NCDA&CS

Annual Progress Report for the Jordan Lake Agriculture Rule (15A NCAC 02B.0264) for the Baseline Period (1997-2001) for Crop Year 2019

A Report to the Division of Water Resources from the Jordan Lake Watershed Oversight Committee: Crop Year 2019, Submitted 2020

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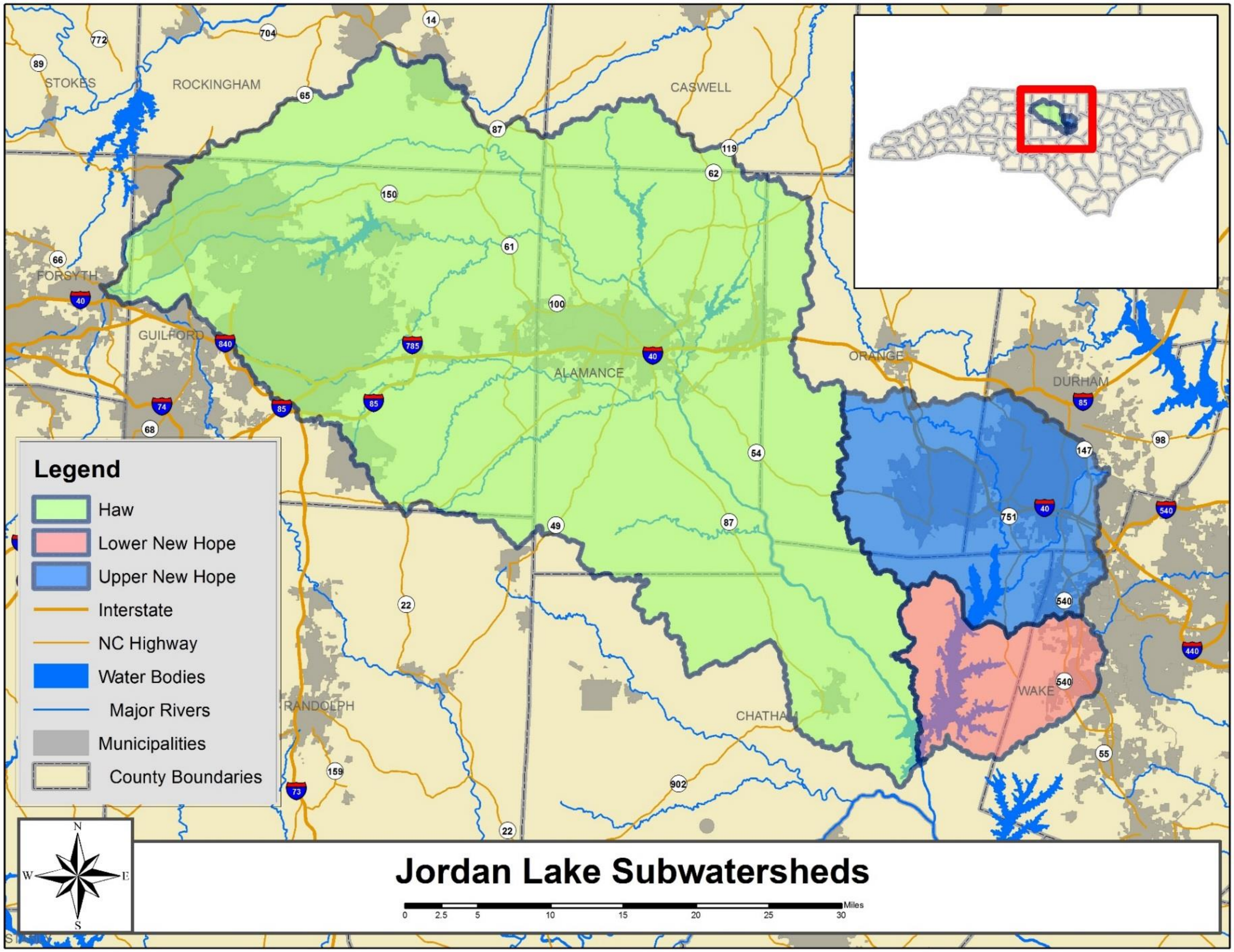
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Summary

This report provides an assessment of collective progress made by the agricultural community to reduce nutrient losses toward compliance with the Jordan Lake Agriculture rule. For this report, the Jordan Lake Watershed Oversight Committee (WOC) implemented the accounting methods approved by the Environmental Management Commission's Water Quality Committee in July 2011 to estimate changes in nitrogen loss and the phosphorus loss trend in the three Jordan subwatersheds for the period between the strategy baseline (1997-2001) and the most recent crop years (CY) for which data was available, 2019. This report provides progress estimates in three categories: cropland nitrogen, pasture nitrogen, and agricultural phosphorus. To produce this report, Division of Soil and Water Conservation staff received, processed and compiled current-year data from agricultural staff in eight counties, and the WOC reviewed and approved this report. Refer to Figure 1 for the location of the Jordan Lake Watershed, including the three subwatersheds affected by this rule.

The cropland nitrogen portion of the report demonstrates agriculture's collective compliance with the Jordan Agriculture Rule and estimates progress made by agriculture in the watershed to decrease the amount of nutrients lost from agricultural management units. Agriculture has been successfully decreasing nutrient losses in each of the Jordan Lake subwatersheds. Each of the three subwatersheds is meeting their cropland nitrogen loss reduction goal from baseline to CY2019, with the Upper New Hope Watershed reporting a 60% reduction, the Lower New Hope Watershed reporting an 81% reduction, and the Haw River Watershed reporting a 41% reduction. Table 1 illustrates the estimated reductions in nitrogen loss collectively achieved by cropland agriculture compared to the 1997-2001 baseline.

Jordan Lake Watershed Oversight Committee Composition, Jordan Agriculture Rule:

1. NC Division of Soil & Water Conservation
2. USDA-NRCS
3. NCDA&CS
4. NC Cooperative Extension Service
5. NC Division of Water Resources
6. Watershed Environmental Interest
7. Watershed Environmental Interest
8. Environmental Interest
9. General Farming Interest
10. Pasture-based Livestock Interest
11. Equine Livestock Interest
12. Cropland Farming Interest
13. Scientific Community

Reductions in cropland nitrogen loss have been achieved through crop shifts and reduction in nitrogen application rates for most major crops in the watershed. From the baseline to 2019, the watershed has experienced a crop shift from crops with higher nitrogen requirements to mixed cool season grass (hay) and soybeans. In addition, the nitrogen rate on mixed cool season grass (hay) has decreased significantly.

Pasture nitrogen loss is also calculated using NLEW and is based on the total number of pasture acres, pastured livestock, and implemented livestock exclusion systems in the watershed. Reported pasture acreage and livestock totals are collected every 5 years from the USDA Census of Agriculture, and implementation data for exclusion systems is collected from local Soil and Water Conservation District staffs in the watershed. Each of the three subwatersheds met their pastureland nitrogen loss reduction goal from baseline to CY2017, with the Upper New Hope Watershed reporting a 54% reduction, the Lower New Hope Watershed reporting a 73% reduction, and the Haw River Watershed reporting a 49% reduction.

Qualitative phosphorus indicators demonstrate that there is no increased risk of phosphorus loss. Primary factors contributing to this trend include a reduction in tobacco acres, a decrease in the amount of animal waste phosphorus, and implementation of conservation tillage on 90% of cropland in the watershed.

Jordan NSW Strategy:

The Environmental Management Commission (EMC) adopted the Jordan Water Supply Nutrient Strategy in 2008. The strategy goal is to reduce the average annual load of nitrogen and phosphorus from each of its subwatersheds to Jordan Lake from 1997-2001 baseline levels. In addition to point source rules, mandatory controls were applied to addressing non-point source pollution in agriculture, nutrient management, riparian buffer protection, and urban stormwater. The management strategy built upon the Neuse and Tar-Pamlico River Basins efforts.

Rule Requirements and Compliance

Effective August 2009, the Agriculture Rule that is part of the Jordan Water Supply Nutrient Strategy provides for a collective strategy for farmers to meet nitrogen loss reduction goals within six to nine years. The goals for this nutrient strategy are specified at the subwatershed level in Table 1 and are compared to the 1997-2001 baseline period. The Lower New Hope Subwatershed has a goal of no increase in nitrogen or phosphorus. The Upper New Hope Subwatershed has a goal of 35% nitrogen loss reduction and 5% phosphorus reduction. The Haw River Subwatershed has a goal of 8% nitrogen loss reduction and 5% phosphorus reduction. All reductions are required for both cropland and pastureland, and the two are calculated separately. A Watershed Oversight Committee (WOC) was established to implement the rule and to assist farmers in complying with the rule.

The Jordan Agriculture rule stipulated that if the initial accounting done for CY2010 found that a nitrogen goal had not been achieved in a subwatershed, then Local Advisory Committees were to be formed in that subwatershed and farmers were to register their operations with the committees. Based on the success on cropland nitrogen reductions relative to the strategy goals estimated in initial reports, the WOC found that such actions were not required.

All counties provided information for the annual report to the WOC in December 2020. Collectively, each of the three subwatersheds is meeting their cropland nitrogen loss reductions, with the Upper New Hope Watershed reporting a 60% reduction, the Lower New Hope Watershed reporting an 81% reduction, and the Haw River Watershed reporting a 41% reduction. These reductions have been achieved primarily by reduced nitrogen application rates and cropping shifts from higher nitrogen crops to lower nitrogen crops. The reduction percentage in each watershed increased from CY2018 to CY2019 largely due to a significant decline in wheat production brought on by a very wet 2018/2019 winter. Soybean acres also saw a notable decline as a normal part of a three-year cropping rotation which resulted in an increase in corn production, but since the fall in wheat production was so much greater than the increase in corn production, overall nitrogen loss reduction percentages increased in all three watersheds. Both corn and wheat require higher nitrogen inputs than other crops planted in the watershed.

In addition, each of the three subwatersheds is meeting their pastureland nitrogen loss reductions for CY2017, with the Upper New Hope Watershed reporting a 54% reduction, the Lower New Hope Watershed reporting a 73% reduction, and the Haw River Watershed reporting a 49% reduction. These reductions have been achieved primarily by reduced nitrogen application rates and an overall reduction in pasture acres. Pastureland nitrogen loss is calculated on a 5-year cycle, and CY2017 is the most recent year for which data is available.

Scope of Report and Methodology

The estimates provided in this report represent whole-county scale calculations of nitrogen loss from cropland and pastureland agriculture in the watershed made by soil and water conservation district technicians using the 'aggregate' version of the Nitrogen Loss Estimation Worksheet, or NLEW. The NLEW is an accounting tool developed to meet the specifications of the Neuse Agriculture Rule and approved by the Water Quality Committee of the Environmental Management Commission (EMC) for use in the Jordan Lake Watershed. The development team included interagency technical representatives of the NC Division of Water Resources (DWR), NC Division of Soil and Water Conservation (DSWC), USDA-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 and pastureland. The NLEW is an "edge-of-management unit" accounting tool which estimates changes in nitrogen loss from cropland and pastureland but does not estimate changes in nitrogen loading to surface waters. An assessment method was developed and approved by the Water Quality Committee of the EMC for phosphorus and is described later in the report.

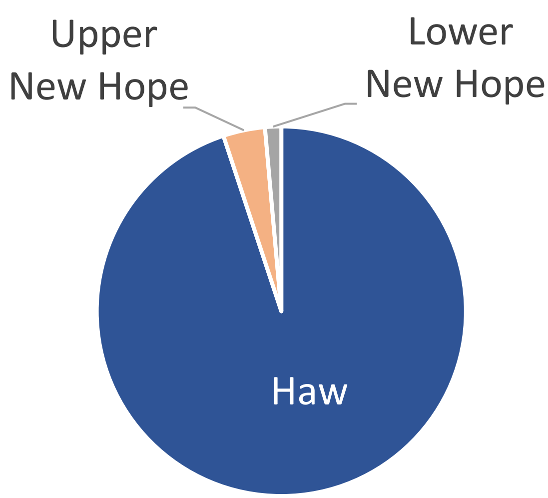
The Nitrogen Loss Estimation Worksheet (NLEW) was developed to estimate a baseline nitrogen loading and percent N reductions based on the regulatory framework developed for the agricultural accounting tool[1]. Changes in nitrogen occur due to nitrogen fertilizer management, conservation practices, cropping shifts, and loss of agricultural lands. The Jordan Lake Agriculture Rule was written so that each sub watershed has a nitrogen loss reduction requirement.

[1] Osmond, D.L., L. Xu, N.N. Ranells, S.C. Hodges, R. Hansard, and S.H. Pratt. 2001. Nitrogen loss estimation worksheet (NLEW): agricultural Nitrogen loading reduction tracking tool. In: Optimizing Nitrogen Management in Food and Energy Production and Environmental Protection. Eds: J. Galloway, E. Cowling, J. Erisman, J. Wisniewski, C. Jordan. Contributed Papers from the 2nd International Nitrogen Conference. October 14-18, 2001. Potomac, MD, USA. Pp.777-783.

Nitrogen Reduction from Cropland from Baseline for CY2019

The Jordan Lake Watershed encompasses just over 1,000,000 acres, and in CY2019 a total of 88,554 acres were planted in cropping systems. Of those, 84,290 acres (95%) were grown in the Haw subwatershed, 3,057 acres (4%) were grown in the Upper New Hope subwatershed, and 1,207 acres (1%) were grown in the Lower New Hope subwatershed. Figure 1 shows a breakdown of these cropland acres by subwatershed:

Figure 1: Total cropland acres grown in CY2019 by subwatershed in the Jordan Lake Watershed



All counties submitted their progress report to the WOC in December 2020.

- For the Lower New Hope Watershed, agriculture achieved a cropland nitrogen loss reduction of 81% compared to the average nitrogen loss from 1997 to 2001.
- For the Upper New Hope Watershed, agriculture achieved a cropland nitrogen loss reduction of 60% compared to the average nitrogen loss from 1997 to 2001.
- For the Haw Watershed, agriculture achieved a cropland nitrogen loss reduction of 41% compared to the average nitrogen loss from 1997 to 2001.

Table 1 lists each county's cropland nitrogen loss (lbs/yr) at the time of the baseline and in CY2018 and CY2019, along with nitrogen loss percent reductions from baseline values in CY2018 and CY2019.

Table 1. Estimated reductions in agricultural nitrogen loss (cropland) from baseline (1997-2001), CY2018 and CY2019, Jordan Lake Watershed †

County	Baseline Nitrogen Loss (lb) †	CY2018 Nitrogen Loss (lb) †	CY2018 N Loss Reduction (%)	CY2019 Nitrogen Loss (lb) †	CY2019 N Loss Reduction (%)
Upper New Hope Subwatershed: Goal of 35% nitrogen loss reduction (1% of total Jordan Lake Watershed cropland)					
Chatham	43,063	7,996	81%	7,463	83%
Durham	37,618	15,565	59%	15,565	59%
Orange	68,632	43,039	37%	38,677	44%
Wake	9,694	3,098	68%	1,723	82%
Total	**159,007**	**69,697**	**56%**	**63,428**	**60%**
Lower New Hope Subwatershed: Goal of no increase in nitrogen loss (4% of total Jordan Lake Watershed cropland)					
Chatham	56,632	11,858	79%	11,858	79%
Wake	38,362	11,151	71%	6,175	84%
Total	**94,994**	**23,009**	**76%**	**18,032**	**81%**
Haw Subwatershed: Goal of 8% nitrogen loss reduction (95% of total Jordan Lake Watershed cropland)					
Alamance	697,634	458,154	34%	440,241	37%
Caswell	260,254	126,569	51%	126,663	51%
Chatham	245,458	55,704	77%	55,704	77%
Guilford	1,393,551	1,101,023	21%	900,852	35%
Orange	231,272	137,983	40%	131,367	43%
Rockingham	169,080	127,705	24%	114,421	32%
Total ‡	**2,997,249**	**2,007,138**	**33%**	**1,769,248**	**41%**

† Nitrogen loss values are for comparative purposes. These are produced via NLEW calculations and based on best available nitrogen application rates to cropland in the watershed. Loss totals represent nitrogen neither used by crops nor intercepted by BMPs in a Soil Management Group. This is not an in-stream loading value.
‡ Total reduction percentages are calculated by comparing current nitrogen loss to baseline nitrogen loss. Individual county totals contribute proportionally, and so smaller watershed trends tend to be more volatile than large watershed trends.

Best Management Practice Implementation

Agriculture is credited with different nitrogen reduction efficiencies, expressed as percentages, for riparian buffer practice installation widths ranging from 20 feet to 100 feet. The NLEW for Jordan Lake provides the percent nitrogen reduction efficiencies for buffer practice installation widths on cropland as displayed in Table 2.

Table 2: Nitrogen loss reduction percentages by buffer practice installation width

Buffer width	Nitrogen loss reduction percentage[2]
20 feet	20%
30 feet	25%
50 feet	30%
100 feet	35%

Riparian buffers have many important functions beyond being effective in reducing nitrogen. Recent research has shown that upwards of 75% of sediment from agricultural sources is from stream banks and that riparian buffers are important for reducing this sediment.[3] In addition, riparian buffers can reduce phosphorus and sediment as it moves through the buffer and provide other critically important functions. According to a report completed in 2007, *Delineating Agriculture in the Lake Jordan River Basin,* the majority of agricultural land is already buffered. This study found that six of the counties had more than 75% of their agricultural land buffered, and that the average buffer width was greater than 50 feet .[4] Due to data availability and staffing limitations, a decision was made to utilize GIS technology and aerial photography for baseline BMP totals. Baseline acreage of riparian buffers on cropland among the different widths for which agriculture receives reductions was obtained through this process first in 1998 and then again in 2010. Overall, total acres of buffers slightly decreased between 1998 and 2010 due to the fact that overall agricultural production acres decreased during that same time period. This helps explain why the first reported buffer acres were noticeably lower than baseline totals. Since the CY2010 report, however, total

[2] These percentages represent the net or relative percent improvement in nitrogen removal resulting from riparian buffer implementation.

[3] Osmond,D., D. Meals, D. Hoag, and M. Arabi. 2012. How to Build Better Agricultural Conservation Programs to Protect Water Quality: The NIFA-CEAP Experience. Soil and Water Conservation Society, Ankeny, IA.

[4] Osmond, Deanna L. 2007. Final Report for the Sampling Analysis: Delineating Agriculture in the Lake Jordan River Basin. Department of Soil Science, North Carolina State University, Raleigh, NC 27606.

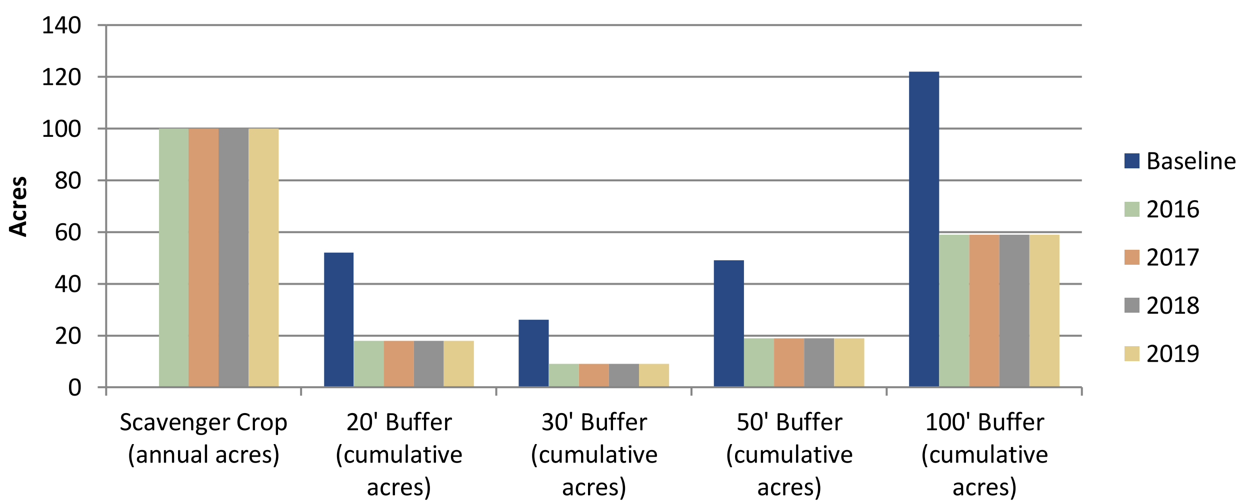
buffer acreage has been obtained through individual contracts implemented through state and federal cost share contracts, and buffer acres are added after each project's completion.

Since the baseline some buffer practices have been installed in the Jordan Lake Watershed through the Division of Mitigation Services (DMS). DMS has completed 63 projects in the watershed from the baseline through 2019, and at least six private mitigation banks from which DMS purchases credits are currently operating in the watershed. DMS project data is not tracked either for previous land use or for the area of buffer restored in conjunction with stream restoration projects. Because DMS funded these buffers for compensatory mitigation for stream or buffer permitted losses also occurring in the watershed, they are not eligible to be counted for reductions under the agriculture rule, even if they are located on agricultural lands. Thus, DMS buffer restoration projects are not included in the totals provided in this report. As DMS continues to install buffers adjacent to and purchase credits generated on agricultural land, this decreases the possibility for buffers to be installed for credit under agriculture rule progress reporting.

In the Lower New Hope Subwatershed, 144 acres (57%) of the buffers in the subwatershed still exist but are no longer eligible for accounting under the agriculture rule because these lands have been taken out of agricultural production. This subwatershed experienced a decrease of 12% of cropland with wide riparian buffers over that time period. In the Upper New Hope Subwatershed, 531 acres (39%) of baseline buffers still exist but are no longer eligible for accounting under the agriculture rule, also because these lands have been taken out of agricultural production. This subwatershed experienced a decrease of 21% of cropland over that time period. For these two watersheds, the limited number of cropland acres greatly increases the effect of any change in agricultural operation land use on overall nitrogen loss reduction percentage. The Haw River Subwatershed only saw a decrease of 1% of buffer acres in the watershed. This is to be expected, since the subwatershed did not lose any cropland acres from 1998 to 2010. Detailed information regarding buffer acreages implemented by subwatershed in baseline (1998) and crop years 2016, 2017, 2018, and 2019 is displayed in Figures 2, 3, and 4.

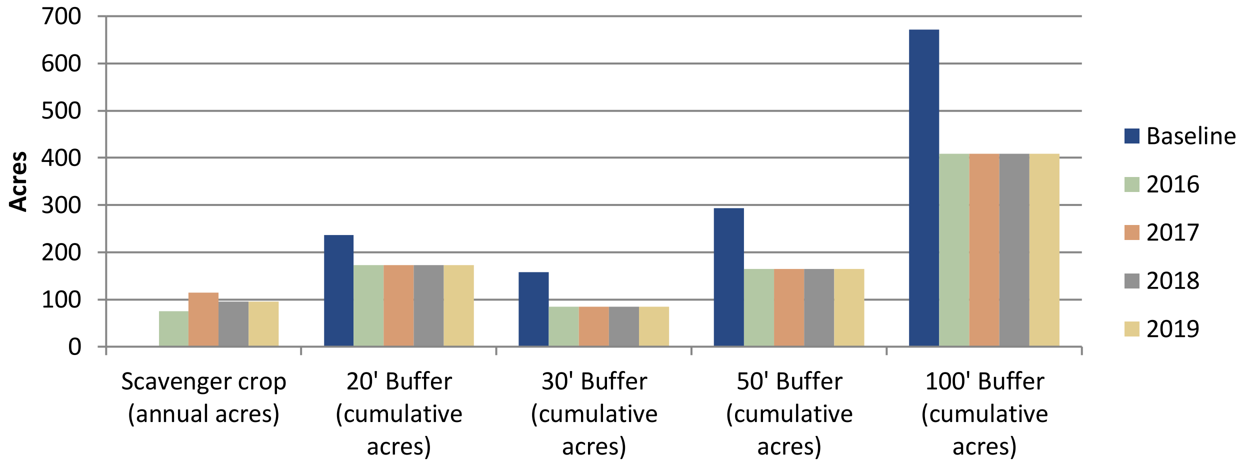
Of the cropland acres in the Jordan Lake Watershed, 1% are in the Lower New Hope Subwatershed.

Figure 2. Nitrogen Reducing BMPs installed on Croplands from Baseline (1998), 2016, 2017, 2018, and 2019, Lower New Hope Subwatershed, Jordan Lake Watershed *



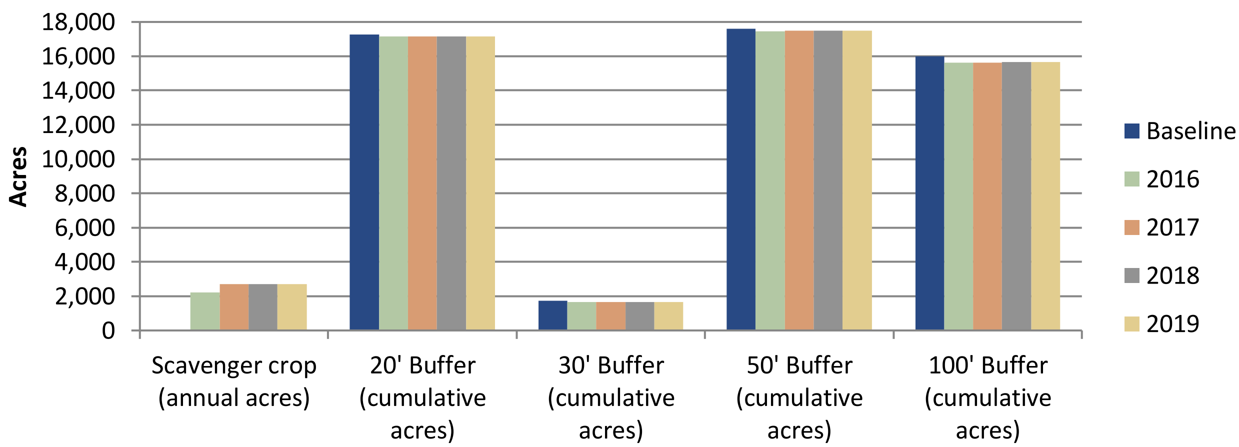
Of the cropland acres in the Jordan Lake Watershed, 4% are in the Upper New Hope Subwatershed.

Figure 3. Nitrogen Reducing BMPs installed on Croplands from Baseline (1998), 2016, 2017, 2018, and 2019, Upper New Hope Subwatershed, Jordan Lake Watershed*



Of the cropland acres in the Jordan Lake Watershed, 95% are in the Haw Subwatershed.

Figure 4. Nitrogen Reducing BMPs installed on Croplands from Baseline (1998), 2016, 2017, 2018, and 2019, Haw Subwatershed, Jordan Lake Watershed*



** The acres of buffers listed include estimated acres from GIS analysis from 1998 and 2010 aerial photography and acres implemented through cost share programs since baseline. Cropland acres affected by the buffer could be 5 to 10 times larger than the acreage shown above.*[5]

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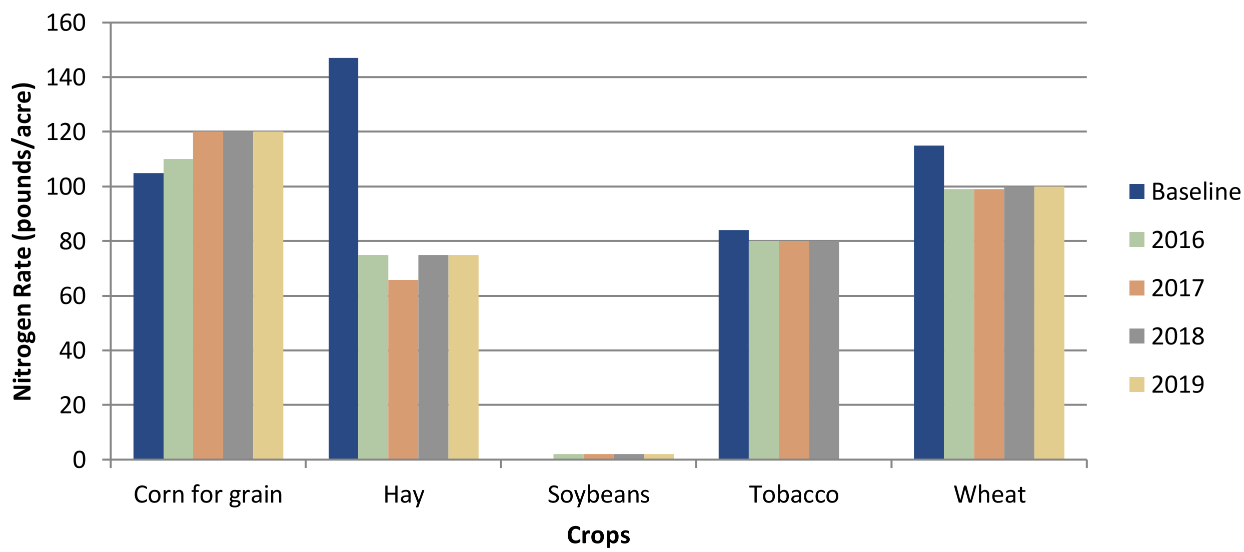
[5] Bruton, Jeffrey Griffin. 2004. Headwater Catchments: Estimating Surface Drainage Extent Across North Carolina and Correlations Between Landuse, Near Stream, and Water Quality Indicators in the Piedmont Physiographic Region. Ph.D. Dissertation. Department of Forestry and Environmental Resources, North Carolina State University, Raleigh, NC 27606.

Fertilization Management

Fertilization rates are revisited annually by counties using data from farmers, commercial applicators and state and federal agencies' professional estimates. Total nitrogen application rates include both organic (waste) and inorganic (fertilizer) sources, even in situations where a producer applies some of both to the same crop. In this watershed, the majority of crops are under fertilized due to economics. Mixed cool season grass (hay) has always been under fertilized in the Jordan Lake Watershed and continues to be under fertilized. Nitrogen fertilization rates on these acres fell in the Lower New Hope and Haw subwatersheds and increased slightly in the Upper New Hope subwatershed. This is important to note as it is the largest acreage crop grown in all three subwatersheds. For many of the high acreage crops, farmers have reduced their nitrogen fertilization from baseline levels, while fertilization rates on other crops have increased or remained the same. Figures 5, 6, and 7 display the nitrogen fertilization rates in pounds per acre for the major crops in the watershed. Nitrogen fertilization rates for soybeans remained consistent with baseline fertilization rates or decreased in the subwatersheds. Nitrogen fertilization rates were higher in 2018 and 2019 than in the baseline period on corn acres due to differences in crop varieties and increased plant population densities, with expected increases in nitrogen uptake that produce higher yields. Wheat experienced decreases in nitrogen fertilization rates in 2018 and 2019 compared to the baseline.

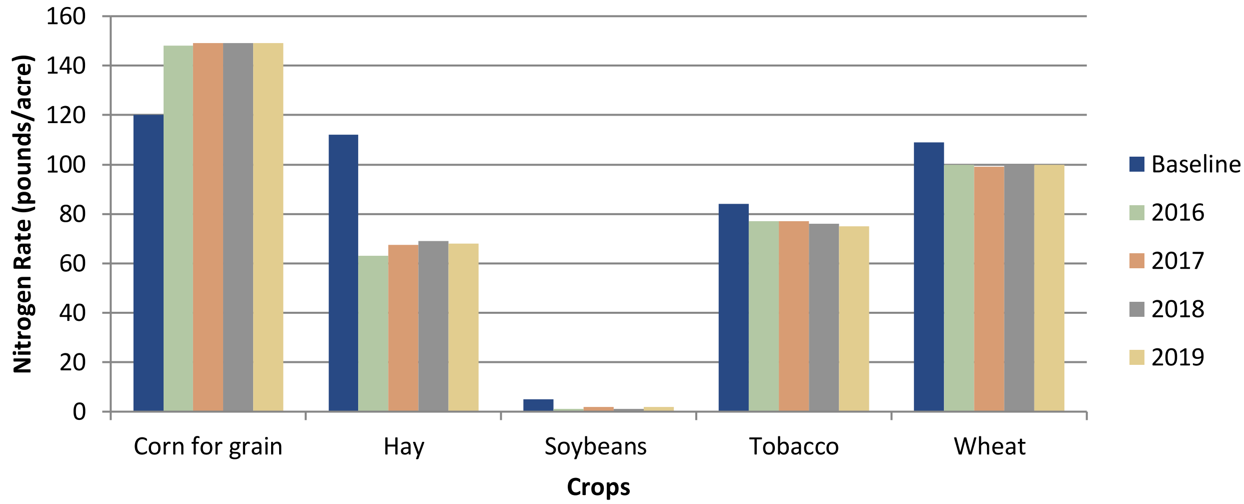
Of the cropland acres in the Jordan Lake Watershed, 1% are in the Lower New Hope Subwatershed.

Figure 5. Average annual nitrogen fertilization rate (lb/ac) on cropland for the baseline (1997-2001) 2016, 2017, 2018, and 2019, Lower New Hope Subwatershed, Jordan Lake Watershed



Of the cropland acres in the Jordan Lake Watershed, 4% are in the Upper New Hope Subwatershed.

Figure 6. Average annual nitrogen fertilization rate (lb/ac) on cropland for the baseline (1997-2001) 2016, 2017, 2018, and 2019, Upper New Hope Subwatershed, Jordan Lake Watershed



Of the cropland acres in the Jordan Lake Watershed, 95% are in the Haw Subwatershed.

Figure 7. Average annual nitrogen fertilization rate (lb/ac) on cropland for the baseline (1997-2001) 2016, 2017, 2018, and 2019, Haw Subwatershed, Jordan Lake Watershed

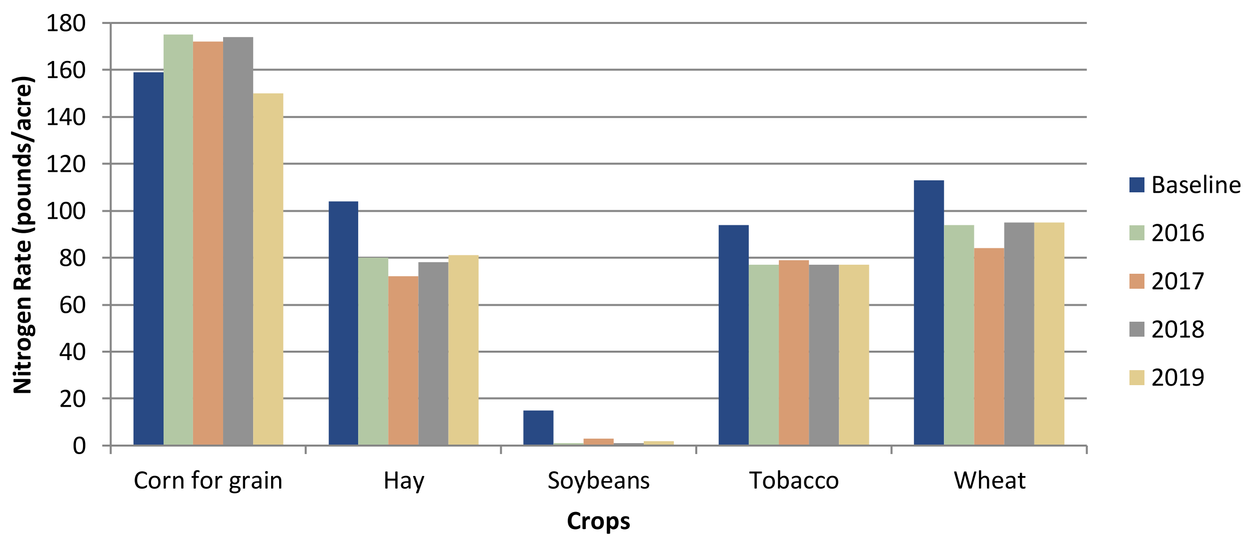


Figure 8 depicts the total annual nitrogen (in pounds) applied to cropland during the baseline (1997-2001), 2016, 2017, 2018, and 2019 to show the impact of fertilization rates related to crops that are grown in each subwatershed. Due to the small size of the subwatersheds in Jordan Lake, minor changes in nitrogen fertilization rates result in significant effects on the reported nitrogen reductions on cropland for smaller subwatersheds. The total amount of nitrogen lost in each of these subwatersheds is a function of the fertilization rate for each crop and the number of acres planted, which means that the largest nitrogen fluxes in the Jordan Lake Watershed occur on hay, wheat, and corn acres in the Haw subwatershed. Of all crops grown in the Jordan Lake Watershed, hay acres grown in the Haw subwatershed encompass the vast majority of all nitrogen applied to cropland. Depending on annual crop rotations, corn in the Haw subwatershed encompasses roughly a third of the total nitrogen volume as hay, and wheat encompasses roughly a fifth of the same.

Figure 8. Total annual nitrogen (lbs) applied annually to cropland for the baseline (1997-2001), 2016, 2017, 2018, and 2019 by Subwatershed, Jordan Lake Watershed

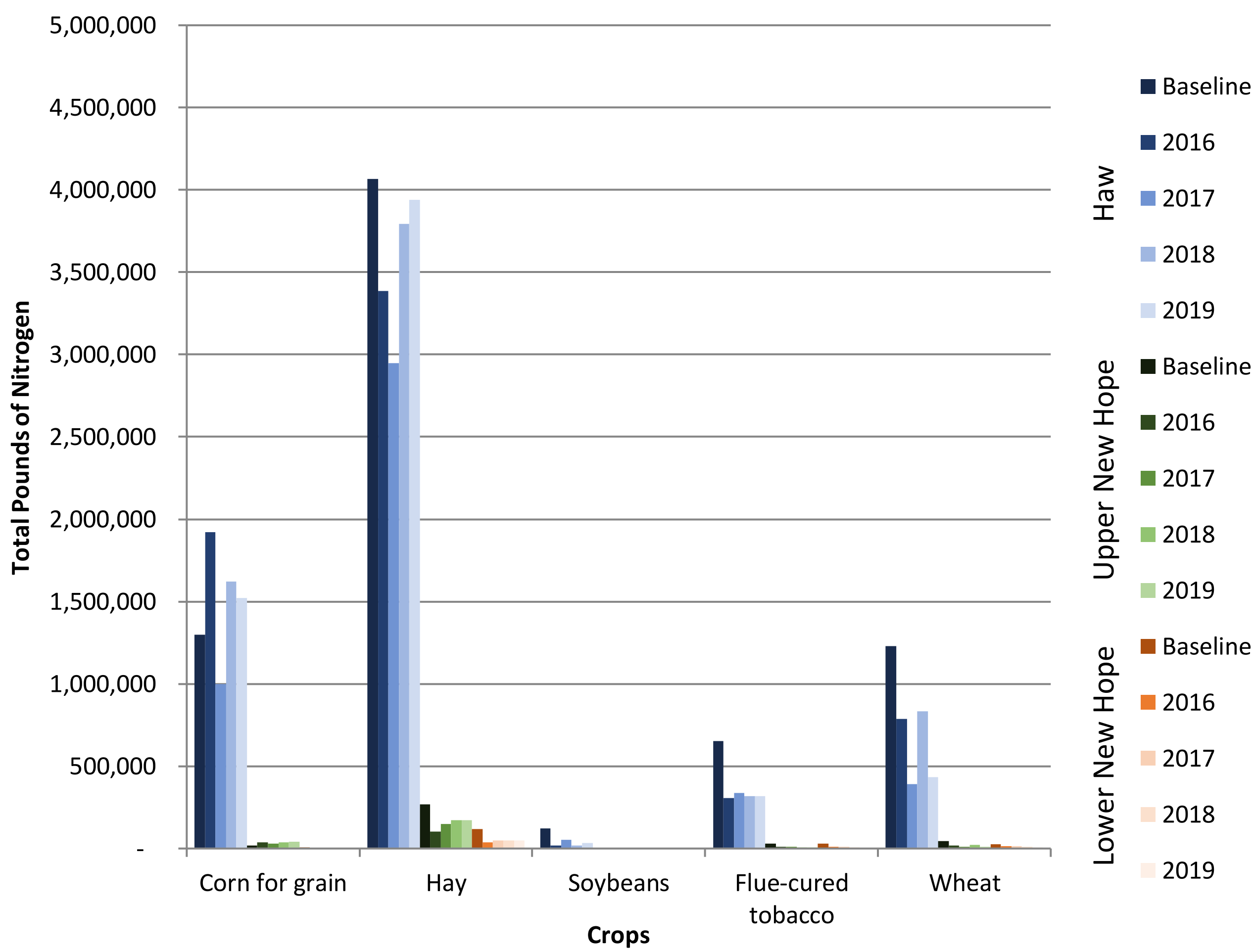
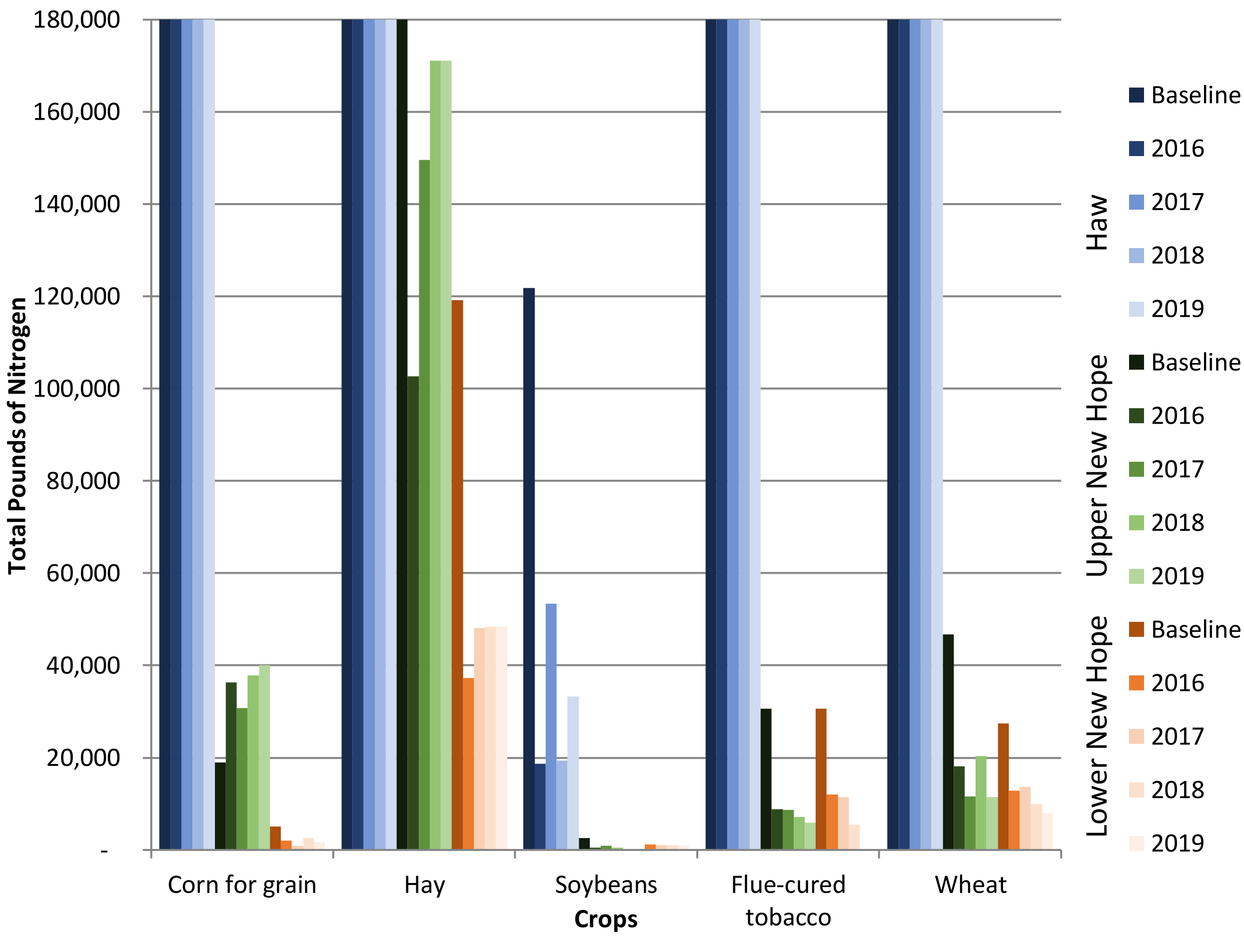


Figure 9. Total annual nitrogen (lbs) applied annually to cropland for the baseline (1997-2001), 2016, 2017, 2018, and 2019 by Subwatershed, Jordan Lake Watershed



Cropping Shifts

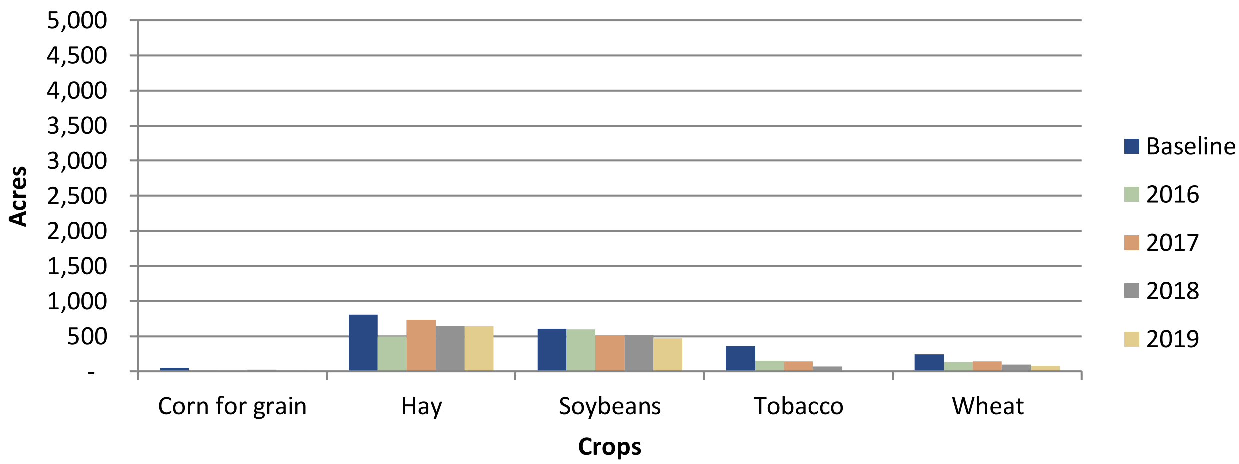
Counties calculated cropland acreage by utilizing crop data reported through the North Carolina Agricultural Statistics Service of the U.S. Department of Agriculture in cooperation with the North Carolina Department of Agriculture and Consumer Services.

Agricultural Statistics reports selected major commodity crops, which means that smaller acreages of vegetable produce and specialty crops are not included in their annual reports. In addition, in any county where it occurs, Agricultural Statistics does not report planted or harvested acreage for any crop where fewer than 500 acres were grown or where fewer than 3 individual producers reported growing a particular crop. Each crop requires different amounts of nitrogen and uses the nitrogen applied with different efficiency rates. Changes in the mix of crops grown can have a significant impact on the cumulative yearly nitrogen loss reduction.

Figures 10, 11, and 12 show crop acres and shifts for the baseline, 2016, 2017, 2018, and 2019. The acres of mixed cool season grass (hay) increased by 9,531 acres in the Haw subwatershed since the baseline but decreased by 35 acres in the Lower New Hope subwatershed and 166 acres in the Upper New Hope subwatershed. This shift to hay production in the Haw subwatershed may be due to the tobacco quota buyout program and increased reporting of hayland by farmers. Overall in the three subwatersheds corn and soybeans have increased by 2,234 and 7,958 acres, respectively, and tobacco and wheat acres have decreased by 3,451, and 6,796 acres, respectively. The significant decline in wheat acres is a result of wet weather during CY2019, which included several major storms and prevented many farmers from accessing their fields in time to plant. A host of factors from individual to global determine crop choices. Crop acreages are expected to fluctuate with the market yearly.

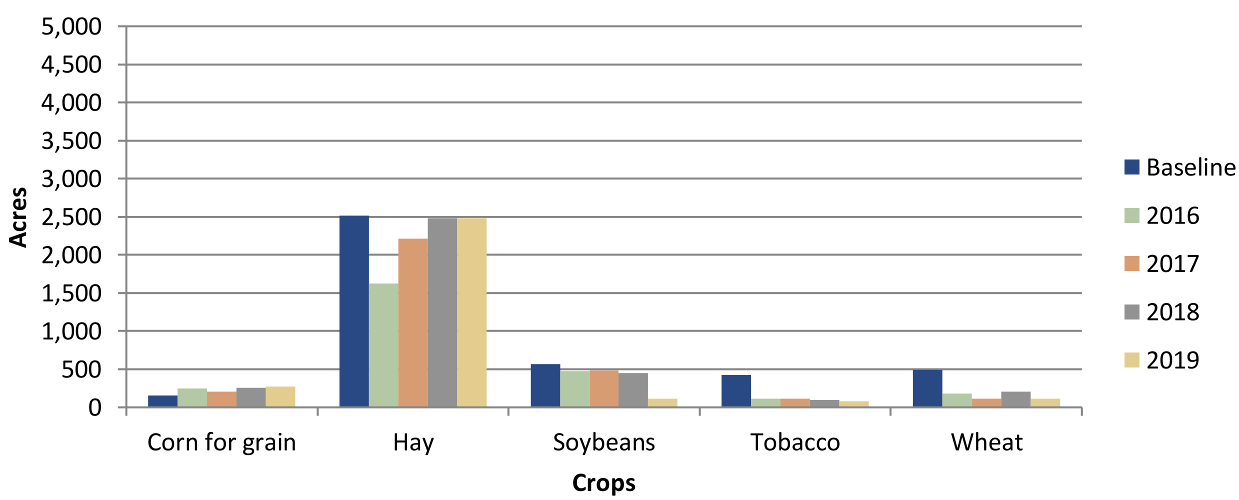
Of the cropland acres in the Jordan Lake Watershed, 1% are in the Lower New Hope Subwatershed.

Figure 10. Acreage of Major Crops for the Baseline (1997-2001), 2016, 2017, 2018, and 2019, Lower New Hope Subwatershed, Jordan Lake Watershed



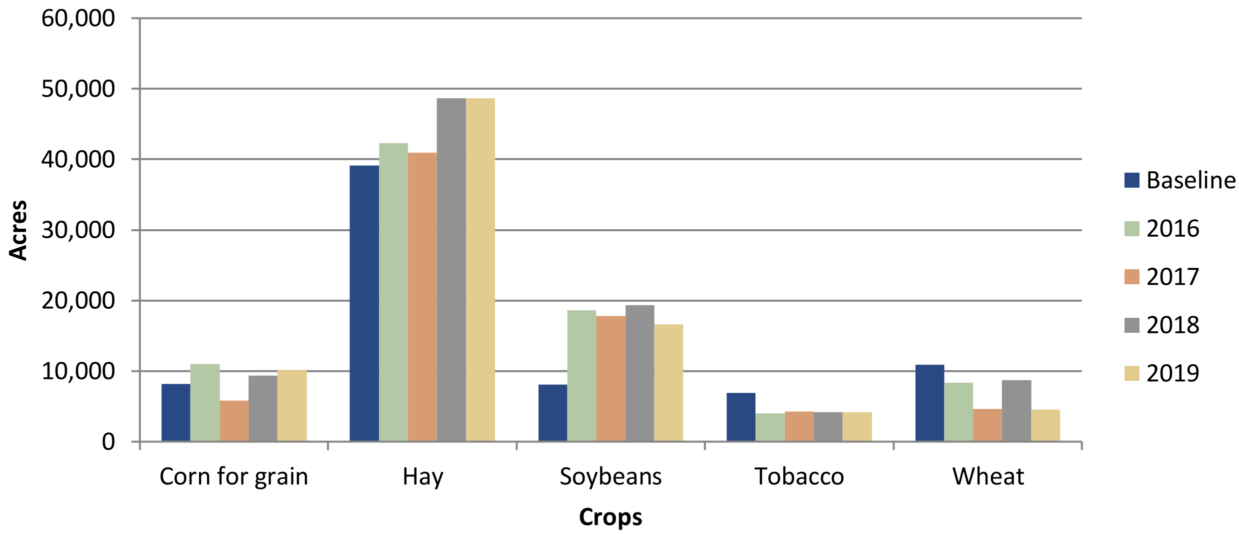
Of the cropland acres in the Jordan Lake Watershed, 4% are in the Upper New Hope Subwatershed.

Figure 11. Acreage of Major Crops for the Baseline (1997-2001), 2016, 2017, 2018, and 2019, Upper New Hope Subwatershed, Jordan Lake Watershed



Of the cropland acres in the Jordan Lake Watershed, 95% are in the Haw Subwatershed.

Figure 12. Acreage of Major Crops for the Baseline (1997-2001), 2016, 2017, 2018, and 2019, Haw Subwatershed, Jordan Lake Watershed

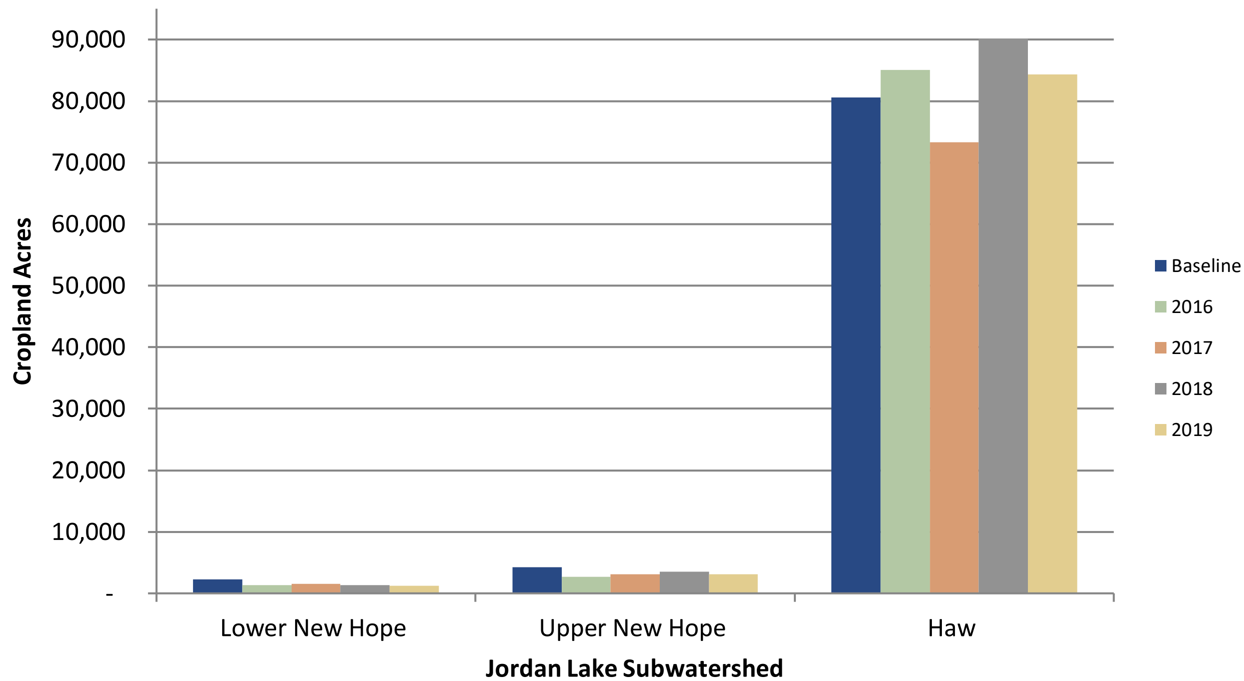


Land Use Change to Development and Cropland Conversion

The number of cropland acres fluctuates every year in the Jordan Lake Watershed and its subwatersheds due to cropland conversion and development. Each year, some cropland is permanently lost to development, or converted to grass or trees and likely to be ultimately lost from agricultural production. Figure 13 displays the total cropland acres in the watershed in the baseline, 2016, 2017, 2018, and 2019. Data regarding land use change since the baseline is summarized below.

Since the baseline, some agricultural acres have been lost permanently to development. These numbers are not directly comparable because they are documented with varying methodologies in each county. In addition to development, cropland can be converted to other uses. The WOC tracks the acres of cropland that are converted to grass or trees through state or federal cost share programs. Since the baseline, the following cropland acres in each subwatershed have been converted to grass or trees through state or federal cost share programs: 46 acres in the Lower New Hope Subwatershed, none in the Upper New Hope Subwatershed and 2,297 acres in the Haw Subwatershed.

Figure 13. Total Cropland Acres in the Jordan Lake Watershed, Baseline (1997-2001), 2016, 2017, 2018, and 2019



Pasture Accounting

Pasture nitrogen loss is also calculated using NLEW and is based on the total number of pasture acres, pastured livestock, and implemented livestock exclusion systems in the watershed. Reported pasture acreage and livestock totals are collected every 5 years from the USDA Census of Agriculture, and implementation data for exclusion systems is collected from local Soil and Water Conservation District staffs in the watershed. Because of this reporting cycle the next pasture-based nitrogen loss calculation will be included in a future report when the 2022 Census of Agriculture is published. In CY2017, the Upper New Hope subwatershed reported a 54% nitrogen loss reduction from baseline, the Lower New Hope subwatershed reported a 73% nitrogen loss reduction from baseline, and the Haw subwatershed reported a 49% nitrogen loss reduction from baseline. For pasture accounting 2002 was chosen as the baseline year because the closest possible Census of Agriculture was collected and published based on 2002 data. Table 3 lists each county's baseline, CY2012 and CY2017 nitrogen (lbs/yr) loss values from pastureland, along with nitrogen loss percent reductions from the baseline in CY2012 and CY2017. For CY2017, all three subwatersheds have exceeded their mandated goals.

Table 3. Estimated reductions in pasture land nitrogen loss from baseline (CY1997-CY2002) for CY2012 and CY2017, Jordan Lake Watershed

Upper New Hope: Goal of 35% Nitrogen Loss Reduction					
County	**Baseline Nitrogen Loss (lbs) †**	**2012 Nitrogen Loss (lbs)**	**2012 N Loss Reduction (%)**	**2017 Nitrogen Loss (lbs)**	**2017 N Loss Reduction (%)**
Chatham	28,977	18,328	37%	15,808	45%
Durham	19,952	8,615	56%	6,352	68%
Orange	20,350	9,892	51%	9,520	53%
Wake	655	261	60%	276	58%
Total	**69,554**	**37,096**	**47%**	**31,956**	**54%**
Lower New Hope: Goal of no net increase in Nitrogen Loss					
County	**2002 Nitrogen Loss (lbs) †**	**2012 Nitrogen Loss (lbs)**	**2012 N Loss Reduction (%)**	**2017 Nitrogen Loss (lbs)**	**2017 N Loss Reduction (%)**
Chatham	57,923	17,642	70%	15,808	73%
Wake	1,386	332	76%	295	79%
Total	**59,309**	**17,974**	**70%**	**16,103**	**73%**
Haw: Goal of 8% Nitrogen Loss Reduction					
County	**2002 Nitrogen Loss (lbs) †**	**2012 Nitrogen Loss (lbs)**	**2012 N Loss Reduction (%)**	**2017 Nitrogen Loss (lbs)**	**2017 N Loss Reduction (%)**
Alamance	201,646	151,357	25%	129,550	36%
Caswell	61,026	27,717	55%	28,513	53%
Chatham	132,263	81,473	38%	68,434	48%
Guilford	211,063	110,495	48%	74,457	65%
Orange	20,313	9,124	55%	8,277	59%
Rockingham	46,637	29,733	36%	33,845	27%
Total	**672,948**	**409,899**	**39%**	**343,076**	**49%**

† These figures were originally calculated using total watershed pasture acres. The Pasture Points Committee concluded that nitrogen loss should be calculated according to only the pasture acres which remain unbuffered at the time of each data collection. As a result, this column has been updated from what was reported previously.

The reduction percentages reported above result from a combination of pasture land loss, fertilization decreases, stocking rate changes, and BMP implementation. Table 4 shows how these factors have changed in the Jordan Lake Watershed since the 2002 baseline.

Table 4. Pasture operation changes from baseline (CY2002) for CY2012 and CY2017, Jordan Lake Watershed

Factor	Baseline	2012	2017	2002-2012 % Change
Pasture Land	99,595 acres	83,096 acres	74,478 acres	-25%
Fertilization†	103 lbs N/acre	81 lbs N/acre	80 lbs N/acre	-22%
Stocking Rate	0.58 animal units/acre	0.72 animal units/acre	0.68 animal units/acre	+18%
Livestock Exclusion System Implementation	976 acres	4,224 acres	6,022 acres	+517%

† *Total fertilization rate equals direct waste deposition times volatilization factor plus supplemental application*

Phosphorus Indicators for CY2017 through CY2019

The qualitative indicators included in Table 5 show the relative changes in land use and management parameters and their relative effect on phosphorus loss risk in the watershed from the baseline. This approach was recommended by the Phosphorus Technical Advisory Committee (PTAC) in 2005 due to the difficulty of developing an aggregate phosphorus tool parallel to the nitrogen NLEW tool. The PTAC reconvened in April 2010 to make minor revisions for the tool's use in this watershed and the approach was approved for use in the Jordan Lake Watershed by the Water Quality Committee of the EMC. This report includes phosphorus indicator data for the baseline period (1997-2001), CY2017, CY2018, and CY2019. Most of the parameters indicate less risk of phosphorus loss than in the baseline.

Phosphorus Technical Assistance Committee (PTAC):

The PTAC'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 was not feasible 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 instead developed recommendations for qualitatively tracking relative changes in practices in land use and management related to agricultural activity that either increase or decrease the risk of phosphorus loss from agricultural lands in the basin on an annual basis.

Contributing to the reduced risk of phosphorus loss is the reduction in the acres of tobacco, the decrease in the amount of animal waste phosphorus, and a movement to 90% conservation tillage on cropland in the watershed.

The soil test phosphorus median number reported for the watershed fluctuates each year due to the nature of how the data is collected and compiled. The soil test phosphorus median numbers shown in Table 5 are generated by using North Carolina Department of Agriculture and Consumer Services (NCDA&CS) soil test laboratory results from voluntary soil testing and the data is reported by the NCDA&CS. The number of samples collected each year varies. The data does not include soil tests that were submitted to private laboratories. The soil test results from the NCDA&CS database represent data from entire counties in the watershed and have not been adjusted to include only those samples collected in the Jordan Lake Watershed.

Table 5. Relative Changes in Land Use and Management Parameters and their Relative Effect on Phosphorus Loss Risk in the Jordan Lake Watershed

Parameter	Units	Source	Baseline (average 1997-2001)	CY2017	CY2018	CY2019	Percent change (baseline to CY2019)	CY2019 P Loss Risk +/-
Cropland	Acres	NC Ag Statistics	87,077	77,989	95,004	88,554	2%	+
Cropland conversion (to grass & trees)	Acres	USDA-NRCS & NCACSP	1,359	2,183	2,270	2,302	69%	-
Conservation tillage[6]	Acres	USDA-NRCS & NCACSP	1,997	19,801	19,801	19,801	892%	-
Vegetated buffers (cumulative)	Acres	GIS analysis	54,212	52,835	52,842	52,842	-3%	+
Tobacco acres	Acres	USDA-NRCS & NCACSP	7,667	4,511	4,302	4,216	-45%	-
Scavenger crop	Acres	USDA-NRCS & NCACSP	0	2,700	2,700	2,700	2,700%	-
Animal waste P	lbs of P/ yr	NC Ag Statistics	7,965,784	4,522,375	4,403,627	4,543,314	-43%	-
Soil test P median	P-Index	NCDA& CS	72	68	64	71	-1%	-

[6] Conservation tillage is being practiced on additional acres but this number only reflects acres under active cost share contracts, not acres where farmers have adopted the use of conservation tillage without cost share assistance. An estimated 93% of producers are practicing conservation tillage on cropland in the Jordan Lake Watershed. Source: *O'Connell, C. and D.L. Osmond. 2018. Carolina Dreamin': A case for understanding farmers' decision-making and hybrid agri-environmental governance initiatives in agricultural communities as complex assemblages in Agri-environmental Governance as an Assemblage: Multiplicity, Power, and Transformation. Editors: Jérémie Forney, Hugh Campbell, Chris Rosin. Rutledge Press.*

The WOC finds that the decreased risk of P loss is associated with the following three important parameters:

- increase in conservation tillage acreage
- decrease in animal waste phosphorus
- decrease in tobacco acreage

A 43% reduction in animal waste phosphorus is due primarily to an overall reduction in watershed animal numbers, including a past closure of a large poultry processing plant in Siler City, which temporarily decreased the demand for broilers in the region and resulted in a significant downturn in production. That plant reopened in 2019 and is currently operating at less than their 250,000 broilers per day production capacity. The WOC expects local producers to meet increased demand incrementally as the modernized Siler City plant approaches an increased full capacity in coming years. Since CY2010 the Jordan Lake Watershed has seen a decline of 9.6 million broilers, 10,200 swine, and 9,900 cattle. Over that same time period the number of layers has increased by roughly 88,000. In addition, the permanent closure of many dairy operations in the watershed have also contributed to reduced animal waste phosphorus.

Most poultry operations are deemed permitted in North Carolina. Operations that are deemed permitted have: (1) fewer animals than the state requires to obtain a state permit or (2) have a waste management system that does not require a state or federal permit. Most poultry operations have dry-litter poultry waste management systems and do not require any additional state or federal permits. Owners or operators of dry-litter poultry waste facilities are, however, required to adhere to rules set forth under 15A NCAC 02T .1303 (Permitting by Regulation) and General Statute 143-215.10C, which include minimum stream setbacks, land application rates, soil analysis, and recordkeeping requirements. Because specific information about the location, number of animals, amount of dry-litter poultry waste produced and fields on which the dry-litter poultry waste is applied is unknown, the extent of potential impacts to water quality due to nutrient contributions from dry-litter poultry waste is difficult to assess.

The WOC recommends that no additional management actions be required of agricultural operations in the watershed at this time to comply with the phosphorus goals of the agriculture rule. The WOC will continue to track and report the identified set of qualitative phosphorus indicators to the Division of Water Resources (DWR) annually, and to bring any concerns raised by the results of this effort to the DWR’s attention as they arise, along with recommendations for any appropriate action. The WOC expects that BMP implementation may continue to increase throughout the watershed in future years, and notes that BMPs installed for nitrogen and sediment control often provide significant phosphorus benefits as well.

Due to the number of permitted biosolids application fields in the piedmont, the Jordan Lake Watershed Oversight Committee also initially recommended adding tracking of the annual application of human biosolids, but ultimately removed this element from the tracking methodology due to lack of readily accessible biosolids data. Biosolids applicators have begun submitting annual reports electronically and that data is being manually entered in a DEQ database. To include this information in this report will require that DEQ enter the data in a useful format. When such a database becomes available the human biosolids component will be tracked as a separate component of phosphorus accounting. In an effort to improve nutrient management strategies that are part of the residuals (biosolids) application program, NC DEQ formed a stakeholder group in 2011 to evaluate available nutrient management tools for phosphorus and make recommendations for future phosphorus management of biosolids applications. The WOC recommends that DEQ re-engage this conversation and will incorporate DWR’s findings in a future report.

BMP Implementation Not Tracked by NLEW

Not all types of nutrient- and sediment-reducing best management practices (BMPs) are tracked by NLEW. Other BMPs 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 estimating a nitrogen benefit. The WOC believes it is worthwhile to recognize these practices because overall conservation practice implementation gives a comprehensive picture of the work that is being done on agricultural land in the watershed. Table 6 identifies these BMPs and tracks their implementation in the watershed since the end of the baseline period.

Table 6. Best management practices installed from 2002 to 2019, Jordan Lake Watershed

Conservation Practice	Units	Baseline-2018 (cumulative)	2009-2019 (active contracts)
Ag road repair-stabilization	feet	3,207	327
Agricultural pond restoration/repair	units	25	8
Closure-waste impoundments	units	19	3
Constructed wetland	acres	2	0
Critical area planting	acres	85	21
Cropland conversion-grass	acres	1,237	286
Cropland conversion-trees	acres	1,033	194
Diversion	feet	6,450	1,378
Fencing (USDA programs)	feet	74,831	73,318
Field border	acres	160	21
Filter strip	acres	0.4	0
Grassed waterway	acres	306	19
Habitat management	acres	310	13
Nutrient management	acres	5,295	186
Nutrient management plan	no.	30	1
Pasture renovation	acres	2,881	59
Pastureland conversion to trees	acres	31	0
Pond	no.	2	1
Prescribed grazing	acres	5,404	3,058
Sediment control basin	units	2	0
Sod-based rotation	acres	10,744	1,125
Streambank and shoreline protection	acres	17,080	1,911
Terrace	feet	31,379	2,166

* Additional BMPs may exist in the watershed as producers may maintain practices after the life of a cost share contract, and other practices are installed by farmers without cost share assistance.

Looking Forward

WOC recognizes the dynamic nature of agricultural business:

- Urban encroachment (i.e., crop selection and production shifts as fields become smaller)
- Age of farmer (i.e., as retirement approaches farmers may move from row crops to livestock)
- Changes in the world economies, energy or trade policies
- Changes in government programs (i.e., commodity support, crop insurance 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 sustainability)

The Jordan Lake WOC will continue to improve rule implementation, relying heavily on the local soil and water conservation districts who work directly with farmers to assist with best management practice design and installation.

Because cropping shifts are susceptible to various pressures, the WOC is working with all counties to continue BMP implementation on both cropland and pastureland that provides for a lasting reduction in nitrogen and phosphorus loss in the watershed while monitoring cropping changes.

Members of the Falls and Jordan Lake WOCs have been working with DWR on issues regarding nutrient offsets that arise from trades involving agricultural land. Also, the WOC feels that additional research is needed on accounting procedures for pasture operations, and supports such research being conducted. Additionally, should readily accessible information become available on biosolids applications to agricultural acres in the watershed, the WOC will consider whether separate accounting for those applications of nutrients is feasible and appropriate.

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.

In 2001, grants from several sources funded a total of two watershed technicians and two basin coordinators. The technicians' primary responsibility was to assist farmers with BMP implementation. These technicians assisted existing county staff to expedite the installation of nutrient reducing BMPs in the basin. On June 30, 2015 the last technician funding was expended, and technician funding is no longer eligible for grant awards by funding entities in the state. Therefore, less technical assistance for BMP implementation is available. Ongoing responsibility for conservation practice planning and installation now depends on local staff that also have other duties. Budget changes at the USDA have necessitated a statewide restructuring of North Carolina NRCS field staff, and these changes have led to a reduction in federally-funded technical capacity at the local level. 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 NCDA&CS Division of Soil and Water Conservation funded by EPA 319(h) funds 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. 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.

Phosphorus accounting and reporting will continue to address qualitative factors and evaluate trends in agricultural phosphorus loss annually. Periodic land use surveys with associated use of the Phosphorus Loss Assessment Tool (PLAT) are needed every five years, but it is unlikely that funding will be available for this activity. Additionally, understanding of agricultural phosphorus management could be improved through in-stream monitoring contingent upon the availability of funding and staff resources.

Over the next year a group called Jordan Lake One Water which is comprised of multiple stakeholders across the watershed is meeting to draft an integrated watershed management plan for future implementation. This plan will be released to the public in time to inform DWR's ongoing rule revision process for the Jordan Lake Nutrient Strategy. This plan will incorporate watershed-scale priorities and draft a framework for incentivizing work in and around the watershed which will promote pollutant reduction simultaneously with economic development and community resilience. Some agricultural stakeholders are participating in this stakeholder process and have begun providing recommendations for ways to incorporate this sector into future partnerships.

Conclusion

The Jordan Lake WOC 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. Significant progress has been made in agricultural nitrogen loss reduction, and the agricultural community is achieving its reduction goals. 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 nitrogen loss reduction goals. 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 nutrient reduction goals of Jordan Lake.

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