biotic index values have a range of 0 - 10, with higher numbers indicating more tolerant species or more polluted conditions. Taxon specific tolerance values can also be found in NCDWQ 2006. NCDWQ criteria for assigning bioclassification are based on summer sampling: June - September. EPT S and BI values can be affected by seasonal changes. However, for samples collected outside summer, EPT S can be adjusted by subtracting out winter/spring Plecoptera or other adjustments based on resampling of summer site. The BI values also are seasonally adjusted for samples outside the summer season. For all samples, organisms are classified as Rare (1 - 2 specimens), Common (3 - 9 specimens), or Abundant (≥ 10 specimens) and all samples are picked on-site. For comprehensive guidance on benthic macroinvertebrate methods and analyses please refer to NCDWQ 2006.

NCDWQ. 2006. Standard Operating Procedures for Benthic Macroinvertebrates. North Carolina Department of Environment and Natural Resources, Division of Water Quality, Biological Assessment Unit. July 2006. Unpublished. http://www.esb.enr.state.nc.us/BAUwww/benthossop.pdf

Table 4. Benthic community data collected from the White Oak River Basin (1983-2009). Basinwide sites are in bold font.

HU/Waterbody	Location	County	SiteID	Date	ST	EPT	BI	EPTBI	Bioclass
03020301 White Oak River									
HOLSTON CR	NC 58	JONES	PB23	02/10/99	58	17	6.25	4.39	Natural
HOLSTON CR	NC 58	JONES	PB23	11/18/99	13	13	4.77	4.77	Not Rated
HOLSTON CR	NC 58	JONES	PB23	03/05/98	50	14	5.65	4.47	Natural
HUNTERS CR	SR 1100	JONES	PB21	02/10/99	56	11	6.78	6.04	Natural
NW PR NEWPORT R	SR 1124	CARTERET	PB7	02/20/08	37	7	5.15	2.77	Natural
				03/02/04	25	6	5.66	4.57	Natural Rated
				02/10/99	40	6	6.52	3.27	Natural
PETTIFORD CR	FSR 128	CARTERET	PB3	02/20/08	43	10	5.96	5.07	Natural
				03/02/04	35	10	5.96	4.67	Natural Rated
				02/23/99	38	10	6.38	5.11	Natural
				03/05/98	30	8	6.67	5.74	Natural
STARKEYS CR	SR 1434	ONSLOW	PB2	03/02/04	50	11	6.63	5.71	Moderate
STARKEYS CR	SR 1434	ONSLOW	PB2	02/11/99	93	15	7.24	6.08	Moderate
SW PR NEWPORT R	SR 1124	CARTERET	PB19	02/10/99	38	10	6.33	4.53	Natural
SW PR NEWPORT R	FS RD 168	CARTERET	PB20	03/05/98	16	2	7.15	5.98	Natural
WEBB CR	SR 1432	ONSLOW	PB15	02/11/99	30	3	7.49	6.36	Severe
WHITE OAK R	US 17	ONSLOW	PB1	06/09/10	70	20	5.99	4.93	Good
				06/30/04	72	21	6.19	5.06	Good-Fair
				02/11/99	61	11	6.97	6.14	Not Rated
				07/14/99	74	15	6.71	5.49	Good-Fair
WHITE OAK R	NR STELLA	ONSLOW	PB18	06/23/86	49	5	7.51	5.51	Poor
WHITE OAK R	NR STELLA	ONSLOW	PB18	07/11/84	58	8	7.34	6.34	Fair
03020302 New River									
BLUE CR	0.5 MI BE WWTP	ONSLOW	PB16	02/12/97	53	7	7.45	6.01	Fair
BLUE CR	SR 1283	ONSLOW	PB27	02/12/97	40	6	6.85	5.94	Fair
E MILL CR	BE CONFL	ONSLOW	PB8	08/05/85	34	0	7.70		Not Rated
E MILL CR	BE CONFL	ONSLOW	PB8	02/16/84	35	1	7.41	3.10	Not Rated
HARRIS CR	SR 1109	ONSLOW	PB6	02/11/08	69	12	6.45	5.68	Moderate
				03/01/04	50	11	6.12	5.43	Moderate
				02/09/99	63	13	6.97	5.91	Moderate
L NORTHEAST CR	SR 1423	ONSLOW	PB5	02/11/08	63	9	6.60	5.99	Moderate
				03/01/04	50	11	5.96	4.91	Moderate
				02/09/99	62	15	6.50	5.26	Natural
N MILL CR	NR CONFL	ONSLOW	PB9	08/06/85	26	2	7.45	6.24	Not Rated
NE MILL CR	BE CONFL	ONSLOW	PB10	08/06/85	48	1	7.69	5.90	Not Rated
NW MILL CR	NC 210 BE DRAINAGE DITCH	ONSLOW	PB11	08/05/85	44	2	7.50	3.85	Not Rated
				02/16/84	22	3	6.83	5.70	Not Rated
NW MILL CR	NC 210 AB DRAINAGE DITCH	ONSLOW	PB26	08/05/85	57	4	7.66	5.97	Not Rated
				02/16/84	43	5	7.48	5.77	Not Rated
NEW R	NC 24	ONSLOW	PB24	07/06/95	10	10	5.98	5.98	Fair
NEW R	SR 1314	ONSLOW	PB4	06/09/10	81	17	5.79	4.40	Good-Fair

Table 4 (Continued). Benthic community data collected from the White Oak River Basin (1983-2009). Basinwide sites are in bold font.

NEW R	SR 1314	ONSLOW	PB4	07/13/99	53	11	6.21	5.42	Good-Fair
				07/14/95	74	12	6.40	5.71	Good-Fair
				08/08/94	52	3	7.09	4.93	Not Rated
				06/26/90	70	15	6.31	5.11	Good-Fair
				07/01/88	88	24	5.96	4.30	Good
				06/24/86	84	24	6.06	4.97	Good
				07/10/85	95	23	6.01	4.45	Good
				07/10/84	92	25	6.08	4.65	Good
				07/12/83	83	20	6.17	5.01	Good-Fair
NORTHEAST CR	SR 1406	ONSLOW	PB17	02/09/99	62	10	7.06	5.67	Moderate
SOUTHWEST CR	SR 1213	ONSLOW	PB14	02/09/99	69	11	7.35	6.30	Moderate
SOUTHWEST CR	SR 1105	ONSLOW	PB13	08/08/94	59	5	6.79	6.46	Fair
WHITE OAK R	HAYWOOD LNDG	JONES	PB22	08/09/94	35	3	8.26	8.00	Not Rated