NCDA&CS

2017 Annual Progress Report (Crop Year 2016) 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 2016

Neuse River Basin Oversight Committee

Summary

The Neuse Basin Oversight Committee (BOC) received and approved crop year (CY[1]) 2016 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 CY2016, agriculture collectively achieved an estimated 52% 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 2017. 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 2016 crop year began in October 2015 and ended in September 2016.

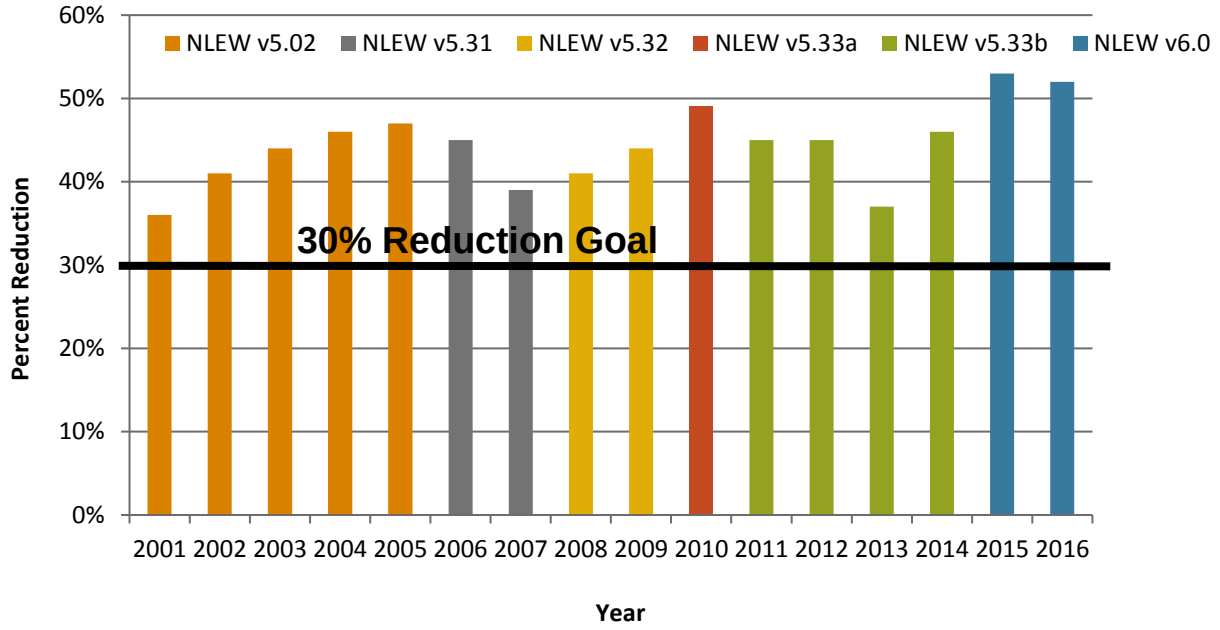
Scope of Report and Methodology

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 2016.

Figure 1. Collective Nitrogen Loss Reduction Percent 2001 to 2016 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 CY2016

All seventeen LACs submitted their sixteenth annual reports to the BOC for approval in September 2017. For the entire basin, in CY2016 agriculture achieved a 52% reduction in nitrogen loss compared to the 1991-1995 baseline. This percentage is 1% lower than the reduction reported for CY2015. Table 2 lists each county's baseline, CY2015 and CY2016 nitrogen (lbs/yr) loss values, and nitrogen loss percent reductions from the baseline in CY2015 and CY2016.

*Table 2. Estimated Reductions in Agricultural Nitrogen Loss from Baseline (1991-1995) for 2015 and 2016, Neuse River Basin**

County	Baseline N Loss (lb)	CY2015 N Loss (lb)*	CY2015 N Reduction (%)	CY2016 N Loss (lb)*	CY2016 N Reduction (%)
Carteret	1,292,586	654,572	49%	579,560	55%
Craven	4,153,187	1,574,823	62%	1,800,518	57%
Durham	220,309	39,312	82%	55,342	75%
Franklin	219,209	35,176	84%	33,896	85%
Granville	193,197	26,701	86%	64,180	67%
Greene	4,439,036	2,030,728	54%	2,083,290	53%
Johnston	6,728,638	3,162,882	53%	3,230,187	52%
Jones	3,283,906	1,859,200	43%	2,031,206	38%
Lenoir	4,455,752	2,711,731	39%	2,650,395	41%
Nash	1,042,072	392,916	62%	438,450	58%
Orange	787,040	109,040	86%	61,123	92%
Pamlico	2,023,294	1,551,263	23%	1,437,444	29%
Person	616,669	139,231	77%	80,349	87%
Pitt	3,399,455	1,604,914	53%	1,917,032	44%
Wake	1,434,602	347,179	76%	288,649	80%
Wayne	8,297,408	3,772,582	55%	3,493,873	58%
Wilson	3,273,647	1,729,865	47%	1,833,161	44%
Total	45,860,007	21,742,116	53%	22,078,655	52%

** 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, and BMP implementation. Winter weather during CY2016 was similar to that of

CY2015, which means planted wheat acres remained low and reduction percentages fairly stable. 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 CY2015. From CY2015 to CY2016 Pamlico experienced a decrease of 1,932 acres of wheat and an increase of 1,540 acres of soybeans. The Pamlico Soil and Water Conservation District Board is working to meet their reduction by making nutrient reducing BMPs a higher priority in their annual NC Agriculture Cost Share Program (ACSP) strategy plan, and they installed water control structures which achieve nutrient reductions on 400 acres in CY2016. In 2016 Pamlico Soil and Water Conservation District was awarded a grant allocation to assist producers in implementing water control structures, and these funds are currently being contracted. As of CY2016 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	CY2013 NLEW v5.33b	CY2014 NLEW v5.33b	CY2015 NLEW v6.0	CY2016 NLEW v6.0
BMP implementation	7%	8%	9%	9%
Fertilization management	6%	8%	10%	11%
Cropping shift	11%	18%	20%	18%
Cropland converted to grass/trees	2%	2%	2%	2%
Cropland lost to idle land	4%	3%	4%	4%
Cropland lost to development	7%	7%	8%	8%
Total	37%	46%	53%	52%

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

BMP Implementation

As illustrated in Figure 2, CY2016 BMP implementation yielded a net increase of 435 acres affected by water control structures and a net increase of 6,843 nutrient scavenger crop acres.

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. A countywide field analysis of buffer acres in Durham is currently being performed by SWCD staff, and they plan to have a finalized report available in time for the CY2017 progress report. The findings of this analysis will help inform subsequent efforts for other urbanized counties which have lost agricultural acreages. An interim adjustment based on DEQ reports[2] has led to a reduction of 20 ft. buffers by 755 acres, 30 ft. buffers by 683 acres, 50 ft. buffers by 2,122 acres, and 100 ft. buffers by 4,015 acres. These adjusted totals have increased the accuracy of nitrogen loss calculations.

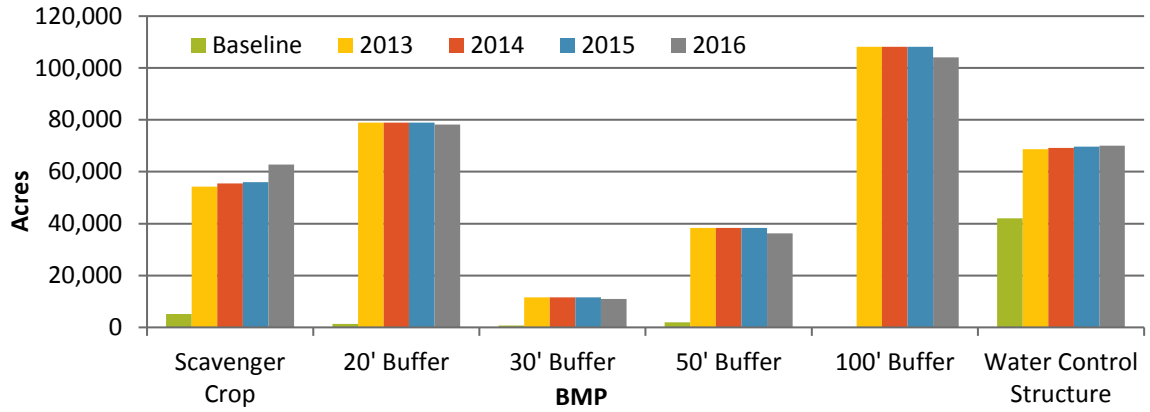
BMP data is collected from state and federal cost share program active contracts, and in some cases BMPs were installed without cost share funding. While there is some variability in the data reported, LACs are reporting the best available information. As additional data is collected, the LACs will review the 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.

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. However, this treatment estimate does not take into account the entire drainage area treated by buffers in the piedmont, which is generally 5 to 10 times higher than 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. 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.

[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

Figure 2: Cumulative Nitrogen Reducing BMPs Installed on Agricultural Lands for Baseline (1991-1995) and from 2013-2016, 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. [3]

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 CY2016 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.

*Table 4: Nutrient-Reducing BMPs Not Accounted for in NLEW, 1996 to 2016, Neuse River Basin**

BMP	Units	1996-2011	2013	2014	2015	2016
Diversion	Feet	149,449	160,655	161,924	166,199	166,600
Fencing (USDA programs)	Feet	154,885	170,501	204,869	214,748	228,216
Field Border	Acres	3,337	5,211	5,217	5,219	5,225
Grassed Waterway	Acres	2,261	2,300	2,351	2,358	2,377
Livestock Exclusion	Feet	81,389	100,860	103,121	118,178	125,190
Precision Agriculture	Acres	0	2,567	3,567	3,660	3,664
Sod Based Rotation	Acres	60,115	92,404	92,404	101,429	102,752
Tillage Management	Acres	34,072	48,649	53,634	59,057	59,680
Terraces	Feet	49,970	50,670	50,670	76,175	76,175

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

[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/

Fertilization Management

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

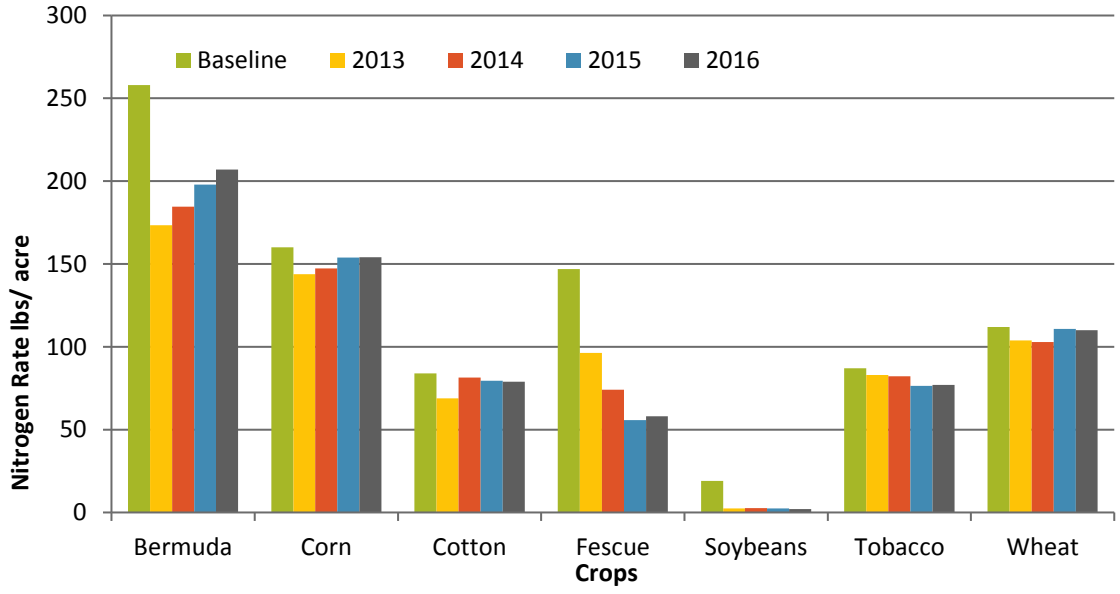
Between CY2015 and CY2016 nitrogen application rates increased by 9 lbs per acre on bermuda hay and 2 lbs per acre on fescue hay, while all other nitrogen application rates remained stable. Figure 3 shows these corresponding application rates.

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, 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

Due to lower commodity prices, there has been an economic incentive for producers to consider more efficient nitrogen rates, timing, and placement alternatives. 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 2013-2016, Neuse River Basin

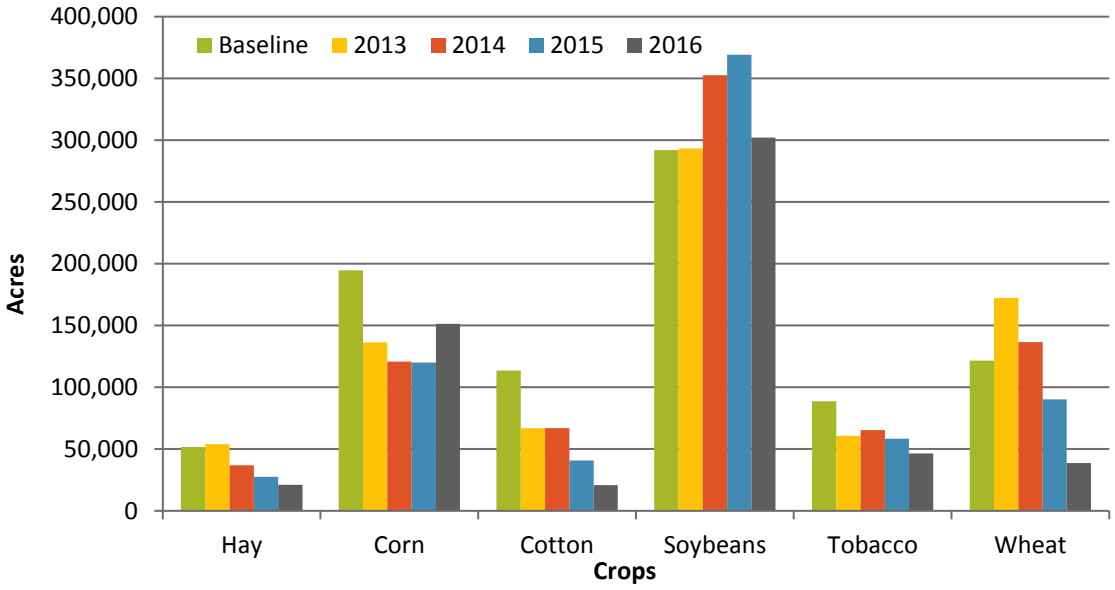


Cropping Shifts

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 wet weather.

Corn requires higher nitrogen application rates than other crops, and corn acres increased by over 45,400 acres from CY2015 to CY2016 due to a temporary price increase. Cotton prices remained low, so cotton decreased by over 17,000 acres from CY2015 to CY2016. Soybean acres, which require no nitrogen input, saw a decrease of over 32,500 acres between CY2015 and CY2016, and this transition caused a slight increase in overall nitrogen loss. In addition, a second consecutive extremely wet fall prevented many farmers from accessing their fields in time to plant a crop of winter wheat. In most cases wheat acres are "double cropped" with soybeans, which means that wheat acres are planted on the same acreage before a spring soybean crop. In CY2016, soybean acreages were accounted for in these double cropped systems, but some of those acres were not fertilized over the winter months where a wheat crop was not planted. This resulted in an overall decrease of over 47,800 wheat acres between CY2015 and CY2016. A host of factors from individual to global determine crop choices.

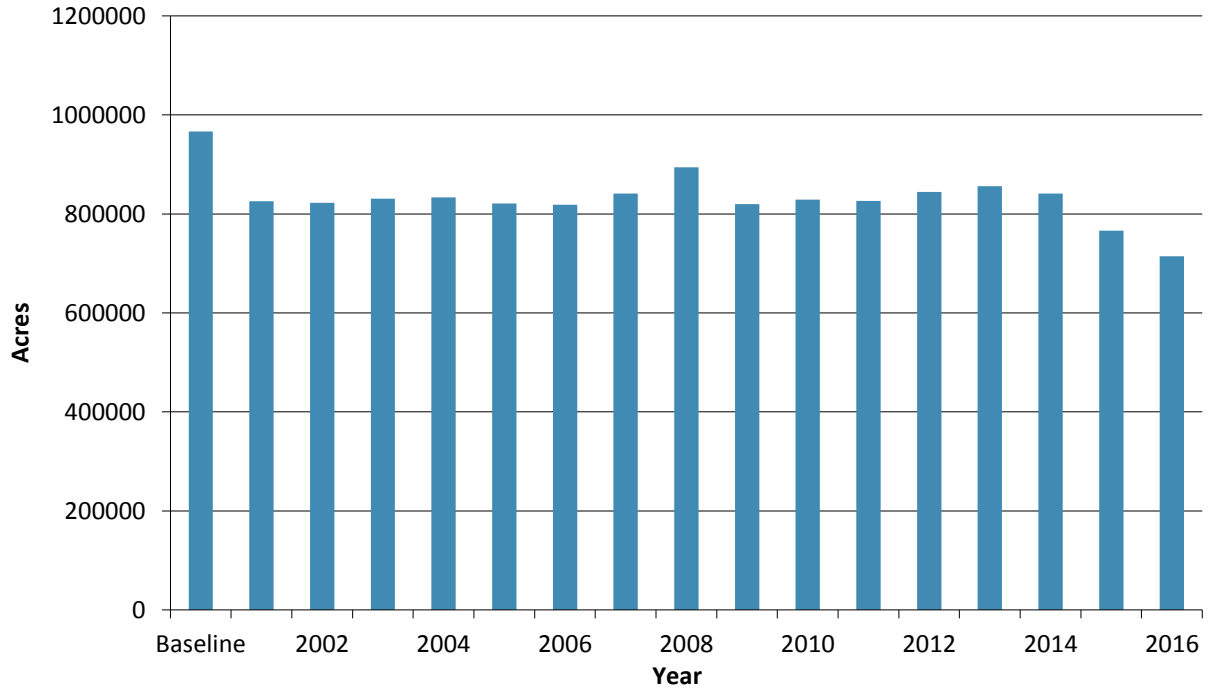
Figure 4. Acreage of Major Crops for the Baseline (1991-1995) and 2013-2016, Neuse River Basin



Land Use Change to Development, Idle Land and Cropland Conversion

The number of cropland acres will fluctuate 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. As of 2015 it was estimated that more than 81,000 acres have been lost to development, and currently more than 22,109 acres have been converted to grass or trees since the baseline. For CY2016 there are approximately 45,355 idle acres and a total of 714,302 NLEW-accountable crop acres. These estimates come from the LAC members' best professional judgment, USDA-Farm Service Agency (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 CY2016 experienced a reduction of over 51,596 crop acres from CY2015 (see Figure 5). A significant portion of this acreage reduction was due to the reduction in wheat, some of which would have been planted but for wet weather.

Figure 5. Total NLEW Accounted Crop Acres in the Neuse River Basin, Baseline (1991-1995) and 2001-2016.



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 for a lasting reduction in nitrogen loss in the basin while monitoring cropping changes. Due to improved weather during the fall growing season in late 2016, the BOC expects reported wheat acre totals in CY2017 to increase significantly.

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)

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. Additionally, members of the BOC plan to participate in a land accounting work group, if reconvened, with the Division of Water Resources to assist in developing a more consistent land accounting framework.

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. Each year it is estimated that 150 LAC members spend over 225 hours on agriculture rule reporting, which accumulates to over $5,400 worth of volunteer time. The Division of Soil and Water Conservation, funded through an EPA 319(h) grant, expends approximately $50,000 on agricultural reporting staff support annually.

In CY2016 soil and water conservation districts spent over $887,000 through the Agriculture Cost Share Program in the Neuse River Basin, and the Natural Resources Conservation Service spent over $3,676,754 through the Environmental Quality Assistance Program in the counties of the Neuse and Tar-Pamlico River Basins. The EPA 319(h) grant program, which is administered by the Department of Environmental Quality, has approximately $1.2 million in competitive grant funds available 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. These programs have all helped fund erosion and nutrient reducing best management practices in the Neuse Basin. Participation by so many members of the local agricultural community demonstrates a commitment toward achieving the nutrient strategy's long-term goals.

Farmers and agency staff personnel with other responsibilities serve on the LACs in a voluntary capacity. 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, an employee within the NCSA&CS Division of Soil and Water Conservation 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. Durham County, for example, has hired part-time staff to assist with detailed agricultural land delineation, including field verification of intact best management practices. Results of this analysis should be available for the CY2017 annual report. Few counties have these kinds of resources, however, so LACs will be trained to handle the new workload to the best of their ability. Because most district staffs have neither the time nor financial resources to synthesize county level data, this centralized collection approach 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.