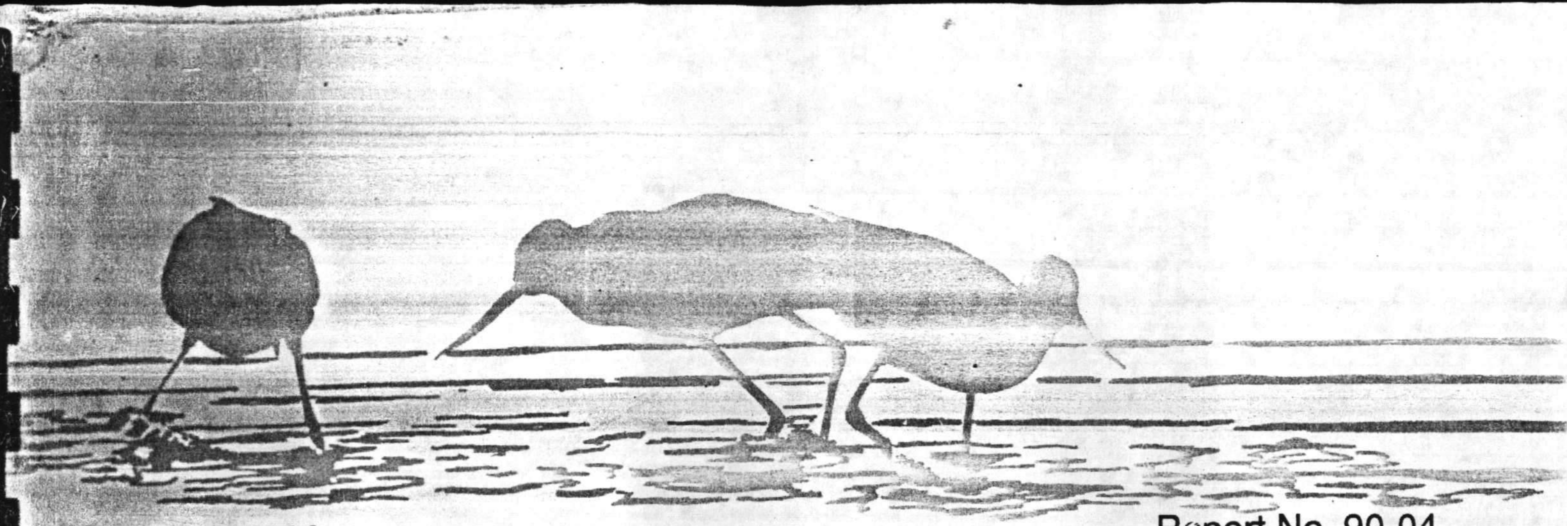

June, 1990

Report No. 90-04

New River, Onslow County: Nutrient Control Measures & Water Quality Characteristics For 1986 - 1989

Water Quality Technical Reports

WATER QUALITY

N.C. Department of Environment, Health, and Natural Resources
Division of Environmental Management • Water Quality Section

NORTH CAROLINA DEPARTMENT OF
ENVIRONMENT, HEALTH, AND
NATURAL RESOURCES

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NEW RIVER, ONSLOW COUNTY: NUTRIENT CONTROL MEASURES AND WATER QUALITY CHARACTERISTICS FOR 1986-1989

NORTH CAROLINA
DEPARTMENT OF ENVIRONMENT, HEALTH AND NATURAL RESOURCES
Division of Environmental Management
Water Quality Section

This report has been approved for release *Steve W. Tedder*
Steve W. Tedder, Chief

Date *June 21st, 1990*

James G. Martin, Governor
William W. Cobey, Jr., Secretary

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

RECOMMENDATION

Based on results of water quality sampling FROM June 1986 through September 1989 it is recommended that the supplemental classification of nutrient sensitive waters be applied to the New River upstream from a line connecting Grey Point to a point of land approximately 2,200 yards downstream from the mouth of Duck Creek. This action will formalize the Director's previous use of NCAC, Title 15A: 2H.0404(c) in the New River. In addition it is recommended that the director use the following implementation strategy for nutrient controls such that the requirements of Title 15A: NCAC 2B .0214 (f), "Quality Standards Applicable to Nutrient Sensitive Waters (NSW)" are met:

1) Nitrogen inputs should be initially controlled through the implementation of agricultural best management practices (BMPs) through the Agricultural Cost-Share program.
2) Phosphorus inputs should be controlled through implementation of agricultural BMPs and point source reductions in phosphorus.
3) All existing wastewater facilities with a permitted design capacity of 0.05 MGD or greater should be given a 2.0 mg/l total phosphorus effluent limit (quarterly average of weekly samples) and have been notified they have until 1992 to achieve compliance with these new limits.
4) All new dischargers or expansions of existing discharges regardless of design capacity, will be required to meet the 2.0 mg/l total phosphorus limit when the new facility becomes operational.
5) As required by North Carolina's antidegradation policy, Title 15A: NCAC 2B .0201(c), individuals considering a new discharge must demonstrate that non-discharge options or connection to an existing system are not feasible.
6) All facilities within the NSW area will be notified of the classification change and nutrient control strategies. They will also be notified that further (more stringent) controls on nutrient inputs may be required in the future.
7) The Division of Environmental Management (DEM) staff will continue to evaluate the eutrophication problems in the New River as well as any localized problems in the tributaries. In continuing the monitoring efforts, staff will attempt to identify any discharges (exempt from nutrient controls) which are having any localized impacts as a result of nutrient contributions and require appropriate control of nutrients on a case-by-case basis.
8) The DEM staff will review success of the above strategy for nutrient controls in 1995 and recommend appropriate modifications at that time.

SUMMARY

The New River in Onslow County has been experiencing decreases in fish populations, increases in frequency of fish kills, discolored waters, low dissolved oxygen, and increasing abundance of algae. Based on these observations and the results of additional sampling in 1986, the director of DEM utilized NCAC, Title 15: 2H.0404 (c) to reduce nutrient inputs to the New River beginning January 1, 1987. This regulation states: "The Director may prohibit or limit any discharge of wastes into surface waters if, in the opinion of the Director, the surface waters experience or the discharge would result in:

(1) growths of microscopic vegetation such that chlorophyll-a values are greater than 40 ug/l; or

(2) growths of microscopic or macroscopic vegetation which substantially impair the intended best usage of the waters."

Existing permits with allowed flows of 0.05 million gallons per day (MGD) or greater would receive 2.0 mg/l total phosphorus limits upon renewal. New permits and expansions would also receive 2.0 mg/l total phosphorus limits. Nitrogen controls were not addressed.

The use of the 0404 regulation to reduce the amount of phosphorus from point sources was a positive step toward the control of nutrients and improvement of water quality in the New River. With complete implementation, the reduction of the phosphorus should have a noticeable impact on the amount of that nutrient available for phytoplankton growth.

DEM has continued water quality evaluations in the New River. This report presents the results for water quality sampling from June 1986 to September 1989. Conclusions from this report are as follows:

- Point source dischargers contribute 65 percent of the total phosphorus load and 49 percent of the total nitrogen load to the New River above Hadnot Point (based on export coefficients). Reduction of total phosphorus effluent concentrations to 2 mg/l is predicted to reduce point source total phosphorus contributions to less than 40 percent.
- Nutrient concentrations in the Wilson Bay area were high. Total nitrogen concentrations for the area averaged over 1 mg/l, with average total phosphorus concentrations of over 0.5 mg/l.

- Algal growth potential testing results from the Morgan Bay area just above Hadnot Point indicated that additions of nitrogen in that area could result in excessive algal growth and related water quality problems.
- Of the 180 chlorophyll-a samples collected between June 1986 and August 1989, 45 percent exceeded the state standard of 40 ug/l. In Wilson Bay, chlorophyll-a samples collected averaged over 100 ug/l and 88 percent exceeded the state standard for the period of this study.
- Chlorophyll-a concentrations, phytoplankton populations and nutrient concentrations in Wilson Bay were all high, indicating that the continued discharge by Jacksonville into Wilson Bay is severely degrading water quality and that efforts to relocate or remove the discharge should be expedited. The frequent violations of state standards indicate a need for widespread nutrient controls.
- Phytoplankton biovolume and density were elevated throughout most of the river. One hundred and twenty eight phytoplankton samples out of 180 for June 1986 through September 1989 had density and biovolume estimates indicative of bloom conditions (algal densities of 10,000 units/ml or greater and/or biovolumes of 5,000 mm^3/m^3).
- The extremely high levels of chlorophyll -a, the large amounts of algae represented by density and biovolume estimates, and the elevated nutrient concentrations even in the presence of massive algal populations are indicative of eutrophication. The numerous fish kills and the low dissolved oxygen levels, in association with the elevated chlorophyll-a levels, provide evidence that these growths of phytoplankton are impairing the best usage of the water.
- As the results from this study indicate, the New River in Onslow County is a highly eutrophic system above Hadnot Point. Continued pressure from the dischargers on the tributaries and the main stem of the river make it imperative that additional protection be afforded this area. The declaration of the New River as Nutrient Sensitive Waters in addition to limiting total phosphorus from point sources should encourage the targeting of cost share monies to Onslow County for nonpoint control of nitrogen inputs.

INTRODUCTION

The New River is a blackwater river located in the coastal plain in the White Oak River Basin. The entire New River watershed is within Onslow County, and above Jacksonville it is surrounded by gum-cypress swamps. As the river approaches Jacksonville, it widens and becomes significantly affected by tidal influences. Decreases in fish populations, increases in the frequency of fish kills, discoloration of the waters, low dissolved oxygen, and increases in the abundance of algae prompted the Wilmington Regional Office in 1986 to request an investigation of water quality in the Jacksonville area.

This investigation reviewed existing data from the ambient network, determined nutrient loading estimates from point and non-point sources and reviewed data collected during monthly sampling of the river and its tributaries during the summer of 1986. The study documented significant biological response to nutrient loading and the need for additional point source control of nutrients into the New River.

As a consequence, the director of DEM utilized NCAC, Title 15A: 2H.0404 (c), referred to in the rest of this report as 0404, to limit nutrient inputs. This regulation states: "The Director may prohibit or limit any discharge of wastes into surface waters if, in the opinion of the Director, the surface waters experience or the discharge would result in:

(1) growths of microscopic vegetation such that chlorophyll-a values are greater than 40 ug/l; or

(2) growths of microscopic or macroscopic vegetation which substantially impair the intended best usage of the waters."

As of January 30, 1987, all new permit requests, and any expansion requests, within the New River Basin upstream from a line connecting Grey Point to a point of land approximately 2,200 yards downstream from the mouth of Duck Creek (Figure 1) received nutrient limitations of 2.0 mg/l phosphorus. Existing permits which have a permitted flow greater than 50,000 gallons per day (0.05MGD) are receiving the 2.0 mg/l phosphorus limitation in their renewed permits. This nutrient limitation applies to all dischargers located on main stem waters and tributaries to the New River upstream from the line of designation. This limit is similar to the management strategies used in the Neuse River Basin as a result of nutrient sensitive waters (NSW) designation.

Environmental evaluation continued on the New River system following this action to further document eutrophication problems and in response to increasing requests from developers, the City of Jacksonville, and Camp Lejune for new and increased discharges into the river and its tributaries.

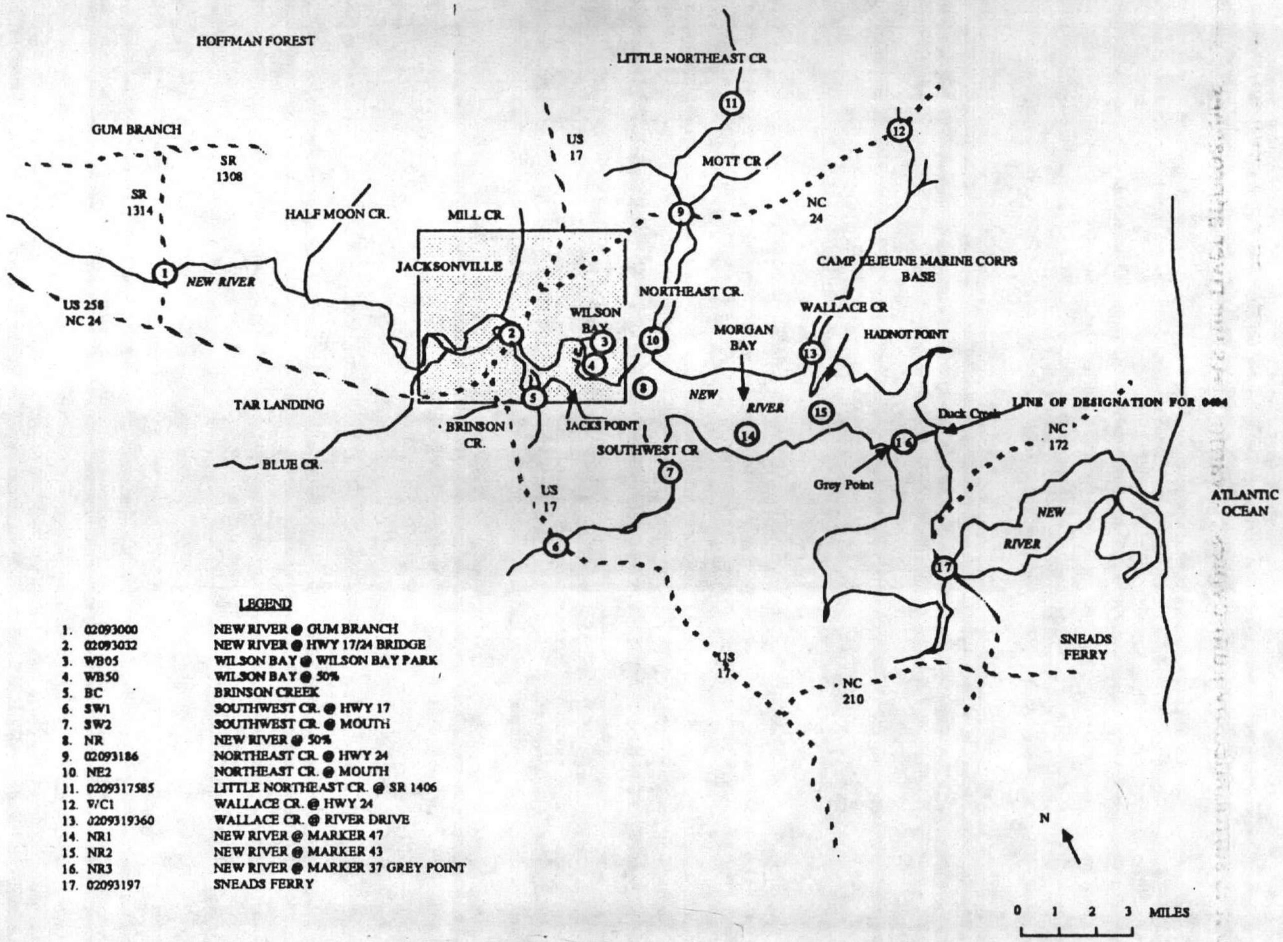


FIGURE 1. STATION LOCATIONS FOR NEW RIVER STUDY 1986-1989.

This report reviews the actions and data taken in the New River Basin since 1986 and recommends possible actions for continued improvements of water quality within the watershed.

POINT SOURCES

Of the 45 point source dischargers permitted by the division within the New River Basin, 37 are located above Hadnot Point (near the mouth of Wallace Creek) where the majority of the water quality violations have been observed. A map and information on these dischargers are included in Appendix I and II. The combined permitted flow of these 37 dischargers is 11.1367 MGD. Approximately 40 percent of the permitted wasteflow in the upper portion is discharged to Wilson Bay. An additional 28 percent is discharged into the mouth of Northeast Creek.

Since the implementation of rule 2H .0404 in January 1987, five permits have been reissued with a phosphorus limit of 2 mg/l and two new permits have been issued with the 2 mg/l phosphorus limit (Table 1). There are 10 existing dischargers with a permitted flow greater than 0.05 MGD that will receive the 2 mg/l limit through permit renewal by 1992. The division has notified them that they will be required to meet the phosphorus limit by February 1, 1992.

Table 1. Location and permitted flow for dischargers receiving the new phosphorus limit of 2 mg/l in the New River as a result of regulation 0404 prior to May 1, 1990.

PERMITTEE	NPDES #	RECEIVING WATER	PERMITTED FLOW MGD	YEAR PERMIT CHANGED OR ISSUED
RENEWED PERMITS				
Mercer Environmental	NC0032239	Northeast Creek	0.3	March 1989
Pollard Enterprises	NC0056952	UT Blue Creek	0.1	June 1988
Viking Utilities	NC0049387	Mott Creek	0.1	July 1987
Richlands WWTP	NC0023230	Mill Swamp	0.21	December 1988
Sentry Utilities	NC0034991	Little Northeast Cr	0.0225	September 1987
NEW PERMITS				
Hinson Arms Apt	NC0071706	UT New River	0.02	May 1988
Windmill Restaurant	NC0071536	Northeast Creek	0.005 summer 0.01 winter	October 1987

NUTRIENT BUDGET

The nutrient budget developed for the New River grouped the loadings into point and nonpoint source categories (Appendix III). Nonpoint sources consisted of export from various land uses (forest, agriculture, wetlands and urban) and precipitation to the open water surface area. The Chowan/Albemarle Action Plan (NRCD 1982) provided the export coefficients for phosphorus and nitrogen loading rates and Table 2 lists that data and land use data for the New River. The estimated nonpoint source loads of total phosphorus (TP) and total nitrogen (TN) loads were 49,928 and 254,743 kg/yr, respectively.

Table 2. Nonpoint nutrient loading for the New River above Hadnot Point. Values based on 1987 landuse data obtained by the Wilmington Regional Office.

LAND USE	AREA km^2 (%)	P-LOADING RATE (kg/km^2-yr)	P-LOAD (kg/yr)	N-LOADING RATE (kg/km^2-yr)	N-LOAD (kg/yr)
Forested	364.7 (50.7)	10	3647	165	60175
Agricultural/Cleared	151.8 (21.1)	110	16698	625	94875
Marsh/Wetlands	34.7 (4.8)	10	347	165	5478
Urban-High density	133.6 (18.6)	200	26720	525	70140
Urban-Low Density	11.7 (1.6)	90	1053	375	4387
Precipitation to Open Water	22.5 (3.1)	65	1463	875	19688
TOTALS	719.0		49928		254743

Point source loads were determined using probable nutrient concentrations (5.3 mg/l TP and 17.4 mg/l TN) obtained from discharger self-monitoring data and permitted wasteflows. In 1987, 6.5 mg/l TP and 17.4 mg/l TN were used to calculate point source nutrient loading (Appendix III). Following the phosphorus ban which became effective in January 1988, it was determined that the TP load in the New River was reduced by approximately 18 percent (EHNR unpublished data); therefore 5.3 mg/l TP was used to determine point source loads (Table 3). The total estimated point source (at permitted conditions) TP and TN loads are 74,326 and 244,004 kg/yr, respectively.

Table 3. Point source nutrient loading for the New River above Hadnot Point. Total point source flow is the sum of the permitted flow for only those dischargers discharging as of January 1, 1990.

BASIN SEGMENT	TOTAL POINT SOURCE FLOW (MGD)	ESTIMATED POINT SOURCE TP (kg/yr)	ESTIMATED POINT SOURCE TN (kg/yr)
New River above Wilson Bay	2.039	14931	49015
Blue Creek	0.131	959	3149
Brinson Creek	0.238	1743	5721
Wilson Bay	4.460	32659	107212
Southwest Creek	0.068	498	1635
Northeast Creek	3.148	23053	75673
Wallace Creek	0.066	483	1599
TOTALS	10.150	74326	244004

A comparison of point source to nonpoint source loading indicates that point sources contribute approximately 60 percent of the TP and 49 percent of the TN to the system (Figure 2). This finding along with the nutrient and biological data presented in this report support the previously described point source controls of phosphorus. Nonpoint source control of nitrogen is encouraged to reduce that nutrient within this system.

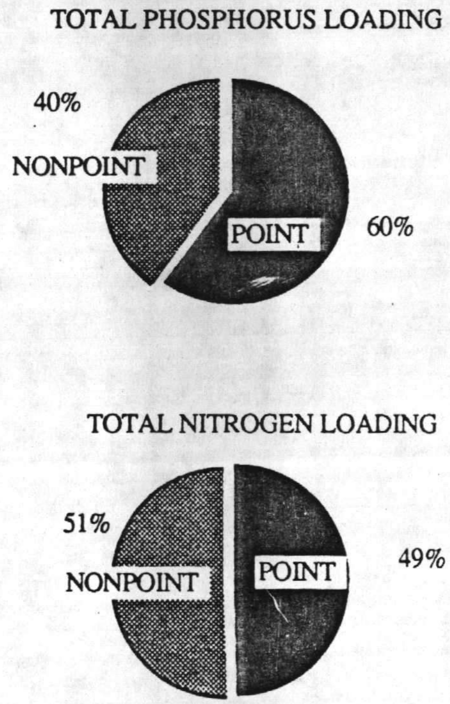


Figure 2. Total phosphorus and total nitrogen loading estimates for the New River above Hadnot Point.

STATION LOCATIONS

Station locations are shown in Figure 1 and station descriptions are provided in Table 4. Appendix IV indicates the classifications assigned to the New River and its tributaries sampled during this study. A total of seventeen stations were sampled during the period of June 1986 through August 1989. Samples were collected during June through September as these are the months during which nuisance phytoplankton blooms are normally reported in these waters. All samples were taken at midpoint of the river or tributary except in Wilson Bay where an extra station near the Wilson Bay Park was sampled. Stations that have been added and dropped during the past four years are indicated in Table 4. These changes were made due to new emphasis on the lower river and resource constraints. Samples were taken monthly during June through September with ambient stations also being sampled in the winter and spring months.

Table 4. Station locations and physical descriptions for New River Study 1986-1989. Map numbers correspond to Figure 1.

MAP #	STATION	LOCATION	WIDTH meters	DEPTH meters	PERIOD SAMPLED
1	02093000	New R@ Gum Branch	7	0.4	86-89
2	02093032	New R @ Hwy 17/24	240	3.0	86-89
3	WB05	Wilson Bay @ Park 5 percent	480	1.0	86-88
4	WB50	Wilson Bay @ 50 percent	480	2.0	86-89
5	BC	Brinson Creek	50	1.0	86-88
6	SW1	Southwest Cr @ Hwy 17	50	1.0	86
7	SW2	Southwest Cr @ mouth	120	5.0	86-88
8	NR	New R btwn marker 50 & 52	1370	4.0	86-89
9	02093186	Northeast Cr @ Hwy 24	240	3.0	86-89
10	NE2	Northeast Cr @ mouth	270	2.0	86-88
11	0209317585	Little Northeast Cr @ SR 1406	8	0.6	86-89
12	WC1	Wallace Cr @ Hwy 24	3	0.5	86
13	0209319360	Wallace Cr @ River Drive	240	2.0	86-89
14	NR1	New R @ marker 47	3600	3.0	89
15	NR2	New R @ marker 43	1640	4.0	88-89
16	NR3	New R @ marker 37	2000	3.0	89
17	02093197	New R @ Sneads Ferry	1000	5.0	86-89

METHODS

A Hydrolab 4000 series multiparameter instrument was used to measure temperature, dissolved oxygen, pH, salinity, and conductivity. Quality control procedures, including pre and post calibration, were conducted in accordance with Standard Operating Procedures Manual, Physical and Chemical Monitoring (EHNR 1989). Depth profile measurements

were taken at 0.15 meters below the surface and at one meter intervals to the bottom. A Secchi disc was used to estimate the depth of light penetration. This device was lowered from the shaded side of the boat until it disappeared. It was then raised until it reappeared. The average between the two depths was considered the secchi value.

Nutrients (nitrogen and phosphorus), biological oxygen demand (BOD_5), and fecal coliform samples were collected as grab samples. Samples were then tagged for identification and preserved as prescribed in the Procedures Manual, and transferred on ice to the Central Laboratory. Laboratory analyses were conducted according to the American Public Health Association (APHA) Standard Methods (APHA 1985).

Fresh aquatic macrophyte samples were used for identification (avoiding the collection of immature plants or those lacking flowers). All parts of the plant, including the roots, were taken for identification. After collection, the plant was wrapped in several layers of wet paper. The specimen and a completed sample identification tag were placed in a plastic bag and transferred on ice to DEM's Biological Assessment Group for identification to the lowest possible taxonomic level.

Phytoplankton and chlorophyll-a samples were also collected as grab samples. Phytoplankton samples were preserved using a modified Lugol's Solution. Identification and quantification methods employed were a modification of Utermohl's (1958) inverted microscope technique. This method is detailed in the Biological Assessment Group's Standard Operating Procedures Manual (EHNR 1990).

Statistical analysis was performed using StatView II software on a MacIntosh II computer. ANOVA analyses were used to determine significant differences for all parameters (except BOD, Secchi depth and fecal coliform) by years and stations. A significance level of 95 percent was used. Significant mean differences were not reported if the overall F test was not significant.

RESULTS AND DISCUSSION

PHYSICAL AND CHEMICAL

Rainfall and Flow. In July 1987 the USGS began collecting flow data at Gum Branch. Rainfall data was collected at Hoffman Forest for the entire duration of this study. A comparison of rainfall to flow indicated that the two sets of data followed each other closely enough for rainfall at Hoffman Forest to be useful as an estimation of inflow.

Figure 3 depicts the total monthly rainfall at Hoffman Forest. Mean rainfall for each month ranged from a low of 4.13 inches in 1988 to a high of 5.87 inches in 1989. The

next highest yearly mean was in 1987 with 4.77 inches. There was no significant difference (p>.05) in rainfall between years.

Heaviest rainfall occurred during July and August of all years, with less rainfall in the spring and winter. April 1989 was fairly wet with approximately eight inches of rainfall for the month. Rainfall in August and September 1989 was also relatively high.

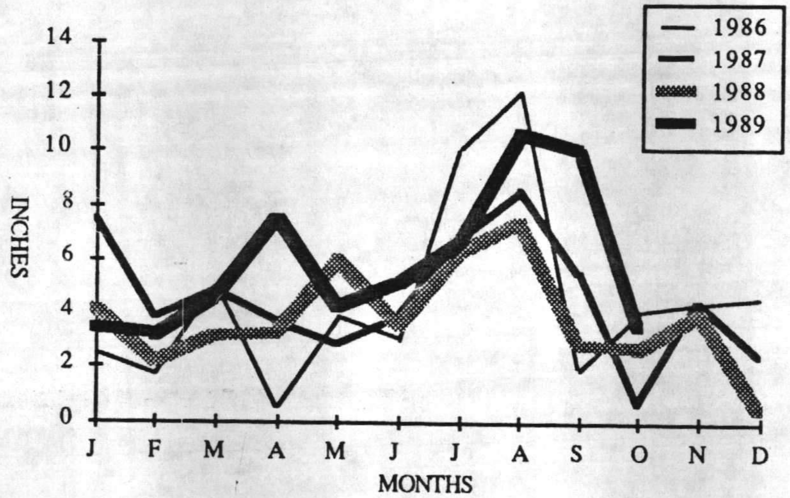


Figure 3. Total monthly rainfall at Hoffman Forest for 1986-1989.

Temperature. Surface water temperatures during the study ranged from 19°C to 34°C. Raw data for temperature and other parameters is presented in Appendix V. Figure 4 is a chart detailing the full distribution of the temperature data. The horizontal line crossing the box is the sample median or point at which 50 percent of the data falls above and 50 percent falls below. The notch around the median indicates the 95 percent confidence interval about the median, while the upper and lower ends of the boxes represent the 75th and 25th percentiles. This range provides a graphic indication of where the bulk of the data are distributed. The upper and lower whiskers indicate the 90th and 10th percentiles and the dots depict extreme values. During the summer growing season of June through September, the median surface water temperature was 27°C. The lowest summer temperatures were found at New River at Gum Branch (02093000), Southwest

Creek at Hwy 17 (SW1), and Little Northeast Creek at SR 1406 (0209317585). These three stations are shaded and relatively narrow when compared to the other wider, more open stations.

There was no strong thermal stratification on any of the sampling dates, as indicated by the differences between top and bottom temperatures of less than or equal to 2°C.

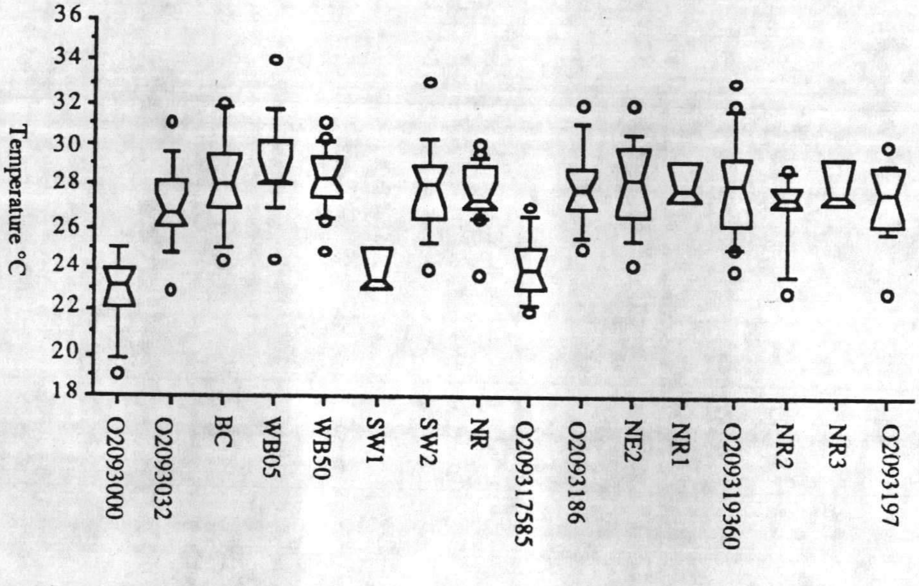


Figure 4. Surface water temperatures for the New River June-September 1986-1989.

Dissolved Oxygen. Surface dissolved oxygen (DO) values ranged from 2.5 to 18.6 mg/l with percent saturation from 29 to greater than 200 percent. Low DO concentrations occurred in Southwest Creek at Highway 17 (SW1), where three out of four DO concentrations were at or below 5 mg/l and saturation was from 39 to 61 percent. Southwest Creek is a slow-moving blackwater stream with a depth of approximately one meter at the sampling point. Low DO concentrations (surface concentrations less than 5 mg/l) were also present near the mouth of Southwest Creek (SW2). The combination of high organic content usually associated with blackwater systems and low flow probably resulted in the low DO concentrations measured at these stations.

Most of the other low DO concentrations were taken at tributary stations (Figure 5). During 1986 and 1989, DO concentrations at Highway 17 on the New River (02093032) were below 60 percent saturation throughout the water column during June through September. The station was well mixed with low salinities except on July 30, 1986, when

the bottom salinity was 16 parts per thousand (ppt). Total monthly rainfall at Hoffman Forest for July 1986 was 10.17 inches, one of the highest totals during the study period. Freshwater inflow from the low DO blackwater upper reaches of the river may have resulted in these low DO concentrations. Sampling in 1985 above the Highway 17 bridge indicated depressed DO levels as close as the mouth of Blue Creek (approximately one mile above Highway 17).

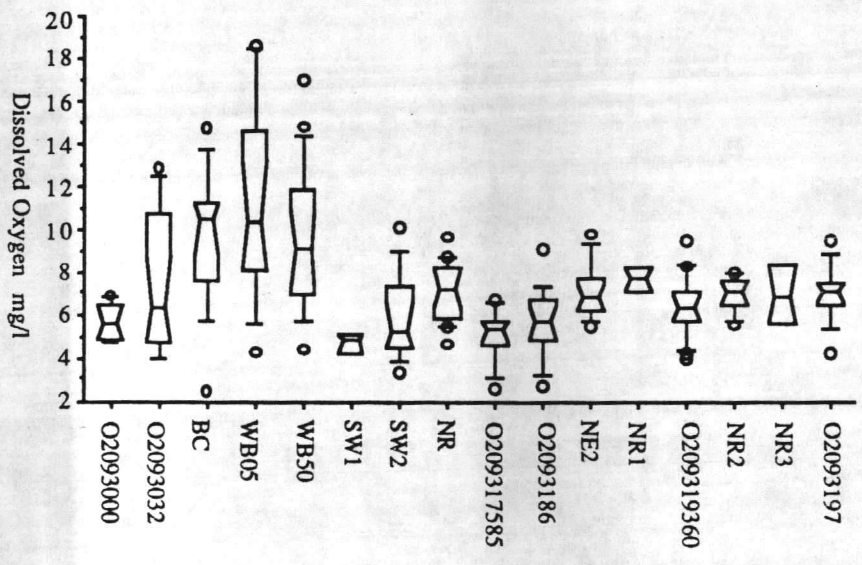


Figure 5. Surface dissolved oxygen concentrations for New River June-September 1986-1989.

Dissolved oxygen profiles for the river stations showed DO concentrations following a clinograde curve during most of the sampling period with sharply decreasing DO concentrations below two meters. Profiles for August 29, 1989, shown in Figure 6 were typical of the dissolved oxygen profiles for the sampling period. Salt wedges contribute to the low bottom DO concentrations by creating a density gradient between the low and high salinity waters. This gradient slows mixing between the more oxygenated surface waters and the bottom waters. As a result, biochemical reactions in the bottom waters and at the sediment interface deplete DO concentrations.

There were no significant differences (p>0.5) between stations and although DO concentrations appeared to be higher at the Highway 17 bridges, there were no significant differences (p>0.5) between the river stations above or below Morgan Bay.

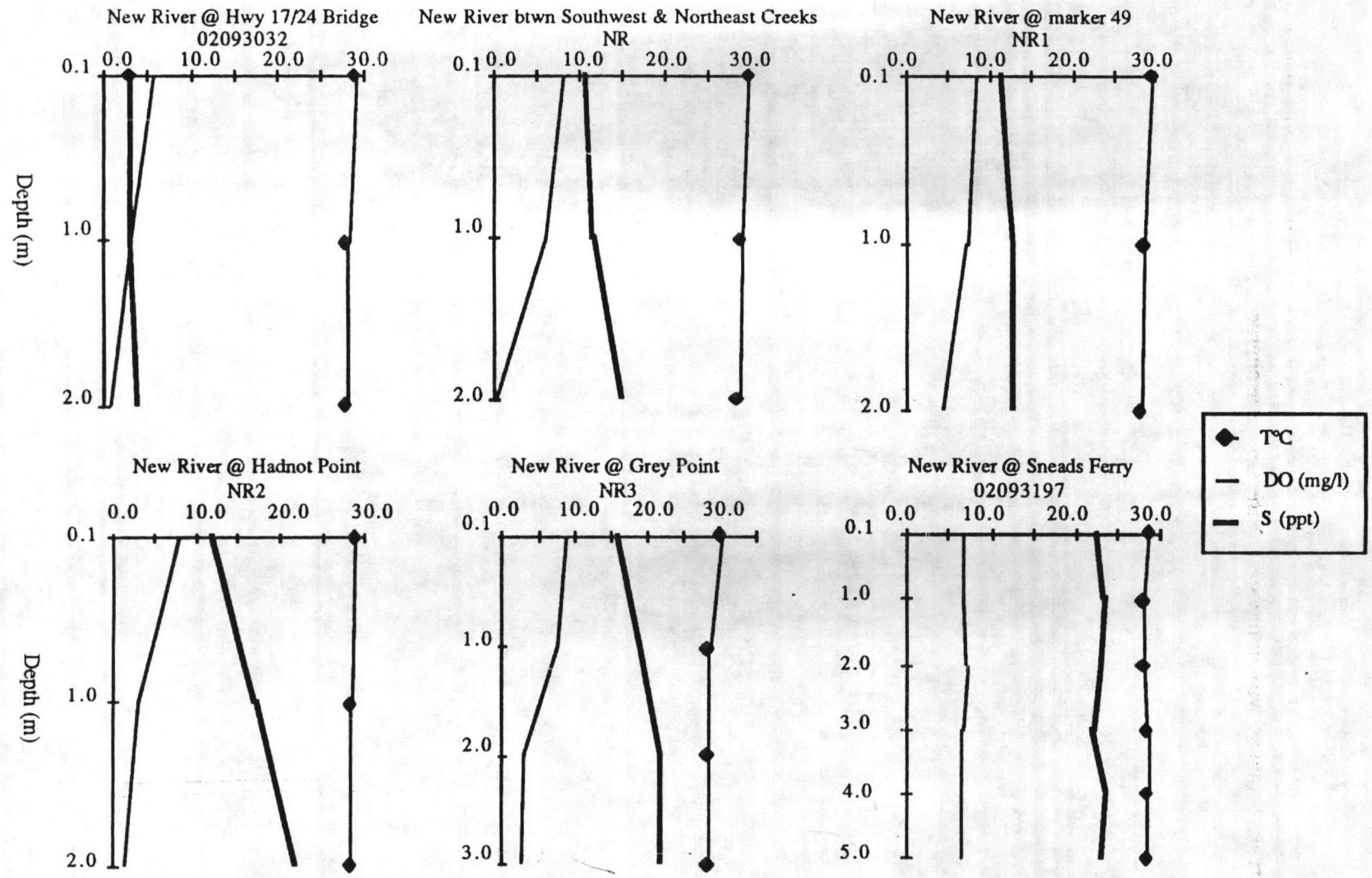


Figure 6. Depth profiles of dissolved oxygen (DO), temperature (T°C) and salinity (S) for main stem stations on the New River during August 29, 1989.

pH. Surface pH measurements ranged from 5.5 to 9.1 standard units (SU) with a average of 7.7 SU. The measurement of 5.5 SU was made at Gum Branch (02093000) on July 20, 1987. Organic discharge from the Richlands WWTP could result in lowered pH values at this site. The elevated pH values made in Wilson Bay (WB05) were probably due the increased algal activity in the area of the City's discharge.

Average pH values for the river stations were highest from the New River between Southwest and Northeast Creeks (NR) down to Sneads Ferry (Figure 7). These values were within the state standard of 6.8 to 8.5 SU for tidal waters.

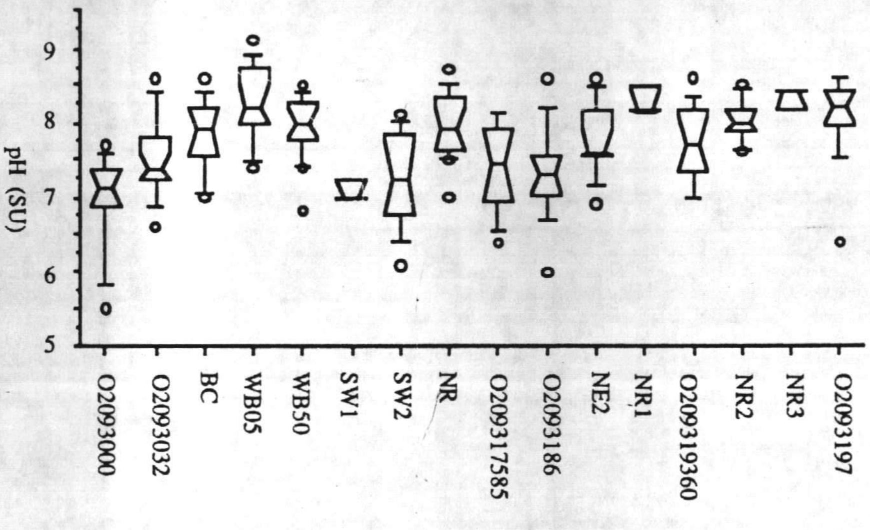


Figure 7. pH values for New River June-September 1986-1989.

Conductivity and Salinity. Conductivity and salinity measurements indicated that salt wedges extended to the 17/24 bridge. Data collected in 1985 indicated that salt wedges occur as far upstream as Tar Landing which is approximately six miles upstream of the 17/24 bridge. Salt wedges were present at all river stations except during high or steady winds and rain events. These two factors resulted in mixing throughout the water column. In May 1986 salt wedges occurred in the tributaries with a wedge reaching as far up Northeast Creek as Little Northeast Creek, which is approximately four miles from the mouth of Northeast Creek.

Salinities were significantly higher at Sneads Ferry (02093197), the station closest to the Atlantic Ocean (Figure 8). Surface salinities ranged from 11 to 26 ppt at this station.

No significant differences (p>0.5)were found in conductivity or salinity between years.

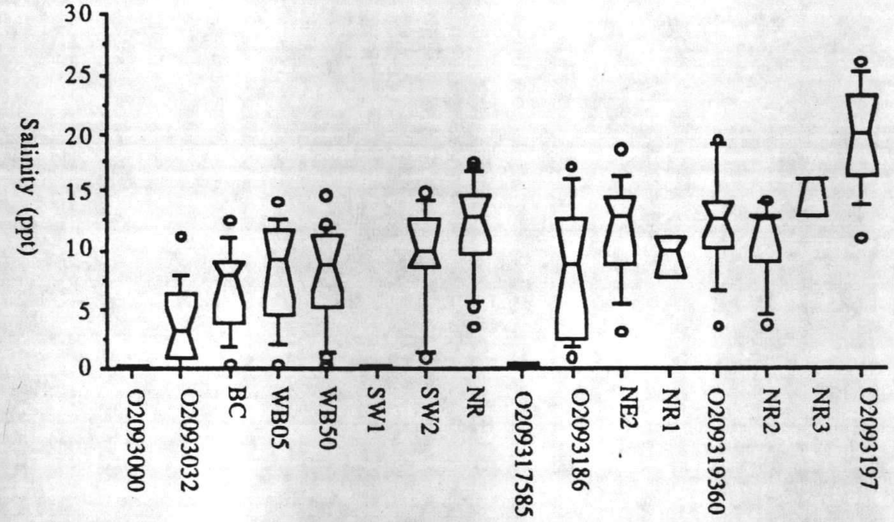


Figure 8. Salinity concentrations on the New River June-September 1986-1989.

Secchi Depth and Turbidity. Secchi depth measurements ranged from 0.2 to 1 meter during June through September (Figure 9). Lowest Secchi depth measurements were found in Wilson Bay at the Park (WB05) and in Northeast Creek at Hwy 24 with highest values near Hadnot Point (NR2). Turbidity readings were also elevated at this station (Figure 9) although not above the state standard of 25 NTU.

Only two turbidity values were above the state standard of 25 NTU during this study, from Gum Branch. On July 13, 1988, turbidity was 50 NTU and, on June 27, 1988, it was 32 NTU. No secchi depth readings were taken at this station. Chlorophyll-a concentrations were low (8 and 10 ug/l) indicating that algal activity was not contributing to the high turbidity. Rainfall the day before and on the day of sampling probably resulted in increased turbidity.

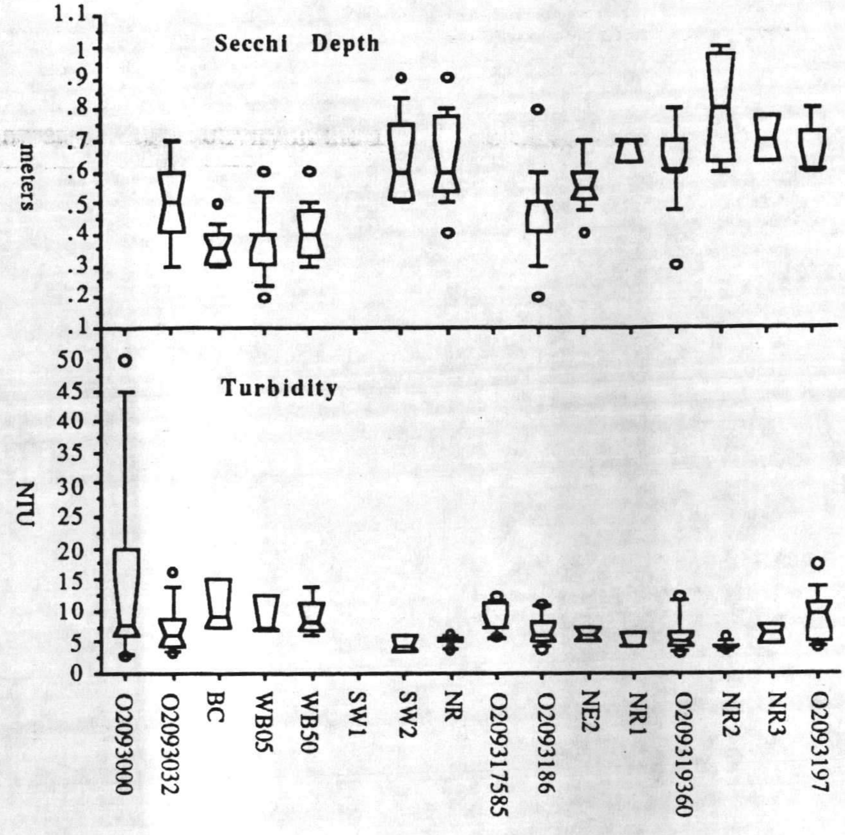


Figure 9. Secchi depth and turbidity for the New River June-September 1986-1989.

Both Wilson Bay and Brinson Creek had shallow Secchi depths due to their shallow depths (average = one meter) and very murky sediment which is easily disturbed by wind action. Wilson Bay also had the highest chlorophyll-a concentrations and phytoplankton populations indicating that phytoplankton probably contributed to the reduced Secchi depths although the turbidity values in Wilson Bay and Brinson Creek were not significantly elevated.

There appeared to be a slight decrease in turbidity and an increase in Secchi depths as the stations progressed downstream. Deepest Secchi depths and lowest turbidity readings were found near Hadnot Point. Downstream of Hadnot Point Secchi depths decreased and turbidity increased due to tidal influences and increased salinity.

NUTRIENTS

Nitrogen. Within the New River highest average concentrations of nitrogen during June through September were found at Gum Branch (02093000) during 1987 (Figure 10). This area is highly agricultural with fields extending to the river banks in many areas. There are two permitted dischargers above this station. Carter Packing (NC0002968) discharged above this station until its permit was rescinded due to violations of its BOD5, total suspended solids and nitrogen effluent limits. This operation ceased discharging in August 1987. Richlands WWTP's discharge (NC0023230) is also located above Gum Branch on Mill Swamp. Self-monitoring data for both dischargers is contained in Table 5. Richlands WWTP had the highest contribution of nitrogen to the system with average total nitrogen (TN) concentrations ranging from 6.12 to 16.30 mg/l. Both ammonia/ammonium (NH_3/NH_4) and TN concentrations in Richlands discharge decreased in 1989. These decreases were accompanied by decreases in flow out of the plant and decreases in nitrogen at Gum Branch.

Table 5 . Self-monitoring data for Carter Packing Company and Richlands WWTP by year.

PARAMETER	YEAR	CARTER PACKING CO. NC0002968			RICHLANDS WWTP NC0023230		
		MAX	MIN	MEAN	MAX	MIN	MEAN
NH3/NH4 mg/l	1986	5.80	1.00	3.17	13.20	LT	2.41
	1987*	4.80	LT	2.53	4.80	.03	2.39
	1988	permit rescinded			5.70	LT	1.96
	1989				3.51	.12	1.52
TOTAL N mg/l	1986	not measured			15.37	2.50	6.94
	1987				35.70	7.57	16.30
	1988	permit rescinded			11.93	9.8	10.70
	1989				10.30	2.25	6.12
TOTAL P mg/l	1986	not measured			4.70	.30	1.92
	1987				6.30	2.42	3.75
	1988	permit rescinded			3.33	1.11	2.12
	1989				4.67	.90	1.74
ACTUAL FLOW MGD	1986	.01	.01	.01	.299	.011	.077
	1987*	.01	.008	.009	.268	016	.075
	1988	permit rescinded			.195	.003	.041
	1989				.196	.010	.029

*Only January through July data for Carter Packing Co.

Downstream, highest nitrogen values were recorded in Wilson Bay (WB05 & WB50) and Brinson Creek (BC). Wilson Bay receives discharge from the City of Jacksonville Wilson Bay WWTP (NC0024121). This plant has had overflows and frequent violations

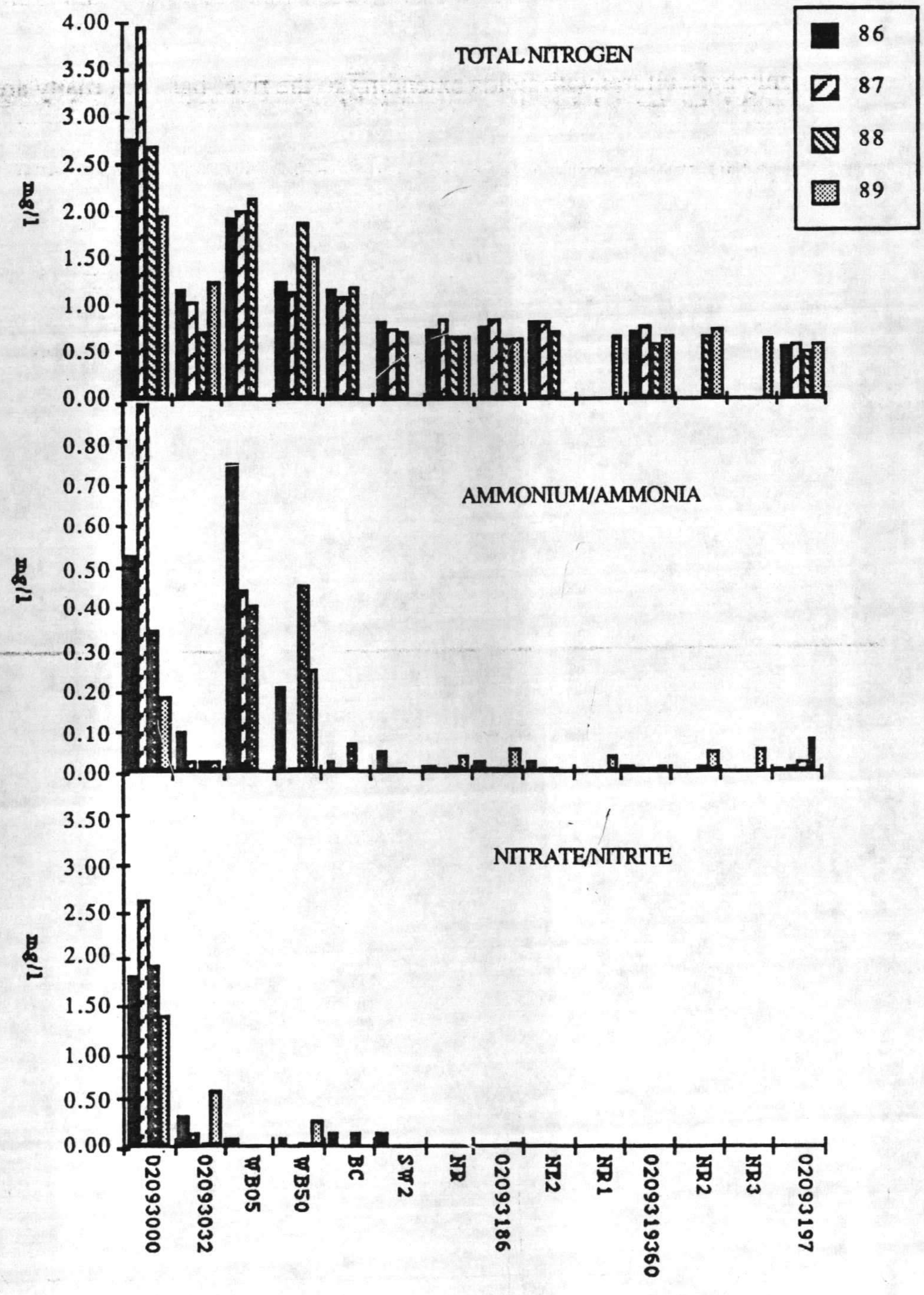


Figure 10. Average summer (June-September) nitrogen concentrations for the New River 1986-1989.

of its permit limits. Dye work completed in 1987 documented a long retention time and limited water circulation patterns within the bay, and indicated that tidal variations were not effective in flushing the bay. As a result of these conditions, Wilson Bay is highly eutrophic with sufficient nitrogen concentrations to support bloom phytoplankton populations year round (Figure 11).

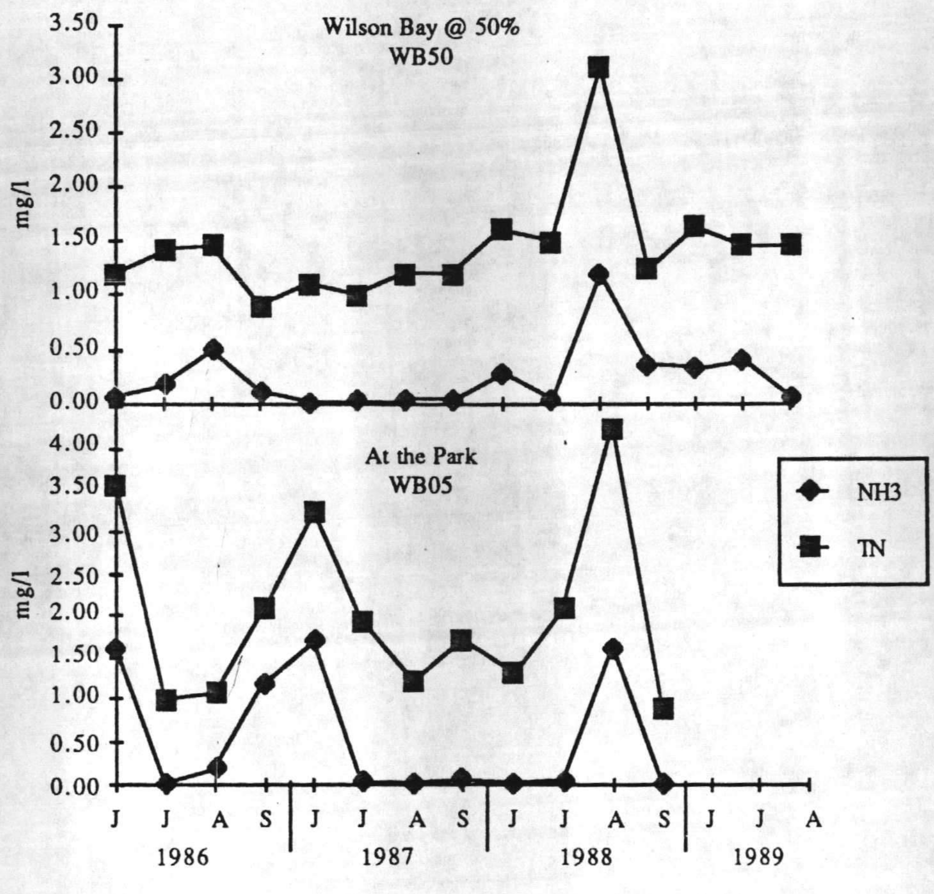
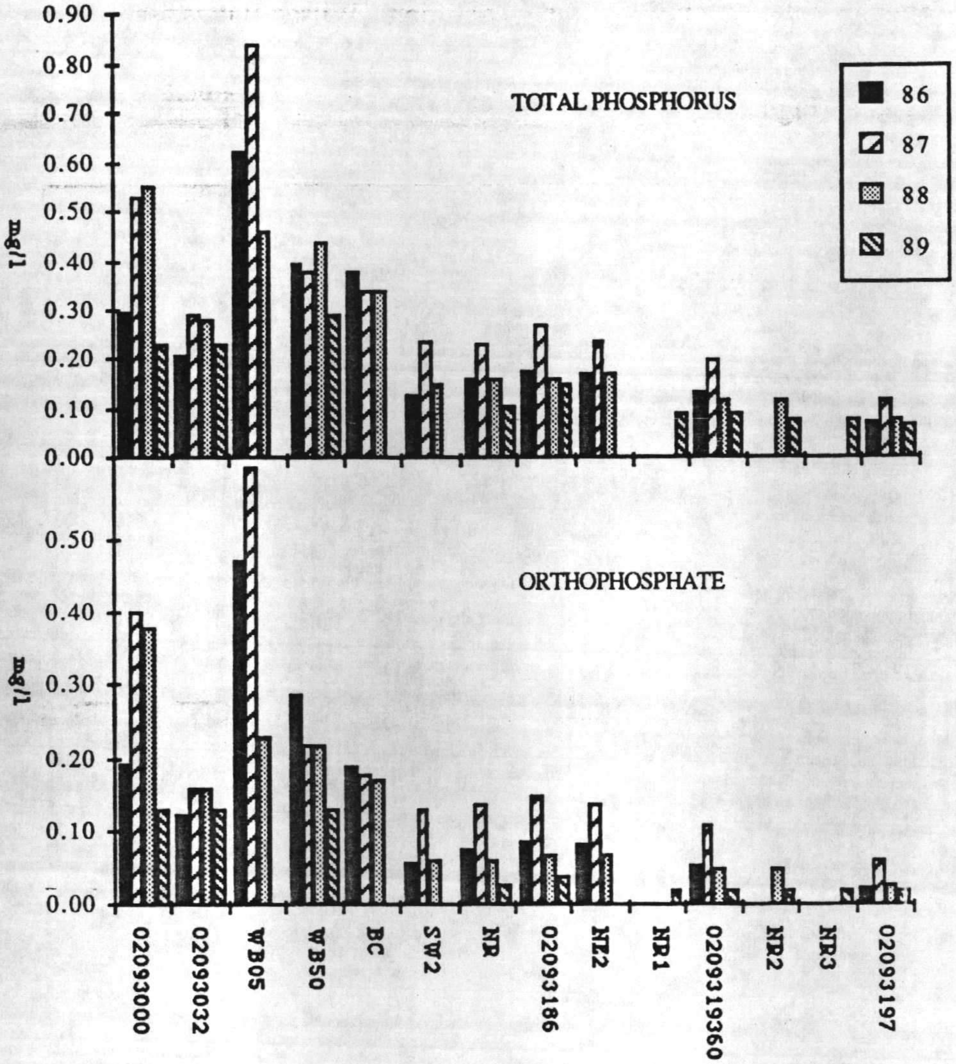


Figure 11. Nitrogen concentrations for Wilson Bay, New River 1986-1989.

Nitrogen concentrations in the lower New River from marker 50 down to Sneads Ferry were lower than in the upper river with NO2/NO3 below detection in 88 percent of the samples.

No significant differences were found between years for nitrogen.

Phosphorus. Phosphorus concentrations were elevated from Gum Branch to Wilson Bay and decreased downstream to Sneads Ferry (Figure 12). Highest concentrations were



Fiugre 12. Average summer (June-September) nitrogen concentrations for the New River 1986-1989.

seen in Wilson Bay during 1987 when PO_4 concentrations averaged 0.60 mg/l and TP concentrations averaged 0.85 mg/l. The threshold concentration of PO_4 for algal growth is 0.05 mg/l and the minimal concentration for TP is 0.1 mg/l. Phytoplankton populations reflected this abundance of nutrients with average biovolumes of 13,619 mm^3/m^3 and densities of 319,444 units/ml. Bloom conditions are considered to exist when phytoplankton biovolume reaches 5,000 mm^3/m^3 and/or density reaches 10,000 units/ml.

Tributary stations had higher concentrations of phosphorus compared to stations located below Wilson Bay (marker 50). Values for Morgan Bay and Sneads Ferry were lower than in the tributaries.

There appeared to be a slight decrease in phosphorus concentrations at all stations in 1989. ANOVA results indicate that TP and PO_4 were significantly lower in 1989 than in 1987; however, there was no significant difference between other years. Several factors may have contributed to this decrease. Rainfall in 1989 was slightly higher during the sampling period. In 1987 the Clean Detergent Act was initiated which banned the use of phosphate detergents and cleaning agents throughout the state. No clear indication of the decrease was evident in a review of self-monitoring data. An in-depth review of self-monitoring data would be necessary to discern the presence of any differences before and after the Clean Detergent Act. This was not performed as part of this study.

BIOLOGICAL DATA

Biochemical Oxygen Demand. Biochemical oxygen demand (BOD) provides an estimate of the amount of oxygen being utilized by biological and chemical processes within the water column. Five day BOD readings were used in this study. Values ranged from 0.6 to 13 mg/l with an average of 4.1 mg/l for all stations. Highest BOD readings were obtained at Wilson Bay and Brinson Creek (Figure 13). The average concentrations for Wilson Bay at WB05 was 12 mg/l and at WB50 the average was 8.5 mg/l. The average concentration for Brinson Creek was 8 mg/l. All other stations had values below 6 mg/l except for a few outliers. The high BOD values for Wilson Bay and Brinson Creek reflect the amount of effluent in each area. Brinson Creek has a 7Q10 of 0.05 MGD and has five permitted dischargers with permitted flows totaling 0.24 MGD. Actual discharge into Brinson Creek is approximately 0.07 MGD according to self-monitoring data. This is still above the stream's 7Q10 (1.4 times greater). Wilson Bay receives 4.46 MGD discharge from the Wilson Bay WWTP. Problems with the plant have resulted in a large buildup of sludge in Wilson Bay increasing BOD (DEM unpublished data).

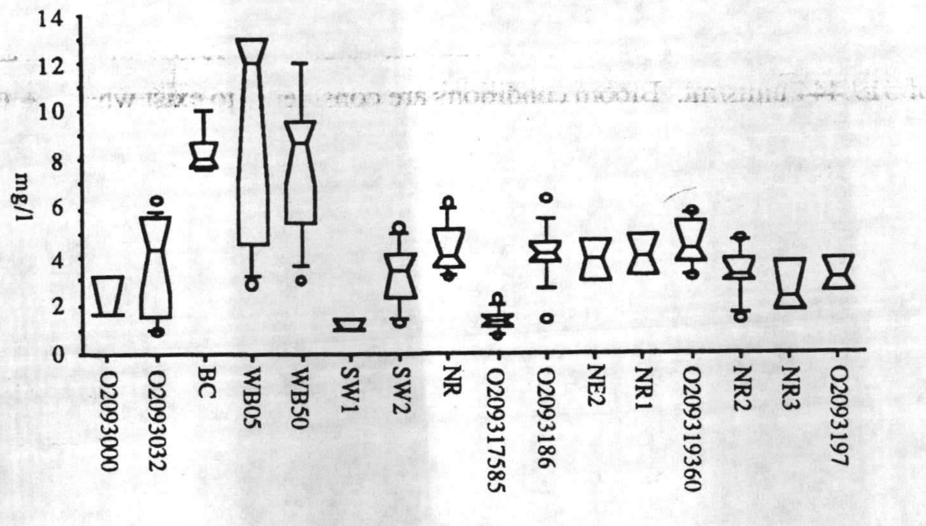


Figure 13. Box chart for BOD 5-day for the New River June-September 1986-1989.

Downstream from Wilson Bay there was little difference in BOD except in Southwest Creek at Hwy 24 (SW1) and Little Northeast Creek (0209317585). BOD at these stations was lower than other stations with concentrations of 0.5 to 2 mg/l, respectively.

Fecal Coliform Bacteria. Fecal coliform bacteria are used as a likely indicator of the presence of other harmful bacteria in surface waters. Most fecal coliform values in the New River were below the state standard of 200 membrane filter fecal coliform colonies(MFFCC)/100ml (Figure 14) with highest values found in the tributaries. Most of the high concentrations below Gum Branch were associated with rain events indicating that nonpoint sources were the primary cause for the elevated levels.

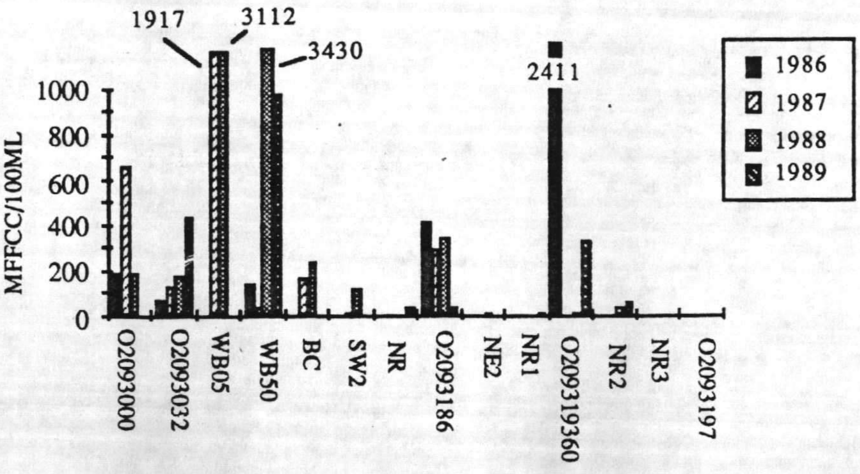


Figure 14. Average summer (June-September) fecal coliform values for New River 1986-1989. Values at NR3 and 02093197 were so low they did not graph.

Wilson Bay was an exception to this as concentrations in 1988 and 1989 were consistently above 200 MFFCC/100ml . Concentrations in Wilson Bay ranged from 150 to 6,800 MFFCC/100ml during 1988 and 1989. These concentrations are a result of operational problems at Jacksonville's Wilson Bay WWTP. As a result of these and other state standard violations, Jacksonville will be closing this treatment plant and is in the process of designing a new WWTP. DEM staff have recommended that the plant be nondischarge due to the nutrient sensitive nature of the New River around Jacksonville.

Aquatic Macrophytes. Samples collected from the New River above Tar Landing in 1985 indicated that alligatorweed (Alternanthera philoxeroides) was present in abundance in the river basin. This macrophyte may be found free-floating, loosely attached and forming mats, rooted, emersed, or in a dry field. Alligatorweed prefers fresh, highly fertile water, but will tolerate brackish water to 30 percent sea water. Dense mats of this weed interfere with navigation, recreational water uses, increase sedimentation, and reduce the drainage capacity of canals and streams which can result in flooding.

Alligatorweed, essentially confined to the coastal plain, is widespread and locally abundant in the Alligator, Cape Fear, Little, Lumber, New, Pasquotank, Perquimans, Scuppernong, Tar, and Waccamaw Rivers. Of the forty-five coastal plain counties, twenty-nine reported alligatorweed infestations (Langeland 1986). The major impact in the study area is the upper narrow reaches of the New River, Half Moon and Blue Creeks, and

Chaney and Mill Creeks, tributaries to the New River located in Jacksonville. As part of the Division of Water Resources Aquatic Plant Control Program, several small plots of alligatorweed (less than five acres) have been treated with Rodeo in Chaney and Mill Creeks in the past three years.

Chlorophyll-a and Phytoplankton Biovolume and Density. Chlorophyll-a concentrations during the four year study ranged from <1 to 310 ug/ml. Twenty eight of fifty two (54%), 26 of 52 (50%), 16 of 47 (38%), and 11 of 29 (38%) of the chlorophyll-a samples analyzed in 1986, 1987, 1988, and 1989 respectively were above the state standard of 40 ug/l. The apparent decrease in the number of violations is probably due to a shift in emphasis from the Morgan Bay area to the lower river stations in 1988 and 1989. Values from Wilson Bay (stations WB05 and WB50) averaged over 100 ug/ml and 88 percent of the samples were above the standard for the period of study. Maximum levels of 260 and 310 ug/ml occurred at WB05 in July 1986 and June 1987 respectively (Figure 15). Wilson Bay receives discharge from Jacksonville's WWTP, which has a permitted flow of 4.46 MGD. The slow flushing rate found in Wilson Bay contributes to the eutrophication problems experienced there by increasing the retention time in the bay. The nutrient concentrations remained very high in this section of the river even in the presence of bloom level phytoplankton populations.

Figure 15 depicts the monthly (June-September) chlorophyll-a values measured in the New River. Measurements taken at Wilson Bay and upstream consistently ranged above the 40 ug/l standard while the stations located below Wilson Bay rarely exceeded the limit. These differences may be due in part to the higher concentration of the dischargers from Wilson Bay upstream and in part due to the greater dilution in the lower reaches where the river is much wider and tidal influences are greater.

The following classes of algal were represented in samples collected from the New River: cryptomonads (Cryptophyceae), diatoms (Bacillariophyceae), greens (Chlorophyceae), chrysophytes (Chrysophyceae), dinoflagellates (Dinophyceae), euglenoids (Euglenophyceae), and yellow greens (Xanthophyceae). Dominant algal classes representing more than 20 percent of the biovolume are presented in Figure 16. Diatoms, dinoflagellates, and chrysophytes were the dominant classes during most of the summer. These classes are normally dominant in brackish waters.

Of the total 180 phytoplankton samples collected for quantitative analysis, 110 samples contained either elevated algal biovolumes or densities. Thirty-six of these samples were collected from the New River, 35 came from Wilson Bay, and the remaining 39 samples were collected from the tributaries.

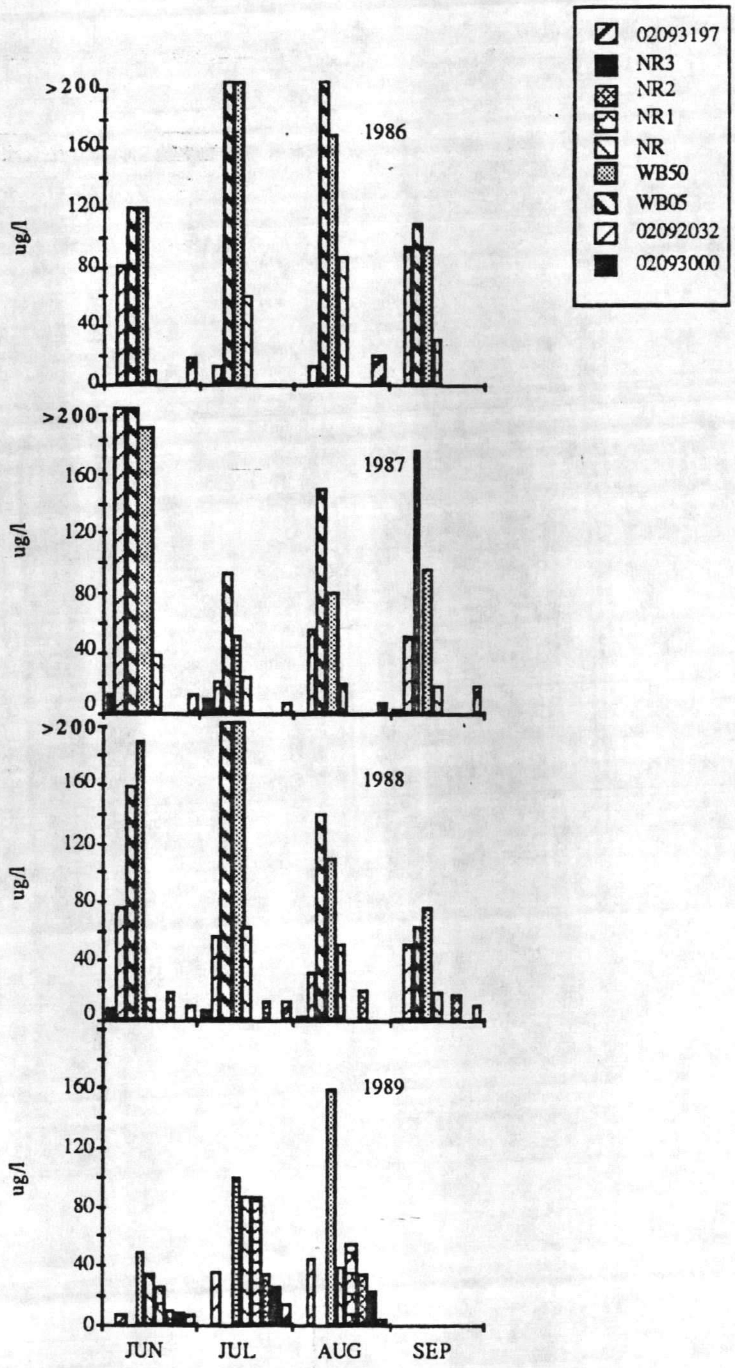


Figure 15. Monthly (June-September) chlorophyll-a concentrations by year for New River mainstem stations and Wilson Bay, 1986-1989.

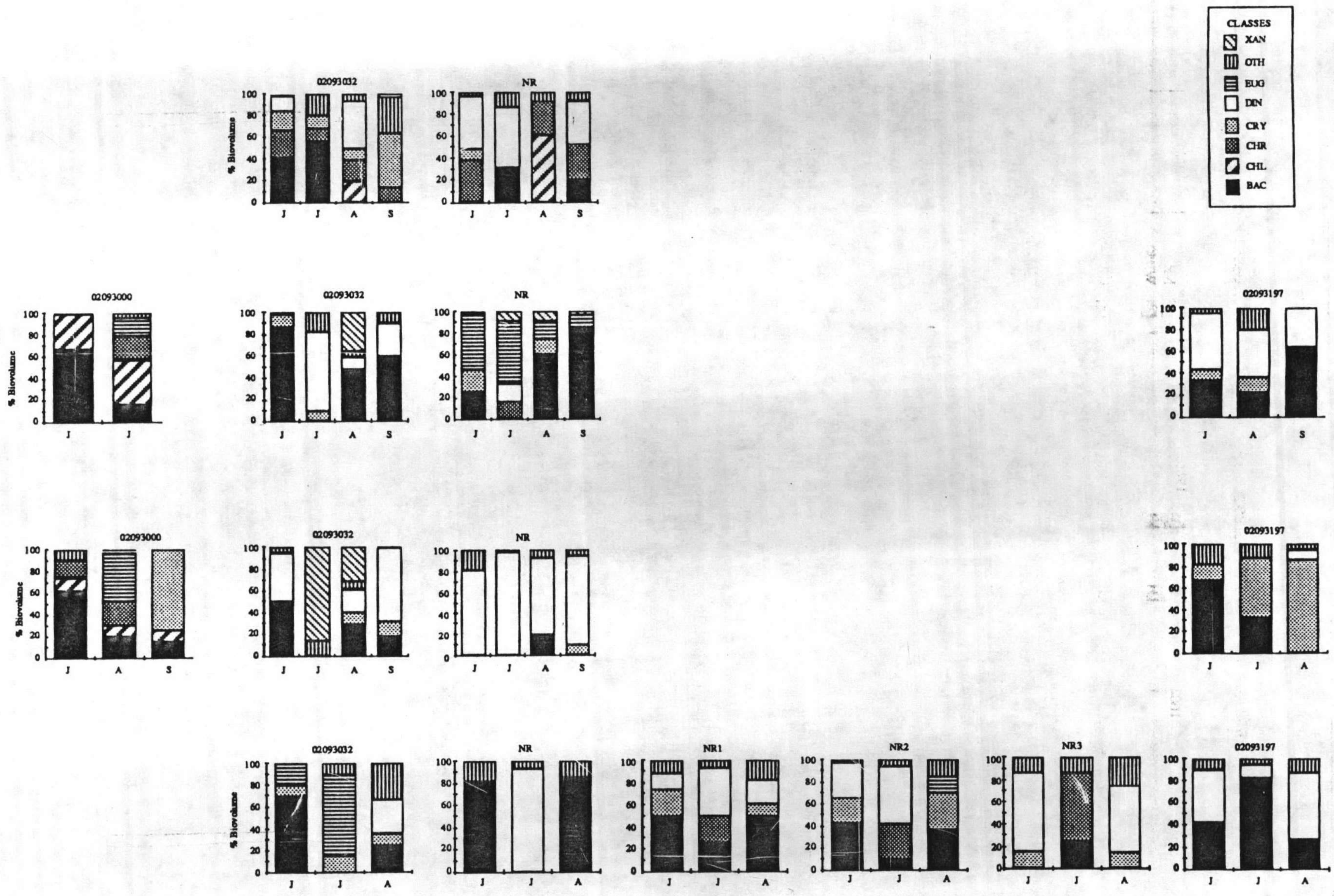


Figure 16. Percent biovolume by class for the mainstem stations of the New River, June-September 1986-1989.

Station 02093000 (Gum Branch) is located 15 miles upstream of Wilson Bay, is more riverine, especially during periods of high flow, and is less likely to exhibit elevated levels of algal activity. As depicted in Figure 17, the average values for this station are well below those exhibited at any other station. Chlorophyll-a values averaged less than 7 ug/l and phytoplankton biovolumes were dominated (comprising more than 20 percent of the total biovolume) by Tabellaria fenestrata (Bacillariophyceae) and Micractinium pusillum (Chlorophyceae). The sample from September 1988 was dominated by Cryptomonas erosa (Cryptophyceae).

Station 02093032 (Highway 17/24 bridge) is approximately three miles upstream of Wilson Bay and experiences slight tidal influence. Phytoplankton density and biovolume from this station in June were dominated by Cyclotella species 2, Skelotonema costatum, and Tabellaria fenestrata. These three diatom species made up 75 percent of the biovolume and over 80 percent of the algal density. Cyclotella species 2 and Skelotonema costatum are often found in estuarine systems and are common to the lower Neuse and Pamlico River Basins.

In 1986, Cyclotella species 2 comprised 55 percent of the biovolume and in 1987 the dinoflagellates, Gymnodinium aurantium and G. species 2 dominated 85 percent of the algal biovolume. The Xanthophyte, Olisthodiscus carterae, contributed 86 percent and the Euglenophyte, Lepocinclis species 3 comprised 70 percent of the 1988 and 1989 algal biovolume, respectively. These three species, along with Gymnodinium nelsoni were co-dominant in August and September for all four years.

The two stations located in Wilson Bay, WB05 and WB50, were dominated by diatoms (Bacillariophyceae). Cyclotella species 2 was the major dominant algae and comprised at least 50 percent and in several cases over 90 percent of the total biovolume. This small centric diatom is apparently able to outcompete other species in this highly eutrophic bay and attain elevated population levels. Yearly averages for algal biovolume, density and chlorophyll-a content all corresponded well for these two stations (Figure 17). The small size of these diatoms is evident when density estimates were compared to biovolume estimates. For example, a density of 500,000 units/ml at WB05 in July 1988 had a biovolume of only 12,000 mm^3/m^3. Gymnodinium aurantium and G. species 4, along with Chroomonas caudata (Cryptophyceae), were also dominant at these stations.

Biovolume estimates at NR, located downstream of the Wilson Bay area between the mouths of Northeast and Southwest Creeks, were dominated by Cyclotella species 2. Gymnodinium aurantium , G. species 4, and Gyrodinium aureolum dominated the 1988 samples and again in July 1989.

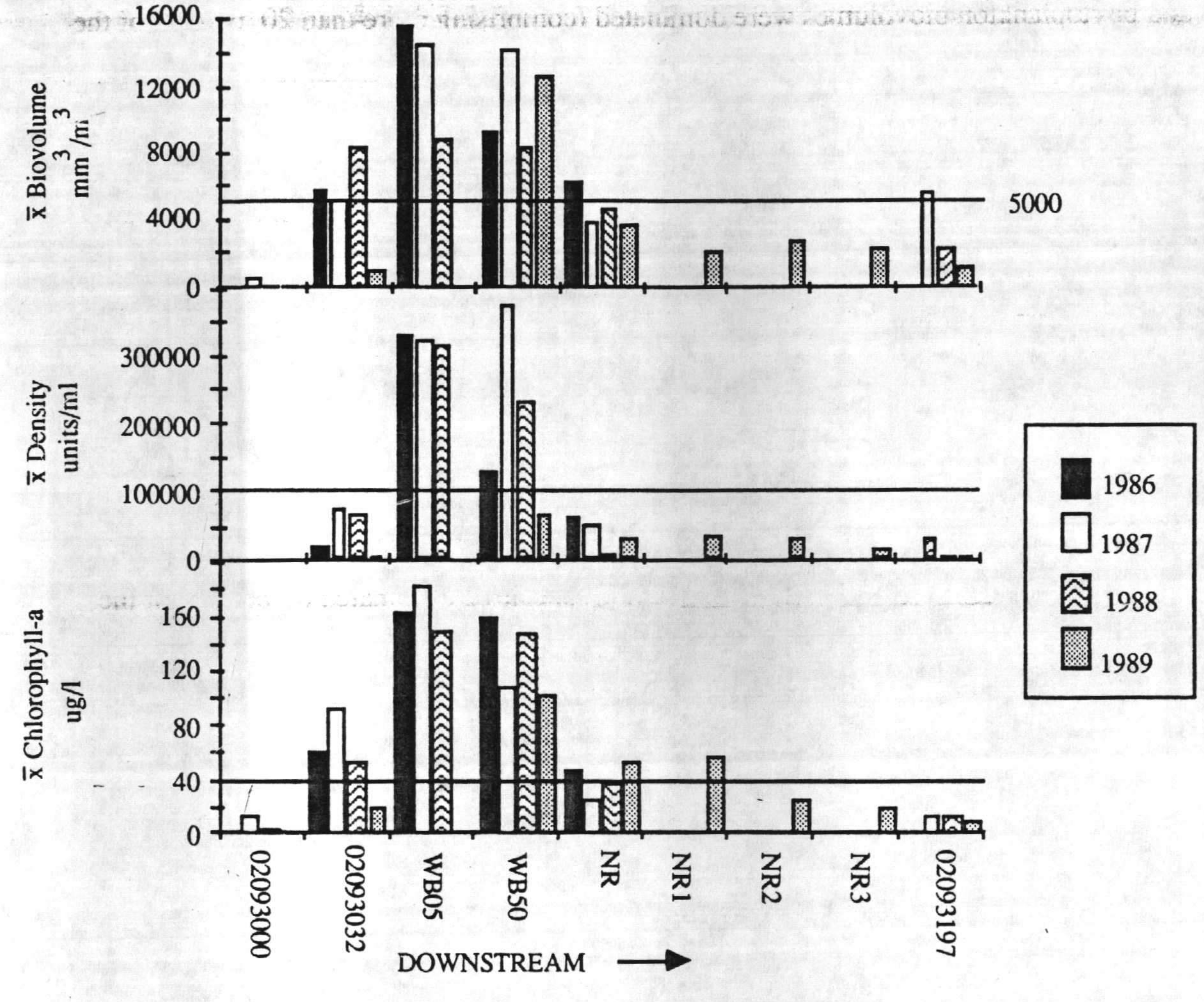


Figure 17. Yearly averages for phytoplankton biovolume, density, and chlorophyll-a at mainstem river stations and Wilson Bay, June-September 1986-1989. (Horizontal lines indicate state standard of 40 ug/l for chlorophyll-a and "bloom" levels for bio-volume and density.)

Stations NR 1, NR 2, AND NR 3 are located farther downstream and were only sampled in 1989. Domination of phytoplankton at these stations varied between Gymnodinium aurantium , Gyrodinium aureolum, Oxyrrhis marina, Prorocentrum minimum, common estuarine dinoflagellates, and Dictyocha fibula (Chrysophyceae).

Skelotonema costatum, Nitzschia closterium, N. species, and Rhizosolenia stolterfothii were the dominant diatoms at 02093197 (Sneads Ferry) due to their euryhaline nature. These algae were responsible for at least 40 percent of the biovolume in July and September of 1987, June of 1988, and June and July of 1989. Chroomonas amphioxeia and Cryptomonas ovata (Cryptophyceae) made up 50 percent of the biovolume in August and September of 1988. Ceratium species, Peridinium trochoideum, and Oxyrrhis marina were the dominant species in July and August 1988. Peridinium trochoideum and Gymnodinium species 4 dominated samples from June and August 1989.

Algal populations at the mouths of the tributaries were similar to the New River assemblages. Brinson Creek (BC) exhibited elevated levels of phytoplankton several times in the study period. Nutrient concentrations were also elevated at this station. A chlorophyll-a value of 220 ug/l was recorded from July 1986 when Cyclotella species 2 made up 97 percent of the biovolume. This species also played an important part in the composition of the phytoplankton populations of Northeast, Southwest, and Wallace Creeks.

Species composition, extremely elevated levels of chlorophyll-a, nuisance phytoplankton populations during the growing season in combination with the continued presence of high nutrient concentrations indicate that this area is very eutrophic and nutrient controls are warranted.

Algal Growth Potential Test. Algal growth potential tests (AGPT) provide information on capacity of a water body to support nuisance algal populations and determine which nutrient may be responsible for limiting algal growth (USEPA 1978). In order to perform this test, water is collected, autoclaved, and filtered. Samples are then treated separately with additions of nitrogen and/or phosphorus. When the added nutrient results in an increase in mean standing crop (MSC) over the control, that nutrient is said to be limiting to phytoplankton growth, indicating that increases of the limiting nutrient to the water body could result in nuisance algal populations. A MSC of 5 mg/l or less generally is a level that will not promote excessive algal growth. MSC exceeding 10 mg/l are associated with highly productive waters which may be subjected to nuisance algal blooms and fish kills

In June 1989, AGPT's were performed for DEM by the United States Environmental Protection Agency Region IV personnel on samples collected from three stations in the New River. The stations were located above, in, and below Morgan Bay. This area was chosen as Jacksonville was contemplating moving their Wilson Bay discharge to this area.

The results indicate that the addition of nitrogen to the samples greatly increases algal production (Table 6). Little change occurred to any samples when phosphorus was added indicating that phosphorus is already present in sufficient quantities to support algal growth. Data from the control samples indicated that NR50, located in the middle of Morgan Bay, can already achieve a MSC above the 5 mg/l lower level without any addition of nutrients. Therefore existing conditions at this station are favorable for algal blooms.

The reduction of phosphorus as outlined in the NSW recommendations would drive the system toward phosphorus limitation. This would theoretically reduce the control MSC and reduce the phytoplankton levels and the likelihood of nuisance blooms.

Table 6. Results of the Algal Growth Potential Tests performed on the New River, Onslow County, June 20, 1989. Test organism was Selenastrum capricornutum.

		MEAN MAXIMUM STANDING CROP (mg/l)				
STATION	TREATMENT	REP 1	REP 2	REP 3	MEAN	RANGE
NR50	CONTROL	4.73	6.40	5.29	5.47	1.67
	C+N	12.19	14.04	15.17	13.80	2.98
	C+P	5.24	5.64	3.97	4.95	1.67
NR1	CONTROL	4.96	3.99	3.10**	4.48	0.97
	C+N	18.21	12.61**	18.21	18.21	0.00
	C+P	8.70**	5.02	4.72	4.87	0.30
NR2	CONTROL	3.14	1.57	2.36	2.44	1.33
	C+N	16.35	16.82	15.55	16.24	1.27
	C+P	1.43	1.22	1.61	1.42	0.39

** outlier

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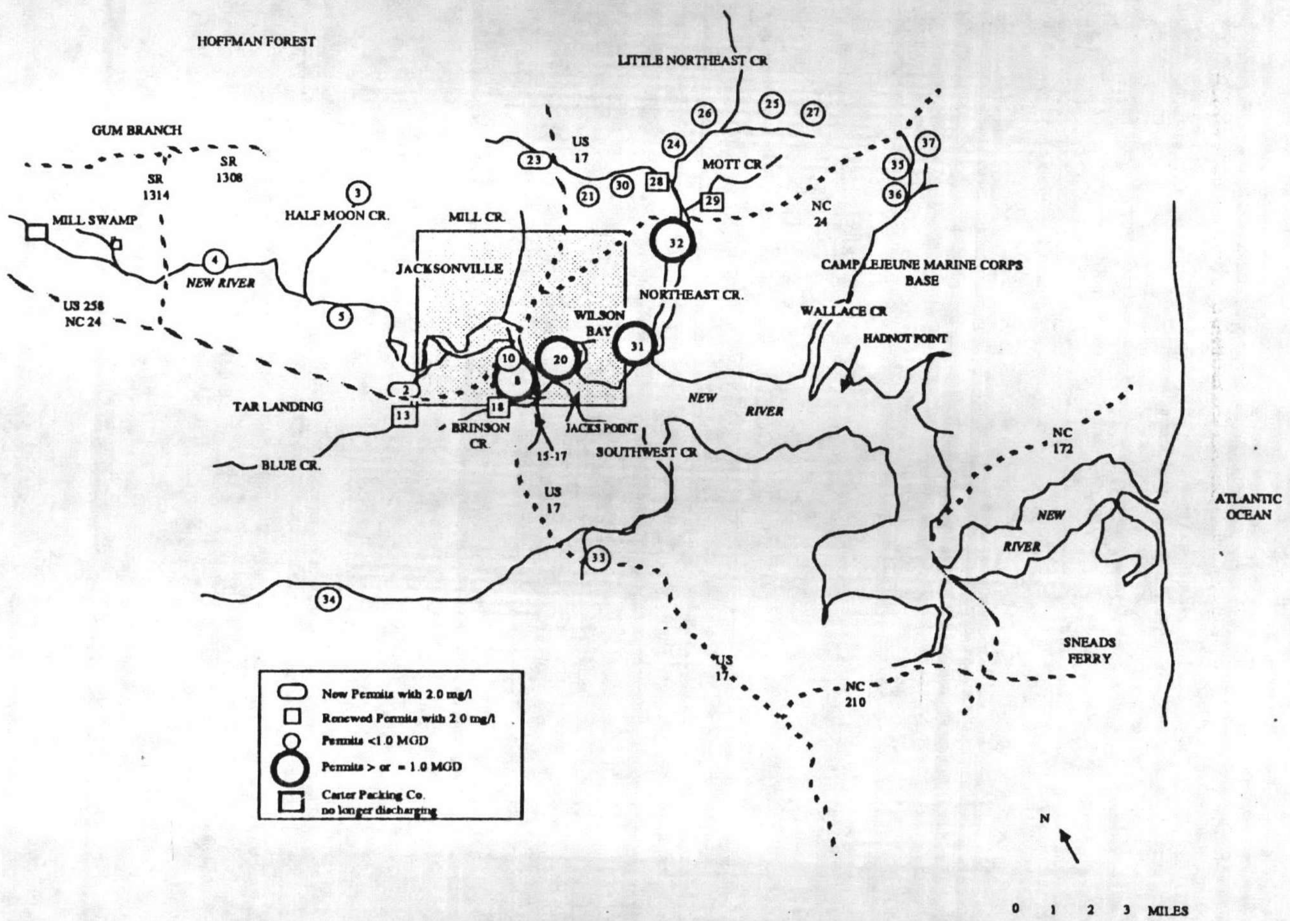


APPENDIX I. NPDES dischargers to the New River above Hadnot Point. See Appendix II for discharger names and flows.

APPENDIX II. Information on dischargers into the New River above Hadnot Point. See Appendix I for locations.

MAP #	PERMIT #	DISCHARGER	ACTUAL FLOW (MGD)	PERMITTED FLOW (MGD)
Upper New River				
1	NC0043699	Summersill Elementary School	.0050	.0090
2	NC0071706	Hinson Arms Apartments	.0080	.0200
3	NC0060739	R.P.D., Inc.	*	.1000
4	NC0062294	Rock Creek Golf & Country Club	ND	.1152
5	NC0036226	Lauradale Subdivision	.1555	.2000
6	NC0056049	Hurst Development	*	.2000
7	NC0023230	Town of Richlands	.0292	.2100
8	NC0062995	USMC Camp Geiger	1.1653	1.6000
		Totals	1.3630	2.4542
Blue Creek				
9	NC0049671	Biscuit Town Restaurant	ND	.0010
10	NC0044377	Worsley Company, Inc.	ND	.0050
11	NC0043656	Blue Creek School	.0053	.0110
12	NC0043702	Southwest High School	.0044	0.0200
13	NC0056952	Pollard Enterprises	.0470	.1000
		Totals	.0567	.1370
Brinson Creek				
14	NC0051853	Southgate MHP	.0040	.0030
15	NC0002585	A-1 Cleaners	.0069	.0080
16	NC0061565	Canady Road Tract	*	.0400
17	NC0028223	Beachams Apts #1	.0260	.0400
18	NC0057053	Sentry Enterprises	.0170	.0870
19	NC0028215	Beachams Apts #2	.0270	.1000
		Totals	.0809	.2780
Wilson Bay				
20	NC0024121	City of Jacksonville	4.1453	4.4600
		Totals	4.1453	4.4600
Northeast Creek				
21	NC0000698	Weyerhaeuser	.0003	.0033
22	NC0043711	Morton Elementary School	.0076	.0075
23	NC0071536	Windmill Restaurant	.0020	.0100
24	NC0034991	Hickory Grove MHP	.0070	.0225
25	NC0036676	Collins Estates MHP	ND	.0250
26	NC0023825	Webb Apartments	.0197	.0250
27	NC0022452	Sherwood MHP	.1500	.0600
28	NC0031577	Mercer Environmental-White Oak	.0798	.2200
29	NC0049387	Hunters Creek-Viking Utility	.0392	.2500
30	NC0032239	Mercer Environmental-Regalwood	.0790	.3000
31	NC0063011	USMC Camp Johnson	.4370	1.0000
32	NC0063002	USMC Tawara Terrace STP	.7958	1.2500
		Totals	1.6084	3.1730

APPENDIX II. continued

<u>Southwest Creek</u>

33	NC0034339	Old Hickory MHP		.0120	.0180
34	NC0030813	Kenwood Estates		.0372	.0500
			Totals	.0492	.0680

<u>Wallace Creek</u>

35	NC0051471	Big Pines MHP		.0027	.0065
36	NC0058874	Piney Green Shopping Center		.0062	.0600
37	NC0062642	Queens Creek Development		*	.5000
			Totals	.0089	.5665

TOTAL FOR ALL DISCHARGERS	7.3214	11.1367

ND - No Discharge   * Not Built

APPENDIX III. Original 0404 documentation.

DIVISION OF ENVIRONMENTAL MANAGEMENT

January 30, 1987

MEMORANDUM

TO: George T. Everett
Chuck Wakild

FROM: R. Paul Wilms

SUBJECT: Point Source Nutrient Limitations, New River
Onslow County, N.C.

I have completed my review of the report prepared by the Water Quality Section concerning the New River in Onslow County. The data and evidence strongly supports the need for additional point source control of nutrients into these receiving waters.

Therefore, based upon the evaluation of data, it is the position of this office that regulations NCAC, 15: 2H.0403 and 2H.0404(c) are clearly appropriate to address this situation.

NCAC, Title 15: 2H.0404(c) states: "The director may prohibit or limit any discharge of wastes into surface waters if, in the opinion of the director, the surface waters experience or the discharge would result in:

(1) growths of microscopic vegetation such that chlorophyll a values are greater than 40 ug/l; or
(2) growths of microscopic or macroscopic vegetation which substantially impair the intended best usage of the waters."

Therefore, effective immediately, the staff should include appropriate nutrient limitations (2.0 mg/l total phosphorous) in all new permit requests and any expansion requests within the New River Basin upstream from a line connecting Grey Point to a point of land approximately 2200 yards downstream from the mouth of Duck Creek. This applies to all main stem waters and tributaries to the New River upstream from this line of designation.

Upon expiration of existing permits which have a design flow greater than 50,000 gallons per day, the same nutrient effluent limitation of 2.0 mg/l phosphorous should be applied to the reissued NPDES permits.

cc: Steve W. Tedder
Preston Howard

NEW RIVER BASIN

ONSLOW COUNTY

APPLICATION OF COASTAL REGULATION 2H.0404(C)

The North Carolina Department of Natural Resources

and Community Development

Division of Environmental Management

Water Quality Section

January 1987

INTRODUCTION

The New River is a blackwater river surrounded by gum-cypress swamp above Jacksonville where the River broadens and becomes significantly affected by tidal influences. Reports of decreases in anadromous fish populations, increasing frequency of fish kills, discoloration of waters, and low dissolved oxygen in the New River prompted the Wilmington Regional Office to request an investigation to assess water quality in the Jacksonville area.

This investigation included review of existing data in the ambient network, estimates of nutrient loading from point and non-point sources, and monthly sampling in the New River and its tributaries during the summer of 1986.

The results of this investigation documented an alarming biological response to current nutrient loading into the New River. The following information summarizes those results and recommends possible actions to improve water quality in the New River watershed.

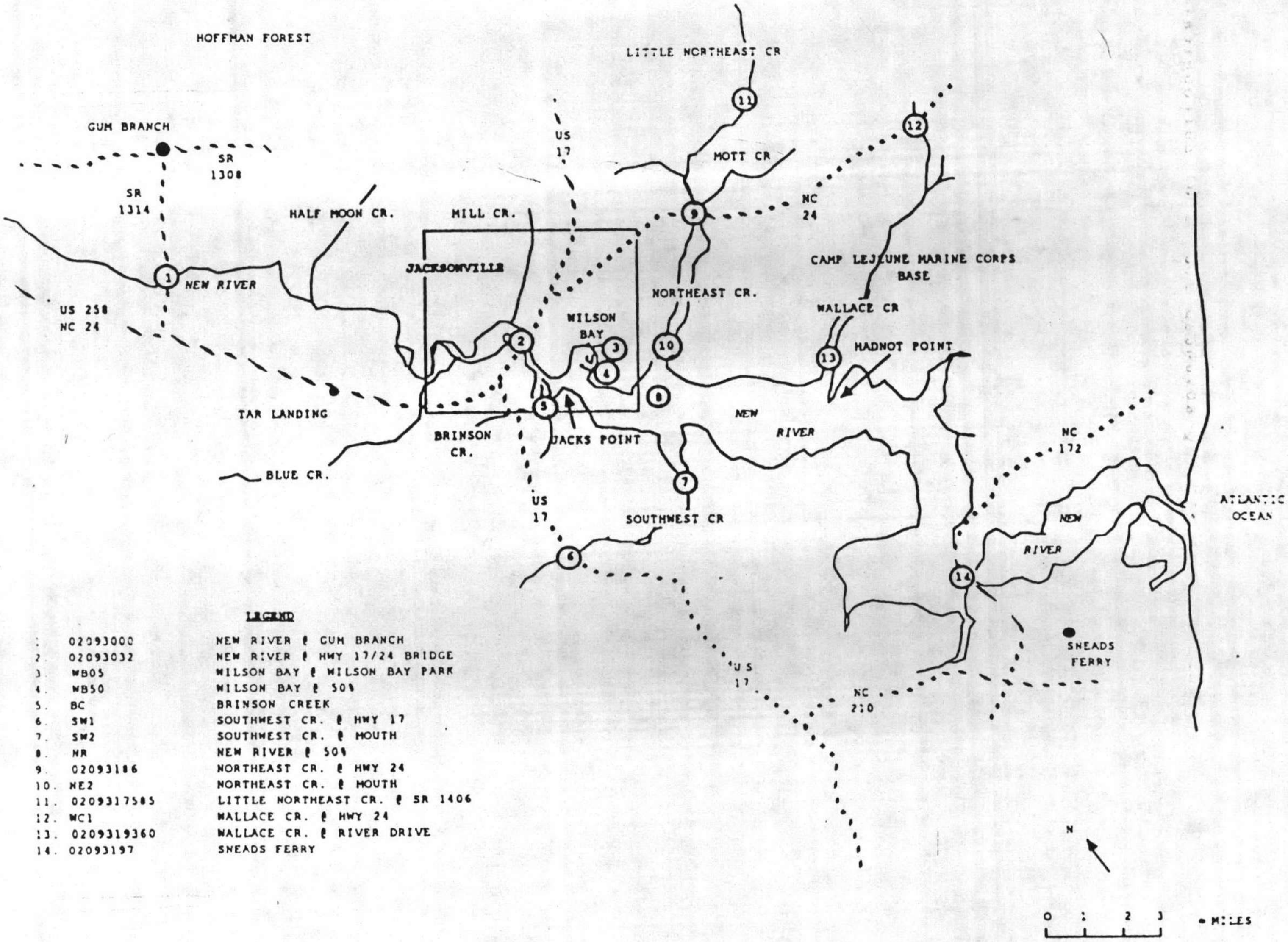


FIGURE 1. STATION LOCATIONS FOR THE NEW RIVER.

BACKGROUND

Problems associated with the over-enrichment of surface waters have been identified in many areas of North Carolina in recent years. These problems are most obvious in fresh waters experiencing advanced stages of eutrophication. Surface scums of blue-green algae and subsequent fish kills have occurred, on the Chowan River in 1972 and Neuse River in 1983.

While having the potential of being just as harmful, overenrichment in estuarine waters is more subtle in appearance. Staff of the Wilmington Regional Office observed impacts often associated with over-enrichment occurring frequently over past years in the New River estuary and its tributaries near Jacksonville, North Carolina. Sixteen fish kills have been documented in the area since 1978. Some of these kills were attributed to sewer overflows and others to low dissolved oxygen concentrations as a result of algal blooms.

Problems in the late summer of 1985 were frequent and rather extensive (Table 1). Fish kills occurred in Northeast Creek, Wilson Bay, and as far upstream as Tar Landing on the New River in August and September. Low dissolved oxygen concentrations (<4 mg/l) and high chlorophyll-a concentrations (300 ug/l) were associated with these kills. With these increased problems, the Regional Office requested the assistance of the Technical Services Branch to assess the extent and potential impacts of over-enrichment in this area.

A survey was conducted October 3, 1985 on the New River from Jack's Point upstream to a point above Tar Landing where further progress was impeded by a dense mat of alligator-weed (<u>Alternanthera philoxeroidos</u>). Low dissolved oxygen concentrations were measured in the surface waters at 7 locations near and above the Hwy 17/24 bridge at Jacksonville. High nutrient and chlorophyll-a concentrations were measured near Wilson Bay. As a result of data review, it was determined that more intensive monitoring in the Jacksonville area would improve assessment of water quality conditions in the area

Table 1. NEW RIVER PROBLEM SUMMARY FOR LATE SUMMER 1985.

- Numerous Fish Kills and Dissolved Oxygen Problems in Late Summer 1985. (Region Requested Assistance)

AUGUST 5	- Fish kill near Wilson Bay
	- Total N 2.2 mg/l in Wilson
SEPTEMBER 5	- Complaint green soupy water
	- Wilson Bay had many indicators of severe nutrient loading problems
	- Chlorophyll = 300 ug/l TN = 3.21 mg/l pH = 9.1 DO = 16.2 mg/l
SEPTEMBER 17	- Fish kill upstream near Tar Landing
	- Chlorophyll = 72 ug/l
	- Phytoplankton upstream dominated by <u>Euglena</u> sp. indicating organic enrichment
OCTOBER 3	- Raleigh & regional staff survey
	- Wilson Bay TN @ 3 sites above 4 mg/l
	- NH_3 above 2 mg/l
	- Chlorophyll = 88 ug/l
	- DO @ 7 sites above 17/24 bridge <4.1 mg/l

CONCLUSION - STRONG EVIDENCE OF SEVERE ENRICHMENT PROBLEMS IN TRIBUTARIES AND IN NEW RIVER NEAR JACKSONVILLE.

Monthly sampling was initiated in 1986 in the New River and major tributaries near Jacksonville (Figure 1). Measured parameters included nutrients, chlorophyll-a, and phytoplankton concentrations, as well as physical data (conductivity, dissolved oxygen, temperature and salinity), and BOD_5 and fecal coliform.

Point Sources

There are a total of forty-three point source discharges permitted by the Division within the New River Basin. Of these forty-three discharges, thirty-five are built and discharging to waters of the basin. Thirty existing discharges are located upstream of Hadnot Point (near mouth of Wallace Creek) in the upper basin where the majority of water quality violations have been observed. The combined wasteflow of these latter thirty discharges totals 10.2 MGD.

Approximately 60 percent of the permitted wasteflow in the upper New River Basin is discharged to Wilson Bay. Another 31 percent is discharged into the mouth of Northeast Creek. Numerous small discharges (0.001 to 0.100 MGD) are located along tributaries throughout the upper basin.

Nutrient Budget

Preliminary nutrient budgets have been developed for the upper New River Basin (above Hadnot Point) for total phosphorus (TP) and total nitrogen (TN). Nutrient loads were grouped into point source and non-point source categories. Non-point sources consisted of export from various land uses (i.e. forest, agriculture, wetlands, and urban) and from precipitation to the open water surface area.

Non-point source loads were estimated using nutrient export coefficients and land use data provided by the Wilmington Regional Office (Table 2). The export coefficients (i.e. p-loading rate, n-loading rate) were obtained from the Chowan/Albemarle Action Plan (NRCD, 1982). The total estimated non-point source TP and TN loads are 49930 kg/yr and 254745 kg/yr, respectively.

TABLE 2. Non-point Nutrient Loading to the Upper New River Basin

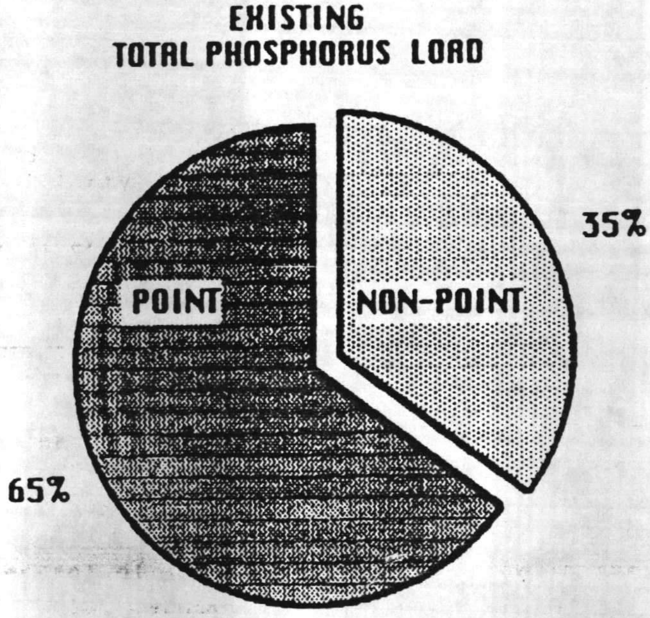
SOURCE - LAND USE	AREA km^2 (%)	P-LOADING RATE (kg/km^2-yr)	P-LOAD (kg/yr)	N-LOADING RATE (kg/km -yr)	N-LOAD (kg/yr)
Forested	364.7 (50.7)	10	3647	165	60175
Agricultural/Cleared	151.8 (21.1)	110	16698	625	94875
Marsh/Wetlands	34.7 (4.8)	10	347	165	5478
Urban - High Density	133.6 (18.6)	200	26720	525	70140
Urban - Low Density	11.7 (1.6)	90	1053	375	4387
Precipitation to Open Water	22.5 (3.1)	65	1463	875	19688
TOTALS	719.0		49928		254743

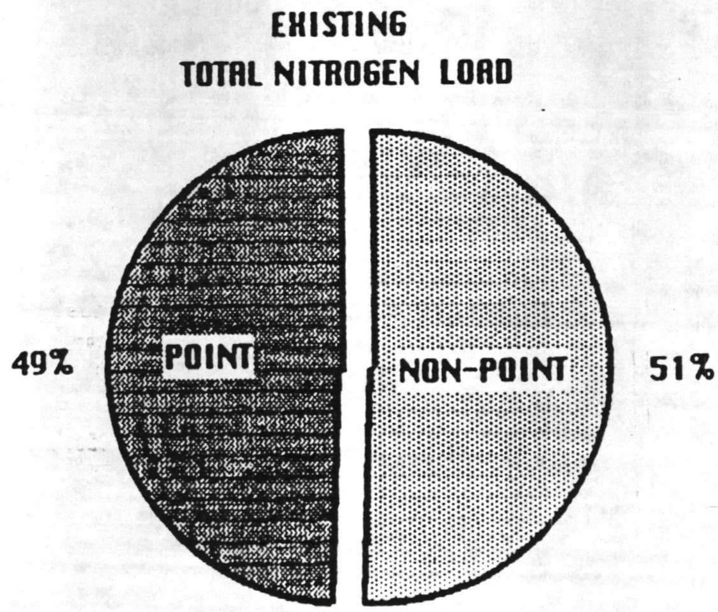
TABLE 3. Point Source Nutrient Loading to the Upper New River

BASIN SEGMENT	TOTAL POINT SOURCE FLOW (MGD)	ESTIMATED POINT SOURCE TP (kg/yr)	ESTIMATED POINT SOURCE TN (kg/yr)
Headwaters of New River	0.429	3850 (2960-4740)	10305 (8765-11845)
Blue Creek	0.131	1175 (905-1445)	3145 (2675-3615)
Brinson Creek	0.238	2135 (1640-2630)	5715 (4860-6570)
Wilson Bay	6.06	54380 (41830-66930)	145570 (123820-167320)
Southwest Creek	0.068	610 (470-750)	1635 (1390-1880)
Northeast Creek	3.138	28155 (21660-34655)	75375 (64115-86640)
Wallace Creek	0.1595	1430 (1100-1760)	3835 (3260-4405)
TOTALS	10.2235	91735	245580

Figure 2.

Upper New River Basin Nutrient Budgets





Point source loads were estimated using probable nutrient concentration ranges obtained from basin-pooled self-monitoring data (performed for Neuse River and Tar/Pamlico River studies) and permitted wasteflows (Table 3). Wasteflows were totaled for various basin segments, and then multiplied by 6.5 mg/l TP and 17.4 mg/l TN to determine point source loads. These concentrations reflect the midpoints of the likely ranges of TP, 5.0 to 8.0 mg/l, and TN, 14.8 mg/l to 20 mg/l. Loading estimates which reflect the ranges are shown in parentheses below the average estimates in Table 3. The total estimated point source (at permitted conditions) TP and TN loads are 91,735 kg/yr and 245,580 kg/yr.

The estimated point source phosphorus load is nearly twice that of the non-point source estimate, accounting for 65 percent of the total basin load (Figure 2). The expected nitrogen contribution from point sources is expected to be about equal to the non-point source TN load (Figure 2). These substantial contributions from point sources to the overall nutrient load have led to elevated nutrient concentrations within the New River Basin.

RESULTS OF 1986 SUMMER SURVEY

River Sites

Sampling included 6 sites on the New River from Gum Branch to Sneads Ferry. Mean values of nutrient, chlorophyll-a and phytoplankton data are presented in Table 4 and the corresponding distributions are shown by station location in Figures 3, 4 and 5.

It should be noted that nutrient values at Gum Branch were elevated (mean TP=0.3 mg/l) and tended to increase during periods of low flow, which generally indicates point source impacts. Problems were identified with effluent discharges from Carter Packing Company. A total of 48 effluent violations (see attached) were found during a 23 month period. Therefore, Gum Branch would not serve as a representative upstream "background level" location.

Downstream, total nitrogen was relatively high (>1 mg/l) at Highway 17/24 near Jacksonville, increased dramatically at Wilson Bay, and gradually declined to more desirable concentrations at Sneads Ferry which is about 30 miles downstream of Gum Branch and is very near the Atlantic Ocean.

Mean concentrations of total phosphorus displayed a similar pattern in a downstream progression. Relative concentrations were not as elevated as nitrogen at Gum Branch, but were extremely high near Wilson Bay.

Chlorophyll-a and phytoplankton analyses revealed a tremendous response to over-enrichment in the Jacksonville area. Mean chlorophyll-a concentrations from the Hwy 17/24 bridge to Station NR 50% (New River at mid channel near the mouths of Northeast and Southwest Creeks ranged from 48-165 ug/l (Figure 5).

It should also be noted that dominance by a single group of organisms was responsible for most of the measured chlorophyll-a concentrations in the Wilson Bay area. Those phytoplankton present were not surface, scum forming, species as seen in our freshwater rivers, but were found in concentrations large enough to severely affect dissolved oxygen in shallow areas. This type of uni-algal dominance is not generally healthy to most food webs (Figure 6).

TABLE 4. NEW RIVER SITES MEAN VALUES JUNE-SEPT 1986.

STATION	CHL-a ug/l	TN mg/l	TP mg/l	DENSITY units/ml	BIOVOLUME mm3/m3
GUM BRANCH	-	2.76	0.30	-	-
NEW RIVER @ 17/24 BRIDGE	51	1.15	0.19	11,400	5,500
WILSON BAY 5%	165	1.94	0.62	320,600	44,800
WILSON BAY 50%	161	1.25	0.40	119,800	19,500
NEW RIVER @ 50%	48	0.76	0.16	62,100	9,400
NEW RIVER @ SNEADS FERRY	18	0.73	0.11	-	-

Figure 3.

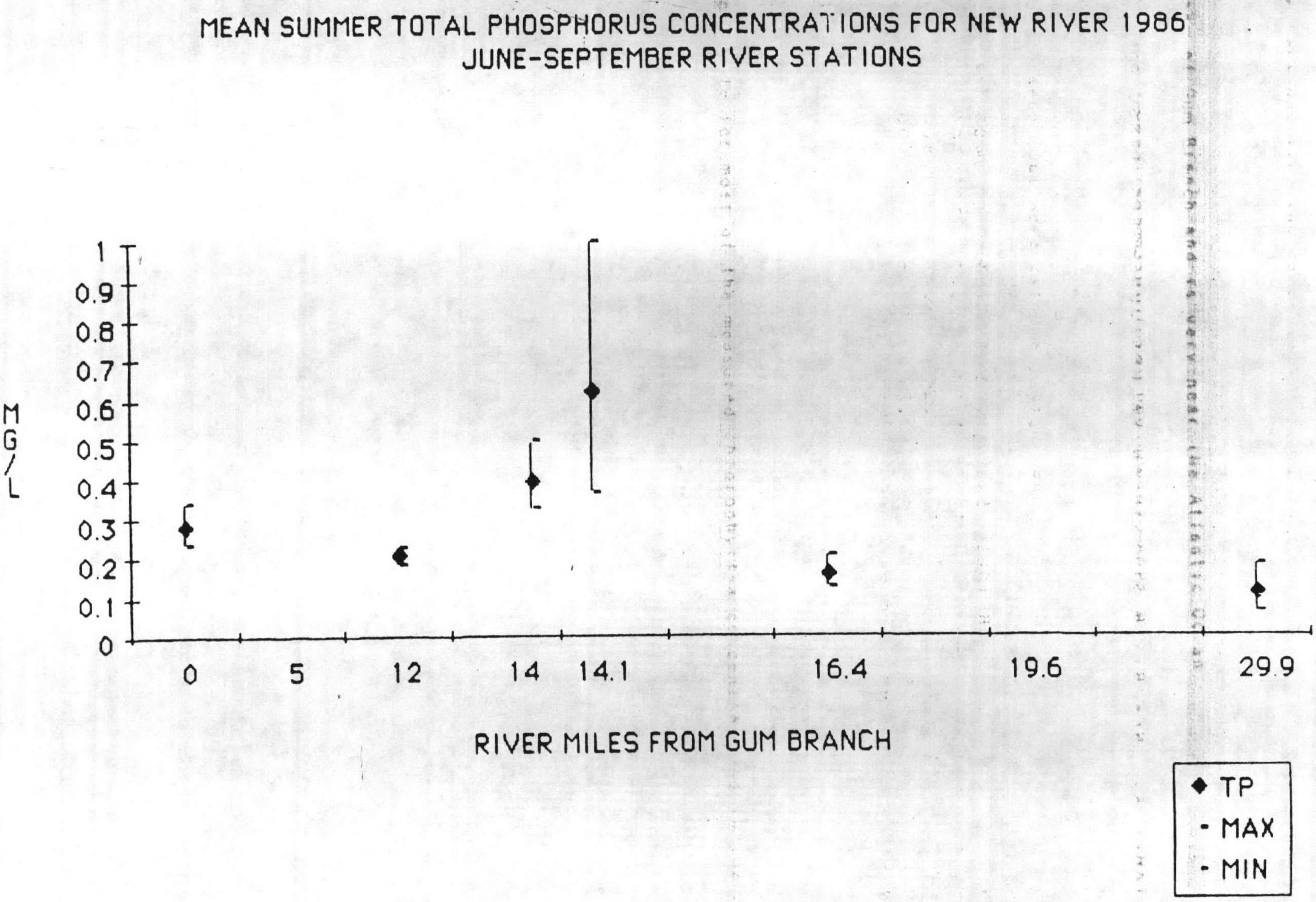

MEAN SUMMER TOTAL PHOSPHORUS CONCENTRATIONS FOR NEW RIVER 1986
JUNE-SEPTEMBER RIVER STATIONS
M G / L
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
5
12
14
14.1
16.4
19.6
29.9
RIVER MILES FROM GUM BRANCH
TP
MAX
MIN

Figure 4.

MEAN SUMMER TOTAL NITROGEN CONCENTRATIONS FOR NEW RIVER 1986
JUNE-SEPTEMBER RIVER STATIONS.

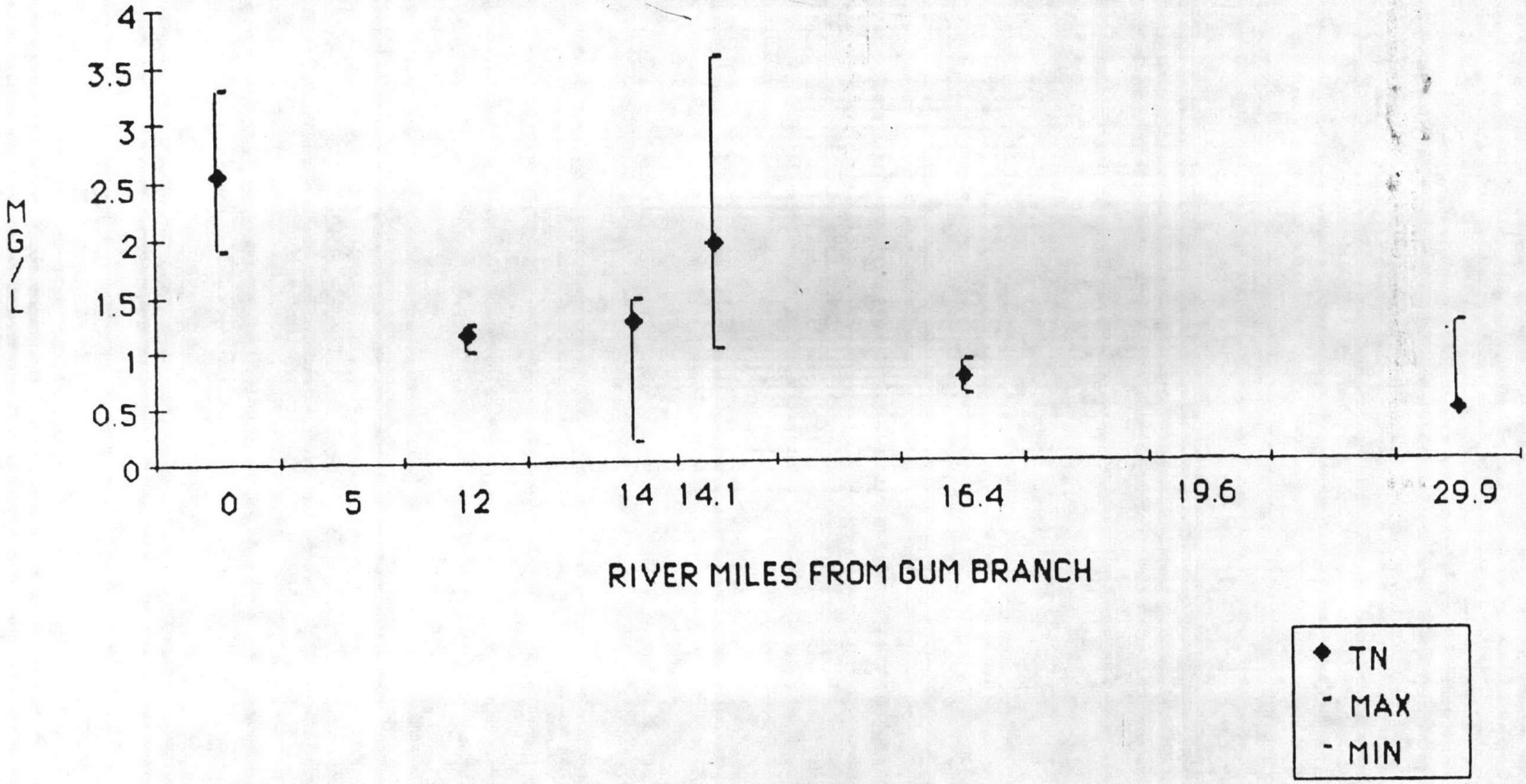


Figure 5.

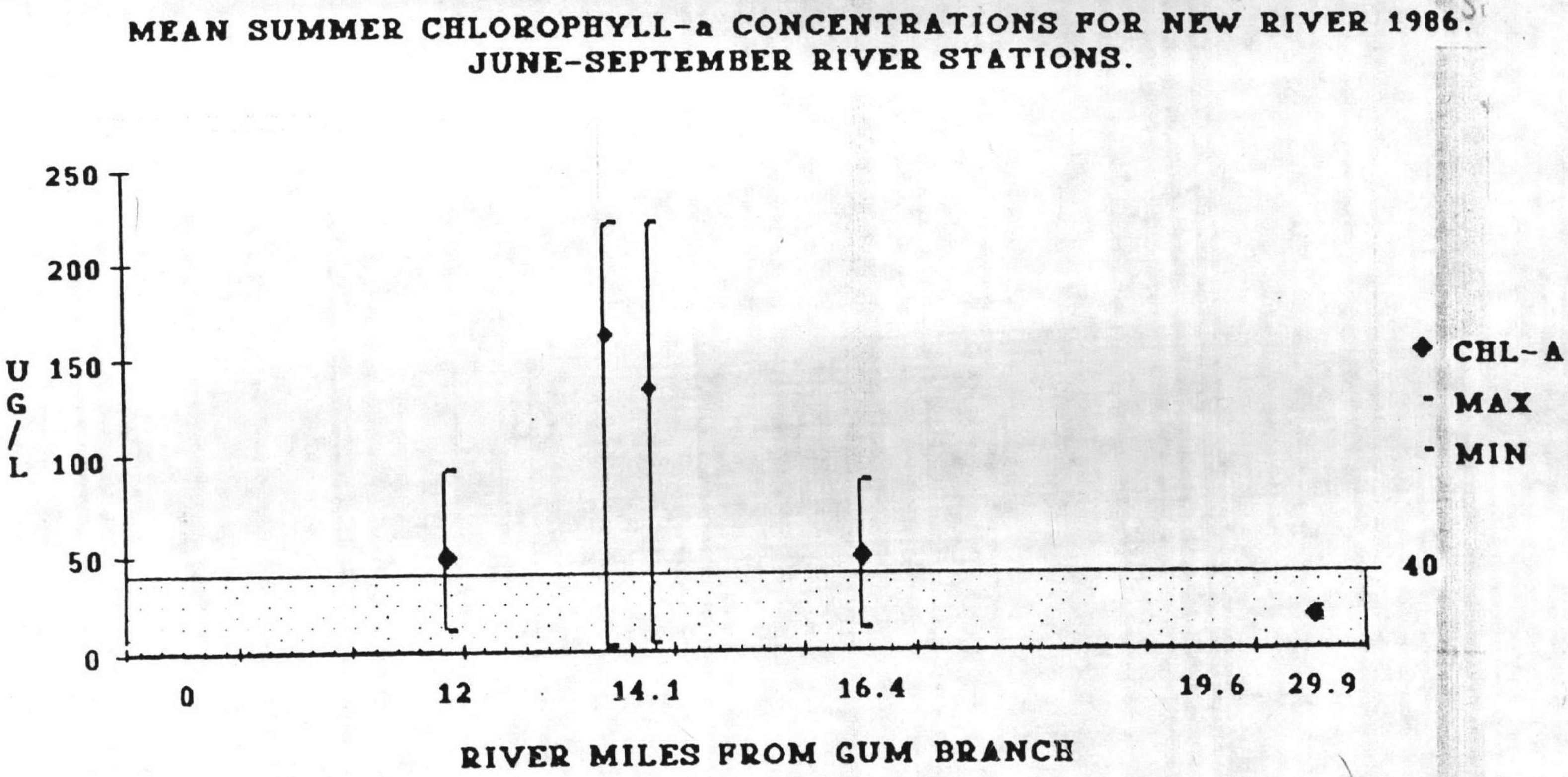
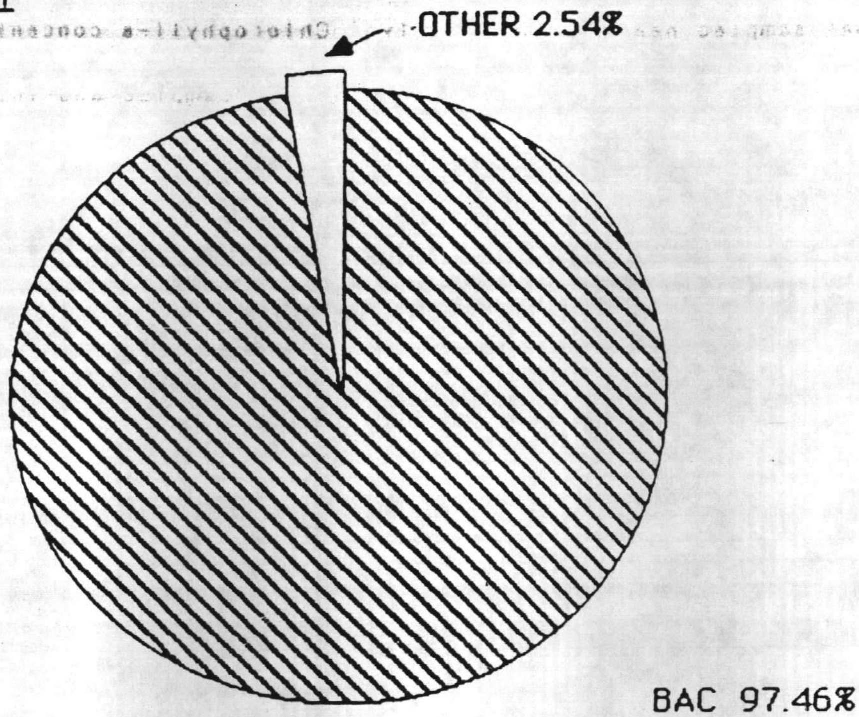

MEAN SUMMER CHLOROPHYLL-a CONCENTRATIONS FOR NEW RIVER 1986.
JUNE-SEPTEMBER RIVER STATIONS.
250
200
150
100
50
0
UG/L
CHL-A
MAX
MIN
40
0
12
14.1
16.4
19.6
29.9
RIVER MILES FROM GUM BRANCH

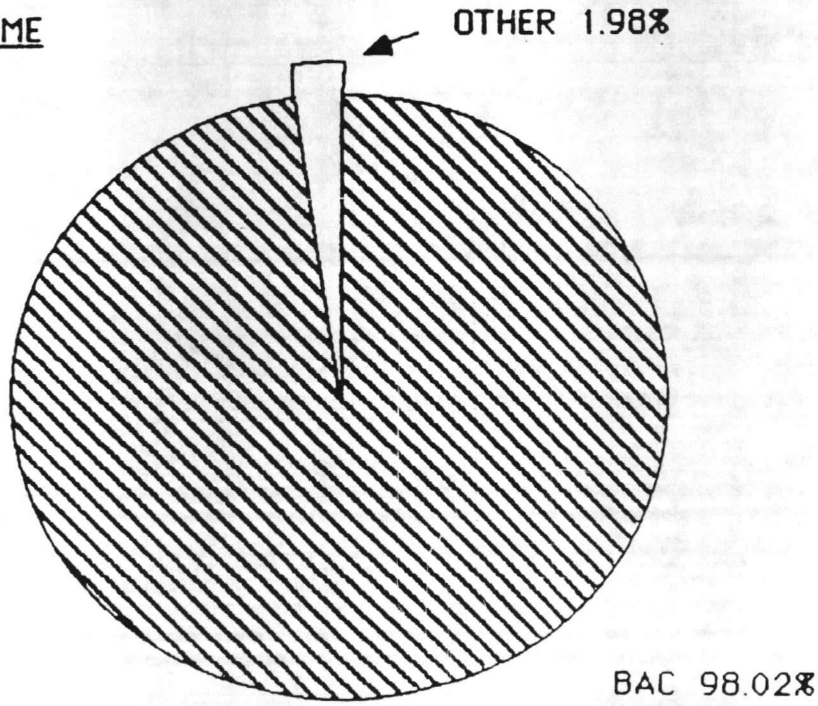
Figure 6.

DENSITY & BIOVOLUME BY CLASS FOR WILSON BAY JULY 1986

DENSITY



BIOVOLUME



Tributary Sites

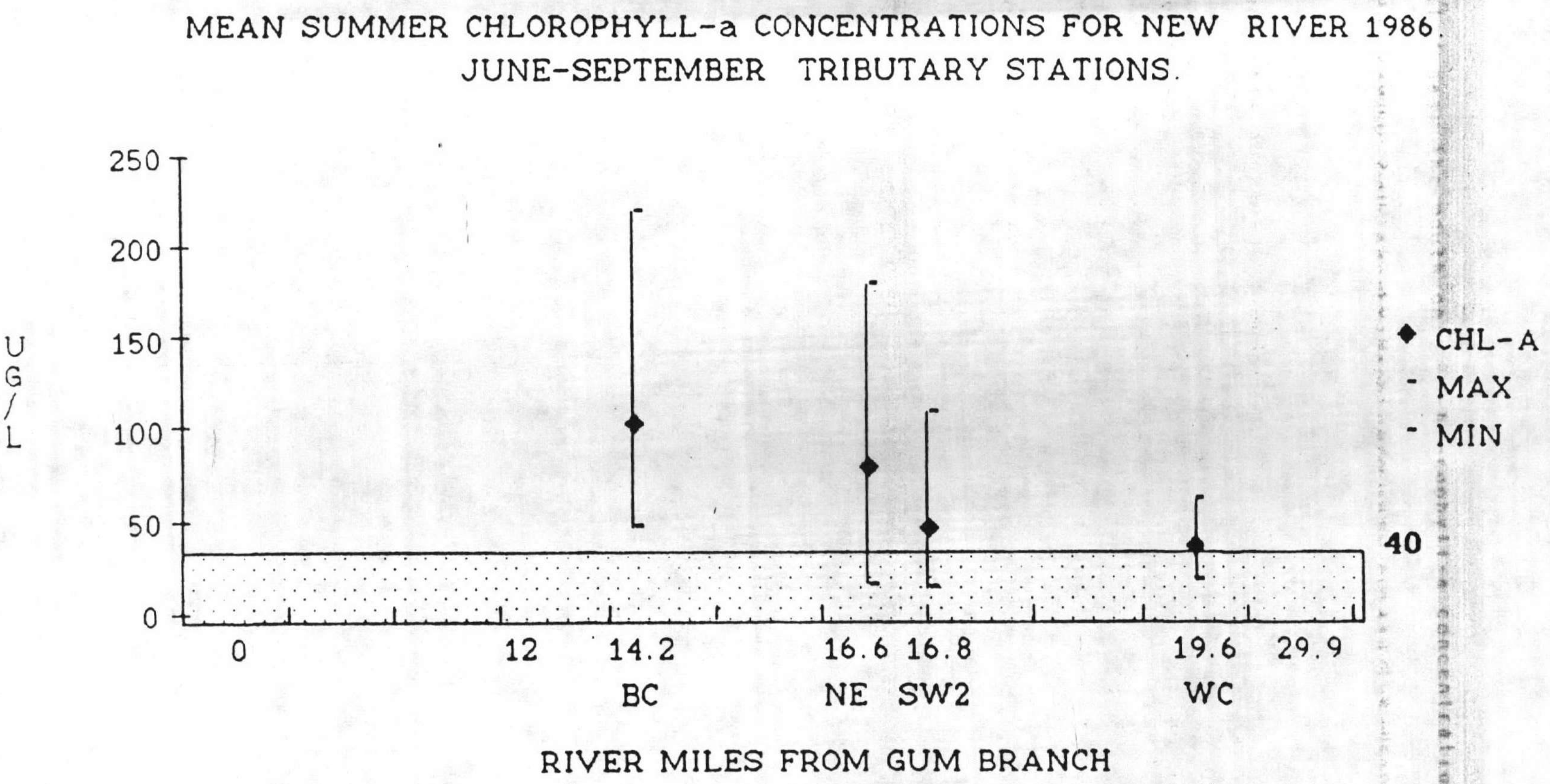
Mean concentrations of chlorophyll-a, nutrients, and phytoplankton for major tributaries to the New River near Jacksonville are presented in Table 5. Brinson Creek was sampled near the mouth only. Chlorophyll-a concentrations at this site exceeded the water quality standard each date sampled and the mean value was 103 ug/l. Little Northeast, which flows into Northeast Creek, also contained chlorophyll-a values well above the standard.

Chlorophyll-a standard exceedances were also identified at the mouths of Northeast, Brinson, Southwest and Wallace Creeks (Figure 7). The only sites sampled during the survey that did not seem to be experiencing significant effects from overenrichment were the most upstream sites on Wallace and Southwest Creeks.

TABLE 5. NEW RIVER TRIBUTARIES MEAN VALUES JUNE-SEPT 1986.

STATION		CHL-a ug/l	TN mg/l	TP mg/l	DENSITY units/ml	BIOVOLUME mm3/m3
BRINSON CREEK	(MOUTH)	103	1.16	0.38	97,100	15,600
LITTLE NORTHEAST CREEK		60	0.58	0.13	-	-
NORTHEAST CREEK	(UP)	54	0.77	0.18	120,600	15,800
	(MOUTH)	79	0.84	0.17	95,200	11,200
SOUTHWEST CREEK	(UP)	2	0.77	0.09	200	100
	(MOUTH)	46	0.86	0.17	31,800	7,300
WALLACE CREEK	(UP)	6	1.04	0.13	2,400	3,400
	(MOUTH)	38	0.64	0.13	15,000	6,100

Figure 7.


MEAN SUMMER CHLOROPHYLL-a CONCENTRATIONS FOR NEW RIVER 1986.
JUNE-SEPTEMBER TRIBUTARY STATIONS.
250
200
150
100
50
0
UG/L
CHL-A
MAX
MIN
40
0
12
14.2
16.6
16.8
19.6
29.9
BC
NE
SW2
WC
RIVER MILES FROM GUM BRANCH

Conclusions

Current nutrient loading into the New River and its tributaries near Jacksonville, N.C. are significantly impacting water quality as indicated by the following:

- Almost 60% of chlorophyll-a samples taken during a survey in the New River and the mouths of Brinson, Little Northeast, Northeast, Southwest and Wallace Creeks from June-September 1986 exceeded 40 ug/l.
- Phytoplankton biovolumes measured during this time period often exceeded 5,000 mm^3/m^3 with uni-algal dominance by certain phytoplankton.
- Phytoplankton density as high as 813,000 units/ml were measured in Wilson Bay. A density of 100,000 units/ml is considered a "bloom" by any phytoplankton ecologist.
- The numerous fish kills and low dissolved oxygen levels, in association with highly colored water and elevated chlorophyll-a levels during the past few years provide strong circumstantial evidence that growths of microscopic vegetation substantially impair the intended best usage of the waters.

NEW RIVER SUMMARY & RECOMMENDATIONS

Based upon the data and evidence available, it is a staff recommendation that the Director exercise his authority as provided in NCAC, Title 15: 2H.0404 which addresses facility location and design involving coastal waste treatment disposal.

NCAC, Title 15: 2H.0404(c) states: "The director may prohibit or limit any discharge of waste into surface waters if, in the opinion of the director, the surface waters experience or the discharge would result in:

(1) growths of microscopic vegetation such that chlorophyll _a_ values are greater than 40 ug/l; or

(2) growths of microscopic or macroscopic vegetation which substantially impair the intended best usage of the waters.

NCAC, T15: 2H.0403 clearly incorporates the New River and its tributaries, as far as applicability of these regulations to the waters in question.

It is the staff's recommendation that the Director determine appropriate nutrient limitations for all new or expanding discharges in this system, as opposed to prohibition of discharge. Currently there are 43 permitted discharges in the area. At this time there are four (4) proposed applications and one (1) proposed expansion. Implementation of .0404(c) therefore would immediately only impact (not prohibit) five proposed actions.

There exist two viable options for facilities which currently hold issued NPDES permits. The first option would be to petition the EMC to exercise its authority relating to the classification of waters. As detailed in NCAC, T15: .0214, the EMC may designate and classify these waters as nutrient sensitive (NSW).

A second option would be for the Director to apply .0404(c) to each existing facility upon expiration of the existing NPDES permits

Both of these options would necessitate nutrient limitations to be incorporated into final permit limitations either basin-wide or case-by-case.

Based upon available data and knowledge, the staff would recommend the same nutrient limitations that will be applied to the Falls and Jordan NSW basin strategy.

Effectiveness of Controls

Since point sources account for a major portion of nutrient loading to the New River Basin, Point source controls will provide an effective means of reducing elevated nutrient levels. If a 1.0 mg/l monthly average phosphorus limit were placed on existing discharges, an estimated 85 percent reduction in point source loading could be achieved. The contribution of point source phosphorus loading to the upper basin would be reduced from the existing level of 65 percent to 22 percent (Figure 8). The corresponding reduction in overall phosphorus mass would be approximately 76,600 kg/yr (55 percent), from 141,665 kg/yr to 64,045 kg/yr (Figure 9).

If a 2.0 mg/l monthly average phosphorus limit were applied, an estimated 69 percent reduction in point source loading could be achieved. The point source contribution to the basin would be reduced to 36 percent (Figure 10). The corresponding reduction in overall phosphorus mass would be approximately 62,500 kg/yr (45 percent), from 141,665 kg/yr to 78,160 kg/yr (Figure 11).

Figure 8.

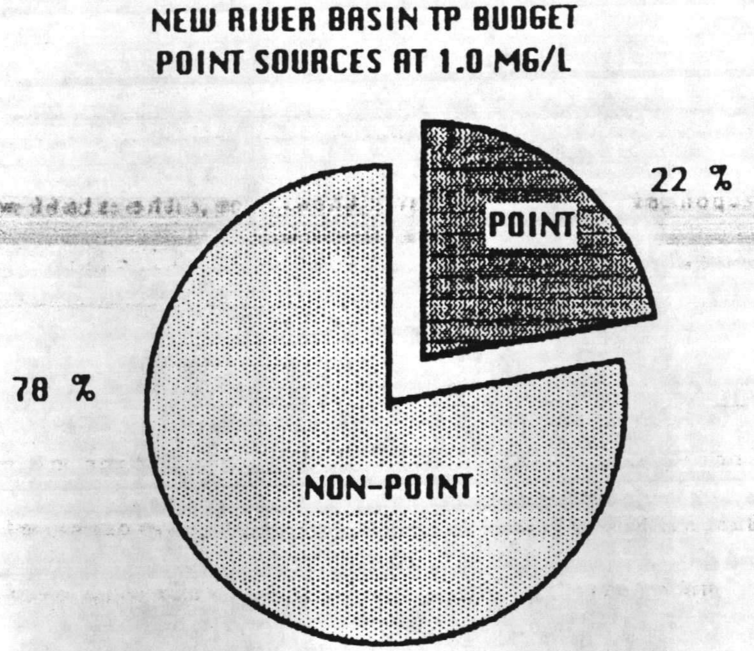


Figure 9.

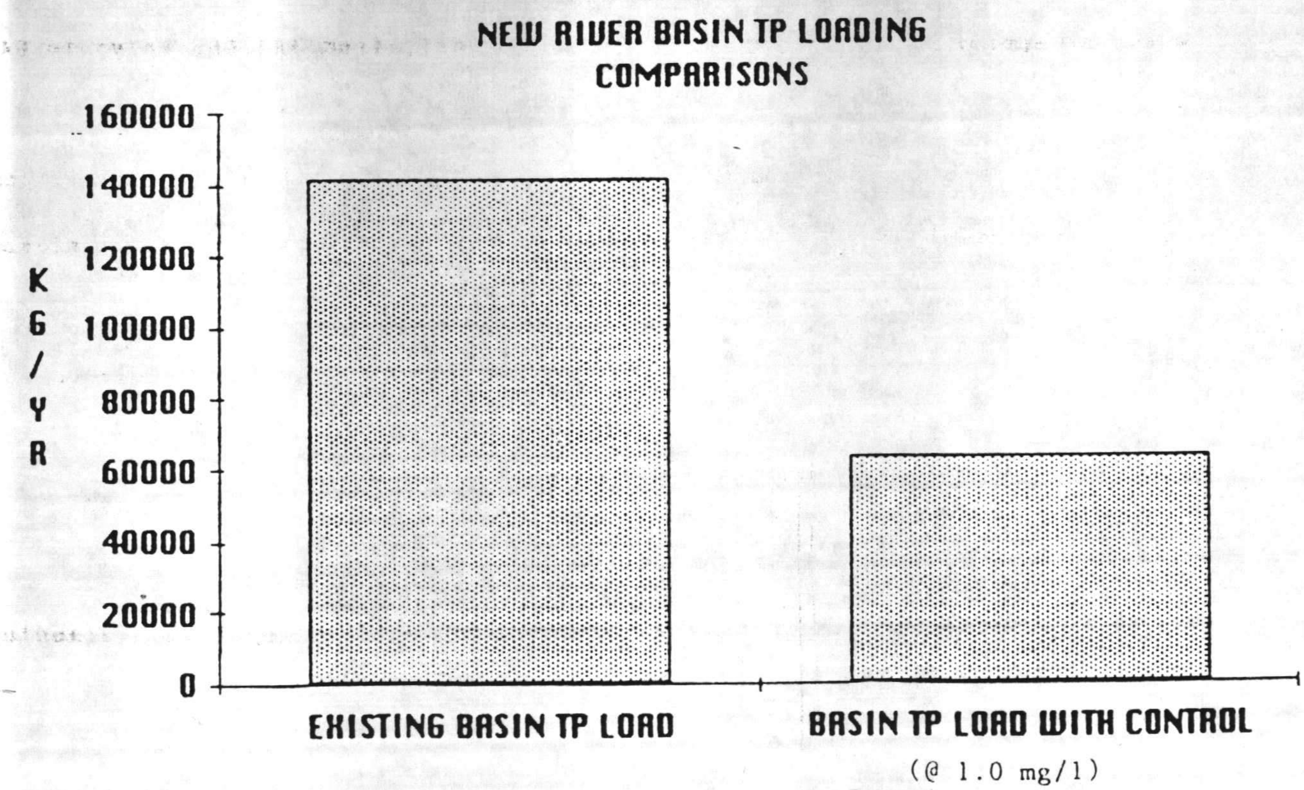


Figure 10.

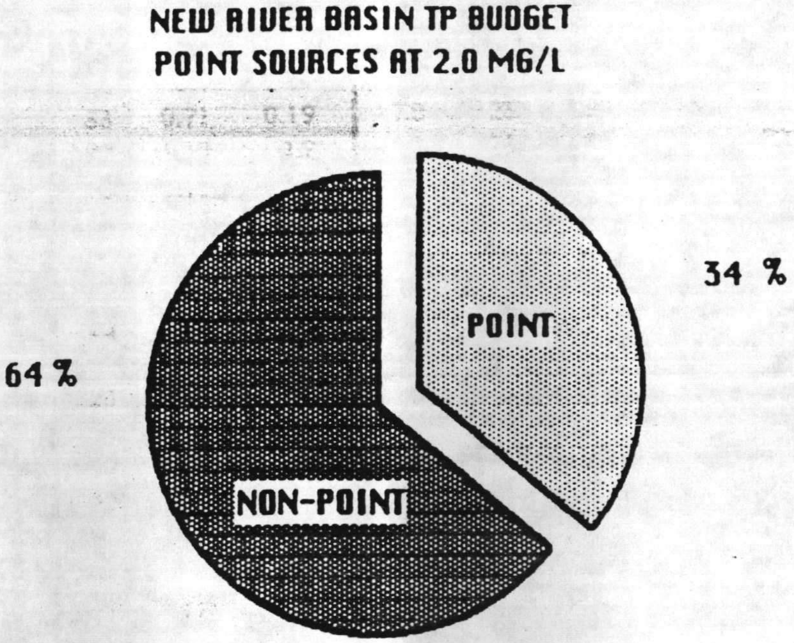
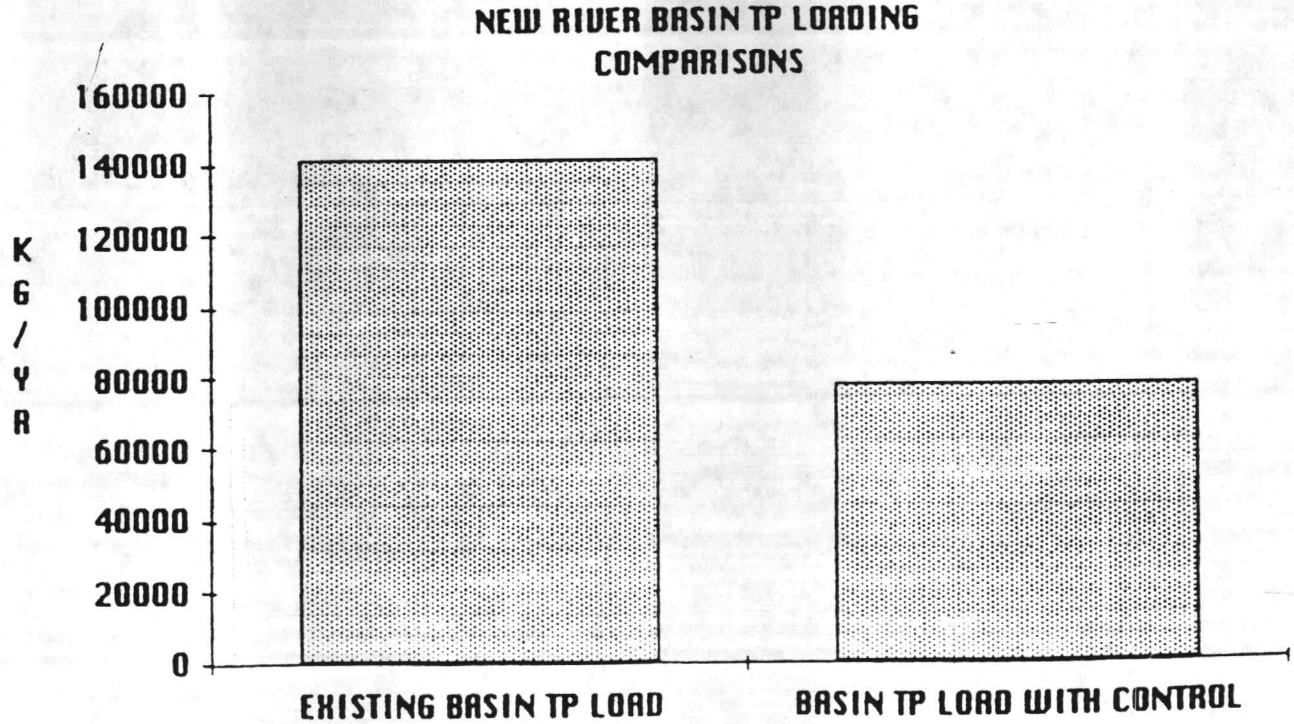
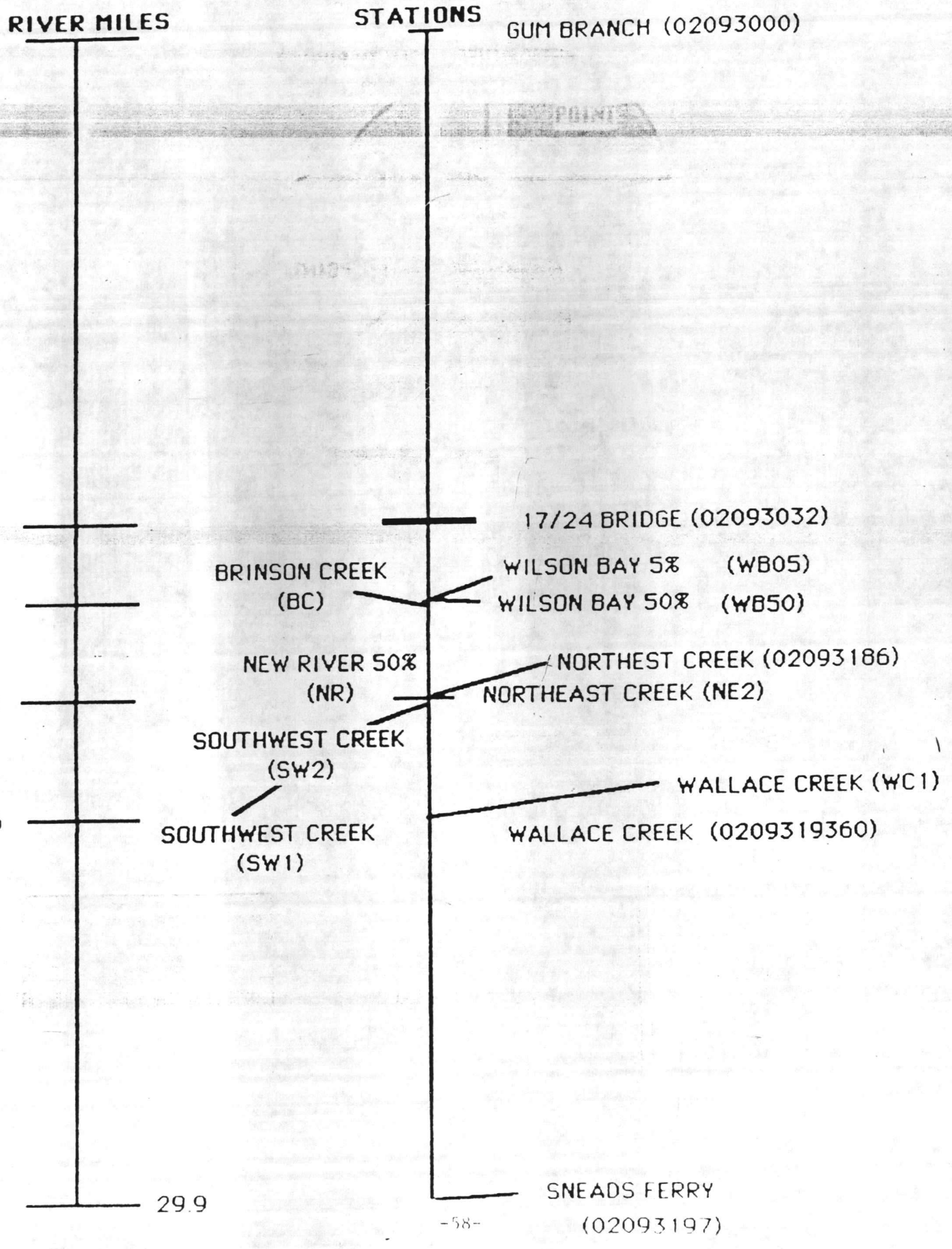


Figure 11.



SCHEMATIC DIAGRAM OF NEW RIVER SAMPLING STATIONS 1986



DATA SUMMARY BY STATION

STATION	DATE	CHL-A	TN	TP	DO	TEMP	pH	S‰	DENSITY	BIOVOLUME
02093000	860611		3.3	0.34	5.6	24				
	860730		1.9	0.24	6.4	24	7	0		
	860910		3.1	0.31	6.9	19	7.7			
02093032	860515	33	0.71	0.19	7.5	23	7.9	13		
	860611	82	1.19	0.2	7.2	26	8		22273	2354
	860730	13	1.19	0.22	4	27	7.3	1	15110	1622
	860828	14	1.23	0.19	4	26	6.6		4905	1514
	860930	94	1.005	0.23	11.3	28.4	8.4	7.6	3406	16524
WB05	860515	120	1.105	0.48	11.6	24	8.5	15	26640	6860
	860611	120	3.57	1	8.1	28	8.3	10	226744	39482
	860724	210	1.01	0.37	14.2	31	8.8	2.5	812993	95042
	860814	220	1.09	0.5	11.3	30	9.1	3	238098	31614
	860910	6	2.09	0.62	8.3	28	8.2	7	2446	1566
	860930	110	NS	NS	5.8	28.5	7.47	11.7	4542	13074
WB50	860611	120	1.21	0.33	10.3	29	8.5	10	75814	11849
	860730	260	1.43	0.5	12	30	8.4	7	372083	45462
	860828	170	1.46	0.4	6.3	28.5	6.8	1	28125	9553
	860930	94	0.905	0.35	7	27.4	7.78	12	3144	10959
BC	860611	62	1.01	0.36	7.6	28	8.6	8	31356	4435
	860730	220	1.41	0.47	10.8	30	7.9	3.5	323520	42943
	860828	47	1.11	0.31	7.1	28.2	7		30308	8791
	860930	84	1.12	0.38	7.3	27.4	7.76	9.2	3232	6103
SW1	860611	0.5	1.03	0.11	4.7	24		0	285	128
	860730	0.5	0.91	0.13	5	26	6.9	0	50	20
	860828	3	0.87	0.07	5.3	23	7		437	305
	860930	3	0.28	0.07	3.4	23	7.3	0	293	199
SW2	860611	14	0.71	0.08	6.9	29	7.8	9	5350	1894
	860730	110	1.02	0.29	3.4	29	6.7	9	112149	21525
	860828	25	0.9	0.13	4.5	28	6.5	1	8472	3066
	860930	36	0.81	0.16	5.5	26.5	7.5	14.2	1118	2801
NR	860611	11	0.605	0.15	8	27	8.5	13	10656	2083
	860730	62	0.81	0.21	4.6	29	7.6	17	180277	23299
	860828	88	0.905	0.13	7.4	28	7		45943	10434
	860930	32	0.705	0.15	5.8	26.8	7.6	14.6	11646	1877
02093186	860515	26	0.61	0.13	6.8	24	7.6	13		
	860611	28	0.605	0.18	7	30		14	9713	7106
	860730	74	0.83	0.2	4.6	27	6.7	2	469558	51718
	860828	81	0.91	0.13	6.8	28	6.9	3	1616	1062
	860930	31	0.72	0.2	4.8	26	7.22	13	1328	2459
NE2	860611	16	0.605	0.15	9.1	30	8.6	15	12053	2320
	860730	180	0.91	0.22	6.8	30	7.6	10	341338	37336
	860828	81	0.81	0.13	6.8	28	6.9	3	26465	1772
	860930	38	1.005	0.19	6.1	25.98	7.3	13.5	873	3557
0209317585	860611	19	0.49	0.17	3.8	27				
	860724	100	0.66	0.12	5.7	24	6.9			
	860910		0.61	0.13	5.2	22	7.5			
WC1	860611	20	0.66	0.28	5.5	26		0		
	860730	0.5	0.76	0.02	6.3	23	4.3	0	344	306

DATA SUMMARY BY STATION

STATION	DATE	CHL-A	TN	TP	DO	TEMP	pH	S°/∞	DENSITY	BIOVOLUME
	860819	4	2.42	0.13	8	23	4.8		815	2814
	860930	2	0.32	0.07	4.3	25	6.4	0	6114	6992
0209319360	860611	18	0.705	0.12	7.2	25		19	11646	3037
	860730	41	0.705	0.13	7.4	33	8.6	8	43584	10837
	860819	29	0.805	0.16	4.2	26	7.8		11180	2143
	860828	62	0.71	0.11	5.5	28	7		2970	6692
	860930	30	0.705	0.14	6.7	28		12	1834	3708
02093197	860611		0.45	0.06	9.8	17	8.4	12		
	860730	14	1.23	0.19	8.3	33	8.6	8		
	860814	21			5.7	27	8.6			
	860910		0.505	0.08	7.4	26	8.6	16		

Dischargers to the New River above Hadnot Point
Onslow County

Permit #		Actual Flow	Permitted Flow
	Upper New River		
NC0002968	Carter Packing Co.	.0100	.0100
NC0023230	Town of Richlands	.0566	.2100
NC0062294	Rock Creek Golf & Country Club	ND	.1152
NC0060739	R.P.D., Inc.	*	.1000
NC0043699	Sumersill Elementary School	.0050	.0090
NC0036226	Lauradale Subdivision	.1555	.2000
NC0056049	Hurst Development	*	.2000
	Totals	.2271	.8442
	Blue Creek		
NC0043702	Southwest High School	.0044	.0200
NC0056952	Pollard Enterprises	.0047	.1000
NC0043656	Blue Creek School	.0053	.0110
NC0049671	Biscuit Town Restaurant	ND	.0010
NC0044377	Onslow Oil Co.	ND	NL
	Totals	.0144	.1320
	Brinson Creek		
NC0057053	Sentry Enterprises	.0075	.0870
NC0028223	Beachams Apts #1	.0260	.0400
NC0061565	Canady Road Tract	*	.0400
NC0051853	Southgate MHP	.0040	.0030
NC0002585	A-1 Cleaners	.0069	.0080
NC0028215	Beachams Apts #2	.0270	.1000
	Totals	.0714	.2780
	Wilson Bay		
NC0003239	USMC Camp Geiger	1.1653	1.6000
NC0024121	City of Jacksonville	2.8260	4.4600
	Totals	3.9913	6.0600
	Northeast Creek		
NC0000698	Weyerhaeuser	.0003	.0033
NC0032239	Mercer Environmental - Regalwood Subdivision	.0790	.3000
NC0031577	Mercer Environmental - White Oak Estates	.0635	.2200
NC0043711	Morton Elementary School	.0076	.0075
NC0036676	Collins Estates MHP	ND	.0250
NC0023825	Webb Apartments	.0197	.0250
NC0034991	Hickory Grove MHP	Unknown	.0225
NC0022462	Sherwood MHP	.1500	.0600
NC0049387	Hunters Creek - Viking Utility	.0392	.2500
NC0003239	Tarawa Terrace	.9758	1.2500
NC0003239	Camp Johnson	.4259	1.0000
	Totals	1.7610	3.1633

Permit #		Actual Flow	Permitted Flow
	Southwest Creek		
NC0030813	Kenwood Estates	.0372	.0500
NC0034339	Old Hickory MHP	.0120	.0180
	Totals	.0492	.0680
	Wallace Creek		
NC0023108	Gatlin-Ramsey MHP	.2820	.0900
NC0030431	Hewitts MHP	.0144	.0030
NC0062642	Queens Creek Development	*	.5000
NC0051471	Big Pines MHP	.0027	.0065
NC0058874	Piney Green Shopping Center - Bailey & Assoc.	.0062	.0600
	Totals	.3053	.6595

Note: These are all permitted discharges. They differ from total MGD in handout which is the total existing dischargers.

ND - No Discharge
NL - No Permit Limit
* - Not Built

FACILITIES LISTED BY PERMITTED FLOWS

1,000 - 10,000 GPD

Carter Packing	.0100
Summersill Elem. Sch.	.0090
Biscuit Town Rest.	.0010
Southgate MHP	.0030
A-1 Cleaners	.0080
Weyerhaeuser	.0033
Morton Elem. Sch.	.0075
Hewitts MHP	.0075
Big Pines MHP	.0065
Total	.0513 MGD

11,000 - 20,000 GPD

Southwest High Sch.	.0200
Blue Creek School	.0110
Old Hickory MHP	.0180
Total	.0490 MGD

21,000 - 50,000 GPD

Beacham Apt. #1	.0400
Canady Road Tract	.0400
Collins Estates MHP	.0250
Webb Apts.	.0250
Hickory Grove MHP	.0225
Kenwood Estates	.0500
Total	.2025 MGD

51,000 - >100,000 GPD

Town of Richlands	.2100
Rock Cr. Country Club	.1152
R.P.D., Inc.	.1000
Lauradale Subdiv.	.2000
Pollard Enterprises	.1000
Sentry Enterprises	.0870
Beacham Apts. #2	.1000
Mercer Environ.-Regalwood	.3000
Mercer Environ.-White Oak	.2200
Sherwood MHP	.0600
Hunters Creek Viking Util.	.2500
Gatlin Ramsey MHP	.0900
Queens Development	.5000
Piney Green Shopping Center	.0600
Total	2.5922 MGD

>1.0 MGD

USMC Camp Geiger	1.6000
City of Jacksonville	4.4600
Tarawa Terrace	1.2500
Camp Jackson	1.0000
Total	8.3100 MGD

Total permitted for basin above Hadnot Point — 11.2050 MGD

OVERALL SUMMARY

Category (GPD)	Category Wasteflow	Percent of Total Basin Wasteflow
1,000-10,000	.0513	.5%
11,000-20,000	.0490	.5%
21,000-50,000	.2025	1.8%
51,000->100,000	2.5922	23.1%
>1,000,000	8.3100	74.1%

Effluent Limit Violations
Carter Packing Company

Permit Limits	BOD5 8 mg/l Daily Maximum (mg/l)	Nitrogen Ammonia 3 mg/l Daily Maximum (mg/l)	TSS 1.4 lbs/day Daily Maximum (lbs/day)	Oil & Grease 0.5 lbs/day Daily Maxi (lbs/day)
Month				
July 1984	38.7		3.67	
August	11.7		1.67	
September	16.7		2.75	
October	48.5		8.84	
November	60.4		6.00	
December	68.2		8.84	
January 1985	25.7	13.4	1.67	
February	89.0	3.4	2.34	0.79
March	31.2	7.8	8.34	
April	56.3	24.6	5.0	8.0
May		MISSING REPORT		
June	19.9		4.8	
July		NO VIOLATIONS		
August		MISSING REPORT		
September		MISSING REPORT		
October	10.7			
November	33.4		3.50	
December	54.8	10.4	7.75	
January 1986	63.1	33.9	7.25	
February	16.1			
March	9.0			
April	10.4		23.58	
May	15.9		3.00	
June	15.8		29.6	
July			1.5	
August	10.4		1.84	
Violation Totals	21	6	19	2

Total number of effluent violations = 48 during the 23 months reported.

DIVISION OF ENVIRONMENTAL MANAGEMENT

June 3, 1987

MEMORANDUM

TO: Dennis Ramsey
Steve W. Tedder
Alan Klimek
Preston Howard

FROM: George T. Everett

SUBJECT: Point Source Nutrient Limitations, New River
Onslow County, N.C.

By correspondence dated January 30, 1987, the Director determined that NCAC, Title 15: 2H.0404(c) was applicable to the New River in Onslow County (see attached).

It has come to my attention that additional clarification of the January 30, 1987 directive may be needed. Effective January 30, 1987, the staff was instructed by the Director to include appropriate nutrient limitations in all new permit requests and any expansion requests within the New River Basin upstream from a line connecting Grey Point to a point of land approximately 2200 yards downstream from the mouth of Duck Creek. This applies to all main stem water and tributaries to the New River upstream from this line of designation.

The nutrient limitations to be included are 2.0 mg/l total phosphorous, with compliance to be determined as a quarterly average based upon weekly data collection.

These limitations are to be applied to all discharges with a design flow of 50,000 gpd and greater.

If there are questions, please contact.

cc: Arthur Mouberry
Dale Overcash
Trevor Clements

DIVISION OF ENVIRONMENTAL MANAGEMENT

January 30, 1987

MEMORANDUM

TO: George T. Everett
Chuck Wakild

FROM: R. Paul Wilms

SUBJECT: Point Source Nutrient Limitations, New River
Onslow County, N.C.

I have completed my review of the report prepared by the Water Quality Section concerning the New River in Onslow County. The data and evidence strongly supports the need for additional point source control of nutrients into these receiving waters.

Therefore, based upon the evaluation of data, it is the position of this office that regulations NCAC, 15: 2H.0403 and 2H.0404(c) are clearly appropriate to address this situation.

NCAC, Title 15: 2H.0404(c) states: "The director may prohibit or limit any discharge of wastes into surface waters if, in the opinion of the director, the surface waters experience or the discharge would result in:

(1) growths of microscopic vegetation such that chlorophyll <u>a</u> values are greater than 40 ug/l; or
(2) growths of microscopic or macroscopic vegetation which substantially impair the intended best usage of the waters."

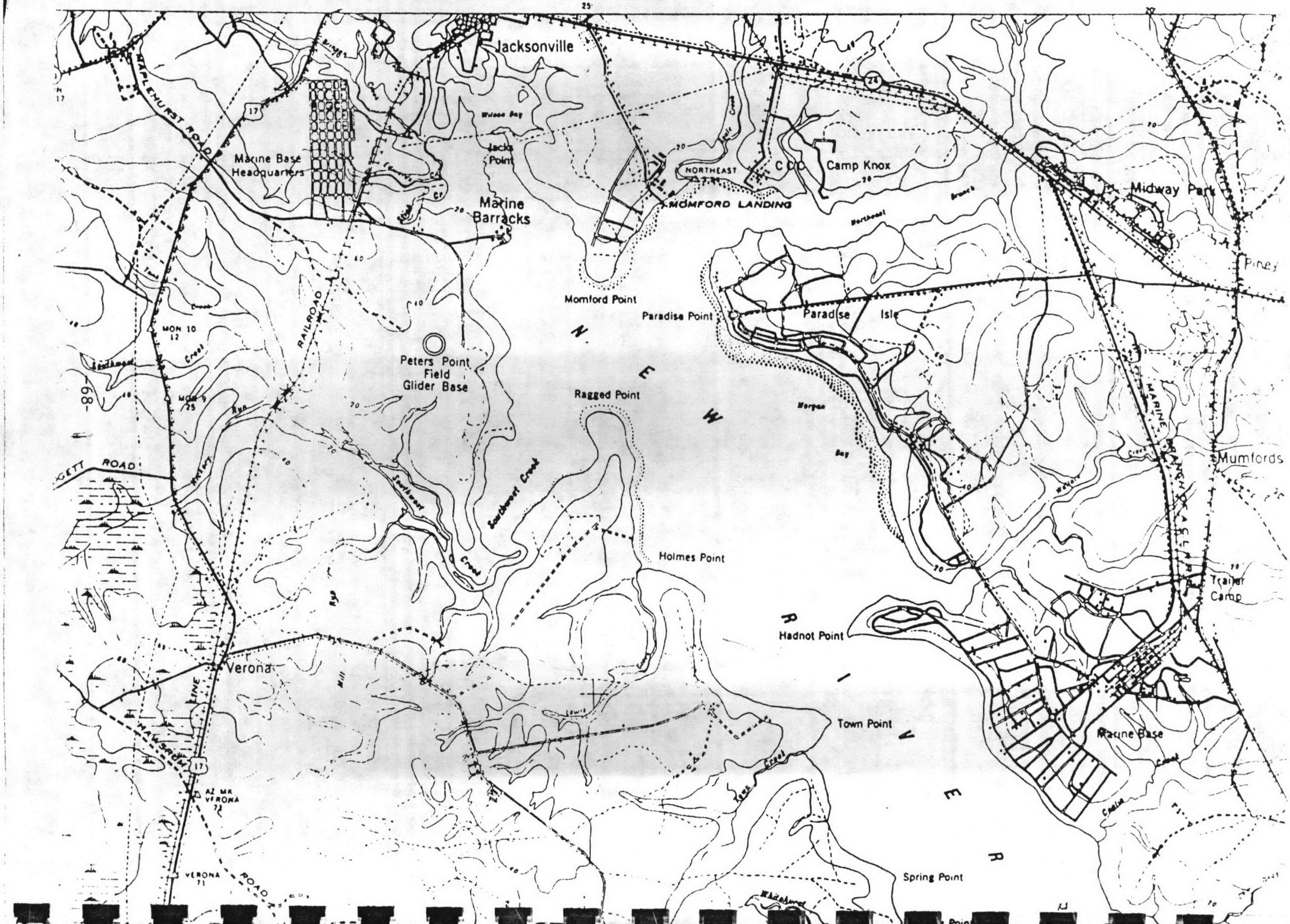
Therefore, effective immediately, the staff should include appropriate nutrient limitations (2.0 mg/l total phosphorous) in all new permit requests and any expansion requests within the New River Basin upstream from a line connecting Grey Point to a point of land approximately 2200 yards downstream from the mouth of Duck Creek. This applies to all main stem waters and tributaries to the New River upstream from this line of designation.

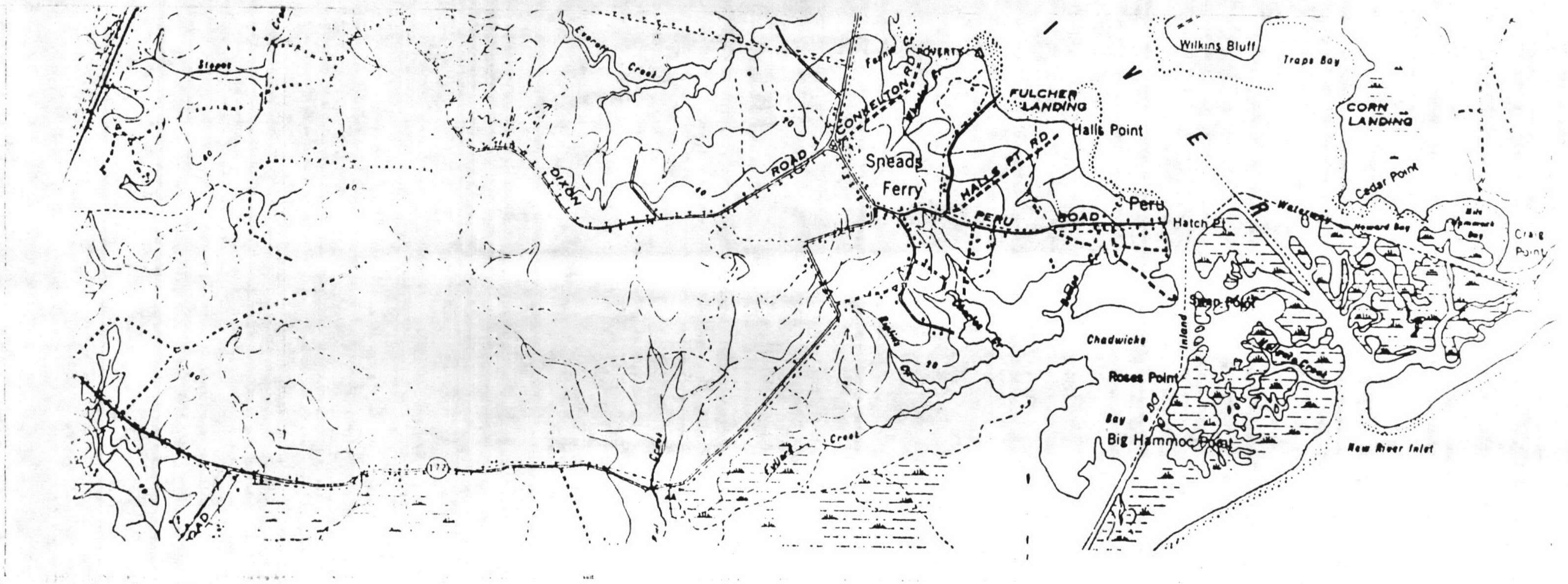
Upon expiration of existing permits which have a design flow greater than 50,000 gallons per day, the same nutrient effluent limitation of 2.0 mg/l phosphorous should be applied to the reissued NPDES permits.

cc: Steve W. Tedder
Preston Howard

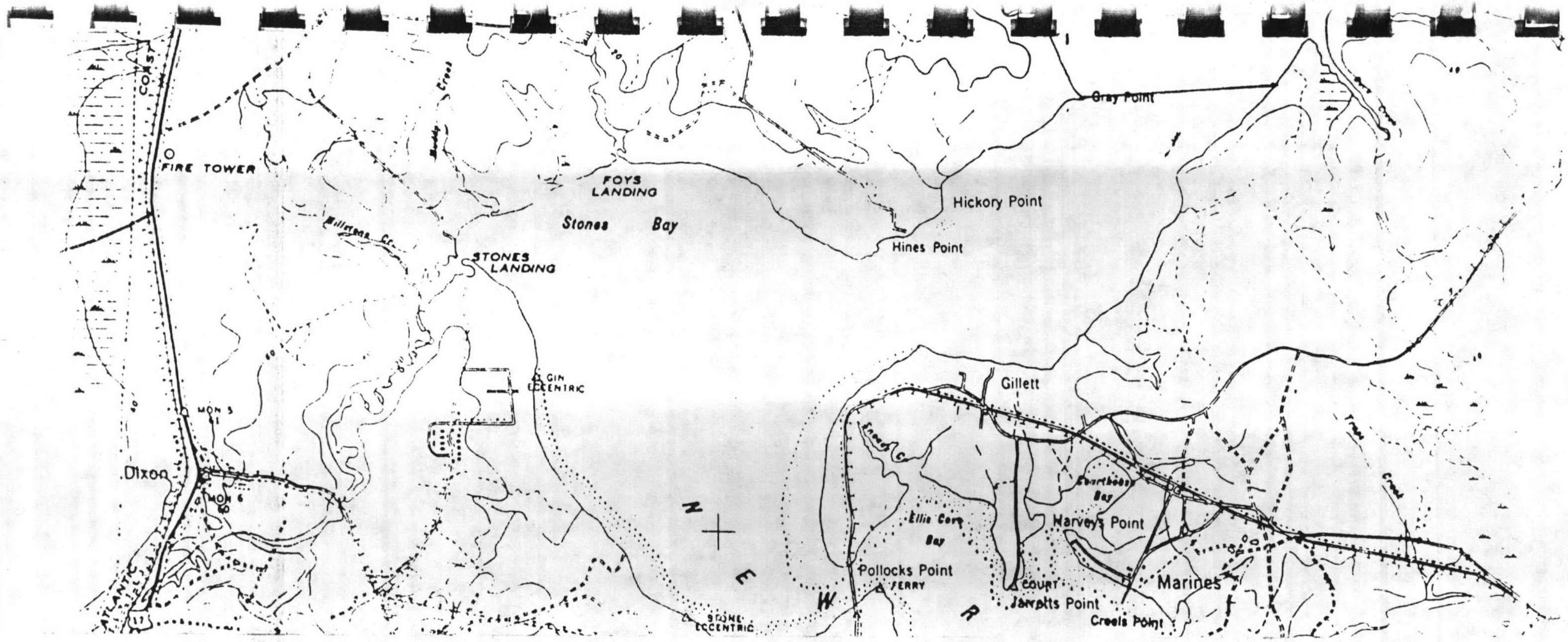
RTH CAROLINA

NEW RIVER





Wilkins Bluff
Traps Bay
FULCHER LANDING
Halls Point
CORN LANDING
Sneads
Ferry
HALLS PT RD
PERU
ROAD
Peru
Hatch Pt
Cedar Point
Howard Bay
Craig Point
DIXON
ROAD
Chadwicks
Roses Point
Big Hammoc Point
New River Inlet
Inland



COAST
FIRE TOWER
FOYS LANDING
Stones Bay
Millstone Cr.
STONES LANDING
Gray Point
Hickory Point
Hines Point
GIN ECCENTRIC
MON 5
Dixon
MON 6
ATLANTIC
Gillett
Courthouse Bay
Harveys Point
Ellis Cove Bay
Pollocks Point
FERRY
COURT
Jarretts Point
Marines
Creels Point
STONE ECCENTRIC
N E W R

APPENDIX IV. Stream classifications for the New River and its tributaries.

Name of Stream	Description	Class
New River	From source to Blue Creek	C
	From Blue Creek to Atlantic Coast Line Railroad Trestle	SB
	From Atlantic Coast Line Railroad Trestle to Grey Point	SC
	From Grey Point to Atlantic Ocean	SA
Blue Creek	From source to New River	SC
Brinson Creek	From source to New River	SC
Wilson Bay	Entire bay	SC
Northeast Creek	From source to New River	SC
Little Northeast Creek	From source to Northeast Creek	C
Southwest Creek	From source to New River	C
Morgan Bay	Entire bay	SC
Wallace Creek	From source to New River	SB

Description of classifications (Title 15A: 2B .0101)

Class C: freshwater protected for secondary recreation, fishing and aquatic life including propagation and survival; all freshwaters are classified to protect these uses at a minimum.

Class SC: saltwaters protected for secondary recreation, fishing and aquatic life including propagation and survival; all saltwaters are classified to protect these uses at a minimum.

Class SB: saltwaters protected for primary recreation which includes swimming on a frequent and/or organized basis and all Class SC uses.

Class SA: suitable for commercial shellfishing and all other tidal saltwater uses.

Appendix V. Physical, chemical and biological data from New River, Onslow County 1986-1989.

DATE	STATION	TIME	DEPTH	TEMP	DO	pH	CONDO	SAL.	SEC	CHL-A	NH3	TKN	NO3	TN	TP	PO4	BOD	FECAL	TURB.	DENSITY	BIOV.
			m	°C	mg/l	SU	uMhos	ppt	m	ug/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	COL.*	FTU	units/ml	mm /m
																	5day				
860206	02093000	1110	0.1	15.0	8.0	6.8	194				0.43	0.7	1.20	1.90	0.45	0.18		230			
860327	02093000	1540	0.1	16.0	8.5	6.9	157	0.0			0.43	0.6	1.10	1.70	0.20	0.10	1.5	100	6.2		
860422	02093000	1400	0.1	17.0	7.8	7.7	310	0.0										290			
860505	02093000	1500	0.1	20.0	7.4	7.7	484	0.0													
860611	02093000	1550	0.1	24.0	5.6		260				0.90	1.3	2.00	3.30	0.34	0.26	NS	240	7.4		
860724	02093000	1545	0.1	24.0	6.4	7.0	183				0.19	0.6	1.30	1.90	0.24	0.12		80			
860814	02093000	1515	0.1	25.0	6.6	7.1	152							0.00							
860910	02093000	1230	0.1	19.0	6.9	7.7	237				0.50	0.8	2.30	3.10	0.31	0.20	1.7	270	4.1		
870108	02093000	1525	0.1	9.0	9.2	6.8	145	0.0		2	0.43	0.7	1.30	2.00	0.13	0.07	1		5.8		
870226	02093000	1315	0.1	7.0	9.9	6.1	133	0.0		3	0.26	0.5	1.20	1.70	0.12	0.06			4.4		
870324	02093000	1605	0.1	13.0	9.4	7.3	172.0	0.0		1	0.04	0.8	1.40	2.20	0.15	0.09			3.9		
870429	02093000	1540	0.1	18.0	7.5	7.5	152.0			1	0.40	0.6	1.40	2.00	0.18	0.07	2				
870622	02093000	1615	0.1	23.0	5.2	6.7	230	0.0		14	0.88	1.1	2.40	3.50	0.50	0.32		710	7.8	635	156
870720	02093000	1100	0.1	25.0	4.7	5.5	168	0.0		11	1.30	1.7	3.90	5.60	0.72	0.57	1.5	350	2.7	2776	819
870825	02093000	1100	0.1	20.5			257	0.0		1	1.20	1.8	2.10	3.90	0.48	0.37		920			
871001	02093000	1047	0.1	18.0	7.2	7.2	228	0.0		3	0.23	0.6	2.20	2.80	0.42	0.32			7.8		
880525	02093000	1300	0.1	20.0	7.4	8.3	198			2	0.21	0.6	1.30	1.90	0.25	0.13			8.2		
880627	02093000	1645	0.1	22.0	4.8	7.1	255			10	0.51	0.8	2.00	2.80	0.54	0.33			32	256	104
880713	02093000	915	0.1	23.0	4.7	7.4	312			8	0.39	0.9	1.70	2.60	0.65	0.43	3.6		50	93	35
890614	02093000	1330	0.1	21.5	6.9	7.3	190			0.5	0.10	0.4	1.60	2.00	0.20	0.11			8		
890822	02093000	935	0.1	22.8	6.6	7.1	162			0.5							0.8		8	175	80
851204	02093032		0.1	12.0	6.4	6.8	353	0.0		3	0.18	0.6	0.44	1.04	0.14	0.06					
860106	02093032	1540	0.1	9.0	9.9	7.9	4000	3.0		9	0.45	1.0	0.81	1.81	0.14	0.08				4053	2794
860206	02093032	1220	0.1	16.0	9.6	7.1	1810	1.0		89	0.41	1.0	0.66	1.66	0.20	0.10		50			
860327	02093032	1450	0.1	17.0	8.2	6.9	293	0.0		7	0.16	0.4	0.61	1.01	0.30	0.05	1.5	10	8.4		
860422	02093032	1430	0.1	19.0	10.1	8.3	17100	8.0		68	0.03	0.7	0.01	0.71	0.18	0.07		230			
860515	02093032	1430	0.1	23.0	7.5	7.9	20100	13.0		33	0.04	0.7	0.01	0.71	0.19	0.09		20			
860611	02093032	1007	0.1	26.0	7.2	8.0	8330	6.0		82	0.04	1.0	0.19	1.19	0.20	0.17	5.6	30	5.9	22273	2354
860611	02093032	1007	1.0	27.0	6.2		9400	6.0													
860611	02093032	1007	1.3	27.0	3.6		11520	7.0													
860611	02093032	1007	1.5	27.0	1.9		14400	10.0													
860611	02093032	1007	2.0	27.0	0.3		15840	11.0													
860730	02093032	1140	0.1	27.0	4.0	7.3	1080	1.0	0.4	13	0.19	0.6	0.59	1.19	0.22	0.12	1.4	240		15110	1622
860730	02093032	1140	0.5	28.0	4.0		959	1.0													
860730	02093032	1140	1.0	27.0	3.3		931	0.5													
860730	02093032	1140	1.5	28.0	0.1		25400	16.0													
860828	02093032	1205	0.1	26.0	4.0	6.6	270	0.0	0.4	14	0.19	0.7	0.53	1.23	0.19	0.09	1.5	30		4905	1514
860828	02093032	1205	0.5	25.9	4.2	6.6	289	0.0													
860828	02093032	1205	1.0	25.8	4.4	6.6	284	0.0													
860828	02093032	1205	1.5	25.2	4.2	6.6	271	0.0													
860828	02093032	1205	2.0	24.5	3.6	6.6	281	0.0													
860930	02093032	1115	0.1	28.4	11.3	8.4	13670	7.6	0.5	94	0.03	1.0	0.01	1.01	0.23	0.12	5.4	5	3.2	3406	16524
860930	02093032	1115	0.5	27.0	10.7	8.4	13560	7.6													
860930	02093032	1115	1.0	26.9	4.1	7.7	16910	9.5													
860930	02093032	1115	1.5	27.2	1.5	7.2	19290	11.1													
870108	02093032	1500	0.1	8.0	8.9	7.4	486	0.0		5	0.21	0.4	0.75	1.15	0.11	0.05	1.9	200	7.8		
870226	02093032	1250	0.1	8.0	8.8	8.2	660	0.0		5	0.30	0.6	0.74	1.34	0.14	0.06		190	9.8		
870324	02093032	1540	0.1	15.0	7.7	7.6	2150	1.0		5	0.18	0.6	0.69	1.29	0.13	0.06		30	5.2		
870513	02093032		0.1		14.0	8.8				150	0.03	0.7	0.01	0.71	0.15	0.03		5		135906	20788
870617	02093032		0.1							75						0.15				35112	3122
870622	02093032	1257	0.1	28.0	12.5		6100	5.0	0.4	260	0.02	0.9	0.05	0.95	0.30	0.15	4.7	30		137653	7782
870622	02093032	1257	1.0	28.0	9.2		7800	5.0													
870622	02093032	1257	1.5	28.0	0.2		16000	10.0													
870720	02093032	1650	0.1	31.0	6.3	7.5	19190	11.2	0.4	22	0.03	0.9	0.01	0.91	0.33	0.20	5.7	40		14324	3342
870720	02093032	1650	1.0	30.0	2.6	7.1	22600	13.6													
870825	02093032	1236	0.1	25.5	9.0	6.9	4970	2.3	0.5	56	0.04	1	0.26	1.26	0.24	0.14	5.6	460	5.6	119311	6672
870825	02093032	1236	0.5	25.2	5.9	6.8	6990	3.5													
870825	02093032	1236	1.0	27.3	1.4	6.9	19590	11.2													
870928	02093032	1445	0.1	26.7	12.4	7.8	11670	6.4	0.5	53	0.09	1.0	0.02	1.02	0.28	0.15		10	4.1	81753	5273
870928	02093032	1445	0.5	25.6	6.2	7.1	13310	7.4													
870928	02093032	1445	1.0	25.8	1.0	6.7	18600	10.9													
870928	02093032	1445	1.5	26.1	0.1	6.7	21010	12.5													
880525	02093032	1225	0.1	23.0	6.5	8.2	1249	1.0		34	0.21	0.6	1.30	1.90	0.25	0.13		80	11		
880627	02093032	1013	0.1	26.5	5.2	7.3	9180	4.8	0.7	76	0.01	0.7	0.01	0.7	0.23	0.10		620	7.7	133723	5799
880627	02093032	1013	0.5	26.7	5.2	7.4	9330	4.9													
880627	02093032	1013	1.0	26.8	5.1	7.4	9380	4.9													
880627	02093032	1013	1.5	26.9	5.0	7.4	9910	5.3													
880627	02093032	1013	2.0	28.7	2.6	7.2	15100	8.5													
880726	02093032	1354	0.1	29.6	12.9	8.6	3632	2.0	0.6	57	0.03	0.5	0.05	0.55	0.40	0.26	6.4	30	6.6	20700	7069
880726	02093032	1354	0.5	28.1	5.3		5628	3.0													
880726	02093032	1354	1.0	29.3	11.6		3656	2.0													
880830	02093032	0920	0.1	27.1	5.2	7.2	2620	0.8	0.7	32	0.09	0.7	0.12	0.82	0.26	0.16	3.8	40		21719	10007
880830	02093032	0920	0.5	27.1	5.0	7.1	3380	1.4													
880830	02093032	0920	1.0	27.1	5.2	7.1	3880	1.6													
880928	02093032	0944	0.1	23.0	6.3	7.2	12480	8.0	0.6	51	0.04	0.8	0.02	0.82	0.22	0.13	3.3	50	4	96777	10612
880928	02093032	0944	1.0	24.0	1.5		17150	10.0													
880928	02093032	0944	2.0	24.0	1.3		18620	11.0													
880928	02093032	0944	3.0	24.0	1.3		18620	11.0													
890613	02093032	1358	0.1	26.3	4.4	7.5	1430	0.0	0.3	3	0.25	0.8	0.69		0.25	0.12	0.9		11	1975	341
890613	02093032	1358	1.0	26.1	4.4	7.1	1430	0.0													

Appendix V. Physical, chemical and biological data from New River, Onslow County 1986-1989.

DATE	STATION	TIME	DEPTH	TEMP	DO	pH	CONDO	SAL.	SEC	CHL-A	NH3	TKN	NO3	TN	TP	PO4	BOD	FECAL	TURB.	DENSITY	BIOV.
			m	°C	mg/l	SU	uMhos	ppt	m	ug/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l 5day	COL.*	FTU	units/ml	mm /m
890613	02093032	1358	2.0	26.0	4.6	7.0	1420	0.0													
890718	02093032	1400	0.1	24.8	4.5	7.3	1147	0.1	0.3	36	0.18	0.6	0.62		0.20	0.13	1	220	16	8967	1094
890718	02093032	1400	1.0	24.6	3.8	7.1	1317	0.2													
890829	02093032	1516	0.1	29.0	5.8	7.4	4700	3.0	0.5	46	0.21	0.5	0.53	1.03	0.24	0.15	4.2	10	48	8967	1093
890829	02093032	1516	1.0	28.0	3.1	7.2	5600	3.0													
890829	02093032	1516	2.0	28.0	0.6	7.1	10000	4.0													
860206	02093186	1320	0.1	16.0	8.0	7.3	2060	1.0		15	0.09	0.4	0.17	0.57	0.11	0.05		190			
860327	02093186	1350	0.1	18.0	8.8	6.7	1710	1.0		19	0.07	0.6	0.23	0.83	0.08	0.01	1.6	350	9.4		
860422	02093186	1305	0.1	19.0	7.5	7.7	12900	8.0		22	0.03	0.5	0.01	0.51	0.12	0.04		110			
860515	02093186	1340	0.1	24.0	6.8	7.6	20500	13.0		26	0.05	0.6	0.01	0.61	0.13	0.05		5			
860611	02093186	1245	0.1	30.0	9.1	8.6	25200	16.0	0.5	24	0.02	0.6	0.01	0.61	0.18	0.11	4.1	10	5.1	9713	7106
860611	02093186	1245	1.0	29.0	6.9		20200	14.0													
860611	02093186	1245	1.5	29.0	2.0		21200	15.0													
860611	02093186	1245	2.0	29.0	3.8		20500	14.0													
860730	02093186	0921	0.1	27.0	4.6	6.7	2980	2.0	0.3	74	0.01	0.8	0.03	0.83	0.20	0.08	2.7	1500		469558	13355
860730	02093186	0921	0.5	29.0	3.4		19100	10.0													
860730	02093186	0921	1.0	30.0	2.4		17600	12.0													
860730	02093186	0921	1.5	30.0	0.2		19900	15.0													
860730	02093186	0921	2.0	30.0	0.2		20900	15.0													
860828	02093186	1400	0.1	26.9	6.7	6.0	1000	1.0	0.4	81	0.04	0.8	0.11	0.91	0.13	0.05	2.7	160		12752	2135
860828	02093186	1400	0.5	26.9	6.8	5.9	2320	1.0													
860828	02093186	1400	1.0	27.0	6.7	5.8	2450	1.0													
860828	02093186	1400	1.5	27.1	6.7	5.8	2780	1.0													
860930	02093186	0812	0.1	26.0	4.8	7.2	22010	13.0	0.5	31	0.07	0.7	0.02	0.72	0.20	0.11	4.5	5	3.9	10866	2242
860930	02093186	0812	0.5	26.1	4.7	7.2	22070	13.1													
860930	02093186	0812	1.0	26.5	3.8	7.2	23090	13.7													
860930	02093186	0812	1.5	26.7	2.6	7.0	23660	14.1													
870108	02093186	1410	0.1	9.0	9.8	7.1	2350	1.0		57	0.02	0.7	0.19	0.89	0.12	0.02	4.2		7		
870226	02093186	1115	0.1	8.0	8.5	6.7	3740	2.0		8	0.06	0.5	0.16	0.66	0.11	0.02			5.2		
870324	02093186	1455	0.1	17.0	7.6	7.3	3940	3.0		7	0.12	0.6	0.14	0.74	0.11	0.05			5.2		
870429	02093186	1200	0.1	21.0	10.5	8.3	11700	9.0		51	0.02	0.6	0.01	0.61	0.15	0.03	6.5			16886	2654
870513	02093186	1150	0.1	24.0	7.9	7.4	9300	5.0		34	0.02	0.4	0.01	0.41	0.14	0.04					
870624	02093186	1230	0.1	28.0	5.2	8.1	15900	9.0	0.5	98	0.04	0.5	0.03	0.53	0.26	0.15	6.4	570		7062	4219
870624	02093186	1230	0.5	28.0	6.4		18600	11.0													
870624	02093186	1230	1.0	28.0	4.5		18000	12.0													
870720	02093186	1600	0.1	32.0	6.2	7.5	27700	17.0	0.4	28	0.02	0.9	0.01	0.91	0.27	0.15	5.4			21719	2974
870720	02093186	1600	1.0	31.0	5.0	7.3	28400	17.5													
870825	02093186	1536	0.1	28.9	7.3	7.4	20530	12.2	0.6	35	0.01	0.9	0.01	0.91	0.30	0.18	>7.4	20	7.4	29609	8020
870825	02093186	1536	0.5	28.4	4.0	7.3	23250	13.7													
870825	02093186	1536	1.0	27.7	1.1	7.0	25050	15.2													
870825	02093186	1536	1.5	27.8	0.3	6.9	25230	15.2													
870825	02093186	1536	2.0	27.8	0.2	6.9	25250	15.6													
870825	02093186	1536	2.5	27.8	0.1	6.9	25580	15.5													
870825	02093186	1536	3.0	27.8	0.1	6.9	25420	15.4													
870928	02093186	1304	0.1	27.0	2.7	6.7	18130	10.5	0.5	37	0.02	1.1	0.01	1.11	0.24	0.13			5.6	48738	32098
870928	02093186	1304	0.5	26.6	2.1	6.8	22710	13.5													
870928	02093186	1304	1.0	26.2	1.8	6.8	22800	13.5													
870928	02093186	1304	1.5	26.0	0.8	6.7	23200	13.9													
880525	02093186	1125	0.1	24.0	6.9	7.2	3570	3.0		61	0.03	0.8	0.01	0.81	0.15	0.06			8.8		
880627	02093186	1255	0.1	27.2	4.7	7.3	15400	8.7	0.8	38	0.01	0.8	0.01	0.81	0.16	0.08	4	730	6.7	6250	3896
880627	02093186	1255	0.5	27.3	4.7	7.3	15500	8.8													
880627	02093186	1255	1.0	27.3	4.6	7.3	15800	9.0													
880726	02093186	1125	0.1	28.0	6.7	7.3	5264	3.0	0.5	25	0.02	0.5	0.01	0.51	0.18	0.08	4.5	150	11	6940	1510
880726	02093186	1125	1.0	28.0	1.9		16450	9.5													
880726	02093186	1125	1.5	28.0	1.0		16900	10.0													
880830	02093186	1103	0.1	27.8	6.1	7.0	4390	1.9	0.6	11	0.01	0.6	0.01	0.61	0.12	0.04	4.1	490	5	9229	6877
880830	02093186	1103	0.5	28.0	5.2	7.1	10210	5.4													
880830	02093186	1103	1.0	28.5	3.8	7.1	12500	6.8													
880928	02093186	1137	0.1	25.0	5.1	7.6	19100	13.0	0.4	30	0.03	0.6	0.01	0.61	0.17	0.09	4.2	30	4.7	20700	4419
880928	02093186	1137	1.0	25.0	2.2		23200	14.0													
890613	02093186	1247	0.1	28.6	7.4	8.2	6510	3.2	0.4	23	0.01	0.4	0.01		0.14	0.01	3.6	60	10	36335	1425
890613	02093186	1247	1.0	28.6	7.3	8.2	6530	3.2													
890718	02093186	1305	0.1	25.5	3.3	7.0	5040	2.2	0.2	794	0.09	0.7	0.14		0.12	0.06	1.4			25	1031
890718	02093186	1305	1.0	27.5	0.9	7.0	14300	8.0													
890829	02093186	1416	0.1	31	5.7	7.3	15800	10	0.5	94	0.10	0.7	0.01		0.18	0.05	>7.6	30	8.1	41575	9296
890829	02093186	1416	1.0	29.5	0.5	6.9	18100	11													
860327	02093197	1120	0.1	17.0	9.8	8.4	19700	12.0			0.03	0.4	0.05	0.45	0.06	0.03	3	5	4.3		
860422	02093197	950	0.1	18.0	7.9	8.1	30200	20.0						0.00				5			
860515	02093197	945	0.1	21.0	7.3	8.2	34600	21.0													
860612	02093197	1320	0.1	28.0	6.4	8.4	34000	23.0		19	0.02	0.6	0.01	0.61	0.07	0.03					
860724	02093197	1120	0.1	29.0	5.5	8.2	28700	20.0													
860814	02093197	1120	0.1	27.0	5.7	8.6	22300	14.0		21				0.00				5			
860910	02093197	1620	0.1	26.0	7.4	8.6	23226	16.0			0.02	0.5	0.01	0.51	0.08	0.02	4.1	5	4.5		
870226	02093197	0920	0.1	7.0	9.8	7.3	20400	15.0		3	0.02	0.3	0.01	0.31	0.04	<.01		5	1.5		
870324	02093197	1105	0.1	12.0	10.4	7.5	17900	12.0		9	0.03	0.5	0.01	0.51	0.04	0.01		5	1.2		
870624	02093197	1335	0.1	29.0	6.7	8.4	37500	24.0	0.6	14	0.02	0.4	0.01	0.41	0.11	0.05		5	4.3		
870624	02093197	1335	1.0	28.0	6.7		38500	24.0													
870624	02093197	1335	2.0	28.0	6.5		39500	25.0													
870624	02093197	1335	3.0	28.0	6.6		40000	25.0													
870624	02093197	1335	4.0	28.0	6.0		40400	26.0													

Appendix V. Physical, chemical and biological data from New River, Onslow County 1986-1989.

DATE	STATION	TIME	DEPTH	TEMP	DO	pH	CONDO	SAL.	SEC	CHL-A	NH3	TKN	NO3	TN	TP	PO4	BOD	FECAL	TURB.	DENSITY	BIOV.
			m	°C	mg/l	SU	uMhos	ppt	m	ug/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	COL.*	FTU	units/ml	mm /m
																	5day				
870624	02093197	1335	5.0	28.0	5.9		40600	26.0													
870624	02093197	1335	6.0	28.0	5.8		41200	26.0													
870624	02093197	1335	7.0	28.0	5.9		41400	26.0													
870624	02093197	1335	8.0	27.0	6.0		42300	26.0													
870624	02093197	1335	9.0	27.0	6.1		43100	28.0													
870720	02093197	1430	0.1	29.0	7.2	7.9	40630	26.0	0.6	19	0.06	0.8	0.02	0.82	0.13	0.07		5		4123	940
870720	02093197	1430	1.0	28.0	6.9	7.9	40700	25.5													
870720	02093197	1430	2.0	28.0	6.6	7.8	41030	26.0													
870720	02093197	1430	3.0	28.0	6.5	7.8	41290	26.0													
870720	02093197	1430	4.0	28.0	6.6	7.8	41500	26.5													
870825	02093197	1810	0.1	26.0	7.5	6.4	19100	11.0		7	0.02	0.6	0.01	0.61	0.11	0.06		5	4.5	11267	1016
871001	02093197	1400	0.1	23.0	7.8	8.0	31200	19.0		19	0.01	0.5	0.01	0.51	0.14	0.05		5	17	74941	14753
880517	02093197	1500	0.1	25.0	8.5	8.1	15000	10.0		4	0.01	0.3	0.01	0.31	0.05	0.01		5	5.5		
880621	02093197	1530	0.1	28.0	7.4		40240	25.0		11	0.02	0.4	0.01	0.41	0.08	0.02		5	9.7	2841	744
880713	02093197	1445	0.1	31.0	7.7	8.0	30976	22.0		13	0.09	0.7	0.01	0.71	0.07	0.02		5	11		
880912	02093197	1710	0.1	27.0	9.4	8.2	25920	14.0		20	0.02	0.6	0.01	0.61	0.08	0.04		5	12	8472	2638
880928	02093197	1640	0.1	30.0	8.8	8.2	30600	21.0		11	0.07	0.5	0.01	0.51	0.07	0.03	2.5	5	11	5980	3396
890613	02093197	1015	0.1	27.3	6.9	8.3	28000	16.4	0.8	8	0.01	0.6	0.01		0.07	0.01	2.3	5	4.9	3306	1876
890718	02093197	1005	0.1	26.1	4.2	7.8	33500	20.0	0.6	15	0.04	0.5	0.02		0.06	0.02			7.1	7919	937
890718	02093197	1005	1.0	26.7	5.1	8.0	36700	23.2													
890718	02093197	1005	2.0	26.7	5.2	7.8	37800	24.1													
890718	02093197	1005	3.0	26.7	4.9	8.0	38400	24.4													
890718	02093197	1005	4.0	26.7	4.8	8.0	39600	25.2													
890718	02093197	1005	5.0	26.7	4.7	8.0	39900	25.5													
890829	02093197	1140	0.1	28.7	6.6	7.9	34800	22.5	0.7	5	0.21	0.6	0.01		0.07	0.02	3.6	5	11	4717	1024
890829	02093197	1140	1.0	28.2	6.7	7.9	34900	23.5													
890829	02093197	1140	2.0	28.2	7.2	7.9	35300	23.0													
890829	02093197	1140	3.0	28.6	6.4	7.9	34700	22.0													
890829	02093197	1140	4.0	28.5	6.4	7.9	35800	23.5													
890829	02093197	1140	5.0	28.5	6.4	7.9	36600	23.0													
860106	0209317585	1410	0.1	9.0	9.2	6.8	179										0.8	20			
860206	0209317585	1415	0.1	15.0	8.0	6.3	145	0.0						0.00			1.5	50			
860327	0209317585	1315	0.1	15.0	8.6	6.8	108	0.0			0.03	0.2	0.06	0.26	0.04	0.01	0.6	30	16		
860422	0209317585	1235	0.1	17.0	5.8	7.5	800	0.0						0.00			1.7	480			
860515	0209317585	1315	0.1	20.0	4.2	7.5	4500	3.0		4							2	120			
860611	0209317585	1510	0.1	27.0	3.8		480			16	0.16	0.4	0.09	0.49	0.17	0.10	NS	130	7		
860724	0209317585	1440	0.1	24.0	5.7	6.9	279			100	0.05	0.5	0.16	0.66	0.12	0.04	1.5	2000			
860814	0209317585	1400	0.1	23.0	6.4	6.9	112			2							2.2	870			
860910	0209317585	1420	0.1	22.0	5.2	7.5	954				0.18	0.5	0.11	0.61	0.13	0.08	1	660	7.5		
870108	0209317585	1300	0.1	8.0	9.6	6.4	95	0.0		0.5	0.03	0.2	0.07	0.27	0.03	<.01	0.8		4.9		
870226	0209317585	1050	0.1	7.0	10.0	6.2	126	0.0		3	0.03	0.2	0.08	0.28	0.04	0.01	0.7		4.4		
870324	0209317585	1230	0.1	11.0	9.2	7.5	83	0.0		2	0.03	0.3	0.03	0.33	0.04	0.01	1		4.2		
870622	0209317585	1530	0.1	25.0	4.5	8.1	340	0.0		17	0.06	0.3	0.13	0.43	0.15	0.06	1.4		9.6	2090	1166
870721	0209317585		0.1							53										169	13
870825	0209317585	1720	0.1	26.0	5.4	6.4	267	0.0		9	0.03	0.3	0.10	0.40	0.08	0.04	1.1		7.5	33	23
871001	0209317585	1229	0.1	19.0	6.6	7.1	380	0.0		2	0.02	0.5	0.08	0.58	0.10	0.04	1.4		11		
880525	0209317585	1200	0.1	21.0	6.3	7.8	194	0.0		9	0.10	0.4	0.11	0.51	0.14	0.04	0.9		16		
880621	0209317585	1415	0.1	22.8	6.7	7.0	270	0.0		1	0.05	0.4	0.42	0.82	0.13	0.04	1.3		12	978	301
880713	0209317585	1030	0.1	25.0	3.7	7.3	600	0.0		4	0.09	0.4	0.27	0.67	0.16	0.07	1		11		
880830	0209317585	1605	0.1	25.0	5.2	7.7	175			2	0.04	0.4	0.10	0.50	0.08	0.09	1.7		5.5	157	440
880928	0209317585	1535	0.1	23.0	5.7	8.1	1456	1.0		9	0.07	0.3	0.12	0.42	0.13	0.05	0.7	460	7.7	1304	769
890822	0209317585	1045	0.1	24.0	6.2	6.9	138			0.5							3.3		5.8	70	82
860611	0209319360	1700	0.1	25.0	7.2		27500	19.0		16	0.03	0.7	0.01	0.71	0.12	0.05	4.2	10	3.9	11646	3037
860611	0209319360	1700	1.0	24.0	5.7		27400	18.0													
860611	0209319360	1700	1.5	24.0	4.7		27600	18.5													
860731	0209319360	1450	0.1	33.0	8.3	8.6	19900	8.0		41	0.01	0.7	0.01	0.71	0.13	0.04		5		43584	10837
860731	0209319360	1450	0.5	32.0	6.6																
860731	0209319360	1450	1.0	31.0	2.5																
860731	0209319360	1450	1.5	31.0	2.3																
860731	0209319360	1450	2.0	31.0	2.2																
860819	0209319360		0.1	26.0	4.2	7.8	15700			29	0.02	0.8	0.01	0.81	0.16	0.09	3.7	12000		11180	2143
860828	0209319360	1052	0.1	28.0	5.5	7.0	1033			62	0.04	0.7	0.01	0.71	0.11	0.04		10		44720	5614
860828	0209319360	1052	0.5	28.1	5.4	7.1	1033														
860828	0209319360	1052	1.0	28.0	4.8	7.1	1032														
860930	0209319360	1425	0.1	28.0	6.7		23108	12.0		25	0.03	0.7	0.01	0.71	0.14	0.06	NS	30	3.1	1834	3708
860930	0209319360	1425	0.5	27.0	6.4		22568	12.0													
860930	0209319360	1425	1.0	27.0	4.1		22672	12.0													
870108	0209319360	1330	0.1	9.0	12.3	7.9	7900	4.0		57	0.02	0.8	0.01	0.81	0.12	0.03			6.3		
870226	0209319360	1050	0.1	8.0	9.6	8.1	11400	8.0		62	0.04	0.8	0.01	0.81	0.12	0.01			5.5		
870324	0209319360	1200	0.1	15.0	11.6	8.7	10700	7.0		83	0.04	0.6	0.01	0.61	0.12	0.04			4.3	10787	10536
870429	0209319360	1100	0.1	21.0	8.3	7.9	15400			11	0.03	0.6	0.01	0.61	0.06	<.01				79133	1157
870624	0209319360	1305	0.1	29.0	6.8	8.3	20100	13.0	0.7	34	0.01	0.5	0.01	0.51	0.17	0.08			4.2	12141	2683
870624	0209319360	1305	0.5	28.0	6.2		25000	15.0													
870624	0209319360	1305	1.0	28.0	5.2		24800	15.0													
870720	0209319360	1515	0.1	32.0	9.5	8.3	31190	19.3	0.6	53	0.02	0.8	0.01	0.81	0.22	0.12				13167	4888
870720	0209319360	1515	1.0	32.0	6.2	8.4	31410	19.0													
870825	0209319360	1411	0.1	27.5	7.8	7.8	28120	17.3	0.6	9	0.01	0.8	0.01	0.81	0.23	0.14			4.9	24544	1409
870825	0209319360	1411	0.5	27.4	6.5	7.7	28450	17.3													
870825	0209319360	1411	1.0	27.0	4.1	7.5	29310	18.0													
870928	0209319360	1200	0.1	25.9	6.3	7.3	22180	13.1	0.6	23	0.01	1.0	0.01	1.01	0.19	0.10			5.6	90662	7973

Appendix V. Physical, chemical and biological data from New River, Onslow County 1986-1989.

DATE	STATION	TIME	DEPTH	TEMP	DO	pH	CONDO	SAL.	SEC	CHL-A	NH3	TKN	NO3	TN	TP	PO4	BOD	FECAL	TURB.	DENSITY	BIOV.
			m	°C	mg/l	SU	uMhos	ppt	m	ug/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	COL.*	FTU	units/ml	mm /m
																	5day				
870928	0209319360	1200	0.5	25.2	4.5	7.3	23740	14.1													
870928	0209319360	1200	1.0	24.8	3.1	7.2	24130	14.4													
870928	0209319360	1200	1.5	25.6	1.0	7.0	25990	15.7													
880627	0209319360	1342	0.1	27.7	4.6	7.3	21100	12.5	0.8	15	0.01	0.6	0.01	0.61	0.14	0.07			6.4	3494	1679
880627	0209319360	1342	0.5	27.7	4.6	7.3	21400	12.7													
880627	0209319360	1342	1.0	28.0	4.0	7.3	22300	12.9													
880726	0209319360	1042	0.1	29.6	7.0	7.7	15400	10.0	0.6	15	0.06	0.5	0.01	0.51	0.11	0.03	3.4	10	4.9	3676	630
880726	0209319360	1042	1.0	28.4	4.3		19100	13.0													
880830	0209319360	0855	0.1	28.4	5.5	7.4	17500	10.1	0.8	26	0.01	0.6	0.01	0.60	0.13	0.05	5.2	5		5490	22641
880830	0209319360	0855	0.5	28.3	5.2	7.4	18000	10.4													
880830	0209319360	0855	1.0	28.5	4.4	7.3	19000	11.4													
880928	0209319360	1109	0.1	24.0	6.4		20678	14.0	0.7	17	0.02	0.6	0.01	0.60	0.10	0.04	3.1	20	3.7	7372	573
880928	0209319360	1109	1.0	24.0	5.1		23422	15.0													
890613	0209319360	1136	0.1	28.0	6.3	8.1	12720	7.0	0.6	16	0.02	0.7	0.01		0.12	0.01	3.6	5	6.1	17294	1316
890613	0209319360	1136	1.0	28.0	6.3	8.0	12750	7.0													
890718	0209319360	1136	0.1	26.1	4.0	7.0	6980	3.4	0.3	100	0.02	0.7	0.04		0.06	0.02	5.4		12	8996	8714
890718	0209319360	1136	1.0	27.6	3.4	7.5	20500	12.0													
890829	0209319360	1337	0.1	29.8	6.0	7.7	21400	14.0	0.6	35	0.06	0.6	0.01		0.09	0.02	5.8	5	11		
890829	0209319360	1337	1.0	28.9	3.7	7.5	21700	14.0													
860611	BC	1047	0.1	28.0	7.6	8.6	11750	8.0	0.3	62	0.04	1.0	0.01	1.01	0.36	0.25				31356	4435
860611	BC	1047	0.5	28.0	6.2		12100	8.0													
860611	BC	1047	0.8	28.0	4.2		12700	9.0													
860611	BC	1047	1.0	28.0	0.2		16800	11.0													
860730	BC	1120	0.1	30.0	10.8	7.9	5200	3.5	0.4	220	0.02	1.4	0.01	1.41	0.47	0.10				323520	42943
860730	BC	1120	0.5	30.0	6.4		6200	4.0													
860730	BC	1120	1.0	29.0	3.2		8000	5.0													
860828	BC	1232	0.1	28.2	7.1	7.0	774		0.3	47	0.05	0.6	0.51	1.11	0.31	0.15				30308	8791
860930	BC	1048	0.1	27.4	7.3	7.8	16130	9.2	0.4	84	0.05	1.1	0.02	1.12	0.38	0.26				3232	6103
870622	BC	1320	0.1	29.0	10.3		12400	9.0	0.3	200	0.02	1.0	0.01	1.01	0.44	0.23				205082	10438
870622	BC	1320	0.5	29.0	3.6		8000	10.0													
870720	BC	1230	0.1	32.0	11.0	7.9	20600	12.5	0.4	70	0.03	1.2	0.02	1.22	0.44	0.27	10	170		37616	8254
870720	BC	1230	1.0	30.0	3.0		23400	14.0													
870825	BC	1308	0.1	26.3	11.5	8.1	8289	4.3	0.4	97	0.02	1.0	0.05	1.05	0.23	0.11				214166	8988
870825	BC	1308	0.5	25.9	9.2	8.0	8590	4.4													
870928	BC	1426	0.1	27.8	14.7	8.2	13330	7.4	0.3	73	0.02	1.0	<.01	1.05	0.25	0.12				358457	15228
870928	BC	1426	0.5	28.0	14.7	8.2	13400	7.4													
880627	BC	1042	0.1	24.3	2.5	7.1	5700	2.8	0.3	14	0.25	1.3	0.58	1.88	0.47	0,24	7.8	600.5		2288	394
880627	BC	1042	0.5	25.8	2.4	7.0	10200	5.4													
880726	BC	1423	0.1	31.7	13.4	8.2	5196	8.2	0.3	57	0.02	0.9	0.01	0.91	0.37	0.17	8	190	17		
880830	BC	1234	0.1	28.7	7.7	7.4	1600	0.3	0.5	83	0.03	1.0	0.12	1.12	0.29	0.14	8.3	100	8.8	168049	12339
880830	BC	1234	0.5	28.8	7.9	7.7	6600	3.2													
880830	BC	1234	1.0	28.1	3.0	7.2	7410	3.6													
880928	BC	1345	0.1	25.4	10.7	8.3	15725	10.0	0.4	64	0.02	0.9	0.01	0.90	0.22	0.11	7.6	80	6.4	120359	9014
880928	BC	1345	0.5	24.2	10.2		15252	10.0													
860611	NE2	1307	0.1	30.0	9.1	8.6	20600	15.0	0.6	16	0.03	0.6	0.01	0.61	0.15	0.09				12053	2320
860611	NE2	1307	1.0	29.0	9.1		21000	14.0													
860611	NE2	1307	1.5	28.0	4.8		21800	15.0													
860611	NE2	1307	2.0	28.0	1.6		20600	14.0													
860730	NE2	0952	0.1	30.0	6.8	7.6	13500	10.0	0.4	180	0.03	0.9	0.01	0.91	0.22	0.09				341338	37336
860730	NE2	0952	0.5	30.0	5.4		16200	12.0													
860730	NE2	0952	1.0	30.0	4.2		17900	13.0													
860730	NE2	0952	1.3	30.0	4.2																
860730	NE2	0952	1.5	30.0	0.3		22200	16.0													
860730	NE2	0952	2.0	30.0	0.1		18900	16.0													
860828	NE2	1345	0.1	28.4	6.8	6.9	6960	3.0	0.5	81	0.04	0.8	0.01	0.81	0.13	0.06				26465	1772
860828	NE2	1345	0.5	28.3	6.8	6.9	6950	3.0													
860828	NE2	1345	1.0	28.4	6.8	6.9	6950	3.5													
860828	NE2	1345	1.5	28.4	6.7	6.9	6980	4.0													
860828	NE2	1345	2.0	28.4	6.5	6.8	7100														
860930	NE2	0840	0.1	25.9	6.1	7.3	22650	13.5	0.6	38	0.03	1.0	0.01	1.01	0.19	0.10	NS			873	3557
860930	NE2	0840	0.5	26.0	6.1	7.5	22740	13.5													
860930	NE2	0840	1.0	27.0	5.7	7.4	24100	14.4													
860930	NE2	0840	1.5	27.1	4.9	7.3	24400	14.6													
870624	NE2	1245	0.1	29.0	7.0	8.4	22400	14.0	0.5	38	0.01	0.7	< 01	0.71	0.24	0.13				5968	1071
870624	NE2	1245	1.0	28.0	6.4		23000	14.0													
870624	NE2	1245	2.0	27.0	4.0		25000	15.0													
870720	NE2	1615	0.1	32.0	7.7	7.8	30120	18.5	0.5	37	0.03	0.9	0.01	0.91	0.25	0.15				28125	17216
870720	NE2	1615	1.0	31.0	6.0	7.5	30200	18.5													
870825	NE2	1556	0.1	27.0	6.5	7.6	25400	15.4	0.6	24	0.01	0.8	< 01	0.81	0.28	0.17				36248	1517
870825	NE2	1556	0.5	27.0	6.3	7.6	25500	15.4													
870825	NE2	1556	1.0	27.0	6.3	7.6	25700	15.6													
870825	NE2	1556	1.5	26.8	3.8	7.5	26200	16.0													
870928	NE2	1325	0.1	25.9	6.2	7.4	21710	12.9	0.5	29	0.01	0.9	< 01	0.91	0.19	0.11				110053	18654
870928	NE2	1325	0.5	25.8	5.2	7.4	21720	12.9													
870928	NE2	1325	1.0	25.3	4.3	7.2	22260	13.2													
870928	NE2	1325	1.5	25.5	1.4	6.9	23590	14.1													
870928	NE2	1325	2.0	25.5	0.7	6.8	23820	14.3													
880627	NE2	1240	0.1	27.4	5.4	7.6	18700	10.8	0.6	19	0.03	0.8	0.01		0.16	0.07	2.6	5		3081	898
880627	NE2	1240	0.5	27.4	5.3	7.6	18800	10.9													
880627	NE2	1240	1.0	27.4	5.2	7.6	18800	10.9													

Appendix V. Physical, chemical and biological data from New River, Onslow County 1986-1989.

DATE	STATION	TIME	DEPTH	TEMP	DO	pH	CONDO	SAL.	SEC	CHL-A	NH3	TKN	NO3	TN	TP	PO4	BOD	FECAL	TURB.	DENSITY	BIOV.
			m	°C	mg/l	SU	uMhos	ppt	m	ug/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	COL.*	FTU	units/ml	mm /m
																	5day				
880627	NE2	1240	1.5	27.0	4.1	7.4	18800	10.9													
880726	NE2	1140	0.1	29.7	9.8	8.3	10400	6.5	0.7	57	0.03	0.7	0.01	0.71	0.20	0.08	4.6	20	7.7		
880726	NE2	1140	1.0	28.4	4.2		17700	11.0													
880726	NE2	1140	1.5	28.0	1.8		18800	11.0													
880830	NE2	1125	0.1	28.4	5.8	7.6	13290	7.3	0.7	33	0.01	0.8	0.01	0.81	0.16	0.06	4 6	30	6	12636	1620
880830	NE2	1125	0.5	28.3	5.7	7.6	13550	7.5													
880830	NE2	1125	1.0	28.2	5.4	7.6	13770	7.6													
880830	NE2	1125	1.5	28.6	1.7	7.1	14230	7.9													
880928	NE2	1155	0.1	24.2	7.7	8.0	20566	13.0	0.5	19	0.02	0.6	0.01	0.60	0.15	0.07	3.1	5	4.4	6434	3177
880928	NE2	1155	0.5	24.2	6.2		21648	13.5													
880928	NE2	1155	1	24.6	2.2		24701	15.0													
860611	NR	1220	0.1	27.0	8.0	8.5	19500	13.0	0.6	11	0.02	0.6	0.01	0.61	0.15	0.07				10656	2083
860611	NR	1220	1.0	27.0	8.1		20100	13.0													
860611	NR	1220	2.0	27.0	8.0		20300	13.0													
860611	NR	1220	3.0	26.0	7.7		21100	13.5													
860611	NR	1220	3.5	26.0	7.5		21300	13.5													
860730	NR	1012	0.1	29.0	4.6	7.6	23200	17.0	0.4	62	0.02	0.8	0.01	0.81	0.21	0.10				180277	23299
860730	NR	1012	0.5	30.0	4.6		23200	17.0													
860730	NR	1012	1.0	30.0	4.4		23200	17.0													
860730	NR	1012	1.5	30.0	3.6		23400	17.0													
860730	NR	1012	2.0	30.0	2.6		24000	18.0													
860730	NR	1012	2.5	30.0	1.3		25400	19.0													
860730	NR	1012	3.0	30.0	0.5		27300	20.0													
860730	NR	1012	3.5	30.0	0.1		28100	21.0													
860730	NR	1012	4.0	30.0	0.1		27200	21.0													
860828	NR	1330	0.1	28.4	7.4	7.0	8850	3.5	0.6	88	0.04	0.9	0.01	0.91	0.13	0.06				45943	8511
860828	NR	1330	0.5	28.4	7.4	7.1	8850	3.5													
860828	NR	1330	1.0	28.4	7.4	7.1	8860	3.5													
860828	NR	1330	2.0	28.3	6.9	7.0	9300	4.0													
860828	NR	1330	3.0	27.5	0.0	6.6	19000	6.5													
860930	NR	0900	0.1	26.8	5.8	7.6	24410	14.6	0.8	32	0.03	0.7	0.01	0.71	0.15	0.08	NS			11820	2407
860930	NR	0900	0.5	26.8	5.8	7.6	24400	14.6													
860930	NR	0900	1.0	26.7	5.7	7.6	24350	14.6													
860930	NR	0900	1.5	26.7	5.6	7.6	24450	14.6													
860930	NR	0900	2.0	26.8	5.2	7.6	24600	14.7													
860930	NR	0900	2.5	27.0	4.5	7.6	24750	14.9													
860930	NR	0753	0.1	26.4	5.6	7.5	23320	13.9													
860930	NR	0753	2.0	26.3	5.3	7.5	23800	14.2													
870624	NR	1210	0.1	29.0	7.3	8.4	23800	15.0	0.5	39	0.02	0.6	<.01	0.61	0.24	0.14				12315	827
870624	NR	1210	1.0	28.0	6.7		24600	15.0													
870624	NR	1210	2.0	28.0	4.7		25400	16.0													
870720	NR	1550	0.1	29.2	8.2	7.9	28140	17.5	0.5	25	0.03	0.9	0.02	0.92	0.23	0.14				14383	1828
870720	NR	1550	1.0	28.0	6.4	7.8	28990	17.7													
870720	NR	1550	2.0	28.0	4.5	7.4	30070	18.7													
870825	NR	1509	0.1	26.7	6.1	7.6	26250	15.8	0.7	20	0.02	1.0	<.01	1.01	0.27	0.16				95903	3072
870825	NR	1509	1.0	26.7	6.1	7.6	26210	15.9													
870825	NR	1509	2.0	26.5	5.1	7.6	26520	16.2													
870825	NR	1509	3.0	26.4	5.6	7.6	27430	16.7													
870928	NR	1248	0.1	27.1	7.2	7.6	22030	13.1	0.5	19	0.01	0.9	<.01	0.91	0.18	0.10				94680	10108
870928	NR	1248	0.5	26.3	6.9	7.6	22050	13.0													
870928	NR	1248	1.0	25.2	6.8	7.6	22380	13.3													
870928	NR	1248	1.5	24.8	5.9	7.5	22460	13.2													
870928	NR	1248	2.0	24.7	5.7	7.5	22990	13.7													
870928	NR	1248	2.5	24.9	3.9	7.4	23330	13.9													
870928	NR	1248	3.0	25.6	0.3	6.7	26920	16 4													
880627	NR	1150	0.1	27.3	5.4	7.7	21200	12.5	0.9	15	0.01	0.7	0.01		0.13	0.05	3.1	5		4814	1382
880627	NR	1150	0.5	27.3	5.4	7.7	21100	12.5													
880627	NR	1150	1.0	27.3	5.4	7.7	21200	12.5													
880627	NR	1150	1.5	27.3	5.4	7.7	21200	12.5													
880627	NR	1150	2.0	27.3	5.4	7.7	21300	12.5													
880627	NR	1150	2.5	27.3	5.3	7.8	21200	12.5													
880726	NR	1152	0.1	29.5	9.7	8.5	16400	10 0	0.7	64	0.07	0.6	0.01	0.61	0.19	0.06	5 2	5	5.6	8298	13029
880726	NR	1152	1.0	29.2	8.2		16900	11.0													
880726	NR	1152	2.0	28.6	5.2		19200	12.0													
880726	NR	1152	3.0	27.9	1.8		18800	12.0													
880830	NR	1147	0.1	28 0	7.2	7.9	15600	8.8	0.8	52	0.03	0.8	0.01	0.81	0.16	0 06	4 8	5	4.8	20264	2021
880830	NR	1147	0.5	28.0	7.4	8.0	15400	8.7													
880830	NR	1147	1.0	28.0	6.5	7.9	15600	8.8													
880830	NR	1147	1.5	28.0	6.3	7.7	17500	10.0													
880830	NR	1147	2.0	27.9	4.9	7.4	18700	10.9													
880830	NR	1147	2.5	27.9	4 9	7 4	18700	10.9													
880928	NR	1239	0.1	23 8	8.8	8.3	20496	13.0	0.8	19	0.02	0.6	0.01	0.60	0.14	0.06	4	5	3.8	7599	2164
880928	NR	1239	1.0	23.5	8.6		20370	13.0													
880928	NR	1239	2.0	24 2	0.7		21648	16.0													
880928	NR	1239	2.5	23.4	4.7		20522	14.0													
890613	NR	1225	0.1	27.5	8.3	8.7	9950	5.3	0.6	35	0.01	0.5	0 01		0.10	0.01	3 4	5	4 8	17032	1192
890613	NR	1225	1 0	27.5	8.3	8 6	9970	5.3													
890613	NR	1225	2.0	27 5	8 3	8 6	9990	5.3													
890613	NR	1225	2.5	27.5	8 4	8 6	10000	5.3													
890718	NR	1245	0 1	27 2	5 8	7 9	15100	8 5	0.6	88	0 08	0 8	0 03		0 11	0.05	3 5	100	5 3	13975	4916

Appendix V. Physical, chemical and biological data from New River, Onslow County 1986-1989.

DATE	STATION	TIME	DEPTH	TEMP	DO	pH	CONDO	SAL.	SEC	CHL-A	NH3	TKN	NO3	TN	TP	PO4	BOD	FECAL	TURB.	DENSITY	BIOV.
			m	°C	mg/l	SU	uMhos	ppt	m	ug/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	COL.*	FTU	units/ml	mm /m
																	5day				
890718	NR	1245	1.0	27.2	5.6	7.7	15100	8.5													
890718	NR	1245	2.0	27.5	3.8	7.7	18600	10.8													
890718	NR	1245	2.5	27.7	3.8	7.7	20200	11.8													
890829	NR	1445	0.1	30.0	8.2	8.2	17300	11.0	0.6	40	0.05	0.7	0.01		0.11	0.03	6.2	5	6.1	62887	5146
890829	NR	1445	1.0	29.0	5.9	8.1	19200	12.0													
890829	NR	1445	2.0	28.6	0.0	7.4	23600	15.0													
890613	NR1	1208	0.1	27.8	7.7	8.6	12240	6.7	0.7	26	0.03	0.6	0.01		0.08	0.01	2.8	20	3.7	17888	910
890613	NR1	1208	1.0	27.7	7.7	8.6	12230	6.7													
890613	NR1	1208	2.0	27.6	7.2	8.5	12500	6.8													
890613	NR1	1208	3.0	26.8	1.3	7.6	18000	10.3													
890718	NR1	1207	0.1	27.1	6.8	8.1	17300	10.0	0.6	88	0.04	0.8	0.01		0.08	0.03	4	20	4.2	46292	3656
890718	NR1	1207	1.0	27.1	6.4	8.0	17700	10.2													
890718	NR1	1207	2.0	27.2	5.0	7.8	19000	11.1													
890718	NR1	1207	3.0	28.0	2.0	7.6	24600	14.9													
890829	NR1	1355	0.1	29.7	8.3	8.1	17900	11.5	0.7	56	0.09	0.6	0.01		0.11	0.02	5.2	5	7	45244	1659
890829	NR1	1355	1.0	28.5	7.1	8.1	20000	12.8													
890829	NR1	1355	2.0	28.1	4.5	7.8	20700	13.0													
880627	NR2	1403	0.1	27.0	6.4	7.8	23700	14.1	1.0	19	0.02	0.6	0.01	0.61	0.12	0.06	2.9	5		12170	3436
880627	NR2	1403	0.5	27.0	6.3	7.8	23400	14.1													
880627	NR2	1403	1.0	27.0	6.3	7.8	23800	14.3													
880627	NR2	1403	1.5	27.2	3.8	7.7	25500	14.6													
880627	NR2	1403	2.0	28.0	2.7	7.4	30500	18.8													
880627	NR2	1403	2.5	28.1	2.5	7.4	31800	19.7													
880726	NR2	1003	0.1	28.0	7.0	8.0	19700	12.5	0.8	13	0.10	0.6	0.01	0.61	0.12	0.04	1.4	5	4	4387	292
880726	NR2	1003	1.0	27.9	7.0		20700	13.0													
880726	NR2	1003	2.0	28.0	5.1		22500	14.5													
880726	NR2	1003	3.0	28.0	2.8		23400	15.0													
880726	NR2	1003	4.0	28.0	1.5		23400	15.0													
880830	NR2	1011	0.1	27.6	6.3	7.6	7880	3.7	0.9	21	0.01	0.8	0.01	0.81	0.13	0.06	4	130	3.8	3363	1276
880830	NR2	1011	0.5	27.7	5.8	7.6	19500	11.3													
880830	NR2	1011	1.0	27.7	5.6	7.6	20100	11.5													
880830	NR2	1011	1.5	27.9	5.3	7.6	21100	12.4													
880830	NR2	1011	2.0	28.0	5.3	7.6	21900	12.9													
880830	NR2	1011	2.5	28.0	5.3	7.6	21800	13.0													
880830	NR2	1011	3.0	28.1	4.6	7.6	22800	13.1													
880928	NR2	1035	0.1	23.0	7.8	8.2	21216	13.0	1.0	18	0.01	0.7	0.01	0.70	0.10	0.04	2.8	5	4.4	5939	3002
880928	NR2	1035	1.0	23.0	7.8		21600	14.0													
880928	NR2	1035	2.0	23.5	3.6		27257	18.0													
880928	NR2	1035	2.5	23.6	3.1		27313	18.0													
890613	NR2	1112	0.1	27.5	7.2	8.5	14030	7.8	0.6	10	0.01	0.7	0.01		0.08	0.01	3.2	110	3.6	32928	1392
890613	NR2	1112	1.0	27.4	7.1	8.5	14100	7.9													
890613	NR2	1112	2.0	27.3	4.9	8.2	16500	9.3													
890613	NR2	1112	3.0	27.4	1.6	8.4	24100	14.6													
890718	NR2	1115	0.1	27.0	5.6	8.0	22000	12.9	0.7	35	0.02	0.7	0.01		0.06	0.02	3.3	70	4.1	15765	5264
890718	NR2	1115	1.0	27.0	5.5	8.0	22000	13.0													
890718	NR2	1115	2.0	27.8	2.6	7.8	24500	14.9													
890718	NR2	1115	3.0	28.1	2.4	7.7	29300	18.0													
890829	NR2	1250	0.1	28.9	8.0	8.1	19000	12.0	0.6	35	0.16	0.8	0.01		0.10	0.02	4.7	10	5.6	43672	1934
890829	NR2	1250	1.0	28.5	3.0	7.6	29400	17.3													
890829	NR2	1250	2.0	28.5	1.2	7.5	34400	21.8													
890613	NR3	1049	0.1	27.6	6.8	8.4	20000	11.7	0.8	9	0.02	0.5	0.01		0.09	0.01	2.3	5	3.5	5365	980
890613	NR3	1049	1.0	27.6	6.8	8.4	20000	11.8													
890613	NR3	1049	2.0	27.3	6.4	8.2	22500	14.0													
890613	NR3	1049	2.5	27.2	2.7	7.8	28300	17.1													
890718	NR3	1051	0.1	27.0	5.0	8.0	26600	16.1	0.6	27	0.04	0.7	0.01		0.07	0.02	1.5	10	8.5	8315	2178
890718	NR3	1051	1.0	27.3	4.3	8.0	28500	17.4													
890718	NR3	1051	2.0	27.5	4.2	7.9	29800	18.3													
890718	NR3	1051	3.0	27.6	3.5	7.9	31100	19.2													
890829	NR3	1225	0.1	30.1	9.0	8.4	24800	16.0	0.7	23	0.16	0.7	0.01		0.08	0.02	4.2	5	6.3	37994	3843
890829	NR3	1225	1.0	28.4	7.5	8.2	27800	19.0													
890829	NR3	1225	2.0	28.4	3.0	7.7	34300	22.0													
890829	NR3	1225	3.0	28.4	2.6	7.6	35000	22.0													
860611	SW1	1855	0.1	24.0	4.7		195	0.0		0.5	0.07	0.5	0.53	1.03	0.11	0.03	1.8	40		285	128
860611	SW1	1855	0.5	24.0	4.5		195														
860611	SW1	1855	1.0	24.0	4.4		192														
860730	SW1	1350	0.1	26.0	5.0	6.9	99	0.0		0.5	0.05	0.6	0.31	0.91	0.13	0.05	1.1	10		50	20
860730	SW1	1350	0.5	26.0	4.6																
860730	SW1	1350	1.0	26.0	4.5																
860828	SW1	1500	0.1	23.0	5.3	7.0	83	0.0		3	0.05	0.5	0.37	0.87	0.07	0.02	0.8	20		437	305
860828	SW1	1500	0.5	23.0	5.7		83	0.0													
860828	SW1	1500	1.0	23.0	5.6		83	0.0													
860930	SW1	1500	0.1	23.0	3.4	7.3	209	0.0		3	0.04	0.2	0.08	0.28	0.07	0.02	1	130		293	199
860930	SW1	1500	0.5	22.0	3.4		207	0.0													
860930	SW1	1500	1.0	22.0	3.6		207	0.0													
860611	SW2	1155	0.1	29.0	6.9	7.8	12700	9.0	0.6	14	0.03	0.7	0.01	0.71	0.08	0.03				5350	1894
860611	SW2	1155	1.0	29.0	6.6		21000	14.0													
860611	SW2	1155	1.5	28.0	6.4		20900	14.0													
860611	SW2	1155	2.0	28.0	5.9		21150	14.0													
860611	SW2	1155	2.5	28.0	5.5		21150	14.0													
860611	SW2	1155	3.0	28.0	2.9		21500	14.5													

Appendix V. Physical, chemical and biological data from New River, Onslow County 1986-1989.

DATE	STATION	TIME	DEPTH	TEMP	DO	pH	CONDO	SAL.	SEC	CHL-A	NH3	TKN	NO3	TN	TP	PO4	BOD	FECAL	TURB	DENSITY	BIOV.
			m	°C	mg/l	SU	uMhos	ppt	m	ug/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l 5day	COL.*	FTU	units/ml	mm /m
860730	SW2	1350	0.1	29.0	3.4	6.7	14700	9.0	0.5	110	0.02	1.0	0.02	1.02	0.29	0.17				112149	21525
860730	SW2	1350	0.5	30.0	0.8		19500	16.0													
860730	SW2	1350	1.0	30.0	0.2		25000	19.0													
860730	SW2	1350	1.5	30.0	0.1		24800	19.0													
860730	SW2	1350	2.0	30.0	0.1		26000	19.0													
860730	SW2	1350	2.5	30.0	0.1		26200	19.0													
860730	SW2	1350	3.0	30.0	0.1		26100	19.0													
860828	SW2	1310	0.1	28.0	4.5	6.5	2110	1.0	0.5	25	0.15	0.8	0.10	0.90	0.13	0.05				8472	3066
860828	SW2	1310	0.5	27.5	4.4	6.3	2070	1.0													
860828	SW2	1310	1.0	27.2	4.2	6.2	9800	5.0													
860828	SW2	1310	1.5	27.3	0.1	6.3	11970	6.0													
860828	SW2	1310	2.0	27.2	0.0	6.5	16230	6.0													
860930	SW2	0930	0.1	26.5	5.5	7.5	23770	14.2	0.6	36	0.04	0.8	0.01	0.81	0.16	0.09	NS			10411	2518
860930	SW2	0930	0.5	26.5	5.4	7.5	23640	14.2													
860930	SW2	0930	1.0	26.5	5.4	7.5	23790	14.1													
860930	SW2	0930	1.5	26.5	5.4	7.5	23800	14.2													
860930	SW2	0930	2.0	26.5	5.3	7.5	23800	14.3													
860930	SW2	0930	2.5	26.6	4.9	7.4	23980	14.4													
870624	SW2	1107	0.1	29.0	6.2	7.9	19400	12.0	0.8	36	0.02	0.4	0.01	0.41	0.27	0.15	1.8	10		7477	1628
870624	SW2	1107	1.0	28.0	5.7		24600	15.0													
870624	SW2	1107	2.0	28.0	2.7		26300	15.0													
870624	SW2	1107	2.5	28.0	0.1		27500	17.0													
870720	SW2	1540	0.1	33.0	8.6	7.8	24770	14.9	0.5	83	0.02	0.8	0.02	0.82	0.24	0.13	4.2	5		17076	18726
870720	SW2	1540	1.0	31.5	7.9	7.6	26640	16.0													
870825	SW2	1440	0.1	27.8	10.1	8.0	22820	13.5	0.5	29	0.01	0.9	<.01	0.91	0.27	0.14				100969	15632
870825	SW2	1440	0.5	27.4	9.8	8.0	23190	14.0													
870825	SW2	1440	1.0	26.3	7.4	7.9	23710	14.2													
870825	SW2	1440	1.5	26.4	4.0	7.6	25050	15.2													
870825	SW2	1440	2.0	27.5	0.1	7.2	26440	15.8													
870825	SW2	1440	2.5	28.5	0.1	6.6	29600	18.1													
870825	SW2	1440	3.0	28.5	0.1	6.6	29560	18.1													
870928	SW2	1230	0.1	25.8	5.0	6.8	17690	10.4	0.5	23	0.02	0.8	<.01	0.81	0.19	0.10	5.2	30		52057	5210
870928	SW2	1230	0.5	25.8	5.1	6.9	18700	10.8													
870928	SW2	1230	1.0	25.5	5.8	7.2	2072	12.1													
870928	SW2	1230	1.5	25.5	5.8	7.3	21100	12.4													
870928	SW2	1230	2.0	25.4	3.9	7.2	21680	12.7													
870928	SW2	1230	2.5	25.4	3.1	7.0	21930	13.0													
870928	SW2	1230	3.0	25.5	2.9	7.0	21900	13.0													
880627	SW2	1128	0.2	26.0	4.0	7.0	17200	9.9		38	0.01	0.7	0.03	0.73	0.15	0.06	3.7	330		571	1057
880627	SW2	1128	0.5	26.3	3.7	6.9	17400	10.0													
880627	SW2	1128	1.0	26.4	3.5	6.9	17700	10.2													
880627	SW2	1128	1.5	26.4	3.5	6.9	17800	10.3													
880627	SW2	1128	2.0	27.3	2.7	7.0	19700	11.5													
880627	SW2	1128	2.5	27.1	3.2	7.1	20400	11.9													
880627	SW2	1128	3.0	27.1	3.3	7.2	20300	11.9													
880627	SW2	1128	3.5	27.0	3.3	7.2	20400	12.0													
880627	SW2	1128	4.0	27.0	3.3	7.2	20400	12.0													
880627	SW2	1128	4.5	26.7	3.3	7.2	20300	11.9													
880627	SW2	1128	5.0	26.6	3.4	7.2	20300	11.9													
880627	SW2	1128	5.5	26.4	3.5	7.2	20300	11.9													
880726	SW2	1210	0.1	28.4	4.3	6.1	2800	1.5	0.9	8	0.06	0.5	0.13	0.63	0.11	0.04	1.3	50	6.6	1656	1270
880726	SW2	1210	1.0	27.2	1.2		18200	10.0													
880726	SW2	1210	2.0	27.1	0.4		19200	11.0													
880726	SW2	1210	3.0	27.0	0.1		19200	11.0													
880726	SW2	1210	4.0	26.9	0.1		19200	11.0													
880830	SW2	1031	0.1	28.2	4.6	6.9	13460	7.9	0.8	140	1.60	4.1	0.12	4.22	0.64	0.41	3.4		2.7	3481	5410
880830	SW2	1031	0.5	28.2	4.6	6.9	13580	7.5													
880830	SW2	1031	1.0	28.3	4.6	6.9	13770	7.7													
880830	SW2	1031	1.5	28.3	4.4	6.9	14500	8.1													
880830	SW2	1031	2.0	28.3	4.2	7.0	14800	8.3													
880830	SW2	1031	2.5	28.2	3.8	7.0	15700	8.9													
880830	SW2	1031	3.0	28.1	3.9	7.1	16300	9.3													
880928	SW2	1213	0.1	24.0	7.9	8.1	18130	11.0	0.6	23	0.01	0.7	0.01	0.70	0.16	0.06	3.3	5	4.3	13247	1137
880928	SW2	1213	1.0	23.4	8.9		18392	11.2													
880928	SW2	1213	2.0	23.1	8.8		18278	11.5													
880928	SW2	1213	3.0	23.0	8.7		18240	11.5													
880928	SW2	1213	4.0	23.0	7.7		18048	11.2													
880928	SW2	1213	5.0	23.0	6.2		18144	11.1													
880928	SW2	1213	6.0	23.0	8.2		18144	11.2													
880928	SW2	1213	7.0	23.0	8.1		17760	11.2													
880928	SW2	1213	8.0	23.0	7.9		17760	11.2													
880928	SW2	1213	9.0	22.9	8.1		18106	11.0													
851204	WB05		0.1	12.0	7.2	7.0	3900	2.0		5	0.59	0.8	0.44	1.24	0.29	0.19					
860106	WB05		0.1	11.0	10.9	8.0		5.0		22	3.40	5.7	0.69	6.39	1.40	1.20				5124	2443
860206	WB05		0.1	17.0	7.4	7.3	6260	5.0		42	4.10	7.0	0.48	7.48	1.80	1.80				6289	21517
860327	WB05		0.1	20.0	11.8	7.8	2475	2.0		25	1.20	1.8	0.72	2.52	0.68	0.51				11966	3472
860422	WB05		0.1	19.0	6.5	7.7	15600	10.0		33	1.20	1.7	0.04	1.74	0.71	0.53				6095	8522
860515	WB05		0.1	24.0	11.6	8.5	22900	15.0		120	0.04	1.1	0.01	1.11	0.48	0.28				26640	6860
860611	WB05	1135	0.1	28.0	8.1	8.3	14600	10.0		120	1.60	3.5	0.07	3.57	1.00	0.94				226744	17855
860611	WB05	1135	0.5	27.0	7.8		14900	10.0													

Appendix V. Physical, chemical and biological data from New River, Onslow County 1986-1989.

DATE	STATION	TIME	DEPTH	TEMP	DO	pH	CONDO	SAL.	SEC	CHL-A	NH3	TKN	NO3	TN	TP	PO4	BOD	FECAL	TURB.	DENSITY	BIOV.
			m	°C	mg/l	SU	uMhos	ppt	m	ug/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	COL.*	FTU	units/ml	mm /m
																	5day				
860611	WB05	1135	1.0	27.0	4.8		14300	9.0													
860724	WB05		0.1	31.0	14.2	8.8	700	2.5		210	0.01	1.0	0.01	1.01	0.37	0.20				812993	21358
860814	WB05		0.1	30.0	11.3	9.1	5300	3.0		220	0.20	1.0	0.09	1.09	0.50	0.33				238098	11900
860910	WB05		0.1	28.0	8.3	8.2	10900	7.0		6	1.20	1.9	0.19	2.09	0.62	0.42					
860930	WB05	1015	0.1	28.5	5.8	7.5	19900	11.7	0.4	110	NS	NS	NS	NS	NS	NS	NS			56424	11666
860930	WB05	1015	0.5	27.4	4.6	7.6	21320	12.6													
870108	WB05	1440	0.1	12.0	14.0	8.2	4410	2.5		170	0.23	1.6	0.57	2.17	0.43	0.09				28037	16250
870226	WB05	1230	0.1	11.0	14.4	8.7	9100	6.0		300	0.03	1.8	0.08	1.88	0.35	0.12				52406	40443
870324	WB05	1520	0.1	19.0	7.6	7.8	7500	5.0		22	2.30	4.4	0.80	5.20	1.00	0.77				6682	1580
870429	WB05																			197047	3296
870513	WB05																			30570	9812
870616	WB05																			28823	7701
870622	WB05	1335	0.1	29.0	11.3		13200	8.0	0.2	310	1.70	3.2	0.04	3.24	1.50	1.20	13	5600		113546	5437
870622	WB05	1335	0.5	29.0	10.6		13200	8.0													
870720	WB05	1635	0.1	34.0	18.5	8.6	23530	14.1		94	0.03	1.9	0.02	1.92	0.80	0.49	>8.2	10		97301	11191
870720	WB05	1635	1.0	34.0	16.5	8.6	23500	14.0													
870825	WB05	1330	0.1	27.6	10.4	8.0	20670	12.2	0.4	150	0.01	1.2	0.02	1.22	0.54	0.32				714819	21439
870825	WB05	1330	0.5	27.6	10.0	8.0	20650	12.1													
870825	WB05	1330	1.0	27.4	4.6	7.8	21050	12.4													
870928	WB05	1353	0.1	27.7	15.9	8.2	16650	9.5	0.3	180	0.06	1.7	<.01	1.71	0.53	0.38	13	140		496111	19836
870928	WB05	1353	0.5	27.8	15.5	8.2	16990	9.7													
870928	WB05	1353	1.0	26.0	12.3	8.1	17520	10.0													
880627	WB05	1058	0.1	28.1	4.3	7.9	16200	9.2	0.4	160	0.01	1.3	0.01	1.31	0.36	0.17	2.9	150		320026	7473
880627	WB05	1058	0.5	27.9	4.6	8.0	15900	9.1													
880627	WB05	1058	1.0	28.0	4.2	7.9	16000	9.1													
880726	WB05	1231	0.1	30.5	18.6	8.8	8000	5.0	0.3	240	0.05	1.9	0.02	2.10	0.58	0.22	13	5400	14	490171	12652
880726	WB05	1231	1.0	30.0	18.0		8100	6.0													
880830	WB05	1203	0.1	28.3	7.7	7.4	1600	0.3	0.4	140	1.60	4.1	0.12	4.22	0.64	0.41	12	6800	7.6	405273	12212
880830	WB05	1203	0.5	28.8	6.8	8.0	9840	5.2													
880830	WB05	1203	1.0	27.6	5.7	7.8	10130	5.4													
880928	WB05	1307	0.1	24.5	9.1	8.2	19800	12.0	0.6	64	0.02	0.9	0.01	0.90	0.25	0.11	5.2	100	5.8	59918	2929
880928	WB05	1307	0.5	24.0	4.2		20580	12.0													
880928	WB05	1307	1.0	24.0	3.3		18718	12.0													
860611	WB50	1113	0.1	29.0	10.3	8.5	14500	10.0	0.4	120	0.06	1.2	0.01	1.21	0.33	0.25	9.6	5		75814	6997
860611	WB50	1113	1.0	27.0	8.8		14900	10.0													
860611	WB50	1113	1.5	27.0	8.6		14900	10.0													
860611	WB50	1113	2.0	27.0	6.6		15300	10.0													
860730	WB50	1107	0.1	30.0	12.0	8.4	10500	7.0	0.4	260	0.18	1.4	0.03	1.43	0.50	0.32	8.8	530		372083	11192
860730	WB50	0834	0.1	28.0	7.8	7.6	10020	6.0													
860730	WB50	0834	0.5	28.0	7.8		10200	6.0													
860730	WB50	0834	0.8	30.0	6.0		17500	8.0													
860730	WB50	0834	1.0	30.0	0.5		21100	14.0													
860730	WB50	0834	1.5	30.0	0.2		23600	17.0													
860828	WB50	1250	0.1	28.5	6.3	6.8	1865	1.0	0.4	170	0.50	1.1	0.36	1.46	0.40	0.24	5.3	5		28125	7389
860828	WB50	1250	0.5	28.3	6.6	6.7	1890	1.0													
860828	WB50	1250	1.0	28.1	6.1	6.6	1880	1.0													
860828	WB50	1250	1.5	28.0	6.2	6.6	1880	1.0													
860930	WB50	1000	0.1	27.4	7.0	7.8	20550	12.0	0.5	94	0.11	0.9	0.01	0.91	0.35	0.34	12	20		55900	11827
860930	WB50	1000	0.5	27.3	5.4	7.6	21480	12.7													
860930	WB50	1000	1.0	27.3	4.2	7.4	21850	12.9													
860930	WB50	0730	0.1	26.3	5.8	7.4	206100	12.1													
860930	WB50	0730	1.0	27.2	4.0	7.2	21700	12.8													
870622	WB50	1340	0.1	29.0	9.9		16100	10.0	0.3	200	0.01	1.1	<.01	1.11	0.44	0.24	9.6	30		195999	7799.8
870622	WB50	1340	0.5	29.0	9.7		16100	10.0													
870622	WB50	1340	1.0	29.0	9.4		16100	10.0													
870720	WB50	1625	0.1	31.0	11.8	7.9	24460	14.7	0.4	52	0.02	1.0	<.01	1.01	0.36	0.23	11	5		23757	4956
870720	WB50	1625	1.0	31.0	11.3	6.2	24180	14.5													
870825	WB50	1340	0.1	27.6	12.8	8.1	19000	11.0	0.4	81	0.03	1.2	0.01	1.21	0.38	0.22				754996	22851
870825	WB50	1340	0.5	27.5	12.8	8.1	20600	12.0													
870825	WB50	1340	1.0	27.3	11.2	8.0	21000	12.4													
870928	WB50	1408	0.1	27.0	14.8	8.2	17600	10.2	0.3	97	0.02	1.2	<.01	1.21	0.33	0.18	12	80		449644	21362
870928	WB50	1408	0.5	26.9	14.8	8.2	17700	10.2													
870928	WB50	1408	1.0	26.2	9.5	8.0	18280	10.6													
870928	WB50	1408	1.5	25.7	4.1	7.2	19740	11.5													
880627	WB50	1110	0.2	27.8	4.4	7.8	15800	9.0	0.4	190	0.28	1.6	0.02	1.62	0.42	0.22	6.9	710		18866	2572
880627	WB50	1110	0.5	27.8	4.3	7.8	15800	9.0													
880627	WB50	1110	1.0	27.8	3.7	7.8	16100	9.2													
880726	WB50	1240	0.1	30.0	17.0	8.4	8550	5.0	0.3	250	0.02	1.5	0.01	1.51	0.48	0.18	8.8	6700		466064	11464
880726	WB50	1240	1.0	29.8	15.9		9000	6.0													
880830	WB50	1216	0.1	28.6	9.3	8.2	9540	5.0	0.5	110	1.20	3.0	0.12	3.12	0.51	0.31	8.6	5700	8.1	358457	10545
880830	WB50	1216	0.5	28.3	7.6	8.1	9600	5.0													
880830	WB50	1216	1.0	28.0	4.7	7.8	10210	5.5													
880928	WB50	1318	0.1	24.8	9.1	8.1	18924	12.0	0.6	76	0.36	1.2	0.04	1.24	0.34	0.17	6	610	6	96252	9058
880928	WB50	1318	0.5	23.8	5.3		20496	12.0													
880928	WB50	1318	1.0	24.0	8.0		19110	13.0													
890613	WB50	1425	0.1	28.4	8.9	7.8	1730	0.4	0.3	50	0.32	1.2	0.44	1.64	0.36	0.14	4.5		14	52581	4316
890613	WB50	1425	1.0	28.4	9.0	7.9	1820	0.4													
890718	WB50	1337	0.1	26.8	5.8	7.7	5800	2.8	0.5	100	0.41	1.1	0.36	1.46	0.19	0.13	3		6.5	36335	962
890718	WB50	1337	1.0	26.6	5.3	7.6	6800	3.4													
890829	WB50	1500	0.1	30.2	9.0	8.3	11700	7.0	0.4	160	0.05	1.4	0.07	1.47	0.32	0.13	>7.4	1600	10	118088	32489

Appendix V. Physical, chemical and biological data from New River, Onslow County 1986-1989.

DATE	STATION	TIME	DEPTH	TEMP	DO	pH	CONDO	SAL.	SEC	CHL-A	NH3	TKN	NO3	TN	TP	PO4	BOD	FECAL	TURB	DENSITY	BIOV
			m	°C	mg/l	SU	uMhos	ppt	m	ug/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	COL.*	FTU	units/ml	mm /m
																	5day				
890829	WB50	1500	1.0	30.0	9.2	8.2	11800	7.0													
860611	WC1	1810	0.1	26.0	5.5		154	0.0		20	0.28	0.6	0.06	0.66	0.28	0.01					
860730	WC1		0.1	23.0	6.3	4.3	167	0.0		0.5	0.14	0.7	0.06	0.76	0.02	0.01	1	340		344	357
860819	WC1		0.1	23.0	8.0	4.8	10900			4	0.04	2.0	0.42	2.42	0.13	0.01	2.1	18000		815	1807
860930	WC1	1400	0.1	25.0	4.3	6.4	120	0.0		2	0.07	0.3	0.02	0.32	0.07	0.01	1.5	340		2459	1205

TEMP = temperature DO = dissolved oxygen CONDO = conductivity SAL. = salinity SEC = Secchi depth CHL-a = chlorophyll-a

NH3 = ammonia/ammonium TKN = total kjeldalh nitrogen NO3 = nitrate/nitrite TN = total nitrogen TP = total phosphorus PO4 = orthophosphate

BOD = 5 day biochemical oxygen demand FECAL COL. = fecal coliform MFM-FCBR/100ml TURB. = turbidity

DENSITY = phytoplankton density BIOV. = phytoplankton biovolume