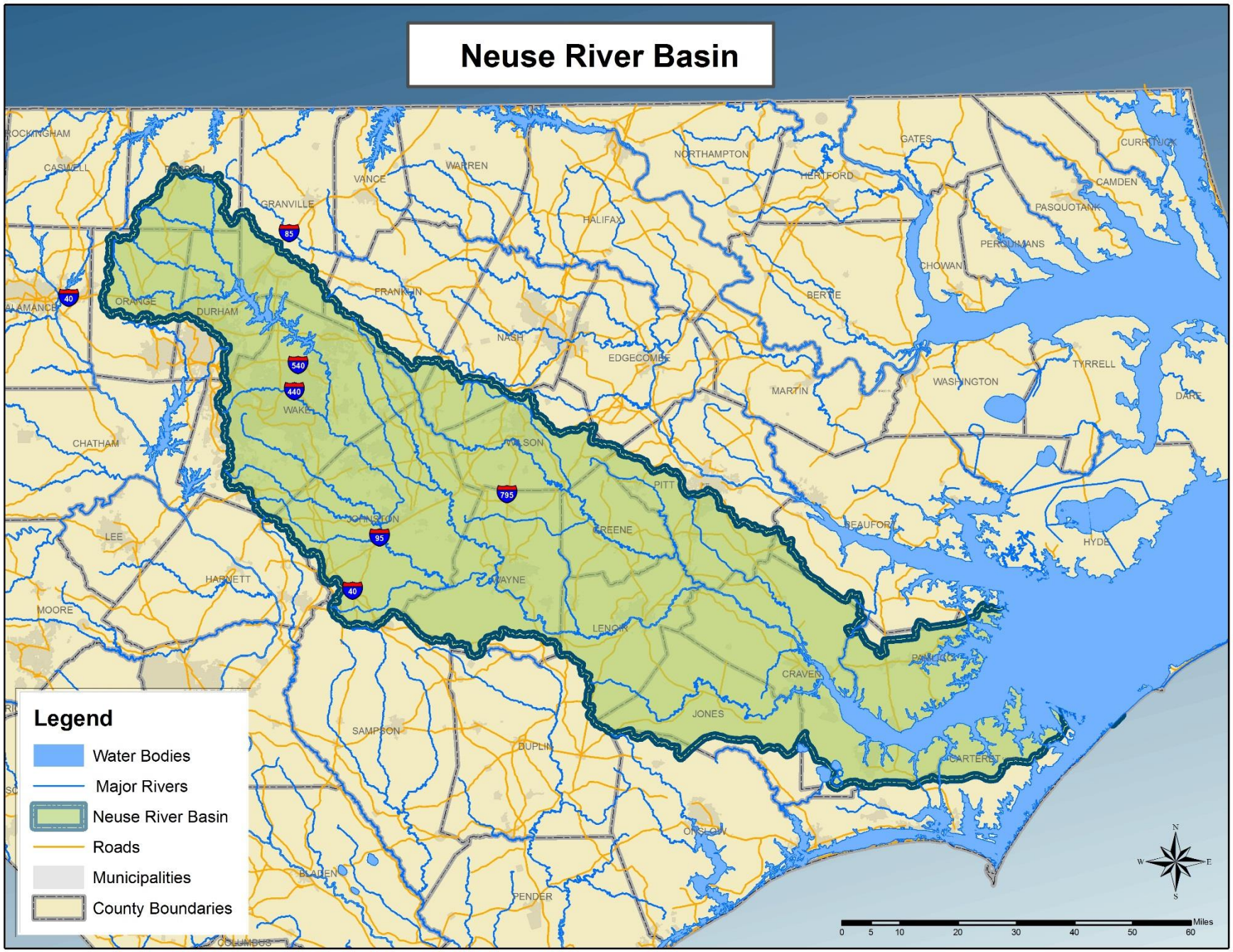
NCDA&CS

2019 Annual Progress Report (Crop Year 2018) on the Neuse Agricultural Rule (15 A NCAC 2B.0238)

A Report to the Environmental Management Commission from the Neuse Basin Oversight Committee: Crop Year 2018


Neuse River Basin
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Summary

The Neuse Basin Oversight Committee (BOC) received and approved crop year (CY[1]) 2018 annual reports estimating the progress from the seventeen Local Advisory Committees (LACs) operating under the Neuse Agriculture rule as part of the Neuse Basin Nutrient Management Strategy. This report demonstrates agriculture's ongoing collective compliance with the Neuse Agriculture Rule and estimates further producer progress in decreasing nutrients. In CY2018, agriculture collectively achieved an estimated 53% reduction in nitrogen loss from agricultural lands compared to the 1991-1995 baseline, continuing to exceed the rule-mandated 30% reduction. Sixteen of the seventeen LACs exceeded the 30% reduction goal established by the BOC. The main reason for the greater nitrogen reduction in these counties is cropping shifts to crops with lower nitrogen demands and application rates.

Rule Requirements and Compliance History

Neuse Nutrient Sensitive Waters (NSW) Strategy

The Environmental Management Commission (EMC) adopted the Neuse nutrient strategy in December, 1997. The NSW strategy goal was to reduce the average annual load of nitrogen delivered to the Neuse River Estuary by 2003 from both point and non-point source pollution by a minimum of 30% of the average annual load from the baseline period (1991-1995). Mandatory nutrient controls were applied to address non-point source pollution in agriculture, urban stormwater, nutrient management, and riparian buffer protection. The overall 30% nitrogen loading reduction target for the Neuse River Estuary has not yet been reached.

Effective December 1997, the rule provides for a collective strategy for farmers to meet the 30% nitrogen loss reductions within five years. A BOC and seventeen LACs were established to implement the Neuse Agriculture rule and to assist farmers with complying with the rule.

All seventeen Local Advisory Committees (LACs) met as required in 2019. The LACs submitted their first annual report to the BOC in May 2002. That report estimated a collective 38% reduction in nitrogen loss with 12 of the 17 LACs exceeding 30% individually. In 2003, all LACs achieved their BOC recommended reduction goal. All counties are currently meeting their goal with the exception of Pamlico County, which reported a 29% reduction. Division of Soil and Water Conservation staff uses input from the LACs to calculate their annual reductions using the Nitrogen Loss Estimation Worksheet (NLEW). Adjustments are made to reflect the most up-to-date scientific research. These revisions lead to adjustments in both individual LAC and basinwide nitrogen loss reduction rates.

[1] The 2018 crop year began in October 2017 and ended in September 2018.

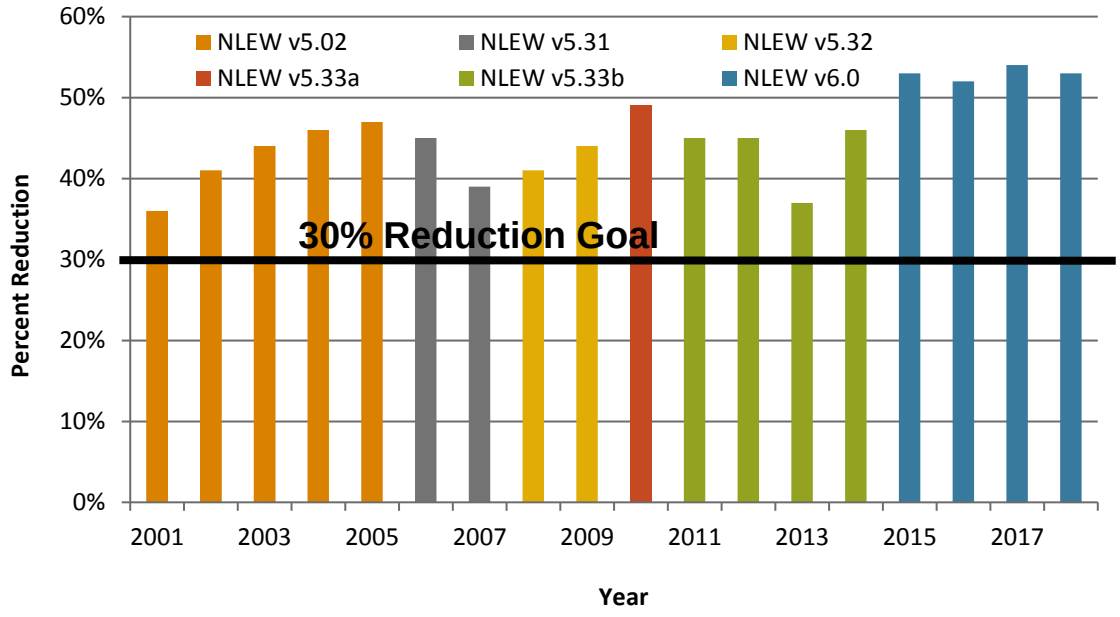
Scope of Report and Methodology

The estimates provided in this report represent whole-county scale calculations of nitrogen loss from cropland agriculture adjusted for acreage in the basin. These estimates were made by NC Division of Soil and Water Conservation (DSWC) staff using the 'aggregate' version of the Nitrogen Loss Estimation Worksheet, or NLEW, an accounting tool developed to meet the specifications of the Neuse Rule and approved by the EMC. The development team included interagency technical representatives of the NC Division of Water Resources (DWR), NC DSWC and USDA-Natural Resources Conservation Service (NRCS) and was led by NC State University Soil Science Department faculty. The NLEW captures application of both inorganic and animal waste sources of fertilizer to cropland. It does not capture the effects of nitrogen applied to pastureland and NLEW is an "edge-of-management unit" accounting tool; it estimates changes in nitrogen loss from croplands, but does not estimate changes in nitrogen loading to surface waters.

Annual Estimates of Nitrogen Loss and the Effect of NLEW Refinements

The NLEW software is periodically revised to incorporate new knowledge gained through research and improvements to data. These changes have incorporated the best available data, but changes to NLEW must be considered when comparing nitrogen loss reduction in different versions of NLEW. Further updates in soil management units are expected as NRCS produces updated electronic soils data. The small changes in soil management units are unlikely to produce significant effects on nitrogen loss reductions. Figure 1 represents the annual percent nitrogen loss reduction from the baseline for 2001 to 2018.

Figure 1. Collective Nitrogen Loss Reduction Percent 2001 to 2018 Based on NLEW, Neuse River Basin.



The first NLEW reports were run in 2001, and agriculture has continued to exceed its collective 30% nitrogen reduction goal since that time. The first NLEW revision (v5.31) marked a significant decrease in the nitrogen reduction efficiencies of buffers based on the best available research information, so baseline and CY2005 were re-calculated, and soil management units were revised. The second (v5.32) and third (v5.33a) revisions were minor updates of soil mapping units. In April of 2011 the NLEW Committee established further reductions (v5.33b) in nitrogen removal efficiencies for buffers based on additional research. In 2016 NLEW software was updated (v6.0) from outdated software and transferred to a web-based platform on NCDA&CS servers. Revised realistic yield and nitrogen use efficiency data from NCSU was incorporated, and some minor calculation errors were corrected for corn, sweet potatoes, and sweet corn. Table 1 lists the changes in buffer nitrogen reduction efficiencies over time.

Table 1. Changes in Buffer Width Options and Nitrogen Reduction Efficiencies in NLEW

Buffer Width	NLEW v5.02 % N Reduction 2001-2005	NLEW v5.31, v5.32, v5.33a % N Reduction 2006-2010	NLEW v5.33b, v6.0 % N Reduction 2011-Current
20’	40% (grass)* 75% (trees & shrubs)*	30%	20%
30'	65%	40%	25%
50'	85%	50%	30%
70'	85%	55%	30%
100'	85%	60%	35%

**NLEW v5.02 - the vegetation type (i.e. trees, shrubs, grass) within 20' and 50' buffers determined reduction values. Based on research results, this distinction was dropped from subsequent NLEW versions.*

Current Status

Nitrogen Reduction from Baseline for CY2018

All seventeen LACs submitted their seventeenth annual reports to the BOC for approval in July 2019. For the entire basin, in CY2018 agriculture achieved a 53% reduction in nitrogen loss compared to the 1991-1995 baseline. This percentage is 1% lower than the reduction reported for CY2017. Table 2 lists each county's baseline, CY2017 and CY2018 nitrogen (lbs/yr) loss values, and nitrogen loss percent reductions from the baseline in CY2017 and CY2018.

*Table 2. Estimated Reductions in Agricultural Nitrogen Loss from Baseline (1991-1995) for 2017 and 2018, Neuse River Basin**

County	Baseline N Loss (lb)	CY2017 N Loss (lb)*	CY2017 N Reduction (%)	CY2018 N Loss (lb)*	CY2018 N Reduction (%)
Carteret	1,292,586	579,560	55%	386,374	70%
Craven	4,153,187	1,624,792	61%	1,689,533	59%
Durham	220,309	46,750	79%	56,971	74%
Franklin	219,209	36,523	83%	32,255	85%
Granville	193,197	34,473	82%	22,829	88%
Greene	4,439,036	2,200,240	50%	2,129,818	52%
Johnston	6,728,638	2,968,504	56%	2,989,292	56%
Jones	3,283,906	1,905,765	42%	1,965,990	40%
Lenoir	4,455,752	2,792,978	37%	2,917,366	35%
Nash	1,042,072	395,734	62%	397,240	62%
Orange	787,040	64,745	92%	66,519	92%
Pamlico	2,023,294	1,515,890	25%	1,445,657	29%
Person	616,669	102,157	83%	91,053	85%
Pitt	3,399,455	1,809,570	47%	1,876,674	45%
Wake	1,434,602	259,360	82%	297,438	79%
Wayne	8,297,408	3,317,882	60%	3,485,566	58%
Wilson	3,273,647	1,667,938	49%	1,688,676	48%
Total	45,860,007	21,322,861	54%	21,539,251	53%

** Nitrogen loss values are for comparative purposes. They represent nitrogen that was applied to agricultural lands in the basin and neither used by crops nor intercepted by BMPs in a Soil Management Unit, based on NLEW calculations. This is not an in-stream loading value.*

Nitrogen loss reductions were achieved through a combination of fertilization rate decreases, cropping shifts, BMP implementation, and cropland acreage fluctuation. Winter weather during CY2018 was similar to that of CY2017. Planted wheat acres increased slightly from the previous year which experienced a large decline in wheat crops when many fields were too wet

to plant. Conditions were slightly improved in CY2018 so some acres rebounded. Factors that influence agricultural nitrogen reductions are shown in Table 3.

Pamlico County is working to improve their reduction, which increased this year compared to CY2018. From CY2017 to CY2018 Pamlico experienced a decrease of 777 acres of soybeans and 848 acres of wheat and an increase of 189 acres of cotton. The Pamlico Soil and Water Conservation District Board has made water control structure implementation the top priority in their FY2020 NC Agriculture Cost Share Program (ACSP) strategy plan. As of CY2018 it is estimated that over 40% of agricultural land in Pamlico County currently has some form of controlled drainage utilizing water control structures. The DSWC, LACs and additional stakeholders are working with others in the agricultural community in this county and the surrounding area to communicate the need for more BMP installation at existing commodity outreach events. The BOC will continue to focus its efforts to monitor this county's progress and encourage BMP implementation.

The NLEW outputs and staff calculations estimate the factors that contributed to the nitrogen reduction by the percentages shown in Table 3.

*Table 3. Factors That Influence Nitrogen Reduction on Agricultural Lands (by percentage), Neuse River Basin**

Practice	CY2015	CY2016	CY2017	CY2018
BMP implementation	9%	9%	10%	9%
Fertilization management	10%	11%	13%	9%
Cropping shift	20%	18%	19%	19%
Cropland converted to grass/trees	2%	2%	2%	2%
Cropland lost to idle land	4%	4%	2%	6%
Cropland lost to development	8%	8%	8%	8%
Total	53%	52%	54%	53%

**Percentages are based on a total of the reduction, not a year-to-year comparison.*

BMP Implementation

As illustrated in Figure 2, CY2018 BMP implementation yielded a net decrease of 4,295 nutrient scavenger crop acres. No additional buffers were implemented in CY2018.

An accurate reassessment of active agricultural land and remaining buffer systems is badly needed due to the rate at which urbanizing counties have lost agricultural land. The feasibility of a countywide GIS analysis of agricultural land buffers in Durham County is being explored for future reporting. This assessment will depend on data availability from state and federal agencies, and the BOC plans to reexamine the suitability of these data sources in the future.

The Division of Soil and Water Conservation, Soil and Water Conservation Districts and Natural Resources Conservation Service staff continue to make refinements to the NLEW accounting process as opportunities arise. LAC members estimate annual nutrient scavenger crop acres based on crop rotations, producer cropping history, state and federal incentive programs, weather patterns, and seed prices. Buffer and water control structure BMP data is collected from state and federal cost share program active contracts, and in some cases (especially nutrient scavenger crops) BMPs that were installed without cost share funding. While there is some opportunity for variability in the data reported, LACs are including data that is the best information currently available. As additional sound data sources become available, the LACs will review these sources and update their methodology for reporting if warranted.

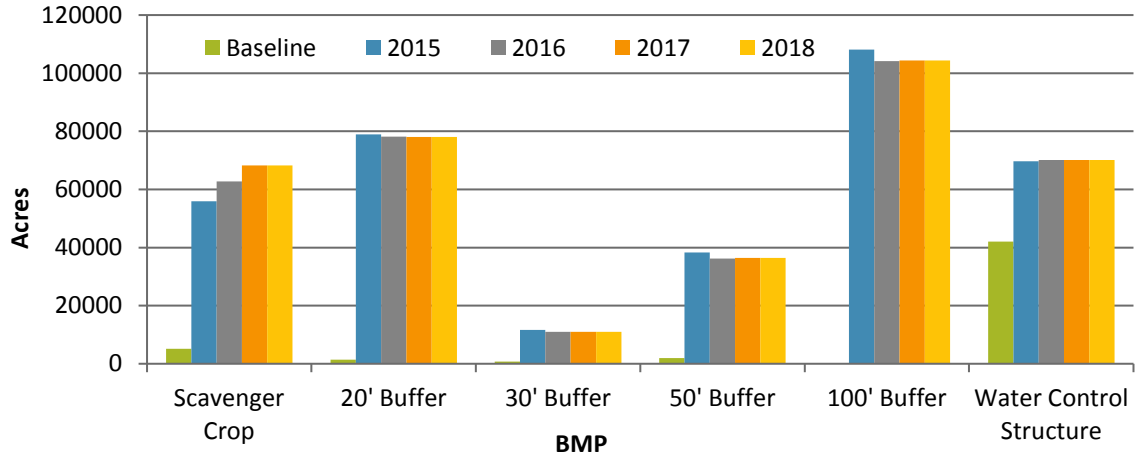
Every effort is being made to ensure that BMPs currently being reported continue to function as designed. Verification of this functionality requires site visits to individual farm owners who may or may not be under active contract. Coastal counties have reported that despite contract expirations, the water control structures which have been checked and which are no longer covered by an operation and maintenance agreement are still being actively managed by producers. Before next year's progress report the Division of Soil and Water Conservation intends to add an option for producers with older contracts to re-enter an operation and maintenance agreement in exchange for a discounted payment and whatever repair funds are necessary to restore structure functionality. The Division plans to coordinate outreach to Districts to determine how many producers are still farming who may need structure repairs or riser replacements. Future availability of this offer is dependent on the identification and procurement of additional funding. Contracts which are re-enrolled in the Agriculture Cost Share Program or structures which are field-verified as still functioning will be retained in future accounting, but other expired contracts will be removed.

Based on the comparison of total cropland acres and state or federal cost share program BMPs, it is estimated that over a third of the Neuse River Basin's cropland receives treatment from reported nitrogen reducing BMPs.[2] This does not include farmer-installed BMPs that are not funded by cost share programs except in some cases where SWCD staff is made aware of work that has been completed. Additionally, the estimated acres do not take into account the entire drainage area treated by buffers in the piedmont, which is generally 5 to 10 times higher than

[2] Osmond, D.L., K. Neas. 2011. Delineating Agriculture in the Neuse River Basin. Prepared for NC Department of Environment and Natural Resources (NCDENR), Division of Water Quality. http://content.ces.ncsu.edu/delineating-agriculture-in-the-neuse-river-basin

the actual acres of the buffer shown in Figure 2.[3] Overall, the total acres of implementation of BMPs have increased since the baseline, as illustrated in Figure 2. The BMP installation goals were set by the local nitrogen reduction strategy, which was approved by the EMC in 1999. Agriculture exceeded all of these goals in CY2008.

Figure 2: Cumulative Nitrogen Reducing BMPs Installed on Agricultural Lands for Baseline (1991-1995) and from 2015-2018, Neuse River Basin (except for scavenger crops, which are an annual practice)



The acres of buffers listed represent actual acres. Acres affected by the buffer could be 5 to 10 times larger in the piedmont than the acreage shown above. [4]

Additional Nutrient BMPs

Not all types of nutrient-reducing BMPs are tracked by NLEW. These include livestock-related nitrogen and phosphorus reducing BMPs, BMPs that reduce soil and phosphorus loss, and BMPs that do not have enough scientific research to support a nitrogen reduction benefit. The BOC believes it is worthwhile to recognize these practices. Table 4 identifies BMPs not accounted for in NLEW and tracks their implementation in the basin since CY1996.

Increased implementation numbers are evident in CY2018 across most BMP types. Some of these BMPs will yield reductions in nitrogen loss that are not reflected in the NLEW accounting in this report but will benefit the estuary.

[3] Bruton, Jeffrey Griffin. 2004. Headwater Catchments: Estimating Surface Drainage Extent Across North Carolina and Correlations Between Landuse, Near Stream, and Water Quality Indicators in the Piedmont Physiographic Region. Ph.D. Dissertation. Department of Forestry and Environmental Resources, North Carolina State University, Raleigh, NC 27606. http://www.lib.ncsu.edu/theses/available/etd-03282004-174056/

[4] Bruton, Jeffrey Griffin. 2004. Headwater Catchments: Estimating Surface Drainage Extent Across North Carolina and Correlations Between Landuse, Near Stream, and Water Quality Indicators in the Piedmont Physiographic Region. Ph.D. Dissertation. Department of Forestry and Environmental Resources, North Carolina State University, Raleigh, NC 27606. http://www.lib.ncsu.edu/theses/available/etd-03282004-174056/

*Table 4: Nutrient-Reducing BMPs Not Accounted for in NLEW, 1996 to 2018, Neuse River Basin**

BMP	Units	1996-2011	2015	2016	2017	2018
Diversion	Feet	149,449	166,199	166,600	178,554	180,717
Fencing (USDA programs)	Feet	154,885	214,748	228,216	234,791	234,827
Field Border	Acres	3,337	5,219	5,225	5,916	5,949
Grassed Waterway	Acres	2,261	2,358	2,377	2,424	2,501
Livestock Exclusion	Feet	81,389	118,178	125,190	131,473	149,501
Precision Agriculture	Acres	0	3,660	3,664	3,664	4,672
Sod Based Rotation	Acres	60,115	101,429	102,752	107,572	109,314
Tillage Management	Acres	34,072	59,057	59,680	60,919	61,384
Terraces	Feet	49,970	76,175	76,175	77,625	77,633

**Cumulative data provided using active contracts in State and Federal cost share programs.*

Fertilization Management

Better nutrient management in the Neuse River has resulted in a reduction of fertilizer application rates from baseline levels. Despite annual fluctuations, fertilization rates for all major crops in the basin have been reduced from the baseline period.

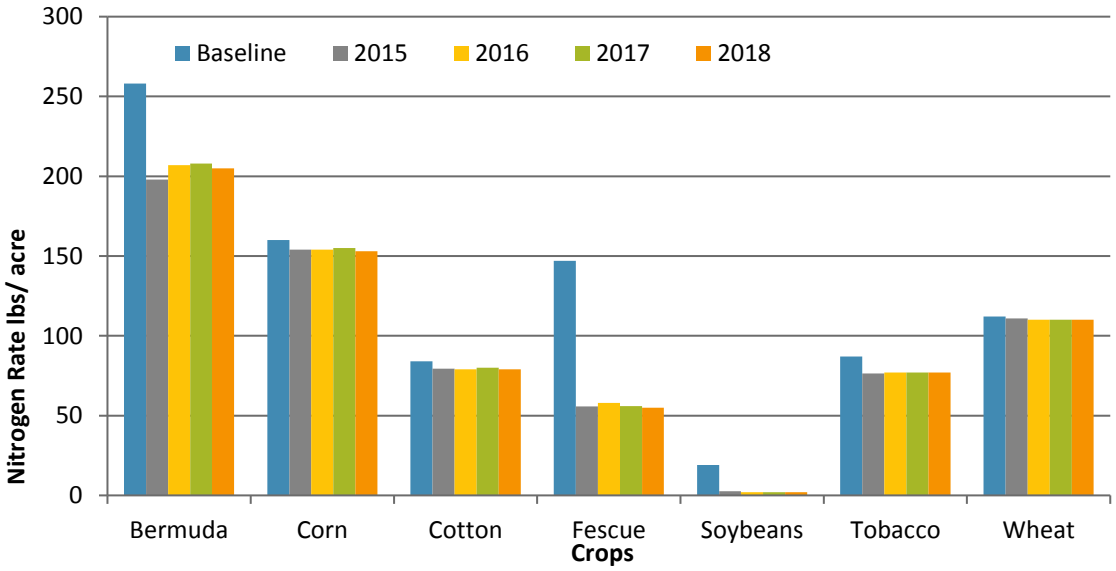
Between CY2017 and CY2018 nitrogen application rates decreased by 3 lbs/acre on bermuda and 2 lbs/acre on corn. Application rates were stable for cotton, fescue, soybeans, tobacco, and wheat. Figure 3 shows these application rates.

Factors Identified by LACs Contributing to Reduced Nitrogen Application Rates

- Economic decisions and fluctuating farm incomes.
- Increased education and outreach on nutrient management (NC Cooperative Extension held 21 nutrient management training sessions and approximately 2,000 farmers and applicators received training.)
- Mandatory animal waste management plans
- The federal government tobacco quota buy-out reducing tobacco acreage.
- Neuse and Tar-Pamlico Nutrient Strategies

Over time there has been an economic incentive for producers to improve nitrogen management. Fertilizer rates and standard application practices are revisited annually by LACs using data from farmers, commercial applicators and state and federal agencies' professional estimates.

Figure 3. Average Annual Nitrogen Fertilization Rate (lbs/ac) for Agricultural Crops for the baseline (1991-1995) and 2015-2018, Neuse River Basin

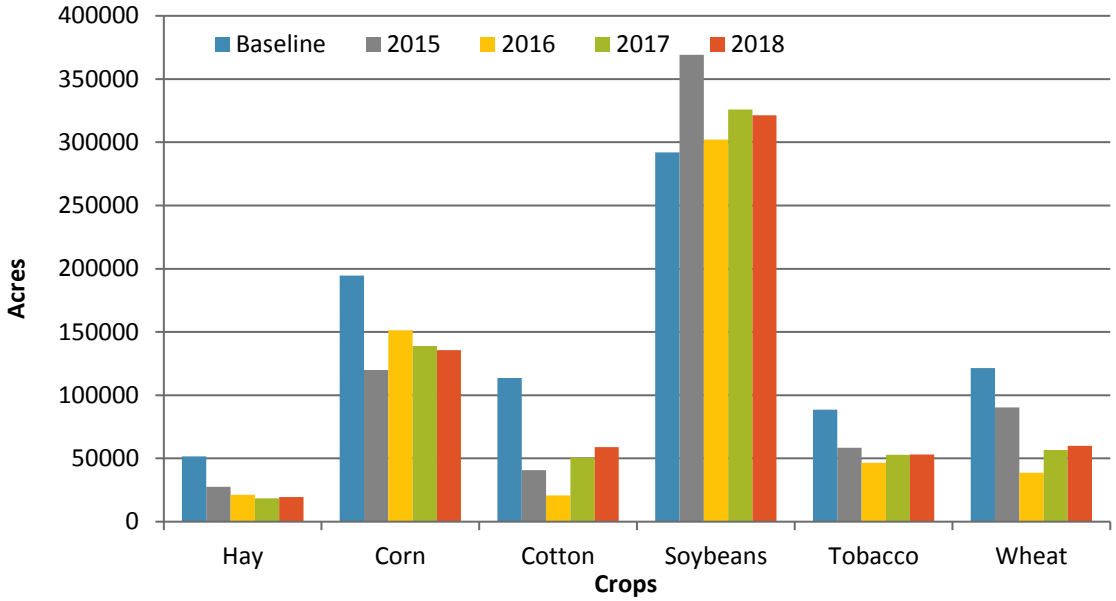


Cropping Shifts

The LACs recalculate the cropland acreage annually by utilizing crop data reported by farmers to the Farm Service Agency. Because each crop type requires different amounts of nitrogen and utilizes applied nitrogen with a different efficiency rate, changes in the mix of crops grown can have significant impact on the cumulative yearly nitrogen loss reduction. The BOC anticipates that the basin will see additional crop shifts in the upcoming year based on changing commodity prices and weather patterns.

Corn requires higher nitrogen application rates than other crops, and corn acres decreased by over 3,100 acres from CY2017 to CY2018. Cotton prices were stable in CY2018, so cotton acres increased by 8,213 acres from CY2017 to CY2018. Soybean acres, which require no nitrogen input, decreased over 4,500 acres between CY2017 and CY2018 due to a price drop, and these cropping shifts caused a slight increase in overall nitrogen loss. There was also an overall increase of 3,155 wheat acres between CY2017 and CY2018. A host of factors from individual to global determine crop choices.

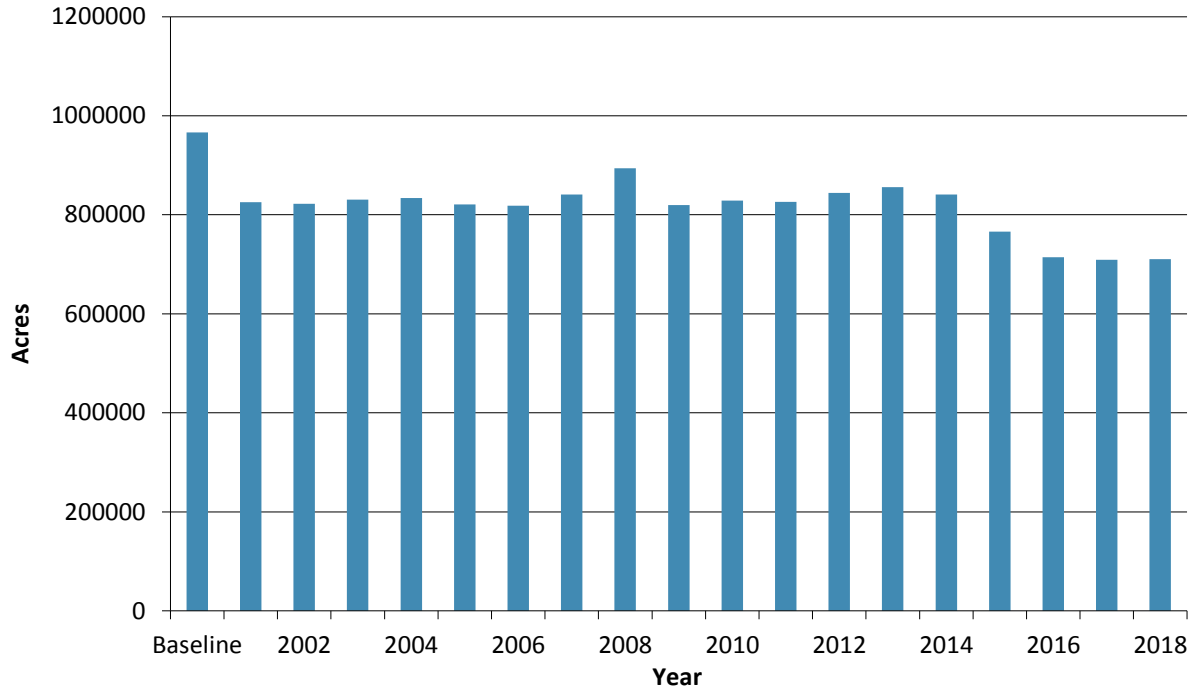
Figure 4. Acreage of Major Crops for the Baseline (1991-1995) and 2015-2018, Neuse River Basin



Land Use Change to Development, Idle Land and Cropland Conversion

The number of cropland acres fluctuates every year in the Neuse River Basin. Each year, some cropland is permanently lost to development or converted to grass or trees. However, idle land is agricultural land that is currently out of production but could be brought back into production at any time. Cropland conversion and cropland lost to development is land taken out of agricultural production and is unlikely to be returned to production. Currently it is estimated that more than 81,000 acres have been lost to development, and currently more than 22,711 acres have been converted to grass or trees since the baseline. For CY2018 there are approximately 64,002 idle acres and a total of 710,407 NLEW-accountable crop acres. These estimates come from the LAC members' best professional judgment, USDA-FSA records and county planning departments. The total crop acres are obtained from USDA-FSA and NC Agricultural Statistics annual reports. Cropland acres have continued to decrease from the baseline period, and CY2018 experienced an increase of over 1,500 crop acres from CY2017 (see Figure 5).

Figure 5. Total NLEW Accounted Crop Acres in the Neuse River Basin, Baseline (1991-1995) and 2001-2018.



Looking Forward

The Neuse BOC will continue to report on rule implementation, relying heavily on Soil and Water Conservation District staff to compile crop reports. The BOC continues to encourage counties to implement additional BMPs to further reduce nitrogen loss.

Because cropping shifts are susceptible to various pressures, the BOC is working with LACs in all counties to continue BMP implementation that provides lasting reduction in nitrogen loss in the basin.

The Neuse BOC will continue to monitor and evaluate crop trends. The current shift to and from crops with higher nitrogen requirements may continue to influence the yearly reduction.

Basin Oversight Committee recognizes the dynamic nature of agricultural business.

- Changes in world economies, energy or trade policies.
- Changes in government programs (i.e., commodity support or environmental regulations)
- Weather (i.e., long periods of drought or rain)
- Scientific advances in agronomics (i.e., production of new types of crops or improvements in crop performance)
- Plant disease or pest problems (i.e., viruses or foreign pests)
- Urban encroachment (i.e., crop selection shifts as fields become smaller)
- Age of farmer (i.e, as retirement approaches farmers may move from row crops to cattle)

Funding

Ongoing agriculture rule reporting has incorporated data processing efficiencies and improvements in recent years. NLEW upgrades have allowed LAC members to more actively participate in the compilation of data and analysis of nitrogen loss trends, and a new Division of Soil and Water Conservation contracting system has helped optimize BMP documentation efforts.

In CY2018 soil and water conservation districts spent over $671,000 through the Agriculture Cost Share Program in the Neuse River Basin, and the Natural Resources Conservation Service spent over $1,851,000 through the Environmental Quality Assistance Program in the counties of the Neuse River Basin. These programs have all helped fund erosion and nutrient reducing BMPs in the Neuse Basin.

The EPA 319(h) grant program, which is administered by the Department of Environmental Quality, has approximately $1.4 million in competitive grant funds available statewide for implementation of approved nonpoint source management programs. Grant funds from the 319(h) program can be used to supplement technical assistance, match cost share funding, and support BMP implementation. The Division of Soil and Water Conservation, funded through an EPA 319(h) grant, expends approximately $50,000 on agricultural reporting staff support annually.

Each year 150 LAC members contribute to agriculture rule reporting to ensure accurate documentation of agricultural acres and fertilization rates. Farmers and agency staff personnel with other responsibilities serve on the LACs in a voluntary capacity. Basin Oversight

Committee members meet at least once per year to review and approve this annual progress report, which includes time spent outside of that annual meeting to review draft documents and approve methodology changes. Participation by so many members of the local agricultural community demonstrates a commitment toward achieving the nutrient strategy's long-term goals.

With less funding available for reporting support at the state level, responsibility for compilation of annual local progress reports falls on these LACs and Soil and Water Conservation District staffs. Few currently serving LAC members were active during the stakeholder process for the Agriculture Rule, so some institutional knowledge about annual reporting requirements has been lost. As a result, training of new Soil and Water Conservation District staff and LAC members regarding rule requirements and reporting is ongoing.

Funding is an integral part in the success of reaching and maintaining the goal through technical assistance and BMP implementation. It is also important for data collection and reporting.

At the present time there is also no funding for a basin coordinator. Part of the responsibilities of the technicians and basin coordinators was to assist with the reporting requirements for the Neuse and Tar-Pamlico Agriculture Rules. In addition to his other duties, the NCDA&CS Division of Soil and Water Conservation Nonpoint Source Planning Coordinator has been assigned the data collection, compilation and reporting duties for the Agriculture Rules for all existing Nutrient Sensitive Waters Strategies.

Now that watershed technician funding has been eliminated, a more centralized approach to data collection and verification is necessary. This evolving approach will involve GIS analysis and more streamlined FSA acreage documentation. GIS data layers and script tools are currently under development for future reports, and these tools will be vetted by the BOC and may be incorporated into the agriculture rule accounting methodology whenever practical. As methods change, LACs will be trained to handle the changing workloads to the best of their ability. Because most district staffs have neither the time nor financial resources to synthesize county level data, centralized collection approaches will come at the expense of local knowledge. Annual agricultural reporting is required by the rules; therefore, continued funding for the Division's only remaining nutrient coordinator position is essential for compliance.

Previously, funding was available for research on conservation practice effectiveness, realistic yields, and nitrogen use efficiencies. Due to eligibility changes and other funding constraints, it is unlikely that new data will be developed. Prior funding sources for such research, which provided much of the scientific information on which NLEW was based, are no longer available. Should new funding be made available, additional North Carolina-specific research information could be incorporated into future NLEW updates.

Conclusion

Significant progress has been made in agricultural nitrogen loss reduction, and the agricultural community consistently reaches its 30% reduction goal. However, the measurable effects of these BMPs on overall in-stream nitrogen reduction may take years to develop due to the nature of non-point source pollution. Nitrogen reduction values presented in this annual summary of agricultural reductions reflect “edge-of-management unit” calculations that contribute to achieving the overall 30% nitrogen loss reduction goal. Significant quantities of agricultural BMPs have been installed since the adoption and implementation of the nutrient management strategy, and agriculture continues to do its part towards achieving the overall goal of a 30% reduction of nitrogen delivered to the Neuse estuary.