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VEGETATED FILTER STRIPS FOR AGRICULTURAL RUNOFF TREATMENT

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DISCLAIMER

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PREFACE

The U. S. Environmental Protection Agency's Chesapeake Bay Study identified nonpoint source contributions of pollutants from agricultural and urban areas as partial reasons for water quality deterioration in the bay and its tributaries. The study also outlined a "framework for action" designed to help restore water quality bay-wide to its once high level. In a spirit of determined institutional cooperation, the State of Maryland, the Commonwealths of Virginia and Pennsylvania, the District of Columbia, and the Environmental Protection Agency joined in implementing a variety of programs to reduce both point and nonpoint pollution of the bay.

In Maryland and Virginia, much support has been given to protecting shoreline around the bay by vegetation, in an effort to "buffer" sensitive receiving waters from the effects of man's activities. Grassed (or vegetated) buffer strips have been promoted on the assumption that they could "filter" sediment and nutrients from naturally occurring runoff, thereby preventing entry of these pollutants into bay waters.

While this strategy seemed logical from a practical standpoint, little information existed to document how well actual vegetated filter strips (VFS) of limited width might remove dissolved pollutants, primarily nitrogen, from agricultural runoff. A key objective of this study was to provide such documentation.

The Agricultural Engineering Departments at both The University of Maryland, College Park and Virginia Polytechnic Institute and State University, Blacksburg participated in the study. This report, however, contains only results from the University of Maryland experiments. Results from the Virginia Tech portion of the study can be found in a separate EPA publication.

ABSTRACT

Nine 0.01 ha (0.03 ac) runoff plots and artificially created rainfall were utilized to evaluate the removal by vegetated filter strips (VFS) of suspended solids, nitrogen, and phosphorus from runoff leaving agricultural production areas. Filters 4.6 m and 9.2 m (15 ft and 30 ft) wide (in the downslope direction) received runoff from bare "source" 22 m long and 5.5 m wide (72.6 ft by 18 ft). Nitrogen as a 30% urea-ammonium-nitrate solution and as broiler litter was applied to the plots in separate experiments.

The ability of VFS to reduce the amount of suspended solids, nitrogen and phosphorus was highly variable and seemed to depend especially on the extent to which runoff concentrated into discrete channels through the vegetated filters. Channelization, in turn, appeared to depend on both topographic features as well as the quality of the stand of vegetation in the filters.

When data from all tests were averaged, mass losses of total suspended solids, nitrogen and phosphorus from bare source areas were reduced by 72%, 17%, and 41%, respectively, by 4.6 m (15 ft) wide filters. TSS, N, and P reductions by 9.2 m (30 ft) wide VFS were 86%, 51%, and 53% respectively. Percentage mass reductions for individual storm events deviated widely from these averages, however, prompting the conclusion that VFS of the size studied should not be relied upon by themselves to reduce nutrients transported in runoff from agricultural areas.

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LIST OF ABBREVIATIONS AND SYMBOLS

ABBREVIATIONS

ac	-- acre
AVE	-- average
BL	-- broiler litter
cm	-- centimeter
ft	-- foot
gm	-- gram
gms	-- grams
ha	-- hectare
in	-- inch
INFILT	-- infiltration
kg	-- kilogram
kg/ha	-- kilogram per hectare
kg/t	-- kilogram per metric tonne
lb	-- pound
lb/ac	-- pound per acre
m	-- meter
mm	-- millimeter
mg/l	-- milligram per litre
min	-- minute
PMR	-- percentage mass reduction
Post-B	-- after nutrient application in bare plot area
Post-F	-- after nutrient application in vegetated filter
PPT	-- precipitation
PR	-- performance ratio
Pre-B	-- before nutrient application in bare plot area
Pre-F	-- before nutrient application in vegetated filter
RT	-- rate
STD DEV	-- standard deviation
SD	-- standard deviation
t/ac	-- ton per acre
t/ha	-- metric tonne per hectare
Total N	-- total nitrogen
Total P	-- total phosphorus
TSS	-- total suspended solids
UAN	-- urea-ammonium-nitrate
VAR	-- variance
VFS	-- vegetated filter strip

SYMBOLS

Cd	-- cadmium
Cu	-- copper
KCl	-- potassium chloride
K_2O	-- potash
N	-- nitrogen
NH_4-N	-- ammonium nitrogen
NO_3-N	-- nitrate nitrogen
P	-- phosphorus
P_2O_5	-- phosphate

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SECTION 1

INTRODUCTION

The EPA Chesapeake Bay Study focused attention on nonpoint source contributions of pollutants as one reason for the general decline in water quality bay-wide. Agriculture is one nonpoint source of pollutants (mainly sediment and agrochemicals). Agricultural best management practices (BMPs) are used to control these losses of pollutants. For agrochemicals, application at recommended rates and times using the appropriate application techniques is a very effective combination of management practices that helps reduce the transport of these substances to receiving waters.

Other structural, cultural and managerial techniques also are used to control agricultural nonpoint source pollution. A popular practice among these is the use of close-growing vegetation around the perimeter of fields and animal operations to "filter" pollutants from runoff leaving these areas. Although the ability of such vegetated filter strips (VFS) to reduce pollutant concentrations has been demonstrated by several researchers, not enough is known about individual treatment mechanisms to permit routine design of reliable filters.

SECTION 2

CONCLUSIONS

Conclusions from this study must be kept within the context under which the research was conducted. This is to say that a "worst case" scenario was created to examine the ability of vegetated filter strips of limited widths (4.6 m and 9.2 m) to remove suspended solids, nitrogen and phosphorus from agricultural runoff. The experimental conditions thus established were believed to be representative of "real world" circumstances that would provide the most severe test of VFS commonly used in the coastal plain of Maryland.

Based on an examination of nutrient losses in surface runoff from plots with and without vegetated filter strips, the following conclusions are drawn:

1. The performance of vegetated filter strips in reducing nutrient losses from agricultural lands is highly variable.

2. Vegetated filter strips are more effective in removing suspended solids from runoff than in removing nutrients.

3. Removals of runoff-transported sediment (and perhaps chemicals attached thereto) at the interface between VFS and upslope areas may consitute a large percentage of the total amount of sediment prevented from leaving areas protected by VFS.

4. Vegetated filter strips appear to be less effective as time goes on in reducing nutrient and suspended solids losses in runoff.

5. The performance of vegetated filter strips generally diminishes as the ratio of vegetated to unvegetated area decreases.

6. The effectiveness of vegetated filter strips is highly dependent on the condition of the filter itself.

7. Subsurface (leaching) losses can be an important component of inorganic nitrogen movement from agricultural areas. When these losses are considered together with surface losses,

the relationship between VFS width and nitrogen removal is not clear.

8. Since the ability of VFS to remove nutrients and suspended solids in this closely controlled experiment was so highly variable, the performance of VFS in actual use is probably much less than expected (although no performance criteria have been established).

9. Vegetated filter strips should not be relied upon as the sole, or even primary means of preventing nutrient movement from agricultural management systems.

SECTION 3

SUMMARY & RECOMMENDATIONS

This study was conducted under closely controlled experimental conditions that were designed to be very representative of typical farming situations in the Maryland coastal plain. A "worst case" scenario was investigated, however, to estimate an upper bound for pollutant losses, and thus a lower bound for VFS effectiveness.

In the upcoming months in Maryland, special attention is expected to be directed toward vegetated filter strips as a best management practice due to the recently passed Chesapeake Bay Critical Area Protection Act. One requirement resulting from the legislation is that, under certain conditions, VFS must be provided around the borders of some agricultural operations. This study provides timely guidance for the implementation of that legislation. Specifically, results of this study demonstrate that VFS performance under "real world" conditions can be highly variable, especially as regards the ability to remove nutrients from runoff. Vegetated filters thus should not be considered as nutrient management BMPs in and of themselves. This study supports findings of other researchers that demonstrate the ability of VFS to reduce suspended solids (sediment) losses in runoff. The time dependent nature of these removals was not adequately defined, nor was the areal distribution of such removals between VFS and upslope source areas.

In addition to defining the performance of VFS in removing nutrients and sediment from agricultural runoff, a major objective of this study was to develop more reliable design criteria (i.e. design equations) for VFS than presently exist. Efforts fell somewhat short of accomplishing this objective. This occurred because the experimental design was developed under the hypothesis that the major nutrient and sediment removal mechanisms would occur in the VFS themselves. This research indicated that significant removals, especially of sediment, can occur at the interface between VFS and upslope areas the VFS are supposed to protect.

The significance of this observation should not be minimized for it suggests that VFS are responsible for some removals of contaminants from agricultural runoff that occur rather independently of VFS width. The extent to which such removals occur does, of course, depend heavily on the condition of the filter and on the surrounding topography. Removal processes at the VFS/source area interface need much more study to determine their significance.

This study focused on the ability of VFS to remove nutrients and sediment from agricultural runoff. It did not investigate the many additional benefits that may accrue from the use of vegetated filter strips, such as stream or ditch bank stabilization. This research thus suggests the following recommendations:

1. VFS should not be considered as a nutrient management technique by themselves.

2. The performance of VFS in actual use, is likely to be highly variable due to a number of natural factors.

3. This and other research suggests that to maximize the ability of VFS to reduce pollutants in runoff, dense stands of vegetation should be established and maintained, and every reasonable attempt made to promote uniform flow of runoff through the filters.

4. Important management questions remain unanswered that could improve VFS performance, and thus should be studied. Answers are needed regarding how long-term VFS performance varies, how VFS can be managed to maximize effectiveness, and how sedimentation at the VFS interface affects total VFS performance. These answers can be found only through continued research.

SECTION 4

REVIEW OF LITERATURE

HIGHLIGHTS OF PREVIOUS RESEARCH

Like many of the agricultural practices now called BMPs for pollution control, vegetated filter strips originated from soil and water conservation practices (SWCPs), i.e. practices designed to reduce erosion and/or manage water more effectively for improved agricultural production. Strip cropping (which is still a widely-used conservation practice) is the forerunner of perimeter-based vegetated filters, and employs strips of perennial grasses, legumes, or hay crops alternated among strips of row crops within a given field. The close-growing vegetated strips effectively reduce slope length, slow runoff velocity, filter soil from runoff, and facilitate absorption of rain by the soil (Schwab, et al., 1966). Not all of the SWCPs adapted for pollution control function equally effectively, however, especially in terms of removing soluble pollutants (Haith and Loehr, 1979).

A number of research studies have investigated the use of vegetated filters for nonpoint source pollution control. Doyle, Stanton and Wolf (1977) applied dairy manure upslope of both fescue and forest buffers and concluded that filter lengths of only 3.7 - 4.6 m (12 - 15 ft) were very effective in removing soluble and suspended pollutants from runoff. Dickey and Vanderholm (1981) studied channelized and overland flow grassed systems for treating feedlot runoff. They observed up to 80% reductions in concentrations of nutrients, solids and oxygen demanding material in filter lengths ranging from 91 to 262 m (300 to 860 ft). They also developed filter design criteria based on residence or contact time concepts.

Livingston and Hegg (1981) used terraced pasture to treat dairy yard runoff with success except for removing nitrate. Sievers, Gardner and Pickett (1981) also used a terraced grass system to treat swine waste. Edwards, et al. (1981) used a similar system for beef feedlot runoff. Norman, Edwards and Owens (1978) presented grass filter design criteria based on making travel time through the filter proportional to BOD concentration in runoff and assumed a 53 m (174 ft) length reduced BOD concentrations by 75%. Young, Otterby and Roos (1982) used the concept of residence time to develop empirical relationships for evaluating pollutant reduction potentials of grassed areas. Young, Huntrods and Anderson (1978) reported on the ability of 24 m (80 ft) long cropped areas to remove pollutants from feedlot runoff. Significant reductions (92% sediment, 64% TN, 59% TP and 80% runoff) were achieved in the strips.

Bingham, Westerman, and Overcash (1980) and Overcash, Bingham, and Westerman (1981) applied chicken manure to grassed areas and measured runoff quality at numerous downslope distances. They concluded that buffer lengths in a 1:1 ratio to land application area were necessary to achieve background levels of contamination in filters downslope of waste application sites. They developed a mathematical model to predict performance, taking into account dilution, infiltration, and pollution potential of the waste application site. Their results are summarized in an EPA report (Westerman, Overcash and Bingham, 1983).

Considerable effort has been placed on developing analytical procedures to describe VFS performance in retaining sediment. The first widely recognized work was performed at the University of Kentucky and concerned erosion control in surface mining areas (Barfield et al., 1977, 1979; Kao and Barfield, 1978; Tollner et al., 1976, 1977, 1978, 1982; Hayes et al., 1979, 1983). Tollner et al. (1976) developed exponential power functions that related sediment trapping efficiency in simulated vegetal material to runoff, soil, and vegetation characteristics. Barfield et al. (1977) developed a steady state model (Kentucky filter strip model) for determining the sediment retention capacity of grass media as a function of flow, sediment load, particle size, slope, and several other parameters. Hayes et al. (1979) extended the model of Barfield to unsteady flow and non-homogeneous sediment. Hayes and Hairston (1983) evaluated Kentucky filter strip model predictions against field data measuring VFS performance in retaining sediment naturally eroded by multiple storm events. Agreement between measured and predicted performance was good.

SUMMARY AND PERSPECTIVE

As evidenced by this comprehensive review of literature, previous studies involving vegetated filters have concentrated on animal waste application areas or surface mined areas. Relatively little work has been undertaken to study the effectiveness of VFS downslope from cropped areas. Several studies have involved sod with vegetation densities that may not be representative of field conditions.

With the exception of the study by Sievers, Garner and Pickett (1975), research has ignored the effect of vertical transport, either upward or downward, of pollutants beneath VFS. Nevertheless, infiltration is almost always cited as the major treatment mechanism operating in vegetated filters. Predictive tools by which to design VFS range from highly complex, cumbersome deterministic models (e.g. University of Kentucky work) to very simplistic and empirical relationships. Required filter lengths for approximately 90-95% pollutant reductions in runoff have ranged from 3 m (10 ft) to lengths equivalent to the area upslope from the filter. If the latter criterion were followed, a square agricultural field one hectare (or one acre) in size would require a VFS of identical size.

SECTION 5

STUDY OBJECTIVES

This study forms the first phase of a comprehensive joint investigation of nutrient and sediment movement from agricultural lands planned by the Agricultural Experiment Stations in Maryland and Virginia, through the Departments of Agricultural Engineering at The University of Maryland and at Virginia Polytechnic Institute and State University (Virginia Tech). This first phase concerned vegetated filter strips (VFS) and had the following objectives:

1. Determine how well VFS remove sediment and nutrients from agricultural runoff
2. Improve design methods for VFS
3. Estimate the effectiveness of existing VFS.

By cooperating on this project, the two universities were able to investigate a wider range of conditions than either research unit could study effectively on its own. As an example, slopes and soils typical of lowland regions in the Chesapeake Bay basin coastal plain as well as residual soils and slopes found in upland regions of the Appalachian province were studied, not just those conditions in one physiographic region. It was also appropriate that, since Bay restoration heavily involves both Maryland and Virginia, both universities should work cooperatively whenever possible. This report deals only with the investigations conducted at the University of Maryland.

SECTION 6

PROCEDURES

EXPERIMENTAL DESIGN AT MARYLAND

Hydrologic agricultural research at the University of Maryland has a very pragmatic orientation to maximize its immediate relevance to the agricultural community, as well as to society at large. Consequently, the general philosophy that governs the design of experiments concerning nonpoint source pollution is to represent "real world" field conditions as closely as possible without compromising the scientific value of the experiments.

Runoff Plots

The study made use of "runoff plots", experimental units in which surface (and sometimes subsurface) flow is confined to a known area. In a typical design, runoff plots utilize artificial borders to define the origin of runoff and subsequently direct it to a collection point for quantity and quality measurements. Soil characteristics are assumed to be uniform within a given plot. This experimental design provides an important intermediate step between pure laboratory and pure "field" experimentation in that many important variables can be held nearly constant within an overall environment that closely resembles "real world" conditions.

Three groups of three plots each were established in an area formerly cropped to corn at the University of Maryland Wye Research and Education Center near Queenstown, MD. The Center is located in the Atlantic coastal plain physiographic province. The plot groups, or sets, were constructed on approximately 3%, 4%, and 5% slopes, respectively (Figure 1) after careful topographic surveying of the area. Each plot had a fallow "source" area that served as the origin of pollutants to vegetated filter strips at the base of each plot (Figure 2). Source areas were 22 m (72.6 ft) long, the standard slope length on which the Universal Soil Loss Equation is based.

Vegetated filters 4.6 m (15 ft) and 9.2 m (30 ft) wide (in the downslope direction) were selected for study because these

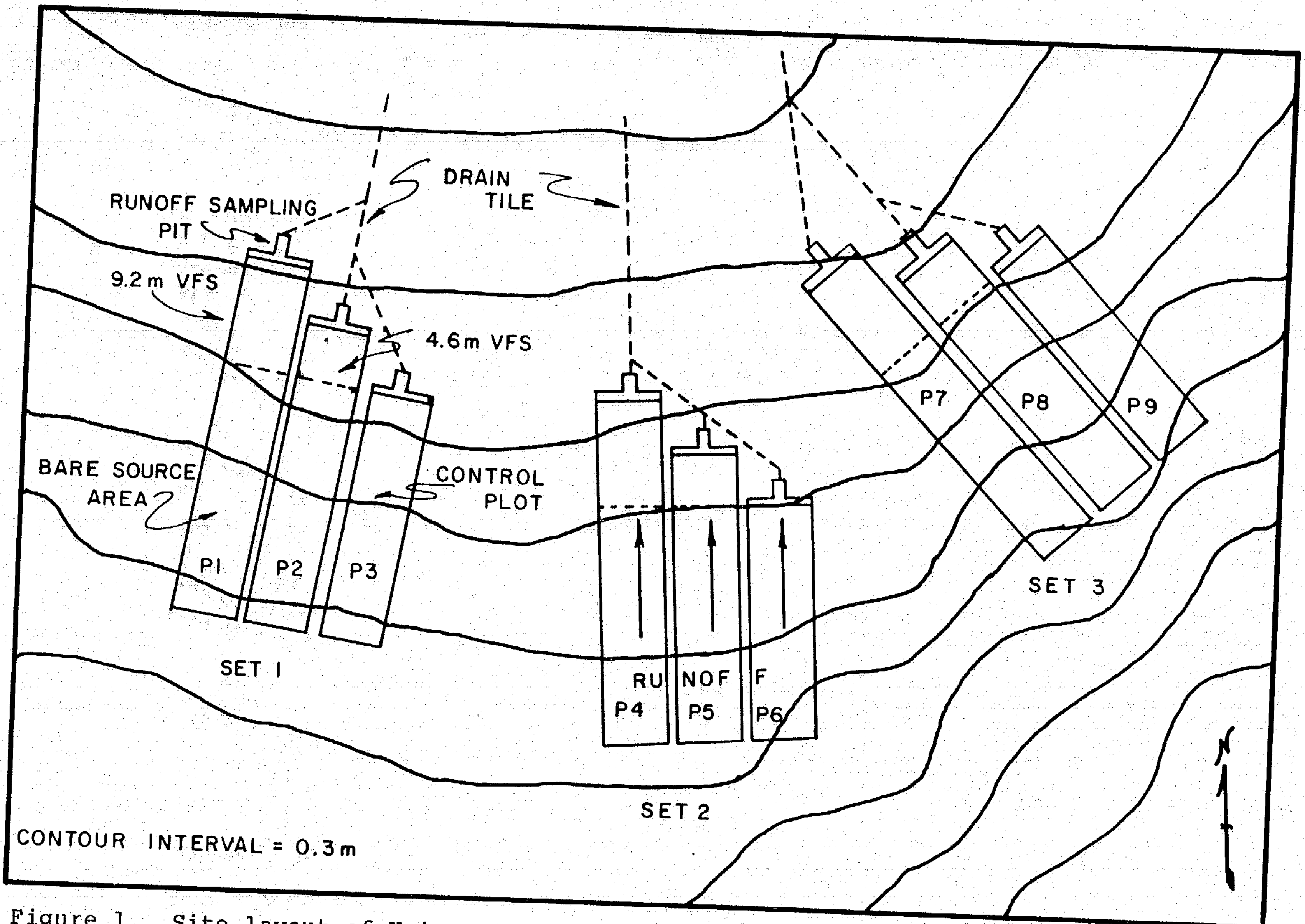

Figure 1. Site layout of University of Maryland vegetated filter strip research plots, Queenstown, MD.

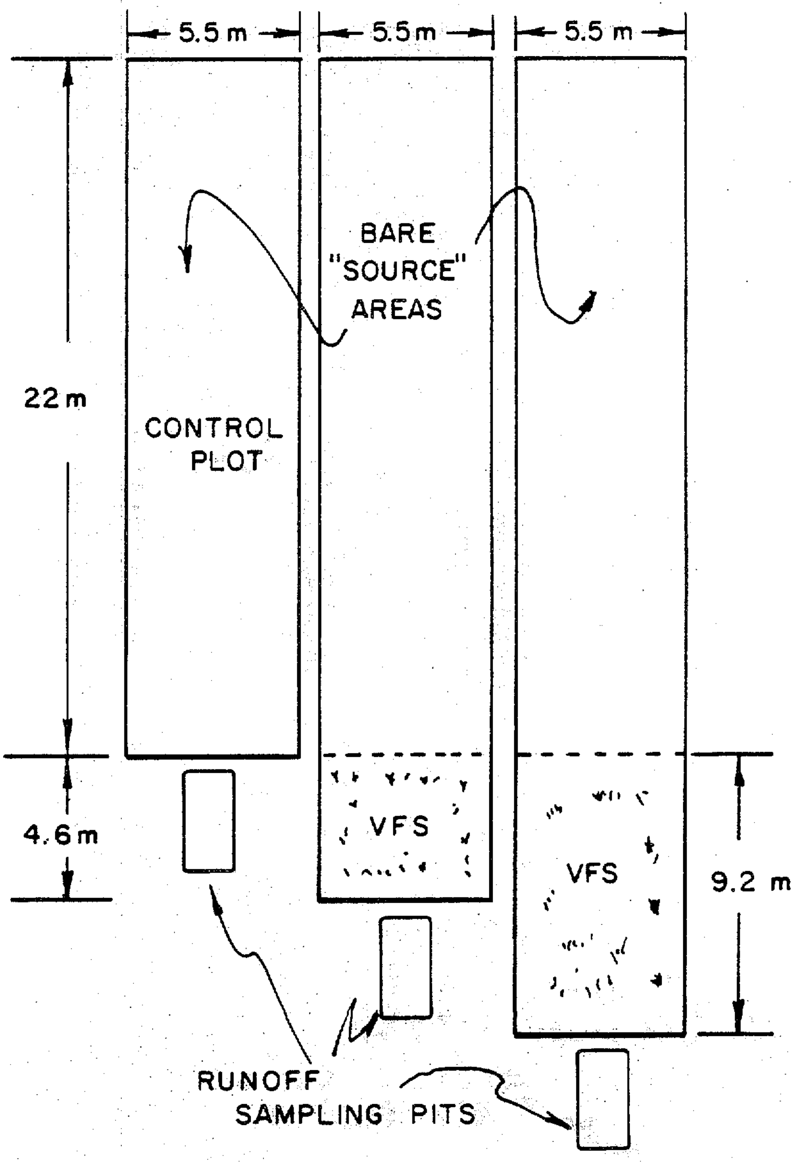

Figure 2. Schematic diagram of one set of experimental runoff plots showing relationship of VFS to bare source areas and arrangement of control plot.

dimensions bracketed widths generally being required by agricultural cost sharing programs in each state. Kentucky-31 fescue, a grass popular in the mid-Atlantic coastal plain, was used for the VFS. Filter areas were seeded using standard farming techniques after residue from the previous corn crop had been chopped and disked. All tillage practices were accomplished on the contour.

VFS of each width were used in each set of plots. In addition, one plot in each group had no VFS and served as a control by which to estimate the delivery of pollutants from source area to filters. This experimental design is commonly used in agricultural hydrologic research (e.g. Neibling and Williams, 1979), however the assumption that pollutant deliveries from different source areas are identical is a liberal one. Recent research (e.g. Wendt, Alberts and Hjelmfelt, 1986) suggests that erosion and runoff rates from adjacent bare plots are variable. Source areas were purposely kept fallow to attain a "worst case" situation for nutrient loss, i.e. the occurrence of precipitation soon after fertilizer application but before a crop has had time to begin nitrogen uptake.

Soils Description

Soil scientists from the University of Maryland Agronomy Department visited the site to describe the soil profile and identify the soil series more precisely than could be done with a soil survey. The soil description is found in Appendix A. Based on this description, the soils were identified as Woodstown sandy loam (typic Hapludult, mesic, fine loamy, siliceous), an agriculturally important soil on Maryland's Eastern Shore.

Rainfall Simulation

Artificial rainfall was used to generate runoff from the plots and was created using a simulator designed by Shanholtz (1981). Water was supplied from a well on site, the pump for which was approximately 24 m (80 ft) deep. Though this was the only feasible means of providing good quality water for the simulations, the supply rate was less than ideal and caused minor problems (as discussed below).

Tests were performed according to the following schedule to generate runoff under a variety of soil moisture conditions. The schedule also permitted an examination of pollutant losses as related to the length of time between nutrient application and occurrence of precipitation.

Run 1 - "Dry soil test", 1-hour duration; 48.25 mm (1.9 in) rain applied

Run 2 - "Wet soil test", conducted 24 hours after Run 1; 1/2-hour duration; 24.13 mm (0.95 in) rain applied

Run 3 - "Very wet soil test", conducted 1 hour after Run 2; 1/2-hour duration; 24.13 mm (0.95 in) rain applied

Runs 4, 5 & 6 - Identical to Runs 1, 2, & 3, respectively; conducted 1 week after Runs 1 - 3

Runs 7 - 12 identical to Runs 1-6, respectively, but conducted approximately 1 month after Runs 1 - 6

Twelve (in the case of plots with no VFS) or 15 raingages were placed uniformly in each plot during each run to record the distribution of rainfall within and between plots. Except when rain appeared imminent, plots were left uncovered between runs. When precipitation threatened, which occurred only once during the two series of tests, plots were covered with plastic sheets.

Nutrient Additions

Two sources of nutrients were used in the study: commercially supplied liquid nitrogen (a 30% N urea-ammonium-nitrate solution) and poultry (broiler) litter. Liquid nitrogen was used exclusively in the first series of tests (i.e. Runs 1 - 6); broiler litter was used exclusively in Runs 7 - 12. Supplemental nutrients were not applied to the plots (except those inherent in the broiler litter), primarily because soil test levels of phosphorus (P) indicated that adequate levels of P were already present in the soil profile.

Both nutrient sources were surface applied by hand without incorporation. Applications were made approximately two days prior to each series of runoff tests.

Liquid nitrogen was applied before Run 1 at a rate of 112 kg N/ha (100 lb N/ac). While the N application rate was slighty high, experience indicated that it generally represented what would be used as a pre-plant, starter application of N for corn production in the Maryland coastal plain.

Broiler litter was applied before Run 7, which was approximately 1 month after Run 1, at 8.9 wet metric tons/ha (4 wet tons/ac), the lowest rate farmers can apply with conventional spreading equipment. After collection, manure was kept on site in burlap bags until it was spread on the plots. Samples of the manure were collected when the manure was applied, and again at the time of rainfall simulation, for subsequent nutrient analysis. Approximately 287 kg N/ha (256 lb N/ac) were applied in manure, but only about 57 kg N/ha (51 lb N/ac) would be expected to be available to crops in the first year of application if the manure were not immediately incorporated into the soil.

Plot Preparation

Bare source areas were rota-tilled to a depth of approximately 15 cm (6 in) using a hand tiller prior to Runs 1 and 6. Tillage was carried out parallel to slope to yield a smooth, uniform surface free from major depressions. Care was taken to prepare all plots in an identical manner.

Soil Sampling

Soil samples were taken approximately one month before any runoff tests began, one month after Run 6 and again one month after Run 12. Samples were collected to a depth of 125 cm (4 ft) using a Giddings soil sampler. Cores were segregated into individual samples according to horizon as identified in the description of the soil profile. Four cores were collected from each source area; two cores were collected from each VFS. Bulk densities were determined for all segregated samples by measuring the volume occupied in the sample tube by each segregate and determining the moisture content of the segregate. Segregated samples at corresponding depths from the four source area cores in each plot were composited to yield one series of bare segregates per plot. Likewise, segregated samples from cores from each VFS were composited to yield one series of VFS segregates per plot.

Runoff Measurement and Sampling

Runoff from each plot was collected in a gutter at the base of each plot and directed into 15 mm (6 in) H-flumes for measurement using FW-1 type water level recorders (Figure 3). Flumes were carefully installed and field calibrated to determine rating curves that would assure reliable measurements.

Discrete runoff samples were hand-collected throughout each runoff event by assistants attending the flumes. Samples were collected 1, 2 and 3 minutes after the inception of runoff and at 3-minute intervals thereafter until the end of runoff. It was each attendant's responsibility to judge the inception of runoff at his plot.

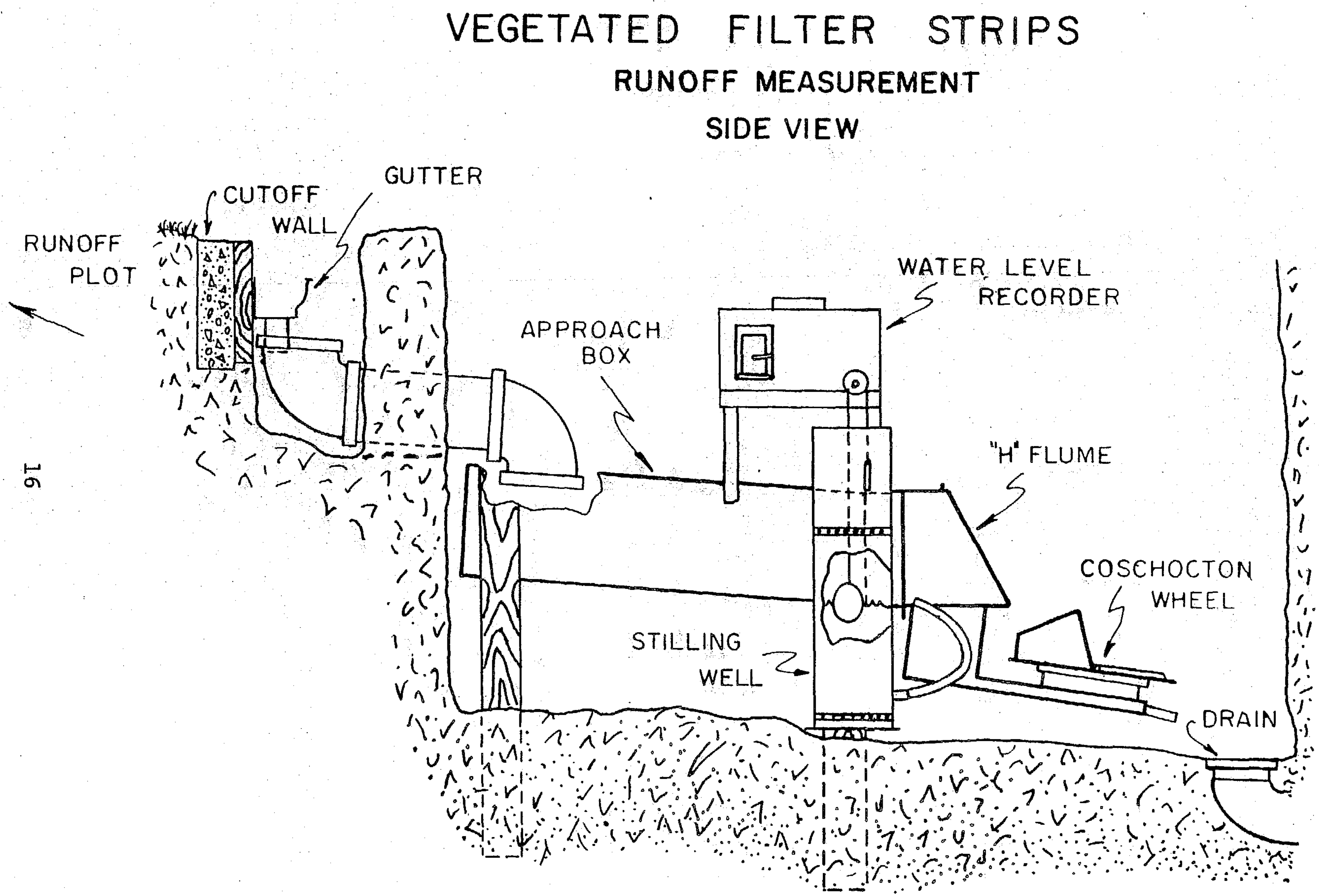

Figure 3. Schematic diagram of instrumentation used to measure and sample runoff from runoff plots.

Persons collecting samples marked the runoff chart at the time rainfall began, when runoff began and at the time each sample was collected so that accurate computations of mass transport in the runoff could be made. Samples were collected in acid-washed Nalgene bottles. Duplicate subsamples were transferred into sterile plastic "Whirlpak" baggies for preservation by freezing. All samples were refrigerated while transfers were being made, a process which took at most 12 hours.

ANALYTICAL PROCEDURES

Broiler litter was analyzed for nutrient content by the University of Maryland Manure Testing Laboratory (UM-MTL). Runoff samples were analyzed for nutrients by the Virginia Tech Agricultural Engineering Laboratory (VPISU-AgE Lab), and for solids by the University of Maryland Wye Research and Education Center Laboratory (UM-WRECL). Soil samples were analyzed for inorganic nitrogen by the Virginia Tech Agronomy Department Nitrogen Laboratory (VPISU-Agrn Lab). Specific analytic techniques and the analyzing laboratory are outlined below.

Total Kjeldahl Nitrogen

TKN was determined colorimetrically with an autoanalyzer on digested, unfiltered samples using Method 351.2 in Methods for Chemical Analysis of Water and Wastes (USEPA, 1979). VPISU - AgE Lab.

Ammonium Nitrogen

Ammonium nitrogen was determined colorimetrically on filtered samples using Method 350.1 in Methods for Chemical Analysis of Water and Wastes (USEPA, 1979). VPISU - AgE Lab.

Nitrate-Nitrite Nitrogen

Nitrate-nitrite nitrogen was determined colorimetrically on filtered samples using Method 353.2 in Methods for Chemical Analysis of Water and Wastes (USEPA, 1979). VPISU - AgE Lab.

Total Phosphorus

Total phosphorus was determined on digested, unfiltered samples colorimetrically using an antoanalyzer according to Method 365.4 in Methods for Chemical Analysis of Water and Wastes (USEPA, 1979). VPISU - AgE Lab.

Ortho-Phosphorus

Otho-phosphorus was determined on undigested, unfiltered samples using Method 365.4 in Methods for Chemical Analysis of Water and Wastes (USEPA, 1979). VPISU - AgE Lab.

Total Suspended Solids

Total suspended solids were determined using Method 160.2 in Methods for Chemical Analysis of Water and Wastes (USEPA, 1979). UM-WRECL.

Volatile Suspended Solids

Volatile suspended solids were determined using Method 160.4 in Methods for Chemical Analysis of Water and Wastes (USEPA, 1979). UM-WRECL.

Extractable Soil Inorganic Nitrogen

Extractable soil N was determined from 5 g air dried soil samples shaken with 50 ml of 2M KCl for 1 hour. Extractable soil NH_4^+-N was determined colorimetrically with the induphenol blue procedure (Keeney and Nelson, 1982). Nitrate+nitrite nitrogen was determined by the sulfanilamide method after reduction to nitrite in a Cd-Cu column (Kenney and Nelson, 1982). VPISU - Agrn Lab.

SECTION 7

RESULTS AND DISCUSSION

MANURE ANALYSIS

Results of the broiler litter analysis are presented in Table 1. These data illustrate the variability that is characteristic of an unstable nutrient source such as animal manure. Samples 1 through 5 all came from plots comprising Set 3: sample 1 was a composite of subsamples from all three plots at the time of manure application; samples 2, 3, and 4 were composites of samples within individual plots collected 3 days after application at the time of testing. Sample 5 was collected at the time of testing, but from a small pile of manure that had been spilled outside of the plots.

Sample 6 was a composite of subsamples from plots in Set 2 at the time of manure application. Sample 7 was also a composite of subsamples from these plots collected one day later at the time of rainfall simulation. Similarly, Samples 8 and 9 were composites of samples from plots in Set 1 collected at the time of manure application and testing, respectively.

TABLE 1. BROILER LITTER ANALYSIS

Sample #	Description	N	P_2O_5	K_2O	Moisture	Dry Matter
		Per Cent				
1	Set 3 @ Application	3.7	3.6	2.6	14.3	85.7
2	Plot 7 @ Test time	3.1	2.4	1.8	16.2	83.8
3	Plot 9 @ Test time	2.1	2.7	1.8	17.7	82.3
4	Plot 8 @ Test time	2.8	3.1	2.0	18.7	81.3
5	Outside Set 3 @ Test	3.2	3.6	2.4	18.4	81.6
6	Set 2 @ Application	4.7	3.3	2.4	17.3	82.7
7	Set 2 @ Test time	3.1	3.0	2.1	5.7	94.3
8	Set 1 @ Application	3.5	3.1	2.2	12.5	87.5
9	Set 1 @ Test time	2.7	3.3	2.2	14.4	85.6

Table 2 translates the nutrient values reported in Table 1 into mass values based on the application of 8.9 t/ha (4 t/ac), the rate used in this study.

All samples exhibited expected behavior of surface applied poultry litter, i.e a reduction in nitrogen content due primarily to atmospheric volatilization of ammonia N. However, sample 5 illustrated the effect that decreased direct exposure of litter to the atmosphere has on volatilization losses. Sample 5 came from a small mound of litter, whereas all other samples were composites of subsamples from litter spread thinly and uniformly over the various plots. For computational purposes, samples 2, 3, 4, 7, and 9 were used to determine the mass of applied nitrogen available for transport during runs 7 - 12.

TABLE 2. MASS NITROGEN APPLICATION FROM BROILER LITTER

Sample #	Description	N Content kg/t	Appl. Rate kg/ha	Mass N Applied kg
1	Set 3 @ Application	37.2	331.5	4.0
2	Plot 7 @ Test time	31.2	277.8	3.4
3	Plot 9 @ Test time	21.1	188.2	2.3
4	Plot 8 @ Test time	28.2	230.9	2.8
5	Outside Set 3 @ Test	32.2	286.7	3.5
6	Set 2 @ Application	47.3	421.1	5.1
7	Set 2 @ Test time	31.2	277.8	3.4
8	Set 1 @ Application	35.2	313.6	3.8
9	Set 1 @ Test time	27.2	241.9	2.9

SIMULATOR PERFORMANCE

The rainfall simulator gave excellent performance, having uniformity coefficients (a measure of how uniformly rainfall was distributed over the plots) in excess of 90% the majority of the time. The mean uniformity coefficient was 0.92, with a standard deviation of 0.03. Table 3 summarizes performance data reported in Table B-1, Appendix B.

Mean amounts of applied precipitation were very near design values for most runs, especially those of 1/2 hour duration (Runs 2, 3, 5, 6, 8, 9, 11, & 12). Data in Table 3 for runs 4 and 10 reveal what are apparently unacceptable variances in precipitation. The apparent poor performance during run 4 was due to difficulties encountered during tests involving Set 1 and Set 2. On days previous to tests involving those plots a delay in schedule prevented the simulator reservoir from being filled to a capacity that would permit a full 1-hour run. Consequently, Run 4 for Plots 1, 2 & 3 was 45 minutes in duration, rather than the desired 1 hour. Run 4 for Plots 4, 5, and 6 was also 45 minutes in length because of a lack of sample bottles to continue runoff sampling for the full time that runoff would have occurred in a 1-hour test. Run 10 for Plots 4, 5, and 6 was also only 45 minutes long due to a lack of supply water. Despite the abbreviated duration for these tests, the rate of application was comparable to that for full duration tests.

TABLE 3. RAINFALL SIMULATOR PERFORMANCE

Run	Precipitation Applied, mm			Uniformity Coefficient		
	Average	Std. Dev.	Var.	Average	Std. Dev.	Var.
1	46.70	2.08	4.33	0.92	0.02	0.0006
2	24.31	1.28	1.63	0.90	0.05	0.0021
3	24.14	1.16	1.35	0.92	0.03	0.0008
4	39.68	7.13	50.89	0.90	0.03	0.0009
5	24.32	1.19	1.41	0.91	0.02	0.0003
6	24.19	0.94	0.89	0.93	0.02	0.0003
7	45.32	2.63	6.89	0.93	0.02	0.0005
8	25.15	2.14	4.60	0.89	0.08	0.0062
9	24.23	0.58	0.34	0.92	0.02	0.0004
10	41.86	7.06	49.91	0.92	0.02	0.0006
11	24.17	0.75	0.57	0.92	0.02	0.0005
12	24.71	0.90	0.82	0.93	0.02	0.0004

HYDROLOGIC RESPONSE

Expected Performance

Theoretically, increasing slope has the effect of increasing runoff from a given area, if all other runoff-affecting conditions (e.g. antecedent moisture, vegetative cover, etc.) are the same. In addition, the presence of vegetation on all or part of an area would be expected to decrease the volume of runoff roughly in proportion to the percentage of area vegetated. Longer slope lengths tend to increase runoff above that produced with shorter slope lengths.

Soil condition, both in a physical sense and with respect to moisture content, also affects runoff potential from an area. For example, areas that have been freshly cultivated generally have a larger capacity to infiltrate incident precipitation than uncultivated areas whose surface may have become sealed (or armored) by previous storm events. Likewise, soils of any given type with lower moisture contents have more unfilled pore space available for infiltrating precipitation than do the same soils with higher soil moisture. The former would thus be expected to produce less runoff than the latter for a given amount of precipitation.

In the study reported herein, Plots 3, 6, and 9 (bare plots) might be expected to produce the most runoff, whereas Plots 1, 4, and 7 (those with the most vegetation) might be expected to produce the least, in any given slope category. Similarly, all plots in a given slope category would be expected to produce increasing amounts of runoff as tests proceeded through runs 1, 2 and 3; 4, 5 and 6; 7, 8 and 9; and 10, 11 and 12. A marked decrease in runoff from all plots between runs 6 and 7 would be expected since at this point all plots were recultivated for initiation of experiments with the broiler litter.

Observed Results

Data describing several characteristics of runoff from the vaious plots are presented in Table 4, as summarized from Table B-2, Appendix B. Unfortunately, not included in these values are results from Plot 3 (bare) during run 7, which due to an equipment malfunction were not available.

Several trends, each of which is indicative of the effect of filter strip width on runoff, are evident from the summary in Table 4. Firstly, it is apparent that increasing filter width increased lag time, i.e. slowed runoff. (Lag time was taken as the time between initiation of rainfall and the appearance of runoff.) This is intuitive considering that vegetation in the strip should increase resistance to flow.

Lag time during runs using broiler litter increased in all categories over that experienced using liquid N. This was likely due to the mulching effect of the litter, and to the "damming" of flow channels through the filters by wood chips contained in the litter. (Obviously the latter effect was not important in the plots with no filters.) The fact that all plots were recultivated before tests involving broiler litter probably also contributed to the increased lag times. Also evident from Table 4 is the effect that continued precipitation had in reducing lag times; i.e. as soil moisture and surface sealing increased, the time for runoff to occur decreased.

The same trends are demonstrated in duration times (length of time runoff occurred) and the amount of runoff that occurred in these tests. (To help normalize runoff data, they have been presented in Table 4 as a fraction of the applied precipitation.)

The data indicate that as filter strip width increased, duration of runoff increased as did the proportion of rainfall that was runoff. These trends were demonstrated during tests with both nitrogen sources, but with broiler litter, magnitudes were reduced from those experienced during liquid N runs.

TABLE 4. SUMMARIZED RUNOFF CHARACTERISTICS

Ave. Ppt[1],mm	Filter Width,m	N Source	Lag[2],min Ave.	Lag[2],min S.D.	Duration[3],min Ave.	Duration[3],min S.D.	% of Ppt[4] Ave.	% of Ppt[4] S.D.
Initial 1-Hour Runs								
42.85	9.2	UAN	4.88	2.09	67.17	4.52	43.26	15.08
42.73	9.2	BL	11.97	4.30	65.33	11.04	33.68	19.90
43.46	4.6	UAN	2.25	0.38	71.50	7.18	62.52	13.28
43.83	4.6	BL	7.17	4.55	70.67	12.61	40.16	20.86
43.25	0.0	UAN	1.50	0.41	72.17	9.44	73.43	20.55
44.22	0.0	BL	3.98	3.82	72.33	5.50	43.78	23.81
1st 0.5-Hour Runs								
24.50	9.2	UAN	4.23	2.61	43.33	3.99	48.89	11.74
24.76	9.2	BL	6.25	1.46	47.67	3.04	47.34	13.45
24.79	4.6	UAN	2.72	1.56	51.50	6.08	75.34	12.14
25.15	4.6	BL	6.72	3.77	52.17	6.84	59.28	13.64
23.70	0.0	UAN	1.38	0.74	53.00	4.06	73.22	15.74
24.08	0.0	BL	2.53	1.20	44.67	6.50	60.56	13.41
2nd 0.5-Hour Runs								
23.44	9.2	UAN	2.92	1.20	50.00	1.83	65.64	12.07
24.72	9.2	BL	5.58	1.64	51.83	1.34	64.88	11.45
24.54	4.6	UAN	1.83	0.85	56.33	6.94	88.32	9.39
24.39	4.6	BL	4.50	2.42	56.50	6.70	74.61	12.73
24.53	0.0	UAN	1.00	0.00	48.83	2.27	80.17	14.09
24.30	0.0	BL	1.25	0.38	53.83	13.73	67.06	18.09

[1] Ave. Ppt - average amount of simulated rain
[2] Lag - time between start of rain and start of runoff
[3] Duration - duration of runoff
[4] % of Ppt. - ratio of runoff amount to rainfall amount
UAN - urea-ammonium-nitrate (liquid nitrogen)
BL - broiler litter

When examining individual hydrologic responses, data in Table B-2 indicate that Plots 4, 5 and 6 (on 3% slope) exhibited expected runoff behavior better than the other groups of plots. Runoff response of Plot 6 might be higher than expected (at nearly 100% of applied precipitation) during runs 1 through 6. Progressively more runoff from Plot 6 during runs 7 through 12 would be the more "expected" response. Surface sealing and/or soil saturation apparently occurred quickly on Plot 6 in runs 1 through 6. Perhaps the organic matter (wood chips and manure particles) in the chicken litter acted as a mulch and helped obscure at least the sealing effects in runs 7 through 12.

The decrease in runoff (Table B-2) from all plots on 3% slope between runs 6 and 7 is also very evident and likely the result of both cultivation of the bare source areas and decreased soil moisture contents. "Recovery" of infiltration capacity between runs 3 and 4 and between runs 9 and 10 (the one-week waiting periods between tests) is also observable for the grassed plots (Plots 4 and 5). As expected, runoff from plots with vegetated filters (Plots 4 and 5) was lower than from the plot with no filter (Plot 6).

In the other slope categories, the bare plots with no filters (Plots 3 and 9) performed basically as expected with increasing runoff as more and more precipitation was applied, although trends were less clearly defined than for the 3% plots. What is more interesting in the 4% and 5% slope categories, however, is that the plots with filters on occasion produced as much or more runoff as the bare plots with no filters. This seemingly incongruous result may reflect higher soil moisture contents in the grassed filters, effectively limiting infiltration and increasing surface runoff above that generated on totally bare plots.

SURFACE LOSSES OF NUTRIENTS

Although approximately 20 discrete runoff samples were collected from each plot in a typical 1-hour test (10 for a 0.5-hour test), laboratory constraints restricted the number of these that could be analyzed to approximately 5 per test. Decisions regarding which samples to analyze were made by examining the accompanying hydrograph, and selecting samples which corresponded to early and late in the runoff event, and at marked changes in runoff rate at intermediate times. Table B-3 in Appendix B contains results of all chemical analyses. Linear interpolation was used to estimate pollutant concentrations at other times during the runoff event for purposes of calculating mass loadings. Observations of analyses for samples taken at a variety of times during runoff suggest that the approach for calculating mass losses in runoff was conservative.

Table 5 contains an abbreviated summary of data presented in Table B-4, Appendix B for nutrient and suspended solids losses in runoff. Not included in these data are results from Plot 3, runs 7 and 8. The hydrograph was not available for run 7 because of an equipment malfunction. Samples from run 8 for nutrient analysis were lost at some time before analysis was performed and thus no nutrient data were available. Nevertheless, several trends are indicated in this summary.

TABLE 5. SURFACE RUNOFF LOSSES OF NUTRIENTS AND SOLIDS

Ave. Ppt[1],mm	Filter Width,m	N Source	Total P[2],gms Ave.	Total P[2],gms S.D.	Total N[3],gms Ave.	Total N[3],gms S.D.	TSS[4],gms Ave.	TSS[4],gms S.D.
Initial 1-Hour Runs								
42.85	9.2	UAN	20.23	12.02	16.38	9.56	5431	4021
42.73	9.2	BL	18.73	8.96	32.63	16.18	1870	1406
43.46	4.6	UAN	28.50	7.73	57.89	49.92	12243	8512
43.83	4.6	BL	19.88	14.11	30.23	17.83	3639	3756
43.25	0.0	UAN	44.01	12.31	42.80	14.29	70827	78676
44.22	0.0	BL	29.00	15.20	32.91	24.96	9454	5013
1st 0.5-Hour Runs								
24.50	9.2	UAN	14.10	10.74	12.30	5.04	3157	1595
24.76	9.2	BL	13.85	10.50	20.63	11.05	1919	2426
24.79	4.6	UAN	14.74	9.60	21.97	11.61	4966	2643
25.15	4.6	BL	20.17	22.42	30.37	14.68	4195	5413
23.52	0.0	UAN	22.35	15.14	30.69	16.77	16220	6379
24.22	0.0	BL	22.50	12.59	28.35	18.09	6623	2307
2nd 0.5-Hour Runs								
23.44	9.2	UAN	11.29	5.05	11.22	7.39	5214	4719
24.72	9.2	BL	12.94	7.63	21.79	10.30	2676	2499
24.54	4.6	UAN	12.46	6.26	13.80	5.76	13143	16205
24.39	4.6	BL	18.12	8.88	39.41	17.70	4652	4568
24.53	0.0	UAN	20.03	11.74	21.14	9.38	13654	4522
24.30	0.0	BL	24.52	4.44	40.27	27.16	8318	2569

[1] Ave. Ppt - average amount of simulated rain
[2] Total P - total phosphorus in runoff
[3] Total N - total nitrogen in runoff
[4] TSS - total suspended solids in runoff
UAN - urea-ammonium-nitrate (liquid nitrogen)
BL - broiler litter

General Trends

Losses of phosphorus were higher from the initial 1-hour and first 0.5-hour tests involving UAN, than they were for the corresponding tests involving broiler litter (except for the 4.6 m plots). At first this might appear unusual, considering that no phosphorus was applied with the UAN, but that the broiler litter did contain P. The higher losses of P during the UAN tests are probably explained by the fact that the losses of suspended solids (and presumedly, attached P) were also much greater for the UAN tests than for those involving broiler litter. Total P losses for the second 0.5-hour runs were somewhat comparable for both UAN and broiler litter tests, with those from the litter tests being slightly greater. Suspended solids losses were not as different in tests with the two nutrient sources during these runs as during the previous two sets of runs, a fact that may have influenced the relationship between P losses. Also evident from data in Table 5 is the fact that P losses generally decreased with increasing filter strip length. Losses of total P also diminished as the number of tests progressed.

The relationship between total nitrogen losses in tests involving UAN and broiler litter was not as clear as for total P losses. Overall, it appeared that total N losses decreased with increasing filter strip width, however. An exception to this general trend occurred during the 1-hour runs involving UAN and 4.6 m (15 ft) filters. Otherwise, during UAN tests, average mass losses from plots with 9.2 m (15 ft) filters were approximately half those from plots with no filters. As with total P, total N losses generally decreased as the number of tests performed increased, indicating probably that less material was available for transport.

For the experimental design used in this study, a mass loss of 10 gms represented an areal loss of 0.84 kg/ha (0.75 lb/ac). Thus total P losses from bare plots from all runs involving UAN amounted to 7.3 kg/ha (6.5 lb/ac); total N losses were 7.9 kg/ha (7 lb/ac). For the entire testing period (losses from UAN plus broiler litter), total P losses for bare plots equalled 13.7 kg/ha (12.2 lb/ac) and total N losses equalled 16.4 kg/ha (14.6 lb/ac). By comparison, total P losses from plots with 9.2 m (15 ft) filter strips amounted to 7.7 kg/ha (6.8 lb/ac) and total N losses were 9.7 kg/ha (8.6 lb/ac). These losses were produced by approximately 1/4 of the total annual precipitation expected at the research site. (This does not mean, however, that annual losses would be expected to be 4 times higher than those reported here.)

Also clearly evident in the data presented in Table 5 is the large variability that occurred in nutrient and solids losses in runoff. Thus, trends indicated by average values such as those presented in Table 5 were often violated in individual situations.

Plots 4, 5, & 6

As expected, total nitrogen losses from the bare plot (Plot 6) decreased as runs 1, 2 and 3 progressed, indicating less material was perhaps available for movement from the site. During runs 3, 4, 5 and 6, total N losses seemed to be approximately constant at 25-30 gms (2.1 - 2.5 kg/ha). Losses of total N during runs 7 through 12 paralleled runoff. Values indicated that a large amount of broiler litter was leaving the site. Most of the nitrogen was probably in the organic form since ammonium-N losses were decreasing.

Losses of nitrogen from plots protected by filters seemed to be increasing as runs progressed from 1 to 3, which may have indicated a movement of trapped material from the filter. This observation seems to be supported by the fact that soluble phosphorus values decreased for these plots while total phosphorus losses remained constant.

In most cases the plots with filters appeared to be effective in reducing total phosphorus and nitrogen losses as compared to the bare plot control.

Plots 1, 2, 3, 7, 8, & 9

Nitrogen losses from these plots appeared more erratic that those from the 3% plots (Table B-4). In general these losses seemed to be a function of the filter condition. The relatively large losses of nitrogen from the vegetated plots indicates that surface runoff was probably "short-circuiting" the filters, because of less-than-perfect sheet flow, and/or because of variations in the density of the filter vegetative growth. In fact, both conditions were observed during the tests.

Total phosphorus losses were also erratic, but in general followed similar trends as total nitrogen losses. The weak trend of decreasing losses as a function of increasing run number indicated that less and less material was available for loss as tests proceeded. Nevertheless, the vegetated plots on these two slopes were not generally effective in reducing soluble nutrient losses (although the magnitude of such losses was relatively small).

SUSPENDED SOLIDS LOSSES

Also presented in Table 5 are data summarizing losses of suspended solids. Generally there were dramatic differences in the mass of solids lost between bare plots and plots protected by vegetated filter strips, losses from bare plots being much greater. Except for the plots with no filters, TSS losses during the initial 1-hour runs and the second 0.5-hour runs were comparable. High initial losses probably reflected the fact that all plots were in a loose, highly erodible, cultivated state at the beginning of the 1-hour tests. High losses in the final 0.5-hour runs were probably caused by the increased proportion of runoff that occurred in the later runs. These patterns may also have reflected the movement of sediment further and further into the VFS until a portion was finally released in the final test. That these trends were in contrast to those for total N and P seemed logical since presumedly only larger, relatively non-reactive soil particles were detained in the VFS.

There was also a marked difference in mass loss of solids in tests involving UAN as opposed to broiler litter. Except for the 4.6 m filter strip plots during the first 0.5-hour runs, TSS losses from UAN tests were 3-4 or more times as large as losses from tests involving broiler litter. This probably reflected the mulching effect of the litter.

RELATIVE SURFACE LOSSES FROM VEGETATED VS. BARE PLOTS

Table 6 contains summary data regarding the relative losses of nutrients and solids in surface runoff from plots with vegetated filters as compared to losses from plots with no filters. Relative losses are expressed as "performance ratios", PRs, defined as the ratio of mass losses from a plot protected by a VFS to losses from the bare plot on the same slope. Because runoff data were not available for run 7, Plot 3, and no nutrient analyses were available for run 8, Plot 3, direct comparisons were not possible for Set 1 during runs 7 and 8. Data for individual plots are presented in Table B-5, Appendix B.

Data in Table 6 represent an average of individual "run-by-run" VFS performance ratios. These data are thus an average of 12 (or in some cases 10, due to the exclusion of data for runs 7 and 8 for some plots) individual performance ratios. Consequently, performance data in Table 6 tend to reflect test-to-test variability in plot behavior.

Data in Table 6 suggest that plots with filter strips may experience larger losses in surface runoff of some pollutants than comparable areas not protected by VFS. This is certainly true on an event-by-event basis, as shown in Table B-5, Appendix B. As observed during the simulation runs, suspended solids were carried into the filters, and in some cases, flushed out. When flushing occurred, mass losses were sometimes greater than for bare control plots. Graphs in Appendix C (e.g. Figure C-1) illustrate this phenomenon and indicate that the performance of the grassed filter strips in reducing nutrient losses as compared to the performance of nonvegetated plots is variable.

When evaluating data in Table 6, however, the possible natural variation in surface losses from adjacent areas should be kept in mind (see earlier discussion under "Experimental Design"). One should also remember that these summary data are somewhat biased, due to the absence of mass loss values from Plot 3 for runs 7 and 8. Since Plot 3 was a bare plot, with normally high nutrient and sediment losses, exclusion of data regarding that plot tends to make Plots 1 and 2 appear less effective than they may actually have been.

TABLE 6. RELATIVE NUTRIENT AND SOLIDS LOSSES FROM VFS PLOTS[1]

Plot	Filter Width, m		Average Performance Ratios[2] TSS	Total N	Total P
1	9.2		20.39	48.59	125.04
4	9.2		10.78	53.87	41.93
7	9.2		43.69	78.41	78.99
		Mean	24.95	64.62	80.12
2	4.6		35.19	177.29	200.61
5	4.6		33.62	64.36	40.69
8	4.6		75.12	112.95	66.35
		Mean	47.65	115.18	94.36

[1]Excludes data for runs 7 and 8, Plot 3

[2]Average of PRs (e.g. $\frac{\text{mass lost, Plot 1, Run 1}}{\text{mass lost, Plot 3, Run 1}}$) from 12 runs

Data in Table 7 lend assistance in interpreting Table 6 and reflect plot performances for the entire series of tests. These data are cumulative mass losses and corresponding performance ratios from all tests. Relative to data in Table 6, those in Table 7 can be thought of as a representation of "long term" VFS performance.

Additionally, Table 7 presents two different attempts to eliminate the bias in plot performance ratios for Set 1 (Plots

1,2, and 3) caused by missing data from runs 7 and 8 for Plot 3. One technique ignores (excludes from the summation process) mass losses measured from runs 7 and 8 for Plots 1 and 2. Thus, for example, the reported total N and P losses for Plots 1 and 2 using this procedure were the summation of losses from runs 1 - 6 and runs 9 - 12. TSS data were treated similarly, but only losses from run 7 were excluded (because TSS data were available from run 8 for all plots).

TABLE 7. MASS LOSSES OF NUTRIENTS AND SOLIDS IN RUNOFF

Plot	Filter Width,m	+++++Mass Lost From All Tests and PRs (%)++++++ TSS gms	PR[1]	Total N gms	PR	Total P gms	PR
1	9.2	19832	19.5	147.2	61.8	139.0	67.9
		19240[a]	18.9	98.1[b]	41.2	112.1[b]	54.7
			6.1[c]		31.4[c]		36.1[c]
2	4.6	30221	29.7	462.5	194.1	235.0	114.8
		29340[a]	28.8	398.8[b]	167.0	208.8[b]	101.9
			9.3[c]		98.5[c]		61.1[c]
3	0.0	101782[a]		238.3[b]	204.8[b]		
		324396[c]		469.4[c]	384.9[c]		
4	9.2	19799	5.3	231.1	48.6	151.1	38.8
5	4.6	84321	22.7	246.9	51.9	164.4	42.2
6	0.0	372216		475.8	389.9		
7	9.2	81979	29.6	311.4	67.3	256.7	67.6
8	4.6	142488	51.5	452.6	97.8	283.8	74.7
9	0.0	276577		462.9	379.9		
Ave.	9.2		18.1		59.2		58.1
			17.9[a]		52.4[b]		53.7[b]
			13.7[c]		49.1[c]		47.5[c]
Ave.	4.6		34.6		114.6		77.2
			34.3[a]		105.6[b]		72.9[b]
			27.8[c]		82.7[c]		59.3[c]

[1]Ratio of filtered plot loss to that of bare plot loss in set
[a]Excluding data from run 7, plot 3
[b]Excluding data from run 7, plot 3 and run 8, plot 3
[c]Assuming plot 3 losses are average of plot 6 and plot 9 losses

The second, and probably more representative, procedure assumes that total mass losses from Plot 3 would have been comparable to those from Plots 6 and 9 (also bare), had data for all 12 runs been available from Plot 3. Thus, using this assumption, mass TSS, TN and TP losses for Plot 3 were calculated as the average of corresponding losses from Plots 6 and 9.

Performance ratios in Tables 6 and 7 indicate that plots with vegetated filter strips generally were somewhat effective in reducing surface losses of both nutrients and solids, as compared to losses from plots with no filters. Additionally it appears that greater reductions were achieved as filter strip width increased. Assuming that Plot 3 produced mass losses comparable to those from Plots 6 and 9, data in Table 7 suggest that doubling the width of filter produced a twofold increase (i.e. a twofold decrease in PRs) in the amount of suspended solids (sediment) retained.

Percentage mass reductions (defined as PMR = 100 - PR) in Table 8 were calculated from the average performance ratios (PRs) in Table 7. These figures represent pollutant mass reductions achieved by VFS using the various assumptions regarding Plot 3 losses described above. As indicated above, VFS appeared most effective in reducing solids (i.e. sediment) losses. Presumedly this occured as a result of the filters slowing down the velocity of runoff and also of providing a physical impediment to the movement of suspended material in the runoff, both actions promoting settling of the suspended soil particles. Total P was reduced to the next greatest degree; total N was least reduced. Both of these trends were expected based on the assumption that P movement is generally dependent on suspended solids transport, whereas N, as a soluble nutrient, can move more freely in the terrestrial environment.

TABLE 8. AVERAGE PERCENTAGE MASS REDUCTIONS (PMRs) IN BARE PLOT LOSSES ACHIEVED BY VFS

Filter Width, m	++Percent Reductions[1] in Bare Plot Losses++		
	TSS	Total N	Total P
9.2	81.9[a]	40.8[b]	41.9[b]
	82.1[b]	47.6[b]	46.3[b]
	86.3[c]	50.9[c]	52.5[c]
4.6	65.4[a]	-14.6[b]	22.8[b]
	65.7[a]	-5.6[b]	27.1[b]
	72.2[c]	17.3[c]	40.7[c]

[1] Percent Mass Reduction, PMR = (100 - PR), using average PRs from Table 7
[a] Excluding data from run 7, plot 3
[b] Excluding data from run 7, plot 3 and run 8, plot 3
[c] Assuming plot 3 losses are average of plot 6 and plot 9 losses

Table 9 summarizes mass pollutant losses from bare plots on an areal basis (extracted from Table 6) and the projected losses from plots protected by VFS using PMRs from Table 8. In calculating areal losses, the conversion (for these experimental conditions) of 10 gms mass lost = 0.84 kg/ha (0.75 lb/ac) was used.

TABLE 9. MASS LOSSES (AREAL BASIS) OF NUTRIENTS AND SOLIDS IN RUNOFF

Plot	Filter Width,m	+++++ Mass Lost From All Tests (Bare Plots) ++++ TSS kg/ha	TSS lb/ac	Total N kg/ha	Total N lb/ac	Total P kg/ha	Total P lb/ac
3	0.0	8850[a]	7634[a]	20.0[b]	17.9[b]	17.2[b]	15.4[b]
		27249[c]	24329[c]	39.4[c]	35.2[c]	32.3[c]	28.9[c]
6	0.0	31266	27916	40.0	35.7	32.8	29.2
9	0.0	23233	20743	38.9	34.7	31.9	28.5
Average[c]		27250	24330	39.4	35.2	32.3	28.9
		+++++ Mass Lost From All Tests (VFS Plots)[d] ++++					
	9.2	3733	3333	19.3	17.3	15.3	13.7
	4.6	7576	6764	32.6	29.1	19.2	17.1

[a]Excluding data from run 7, plot 3
[b]Excluding data from run 7, plot 3 and run 8, plot 3
[c]Assuming plot 3 losses are average of plot 6 and plot 9 losses
[d]Projected losses using assumption "c" and average PMRs from Table 8

Table 9 simply presents surface losses of pollutants in more familiar mass terms. When viewed from this perspective, VFS appear especially effective in reducing suspended solids losses in runoff. As indicated in in Table 9, VFS 4.6 m and 9.2 m wide (15 ft and 30 ft) reduced suspended solids (primarily sediment) losses from an average of 27 t/ha (12 t/ac) to approximately 7 t/ha (3.3 t/ac) and 3.7 t/ha (1.6 t/ac), respectively.

SUBSURFACE LOSSES OF INORGANIC NITROGEN

Table 10 summarizes data presented in Tables B-6 and B-7, Appendix B concerning the movement of inorganic nitrogen into the soil profile to a depth of 125 cm (48 in). These data reflect leaching of nitrogen during tests involving UAN (runs 1 - 6).

TABLE 10. MASS CHANGES IN SOIL INORGANIC NITROGEN

Plot	Filter Width, m	Total Infil. mm	Total Plot Inorganic N, kg Before	After	Net Change kg	%
1	9.2	101.98	2.01	2.15	0.14	6.97
2	4.6	66.44	0.59	1.75	1.16	196.61
3	0.0	73.02	0.66	1.71	1.05	159.09
4	9.2	98.33	1.41	2.19	0.78	55.32
5	4.6	52.57	1.34	3.68	2.34	174.63
6	0.0	2.86	1.95	1.66	-0.29	-14.87
7	9.2	66.22	1.60	2.75	1.15	71.87
8	4.6	32.25	1.89	2.61	0.72	38.10
9	0.0	58.94	1.31	2.50	1.19	90.84
Ave.	9.2	88.84	1.67	2.36	0.69	44.72
Ave.	4.6	50.42	1.27	2.68	1.41	136.45
Ave.	0.0	44.94	1.31	1.96	0.65	78.35

Inorganic N increased in the profile of all plots except one (Plot 6) during tests with UAN. No obvious trends are reflected in Table 10, however. On average, it appeared that increased VFS widths increased infiltration, yet the relationship did not extend to increased nitrogen leaching. If such did occur, however, the trend might have been masked by uptake of nitrogen by the vegetation in the VFS. Crop uptake of N was not measured but data in Table B-7, Appendix B suggest that for certain plots (Plots 1 and 2), crop uptake was significant.

Table B-7 in Appendix B also reveals that inorganic N increases, expressed on an areal basis, were greatest in the bare areas of each plot (up to twice the original N content). Conversely, increases in the filter areas were a maximum of approximately 50% of original N content. This would seem to support the notion that VFS can help minimize subsurface losses of nitrogen despite the fact that they do tend to increase infiltration. Likewise, leaching losses would probably have been less in the bare source areas had a crop been actively growing there.

Figures C-10 through C-27 in Appendix C illustrate the variable nature of nitrogen leaching in the different plots. A common trend exhibited, however, was a large increase in nitrate levels in the upper profile.

COMBINED SURFACE AND SUBSURFACE N LOSSES

The combined effect of surface and subsurface nitrogen losses from all plots during tests with UAN is presented in Table 11.

TABLE 11. COMBINED N LOSSES, RUNS 1-6

Plot	Filter Width,m	Runoff mm	Infiltration mm	Total N Lost, gms Surface	Leaching	Combined
1	9.2	72.50	52.57	47.2	140.0	187.2
2	4.6	116.20	66.44	257.0	1160.0	1417.0
3	0.0	103.85	73.02	131.2	1050.0	1181.2
4	9.2	72.78	98.33	90.9	780.0	870.9
5	4.6	126.53	52.57	112.3	2340.0	2452.3
6	0.0	177.98	2.86	211.2	-290.0	- 78.8
7	9.2	132.90	66.22	101.3	1150.0	1251.3
8	4.6	162.86	32.25	192.6	720.0	912.6
9	0.0	138.06	58.94	225.4	1190.0	1415.4

Two trends are apparent from data in Table 11. Firstly, where surface (i.e. runoff) losses of nitrogen were concerned, increased filter width resulted in decreased losses, as compared to losses from plots with no VFS. Secondly, and perhaps more importantly, subsurface (i.e. leaching) losses of N far outweighed surface losses, and did not appear to be related to VFS width. That subsurface losses were the dominant pathway for N transport from plots was somewhat expected, considering that runoff occurs only after infiltration and surface detention have been satisfied by precipitation. It is assumed that as infiltration procedes, soluble nitrogen is taken into the profile, reducing the amount available for surface transport.

MATHEMATICAL MODELING OF VFS PERFORMANCE

A variety of factors are presumed to influence the ability of vegetated filter strips to remove pollutants from agricultural runoff. Some of the more important of these include:

1. Characteristics of pollutants
2. Physical characteristics of vegetation in filter

3. Hydrologic characteristics of soils and vegetation in filter and area generating runoff (source area)
4. Topographic features of source area and filters
5. Relative sizes of source and filter areas
6. Precipitation characteristics
7. Antecedent soil moisture.

Any mathematical description of VFS performance should consider most of these. The extent to which these variables are actually incorporated, however, can affect the complexity of the resulting model. A range of model formats can be adopted, extending from simplified empirical relationships to complex deterministic models. The simplified approach was favored in this study.

Test of Existing Models

Other researchers have attempted to develop simple models that predict pollutant reductions in runoff moving through vegetated strips. Westerman, Overcash and Bingham (1983) reduced the number of variables considered in their analytically derived model of the form:

$$P_m = 100\ \{1 - (1+K)e^{(1/(1+D))\ln(1/(1+K))}\} \qquad \text{(Eq. 1)}$$

where:

P_m = percent reduction in pollutant mass
K = ratio of filter width (downslope) to source area slope length
D = ratio of infiltration rate to rainfall rate.

This model was developed for animal waste application sites where both the application (source) and filter area were vegetated.

Table B-8 in Appendix B shows results of applying this model in this study in which the source areas were not vegetated. The data base used included those runs in which observed pollutant reductions were in a believable range. On average, predicted reductions in total P and total N matched observed reductions fairly well. The model was not able to predict the negative reductions (i.e. increases) that were observed during several runs. The model did not predict observed TSS reductions very well.

Young, Otterby, and Roos (1982) developed an empirical relationship to predict reductions in phosphorus concentrations in runoff from animal waste application sites as it moved through vegetated areas. The reductions were based on the "contact time" of runoff with the grassed area. Contact time was a function of both slope and condition of the vegetated cover. The model took the form:

$$D_P = -49.3 + 50.5 \log T_C \qquad \text{(Eq. 2)}$$

where

D_P = percent reduction in phosphorus concentration
T_C = contact time in seconds.

Table B-9, Appendix B compares predictions made with this model to observed reductions in total N and P and in TSS. As with the model of Westerman, Overcash and Bingham (1983), this model predicted average reductions in total P and N that were in the range of observed reductions. Two conditions were tested: a) a "good" filter condition, i.e. more than 75% vegetative cover, and b) a "fair" filter condition, which assumed between 50% and 75% vegetative cover in the filter area. As with the Westerman model, though average reductions were similar to observed values, increases in pollutant mass were not predicted. Reductions in TSS were not predicted well.

Development of Linear Model

An effort was made to include more variables in an empirical model in hopes of predicting TSS reductions better than both the Westerman and Young models. Multiple linear regression was used to keep the resulting relationship as simple as possible. Independent variables considered were antecedent soil moisture in the bare source area, ratio of filter width to source area slope length, plot slope and runoff rate per unit width of of plot.

From the data base consisting of results from all tests, those runs which a) had reasonable observed pollutant reductions and b) data for all four independent variables were selected for developing the model. The data base thus included a range of one-hour and half-hour test results. (This same data base was used for the Westerman and Young models.)

The analysis resulted in relationships with unacceptably low correlation coefficients. As demonstrated by these very low correlation coefficients, the equations were worthless for predictive purposes. After considering that the data base used for the analysis included results of tests in which an abnormal amount of rainfall was applied in a very short period of time, a more realistic data base was developed that only included data for the 1-hour tests. These tests were made at approximately 1-week intervals and were thought to be more representative of natural events.

Regression equations developed using the revised data base had much-improved, but still unacceptable, correlation coefficients. That the correlation coefficients were much improved in the revised analysis, however, indicated that the variables investigated became less important as the frequency of precipitation events decreased. This may occur because of any number of factors (such as variable hydrologic response with increased precipitation), or because the model simply failed to adequately represent removal mechanisms.

In contrast to Equation 1 (Westerman model) and Equation 2 (Young model), linear regressions did predict TSS removals fairly well. Even so, correlation coefficients were not high, indicating that, as with, Equations 1 and 2, removal mechanisms were not adequately described. This is perhaps the most important result of the mathematical model analysis.

Neither of the linear regressions explicitly included variables that describe the erosion and sedimentation process. As evidenced by visual observations during the various tests, sediment deposition was an important removal mechanism both within and outside the filters. For example, ponding of runoff occurred at some point on virtually all plots at the interface between source area and VFS. During ponding, sedimentation of eroded soil particles occurred as indicated by changes in the topography of the bare areas at the VFS interface.

Likely, TSS removals, and perhaps some nutrient removals, occurring at this interface were somewhat independent of VFS width. In addition, measurements were not made during this study that would permit an allocation of pollutant removals to particular sites within the plot (i.e. within VFS or elsewhere). In retrospect, it is not surprising that regression equations based on data that ignore where pollutant removals occurred, would fail to adequately predict such removals. A much more complex model format based on an improved data base might be indicated.

INVESTIGATION OF EXISTING VFS

Vegetated filter strips are a best management practice eligible for cost-sharing under both the state supported Maryland Agricultural Cost Share (MACS) program at 87.5% of cost and the federal USDA Agricultural Cost-share Program (ACP) at 75% of cost. The estimated lifetime for VFS under both programs is 10 years.

Despite the financial incentives for implementation, very few VFS projects have been supported under the MACS program. For example of nearly 2,000 practices cost-shared between July, 1983 and June, 1986, only 5 were filter strips (Weismiller and

Magette, 1986). Statewide, in fiscal year 1985, only 25 ha (62 ac) of filter strips were included in agricultural conservation plans developed through Maryland soil conservation districts (Weismiller and Magette, 1986). Due to these facts, a formal onsite investigation of VFS in Maryland was not felt justified.

Informal surveys of vegetated filter strips on several Maryland farms, however, indicated that a wide range of conditions exist that would result in highly variable performance of VFS in removing pollutants from runoff. Chief among the conditions that would diminish VFS performance is the occurrence of concentrated flow at some point through most existing VFS. As discussed previously, VFS will perform best when runoff moves through the filters by sheet (thin, uniform) flow. Natural topographic features generally prevent this from occurring in actual practice. Variations in VFS management (e.g. mowing or no mowing), widths, type and density of vegetative cover (e.g. riparian or farmer-planted) were all observed and would affect performance.

SECTION 8

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APPENDIX A

SOILS DESCRIPTION

Horizon	Depth, cm	Description
Ap	0-22	Dark brown (10 YR 3/3) sandy loam; weak subangular blocky and platy structure; firable; abrupt, smooth boundry
BE	22-34	Dark yellowish brown (10 YR 4/6) sandy loam; weak subangular blocky structure; firable; clear smooth boundry
Bt1	34-51	Dark yellowish brown (10 YR 4/6) sandy clay loam; moderate subangular blocky structure; thin continuous clay films; friable; clear smooth boundry
Bt2	51-65	Dark yellowish brown (10 YR 4/6) sandy clay loam; moderate subangular blocky structure; thin discontinuous clay films; common distinct light brownish grey (2.5 YR 6/2) mottles; friable; clear smooth boundry
BC	65-70+	Yellowish brown (10 YR 5/6) loamy sand; weak subangular blocky structure; few patch clay films; many distinct light brownish grey (10 YR 6/2) mottles; very friable

Tentative Classification: typic hapludult, fine loamy, siliceous, mesic

Physiographic position: upland backslope
Drainage: moderately well drained
Vegetation: grasses
Parent material: coastal plain sediments
Notes: a few rounded gravels were found throughout the profile.

APPENDIX B

SIMULATOR PERFORMANCE, RAW CHEMICAL DATA, VFS PERFORMANCE, TEST OF VFS MODELS

TABLE B-1. RAINFALL SIMULATOR PERFORMANCE

RUN	PLOT	MO	DAY	UNIFORM COEFF	MEAN APP DEPTH (MM)
1	1	7	18	0.918377	45.06
1	2	7	18	0.881800	49.68
1	3	7	18	0.977424	47.82
1	4	7	18	0.923715	44.13
1	5	7	18	0.924187	44.43
1	6	7	18	0.914716	44.30
1	7	7	23	0.935117	47.46
1	8	7	23	0.914585	48.53
1	9	7	23	0.927674	48.87
			AVG	0.924177	46.70
			STD	0.023519	2.08
			VAR	0.000553	4.33
2	1	7	19	0.942788	23.28
2	2	7	19	0.935849	25.13
2	3	7	19	0.910401	22.52
2	4	7	19	0.912034	23.64
2	5	7	19	0.896723	24.11
2	6	7	19	0.897240	23.52
2	7	7	24	0.775390	27.11
2	8	7	24	0.914010	25.18
2	9	7	24	0.890925	24.26
			AVG	0.897262	24.31
			STD	0.046099	1.28
			VAR	0.002125	1.63
3	1	7	19	0.933911	23.47
3	2	7	19	0.915736	24.57
3	3	7	19	0.932605	23.24
3	4	7	19	0.912157	21.59
3	5	7	19	0.896063	25.81
3	6	7	19	0.852941	24.47
3	7	7	24	0.951540	24.93
3	8	7	24	0.953293	24.94
3	9	7	24	0.924084	24.26
			AVG	0.919147	24.14
			STD	0.029088	1.16
			VAR	0.000846	1.35

continued

TABLE B-1. (continued)

RUN	PLOT	MO	DAY	UNIFORM COEFF	MEAN APP DEPTH (MM)
4	1	7	25	0.871220	34.71
4	2	7	25	0.867268	33.82
4	3	7	25	0.839373	33.30
4	4	7	25	0.920195	34.80
4	5	7	25	0.904417	36.42
4	6	7	25	0.920133	35.12
4	7	7	30	0.918112	50.95
4	8	7	30	0.915641	47.85
4	9	7	30	0.935529	50.12
			AVG	0.899098	39.68
			STD	0.030250	7.13
			VAR	0.000915	50.89
5	1	7	29	0.919599	25.89
5	2	7	29	0.915369	25.45
5	3	7	29	0.888793	24.49
5	4	7	30	0.902365	22.20
5	5	7	30	0.892784	24.64
5	6	7	30	0.898770	22.37
5	7	7	31	0.924796	24.86
5	8	7	31	0.949406	24.23
5	9	7	31	0.925420	24.79
			AVG	0.913033	24.32
			STD	0.018191	1.19
			VAR	0.000330	1.41
6	1	7	29	0.943106	22.06
6	2	7	29	0.921268	23.86
6	3	7	29	0.901245	25.51
6	4	7	30	0.924396	24.76
6	5	7	30	0.905075	23.69
6	6	7	30	0.955828	25.00
6	7	7	31	0.932195	23.81
6	8	7	31	0.939680	24.37
6	9	7	31	0.945159	24.70
			AVG	0.929772	24.19
			STD	0.017392	0.94
			VAR	0.000302	0.89

continued

TABLE B-1. (continued)

RUN	PLOT	MO	DAY	UNIFORM COEFF	MEAN APP DEPTH (MM)
7	1	9	12	0.972566	42.96
7	2	9	12	0.957760	46.77
7	3	9	12	0.909972	45.85
7	4	9	10	0.892408	40.52
7	5	9	10	0.899584	44.72
7	6	9	10	0.930535	43.12
7	7	9	9	0.932262	47.43
7	8	9	9	0.927553	46.87
7	9	9	9	0.921531	49.68
			AVG	0.927130	45.32
			STD	0.024337	2.63
			VAR	0.000592	6.89
8	1	9	13	0.923796	23.08
8	2	9	13	0.913154	23.94
8	3	9	13	0.972509	24.64
8	4	9	11	0.932628	23.99
8	5	9	11	0.905823	24.62
8	6	9	11	0.962408	24.02
8	7	9	10	0.749789	28.13
8	8	9	10	0.748442	29.89
8	9	9	10	0.899648	24.05
			AVG	0.889799	25.15
			STD	0.078589	2.14
			VAR	0.006176	4.60
9	1	9	13	0.911394	23.93
9	2	9	13	0.916129	25.20
9	3	9	13	0.965812	24.77
9	4	9	11	0.906502	23.35
9	5	9	11	0.891822	24.50
9	6	9	11	0.923885	24.19
9	7	9	10	0.926493	24.76
9	8	9	10	0.916215	23.74
9	9	9	10	0.887743	23.60
			AVG	0.916221	24.23
			STD	0.021467	0.58
			VAR	0.000460	0.34

continued

TABLE B-1. (continued)

RUN	PLOT	MO	DAY	UNIFORM COEFF	MEAN APP DEPTH (MM)
10	1	9	19	0.926290	46.80
10	2	9	19	0.955319	47.75
10	3	9	19	0.900295	47.84
10	4	9	17	0.944357	32.26
10	5	9	17	0.935463	30.75
10	6	9	17	0.939961	32.79
10	7	9	16	0.897080	46.40
10	8	9	16	0.876453	46.14
10	9	9	19	0.940230	46.04
			AVG	0.923938	41.86
			STD	0.024938	7.06
			VAR	0.000621	49.91
11	1	9	20	0.900842	23.45
11	2	9	20	0.934831	24.11
11	3	9	20	0.886343	23.56
11	4	9	18	0.921372	25.67
11	5	9	18	0.957890	24.82
11	6	9	18	0.947570	24.83
11	7	9	17	0.910273	24.23
11	8	9	17	0.892910	23.49
11	9	9	17	0.942029	23.37
			AVG	0.921562	24.17
			STD	0.024058	0.75
			VAR	0.000578	0.57
12	1	9	20	0.935436	24.16
12	2	9	20	0.955319	25.42
12	3	9	20	0.897200	24.19
12	4	9	18	0.918712	26.64
12	5	9	18	0.962491	23.66
12	6	9	18	0.945985	24.43
12	7	9	17	0.910226	25.50
12	8	9	17	0.921970	23.84
12	9	9	17	0.940046	24.60
			AVG	0.931931	24.71
			STD	0.020297	0.90
			VAR	0.000411	0.82

TABLE B-2. HYDROLOGIC RESPONSE OF RUNOFF PLOTS

RUN	N SOURCE	PLOT	FILTER WIDTH M	DATE MO	DATE DAY	MEAN APP DEPTH (MM)	LAG (MIN)	DUR (MIN)	MOIS CONT %	MOIS CONT %	RUNOFF (MM)	INFILT (MM)	INFIL RATE (MM/HR)	INF RT TO RAIN RT	RUNOFF AS % OF PPT
1	UAN	1	9.2	7	18	45.06	8.00	70	9.55	11.15	9.566	35.494	30.42	0.68	21.23
1		4		7	18	44.13	2.50	69	9.67	10.35	14.368	29.760	25.88	0.59	32.56
1		7		7	23	47.46	7.00	70	10.00	11.90	24.806	22.658	19.42	0.41	52.26
4		1		7	25	34.71	3.30	65	12.34	12.48	14.966	19.747	18.23	0.53	43.11
4		4		7	25	34.80	3.00	58	10.89	15.90	14.292	20.506	21.21	0.61	41.07
4		7		7	30	50.95	5.50	71	10.79	12.91	35.310	15.642	13.22	0.26	69.30
					AVG	42.85	4.88	67.17			18.88	23.97	21.40	0.51	43.26
					STD	6.12	2.09	4.52			8.65	6.67	5.51	0.14	15.08
					VAR	37.42	4.38	20.47			74.76	44.54	30.40	0.02	227.30
7	Broiler	1	9.2	9	12	42.96	13.00	71	10.57	15.21	4.547	38.413	32.46	0.76	10.58
7	Litter	4		9	10	40.52	15.00	67	8.80	15.52	9.992	30.529	27.34	0.67	24.66
7		7		9	9	47.43	5.30	73	8.92	6.61	14.514	32.916	27.05	0.57	30.60
10		1		9	19	46.80	14.50	69	16.64	16.37	20.051	26.753	23.26	0.50	42.84
10		4		9	17	32.26	17.00	41	16.19	15.18	6.745	25.513	37.34	1.16	20.91
10		7		9	16	46.40	7.00	71	13.21	11.67	33.625	12.772	10.79	0.23	72.47
					AVG	42.73	11.97	65.33			14.91	27.82	26.37	0.65	33.68
					STD	5.27	4.30	11.04			9.79	7.94	8.28	0.28	19.90
					VAR	27.79	18.52	121.89			95.85	63.07	68.51	0.08	396.01
2	UAN	1	9.2	7	19	23.28	3.00	47	16.73	16.73	10.592	12.691	16.20	0.70	45.49
2		4		7	19	23.64	3.50	42	18.10	16.50	9.683	13.956	19.94	0.84	40.96
2		7		7	24	27.11	4.00	42	13.69	14.87	14.788	12.322	17.60	0.65	54.55
5		1		7	29	25.89	3.00	45	14.13	13.24	10.252	15.639	20.85	0.81	39.60
5		4		7	30	22.20	9.90	36	11.55	14.62	8.924	13.276	22.13	1.00	40.20
5		7		7	31	24.86	2.00	48	13.15	14.40	18.031	6.827	8.53	0.34	72.54
					AVG	24.50	4.23	43.33			12.05	12.45	17.54	0.72	48.89
					STD	1.65	2.61	3.99			3.27	2.73	4.48	0.20	11.74
					VAR	2.73	6.79	15.89			10.67	7.47	20.11	0.04	137.90
8	Broiler	1	9.2	9	13	23.08	6.00	46	22.19	16.74	8.229	14.851	19.37	0.84	35.65
8	Litter	4		9	11	23.99	9.00	47	21.54	17.56	9.384	14.611	18.65	0.78	39.11
8		7		9	10	28.13	5.00	52	22.18	16.58	17.146	10.980	12.67	0.45	60.96
11		1		9	20	23.45	7.00	43	19.70	16.49	9.449	14.004	19.54	0.83	40.29
11		4		9	18	25.67	4.50	47	19.04	17.66	9.590	16.081	20.53	0.80	37.36
11		7		9	17	24.23	6.00	51	16.96	22.39	17.131	7.101	8.35	0.34	70.70
					AVG	24.76	6.25	47.67			11.82	12.94	16.52	0.67	47.34
					STD	1.71	1.46	3.04			3.79	3.04	4.46	0.20	13.45
					VAR	2.93	2.15	9.22			14.33	9.23	19.90	0.04	180.79

continued

TABLE B-2. (continued)

RUN	N SOURCE	PLOT	FILTER WIDTH M	DATE MO	DAY	MEAN APP DEPTH (MM)	LAG (MIN)	DUR (MIN)	MOIS CONT %	MOIS CONT %	RUNOFF (MM)	INFILT (MM)	INFIL RATE (MM/HR)	INF RT TO RAIN RT	RUNOFF AS % OF PPT
3	UAN	1	9.2	7	19	23.47	2.00	53	*	*	13.479	9.991	11.31	0.48	57.43
3		4		7	19	21.59	1.00	51	*	*	12.888	8.702	10.24	0.47	59.69
3		7		7	24	24.93	4.50	50	*	*	20.973	3.953	4.74	0.19	84.14
6		1		7	29	22.06	2.50	49	*	14.64	13.646	8.418	10.31	0.47	61.85
6		4		7	30	24.76	4.00	47	*	*	12.622	12.135	15.49	0.63	50.98
6		7		7	31	23.81	3.50	50	*	*	18.990	4.818	5.78	0.24	79.76
					AVG	23.44	2.92	50.00			15.43	8.00	9.65	0.41	65.64
					STD	1.25	1.20	1.83			3.28	2.84	3.58	0.15	12.07
					VAR	1.57	1.45	3.33			10.79	8.04	12.78	0.02	145.61
9	Broiler	1	9.2	9	13	23.93	6.00	53	21.05	25.87	14.446	9.481	10.73	0.45	60.38
9	Litter	4		9	11	23.35	8.00	51	22.88	20.06	12.439	10.912	12.84	0.55	53.27
9		7		9	10	24.76	3.00	54	*	*	19.648	5.109	5.68	0.23	79.36
12		1		9	20	24.16	6.00	52	21.47	17.99	15.352	8.812	10.17	0.42	63.53
12		4		9	18	26.64	6.50	51	19.73	18.13	13.839	12.797	15.06	0.57	51.96
12		7		9	17	25.50	4.00	50	17.90	18.68	20.604	4.898	5.88	0.23	80.79
					AVG	24.72	5.58	51.83			16.05	8.67	10.06	0.41	64.88
					STD	1.09	1.64	1.34			3.02	2.88	3.41	0.14	11.45
					VAR	1.18	2.70	1.81			9.11	8.28	11.64	0.02	131.17
1	UAN	2	4.6	7	18	49.68	2.00	84	9.74	9.99	21.035	28.647	20.46	0.41	42.34
1		5		7	18	44.43	3.00	74	9.29	11.16	27.402	17.031	13.81	0.31	61.67
1		8		7	23	48.53	2.50	76	11.53	9.23	32.530	16.001	12.63	0.26	67.03
4		2		7	25	33.82	2.00	65	10.91	13.00	18.085	15.731	14.52	0.43	53.48
4		5		7	25	36.42	2.00	65	18.06	12.00	23.583	12.841	11.85	0.33	64.75
4		8		7	30	47.85	2.00	65	11.34	14.13	41.072	6.782	6.26	0.13	85.83
					AVG	43.46	2.25	71.50			27.28	16.17	13.26	0.31	62.52
					STD	6.15	0.38	7.18			7.69	6.53	4.19	0.10	13.28
					VAR	37.87	0.15	51.58			59.17	42.65	17.52	0.01	176.38
7	Broiler	2	4.6	9	12	46.77	6.00	77	10.48	17.59	7.519	39.251	30.59	0.65	16.08
7	Litter	5		9	10	44.72	3.00	68	8.25	13.48	8.171	36.550	32.25	0.72	18.27
7		8		9	9	46.87	4.50	85	14.97	14.97	17.851	29.020	20.49	0.44	38.09
10		2		9	19	47.75	6.00	77	16.63	15.23	24.452	23.300	18.16	0.38	51.21
10		5		9	17	30.75	17.00	45	13.74	15.08	12.130	18.621	24.83	0.81	39.45
10		8		9	16	46.14	6.50	72	14.23	13.08	35.944	10.199	8.50	0.18	77.90
					AVG	43.83	7.17	70.67			17.68	26.16	22.47	0.53	40.16
					STD	5.92	4.55	12.61			10.03	10.06	8.01	0.22	20.86
					VAR	35.08	20.72	158.89			100.66	101.21	64.13	0.05	435.00

continued

TABLE B-2. (continued)

RUN	N SOURCE	PLOT	FILTER WIDTH M	DATE MO	DATE DAY	MEAN APP DEPTH (MM)	LAG (MIN)	DUR (MIN)	MOIS CONT %	MOIS CONT %	RUNOFF (MM)	INFILT (MM)	INFIL RATE (MM/HR)	INF RT TO RAIN RT	RUNOFF AS % OF PPT
2	UAN	2	4.6	7	19	25.13	5.50	51	16.79	14.38	14.987	10.142	11.93	0.47	59.64
2		5		7	19	24.11	3.30	44	16.13	16.78	19.133	4.980	6.79	0.28	79.35
2		8		7	24	25.18	1.00	64	17.82	16.24	19.661	5.519	5.17	0.21	78.08
5		2		7	29	25.45	1.50	51	14.63	17.42	18.943	6.508	7.66	0.30	74.43
5		5		7	30	24.64	3.50	49	10.95	14.17	15.634	9.004	11.03	0.45	63.45
5		8		7	31	24.23	1.50	50	12.78	15.61	23.521	0.711	0.85	0.04	97.07
					AVG	24.79	2.72	51.50			18.65	6.14	7.24	0.29	75.34
					STD	0.50	1.56	6.08			2.82	3.04	3.69	0.15	12.14
					VAR	0.25	2.43	36.92			7.93	9.26	13.63	0.02	147.37
8	Broiler	2	4.6	9	13	23.94	5.00	65	21.55	19.17	13.036	10.908	10.07	0.42	54.44
8	Litter	5		9	11	24.62	12.00	45	20.44	18.28	13.148	11.473	15.30	0.62	53.40
8		8		9	10	29.89	3.30	49	19.97	19.52	19.071	10.816	13.24	0.44	63.81
11		2		9	20	24.11	4.00	47	18.56	17.54	13.500	10.613	13.55	0.56	55.99
11		5		9	18	24.82	12.00	57	18.84	17.66	10.394	14.430	15.19	0.61	41.87
11		8		9	17	23.49	4.00	50	17.22	11.18	20.239	3.248	3.90	0.17	86.17
					AVG	25.15	6.72	52.17			14.90	10.25	11.87	0.47	59.28
					STD	2.17	3.77	6.84			3.53	3.39	3.96	0.16	13.64
					VAR	4.69	14.20	46.81			12.45	11.48	15.71	0.02	185.94
3	UAN	2	4.6	7	19	24.57	3.50	54	*	*	19.156	5.414	6.02	0.24	77.96
3		5		7	19	25.81	2.00	55	*	*	22.583	3.223	3.52	0.14	87.51
3		8		7	24	24.94	1.00	70	*	*	21.708	3.235	2.77	0.11	87.03
6		2		7	29	23.86	1.50	54	*	*	23.998	0.000	0.00	0.00	100.58
6		5		7	30	23.69	2.00	58	*	*	18.195	5.495	5.68	0.24	76.81
6		8		7	31	24.37	1.00	47	*	*	24.369	0.000	0.00	0.00	100.00
					AVG	24.54	1.83	56.33			21.67	2.89	3.00	0.12	88.32
					STD	0.71	0.85	6.94			2.31	2.24	2.40	0.10	9.39
					VAR	0.50	0.72	48.22			5.32	5.02	5.77	0.01	88.16
9	Broiler	2	4.6	9	13	25.20	3.00	64	23.19	22.34	18.671	6.526	6.12	0.24	74.10
9	Litter	5		9	11	24.50	9.00	45	20.58	19.88	16.954	7.549	10.06	0.41	69.19
9		8		9	10	23.74	2.50	54	*	*	20.803	2.938	3.26	0.14	87.63
12		2		9	20	25.42	3.00	55	20.37	18.26	17.784	7.633	8.33	0.33	69.97
12		5		9	18	23.66	6.50	65	19.73	18.13	12.780	10.876	10.04	0.42	54.02
12		8		9	17	23.84	3.00	56	18.37	20.97	22.108	1.734	1.86	0.08	92.73
					AVG	24.39	4.50	56.50			18.18	6.21	6.61	0.27	74.61
					STD	0.70	2.42	6.70			2.98	3.07	3.18	0.13	12.73
					VAR	0.50	5.83	44.92			8.90	9.40	10.11	0.02	162.09

continued

TABLE B-2. (continued)

RUN	N SOURCE	PLOT	FILTER WIDTH M	DATE MO	DAY	MEAN APP DEPTH (MM)	LAG (MIN)	DUR (MIN)	MOIS CONT %	MOIS CONT %	RUNOFF (MM)	INFILT (MM)	INFIL RATE (MM/HR)	INF RT TO RAIN RT	RUNOFF AS % OF PPT
1	UAN	3	0.0	7	18	47.82	1.50	83	10.70	NA	18.883	28.933	20.92	0.44	39.49
1		6		7	18	44.30	1.00	80	3.62	NA	43.114	1.188	0.89	0.02	97.32
1		9		7	23	48.87	1.00	76	10.58	NA	32.747	16.127	12.73	0.26	67.00
4		3		7	25	33.30	2.00	54	11.02	NA	21.880	11.415	12.68	0.38	65.72
4		6		7	25	35.12	2.00	69	18.17	NA	35.250	0.000	0.00	0.00	100.00
4		9		7	30	50.12	1.50	71	12.82	NA	35.627	14.496	12.25	0.24	71.08
					AVG	43.25	1.50	72.17			31.25	12.03	9.91	0.22	73.43
					STD	6.66	0.41	9.44			8.36	9.76	7.32	0.17	20.55
					VAR	44.35	0.17	89.14			69.82	95.20	53.63	0.03	422.47
7	Broiler	3	0.0	9	12	45.85	3.00	64	9.36	NA	*	45.847	42.98	0.94	0.00
7	Litter	6		9	10	43.12	12.30	76	6.95	NA	17.530	25.586	20.20	0.47	40.66
7		9		9	9	49.68	1.00	71	10.29	NA	15.576	34.102	28.82	0.58	31.35
10		3		9	19	47.84	3.00	81	17.09	NA	26.592	21.245	15.74	0.33	55.59
10		6		9	17	32.79	3.30	68	12.66	NA	23.846	8.941	7.89	0.24	72.73
10		9		9	19	46.04	1.30	74	15.99	NA	28.700	17.337	14.06	0.31	62.34
					AVG	44.22	3.98	72.33			18.71	25.51	21.61	0.48	43.78
					STD	5.49	3.82	5.50			9.57	11.88	11.48	0.23	23.81
					VAR	30.12	14.61	30.22			91.60	141.16	131.75	0.06	567.15
2	UAN	3	0.0	7	19	22.52	2.50	50	16.90	NA	15.217	7.304	8.77	0.39	67.57
2		6		7	19	23.52	1.50	57	15.33	NA	29.423	0.000	0.00	0.00	100.00
2		9		7	24	24.26	0.50	57	15.42	NA	15.935	8.322	8.76	0.36	65.69
5		3		7	29	24.49	1.00	48	16.17	NA	14.601	9.889	12.36	0.50	59.62
5		6		7	30	22.37	1.30	39	10.12	NA	21.162	1.211	1.86	0.08	94.59
5		9		7	31	24.79	0.50	44	12.98	NA	18.036	6.750	9.20	0.37	72.77
					AVG	23.70	1.38	53.00			18.79	6.38	7.47	0.31	73.22
					STD	0.77	0.74	4.06			6.15	3.80	4.56	0.19	15.74
					VAR	0.59	0.55	16.50			37.88	14.41	20.77	0.04	247.68
8	Broiler	3	0.0	9	13	24.64	5.00	37	21.01	NA	11.161	13.477	21.85	0.89	45.30
8	Litter	6		9	11	24.02	3.00	36	17.56	NA	13.036	10.988	18.31	0.76	54.26
8		9		9	10	24.05	2.00	49	20.20	NA	13.950	10.095	12.36	0.51	58.02
11		3		9	20	23.56	2.00	50	19.84	NA	12.107	11.452	13.74	0.58	51.39
11		6		9	18	24.83	1.50	53	15.67	NA	21.400	3.428	3.88	0.16	86.19
11		9		9	17	23.37	1.70	43	18.37	NA	15.937	7.431	10.37	0.44	68.20
					AVG	24.08	2.53	44.67			14.60	9.48	13.42	0.56	60.56
					STD	0.53	1.20	6.50			3.39	3.25	5.72	0.23	13.41
					VAR	0.28	1.44	42.22			11.49	10.56	32.77	0.05	179.73

continued

TABLE B-2. (continued)

RUN	N SOURCE	PLOT	FILTER WIDTH M	DATE MO	DATE DAY	MEAN APP DEPTH (MM)	LAG (MIN)	DUR (MIN)	MOIS CONT %	MOIS CONT %	RUNOFF (MM)	INFILT (MM)	INFIL RATE (MM/HR)	INF RT TO RAIN RT	RUNOFF AS % OF PPT
3	UAN	3	0.0	7	19	23.24	1.00	45	*	NA	17.323	5.918	7.89	0.34	74.54
3		6		7	19	24.47	1.00	50	*	NA	24.012	0.457	0.55	0.02	98.13
3		9		7	24	24.26	1.00	49	*	NA	16.810	7.447	9.12	0.38	69.30
6		3		7	29	25.51	1.00	47	*	NA	15.947	9.559	12.20	0.48	62.52
6		6		7	30	25.00	1.00	52	*	NA	25.020	0.000	0.00	0.00	100.00
6		9		7	31	24.70	1.00	50	*	NA	18.906	5.796	6.95	0.28	76.54
					AVG	24.53	1.00	48.83			19.67	4.86	6.12	0.25	80.17
					STD	0.70	0.00	2.27			3.55	3.51	4.44	0.18	14.09
					VAR	0.49	0.00	5.14			12.60	12.30	19.72	0.03	198.41
9	Broiler	3	0.0	9	13	24.77	1.50	81	23.88	NA	18.771	5.994	4.44	0.18	75.80
9	Litter	6		9	11	24.19	1.00	37	18.77	NA	15.590	8.604	13.95	0.58	64.44
9		9		9	10	23.60	1.00	48	*	NA	12.096	11.505	14.38	0.61	51.25
12		3		9	20	24.19	2.00	50	20.59	NA	10.437	13.756	16.51	0.68	43.14
12		6		9	18	24.43	1.00	59	16.50	NA	24.325	0.101	0.10	.00	99.59
12		9		9	17	24.60	1.00	48	19.42	NA	16.761	7.835	9.79	0.40	68.15
					AVG	24.30	1.25	53.83			16.33	7.97	9.86	0.41	67.06
					STD	0.37	0.38	13.73			4.53	4.32	5.86	0.24	18.09
					VAR	0.14	0.15	188.47			20.54	18.70	34.33	0.06	327.39

TABLE B-3. BASIC DATA - CHEMICAL ANALYSES OF RUNOFF SAMPLES

Time min	Run ID	Plot ID	NH4-N mg/l	NO3-N mg/l	TKN mg/l	P2O4-P mg/l	TP mg/l	ORG N mg/l	TOT N mg/l	TSS mg/l	VSS mg/l
2	1	1	1.840	1.420	*	*	*	0.000	1.420	*	*
15	1	1	0.389	0.218	12.200	0.750	5.850	11.811	12.418	4407.0	519.0
27	1	1	*	*	*	*	14.000	0.000	0.000	*	*
30	1	1	1.070	0.578	3.390	0.530	*	2.320	3.968	1540.0	125.0
48	1	1	0.973	0.433	1.090	0.430	*	0.117	1.523	1682.0	148.0
60	1	1	2.720	0.093	2.600	0.380	3.910	0.000	2.693	721.0	83.0
63	1	1	3.160	0.413	9.900	0.400	2.960	6.740	10.313	*	*
6	2	1	1.130	0.810	11.800	0.730	7.160	10.670	12.610	3795.0	453.0
9	2	1	1.690	0.468	10.400	0.280	4.600	8.710	10.868	1453.0	144.0
21	2	1	0.860	0.500	8.800	0.550	5.290	7.940	9.300	1685.0	164.0
33	2	1	0.281	0.531	4.300	0.240	*	4.019	4.831	491.0	57.0
36	2	1	0.189	0.308	1.960	0.240	4.190	1.771	2.268	*	*
39	2	1	*	0.001	*	*	*	0.000	0.001	488.0	63.0
42	2	1	29.600	0.214	*	*	*	0.000	0.214	*	*
3	3	1	0.353	0.879	15.500	2.560	13.200	15.147	16.379	3549.0	435.0
6	3	1	0.550	0.349	1.610	0.360	*	1.060	1.959	1636.0	135.0
21	3	1	0.290	0.070	2.910	0.160	4.510	2.620	2.980	1369.0	123.0
30	3	1	1.122	0.856	*	1.700	*	0.000	0.856	1484.0	130.0
3	4	1	*	0.035	*	*	*	0.000	0.035	*	*
6	4	1	0.236	0.638	3.930	0.800	4.510	3.694	4.568	3483.0	424.0
9	4	1	0.701	0.521	4.330	0.250	5.580	3.629	4.851	1241.0	117.0
27	4	1	0.234	0.416	1.970	0.210	2.320	1.736	2.386	1419.0	153.0
54	4	1	0.157	0.311	1.440	0.180	2.160	1.283	1.751	403.0	58.0
3	5	1	0.118	0.278	2.620	0.220	*	2.502	2.898	2409.0	185.0
6	5	1	0.200	0.290	2.540	0.310	0.010	2.340	2.830	785.0	77.0
18	5	1	0.146	0.102	1.730	0.240	0.967	1.584	1.832	*	*
30	5	1	0.271	0.069	1.520	0.260	0.887	1.249	1.589	605.0	67.0
33	5	1	0.193	0.079	2.910	0.190	0.610	2.717	2.989	502.0	49.0
3	6	1	0.126	0.342	*	0.290	*	0.000	0.342	3255.0	400.0
6	6	1	0.412	0.415	*	0.410	*	0.000	0.415	1171.0	105.0
18	6	1	0.516	0.479	4.700	0.260	4.670	4.184	5.179	876.0	88.0
30	6	1	0.110	0.089	1.520	0.370	11.500	1.410	1.609	722.0	66.0

continued

TABLE B-3. (continued)

Time min	Run ID	Plot ID	NH4-N mg/l	NO3-n mg/l	TKN mg/l	P2O4-P mg/l	TP mg/l	ORG-N mg/l	TOT N mg/l	TSS mg/l	VSS mg/l
3	7	1	0.529	0.170	2.800	2.100	4.950	2.271	2.970	169.0	27.0
18	7	1	0.297	0.001	3.500	1.200	6.140	3.203	3.501	390.0	118.0
27	7	1 *		1.490 *		6.750 *		0.000	1.490	279.0	55.0
42	7	1 *	*		25.900 *		29.600	25.900	25.900	1095.0	238.0
51	7	1	3.510 *		128.000 *		22.500	124.490	128.000	651.0	128.0
57	7	1	14.100	0.260	21.700	5.900	14.000	7.600	21.960	653.0	153.0
60	7	1 *		0.732 *	*	*		0.000	0.732 *	*	
3	8	1 *	*		2.050 *		5.290	2.050	2.050	369.0	65.0
9	8	1 *		0.186	9.270	2.600 *		9.270	9.456	498.0	11.0
18	8	1	9.220	0.076	10.200	2.200	7.250	0.980	10.276	351.0	73.0
30	8	1	7.320	0.390	8.860	2.500	5.180	1.540	9.250 *	*	
33	8	1	9.360	0.041	9.390	2.200	1.330	0.030	9.431 *	*	
36	8	1	8.410	0.720	9.880	2.000	6.100	1.470	10.600	202.0	52.0
3	9	1	0.294	0.027	6.500	0.370	2.080	6.206	6.527	641.0	91.0
15	9	1	6.230	0.034	6.820	2.300	13.000	0.590	6.854	480.0	96.0
27	9	1	4.660	0.039	7.190	1.500	3.590	2.530	7.229 *	*	
2	10	1	0.240	0.166	3.270	0.430 *		3.030	3.436	409.0	65.0
9	10	1	0.292	0.129	6.940	1.900	9.600	6.648	7.069	314.0	68.0
39	10	1	1.500	0.132	3.850	1.000	1.590	2.350	3.982	337.0	75.0
51	10	1	1.710	0.330	4.950	0.860	4.930	3.240	5.280	263.0	55.0
57	10	1	1.920	0.081	6.220	0.940	2.270	4.300	6.301	170.0	43.0
1	11	1	7.29	2.870 *		0.900 *		0.000	2.870 *	*	
3	11	1	0.45	1.210	6.900	0.810	7.850	6.450	8.110	445.0	72.0
18	11	1	4.27	0.434	3.520	0.900	3.270	0.000	3.954 *	*	
27	11	1	1.6	0.511	4.890	1.600 *		3.290	5.401	231.0	52.0
33	11	1	0.49	0.234	4.170	1.000 *		3.680	4.404	161.0	42.0
1	12	1 *		0.518 *		0.720 *		0.000	0.518	584.0	97.0
3	12	1	3.190	0.358	4.210	0.940	2.160	1.020	4.568	1221.0	232.0
15	12	1	0.451	0.142	2.300	0.680	3.610	1.849	2.442	297.0	62.0
27	12	1	0.451	0.065	2.700	0.600	4.860	2.249	2.765 *	*	
36	12	1	2.770	0.070	2.790	0.680	3.070	0.020	2.860	110.0	49.0

continued

TABLE B-3. (continued)

Time min	Run ID	Plot ID	NH4-N mg/l	NO3-N mg/l	TKN mg/l	P2O4-P mg/l	TP mg/l	ORG N mg/l	TOT N mg/l	TSS mg/l	VSS mg/l
6	1	2	0.990	1.310	6.200	1.400	3.050	5.210	7.510	5786.0	472.0
15	1	2	*	*	*	*	*	0.000	0.000	*	*
27	1	2	1.860	0.173	8.810	0.450	3.710	6.950	8.983	1785.0	180.0
48	1	2	1.870	0.801	86.500	0.200	8.910	84.630	87.301	1838.0	179.0
54	1	2	*	0.710	*	*	*	0.000	0.710	*	*
63	1	2	0.505	0.576	*	0.170	3.210	0.000	0.576	1418.0	144.0
69	1	2	0.210	0.410	1.430	0.110	3.160	1.220	1.840	597.0	62.0
3	2	2	0.318	0.080	10.000	0.530	9.340	9.682	10.080	12279.0	1042.0
6	2	2	0.448	0.352	7.400	0.270	13.700	6.952	7.752	1830.0	185.0
15	2	2	0.338	0.274	7.100	0.710	10.300	6.762	7.374	1280.0	152.0
3	3	2	1.838	0.122	6.330	0.970	4.490	4.492	6.452	5378.0	402.0
6	3	2	1.691	0.108	3.110	0.280	2.490	1.419	3.218	1489.0	96.0
18	3	2	1.810	0.022	3.390	0.270	8.210	1.580	3.412	1364.0	98.0
30	3	2	2.320	*	3.800	0.270	8.550	1.480	3.800	1343.0	110.0
6	4	2	0.118	*	7.750	0.400	4.670	7.632	7.750	6948.0	52.0
9	4	2	0.197	0.193	24.100	0.330	20.500	23.903	24.293	881.0	101.0
30	4	2	0.197	0.237	6.520	0.150	6.550	6.323	6.757	1968.0	223.0
48	4	2	0.412	0.109	6.230	0.140	4.170	5.818	6.339	*	*
54	4	2	1.230	0.133	5.950	0.140	7.260	4.720	6.083	856.0	109.0
2	5	2	*	0.038	8.530	0.270	5.000	8.530	8.568	4528.0	530.0
6	5	2	0.952	0.161	3.690	0.580	4.290	2.738	3.851	622.0	60.0
18	5	2	0.134	0.170	5.560	0.190	3.000	5.426	5.730	579.0	54.0
33	5	2	0.261	0.201	7.400	0.240	3.220	7.139	7.601	725.0	72.0
39	5	2	0.244	0.447	8.210	0.330	3.620	7.966	8.657	266.0	37.0
6	6	2	1.960	0.064	8.040	0.160	4.330	6.080	8.104	*	*
12	6	2	3.430	0.005	7.720	0.160	5.170	4.290	7.725	1029.0	93.0
21	6	2	2.150	0.034	6.160	0.120	5.590	4.010	6.194	1020.0	94.0
33	6	2	0.811	0.005	6.090	0.170	7.550	5.279	6.095	726.0	80.0
42	6	2	0.150	0.173	15.500	0.350	4.920	15.350	15.673	180.0	20.0

continued

TABLE B-3. (continued)

Time min	Run ID	Plot ID	NH4-N mg/l	NO3-N mg/l	TKN mg/l	P2O4-P mg/l	TP mg/l	ORG N mg/l	TOT N mg/l	TSS mg/l	VSS mg/l
3	7	2	0.438	0.103	2.080	0.780	4.700	1.642	2.183	537.0	60.0
21	7	2	0.999	0.705	1.640	0.490	6.040	0.641	2.345	483.0	62.0
27	7	2	4.024	5.740 *		2.700	6.580	0.000	5.740 *	*	
36	7	2	3.710	0.410	13.200	1.500	7.710	9.490	13.610	794.0	97.0
51	7	2	4.580	0.040	26.900	2.900	12.100	22.320	26.940	924.0	145.0
60	7	2	6.190	0.030	17.100	2.600	12.700	10.910	17.130	601.0	95.0
63	7	2	6.210	0.203	26.300	9.300	10.100	20.090	26.503 *	*	
66	7	2	4.840	0.497	25.100	10.400	9.800	20.260	25.597	359.0	72.0
3	8	2	11.300	0.005 *		0.200	1.370	0.000	0.005	528.0	63.0
9	8	2	18.300	0.580 *		2.700	7.790	0.000	0.580	915.0	122.0
18	8	2	6.270	0.529	27.300	2.100	6.930	21.030	27.829	819.0	103.0
30	8	2	0.537	0.031	6.060	0.510	9.360	5.523	6.091	531.0	79.0
39	8	2	14.200	0.240	19.400	2.700	4.050	5.200	19.640	202.0	47.0
2	9	2	0.322	0.064	3.800	0.390	2.660	3.478	3.864	1314.0	157.0
6	9	2	1.970	0.040	29.900	0.530	21.500	27.930	29.940	1024.0	160.0
18	9	2	1.010	0.176	17.000 *		7.800	15.990	17.176	829.0	97.0
33	9	2	2.510	0.046	15.300	0.160	4.500	12.790	15.346	2247.0	348.0
39	9	2	3.680	0.217	12.000	1.200	5.920	8.320	12.217 *	*	
2	10	2 *		0.111	1.480 *		0.717	1.480	1.591	657.0	80.0
12	10	2 *		0.484	8.170 *		6.450	8.170	8.654	861.0	117.0
33	10	2 *		0.377	8.370	0.970	8.920	8.370	8.747	781.0	117.0
57	10	2	0.506	0.072	6.900	0.620	11.000	6.394	6.972	750.0	98.0
66	10	2	3.200	0.126	13.400	0.350	14.400	10.200	13.526 *	*	
2	11	2	0.910	0.150	3.090	0.190	4.500	2.180	3.240	952.0	125.0
6	11	2	1.180	1.440	11.000	0.860	3.580	9.820	12.440	930.0	148.0
21	11	2	0.396	0.077	8.600	0.660	6.300	8.204	8.677 *	*	
30	11	2	1.030	0.072	11.400	0.850	3.960	10.370	11.472 *	*	
39	11	2	0.040 *		6.600	1.100	6.630	6.560	6.600	253.0	62.0
2	12	2	0.212	0.300	1.075	0.110	6.000	0.863	1.375 *	*	
6	12	2	0.760	0.051	17.500	0.690	11.000	16.740	17.551	955.0	143.0
21	12	2	0.803	0.080	17.500	0.590	7.260	16.697	17.580	685.0	99.0
30	12	2	0.326 *		10.100	0.540	13.400	9.774	10.100	828.0	118.0
39	12	2	0.682 *		4.500	0.560	2.750	3.818	4.500	204.0	55.0

continued

TABLE B-3. (continued)

Time min	Run ID	Plot ID	NH4-N mg/l	NO3-N mg/l	TKN mg/l	P2O4-P mg/l	TP mg/l	ORG N mg/l	TOT N mg/l	TSS mg/l	VSS mg/l
2	7	3 *		3.343	17.900	4.800	11.200	17.900	21.243	3778.0	422.0
6	7	3 *		1.800	5.390	6.200	13.200	5.390	7.190 *	*	
21	7	3 *		0.620	109.000	9.700	14.400	109.000	109.620 *	*	
39	7	3	5.860	0.686	75.900	30.000	15.000	70.040	76.586	4660.0	1120.0
57	7	3	7.840	0.266	68.200	31.000 *		60.360	68.466	4426.0	686.0
60	7	3	4.300	0.044	9.220	32.000 *		4.920	9.264	1067.0	173.0
2	8	3 *	*	*	*	*	*	*		2564.0	399.0
3	8	3 *	*	*	*	*	*	*		3911.0	536.0
15	8	3 *	*	*	*	*	*	*		3191.0	422.0
27	8	3 *	*	*	*	*	*	*		1818.0	184.0
30	8	3 *	*	*	*	*	*	*		479.0	84.0
1	9	3	6.900	0.831	8.780	3.200	7.690	1.880	9.611	2664.0	346.0
3	9	3	7.250	0.169	9.590	2.800	3.350	2.340	9.759	4361.0	579.0
18	9	3	5.920	0.078 *		2.000	8.840	0.000	0.078	3402.0	347.0
30	9	3	6.620	0.115	24.000	3.600	7.480	17.380	24.115	1388.0	149.0
36	9	3	6.510	0.142 *		3.200 *		0.000	0.142	379.0	53.0
2	10	3	3.570	0.391	8.020	0.930	3.390	4.450	8.411	611.0	105.0
9	10	3	2.420	0.140	14.000	1.300	9.980	11.580	14.140	4354.0	509.0
36	10	3	4.770	0.100	12.400	1.300	11.900	7.630	12.500	3616.0	497.0
60	10	3	0.287	0.090	10.900	2.200	10.000	10.613	10.990	774.0	107.0
63	10	3 *		0.102	8.110 *		1.380	8.110	8.212	303.0	42.0
2	11	3	5.800	1.990	9.270	1.400	3.230	3.470	11.260 *	*	
3	11	3	2.360	0.245	9.110	2.000	12.300	6.750	9.355	5235.0	650.0
6	11	3	4.150	1.610	8.900	1.700	13.100	4.750	10.510 *	*	
15	11	3	2.510	0.435	6.940	0.680	16.600	4.430	7.375 *	*	
30	11	3	0.517	0.135	6.210	0.950	11.800	5.693	6.345 *	*	
33	11	3 *		0.347	5.39	0.86	4.94	5.390	5.737	406.0	88.0
2	12	3	2.420	1.130	18.100	0.930	22.000	15.680	19.230	7444.0	622.0
3	12	3	3.560	0.880	12.200	1.000	27.400	8.640	13.080 *	*	
15	12	3	2.850	0.137	7.680	1.000	18.800	4.830	7.817	2871.0	334.0
30	12	3	3.340	0.140	11.300	1.100	4.860	7.960	11.440	1287.0	177.0
36	12	3	1.250	0.166	3.440	0.410	4.190	2.190	3.606 *	*	

continued

TABLE B-3. (continued)

Time min	Run ID	Plot ID	NH4-N mg/l	NO3-N mg/l	TKN mg/l	P2O4-P mg/l	TP mg/l	ORG N mg/l	TOT N mg/l	TSS mg/l	VSS mg/l
2	7	3	*	3.343	17.900	4.800	11.200	17.900	21.243	3778.0	422.0
6	7	3	*	1.800	5.390	6.200	13.200	5.390	7.190	*	*
21	7	3	*	0.620	109.000	9.700	14.400	109.000	109.620	*	*
39	7	3	5.860	0.686	75.900	30.000	15.000	70.040	76.586	4660.0	1120.0
57	7	3	7.840	0.266	68.200	31.000	*	60.360	68.466	4426.0	686.0
60	7	3	4.300	0.044	9.220	32.000	*	4.920	9.264	1067.0	173.0
2	8	3	*	*	*	*	*	*	*	2564.0	399.0
3	8	3	*	*	*	*	*	*	*	3911.0	536.0
15	8	3	*	*	*	*	*	*	*	3191.0	422.0
27	8	3	*	*	*	*	*	*	*	1818.0	184.0
30	8	3	*	*	*	*	*	*	*	479.0	84.0
1	9	3	6.900	0.831	8.780	3.200	7.690	1.880	9.611	2664.0	346.0
3	9	3	7.250	0.169	9.590	2.800	3.350	2.340	9.759	4361.0	579.0
18	9	3	5.920	0.078	*	2.000	8.840	0.000	0.078	3402.0	347.0
30	9	3	6.620	0.115	24.000	3.600	7.480	17.380	24.115	1388.0	149.0
36	9	3	6.510	0.142	*	3.200	*	0.000	0.142	379.0	53.0
2	10	3	3.570	0.391	8.020	0.930	3.390	4.450	8.411	611.0	105.0
9	10	3	2.420	0.140	14.000	1.300	9.980	11.580	14.140	4354.0	509.0
36	10	3	4.770	0.100	12.400	1.300	11.900	7.630	12.500	3616.0	497.0
60	10	3	0.287	0.090	10.900	2.200	10.000	10.613	10.990	774.0	107.0
63	10	3	*	0.102	8.110	*	1.380	8.110	8.212	303.0	42.0
2	11	3	5.800	1.990	9.270	1.400	3.230	3.470	11.260	*	*
3	11	3	2.360	0.245	9.110	2.000	12.300	6.750	9.355	5235.0	650.0
6	11	3	4.150	1.610	8.900	1.700	13.100	4.750	10.510	*	*
15	11	3	2.510	0.435	6.940	0.680	16.600	4.430	7.375	*	*
30	11	3	0.517	0.135	6.210	0.950	11.800	5.693	6.345	*	*
33	11	3	*	0.347	5.39	0.86	4.94	5.390	5.737	406.0	88.0
2	12	3	2.420	1.130	18.100	0.930	22.000	15.680	19.230	7444.0	622.0
3	12	3	3.560	0.880	12.200	1.000	27.400	8.640	13.080	*	*
15	12	3	2.850	0.137	7.680	1.000	18.800	4.830	7.817	2871.0	334.0
30	12	3	3.340	0.140	11.300	1.100	4.860	7.960	11.440	1287.0	177.0
36	12	3	1.250	0.166	3.440	0.410	4.190	2.190	3.606	*	*

continued

TABLE B-3. (continued)

Time min	Run ID	Plot ID	NH4-N mg/l	NO3-N mg/l	TKN mg/l	P2O4-P mg/l	TP mg/l	ORG N mg/l	TOT N mg/l	TSS mg/l	VSS mg/l
3	1	4	0.204	0.537	16.900 *		14.700	16.696	17.437	3968.0	430.0
9	1	4	0.330	0.089 *		0.390 *		0.000	0.089	2624.0	330.0
18	1	4	2.390	0.176 *	*	*		0.000	0.176	1599.0	118.0
39	1	4	1.740	0.158	5.970	0.290	9.200	4.230	6.128 *	*	
48	1	4 *	*	*	*		15.300	0.000	0.000 *	*	
63	1	4	1.030	0.065	5.270	0.270	2.880	4.240	5.335	1442.0	148.0
6	2	4	1.720	0.597	4.960	1.700	4.610	3.240	5.557	3002.0	390.0
9	2	4	0.334	0.185	8.560	2.700	11.600	8.226	8.745 *	*	
21	2	4	0.516	0.159	12.960	0.350	8.340	12.444	13.119	1895.0	235.0
36	2	4	0.640	0.059	9.300	0.580	5.590	8.660	9.359	1196.0	145.0
39	2	4	0.769	0.060	2.990	0.300 *		2.221	3.050	742.0	93.0
3	3	4	0.710	0.485	4.210 *		7.880	3.500	4.695	2468.0	302.0
6	3	4	1.410	0.078	16.200	0.340	6.340	14.790	16.278	2459.0	231.0
21	3	4	1.330	0.201	11.810	0.200	3.730	10.480	12.011	942.0	89.0
36	3	4	0.911	0.306	10.120	0.210	5.780	9.209	10.426	1061.0	105.0
42	3	4	0.563	0.072	1.480	0.210	0.424	0.917	1.552	531.0	77.0
6	4	4	0.403	0.646	3.480	0.210	0.247	3.077	4.126	2126.0	246.0
9	4	4	0.435 *		4.200	0.220	4.940	3.765	4.200	1408.0	115.0
15	4	4	0.471	2.120	4.540	0.190	1.670	4.069	6.660	1659.0	192.0
30	4	4	0.504	0.334	3.190	0.170	1.670	2.686	3.524	1149.0	130.0
48	4	4	0.549	0.713	4.740	0.210 *		4.191	5.453	438.0	48.0
1	5	4	1.840	5.350	3.150	0.430	2.100	1.310	8.500	909.0	113.0
3	5	4	1.610	3.650	3.890	0.310	6.000	2.280	7.540	1143.0	124.0
12	5	4	1.120	0.857	4.200	0.240	6.410	3.080	5.057	1125.0	143.0
24	5	4	9.560	0.210	4.480	0.350	6.750	0.000	4.690	991.0	101.0
30	5	4	0.818	0.736	1.240	0.310 *		0.422	1.976 *	*	
3	6	4	0.563	0.079	2.700	0.210	6.480	2.137	2.779	2587.0	210.0
6	6	4	0.604	0.291	2.130	0.320 *		1.526	2.421	1074.0	115.0
18	6	4	0.243	0.065	1.970	0.240 *		1.727	2.035	1055.0	113.0
33	6	4	0.444	0.088	4.330	0.270 *		3.886	4.418	771.0	91.0
39	6	4	0.243	0.102	2.070	0.160	1.350	1.827	2.172 *	*	

continued

TABLE B-3. (continued)

Time min	Run ID	Plot ID	NH4-N mg/l	NO3-N mg/l	TKN mg/l	P2O4-P mg/l	TP mg/l	ORG N mg/l	TOT N mg/l	TSS mg/l	VSS mg/l
1	7	4	0.298	0.000	0.679	1.300	1.380	0.381	0.679	279.0	37.0
18	7	4	0.240	0.003	1.750	1.300	1.320	1.510	1.753	161.0	39.0
30	7	4	1.179	0.001	3.250	3.200	4.130	2.071	3.251	118.0	32.0
42	7	4 *		0.018	35.500	7.900	23.000	35.500	35.518	3497.0	798.0
54	7	4	1.700	0.133	40.200	7.800	24.700	38.500	40.333	350.0	96.0
60	7	4	1.680	0.270	45.900 *		24.600	44.220	46.170	336.0	105.0
2	8	4	2.220	0.066	1.560	0.040 *		0.000	1.626	206.0	39.0
6	8	4 *	*		8.030 *		8.030	8.030	8.030	222.0	55.0
15	8	4	24.600	0.232	33.900	5.400	7.060	9.300	34.132	224.0	60.0
27	8	4	6.860	0.111	13.300	2.700	7.750	6.440	13.411	181.0	56.0
33	8	4	3.690	0.114	6.910	4.200	3.270	3.220	7.024	183.0	58.0
1	9	4	2.360	0.113	5.600	0.780	1.220	3.240	5.713	227.0	52.0
3	9	4	6.040	0.320	13.700	0.210	7.160	7.660	14.020	362.0	88.0
18	9	4	5.450	0.294	14.400	1.100	6.270	8.950	14.694	221.0	60.0
30	9	4	11.900	0.251	20.200	2.400	14.900	8.300	20.451	220.0	59.0
36	9	4	9.090	0.103 *		2.500	5.720	0.000	0.103	161.0	50.0
2	10	4	1.080	0.017	2.580	0.360 *		1.500	2.597	238.0	32.0
6	10	4	2.380	1.360	7.040	0.650	0.717	4.660	8.400	360.0	75.0
21	10	4	1.370	0.116	4.660	0.970	3.520	3.290	4.776	422.0	65.0
30	10	4	6.300	0.299	7.960	0.410	9.890	1.660	8.259	217.0	44.0
36	10	4	1.170	0.302	5.230	0.480 *		4.060	5.532	264.0	56.0
2	11	4	0.991	0.191	4.040	0.350	0.606	3.049	4.231	219.0	36.0
3	11	4	0.289	0.043	2.130	0.150	0.531	1.841	2.173 *	*	
6	11	4	0.290	0.160	9.870	0.250	2.110	9.580	10.030	371.0	57.0
18	11	4	1.750	0.290	5.720	1.300	3.490	3.970	6.010 *	*	
21	11	4	1.800	0.352	12.400	0.690	5.860	10.600	12.752 *	*	
24	11	4	1.620	0.224	3.190	0.760	5.900	1.570	3.414 *	*	
27	11	4	1.260	0.181	3.830	0.810	4.150	2.570	4.011 *	*	
33	11	4	1.220	0.155	3.780	0.830	2.930	2.560	3.935 *	*	
2	12	4	1.580	0.046	1.910	0.270 *		0.330	1.956	350.0	52.0
6	12	4	1.540	0.201	13.100	1.100 *		11.560	13.301	595.0	94.0
18	12	4	1.100	0.092	2.560	0.510	2.770	1.460	2.652	353.0	59.0
30	12	4	1.200	0.065	3.600	0.870	5.900	2.400	3.665	351.0	75.0
36	12	4	0.952	0.154	5.100	0.700	1.310	4.148	5.254	232.0	57.0

continued

TABLE B-3. (continued)

Time min	Run ID	Plot ID	NH4-N mg/l	NO3-N mg/l	TKN mg/l	P2O4-P mg/l	TP mg/l	ORG N mg/l	TOT N mg/l	TSS mg/l	VSS mg/l
3	1	5	0.149	0.723	7.100	0.860	2.090	6.951	7.823	2319.0	294.0
18	1	5	0.439	0.089	8.200	0.320	5.720	7.761	8.289	1232.0	106.0
39	1	5 *		0.930 *		0.490	12.600	0.000	0.930	4299.0	434.0
57	1	5	2.600	0.078	4.720	0.460	8.160	2.120	4.798	1738.0	149.0
66	1	5	0.949	0.451 *		0.370	14.400	0.000	0.451	804.0	103.0
2	2	5	0.393 *		8.380	0.220	8.100	7.987	8.380	2546.0	251.0
6	2	5	0.542	1.636	3.100	0.230	5.990	2.558	4.736	2328.0	239.0
18	2	5	0.829	0.388	3.460	0.240	6.240	2.631	3.848	2138.0	209.0
33	2	5	1.620	0.081	3.490	0.270	9.260	1.870	3.571 *	*	
42	2	5	1.320	0.147	3.630	0.390	3.730	2.310	3.777	843.0	104.0
2	3	5	0.366	0.908	4.740	0.430 *		4.374	5.648	7679.0	937.0
18	3	5	0.760	0.428	5.390	0.480 *		4.630	5.818	3351.0	322.0
33	3	5	0.798	0.065	3.400	0.450	4.000	2.602	3.465 *	*	
45	3	5	0.818	0.155	2.890	0.520	4.060	2.072	3.045	1765.0	224.0
6	4	5	0.197	0.460	5.100	0.320	3.440	4.903	5.560	2769.0	262.0
9	4	5	0.618	1.370	14.600	0.450	17.400	13.982	15.970 *	*	
27	4	5	1.040	0.249	10.000	0.260	5.020	8.960	10.249 *	*	
48	4	5	0.498	0.230	4.600	0.200	3.090	4.102	4.830 *	*	
2	5	5	0.157	0.086	2.320	0.250	1.400	2.163	2.406	643.0	71.0
3	5	5	0.420	0.118	3.370	0.130	1.900	2.950	3.488	1031.0	95.0
15	5	5	1.620	0.934	6.220	0.320	2.060	4.600	7.154	1273.0	106.0
30	5	5	0.910	0.471	2.590 *		1.710	1.680	3.061	1105.0	114.0
36	5	5	0.341	0.319	2.740	0.160	1.670	2.399	3.059 *	*	
2	6	5	1.730	0.087	5.020	0.270	5.510	3.290	5.107	1285.0	147.0
3	6	5	0.785	0.067	3.740	0.630	4.540	2.955	3.807	2198.0	204.0
9	7	5	1.270	0.719	2.040 *		1.960	0.770	2.759	74.0	13.0
21	7	5	3.370	0.021	2.700	0.410	2.090	0.000	2.721	91.0	20.0
36	7	5	4.100	0.034	13.400	1.600	6.900	9.300	13.434	522.0	95.0
51	7	5	28.800	0.193	25.600	5.300	9.110	0.000	25.793 *	*	
60	7	5	17.700	0.015	30.800	2.800	10.000	13.100	30.815	325.0	76.0
63	7	5	7.600	0.010	29.600	6.200	18.500	22.000	29.610	314.0	77.0

continued

TABLE B-3. (continued)

Time min	Run ID	Plot ID	NH4-N mg/l	NO3-N mg/l	TKN mg/l	P2O4-P mg/l	TP mg/l	ORG N mg/l	TOT N mg/l	TSS mg/l	VSS mg/l
3	8	5	4.080	0.344	12.100	1.200	4.260	8.020	12.444	267.0	58.0
12	8	5	10.800	0.046	22.200	1.300	5.010	11.400	22.246	*	*
24	8	5	9.090	0.262	33.400	3.000	7.710	24.310	33.662	272.0	56.0
36	8	5	15.500	*	32.800	4.900	8.680	17.300	32.800	192.0	82.0
1	9	5	5.640	0.035	*	1.200	3.240	0.000	0.035	332.0	58.0
3	9	5	7.220	0.046	6.810	0.960	3.610	0.000	6.856	316.0	67.0
15	9	5	10.500	0.378	25.700	2.200	7.530	15.200	26.078	264.0	35.0
30	9	5	2.900	0.056	14.700	0.460	3.800	11.800	14.756	225.0	48.0
1	10	5	1.780	1.310	3.680	*	1.050	1.900	4.990	300.0	50.0
6	10	5	3.590	0.955	7.600	0.960	2.600	4.010	8.555	307.0	63.0
18	10	5	1.740	0.426	6.540	0.920	8.640	4.800	6.966	277.0	52.0
33	10	5	3.960	0.250	4.290	0.840	1.050	0.330	4.540	273.0	55.0
42	10	5	3.150	0.421	6.170	1.100	1.160	3.020	6.591	484.0	104.0
1	11	5	1.430	0.472	3.590	0.640	1.910	2.160	4.062	*	*
2	11	5	0.696	0.327	5.040	0.690	2.600	4.344	5.367	*	*
3	11	5	2.960	0.991	4.330	0.630	2.840	1.370	5.321	*	*
6	11	5	1.300	1.114	4.290	0.640	2.810	2.990	5.404	*	*
9	11	5	1.380	0.957	4.910	0.650	2.220	3.530	5.867	*	*
15	11	5	*	*	*	*	*	0.000	0.000	871.0	136.0
24	11	5	1.240	0.179	2.350	0.970	2.250	1.110	2.529	337.0	63.0
36	11	5	0.991	0.152	6.060	0.810	2.270	5.069	6.212	*	*
39	11	5	1.190	0.141	4.990	0.610	2.760	3.800	5.131	172.0	37.0
1	12	5	0.334	0.156	5.490	0.230	2.950	5.156	5.646	*	*
2	12	5	2.170	0.076	4.810	0.620	1.710	2.640	4.886	*	*
3	12	5	0.138	0.036	4.020	0.520	1.490	3.882	4.056	*	*
6	12	5	2.870	0.154	3.830	0.680	2.640	0.960	3.984	*	*
9	12	5	2.310	0.094	3.440	1.300	3.420	1.130	3.534	*	*
18	12	5	2.540	0.103	4.900	0.710	3.070	2.360	5.003	*	*
21	12	5	2.810	0.124	11.100	0.520	4.040	8.290	11.224	*	*
24	12	5	2.860	0.129	4.020	0.800	2.990	1.160	4.149	*	*
27	12	5	0.800	0.084	4.060	0.630	3.880	3.260	4.144	*	*
33	12	5	1.000	0.096	3.470	0.610	4.850	2.470	3.566	*	*
36	12	5	2.920	0.030	3.480	0.650	3.900	0.560	3.510	*	*
39	12	5	1.460	0.052	3.140	0.550	0.162	1.680	3.192	172.0	37.0

continued

TABLE B-3. (continued)

Time min	Run ID	Plot ID	NH4-N mg/l	NO3-N mg/l	TKN mg/l	P2O4-P mg/l	TP mg/l	ORG N mg/l	TOT N mg/l	TSS mg/l	VSS mg/l
3	1	6	1.020	2.740	4.740	0.880	10.700	3.720	7.480	*	*
9	1	6	1.000	0.899	8.980	0.400	15.200	7.980	9.879	*	*
36	1	6	1.010	0.534	8.290	0.260	11.000	7.280	8.824	10059.0	1035.0
54	1	6	1.480	0.169	24.800	0.440	9.230	23.320	24.969	6411.0	457.0
60	1	6	1.880	0.153	4.300	1.200	6.700	2.420	4.453	1544.0	150.0
1	2	6	2.120	0.233	14.500	*	23.100	12.380	14.733	10161.0	852.0
2	2	6	2.370	0.743	*	1.300	*	0.000	0.743	10941.0	766.0
18	2	6	1.460	0.493	11.500	0.600	11.200	10.040	11.993	6911.0	355.0
30	2	6	1.120	4.840	5.800	0.610	9.060	4.680	10.640	378.0	55.0
39	2	6	0.949	0.648	2.780	0.630	3.550	1.831	3.428	475.0	34.0
1	3	6	2.280	1.010	14.200	0.660	12.800	11.920	15.210	8876.0	737.0
2	3	6	1.660	1.030	11.600	0.750	14.300	9.940	12.630	*	*
18	3	6	1.470	0.267	5.880	0.390	17.100	4.410	6.147	6778.0	472.0
30	3	6	1.460	0.349	3.790	1.600	10.200	2.330	4.139	3591.0	268.0
33	3	6	2.360	0.147	2.500	0.370	1.710	0.140	2.647	748.0	81.0
2	4	6	2.390	5.140	8.330	0.170	*	5.940	13.470	29289.0	2047.0
6	4	6	*	2.400	7.210	0.230	12.100	7.210	9.610	7536.0	518.0
27	4	6	1.110	0.313	3.270	0.410	11.900	2.160	3.583	4348.0	299.0
45	4	6	0.224	0.276	2.990	0.310	6.030	2.766	3.266	1417.0	107.0
48	4	6	0.696	0.084	7.110	0.990	7.110	6.414	7.194	315.0	36.0
1	5	6	2.260	16.400	18.900	0.250	7.170	16.640	35.300	5200.0	466.0
3	5	6	3.940	6.710	14.800	0.410	7.160	10.860	21.510	6337.0	473.0
18	5	6	1.350	1.080	4.990	0.230	4.790	3.640	6.070	12139.0	823.0
30	5	6	0.603	0.446	8.350	0.100	5.760	7.747	8.796	1893.0	151.0
33	5	6	0.200	0.399	2.090	0.180	3.160	1.890	2.489	436.0	51.0
1	6	6	1.180	3.230	11.100	0.360	8.940	9.920	14.330	6589.0	1682.0
2	6	6	1.110	2.330	9.800	0.230	7.150	8.690	12.130	4726.0	341.0
18	6	6	2.000	0.333	7.240	0.860	5.300	5.240	7.573	6154.0	314.0
30	6	6	2.100	0.298	5.440	0.250	8.130	3.340	5.738	4731.0	249.0
33	6	6	2.000	0.290	1.110	0.980	*	0.000	1.400	*	*

continued

TABLE B-3. (continued)

Time min	Run ID	Plot ID	NH4-N mg/l	NO3-N mg/l	TKN mg/l	P2O4-P mg/l	TP mg/l	ORG N mg/l	TOT N mg/l	TSS mg/l	VSS mg/l
2	7	6	9.880	0.958	17.400	*	3.730	7.520	18.358	2498.0	274.0
18	7	6	3.140	0.127	9.200	1.900	8.120	6.060	9.327	1125.0	128.0
33	7	6	8.720	*	53.200	7.200	*	44.480	53.200	3590.0	503.0
45	7	6	17.500	0.200	*	11.100	*	0.000	0.200	3578.0	553.0
57	7	6	6.030	*	*	3.900	19.500	0.000	0.000	8317.0	980.0
3	8	6	12.200	0.085	20.400	9.300	4.970	8.200	20.485	4307.0	552.0
6	8	6	*	*	20.700	*	*	20.700	20.700	4831.0	495.0
18	8	6	9.870	0.228	46.000	2.100	16.700	36.130	46.228	3706.0	348.0
30	8	6	8.710	0.384	23.300	5.500	11.800	14.590	23.684	1199.0	134.0
33	8	6	23.500	0.239	11.100	5.300	12.700	0.000	11.339	334.0	67.0
2	9	6	0.988	0.270	24.900	0.960	15.300	23.912	25.170	5025.0	511.0
3	9	6	14.600	0.239	34.200	3.500	18.800	19.600	34.439	5560.0	927.0
18	9	6	3.880	0.001	31.800	1.900	16.700	27.920	31.801	4196.0	625.0
30	9	6	*	*	106.000	*	8.560	106.000	106.000	1841.0	138.0
3	10	6	0.774	*	14.700	0.390	21.700	13.926	14.700	7794.0	998.0
9	10	6	6.200	2.340	21.300	2.900	14.600	15.100	23.640	3980.0	583.0
27	10	6	*	0.102	9.230	1.700	8.160	9.230	9.332	3549.0	452.0
36	10	6	1.690	0.131	3.760	1.200	6.240	2.070	3.891	*	*
39	10	6	1.380	0.257	11.900	1.500	10.700	10.520	12.157	*	*
45	10	6	2.360	0.742	5.540	1.500	1.160	3.180	6.282	290.0	53.0
2	11	6	3.880	5.410	24.300	1.300	5.740	20.420	29.710	*	*
3	11	6	2.980	0.331	20.000	1.100	11.000	17.020	20.331	4473.0	515.0
15	11	6	2.160	0.243	16.900	1.400	12.500	14.740	17.143	*	*
18	11	6	3.180	0.208	7.680	1.800	3.930	4.500	7.888	3427.0	332.0
21	11	6	3.580	0.197	12.000	0.800	10.500	8.420	12.197	*	*
24	11	6	1.980	0.128	14.100	0.930	9.430	12.120	14.228	*	*
27	11	6	4.240	0.109	15.200	0.650	9.480	10.960	15.309	*	*
30	11	6	4.200	0.369	10.400	0.640	8.100	6.200	10.769	*	*
33	11	6	*	*	8.250	*	7.050	8.250	8.250	321.0	69.0
1	12	6	0.463	1.320	8.250	0.870	11.300	7.787	9.570	2817.0	403.0
3	12	6	3.170	0.290	20.200	0.950	18.300	17.030	20.490	4839.0	650.0
18	12	6	2.690	0.423	15.900	0.750	9.310	13.210	16.323	3169.0	415.0
33	12	6	2.320	0.580	5.200	0.620	3.130	2.880	5.780	507.0	81.0
36	12	6	0.216	0.796	6.200	0.850	4.920	5.984	6.996	233.0	65.0

continued

TABLE B-3. (continued)

Time min	Run ID	Plot ID	NH4-N mg/l	NO3-N mg/l	TKN mg/l	P2O4-P mg/l	TP mg/l	ORG N mg/l	TOT N mg/l	TSS mg/l	VSS mg/l
3	1	7	2.280	0.380	2.780	1.400	*	0.500	3.160	5230.0	294.0
6	1	7	*	0.482	3.320	1.900	6.600	3.320	3.802	2591.0	222.0
33	1	7	3.820	*	5.610	*	7.770	1.790	5.610	2884.0	246.0
54	1	7	3.790	*	13.300	0.860	10.900	9.510	13.300	2046.0	210.0
60	1	7	1.550	0.019	6.040	0.410	*	4.490	6.059	1128.0	136.0
2	2	7	*	*	*	*	*	*	*	5088.0	351.0
3	2	7	*	*	*	*	*	*	*	1846.0	165.0
18	2	7	1.210	0.296	4.660	*	5.790	3.450	4.956	*	*
30	2	7	*	*	*	*	*	*	*	1879.0	152.0
33	2	7	*	*	*	*	*	*	*	1296.0	117.0
2	3	7	1.720	0.610	3.760	0.870	4.670	2.040	4.370	3150.0	281.0
3	3	7	2.790	0.352	3.110	0.460	4.520	0.320	3.462	1662.0	160.0
18	3	7	0.502	0.270	2.170	0.250	4.310	1.668	2.440	2698.0	231.0
2	4	7	0.623	0.952	6.940	*	0.933	6.317	7.892	1340.0	115.0
3	4	7	*	0.877	4.090	0.930	1.180	4.090	4.967	1299.0	144.0
33	4	7	0.471	0.494	3.150	0.350	7.260	2.679	3.644	2270.0	206.0
60	4	7	*	0.478	3.270	0.180	4.410	3.270	3.748	1573.0	132.0
66	4	7	*	0.387	5.100	0.300	3.420	5.100	5.487	846.0	94.0
3	5	7	*	0.297	3.800	0.260	*	3.800	4.097	4609.0	378.0
6	5	7	0.955	0.781	4.090	0.270	14.800	3.135	4.871	1842.0	162.0
18	5	7	0.592	0.304	6.090	0.290	12.900	5.498	6.394	2116.0	194.0
33	5	7	*	0.044	1.640	0.180	*	1.640	1.684	1828.0	169.0
39	5	7	0.569	0.256	3.800	*	2.910	3.231	4.056	1002.0	97.0
2	6	7	*	0.382	1.560	*	0.081	1.560	1.942	6436.0	491.0
3	6	7	0.271	0.379	2.740	0.420	0.857	2.469	3.119	2280.0	63.0
33	6	7	*	0.364	1.320	0.230	0.076	1.320	1.684	1846.0	183.0
36	6	7	0.725	0.381	*	0.260	*	0.000	0.381	1028.0	118.0
3	7	7	0.746	*	15.450	0.550	7.890	14.704	15.450	544.0	57.0
15	7	7	0.919	0.876	5.600	0.760	*	4.681	6.476	110.0	20.0
27	7	7	0.565	0.333	4.510	3.400	3.530	3.945	4.843	136.0	23.0
45	7	7	*	0.382	27.300	4.200	16.900	27.300	27.682	1155.0	142.0
60	7	7	*	0.007	34.400	4.500	15.600	34.400	34.407	1213.0	159.0
63	7	7	*	0.038	8.730	3.600	*	8.730	8.768	999.0	127.0

continued

TABLE B-3. (continued)

Time min	Run ID	Plot ID	NH4-N mg/l	NO3-N mg/l	TKN mg/l	P2O4-P mg/l	TP mg/l	ORG N mg/l	TOT N mg/l	TSS mg/l	VSS mg/l
2	8	7 *		0.284	4.210	0.220	6.990	4.210	4.494	474.0	48.0
6	8	7	5.080	0.092	5.150	1.500 *		0.070	5.242	351.0	40.0
18	8	7	5.080	0.422	12.700	3.600	5.330	7.620	13.122	993.0	84.0
30	8	7	11.100	0.217	17.700	2.800	5.670	6.600	17.917	1165.0	116.0
39	8	7	10.700	0.243	24.400	2.300	5.200	13.700	24.643	331.0	52.0
1	9	7	7.560	0.185	17.400	3.200	25.300	9.840	17.585	2533.0	266.0
2	9	7	7.040	0.187	8.940	2.800	3.000	1.900	9.127	1489.0	154.0
15	9	7	6.480	0.389	11.700	0.340	11.100	5.220	12.089	2359.0	213.0
30	9	7	7.880	0.202	8.570	0.980	1.320	0.690	8.772	1787.0	186.0
39	9	7	9.360	0.200	8.860	2.600	5.590	0.000	9.060 *	*	
3	10	7	2.810	0.773	10.300	1.100	7.470	7.490	11.073	1093.0	121.0
6	10	7	3.480	0.764	12.700	1.000	8.370	9.220	13.464	1061.0	115.0
30	10	7	0.603	0.241	3.930	0.900	0.892	3.327	4.171 *	*	
60	10	7	1.820	0.428	4.530	1.500	0.672	2.710	4.958	503.0	59.0
66	10	7	0.478	0.128	2.660	0.490	0.502	2.182	2.788	435.0	63.0
1	11	7 *	*		7.470 *	*		7.470	7.470	26990.0	2598.0
3	11	7 *	*		13.900 *		17.800	13.900	13.900	1267.0	130.0
15	11	7	0.721	0.390	4.430	0.620	11.900	3.709	4.820	1698.0	125.0
30	11	7	2.230	0.187	3.790	0.910	4.950	1.560	3.977	1824.0	183.0
36	11	7	1.320	0.279	3.080	1.000	7.170	1.760	3.359 *	*	
1	12	7	2.610	0.713	5.740	1.800 *		3.130	6.453	2249.0	194.0
2	12	7	1.400	0.822	8.660	1.400 *		7.260	9.482	1484.0	137.0
15	12	7	1.480	0.563	5.960	2.400 *		4.480	6.523	1879.0	134.0
30	12	7	1.160	0.396	4.030	1.300 *		2.870	4.426	1089.0	106.0
36	12	7	1.300	0.326	2.890	1.100 *		1.590	3.216	477.0	66.0
12	1	8	0.457	0.151 *		0.870 *		0.000	0.151	2816.0	296.0
15	1	8	1.800	0.482	15.410	1.830	9.150	13.610	15.892	4760.0	416.0
39	1	8 *		0.100 *	*	*		0.000	0.100	5459.0	383.0
60	1	8	1.150	0.222	15.790	0.140	7.580	14.640	16.012	3406.0	285.0
63	1	8	0.412 *		1.520	0.250	0.892	1.108	1.520	2136.0	161.0

continued

TABLE B-3. (continued)

Time min	Run ID	Plot ID	NH4-N mg/l	NO3-N mg/l	TKN mg/l	P2O4-P mg/l	TP mg/l	ORG N mg/l	TOT N mg/l	TSS mg/l	VSS mg/l
3	2	8	0.204	0.519	1.890	0.210	0.395	1.686	2.409	*	*
6	2	8	0.261	0.959	15.000	0.940	13.100	14.739	15.959	2959.0	241.0
18	2	8	2.980	0.141	*	0.270	*	0.000	0.141	2948.0	201.0
36	2	8	*	1.240	6.880	0.930	5.710	6.880	8.120	*	*
39	2	8	1.920	0.133	*	0.170	*	0.000	0.133	*	*
3	3	8	3.930	0.548	9.350	0.330	15.700	5.420	9.898	5008.0	347.0
6	3	8	2.040	0.307	2.340	0.320	0.431	0.300	2.647	2297.0	178.0
21	3	8	1.970	0.158	3.320	0.320	2.790	1.350	3.478	4381.0	333.0
33	3	8	2.240	0.155	5.190	0.490	4.370	2.950	5.345	*	*
36	3	8	0.502	0.262	*	0.250	*	0.000	0.262	1607.0	139.0
39	3	8	1.450	0.055	2.210	0.320	1.320	0.760	2.265	*	*
6	4	8	1.090	2.850	4.780	*	1.490	3.690	7.630	2842.0	232.0
9	4	8	0.958	0.363	*	0.310	*	0.000	0.363	3347.0	234.0
42	4	8	0.357	0.442	3.680	0.270	6.890	3.323	4.122	5478.0	353.0
66	4	8	0.502	0.159	7.840	0.270	1.250	7.338	7.999	904.0	91.0
2	5	8	0.060	0.856	1.600	0.250	0.276	1.540	2.456	4542.0	292.0
3	5	8	0.877	1.300	2.620	0.210	0.247	1.743	3.920	2566.0	168.0
18	5	8	0.909	*	12.000	0.260	0.644	11.091	12.000	2347.0	172.0
33	5	8	0.451	0.148	19.200	0.280	1.210	18.749	19.348	*	*
39	5	8	0.465	0.508	2.620	0.260	20.000	2.155	3.128	*	*
2	6	8	0.524	0.087	7.020	0.380	*	6.496	7.107	4942.0	333.0
3	6	8	1.810	*	4.540	0.220	*	2.730	4.540	2632.0	205.0
18	6	8	0.283	0.305	1.240	0.260	0.502	0.957	1.545	2750.0	231.0
33	6	8	0.334	0.154	1.810	0.200	0.005	1.476	1.964	1529.0	138.0
39	6	8	0.384	*	*	0.310	1.640	0.000	0.000	532.0	70.0
2	7	8	3.550	0.627	13.700	*	6.140	10.150	14.327	*	*
3	7	8	1.420	0.150	5.500	0.540	3.760	4.080	5.650	988.0	97.0
15	7	8	4.720	0.480	8.190	4.100	6.270	3.470	8.670	720.0	76.0
27	7	8	8.580	0.123	9.810	2.700	9.430	1.230	9.933	1641.0	205.0
45	7	8	2.610	0.014	31.200	*	22.100	28.590	31.214	3240.0	317.0
60	7	8	12.400	0.220	29.700	6.600	16.600	17.300	29.920	2793.0	304.0
66	7	8	18.300	0.416	43.300	6.600	12.100	25.000	43.716	748.0	109.0

continued

TABLE 8-3. (continued)

Time min	Run ID	Plot ID	NH4-N mg/l	NO3-N mg/l	TKN mg/l	P2O4-P mg/l	TP mg/l	ORG N mg/l	TOT N mg/l	TSS mg/l	VSS mg/l
2	8	8	1.910	0.107	7.230	0.890	5.300	5.320	7.337	976.0	108.0
3	8	8	6.060	0.086	9.510	2.500	5.080	3.450	9.596	*	*
18	8	8	*	0.152	7.720	2.100	5.320	7.720	*	*	*
30	8	8	*	0.057	7.760	*	2.100	7.760	7.817	2406.0	208.0
36	8	8	0.506	0.053	8.040	*	1.390	7.534	8.093	*	*
1	9	8	*	0.073	10.700	*	8.270	10.700	10.773	10919.0	676.0
2	9	8	*	0.054	47.700	*	19.500	47.700	47.754	5556.0	400.0
18	9	8	*	0.030	6.010	1.100	2.130	6.010	6.040	4101.0	305.0
30	9	8	3.470	0.350	22.600	1.500	13.700	19.130	22.950	3126.0	263.0
36	9	8	9.780	0.111	22.100	4.400	6.950	12.320	22.211	860.0	101.0
1	10	8	1.410	1.061	6.740	1.800	2.490	5.330	7.801	1059.0	113.0
6	10	8	2.500	0.514	7.230	1.200	3.490	4.730	7.744	1723.0	170.0
57	10	8	1.970	*	5.290	1.200	1.490	3.320	5.290	1181.0	127.0
63	10	8	0.877	0.137	4.320	0.820	0.717	3.443	4.457	446.0	69.0
1	11	8	0.591	0.137	3.570	0.150	32.670	2.979	3.707	*	*
3	11	8	3.270	2.740	7.860	0.580	*	4.590	10.600	2080.0	185.0
15	11	8	2.05	0.507	24.2	2.5	22.34	22.150	24.707	11082.0	865.0
30	11	8	2.110	0.036	4.900	0.550	*	2.790	4.936	1251.0	108.0
33	11	8	*	*	4.770	*	18.700	4.770	4.770	1290.0	158.0
36	11	8	1.700	0.636	3.360	0.720	0.349	1.660	3.996	*	*
1	12	8	1.640	*	3.560	0.720	2.420	1.920	3.560	*	*
2	12	8	1.230	1.240	5.150	0.680	1.250	3.920	6.390	3727.0	289.0
15	12	8	1.720	*	3.030	0.630	0.040	1.310	3.030	2872.0	181.0
30	12	8	1.800	0.142	17.600	0.740	8.110	15.800	17.742	1645.0	104.0
39	12	8	1.590	0.769	2.540	0.860	6.250	0.950	3.309	387.0	61.0
3	1	9	4.410	0.698	1.180	0.740	15.900	0.000	1.878	4638.0	421.0
39	1	9	4.180	0.093	*	0.320	3.230	0.000	0.093	10527.0	692.0
60	1	9	3.430	0.070	21.300	*	24.000	17.870	21.370	*	*
63	1	9	0.651	0.122	*	0.240	4.110	0.000	0.122	1868.0	131.0
1	2	9	5.480	2.830	23.800	0.470	14.000	18.320	26.630	5932.0	515.0
3	2	9	3.650	1.020	20.700	0.930	14.200	17.050	21.720	8271.0	586.0
18	2	9	2.090	0.249	50.000	0.820	*	47.910	50.249	9957.0	614.0
30	2	9	3.650	0.236	2.540	*	*	0.000	2.776	*	*
33	2	9	*	0.018	4.810	0.390	28.600	4.810	4.828	1371.0	132.0

continued

TABLE B-3. (continued)

Time min	Run ID	Plot ID	NH4-N mg/l	NO3-N mg/l	TKN mg/l	P2O4-P mg/l	TP mg/l	ORG N mg/l	TOT N mg/l	TSS mg/l	VSS mg/l
1	3	9	1.910	0.085	25.700	0.340	13.600	23.790	25.785	10540.0	771.0
3	3	9	1.320 *		8.040	0.470	5.930	6.720	8.040	7839.0	486.0
18	3	9	1.560	0.556	30.800	1.700 *		29.240	31.356	10415.0	616.0
30	3	9	2.170	0.649	6.030	0.330	9.770	3.860	6.679	3417.0	226.0
33	3	9	1.970	0.040	3.760	0.490	5.050	1.790	3.800	1561.0	137.0
1	4	9	1.330	5.690	7.430	0.300	5.900	6.100	13.120	2533.0	299.0
2	4	9	1.880	0.106	14.400	0.340	13.700	12.520	14.506	6832.0	688.0
33	4	9	0.875	0.134	9.350	0.500	13.100	8.475	9.484	7086.0	451.0
63	4	9	1.180	0.068	3.800	0.530	3.880	2.620	3.868	1510.0	170.0
1	5	9	1.950	7.220	13.500	0.340	10.500	11.550	20.720	6491.0	458.0
3	5	9	2.330	5.050	5.440 *		7.180	3.110	10.490	6462.0	387.0
15	5	9	0.589	1.090	5.560 *		5.820	4.971	6.650 *	*	
30	5	9	0.337	0.313	3.230	0.380	2.480	2.893	3.543	4011.0	270.0
33	5	9	0.452	0.092 *		0.240 *		0.000	0.092	1184.0	114.0
1	6	9	0.707	1.231	6.740	1.100	6.850	6.033	7.971	7694.0	663.0
3	6	9	0.774	0.548	6.780	0.860	9.490	6.006	7.328	6892.0	411.0
15	6	9	0.591	0.049	8.080 *		12.200	7.489	8.129	7010.0	356.0
30	6	9	1.550	0.592 *		0.350 *		0.000	0.592	4505.0	259.0
33	6	9	0.320	0.142	2.790	0.250	3.190	2.470	2.932	1165.0	109.0
2	7	9 *		0.801 *		1.300	4.370	0.000	0.801	1438.0	123.0
15	7	9 *		0.140	3.530	0.860	3.640	3.530	3.670	1249.0	159.0
27	7	9 *		1.150	4.380 *	*		4.380	5.530	11427.0	1374.0
45	7	9 *	*		53.200 *		34.800	53.200	53.200	9860.0	910.0
60	7	9	1.540	0.407	2.500	8.800	23.200	0.960	2.907	4224.0	404.0
63	7	9	2.050	0.735	53.700	9.300	23.600	51.650	54.435	1427.0	162.0
1	8	9	2.620	0.095	7.680	0.340	3.910	5.060	7.775	2224.0	245.0
3	8	9	1.030	0.059	13.300	3.700	6.570	12.270	13.359	7060.0	644.0
18	8	9	6.620	0.039	17.400	3.200	21.300	10.780	17.439	7277.0	545.0
33	8	9	6.140	0.002	12.900	3.900	10.900	6.760	12.902	1334.0	129.0
1	9	9	6.590	0.108	15.300	2.100	13.600	8.710	15.408	3419.0	315.0
2	9	9	8.440	0.092	17.400	1.800	7.760	8.960	17.492	10255.0	620.0
18	9	9	3.620	0.083	28.800	2.800	22.300	25.180	28.883	9459.0	651.0
30	9	9	8.860	0.152	26.000	2.600	18.600	17.140	26.152	6238.0	392.0
33	9	9	11.100	0.191	21.100	1.500	10.100	10.000	21.291	1311.0	120.0

continued

TABLE B-3. (continued)

Time min	Run ID	Plot ID	NH4-N mg/l	NO3-N mg/l	TKN mg/l	P2O4-P mg/l	TP mg/l	ORG N mg/l	TOT N mg/l	TSS mg/l	VSS mg/l
2	10	9	2.060	0.285	12.200	0.980	12.000	10.140	12.485	1521.0	184.0
6	10	9	4.520	1.270	29.700	1.200	*	25.180	30.970	6078.0	509.0
36	10	9	*	*	*	*	*	0.000	0.000	5710.0	410.0
60	10	9	1.730	0.574	5.840	0.580	5.860	4.110	6.414	2347.0	195.0
63	10	9	2.100	0.205	6.490	*	6.220	4.390	6.695	886.0	114.0
1	11	9	1.120	7.700	10.500	0.760	0.828	9.380	18.200	3581.0	318.0
2	11	9	1.080	4.840	9.860	*	0.936	8.780	14.700	6145.0	444.0
18	11	9	1.280	0.132	31.200	0.570	45.600	29.920	31.332	5161.0	395.0
30	11	9	*	*	10.100	0.730	1.380	10.100	10.100	2912.0	231.0
1	12	9	*	*	8.410	*	12.600	8.410	8.410	5389.0	453.0
2	12	9	7.260	0.113	10.800	1.800	12.900	3.540	10.913	7294.0	502.0
18	12	9	1.810	0.162	1.640	*	11.900	0.000	1.802	6339.0	412.0
33	12	9	*	*	*	0.720	*	0.000	0.000	928.0	77.0
36	12	9	1.180	0.218	12.100	*	15.800	10.920	12.318	737.0	86.0

TABLE B-4. CALCULATED MASS LOSSES IN RUNOFF

RUN	NITROGEN SOURCE	PLOT	FILTER WIDTH m	NH4 gms	NO3 gms	TKN gms	P2O5 gms	TP gms	ORG-N gms	TN gms	TSS gms	VSS gms
1	UAN	1	9.2	2.034	0.710	3.990	0.763	14.573	1.956	4.700	2605.382	234.93
1		4		4.270	0.354	18.293	0.748	27.609	14.023	18.647	1935.16	160.103
1		7		14.919	1.000	31.400	5.392	36.287	18.315	31.767	10863.49	973.757
4		1		0.785	1.064	5.934	0.548	7.472	5.149	6.998	3139.856	348.397
4		4		1.234	2.211	9.708	0.460	4.555	8.474	11.919	2718.528	302.888
4		7		1.504	3.545	20.725	2.756	30.907	19.221	24.270	11322.16	1051.736
		AVG		4.12	1.48	15.01	1.78	20.23	11.19	16.38	5430.76	511.97
		STD		4.95	1.08	9.52	1.80	12.02	6.49	9.56	4021.39	359.54
		VAR		24.55	1.18	90.67	3.23	144.46	42.07	91.42	16171595.50	129271.25
7	Broiler	1	9.2	2.144	0.684	34.471	4.771	17.954	32.327	35.155	591.738	126.449
7	Litter	4		2.110	0.082	41.032	9.711	26.523	38.922	41.114	2314.63	536.88
7		7		0.000	0.762	56.716	9.752	32.902	56.716	57.478	2244.055	285.771
10		1		4.046	0.564	17.153	4.266	15.776	13.107	17.717	1071.29	233.723
10		4		3.046	0.550	6.888	0.880	4.927	3.842	7.438	443.957	79.27
10		7		8.834	2.319	34.531	6.172	14.274	25.697	36.850	4557.706	506.884
		AVG		3.36	0.83	31.80	5.93	18.73	28.44	32.63	1870.56	294.83
		STD		2.73	0.70	16.10	3.12	8.96	17.19	16.18	1406.35	174.26
		VAR		7.48	0.49	259.30	9.76	80.21	295.37	261.77	1977810.78	30364.92
2	UAN	1	9.2	1.775	0.903	14.843	0.747	8.910	13.068	15.746	2499.944	248.854
2		4		0.849	0.242	18.403	1.550	14.024	17.554	18.645	3229.105	404.739
2		7		3.070	0.751	11.824	0.000	14.692	8.754	12.575	4749.64	404.036
5		1		0.343	0.214	3.266	0.449	1.354	2.923	3.480	1185.037	123.529
5		4		5.701	2.134	6.258	0.453	9.600	0.557	8.392	1648.166	190.411
5		7		2.126	1.109	13.823	0.796	36.042	11.697	14.932	5631.47	520.762
		AVG		2.31	0.89	11.40	0.67	14.10	9.09	12.30	3157.23	315.39
		STD		1.75	0.64	5.16	0.47	10.74	5.85	5.04	1594.87	138.37
		VAR		3.07	0.42	26.59	0.22	115.24	34.20	25.37	2543607.25	19146.07

continued

TABLE B-4. (continued)

RUN	NITROGEN SOURCE	PLOT	FILTER WIDTH m	NH4 gms	NO3 gms	TKN gms	P2O5 gms	TP gms	ORG-N gms	TN gms	TSS gms	VSS gms
8	Broiler	1	9.2	12.258	0.265	13.637	3.305	8.953	1.379	13.902	479.749	104.387
8	Litter	4		24.622	0.269	34.043	6.026	11.752	9.421	34.312	337.557	92.949
8		7		19.544	0.829	35.362	8.194	16.947	15.818	36.191	2503.188	233.632
11		1		4.62	0.998	7.353	1.646	3.568	2.733	8.351	499.714	107.836
11		4		2.299	0.380	9.864	1.428	6.494	7.565	10.244	610.39	93.782
11		7		3.068	1.018	19.735	2.011	35.383	16.667	20.753	7083.781	635.585
		AVG		11.07	0.63	20.00	3.77	13.85	8.93	20.63	1919.06	211.36
		STD		8.56	0.33	11.08	2.52	10.50	5.84	11.05	2426.09	195.99
		VAR		73.24	0.11	122.74	6.33	110.25	34.14	122.21	5885912.78	38411.51
3	UAN	1	9.2	1.382	0.854	5.972	1.523	14.681	4.590	6.826	3400.853	296.327
3		4		2.736	0.436	27.012	0.516	10.476	24.276	27.448	2867.249	273.599
3		7		4.011	1.063	8.759	1.122	15.724	4.748	9.822	15513.16	811.318
6		1		0.852	0.798	8.635	0.766	16.022	7.783	9.433	2096.278	199.738
6		4		0.837	0.276	5.584	0.574	9.250	4.747	5.860	2213.625	238.5
6		7		1.510	1.213	6.701	1.082	1.560	5.191	7.914	5194.232	520.728
		AVG		1.89	0.77	10.44	0.93	11.29	8.56	11.22	5214.23	390.04
		STD		1.14	0.33	7.51	0.35	5.05	7.12	7.39	4718.59	214.50
		VAR		1.30	0.11	56.37	0.12	25.51	50.63	54.58	22265045.01	46012.39
9	Broiler	1	9.2	12.164	0.087	17.177	4.350	19.776	5.013	17.264	1233.348	236.631
9	Litter	4		15.179	0.602	33.487	2.594	17.628	18.308	34.089	540.667	141.475
9		7		23.876	0.984	34.342	3.397	22.024	10.466	35.326	6808.553	653.974
12		1		2.592	0.382	7.236	1.824	9.963	4.644	7.618	1028.703	222.358
12		4		2.885	0.269	12.675	1.773	8.246	9.791	12.944	939.677	167.719
12		7		4.895	2.052	21.445	6.524	0.000	16.550	23.497	5507.705	448.39
		AVG		10.27	0.73	21.06	3.41	12.94	10.80	21.79	2676.44	311.76
		STD		7.69	0.66	10.06	1.66	7.63	5.20	10.30	2498.86	182.19
		VAR		59.20	0.43	101.25	2.74	58.26	26.99	106.16	6244307.19	33193.34

continued

TABLE B-4. (continued)

RUN	NITROGEN SOURCE	PLOT	FILTER WIDTH m	NH4 gms	NO3 gms	TKN gms	P2O5 gms	TP gms	ORG-N gms	TN gms	TSS gms	VSS gms
1	UAN	2	4.6	4.738	1.845	160.638	0.824	19.303	155.900	162.483	1839.771	191.065
1		5		5.952	2.017	25.834	1.769	38.849	19.882	27.851	11254.39	1098.318
1		8		6.816	1.070	73.215	4.440	39.115	66.399	74.285	22335.85	1721.809
4		2		0.731	0.506	25.532	0.477	22.359	24.801	26.038	4019.37	462.734
4		5		2.724	1.728	32.912	0.993	25.173	30.188	34.640	9567.381	905.256
4		8		3.552	2.813	27.880	1.708	26.174	17.432	22.026	24443.7	1648.603
		AVG		4.09	1.66	57.67	1.70	28.50	52.43	57.89	12243.41	1004.63
		STD		2.03	0.73	48.97	1.31	7.73	49.06	49.92	8511.90	563.21
		VAR		4.13	0.53	2398.47	1.71	59.76	2407.25	2492.03	72452375.23	317206.48
7	Broiler	2	4.6	4.955	0.359	22.372	2.911	11.664	17.417	22.731	880.676	129.502
7	Litter	5		11.337	0.100	16.150	2.555	7.407	4.813	16.250	348.231	68.094
7		8		16.829	0.277	66.033	12.318	45.047	49.204	66.310	6936.278	724.833
10		2		1.952	1.046	28.351	3.036	33.068	26.399	29.397	2820.648	398.129
10		5		4.854	0.947	11.032	1.625	9.113	6.178	11.979	509.277	99.563
10		8		11.648	1.849	32.864	6.347	12.982	21.216	34.713	10338.42	925.557
		AVG		8.60	0.76	29.47	4.80	19.88	20.87	30.23	3638.92	390.95
		STD		5.10	0.60	17.88	3.67	14.11	14.83	17.83	3756.25	330.36
		VAR		26.00	0.36	319.56	13.45	198.98	219.85	317.89	14109441.41	109138.58
2	UAN	2	4.6	0.791	0.628	15.857	1.352	24.105	15.066	16.485	3279.297	356.789
2		5		2.785	1.572	9.571	0.702	19.400	6.786	11.143	5279.094	527.962
2		8		6.088	1.621	32.540	1.611	27.991	26.452	34.161	8499.428	607.337
5		2		0.908	0.514	16.219	0.779	9.230	15.311	16.733	1755.122	170.122
5		5		2.680	1.478	10.327	0.573	4.372	7.647	11.805	2698.455	245.934
5		8		2.702	2.482	39.036	0.872	3.359	36.334	41.518	8286.637	590.654
		AVG		2.66	1.38	20.59	0.98	14.74	17.93	21.97	4966.34	416.47
		STD		1.75	0.66	11.19	0.37	9.60	10.46	11.61	2642.80	169.57
		VAR		3.06	0.44	125.22	0.14	92.07	109.39	134.80	6984372.59	28755.40

continued

TABLE B-4. (continued)

RUN	NITROGEN SOURCE	PLOT	FILTER WIDTH m	NH4 gms	NO3 gms	TKN gms	P2O5 gms	TP gms	ORG-N gms	TN gms	TSS gms	VSS gms
8	Broiler	2	4.6	14.155	0.732	40.229	3.373	14.586	26.074	40.961	1404.707	187.087
8	Litter	5		17.295	0.349	44.956	3.615	11.004	27.661	45.305	513.334	111.685
8		8		9.604	0.310	22.635	2.165	12.072	13.031	22.945	5073.461	465.852
11		2		1.454	0.873	19.323	1.497	10.051	17.869	20.196	1310.848	225.33
11		5		2.101	0.902	5.911	1.191	3.586	3.810	6.813	1036.049	167.412
11		8		6.777	2.558	43.429	4.368	69.738	36.652	45.987	15831.09	1273.23
		AVG		8.56	0.95	29.41	2.70	20.17	20.85	30.37	4194.91	405.10
		STD		5.83	0.75	14.46	1.16	22.42	10.68	14.68	5413.07	404.10
		VAR		34.01	0.57	209.19	1.35	502.53	113.96	215.45	29301331.32	163295.90
3	UAN	2	4.6	5.389	0.130	9.844	0.816	18.982	4.455	9.974	4189.771	304.701
3		5		2.331	1.331	15.418	1.536	13.240	13.087	16.749	48839.38	4332.258
3		8		6.655	0.685	11.361	1.114	8.977	4.706	12.046	10627.2	815.471
6		2		7.382	0.105	25.190	0.545	20.059	17.808	25.295	3262.71	308.215
6		5		2.093	0.179	9.970	1.679	12.102	7.877	10.149	3286.547	320.183
6		8		2.360	0.775	7.802	0.846	1.417	5.442	8.577	8652.021	736.288
		AVG		4.37	0.53	13.26	1.09	12.46	8.90	13.80	13142.94	1136.19
		STD		2.19	0.45	5.81	0.40	6.26	4.95	5.76	16205.24	1444.55
		VAR		4.79	0.20	33.81	0.16	39.18	24.54	33.19	262609965.48	2086736.15
9	Broiler	2	4.6	4.484	0.319	52.325	1.014	26.839	47.841	52.644	3421.876	485.772
9	Litter	5		19.258	0.525	44.713	3.609	13.846	25.455	45.238	667.543	115.491
9		8		10.969	0.339	63.139	3.838	28.332	52.170	63.478	12767.96	962.456
12		2		1.755	0.000	39.518	1.562	24.764	37.763	39.518	2036.061	299.703
12		5		3.953	0.189	8.774	1.459	6.298	4.821	8.963	322.057	69.28
12		8		5.291	2.210	24.379	2.189	8.611	19.088	26.589	8696.561	589.671
		AVG		7.62	0.60	38.81	2.28	18.12	31.19	39.41	4652.01	420.40
		STD		5.91	0.74	17.89	1.08	8.88	16.51	17.70	4568.15	304.84
		VAR		34.96	0.55	320.05	1.17	78.82	272.55	313.30	20867987.71	92928.90

continued

TABLE B-4. (continued)

RUN	NITROGEN SOURCE	PLOT	FILTER WIDTH m	NH4 gms	NO3 gms	TKN gms	P2O5 gms	TP gms	ORG-N gms	TN gms	TSS gms	VSS gms
1	UAN	3	0.0	7.953	0.498	32.758	1.560	50.177	24.805	33.256	17036.48	1393.583
1		6		6.065	2.704	64.920	1.961	59.448	58.855	67.624	224404.8	25019.18
1		9		15.442	0.824	53.453	1.520	41.487	38.011	54.277	123561.7	8848.5
4		3		1.309	1.017	35.676	1.458	19.360	34.367	36.693	10854.51	1039.077
4		6		5.435	4.687	19.555	1.436	45.617	14.120	24.242	24356.66	1690.554
4		9		5.164	0.508	40.227	2.022	47.993	35.063	40.735	24748.59	1919.698
		AVG		6.89	1.71	41.10	1.66	44.01	34.20	42.80	70827.12	6651.77
		STD		4.30	1.53	14.63	0.24	12.31	13.63	14.29	78676.47	8644.31
		VAR		18.53	2.34	213.99	0.06	151.47	185.77	204.17	6189986867.23	74724065.94
7	Broiler	3	0.0	*	*	*	*	*	*	*	*	*
7	Litter	6		22.569	0.488	0.000	14.529	29.117	0.000	0.488	8329.139	1118.418
7		9		2.931	1.416	55.259	11.574	51.562	52.328	56.675	16246.98	1644.046
10		3		9.994	0.356	39.974	4.881	34.853	29.980	40.330	9993.926	1301.455
10		6		10.052	2.171	33.630	5.448	28.256	23.578	35.801	9022.269	1215.803
10		9		10.783	3.169	60.986	3.080	30.222	50.203	64.155	13133.97	1021.995
		AVG		9.39	1.27	31.64	6.59	29.00	26.01	32.91	9454.38	1050.29
		STD		7.15	1.12	24.13	4.96	15.20	21.03	24.96	5013.45	508.52
		VAR		51.05	1.25	582.44	24.64	231.06	442.11	623.12	25134682.60	258595.95
2	UAN	3	0.0	1.504	0.617	23.066	1.442	7.222	0.825	24.508	23730.29	2415.383
2		6		5.604	5.923	37.024	2.762	46.600	31.420	42.947	21224.79	1305.482
2		9		5.641	0.943	59.705	1.480	40.058	54.064	60.648	15196.07	997.575
5		3		2.332	0.257	11.328	0.510	14.152	8.996	11.585	5333.999	401.948
5		6		4.843	6.884	22.162	0.638	14.607	17.319	29.046	20553.39	1439.396
5		9		2.043	4.189	11.190	0.785	11.479	9.147	15.379	11283.88	715.373
		AVG		3.66	3.14	27.41	1.27	22.35	20.30	30.69	16220.40	1212.53
		STD		1.74	2.66	16.85	0.77	15.14	17.81	16.77	6378.99	639.97
		VAR		3.02	7.06	283.92	0.59	229.31	317.33	281.34	40691562.97	409562.92

continued

TABLE B-4. (continued)

RUN	NITROGEN SOURCE	PLOT	FILTER WIDTH m	NH4 gms	NO3 gms	TKN gms	P2O5 gms	TP gms	ORG-N gms	TN gms	TSS gms	VSS gms
8	Broiler	3	0.0	*	*	*	*	*	*	*	3778.077	483.51
8	Litter	6		16.583	0.386	52.430	6.963	20.842	35.847	52.816	5009.241	497.005
8		9		8.847	0.057	25.818	5.916	25.657	16.971	25.875	9345.451	785.13
11		3		3.402	0.912	10.68	1.548	20.281	7.278	11.592	4414.955	573.714
11		6		7.954	0.682	37.558	2.841	25.286	29.604	38.240	7824.399	825.941
11		9		2.369	2.839	38.763	1.276	42.963	36.394	41.602	9363.434	707.45
		AVG		6.53	0.81	27.54	3.09	22.50	21.02	28.35	6622.59	645.46
		STD		5.45	0.96	17.76	2.53	12.59	14.01	18.09	2307.18	134.99
		VAR		29.70	0.92	315.25	6.38	158.40	196.16	327.12	5323057.37	18223.01
3	UAN	3	0.0	1.764	0.668	15.149	1.608	18.662	13.385	15.817	10012.13	821.968
3		6		4.519	1.489	20.771	2.252	42.168	16.252	22.260	19139.77	1443.381
3		9		3.352	0.911	37.907	2.059	16.246	34.555	38.818	16437.92	1003.7
6		3		1.461	0.138	9.187	0.751	2.161	7.726	9.325	5672.716	457.618
6		6		5.413	2.660	22.405	1.645	19.971	16.992	25.065	16396.86	953.069
6		9		2.076	0.821	14.729	1.410	20.993	12.653	15.550	14262.44	799.306
		AVG		3.10	1.11	20.02	1.62	20.03	16.93	21.14	13653.64	913.17
		STD		1.47	0.80	9.09	0.48	11.74	8.43	9.38	4522.19	294.31
		VAR		2.16	0.63	82.55	0.23	137.75	71.11	88.06	20450245.65	86620.29
9	Broiler	3	0.0	14.680	0.262	41.444	6.164	16.410	26.764	41.706	6348.467	719.631
9	Litter	6		12.690	0.131	94.259	4.379	29.006	81.569	94.390	7546.513	1112.31
9		9		9.599	0.159	36.215	3.545	24.878	26.616	36.374	12239.63	802.42
12		3		3.938	0.459	12.980	1.290	21.497	9.042	13.439	4606.28	464.611
12		6		7.760	1.316	41.578	2.272	28.989	33.818	42.894	8408.526	1125.679
12		9		6.364	0.326	12.507	2.575	26.341	6.143	12.833	10756.96	723.283
		AVG		9.17	0.44	39.83	3.37	24.52	30.66	40.27	8317.73	824.66
		STD		3.66	0.41	27.23	1.58	4.44	24.84	27.16	2568.63	232.66
		VAR		13.36	0.16	741.45	2.50	19.74	616.94	737.63	6597836.67	54132.21

TABLE B-5. VEGETATED FILTER STRIP PERFORMANCE AS A PERCENTAGE OF BARE PLOT LOSSES

RUN PLOT	Filter	Parameter	1	2	3	4	5	6	7	8	9	10	11	12	Average
1	9.2 m	TSS	15.29	10.53	33.87	28.93	22.22	36.95	*	12.70	19.43	10.72	11.32	22.33	20.39
		Total N	14.13	64.25	43.16	19.07	30.04	101.16	*	*	41.39	43.93	72.04	56.69	48.59
		Total P	29.04	123.37	78.67	38.60	9.57	741.41	*	*	120.51	45.26	17.59	46.35	125.04
4	9.2 m	TSS	0.86	15.21	14.98	11.16	8.02	13.50	27.79	6.74	7.16	4.92	7.80	11.18	10.78
		Total N	27.57	43.41	123.31	49.17	28.89	23.40	200.00	64.97	8.00	20.78	26.79	30.18	53.87
		Total P	46.44	30.09	24.84	9.99	65.72	46.32	91.09	56.39	60.77	17.44	25.68	28.44	41.93
7	9.2 m	TSS	8.79	31.26	94.37	45.75	49.91	36.42	13.81	26.79	55.63	34.70	75.65	51.20	43.69
		Total N	58.53	20.73	25.30	59.58	97.09	50.89	101.42	139.86	97.12	57.44	49.88	183.10	78.41
		Total P	87.47	36.68	96.79	64.40	313.98	7.43	63.81	66.05	88.53	47.23	82.36	*	78.99
	Average	TSS	8.31	19.00	47.74	28.61	26.72	28.96	20.80	15.41	27.41	16.78	31.59	28.24	24.96
		Total N	33.41	42.80	63.92	42.61	52.01	58.48	150.71	102.42	48.84	40.72	49.57	89.99	64.62
		Total P	54.32	63.38	66.77	37.66	129.76	265.05	77.45	61.22	89.94	36.64	41.88	37.40	80.12
2	4.6 m	TSS	10.80	13.82	41.85	37.02	32.90	57.52	*	37.18	53.90	28.22	29.69	44.20	35.19
		Total N	488.58	67.26	63.06	70.96	144.43	271.26	*	*	126.23	72.89	174.22	294.05	177.29
		Total P	38.46	333.77	101.71	115.49	65.22	928.23	*	*	163.55	94.88	49.56	115.20	200.61
5	4.6 m	TSS	5.01	24.87	255.17	39.28	13.13	20.04	4.18	10.25	8.85	5.64	13.24	3.83	33.62
		Total N	41.19	25.95	75.24	142.89	40.64	40.49	200.00	85.78	47.93	33.46	17.82	20.89	64.36
		Total P	65.35	41.63	31.40	55.18	29.93	60.60	25.44	52.80	47.73	42.25	14.18	21.73	40.69
8	4.6 m	TSS	18.08	55.93	64.65	98.77	73.44	60.66	42.69	54.29	104.32	78.72	169.07	80.85	75.12
		Total N	136.86	56.33	31.03	54.07	269.96	55.16	117.00	88.68	174.52	54.11	110.54	207.19	112.95
		Total P	94.28	69.87	55.26	54.54	29.26	6.75	87.36	47.05	113.88	42.96	162.32	32.69	66.35
	Average	TSS	11.30	31.54	120.56	58.36	39.82	46.07	23.44	33.91	55.69	37.53	70.67	42.96	47.65
		Total N	222.21	49.85	56.44	89.31	151.68	122.30	158.50	87.23	116.23	53.49	100.86	174.04	115.18
		Total P	66.03	148.42	62.79	75.07	41.47	331.86	56.40	49.93	108.39	60.03	75.35	56.54	94.36

TABLE B-6. BASIC AND COMPUTED NITROGEN LEACHING DATA

PLOT	SAMPLE TIME	DEPTH INCREMENT cm	TOTAL DEPTH cm	BULK DENSITY gm/cc	PORTION SAMPLED	NH-4 ppm	NH-4 mg/kg	NH-4 kg/ha	NO-3 ppm	NO-3 mg/kg	NO-3 kg/ha	Inorg-N kg/ha	Inorg-N kg	Inorg-N Plot kg
1	Pre-Appli	11	11	0.980	Bare	0.392	3.92	4.23	0.379	3.79	4.09	8.311		
	cation	11	22	1.140		0.387	3.87	4.85	0.194	1.94	2.43	7.286		
		6	28	1.160		0.477	4.77	3.32	0.275	2.75	1.91	5.234		
		6	34	1.380		0.361	3.61	2.99	0.206	2.06	1.71	4.695		
		9	43	1.680		0.220	2.20	3.33	0.932	9.32	14.09	17.418		
		9	51	1.450		0.159	1.59	2.07	0.343	3.43	4.48	6.551		
		7	58	1.530		0.195	1.95	2.09	0.160	1.60	1.71	3.802		
		7	65	1.540		0.235	2.35	2.53	0.206	2.06	2.22	4.754		
		20	85	1.640		0.090	0.90	2.95	0.191	1.91	6.26	9.217		
		20	105	1.540		0.512	5.12	15.77	0.286	2.86	8.81	24.578		
		20	125	1.410		0.225	2.25	6.35	0.935	9.35	26.37	32.712		
						Profile Total		50.48			74.08	124.56	1.51	
1	Pre-Appli	11	11	0.980	Filter	0.338	3.38	3.64	0.114	1.14	1.23	4.873		
	cation	11	22	1.140		0.422	4.22	5.29	0.137	1.37	1.72	7.010		
		6	28	1.160		0.235	2.35	1.64	0.314	3.14	2.19	3.821		
		6	34	1.160		0.268	2.68	1.87	0.114	1.14	0.79	2.659		
		9	43	1.680		0.191	1.91	2.89	0.171	1.71	2.59	5.473		
		8	51	1.450		0.373	3.73	4.33	0.090	0.9	1.04	5.371		
		7	58	1.530		0.179	1.79	1.92	0.192	1.92	2.06	3.973		
		7	65	1.540		0.289	2.89	3.12	0.079	0.79	0.85	3.967		
		20	85	1.640		0.324	3.24	10.63	0.632	6.32	20.73	31.357		
		20	105	1.540		0.336	3.36	10.35	0.079	0.79	2.43	12.782		
		20	125	1.410		0.498	4.98	14.04	0.114	1.14	3.21	17.258		
						Profile Total		59.70			38.84	98.54	0.49	2.01

continued

TABLE B-6. (continued)

PLOT	SAMPLE TIME	DEPTH INCREMENT cm	TOTAL DEPTH cm	BULK DENSITY gm/cc	PORTION SAMPLED	NH-4 ppm	NH-4 mg/kg	NH-4 kg/ha	NO-3 ppm	NO-3 mg/kg	NO-3 kg/ha	Inorg-N kg/ha	Inorg-N kg	Inorg-N Plot kg
1	Post App-	11	11	0.980	Bare	0.277	2.77	2.99	2.742	27.42	29.56	32.545		
	lication	11	22	1.140		0.540	5.40	6.77	0.874	8.74	10.96	17.732		
		6	28	1.160		0.564	5.64	3.93	0.125	1.25	0.87	4.795		
		6	34	1.160		0.206	2.06	1.43	0.451	4.51	3.14	4.573		
		9	43	1.680		0.218	2.18	3.30	0.761	7.61	11.51	14.802		
		8	51	1.450		0.314	3.14	3.64	0.411	4.11	4.77	8.410		
		7	58	1.530		0.462	4.62	4.95	0.310	3.1	3.32	8.268		
		7	65	1.540		0.775	7.75	8.35	0.436	4.36	4.70	13.055		
		20	85	1.640		0.242	2.42	7.94	0.183	1.83	6.00	13.940		
		20	105	1.540		0.277	2.77	8.53	0.402	4.02	12.38	20.913		
		20	125	1.410		0.356	3.56	10.04	0.171	1.71	4.82	14.861		
						Profile Total		61.87			92.03	153.89	1.87	
1	Post App-	11	11	0.980	Filter	0.420	4.20	4.53	0.067	0.67	0.72	5.250		
	lication	11	22	1.140		0.222	2.22	2.78	0.194	1.94	2.43	5.217		
		6	28	1.160		0.155	1.55	1.08	0.114	1.14	0.79	1.872		
		6	34	1.160		0.155	1.55	1.08	0.017	0.17	0.12	1.197		
		9	43	1.680		0.324	3.24	4.90	0.114	1.14	1.72	6.623		
		8	51	1.450		0.303	3.03	3.51	0.114	1.14	1.32	4.837		
		7	58	1.530		0.213	2.13	2.28	0.114	1.14	1.22	3.502		
		7	65	1.540		0.269	2.69	2.90	0.148	1.48	1.60	4.495		
		20	85	1.640		0.193	1.93	6.33	0.079	0.79	2.59	8.922		
		20	105	1.540		0.168	1.68	5.17	0.067	0.67	2.06	7.238		
		20	125	1.410		0.156	1.56	4.40	0.090	0.9	2.54	6.937		
						Profile Total		38.97			17.12	56.09	0.28	2.15

continued

TABLE B-6. (continued)

PLOT	SAMPLE TIME	DEPTH INCREMENT cm	TOTAL DEPTH cm	BULK DENSITY gm/cc	PORTION SAMPLED	NH-4 ppm	NH-4 mg/kg	NH-4 kg/ha	NO-3 ppm	NO-3 mg/kg	NO-3 kg/ha	Inorg-N kg/ha	Inorg-N kg	Inorg-N Plot kg
2	Pre-Appli	11	11	0.980	Bare	0.527	5.27	5.68	0.380	3.80	4.10	9.777		
	cation	11	22	1.140		0.114	1.14	1.43	0.208	2.08	2.61	4.038		
		6	28	1.600		0.059	0.59	0.57	0.092	0.92	0.88	1.450		
		6	34	1.380		0.022	0.22	0.18	0.087	0.87	0.72	0.903		
		9	43	1.680		0.284	2.84	4.29	0.126	1.26	1.91	6.199		
		8	51	1.450		0.035	0.35	0.41	0.059	0.59	0.68	1.090		
		7	58	1.530		0.028	0.28	0.30	0.070	0.70	0.75	1.050		
		7	65	1.540		0.050	0.50	0.54	0.264	2.64	2.85	3.385		
		20	85	1.640		0.002	0.02	0.06	0.229	2.29	7.51	7.574		
		20	105	1.540		0.004	0.04	0.12	0.109	1.09	3.36	3.480		
		20	125	1.540		0.004	0.04	0.12	0.109	1.09	3.36	3.480		
						Profile Total		13.71			28.72	42.43	0.52	
2	Pre-Appli	11	11	0.980	Filter	0.007	0.07	0.08	0.254	2.54	2.74	2.814		
	cation	11	22	1.140		0.274	2.74	3.44	0.293	2.93	3.67	7.110		
		6	28	1.600		0.059	0.59	0.57	0.070	0.70	0.67	1.238		
		6	34	1.380		0.021	0.21	0.17	0.024	0.24	0.20	0.373		
		9	43	1.680		0.110	1.10	1.66	0.024	0.24	0.36	2.026		
		8	51	1.450		0.004	0.04	0.05	0.088	0.88	1.02	1.067		
		7	58	1.530		0.006	0.06	0.06	0.075	0.75	0.80	0.868		
		7	65	1.540		0.032	0.32	0.34	0.062	0.62	0.67	1.013		
		20	85	1.640		0.021	0.21	0.69	0.024	0.24	0.79	1.476		
		20	105	1.540		0.004	0.04	0.12	0.139	1.39	4.28	4.404		
		20	125	1.410		0.007	0.07	0.20	0.224	2.24	6.32	6.514		
						Profile Total		7.38			21.52	28.90	0.07	0.59

continued

TABLE B-6. (continued)

PLOT	SAMPLE TIME	DEPTH INCREMENT cm	TOTAL DEPTH cm	BULK DENSITY gm/cc	PORTION SAMPLED	NH-4 ppm	NH-4 mg/kg	NH-4 kg/ha	NO-3 ppm	NO-3 mg/kg	NO-3 kg/ha	Inorg-N kg/ha	Inorg-N kg	Inorg-N Plot kg
2	Post App-	11	11	0.980	Bare	0.155	1.55	1.67	3.606	36.06	38.87	40.544		
	lication	11	22	1.140		0.051	0.51	0.64	2.557	25.57	32.06	32.704		
		6	28	1.600		0.015	0.15	0.14	1.188	11.88	11.40	11.549		
		6	34	1.380		0.024	0.24	0.20	0.275	2.75	2.28	2.476		
		9	43	1.680		0.009	0.09	0.14	0.159	1.59	2.40	2.540		
		8	51	1.450		0.018	0.18	0.21	0.198	1.98	2.30	2.506		
		7	58	1.530		0.028	0.28	0.30	0.440	4.4	4.71	5.012		
		7	65	1.540		0.153	1.53	1.65	0.638	6.38	6.88	8.527		
		20	85	1.640		0.055	0.55	1.80	0.331	3.31	10.86	12.661		
		20	105	1.540		0.046	0.46	1.42	0.395	3.95	12.17	13.583		
		20	125	1.410		0.049	0.49	1.38	0.253	2.53	7.13	8.516		
						Profile Total		9.55			131.07	140.62	1.71	
2	Post App-	11	11	0.980	Filter	0.192	1.92	2.07	0.013	0.13	0.14	2.210		
	lication	11	22	1.140		0.147	1.47	1.84	0.089	0.89	1.12	2.959		
		6	28	1.600		0.008	0.08	0.08	0.054	0.54	0.52	0.595		
		6	34	1.380		0.014	0.14	0.12	0.024	0.24	0.20	0.315		
		9	43	1.680		0.035	0.35	0.53	0.043	0.43	0.65	1.179		
		8	51	1.450		0.032	0.32	0.37	0.043	0.43	0.50	0.870		
		7	58	1.530		0.005	0.05	0.05	0.037	0.37	0.40	0.450		
		7	65	1.540		0.059	0.59	0.64	0.234	2.34	2.52	3.159		
		20	85	1.640		0.004	0.04	0.13	0.087	0.87	2.85	2.985		
		20	105	1.540		0.005	0.05	0.15	0.032	0.32	0.99	1.140		
		20	125	1.410		0.002	0.02	0.06	0.054	0.54	1.52	1.579		
						Profile Total		6.04			11.40	17.44	0.04	1.75

continued

TABLE B-6. (continued)

PLOT	SAMPLE TIME	DEPTH INCREMENT cm	TOTAL DEPTH cm	BULK DENSITY gm/cc	PORTION SAMPLED	NH-4 ppm	NH-4 mg/kg	NH-4 kg/ha	NO-3 ppm	NO-3 mg/kg	NO-3 kg/ha	Inorg-N kg/ha	Inorg-N kg	Inorg-N Plot kg
3	Pre-Appli	11	11	0.980	Bare	0.378	3.78	4.07	0.463	4.63	4.99	9.066		
	cation	11	22	1.140		0.481	4.81	6.03	0.174	1.74	2.18	8.214		
		6	28	1.600		0.035	0.35	0.34	0.153	1.53	1.47	1.805		
		6	34	1.680		0.070	0.70	0.71	0.197	1.97	1.99	2.691		
		9	43	1.680		0.070	0.70	1.06	0.197	1.97	2.98	4.037		
		8	51	1.450		0.024	0.24	0.28	0.109	1.09	1.26	1.543		
		7	58	1.530		0.133	1.33	1.42	0.334	3.34	3.58	5.002		
		7	65	1.540		0.035	0.35	0.38	0.229	2.29	2.47	2.846		
		20	85	1.640		0.090	0.90	2.95	0.229	2.29	7.51	10.463		
		20	105	1.540		0.020	0.20	0.62	0.120	1.20	3.70	4.312		
		20	125	1.410		0.035	0.35	0.99	0.121	1.21	3.41	4.399		
						Profile Total		18.84			35.54	54.38	0.66	0.66
3	Post App-	11	11	0.980	Bare	0.337	3.37	3.63	4.074	40.74	43.92	47.551		
	lication	11	22	1.140		0.316	3.16	3.96	1.132	11.32	14.20	18.158		
		6	28	1.680		0.048	0.48	0.48	0.435	4.35	4.38	4.869		
		6	34	1.680		0.048	0.48	0.48	0.435	4.35	4.38	4.869		
		9	43	1.680		0.048	0.48	0.73	0.435	4.35	6.58	7.303		
		8	51	1.450		0.028	0.28	0.32	0.740	7.40	8.58	8.909		
		7	58	1.530		0.051	0.51	0.55	0.286	2.86	3.06	3.609		
		7	65	1.540		0.005	0.05	0.05	0.523	5.23	5.64	5.692		
		20	85	1.640		0.048	0.48	1.57	0.264	2.64	8.66	10.234		
		20	105	1.540		0.032	0.32	0.99	0.472	4.72	14.54	15.523		
		20	125	1.410		0.024	0.24	0.68	0.459	4.59	12.94	13.621		
						Profile Total		13.45			126.89	140.34	1.71	1.71

continued

TABLE B-6. (continued)

PLOT	SAMPLE TIME	DEPTH INCREMENT cm	TOTAL DEPTH cm	BULK DENSITY gm/cc	PORTION SAMPLED	NH-4 ppm	NH-4 mg/kg	NH-4 kg/ha	NO-3 ppm	NO-3 mg/kg	NO-3 kg/ha	Inorg-N kg/ha	Inorg-N kg	Inorg-N Plot kg
4	Pre-Appli	11	11	1.190	Bare	0.436	4.36	5.71	0.472	4.72	6.18	11.886		
	cation	11	22	1.410		0.220	2.20	3.41	0.281	2.81	4.36	7.771		
		6	28	1.540		0.134	1.34	1.24	0.256	2.56	2.37	3.604		
		6	34	1.430		0.118	1.18	1.01	0.386	3.86	3.31	4.324		
		9	43	1.550		0.076	0.76	1.06	0.182	1.82	2.54	3.599		
		8	51	1.620		0.085	0.85	1.10	0.711	7.11	9.21	10.316		
		7	58	1.690		0.241	2.41	2.85	0.166	1.66	1.96	4.815		
		7	65	1.690		0.241	2.41	2.85	0.166	1.66	1.96	4.815		
		20	85	1.680		0.253	2.53	8.50	0.158	1.58	5.31	13.810		
		20	105	1.500		0.214	2.14	6.42	0.157	1.57	4.71	11.130		
		20	125	1.500		0.453	4.53	13.59	0.100	1.00	3.00	16.590		
						Profile Total		47.74			44.91	92.66	1.13	
4	Pre-Appli	11	11	1.190	Filter	0.158	1.58	2.07	0.364	3.64	4.76	6.833		
	cation	11	22	1.410		0.430	4.30	6.67	0.043	0.43	0.67	7.336		
		6	28	1.540		0.184	1.84	1.70	0.083	0.83	0.77	2.467		
		6	34	1.430		0.176	1.76	1.51	0.240	2.40	2.06	3.569		
		9	43	1.550		0.221	2.21	3.08	0.038	0.38	0.53	3.613		
		8	51	1.620		0.222	2.22	2.88	0.035	0.35	0.45	3.331		
		7	58	1.690		0.158	1.58	1.87	0.091	0.91	1.08	2.946		
		7	65	1.690		0.158	1.58	1.87	0.091	0.91	1.08	2.946		
		20	85	1.680		0.055	0.55	1.85	0.124	1.24	4.17	6.014		
		20	105	1.500		0.171	1.71	5.13	0.079	0.79	2.37	7.500		
		20	125	1.500		0.225	2.25	6.75	0.092	0.92	2.76	9.510		
						Profile Total		35.37			20.69	56.07	0.28	1.41

continued

TABLE B-6. (continued)

PLOT	SAMPLE TIME	DEPTH INCREMENT cm	TOTAL DEPTH cm	BULK DENSITY gm/cc	PORTION SAMPLED	NH-4 ppm	NH-4 mg/kg	NH-4 kg/ha	NO-3 ppm	NO-3 mg/kg	NO-3 kg/ha	Inorg-N kg/ha	Inorg-N kg	Inorg-N Plot kg
4	Post Application	11	11	1.190	Bare	0.201	2.01	2.63	2.065	20.65	27.03	29.662		
		11	22	1.410		0.125	1.25	1.94	0.752	7.52	11.66	13.602		
		6	28	1.540		0.103	1.03	0.95	0.510	5.10	4.71	5.664		
		6	34	1.430		0.128	1.28	1.10	0.447	4.47	3.84	4.934		
		9	43	1.550		0.210	2.10	2.93	0.305	3.05	4.25	7.184		
		8	51	1.620		0.230	2.30	2.98	0.397	3.97	5.15	8.126		
		7	58	1.580		0.307	3.07	3.40	0.626	6.26	6.92	10.319		
		7	65	1.690		0.363	3.63	4.29	0.403	4.03	4.77	9.062		
		20	85	1.680		0.262	2.62	8.80	0.255	2.55	8.57	17.371		
		20	105	1.500		0.269	2.69	8.07	0.281	2.81	8.43	16.500		
		20	125	1.500		0.442	4.42	13.26	0.665	6.65	19.95	33.210		
						Profile Total		50.35			105.28	155.63	1.89	
4	Post Application	11	11	1.190	Filter	0.329	3.29	4.31	0.132	1.32	1.73	6.034		
		11	22	1.410		0.217	2.17	3.37	0.076	0.76	1.18	4.544		
		6	28	1.540		0.196	1.96	1.81	0.048	0.48	0.44	2.255		
		6	34	1.430		0.186	1.86	1.60	0.076	0.76	0.65	2.248		
		9	43	1.550		0.241	2.41	3.36	0.048	0.48	0.67	4.032		
		8	51	1.620		0.221	2.21	2.86	0.131	1.31	1.70	4.562		
		7	58	1.580		0.326	3.26	3.61	0.068	0.68	0.75	4.358		
		7	65	1.690		0.204	2.04	2.41	0.038	0.38	0.45	2.863		
		20	85	1.680		0.155	1.55	5.21	0.116	1.16	3.90	9.106		
		20	105	1.500		0.155	1.55	4.65	0.132	1.32	3.96	8.610		
		20	125	1.500		0.254	2.54	7.62	0.110	1.10	3.30	10.920		
						Profile Total		40.80			18.73	59.53	0.30	2.19

continued

TABLE B-6. (continued)

PLOT	SAMPLE TIME	DEPTH INCREMENT cm	TOTAL DEPTH cm	BULK DENSITY gm/cc	PORTION SAMPLED	NH-4 ppm	NH-4 mg/kg	NH-4 kg/ha	NO-3 ppm	NO-3 mg/kg	NO-3 kg/ha	Inorg-N kg/ha	Inorg-N kg	Inorg-N Plot kg
5	Pre-Appli	11	11	1.190	Bare	0.411	4.11	5.38	0.402	4.02	5.26	10.642		
	cation	11	22	1.410		0.469	4.69	7.27	0.402	4.02	6.24	13.509		
		6	28	1.540		0.303	3.03	2.80	0.298	2.98	2.75	5.553		
		6	34	1.500		0.460	4.60	4.14	0.423	4.23	3.81	7.947		
		9	43	1.550		0.260	2.60	3.63	0.350	3.50	4.88	8.510		
		8	51	1.620		0.118	1.18	1.53	0.198	1.98	2.57	4.095		
		7	58	1.580		0.315	3.15	3.48	0.647	6.47	7.16	10.640		
		7	65	1.690		0.235	2.35	2.78	0.206	2.06	2.44	5.217		
		20	85	1.680		0.201	2.01	6.75	0.240	2.40	8.06	14.818		
		20	105	1.500		0.217	2.17	6.51	0.109	1.09	3.27	9.780		
		20	125	1.500		0.123	1.23	3.69	0.174	1.74	5.22	8.910		
						Profile Total		47.97			51.65	99.62	1.21	
5	Pre-Appli	11	11	1.190	Filter	0.321	3.21	4.20	0.148	1.48	1.94	6.139		
	cation	11	22	1.410		0.242	2.42	3.75	0.171	1.71	2.65	6.406		
		6	28	1.540		0.097	0.97	0.90	0.108	1.08	1.00	1.894		
		6	34	1.430		0.232	2.32	1.99	0.148	1.48	1.27	3.260		
		9	43	1.550		0.247	2.47	3.45	0.048	0.48	0.67	4.115		
		8	51	1.620		0.181	1.81	2.35	0.048	0.48	0.62	2.968		
		7	58	1.580		0.198	1.98	2.19	0.131	1.31	1.45	3.639		
		7	65	1.690		0.086	0.86	1.02	0.091	0.91	1.08	2.094		
		20	85	1.680		0.230	2.30	7.73	0.051	0.51	1.71	9.442		
		20	105	1.500		0.055	0.55	1.65	0.099	0.99	2.97	4.620		
		20	125	1.500		0.081	0.81	2.43	0.132	1.32	3.96	6.390		
						Profile Total		31.65			19.32	50.97	0.13	1.34

continued

TABLE B-6. (continued)

PLOT	SAMPLE TIME	DEPTH INCREMENT cm	TOTAL DEPTH cm	BULK DENSITY gm/cc	PORTION SAMPLED	NH-4 ppm	NH-4 mg/kg	NH-4 kg/ha	NO-3 ppm	NO-3 mg/kg	NO-3 kg/ha	Inorg-N kg/ha	Inorg-N kg	Inorg-N Plot kg
5	Post App-	11	11	1.190	Bare	1.233	12.33	16.14	5.895	58.95	77.17	93.306		
	lication	11	22	1.410		0.241	2.41	3.74	5.358	53.58	83.10	86.840		
		6	28	1.540		0.509	5.09	4.70	0.461	4.61	4.26	8.963		
		6	34	1.430		0.390	3.90	3.35	0.460	4.60	3.95	7.293		
		9	43	1.550		0.277	2.77	3.86	0.252	2.52	3.52	7.380		
		8	51	1.620		0.176	1.76	2.28	0.158	1.58	2.05	4.329		
		7	58	1.580		0.218	2.18	2.41	0.544	5.44	6.02	8.428		
		7	65	1.690		1.504	15.04	17.79	0.263	2.63	3.11	20.904		
		20	85	1.680		0.205	2.05	6.89	0.207	2.07	6.96	13.843		
		20	105	1.500		0.234	2.34	7.02	0.402	4.02	12.06	19.080		
		20	125	1.500		0.208	2.08	6.24	0.363	3.63	10.89	17.130		
						Profile Total		74.42			213.07	287.49	3.49	
5	Post App-	11	11	1.190	Filter	0.387	3.87	5.07	0.114	1.14	1.49	6.558		
	lication	11	22	1.410		0.337	3.37	5.23	0.234	2.34	3.63	8.856		
		6	28	1.540		0.201	2.01	1.86	0.035	0.35	0.32	2.181		
		6	34	1.430		0.219	2.19	1.88	0.092	0.92	0.79	2.668		
		9	43	1.550		0.256	2.56	3.57	0.125	1.25	1.74	5.315		
		8	51	1.620		0.085	0.85	1.10	0.091	0.91	1.18	2.281		
		7	58	1.580		0.184	1.84	2.04	0.091	0.91	1.01	3.042		
		7	65	1.690		0.233	2.33	2.76	0.100	1.00	1.18	3.939		
		20	85	1.680		0.390	3.90	13.10	0.137	1.37	4.60	17.707		
		20	105	1.500		0.373	3.73	11.19	0.125	1.25	3.75	14.940		
		20	125	1.500		0.189	1.89	5.67	0.048	0.48	1.44	7.110		
						Profile Total		53.46			21.14	74.60	0.19	3.68

continued

TABLE B-6. (continued)

PLOT	SAMPLE TIME	DEPTH INCREMENT cm	TOTAL DEPTH cm	BULK DENSITY gm/cc	PORTION SAMPLED	NH-4 ppm	NH-4 mg/kg	NH-4 kg/ha	NO-3 ppm	NO-3 mg/kg	NO-3 kg/ha	Inorg-N kg/ha	Inorg-N kg	Inorg-N Plot kg
6	Pre-Appli cation	11	11	1.190	Bare	0.512	5.12	6.70	5.117	51.17	66.98	73.684		
		11	22	1.410		0.295	2.95	4.58	0.240	2.40	3.72	8.298		
		6	28	1.540		0.268	2.68	2.48	0.448	4.48	4.14	6.616		
		6	34	1.430		0.266	2.66	2.28	0.018	0.18	0.15	2.437		
		9	43	1.550		0.184	1.84	2.57	0.035	0.35	0.49	3.055		
		8	51	1.620		0.206	2.06	2.67	0.606	6.06	7.85	10.524		
		7	58	1.580		0.369	3.69	4.08	0.200	2.00	2.21	6.293		
		7	65	1.690		0.521	5.21	6.16	0.356	3.56	4.21	10.375		
		20	85	1.680		0.235	2.35	7.90	0.194	1.94	6.52	14.414		
		20	105	1.500		0.276	2.76	8.28	0.183	1.83	5.49	13.770		
		20	125	1.500		0.229	2.29	6.87	0.151	1.51	4.53	11.400		
						Profile Total		54.56			106.30	160.87	1.95	1.95
6	Post App- lication	11	11	1.190	Bare	0.567	5.67	7.42	2.041	20.41	26.72	34.139		
		11	22	1.410		0.413	4.13	6.41	1.347	13.47	20.89	27.298		
		6	28	1.540		0.321	3.21	2.97	0.764	7.64	7.06	10.025		
		6	34	1.430		0.142	1.42	1.22	0.470	4.70	4.03	5.251		
		9	43	1.550		0.087	0.87	1.21	0.121	1.21	1.69	2.902		
		8	51	1.620		0.169	1.69	2.19	0.084	0.84	1.09	3.279		
		7	58	1.580		0.072	0.72	0.80	0.794	7.94	8.78	9.578		
		7	65	1.690		0.321	3.21	3.80	0.436	4.36	5.16	8.955		
		20	85	1.680		0.181	1.81	6.08	0.229	2.29	7.69	13.776		
		20	105	1.500		0.271	2.71	8.13	0.131	1.31	3.93	12.060		
		20	125	1.500		0.213	2.13	6.39	0.109	1.09	3.27	9.660		
						Profile Total		46.61			90.31	136.92	1.66	1.66

continued

TABLE B-6. (continued)

PLOT	SAMPLE TIME	DEPTH INCREMENT cm	TOTAL DEPTH cm	BULK DENSITY gm/cc	PORTION SAMPLED	NH-4 ppm	NH-4 mg/kg	NH-4 kg/ha	NO-3 ppm	NO-3 mg/kg	NO-3 kg/ha	Inorg-N kg/ha	Inorg-N kg	Inorg-N Plot kg
7	Pre-Appli	11	11	1.420	Bare	0.306	3.06	4.78	0.733	7.33	11.45	16.229		
	cation	11	22	1.670		0.172	1.72	3.16	0.143	1.43	2.63	5.787		
		6	28	1.340		0.233	2.33	1.87	0.125	1.25	1.01	2.878		
		6	34	1.490		0.215	2.15	1.92	0.316	3.16	2.83	4.747		
		9	43	1.640		0.063	0.63	0.93	0.460	4.60	6.79	7.719		
		8	51	1.540		0.214	2.14	2.64	0.198	1.98	2.44	5.076		
		7	58	1.740		0.300	3.00	3.65	0.150	1.50	1.83	5.481		
		7	65	1.340		0.082	0.82	0.77	0.606	6.06	5.68	6.453		
		20	85	1.570		0.208	2.08	6.53	0.229	2.29	7.19	13.722		
		20	105	1.550		0.234	2.34	7.25	0.229	2.29	7.10	14.353		
		20	125	1.560		0.312	3.12	9.73	0.171	1.71	5.34	15.070		
						Profile Total		43.24			54.27	97.52	1.18	
7	Pre-Appli	11	11	1.420	Filter	0.528	5.28	8.25	0.018	0.18	0.28	8.529		
	cation	11	22	1.670		0.384	3.84	7.05	0.256	2.56	4.70	11.757		
		6	28	1.340		0.316	3.16	2.54	0.115	1.15	0.92	3.465		
		6	34	1.640		0.546	5.46	5.37	0.035	0.35	0.34	5.717		
		9	43	1.640		0.546	5.46	8.06	0.035	0.35	0.52	8.576		
		8	51	1.540		0.459	4.59	5.65	0.129	1.29	1.59	7.244		
		7	58	1.740		0.374	3.74	4.56	0.114	1.14	1.39	5.944		
		7	65	1.340		0.096	0.96	0.90	0.169	1.69	1.59	2.486		
		20	85	1.570		0.101	1.01	3.17	0.145	1.45	4.55	7.724		
		20	105	1.550		0.124	1.24	3.84	0.104	1.04	3.22	7.068		
		20	125	1.560		0.078	0.78	2.43	0.363	3.63	11.33	13.759		
						Profile Total		51.83			30.44	82.27	0.41	1.60

continued

TABLE B-6. (continued)

PLOT	SAMPLE TIME	DEPTH INCREMENT cm	TOTAL DEPTH cm	BULK DENSITY gm/cc	PORTION SAMPLED	NH-4 ppm	NH-4 mg/kg	NH-4 kg/ha	NO-3 ppm	NO-3 mg/kg	NO-3 kg/ha	Inorg-N kg/ha	Inorg-N kg	Inorg-N Plot kg
7	Post Application	11	11	1.420	Bare	0.457	4.57	7.14	0.978	9.78	15.28	22.415		
		11	22	1.670		0.270	2.70	4.96	2.220	22.20	40.78	45.741		
		6	28	1.340		0.868	8.68	6.98	1.909	19.09	15.35	22.327		
		6	34	1.490		0.205	2.05	1.83	1.215	12.15	10.86	12.695		
		9	43	1.640		0.223	2.23	3.29	0.316	3.16	4.66	7.956		
		8	51	1.540		0.059	0.59	0.73	0.715	7.15	8.81	9.536		
		7	58	1.740		0.267	2.67	3.25	0.117	1.17	1.43	4.677		
		7	65	1.340		0.085	0.85	0.80	0.533	5.33	5.00	5.797		
		20	85	1.570		0.347	3.47	10.90	0.240	2.40	7.54	18.432		
		20	105	1.550		0.196	1.96	6.08	0.172	1.72	5.33	11.408		
		20	125	1.560		0.190	1.90	5.93	0.194	1.94	6.05	11.981		
						Profile Total		51.88			121.09	172.96	2.10	
7	Post Application	11	11	1.420	Filter	0.394	3.94	6.15	0.173	1.73	2.70	8.857		
		11	22	1.670		0.108	1.08	1.98	0.423	4.23	7.77	9.754		
		6	28	1.340		0.394	3.94	3.17	0.018	0.18	0.14	3.312		
		6	34	1.640		0.409	4.09	4.02	0.125	1.25	1.23	5.255		
		9	43	1.640		0.409	4.09	6.04	0.125	1.25	1.85	7.882		
		8	51	1.540		0.692	6.92	8.53	0.814	8.14	10.03	18.554		
		7	58	1.740		0.690	6.90	8.40	0.423	4.23	5.15	13.556		
		7	65	1.340		0.063	0.63	0.59	0.326	3.26	3.06	3.649		
		20	85	1.570		0.059	0.59	1.85	0.350	3.50	10.99	12.843		
		20	105	1.550		0.196	1.96	6.08	0.131	1.31	4.06	10.137		
		20	125	1.560		0.734	7.34	22.90	0.399	3.99	12.45	35.350		
						Profile Total		69.72			59.43	129.15	0.65	2.75

continued

TABLE B-6. (continued)

PLOT	SAMPLE TIME	DEPTH INCREMENT cm	TOTAL DEPTH cm	BULK DENSITY gm/cc	PORTION SAMPLED	NH-4 ppm	NH-4 mg/kg	NH-4 kg/ha	NO-3 ppm	NO-3 mg/kg	NO-3 kg/ha	Inorg-N kg/ha	Inorg-N kg	Inorg-N Plot kg
8	Pre-Appli	11	11	1.420	Bare	0.608	6.08	9.50	0.728	7.28	11.37	20.868		
	cation	11	22	1.670		0.564	5.64	10.36	0.035	0.35	0.64	11.004		
		6	28	1.340		0.485	4.85	3.90	1.011	10.11	8.13	12.028		
		6	34	1.490		0.346	3.46	3.09	0.035	0.35	0.31	3.406		
		9	43	1.640		0.322	3.22	4.75	0.286	2.86	4.22	8.974		
		8	51	1.540		0.408	4.08	5.03	0.134	1.34	1.65	6.677		
		7	58	1.740		0.400	4.00	4.87	0.184	1.84	2.24	7.113		
		7	65	1.340		0.295	2.95	2.77	0.223	2.23	2.09	4.859		
		20	85	1.570		0.462	4.62	14.51	0.068	0.68	2.14	16.642		
		20	105	1.550		0.532	5.32	16.49	0.162	1.62	5.02	21.514		
		20	125	1.560		0.082	0.82	2.56	0.521	5.21	16.26	18.814		
						Profile Total		77.83			54.07	131.90	1.60	
8	Pre-Appli	11	11	1.420	Filter	0.736	7.36	11.50	0.139	1.39	2.17	13.668		
	cation	11	11	1.420		0.736	7.36	11.50	0.139	1.39	2.17	13.668		
		6	28	1.340		0.294	2.94	2.36	0.399	3.99	3.21	5.572		
		6	34	1.540		0.642	6.42	5.93	0.018	0.18	0.17	6.098		
		9	43	1.540		0.642	6.42	8.90	0.018	0.18	0.25	9.148		
		8	51	1.540		0.642	6.42	7.91	0.018	0.18	0.22	8.131		
		7	58	1.740		0.550	5.50	6.70	0.102	1.02	1.24	7.941		
		7	65	1.340		0.357	3.57	3.35	0.139	1.39	1.30	4.652		
		20	85	1.570		0.347	3.47	10.90	0.092	0.92	2.89	13.785		
		20	105	1.560		0.312	3.12	9.73	0.226	2.26	7.05	16.786		
		20	125	1.560		0.312	3.12	9.73	0.226	2.26	7.05	16.786		
						Profile Total		88.51			27.73	116.23	0.29	1.89

continued

TABLE B-6. (continued)

PLOT	SAMPLE TIME	DEPTH INCREMENT cm	TOTAL DEPTH cm	BULK DENSITY gm/cc	PORTION SAMPLED	NH-4 ppm	NH-4 mg/kg	NH-4 kg/ha	NO-3 ppm	NO-3 mg/kg	NO-3 kg/ha	Inorg-N kg/ha	Inorg-N kg	Inorg-N Plot kg
8	Post Application	11	11	1.420	Bare	0.347	3.47	5.42	0.119	1.19	1.86	7.279		
		11	22	1.670		0.353	3.53	6.48	3.316	33.16	60.91	67.400		
		6	28	1.340		0.288	2.88	2.32	1.605	16.05	12.90	15.220		
		6	34	1.490		0.420	4.20	3.75	1.099	10.99	9.83	13.580		
		9	43	1.640		0.301	3.01	4.44	0.893	8.93	13.18	17.623		
		8	51	1.540		0.492	4.92	6.06	0.257	2.57	3.17	9.228		
		7	58	1.740		0.868	8.68	10.57	0.224	2.24	2.73	13.301		
		7	65	1.340		0.423	4.23	3.97	0.233	2.33	2.19	6.153		
		20	85	1.570		0.353	3.53	11.08	0.125	1.25	3.93	15.009		
		20	105	1.550		0.119	1.19	3.69	0.035	0.35	1.09	4.774		
		20	125	1.560		0.281	2.81	8.77	0.347	3.47	10.83	19.594		
						Profile Total		66.56			122.60	189.16	2.30	
8	Post Application	11	11	1.420	Filter	0.823	8.23	12.86	0.228	2.28	3.56	16.417		
		11	22	1.670		0.103	1.03	1.89	0.399	3.99	7.33	9.222		
		6	28	1.340		0.569	5.69	4.57	0.131	1.31	1.05	5.628		
		6	34	1.540		0.779	7.79	7.20	0.149	1.49	1.38	8.575		
		9	43	1.540		0.779	7.79	10.80	0.149	1.49	2.07	12.862		
		8	51	1.540		0.779	7.79	9.60	0.149	1.49	1.84	11.433		
		7	58	1.740		0.343	3.43	4.18	0.228	2.28	2.78	6.955		
		7	65	1.340		0.249	2.49	2.34	0.092	0.92	0.86	3.199		
		20	85	1.570		0.394	3.94	12.37	0.149	1.49	4.68	17.050		
		20	105	1.570		0.394	3.94	12.37	0.149	1.49	4.68	17.050		
		20	125	1.570		0.394	3.94	12.37	0.149	1.49	4.68	17.050		
						Profile Total		90.54			34.90	125.44	0.31	2.61

continued

TABLE B-6. (continued)

PLOT	SAMPLE TIME	DEPTH INCREMENT cm	TOTAL DEPTH cm	BULK DENSITY gm/cc	PORTION SAMPLED	NH-4 ppm	NH-4 mg/kg	NH-4 kg/ha	NO-3 ppm	NO-3 mg/kg	NO-3 kg/ha	Inorg-N kg/ha	Inorg-N kg	Inorg-N Plot kg
9	Pre-Appli	11	11	1.420	Bare	0.477	4.77	7.45	0.459	4.59	7.17	14.620		
	cation	11	22	1.670		0.362	3.62	6.65	0.224	2.24	4.11	10.765		
		6	28	1.340		0.214	2.14	1.72	1.257	12.57	10.11	11.827		
		6	34	1.490		0.206	2.06	1.84	0.117	1.17	1.05	2.888		
		9	43	1.740		0.235	2.35	3.68	0.124	1.24	1.94	5.622		
		8	51	1.740		0.235	2.35	3.27	0.124	1.24	1.73	4.997		
		7	58	1.740		0.235	2.35	2.86	0.124	1.24	1.51	4.373		
		7	65	1.340		0.556	5.56	5.22	0.217	2.17	2.04	7.251		
		20	85	1.570		0.237	2.37	7.44	0.290	2.90	9.11	16.548		
		20	105	1.550		0.364	3.64	11.28	0.114	1.14	3.53	14.818		
		20	125	1.560		0.279	2.79	8.70	0.169	1.69	5.27	13.978		
						Profile Total		60.12			47.56	107.69	1.31	1.31
9	Post App-	11	11	1.420	Bare	0.364	3.64	5.69	1.347	13.47	21.04	26.726		
	lication	11	22	1.670		0.229	2.29	4.21	1.803	18.03	33.12	37.328		
		6	28	1.340		0.210	2.10	1.69	1.342	13.42	10.79	12.478		
		6	34	1.490		0.217	2.17	1.94	1.508	15.08	13.48	15.422		
		9	43	1.740		0.260	2.60	4.07	0.324	3.24	5.07	9.145		
		8	51	1.740		0.260	2.60	3.62	0.324	3.24	4.51	8.129		
		7	58	1.740		0.260	2.60	3.17	0.324	3.24	3.95	7.113		
		7	65	1.340		0.554	5.54	5.20	0.557	5.57	5.22	10.421		
		20	85	1.570		0.846	8.46	26.56	0.402	4.02	12.62	39.187		
		20	105	1.550		0.543	5.43	16.83	0.184	1.84	5.70	22.537		
		20	125	1.560		0.266	2.66	8.30	0.298	2.98	9.30	17.597		
						Profile Total		81.27			124.81	206.08	2.50	2.50

TABLE B-7. INORGANIC NITROGEN LEACHING SUMMARY (TOTALS FOR 125 cm PROFILE)

PLOT	FILTER LENGTH m	BARE AREA kg/ha Before	After	% CHANGE	FILTER AREA kg/ha Before	After	% CHANGE	TOTAL PLOT kg Before	After	NET CHANGE kg	%
1	9.2	124.56	153.89	23.55	98.54	56.09	-43.08	2.01	2.15	0.14	6.97
2	4.6	42.43	140.62	231.42	28.90	17.44	-39.65	0.59	1.75	1.16	196.61
3	0	54.68	140.34	156.66				0.66	1.71	1.05	159.09
4	9.2	92.66	155.63	67.96	56.07	59.53	6.17	1.41	2.19	0.78	55.32
5	4.6	99.62	287.49	188.59	50.97	74.60	46.36	1.34	3.68	2.34	174.63
6	0	160.87	136.92	-14.89				1.95	1.66	-0.29	-14.87
7	9.2	97.52	172.96	77.36	82.27	129.15	56.98	1.60	2.75	1.15	71.87
8	4.6	131.90	189.16	43.41	116.23	125.44	7.92	1.89	2.61	0.72	38.10
9	0	107.69	206.08	91.36				1.31	2.50	1.19	90.84
							Average	1.42	2.33	0.92	
							Variance	0.24	0.37	0.48	
							Std. Dev.	0.49	0.61	0.70	

TABLE B-8. PREDICTED VS. OBSERVED POLLUTANT REDUCTIONS, NCSU MODEL

RUN	PLOT	SLOPE %	FILTER WIDTH m	FILTER/ SOURCE RATIO K	INFIL to PRECIP RATIO D	1/1+K	1/1-D	% REDUC (predict)	TP % REDUC (obs)	TN % REDUC (obs)	TSS % REDUC (obs)
1	1	4	9.2	0.413	0.79	0.71	4.71	72.27	70.96	85.87	84.71
2	1	4	9.2	0.413	0.55	0.71	2.20	33.92	-23.37	35.75	89.47
3	1	4	9.2	0.413	0.43	0.71	1.74	22.60	21.33	56.84	66.03
4	1	4	9.2	0.413	0.57	0.71	2.32	36.63	61.40	80.93	71.07
5	1	4	9.2	0.413	0.60	0.71	2.53	40.98	90.43	69.96	77.78
6	1	4	9.2	0.413	0.38	0.71	1.62	19.21	-641.42	-1.16	63.05
9	1	4	9.2	0.413	0.40	0.71	1.66	20.30	-20.51	58.61	80.57
10	1	4	9.2	0.413	0.57	0.71	2.33	36.95	54.74	56.07	89.28
11	1	4	9.2	0.413	0.60	0.71	2.48	40.09	82.41	27.96	88.68
12	1	4	9.2	0.413	0.36	0.71	1.57	18.00	53.65	43.31	77.67
1	2	4	4.6	0.207	0.58	0.83	2.36	22.60	61.53	-388.58	89.20
2	2	4	4.6	0.207	0.40	0.83	1.68	11.95	-233.77	32.74	86.18
3	2	4	4.6	0.207	0.22	0.83	1.28	5.18	-1.71	36.94	58.15
4	2	4	4.6	0.207	0.47	0.83	1.87	15.10	-15.49	29.04	62.97
5	2	4	4.6	0.207	0.26	0.83	1.34	6.26	34.78	-44.44	67.10
6	2	4	4.6	0.207	0.00	0.83	1.00	0.00	-828.23	-171.26	42.48
9	2	4	4.6	0.207	0.26	0.83	1.35	6.36	-63.55	-26.23	46.10
10	2	4	4.6	0.207	0.49	0.83	1.95	16.41	5.12	27.11	71.78
11	2	4	4.6	0.207	0.44	0.83	1.79	13.75	50.44	-74.22	70.31
12	2	4	4.6	0.207	0.30	0.83	1.43	7.76	-15.20	-194.05	55.80
1	4	3	9.2	0.413	0.67	0.71	3.07	51.13	53.56	72.43	99.14
2	4	3	9.2	0.413	0.59	0.71	2.44	39.24	69.91	56.59	84.79
3	4	3	9.2	0.413	0.40	0.71	1.68	20.82	75.16	-23.31	85.02
4	4	3	9.2	0.413	0.59	0.71	2.43	39.11	90.01	50.83	88.84
5	4	3	9.2	0.413	0.60	0.71	2.49	40.21	34.28	71.11	91.98
6	4	3	9.2	0.413	0.49	0.71	1.96	28.28	53.68	76.62	86.50
8	4	3	9.2	0.413	0.61	0.71	2.56	41.62	43.61	35.03	93.26
9	4	3	9.2	0.413	0.47	0.71	1.88	26.16	39.23	63.88	92.84
10	4	3	9.2	0.413	0.79	0.71	4.78	72.96	82.56	79.22	95.08
11	4	3	9.2	0.413	0.63	0.71	2.68	43.99	74.32	73.21	92.20
12	4	3	9.2	0.413	0.48	0.71	1.92	27.36	71.55	69.82	88.82

continued

TABLE 8-8. (continued)

RUN	PLOT	SLOPE %	FILTER WIDTH m	FILTER/ SOURCE RATIO K	INFIL to PRECIP RATIO D	1/1+K	1/1-D	% REDUC (predict)	TP % REDUC (obs)	TN % REDUC (obs)	TSS % REDUC (obs)
1	5	3	4.6	0.207	0.38	0.83	1.62	11.04	34.65	58.81	94.98
2	5	3	4.6	0.207	0.21	0.83	1.26	4.78	58.37	74.05	75.13
3	5	3	4.6	0.207	0.12	0.83	1.14	2.65	68.60	24.76	-155.17
4	5	3	4.6	0.207	0.35	0.83	1.54	9.74	44.82	-42.89	60.72
5	5	3	4.6	0.207	0.37	0.83	1.58	10.27	70.07	59.36	86.87
6	5	3	4.6	0.207	0.23	0.83	1.30	5.52	39.40	59.51	79.96
8	5	3	4.6	0.207	0.47	0.83	1.87	15.14	47.20	14.22	89.75
9	5	3	4.6	0.207	0.31	0.83	1.45	8.04	52.27	52.07	91.15
10	5	3	4.6	0.207	0.61	0.83	2.54	25.08	67.75	66.54	94.36
11	5	3	4.6	0.207	0.58	0.83	2.39	22.99	85.82	82.18	86.76
12	5	3	4.6	0.207	0.46	0.83	1.85	14.79	78.27	79.10	96.17
1	7	5	9.2	0.413	0.48	0.71	1.91	27.08	12.53	41.47	91.21
2	7	5	9.2	0.413	0.45	0.71	1.83	25.03	63.32	79.27	68.74
3	7	5	9.2	0.413	0.16	0.71	1.19	6.31	3.21	74.70	5.63
4	7	5	9.2	0.413	0.31	0.71	1.44	14.20	35.60	40.42	54.25
5	7	5	9.2	0.413	0.27	0.71	1.38	12.27	-213.98	2.91	50.09
6	7	5	9.2	0.413	0.20	0.71	1.25	8.40	92.57	49.11	63.58
7	7	5	9.2	0.413	0.69	0.71	3.27	54.34	36.19	-1.42	86.19
8	7	5	9.2	0.413	0.39	0.71	1.64	19.86	33.95	-39.87	73.21
9	7	5	9.2	0.413	0.21	0.71	1.26	8.60	11.47	2.88	44.37
10	7	5	9.2	0.413	0.28	0.71	1.38	12.31	52.77	42.56	65.30
11	7	5	9.2	0.413	0.29	0.71	1.41	13.35	17.64	50.12	24.35
12	7	5	9.2	0.413	0.19	0.71	1.24	7.89	100.00	-83.10	48.80
1	8	5	4.6	0.207	0.33	0.83	1.49	8.84	5.72	-36.86	81.92
2	8	5	4.6	0.207	0.22	0.83	1.28	5.14	30.12	43.67	44.07
3	8	5	4.6	0.207	0.13	0.83	1.15	2.76	44.74	68.97	35.35
4	8	5	4.6	0.207	0.14	0.83	1.17	3.06	45.46	45.93	1.23
5	8	5	4.6	0.207	0.03	0.83	1.03	0.57	70.74	-169.97	26.56
6	8	5	4.6	0.207	0.00	0.83	1.00	0.00	93.25	44.84	39.34
7	8	5	4.6	0.207	0.62	0.83	2.63	26.35	12.64	-17.00	57.31
8	8	5	4.6	0.207	0.36	0.83	1.57	10.12	52.95	11.32	45.71
9	8	5	4.6	0.207	0.12	0.83	1.14	2.62	-13.88	-74.51	-4.32
10	8	5	4.6	0.207	0.22	0.83	1.28	5.20	57.04	45.89	21.28
11	8	5	4.6	0.207	0.14	0.83	1.16	2.97	-62.32	-10.54	-69.07
12	8	5	4.6	0.207	0.07	0.83	1.08	1.46	67.31	-107.19	19.15
							AVE	19.48	11.03	15.12	62.30
							STD	16.53	144.78	79.96	40.48

TABLE B-9. PREDICTED VS. OBSERVED POLLUTANT REDUCTIONS, USDA MODEL

RUN	PLOT	SLOPE %	FILTER WIDTH m	CONTACT TIME (GOOD)	CONTACT TIME (FAIR)	% REDUC GOOD (predict)	% REDUC FAIR (predict)	TP % REDUC (obs)	TN % REDUC (obs)	TSS % REDUC (obs)
1	1	4	9.2	25.03	21.30	21.32	17.79	70.96	85.87	84.71
2	1	4	9.2	25.03	21.30	21.32	17.79	-23.37	35.75	89.47
3	1	4	9.2	25.03	21.30	21.32	17.79	21.33	56.84	66.03
4	1	4	9.2	25.03	21.30	21.32	17.79	61.40	80.93	71.07
5	1	4	9.2	25.03	21.30	21.32	17.79	90.43	69.96	77.78
6	1	4	9.2	25.03	21.30	21.32	17.79	-641.42	-1.16	63.05
9	1	4	9.2	25.03	21.30	21.32	17.79	-20.51	58.61	80.57
10	1	4	9.2	25.03	21.30	21.32	17.79	54.74	56.07	89.28
11	1	4	9.2	25.03	21.30	21.32	17.79	82.41	27.96	88.68
12	1	4	9.2	25.03	21.30	21.32	17.79	53.65	43.31	77.67
1	2	4	4.6	12.51	10.65	6.12	2.59	61.53	-388.58	89.20
2	2	4	4.6	12.51	10.65	6.12	2.59	-233.77	32.74	86.18
3	2	4	4.6	12.51	10.65	6.12	2.59	-1.71	36.94	58.15
4	2	4	4.6	12.51	10.65	6.12	2.59	-15.49	29.04	62.97
5	2	4	4.6	12.51	10.65	6.12	2.59	34.78	-44.44	67.10
6	2	4	4.6	12.51	10.65	6.12	2.59	-828.23	-171.26	42.48
9	2	4	4.6	12.51	10.65	6.12	2.59	-63.55	-26.23	46.10
10	2	4	4.6	12.51	10.65	6.12	2.59	5.12	27.11	71.78
11	2	4	4.6	12.51	10.65	6.12	2.59	50.44	-74.22	70.31
12	2	4	4.6	12.51	10.65	6.12	2.59	-15.20	-194.05	55.80
1	4	3	9.2	28.90	24.60	24.48	20.94	53.56	72.43	99.14
2	4	3	9.2	28.90	24.60	24.48	20.94	69.91	56.59	84.79
3	4	3	9.2	28.90	24.60	24.48	20.94	75.16	-23.31	85.02
4	4	3	9.2	28.90	24.60	24.48	20.94	90.01	50.83	88.84
5	4	3	9.2	28.90	24.60	24.48	20.94	34.28	71.11	91.98
6	4	3	9.2	28.90	24.60	24.48	20.94	53.68	76.62	86.50
8	4	3	9.2	28.90	24.60	24.48	20.94	43.61	35.03	93.26
9	4	3	9.2	28.90	24.60	24.48	20.94	39.23	63.88	92.84
10	4	3	9.2	28.90	24.60	24.48	20.94	82.56	79.22	95.08
11	4	3	9.2	28.90	24.60	24.48	20.94	74.32	73.21	92.20
12	4	3	9.2	28.90	24.60	24.48	20.94	71.55	69.82	88.82

continued

TABLE 8-9. (continued)

RUN	PLOT	SLOPE %	FILTER WIDTH m	CONTACT TIME (GOOD)	CONTACT TIME (FAIR)	% REDUC GOOD (predict)	% REDUC FAIR (predict)	TP % REDUC (obs)	TN % REDUC (obs)	TSS % REDUC (obs)
1	5	3	4.6	14.45	12.30	9.27	5.74	34.65	58.81	94.98
2	5	3	4.6	14.45	12.30	9.27	5.74	58.37	74.05	75.13
3	5	3	4.6	14.45	12.30	9.27	5.74	68.60	24.76	-155.17
4	5	3	4.6	14.45	12.30	9.27	5.74	44.82	-42.89	60.72
5	5	3	4.6	14.45	12.30	9.27	5.74	70.07	59.36	86.87
6	5	3	4.6	14.45	12.30	9.27	5.74	39.40	59.51	79.96
8	5	3	4.6	14.45	12.30	9.27	5.74	47.20	14.22	89.75
9	5	3	4.6	14.45	12.30	9.27	5.74	52.27	52.07	91.15
10	5	3	4.6	14.45	12.30	9.27	5.74	67.75	66.54	94.36
11	5	3	4.6	14.45	12.30	9.27	5.74	85.82	82.18	86.76
12	5	3	4.6	14.45	12.30	9.27	5.74	78.27	79.10	96.17
1	7	5	9.2	22.39	19.05	18.88	15.34	12.53	41.47	91.21
2	7	5	9.2	22.39	19.05	18.88	15.34	63.32	79.27	68.74
3	7	5	9.2	22.39	19.05	18.88	15.34	3.21	74.70	5.63
4	7	5	9.2	22.39	19.05	18.88	15.34	35.60	40.42	54.25
5	7	5	9.2	22.39	19.05	18.88	15.34	-213.98	2.91	50.09
6	7	5	9.2	22.39	19.05	18.88	15.34	92.57	49.11	63.58
7	7	5	9.2	22.39	19.05	18.88	15.34	36.19	-1.42	86.19
8	7	5	9.2	22.39	19.05	18.88	15.34	33.95	-39.87	73.21
9	7	5	9.2	22.39	19.05	18.88	15.34	11.47	2.88	44.37
10	7	5	9.2	22.39	19.05	18.88	15.34	52.77	42.56	65.30
11	7	5	9.2	22.39	19.05	18.88	15.34	17.64	50.12	24.35
12	7	5	9.2	22.39	19.05	18.88	15.34	100.00	-83.10	48.80
1	8	5	4.6	11.19	9.53	3.67	0.14	5.72	-36.86	81.92
2	8	5	4.6	11.19	9.53	3.67	0.14	30.12	43.67	44.07
3	8	5	4.6	11.19	9.53	3.67	0.14	44.74	68.97	35.35
4	8	5	4.6	11.19	9.53	3.67	0.14	45.46	45.93	1.23
5	8	5	4.6	11.19	9.53	3.67	0.14	70.74	-169.97	26.56
6	8	5	4.6	11.19	9.53	3.67	0.14	93.25	44.84	39.34
7	8	5	4.6	11.19	9.53	3.67	0.14	12.64	-17.00	57.31
8	8	5	4.6	11.19	9.53	3.67	0.14	52.95	11.32	45.71
9	8	5	4.6	11.19	9.53	3.67	0.14	-13.88	-74.51	-4.32
10	8	5	4.6	11.19	9.53	3.67	0.14	57.04	45.89	21.28
11	8	5	4.6	11.19	9.53	3.67	0.14	-62.32	-10.54	-69.07
12	8	5	4.6	11.19	9.53	3.67	0.14	67.31	-107.19	19.15
					AVE	13.88	10.35	11.03	15.12	62.30
					STD	7.95	7.95	144.78	79.96	40.48

APPENDIX C

POLLUTANT REDUCTION & NITROGEN LEACHING GRAPHS

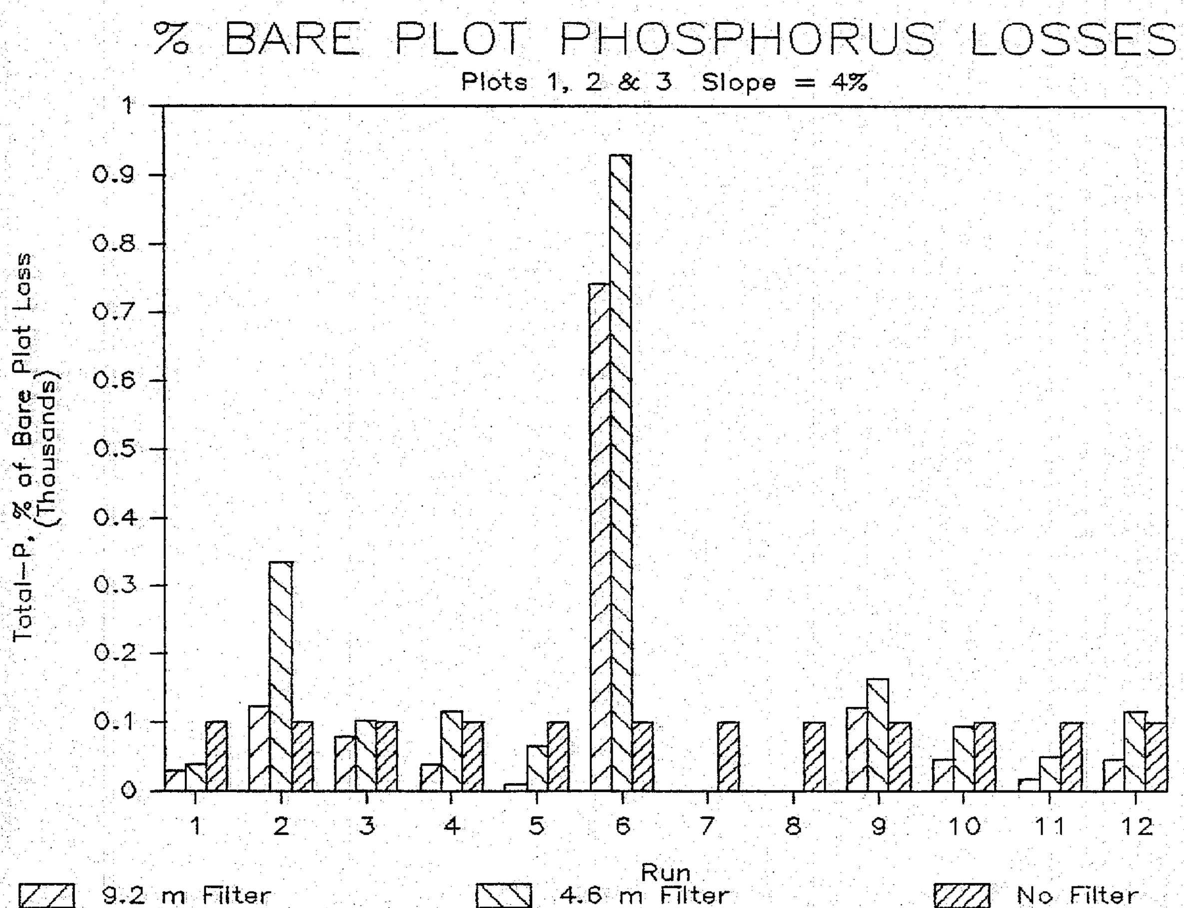

Figure C-1. Mass losses of TP from Plot 1 (with 9.2 m VFS) and Plot 2 (with 4.6 m VFS), expressed as a percentage of Plot 3 (with no VFS) losses.

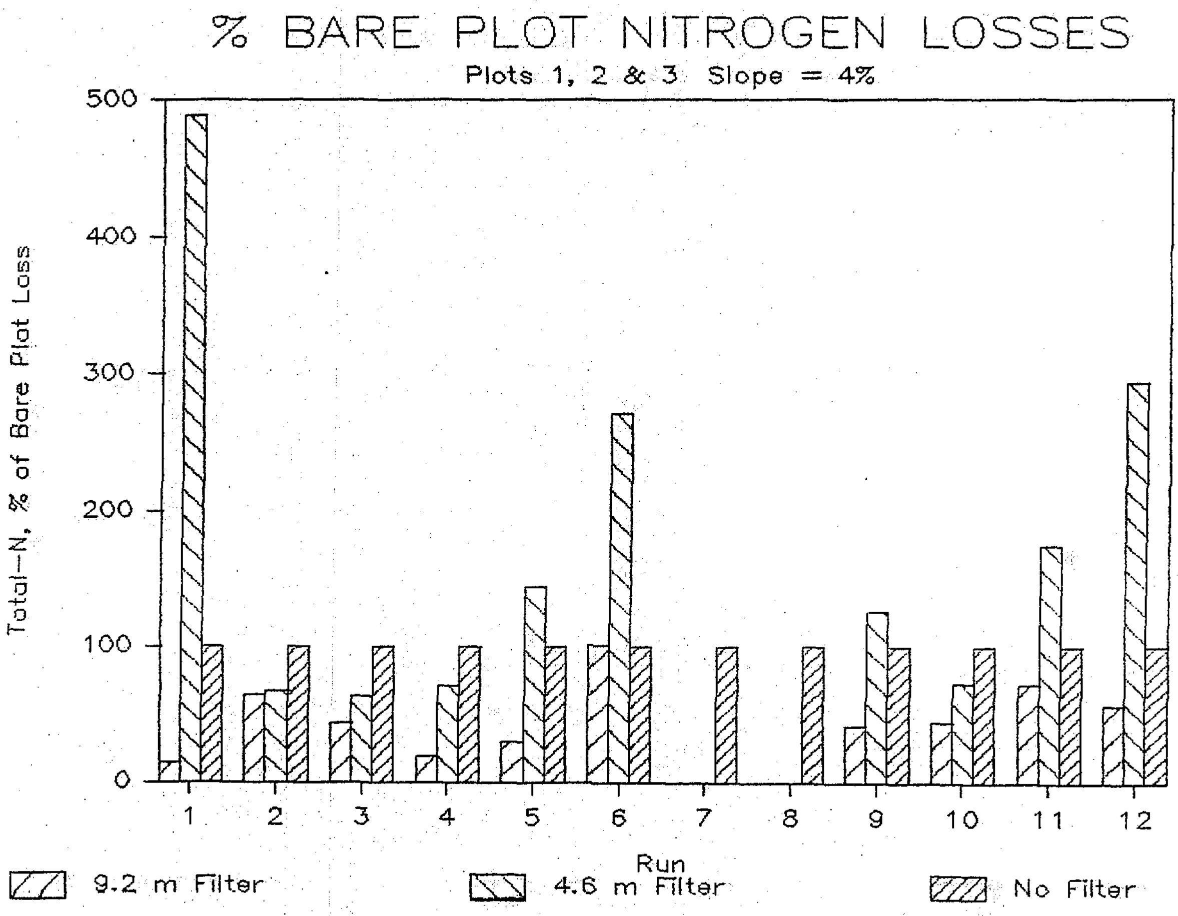

Figure C-2. Mass losses of TN from Plot 1 (with 9.2 m VFS) and Plot 2 (with 4.6 m VFS), expressed as a percentage of Plot 3 (with no VFS) losses.

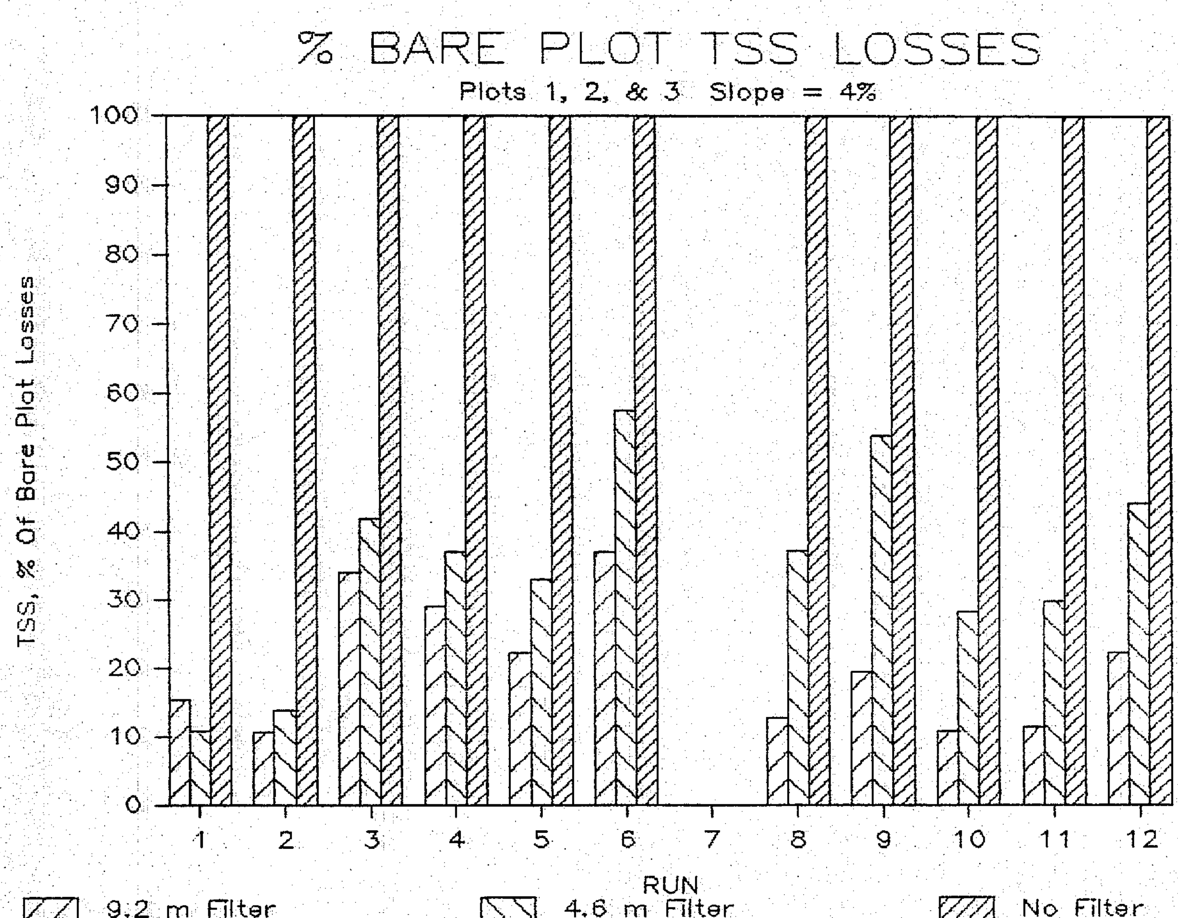

Figure C-3. Mass losses of TSS from Plot 1 (with 9.2 m VFS) and Plot 2 (with 4.6 m VFS), expressed as a percentage of Plot 3 (with no VFS) losses.

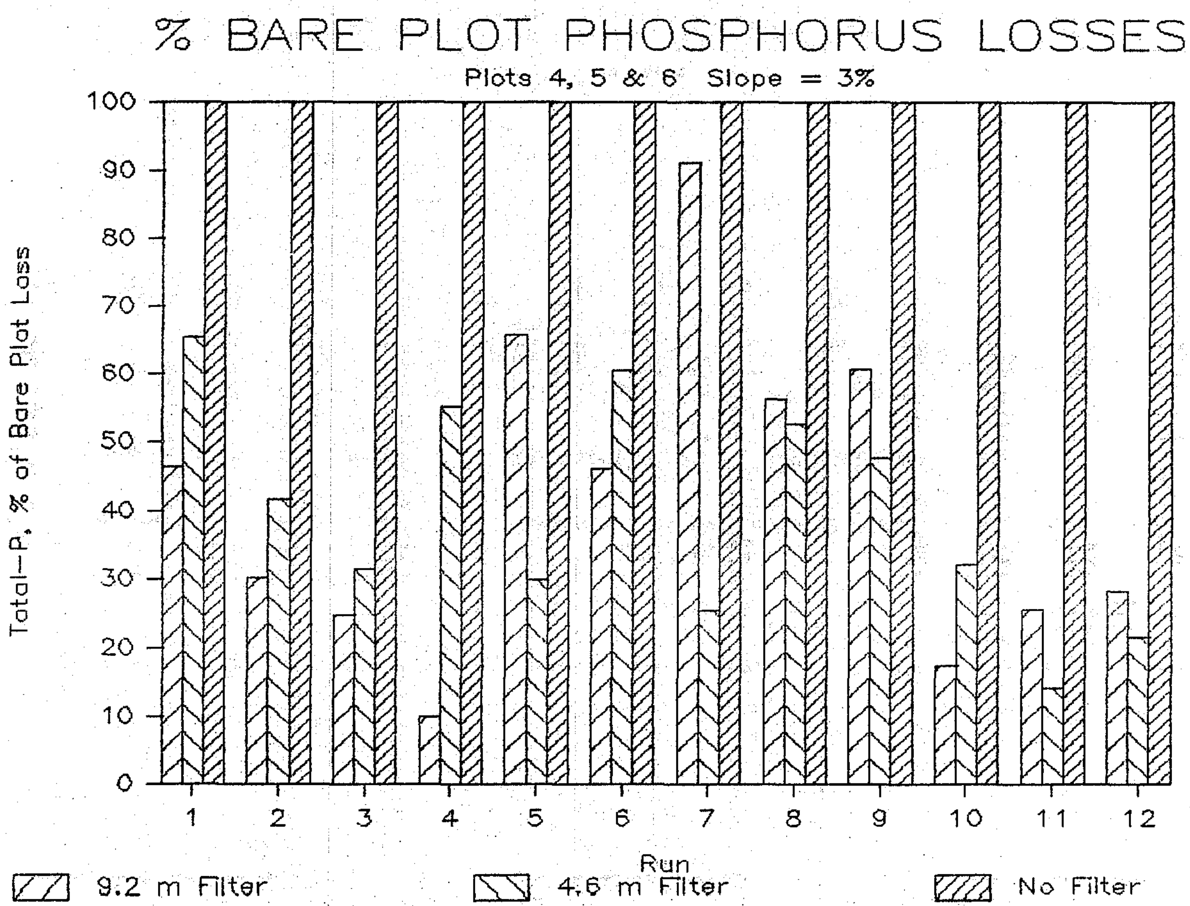

Figure C-4. Mass losses of TP from Plot 4 (with 9.2 m VFS) and Plot 5 (with 4.6 m VFS), expressed as a percentage of Plot 6 (with no VFS) losses.

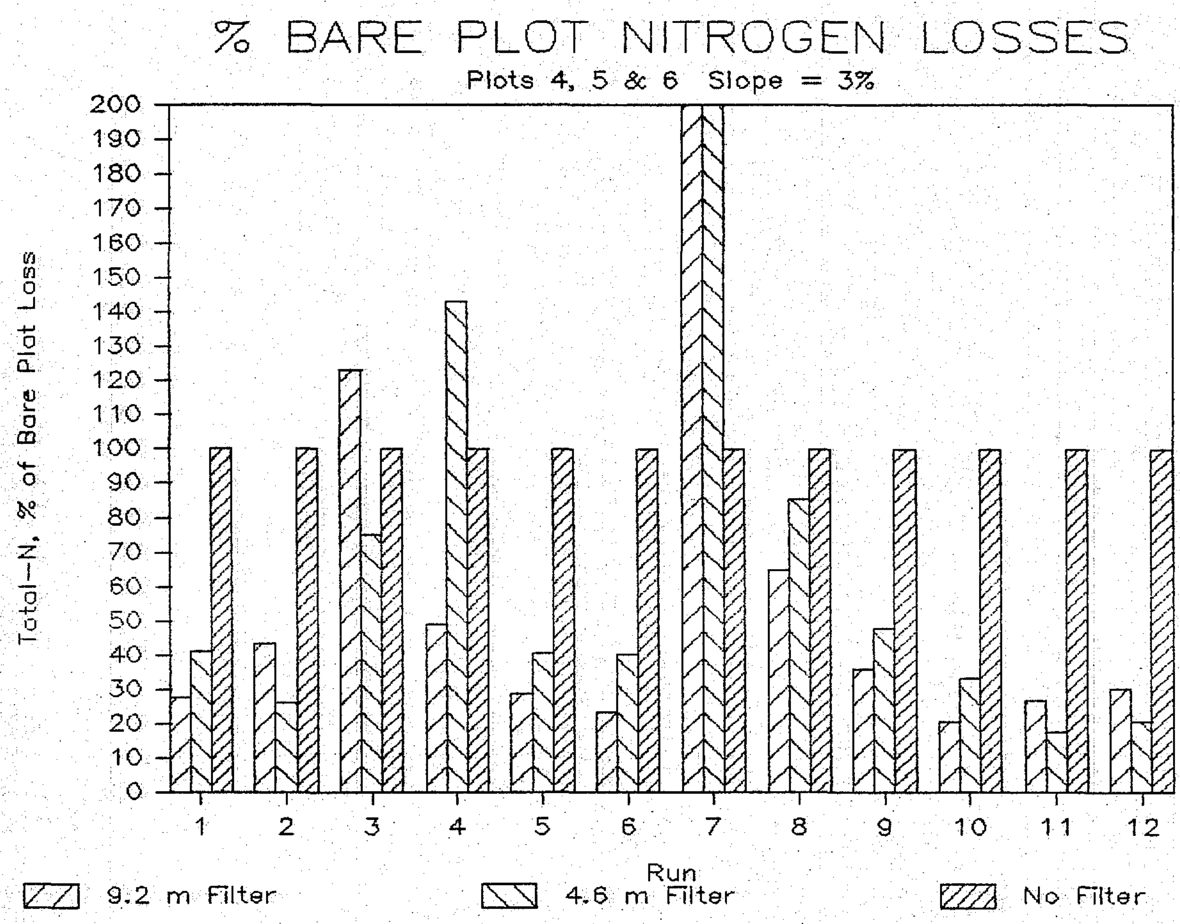

Figure C-5. Mass losses of TN from Plot 4 (with 9.2 m VFS) and Plot 5 (with 4.6 m VFS), expressed as a percentage of Plot 6 (with no VFS) losses.

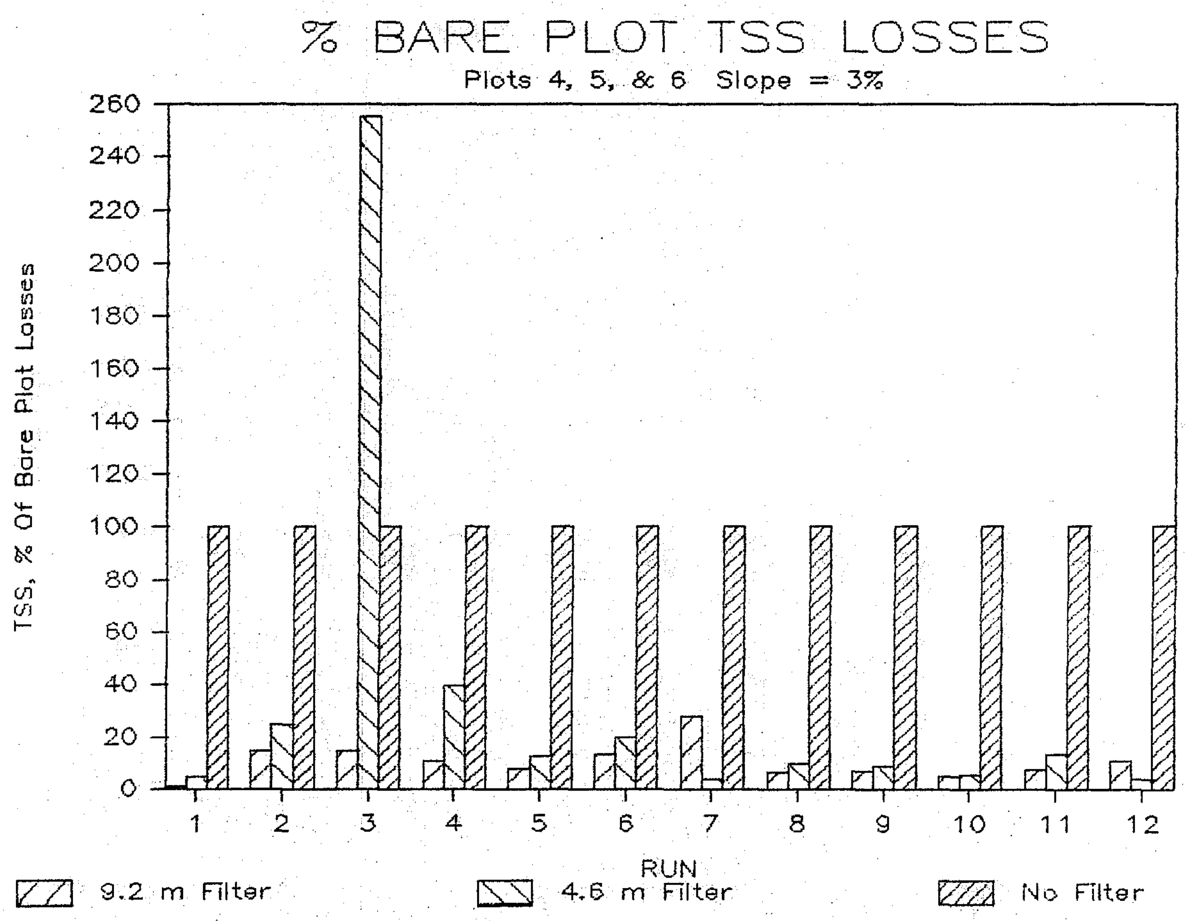

Figure C-6. Mass losses of TSS from Plot 4 (with 9.2 m VFS) and Plot 5 (with 4.6 m VFS), expressed as a percentage of Plot 6 (with no VFS) losses.

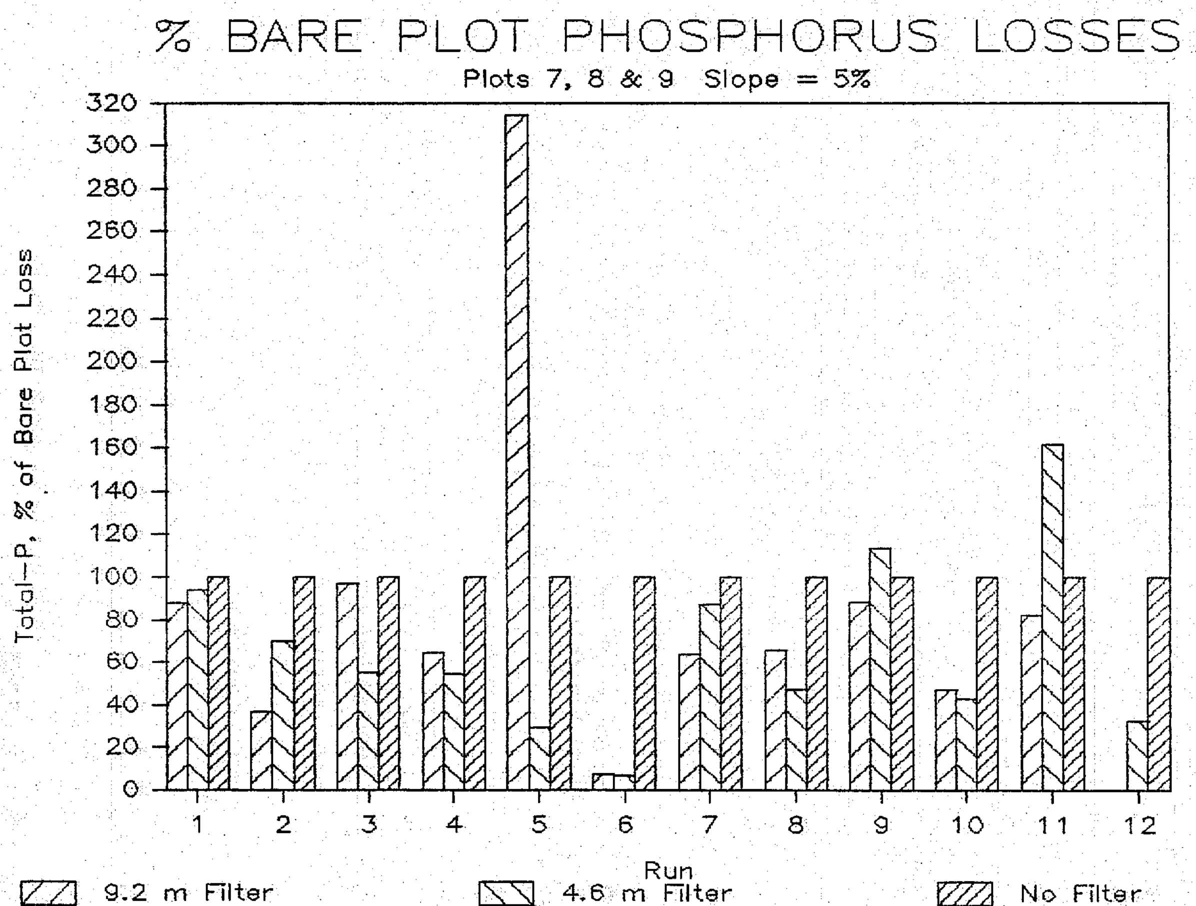

Figure C-7. Mass losses of TP from Plot 7 (with 9.2 m VFS) and Plot 8 (with 4.6 m VFS), expressed as a percentage of Plot 9 (with no VFS) losses.

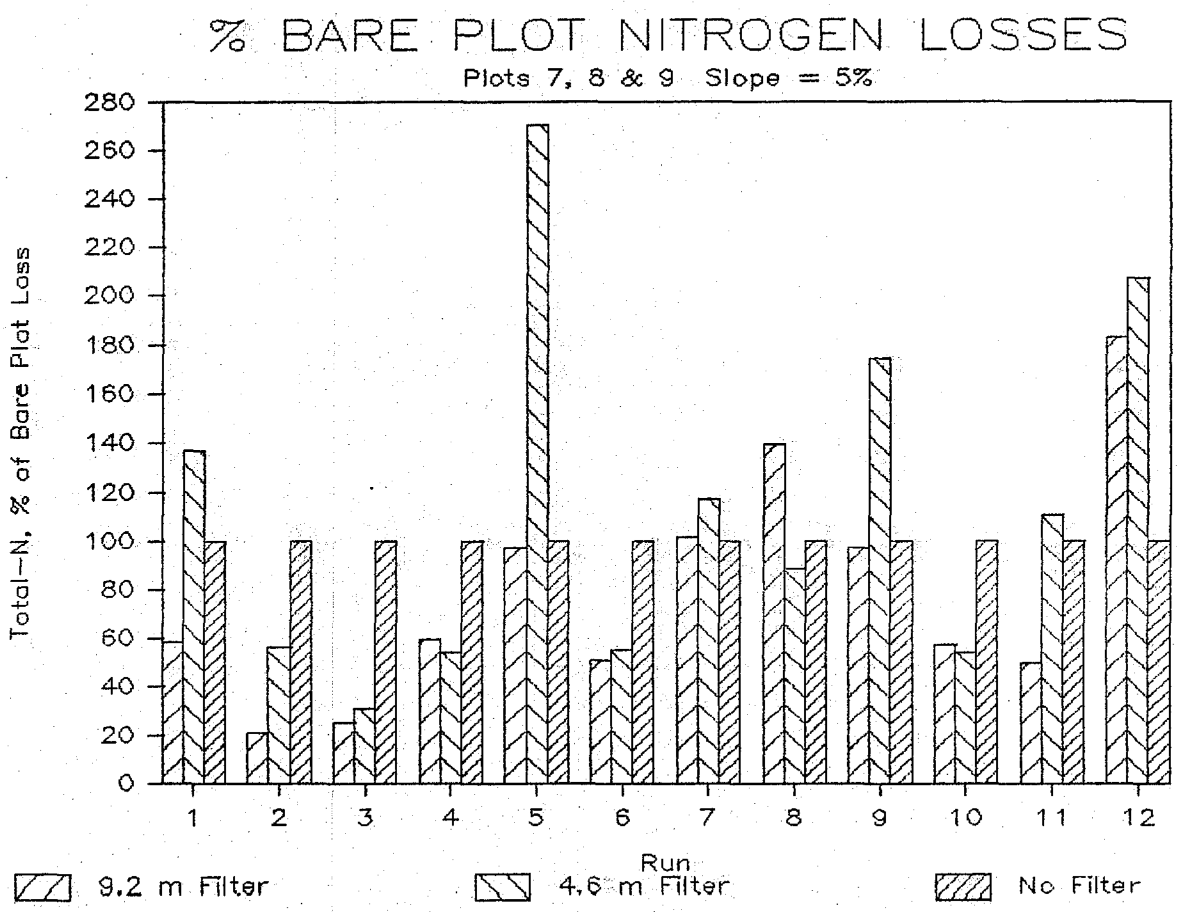

Figure C-8. Mass losses of TN from Plot 7 (with 9.2 m VFS) and Plot 8 (with 4.6 m VFS), expressed as a percentage of Plot 9 (with no VFS) losses.

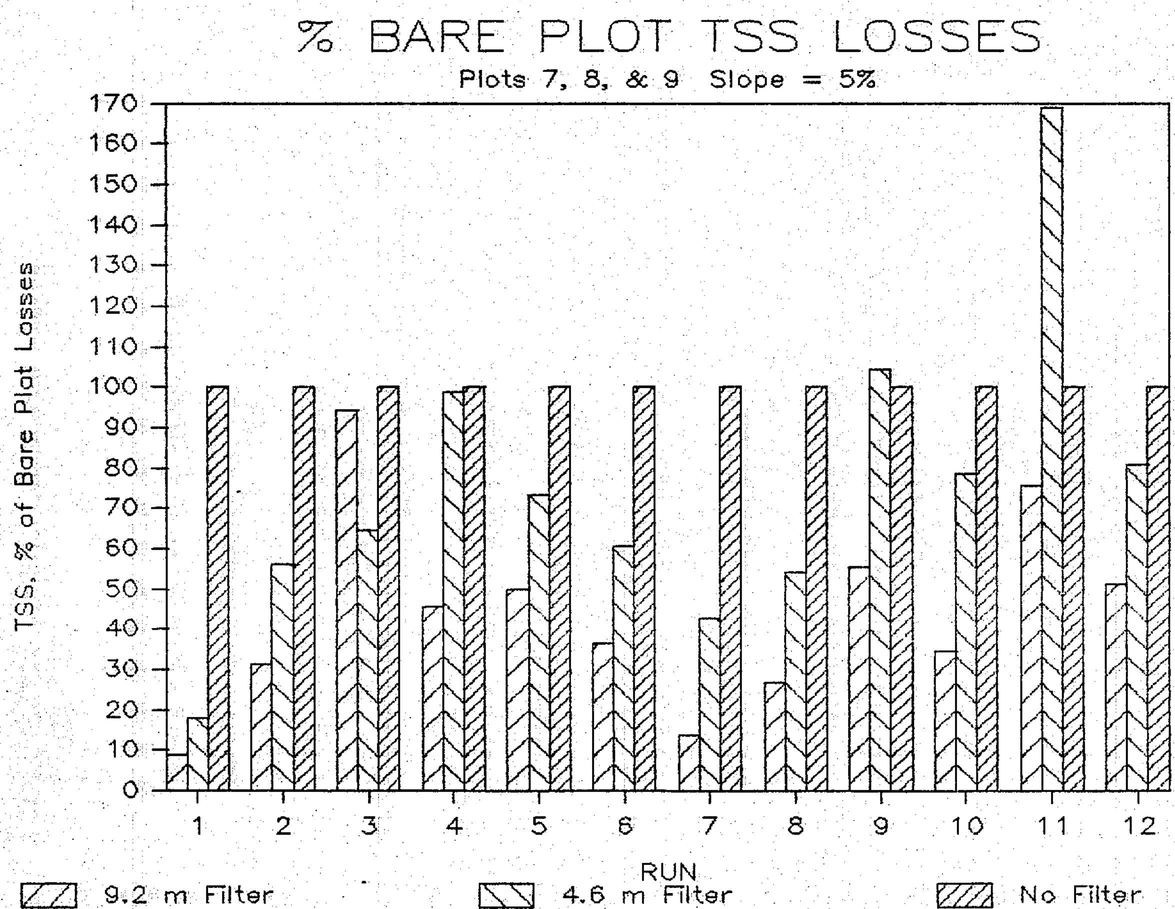

Figure C-9. Mass losses of TSS from Plot 7 (with 9.2 m VFS) and Plot 8 (with 4.6 m VFS), expressed as a percentage of Plot 9 (with no VFS) losses.

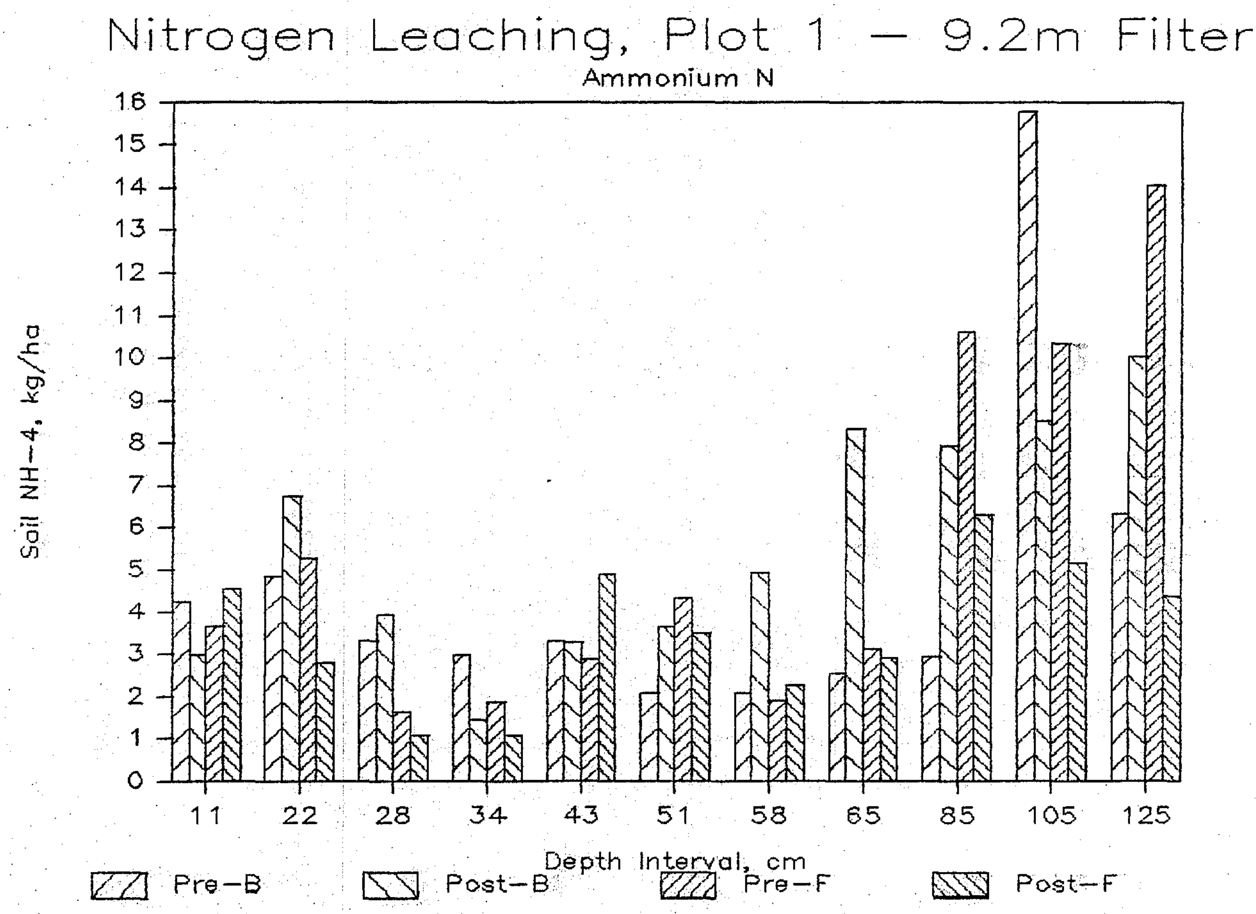

Figure C-10. Comparison of ammonium-N in soil profile of bare portion (Pre-B) and VFS (Pre-F) of Plot 1 before UAN tests and after UAN tests (Post-B and Post-F).

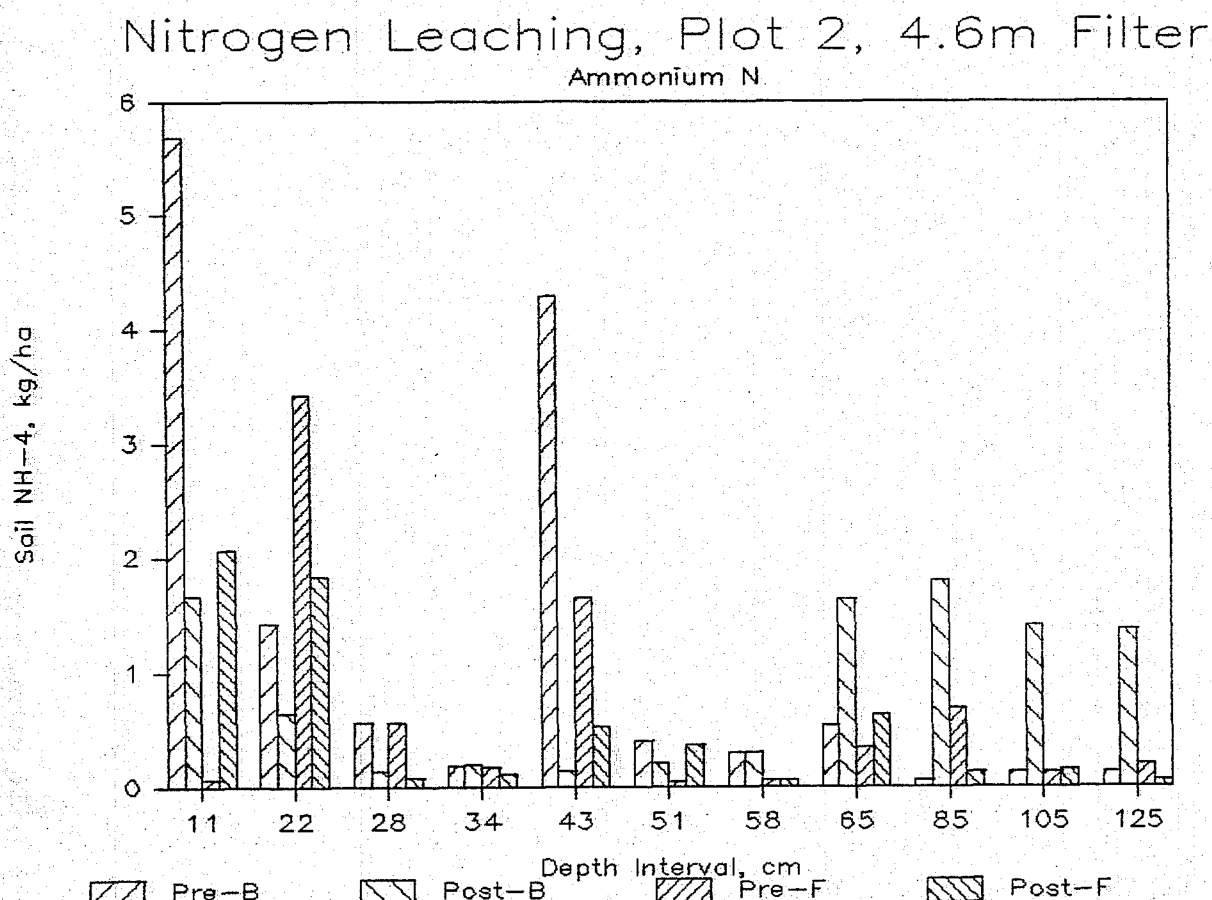

Figure C-11. Comparison of ammonium-N in soil profile of bare portion (Pre-B) and VFS (Pre-F) of Plot 2 before UAN tests and after UAN tests (Post-B and Post-F).

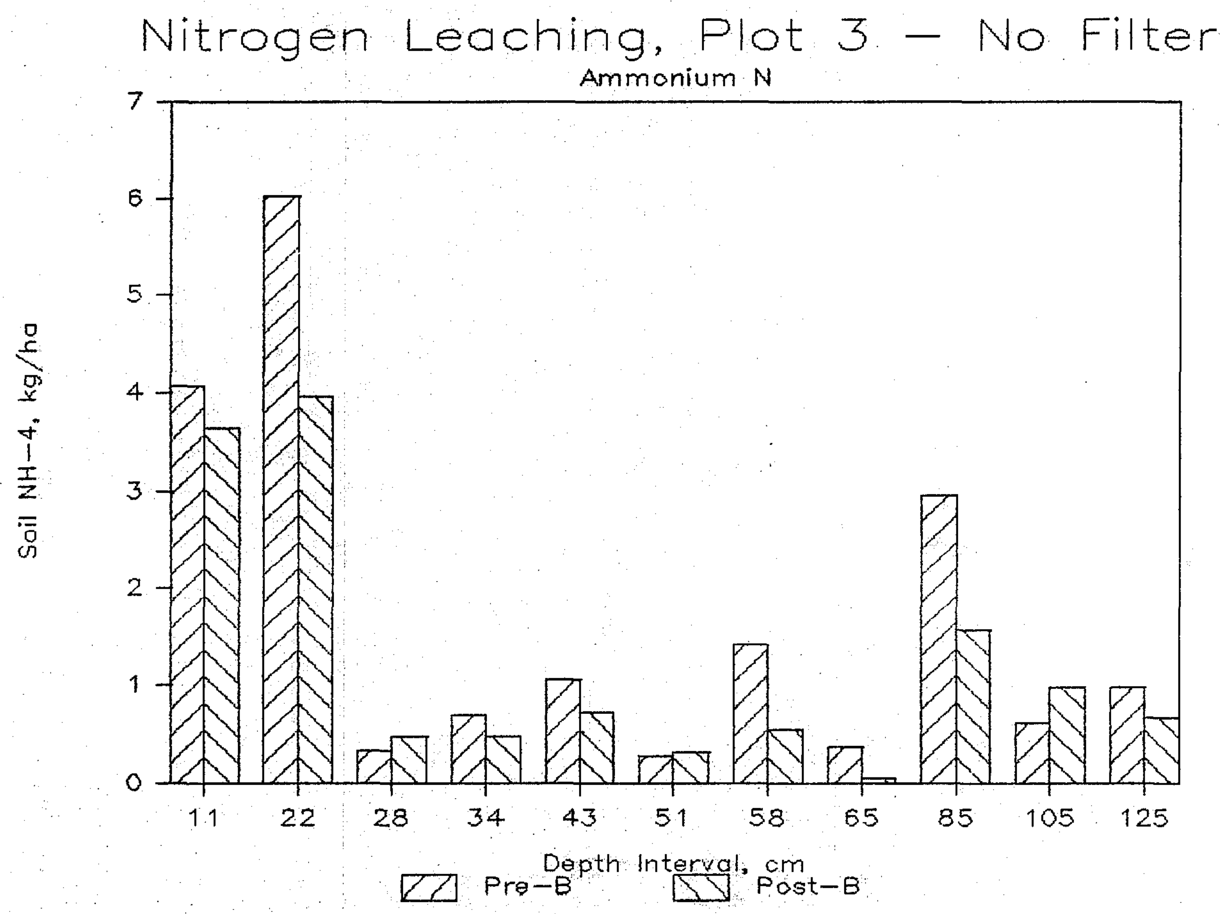

Figure C-12. Comparison of ammonium-N in soil profile of Plot 3 before UAN tests (Pre-B) and after UAN tests (Post-B).

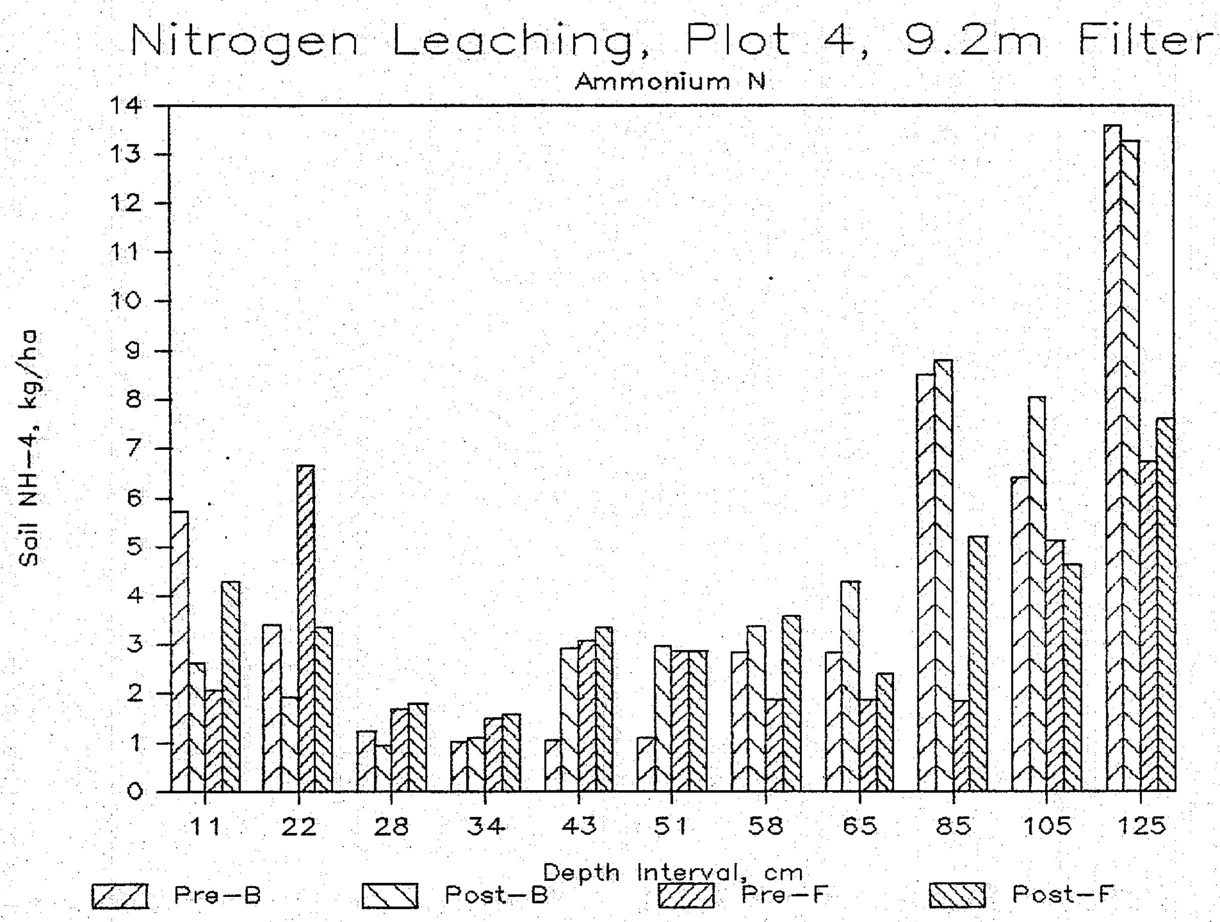

Figure C-13. Comparison of ammonium-N in soil profile of bare portion (Pre-B) and VFS (Pre-F) of Plot 4 before UAN tests and after UAN tests (Post-B and Post-F).

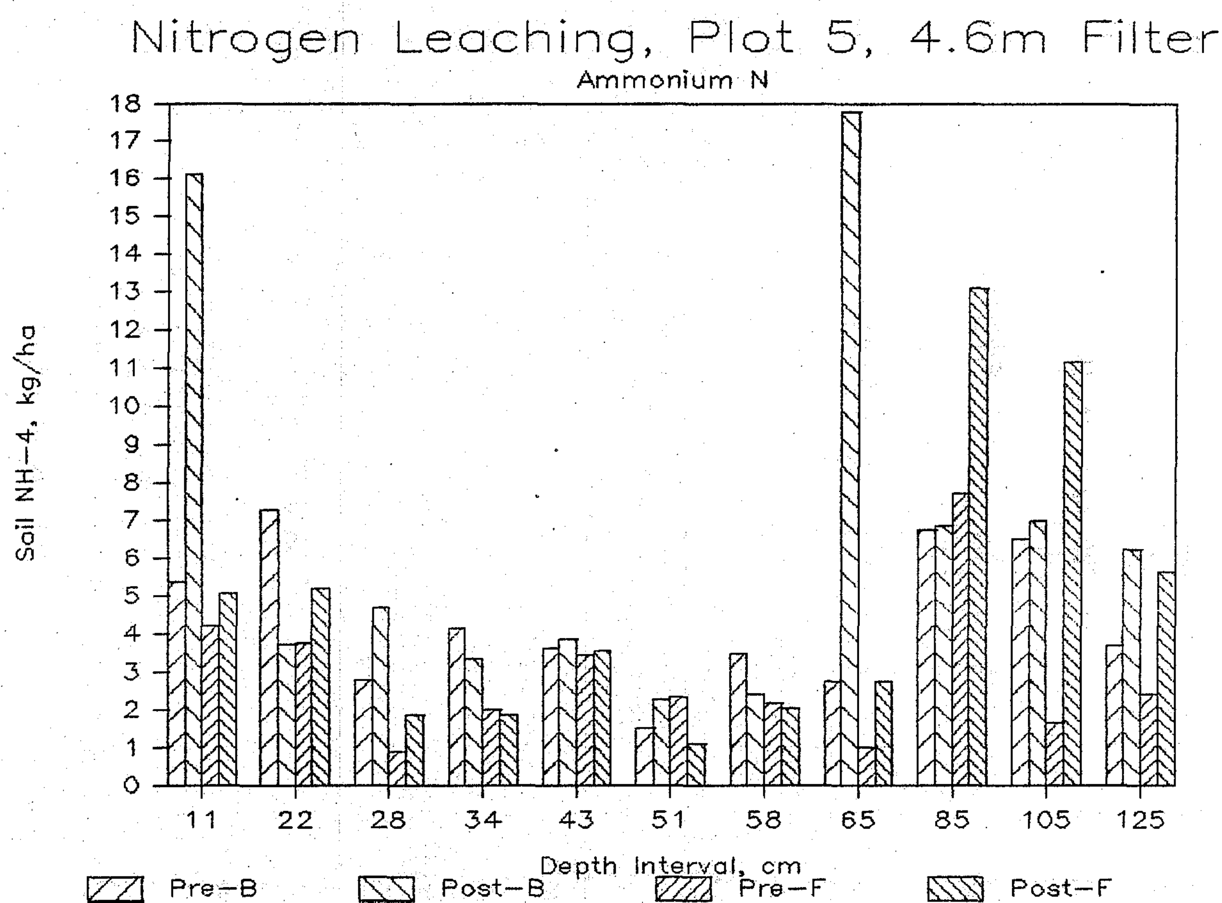

Figure C-14. Comparison of ammonium-N in soil profile of bare portion (Pre-B) and VFS (Pre-F) of Plot 5 before UAN tests and after UAN tests (Post-B and Post-F).

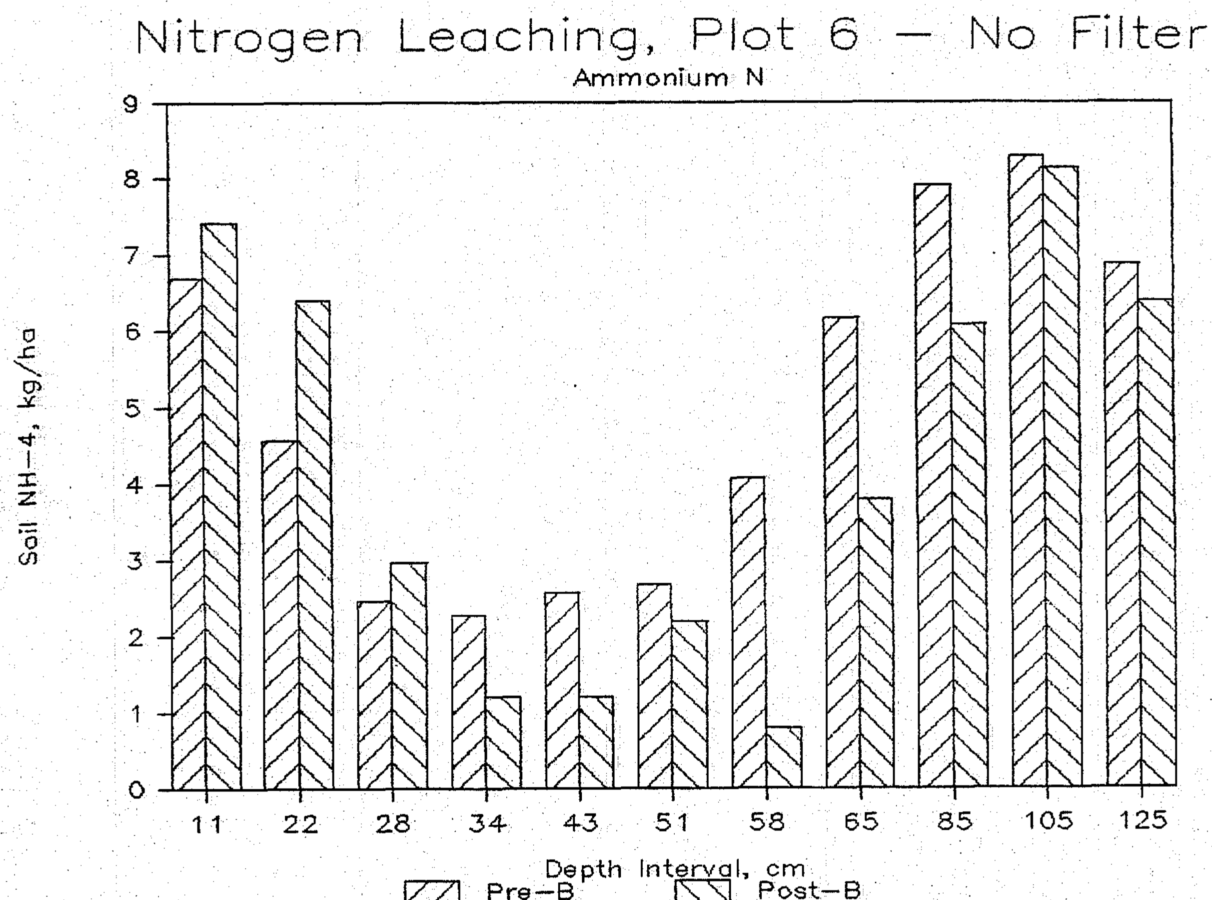

Figure C-15. Comparison of ammonium-N in soil profile of Plot 6 before UAN tests (Pre-B) and after UAN tests (Post-B).

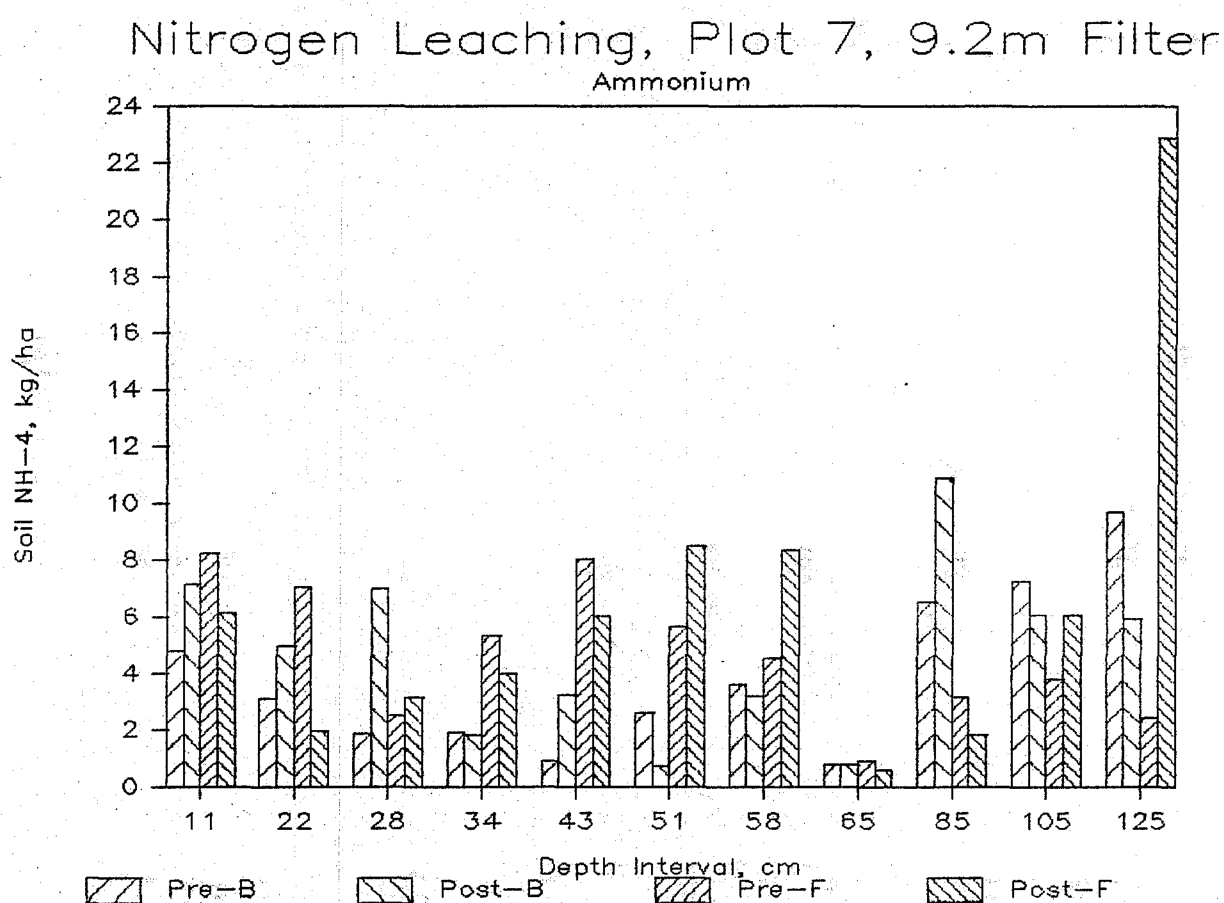

Figure C-16. Comparison of ammonium-N in soil profile of bare portion (Pre-B) and VFS (Pre-F) of Plot 7 before UAN tests and after UAN tests (Post-B and Post-F).

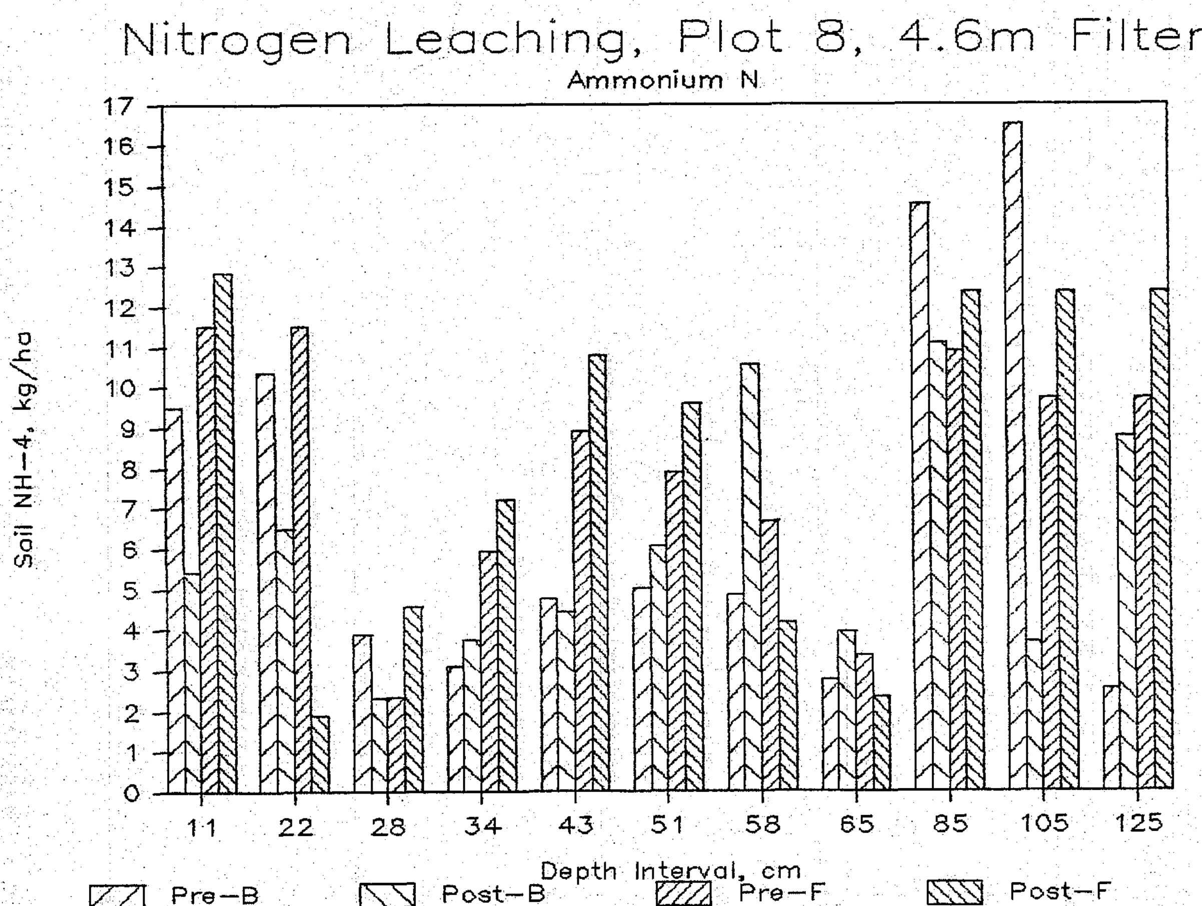

Figure C-17. Comparison of ammonium-N in soil profile of bare portion (Pre-B) and VFS (Pre-F) of Plot 8 before UAN tests and after UAN tests (Post-B and Post-F).

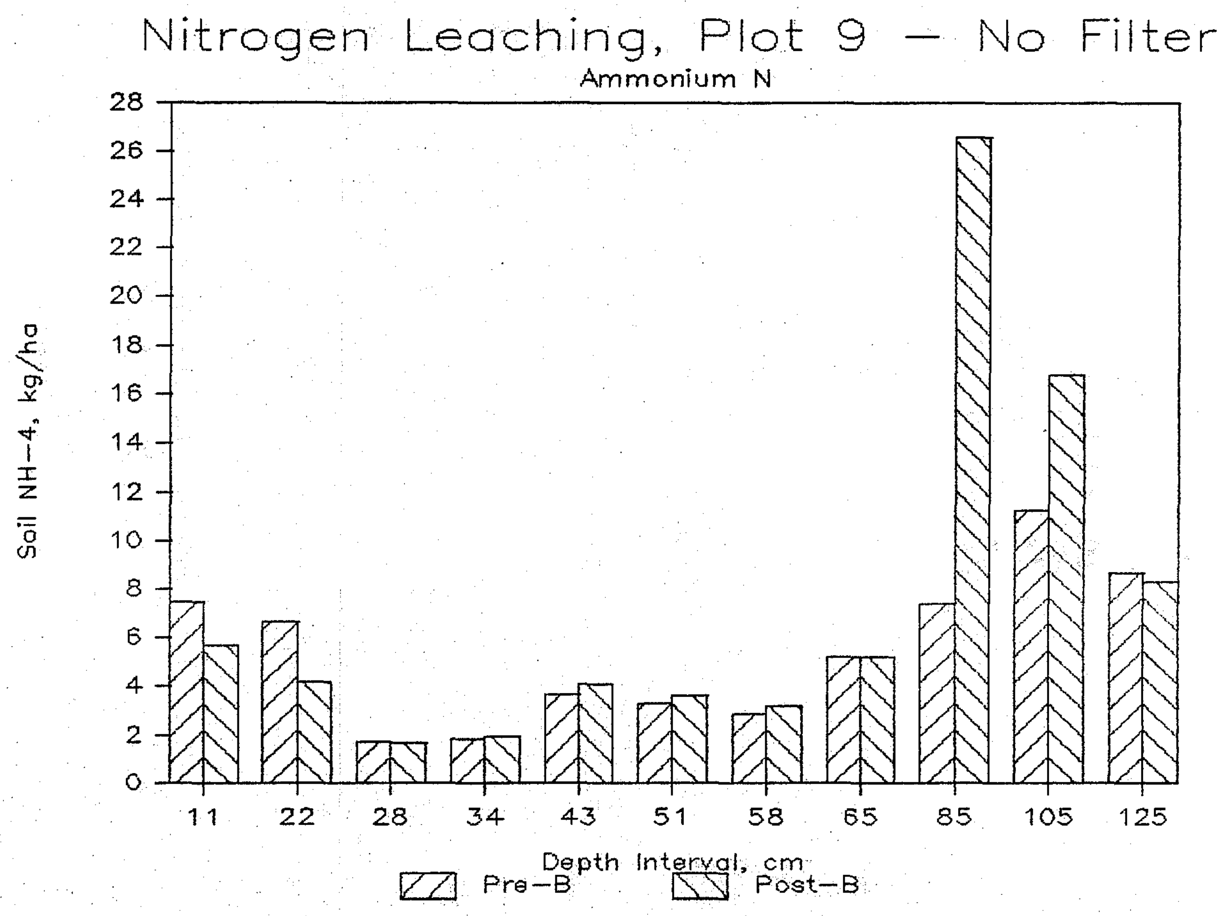

Figure C-18. Comparison of ammonium-N in soil profile of Plot 9 before UAN tests (Pre-B) and after UAN tests (Post-B).

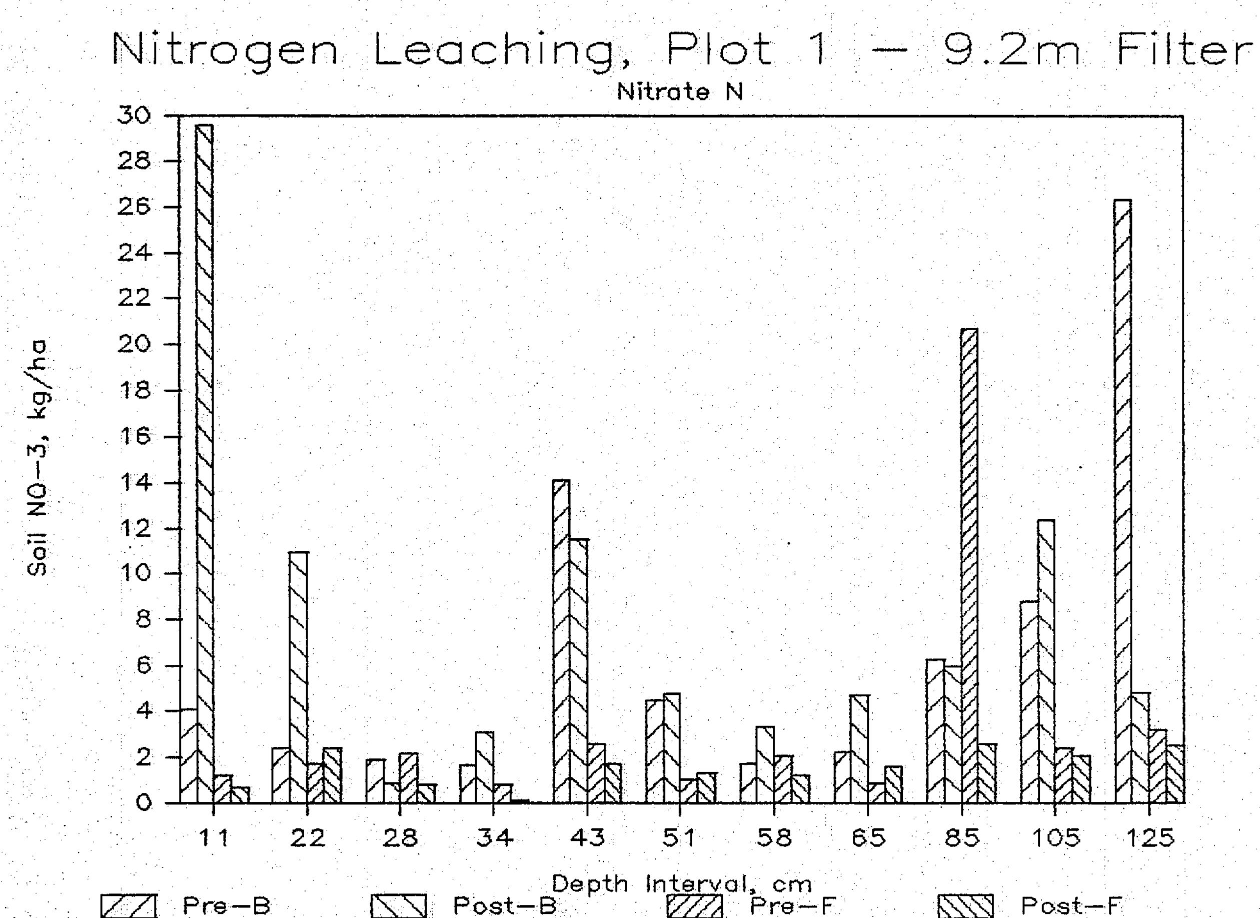

Figure C-19. Comparison of nitrate-N in soil profile of bare portion (Pre-B) and VFS (Pre-F) of Plot 1 before UAN tests and after UAN tests (Post-B and Post-F).

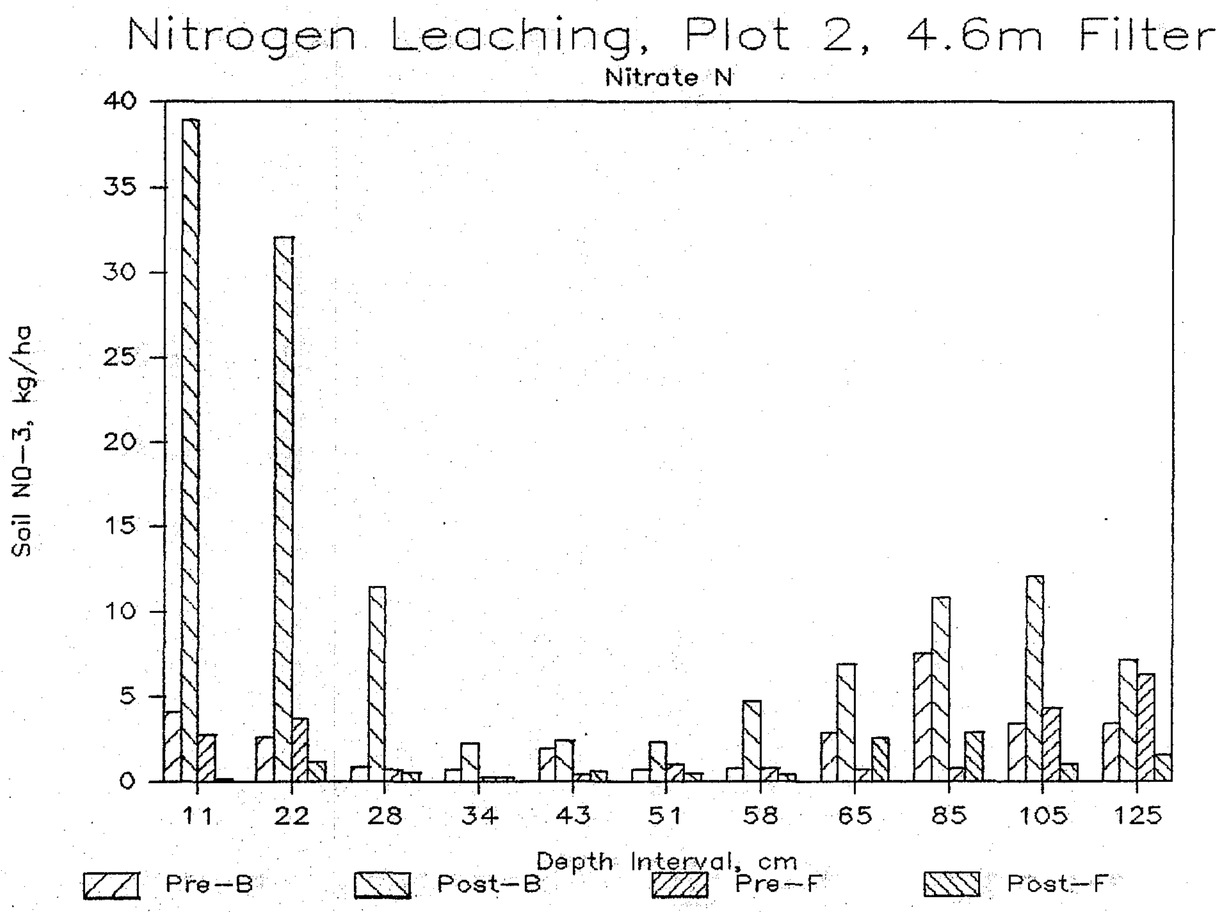

Figure C-20. Comparison of nitrate-N in soil profile of bare portion (Pre-B) and VFS (Pre-F) of Plot 2 before UAN tests and after UAN tests (Post-B and Post-F).

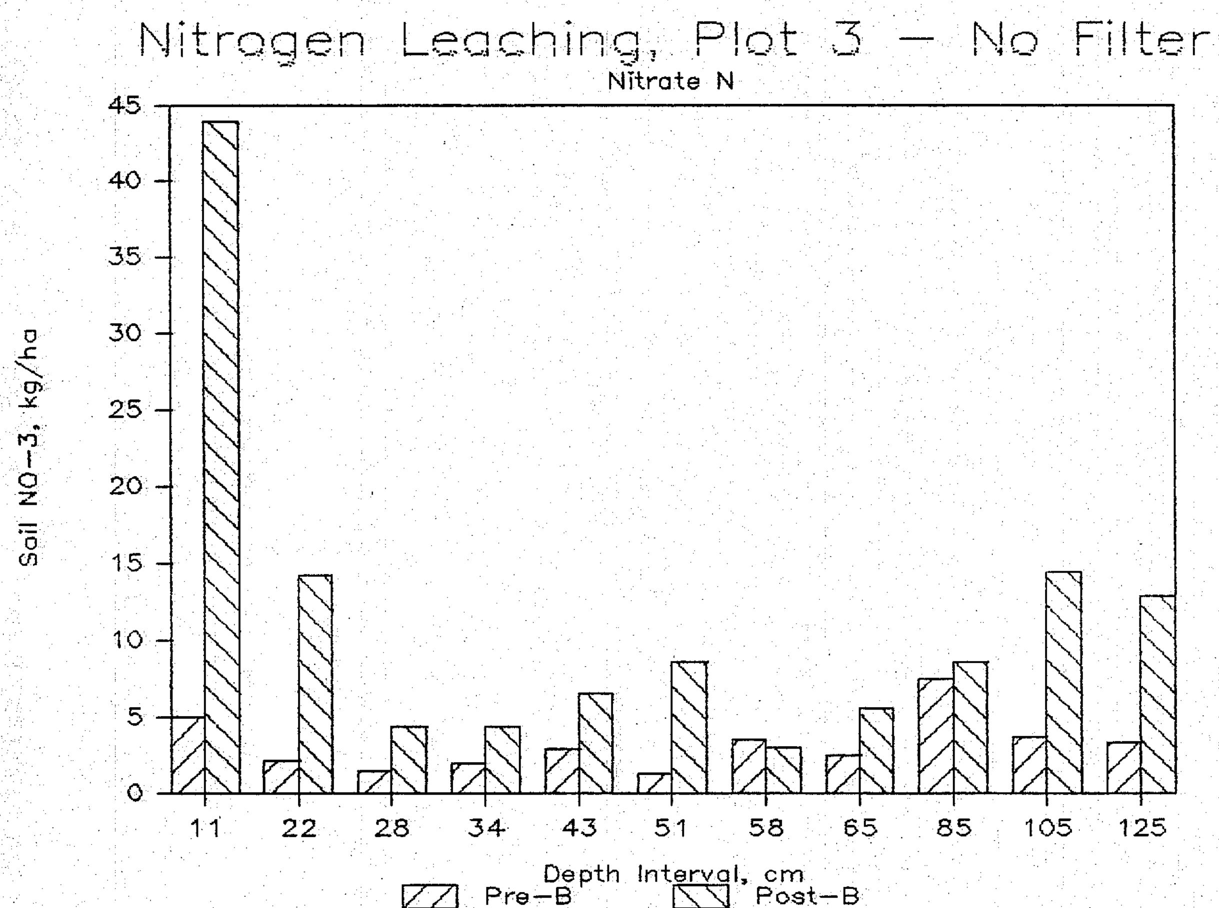

Figure C-21. Comparison of nitrate-N in soil profile of Plot 3 before UAN tests (Pre-B) and after UAN tests (Post-B).

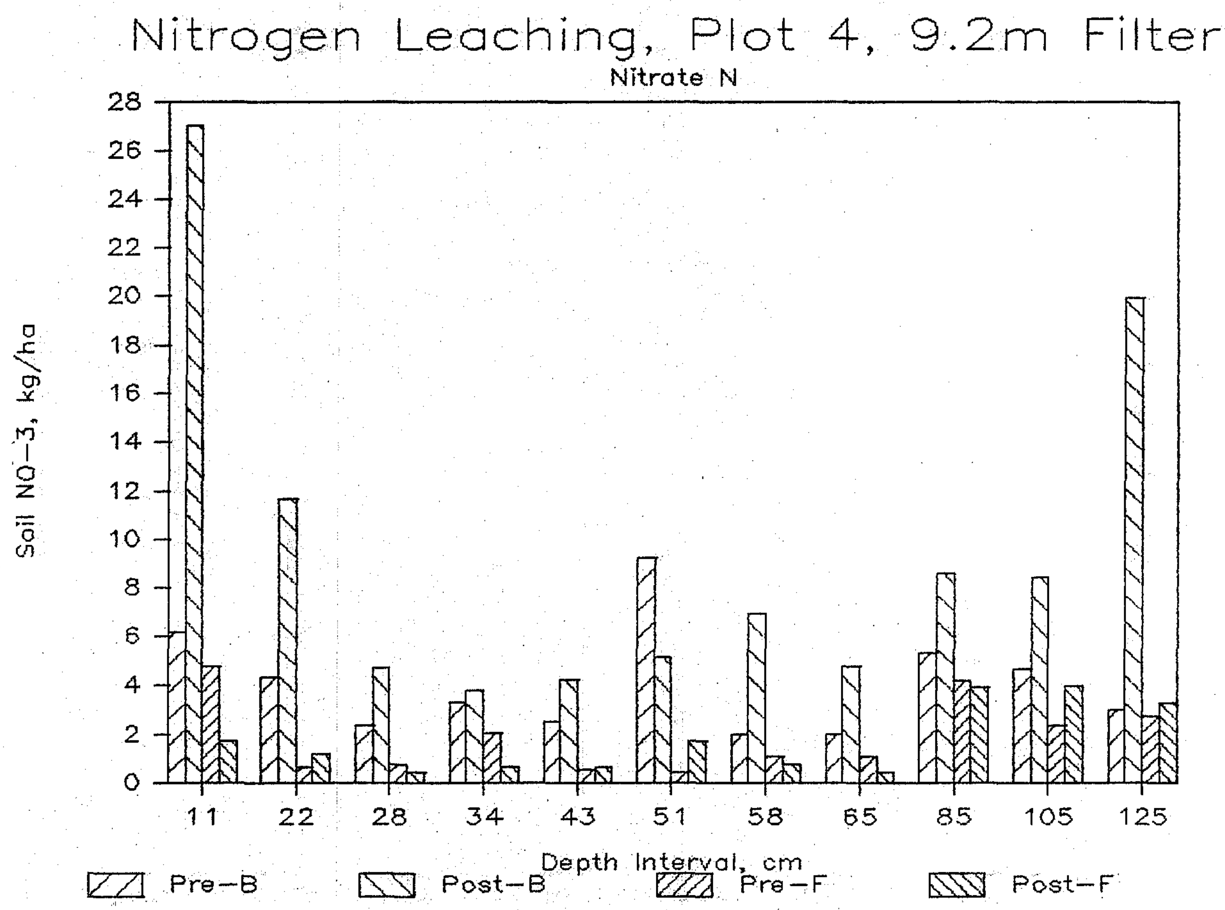

Figure C-22. Comparison of nitrate-N in soil profile of bare portion (Pre-B) and VFS (Pre-F) of Plot 4 before UAN tests and after UAN tests (Post-B and Post-F).

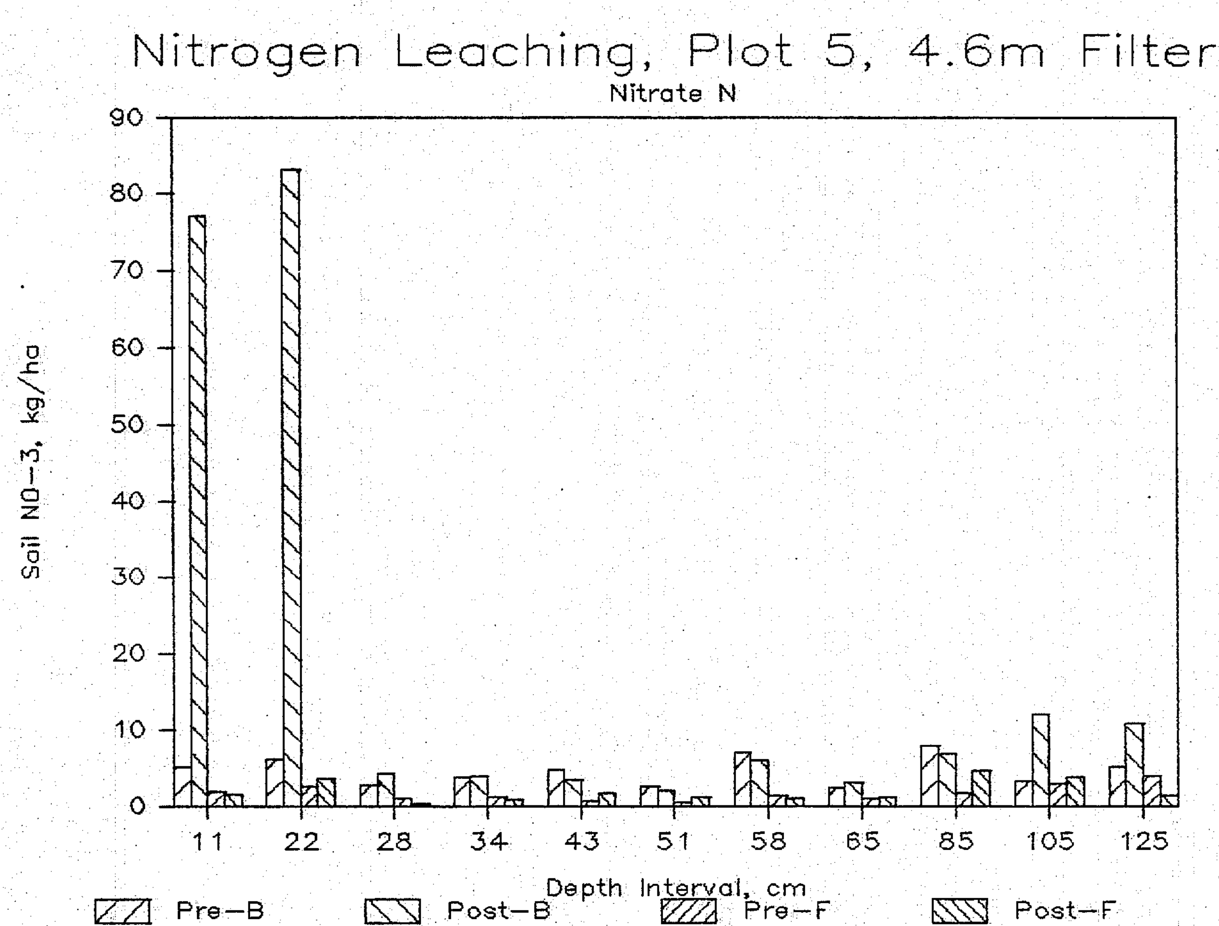

Figure C-23. Comparison of nitrate-N in soil profile of bare portion (Pre-B) and VFS (Pre-F) of Plot 5 before UAN tests and after UAN tests (Post-B and Post-F).

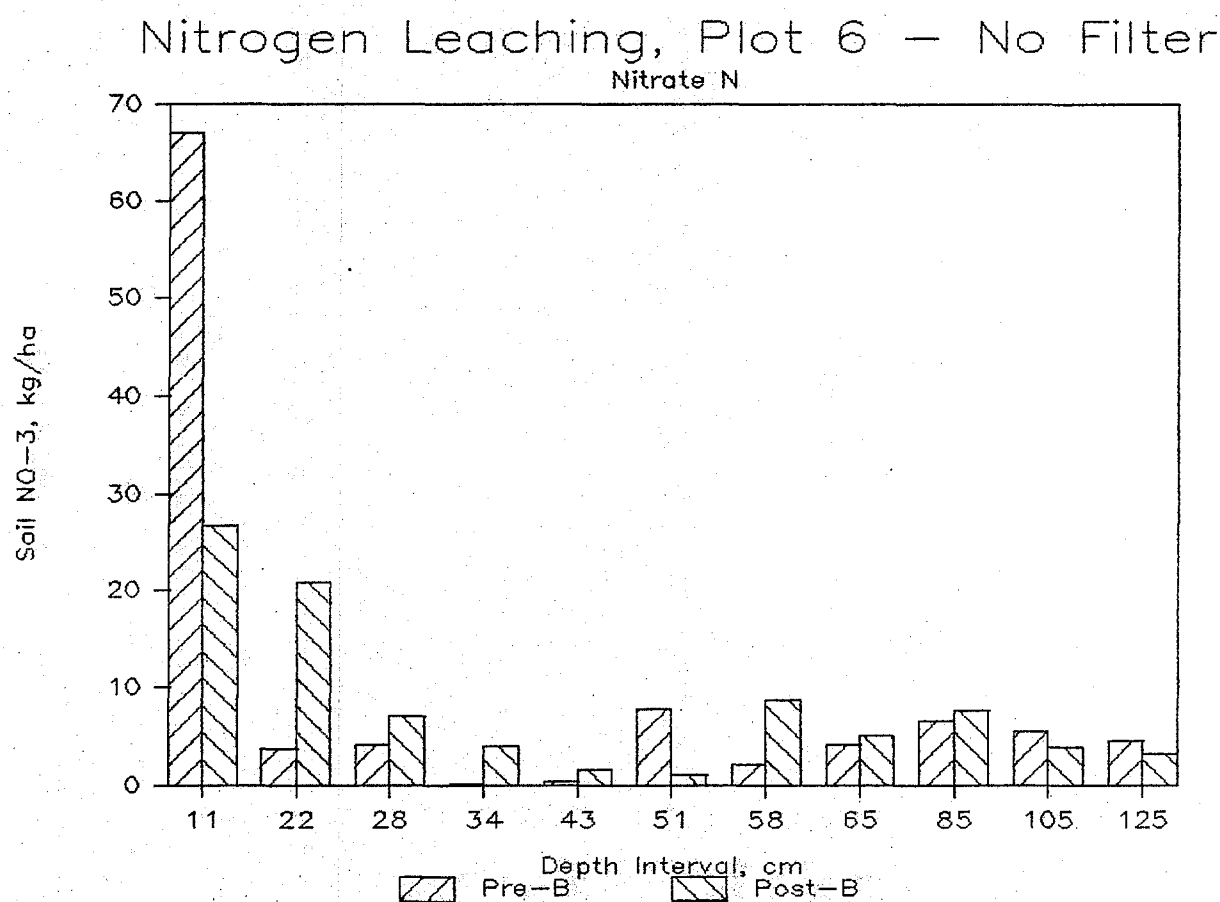

Figure C-24. Comparison of nitrate-N in soil profile of Plot 6 before UAN tests (Pre-B) and after UAN tests (Post-B).

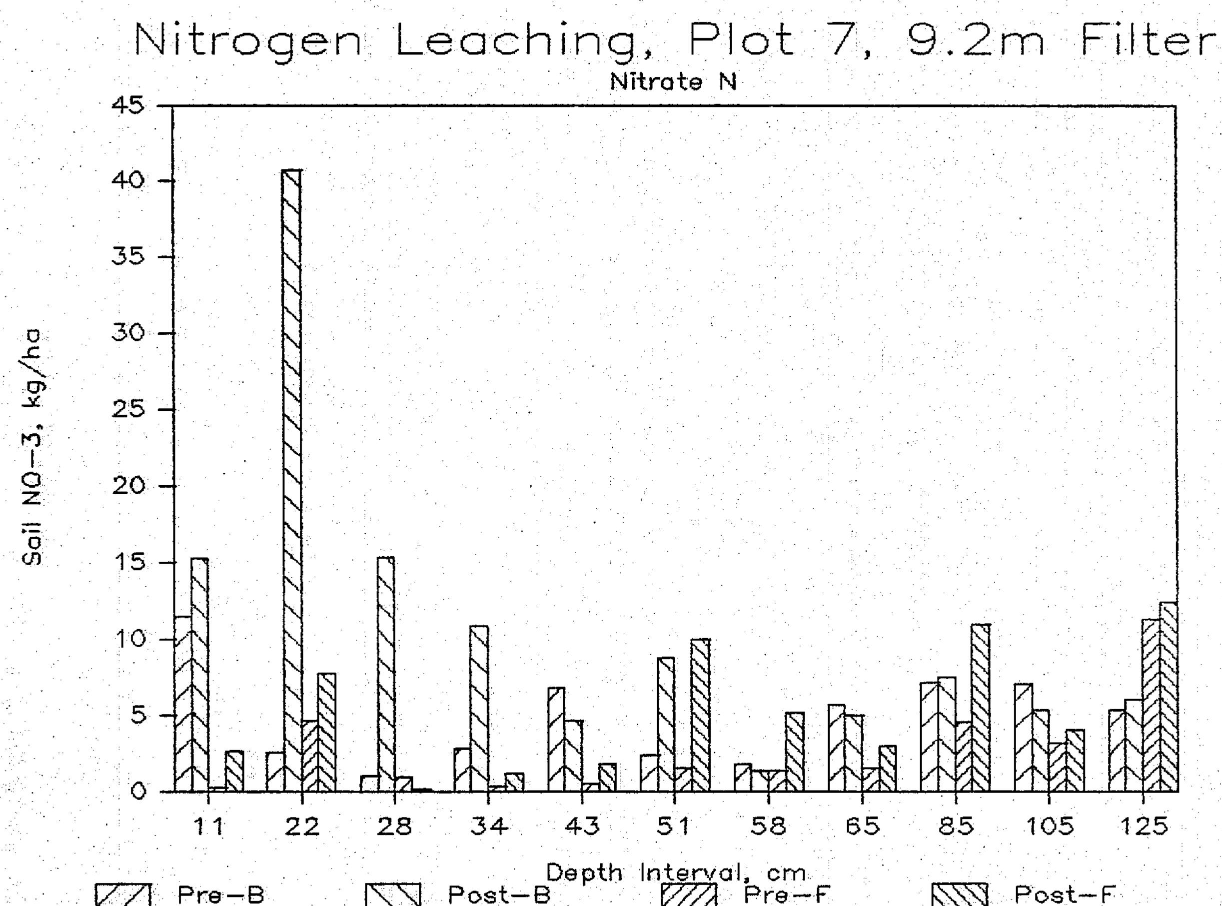

Figure C-25. Comparison of nitrate-N in soil profile of bare portion (Pre-B) and VFS (Pre-F) of Plot 7 before UAN tests and after UAN tests (Post-B and Post-F).

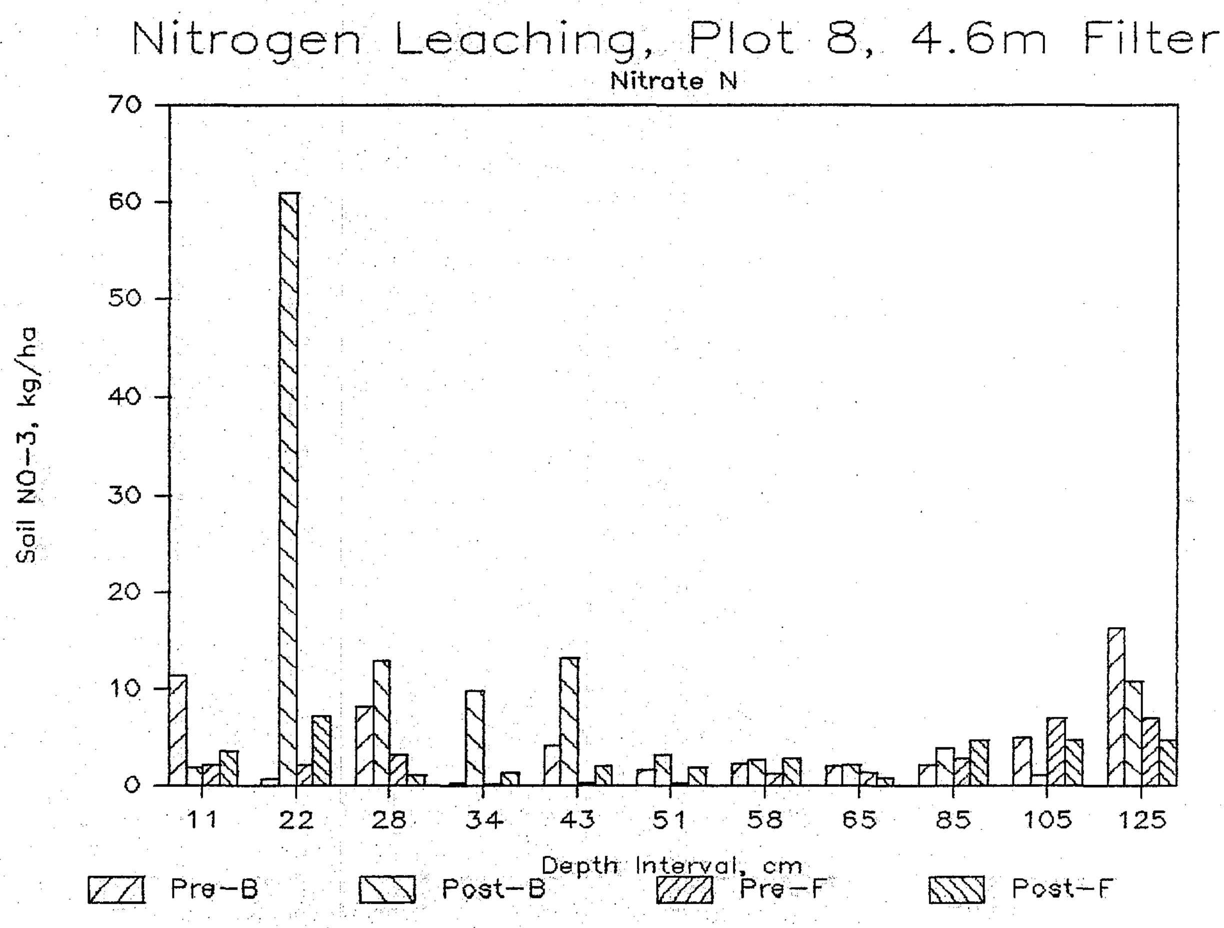

Figure C-26. Comparison of nitrate-N in soil profile of bare portion (Pre-B) and VFS (Pre-F) of Plot 8 before UAN tests and after UAN tests (Post-B and Post-F).

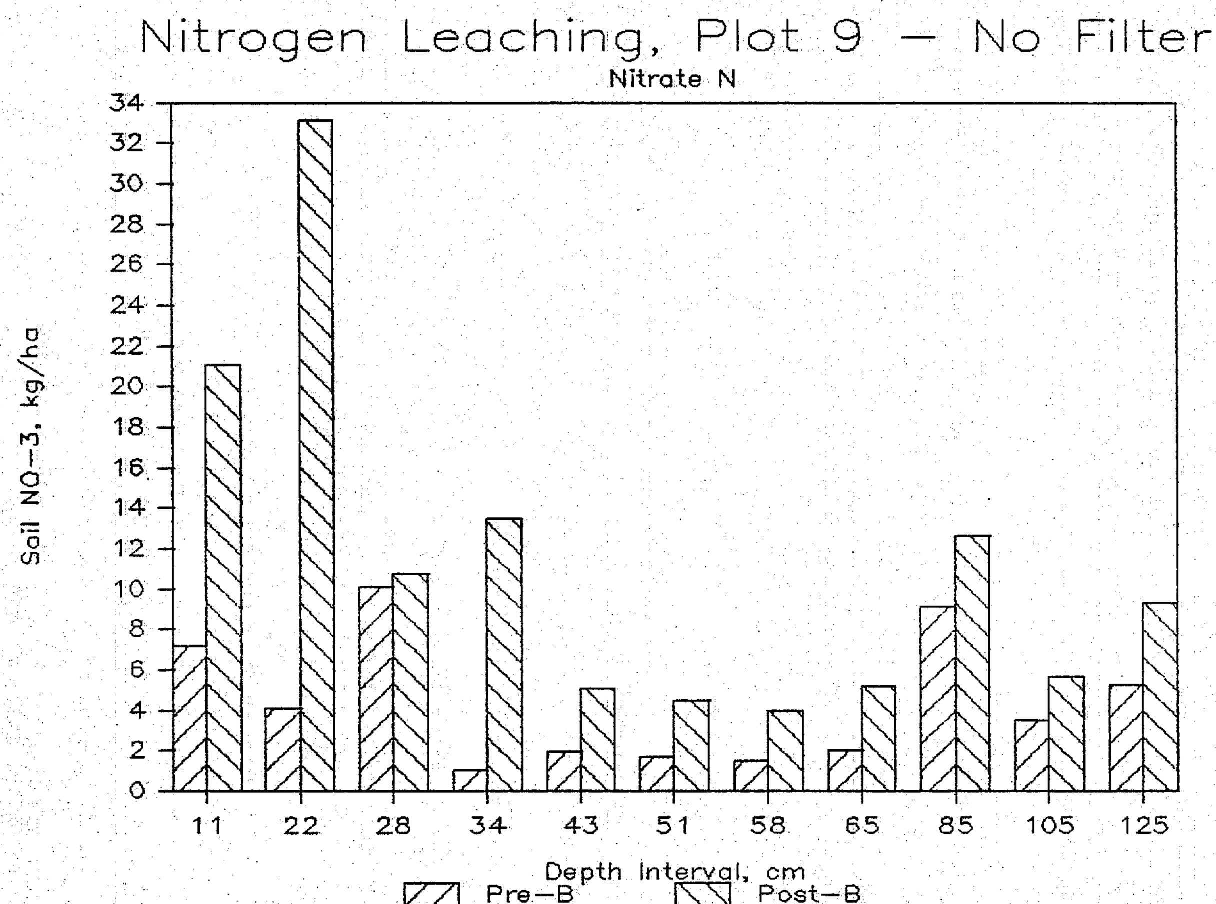

Figure C-27. Comparison of nitrate-N in soil profile of Plot 9 before UAN tests (Pre-B) and after UAN tests (Post-B).