BASINWIDE ASSESSMENT REPORT: PASQUOTANK RIVER BASIN

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

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INTRODUCTION TO PROGRAM METHODS

The North Carolina 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 Pasquotank River basin has been sampled by the Environmental Sciences Section's (ESS) Biological Assessment Unit (BAU) for benthic macroinvertebrates in 1995, 2000, 2005, and 2010. For a complete list of all historic benthic macroinvertebrate samples obtained by the BAU (including data for the Pasquotank River Basin) please refer to the following link: http://portal.ncdenr.org/web/wq/benthosdata.

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 Pasquotank River basin include benthic macroinvertebrates. 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 Pasquotank River basin encompasses 3,697 square miles of flat lands and vast open waters (42 percent of the basin) in the far northeast outer coastal plain (Figure 1, Figure 2). It includes all or parts of Camden, Currituck, Dare, Gates, Hyde, Pasquotank, Perquimans, Tyrell and Washington counties. A small portion of the basin extends into Virginia. Watersheds in this basin drain into sections of Albemarle, Currituck, Croatan, Roanoke and Pamlico Sounds. Urban areas include Elizabeth City, Hertford, Columbia, Manteo and the Outer Banks north of Manteo.

Located on the northwest side of Albemarle Sound, the Pasquotank River is freshwater above and brackish and tidally influenced below Elizabeth City. Little River is a low-velocity freshwater stream that flows along the border of Perquimans and Pasquotank counties. Perquimans River originates in the Great Dismal Swamp, and has the town of Hertford in its watershed. The Scuppernong River watershed is mainly forested wetlands and agriculture with widespread use of canals which drain the wetlands.

Basinwide sampling for macroinvertebrates in 2010 was limited to subbasins 50, 52, 53, and 54. It is difficult to find flowing, wadeable or boatable, freshwater sites with relatively high pH in the basin which would allow for benthic assessment.

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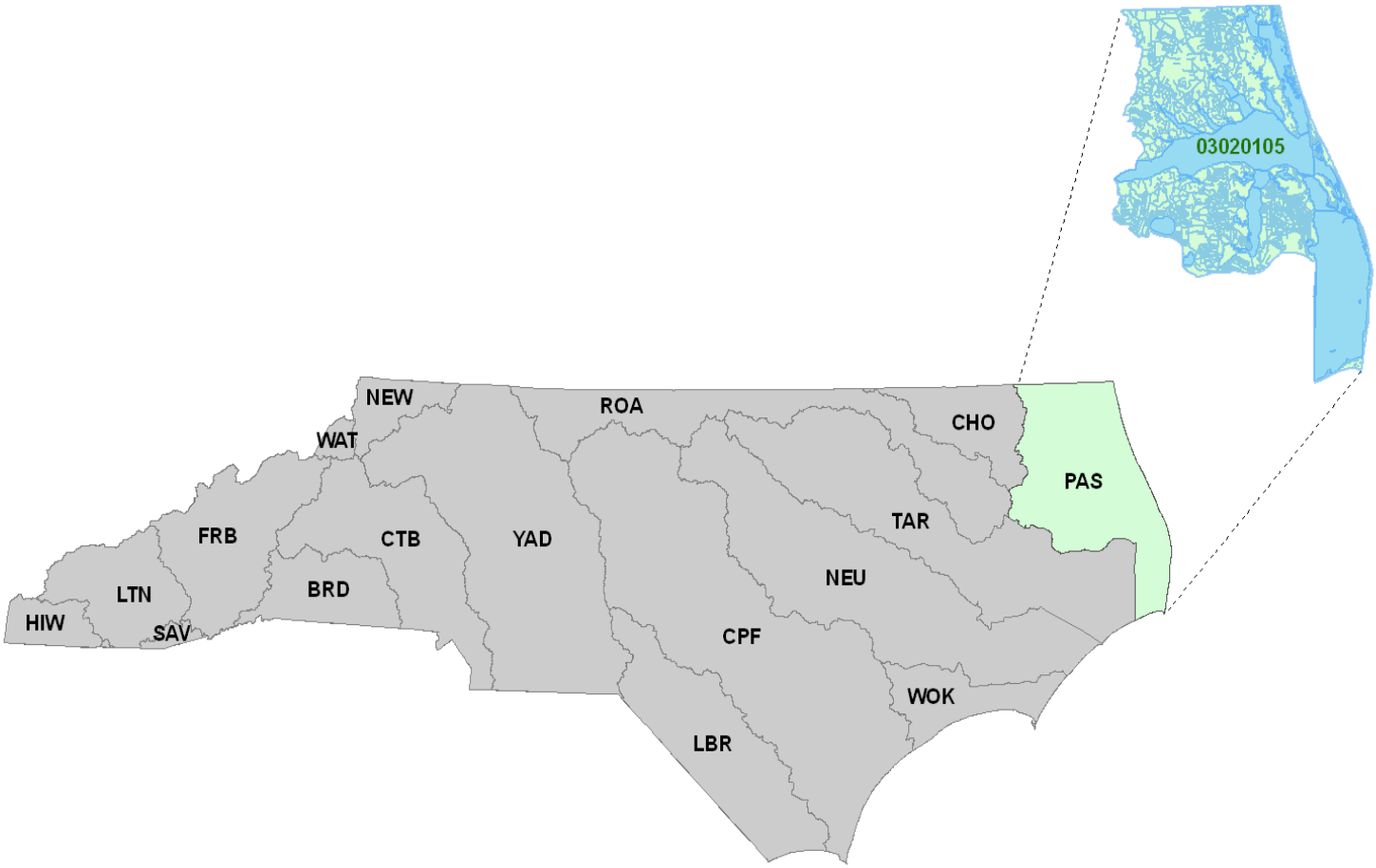


Figure 1. **Geographic relationships and eight-digit hydrologic units of the Pasquotank River basin.**

PASQUOTANK RIVER HUC 03010205

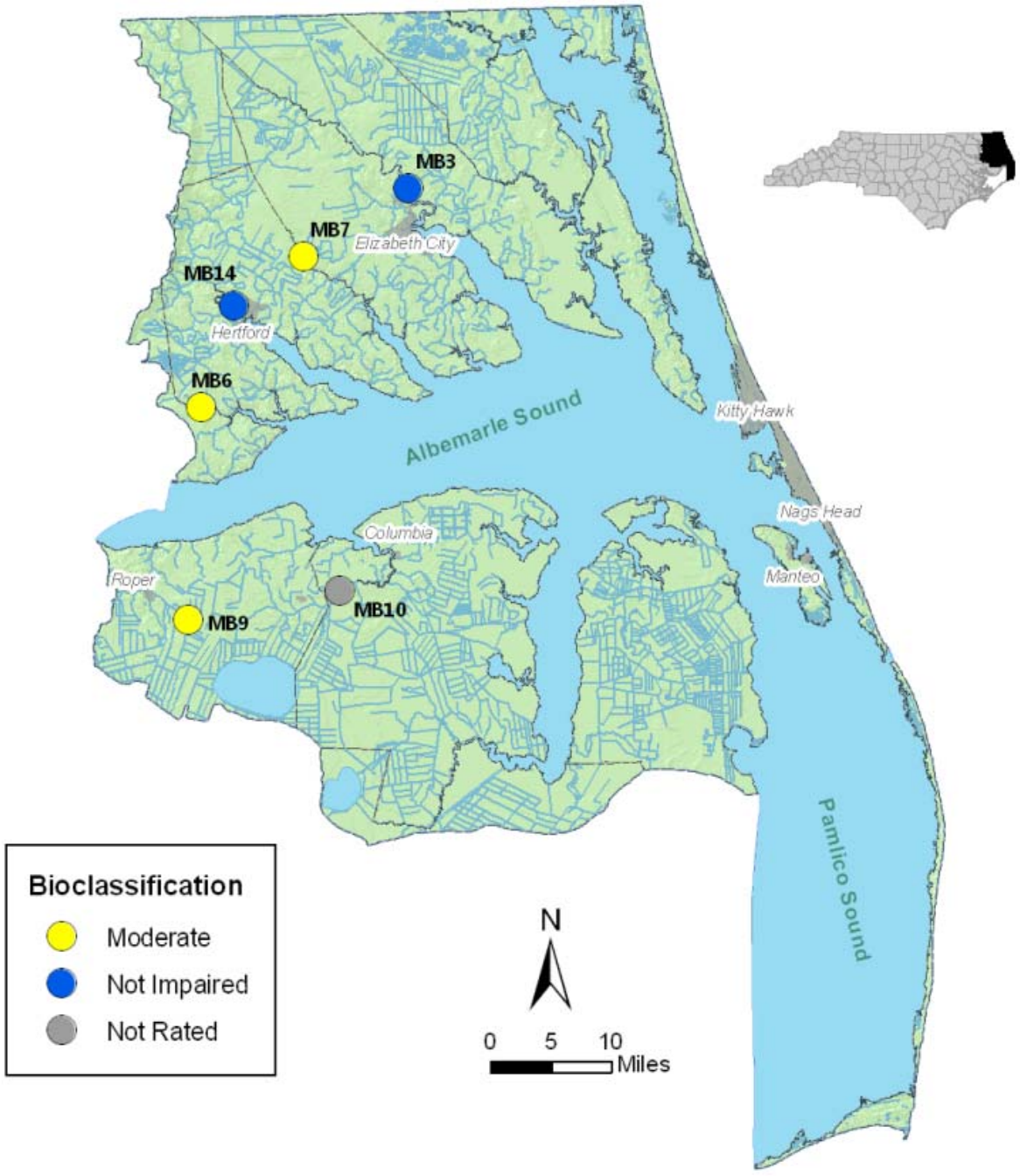


Figure 2 **Sampling sites in HUC 03010205 (2010).**

River and Stream Assessment

Several sites sampled during the most recent basinwide cycle in 2005 were not sampled in 2010 due to staffing reductions. These sites included Newbegun Creek at SR 1132 (Camden County) Pasquotank River at SR 1361 (Pasquotank County), Newland Drainage Canal at SR 1363 (Pasquotank County), Perquimans River at NC 37 (Perquimans County) and UT Cowells Creek at NC 34 (Currituck County).

Table 1. Waterbodies Monitored in HUC 03010205.

Site ID	Waterbody	County	Location	2005	2010
MB3	Pasquotank R	Pasquotank	Goat Island	Fair	Not Impaired
MB7	Little R	Perquimans	SR 1221	Moderate	Moderate
MB14	Perquimans R	Perquimans	Near Knowles Landing	Fair	Not Impaired
MB6	Burnt Mill Cr	Chowan	NC 37	Moderate	Moderate
MB9	Main Canal	Washington	SR 1180	Severe	Moderate
MB10	Scuppernong R	Tyrrell	SR 1105	Poor	Not Rated

SPECIAL STUDIES

Between 2005-2010, there were no special studies conducted in this basin.

GLOSSARY

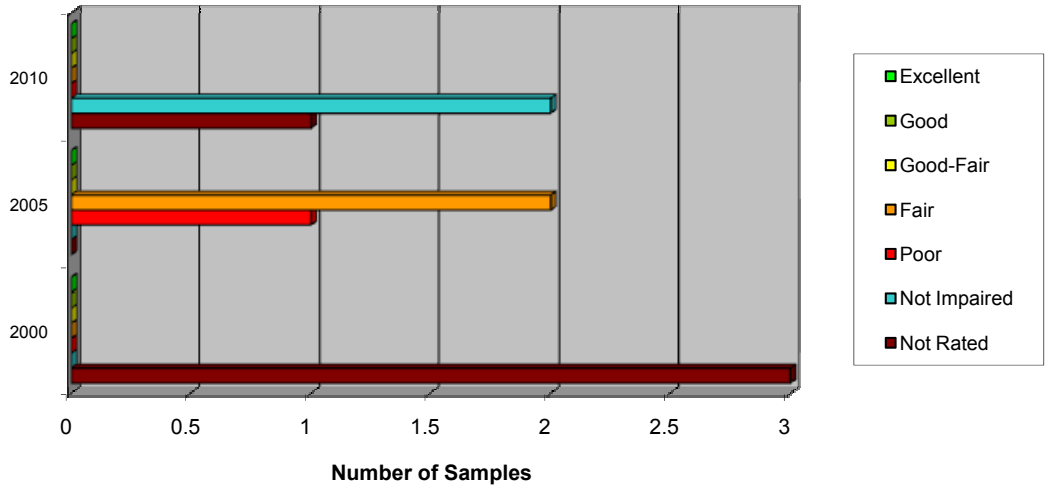
7Q10	A value which represents the lowest average flow for a seven day period that will recur on a ten year frequency. This value is applicable at any point on a stream. 7Q10 flow (in cfs) is used to allocate the discharge of toxic substances to streams.
Bioclass	Criteria have been developed to assign bioclassifications ranging from Poor to Excellent to each benthic sample based on the number of taxa present in the intolerant groups (EPT) and the Biotic Index value.
cfs	Cubic feet per second, generally the unit in which stream flow is measured.
CHL *a*	Chlorophyll *a*.
Class C Waters	Freshwaters protected for secondary recreation, fishing, and aquatic life including propagation and survival, and wildlife. All freshwaters shall be classified to protect these uses at a minimum.
Conductivity	In this report, synonymous with specific conductance and reported in the units of μmhos/cm at 25 ^{o}C. Conductivity is a measure of the resistance of a solution to electrical flow. Resistance is reduced with increasing content of ionized salts.
NCDWQ	The North Carolina Division of Water Quality.
D.O.	Dissolved Oxygen.
Ecoregion	An area of relatively homogeneous environmental conditions, usually defined by elevation, geology, and soil type. Examples include Southern Outer Piedmont, Carolina Flatwoods, Sandhills, and Slate Belt.
EPT	The insect orders (Ephemeroptera, Plecoptera, Trichoptera); as a whole, the most intolerant insects present in the benthic community.
EPT N	The abundance of Ephemeroptera, Plecoptera, Trichoptera insects present, using values of 1 for Rare, 3 for Common and 10 for Abundant.
EPTS	Taxa richness of the insect orders Ephemeroptera, Plecoptera and Trichoptera. Higher taxa richness values are associated with better water quality.
HQW	High Quality Waters. Waters which are rated as excellent based on biological and physical/chemical characteristics through Division monitoring or special studies; primary nursery areas designated by the Marine Fisheries Commission; and all Class SA waters.
IWC	Instream Waste Concentration. The percentage of a stream comprised of an effluent calculated using permitted flow of the effluent and 7Q10 of the receiving stream.
Major Discharger	Greater than or equal to one million gallons per day discharge (≥ 1 MGD).

MGD	Million Gallons per Day, generally the unit in which effluent discharge flow is measured.
Minor Discharger	Less than one million gallons per day discharge (< 1 MGD).
NPDES	National Pollutant Discharge Elimination System.
NCBI (EPT BI)	North Carolina Biotic Index, EPT Biotic Index. A summary measure of the tolerance values of organisms found in the sample, relative to their abundance. Sometimes noted as the NCBI or EPT BI.
NCIBI	North Carolina Index of Biotic Integrity (NCIBI); a summary measure of the effects of factors influencing the fish community.
NSW	Nutrient Sensitive Waters. Waters subject to growths of microscopic or macroscopic vegetation requiring limitations on nutrient inputs.
NTU	Nephelometric Turbidity Unit.
ORW	Outstanding Resource Waters. Unique and special waters of exceptional state or national recreational or ecological significance which require special protection to maintain existing uses.
Parametric Coverage	A listing of parameters measured and reported.
SOC	A consent order between an NPDES permittee and the Environmental Management Commission that specifically modifies compliance responsibility of the permittee, requiring that specified actions are taken to resolve non-compliance with permit limits.
Total S (or S)	The number of different taxa present in a benthic macroinvertebrate sample.
UT	Unnamed tributary.
WWTP	Wastewater treatment plant.

Appendix 1. Summary of Benthic Macroinvertebrate Data in the Pasquotank River Basin

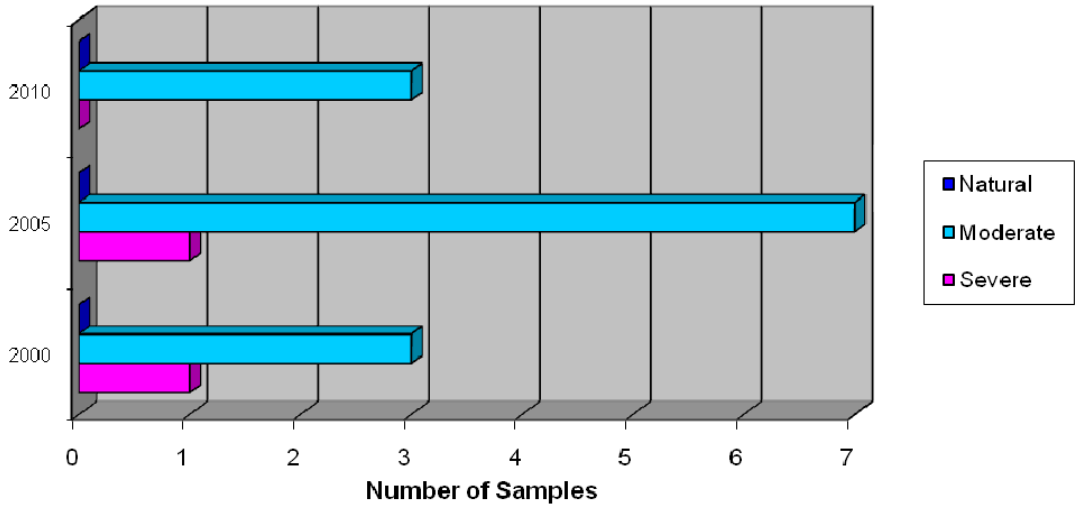
Since 2000, the largest trend noted among the river and stream samples was a reduction in Not Rated designations and an increase in the number of Not Impaired designations (Figure 3). The sources of these improvements were the Pasquotank River at Goat Island and the Perquimans River near Knowles Landing. Both of these sites improved from Not Rated (2000) and Fair (2005) to both receiving Not Impaired designations in 2010. In 2005 Coastal B rivers were assigned bioclassifications (based on EPTS criteria). However, upon a more rigorous review of existing data and critiera for Coastal B rivers, it was determined in 2010 that all subsequent Coastal B river samples should not be assigned a bioclassification (i.e., Poor, Fair, Good-Fair, Good, Excellent) and were instead designated as Not Rated or Not Impaired. Not Rated is equivalent to a Fair bioclassification or worse based on the provisional (EPTS) Coastal B criteria, while a Not Impaired designation is equivalent to a bioclassification of Good-Fair or better. The 2005 samples at these two sites were Fair (based on EPTS) with both samples producing an EPTS of four. Conversely, the 2010 sample on the Pasquotank River resulted in an EPTS of six while the Perquimans River sample resulted in an EPTS of eight. The large increase in these pollution intolerant EPT taxa from 2005 to 2010 suggests an improvement in physico-chemical conditions in these waterbodies since 2005. Had bioclassifications been assigned to these samples in 2010, they would have both rated Good-Fair. The only other river station sampled in this basin from all three basin cycles (Scuppernong River at SR 1105) received a Poor bioclassification in 1995 and 2005 with three and two EPT taxa collected respectively. This site received a Not Rated designation in 2010 with one EPT taxa collected. If the 2010 sample had been assigned a bioclassification, it would have also received a Poor bioclassification. These data strongly suggest that physico-chemical conditions in the Scuppernong River have not improved since monitoring first commenced in 1995. Although this basin was monitored in 1995, there were only two long-term sites: Scuppernong River and the Perquimans River at US 17. The Scuppernong River is discussed above. The Perquimans station at US 17 was dropped as a monitoring site in 2000 and has never been resampled. Given the paucity of monitoring in 1995, these two samples are not included in the data presented in Figure 3.

Figure 3. Bioclassification Trends in the Pasquotank River Basin: 2000-2010. Stream and River Samples.



The most notable trend amond swamp samples in the river basin from 2000-2010 is a decrease in the number of Severe bioclassifications and an overall increase in Moderate bioclassifications. However, due to a reduction in staff, the number of swamp samples collected in 2010 relative to previous years decreased so definitive conclusions about water quality trends cannot be made. However, of the three swamp systems evaluated, two (Burnt Mill Creek at NC 37 and Little River at SR 1221) remained unchanged from 2000-2010 and both received Moderate bioclassifiations. Conversely, in 2010, Main Canal at SR 1180 improved to Moderate from the previous Severe bioclassifications recored in 2000 and 2005. This improvement in 2010 suggests improved physico-chemical conditions here relative to earler samples, and may be related to the incresed flows observed in 2010 relative to levels seen in 2005. Although swamp samples were taken in 1995 there were no swamp criteria in place to assign these samples bioclassifications. As a result, these samples are not included in Figure 4.

Figure 4. Bioclassification Trends in the Pasquotank River Basin: 2000-2010. Swamp Samples.



Appendix 2. Benthic Macroinvertebrate Sampling Methods

Boat Sampling

Most collections are made in wadeable streams, but there are some locations where a boat is required. Such locations are usually large coastal plain rivers. In such habitats, petite ponar dredge samples replace kick-net samples, but all other standard qualitative collection techniques are used. Most of these large-river sites have little or no visible current. Coastal B criteria are used to evaluate such sites.

The standard boat method aims at a total of 10 composite samples per site. Sweeps, epifaunal collections, visual collections, and part of the leaf-pack/debris sample are performed along the edges in wadeable depths. Petite ponar samples are collected from deeper areas using the boat, along with part of the leaf-pack/debris sample, part of one epifaunal wash, and visual collections from logs in the current. Petite ponar samples are collected at three locations between midstream and the bank, with three replicates at each location (a total of nine samples). The three locations should include a variety of depths; one of those depths should be between two and three meters. No petite ponar samples are collected from the area normally sampled during shore work (i.e. areas less than two meters in depth).

Swamp Stream Method

The Biological Assessment Unit defines “swamp streams” as those streams that are within the coastal plain ecoregion and that normally have no visible flow during a part of the year. The low flow period usually occurs during the summer; flowing water should be present in swamp streams during the winter. Sampling during the winter, high-flow period provides the best opportunity for detecting differences between natural and stressed benthic communities in these systems. The swamp stream must have visible flow in this winter period, with flow comparable to a coastal plain stream that would have acceptable flow for sampling in summer. Swamp streams with pH values of 4.0 s.u. or lower can not be rated; those streams with pH values between 4.0 and 4.5 s.u. are difficult to evaluate.

The swamp sampling method utilizes a variety of collection techniques to inventory the macroinvertebrate fauna at a site. Nine sweep samples (one series of three by each field team member) are 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. A sweep is defined as the area that can be reached from a given standing location. Each sweep should be emptied into a tub before the next sweep is collected, to prevent clogging of the net, but all three sweeps can be combined in the same tub. Three log/debris washes are also collected. Visual collections are the final technique used at each site.

For all three sampling methods (full-scale, boat, and swamp), organisms are removed from each sample at the field site and preserved in 95% ethanol. The purpose of these collections is to inventory the aquatic fauna and produce an indication of relative abundance for each taxon. Organisms are classified as Rare (1 - 2 specimens), Common (3 - 9 specimens), or Abundant (≥ 10 specimens).

Habitat Evaluation

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

Appendix 3. Benthic Macroinvertebrate Critieria

Boat Samples, Coastal B Rivers Criteria

The Biological Assessment Unit has limited data on Coastal B streams, therefore draft criteria have been developed based only on EPT taxa richness (Table 2). However, biotic index values and total taxa richness values are used to evaluate between-year and among-site comparisons. The criteria that are presented here will continue to be evaluated. Any bioclassification derived from these draft criteria should be considered tentative and should not be used for use support decisions.

Table 2. Draft Criteria for Coastal B Rivers

Bioclassification	EPT S
Excellent	> 11
Good	9-11
Good-Fair	6-8
Fair	3-5
Poor	<3

Swamp Stream Criteria

Swamp stream criteria are used to evaluate a stream based on three benthic macroinvertebrate metrics (total taxa richness, EPT taxa richness, and the Biotic Index) and the coastal plain habitat score.

In the following, raw measures for total taxa richness, EPT richness, biotic index, and habitat are referred to as “values.” After adjustments are made for swamp criteria, the measures are referred to as “scores.” The convention is made to reduce confusion.

Swamps in the Chowan and Pasquotank basins are classified as A, B, or C depending on geographic location. The metric scores derived below depend on the swamp classification and, in some cases, pH.

If the stream channel is braided, the value for total taxa richness is increased by eight. Corrected total taxa richness is determined from Table 3 for Swamp A and Swamp B streams. Find the pH for the collection on the left. Find the set of three columns which correspond to the stream type (Swamp A or Swamp B), the find the range which corresponds to the total taxa richness for the site (corrected for a braided stream as indicated above, if necessary). Find the corrected total taxa richness score at the top of the appropriate column.

Table 3. Determination of Corrected Taxa Richness Scores for Swamp A and B Streams Adjusted for pH.

	Corrected Total Taxa Richness Score					
	Swamp A			*Swamp B*		
	5	**3**	**1**	**5**	**3**	**1**
pH						
≥5.5	>51	35-51	<35	>38	25-38	<25
5.4	>49	32-49	<32	>36	23-36	<23
5.3	>46	29-46	<29	>34	21-34	<21
5.2	>43	26-43	<26	>32	19-32	<19
5.1	>40	23-40	<23	>30	17-30	<17
5.0	>37	20-37	<20	>28	≤28	ND
4.9	>35	17-35	<17	>26	≤26	ND
4.8	>33	13-33	<13	>24	≤24	ND
4.7	>30	10-30	<10	>22	≤22	ND
4.6	>28	0-28	ND	>20	≤20	ND
4.5	>26	0-26	ND	>18	≤18	ND
4.4	>23	0-23	ND			
4.3	>20	0-20	ND			
4.2	>17	0-17	ND			
4.1	>14	0-14	ND			

Corrected total taxa richness scores are assigned as follows for Swamp C streams:

if the total taxa richness > 34, total taxa richness score = 5
if the total taxa richness is ≤ 34, total taxa richness score = 3

Biotic index scores for Swamp A, B, and C streams are derived using Table 4.

Table 4. Determination of Biotic Index Scores for Swamp A, B, and C Streams

	Swamp A	**Swamp B**	**Swamp C**
BI Score			
5	<6.8	<7.0	<7.2
3	6.8-7.5	7.0-7.9	7.2-8.1
1	>7.5	>7.9	>8.1

For EPT taxa richness add two to the value if the channel is braided, no matter the stream type.

For Swamp A streams, the EPT richness score is determined from Table 5. Find the pH for the collection in the left column. Move to the right to find the appropriate range for the EPT Richness value. Read the corrected EPT richness score from the top of the column.

Table 5. EPT Richness Scores for Swamp A streams adjusted for pH.

	Corrected EPT Richness Value		
	5	**3**	**1**
pH			
≥5.5	>17	7-17	0-6
5.4	>15	6-15	0-5
5.3	>13	5-13	0-4
5.2	>11	4-11	0-3
5.1	>9	3-9	0-2
5.0	>8	0-8	ND
4.9	>7	0-7	ND
4.8	>6	0-6	ND
4.7	>5	0-5	ND
4.6	>4	0-4	ND
4.5	>4	ND	ND

For Swamp B streams, the EPT richness score is not dependant on pH; scores are assigned as follows:

if EPT richness value > 5, EPT richness score = 5
if EPT richness value is between 2 and 4 inclusive, EPT richness score = 3
if EPT richness value is 0 or 1, EPT richness score = 1

For all Swamp C streams the EPT richness score is assigned a 1. An adjustment for very low numbers of EPT taxa in Swamp C streams will be made after the site score is determined.

Habitat scores are assigned irrespective of stream type:

if habitat value > 79, habitat score = 5
if habitat value is between 60 and 79 inclusive, habitat score = 3
if habitat value is < 60, habitat score = 1

The site score is calculated from the following:

Site Score = [(2xBI score + habitat score + EPT S score + Taxa Richness score) – 5]/2

For Swamp C streams, add two to the site score.

Stress ratings based on the scores are: Natural (9 - 10), Moderate (4 - 8) and Severe (1 - 3).

APPENDIX 4: TEMPLATE SUMMARY REPORTS

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
PASQUOTANK R	**GOAT IS**	**MB3**	**08/24/05**	**Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
PASQUOTANK	50	03010205	36.344444	-76.221944	30-3-(3)	hesapeake-Pamlico Lowlands and Tidal Marsh

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-IV;Sw	152.1	0	300	5.0

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	100	0	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)	28.7
Dissolved Oxygen (mg/L)	2.4
Specific Conductance (µS/cm)	152
pH (s.u.)	6.4

Water Clarity	tannic

Habitat Assessment Scores (max)

Channel Modification (5)	15
Instream Habitat (20)	15
Bottom Substrate (15)	4
Pool Variety (10)	4
Riffle Habitat (16)	0
Bank Erosion (7)	10
Bank Vegetation (7)	10
Light Penetration (10)	2
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	70

Site Photograph

Substrate silt, detritus

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/23/10	11038	32	6	7.16	5.16	Not Impaired
08/24/05	9721	52	4	7.61	6.60	Fair
08/02/00	8235	31	4	7.91	6.44	Not Rated

Data Analysis

Although the 2010 sample showed a large decline in overall taxa richness relative to the 2005 collection, the EPT richness was the highest on record. Intolerant EPT taxa collected for the first time at this location included the caddislies *Oecetis persimilis* , *Cyrnellus fraternus* , and *Polycentropus spp* . In addition to the increased EPT richness, the BI and EPTBI both reached all-time lows for this location. Several tolerant taxa present from the 2000 and 2005 samples were absent in the 2010 collection and included several dragonflies (*Neurocordulia obsoleta* , *Tetragoneuria spp* , *Pachydiplax longipennis)* , the chironomdis *Glyptotendipes spp* , *Kiefferulus dux* , and the oligochaete *Stylaria lacustris* . Combined, these data suggest improved conditions here relative to previous samples. However, specefic conductance data from 2005 to 2010 actually increased slightly (152 µS/cm to 203 µS/cm) so the reason for the improvement in the community is unclear. This site has previously been assigned bioclassifications. However, these bioclassifications were based on provisional biocriteria. Given the provisional status of biocriteria for large, non wadeable coastal plain rivers, the 2010 sample was assigned a Not Impaired rating. However, for purposes of inter-year comparison, the 2010 collection would have received a Good-Fair bioclassification based on the provisional criteria.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
LITTLE R	**SR 1221**	**MB7**	**02/23/05**	**Moderate**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
PERQUIMANS	52	03010205	36.268333	-76.378333	30-5-(1)a	hesapeake-Pamlico Lowlands and Tidal Marsh

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C;Sw	27.5	1	15	0.5

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	100	0	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)	8.7
Dissolved Oxygen (mg/L)	10.6
Specific Conductance (µS/cm)	243
pH (s.u.)	7.1

Water Clarity: slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	15
Instream Habitat (20)	15
Bottom Substrate (15)	3
Pool Variety (10)	6
Riffle Habitat (16)	0
Bank Erosion (7)	10
Bank Vegetation (7)	10
Light Penetration (10)	10
Left Riparian Score (5)	2
Right Riparian Score (5)	5
Total Habitat Score (100)	75

Site Photograph

Substrate: silt, detritus

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/01/10	10898	24	2	7.82	5.90	Moderate
02/23/05	9565	40	1	7.94	5.90	Moderate
02/11/00	8067	24	0	8.28	0.00	Moderate

Data Analysis

Although the total taxa richness decreased in 2010 relative to the 2005 sample, the BI reached an all-time low for this location while the EPT richness (althouhg still low) also attained a maximum in 2010. These data suggest that an improvement in physico-chemical may have occured since the 2005 sample. Indeed, this conclusionis supported by the more favorable water chemistry parameters as the specefic conductance decreased from 243 µS/cm in 2005 to 178 µS/cm in 2010. EPT taxa collected in 2010 but absent from previous collections include

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
PERQUIMANS R	NR KNOWLES LDG	MB14	08/23/05	Fair

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
PERQUIMANS	52	03010205	36.213611	-76.483611	30-6-(1)b	hesapeake-Pamlico Lowlands and Tidal Marsh

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C;Sw	159.5	0	150	5.0

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	90	10	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)	29.7
Dissolved Oxygen (mg/L)	3.2
Specific Conductance (µS/cm)	303
pH (s.u.)	6.8
Water Clarity	tannic

Habitat Assessment Scores (max)

Channel Modification (5)	15
Instream Habitat (20)	15
Bottom Substrate (15)	7
Pool Variety (10)	4
Riffle Habitat (16)	0
Bank Erosion (7)	10
Bank Vegetation (7)	10
Light Penetration (10)	2
Left Riparian Score (5)	5
Right Riparian Score (5)	4
Total Habitat Score (100)	72

Site Photograph

Substrate silt, detritus

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/22/10	11040	44	8	7.98	5.45	Not Impaired
08/23/05	9720	41	4	7.60	5.70	Fair
08/02/00	8234	45	4	7.62	6.50	Not Rated

Data Analysis

Although total taxa richness has been stable at this location since assessments started in 2000, the 2010 sample resulted in a doubling of intolerant EPT taxa. EPT taxa not previously collected here but present in 2010 included the caddisflies *Hydroptila spp* , *Triaenodes injustus* , and *Cyrnellus fraternus* . The biological data suggest improved physico-chemical conditions at this location and while the specific conductance counter indicates this assertion (303 µS/cm in 2005, 343 µS/cm in 2010) the dissolved oxygen did increase significant in 2010 (5.1 mg/l) from levels observed in 2005 (3.2 mg/l). This site has previously been assigned bioclassifications. However, these bioclassifications were based on provisional biocriteria. Given the provisional status of biocriteria for large, non wadeable coastal plain rivers, the 2010 sample was assigned a Not Impaired rating. However, for purposes of inter-year comparison, the 2010 collection would have received a Good-Fair bioclassification based on the provisional criteria.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
BURNT MILL CR	**NC 37**	**MB6**	**02/21/05**	**Moderate**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
CHOWAN	52	03010205	36.096111	-76.534722	30-8-1	hesapeake-Pamlico Lowlands and Tidal Marsh

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C;Sw	4.6	2	6	0.2

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	0	20	80	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)	12.4
Dissolved Oxygen (mg/L)	12.9
Specific Conductance (µS/cm)	277
pH (s.u.)	7.0
Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	7
Instream Habitat (20)	10
Bottom Substrate (15)	7
Pool Variety (10)	6
Riffle Habitat (16)	0
Bank Erosion (7)	4
Bank Vegetation (7)	8
Light Penetration (10)	7
Left Riparian Score (5)	2
Right Riparian Score (5)	2
Total Habitat Score (100)	53

Site Photograph

Substrate silt, sand, detritus

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/02/10	10899	45	2	7.83	6.75	Moderate
02/21/05	9549	54	0	7.75	0.00	Moderate
02/22/00	8086	37	0	7.66	0.00	Moderate
02/27/95	6758	41	2	7.96	7.95	Not Rated

Data Analysis

Although the total species richness (ST) has varied somewhat since 1995, the biotic index (BI) has been very stable. Several pollution tolerant taxa have been present at this location from each of the four collection events and included *Enallagma spp* (damselfly), *Peltodytes spp* (beetle), *Chironomus spp* (midge), *Pisidium spp* (bivalve) and the gastropod *Physa spp* . The largely pollution tolerant invertebrate community present here since 1995 is consistent with the elevated specific conductivity data over the same general time frame: 216 µS/cm in 2000, 277 µS/cm in 2005, and 190 µS/cm in 2010. The high BI and specific conductance values suggest anthropogenic disturbance in this catchment.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
MAIN CANAL	**SR 1180**	**MB9**	**02/21/05**	**Severe**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
WASHINGTON	53	03010205	35.848889	-76.561389	30-9-4	Swamps and Peatlands

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C;Sw	Incalculable	4	4	0.5

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	0	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)	13.5
Dissolved Oxygen (mg/L)	4.5
Specific Conductance (µS/cm)	205
pH (s.u.)	6.5
Water Clarity	turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	2
Bottom Substrate (15)	1
Pool Variety (10)	0
Riffle Habitat (16)	0
Bank Erosion (7)	7
Bank Vegetation (7)	2
Light Penetration (10)	2
Left Riparian Score (5)	0
Right Riparian Score (5)	0
Total Habitat Score (100)	19

Site Photograph

Substrate silt, detritus

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/02/10	10900	28	2	7.36	6.75	Moderate
02/21/05	9548	33	1	8.32	6.60	Severe
02/23/00	8071	31	1	8.34	9.20	Severe
02/27/95	6757	31	2	7.53	7.40	Not Rated

Data Analysis

Although the total species diversity decreased to an all-time low in 2010, the number of EPT speceis increased and the BI and EPTBI both decreased relative to previous samples. Although the improvement in the EPT richness and BI and EPTBI suggest improved physico-chemcial conditions, the specefic conductance data at this locations does not support this assertion as it has remained essentially identical: 212 µS/cm in 2000, 205 µS/cm in 2005, and 205 µS/cm in 2010.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
SCUPPERNONG R	**SR 1105**	**MB10**	**08/25/05**	**Poor**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
TYRRELL	53	03010205	35.877778	-76.337500	30-14-4-(1)	Chesapeake-Pamlico Lowlands and Tidal Marshes

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C;Sw	136.9	0	40	5.0

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	100	0	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)	29.4
Dissolved Oxygen (mg/L)	2.2
Specific Conductance (µS/cm)	294
pH (s.u.)	6.4

Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	10
Instream Habitat (20)	20
Bottom Substrate (15)	4
Pool Variety (10)	10
Riffle Habitat (16)	0
Bank Erosion (7)	10
Bank Vegetation (7)	10
Light Penetration (10)	8
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	87

Site Photograph

Substrate silt, detritus

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/20/10	11043	53	1	7.86	6.80	Not Rated
08/25/05	9722	59	2	7.85	7.02	Poor
08/07/95	6893	46	3	7.40	7.14	Fair
06/21/83	2961	46	1	7.87	5.80	Poor

Data Analysis

Overall, the biological community here has been quite stable since the first assessment in 1983. The high conductivity (173 µS/cm in 2005, 294 µS/cm in 2010) and consistently low dissolved oxygen levels (0.15 mg/l in 2005 and 2.2 mg/l in 2010) have contributed to the low EPT richness, high BI and the resultant Poor and Fair bioclassifications. Not surprisingly, several tolerant invertebrate taxa have consistently been collected here and include the damselfly *Enallagma spp* , the dragonfly *Pachydiplax longipennis* , the hemiptera *Belostoma spp* , and the low dissolved oxygen tolerant gastropod *Physa spp* . This site has previously been assigned bioclassifications. However, these bioclassifications were based on provisional biocriteria. Given the provisional status of biocriteria for large, non wadeable coastal plain rivers, the 2010 sample was assigned a Not Impaired rating. However, for purposes of inter-year comparison, the 2010 collection would have received a Poor bioclassification based on the provisional criteria.