DELINEATING AGRICULTURE IN THE LAKE JORDAN RIVER BASIN

Final Report for the
Sampling Analysis: Delineating Agriculture in the Lake Jordan River Basin

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EXECUTIVE SUMMARY

Under the proposed Lake Jordan Rules, the Basin Oversight Committee (BOC) is tasked with submitting agricultural information on a yearly basis. Unfortunately, some of this information, such as fertilizer rates, is based on best professional judgment; there are no fertilizer-use statistics that are reliable. In addition, best management practices (BMPs) are only captured if they are cost shared. To obtain a better estimate of agricultural practices, this one-time statistically valid area sampling frame was applied to agricultural fields in the Lake Jordan River Basin in order to collect an agricultural baseline of cropping systems, soil types and currently used best management practices, livestock types and numbers, and producer information.

Using a valid statistical sampling technique, random census blocks were selected. The number of maps selected per county in the Lake Jordan basin was based on how much of the county was within the river basin boundaries, as well as the amount of agriculture. Counties sampled consisted of Alamance, Caswell, Chatham, Durham, Forsyth, Guilford, Orange, Randolph, Rockingham, and Wake. Most of these counties only had a portion of its area within the Lake Jordan watershed boundary. Enumerators employed by the North Carolina Department of Agriculture and Consumer Service (NCDA&CS), Division of Statistics administered the survey. The data set consisted of 1,156 records.

We collected information on a wide variety of agricultural characteristics, including number of acres in development, wildlife, and CREP/CRP. Other data collected consisted of county, field size (ac), current crop, fertilizer applications (amount and type), tillage type, cover crop use, presence of different types of buffers, buffer widths, acreage affected by the buffers, field slope, receiving slope length, and presence of other BMPs (sediment basin or pond). Slope length was also determined in order to calculate soil loss. The survey instrument is attached at the end of this report. After the information was collected, the data were then transformed in order to report on them.

Most counties have reasonable cover crop use for cropped fields; however, since generally more than 50% of all acres were in hay or pasture, most fields do not require cover crops. Soil erosion rates were low. Part of this was because much of the land area is in pasture or hay. In addition, some cropland (2 to 58%) was under conservation tillage (CT).

Most BMPs consist of buffers, rather than sediment basins or ponds. From 92% - 40% of all agricultural acres are buffered with trees, vegetation, or trees and vegetation. Six out of 9 counties had more than 75% of their agricultural land buffered. The average buffer width is greater than the proposed 50 feet. Of the total buffers enumerated, 52% of them were tree buffers, 31% vegetative buffers, and 17% mixed buffers (trees + vegetation).

In many counties for most crops, nitrogen (N) fertilizer rates were below the expected rates based on realistic yield expectations. Some crops, such as pasture and hay, were often not fertilized or under fertilized. The majority of farmers use the same fertilizer plan for a particular crop, regardless of soil test recommendations or differences in yield goal. Mostly, however, this prescriptive fertilization did not translate into excess nutrient applications of crops.

Average soil test phosphorus (P) levels were in the high range. Three counties had medium soil test P levels (Chatham, Forsyth and Randolph), five had high levels (Alamance, Guilford, Orange, Rockingham, and Wake counties), and Caswell County had a very high average soil test level. However, 65% of all fields test low or medium for P.

The field data from this sample was used in the North Carolina Agricultural Nutrient Assessment Tool (NCANAT). Phosphorus Loss Assessment Tool (PLAT) analysis showed that potential off-site loss of P from agricultural fields in the Lake Jordan River Basin is very low. Likewise, when data were analyzed in the Nitrogen Loss Assessment Tool (NLEW), the N losses were low because fertilizer N application rates were often lower than the recommended N rates.

Most livestock in the basin consists of cattle, followed by horses. There are small amounts of goats, sheep, llamas and donkeys. Except for Orange County, stocking rates in all counties were below maximum recommended rates.

Only 50% of the farmers surveyed consider farming to be their primary activity. Most of the remaining producers had very little income from their agricultural activities suggesting a large number of hobby farmers in this basin.

Most producers (82%) did not have a nutrient management plan. Of these, 70% determined their own fertilizer rates. Only 13% received fertilizer recommendations from USDA- Natural Resources Conservation Service (NRCS), fertilizer dealers or extension. For those producers with nutrient management plans, most were written by NRCS. Nutrients are generally applied by the producers (70%). Fertilizer dealers applied only 17% of the nutrients.

In summary, when all the data are combined, it appears that producers in the Lake Jordan River Basin are minimizing environmental impact of nutrient and soil losses from agricultural fields due to the types of cropping systems used and under fertilization of most crops. Best management practices, primarily buffers are being used, as well as cover crops and conservation tillage; nutrient inputs generally are below recommended levels.

DELIVERABLES

- Nutrient management training materials for the Upper Lake Jordan (Lake Jordan) for both producers and green industry personnel. (Since the rules are not yet finalized, we could not begin nutrient management training. This change was approved by DENR.)
- Train-the-trainers (NCCES agents) to deliver nutrient management education. (Since the rules are not yet finalized, we could not begin nutrient management training. This change was approved by DENR.)
- Track the numbers and types of individuals trained, by county in nutrient management. (Since the rules are not yet finalized, we could not begin nutrient management training. This change was approved by DENR.)
- Aggregate version of NLEW for the Lake Jordan watershed.
- Training for the aggregate NLEW. (Since the rules are not yet finalized, we could not begin nutrient management training. This change was approved by DENR.)
- Report on current agricultural practices (provide an on-ground assessment of current agricultural practices using the area frame sampling technique developed for the Lake Jordan watershed.
- Quarterly reports.
- Final report.

INTRODUCTION

Under the Lake Jordan Rules, the Lake Jordan BOC is charged with determining a baseline for N losses. To calculate the N losses and change in N losses due to BMP implementation, a tracking and reporting field-scale tool was developed (NLEW), to accommodate this task (Osmond et al., 2001). Under the proposed Lake Jordan Rules, N-reduction plans will be implemented at county level before producer involvement is required. There are 10 counties in the Lake Jordan Basin: Alamance, Caswell, Chatham, Durham, Forsyth, Guilford, Orange, Randolph, Rockingham, and Wake. Unlike the Neuse Rules, in the Lake Jordan Basin, P also has to be considered.

Under the Lake Jordan, the BOC has to establish a baseline that recreates many agricultural historical events. This information will be collected yearly and then compared from one year to the next to determine reductions in N from agricultural producers. Unfortunately, fertilizer rates that are used in this accounting are best professional judgment; there are no fertilizer-use statistics that are reliable. In addition, BMPs are only captured if they are cost shared. To obtain a better estimate of practices, this one-time sampling was designed to better assess agricultural conditions.

PURPOSE AND GOALS

The goal of this proposal is primarily to identify current agricultural practices by applying a statistically valid area sampling frame to agricultural fields in the Lake Jordan River Basin in order to collect an agricultural baseline of cropping systems, soil types and currently used best management practices. This work is critical if the mandated baseline information is to be obtained. Specific objectives are:

1) collect field-scale agricultural data set to quantify current agricultural practices and provide baseline buffer information.
2) use collected data in NCANAT (PLAT & NLEW combined) to determine N and P losses in the Lake Jordan Basin.

METHODOLOGY

In order to obtain statistically defensible data to meet the two objectives, we have done the following:

1) Determined the sample units through area sampling, which is a proven and defensible sampling technique. It is well tested and is used by USDA-NASS and others who need data on agricultural fields.

   From judgments of field-to-field variation in N runoff and of the number of fields to put in each sampled area, a sample size of approximately 200 areas was deemed adequate to give a sampling CV (coefficient of variation) of 4%. These sampling areas were randomly selected and segmented for enumerators to collect data. Maps were printed with the census block outlined and road names printed on the map. Census blocks were then segmented by hand.

2) Conduct the survey
The field survey was designed and pre-tested. The survey was used to collect relevant information on all fields within the selected sample segment. The data were collected by the National Association of State Departments of Agriculture under the supervision of USDA-NASS (National Agricultural Statistics Service) enumerators.

3) Analyze data by:
- County
- Crop
- Crop acres
- % crop acres
- N, P, and K rates
- BMPs
- Other land uses
- Animal sources
- Farm structure
- Nutrient management planning

4) Determine N and P losses. Collected data was used in the field-scale North Carolina Agricultural Nutrient Assessment Tool (NCANAT) to determine nitrogen (N) and phosphorus (P) losses.

Area Frame Sampling

Determining the Census Blocks to Map
In an area frame sample, the collection of N sampling units is determined clerically and then selected randomly (Monroe and Finkner, 1959). Data acquisition for frame construction is the first step in the process. Tiger data were obtained from the U. S. Census Bureau for each county in the Lake Jordan River Basin. The census blocks were then extracted from the Tiger files and merged into a single consistent data table. Census blocks were used to define the areas from which samples would be randomly accessed. Efforts were taken to ensure that data were not resorted in order to maintain the data in its serpentine order as created by the Census Bureau.

Once those data were sorted, a rural filter was applied to the data. For a census block to remain on the list, it had to have an area of 10 acres or more and had to contain more acres than persons to be considered for sampling. Then the Lake Jordan River Basin filter was applied. For census blocks to remain on the frame, only census blocks that were entirely or to some extent within the Lake Jordan basin were used. Each of the listed census blocks had a specific acreage associated with it.

Listed census blocks then had their areas (in acres) accumulated. For all valid census blocks, the accumulated area of the census block equaled the area of all proceeding blocks plus the area of that block. A convenient sample unit size was then selected. This is an iterative step where trial sample sizes can be experimented with to get reasonable sample unit sizes. For the purposes of

this survey, the sample size was determined to be 300 acres. From this, a provisional total population size (N) was calculated (N= total area / sample size). The total population size (N) is then readjusted to a convenient integer that must be divisible by 5 to allow for the five replicate sub samples.

A census block could itself become a sampling unit if the area of the census block was around 300 acres. If the census block area was less than 300, it may be combined with the next or previous census block or blocks to make the count unit, which is the technical term to describe the census block, or blocks that contains the sampling units. The area sampling calculations with cumulative areas and cumulative sampling units define all of these units (Finkner and Monroe).

To randomly select the sampling units, a set of random number seeds were determined for each of the five sub samples from a random number generator and then applied to the cumulative sampling units and those sampling units that were hit became the areas to be sampled. Sample selections for the Lake Jordan area sample have been made in 5 replicate sub samples, each covering all counties in the watershed for a total of 172 sampling units (Fig. 1). Each selected cumulative sampling unit that qualified was marked for the plotting of its containing count unit.

Once these census blocks were determined, plots were batched for printing. The count units were outlined on 1993 land cover digital orthographic quarter quadrangles (DOQQ). The census blocks of the count unit were plotted as an aerial view outlined in blue with its associated assigned number of sampling units. Because most soils data is now electronically available, soil mapping units were associated with the sampled field through the use of a latitude/longitude reading obtained for each field through hand-held global positioning equipment. The soil mapping unit information was electronically layered into the fields selected for sampling in order to determine the predominant soil series. This saved both time and money and did not require the printing of soil maps.

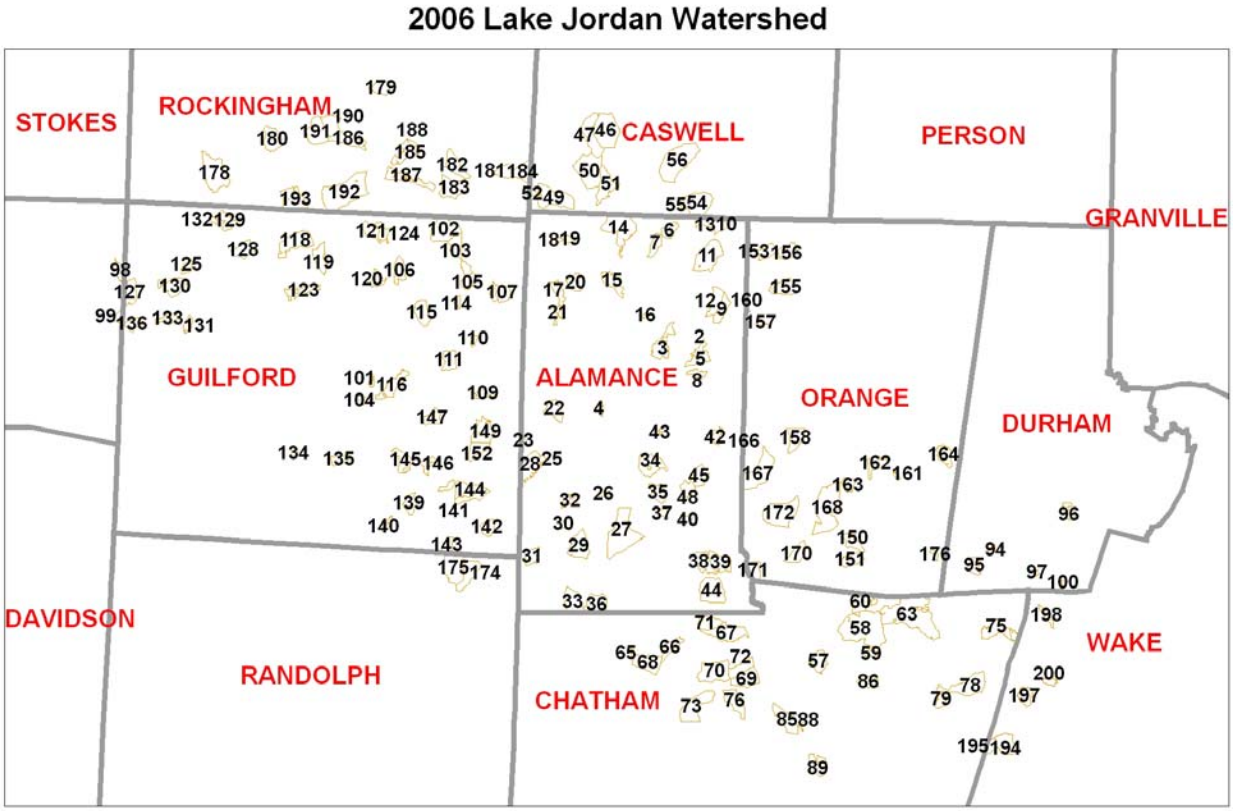

Figure 1. Lake Jordan Basin and count units selected.

Determining the Sampling Segments

The selected census blocks count unit was segmented into the number of assigned sampling units (ASUs). The ASU dictates the number of segments into which the count unit should be divided. The ASU was calculated as

$$\text{ASU} = (\text{cumulative sampling unit})_x - (\text{cumulative sampling unit})_{x-1}, \quad \text{[Equation 1]}$$

where x - 1 = the preceding cumulative sample unit of x, and the cumulative sampling units was calculated as

Cumulative Sampling Units = Cumulative_Acres/(Total_Acres/Adjusted_N) [Equation 2]

Assigned sampling units are numbers of potential sampling units and their boundaries must allocate all fields in the census block count unit to one and only one segment. Natural boundaries, such as roads, streams and property lines, are useful boundaries. Imaginary boundaries such as lines through the middle of woods are acceptable and sometimes necessary but less useful than natural boundaries. Imaginary boundaries may also be extensions of roads or point-to-point lines or similar ones, so long as the enumerator will have an objective basis for deciding whether a field is in or out of a segment.

The ASU number was designated on the maps. When there were two to four ASU numbers, the boundaries were all delineated in one pass. During segmentation, we tried to ensure that the amount of cultivated land (land in fields) was about equal over the segments. However, since field distribution was generally irregular, especially in heavily forested areas, this was not always possible. With five or more ASUs, the count units were divided into two, three or four parts before drawing in all segment boundaries. Segments were numbered and then selected from a random number table. The selected segment was outlined in red.

Enumeration of the Sampling Segments

A public service campaign to inform area producers about the survey began a few months before the survey. The public information used for this campaign can be found in Appendix 1.

Enumerators were trained by NC State and NCDA&CS personnel before they collected any of the information. This one-day training involved both classroom discussion of the sampling strategy and survey instrument, as well as a field exercise. The Lake Jordan Rules, BMPs, fertilizer information collection and sample surveys were explained to the enumerators. During the remainder of the training, the enumerators had hands-on field training. The enumerators were taught to recognize the different types of BMPs and to determine the area affected by them.

Training books were developed for the enumerators and used during the training session (Appendix 2). These books could also be referred to during the actual survey. The booklet included a wide range of information ranging from the reason the survey was being performed to pictures of buffers and controlled drainage.

The data survey instrument allowed collection of the following information: county, field size (ac), previous crop, current crop, fertilizer applications for previous crop (amount and type), fertilizer applications for current crop (amount and type), tillage type, cover crop use, presence of different types of buffers, buffer widths, acreage affected by the buffers, field slope, slope length, receiving slope length, and presence of other BMPs (sediment basin or pond), animal types and numbers, nutrient management planning, and farm structure. The survey instrument is attached at the end of this report (Appendix 3).

Enumerators visited all segments to collect the necessary information. The agricultural community was extremely helpful with this survey, in that we only had 22 refusals or fields that count not be accessed. All fields within the selected segment were enumerated if they were currently agricultural lands, including idle fields. If there were no fields within the segment, the enumerator made note of this delineated changed land use and acreage and continued. This was especially important since the land coverage data that we were using was from 1993. Fields that had become fallow were noted as such.

If producers did not have soil samples available, enumerators asked producers if they could take soil samples. Approximately 40% of the producers had soil samples from which the enumerators could determine the soil test P-Index amount. Enumerators took soil samples in 64% of the fields, which were analyzed by the North Carolina Department of Agriculture and Consumer Services (NCDA&CS) soil test lab. Producers also received soil testing results. Soil loss was

calculated using RUSLE, except for pasture and hay where we used a default loss of 0.5 ton acre^{-1}, which is the maximum soil loss for pasture or hay.

Three individuals reviewed each field survey: the enumerator's supervisor, an employee of NCDA&CS and the principle investigator of the project. Any potential irregularities discovered in the review were addressed with the enumerator to explain or revisit the sample site. The data set consisted of approximately 800 records, each record representing a field. A few of these records were then subdivided if two crops (winter cereal and summer crop) were produced on the same field.

Data Processing

Once the quality of each survey was assured, all data was entered into a SAS database for processing (SAS, 1985). It took considerable effort and time to transform the data into a useful format. We had to separate fertilizer applications into winter crops and summer crops. To determine the N and P amount per application for each record, we had to first determine the amount of N and P applied at each application. We used fertilize application rate, N and P analysis of the nutrient material, and material type (e.g. liquid fertilizer, pounds fertilizer, or pounds elemental N). For crops with multiple applications of N or P, we then had to add each N or P addition to determine the total N or P applied to each crop. Sometimes nutrients were applied only once, but in some instances, there were five applications of nutrients over the course of a growing season.

When a winter cereal crop was grown in 2005 and it was fertilized, we considered the crop to be produced in the next year (in this case 2006) because most of the fertilizer is applied in the proceeding calendar year to when the crop is planted. In some fields two crops were produced for a calendar year so the records were separated and stored as two unique records. Because of the double cropping, there are more data records than sample records.

We had to be very careful about collecting tillage and cover crop information. To be considered conservation tillage, 30% residue had to be left on the surface. Many farmers believed that they were using conservation tillage if they were using no-till techniques. Some producers told us they were producing a winter cereal cover crop, but if this crop was fertilized with N, it had to be disqualified as such.

Numerous transformations had to be made with the BMP data in order to characterize the different buffer types and the acreage that they affected. Vegetation characteristics and widths were determined; tree or shrub buffer were considered the same type and vegetative buffers were separated and considered to be grass buffers. This separation of buffer type was used in presentation of data. However, NCANAT only uses buffer width and does not discriminate between buffer types.

To accommodate different slope directions, the survey instrument allowed for three separate water flow directions per field, and thus three different types of possible buffers and/or ditch systems.

The NCANAT was used to determine N and P losses. For the NCANAT program to execute, there must be a minimum data set in order to process the data. If a minimum data set did not exist, the record was discarded. Each record (field) that contained the minimum data set was then run through the field version of NCANAT. Approximately 100 samples could not be used because map units did not match and therefore could not be processed. About 250 fields were pasture, which could be run through PLAT, but not NLEW. (NLEW cannot run pasture conditions.) Nitrogen and P losses from NCANAT were summed for county and crop.

RESULTS

Land Use

In all, 908 questionnaires were completed. Of these 699 were agricultural, 239 were non-agricultural, and 23 were refusals or inaccessible. Of the 699 agricultural questionnaires, 650 were useable. The total number of agricultural acres enumerated was 5218.2 acres. The average field size ranged from less than 1 acre to a maximum size of 70 acres; the mean was 8.0 acres per field and a standard deviation of 8.5 acres. No fields were enumerated in Durham County; all segments had become urban.

Guilford County had the largest number of agricultural fields (275) enumerated followed by Alamance (142) (Table 1). Guilford County had the largest number of agricultural fields (30) and acres (356.1) that changed from an agriculture to urban land uses followed by Chatham and Alamance (~ 8 fields and 130 acres). The remaining counties had 0 to 58 acres developed. In most counties, a greater number of fields and acres had become idle than had been transformed to development. The range for idle lands for each county was 0 to 70 fields and 0 to 338.6 acres. Some counties had agricultural fields transformed to wildlife habitat (including hunting) or removed from farming through the installation of woodlands, either privately or as part of government programs, such as CREP and CRP.

Table 1. Information on Segments That Were Not Enumerated.

County	Total Ag Acreage in Lake Jordan Basin*	Number of Ag Fields Surveyed	Ag Acres Sampled	Number of Fields – Acres in Development	Number Fields Not in Agriculture	Idle (#fields – acres)	Wildlife (# fields – acres)	CREP/ CRP/ Woods (# fields – acres)	Other
Alamance	129,745	142	1206.3	9 – 135	28	18 – 226.5	1 – 200		
Caswell		34	165.6	0	15	12 - 60	1 – 5	1 – 24	1 – 12
Chatham		45	544.0	8 – 123	18	7 – 50	1 – 11	1 – 1.5	1 – 9
Forsyth		9	60.5	1 – 10	6	5 – 43	0	0	0
Guilford	7,487	275	1983.0	30 – 356.1	116	70 – 338.6	8 – 29.8	4 – 29	4 – 2.9
Orange	1,862	54	595.9	6 – 23.3	17	10 – 56.5	0	0	1 – 2.5
Randolph	83	10	93.0	5 – 58	5	0	0	0	0
Rockingham		70	524.4	4 – 26.5	22	9 – 36.8	2 – 5	4 – 24.5	2 – 26
Wake	6,323	11	45.5	0	7	7 – 16.5	0	0	0
Total		647	5218.2	63 – 731.9	234	138 – 827.4	13 – 250.8	10 – 79	9 – 52.4

*Agricultural acres determined through the Lake Jordan Aggregate NLEW.

Chatham, Forsyth, and Randolph had only pasture and hay lands sampled (Table 2). Hay acreage was greater than pasture acreage in Chatham and Forsyth, whereas pasture was the greater land use in Randolph County. Wake County had a small amount of oats (6%) with the remainder of the surveyed land in pasture.

The remaining counties (Alamance, Caswell, Guildford, Orange, and Rockingham) had more diverse agricultural systems. Fourteen crops were enumerated in Guilford County, nine in Alamance, seven in Orange and Rockingham and six in Caswell (Table 2). Despite more diverse agricultural systems, Alamance (75%), Caswell (74%), Guilford (61%), and Orange (62%) counties all reported greater than 50% of pasture and hay land uses. Data from Rockingham County indicated that hay and pasture were only 45% of the land use.

Each remaining crop (wheat, corn silage, soybeans, and tobacco – both flue cured (FC) and burley) produced in Rockingham County comprised at least 10% the total agricultural acreage. Only soybeans and corn in Orange County and soybeans in Guilford County represented over 10% of the total crop acreage for that county. Tobacco production represented about 5% of the crop acres in each of the counties where it was produced - Alamance, Caswell, and Guilford – with the exception Rockingham County where tobacco production reached 18% of the total agricultural land use.

We analyzed the percent of acreage that were not fertilized (% acres fertilized) to determine if any crops were typically not fertilized. Three crop types (pasture, hay and soybeans) were frequently not fertilized. Alamance, Chatham, Guilford, and Rockingham had only 55% to 78% hay acres fertilized. Thirty percent or more of pastures in six out of nine counties (Alamance, Caswell, Chatham, Orange, Rockingham, and Wake) were not fertilized. In Caswell County, no soybean fields were fertilized. In Alamance and Guilford counties, 67% to 86% of all crop acres of soybeans were fertilized. Sometimes more than 100% of crop acres were fertilized. This is because some fields received both commercial and organic fertilizer types.

Table 2. Field Acres Sampled, Number of Fields, % of Crop Acres, Field Acres Fertilized, Number of Fertilized Fields and % Acres Fertilized by Crop and County.

Crop	Field Acres Sampled	Number of Fields	% Crop Acres	Field Acres Fertilized	Number of Fields Fertilized*	% Acres Fertilized
	Alamance					
Wheat	103.1	18	0.08	95.1	17	0.94
Rye	51.0	5	0.04	51.0	5	1.00
Corn silage	23.0	1	0.02	23.0	1	1.00
Corn	24.5	4	0.02	24.5	4	1.00
Hay	251.8	33	0.21	146.8	18 (3)	0.64
Sorghum silage	7.0	1	0.01	7.0	(1)	1.00
Soybeans	34.0	3	0.03	26.0	2	0.67
Tobacco, FC	67.3	19	0.05	67.3	19	1.00
Pasture	663.6	58	0.54	325.7	26	0.45
	Caswell					
Wheat	4.0	1	0.02	4.0	1	1.00
Corn	11.5	4	0.07	11.5	4	1.00
Hay	6.7	4	0.04	8	2 (1)	1.19
Soybeans	14.5	8	0.09	0		0.00
Tobacco, FC	13.7	5	0.08	13.7	5	1.00
Pasture	115.2	12	0.70	39.7	1 (2)	0.34
	Chatham					
Hay	305.5	26	0.56	220.0	8 (15)	0.72
Pasture	238.5	19	0.44	139.0	10 (1)	0.58
	Forsyth					
Hay	53.5	8	0.88	53.5	8	1.00
Pasture	7.0	1	0.12	7.0	1	1.00
	Guilford					
Oats	16.6	6	0.01	21.6	6 (1)	1.30
Wheat	161.7	24	0.08	161.7	24	1.00
Barley	20.3	3	0.01	20.3	3	1.00
Corn silage	40.0	5	0.02	56.0	5 (2)	1.40
Corn	112.7	15	0.05	112.7	14 (1)	1.00
Hay	498.4	75	0.24	387.1	45 (16)	0.78
Soybeans	352.0	56	0.17	279.5	45 (1)	0.79
Watermelons	6.0	2	0.00	6.0	2	1.00
Vegetables	10.1	5	0.00	10.0	4	0.99
Tobacco - burley	2.1	2	0.00	2.1	2	1.00
Tobacco, FC	101.9	13	0.05	101.9	13	1.00
Pasture	782.8	89	0.37	281.0	49	0.36
Nursery	1.0	1	0.00	1.0	1	1.00

Tomatoes	1.0	1	0.00	2.0	1 (1)	2.00
	Orange					
Wheat	37.0	2	0.06	37.0	2	1.00
Corn	63.9	4	0.10	63.9	4	1.00
Hay	219.6	20	0.36	241.6	14 (4)	1.10
Sorghum	22.0	1	0.04	22.0	1	1.00
Soybeans	70.0	4	0.11	39.0	2	0.56
Tobacco, FC	42.0	8	0.07	41.5	8	0.99
Pasture	157.4	16	0.26	108.0	5 (3)	0.69
	Randolph					
Hay	41.0	8	0.44	41	(6)	1.00
Pasture	52.0	4	0.53	52	4 (4)	1.00
	Rockingham					
Wheat	102.5	12	0.19	102.5	12	1.00
Corn silage	53.5	6	0.10	21.0	2	0.39
Hay	104	14	0.19	57.0	6	0.55
Soybeans	57.4	7.0	0.10	49.5	6	0.86
Tobacco, burley	3.0	2	0.01	3.0	2	1.00
Tobacco, FC	91.5	10	0.17	91.5	10	1.00
Pasture	141.0	21	0.26	94.5	15	0.67
	Wake County					
Oats	3.5	2	0.08	3.5	2	1.00
Pasture	42.0	9	0.92	23.5	6	0.56

* Number of fields with commercial fertilizer = no parenthesis; Number of fields with organic applications = parenthesis.

Drainage Directions

Each field was divided into up to 3 drainage directions if slope, slope length or BMP differences were evident. The minimum drainage direction for each field was generally 1 and the maximum was 3 (Table 3). Randolph County appeared to have the most complex slope systems.

Table 3. Drainage Direction.

County	Number of Fields	Minimum Drainage Directions	Maximum Drainage Directions	Mean
Alamance	142	1	3	1.4
Caswell	34	1	3	1.2
Chatham	45	1	3	1.4
Forsyth	9	1	2	1.6
Guilford	275	1	3	1.6
Orange	54	1	3	1.7
Randolph	10	2	3	2.6
Rockingham	70	1	3	1.7
Wake	11	1	2	1.1

Agronomic and BMP Results

Cover Crops

Cover crops are infrequently used in the Lake Jordan watershed. Cover crops were planted in only 3 out of the 5 counties in which cropland were identified (Table 4). Four counties (Chatham, Forsyth, Randolph, and Wake) had no crops besides hay and pasture enumerated. Alamance county had the greatest amount of cover crop usage 44.9% of the total acres planted to field crops) followed by Orange with only 23.5% of the cropland planted to cover crops. Thus cover crop usage is fairly high in some counties (Alamance, Orange and Rockingham) and low in others (Caswell and Guilford) in this basin.

Table 4. Acres and Percentage of Fields Planted to Cover Crops by County.

County	Acres sampled	Wheat Cover Acres	% of Total Acres	Rye Cover Acres	% of Total Acres	Oats Cover Acres	% of Total Acres
Alamance	155.8	19.0	12.2	51.0	32.7		
Caswell	46.4						
Chatham	NA						
Forsyth	NA						
Guilford	626.8						
Orange	197.9			46.5	23.5		
Randolph	NA						
Rockingham	205.4			32.5	15.8	1.5	0.7
Wake	NA						
Total	1235.8	19.0		130	10.5	1.5	0.1

Conservation Tillage

Conservation tillage was used in all of the counties in the Lake Jordan watershed that produced crops other than hay and pasture. About 25% of all cropland acres farmed in Guilford and Orange are in conservation tillage (Table 5). Alamance and Caswell both had about 16% of the cropland acreage under conservation tillage, while Rockingham had 12%. Considering that the majority of the land area in most counties was either pasture or hay, much of the cropped acreage was in conservation tillage.

Table 5. Percentage of Cropped Acreage in Conservation Tillage by County and Crops.

County	% CT – Spring Crops	% CT – Summer Crops
Alamance	23	6
Caswell		11
Chatham	NA	NA
Forsyth	NA	NA
Guilford	23	58
Orange	2	7
Randolph	NA	NA
Rockingham	6	9

Wake NA

BMPs: Sediment Basins and Riparian Buffers

Only Alamance (133.8 acres), Chatham (9.0 acres), Guilford (34.5 acres) and Orange County (33.2) had agricultural acres that were drained by sediment basins or ponds. Thus the majority of the BMP credit is due to buffers.

We are confident that the buffer data is very solid. Each BMP record was reviewed against the 1993 DOQQ maps by two professionals – one from USDA-NASS and the other from NC State University. Remarkably, there had been almost no changes in buffer placement and type. The enumerators did locate some fields that were no longer farmed, particularly in rapidly urbanizing counties. No data was collected on these fields but changes in field use can be found in Table 1.

Table 6 shows the percentage of agricultural fields buffered by either vegetative or tree buffers. Some counties, such as Wake and Forsyth, have most of their agricultural fields buffered; only 8 % of the acreage is not buffered. One county, Caswell, has a high proportion of its agricultural fields (60%) not buffered. These results would suggest that some counties have a large potential for buffer installation; others do not.

Table 6. Number of Acres and Percentage of this Area with no Buffers by County.

County	Total Ag Acres	No Buffers – Acres Affected	% Ag Fields Not Buffered
Alamance	1206.3	313.6	26
Caswell	165.6	99.2	60
Chatham	544.0	200.2	37
Forsyth	60.5	4.9	8
Guilford	1983.0	699.8	35
Orange	595.9	84.7	14
Randolph	93.0	41.7	45
Rockingham	524.4	184.4	35
Wake	45.5	3.5	8
Total	5218.2	1632.0	31

Buffer widths were reported for each type of buffer: shrub/tree or vegetative. Some buffers were a combination of shrub/tree and vegetative, some buffers existed as only vegetative or tree/shrub buffers.

The minimum width of tree/shrub buffers ranged from a low of 10 feet to over 1000 feet, with a mean width of 126 feet (Table 7). Mean buffer width in all counties was always greater than the standard width of 50 feet.

Table 7. Number of Fields with Buffers and Minimum, Maximum and Mean Tree/Shrub Buffer Widths.

County	Number of fields	Width (feet)		
		Minimum	Maximum	Mean
Alamance	70	10	605	159
Caswell	23	15	300	105
Chatham	15	15	200	81
Forsyth	9	100	200	121
Guilford	173	10	600	106
Orange	33	15	800	192
Randolph	7	40	150	108
Rockingham	43	20	1001	137
Wake	10	100	200	110
Total	383	10	1001	126

Vegetative buffers were not found in all counties; those sampled had a width range from 3 to 580 feet with a mean of 76 feet (Table 8).

Table 8. Number of Fields with Buffers and Minimum, Maximum and Mean Vegetative Buffer Widths.

County	Number of fields	Width (feet)		
		Minimum	Maximum	Mean
Alamance	71	5	580	69
Caswell	8	20	200	96
Chatham	19	10	130	46
Guilford	100	10	350	83
Orange	35	3	560	79
Randolph	1	15	15	15
Rockingham	36	3	580	76
Total	270	3	580	76

When dual vegetative types existed, the buffer widths were summed for a total vegetative width. Table 9 represents dual vegetative type buffers when they existed or single buffer vegetative type. Mean buffer widths exceed the minimum 50-foot buffer width required by the state of North Carolina.

Table 9. Number of Fields with Buffers and Minimum, Maximum and Mean Shrub/Tree + Vegetative Buffer Widths.

County	Number of fields	Width (feet)		
		Minimum	Maximum	Mean
Alamance	70	5	880	141
Caswell	23	15	420	117
Chatham	15	10	230	69
Forsyth	9	100	200	121
Guilford	173	10	600	125
Orange	33	5	900	182
Randolph	7	40	165	110
Rockingham	43	20	1001	172
Wake	10	100	200	110
Total	512	5	1001	134

The number of agricultural field acres affected by buffers is presented in Table 10. The largest number of agricultural acres was affected by tree/shrub buffers (1858.2 acres). Vegetative buffers affected the second largest number of acres (1104.3) although some counties had no vegetative buffers (Forsyth and Wake). Mixed buffers (tree/shrub with vegetative) affected the least number of acres (588.9).

Table 10. Total Buffer Acres Affected for Tree/Shrub Buffers, Vegetative Buffers and Mixed (Tree/shrub + Vegetative) Buffer Types.

County	Total Buffer Acres Affected		
	Tree/shrub Only	Vegetative Only	Tree/shrub + Vegetative
Alamance	453.4	92.2	143.2
Caswell	44.0	6.7	15.8
Chatham	134.5	01.8	7.5
Forsyth	55.6		
Guilford	801.2	266.9	189.6
Orange	159.3	263.6	83.1
Randolph	48.7	2.8	
Rockingham	119.4	70.3	149.7
Wake	42.1		
Total	1858.2	1104.3	588.9

Nitrogen, Phosphorus, and Potassium Rates

The average N, P and potassium (K) rates were sorted by type of applied nutrient (commercial fertilizer or manure), county and crop, and presented as number of acres of a particular crop surveyed, total acres of the crop, number of fields surveyed and average N, P and K rates (Table 11 a-z). Nitrogen is reported as elemental N, P as P_20_5 and K as K_20. Nutrient data were determined by using all relevant records, including those that could not be utilized in NCANAT

due to missing information, such as soil mapping unit. Appropriate N rates will be discussed in the NLEW section, while P rates will be discussed in the Soil Test P and P Fertilization section.

Alamance County

Table 11 a. Commercial Fertilizer Nitrogen Rates 2006.

Crop	Field Acres Sampled	Number of Fields	Minimum N Rate	Maximum N Rate	Mean N Rate
Wheat	95.1	17	30	115	70
Rye	51.0	5	15.0	15.0	15
Corn silage	23.0	1	99	99	99
Corn	24.5	4	27	82	62
Hay	131.3	18	15	96	61
Soybeans	10.0	1	12	12	12
Tobacco, FC	67.3	19	48	94	87
Pasture	325.7	26	18	98	62

Table11 b. Commercial Fertilizer Phosphorus Rates 2006.

Crop	Field Acres Sampled	Number of Fields	Minimum P Rate	Maximum P Rate	Mean P Rate
Wheat	95.1	17	25	72	49
Rye	51.0	5	30	30	30
Corn silage	23.0	1	0	0	0
Corn	24.5	4	0	104	43
Hay	131.3	18	0	68	35
Soybeans	26.0	2	0	72	36
Tobacco, FC	67.3	19	66	128	110
Pasture	325.7	26	0	184	40

Table 11 c. Commercial Fertilizer Potassium Rates 2006.

Crop	Field Acres Sampled	Number of Fields	Minimum K Rate	Maximum K Rate	Mean K Rate
Wheat	95.1	17	25	72	52
Rye	51.0	5	30	30	30
Corn	10.5	4	90	104	97
Hay	130.3	33	20	68	37
Soybeans	26.0	3	0	72	36
Tobacco, FC	67.3	19	84	220	188
Pasture	126.2	16	30	60	45

Table 11 d. Commercial Fertilizer Nitrogen Rates 2006.

Crop	Field Acres Sampled	Number of Fields	Minimum N Rate	Maximum N Rate	Mean N Rate
Wheat	4.0	1	68	68	68
Corn	11.5	4	154	170	166
Hay	5.5	2	30	68	49
Tobacco, FC	13.7	5	62	103	86
Pasture	0.7	1	34	34	34

Table 11 e. Commercial Fertilizer Phosphorus Rates 2006.

Crop	Field Acres Sampled	Number of Fields	Minimum P Rate	Maximum P Rate	Mean P Rate
Wheat	4.0	1	0	0	0
Corn	11.5	4	68	138	86
Hay	5.5	2	68	78	73
Tobacco, FC	13.7	5	72	104	82
Pasture	0.7	1	34	34	34

Table 11 f. Commercial Fertilizer Potassium Rates 2006.

Crop	Field Acres Sampled	Number of Fields	Minimum K Rate	Maximum K Rate	Mean K Rate
Wheat	4.0	1	0	0	0
Corn	4.5	3	68	68	68
Hay	5.5	2	68	78	73
Tobacco, FC	13.7	5	136	156	141
Pasture	0.7	1	34	34	34

Chatham County

Table 11 g. Commercial Fertilizer Nitrogen Rates 2006.

Crop	Field Acres Sampled	Number of Fields	Minimum N Rate	Maximum N Rate	Mean N Rate
Hay	36.0	6	18	90	51
Pasture	132.0	10	30	100	77

Table 11 h. Commercial Fertilizer Phosphorus Rates 2006.

Crop	Field Acres Sampled	Number of Fields	Minimum P Rate	Maximum P Rate	Mean P Rate
Hay	36.0	6	0	30	21
Pasture	132.0	10	0	0	34

Table 11 i. Commercial Fertilizer Potassium Rates 2006.

Crop	Field Acres Sampled	Number of Fields	Minimum K Rate	Maximum K Rate	Mean K Rate
Hay	32.5	5	12	30	25
Pasture	92.0	7	30	60	49

Forsyth County

Table 11 j. Commercial Fertilizer Nitrogen Rates 2006.

Crop	Field Acres Sampled	Number of Fields	Minimum N Rate	Maximum N Rate	Mean N Rate
Hay	53.5	8	17	68	62
Pasture	7.0	1	108	108	108

Table 11 k. Commercial Fertilizer Phosphorus Rates 2006.

Crop	Field Acres Sampled	Number of Fields	Minimum P Rate	Maximum P Rate	Mean P Rate
Hay	53.5	8	17	68	62
Pasture	7.0	1	108	108	108

Table 11 l. Commercial Fertilizer Potassium Rates 2006.

Crop	Field Acres Sampled	Number of Fields	Minimum K Rate	Maximum K Rate	Mean K Rate
Hay	53.5	8	17	68	62
Pasture	7.0	1	108	108	108

Table11 m. Commercial Fertilizer Nitrogen Rates 2006.

Crop	Field Acres Sampled	Number of Fields	Minimum N Rate	Maximum N Rate	Mean N Rate
Oats	9.6	4	0	34	26
Wheat	161.7	24	0	135	91
Barley	20.3	3	30	30	30
Corn silage	40.0	5	45	195	77
Corn	96.7	14	22	157	108
Hay	309.4	44	3.6	236	56
Soybeans	228.7	37	10	35	20
Watermelons	6.0	2	30	60	45
Vegetables	10.0	4	40	67	58
Tobacco - burley	2.1	2	165	165	165
Tobacco, FC	101.9	13	48	202	95
Pasture	234.3	41	6	510	72
Nursery	1.0	1	136	136	136
Tomatoes	1.0	1	81	81	81

Table 11 n. Commercial Fertilizer Phosphorus Rates 2006.

Crop	Field Acres Sampled	Number of Fields	Minimum P Rate	Maximum P Rate	Mean P Rate
Oats	16.6	6	0	34	17
Wheat	161.7	24	0	70	59
Barley	20.3	3	81	81	81
Corn silage	40.0	5	0	90	38
Corn	96.7	14	22	130	88
Hay	316.1	45	0	138	45
Soybeans	277.5	45	0	70	40
Watermelons	6.0	2	30	60	45
Vegetables	10.0	4	60	80	65
Tobacco - burley	2.1	2	104	104	104
Tobacco, FC	101.9	13	40	160	103
Pasture	235.7	42	0	510	61
Nursery	1.0	1	0	0	0
Tomatoes	1.0	1	81	81	81

Table 11 o. Commercial Fertilizer Potassium Rates 2006.

Crop	Field Acres Sampled	Number of Fields	Minimum K Rate	Maximum K Rate	Mean K Rate
Oats	16.6	6	0	34	17
Wheat	161.7	24	0	90	61
Barley	20.3	3	90	90	90
Corn silage	40.0	5	50	90	74
Corn	96.7	14	22	130	89
Hay	316.1	45	5	180	53
Soybeans	269.5	44	0	96	70
Watermelons	6.0	2	30	60	45
Vegetables	10.0	4	60	80	65
Tobacco - burley	2.1	2	184	184	184
Tobacco, FC	101.9	13	141	253	198
Pasture	202.0	38	1	510	88
Tomatoes	1.0	1	81	81	81

Orange County

Table 11 p. Commercial Fertilizer Nitrogen Rates 2006.

Crop	Field Acres Sampled	Number of Fields	Minimum N Rate	Maximum N Rate	Mean N Rate
Wheat	37.0	2	0	28	14
Corn	63.9	4	66	180	95
Hay	151.6	14	10	136	53
Sorghum	22.0	1	20	20	20
Soybeans	39.0	2	9	20	15
Tobacco, FC	41.5	8	48	156	87
Pasture	40.0	5	6	60	40

Table 11 q. Commercial Fertilizer Phosphorus Rates 2006.

Crop	Field Acres Sampled	Number of Fields	Minimum P Rate	Maximum P Rate	Mean P Rate
Wheat	37.0	2	0	60	45
Corn	63.9	4	0	60	45
Hay	151.6	14	0	102	56
Sorghum	22.0	1	40	40	40
Soybeans	39.0	2	40	54	47
Tobacco, FC	41.5	8	0	192	80
Pasture	40.0	5	0.8	72	47

Table 11 r. Commercial Fertilizer Potassium Rates 2006.

Crop	Field Acres Sampled	Number of Fields	Minimum K Rate	Maximum K Rate	Mean K Rate
Wheat	37.0	2	0	55	28
Corn	52.9	3	60	60	60
Hay	151.6	14	35	102	59
Sorghum	22.0	1	40	40	40
Soybeans	39.0	2	40	108	74
Tobacco, FC	41.5	8	144	344	190
Pasture	40.0	5	3	72	47

Rockingham County

Table 11 s. Commercial Fertilizer Nitrogen Rates 2006.

Crop	Field Acres Sampled	Number of Fields	Minimum N Rate	Maximum N Rate	Mean N Rate
Wheat	102.5	12	0	128	85
Corn silage	21.0	2	125	125	125
Hay	57.0	6	20	68	50
Soybeans	49.5	6	13	25	17
Tobacco, burley	1.0	1	246	246	246
Tobacco, FC	91.5	10	90	138	110
Pasture	94.5	15	17	60	47

Table 11 t. Commercial Fertilizer Phosphorus Rates 2006.

Crop	Field Acres Sampled	Number of Fields	Minimum P Rate	Maximum P Rate	Mean P Rate
Wheat	102.5	12	0	60	30
Corn silage	21.0	2	45	45	45
Hay	57.0	6	0	84	36
Soybeans	49.5	6	38	50	43
Tobacco, burley	3.0	2	104	160	132
Tobacco, FC	91.5	10	104	216	144
Pasture	94.5	15	14	80	48

Table 11 u. Commercial Fertilizer Potassium Rates 2006.

Crop	Field Acres Sampled	Number of Fields	Minimum K Rate	Maximum K Rate	Mean K Rate
Wheat	77.5	10	0	60	37
Corn silage	21.0	2	45	45	45
Hay	52.5	4	23	84	54
Soybeans	49.5	6	50	90	69
Tobacco, burley	3.0	2	156	240	198
Tobacco, FC	91.5	10	156	352	222
Pasture	94.5	15	14	80	48

Wake County

Table 11 v. Commercial Fertilizer Nitrogen Rates 2006.

Crop	Field Acres Sampled	Number of Fields	Minimum N Rate	Maximum N Rate	Mean N Rate
Oats	3.5	2	102	102	102
Pasture	23.5	6	10	14	12

Table 11 w. Commercial Fertilizer Phosphorus Rates 2006.

Crop	Field Acres Sampled	Number of Fields	Minimum P Rate	Maximum P Rate	Mean P Rate
Oats	3.5	2	0	0	0
Pasture	23.5	6	0	10	5

Table 11 x. Commercial Fertilizer Potassium Rates 2006.

Crop	Field Acres Sampled	Number of Fields	Minimum K Rate	Maximum K Rate	Mean K Rate
Oats	3.5	2	0	0	0
Pasture	8.5	3	10	10	10

Organic sources of nutrients were applied to 75 fields (Table 12). Poultry litter (either house litter or stockpiled) was applied to 53% o the fields receiving organic nutrient sources. Biosolids were the second most applied organic source (20%), followed by dairy lagoon liquid (13%). Most fields received only one application of organic nutrients per year, the exception being poultry lagoon liquid (4 applications) and biosolids. Six of the 15 fields received two biosolid applications per year.

Table 12. Types of Organic Sources Applied and the Number of Fields to which the Organic Sources are Applied per Application.

Organic Source	Application 1	Application 2	Application 3	Application 4
	Number of Fields			
Broiler House Litter	4			
Broiler stockpiled	36			
Dairy Lagoon Liquid)	10			
Dairy Scraped Manure)	6			
Poultry lagoon Liquid)	4	4	4	4
Other (Biosolids)	15	6		
Number of Fields	75			

Organic N, either animal waste or biosolids from wastewater treatment plants, was primarily applied to hay and pasture although there are some exceptions (oats, corn silage, corn, soybeans, and tomatoes) in Guilford County and sorghum silage in Alamance (Table 13). Average N rates ranged from low of 8 lb ac^{-1} yr^{-1} to 363 lb ac^{-1} yr^{-1}. Most of the average N rates for each crop were appropriate, although several crops in Guilford (oats, hay, and pasture) were probably over fertilized. The average N rate was 243.9 lb ac^{-1} yr^{-1} and organic sources were applied to 699.8 acres

Table 13. Applied Organic Nitrogen (2006).

Crop	**Field Acres Applied**	**Number of Fields**	**lb N per acre per year**		
			Minimum Rate	**Maximum Rate**	**Average Rate**
	Alamance				
Hay	14.5	3	152	152	152
Sorghum silage	7.0	1	152	152	152
	Caswell				
Hay	2.5	1	108	108	108
Pasture	39.0	2	216	216	216
	Chatham				
Hay	184.5	15	62	612	240
Pasture	7.0	1	8	8	8
	Guilford				
Oats	5.0	1	264	264	264
Corn silage	16.0	2	69	307	188
Corn	16.0	1	180	180	180
Hay	71.0	16	150	510	358
Soybeans	2.0	1	264	264	264
Pasture	45.3	7	6	510	363
Tomatoes	1.0	1	2	2	2
	Orange				
Hay	116.0	5	24	88	65
Pasture	80.0	4	87	108	92
	Randolph				
Hay	41.0	6	166	320	245
Pasture	52.0	4	256	320	288

Just as organic N was primarily applied to hay and pasture, so too was organic P. Average P rates ranged from low of 1 lb ac^{-1} yr^{-1} to a maximum of 1481 lb ac^{-1} yr^{-1} (Table 14). The average application from all organic sources to all crops is 170 lb ac^{-1} yr^{-1}. Organic sources of nutrients were applied to 699.8 acres.

Table 14. Applied Organic Phosphorus (2006).

Crop	**Field Acres Applied**	**Number of Fields**	**lb P205 per acre per year**		
			Minimum Rate	**Maximum Rate**	**Average Rate**
	Alamance				
Hay	14.5	3	206	206	206
Sorghum silage	7.0	1	206	206	206
	Caswell				
Hay	2.5	1	117	117	117
Pasture	39.0	2	234	234	234
	Chatham				
Hay	184.5	15	24	234	123
Pasture	7.0	1	5	5	5
	Guilford				
Oats	5.0	1	1481	1481	1481
Corn silage	16.0	2	42	172	107
Corn	16.0	1	101	101	101
Hay	71.0	16	90	330	235
Soybeans	2.0	1	148	148	148
Pasture	45.3	7	4	330	240
Tomatoes	1.0	1	1	1	1
	Orange				
Hay	116.0	5	28	60	50
Pasture	80.0	4	117	141	135
	Randolph				
Hay	41.0	6	120	220	172
Pasture	52.0	4	176	240	208

Information for crop fertilization was derived from 208 producers. Of these farmers, 79 had only one field sampled, and, thus, one fertilizer formulation. There were 129 producers that had 2 to 10 fields of the same crop enumerated with fertilizer rates reported. This allowed us to determine if the same fertilization was used for a given crop on multiple fields by the same producer. We found that 120 producers had exactly the same fertilizer rates for the same crop regardless of the soil test P or soil-mapping unit. This is not to imply that all producers used the same fertilizer regime; rather, each producer had one fertilizer regime per crop.

There were 9 producers with multiple fields in the same crop that did not apply similar fertilizer rates (Table 15). For example, in Alamance County, one producer had 6 fields of pasture (first cell). Three of these fields had one fertilizer regime, 2 fields had the same rates but different than the 3 fields and 1 field had a completely unique fertilization. Most of the differences in fertilizer regime were very subtle.

Table 15. Number of Fields with Different Fertilizer Rates by Crop and County.

County	Crop		
	Pasture	**Hay**	**Tobacco, FC**
Alamance	3-2-1		
Guilford	5-3-3-1	1-1; 1-1	
Rockingham		1-1; 2-1	2-1; 2-1
Orange			2-1

Soil Test P and P Fertilization

In the last 3 years, 64% of the acres surveyed were not soil sampled, while 36% of the acreage did have samples. Sixty percent of the producers had the enumerators pull soil samples to be sent to the soil test lab. Producers in Chatham and Randolph counties did a much better job of soil sampling than the other counties (Table 16).

Table 16. Soil Sampling Timing* by Acreage and County

County	Yes	No	% Acreage Sampled With the Correct Frequency
Alamance	397.2	809.1	33
Caswell	78.0	87.6	47
Chatham	362.5	181.5	67
Forsyth	0.0	60.5	0
Guilford	575.1	1407.9	29
Orange	273.0	322.9	46
Randolph	78.0	15.0	84
Rockingham	116.0	408.4	22
Wake	8.5	37.0	19
Total	1888.3	3329.9	36

* Fields should be soil sampled every three years

The mean and weighted mean soil test P levels are presented in Table 17. Soil test P levels were available for the majority of the fields either because they were sampled during enumeration or the producer had soil test results. The maximum soil test levels in some of the counties were over 5 to 6 times higher than a very high soil test rating level.

The mean and weighted soil test P values are somewhat similar, although there are fairly large differences for data from Orange and Caswell counties. Weighted soil test P mean takes each soil test value, multiplies it by the number of acres for that soil test value and then sums all values. This summed value is then divided by the total number of acres. Using the weighted soil test P mean gives us more information than just the mean value. Of the 9 counties sampled, 1 (Caswell County) had weighted mean soil test P levels above 100, reflecting very high P soil test ratings; these soils do not need additional P, even as starter. Weighted average soil test P values for four of the counties (Alamance, Orange, Rockingham, and Wake counties) were high, which indicates that only starter P is needed and should not exceed an application amount of 20 lb P_20_5 ac-1. Four counties (Chatham, Forsyth, Guilford, and Randolph) had medium soil test P, indicating that these soils still need applications of P fertilizers beyond starter rates for some fields.

Table 17. Mean and Weighted Mean Soil Test P-Index by County.

County	Number of Fields	Soil Test P-Index			
		Minimum	Maximum	Weighted Mean	Mean
Alamance	120	1	559	78	60
Caswell	30	6	633	291	121
Chatham	44	9	103	30	28
Forsyth	9	5	120	50	41
Guilford	268	1	307	50	61
Orange	53	1	528	117	86
Randolph	10	29	178	44	50
Rockingham	67	5	223	94	78
Wake	11	30	152	80	87
Total	612	1	633	74	65

Of the 74 fields to which animal waste was applied, 17 fields had soil test P levels of very high (>100 P index). Of these fields, 11 had P indices between 100 to 200. There were 2 fields in each of the three soil test categories: 200 to 300, 301 to 400, and >500. Eight of the fields with soil tests of very high had biosolids applied representing 57% of the fields to which biosolids are applied, 7 fields had dairy waste applications (44% of the fields) and 2 fields had broiler litter (5%).

When soil test levels are above 60, crops do not need additional P except for perhaps as starter fertilizer. We divided fields into those with soil test levels above 60 and those less than or equal to 60 to determine if P fertilization rates are different (Table 18). The average amount of P fertilizer used on very high/high or medium/low soil test P soils was, on average, different;

average P_2O_5 added was 71 lb ac^{-1} for soils testing high or very high but only 24 lb P_2O_5 ac^{-1} for soils testing low or medium. This is opposite of how producers should be fertilizing.

Of the fields sampled, 65% had soil test levels in the medium or low category. These soil test P results are very different from the Tar-Pamlico River basin where there are almost twice as many acres testing high and very high as medium or low. Fields testing very low to medium would need between 150 lbs P_20_5 ac^{-1} to 40 lbs P_20_5 ac^{-1} in order to bring the P level to the recommended soil test rating. Thus for fields testing low or medium for P, nutrient management plans would increase P fertilizer rates for these fields. For fields testing high or very high, fertilizer rates would decline under nutrient management planning. Since there are more fields testing low or medium than high or very high, implementation of nutrient management plans may actually increase P fertilizer into the Lake Jordan Basin.

Table 18. P Fertilization Rates for Soils Testing High and Very High (P-Index >60) and Soils Testing Low and Medium (≤ 60).

County/ Crop	High and Very High Soil Test P (>60)					Low and Medium Soil Test P (≤ 60)				
	# Fields	# Acres	P Fertilization (lbs P_20_5/ac)			# Fields	# Acres	P Fertilization (lbs P_20_5/ac)		
			Min	Max	Mean			Min	Max	Mean
Alamance										
Rye	1	5.5	30	30	30	4	45.5	30	30	30
Wheat	6	15.0	33	72	47	16	107.1	0	72	38
Corn	1	7.0	69	69	69	3	17.5	0	104	35
Corn Silage						1	23.0	0	0	0
Hay	3	9.0	33	51	41	29	199.8	0	68	17
Soybean	1	10.0	72	72	72	2	24	0	0	0
Sorghum						1	7.0	0	0	0
Tobacco	8	32.8	66	128	92	11	34.5	102	128	123
Pasture	1	2.0	33	33	33	57	661.6	0	184	18
Caswell										
Wheat						1	4	0	0	0
Corn	2	2.0	68	68	68	2	9.5	68	138	103
Hay	2	5.5	68	78	73	2	1.2	0	0	0
Soybeans						8	14.5	0	0	0
Tobacco, FC						5	13.7	72	104	82
Pasture						12	115.2	0	34	2.8
Chatham										
Pasture	1	7.0	30	30	30	18	231.5	0	60	17
Hay						26	305.5	0	30	5
Forsyth										
Other Hay	1	17.0	68	68	68	26	305.5	17	68	60
Pasture	1	7.0	108	108	108					

Guilford										
Wheat	7	32.2	50	70	62	16	120.5	0	70	58
Barley	2	14	81	81	81	1	6.3	81	81	81
Oats						6	16.6	0	34	17
Corn Silage	2	18.0	50	90	70	3	22.0	0	60	17
Corn	4	20.9	130	130	130	11	91.8	0	100	65
Hay	7	40.2	51	136	68	67	451.2	0	138	22
Soybeans	10	49.9	30	70	54	45	293.1	0	70	27
Watermelons	1	2.0	60	60	60	1	4.0	30	30	30
Vegetables	3	8.0	60	60	60	2	2.1	0	80	40
Tobacco, FC, Burley	2	2.1	104	104	104					
Tobacco, FC	5	34.0	40	128	77	8	67.9	40	160	120
Pasture	9	39.0	28	67	46	80	743.8	0	510	27
Tomatoes	1	1.0	81	81	81					
Nursery						1	1.0	0	0	0
Orange										
Wheat	1	22	55	55	55	1	15	0	0	0
Rye						5	46.5	0	0	0
Hay	5	86.0	40	72	49	15	133.6	0	102	36
Corn						4	63.9	0	60	45
Sorghum	1	22.0	40	40	40					
Soybeans	2	39	40	54	47	2	31	0	0	0
Tobacco, FC	4	28	89	192	115	4	13.5	0	89	44
Pasture	2	17.0	40	72	56	14	104.4	0	59.5	8.6
Randolph										
Hay						6	41.0	0	0	0
Pasture						2	15.9	0	45	23
Rockingham										
Oats						1	1.5	0	0	0
Rye						4	32.5	0	0	0
Wheat						8	57.0	0	60	18
Hay	3	37.5	23	84	49					
Soybeans	5	41.5	38	50	42					
Tobacco, Burley	2	3.0	104	160	132					
Tobacco, FC	8	85.5	104	216	147	2	6.0	104	160	132
Pasture	5	29.5	45	60	55	16	111.5	0	80	28
Wake										
Oats						2	3.5	0	0	0
Pasture						9	111.5	0	80	28
All Counties										
All Crops	124	837.6	23	216	71	562	4600.2	0	510	24

Slope, Soil Loss, and Receiving Slopes

Field slopes ranged from less than 1% to as high as 16% with a weighted mean ranging from a low of 3.4% slope (Randolph) to a high of 7.5% (Wake) (Table 19). Most of the agricultural fields sampled in Wake County, however were in pasture and as a result had a very low soil erosion loss. Pasture and hay typically have very low soil erosion rates. We assumed 0.5 t ac^{-1} soil loss for pasture and hay, which would be a maximum. Soil erosion was calculated using RUSLE for all cropped fields. Soil loss ranged from a minimum of 0.05 t ac^{-1} to a maximum of 32.7 t ac^{-1}, with a weighed average of 1.5 t ac^{-1}. Chatham, Forsyth and Randolph counties had the lowest weighted soil loss mean (0.5 t ac^{-1}), while Alamance had the highest loss (2.0 t ac^{-1}). However, all counties were under the tolerable soil loss levels and it appeared that soil erosion is being well controlled in the counties within the Lake Jordan watershed.

Table 19. Minimum, Maximum and Weighted Means for Field Slope and Soil Erosion by County.

County	Number of Fields	Field Slope (%)			Soil Erosion (t/ac)		
		Min	Max	Weighted Mean	Min	Max	Weighted Mean
Alamance	141	1	14	5.3	0.07	27.1	2.0
Caswell	34	2	9	4.6	0.05	11.1	1.5
Chatham	45	1	15	4.0	0.50	0.5	0.5
Forsyth	9	2	14	5.3	0.50	0.5	0.5
Guilford	272	1	16	5.3	0.10	32.7	1.4
Orange	54	2	10	3.9	0.10	14.4	1.9
Randolph	10	1	6	3.4	0.50	0.5	0.5
Rockingham	70	1	15	6.0	0.23	12.7	1.7
Wake	11	2	16	7.5	0.50	1.1	0.6
Total	646		16	5.2	0.05	32.7	1.5

Receiving slopes are the slopes within the field that allow deposition of eroded materials. Some fields had only one slope direction and thus only one receiving slope whereas other fields could have as many as three slope directions; thus Table 20 is presented by slope direction. Mean receiving slope lengths ranged from a low of 10 feet to a high of 30 feet. Receiving slopes are particularly useful if soil loss is occurring from the adjacent agricultural field. Since soil loss was, on average, so low, receiving slopes would have less effect due to the lack of sediment loss from fields.

Table 20. Number and Means for Receiving Slope Width by Direction and County.

County	Direction A		Direction B		Direction C	
	Number	Mean Receiving Slope Length (ft)	Number	Mean Receiving Slope Length (ft)	Number	Mean Receiving Slope Length (ft)
Alamance	142	13	51	30	12	12
Caswell	34	10	5	10	1	10
Chatham	45	22	16	20	1	10
Forsyth	9	10	5	10		
Guilford	274	16	124	17	27	19
Orange	55	17	28	13	10	10
Randolph	10	24	10	20	6	22
Rockingham	70	14	39	16	12	21
Wake	11	10	2	10		
All	650	15	280	19	69	17

Agricultural Demographics

Of the respondents to this question, 50% (107 people) consider agriculture to be their primary source of income and 50% (108 people) did not. For those producers for whom their agricultural activities were not a primary source of income, 17% (17 people) indicated that it was a secondary source of income, 45% (47 people) said it was a minor source, and 39% (41 people) said they received no income from their farming activities. These data suggest that there are large numbers of hobby farmers in this basin.

Fertilizer Use Information

Of the 214 producers who answered this question, 175 or 82% did not have a nutrient management plan, while 39 individuals or 18% did have a nutrient management plan. For those not having a plan, nutrient recommendations were made by the following organizations or individuals (Table 21).

Table 21. Organizations or Individuals Who Make Fertilizer Recommendations When a Nutrient Management Plan is not Used.

Organization or Individual	Number of People	%
Fertilizer Dealer	15	9
NRCS	5	3
Extension	2	1
Friend/Other Farmer	5	3
Self	123	70
Other	7	4
No Commercial Fertilizer Applied	18	10

For those individuals who have nutrient management plans, 76% (29 producers) use both commercial fertilizer and animal waste. Four producers (11%) use only animal waste and 5 farmers or 13% use only commercial fertilizer. From Table 22, it is apparent that the majority of nutrient management plans are written by NRCS.

Table 22. Organizations or Individuals Who Write Nutrient Management Plans.

Organization or Individual	Number of People	%
Fertilizer Dealer	1	3
NRCS	27	71
Self	4	11
Other	6	16

Nutrients are applied mostly by the farmers themselves (66.6%) but also by others (Table 23).

Table 23. Organizations or Individuals Who Apply Nutrients.

Organization or Individual	Number of People	%
Fertilizer Dealer	36	17
Friend/Other Farmer	17	8
Self	147	69
Other	13	6

Animal Agriculture

We collected information on different animal species – cattle, horses, sheep, goats, and other animals. The number of fields containing any animal type is listed below, as are the average head on a given field and the average day on pasture. Guilford had the most number of pastured fields (88) whereas Forsyth had the least (1). Considerably more cattle are found in this basin than horses, sheep or goats (Table 24 and 25). The largest number of cattle on any field was in Orange County and the longest cattle were grazed was in Forsyth (365 days). The second largest animal population was horses with 1.4 average head and 93.8 average days. Wake County had the most horses, followed by Orange and Guilford. The pastures were rarely grazed all year long, with the average grazing duration of 144 days for cattle and 94 days for horses.

Table 24. Average Head and Average Day of Cattle and Horses per Field.

County	Animal Type			
	Cattle		Horses	
	Average Head	Average Day	Average Head	Average Day
Alamance	18.1	182.2	1.4	50.2
Caswell	9.6	164.2	0.2	16.7
Chatham	11.4	223.8	0.7	73.0
Forsyth	12.0	365.0		
Guilford	19.9	114.6	1.9	104.0
Orange	42.4	145.7	2.0	120.7
Randolph	13.0	273.8	0	0
Rockingham	5.6	100.0	0.7	123.5
Wake	0	0	3.1	341.1
Total	18.1	144.0	1.4	93.8

Sheep were only found in Rockingham County and goats were only enumerated in Caswell, Guilford and Rockingham counties (Table 25).

Table 25. Average Head and Average Day of Goats and Sheep per Field.

County	Animal Type			
	Goats		Sheep	
	Average Head	Average Day	Average Head	Average Day
Alamance	0	6.3	0	0
Caswell	3.8	32.9	0	0
Chatham	0	0	0	0
Forsyth	0	0	0	0
Guilford	0.7	29.8	0	0
Orange	0	0	0	0
Randolph	0	0	0	0
Rockingham	17.0	40.9	23	57.5
Wake	0	0	0	0
Total	2.1	18.2	23	57.5

When the number of livestock were calculated on a per acre per year basis, on average, all livestock were under the recommended rate of two cattle per acre per year, except cattle in Orange County (Table 26). Approximate stocking rates for horses are approximately the same as for cattle, whereas sheep and goat stocking rates are approximately 5 animals per acre per year. Except for Orange County, the animal stocking rate for all livestock is lower than accepted rates. There are other exceptions that were not enumerated (see Lake Jordan Watershed Special Situations). Stocking rates for these exceptions were much greater than recommended.

Table 26. Livestock Numbers per Acre Per Year by County.

County	Number of Fields	Animal Type			
		Cattle	Horses	Goats	Sheep
Alamance	58	1.1	0.1	0	0
Caswell	12	0.5	0.1	1.3	0
Chatham	20	0.6	0.2	0	0
Forsyth	1	1.7	0	0	0
Guilford	88	0.9	0.3	0.1	0
Orange	21	3.1	0.1	0	0
Randolph	4	0.8	0	0	0
Rockingham	22	0.4	0.4	1.6	2.2
Wake	9	0.0	1.0	0	0

Donkey, llama, ostrich, hogs and emus were also found in the basin, albeit in low numbers (Table 27).

Table 27. Other Animal Types, Numbers and Average Days Grazed per Year.

County	Field Acres	Animal Type	Number of Animals	Average Days Grazed Per Year
Alamance	5	Donkey	1	45
Alamance	3	Donkey	1	45
Alamance	5	Donkey	1	45
Alamance	10.5	Donkey	1	45
Alamance	7	Donkey	1	45
Alamance	4	Donkey	1	45
Guilford	2.5	Llama	1	115
Guilford	12	Llama	1	250
Guilford	1.3	Llama	1	120
Guilford	1.3	Donkey	3	120
Guilford	16	Emus	3	250
Guilford	16	Ostrich	4	250
Guilford	7	Hogs	20	365
Guilford	1	Donkey	2	365
Rockingham	9	Donkey	6	180
Rockingham	3	Donkey	6	180
Rockingham	9	Donkey	6	180
Rockingham	4	Donkey	6	180
Rockingham	7	Donkey	6	180

Lake Jordan Watershed Special Situations

Some fields could not be evaluated for nutrient application amounts because the farming system was so unique or there was insufficient data. These situations were not enumerate but are described below.

Alamance County

Producer had approximately 20 acres of grassed waterways in 12 fields. These waterways were all fertilized the same, which was different from the cultivated field. They received 2 fertilizer applications; 200 lbs of 17-17-17 applied in November by surface application, and 200 lbs of 34% nitrogen applied in March by surface application.

Producer has 70 acres that is grazed by 15-20 cows for 2-week periods throughout the year. The cows are grazed then immediately taken to market, the producer gets more cows, keeps for 2 weeks, and sells. This is more like a feedlot than pasture.

One segment had 9 fields that had soil tests done by Synagro. Synagro never furnished the results for these fields, and the producer denied access to take a soil sample.

Guilford County
One producer with 0.5-ac area had approximately 23 hogs in one corner with a garden in the remainder of area. Hog manure was spread on the garden (no lagoon).

One producer had 2 horses with no pasture in a 0.1 acre area, no fertilizer, feeding hay, and has a small shed/barn that the horses use.

Orange County
One producer had 10 fields totaling 160 acres in the segment. He has 400 ac total in his operation. He uses waste from Synagro on his hay and pasture. NRCS confirmed that his ponds are fenced. He has between 200-250 head of cattle that he moves every 10 days between the fields. We did not include in the data.

Rockingham County
A 0.5-acre field planted in soybeans had 8 cattle for 125 days during the year. The field is grazed before planting and after harvest.

A 30-acre hay field had human waste applied by the owner; another farmer cuts the hay. The owner has a septic tank business and disposes of the septage on this field. The septage is tested only for pH.

Four fields totaling 33 acres in one segment were planted in corn with a cover of rye/vetch/crimson clover/Japanese radish. He also has dairy cows (not in the segment). When they have calves, he scrapes the lot and spreads the manure on strips where he is going to plant the corn. He had no ideas of quantity per acre; just trying to cover as much land as possible. These fields were included with "no" manure on the questionnaire.

North Carolina Agricultural Nutrient Assessment Tool (NCANAT) Results
The NCANAT contains the P (PLAT) and N (NLEW) accounting tools. The majority of all fields were analyzed in NCANAT. The PLAT provides a P risk assessment for agricultural fields, while NLEW develops N field loss information.

PLAT Results
There are four potential loss pathways in PLAT: erosion (I), soluble P in overland flow (II), leaching (III), and loss of applied P (IV). A rating is associated with each loss pathway as well as a total loss. In the program, these losses are calculated in lbs per acre, but then transformed to a rating. Ratings between 0 and 25 are considered low for P loss, whereas ratings of 26-50 are medium. High (51-100) and very high (>100) loss potential suggest a need to change management. Distribution of PLAT ratings is low for all counties (Table 26), suggesting that the risk for P losses from agricultural fields is minimal. In fact, the highest PLAT rating level is from Randolph County at 12.7, which is only half the level to the break between low and medium ratings (Table 27). Forsyth County had the lowest PLAT rating (2.8) of all counties in the Lake Jordan Basin. All these counties have average losses under 0.25 lb P ac^{-1}.

When the discrete P pathway losses are analyzed there is no particular trend apparent. Rockingham County had the highest loss from the erosion pathway (0.10 lb P ac^{-1}), Alamance had the greatest soluble P loss (0.08 lb P ac^{-1}), and Randolph County had the greatest loss from animal waste or commercial fertilizer at 0.22 lb P ac^{-1} (Table 25).

Table 27. PLAT Risk Assessment by County.

		Loss Pathway				
County	**Units of P Loss**	**I**	**II**	**III**	**IV**	**Total**
Alamance	lbs per acre	0.28	0.08	0	0.06	0.18
	rating index	1.4	4.2	0	3.2	8.8
Caswell	lbs per acre	0.02	0.03	0	0.09	0.14
	rating index	0.8	1.4	0	4.5	7.1
Chatham	lbs per acre	0.01	0.01	0	0.06	0.08
	rating index	0.5	0.5	0	2.8	3.8
Forsyth	lbs per acre	0.01	0.01	0	0.04	0.06
	rating index	0.25	0.25	0	1.9	2.8
Guilford	lbs per acre	0.02	0.02	0	0.06	0.13
	rating index	1.5	1.4	0	3.1	6.3
Orange	lbs per acre	0.03	0.08	0	0.13	0.24
	rating index	1.6	3.8	0	6.4	11.8
Randolph	lbs per acre	0.02	0.08	0	0.22	0.25
	rating index	0.9	0.9	0	11	12.7
Rockingham	lbs per acre	0.10	0.07	0	0.04	0.21
	rating index	5.1	3.6	0	1.8	10.4
Wake	lbs per acre	0.04	0.03	0	0.00	0.08
	rating index	2.1	1.6	0	0.1	3.9

NLEW Results

The NLEW tool estimates relative N losses for cropland only. It does not estimate N losses for pastures. No crop is 100% efficient in using all the fertilizer N provided, and thus, there will always be some losses of N. Table 28 shows an overall N loss by county for the crops that we surveyed. In almost half of the counties (Alamance, Forsyth, Guilford, and Rockingham) the amount of fertilizer N (N applied) was less than the crops needed (N needed) based on realistic yield expectations, which are a function of soil mapping unit (Table 28). This analysis does not include pastures, many of which were not fertilized. When N applied was greater than N needed (Caswell, Chatham, Orange, Randolph, and Wake), the amount of excess N was generally quite small. The total amount of under fertilization for cropland, as calculated by NLEW, was

235,009 lb of N. If pasture could be included in the analysis, the amount of N under fertilization would be even greater. From these results, it is clear that there is significant N under fertilization. If nutrient management plans were implemented, N rates into the basin would probably increase.

Table 28. N Losses by County as Calculated in NLEW.

County	Metric	N Applied	N Needed	Excess N	N Lost
Almanace	Mean	306	824	44	125
	Total	32,475	87,340	4,631	13,263
Caswell	Mean	416	369	58	158
	Total	4,158	3,687	582	1,575
Chatham	Mean	3,175	2,169	1,716	1,866
	Total	98,414	67,245	53,205	57,838
Forsyth	Mean	338	1,064	0	338
	Total	3,375	10,635	0	3,375
Guilford	Mean	440	1,090	89	188
	Total	112,734	278,898	22,719	48,054
Orange	Mean	1,763	1,739	170	2,761
	Total	109,314	107,831	10,587	171,192
Randolph	Mean	1,434	1,063	409	615
	Total	22,944	17,013	6,546	9,846
Rockingham	Mean	486	1,107	102	225
	Total	35,983	81,886	7,542	16,624
Wake	Mean	179	114	65	53
	Total	357	228	129	106

OUTCOMES AND CONCLUSIONS

The area frame sampling technique did an excellent job of allowing proper selection of fields within the Lake Jordan River Basin. Agricultural information that is not generally collected through USDA agricultural surveys was gathered. This information demonstrates much more detail about current agricultural practices than normally obtained. In addition, the data was used in agricultural accounting tools in order that we could generalize about potential nonpoint source pollution losses from agricultural activities.

In general, this survey demonstrated that agricultural producers are minimizing soil erosion through cover crops, conservation tillage and hay and pasture cropping systems. Potential P losses as determined through the use of PLAT are low, in part because soil test P is not excessive from an environmental standpoint. Over half of the counties surveyed, however, had high agronomic soil test P levels, although 65% of all fields had soil test levels of low or medium. Nitrogen fertilizer rates are almost always less than recommended; in some instances, farmers are still applying N to soybeans, which is not needed. If farmers followed certified nutrient management plans in this basin, it would increase the amount of N and P added to the basin.

Nitrogen and P reducing BMPs are used throughout the basin, primarily as buffers. Most fields are naturally buffered with trees, vegetation (grass and forbs) or a combination, although some counties, such as Caswell, had few buffered fields.

The data collected through this survey gave us a statistically valid sample of agricultural activities. The types of data collected are rarely sampled anywhere in the United States; thus this unique data set allows us a better view of agricultural activities that impact water quality. The data lead us to believe that many producers are under fertilizing, that stocking rates are low, and that the majority of fields are buffered. There are a few outliers to this trend – a few fields with very high soil test P (>500), densely stock fields (the swine example) but these are the exceptions. In general, it does not appear that agricultural activities are such that large amounts of nutrients would be delivered from this sector.

BUDGET

Description	Budget ($)	*Spent ($)*
Salaries	7,517.00	9,228.38
Fringe	1,728.00	1,318.77
Total Personnel Costs	9,245.00	10,547.15
Contracted Services	85,000.00	85,000.00
Supplies and Materials	4,000.00	3,665.63
Travel	1,335.00	167.12
Current Services	40,165.00	40,165.10
Fixed Charges	0	200.00
Total Direct Costs	139,745.00	139,745.00
Total Indirect Costs	13,975.00	13,975.00
Total Costs	153,720.00	153,720.00

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APPENDICES

Appendix 1: Public Information On The Survey Released From NCDA&CS - Statistics Division

For more information, contact**:**
North Carolina Agricultural Statistics Service
1-800-437-8451

Study Will Validate Best Management Practices in the Lake Jordan River Basin

The Lake Jordan Best Management Practices Survey will be conducted by the North Carolina Agricultural Statistics Service for North Carolina State University. This survey will collect information concerning cover crops, fertilizer rates, soil fertility, controlled drainage, riparian buffers, and other production information from producers in the Lake Jordan River Basin.

What do farmers have to do in the Lake Jordan River Basin drainage area to meet the Lake Jordan Rules? In 2001, the North Carolina Environmental Management Commission passed a rule that affects all farmers in the Neuse River Basin. (Rules can be found at http://h2o.enr.state.nc.us/nps/tarpam.htm). The goal of the Rules is to reduce nitrogen loss into the Lake Jordan River by 30% when the rules end in 2006.

Agricultural producers must either use mandatory best management practices on all of their acres or join a Local Area Committee. Most farmers have already joined their Local Area Committee. In order to use the Local Area Committee option, however, the agricultural sector must utilize a nitrogen accounting tool to track changes in nitrogen from the use of best management practices. To track the use of best management practices and their reduction of nitrogen, an accounting tool has been developed by a committee from North Carolina State University and other state agencies. Reporting by the Local Area Committees, during the fall of 2003, indicated that the 30% N reduction goal has been met. This survey will help to validate the information acquired.

North Carolina farm operators in the study will be contacted by interviewers to collect the information from August 2004 through January 2005. Individual operator information will be confidential. Published results will be available in local extension offices in the summer of 2001, or on the internet at http://www.soil.ncsu.edu.

- (Since the rules are not yet compete, we could not begin nutrient management training. This change was approved by DENR.)

Appendix 2: Lake Jordan Best Management Practices Survey Interviewer's Guide

LAKE JORDAN RIVER BASIN
BEST MANAGEMENT PRACTICES SURVEY

Interviewer=s Guide

I. Lake Jordan Best Management Practices Survey

General

The Lake Jordan Watershed Best Management Practices Survey will be conducted by the North Carolina Agricultural Statistics Service for North Carolina State University. This survey will collect information concerning fertilizer and manure use, controlled drainage, and riparian buffers from producers in the Lake Jordan Watershed.

This survey will collect information concerning cover crops, fertilizer rates, soil fertility, riparian buffers, and other production information from producers in the Lake Jordan Watershed in order to establish a baseline of farmers' practices. A detailed baseline will help give the agricultural community science-based information as water quality regulations begin to be implemented..

Survey Purpose

The purpose of the survey is to provide data that will benchmark management practices of Lake Jordan Watershed farmers and to provide information for a tool that tracks nitrogen and phosphorus loss from agriculture. The accounting tools that tract the progress of nitrogen and phosphorus in the Lake Jordan Watershed will be used to determine nitrogen and phosphorus losses. The data that we collect will accomplish this goal objectively while keeping individual farmers' reports confidential. If another agency collected the information, it would be public record and available for anyone to review. Future surveys will track the progress from the information that is collected in this survey.

Use of the Lake Jordan Watershed Best Management Practices Survey

At the present time, no baseline information exists on the extent of best management practices in the Lake Jordan Watershed. This survey will establish that baseline. The information will also be used in two agricultural BMP tracking and accounting tools.

Reasons to Participate

It is important for agricultural producers to participate in this survey to validate independently baseline agricultural practices and nitrogen and phosphorus reductions.

Information will be used in summary form only and all personal information will be kept **STRICTLY CONFIDENTIAL**.

II. Terms and Definitions

Most of the terms you will be able to find in your NASS Interviewer's Manual. Terms that are relevant to this survey are:

Acre	Growing Season
Crop	Segment Boundaries
Cover Crop	Manure
Fertilization	Strip-till
Fertilizer	No-till
Field Diagram	Yield
	Refusal
	Sampling Frame
	Sampling Unit

Additional Terms or information:

Commercial Fertilizer: Plant nutrients that are not organic.

Conservation Tillage: Tillage method that will leave a minimum of 30% of the soil surface covered by residue following planting

Conventional Tillage: Tillage that leaves less than 30% vegetative material on the surface.

Cover Crop: Crop grown in the fall and winter to protect the soil from wind and water erosion. Cover crops are usually small grain crops that are either killed with herbicides or plowed down prior to spring planting.

Drainage Direction: The direction that either surface or ground water flows from a field into the nearest ditch, stream, river or lake.

Field: A continuous area of land devoted to annual or perennial crop use including field buffers. This includes fields that are hay or pasture. Excludes wasteland, woods, and farmstead.

Field Slope: The percent slope of the field, measured from the highest point of the field to the lowest point of the field.

Hydrologic Condition: Hydrologic condition is based on factors that affect infiltration and runoff, including density and percent canopy of vegetation, amount of year round cover, amount of grass or close seeded legumes in rotation, percent of surface residue cover, and surface roughness.

- Cropland choices are Good or Poor. A poor condition is a finely prepared seedbed, not drilled, with a low plant population, and not in rotation with a sod. A good condition is rough seedbed, high plant population, and in rotation with sod, high residue-producing crop, or conservation tillage.
- Pasture choices are Good, Fair, or Poor. A poor condition is over-stocked, under fertilized, low year-round plant population and poor plant condition. A good condition is properly stocked, adequate nutrient management, and a full plant population (nearly 100% cover). A fair condition is represented by factors less than "Good" and better than "Poor", and is determined at the planner's discretion.

Nutrient Management Plan: Timing, placement, rate and form of nutrients that supply adequate nutrition, while reducing environmental losses.

Pond: Ponds are located in depressional areas. There is no stream flowing into the pond. The pond may have a spillway exiting the pond.

Receiving Slope: The receiving slope is the concave slope extending from the base of the RUSLE slope to the field edge or to a source of concentrated runoff flow in a defined channel. A change in the RUSLE slope of 50% or more would be the beginning of the receiving slope.

Riparian Buffer: Vegetation growing next to a stream. The vegetation can be either trees, grasses or shrubs.

Sample Segment: For this survey, the sample segment is defined as the area on the aerial photo that is outlined in black with a circled number identifier. This term is used so that it is not confused with our regular area frame work. In this survey, **we will not be accounting for the total acreage within the boundary.**

Sediment Basin: Sediment basins are ponds within streams. There is a stream into and out of the pond.

Slope Length: The length of the slope is the length in feet from the highest to lowest point.

Vegetative Buffer: (see Appendix 1) Vegetation growing next to a stream, river, pond or lake that is not trees. The vegetation may be a pure grass stand or a mix of grasses and other types of plants, such as shrubs or weeds.

III. Survey Design

The 2006 Lake Jordan Watershed Best Management Practices Survey will use an area frame sample only. The area frame photos and segment selection were done by NCSU. The area photos were taken in 1993. A "road map" is also on the back of the aerial photo. The sample segment was randomly selected from a larger Census block. This block was divided, numbered, and then the sample segment selection was made. The sample segment is the area outlined in black with a circled number. Questionnaires will be completed for each field within the sample segment. We are only interested in cultivated cropland, hay, or pasture fields in the sample segment.

A total of 172 sample segments will be in the sample. Because we do not know the operators within the sample segments, we could not coordinate this survey with any of our ongoing surveys. Keep this in mind, if an operator indicates that he was recently contacted. Since our Agricultural Resource Management Phase II Survey, Vegetable Chemical Use Survey, and Conservation Effects and Assessment Survey all ask for fertilizers applied, the operator may have been interviewed for one of our other surveys.

Lake Jordan Watershed Counts by County

2006

County	Sample Segment Count	County	Sample Segment Count
Beaufort	44	Orange	20
Caswell	9	Randolph	2
Chatham	22	Rockingham	15
Durham	5	Wake	6
Forsyth	2		
Guilford	47		
		Total	172

IV. Survey Time Frame

Data collection will be September 30 through December 31, 2006. If there are any problems meeting this schedule, please contact your supervisor.

All time and mileage should be charged to project code **450**.

Only pasture, hayland, and cultivated fields will be enumerated.

IV. Completing the Questionnaire

Identification

Step 1: Locate the sample segment identified on the envelope label. Using the aerial photo or county map (located on the back of the photo), identify any landmarks (roads, streams, etc.) to orient the map to the sample segment. The sample segment is outlined on the photo with a circled number. Drive around the segment, if possible, and locate the boundaries of the sample segment. Remember the sample segment may have changed significantly from the photo.

Step 2: Locate an operator for any of the fields within the sample segment. Determine how many of the field(s) for which he/she is the operator. Using the red China marker pencil, draw the field boundaries in red on the photo and number the field beginning with 1. All fields in the sample segment have to be drawn in red and numbered. Do not account for the total land in the sample segment.

Step 3: Ideally, you and the farmer should go to the field so that you can draw the field with the drainage direction. Practically, you may have to go by yourself to the field, you may not be able to get to the field, or the farmer may not allow you to go to the field. Make notes as to how the field was drawn – with or without the farmer, with or without entering the field. After you have located the farmer, and drawn and numbered his/her field(s) in red, complete one questionnaire per field. You need to draw the field on the back of the questionnaire and indicate drainage direction, streams, buffers, etc.

Step 4: Continue to locate all of the farmers operating agricultural fields (i.e. cultivated fields, hay, or pasture) in the sample segment and complete the needed questionnaires. In some sample segments, one farmer may operate all or most of the fields. In this case, one farmer will complete a questionnaire for each field; thus, you will have several questionnaires all completed by one farmer. Other sample segments may have several farmers operating within the segment boundaries. In that situation, you will need to contact each farmer to complete the needed questionnaire(s).

Note: When numbering the fields within the segment, use each field number ONE TIME ONLY. For example, if you have 2 operators in the segment and each have 2 fields, farmer1 will have fields 1 and 2, and farmer2 will have fields 3 and 4.

Identification Section

Copy the county code and the sample number from the envelope to the questionnaire. Write the field number from the photo on the questionnaire.

Complete the name, address, and telephone number section at the top. There will be one questionnaire for each field that is drawn on the photo.

You will also be using your GPS unit to record the latitude and longitude. The procedure is to walk into the field 10 paces, turn on the GPS unit and wait for the latitude and longitude to appear. Copy the latitude/longitude to the questionnaire. The format of the latitude/longitude is degrees, minutes, and seconds. (xx.xx.xx) The GPS unit will automatically display in this format.

After the completion of the sample segment, make sure that the number of questionnaires match the number of fields drawn.

Land Use

In order to correctly identify various land uses of areas on the photo that appear to be fields, please indicate how the field is currently used. Check the use of the field. The field can be numbered and a questionnaire used even if the field is not in use. This will help keep track of the fields.

If the land use is "agricultural," a questionnaire has to be completed.
If a use other than "agricultural" is recorded, the questionnaire is only completed if the field had fertilizer or manure applied in 2006.

Question 1

Record the number of acres in the field to tenths of an acre. For example, if the field is 2 acres, you record 2.0. The total field acres are important because yields and application rates are all on a per acre basis.

If any portion of the field is in the sample segment, the field should be accounted for.

***Enumerator Note**

Draw the field diagram on the separate grid sheet. Label the grid sheet with the segment and field numbers (in case it is separated from the questionnaire). Sketch the field with the farmer, and make adjustments when you are actually at the field. Indicate the crest (highest point) of the field with a solid line, and the drainage direction with arrows from the crest line. Draw and label the nearest ditch, stream or river, water control structures, and the vegetative buffers (grass, trees, or shrubs) on the diagram. Insert the completed grid sheet in the questionnaire.

You are not responsible for a perfect drawing, but a sketch of the field is necessary in analyzing the data you have collected.

See Appendix 3 for examples.

Question 2

The table pertains to crops grown for the **2006 crop year** (i.e. planted in the fall of 2005 or spring of 2005). Small grains, such as wheat or oats, planted in the fall of 2005 would be for the 2005 crop year. It is important to know the crops planted and yields per acre. Each crop receives different amounts of nitrogen, so the crop determines the amount of nitrogen that is applied.

Column 1 - Indicates which planting season (fall or spring)

Column 2 - Use the crop table in Appendix 2 for the crop code in column 2.

Fall of 2005: If there was a small grain planted in the fall 2003, circle one of the crops listed (wheat, oats, rye, barley, triticale) and record the appropriate code in box 211. If small grains were not planted, leave box 211 blank.

Spring/Summer of 2006: Record the crop name on the top line and the crop code in box 219.

Hay and Pasture: If the field is hayland or pastureland, leave "fall crops" blank and record information as a spring crop.

Column 3 - Record the month planted. Write the name of the month on the top line and the number in box 212 (i.e. 1 for Jan, 2 for Feb, etc).

Column 4 - Cover crops can be used to reduce nitrogen movement. It is important to know the length of the cover crop on the land. Check if the small grain was a cover crop or not, then record the corresponding number in box 213. A cover crop CANNOT receive fertilizer. If a farmer says that the crop was a cover crop and they have applied fertilizer, DO NOT check the cover crop box.

Column 5 – Conservation tillage reduces soil loss and energy use. Check if conservation tillage was used or not. Record the corresponding number in box 215 or 223. (Example: Conservation tillage must leave 30% cover on the surface. For instance, a cotton farmer who uses minimum tillage with cotton crops year-after-year is NOT conservation tillage. A farmer who plants a cover crop in the fall and cotton in the summer does have conservation tillage. A farmer could lightly disk corn and still meet the 30% cover.)

*********If conservation tillage used, write note to indicate type of tillage and number of years that type of tillage has been used. For example, the field was notill for the last 3 years. Your note should read "Notill – 3yrs."**

Column 6 - Record the date of harvest. If not harvested, dash the box. You may record the month, day, year (xx/xx/xx) on the top line, but the bottom line is to record the Julian date (boxes

216 and 224). For hay and pasture, the harvest data should be the last cutting for hay and blank for pasture.

Column 7 - Record the date the cover crop was killed. If crop was harvested, dash the box. You may record the month, day, year (xx/xx/xx) on the top line, but the bottom line is to record the Julian date (box 217). Do NOT use box 225.

Question 2a:
If the land was recorded as hay or pasture in question 2, record if it was used in the 2006 crop year to graze animals as any time.

Question2b:
If question 2a is "yes," record the type of livestock grazed, the average number grazed, and the average number of days the field was grazed.

Question 3

If a soil test has been completed in the last 3 years AND the farmer has the copy of the test, you will not have to take a soil sample of the field.

1. Soil test completed in last 3 years and farmer has results.
    a. Copy the P-index from the Soil Test Report. The P-index will be P-I on the report. See Appendix 5 for a sample of a Soil Test Report.
    b. Following the flow of the questionnaire, question 5 will be "yes," box 801 will be 1, and go to question 5a.
    c. Question 5a will be "yes," box 802 will be 1, and go to question 5b.
    d. Question 5b will be the value of P-I from the farmer's soil report. Go to question 6.

2. Soil test NOT completed in last 3 years.
    a. On the Soil Test Report, the "Sample No." will be the same as the "sample identification" on the Soil Sample Information Sheet that was completed at the time of the interview.
    b. Following the flow of the questionnaire, question 5 will be "no" and box 801 will be 3. Go to question 5c.
    c. Question 5c - Ask the farmer for permission to collect a soil sample after harvest, and to write his name and address on the Soil Sample Information Sheet that is sent to NCDA.
        i. If the farmer does NOT give permission to both collect the soil sample AND give his name to the soil lab, box 804 is 3 then go to question 6.
        ii. If the farmer does give permission to both collect the soil sample AND give his name to the soil lab, box 804 is 1. Some information about the field will need to be recorded on the Soil Sample Information Sheet. You will record it now for use later.
            1. Record a "Farm ID." This is how the farmer knows the field. For example, "Jones Farm" or "Back40", etc. This will be on

the Soil Test Report.

2. Record a "Sample ID." This is how the farmer identifies the particular field. This should be 6 or less number and letter combination. For example, "FLD1" or "1F", etc.
3. Lime applied – If lime has been applied to the field in the last 12 months, record the tons per acre to tenths AND the 2-digit month and year. For example the farmer applied ½ ton of lime per acre in December 2005…you record ".5 t/ac" and "mo12 yr2005."

3. <u>Soil test completed in last 3 years and farmer does NOT have results.</u>
   a. On the Soil Test Report, the "Sample No." will be the same as the "sample identification" on the Soil Sample Information Sheet that was completed at the time of the interview.
   b. Following the flow of the questionnaire, question 5 will be "yes" and box 801 will be 1. Go to question 5a.
   c. Question 5a will be "no," box 802 will be 3, and go to question 5c.
   d. Question 5c - Ask the farmer for permission to collect a soil sample after harvest, and to write his name and address on the Soil Sample Information Sheet that is sent to NCDA.
      i. If the farmer does NOT give permission to both collect the soil sample AND give his name to the soil lab, box 804 is 3 then go to question 6.
      ii. If the farmer does give permission to both collect the soil sample AND give his name to the soil lab, box 804 is 1. Some information about the field will need to be recorded on the Soil Sample Information Sheet. You will record it now for use later.
         1. Record a "Farm ID." This is how the farmer knows the field. For example, "Jones Farm" or "Back40", etc. This will be on the Soil Test Report.
         2. Record a "Sample ID." This is how the farmer identifies the particular field. This should be 6 or less number and letter combination. For example, "FLD1" or "1F", etc.
         3. Lime applied – If lime has been applied to the field in the last 12 months, record the tons per acre to tenths AND the 2-digit month and year. For example the farmer applied ½ ton of lime per acre in December 2005…you record ".5 t/ac" and "mo12 yr2005."

Question 4

The table in question 4 is to record <u>commercial</u> fertilizers that were applied to the particular field during the 2006 crop year (i.e. fall planting through 2006). The fertilizers should include custom applied fertilizer, including fertilizers applied in the fall of 2005.

If there were fertilizers applied, check Ayes,@ record 1 in box 301 and complete the fertilizer table for the fertilizers applied. Use one line per application. If additional lines are needed,

please record on a blank sheet of paper with the sample segment and field number recorded at the top of each additional sheet.

If there were no fertilizers applied, check Ano,@ record 3 in box 301 and go to Question 4.

Column 1 - Record the crop name.

Column 2 - Record the crop code. See Appendix 2 for a list of crop codes. If the crop is not listed, write the crop name and leave the crop code blank.

Columns 3 - Enter the percentage analysis of nitrogen, phosphate, and potash OR the actual pounds of nutrients per acre. If the total percentage (i.e. nitrogen+phosphate+potash) is greater than 85, verify if it is the actual nutrients. The other 15 percent will be carrier materials in the commercial fertilizer. This is also helpful for probing that the farmer is giving percent or actual nutrients.

Column 4 - Record the quantity of the material applied per acre. If actual nutrients were recorded in columns 3 - 5, leave column 6 empty.

Column 5 - Record the unit of the material reported in columns 3 - 5 (1 for pounds, 12 for gallons, 15 for tons, and 19 if actual nutrients).

Column 6 – Enter the month of the application. The codes for this column are located at the bottom of the table.

Column 7 – Record how the fertilizer was applied. The codes for this column are located at the bottom of the table.

See additional handout for recording fertilizer applications and “normal” amounts applied to fields.

Question 5

The table in question 5 is to record unprocessed manure that was applied to the particular field during the 2006 crop year (i.e. fall planting through 2006). The manure should exclude commercially prepared manure.

If manure was applied, check Ayes,@ record 1 in box 401 and complete the manure table for all applications of manure. Use one line per application. If additional lines are needed, please record on a blank sheet of paper with the sample segment and field number recorded at the top of each additional sheet.

If there was no manure applied, check Ano,@ record 3 in box 401 and go to Question 5.

Column 1 - Record the crop name.

Column 2 - Record the crop code. See Appendix 2 for a list of crop codes. If the crop is not listed, write the crop name and leave the crop code blank.

Columns 3 - Enter the actual pounds of nutrients applied per material code. For example, chicken litter would be 75 lb N and 80 lb P_2O_5 per ton of litter.
Farmers may also report this as pounds of N per unit application. For example, 53 lb N/1 ton of chicken litter. If they report in pounds of N per unit application, write it in the line of the table as they report it and continue with columns 6 through 8.
Farmers may also have a Waste Analysis Report from NCDA Agronomic Division. The waste description is on the report with nitrogen (N) and phosphate (P_2O_5) recommendations. Examples of this report and information sheet are in the last section of your manual.

Column 4 - Record the quantity of the material applied per acre. If actual nutrients were recorded in columns 3 - 5, leave column 6 empty.

Column 5 - Record the unit of the material reported in columns 3 - 5 (1 for pounds, 12 for gallons, 15 for tons, and 19 if actual nutrients).

Column 6 – Enter the month of the application. The codes for this column are located at the bottom of the table.

Column 7 – Record how the fertilizer was applied. The codes for this column are located at the bottom of the table.

Column 8 – Enter the code for the major source of manure. If the respondent can not (or will not) select one from the list, consider the response a refusal. "Ref" should be written to the side of the box. You have to choose one of the manures in the list. If "other" is recorded, note the type of manure.

Question 6

Drainage directions are important for determining how ground and surface water flow. While most fields will probably only have one drainage direction, there is space to record 3 drainage directions. You will need to take the time needed to properly determine the number of drainage directions.

One drainage direction - complete Table A and go to question 12.
Two drainage directions - complete Tables A and B then go to question 12.
Three drainage directions – complete Tables A, B, and C then go to question 12.

If the slopes, receiving slopes, slope length and edge-of-field practices are the same for the drainage directions, note the number of drainage directions but only go to Table A.

<u>Completing Tables A, B, and C:</u>

Questions 7, 8, and/or 9 - Vegetation type and width affects the effectiveness of buffers in reducing pollutants. If there is no buffer, check "none." Check one (or two) type of buffer (shrub/tree or vegetative), and record the distance in feet to the nearest 5 foot increment for each buffer. For example, sometimes there will be a tree buffer next to the stream (example distance is 30 ft) and then a grass buffer next to the tree buffer (example distance is 20 ft). In this case you will need to mark both buffers.

a - Because of field topography, the entire field may not drain to an outlet (ditch, stream, river). Therefore it is important to know how much of the field drains to an outlet.

Only ask if either (or both) of the buffers checked in the previous question.
If either of the buffers was 20 feet or greater, ask how much of the field was affected by the vegetative buffer. Record as a percentage of the field.

b – Field slope is recorded as a percentage. This is determined using the clinometer.

c – Slope Length – recorded in feet. Use the GPS to determine the length, or determine with pacing the length.

d – Receiving slope – check one of the distance categories.

e – Determine if there is a sediment basin in the drainage area. Check yes or no.

f – Determine if there is a pond in the drainage area. Check yes or no.

Question 10
If the field is under conservation tillage (recorded in question 2) **OR** if the field is hay, dash box 811 and 812.

If conservation tillage was not used in question 2 column 5, choose if the hydrologic condition is good or poor.

If the field is pasture (recorded in question 2), choose if the hydrologic condition is good, fair, or poor.

Question 11

Ask the question as worded. If the farmer is unsure how to classify himself, ask if his gross income from farming is more than 50%. If it is, farming is the primary occupation.

Question 12

Watch the skips in question 12. First, determine if the farmer follows a nutrient management plan was followed for crop year 2006.

No – complete 12a

12a – Check who makes the commercial fertilizer recommendations. Do NOT include animal waste applications.
More than one can be checked. If question 4 on page 2 was "no," the option "No Commercial Fertilizer Applied" should be the only option checked.
Yes – complete 12b and 12c
12b – Check one option; animal waste only, commercial fertilizer only, or both
12c – Check one option. If "other" is checked, please specify.

Question 13

Ask ALL respondents. Include applications of commercial fertilizers AND animal waste. More than one can be checked. If "other" is checked, please specify.

Question 14

Synthesized results will be available on the Internet at http://www.soil.ncsu.edu/publications. No individual farm or field data will be published; only county-level information.

Question 15

Do not ask the farmer this question. It will be recorded in the office using soil maps. This will be very useful once the crop and fertilizer/manure application information is obtained, because newly developed N fertilizer management is determined by the predominant soil type of a field.

Record the name of the respondent, their phone number (if different than on the front), and the date of the interview.

Respondent code box can be 1, 2, or, 3;
1 = operator, manager, or partner, 2 = spouse, and 3 = other (such as another relative, etc).

Response code can be 2, 3, or, 7; 2 = telephone, 3 = interview, and 7 = refusal. Most interviews will be A3." However, you may obtain most information from one respondent concerning what is planted, but have to call the operator to obtain the fertilizer information. Make note if there is more than one respondent.

Enumerator code is your 3-digit code.

Evaluation will be completed by the office.

V. Problems and Special Situations

Sample Segment does not have any agricultural fields

If the sample segment has fields defined as agricultural land use in 2006, there has to be a completed questionnaire for the sample segment. A questionnaire is used for fields that appear on the photo as a field such as, fields that had been agricultural but are now developed. For these

fields, a questionnaire with the field number (same as photo) will be in the segment envelope with ONLY the land use checked and the approximate acres in the field. Write notes on the front of the envelope or the questionnaire if there is an extremely unusual situation.

Before you decide that there are no fields in the boundary, investigate the area thoroughly.

Sample Segment is different than the photo

Make any notes on the front of the envelope concerning how a sample segment has changed; changes could have occurred. The sample segment map can be marked using the red China marker pencil to indicate changes.

Refusal

Prepare a questionnaire with the field number on the questionnaire and (if possible) obtain the farmer=s name and what crops are in the field. Estimate the field acreage. If the field can be observed, record as much information about the field as possible. Write notes about the refusal on the questionnaire.

Inaccessible

Given the length of the data collection period, there should be very few inaccessibles. Someone who is not available in October may be available in November or December. If an operator is truly inaccessible for the entire 3-month period, prepare a questionnaire with the field number on the questionnaire and (if possible) obtain the farmer=s name, what crops are in the field, and estimated acreage. If the field can be observed, record as much information about the field as possible. Write notes about the situation.

Soil Sampling

Soil samples will be obtained from the field if:

- farmer has not completed a soil test in the last 2 years;
- farmer has completed a soil test in the last 2 years but does not have the results;
- permission is obtained from the respondent
    - IMPORTANT----the respondent's name will be used as the person granting permission to enter the field for the soil sample and to attach their name to the sample so they can get a result. This is very important since it concerns confidentiality for the soil test only!

When to take soil sample:

- Samples from cultivated fields have to be taken after harvest.
- Samples from pasture or hay fields can be taken anytime.

Identification information:

- Do NOT contact the farmer for the soil sample information….it is all on the

questionnaire.

- Copy all of the information from the questionnaire to the Soil Sample Information sheet prior to mailing the questionnaire to the office.
- Copy the name, address, and phone from the questionnaire to the Soil Sample Information sheet. (do not complete email address for respondent)
- Copy the Farm ID from page 1 of the questionnaire to the Farm ID # box on the Soil Sample Information sheet.
- Copy the Sample ID from page 1 of the questionnaire to the Sample Identification column on the Soil Sample Information sheet.
- If lime was applied in the last 12 months to the field, copy the lime information from page 1 of the questionnaire to the Lime column on the Soil Sample Information sheet.
- Copy the crop from question 2 page 1 of the questionnaire to the First Crop column. The back of the Soil Sample Information sheet contains a list of codes used for this crop. Note…if double-cropped the code is 018.
- Do not complete Second Crop column.

Samples to the lab:

- If sampled soil is extremely wet, let the excess dry off the soil before putting in the sampling box.
- Samples will be collected by your supervisor and brought to the office.
- Do NOT send any samples directly to the soil lab!

Soil Sampling Quick Reference

When

- Cultivated crops – sample after harvest
- Pasture and hayland – do now
- Want soil moist, but not wet.

Number of Samples Per Field

Field Size	Number of Samples
Less than or equal 20 acres	10 samples
21 – 30 acres	15 samples
31 – 40 acres	20 samples
41 – 50 acres	25 samples
51 or more acres	30 samples

Taking Sample

- Walk in zigzag pattern across the entire field.
- Cultivated conventional tillage --- sample depth of 8 inches.
- Not cultivated conventional tillage --- sample depth of 4 inches.
- Hayland or pasture --- sample depth of 4 inches.
- Push vegetative matter from top of soil before taking sample.

- Put all samples from the SAME field in the bucket and mix together.

Boxing Samples

- **There will be one small soil sample box for EACH field.**
- Dry soil before putting in small soil sample box.
- Remove vegetative matter from sample.
- Fill small soil sample box to "fill line" and close the flaps.
- Discard remainder of soil.
- Write last name of farmer on top of small soil sample box (note: do this before you fold the box).
    - If more than one box per farmer (i.e. he had more than one field in the segment), write the farmer's name on top of each and number the boxes (1 of 3, 2 of 3, etc).
- Do **NOT** use tape on box.
- Do **NOT** put soil in plastic bag.

Preparing Samples for Pickup

- Copy the necessary information from the questionnaire to the Soil Sample Information sheet. (Farm ID, Sample ID, lime information, and crop)
- Beginning at the bottom left and moving to the right, place the small soil sample boxes in the larger box.
- Fold the Soil Sample Information sheet and put in flap of box.
- When the large box is full, call your supervisor for pickup.
- Supervisors will collect large boxes and contact the office.

Clinometer

The clinometer is a device to aid in determining the slope percent. Each clinometer has a string so it can be worn around your neck. This helps in the field for easy access and makes it less likely to lose. Always measure up slope (you are at bottom of the slope). Measure against the florescent mark on the 6-ft stake.

- Walk to the bottom of the slope to be measured.
- Walk up the slope and put your 6-ft stake in the ground. The stake needs to be as far as possible but you HAVE to be able to see the mark on the stake from the bottom of the slope.
- Return to the bottom of the slope, and face the stake (that is up slope).
- Hold clinometer with dial to the left.
- While holding the clinometer to your eye, align the "line" in the clinometer with the florescent mark on the stake. To do this, you have to visually locate the mark with the eye that is NOT looking through the clinometer.
- When the mark on the stake and the line in the clinometer are aligned**, read the degrees scale on the right of the clinometer line.**
- Record the degrees on the questionnaire as the slope percent of the field.

Returning Equipment and Maps

ALL equipment and ALL maps should be returned to your supervisor. You are responsible for the following:

- Clinometer (labeled with NCSU)
- Soil Probe (labeled with NCSU) and extra tips
- Maps for your segments
- GPS Unit (labeled with NCDA)
- Stakes
- Bucket

Appendix 3: Lake Jordan Best Management Practices Survey 2006

Project 450

Lake Jordan River Basin Best Management Practices Survey 2006

Latitude _____ Longitude _____

County_____ Sample _____Field _____

Name of Operator _____

Address _____

City _____, NC Zip_____

Telephone _____

Purpose of survey -
This survey is designed to help farmers add more flexibility to the Best Management Practices (BMPs) required in the Lake Jordan river basin. The program will develop a baseline of nitrogen and phosphorus use, track nitrogen and phosphorus reduction and demonstrate what type of BMPs farmers currently utilize. By law, your response will remain confidential. It will only be used in combination with other reports to summarize the results for the Lake Jordan river basin. The results of this survey will be available at the end of 2007.

1. How many acres are in the field?..... 112 ___.___Acres

Enumerator note: Draw the sample field on the back diagram. Mark the crest of the field and the drainage directions. Indicate the nearest ditch, stream, or river, water, control structures, along with the vegetative buffers on the diagram. If factors of the drainage directions are the same, do not separate.

2. Now I would like to ask some questions about the crops planted on this field in the fall of 2005 and spring and summer of 2006.

Planting Season	Crop and Crop Code	Month Planted (1=Jan,....12=Dec)	Was this a Cover Crop? [1]	Was Conservation Tillage Used? [2]	Date of Harvest (mm/dd/yy)	Date Cover Crop Killed (mm/dd/yy)
Fall of 2005	(Circle one.) Wheat, Oats, Rye, Barley, Triticale		Yes ☐ 1 No ☐ 3	Yes ☐ 1 No ☐ 3		
	211	212	213	215	216	217
Spring/ Summer 2006	Crop			Yes ☐ 1 No ☐ 3		
	219			223	224	225

[1] Cover Crop - Crop grown in the fall and winter to protect the soil from wind and water erosion. Cover crops are usually small grain crops that are either killed with herbicides or plowed down prior to spring planting.
[2] Conservation Tillage - Tillage method that will leave a minimum of 30% of the soil surface covered by residue following planting.

2a. If hayland or pastureland in this FIELD,was it used anytime during the past year to graze animals? 226
Yes ☐ -1 (go to 2b) No ☐ -3 (go to 3)

2b. For this FIELD, record the type of livestock grazed, the average number of livestock grazed, and the average number of days grazed per year.

Type of Livestock (Check all that were grazed in THIS field.)	Average Number Grazed (Head)	Average Number Days Grazed Per Year
☐ Cattle (cows, calves, bulls, and all other cattle)	227	228
☐ Horses	229	230
☐ Goats	231	232
☐ Sheep	233	234
☐ Other (specify:_____)	235	236
☐ Other (specify:_____)	237	238

3. Has a soil test been completed on this field in the last 2 years? 801
Yes ☐ -1 (go to 3a) No ☐ -3 (go to 3c)

3a. Do you have a copy of the soil test available? 802
Yes ☐ -1 (go to 3b) No ☐ -3 (go to 3c)

3b. Copy the P-index from latest soil test (go to 4)..... 803

3c. With your permission, I will collect soil samples from this field after harvest.Your name will be given to the NCDA soil lab so that the results of the free soil test can be sent to you.
Will that be all right? 804
Yes ☐ -1 No ☐ -3

Sample ID 820 __ __ __ __ __ __ Farm ID _____ Lime (if applied in last 12 months) ___.___ t/ac mo___ ___ yr 200___

4. Were COMMERCIAL FERTILIZERS applied to this field for the 2006 crop year?
(Include custom applied fertilizer.)
(Fall of 2005 through the Summer of 2006.)..... Yes ☐ -1 (continue)
No ☐ -3 (go to item 5) 301

1 Crop	2 Crop Code	3 Materials Used ➡➡ *(Enter percentage analysis or actual pounds of plant nutrients applied per acre.)*			4 Quantity Applied per Acre (leave blank if actual nutrients were reported)	5 Used Material Code 1 Pounds 12 Gallons 15 Tons 19 Pounds of actual nutrients	6 Month of Application [Enter Code.]	7 How was this applied? [Enter Code.]
		N Nitrogen	P_2O_5 Phosphate	K_2O Potash				
	310	311	312	313	314	315	316	317
	320	321	322	323	324	325	326	327
	330	331	332	333	334	335	336	337
	340	341	342	343	344	345	346	347
	350	351	352	353	354	355	356	357
	360	361	362	363	364	365	366	367
	370	371	372	373	374	375	376	377

Codes for Column 6

1	January	6	June	11	November
2	February	7	July	12	December
3	March	8	August		
4	April	9	September		
5	May	10	October		

Codes for Column 7

1 Injected
2 Incorporated within 48 hours
3 Incorporated between 48 hrs and 4 weeks
4 Incorporated between 4 weeks and 3 months
5 Surface Application

5. Was MANURE applied to this field for the 2006 crop year?
(Fall of 2005 through the Summer of 2006)..... Yes ☐ -1 (continue)
No ☐ -3 (go to item 6) 401

1 Crop	2 Crop Code	3 Materials Used ➡➡ *(Enter percentage analysis or actual pounds of plant nutrients applied per acre.)*		4 Quantity Applied per Acre (leave blank if actual nutrients were reported)	5 Used Material Code 1 Pounds 12 Gallons 15 Tons 19 Pounds of actual nutrients	6 Month of Application [Enter Code.]	7 How was this applied? [Enter Code.]	8 Major Source of Manure [Enter Code.]
		N Nitrogen	P_2O_5 Phosphate					
	410	411	412	414	415	416	417	418
	420	421	422	424	425	426	427	428
	430	431	432	434	435	436	437	438
	440	441	442	444	445	446	447	448
	450	451	452	454	455	456	457	458
	460	461	462	464	465	466	467	468
	470	471	472	474	475	476	477	478

Codes for Column 6

1	January	7	July
2	February	8	August
3	March	9	September
4	April	10	October
5	May	11	November
6	June	12	December

Codes for Column 7

1 Injected
2 Incorporated within 48 hours
3 Incorporated between 48 hrs and 4 weeks
4 Incorporated between 4 weeks and 3 months
5 Surface Application (liquid or dry broadcast)

Codes for Column 8

1	Broiler - house litter	7	Hogs - lagoon liquid
2	Broiler - stockpiled litter	8	Hogs - lagoon sludge
3	Dairy - lagoon liquid	9	Turkey - house litter
4	Dairy - lagoon sludge	10	Turkey - stockpiled litter
5	Dairy - scraped manure	11	Other
6	Poultry layer - lagoon liquid		

6. How many drainage directions are in the field?

☐ 1 (Complete Table A) ☐ 2 (Complete Tables A+B) 3 (Complete Tables A+B+C) 810

TABLE A - First Drainage Direction in Field

7. What type(s) of buffer is between this field and the nearest ditch, stream or river?
(Record the distance in feet using 5 foot increments.)

_____ none 501

_____ shrub/tree buffer ..... 502 ft.

_____ vegetative buffer (not shrub/tree) ..... 503 ft.

a. How much of the field is affected by either the vegetative and/or shrub/tree buffer? ..... 504 %

b. Field Slope ..... 505 %

c. Slope Length ..... 510 ft.

d. Receiving Slope width (in field) 507
(Check one.)

____ 0-9 feet (1)	____ 30-49 feet (4)	____ 150-199 feet (7)
____ 10-19 feet (2)	____ 50-99 feet (5)	____ 200-299 feet (8)
____ 20-29 feet (3)	____ 100-149 feet (6)	____ 300 or more feet (9)

e. Is there a sediment basin in the drainage area? 508
Yes ☐ -1
No ☐ -3

f. Is there a pond in the drainage area? 509
Yes ☐ -1
No ☐ -3

OFFICE USE C = 511 LS = 512 K = 513 R = 514 P = 515

TABLE B - Second Drainage Direction in Field

8. What type(s) of buffer is between this field and the nearest ditch, stream or river?
(Record the distance in feet using 5 foot increments.)

_____ none 601

_____ shrub/tree buffer ..... 602 ft.

_____ vegetative buffer (not shrub/tree) ..... 603 ft.

a. How much of the field is affected by either the vegetative and/or shrub/tree buffer? ..... 604 %

b. Field Slope ..... 605 %

c. Slope Length ..... 610 ft.

d. Receiving Slope width (in field) 607
(Check one.)

____ 0-9 feet (1)	____ 30-49 feet (4)	____ 150-199 feet (7)
____ 10-19 feet (2)	____ 50-99 feet (5)	____ 200-299 feet (8)
____ 20-29 feet (3)	____ 100-149 feet (6)	____ 300 or more feet (9)

e. Is there a sediment basin in the drainage area? 608
Yes ☐ -1
No ☐ -3

f. Is there a pond in the drainage area? 609
Yes ☐ -1
No ☐ -3

OFFICE USE C = 611 LS = 612 K = 613 R = 614 P = 615

TABLE C - Third Drainage Direction in Field

9. What type(s) of buffer is between this field and the nearest ditch, stream or river?
(Record the distance in feet using 5 foot increments.)

_____ none 701

_____ shrub/tree buffer ..... 702 ft.

_____ vegetative buffer (not shrub/tree) ..... 703 ft.

a. How much of the field is affected by either the vegetative and/or shrub/tree buffer? ..... 704 %

b. Field Slope ..... 705 %

c. Slope Length ..... 710 ft.

d. Receiving Slope width (in field) 707
(Check one.)

____ 0-9 feet	(1)	____ 30-49 feet	(4)	____ 150-199 feet	(7)
____ 10-19 feet	(2)	____ 50-99 feet	(5)	____ 200-299 feet	(8)
____ 20-29 feet	(3)	____ 100-149 feet	(6)	____ 300 or more feet	(9)

e. Is there a sediment basin in the drainage area? 708
Yes ☐ -1
No ☐ -3

f. Is there a pond in the drainage area? 709
Yes ☐ -1
No ☐ -3

OFFICE USE C = 711 LS = 712 K = 713 R = 714 P = 715

10. What is the hydrologic condition?
(If the field is under conservation tillage or hay, do not answer.)

Conventional tillage ____ good ____ poor 811

Pasture ____ good ____ fair ____ poor 812

11. Do you consider farming your primary occupation? 813

Yes ☐ -1 (go to 12) No ☐ -3 (go to 11a)

11a. If no, which source do you consider your farm income to be? 815

(Check one) ☐ 1 Secondary source of income ☐ 2 Minor source of income
☐ 3 None

12. Do you follow a nutrient management plan? 816

Yes ☐ -1 (complete 12a and 12b) No ☐ -3 (go to 13)

12a. Which of the following are included in the nutrient management plan? 817
(Check one.)
☐ 1 animal waste only ☐ 2 commercial fertilizers only
☐ 3 both animal waste and commercial fertilizers

12b. Who writes the nutrient management plan? 818

☐ 1 Fertilizer Dealer ☐ 2 Paid Consultant ☐ 3 NRCS ☐ 4 Extension
☐ 5 Friend or another farmer ☐ 6 Self ☐ 7 Other (specify) _____

13. Who makes the commercial fertilizer recommendations? 819
(Check all that apply.)
☐ 1 Fertilizer Dealer ☐ 2 Paid Consultant ☐ 3 NRCS ☐ 4 Extension
☐ 5 Friend or another farmer ☐ 6 Self ☐ 7 Other (specify) _____

14. Who applies your nutrients? 820
(Includes all applications of animal waste and commercial fertilizers.)
(Check all that apply.)
☐ 1 Fertilizer Dealer ☐ 2 Friend or another farmer ☐ 3 Self
☐ 4 Other (specify) _____

15. Results of the survey will be available at www.soil.ncsu.edu. 814

16. Predominant soil mapping unit for this field ..... **OFFICE USE**

Respondent's name _____ Phone _____ Date _____

Respondent		Response Code		Enum.	Eval.
1-Op/Mgr/Ptr 2-Sp 3-Other	101	2-Tel 3-Int 7-Ref.	910	098	100
S/E					