Annual Progress Report on Tar-Pamlico Agriculture Rule and Request for Full Approval of Four Local Nitrogen Strategies

A Report to the *Water Quality Committee* of the NC EMC from the Tar-Pamlico Basin Oversight Committee

November 9, 2005

Summary

The Tar-Pamlico Basin Oversight Committee (BOC) has received and approved annual reports estimating progress for the 2004 crop year from the fourteen Local Advisory Committees (LACs) operating under the Tar-Pamlico Agriculture Rule as part of the Tar-Pamlico Basin nutrient strategy. For the entire basin, agriculture has achieved an estimated 47% reduction in nitrogen loss compared to a 1991 baseline. This adds 2% to 2003 reductions reported last Fall and continues to exceed the rule-mandated 30% reduction. Thirteen of the fourteen LACs continue to exceed the 30% reduction goal with six LACs reporting reduction increases, which range between 1% and 19%. The remaining LAC, Washington County, has maintained the 25% reduction it achieved in 2003 and continues to implement its strategy approved in the Fall of 2002. The contribution of BMP implementation to the overall reduction increased in the past year, while reduced fertilizer application and cropping shifts remain the dominant factors. Since crop shifts are susceptible to economic pressures, all LACs will continue to increase BMP implementation, ensure BMP maintenance, improve tracking, and monitor cropping changes. Six Tar-Pamlico Technician positions, filled between September 2003 and June 2004, have been instrumental in providing information for this report, and will continue to play key roles in further implementation.

To date, the EMC has granted full approval to nine local nitrogen strategies under the rule, along with five conditional approvals. Four of the five remaining conditionally approved strategies – Beaufort, Hyde, Martin, and Washington - have now satisfactorily addressed unresolved items related to completing outreach and registration activities and BMP quantification. The BOC recommends that the EMC grant full approval to these four strategies, and anticipates receiving a complete strategy from the remaining LAC, Halifax, within the next year.

This annual report includes refinements to values reported in each of the last two years. In September 2004, NCSU scientists released a new version of the Nitrogen Loss Evaluation Worksheet (NLEW) software that incorporates updated Natural Resource Conservation Service (NRCS) soils and accounts for certain vegetable crops grown in the basin. For this report, all previous years were rerun using this new version. This has led to adjustments in both individual LAC and basinwide nitrogen reduction rates for each year previously reported.

Rule History

In 2000, the EMC moved the nonpoint source side of the Tar-Pamlico nutrient strategy to a regulatory approach with the adoption of rules addressing agriculture, urban stormwater, nutrient management, and riparian buffer protection. This rulemaking built on the precedent-setting Neuse effort three years earlier, which for the first time regulated cropland agriculture in the state. The agriculture rule supports the overall goals of the Tar-Pamlico nutrient strategy to reduce nitrogen loading to the Pamlico estuary by 30% from 1991 levels and to limit phosphorus loading to 1991 levels.

Rule Requirements

Effective in September 2001, the Agriculture Rule requires a collective 30% reduction in nitrogen loading from the baseline year of 1991 by basin agricultural operations. This reduction is required within five years, by September 2006. Local Advisory Committees (LACs) were given two years to develop nitrogen strategies. Phosphorus strategies shall be required to meet the "no increase" phosphorus goal within four years of the date that the EMC approves a phosphorus accounting methodology.

The BOC is composed of ten individuals appointed by the Secretary of the Department of Environment and Natural Resources and representing a cross-section of agricultural, environmental, scientific, and water quality interests. Responsibilities of the BOC include developing methods to track and account for nitrogen and phosphorus reductions, approving local reduction strategies, and presenting annual progress reports to the EMC.

Each of the fourteen county-level LACs is comprised of ten to fifteen individuals representing local agricultural agencies and farmers. The agencies include DSWC, NCDA, NRCS, CES, and the Soil and Water Conservation District (SWCD). Responsibilities of LACs include conducting farmer registration, developing local nitrogen and phosphorus strategies, providing annual progress reports, and ensuring maintenance of the goals once reached.

Changes to NLEW Nitrogen Accounting Tool for 2005

The essence of NLEW is an empirically derived spreadsheet model that estimates nitrogen export from agricultural management units through surface water and groundwater partitioning of nitrogen movement. The primary use of NLEW is to estimate relative reduction in nitrogen export through a pre- and post-BMP implementation calculation, rather than estimating delivery to surface waters.

In September 2004, NCSU scientists completed a new version of NLEW. This latest refinement incorporates updated soil series that are now certified by NRCS. It also adds accounting for vegetable crops such as cucumbers and peppers. Because these improvements showed significant and varying effects across counties, it was necessary to regenerate NLEW runs for all previous reporting years including the baseline using the updated version. This "re-running" of previous year's data led to changes across all counties and the basin as a whole. Table 1 compares results between original and new NLEW runs.

Implementation Issues

Unlike the Neuse basin, the Tar-Pamlico received no new funds for rule implementation. As an alternative, in 2002 DWQ and DSWC staff obtained 319 grant funds for six new Technician positions. Combining resources with those remaining in the Neuse basin yielded a total of 8.5

positions covering all or portions of twenty-four counties. As of June 2004, all Tar-Pamlico positions have been filled. These staff have been instrumental in collecting and processing information for the annual reports, and will play key roles in ongoing implementation. During the past year, they also compiled post-baseline BMP implementation data from files to confirm estimated values, and completed compilation of farmer registration information. Basinwide, they estimate that 73% of producers and 87% of cropland was successfully registered under the rule. In 2003, the Division of Soil and Water Conservation also obtained a 319 grant for $500,000 to augment BMP cost share in the Tar-Pamlico Basin, and the Technicians are working to recruit producers to implement BMPs with those funds.

Table 1. Adjustments to Basin Nitrogen Loss Reduction Estimates With Revised NLEW

	PERCENT NITROGEN REDUCTION RELATIVE TO 1991 BASELINE					
County	**NLEW 5.01 2001 N Loss**	**NLEW 5.02* 2001 N Loss**	**NLEW 5.01 2002 N Loss**	**NLEW 5.02* 2002 N Loss**	**NLEW 5.01 2003 N Loss**	**NLEW 5.02 * 2003 N Loss**
Beaufort	***18%***	***18%***	***27%***	***27%***	35%	33%
Edgecombe	***24%***	***29%***	***29%***	40%	40%	42%
Franklin	45%	67%	45%	69%	43%	65%
Granville	43%	44%	51%	50%	56%	55%
Halifax	42%	50%	35%	46%	39%	53%
Hyde	45%	44%	47%	49%	63%	64%
Martin	***24%***	*33%*	***26%***	37%	40%	49%
Nash	51%	44%	50%	45%	54%	47%
Person	49%	50%	49%	50%	49%	50%
Pitt	46%	54%	46%	48%	48%	50%
Vance	53%	55%	56%	58%	60%	61%
Warren	46%	47%	49%	51%	58%	57%
Washington	***14%***	***13%***	***23%***	***23%***	***25%***	***25%***
Wilson	50%	49%	53%	52%	46%	44%
Total/Avg.	**35%**	**39%**	**38%**	**41%**	**45%**	**47%**

Bold italic = Loss reductions less than 30%.
*NLEW Verson 5.02 was released in September 2004

Progress through 2004

Nitrogen Reduction from Baseline in 2004

This third annual report adds one crop year - 2004 - and follows the second annual progress report provided in October 2004, which covered implementation from 1992 through 2003. The BOC reported last year that ten of fourteen counties had exceeded their individual 30% reduction goals, with a basinwide aggregate 45% reduction in nitrogen loss. The aggregate reduction for 2003 has been revised using the updated version of the NLEW software (see inset, pg.2) from the previously reported 45% reduction in nitrogen loss to a 47% reduction. With the aggregate 47% reduction reported this year, thirteen of the fourteen counties continue to estimate individual reductions greater than 30% through 2004. Table 2 provides nitrogen loss reductions by county and for the basin. Values in the table are based on the updated NLEW, Version 5.02, except for the middle column, which provides the percent loss values reported last year, for crop year 2003, for comparison.

Table 2. Estimated Reductions in Agricultural Nitrogen Loss from Baseline for 2003 & 2004, Tar-Pamlico River River Basin (all values per NLEW 5.02 except as noted)

County	Baseline N Loss (lb)*	2003 Reported N Loss (%) (NLEW 5.01)	2004 N Loss (lb)*	2004 N Loss (%)
Beaufort	9,570,066	35%	6,622,183	31%
Edgecombe	5,416,956	40%	3,115,152	42%
Franklin	1,861,182	43%	574,903	69%
Granville	868,051	56%	454,344	48%
Halifax	2,997,660	39%	1,414,596	53%
Hyde	5,621,800	63%	2,551,632	55%
Martin	894,993	40%	442,322	51%
Nash	4,456,981	54%	2,243,604	50%
Person	168,038	49%	84,125	50%
Pitt	6,284,131	48%	2,601,849	59%
Vance	389,925	60%	76,952	80%
Warren	532,133	58%	267,318	50%
Washington	979,128	***25%***	736,032	***25%***
Wilson	691,330	46%	355,837	49%
Total/Avg.	**40,732,374**	**45%**	**21,540,849**	**47%**

Bold italic = Loss reductions less than 30%.

* Nitrogen loss values are for comparative purposes. They represent fertilizer that was applied to agricultural lands in the basin and neither used by crops nor intercepted by BMPs, based on NLEW calculations.

Nitrogen loss reductions from agricultural land have been achieved through a combination of fertilization rate decreases, cropping shifts, BMP implementation, and reduction in cropland acreage. Staff estimates that these factors contributed in the following proportions:

	2001	2002	2003	2004
Fertilization rate decreases:	23.7%	24.1%	23%	22.5%
Cropping shifts:	8.2%	7.7%	11.6%	11.8%
BMP implementation:	1.9%	3.2%	5.1%	6.5%
Reduction in cropland acreage:	4.7%	5.3%	7.1%	6.3%
TOTAL	38.5%	40.3%	46.8%	47.1%

These 'breakout' values are based on NLEW results. Like the loss reduction estimates above, these values have changed from those estimated last year as a result of the NLEW software improvements. Based on the new version, the contribution of N rate decreases is significantly greater than previously estimated, while BMPs and crop shifts play less of a role.

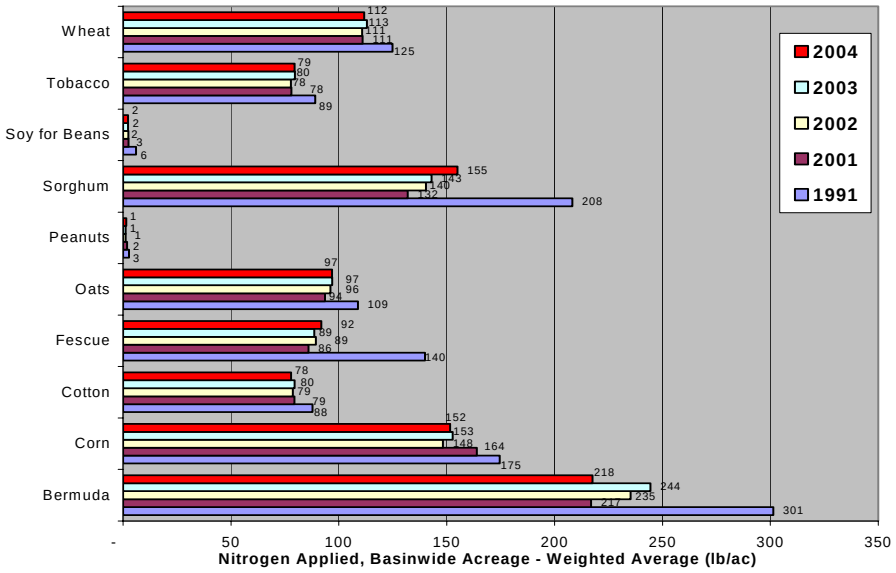
The Basin Oversight Committee believes that annual accounting will continue to reveal a degree of variability in nitrogen loss reduction in the basin over time. The next few sections describe some more readily identified source of variability. However, we also note that the business and science of agriculture are under perpetual change as a result of a great number of forces. These forces may include:

- Changes in world economies or trade policies
- Government program changes, e.g. commodity supports or environmental regulations
- Weather – e.g., long periods of drought or rain, large-scale meteorological events
- Plant diseases or pest problems such as exotic pests or viruses
- Technology - new crops brought into production or changes in how crops are grown as a result of research and development
- Effects of other land uses
  - closing of an animal processing plant results in nearby contract growers depopulating houses and shifting crops and nutrient sources
  - large grain grower renting local farms moves to other crop as rental lands sold to development
  - new industries which may increase the demand for corn and soy crops
- Age of farmer, i.e., approaching retirement farmer may move from row crop to cattle

Fertilization Rate Decreases

Reductions in fertilizer application have played easily the greatest role in progress to date, comprising almost half of the total reduction. The most effective means of reducing nitrogen loss is through reduction of inputs and minimization of use inefficiencies. Increased fertilizer costs and a growing understanding of optimum nutrient management have led to significant reductions in fertilization rates in the basin. Figure 1 illustrates how average nitrogen rates have decreased on most major crops between 1991 and 2004. Original values were developed by consensus within each LAC and have been adjusted annually based on cost share contract information and additional LAC input.

Figure 1. Acreage-Weighted Average Nitrogen Fertilization Rates by Crop, 1991-2004, Tar-Pamlico River Basin



Factors identified by LACs as contributing to reduced nitrogen rates include the following:

- Farmers face rising fertilizer costs and dwindling farm incomes.
- Agencies have responded with increasing education and outreach on nutrient management.

- Compliance with DWQ animal regulations has resulted in lower waste application rates.
- Reductions in tobacco poundage quotas and contract growing of tobacco.
- Loss of the USDA ACP cost share program, which funded nutrient management on pasture.
- Neuse and Tar-Pamlico agriculture rules.

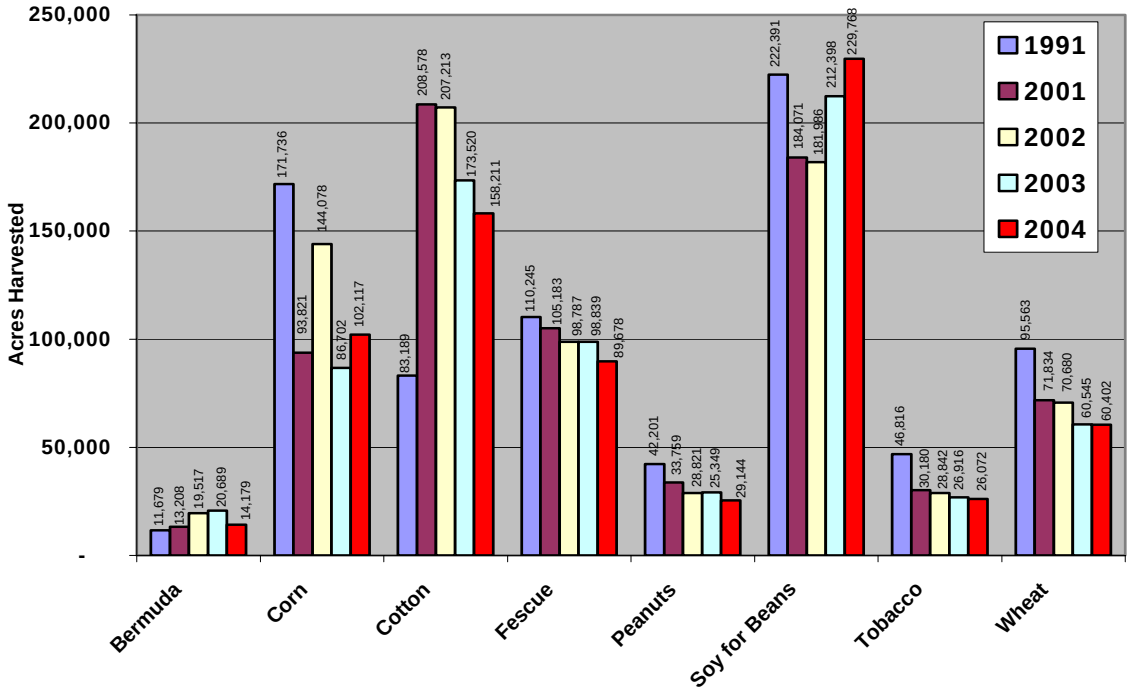
Cropping Shifts

At 11.8%, the overall effect from crop shifts is the second most influential factor affecting nitrogen loss in the basin. This is only a slight increase from 2003, when crop shift accounted for about 11.6% of the entire reduction. Since different crops require different amounts of nitrogen and use applied nitrogen with different efficiencies, changes in the mix of crops grown affects nitrogen loss. A host of factors from individual to global influences crop choices.

The most significant crop shift affecting nitrogen loss after the baseline was a corn-to-cotton shift during the 1990's (see Figure 2). During this period, corn decreased from 21% of all cropland in the basin to 12%, while cotton simultaneously increased from 10% of all cropland to 23%. Since cotton is fertilized at roughly half the N rate of corn (see Figure 1) and both use N with similar efficiency, this yielded sizable decreases in basin N applied and loss by 2001.

Since 2001, the corn-to-cotton effect has reversed itself mildly. However, a jump in soybean acres in 2003 contributed greatly to an approximately 50% increase in the role of crop shift in the basin N loss reduction. This increase in soybean acreage is also significant to reducing the overall nitrogen loss in the basin, since soybeans receive little to no nitrogen, while almost all crops they replaced receive at least 80 lbs per acre, a large difference.

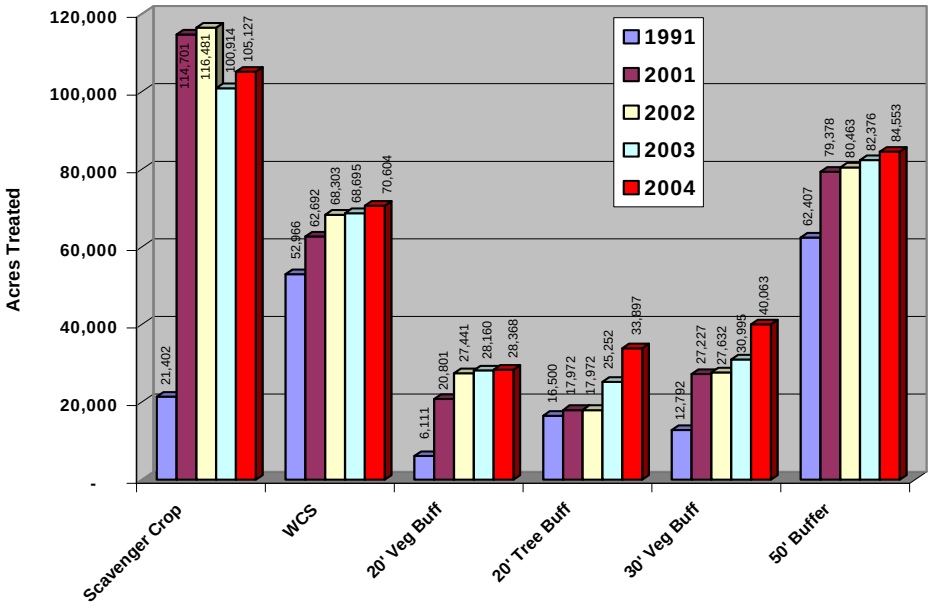
Figure 2. Acreage Changes of Major Crops, Tar-Pamlico River Basin, 1992-2004



BMP Implementation

While BMP implementation makes a lesser contribution to overall reduction than other factors, the number of BMPs installed in the Basin since 1991 has steadily increased. The fraction of all cropland treated by nitrogen-reducing practices increased from 46% in 2003 to 49% in 2004. The overall nitrogen loss reduction in the basin attributed to the use of BMPs is estimated to be 6.5%. This is an increase from the 5.1% reported in 2003. Figure 3 below illustrates the extent of BMP implementation. Much of this was accomplished with assistance from cost share programs. It is important to recognize that cost share programs involve significant expenses to basin farmers, and many farmers also implement practices without cost share assistance. The BOC recognizes farmers for their efforts, and hopes to better quantify unassisted implementation in future annual reports.

Figure 3. BMPs Installed in the Tar-Pamlico River Basin, 1992-2004



Non-Credit BMPs

Certain practices on the landscape provide nitrogen reduction benefits that are difficult to quantify and that are *not* included in the estimates provided here. Such practices in Tar-Pamlico counties since 1991 include:

- Significant losses of confined animal operations in some counties.
- Closure of abandoned lagoons following shutdown of animal operations.
- For some animal operations, compliance with DWQ's .0200 regulations involved removal of direct discharges to surface waters.
- Dry stack waste storage facilities installed for poultry litter.

In addition, many BMPs are not recognized for substantial nitrogen benefits but clearly reduce phosphorus and erosion losses and benefit water quality in other ways. Table 2 lists these other types of BMPs installed from 1992 to 2004. Units of BMPs reported in this table are the actual BMP footprint acreage, not acreage treated by these BMPs.

Table 3. Additional, Non-N Credit, BMPs Installed 2001 - 2004, Tar-Pamlico Basin

BMP	Units	2001	2002	2003	2004
Conservation Tillage	Acres	60,650	70,211	70,279	70,341
Conservation Tillage 3 Yr.	Acres	128	8,111	13,029	17,446
Long Term No-Till	Acres	936	3,351	3,743	3,881
Terraces	Feet	206,560	444,294	444,394	444,394
Diversion	Feet	176,797	332,510	332,510	338,800
Sod Based Rotation	Acres	1,337	2,274	2,705	3,149
Strip Cropping	Acres	567	425	425	425
Field Border	Acres	118	254	269	301
Grassed Waterway	Acres	314	522	523	526
Livestock Exclusion	Feet	21,662	43,262	59,856	62,858

* Information obtained from NC Agricultural Cost Share Reports 12/2001 through 12/2004. This does not include Best Management Practices that were voluntarily installed through various federal programs or without government assistance. Values expressed are cumulative from 2001 to 2004.

Reduction in Cropland Acreage

Cropland acres can vary significantly each year, however, the general basin trend mirrors decreases seen statewide. The LACs report that basin cropland acreage has decreased 8.5% since 1991. This acreage reduction resulted in an estimated 6.7% reduction in N loss. This includes not only land converted to development, but idled land and cropland converted to buffer practices. The BOC expects to provide a breakout of these factors' contributions to cropland loss in future annual reports.

A significant fraction of the acreage drop reported here went to non-development use, yielding real net reductions in N loss. One county, Hyde, is responsible for 35% of the basin's entire cropland acreage decrease since the baseline period, with a drop of approximately 30,000 acres. Hyde County has the lowest population density in the basin and has experienced virtually no growth in the last decade. The acreage reduction in this county has been attributed to retirement of marginal croplands that were created from pocosin, returning them to wetland functionality. This retirement process has been accomplished primarily under the federal Wetlands Reserve Program. This trend has resulted in real reductions in nutrient loading to the Pamlico estuary.

Phosphorus Accounting

Background: The agriculture rule requires the BOC to develop and implement an accounting method for phosphorus in the same manner that it does for nitrogen. However, it recognizes that a phosphorus tool analogous to NLEW has not been developed and that doing so may present significant challenges. The rule calls for the formation of a technical advisory committee to address this challenge, and makes both the timing and content of implementation of phosphorus accounting contingent on the recommendations of this committee.

During rule development and early implementation, a separate effort occurred that addressed phosphorus management on agricultural lands in the state. The USDA-NRCS in North Carolina conducted a 3-year interagency process to revise the state Nutrient Management standard, Standard 590 of the Field Office Technical Guide, to comply with a 1999 change in federal

NRCS nutrient management policy. The change in federal policy resulted from a growing body of research during the 1990's that substantiated the real potential for phosphorus loss from agricultural lands, contrary to previous understanding, through a number of pathways. The Soil and Water Conservation Commission adopted the revised state 590 standard in May 2003. This process yielded a field-scale phosphorus loss risk assessment tool, PLAT, which is very useful in individual site applications. The BOC explored the potential for aggregating this tool to a county scale as done with NLEW, but was advised by researchers and other technical experts that this concept was technically insupportable due to the site-specific and highly variable behavior of phosphorus in soils and through landscapes.

PTAC: In Summer 2004, the BOC initiated the Phosphorus Technical Advisory Committee called for in the rule, and the Division contracted with NCSU researchers to provide technical support. The committee included representation from the NC Department of Agriculture, Division of Soil and Water Conservation, DWQ Planning, DWQ Non-Discharge Permitting, USDA-NRCS, NC Farm Bureau, NC Environmental Defense, and NC State University Soil Science Department. The committee met and communicated frequently over the last year, and ultimately produced the *attached report*.

PTAC Findings: The committee's overall purpose was to establish a phosphorus accounting method for agriculture in the basin. It determined that a defensible, aggregated, county-scale accounting method for estimating phosphorus losses from agricultural lands is not currently feasible. This is due to "the complexity of phosphorus behavior and transport within a watershed, the lack of suitable data required to adequately quantify the various mechanisms of phosphorus loss and retention within watersheds of the basin, and the problem with not being able to capture agricultural conditions as they existed in 1991. The PTAC has instead evaluated, to the limits of available data, trends in land use and management related to agricultural activity in the basin from 1991 to the present. In addition, it has developed recommendations for *qualitatively* tracking relative changes in practices that either increase or decrease the risk of phosphorus loss from agricultural lands in the basin on an annual basis. The committee believes this approach to be the best alternative toward meeting the spirit of the Rule."

In addressing the question of whether basin agricultural phosphorus losses have increased since 1991, the committee found that, "Although we cannot know with absolute certainty, we would conclude from this relative change assessment that no substantial increases in phosphorus loading from agricultural activities have occurred in the Tar-Pamlico River Basin relative to 1991 levels." Recognizing uncertainties associated with all metrics, the two primary measures of phosphorus inputs to the basin – crop acres and animal waste phosphorus – showed decreases and small increases, respectively. The main measure of residual phosphorus – soil P content – showed an increase through 1995 followed by a decrease through 2003. Importantly, phosphorus capture/retention as represented by BMP implementation showed great increases over the time period, supporting the belief that losses may have decreased in the basin.

The committee observed that, "This conclusion is corroborated by water quality data showing a net decrease in phosphorus loading in the basin (estimated to be 33% between 1991 and 2002)." This estimate resulted from a trend evaluation conducted by DWQ Modeling Unit staff, which examined instream trends at Grimesland, seven miles above the estuary at Washington, over 12 years. The committee recognized that this trend reflects all sources, including point sources, which comprise approximately one-third of all phosphorus inputs and which reduced discharge

loads by approximately 60% over this period. Given the overall trend estimate, it appears that nonpoint sources as a whole achieved reductions. Recognizing that agriculture is easily the largest nonpoint source of phosphorus, this observation appeared to support the conclusion of no increase and potential decrease.

Management Implications: In terms of annual accounting, the committee identified a set of qualitative indicators, listed in the Executive Summary, that can be compared in future years to 2003, the latest year it evaluated, for positive or negative trends. The committee did not feel it appropriate to utilize this set of indicators in a quantitative summation of trend, but rather to monitor for any gross changes in agricultural status that would merit further attention by the EMC.

Based on the PTAC's findings, the BOC recommends that no additional management actions be required of agricultural operations in the basin at this time to comply with the "no net increase" phosphorus goal of the agriculture rule. We propose to track and report the identified set of qualitative phosphorus indicators to the EMC annually, and to bring any concerns raised by the results of this effort to the EMC's attention as they arise, along with recommendations for any appropriate action. The BOC expects that BMP implementation will continue to increase throughout the basin in future years, and notes that BMPs installed for nitrogen, pathogen and sediment control often provide significant phosphorus benefits as well. With this expectation in mind, we feel reasonably confident that phosphorus losses will continue to improve over time.

Future: The committee did not foresee any changes that would allow for either *quantitative* accounting relative to 1991 in the Tar-Pamlico Basin, or large-scale agricultural phosphorus accounting in *any* basin. Division staff is exploring the potential for long-term, periodic statistical sampling of a randomly selected set of fields as an alternative trend tool for this and other basins. One round of such sampling has been conducted in both the Neuse and Tar-Pamlico Basins since implementation of the agriculture rules.

Looking Forward

The BOC will continue to improve rule implementation, relying heavily on the basin Technicians to work with the LACs and farmers. The BOC is focusing on a number of issues, including assisting the Washington County LAC to reach a 30% reduction.

Washington Strategy

The Washington LAC's reduction remained unchanged from 2003 to 2004 at 25% nitrogen loss reduction. Further improvements in nutrient management and installation of water control structures are possible and will be sought toward the 30% goal. Although the US Navy may still proceed with a proposed plan for placing its outlying landing field in the county, the reduction strategy will rely on management improvements that are independent of the OLF outcome.

To achieve the 30% N goal, Washington County will need to install an additional 2,597 acres of water control, or approximately 34 additional structures, to increase the current 8,443 acres affected to 11,140. To assist in this implementation, the Division of Soil and Water Conservation will target funds from a recently acquired 319 grant for $500,000 in part to augment BMP cost share in Washington County. The County has also recently acquired a new

District Technician who will aid implementation. One issue that remains challenging is the economic difficulties local growers have with providing their required 25% of the cost share.

Other Issues

Since *cropping shifts* are susceptible to various pressures, the BOC is working with LACs in all counties to continue BMP implementation that provides for a lasting reduction in N loss in the basin while monitoring cropping changes.

As discussed in the Reduction in Cropland Acreage section above, the BOC plans to establish an accurate method to estimate each of the factors contributing to overall *crop acreage decrease* in the next annual report. The BOC also hopes to quantify the extent of unassisted BMP implementation in future years.

In large measure, the success of this program hinges on *funding* from various sources, which supports BMP cost-share, technical assistance to farmers, outreach information, development of accounting processes, and staff positions to carry out these activities. Progress achieved to date has largely come through extensive efforts by existing agencies to take existing cost share programs to their producers.

The BOC expects that work of the basin technicians and recently added or improved funding streams will continue to increase implementation of nutrient reducing activities, yield better accounting, and provide for lasting maintenance of these benefits. We plan to increasingly address *long-term issues* as we move forward.

Recommendation

The Tar-Pamlico Basin Oversight Committee has reviewed and approved annual reports from all fourteen LACs. In addition, four of the five strategies that were conditionally approved last year have now satisfactorily addressed unresolved items. The BOC requests that the EMC grant full approval to these four strategies identified below, and anticipates receiving a complete strategy from the remaining LAC within the next year. Remaining conditional items pertaining to the Halifax County strategy primarily involve completely quantifying BMP implementation to date.

Full Approval Granted 03'- 04'	**Full Approval Requested**	Remaining Conditional Approvals
Franklin, Pitt, Granville, Vance, Nash, Wilson, Person, Warren, Edgecombe	**Beaufort** **Hyde** **Martin** **Washington**	Halifax