NCDA&CS

2022 Annual Progress Report for the Jordan Lake Agriculture Rule (15A NCAC 02B.0264) for the Baseline Period (1997-2001) for Crop Year 2020

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

Date approved by Jordan Lake Watershed Oversight Committee: February 25th, 2022
Date submitted to NC Division of Water Resources: March 1st, 2022

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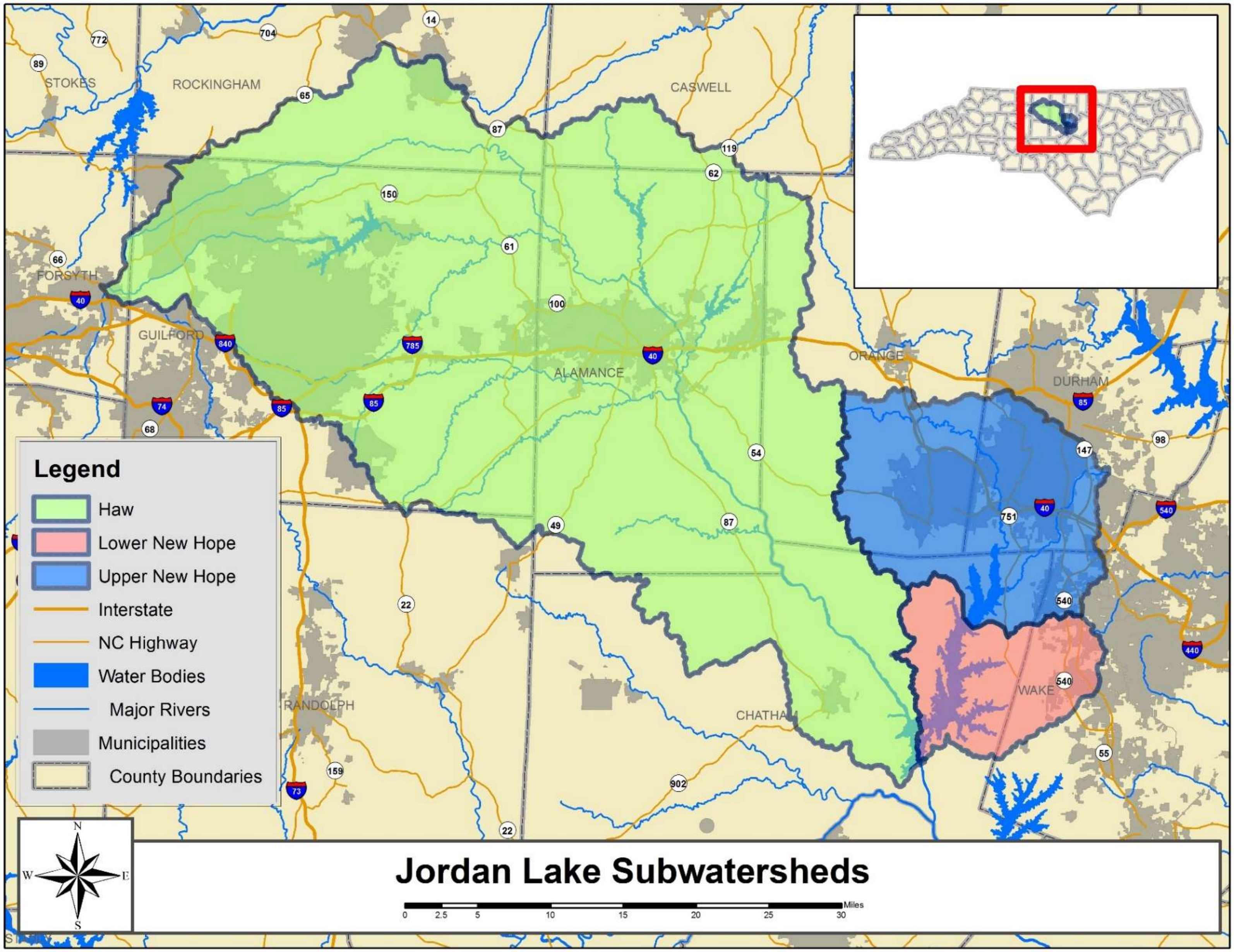
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Summary

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, 2020. 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 most recently available 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 CY2020, with the Upper New Hope Watershed reporting an estimated 42% reduction, the Lower New Hope Watershed reporting an estimated 67% reduction, and the Haw River Watershed reporting an estimated 28% reduction (see "Nitrogen Reduction from Cropland from Baseline for CY2020" on page 7). 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 2020, 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 from baseline.

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 wide adoption and implementation of conservation tillage on 90% of cropland in the watershed since baseline.

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 of 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 January 2022. Collectively, each of the three subwatersheds is meeting their cropland nitrogen loss reductions, with the Upper New Hope Watershed reporting an estimated 42% reduction, the Lower New Hope Watershed reporting an estimated 67% reduction, and the Haw River Watershed reporting an estimated 28% reduction (see "Nitrogen Reduction from Cropland from Baseline for CY2020"on page 7). These reductions have been achieved primarily by reduced nitrogen application rates and cropping shifts from higher nitrogen crops to lower nitrogen crops since baseline. The reduction percentage in each watershed decreased from CY2020 to CY2019 largely due to an increase in total cropland acres and increased corn and wheat production. Wheat acres increased from CY2019 in part due to improved conditions. A mix of rain events and dry days in October 2019 gave farmers greater opportunity to harvest summer crops and plant winter crops including wheat compared to conditions the previous crop year[1]. Additionally, the winter was abnormally dry with unseasonably warm conditions in February and March 2020, enabling smoother harvest of winter crops and activating an earlier growing season[2]. Soybean acres saw an increase, but as there were similar acreage increases for corn and wheat in CY2020, the impact of increased soybean production was minimized. Both corn and wheat require higher nitrogen inputs than other crops planted in the watershed. Total cropland acres also most likely increased in CY2020 due to the use of a merged dataset consisting of crop acres

[1] Davis, C. 2019. The Heat Backed Off and Rain Picked Up in October. Prepared by North Carolina State Climate Office for the Climate Blog, Climate Summary. https://climate.ncsu.edu/blog/2019/11/the-heat-backed-off-and-rain-picked-up-in-october/

[2] Davis, C. and K. Dello. 2021. An Extreme, Unusual 2020: the Weather Year in Review. Prepared by North Carolina State Climate Office for the Climate Blog, Climate Summary. https://climate.ncsu.edu/blog/2021/01/an-extreme-unusual-2020-the-weather-year-in-review/

reported by North Carolina Agricultural Statistics Service (NASS) of the U.S. Department of Agriculture from CY2020 and CY2018 . As is discussed in the "Nitrogen Reduction from Cropland from Baseline for CY2020" section of this report, total cropland acres for CY2020 were calculated using corn, wheat, and soybean acreages reported by NASS in 2020 and hay and tobacco acreages reported by NASS in 2018 that were estimated to remain mostly constant for CY2020.

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 were achieved primarily by reduced nitrogen application rates and an overall reduction in pasture acres. Pastureland nitrogen loss is calculated on a 5-year cycle based on agriculture census data availability, 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.

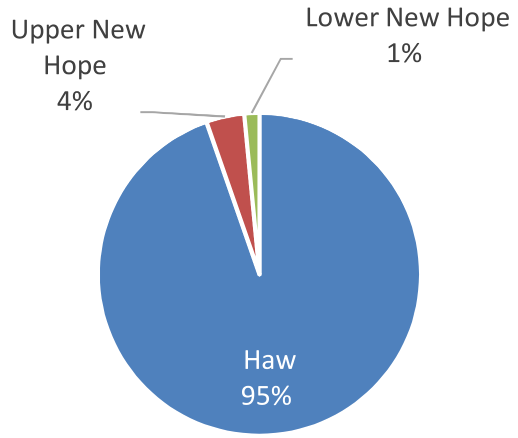
The Nitrogen Loss Estimation Worksheet (NLEW) was developed to estimate a baseline nitrogen loading and percent N reductions based on the regulatory framework developed for the agricultural accounting tool[3]. Changes in nitrogen occur due to nitrogen fertilizer management, conservation practices, cropping shifts, and loss of agricultural lands. The Jordan Lake Agriculture Rule was written so that each subwatershed has a nitrogen loss reduction requirement.

[3] 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 CY2020

The Jordan Lake Watershed encompasses just over 1,000,000 acres, and in CY2020 a total of 98,342 acres were estimated to be planted in cropping systems. Of those, 93,104 acres (95%) were grown in the Haw subwatershed, 3,742 acres (4%) were grown in the Upper New Hope subwatershed, and 1,496 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 CY2020 by subwatershed in the Jordan Lake Watershed



Data Changes in CY2020 and Impact on Nitrogen Reduction Estimates from Baseline

Since 2019, the North Carolina Agricultural Statistics Service (NASS) of the U.S. Department of Agriculture has discontinued annual county acreage estimates for hay and tobacco. This is a significant issue because hay constitutes the largest acreage crop grown in all three Jordan Lake subwatersheds. For this report, hay and tobacco acreages in each county were estimated to remain at the acreage levels reported in 2018. An exception is for 2020 tobacco acreage in the portion of the Upper New Hope subwatershed lying in Orange County where no tobacco acreage was reported for 2020 because of traditionally low tobacco acreage grown in that portion of the subwatershed. Using a merged dataset consisting of 2018 and 2020 crop year data may misrepresent total cropland acres in production in CY2020, and in turn impact the annual nitrogen reduction estimates from baseline achieved by the agriculture community in each Jordan Lake subwatershed. The Jordan Lake Watershed Oversight Committee is currently working with the Division of Water Resources to adjust annual reporting methodology to account for this data change.

All counties submitted their progress report to the WOC in January 2022. The following reductions were calculated using a merged data set consisting of 2018 and 2020 crop year data.

- For the Lower New Hope Watershed, agriculture achieved an estimated cropland nitrogen loss reduction of 67% compared to the average nitrogen loss from 1997 to 2001.
- For the Upper New Hope Watershed, agriculture achieved an estimated cropland nitrogen loss reduction of 42% compared to the average nitrogen loss from 1997 to 2001.
- For the Haw Watershed, agriculture achieved an estimated cropland nitrogen loss reduction of 28% 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 CY2019 and CY2020, along with estimated nitrogen loss percent reductions from baseline values in CY2019 and CY2020.

Table 1. Estimated reductions in agricultural nitrogen loss (cropland) from baseline (1997-2001), CY2019 and CY2020, Jordan Lake Watershed †

County	Baseline Nitrogen Loss (lb)†	CY2019 Nitrogen Loss (lb)†*	CY2019 N Loss Reduction (%)‡*	CY2020 Nitrogen Loss (lb)†**	CY2020 N Loss Reduction (%)‡**
Upper New Hope Subwatershed: Goal of 35% nitrogen loss reduction (1% of total Jordan Lake Watershed cropland)					
Chatham	43,063	7,463	83%	14,326	67%
Durham	37,618	15,565	59%	30,621	19%
Orange	68,632	38,677	44%	45,261	34%
Wake	9,694	1,672	83%	2,650	73%
Total	**159,007**	**63,377**	60%	**92,859**	42%
Lower New Hope Subwatershed: Goal of no increase in nitrogen loss (4% of total Jordan Lake Watershed cropland)					
Chatham	56,632	11,858	79%	21,308	62%
Wake	38,362	6,617	83%	10,485	73%
Total	**94,994**	**18,475**	81%	**31,793**	67%
Haw Subwatershed: Goal of 8% nitrogen loss reduction (95% of total Jordan Lake Watershed cropland)					
Alamance	697,634	440,241	37%	576,840	17%
Caswell	260,254	126,663	51%	151,693	42%
Chatham	245,458	55,704	77%	101,201	59%
Guilford	1,393,551	900,852	35%	1,004,281	28%
Orange	231,272	131,367	43%	153,924	33%
Rockingham	169,080	114,421	32%	156,924	7%
Total	**2,997,249**	**1,769,248**	41%	**2,144,864**	28%

† *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.*

**Some CY2019 Nitrogen Loss and Reduction values may have changed since reported to fix a spreadsheet error.*

****CY2020 Nitrogen Loss and Reduction values were estimated based on crop acreage data reported for CY2020 and CY2018 due to reporting changes from the North Carolina Agriculture Statistics Service (NASS). Using a merged dataset may misrepresent total cropland acres in production in CY2020 and impact annual nitrogen reduction estimates from baseline.*

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[4]
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.[5] 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,* most agricultural land in the watershed is already buffered. This study found that six counties within the watershed had more than 75% of their agricultural land buffered, and that the average buffer width was greater than 50 feet .[6] 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 as a result of decreased overall agricultural production acres during the same time period. This is also reflected in the reported buffer acres included in the first annual progress report (CY2010), which were noticeably lower than baseline totals. Since the CY2010 report, total 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 2020, 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.

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

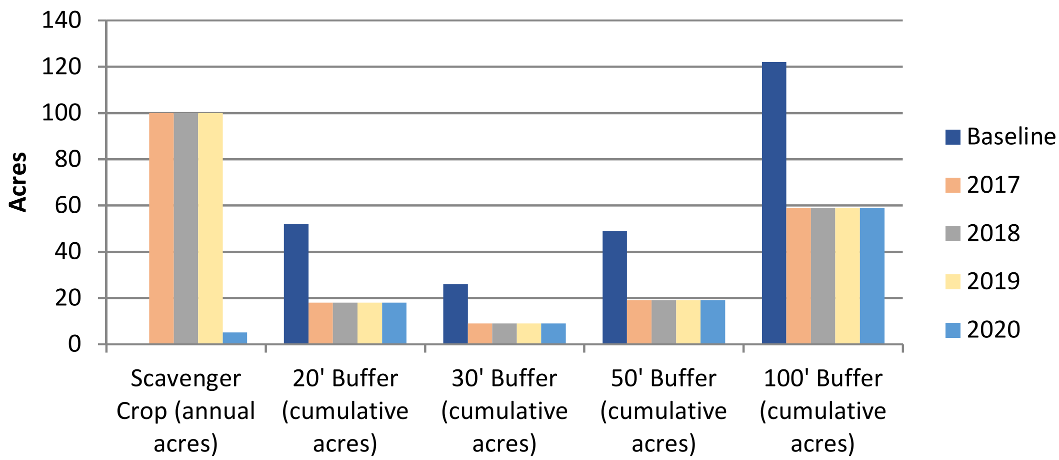
[5] Osmond,D., D. Meals, D. Hoag, and M. Arabi. 2012. How to Build Better Agricultural Conservation Programs to Protect Water Quality: The NIFA-CEAP Experience. Soil and Water Conservation Society, Ankeny, IA.

[6] 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.

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 from 1998 to 2010. 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 from 1998 to 2010. 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 2017, 2018, 2019, and 2020 is displayed in Figures 2, 3, and 4.

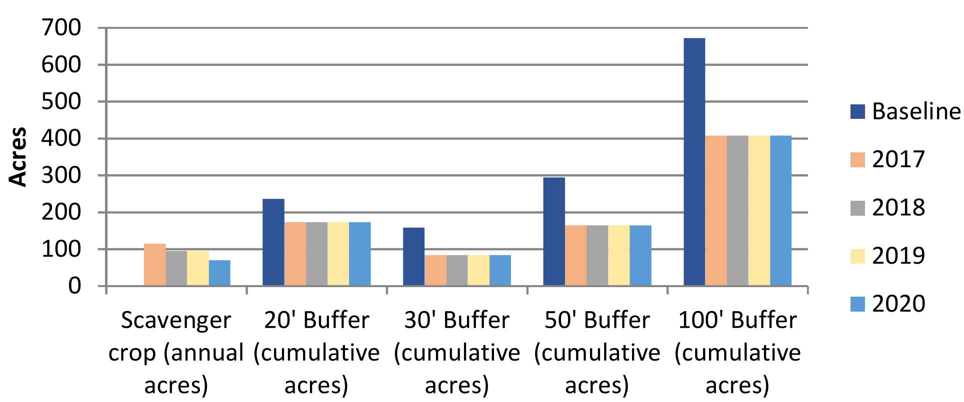
Of the cropland acres in the Jordan Lake Watershed, 1% are in the Lower New Hope Subwatershed.

Figure 2. Nitrogen Reducing BMPs installed on Croplands from Baseline (1998), 2017, 2018, 2019, and 2020, Lower New Hope Subwatershed, Jordan Lake Watershed *



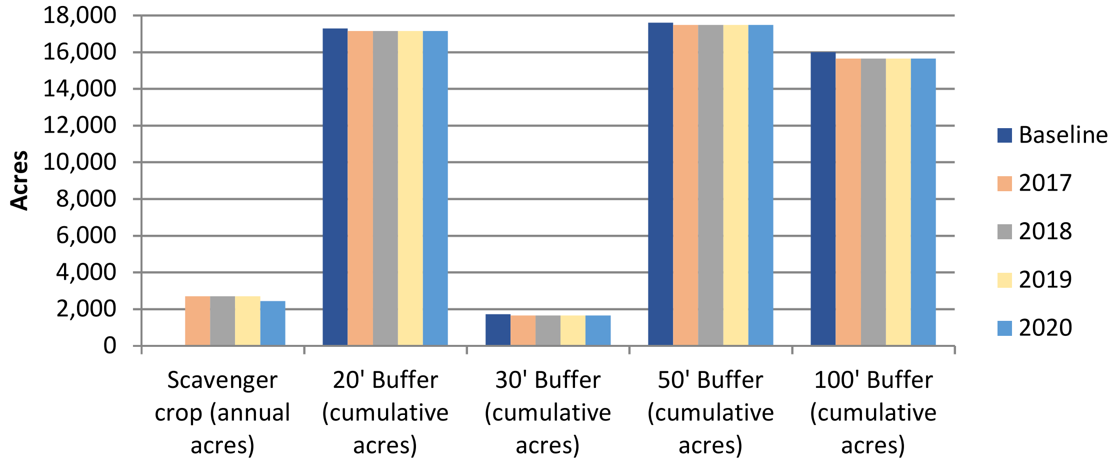
Of the cropland acres in the Jordan Lake Watershed, 4% are in the Upper New Hope Subwatershed.

Figure 3. Nitrogen Reducing BMPs installed on Croplands from Baseline (1998), 2017, 2018, 2019, and 2020, 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), 2017, 2018, 2019, and 2020, 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.*[7]

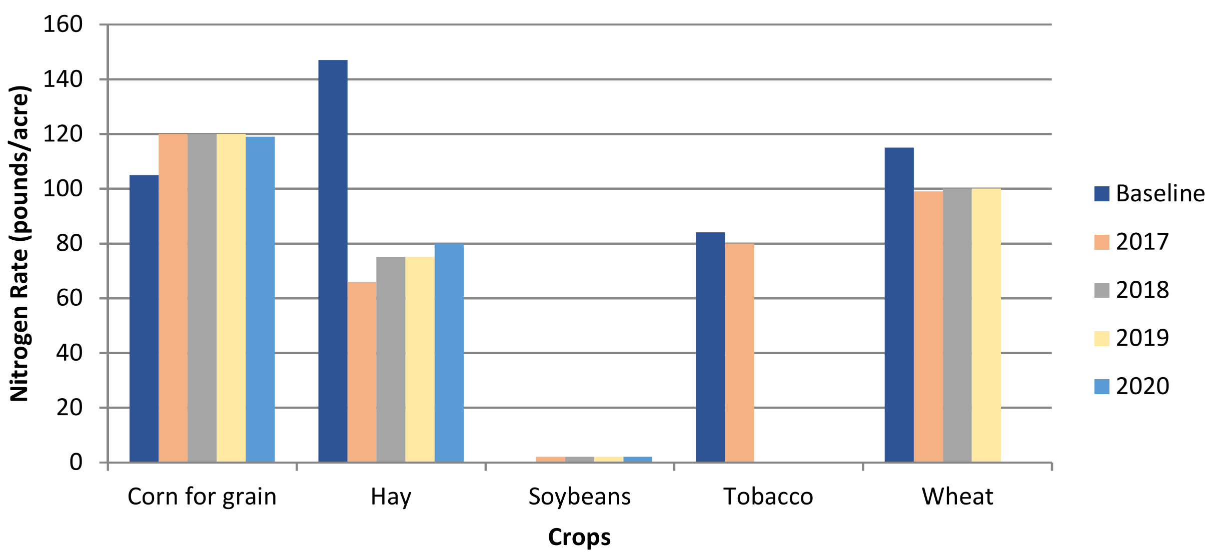
[7] Bruton, Jeffrey Griffin. 2004. Headwater Catchments: Estimating Surface Drainage Extent Across North Carolina and Correlations Between Landuse, Near Stream, and Water Quality Indicators in the Piedmont Physiographic Region. Ph.D. Dissertation. Department of Forestry and Environmental Resources, North 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. In CY2020 nitrogen fertilization rates on hay acres increased by 5 and 7 pounds per acre respectively in the Lower New Hope and Upper New Hope subwatersheds and increased only slightly (1 lb/acre) in the Haw 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, 2019, and 2020 than in the baseline period on corn acres in the Lower New Hope and Upper New Hope 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 2019 and 2020 compared to the baseline.

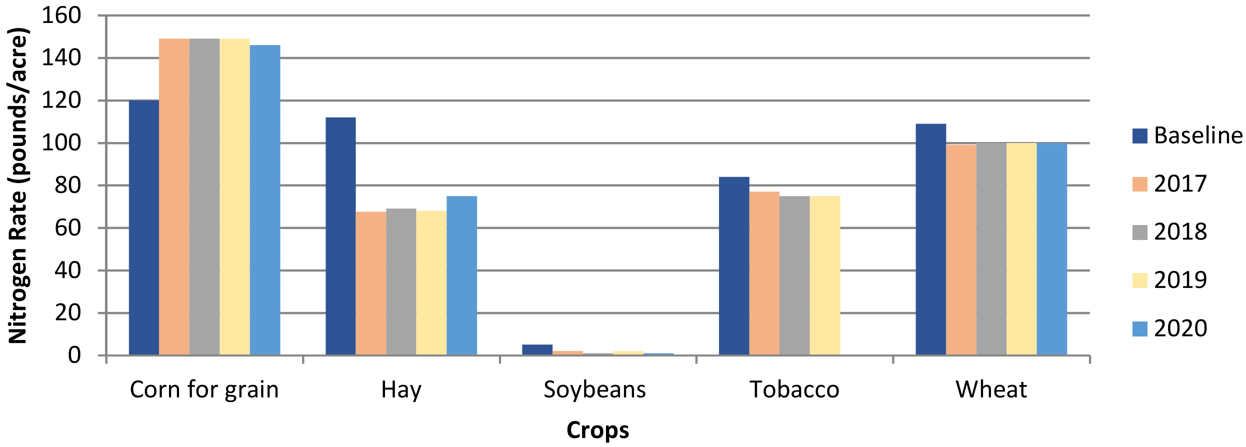
Of the cropland acres in the Jordan Lake Watershed, 1% are in the Lower New Hope Subwatershed.

Figure 5. Average annual nitrogen fertilization rate (lb/ac) on cropland for the baseline (1997-2001) 2017, 2018, 2019, and 2020, 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) 2017, 2018, 2019, and 2020, 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) 2017, 2018, 2019, and 2020, Haw Subwatershed, Jordan Lake Watershed

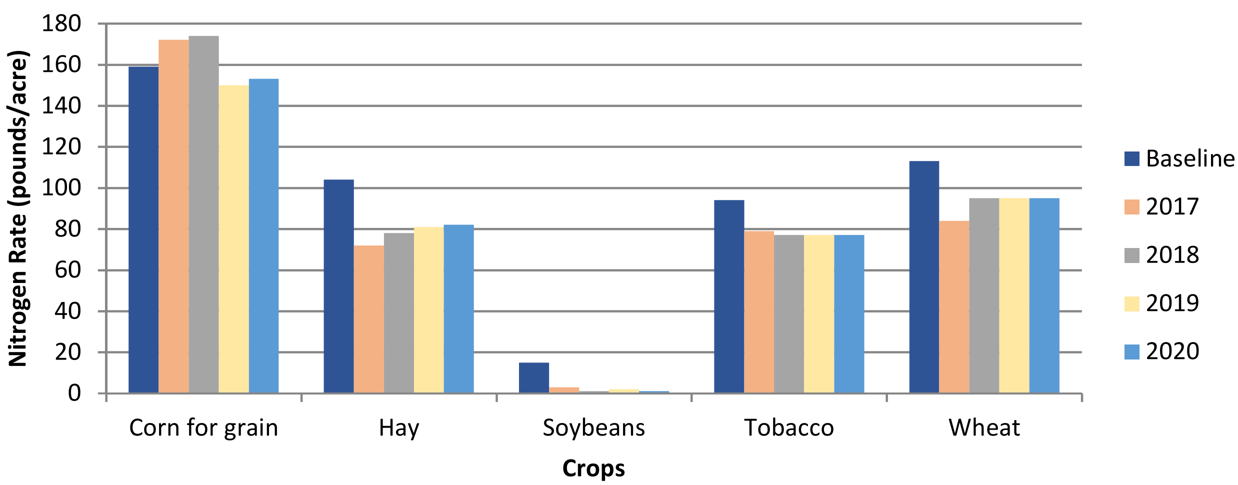
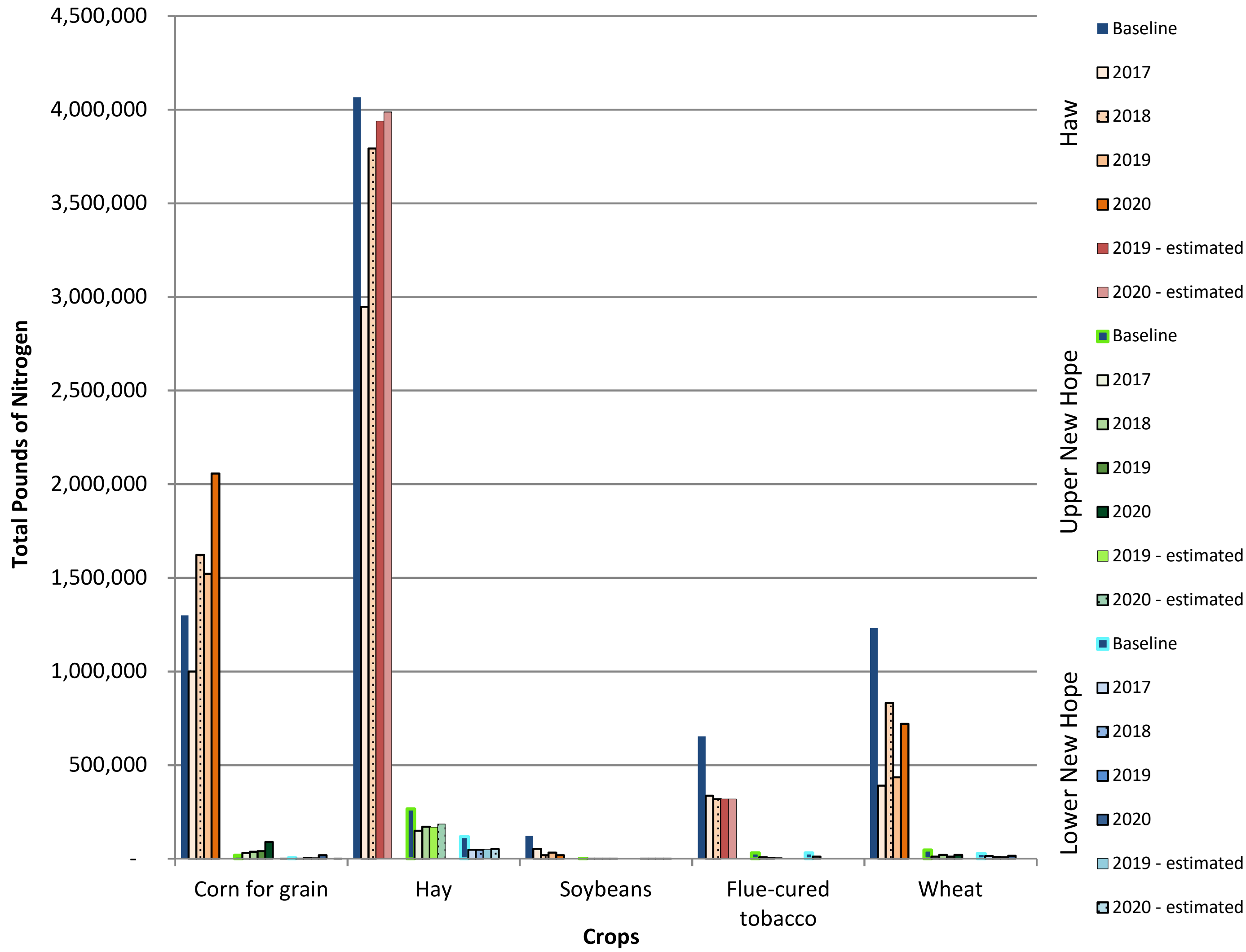


Figure 8 depicts the total annual nitrogen (in pounds) applied to cropland during the baseline (1997-2001), 2017, 2018, 2019, and 2020, to show the impact of fertilization rates related to crops that are grown in each subwatershed. Due to the small size of the subwatersheds in Jordan Lake, minor changes 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 most of all nitrogen applied to cropland. In CY2020, corn in the Haw subwatershed encompasses roughly half 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), 2017, 2018, 2019, and 2020 by Subwatershed, Jordan Lake Watershed*



****CY2020 hay and tobacco acres are graphed as estimated because the North Carolina Agriculture Statistics Service (NASS) discontinued reporting annual acreages for those crops in 2019. Hay and tobacco estimates graphed are based on 2018 reported NASS data for those crops.*

Cropping Shifts

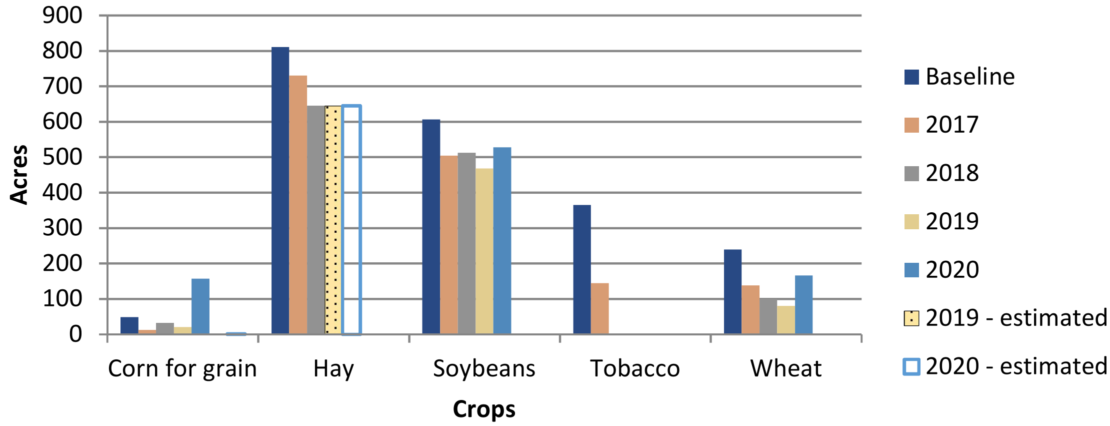
Counties calculated cropland acreage by utilizing crop data reported through the North Carolina Agricultural Statistics Service of the U.S. Department of Agriculture in cooperation with the North Carolina Department of Agriculture and Consumer Services.

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 specific 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 reductions seen in each subwatershed. For this report, 2020 county acreage data were obtained for corn, soybeans, and wheat. Since 2019, Agriculture Statistics has discontinued county acreage estimates for hay and tobacco. For this report, hay and tobacco acreages in each county were estimated to remain at the acreage levels reported in 2018. An exception is for 2020 tobacco acreage in the portion of the Upper New Hope subwatershed lying in Orange County where no tobacco acreage was reported for 2020 because of traditionally low tobacco acreage grown in that portion of the subwatershed. This data discontinuance presents a significant issue in estimating annual nitrogen reductions from baseline for CY2020 in all three subwatersheds as hay constitutes the largest acreage crop grown in the Jordan Lake watershed. The Watershed Oversight Committee is currently working with the Division of Water Resources to adjust future annual reporting methodology to account for this issue.

Figures 10, 11, and 12 show crop acres and shifts for the baseline, 2017, 2018, 2019, and 2020. Overall in the three subwatersheds, corn and soybeans have increased by 5,839 and 10,998 acres, respectively, and tobacco and wheat acres have decreased by 3,590, and 3,681 acres, respectively, from baseline. A host of factors from individual choice to global markets determine crop selections. Crop acreages are expected to annually fluctuate with the market.

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

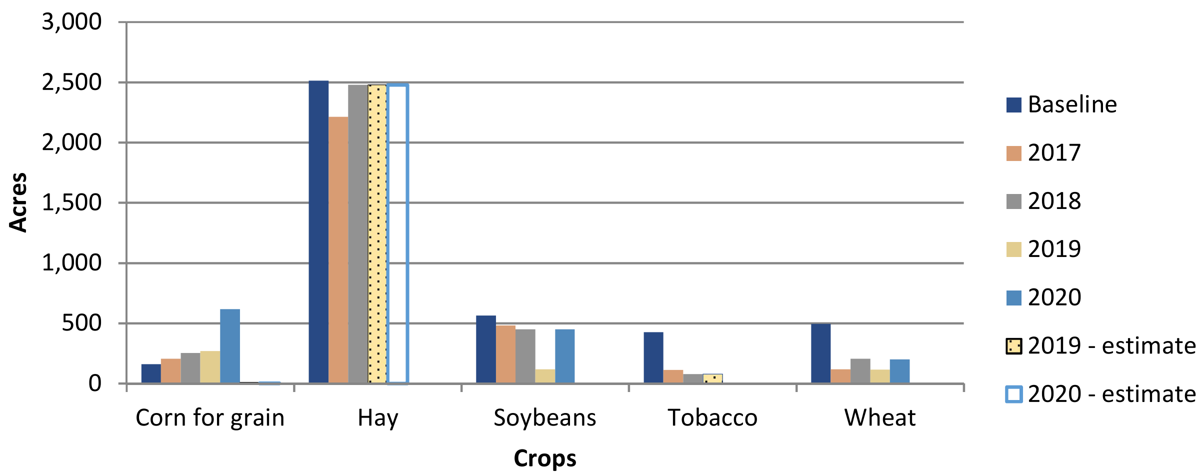
Figure 10. Acreage of Major Crops for the Baseline (1997-2001), 2017, 2018, 2019, and 2020, Lower New Hope Subwatershed, Jordan Lake Watershed*



*****_Corn acreage values in 2017, 2018, and 2019 changed slightly to fix a spreadsheet error. Tobacco acreage reported in 2018 was changed to reflect the 2018 tobacco acreage data that can currently be pulled from the Agriculture Statistics database (zero acres for Wake and Chatham counties). Additionally, Agriculture Statistics discontinued reporting annual hay acres starting in 2019. The hay acreage graphed as estimated for 2019 and 2020 is the 2018 reported acreage._

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

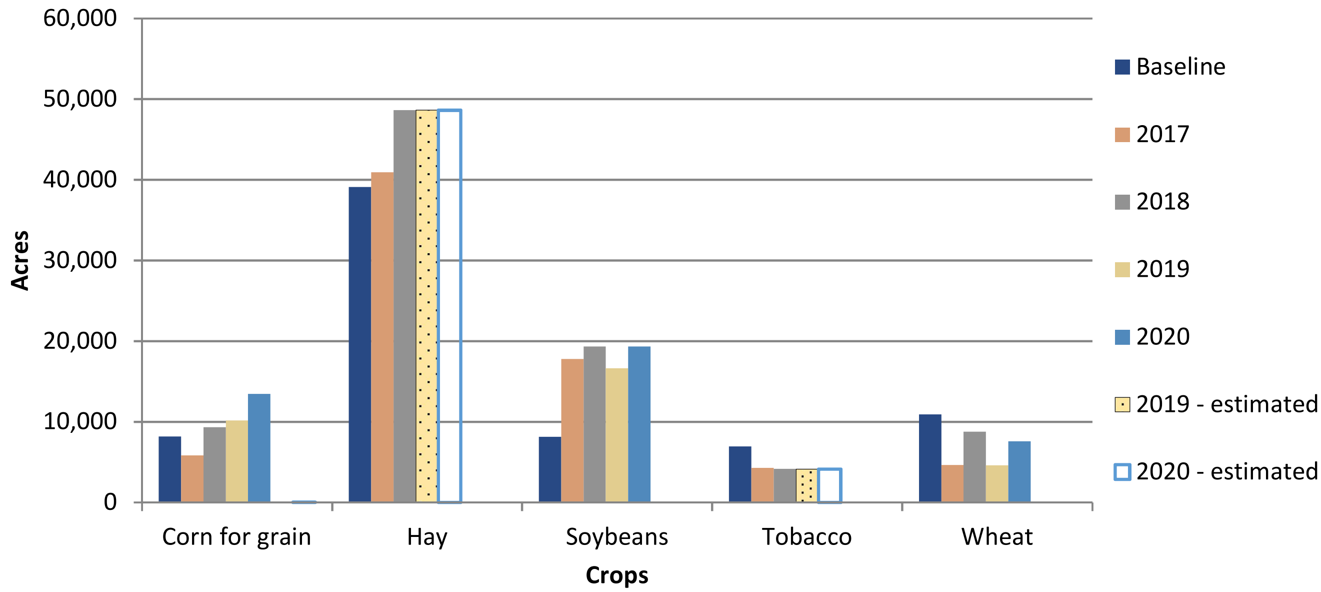
Figure 11. Acreage of Major Crops for the Baseline (1997-2001), 2017, 2018, 2019, and 2020, Upper New Hope Subwatershed, Jordan Lake Watershed*



*****_Corn acreage values in 2017, 2018, and 2019 slightly changed to fix a spreadsheet error. Agriculture Statistics discontinued reporting annual hay and tobacco acres starting in 2019. The hay acreage graphed as estimated for 2019 and 2020 is the 2018 reported acreage. In 2019, tobacco acreage was estimated to remain at 2018 reported levels. No tobacco acreage was reported in 2020 in the portion of the Upper New Hope subwatershed lying in Orange County because of traditionally low tobacco acreage grown in that portion of the subwatershed._

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), 2017, 2018, 2019, and 2020, Haw Subwatershed, Jordan Lake Watershed*



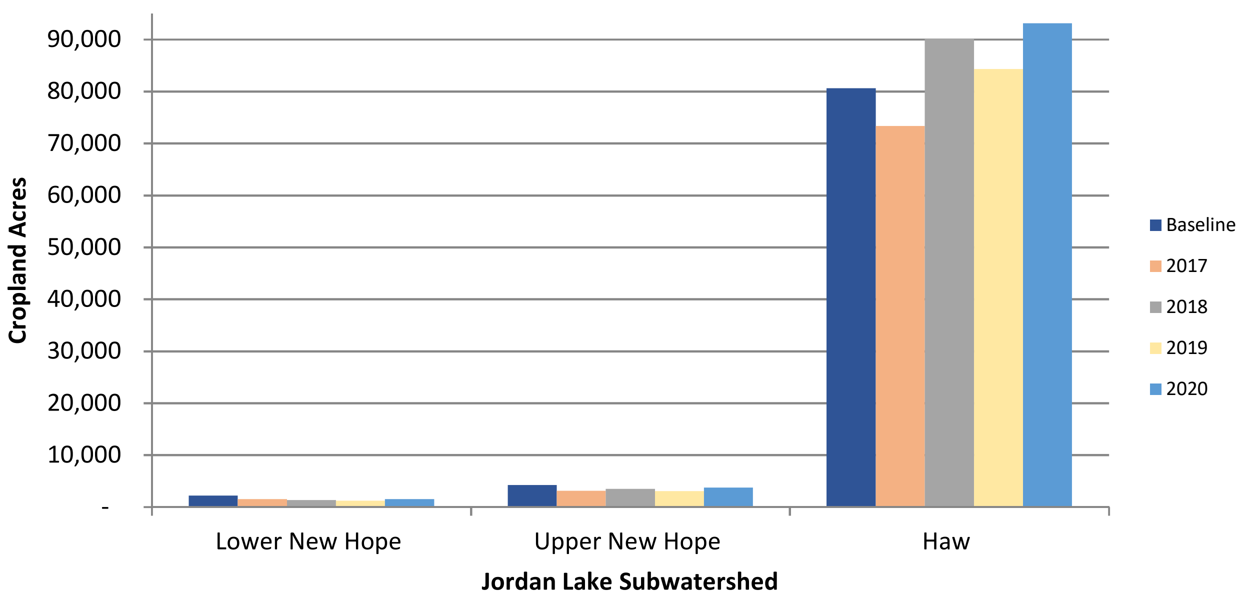
Agriculture Statistics discontinued reporting annual hay and tobacco acres starting in 2019. The hay and tobacco acreage graphed as estimated for 2019 and 2020 is the 2018 reported acreage.

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, 2017, 2018, 2019, and 2020. 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: 47 acres in the Lower New Hope Subwatershed, none in the Upper New Hope Subwatershed and 2,301 acres in the Haw Subwatershed.

Figure 13. Total Cropland Acres in the Jordan Lake Watershed, Baseline (1997-2001), 2017, 2018, 2019, and 2020*



*****_Total cropland acres increased in CY2020 due to gains in corn and wheat production, but most likely also due to the use of a merged dataset consisting of crop acres reported by North Carolina Agricultural Statistics Service of the U.S. Department of Agriculture for CY2020 and CY2018 (see "Nitrogen Reduction from Cropland from Baseline for CY2020"on page 7)._

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%**

† 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.

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

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 pastureland 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	2002-2017 % 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 CY2018 through CY2020 Since Baseline

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), CY2018, CY2019, and CY2020. Most of the parameters indicate less risk of phosphorus loss than in the baseline.

Contributing to the reduced risk of phosphorus loss since baseline 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 on agricultural land 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.

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.

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

Parameter	Units	Source	Baseline (average 1997-2001)	CY2018	CY2019	CY2020	Percent change (baseline to CY2020)	CY2020 P Loss Risk +/-
Reported Cropland (annual)	Acres	NC Ag Statistics	87,077	94,926*	88,559*	98,342	13%	+
Cropland conversion to Grass & Trees (cumulative)	Acres	USDA-NRCS & NCACSP	1,359	2,270	2,302	2,348	73%	-
Conservation tillage[8] (active contract – 10 yr rolling window)	Acres	USDA-NRCS & NCACSP	1,997	19,801	19,801	2,179†	9%	-
Vegetated buffers (cumulative)	Acres	GIS analysis	54,212	52,842	52,842	52,842	-3%‡	+
Tobacco acres (annual)	Acres	USDA-NRCS & NCACSP	7,667	4,216*	-§	-§	-46%	-
Scavenger crop (annual)	Acres	USDA-NRCS & NCACSP	0	2,700	2,700	2,420	2,420%	-
Animal waste P (annual)	lbs of P/ yr	NC Ag Statistics	7,965,784	4,403,627	4,531,205**	4,664,407	-41%	-
Soil test P median (annual)	P-Index	NCDA& CS	72	64	71	78	8%	+

† *Contracted conservation tillage acres are notably lower than CY2018 and CY2019 data. Older contracts implemented at the start of annual reporting have since expired; however, conservation tillage continues to be widely used (see footnote 8).*

‡*Total acres of buffers have slightly decreased. Additional agricultural land in the Jordan Lake Watershed may be buffered as a result of Division of Mitigation Services activities in the watershed, which cannot be included in this report for nutrient reduction credit.*

**Tobacco and total cropland acreage were adjusted for CY2018 based on updated data from USDA NASS since this value was reported. Total cropland was adjusted for CY2019 to fix a spreadsheet error.*

***Animal Waste P was adjusted for CY2019 based on updated data from USDA NASS since this value was reported.*

§ *Tobacco acreage was last reported by NASS in CY2018. Tobacco acreage declined in North Carolina since the phase out of the Federal Tobacco Quota Program and enactment of the Fair and Equitable Tobacco Reform Act in 2004. The Jordan Lake watershed is not an exception to this statewide trend and has seen a decline in tobacco acreage grown since baseline.*

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[8] 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 from baseline is associated with the following three important parameters:

- continued high adoption of conservation tillage
- decrease in animal waste phosphorus
- decrease in tobacco acreage

A 41% 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 their 250,000 broilers per day production capacity. The WOC expects local producers to meet increased demand incrementally. Since CY2001 the Jordan Lake Watershed has seen a decline of 9.2 million broilers, 10,300 swine, and 9,900 cattle. Over that same time period, the number of layers has increased by roughly 98,000. 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.

Relative to CY2020 and the baseline, the WOC recommends that no additional management actions be required of agricultural operations in the watershed based on available data 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. Since then, biosolids applicators have begun submitting annual reports electronically to DEQ in a digital Portable Document Format (PDF) and that data is being manually entered into a DEQ database. However, the data are not complete nor in a useable format. To improve nutrient management strategies that are part of the residuals (biosolids) application program, the WOC recommends DEQ provide rate, nutrient content, and spatial application information for permitted biosolids application data in a usable format for incorporation in future reporting.

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 2020, Jordan Lake Watershed*

Conservation Practice	Units	Baseline-2020 (cumulative)	2010-2020 (active contracts – 10 year rolling window)
Ag road repair-stabilization	feet	3,207	327
Agricultural pond restoration/repair	units	26	9
Closure-waste impoundments	units	20	3
Constructed wetland	acres	2	0
Critical area planting	acres	86	21
Cropland conversion-grass	acres	1,256	286
Cropland conversion-trees	acres	1,092	239
Diversion	feet	6,450	1,378
Fencing (USDA programs)	feet	80,587	73,846
Field border	acres	162	23
Filter strip	acres	0.4	0
Grassed waterway	acres	312	24
Habitat management	acres	345	48
Nutrient management	acres	5,381	272
Nutrient management plan	no.	30	1
Pasture renovation	acres	3,156	334
Pastureland conversion to trees	acres	31	0
Pond	no.	2	1
Prescribed grazing	acres	6,746	3,394
Sediment control basin	units	2	0
Sod-based rotation	acres	11,271	1,592
Streambank and shoreline protection	acres	18,816	1,911
Terrace	feet	31,379	10,970

* *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)
- Plant disease or pest problems (i.e., viruses or foreign pests).

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 worked 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. With more readily accessible information on biosolids applications to agricultural acres in the watershed now available, 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 to work within the Jordan Lake Watershed. The technicians' primary responsibility was to assist farmers with BMP implementation and to support 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 with other duties. Additionally, 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 previously funded was also to assist with the reporting requirements for the Neuse and Tar-Pamlico Agriculture Rules. Currently, in addition to other duties, the Nonpoint Source Planning Coordinator position 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 likely involve GIS analysis and more streamlined acreage documentation. Because most district staff 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.

A group called Jordan Lake One Water, which is comprised of multiple stakeholders across the watershed, worked throughout 2020 and 2021 to draft an integrated watershed management plan and vision document. This vision document was released to the public and submitted to DWR staff in Fall 2021 to inform DWR's ongoing rule revision process for the Jordan Lake Nutrient Strategy. This document incorporates watershed-scale priorities and discusses a new framework for incentivizing work in and around the Jordan Lake watershed to promote pollutant reduction simultaneously with economic development and community resilience. Some agricultural stakeholders participated in the stakeholder process during the plan's development and provided recommendations for ways to incorporate agriculture into future partnerships. The Jordan Lake One Water group will continue to be active in working to realize its integrated watershed management vision during the rule revision process in the coming year.

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.