This is to certify that the

thesis entitled

Evaluating The Performance of Distrubed Lysimeters Using an Undisturbed Lysimeter as a Control

presented by

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has been accepted towards fulfillment
of the requirements for

M.S. degree in Agric. Eng.

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Date October 6, 1995

EVALUATING THE PERFORMANCE OF DISTURBED LYSIMETERS USING AN UNDISTURBED LYSIMETER AS A CONTROL

By

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A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

MASTER OF SCIENCE

Department of Agricultural Engineering

1995

ABSTRACT

EVALUATING THE PERFORMANCE OF DISTURBED LYSIMETERS USING AN UNDISTURBED LYSIMETER AS A CONTROL

By

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Drainage rate and volume from each of four disturbed soil profile lysimeters were compared to that of the other three lysimeters. Drainage from the disturbed lysimeters was also compared to an undisturbed soil profile lysimeter. The five lysimeters were also used to evaluate leachate from four nitrate fertilizer schemes used on a seed corn crop.

During the study, the four disturbed lysimeters went through five years of "settling" during which significant differences did exist in drainage rate and nitrate concentrations between them and the undisturbed lysimeter. The differences became less as the project progressed. No significant differences could be found among drainage rates or volumes in 1993.

Investigation of the nitrogen fertilizer treatments showed that lower nitrogen application rates result in lower amounts of nitrate in leachate. Grain yield from a plant response fertilization treatment and the 101 kg N/ha treatment both showed no significant difference when compared to a 202 kg N/ha treatment.

To my best friend, whom I am lucky to have as a wife, Tina.

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INTRODUCTION

BACKGROUND

Over the last century many technological advances have improved agriculture. Heavy machinery and a cheap supply of fertilizer have made it easier for a single farmer to farm more land than ever before. Coupled with advances in technology is the responsibility for the care of the Earth's other precious resources which mandate a change in management practices.

The most precious of the resources our Earth has to offer is water. Water is utilized by every living organism to survive. Unfortunately, some of our current agricultural practices might be harming the quality of our ground water resources. In an effort to understand the impact our agriculture has on ground water, a device called a lysimeter is being used by many agricultural scientists.

A lysimeter is an enclosed block of soil with a drain at the bottom. From this drain, all the water that passes through the soil block can be collected, measured and tested to see what has been added to it in the soil environment. The soil at the top of a lysimeter is normally cropped to simulate real crop soil conditions. Lysimeters can be small and kept in a greenhouse on a bench, or, like the lysimeters at Pioneer Hi-Bred International, Inc. seed corn facility in Constantine, Michigan, can be very large and are installed directly into a farm field with a crop grown on top of it.

Pioneer Hi-Bred International, Inc. has a hybrid seed corn production plant in Constantine Michigan. The seed corn industry has become very important to St. Joseph County and other parts of southwest Michigan and northwest Indiana because of a favorable climate, abundant irrigation water, and soils that are predominately sandy loam and sands. These well-drained soils allow traffic over the field most of the season, regardless of the weather.

Historically, farmers apply enough nitrogen fertilizer to make sure that the crop has an abundant supply of nitrogen to have a bountiful harvest. Seed producers in St. Joseph County also utilize irrigation as a supplement to precipitation to ensure that their crop will not suffer from a depleted water supply.

For a number of years prior to the start of this project, the village of Constantine's water supply was tested for nitrogen, among other pollutants. The water supply was found to exceed the Public Health Standard of 10 parts per million nitrate-nitrogen. This raised concern about nitrate in ground water, particularly under seed corn growing areas. In response to this public concern, researchers at Michigan State University and at Pioneer acknowledged the need to study nitrogen management strategies and seek ways to minimize nitrate leaching in seed corn production areas like St. Joseph County. The researchers decided that to be able to provide growers information on an alternative nitrogen (N) fertilizer strategy, research would need to be conducted to identify best management practices to minimize leaching. The goal of this research was to develop management strategies for producing a quality product with acceptable profitability and at minimum risk to the environment. An equally important goal was to develop a computerized simulation model for inbred seed corn production. One such model is CERES-IM. Martin (1992) discusses the CERES-IM model and the changes made to adapt the CERES-MAIZE model to production seed corn fields. This model is essential to make decisions in finding N management strategies to reduce leaching and maintain profitability over multiple years.

Five large lysimeters were installed in Constantine, Michigan in seed corn plots to assist in the research. Each lysimeter spans five rows of seed corn and is 2.3 meters deep with a drain underneath.

One of these five lysimeters was constructed around an undisturbed block of soil. The other four lysimeters contain disturbed soil profiles, filled one soil horizon at a time making sure the density was the same as when the soil was excavated. It is commonly believed that an undisturbed soil profile lysimeter is the preferred type to build, but they cost more and take much more time and equipment to install.

Kohnke et al (1940) in a review of lysimeter research stated that:

> *In the filled-in lysimeters it is frequently noticed that in the first year or two the nitrate content of the percolate is rather high, but afterwards it decreases to very low rates.*

They explain this phenomenon as a result of an increased number of macropores in recently disturbed soils of all types which tend to make conditions favorable for nitrification. It is assumed that these macropores later slowly close up, resulting in fewer macropores in the disturbed soil than occur in the natural soil. This later condition is less favorable for nitrification because less.

OBJECTIVES

The goal of this research is to determine differences in flow pattern and nitrate leachate concentration and amount between an undisturbed soil profile lysimeter and disturbed profile lysimeters installed in a sandy soil.

The specific objectives of this research were:

1. To determine if significant differences have occurred in drainage rate and amount between the two different types of lysimeters.

2. To determine if significant differences have occurred in the transport of nitrogen in the form of nitrate between the two types of lysimeters.

3. To determine if significant differences in nitrate leaching or grain yield have occurred within four different nitrogen fertilizer treatment schemes.

LITERATURE REVIEW

Lysimeters are defined by Aboukhaled et al (1982) as large containers filled with soil (or enclosing a soil block) to represent the field environment. Lysimeters can have bare or vegetated surfaces for determining the evapotranspiration a growing crop, a reference vegetative cover, or evaporation from bare soil. Many other researchers have recently began using lysimeters to analyze irrigation schemes, ground water recharge and nitrate and pesticide leaching (Bergstrom, 1987; Dowdell & Webster, 1980; King et al, 1977; Martin et al, 1994; Watts & Martin, 1981; Prunty & Montgomery, 1991).

Types of Lysimeters

Lysimeters have been used as research tools since 1688. The first known lysimeter was built by Philippe De la Hire in Rungis, near Paris, France (Kohnke et al, 1940). These first lysimeters were described as being round with lead walls, filled with sandy loam soils. One hundred years later, John Dalton built a round lysimeter with tinned iron walls and filled it with "good fresh soil". Kohnke has discussed literature from 1688 up to 1939. Harrold & Dreibelbis (1958) reviewed literature on lysimeters for the period 1939 to 1955. Later, Harrold et al (1967) reviewed literature for the period

1955 to 1962. In these reviews, lysimeters were classified according to their construction. This yielded three major types;

1. Monolith, or undisturbed soil-block.
2. Ebermayer.
3. Filled in or disturbed.

Aboukhaled et al (1982) categorized lysimeters as "weighing" or "non-weighing". Weighing refers to scales placed under a disturbed or undisturbed soil block in order to monitor changes in the mass of the lysimeter soil. This change in mass, over short time periods like hours or days, is mostly due to changes in water content in the soil. Monitoring this change hourly helps develop evaporation and transpiration equations and can also provide a reference ET for evapotranspiration (ET) estimations. This publication covers many special considerations in the selection, design and operation of lysimeters. Detailed descriptions of over a dozen lysimeters are discussed.

Monolith, herein called "undisturbed", lysimeters are widely accepted as "natural" lysimeters because the soil structure is still as it was in nature. Undisturbed lysimeters are built by encasing a block of soil in an enclosure with a drainage system at the bottom.

Ebermayer lysimeters consist of a plate inserted under an area of soil to catch vertical drainage. Unlike other lysimeters, Ebermayer lysimeters have no walls to control horizontal water movement.

Disturbed lysimeters can be built to the same dimensions as the undisturbed lysimeters. The only difference between the two types of lysimeters is that in the final construction of disturbed lysimeters they are filled, usually by hand, with mixed soil. The soil structure and pore structure are mostly or totally destroyed during this process.

Bergstrom (1989) detailed the differences between the three major types of lysimeters; disturbed, undisturbed, and Ebermayer. He also discussed concerns which must be considered when using lysimeters in pesticide leaching studies.

Disturbed versus Undisturbed Lysimeters

Dowdell and Webster (1980) found higher nitrate in leachate from undisturbed lysimeters than in leachate from adjoining soils after installing twelve undisturbed lysimeters in a stone free loamy sand. This increase was presumably caused by the increased aeration, and subsequent mineralization of soil organic mater associated with the installation, and from plowing and planting activities. This increase has not reoccurred in these lysimeters.

Kohnke et al (1940), in a broad review of lysimeters, noted that percolate from various disturbed soils tended to be high in nitrate content for a year or two, then the nitrate concentration decreased to very low rates.. He suggests that this decrease was due to aeration caused by stirring and mixing the soil, and also due to more large pore space which would tend to make conditions favorable for nitrification. Later these large pores closed up and nitrification slowed down. The soil in disturbed lysimeters does not have cracks and fissures that are found in natural soils. With the natural soil cracks and fissures absent from the lysimeter, the lysimeter will have lower rates of nitrification than the natural soil because of reduced aeration.

Aboukhaled et al (1982) remarked that breaking up any soil will change soil structure, aeration and soil moisture retention characteristics, leading to differences in soil water tension and soil water movement as well as differences in soil heat flux. Black et al (1968) showed that the temperatures in lysimeters placed in Plainfield sand were higher than that in the surrounding natural soils. This would imply that in winter months less water would be kept frozen in the soil. Also, warmer temperatures could increase nitrification and other microbial activities.

Aboukhaled et al (1982) also found what he called contradictory results among various reported research. Some researchers reported better growth on their disturbed lysimeters than found in the surrounding field. Other researchers reported poorer growth on disturbed lysimeters. It was suggested that most of the discrepancies found between lysimeter plots and field plots result from treating the two plots differently. Aboukhaled believes that both disturbed and undisturbed lysimeters will mimic the natural soil evapotranspiration (ET) characteristics if the water content of the soil in the lysimeter is kept high and the same done for the entire surrounding research field. He also suggested that deep plowing or subsoiling of the rest of the border area and field plots will break up the soil and will yield more reliable data.

Some research has been done to specifically investigate the effects of disturbing a soil profile. McMahon and Thomas (1974) investigated chloride flow through disturbed and undisturbed soil cores containing silt loams and silty clay loams. They found that chloride movement was deeper in undisturbed cores than in disturbed cores. They concluded that ped structure influences ion, chloride and nitrogen, flow as well as water flow. The water flowed predominantly through macropores and carried ions with it. Some ions were carried deep into the soil. They give no indication of rates of water flows.

Cassel et. al. (1974) investigated two loamy soils in disturbed and undisturbed soil cores representing moderate and strong soil structure. Their investigations showed that, under experimental conditions, more water is required to displace a given quantity of NO_3 through a disturbed profile compared to that for an undisturbed profile. They also found that disturbed soils can have a capacity to hold more water than undisturbed soils.

Bergstrom (1987) conducted an experiment in which tile drained plots were compared to lysimeter drainage. The soil profile consisted of four layers; a topsoil layer consisting of clay loam, a fine sand layer, an oxidized clay layer, and then a non oxidized clay layer. He found that water moved faster through disturbed soils in both cases. The greatest differences between disturbed and undisturbed soils occurred during dry periods.

Drainage in Lysimeters

Dreibelbis (1961) compared the moisture content of various soil layers within undisturbed monolith lysimeters to that of the surrounding watershed. He found that even in large, undisturbed lysimeters (3 lysimeters 2.4 m in depth with a 0.005 ha (0.002

acre) surface area) the moisture content is different in the lysimeter than that of the surrounding watershed. These lysimeters were in fine textured soils classified as Muskingum and Keene silt loams (Coshocton OH). In all the cases studied, the lysimeter contained more water than the watershed when the moisture content was high. When the soil drained and the moisture content lowered, the lysimeters contained less water than the watershed. When filled with Keene silt loam, the lysimeter and its watershed area agreed best among all profiles when around 30 mm of water was in the 0 - 0.13 m profile. He stated that the presence of any restricting layers in the natural soil or natural variations in soil type will cause a difference in soil water content between lysimeters and watersheds.

A study of the conditions in four disturbed lysimeters located across the state of Oklahoma has supported Dreibelbis' findings that the moisture content is different inside the lysimeter than it is in the surrounding soil (Fisher and Elliot, 1994). These lysimeters are 1.5 m deep with a surface area of 0.95 m^2. The lysimeters were filled with multiple 0.3 - 0.4 m deep "soil blocks" cut from the soil with a flat spade. The soils used at the various sites included silt loams, a clay loam and a silty clay loam. A drain pipe was laid in the bottom of the lysimeter and covered with gravel and then a 50 mm deep layer of sand. This study found that the moisture in the semi-undisturbed lysimeters was generally lower than that in the natural field.

Macropores provide an easily accessible pathway for water to travel from the surface into the ground water. These pores are produced by soil fauna (such as worms, moles, gophers and wombats), live or decayed plant roots, cracks and fissures, and natural soil pipes formed by subsurface flow of water (Beven and Germann, 1982). Macropore flow interacts with other soil water only to a limited extent. More mixing can be assumed with small precipitation events than with larger events (Thomas and Phillips, 1979).

Drainage Systems for Lysimeters

The reason researchers have contained soil in lysimeters is to confine the water to a known area of influence. The water in the lysimeter will percolate down to the bottom of the lysimeter from where it is then removed. There are two ways to remove the water: either provide an area for water to accumulate and allow free drainage into this area, or install a suction device at the bottom of the lysimeter to remove water from the soil.

Suction can be achieved as simply as placing porous suction cups at the level in the soil where suction is desired (Brown et al, 1985). Suction created when the water is pumped out of these cups and a partial vacuum results causing water in the soil to enter the cup. Porous plates can also be used in the same fashion (Ritchie & Burnett, 1968). Black et al (1968) applied suction to a network of porous cups which was placed under a network of weighing lysimeters and electronically controlled. Black found that a suction of 200 - 300 mm of water was sufficient to stop abnormal water accumulation at the bottom of a lysimeters containing Plainfield sand.

Free drainage lysimeters usually have a layer of gravel or other porous media at the bottom to allow free water to have relatively unobstructed flow to a drain or sampling line. This gravel is sometimes separated from the overlying soil by a geosynthetic fabric to keep the two from mixing. Disturbed lysimeters have been made with drain tile laid along the bottom of a lined trench (Bergstrom, 1987). In other lysimeters Bergstrom left water in the gravel layer under undisturbed monoliths and pumped this water out weekly. Some of the lysimeters in Coshocton, Ohio drain freely (Garstka, 1937). These early lysimeters had surface runoff collectors to collect water which did not percolate through the soil.

Litaor (1988) has reviewed different ways to collect soil water. These collection devices are called "soil solution samplers". Litaor exposes what he calls "contradictory results" between data obtained from suction and free drainage. Some sampling techniques such as free draining of lysimeters may predominantly collect water from macropores. Whereas suction collection devices installed at the bottom of a lysimeter might draw water out of the soil micropores which would not normally drain in natural conditions. In his paper he concludes with a cautionary note stating;

> *"The user should realize that the composition and concentrations of soil solutions are not homogeneous and solute concentrations from macropores are probably different from that collected from micropores."*

Drainage Measuring Devices

The most straight forward method of sampling is letting the drainage collect and then pumping the water out and measuring this volume of water (Black et al, 1968; Martin et. al., 1994), or determining the weight of the water (Bergstrom, 1987). Garstka (1937) reported that the original lysimeters in Coshocton, Ohio were free draining into a reservoir. The level of water in the reservoir was then recorded on a chart recorder through the use of floats and float position transmitters.

Remote field locations and projects requiring hourly data require data loggers (small computers capable of recording data and operating electrical switches) to monitor lysimeter flow and possibly collect data. Loudon et. al. (1991) developed a sampling system and used it to monitor 2 to 5 lysimeters, monitor a weather station, pump out the lysimeter and collect multiple samples. (also, Martin et. al., 1994)

Techniques For Filling Disturbed Lysimeters

Many small disturbed lysimeters, also called "disturbed soil cores", are filled with soil which has been air dried and passed through a 2-mm sieve before being packed into the lysimeter container (Cassel et. al., 1974). Attention should be given to the location of the horizons in the original soil and this position kept when the soil is repacked into the lysimeter (Kohnke et al, 1940; Cassel et. al., 1974; Loudon et. al., 1991). Loudon also suggests that the bulk density of the original undisturbed soil be recorded for comparison to that of disturbed lysimeters.

Kohnke et al (1940) suggests that;

"The heavier the soil and the more mature its profile the greater will be the disturbance created by digging and replacing, even if an attempt be made to keep the horizons in their original sequence."

He also thought that sandy soils with undeveloped soil profiles would be less likely to be affected by removal and replacing into a lysimeter.

On advantage of disturbed lysimeters is that they can be fitted with monitoring equipment like temperature measuring devices or other monitoring devices during the site filling process (Black et al, 1968).

Techniques For Encasing Undisturbed Soil Monoliths

Undisturbed lysimeters encapsulate soil monoliths. The process used in encapsulating larger monoliths is costly and time consuming. This process usually involves digging around the soil to be encased and lowering a casing over a soil block or building an encasement around the soil block. This process was used for the In-Place lysimeters near Coshocton, Ohio (Garstka, 1937).

Now, with the use of large machinery, soil monoliths can be encapsulated easier by forcing a casing down over the undisturbed soil monolith. Cylindrical lysimeter casings have been made from PVC, fiberglass (Belford, 1979) and specially constructed steel barrels (Brown et al, 1985). All these methods employ some kind of vertical force, usually exerted by a back hoe bucket, to press the casing over the monolith. Along with this force, a process of excavating, trimming and pressing is repeated until the casings were full. These medium sized lysimeters can, after being encased, be moved to a research site which would be somewhat different than the highly disturbed site where they were captured..

Many researchers have now accepted this process of pressing a container into the ground as the "traditional" or accepted approach (Schneider et al, 1993; Loudon, 1991; Brown et al, 1974). Each researcher has used slightly different methods to press the container into the soil and remove it, each suitable for their unique case.

Schneider et al (1993) also encapsulated soil by the "traditional" method of pressing down a casing and undercutting the monolith in order to remove it. Dead weight was use as the force to press down the casing. This weight was accomplished with water tanks placed on support members attached to the lysimeter, weight was constantly increased by the addition of water to the tanks. Schneider then made a disturbed lysimeter for the lower profile from saturated soil underneath the removed undisturbed monolith. He filled the lower tanks with 0.15-m increments of the soil, saturated the soil and drained the packed soil. His surface was 2-m by 4-m with a total depth of 2.5-m.

Hand tools were used by Brown et. al. (1974) and others to trim the last bit of soil from the side of their monolith in order for the casing to slide down. Brown et al also wetted the sides of the monolith to lubricate the walls to help in the cutting process.

Loudon et. al. (1991) describes a tool designed to carve the soil nearly to the plane of the inside face of each side wall. The weight of the container was then enough to encase 0.3 m depth of soil before added force became necessary.

Nitrogen Flow Through Sandy Soils

Nitrogen is found in soils in mainly four forms; Organic Matter, Nitrate (NO_3), Nitrite (NO_2), and Ammonium-Nitrogen (NH_4). Testing has shown that leachate commonly contains less than 1% $NO_2 + NH_4$ (Shaw and Jones, 1974; Bergstrom, 1987).

Nitrate, the most common form of nitrogen in soils, is soluble in water and therefore is carried through the soil matrix by water. These nitrate ions can move in water either by diffusion or convection. Diffusion can take place over a 10 mm distance, while convection can move ions great distances. (Wild and Babiker, 1976; Greencorn, 1983). Because of the fact that nitrate is transported with water, leaching loss of nitrate can not be reduced to zero (Watts and Martin, 1981).

When the soil is at field capacity or greater moisture content, the pattern of movement of nitrogen through sandy soils is that of a diffuse band moving downward with each precipitation event (Shaw and Jones, 1974). Prunty and Montgomery (1991) found this same occurrence in 2.3 m deep lysimeters filled with a reconstructed loamy fine sand and noted that it took one year to see excess nitrates in leachate after the addition of fertilizers. Dowdell and Webster (1980) reported an excess the first winter after fertilizers were applied to grass swards on twelve 0.11 m deep undisturbed lysimeters containing a loamy sand.

Wild and Babiker (1976) studied the variability of nitrate leaching depths under field conditions in a weakly structured loamy sand and found considerable asymmetry in the vertical distribution of nitrate in soil profiles. Calcium nitrate and calcium chloride were applied to individual plots which were initially at field capacity. Four irrigation rates were used, the lowest being 2.5 mm on twenty successive days and the highest rate being 25 mm on days 3 and 7. They found that the modal depth of movement, the depth of highest concentration of the two ions (nitrate and chloride), was about half the mean depth of movement, indicating a highly skewed distribution and a pronounced leading tail of chloride and nitrate. These findings fit a hypothesis that water was carrying nitrate and chloride down macropores within the soil, and that only part of the solutions moved uniformly through the micropores. No significant difference could be found in leaching due to irrigation period. Other research has shown that isolated extremes in solute displacement rates can occur at various depths in a field plot (Van De Pol et al, 1977; Biggar and Nielsen, 1976).

Richter and Jury (1986) studied individual lysimeters filled with coarse sandy loam which showed evidence of water and solute movement through preferential pathways. The lysimeters were 0.2 m in diameter and 0.19 m deep. These micro-lysimeters were brought to field capacity, then they were irrigated with a bromide water solution at 5.5 mm/h and 9.5 mm/h three times a week, both rates were controlled to apply typically 10 - 30 mm of water. Preferential water movement moved solution through a small part of the wetted pore space in the lysimeters and allowed deep penetration of the solute. Bromide was detected in most lysimeters in the first drainage event. There was also a lack of correlation between drainage flux and solute concentration at a given depth within any plot.

The theory that a portion of the solute moves through larger pore spaces has been investigated by other researchers (Mc Mahon and Thomas, 1974; Thomas and Phillips, 1979). These researchers have postulated that if water moves through macropores, it interacts with solutes in the relatively immobile soil water in micropores to only a limited extent. Thomas and Phillips suggested that leaching occurs when a small quantity of NO_3 diffuses from the smaller pores to the surfaces of the macropores and then is moved through the soil profile.

Literature On Pioneer Project

Much of the literature published to date based on the research being carried out in Constantine, Michigan has been in the form of internal reports. Much knowledge regarding the fate of nitrogen applied to seed corn production has been acquired. This has prompted other research within the seed production industry to evaluate fertilizer cost and effectiveness (Martin, 1992).

Martin modified the CERES-MAZE model to better model seed corn and take seed corn cultural practices into account. The new model is called CERES IM. A three year report (Ritchie et al., 1993) covered the first three years of the project and concluded that nitrogen fertilizer application rates for seed corn production can be reduced to 80 to 110 kg/ha without a reduction in profit. A split nitrogen application is also recommended in order to supply most of the nitrogen to the plant when the plant is most likely to use it (Martin et al., 1994).

Much was learned during the planning and set-up of the lysimeters for Pioneer Hi-Bred International, Inc. Loudon et al. (1991) described the process used for the seed corn projects.

METHODOLOGY

The lysimeters used for this analysis were located at the Pioneer Hi-Bred International, Inc. seed corn processing plant at the south edge of Constantine Michigan. Ground water in this area is at a depth of approximately 5 to 6 meters. This ground water is the only aquifer in the area and also acts as the primary source for domestic water. The soil at the study site is mapped as Elston sandy loam (coarse-loamy, mixed, mesic Typic Argiudolls). The five lysimeters used in this study were installed in the fall of 1988, one of which was an undisturbed profile (soil monolith) lysimeter. The other four were disturbed profile lysimeters.

The four disturbed profile lysimeters had dimensions of 0.91 m by 3.81 m by 1.83 m deep (Figures 1 & 2). An access chamber measuring 1.22 m by 1.22 m by 1.83 m deep was attached to the long side of the lysimeter to collect drainage and house collection equipment. This chamber was placed 0.61 m lower than the lysimeter to allow collection containers to fit under lysimeter drains. These drains were 13 mm steel pipes attached to the side wall at the bottom of the lysimeter to provide a drain from the bottom of the lysimeter.

The undisturbed lysimeter container had the same horizontal dimensions as the disturbed lysimeters. The first attempt to encapsulate 1.83 m of soil resulted in cracking the soil monolith. The second attempt was to only encapsulate 1.53 m of soil. This resulted with the bottoms of the disturbed lysimeters being 0.3 m deeper than the undisturbed lysimeter. The access chamber was bolted onto the undisturbed lysimeter instead of welding as was used for the disturbed lysimeters. All the lysimeters were buried approximately 0.3 m below the soil surface so they would not interfere with normal field operations.

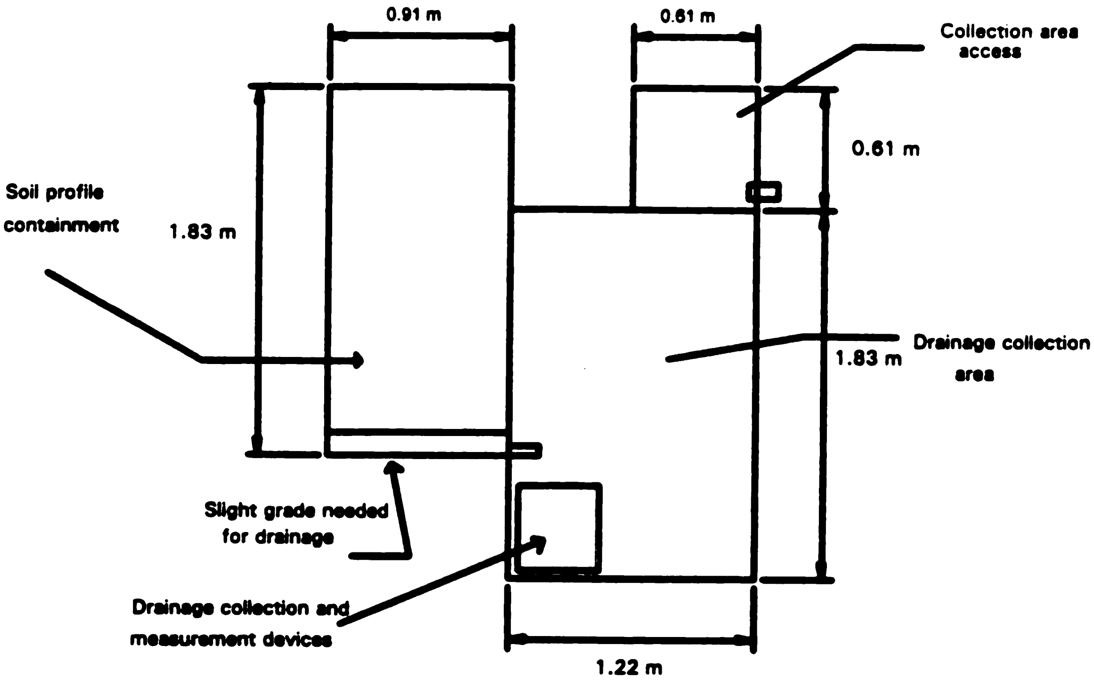

Figure 1. Side view of lysimeter casing and access chamber.

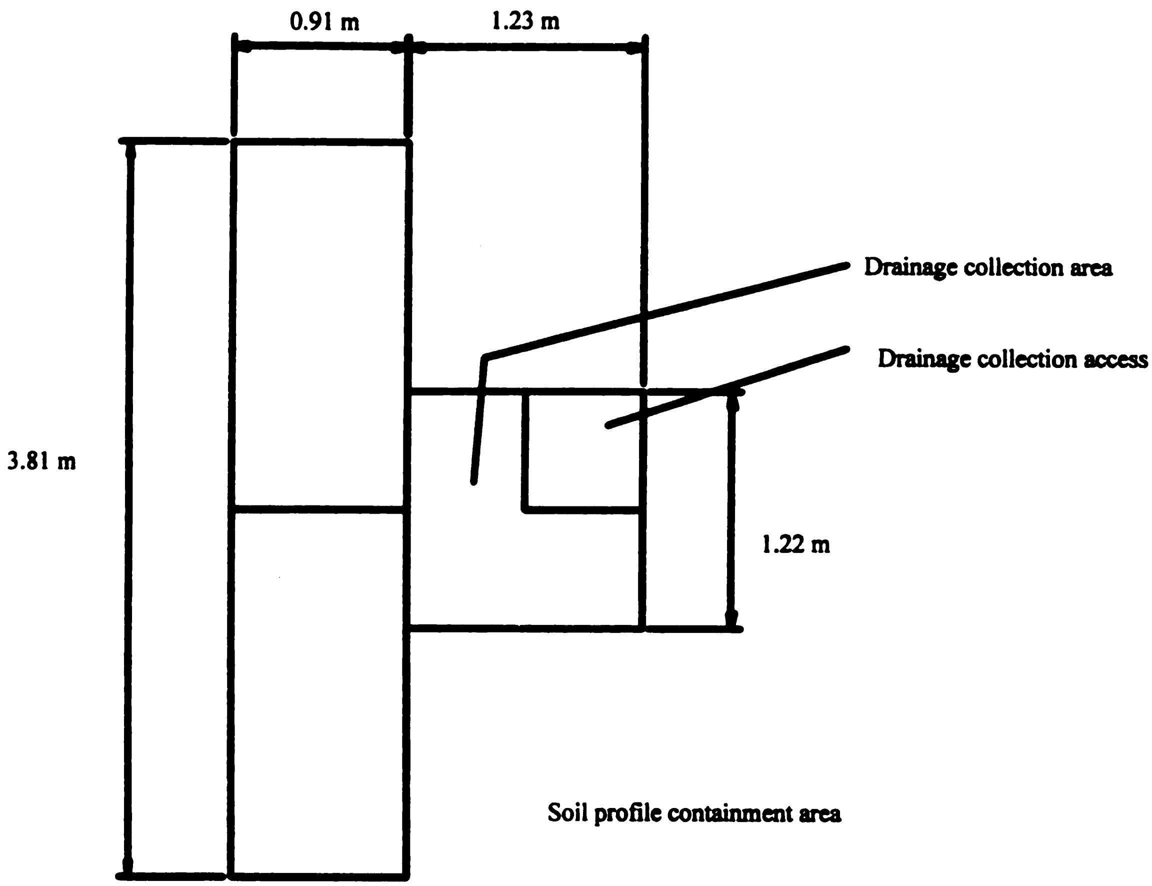

Figure 2. Top view of lysimeter casing and access chamber.

Undisturbed Lysimeter

The undisturbed soil profile lysimeter container was designed by Phil Gerrish, a student in Agricultural Engineering at Michigan State University. This container needed to be designed to retain its intended shape during movement and also during an inversion. After the container had encapsulated the monolith, the container and monolith needed to be removed, rotated 180° to weld a bottom plate on the lysimeter, and finally rotated back and transported to another part of the field where it was permanently installed. Calculations done by the designer estimated the deflections of the sidewalls of the soil container to be less than 10 mm during inversion. Steel was used for the walls, bottom and support members of the lysimeter. Rough welds inside the container were ground smooth and any other imperfections such as weld splatter which might provide a source of friction as the sidewalls were slid over the soil monolith were removed. The metal surfaces of the lysimeter were then coated with an epoxy paint and sprayed with silicon. (Loudon et al, 1991)

This lysimeter was installed in the same soil as the four disturbed lysimeters. A borrow area was prepared outside the field boundary by first removing the top 0.3 m of soil down to the level desired for the top of the lysimeter. The undisturbed monolith was taken outside the field to avoid compaction and preserve the structure of the soil in the field. The bottomless lysimeter container was then placed on the excavated soil surface of the borrow area, and gradually lowered over a soil monolith as the surrounding soil was removed. This soil was removed by trenching with a back hoe around the area of the lysimeter container then removing the last 200 - 300 mm of soil near the monolith by hand with shovels. A carving tool was used to reach under the edge of the lysimeter container and remove soil leaving a vertical soil face just 1 - 2 mm larger than the container. The container wall cut the last few grains of soil off the monolith to form the monolith block to the exact size and shape of the lysimeter container. After the first 300 - 400 mm were contained, it was necessary to push on the container with a back hoe. A press bar made from 152.4 mm I-beam was placed across the top of the container to distribute the force from the back hoe evenly on both sides. It was moved back and forth on the container so that force could be applied wherever needed to move the container down evenly over each short section of monolith.

The undisturbed lysimeter encapsulated 1.5 m (5 ft) of soil. When this soil had been containerized six steel I-beams, twice the width of the container in length, were forced under the container using the teeth on the back hoe bucket to push it under. It was then leveled and set 4 - 5 mm below the bottom edge of the container. Then, two sections of bottom plate were slid individually along the I-beams to shear the sand at the elevation of the container bottom and hold the sandy soil in the bottom of the lysimeter while it was lifted out of the borrow area.

The top of this container was covered with plywood and the entire block was securely wrapped with chains. The chains were trussed out (figure 2) on one side to provide extra support against deflection to the lower, long side of the container while the block was being rotated. Pivot points were constructed on the lysimeter walls (figure 3) to allow easy removal from the borrow area, inversion, and reinstallation at its final destination. After the soil block was inverted, bottom side up, the bottom plates were removed to expose the bottom of the soil block. With the bottom exposed, 50 mm of sand were removed in order to have room for a 50 mm layer of peastone. The peastone was separated from the sand by a geosynthetic fabric. This stone layer was installed to ensure good drainage at the bottom surface of the soil block, the same as was done for the undisturbed lysimeter installations. A new bottom plate, coated with marine epoxy paint, was welded to the bottom of the lysimeter. As the bottom plate was welded in place, it was not possible to avoid burning paint off a short distance around the welds, inside the container. The outside surface of the corner welds were painted with epoxy paint, the inside surface of the container was not repainted.

An excavation similar to that done for the disturbed lysimeter installations was dug, making extra room for the I-beams which were replaced to stabilize the bottom of the lysimeter as it was lowered into place. The lysimeter was set upright and placed in the new hole. The access chamber for the undisturbed lysimeter was added after the lysimeter was in place. To avoid burning additional paint on the interior of the lysimeter, the access chamber in the undisturbed lysimeter was bolted to the lysimeter container instead of being welded on as were the access holes for the disturbed lysimeters.

Table 1 presents a summary of the results from soil borings taken close, but not in, the soil borrow area for the undisturbed monolith.

Table 1. Typical Soil Profiles of lysimeter areas.

Undisturbed Lysimeter (as installed Fall, 1988)

	Soil depth (from soil borings) mm
loam	0 - 360
clay loam	360 - 560
gravely sandy loam *	560 - 940
gravely loamy sand *	940 - 1140
fine sand *	1140 - 1600
med sand *	1600 - 1935
geotextile fabric	1935
pea gravel	1935 - 1986

*gravely mixtures found as close to the surface as 560 mm by soil borings

Disturbed Lysimeters (as installed Fall, 1988)

	mm
loam	0 - 270 mm
clay loam	270 - 580
sandy loam / loamy sand mix	580 - 1600
fine sand	1600 - 2235
geotextile fabric	2235
pea gravel	2235 - 2286

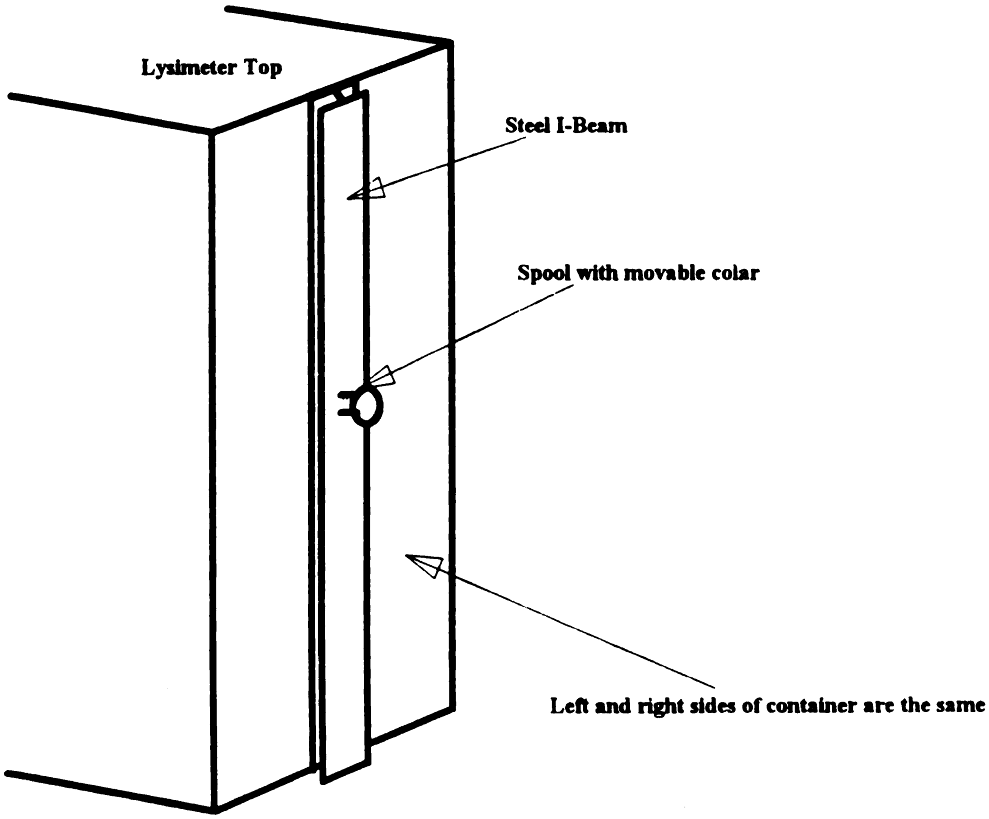

Figure 3. Diagram of pivot points for the lysimeter container.

DISTURBED LYSIMETER

The disturbed lysimeter containers were easier to designed than the container for the undisturbed lysimeter, and they were inherently easier to install. Since these containers did not have to support the soil during handling and transport, the only concern in this design was that the container did not collapse before they were filled with soil.

Installation of the disturbed profile lysimeters began by first analyzing the soil at the lysimeter site by doing soil borings to determine the location and depth of all the soil horizons present. This was done ahead of installation to plan for the number of layers to be excavated and handled separately. When installation began, the soil was removed layer by layer and placed in individual piles on plastic sheets (6 mil PE) by horizon so that the soil could be returned to approximately the same depth from which it was removed. This process involved significant manual labor in conjunction with a back hoe to carefully remove the soil to the exact level of a significant textural change.

This soil is mapped as an Elston Sandy Loam (USDA, 1983). Several soil borings were performed in 1988 which helped further describe the soil composition. Results of these borings were used to develop the representative soil description in Table 1. In these soil borings, small stones (10-20 mm) were found as close to the surface as 560 mm below the surface, in the B horizon. The C horizon for the research site is mostly medium sand. Occasional stony areas were found in the C horizon also.

After the excavation was dug to the proper depth, the lysimeter container was hung from a back hoe bucket and lowered into the excavation. After the lysimeter was in place, the filling of the lysimeter occurred as follows (Loudon, 1991):

1. A 50 mm (2 in.) layer of peastone was placed in the bottom of the lysimeter to provide free drainage for water to move from the bottom soil surface of the lysimeter to the outlet pipe.

2. A layer of geosynthetic fabric typical of that used as a wrap for agricultural drainage tile was placed over the peastone.

3. Soil was then replaced horizon after horizon in approximately 100 mm layers and "walked in " to simulate the original soil density. In this process the back hoe operator sat in one location and "spooned" the soil into the excavation using the backhoe bucket. The operator could place the soil most places around the hole without moving the backhoe which would have increased surface soil compaction. The rate of delivery of soil to the hole was about right to keep up with men in the hole who were moving soil around to keep each addition to 100 - 150 mm and walk on the soil to pack it into place. Each layer was repacked keeping soil inside and outside the lysimeter container at the same level to avoid stress on the container walls.

4. After all subsoil horizons were repacked, top soil was then replaced and finished to original grade by a small dozer.

Field Practices

Seed corn (inbred maize) in a small plot layout has been grown on the lysimeter sites since 1989. Previous to the seed corn, the site was a field of grasses with a sparse population of alfalfa. The seed corn plots were planted as typical Pioneer seed corn fields with 4 rows of corn designated as "female" for every 1 row designated as "male".

The field was planted with 3 inbreds to test for differences in genetic coefficients and nitrogen response. The same inbred was planted on all 5 lysimeters to be able to compare leaching. Figure 4 is a plot diagram showing the location, nitrogen treatment and variety of seed corn planted. At tassel initiation, the tassels were removed from the plants designated as "female", forcing the female plants to be fertilized by the male plants. This is normally done with 2 inbreds to provide the desired cross for a hybrid, but to simplify planting and timing of pollen shed, the same variety was used for both "male" and "female" plants in any given plot.

The four disturbed lysimeters were the primary nitrogen management research plots and each was fertilized differently. Four different nitrogen application schemes were used.

1. Control plot received 0 kg/ha, except in the first year when 34 kg/ha as pre-plant and 168 kg/ha as side dress were applied.
2. Model treatment received nitrogen as needed.
3. 202 kg/ha {all as pre-plant}.
4. 101 kg/ha {34 kg/ha as pre-plant and 67 as side dress}.

Lysimeter 3 (the undisturbed profile lysimeter) and lysimeter 5 both have received the same nitrogen treatments of 202 kg/ha (180 lb./ac) applied before planting. The first year 90 kg N/ha was added to the model, then in 1990 and 1991 no fertilizer was applied to the model treatment. In 1992 and 1993, 55 kg/ha was added to the model treatment plots.

The model treatment plots received nitrogen as soon as the plants showed a need for it. There are various methods of determining when the plants are starting to need nitrogen, before it is nitrogen deficient. These methods have included, visual determination of leaf color change, chlorophyll meter detection of leaf color change, height / growth change and aerial photography. Using each of these methods the color or growth rate of the field or field plot was compared to a well fertilized block. Any difference was assumed to indicate the beginning of a nitrogen deficiency. Fertilizer was added soon after the difference was observed. The fertilization rate was determined by the stage of growth of the plant.

With the exception of the first year, the plots were chisel plowed in April of each year to prepare the soil for planting. The soil profile disturbance on and around the lysimeters before the first planting was major due to the operations associated with installing the five lysimeters. The topsoil was removed and replaced on and around the lysimeters during installation. The entire field was chisel plowed in the spring before planting. The plots were chisel plowed in the fall of 1989 after installation.

LYSIMETER PLOTS, CONSTANTINE MICHIGAN

Entry (kg/ha) / Treatment

	Rep 1				Rep 2				Rep 3				Rep 4			
5	202 pre 3	Model 1	101 split 2	Check 2	101 split 3	202 pre 1	Model 2	Check 3	Model 1	202 pre 2	Check 2	101 split 1	Check 3	Model 3	202 pre 2	101 split 1
4	202 pre 3	Model 1	101 split 2	Check 2	101 split 3	202 pre 1	Model 2	Check 3	Model 1	202 pre 2	Check 2	101 split 1	Check 3	Model 3	202 pre 2	101 split 1
3	202 pre 2	Model 3	101 split 1	Check 1	101 split 2	202 pre 3	Model 1	Check 1	Model 2	202 pre 3	Check 3	101 split 2	Check 2	Model 1	202 pre 3	101 split 2
2	202 pre 1	Model 2	101 split 3	Check 3	101 split 1	202 pre 2	Model 3	Check .2	Model 3	202 pre 1	Check 1	101 split 3	Check 1	Model 2	202 pre 1	101 split 3
1	202 pre 1	Model 2	101 split 3	Check 3	101 split 1	202 pre 2	Model 3	Check 2	Model 3	202 pre 1	Check 1	101 split 3	Check 1	Model 2	202 pre 1	101 split 3
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
			Lys 1				Lys 2			Lys 3	Lys 4				Lys 5	

Figure 4. Plot diagram showing variety planted (entry) and nitrogen fertilizer treatment.

Each year the plots were planted in May, cultivated in June and harvested in September. The harvest for plot yield was done by hand. The field was then combined to remove the remainder of the corn from the plot edges and border area of the field. A listing of plot activity is given in Table 2 for 1989 through 1993.

The first planting occurred on May 16, 1989 along with an application of fertilizers including nitrogen. After being combined in late October 1989, the research site was chopped with a flail to reduce the size of the stalks which were left in the field, then chisel plowed . In 1990 and following years fall tillage was considered unnecessary and the field was only chisel plowed in the spring before planting.

Plant samples were taken four times a year to determine the nitrogen content in various parts of the plant. These samples were taken every year at stage V-6, detasseling, grain filling and at harvest. The whole plant was tested in four parts; grain, cob, tassel, and the remaining plant tissue. These plant samples were all kept by Pioneer personnel and ground. Then, all four samples were sent to the Michigan State University Soil Testing Service where they were tested for TKN (Total Kjeldahl Nitrogen).

All plots were irrigated in an attempt to keep the soil available water capacity above 50%. Irrigation and precipitation dates and amounts are tabulated in Appendix B. SCHEDULER, a program produced by Michigan State University Department of Agricultural Engineering (Shayya & Bralts, 1993), was used with weather data from Centerville and precipitation data from the research site to estimate soil water content. This information was then used for irrigation scheduling. Each irrigation cycle applied approximately 25 mm of water.

Table 2. Field Practices at MSU plots in Constantine, Michigan.

Date	Operation Performed on Field Plots
16-May-1989	First planting and preplant N application
22-June-1989	Sprayed herbicide
26-June-1989	Thinned plots, soil samples taken
28-June-1989	Sidedress nitrogen treatment applied, cultivated plots, first plant samples
18-July-1989	Weeded plots
19-July-1989	50 lb. N applied to model treatment (ammonium Nitrate)
22-July-1989	Inbred 1 detasseled
27-July-1989	Second plant samples taken
1-Aug-1989	Soil sampled, close to lysimeters (collected at tasseling)
18-Aug-1989	Third Plant samples collected
21-Aug-1989	Removed male corn rows from plots
27-Sep-1989	Harvested plots
2-Oct-1989	Collect test plant samples
Mid-October	Fall tillage
30-Oct-1989	"Big Rain" event applied through irrigation system this day and next.
25-Apr-1990	Soil samples taken
27-Apr-1990	Chisel plowed field
2-May-1990	Preplant N applied, plots planted
8-May-1990	Sprayed plots
15-June-1990	Cultivated plots

Table 2 cont.

18-June-1990	Removed volunteers and thinned plots
25-June-1990	Plots treated for corn borer with Dipel, nitrogen applied to plots, first plant samples taken
10-July-1990	Plots treated for Japanese Beetle with Sevin
17-July-1990	Plots rouged
20-July-1990	Detasseled Inbred 1
23-July-1990	Applied 40 kg N/ac to Inbred 1 Model plots
27-July-1990	Detasseled Inbred 2 and 3, Plots weeded, second plant sample taken
2-Aug-1990	Hoed weeds
14-Aug-1990	Male rows removed
16-Aug-1990	Third plant sample taken on Inbred 1
23-Aug-1990	Third plant sample taken on Inbred 2 and 3
12-Sep-1990	Harvested Inbred 1, Fourth plant sample taken on Inbred 1
25-Sep-1990	Harvested Inbreds 2 and 3, Fourth plant sample taken on Inbred 2 and 3
9-Nov-1990	Plots gleaned off
29-Nov-1990	Soil samples taken
2-Apr-1991	Soil samples taken for P & K
20-Apr-1991	Lasso-Atrazine
26-Apr-1991	P applied to rep 1 and 2
4-May-1991	Chiseled plot E to W 0.25 meters deep

Table 2. (con't)

8-May-1991	Field cultivated plots, applied N, planted plots
3-June-1991	Cultivated plots
3-June-1991	Treated for ECB1 (Javeline)
12-June-1991	Thinned plots
13-June-1991	V6 plant samples taken, Sidedress N applied, check treated for ECB1 (Pounce)
8-July-1991	Detassled PO2, plant samples taken
26-July-1991	Sprayed plot for Japanese beetles (Peneap 3pt)
29-July-1991	Detassled P38
31-July-1991	Detassled T10
2-Apr-1992	Took soil samples for P & K
6-Apr-1992	Rototilled residue. Broke up stalks to prevent plugging of field cultivator.
4-May-1992	Chisel plowed
6-May-1992	Planted and fertilized plots
11-June-1992	Cultivated plots
1-July-1992	Fertilized 101 kg/ha plots and irrigated
2-July-1992	Fertilized Model treatment with 101 kg/ha.
8-July-1992	Irrigated
3-Aug-1992	Destroyed male PO2 Detassled P38 & T10

Table 2. (con't)

8-Aug-1992	Destroyed male P38
11-Aug-1992	Destroyed male T10
20-Aug-1992	Irrigated
24-Aug-1992	Irrigated
	Harvested grain and took 4th plant samples
5-Nov-1992	Gleaned corn off plots
8-May-1993	Fertilized, Tilled and Planted plots
18-May-1993	Corn emerged
6-June-1993	Hoed 3/4 of field
2-July-1993	Applied Nitrogen to Model plots
13-July-1993	Hoed rogues
20-July-1993	Silk and Shed (PO2 is 50% shed)
20-July-1993	Took plant and tassel samples
28-July-1993	Detasseled P38 and T10
11-Aug-1993	Plant Sample #3
13-Aug-1993	PO2 "Male" rows destroyed
16-Aug-1993	P38 "Male" rows destroyed
16-Aug-1993	T10 "Male" rows destroyed

Sampling System

The leachate sampling system employed a Campbell Scientific CR-10 micro-datalogger to monitor and sample drainage from five drainage lysimeters. Along with the sampling procedures, the CR-10 was also used to log data from a weather station.

The weather station included sensors for relative humidity, air temperature, soil temperature, wind speed and direction, rainfall, and solar radiation (Table 3). The sensors were mounted 2 m above ground, except for the precipitation gauge which was set on a concrete pad at ground level.

Table 3. Description of Campbell Scientific, Inc. weather station sensors.

Description	CS Model #	Accuracy	
Tipping Bucket Rain Gauge	6011-A	+/- 0.25 mm per tip	
R.M. Young Wind Sentry Anemometer	03101-5	+/- 0.5 m/s	
R.M. Young Wind Sentry Vane	03301-5	+/- 5 deg.	
Pyranometer	LI200S		
Temperature and Relative Humidity Probe	207	Temp.	+/- 0.2 deg. C
		RH	+/- 5%
Temperature Probe {Soil}	107B	+/- 0.2 deg. C	

The data were recorded hourly for mean air temperature, mean RH, total solar radiation, total precipitation, mean wind speed, soil temperature, battery volts and accumulated drainage tips from all 5 lysimeters. Daily max and min values were recorded for temperature, RH, battery voltage, wind speed, wind speed and box temperature. Also recorded daily were total solar radiation, total precipitation, mean wind speed, wind vector magnitude, wind direction (with standard deviation), maximum wind speed, mean soil temperature and mean box temperature. The stored data, daily and hourly output, in the datalogger was read nightly by a VAX computer located at Michigan State University's Kellogg Biological Station located near Hickory Corners. Programs were written for the VAX to retrieve the datalogger information and organize this data in a more usable form. Programs were also written which clean up and recognize faulty data.

A tipping bucket rain gauge (Sierra Misco PN SP2501-BA) was mounted under the drain pipe in each lysimeter, on top of a 38 liter bucket to measure and contain the volume of drainage coming from the lysimeter (Figure 5). The five tipping bucket assemblies were monitored by the CR-10 by using an eight channel pulse counter (SDM-SW8A) produced by Campbell Scientific to increase the capabilities of the CR-10, which normally has only 2 pulse channels. The CR-10 counted tips from the tipping buckets. Then the volume of drainage was calculated from the total number of tips and a calibrated volume per tip.

The CR-10 started a sequence to sample drainage from any lysimeter after a preset amount of drainage, set at 0.56 cm (0.25 inches), had passed through the tipping bucket.

Figure 6 is a wiring diagram of the sampling system. The CR-10 controlled 3 relays for each lysimeter, 15 relays total, through another add-on device (Campbell Scientific's SDM-CD16). These relays in turn controlled a 12 volt water pump (Flowjet 2100) at each lysimeter which pumped the water from under the lysimeter through a sampling box and into a drywell. In the pump line, a solenoid diverting valve (Spraying Systems PM AA144 Directovalve) was installed and controlled by the CR-10 to send 500 ml to a sample bottle during the middle of the pumping cycle. After the CR-10 turned the pump off, a motor in the sampler was turned on which moved the sampler to a new bottle, preparing for the next sampling sequence.

The Campbell Scientific CR-10 was programmed by Thomas Olmsted, a student at Michigan State University at the time the lysimeters were built. Figure 7 is a flow chart of the sampling portion of the program. When the datalogger approached 10 minutes before the hour, counts from the tipping buckets would be counted but no action to take or log a sample would be performed until after the datalogger had time to write an hourly output file.

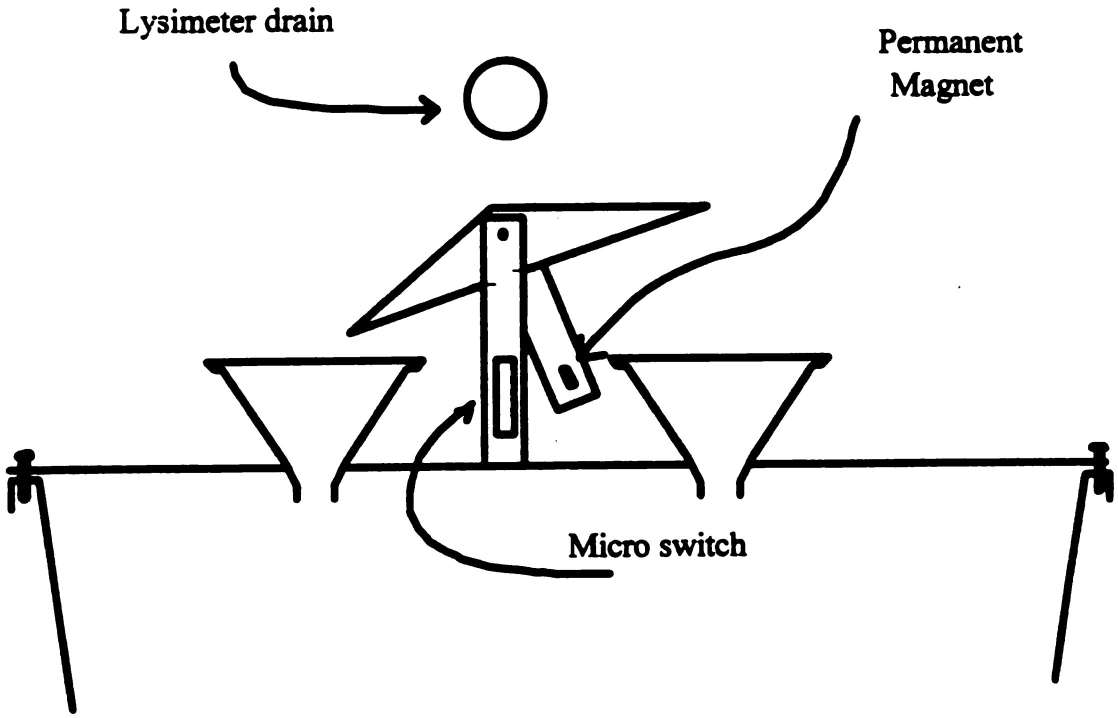

Figure 5. Tipping bucket assembly.

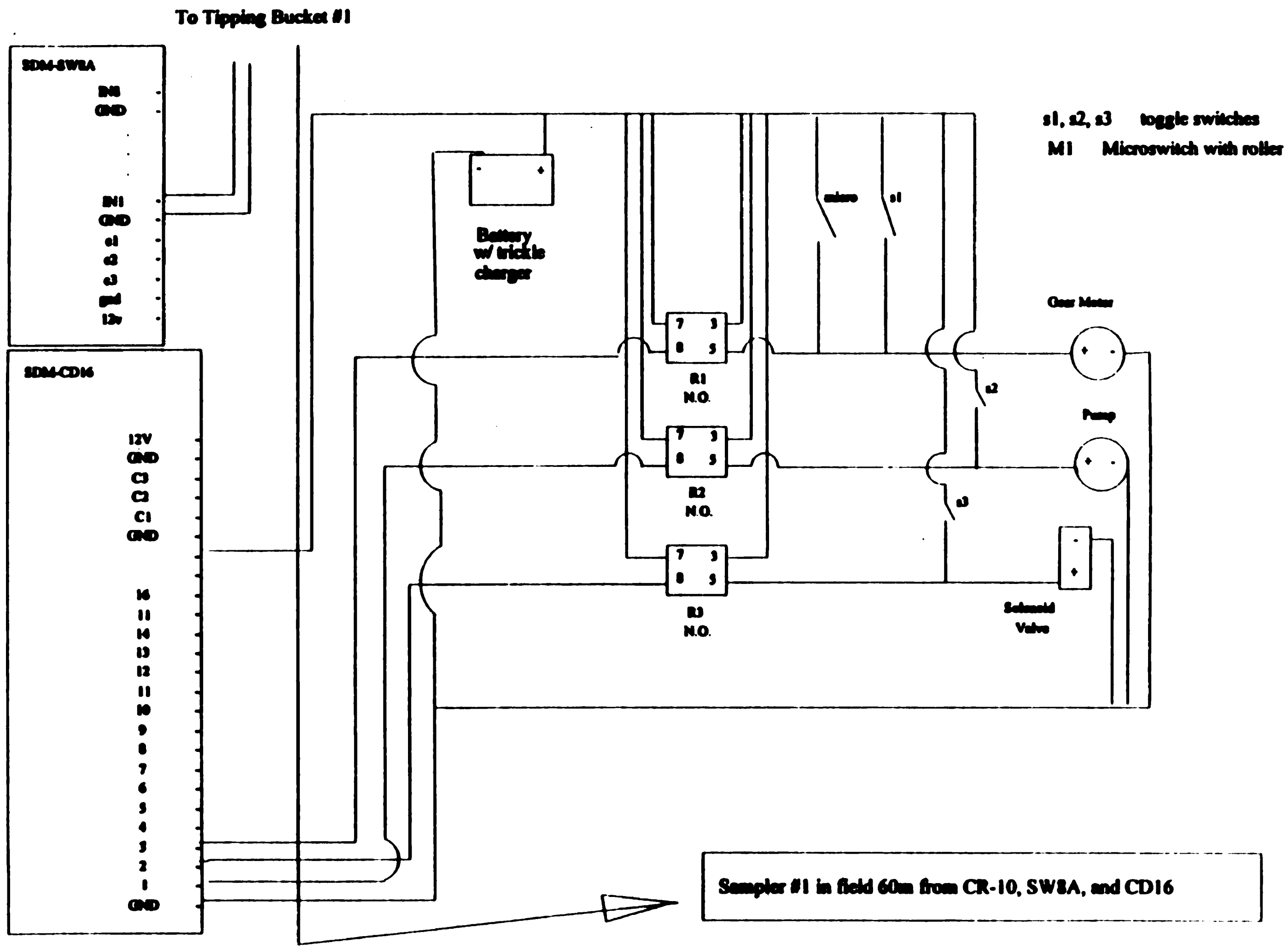

Figure 6. Sampling system wiring diagram.

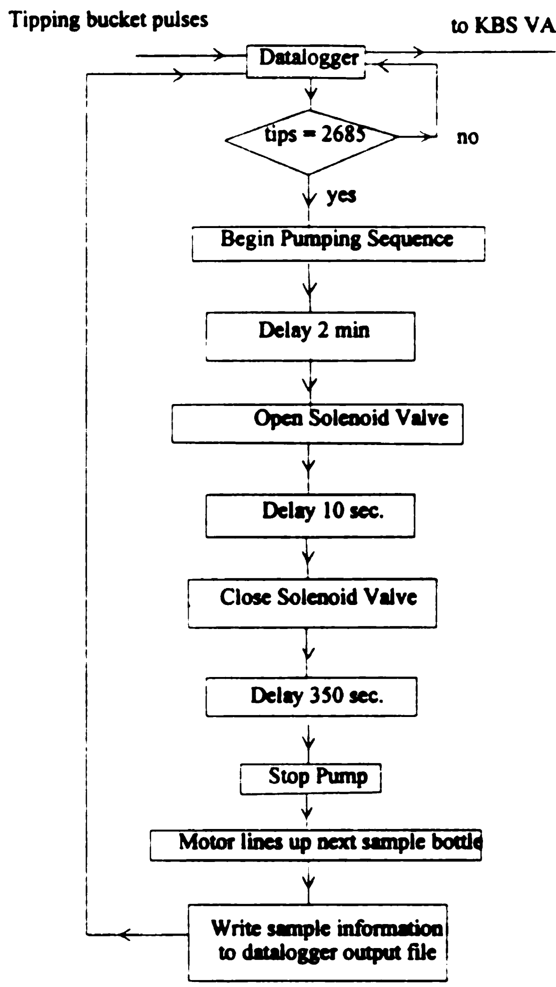

Figure 7. Sampling program flow chart.

Leachate Testing Procedure

The automatic sampling system took a 500 ml sample every 6.35 mm (0.25 inches) of drainage (approximately 22 liters). From this 500 ml sample, a 20 - 30 ml subsample was later taken and frozen. When there were approximately 30 to 40 frozen samples, these samples were taken to Michigan State University to be analyzed for NO_3 at the Soil Testing Lab.

The Soil Testing Lab used a Lachat QuikChem Automated Flow Injection Ion Analyzer with QuikChem Method No. 10-107-04-1-A to determine the concentration of nitrate contained in the samples. The concentration data were then input into a spreadsheet along with the sample date, volume sampled and sample number. With this data in a spreadsheet, nitrogen loads were calculated and drainage trends were charted. (Appendix C)

Statistical Analysis

Mean comparisons of drainage and nitrogen leaching were made between the five lysimeters for the 1990, 1991, 1992 and 1993 leaching years. Significant mean differences were determined using two tailed Student's t Test criteria assuming equal variance and an alpha of 0.10.

RESULTS

Collection Of Drainage Data

The evaluation of the performance of the disturbed profile lysimeters at the Pioneer plant near Constantine Michigan included comparison of the drainage volume passing through each of the four disturbed lysimeters at the site. Drainage through each of the disturbed lysimeters was compared to the other disturbed lysimeters. Drainage through the disturbed lysimeters was also compared to the drainage through the undisturbed lysimeter. The initial hypothesis was that no significant difference in drainage is present between the disturbed profile lysimeters and the undisturbed profile lysimeter installed at Constantine. An agreement at the 90% confidence level between drainage data sets was chosen as acceptable.

Drainage from the five lysimeters was measured by the tipping bucket setup described earlier. This data consisted of a record of the number of tipping bucket tips on an hourly basis. Each tipping bucket was calibrated so the volume of one tip was known (Table 4). The calibration on these tipping buckets were checked periodically, but no cause for a change in calibration was ever found.

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Table 4. Tipping bucket calibration volumes.

Lysimeter 1	0.00824 liters/tip
Lysimeter 2	0.00868 liters/tip
Lysimeter 3*	0.00770 liters/tip
Lysimeter 4	0.00824 liters/tip
Lysimeter 5	0.00824 liters/tip

* *Lysimeter 3 is the undisturbed lysimeter.*

Data were lost for all lysimeters on the dates listed in Table 5. These losses occurred due to power loss (dead batteries), computer down time (from lightning strikes) and sampler system malfunctions. Other causes might also be present, but not diagnosed.

The largest time period from which data were lost was January 10, 1991 to April 1, 1991. These data were lost during computer repairs. No samples were taken during this time by the automated system. Some drainage volumes were estimated by measuring the volume which accumulated in the manhole attached to the lysimeter.

Data were also lost for individual lysimeters from time to time due to tipping bucket failure. This failure can be attributed to the moist location in which the tipping buckets were located and damage from the indigenous population (mice) of the area in which the lysimeters were located. These lost data were replaced with the average volume drained from the other lysimeters for the time in question. Appendix A contains a tabulation of the tips, volumes and missing value estimates used for the five lysimeters.

Table 5. Dates for which no automated data were available.

- 15-Jan.-1990 to 5-Feb.-1990
- 1-Jul.-1990
- 20-Sep.-1990
- 27-Sep-1990
- 4-Oct-1990
- 10-Dec-1990 to 18-Dec-1990
- 25-Dec-1990 to 29-Dec-1990
- 10-Jan-1991 to 1-Apr-1991
- 8-Apr-1991
- 22-Apr-1991
- 26-Apr-1991
- 9-May-1991 to 14-May-1991
- 22-Apr-1993
- 2-Jun-1993
- 23-Jul-1993
- 25-Aug-1993
- Automatic Computer Controlled sampling ended September 16, 1993.

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Evaluation Of Drainage Rates

The plot on which the lysimeters are located received precipitation and, if needed, supplemental irrigation during dry periods in the growing season. Precipitation and Irrigation amounts are tabulated in Appendix B.

The ideal result of drainage measurements through the lysimeters would be exact agreement between drainage rates on an hourly basis. In a field situation soil infiltration and percolation rates, as well as soil moisture holding capacity, vary over the entire field even if the soil type does not change. This soil variation causes variation in measurements of drainage rates, but total flows over a long period of time should still agree within some range of natural variation. Due to soil variations and other natural variations such as precipitation and irrigation distribution uniformity, drainage data agreement within +/- 10% between the two types of lysimeters was taken as an acceptable level.

The smallest time periods investigated were single storm events. Daily drainage data were used to compare drainage between lysimeters. Although hourly data were accumulated, they were only used to evaluate time to peak for single storm events.

Logging of drainage data began June 23, 1989. Before October 30, 1989 there was no substantial drainage due to a dry summer. This low flow of drainage prompted the researchers to attempt to test the lysimeters and data acquisition system with an artificial "Big Storm" which was applied with the solid set irrigation system at the site on October 30 and 31, 1989. There was a variation in depth of irrigation water applied to the lysime

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lysimeters due to an inadvertent use of sprinklers with different sized nozzles and heads. This produced different irrigation depths on each lysimeter. The uniformity of this untested system was very poor for this irrigation. Rain gauge catch at each lysimeter was as follows:

- Lysimeter 1 72.4 mm
- Lysimeter 2 90.2 mm
- Lysimeter 3 133.4 mm
- Lysimeter 4 77.5 mm
- Lysimeter 5 85.1 mm

This lack of uniformity lends error to observations based on this event. As is seen in Figure 8, drainage from the event starting on October 30, 1989 is radically different from lysimeter to lysimeter.

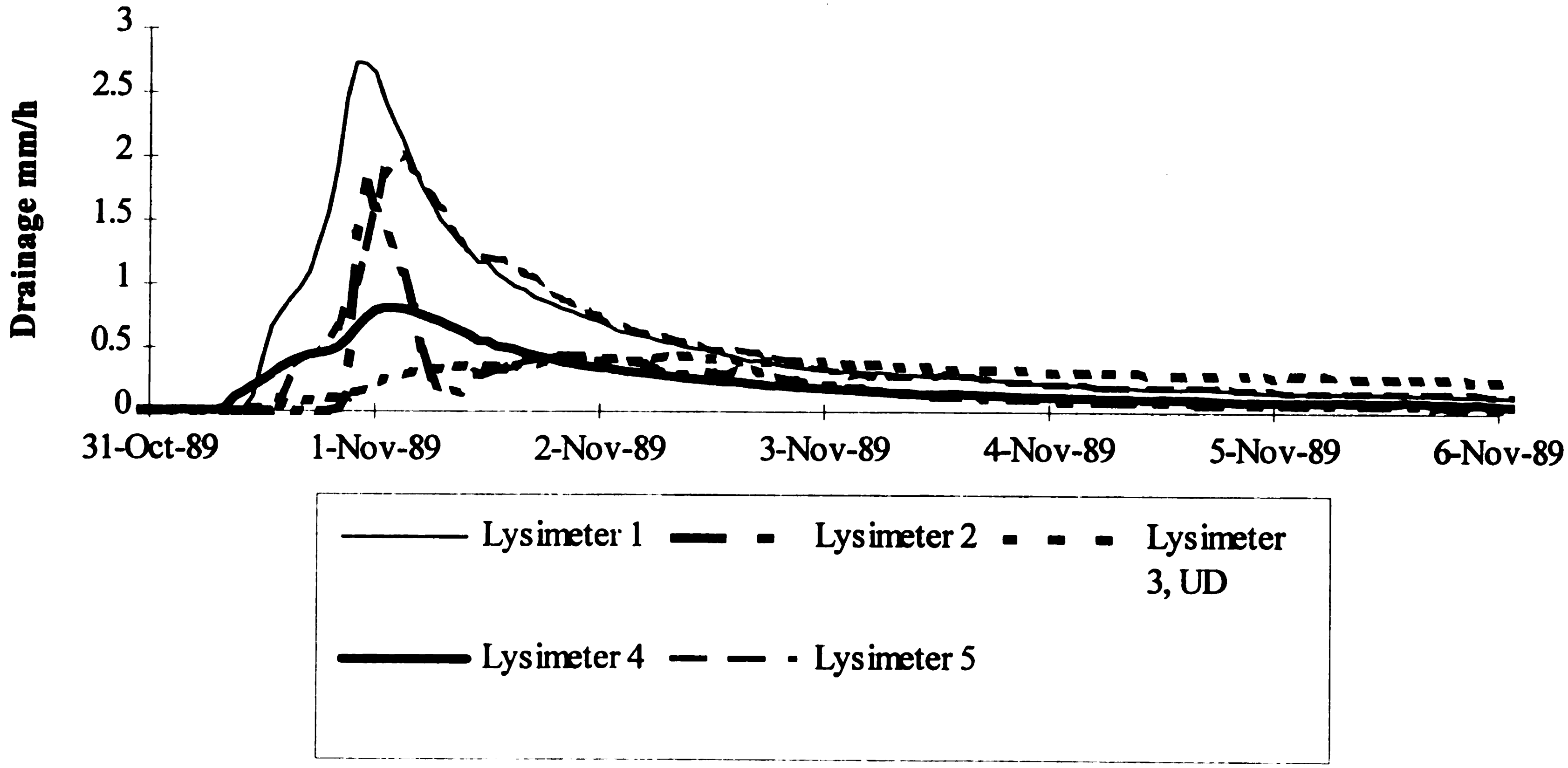

Figure 8. Drainage produced by "Big Storm" event on 10-30-89 and 10-31-89.

Instantaneous flows and total flows for many singular events from each of the lysimeters did not agree with each other (Appendix A). It is only after the total drainage from a few storm events had been accumulated that agreement could be seen (Figure 9).

A few relatively singular events occurred which were only minimally effected by the previous or the next storm event. In Figure 10 the most isolated event recorded is shown. The precipitation which started this event was 13.5 mm on November 4 with an additional amount of 34 mm received on November 5, 1990. Toward the end of this drainage event 6.4 mm fell on November 22, 1990. In this event the total water drained from each lysimeter was within 10% of the average water drained from all five lysimeters (Table 6). The flow from one disturbed lysimeter, lysimeter 5, lagged behind and did not peak at as high a rate as the flow for the other four lysimeters.

Table 6. Drainage from individual lysimeters during the drainage event which began November 4, 1990.

	mm Drained
Lysimeter 1	43.12
Lysimeter 2	37.99
Lysimeter 3*	40.94
Lysimeter 4	39.41
Lysimeter 5	39.89
Average	40.27

* Lysimeter 3 is undisturbed.

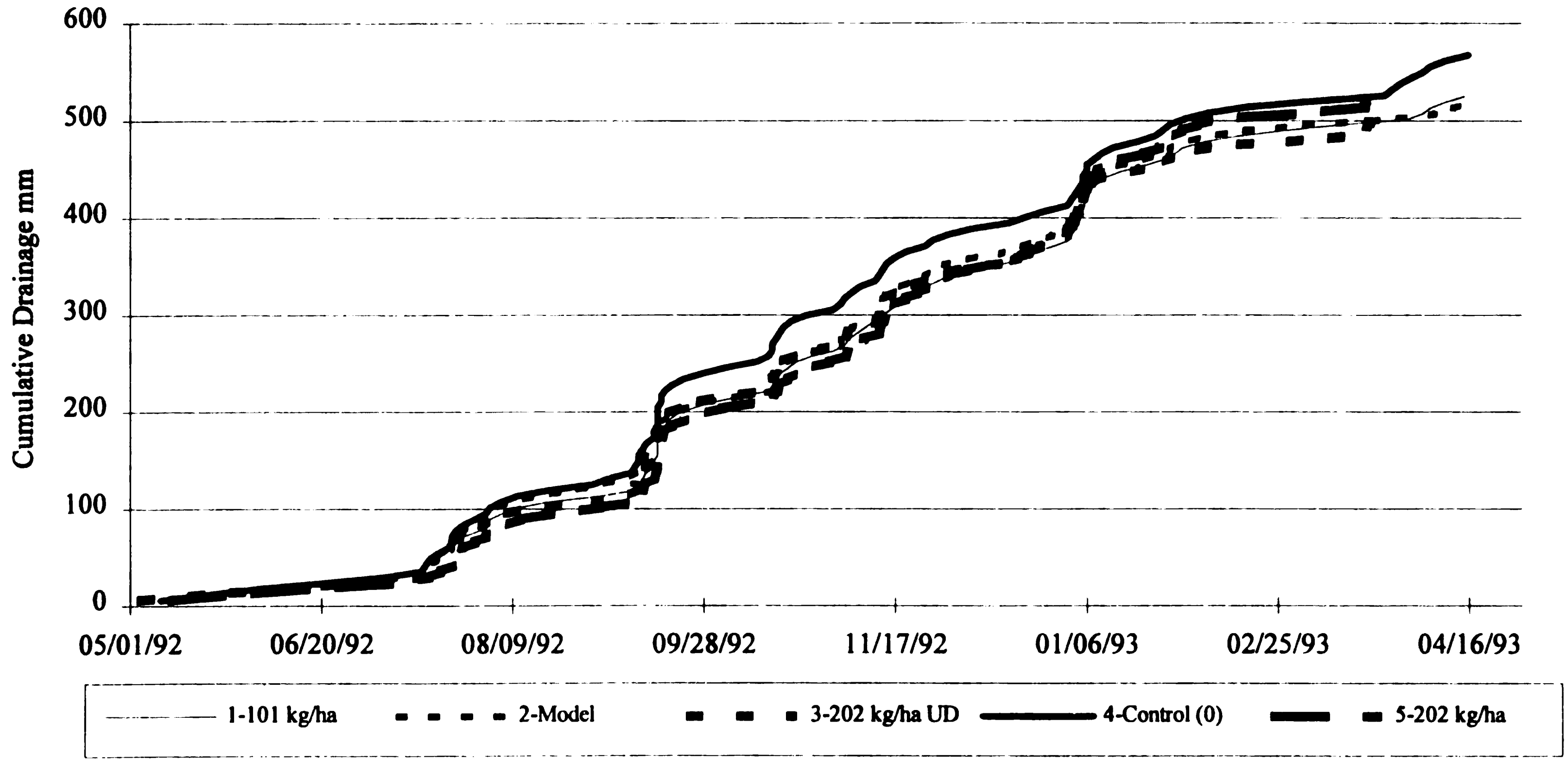

Figure 9. Cumulative Drainage May 1, 1992 through April 30, 1993.

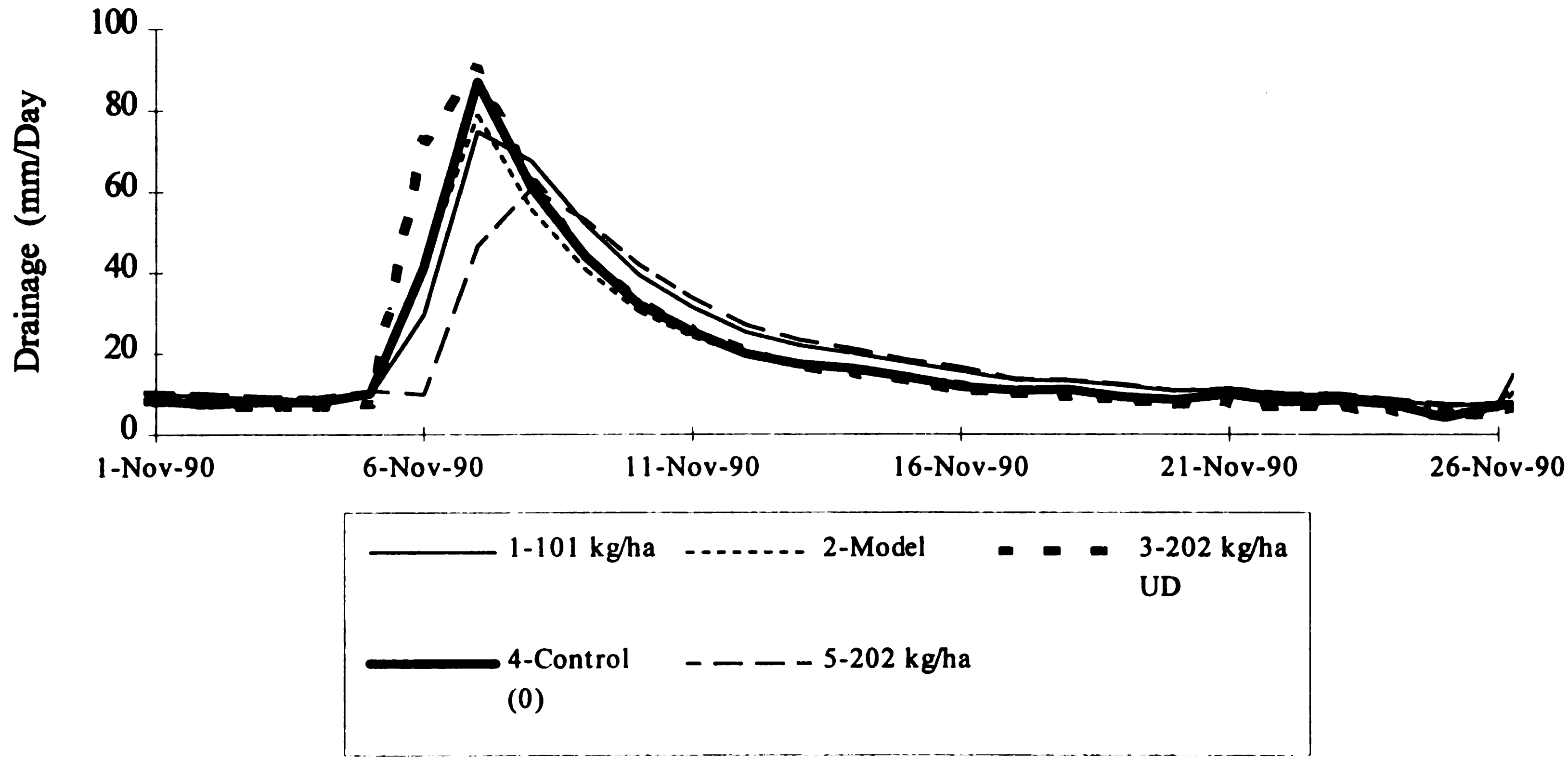

Figure 10. Drainage Rates From A Singular Drainage Event.

As can be seen from the graph of cumulative drainage during 1992 for the five lysimeters (Figure 9), the yearly cumulative drainage is within 10% of the average drainage (including the undisturbed lysimeter). Total drainage for this period was 367 mm, 341 mm, 359 mm, 360 mm, 390 mm for lysimeters 1-5 respectively. The 1990 and 1991 years showed the largest differences between the total annual drainage flows for the various lysimeters.

Flow volumes for early 1991 are not as accurate as for other years. Drainage volumes for January through March of 1991 were acquired manually three times over three months before the datalogger was back on-line in April 1991. Manual drainage volumes were obtained by measuring the depth of accumulated water in the drainage collection chamber adjacent to the lysimeter and calculating the volume present. This period effects the end of 1990 cumulative results and the beginning of 1991 results. (Appendix A)

The times to peak drainage for the five lysimeters do not agree with each other on individual storm events. Every drainage event which occurred during 1989 through 1993 was investigated (Appendix A). The events shown here were chosen because events occurring in the fall are generally larger than other times during the year and showed differences to a greater extent. The lag seen in time to peak between lysimeters in the fall can be as great as one or two days early in the life of the lysimeter. When the first big drainage event was forced on October 30, 1989 ("Big Storm") lysimeter 1 peaked first. Lysimeter 3 (the undisturbed lysimeter) peaked 34 hours after lysimeter 1 (Figure 8). The other lysimeters peaked within 5 hours after lysimeter 1. In the November 1990 event (Figure 10), which was triggered by 13.5 mm of precipitation on November 4 and

34 mm on November 5, lysimeters 3 and 5 peaked 26 hours after lysimeter 2, but only 16 hours after lysimeters 1 and 4. In an event in October and November 1991, triggered by 14 mm of precipitation on October 24, 37 mm on October 25 and 17 mm on October 26, lysimeter 3 peaked first. The other lysimeters peaked within 16 to 19 hours after lysimeter 3. In an event triggered by 45 mm of precipitation on October 14, 1992, lysimeters 3 and 4 peaked first, followed 4 hours later by lysimeter 2, and 29 hours later by lysimeters 1 and 5.

Comparisons were made of the four disturbed lysimeters looking at the mean difference in cumulative flow from June 8, 1989 to September 16, 1993, and also cumulative flow on an annual basis, May 1 to April 30 for each leaching year (June 8, 1989 to April 30, 1990 for the first year). Each lysimeter was compared to each of the other four lysimeters, including a comparison to the undisturbed lysimeter.

A Student's t-test with equal variance assumed was performed on the daily cumulative drainage data from each of the lysimeters, comparing them to each of the other disturbed lysimeters, one year at a time (Table 7). The Students t-test was performed using $\alpha = 0.10$. If the absolute value of t is less than the t critical for that comparison, the two lysimeters compared are, with 90% confidence, yielding the same drainage amounts.

Table 7. Values of t from Student's t-test comparing daily cumulative drainage between disturbed lysimeters for each year.

Lysimeters	1989	1990	1991	1992	1993
1 vs. 2	2.07	5.25	3.29	-0.48	0.62
1 vs. 4	0.53	-0.01	-0.23	-1.70	-0.05
1 vs. 5	1.12	3.17	1.79	-0.17	0.99
2 vs. 4	-1.51	-5.31	-3.52	-1.24	-0.66
2 vs. 5	-0.94	-2.19	-1.46	0.29	0.37
4 vs. 5	0.57	3.20	2.02	1.50	1.01

alpha = 0.10

t Critical two-tail = 1.65

Early in the life of the lysimeters, drainage volume agreement was less than expected among the five lysimeters. An agreement of at least 90% was hoped for but not achieved until the 1992 season. In 1992, lysimeters 1,2, and 5 were in agreement. Lysimeter 4 was in agreement with lysimeters 2 and 5 but not with lysimeter 1.

The 1993 season was the best year for agreement in drainage amount. Based on the Student's t-test for two sets of means with equal variances, total flows for all four disturbed lysimeters in the 1993 season were statistically the same.

Figure 11 is a graph of cumulative drainage for the 1991, 1992 and 1993 seasons for the four disturbed lysimeters and the undisturbed lysimeter. This graph shows the drainage trends and shows that the trends are the same in all four disturbed lysimeters, as well as with the undisturbed. The volume of drainage produced by the individual lysimeters is expected to be the same over a few precipitation events, but this drainage is not equal on a daily time frame.

The 1992 summer was unseasonably wet, with less solar radiation than Michigan normally receives. This year showed little resemblance to 1991 and 1993 which were more characteristic of Michigan weather. The 1993 season shows distinctly that late spring and fall are when drainage rates peaked.

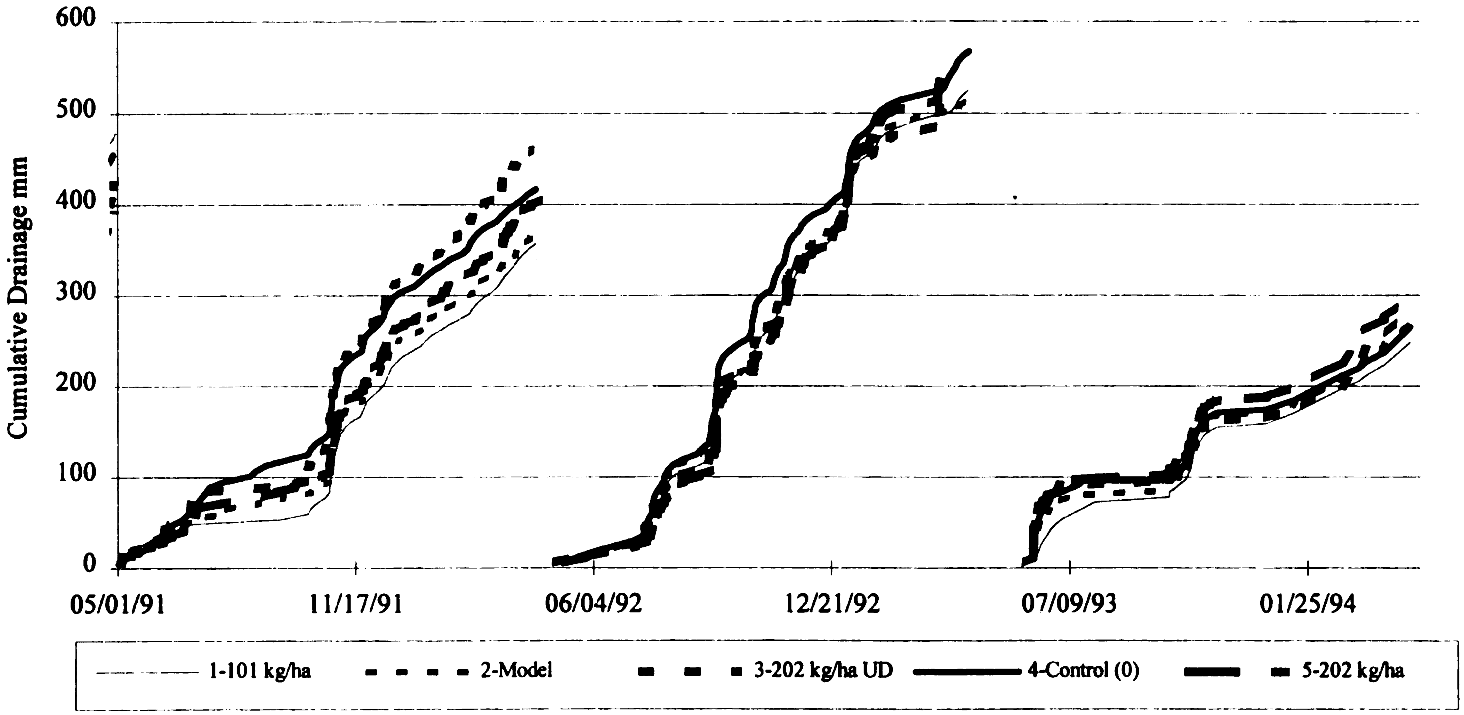

Figure 11. Cumulative drainage for 1991 through 1993 leaching years.

A major factor in the analysis of the drainage rates from the disturbed lysimeters was the comparison of these lysimeters to a control. The control in this case was the undisturbed lysimeter, lysimeter 3, of the same surface area and in the same field as the disturbed lysimeters. The only differences between the undisturbed lysimeter and the disturbed lysimeters were the method used to fill the containers with soil and the fact that the bottom of the undisturbed lysimeter was 0.3 meter higher due to problems encountered while encapsulating the monolith of soil. The upper edge of the lysimeter containers are approximately the same depth below the soil surface.

The average total annual drainage over a five year period across all five lysimeters (Table 8) is 340 mm (13.5 inches) of drainage. The maximum difference in total annual drainage between any two lysimeters was 131 mm in 1991 (when measurements were questionable) between lysimeters 3 and 2. There was also a difference of 80 mm between lysimeter 3 (undisturbed) and the next highest lysimeter (lysimeter 1) in 1991. The difference between lysimeters in other years was much less, 23 to 49 mm each year. Of the five years studied the most precipitation occurred during 1992 but the maximum difference in drainage was only 23 mm between lysimeters 1 and 5.

Table 8. Cumulative drainage May 1 to April 30.

From	To	Lysimeter 1 mm	Lysimeter 2 mm	Lysimeter 3 mm	Lysimeter 4 mm	Lysimeter 5 mm
7-June-89	30-Apr-90	396	369	352	384	385
1-May-90	30-Apr-91	254	211	205	219	246
1-May-91	30-Apr-92	460	409	540	454	446
1-May-92	30-Apr-93	367	341	359	360	390
1-May-93	28-Apr-94	387	413	434	431	399

Table 9. Student's t-Test results comparing daily drainage from each of the four disturbed lysimeters to the undisturbed lysimeter.

	Lys 1 t	Lys 2 t	Lys 4 t	Lys 5 t
1990	3.36[d]	-2.36[d]	-3.40[d]	-0.01
1991	-3.29[d]	-6.33[d]	3.07[d]	4.93[d]
1992	0.25	0.73	-1.95[d]	-0.41
1993	1.18	0.56	-1.19	-0.19

[d] Significantly different than undisturbed lysimeter
t critical two-tail = 1.65

The results of t-tests performed on daily cumulative drainage data from 1990 and 1991 show poor agreement between the disturbed lysimeters' drainage and the undisturbed lysimeter's drainage (Table 9). Since the beginning of the 1992 leaching year (May 1992) drainage from all of the disturbed lysimeters show agreement with the undisturbed lysimeter at the 90% confidence level, except for lysimeter 4 which was not in agreement in 1992.

Graphs of Drainage events early in the experiment, from February of 1990 until June of 1990, show that drainage flow rates peaked in the four disturbed lysimeters earlier and at a higher flow rate than the drainage rate peaked in the undisturbed lysimeter (Figure 12).

The drainage rate through all five lysimeters behaved about the same for the next few months with the drainage through the disturbed lysimeters beginning to slow down compared to the drainage rate through the undisturbed lysimeter. After July of 1991 the disturbed lysimeters drained at a much slower rate than the undisturbed lysimeter. The largest differences in peak drainage rate occurred during the period from July 1991 through October 1991 (Figure 13). After these events, the drainage began slowly agreeing better with the passing of each season. During the 1993 leaching year the drainage pattern from the undisturbed lysimeter and the disturbed lysimeters was almost the same. The larger volume drainage events still flowed through the undisturbed lysimeter

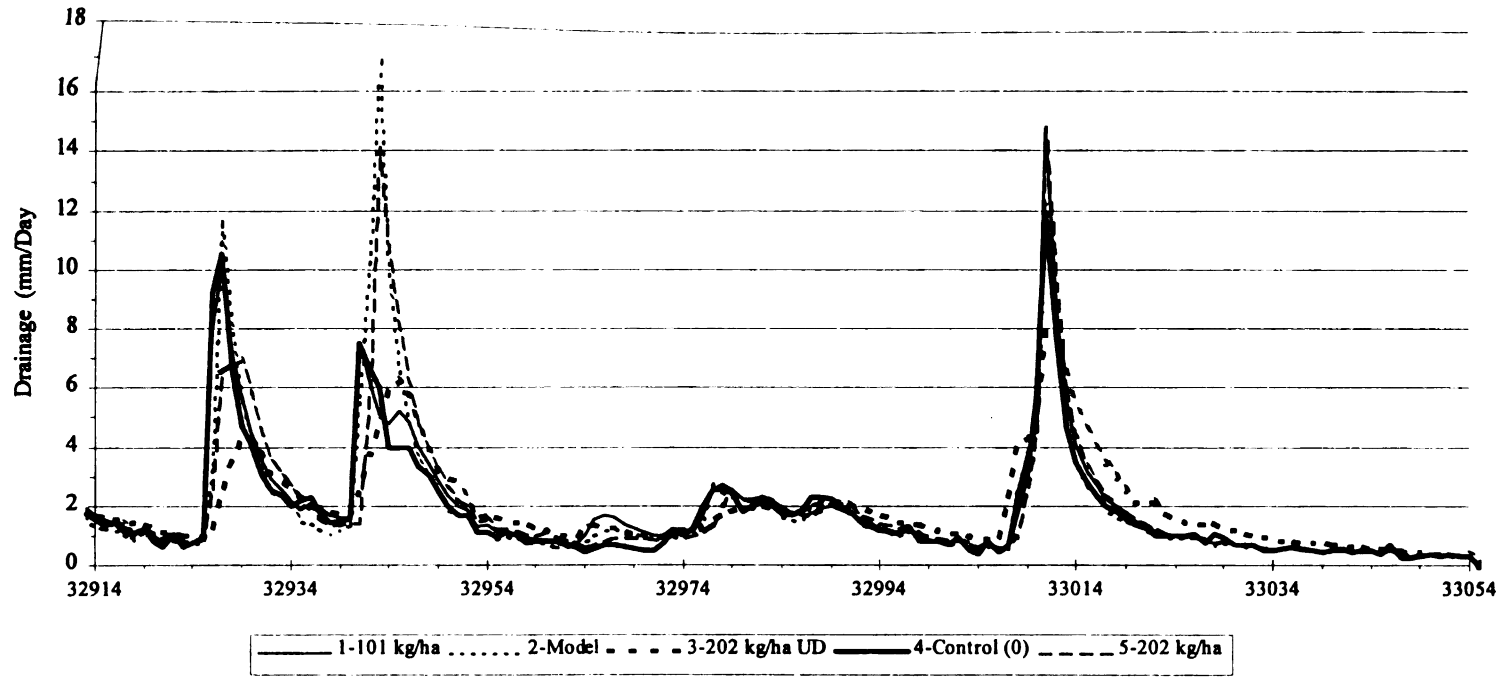

Figure 12. Drainage events, spring of 1990.

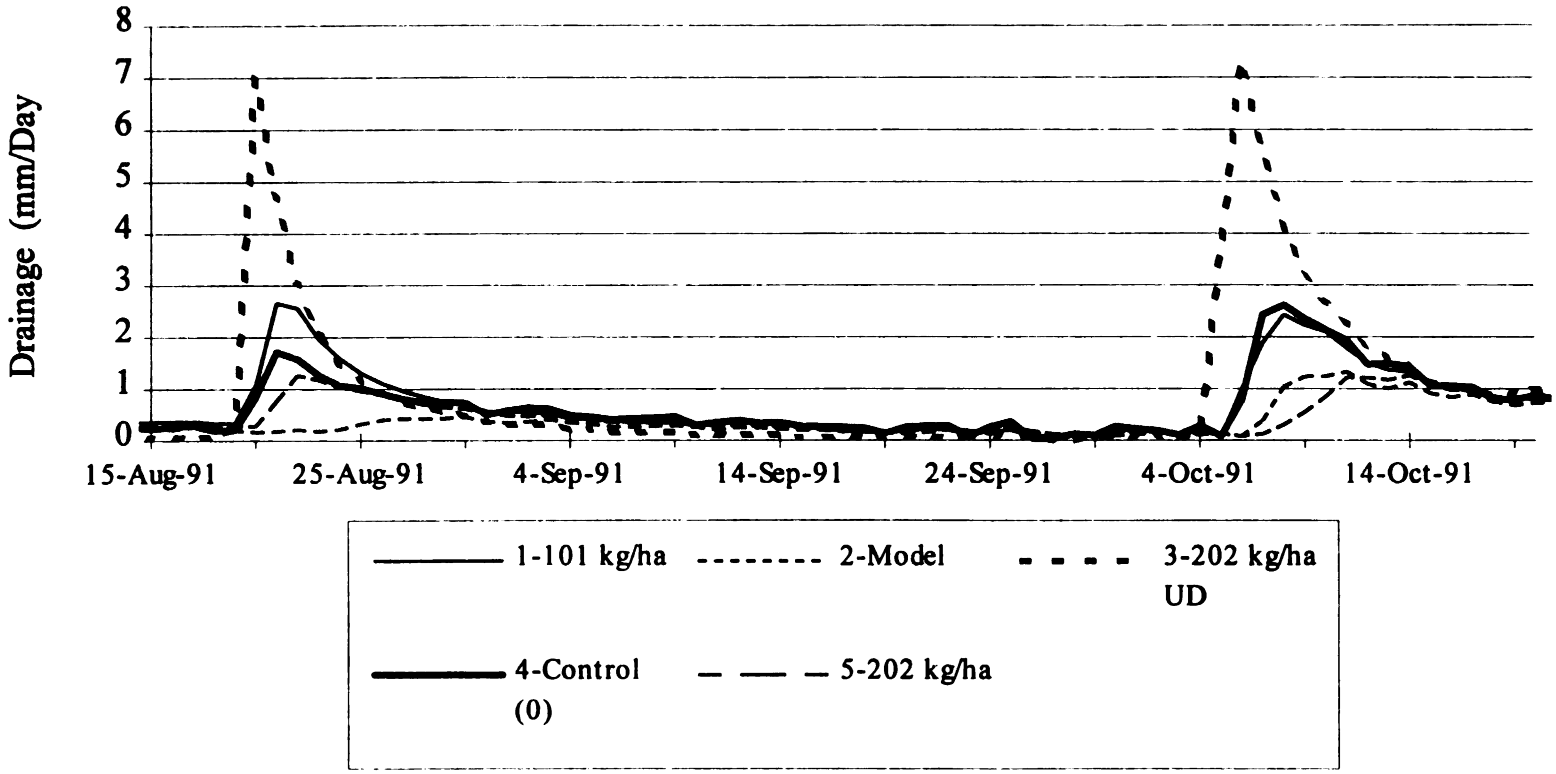

Figure 13. Drainage events, fall of 1991.

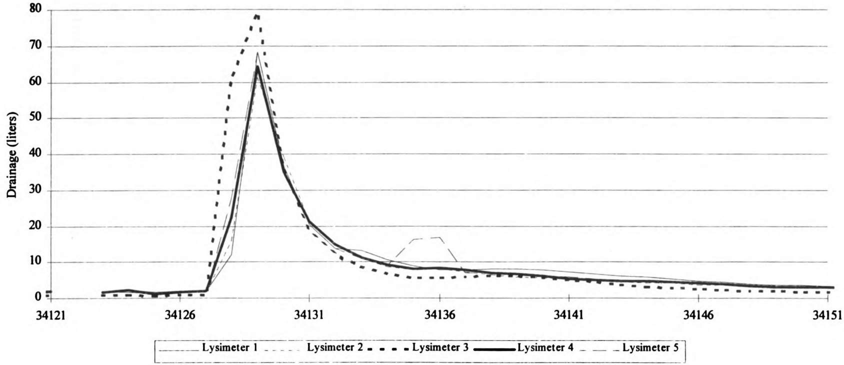

Figure 14. Single drainage event, June of 1993.

fastest (Figure 14), but differences in drainage from most storm events was indistinguishable. As can be seen in this figure, the peak drainage rate through the disturbed lysimeters approached the rate seen in the undisturbed lysimeter.

We can also compare the average drainage from all five lysimeters to drainage which should be expected given the precipitation, irrigation and evapotranspiration (ET) for the comparison period. To calculate what drainage is expected, a simple water balance was performed, based on the following daily calculation;

Soil Storage = Precipitation + Irrigation - Evapotranspiration - Drainage.

Drainage was assumed to occur if the previous days Soil Storage exceeded 225 mm of water. This 225 mm of water is the maximum available water capacity of the soil for a 1.52 m depth of soil. The maximum available water capacity of 225 mm of water was based on a soil textural analysis performed during the installation of the lysimeters. Calculations were performed as if all drainage and precipitation happened at the same time, once a day.

Cumulative drainage graphs, calculated and measured, for 1991 and 1992 are presented in Figures 15 and 16. Figure 15 starts on April 1, 1991 in order to miss three months of uncertain drainage amounts are presented in Table 10. Values of ET used in calculating expected drainage. Daily ET values during the growing season were calculated by SCS-Scheduler V. 3.00 (Shayya & Bralts, 1994) using actual weather data.

Off season ET was calculated by the same software package but using an "historical" weather option which calculates an average monthly ET based on long term average weather data and the present crop type. The off season crop was assumed to have a 250 mm root zone, typical of weeds present for part of the year, with a constant crop coefficient of Kc = 0.10. The value Kc is a coefficient relating the ET of a crop to that of a reference crop, in this case, irrigated mowed grass. The value of 0.10 was chosen for the off season Kc value because it is the lowest value of Kc which could be chosen, representing a sparse weed population on bare ground.

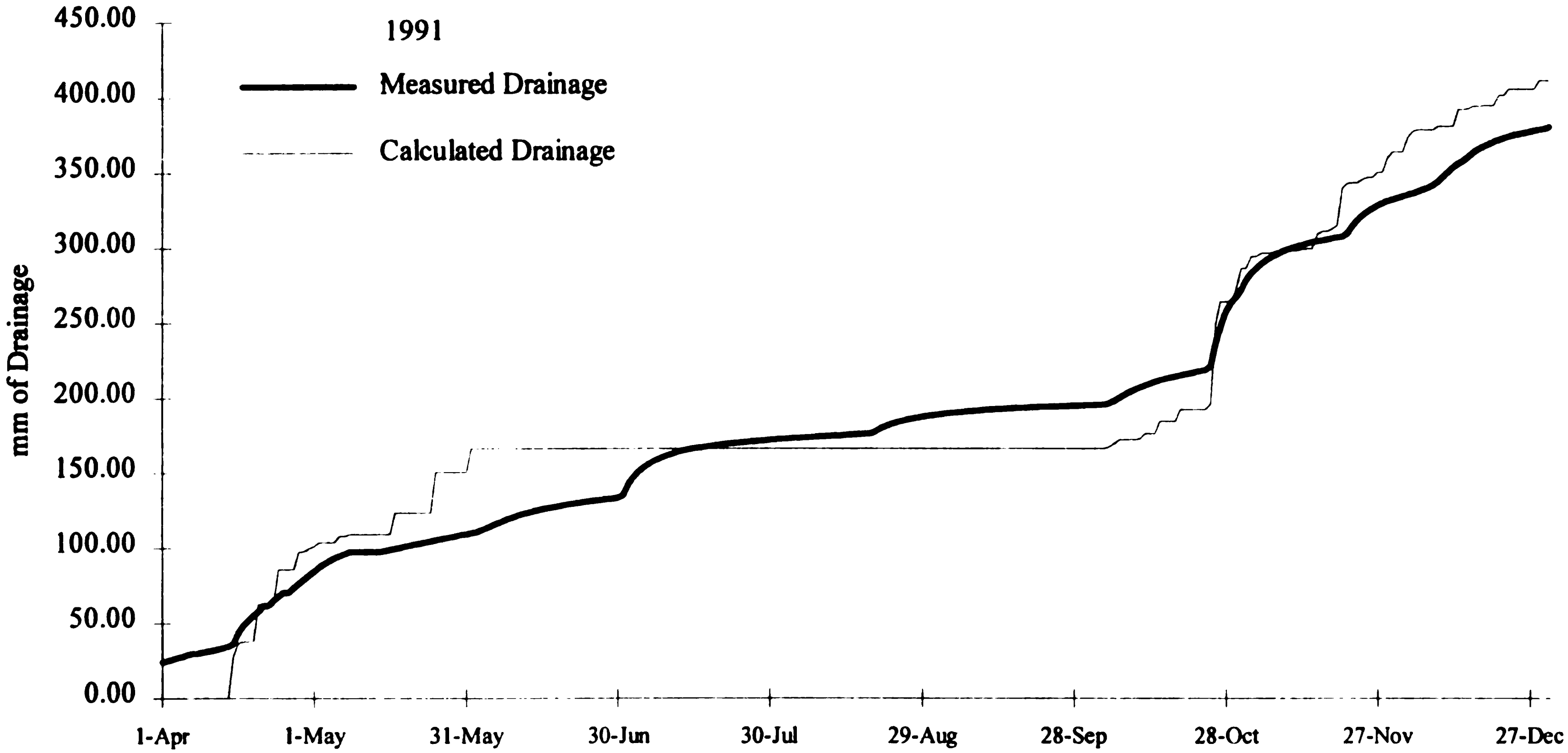

Figure 15. Comparison of 1991 cumulative measured drainage and cumulative calculated drainage.

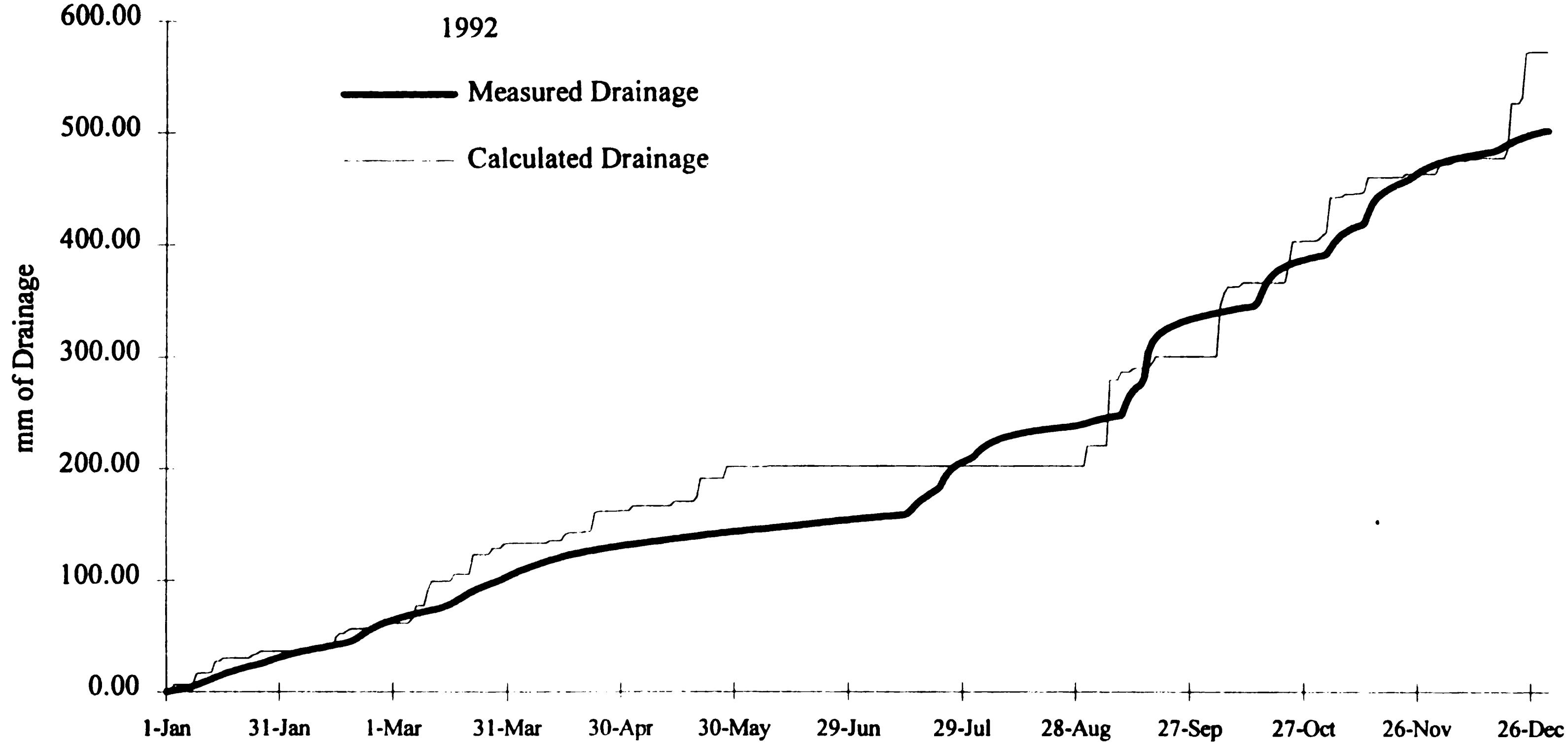

Figure 16. Comparison of 1992 cumulative measured drainage and cumulative calculated drainage.

Table 10. ET values for 1991 and 1992.

Average ET (mm/day)	1991	1992
January*	0.00	0.00
February*	0.00	0.00
March*	0.00	0.00
April*	0.25	0.25
May*	0.51	0.57
May	1.66	1.15
June	4.62	2.84
July	6.86	4.22
August	3.12	4.60
September	1.78	2.22
September*	0.25	0.25
October*	0.25	0.25
November*	0.00	0.00
December*	0.00	0.00

* ET for mostly bare soil surface.

In Figure 17 it is seen that cumulative annual rainfall and irrigation far exceed cumulative drainage. Most of the difference occurs during the growing season when crops are using most of the available water. Figure 18 is a graph of drainage from individual "storm events" expressed as a percentage of the precipitation for the event. Each "storm event" is defined as starting on any day which received 15 mm of precipitation or more. At least 10 days were required before the event ended and the next event could begin (no time was lost between events). The event time of 10 days allows most of the drainage from a storm to drain. One large event (November 4, 1990) drained 72% of its total drainage in 10 days, other events investigated drained 65% to 100% in 10 days.

These graphs show that during the growing season, less of the precipitation ends up as drainage. Figure 18 also shows an increase in percent of precipitation drained each fall. Increased precipitation results in higher percentages of precipitation which drained.

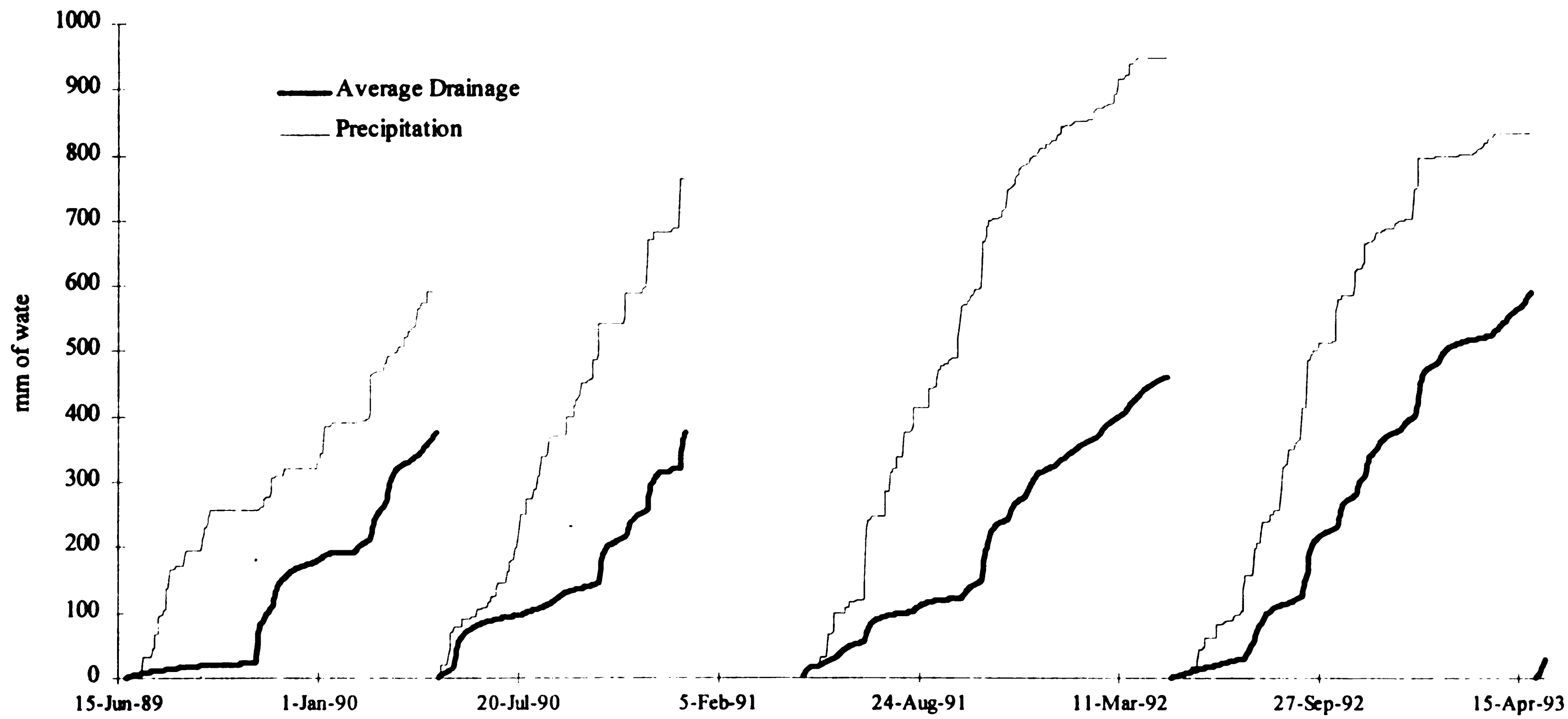

Figure 17. Graph of Cumulative Drainage and Cumulative Precipitation, by year.

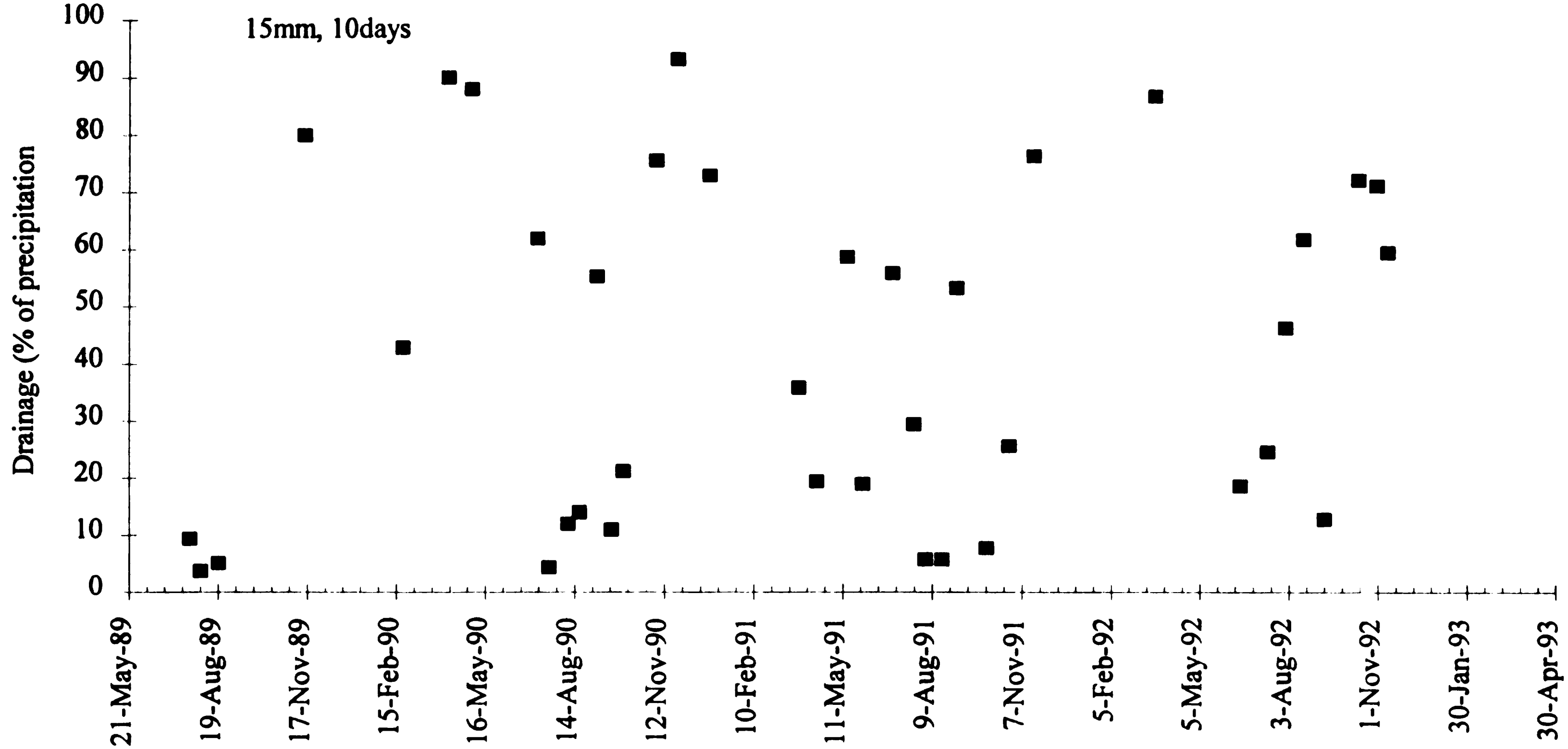

Figure 18. Event Drainage expressed as a percentage of the event's precipitation.

Comparison Of Nitrate Flux Within Lysimeters

The flow of water and the concentration of nitrates in that water work together to move nitrates through the soil and produce nitrate leaching. The yearly cumulative nitrate loads found in leachate from lysimeters 3 and 5 (undisturbed and disturbed with same fertilization scheme) are graphed in Figure 19. The nitrate leaching rate is represented by the slope of the cumulative nitrate load curve. This curve tends to have the same shape every year. The steepest parts of the curve, the largest leaching rates, are found in the late fall of each year. The relatively dry, warm summer months cause soil nitrogen mineralization which makes nitrate available to leach, but during the growing season much of what is produced is taken up by the corn crop. In the fall, the crop, at the end of its life cycle, stops removing nitrogen and the concentration of nitrate found in drainage increases. When the soil cools with winter weather, N-mineralization slows and less leaching occurs because of less nitrogen available to leach.

Figure 19 also shows a difference between leaching rates from the undisturbed lysimeter and the disturbed lysimeter even though both received 202 kg N/ha each year. The differences are mostly produced during November and December of each year where the curves diverge and are non-parallel. Little difference can be seen in 1989. The disturbed lysimeter leaching rates were close to that of the undisturbed lysimeter until November of 1990 when leaching in the undisturbed lysimeter began to slow down, but leaching continued at a higher rate in the disturbed lysimeter. This difference was recorded automatically, before the three month long computer system failure.

This trend switched in the fall of 1991 and 1992 with leaching rates in the disturbed lysimeter slowing before that in the undisturbed lysimeter. This switch is due to a difference in nitrate concentration in drainage. In November of 1990 the nitrate concentration in drainage water leveled off in drainage from the undisturbed lysimeter (#3) but concentrations continued to rise in the disturbed lysimeter (#5). In the fall of 1991 and 1992 the concentration of nitrate found in drainage from both lysimeters behaved the same, but with concentration in the undisturbed lysimeter being slightly higher than that for the disturbed lysimeter. In the 1993 leaching rate slowed at about the same time in both lysimeters and nitrogen leached for the year was reduced.

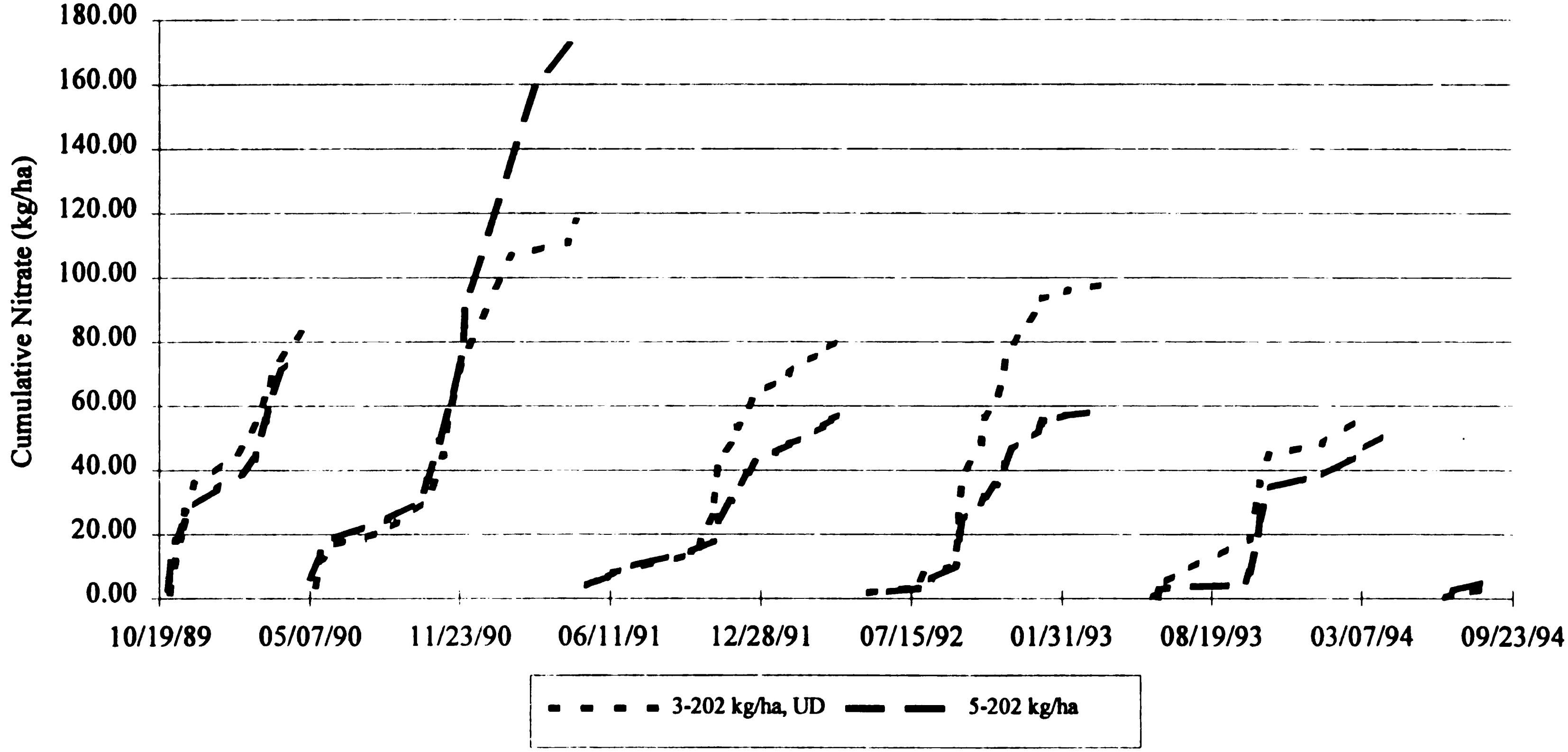

Figure 19. Yearly cumulative nitrate load from lysimeters 3 and 5 each receiving 202 kg N/ha.

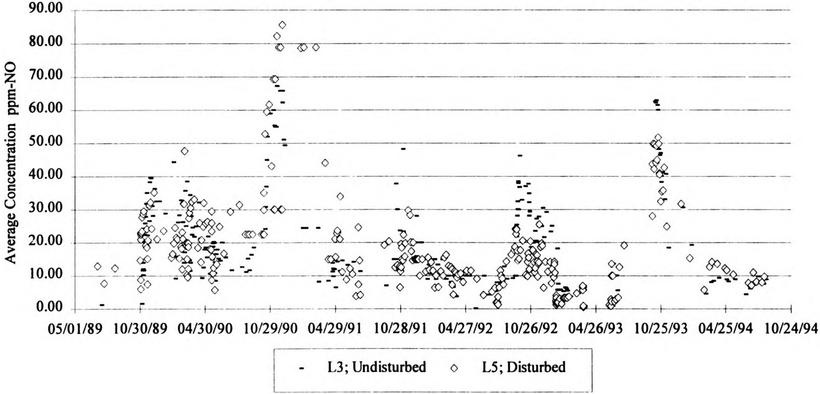

Figure 20. Averaged nitrate concentrations found in leachate from disturbed and undisturbed lysimeters receiving 202 kg/ha N per year.

Figures 20, 21 and 22 are graphs of nitrate concentrations in leachate from the 202 kg/ha treatment disturbed and undisturbed lysimeters. These graphs show that the seasonal concentration peaks occur at approximately the same time for both lysimeters and concentrations are generally higher in the fall. In 1989 and 1990 the disturbed lysimeter leachate concentration peaked higher than that for the undisturbed lysimeter. Starting in the fall of 1991 and continuing through 1994, the undisturbed lysimeter nitrate concentration was generally higher than that for the disturbed on the same sample dates.

There was little precipitation in the spring and summer of 1989. The first drainage events happened in the late fall and winter of 1989 - 1990, the largest of which was induced using irrigation on October 30 and 31, 1989.

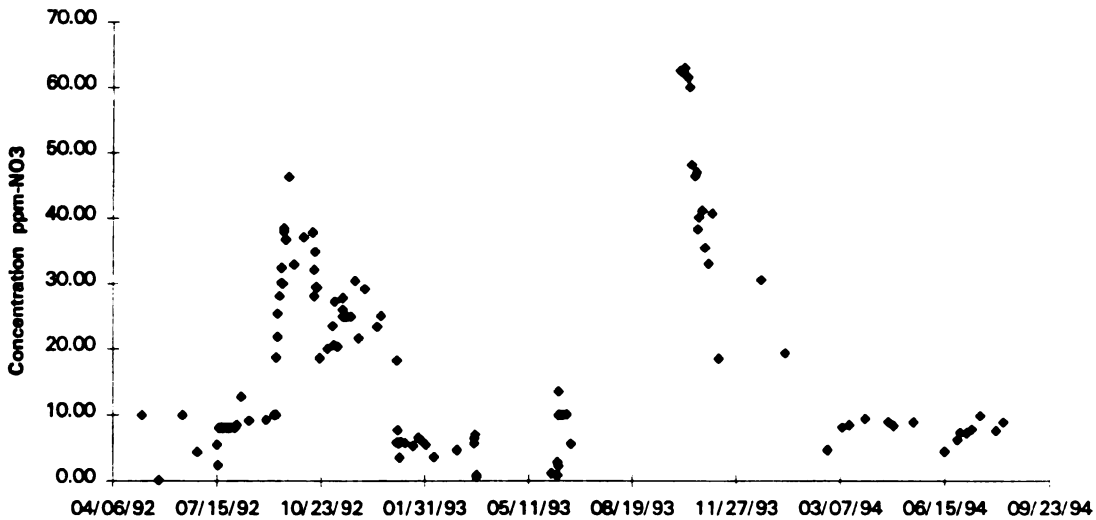

Figure 21. N Concentrations found in drainage from the undisturbed lysimeter(#3).

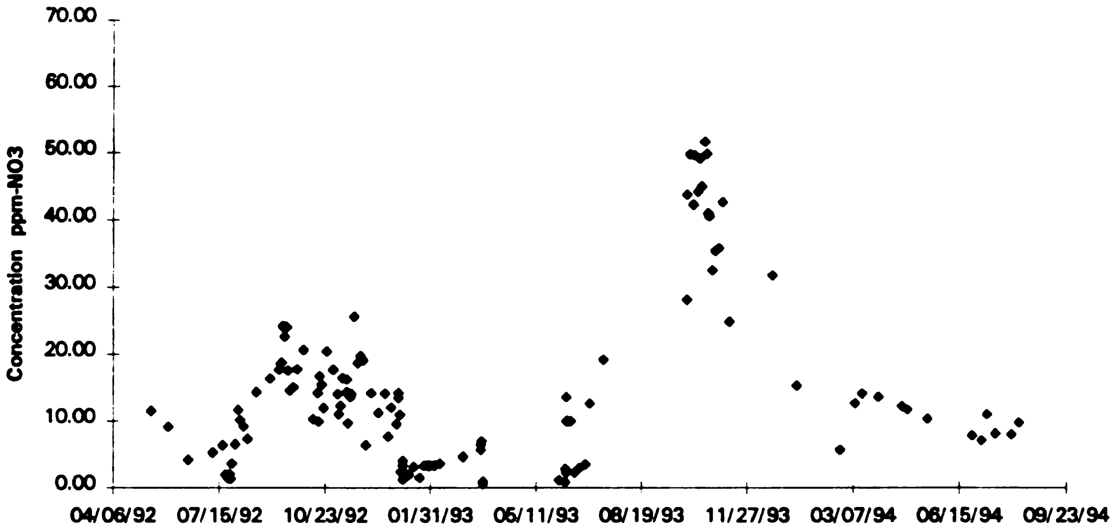

Figure 22. N Concentrations found in drainage from the disturbed lysimeter (#5).

The leachate concentrations found in samples from events during the fall of 1990 are 50% greater than any fall season since (Figure 20). These unusually high concentrations are believed to have been caused by the installation process for the lysimeters. Bergstrom (1987) also found similar occurrences and attributed this to increased aeration and subsequent mineralization of soil organic matter caused by the lysimeter installation process. The higher concentrations could also have been from a build up of nitrates in the soil from 1989 when flow to move nitrate through the soil was slow.

The results from a comparison of nitrate leaching amounts between the undisturbed lysimeter and disturbed lysimeter receiving the same N-fertilizer rate (202 kg/ha) using Students t-Test criteria, assuming equal variances and $\alpha = 0.10$, is tabulated in Table 11. Samples for leachate were collected about every 6.4 mm (0.25 inch or 22 liters) of drainage, values are tabulated in Appendix C. These results show that in the 1989 leaching year (June 7, 1989 to April 31, 1990), when the lysimeters were new, there was no significant difference in nitrogen leaching amounts between the undisturbed and the disturbed lysimeter. Both were fertilized at a rate of 202 kg/ha preplant starting in 1989. Students t-test results for the 1990, 1991 and 1992 leaching years show that we could not be 90% confident that the nitrate loads from the two lysimeters, were the same. In 1993 and 1994 the amounts leached from the two lysimeters were not different at the 90% confidence level.

Table 11. Student's t-Test results for nitrate values found in leachate from lysimeter #3 (undisturbed) and lysimeter #5 (disturbed). {$\alpha = 0.10$}

	t	t Critical two-tail	Result
1989	-0.047	1.97	pass
1990	2.463	1.97	fail
1991	-4.947	1.97	fail
1992	-6.066	1.97	fail
1993	0.523	1.97	pass
1994	-0.134	2.03	pass

For the purpose of this analysis, the 1994 season data ended in September. This made the '94 data set smaller than previous years which went from May 1 to April 31 of the next year. The size of the data set determines t-critical.

Results Of Nitrogen Application Rate And Timing

Table 12 contains a summary of the overall nitrogen balance for the 1990 through 1993 seasons. This balance was performed using data from one of the three plant inbreds (entry 2). This was the only inbred which was planted on a lysimeter. The first year of data, July 1989 through April 1990, was not utilized for this comparison for two reasons. First, the control plot received 202 kg/ha of nitrogen in 1989. Second, the field in which the plots were located was not under cultivation for many years prior to the installation of the lysimeters, but a sparse population of alfalfa still existed. The presence of alfalfa tilled under and the soil disturbance during the installation of the lysimeters left uncertainties of the origin of the nitrogen occurring in drainage during the first year, and to some extent the following years also.

Table 12. Soil-plant nitrogen balance for the period of May 1, 1990 to April 31, 1994.

Lys.	Treatment kg/ha	Tot N Cob kg/ha	Tot N grain kg/ha	Fert N kg/ha	Leach* N kg/ha	Tot N added kg/ha	Tot N removed kg/ha	Net Soil N Change kg/ha
1	101	19	354	403	123	403	496	-93
2	Model	16	320	112	114	112	449	-337
3	202	19	311	806	340	806	670	137
4	0#	15	259	202	77	202	352	-150
5	202	29	362	806	342	806	733	73

* estimated for dates listed in Table 2.

The first year of the study (1989) the zero treatment received 202 kg/ha and the model received 90 kg/ha.

The nitrogen balance for the 202 kg/ha (180 lb./ac) treatment showed that the addition of nitrogen at this rate was greater than the total removal of nitrogen from the soil for the period of May 1, 1990 to May 1, 1993. The Model, 101 kg/ha (90 lb./ac) and the Control (0 kg/ha) treatments resulted in a net removal of nitrogen from the soil while maintaining profitable yields (Martin, 1992).

Figure 23 is a graph of cumulative nitrate leached through each lysimeter during each year for July 1989 to September 1994. This graph shows the differences between the four nitrogen application rates as measured with disturbed profile lysimeters along with the undisturbed lysimeter which received a 202 kg/ha preplant application. There is little difference in the leaching loss between treatments early in each season, but after harvest the cumulative nitrate curves diverge with the 202 kg/ha treatments leaching more than twice that for the control treatment. The Model and 101 kg/ha treatments result in about the same amount of nitrate leaching after a few years of continuous growing of corn on the same plot. The first year 90 kg N/ha was added to the model, then in 1990 and 1991 no fertilizer was applied to the model treatment and the first year 202 kg/ha was applied to the Control (0 kg/ha) plots.

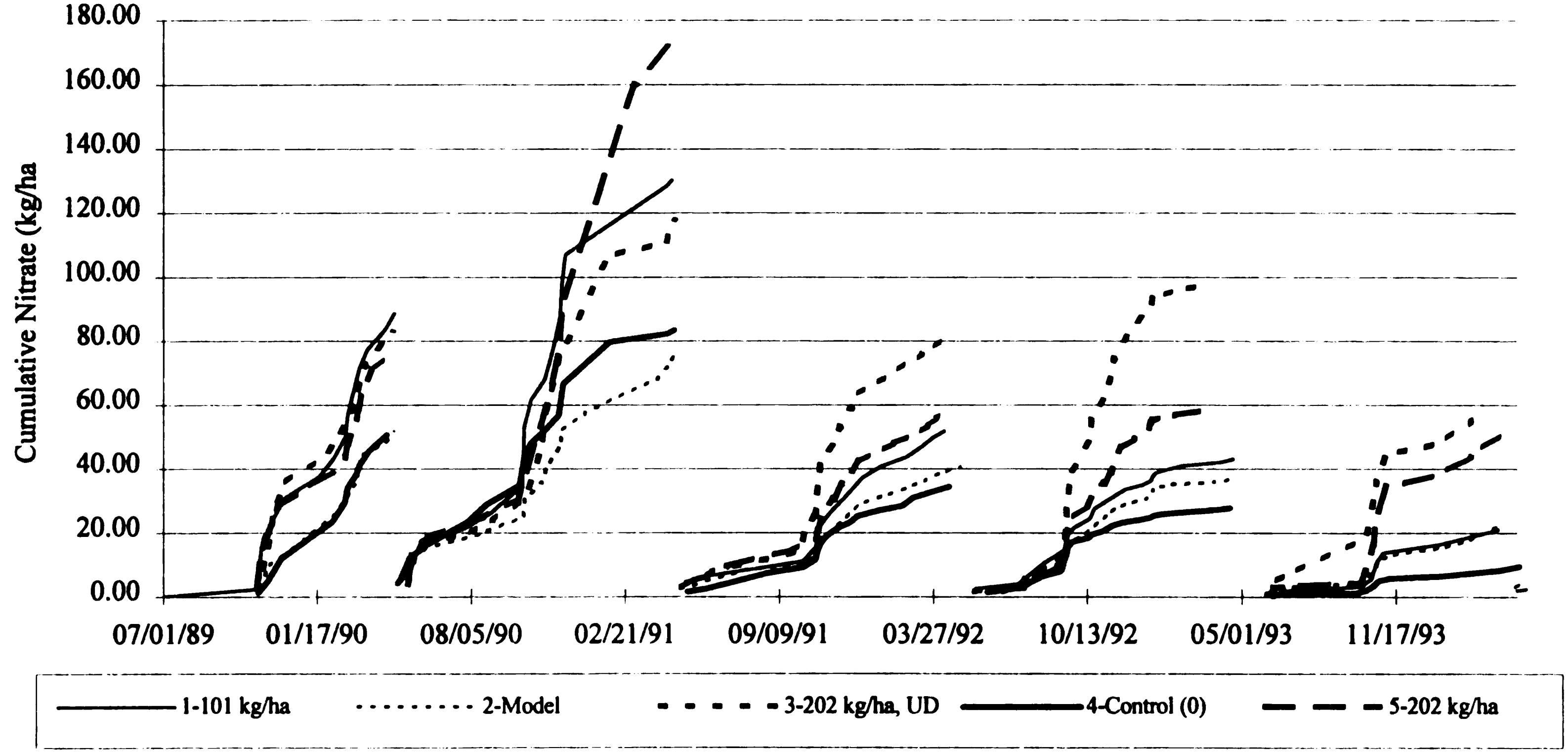

Figure 23. Yearly cumulative nitrate load for all five treatments (all five lysimeters).

In Figures 24 and 25, cumulative nitrate leached is plotted against cumulative drainage. These graphs show drainage from May 1, 1992 through April 30, 1993 and from May 1, 1993 through April 30, 1994, respectively. Cumulative values were reset to zero on May 1 for each year, this allows the reader to see the difference between lysimeters and differences between years. The slopes of these lines are proportional to the nitrate concentration in the drainage water. The steeper the slope, the higher the concentration of nitrate. The steepest portions of these graphs, thus the heavier concentrations, happen after approximately the first 100 mm of drainage following planting and initial fertilization each year. During the initial drainage after May 1 graphs of drainage from all four treatments take about the same path, but through the steepest parts of the curve the 202 kg/ha treatment line result in a much steeper curve than does

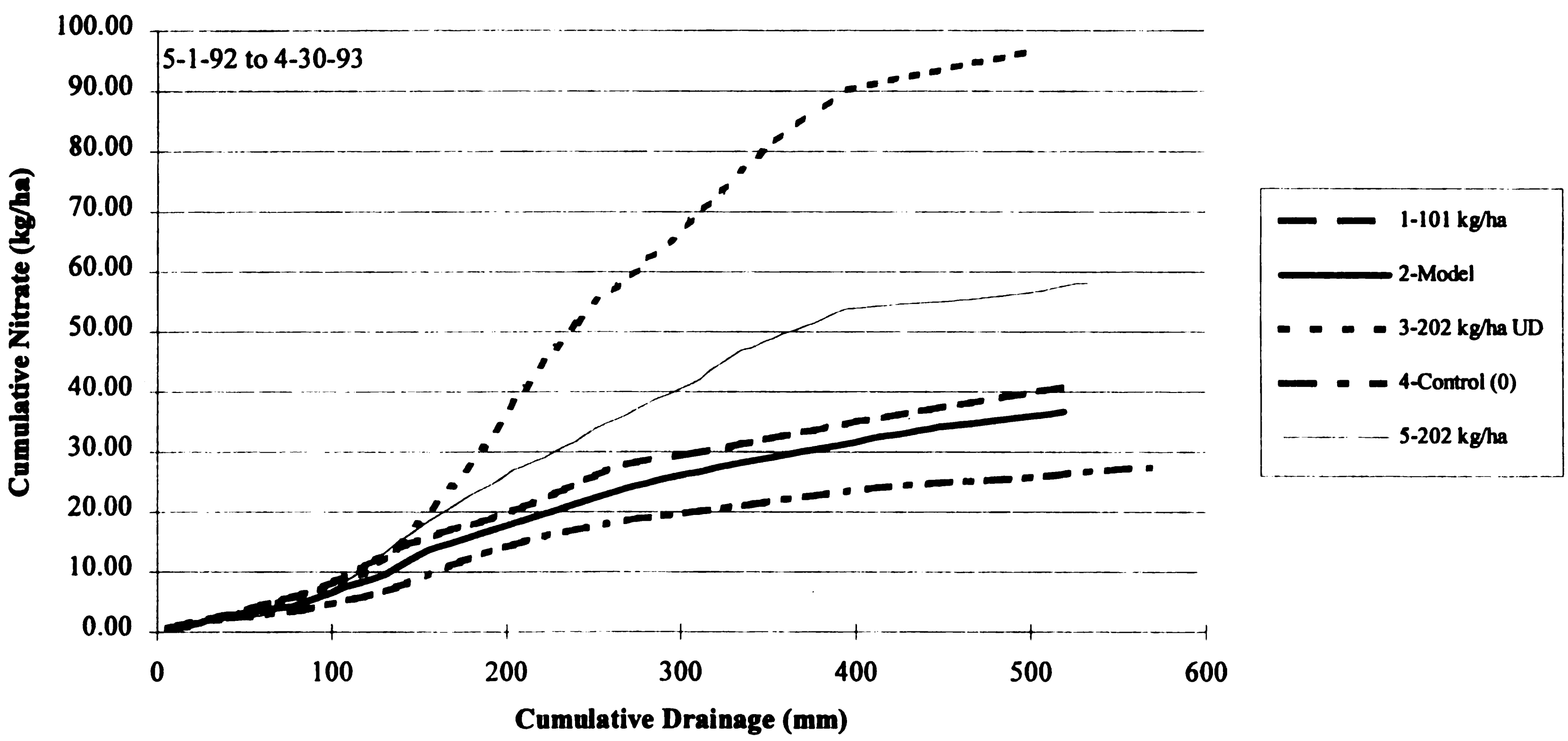

Figure 24. Nitrate load plotted against cumulative drainage for 5-1-92 through 4-30-93.

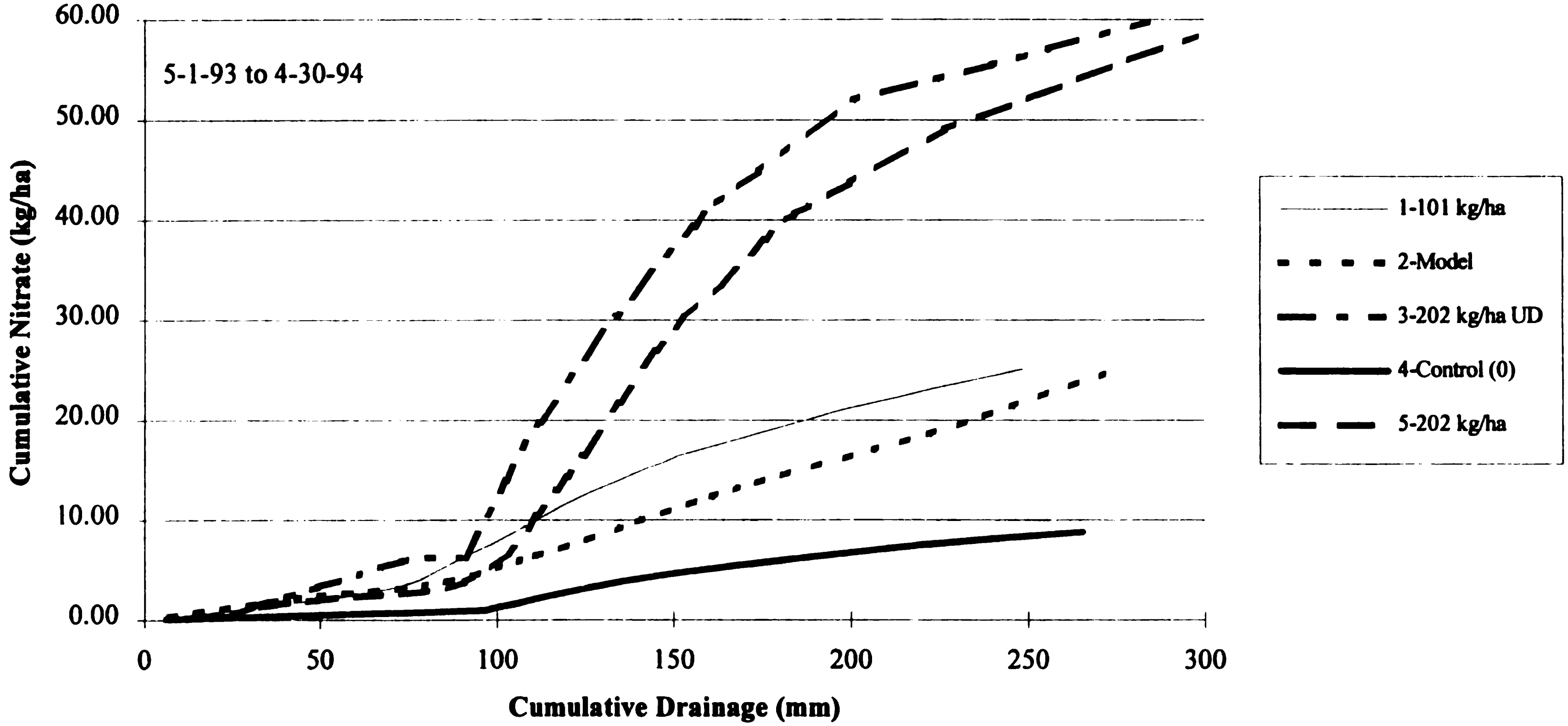

Figure 25. Nitrate load plotted against cumulative drainage for 5-1-93 through 4-30-94.

the lines for the Model and the 101 kg/ha treatments. The line for the Control treatment always has the flattest curve, meaning that the concentration of nitrate from the Control treatment is the lowest.

The concentration of nitrate in public water, or ground water for public consumption, must be less than 10 PPM nitrate. Figure 26 is a graph showing the percentage of leachate samples which tested to be less than 10 PPM nitrate for each treatment for the period May 1992 through April 1994. This time period was chosen for presentation because leachate from more recent years is closer to natural field situations than earlier data which was influenced more by soil disturbances from filling the lysimeters. This leachate is an indication of what is being sent to the ground water. This water will be diluted by water from non-farmed land.

There has been little difference in yield between the 202 kg/ha application and the Model treatment. Table 13 contains the stover, cob and grain yield for the inbred on the lysimeters for growing seasons 1990 through 1993 averaged over four replications. Figure 27 is a graphical representation of the grain yields with the 90% confidence intervals shown. From Table 13 and Figure 27 it is seen that the model treatment produced slightly more than the conventional 202 kg/ha treatment 3 out of the 4 years, but confidence intervals overlap making differences not significant. Grain yield from the 101 kg/ha treatment was consistently higher than that for the 202 kg/ha treatment.

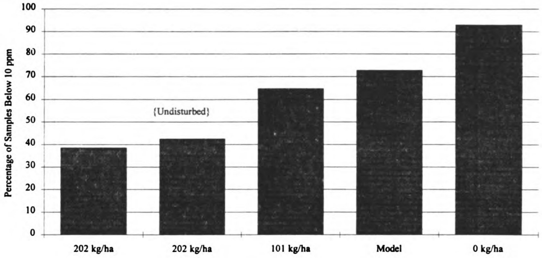

Figure 26. Percentage of drainage samples testing below 10 ppm nitrate (5-92 to 8-94).

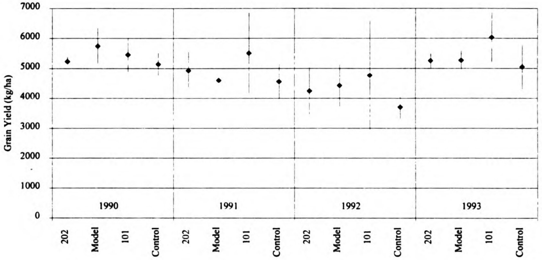

Figure 27. Yield and 90% confidence intervals for 1990, 1991, 1992 & 1993 grain harvests.

Table 13. Yield taken at harvest for inbred 2.

Year	Treatment kg N/ha	Total Dry Stover kg/ha	Total Dry Cob kg/ha	Total Dry Grain kg/ha
90	202	7236	1260	5229
90	0 (model)	7666	1386	5749
90	101	7404	1345	5450
90	0	6760	1193	5137
91	202	9144	1350	4929
91	0 (model)	8436	1133	4605
91	101	9996	1378	5511
91	0	8571	1101	4558
92	202	9285	1328	4247
92	(model)	8156	1378	4427
92	101	8474	1234	4777
92	0	6798	1146	3706
93	202	9881	1352	5253
93	(model)	8602	1369	5268
93	101	9322	1549	6036
93	0	7596	1219	5051

DISCUSSION

The initial hypothesis was:

No significant difference in drainage amounts is present between data from the disturbed profile lysimeters and the undisturbed profile lysimeter installed near Constantine. Agreement with a 90% level of confidence was chosen as an acceptable agreement.

This hypothesis is true for the last year of data analyzed, but significant differences did exist before 1993. Student's t-test results have shown that drainage data and nitrogen leachate data from the disturbed lysimeter for 1989 through 1992 are significantly different, at a 90% confidence level, than drainage and leachate from the undisturbed lysimeter over the same time period.

The first sizable drainage event was forced by irrigation on October 30, 1989. This event drained differently through the disturbed lysimeters than it did through the undisturbed lysimeter. Although the undisturbed lysimeter received more water than any of the disturbed lysimeters, the drainage flow through the undisturbed lysimeter peaked approximately 35 hours after the peak flow in the disturbed lysimeters. This trend of time to peak in the undisturbed lysimeter lagging that of the disturbed lysimeters continued until October 1991 with a gradual lessening of the difference between peak flows, with each disturbed lysimeter slowing at different rates.

Drainage events peaked very close together in May, June, July and August of 1991. But in October and November of 1991, the drainage flow from the disturbed lysimeters began arriving at peak flow, 16 to 19 hours, after the drainage peaked in the undisturbed lysimeter (lysimeter 3). The largest lag which occurred in the period from October 1991 to September 16, 1993 was a 29 hour difference during October of 1992 between the undisturbed lysimeter and lysimeters 1 and 5. This difference in time to peak has gradually decreased to a point were all lysimeters peak within 10 hours of each other, not in any repetitive order.

These three phases of differing times to peak support a theory that filled-in lysimeters will drain faster than expected through a weak macropore structure for the first few years. After the soil has settled, the filled in lysimeters may drain more slowly due to reduced macropore area.

Drainage through soil flows through pores of various sizes in the soil at different rates. In an undisturbed lysimeter the soil pores remain unaltered preserving whatever macropores exist, except for the top layer of soil which is normally plowed. In the disturbed lysimeters the soil is dug out and replaced by horizon, maintaining as closely as possible the same density and horizon thickness, but it is not currently possible to reestablish soil pore structure to its original state. Soil structure and texture work together to form the pores which water flows through. In disturbed soils most micropores have been altered, but many new macropores are believed to be present. The macropores which are initially formed from repacking disturbed soils are short-lived and eventually are reduced in size by fines from the soil above (Kohnke et al, 1940). This is what is believed to have happened to the soil in the disturbed lysimeters at Constantine.

Great care was taken with this soil to repack the soil in the disturbed lysimeters to the original location and soil density. But, soil density was not the only factor affecting drainage. The proportion of macropores and micropores determines soil porosity. Changing in these proportions will change soil porosity.

As can be seen from the time to peek data, water flowed through the disturbed lysimeters faster than through the undisturbed lysimeter from 1989 until the summer of 1991. One possible reason for slowing of the water flow is that macropores in the disturbed lysimeters could have closed up enough in 1991 so that the flow through the disturbed lysimeters was close to that seen in the undisturbed lysimeter. Then, as shown by drainage flows through the disturbed lysimeters peaking after the flow peaked in the undisturbed lysimeter, the disturbed lysimeters drained slower starting in the summer of 1991.

The depth of encased soil is different between the disturbed lysimeters and the undisturbed lysimeter. The undisturbed lysimeter is only 84% the depth of the disturbed lysimeters. This could change the time to peak drainage in the lysimeter and also change the timing and amount of peak nitrogen leaching.

Since 1992, differences in the time to peak flow through the lysimeters have continually decreased to the point where in 1993 no one lysimeter consistently lags the other four. This improvement in drainage could be due to improved soil structure in the disturbed soil profiles. The soil has been undergoing a natural process of rebuilding macropores and micropores since installation. While the macropores created during installation were degrading and filling in, roots, worms and other soil fauna along with water draining, freezing and thawing have been continually moving soil particles, forming the soil pore matrix. The author now believes that the soil is regaining a balance between macropores and micropores which will eventually stay as stable as the structure in the undisturbed lysimeter. This process may take several years before better correlation between the disturbed lysimeter soils and the undisturbed lysimeter soil is achieved.

Average drainage from the five lysimeters was also compared to a calculated drainage. This estimate of drainage was based on actual rainfall and irrigation data, and calculated evapotranspiration data generated using an irrigation scheduling package titled "SCS-Scheduler Version 3.00" (Shayya & Bralts, 1994). This comparison allowed the author to place more confidence in the overall accuracy of the measured drainage from the lysimeters. The calculated drainage shows the trends seen in the fall in the actual drainage, but also shows no drainage during summer months. However, drainage in the lysimeters continued even during the driest part of the year when irrigation was required.

The equation utilized to calculate drainage incorporated one soil storage term for the entire depth of the lysimeter. Better correlation might be achieved with two or more soil storage terms, or one for each horizon, incorporating each horizon's water holding capacity and initial water content. Two term equations could be made with a macropore transport term and a separate term for micropores, allowing for rapid transport of some water through a macropore system and slowly moving other water through a micropore system.

Nitrate loads found in drainage were significantly different between the two types of lysimeters for the period 1989 through 1992. During the 1990 season, before the errors associated with January through March 1991, the disturbed soil leached about 50% more nitrate than the undisturbed soil. Then, in the 1991 and 1992 seasons the disturbed lysimeter leached much less than the undisturbed soil. In 1993 the two lysimeters leached, and drained about the same.

Differences in nitrate concentrations the first year were not detectable. There was below normal precipitation and due to this, drainage was minimal the first summer and fall. The disturbed lysimeter leached higher nitrate concentrations than was seen from the undisturbed lysimeter the second year and part of the third year (1990 and 1991).

The disturbed lysimeter then began leaching lower concentrations of nitrate than was found in the undisturbed lysimeter in 1991. This disagreement then slowly lessened and in 1993 and 1994 there was no significant difference (based on a two-tailed Student's t-test with $\alpha = 0.10$) between leachate from the disturbed lysimeter and undisturbed lysimeter.

The data from the disturbed and undisturbed lysimeters near Constantine seem to support the statement which Kohnke et al (1940) made which stated that:

> *"In the filled-in lysimeters it is frequently noticed that in the first year or two the nitrate content of the percolate is rather high, but afterwards it decreases to very low rates."*

With the long study, which has so far incorporated five years of lysimeter study at the same sight with one of the objectives being to compare a disturbed soil profile lysimeter to an undisturbed profile lysimeter. It has appeared in the last year that soil characteristics of the disturbed soil can eventually be considered the same as the undisturbed soil profile for drainage studies. In this study, with a loamy sand, it took five years for the soil in a disturbed lysimeter to adjust to approximately the same drainage characteristics as was found in the undisturbed lysimeter.

As was seen with the first large drainage events, much more nitrate leached from the disturbed soil than leached from the undisturbed soil. This could be due to the fact that the nitrogen held in organic matter was exposed to oxygen and water and mineralized faster than organic matter in the undisturbed soil. The undisturbed lysimeter also potentially suffered from the effect of aeration of organic soil because the top horizon of the soil in the lysimeter was disturbed. After the newly mineralized nitrogen washed out, leaching decreased, possibly due to the reduced supply of nitrate-nitrogen along preferential water flow pathways. As the soil structure is slowly rebuilt, the nitrogen balance is expected to become closer to that found in undisturbed soils.

The best type of lysimeter to build is of course the undisturbed soil profile lysimeter. This lysimeter is costly to build on a large scale, but is the most reliable over a wide range of soils and can confidently be compared to entire field operations with minimal error. Undisturbed lysimeter installations should still undergo a year of operation before data is used to compare to real field situations. This is due to the disturbance of the top soil.

Disturbed soil profile lysimeters can be used with confidence for comparing treatments in sandy soils. The disturbed lysimeters are much less time consuming to install and much cheaper. After a few years have passed and the disturbed lysimeters have matured and regained pore structure, they can then be confidently used as a model for the natural soil conditions. In the Constantine case an undisturbed lysimeter of the same surface area was available in the same field for comparison. When aging process in the disturbed lysimeters had progressed far enough, the lysimeters drained and leached nitrate similarly. Soil structure, as well as soil type must be considered when choosing a site for a group of disturbed lysimeters.

The results of the first five years of nitrogen application rate and timing studies which used the disturbed lysimeters show that disturbed lysimeters can definitely be used for comparisons of cultural practices on sandy soils. The nitrate load data for 1990 shows the 0 kg/ha plot, which received 202 kg N/ha in 1989, leaching more than the model plot, which received 90 kg N/ha in 1989 and no nitrogen in 1990. In 1991, 1992 and 1993 most trends between the four disturbed lysimeters are relatively unchanging from year to year.

One trend, which attention should be drawn to, is the closeness of the nitrate load results between the 101 kg/ha split application and the model. Yield is very close between all treatments, but nitrate leaching is very close between the model and the 101 kg/ha treatments. The 202 kg/ha treatments leach two to three times more nitrate than the model or the 101 kg/ha treatments.

Grain yields for the Model treatment and the 101 kg N/ha treatment have not shown significant differences when compared to the 202 kg N/ha treatment. The last year of the study, 1994, the control was beginning to show a significant grain yield difference. This work shows that a treatment such as the Model treatment or even a 101 kg N/ha split application will reduce the nitrogen added to the ground water supply without significantly reducing yields.

There definitely exists significant nitrate concentration differences in leachate from the four nitrogen treatments. The zero nitrogen treatment still produced nitrate leachate, but over 90% of the leachate samples from May 1, 1992 through August 31, 1994 tested below 10 PPM, which is the public water supply standard for nitrogen. About 40% of the leachate samples from the conventional 202 kg N/ha treatment tested below the 10 PPM level. For the 101 kg N/ha treatment about 65% of the samples were below 10 PPM nitrogen and for the Model over 70% were below 10 PPM.

These nitrogen rate and timing results show that better nitrogen management leads to less nitrate loss through leaching. The best nitrogen management practice will be multiple applications of small quantities of nitrogen at periods in the plants life cycle when the plant needs nitrogen.

CONCLUSIONS

Objective 1:

During the first three years, 1989 through 1991, the disturbed lysimeters drainage rates were not the same as the undisturbed lysimeters rates. After this three year period of aging, we are confident that the disturbed lysimeters drained the same amount at the same rate.

Objective 2:

Differences in nitrate concentrations the first year were not detectable. The second year and part of the third year (1990 and 1991), the disturbed lysimeter leached higher nitrate concentrations than was seen from the undisturbed lysimeter. The disturbed lysimeter then began leaching lower concentrations of nitrate than undisturbed lysimeter in 1991. This disagreement then slowly lessened and in 1992 and 1993 there were no significant differences between leachate concentrations from the disturbed lysimeter and the undisturbed lysimeter.

Objective 3:

There exists significant nitrate concentration differences in leachate from the four nitrogen treatments.

Grain yields for the Model treatment and the 101 kg N/ha treatment did not show significant differences when compared to the 202 kg N/ha treatment. The last year of the study, 1994, the control (0 kg/ha) was beginning to show a grain yield difference.

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APPENDICES

APPENDIX A

APPENDIX A.

Lysimeter drainage volumes.

Daily drainage by lysimeter

Date	Lysimeter 1 (mm)	Lysimeter 2 (mm)	Lysimeter 3 (mm)	Lysimeter 4 (mm)	Lysimeter 5 (mm)	Lysimeters Changed
23-Jun-89	8	8	6	5	9	
24-Jun-89	8	8	6	5	9	
25-Jun-89	8	8	6	6	9	
26-Jun-89	8	9	6	6	9	
27-Jun-89	7	8	5	5	8	
28-Jun-89	6	7	5	3	7	
29-Jun-89	6	6	4	4	6	
30-Jun-89	7	8	4	6	7	
1-Jul-89	6	7	4	5	6	
2-Jul-89	6	7	3	4	6	
3-Jul-89	5	6	3	4	5	
4-Jul-89	5	6	2	4	5	
5-Jul-89	5	5	3	3	5	
6-Jul-89	5	6	3	4	5	
7-Jul-89	5	6	3	3	5	
8-Jul-89	5	6	3	5	5	
9-Jul-89	5	6	3	5	5	
10-Jul-89	4	6	3	3	5	
11-Jul-89	4	4	2	3	4	
12-Jul-89	4	5	2	4	4	
13-Jul-89	4	5	2	4	4	
14-Jul-89	4	4	2	2	4	

Date	Lysimeter 1 (mm)	Lysimeter 2 (mm)	Lysimeter 3 (mm)	Lysimeter 4 (mm)	Lysimeter 5 (mm)	Lysimeters Changed
15-Jul-89	4	3	1	3	3	
16-Jul-89	4	4	2	3	3	
17-Jul-89	4	4	2	3	3	
18-Jul-89	4	4	2	3	3	
19-Jul-89	4	4	2	4	3	
20-Jul-89	3	3	2	1	3	
21-Jul-89	3	3	1	1	3	
22-Jul-89	3	2	1	0	3	
23-Jul-89	3	2	1	2	2	
24-Jul-89	3	2	1	2	3	
25-Jul-89	3	2	1	2	3	
26-Jul-89	4	2	1	3	3	
27-Jul-89	4	3	1	4	3	
28-Jul-89	4	3	1	1	3	
29-Jul-89	6	3	1	3	3	
30-Jul-89	6	3	1	2	3	
31-Jul-89	5	2	1	2	3	
1-Aug-89	5	2	1	2	3	
2-Aug-89	6	3	0	3	3	
3-Aug-89	6	3	0	3	3	
4-Aug-89	6	4	0	2	4	
5-Aug-89	5	3	0	2	4	
6-Aug-89	5	2	0	1	2	
7-Aug-89	4	1	0	3	2	
8-Aug-89	5	1	0	3	3	
9-Aug-89	4	1	0	3	2	
10-Aug-89	4	1	0	2	2	
11-Aug-89	4	1	0	3	2	
12-Aug-89	5	1	0	4	2	
13-Aug-89	4	1	0	3	2	
14-Aug-89	4	2	1	3	2	
15-Aug-89	4	2	1	3	2	
16-Aug-89	4	1	1	2	2	
17-Aug-89	3	1	1	3	2	
18-Aug-89	4	1	1	3	2	
19-Aug-89	4	1	1	4	2	
20-Aug-89	4	1	1	3	2	
21-Aug-89	3	1	1	2	2	
22-Aug-89	3	1	1	5	2	

Date	Lysimeter 1 (mm)	Lysimeter 2 (mm)	Lysimeter 3 (mm)	Lysimeter 4 (mm)	Lysimeter 5 (mm)	Lysimeters Changed
23-Aug-89	3	1	1	2	2	
24-Aug-89	1	1	1	2	2	
25-Aug-89	0	1	1	3	2	
26-Aug-89	1	1	1	3	2	
27-Aug-89	3	1	1	2	2	
28-Aug-89	3	1	1	3	2	
29-Aug-89	3	1	1	3	2	
30-Aug-89	3	1	1	2	2	
31-Aug-89	3	1	1	4	2	
1-Sep-89	2	1	1	3	2	
2-Sep-89	2	0	1	0	1	
3-Sep-89	2	0	0	1	1	
4-Sep-89	3	0	1	3	1	
5-Sep-89	2	0	0	2	1	
6-Sep-89	1	0	0	2	1	1
7-Sep-89	1	0	0	2	2	1
8-Sep-89	1	0	0	2	2	1
9-Sep-89	1	0	0	2	2	1
10-Sep-89	0	0	0	0	1	
11-Sep-89	2	0	0	1	1	
12-Sep-89	2	0	0	1	1	
13-Sep-89	2	0	0	2	1	
14-Sep-89	2	0	0	3	1	
15-Sep-89	2	0	0	2	1	
16-Sep-89	2	0	0	2	1	
17-Sep-89	1	0	0	1	1	
18-Sep-89	1	0	0	1	1	
19-Sep-89	2	0	0	3	1	
20-Sep-89	2	0	0	2	1	
21-Sep-89	2	0	0	4	1	
22-Sep-89	1	0	2	5	1	3
23-Sep-89	0	0	0	0	1	1,3,
24-Sep-89	1	0	1	2	1	1,3,
25-Sep-89	2	0	2	4	1	1,3,
26-Sep-89	1	0	1	1	1	1,3,
27-Sep-89	1	0	1	2	1	1,3,
28-Sep-89	2	0	2	4	1	1,3,
29-Sep-89	1	0	1	2	1	1,3,
30-Sep-89	1	0	1	3	1	1,3,
1-Oct-89	2	0	2	4	1	1,3,

Date	Lysimeter 1 (mm)	Lysimeter 2 (mm)	Lysimeter 3 (mm)	Lysimeter 4 (mm)	Lysimeter 5 (mm)	Lysimeters Changed
2-Oct-89	1	0	1	1	1	1,3,4,
3-Oct-89	0	0	0	0	0	1,3,4,
4-Oct-89	0	0	0	0	0	1,3,4,
5-Oct-89	0	0	0	0	0	1,3,4,
6-Oct-89	0	0	0	0	1	1,3,4,
7-Oct-89	0	0	0	0	0	1,3,4,
8-Oct-89	0	0	0	0	0	1,3,4,
9-Oct-89	0	0	0	0	0	1,3,4,
10-Oct-89	0	0	0	0	0	1,3,4,
11-Oct-89	0	0	0	0	0	1,3,4,
12-Oct-89	0	0	0	0	0	1,3,4,
13-Oct-89	0	0	0	0	0	1,3,4,
14-Oct-89	0	0	0	0	0	1,3,4,
15-Oct-89	0	0	0	0	0	1,3,4,
16-Oct-89	0	0	0	0	0	1,3,4,
17-Oct-89	0	0	0	0	0	1,3,4,
18-Oct-89	0	0	0	0	0	1,3,4,
19-Oct-89	0	0	0	0	0	3,4,
20-Oct-89	0	0	0	0	0	3,4,
21-Oct-89	0	0	0	0	0	3,4,
22-Oct-89	0	0	0	0	0	3,4,
23-Oct-89	0	0	0	0	0	3,4,
24-Oct-89	0	0	0	0	0	3,4,
25-Oct-89	0	0	0	0	0	3,4,
26-Oct-89	0	0	0	0	0	3,4,
27-Oct-89	1	1	1	1	0	3,4,
28-Oct-89	0	0	0	2	0	3
29-Oct-89	0	0	0	2	0	3
30-Oct-89	1	0	0	5	0	3
31-Oct-89	245	118	17	164	91	
1-Nov-89	366	275	101	324	371	
2-Nov-89	136	179	117	144	147	
3-Nov-89	80	79	101	84	79	
4-Nov-89	54	43	86	59	57	
5-Nov-89	43	32	78	46	46	
6-Nov-89	32	25	71	31	36	
7-Nov-89	28	24	65	28	29	
8-Nov-89	24	22	59	26	26	
9-Nov-89	20	17	57	21	22	
10-Nov-89	16	13	55	17	18	

Date	Lysimeter 1 (mm)	Lysimeter 2 (mm)	Lysimeter 3 (mm)	Lysimeter 4 (mm)	Lysimeter 5 (mm)	Lysimeters Changed
11-Nov-89	20	18	53	25	18	
12-Nov-89	22	20	47	26	19	
13-Nov-89	24	23	43	27	24	
14-Nov-89	23	20	35	23	24	
15-Nov-89	23	22	32	23	23	
16-Nov-89	35	29	31	47	42	
17-Nov-89	81	98	54	104	60	
18-Nov-89	99	77	70	99	83	
19-Nov-89	76	54	68	79	72	
20-Nov-89	55	39	59	54	53	
21-Nov-89	42	29	46	41	41	
22-Nov-89	36	26	40	35	35	
23-Nov-89	32	23	36	31	30	
24-Nov-89	30	22	33	29	27	
25-Nov-89	28	21	30	27	26	
26-Nov-89	24	17	28	23	23	
27-Nov-89	24	20	26	27	24	
28-Nov-89	18	13	29	14	18	
29-Nov-89	18	14	27	20	18	
30-Nov-89	16	13	23	18	17	
1-Dec-89	15	12	19	18	16	
2-Dec-89	14	11	17	16	16	
3-Dec-89	12	9	17	14	13	
4-Dec-89	14	12	18	18	15	
5-Dec-89	12	9	17	13	12	
6-Dec-89	10	7	15	10	11	
7-Dec-89	9	6	14	9	8	
8-Dec-89	11	8	14	13	9	
9-Dec-89	11	9	14	14	10	
10-Dec-89	10	8	13	10	9	
11-Dec-89	9	6	12	9	8	
12-Dec-89	9	7	11	10	8	
13-Dec-89	9	7	10	10	7	
14-Dec-89	8	6	10	8	7	
15-Dec-89	8	6	9	9	7	
16-Dec-89	7	5	8	6	6	
17-Dec-89	7	5	8	7	5	
18-Dec-89	7	5	7	7	5	
19-Dec-89	7	5	6	8	5	
20-Dec-89	6	5	6	6	5	

Date	Lysimeter 1 (mm)	Lysimeter 2 (mm)	Lysimeter 3 (mm)	Lysimeter 4 (mm)	Lysimeter 5 (mm)	Lysimeters Changed
21-Dec-89	5	4	6	5	4	
22-Dec-89	5	4	5	5	4	
23-Dec-89	6	4	5	6	4	
24-Dec-89	7	6	5	9	5	
25-Dec-89	7	7	5	10	6	
26-Dec-89	4	4	4	3	4	
27-Dec-89	5	5	4	6	4	
28-Dec-89	4	3	4	4	3	
29-Dec-89	5	4	4	5	4	
30-Dec-89	5	33	4	43	4	
31-Dec-89	8	23	7	18	8	
1-Jan-90	7	21	7	11	8	
2-Jan-90	6	17	7	12	7	
3-Jan-90	8	23	9	18	8	
4-Jan-90	8	27	9	21	10	
5-Jan-90	6	24	8	18	8	
6-Jan-90	6	19	9	23	7	
7-Jan-90	5	17	13	17	6	
8-Jan-90	7	22	18	17	7	
9-Jan-90	8	13	13	6	10	5
10-Jan-90	5	6	2	2	4	5
11-Jan-90	7	7	2	5	5	5
12-Jan-90	4	4	2	2	33	
13-Jan-90	4	3	2	1	22	
14-Jan-90	3	2	1	1	9	
15-Jan-90	0	0	0	0	0	all
16-Jan-90	0	0	0	0	0	all
17-Jan-90	0	0	0	0	0	all
18-Jan-90	0	0	0	0	0	all
19-Jan-90	0	0	0	0	0	all
20-Jan-90	0	0	0	0	0	all
21-Jan-90	0	0	0	0	0	all
22-Jan-90	0	0	0	0	0	all
23-Jan-90	0	0	0	0	0	all
24-Jan-90	0	0	0	0	0	all
25-Jan-90	0	0	0	0	0	all
26-Jan-90	0	0	0	0	0	all
27-Jan-90	0	0	0	0	0	all
28-Jan-90	0	0	0	0	0	all
29-Jan-90	0	0	0	0	0	all

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Date	Lysimeter 1 (mm)	Lysimeter 2 (mm)	Lysimeter 3 (mm)	Lysimeter 4 (mm)	Lysimeter 5 (mm)	Lysimeters Changed
30-Jan-90	0	0	0	0	0	all
31-Jan-90	0	0	0	0	0	all
1-Feb-90	0	0	0	0	0	all
2-Feb-90	0	0	0	0	0	all
3-Feb-90	0	0	0	0	0	all
4-Feb-90	0	0	0	0	0	all
5-Feb-90	0	0	0	0	0	all
6-Feb-90	18	18	16	21	13	
7-Feb-90	25	16	22	19	20	
8-Feb-90	26	23	22	27	24	
9-Feb-90	23	19	22	21	23	
10-Feb-90	20	17	21	19	21	
11-Feb-90	18	15	20	17	19	
12-Feb-90	17	14	19	17	18	
13-Feb-90	15	14	18	13	17	
14-Feb-90	14	11	17	13	14	
15-Feb-90	15	13	16	15	16	
16-Feb-90	12	11	15	9	13	
17-Feb-90	10	8	14	8	10	
18-Feb-90	12	11	13	13	12	
19-Feb-90	9	9	12	7	11	
20-Feb-90	9	8	12	9	10	
21-Feb-90	10	10	11	11	11	
22-Feb-90	97	41	14	111	32	
23-Feb-90	121	140	30	127	78	
24-Feb-90	85	94	42	77	81	
25-Feb-90	68	66	51	57	84	
26-Feb-90	54	53	50	49	70	
27-Feb-90	43	39	45	37	53	
28-Feb-90	35	31	38	31	43	
1-Mar-90	31	28	35	29	38	
2-Mar-90	26	24	32	24	32	
3-Mar-90	22	18	28	26	25	
4-Mar-90	25	17	25	27	23	
5-Mar-90	23	15	23	21	19	
6-Mar-90	20	13	22	17	16	
7-Mar-90	19	14	21	18	16	
8-Mar-90	19	17	20	19	17	
9-Mar-90	91	66	29	90	17	
10-Mar-90	74	127	44	80	73	

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Date	Lysimeter 1 (mm)	Lysimeter 2 (mm)	Lysimeter 3 (mm)	Lysimeter 4 (mm)	Lysimeter 5 (mm)	Lysimeters Changed
11-Mar-90	61	204	58	72	169	
12-Mar-90	58	118	71	48	128	
13-Mar-90	62	78	75	48	96	
14-Mar-90	58	58	70	47	74	
15-Mar-90	48	43	58	40	57	
16-Mar-90	41	36	47	37	47	
17-Mar-90	34	30	39	30	39	
18-Mar-90	29	23	36	24	32	
19-Mar-90	24	20	33	20	27	
20-Mar-90	22	19	28	20	25	
21-Mar-90	16	13	18	13	18	
22-Mar-90	16	14	20	13	19	
23-Mar-90	14	11	19	11	15	
24-Mar-90	14	12	18	13	15	
25-Mar-90	13	11	17	12	14	
26-Mar-90	11	9	17	9	13	
27-Mar-90	11	9	15	10	12	
28-Mar-90	10	9	14	10	14	
29-Mar-90	9	8	13	9	12	
30-Mar-90	9	8	12	8	10	
31-Mar-90	8	7	11	8	9	
1-Apr-90	12	9	15	5	8	
2-Apr-90	19	12	16	6	8	
3-Apr-90	20	14	15	8	10	
4-Apr-90	19	15	15	8	11	
5-Apr-90	16	14	13	7	11	
6-Apr-90	15	13	12	7	11	
7-Apr-90	13	12	12	6	11	
8-Apr-90	12	11	11	6	10	
9-Apr-90	12	11	11	9	11	
10-Apr-90	15	14	14	14	12	
11-Apr-90	13	12	14	12	11	
12-Apr-90	13	11	14	15	12	
13-Apr-90	19	17	15	23	12	
14-Apr-90	31	32	18	30	16	
15-Apr-90	33	31	20	31	24	
16-Apr-90	31	28	22	29	30	
17-Apr-90	27	22	23	22	27	
18-Apr-90	27	23	23	24	26	
19-Apr-90	28	25	24	26	29	

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Date	Lysimeter 1 (mm)	Lysimeter 2 (mm)	Lysimeter 3 (mm)	Lysimeter 4 (mm)	Lysimeter 5 (mm)	Lysimeters Changed
20-Apr-90	26	23	23	24	27	
21-Apr-90	23	19	23	21	24	
22-Apr-90	22	19	22	20	23	
23-Apr-90	20	18	22	22	21	
24-Apr-90	21	24	24	28	20	
25-Apr-90	23	27	25	28	22	
26-Apr-90	24	26	26	27	25	
27-Apr-90	22	23	26	24	25	
28-Apr-90	21	21	25	21	24	
29-Apr-90	19	17	23	17	21	
30-Apr-90	17	16	22	16	19	
1-May-90	15	14	20	15	17	
2-May-90	14	13	19	13	16	
3-May-90	13	12	17	13	15	
4-May-90	14	14	17	16	16	
5-May-90	11	11	16	10	13	
6-May-90	10	10	15	10	12	
7-May-90	10	10	14	10	11	
8-May-90	9	8	13	8	11	
9-May-90	10	10	12	11	11	
10-May-90	8	9	12	6	10	
11-May-90	6	5	11	4	7	
12-May-90	8	8	10	10	9	
13-May-90	6	6	10	5	8	
14-May-90	8	7	27	8	7	
15-May-90	28	31	48	21	11	
16-May-90	46	45	51	38	32	
17-May-90	56	58	59	69	54	
18-May-90	177	146	96	143	177	
19-May-90	103	85	94	91	113	
20-May-90	67	54	80	56	71	
21-May-90	49	40	66	42	52	
22-May-90	38	32	57	33	41	
23-May-90	33	27	49	28	34	
24-May-90	27	23	41	24	28	
25-May-90	24	20	36	22	25	
26-May-90	21	18	31	19	22	
27-May-90	18	16	25	16	19	
28-May-90	16	15	26	15	17	
29-May-90	13	13	26	12	15	

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Date	Lysimeter 1 (mm)	Lysimeter 2 (mm)	Lysimeter 3 (mm)	Lysimeter 4 (mm)	Lysimeter 5 (mm)	Lysimeters Changed
30-May-90	12	11	21	12	13	
31-May-90	12	11	19	12	13	
1-Jun-90	11	11	17	12	12	
2-Jun-90	12	11	16	13	12	
3-Jun-90	10	10	16	9	11	
4-Jun-90	9	8	17	13	9	
5-Jun-90	10	9	15	11	9	
6-Jun-90	8	9	14	8	9	
7-Jun-90	8	7	13	8	8	
8-Jun-90	8	8	12	8	8	
9-Jun-90	7	7	11	6	8	
10-Jun-90	6	6	11	6	7	
11-Jun-90	7	6	10	7	7	
12-Jun-90	7	7	10	8	7	
13-Jun-90	6	7	9	6	7	
14-Jun-90	6	7	9	6	7	
15-Jun-90	6	6	9	6	6	
16-Jun-90	6	6	8	6	6	
17-Jun-90	6	6	8	7	6	
18-Jun-90	5	6	8	5	6	
19-Jun-90	5	6	7	6	6	
20-Jun-90	5	6	7	6	6	
21-Jun-90	5	5	6	5	5	
22-Jun-90	6	7	6	8	6	
23-Jun-90	4	6	6	3	6	
24-Jun-90	4	4	5	3	4	
25-Jun-90	4	4	5	4	4	
26-Jun-90	4	4	5	5	4	
27-Jun-90	4	4	4	4	4	
28-Jun-90	4	4	4	5	4	
29-Jun-90	4	4	4	4	4	
30-Jun-90	4	4	4	4	4	
1-Jul-90	0	0	0	0	0	all
2-Jul-90	4	4	3	4	4	
3-Jul-90	4	4	3	5	4	
4-Jul-90	4	4	3	3	4	
5-Jul-90	3	3	3	3	3	
6-Jul-90	3	3	3	3	3	
7-Jul-90	4	3	3	4	3	
8-Jul-90	4	4	3	5	4	

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Date	Lysimeter 1 (mm)	Lysimeter 2 (mm)	Lysimeter 3 (mm)	Lysimeter 4 (mm)	Lysimeter 5 (mm)	Lysimeters Changed
9-Jul-90	3	4	3	3	4	
10-Jul-90	3	3	3	3	3	
11-Jul-90	3	3	3	4	3	
12-Jul-90	3	3	3	2	3	
13-Jul-90	3	3	3	4	3	
14-Jul-90	3	4	3	4	4	
15-Jul-90	2	3	2	2	3	
16-Jul-90	2	2	2	2	3	
17-Jul-90	2	2	2	2	3	
18-Jul-90	3	2	2	3	3	
19-Jul-90	3	3	2	3	3	
20-Jul-90	3	3	2	3	3	
21-Jul-90	2	2	2	5	3	
22-Jul-90	2	2	2	6	3	
23-Jul-90	2	2	2	19	2	
24-Jul-90	4	2	2	22	2	
25-Jul-90	9	2	2	21	2	
26-Jul-90	12	2	2	21	2	
27-Jul-90	13	3	3	20	3	
28-Jul-90	13	4	3	19	4	
29-Jul-90	13	5	4	17	4	
30-Jul-90	11	5	4	14	4	
31-Jul-90	10	4	4	13	3	
1-Aug-90	10	4	4	12	3	
2-Aug-90	9	5	5	12	4	
3-Aug-90	9	5	5	11	4	
4-Aug-90	9	5	5	11	4	
5-Aug-90	7	4	5	8	4	
6-Aug-90	7	4	5	8	3	
7-Aug-90	7	4	5	9	4	
8-Aug-90	7	4	5	8	4	
9-Aug-90	7	4	5	8	4	
10-Aug-90	6	4	4	7	4	
11-Aug-90	6	4	4	6	4	
12-Aug-90	6	4	4	6	3	
13-Aug-90	5	3	4	10	3	
14-Aug-90	6	3	7	18	3	
15-Aug-90	8	3	12	19	4	
16-Aug-90	8	3	14	19	5	
17-Aug-90	8	4	16	20	6	

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18-Aug-
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Date	Lysimeter 1 (mm)	Lysimeter 2 (mm)	Lysimeter 3 (mm)	Lysimeter 4 (mm)	Lysimeter 5 (mm)	Lysimeters Changed
18-Aug-90	8	4	16	18	7	
19-Aug-90	7	4	16	15	8	
20-Aug-90	8	4	16	15	8	
21-Aug-90	8	5	15	14	9	
22-Aug-90	8	5	14	15	9	
23-Aug-90	10	5	15	18	9	
24-Aug-90	12	6	15	23	11	
25-Aug-90	14	8	16	23	14	
26-Aug-90	15	9	16	21	16	
27-Aug-90	15	9	16	20	17	
28-Aug-90	15	10	16	17	16	
29-Aug-90	14	9	15	15	15	
30-Aug-90	13	8	14	14	14	
31-Aug-90	12	8	14	13	13	
1-Sep-90	12	8	13	12	12	
2-Sep-90	11	7	12	11	11	
3-Sep-90	11	6	11	10	10	
4-Sep-90	11	7	11	11	10	
5-Sep-90	10	7	10	10	10	
6-Sep-90	10	7	10	11	9	
7-Sep-90	8	6	9	6	8	
8-Sep-90	8	5	8	8	7	
9-Sep-90	8	6	8	7	7	
10-Sep-90	7	5	7	7	7	
11-Sep-90	7	4	7	7	6	
12-Sep-90	7	5	7	7	6	
13-Sep-90	7	5	6	8	6	
14-Sep-90	7	6	6	7	7	
15-Sep-90	6	4	6	6	6	
16-Sep-90	5	3	5	4	5	
17-Sep-90	5	2	5	4	4	
18-Sep-90	6	3	5	7	5	
19-Sep-90	5	4	4	5	5	
20-Sep-90	0	0	0	0	0	all
21-Sep-90	5	3	4	6	5	
22-Sep-90	4	3	4	4	4	
23-Sep-90	3	2	3	8	4	
24-Sep-90	6	2	3	14	4	
25-Sep-90	11	3	3	15	5	
26-Sep-90	10	3	3	10	5	

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27-Sep
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3-No
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Date	Lysimeter 1 (mm)	Lysimeter 2 (mm)	Lysimeter 3 (mm)	Lysimeter 4 (mm)	Lysimeter 5 (mm)	Lysimeters Changed
27-Sep-90	0	0	0	0	0	all
28-Sep-90	10	3	4	10	3	
29-Sep-90	9	4	4	9	3	
30-Sep-90	9	4	4	8	3	
1-Oct-90	9	4	4	9	3	
2-Oct-90	8	4	4	7	3	
3-Oct-90	9	5	4	10	3	
4-Oct-90	0	0	0	0	0	all
5-Oct-90	10	8	4	40	3	
6-Oct-90	21	11	5	30	3	
7-Oct-90	24	11	6	24	4	
8-Oct-90	22	11	7	22	5	
9-Oct-90	33	32	9	55	6	
10-Oct-90	309	104	103	303	119	
11-Oct-90	237	179	28	203	127	
12-Oct-90	111	90	89	92	64	3,
13-Oct-90	72	56	57	59	43	3,
14-Oct-90	51	40	41	41	30	3,
15-Oct-90	39	29	30	30	22	3,
16-Oct-90	33	25	25	26	18	3,
17-Oct-90	28	22	23	24	16	3,
18-Oct-90	22	18	17	17	13	3,
19-Oct-90	19	14	15	16	11	3,
20-Oct-90	17	15	14	15	10	3,
21-Oct-90	15	13	13	12	9	3,
22-Oct-90	14	12	11	12	8	3,
23-Oct-90	13	11	11	11	8	3,
24-Oct-90	12	10	10	10	7	3,
25-Oct-90	11	9	9	7	9	3,
26-Oct-90	11	10	11	10	13	
27-Oct-90	11	10	11	9	13	
28-Oct-90	10	8	9	7	11	
29-Oct-90	11	10	10	9	12	
30-Oct-90	11	10	9	9	12	
31-Oct-90	10	9	8	8	11	
1-Nov-90	10	9	8	8	11	
2-Nov-90	9	9	7	7	10	
3-Nov-90	9	8	7	8	9	
4-Nov-90	9	8	7	8	9	
5-Nov-90	10	10	8	10	11	

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13-De
14-De
15-De

Date	Lysimeter 1 (mm)	Lysimeter 2 (mm)	Lysimeter 3 (mm)	Lysimeter 4 (mm)	Lysimeter 5 (mm)	Lysimeters Changed
6-Nov-90	30	42	72	41	10	
7-Nov-90	75	79	90	87	47	
8-Nov-90	68	56	62	61	61	
9-Nov-90	52	41	45	44	53	
10-Nov-90	39	30	33	32	42	
11-Nov-90	31	24	26	25	34	
12-Nov-90	25	20	21	20	27	
13-Nov-90	22	17	17	17	23	
14-Nov-90	20	16	15	16	21	
15-Nov-90	18	14	13	14	18	
16-Nov-90	16	13	11	12	17	
17-Nov-90	14	10	10	11	14	
18-Nov-90	13	11	10	11	14	
19-Nov-90	12	10	8	9	13	
20-Nov-90	11	9	7	9	11	
21-Nov-90	11	10	8	10	11	
22-Nov-90	10	9	7	8	10	
23-Nov-90	10	9	7	8	10	
24-Nov-90	9	7	6	8	9	
25-Nov-90	7	6	5	4	8	
26-Nov-90	8	6	5	7	7	
27-Nov-90	32	22	8	8	25	
28-Nov-90	296	161	99	255	285	
29-Nov-90	166	164	0	164	182	
30-Nov-90	94	80	48	87	103	
1-Dec-90	61	50	37	52	66	
2-Dec-90	44	36	26	38	48	
3-Dec-90	36	32	22	47	41	
4-Dec-90	27	21	16	42	27	5
5-Dec-90	25	25	18	29	24	5
6-Dec-90	25	24	17	21	22	5
7-Dec-90	25	22	19	22	22	5
8-Dec-90	22	21	19	20	20	5
9-Dec-90	21	21	19	21	20	5
10-Dec-90	0	0	0	0	0	all
11-Dec-90	0	0	0	0	0	all
12-Dec-90	0	0	0	0	0	all
13-Dec-90	0	0	0	0	0	all
14-Dec-90	0	0	0	0	0	all
15-Dec-90	0	0	0	0	0	all

Date	Lysimeter 1 (mm)	Lysimeter 2 (mm)	Lysimeter 3 (mm)	Lysimeter 4 (mm)	Lysimeter 5 (mm)	Lysimeters Changed
16-Dec-90	0	0	0	0	0	all
17-Dec-90	0	0	0	0	0	all
18-Dec-90	0	0	0	0	0	all
19-Dec-90	9	7	7	6	10	
20-Dec-90	11	9	8	10	11	
21-Dec-90	33	30	26	28	34	
22-Dec-90	8	7	9	8	8	
23-Dec-90	6	6	9	6	8	
24-Dec-90	8	9	12	12	9	
25-Dec-90	0	0	0	0	0	all
26-Dec-90	0	0	0	0	0	all
27-Dec-90	0	0	0	0	0	all
28-Dec-90	0	0	0	0	0	all
29-Dec-90	0	0	0	0	0	all
30-Dec-90	280	221	300	325	286	
31-Dec-90	148	141	136	136	152	
1-Jan-91	89	77	77	79	95	
2-Jan-91	57	50	49	51	63	
3-Jan-91	44	37	36	39	48	
4-Jan-91	36	30	27	32	39	
5-Jan-91	30	26	22	27	33	
6-Jan-91	23	20	17	20	25	
7-Jan-91	21	17	15	19	22	
8-Jan-91	14	15	19	18	14	
9-Jan-91	14	17	19	16	13	
10-Jan-91	0	0	0	0	0	all
11-Jan-91	0	0	0	0	0	all
12-Jan-91	0	0	0	0	0	all
13-Jan-91	0	0	0	0	0	all
14-Jan-91	0	0	0	0	0	all
15-Jan-91	0	0	0	0	0	all
16-Jan-91	0	0	0	0	0	all
17-Jan-91	0	0	0	0	0	all
18-Jan-91	0	0	0	0	0	all
19-Jan-91	0	0	0	0	0	all
20-Jan-91	0	0	0	0	0	all
21-Jan-91	0	0	0	0	0	all
22-Jan-91	0	0	0	0	0	all
23-Jan-91	0	0	0	0	0	all
24-Jan-91	0	0	0	0	0	all

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3-F
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10-I
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4-I
5-I

Date	Lysimeter 1 (mm)	Lysimeter 2 (mm)	Lysimeter 3 (mm)	Lysimeter 4 (mm)	Lysimeter 5 (mm)	Lysimeters Changed
25-Jan-91	0	0	0	0	0	all
26-Jan-91	0	0	0	0	0	all
27-Jan-91	0	0	0	0	0	all
28-Jan-91	0	0	0	0	0	all
29-Jan-91	0	0	0	0	0	all
30-Jan-91	0	0	0	0	0	all
31-Jan-91	0	0	0	0	0	all
1-Feb-91	0	0	0	0	0	all
2-Feb-91	0	0	0	0	0	all
3-Feb-91	0	0	0	0	0	all
4-Feb-91	0	0	0	0	0	all
5-Feb-91	0	0	0	0	0	all
6-Feb-91	0	0	0	0	0	all
7-Feb-91	0	0	0	0	0	all
8-Feb-91	0	0	0	0	0	all
9-Feb-91	0	0	0	0	0	all
10-Feb-91	0	0	0	0	0	all
11-Feb-91	0	0	0	0	0	all
12-Feb-91	0	0	0	0	0	all
13-Feb-91	0	0	0	0	0	all
14-Feb-91	0	0	0	0	0	all
15-Feb-91	0	0	0	0	0	all
16-Feb-91	0	0	0	0	0	all
17-Feb-91	0	0	0	0	0	all
18-Feb-91	0	0	0	0	0	all
19-Feb-91	0	0	0	0	0	all
20-Feb-91	0	0	0	0	0	all
21-Feb-91	0	0	0	0	0	all
22-Feb-91	0	0	0	0	0	all
23-Feb-91	0	0	0	0	0	all
24-Feb-91	0	0	0	0	0	all
25-Feb-91	0	0	0	0	0	all
26-Feb-91	0	0	0	0	0	all
27-Feb-91	0	0	0	0	0	all
28-Feb-91	0	0	0	0	0	all
1-Mar-91	0	0	0	0	0	all
2-Mar-91	0	0	0	0	0	all
3-Mar-91	0	0	0	0	0	all
4-Mar-91	0	0	0	0	0	all
5-Mar-91	0	0	0	0	0	all

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31-
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3-A
4-A
5-A
6-A
7-A
8-A
9-A
10-A
11-A
12-A
13-A
14-A

Date	Lysimeter 1 (mm)	Lysimeter 2 (mm)	Lysimeter 3 (mm)	Lysimeter 4 (mm)	Lysimeter 5 (mm)	Lysimeters Changed
6-Mar-91	0	0	0	0	0	all
7-Mar-91	0	0	0	0	0	all
8-Mar-91	0	0	0	0	0	all
9-Mar-91	0	0	0	0	0	all
10-Mar-91	0	0	0	0	0	all
11-Mar-91	0	0	0	0	0	all
12-Mar-91	0	0	0	0	0	all
13-Mar-91	0	0	0	0	0	all
14-Mar-91	0	0	0	0	0	all
15-Mar-91	0	0	0	0	0	all
16-Mar-91	0	0	0	0	0	all
17-Mar-91	0	0	0	0	0	all
18-Mar-91	0	0	0	0	0	all
19-Mar-91	0	0	0	0	0	all
20-Mar-91	0	0	0	0	0	all
21-Mar-91	0	0	0	0	0	all
22-Mar-91	0	0	0	0	0	all
23-Mar-91	0	0	0	0	0	all
24-Mar-91	0	0	0	0	0	all
25-Mar-91	0	0	0	0	0	all
26-Mar-91	0	0	0	0	0	all
27-Mar-91	0	0	0	0	0	all
28-Mar-91	0	0	0	0	0	all
29-Mar-91	0	0	0	0	0	all
30-Mar-91	0	0	0	0	0	all
31-Mar-91	0	0	0	0	0	all
1-Apr-91	0	0	0	0	0	all
2-Apr-91	19	12	16	6	8	
3-Apr-91	20	14	15	8	10	
4-Apr-91	19	15	15	8	11	
5-Apr-91	16	14	13	7	11	
6-Apr-91	15	13	12	7	11	
7-Apr-91	13	12	12	6	11	
8-Apr-91	0	0	0	0	0	all
9-Apr-91	12	11	11	9	11	
10-Apr-91	10	8	10	7	9	
11-Apr-91	10	8	11	9	9	
12-Apr-91	11	9	12	11	9	
13-Apr-91	11	10	11	10	10	
14-Apr-91	11	10	11	11	10	

Date	Lysimeter 1 (mm)	Lysimeter 2 (mm)	Lysimeter 3 (mm)	Lysimeter 4 (mm)	Lysimeter 5 (mm)	Lysimeters Changed
15-Apr-91	23	29	20	31	10	
16-Apr-91	115	114	115	61	58	
17-Apr-91	40	83	85	46	70	
18-Apr-91	29	54	59	30	56	
19-Apr-91	48	41	44	32	44	
20-Apr-91	38	33	35	22	43	
21-Apr-91	55	69	60	35	50	
22-Apr-91	0	0	0	0	0	all
23-Apr-91	54	44	47	24	49	
24-Apr-91	41	33	36	17	39	
25-Apr-91	38	35	38	20	37	
26-Apr-91	0	0	0	0	0	all
27-Apr-91	52	46	45	25	42	
28-Apr-91	44	37	39	21	39	
29-Apr-91	42	37	35	23	37	
30-Apr-91	40	33	34	33	33	
1-May-91	40	35	34	34	34	
2-May-91	38	32	32	32	31	
3-May-91	34	29	28	29	29	
4-May-91	30	26	24	26	25	
5-May-91	28	25	21	25	25	
6-May-91	23	19	17	19	21	
7-May-91	19	17	15	17	18	
8-May-91	19	16	14	17	17	
9-May-91	0	0	0	0	0	all
10-May-91	0	0	0	0	0	all
11-May-91	0	0	0	0	0	all
12-May-91	0	0	0	0	0	all
13-May-91	0	0	0	0	0	all
14-May-91	0	0	0	0	0	all
15-May-91	11	10	8	10	11	
16-May-91	11	11	8	11	10	
17-May-91	10	9	7	8	10	
18-May-91	9	8	7	9	9	
19-May-91	10	9	7	9	9	
20-May-91	9	9	8	9	9	
21-May-91	9	9	9	9	9	
22-May-91	9	8	10	9	8	
23-May-91	9	8	12	10	8	
24-May-91	9	8	12	10	8	

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Date	Lysimeter 1 (mm)	Lysimeter 2 (mm)	Lysimeter 3 (mm)	Lysimeter 4 (mm)	Lysimeter 5 (mm)	Lysimeters Changed
25-May-91	9	7	12	10	8	
26-May-91	9	7	12	10	8	
27-May-91	9	7	11	10	7	
28-May-91	9	6	11	10	7	
29-May-91	9	7	11	11	7	
30-May-91	9	7	10	10	7	
31-May-91	8	6	10	9	7	
1-Jun-91	9	6	10	9	6	
2-Jun-91	9	6	19	10	6	
3-Jun-91	13	6	34	18	6	
4-Jun-91	17	6	37	31	6	
5-Jun-91	19	8	32	32	7	
6-Jun-91	20	12	27	27	8	
7-Jun-91	20	14	23	24	10	
8-Jun-91	19	14	19	20	11	
9-Jun-91	18	14	17	19	12	
10-Jun-91	17	13	15	17	12	
11-Jun-91	15	13	14	15	12	
12-Jun-91	14	11	12	13	11	
13-Jun-91	13	10	11	12	10	
14-Jun-91	13	11	10	13	10	
15-Jun-91	12	10	9	11	10	
16-Jun-91	10	9	8	9	9	
17-Jun-91	8	8	7	9	8	1,
18-Jun-91	8	8	6	9	8	1,
19-Jun-91	7	8	6	8	8	1,
20-Jun-91	7	8	5	9	8	1,
21-Jun-91	7	8	5	9	8	1,
22-Jun-91	6	7	4	7	7	1,
23-Jun-91	6	6	4	7	6	1,
24-Jun-91	6	7	4	7	6	1,
25-Jun-91	6	7	3	7	6	1,
26-Jun-91	6	6	3	7	6	1,
27-Jun-91	5	6	3	6	6	1,
28-Jun-91	5	6	3	6	6	1,
29-Jun-91	5	6	3	6	6	1,
30-Jun-91	5	6	4	6	6	1,
1-Jul-91	21	6	65	9	6	1,
2-Jul-91	92	12	221	61	75	1,
3-Jul-91	59	9	92	74	63	1,

Date	Lysimeter 1 (mm)	Lysimeter 2 (mm)	Lysimeter 3 (mm)	Lysimeter 4 (mm)	Lysimeter 5 (mm)	Lysimeters Changed
4-Jul-91	49	49	49	51	47	1,2,3,
5-Jul-91	37	37	37	38	35	1,2,3,
6-Jul-91	30	30	30	31	28	1,2,3,
7-Jul-91	25	25	25	25	25	1,2,3,5,
8-Jul-91	20	20	20	20	20	1,2,3,5,
9-Jul-91	19	19	19	19	19	1,2,3,5,
10-Jul-91	16	16	16	16	16	1,2,3,5,
11-Jul-91	15	15	15	15	15	1,2,3,5,
12-Jul-91	14	14	14	14	14	1,2,3,5,
13-Jul-91	11	11	11	11	11	1,2,3,5,
14-Jul-91	10	10	10	10	10	1,2,3,5,
15-Jul-91	10	10	10	10	10	1,2,3,5,
16-Jul-91	1	1	2	10	4	5
17-Jul-91	5	5	3	10	6	5
18-Jul-91	8	8	3	9	7	5
19-Jul-91	7	7	2	7	6	5
20-Jul-91	6	6	2	7	5	5
21-Jul-91	6	6	2	7	5	5
22-Jul-91	6	6	2	8	6	5
23-Jul-91	5	6	2	6	5	5
24-Jul-91	5	5	2	6	5	5
25-Jul-91	5	5	1	5	3	
26-Jul-91	4	4	1	5	5	
27-Jul-91	5	5	1	6	5	
28-Jul-91	5	5	1	6	5	
29-Jul-91	4	5	1	5	5	
30-Jul-91	3	4	1	4	5	
31-Jul-91	4	4	1	5	5	
1-Aug-91	3	4	1	4	4	
2-Aug-91	3	4	1	5	4	
3-Aug-91	3	4	1	3	4	
4-Aug-91	3	3	1	3	4	
5-Aug-91	3	3	1	3	3	
6-Aug-91	3	3	1	3	3	
7-Aug-91	3	3	1	4	3	
8-Aug-91	3	4	1	5	4	
9-Aug-91	3	3	1	3	3	
10-Aug-91	2	3	0	2	3	
11-Aug-91	2	2	0	2	3	
12-Aug-91	3	2	0	3	3	

Date	Lysimeter 1 (mm)	Lysimeter 2 (mm)	Lysimeter 3 (mm)	Lysimeter 4 (mm)	Lysimeter 5 (mm)	Lysimeters Changed
13-Aug-91	4	3	0	3	3	
14-Aug-91	4	3	1	3	3	
15-Aug-91	4	3	1	3	3	
16-Aug-91	4	3	1	3	3	
17-Aug-91	5	3	1	4	4	
18-Aug-91	4	2	1	2	3	
19-Aug-91	4	2	3	2	3	
20-Aug-91	13	2	84	10	3	
21-Aug-91	32	2	56	21	9	
22-Aug-91	31	3	36	19	15	
23-Aug-91	24	2	25	15	14	
24-Aug-91	19	3	18	13	13	
25-Aug-91	16	4	14	12	12	
26-Aug-91	13	5	12	11	11	
27-Aug-91	12	5	9	10	9	
28-Aug-91	10	5	8	9	8	
29-Aug-91	9	5	7	9	8	
30-Aug-91	8	6	6	9	7	
31-Aug-91	7	4	4	6	7	
1-Sep-91	7	4	4	7	6	
2-Sep-91	7	4	4	8	6	
3-Sep-91	6	5	4	7	6	
4-Sep-91	5	4	3	6	5	
5-Sep-91	5	4	2	5	5	
6-Sep-91	4	3	2	5	4	
7-Sep-91	4	3	2	5	4	
8-Sep-91	4	3	2	5	4	
9-Sep-91	4	3	2	6	4	
10-Sep-91	3	3	1	4	4	
11-Sep-91	4	2	1	4	3	
12-Sep-91	4	3	1	5	3	
13-Sep-91	4	3	1	4	3	
14-Sep-91	4	3	1	4	3	
15-Sep-91	3	2	1	3	3	
16-Sep-91	3	2	1	3	3	
17-Sep-91	2	2	1	3	3	
18-Sep-91	2	2	1	3	3	
19-Sep-91	2	2	0	2	2	
20-Sep-91	2	2	0	3	2	
21-Sep-91	3	2	1	3	3	

Date	Lysimeter 1 (mm)	Lysimeter 2 (mm)	Lysimeter 3 (mm)	Lysimeter 4 (mm)	Lysimeter 5 (mm)	Lysimeters Changed
22-Sep-91	2	2	1	3	3	
23-Sep-91	1	2	1	1	2	
24-Sep-91	2	2	1	3	2	
25-Sep-91	2	3	1	4	3	
26-Sep-91	1	2	1	0	2	
27-Sep-91	1	1	0	0	1	
28-Sep-91	2	1	0	1	1	
29-Sep-91	1	1	0	1	1	
30-Sep-91	2	1	1	3	2	
1-Oct-91	2	1	1	3	2	
2-Oct-91	2	2	1	2	2	
3-Oct-91	2	1	1	1	1	
4-Oct-91	2	1	1	3	2	
5-Oct-91	1	2	44	1	2	
6-Oct-91	12	1	88	9	1	
7-Oct-91	23	5	67	29	1	
8-Oct-91	29	13	49	31	4	
9-Oct-91	27	15	38	28	7	
10-Oct-91	25	15	32	26	10	
11-Oct-91	21	16	27	23	15	
12-Oct-91	18	13	22	18	15	
13-Oct-91	16	12	20	18	14	
14-Oct-91	16	14	17	17	15	
15-Oct-91	13	11	14	13	13	
16-Oct-91	12	10	12	13	12	
17-Oct-91	12	11	12	12	12	
18-Oct-91	10	9	11	10	10	
19-Oct-91	10	8	11	10	9	
20-Oct-91	10	9	12	11	10	
21-Oct-91	9	9	12	10	10	
22-Oct-91	8	8	12	8	9	
23-Oct-91	8	8	12	9	9	
24-Oct-91	8	8	13	9	8	
25-Oct-91	17	8	106	18	8	
26-Oct-91	176	179	285	212	111	
27-Oct-91	140	150	169	145	132	
28-Oct-91	124	126	128	128	133	
29-Oct-91	74	74	70	75	87	
30-Oct-91	51	50	43	51	62	
31-Oct-91	56	57	82	60	52	

Date	Lysimeter 1 (mm)	Lysimeter 2 (mm)	Lysimeter 3 (mm)	Lysimeter 4 (mm)	Lysimeter 5 (mm)	Lysimeters Changed
1-Nov-91	82	86	92	85	82	
2-Nov-91	56	54	60	55	67	
3-Nov-91	41	41	46	42	53	
4-Nov-91	36	35	40	35	45	
5-Nov-91	30	32	33	34	38	
6-Nov-91	26	28	25	27	31	
7-Nov-91	23	23	19	24	27	
8-Nov-91	20	20	15	21	24	
9-Nov-91	18	19	13	19	22	
10-Nov-91	17	17	11	17	20	
11-Nov-91	15	14	9	13	17	
12-Nov-91	13	13	8	13	15	
13-Nov-91	12	13	8	12	14	
14-Nov-91	11	11	7	10	12	
15-Nov-91	10	10	6	9	11	
16-Nov-91	8	8	5	7	9	
17-Nov-91	9	9	6	10	10	
18-Nov-91	9	10	6	9	10	
19-Nov-91	7	8	5	7	9	
20-Nov-91	7	8	5	7	8	
21-Nov-91	15	18	75	19	8	
22-Nov-91	47	77	84	74	31	
23-Nov-91	50	56	55	58	45	
24-Nov-91	43	41	38	41	40	
25-Nov-91	34	32	31	31	35	
26-Nov-91	29	27	25	28	31	
27-Nov-91	25	23	20	22	27	
28-Nov-91	21	20	18	20	23	
29-Nov-91	19	18	15	18	21	
30-Nov-91	16	15	12	13	18	
1-Dec-91	14	13	11	14	15	
2-Dec-91	14	14	13	15	16	
3-Dec-91	13	13	13	11	13	5,
4-Dec-91	11	11	15	10	12	5,
5-Dec-91	15	18	18	17	17	5,
6-Dec-91	16	17	17	15	16	5,
7-Dec-91	17	18	18	16	17	5,
8-Dec-91	18	18	23	18	19	5,
9-Dec-91	19	18	51	39	32	5,
10-Dec-91	31	38	53	47	42	5,

Date	Lysimeter 1 (mm)	Lysimeter 2 (mm)	Lysimeter 3 (mm)	Lysimeter 4 (mm)	Lysimeter 5 (mm)	Lysimeters Changed
11-Dec-91	37	40	45	40	41	5,
12-Dec-91	39	40	40	38	39	5,
13-Dec-91	32	29	31	29	30	5,
14-Dec-91	27	25	29	23	26	5,
15-Dec-91	32	34	38	31	34	5,
16-Dec-91	37	39	35	35	36	5,
17-Dec-91	33	31	29	27	30	5,
18-Dec-91	26	22	23	20	23	5,
19-Dec-91	24	20	20	19	21	5,
20-Dec-91	22	20	19	19	20	5,
21-Dec-91	19	17	15	14	16	5,
22-Dec-91	18	17	15	15	16	5,
23-Dec-91	15	14	12	11	13	5,
24-Dec-91	13	12	11	10	11	5,
25-Dec-91	12	10	10	9	10	5,
26-Dec-91	11	11	9	9	10	5,
27-Dec-91	10	9	8	7	9	5,
28-Dec-91	11	11	9	10	10	5,
29-Dec-91	10	10	8	7	9	5,
30-Dec-91	8	7	7	5	7	5,
31-Dec-91	15	15	14	13	14	5,
1-Jan-92	8	8	8	7	8	5,
2-Jan-92	8	8	8	8	8	5,
3-Jan-92	7	8	8	6	7	5,
4-Jan-92	7	7	9	5	7	5,
5-Jan-92	8	7	10	6	8	5,
6-Jan-92	8	7	12	7	8	5,
7-Jan-92	9	7	16	9	10	5,
8-Jan-92	12	13	19	17	11	
9-Jan-92	14	17	19	16	13	
10-Jan-92	15	17	17	15	14	
11-Jan-92	16	17	16	15	16	
12-Jan-92	15	16	19	15	17	
13-Jan-92	16	17	21	17	18	
14-Jan-92	15	19	19	15	17	
15-Jan-92	18	19	18	16	17	
16-Jan-92	17	18	17	17	19	
17-Jan-92	16	16	15	13	19	
18-Jan-92	14	13	13	12	17	
19-Jan-92	16	15	14	14	18	

Date	Lysimeter 1 (mm)	Lysimeter 2 (mm)	Lysimeter 3 (mm)	Lysimeter 4 (mm)	Lysimeter 5 (mm)	Lysimeters Changed
20-Jan-92	13	13	12	10	17	
21-Jan-92	12	12	12	10	16	
22-Jan-92	12	13	12	11	15	
23-Jan-92	12	13	11	10	15	
24-Jan-92	9	9	9	5	12	
25-Jan-92	9	9	10	7	12	
26-Jan-92	9	8	18	8	12	
27-Jan-92	9	10	24	11	15	
28-Jan-92	9	9	23	13	17	
29-Jan-92	10	11	21	15	20	
30-Jan-92	11	13	19	15	22	
31-Jan-92	10	11	16	12	20	
1-Feb-92	10	10	14	11	18	
2-Feb-92	11	11	13	12	18	
3-Feb-92	11	11	12	12	17	
4-Feb-92	10	10	11	9	15	
5-Feb-92	10	9	10	10	14	
6-Feb-92	10	10	10	10	14	
7-Feb-92	9	9	9	8	12	
8-Feb-92	8	7	9	6	11	
9-Feb-92	7	6	10	6	9	
10-Feb-92	8	8	12	9	11	
11-Feb-92	6	7	11	6	10	
12-Feb-92	7	7	11	9	10	
13-Feb-92	8	8	11	9	12	
14-Feb-92	7	7	10	8	11	
15-Feb-92	8	8	10	9	12	
16-Feb-92	6	5	8	5	9	
17-Feb-92	7	6	11	9	9	
18-Feb-92	9	7	17	13	11	
19-Feb-92	9	6	24	17	11	
20-Feb-92	12	8	40	28	12	
21-Feb-92	17	23	50	40	12	
22-Feb-92	28	36	44	42	14	
23-Feb-92	31	31	35	35	16	
24-Feb-92	28	26	30	29	19	
25-Feb-92	24	22	25	23	20	
26-Feb-92	22	21	23	21	21	
27-Feb-92	18	17	20	17	19	
28-Feb-92	17	17	18	16	18	

Date	Lysimeter 1 (mm)	Lysimeter 2 (mm)	Lysimeter 3 (mm)	Lysimeter 4 (mm)	Lysimeter 5 (mm)	Lysimeters Changed
29-Feb-92	14	12	15	12	15	
1-Mar-92	15	15	15	14	16	
2-Mar-92	13	13	14	12	14	
3-Mar-92	12	12	13	12	13	
4-Mar-92	12	12	12	11	13	
5-Mar-92	11	12	12	12	12	
6-Mar-92	11	12	12	12	12	
7-Mar-92	10	12	10	10	12	
8-Mar-92	10	10	10	9	11	
9-Mar-92	12	11	11	12	11	
10-Mar-92	10	10	9	8	11	
11-Mar-92	10	9	8	8	10	
12-Mar-92	9	9	8	7	10	
13-Mar-92	10	8	15	8	9	
14-Mar-92	12	10	23	10	10	
15-Mar-92	20	16	24	15	11	
16-Mar-92	28	23	23	21	16	
17-Mar-92	28	21	21	18	20	
18-Mar-92	27	20	31	18	23	
19-Mar-92	24	17	53	14	37	
20-Mar-92	22	17	42	13	46	
21-Mar-92	23	18	33	15	43	
22-Mar-92	23	19	26	15	36	
23-Mar-92	21	17	22	15	30	
24-Mar-92	20	16	19	15	25	
25-Mar-92	19	16	18	15	23	
26-Mar-92	17	14	16	14	21	
27-Mar-92	15	12	15	10	19	
28-Mar-92	19	13	19	12	19	
29-Mar-92	22	16	26	13	20	
30-Mar-92	24	19	28	12	20	
31-Mar-92	27	24	26	15	22	
1-Apr-92	27	23	23	14	22	
2-Apr-92	24	20	20	13	22	
3-Apr-92	22	19	20	15	22	
4-Apr-92	19	15	19	11	19	
5-Apr-92	17	14	18	11	17	
6-Apr-92	18	16	18	14	18	
7-Apr-92	17	16	17	14	17	
8-Apr-92	16	15	16	14	16	

Date	Lysimeter 1 (mm)	Lysimeter 2 (mm)	Lysimeter 3 (mm)	Lysimeter 4 (mm)	Lysimeter 5 (mm)	Lysimeters Changed
9-Apr-92	16	15	15	14	16	
10-Apr-92	15	14	15	15	15	
11-Apr-92	14	13	13	11	14	
12-Apr-92	12	10	11	10	12	
13-Apr-92	13	12	12	13	13	
14-Apr-92	13	12	11	12	13	
15-Apr-92	12	11	10	12	12	
16-Apr-92	11	11	9	11	12	
17-Apr-92	10	9	8	9	10	
18-Apr-92	10	9	8	10	10	
19-Apr-92	10	9	7	10	10	
20-Apr-92	9	9	7	10	10	
21-Apr-92	8	9	6	8	9	
22-Apr-92	8	7	5	6	8	
23-Apr-92	9	8	7	9	8	
24-Apr-92	8	8	6	8	8	
25-Apr-92	8	7	6	7	8	
26-Apr-92	7	7	5	7	7	
27-Apr-92	7	6	5	7	7	
28-Apr-92	7	7	6	8	7	
29-Apr-92	7	7	6	8	7	
30-Apr-92	6	6	5	6	7	
1-May-92	7	7	6	8	7	
2-May-92	6	6	5	5	6	
3-May-92	6	5	5	5	6	
4-May-92	6	6	6	6	6	
5-May-92	5	5	5	5	5	
6-May-92	6	5	5	5	5	
7-May-92	6	5	6	6	5	
8-May-92	7	6	6	8	6	
9-May-92	6	6	5	5	6	
10-May-92	6	5	5	5	5	
11-May-92	7	6	6	7	5	
12-May-92	7	6	5	6	5	
13-May-92	7	6	5	5	5	
14-May-92	7	5	5	6	5	
15-May-92	7	6	5	6	5	
16-May-92	7	6	5	6	5	
17-May-92	7	6	4	6	5	
18-May-92	7	5	4	5	5	

Date	Lysimeter 1 (mm)	Lysimeter 2 (mm)	Lysimeter 3 (mm)	Lysimeter 4 (mm)	Lysimeter 5 (mm)	Lysimeters Changed
19-May-92	7	6	4	6	5	
20-May-92	7	6	4	6	5	
21-May-92	7	6	4	7	5	
22-May-92	7	6	4	7	5	
23-May-92	7	7	4	6	5	
24-May-92	7	6	4	6	5	
25-May-92	7	6	4	7	5	
26-May-92	6	6	3	6	5	
27-May-92	6	6	3	6	5	
28-May-92	6	5	3	5	4	
29-May-92	6	5	3	6	4	
30-May-92	6	6	3	6	5	
31-May-92	5	5	2	5	4	
1-Jun-92	5	5	2	5	4	
2-Jun-92	5	5	2	5	4	
3-Jun-92	5	5	3	6	4	
4-Jun-92	5	5	3	6	4	
5-Jun-92	5	5	3	4	4	
6-Jun-92	4	4	3	4	4	
7-Jun-92	4	4	3	3	4	
8-Jun-92	4	4	4	4	4	
9-Jun-92	4	4	5	5	4	
10-Jun-92	4	4	5	4	4	
11-Jun-92	4	4	5	4	4	
12-Jun-92	5	4	6	5	4	
13-Jun-92	5	5	6	5	4	
14-Jun-92	5	5	6	4	4	
15-Jun-92	4	4	6	3	3	
16-Jun-92	5	5	6	5	3	
17-Jun-92	6	6	7	7	4	
18-Jun-92	6	6	6	5	4	
19-Jun-92	5	5	6	4	3	
20-Jun-92	6	5	5	4	3	
21-Jun-92	6	5	5	4	3	
22-Jun-92	6	6	5	6	3	
23-Jun-92	7	7	5	7	4	
24-Jun-92	6	6	4	5	4	
25-Jun-92	5	5	4	4	3	
26-Jun-92	5	5	4	4	3	
27-Jun-92	5	5	4	4	3	

Date	Lysimeter 1 (mm)	Lysimeter 2 (mm)	Lysimeter 3 (mm)	Lysimeter 4 (mm)	Lysimeter 5 (mm)	Lysimeters Changed
28-Jun-92	6	5	4	5	3	
29-Jun-92	5	5	4	5	3	
30-Jun-92	5	5	3	5	3	
1-Jul-92	5	5	3	5	3	
2-Jul-92	5	5	4	6	3	
3-Jul-92	4	5	3	3	3	
4-Jul-92	5	5	3	5	3	
5-Jul-92	5	5	3	4	3	
6-Jul-92	4	4	2	4	3	
7-Jul-92	5	4	3	5	3	
8-Jul-92	5	5	3	5	4	
9-Jul-92	4	4	2	3	3	
10-Jul-92	4	4	2	4	3	
11-Jul-92	4	4	2	4	3	
12-Jul-92	5	4	2	5	3	
13-Jul-92	4	4	2	4	3	
14-Jul-92	4	5	9	5	3	
15-Jul-92	20	23	71	42	4	
16-Jul-92	45	61	75	66	16	
17-Jul-92	42	53	51	57	32	
18-Jul-92	35	38	36	43	29	
19-Jul-92	30	30	34	34	25	
20-Jul-92	27	31	33	31	24	
21-Jul-92	26	30	28	31	23	
22-Jul-92	26	27	23	29	23	
23-Jul-92	26	49	37	58	23	
24-Jul-92	54	116	94	113	75	
25-Jul-92	55	69	65	72	74	
26-Jul-92	44	45	43	48	53	
27-Jul-92	33	33	30	34	38	
28-Jul-92	28	27	23	28	32	
29-Jul-92	23	22	19	23	26	
30-Jul-92	20	19	16	20	23	
31-Jul-92	17	16	13	16	19	
1-Aug-92	22	54	23	34	19	
2-Aug-92	30	67	33	58	39	
3-Aug-92	30	45	33	46	44	
4-Aug-92	28	32	29	34	37	
5-Aug-92	24	26	23	27	30	
6-Aug-92	21	23	19	23	26	

Date	Lysimeter 1 (mm)	Lysimeter 2 (mm)	Lysimeter 3 (mm)	Lysimeter 4 (mm)	Lysimeter 5 (mm)	Lysimeters Changed
7-Aug-92	19	20	16	21	23	
8-Aug-92	16	17	13	17	20	
9-Aug-92	15	15	11	15	17	
10-Aug-92	14	14	9	14	16	
11-Aug-92	12	12	7	12	13	
12-Aug-92	11	11	6	11	12	
13-Aug-92	11	11	6	10	11	
14-Aug-92	10	10	5	10	10	
15-Aug-92	9	9	4	9	10	
16-Aug-92	8	9	4	9	9	
17-Aug-92	8	8	3	8	9	
18-Aug-92	8	8	3	8	8	
19-Aug-92	7	7	3	7	7	
20-Aug-92	7	7	2	6	7	
21-Aug-92	6	6	2	6	6	
22-Aug-92	6	6	2	6	6	
23-Aug-92	6	7	2	6	6	
24-Aug-92	5	8	2	5	6	
25-Aug-92	5	8	2	5	5	
26-Aug-92	5	8	2	5	5	
27-Aug-92	5	8	2	6	5	
28-Aug-92	4	8	2	4	5	
29-Aug-92	5	13	16	7	5	
30-Aug-92	4	16	19	15	5	
31-Aug-92	4	14	17	19	6	
1-Sep-92	6	13	14	20	7	
2-Sep-92	9	14	13	21	8	
3-Sep-92	8	11	10	15	8	
4-Sep-92	8	10	9	14	8	
5-Sep-92	8	10	8	14	8	
6-Sep-92	7	10	7	12	8	
7-Sep-92	7	9	7	12	8	
8-Sep-92	7	8	5	9	7	
9-Sep-92	7	9	6	12	7	
10-Sep-92	57	121	195	148	32	
11-Sep-92	97	96	110	120	94	
12-Sep-92	65	57	58	68	65	
13-Sep-92	47	40	35	45	45	
14-Sep-92	36	30	24	34	35	
15-Sep-92	80	35	112	123	84	

Date	Lysimeter 1 (mm)	Lysimeter 2 (mm)	Lysimeter 3 (mm)	Lysimeter 4 (mm)	Lysimeter 5 (mm)	Lysimeters Changed
16-Sep-92	305	175	325	316	318	
17-Sep-92	113	119	90	108	127	
18-Sep-92	65	61	47	61	75	
19-Sep-92	43	41	30	41	50	
20-Sep-92	34	33	24	34	39	
21-Sep-92	27	28	23	29	31	
22-Sep-92	22	21	20	22	24	
23-Sep-92	19	19	17	21	21	
24-Sep-92	18	19	14	20	21	
25-Sep-92	18	17	13	18	19	
26-Sep-92	17	16	13	17	17	
27-Sep-92	14	13	11	13	15	
28-Sep-92	13	11	9	12	13	
29-Sep-92	13	11	8	13	12	
30-Sep-92	13	11	8	13	12	
1-Oct-92	13	11	9	13	12	
2-Oct-92	12	11	9	12	12	
3-Oct-92	11	10	9	11	10	
4-Oct-92	9	8	8	9	9	
5-Oct-92	9	8	8	10	8	
6-Oct-92	10	9	8	11	8	
7-Oct-92	11	9	8	12	9	
8-Oct-92	11	10	7	12	9	
9-Oct-92	9	8	6	9	8	
10-Oct-92	9	8	5	9	8	
11-Oct-92	9	7	5	8	7	
12-Oct-92	9	7	4	8	7	
13-Oct-92	8	6	4	7	7	
14-Oct-92	8	7	4	8	7	
15-Oct-92	19	42	80	113	7	
16-Oct-92	75	124	136	133	57	
17-Oct-92	88	107	103	105	86	
18-Oct-92	68	64	63	67	75	
19-Oct-92	51	44	41	46	56	
20-Oct-92	40	35	28	34	43	
21-Oct-92	30	24	20	24	32	
22-Oct-92	26	21	17	21	27	
23-Oct-92	23	20	15	21	25	
24-Oct-92	19	17	13	15	20	
25-Oct-92	17	15	12	15	18	

Date	Lysimeter 1 (mm)	Lysimeter 2 (mm)	Lysimeter 3 (mm)	Lysimeter 4 (mm)	Lysimeter 5 (mm)	Lysimeters Changed
26-Oct-92	15	14	11	12	16	
27-Oct-92	14	12	10	12	14	
28-Oct-92	13	12	9	11	14	
29-Oct-92	11	10	8	9	12	
30-Oct-92	11	10	8	9	11	
31-Oct-92	10	9	7	8	10	
1-Nov-92	11	10	8	11	10	
2-Nov-92	14	13	16	12	11	
3-Nov-92	52	98	87	81	25	
4-Nov-92	66	74	65	68	64	
5-Nov-92	56	50	45	48	57	
6-Nov-92	43	35	31	36	44	
7-Nov-92	35	29	24	31	37	
8-Nov-92	29	24	19	25	30	
9-Nov-92	24	20	15	21	26	
10-Nov-92	21	18	13	19	23	
11-Nov-92	18	16	12	16	19	
12-Nov-92	18	17	17	16	19	
13-Nov-92	82	144	160	93	87	
14-Nov-92	103	98	100	80	121	
15-Nov-92	70	59	57	58	79	
16-Nov-92	51	43	38	44	58	
17-Nov-92	38	32	27	31	43	
18-Nov-92	31	26	22	26	34	
19-Nov-92	27	22	19	23	29	
20-Nov-92	25	21	18	22	27	
21-Nov-92	21	19	18	18	23	
22-Nov-92	21	20	18	21	22	
23-Nov-92	17	16	15	14	27	
24-Nov-92	20	21	17	18	29	
25-Nov-92	25	38	26	27	28	
26-Nov-92	30	34	30	28	31	
27-Nov-92	30	29	26	27	32	
28-Nov-92	27	25	22	24	30	
29-Nov-92	24	21	18	22	27	
30-Nov-92	21	20	16	19	24	
1-Dec-92	19	17	14	17	21	
2-Dec-92	17	15	12	13	19	
3-Dec-92	15	12	10	13	16	
4-Dec-92	14	13	9	13	16	

Date	Lysimeter 1 (mm)	Lysimeter 2 (mm)	Lysimeter 3 (mm)	Lysimeter 4 (mm)	Lysimeter 5 (mm)	Lysimeters Changed
5-Dec-92	12	10	7	10	13	
6-Dec-92	13	11	8	12	14	
7-Dec-92	11	10	6	9	12	
8-Dec-92	10	9	6	8	11	
9-Dec-92	11	10	6	11	11	
10-Dec-92	10	10	6	9	11	
11-Dec-92	8	7	4	6	9	
12-Dec-92	8	7	5	6	8	
13-Dec-92	8	7	5	7	8	
14-Dec-92	8	7	5	8	8	
15-Dec-92	9	9	6	10	9	
16-Dec-92	7	7	6	4	18	
17-Dec-92	14	16	13	7	17	
18-Dec-92	18	27	24	17	15	
19-Dec-92	25	30	27	21	22	
20-Dec-92	26	24	24	19	27	
21-Dec-92	27	24	23	22	30	
22-Dec-92	23	20	19	19	26	
23-Dec-92	20	17	16	15	22	
24-Dec-92	18	15	15	16	19	
25-Dec-92	17	16	13	14	19	
26-Dec-92	14	11	11	11	15	
27-Dec-92	14	12	11	13	15	
28-Dec-92	12	11	9	10	13	
29-Dec-92	13	11	10	12	14	
30-Dec-92	12	11	13	11	13	
31-Dec-92	0	0	0	0	0	all
1-Jan-93	127	116	121	101	122	
2-Jan-93	79	65	66	67	82	
3-Jan-93	55	45	42	46	58	
4-Jan-93	118	104	158	97	101	
5-Jan-93	183	193	189	154	188	
6-Jan-93	112	113	106	100	128	
7-Jan-93	70	66	62	64	82	
8-Jan-93	47	44	40	44	56	
9-Jan-93	38	33	29	33	43	
10-Jan-93	32	27	23	27	35	
11-Jan-93	26	22	18	23	29	
12-Jan-93	23	21	16	22	26	
13-Jan-93	19	18	12	16	22	

Date	Lysimeter 1 (mm)	Lysimeter 2 (mm)	Lysimeter 3 (mm)	Lysimeter 4 (mm)	Lysimeter 5 (mm)	Lysimeters Changed
14-Jan-93	16	14	10	14	18	
15-Jan-93	15	14	10	14	16	
16-Jan-93	15	13	10	14	16	
17-Jan-93	12	11	7	9	14	
18-Jan-93	11	9	6	8	11	
19-Jan-93	10	9	6	9	11	
20-Jan-93	11	10	7	11	11	
21-Jan-93	11	10	6	10	12	
22-Jan-93	9	8	12	8	11	
23-Jan-93	9	11	17	23	23	
24-Jan-93	10	16	17	26	27	
25-Jan-93	18	29	25	41	30	
26-Jan-93	33	40	29	45	43	
27-Jan-93	35	34	26	35	45	
28-Jan-93	34	29	24	30	40	
29-Jan-93	28	21	20	23	31	
30-Jan-93	27	22	20	25	30	
31-Jan-93	23	19	17	20	25	
1-Feb-93	17	13	14	13	19	
2-Feb-93	17	14	14	15	18	
3-Feb-93	15	13	12	13	17	
4-Feb-93	13	11	11	12	15	
5-Feb-93	13	12	10	13	15	
6-Feb-93	12	10	9	10	13	
7-Feb-93	12	10	8	11	13	
8-Feb-93	9	8	7	8	10	
9-Feb-93	10	9	7	9	10	
10-Feb-93	9	8	6	7	9	
11-Feb-93	9	8	6	8	9	
12-Feb-93	9	9	6	9	9	
13-Feb-93	8	7	5	6	8	
14-Feb-93	7	6	4	5	7	
15-Feb-93	7	6	4	6	7	
16-Feb-93	7	7	4	6	7	
17-Feb-93	6	6	4	6	6	
18-Feb-93	6	6	4	6	6	
19-Feb-93	7	6	4	6	6	
20-Feb-93	6	6	3	6	6	
21-Feb-93	7	7	4	8	7	
22-Feb-93	4	5	2	2	5	

Date	Lysimeter 1 (mm)	Lysimeter 2 (mm)	Lysimeter 3 (mm)	Lysimeter 4 (mm)	Lysimeter 5 (mm)	Lysimeters Changed
23-Feb-93	4	4	2	3	5	
24-Feb-93	4	3	2	3	4	
25-Feb-93	5	4	2	5	4	
26-Feb-93	4	4	2	3	4	
27-Feb-93	5	4	2	4	4	
28-Feb-93	5	4	2	5	4	
1-Mar-93	5	5	2	5	5	
2-Mar-93	4	5	2	4	4	
3-Mar-93	4	4	2	3	4	
4-Mar-93	4	4	2	4	4	
5-Mar-93	3	4	1	2	4	
6-Mar-93	4	3	1	3	5	
7-Mar-93	4	4	2	5	4	5
8-Mar-93	2	3	1	2	2	5
9-Mar-93	9	3	1	2	4	5
10-Mar-93	11	4	2	4	5	5
11-Mar-93	9	3	0	1	3	5
12-Mar-93	9	3	1	3	4	5
13-Mar-93	9	4	2	5	5	5
14-Mar-93	6	3	1	2	3	5
15-Mar-93	7	3	1	5	4	5
16-Mar-93	6	3	1	4	3	5
17-Mar-93	1	2	7	1	3	5
18-Mar-93	0	3	24	4	8	5
19-Mar-93	3	4	21	7	9	5
20-Mar-93	6	4	109	6	31	5
21-Mar-93	5	4	84	5	25	5
22-Mar-93	5	4	118	6	33	5
23-Mar-93	6	6	6	6	6	1,3,5,
24-Mar-93	4	3	4	4	4	1,3,5,
25-Mar-93	9	3	9	15	9	1,3,5,
26-Mar-93	20	3	20	37	20	1,3,5,
27-Mar-93	22	4	22	41	22	1,3,5,
28-Mar-93	23	4	23	43	23	1,3,5,
29-Mar-93	20	4	20	36	20	1,3,5,
30-Mar-93	17	3	17	31	17	1,3,5,
31-Mar-93	21	4	16	27	17	3,5,
1-Apr-93	18	4	12	20	13	3,5,
2-Apr-93	17	3	10	18	12	3,5,
3-Apr-93	26	3	16	28	23	3

Date	Lysimeter 1 (mm)	Lysimeter 2 (mm)	Lysimeter 3 (mm)	Lysimeter 4 (mm)	Lysimeter 5 (mm)	Lysimeters Changed
4-Apr-93	34	8	21	34	29	3
5-Apr-93	33	14	23	31	34	3
6-Apr-93	30	16	21	26	31	3
7-Apr-93	26	16	20	24	28	3
8-Apr-93	23	17	19	22	26	3
9-Apr-93	20	16	17	19	23	3
10-Apr-93	18	14	15	16	20	3
11-Apr-93	17	14	15	16	19	3
12-Apr-93	14	12	12	12	15	3
13-Apr-93	14	12	13	13	15	3
14-Apr-93	13	13	13	14	15	3
15-Apr-93	13	13	13	14	14	3
16-Apr-93	10	11	10	9	11	3
17-Apr-93	11	11	10	10	10	3
18-Apr-93	13	14	14	14	11	3
19-Apr-93	16	18	18	17	12	3
20-Apr-93	17	18	16	14	11	3
21-Apr-93	32	51	44	38	13	3
22-Apr-93	0	0	0	0	0	all
23-Apr-93	48	46	46	47	48	3
24-Apr-93	37	35	36	36	42	3
25-Apr-93	29	26	26	26	32	3
26-Apr-93	24	22	22	22	27	3
27-Apr-93	21	20	21	21	25	3
28-Apr-93	20	18	19	19	22	3
29-Apr-93	17	17	17	17	20	3
30-Apr-93	15	14	14	14	17	3
1-May-93	14	13	13	14	16	3
2-May-93	14	13	13	14	15	3
3-May-93	15	18	16	14	14	3
4-May-93	19	24	20	16	13	3
5-May-93	21	22	20	17	13	3
6-May-93	34	62	53	44	15	3
7-May-93	57	64	63	62	34	3
8-May-93	46	46	46	46	46	3
9-May-93	37	35	36	36	41	3
10-May-93	31	30	31	31	35	3
11-May-93	27	26	23	27	30	
12-May-93	24	23	20	24	27	
13-May-93	20	19	17	21	22	

Date	Lysimeter 1 (mm)	Lysimeter 2 (mm)	Lysimeter 3 (mm)	Lysimeter 4 (mm)	Lysimeter 5 (mm)	Lysimeters Changed
14-May-93	20	19	16	21	22	
15-May-93	17	15	13	16	18	
16-May-93	17	14	12	15	16	
17-May-93	17	14	11	16	16	
18-May-93	16	14	10	15	16	
19-May-93	15	12	8	13	14	
20-May-93	15	11	7	12	1	
21-May-93	13	10	6	11	10	5'
22-May-93	13	10	6	11	10	5'
23-May-93	13	10	6	12	10	5'
24-May-93	11	9	5	8	8	5'
25-May-93	10	7	4	7	7	5'
26-May-93	10	7	4	9	8	5'
27-May-93	10	8	4	9	8	5'
28-May-93	9	7	4	7	7	5'
29-May-93	9	7	4	7	6	5'
30-May-93	10	8	5	11	8	5'
31-May-93	8	7	3	5	6	5'
1-Jun-93	8	6	3	7	6	5'
2-Jun-93	0	0	0	0	0	all
3-Jun-93	7	6	3	6	6	5'
4-Jun-93	7	6	3	7	6	5'
5-Jun-93	6	5	2	4	4	5'
6-Jun-93	6	5	3	6	5	5'
7-Jun-93	7	5	3	7	5	5'
8-Jun-93	42	55	210	78	96	5'
9-Jun-93	237	212	275	223	237	5,1
10-Jun-93	127	136	124	121	127	5,1
11-Jun-93	71	74	65	73	71	5,1
12-Jun-93	48	50	42	52	48	5,1
13-Jun-93	45	37	30	39	38	5'
14-Jun-93	37	30	24	32	31	5'
15-Jun-93	31	27	19	28	56	
16-Jun-93	27	28	20	29	58	
17-Jun-93	27	25	21	28	25	
18-Jun-93	28	22	21	24	24	5
19-Jun-93	28	21	21	23	23	5
20-Jun-93	27	20	19	21	22	5
21-Jun-93	25	18	18	19	20	5
22-Jun-93	23	17	15	18	18	5

Date	Lysimeter 1 (mm)	Lysimeter 2 (mm)	Lysimeter 3 (mm)	Lysimeter 4 (mm)	Lysimeter 5 (mm)	Lysimeters Changed
23-Jun-93	21	15	13	17	17	5
24-Jun-93	20	15	11	16	16	5
25-Jun-93	18	14	10	15	14	5
26-Jun-93	17	13	9	15	13	5
27-Jun-93	15	13	8	13	12	5
28-Jun-93	14	11	7	12	11	5
29-Jun-93	13	10	6	11	10	5
30-Jun-93	12	10	6	11	10	5
1-Jul-93	12	9	6	10	9	5
2-Jul-93	11	9	5	10	9	5
3-Jul-93	10	9	4	9	8	5
4-Jul-93	10	8	4	8	8	5
5-Jul-93	10	8	4	9	8	5
6-Jul-93	9	7	3	7	7	5
7-Jul-93	9	7	4	7	7	5
8-Jul-93	8	7	3	7	6	5
9-Jul-93	8	7	3	7	6	5
10-Jul-93	8	6	3	7	6	5
11-Jul-93	8	7	3	7	6	5
12-Jul-93	7	6	2	6	5	5
13-Jul-93	7	6	3	6	5	5
14-Jul-93	6	6	2	5	5	5
15-Jul-93	7	5	2	6	5	5
16-Jul-93	7	6	2	6	5	5
17-Jul-93	6	5	2	6	5	5
18-Jul-93	6	6	2	6	5	5
19-Jul-93	5	5	2	6	5	5
20-Jul-93	6	5	2	6	5	5
21-Jul-93	5	5	2	6	5	5
22-Jul-93	5	5	2	7	5	5
23-Jul-93	0	0	0	0	0	all
24-Jul-93	5	5	2	7	5	
25-Jul-93	5	5	2	7	5	
26-Jul-93	4	5	2	6	4	
27-Jul-93	5	4	2	6	4	
28-Jul-93	4	4	2	6	4	
29-Jul-93	4	4	1	5	4	
30-Jul-93	4	3	1	5	4	
31-Jul-93	5	4	2	6	4	
1-Aug-93	5	4	2	7	4	

Date	Lysimeter 1 (mm)	Lysimeter 2 (mm)	Lysimeter 3 (mm)	Lysimeter 4 (mm)	Lysimeter 5 (mm)	Lysimeters Changed
2-Aug-93	3	4	1	4	4	
3-Aug-93	4	3	1	4	2	
4-Aug-93	3	3	1	4	3	
5-Aug-93	5	3	1	5	3	
6-Aug-93	4	4	1	5	4	
7-Aug-93	3	3	1	3	3	
8-Aug-93	3	3	1	4	3	
9-Aug-93	4	3	1	5	3	
10-Aug-93	3	3	1	4	3	
11-Aug-93	3	3	1	4	3	
12-Aug-93	3	3	1	4	3	
13-Aug-93	3	3	1	3	3	
14-Aug-93	2	2	1	3	2	
15-Aug-93	2	3	1	4	3	
16-Aug-93	2	3	1	3	3	
17-Aug-93	1	2	1	3	2	
18-Aug-93	3	2	1	4	2	
19-Aug-93	3	3	1	4	3	
20-Aug-93	3	3	1	3	2	
21-Aug-93	3	2	0	3	2	
22-Aug-93	3	2	1	4	2	
23-Aug-93	3	3	1	4	2	
24-Aug-93	1	2	5	3	1	
25-Aug-93	0	0	0	0	0	all
26-Aug-93	3	3	3	6	1	
27-Aug-93	2	4	2	7	1	
28-Aug-93	2	4	3	7	1	
29-Aug-93	3	7	3	12	1	
30-Aug-93	3	14	18	32	1	
31-Aug-93	3	19	29	53	2	
1-Sep-93	5	30	48	63	2	
2-Sep-93	16	72	165	131	6	
3-Sep-93	122	194	247	234	67	
4-Sep-93	81	101	90	96	73	
5-Sep-93	59	59	50	58	52	
6-Sep-93	41	41	31	40	40	
7-Sep-93	33	32	22	32	32	
8-Sep-93	28	27	18	27	27	
9-Sep-93	23	23	18	24	24	
10-Sep-93	18	18	16	18	19	

Date	Lysimeter 1 (mm)	Lysimeter 2 (mm)	Lysimeter 3 (mm)	Lysimeter 4 (mm)	Lysimeter 5 (mm)	Lysimeters Changed
11-Sep-93	17	18	16	20	19	
12-Sep-93	16	18	13	18	18	
13-Sep-93	14	15	11	16	16	
14-Sep-93	13	15	9	15	15	
15-Sep-93	12	77	110	82	17	
16-Sep-93	47	108	102	106	60	

APPENDIX B

Appendix B.

Daily Precipitation and Irrigation

Date	Pioneer CR-10 (mm)	Pioneer Manual (mm)	3rivers (mm)	Irrigation (mm)	total daily mm
6/23/89					0
6/24/89					0
6/25/89					0
6/26/89	7				7
6/27/89					0
6/28/89					0
6/29/89					0
6/30/89					0
7/1/89					0
7/2/89					0
7/3/89					0
7/4/89					0
7/5/89					0
7/6/89					0
7/7/89					0
7/8/89					0
7/9/89	25				25
7/10/89					0
7/11/89					0
7/12/89					0
7/13/89					0
7/14/89					0
7/15/89					0
7/16/89					0
7/17/89					0
7/18/89					0
7/19/89	8			2	9
7/20/89	3				3
7/21/89	1				1
7/22/89				21	21
7/23/89					0
7/24/89					0
7/25/89	0				0
7/26/89	3			26	28

Date	Pioneer CR-10 (mm)	Pioneer Manual (mm)	3rivers (mm)	Irrigation (mm)	total daily mm
7/27/89				1	1
7/28/89					0
7/29/89					0
7/30/89	8				8
7/31/89					0
8/1/89					0
8/2/89				33	33
8/3/89					0
8/4/89	4				4
8/5/89	25				25
8/6/89					0
8/7/89					0
8/8/89					0
8/9/89					0
8/10/89					0
8/11/89	2				2
8/12/89	4				4
8/13/89	0				0
8/14/89					0
8/15/89	0				0
8/16/89					0
8/17/89					0
8/18/89					0
8/19/89					0
8/20/89	20				20
8/21/89					0
8/22/89	2				2
8/23/89					0
8/24/89					0
8/25/89					0
8/26/89					0
8/27/89					0
8/28/89					0
8/29/89					0
8/30/89					0
8/31/89					0
9/1/89					0
9/2/89					0
9/3/89					0
9/4/89					0
9/5/89					0
9/6/89	11				11
9/7/89	9				9
9/8/89	8				8

Date	Pioneer CR-10 (mm)	Pioneer Manual (mm)	3rivers (mm)	Irrigation (mm)	total daily mm
9/9/89	7				7
9/10/89					0
9/11/89					0
9/12/89	10				10
9/13/89	6				6
9/14/89	9				9
9/15/89	0				0
9/16/89	0				0
9/17/89					0
9/18/89					0
9/19/89					0
9/20/89					0
9/21/89					0
9/22/89					0
9/23/89					0
9/24/89					0
9/25/89					0
9/26/89					0
9/27/89					0
9/28/89					0
9/29/89					0
9/30/89					0
10/1/89					0
10/2/89					0
10/3/89					0
10/4/89					0
10/5/89					0
10/6/89					0
10/7/89					0
10/8/89					0
10/9/89					0
10/10/89					0
10/11/89					0
10/12/89					0
10/13/89					0
10/14/89					0
10/15/89					0
10/16/89					0
10/17/89					0
10/18/89					0
10/19/89					0
10/20/89					0
10/21/89					0
10/22/89					0

Date	Pioneer CR-10 (mm)	Pioneer Manual (mm)	3rivers (mm)	Irrigation (mm)	total daily mm
10/23/89					0
10/24/89					0
10/25/89					0
10/26/89					0
10/27/89					0
10/28/89					0
10/29/89					0
10/30/89					0
10/31/89	2			90	92
11/1/89					0
11/2/89					0
11/3/89	1				1
11/4/89					0
11/5/89	3				3
11/6/89					0
11/7/89	13				13
11/8/89	0				0
11/9/89	1				1
11/10/89	1				1
11/11/89					0
11/12/89					0
11/13/89					0
11/14/89	8				8
11/15/89	21				21
11/16/89	1				1
11/17/89					0
11/18/89					0
11/19/89	4				4
11/20/89					0
11/21/89					0
11/22/89					0
11/23/89					0
11/24/89					0
11/25/89					0
11/26/89					0
11/27/89	10				10
11/28/89					0
11/29/89					0
11/30/89					0
12/1/89					0
12/2/89	0				0
12/3/89			3		0
12/4/89			0		0
12/5/89	0		0		0

Date	Pioneer CR-10 (mm)	Pioneer Manual (mm)	3rivers (mm)	Irrigation (mm)	total daily mm
12/6/89			0		0
12/7/89			0		0
12/8/89			0		0
12/9/89			0		0
12/10/89			0		0
12/11/89			1		0
12/12/89			0		0
12/13/89			0		0
12/14/89			1		0
12/15/89			0		0
12/16/89			0		0
12/17/89			0		0
12/18/89			0		0
12/19/89			2		0
12/20/89			2		0
12/21/89			1		0
12/22/89			1		0
12/23/89			0		0
12/24/89			0		0
12/25/89			0		0
12/26/89			2		0
12/27/89			0		0
12/28/89			1		0
12/29/89			0		0
12/30/89			1		0
12/31/89	6		9		6
1/1/90	5		0		5
1/2/90			0		0
1/3/90	7		0		7
1/4/90	4		9		4
1/5/90	1		3		1
1/6/90	1		0		1
1/7/90	39		0		39
1/8/90	1		0		1
1/9/90			1		0
1/10/90			5		0
1/11/90			0		0
1/12/90			1		0
1/13/90			0		0
1/14/90	8		0		8
1/15/90			0		0
1/16/90			1		0
1/17/90			2		0
1/18/90			7		0

Date	Pioneer CR-10 (mm)	Pioneer Manual (mm)	3rivers (mm)	Irrigation (mm)	total daily mm
1/19/90			0		0
1/20/90			0		0
1/21/90			5		0
1/22/90			0		0
1/23/90			0		0
1/24/90			0		0
1/25/90			10		0
1/26/90			11		0
1/27/90			0		0
1/28/90			0		0
1/29/90			0		0
1/30/90			0		0
1/31/90			0		0
2/1/90			2		0
2/2/90			14		0
2/3/90			0		0
2/4/90			0		0
2/5/90			0		0
2/6/90			0		0
2/7/90			0		0
2/8/90			0		0
2/9/90	1		2		1
2/10/90	0		0		0
2/11/90			0		0
2/12/90			0		0
2/13/90			0		0
2/14/90			0		0
2/15/90			30		0
2/16/90	1		4		1
2/17/90	2		0		2
2/18/90	2		0		2
2/19/90			0		0
2/20/90			0		0
2/21/90	8		0		8
2/22/90	58		12		58
2/22/90	3		34		3
2/22/90			4		0
2/22/90			4		0
2/22/90			0		0
2/22/90	3		0		3
2/22/90			0		0
3/1/90			0		0
3/2/90			0		0
3/3/90			0		0

Date	Pioneer CR-10 (mm)	Pioneer Manual (mm)	3rivers (mm)	Irrigation (mm)	total daily mm
3/4/90			0		0
3/5/90			0		0
3/6/90			6		0
3/7/90			0		0
3/8/90	13		0		13
3/9/90	1		15		1
3/10/90	10		6		10
3/11/90	2		11		2
3/12/90			5		0
3/13/90			0		0
3/14/90			0		0
3/15/90	2		0		2
3/16/90			0		0
3/17/90	0		0		0
3/18/90	2		1		2
3/19/90			2		0
3/20/90			0		0
3/21/90			0		0
3/22/90	10		0		10
3/23/90			12		0
3/24/90			0		0
3/25/90			0		0
3/26/90			0		0
3/27/90			0		0
3/28/90			0		0
3/29/90	13				13
3/30/90	1				1
3/31/90	3				3
4/1/90	6				6
4/2/90					0
4/3/90					0
4/4/90	7				7
4/5/90	1				1
4/6/90					0
4/7/90					0
4/8/90	1				1
4/9/90	7				7
4/10/90	17				17
4/11/90	2				2
4/12/90					0
4/13/90	2				2
4/14/90	7				7
4/15/90					0
4/16/90	1				1

Date	Pioneer CR-10 (mm)	Pioneer Manual (mm)	3rivers (mm)	Irrigation (mm)	total daily mm
4/17/90	0				0
4/18/90					0
4/19/90					0
4/20/90	16				16
4/21/90	0				0
4/22/90					0
4/23/90					0
4/24/90					0
4/25/90					0
4/26/90					0
4/27/90					0
4/28/90	1				1
4/29/90					0
4/30/90					0
5/1/90					0
5/2/90					0
5/3/90	1				1
5/4/90	18				18
5/5/90					0
5/6/90					0
5/7/90					0
5/8/90					0
5/9/90					0
5/10/90	16				16
5/11/90					0
5/12/90	12				12
5/13/90	21				21
5/14/90	0				0
5/15/90	2				2
5/16/90	7				7
5/17/90					0
5/18/90					0
5/19/90					0
5/20/90					0
5/21/90	0				0
5/22/90					0
5/23/90					0
5/24/90					0
5/25/90	11				11
5/26/90					0
5/27/90					0
5/28/90					0
5/29/90					0
5/30/90					0

Date	Pioneer CR-10 (mm)	Pioneer Manual (mm)	3rivers (mm)	Irrigation (mm)	total daily mm
5/31/90					0
6/1/90					0
6/2/90	3				3
6/3/90	1				1
6/4/90					0
6/5/90					0
6/6/90					0
6/7/90					0
6/8/90	11				11
6/9/90					0
6/10/90					0
6/11/90					0
6/12/90					0
6/13/90					0
6/14/90	3				3
6/15/90					0
6/16/90					0
6/17/90					0
6/18/90					0
6/19/90					0
6/20/90	8				8
6/21/90					0
6/22/90	5				5
6/23/90	3				3
6/24/90					0
6/25/90					0
6/26/90	1				1
6/27/90	0				0
6/28/90	11				11
6/29/90	8				8
6/30/90					0
7/1/90					0
7/2/90					0
7/3/90	0				0
7/4/90					0
7/5/90					0
7/6/90					0
7/7/90					0
7/8/90					0
7/9/90				18	18
7/10/90	0				0
7/11/90	16				16
7/12/90					0
7/13/90	1				1

Date	Pioneer CR-10 (mm)	Pioneer Manual (mm)	3rivers (mm)	Irrigation (mm)	total daily mm
7/14/90	2				2
7/15/90	0				0
7/16/90	16				16
7/17/90					0
7/18/90	3				3
7/19/90	5				5
7/20/90	19				19
7/21/90	0				0
7/22/90	27				27
7/23/90					0
7/24/90					0
7/25/90					0
7/26/90					0
7/27/90					0
7/28/90					0
7/29/90				22	22
7/30/90					0
7/31/90					0
8/1/90					0
8/2/90					0
8/3/90					0
8/4/90	15				15
8/5/90					0
8/6/90					0
8/7/90					0
8/8/90				22	22
8/9/90					0
8/10/90					0
8/11/90	8				8
8/12/90	16				16
8/13/90	4				4
8/14/90					0
8/15/90					0
8/16/90					0
8/17/90					0
8/18/90	2				2
8/19/90	0				0
8/20/90	22				22
8/21/90	6				6
8/22/90					0
8/23/90					0
8/24/90					0
8/25/90					0
8/26/90					0

Date	Pioneer CR-10 (mm)	Pioneer Manual (mm)	3rivers (mm)	Irrigation (mm)	total daily mm
8/27/90	0				0
8/28/90	1				1
8/29/90					0
8/30/90					0
8/31/90					0
9/1/90					0
9/2/90					0
9/3/90					0
9/4/90	1				1
9/5/90					0
9/6/90	3				3
9/7/90	26				26
9/8/90					0
9/9/90					0
9/10/90					0
9/11/90					0
9/12/90					0
9/13/90					0
9/14/90	17				17
9/15/90					0
9/16/90	11				11
9/17/90	0				0
9/18/90	2				2
9/19/90	4				4
9/20/90					0
9/21/90	18				18
9/22/90	2				2
9/23/90	1				1
9/24/90					0
9/25/90					0
9/26/90					0
9/27/90					0
9/28/90	1				1
9/29/90					0
9/30/90	2				2
10/1/90					0
10/2/90	0				0
10/3/90	30				30
10/4/90					0
10/5/90					0
10/6/90					0
10/7/90	1				1
10/8/90	8				8
10/9/90	46				46

Date	Pioneer CR-10 (mm)	Pioneer Manual (mm)	3rivers (mm)	Irrigation (mm)	total daily mm
10/10/90	0				0
10/11/90					0
10/12/90					0
10/13/90					0
10/14/90					0
10/15/90					0
10/16/90					0
10/17/90					0
10/18/90					0
10/19/90					0
10/20/90					0
10/21/90					0
10/22/90					0
10/23/90					0
10/24/90					0
10/25/90					0
10/26/90					0
10/27/90					0
10/28/90					0
10/29/90					0
10/30/90					0
10/31/90					0
11/1/90					0
11/2/90					0
11/3/90					0
11/4/90	14				14
11/5/90	34				34
11/6/90					0
11/7/90					0
11/8/90					0
11/9/90					0
11/10/90	0				0
11/11/90					0
11/12/90					0
11/13/90					0
11/14/90					0
11/15/90					0
11/16/90					0
11/17/90					0
11/18/90					0
11/19/90					0
11/20/90					0
11/21/90	1				1
11/22/90	6				6

Date	Pioneer CR-10 (mm)	Pioneer Manual (mm)	3rivers (mm)	Irrigation (mm)	total daily mm
11/23/90	1				1
11/24/90					0
11/25/90					0
11/26/90	1				1
11/27/90	59				59
11/28/90	13				13
11/29/90					0
11/30/90					0
12/1/90					0
12/2/90					0
12/3/90	12				12
12/4/90					0
12/5/90					0
12/6/90					0
12/7/90					0
12/8/90					0
12/9/90					0
12/10/90					0
12/11/90					0
12/12/90					0
12/13/90					0
12/14/90					0
12/15/90					0
12/16/90					0
12/17/90					0
12/18/90					0
12/19/90					0
12/20/90					0
12/21/90	6				6
12/22/90					0
12/23/90					0
12/24/90					0
12/25/90					0
12/26/90					0
12/27/90					0
12/28/90					0
12/29/90	76				76
12/30/90	0				0
12/31/90					0
1/1/91					0
1/2/91	0				0
1/3/91			0		0
1/4/91					0
1/5/91					0

Date	Pioneer CR-10 (mm)	Pioneer Manual (mm)	3rivers (mm)	Irrigation (mm)	total daily mm
1/6/91	0		6		6
1/7/91					0
1/8/91	7				0
1/9/91			0		0
1/10/91			0		0
1/11/91			4		4
1/12/91			11		11
1/13/91			1		1
1/14/91			0		0
1/15/91			0		0
1/16/91			5		5
1/17/91			4		4
1/18/91			0		0
1/19/91			0		0
1/20/91			0		0
1/21/91			1		1
1/22/91			0		0
1/23/91			0		0
1/24/91			0		0
1/25/91			0		0
1/26/91			0		0
1/27/91			0		0
1/28/91			0		0
1/29/91			0		0
1/30/91			2		2
1/31/91			1		1
2/1/91			0		0
2/2/91			0		0
2/3/91			0		0
2/4/91			0		0
2/5/91			0		0
2/6/91			0		0
2/7/91			0		0
2/8/91			0		0
2/9/91			0		0
2/10/91			0		0
2/11/91			0		0
2/12/91			0		0
2/13/91			0		0
2/14/91			9		9
2/15/91			2		2
2/16/91			1		1
2/17/91			0		0
2/18/91			0		0

Date	Pioneer CR-10 (mm)	Pioneer Manual (mm)	3rivers (mm)	Irrigation (mm)	total daily mm
2/19/91			4		4
2/20/91			0		0
2/21/91			0		0
2/22/91			0		0
2/23/91			0		0
2/24/91			0		0
2/25/91			0		0
2/26/91			0		0
2/27/91			1		1
2/28/91			2		2
3/1/91			0		0
3/2/91			7		7
3/3/91			2		2
3/4/91			0		0
3/5/91			0		0
3/6/91			2		2
3/7/91			1		1
3/8/91			0		0
3/9/91			0		0
3/10/91			2		2
3/11/91			0		0
3/12/91			0		0
3/13/91			0		0
3/14/91			0		0
3/15/91			0		0
3/16/91			0		0
3/17/91			0		0
3/18/91			13		13
3/19/91			0		0
3/20/91			0		0
3/21/91			0		0
3/22/91			0		0
3/23/91			4		4
3/24/91			3		3
3/25/91			0		0
3/26/91			0		0
3/27/91			9		9
3/28/91			26		26
3/29/91			2		2
3/30/91			0		0
3/31/91			0		0
4/1/91			3		3
4/2/91			0		0
4/3/91			0		0

Date	Pioneer CR-10 (mm)	Pioneer Manual (mm)	3rivers (mm)	Irrigation (mm)	total daily mm
4/4/91	7		0		0
4/5/91	1		12		12
4/6/91			0		0
4/7/91			0		0
4/8/91					
4/9/91	53		1		1
4/10/91			5		5
4/11/91			0		0
4/12/91			0		0
4/13/91	2		1		1
4/14/91	15		8		8
4/15/91	28		29		29
4/16/91	4		10		10
4/17/91			1		1
4/18/91			0		0
4/19/91	20		0		0
4/20/91			25		25
4/21/91			0		0
4/22/91					
4/23/91	10		0		0
4/24/91	9		24		24
4/25/91	0		0		0
4/26/91					
4/27/91	13		0		0
4/28/91	1		13		13
4/29/91	3		1		1
4/30/91			2		2
5/1/91	4		2		2
5/2/91			3		3
5/3/91			0		0
5/4/91			0		0
5/5/91	7		0		0
5/6/91	0		6		6
5/7/91			0		0
5/8/91	3		2		2
5/9/91					
5/10/91					
5/11/91					
5/12/91					
5/13/91					
5/14/91					
5/15/91			0		0
5/16/91	24		0		0
5/17/91	0		19		19

Date	Pioneer CR-10 (mm)	Pioneer Manual (mm)	3rivers (mm)	Irrigation (mm)	total daily mm
5/18/91	0		0		0
5/19/91	0		0		0
5/20/91	0		0		0
5/21/91	0		0		0
5/22/91	0		0		0
5/23/91		1	0		1
5/24/91		11	1		11
5/25/91		8	34		8
5/26/91			0		0
5/27/91			0		0
5/28/91			0		0
5/29/91			0		0
5/30/91		5	0		5
5/31/91		27	4		27
6/1/91		0	26		0
6/2/91			0		0
6/3/91			0		0
6/4/91			0		0
6/5/91			0		0
6/6/91			0		0
6/7/91			0		0
6/8/91			0		0
6/9/91			0		0
6/10/91			0		0
6/11/91		13	0		13
6/12/91			11		0
6/13/91			0		0
6/14/91			0		0
6/15/91		2	0		2
6/16/91			8		0
6/17/91			0		0
6/18/91			0		0
6/19/91			0		0
6/20/91			0		0
6/21/91			0		0
6/22/91		1	0		1
6/23/91			1		0
6/24/91			0		0
6/25/91			0		0
6/26/91			0		0
6/27/91			0		0
6/28/91			0		0
6/29/91			0		0
6/30/91		55	0		55

Date	Pioneer CR-10 (mm)	Pioneer Manual (mm)	3rivers (mm)	Irrigation (mm)	total daily mm
7/1/91		42	39		42
7/2/91		0	71		0
7/3/91		4	0		4
7/4/91			12		12
7/5/91			0		0
7/6/91			0		0
7/7/91			0		0
7/8/91			7		7
7/9/91			0		0
7/10/91			0		0
7/11/91			0		0
7/12/91			0		0
7/13/91			0		0
7/14/91			0		0
7/15/91			0		0
7/16/91			0		0
7/17/91			0		0
7/18/91			0		0
7/19/91			0		0
7/20/91			0		0
7/21/91			0		0
7/22/91			37		37
7/23/91			1		1
7/24/91			0		0
7/25/91			0		0
7/26/91			0		0
7/27/91			0	29	29
7/28/91			0		0
7/29/91	1		1		1
7/30/91			4		4
7/31/91			0		0
8/1/91			0		0
8/2/91	1		0		0
8/3/91	17		17		17
8/4/91			0		0
8/5/91			0		0
8/6/91			0		0
8/7/91			0		0
8/8/91	42		1		1
8/9/91			38		38
8/10/91			0		0
8/11/91			0		0
8/12/91			0		0
8/13/91			0		0

Date	Pioneer CR-10 (mm)	Pioneer Manual (mm)	3rivers (mm)	Irrigation (mm)	total daily mm
8/14/91			0		0
8/15/91			0		0
8/16/91			0		0
8/17/91	10		3		3
8/18/91	10		2		2
8/19/91	43		6		6
8/20/91			26		26
8/21/91			0		0
8/22/91	0		0		0
8/23/91			0		0
8/24/91			0		0
8/25/91			0		0
8/26/91			0		0
8/27/91			0		0
8/28/91			0		0
8/29/91	0		0		0
8/30/91			0		0
8/31/91			1		1
9/1/91			0		0
9/2/91			0		0
9/3/91	26		0		0
9/4/91	0		28		28
9/5/91			0		0
9/6/91			0		0
9/7/91			0		0
9/8/91			0		0
9/9/91	6		5		5
9/10/91	3		1		1
9/11/91			0		0
9/12/91	29		10		10
9/13/91			17		17
9/14/91			0		0
9/15/91			5		5
9/16/91			0		0
9/17/91	0		0		0
9/18/91	1		0		0
9/19/91	0		1		1
9/20/91			0		0
9/21/91			0		0
9/22/91	6		0		0
9/23/91	1		7		7
9/24/91			0		0
9/25/91			1		1
9/26/91			3		3

Date	Pioneer CR-10 (mm)	Pioneer Manual (mm)	3rivers (mm)	Irrigation (mm)	total daily mm
9/27/91			0		0
9/28/91			0		0
9/29/91			0		0
9/30/91			0		0
10/1/91			0		0
10/2/91			0		0
10/3/91	0		31		31
10/4/91	15		19		19
10/5/91	3		24		24
10/6/91	3		3		3
10/7/91			3		3
10/8/91			0		0
10/9/91			0		0
10/10/91			0		0
10/11/91	6		2		2
10/12/91	1		4		4
10/13/91			0		0
10/14/91	7		1		1
10/15/91			8		8
10/16/91			0		0
10/17/91			0		0
10/18/91	0		0		0
10/19/91	4		9		9
10/20/91			0		0
10/21/91			0		0
10/22/91			0		0
10/23/91			0		0
10/24/91	14		0		0
10/25/91	38		5		5
10/26/91	17		53		53
10/27/91	0		15		15
10/28/91			0		0
10/29/91			0		0
10/30/91	17		9		9
10/31/91			14		14
11/1/91			0		0
11/2/91	0		8		8
11/3/91			0		0
11/4/91			2		2
11/5/91			0		0
11/6/91			0		0
11/7/91			2		2
11/8/91			0		0
11/9/91	1		0		0

Date	Pioneer CR-10 (mm)	Pioneer Manual (mm)	3rivers (mm)	Irrigation (mm)	total daily mm
11/10/91			0		0
11/11/91			0		0
11/12/91	1		1		1
11/13/91			1		1
11/14/91	3		0		0
11/15/91	4		10		10
11/16/91			2		2
11/17/91	0		0		0
11/18/91	3		2		2
11/19/91			2		2
11/20/91	27		24		24
11/21/91			3		3
11/22/91			1		1
11/23/91	0		0		0
11/24/91			2		2
11/25/91			1		1
11/26/91			0		0
11/27/91	1		3		3
11/28/91	4		0		0
11/29/91	1		10		10
11/30/91	3		4		4
12/1/91			0		0
12/2/91			0		0
12/3/91	2		10		10
12/4/91			4		4
12/5/91			1		1
12/6/91			0		0
12/7/91			0		0
12/8/91			0		0
12/9/91			3		3
12/10/91			0		0
12/11/91			0		0
12/12/91			0		0
12/13/91			11		11
12/14/91			0		0
12/15/91			1		1
12/16/91			2		2
12/17/91			0		0
12/18/91			1		1
12/19/91			0		0
12/20/91			0		0
12/21/91			7		7
12/22/91			0		0
12/23/91			4		4

Date	Pioneer CR-10 (mm)	Pioneer Manual (mm)	3rivers (mm)	Irrigation (mm)	total daily mm
12/24/91			0		0
12/25/91			0		0
12/26/91			0		0
12/27/91			0		0
12/28/91			0		0
12/29/91			6		6
12/30/91			0		0
12/31/91			0		0
1/1/92			0		0
1/2/92			0		0
1/3/92			6		6
1/4/92			0		0
1/5/92			0		0
1/6/92			0		0
1/7/92			0		0
1/8/92	7		0		0
1/9/92			10		10
1/10/92	1		1		1
1/11/92			0		0
1/12/92	0		0		0
1/13/92	1		1		1
1/14/92			9		9
1/15/92			0		0
1/16/92			3		3
1/17/92			0		0
1/18/92			0		0
1/19/92			0		0
1/20/92			0		0
1/21/92			0		0
1/22/92			0		0
1/23/92			0		0
1/24/92			3		3
1/25/92			1		1
1/26/92			2		2
1/27/92			0		0
1/28/92			0		0
1/29/92			0		0
1/30/92			0		0
1/31/92			0		0
2/1/92			0		0
2/2/92			0		0
2/3/92			0		0
2/4/92			0		0
2/5/92			0		0

Date	Pioneer CR-10 (mm)	Pioneer Manual (mm)	3rivers (mm)	Irrigation (mm)	total daily mm
2/6/92			0		0
2/7/92			0		0
2/8/92			1		1
2/9/92			2		2
2/10/92			0		0
2/11/92			0		0
2/12/92			0		0
2/13/92			0		0
2/14/92			0		0
2/15/92			11		11
2/16/92			3		3
2/17/92			0		0
2/18/92			3		3
2/19/92			2		2
2/20/92			0		0
2/21/92			0		0
2/22/92			0		0
2/23/92			1		1
2/24/92			0		0
2/25/92			3		3
2/26/92			0		0
2/27/92			0		0
2/28/92			0		0
2/29/92			1		1
3/1/92			0		0
3/2/92			0		0
3/3/92			0		0
3/4/92			0		0
3/5/92			0		0
3/6/92			4		4
3/7/92			12		12
3/8/92			0		0
3/9/92			0		0
3/10/92			14		14
3/11/92			8		8
3/12/92			0		0
3/13/92			0		0
3/14/92			0		0
3/15/92			0		0
3/16/92			0		0
3/17/92			6		6
3/18/92			0		0
3/19/92			0		0
3/20/92			0		0

Date	Pioneer CR-10 (mm)	Pioneer Manual (mm)	3rivers (mm)	Irrigation (mm)	total daily mm
3/21/92			0		0
3/22/92			17		17
3/23/92			0		0
3/24/92			0		0
3/25/92			0		0
3/26/92			1		1
3/27/92			5		5
3/28/92			0		0
3/29/92			0		0
3/30/92			4		4
3/31/92					
4/1/92					
4/2/92					
4/3/92					
4/4/92					
4/5/92					
4/6/92					
4/7/92					
4/8/92					
4/9/92					
4/10/92					
4/11/92					
4/12/92					
4/13/92					
4/14/92					
4/15/92					
4/16/92					
4/17/92					
4/18/92					
4/19/92					
4/20/92					
4/21/92					
4/22/92					
4/23/92					
4/24/92					
4/25/92					
4/26/92					
4/27/92					
4/28/92					
4/29/92					
4/30/92					
5/1/92					
5/2/92					
5/3/92					0

Date	Pioneer CR-10 (mm)	Pioneer Manual (mm)	3rivers (mm)	Irrigation (mm)	total daily mm
5/4/92		0			0
5/5/92					0
5/6/92					0
5/7/92					0
5/8/92		1			1
5/9/92		1			1
5/10/92					0
5/11/92					0
5/12/92		6			6
5/13/92					0
5/14/92					0
5/15/92					0
5/16/92					0
5/17/92		1			1
5/18/92					0
5/19/92					0
5/20/92					0
5/21/92					0
5/22/92		2			2
5/23/92		7			7
5/24/92					0
5/25/92					0
5/26/92					0
5/27/92					0
5/28/92					0
5/29/92		8			8
5/30/92		19			19
5/31/92					0
6/1/92					0
6/2/92					0
6/3/92					0
6/4/92		3			3
6/5/92					0
6/6/92		14			14
6/7/92					0
6/8/92					0
6/9/92					0
6/10/92					0
6/11/92					0
6/12/92					0
6/13/92					0
6/14/92					0
6/15/92					0
6/16/92					0

Date	Pioneer CR-10 (mm)	Pioneer Manual (mm)	3rivers (mm)	Irrigation (mm)	total daily mm
6/17/92		19			19
6/18/92					0
6/19/92					0
6/20/92					0
6/21/92					0
6/22/92		1			1
6/23/92	4	1			1
6/24/92					0
6/25/92	3	5			5
6/26/92	0				0
6/27/92					0
6/28/92					0
6/29/92					0
6/30/92					0
7/1/92					0
7/2/92	3				0
7/3/92	1				0
7/4/92	3	9			9
7/5/92	0				0
7/6/92					0
7/7/92					0
7/8/92	1	2			2
7/9/92		6			6
7/10/92	5				0
7/11/92					0
7/12/92	0	14			14
7/13/92	34	37			37
7/14/92	17	24			24
7/15/92	5	0			0
7/16/92		10			10
7/17/92		6			6
7/18/92					0
7/19/92					0
7/20/92		3			3
7/21/92	0				0
7/22/92	1	44			44
7/23/92	40	1			1
7/24/92					0
7/25/92	0				0
7/26/92	8	12			12
7/27/92					0
7/28/92					0
7/29/92					0
7/30/92	8	31			31

Date	Pioneer CR-10 (mm)	Pioneer Manual (mm)	3rivers (mm)	Irrigation (mm)	total daily mm
7/31/92	23	12			12
8/1/92					0
8/2/92	0				0
8/3/92					0
8/4/92					0
8/5/92					0
8/6/92		15			15
8/7/92	2				0
8/8/92	10				0
8/9/92					0
8/10/92					0
8/11/92	0				0
8/12/92	5	6			6
8/13/92					0
8/14/92					0
8/15/92					0
8/16/92					0
8/17/92					0
8/18/92	6	8			8
8/19/92	26				0
8/20/92					0
8/21/92				34	34
8/22/92					0
8/23/92					0
8/24/92	4				0
8/25/92					0
8/26/92		6			6
8/27/92	22	29			29
8/28/92	2				0
8/29/92					0
8/30/92					0
8/31/92					0
9/1/92		14			14
9/2/92	6				0
9/3/92	5				0
9/4/92					0
9/5/92		5			5
9/6/92	3				0
9/7/92		8			8
9/8/92	7	56			56
9/9/92	41				0
9/10/92	3				0
9/10/92					0
9/10/92					0

Date	Pioneer CR-10 (mm)	Pioneer Manual (mm)	3rivers (mm)	Irrigation (mm)	total daily mm
9/10/92					0
9/10/92					0
9/10/92	71	81			81
9/10/92					0
9/10/92					0
9/10/92	10	11			11
9/10/92					0
9/20/92		6			6
9/21/92	4	6			6
9/22/92	0				0
9/23/92					0
9/24/92					0
9/25/92					0
9/26/92	6	15			15
9/27/92	6				0
9/28/92					0
9/29/92					0
9/30/92					0
10/1/92					0
10/2/92					0
10/3/92					0
10/4/92					0
10/5/92	0				0
10/6/92					0
10/7/92	0				0
10/8/92	1				1
10/9/92	1				1
10/10/92	1				1
10/11/92					0
10/12/92					0
10/13/92	2				2
10/14/92	46				46
10/15/92	11				11
10/16/92	6				6
10/16/92	0				0
10/16/92	0				0
10/16/92					0
10/16/92	4				4
10/21/92					0
10/22/92					0
10/23/92					0
10/24/92					0
10/25/92					0
10/26/92					0

Date	Pioneer CR-10 (mm)	Pioneer Manual (mm)	3rivers (mm)	Irrigation (mm)	total daily mm
10/27/92					0
10/28/92					0
10/29/92					0
10/30/92					0
10/31/92					0
11/1/92	19				19
11/2/92	21				21
11/3/92	0				0
11/4/92	0				0
11/5/92	1				1
11/6/92	0				0
11/7/92					0
11/8/92	0				0
11/9/92	2				2
11/10/92	4				4
11/11/92	3				3
11/12/92	31				31
11/13/92					0
11/14/92	0				0
11/15/92	0				0
11/16/92	3				3
11/17/92					0
11/18/92					0
11/19/92	1				1
11/20/92					0
11/21/92	2				2
11/22/92	13				13
11/23/92					0
11/24/92					0
11/25/92					0
11/26/92					0
11/27/92					0
11/28/92					0
11/29/92	0				0
11/30/92					0
12/1/92					0
12/2/92	3				3
12/3/92					0
12/4/92					0
12/5/92					0
12/6/92					0
12/7/92					0
12/8/92					0
12/9/92					0

Date	Pioneer CR-10 (mm)	Pioneer Manual (mm)	3rivers (mm)	Irrigation (mm)	total daily mm
12/10/92					0
12/11/92	8				8
12/12/92	1				1
12/13/92	0				0
12/14/92	0				0
12/15/92	3				3
12/16/92					0
12/17/92					0
12/18/92					0
12/19/92	2				2
12/20/92					0
12/21/92	0				0
12/22/92	1				1
12/23/92					0
12/24/92					0
12/25/92					0
12/26/92					0
12/27/92					0
12/28/92					0
12/29/92	8				8
12/30/92	41				41
1/1/93					0
1/2/93					0
1/3/93	5				5
1/4/93	40				40
1/5/93	1				1
1/6/93					0
1/7/93					0
1/8/93					0
1/9/93					0
1/10/93					0
1/11/93					0
1/12/93					0
1/13/93					0
1/14/93	0				0
1/15/93					0
1/16/93					0
1/17/93					0
1/18/93					0
1/19/93					0
1/20/93					0
1/21/93	2				2
1/22/93	1				1
1/23/93					0

Date	Pioneer CR-10 (mm)	Pioneer Manual (mm)	3rivers (mm)	Irrigation (mm)	total daily mm
1/24/93					0
1/25/93					0
1/26/93					0
1/27/93					0
1/28/93	1				1
1/29/93					0
1/30/93					0
1/31/93					0
2/1/93					0
2/2/93					0
2/3/93					0
2/4/93					0
2/5/93					0
2/6/93					0
2/7/93					0
2/8/93					0
2/9/93					0
2/10/93					0
2/11/93					0
2/12/93					0
2/13/93					0
2/14/93	0				0
2/15/93					0
2/16/93					0
2/17/93					0
2/18/93					0
2/19/93					0
2/20/93					0
2/21/93					0
2/22/93					0
2/23/93					0
2/24/93					0
2/25/93					0
2/26/93					0
2/27/93					0
2/28/93					0
3/1/93	3				3
3/2/93	2				2
3/3/93	0				0
3/4/93	1				1
3/5/93	3				3
3/6/93					0
3/7/93	1				1
3/8/93	2				2

Date	Pioneer CR-10 (mm)	Pioneer Manual (mm)	3rivers (mm)	Irrigation (mm)	total daily mm
3/9/93	0				0
3/10/93	1				1
3/11/93	4				4
3/12/93	3				3
3/13/93					0
3/14/93					0
3/15/93	0				0
3/16/93	6				6
3/17/93					0
3/18/93					0
3/19/93	0				0
3/20/93	5				5
3/21/93					0
3/22/93	3				3
3/23/93					0
3/24/93					0
3/25/93					0
3/26/93					0
3/27/93					0
3/28/93					0
3/29/93					0
3/30/93					0
3/31/93					0
4/1/93					0
4/2/93					0
4/3/93					0
4/4/93					0
4/5/93					0
4/6/93					0
4/7/93					0
4/8/93					0
4/9/93					0
4/10/93					0
4/11/93					0
4/12/93					0
4/13/93					0
4/14/93					0
4/15/93					0
4/16/93					0
4/17/93					0
4/18/93					0
4/19/93					0
4/20/93					0
4/21/93					0

Date	Pioneer CR-10 (mm)	Pioneer Manual (mm)	3rivers (mm)	Irrigation (mm)	total daily mm
4/22/93					0
4/23/93					0
4/24/93					0
4/25/93					0
4/26/93					0
4/27/93					0
4/28/93					0
4/29/93					0
4/30/93					0
5/1/93					0
5/2/93		5			5
5/3/93		4			4
5/4/93		17			17
5/5/93					0
5/6/93					0
5/7/93					0
5/8/93					0
5/9/93		1			1
5/10/93					0
5/11/93					0
5/12/93					0
5/13/93					0
5/14/93		0			0
5/15/93		1			1
5/16/93		1			1
5/17/93					0
5/18/93		3			3
5/19/93					0
5/20/93					0
5/21/93					0
5/22/93		6			6
5/23/93		10			10
5/24/93					0
5/25/93					0
5/26/93					0
5/27/93					0
5/28/93		1			1
5/29/93					0
5/30/93		13			13
5/31/93					0
6/1/93					0
6/2/93		1			1
6/3/93					0
6/4/93		20			20

Date	Pioneer CR-10 (mm)	Pioneer Manual (mm)	3rivers (mm)	Irrigation (mm)	total daily mm
6/5/93					0
6/6/93		0			0
6/7/93		41			41
6/8/93		41			41
6/9/93					0
6/10/93					0
6/11/93					0
6/12/93					0
6/13/93					0
6/14/93					0
6/15/93					0
6/16/93					0
6/17/93					0
6/18/93					0
6/19/93					0
6/20/93		15			15
6/21/93					0
6/22/93					0
6/23/93					0
6/24/93					0
6/25/93					0
6/26/93					0
6/27/93		7			7
6/28/93		1			1
6/29/93					0
6/30/93		5			5
7/1/93					0
7/2/93					0
7/3/93					0
7/4/93					0
7/5/93					0
7/6/93					0
7/7/93					0
7/8/93		6			6
7/9/93		26			26
7/10/93					0
7/11/93		20			20
7/12/93					0
7/13/93		5			5
7/14/93					0
7/15/93					0
7/16/93					0
7/17/93					0
7/18/93		1			1

Date	Pioneer CR-10 (mm)	Pioneer Manual (mm)	3rivers (mm)	Irrigation (mm)	total daily mm
7/19/93					0
7/20/93					0
7/21/93					0
7/22/93					0
7/23/93					0
7/24/93	5				0
7/25/93	1	8			8
7/26/93					0
7/27/93				25	25
7/28/93					0
7/29/93					0
7/30/93					0
7/31/93					0
8/1/93					0
8/2/93					0
8/3/93	7				0
8/4/93	0				0
8/5/93		5			5
8/6/93	9				0
8/7/93					0
8/8/93					0
8/9/93		13			13
8/10/93	5				0
8/11/93					0
8/12/93		8			8
8/13/93		4		30	34
8/14/93					0
8/15/93	4				0
8/16/93	0				0
8/17/93					0
8/18/93					0
8/19/93					0
8/20/93					0
8/21/93					0
8/22/93					0
8/23/93	4			25	25
8/24/93	20	34			34
8/26/93	1	1			1
8/27/93	21				0
8/28/93					0
8/29/93	19				0
8/30/93		55			55
8/31/93	14	14			14
9/1/93					0

Date	Pioneer CR-10 (mm)	Pioneer Manual (mm)	3rivers (mm)	Irrigation (mm)	total daily mm
9/2/93	41				0
9/3/93	2	48			48
9/4/93					0
9/5/93					0
9/6/93	10	14			14
9/7/93					0
9/8/93					0
9/9/93	2				0
9/10/93	1				0
9/11/93	0				0
9/12/93					0
9/13/93					0
9/14/93	34	58			58
9/15/93	3				0
9/16/93					0

APPENDIX C

APPENDIX C.

Drainage sample volumes and Nitrate concentration data.

	Lys#	Sample#	Vol liters	Drain mm	NO3-N ppm	Load kg/ha	cum drain (mm)	cum load kg/ha
07/04/89	1	2	22.12	5.94	2.90	0.172	5.94	0.17
07/23/89	1	3	22.12	5.94	9.37	0.556	11.87	0.73
08/08/89	1	4	22.12	5.94	6.77	0.402	17.81	1.13
08/31/89	1	5	22.12	5.94	11.41	0.677	23.74	1.81
10/30/89	1	6	16.00	4.29	12.06	0.518	28.04	2.33
10/31/89	1	7	22.13	5.94	12.63	0.750	33.98	3.08
10/31/89	1	8	22.13	5.94	16.41	0.975	39.91	4.05
10/31/89	1	9	22.14	5.94	14.92	0.886	45.86	4.94
11/01/89	1	10	22.13	5.94	19.58	1.163	51.79	6.10
11/01/89	1	11	22.13	5.94	7.61	0.452	57.73	6.55
11/01/89	1	12	22.22	5.96	18.32	1.092	63.70	7.64
11/01/89	1	13	22.12	5.94	16.57	0.984	69.63	8.63
11/02/89	1	14	22.12	5.94	18.23	1.082	75.57	9.71
11/02/89	1	15	22.12	5.94	23.55	1.398	81.50	11.11
11/03/89	1	16	22.12	5.94	18.47	1.096	87.44	12.20
11/04/89	1	17	22.12	5.94	21.27	1.263	93.38	13.47
11/05/89	1	18	22.12	5.94	20.56	1.220	99.31	14.69
11/08/89	1	19	22.12	5.94	27.23	1.616	105.25	16.30
11/12/89	1	20	22.12	5.94	27.94	1.659	111.18	17.96
11/15/89	1	21	22.12	5.94	15.69	0.931	117.12	18.89
11/17/89	1	22	22.12	5.94	22.07	1.310	123.06	20.20
11/18/89	1	23	22.12	5.94	21.79	1.293	128.99	21.50
11/19/89	1	24	22.12	5.94	13.10	0.778	134.93	22.27
11/20/89	1	25	22.12	5.94	14.80	0.879	140.86	23.15
11/21/89	1	26	22.12	5.94	20.07	1.191	146.80	24.34
11/24/89	1	27	22.12	5.94	30.42	1.806	152.74	26.15
11/26/89	1	28	22.12	5.94	32.81	1.948	158.67	28.10
11/30/89	1	29	22.12	5.94	22.72	1.349	164.61	29.45
12/06/89	1	30	22.12	5.94	26.28	1.560	170.54	31.01
12/14/89	1	31#	22.12	5.94	24.37	1.447	176.48	32.45
12/25/89	1	32#	22.12	5.94	24.37	1.447	182.42	33.90
01/06/90	1	33	22.12	5.94	22.45	1.333	188.35	35.23
01/19/90	1	34	22.12	5.94	36.29	2.154	194.29	37.39
01/29/90	1	35	22.12	5.94	35.76	2.123	200.22	39.51

Estimates were made in drainage amount.

	Lys#	Sample#	Vol liters	Drain mm	NO3-N ppm	Load kg/ha	cum drain (mm)	cum load kg/ha
02/01/90	1	36	22.12	5.94	16.72	0.992	206.16	40.50
02/04/90	1	37	22.12	5.94	31.15	1.849	212.09	42.35
02/08/90	1	38	22.12	5.94	19.48	1.156	218.03	43.51
02/11/90	1	39	22.12	5.94	30.76	1.826	223.97	45.33
02/17/90	1	40	22.12	5.94	32.04	1.902	229.90	47.23
02/22/90	1	41	22.12	5.94	26.72	1.586	235.84	48.82
02/23/90	1	42	22.36	6.00	20.13	1.208	241.84	50.03
02/23/90	1	43	22.26	5.97	14.64	0.875	247.81	50.90
02/24/90	1	44	22.12	5.94	28.54	1.694	253.75	52.60
02/25/90	1	45	22.12	5.94	35.37	2.100	259.68	54.70
02/26/90	1	46	22.12	5.94	36.80	2.184	265.62	56.88
02/28/90	1	47#	22.12	5.94	42.72	2.536	271.56	59.42
03/03/90	1	48	22.13	5.94	48.64	2.889	277.50	62.30
03/06/90	1	49	22.12	5.94	43.29	2.570	283.43	64.87
03/09/90	1	50	22.33	5.99	45.66	2.736	289.42	67.61
03/10/90	1	51	22.12	5.94	11.59	0.688	295.36	68.30
03/11/90	1	52	22.12	5.94	4.54	0.269	301.30	68.57
03/12/90	1	53	22.15	5.94	41.67	2.477	307.24	71.05
03/13/90	1	54	22.12	5.94	8.19	0.486	313.18	71.53
03/15/90	1	55	22.12	5.94	22.15	1.315	319.11	72.85
03/16/90	1	56	22.12	5.94	30.06	1.784	325.05	74.63
03/19/90	1	57	22.12	5.94	23.16	1.375	330.98	76.01
03/23/90	1	58	22.12	5.94	19.65	1.166	336.92	77.17
03/29/90	1	59	22.14	5.94	31.76	1.887	342.86	79.06
04/08/90	1	60	22.14	5.94	25.76	1.530	348.80	80.59
04/13/90	1	61	22.16	5.95	20.45	1.216	354.75	81.81
04/16/90	1	62	22.25	5.97	31.51	1.881	360.72	83.69
04/18/90	1	63	22.17	5.95	24.96	1.485	366.67	85.17
04/21/90	1	64	22.16	5.95	19.35	1.151	372.62	86.32
04/25/90	1	65	22.16	5.95	21.56	1.282	378.56	87.60
04/28/90	1	66	22.15	5.94	21.24	1.263	384.51	88.87
05/03/90	1	67	22.14	5.94	29.55	1.756	390.45	90.62
05/10/90	1	68	22.14	5.94	12.29	0.730	396.39	91.35
05/16/90	1	69	22.20	5.96	32.54	1.939	402.35	93.29
05/17/90	1	70	22.35	6.00	16.17	0.970	408.34	94.26
05/18/90	1	71	22.45	6.02	22.89	1.379	414.37	95.64
05/18/90	1	72	22.37	6.00	21.79	1.308	420.37	96.95
05/19/90	1	73	22.48	6.03	18.73	1.130	426.40	98.08
05/20/90	1	74	22.25	5.97	20.02	1.195	432.37	99.27
05/21/90	1	75	22.20	5.96	32.65	1.945	438.33	101.22
05/23/90	1	76	22.17	5.95	20.00	1.190	444.28	102.41
05/25/90	1	77	22.16	5.95	20.00	1.189	450.23	103.60
05/30/90	1	78	22.15	5.94	27.37	1.627	456.17	105.22
06/06/90	1	79	22.14	5.94	10.23	0.608	462.11	105.83

Estimates were made in drainage amount.

	Lys#	Sample#	Vol liters	Drain mm	NO3-N ppm	Load kg/ha	cum drain (mm)	cum load kg/ha
06/18/90	1	80	22.13	5.94	23.63	1.403	468.05	107.24
07/06/90	1	81	22.12	5.94	25.47	1.512	473.99	108.75
07/27/90	1	82	22.14	5.94	25.45	1.512	479.93	110.26
08/03/90	1	83	22.13	5.94	20.23	1.201	485.87	111.46
08/14/90	1	84	22.12	5.94	20.05	1.190	491.80	112.65
08/23/90	1	85	22.13	5.94	22.40	1.330	497.74	113.98
08/29/90	1	86	22.14	5.94	15.63	0.929	503.68	114.91
09/04/90	1	87	22.14	5.94	41.35	2.457	509.63	117.37
09/14/90	1	88	22.13	5.94	33.00	1.960	515.56	119.33
10/08/90	1	89	22.21	5.96	32.77	1.953	521.52	121.28
10/10/90	1	90	22.78	6.11	39.80	2.433	527.64	123.71
10/10/90	1	91	23.15	6.21	26.93	1.673	533.85	125.39
10/10/90	1	92	23.06	6.19	29.48	1.824	540.04	127.21
10/10/90	1	93	22.87	6.14	34.90	2.142	546.17	129.35
10/11/90	1	94	22.78	6.11	38.80	2.372	552.29	131.72
10/11/90	1	95	22.99	6.17	40.76	2.515	558.46	134.24
10/11/90	1	96	22.41	6.01	41.40	2.490	564.47	136.73
10/12/90	1	97	22.33	5.99	41.55	2.490	570.46	139.22
10/12/90	1	98	22.26	5.97	41.06	2.453	576.44	141.67
10/13/90	1	99	22.22	5.96	40.38	2.408	582.40	144.08
10/15/90	1	100	22.18	5.95	38.96	2.319	588.35	146.40
10/17/90	1	101	22.18	5.95	35.00	2.083	594.30	148.48
10/21/90	1	102	22.15	5.94	35.00	2.080	600.25	150.56
10/27/90	1	103	22.14	5.94	25.99	1.544	606.19	152.11
11/04/90	1	104	22.13	5.94	22.22	1.320	612.13	153.42
11/07/90	1	105	22.24	5.97	29.10	1.737	618.10	155.16
11/08/90	1	106	22.22	5.96	27.65	1.649	624.06	156.81
11/09/90	1	107	22.20	5.96	42.75	2.547	630.02	159.36
11/11/90	1	108	22.17	5.95	43.39	2.581	635.97	161.94
11/15/90	1	109	22.17	5.95	46.20	2.749	641.91	164.69
11/20/90	1	110	22.16	5.95	46.20	2.747	647.86	167.43
11/27/90	1	111	22.15	5.94	41.10	2.443	653.81	169.88
11/28/90	1	112	22.14	5.94	41.70	2.478	659.75	172.35
11/28/90	1	113	22.13	5.94	35.90	2.132	665.69	174.49
11/28/90	1	114	22.12	5.94	36.30	2.155	671.62	176.64
11/28/90	1	115	22.14	5.94	39.30	2.335	677.56	178.98
11/29/90	1	116	22.13	5.94	38.50	2.286	683.50	181.26
11/29/90	1	117	22.12	5.94	40.30	2.392	689.44	183.66
11/30/90	1	118	22.13	5.94	40.30	2.393	695.38	186.05
12/01/90	1	119	22.14	5.94	41.80	2.483	701.32	188.53
12/02/90	1	120	22.14	5.94	43.30	2.573	707.26	191.10
12/05/90	1	121	22.13	5.94	41.70	2.476	713.20	193.58
12/05/90	1	122	22.21	5.96	38.20	2.277	719.16	195.86
01/23/91	#	123	161.36	43.30	25.30	10.955	762.46	206.81

Estimates were made in drainage amount.

	Lys#	Sample#	Vol liters	Drain mm	NO3-N ppm	Load kg/ha	cum drain (mm)	cum load kg/ha
02/01/91	#	124	87.94	23.60	24.80	5.853	786.06	212.67
03/06/91	#	125	44.72	12.00	21.60	2.592	0	0
04/01/91	1	1	22.17	5.95	17.77	1.057	5.95	1.06
04/06/91	1	2	22.14	5.94	13.33	0.792	11.89	1.85
04/16/91	1	3	22.25	5.97	11.52	0.688	17.86	2.54
04/16/91	1	4	22.57	6.06	6.57	0.398	23.92	2.93
04/17/91	1	5	22.26	5.97	11.49	0.686	29.89	3.62
04/19/91	1	6	22.18	5.95	11.50	0.684	35.84	4.31
04/21/91	1	7	22.38	6.01	5.14	0.309	41.85	4.61
04/22/91	1	8	22.22	5.96	6.30	0.376	47.81	4.99
04/24/91	1	9	22.19	5.95	11.22	0.668	53.77	5.66
04/27/91	1	10	22.12	5.94	14.41	0.855	59.70	6.51
04/29/91	1	11	22.18	5.95	14.45	0.860	65.66	7.37
04/30/91	1	13	22.18	5.95	12.82	0.763	71.61	8.14
05/02/91	1	14	22.17	5.95	13.62	0.810	77.56	8.95
05/05/91	1	15	22.18	5.95	13.62	0.811	83.51	9.76
05/12/91	1	16	22.15	5.94	13.62	0.810	89.45	10.57
05/19/91	1	18	22.14	5.94	8.98	0.534	95.39	11.10
05/27/91	1	19	22.13	5.94	9.02	0.536	101.33	11.64
06/17/91	1	21	66.43	17.83	6.51	1.161	119.16	12.80
09/15/91	1	21	22.14	5.94	20.79	1.235	125.10	14.03
10/08/91	#	22	22.17	5.95	15.00	0.892	131.05	14.92
10/10/91	#	23	22.17	5.95	15.00	0.892	137.00	15.82
10/15/91	#	24	22.15	5.94	15.00	0.892	142.94	16.71
10/22/91	#	25	22.13	5.94	15.00	0.891	148.88	17.60
10/26/91	1	26	22.46	6.03	26.65	1.606	154.91	19.21
10/26/91	#		22.45	6.02	15.00	0.904	160.93	20.11
10/27/91	#		22.37	6.00	15.00	0.900	166.94	21.01
10/27/91	#		22.38	6.01	15.00	0.901	172.94	21.91
10/28/91	#		22.46	6.03	15.00	0.904	178.97	22.81
10/28/91	#		22.31	5.99	15.00	0.898	184.96	23.71
10/29/91	#		22.25	5.97	15.00	0.896	190.93	24.61
10/30/91	#		22.20	5.96	15.00	0.894	196.88	25.50
11/01/91	#		22.26	5.97	15.00	0.896	202.86	26.40
11/02/91	#		22.24	5.97	15.00	0.895	208.83	27.29
11/03/91	#		22.22	5.96	15.00	0.894	214.79	28.19
11/05/91	#		22.17	5.95	15.00	0.892	220.74	29.08
11/08/91	#		22.16	5.95	15.00	0.892	226.69	29.97
11/13/91	#		22.14	5.94	15.00	0.891	232.63	30.86
11/21/91	#		22.17	5.95	15.00	0.892	238.58	31.76
11/23/91	#		22.26	5.97	15.00	0.896	244.55	32.65
11/25/91	#		22.18	5.95	15.00	0.893	250.50	33.54
11/27/91	#		22.16	5.95	15.00	0.892	256.45	34.44
12/02/91	#		22.17	5.95	15.00	0.892	262.40	35.33

Estimates were made in drainage amount.

	Lys#	Sample#	Vol liters	Drain mm	NO3-N ppm	Load kg/ha	cum drain (mm)	cum load kg/ha
12/07/91	1	27	22.15	5.94	17.14	1.019	268.34	36.35
12/11/91	1	28	22.18	5.95	21.40	1.274	274.29	37.62
12/13/91	#		22.17	5.95	15.00	0.892	280.24	38.51
12/15/91	#		22.17	5.95	15.00	0.892	286.19	39.41
12/17/91	#		22.17	5.95	15.00	0.892	292.14	40.30
12/21/91	#		22.18	5.95	15.00	0.893	298.09	41.19
12/26/91	#		22.14	5.94	15.00	0.891	304.04	42.08
01/03/92	#		22.13	5.94	15.00	0.891	309.97	42.97
01/11/92	#		22.17	5.95	15.00	0.892	315.92	43.87
01/15/92	#		22.15	5.94	15.00	0.892	321.87	44.76
01/20/92	#		22.14	5.94	15.00	0.891	327.81	45.65
01/28/92	#		22.13	5.94	15.00	0.891	333.75	46.54
02/04/92	#		22.14	5.94	15.00	0.891	339.69	47.43
02/13/92	1	30	22.13	5.94	8.50	0.505	345.63	47.94
02/21/92	1	31	22.16	5.95	9.80	0.583	351.57	48.52
02/24/92	1	32	22.17	5.95	6.60	0.393	357.52	48.91
02/28/92	1	33	22.15	5.94	18.20	1.082	363.47	49.99
03/04/92	1	34	22.14	5.94	18.00	1.069	369.41	51.06
03/11/92	1	35	22.13	5.94	9.42	0.559	375.35	51.62
03/16/92	1	36	22.20	5.96	14.07	0.838	381.30	52.46
03/19/92	#	37	22.16	5.95	15.00	0.892	387.25	53.35
03/22/92	1	38	22.17	5.95	11.70	0.696	393.20	54.05
03/26/92	1	39	22.15	5.94	8.30	0.493	399.14	54.54
03/30/92	1	40	22.16	5.95	10.86	0.646	405.09	55.19
04/02/92	1	41	22.16	5.95	2.07	0.123	411.04	55.31
04/06/92	1	42	22.15	5.94	10.32	0.613	416.98	55.92
04/11/92	1	43	22.14	5.94	12.31	0.731	422.92	56.66
04/17/92	1	44	22.15	5.94	13.26	0.788	428.87	57.44
04/26/92	1	45	22.13	5.94	10.76	0.639	434.81	58.08
05/08/92	1	46	22.13	5.94	11.61	0.689	440.74	58.77
05/19/92	1	47	22.15	5.94	7.21	0.429	446.69	59.20
05/31/92	1	48	22.13	5.94	7.91	0.470	452.63	59.67
06/16/92	1	49	22.13	5.94	4.67	0.277	458.57	59.95
06/30/92	1	50	22.12	5.94	6.07	0.360	464.50	60.31
07/15/92	1	51	22.21	5.96	6.47	0.386	470.46	60.69
07/17/92	1	52	22.20	5.96	4.31	0.257	476.42	60.95
07/19/92	1	53	22.17	5.95	11.00	0.654	482.37	61.60
07/22/92	1	54	22.17	5.95	6.09	0.362	488.32	61.97
07/24/92	1	55	22.22	5.96	9.68	0.577	494.28	62.54
07/25/92	1	56	22.20	5.96	8.10	0.483	500.24	63.03
07/27/92	1	57	22.17	5.95	9.19	0.547	506.19	63.57
07/31/92	1	58	22.15	5.94	6.31	0.375	512.13	63.95
08/03/92	1	59	22.17	5.95	8.91	0.530	518.08	64.48
08/03/92	1	60	22.17	5.95	5.31	0.316	524.03	64.79

Estimates were made in drainage amount.

	Lys#	Sample#	Vol liters	Drain mm	NO3-N ppm	Load kg/ha	cum drain (mm)	cum load kg/ha
08/06/92	1	61	22.16	5.95	14.23	0.846	529.98	65.64
08/10/92	1	62	22.17	5.95	14.22	0.846	535.93	66.49
08/18/92	1	63	22.13	5.94	14.36	0.853	541.87	67.34
09/01/92	1	64	22.14	5.94	15.29	0.908	547.81	68.25
09/10/92	1	65	22.23	5.97	15.11	0.901	553.77	69.15
09/11/92	1	66	22.51	6.04	15.78	0.953	559.81	70.10
09/12/92	1	67	22.41	6.01	15.32	0.921	565.83	71.02
09/13/92	1	68	22.23	5.97	14.02	0.836	571.79	71.86
09/15/92	1	69	22.17	5.95	13.76	0.819	577.74	72.68
09/15/92	1	n?	23.07	6.19	10.00	0.619	583.93	73.30
09/16/92	1	n?	22.99	6.17	10.00	0.617	590.10	73.91
09/16/92	1	n?	22.76	6.11	10.00	0.611	596.21	74.53
09/16/92	1	n?	23.23	6.23	10.00	0.623	602.44	75.15
09/16/92	1	70	22.42	6.02	7.29	0.439	608.46	75.59
09/17/92	1	71	22.32	5.99	5.40	0.323	614.45	75.91
09/18/92	1	72	22.42	6.02	8.23	0.495	620.47	76.41
09/19/92	1	73	22.19	5.95	10.28	0.612	626.42	77.02
09/21/92	1	74	22.17	5.95	10.99	0.654	632.37	77.67
09/25/92	1	75	22.15	5.94	9.02	0.536	638.31	78.21
09/30/92	1	76	22.14	5.94	12.32	0.732	644.25	78.94
10/07/92	1	77	22.13	5.94	10.95	0.650	650.19	79.59
10/15/92	1	78	22.19	5.95	13.11	0.781	656.15	80.37
10/16/92	1	79	22.25	5.97	11.63	0.694	662.12	81.07
10/17/92	1	80	22.26	5.97	12.51	0.747	668.09	81.81
10/18/92	1	81	22.22	5.96	12.18	0.726	674.06	82.54
10/20/92	1	82	22.28	5.98	13.80	0.825	680.03	83.36
10/22/92	1	83	22.16	5.95	13.34	0.793	685.98	84.16
10/26/92	1	84	22.15	5.94	12.45	0.740	691.93	84.90
11/01/92	1	85	22.15	5.94	8.68	0.516	697.87	85.41
11/04/92	1	86	22.23	5.97	10.32	0.616	703.83	86.03
11/05/92	1	87	22.22	5.96	5.54	0.330	709.80	86.36
11/22/92	1	# sampler caught on wires and missed 8 samples	177.87	47.73	4.61	2.200	757.53	88.56
11/25/92	1	89	22.17	5.95	7.30	0.434	763.48	88.99
11/28/92	1	90	22.17	5.95	6.64	0.395	769.43	89.39
12/01/92	1	91	22.18	5.95	5.23	0.311	775.38	89.70
12/07/92	1	92	22.14	5.94	6.13	0.364	781.32	90.06
12/15/92	1	93	22.13	5.94	5.91	0.351	787.26	90.42
12/20/92	1	94	22.22	5.96	5.21	0.311	793.22	90.73
12/23/92	1	95	22.15	5.94	5.15	0.306	799.17	91.03

Estimates were made in drainage amount.

	Lys#	Sample#	Vol liters	Drain mm	NO3-N ppm	Load kg/ha	cum drain (mm)	cum load kg/ha
12/28/92	1	96	22.14	5.94	6.61	0.393	805.11	91.43
01/01/93	1	97	22.32	5.99	4.77	0.286	811.10	91.71
01/02/93	1	98	22.26	5.97	5.98	0.357	817.07	92.07
01/03/93	1	99	22.22	5.96	5.06	0.302	823.03	92.37
01/04/93	1	100	22.18	5.95	5.89	0.351	828.99	92.72
01/04/93	1	101	22.55	6.05	8.00	0.484	835.04	93.20
01/05/93	1	102	22.46	6.03	3.15	0.190	841.06	93.39
01/05/93	1	103	22.40	6.01	3.78	0.227	847.08	93.62
01/06/93	1	104	22.35	6.00	6.08	0.365	853.07	93.99
01/06/93	1	105	22.29	5.98	5.05	0.302	859.05	94.29
01/07/93	1	106	22.31	5.99	5.21	0.312	865.04	94.60
01/09/93	1	107	22.19	5.95	4.82	0.287	871.00	94.89
01/11/93	1	109	22.17	5.95	4.70	0.280	876.95	95.17
01/15/93	1	?date	22.14	5.94	5.39	0.320	882.89	95.49
01/21/93	1	?	22.16	5.95	4.23	0.252	888.83	95.74
01/26/93	1	?	22.18	5.95	4.61	0.274	894.79	96.01
01/29/93	1	?	22.22	5.96	4.46	0.266	900.75	96.28
01/31/93	1	N?	22.15	5.94	5.00	0.297	906.69	96.58
02/05/93	1	N?	22.14	5.94	5.00	0.297	912.63	96.87
02/13/93	1	N?	22.13	5.94	5.00	0.297	918.57	97.17
02/26/93	1	N?	22.13	5.94	5.00	0.297	924.51	97.47
03/12/93	1	N?	22.13	5.94	5.00	0.297	930.45	97.76
03/31/93	1	N?	22.10	5.93	5.00	0.297	936.38	98.06
04/04/93	1	N?	22.17	5.95	5.00	0.297	942.33	98.36
04/06/93	1	N?	22.16	5.95	4.00	0.238	948.28	98.60
04/10/93	1	N?	22.18	5.95	4.00	0.238	954.23	98.83
04/15/93	1	N?	22.14	5.94	4.00	0.238	960.17	99.07
04/20/93	1	N?	22.14	5.94	4.00	0.238	966.11	99.31
06/02/93	1		24.73	6.64	4.23	0.281	972.75	99.59
06/08/93	1		22.44	6.02	2.86	0.172	978.77	99.76
06/13/93	1		22.20	5.96	3.71	0.221	984.73	99.98
06/14/93	1		22.17	5.95	4.48	0.267	990.68	100.25
06/17/93	1		22.19	5.95	4.17	0.248	996.63	100.50
06/20/93	1		22.16	5.95	5.22	0.310	1002.58	100.81
06/23/93	1	1120	22.17	5.95	4	0.221	1008.53	101.03
06/27/93	1	1121	22.14	5.94	4	0.216	1014.47	101.25
07/03/93	1	1122	22.16	5.95	5	0.277	1020.42	101.52
07/12/93	1	1123	22.13	5.94	4	0.214	1026.35	101.74
07/13/93	1	?date	22.13	5.94	8	0.467	1032.29	102.20
07/14/93	1	?date	22.13	5.94	7	0.395	1038.23	102.60
10/01/93	1	126		0.00	12	0.000	1038.23	102.60
10/01/93	1	127		0.00	18	0.000	1038.23	102.60
10/04/93	1	200	9	2.28	19	0.434	1040.51	103.03
10/07/93	1	201	12	3.22	17	0.559	1043.73	103.59

Estimates were made in drainage amount.

	Lys#	Sample#	Vol liters	Drain mm	NO3-N ppm	Load kg/ha	cum drain (mm)	cum load kg/ha
10/08/93	1	202	6	1.48	20	0.289	1045.21	103.88
10/11/93	1	203	10	2.68	16	0.431	1047.89	104.31
10/13/93	1	204	7	1.88	18	0.342	1049.77	104.65
10/15/93	1	205	8	2.15	15	0.324	1051.92	104.98
10/18/93	1	206	39	10.47	19	1.950	1062.38	106.93
10/20/93	1	207	39	10.47	20	2.063	1072.85	108.99
10/21/93	1	208	15	4.03	18	0.710	1076.87	109.70
10/22/93	1	209	13	3.49	17	0.577	1080.36	110.28
10/25/93	1	210	34	9.12	15	1.352	1089.49	111.63
10/28/93	1	211	26	6.98	16	1.084	1096.46	112.71
10/31/93	1	212	18	4.83	12	0.591	1101.29	113.30
11/04/93	1	213	14	3.76	16	0.585	1105.05	113.89
11/10/93	1	214	16	4.29	12	0.509	1109.34	114.40
12/21/93	1	215	14	3.76	7	0.274	1113.10	114.67
01/03/94	1	216	43	11.54	7	0.848	1124.64	115.52
02/23/94	1	217	100	26.84	5	1.318	1151.48	116.84
				0.00				
				0.00				
				0.00				
07/20/89	2	2	37.66	10.11	5.20	0.526	10.11	0.53
10/30/89	2	3	44.24	11.87	4.21	0.500	21.98	1.03
11/01/89	2	4	44.24	11.87	11.00	1.306	33.85	2.33
11/01/89	2	5	44.24	11.87	5.22	0.620	45.72	2.95
11/02/89	2	6	44.24	11.87	14.81	1.758	57.59	4.71
11/03/89	2	7	44.24	11.87	13.91	1.651	69.47	6.36
11/09/89	2	8	44.24	11.87	16.79	1.993	81.34	8.35
11/17/89	2	9	44.24	11.87	13.97	1.659	93.21	10.01
11/18/89	2	10	44.24	11.87	13.29	1.578	105.08	11.59
11/23/89	2	11	44.24	11.87	22.85	2.713	116.95	14.30
12/03/89	2	12	44.24	11.87	17.95	2.131	128.83	16.43
12/31/89	2	13	44.24	11.87	13.60	1.615	140.70	18.05
01/18/90	2	14	44.24	11.87	30.62	3.635	152.57	21.68
01/28/90	2	15	44.24	11.87	12.95	1.537	164.44	23.22
02/05/90	2	16	44.24	11.87	21.65	2.570	176.31	25.79
02/09/90	2	17	22.12	5.94	11.80	0.700	182.25	26.49
02/13/90	2	18	22.13	5.94	17.95	1.066	188.19	27.56
02/21/90	2	19	22.12	5.94	18.74	1.112	194.12	28.67
02/23/90	2	20	22.40	6.01	15.93	0.958	200.13	29.63
02/23/90	2	21	22.12	5.94	13.14	0.780	206.07	30.41
02/24/90	2	22	22.12	5.94	11.40	0.677	212.01	31.08
02/25/90	2	23	22.12	5.94	19.63	1.165	217.94	32.25
02/25/90	2	24	22.13	5.94	5.75	0.341	223.88	32.59
02/28/90	2	25	22.12	5.94	10.61	0.630	229.82	33.22
03/04/90	2	26	22.12	5.94	23.89	1.418	235.75	34.64

Estimates were made in drainage amount.

	Lys#	Sample#	Vol liters	Drain mm	NO3-N ppm	Load kg/ha	cum drain (mm)	cum load kg/ha
03/09/90	2	27	22.12	5.94	11.59	0.688	241.69	35.33
03/10/90	2	28	22.12	5.94	11.71	0.695	247.62	36.02
03/10/90	2	29	22.12	5.94	14.72	0.874	253.56	36.90
03/11/90	2	30	22.12	5.94	34.45	2.045	259.50	38.94
03/11/90	2	31	22.52	6.04	11.58	0.700	265.54	39.64
03/11/90	2	32	22.12	5.94	13.94	0.827	271.48	40.47
03/12/90	2	33	22.12	5.94	13.66	0.811	277.41	41.28
03/13/90	2	34	22.12	5.94	12.21	0.725	283.35	42.00
03/14/90	2	35	22.12	5.94	15.50	0.920	289.28	42.92
03/16/90	2	36	22.12	5.94	14.63	0.868	295.22	43.79
03/18/90	2	37	22.12	5.94	18.67	1.108	301.16	44.90
03/29/90	2	38	22.12	5.94	19.69	1.169	307.09	46.07
03/29/90	2	39	22.13	5.94	10.79	0.641	313.03	46.71
04/09/90	2	40	22.13	5.94	11.49	0.682	318.97	47.39
04/14/90	2	41	22.17	5.95	13.57	0.807	324.92	48.20
04/17/90	2	42	22.15	5.94	12.72	0.756	330.86	48.96
04/20/90	2	43	22.15	5.94	16.34	0.971	336.81	49.93
04/24/90	2	44	22.15	5.94	16.24	0.965	342.75	50.89
04/27/90	2	45	22.16	5.95	15.52	0.923	348.70	51.82
05/01/90	2	46	22.15	5.94	14.96	0.889	354.64	52.70
05/07/90	2	47	22.13	5.94	18.62	1.106	360.58	53.81
05/15/90	2	48	22.19	5.95	21.75	1.295	366.53	55.11
05/17/90	2	49	22.18	5.95	25.58	1.523	372.49	56.63
05/18/90	2	50	22.42	6.02	28.62	1.722	378.50	58.35
05/18/90	2	51	22.34	5.99	27.82	1.668	384.50	60.02
05/19/90	2	52	22.27	5.98	27.95	1.670	390.47	61.69
05/20/90	2	53	22.21	5.96	28.46	1.696	396.43	63.38
05/22/90	2	54	22.17	5.95	15.97	0.950	402.38	64.33
05/25/90	2	55	22.15	5.94	17.30	1.028	408.33	65.36
05/29/90	2	56	22.16	5.95	8.72	0.519	414.27	65.88
06/06/90	2	57	22.13	5.94	19.71	1.171	420.21	67.05
06/17/90	2	58	22.13	5.94	24.05	1.428	426.15	68.48
07/02/90	2	59	22.12	5.94	13.53	0.803	432.09	69.28
07/28/90	2	60	22.12	5.94	20.55	1.220	438.02	70.50
08/16/90	2	61	22.12	5.94	19.64	1.166	443.96	71.67
08/28/90	2	62	22.13	5.94	18.85	1.119	449.90	72.79
09/08/90	2	63	22.12	5.94	23.97	1.423	455.83	74.21
10/10/90	2	64	22.28	5.98	24.52	1.466	461.81	75.68
10/11/90	2	65	22.54	6.05	19.07	1.153	467.86	76.83
10/11/90	2	66	22.64	6.08	24.46	1.486	473.94	78.32
10/11/90	2	67	22.63	6.07	19.47	1.182	480.01	79.50
10/12/90	2	68	22.26	5.97	20.08	1.199	485.98	80.70
10/13/90	2	69	22.20	5.96	25.28	1.506	491.94	82.20
10/16/90	2	70	22.16	5.95	25.41	1.511	497.89	83.72

Estimates were made in drainage amount.

	Lys#	Sample#	Vol liters	Drain mm	NO3-N ppm	Load kg/ha	cum drain (mm)	cum load kg/ha
10/20/90	2	71	22.16	5.95	25.30	1.505	503.83	85.22
10/27/90	2	72	22.14	5.94	14.96	0.889	509.78	86.11
11/04/90	2	73	22.13	5.94	24.69	1.466	515.71	87.58
11/07/90	2	74	22.28	5.98	29.19	1.745	521.69	89.32
11/08/90	2	75	22.41	6.01	18.05	1.085	527.71	90.41
11/09/90	2	76	22.19	5.95	23.53	1.401	533.66	91.81
11/12/90	2	77	22.19	5.95	23.69	1.411	539.62	93.22
11/18/90	2	78	22.14	5.94	24.00	1.426	545.56	94.64
11/27/90	2	79	22.14	5.94	24.00	1.426	551.50	96.07
11/28/90	2	80	22.14	5.94	22.60	1.343	557.44	97.41
11/28/90	2	81	22.14	5.94	22.70	1.349	563.38	98.76
11/29/90	2	82	22.14	5.94	22.30	1.325	569.32	100.09
11/29/90	2	83	22.14	5.94	22.10	1.313	575.26	101.40
11/30/90	2	84	22.14	5.94	23.00	1.367	581.21	102.77
12/01/90	2	85	22.14	5.94	23.30	1.384	587.15	104.15
12/03/90	2	86	22.14	5.94	23.00	1.367	593.09	105.52
12/06/90	2	87	22.14	5.94	22.80	1.355	599.03	106.87
12/09/90	2	88	22.14	5.94	22.20	1.319	604.97	108.19
12/31/90	2	89	22.14	5.94	20.70	1.230	610.91	109.42
01/23/91	#	90	161.36	43.30	11.98	5.187	654.21	114.61
02/01/91	#	91	87.94	23.60	9.10	2.148	677.81	116.75
03/06/91	#	92	44.72	12.00	14.42	1.730	0	0
04/03/91	2	1	22.14	5.94	14.59	0.867	5.94	0.87
04/09/91	2	2	22.12	5.94	9.10	0.540	11.88	1.41
04/16/91	2	3	22.12	5.94	14.42	0.856	17.81	2.26
04/16/91	2	4	22.58	6.06	11.03	0.668	23.87	2.93
04/18/91	2	6	44.24	11.87	13.80	1.638	35.74	4.57
04/20/91	2	7	22.12	5.94	11.12	0.660	41.68	5.23
04/21/91	2	8	22.12	5.94	14.76	0.876	47.62	6.11
04/23/91	2	9	22.12	5.94	11.84	0.703	53.55	6.81
04/25/91	2	10	22.14	5.94	13.04	0.775	59.49	7.58
04/27/91	2	11	22.12	5.94	7.72	0.458	65.43	8.04
04/29/91	2	12	22.19	5.95	9.77	0.582	71.38	8.62
05/01/91	2	13	22.18	5.95	6.42	0.382	77.34	9.01
05/04/91	2	14	22.18	5.95	16.56	0.986	83.29	9.99
05/07/91	2	15	22.14	5.94	11.59	0.689	89.23	10.68
05/20/91	2	17	22.13	5.94	5.57	0.331	95.17	11.01
07/03/91	2	20	110.65	29.69	22.51	6.684	124.86	17.69
07/25/91	#	21	22.00	5.90	10.50	0.620	130.77	18.31
08/01/91	2	22	22.12	5.94	6.50	0.386	136.70	18.70
08/27/91	2	23	22.13	5.94	9.59	0.570	142.64	19.27
09/17/91	2	24	22.12	5.94	6.19	0.367	148.58	19.64
10/10/91	2	25	22.13	5.94	9.47	0.562	154.51	20.20
10/16/91	2	26	22.13	5.94	11.41	0.678	160.45	20.88

Estimates were made in drainage amount.

	Lys#	Sample#	Vol liters	Drain mm	NO3-N ppm	Load kg/ha	cum drain (mm)	cum load kg/ha
10/25/91	2	27	22.13	5.94	12.78	0.759	166.39	21.64
10/26/91	2	28	22.46	6.03	10.16	0.612	172.42	22.25
10/26/91	2	29	22.39	6.01	8.43	0.507	178.43	22.76
10/27/91	2	30	22.30	5.98	12.11	0.725	184.41	23.48
10/27/91	2	31	22.41	6.01	13.03	0.784	190.43	24.26
10/28/91	2	32	22.42	6.02	6.90	0.415	196.44	24.68
10/28/91	2	33	22.26	5.97	8.38	0.501	202.42	25.18
10/29/91	2	34	22.20	5.96	10.25	0.611	208.37	25.79
10/31/91	2	35	22.17	5.95	11.06	0.658	214.32	26.45
11/01/91	2	36	22.26	5.97	10.85	0.648	220.30	27.10
11/02/91	2	37	22.20	5.96	14.50	0.864	226.25	27.96
11/03/91	2	35	22.17	5.95	12.02	0.715	232.20	28.67
11/06/91	#	36	22.16	5.95	12.00	0.714	238.15	29.39
11/09/91	#	37	22.14	5.94	12.00	0.713	244.09	30.10
11/15/91	2	38	22.13	5.94	12.85	0.763	250.03	30.86
11/22/91	2	39	22.29	5.98	10.23	0.612	256.01	31.48
11/23/91	2	40	22.21	5.96	9.26	0.552	261.97	32.03
11/24/91	2	41	22.17	5.95	9.20	0.547	267.92	32.58
11/27/91	2	42	22.15	5.94	12.02	0.714	273.86	33.29
12/01/91	2	43	22.13	5.94	15.22	0.904	279.80	34.19
12/06/91	2	44	22.13	5.94	13.70	0.814	285.74	35.01
12/10/91	2	-	22.17	5.95	9.80	0.583	291.69	35.59
12/12/91	2	45	22.18	5.95	18.36	1.093	297.64	36.68
12/14/91	2	46	22.15	5.94	14.75	0.877	303.59	37.56
12/16/91	2	47	22.17	5.95	12.83	0.763	309.54	38.32
12/20/91	2	48	22.14	5.94	8.95	0.532	315.48	38.86
12/24/91	2	49	22.13	5.94	7.12	0.423	321.42	39.28
01/02/92	2	50	22.13	5.94	11.75	0.698	327.35	39.98
01/10/92	2	51	22.16	5.95	5.95	0.354	333.30	40.33
01/14/92	2	52	22.13	5.94	9.16	0.544	339.24	40.87
01/19/92	2	53	22.13	5.94	7.26	0.431	345.18	41.30
01/25/92	2	54	22.13	5.94	10.87	0.646	351.12	41.95
02/02/92	2	55	22.14	5.94	6.91	0.411	357.06	42.36
02/10/92	2	56	22.13	5.94	11.60	0.689	363.00	43.05
02/23/92	2	57	44.34	11.90	8.90	1.059	374.90	44.11
02/26/92	2	58	22.14	5.94	6.90	0.410	380.84	44.52
03/02/92	2	59	22.13	5.94	7.40	0.439	386.78	44.96
03/09/92	2	60	22.13	5.94	13.30	0.790	392.71	45.75
03/16/92	2	61	22.15	5.94	10.30	0.612	398.66	46.36
03/20/92	2	62	22.13	5.94	9.08	0.539	404.60	46.90
03/24/92	2	63	22.13	5.94	11.82	0.702	410.54	47.60
03/30/92	2	64	22.14	5.94	4.71	0.280	416.48	47.88
04/02/92	2	65	22.14	5.94	8.16	0.485	422.42	48.37
04/07/92	2	66	22.13	5.94	12.72	0.755	428.36	49.12

Estimates were made in drainage amount.

	Lys#	Sample#	Vol liters	Drain mm	NO3-N ppm	Load kg/ha	cum drain (mm)	cum load kg/ha
04/12/92	2	67	22.13	5.94	10.73	0.637	434.30	49.76
04/19/92	2	68	22.13	5.94	10.65	0.632	440.23	50.39
04/30/92	2	69	22.13	5.94	5.21	0.309	446.17	50.70
05/13/92	2	70	22.13	5.94	8.95	0.532	452.11	51.23
05/26/92	2	71	22.13	5.94	5.72	0.340	458.05	51.57
06/10/92	2	72	22.12	5.94	4.57	0.271	463.99	51.84
06/25/92	2	73	22.12	5.94	6.39	0.379	469.92	52.22
07/11/92	2	74	22.12	5.94	10.10	0.600	475.86	52.82
07/16/92	2	75	22.22	5.96	2.74	0.163	481.82	52.99
07/17/92	2	76	22.18	5.95	6.51	0.387	487.77	53.37
07/20/92	2	77	22.23	5.97	6.44	0.384	493.74	53.76
07/22/92	2	78	22.16	5.95	4.14	0.246	499.69	54.00
07/24/92	2	79	22.33	5.99	6.06	0.363	505.68	54.37
07/24/92	2	80	22.31	5.99	3.43	0.205	511.66	54.57
07/25/92	2		22.21	5.96		0.000	517.62	54.57
07/27/92	2		22.17	5.95		0.000	523.57	54.57
07/30/92	2	81	22.18	5.95	11.46	0.682	529.53	55.25
08/01/92	2	82.00	22.24	5.97	10.21	0.609	535.49	55.86
08/03/92	2	83.00	22.19	5.95	9.86	0.587	541.45	56.45
08/05/92	2	84.00	22.16	5.95	10.26	0.610	547.40	57.06
08/08/92	2	85.00	22.14	5.94	13.27	0.788	553.34	57.85
08/15/92	2	86.00	22.13	5.94	8.72	0.518	559.28	58.37
08/25/92	2	87.00	22.13	5.94	7.72	0.458	565.21	58.83
09/01/92	2	88.00	22.16	5.95	8.21	0.488	571.16	59.31
09/08/92	2	89.00	22.13	5.94	11.76	0.698	577.10	60.01
09/10/92	2	90.00	22.36	6.00	17.78	1.067	583.10	61.08
09/11/92	2	91.00	22.31	5.99	17.31	1.036	589.09	62.11
09/11/92	2	92.00	22.24	5.97	16.07	0.959	595.06	63.07
09/13/92	2	93.00	22.19	5.95	15.83	0.943	601.01	64.02
09/15/92	2		22.17	5.95		0.000	606.96	64.02
09/16/92	2		22.92	6.15		0.000	613.11	64.02
09/16/92	2		22.44	6.02		0.000	619.13	64.02
09/17/92	2		22.69	6.09		0.000	625.22	64.02
09/17/92	2		22.50	6.04		0.000	631.26	64.02
09/18/92	2		22.22	5.96		0.000	637.22	64.02
09/20/92	2		22.19	5.95		0.000	643.18	64.02
09/23/92	2		22.16	5.95		0.000	649.12	64.02
09/28/92	2		22.14	5.94		0.000	655.06	64.02
10/06/92	2		22.13	5.94		0.000	661.00	64.02
10/15/92	2		22.19	5.95		0.000	666.96	64.02
10/16/92	2		22.32	5.99		0.000	672.95	64.02
10/16/92	2		22.31	5.99		0.000	678.93	64.02
10/17/92	2		22.29	5.98		0.000	684.92	64.02
10/18/92	2		22.22	5.96		0.000	690.88	64.02

Estimates were made in drainage amount.

	Lys#	Sample#	Vol liters	Drain mm	NO3-N ppm	Load kg/ha	cum drain (mm)	cum load kg/ha
10/20/92	2		22.19	5.95		0.000	696.83	64.02
10/22/92	2		22.16	5.95		0.000	702.78	64.02
10/27/92	2		22.14	5.94		0.000	708.72	64.02
11/03/92	2	94.00	22.32	5.99	9.00	0.539	714.71	64.56
11/03/92	2	95.00	22.44	6.02	7.19	0.433	720.73	64.99
11/04/92	2	96.00	22.22	5.96	6.95	0.414	726.70	65.40
11/06/92	2	97.00	22.21	5.96	8.56	0.510	732.66	65.91
11/09/92	2	98.00	22.16	5.95	6.47	0.385	738.60	66.30
11/13/92	2	99.00	22.31	5.99	6.23	0.373	744.59	66.67
11/13/92	2	100.00	22.40	6.01	5.62	0.338	750.60	67.01
11/14/92	2	101.00	22.32	5.99	4.62	0.277	756.59	67.29
11/14/92	2	102.00	22.24	5.97	6.90	0.412	762.56	67.70
11/16/92	2	103.00	22.19	5.95	6.98	0.416	768.51	68.11
11/18/92	2	104.00	22.17	5.95	6.09	0.362	774.46	68.48
11/21/92	2	105.00	22.15	5.94	6.13	0.364	780.41	68.84
11/25/92	2		22.19	5.95		0.000	786.36	68.84
11/27/92	2		22.17	5.95		0.000	792.31	68.84
11/30/92	2		22.15	5.94		0.000	798.25	68.84
12/06/92	2	106.00	22.16	5.95	5.85	0.348	804.20	69.19
12/15/92	2	107.00	22.13	5.94	5.57	0.331	810.14	69.52
12/19/92	2	108.00	22.23	5.97	5.36	0.320	816.11	69.84
12/23/92	2	109.00	22.15	5.94	5.35	0.318	822.05	70.16
12/28/92	2		22.14	5.94		0.000	827.99	70.16
01/01/93	2		22.52	6.04		0.000	834.03	70.16
01/02/93	2		22.25	5.97		0.000	840.00	70.16
01/03/93	2	110.00	22.19	5.95	5.44	0.324	845.96	70.48
01/04/93	2	111.00	22.43	6.02	6.81	0.410	851.98	70.89
01/05/93	2	112.00	22.48	6.03	7.28	0.439	858.01	71.33
01/05/93	2	113.00	22.58	6.06	4.67	0.283	864.07	71.61
01/05/93	2	114.00	22.72	6.10	3.27	0.199	870.17	71.81
01/06/93	2	115.00	22.31	5.99	4.43	0.265	876.15	72.08
01/07/93	2	116.00	22.24	5.97	6.15	0.367	882.12	72.44
01/08/93	2	117.00	22.19	5.95	4.32	0.257	888.08	72.70
01/10/93	2	118.00	22.16	5.95	5.97	0.355	894.02	73.06
01/14/93	2	119.00	22.14	5.94	3.32	0.197	899.97	73.25
01/21/93	2	? n	22.13	5.94		0.000	905.90	73.25
01/26/93	2	? n	22.19	5.95		0.000	911.86	73.25
01/28/93	2	? n	22.21	5.96		0.000	917.82	73.25
01/31/93	2	120.00	22.15	5.94	3.77	0.224	923.76	73.48
02/06/93	2	? n	22.13	5.94		0.000	929.70	73.48
02/16/93	2	121.00	22.13	5.94	4.13	0.245	935.64	73.72
03/03/93	2	122.00	22.13	5.94	3.49	0.207	941.58	73.93
03/26/93	2	123.00	22.13	5.94	3.58	0.213	947.52	74.14
04/07/93	2	124.00	22.14	5.94	2.67	0.159	953.46	74.30

Estimates were made in drainage amount.

	Lys#	Sample#	Vol liters	Drain mm	NO3-N ppm	Load kg/ha	cum drain (mm)	cum load kg/ha
04/12/93	2	125.00	22.13	5.94	4.45	0.264	959.40	74.57
04/18/93	2		22.18	5.95		0.000	965.35	74.57
04/21/93	2		22.41	6.01		0.000	971.36	74.57
06/02/93	2		26.07	7.00		0.000	978.36	74.57
06/08/93	2		22.38	6.01		0.000	984.36	74.57
06/09/93	2		22.44	6.02		0.000	990.39	74.57
06/09/93	2		22.90	6.15		0.000	996.53	74.57
06/10/93	2		22.70	6.09		0.000	1002.62	74.57
06/10/93	2		2.32	0.62		0.000	1003.25	74.57
06/11/93	2		22.34	5.99		0.000	1009.24	74.57
06/12/93	2		22.20	5.96		0.000	1015.20	74.57
06/14/93	2	126.00	22.18	5.95	4	0.216	1021.15	74.78
06/16/93	2	127.00	22.17	5.95	3	0.190	1027.10	74.97
06/20/93	2		22.17	5.95		0.000	1033.05	74.97
06/24/93	2	128.00	22.15	5.94	3	0.192	1038.99	75.16
07/01/93	2		22.13	5.94		0.000	1044.93	75.16
07/11/93	2	129.00	22.13	5.94	5	0.278	1050.87	75.44
10/01/93	2	130.00		0.00	6	0.000	1050.87	75.44
10/01/93	2	131.00		0.00	7	0.000	1050.87	75.44
10/01/93	2	132.00		0.00	12	0.000	1050.87	75.44
10/04/93	2	200.00	12	3.22	11	0.358	1054.09	75.80
10/07/93	2	201.00	15	4.03	11	0.437	1058.12	76.24
10/08/93	2	202.00	6	1.61	11	0.175	1059.73	76.41
10/11/93	2	203.00	10	2.68	11	0.293	1062.41	76.70
10/13/93	2	204.00	8	2.01	10	0.194	1064.42	76.90
10/15/93	2	205.00	11	2.95	10	0.308	1067.37	77.21
10/18/93	2	206.00	39	10.47	11	1.182	1077.84	78.39
10/20/93	2	207.00	39	10.47	13	1.370	1088.31	79.76
10/21/93	2	208.00	12	3.22	13	0.415	1091.53	80.17
10/22/93	2	209.00	11	2.95	14	0.417	1094.48	80.59
10/25/93	2	210.00	37	9.93	11	1.133	1104.41	81.72
10/28/93	2	211.00	22	5.90	11	0.675	1110.31	82.40
10/31/93	2	212.00	15	4.03	12	0.494	1114.34	82.89
11/04/93	2	213.00	13	3.49	13	0.455	1117.82	83.35
11/10/93	2	214.00	14	3.76	9	0.356	1121.58	83.70
12/21/93	2	215.00	13	3.49	10	0.344	1125.07	84.05
01/03/94	2	216.00	35	9.39	11	0.996	1134.46	85.04
02/23/94	2	217.00	100	26.84	11	3.067	1161.30	88.11
				0.00				
				0.00				
				0				
07/10/89	3		22.12	5.94	1.27	0.08	5.94	0.08
10/30/89	3		20.00	5.37	1.61	0.09	11.30	0.17
11/01/89	3		22.12	5.94	11.64	0.74	17.24	0.91

Estimates were made in drainage amount.

	Lys#	Sample#	Vol liters	Drain mm	NO3-N ppm	Load kg/ha	cum drain (mm)	cum load kg/ha
11/02/89	3		22.12	5.94	14.00	0.89	23.17	1.80
11/02/89	3		22.12	5.94	10.29	0.65	29.11	2.45
11/03/89	3		22.12	5.94	12.11	0.77	35.05	3.22
11/04/89	3		22.12	5.94	20.36	1.29	40.98	4.52
11/05/89	3		22.12	5.94	11.63	0.74	46.92	5.25
11/06/89	3		22.12	5.94	22.41	1.42	52.85	6.68
11/07/89	3		22.12	5.94	24.32	1.54	58.79	8.22
11/08/89	3		22.12	5.94	25.85	1.64	64.73	9.86
11/10/89	3		22.12	5.94	27.84	1.77	70.66	11.63
11/11/89	3		22.12	5.94	31.79	2.02	76.60	13.65
11/13/89	3		22.12	5.94	35.07	2.23	82.53	15.88
11/15/89	3		22.12	5.94	22.31	1.42	88.47	17.29
11/17/89	3		22.12	5.94	30.73	1.95	94.41	19.24
11/18/89	3		22.12	5.94	20.07	1.27	100.34	20.52
11/19/89	3		22.12	5.94	26.63	1.69	106.28	22.21
11/21/89	3		22.12	5.94	38.30	2.43	112.21	24.64
11/22/89	3		22.12	5.94	39.72	2.52	118.15	27.16
11/25/89	3		22.12	5.94	39.54	2.51	124.09	29.67
11/28/89	3		22.12	5.94	31.15	1.98	130.02	31.65
11/30/89	3		22.12	5.94	28.12	1.79	135.96	33.44
12/05/89	3		22.12	5.94	36.30	2.30	141.89	35.74
12/10/89	3		22.12	5.94	32.56	2.07	147.83	37.81
12/18/89	3		22.12	5.94	32.56	2.07	153.77	39.88
01/04/90	3		22.12	5.94	28.82	1.83	159.70	41.70
01/28/90	3		22.12	5.94	44.41	2.82	165.64	44.52
02/01/90	3		22.12	5.94	9.19	0.58	171.57	45.11
02/04/90	3		22.12	5.94	15.87	1.01	177.51	46.12
02/08/90	3		22.15	5.94	26.17	1.66	183.45	47.78
02/12/90	3		22.12	5.94	28.30	1.80	189.39	49.58
02/16/90	3		22.12	5.94	32.83	2.08	195.33	51.66
02/22/90	3		22.12	5.94	26.20	1.66	201.26	53.32
02/25/90	3		22.18	5.95	13.99	0.89	207.21	54.22
02/26/90	3		22.12	5.94	17.12	1.09	213.15	55.30
02/28/90	3		22.12	5.94	35.69	2.27	219.09	57.57
03/02/90	3		22.13	5.94	25.08	1.59	225.02	59.16
03/05/90	3		22.12	5.94	38.53	2.45	230.96	61.61
03/08/90	3		22.12	5.94	11.99	0.76	236.90	62.37
03/10/90	3		22.12	5.94	11.71	0.74	242.83	63.11
03/12/90	3		22.12	5.94	14.72	0.93	248.77	64.05
03/13/90	3		22.12	5.94	34.45	2.19	254.70	66.23
03/14/90	3		22.12	5.94	11.58	0.74	260.64	66.97
03/15/90	3		22.25	5.97	13.94	0.89	266.61	67.86
03/17/90	3		22.12	5.94	28.03	1.78	272.55	69.64
03/19/90	3		22.12	5.94	22.47	1.43	278.48	71.07

Estimates were made in drainage amount.

	Lys#	Sample#	Vol liters	Drain mm	NO3-N ppm	Load kg/ha	cum drain (mm)	cum load kg/ha
03/21/90	3		22.12	5.94	24.61	1.56	284.42	72.63
03/25/90	3		22.15	5.94	21.85	1.39	290.36	74.02
03/30/90	3		22.14	5.94	24.99	1.59	296.30	75.61
04/07/90	3		22.14	5.94	32.15	2.04	302.25	77.65
04/12/90	3		22.14	5.94	21.31	1.35	308.19	79.00
04/16/90	3		22.15	5.94	9.34	0.59	314.13	79.60
04/20/90	3		22.15	5.94	12.58	0.80	320.07	80.40
04/23/90	3		22.15	5.94	17.94	1.14	326.02	81.54
04/26/90	3		22.16	5.95	18.54	1.18	331.97	82.72
04/29/90	3		22.15	5.94	15.57	0.99	337.91	83.71
05/03/90	3		22.15	5.94	21.91	1.39	343.85	85.10
05/08/90	3		22.14	5.94	10.65	0.68	349.79	85.78
05/14/90	3		22.17	5.95	15.00	0.95	355.74	86.73
05/16/90	3		22.21	5.96	18.85	1.20	361.70	87.93
05/17/90	3		22.36	6.00	19.86	1.27	367.70	89.21
05/18/90	3		22.29	5.98	20.31	1.30	373.69	90.51
05/19/90	3		22.28	5.98	19.90	1.27	379.66	91.78
05/20/90	3		22.26	5.97	20.01	1.28	385.64	93.06
05/21/90	3		22.31	5.99	10.90	0.70	391.63	93.76
05/22/90	3		22.21	5.96	14.17	0.90	397.59	94.66
05/23/90	3		22.26	5.97	8.59	0.55	403.56	95.21
05/25/90	3		22.23	5.97	16.55	1.06	409.52	96.26
05/28/90	3		22.15	5.94	17.91	1.14	415.47	97.40
05/31/90	3		22.15	5.94	15.25	0.97	421.41	98.37
06/05/90	3		22.15	5.94	14.59	0.93	427.36	99.30
06/11/90	3		22.14	5.94	20.07	1.28	433.30	100.58
06/20/90	3		22.13	5.94	15.60	0.99	439.24	101.57
07/08/90	3		22.12	5.94	11.68	0.74	445.17	102.31
08/05/90	3		22.12	5.94	12.75	0.81	451.11	103.12
08/17/90	3		22.12	5.94	11.21	0.71	457.04	103.83
08/22/90	3		22.17	5.95	15.26	0.97	462.99	104.80
08/27/90	3		22.15	5.94	11.68	0.74	468.94	105.54
09/01/90	3		22.14	5.94	16.43	1.04	474.88	106.59
09/08/90	3		22.13	5.94	18.60	1.18	480.82	107.77
10/10/90	3		23.24	6.24	24.15	1.61	487.05	109.38
10/12/90	3		22.17	5.95	30.87	1.96	493.00	111.34
10/13/90	3		22.12	5.94	37.00	2.35	498.94	113.69
10/15/90	3		22.12	5.94	45.00	2.86	504.88	116.55
10/17/90	3		22.12	5.94	52.00	3.30	510.81	119.85
10/24/90	3		22.12	5.94	59.00	3.75	516.75	123.60
11/02/90	3		22.13	5.94	60.04	3.81	522.69	127.41
11/06/90	3		22.28	5.98	55.38	3.54	528.66	130.95
11/07/90	3		22.25	5.97	55.00	3.51	534.64	134.47
11/08/90	3		22.21	5.96	55.00	3.51	540.60	137.97

Estimates were made in drainage amount.

	Lys#	Sample#	Vol liters	Drain mm	NO3-N ppm	Load kg/ha	cum drain (mm)	cum load kg/ha
11/10/90	3		22.17	5.95	55.00	3.50	546.55	141.47
11/13/90	3		22.15	5.94	67.28	4.28	552.49	145.75
11/20/90	3		22.13	5.94	65.80	4.18	558.43	149.93
11/28/90	3		22.14	5.94	65.80	4.18	564.37	154.11
11/28/90	3		22.13	5.94	62.30	3.96	570.31	158.07
12/01/90	3		22.12	5.94	51.10	3.24	576.24	161.31
12/04/90	3		22.12	5.94	49.40	3.14	582.18	164.45
01/23/91	3		161.36	43.30	24.40	11.30	625.48	175.75
02/01/91	3		87.94	23.60	24.40	6.16	649.08	181.91
03/06/91	3		44.72	12.00	24.40	3.13	661.08	185.04
03/08/91	3		22.15	5.94	8.20	0.52	0.00	0.00
04/05/91	3		22.14	5.94	8.46	0.54	5.94	0.54
04/16/91	3		22.55	6.05	11.24	0.73	11.99	1.27
04/16/91	3		22.85	6.13	13.90	0.91	18.12	2.18
04/17/91	3		22.25	5.97	9.79	0.63	24.10	2.80
04/18/91	3		22.23	5.97	12.19	0.78	30.06	3.58
04/20/91	3		22.18	5.95	12.00	0.76	36.01	4.34
04/21/91	3		22.22	5.96	12.00	0.77	41.98	5.11
04/23/91	3		22.28	5.98	14.70	0.94	47.95	6.05
04/24/91	3		22.17	5.95	6.45	0.41	53.90	6.46
04/28/91	3		22.18	5.95	22.63	1.44	59.86	7.90
04/30/91	3		22.21	5.96	14.26	0.91	65.82	8.81
05/03/91	3		22.21	5.96	23.10	1.47	71.78	10.28
05/06/91	3		22.16	5.95	11.54	0.73	77.72	11.02
05/13/91	3		22.14	5.94	14.60	0.93	83.66	11.94
05/28/91	3		22.15	5.94	13.29	0.84	89.61	12.79
06/05/91	3		44.46	11.93	11.56	1.48	101.54	14.26
06/08/91	3		22.18	5.95	10.58	0.67	107.49	14.94
06/14/91	3		22.15	5.94	14.12	0.90	113.44	15.84
06/29/91	3		22.12	5.94	14.53	0.92	119.37	16.76
07/03/91	3		112.43	30.17	11.38	3.67	149.54	20.43
09/12/91	3		22.13	5.94	7.06	0.45	155.48	20.88
10/05/91	3		22.23	5.97	15.00	0.96	161.45	21.84
10/06/91	3		22.25	5.97	15.00	0.96	167.42	22.79
10/07/91	3		22.21	5.96	15.00	0.96	173.38	23.75
10/09/91	3		22.18	5.95	15.00	0.95	179.33	24.71
10/11/91	3		22.16	5.95	37.82	2.41	185.28	27.11
10/14/91	3		22.14	5.94	30.00	1.91	191.22	29.02
10/21/91	3		22.14	5.94	23.67	1.50	197.16	30.52
10/25/91	3		22.58	6.06	20.00	1.30	203.22	31.82
10/26/91	3		23.11	6.20	20.00	1.33	209.42	33.14
10/26/91	3		23.49	6.30	20.00	1.35	215.72	34.49
10/26/91	3		22.69	6.09	20.00	1.30	221.81	35.80
10/26/91	3		22.84	6.13	20.00	1.31	227.94	37.11

Estimates were made in drainage amount.

	Lys#	Sample#	Vol liters	Drain mm	NO3-N ppm	Load kg/ha	cum drain (mm)	cum load kg/ha
10/27/91	3		22.42	6.02	20.00	1.29	233.96	38.39
10/27/91	3		22.91	6.15	20.00	1.32	240.11	39.71
10/27/91	3		22.78	6.11	20.00	1.31	246.22	41.02
10/28/91	3		22.31	5.99	20.00	1.28	252.21	42.30
10/29/91	3		22.24	5.97	20.00	1.28	258.17	43.57
10/30/91	3		22.18	5.95	20.00	1.27	264.13	44.85
10/31/91	3		22.45	6.02	23.40	1.51	270.15	46.36
11/01/91	3		22.26	5.97	48.25	3.08	276.12	49.44
11/02/91	3		22.21	5.96	20.00	1.28	282.08	50.71
11/03/91	3		22.18	5.95	20.00	1.27	288.04	51.99
11/06/91	3		22.18	5.95	20.00	1.27	293.99	53.26
11/10/91	3		22.14	5.94	20.00	1.27	299.93	54.53
11/21/91	3		22.21	5.96	20.00	1.28	305.89	55.81
11/22/91	3		22.55	6.05	20.00	1.29	311.94	57.10
11/23/91	3		22.23	5.97	20.00	1.28	317.91	58.38
11/24/91	3		22.27	5.98	20.00	1.28	323.88	59.66
11/27/91	3		22.15	5.94	20.00	1.27	329.83	60.93
12/02/91	3		22.14	5.94	20.00	1.27	335.77	62.20
12/07/91	3		22.15	5.94	28.01	1.78	341.71	63.98
12/09/91	3		22.21	5.96	20.00	1.28	347.67	65.25
12/11/91	3		22.22	5.96	20.00	1.28	353.63	66.53
12/13/91	3		22.21	5.96	20.00	1.28	359.59	67.80
12/15/91	3		22.18	5.95	20.00	1.27	365.55	69.08
12/17/91	3		22.16	5.95	20.00	1.27	371.49	70.35
12/21/91	3		22.15	5.94	20.00	1.27	377.44	71.62
12/28/91	3		22.14	5.94	14.97	0.95	383.38	72.57
01/06/92	3		22.14	5.94	8.98	0.57	389.32	73.14
01/10/92	3		22.15	5.94	13.33	0.85	395.26	73.99
01/15/92	3		22.15	5.94	10.54	0.67	401.21	74.66
01/20/92	3		22.15	5.94	14.88	0.95	407.15	75.61
01/26/92	3		22.17	5.95	14.97	0.95	413.10	76.56
01/30/92	3		22.15	5.94	8.98	0.57	419.05	77.13
02/04/92	3		22.14	5.94	13.33	0.85	424.99	77.98
02/11/92	3		22.14	5.94	10.54	0.67	430.93	78.65
02/18/92	3		22.15	5.94	14.88	0.95	436.87	79.59
02/21/92	3		22.20	5.96	14.97	0.95	442.83	80.55
02/22/92	3		22.18	5.95	10.00	0.64	448.78	81.18
02/25/92	3		22.16	5.95	10.00	0.64	454.73	81.82
02/28/92	3		22.15	5.94	8.98	0.57	460.67	82.39
03/05/92	3		22.16	5.95	10.00	0.64	466.62	83.03
03/12/92	3		22.14	5.94	8.15	0.52	472.56	83.55
03/16/92	3		22.16	5.95	4.12	0.26	478.51	83.81
03/19/92	3		22.22	5.96	6.59	0.42	484.47	84.23
03/20/92	3		22.19	5.95	10.00	0.64	490.42	84.86

Estimates were made in drainage amount.

	Lys#	Sample#	Vol liters	Drain mm	NO3-N ppm	Load kg/ha	cum drain (mm)	cum load kg/ha
03/23/92	3		22.16	5.95	10.51	0.67	496.37	85.53
03/27/92	3		22.15	5.94	3.76	0.24	502.32	85.77
03/30/92	3		22.16	5.95	10.65	0.68	508.26	86.45
04/03/92	3		22.15	5.94	10.00	0.64	514.21	87.09
04/07/92	3		22.15	5.94	10.00	0.64	520.15	87.72
04/12/92	3		22.14	5.94	9.03	0.57	526.09	88.30
04/21/92	3		22.13	5.94	10.00	0.64	532.03	88.93
05/04/92	3		22.12	5.94	10.00	0.63	537.97	89.57
05/20/92	3		22.12	5.94	0.15	0.01	543.90	89.58
06/12/92	3		22.12	5.94	10.00	0.63	549.84	90.21
06/26/92	3		22.13	5.94	4.33	0.28	555.78	90.49
07/15/92	3		22.22	5.96	5.45	0.35	561.74	90.83
07/16/92	3		22.24	5.97	2.41	0.15	567.71	90.99
07/17/92	3		22.19	5.95	8.00	0.51	573.66	91.50
07/19/92	3		22.25	5.97	8.00	0.51	579.63	92.01
07/21/92	3		22.16	5.95	8.00	0.51	585.58	92.52
07/24/92	3		22.28	5.98	8.00	0.51	591.56	93.03
07/24/92	3		22.25	5.97	8.00	0.51	597.53	93.54
07/26/92	3		22.26	5.97	8.00	0.51	603.50	94.05
07/28/92	3		22.15	5.94	8.00	0.51	609.45	94.56
08/01/92	3		22.15	5.94	8.00	0.51	615.39	95.07
08/03/92	3		22.18	5.95	8.48	0.54	621.34	95.61
08/07/92	3		22.18	5.95	12.77	0.81	627.30	96.42
08/15/92	3		22.13	5.94	9.11	0.58	633.23	97.00
08/31/92	3		22.15	5.94	9.29	0.59	639.18	97.59
09/08/92	3		22.13	5.94	10.00	0.64	645.12	98.22
09/10/92	3		22.60	6.06	10.00	0.65	651.18	98.87
09/10/92	3		22.48	6.03	18.67	1.20	657.21	100.08
09/11/92	3		22.37	6.00	21.84	1.40	663.22	101.48
09/11/92	3		22.27	5.98	25.42	1.62	669.19	103.10
09/13/92	3		22.25	5.97	28.13	1.80	675.16	104.90
09/15/92	3		22.92	6.15	30.13	1.98	681.31	106.88
09/15/92	3		25.43	6.82	32.44	2.37	688.14	109.25
09/16/92	3		23.40	6.28	30.00	2.02	694.42	111.27
09/16/92	3		23.71	6.36	30.00	2.04	700.78	113.31
09/16/92	3		22.81	6.12	30.00	1.96	706.90	115.27
09/16/92	3		22.49	6.04	30.00	1.94	712.94	117.21
09/17/92	3		22.34	5.99	38.00	2.44	718.93	119.65
09/17/92	3		22.23	5.97	38.52	2.46	724.90	122.10
09/19/92	3		22.17	5.95	36.78	2.34	730.85	124.44
09/22/92	3		22.15	5.94	46.30	2.94	736.79	127.39
09/27/92	3		22.14	5.94	32.93	2.09	742.73	129.48
10/06/92	3		22.14	5.94	37.08	2.36	748.67	131.84
10/15/92	3		22.28	5.98	37.81	2.42	754.65	134.26

\# Estimates were made in drainage amount.

	Lys#	Sample#	Vol liters	Drain mm	NO3-N ppm	Load kg/ha	cum drain (mm)	cum load kg/ha
10/16/92	3		22.38	6.01	32.18	2.07	760.66	136.32
10/16/92	3		22.31	5.99	28.13	1.80	766.65	138.12
10/17/92	3		22.30	5.98	34.91	2.23	772.63	140.36
10/18/92	3		22.25	5.97	29.53	1.89	778.60	142.24
10/19/92	3		22.29	5.98	29.40	1.88	784.58	144.13
10/22/92	3		22.15	5.94	18.64	1.19	790.53	145.31
10/29/92	3		22.15	5.94	20.04	1.27	796.47	146.58
11/03/92	3		22.28	5.98	23.50	1.50	802.45	148.09
11/04/92	3		22.25	5.97	20.59	1.31	808.42	149.40
11/05/92	3		22.21	5.96	27.21	1.73	814.38	151.14
11/08/92	3		22.17	5.95	20.36	1.30	820.33	152.43
11/13/92	3		22.55	6.05	26.00	1.68	826.38	154.12
11/13/92	3		22.46	6.03	27.84	1.79	832.41	155.91
11/13/92	3		22.50	6.04	25.00	1.61	838.45	157.53
11/14/92	3		22.31	5.99	25.00	1.60	844.43	159.13
11/15/92	3		22.32	5.99	25.00	1.60	850.42	160.73
11/17/92	3		22.19	5.95	25.00	1.59	856.38	162.32
11/21/92	3		22.17	5.95	25.00	1.59	862.33	163.91
11/25/92	3		22.19	5.95	30.44	1.94	868.28	165.85
11/28/92	3		22.18	5.95	21.62	1.38	874.23	167.23
12/04/92	3		22.15	5.94	29.20	1.86	880.18	169.08
12/16/92	3		22.15	5.94	23.35	1.48	886.12	170.57
12/20/92	3		22.18	5.95	25.03	1.59	892.07	172.16
01/04/93	3		134.04	35.97	18.25	7.02	928.04	179.18
01/04/93	3		22.73	6.10	5.80	0.38	934.14	179.56
01/05/93	3		23.21	6.23	5.81	0.39	940.37	179.95
01/05/93	3		22.48	6.03	5.81	0.37	946.40	180.32
01/05/93	3		22.41	6.01	7.62	0.49	952.42	180.81
01/06/93	3		22.35	6.00	5.71	0.37	958.42	181.18
01/07/93	3		22.25	5.97	3.58	0.23	964.39	181.41
01/08/93	3		22.20	5.96	5.87	0.37	970.34	181.78
01/12/93	3		22.17	5.95	5.78	0.37	976.29	182.15
01/20/93	3		22.14	5.94	5.34	0.34	982.23	182.49
01/25/93	3		22.18	5.95	6.52	0.42	988.19	182.90
01/28/93	3		22.18	5.95	6.15	0.39	994.14	183.30
02/01/93	3		22.20	5.96	5.48	0.35	1000.10	183.64
02/09/93	3		22.14	5.94	3.67	0.23	1006.04	183.88
03/03/93	3		22.13	5.94	4.67	0.30	1011.98	184.17
03/20/93	3		22.36	6.00	6.47	0.42	1017.98	184.59
03/20/93	3		22.96	6.16	5.65	0.37	1024.14	184.96
03/21/93	3		22.33	5.99	6.97	0.45	1030.13	185.41
03/22/93	3		26.65	7.15	0.52	0.04	1037.28	185.45
03/22/93	3		22.52	6.04	0.93	0.06	1043.32	185.51
06/02/93	3		23.12	6.20	1.15	0.08	1049.53	185.59

Estimates were made in drainage amount.

	Lys#	Sample#	Vol liters	Drain mm	NO3-N ppm	Load kg/ha	cum drain (mm)	cum load kg/ha
06/08/93	3		23.04	6.18	0.88	0.06	1055.71	185.64
06/08/93	3		23.02	6.18	2.86	0.19	1061.89	185.83
06/09/93	3		23.38	6.27	2.21	0.15	1068.16	185.98
06/09/93	3		22.69	6.09	13.59	0.89	1074.25	186.87
06/09/93	3		23.14	6.21		0.00	1080.46	186.87
06/09/93	3		22.51	6.04		0.00	1086.50	186.87
06/10/93	3		22.37	6.00		0.00	1092.51	186.87
06/10/93	3		22.28	5.98		0.00	1098.48	186.87
06/11/93	3	3112	22.21	5.96		0.00	1104.44	186.87
06/13/93	3	3113	22.17	5.95		0.00	1110.39	186.87
06/17/93	3	3114	22.15	5.94	10.07	0.64	1116.34	187.51
06/21/93	3	3115	22.15	5.94	5.63	0.36	1122.28	187.86
06/27/93	3	3116	22.14	5.94	12.97	0.82	1128.22	188.69
07/01/93	3	3117	22.12	5.94	10.63	0.67	1134.16	189.36
07/02/93	?date	3118		0.00	62.14	0.00	1134.16	189.36
07/03/93	?date	3119		0.00	49	0.00	1134.16	189.36
10/04/93	3	200	20	5.37	63	3.59	1139.53	192.96
10/07/93	3	201	17	4.56	62	3.04	1144.09	195.99
10/08/93	3	202	6	1.61	63	1.08	1145.70	197.08
10/11/93	3	203	10	2.68	62	1.77	1148.38	198.84
10/13/93	3	204	13	3.49	60	2.24	1151.87	201.08
10/15/93	3	205	13	3.49	48	1.80	1155.36	202.89
10/18/93	3	206	36	9.66	46	4.80	1165.02	207.69
10/20/93	3	207	34	9.12	47	4.59	1174.14	212.28
10/21/93	3	208	11	2.95	38	1.21	1177.10	213.49
10/22/93	3	209	11	2.95	40	1.27	1180.05	214.76
10/25/93	3	210	36	9.66	41	4.26	1189.71	219.02
10/28/93	3	211	23	6.04	35	2.29	1195.75	221.31
10/31/93	3	212	13	3.35	33	1.19	1199.10	222.50
11/04/93	3	213	15	4.03	41	1.75	1203.13	224.26
11/10/93	3	214	10	2.68	19	0.53	1205.81	224.79
12/21/93	3	215	15	4.03	31	1.32	1209.83	226.11
01/03/94	3	216	30	8.05	19	1.66	1217.88	227.77
02/23/94	3	217	100	26.84	5	1.33	1244.72	229.10
				0				
				0				
				0				
08/09/89	4	2	44.24	11.87	0.71	0.08	11.87	0.08
10/29/89	4	3	36.01	9.66	2.23	0.22	21.54	0.30
11/01/89	4	4	44.24	11.87	3.22	0.38	33.41	0.68
11/01/89	4	5	44.24	11.87	5.09	0.60	45.28	1.29
11/02/89	4	6	44.24	11.87	6.47	0.77	57.15	2.05
11/03/89	4	7	44.24	11.87	6.14	0.73	69.02	2.78

Estimates were made in drainage amount.

	Lys#	Sample#	Vol liters	Drain mm	NO3-N ppm	Load kg/ha	cum drain (mm)	cum load kg/ha
11/07/89	4	8	44.24	11.87	10.42	1.24	80.89	4.02
11/14/89	4	9	44.24	11.87	8.55	1.02	92.77	5.04
11/17/89	4	10	44.24	11.87	10.44	1.24	104.64	6.27
11/19/89	4	11	44.24	11.87	12.91	1.53	116.51	7.81
11/23/89	4	12	44.24	11.87	18.22	2.16	128.38	9.97
12/01/89	4	13	44.24	11.87	16.75	1.99	140.25	11.96
12/17/89	4	14	44.24	11.87	17.37	2.06	152.13	14.02
01/20/90	4	15	44.24	11.87	17.99	2.14	164.00	16.16
01/30/90	4	16	44.24	11.87	31.74	3.77	175.87	19.93
02/06/90	4	17	44.24	11.87	30.33	3.60	187.74	23.53
02/09/90	4	18	22.13	5.94	26.47	1.57	193.68	25.10
02/13/90	4	19	22.12	5.94	27.60	1.64	199.62	26.74
02/21/90	4	20	22.13	5.94	25.43	1.51	205.56	28.25
02/22/90	4	21	22.12	5.94	18.60	1.10	211.49	29.35
02/23/90	4	22	22.12	5.94	21.46	1.27	217.43	30.62
02/23/90	4	23	22.12	5.94	20.21	1.20	223.36	31.82
02/24/90	4	24	22.12	5.94	23.46	1.39	229.30	33.22
02/26/90	4	25	22.12	5.94	16.54	0.98	235.23	34.20
02/27/90	4	26	22.12	5.94	16.64	0.99	241.17	35.19
03/02/90	4	27	22.18	5.95	12.30	0.73	247.12	35.92
03/05/90	4	28	22.12	5.94	24.51	1.45	253.06	37.37
03/09/90	4	29	22.12	5.94	15.71	0.93	258.99	38.31
03/09/90	4	30	22.12	5.94	11.18	0.66	264.93	38.97
03/10/90	4	31	22.12	5.94	12.54	0.74	270.87	39.71
03/11/90	4	32	22.12	5.94	13.24	0.79	276.80	40.50
03/13/90	4	33	22.18	5.95	11.17	0.66	282.75	41.16
03/15/90	4	34	22.13	5.94	14.02	0.83	288.69	42.00
03/17/90	4	35	22.12	5.94	17.56	1.04	294.63	43.04
03/20/90	4	36	22.12	5.94	15.76	0.94	300.57	43.98
03/25/90	4	37	22.14	5.94	25.58	1.52	306.51	45.49
04/03/90	4	38	22.13	5.94	20.47	1.22	312.45	46.71
04/12/90	4	39	22.14	5.94	30.30	1.80	318.39	48.51
04/15/90	4	40	22.17	5.95	21.56	1.28	324.34	49.79
04/18/90	4	41	22.15	5.94	15.54	0.92	330.28	50.72
04/21/90	4	42	22.15	5.94	17.01	1.01	336.22	51.73
04/24/90	4	43	22.17	5.95	17.58	1.05	342.17	52.77
04/27/90	4	44	22.16	5.95	15.60	0.93	348.12	53.70
05/01/90	4	45	22.14	5.94	19.03	1.13	354.06	54.83
05/08/90	4	46	22.14	5.94	23.33	1.39	360.00	56.22
05/16/90	4	47	22.18	5.95	21.29	1.27	365.95	57.49
05/17/90	4	48	22.31	5.99	18.93	1.13	371.94	58.62
05/18/90	4	49	22.36	6.00	16.04	0.96	377.94	59.58
05/18/90	4	50	22.31	5.99	23.78	1.42	383.93	61.01
05/19/90	4	51	22.28	5.98	18.98	1.13	389.91	62.14

Estimates were made in drainage amount.

	Lys#	Sample#	Vol liters	Drain mm	NO3-N ppm	Load kg/ha	cum drain (mm)	cum load kg/ha
05/20/90	4	52	22.21	5.96	16.03	0.96	395.87	63.10
05/22/90	4	53	22.24	5.97	14.00	0.84	401.84	63.93
05/25/90	4	54	22.15	5.94	20.01	1.19	407.78	65.12
05/29/90	4	55	22.13	5.94	10.09	0.60	413.72	65.72
06/05/90	4	56	22.17	5.95	14.12	0.84	419.67	66.56
06/16/90	4	57	22.13	5.94	25.38	1.51	425.61	68.07
07/02/90	4	58	22.13	5.94	26.61	1.58	431.55	69.65
07/23/90	4	59	22.15	5.94	27.86	1.66	437.49	71.30
07/27/90	4	60	22.16	5.95	23.12	1.37	443.44	72.68
07/31/90	4	61	22.17	5.95	24.30	1.45	449.39	74.12
08/08/90	4	62	22.13	5.94	26.55	1.58	455.32	75.70
08/15/90	4	63	22.15	5.94	25.17	1.50	461.27	77.20
08/20/90	4	64	22.14	5.94	23.33	1.39	467.21	78.58
08/24/90	4	65	22.16	5.95	14.92	0.89	473.16	79.47
08/28/90	4	66	22.15	5.94	28.08	1.67	479.10	81.14
09/03/90	4	67	22.13	5.94	23.68	1.41	485.04	82.55
09/12/90	4	68	22.13	5.94	25.97	1.54	490.98	84.09
10/06/90	4	69	22.17	5.95	26.08	1.55	496.93	85.64
10/09/90	4	70	22.23	5.97	19.18	1.14	502.89	86.78
10/10/90	4	71	22.36	6.00	22.89	1.37	508.89	88.16
10/10/90	4	72	22.95	6.16	23.32	1.44	515.05	89.59
10/10/90	4	73	22.87	6.14	25.02	1.54	521.19	91.13
10/10/90	4	74	23.43	6.29	21.90	1.38	527.48	92.51
10/11/90	4	75	22.54	6.05	12.43	0.75	533.52	93.26
10/11/90	4	76	22.41	6.01	13.25	0.80	539.54	94.05
10/12/90	4	77	22.31	5.99	11.93	0.71	545.53	94.77
10/12/90	4	78	22.24	5.97	13.49	0.81	551.49	95.57
10/14/90	4	79	22.23	5.97	17.81	1.06	557.46	96.64
10/16/90	4	80	22.17	5.95	19.22	1.14	563.41	97.78
10/20/90	4	81	22.14	5.94	15.30	0.91	569.35	98.69
10/27/90	4	82	22.13	5.94	17.65	1.05	575.29	99.74
11/05/90	4	83	22.14	5.94	13.83	0.82	581.23	100.56
11/07/90	4	84	22.26	5.97	17.87	1.07	587.20	101.63
11/08/90	4	85	22.22	5.96	20.68	1.23	593.17	102.86
11/09/90	4	86	22.19	5.95	20.00	1.19	599.12	104.05
11/12/90	4	87	22.16	5.95	20.68	1.23	605.07	105.28
11/17/90	4	88	22.14	5.94	21.70	1.29	611.01	106.57
11/26/90	4	89	22.13	5.94	17.80	1.06	616.95	107.63
11/28/90	4	90	22.69	6.09	19.60	1.19	623.04	108.82
11/28/90	4	91	23.48	6.30	19.70	1.24	629.34	110.06
11/28/90	#	92	22.59	6.06	20.00	1.21	635.40	111.27
11/29/90	#	93	22.48	6.03	20.00	1.21	641.43	112.48
11/29/90	#	94	22.54	6.05	20.00	1.21	647.48	113.69
11/30/90	#	95	22.29	5.98	20.00	1.20	653.46	114.89

Estimates were made in drainage amount.

	Lys#	Sample#	Vol liters	Drain mm	NO3-N ppm	Load kg/ha	cum drain (mm)	cum load kg/ha
11/30/90	#	96	22.29	5.98	20.00	1.20	659.44	116.08
12/02/90	#	97	22.17	5.95	20.00	1.19	665.39	117.27
12/04/90	4	98	22.21	5.96	19.00	1.13	671.35	118.40
12/06/90	4	99	22.16	5.95	20.00	1.19	677.30	119.59
01/23/91	Volume guess and N guess	100	161.36	43.30	20.00	8.66	720.60	128.25
02/01/91	"	101	87.94	23.60	7.90	1.86	744.20	130.12
03/06/91	"	102	44.72	12.00	7.90	0.95	0.00	0.00
04/06/91	4	2	44.36	11.90	6.94	0.83	11.90	0.83
04/16/91	4	4	22.23	5.97	7.73	0.46	17.87	1.29
04/17/91	4	5	22.33	5.99	5.37	0.32	23.86	1.61
04/19/91	4	6	22.19	5.95	6.03	0.36	29.82	1.97
04/22/91	4	7	22.22	5.96	3.79	0.23	35.78	2.19
04/25/91	4	8	22.15	5.94	4.16	0.25	41.72	2.44
04/27/91	4	9	22.12	5.94	8.23	0.49	47.66	2.93
04/30/91	4	10	22.17	5.95	8.18	0.49	53.61	3.42
05/02/91	4	11	22.18	5.95	5.74	0.34	59.56	3.76
05/05/91	4	12	22.16	5.95	6.87	0.41	65.51	4.17
05/12/91	4	13	11.07	2.97	8.42	0.25	68.48	4.42
05/20/91	4	14	11.07	2.97	3.36	0.10	71.45	4.52
05/28/91	4	15	22.13	5.94	5.47	0.32	77.39	4.84
06/04/91	4	16	22.17	5.95	7.86	0.47	83.34	5.31
06/06/91	4	17	22.23	5.97	4.03	0.24	89.30	5.55
06/10/91	4	18	22.15	5.94	1.14	0.07	95.25	5.62
06/15/91	4	19	22.14	5.94	6.75	0.40	101.19	6.02
06/24/91	4	20	22.14	5.94	7.80	0.46	107.13	6.48
07/03/91	4	21	44.53	11.95	5.11	0.61	119.08	7.09
07/17/91	4	22	88.61	23.78	6.10	1.45	142.86	8.54
07/29/91	4	23	22.13	5.94	5.50	0.33	148.80	8.87
08/20/91	4	24	22.17	5.95	8.20	0.49	154.75	9.36
08/25/91	4	25	22.14	5.94	12.10	0.72	160.69	10.08
09/02/91	4	26	22.13	5.94	6.30	0.37	166.63	10.45
09/19/91	4	27	22.12	5.94	9.98	0.59	172.56	11.04
10/08/91	4	28	22.17	5.95	2.57	0.15	178.51	11.20
10/10/91	4	29	22.16	5.95	11.36	0.68	184.46	11.87
10/14/91	4	30	22.18	5.95	9.64	0.57	190.41	12.45
10/21/91	4	31	22.14	5.94	12.08	0.72	196.35	13.16
10/26/91	4	#	22.54	6.05	10.00	0.60	202.40	13.77
10/26/91	4	#	22.50	6.04	10.00	0.60	208.44	14.37

Estimates were made in drainage amount.

	Lys#	Sample#	Vol liters	Drain mm	NO3-N ppm	Load kg/ha	cum drain (mm)	cum load kg/ha
10/26/91	4	#	22.41	6.01	10.00	0.60	214.45	14.97
10/27/91	4	#	22.31	5.99	10.00	0.60	220.44	15.57
10/27/91	4	#	22.40	6.01	10.00	0.60	226.45	16.17
10/28/91	4	#	22.36	6.00	10.00	0.60	232.45	16.77
10/28/91	4	#	22.28	5.98	10.00	0.60	238.43	17.37
10/29/91	4	#	22.22	5.96	10.00	0.60	244.39	17.97
10/31/91	4	#	22.23	5.97	10.00	0.60	250.36	18.56
11/01/91	4	#	22.50	6.04	10.00	0.60	256.39	19.17
11/02/91	4	#	22.22	5.96	10.00	0.60	262.36	19.76
11/03/91	4	32	22.18	5.95	8.54	0.51	268.31	20.27
11/05/91	4	33	22.17	5.95	13.66	0.81	274.26	21.08
11/09/91	4	34	22.15	5.94	7.98	0.47	280.20	21.56
11/14/91	4	35	22.13	5.94	7.86	0.47	286.14	22.03
11/22/91	4	36	22.36	6.00	11.41	0.68	292.14	22.71
11/23/91	4	37	22.22	5.96	11.10	0.66	298.10	23.37
11/24/91	4	38	22.26	5.97	13.13	0.78	304.08	24.16
11/26/91	4	39	22.17	5.95	6.65	0.40	310.03	24.55
12/01/91	4	40	22.14	5.94	7.59	0.45	315.97	25.00
12/06/91	4	41	22.15	5.94	9.97	0.59	321.91	25.60
12/10/91	4	42	22.21	5.96	5.43	0.32	327.87	25.92
12/11/91	4	43	22.18	5.95	9.19	0.55	333.82	26.47
12/13/91	4	44	22.17	5.95	7.24	0.43	339.77	26.90
12/16/91	4	45	22.26	5.97	8.66	0.52	345.75	27.41
12/19/91	4	46	22.16	5.95	6.23	0.37	351.69	27.78
12/25/91	4	47	22.14	5.94	8.76	0.52	357.64	28.31
01/05/92	4	48	22.13	5.94	6.56	0.39	363.57	28.69
01/11/92	4	49	22.14	5.94	10.42	0.62	369.52	29.31
01/16/92	4	50	22.15	5.94	4.48	0.27	375.46	29.58
01/22/92	4	51	22.15	5.94	5.94	0.35	381.40	29.93
01/30/92	4	52	22.15	5.94	5.19	0.31	387.35	30.24
02/05/92	4	53	22.15	5.94	6.20	0.37	393.29	30.61
02/15/92	4	54	22.14	5.94	6.60	0.39	399.23	31.00
02/20/92	4	55	22.19	5.95	8.30	0.49	405.19	31.50
02/22/92	4	56	22.23	5.97	3.70	0.22	411.15	31.72
02/25/92	4	57	22.16	5.95	22.00	1.31	417.10	33.03
02/29/92	4	58	22.14	5.94	9.60	0.57	423.04	33.60
03/06/92	4	59	22.14	5.94	8.59	0.51	428.98	34.11
03/15/92	4	60	22.16	5.95	7.81	0.46	434.93	34.57
03/19/92	4	61	22.14	5.94	5.67	0.34	440.87	34.91
03/24/92	4	62	22.15	5.94	8.24	0.49	446.81	35.40
03/30/92	4	63	22.16	5.95	8.89	0.53	452.76	35.93
04/05/92	4	64	22.13	5.94	8.14	0.48	458.70	36.41
04/10/92	4	65	22.15	5.94	6.88	0.41	464.64	36.82
04/17/92	4	66	22.13	5.94	3.64	0.22	470.58	37.03

Estimates were made in drainage amount.

	Lys#	Sample#	Vol liters	Drain mm	NO3-N ppm	Load kg/ha	cum drain (mm)	cum load kg/ha
04/27/92	4	67	22.13	5.94	7.41	0.44	476.52	37.47
05/09/92	4	68	22.13	5.94	10.85	0.64	482.46	38.12
05/22/92	4	69	22.13	5.94	1.26	0.07	488.40	38.19
06/04/92	4	70	22.13	5.94	5.30	0.31	494.34	38.51
06/21/92	4	71	22.12	5.94	10.16	0.60	500.27	39.11
07/07/92	4	72	22.13	5.94	7.66	0.45	506.21	39.57
07/16/92	4	73	22.22	5.96	3.87	0.23	512.17	39.80
07/17/92	4	74	22.36	6.00	1.72	0.10	518.17	39.90
07/18/92	4	75	22.18	5.95	1.37	0.08	524.13	39.98
07/20/92	4	76	22.17	5.95	1.24	0.07	530.08	40.06
07/23/92	4	77	22.19	5.95	5.36	0.32	536.03	40.38
07/24/92	4	78	22.44	6.02	3.88	0.23	542.05	40.61
07/24/92	4	79	22.26	5.97	3.04	0.18	548.03	40.79
07/25/92	4	80	22.21	5.96	2.84	0.17	553.99	40.96
07/27/92	4	81	22.17	5.95	3.25	0.19	559.94	41.15
07/30/92	4	82	22.15	5.94	7.18	0.43	565.88	41.58
08/02/92	4	83	22.21	5.96	6.11	0.36	571.84	41.94
08/03/92	4	84	22.22	5.96	6.52	0.39	577.80	42.33
08/06/92	4	85	22.17	5.95	6.52	0.39	583.75	42.72
08/10/92	4	86	22.15	5.94	5.50	0.33	589.70	43.05
08/18/92	4	87	22.14	5.94	6.46	0.38	595.64	43.43
08/30/92	4	88	22.15	5.94	8.66	0.51	601.58	43.95
09/03/92	4	89	22.14	5.94	6.90	0.41	607.52	44.36
09/09/92	4	90	22.14	5.94	11.03	0.66	613.46	45.01
09/10/92	4	91	22.45	6.02	11.23	0.68	619.49	45.69
09/11/92	4	92	22.64	6.08	11.50	0.70	625.56	46.39
09/11/92	4	93	22.57	6.06	11.60	0.70	631.62	47.09
09/12/92	4	94	22.22	5.96	11.53	0.69	637.58	47.78
09/13/92	4	95	22.18	5.95	11.55	0.69	643.54	48.46
09/15/92	4	96	23.67	6.35	11.16	0.71	649.89	49.17
09/15/92	4	97	23.66	6.35	10.91	0.69	656.24	49.87
09/16/92	4	98	23.15	6.21	9.83	0.61	662.45	50.48
09/16/92	4	99	22.86	6.13	9.24	0.57	668.58	51.04
09/16/92	4	100	22.64	6.08	8.65	0.53	674.66	51.57
09/16/92	4		22.48	6.03	8.00	0.48	680.69	52.05
09/17/92	4		22.36	6.00	8.00	0.48	686.69	52.53
09/17/92	4		22.26	5.97	8.00	0.48	692.67	53.01
09/18/92	4		22.20	5.96	8.00	0.48	698.62	53.49
09/20/92	4	101	22.19	5.95	6.72	0.40	704.58	53.89
09/23/92	4	102	22.16	5.95	4.65	0.28	710.52	54.16
09/28/92	4	103	22.14	5.94	6.09	0.36	716.47	54.52
10/04/92	4	104	22.16	5.95	5.35	0.32	722.41	54.84
10/12/92	4	105	22.13	5.94	5.26	0.31	728.35	55.15
10/15/92	4	106	22.53	6.05	6.13	0.37	734.40	55.53

Estimates were made in drainage amount.

	Lys#	Sample#	Vol liters	Drain mm	NO3-N ppm	Load kg/ha	cum drain (mm)	cum load kg/ha
10/16/92	4	107	22.36	6.00	4.03	0.24	740.40	55.77
10/16/92	4	108	22.30	5.98	5.56	0.33	746.38	56.10
10/17/92	4	109	22.29	5.98	4.12	0.25	752.36	56.35
10/18/92	4	110	22.25	5.97	3.00	0.18	758.33	56.53
10/19/92	4	111	22.31	5.99	3.53	0.21	764.32	56.74
10/21/92	4	112	22.16	5.95	3.92	0.23	770.27	56.97
10/25/92	4	113	22.14	5.94	4.45	0.26	776.21	57.23
11/01/92	4	114	22.13	5.94	3.46	0.21	782.15	57.44
11/03/92	4	115	22.26	5.97	3.55	0.21	788.12	57.65
11/04/92	4	116	22.22	5.96	2.49	0.15	794.08	57.80
11/06/92	4	117	22.17	5.95	3.30	0.20	800.03	58.00
11/08/92	4	118	22.16	5.95	6.47	0.38	805.98	58.38
11/12/92	4	119	22.17	5.95	2.45	0.15	811.93	58.53
11/13/92	4	120	22.27	5.98	3.72	0.22	817.91	58.75
11/14/92	4	121	22.32	5.99	4.07	0.24	823.90	58.99
11/15/92	4	122	22.20	5.96	5.60	0.33	829.85	59.33
11/17/92	4	123	22.17	5.95	3.42	0.20	835.80	59.53
11/20/92	4	124	22.15	5.94	3.58	0.21	841.75	59.74
11/25/92	4	125	22.16	5.95	4.07	0.24	847.69	59.99
11/27/92	4	126	22.16	5.95	4.99	0.30	853.64	60.28
12/01/92	4	127	22.15	5.94	3.23	0.19	859.58	60.47
12/07/92	4	128	22.13	5.94	3.02	0.18	865.52	60.65
12/17/92	4	129	22.13	5.94	4.38	0.26	871.46	60.91
12/21/92	4	130	22.15	5.94	4.15	0.25	877.40	61.16
12/26/92	4	131	22.14	5.94	3.00	0.18	883.35	61.34
01/01/93	4	132	22.28	5.98	3.32	0.20	889.33	61.54
01/02/93	4	133	22.23	5.97	3.02	0.18	895.29	61.72
01/03/93	4	134	22.19	5.95	2.28	0.14	901.25	61.85
01/04/93	4	135	22.41	6.01	2.48	0.15	907.26	62.00
01/05/93	4	136	22.53	6.05	2.03	0.12	913.31	62.12
01/05/93	4	137	22.36	6.00	2.14	0.13	919.31	62.25
01/06/93	4	138	22.31	5.99	1.94	0.12	925.29	62.37
01/06/93	4	139	22.25	5.97	1.79	0.11	931.26	62.48
01/08/93	4	140	22.20	5.96	1.31	0.08	937.22	62.55
01/10/93	4	141	22.17	5.95	1.63	0.10	943.17	62.65
01/13/93	4	142	22.15	5.94	1.18	0.07	949.11	62.72
01/19/93	4	143	22.13	5.94	1.82	0.11	955.05	62.83
01/24/93	4	144	22.24	5.97	1.21	0.07	961.02	62.90
01/26/93	4	145	22.19	5.95	1.43	0.09	966.98	62.99
01/28/93	4	146	22.16	5.95	2.45	0.15	972.92	63.13
02/01/93	4	147	22.13	5.94	2.52	0.15	978.86	63.28
02/07/93	4	148	22.14	5.94	3.26	0.19	984.80	63.48
02/17/93	4	149	22.12	5.94	3.01	0.18	990.74	63.65
03/06/93	4		22.12	5.94		0.00	996.67	63.65

Estimates were made in drainage amount.

	Lys#	Sample#	Vol liters	Drain mm	NO3-N ppm	Load kg/ha	cum drain (mm)	cum load kg/ha
03/25/93	4		22.14	5.94		0.00	1002.62	63.65
03/27/93	4		22.22	5.96		0.00	1008.58	63.65
03/29/93	4	150	22.17	5.95	2.18	0.13	1014.53	63.78
04/01/93	4	151	22.16	5.95	0.92	0.05	1020.47	63.84
04/04/93	4	152	22.23	5.97	3.83	0.23	1026.44	64.07
04/06/93	4	153	22.16	5.95	2.18	0.13	1032.39	64.20
04/10/93	4	154	22.14	5.94	0.92	0.05	1038.33	64.25
04/16/93	4	155	22.13	5.94		0.00	1044.27	64.25
04/21/93	4	156	22.17	5.95		0.00	1050.22	64.25
06/02/93	4	157	24.75	6.64		0.00	1056.86	64.25
06/08/93	4	4155	22.53	6.05	1.85	0.11	1062.90	64.36
06/09/93	4	4156	22.51	6.04	4.03	0.24	1068.94	64.61
06/09/93	4	4157	22.49	6.04	3.77	0.23	1074.98	64.83
06/09/93	4	4158	22.85	6.13	3.27	0.20	1081.11	65.03
06/10/93	4	4159	22.33	5.99	4.31	0.26	1087.10	65.29
06/10/93	4	4160	22.45	6.02	1.07	0.06	1093.13	65.36
06/11/93	4	4161	22.21	5.96	3.89	0.23	1099.09	65.59
06/13/93	4	4162	22.26	5.97	6.53	0.39	1105.06	65.98
06/15/93	4	4163	22.17	5.95	4.97	0.30	1111.01	66.28
06/18/93	4	4164	22.16	5.95	6.12	0.36	1116.96	66.64
06/22/93	4	4165	22.14	5.94	9.53	0.57	1122.90	67.21
06/23/93	4		22.17	5.95	8.98	0.53	1128.85	67.74
07/04/93	4		22.13	5.94		0.00	1134.79	67.74
07/15/93	4		22.13	5.94		0.00	1140.73	67.74
10/04/93	4	200	15	4.03	8.48	0.34	1144.75	68.08
10/07/93	4	201	18	4.70	6.69	0.31	1149.45	68.40
10/08/93	4	202	7	1.88	8.51	0.16	1151.33	68.56
10/11/93	4	203	11	2.82	8.17	0.23	1154.14	68.79
10/13/93	4	204	9	2.42	8.14	0.20	1156.56	68.98
10/15/93	4	205	10	2.68	8.06	0.22	1159.24	69.20
10/18/93	4	206	38	10.20	7.29	0.74	1169.44	69.94
10/20/93	4	207	40	10.73	6.80	0.73	1180.17	70.67
10/21/93	4	208	14	3.62	5.61	0.20	1183.80	70.87
10/22/93	4	209	12	3.22	5.79	0.19	1187.02	71.06
10/25/93	4	210	36	9.66	4.91	0.47	1196.68	71.54
10/28/93	4	211	24	6.44	4.52	0.29	1203.12	71.83
10/31/93	4	212	16	4.29	4.46	0.19	1207.41	72.02
11/04/93	4	213	14	3.76	5.07	0.19	1211.17	72.21
11/10/93	4	214	15	4.03	2.48	0.10	1215.19	72.31
12/21/93	4	215	14	3.76	3.80	0.14	1218.95	72.45
01/03/94	4	216	37	9.93	3.84	0.38	1228.88	72.83
02/23/94	4	217	100	26.84	3.35	0.90	1255.71	73.73
				0.00				
				0.00				

Estimates were made in drainage amount.

	Lys#	Sample#	Vol liters	Drain mm	NO3-N ppm	Load kg/ha	cum drain (mm)	cum load kg/ha
				0.00				
07/02/89	5	2	22.12	5.94	13.02	0.773	5.94	0.77
07/21/89	5	3	22.12	5.94	7.80	0.463	11.87	1.24
08/20/89	5	4	22.12	5.94	12.36	0.734	17.81	1.97
10/30/89	5	5	18.00	4.83	14.73	0.712	22.64	2.68
10/31/89	5	6	22.13	5.94	8.87	0.527	28.58	3.21
11/01/89	5	7	22.13	5.94	6.02	0.358	34.52	3.57
11/01/89	5	8	22.13	5.94	21.03	1.249	40.45	4.81
11/01/89	5	9	22.13	5.94	22.49	1.336	46.39	6.15
11/01/89	5	10#	22.13	5.94	22.98	1.365	52.33	7.51
11/01/89	5	11#	22.12	5.94	22.98	1.364	58.27	8.88
11/02/89	5	12#	22.12	5.94	22.98	1.364	64.20	10.24
11/03/89	5	13#	22.12	5.94	22.98	1.364	70.14	11.61
11/04/89	5	14	22.12	5.94	23.46	1.393	76.08	13.00
11/05/89	5	15	22.12	5.94	27.67	1.642	82.01	14.64
11/07/89	5	16	22.12	5.94	28.72	1.705	87.95	16.35
11/10/89	5	17	22.12	5.94	29.45	1.748	93.88	18.09
11/14/89	5	18	22.12	5.94	19.21	1.140	99.82	19.24
11/17/89	5	19	22.12	5.94	24.13	1.432	105.75	20.67
11/18/89	5	20	22.12	5.94	18.56	1.102	111.69	21.77
11/19/89	5	21	22.12	5.94	7.49	0.445	117.63	22.21
11/20/89	5	22	22.12	5.94	15.12	0.898	123.56	23.11
11/21/89	5	23	22.12	5.94	20.72	1.230	129.50	24.34
11/24/89	5	24	22.12	5.94	31.25	1.855	135.43	26.20
11/27/89	5	25	22.12	5.94	32.23	1.913	141.37	28.11
12/01/89	5	26	22.12	5.94	24.29	1.442	147.31	29.55
12/07/89	5	27	22.12	5.94	35.13	2.085	153.24	31.64
12/17/89	5	28	22.12	5.94	21.08	1.251	159.18	32.89
01/04/90	5	29	22.12	5.94	23.66	1.404	165.11	34.29
01/26/90	5	#44	22.12	5.94	15.47	0.918	171.05	35.21
01/29/90	5	45	22.12	5.94	16.56	0.983	176.99	36.19
02/01/90	5	46	22.12	5.94	19.83	1.177	182.92	37.37
02/04/90	5	47	22.12	5.94	24.52	1.455	188.86	38.83
02/08/90	5	48	22.12	5.94	21.57	1.280	194.79	40.11
02/11/90	5	49	22.16	5.95	21.06	1.252	200.74	41.36
02/16/90	5	50	22.12	5.94	15.21	0.903	206.68	42.26
02/22/90	5	51	22.12	5.94	18.88	1.121	212.61	43.38
02/23/90	5	52	22.12	5.94	18.23	1.082	218.55	44.46
02/24/90	5	53	22.12	5.94	12.02	0.714	224.48	45.18
02/25/90	5	54	22.12	5.94	23.18	1.376	230.42	46.55
02/26/90	5	55	22.13	5.94	21.19	1.258	236.36	47.81
02/28/90	5	56	22.12	5.94	31.81	1.888	242.30	49.70
03/02/90	5	57	22.12	5.94	31.74	1.884	248.23	51.58
03/04/90	5	58	22.12	5.94	47.67	2.830	254.17	54.41

Estimates were made in drainage amount.

	Lys#	Sample#	Vol liters	Drain mm	NO3-N ppm	Load kg/ha	cum drain (mm)	cum load kg/ha
03/09/90	5	59	22.12	5.94	19.10	1.134	260.10	55.55
03/10/90	5	60	22.12	5.94	19.96	1.185	266.04	56.73
03/11/90	5	61	22.12	5.94	10.30	0.611	271.98	57.34
03/11/90	5	62	22.12	5.94	15.04	0.893	277.91	58.24
03/12/90	5	63	22.12	5.94	9.52	0.565	283.85	58.80
03/13/90	5	64	22.12	5.94	19.83	1.177	289.78	59.98
03/13/90	5	65	22.12	5.94	18.75	1.113	295.72	61.09
03/14/90	5	66	22.26	5.97	12.07	0.721	301.69	61.81
03/16/90	5	67	22.13	5.94	27.43	1.629	307.63	63.44
03/17/90	5	68	22.19	5.95	29.05	1.730	313.59	65.17
03/20/90	5	69	22.17	5.95	30.55	1.818	319.54	66.99
03/24/90	5	70	22.16	5.95	32.34	1.923	325.48	68.91
03/30/90	5	71	22.14	5.94	33.07	1.965	331.42	70.88
04/09/90	5	72	22.16	5.95	18.52	1.101	337.37	71.98
04/15/90	5	73	22.20	5.96	25.93	1.545	343.33	73.52
04/18/90	5	74	22.22	5.96	14.17	0.845	349.29	74.37
04/20/90	5	75	22.17	5.95	20.86	1.241	355.24	75.61
04/24/90	5	76	22.15	5.94	24.92	1.481	361.18	77.09
04/27/90	5	77	22.16	5.95	32.05	1.906	367.13	79.00
05/01/90	5	78	22.15	5.94	25.92	1.541	373.07	80.54
05/06/90	5	79	22.14	5.94	26.34	1.565	379.02	82.10
05/13/90	5	80	22.13	5.94	18.16	1.078	384.95	83.18
05/17/90	5	81	22.18	5.95	17.94	1.068	390.91	84.25
05/18/90	5	82	22.45	6.02	25.96	1.564	396.93	85.81
05/18/90	5	83	22.84	6.13	23.54	1.443	403.06	87.26
05/19/90	5	84	22.34	5.99	29.48	1.767	409.05	89.02
05/19/90	5	85	22.28	5.98	8.73	0.522	415.03	89.54
05/20/90	5	86	22.22	5.96	15.79	0.942	421.00	90.49
05/22/90	5	87	22.19	5.95	10.79	0.643	426.95	91.13
05/24/90	5	88	22.17	5.95	12.40	0.738	432.90	91.87
05/27/90	5	89	22.15	5.94	5.76	0.342	438.84	92.21
06/01/90	5	90	22.14	5.94	13.56	0.806	444.79	93.01
06/09/90	5	91	22.13	5.94	24.93	1.481	450.72	94.50
06/21/90	5	92	22.12	5.94	16.78	0.996	456.66	95.49
07/09/90	5	93	22.12	5.94	29.40	1.745	462.60	97.24
08/04/90	5	94	22.12	5.94	31.44	1.866	468.53	99.10
08/20/90	5	95#	22.13	5.94	22.50	1.336	474.47	100.44
08/27/90	5	96#	22.14	5.94	22.50	1.337	480.41	101.78
09/01/90	5	97#	22.14	5.94	22.50	1.337	486.35	103.11
09/10/90	5	98#	22.13	5.94	22.50	1.336	492.29	104.45
10/04/90	5	99#	29.37	7.88	22.50	1.773	500.17	106.22
10/04/90	5	100#	22.13	5.94	22.50	1.336	506.11	107.56
10/10/90	5	101#	22.50	6.04	22.50	1.359	512.15	108.92
10/11/90	5	102#	22.40	6.01	22.50	1.352	518.16	110.27

Estimates were made in drainage amount.

	Lys#	Sample#	Vol liters	Drain mm	NO3-N ppm	Load kg/ha	cum drain (mm)	cum load kg/ha
10/11/90	5	103	22.28	5.98	35.09	2.098	524.14	112.37
10/12/90	5	104	22.22	5.96	29.91	1.783	530.10	114.15
10/14/90	5	105	22.16	5.95	52.81	3.140	536.05	117.29
10/19/90	5	106	22.14	5.94	59.54	3.537	541.99	120.83
10/27/90	5	107	22.14	5.94	61.66	3.663	547.93	124.49
11/03/90	5	108	22.14	5.94	43.10	2.561	553.87	127.05
11/07/90	5	109	22.21	5.96	69.31	4.131	559.83	131.18
11/09/90	5	110	22.21	5.96	30.00	1.788	565.79	132.97
11/10/90	5	111	22.23	5.97	30.00	1.790	571.76	134.76
11/13/90	5	112	22.16	5.95	69.31	4.122	577.71	138.88
11/17/90	5	113	22.14	5.94	82.20	4.884	583.65	143.77
11/23/90	5	114	22.14	5.94	78.90	4.688	589.59	148.45
11/28/90	5	115	22.40	6.01	78.90	4.743	595.60	153.20
11/28/90	5	116	22.65	6.08	30.00	1.823	601.68	155.02
11/28/90	5	117	23.62	6.34	30.00	1.902	608.02	156.92
11/28/90	5	118	22.60	6.06	30.00	1.819	614.08	158.74
11/29/90	5	119	22.49	6.04	30.00	1.811	620.12	160.55
11/29/90	5	120	22.39	6.01	30.00	1.803	626.13	162.35
11/29/90	5	121	22.31	5.99	30.00	1.796	632.11	164.15
11/30/90	5	122	22.26	5.97	30.00	1.792	638.09	165.94
12/01/90	5	123	22.22	5.96	30.00	1.789	644.05	167.73
12/03/90	5	124	22.19	5.95	85.60	5.097	650.00	172.83
01/23/91	#drain guess	125	160.24	43.00	78.60	33.798	693.00	206.63
02/01/91	from rain data	126	87.94	23.60	78.90	18.620	716.60	225.25
03/06/91	#	127	44.72	12.00	78.90	9.468	0.00	0.00
04/01/91	5	1	22.13	5.94	44.10	2.619	5.94	2.62
04/09/91	5	2	22.14	5.94	15.00	0.891	11.88	3.51
04/16/91	5	4	22.30	5.98	15.00	0.898	17.86	4.41
04/28/91	5	8	157.05	42.14	21.10	8.893	60.01	13.30
04/30/91	5	9	22.18	5.95	15.70	0.934	65.96	14.23
05/03/91	5	10	22.17	5.95	22.80	1.356	71.91	15.59
05/05/91	5	11	22.16	5.95	23.61	1.404	77.86	17.00
05/12/91	5	12	7.38	1.98	21.10	0.418	79.84	17.41
05/13/91	5	13	7.38	1.98	33.90	0.671	81.82	18.08
05/18/91	5	14	7.38	1.98	11.19	0.222	83.80	18.31
05/29/91	5	15	22.13	5.94	8.88	0.527	89.74	18.83
06/08/91	5	16	22.14	5.94	12.20	0.725	95.68	19.56
06/15/91	5	17	22.13	5.94	10.51	0.624	101.62	20.18
06/25/91	5	18	22.13	5.94	3.90	0.232	107.56	20.41
07/02/91	5	19	22.26	5.97	24.66	1.473	113.53	21.89

Estimates were made in drainage amount.

	Lys#	Sample#	Vol liters	Drain mm	NO3-N ppm	Load kg/ha	cum drain (mm)	cum load kg/ha
07/03/91	5	20	22.22	5.96	7.35	0.438	119.49	22.33
07/05/91	5	21	22.22	5.96	14.60	0.871	125.45	23.20
07/07/91	5	22	22.16	5.95	4.23	0.252	131.40	23.45
09/12/91	5	23	66.39	17.82	19.32	3.442	149.22	26.89
09/26/91	5	24	22.12	5.94	20.41	1.212	155.15	28.10
10/13/91	5	25	22.14	5.94	12.55	0.746	161.09	28.85
10/20/91	5	26	22.13	5.94	13.13	0.780	167.03	29.63
10/26/91	5	27	22.47	6.03	12.81	0.772	173.06	30.40
10/26/91	5	28	22.37	6.00	12.12	0.728	179.07	31.13
10/27/91	5	29	22.33	5.99	6.51	0.390	185.06	31.52
10/27/91	5	30	22.39	6.01	11.60	0.697	191.07	32.21
10/28/91	5	31	22.67	6.08	11.32	0.689	197.15	32.90
10/29/91	5	32	22.28	5.98	19.59	1.171	203.13	34.07
10/30/91	5	33	22.24	5.97	12.50	0.746	209.10	34.82
10/31/91	5	34	22.20	5.96	18.46	1.100	215.05	35.92
11/01/91	5	#	44.49	11.94	15.00	1.791	226.99	37.71
11/03/91	5	36	22.20	5.96	14.60	0.870	232.95	38.58
11/05/91	5	37	22.24	5.97	22.36	1.334	238.92	39.91
11/08/91	5		22.16	5.95	15.78	0.938	244.87	40.85
11/11/91	5		22.15	5.94	19.80	1.177	250.81	42.03
11/18/91	5	38	22.14	5.94	29.79	1.770	256.75	43.80
11/23/91	5	39	22.20	5.96	28.29	1.685	262.71	45.48
11/25/91	5	40	22.18	5.95	20.08	1.195	268.66	46.68
11/27/91	5	41	22.17	5.95	17.36	1.033	274.61	47.71
11/30/91	5	42	22.14	5.94	14.60	0.867	280.55	48.58
01/07/92	5	43	22.26	5.97	11.23	0.671	286.53	49.25
01/13/92	5	44	22.15	5.94	15.47	0.920	292.47	50.17
01/17/92	5	45	22.16	5.95	11.81	0.702	298.42	50.87
01/21/92	5	46	22.14	5.94	14.08	0.837	304.36	51.71
01/27/92	5	47	22.15	5.94	11.55	0.687	310.30	52.40
01/31/92	5	48	22.16	5.95	6.39	0.380	316.25	52.78
02/04/92	5	49	22.14	5.94	10.10	0.600	322.19	53.38
02/11/92	5	50	22.14	5.94	6.60	0.392	328.13	53.77
02/18/92	5	51	22.14	5.94	11.40	0.677	334.07	54.45
02/24/92	5	52	22.15	5.94	10.00	0.594	340.02	55.04
02/28/92	5	53	22.20	5.96	15.50	0.923	345.97	55.96
03/04/92	5	54	22.14	5.94	16.30	0.968	351.91	56.93
03/10/92	5	55	22.14	5.94	13.03	0.774	357.86	57.71
03/17/92	5	56	22.16	5.95	12.60	0.749	363.80	58.46
03/20/92	5	57	22.19	5.95	7.32	0.436	369.76	58.89
03/21/92	5	58	22.25	5.97	11.97	0.715	375.73	59.61
03/24/92	5	59	22.17	5.95	4.37	0.260	381.68	59.87
03/27/92	5	60	22.15	5.94	11.37	0.676	387.62	60.54
03/31/92	5	61	22.16	5.95	10.96	0.652	393.57	61.19

Estimates were made in drainage amount.

	Lys#	Sample#	Vol liters	Drain mm	NO3-N ppm	Load kg/ha	cum drain (mm)	cum load kg/ha
04/03/92	5	62	22.16	5.95	9.46	0.563	399.51	61.76
04/07/92	5	63	22.15	5.94	10.49	0.624	405.46	62.38
04/13/92	5	64	22.14	5.94	10.75	0.639	411.40	63.02
04/19/92	5	65	22.14	5.94	8.12	0.482	417.34	63.50
04/29/92	5	66	22.13	5.94	11.55	0.686	423.28	64.19
05/12/92	5	67	22.12	5.94	11.50	0.683	429.22	64.87
05/28/92	5	68	22.13	5.94	9.14	0.543	435.15	65.41
06/16/92	5	69	22.13	5.94	4.23	0.251	441.09	65.66
07/09/92	5	70	22.13	5.94	5.27	0.313	447.03	65.98
07/18/92	5	71	22.17	5.95	6.39	0.380	452.98	66.36
07/21/92	5	72	22.16	5.95	1.95	0.116	458.93	66.47
07/24/92	5	73	22.24	5.97	1.41	0.084	464.90	66.56
07/25/92	5	74	22.27	5.98	2.08	0.124	470.87	66.68
07/26/92	5	75	22.28	5.98	1.33	0.080	476.85	66.76
07/27/92	5	76	22.18	5.95	3.67	0.218	482.80	66.98
07/30/92	5	77	22.17	5.95	6.52	0.388	488.75	67.37
08/02/92	5	78	22.20	5.96	11.66	0.695	494.71	68.06
08/04/92	5	79	22.19	5.95	10.12	0.603	500.66	68.66
08/07/92	5	80	22.18	5.95	9.22	0.549	506.62	69.21
08/11/92	5	83	22.14	5.94	7.38	0.438	512.56	69.65
08/19/92	5	84	22.15	5.94	14.37	0.854	518.50	70.51
09/01/92	5	85	22.13	5.94	16.42	0.975	524.44	71.48
09/10/92	5	86	22.24	5.97	17.74	1.059	530.41	72.54
09/11/92	5	87	22.29	5.98	18.64	1.115	536.39	73.65
09/12/92	5	88	22.23	5.97	18.78	1.120	542.36	74.77
09/13/92	5	89	22.19	5.95	24.18	1.440	548.31	76.21
09/15/92	5	90	23.20	6.23	22.67	1.411	554.54	77.63
09/16/92	5	91	23.25	6.24	24.14	1.506	560.78	79.13
09/16/92	5	#	23.09	6.20	20.00	1.239	566.97	80.37
09/16/92	5	#	22.78	6.11	20.00	1.223	573.09	81.59
09/16/92	5	#	22.63	6.07	20.00	1.215	579.16	82.81
09/16/92	5	#	22.50	6.04	18.00	1.087	585.20	83.90
09/17/92	5	#	22.45	6.02	18.00	1.084	591.22	84.98
09/17/92	5	#	22.30	5.98	18.00	1.077	597.20	86.06
09/18/92	5	92	22.23	5.97	17.61	1.051	603.17	87.11
09/20/92	5	93	22.20	5.96	14.60	0.870	609.13	87.98
09/23/92	5	94	22.16	5.95	15.13	0.900	615.07	88.88
09/27/92	5	95	22.15	5.94	17.78	1.057	621.02	89.93
10/03/92	5	96	22.14	5.94	20.66	1.227	626.96	91.16
10/12/92	5	97	22.13	5.94	10.28	0.610	632.90	91.77
10/16/92	5	98	22.26	5.97	14.24	0.851	638.87	92.62
10/17/92	5	99	22.28	5.98	9.95	0.595	644.85	93.22
10/18/92	5	100	22.24	5.97	16.80	1.003	650.82	94.22
10/20/92	5	101	22.21	5.96	15.47	0.922	656.78	95.14

Estimates were made in drainage amount.

	Lys#	Sample#	Vol liters	Drain mm	NO3-N ppm	Load kg/ha	cum drain (mm)	cum load kg/ha
10/22/92	5	102	22.17	5.95	11.95	0.711	662.73	95.85
10/25/92	5	103	22.15	5.94	20.44	1.215	668.67	97.07
10/31/92	5	104	22.14	5.94	17.76	1.055	674.61	98.12
11/04/92	5	105	22.24	5.97	14.08	0.840	680.58	98.96
11/05/92	5	106	22.27	5.98	11.05	0.660	686.56	99.62
11/07/92	5	107	22.22	5.96	12.32	0.735	692.52	100.36
11/09/92	5	108	22.20	5.96	16.48	0.982	698.48	101.34
11/13/92	5	109	22.18	5.95	16.27	0.968	704.43	102.31
11/13/92	5	110	22.40	6.01	14.36	0.863	710.44	103.17
11/14/92	5	111	22.33	5.99	9.73	0.583	716.43	103.75
11/15/92	5	112	22.28	5.98	13.86	0.829	722.41	104.58
11/16/92	5	113	22.23	5.97	13.64	0.814	728.38	105.40
11/17/92	5	114	22.20	5.96	14.10	0.840	734.34	106.24
11/20/92	5	115	22.17	5.95	25.56	1.521	740.28	107.76
11/23/92	5	116	22.17	5.95	18.66	1.110	746.23	108.87
11/26/92	5	117	22.17	5.95	19.81	1.179	752.18	110.05
11/28/92	5	118	22.19	5.95	19.11	1.138	758.14	111.18
12/01/92	5	119	22.16	5.95	6.41	0.381	764.09	111.57
12/06/92	5	120	22.17	5.95	14.24	0.847	770.03	112.41
12/13/92	5	121	22.13	5.94	11.25	0.668	775.97	113.08
12/19/92	5	122	22.15	5.94	14.16	0.842	781.92	113.92
12/22/92	5	123	22.21	5.96	7.74	0.461	787.88	114.38
12/25/92	5	124	22.15	5.94	12.03	0.715	793.82	115.10
12/30/92	5	125	22.14	5.94	9.52	0.566	799.76	115.66
01/01/93	5	126	22.37	6.00	14.27	0.857	805.77	116.52
01/01/93	5	127	22.32	5.99	13.54	0.811	811.76	117.33
01/02/93	5	128	22.26	5.97	10.94	0.654	817.73	117.99
01/03/93	5	129	22.22	5.96	2.40	0.143	823.69	118.13
01/04/93	5	130	22.54	6.05	2.44	0.148	829.74	118.28
01/05/93	5	131	22.54	6.05	4.06	0.246	835.79	118.52
01/05/93	5	132	22.46	6.03	1.24	0.075	841.82	118.60
01/05/93	5	133	22.43	6.02	3.32	0.200	847.84	118.80
01/06/93	5	134	22.36	6.00	1.86	0.112	853.84	118.91
01/07/93	5	135	22.30	5.98	1.91	0.114	859.82	119.02
01/08/93	5	136	22.25	5.97	1.63	0.097	865.79	119.12
01/09/93	5	137	22.26	5.97	1.83	0.109	871.76	119.23
01/11/93	5	138	22.17	5.95	1.95	0.116	877.71	119.34
01/15/93	5	139	22.15	5.94	3.09	0.184	883.66	119.53
01/21/93	5	140	22.14	5.94	1.53	0.091	889.60	119.62
01/25/93	5	141	22.17	5.95	3.25	0.193	895.55	119.81
01/27/93	5	142	22.20	5.96	3.34	0.199	901.51	120.01
01/29/93	5	143	22.18	5.95	3.38	0.201	907.46	120.21
01/31/93	5	144	22.17	5.95	3.35	0.199	913.41	120.41
02/04/93	5	145	22.15	5.94	3.38	0.201	919.35	120.61

Estimates were made in drainage amount.

	Lys#	Sample#	Vol liters	Drain mm	NO3-N ppm	Load kg/ha	cum drain (mm)	cum load kg/ha
02/09/93	;# from lys3		22.14	5.94	3.67	0.218	925.29	120.83
03/03/93	#		22.13	5.94	4.67	0.277	931.23	121.11
03/20/93	#		22.36	6.00	6.47	0.388	937.23	121.50
03/20/93	#		22.96	6.16	5.65	0.348	943.39	121.84
03/21/93	#		22.33	5.99	6.97	0.418	949.38	122.26
03/22/93	#		26.65	7.15	0.52	0.037	956.54	122.30
03/22/93	#		22.52	6.04	0.93	0.056	962.58	122.36
06/02/93	#		23.12	6.20	1.15	0.071	968.78	122.43
06/08/93	#		23.04	6.18	0.88	0.054	974.97	122.48
06/08/93	#		23.02	6.18	2.00	0.124	981.14	122.61
06/09/93	#		23.38	6.27	2.21	0.139	987.42	122.74
06/09/93	#		22.69	6.09	13.59	0.827	993.51	123.57
06/09/93	#		23.14	6.21	5.00	0.310	999.72	123.88
06/09/93	#		22.51	6.04	5.00	0.302	1005.76	124.18
06/10/93	#		22.37	6.00	2.00	0.120	1011.76	124.30
06/10/93	#		22.28	5.98	5.00	0.299	1017.74	124.60
06/11/93	#		22.21	5.96	2.00	0.119	1023.70	124.72
06/13/93	#		22.17	5.95	2.00	0.119	1029.65	124.84
06/17/93	5	147	22.15	5.94	2.26	0.134	1035.59	124.98
06/21/93	5	148	22.15	5.94	2.91	0.173	1041.54	125.15
06/27/93	5	149	22.14	5.94	3.46	0.206	1047.48	125.35
07/01/93	5	150		0.00	12.59	0.000	1047.48	125.35
07/02/93	5	151		0.00	13.79	0.000	1047.48	125.35
07/03/93	5	152		0.00	15.56	0.000	1047.48	125.35
07/04/93	5	153		0.00	12.35	0.000	1047.48	125.35
07/05/93	5	154		0.00	12.31	0.000	1047.48	125.35
07/14/93	5	155		0.00	19.23	0.000	1047.48	125.35
10/01/93	5	156		0.00	28.09	0.000	1047.48	125.35
10/01/93	5	157		0.00	43.78	0.000	1047.48	125.35
10/04/93	5	200	9.50	2.55	49.83	1.270	1050.03	126.62
10/07/93	5	201	14.50	3.89	42.27	1.645	1053.92	128.27
10/08/93	5	202	7.00	1.88	49.66	0.933	1055.80	129.20
10/11/93	5	203	11.50	3.09	44.22	1.365	1058.88	130.57
10/13/93	5	204	8.00	2.15	49.20	1.056	1061.03	131.62
10/15/93	5	205	8.50	2.28	45.03	1.027	1063.31	132.65
10/18/93	5	206	38.00	10.20	51.74	5.276	1073.51	137.93
10/20/93	5	207	39.00	10.47	49.87	5.219	1083.97	143.15
10/21/93	5	208	17.00	4.56	41.02	1.871	1088.54	145.02
10/22/93	5	209	14.00	3.76	40.55	1.523	1092.29	146.54
10/25/93	5	210	36.00	9.66	32.51	3.141	1101.95	149.68
10/28/93	5	211	28.00	7.51	35.45	2.664	1109.47	152.34
10/31/93	5	212	20.00	5.37	35.82	1.922	1114.83	154.27
11/04/93	5	213	15.00	4.03	42.64	1.716	1118.86	155.98

Estimates were made in drainage amount.

	Lys#	Sample#	Vol liters	Drain mm	NO3-N ppm	Load kg/ha	cum drain (mm)	cum load kg/ha
11/10/93	5	214	16.00	4.29	24.86	1.067	1123.15	157.05
12/21/93	5	215	15.00	4.03	31.78	1.279	1127.18	158.33
01/03/94	5	216	43.00	11.54	15.33	1.769	1138.72	160.10
02/23/94	5	217	100.00	26.84	5.76	1.546	1165.55	161.64

Estimates were made in drainage amount.