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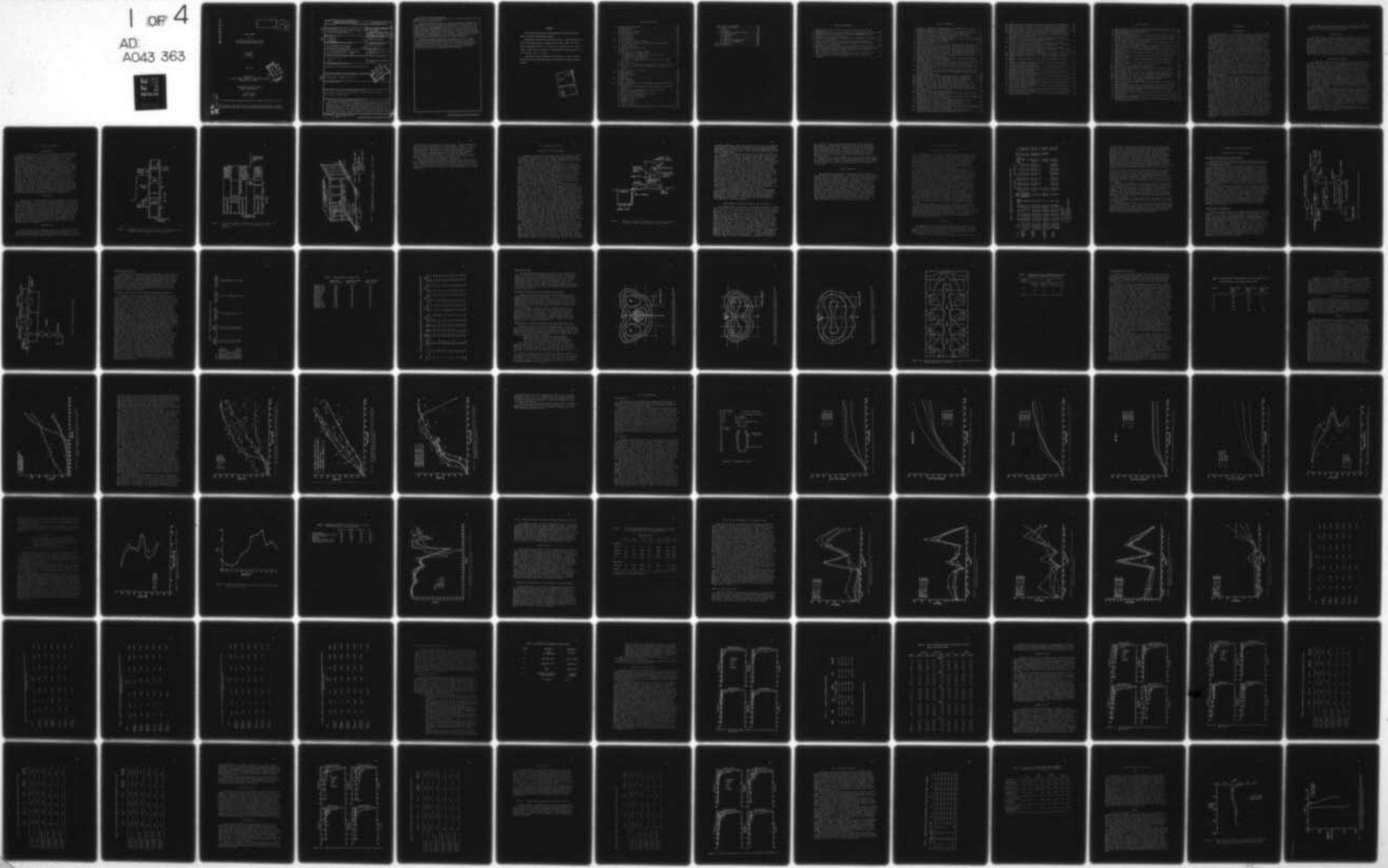

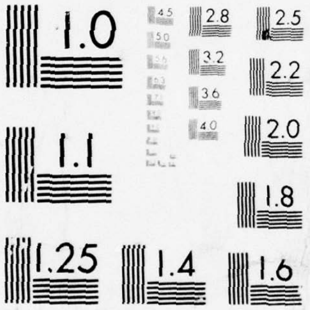

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FINAL REPORT

ON

FATE OF METALS APPLIED IN SEWAGE AT LAND WASTEWATER DISPOSAL SITES

K.W. BROWN
C. WOODS
J.F. SLOWEY

JUNE 1975

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AUG 22 1977
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U.S. ARMY MEDICAL RESEARCH & DEVELOPMENT COMMAND
Washington, DC 20314

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This study was conducted to investigate the fate of copper, zinc, cadium, nickel, and lead contaminants in secondary treated sewage effluent for four different soils. Five large undisturbed monoliths of each soil were enclosed in drainage lysimeters. In addition field plots of two of the soils were treated similarly. The effluent was spiked with 1 ppm of each of the metals and applied at a rate which averaged 2.7 cm (1-1/16 inches) per week for a period of one year. Natural rainfall was excluded from the plots to

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20.
facilitate continuous application.

Samples of the Bermuda grass, soil samples at a series of depths, and samples of water in the root zone area from the bottom of the lysimeter were periodically collected and analyzed for heavy metals. The total metal content of the soil samples ~~were~~ was determined as well as the soluable, exchangeable and organic bond fractions. Sub studies including pH adjustment of the sewage effluent, rainfall, and the application of primary clarified effluent on the fate of the applied metals were conducted. Supplemental data including the movement of water through the soil as traced by bromide spike, soil air status, and meteorological data during the study are included.

The majority of the applied metal accumulated in the top 12-1/2-cm of soil, ~~(5 inches of the soil)~~ with the greatest concentrations at the surface. Downward movement of the metals in the profile was slow and no metals were detected in the leachate water collected at 75 cm (2-1/2 feet) and 150 cm (5 feet) in any of the soils. Only very small portions of the applied metals were taken up by the vegetation during the study.

or

FOREWORD

This research was funded by the Department of the Army, U.S. Army Medical Research and Development Command.

The work was conducted during the period April 1, 1973 to October 30, 1974 at Texas A&M University, College Station, Texas 77843. The principle investigators were Dr. K. W. Brown, Dr. C. Woods and Dr. J. Frank Slowey. Much of the field work was accomplished under the supervision of Mr. G. Hanczar and Mr. C. Kline.

The study was under the general supervision of Cpt. John P. Glennon, MSC, Military Environmental Sanitarian, Environmental Protection Research Division

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Table of Contents

List of Appendixes

List of Figures

List of Tables

I. Background

INTRODUCTION

The concentration of heavy metals found in sewage effluent is dependent on many factors. Many of the metals originate from industrial activities including plating plants, foundries, and alloy and munitions plants. Other sources commonly found in sewage plants are waste water from cooling towers and catalytic reactions used in chemical and petrochemical processes. The plumbing in factories as well as domestic homes may be a source of dissolved copper, zinc, cadmium and chrome, depending on the type of water supply. While some metals may originate in the water supply, significant concentrations are rarely found.

Once the waste water is released into the sewage system, the metals undoubtedly become bound to the organic and, to a lesser extent, to the inorganic constituents of the raw sewage. Since one of the primary objectives of a sewage treatment plant is to remove and concentrate the solids, a sizable fraction of the metals are removed by most treatment plants (Stones, 1960; Argo and Culp, 1972a; and Blakeslee, 1973). However, since the clarification is rarely complete and since some metals may be in soluble forms, heavy metals are often constituents of sewage plant effluent (Argo and Culp, 1972b). While it may be possible to remove much of the heavy metals from effluent, such processes are generally tedious and expensive (Rose, 1973 and Wing et al., 1974). This is particularly so where large quantities of water must be cleared up. Since it is undesirable to release waters contaminated with heavy metals into streams, alternate means of disposal must be developed.

Land irrigation provides one possible means of dispensing of the water. Irrigation with sewage effluent has been in practice for a long time in certain areas (Law, 1968). The land disposal of sewage sludge both as a solid and in a liquid slurry has also been widely practiced (Law, 1968). Many of these wastes were contaminated with heavy metals and through repeated applications have built up in the soil (Rohde, 1962) and in some cases have reached significant concentrations in vegetation, particularly root crops grown on the soils (LeRiche, 1968 and Garner, 1966).

Although such land disposal has been conducted for many years in some places, there are virtually no records on how much material was applied or in what concentrations. Nor have measurements been made of the movement of metals below the root zone. Literature on the soil chemistry of heavy metals (Leeper, 1972) indicate that most soils have a huge capacity to absorb and inactivate heavy metals. Any soil will only have a finite capacity to absorb metals by either of these processes and once this is reached, the metals will move to lower depths. Natural processes within the soil may also result in conditions that would allow the metals to move down with the water. No data is available on the movement of trace elements below the root zone (Page, 1974). Certainly it would be undesirable to conduct land disposal of heavy metal contaminated effluents in such a way that the metals would leach through the soil to streams or underground water supplies.

This research was thus undertaken to investigate the mobility of heavy metals applied in sewage effluent as irrigation to the surface of four undisturbed soil profiles.

Objectives

The objectives of this study were to determine the fate of copper, zinc, cadmium, nickel, and lead applied to soils as treatment from sewage effluent. Specifically, the project was designed (1) to determine what degree of metal removal is accomplished by different soils and at what depths the metals accumulate, (2) to determine what portion of the accumulated metal is associated with the organic fraction of the soil, (3) to determine what portion of the metal is water soluble or available for plant or microbial uptake, and (4) to determine how the accumulation or movement of metals is influenced by variations in sewage plant performance (BOD, TOC, pH) and precipitation on the disposal site.

Experimental Design

To meet the objectives, four soils, a silty sand (SM(d/u)), an acid inorganic clay of low to medium plasticity (CL), a basic CL, and a clayey sand (SC), were selected. Five large, undisturbed monolith lysimeters were collected from each soil. In addition, two field plots were established on the SM(d/u) and two on the basic CL soils. Treated sewage effluent from a waste activated sewage plant was spiked with 1 ppm of Cu, Zn, Cd, Ni, and Pb and weekly applications of two inches, or in some cases less where infiltration became limiting, were applied to the lysimeters and field plots for a period of one year. The effluent was also spiked with 100 ppm Bromide as KBr to trace water movement. Natural rainfall was excluded from the plots throughout the research. During one six week period at the middle of the year, special treatments, including the substitution of effluent with lower pH, clarified primary effluent, and rainfall was applied to selected lysimeters.

The quality of the applied waste water was monitored throughout the experiment. Soil samples were collected approximately bi-monthly throughout the experiment at a series of depths to be analyzed for metal accumulation and soil pH. The Bermudagrass grown on the lysimeters and field plots was harvested and analyzed for the metals of interest. Water samples were collected from suction cups in the root zone in the lysimeters and field plots and from the bottom of the lysimeters. These were analyzed for the metals of interest and the presence of bromide. The metals were analyzed as totals, the soluble fraction, the organic fraction, and the exchangeable fraction.

Supplemental measurements, including soil water, soil temperature, soil air, and meteorological parameters were taken to assist in data interpretation.

II. Field Installations

Lysimeters

A detailed description of the technique for installing the lysimeters used in this project is given by Brown et al. (1974). Briefly the technique is as follows: Casings 152.3 cm (60 in) wide, 203 cm (80 in) long, and 152.3 cm (60 in) tall were fabricated from .635 cm (1/4 in) steel plate. The casings were sandblasted, coated with epoxy base, heavy metal free paint (Shertar), and forced into the ground with pressure applied by two backhoes. The soil was dug away around the outside to relieve the pressure as the casings were pushed. Angle irons or plates were forced under the casings once they were in place. These were bolted temporarily to the angle iron used to reinforce the castings. A temporary top was also bolted in place. A crane was then used to lift the soil monoliths enclosed in the metal box, and roll it upside down. Porous ceramic suction cups were installed in the soil at the bottom of the profile. The tubes used to conduct the leachate to the surface were threaded through a 1.27 cm (1/2 in) PVC tube installed along the inside of one wall. A one-quarter inch steel bottom plate treated as described above was then welded to the lysimeter. They were turned upright and installed in holes dug to receive them under the rainshelters. The space around each lysimeter was filled with soil to assure that similar soil thermal gradients would develop in the enclosed monoliths. The entire area was then sprigged with coastal Bermuda grass.

Field Layout

The location of soils suitable for the field plots dictated the field layout. In the SM(d/u) soil two adjacent plots 5.46 m (18 ft) square were selected side by side (Figure 1). The rainshelter was installed such that in the rest position it was north of the plots and did not interfere with the radiation balance or air flow. On the basic CL soil, the variability of the soil prevented the placement of both field plots under the same rainshelter. Thus, soil for the field plots was selected and the lysimeters were arranged around them so that maximum coverage could be achieved with the rainshelters (Figure 2). Again the shelters were to the north of the plots. All the lysimeters were brought to the basic CL soil location for installation. The SM(d/u) field plots were located about a mile to the northeast of the basic CL installation.

Rainshelters

The rainshelters are shown in figure 3. They were specially constructed of materials, including fiberglass and plastic, to assure that metals would not be leached onto the plots. The metal parts were coated with a metal-free paint. The rainshelters were

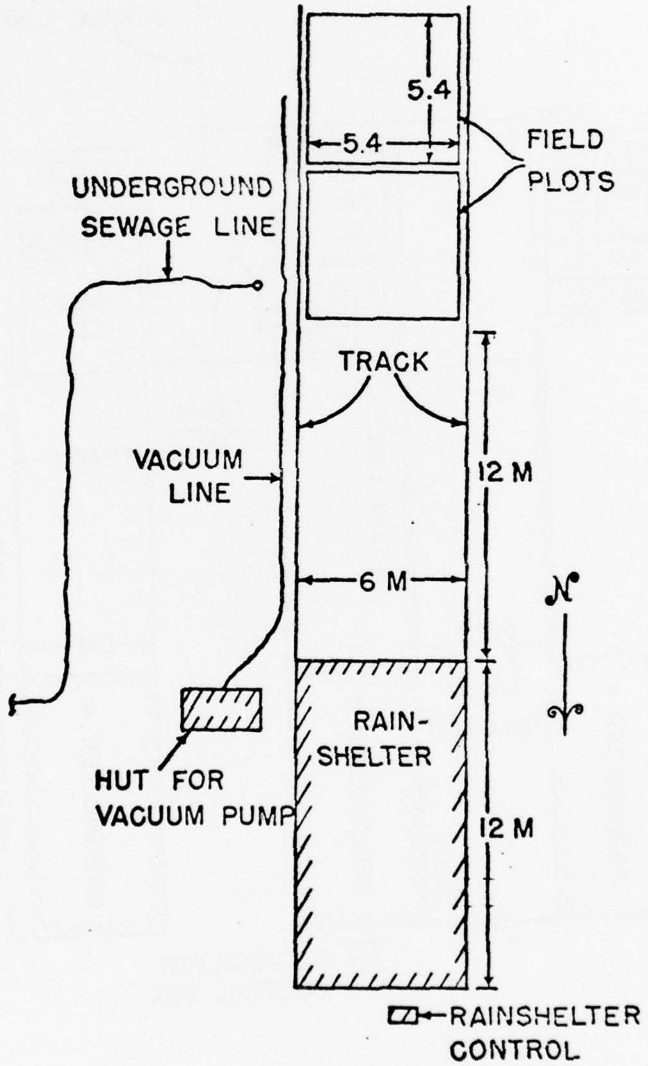

Figure 1. Schematic diagram of field layout at the SM(d/u) field plots with the rainshelter in rest position

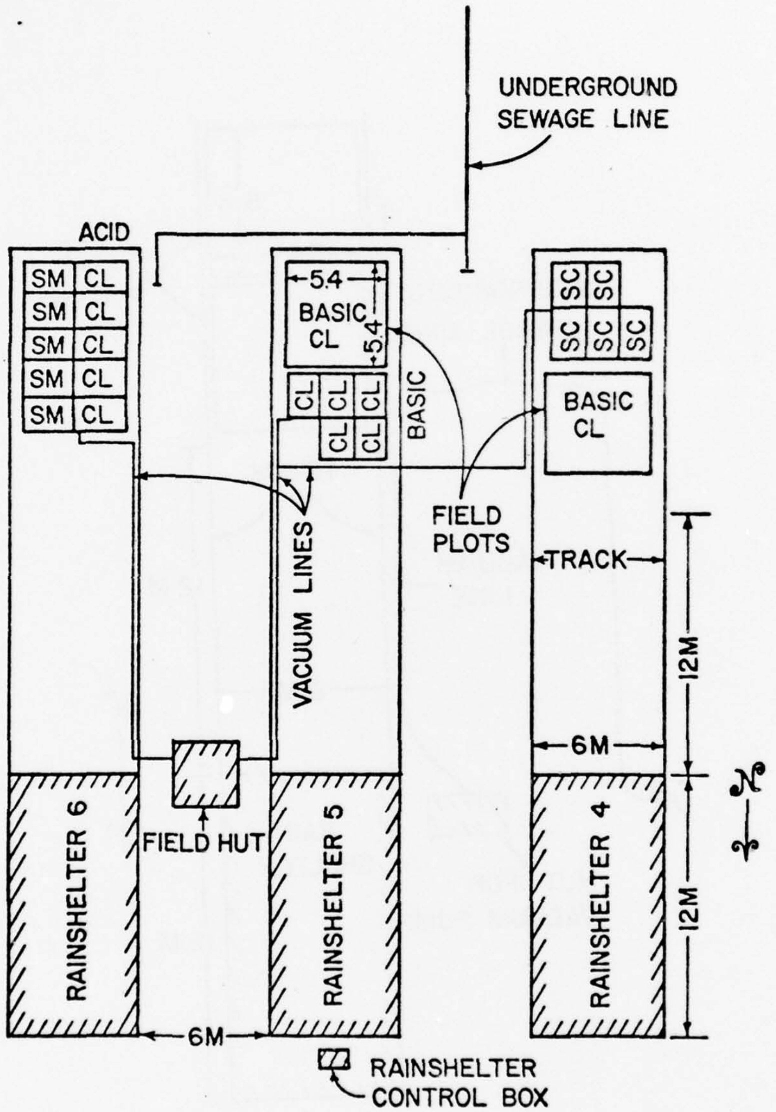

Figure 2. Schematic diagram of field layout at the lysimeter and basic CL field plot with the rainshelters in rest position.

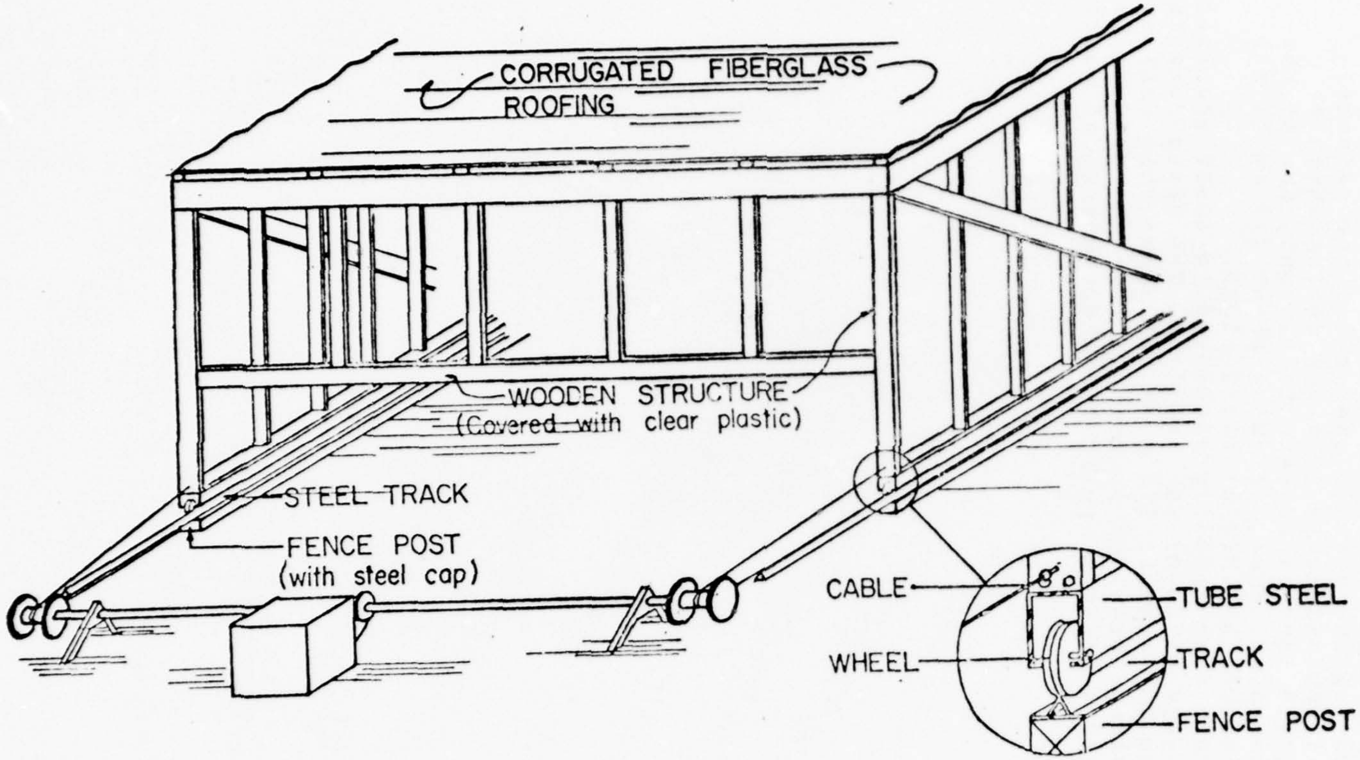

Figure 3. Schematic diagram of a movable rainshelter used in these experiments to exclude natural rainfall

automatically activated by a rainfall sensor. They covered the plots within two minutes of the beginning of rainfall. The rain sensor was heated by means of a small resistor, and after the rain dried off, the shelters automatically returned to their rest positions. During the year of operation, the rainshelters were activated approximately 80 times during which a total of 80.6 cm (31.8 inches) of rain fell. Only one of the shelters malfunctioned one time, allowing about 2.5 cm (1 in) of rain to reach one of the SM(d/u) field plots.

The rainshelters were manually activated to cover the field plots each time sewage effluent was applied. The spray nozzels were suspended from the roof at 1.8 m (6 ft) above this soil surface. The rainshelters provided protection from the wind during spraying and allowed a uniform application independent of weather conditions.

III. Sample Collection

Collection of Water Samples

A schematic diagram of the water collection system is shown in figure 4. Leachate from the bottom of each lysimeter was collected through 13 porous cups (Coors Type #70001-P-6-C) with a bubbling pressure of .5 bars, a conductivity of 1.2 ml, cm^{-2}, min^{-1}, bar^{-1} and a surface area of 38.8 cm^{2}.

Plexiglass caps were sealed to the open end of the cups with a water proof two part epoxy (Armstrong #34). Nylon tubes .159 cm (.063 in) in diameter were cemented into the plexiglass caps with another two part epoxy (Armstrong #6) which adheres well to nylon. The 13 tubes lead to a glass collection manifold on the soil surface. Nylon tubes of .32 cm (.13 in) diameter were used to convey the leachate to the graduated collection bottles in the field hut. A continuous vacuum was maintained simultaneously on all the 20 collection bottles via a manifold. The line coming in from the field was equipped with a stop cock. The bottle was also equipped with an outflow tube which was similarly equipped with a stop cock.

At the beginning of the experiment, the vacuum pump was controlled to provide a continuous potential equivalent to -1/3 bar on the suction cups. Water was not removed fast enough, and after 8 weeks, the vacuum regulation was bypassed and a continuous potential equivalent to -0.8 bar was maintained for the remainder of the experiment. While the vacuum was on, the incoming stop cock was opened and the outflow was closed. Depending on the season, the 19 liter (5 gal.) bottles had to be emptied every 2-4 days. First the volume of the accumulated water was recorded, then the vacuum was turned off. A valve was opened to bleed the vacuum from the system. During the bleeding, the incoming stop cocks were closed, and the plastic cube containers were positioned in the drain trough under the outflow line. Once the system was at atmospheric pressure, the stop cocks on the outflow line were opened and the system was pressurized by means of a small pump. All of the accumulated water was forced out of the bottles into the sample containers. The excess water overflowed into the trough and was drained away. As the collection bottles emptied, the outflow stop cocks were closed. After all bottles were emptied, the pressure pump was turned off, and the vacuum pump was turned on. The inflow lines were again opened. The entire process typically took about one hour, thus suction to the bottom of the lysimeters was only interrupted for short intervals.

The major difficulties that arose were caused by algae and calcium carbonate. Algae accumulated in the field manifold and the nylon lines, particularly in the SC soil early in the experiment. Calcium carbonate continuously accumulated in the entire system, particularly in the lysimeters containing the basic CL soil. The algae was physically removed, and the manifold and lines were covered to prevent light from entering them. This very nearly eliminated the algae problem. The calcium carbonate accumulation required periodic flushing of the manifold and the lines with a dilute solution of hydrochloric acid. This was done

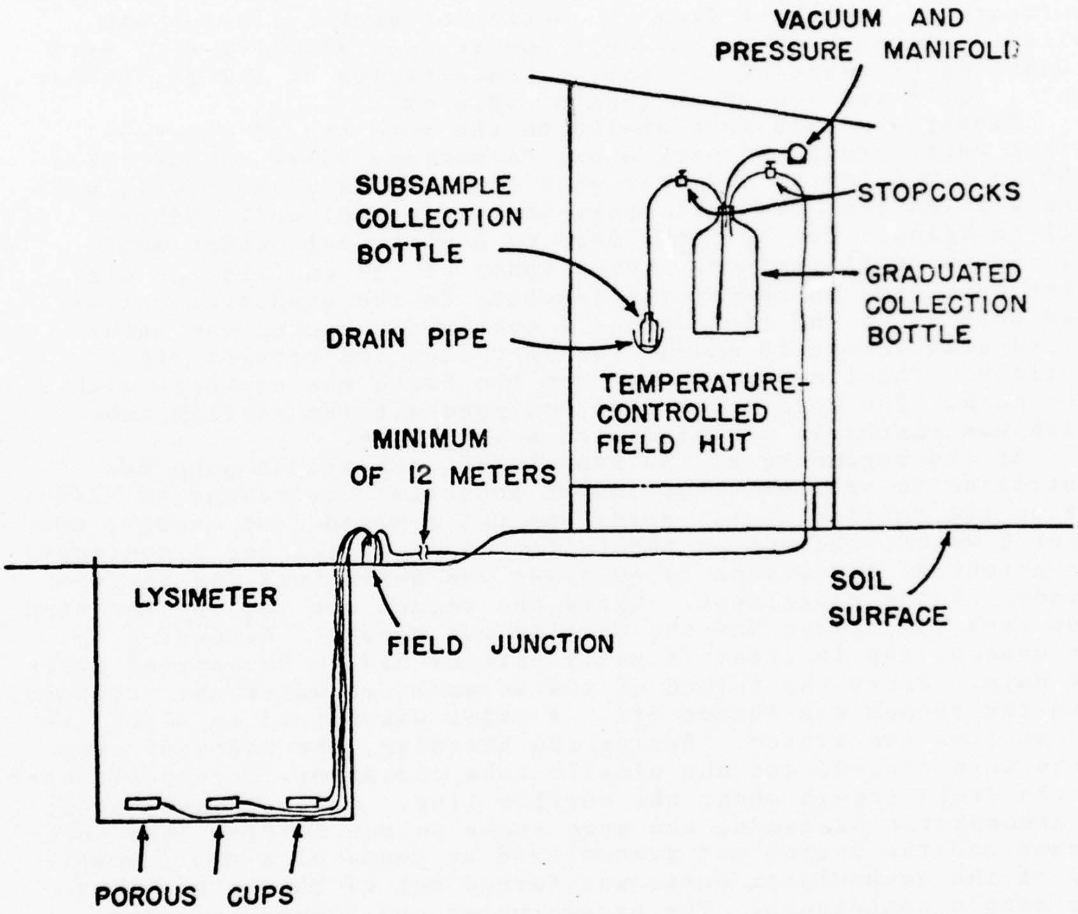

Figure 4. Schematic diagram of the sample collection system for the porous cups in the bottom of the lysimeters

as needed immediately after the collection bottles were emptied; the flushing solution was discarded before the vacuum was reestablished. Occasionally tubes became blocked completely and sections needed to be replaced. In all cases, splicing was done by means of glass tubes.

Soil solution samples from the root zone were collected in each lysimeter at 75 cm (30 in) and in each field plot at 75 cm (30 in) and 150 cm (60 in). Collection was done through a porous ceramic cup (Soil Moisture Number 2131) with a bubbling pressure greater than 1 bar, a flow rate of 1 ml cm^{-2} min^{-1} bar^{-1} and a surface area of 31.43 cm^2. Nylon tube similar to that described above was attached to the suction cups with the same materials. Before installation, all of these cups had been leached with a dilute HCl solution to remove traces of copper which were detected. The suction cups were installed in the bottom of an augered hole. The space remaining between the cup and the surface was filled with a PVC tube attached to the suction cups. The nylon tubes lead through a rubber stopper to a 250 ml (.264 qt) collection flask positioned in the field. These were connected to a field vacuum manifold maintained continuously at about -0.6 bars. Any excess water from the samples overflowed into the manifold and was periodically drained from a trap. Early in the experiment, some water did move from the manifold to the collection bottles when the vacuum was interrupted, but subsequent adjustments in the elevation of the inlets to the vacuum manifold cured this problem.

Lysimeter water samples were collected as often as three times a week and composited for analysis. Root zone samples were collected weekly when samples were available. During the drier parts of the season, a period of several weeks went by between the collection of enough samples to allow analysis. All samples were brought to the laboratory and refrigerated until analysis could be conducted.

Soil Sample Collection for Metal and pH Analysis

Soil samples were collected at the following depths: surface 0-2.5, 2.5-5, 5-7.6, 7.6-10.2, 10.2-12.7, 12.7-19, 19-25.4, 25.4-38.1, 38.1-63.5, 63.5-89, 89-114.4, 114.4-140 cm (0-1 (including surface), 1-2, 2-3, 3-4, 4-5, 5-7.5, 7.5-10, 10-15, 15-25, 25-35, 35-45, 45-55 in). Samples were taken at the beginning of the experiment and every month for the first six months. Thereafter, samples were taken every other month. The surface samples were scrapings taken with a plastic spoon. The depth samples were taken with a 2.22 cm (7/8") diameter coring tool with a 25.4 cm (10 in) cut away barrel. Soil sample locations were selected at random. The coring tool was sandblasted to remove the protective metal plating and coated with epoxy paint (Shertar) to prevent contamination of samples. Since the five shallowest depths did not provide enough soil for metal analysis, samples were taken in three locations and pooled. The samples were cut and handled with plastic spoons. They were placed in plastic bags and frozen until analysis. Every possible precaution was taken to prevent contamination of samples from the layer above. This included discarding the top of cores which may have been contaminated by soil falling in and wiping off the coring tool with a rag or washing it with distilled water when this became necessary. Once the sampling was completed, a PVC tube was pushed into the hole to a depth 1.27 cm (1/2 inch) below the soil surface. A tight fitting rubber stopper was put in the tube and the area was covered with a small amount of soil.

A complete set of soil samples were taken at each site where the lysimeters were filled. This included disturbed bulk samples and undisturbed core samples. Samples were collected to a depth of five feet in all cases. These were taken to the laboratory for analysis.

Grass Sampling

The Bermudagrass produced a lush green crop on both the field plots and the lysimeters. The grass grew from early March through October. During the winter, the tops were killed by low temperature, and no growth occurred. During the growing season, the grass was periodically clipped to a height of two inches. This was generally done when the growth reached 15.2-20 cm (6-8 in). All the grass from each field plot and lysimeter was collected and placed in plastic bags for transport to the laboratory. Early in the study comparisons were made between washed and unwashed grass samples. No systematic differences in metal concentration were detected; therefore, washing was discontinued. When samples were small, the entire sample was dried in acid-washed beakers at 70°C (158°F). When samples were larger, subsamples were dried and the moisture fraction was used to determine the dry weight of the total sample. All dried samples were stored in plastic bags until analysis.

IV. Soil Characteristics

Characterization of Soils

Soil samples were collected from the side of the pits from which the lysimeters were taken. Three undisturbed samples were taken by forcing 5 cm (2 in) by 2.7 cm (1 in) long cylinders into the soil at a series of depths. These were used for determining bulk density and moisture relations. Bulk samples were taken, air dried and ground to pass through a 2mm (.079 in) sieve in preparation for further analyses. Sampling depths were arbitrarily selected except where distinct layers in the profile necessitated other sampling intervals.

All analyses were carried out according to standard procedures and are described briefly as follows. The texture was measured on samples dispersed with a milk shake mixer in a solution of sodium hexametaphosphate (calgon) as described in Black (1965). The density of the suspension was measured at appropriate times with a Bouyoucos hydrometer. Appropriate temperature corrections were made. The USDA classification of sand being the particles from 2.0 to 0.02 mm, silt from 0.02 to 0.002 mm and clay being less than 0.002 mm was used. Rheological characteristics of the soil were determined by procedures described by the Corps of Engineers (1960). The liquid limit was determined by using a standard repeated drop technique. The plastic limit was determined by rolling the soil into cylinders. These results were used to determine the ASHO classification.

The bulk density was calculated as the dry weight per unit volume. The water contents were determined in the same cores and are expressed as percent by volume. A series of moisture potentials including saturation, field capacity, wilting point and oven dry were utilized. The height and diameter of the soil core at each potential was utilized to determine the bulk density.

The cation exchange capacity was determined by replacing all the cations with NH_4 then measuring the evolved NH_3. The technique is described by Schollenberger and Simon (1945). The results are expressed in milliequivalents per 100 g of soil dried to 105°C. The percent carbon was determined by a wet oxidation technique described by Clark and Ogg (1942). A 1:1 weight ratio of soil to water was prepared for pH determinations which were made with a standard pH meter.

Results

The results of the soil characterization are shown in table 1. The SM(d/u) soil had a deep uniform profile with a sand content of all layers greater than 80%. The bulk density was independent of the moisture potential. The water retention and cation exchange capacity were both very low.

The basic CL soil profile was reasonably uniform except for

Table 1. Characteristics of soils utilized in heavy metal leaching study.

Soil	Depth cm	Depth in	Sand %	Silt %	Clay %	Texture USDA	ASHO classified	Bulk Density FC^1 g/cm^3	Bulk Density WP^2 g/cm^3	Bulk Density OD^3 g/cm^3	Water Retention^4 Sat^5	Water Retention^4 FC	Water Retention^4 WP	CEC^6 meq/100g	Carbon^7 %	pH
SM(d/u)	0.0-15.2	0-6	81.1	4.5	14.4	SL	SM(d/u)	1.38	1.39	1.39	43.6	10.0	2.8	0.3	0.4	6.45
(Lakeland)	15.2-30.5	6-12	80.6	2.5	16.9	SL	SM(d/u)	1.46	1.46	1.48	39.6	8.5	2.3	0.61	0.1	6.13
	30.5-61	12-24	80.2	4.3	15.5	SL	SM(d/u)	1.51	1.52	1.53	36.5	9.2	0.8	2.05	0.1	5.96
	61.0-91.5	24-36	81.3	4.1	14.7	SL	SM(d/u)	1.55	1.55	1.56	36.2	9.9	0.7		0.1	5.83
	91.5-122	36-48	80.2	4.8	15.0	SL	SM(d/u)	1.55	1.54	1.56	35.9	10.3	0.4		0.1	6.13
	122.0-152	48-60	80.9	4.1	15.0	SL	SM(d/u)	1.56	1.56	1.57	32.3	10.4	0.4	1.31	0.1	6.29
CL basic	0.0-15.2	0-6	48.2	15.2	36.6	SC	CL	1.44	1.48	1.49	40.0	31.8	10.8	19.6	1.40	7.69
(Norwood)	15.2-30.5	6-12	49.6	15.1	35.3	SCL	CL	1.39	1.50	1.52	42.1	32.3	10.4	21.1	1.40	7.73
	30.5-61	12-24	36.0	18.4	45.6	C	CL	1.31	1.68	1.72	45.3	35.1	17.1	22.9	1.60	7.74
	61.0-91.5	24-36	40.5	22.3	37.2	CL	CL	1.32	1.43	1.39	46.1	34.2	9.9	17.8	1.51	7.86
	91.5-119	36-47	42.0	25.0	33.0	CL	CL	1.26	1.59	1.66	48.2	38.2	17.0	16.2	1.54	7.75
	119.0-122	47-48	23.1	20.5	55.6	C	ML								2.32	
	122.0-152	48-60	49.1	15.8	35.1	SCL	CL	1.32	1.55	1.60	48.3	39.2	16.2	13.2	1.36	7.95
CL acid	0.0-25.4	0-10	41.8	12.9	45.3	C	CL	1.4						17.2	1.34	5.59
(Nacogdoches)	25.4-50.8	10-20	20.2	11.3	68.5	C	CL-ML	1.42						25.1	.95	5.50
	50.8-91.5	20-36	14.3	10.0	75.7	C	ML	1.45						31.6	.40	5.68
	91.5-152	36-60	13.5	10.3	76.2	C	ML	1.47						38.0	.48	5.75
	152.0-183	60-72	9.9	11.4	78.7	C	ML	1.5						24.6	.38	5.69
SC	0.0-15.2	0-6	60.3	10.0	29.7	SCL	SC	1.49	1.67	1.76	37.0	30.4	10.9	27.4		6.86
(Bastrop)	15.2-30.5	6-12	39.8	12.6	47.6	C	SC	1.43	1.73	1.97	41.6	35.8	15.0	34.7		7.09
	30.5-61	12-24	36.5	11.5	52.0	C	SC	1.39	1.62	2.12	42.4	37.4	15.9	38.6		7.15
	61.0-91.5	24-36	33.2	12.0	54.8	C	SC	1.37	1.68	2.02	42.3	36.1	18.0	39.2		7.54
	91.5-122	36-48	35.4	10.8	53.8	C	SC	1.34	1.67	1.88	44.0	36.6	18.4	34.5		7.40
	122.0-152	48-60	58.1	5.6	36.3	SCL	SC	1.40	1.62	1.73	44.0	32.2	12.8	20.4		7.63

1. FC = field capacity
2. WP = wilting point
3. OD = oven dry
4. by volume
5. sat. = saturated
6. CEC = cation exchange capacity
7. by dry weight

the thin layer of greater clay content between 120 and 122 cm (47 and 48 in). This layer was classified as ML in the ASHO system. This layer may restrict the vertical movement of water in both the lysimeter and the field plots. Water may move horizontally above the layer in the field, but this movement would be interrupted by the walls in the lysimeters. The bulk density of this soil increased as the soil dried from field capacity to oven dry. The density increase upon drying was greater than 30% by volume and the available water in the profile calculated as the difference between the water content at field capacity and the wilting point averaged 22% by volume. The cation exchange capacity and the carbon increased to a depth of 61 cm (24 in) and decreased thereafter except for the ML layer.

The Acid CL soil had a CL surface layer and a CL-ML transition for 25.4-50.8 cm (10-20 in). Clay content increased with depth from 45% to 79%. Unfortunately the undisturbed cores were lost and the moisture density and moisture relations could not be fully determined on undisturbed cores. The CEC was about the same as that of the basic CL soil except that it increased more with depth. The percent carbon decreased sharply with depth.

The SC soil increased in clay content from 30% at the surface to 54% at 122 cm (48 in). Below this level the sand fraction increased markedly. This soil showed the greatest increase in bulk density of any used. Volume changes upon drying were dramatic. The SC soil held a large amount of water at the wilting point and thus had less available water than the Basic CL soil. The surface layer of this soil had a cation exchange capacity 1/3 larger than the Cl soils and 10 times larger than the SM(d/u) soil.

The pH profiles of these soils will be discussed in a later section. A morphological description of the profiles is given in appendix A.

The soils were selected to typify the range of textures and other characteristics. They are all deep soils which were deposited by water in the flood plane of a river. While they represent extensive areas, they are much more uniform with depth than many of the soils formed by other processes, which are often characterized by abrupt changes in the profiles.

V. Sewage Source and Application

Description of Sewage Source

Wastewater Treatment Plant Descriptions

The treated sewage effluent used in this project came from two sources: Texas A&M University Wastewater Plant and the City of Bryan Wastewater Plant.

The Texas A&M University Wastewater Treatment Plant is a primary treatment process followed by biosorption. The design capacity of the plant is 2.0 million gallons per day. A flow sheet of the University plant is shown on Figure 5. The monthly average flows into this plant during the study period was less than 2.0 million gallons per day but the maximum flows were as high as 4.5 million gallons per day, (see Table 2) causing the plant to be overloaded. During the overload period, the plants efficiency decreased causing the total suspended solids and biochemical oxygen demand to be high. During these brief periods of plant upset, the sewage was collected from the Bryan Wastewater Treatment Plant.

The Bryan Wastewater Treatment Plant is a primary treatment process followed by trickling filters. A flow sheet of this plant is shown on Figure 6. The design flow is 3.5 million gallons per day, and the plant was operated at full capacity or overloaded during the study period (Table 3). The sewage used in this study was collected from the chlorine contact chamber at both plants.
process followed by trickling filters. A flow sheet of this plant is shown on Figure 6. The design flow is 3.5 million gallons per day, and the plant was operated at full capacity or overloaded during the study period (Table 3). The sewage used in this study was collected from the chlorine contact chamber at both plants.

Sewage Quality Parameters

The basic sewage quality parameters measured were pH, total alkalinity, hardness, biochemical oxygen demand, (BOD), and total organic carbon (TOC). The methods used for measuring each parameter were taken from Standard Methods for the Examination of Water and Wastewater, 13th Edition, 1971. pH was measured by means of a pH meter with glass and calomel electrodes. Alkalinity was measured by titrating an aliquot of the sample to a methyl orange endpoint. Hardness was measured by titrating with standard EDTA endpoint. The BOD was measured by the standard 5-day incubation procedure. Initial final oxygen concentrations were measured using a YSI Dissolved Oxygen Probe. Periodic checking of the oxygen probe was made using the Winkler test. TOC was measured using either a Beckman Model 915 Total Carbon Analyzer or an Oceanography International Carbon Analyzer equipped with direct injection module.

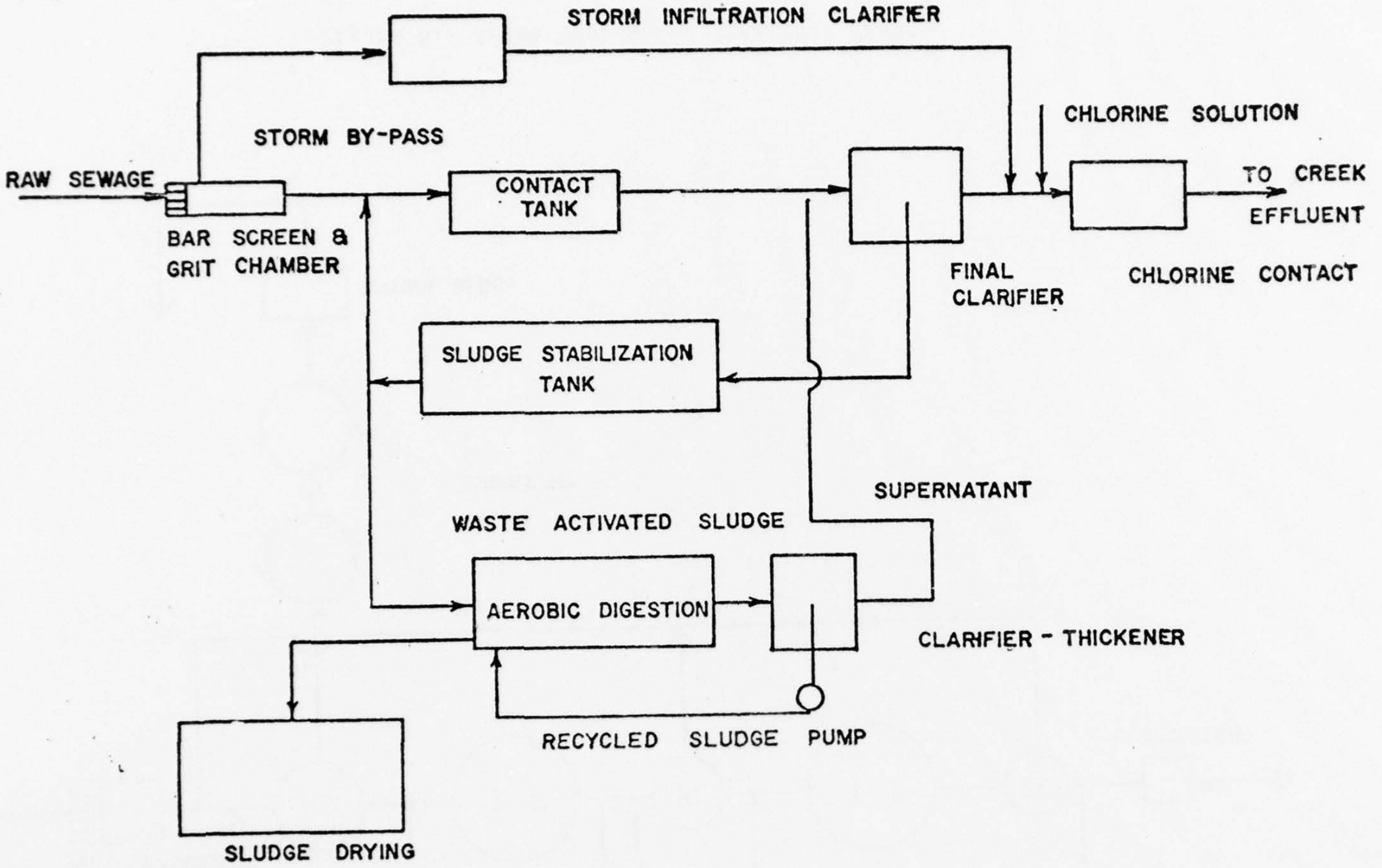

Figure 5. Texas A&M University Wastewater Treatment Plant

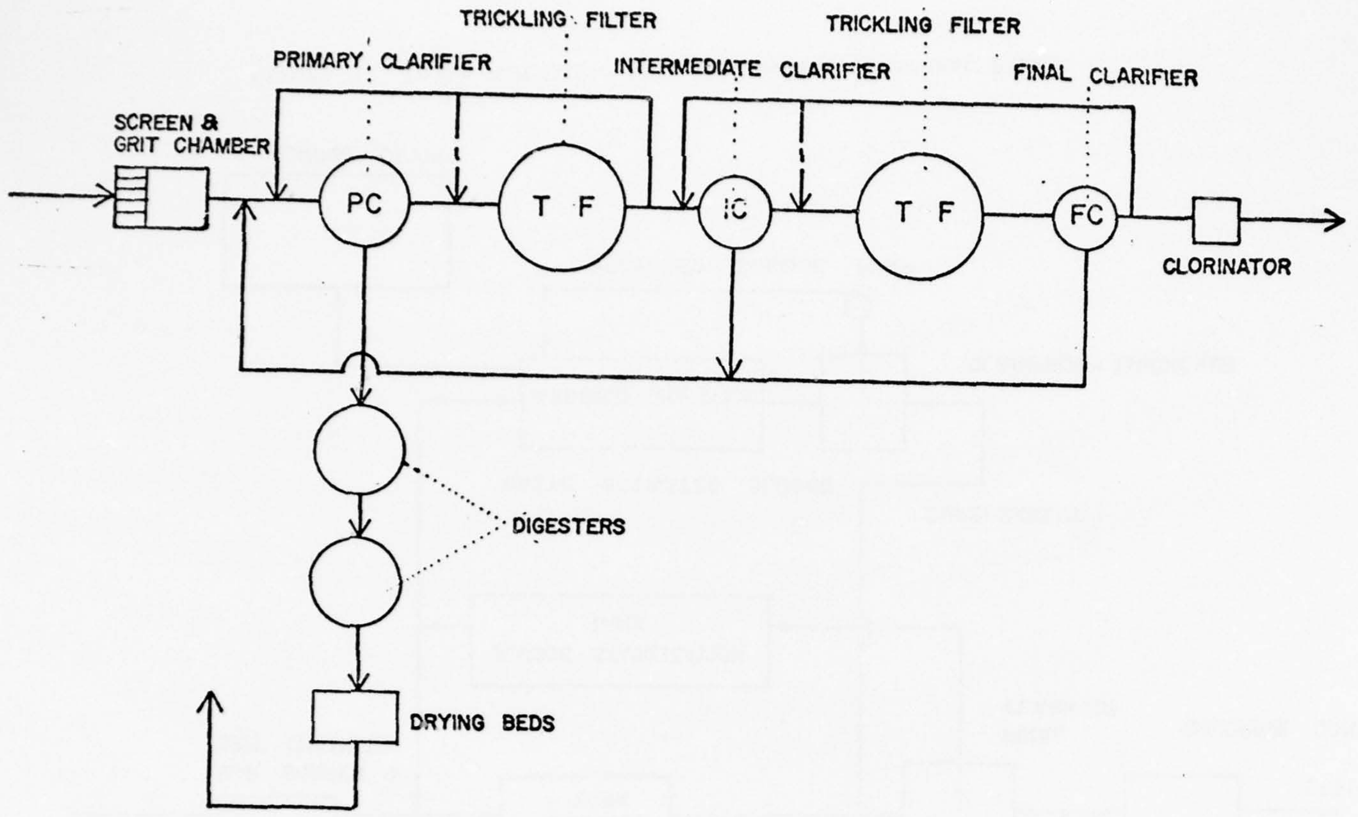

Figure 6. Bryan Wastewater Treatment Plant

Quality of Wastewater

A summary of the quality of the sewage used in this project is shown in Table 4. Detailed data for each load of effluent are given in appendix B. The quality data shown in Tables 2 and 3 are the results of measurements taken by the wastewater treatment plant personnel on samples collected independent of this study. The results indicated, for the samples from this project, that the biochemical oxygen demand is consistently lower than that reported by the wastewater treatment plant personnel because generally no sewage was collected for project purposes during periods of extreme plant upset.

Transport, spiking and distribution of the sewage effluent

The sewage effluent was pumped from the chlorination tank into a 4550 liter (1200 gal) capacity epoxy (Shertar) coated steel tank trailer. In order to avoid metal contamination, PVC pipe and fittings were used throughout. Once the required amount of effluent (usually 3800 liters (1000 gal)) was pumped into the tank, the intake valve was closed and a recirculating valve was opened. Notes were taken on the appearance of the effluent. These are given in appendix B. When the effluent quality was unacceptable due to plant failure, effluent was drawn from the Bryan plant. The spikes were added as the pump recirculated the effluent. To avoid precipitation of the lead, two separate spikes were used. One contained the $Pb(NO_3)_2$ while the other contained the $CdSO_4 \cdot H_2O$, $ZnSO_4 \cdot 7H_2O$, $NiSO_4 \cdot 6H_2O$ and $CuSO_4 \cdot H_2O$. These were dissolved in distilled water to make a stock solution. The lead spike was made by diluting the proper amount of $Pb(NO_3)_2$ stock solution to 100 ml. The other spike was made by combining and diluting the proper amounts of each stock solution to 1000 ml volume. All spikes were stored in plastic containers until used. An interval of 10 minutes was allowed between adding the lead spikes and the spike containing the other metals to assure dissipation of the lead before additional sulfate ions were added. Dye tests indicated that 8 minutes were required to achieve complete mixing in the tank. The pump was run for either 15 minutes after the last spike was added, or for approximately the 30 minutes required to transport the trailer to the field. Short lengths of flexible tubing, GenLine air transfer hose code #805, and underground 3.8 cm (1-1/2") PVC pipe were used to convey the effluent to the rainshelters. At the SM(d/u) field plot location, 30.5 m (100 ft) of PVC was used while 9.15 m (300 ft) was required at the lysimeter location. The rainshelters were moved into position and the flexible tubes were hooked up to the spray manifolds which were suspended inside each rainshelter 1.8 m (6 feet) over the plots. A gauge was mounted on each rainshelter to monitor the water pressure. Plastic dish pans were placed on the soil between the lysimeters and field plots to collect the samples used for the effluent analyses. These samples were placed in glass bottles and taken to the laboratory for analysis as soon as the spraying was completed.

Table 2. Texas A&M Wastewater Treatment Plant

Month	Flow Average Million Gallons	Flow Maximum Per Day	Biochemical Oxygen Demand, mg/l	Total Settleable Solids, mg/l	Total Suspended Solids, mg/l
October 1973	1.9	3.8	3	2	2
November 1973	1.7	3.0	6	2	47
December 1973	1.4	4.1	6	9	120
January 1974	1.7	4.5	4	4	41
February 1974	1.5	2.8	15	5	52
March 1974	1.4	2.5	26	6	118
April 1974	1.7	3.1	31	<1	44
May 1974	1.8	3.0	17	10	31
June 1974	1.5	3.0	7	<1	8
July 1974	1.4	2.5	10	<1	5
August 1974	1.7	4.0	5	6	11
September 1974	1.9	4.0	2	<1	7
October 1974	1.8	4.1	3	3	33
November 1974	1.7	3.6	26	39	573

Table 3. Bryan Wastewater Treatment Plant

	Flow, Million Gallons Per Day	Biochemical Oxygen Demand, mg/l	Total Settleable Solids, mg/l
October 1973	4.25	15	16
November 1973	3.69	17	18
December 1973	3.54	16	15
January 1974	3.63	17	15
February 1974	3.47	19	19
March 1974	3.69	18	17
April 1974	3.86	18	20
May 1974	3.87	19	18
June 1974	4.03	17	17
July 1974	3.85	17	18
August 1974	3.88	16	15
September 1974	3.93	16	17
October 1974	3.76	17	12
November 1974	3.95	16	15

Table 4. Monthly and grand average of characteristics of sewage effluent applied to the lysimeters and field plots.

Month	pH	Alkalinity Mg/1	Hard-ness Mg/1	BOD Mg/1	TOC ppm	Cd ppm TOT	Cd ppm EXT	Cu ppm TOT	Cu ppm EXT	Ni ppm TOT	Ni ppm EXT	Pb ppm TOT	Pb ppm EXT	Zn ppm TOT	Zn ppm EXT
11	7.9	314.14	63.4	9.6	50.3	.998	---	.99	---	.985	---	.90	---	1.09	---
12	7.9	346	62.9	3.58	29.4	.967	.866	.97	.965	.975	1.01	.95	.636	1.1	.835
1	8.0	354	79.1	1.76	33.1	1.13	.898	.99	.744	1.10	.77	.97	.72	1.19	.90
2	7.03	347.86	63.8	4.37	41.9	.85	.568	.79	.49	.915	.51	.64	.52	.88	.66
3	7.66	362.8	43.3	6.01	46.4	.84	.30	.76	.45	.87	.42	.67	.42	.87	.63
4	7.72	208.4	38.6	7.13	34.7	1.07	.54	1.09	.59	1.05	.53	.91	.565	1.04	.64
5	7.7	184.7	41.6	8.25	34.2	.73	.56	1.00	.49	.86	.49	.64	.57	.95	.67
6	7.8	172	45.9	2.75	44.6	.70	.56	.64	.32	.62	.33	.56	.43	.88	.45
7	7.6	232.3	36.2	3.21	24.1	.64	.54	.67	.41	.69	.42	.89	.56	.82	.74
8	7.9	296	41.7	11.9	38.1	.57	.47	.59	.30	.62	.26	.54	.52	.68	.56
9	8.2	315	40.1	8.9	19.2	.58	.60	.56	.22	.48	.24	.50	.42	.71	.59
10	8.2	351	20.9	10.1	48.7	.89	.71	.82	.70	.92	.66	.65	.83	.93	.88
Mean	7.82	285.16	46.9	6.39	34.37	.822	.593	.828	.50	.75	.49	.74	.55	.91	.68

Application Rate

The experiment was originally designed for an application rate of 5 cm (2 in) of spiked effluent per week. After three months of application, it became evident that the soil in the lysimeters and the field plots was becoming too wet. Rather than proceed with the wet soil conditions which resulted in runoff and reduced oxygen supply to the grass roots, the application rates to all lysimeters and field plots were reduced to 2.96 cm (1-1/16 in) per week. The sewage application schedule to both the lysimeters and field plots of all soils studies is given in appendix C.

Selection of Nozzles and Uniformity of Application

After several type spray nozzles were tested, Rainbird series #2400 in brass were selected. Tests indicated that the sewage moving through the nozzles did not pick up significant quantities of the metals used in these studies. Few problems with blocked nozzles occurred. The spray patterns of the half round nozzle at different pressures are shown in figures 7-9. The patterns are for inverted nozzles located at 1.8 m (6 ft) above the plots.

It is evident that more uniform distribution could be achieved at higher pressures; therefore, the effluent was sprayed at 25 lbs. at all times. The nozzles were arranged in patterns under the rainshelters in order to provide as uniform distribution as possible. The uniformity was determined by collecting the sprayed effluent in small paper cups placed on the lysimeters and field plots. A typical distribution pattern is shown in figure 10.

Determination of fecal coliform in the lysimeter drain water

Samples of leachate from the lysimeters were tested periodically to determine if fecal coliform were present. The samples were collected in sterilized bottles after at least 50 ml of the leachate was flushed through the drain tube to remove any contaminant. A procedure given in Millipore Bulletin AM302 was used. It is briefly described as follows:

> Fifty ml of the leachate was drawn through a Millipore filter by means of a vacuum pump.
> The filters were incubated on a Baito-Endo Auger in a petri dish at 44.5°C (112°F) for 24 hours.

The results of the analysis after one year of effluent application are given in table 5. The absence of fecal coliform in the leachate samples from the basic CL soil even after one year, indicates that the sample collection and handling technique was adequate to prevent the contamination of the leachate.

After one year the fecal coliform bacteria had broken through all lysimeters which had a surface soil pH of 6.8 or below except one of the acid CL soils. They had not come through the basic CL soil which had a pH of 7.3 or greater throughout the entire profile. Thus the differences in pH may have influenced the mobility of the bacteria.

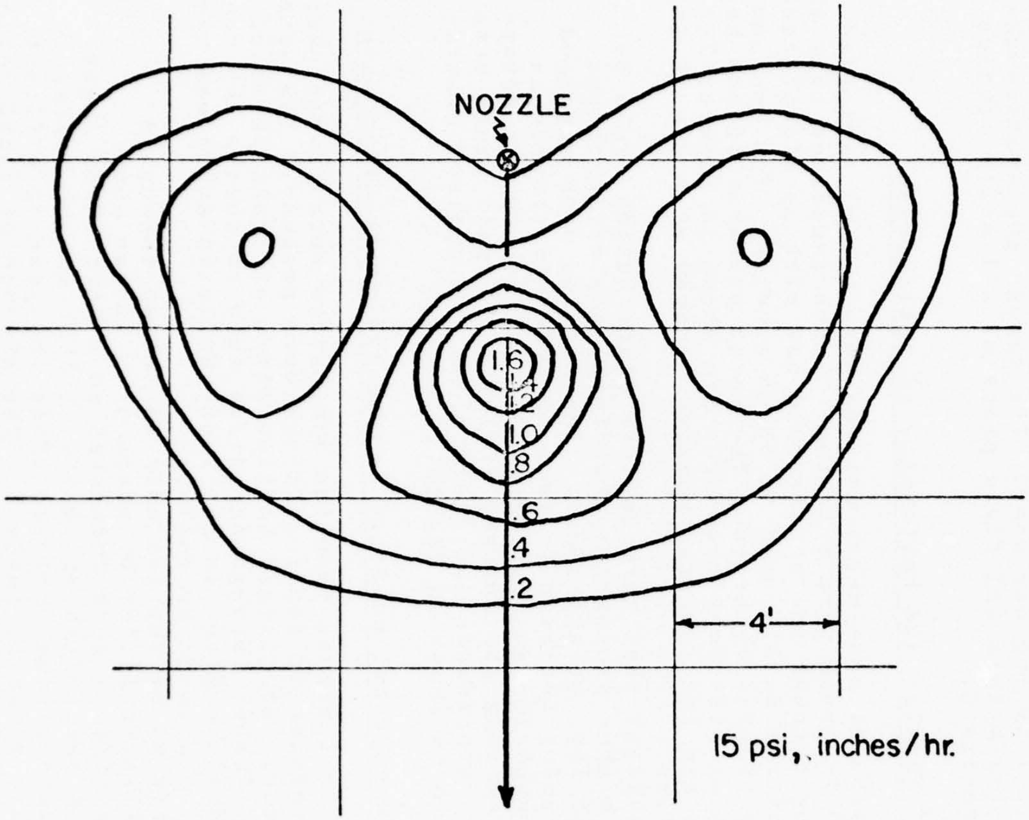

Figure 7. Spray distribution for a half round #2400 nozzle suspended six feet above the collection surface. The pressure was 15 lbs.

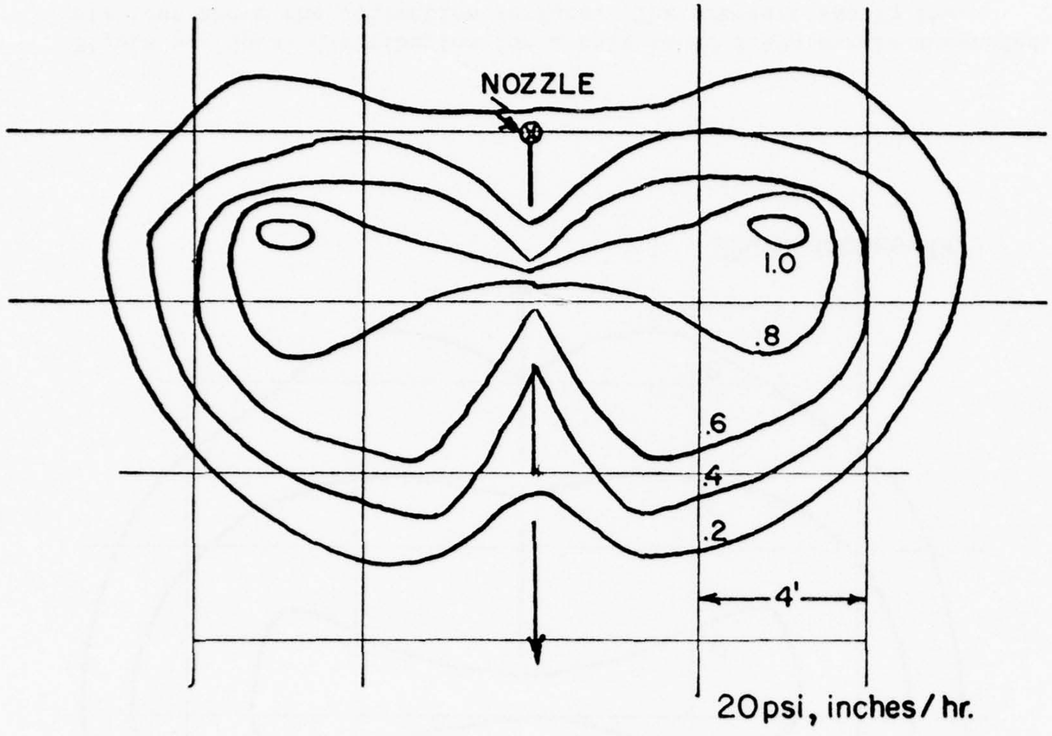

Figure 8. Spray distribution for a half round #2400 nozzle suspended six feet above the collection surface. The pressure was 20 lbs.

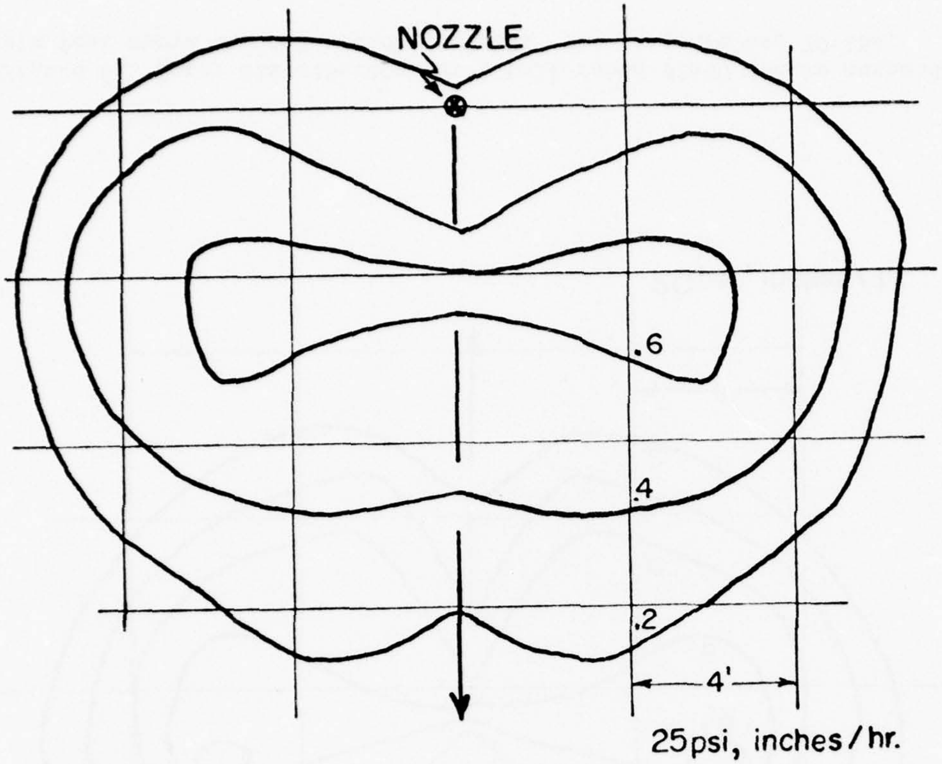

Figure 9. Spray distribution for a half round #2400 nozzle suspended six feet above the collection surface. The pressure was 25 lbs.

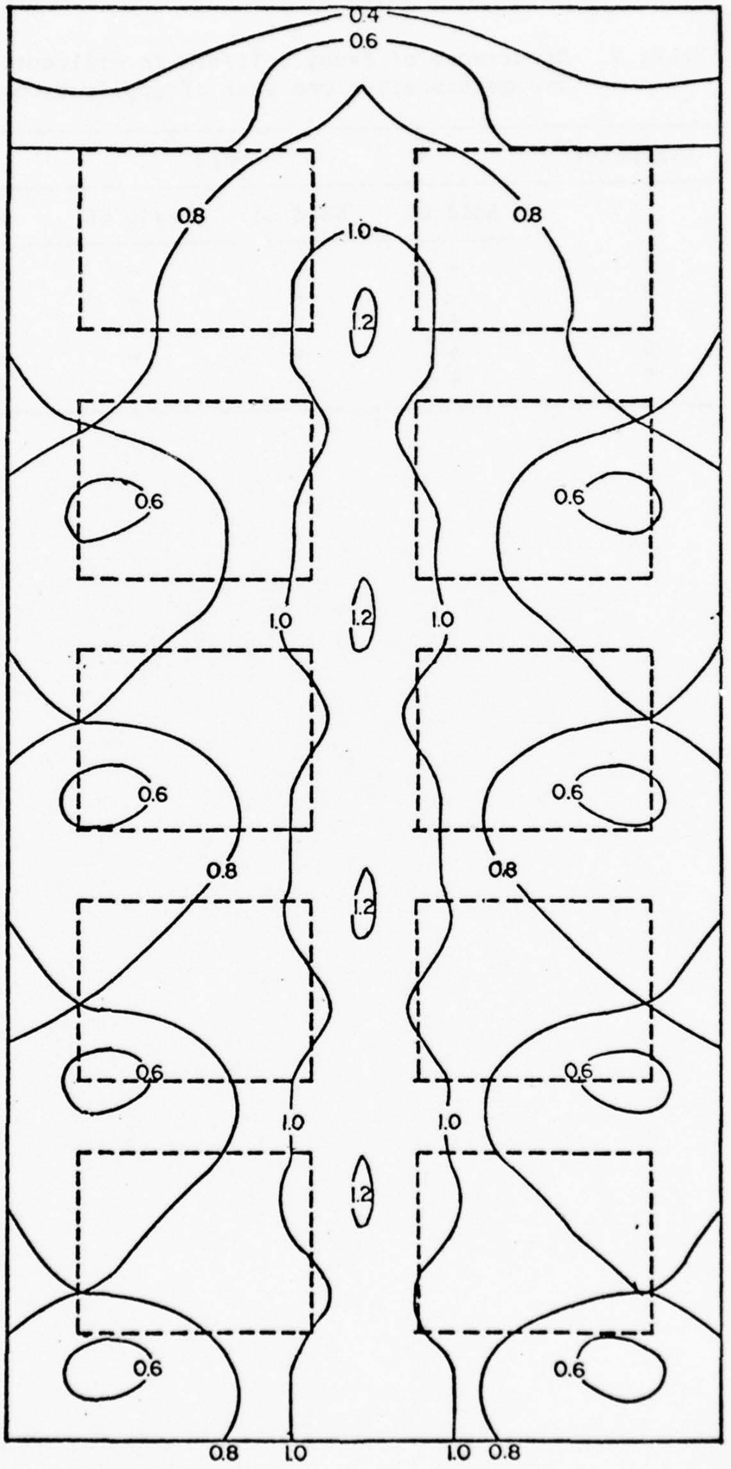

Figure 10. Typical distribution pattern for sewage spray distribution system under each rainshelter.

Table 5. Occurrence of fecal coliform in effluent from lysimeters after one year of applications

Lysimeter	Soil			
	Acid CL	SM(d/u)	Basic CL	SC
1	+	+	-	+
2	-	+	-	+
3	+	+	-	+
4	+	+	-	+
5	+	+	-	+

Loss of metal in effluent

After about 6 months of operation, the concentrations of metals in the effluent collected as it fell on the plots began to decrease despite no changes in spike or effluent handling procedures. Possible points of loss were investigated, these being the tank and the PVC tube used to conduct the effluent to the field.

As far as possible, all plumbing fixtures used to handle the effluent were made of PVC pipe and fittings. The inside of the pump housing and the fittings that had to be welded to the tank as well as the steel tank were coated with a heavy metal-free epoxy base enamel (Shertar), to minimize the possibility of contamination of the sewage. To determine if the metals were precipitating in the tank, or adhering to the film which accumulated on the walls and bottom, samples were collected periodically for analysis. This was done by wiping a 97 cm^2 (15 $inches^2$) area of the bottom of the tank with filter papers wetted with distilled water. Three pieces of filter paper were used, one after theot her to wash the same area. These were each handled and analyzed separately. After the second wiping, the surface appeared to be clean and was visually comparable with a freshly painted surface. The filters were digested in 10 ml HNO_3 (conc.) and 0.5 ml H_2O_2 (30%). After a second addition of the HNO_3 and H_2O_2, the solution was heated to dryness. Then 25 ml of HCl were added and the material was heated for 15 minutes. The extract was then brought to 100 ml by adding 10% HCl, before analysis by atomic absorption. Typical results are given in table 6 after 75 loads of effluent had been handled in the tank. It can be clearly seen that the technique adequately removed any metal-containing material on the surface of the tank. In all tests the third filter paper contacted small or negligible concentration. Assuming that the area wipe was representative of the inside surface of the tank, the value measured would be equivalent to 0.8 g of zinc. This is equivalent to 0.3% of the zinc that had been added to the effluent which passed through the tank. Thus it was apparent that only insignificant amounts were lost in the tank.

Since the losses were not occurring in the tank, attention was turned to the conducting lines. There was no practical means of wiping the tubes, especially those buried in the ground. Therefore, a dilute concentration of HCl was utilized to flush the lines. To do this 2.26 Kg (5 lbs) concentrated HCl was added to 3800 liters (1000 gal) of water in the tank trailer. The rainshelters were moved off the plots and plumbing was arranged to get the solution to the shelters so that it would not fall on the lysimeters or the field plots. After circulating the solution in the tank, 1/3 was pumped to each rainshelter. The total volume passed through underground field lines and 1/3 passed through the plumbing in each rainshelter.

After this treatment the concentrations of metals reaching the plots again reached the desired level. Thus the pipe or the residue in the pipe had been acting as a sink for the metals. Thereafter the system was periodically flushed as described above to prevent further losses.

Table 6. Concentrations of metals collected on filter paper used to wipe the inside of the effluent transport tank.

Metal	First filter paper mg/cm^2	Second filter paper mg/cm^2	Third filter paper mg/cm^2
Cd	.085	.027	0
Cu	.102	.033	0
Ni	.091	.027	0
Pb	.133	.04	0
Zn	.167	.064	.0008

VI. Bromide Study

Introduction

Bromide in the form of KBr was added to each load of sewage at a concentration of 100 mgKBr/l. The bromide was added for two purposes: to check on leakage between the soil and the sides of the lysimeter and to determine how rapidly a very mobile anion would move through the soil being studied. The bromide ion is known to move through soil much more rapidly than the heavy metal ions so the mobility of bromide can be used as a reference for assessing the mobility of heavy metal ions. Bromide has the additional advantage of not being present in significant concentrations in most soils.

Bromide Analysis

Bromide in the water samples was determined by means of a specific ion electrode (Orion model 94-35). In order to minimize the influence of background concentrations of other ions, particularly chloride, standards were made with sewage effluent water to be used for analyzing the bromide in the water put on the plots. For the water collected in suction cups and the leachate from the lysimeters, standards were checked by adding bromide to certain samples. Calibration curves were made throughout each set of analyses.

Results

The concentration of bromide in the lysimeter leachate during the first 16 weeks of the experiment are shown on an expanded scale in figure 11. The concentration of bromide in the leachate from all the lysimeters but the clayey sand (SC) remained constant at background concentrations for the first eight weeks of collection. This provides evidence that the sewage effluent applied did not move down any channels that may have been present along the edge of the inside walls of the lysimeters. The concentration in the leachate from the SC soil jumped from the background value of 5 ppm to 19 ppm as soon as the effluent was applied. The concentration tripled in 18 weeks and reached the concentration in the applied sewage after 16 weeks. Similar precautions were taken in all lysimeters to seal any conducting channels that may have developed along the walls. There is no reason why the precautions should have worked in three of the soils and not the fourth. Thus an alternate explanation must be sought. The clay in the SC soil was an expansive montmorillonite and shrinkage cracks were evident throughout the profile. The soil has some cracks which were evident from the surface when effluent application was begun. It is speculated that the effluent and the bromide traveled down these cracks and thus caused the initial increase in concentration. Kissel et al. (1973) has shown that water movement through cracked channels can be significant even when the soil is wet and cracks are swelled shut. This would indicate that the water applied to a shrinking swelling soil would move through preferential channels.

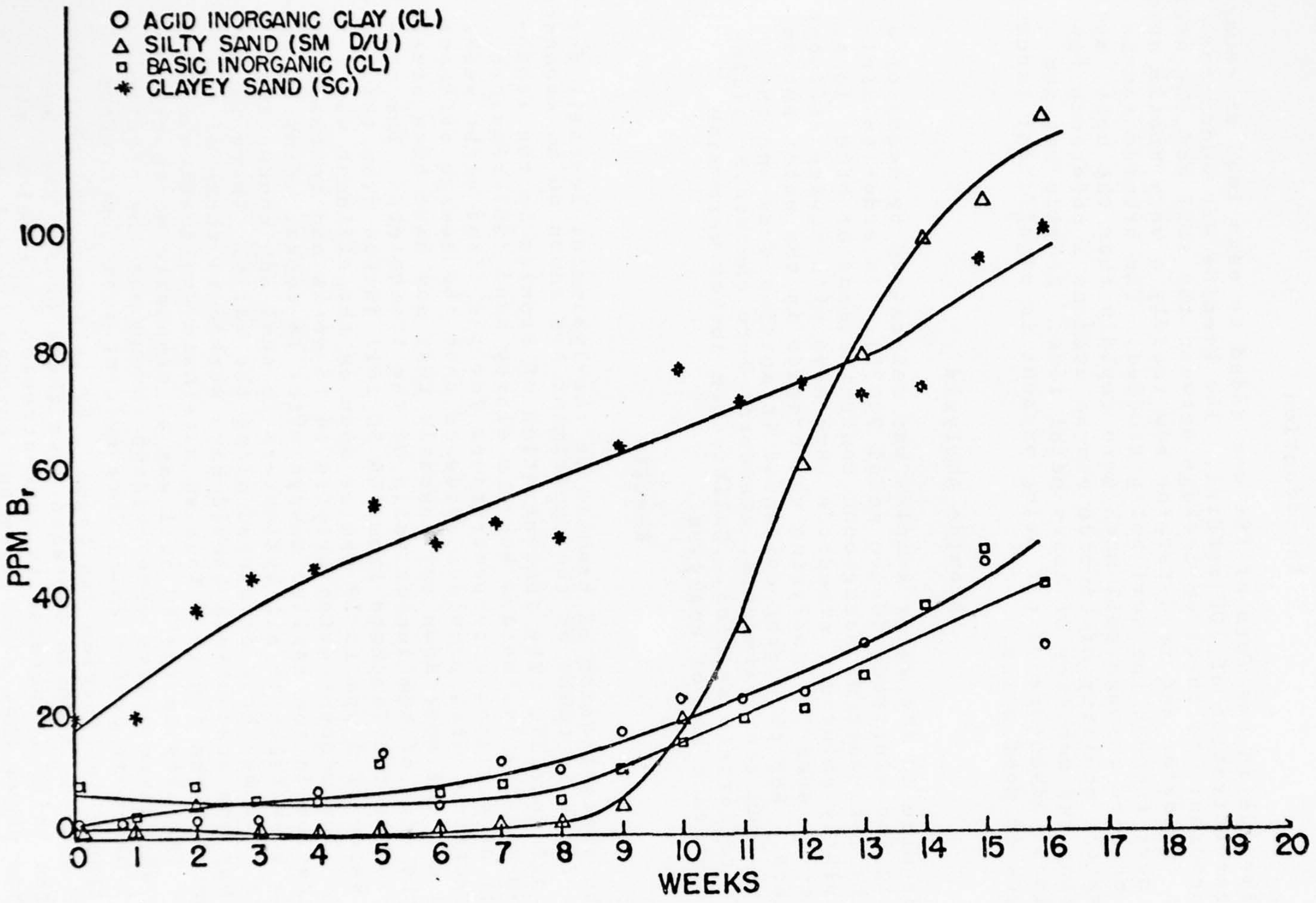

Figure 11. Average concentrations of bromide in the lysimeter leachate. Expanded scale for first 16 weeks.

This may result in the heavy metals being concentrated adjacent to such channels and if the soil becomes saturated with the metals, they would be expected to move through shrinking swelling soils more rapidly than would be expected if the water had moved uniformly through the profile. The large surface areas of shrinking swelling montmorillonitic soils may have a large capacity to absorb metals and thus, although the bromide and the water move more rapidly, the metals may concentrate in the soil adjacent to the cracks very near the surface.

During the first 15 weeks of the experiment, only the silty sand (SM(d/u)) exhibits a classical breakthrough curve with a 50% concentration reached on the 11th week. By the 14th week the concentration is that of the water added. It increases thereafter to concentrations greater than that applied as a result of the loss of water from the soil profile by evaporation. The concentration of bromide in the leachate from all lysimeters for the entire period of the experiment is shown in figure 12. The concentration of bromide in all the soils continues to climb slowly after the first 16 weeks. The scatter in the data as the experiment proceeded is a result of the variable concentration of bromide resulting from the evaporative loss of water and the redilution when more water was added. The Basic CL soil exhibits a breakthrough curve requiring about 20 weeks to reach 50% concentration. The Acid CL soil does not demonstrate a typical breakthrough curve, but instead the concentrations in the leachate remain very constant for a long period of time with a slight increase. This is attributed to the slow movement of water through the soil. After 26 weeks, bromide additions ceased but all concentrations continued by the evaporation losses continued to climb slightly as the leachate which had been concentrated by the evaporation losses continued to move through the profile.

A comparison of the concentration of bromide from the soil solution collected at 150 cm (60 in) in the field plots and the leachate collected from the lysimeters should reveal the relative rates of water movement in the two systems. These data plus the concentrations in soil solution collected at 75 cm (30 in) in the lysimeters and field plots are shown in figures 13 and 14 for the Basic CL and SM(d/u) soils. The bromide reached the 75 cm (30 in) depth in the field plot approximately four weeks before it reached the same depth in the lysimeters. The delay in reaching the 150 cm (60 in) level was large and increased with time. Early in the experiment the suction on the lysimeters was adjusted to be similar to that at the same depth in the field plot. During this time, water built up in the soil profile. After the 8th week, the vacuum was increased to remove the water and prevent further build up. These changes provide a possible explanation on the delay in bromide reaching the lower levels in the lysimeters.

The concentration at the depths in the SM(d/u) lysimeters and field plots are shown in figure 14. In the lysimeter the concentration reached 50 ppm at 75 cm (30 in) in 4 weeks and at 150 cm (60 in) in 11 weeks. The data for the field plot exhibits more scatter, but otherwise does not differ from that taken in the lysimeter. The SM(d/u) soil was more permeable than the basic CL soil. As a result the water did not accumulate early

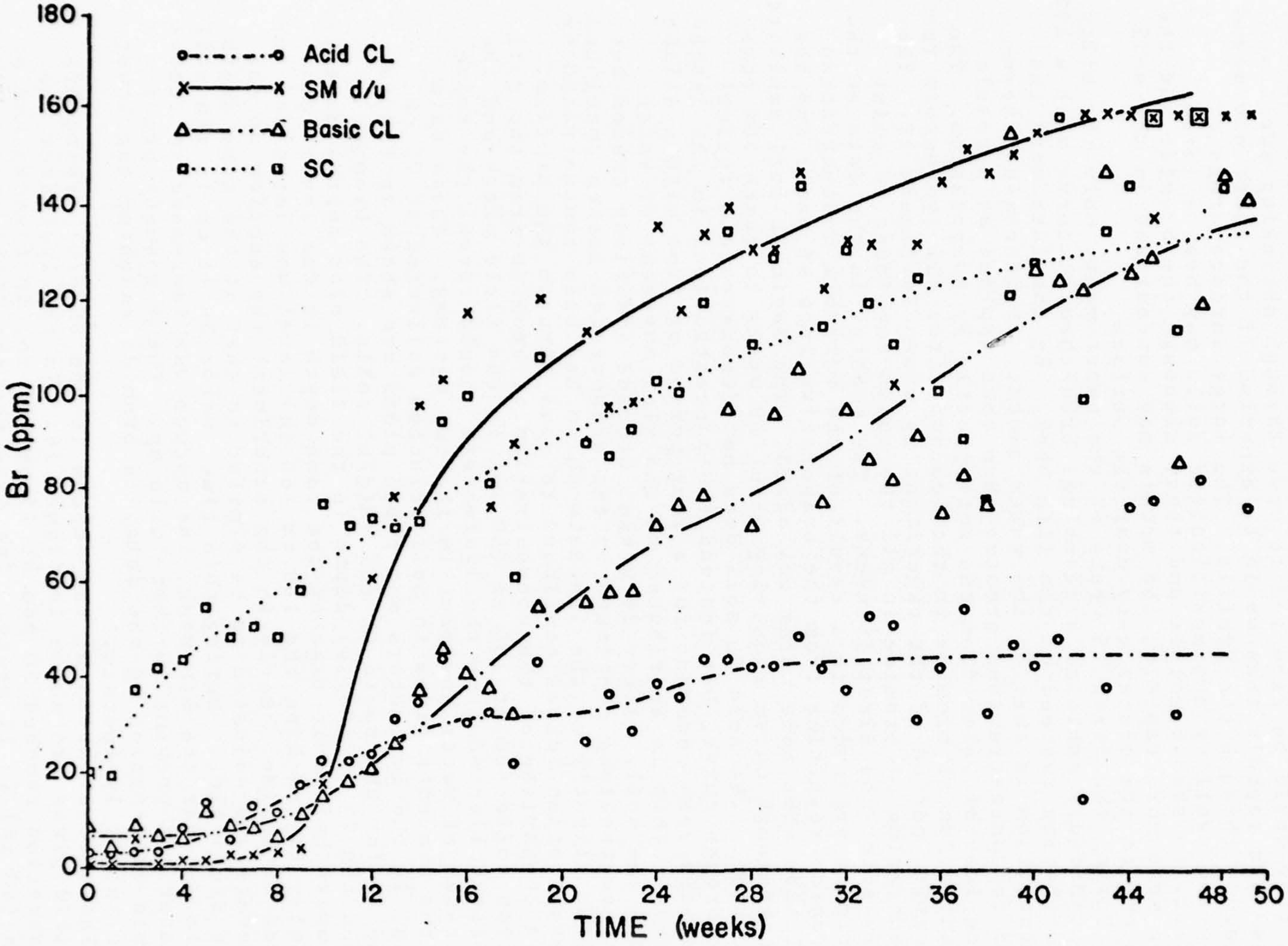

Figure 12. The concentration of Br^- in the effluent from the suction cups in the bottom of the lysimeters of each of the four soils.

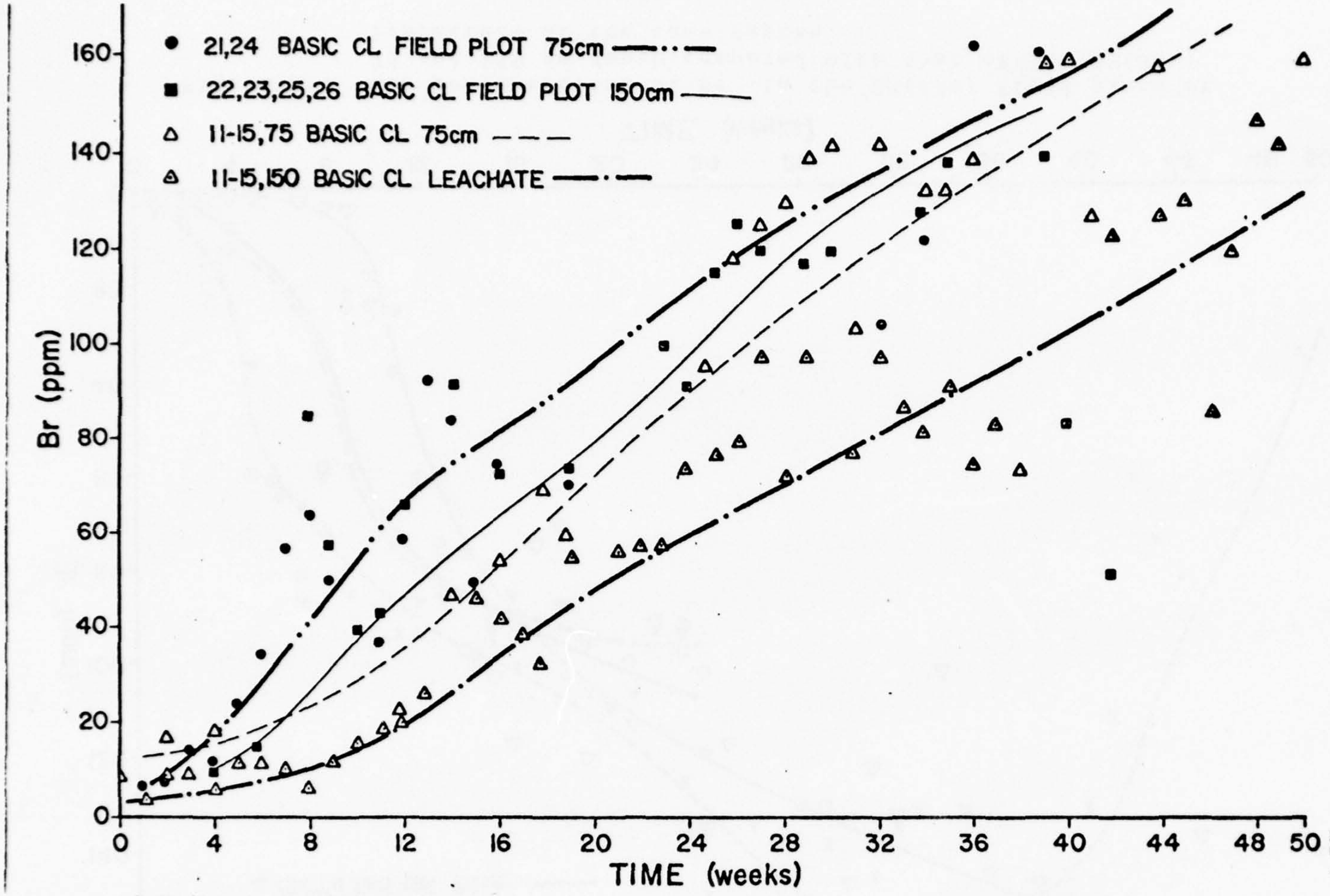

Figure 13. The concentration of Br^- in the basic CL field plots at 75 and 150 cm depth compared with that of the Basic CL lysimeters at the same depths.

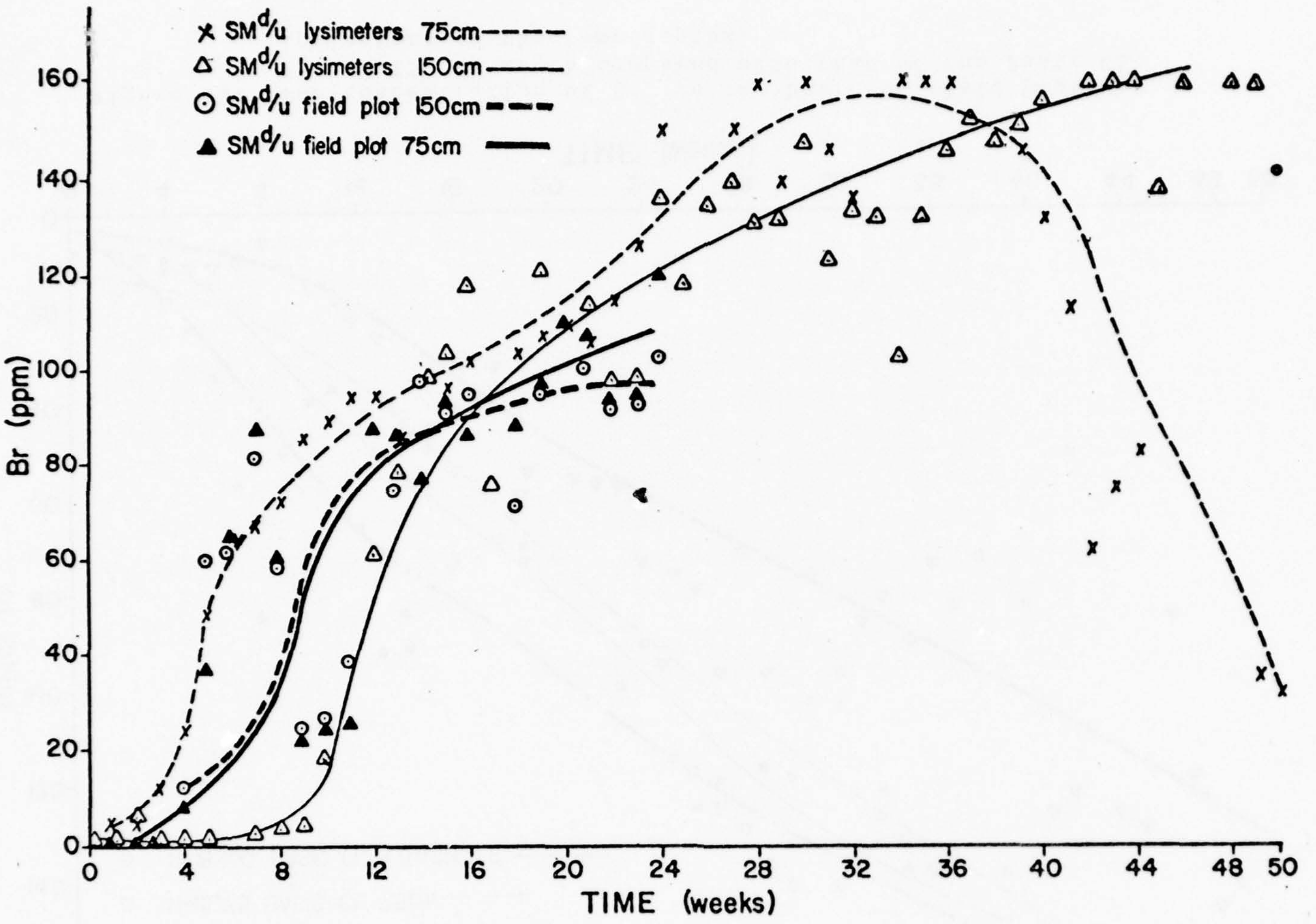

Figure 14. The concentration of Br^- in the SM(d/u) field plots at 75 and 150 cm depth compared with that of the SM(d/u) lysimeters at the same depths.

in the experiment and the concentration profiles are similar throughout the experiment. Applications of bromide continued through the 26th week. By the 36th week the concentration at 75 cm (30 in) began to decrease. By the 44th week, the concentration was 50 ppm.

These results reveal that water movement in the lysimeters did not differ greatly from that in the field plots. If adequate suction is applied to the lysimeters, nearly identical water movement can be achieved.

VII. Water Balance

Soil Moisture

Soil moisture was periodically measured by two means. A soil moisture neutron probe (Troxler model 105A, Gauge model 1257) was used to measure the volume percent moisture profiles in the lysimeters and the field plots.

The soil moisture potential was measured with mercury tensiometers similar to those shown in figure 15. They were made of suction cups (Soil Moisture #2131) with a bubbling pressure greater than one atmosphere and a conductivity of 1 ml cm^{-2} min^{-1} bar^{-1} and a surface area of 31.4 cm^2. The tubes and cups were refilled with water as necessary. The end of the shorter tube was sealed and the longer tube was placed in a mercury well. As the soil moisture potential changed, the water moved through the porous cups either decreasing or increasing the suction on the mercury column. Tensiometer readings were taken several times per week. Tensiometers were installed in each field plot and each lysimeter at a depth of 30 cm (11.8 in). In addition one lysimeter of each soil and one of each field plot were equipped with a bank of tensiometers at 3.9, 7.9, 11.8, 15.7, 19.7, 27.6, 35.4, 43.3 and 55.1 inches (10, 20, 30, 40, 50, 70, 90, 110, 140 cm).

Water Balance

Vacuum was applied continuously to the suction cups located at the bottom of each lysimeter. The cumulative fluxes of water expressed as a depth for all lysimeters are shown in figures 16, 17, 18, and 19. Detailed data for each lysimeter are tabularized in Appendix D. The -1/3 bar suction maintained at first was insufficient to draw the water from the soil. Thus in all lysimeters the outflow for the first 6-7 weeks was low. The suction was then increased to -0.8 bars. The 5 cm per week application rate was still causing excess water both on the lysimeters and on the Basic CL land plot. All applications were thus reduced to 2.7 cm per week after the 12th week. The reduction plus the increased evaporative demand during the summer months resulted in a decreased flux rate during the second half of the year.

The lowest total flux of water occurred in the SC soil followed by the Acid CL soil; the greatest flux was from the SM(d/u) profile. The differences between the flux through the 4 soils can be clearly seen in figure 20 where the average values are given. Variability between lysimeters of the same soil was typically 5%, but one lysimeter of each soil had a markedly higher or lower flux than did the others. This variability between soil monoliths taken next to each other in the field may be typical of the horizontal variability that exists in nature.

Typical soil water content profiles are shown in figure 21 for each of the soils. On this particular date, all the lysimeters were dry near the surface and moisture content increased with depth. As would be expected from the soil characterization data, the SM(d/u) profile had the lowest moisture content while the other profiles did not differ greatly. The average moisture

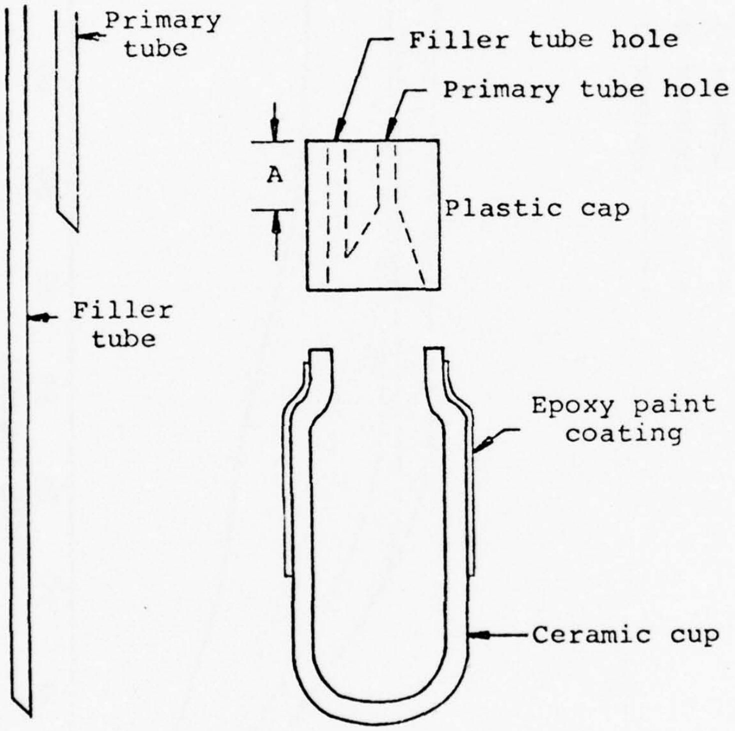

Figure 15. Tensiometer components.

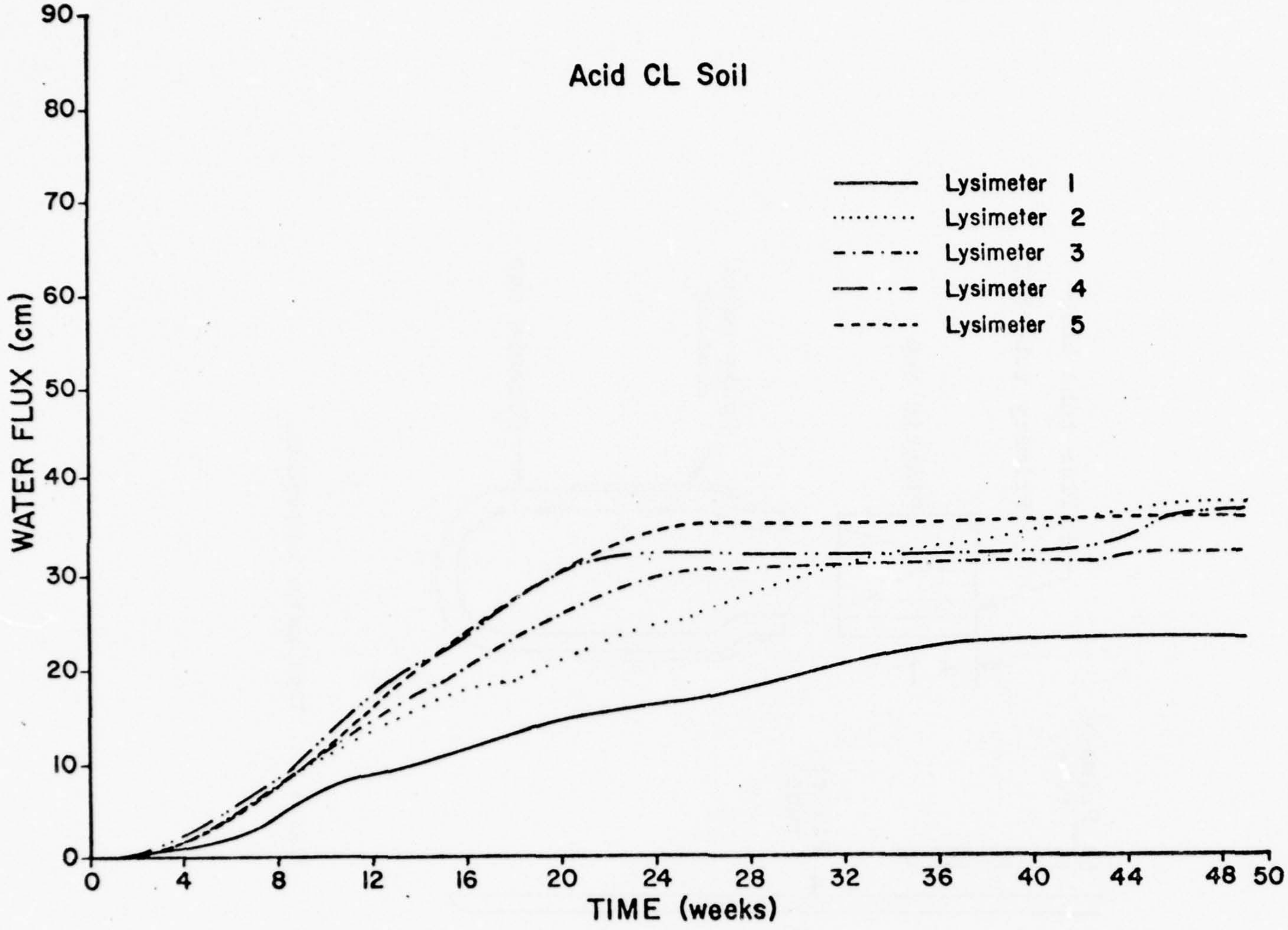

Figure 16. Weekly water flux in the individual acid CL lysimeters.

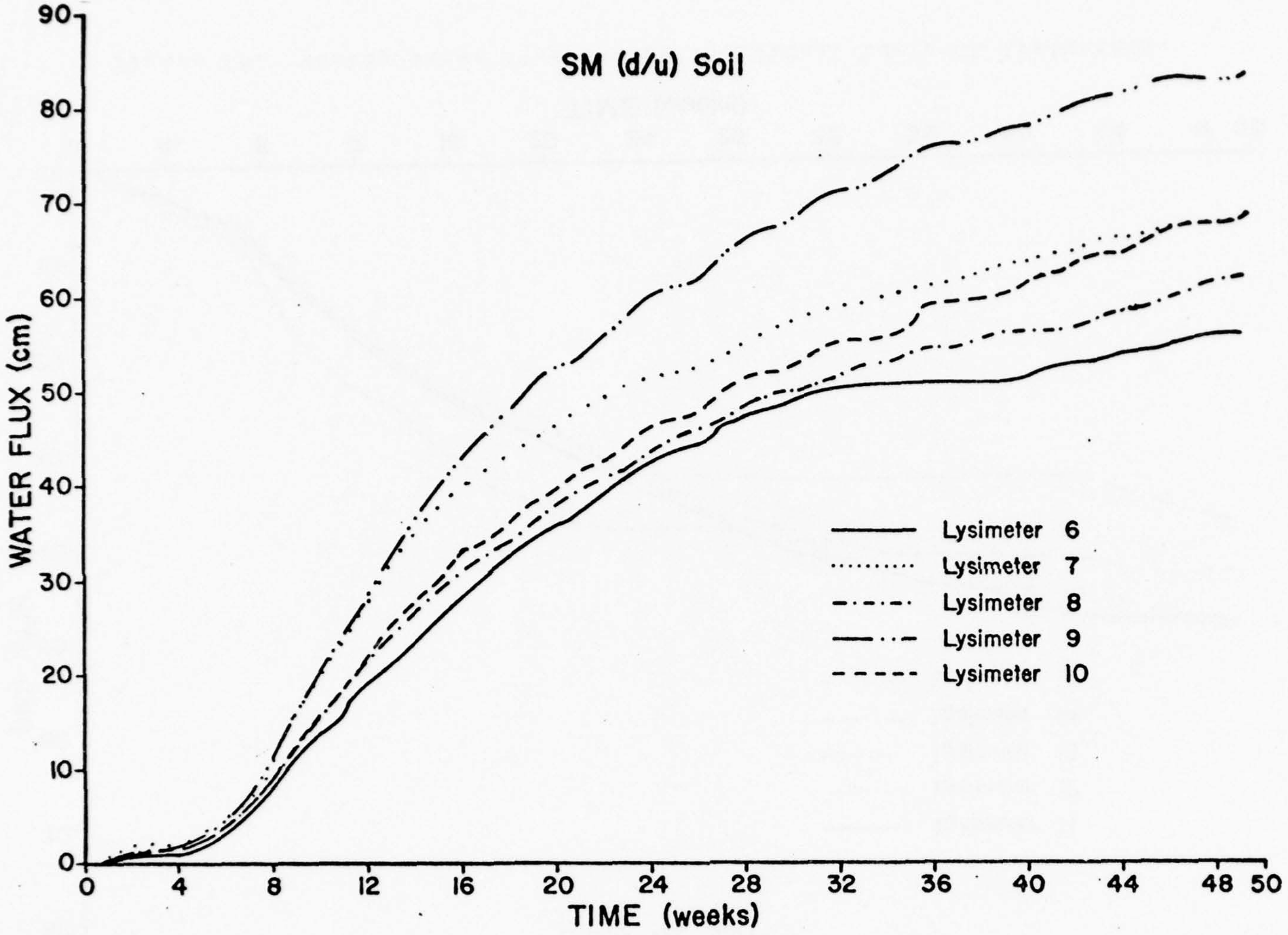

Figure 17. Weekly water flux in the individual SM(d/u) lysimeters.

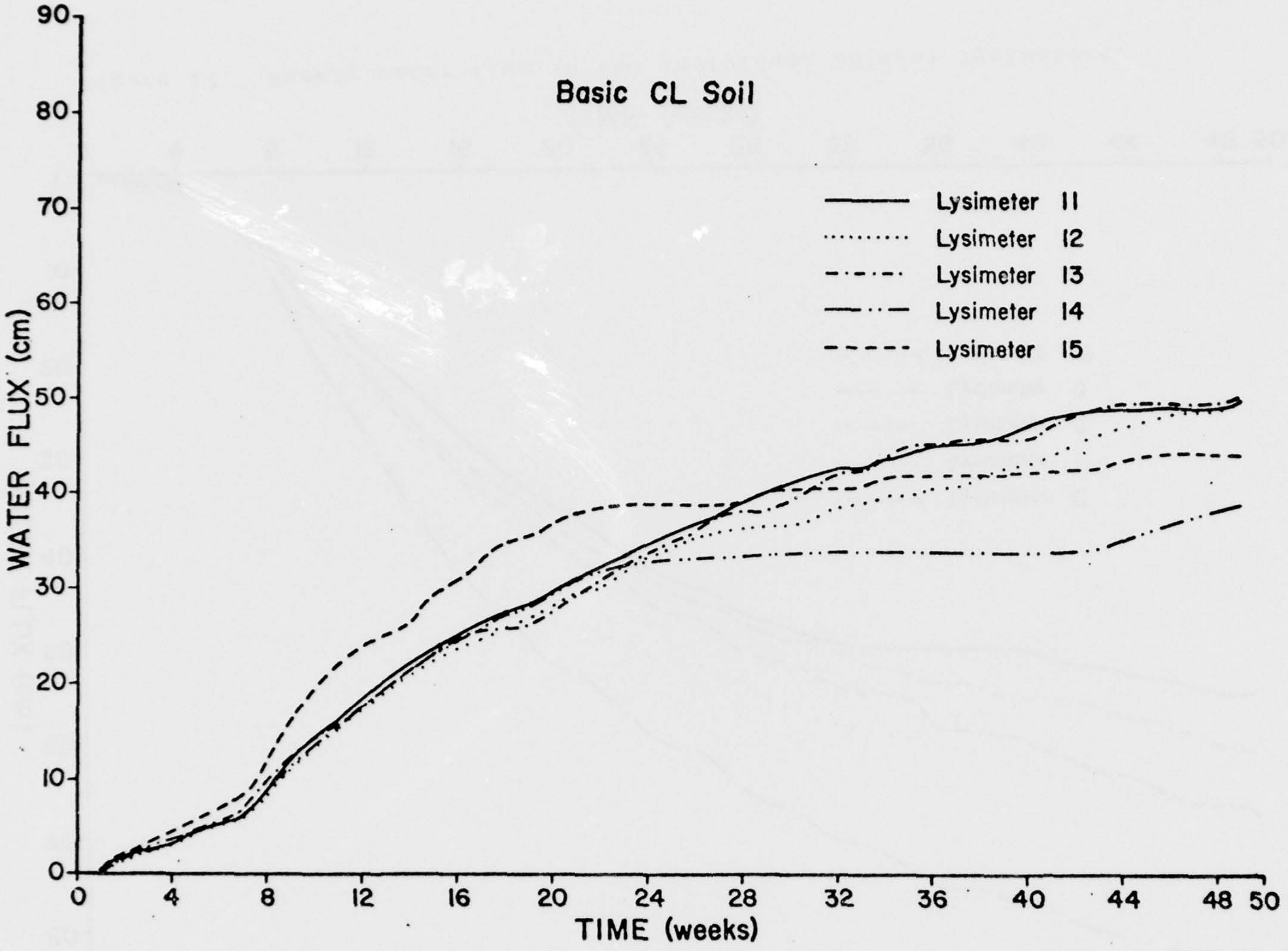

Figure 18. Weekly water flux in the individual basic CL lysimeters.

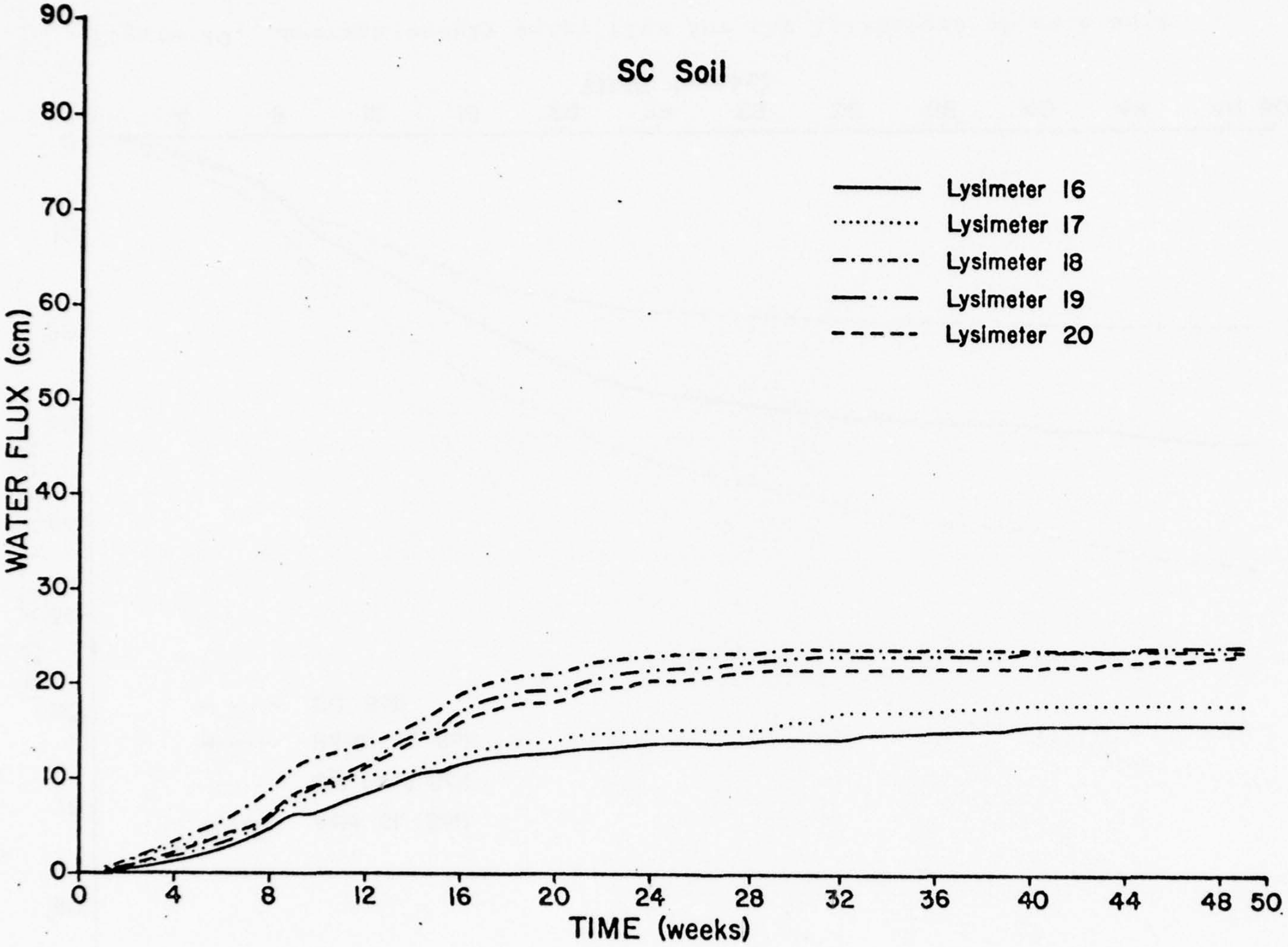

Figure 19. Weekly water flux in the individual SC lysimeters.

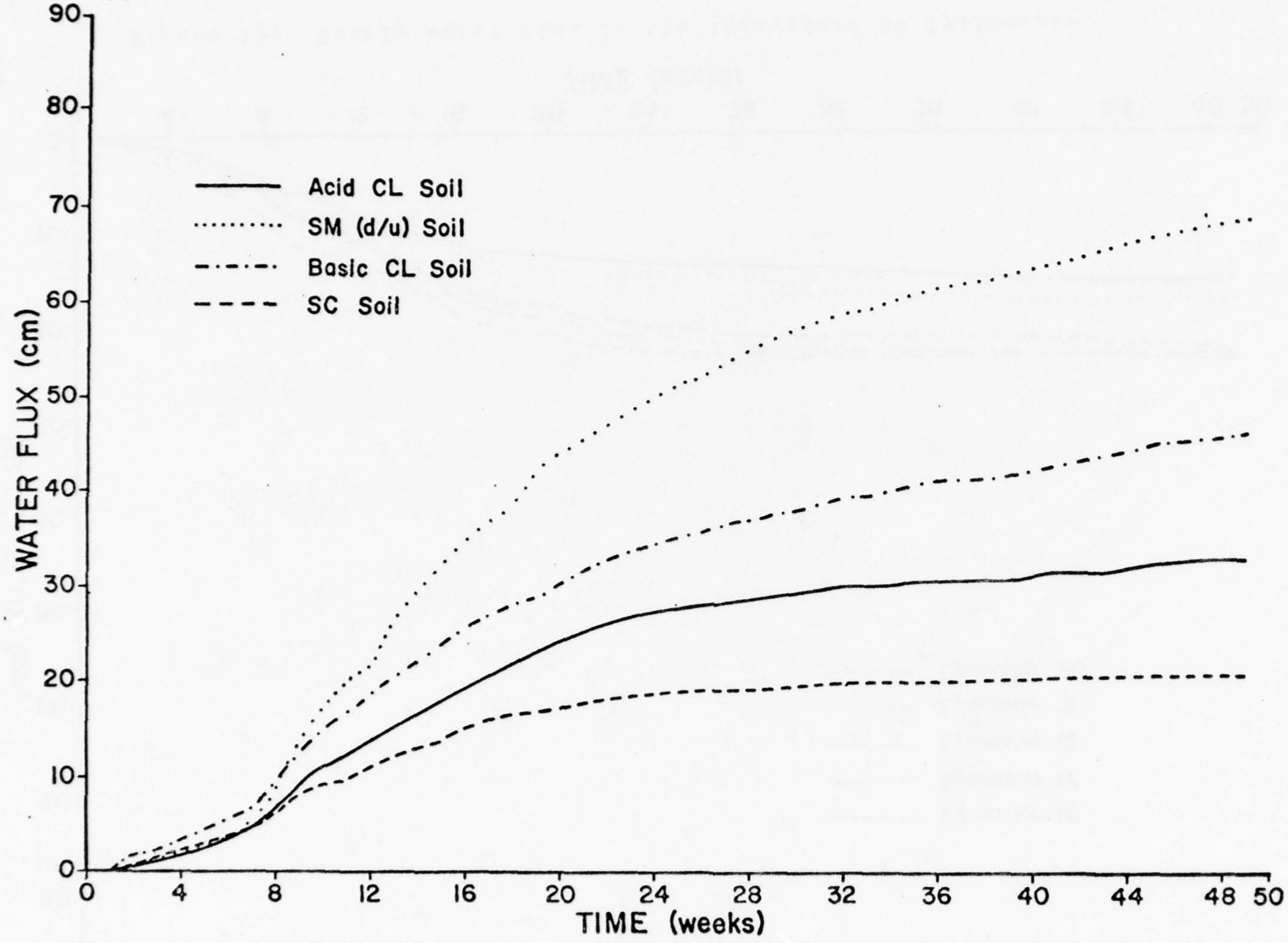

Figure 20. Average weekly water flux for the lysimeters of each soil.

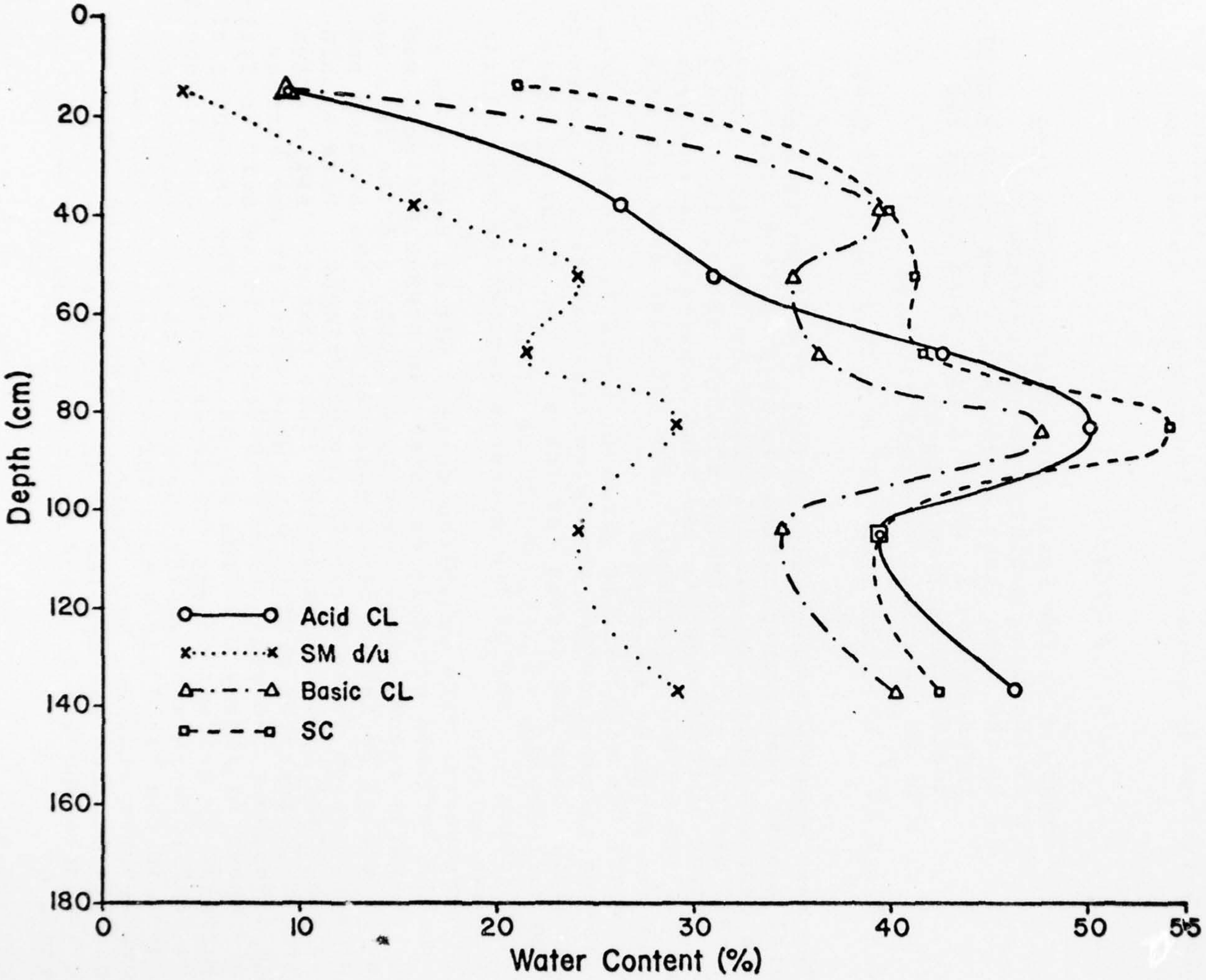

Figure 21. Percent water content with depth for each of the four soils studied. Values are averages of five lysimeters each.

content profile for the basic Cl lysimeters and that for the two basic CL field plots are shown in figure 22. The two profiles are essentially the same, indicating that with proper management, moisture conditions similar to those found in the field can be achieved in lysimeters.

The water balance was calculated in two ways. The meteorological data given in appendix E was utilized to calculate the evapotranspiration by means of the Thornthwaite formula as follows:

$$e = 1.6\ (10T/I)^{a}$$

where e is the month evapotranspiration (cm)
T is the mean monthly air temperature (°C)
I is the heat index which is the sum of 12 monthly index values i, where i is a function of the monthly mean temperatures.
a is an emperical constant given as

$$a = 6.7 \times 10^{-7}\ I^{3} - 7.71 \times 10^{-5}\ I^{2} + 1.79 \times 10^{-2}\ I + 0.49$$

The mean monthly evapotranspirations are shown in figure 23. The total annual evapotranspiration was 12.3 cm (4.8 in).

The evapotranspiration was calculated as the initial water in the soil profile plus the sewage effluent added, less the flux out the bottom of the lysimeters and that remaining in the profile at the end of the experiment. The detailed data for each lysimeter are given in Appendix F.

A summary for each soil is given in table 7. If the evapotranspiration calculated from the meteorological data is taken as being accurate, then the errors for the acid CL, SM(d/u), Basic CL and SC soil are 26, -9, 12, and 39 cm (10.2, -3.5, 4.7, and 15 in) respectively. Any of the measured parameters may contribute to these errors.

The tensiometer data exhibited quite a bit of scatter as a result of the variable schedule on which the sewage effluent was applied. General trends were, however, evident, and the data was of value in making decisions about changing both the suction and effluent application rates early in the experiment. Data within a day or two after application in the finer textured soils often demonstrated an inverted profile with more water at the surface. Readings throughout the year taken at 4 depths in an acid CL lysimeter are shown in figure 24. The wet period at the beginning of the experiment is evident as are the dryer months which correspond with the 28th through 46th weeks. Comparing these results with those taken in the field plots substantiates that the soil moisture movement was similar, both inside and outside the lysimeters once adequate suction was applied to the bottom of the lysimeters. Figures showing detailed tensiometer data are presented in Appendix G.

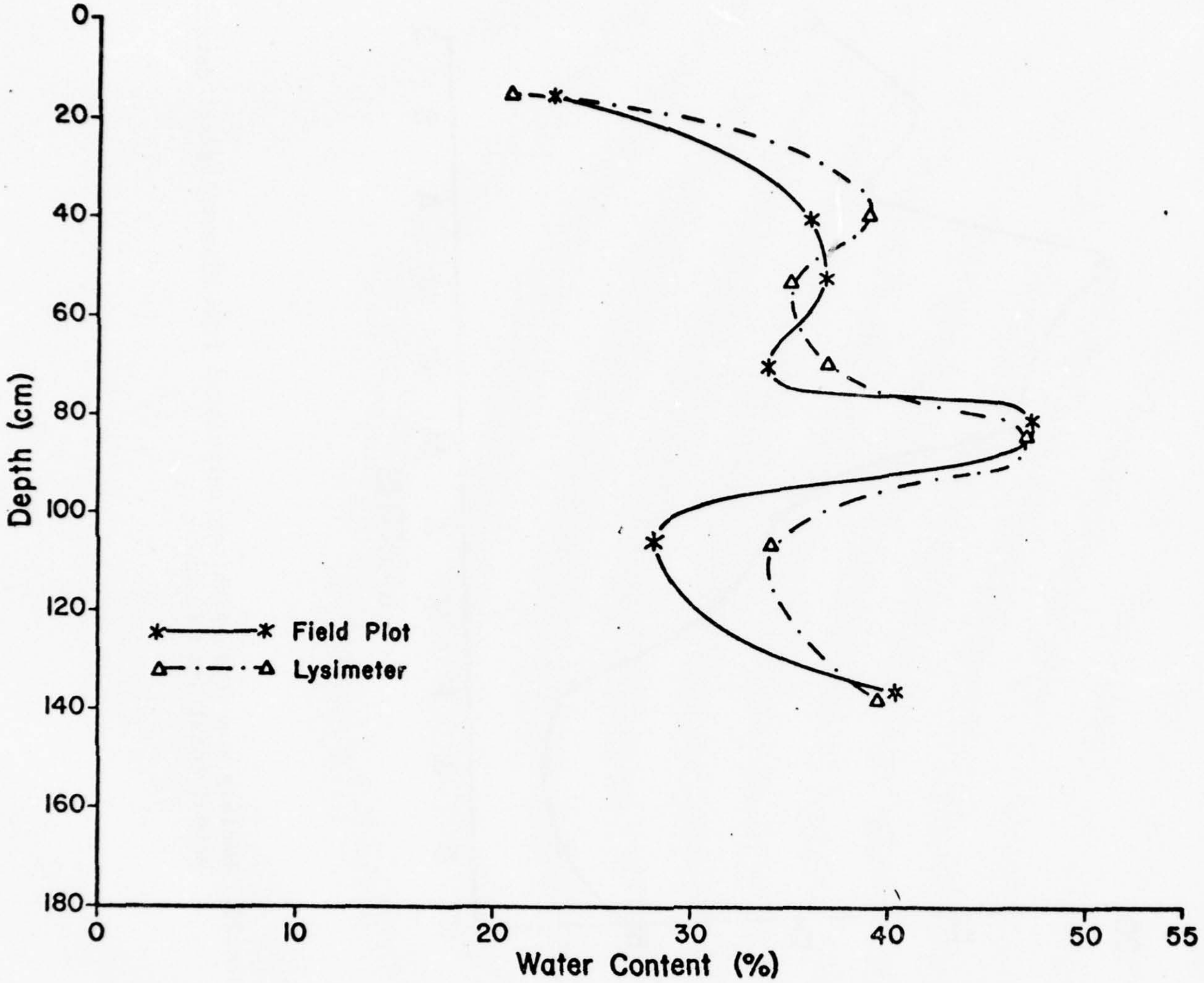

Figure 22. Percent water content with depth for basic CL soil lysimeter and field plot

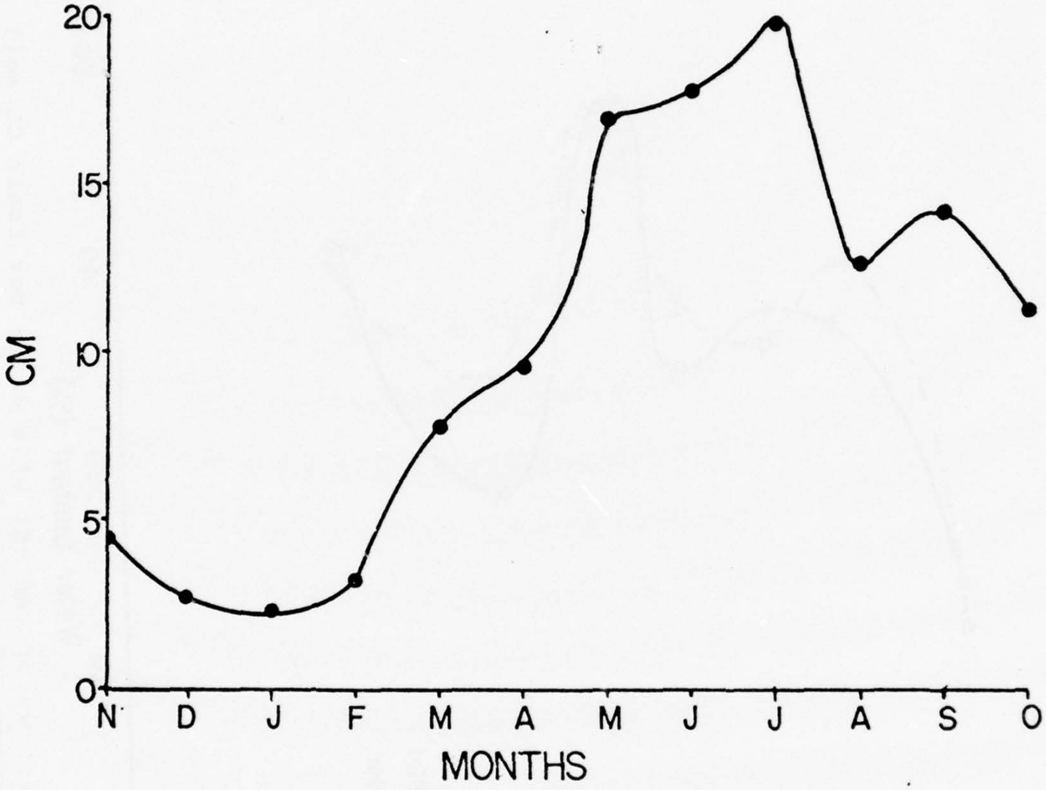

Figure 23. Monthly evapotranspiration calculated from climatological data. Annual total was 123 cm.

Table 7. Average water balance in cm for the four soils depth for the entire period of the experiment.

	Acid CL	SM(d/u)	Basic CL	SC
Water Applied	170	170	170	170
Initial Water Content of Soil	67	47	61	67
Applied + Initial	238	218	231	239
Leachate	33	68	47	21
Final Water Content of Soil	55	35	51	53
Evapotranspiration + error	149	114	135	162

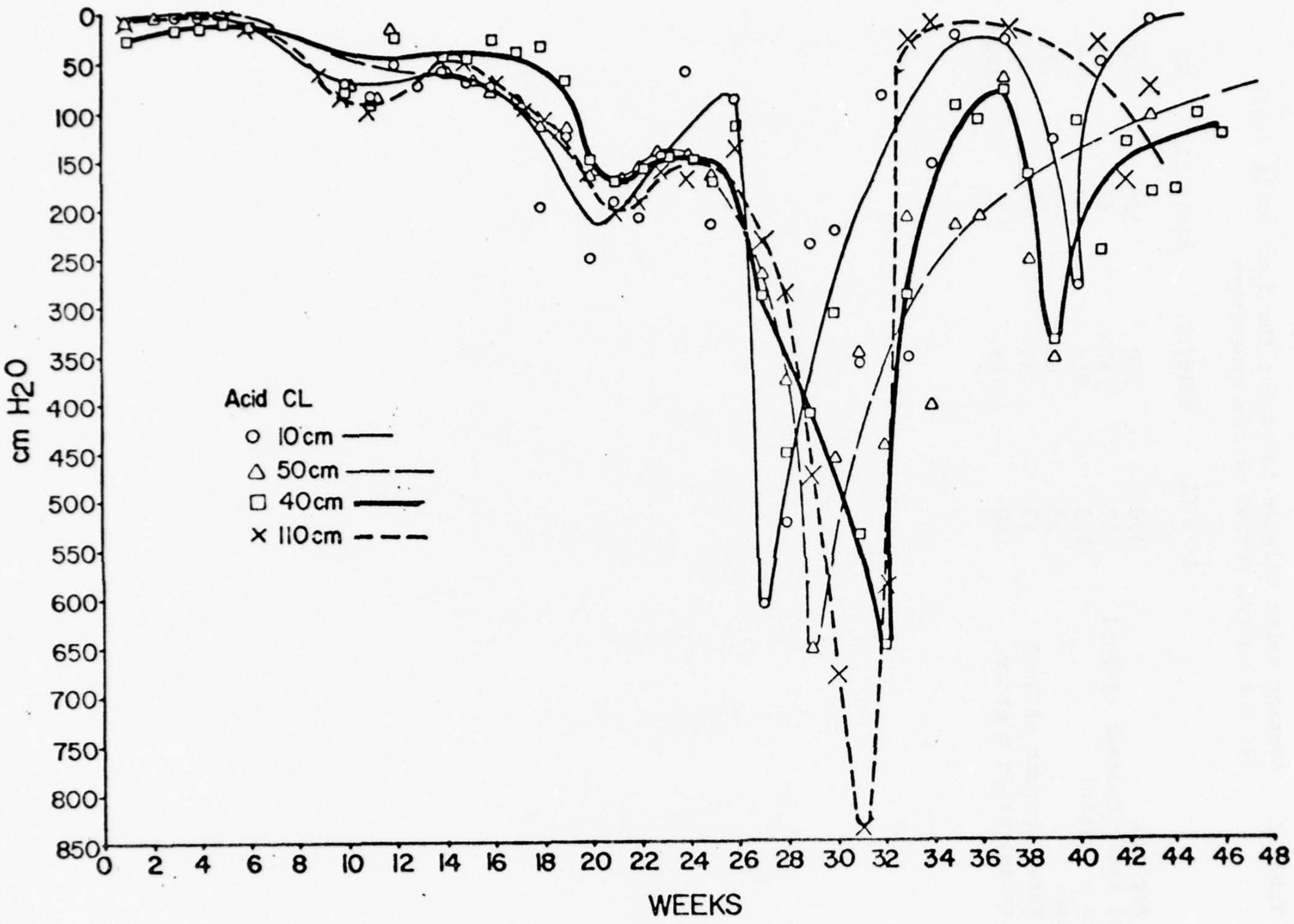

Figure 24. Tensiometer readings taken throughout the year taken at four depths in an acid CL lysimeter.

VIII. Metal Accumulation and Loss Through Vegetation and Soil

An attempt was made to keep a detailed account of the quantities of metals applied and what happened to them. The concentration of each metal in the applied water was determined as described previously. The leachate water from the bottom of the lysimeters was analyzed quantitatively for metal content. The only other places for the metals to accumulate are either in the vegetation growing on the lysimeters or directly in the soil. Therefore, the coastal bermudagrass growing on the lysimeters was periodically harvested, weighed and analyzed for metal content. Likewise, soil samples were taken periodically throughout the duration of the experiment and analyzed for metals.

Grass Yield

The average grass yields for the lysimeters containing the four different soils as well as those on the field plots are given in table 8. The grass was harvested at intervals more frequent than would be customary for hay production. On the other hand, if cattle were grazing the area, the harvest would be nearly continuous. The SM(d/u) and SC lysimeters yielded less than the Basic CL and acid CL lysimeters. Since no effort was made to correct soil nutrient deficiencies which may have been present, this may be partially responsible for yield differences. There was little correlation between the harvestable grass in the lysimeters and the field plots of identical soil.

The grass was already established on the SM(d/u) field plots. Grass was sprigged on the lysimeters and the Basic CL field plot at the beginning of the experiment. The slow growth of grass after sprigging is responsible for the lower yields early in the study. By the middle of the year, all surfaces were well covered with grass. The total yields for the year were in the normal range for the soils and climate.

Preparation and Analyses of Grass Samples for Heavy Metals

After harvesting, a portion of each sample was oven-dried at 70°C (158°F) and stored in plastic bags until analyses. A dry ashing technique was utilized to prepare the samples for atomic absorption spectroscopy. The technique is described in detail by Jones and Isaac (1969). Briefly, it consisted of ashing one gram of the dry plant material in a porcelain dish at 500°C (932°F). The ash was dissolved in 5 ml of 20% HCl and heated as necessary to dissolve the residue. The solution was filtered through acid washed filter paper which was then rinsed with hot water. If not analyzed immediately, samples were stored in polyethylene bottles. They were analyzed on a Perkin-Elmer atomic absorption spectrophotometer.

Table 8. Yield of Grass Dry Weight in Kg/Ha. Averages of 5 lysimeters and 2 field plots are shown for each harvest date.

	Date Harvested					
	12/17	3/23	5/3	6/17	7/31	10/28	Total
Lysimeters:							
SM D/µ	161	*	853	645	1020	1347	4026
Acid CL	373	439	2510	4193	3861	1973	13349
Basic CL	504	313	1276	1047	3942	1679	8761
SC	118	297	1162	650	1933	1138	5298
Field Plots:							
Basic CL	120	1186	2287	1341	2607	778	8319
SM D/V	742	296	2768	----	----	----	3806

* Samples burned in faulty drying oven.

Metal Uptake and Removal by Harvested Grass

The concentrations of metals in the harvested grass are shown in figures 25, 26, 27, 28, and 29. For all metals a general increase in concentration is found as the metals build up in the soil from the repeated application. For all metals, peaks in concentration are obtained in the April, June, and October '74 samples except for the copper. This cyclic trend in concentration over the growing season is more profound than the gradual increases resulting from the repeated applications. The annual trend may be associated with rapidity of growth, age of the vegetation at harvest, cycling of soil microbial activity which may result in cyclical availability of the metals or other factors not investigated here. The samples of grass harvested in mid-March were lost in a fire. Therefore, additional small samples were collected three weeks later. The grass harvested was small and young. The concentrations measured on these samples were the lowest observed for all metals. This indicates the possibility that the age of the grass may be an important factor, but does not rule out the other possibilities mentioned above.

Differences in concentrations in grass harvested from different soils are much less evident than differences between harvest date. For all the metals except the lead, the concentration in the grass harvested from the SM(d/u) soil was lower at the beginning of the application and were higher late in the application period than those found in the grass harvested from other soils. This is indicative of the lower initial concentrations of these metals in this soil, and the lower capacity of this soil to inactivate the applied metals.

The quantity of metals harvested in the grass are given in tables 9, 10, 11, 12, and 13. The uptake of the essential minor nutrient zinc in the grass is three or more times greater than that of the other metals. Uptake of copper was second in most cases. The uptake of the other metals from any particular soil were similar, reflecting its probable dependence on the amounts applied. Differences in uptake between soils are attributed to the grass yield and not the concentrations in the grass. The SM(d/u) and SC lysimeters had the lowest metal uptake and the lowest grass yields.

Metals in Root Zone Water

Root zone samples were analyzed for metals by direct absorption into the flame of the atomic absorption spectrophotometer. Quantitation was by comparison to standards of known metal concentration. Detection limits applicable to this procedure were 0.01 ppm for Cd, Cu, Zn, 0.05 for Ni, and 0.07 ppm for Pb. No metals were found in any of the root zone water samples.

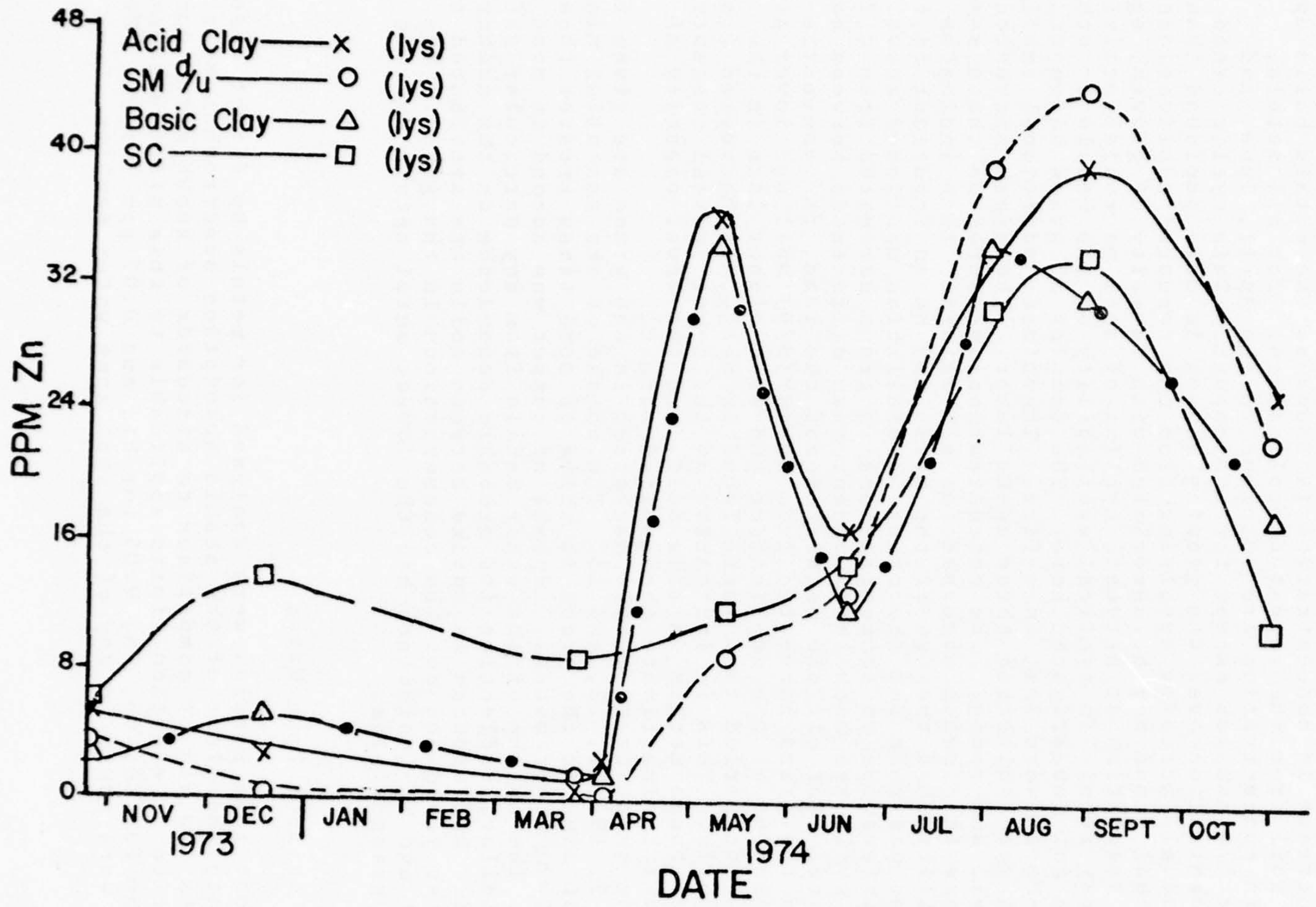

Figure 25. Concentration of zinc in the grass harvested from the lysimeters containing the four different soils.

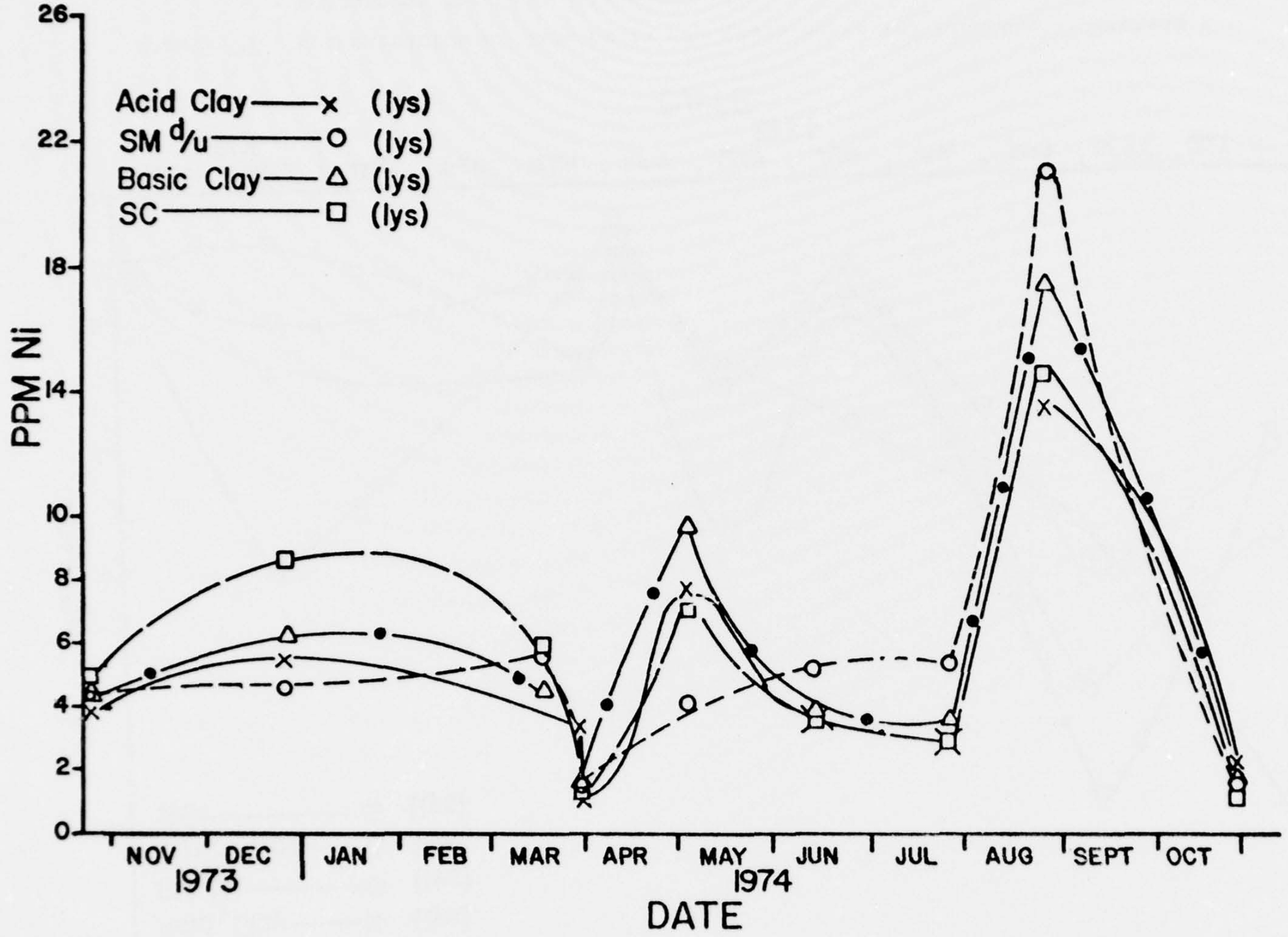

Figure 26. Concentration of nickel in the grass harvested from the lysimeters containing the four different soils.

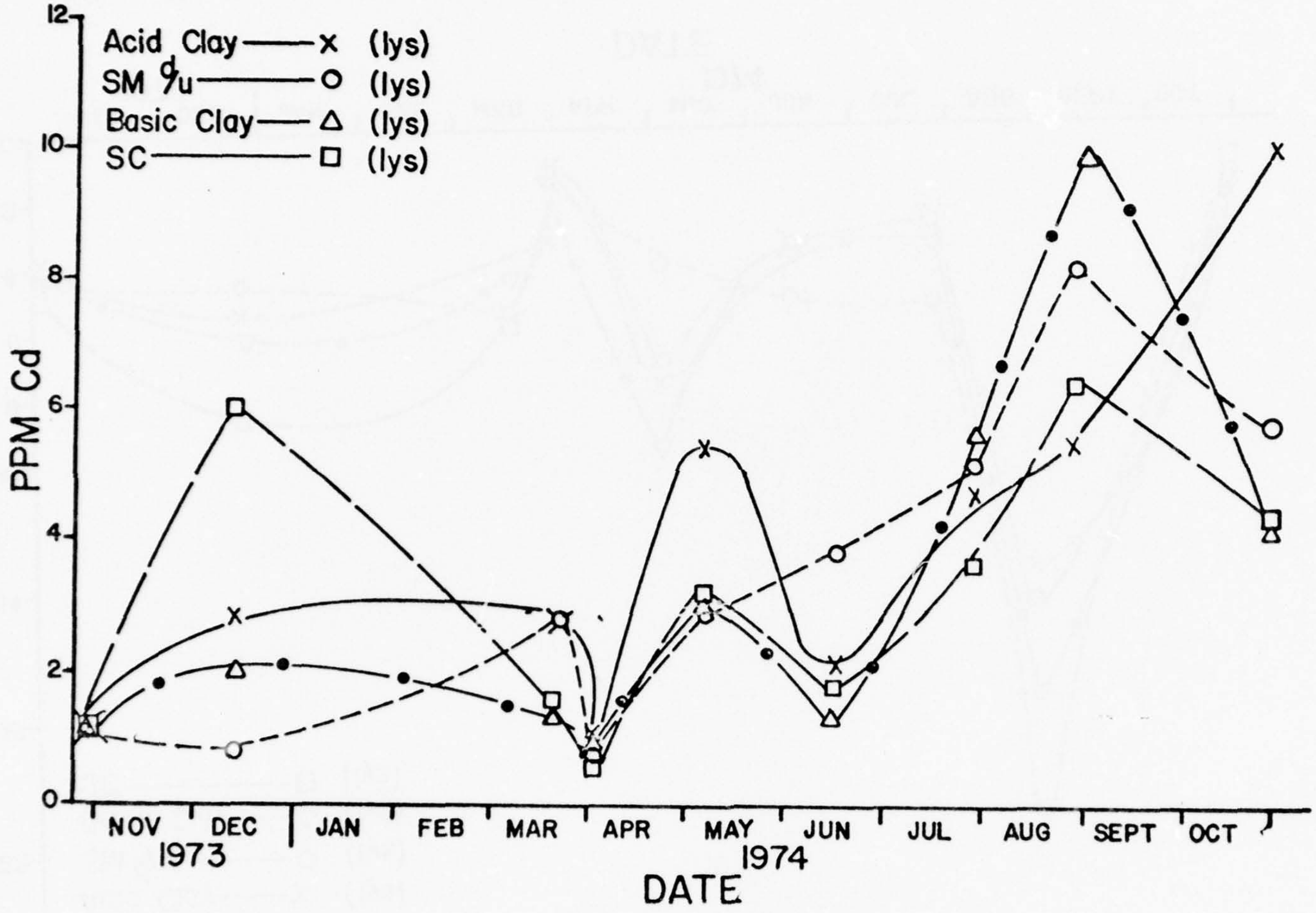

Figure 27. Concentration of cadmium in the grass harvested from the lysimeters containing the four different soils.

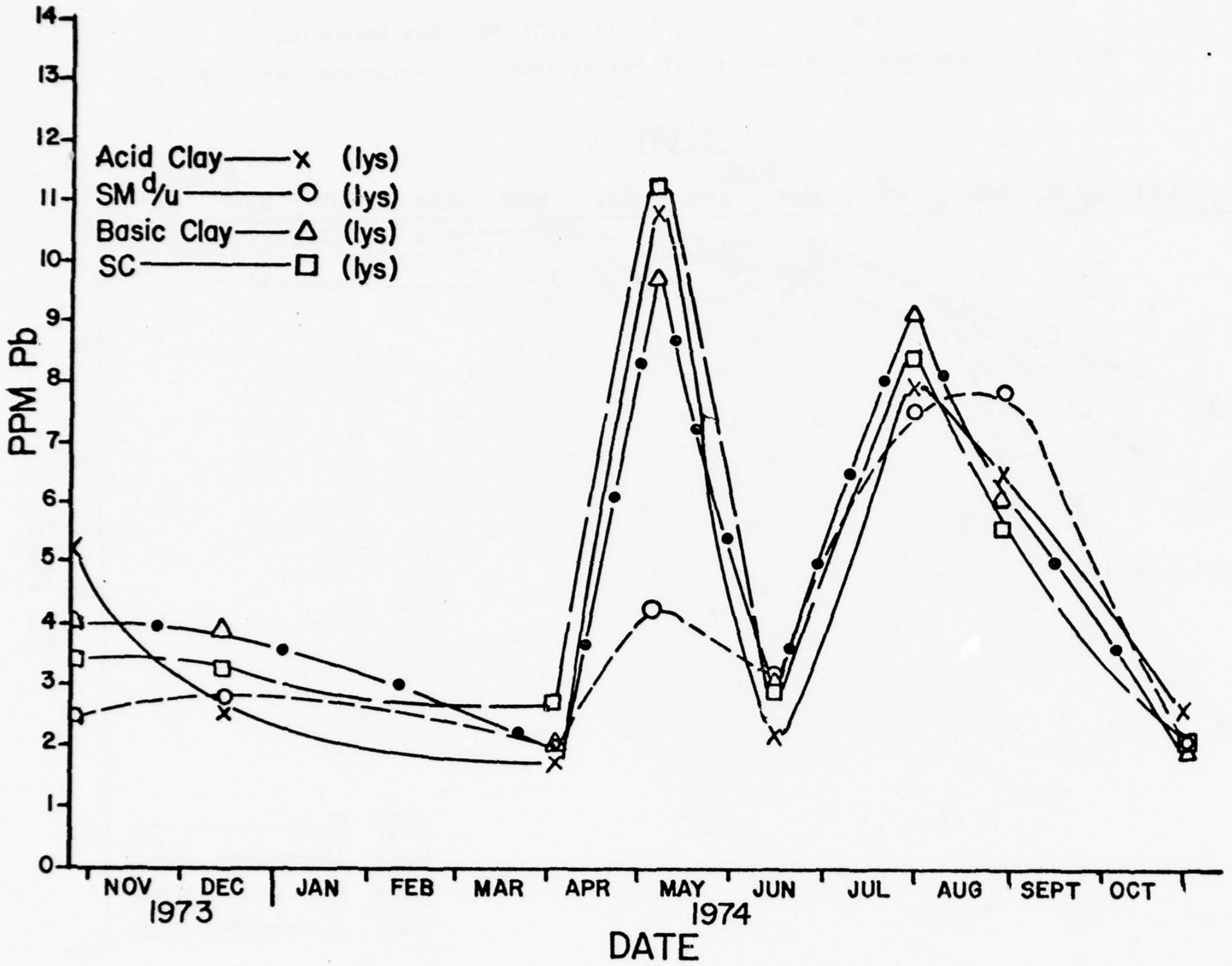

Figure 28. Concentration of lead in the grass harvested from the lysimeters containing the four different soils.

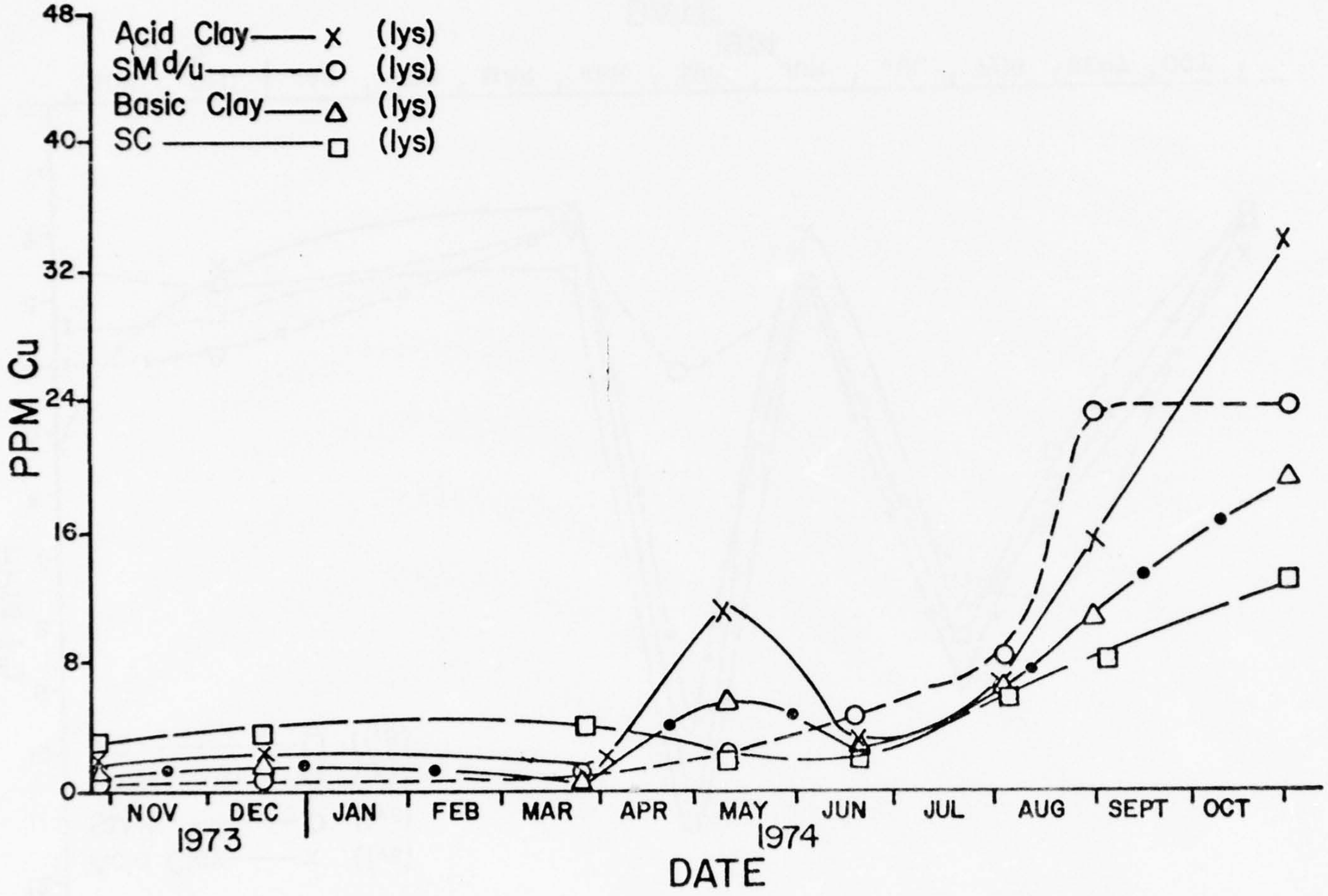

Figure 29. Concentration of copper in the grass harvested from the lysimeters containing the four different soils.

Table 9 . Amount of zinc in the grass harvested from the lysimeters and field plots. Uptake given in g/Ha.

Soil	Date						
	12/17	3/23	5/3	6/17	7/31	10/28	Total
acid CL lysimeter	.403	----	90.385	71.155	127.413	49.818	339.174
SM d/µ lysimeter	.161	7.190	7.190	9.475	40.432	30.121	94.569
basic CL lysimeter	2.480	.366	43.818	12.606	134.580	29.483	223.333
SC lysimeter	1.645	2.459	15.222	9.601	58.125	13.802	100.854
basic CL field plot	.228	13.900	112.269	31.232	10[illegible].749	9.974	272.352
SM d/µ field plot	----	----	88.576				88.576

Table 10. Amount of nickel in the grass harvested from the lysimeters and field plots. Uptake given in g/Ha.

Soil	Date						
	12/17	3/23	5/3	6/17	7/31	10/28	Total
acid CL lysimeter	2.033	----	20.005	13.282	41.815	4.439	81.574
SM d/µ lysimeter	.750	----	3.412	3.309	9.25	2.438	19.159
basic CL lysimeter	3.16	1.449	12.556	3.518	30.275	2.384	53.342
SC lysimeter	1.049	1.729	8.924	2.295	12.333	1.309	27.639
basic CL field plot	.610	----	41.349	5.149	21.091	1.066	69.265
SM d/µ field plot			21.369				21.369

Table 11. Amount of cadmium in the grass harvested from the lysimeters and field plots.
Uptake given in g/Ha.

Soil	Date						
	12/17	3/23	5/3	6/17	7/31	10/28	Total
acid CL lysimeter	1.089	----	13.855	8.847	18.340	21.032	63.163
SM d/μ lysimeter	.138	----	2.482	2.516	5.222	7.947	15.685
basic CL lysimeter	1.084	.410	3.751	1.467	22.627	6.968	36.307
SC lysimeter	.710	.475	3.893	1.118	7.152	5.075	18.423
basic CL field plot	.184	----	14.500	3.916	14.860	5.617	39.077
SM d/μ field plot			10.269				10.269

Table 12. Amount of lead in the grass harvested from the lysimeters and field plots. Uptake given in g/Ha.

Soil	Date						
	12/17	3/23	5/3	6/17	7/31	10/28	Total
acid CL lysimeter	.895	----	25.326	9.728	30.772	5.327	72.048
SM d/µ lysimeter	.388	----	3.745	2.141	7.834	2.829	16.937
basic CL lysimeter	1.945	----	12.505	3.305	35.596	3.358	56.709
SC lysimeter	.380	----	13.142	2.054	16.72	2.390	34.686
basic CL field plot	.386	----	34.076	3.339	22.551	1.556	61.908
SM d/µ field plot		----	12.373				12.373

Table 13. Amount of copper in the grass harvested from the lysimeters and field plots. Uptake given in g/Ha.

Soil	Date						
	12/17	3/23	5/3	6/17	7/31	10/28	Total
acid CL lysimeter	.809	----	27.635	13.040	21.930	65.267	128.680
SM d/µ lysimeter	.227	----	1.261	2.670	8.048	31.601	43.807
basic CL lysimeter	.852	.207	7.299	3.138	26.963	32.388	70.847
SC lysimeter	.426	1.066	1.697	1.833	10.284	14.498	29.804
basic CL field plot	.113	2.562	16.238	5.364	18.849	10.067	53.193
SM d/µ field plot			11.100				11.100

Metals in Lysimeter Leachate Water

Two extraction procedures were used to analyze the metal concentrations in the lysimeter leachate water. The first procedure was identical to the APDC/MIBK procedure for the "extractable" metals in the sewage samples. The second procedure was similar to the first, but an initial digestion of the sample with $K_2S_2O_8$ solution was employed, before extraction, in order to break down any organically bound metals in solution and thus make them extractable. The extraction procedures were employed instead of the direct aspiration technique because of the need to have the best possible detection limits. The detection limits achieved were 0.0006 ppm for Cd and 0.001 ppm for the other four elements. The concentration of heavy metals in the leachate samples collected from lysimeters throughout the experiment never exceeded the detection limits.

Soil Analysis Procedure

The soil samples were analyzed for metal content using the scheme and methods (with slight modifications) of Smith and Shoukry (1968) for the "available", "water soluble", "exchangeable", "organic bound" and "mineral" fractions. Modifications included the use of DTPA for the "available" fraction according to the method of Lindsay and Norvell (1969) and a procedure described by Pawluk (1967) for the "mineral" fraction. The overall analytical scheme employed and the fractions obtained were as shown in Table 14. Each fraction was analyzed for metals by atomic absorption spectrophotometry.

The actual procedures were as follows:

1. Soil samples were air-dried, ground to pass a number 8 sieve, and two fractions of 10-20 grams each were weighed.
2. Split I was extracted twice with 20 ml DTPA extractant solution (Lindsay and Norvell, 1969) and vigorous shaking for two hours. After centrifugation, the two extracts were combined for analysis.

3a. Split II was leached of "water soluble" metals by shaking with 20 ml of deionized distilled water for 20 minutes, and after centrifuging the solution was decanted and retained for analysis.

b. The soil remaining from 3a was extracted by shaking for two hours with 20 ml 1N ammonium acetate at pH 7, followed by centrifuging and decanting. The decant was retained for analysis.

c. The soil remaining from 3b was then treated with 20 ml of 30% hydrogen peroxide and 1 ml concentrated nitric acid and placed in a 75°C (158°F) water bath overnight. Following centrifugation the solution was decanted and diluted to 50 ml in a volumetric flask.

d. The soil remaining from 3c was treated with 10 ml concentrated nitric acid and 10 ml 48% hydrofluoric acid in a teflon beaker. The soils were then placed

Table 14. Analyses of soil samples for heavy metals

Split	Extractant	Designation
I	DTPA Soil Discarded	Available
II	Deionized Water	Water soluable
II	NH_4OAc(1N, pH7)	Exchangeable
II	H_2O_2	Organic Bound
II	Digested with HNO_3-HF Soil Discarded	Mineral Associated
	Σ of split II	Total

on a hot plate and evaporated to dryness. The addition of nitric and hydrofluoric acids was repeated and the sample again taken to dryness. After the addition of 5 ml concentrated hydrochloric acid and evaporation to dryness, the residue was taken up in 5 ml hydrochloric acid and centrifuged. The supernate was then decanted and diluted to a volume of 100 ml with deionized distilled water.

The "total" metal content of the soil was obtained by the combination of 3a, 3b, 3c, and 3d.

The precision of these soil analysis procedures as applied to Basic CL soil is as shown in Table 15.

Results of Soil Analyses

Results of this study indicated that over a one year period the downward migration or translocation of cadmium, copper, lead, nickel, and zinc applied in sewage effluent to four test soils by spray irrigation was minimal with the migration rates being 12.7 cm (5 in) per year or less. In general, no significant difference in ability to filter out the metals was found between the four soils tested.

Of the various extractants used in this study, the DTPA extraction method of Lindsay and Norvell (1969) for "available" metals recovered the most. This method recovered from 10% to 100% of the metals added in the upper few inches of soil. In most cases, it averaged between 50% and 100%. For this reason, the DTPA extracts were considered to provide a good indication of the degree of translocation of the metals that occurred. Results for the other extractants (neutral ammonium acetate, distilled water and 30% hydrogen peroxide at pH 2) indicated similar or even less migration. In the case of the "total" metal content, results were similar although not as definitive in several instances. Since most of the "total" was due to insoluble inorganic or residual mineral associated metals, more variations in the HNO_3-HF digestion efficiency occurred from one sample analysis period to another than was observed for the other extraction methods. As a result some variations in "total" metal values from one sample period to another were observed in several cases. Even so, for most metals and soils, the "total" metal concentrations measured indicate no significant migration of these 5 metals below the top 7.6 to 12.7 cm (3 to 5 in) of soil. Indeed as indicated in Table 16, when a comparison of the metal content in a thin surface layer of a few millimeters is made to the content in the overall top one inch of soil, it is apparent that much of the added metals remain associated with the thin surface mat. In all instances, the ratio of the metals in this surface film to those in the top 2.5 cm of soil increased with sewage effluent addition usually peaking at 6 to 10 months of application and decreasing again by the 12th month of sewage application.

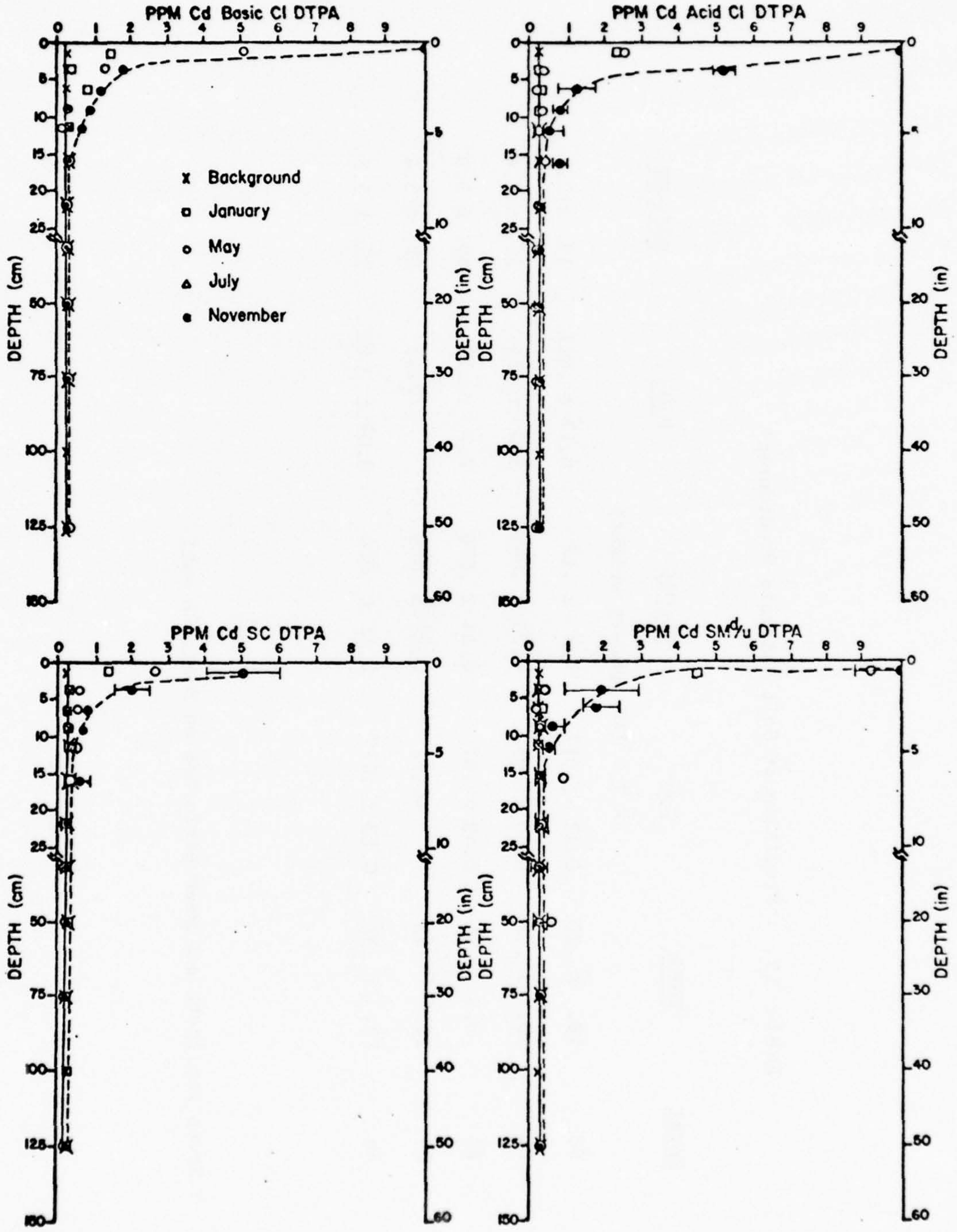

Figure 30. DTPA extractable cadmium in the soil profiles from lysimeters.

Table 15. Precision of Soil Analysis Procedures*

Metal	DTPA	H_2O	NH_4OAC	H_2O_2	HNO_3-HF
		$\bar{X} \pm \sigma$ (in ppm dry weight)			
Cd	18. ± .20	0.12 ± .017	4.7 ± .12	0.17 ± .011	13. ± 2.1
Cu	20. ± .77	0.60 ± .052	0.73 ± .041	3.0 ± .14	16. ± 2.4
Ni	8.3 ± .91	0.43 ± .07	0.64 ± .078	2.7 ± .19	20. ± 3.9
Pb	21. ± .43	<0.19	0.34 ± .089	<0.47	19. ± 3.4
Zn	13. ± .32	0.23 ± .077	0.48 ± .024	0.09 ± .023	33. ± 5.8

* Seven replicate analyses performed on Basic CL soil

Table 16. Ratio of DTPA Extractable and Total Metals in Surface Film to Top One-Inch Layer

	Acid CL		Basic CL		SC		SM d/u	
Months	DTPA	Total	DTPA	Total	DTPA	Total	DTPA	Total
				Cadmium				
0	----	----	----	----	----	----	----	----
2	7.3	1.9	5.1	42.5	3.3	8.7	1.9	5.2
6	13.9	6.4	4.1	13.3	8.2	8.3	6.4	12.1
10	13.8	9.0	7.2	7.2	9.1	9.2	10.7	4.7
12	3.3	2.8	3.2	2.2	1.6	1.5	2.1	3.2
				Copper				
0	1.2	1.9	0.7	0.9	1.0	1.1	1.0	0.8
2	1.5	2.1	1.3	4.0	3.8	1.8	5.5	2.4
6	6.7	4.5	3.2	2.4	5.4	2.6	3.5	4.3
10	4.1	3.7	2.6	2.4	6.1	4.6	3.5	2.7
12	2.0	1.6	2.3	1.1	1.6	1.2	1.7	1.3
				Lead				
0	1.9	1.3	1.0	0.8	0.9	1.0	1.2	0.9
2	2.6	1.1	3.5	3.5	2.3	1.2	3.6	2.9
6	6.2	1.6	4.7	2.1	4.7	2.7	6.0	3.4
10	3.9	1.8	3.2	3.6	5.4	4.8	5.2	3.4
12	4.6	1.1	2.0	1.1	1.5	1.1	1.8	1.7
				Nickel				
0	0.5	1.1	----	0.9	1.1	1.2	----	1.3
2	2.2	1.3	6.1	2.2	6.8	1.3	6.3	5.6
6	5.0	1.9	4.1	2.6	6.1	2.8	6.0	5.9
10	0.5	1.7	4.6	2.5	5.8	4.8	5.7	3.3
12	2.5	1.1	3.0	1.3	1.7	1.2	2.3	2.2
				Zinc				
0	1.4	1.3	0.6	0.8	1.0	1.1	1.1	1.0
2	1.5	1.0	4.6	1.9	2.6	1.3	4.6	3.4
6	6.0	1.5	4.6	1.9	3.6	2.1	5.3	5.4
10	4.6	1.3	4.4	2.1	5.9	3.6	5.7	3.5
12	2.2	0.9	2.8	1.3	1.8	1.1	1.8	2.5

Additional evidence for lack of metal movement to deeper depths was indicated by the absence of these metals in detectable quantities in filtrate waters obtained from suction cups or tubes located at depths of 30 in (75 cm) and 60 in (150 cm).

Cadmium in Soil

As shown in Figure 30, no evidence was found for migration of cadmium below approximately 7.6 cm (3 in) depth over the 12 month period. Furthermore there did not appear to be any difference in migration within the four soil types. If we assume that the Lindsay-Norvell DTPA extraction test does indicate the "available" cadmium present in the soils then the results also indicate that from 50% to 100% of the cadmium added to the soils existed in forms "available" for plant uptake and microbial activity.

None of the cadmium added was found to be water soluble after application but from 5% to 50% was extractable with neutral ammonium acetate. The greatest amount of this "exchangeable" cadmium, 35% to 50%, was found in the SC soil lysimeters and the least, less than 20%, in the acid CL soil.

As previously mentioned, some variations in the HNO_3-HF digestion values were observed from time to time that did not appear to be related to true variations in the metal concentrations. This was most evident in the case of cadmium where the DTPA extracts from fraction I of the soil sample split exceeded the "total" found for fraction II in a number of cases. This discrepancy was probably due to loss of some of the cadmium in fraction II as a result of the number of sequential extraction steps involved with the potential loss of cadmium during each. In addition, the HNO_3-HF digestion for residual cadmium may not have recovered all of the metal. For this reason, the budget for cadmium presented in Table 17 does not account for all of the cadmium applied to the soils.

Copper in Soil

As indicated by the vertical profiles of DTPA extracts shown in Figure 31, copper in the sewage effluent was retained in the upper few inches of soil. Slight differences in the DTPA extracts below 12.7 cm (5 in) especially in the Basic CL soil are not considered significant but rather appear to represent small variations in extraction efficiencies for different sample periods. Based upon these DTPA extracts, 20% to 100% of the copper added will be "available". As in the case of cadmium, no water soluble copper was found. In addition, only trace quantities of ammonium acetate extractable copper were found.

Evidence of small but consistent quantities of organically associated copper were found. Up to 25% of the added copper was extractable by 30% hydrogen peroxide adjusted to pH 2. Largest amount of this form of copper was found for the SM(d/u) soil where between 8% and 26% of the copper was so extracted. Both

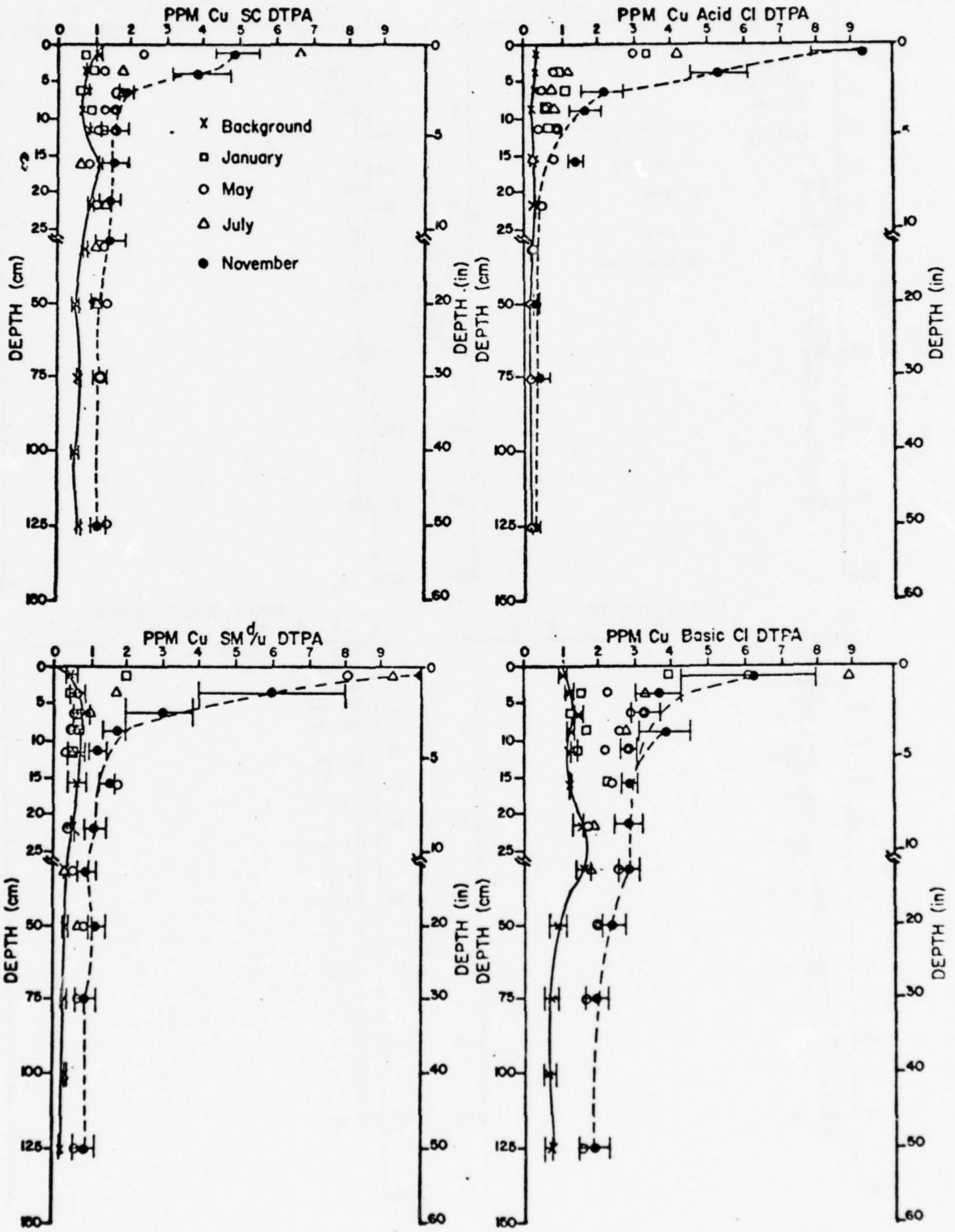

Figure 31. DTPA extractable copper in the soil profiles from lysimeters.

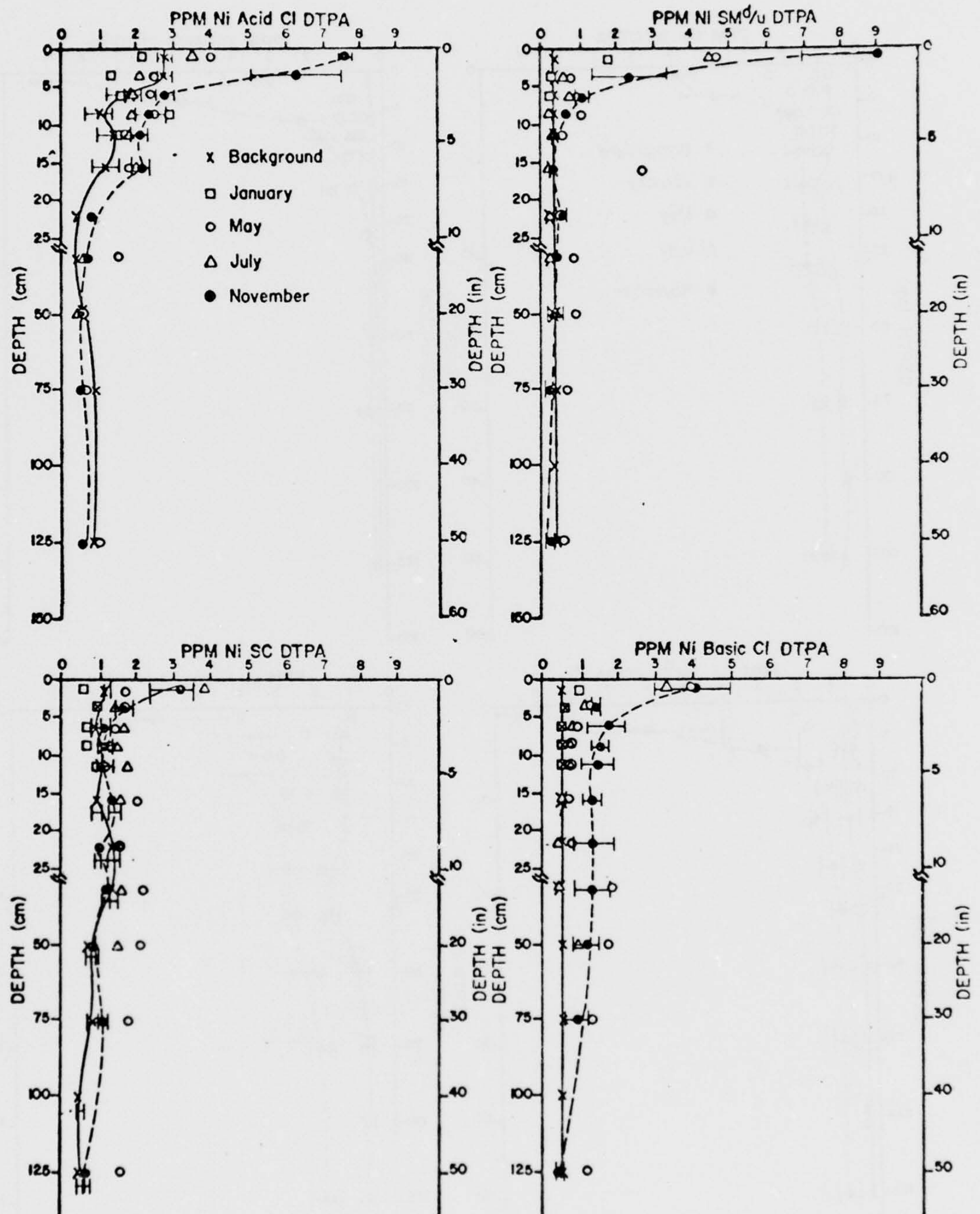

Figure 32. DTPA extractable nickel in the soil profiles from lysimeters.

Table 17. Metal balance in Kg/ha for cadmium on the lysimeters and field plots.

	acid Cl	basic Cl	SC	SM d/μ	SM d/μ land plot	basic Cl land plot
Total applied	14.16	14.16	14.16	14.16	6.67	14.16
Plant uptake	0.06	0.04	0.02	0.02	0.01	0.04
Total less that taken up by plants	14.10	14.12	14.14	14.14	6.66	14.12
% recovered in the top 5" of soil	58	24	28	38	10	45
% recovered in the top 7.5" of soil	65	29	33	43	16	51
% recovered in the top 10" of soil	72	32	33	43	24	53

Table 18. Metal balance in Kg/ha for copper on the lysimeters and field plots.

	acid Cl	basic Cl	SC	SM d/μ	SM d/μ land plot	basic Cl land plot
Total applied	14.13	14.13	14.13	14.13	6.75	14.13
Plant uptake	0.13	0.07	0.03	0.04	0.01	0.05
Total less that taken up by plants	14.00	14.06	14.10	14.09	6.74	14.08
% recovered in the top 5" of soil	169	154	112	138	19	205
% recovered in the top 7.5" of soil	180	179	140	167	24	240
% recovered in the top 10" of soil	196	201	154	181	32	249

Table 19. Metal balance in Kg/ha for nickel on the lysimeters and field plots.

	acid Cl	basic Cl	SC	SM d/μ	SM d/μ land plot	basic Cl land plot
Total applied	14.13	14.13	14.13	14.13	6.75	14.13
Plant uptake	0.08	0.05	0.03	0.04	0.01	0.05
Total less that taken up by plants	14.05	14.08	14.10	14.09	6.74	14.08
% recovered in the top 5" of soil	118	75	102	63	15	114
% recovered in the top 7.5" of soil	200	109	122	80	24	173
% recovered in the top 10" of soil	340	142	154	99	30	186

acid and basic CL soils ranged from trace up to 10%. Only in the SC soil were no significant amounts of peroxide extractable not found. This association of copper with organic matter was expected since McLaren and Crawford (1973a) had found up to 35% of the copper in 24 different English soils. Copper absorption by organic matter has also been reported by others (Mitchell, 1964; Leeper, 1972).

That copper did not migrate below the top 12.7 cm (5 in) of soil is also indicated by the metal balance presented in Table 18. More than 100% of the copper added to each type soil is accounted for within the top 12.7 cm (5 in) of all lysimeters as well as the Basic CL land plot.

Nickel in Soil

Results for nickel are very similar to those observed for copper. Vertical profiles for the DTPA extracts are shown in Figure 32 and indicate migration of less than 12.7 cm (5 in) for all soils. The DTPA extracts indicate that from 10% to 100% of the added nickel was "available". However, the average value for this fraction was probably less than for the other metals. No appreciable water soluble or ammonium acetate extractable nickel was found. As in the case of copper, a portion of the nickel added was associated with the peroxide extracts with the largest amount (up to 30%) being found in the SM(d/u) soil. A metal balance for nickel is presented in Table 19 and indicates that all added nickel could be accounted for in the top 25.4 cm (10 in) of soils and for three of the soils within the top 12.7 cm (5 in). However, it should be pointed out that greater uncertainty exists in the metals balance than in the soil profiles, and migration below 12.7 cm (5 in) probably did not occur.

Lead in Soil

Data for DTPA extracts from the various soils shown in Figure 33 indicates lead was retained within the top 7.6 cm (3 in) for the SC and SM(d/u) soils. Basic CL and Acid CL soils data were not as well defined with the possibility that lead might have migrated slightly deeper in these soils. However, the metal balance presented in Table 20 indicates that all of the lead in Acid CL lysimeters was recovered in the top 12.7 cm (5 in). In the case of Basic CL soil, a difference existed between the lysimeters and land plot values. Based upon the land plot, it can be assumed that the lead probably did not reach the 19.1 cm (7-1/2 in) depth.

Lead was not found in water, ammonium acetate or hydrogen peroxide extracts suggesting that the lead existed in some insoluble, non-exchangeable inorganic form that probably accounts for its immobility.

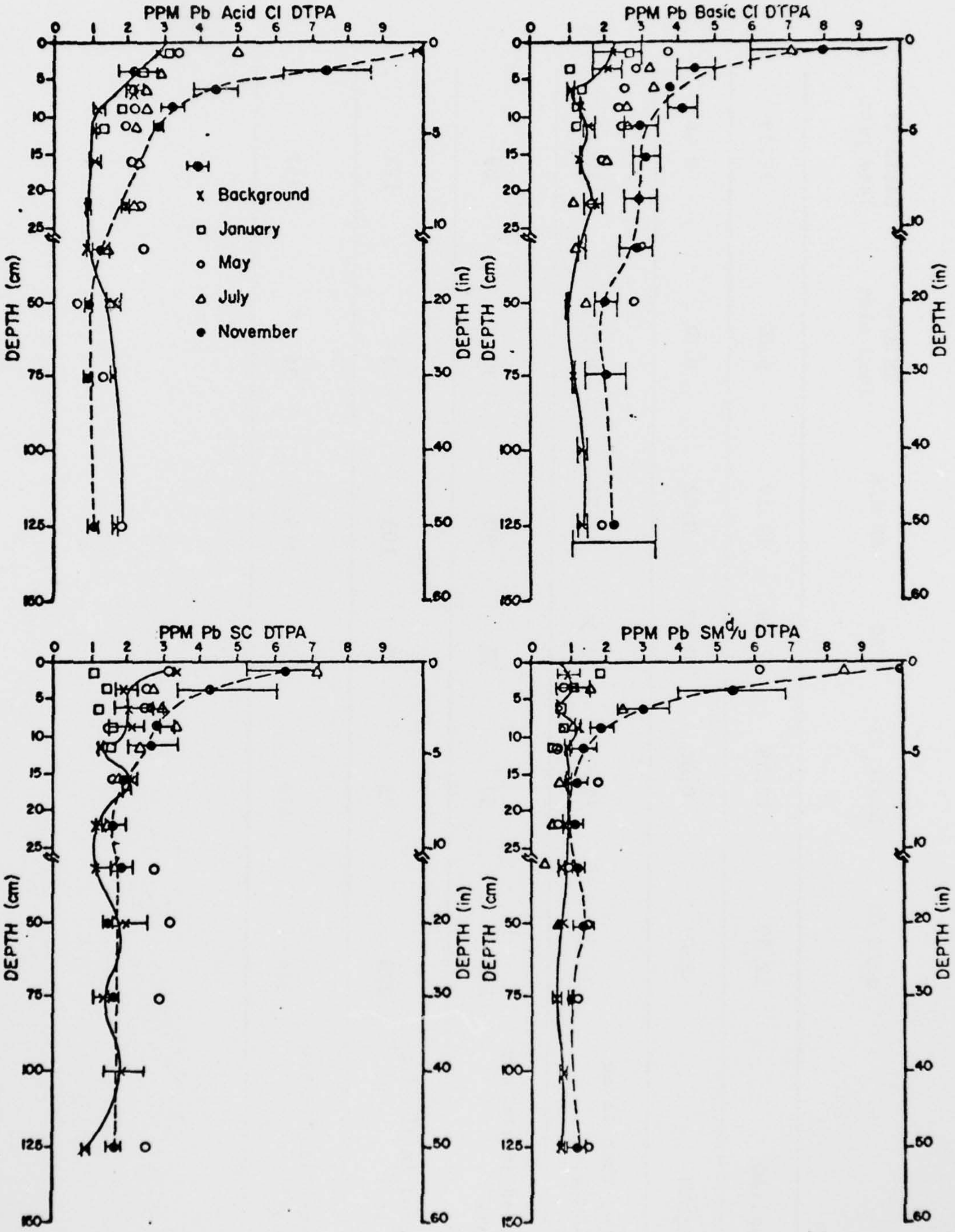

Figure 33. DTPA extractable lead in the soil profiles from lysimeters.

Table 20. Metal balance in Kg/ha for lead on the lysimeters and field plots.

	acid Cl	basic Cl	SC	SM d/u	SM d/u land plot	basic Cl land plot
Total applied	12.59	12.59	12.59	12.59	6.02	12.59
Plant uptake	0.07	0.06	0.03	0.02	0.01	0.06
Total less that taken up by plants	12.52	12.53	12.56	12.57	6.01	12.53
% recovered in the top 5" of soil	190	57	33	90	30	89
% recovered in the top 7.5" of soil	225	73	45	103	13	122
% recovered in the top 10" of soil	324	116	76	115	24	157

Zinc in Soil

Vertical profiles in Figure 34 suggests zinc may have moved from 12.7 to 19.7 (5 to 7-1/2 in) depths in both the Acid and Basic CL soils but probably did not move below 2 to 3 inches in the other two soils. From 10 to 100% of the added zinc was associated with the DTPA extracts. However, only trace quantities were found in the other extracts. Attempts to arrive at a metal balance for zinc have not met with much success. The reasons for this inability to account for the added zinc are not known at this time.

The concentrations of total zinc in the soil before the treatments were applied were quite high. The amounts added were small compared to the background, thus calculations of a balance resulted in sporadic results, ranging from -3% to several hundred percent, depending on the depth of profile considered. Consequently, the detailed results are shown in Table 20a.

Effect of Sewage Quality Parameters on Metal Migration

It was originally intended to correlate where possible the effect of various sewage effluent quality parameters such as pH, alkalinity, hardness, biochemical oxygen demand and total organic carbon, on migration of the metals within the various soils. However, due to lack of sufficient metal migration over the time span of the project such correlations were not possible.

Table 20a. Metal balance in Kg/ha for zinc on the lysimeters and field plots.

	acid Cl	basic Cl	SC	SM d/µ	SM d/µ land plot	basic Cl land plot
Total applied	17.02	17.02	17.02	17.02	8.13	17.02
Plant uptake	.34	.22	.10	.09	.09	.27
Total less that taken up by plants	16.68	16.80	16.92	16.93	8.04	16.75
% recovered in the top 5" of soil	273	20	29	57	-11	66
% recovered in the top 7.5" of soil	402	35	-3	72	-7	50
% recovered in the top 10" of soil	684	46	2	82	-3	35

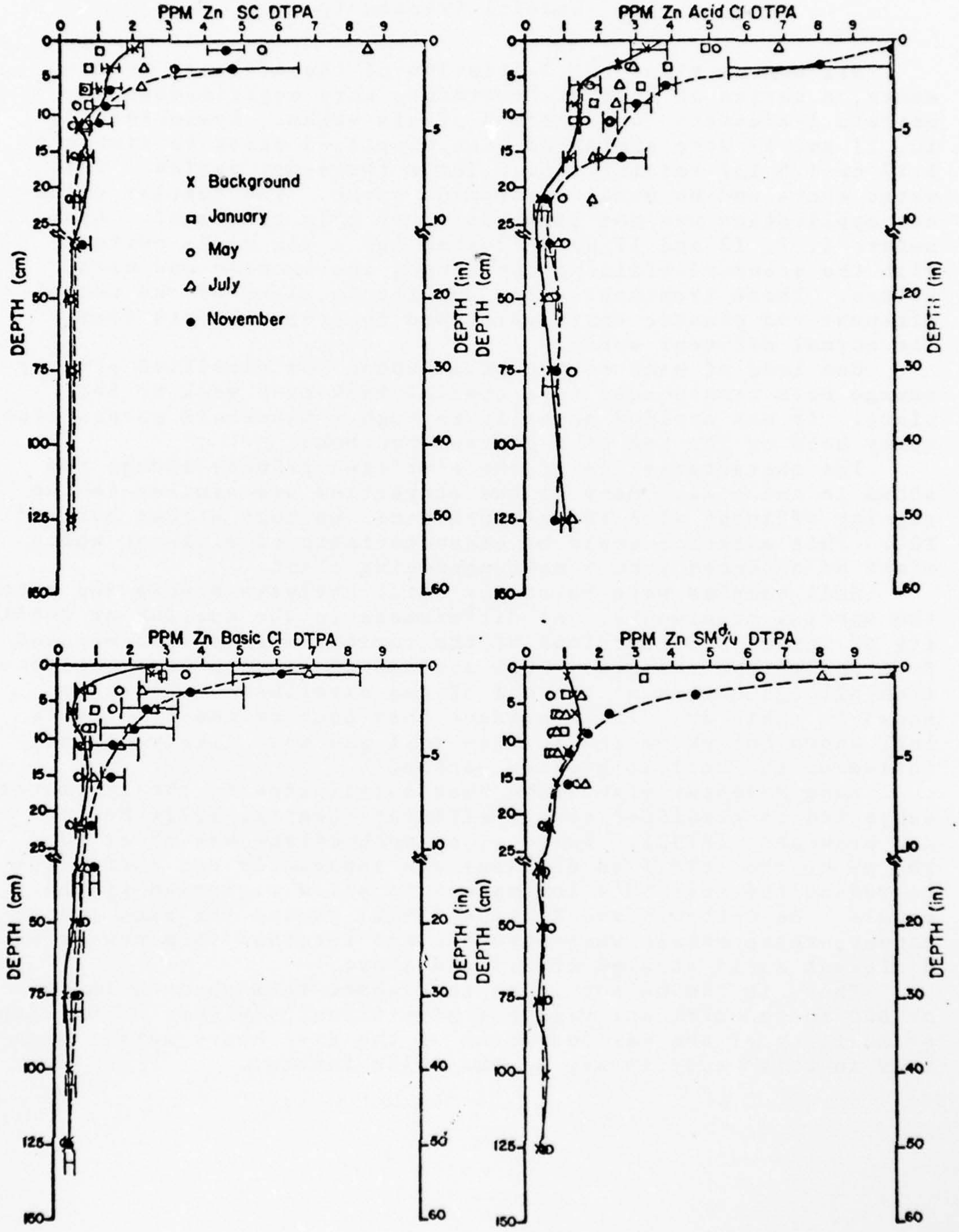

Figure 34. DTPA extractable zinc in the soil profiles from lysimeters.

IX. Special Treatments

Six months after the initiation of the effluent treatments, a series of special treatments were superimposed on certain lysimeters for a period of six weeks. Lysimeters 3, 10, 11 and 19 were sprinkled with distilled water to simulate 1.27 cm (.5 in) rainfall daily for a three-day period. This water contained no metal or bromide spike. The regular effluent application was not interrupted by this treatment. Lysimeters 2, 7, 13 and 17 were treated for a six weeks period with the standard effluent containing the bromide and metal spikes. These treatments were applied in place of the normal effluent and plastic tents were used to protect plots from the normal effluent spray.

One load of each of the pH adjusted and clarified primary sewage were transported in a special tank each week to the plots. It was applied manually through a hand-held garden type spray head on the end of a pressurized hose.

The characteristics of the clarified primary sewage are shown in table 21. Many of the properties are similar to the regular effluent with the exception of the much higher BOD and TOC. This material would be characteristic of effluent which might be expected from a malfunctioning plant.

Soil samples were taken for metal analysis before and after the special treatments. No differences in the buildup or mobility of any of the fractions of the various metals were evident from analytical results. Soil surface pH samples were collected from all lysimeters at the end of the experiment. These are shown in table 22. It is evident that none of the treatments influenced the pH of the surface soil and most likely did not influence the soil at greater depths.

Some movement might have been anticipated in the lysimeters subjected to acidified sewage effluent (Leeper, 1972; McLaren and Crawford, 1973b). However, no such effect was observed. The pH of the acidified effluent was apparently not sufficient to reduce the soil pH's low enough to allow migration of the metals. As Cottenie and Kiekens (1972) showed for zinc and copper, these metals were absorbed and retained in a number of different soils at a pH of 3.5 and above.

Thus, it can be concluded that short-term changes in pH or BOD in the effluent will not significantly alter the buildup or mobility of the various forms of the five heavy metals examined in this study in any of the soils tested.

Table 21. Characteristics of clarified primary effluent used for special treatments.

Date	pH	Alka-linity	Hard-ness	BOD	TOC	Cd		Cu		Ni		Pb		Zn	
						T	E	T	E	T	E	T	E	T	E
5/23	6.7	240	40	90	95	0.78	0.26	1.10	0.40	0.96	0.30	0.30	0.62	1.30	0.86
5/28	8.1	260	39	68	73	0.85	0.24	1.20	0.06	0.93	0.06	0.61	0.32	2.00	0.28
6/3	7.7	225	48	90	89	1.10	0.12	1.30	0.15	2.10	0.12	0.65	0.23	2.10	0.26
6/11	-	220	33	-	129	1.20	1.20	1.40	1.40	1.80	1.20	0.95	1.40	4.00	1.10
6/21	7.5	270	39	-	118	1.00	0.38	1.10	0.19	1.00	0.05	0.86	0.36	1.60	0.10
6/25	7.9	210	36	48	63	0.71	0.36	0.61	0.10	1.50	0.06	0.69	0.25	0.92	0.19

Table 22. The pH of *soil surface* samples taken immediately before and after the 6 weeks special treatments.

	SC		Acid CL		Basic CL		SM(d/u)	
	B	A	B	A	B	A	B	A
Usual Effluent	8.65	8.63	---	8.47	7.64	8.67	7.68	8.96
Usual Effluent	8.01	8.74	8.55	8.76	8.29	8.32	7.53	9.19
3.8 cm (1-1/2") rainfall once	8.36	8.68	---	8.54	7.64	8.30	8.67	8.80
5.1 cm (2") effluent pH 4.5 for 6 weeks	8.60	7.77	---	8.22	8.26	7.99	7.72	6.48
5.1 cm (2") clarified primary effluent for 6 weeks	8.44	8.57	---	8.26	7.96	8.85	8.21	8.28

X. pH and Oxygen in the Soil

pH

Soils with a range in pH were selected for this study. The SM(d/u) soil and acid CL had initial pH values averaging 6 and 5.6 respectively throughout the profiles at the beginning of the experiment. The Basic CL soil had an initial pH of 7.7 while the pH of the SC soil averaged 7.4. The application of the basic sewage effluent slowly increased the pH of all profiles. Initial and final pH profiles are plotted in figures 35, 36, 37 and 38. The SM(d/u) soil which contained the least amount of clay and exchange sites exhibited a pH adjustment from the initial average of 6 to a final average value of 8.4. The Basic CL soil became more basic throughout the profile with an average pH adjustment of nearly 1 unit. The pH of the Acid CL soil changed over 2 units at the surface and less than 1/2 unit at greater depths. This is indicative of the slower water movement through this soil. The pH of the SC soil changed 1 unit in only a thin layer at the surface. While the SC soil did not have the greatest clay content, the clay probably had a greater surface area and thus more exchange sites than that found in the other soils.

Oxygen

The oxygen diffusion rate is indicative of the supply of oxygen through the water film to the roots and microbes in the soil. It increases as the soil dries and decreases sharply when the soil is rewetted. The results for an 18 day period initiated immediately after the application of the last 2.5 cm (1 inch) of sewage effluent are shown in figures 39 through 42. For all soils the ODR increased with time as is anticipated. The basic CL soil and the SC soil started at very low values indicating that the oxygen supply was limited.

Data in the literature (Lemon and Erickson, 1952) indicate that below an ODR of .35 ug cm^{-2} min^{-1}, the respiration of roots is below optimum values. SC soil remained below this level at all depths measured for 4 days while the basic CL soil remained below this level for 2 days. The ODR should decrease with depth in all cases. The occasional profiles with SC soil and SM(d/u) soil remain unexplained. The ODR in the acid CL and SM(d/u) soil did not change greatly throughout the measuring period and were at all times above the critical value. These results indicate that during part of the interval between application at least the SC and basic CL soil suffered from a shortage of oxygen. During periods of low evapotranspiration, when all the soil became wet, they may have all had oxygen diffusion rates below that required for optimum biological activity in the root zones.

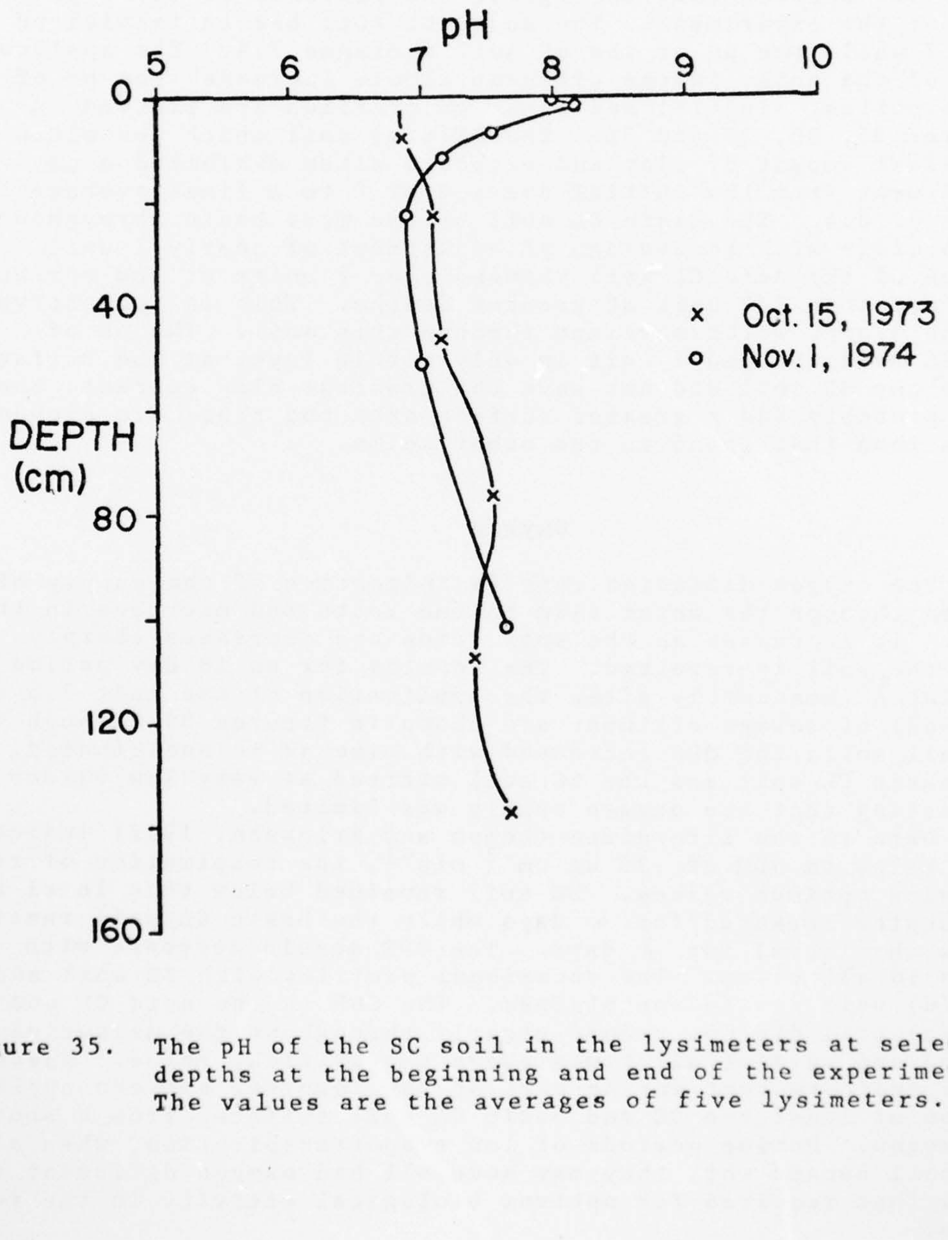

Figure 35. The pH of the SC soil in the lysimeters at selected depths at the beginning and end of the experiment. The values are the averages of five lysimeters.

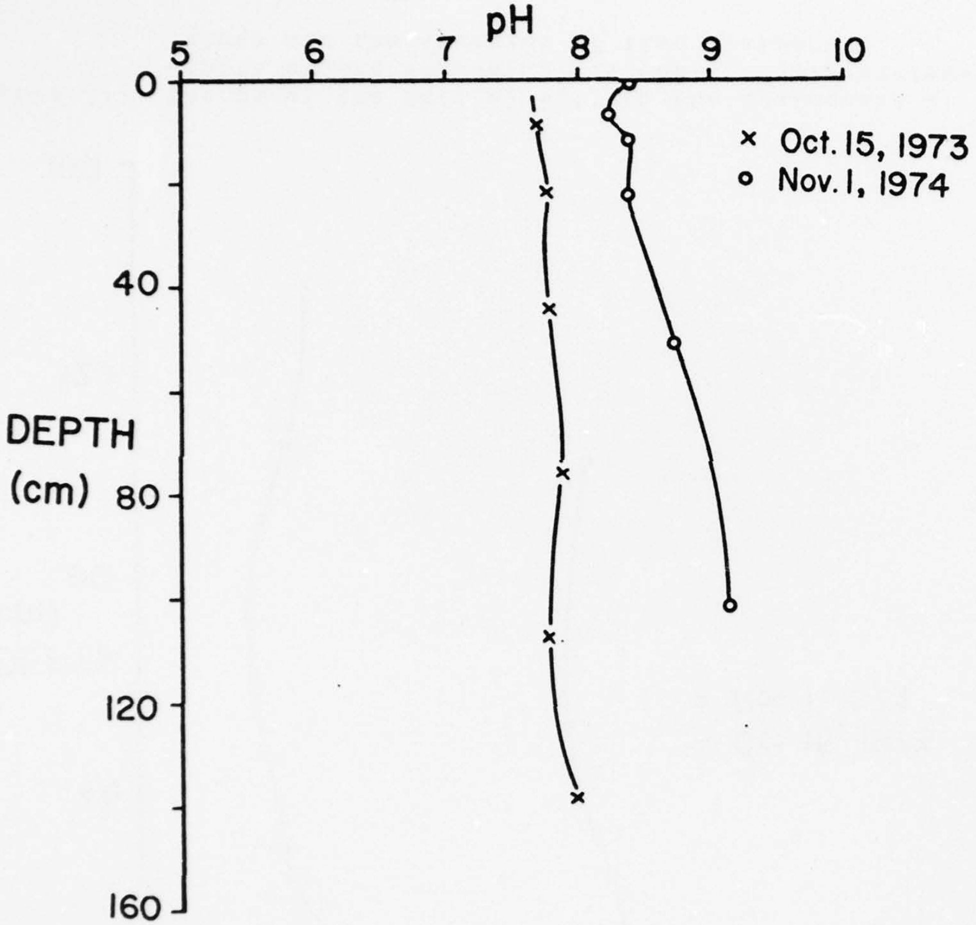

Figure 36. The pH of the basic CL soil in the lysimeters at selected depths at the beginning and end of the experiment. The values are the averages of five lysimeters.

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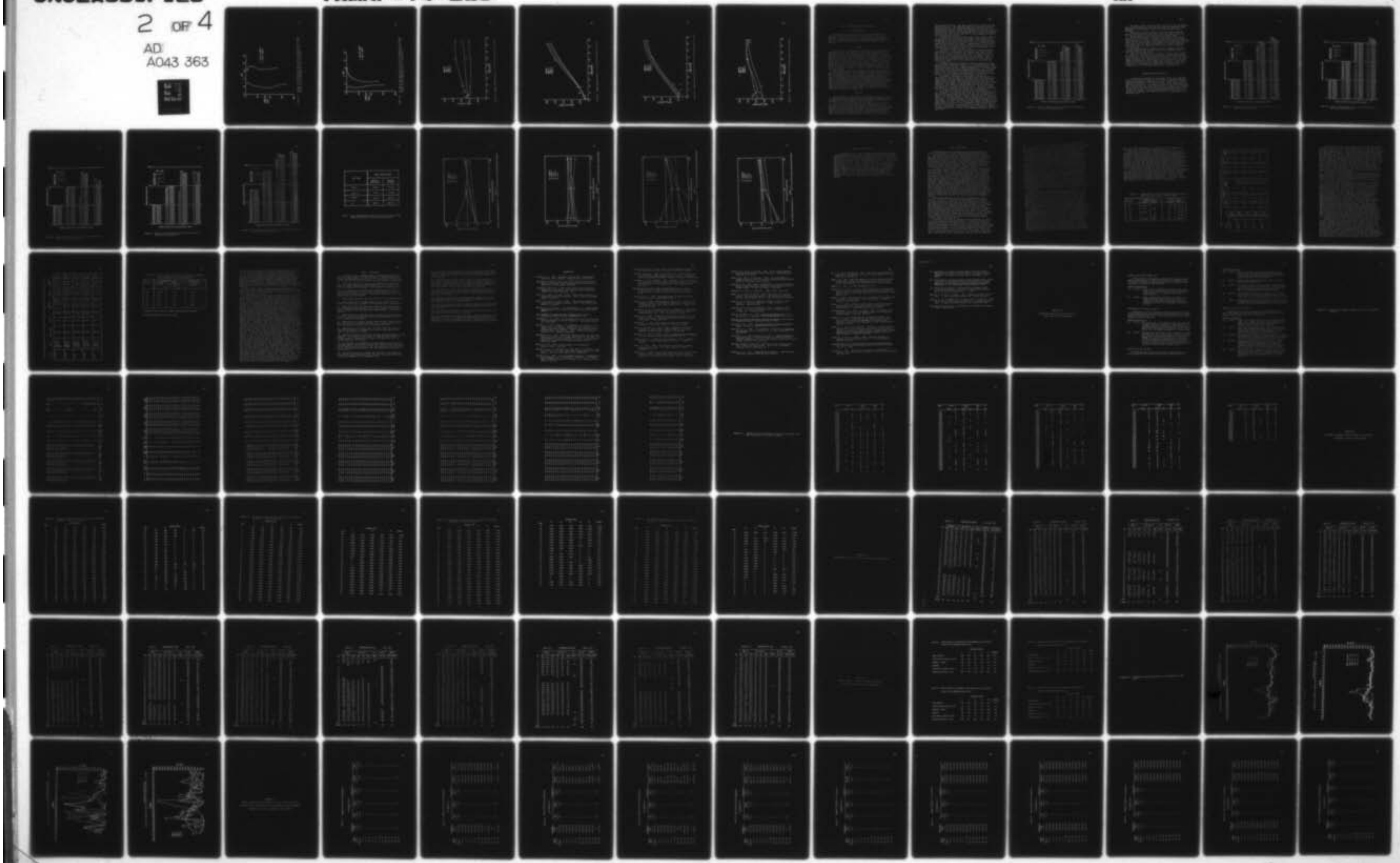

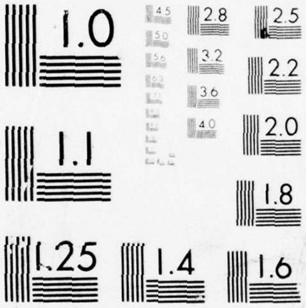

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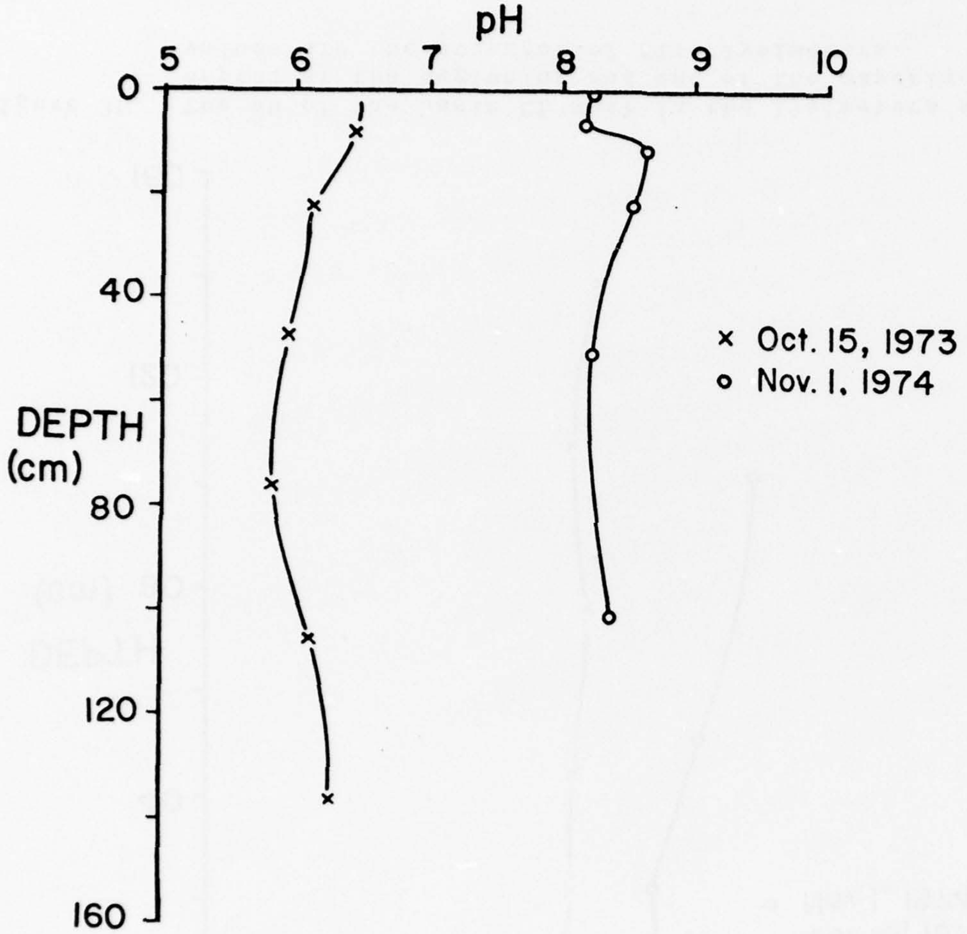

Figure 37. The pH of the SM(d/u) soil in the lysimeters at selected depths at the beginning and end of the experiment. The values are the averages of five lysimeters.

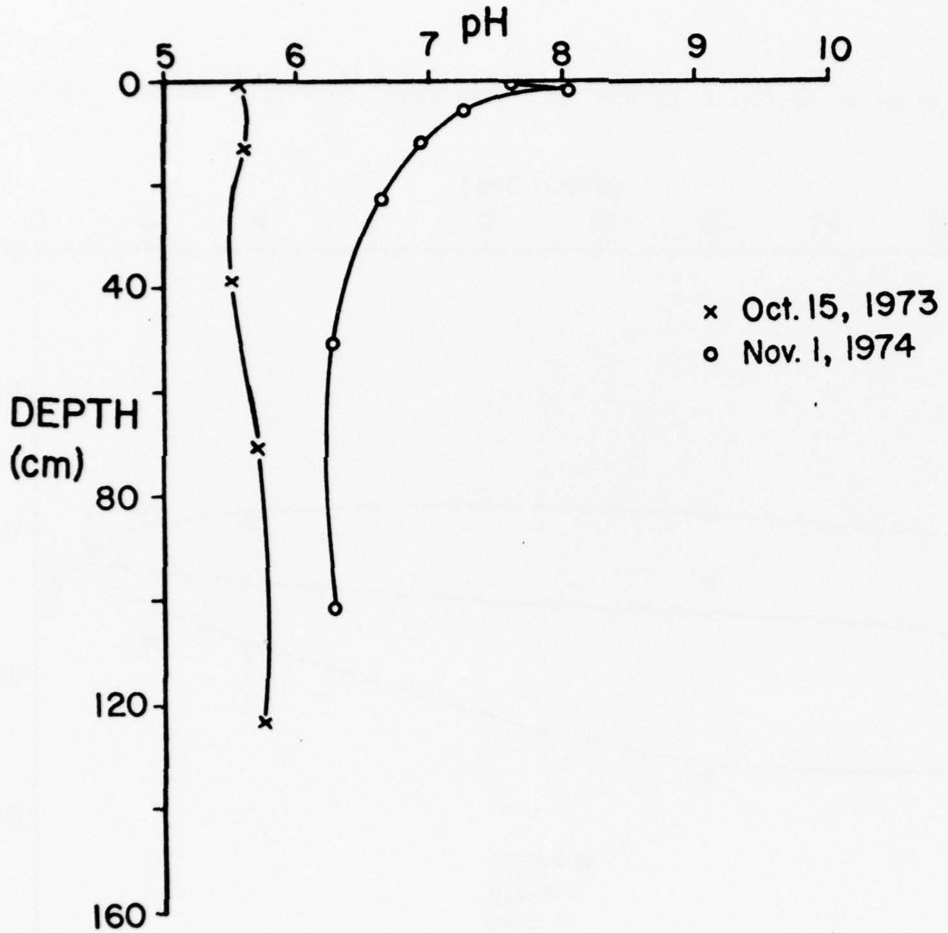

Figure 38. The pH of the acid CL soil in the lysimeters at selected depths at the beginning and end of the experiment. The values are the averages of five lysimeters.

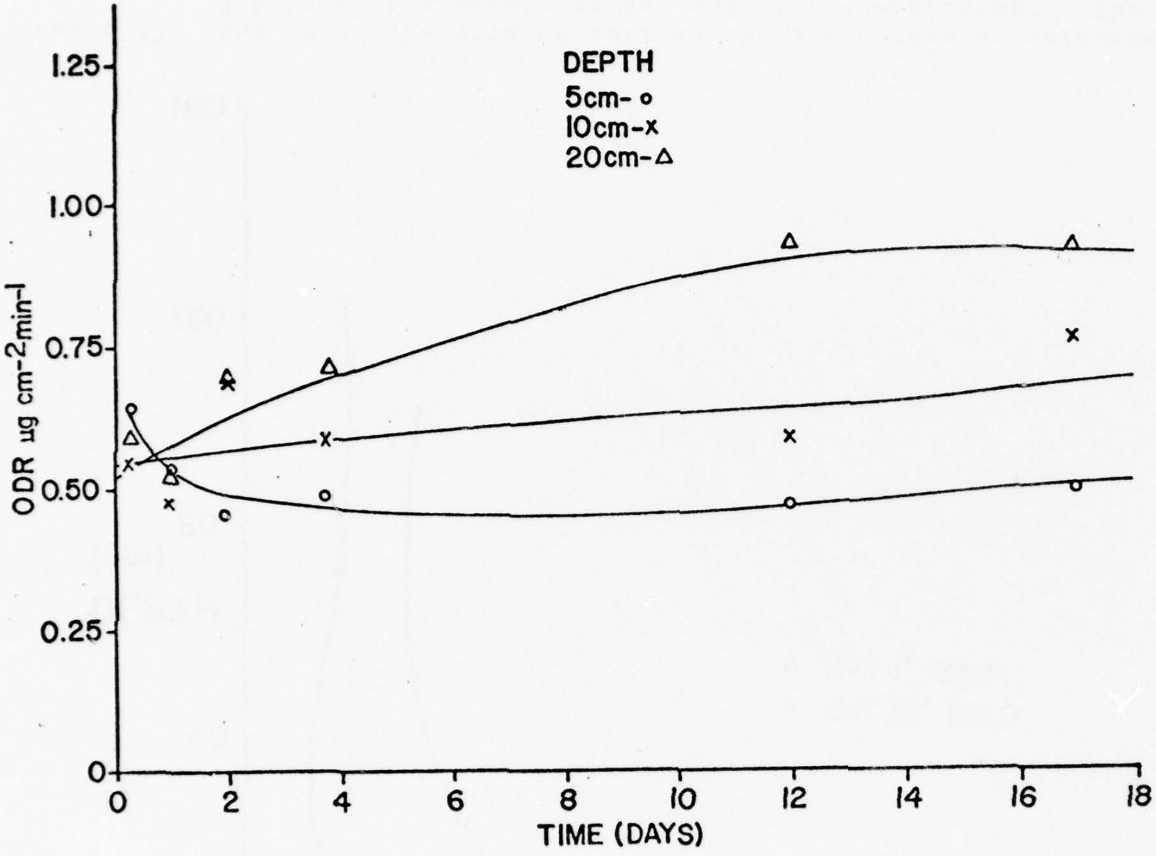

Figure 39. Oxygen diffusion rates at 5, 10, and 20 cm depths in SM d/μ soil.

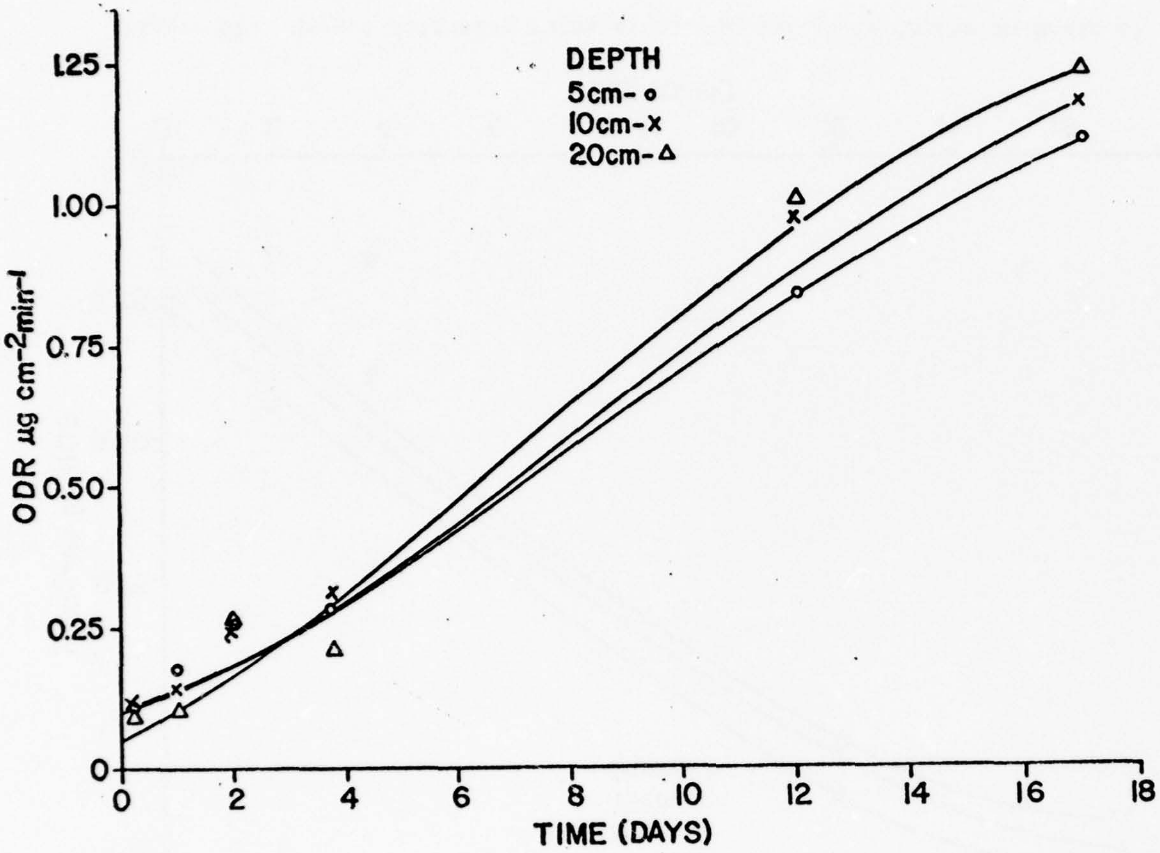

Figure 40. Oxygen diffusion rates at 5, 10, and 20 cm depths in SC soil.

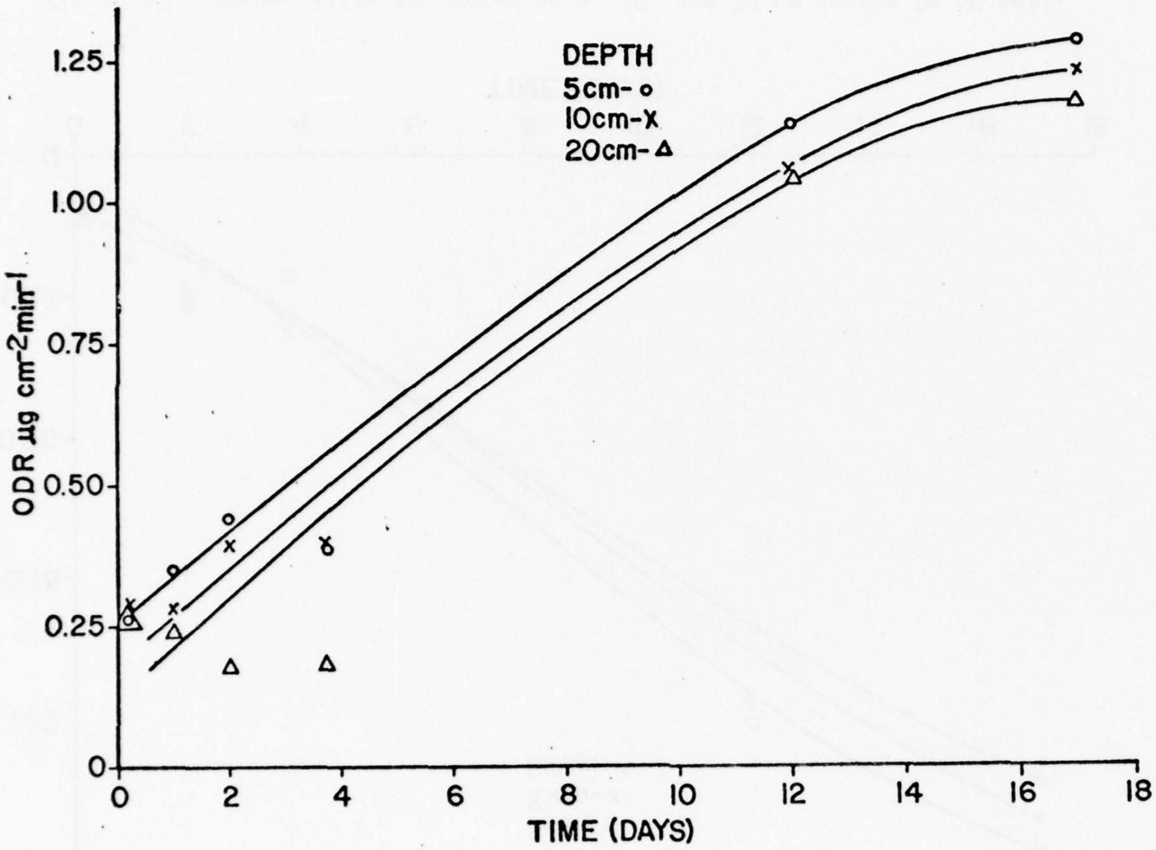

Figure 41. Oxygen diffusion rates at 5, 10, and 20 cm depths in basic C1 soil.

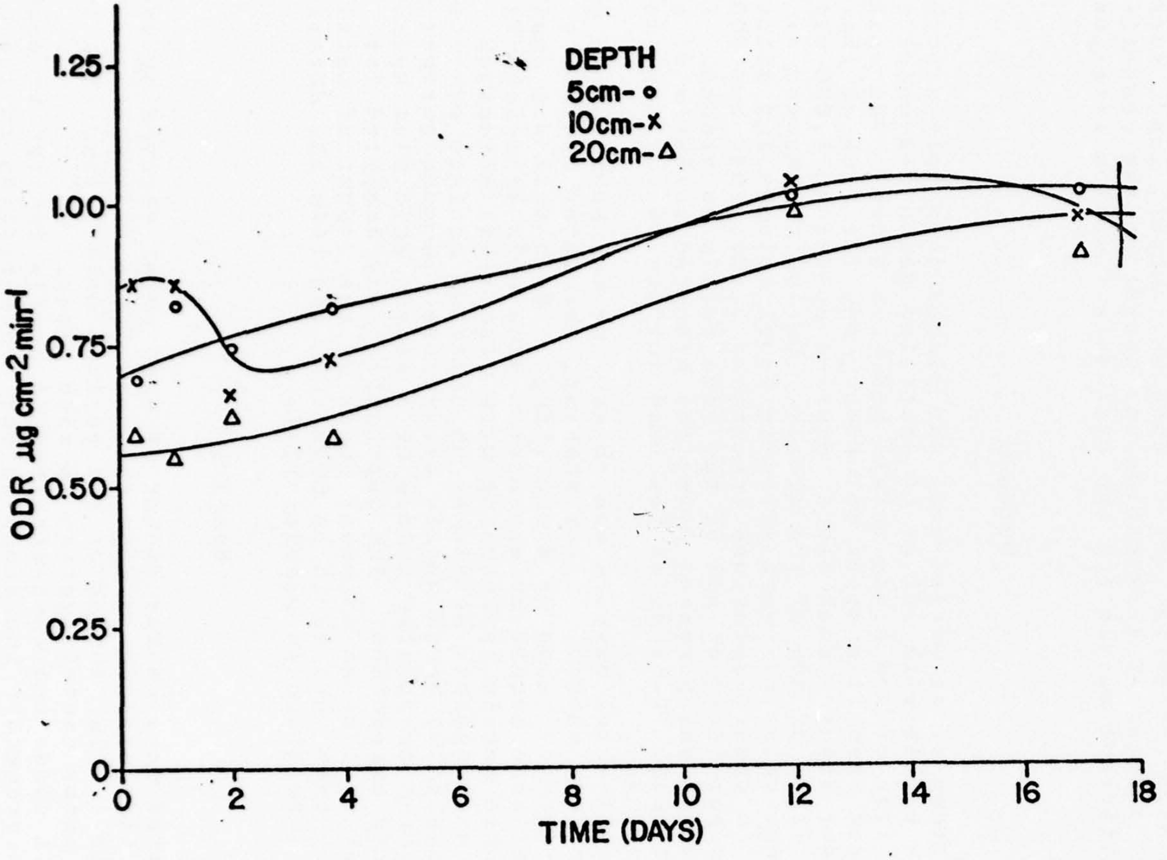

Figure 42. Oxygen diffusion rates at 5, 10, and 20 cm depths in acid C1 soil.

XI. Soil-Metal Saturation Study

Introduction

The objective of this special laboratory study was to determine the ability of the four soils used in this study to absorb high concentrations of cadmium, copper, lead, nickel, and zinc. Additional information was sought on the competition of different metals for the available fixation sites on the soil.

Methods

Ten grams of air-dried soil was placed in a polycarbonate centrifuge bottle with 100 ml of distilled deionized water to which all five of the study metals had been added. The spike was prepared from five stock solutions, one for each of the five metals under study. Each stock solution contained 1,000 milligrams per liter of one of the metals. During the course of the study, these solutions were mixed in equal volumes and diluted as needed to create solutions containing 1, 10, 100, and 200 milligrams per liter of all of the five metals as needed. The stock solution was prepared using the hydrated sulfates of all metals but lead. Because of low lead sulfate solubility, lead nitrate was used.

The soil-metal mixture was shaken for two hours at 25 cps in a laboratory shaker. After shaking, the water and soils were separated by means of a centrifuge. Each soil was analyzed for 1) available metals by extraction with DTPA solution, 2) water soluble metals by leaching with distilled, deionized water, 3) exchangeable metals by an ammonium acetate extraction, and 4) organically bound metals by hydrogen peroxide extraction, and 5) mineral associated metals by a nitric acid plus hydroflouric acid extraction. The supernatant was analyzed for total metal so that an internal check on the amount of metal taken up by each soil could be made. In addition the detailed procedures are given in chapter VIII.

Results

Detailed data on the amount of each metal removed by various extracting procedures from the soil after treatment is shown in Appendix I. The amount of the various metals remaining in the spike after centrifugation is also given.

In all cases the concentration of metals removed by each extraction procedure increased as the concentration in the original spike increased. The largest portion of all metals was generally removed by the DTPA extractant indicating that they would have been available to plants. Generally the ammonium acetate extraction removed the second most amount of metal; again indicating the availability to plants. The exception to this pattern was lead. The DTPA removed very little lead from any of the soils. The ammonium acetate was more effective in removing lead, but the quantities were not as great as for other metals applied. Nitric and hydroflouric acid was required to remove most of the lead indicating that it was more tightly held than the other metals and that it was probably associated with the mineral fraction.

At increased concentrations in the spike, a small fraction of each metal was extractable with water, while none of the background metals were water extractable. At concentrations of 100 ppm in the spike, typically 1 or 2% of the metals added remained extractable with water. Three percent of the nickel and zinc were extractable from the SM(d/u) soil, indicative of fewer absorption sites in this soil. Water extractable lead from all the soils was less than .05%.

The Basic CL soil was most effective in removing metals from the spike. At 100 ppm in the spike, this soil removed 64% of the cadmium, 99.7% of the copper, 100% of the lead, 57% of the nickel and 62% of the zinc. The SM(d/u) soil was least effective in removing metals from the spike. Again at 100 ppm in the spike this soil removed 32% of the cadmium, 55% of the copper, 98% of the lead, 2.5% of the nickel and 5.5% of the zinc.

Hydrogen peroxide extraction to remove organically bound metals yielded quantities similar to or slightly greater than that extracted by water. Copper consistently had higher organic association than the other metals investigated. For the soils and metals which had high available metal contents, the fractions found in the nitric and hydroflouric extractions were small. For cases where the metals were not available such as for lead, greater quantities were mineral associated.

In order to determine if there was a maximum amount of metal which could be adsorbed by these soils, the mixed spike concentration was increased to 200 mg/l of each of the five metals being studied. This was the practical limit for a mixed spike since at higher concentrations, lead was forced out of solution. The amount of metals taken up from all the spike concentrations is shown in figures 43-47. For these figures the uptake was taken as that which did not remain in the spike after it was separated from the soil by centrifugation.

Note that the ratio of spike to soil used is such that if all the metal in the spike were taken up, the concentration in the soil in mg/Kg (ppm) would be 10 times the concentration in mg/l in the original spike. Figure 43 shows that at concentrations of 1, 10, and 100 mg/Kg, all the cadmium was removed from the spike. At concentrations of 500-600 mg/Kg cadmium saturation begins to occur. The Basic CL soil shows a slightly higher uptake while the SM(d/u) soil exhibits a lower uptake than the other soils at spike concentrations of 100 mg/l and a marked decline at 200 mg/l. The lower absorption capacity of this soil is associated with its lower cation exchange capacity and surface area.

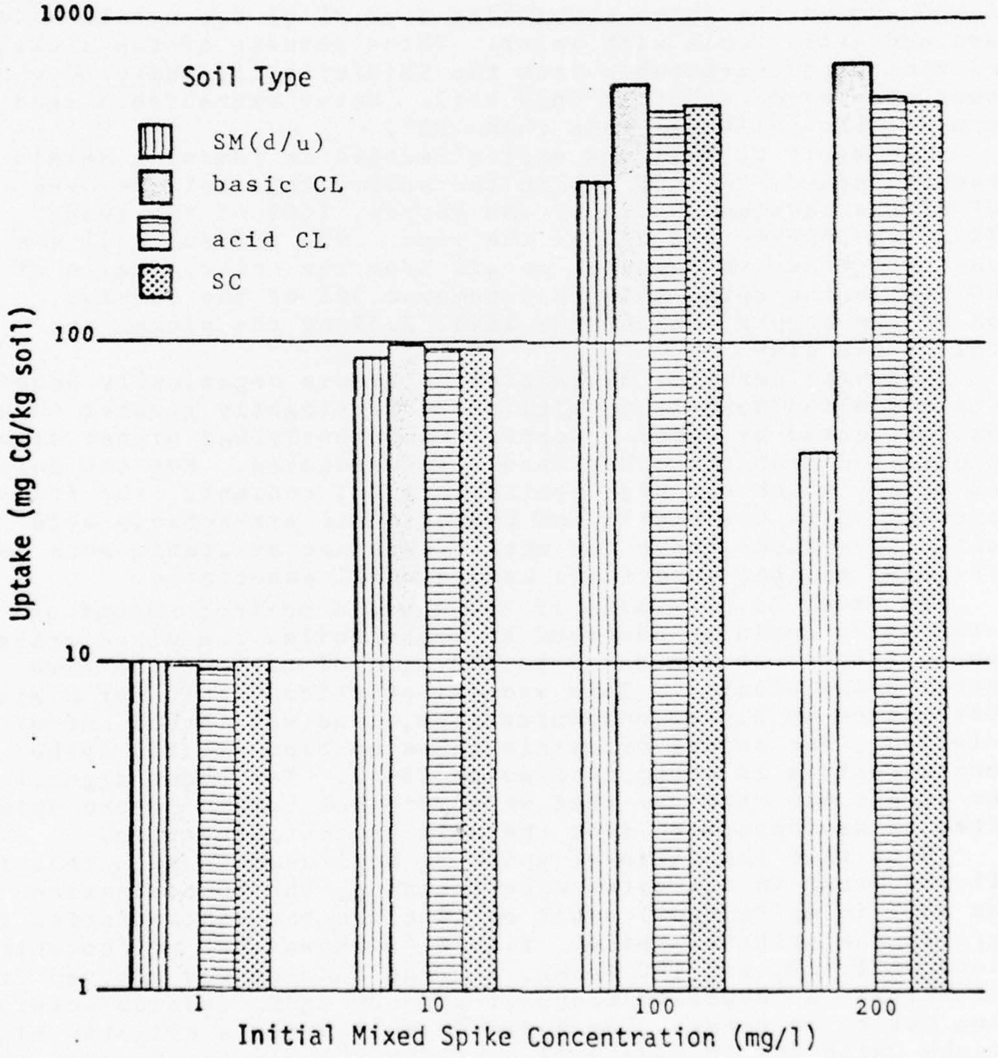

Figure 43. Uptake of cadmium in mg/Kg by each of the four soils from 1, 10, 100 and 200 ppm solutions.

The copper uptake capacity (Fig. 44) for all but the SM(d/u) soil exceeds 1000 mg/l, and only small amounts remained in the supernatant for the other 3 soils at spike concentrations of 200 mg/l.

Lead uptake shown in figure 45 was very nearly complete for all spike concentrations used. Only the SM(d/u) soil did not take up quite all the lead from the 200 mg/l spike.

Nickel uptake shown in figure 46 was again lower for the SM(d/u) soil at 100 mg/l. The data is missing for the higher concentration in this soil. The maximum uptake from the combined spike for the other three soils appears to be 5-600 mg/Kg and is even lower when the spike concentration is higher indicating that nickel may not compete as effectively for the available fixation sites.

Zinc uptake shown in figure 47 shows a pattern similar to cadmium uptake except that the acid CL soil exhibits less uptake from the 200 mg/k spike.

The total uptake of all the metals for each soil is shown in figure 48. The SM(d/u) soil exhibits slightly lower uptake at the 10 mg/l level and a larger decrease at the 100 mg/l level, again indicating the competition for available sites. At high spike concentrations, the greatest total amounts of metal were similar and slightly lower, indicating that their total capacities were in the range of 4-5000 mg/Kg. The possibility of competition was investigated and will be discussed next.

Competition Between Metals

In order to determine if the various metal ions competed for a fixed number of sites on the soils, a comparison was made between the uptake of cadmium by all four soils from a spike containing 200 mg/l of all 5 metals and a spike containing 200 mg/l of cadmium only. As shown in table 23, all soils took much more cadmium when the other metals were not present in the spike. In the case of the basic CL, the soil took almost twenty times as much as cadmium. This clearly illustrated that there was competition between the various metals for the absorption sites on these soils.

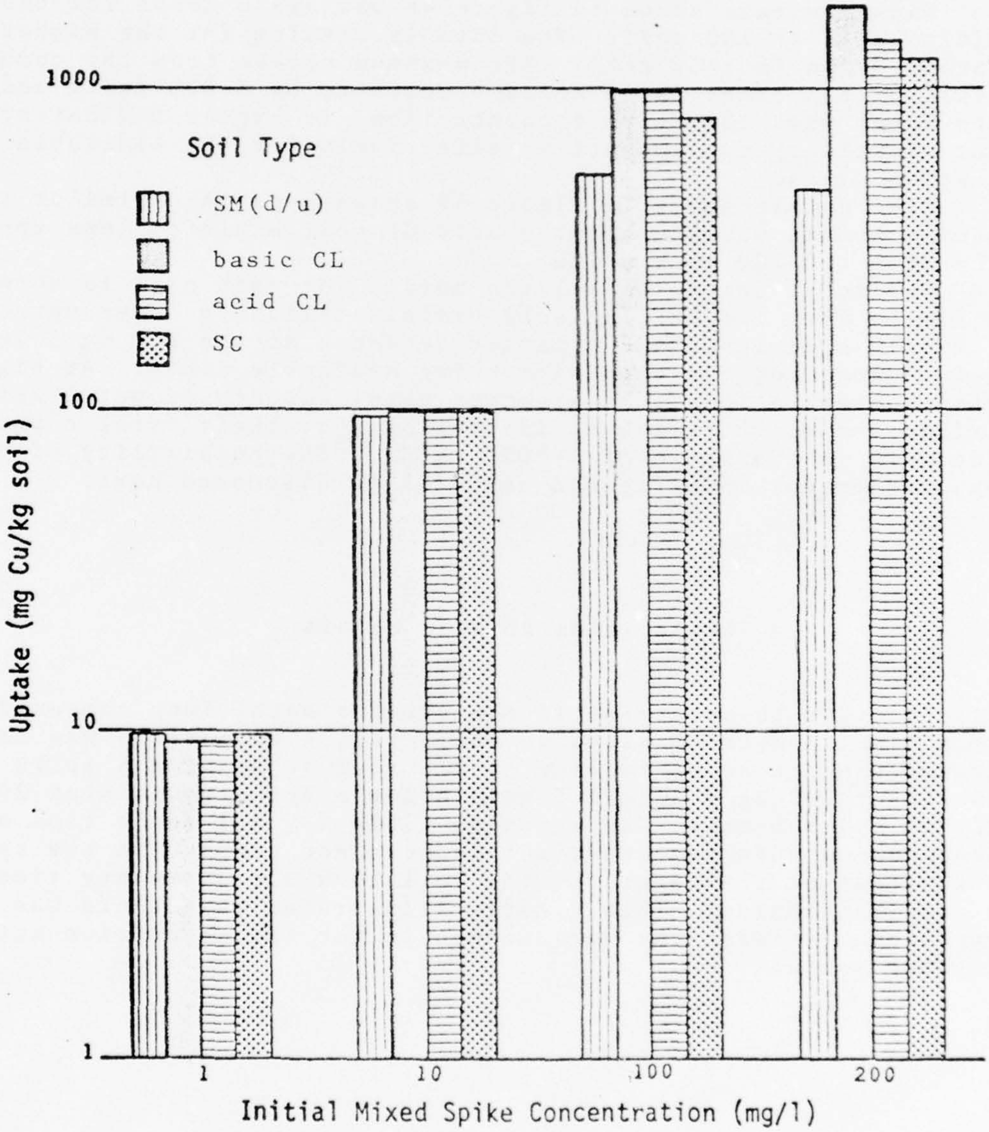

Figure 44. Uptake of copper in mg/Kg by each of the four soils from 1, 10, 100 and 200 ppm solutions.

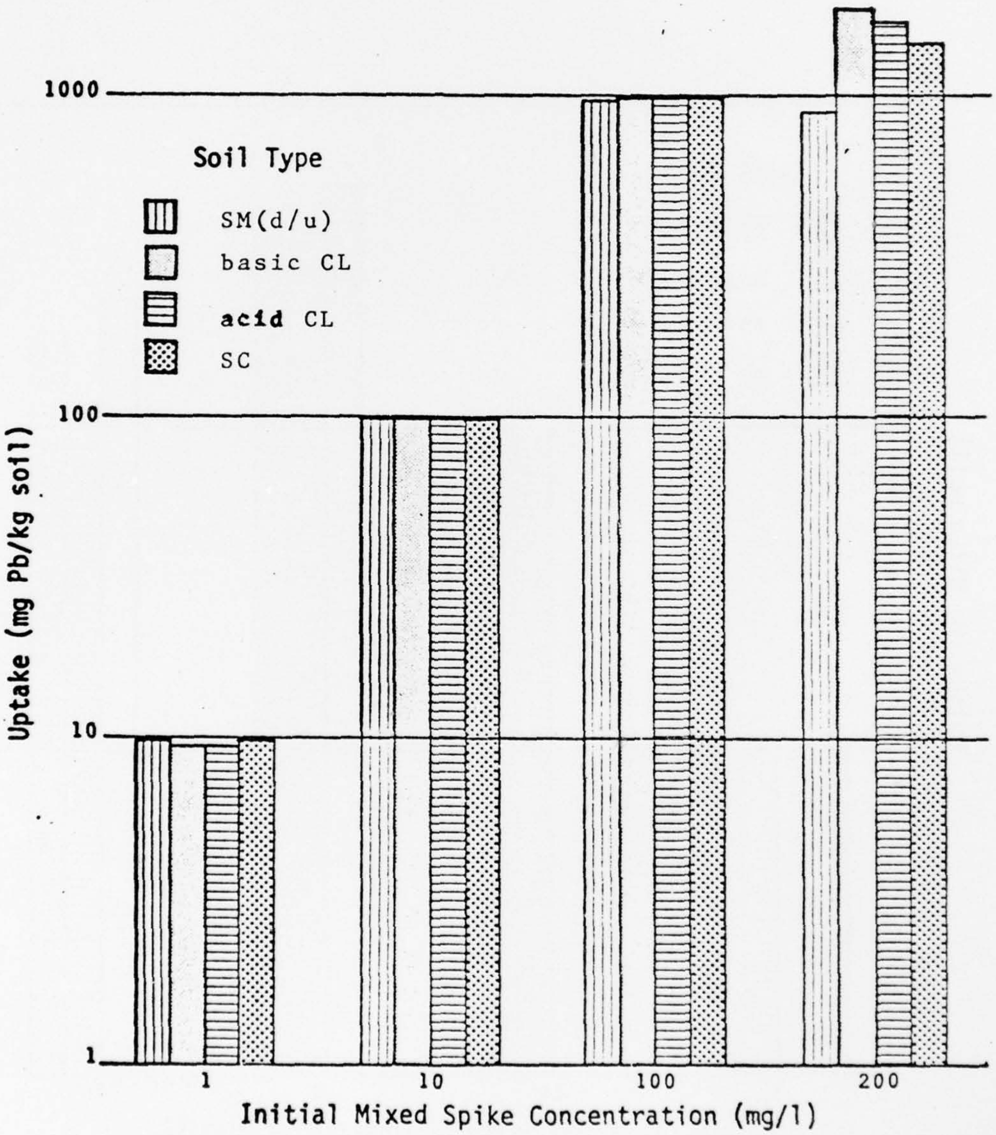

Figure 45. Uptake of lead in mg/Kg by each of the four soils from 1, 10, 100 and 200 ppm solutions.

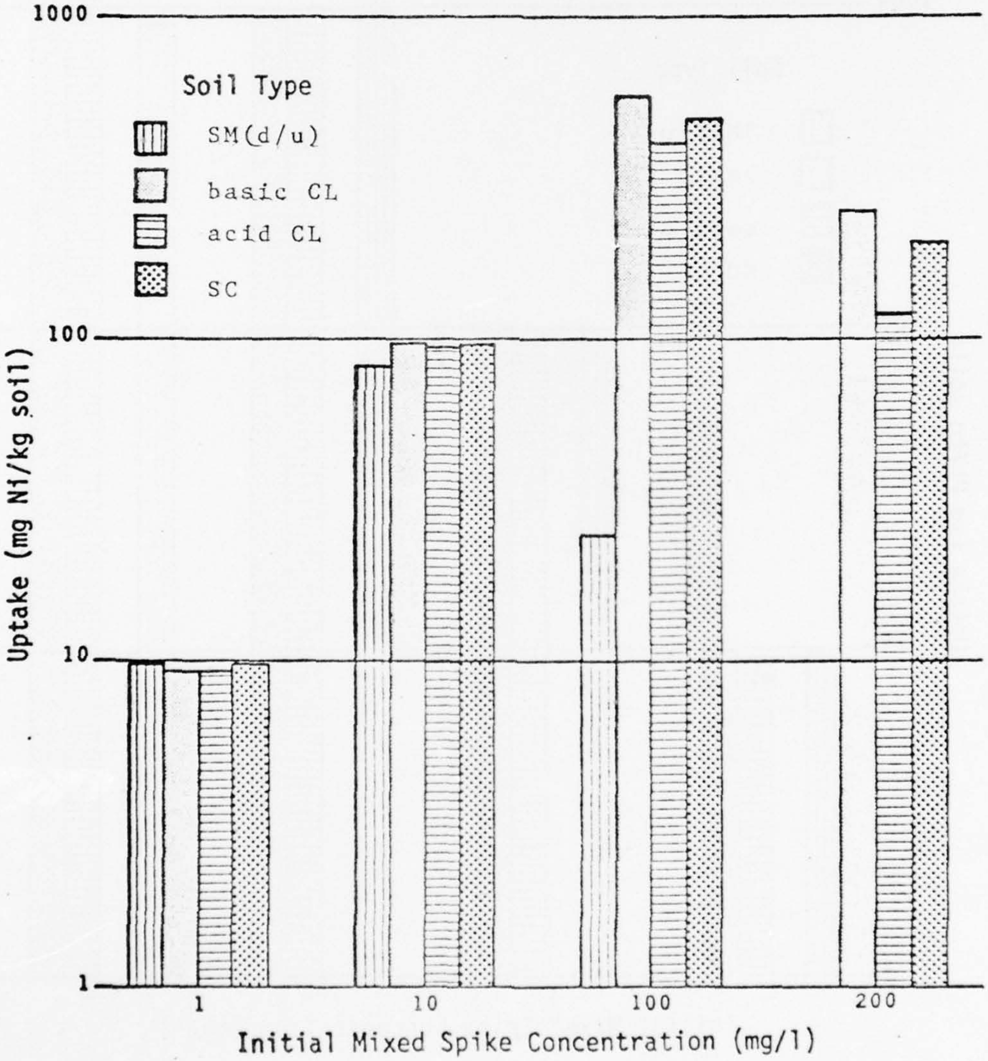

Figure 46. Uptake of nickel in mg/Kg by each of the four soils from 1, 10, 100 and 200 ppm solutions.

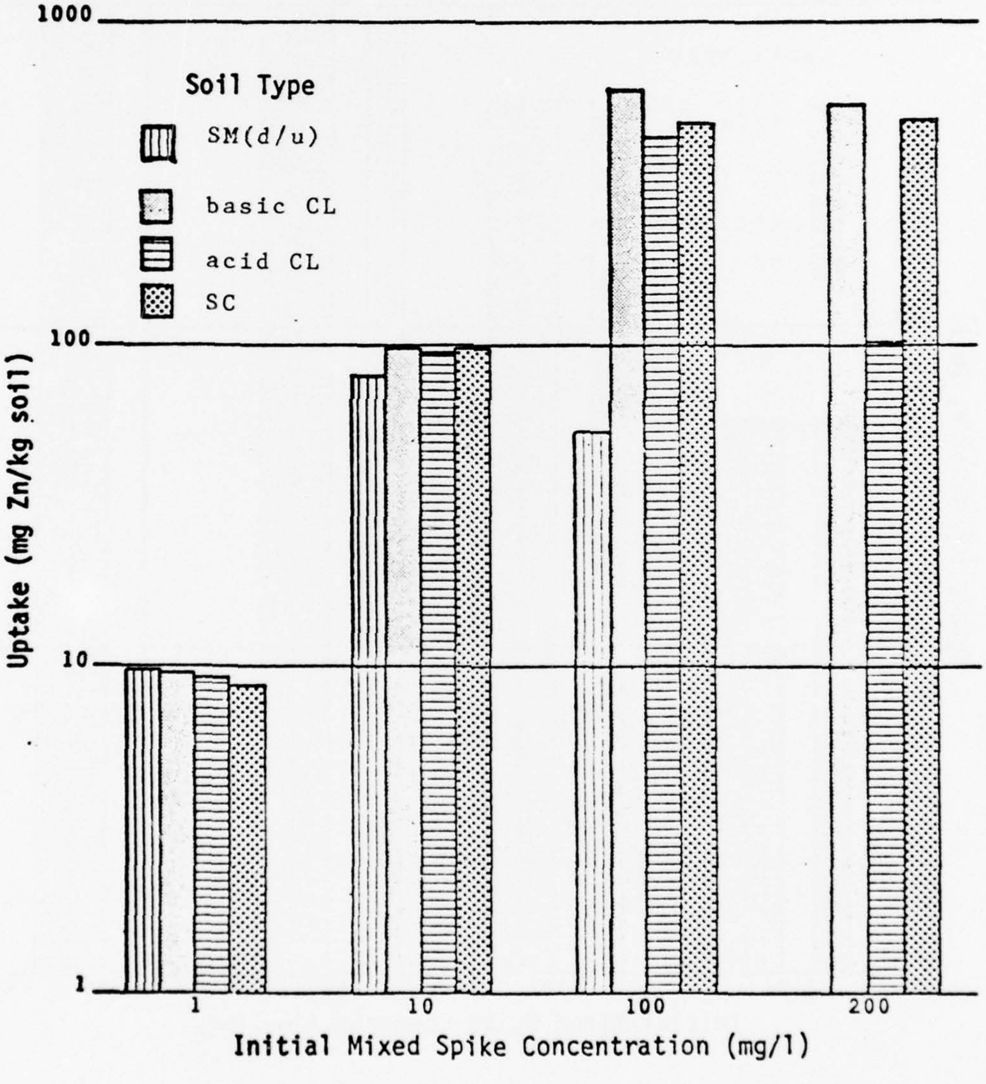

Figure 47. Uptake of zinc in mg/Kg by each of the four soils from 1, 10, 100 and 200 ppm solutions.

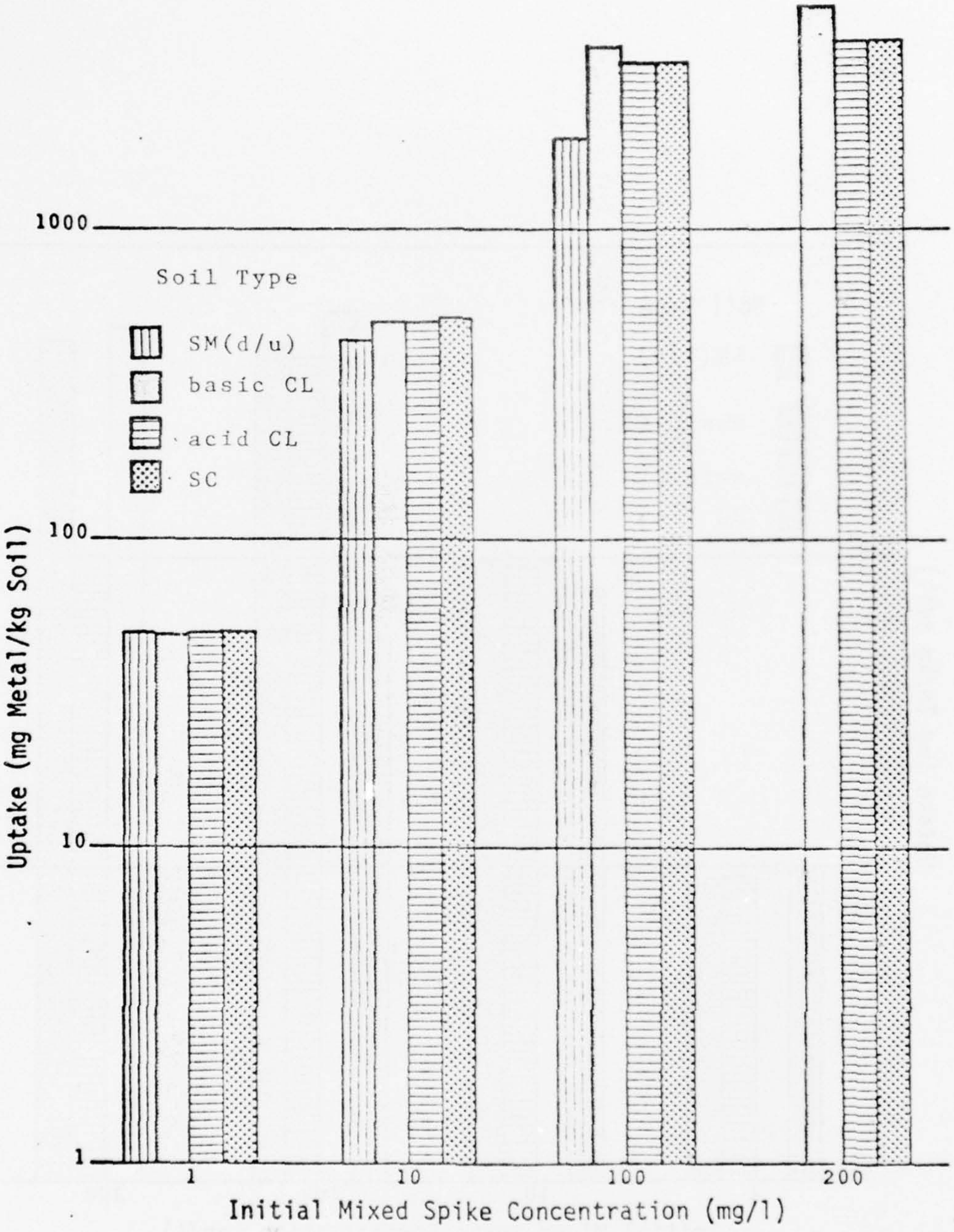

Figure 48. Total metal uptake in mg/Kg by each of the four soils from 1, 10, 100 and 200 ppm solutions.

Soil Type	Total Cadmium Uptake	
	200 mg/l Mixed Spike	200 mg/l Cd Spike
SM(d/u)	56.00	171.00
basic CL	4.67	91.00
acid CL	75.34	182.50
SC	59.34	166.00

Table 23. Total cadmium uptake by each of the four soils from a 200 ppm mixed spike solution and a 200 ppm cadmium solution.

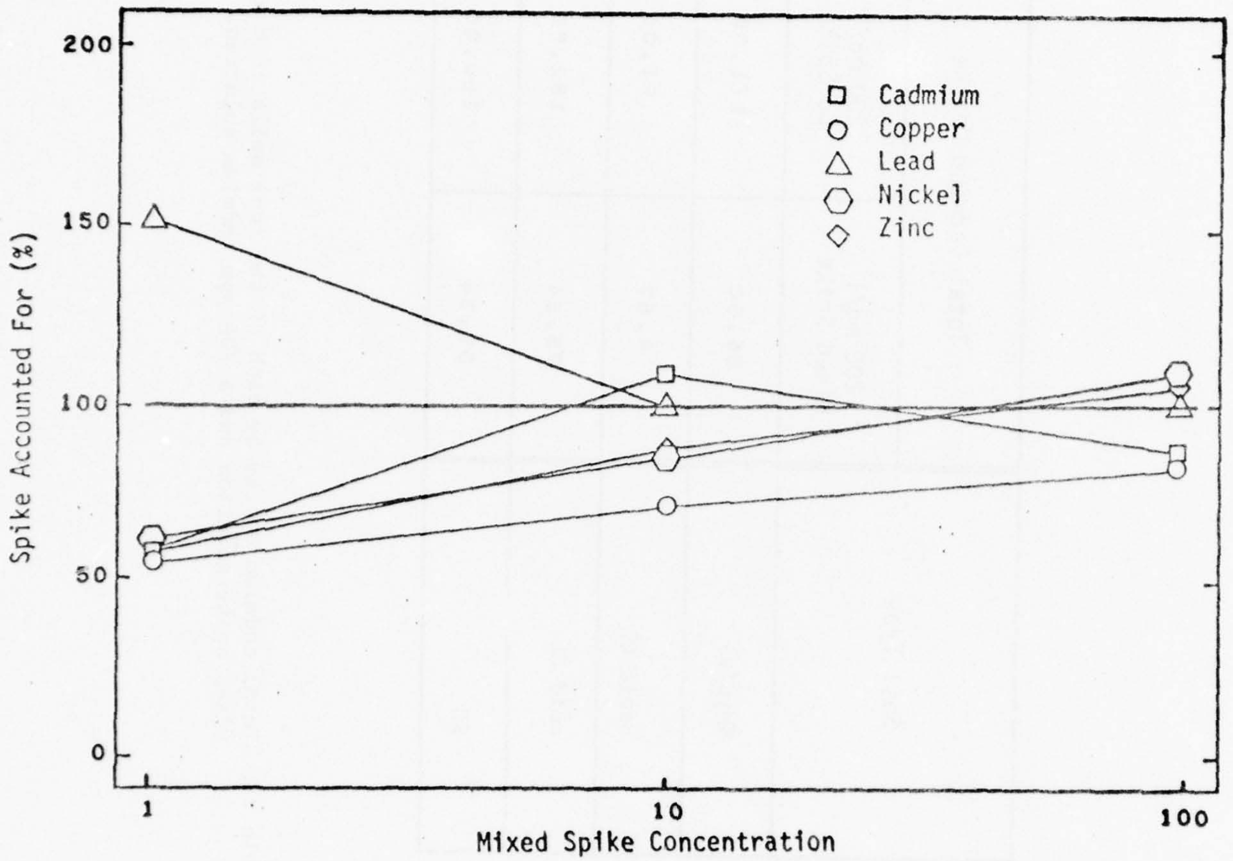

FIGURE 49
Per Cent Of Metal Accounted For in SM(d/u) Soil At Different Mixed Spike Concentrations

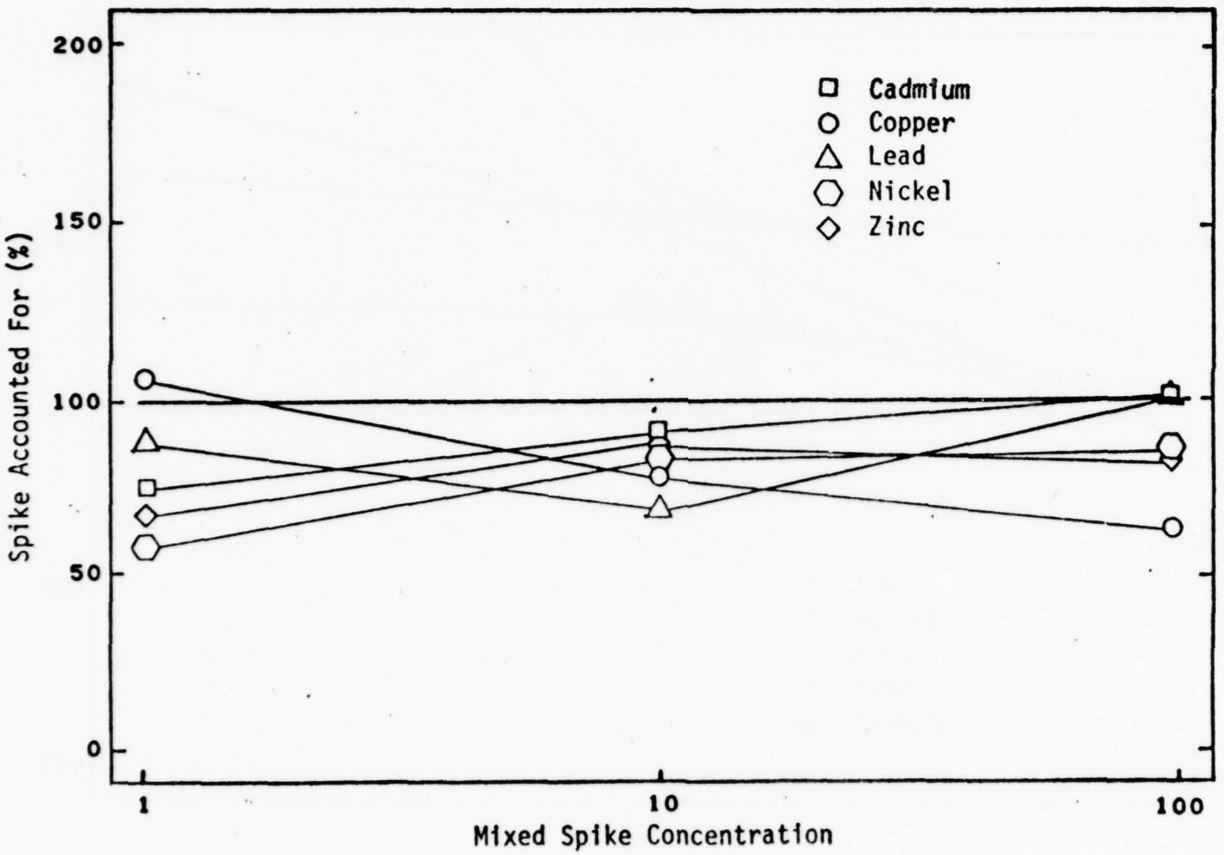

FIGURE 50
Per Cent Of Metal Accounted For In basic CL At Different Mixed Spike Concentrations

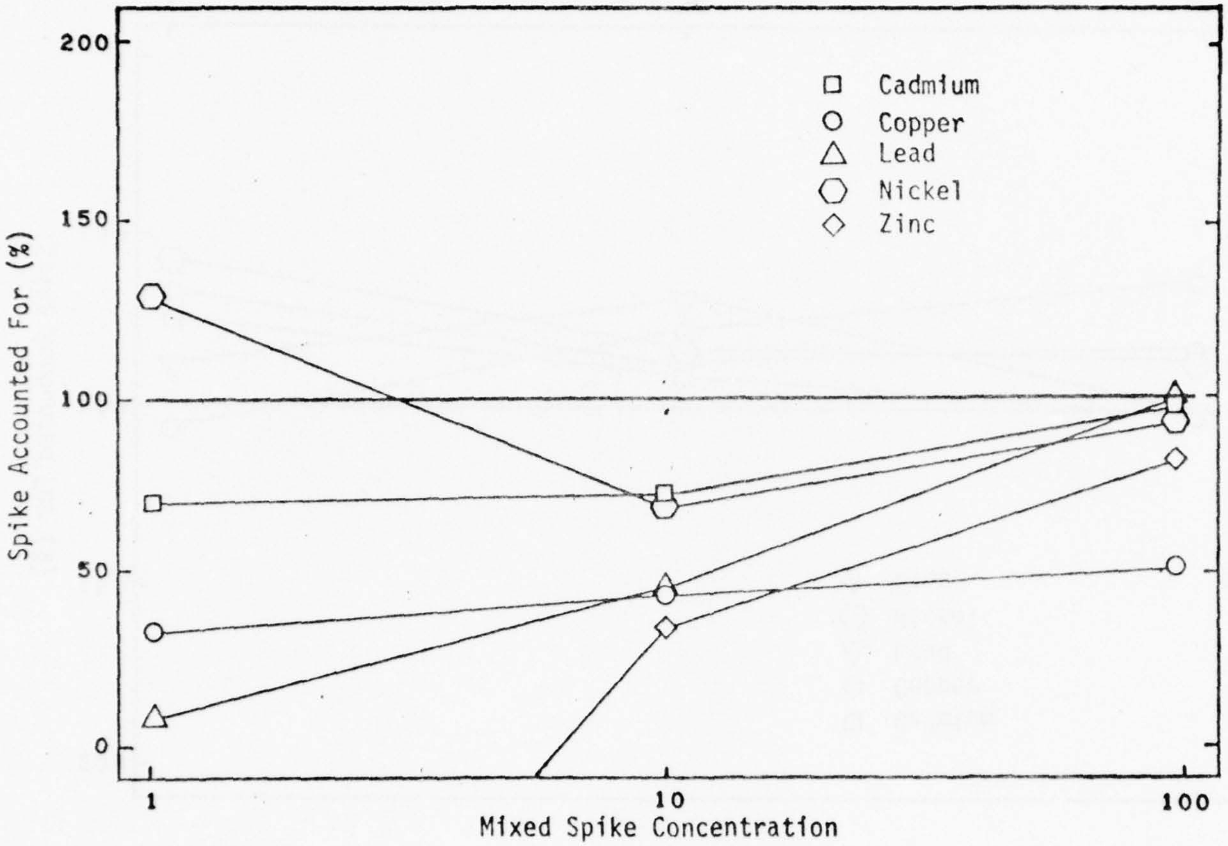

FIGURE 51

Per Cent Of Metal Accounted For In acid CL Soil At Different Mixed Spike Concentrations

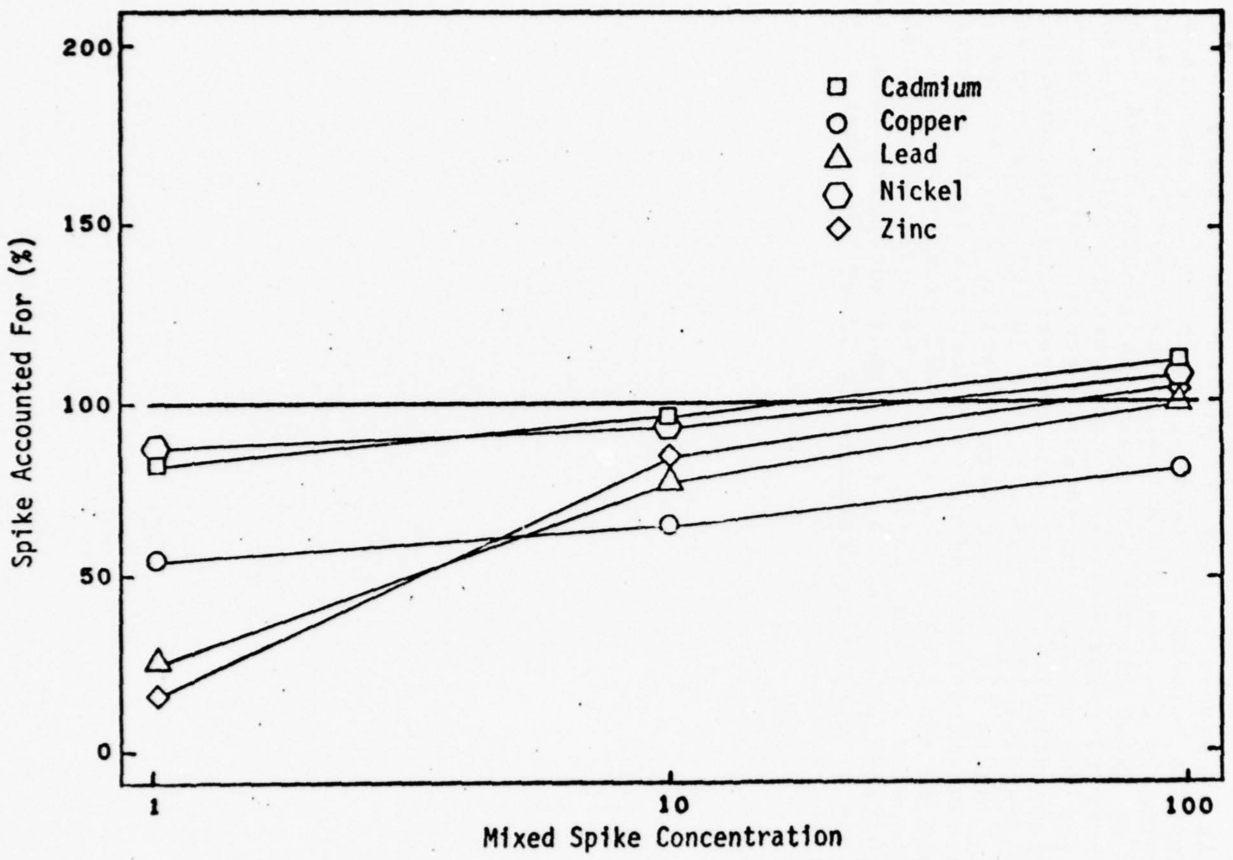

FIGURE 52
Per Cent Of Metal Accounted For In SC Soil At Different Mixed Spike Concentrations

Test of the Procedures

As a general test of the procedures followed in this study, a materials balance was made by comparing the amounts of metal remaining in the supernatant plus that found in the various fractions of Split II with the amount originally added. The results are shown in figures 49-52. Considerable scatter is found in the data for the one mg/l mixed spike concentration. The results were generally low. There was appreciable improvement in the accountability of the spike at the 10 mg/l spike concentration level. Again the results were generally low. At the 100 mg/l spike concentration, the results improved again showing that between 80 and 120% of the spike was being recovered. The results were still slightly low in the case of the basic CL and the acid CL clays. At the higher concentrations, the recovery of copper is consistently lower than that of the other metals.

XII. Discussion

As discussed in the introduction, the concentration of heavy metals found in sewage effluent depends on many factors. The concentrations of heavy metals commonly found in sewage effluent are lower than the 1 ppm concentrations used here. Blakeslee (1973) reported mean concentration in the effluent of 57 Michigan plants as 0.14 ppm Cu, 0.43 ppm Ni, 0.44 ppm Zn, 0.027 ppm Cd, and 0.14 ppm Pb. The maximum concentration found for all the metals but Cd were 1.3 ppm or greater. Thus, for all metals except perhaps cadmium, the values used here were within the range of concentrations normally found.

The fate of trace elements applied to soil in sewage effluent may depend somewhat on the form of the elements at the time of application. Ionic forms might be expected to leach further than those which are associated with the organic constituents of the effluent. While the differences may be slight, attempts were made in this study to allow the spikes to equilibrate with the effluent before application. Equilibration was enhanced by rapid mixing during the 15-30 minutes required to transport the effluent. Comparison of the APDC-MIBK extraction of the effluent which should represent soluble forms of the heavy metals and the total metal content (table 4) reveal that 60-70% of the metals remained in extractable forms. Blakeslee (1973) found that typically 50% of the metals he detected were in the filtrate of the effluents. Considering the possibility that the extractant used here may have removed some loosely held ions, the comparison reveals that the equilibration process was adequate to achieve distributions similar to those resulting in treatment plants.

Heavy metals applied to soil may be fixed by the soils, taken up by plants or leached from the bottom of the profile. In order to achieve a fair test of the possibility of metals leaching through soil profiles, some assurance must be had that the applied water had displaced the water already in the profile, thus resulting in a complete breakthrough of the new water. Water movement processes in the soil may be slow, and if evaporation approximates water application over a period of a year, little or no water may pass below the root zone. To assure that breakthrough occurred, bromide was utilized as a tracer. Bromide is a highly mobile anion which occurs infrequently in nature (Bowen, 1966) and has proven useful in miscible displacement studies (Smith and David, 1974).

Therefore, the effluent applied to the lysimeters and field plots were spiked with 100 ppm bromide. Classical breakthrough curves were found for the SM(d/u) soil and the basic CL soil. Complete breakthrough occurred within 16 and 32 weeks respectively for these two soils. The SC soil which exhibited shrinkage cracks showed rapid movement of the bromide through the profile to the suction cups at 150 cm. The Acid CL soil had a very tight subsoil, and although bromide was evident in the leachate throughout, mean concentration never reached more than 40% of that applied.

Thus, for all the soils but the Acid CL, internal drainage was great enough and the application of effluent sufficiently exceeded the evapotranspiration rate so that complete breakthrough occurred. Any metals which might have occurred in a soluble highly mobile form would have had adequate chance to migrate through at least three of the four soil profiles enclosed in the lysimeters.

Comparison of the lysimeter and field plot water balance data reveal that with proper management, similar water potential and content profiles can be achieved. Thus, there should be no difficulty extrapolating lysimeter derived data to the field.

Only small amounts of the applied metals were taken up by the grass. Of the 12-14 Kg/Ha of each metal added during the year, less than 1% and in most cases, less than 0.5% was removed by the harvested grass during the same period. Lesser amounts of cadmium and nickel were taken up. Differences in uptake between soils appeared to be more related to grass yield than concentration differences in the grass harvested from soils. Although the concentration of metals in the grass varied from one sampling date to another, the data indicated, particularly for zinc, cadmium and copper, that the concentration in the plants increased as the concentration in the soils increased. The concentration of all the metals in the harvested grass from all plots were of the same order of magnitude. Zinc concentrations were a little higher than the others, but concentrations of nickel, cadmium, lead and copper were all similar and all increased throughout the year of application. This suggests that similar fractions of all the metals were held in forms available to the plants.

Typical and toxic concentrations of trace elements found in plants have been reported by Allowy (1968)(Table 24). Only in the case of copper did the concentration in the grass reach the potentially toxic level of 20 ppm. This occurred in the final harvests in the acid CL and SM(d/u) soils. Toxic levels of Cd and Pb in vegetation have not been established in the literature. The concentrations of the applied metals in the harvested grass for all the metals but zinc exceeded the upper end of the normal range reported by Allowy (1968) at least during some harvest during the year. The cadmium concentrations are as great as 30 times the upper end of the normal range.

The greatest concentrations were found in the few millimeter thick surface samples. The concentrations of all metals decreased with depth so that at a depth of 15 cm (6 inches) concentrations were similar to background levels. After the one year, the majority of the applied metals could have been removed by removal of the top 5 cm (2 inches) of soil. In some cases removal of the top 2-1/2 cm (1 inch) would have removed over 50% of the applied metals. Typical concentrations of heavy metals in soil were reported by Allowy (1968)(Table 24). Only the very surface samples of a few soils exceeded the 7 ppm upper end of the normal range in soils for cadmium. All other concentrations found were within and in some cases, were below the normal range. Had the soil been plowed, this concentration would have been decreased to well below the 7 ppm reported as the upper limit found in some untreated soils.

Several of the profiles of DTPA extracted metals indicated an increase in the concentrations over the background levels at depths greater than 65 cm. In the majority of the cases, however, all the data from samples other than the background were within one standard deviation of the final samples collected in November. The background samples were taken from the side of the pit from which the lysimeters were filled and not inside the lysimeters as were all the rest of the samples. These samples may thus not have been representative of the soil in the lysimeter or may for some reason have undergone changes during storage and processing which resulted in less DTPA extractable metals.

No metals were detected in either the root zone water samples collected at 75 cm in the profile nor in the leachate collected from the bottom of the 150 cm deep lysimeters. These results further substantiate that metals did not move into or through the lower part of the profiles investigated. The four soils used had the ability to absorb the metals in forms which rendered them unable to move in soluble forms to these depths.

Table 24. Concentration of heavy metals typically found in plants and soils (after Allowy, 1968).

Element	Concentration in Plants (ppm)		Concentration in Soil (ppm)	
	Normal	Toxic	Common	Range
Cd	0.2-0.3	--	0.06	0.01-7
Cu	4-15	>20	20	2-100
Pb	0.1-10	--	10	2-200
Ni	1	>50	40	10-1000
Zn	15-200	>200	50	10-300

Table 25. Concentration of metals extracted from the surface samples of the four soils.

Metal	Soil	Background			November		
		DTPA (ppm)	TOTAL (ppm)	DTPA/TOTAL	DTPA (ppm)	TOTAL (ppm)	DTPA/TOTAL
Cadmium	Acid CL	< .3	< .3		30	33	.91
	SM(d/u)	< .3	< .3		42	35	1.2
	Basic CL	< .3	< .3		16	13	1.23
	SC	< .3	< .3		10	12	.83
Copper	Acid CL	.5	8.1	.06	19	63	.30
	SM(d/u)	.5	1.7	.29	29	49	.59
	Basic CL	.7	5.3	.13	14	40	.35
	SC	1.2	3.2	.37	8	31	.25
Zinc	Acid CL	4.6	11.6	.03	26	143	.18
	SM(d/u)	2	5.3	.37	29	48	.60
	Basic CL	1.5	24	.06	17	52	.32
	SC	2.1	16	.13	7.9	32	.24
Lead	Acid CL	4.4	29	.15	24	51	.47
	SM(d/u)	1.2	2.4	.5	40	36	1.11
	Basic CL	2.2	7	.31	16	19	.84
	SC	3.1	7.6	.40	9	18	.5
Nickel	Acid CL	1.5	46	.03	19	73	.26
	SM(d/u)	< .4	2	.2	21	36	.58
	Basic CL	< .5	8.3	.06	12	28	.42
	SC	1.3	4.0	.32	5	22	.22

The laboratory study revealed that all the soils had a large capacity to absorb the five heavy metals under study. The SM(d/u) soil which has the lowest capacity absorbed up to 100 ppm of all the metals simultaneously. When spike concentrations were increased the absorption of cadmium, copper and lead increased to 400, 600 and 1000 ppm, but that of nickel and zinc were only 20 and 50 ppm. For the other three soils absorption capacity of all five metals simultaneously was 5-600 ppm and in some cases, much greater. At higher concentrations competition for absorption sites was evident. Zinc and nickel were excluded from these soils first. The competition became evident for concentrations of 500 ppm for zinc, nickel and cadmium, but was not yet evident at concentrations of 1000 mg/kg for lead and copper. When only cadmium was present in the spike at concentrations of 200 mg/l, two or more times as much cadmium were taken up than when all the metals were present, each at concentrations of 200 mg/l.

The laboratory study revealed that the soils had a much higher capacity to absorb metals than was utilized in the field during the study. In both studies, it was evident that as the concentration of metals in the soils increased as a result of metal additions, the fraction of metals in the forms available to plants and microbes increased.

In Table 25 the rate of DTPA to total metal is calculated for the surface layer of each soil for each metal. The background concentrations of cadmium are low and thus the ratio is meaningless, we find, however, that for all the other metals and other soils except zinc and nickel in the SC soil, the ratio of DTPA to total metal was two or more greater by the end of the study. At the beginning of the study, the metals removed by the H_2O, HN_4OAc, and H_2O_2 extracting procedures were nearly negligible. Table 26 shows the concentrations and percentages of the total metals these extractions represented by the end of the study. While the water extracted did not remove much metal from any soil, significant amounts typically 0.5-1.5% were evident in the treated soil. The ammonium acetate extraction yielded 9-48% of the cadmium and smaller fractions of all the other metals. Ammonium acetate extracted more of each of the metals from the SM(d/u) soil, which had the low surface area than from the other soils tested. The H_2O_2 extraction for the organically bound metal removed small amounts of zinc but large amounts of cadmium, copper and nickel. The metals remaining for the nitric and hydroflouric acid removal typically ran greater than 90% of the total except for the SM(d/u) soils which had large fractions in other forms.

Lehman and Wilson (1971) also found in lysimeter studies of a number of soils that under the aerobic conditions of intermittent flooding such as occurred in the present study, trace metals including cadmium, copper, lead, nickel and zinc, were removed from sewage effluent at or near the soil surface. In a calcareous soil, 98% of the lead applied was removed in the top 12.7 cm (3 in). Similar results were observed for nickel. Cadmium was present in the sewage effluent but none was detected in filtrates obtained from the 12.7 cm (3 in) depth suggesting this metal was also removed at or near the surface. Some migration of copper and zinc were observed but only when high infiltration rates were used; a condition not reached in the present study.

Table 26 Concentration of metals recovered by different extractions from November surface samples.

Metal	Soil	Total (ppm)	H_2O		NH_3OAC		H_2O_2		HNO_3-HT	
			ppm	%	ppm	%	ppm	%	ppm	%
Cadmium	Acid CL	33	.1	.3	3	9.1	1.7	5.2	28	85.4
	SM(d/u)	35	.1	.3	17	48.3	1.1	3.1	17	48.3
	Basic CL	13	.1	.8	2	15.5	.8	6.2	10	77.5
	SC	12	.1	.8	3	24	1.4	11.2	8	64.0
Copper	Acid CL	63	.5	.8	.5	.8	2	3.2	60	95.2
	SM(d/u)	49	.5	1.0	2.1	4.03	6.4	13.1	40	81.6
	Basic CL	40	.2	.5	.4	1	1.4	3.5	38	95
	SC	31	.5	1.6	.3	1	.8	2.6	29	94.8
Lead	Acid CL	51	.2	.3	.2	.3	.2	.3	51	98.8
	SM(d/u)	36	.2	.5	.4	1.1	.2	.5	36	97.9
	Basic CL	19	.2	1.0	.2	1	.2	1	19	97
	SC	18	.2	1.1	.2	1.1	.2	1.1	18	96.7
Nickel	Acid CL	73	.8	1.1	.5	.7	3.9	5.3	68	92.9
	SM(d/u)	36	.4	1.1	2.5	6.9	8.3	22.9	25	69.1
	Basic CL	28	.4	1.4	.4	1.4	1.3	4.6	26	92.6
	SC	23	.4	1.8	.4	1.8	3	13.2	19	83.2
Zinc	Acid CL	143	.7	.5	.3	.2	1	.7	141	98.6
	SM(d/u)	48	.2	.4	4.2	8.8	.5	1	43	89.8
	Basic CL	52	.3	.6	.4	.8	.2	.4	51	98.2
	SC	32	.5	1.6	.3	.9	.8	2.5	30	95

Table 27. Water quality criteria for surface and drinking water developed by various agencies.

Element	Continuous Use		20 year use
	FWPCA[1] Any Soil	NAS[2] Coarse Textured Soil	FWPCA Fine Textured Soil
	ppm		
Cd	0.005	0.01	0.05
Cu	0.2	0.2	5.0
Pb	5.0	5.0	20.0
Ni	0.5	0.2	2.0
Zn	5.0	2.0	10.0

[1] Federal Water Pollution Control Administration (1968)

[2] National Academy of Science (1973)

As in the present study, bermudagrass clippings assimulated several of the metals but not in significant quantities.

It is more difficult to compare the results of this study with those of Ng and Bloomfield (1962)since their emphasis was upon the effect of decomposing organic matter under anaerobic conditions upon mobility of certain trace elements. Under these conditions of continuous flooding considerable mobility of copper, nickel, lead and zinc among other metals was observed. Subsequent reoxidation of the soil did cause some immobilization of these metals with the exception of copper and nickel.

Other recent studies indicating metal removal by soil filtration include those of Wentick and Etzel (1972) who found copper and zinc to be quantitatively removed on three different soils of varying clay content.

Recommendations on the amount of metals that can be added to various soils without detrimental effects on plants must be based on many factors. Some general guidelines for concentrations of metals in irrigation water which have been established by various agencies are summarized for the metals of interest in table 27. Agreement between the FWPCA and NAS are reasonable considering the scattered data they had to base their recommendations on. Both lead and zinc are acceptable in concentrations greater than those utilized here, while acceptable concentrations of copper and nickel are less than the 1 ppm used here and recommendations on cadmium are much less. The standards allow the possibility of higher concentrations of all metals for a specified time period. Details of some of the standards allow greater concentrations on fine textured basic soils than on coarser texture or more acid soils. The results of this study suggest that the limits already established are reasonable for some metals. Cadmium at the rate of 1 ppm in irrigation water equivalent to 140 cm per year, resulted in levels in the vegetation which were at the lower end of the toxic range. The FWPCA recommends that 1/20 of the concentrations used here may be applied for 20 years before one reached the toxic level. Thus, the agreement is good. Zinc is allowed for 20 years at concentrations as high as 20 ppm with toxicity expected at 200 ppm or greater. In the present study 1/400 of the allowable amount was applied in one year and the concentrations in the vegetation reached 40 ppm or 1/5 the lower toxic limit. Thus, the allowable amount of zinc may be too great. Nickel toxicity is possible at concentrations greater than 50 ppm (Allowy, 1968). In the present study, concentrations of 25 ppm were reached in one year with 1 ppm irrigation water. The recommendations allow 2 ppm for 20 years. Here again the recommendations appear too high. The discrepancies may well be a result of different interpretations of the quantity of irrigation water used and from differences in the form of the metal. For purposes of growing a crop, typically 50 cm of irrigation water are needed per year. If the purpose is to dispose of water, then as much as three times this amount may be applied to the land. This would alter greatly the amount of metal applied. With time, metals added to the soil may revert to less available forms, thus their potential toxicity may decrease, allowing greater long term application rates than would otherwise be permissable.

XIII. Conclusions

1. The copper, zinc, cadmium, nickel and lead applied to lysimeters and field plots in concentrations of 1 ppm in secondary treated sewage effluent at a rate of 2.7 cm per week for a period of one year did not leach from the four soil profiles investigated.

2. The largest portion of the applied metals were immobilized near the surface suggesting the possibility that disposal sites could be renewed by the removal of thin layers of surface soils.

3. The influence of soil properties including texture, CEC and pH were not detectable in the field, despite the use of soils with widely varying properties. Differential behavior of the five metals used were not evident.

4. Plant uptake accounted for less than 1% of the applied metals.

5. Plant uptake of the metals showed a cyclic trend over the season, but generally increased as the applied metals accumulated.

6. While some plants may accumulate slightly more metals than the bermudagrass utilized here, the results suggest that rejuvination of disposal sites by harvesting crops would be a very slow process.

7. Applications of distilled water to simulate rainfall at the rate of 2.5 inches per week for 6 weeks had no apparent influence on the movement of the metals.

8. Applications of primary treated effluent with a BOD greater than that which was normally applied, for a 6-week period, did not have a detectable influence on the movement of metals.

9. Applications of effluent with a pH lower than that normally used for a period of six weeks did not have a detectable influence on the movement of metals.

10. Laboratory studies reveal that the soil investigated has a large capacity to absorb the five metals of interest when applied in distilled water. Quantities as large as 600 ppm metal were absorbed completely by the soil.

11. The capacity of the SM(d/u) soil which has the lowest cation exchange capacity and lowest surface area exhibits metal saturation at concentrations below those of the other three soils in the laboratory. This was not observed at the low application rates used in the field.

12. Greater absorption of cadmium was observed in the laboratory from solutions not containing other ions than from mixed solutions, indicating competition for available sites.

13. The flow of water through the soils in the lysimeters could be made to equal that flowing through the field soils by the application of sufficient suction to the porous cups in the bottom of the lysimeters.

14. Metal balances on the top 12.7 cm of soil accounted for less of the cadmium applied, perhaps because of loss in extraction procedures. The metal balance for copper, nickel and lead were reasonable, while that for zinc was sporadic. The variability was probably a result of the high background concentration.

15. Only small fractions of the metals originally in the soil were in forms available to the plants. Much of the metals applied during the study were, however, found in the available form by the end of the study.

16. The high availability of metals may have contributed to the high concentrations of metals, particularly cadmium, found in the grass which was harvested from the plots.

17. The large capacity of soils to absorb heavy metals from sewage effluent makes them a desirable medium for disposal of metal polluted effluent.

18. The likelihood of metals leaching from the soil is small, provided excessive amounts are not applied.

19. Precautions must be taken to prevent build-ups which would be too toxic to plants. It would appear that heavy applications of effluent of the quality investigated here could proceed for several years before toxic concentrations would be reached for most metals.

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Appendix A

Field Descriptions of Each of the Four Soils Used in This Experiment

Norwood Soil Series (Basic CL)

The Norwood series comprises reddish well-drained alluvial soils. Flood waters of rivers have carried in sediments from the Reddish Prairies of West Texas and from the sandy forested soils and the Blackland Prairie soils.

Profile description:

A_1 0-15" -- Light brown (7.5YR 6/4; 5/4 moist) sandy clay loam, very friable when moist and hard when dry; calcareous; pH 7.70; grades indistinctly to horizon below.

AC 15-60" -- Light reddish-brown (5YR 6/4; 5/4 moist) clay loam weakly stratified with thin layers of sandy clay loam; very friable when moist and slightly hard when dry: permeable; calcareous; pH 7.80.

Nacogdoches Soil Series (Acid CL)

Nacogdoches soils are deep, well-drained upland soils with a dark reddish-brown fine sandy loam surface and dark red clayey subsoils extending below 60". They are developed from old marine sediments high in glauconite.

Profile description:

A_1 0-7" -- Red (2.5YR 5/6; 3/5.6, moist) clay, weak granular in upper portion to massive in lower portion; very friable; slightly hard dry; few fine pores; few small hard ferrugineous concretions 2-5 mm in diameter; pH 5.07; grades gradually to horizon below.

B_{2t} 7-60" -- Red (10R 4/6; 3/6, moist) clay; moderate to strong subangular blocky; friable moist, hard dry sticky and plastic; fine pores common, few large pores; common fine hard dark ferrugineous concretions 2-6 mm in diameter; clayskins almost continuous; few soft brownish yellow semi-hard concretions 3-15 mm in diameter which cause brownish-yellowish streaks in the soil when crushed; pH 5.5.

Bastrop Soil Series (SC)

The Bastrop soils occur on low river terraces adjacent to flood plains and were developed under tall bunch grasses.

Profile description:

A_1	0-15"	-- Brown (7.5YR 5/2; 3/2 moist) sandy clay loam, very friable when moist, slightly hard when dry; weakly granular; numerous grass roots; pH 6.95; grades gradually to horizon below.
A_3	15-18"	-- Light reddish-brown transitional layer of clay; heavier than A_1 horizon.
B_2	18-30"	-- Yellowish-red (5YR 5/6; 4/6, moist) clay; friable to firm when moist, hard when dry, slightly sticky when wet; massive; porous; grass roots abundant; pH 7.1; grades gradually to horizon below.
B_3	30-55"	-- Yellowish-red (5YR 5/1; 4/1 moist) clay; friable when moist, hard when dry; massive; porous, grass roots few; pH 7.4; grades gradually to horizon below.
C_1	55-60"	-- Yellowish-red (5YR 5/1; 4/1 moist) sandy clay loam, friable when moist, slightly hard when dry; massive; porous; pH 7.65; grades gradually to horizon below.

Lakeland Soil Series (SM(d/u))

Lakeland soils consist of deep light-colored loamy sands over clayey materials and were developed in acid sandy clay loam under scrubby hardwood forests on the upland.

Profile description:

A_1	0-12"	-- Light brownish-gray (10YR 6/2; 5/2, moist) sandy loam; very friable when moist and loose when dry, single grain; pH 6.30; small roots abundant; boundary with horizon below is abrupt.
A_2	12-37"	-- Very pale brown (10YR 8/3.5; 7/3.5, moist) sandy loam; very friable when moist and loose when dry; single grain; pH 5.65; roots abundant in upper part; grades gradually to horizon below.
A_3	37-46"	-- Very pale brown (10YR 8/3; 7/3, moist) sandy loam mottled with yellow and reddish yellow; very friable, loose; pH 6.10; grades gradually to horizon below.
Ac	46-53"	-- Very pale brown (10 YR 8/3; 7/3, moist); sandy loam mottled with yellow, white and distinct yellowish red; the yellowish red is centered around ferruginous concretions; friable; massive; pH 6.20; boundary with horizon below is abrupt.
B_{21}	53-60"	-- White (10YR 8/2; 7/2, moist) sandy loam coarsely mottled with red (10YR 4/6; same when moist); very firm when moist, very hard when dry, and very sticky when wet; weak medium blocky; few roots; pH 6.30.

Appendix B. Physical and chemical characteristics of the applied effluent.

Date	Plant	Appear-ance	Depth of Foam	pH	Alka-linity mg/l	Hard-ness mg/l	BOD mg/l	TOC ppm	Cd ppm		Cu ppm		Ni ppm		Pb ppm		Zn ppm	
									TOT	EXT	TOT	EXT	TOT	EXT	TOT	EXT	TOT	EXT
11/05	A&M	---	---	---	---	---	---	--	--	--	--	--	--	--	--	--	--	--
11/11	A&M	clear	0	8.0	223	50	---	63	--	--	--	--	--	--	--	--	--	--
11/16	A&M	---	---	7.7	238	65	9.6	36	1.09	--	1.04	--	1.20	--	1.03	--	1.22	--
11/19	A&M	---	---	7.9	280	60	---	--	0.95	--	0.92	--	0.72	--	0.65	--	0.90	--
11/27	A&M	---	---	7.9	400	68	---	49	0.92	--	1.00	--	0.97	--	0.88	--	1.15	--
11/27	A&M	---	---	8.1	342	48	---	48	0.99	--	0.97	--	0.99	--	0.89	--	1.09	--
11/27	A&M	---	---	7.9	360	77	---	48	1.00	--	0.98	--	1.00	--	0.89	--	1.15	--
11/28	A&M	---	---	7.8	356	76	---	58	1.04	--	1.03	--	1.03	--	1.07	--	1.05	--
12/05	12	---	---	8.0	359	42	1.5	14	0.80	--	0.88	--	0.91	--	0.85	--	0.91	--
12/05	---	---	---	8.0	359	42	1.5	14	0.96	--	0.97	--	0.97	--	0.88	--	1.12	--
12/09	---	---	---	7.9	365	92	---	27	0.96	--	0.89	--	1.02	--	0.88	--	1.10	--
12/12	---	---	---	7.7	374	56	5.2	8	0.85	--	0.93	--	0.91	--	0.88	--	1.05	--
12/13	B	clear	0	7.7	355	70	7.2	40	1.05	--	1.14	--	0.99	--	1.17	--	1.36	--
12/14	B	clear	0	7.5	304	68	6.9	17	1.10	--	1.09	--	1.11	--	1.06	--	1.35	--
12/17	B	clear	0	7.8	422	88	6.3	--	1.00	--	1.01	--	0.97	--	0.85	--	1.12	--
12/24	---	---	---	8.1	272	59	3.1	43	1.00	0.87	0.95	0.97	0.93	1.00	0.89	0.68	1.05	0.94
12/26	---	---	---	7.9	329	40	1.0	43	0.96	0.80	0.92	0.95	0.94	1.00	0.92	0.70	1.00	0.92
12/26	---	---	---	7.9	304	83	1.0	41	1.00	0.80	0.97	0.97	0.93	0.97	0.97	0.81	1.12	0.98
12/27	---	---	---	8.2	339	52	2.1	35	0.93	0.73	0.92	0.94	0.93	1.00	0.93	0.66	1.01	0.88
12/31	---	---	---	8.2	359	---	---	42	1.00	1.00	0.95	0.99	0.99	1.10	1.01	0.66	1.10	0.86
12/31	---	---	---	8.0	357	---	---	29	0.96	1.00	0.97	0.97	1.07	1.00	1.05	0.31	1.01	0.43
1/02	---	---	---	---	360	120	---	24	1.14	0.97	0.85	0.96	1.00	1.03	0.85	0.83	1.00	0.98
1/04	---	---	---	7.8	430	84	1	10	1.06	0.95	1.01	1.02	1.16	1.09	0.90	0.93	1.13	1.00
1/07	A&M	clear	0	---	330	80	3.4	12	1.10	0.96	1.00	0.70	1.13	0.87	0.97	0.86	1.01	0.90
1/07	A&M	clear	0	---	340	84	1.6	30	1.08	0.95	1.08	0.82	1.13	0.88	1.01	0.87	1.12	0.9

Date	Plant	Appear-ance	Depth of Foam	pH	Alka-linity mg/l	Hard-ness mg/l	BOD mg/l	TOC ppm	Cd ppm		Cu ppm		Ni ppm		Pb ppm		Zn ppm	
									TOT	EXT	TOT	EXT	TOT	EXT	TOT	EXT	TOT	EXT
1/09	A&M	clear	0	7.9	330	80	1	24	1.04	0.75	1.09	0.59	1.03	0.63	0.97	0.48	1.08	0.74
1/12	A&M	clear	0	7.9	340	76	1.4	--	1.01	0.75	0.85	0.54	0.83	0.48	1.12	0.51	0.91	0.75
1/14	A&M	clear	film	8.0	320	88	1	--	1.02	0.91	0.86	0.79	0.91	0.75	0.91	0.81	1.03	0.93
1/14	A&M	clear	film	8.0	370	88	1	--	1.02	0.91	0.86	0.79	0.91	0.75	0.91	0.81	1.03	0.93
1/14	A&M	clear	film	8.0	330	48	1.0	19	1.04	0.78	0.90	0.54	0.95	0.46	0.94	0.51	1.05	0.79
1/21	A&M	clear	0	---	320	71	---	94	1.06	0.93	1.00	0.65	1.47	0.76	1.03	0.66	1.55	0.93
1/30	A&M	dirty	film	8.2	400	68	3.4	39	1.36	0.93	0.95	0.69	1.20	0.74	0.92	0.70	1.53	0.93
1/31	A&M	dirty	film	8.1	380	62	2.8	46	1.62	0.98	1.44	0.84	1.44	0.84	1.13	0.72	1.87	0.96
2/01	A&M	clear	1/16	8.0	395	59	6.0	42	0.83	0.56	0.66	0.33	0.88	0.35	0.59	0.36	0.71	0.50
2/01	A&M	clear	1/16	7.9	375	61	3.0	47	0.90	0.56	0.75	0.33	1.03	0.36	0.64	0.34	0.87	0.52
2/02	A&M	clear	1/16	---	360	52	---	43	0.87	0.56	0.75	0.41	1.09	0.47	0.64	0.33	0.77	0.52
2/02	A&M	clear	1/16	---	360	60	---	48	0.83	0.38	0.75	0.21	0.88	0.26	0.57	0.18	0.71	0.28
2/04	A&M	clear	1/8	7.8	365	64	2.8	46	1.00	1.16	0.88	1.28	1.02	1.33	0.85	1.58	0.90	1.09
2/06	A&M	dirty	1/16	8.4	385	51	4.0	38	0.79	0.48	0.76	0.32	1.07	0.34	0.67	0.33	0.93	0.55
2/07	A&M	cloudy	1/8	5.0	325	72	5.8	43	1.00	0.47	0.84	0.47	0.81	0.48	0.69	0.47	1.34	0.73
2/07	A&M	dirty	1/8	5.6	325	52	4.8	33	1.00	--	0.79	--	0.84	--	0.66	--	1.02	--
2/08	A&M	very dirty	1/8	7.9	410	49	7.6	47	0.66	0.53	0.67	0.32	0.73	0.36	0.41	0.36	0.67	0.59
2/14	A&M	dirty	1/32	7.7	365	69	7.6	52	0.65	0.57	0.58	0.43	0.60	0.39	0.49	0.50	0.83	0.75
2/14	A&M	clear	0	7.3	325	69	4.9	37	0.96	0.55	0.97	0.69	0.77	0.61	0.58	0.63	1.09	0.82
2/15	A&M	clear	0	5.9	310	65	3.33	40	0.93	0.46	0.89	0.47	0.96	0.48	0.58	0.47	0.89	0.68
2/18	A&M	clear	0	---	---	55	4.8	37	0.85	0.59	0.89	0.49	0.75	0.46	0.77	0.52	0.76	0.64
2/20	A&M	clear	0	7.8	275	59	2.6	35	0.79	0.72	0.89	0.64	1.22	0.62	0.78	0.61	0.88	0.77
2/21	A&M	clear	0	5.1	295	69	1.9	43	0.79	0.34	0.81	0.38	1.09	0.43	0.75	0.41	0.90	0.59
2/27	A&M	clear	0	---	---	51	2.0	40	0.79	0.59	0.79	0.61	0.90	0.70	0.58	0.64	0.80	0.93
3/01	A&M	clear	0	7.9	455	45	10.0	59	0.81	--	0.78	1.01	0.77	1.00	0.70	1.02	0.85	1.00

Date	Plant	Appearance	Depth of Foam	pH	Alkalinity mg/l	Hardness mg/l	BOD mg/l	TOC ppm	Cd ppm		Cu ppm		Ni ppm		Pb ppm		Zn ppm	
									TOT	EXT	TOT	EXT	TOT	EXT	TOT	EXT	TOT	EXT
3/01	A&M	dirty	1/16	7.9	390	52	1.4	30	0.81	0.41	0.78	0.45	0.87	0.43	0.64	0.45	0.90	0.61
3/05	A&M	dirty	1/32	7.8	420	41	6.3	61	0.63	--	0.64	--	0.82	--	0.58	--	0.56	--
3/05	A&M	dirty	1/32	8.1	450	41	9.4	64	0.78	--	0.66	--	0.82	--	0.58	--	0.62	--
3/05	A&M	dirty	1/32	8.1	410	46	4.0	54	0.89	0.32	0.74	0.36	1.00	0.38	0.77	0.20	0.80	0.45
3/06	A&M	dirty	film	7.2	410	46	7.3	45	0.81	0.24	0.70	0.26	0.82	0.28	0.71	0.12	0.77	0.29
3/07	A&M	dirty	film	7.7	390	36	6.8	54	0.96	0.26	0.91	0.38	0.96	0.42	0.70	0.32	1.84	0.55
3/11	A&M	clear	film	7.6	360	45	2.9	37	0.86	0.34	0.76	0.35	1.05	0.40	0.79	0.26	0.93	0.55
3/11	A&M	clear	film	7.4	360	53	5.3	41	0.77	0.32	0.73	0.38	1.14	0.30	0.71	0.24	0.71	0.40
3/12	A&M	clear	0	7.8	330	--	5.4	40	0.83	--	0.72	--	0.66	--	0.67	--	0.83	--
3/18	A&M	dirty	1/16	8.1	300	54	15.0	48	0.89	0.20	0.84	0.41	0.83	0.51	0.46	0.40	0.84	0.85
3/19	A&M	clear	1/16	7.5	310	39	5.4	65	0.87	0.24	0.83	0.52	1.00	0.53	0.69	0.42	0.87	0.78
3/19	A&M	clear	1/16	7.3	320	51	6.5	45	0.87	0.37	0.83	0.43	0.91	0.43	0.69	0.42	0.87	0.69
3/20	A&M	clear	1/16	8.1	310	39	5.1	36	0.80	0.30	0.78	0.52	0.82	0.49	0.66	0.46	0.80	0.76
3/28	A&M	clear	film	6.3	290	31	2.9	41	0.85	--	0.79	0.43	0.68	0.28	0.61	0.48	0.83	0.46
3/29	A&M	clear	1/16	7.8	300	30	2.5	22	1.0	--	0.74	0.36	0.83	0.51	0.76	0.62	0.84	0.77
4/01	A&M	clear	film	7.2	230	36	2.2	37	0.90	0.24	0.79	0.48	0.81	0.28	0.58	0.37	0.86	0.30
4/02	A&M	dirty	1/32	7.6	290	35	2.2	50	1.73	1.00	1.68	1.44	1.68	1.33	1.39	1.18	1.68	1.30
4/03	A&M	dirty	1/8	7.4	250	40	2.0	37	1.53	0.78	1.64	1.14	1.57	1.14	1.56	0.88	1.61	1.08
4/04	A&M	clear	1/16	7.9	250	40	4.2	51	1.70	0.71	1.75	1.20	1.70	1.06	1.48	0.96	1.81	1.08
4/04	A&M	clear	1/16	8.1	310	39	3.7	53	1.50	0.92	1.57	1.38	1.57	1.26	1.56	1.04	1.47	1.40
4/09	A&M	dirty	1/16	8.3	190	40	7.2	21	0.87	0.70	0.92	1.08	0.83	0.89	0.79	0.65	0.92	1.00
4/10	A&M	dirty	1/16	7.9	200	37	10.3	---	0.80	0.46	0.90	0.32	0.73	0.23	0.79	0.37	0.89	0.39
4/10	A&M	dirty	1/16	8.3	190	40	18.4	33	0.80	0.46	0.81	0.34	0.77	0.27	0.79	0.41	0.89	0.39
4/10	A&M	dirty	1/16	7.4	150	39	5.8	20	--	--	--	--	--	--	--	--	--	--

Date	Plant	Appearance	Depth of Foam	pH	Alkalinity mg/l	Hardness mg/l	BOD mg/l	TOC ppm	Cd ppm TOT	Cd ppm EXT	Cu ppm TOT	Cu ppm EXT	Ni ppm TOT	Ni ppm EXT	Pb ppm TOT	Pb ppm EXT	Zn ppm TOT	Zn ppm EXT
4/16	A&M	clear	1/2	--	---	--	---	---	0.92	0.33	0.87	0.10	0.87	0.12	0.64	0.26	0.82	0.20
4/17	A&M	dirty	1/32	6.7	120	39	6.0	29	0.88	0.48	0.91	0.20	0.81	0.14	0.75	0.43	0.78	0.42
4/17	A&M	dirty	1/32	8.3	195	38	12.4	34	0.79	0.49	0.87	0.19	0.74	0.22	0.69	0.40	0.73	0.46
4/19	A&M	dirty	0	7.9	180	41	15.00	25	0.93	0.47	0.92	0.15	0.97	0.24	0.69	0.44	0.74	0.42
4/23	A&M	cloudy	0	8.3	190	44	7.5	37	1.00	0.46	1.11	0.37	1.00	0.28	0.85	0.46	0.95	0.50
4/24	A&M	clear	0	7.3	170	35	4.4	32	0.87	0.28	0.89	0.22	0.86	0.20	0.61	0.31	0.77	0.22
4/24	A&M	cloudy	film	7.6	230	35	5.0	32	1.07	0.42	1.00	0.37	1.07	0.32	0.79	0.36	0.93	0.44
4/29	A&M	clear	0	7.3	190	40	7.8	30	0.79	0.43	0.81	0.44	0.89	0.50	0.61	0.52	0.73	0.60
5/01	A&M	dirty	film	7.6	190	36	---	24	0.86	0.36	0.96	0.37	1.00	0.44	0.61	0.48	0.73	0.56
5/02	A&M	dirty	1/8	6.3	105	33	5.4	21	1.00	0.44	1.00	0.48	1.07	0.50	0.70	0.44	0.89	0.60
5/06	A&M	clear	film	7.7	200	37	10.5	41	0.40	0.20	0.73	0.19	0.64	0.28	0.57	0.70	0.75	0.40
5/06	A&M	dirty	1/4	7.8	180	35	2.5	23	0.53	0.61	1.04	0.51	0.67	0.67	0.71	0.60	0.98	0.82
5/08	A&M	dirty	1/8	8.2	200	38	13.00	45	0.37	0.26	0.85	0.22	0.69	0.29	0.46	0.44	0.75	0.50
5/08	A&M	very dirty	1/4	7.5	200	36	5.7	20	0.34	0.24	0.88	0.37	0.64	0.44	0.54	0.49	0.85	0.68
5/10	A&M	cloudy	film	7.8	170	33	10.8	46	0.56	0.50	0.78	0.37	0.97	0.42	0.63	0.52	0.76	0.65
5/13	A&M	clear	0	8.0	200	50	4.9	42	0.69	1.02	1.00	0.72	0.82	0.66	0.70	0.67	0.86	0.88
5/13	A&M	dirty	1/8	8.0	205	48	5.7	35	0.69	0.82	0.94	0.52	0.85	0.55	0.54	0.56	0.98	0.76
5/14	A&M	clear	0	7.7	190	45	7.2	42	0.92	1.10	1.03	0.67	0.97	0.66	0.61	0.73	1.02	0.85
5/14	A&M	dirty	1/8	7.8	205	46	6.8	34	0.77	1.00	1.00	0.78	0.91	0.64	0.59	0.65	0.98	0.85
5/15	A&M	clear	0	7.8	200	41	7.6	52	0.86	0.85	1.19	0.54	0.94	0.45	0.70	0.48	1.07	0.72
5/15	A&M	dirty	1/16	7.9	210	42	14.00	38	0.81	1.00	1.13	0.32	0.91	0.31	0.70	0.50	1.00	0.67
5/17	A&M	very dirty	film	7.6	200	39	6.0	30	1.00	--	1.30	--	1.09	--	0.95	--	1.41	--
5/24	A&M	clear	0	7.6	180	53	---	26	0.89	0.06	1.30	0.85	0.82	0.65	0.61	0.77	1.20	0.81
5/27	A&M	clear	0	6.7	160	38	8.5	35	0.96	0.23	1.00	0.69	0.93	0.69	0.61	0.79	1.10	0.86
5/30	A&M	clear	0	8.0	170	49	21.00	27	0.81	0.56	0.95	0.42	0.82	0.42	0.64	0.38	0.94	0.53

Date	Plant	Appearance	Depth of Foam	pH	Alkalinity mg/l	Hardness mg/l	BOD mg/l	TOC ppm	Cd ppm		Cu ppm		Ni ppm		Pb ppm		Zn ppm	
									TOT	EXT	TOT	EXT	TOT	EXT	TOT	EXT	TOT	EXT
5/30	---	---	---	8.5	160	50	2.4	35	0.63	0.36	0.86	0.26	0.82	0.24	0.56	0.57	0.90	0.28
6/04	A&M	clear	0	---	165	48	2.8	38	0.71	0.28	0.56	0.15	0.65	0.18	0.45	0.32	0.82	0.28
6/07	A&M	clear	0	---	175	43	---	32	0.89	0.70	0.88	0.41	1.00	0.39	0.70	0.48	0.91	0.67
6/17	A&M	clear	0	8.0	180	47	4.3	65	0.68	0.54	0.58	0.27	0.21	0.30	0.35	0.55	0.70	0.27
6/17	A&M	clear	0	8.2	180	46	3.3	79	1.00	0.32	0.72	0.13	0.27	0.15	0.46	0.10	1.70	0.10
6/20	A&M	clear	0	7.2	190	39	3.8	45	0.60	0.73	0.75	0.30	0.53	0.32	0.46	0.36	0.85	0.43
6/22	A&M	clear	0	7.9	185	38	---	33	0.60	0.84	0.79	0.38	0.21	0.34	0.42	0.42	0.78	0.61
6/27	A&M	clear	0	7.8	185	51	2.5	38	0.51	0.64	0.40	0.58	0.79	0.57	0.59	0.63	0.66	0.75
6/27	A&M	dirty	1/32	7.0	125	51	1.1	42	0.69	0.58	0.39	0.31	0.81	0.32	0.85	0.36	0.73	0.48
6/28	A&M	clear	0	7.8	175	46	1.8	39	0.66	0.58	0.44	0.46	0.89	0.53	0.76	0.49	0.70	0.65
7/01	A&M	clear	0	7.2	185	43	4.0	46	0.86	--	0.86	--	0.91	--	1.00	--	0.63	--
7/02	A&M	clear	0	8.0	185	41	3.5	18	0.67	0.37	0.48	0.27	0.55	0.34	1.00	0.42	0.54	0.60
7/11	A&M	cloudy	0	7.7	185	37	1.4	31	0.62	0.43	0.55	0.41	0.94	0.39	0.77	0.50	0.87	0.56
7/11	A&M	cloudy	0	7.8	170	35	1.7	34	0.62	0.43	0.60	0.41	0.94	0.36	1.00	0.53	0.91	0.53
7/12	A&M	cloudy	0	7.5	180	36	---	17	0.38	0.36	0.64	0.28	0.31	0.16	0.58	0.46	0.74	0.54
7/12	A&M	cloudy	0	8.1	170	35	---	23	0.58	0.43	0.77	0.40	0.69	0.44	0.71	0.65	1.00	0.72
7/16	A&M	cloudy	0	7.9	345	37	---	22	0.61	0.58	0.63	0.44	0.61	0.39	0.61	0.43	0.76	0.87
7/22	A&M	cloudy	0	8.2	215	--	6.6	18	0.79	--	0.75	--	0.65	--	1.60	--	1.20	--
7/23	A&M	cloudy	0	6.9	145	35	4.5	29	0.66	0.71	0.81	0.67	0.68	0.51	1.30	0.61	0.98	0.75
7/24	A&M	cloudy	0	7.4	165	31	3.9	1	0.55	0.71	0.69	0.47	0.65	0.40	1.00	0.59	0.80	0.68
7/24	---	---	---	6.9	165	35	2.0	33	0.58	0.69	0.75	0.49	0.65	0.40	1.10	0.48	0.80	0.61
7/25	A&M	cloudy	0	8.0	365	36	3.5	20	0.58	0.56	0.70	0.41	0.61	0.38	0.67	0.57	0.76	0.87
7/25	A&M	cloudy	0	7.3	285	36	1.0	19	0.71	0.70	0.68	0.77	0.82	0.62	0.76	0.98	1.10	0.98
7/26	A&M	cloudy	0	8.2	430	--	---	17	0.55	0.53	0.53	0.56	0.63	0.56	0.58	0.49	0.61	0.96
7/26	A&M	cloudy	0	7.1	295	34	---	34	0.82	0.59	0.58	0.53	0.79	0.52	0.64	0.56	0.55	0.94

Date	Plant	Appear-ance	Depth of Foam	pH	Alka-linity mg/l		BOD mg/l	TOC ppm	Cd ppm		Cu ppm		Ni ppm		Pb ppm		Zn ppm	
									TOT	EXT	TOT	EXT	TOT	EXT	TOT	EXT	TOT	EXT
8/06	A&M	cloudy	0	8.5	335	33	18.0	28	0.56	0.10	0.63	0.45	0.72	0.46	0.74	0.79	0.62	0.84
8/06	A&M	cloudy	0	7.9	315	33	1.0	22	0.53	0.30	0.63	0.33	0.59	0.34	0.42	0.70	0.58	0.75
8/07	A&M	cloudy	0	7.9	315	31	9.7	23	0.66	0.63	0.78	0.39	0.56	0.32	0.71	0.88	0.67	0.75
8/07	A&M	cloudy	0	7.9	340	33	5.0	16	0.66	0.70	0.88	0.56	0.63	0.50	0.66	0.94	0.69	0.86
8/08	A&M	dirty	1/8	7.9	265	41	5.7	22	0.63	0.65	0.63	0.24	0.66	0.26	0.58	0.76	0.56	0.70
8/08	A&M	dirty	1/16	7.7	255	39	18.00	13	0.50	0.32	0.47	0.06	0.44	0.08	0.32	0.36	0.44	0.26
8/09	A&M	cloudy	0	7.2	280	55	---	25	0.64	0.41	0.77	0.21	0.59	0.211	0.66	0.33	0.91	0.42
8/12	A&M	cloudy	0	8.0	310	48	13.0	31	0.57	0.36	0.83	0.21	0.68	0.21	0.72	0.33	0.94	0.37
8/12	A&M	cloudy	0	8.5	310	43	---	17	0.57	0.41	0.73	0.19	0.65	0.19	0.60	0.47	0.88	0.37
8/13	A&M	cloudy	0	8.5	340	54	4.0	13	0.71	0.30	0.80	0.17	0.65	0.17	0.63	0.26	1.10	0.27
8/13	A&M	cloudy	0	7.8	325	37	4.6	32	0.68	1.20	0.71	0.74	0.71	0.67	0.61	0.67	0.78	0.92
8/14	A&M	cloudy	0	7.7	315	34	13.0	32	0.62	1.0	0.71	0.46	0.71	0.41	0.55	0.62	0.71	0.78
8/28	A&M	clear	0	7.9	295	39	50.0	82	0.62	0.43	0.82	0.14	0.85	0.14	0.37	0.17	0.65	0.27
8/29	A&M	very dirty	1/8	8.0	250	34	16.0	196	0.16	0.23	0.31	0.07	0.23	0.05	0.13	0.08	0.21	0.29
8/30	A&M	cloudy	0	7.4	190	72	8.3	20	0.44	0.47	0.43	0.30	0.58	0.32	0.41	0.44	0.45	0.62
9/06	A&M	dirty	1/8	7.4	340	36	---	8	0.63	0.50	0.68	0.30	0.70	0.30	0.65	0.40	0.80	0.70
9/09	A&M	dirty	1/8	8.4	305	38	4.0	13	0.59	0.55	0.65	0.30	0.70	0.30	0.70	0.45	0.73	0.70
9/10	A&M	very dirty	1/16	9.6	326	37	17.0	7	0.50	0.55	0.63	0.25	0.58	0.25	0.37	0.45	0.60	0.65
9/11	A&M	cloudy	film	8.3	350	41	10.0	1	0.56	0.30	0.68	0.15	0.65	0.15	0.62	0.40	0.65	0.40
9/11	A&M	cloudy	film	---	---	--	---	--	0.53	0.27	0.65	0.10	0.61	0.10	0.58	0.35	0.63	0.35
9/16	A&M	cloudy	film	8.3	325	46	6.7	28	0.57	0.77	0.63	0.40	0.40	0.45	0.42	0.37	0.75	0.84
9/19	A&M	cloudy	film	8.7	340	39	---	3	0.42	0.73	0.58	0.12	0.30	0.10	0.33	0.26	0.62	0.47
9/19	A&M	cloudy	film	--	---	41	---	3	0.87	0.88	0.58	0.18	0.45	0.23	0.32	0.23	1.20	0.63
9/25	A&M	cloudy	film	6.9	320	42	---	66	0.56	0.68	0.39	0.22	0.35	0.30	0.36	0.47	0.62	0.63

Date	Plant	Appearance	Depth of Foam	pH	Alkalinity mg/l	Hardness mg/l	BOD mg/l	TOC ppm	Cd ppm		Cu ppm		Ni ppm		Pb ppm		Zn ppm	
									TOT	EXT	TOT	EXT	TOT	EXT	TOT	EXT	TOT	EXT
9/26	A&M	cloudy	0	7.9	315	41	6.9	22	0.60	0.63	0.36	0.20	0.30	0.27	0.40	0.57	0.62	0.57
9/30	A&M	clear	0	---	213	--	---	41	0.51	0.73	0.33	0.17	0.30	0.17	0.70	0.62	0.62	0.52
10/14	A&M	clear	0	8.2	348	19	5.9	64	1.20	0.63	1.10	1.05	1.00	1.05	0.87	1.02	1.00	0.89
10/16	A&M	clear	0	8.4	350	20	8.0	27	0.91	0.68	0.75	0.21	0.91	0.24	0.10	0.74	0.84	0.70
10/17	A&M	cloudy	film	8.4	370	21	43.0	40	0.83	1.00	0.75	0.79	0.91	0.80	0.56	0.63	0.91	0.91
10/17	A&M	cloudy	film	8.4	348	19	5.9	64	0.91	1.00	0.80	0.72	0.91	0.70	0.90	0.78	0.91	0.87
10/18	A&M	cloudy	film	7.8	330	25	---	31	0.86	0.74	0.60	0.31	0.91	0.20	0.71	0.78	0.75	0.84
10/18	A&M	cloudy	film	8.4	380	20	---	20	1.00	0.72	0.85	0.10	0.88	0.10	0.90	0.78	0.91	0.75
10/24	A&M	cloudy	film	8.1	322	19	---	50	0.92	0.41	0.93	0.65	0.82	0.83	0.83	0.92	1.00	0.50
10/24	A&M	cloudy	film	8.1	364	20	---	69	0.53	0.39	0.51	1.00	0.87	0.66	0.27	0.56	0.50	0.60
10/25	B	very dirty	0	8.2	325	19	---	47	0.89	0.76	0.89	0.75	1.00	0.83	1.00	1.10	1.20	1.00
10/27	B	very dirty	1/4	8.0	408	26	2.5	61	0.89	0.76	0.89	0.75	0.97	0.66	0.97	0.92	1.10	1.20
10/27	B	clear	0	8.3	340	16	1.3	--	0.71	0.40	0.72	0.80	0.92	0.83	0.63	0.89	0.83	0.70
10/27	A&M	clean	0	8.3	330	27	4.3	63	1.00	1.00	1.00	0.85	1.00	1.00	0.94	0.88	1.20	1.60

Appendix C. Sewage application schedule to both the lysimeters and the field plots of all soils studied.

date	SM d/μ		Basic CL		Acid CL	SC
	Field	Lys	Field	Lys	Lys	Lys
11/05	X					
11/11		X	X	X	X	X
11/16		X	X	X	X	X
11/19		X	X	X	X	X
11/27			X	X		
11/27			X			X
11/27		X			X	
11/28	X					
12/05		XX			XX	
12/09		X	X	X	X	X
12/12		X	X		X	X
12/13	X					
12/14		X	X	X	X	X
12/17		X	X	X	X	X
12/24		X	X	X	X	X
12/26		X	X	X	X	X
12/26	X					
12/27		X	X	X	X	X
12/31		X	X	X	X	X
12/31	X					
1/02		X	X	X	X	
1/04		X	X	X	X	X
1/07		X	X	X	X	X
1/07	X					
1/09		X	X	X	X	X
1/12		X	X	X	X	X
1/14	X					
1/14		X	X		X	X
1/14			X	X		
1/21	X					
1/30	X	X	X	X	X	X
1/31		X	X		X	X
2/01		X	X		X	X
2/01			X	X		
2/02			X	X		
2/02	X					
2/04		X	X	X	X	X

date	SM d/μ		Basic		Acid	SC
			CL		CL	
	Field	Lys	Field	Lys	Lys	Lys
2/06		X	X		X	X
2/07			X	X		
2/07		X	X		X	X
2/08	X					
2/14		X	X		X	X
2/14			X	X		
2/15	X					
2/18		X	X		X	X
2/20	X					
2/21			X	X		
2/27			X	X		
3/01		X	X		X	X
3/01		X	X		X	X
3/05		X	X		X	X
3/05		X	X		X	X
3/05	X					
3/06			X	X		
3/07	X					
3/11	X					
3/11		X	X		X	X
3/12			X	X		
3/18		X	X		X	X
3/19	X					
3/19		X	X		X	X
3/20		X	X		X	X
3/28	X					
3/29			X	X		
4/01	X					
4/02			X	X		
4/03		X	X		X	X
4/04		X	X		X	X
4/04		X	X		X	X
4/09		X	X		X	X
4/10			X	X		
4/10	X					
4/10		X	X		X	X

date	SM d/μ		Basic CL		Acid CL	SC
	Field	Lys	Field	Lys	Lys	Lys
4/16		1/2X	1/2X			
4/17		X	X		X	
4/17			X	X		
4/19		X	X		X	X
4/23	X					
4/24		X	X		X	X
4/24			X	X		
4/29			X	X		
5/01		X	X		X	X
5/02	X					
5/06	X					
5/06			X	X		
5/08		X	X		X	X
5/08	X					
5/10		X	X			
5/13		X	X			
5/13		X	X			
5/14			X	X		
5/14		X	X		X	X
5/15		X	X		X	X
5/15		X	X		X	X
5/17		X	X			
5/24			X	X		
5/27		X	X		X	X
5/30		X	X		X	X
5/30			X	X		
6/04		X	X		X	X
6/07			X	X		
6/17		X	X		X	X
6/17			X	X		
6/20		X	X		X	X
6/22		X	X		X	X
6/27		X	X		X	X
6/27			X	X		
6/28			X	X		

date	SM d/μ		Basic CL		Acid CL	SC
	Field	Lys	Field	Lys	Lys	Lys
7/01		X	X			
7/02		X	X		X	X
7/11		X	X		X	X
7/11		X	X		X	X
7/12		X	X		X	X
7/12			X	X		
7/16			X	X		
7/22		X	X		X	X
7/23			X	X		
7/24		X	X		X	X
7/24						
7/25		X	X			
7/25		X	XX	X		
7/26		X	XX	X	X	X
7/26						
8/06			XX	XX		
8/06						
8/07		X	XX	X	X	X
8/07						
8/08		X	X		X	X
8/08		X	X		X	X
8/09		X	X			
8/12		XX	XX		XX	XX
8/12						
8/13		XX	XX		X	X
8/13						
8/14			X		X	
8/28			X		X	
8/29		X	X		X	X
8/30		X	X		X	X
9/06			X	X		
9/09		X	X		X	X
9/10		X	X			
9/11			X	X		
9/11		X	X		X	X

date	SM d/μ		Basic CS		Acid CS	SC
	Field	Lys	Field	Lys	Lys	Lys
9/16		X	X		X	X
9/19		XX	XX		X	X
9/19						
9/25		X	X		X	X
9/26			X	X		
9/30		X	X		X	X
10/14			X	X		
10/16		X	X		X	X
10/17		X	XX	X	X	X
10/17						
10/18		XX	XX		X	X
10/18						
10/24		X	X			
10/24		X	X		X	X
10/25			X	X		
10/27		X	X		X	X
10/27			X	X		
10/27		X	X		X	X

Appendix D

The weekly cumulative water outflow for individual lysimeters of all 4 soils studied

Table D-1. The weekly cumulative water outflow for individual lysimeters of the acid CL soil

			Lysimeter Number			
Week	1	2	3	4	5	Average
1	.112	.148	.150	.183	.154	.149
2.	.405	.635	.666	.823	.798	.6654
3	.149	.266	.370	.696	.447	.3856
4	.488	.610	.777	1.223	.711	.7618
5	.624	1.160	1.114	1.023	.798	.9438
6	.514	.917	.983	1.059	.937	.882
7	.710	.831	.998	.997	1.025	.9122
8	1.487	2.136	2.224	2.348	2.326	2.1042
9	1.646	2.460	2.497	2.826	2.904	2.4666
10	.985	1.612	1.686	2.170	2.176	1.7258
11	.857	1.268	1.460	1.754	2.021	1.472
12	.804	1.246	1.436	1.749	2.268	1.5006
13	.809	1.118	1.430	1.721	2.053	1.4262
14	.724	1.055	1.513	1.755	1.875	1.3844
15	.613	1.010	1.471	1.656	1.792	1.3084
16	.651	1.029	1.518	1.782	1.649	1.3258
17	.589	.920	1.418	1.751	1.622	1.260
18	.953	.879	1.385	1.662	1.546	1.285
19	.474	.686	1.124	1.344	1.199	.9654
20	.481	.748	1.329	1.307	1.236	1.0202
21	.694	1.167	2.131	1.624	1.920	1.5072
22	.450	.762	1.150	.448	1.219	.8058
23	.558	1.030	.770	.208	1.236	.7604
24	.450	.781	.356	.108	.653	.4696
25	.346	.595	.382	.075	.593	.3982
26	.529	.874	.285	.052	.244	.3968
27	.481	.796	.352	.355	.101	.417

Week	Lysimeter Number 1	2	3	4	5	Average
28	.571	.086	.176	0	.042	.175
29	.556	.913	.312	0	0	.35
30	.393	.953	.085	0	0	.29
31	.504	.837	0	0	0	.27
32	.858	.948	0	0	0	.36
33	.226	.322	0	0	0	.11
34	.437	.721	0	0	0	.23
35	.565	.608	0	0	0	.24
36	.517	.263	0	0	0	.15
37	.212	.136	0	0	0	.07
38	.194	.059	0	0	0	.05
39	.038	.408	0	0	0	.09
40	.295	.769	.223	.139	.442	.38
41	.054	.791	.105	0	.042	.2
42	0	.223	0	0	0	.05
43	0	.256	0	.397	0	.12
44	0	.794	.544	.947	0	.46
45	.031	.674	.384	1.262	0	.47
46	0	.197	.101	.631	0	.18
47	0	.157	.025	.795	0	.20
48	0	0	0	.082	0	.01
49	0	.117	0	.568	0	.14

Table D-2. The weekly cumulative water outflow for individual lysimeters of the SM(d/u) soil.

	Lysimeter Number					
Week	6	7	8	9	10	Average
1	.210	.415	,089	.094	.184	.1984
2	.567	.629	.474	.661	.453	.5568
3	.195	.139	.080	.276	.202	.1784
4	.634	.778	.481	.222	.213	.4656
5	1.356	1.471	.954	.986	.601	1.0736
6	1.184	1.528	1.200	1.207	.586	1.141
7	1.325	1.908	1.879	2.001	1.586	1.7398
8	2.550	3.732	3.486	4.208	3.614	3.518
9	3.302	5.625	4.685	6.205	5.302	5.0238
10	2.541	3.845	3.057	4.150	3.121	3.3428
11	2.433	3.513	2.567	3.664	2.669	2.9692
12	2.609	4.409	2.713	4.559	2.778	3.4136
13	2.404	3.923	2.523	4.153	2.987	3.198
14	2.350	3.231	2.500	3.848	2.912	2.9682
15	2.242	2.526	2.120	2.407	2.541	2.5672
16	2.340	2.266	2.119	3.348	2.408	2.4962
17	2.046	1.857	1.803	2.668	1.083	1.8914
18	1.861	1.557	1.800	2.490	1.904	1.9224
19	1.426	1.085	1.257	1.792	1.342	1.3816
20	1.604	1.262	1.407	2.019	1.469	1.5522
21	2.346	1.909	1.982	2.441	2.245	2.1846
22	1.765	1.449	1.651	2.193	1.777	1.767
23	1.590	1.186	1.376	1.697	1.549	1.4796
24	1.562	1.143	1.431	1.728	1.582	1.4892
25	0.754	0.518	0.471	0.659	0.687	0.6178
26	1.524	2.003	1.381	1.578	1.500	1.5962
27	1,432	1,220	1,296	1.879	1,526	1.4706

	Lysimeter Number					
Week	6	7	8	9	10	Average
28	1.242	1.243	1.268	1.650	1.425	1.3656
29	1.101	1.151	1.049	1.245	2.849	1.14
30	0.89	1.053	0.909	1.195	1.012	1.01
31	0.894	0.949	0.766	1.419	0.895	0.99
32	0.455	0.738	0.762	1.512	0.93	0.87
33	0.143	0.312	0.359	0.631	0.383	0.37
34	0.328	0.693	0.773	1.423	0.908	0.82
35	0.093	0.735	0.909	1.421	1.044	0.85
36	0.25	0.536	0.787	1.079	0.948	0.68
37	0	0.61	0.257	0.564	0.681	0.42
38	0	0.523	0.342	0.535	0.885	0.46
39	0	0.835	0.617	0.79	0.973	0.64
40	0.635	0.597	0.585	0.757	0.755	0.66
41	0.743	0.584	0.261	0.836	0.94	0.69
42	0.209	0.516	0.103	1.066	0.987	0.58
43	0.642	0.725	1.057	0.834	1.116	0.91
44	0.362	0.371	0.597	0.576	0.668	0.51
45	0.612	0.580	0.985	0.823	1.076	0.82
46	0.305	0.325	0.631	0.512	0.631	0.48
47	0.657	0.439	0.993	0.037	0.992	0.60
48	0.302	0.253	0.529	0	0	0.22
49	0.372	0.393	0.755	0.395	0.999	0.61

Table D-3. The weekly cumulative water outflow for individual lysimeters of the basic CL soil.

	Lysimeter Number					
Week	11	12	13	14	15	Average
1	0.447	0.369	0.331	0.471	0.556	0.4348
2	1.209	1.114	1.131	1.297	1.655	1.2812
3	0.555	0.779	0.432	0.795	1.050	0.7222
4	0.762	1.055	1.174	0.851	1.197	0.9978
5	1.135	1.210	1.294	1.042	1.111	1.1584
6	0.875	0.931	1.183	0.843	1.073	0.981
7	0.993	0.935	1.130	0.948	1.548	1.1108
8	2.771	2.038	2.942	2.456	3.549	2.7512
9	3.565	2.805	2.828	2.753	4.494	3.289
10	2.071	2.140	1.901	2.044	3.330	2.2972
11	1.886	1.700	1.468	1.669	2.317	1.808
12	2.176	2.024	1.791	2.003	1.939	1.9876
13	1.831	1.843	1.868	1.887	1.295	1.7448
14	1.719	1.708	1.895	1.852	0.995	1.6338
15	1.571	1.666	1.692	1.740	3.324	1.9986
16	1.266	1.200	1.635	1.622	1.089	1.3624
17	1.083	1.191	1.053	0.617	1.437	1.3512
18	1.299	1.359	0.365	1.291	1.678	1.1984
19	0.924	0.827	0.563	0.971	0.615	0.980
20	1.074	1.396	1.006	1.168	0.779	1.0846
21	1.594	2.028	2.081	1.809	1.383	1.779
22	1.253	0.879	1.618	0.951	0.550	1.0502
23	1.196	1.136	1.460	0.545	0.328	0.933
24	1.305	1.672	1.420	0.388	0.178	0.9926
25	0.609	0.782	0.404	0.274	0.102	0.4342
26	1.279	1.413	1.511	0.250	0.840	0.9074
27	1.526	1.135	1.642	0.133	0.660	0.9004

	Lysimeter Number					
Week	11	12	13	14	15	Average
28	1.283	0.335	0.521	0.910	0.130	0.472
29	1.202	0.102	0.030	0.061	1.095	0.500
30	0.855	0.389	1.386	0.026	0.177	0.510
31	0.941	0.571	1.304	0.183	0.072	0.62
32	0.790	1.248	1.379	0.223	0.073	0.74
33	0.045	0.234	0.386	0	0.332	0.20
34	0.686	0.804	1.255	0	0.971	0.74
35	0.771	0.334	1.218	0.026	0.173	0.51
36	0.688	0.189	0.189	0	0	0.33
37	0.308	0	0.417	0	0	0.14
38	0.12	0.051	0.172	0	0	0.27
39	0.967	0.789	0.068	0	0.13	0.39
40	0.858	0.652	0	0	0.271	0.36
41	0.843	0.906	1.262	0	0.089	0.62
42	0.751	1.165	1.343	0.059	0.130	0.69
43	0.450	0.070	0.896	0.059	0.105	0.43
44	0.031	0.677	0.277	0.945	0.879	0.57
45	0.156	0.846	0.068	1.040	0.607	0.54
46	0	0.498	0	0.631	0	0.22
47	0	0.507	0	0.873	0	0.28
48	0.208	0.269	0.139	0.510	0	0.23
49	0.631	0.555	0.733	0.829	0	0.55

Table D-4. The weekly cumulative water outflow for individual lysimeters of the SC soil.

	Lysimeter Number					
Week	16	17	18	19	20	Average
1	0.040	0.124	0.516	0.235	0.179	0.2188
2	0.438	0.758	0.876	0.478	1.067	0.7234
3	0.319	0.644	0.838	0.469	0.495	0.553
4	0.508	0.802	0.997	0.603	0.593	0.7006
5	0.611	0.542	1.180	0.724	0.875	0.7864
6	0.585	0.530	0.745	0.774	0.832	0.6932
7	0.703	0.739	1.083	0.958	0.711	0.8388
8	1.593	1.306	2.568	1.790	1.459	1.7432
9	1.432	1.519	2.390	2.054	2.110	1.901
10	0.192	1.017	1.113	1.125	1.198	0.929
11	0.744	0.824	0.541	1.011	0.462	0.7164
12	1.041	0.958	1.014	1.321	1.475	1.1618
13	0.997	0.462	1.023	1.533	1.244	1.0518
14	0.897	0.189	1.015	1.434	1.231	0.9532
15	0.681	0.871	1.218	0.914	0.737	0.8842
16	0.814	0.801	1.959	1.723	1.384	1.3362
17	0.465	0.689	0.960	1.292	1.017	0.8846
18	0.355	0.435	0.614	0.585	0.633	0.5244
19	0.166	0.178	0.282	0.234	0.654	0.3028
20	0.208	0.220	0.296	0.172	0.306	0.2404
21	0.380	0.551	0.766	0.696	0.707	0.6200
22	0.211	0.251	0.575	0.494	0.541	0.4144
23	0.214	0.216	0.397	0.487	0.564	0.3756
24	0.133	0.130	0.251	0.340	0.432	0.2572
25	0.088	0.096	0.103	0.024	0	0.0622
26	0.480	0.500	0.194	0.215	0.302	0.1618

	Lysimeter Number					
Week	16	17	18	19	20	Average
27	0.560	0.480	0.32	0.194	0.419	0.1498
28	0.013	0	0	0.413	0	0.1032
29	0.265	0.119	0.193	0.278	0.173	0.20
30	0.053	0.631	0.143	0.232	0.173	0.250
31	0.085	0.221	0	0.102	0.051	0.090
32	0	0.735	0	0.025	0.064	0.170
33	0.28	0.045	0	0.28	0.026	0.07
34	0.074	0.05	0	0.043	0	0.04
35	0.24	0.207	0	0	0	0.09
36	0.121	0.062	0	0	0	0.03
37	0.100	0.202	0	0	0	0.06
38	0.101	0.103	0	0	0	0.04
39	0.089	0.216	0	0	0	0.06
40	0.253	0.07	0	0.332	0.232	0.18
41	0.085	0	0	0	0	0.02
42	0.145	0	0	0.052	0.134	0.07
43	0.024	0	0	0.032	0.309	0.07
44	0	0	0	0.107	0.243	0.07
45	0	0	0	0.185	0	0.04
46	0	0	0	0.086	0.189	0
47	0	0	0	0.52	0.366	0.08
48	0	0	0	0.050	0.253	0.06
49	0	0	0	0	0	0

Appendix E

Meteorological data for the 12 months of this experiment

Table E-1. METEOROLOGICAL DATA October, 1973

	Temp. C°			Rel. Hum. %			cm.	cal/cm^2	Km/day
DAY	MAX	MIN	MEAN	6AM	6PM	MEAN	PRECIP.	SOL. RAD.	WIND MOVEMENT
1	29.4	20.0	24.4	96	74	85		308	55
2	31.1	19.4	25	96	72	84		260	47
3	31.7	20.5	26.1	96	69	82		282	163
4	29.4	18.8	23 8	95	79	87	4.4	217	52
5	28.3	18.8	23.3	95	90	92	1.8	291	113
6	27.8	20.5	23.8	96	92	94	.5	260	45
7	30	20	25	96	74	85		360	114
8	30.6	19.4	25	98	79	88		321	50
9	31.1	19.4	25	97	75	88		373	269
10	30.6	23.3	26.6	96	91	93		273	195
11	24.4	17.7	21.1	95	94	94	6.9	48	330
12	25.5	17.2	21.1	96	86	91		213	159
13	21.1	16.6	18.8	95	94	94	6.4	139	148
14	19.4	18.3	18.8	96	96	96	.8	113	63
15	21.6	18.8	20	96	98	97		48	155
16	22.2	17.2	19.4	97	96	96		191	6
17	22.2	11.1	16.6	87	72	79	3.0	334	175
18		8.3						347	147
19								334	2
20								338	3
21								351	21
22	28.8	13.8	21.1		70			325	42
23	28.3	10	18.8	97	66	81		247	2
24	27.7	11.1	19.4	96	84	90		221	37
25	28.8	17.7	23.3	96	86	91		243	109
26	28.3	18.3	23.3	94	70	82		247	13
27	27.7	16.1	21.6	96	92	94	.8	217	187
28	22.2	10.5	16.1	97	70	83		295	190
29	22.2	12.2	17.2	97	86	91		304	23
30	21.6	11.6	16.6	96	96	96	2.2	61	140
31	20.5	9.4	15	91	88	89	.5	325	134
Total							27.3		
Average	26.3	16.3	21.3	96	83	89		254	102

Table E-2. METEOROLOGICAL DATA November, 1973

	Temp. C°			Rel. Hum. %			cm.	cal/cm^2	Km/day
DAY	*MAX*	*MIN*	*MEAN*	*6AM*	*6PM*	*MEAN*	*PRECIP.*	*SOL. RAD.*	WIND MOVEMENT
1	25.5	7.2	16.1	97	89	93		295	72
2	29.4	14.4	21.6	96	89	92		265	290
3	23.8	16.1	20	92	94	93		113	161
4	30	20.5	25	96	95	95		191	119
5	22.2	13.3	17.7	95	92	93		87	161
6	15	13.8	13.3	94	92	96		61	113
7	25.5	15	20	97	94	95	.1	121	187
8	28.8	24.4	26.6	96	90	93		295	52
9	24.4	10.5	17.2	90	89	89		160	163
10	17.7	8.3	12.7	86	75	80		243	270
11	20	6.1	12.7	89	89	89		295	48
12	25.5	8.3	16.6	98	85	91		230	118
13	27.7	15	22.2	98	80	89		247	159
14	28.8	18.8	23.8	97	76	86		252	206
15	27.2	10	18.3	94	60	77		256	275
16	23.3	6.1	14.4	98	62	80		291	108
17	26.6	7.7	17.2	99	81	90		260	8
18	35	18.3	26.6	98	76	87		239	356
19	28.3	21.1	24.4	97	83	90		195	155
20	23.3	7.7	15.5	96	82	89	1.9	182	370
21	23.3	5.5	14.4	94	81	87		286	113
22	27.7	13.8	20.5	96	88	92		200	79
23	27.2	21.6	24.4	94	92	93	1.0	178	42
24	27.2	12.7	20	93	95	94	1.0	204	475
25	22.7	10	16.1	96	81	88		221	287
26	23.3	16.1	19.4	97	95	96	1.3	139	121
27	21.1	9.4	15	96	55	75		187	190
28	14.4	3.8	8.8	84	73	78		252	126
29	20.5	2.2	11.1	97	60	78		291	61
30	21.1	3.8	12.2	96	81	88		269	58
31									
Total							5.3		
Average	24.6	12.1	18.1	95	83	89		217	165

Table E-3 METEOROLOGICAL DATA December, 1973

	Temp. C°			Rel. Hum. %			cm.	cal/cm^2	Km/day
DAY	MAX	MIN	MEAN	6AM	6PM	MEAN	PRECIP.	SOL. RAD.	WIND MOVEMENT
1	22.2	13.3	17.7	96	81	88		299	74
2	23.8	9.4	16.6	97	78	87		221	140
3							.6	182	203
4								204	164
5								308	224
6								213	1586
7								200	8
8								213	172
9								121	16
10	13.3	2.2	7.7		64			208	48
11	20.5	1.6	11.1	92	83	87		217	101
12	25	10.5	17.7	93	70	81		204	332
13	19.4	5	12.2	90	60	75		200	169
14	22.2	3.8	13.3	90	89	89		208	42
15	12.7	1.6	7.2	83	68	75		187	272
16								243	34
17								160	166
18	23.3	8.3	15.5						89
19	17.2	-1.1	7.7	89	74	81	2.2	61	517
20	5	-3.3	.5	76	62	69		156	327
21	12.2	-5	3.3	96	54	75		243	163
22	20	-.5	9.4	100	74	87		226	163
23	20.5	9.4	15	99	92	95	2.9	134	211
24								217	214
25									8
26	18.8	4.4	11.6		70			178	187
27	13.8	1.1	7.2	97		90		213	56
28	22.7	5	13.8	99	81	90		208	105
29	18.3	6.1	12.2	97	82	89		187	248
30	23.8	3.8	13.8	99	85	92		132	161
31	6.6	-1.1	2.7		73			104	242
Total							5.7		
Average	18	3.7	10.8	93	74	84		195	208

Table E-4 METEOROLOGICAL DATA January, 1974

	Temp. C°			Rel. Hum. %			cm.	cal/cm^2	Km/day
DAY	MAX	MIN	MEAN	6AM	6PM	MEAN	PRECIP.	SOL. RAD.	WIND MOVEMENT
1	4.4	-5.5	-.5	86	71	78			441
2	4.4	.5	2.2	86	98	92			155
3	.5	-2.7	-1.1	95	79	87			193
4	2.7	-1.6	.5	71	63	67			364
5	7.2	2.2	4.4	93	99	96			76
6	17.2	6.1	11.6	98	78	88			42
7							.2		45
8	15.5	4.4	10	97	99	98	.1	87	118
9	21.1	2.7	11.6	91	96	93	.1	39	164
10	3.3	1.1	23	97	97	97		48	159
11	4.4	-1.1	1.6	96	89	92	.3	113	203
12	5	-2.2	1.1	72	91	81		95	222
13	5	-1.1	1.6	94	96	95	.1	43	180
14	16.6	5	10.5	99	97	98	.3	143	21
15	13.8	11.1	12.2	98	96	97		87	108
16	20	10.5	15	97	91	94		178	55
17	24.4	13.8	18.8	96	89	92		213	74
18	23.8	14.4	19.4	93	75	89	1.8	160	295
19	14.4	6.6	10.5	96	88	92		48	274
20	21.1	3.8	12.2	98	76	87		253	50
21	22.7	3.3	12.7	98	80	89		256	113
22	21.6	10	15.5	95	76	85	1.6	95	214
23	10	4.4	7.2	95	96	95	1.9	52	219
24	6.6	4.4	5.5	94	90	92	2.0	39	237
25	8.8	4.4	6.6	97	96	96	1.4	91	285
26	18.8	7.7	13.3	96	64	80	.8	260	47
27	20	8.8	14.4	98	95	96		87	155
28	15.5	6.1	10.5	79	73	76	.1	267	161
29	18.8	.5	9.4	98	62	80		226	109
30	21.6	2.2	11.6	97	52	74		291	2
31	23.8	4.4	13.8	96	64	80		286	79
Total							10.7		
Average	13.8	4.1	8.8	93	84	89		144	162

Table E-5 METEOROLOGICAL DATA February, 1974

	Temp. C°			Rel. Hum. %			cm.	cal/cm^2	Km/day
DAY	MAX	MIN	MEAN	6AM	6PM	MEAN	PRECIP.	SOL. RAD.	WIND MOVEMENT
1	24.4	11.6	17.7	95	71	83		213	79
2	26.1	11.6	18.8	88	67	77		263	274
3	17.2	4.4	10.5	83	51	67		343	159
4	18.8	.5	9.4	94	58	76		325	208
5	20	4.4	12.2	94	86	90		147	106
6	18.3	4.4	11.1	94	68	81	.1	108	328
7	6.6	-.5	2.7	77	71	74		121	280
8	8.3	-3.3	2.2	85	55	70		260	245
9	15.5	-3.3	6.1	85	51	63		278	188
10	20	-2.2	8.8	95	54	74		269	129
11	22.2	0	11.1	96	59	77		299	109
12	24.4	6.1	15	96	64	80		308	8
13	25.5	14.4	20.5	94	74	84		273	403
14	21.1	16.1	18.3	94	81	87		87	272
15	21.1	7.7	14.4	96	59	77		226	169
16	18.3	3.8	11.1	96	70	83		334	45
17	20.5	0	10	98	70	84		334	113
18	24.4	12.7	18.3	95	46	70		130	275
19	21.6	5.5	13.3	79	52	65		325	156
20	25	9.4	17.2	95	72	83		343	153
21	21.6	4.4	12.7	44	72	73	.8	91	522
22	15	1.6	8.3	75	53	64		269	76
23	22.2	0	11.1	83	60	71		291	201
24	12.2	-2.2	5	75	59	67		338	531
25				80				421	206
26	13.3	-4.4	4.4	54	96	75		304	109
27	18.8	6.6	12.7	53	89	71		221	118
28	22.2	12.2	17.2	72	96	84		291	402
Total							.9		
Average	19.4	4.5	11.9	88	67	76		258	209

Table E-6 METEOROLOGICAL DATA March 1974

	Temp. C°			Rel. Hum. %			cm.	cal/cm^2	Km/day
DAY	MAX	MIN	MEAN	6AM	6PM	MEAN	PRECIP.	SOL. RAD.	WIND MOVEMENT
1	26.6	11.7	18.8	63	95	79		260	322
2	25.5	15.5	26.1	71	88	79		325	369
3	27.7	17.7	22.7	70	93	81		347	549
4	28.3	18.8	24.3	73	72	72		265	398
5	27.7	19.4	24.3	93	68	80		234	76
6	27.2	18.8	22.7	92	67	79		278	317
7								278	209
8								243	385
9								200	246
10								221	312
11					66		trace	325	275
12	24.4	16.6	20.5	92	64	78		139	158
13	22.7	12.7	17.7	80	59	69		278	169
14	19.4	11.6	15.5	93	93	94		178	53
15	22.2	11.6	16.6	96	85	90		187	100
16	23.3	12.2	17.7	91	52	71	1.4	369	71
17	26.1	7.7	16.6	93	69	81		425	101
18	27.2	18.3	22.7	95	81	88		304	296
19	32.2	17.7	25	96	63	79		377	325
20	27.7	8.3	17.7	85	95	90		269	156
21	12.2	3.8	7.7	86	60	73	.1	317	322
22	20	1.1	10.5	88	69	78		386	166
23	26.1	2.7	14.4	95	65	80		386	204
24	4.4	22.2	3.3	85	98	91		52	396
25	10	2.2	6.1	97	89	93	2.7	178	229
26	17.7	8.8	13.3	96	87	91	.3	226	134
27	22.2	13.3	17.7	96	77	86		295	18
28	24.4	13.8	18.9	96	79	87		173	97
29	29.4	13.3	21.1	94	47	70			211
30	29.4	8.3	18.9	92	63	77			48
31	31.6	16.6	23.9	95	65	80			277
Total							4.5		
Average	23.7	12.5	17.9	89	74	81		268	225

Table E-7 METEOROLOGICAL DATA April, 1974

	Temp. C°			Rel. Hum. %			cm.	cal/cm^2	Km/day
DAY	MAX	MIN	MEAN	6AM	6PM	MEAN	PRECIP.	SOL. RAD.	WIND MOVEMENT
1	31.6	14.4	22.7	96	48	72		425	420
2	29.4	8.3	18.8	84	73	78		473	8
3	30	14.4	22.2	95	46	70		425	401
4	18.8	8.9	13.8	64	56	60		360	222
5	21.1	2.2	11.6	78	50	64		442	211
6	23.8	4.4	13.8	88	56	72		529	66
7	29.4	12.7	21.1	95	62	78		442	423
8	23.3	10	16.6	71	55	63		486	262
9	23.3	4.4	13.8	89	55	72		477	196
10	22.2	12.2	17.2	92	95	93		91	161
11	21.6	13.3	17.2	93	81	87	3.6	208	486
12	28.3	15	21.6	96	67	81		317	270
13	28.8	19.4	23.8	93	72	82		451	8
14	21.6	12.2	16.6	62	61	61		408	204
15	19.4	9.4	14.4	80	76	78		226	204
16	25	6.1	15.5	98	53	75		494	79
17	26.1	8.8	17.2	82	61	71		516	8
18	26.6	12.7	19.4	97	68	81		416	240
19	26.6	15.5	21.1	96	87	91		312	161
20	24.4	18.3	21.1	95	90	92		182	277
21								347	328
22	25.5				84		.9	295	369
23	27.2	15.5	21.1	96	67	81		438	103
24	27.7	15	21.1	96	59	77		477	81
25	26.6	13.8	20	94	61	77		473	6
26	26.6	14.4	20.5	94	64	80		434	8
27	28.8	14.4	21.7	96	67	81		455	240
28	27.7	20.5	24.4	92	72	82		356	365
29	28.3	20	23.8	95	72	83		325	184
30	25.5	20	22.2	95	94	94		230	428
Total							4.5		
Average	25.7	12.7	19.1	89	67	78		384	214

Table E-8. METEOROLOGICAL DATA May, 1974

	Temp. C°			Rel. Hum. %			cm.	cal/cm^2	Km/day
DAY	MAX	MIN	MEAN	6AM	6PM	MEAN	PRECIP.	SOL. RAD.	WIND MOVEMENT
1	22.2	17.7	20	95	83	89	.9	243	6
2	30.5	17.7	23.8	94	73	83		477	203
3	32.7	20.5	26.6	95	64	79		455	224
4	31.6	17.7	24.4	94	95	94		455	8
5	23.8	17.2	20.5	95	94	94		360	193
6	24.4	16.6	20.5		68			360	140
7	27.2	12.2	19.4	95	59	77		494	163
8	29.4	16.1	22.7	95	62	78		429	53
9	30.5	16.6	23.3	94	73	83		343	105
10	21.6	16.7	18.8	93	89	91	3.7	204	196
11	26.6	15.5	21.1	96	89	92		473	97
12	31.1	16.6	24.4	96	69	82		438	40
13	30	16.6	23.8	97	79	88		386	118
14	28.8	22.7	25.5	91	83	87		187	319
15	31.6	23.3	27.2	95	77	86	.1	425	221
16	31.1	23.8	27.2	94	75	84		403	245
17	31.6	23.3	27.2	94	68	81		451	322
18	32.3	22.2	27.2	94	64	79		455	322
19	32.2	21.1	26.6	96	71	83		490	483
20	28.8	20	24.4	98	90	94		356	55
21	28.8	20	24.4	96	82	89		343	19
22	30.5	19.4	25	96	70	83		412	10
23	31.6	16.6	23.8	96	65	80		494	109
24	32.2	20.5	26.1	95	66	80		451	43
25	32.7	21.1	26.6	94	69	81		533	58
26	28.3	20	23.8	96	67	81		529	299
27	33.3	20.5	26.6	96	62	79	1.1	507	101
28	32.2	19.4	25.5	96	65	80		516	116
29	33.3	21.6	27.2	95	68	81		403	155
30	30.5	21.6	26.1	94	82	88	1.3	226	330
31	32.2	21.1	26.7	95	67	81	1.2	364	159
Total							8.3		
Average	29.8	19.2	24.4	95	74	84		422	158

Table E-9. METEOROLOGICAL DATA June, 1974

	Temp. C°			Rel. Hum. %			cm.	cal/cm^2	Km/day
DAY	MAX	MIN	MEAN	6AM	6PM	MEAN	PRECIP.	SOL. RAD.	WIND MOVEMENT
1	30.6	20	25	94	70	82	2.9		320
2	32.2	20.6	26.1	96	66	81			166
		21.1		97					114
4								425	6
5								429	233
6								551	485
7								330	438
8								451	431
9								234	401
10	28.9				78			356	114
11	32.8	20	26.1	96	67			455	109
12	29.4	21.1	25	95	87	91	.1	252	53
13	32.2	18.9	25.6	95	69	82		468	159
14	33.9	20	26.7	94	63	78		499	113
15	34.4	18.9	26.7	94	60	77		533	43
16	34.4	20.6	27.2	95	68	81		542	55
17	35	20.6	27.8	95	63	79		564	113
18	33.9	22.8	28.3	95	63	79		494	163
19	34.4	20.6	27.2	95	63	79		477	270
20	35.6	21.7	28.3	95	68	81		429	6
21	34.4	21.1	27.8	95	62	78		464	230
22	35.6	21.1	28.3	95	61	78		507	111
23	37.8	21.7	29.4	96	61	78			122
24		22.8		83	61	74			108
25	28.3	12.2	20	96	58	77		555	258
26	28.3	13.3	20.6	93	75	76		560	72
27	30.6	13.9	22.2	94	59	76		520	85
28	26.7	16.1	23.3	96	58	77		330	124
29	31.1	16.7	23.9	96	60	78		507	61
30	33.9	17.2	25.6	97	62	79		520	153
Total							3.0		
Average	32.5	19.3	25.8	95	65	79		458	171

Table E-10. METEOROLOGICAL DATA July, 1974

	Temp. C°			Rel. Hum. %			cm.	cal/cm^2	Km/day
DAY	MAX	MIN	MEAN	6AM	6PM	MEAN	PRECIP.	SOL. RAD.	WIND MOVEMENT
1	34.4	21.1	27.7	98	71	84		382	214
2	33.8	23.3	28.8	96	79	87		403	229
3	35	22.2	28.3	95	64	79		390	290
4	35.5	23.8	29.4	95	63	79		412	274
5	37.2	24.4	30.5	94	60	77	.1	490	101
6	37.2	22.7	30	95	58	76		472	121
7	36.6	21.1	28.3	96	66	81		503	269
8	36.6	22.2	26.6	97	77	88		542	103
9	33.8	22.2	27.7		60	79			1095
10	33.8	18.8	26.1	96	55	75			61
11	30.5	19.4	25	95	87	91			37
12	31.6	19.4	25.5	95	80	91	.8		24
13	35	18.8	26.6	96	62	79			98
14	37.7	21.1	29.4	96	93	94			100
15	33.3	23.3	28.3	96	70	83	.1	485	132
16	33.8	21.1	27.2	96	74	85		485	32
17	31.1	20	25.5	96	90	93		118	53
18	31.6	21.1	26.1	96	68	82	1.2	393	77
19	35	18.8	26.6	96	60	78		603	121
20	36.6	21.1	28.8	95	58	76		551	11
21	37.7	21.6	29.4	80	56	68		538	37
22	38.3	22.7	30.5	94				498	48
23	36.6	22.7	29.4		68				716
24	35	22.2	28.3	96	60	78		485	18
25	35.5	24.4	30	95	58	76		485	592
26	35.5	25	30	92	66	79		288	180
27	34.4	25.5	30	90	64	77		485	512
28	38.8	22.7	30.5	97	56	76		577	230
29	38.3	22.2	30	98	52	75		498	6
30	32.7	22.2	26.6	92	63	77		485	159
31	31.1	20	25.5	92	70	81	.6	433	113
Total							2.8		
Average	35	21.8	28.1	94.7	67	81		458	195

Table E-11. METEOROLOGICAL DATA August, 1974

	Temp. C°			Rel. Hum. %			cm.	cal/cm^2	Km/day
DAY	MAX	MIN	MEAN	6AM	6PM	MEAN	PRECIP.	SOL. RAD.	WIND MOVEMENT
1	34.4	19.4	26.7	92	62	77	.7	538	50
2	25.5	18.8	22.2	92	84	88		249	118
3	33.3	18.8	26.1	92	61	76	1.8	446	39
4	30.5	21.1	25.6	92	82	87		459	8
5	30	20	25	94	56	75		288	147
6	28.3	20	23.9	90	92	91		288	18
7	25	20	22.2	92	91	91		157	166
8	26.6	20	23.3	92	88	90	1.8	288	114
9				92			3.4	433	163
10								511	272
11								524	6
12	33.3	22.2	27.8	92	62	72		341	243
13	33.8	21.6	22.2	92	61	76		485	114
14	34.4	22.2	28.3	92	66	79		524	47
15	33.3	20.5	26.7	92	60	76			164
16	34.4	20.5	27.2	92	60	76		629	109
17	34.4	21.1	27.8	92	62	77		577	164
18	35	21.1	27.8	93	58	77		498	76
19	35	21.1	27.8	96	62	79		669	82
20	33.3	21.1	27.2	92	58	75		538	180
21	33.3	20	26.7	92	56	74		578	126
22	33.8	21.1	27.2	91	60	75		524	111
23	33.3	18.8	26.1	90	70	80		393	16
24	33.8	21.1	27.2	92	62	77		485	61
25	28.8	19.4	23.9	92	93	92		170	98
26	27.7	21.1	24.4	93	76	84	3.6	341	14
27	30.5	20	25	92	80	86		393	340
28							.6	354	55
29							4.0	144	108
30							4.7	341	56
31								448	112
Total							20.6		
Average	31.7	20.5	29.9	92	69	80		420	109

Table E-12. METEOROLOGICAL DATA September, 1974

	Temp. C°			Rel. Hum. %			cm.	cal/cm^2	Km/day
DAY	MAX	MIN	MEAN	6AM	6PM	MEAN	PRECIP.	SOL. RAD.	WIND MOVEMENT
1								485	192
2	32.2	21.1	26.6		68		1.1	524	113
3	17.2	14.4	15.5	90	82	86		144	159
4	22.2	12.2	17.2	92	58	75		446	158
5	23.3	9.4	16.1	92	57	74		524	166
6	24.4	10	17.2	92	58	75		446	106
7	26.6	12.7	19.4	93	68	80		433	8
8	27.2	15.5	21.1	93	72	82		38	242
9		18.8		95			.7	118	291
10							2.3	262	304
11								38	203
12							2.3	315	279
13								92	108
14							8.9		167
15							1.1		8
16	31.1	22.7	26.7	98	90	94		223	14
17	31.1	22.2	26.7	97	88	92		302	166
18	30	21.6	25.6	96	82	89		354	64
19	31.6	21.6	26.7	96	78	87		367	16
20	31.1	20.5	25.6	96	76	86		315	100
21	25.5	21.1	23.3	96	88	92		262	27
22	25	17.7	21.1	84	76	80		367	179
23	22.7	14.4	18.3	83	75	79		315	156
24	26.1	13.8	20	92	80	86		288	483
25	20	14.4	17.2	96	91	93	1.7	118	113
26	20	14.4	17.2	97	81	89	.1	275	32
27	30	13.3	21.7	97	71	81		341	48
28	29.4	15.5	22.2	93	70	81		341	93
29	26.1	9.4	17.8	98	65	81		485	106
30	26.1	7.7	16.7	99	70	84		380	193
Total							18.2		
Average	26.3	15.8	20.9	94	75	84		307	143

Table E-13. METEOROLOGICAL DATA October, 1974

	Temp. C°			Rel. Hum. %			cm.	cal/cm^2	Km/day
DAY	MAX	MIN	MEAN	6AM	6PM	MEAN	PRECIP.	SOL. RAD.	WIND MOVEMENT
1	28.8	7.7	18.3	98	65	81		380	43
2	29.4	9.4	19.4	98	66	82		393	69
3	27.7	11.1	19.4	94	68	81		433	143
4	29.4	13.8	21.6	97	71	84		262	48
5	29.4	13.8	21.6	97	68	82		380	114
6	28.8	14.4	21.6	97	76	86		288	211
7	27.7	14.4	21.1	97	69	83		393	155
8	29.4	13.3	21.1	98	70	84		341	14
9	30.5	16.1	23.3	97	69	83		341	1579
10	31.1	16.1	23.3	98	66	82		393	16
11	30.5	17.2	23.8	99	67	83		341	198
12	29.4	13.8	21.6	99	72	85		341	132
13	30	18.8	24.4	99	73	86		433	40
14	25	18.8	21.6	99	70	84	1.1	144	118
15	16.1	11.1	13.3	90	70	80		302	191
16	14.4	3.8	8.8	99	65	82		341	156
17	26.1	7.2	16.6	98	65	81		393	50
18	28.3	9.4	18.8	98	65	81		341	5
19	27.2	13.8	20.5	98	71	84		341	1166
20	25.5	13.8	19.4	99	75	87		341	52
21	24.4	15	19.4	96	76	86		288	161
22	30.5	11.6	21.1	95	72	83		341	161
23	30	16.1	22.7	98	77	86		197	39
24	23.3	15	18.8	96	74	85		223	127
25	21.6	15	18.3	97	76	86		197	52
26	24.4	10	17.2	99	70	84		288	105
27	25.5	10.5	17.7	100	76	88		197	50
28	22.2	18.8	20.5	100	94	97	7.6	144	208
29	27.7	23.3	25.6	98	79	88	1.8	288	163
30	26.1	24.4	25	98	86	92		236	208
31	22.2	17.7	20	100	94	97	1.1	105	372
Total							11.6		
Average	26.5	14.0	20.2	98	73	85		304	198

Appendix F

Water balance for each individual lysimeter for the entire period of the experiment

Table F-1. Water balance for the Acid Cl soils lysimeters for the entire period of the experiment given in cm.

	Lysimeter Number					
	1	2	3	4	5	Average
Water applied	170	170	170	170	170	170
Initial water content of soil	66	66	67	67	71	67
Applied + Initial	236	236	237	237	241	237
Leachate	23	38	33	37	36	33
Final water content of soil	55	61	55	55	49	55
Evapotranspiration + error	158	137	149	145	156	149

Table F-2. Water balance for the SM(d/u) soils lysimeters for the entire period of the experiment given in cm.

	Lysimeter number					
	6	7	8	9	10	Average
Water applied	170	170	170	170	170	170
Initial water content of soil	34	52	52	49	49	47
Applied + Initial	204	222	222	219	219	217
Leachate	56	69	63	84	69	68
Final water content of soil	20	46	36	33	42	35
Evapotranspiration + error	128	107	123	102	108	114

Table F-3. Water balance for the Basic C1 soils lysimeters for the entire period of the experiment given in cm.

	Lysimeter Number					
	11	12	13	14	15	Average
Water applied	170	170	170	170	170	170
Initial water content of soil	66	53	62	64	60	61
Applied + Initial	236	223	232	234	230	231
Leachate	50	50	51	39	44	47
Final water content of soil	61	43	53	47	51	51
Evapotranspiration + error	125	130	128	148	135	133

Table F-4. Water balance for the SC soils lysimeters for the entire period of the experiment given in cm.

	Lysimeter Number					
	16	17	18	19	20	Average
Water applied	170	170	170	170	170	170
Initial water content of soil	63	72	73	68	69	69
Applied + Initial	233	242	243	238	239	239
Leachate	16	18	24	24	23	21
Final water content of soil	53	59	59	43	53	53
Evapotranspiration + error	164	165	160	171	163	165

Appendix G. Tensiometer data with depth for one lysimeter of each soil.

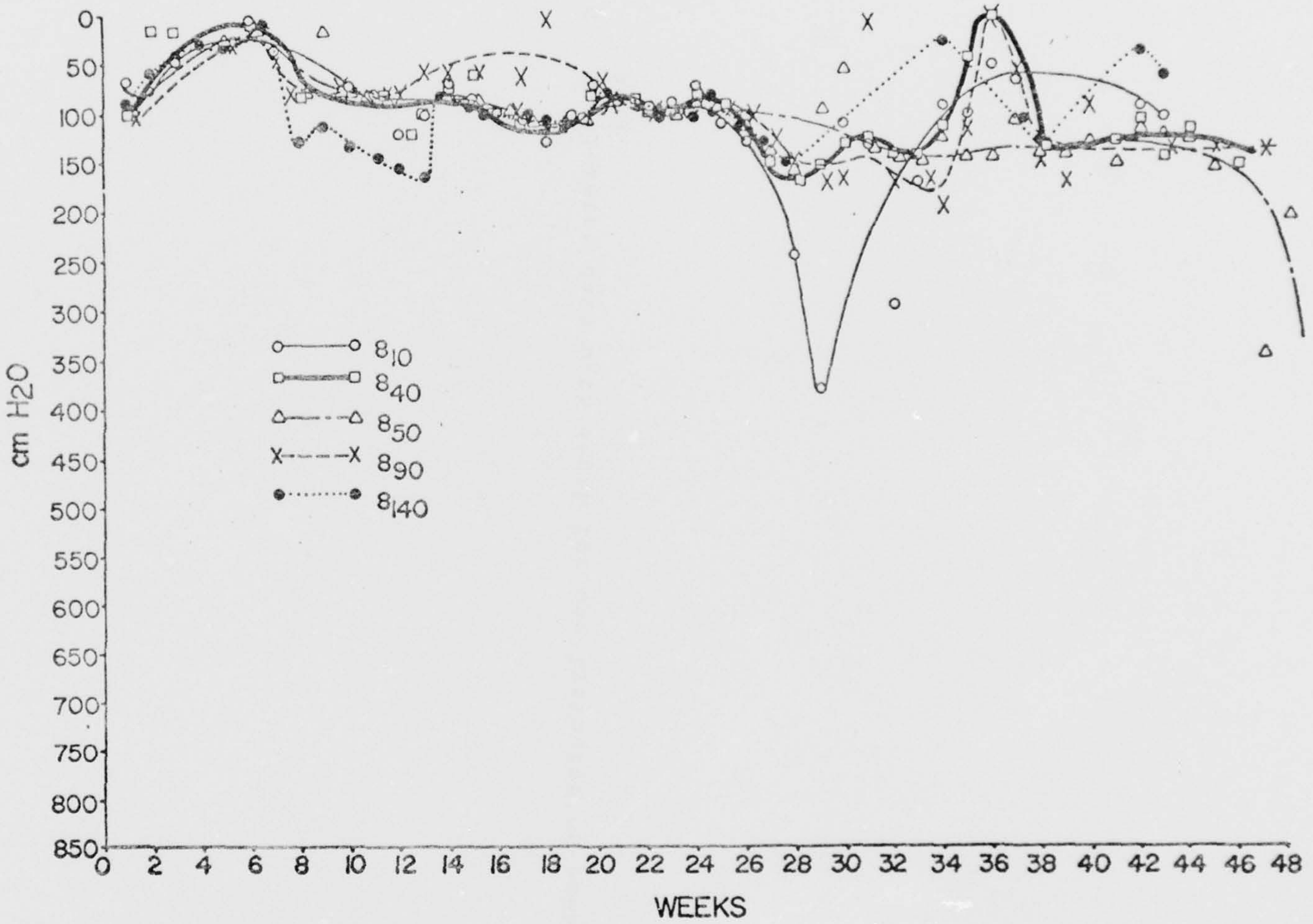

Figure G1. Water potential at selected depths in the SM(d/u) lysimeter during the experiment.

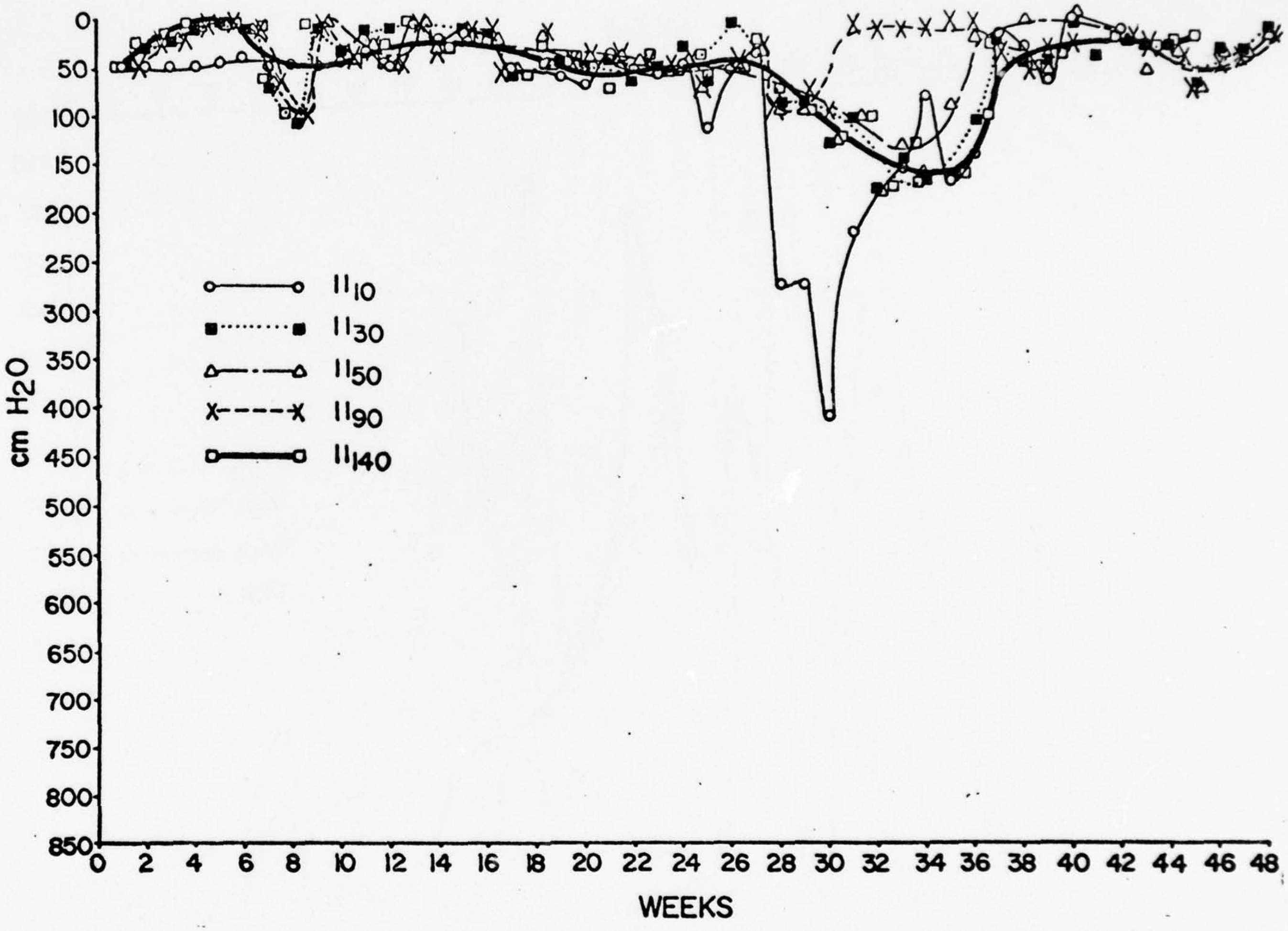

Figure G2. Water potential at selected depths in the Basic CL lysimeter during the experiment.

Total							4.5		
Average	23.7	12.5	17.9	89	74	81		268	225

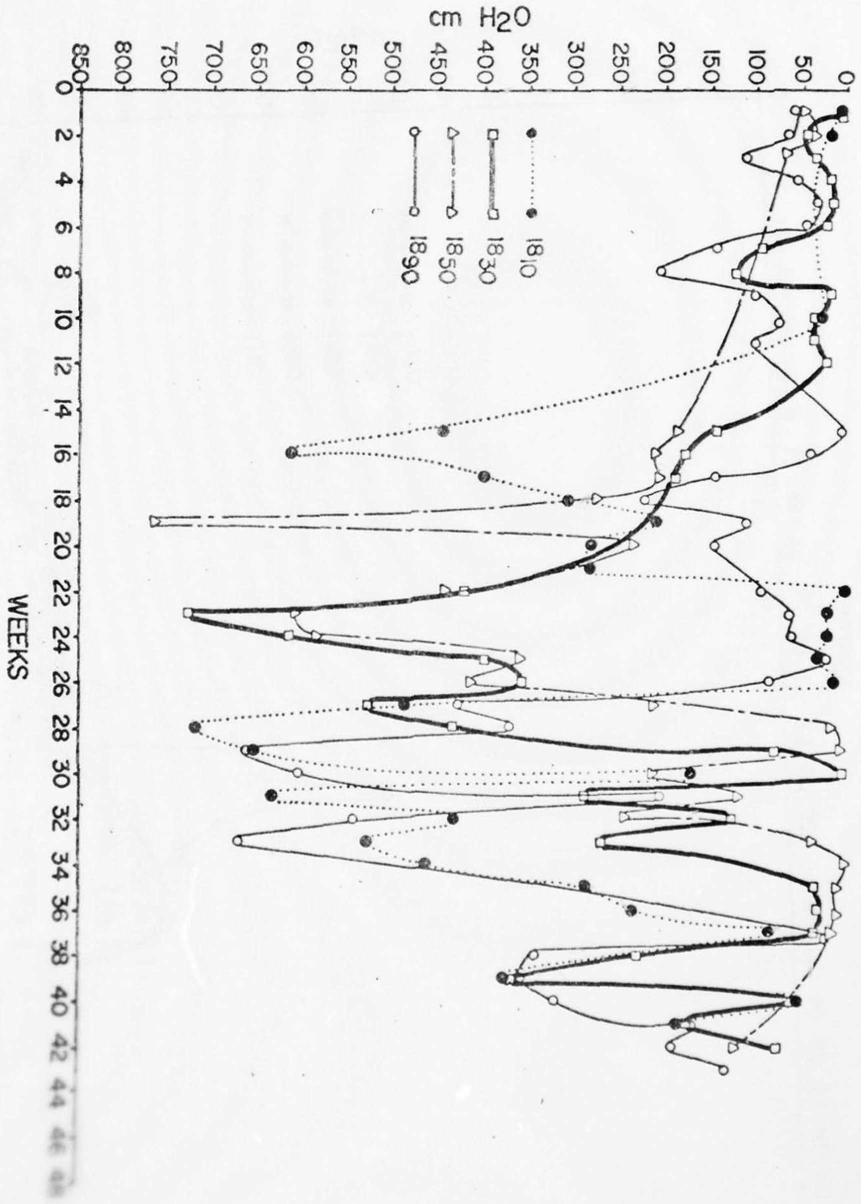

Figure G3. Water potential at selected depths in the SC lysimeter during the experiment.

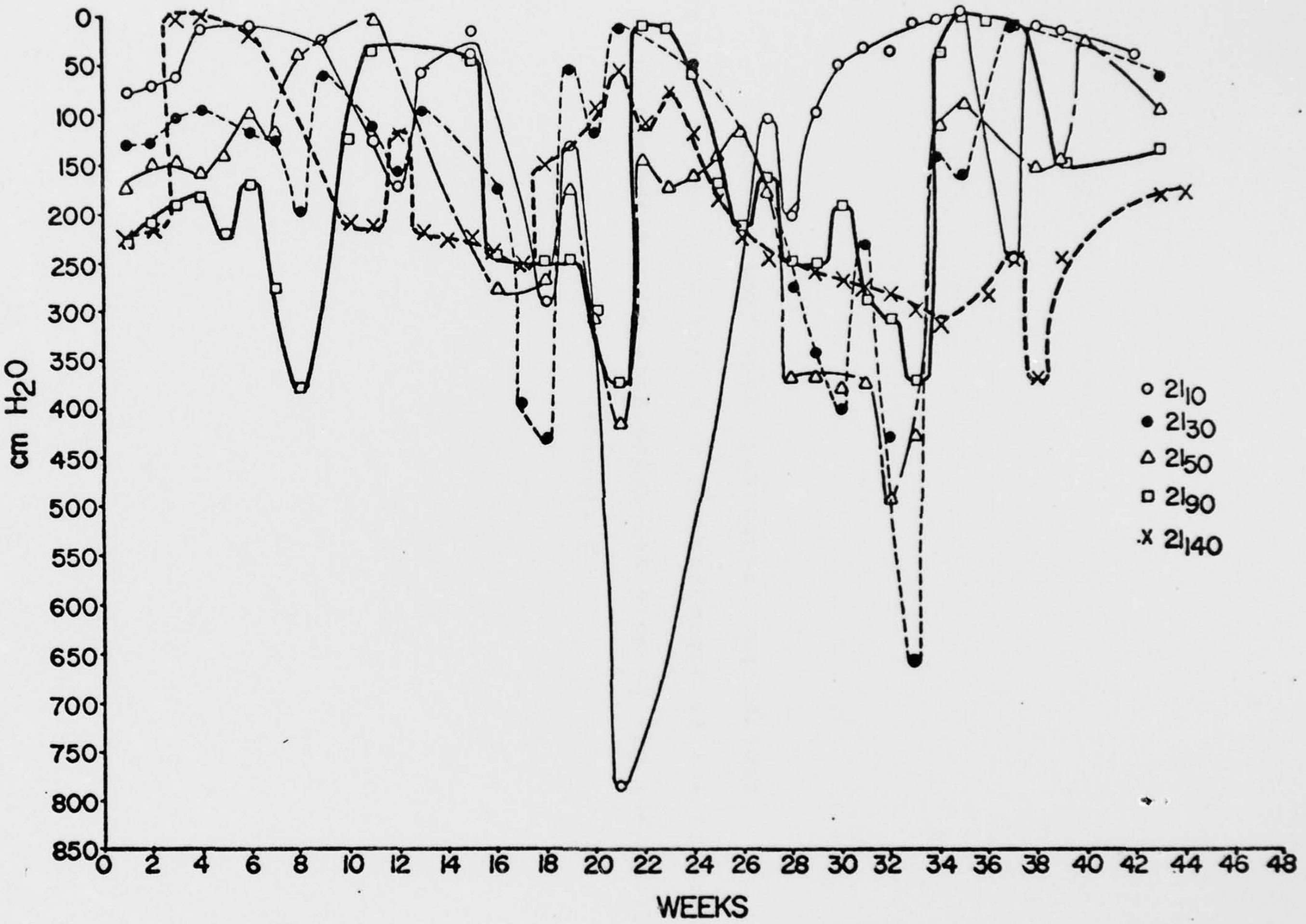

Figure G4. Water potential at selected depths in the Basic CL field plot during the experiment.

Appendix H

Metal concentrations with depth for each of the four soils and each of the five metals at the beginning of the experiment, January, May, July, September, and November

Table H-1. Cadmium in Acid CL Soil Background

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	< 0.3	< 0.2	< 0.2	< 0.2	< 0.3	< 0.3
0 - 1	"	"	"	"	"	"
1 - 2	"	"	"	"	"	"
2 - 3	"	"	"	"	"	"
3 - 4	"	"	"	"	"	"
4 - 5	"	"	"	"	"	"
5 - 7.5	"	"	"	"	"	"
7.5 - 10	"	"	"	"	"	"
10 - 15	"	"	"	"	"	"
15 - 25	"	"	"	"	"	"
25 - 35	"	"	"	"	"	"
35 - 45	----	----	----	----	----	----
45 - 55	"	"	"	"	"	"

Table H-2. Copper in Acid CL Soil Background

(in ppm-dry wt.)

	Fraction I	Fraction II				
Depth (in.)	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	0.5 ± 0.1	< 0.1	< 0.2	< 0.2	8.1 ± 1.1	8.1 ± 1.1
0 - 1	0.4 ± 0.0	"	"	"	4.3 ± 1.9	4.3 ± 1.9
1 - 2	0.4 ± 0.0	"	"	"	5.2 ± 1.4	5.2 ± 1.4
2 - 3	0.3 ± 0.1	"	"	"	3.6 ± 0.2	3.6 ± 0.2
3 - 4	0.2 ± 0.1	"	"	"	3.2 ± 0.4	3.2 ± 0.4
4 - 5	0.4 ± 0.2	"	"	"	3.0 ± 0.6	3.0 ± 0.6
5 - 7.5	0.3 ± 0.1	"	"	"	2.6 ± 0.2	2.6 ± 0.2
7.5 - 10	0.2 ± 0.0	"	"	"	1.8 ± 0.7	1.8 ± 0.7
10 - 15	< 0.1	"	"	"	1.7 ± 0.2	1.7 ± 0.2
15 - 25	0.2 ± 0.1	"	"	"	1.3 ± 0.1	1.3 ± 0.1
25 - 35	< 0.1	"	"	"	1.6 ± 0.1	1.6 ± 0.1
35 - 45	----	----	----	----	----	----
45 - 55	0.2 ± 0.1	"	"	"	1.4 ± 0.2	1.4 ± 0.2

Table H-3. **Lead in Acid CL Soil Background**

(in ppm-dry wt.)

	Fraction I	**Fraction II**				
Depth (in.)	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	4.4 ± 0.8	< 0.3	< 0.5	< 0.5	29 ± 1	29 ± 1
0 - 1	2.3 ± 0.3	"	"	"	22 ± 0.6	22 ± 0.6
1 - 2	2.2 ± 0.9	"	"	"	21 ± 3	21 ± 3
2 - 3	2.2 ± 0.4	"	"	"	20 ± 3	20 ± 3
3 - 4	1.2 ± 0.3	"	"	"	21 ± 4	21 ± 4
4 - 5	1.1 ± 0.0	"	"	"	17 ± 5	17 ± 5
5 - 7.5	1.1 ± 0.2	"	"	"	20 ± 4	20 ± 4
7.5 - 10	0.9 ± 0.1	"	"	"	14 ± 1	14 ± 1
10 - 15	0.9 ± 0.0	"	"	"	13 ± 1	13 ± 1
15 - 25	1.6 ± 0.3	"	"	"	13 ± 0.5	13 ± 0.5
25 - 35	1.6 ± 0.1	"	"	"	15 ± 0.0	15 ± 0.0
35 - 45	----	----	----	----	----	----
45 - 55	1.6 ± 0.1	"	"	"	13 ± 0.5	13 ± 0.5

Table H-4. Nickel in Acid CL Soil Background

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	1.5 ± 0.8	< 0.4	< 0.5	< 0.5	46 ± 10	46 ± 10
0 - 1	2.8 ± 0.4	"	"	"	42 ± 12	42 ± 12
1 - 2	2.3 ± 0.4	"	"	"	57 ± 22	57 ± 22
2 - 3	1.7 ± 0.9	"	"	"	36 ± 2	36 ± 2
3 - 4	1.0 ± 0.8	"	"	"	34 ± 0.5	34 ± 0.5
4 - 5	1.4 ± 0.9	"	"	"	30 ± 0.5	30 ± 0.5
5 - 7.5	1.2 ± 0.7	"	"	"	30 ± 0.5	30 ± 0.5
7.5 - 10	< 0.4	"	"	"	26 ± 5	25 ± 5
10 - 15	< 0.4	"	"	"	24 ± 1	24 ± 1
15 - 25	0.5 ± 0.1	"	"	"	24 ± 0.5	24 ± 0.5
25 - 35	0.9 ± 0.0	"	"	"	23 ± 0.5	23 ± 0.5
35 - 45	----	----	----	----	----	----
45 - 55	0.8 ± 0.1	"	"	"	18 ± 0.5	18 ± 0.5

Table H-5. Zinc in Acid CL Soil Background

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	4.6 ± 0.1	< 0.1	< 0.2	< 0.2	116 ± 14	116 ± 14
0 - 1	3.3 ± 0.9	"	"	"	89 ± 5	89 ± 5
1 - 2	2.6 ± 0.0	"	"	"	97 ± 3	97 ± 3
2 - 3	1.5 ± 0.8	"	"	"	88 ± 11	88 ± 11
3 - 4	1.3 ± 0.2	"	"	"	84 ± 14	84 ± 14
4 - 5	1.5 ± 0.0	"	"	"	82 ± 15	82 ± 15
5 - 7.5	1.2 ± 0.1	"	"	"	79 ± 6	79 ± 6
7.5 - 10	0.4 ± 0.1	"	"	"	62 ± 11	62 ± 11
10 - 15	0.4 ± 0.0	"	"	"	59 ± 3	59 ± 3
15 - 25	0.6 ± 0.2	"	"	"	60 ± 2	60 ± 2
25 - 35	0.7 ± 0.2	"	"	"	61 ± 0	61 ± 0
35 - 45	----	----	----	----	----	----
45 - 55	1.1 ± 0.2	"	"	"	45 ± 0	45 ± 0

Table H-6. **Cadmium in SM(d/u)** Soil Background

(in ppm-dry wt.)

	Fraction I	Fraction II				
Depth (in.)	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	< 0.3	< 0.2	< 0.2	< 0.2	< 0.3	< 0.3
0 - 1	"	"	"	"	"	"
1 - 2	"	"	"	"	"	"
2 - 3	"	"	"	"	"	"
3 - 4	"	"	"	"	"	"
4 - 5	"	"	"	"	"	"
5 - 7.5	"	"	"	"	"	"
7.5 - 10	"	"	"	"	"	"
10 - 15	"	"	"	"	"	"
15 - 25	"	"	"	"	"	"
25 - 35	"	"	"	"	"	"
35 - 45	"	"	"	"	"	"
45 - 55	"	"	"	"	"	"

Table H-7. Copper in Sm(d/u) Soil Background

(in ppm-dry wt.)

	Fraction I	Fraction II				
Depth (in.)	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	0.5 ± 0.1	< 0.1	< 0.2	< 0.2	1.7 ± 0.1	1.7 ± 0.1
0 - 1	0.5 ± 0.2	"	"	"	2.0 ± 0.0	2.0 ± 0.0
1 - 2	0.6 ± 0.4	"	"	"	1.4 ± 0.1	1.4 ± 0.1
2 - 3	0.8 ± 0.5	"	"	"	1.2 ± 0.1	1.2 ± 0.1
3 - 4	0.7 ± 0.4	"	"	"	1.8 ± 0.2	1.8 ± 0.2
4 - 5	0.6 ± 0.4	"	"	"	1.0 ± 0.1	1.0 ± 0.1
5 - 7.5	0.6 ± 0.5	"	"	"	1.4 ± 0.1	1.4 ± 0.1
7.5 - 10	0.5 ± 0.0	"	"	"	1.4 ± 0.0	1.4 ± 0.0
10 - 15	0.4 ± 0.0	"	"	"	1.9 ± 0.1	1.9 ± 0.1
15 - 25	0.3 ± 0.1	"	"	"	1.6 ± 0.1	1.6 ± 0.1
25 - 35	0.2 ± 0.1	"	"	"	1.8 ± 0.0	1.8 ± 0.0
35 - 45	0.3 ± 0.1	"	"	"	1.5 ± 0.1	1.5 ± 0.1
45 - 55	0.2 ± 0.0	"	"	"	1.5 ± 0.1	1.5 ± 0.1

Table H-8. Lead in SM(d/u) Soil Background

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	1.2 ± 0.1	< 0.3	< 0.5	< 0.5	2.4 ± 0.2	2.4 ± 0.2
0 - 1	1.0 ± 0.6	"	"	"	2.8 ± 0.7	2.8 ± 0.7
1 - 2	1.2 ± 0.9	"	"	"	2.4 ± 0.6	2.4 ± 0.6
2 - 3	0.9 ± 0.2	"	"	"	2.5 ± 0.9	2.5 ± 0.9
3 - 4	1.0 ± 0.3	"	"	"	3.9 ± 0.5	3.9 ± 0.5
4 - 5	1.0 ± 0.1	"	"	"	1.7 ± 0.7	1.7 ± 0.7
5 - 7.5	1.0 ± 0.0	"	"	"	3.5 ± 0.1	3.5 ± 0.1
7.5 - 10	0.9 ± 0.1	"	"	"	3.7 ± 0.1	3.7 ± 0.0
10 - 15	0.8 ± 0.2	"	"	"	2.3 ± 1.0	2.3 ± 1.0
15 - 25	0.9 ± 0.0	"	"	"	2.8 ± 0.1	2.8 ± 0.1
25 - 35	0.7 ± 0.1	"	"	"	3.4 ± 0.0	3.4 ± 0.0
35 - 45	0.9 ± 0.1	"	"	"	1.2 ± 0.0	1.2 ± 0.0
45 - 55	0.8 ± 0.1	"	"	"	1.2 ± 0.0	1.2 ± 0.0

Table H-9. Nickel in SM(d/u) Soil Background

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	< 0.4	< 0.4	< 0.5	< 0.5	2.0 ± 0.2	2.0 ± 0.2
0 - 1	"	"	"	"	1.5 ± 0.6	1.5 ± 0.6
1 - 2	"	"	"	"	1.8 ± 0.2	1.8 ± 0.2
2 - 3	"	"	"	"	1.9 ± 0.1	1.9 ± 0.1
3 - 4	"	"	"	"	3.0 ± 1.0	3.0 ± 1.0
4 - 5	"	"	"	"	1.6 ± 0.1	1.6 ± 0.1
5 - 7.5	"	"	"	"	1.5 ± 0.1	1.5 ± 0.1
7.5 - 10	"	"	"	"	1.6 ± 0.2	1.6 ± 0.2
10 - 15	"	"	"	"	1.7 ± 0.0	1.7 ± 0.0
15 - 25	"	"	"	"	2.3 ± 0.1	2.3 ± 0.1
25 - 35	"	"	"	"	2.3 ± 0.1	2.3 ± 0.1
35 - 45	"	"	"	"	2.3 ± 0.3	2.3 ± 0.3
45 - 55	"	"	"	"	2.2 ± 0.1	2.2 ± 0.1

Table H-10. Zinc in SM(d/u) Soil Background

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	2.0 ± 1.0	< 0.1	< 0.2	< 0.2	5.3 ± 0.9	5.3 ± 0.9
0 - 1	1.9 ± 0.7	"	"	"	5.6 ± 0.7	5.6 ± 0.7
1 - 2	1.6 ± 0.2	"	"	"	4.0 ± 0.0	4.0 ± 0.0
2 - 3	1.3 ± 0.1	"	"	"	3.4 ± 0.3	3.4 ± 0.3
3 - 4	1.5 ± 0.2	"	"	"	4.7 ± 0.3	4.7 ± 0.3
4 - 5	1.2 ± 0.1	"	"	"	3.2 ± 0.6	3.2 ± 0.6
5 - 7.5	1.2 ± 0.3	"	"	"	3.2 ± 0.3	3.2 ± 0.3
7.5 - 10	0.8 ± 0.2	"	"	"	3.1 ± 0.0	3.1 ± 0.0
10 - 15	0.5 ± 0.1	"	"	"	4.1 ± 0.2	4.1 ± 0.2
15 - 25	0.5 ± 0.1	"	"	"	3.5 ± 0.1	3.5 ± 0.1
25 - 35	0.3 ± 0.1	"	"	"	3.3 ± 0.1	3.3 ± 0.1
35 - 45	0.6 ± 0.2	"	"	"	3.1 ± 0.1	3.1 ± 0.1
45 - 55	0.3 ± 0.1	"	"	"	2.6 ± 0.1	2.6 ± 0.1

Table H-11. Cadmium in Basic CL Soil Background

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	< 0.3	< 0.2	< 0.2	< 0.2	< 0.3	< 0.3
0 - 1	"	"	"	"	"	"
1 - 2	"	"	"	"	"	"
2 - 3	"	"	"	"	"	"
3 - 4	"	"	"	"	"	"
4 - 5	"	"	"	"	"	"
5 - 7.5	"	"	"	"	"	"
7.5 - 10	"	"	"	"	"	"
10 - 15	"	"	"	"	"	"
15 - 25	"	"	"	"	"	"
25 - 35	"	"	"	"	"	"
35 - 45	"	"	"	"	"	"
45 - 55	"	"	"	"	"	"

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FATE OF METALS APPLIED IN SEWAGE TO LAND WASTEWATER DISPOSAL SI--ETC(U)
SEP 75 K W BROWN, C WOODS, J F SLOWEY DADA17-73-C-3102

UNCLASSIFIED TAMRF-74-256 NL

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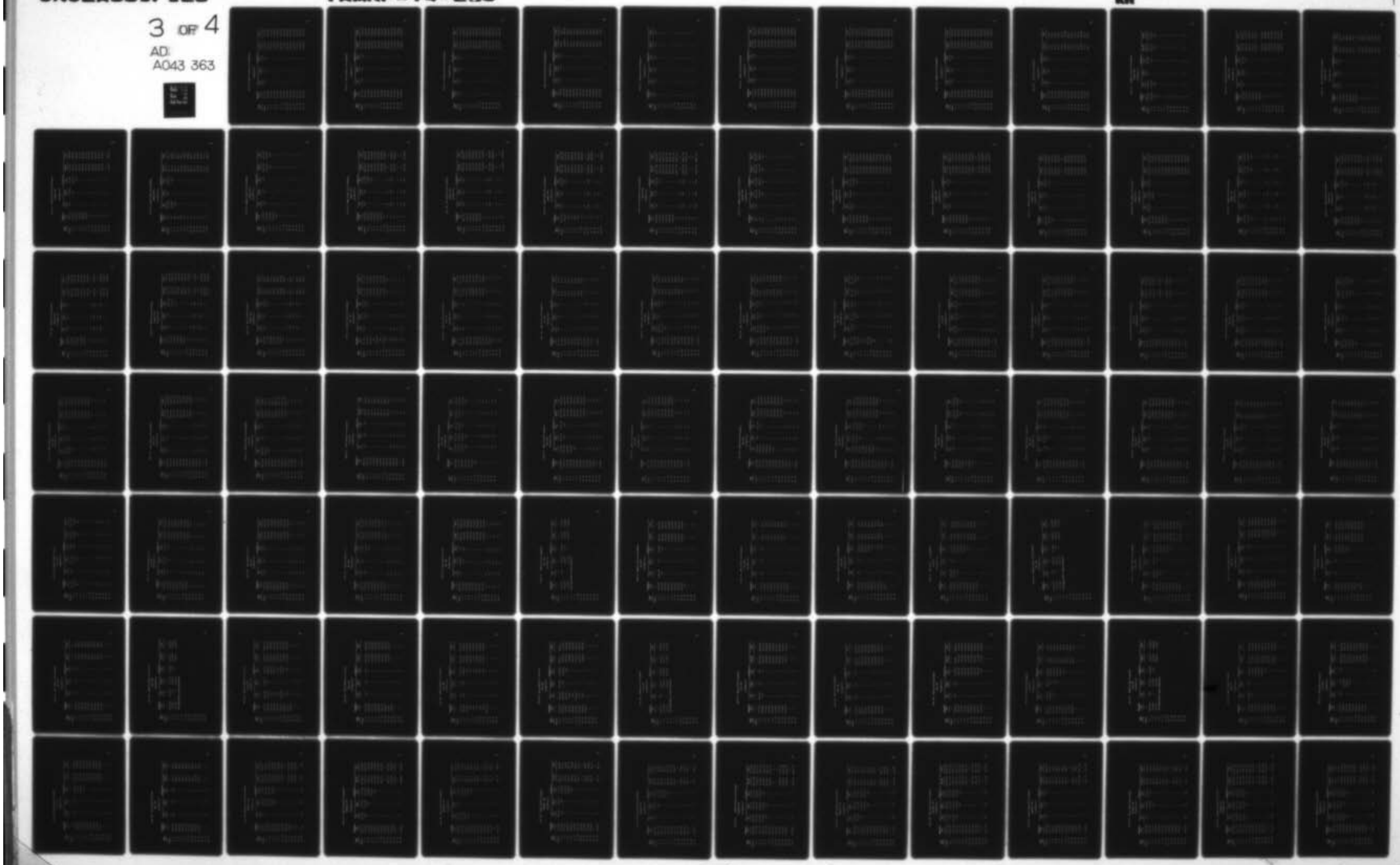

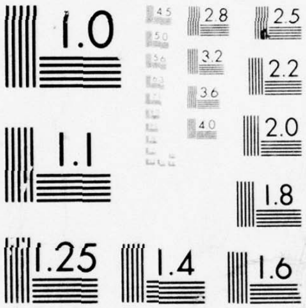

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Table H-12. Copper in Basic CL Soil Background

(in ppm-dry wt.)

	Fraction I	Fraction II				
Depth (in.)	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	0.7 ± 0.1	< 0.1	< 0.2	< 0.2	5.3 ± 0.3	5.3 ± 0.3
0 - 1	1.0 ± 0.1	"	"	"	6.0 ± 0.1	6.0 ± 0.1
1 - 2	1.2 ± 0.1	"	"	"	6.4 ± 0.2	6.4 ± 0.2
2 - 3	1.4 ± 0.2	"	"	"	5.9 ± 0.5	5.9 ± 0.5
3 - 4	1.2 ± 0.1	"	"	"	5.7 ± 0.6	5.7 ± 0.6
4 - 5	1.3 ± 0.2	"	"	"	6.0 ± 0.2	6.0 ± 0.2
5 - 7.5	1.2 ± 0.0	"	"	"	5.4 ± 0.4	5.4 ± 0.4
7.5 - 10	1.5 ± 0.1	"	"	"	6.0 ± 0.2	6.0 ± 0.2
10 - 15	1.6 ± 0.3	"	"	"	6.8 ± 0.6	6.8 ± 0.6
15 - 25	0.9 ± 0.4	"	"	"	6.1 ± 0.5	6.1 ± 0.5
25 - 35	0.7 ± 0.2	"	"	"	5.5 ± 0.4	5.5 ± 0.4
35 - 45	0.6 ± 0.2	"	"	"	5.0 ± 0.4	5.0 ± 0.4
45 - 55	0.6 ± 0.1	"	"	"	5.9 ± 0.2	5.9 ± 0.2

Table H-13. Lead in Basic CL Soil Background

(in ppm-dry wt.)

	Fraction I	Fraction II				
Depth (in.)	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	2.2 ± 1.2	< 0.3	< 0.5	< 0.5	7.0 ± 1.0	7.0 ± 1.0
0 - 1	2.3 ± 1.1	"	"	"	8.9 ± 0.4	8.9 ± 0.4
1 - 2	2.2 ± 0.8	"	"	"	8.7 ± 1.3	8.7 ± 1.3
2 - 3	1.2 ± 0.1	"	"	"	8.0 ± 0.0	8.0 ± 0.0
3 - 4	1.4 ± 0.0	"	"	"	7.8 ± 1.5	7.8 ± 1.5
4 - 5	1.6 ± 0.2	"	"	"	8.0 ± 0.9	8.0 ± 0.9
5 - 7.5	1.4 ± 0.0	"	"	"	7.3 ± 2.7	7.3 ± 2.7
7.5 - 10	1.8 ± 0.6	"	"	"	5.0 ± 0.2	5.0 ± 0.2
10 - 15	1.4 ± 0.1	"	"	"	8.7 ± 2.3	8.7 ± 2.3
15 - 25	1.0 ± 0.1	"	"	"	9.2 ± 2.8	9.2 ± 2.8
25 - 35	1.2 ± 0.1	"	"	"	7.8 ± 2.2	7.8 ± 2.2
35 - 45	1.4 ± 0.2	"	"	"	7.0 ± 0.4	7.0 ± 0.4
45 - 55	1.4 ± 0.1	"	"	"	8.2 ± 0.7	8.2 ± 0.7

Table H-14. Nickel in Basic CL Soil Background

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	< 0.5	< 0.4	< 0.5	< 0.5	8.3 ± 0.4	8.3 ± 0.4
0 - 1	"	"	"	"	9.6 ± 0.4	9.6 ± 0.4
1 - 2	"	"	"	"	10.0 ± 1.0	10.0 ± 1.0
2 - 3	"	"	"	"	9.6 ± 0.1	9.6 ± 0.1
3 - 4	"	"	"	"	8.6 ± 0.7	8.6 ± 0.7
4 - 5	"	"	"	"	9.4 ± 0.4	9.4 ± 0.4
5 - 7.5	"	"	"	"	8.6 ± 2.5	8.6 ± 2.5
7.5 - 10	"	"	"	"	9.8 ± 0.2	9.8 ± 0.2
10 - 15	"	"	"	"	11.0 ± 0.0	11.0 ± 0.0
15 - 25	"	"	"	"	11.0 ± 1.0	11.0 ± 1.0
25 - 35	"	"	"	"	10.0 ± 3.0	10.0 ± 3.0
35 - 45	"	"	"	"	8.2 ± 1.7	8.2 ± 1.7
45 - 55	"	"	"	"	12.0 ± 1.0	12.0 ± 1.0

Table H-15. Zinc in Basic CL Soil Background

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	1.5 ± 0.9	< 0.1	< 0.2	< 0.2	24 ± 3	24 ± 3
0 - 1	2.6 ± 0.4	"	"	"	30 ± 0.5	30 ± 0.5
1 - 2	0.6 ± 0.1	"	"	"	27 ± 2	27 ± 2
2 - 3	0.4 ± 0.1	"	"	"	26 ± 1	26 ± 1
3 - 4	0.5 ± 0.0	"	"	"	23 ± 3	23 ± 3
4 - 5	0.8 ± 0.2	"	"	"	26 ± 2	26 ± 2
5 - 7.5	0.8 ± 0.1	"	"	"	23 ± 5	23 ± 5
7.5 - 10	0.6 ± 0.1	"	"	"	25 ± 2	25 ± 2
10 - 15	0.6 ± 0.1	"	"	"	29 ± 2	29 ± 2
15 - 25	0.5 ± 0.1	"	"	"	27 ± 5	27 ± 5
25 - 35	0.3 ± 0.0	"	"	"	26 ± 5	26 ± 5
35 - 45	0.4 ± 0.1	"	"	"	20 ± 2	20 ± 2
45 - 55	0.5 ± 0.2	"	"	"	31 ± 0	31 ± 0

Table H-16. Cadmium in SC Soil Background

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	< 0.3	< 0.2	< 0.2	< 0.2	< 0.3	< 0.3
0 - 1	"	"	"	"	"	"
1 - 2	"	"	"	"	"	"
2 - 3	"	"	"	"	"	"
3 - 4	"	"	"	"	"	"
4 - 5	"	"	"	"	"	"
5 - 7.5	"	"	"	"	"	"
7.5 - 10	"	"	"	"	"	"
10 - 15	"	"	"	"	"	"
15 - 25	"	"	"	"	"	"
25 - 35	"	"	"	"	"	"
35 - 45	"	"	"	"	"	"
45 - 55	"	"	"	"	"	"

Table H-17. Copper in SC Soil Background

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	1.2 ± 0.2	< 0.1	< 0.2	< 0.2	3.2 ± 0.7	3.2 ± 0.7
0 - 1	1.2 ± 0.1	"	"	"	2.9 ± 0.3	2.9 ± 0.3
1 - 2	0.8 ± 0.0	"	"	"	3.1 ± 0.1	3.1 ± 0.1
2 - 3	0.9 ± 0.0	"	"	"	2.8 ± 0.4	2.8 ± 0.4
3 - 4	0.7 ± 0.0	"	"	"	2.8 ± 0.1	2.8 ± 0.1
4 - 5	0.9 ± 0.0	"	"	"	3.7 ± 0.1	3.7 ± 0.1
5 - 7.5	1.2 ± 0.1	"	"	"	5.0 ± 0.3	5.0 ± 0.3
7.5 - 10	1.0 ± 0.2	"	"	"	4.4 ± 0.4	4.4 ± 0.4
10 - 15	0.8 ± 0.1	"	"	"	4.2 ± 0.2	4.2 ± 0.2
15 - 25	0.5 ± 0.2	"	"	"	4.3 ± 0.5	4.3 ± 0.5
25 - 35	0.6 ± 0.1	"	"	"	4.0 ± 0.5	4.0 ± 0.5
35 - 45	0.5 ± 0.2	"	"	"	5.2 ± 0.5	5.2 ± 0.5
45 - 55	0.6 ± 0.1	"	"	"	4.8 ± 0.1	4.8 ± 0.1

Table H-18. **Lead in SC Soil Background**

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	3.1 ± 0.6	< 0.3	< 0.5	< 0.5	7.6 ± 1.0	7.6 ± 1.0
0 - 1	3.4 ± 0.4	"	"	"	7.6 ± 0.6	7.6 ± 0.6
1 - 2	2.0 ± 0.6	"	"	"	7.5 ± 0.7	7.5 ± 0.7
2 - 3	2.1 ± 1.0	"	"	"	9.7 ± 1.3	9.7 ± 1.3
3 - 4	2.2 ± 1.3	"	"	"	7.4 ± 1.6	7.4 ± 1.6
4 - 5	1.3 ± 0.2	"	"	"	8.0 ± 0.6	8.0 ± 0.6
5 - 7.5	2.2 ± 0.1	"	"	"	8.5 ± 0.4	8.5 ± 0.4
7.5 - 10	1.2 ± 0.2	"	"	"	5.7 ± 0.5	5.7 ± 0.5
10 - 15	1.2 ± 0.0	"	"	"	8.6 ± 0.9	8.6 ± 0.9
15 - 25	2.0 ± 1.1	"	"	"	8.5 ± 0.8	8.5 ± 0.8
25 - 35	1.3 ± 0.5	"	"	"	8.2 ± 0.3	8.2 ± 0.3
35 - 45	1.9 ± 1.1	"	"	"	8.2 ± 1.3	8.2 ± 1.3
45 - 55	0.9 ± 0.1	"	"	"	7.0 ± 1.1	7.0 ± 1.1

Table H-19. Nickel in SC Soil Background

(in ppm-dry wt.)

	Fraction I	Fraction II				
Depth (in.)	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	1.3 ± 0.1	< 0.4	< 0.5	< 0.5	4.0 ± 1.4	4.0 ± 1.4
0 - 1	1.2 ± 0.2	"	"	"	3.3 ± 0.1	3.3 ± 0.1
1 - 2	1.0 ± 0.4	"	"	"	3.5 ± 0.4	3.5 ± 0.4
2 - 3	0.9 ± 0.2	"	"	"	3.6 ± 0.9	3.6 ± 0.9
3 - 4	1.2 ± 0.2	"	"	"	3.6 ± 0.4	3.6 ± 0.4
4 - 5	1.1 ± 0.1	"	"	"	6.2 ± 0.7	6.2 ± 0.7
5 - 7.5	1.0 ± 0.3	"	"	"	7.9 ± 0.1	7.9 ± 0.1
7.5 - 10	1.4 ± 0.3	"	"	"	6.0 ± 0.2	6.0 ± 0.2
10 - 15	1.4 ± 0.3	"	"	"	8.8 ± 1.2	8.8 ± 1.2
15 - 25	0.7 ± 0.2	"	"	"	9.0 ± 2.0	9.0 ± 2.0
25 - 35	0.9 ± 0.1	"	"	"	7.2 ± 0.8	7.2 ± 0.8
35 - 45	0.5 ± 0.2	"	"	"	9.0 ± 0.4	9.0 ± 0.4
45 - 55	0.5 ± 0.2	"	"	"	9.9 ± 0.1	9.9 ± 0.1

Table H-20. Zinc in SC Soil Background

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	2.1 ± 0.6	< 0.1	< 0.2	< 0.2	16 ± 5	16 ± 5
0 - 1	2.1 ± 0.4	"	"	"	14 ± 1	14 ± 1
1 - 2	1.4 ± 0.4	"	"	"	14 ± 2	14 ± 2
2 - 3	1.1 ± 0.4	"	"	"	13 ± 4	13 ± 4
3 - 4	1.1 ± 0.6	"	"	"	14 ± 4	14 ± 4
4 - 5	1.1 ± 0.6	"	"	"	21 ± 0.0	21 ± 0.0
5 - 7.5	0.8 ± 0.1	"	"	"	28 ± 2	28 ± 2
7.5 - 10	0.6 ± 0.1	"	"	"	20 ± 2	20 ± 2
10 - 15	0.4 ± 0.0	"	"	"	21 ± 1	21 ± 1
15 - 25	0.3 ± 0.1	"	"	"	26 ± 1	26 ± 1
25 - 35	0.4 ± 0.1	"	"	"	22 ± 0.5	22 ± 0.5
35 - 45	0.4 ± 0.0	"	"	"	29 ± 3	29 ± 3
45 - 55	0.3 ± 0.1	"	"	"	28 ± 1	28 ± 1

Table H-21. Cadmium in Acid CL Soil Lysimeters

January, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	16.0 ± 2.0	0.5 ± 0.1	< 0.2	3.4 ± 1.0	7.0 ± 0.5	11.0 ± 1.1
0 - 1	2.2 ± 0.3	1.0 ± 0.5	"	< 0.2	4.7 ± 2.0	5.7 ± 2.1
1 - 2	< 0.3	< 0.2	"	"	< 0.3	< 0.3
2 - 3	< 11	"	"	"	"	"
3 - 4	"	"	"	"	"	"
4 - 5	"	"	"	"	"	"
5 - 7.5	---	"	"	"	"	"
7.5 - 10	---	"	"	"	"	"
10 - 15	---	"	"	"	"	"
15 - 25	---	"	"	"	"	"
25 - 35	---	"	"	"	"	"
35 - 45	---	---	---	---	---	---
45 - 55	---	"	"	"	"	"

Table H-22. Copper in Acid CL Soil Lysimeters

January, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	5.2 ± 0.6	< 0.1	0.5 ± 0.1	2.0 ± 0.2	8.8 ± 2.0	11.0 ± 2.0
0 - 1	3.4 ± 0.5	"	< 0.2	< 0.2	5.3 ± 1.0	5.3 ± 1.0
1 - 2	1.0 ± 0.1	"	"	"	4.0 ± 1.0	4.0 ± 1.0
2 - 3	1.1 ± 0.2	"	"	"	4.8 ± 1.1	4.8 ± 1.1
3 - 4	0.6 ± 0.2	"	"	"	2.7 ± 0.3	2.7 ± 0.3
4 - 5	0.6 ± 0.1	"	"	"	---	---
5 - 7.5	---	"	"	"	4.3 ± 1.2	4.3 ± 1.2
7.5 - 10	---	"	"	"	3.0 ± 0.2	3.0 ± 0.2
10 - 15	---	"	"	"	1.9 ± 0.4	1.9 ± 0.4
15 - 25	---	"	"	"	1.9 ± 0.3	1.9 ± 0.3
25 - 35	---	"	"	"	1.6 ± 0.5	1.6 ± 0.5
35 - 45	---	"	"	"	2.2 ± 0.0	2.2 ± 0.0
45 - 55	---	"	"	"	3.8 ± 0.5	3.8 ± 0.5

Table H-23. Lead in Acid CL Soil Lysimeters

January, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	7.9 ± 0.7	< 0.3	< 0.5	< 0.5	26 ± 2	26 ± 2
0 - 1	3.1 ± 0.4	"	"	"	24 ± 4	24 ± 4
1 - 2	2.4 ± 0.5	"	"	"	18 ± 1	18 ± 1
2 - 3	2.0 ± 0.2	"	"	"	24 ± 2	24 ± 2
3 - 4	1.8 ± 0.4	"	"	"	22 ± 4	22 ± 4
4 - 5	1.3 ± 0.2	"	"	"	---	---
5 - 7.5	---	"	"	"	21 ± 1	21 ± 1
7.5 - 10	---	"	"	"	14 ± 4	14 ± 4
10 - 15	---	"	"	"	17 ± 4	17 ± 4
15 - 25	---	"	"	"	16 ± 4	16 ± 4
25 - 35	---	"	"	"	12 ± 0	12 ± 0
35 - 45	---	"	"	"	12 ± 1	12 ± 1
45 - 55	---	"	"	"	15 ± 2	15 ± 2

Table H-24. Nickel in Acid CL Soil Lysimeters

January, 1974

(in ppm-dry wt.)

	Fraction I	Fraction II				
Depth (in.)	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	4.8 ± 1.0	< 0.4	0.7 ± 0.4	1.3 ± 0.4	47 ± 8.0	49 ± 8.0
0 - 1	2.2 ± 0.5	"	< 0.5	1.0 ± 0.2	37 ± 9.0	38 ± 9.0
1 - 2	1.3 ± 0.2	"	"	< 0.5	36 ± 3.0	36 ± 3.0
2 - 3	1.6 ± 0.1	"	"	"	27 ± 2.0	27 ± 2.0
3 - 4	2.9 ± 0.4	"	"	"	30 ± 1.0	30 ± 1.0
4 - 5	1.5 ± 0.1	"	"	"	31 ± 1.0	31 ± 1.0
5 - 7.5	---	"	"	"	53 ± 9.0	53 ± 9.0
7.5 - 10	---	"	"	"	33 ± 1.0	33 ± 1.0
10 - 15	---	"	"	"	28 ± 0.5	28 ± 0.5
15 - 25	---	"	"	"	27 ± 2.0	27 ± 2.0
25 - 35	---	"	"	"	23 ± 4.0	23 ± 4.0
35 - 45	---	"	"	"	---	---
45 - 55	---	"	"	"	29 ± 1.0	29 ± 1.0

Table H-25. Zinc in Acid CL Soil Lysimeters

January, 1974

(in ppm-dry wt.)

	Fraction I	Fraction II				
Depth (in.)	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	7.5	0.7 ± 0.2	< 0.2	3.0 ± 0.5	49 ± 3	53 ± 3
0 - 1	4.9	1.2 ± 0.5	"	< 0.2	53 ± 14	54 ± 14
1 - 2	3.9	< 0.1	"	"	78 ± 5	78 ± 5
2 - 3	3.1	"	"	"	80 ± 7	80 ± 7
3 - 4	1.8	"	"	"	73 ± 6	73 ± 6
4 - 5	1.3	"	"	"	75 ± 11	75 ± 11
5 - 7.5	---	"	"	"	80 ± 14	80 ± 14
7.5 - 10	---	"	"	"	60 ± 2	60 ± 2
10 - 15	---	"	"	"	64 ± 4	64 ± 4
15 - 25	---	"	"	"	67 ± 10	67 ± 10
25 - 35	---	"	"	"	70 ± 6	70 ± 6
35 - 45	---	"	"	"	47 ± 1	47 ± 1
45 - 55	---	"	"	"	62 ± 9	62 ± 9

Table H-26. **Cadmium in Basic CL Soil Lysimeters**

January, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	7.7 ± 2.0	< 0.2	< 0.2	< 0.2	17.0 ± 1.7	17.0 ± 1.7
0 - 1	1.5 ± 1.1	"	"	"	0.4 ± 0.1	0.4 ± 0.1
1 - 2	0.4 ± 0.2	"	"	"	< 0.3	< 0.3
2 - 3	0.8 ± 0.4	"	"	"	"	"
3 - 4	< 0.3	"	"	"	"	"
4 - 5	"	"	"	"	"	"
5 - 7.5	"	"	"	"	"	"
7.5 - 10	"	"	"	"	"	"
10 - 15	"	"	"	"	"	"
15 - 25	"	"	"	"	"	"
25 - 35	"	"	"	"	"	"
35 - 45	"	"	"	"	"	"
45 - 55	"	"	"	"	"	"

Table H-27. **Copper in Basic CL Soil Lysimeters**

January, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	5.1 ± 1.0	< 0.1	< 0.2	1.4 ± 0.3	20.0 ± 1.0	21.0 ± 1.0
0 - 1	3.9 ± 0.8	"	"	1.1 ± 0.7	4.2 ± 0.7	5.3 ± 1.0
1 - 2	1.5 ± 0.6	"	"	< 0.2	9.3 ± 0.6	9.3 ± 0.6
2 - 3	1.2 ± 0.5	"	"	"	6.1 ± 0.5	6.1 ± 0.5
3 - 4	0.6 ± 0.6	"	"	"	6.2 ± 1.0	6.2 ± 1.0
4 - 5	1.2 ± 0.7	"	"	"	6.8 ± 0.9	6.8 ± 0.9
5 - 7.5	---	"	"	"	6.1 ± 0.8	6.1 ± 0.8
7.5 - 10	---	---	---	---	---	---
10 - 15	---	< 0.1	< 0.2	< 0.2	7.2 ± 1.1	7.2 ± 1.1
15 - 25	---	"	"	"	6.8 ± 0.7	6.8 ± 0.7
25 - 35	---	---	---	---	---	---
35 - 45	---	---	---	---	---	---
45 - 55	---	< 0.1	< 0.2	< 0.2	6.3 ± 0.6	6.3 ± 0.6

Table H-28. Lead in Basic CL Soil Lysimeters

January, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	6.8 ± 2.0	< 0.3	< 0.5	< 0.5	23.0 ± 2.0	23.0 ± 2.0
0 - 1	1.9 ± 1.1	"	"	"	6.6 ± 2.1	6.6 ± 2.1
1 - 2	1.2 ± 0.8	"	"	"	9.8 ± 1.6	9.8 ± 1.6
2 - 3	0.8 ± 0.3	"	"	"	8.6 ± 2.0	8.6 ± 2.0
3 - 4	0.9 ± 0.3	"	"	"	8.4 ± 2.1	8.4 ± 2.1
4 - 5	0.6 ± 0.8	"	"	"	8.2 ± 1.9	8.2 ± 1.9
5 - 7.5	---	"	"	"	7.9 ± 3.0	7.9 ± 3.0
7.5 - 10	---	---	---	---	---	---
10 - 15	---	< 0.3	< 0.5	< 0.5	7.9 ± 2.1	7.9 ± 2.1
15 - 25	---	"	"	"	10.0 ± 2.4	10.0 ± 2.4
25 - 35	---	---	---	---	---	---
35 - 45	---	---	---	---	---	---
45 - 55	---	"	"	"	7.2 ± 1.9	7.2 ± 1.9

Table H-29. Nickel in Basic CL Soil Lysimeters

January, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	11.0 ± 2.5	< 0.4	< 0.5	2.0 ± 0.5	24.0 ± 9.0	26.0 ± 9.0
0 - 1	1.8 ± 0.4	"	"	< 0.5	12.0 ± 3.0	12.0 ± 3.0
1 - 2	< 0.3	"	"	"	9.8 ± 1.1	9.8 ± 1.1
2 - 3	< 0.3	"	"	"	10.0 ± 2.0	10.0 ± 2.0
3 - 4	< 0.3	"	"	"	9.2 ± 0.9	9.2 ± 0.9
4 - 5	< 0.3	"	"	"	8.8 ± 1.1	8.8 ± 1.1
5 - 7.5	---	"	"	"	10.0 ± 1.3	10.0 ± 1.3
7.5 - 10	---	---	---	---	---	---
10 - 15	---	< 0.4	< 0.5	< 0.5	12.0 ± 1.4	12.0 ± 1.4
15 - 25	---	"	"	"	10.0 ± 2.0	10.0 ± 2.0
25 - 35	---	---	---	---	---	---
35 - 45	---	---	---	---	---	---
45 - 55	---	"	"	"	9.9 ± 1.1	9.9 ± 1.1

Table H-30. Zinc in Basic CL Soil Lysimeters

January, 1974

(in ppm-dry wt.)

	Fraction I	Fraction II				
Depth (in.)	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	15.0 ± 4.0	< 0.1	< 0.2	1.0 ± 0.2	55.0 ± 12.0	56.0 ± 12.0
0 - 1	3.3 ± 2.0	"	"	< 0.2	29.0 ± 5.0	29.0 ± 5.0
1 - 2	1.2 ± 0.5	"	"	"	26.0 ± 3.0	26.0 ± 3.0
2 - 3	0.8 ± 0.3	"	"	"	26.0 ± 5.0	26.0 ± 5.0
3 - 4	1.0 ± 0.4	"	"	"	36.0 ± 6.0	36.0 ± 6.0
4 - 5	0.9 ± 0.2	"	"	"	22.0 ± 4.0	22.0 ± 4.0
5 - 7.5	---	"	"	"	30.0 ± 5.0	30.0 ± 5.0
7.5 - 10	---	---	---	---	---	---
10 - 15	---	< 0.1	< 0.2	< 0.2	26.0 ± 3.0	26.0 ± 3.0
15 - 25	---	"	"	"	25.0 ± 4.0	25.0 ± 4.0
25 - 35	---	---	---	---	---	---
35 - 45	---	---	---	---	---	---
45 - 55	---	< 0.1	< 0.2	< 0.2	26.0 ± 3.0	26.0 ± 3.0

Table H-31. **Cadmium in SM(d/u)** Soil Lysimeters

January, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	8.7	< 0.2	10.0 ± 5.0	1.0 ± 0.2	10.0 ± 4.0	21.0 ± 6.4
0 - 1	4.5	"	1.0 ± 0.2	0.8 ± 0.4	2.2 ± 1.0	4.0 ± 1.1
1 - 2	< 0.3	"	< 0.2	< 0.2	< 0.3	< 0.3
2 - 3	"	"	"	"	"	"
3 - 4	"	"	"	"	"	"
4 - 5	"	"	"	"	"	"
5 - 7.5	---	"	"	"	"	"
7.5 - 10	---	"	"	"	"	"
10 - 15	---	"	"	"	"	"
15 - 25	---	"	"	"	"	"
25 - 35	---	"	"	"	"	"
35 - 45	---	"	"	"	"	"
45 - 55	---	"	"	"	"	"

Table H-32. Copper in SM(d/u) Soil Lysimeters

January, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	11.0 ± 4.0	1.0 ± 0.1	1.0 ± 0.4	2.0 ± 0.5	12.0 ± 3.0	16.0 ± 3.0
0 - 1	2.0 ± 0.5	< 0.1	< 0.2	2.2 ± 0.2	5.5 ± 2.0	6.7 ± 2.0
1 - 2	0.4 ± 0.2	"	"	< 0.2	1.8 ± 0.1	1.8 ± 0.1
2 - 3	0.7 ± 0.4	"	"	"	1.3 ± 0.1	1.3 ± 0.1
3 - 4	0.6 ± 0.2	"	"	"	1.4 ± 0.1	1.4 ± 0.1
4 - 5	0.5 ± 0.1	"	"	"	2.2 ± 0.3	2.2 ± 0.3
5 - 7.5	---	"	"	"	3.6 ± 0.4	3.6 ± 0.4
7.5 - 10	---	"	"	"	2.2 ± 0.2	2.2 ± 0.2
10 - 15	---	"	"	"	2.1 ± 0.2	2.1 ± 0.2
15 - 25	---	"	"	"	1.4 ± 0.1	1.4 ± 0.1
25 - 35	---	"	"	"	2.1 ± 0.2	2.1 ± 0.2
35 - 45	---	"	"	"	1.0 ± 0.1	1.0 ± 0.1
45 - 55	---	"	"	"	1.9 ± 0.1	1.9 ± 0.1

Table H-33. **Lead in SM(d/u)** Soil Lysimeters

January, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	6.8 ± 1.4	< 0.3	< 0.5	< 0.5	22.0 ± 3.0	22.0 ± 3.0
0 - 1	1.9 ± 0.6	"	"	"	7.7 ± 0.8	7.7 ± 0.8
1 - 2	1.2 ± 0.4	"	"	"	3.5 ± 0.0	3.5 ± 0.0
2 - 3	0.8 ± 0.4	"	"	"	4.5 ± 0.6	4.5 ± 0.6
3 - 4	0.9 ± 0.3	"	"	"	3.7 ± 1.4	3.7 ± 1.4
4 - 5	0.6 ± 0.3	"	"	"	4.9 ± 0.3	4.9 ± 0.3
5 - 7.5	---	"	"	"	4.5 ± 0.5	4.5 ± 0.5
7.5 - 10	---	"	"	"	4.0 ± 0.2	4.0 ± 0.2
10 - 15	---	"	"	"	---	---
15 - 25	---	"	"	"	3.3 ± 0.2	3.3 ± 0.2
25 - 35	---	"	"	"	3.6 ± 0.0	3.6 ± 0.0
35 - 45	---	"	"	"	1.7 ± 0.1	1.7 ± 0.1
45 - 55	---	"	"	"	1.9 ± 0.2	1.9 ± 0.2

Table H-34. **Nickel in SM(d/u)** Soil Lysimeters

January, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	11.3 ± 4.0	< 0.4	< 0.5	3.0 ± 0.2	11.0 ± 2.0	14.0 ± 2.0
0 - 1	1.8 ± 1.0	"	"	< 0.5	2.5 ± 0.4	2.5 ± 0.4
1 - 2	< 0.3	"	"	"	1.4 ± 0.2	1.4 ± 0.2
2 - 3	"	"	"	"	1.8 ± 0.2	1.8 ± 0.2
3 - 4	"	"	"	"	1.4 ± 0.1	1.4 ± 0.1
4 - 5	"	"	"	"	---	---
5 - 7.5	---	"	"	"	2.0 ± 0.2	2.0 ± 0.2
7.5 - 10	---	"	"	"	1.6 ± 0.1	1.6 ± 0.1
10 - 15	---	"	"	"	2.1 ± 0.0	2.1 ± 0.0
15 - 25	---	"	"	"	2.3 ± 0.1	2.3 ± 0.1
25 - 35	---	"	"	"	2.5 ± 0.2	2.5 ± 0.2
35 - 45	---	"	"	"	2.0 ± 0.1	2.0 ± 0.1
45 - 55	---	"	"	"	2.3 ± 0.2	2.3 ± 0.2

Table H-35. Zinc in SM(d/u) Soil Lysimeters

January, 1974

(in ppm-dry wt.)

	Fraction I	Fraction II				
Depth (in.)	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	15.0 ± 6.0	0.7 ± 0.3	5.5 ± 0.6	0.9 ± 0.1	26.0 ± 6.0	33.0 ± 6.0
0 - 1	3.3 ± 1.0	<	2.0 ± 0.2	<	7.8 ± 1.0	9.8 ± 1.0
1 - 2	1.2 ± 0.3	"		"	4.4 ± 0.1	5.3 ± 0.1
2 - 3	0.8 ± 0.1	"	"	"	4.3 ± 0.7	4.3 ± 0.7
3 - 4	1.0 ± 0.2	"	"	"	4.1 ± 1.0	4.1 ± 1.0
4 - 5	0.9 ± 0.2	"	"	"	4.8 ± 0.3	4.8 ± 0.3
5 - 7.5	---	"	"	"	3.6 ± 0.4	3.6 ± 0.4
7.5 - 10	---	"	"	"	3.7 ± 0.3	3.7 ± 0.3
10 - 15	---	"	"	"	3.9 ± 0.2	3.9 ± 0.2
15 - 25	---	"	"	"	2.6 ± 0.2	2.6 ± 0.2
25 - 35	---	"	"	"	3.4 ± 0.1	3.4 ± 0.1
35 - 45	---	"	"	"	3.0 ± 0.3	3.0 ± 0.3
45 - 55	---	"	"	"	3.0 ± 0.2	3.0 ± 0.2

Table H-36. Cadmium in SC Soil Lysimeters

January, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	4.6 ± 2.1	< 0.2	1.3 ± 0.6	< 0.2	7.4 ± 3.4	8.7 ± 3.4
0 - 1	1.4 ± 0.4	"	< 0.2	"	1.0 ± 0.6	1.0 ± 0.6
1 - 2	< 0.3	"	"	"	< 0.3	< 0.3
2 - 3	"	"	"	"	"	"
3 - 4	"	"	"	"	"	"
4 - 5	"	"	"	"	"	"
5 - 7.5	----	----	----	----	----	----
7.5 - 10	----	< 0.2	< 0.2	< 0.2	< 0.3	< 0.3
10 - 15	----	"	"	"	"	"
15 - 25	----	----	----	----	----	----
25 - 35	----	< 0.2	< 0.2	< 0.2	< 0.3	< 0.3
35 - 45	----	"	"	"	"	"
45 - 55	----	"	"	"	"	"

Table H-37. Copper in SC Soil Lysimeters

January, 1974

(in ppm-dry wt.)

	Fraction I	Fraction II				
Depth (in.)	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	3.0 ± 1.0	< 0.1	< 0.2	2.6 ± 0.9	11.0 ± 5.6	14.0 ± 5.6
0 - 1	0.8 ± 0.3	"	"	< 0.2	7.6 ± 2.0	7.6 ± 2.0
1 - 2	1.0 ± 0.4	"	"	"	4.2 ± 1.4	4.2 ± 1.4
2 - 3	0.6 ± 0.2	"	"	"	3.7 ± 1.9	3.7 ± 1.9
3 - 4	0.9 ± 0.3	"	"	"	3.1 ± 2.0	3.1 ± 2.0
4 - 5	1.2 ± 0.4	"	"	"	4.2 ± 1.3	4.2 ± 1.3
5 - 7.5	----	"	"	"	5.8 + 1.7	5.8 ± 1.7
7.5 - 10	----	----	----	----	----	----
10 - 15	----	< 0.1	< 0.2	< 0.2	4.9 ± 1.0	4.9 ± 1.0
15 - 25	----	----	----	----	----	----
25 - 35	----	< 0.1	< 0.2	< 0.2	4.7 ± 1.1	4.7 ± 1.1
35 - 45	----	"	"	"	4.5 ± 0.7	4.5 ± 0.7
45 - 55	----	"	"	"	4.9 ± 1.4	4.9 ± 1.4

Table H-38. Lead in SC Soil Lysimeters

January, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	2.8 ± 0.7	< 0.3	< 0.5	< 0.5	15.0 ± 6.0	15.0 ± 6.0
0 - 1	1.2 ± 0.5	"	"	"	12.0 ± 1.5	12.0 ± 1.5
1 - 2	1.5 ± 0.5	"	"	"	11.0 ± 3.0	11.0 ± 3.0
2 - 3	1.3 ± 0.3	"	"	"	9.1 ± 2.0	9.1 ± 2.0
3 - 4	1.7 ± 0.6	"	"	"	11.0 ± 4.0	11.0 ± 4.0
4 - 5	1.6 ± 0.4	"	"	"	8.2 ± 5.3	8.2 ± 5.3
5 - 7.5	----	"	"	"	8.5 ± 4.0	8.5 ± 4.0
7.5 - 10	----	----	----	----	----	----
10 - 15	----	< 0.3	< 0.5	< 0.5	7.8 ± 2.0	7.8 ± 2.0
15 - 25	----	----	----	----	----	----
25 - 35	----	< 0.3	< 0.5	< 0.5	7.9 ± 3.0	7.9 ± 3.0
35 - 45	----	"	"	"	8.3 ± 2.0	8.3 ± 2.0
45 - 55	----	"	"	"	8.1 ± 4.0	8.1 ± 4.0

Table H-39. Nickel in SC Soil Lysimeters

January, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	4.1 ± 3.1	< 0.4	< 0.5	3.8 ± 2.4	9.2 ± 5.0	13.0 ± 5.5
0 - 1	0.6 ± 0.3	"	"	1.7 ± 1.2	8.5 ± 4.5	10.0 ± 4.7
1 - 2	1.0 ± 0.3	"	"	< 0.5	9.1 ± 3.4	9.1 ± 3.4
2 - 3	0.7 ± 0.1	"	"	"	7.5 ± 5.0	7.5 ± 5.0
3 - 4	0.8 ± 0.2	"	"	"	6.5 ± 1.6	6.5 ± 1.6
4 - 5	1.0 ± 0.1	"	"	"	6.6 ± 3.4	6.6 ± 3.4
5 - 7.5	----	"	"	"	7.4 ± 2.1	7.4 ± 2.0
7.5 - 10	----	----	----	----	----	----
10 - 15	----	< 0.4	< 0.5	< 0.5	7.0 ± 1.7	7.0 ± 1.7
15 - 25	----	----	----	----	----	----
25 - 35	----	< 0.4	< 0.5	< 0.5	6.8 ± 1.8	6.8 ± 1.8
35 - 45	----	"	"	"	8.1 ± 0.7	8.1 ± 0.7
45 - 55	----	"	"	"	9.1 ± 1.2	9.1 ± 1.2

Table H-40. Zinc in SC Soil Lysimeters

January, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	2.9 ± 2.4	< 0.1	< 0.2	1.6 ± 1.2	22 ± 7	24 ± 7
0 - 1	1.1 ± 0.3	"	"	< 0.2	18 ± 9	18 ± 9
1 - 2	0.8 ± 0.6	"	"	"	26 ± 2	26 ± 2
2 - 3	0.7 ± 0.1	"	"	"	20 ± 0	20 ± 0
3 - 4	0.7 ± 0.4	"	"	"	18 ± 5	18 ± 5
4 - 5	1.1 ± 0.6	"	"	"	19 ± 10	19 ± 10
5 - 7.5	----	"	"	"	20 ± 9	20 ± 9
7.5 - 10	----	----	----	----	----	----
10 - 15	----	< 0.1	< 0.2	< 0.2	10 ± 2	10 ± 2
15 - 25	----	----	----	----	-----	----
25 - 35	----	< 0.1	< 0.2	< 0.2	25 ± 4	25 ± 4
35 - 45	----	"	"	"	22 ± 4	22 ± 4
45 - 55	----	"	"	"	23 ± 2	23 ± 2

Table H-41. Cadmium in Acid CL Soil Lysimeters

May, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	50. ± 4.	<0.2	4.6 ± 1.0	1.2 ± 0.6	21. ± 12.	27. ± 12.
0 - 1	3.6 ± 1.1	"	<0.2	<0.2	4.2 ± 0.3	4.2 ± 0.3
1 - 2	0.5 ± 0.3	"	"	"	2.3 ± 1.2	2.3 ± 1.2
2 - 3	<0.3	"	"	"	1.2 ± 0.2	1.2 ± 0.2
3 - 4	0.4 ± 0.0	"	"	"	0.6 ± 0.3	0.6 ± 0.3
4 - 5	<0.3	"	"	"	0.7 ± 0.1	0.7 ± 0.1
5 - 7.5	0.5 ± 0.2	"	"	"	1.4 ± 0.0	1.4 ± 0.0
7.5 - 10	<0.3	"	"	"	<0.3	<0.3
10 - 15	<0.3	----	----	----	----	----
15 - 25	<0.3	----	----	----	----	----
25 - 35	<0.3	----	----	----	----	----
35 - 45	----	----	----	----	----	----
45 - 55	<0.3	----	----	----	----	----

Table H-42. Copper in Acid CL Soil Lysimeters

May, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	20. ± 6.	0.6	<0.2	0.4	22. ± 5.	23. ± 5.
0 - 1	3.0 ± 1.2	<0.1	"	<0.2	5.1 ± 0.6	5.1 ± 0.6
1 - 2	0.8 ± 0.4	"	"	"	3.0 ± 0.4	3.0 ± 0.4
2 - 3	0.4 ± 0.1	"	"	"	2.4 ± 0.6	2.4 ± 0.6
3 - 4	0.5 ± 0.1	"	"	"	2.8 ± 0.8	2.8 ± 0.8
4 - 5	0.4 ± 0.3	"	"	"	2.3 ± 0.8	2.3 ± 0.8
5 - 7.5	0.6 ± 0.2	"	"	"	3.9 ± 2.2	3.9 ± 2.2
7.5 - 10	0.4 ± 0.2	"	"	"	2.8 ± 0.5	2.8 ± 0.5
10 - 15	0.3 ± 0.0	----	----	----	----	----
15 - 25	0.2 ± 0.1	----	----	----	----	----
25 - 35	<0.2	----	----	----	----	----
35 - 45	----	----	----	----	----	----
45 - 55	<0.2	----	----	----	----	----

Table H-43. **Lead in Acid CL Soil Lysimeters**

May, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	21. ± 6.	<0.3	<0.5	<0.5	41 ± 8	41 ± 8
0 - 1	3.4 ± 1.1	"	"	"	26 ± 5	26 ± 5
1 - 2	2.2 ± 0.8	"	"	"	21 ± 8	21 ± 8
2 - 3	2.1 ± 0.6	"	"	"	23 ± 3	23 ± 3
3 - 4	2.2 ± 0.6	"	"	"	20 ± 5	20 ± 5
4 - 5	1.9 ± 0.4	"	"	"	18 ± 7	18 ± 7
5 - 7.5	2.1 ± 0.5	"	"	"	22 ± 4	22 ± 4
7.5 - 10	2.4 ± 0.5	"	"	"	23 ± 8	23 ± 8
10 - 15	2.4 ± 0.5	----	----	----	----	----
15 - 25	0.6 ± 0.2	----	----	----	----	----
25 - 35	1.3 ± 0.4	----	----	----	----	----
35 - 45	----	----	----	----	----	----
45 - 55	1.8 ± 0.1	----	----	----	----	----

Table H-44. Nickel in Acid CL Soil Lysimeters

May, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	20. ± 4.	0.8 ± 0.4	<0.5	1.2 ± 0.5	67 ± 16	69 ± 16
0 - 1	4.0 ± 1.0	0.4 ± 0.0	"	<0.5	37 ± 8	37 ± 8
1 - 2	2.5 ± 0.6	<0.4	"	"	43 ± 9	43 ± 9
2 - 3	2.4 ± 0.6	"	"	"	28 ± 3	28 ± 3
3 - 4	2.5 ± 0.7	"	"	"	29 ± 9	29 ± 9
4 - 5	1.7 ± 0.3	"	"	"	30 ± 11	30 ± 11
5 - 7.5	1.8 ± 0.5	"	"	"	41 ± 9	41 ± 9
7.5 - 10	1.2 ± 0.5	"	"	"	47 ± 6	47 ± 6
10 - 15	1.5 ± 0.3	----	----	----	----	----
15 - 25	0.6 ± 0.3	----	----	----	----	----
25 - 35	0.7 ± 0.2	----	----	----	----	----
35 - 45	----	----	----	----	----	----
45 - 55	1.0 ± 0.4	----	----	----	----	----

Table H-45. Zinc in Acid CL Soil Lysimeters

May, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	31. ± 9.	0.8 ± 0.4	0.3 ± 0.1	0.2 ± 0.1	119 ± 21	120 ± 21
0 - 1	5.2 ± 2.8	0.6 ± 0.4	<0.2	<0.2	78 ± 4	79 ± 4
1 - 2	2.8 ± 0.8	0.3 ± 0.2	"	"	73 ± 25	73 ± 25
2 - 3	1.7 ± 0.0	<0.1	"	"	72 ± 12	72 ± 12
3 - 4	1.7 ± 0.4	"	"	"	64 ± 11	64 ± 11
4 - 5	1,6 ± 0.9	"	"	"	56 ± 18	56 ± 18
5 - 7.5	2.0 ± 0.7	"	"	"	77 ± 15	77 ± 15
7.5 - 10	1.0 ± 0.8	"	"	"	85 ± 26	85 ± 26
10 - 15	1.1 ± 0.3	----	----	----	----	----
15 - 25	0.7 ± 0.2	----	----	----	----	----
25 - 35	1.3 ± 0.5	----	----	----	----	----
35 - 45	----	----	----	----	----	----
45 - 55	1.2 ± 0.5	----	----	----	----	----

Table H-46. Cadmium in SM(d/u) Soil Lysimeters

May, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	58. ± 11.	0.5 ± 0.2	20. ± 5.	1.2 ± 0.5	24. ± 8.	46. ± 9.
0 - 1	9.1 ± 6.2	<0.2	1.5 ± 0.8	<0.2	2.3 ± 1.1	3.8 ± 1.4
1 - 2	0.4 ± 0.1	"	<0.2	"	<0.3	<0.3
2 - 3	<0.3	"	"	"	"	"
3 - 4	<0.3	"	"	"	"	"
4 - 5	0.4 ± 0.3	"	"	"	"	"
5 - 7.5	0.9 ± 0.4	"	"	"	"	"
7.5 - 10	<0.3	"	"	"	"	"
10 - 15	"	----	----	----	----	----
15 - 25	"	----	----	----	----	----
25 - 35	"	----	----	----	----	----
35 - 45	----	----	----	----	----	----
45 - 55	<0.3	----	----	----	----	----

Table H-47. Copper in SM(d/u) Soil Lysimeters

May, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	28. ± 7.	0.5 ± 0.3	1.0 ± 0.3	3.8 ± 1.0	22. ± 8.	27. ± 8.
0 - 1	8.1 ± 2.9	<0.1	<0.2	<0.2	6.3 ± 1.3	6.3 ± 1.3
1 - 2	0.7 ± 0.1	"	"	"	2.3 ± 0.5	2.3 ± 0.5
2 - 3	0.4 ± 0.1	"	"	"	1.8 ± 0.4	1.8 ± 0.4
3 - 4	0.4 ± 0.0	"	"	"	2.0 ± 0.5	2.0 ± 0.5
4 - 5	0.3 ± 0.2	"	"	"	2.0 ± 0.4	2.0 ± 0.4
5 - 7.5	1.7 ± 0.7	"	"	"	3.2 ± 0.6	3.2 ± 0.6
7.5 - 10	0.4 ± 0.2	"	"	"	2.2 ± 0.7	2.2 ± 0.7
10 - 15	0.5 ± 0.1	----	----	----	----	----
15 - 25	0.8 ± 0.2	----	----	----	----	----
25 - 35	0.7 ± 0.1	----	----	----	----	----
35 - 45	----	----	----	----	----	----
45 - 55	0.6 ± 0.2	----	----	----	----	----

Table H-48. Lead in SM(d/u) Soil Lysimeters

May, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	37. ± 6.	<0.3	<0.5	<0.5	38. ± 15.	38. ± 15.
0 - 1	6.2 ± 2.8	"	"	"	11. ± 3.	11. ± 3.
1 - 2	0.9 ± 0.3	"	"	"	5.4 ± 0.7	5.4 ± 0.7
2 - 3	0.7 ± 0.3	"	"	"	4.0 ± 1.4	4.0 ± 1.4
3 - 4	0.9 ± 0.3	"	"	"	4.2 ± 1.6	4.2 ± 1.6
4 - 5	0.7 ± 0.1	"	"	"	3.3 ± 0.9	3.3 ± 0.9
5 - 7.5	1.8 ± 0.8	"	"	"	6.2 ± 1.5	6.2 ± 1.5
7.5 - 10	0.7 ± 0.1	"	"	"	4.3 ± 2.0	4.3 ± 2.0
10 - 15	1.0 ± 0.1	----	----	----	----	----
15 - 25	1.3 ± 0.1	----	----	----	----	----
25 - 35	0.9 ± 0.3	----	----	----	----	----
35 - 45	----	----	----	----	----	----
45 - 55	1.5 ± 0.2	----	----	----	----	----

Table H-49. Nickel in SM(d/u) Soil Lysimeters

May, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	29. ± 9.	1.1 ± 0.1	<0.5	4.9 ± 2.0	28. ± 11.	34. ± 11.
0 - 1	4.8 ± 2.1	<0.4	"	<0.5	5.8 ± 1.6	5.8 ± 1.6
1 - 2	0.9 ± 0.2	"	"	"	3.4 ± 1.3	3.4 ± 1.3
2 - 3	1.0 ± 0.6	"	"	"	----	----
3 - 4	1.1 ± 0.6	"	"	"	4.0 ± 0.9	4.0 ± 0.9
4 - 5	0.6 ± 0.3	"	"	"	----	----
5 - 7.5	2.2 ± 0.6	"	"	"	2.6 ± 0.1	2.6 ± 0.1
7.5 - 10	0.6 ± 0.3	"	"	"	2.1 ± 0.1	2.1 ± 0.1
10 - 15	0.8 ± 0.3	----	----	----	----	----
15 - 25	1.0 ± 0.2	----	----	----	----	----
25 - 35	0.7 ± 0.2	----	----	----	----	----
35 - 45	----	----	----	----	----	----
45 - 55	0.6 ± 0.2	----	----	----	----	----

Table H-50. Zinc in SM(d/u) Soil Lysimeters

May, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	34. ± 11.	0.7 ± 0.2	2.6 ± 0.4	0.4 ± 0.2	50. ± 20.	54. ± 20.
0 - 1	6.4 ± 2.6	<0.1	0.3	<0.2	9.7 ± 1.2	10. ± 1.2
1 - 2	0.7 ± 0.1	"	<0.2	"	5.0 ± 1.6	5.0 ± 1.6
2 - 3	0.9 ± 0.3	"	"	"	4.1 ± 1.4	4.1 ± 1.4
3 - 4	0.8 ± 0.4	"	"	"	4.1 ± 1.1	4.1 ± 1.1
4 - 5	0.9 ± 0.3	"	"	"	3.2 ± 0.1	3.2 ± 0.1
5 - 7.5	1.4 ± 0.6	"	"	"	7.7 ± 1.7	7.7 ± 1.7
7.5 - 10	0.4 ± 0.6	"	"	"	4.2 ± 1.6	4.2 ± 1.6
10 - 15	0.5 ± 0.1	----	----	----	----	----
15 - 25	0.8 ± 0.3	----	----	----	----	----
25 - 35	0.5 ± 0.1	----	----	----	----	----
35 - 45	----	----	----	----	----	----
45 - 55	0.6 ± 0.2	----	----	----	----	----

Table H-51. Cadmium in Basic CL Soil Lysimeters

May, 1974

(in ppm-dry wt.)

	Fraction I	Fraction II				
Depth (in.)	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	21.0 ± 5.0	< 0.2	12.0 ± 6	< 0.2	20.0 ± 11	32.0 ± 13
0 - 1	5.1 ± 2.5	"	< 0.2	"	2.4 ± 1.1	2.4 ± 1.1
1 - 2	1.3 ± 1.1	"	"	"	1.3 ± 1.4	1.3 ± 1.4
2 - 3	0.3 ± 0.2	"	"	"	< 0.3	< 0.3
3 - 4	< 0.3	"	"	"	"	"
4 - 5	"	"	"	"	"	"
5 - 7.5	"	"	"	"	"	"
7.5 - 10	"	"	"	"	"	"
10 - 15	----	----	----	----	----	----
15 - 25	----	----	----	----	----	----
25 - 35	----	----	----	----	----	----
35 - 45	----	----	----	----	----	----
45 - 55	----	----	----	----	----	----

Table H-52. Copper in Basic CL Soil Lysimeters

May, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	19.0 ± 4.0	0.4 ± 0.2	1.0 ± 0.2	< 0.2	19.0 ± 5.0	20.0 ± 5.0
0 - 1	6.0 ± 2.8	0.2 ± 0.1	< 0.2	"	8.2 ± 1.4	8.4 ± 1.4
1 - 2	2.2 ± 0.5	< 0.1	"	"	7.7 ± 1.0	7.7 ± 1.0
2 - 3	2.3 ± 0.6	"	"	"	6.8 ± 0.9	6.8 ± 0.9
3 - 4	2.5 ± 0.6	"	"	"	7.5 ± 1.2	7.5 ± 1.2
4 - 5	2.1 ± 0.6	"	"	"	6.7 ± 1.6	6.7 ± 1.6
5 - 7.5	2.2 ± 0.9	"	"	"	7.7 ± 1.1	7.7 ± 1.1
7.5 - 10	1.8 ± 0.4	"	"	"	6.4 ± 2.0	6.4 ± 2.0
10 - 15	2.5 ± 0.4	----	----	----	----	----
15 - 25	1.9 ± 0.6	----	----	----	----	----
25 - 35	1.6 ± 0.4	----	----	----	----	----
35 - 45	1.6 ± 0.4	----	----	----	----	----
45 - 55	1.5 ± 0.4	----	----	----	----	----

Table H-53. Lead in Basic CL Soil Lysimeters

May, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	18.0 ± 4.0	< 0.3	< 0.5	< 0.5	25.0 ± 9.0	25.0 ± 9.0
0 - 1	3.8 ± 2.6	"	"	"	12.0 ± 5.0	12.0 ± 5.0
1 - 2	2.9 ± 1.1	"	"	"	8.4 ± 2.3	8.4 ± 2.3
2 - 3	2.6 ± 0.7	"	"	"	8.1 ± 2.8	8.1 ± 2.8
3 - 4	2.4 ± 0.8	"	"	"	8.5 ± 1.6	8.5 ± 1.6
4 - 5	2.5 ± 0.5	"	"	"	7.3 ± 2.1	7.3 ± 2.1
5 - 7.5	1.9 ± 0.6	"	"	"	7.2 ± 3.5	7.2 ± 3.5
7.5 - 10	1.7 ± 0.4	"	"	"	6.0 ± 0.9	6.0 ± 0.9
10 - 15	2.8 ± 0.2	----	----	----	----	----
15 - 25	2.5 ± 0.7	----	----	----	----	----
25 - 35	2.2 ± 0.7	----	----	----	----	----
35 - 45	----	----	----	----	----	----
45 - 55	1.9 ± 0.6	----	----	----	----	----

Table H-54. Nickel in Basic CL Soil Lysimeters

May, 1974

(in ppm-dry wt.)

	Fraction I	Fraction II				
Depth (in.)	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	16.0 ± 3.0	0.9 ± 0.4	< 0.5	< 0.5	27.0 ± 10	28 ± 10
0 - 1	3.9 ± 2.2	0.8 ± 0.2	"	"	9.6 ± 1.7	11 ± 2
1 - 2	1.2 ± 0.3	< 0.4	"	"	11.0 ± 2	11 ± 2
2 - 3	0.9 ± 0.5	"	"	"	10.0 ± 2	10 ± 2
3 - 4	0.6 ± 0.3	"	"	"	8.9 ± 1.5	8.9 ± 1.5
4 - 5	0.7 ± 0.3	"	"	"	8.1 ± 1.1	8.1 ± 1.1
5 - 7.5	0.6 ± 0.2	"	"	"	8.1 ± 2.9	8.1 ± 2.9
7.5 - 10	0.8 ± 0.3	"	"	"	8.4 ± 2.5	8.4 ± 2.5
10 - 15	1.8 ± 0.4	----	----	----	----	----
15 - 25	1.7 ± 0.6	----	----	----	----	----
25 - 35	1.3 ± 0.6	----	----	----	----	----
35 - 45	----	----	----	----	----	----
45 - 55	1.0 ± 0.4	----	----	----	----	----

Table H-55. Zinc in Basic CL Soil Lysimeters

May, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	16.0 ± 3.0	< 0.1	< 0.2	< 0.2	45 ± 13	45 ± 13
0 - 1	3.5 ± 1.4	"	"	"	24 ± 5	24 ± 5
1 - 2	1.7 ± 1.0	"	"	"	25 ± 3	25 ± 3
2 - 3	1.5 ± 0.8	"	"	"	23 ± 3	23 ± 3
3 - 4	0.7 ± 0.3	"	"	"	25 ± 4	25 ± 4
4 - 5	0.7 ± 0.2	"	"	"	21 ± 2	21 ± 2
5 - 7.5	0.6 ± 0.2	"	"	"	22 ± 7	22 ± 7
7.5 - 10	0.4 ± 0.1	"	"	"	20 ± 4	20 ± 4
10 - 15	0.9 ± 0.1	----	----	----	----	----
15 - 25	0.8 ± 0.4	----	----	----	----	----
25 - 35	0.5 ± 0.2	----	----	----	----	----
35 - 45	----	----	----	----	----	----
45 - 55	0.4 ± 0.1	----	----	----	----	----

Table H-56. Cadmium in SC Soil Lysimeters

May, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	22.0 ± 6.0	0.5 ± 0.2	11.0 ± 6.0	2.5 ± 1.0	11.0 ± 3.0	25.0 ± 7.0
0 - 1	2.7 ± 1.6	0.2 ± 0.1	0.5 ± 0.1	0.2 ± 0.1	2.1 ± 0.1	3.0 ± 0.9
1 - 2	0.6 ± 0.3	0.3 ± 0.1	0.9 ± 0.2	< 0.2	< 0.3	1.2 ± 0.2
2 - 3	0.5 ± 0.4	< 0.2	< 0.2	"	"	< 0.3
3 - 4	0.3 ± 0.2	"	"	"	"	"
4 - 5	0.4 ± 0.3	"	"	"	"	"
5 - 7.5	< 0.3	"	"	"	"	"
7.5 - 10	"	----	----	----	----	----
10 - 15	"	----	----	----	----	----
15 - 25	"	----	----	----	----	----
25 - 35	"	----	----	----	----	----
35 - 45	"	----	----	----	----	----
45 - 55	"	----	----	----	----	----

Table H-57. Copper in SC Soil Lysimeters

May, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	13.0 ± 3.0	0.6 ± 0.2	0.3 ± 0.2	0.4 ± 0.1	15.0 ± 2.0	16.0 ± 2.0
0 - 1	2.4 ± 1.2	0.2 ± 0.0	< 0.2	< 0.2	6.0 ± 1.6	6.2 ± 1.6
1 - 2	1.3 ± 0.6	0.3 ± 0.1	"	"	4.6 ± 1.3	4.9 ± 1.3
2 - 3	1.6 ± 0.8	0.2 ± 0.0	"	"	4.9 ± 0.9	5.1 ± 0.9
3 - 4	1.3 ± 0.4	< 0.1	"	"	4.9 ± 1.1	4.9 ± 1.1
4 - 5	1.1 ± 0.2	"	"	"	4.4 ± 2.1	4.4 ± 2.1
5 - 7.5	1.3 ± 0.6	"	"	"	7.0 ± 1.3	7.0 ± 1.3
7.5 - 10	1.1 ± 0.2	"	"	"	6.3 ± 0.6	6.3 ± 0.6
10 - 15	1.3 ± 0.4	----	----	----	----	----
15 - 25	1.4 ± 0.1	----	----	----	----	----
25 - 35	1.2 ± 0.1	----	----	----	----	----
35 - 45	----	----	----	----	----	----
45 - 55	1.4 ± 0.2	----	----	----	----	----

Table H-58. **Lead in SC Soil Lysimeters**

May, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	15.0 ± 4.0	< 0.3	< 0.5	< 0.5	21.0 ± 2.0	21.0 ± 2.0
0 - 1	3.2 ± 1.1	"	"	"	7.8 ± 1.0	7.8 ± 1.0
1 - 2	2.6 ± 0.8	"	"	"	5.7 ± 1.7	5.7 ± 1.7
2 - 3	2.5 ± 1.2	"	"	"	6.9 ± 2.1	6.9 ± 2.1
3 - 4	1.5 ± 0.6	"	"	"	6.2 ± 1.3	6.2 ± 1.3
4 - 5	1.5 ± 0.7	"	"	"	6.0 ± 1.9	6.0 ± 1.9
5 - 7.5	1.6 ± 0.6	"	"	"	9.1 ± 0.9	9.1 ± 0.9
7.5 - 10	1.3 ± 0.4	"	"	"	8.6 ± 1.0	8.6 ± 1.0
10 - 15	2.6 ± 0.6	----	----	----	----	----
15 - 25	3.2 ± 0.3	----	----	----	----	----
25 - 35	2.9 ± 0.3	----	----	----	----	----
35 - 45	----	----	----	----	----	----
45 - 55	2.5 ± 0.4	----	----	----	----	----

Table H-59. **Nickel in SC Soil Lysimeters**

May, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	11.0 ± 4.0	0.9 ± 0.1	< 0.5	2.1 ± 0.2	21.0 ± 2.0	24.0 ± 2.0
0 - 1	1.8 ± 0.7	0.8 ± 0.2	"	< 0.5	7.8 ± 1.0	8.6 ± 1.0
1 - 2	1.7 ± 1.3	1.0 ± 0.2	"	"	5.7 ± 1.7	6.7 ± 1.7
2 - 3	1.5 ± 0.6	0.6 ± 0.1	"	"	6.9 ± 2.1	7.5 ± 2.1
3 - 4	1.4 ± 0.4	0.7 ± 0.1	"	"	6.2 ± 1.3	6.9 ± 1.3
4 - 5	1.6 ± 0.6	< 0.4	"	"	6.0 ± 1.9	6.0 ± 1.9
5 - 7.5	2.1 ± 0.6	"	"	"	9.1 ± 0.9	9.1 ± 0.9
7.5 - 10	1.7 ± 0.4	"	"	"	8.6 ± 1.0	8.6 ± 1.0
10 - 15	2.2 ± 0.3	----	----	----	----	----
15 - 25	2.1 ± 0.5	----	----	----	----	----
25 - 35	1.8 ± 0.7	----	----	----	----	----
35 - 45	----	----	----	----	----	----
45 - 55	1.6 ± 0.6	----	----	----	----	----

Table H-60. Zinc in SC Soil Lysimeters

May, 1974

(in ppm-dry wt.)

	Fraction I	Fraction II				
Depth (in.)	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	20.0 ± 16.0	1.6 ± 0.2	0.6 ± 0.2	0.9 ± 0.0	20.0 ± 3.0	23.0 ± 3.0
0 - 1	5.6 ± 6.5	1.3 ± 0.3	0.4 ± 0.3	1.0 ± 0.3	8.4 ± 2.4	11.0 ± 3.0
1 - 2	3.2 ± 3.6	1.1 ± 0.1	< 0.2	0.4 ± 0.1	9.3 ± 3.1	10.0 ± 3.0
2 - 3	0.7 ± 0.4	1.7 ± 0.5	"	< 0.2	8.6 ± 2.1	10.0 ± 2.0
3 - 4	0.4 ± 0.2	0.9 ± 0.4	"	"	9.0 ± 1.8	9.9 ± 1.8
4 - 5	0.3 ± 0.1	1.0 ± 0.5	"	"	7.7 ± 3.2	8.7 ± 3.2
5 - 7.5	0.4 ± 0.2	0.8 ± 0.2	"	"	9.4 ± 0.8	10.0 ± 0.8
7.5 - 10	0.2 ± 0.1	< 0.1	"	"	8.8 ± 0.6	8.8 ± 0.6
10 - 15	0.4 ± 0.1	----	----	----	----	----
15 - 25	0.4 ± 0.0	----	----	----	----	----
25 - 35	0.4 ± 0.0	----	----	----	----	----
35 - 45	----	----	----	----	----	----
45 - 55	0.4 ± 0.1	----	----	----	----	----

Table H-61. Cadmium in Basic CL Land Plot

May, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	33.0 ± 3.0	< 0.2	< 0.2	< 0.2	31.0 ± 9.0	31.0 ± 9.0
0 - 1	2.8 ± 2.5	"	"	"	2.2 ± 0.0	2.2 ± 0.0
1 - 2	0.6 ± 0.4	"	"	"	< 0.3	< 0.3
2 - 3	0.6 ± 0.3	"	"	"	"	"
3 - 4	< 0.3	"	"	"	"	"
4 - 5	0.5 ± 0.2	"	"	"	"	"
5 - 7.5	< 0.3	"	"	"	"	"
7.5 - 10	"	"	"	"	"	"
10 - 15	"	----	----	----	----	----
15 - 25	"	----	----	----	----	----
25 - 35	"	----	----	----	----	----
35 - 45	"	----	----	----	----	----
45 - 55	"	----	----	----	----	----

Table H-62. Copper in Basic CL Land Plot

May, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	20.0 ± 0.0	0.3 ± 0.1	0.6 ± 0.2	< 0.2	22.0 ± 1.0	23.0 ± 1.0
0 - 1	3.8 ± 2.0	< 0.2	< 0.2	"	9.4 ± 0.4	9.4 ± 0.4
1 - 2	1.8 ± 0.2	"	"	"	8.5 ± 0.4	8.5 ± 0.4
2 - 3	1.5 ± 0.3	"	"	"	7.7 ± 1.0	7.7 ± 1.0
3 - 4	1.5 ± 0.1	"	"	"	7.2 ± 0.1	7.2 ± 0.1
4 - 5	1.9 ± 0.2	"	"	"	11.0 ± 2.0	11.0 ± 2.0
5 - 7.5	1.6 ± 0.2	"	"	"	8.7 ± 1.3	8.7 ± 1.3
7.5 - 10	1.5 ± 0.1	"	"	"	9.3 ± 0.7	9.3 ± 0.7
10 - 15	2.9 ± 0.0	----	----	----	----	----
15 - 25	1.5 ± 0.0	----	----	----	----	----
25 - 35	1.8 ± 0.1	----	----	----	----	----
35 - 45	----	-----	----	----	----	----
45 - 55	1.0 ± 0.1	----	----	----	----	----

Table H-63. Lead in Basic CL Land Plot

May, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	23.0 ± 0.0	< 0.3	< 0.5	< 0.5	28.0 ± 6.0	28.0 ± 6.0
0 - 1	3.2 ± 1.7	"	"	"	8.8 ± 0.6	8.8 ± 0.6
1 - 2	2.3 ± 0.6	"	"	"	9.4 ± 0.1	9.4 ± 0.1
2 - 3	1.8 ± 0.2	"	"	"	8.7 ± 0.2	8.7 ± 0.2
3 - 4	1.6 ± 0.2	"	"	"	7.6 ± 0.8	7.6 ± 0.8
4 - 5	3.4 ± 0.7	"	"	"	9.9 ± 1.1	9.9 ± 1.1
5 - 7.5	2.2 ± 1.1	"	"	"	7.7 ± 0.4	7.7 ± 0.4
7.5 - 10	1.8 ± 0.4	"	"	"	8.7 ± 0.5	8.7 ± 0.5
10 - 15	3.5 ± 0.3	----	----	----	----	----
15 - 25	1.4 ± 0.2	----	----	----	----	----
25 - 35	1.7 ± 0.2	----	----	----	----	----
35 - 45	----	----	----	----	----	----
45 - 55	1.8 ± 0.3	----	----	----	----	----

Table H-64. Nickel in Basic CL Land Plot

May, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	22.0 ± 4.0	0.5 ± 0.2	< 0.5	0.9 ± 0.4	36 ± 8	37 ± 8
0 - 1	2.8 ± 1.9	< 0.4	"	< 0.5	14 ± 2	14 ± 2
1 - 2	2.8 ± 0.8	"	"	"	11 ± 1	11 ± 1
2 - 3	0.9 ± 0.4	"	"	"	11 ± 1	11 ± 1
3 - 4	0.6 ± 0.2	"	"	"	10 ± 0	10 ± 0
4 - 5	1.5 ± 0.7	"	"	"	18 ± 1	18 ± 1
5 - 7.5	2.1 ± 1.7	"	"	"	13 ± 4	13 ± 4
7.5 - 10	2.1 ± 0.2	"	"	"	13 ± 1	13 ± 1
10 - 15	2.4 ± 0.1	----	----	----	----	----
15 - 25	0.6 ± 0.0	----	----	----	----	----
25 - 35	0.9 ± 0.0	----	----	----	----	----
35 - 45	----	----	----	----	----	----
45 - 55	0.9 ± 0.3	----	----	----	----	----

Table H-65. Zinc in Basic CL Land Plot

May, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	20.0 ± 2.0	< 0.1	< 0.2	< 0.2	52 ± 3	5 ± 3
0 - 1	2.5 ± 1.7	"	"	"	29 ± 3	29 ± 3
1 - 2	1.2 ± 0.2	"	"	"	31 ± 2	31 ± 2
2 - 3	1.0 ± 0.4	"	"	"	28 ± 0	28 ± 0
3 - 4	0.7 ± 0.3	"	"	"	23 ± 1	23 ± 1
4 - 5	0.8 ± 0.1	"	"	"	23 ± 0	23 ± 0
5 - 7.5	1.0 ± 0.3	"	"	"	29 ± 2	29 ± 2
7.5 - 10	0.6 ± 0.1	"	"	"	26 ± 1	26 ± 1
10 - 15	1.4 ± 0.5	----	----	----	----	----
15 - 25	0.6 ± 0.1	----	----	----	----	----
25 - 35	0.7 ± 0.1	----	----	----	----	----
35 - 45	----	----	----	----	----	----
45 - 55	0.4 ± 0.0	----	----	----	----	----

Table H-66. Cadmium in SM(d/u) Land Plot

May, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	24. ± 1.	<0.2	15. ± 2.	1.0 ± 0.2	9.3 ± 1.7	25. ± 2.7
0 - 1	1.6 ± 0.3	"	1.0 ± 0.4	<0.2	0.9 ± 0.0	1.9 ± 0.4
1 - 2	<0.3	"	<0.2	"	<0.3	<0.3
2 - 3	"	"	"	"	"	"
3 - 4	"	"	"	"	"	"
4 - 5	"	"	"	"	"	"
5 - 7.5	"	"	"	"	"	"
7.5 - 10	"	"	"	"	"	"
10 - 15	----	----	----	----	----	----
15 - 25	----	----	----	----	----	----
25 - 35	----	----	----	----	----	----
35 - 45	----	-----	----	----	----	----
45 - 55	----	----	----	----	----	----

Table H-67. Copper in SM(d/u) Land Plot

May, 1974

(in ppm-dry wt.)

	Fraction I	Fraction II				
Depth (in.)	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	20.0 ± 5.0	0.2 ± 0.2	1.2 ± 0.6	5.1 ± 2.0	7.2 ± 1.8	14.0 ± 2.8
0 - 1	2.3 ± 1.0	< 0.1	< 0.2	< 0.2	1.4 ± 0.4	1.4 ± 0.4
1 - 2	0.4 ± 0.1	"	"	"	2.2 ± 0.1	2.2 ± 0.1
2 - 3	0.4 ± 0.1	"	"	"	2.2 ± 0.2	2.2 ± 0.2
3 - 4	0.4 ± 0.1	"	"	"	1.5 ± 0.1	1.5 ± 0.1
4 - 5	0.2 ± 0.0	"	"	"	1.9 ± 0.0	1.9 ± 0.0
5 - 7.5	0.4 ± 0.2	"	"	"	2.5 ± 0.4	2.5 ± 0.4
7.5 - 10	0.4 ± 0.0	"	"	"	2.9 ± 0.4	2.9 ± 0.4
10 - 15	----	----	----	----	----	----
15 - 25	----	----	----	----	----	----
25 - 35	----	----	----	----	----	----
35 - 45	----	----	----	----	----	----
45 - 55	----	----	----	----	----	----

Table H-68. Lead in SM(d/u) Land Plot

May, 1974

(in ppm-dry wt.)

	Fraction I	Fraction II				
Depth (in.)	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	17.0 ± 5.0	< 0.3	< 0.5	< 0.5	14.0 ± 4.0	14.0 ± 4.0
0 - 1	2.0 ± 0.2	"	"	"	1.4 ± 0.1	1.4 ± 0.1
1 - 2	0.7 ± 0.1	"	"	"	5.6 ± 0.0	5.6 ± 0.0
2 - 3	0.9 ± 0.4	"	"	"	4.5 ± 0.0	4.5 ± 0.0
3 - 4	0.6 ± 0.1	"	"	"	2.5 ± 0.3	2.5 ± 0.3
4 - 5	0.5 ± 0.1	"	"	"	4.5 ± 0.5	4.5 ± 0.5
5 - 7.5	0.8 ± 0.0	"	"	"	3.2 ± 1.8	3.2 ± 1.8
7.5 - 10	0.7 ± 0.2	"	"	"	5.6 ± 0.0	5.6 ± 0.0
10 - 15	----	----	----	----	----	----
15 - 25	----	----	----	----	----	----
25 - 35	----	----	----	----	----	----
35 - 45	----	----	----	----	----	----
45 - 55	----	----	----	----	----	----

Table H-69. Nickel in SM(d/u) Land Plot

May, 1974

(in ppm-dry wt.)

	Fraction I	Fraction II				
Depth (in.)	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	14.0 ± 2.0	0.9	< 0.5	7.1 ± 3.0	14.0 ± 2.0	22.0 ± 3.6
0 - 1	1.6 ± 0.4	< 0.4	"	1.0 ± 0.5	4.9 ± 0.1	5.9 ± 0.5
1 - 2	0.4 ± 0.0	"	"	< 0.5	1.4 ± 0.7	1.4 ± 0.7
2 - 3	0.3 ± 0.0	"	"	"	1.2 ± 0.3	1.2 ± 0.3
3 - 4	0.4 ± 0.0	"	"	"	1.7 ± 0.8	1.7 ± 0.8
4 - 5	0.3 ± 0.0	"	"	"	1.0 ± 0.0	1.0 ± 0.0
5 - 7.5	0.5 ± 0.1	"	"	"	3.3 ± 2.5	3.3 ± 2.5
7.5 - 10	0.5 ± 0.1	"	"	"	2.8 ± 0.4	2.8 ± 0.4
10 - 15	----	----	----	----	----	----
15 - 25	----	----	----	----	----	----
25 - 35	----	----	----	----	----	----
35 - 45	----	----	----	----	----	----
45 - 55	----	----	----	----	----	----

Table H-70. Zinc in SM(d/u) Land Plot

May, 1974

(in ppm-dry wt.)

	Fraction I	Fraction II				
Depth (in.)	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	20.0 ± 2.0	< 0.1	1.0 ± 0.5	0.2	18.0 ± 0	19.0 ± 0.5
0 - 1	2.2 ± 0.1	"	< 0.2	< 0.2	4.0 ± 1.2	4.2 ± 1.2
1 - 2	0.5 ± 0.1	"	"	"	3.8 ± 0.6	3.8 ± 0.6
2 - 3	0.7 ± 0.2	"	"	"	3.8 ± 0.2	3.8 ± 0.2
3 - 4	0.7 ± 0.1	"	"	"	2.6 ± 0.5	2.6 ± 0.5
4 - 5	0.4 ± 0.0	"	"	"	4.0 ± 0.0	4.0 ± 0.0
5 - 7.5	0.3 ± 0.1	"	"	"	4.1 ± 1.0	4.1 ± 1.0
7.5 - 10	0.2 ± 0.0	"	"	"	4.1 ± 0.9	4.1 ± 0.9
10 - 15	----	----	----	----	----	----
15 - 25	----	----	----	----	----	----
25 - 35	----	----	----	----	----	----
35 - 45	----	----	----	----	----	----
45 - 55	----	----	----	----	----	----

Table H-71. **Cadmium in Acid CL Lysimeters**

July, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	--	--	--	--	--	--
0 - 1	8.2 ± 3.3	< 0.1	0.6 ± 0.2	0.5 ± 0.1	6.3 ± 2.5	7.4 ± 2.5
1 - 2	3.3 ± 2.0	"	0.2 ± 0.1	< 0.2	1.3 ± 0.6	1.5 ± 0.6
2 - 3	1.5 ± 0.6	"	0.3 ± 0.2	"	1.5 ± 0.6	1.8 ± 0.6
3 - 4	*All Samples Below 3 Inches Contaminated*					
4 - 5						
5 - 7.5						
7.5 - 10						
10 - 15						
15 - 25						
25 - 35						
35 - 45						
45 - 55						

Table H-72. Copper in Acid CL Soil Lysimeters

July, 1974

(in ppm-dry wt.)

	Fraction I	Fraction II				
Depth (in.)	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	--	--	--	--	--	--
0 - 1	4.2 ± 1.5	0.2 ± 0.1	< 0.1	0.2 ± 0.1	8.2 ± 2.7	8.6 ± 2.7
1 - 2	1.2 ± 0.6	< 0.1	"	< 0.1	3.4 ± 0.5	3.4 ± 0.5
2 - 3	0.7 ± 0.2	"	"	"	3.9 ± 1.4	3.9 ± 1.4
3 - 4	0.8 ± 0.3	"	"	"	3.2 ± 0.4	3.2 ± 0.4
4 - 5	0.9 ± 0.5	"	"	"	3.3 ± 0.6	3.3 ± 0.6
5 - 7.5	0.3 ± 0.1	"	"	"	2.2 ± 0.2	2.2 ± 0.2
7.5 - 10	0.3 ± 0.1	"	"	"	3.6 ± 1.5	3.6 ± 1.5
10 - 15	0.1 ± 0.1	"	"	"	1.8 ± 0.1	1.8 ± 0.1
15 - 25	< 0.1	--	--	--	--	--
25 - 35	--	--	--	--	--	--
35 - 45	--	--	--	--	--	--
45 - 55	--	--	--	--	--	--

Table H-73. **Lead in Acid CL Soil Lysimeters**

July, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	--	--	--	--	--	--
0 - 1	5.0 ± 1.2	< 0.2	< 0.2	< 0.4	26 ± 5	26 ± 5
1 - 2	2.9 ± 0.9	"	"	"	21 ± 3	21 ± 3
2 - 3	2.5 ± 0.3	"	"	"	25 ± 3	25 ± 3
3 - 4	2.5 ± 0.3	"	"	"	21 ± 1	21 ± 1
4 - 5	2.2 ± 0.7	"	"	"	20 ± 1	20 ± 1
5 - 7.5	2.3 ± 0.2	"	"	"	15 ± 5	15 ± 5
7.5 - 10	2.2 ± 0.6	"	"	"	22 ± 4	22 ± 4
10 - 15	1.4 ± 0.3	"	"	"	21 ± 4	21 ± 4
15 - 25	1.5 ± 0.7	--	--	--	--	--
25 - 35	--	--	--	--	--	--
35 - 45	--	--	--	--	--	--
45 - 55	--	--	--	--	--	--

Table H-74. Nickel in Acid CL Soil Lysimeter

July, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface						
0 - 1	3.5 ± 1.2	< 0.4	< 0.2	0.8 ± 0.4	38 ± 5	39 ± 5
1 - 2	2.1 ± 0.5	"	"	0.5 ± 0.2	33 ± 5	34 ± 5
2 - 3	1.9 ± 0.4	"	"	0.4 ± 0.1	36 ± 5	36 ± 5
3 - 4	1.9 ± 0.5	"	"	0.5 ± 0.2	32 ± 5	32 ± 5
4 - 5	1.8 ± 0.3	"	"	< 0.3	29 ± 1	29 ± 1
5 - 7.5	2.0 ± 1.7	"	"	< 0.3	23 ± 4	23 ± 4
7.5 - 10	0.7 ± 0.4	"	"	< 0.3	37 ± 10	37 ± 10
10 - 15	0.5 ± 0.4	"	"	< 0.3	36 ± 7	36 ± 7
15 - 25	0.4 ± 0	--	--	--	--	--
25 - 35	--	--	--	--	--	--
35 - 45	--	--	--	--	--	--
45 - 55	--	--	--	--	--	--

Table H-75. Zinc in Acid [illegible] Soil Lysimeters

July, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	--	--	--	--	--	--
0 - 1	6.9 ± 3.6	0.6 ± 0.4	< 01	0.2 ± 0.2	88 ± 12	89 ± 12
1 - 2	2.9 ± 0.7	0.7 ± 0.5	"	0.2 ± 0.1	79 ± 12	80 ± 12
2 - 3	2.5 ± 0.5	< 0.1	"	0.2 ± 0.1	92 ± 15	92 ± 15
3 - 4	2.1 ± 0.3	"	"	0.2 ± 0.1	78 ± 8	78 ± 8
4 - 5	1.8 ± 0.2	"	"	0.2 ± 0.1	77 ± 5	77 ± 5
5 - 7.5	0.9 ± 0.3	"	"	< 0.1	53 ± 10	53 ± 10
7.5 - 10	0.9 ± 0.3	"	"	"	86 ± 27	86 ± 27
10 - 15	0.6 ± 0.1	"	"	"	78 ± 20	78 ± 20
15 - 25	0.6 ± 0.1	"	"	--	--	--
25 - 35	--	--	--	--	--	--
35 - 45	--	--	--	--	--	--
45 - 55	--	--	--	--	--	--

Table H-76. Cadmium in Basic CL Soil Lysimeters

July, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	--	--	--	--	--	--
0 - 1	11.0 ± 1.5	< 0.1	1.6 ± 0.8	1.1 ± 0.4	6.8 ± 1.3	9.5 ± 1.6
1 - 2	2.3 ± 0.3	"	0.2 ± 0.1	< 0.2	1.0 ± 0.3	1.2 ± 0.3
2 - 3	2.5 ± 0.6	"	0.1 ± 0.0	"	1.0 ± 0.2	1.1 ± 0.2
3 - 4	*All Samples Below 3 inches Contaminated*					
4 - 5						
5 - 7.5						
7.5 - 10						
10 - 15						
15 - 25						
25 - 35						
35 - 45						
45 - 55						

Table H-77. Copper in Basic CL Soil Lysimeters

July, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	--	--	--	--	--	--
0 - 1	8.8 ± 2.0	0.2 ± 0.1	0.1 ± 0.1	0.5 ± 0.1	14.0 ± 2.0	15.0 ± 2.0
1 - 2	3.2 ± 0.9	0.1 ± 0.0	< 0.1	0.2 ± 0.1	7.7 ± 1.7	10.0 ± 1.7
2 - 3	3.2 ± 1.1	< 0.1	"	0.1 ± 0.0	8.2 ± 1.7	8.3 ± 1.7
3 - 4	2.7 ± 0.6	"	"	0.3 ± 0.2	8.2 ± 0.9	8.6 ± 0.9
4 - 5	2.7 ± 0.3	"	"	0.1 ± 0.0	8.2 ± 0.6	8.3 ± 0.6
5 - 7.5	2.3 ± 0.4	"	"	< 0.1	8.3 ± 0.8	8.3 ± 0.8
7.5 - 10	1.7 ± 0.3	"	"	"	8.7 ± 0.9	8.7 ± 0.9
10 - 15	1.7 ± 0.4	"	"	"	7.9 ± 1.3	7.9 ± 1.3
15 - 25	2.0 ± 0.4	"	"	"	11.0 ± 2.0	11.0 ± 2.0
25 - 35	--	--	--	--	--	--
35 - 45	--	--	--	--	--	--
45 - 55	--	--	--	--	--	--

Table H-78. Lead in Basic CL Soil Lysimeters

July, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	--	--	--	--	--	--
0 - 1	7.2 ± 0.7	< 0.2	< 0.2	< 0.2	16.0 ± 2	16.0 ± 2.0
1 - 2	3.3 ± 1.3	"	"	"	8.6 ± 2.1	8.6 ± 2.1
2 - 3	3.3 ± 1.1	"	"	"	8.6 ± 2.5	8.6 ± 2.5
3 - 4	2.6 ± 0.7	"	"	"	8.4 ± 0.9	8.4 ± 0.9
4 - 5	2.6 ± 0.5	"	"	"	8.3 ± 1.1	8.3 ± 1.1
5 - 7.5	2.1 ± 0.3	"	"	"	8.1 ± 1.4	8.1 ± 1.4
7.5 - 10	1.2 ± 0.3	"	"	"	9.3 ± 2.1	9.3 ± 2.1
10 - 15	1.3 ± 0.5	"	"	"	8.0 ± 1.5	8.0 ± 1.5
15 - 25	1.5 ± 0.4	"	"	"	9.0 ± 0.5	9.0 ± 0.5
25 - 35	--	--	--	--	--	--
35 - 45	--	--	--	--	--	--
45 - 55	--	--	--	--	--	--

Table H-79. Nickel in Basic CL Soil Lysimeters

July, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	--	--	--	--	--	--
0 - 1	3.3 ± 0.5	< 0.4	< 0.4	1.4 ± 0.5	14.0 ± 4.0	15.0 ± 4.0
1 - 2	1.1 ± 0.7	"	"	0.4 ± 0.2	8.7 ± 1.8	9.1 ± 1.8
2 - 3	0.8 ± 0.1	"	"	0.4 ± 0.3	9.9 ± 1.3	10.3 ± 1.3
3 - 4	0.7 ± 0.1	"	"	0.4 ± 0.1	9.2 ± 1.1	9.6 ± 1.1
4 - 5	0.8 ± 0.4	"	"	< 0.3	9.0 ± 0.6	9.0 ± 0.6
5 - 7.5	0.4 ± 0.2	"	"	"	10.0 ± 1.4	10.0 ± 1.4
7.5 - 10	0.4 ± 0.2	"	"	"	10.2 ± 2.4	10.0 ± 2.4
10 - 15	< 0.4	"	"	"	10.0 ± 1.0	10.0 ± 1.0
15 - 25	0.9 ± 0.3	"	"	"	14.0 ± 0.0	14.0 ± 0.0
25 - 35	--	--	--	--	--	--
35 - 45	--	--	--	--	--	--
45 - 55	--	--	--	--	--	--

Table H-80. Zinc in Basic CL Soil Lysimeters

July, 1974

(in ppm-dry wt.)

	Fraction I	Fraction II				
Depth (in.)	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	--	--	--	--	--	--
0 - 1	6.9 ± 3.6	< 0.4	< 0.1	< 0.2	49 ± 3	49 ± 3
1 - 2	2.4 ± 1.0	"	"	"	28 ± 4	28 ± 4
2 - 3	2.6 ± 1.0	"	"	"	29 ± 6	29 ± 6
3 - 4	1.9 ± 0.9	"	"	"	29 ± 3	29 ± 3
4 - 5	1.7 ± 0.3	"	"	"	28 ± 3	28 ± 3
5 - 7.5	1.0 ± 0.3	"	"	"	29 ± 3	29 ± 3
7.5 - 10	0.6 ± 0.1	"	"	"	32 ± 5	32 ± 5
10 - 15	0.7 ± 0.3	"	"	"	29 ± 4	29 ± 4
15 - 25	0.7 ± 0.2	"	"	"	27 ± 4	27 ± 4
25 - 35	--	--	--	--	--	--
35 - 45	--	--	--	--	--	--
45 - 55	--	--	--	--	--	--

Table H-81. **Cadmium** in SM(d/u) Soil Lysimeters

July, 1974

(in ppm-dry wt.)

	Fraction I	Fraction II				
Depth (in.)	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	--	--	--	--	--	--
0 - 1	12.4 ± 5.5	0.1 ± 0.0	3.7 ± 1.9	0.7 ± 0.4	5.4 ± 1.3	9.9 ± 1.3
1 - 2	1.4 ± 0.7	< 0.1	0.4 ± 0.4	< 0.2	0.6 ± 0.2	1.0 ± 0.4
2 - 3	1.1 ± 0.7	"	0.3 ± 0.2	"	0.6 ± 0.2	0.9 ± 0.2
3 - 4	*All Samples Below 3 inches Contaminated*					
4 - 5						
5 - 7.5						
7.5 - 10						
10 - 15						
15 - 25						
25 - 35						
35 - 45						
45 - 55						

Table H-82. Copper in SM(d/u) Soil Lysimeters

July, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface						
0 - 1	9.3 ± 4.2	0.3 ± 0.2	0.31 ± 0.1	2.0 ± 0.6	11.0 ± 1.0	14.0 ± 1.2
1 - 2	1.8 ± 0.9	0.2 ± 0.2	< 0.1	0.6 ± 0.3	3.2 ± 1.1	4.0 ± 1.2
2 - 3	1.0 ± 0.7	< 0.1	"	0.2 ± 0.1	2.4 ± 0.5	2.6 ± 0.5
3 - 4	0.6 ± 0.2	< 0.1	"	0.2 ± 0.1	2.3 ± 0.4	2.5 ± 0.4
4 - 5	0.5 ± 0.2	< 0.1	"	< 0.1	2.1 ± 0.2	2.1 ± 0.2
5 - 7.5	1.5 ± 1.3	0.2 ± 0.2	"	0.5 ± 0.5	2.5 ± 0.3	3.2 ± 0.3
7.5 - 10	0.4 ± 0.1	< 0.1	"	< 0.1	2.7 ± 0.3	2.7 ± 0.3
10 - 15	0.3 ± 0	< 0.1	"	< 0.1	2.6 ± 0.2	2.6 ± 0.2
15 - 25	0.6 ± 0.4	--	--	--	--	--
25 - 35	--	--	--	--	--	--
35 - 45	--	--	--	--	--	--
45 - 55	--	--	--	--	--	--

Table H-83. Lead in SM(d/u) Soil Lysimeters

July, 1974

(in ppm-dry wt.)

	Fraction I	Fraction II				
Depth (in.)	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface						
0 - 1	8.5 ± 3.8	< 0.2	< 0.1	< 0.3	14.0 ± 1.0	14.0 ± 1.0
1 - 2	1.6 ± 0.9	"	"	"	4.5 ± 1.0	4.5 ± 1.0
2 - 3	2.5 ± 1.7	"	"	"	4.4 ± 0.8	4.4 ± 0.8
3 - 4	1.3 ± 0.8	"	"	"	4.7 ± 0.6	4.7 ± 0.6
4 - 5	0.8 ± 0.4	"	"	"	3.7 ± 0.8	3.7 ± 0.8
5 - 7.5	0.8 ± 0.5	"	"	"	4.6 ± 1.0	4.6 ± 1.0
7.5 - 10	0.6 ± 0.1	"	"	"	4.1 ± 0.7	4.1 ± 0.7
10 - 15	0.4 ± 0	"	"	"	4.1 ± 1.0	4.1 ± 1.0
15 - 25	0.8 ± 0.4	--	--	--	--	--
25 - 35	--	--	--	--	--	--
35 - 45	--	--	--	--	--	--
45 - 55	--	--	--	--	--	--

Table H-84. Nickel in SM(d/u) Soil Lysimeters

July, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface						
0 - 1	4.5 ± 2.1	< 0.4	< 0.4	2.7 ± 1.1	8.8 ± 1.4	11.5 ± 1.8
1 - 2	0.7 ± 0.6	< 0.1	< 0.1	0.6 ± 0.3	2.2 ± 0.6	2.8 ± 0.7
2 - 3	0.6 ± 0.3	"	"	< 0.3	2.0 ± 0.6	2.0 ± 0.6
3 - 4	< 0.4	"	"	< 0.3	1.9 ± 0.3	1.9 ± 0.3
4 - 5	< 0.4	"	"	< 0.3	1.7 ± 0.4	1.7 ± 0.4
5 - 7.5	< 0.4	"	"	< 0.3	3.1 ± 0.7	3.1 ± 0.7
7.5 - 10	< 0.4	"	"	< 0.3	2.8 ± 0.5	2.8 ± 0.5
10 - 15	< 0.4	"	"	< 0.3	2.3 ± 0.4	2.3 ± 0.5
15 - 25	0.4 ± 0.2	--	--	--	--	--
25 - 35	--	--	--	--	--	--
35 - 45	--	--	--	--	--	--
45 - 55	--	--	--	--	--	--

Table H-85. Zinc in SM(d/u) Soil Lysimeters

July, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface						
0 - 1	8.1 ± 3.9	0.4 ± 0.3	0.5 ± 0.3	0.2 ± 0.2	19.0 ± 2	20.0 ± 2
1 - 2	1.6 ± 1.1	0.2 ± 0.1	< .04	0.2 ± 0.1	0.6 ± 1.2	7.0 ± 1.2
2 - 3	1.1 ± 0.7	0.1 ± 0.1	"	< 0.2	5.9 ± 0.9	6.0 ± 0.9
3 - 4	1.0 ± 0.3	< 0.2	"	"	5.5 ± 0.8	5.5 ± 0.8
4 - 5	0.8 ± 0.1	< 0.2	"	"	4.6 ± 0.4	4.6 ± 0.4
5 - 7.5	1.0 ± 0.7	0.5 ± 0.5	"	"	7.5 ± 2.4	8.0 ± 2.5
7.5 - 10	0.5 ± 0.1	< 0.1	"	"	6.2 ± 1.5	6.2 ± 1.5
10 - 15	0.3 ± 0.1	< 0.1	"	"	5.5 ± 0.9	5.5 ± 0.9
15 - 25	0.3 ± 0	--	--	--	--	--
25 - 35	--	--	--	--	--	--
35 - 45	--	--	--	--	--	--
45 - 55	--	--	--	--	--	--

Table H-86. **Cadmium in SC Soil Lysimeters**

July, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	--	--	--	--	--	--
0 - 1	12.0 ± 5.5	< 0.1	2.2 ± 1.3	1.2 ± 0.6	4.6 ± 2.1	8.0 ± 2.5
1 - 2	2.1 ± 0.8	"	0.4 ± 0.2	0.5 ± 0.5	1.8 ± 1.7	2.7 ± 1.8
2 - 3	3.0 ± 1.6	"	0.4 ± 0.3	0.6 ± 0.4	1.4 ± 0.9	2.4 ± 1.0
3 - 4						
4 - 5						
5 - 7.5						
7.5 - 10						
10 - 15						
15 - 25						
25 - 35						
35 - 45						
45 - 55						

*All Samples Below 3 inches Contiminated

Table H-87. Copper in SC Soil Lysimeters

July, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	--	--	--	--	--	--
0 - 1	6.7 ± 2.6	0.3 ± 0.1	< 0.1	< 0.1	11.0 ± 2.0	11.0 ± 2.0
1 - 2	1.8 ± 0.4	< 0.1	"	"	6.3 ± 1.2	6.3 ± 1.2
2 - 3	1.7 ± 0.1	"	"	"	6.6 ± 0.6	6.6 ± 0.6
3 - 4	1.7 ± 0.5	"	"	"	6.3 ± 0.4	6.3 ± 0.4
4 - 5	1.6 ± 0.3	"	"	"	7.6 ± 0.7	7.6 ± 0.7
5 - 7.5	1.6 ± 0.5	"	"	"	6.7 ± 1.1	6.7 ± 1.1
7.5 - 10	1.3 ± 0.3	"	"	"	6.8 ± 0.7	6.8 ± 0.7
10 - 15	1.1 ± 0.2	"	"	"	6.0 ± 0.7	6.0 ± 0.7
15 - 25	1.1 ± 0.2	"	"	"	7.9 ± 1.1	7.9 ± 1.1
25 - 35	--	--	--	--	--	--
35 - 45	--	--	--	--	--	--
45 - 55	--	--	--	--	--	--

Table H-88. Lead in SC Soil Lysimeters

July, 1974

(in ppm-dry wt.)

	Fraction I	Fraction II				
Depth (in.)	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	--	--	--	--	--	--
0 - 1	7.2 ± 2.6	< 0.2	< 0.2	< 0.2	15.0 ± 2.3	15.0 ± 2.3
1 - 2	2.8 ± 0.4	"	"	"	10.0 ± 1.4	10.0 ± 1.4
2 - 3	3.0 ± 0.7	"	"	"	11.0 ± 3.0	11.0 ± 3.0
3 - 4	3.4 ± 1.0	"	"	"	9.8 ± 0.8	9.8 ± 0.8
4 - 5	2.4 ± 0.7	"	"	"	10.0 ± 0.6	10.0 ± 0.6
5 - 7.5	1.8 ± 0.5	"	"	"	9.4 ± 0.0	9.4 ± 0.0
7.5 - 10	1.5 ± 0.2	"	"	"	9.1 ± 0.9	9.1 ± 0.9
10 - 15	1.7 ± 0.3	"	"	"	8.4 ± 0.5	8.4 ± 0.5
15 - 25	1.7 ± 0.4	"	"	"	7.2 ± 1.4	7.2 ± 1.4
25 - 35	--	--	--	--	--	--
35 - 45	--	--	--	--	--	--
45 - 55	--	--	--	--	--	--

Table H-89. Nickel in SC Soil Lysimeters

July, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	—	—	—	—	—	—
0 - 1	3.9 ± 1.8	< 0.4	< 0.4	2.1 ± 0.6	12.0 ± 2	14.0 ± 2.1
1 - 2	1.4 ± 0.3	"	"	0.9 ± 0.1	6.5 ± 1.2	7.4 ± 1.2
2 - 3	1.7 ± 0.4	"	"	1.0 ± 0.2	6.3 ± 0.6	7.3 ± 0.6
3 - 4	1.5 ± 0.3	"	"	1.0 ± 0.2	5.9 ± 0.4	6.9 ± 0.4
4 - 5	1.8 ± 0.9	"	"	1.0 ± 0.2	7.6 ± 0.6	8.6 ± 0.6
5 - 7.5	1.6 ± 0.4	"	"	0.5 ± 0.3	7.7 ± 0.6	8.2 ± 0.7
7.5 - 10	1.6 ± 0.3	"	"	0.5 ± 0.2	8.2 ± 1.0	8.7 ± 1.0
10 - 15	1.6 ± 0.4	"	"	0.5 ± 0.0	7.9 ± 0.8	8.4 ± 0.8
15 - 25	1.5 ± 0.2	"	"	< 0.4	9.1 ± 0.7	9.5 ± 0.8
25 - 35	—	—	—	—	—	—
35 - 45	—	—	—	—	—	—
45 - 55	—	—	—	—	—	—

Table H-90. Zinc in SC Soil Lysimeters

July, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	--	--	--	--	--	--
0 - 1	8.5 ± 7.5	0.6 ± 0.3	0.2 ± 0.1	0.6 ± 0.2	32 ± 5	33 ± 5
1 - 2	2.4 ± 1.4	0.5 ± 0.4	< 0.2	0.3 ± 0.2	26 ± 2	27 ± 2
2 - 3	2.2 ± 1.4	< 0.2	< 0.2	0.2 ± 0.1	26 ± 6	26 ± 6
3 - 4	1.2 ± 0.6	"	< 0.1	0.2 ± 0.1	22 ± 2	22 ± 2
4 - 5	1.1 ± 0.5	"	"	0.2 ± 0.1	26 ± 2	26 ± 2
5 - 7.5	0.5 ± 0.4	"	"	< 0.2	26 ± 3	26 ± 3
7.5 - 10	0.5 ± 0.3	"	"	"	29 ± 2	29 ± 2
10 - 15	0.4 ± 0.1	"	"	"	26 ± 3	26 ± 3
15 - 25	0.2 ± 0.0	"	"	"	19 ± 5	19 ± 5
25 - 35	--	--	--	--	--	--
35 - 45	--	--	--	--	--	--
45 - 55	--	--	--	--	--	--

Table H-91. Cadmium in Basic CL Land Plot

July, 1974

(in ppm-dry wt.)

	Fraction I	Fraction II				
Depth (in.)	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	--	--	--	--	--	--
0 - 1	12.0 ± 1.0	< 0.1	1.1 ± 0.1	0.8 ± 0.0	5.5 ± 0.9	7.4 ± 0.9
1 - 2	1.6 ± 0.2	"	0.1 ± 0.0	< 0.2	0.7 ± 0.2	0.8 ± 0.2
2 - 3	1.4 ± 0.2	"	0.3 ± 0.2	"	0.8 ± 0.1	1.1 ± 0.2
3 - 4	*All Samples Below 3 inches Contaminated*					
4 - 5						
5 - 7.5						
7.5 - 10						
10 - 15						
15 - 25						
25 - 35						
35 - 45						
45 - 55						

Table H-92. Copper in Basic CL Land Plot

July, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	--	--	--	--	--	--
0 - 1	8.6 ± 1.0	0.2 ± 0.0	< 0.1	0.5 ± 0.0	12.0 ± 2.0	13.0 ± 2.0
1 - 2	3.0 ± 0.8	< 0.1	"	0.2 ± 0.0	8.1 ± 1.9	8.3 ± 1.9
2 - 3	3.1 ± 0.9	"	"	0.2 ± 0.0	8.4 ± 0.3	8.6 ± 0.3
3 - 4	4.1 ± 2.0	"	"	0.1 ± 0.0	7.6 ± 0.3	7.7 ± 0.3
4 - 5	3.3 ± 1.1	"	"	0.2 ± 0.1	7.8 ± 1.6	8.0 ± 1.6
5 - 7.5	2.9 ± 0.1	"	"	< 0.1	7.3 ± 0.4	7.3 ± 0.4
7.5 - 10	2.2 ± 0.2	"	"	"	6.8 ± 0.2	6.8 ± 0.2
10 - 15	2.6 ± 0.5	"	"	"	8.2 ± 14.	8.2 ± 1.4
15 - 25	1.9 ± 0.1	"	"	"	9.8 ± 0.3	9.8 ± 0.3
25 - 35	--	--	--	--	--	--
35 - 45	--	--	--	--	--	--
45 - 55	--	--	--	--	--	--

Table H-93. Lead in Basic Cl Land Plot

July, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	--	--	--	--	--	--
0 - 1	9.1 ± 0.2	< 0.2	< 0.2	< 0.3	14.0 ± 3.0	14.0 ± 3.0
1 - 2	3.4 ± 1.1	"	0.3 ± 0.1	"	8.2 ± 1.8	8.5 ± 1.8
2 - 3	3.4 ± 1.1	"	0.8 ± 0.7	"	8.2 ± 1.2	9.0 ± 1.4
3 - 4	3.8 ± 1.5	"	< 0.2	"	8.4 ± 0.3	8.4 ± 0.3
4 - 5	3.1 ± 0.9	"	"	"	8.5 ± 1.5	8.5 ± 1.5
5 - 7.5	2.8 ± 0.6	"	"	"	7.3 ± 0.3	7.2 ± 0.3
7.5 - 10	2.1 ± 0.3	"	"	"	7.0 ± 0.5	7.0 ± 0.5
10 - 15	1.8 ± 0.1	"	"	"	7.8 ± 0.8	7.8 ± 0.8
15 - 25	1.3 ± 0.1	"	"	"	8.4 ± 0.5	8.7 ± 0.5
25 - 35	--	--	--	--	--	--
35 - 45	--	--	--	--	--	--
45 - 55	--	--	--	--	--	--

Table H-94. Nickel in Basic CL Land Plot

July, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	--	--	--	--	--	--
0 - 1	5.2 ± 0.8	< 0.4	< 0.4	1.5 ± 0.2	14.0 ± 2.0	16.0 ± 2.0
1 - 2	1.4 ± 0.3	"	"	0.4 ± 0.1	8.6 ± 2.3	9.0 ± 2.3
2 - 3	1.4 ± 0.3	"	"	0.4 ± 0.2	9.2 ± 0.3	9.6 ± 0.36
3 - 4	1.8 ± 0.9	"	"	< 0.4	8.9 ± 0.1	8.9 ± 0.1
4 - 5	1.6 ± 0.6	"	"	"	8.7 ± 0.8	8.7 ± 0.8
5 - 7.5	1.8 ± 0.2	"	"	"	8.7 ± 0.3	8.7 ± 0.3
7.5 - 10	1.2 ± 0.2	"	"	"	8.0 ± 0.1	8.0 ± 0.1
10 - 15	1.2 ± 0.2	"	"	"	9.0 ± 1.6	9.0 ± 1.6
15 - 25	1.0 ± 0	"	"	"	12.0 ± 1.0	12.0 ± 1.0
25 - 35	--	--	--	--	--	--
35 - 45	--	--	--	--	--	--
45 - 55	--	--	--	--	--	--

Table H-95. Zinc in Basic CL Land Plot

July, 1974

(in ppm-dry wt.)

	Fraction I	Fraction II				
Depth (in.)	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	--	--	--	--	--	--
0 - 1	5.8 ± 1.0	< 0.1	< 0.1	< 0.2	38 ± 4	38 ± 4
1 - 2	1.8 ± 0.6	"	"	"	29 ± 5	29 ± 5
2 - 3	1.8 ± 0.7	"	"	"	30 ± 1	30 ± 1
3 - 4	2.0 ± 0.9	"	"	"	29 ± 0	29 ± 0
4 - 5	1.5 ± 0.3	"	"	"	28 ± 2	28 ± 2
5 - 7.5	1.3 ± 0.6	"	"	"	32 ± 3	32 ± 3
7.5 - 10	0.8 ± 0.1	"	"	"	25 ± 1	25 ± 1
10 - 15	0.7 ± 0.2	"	"	"	31 ± 3.0	31 ± 3
15 - 25	0.6 ± 0.1	"	"	"	23 ± 1	23 ± 1
25 - 35	--	--	--	--	--	--
35 - 45	--	--	--	--	--	--
45 - 55	--	--	--	--	--	--

Table H-96. Cadmium in Acid CL Soil Lysimeters

September, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	51 ± 26	< 0.2	4.4 ± 0.8	1.3 ± 0.7	46.0 ± 13	53.0 ± 13
0 - 1	3.7 ± 1.8	"	0.4 ± 0.1	0.5 ± 0.5	5.0 ± 1.2	5.9 ± 1.3
1 - 2	0.7 ± 0.5	"	0.2 ± 0.1	0.3 ± 0.1	0.7 ± 0.2	1.2 ± 0.2
2 - 3	0.6 ± 0.3	"	0.2 ± 0.0	0.3 ± 0.1	0.7 ± 0.5	1.2 ± 0.5
3 - 4	0.4 ± 0.3	"	< 0.1	< 0.2	0.7 ± 0.1	0.7 ± 0.1
4 - 5	0.3 ± 0.2	"	"	"	0.8 ± 0.3	0.8 ± 0.3
5 - 7.5	0.9 ± 0.5	"	"	"	1.0 ± 0.3	1.0 ± 0.3
7.5 - 10	0.3 ± 0.1	"	"	"	--	--
10 - 15	0.2 ± 0.1	"	"	"	0.3 ± 0.1	0.3 ± 0.1
15 - 25	< 0.2	"	"	"	0.3 ± 0.1	0.3 ± 0.1
25 - 35	< 0.2	"	"	"	0.4 ± 0.0	0.4 ± 0.0
35 - 45	--	--	--	--	--	--
45 - 55	< 0.2	< 0.2	< 0.1	< 0.2	< 0.3	< 0.3

Table H-97. Copper in Acid CL Soil Lysimeters

September, 1974

(in ppm-dry wt.)

	Fraction I	Fraction II				
Depth (in.)	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	26.0 ± 7.0	0.2 ± 0.1	0.9 ± 0.4	1.9 ± 0.4	34.0 ± 6.0	37.0 ± 6.0
0 - 1	6.4 ± 4.6	< 0.1	0.1 ± 0.0	0.5 ± 0.2	9.6 ± 2.1	10.0 ± 2.1
1 - 2	1.7 ± 0.7	"	< 0.1	0.4 ± 0.1	4.7 ± 1.3	5.1 ± 1.3
2 - 3	0.9 ± 0.2	"	"	0.3 ± 0.1	7.3 ± 0.8	7.6 ± 0.8
3 - 4	0.8 ± 0.2	"	"	< 0.1	5.7 ± 0.6	5.7 ± 0.6
4 - 5	0.7 ± 0.3	"	"	"	6.0 ± 2.3	6.0 ± 2.3
5 - 7.5	0.9 ± 0.5	"	"	"	8.1 ± 1.4	8.1 ± 1.4
7.5 - 10	0.6 ± 0.1	"	"	"	--	--
10 - 15	0.3 ± 0.1	"	"	"	3.8 ± 1.1	3.8 ± 1.1
15 - 25	0.3 ± 0.1	"	"	"	3.6 ± 1.0	3.6 ± 1.0
25 - 35	0.1 ± 0.0	"	"	"	2.7 ± 0.3	2.7 ± 0.3
35 - 45	--	--	--	--	--	--
45 - 55	0.2 ± 0.1	--	--	--	2.8 ± 0.4	2.8 ± 0.4

Table H-98. **Lead in Acid CL Soil Lysimeters**

September, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	35.0 ± 16	0.5 ± 0.2	< 0.2	0.4 ± 0.0	63 ± 11	64 ± 11
0 - 1	9.0 ± 3.0	0.3 ± 0.1	"	0.6 ± 0.5	34 ± 4	35 ± 4
1 - 2	4.5 ± 1.1	0.4 ± 0.0	"	0.4 ± 0.2	21 ± 4	22 ± 4
2 - 3	4.5 ± 1.7	< 0.2	"	0.3 ± 0.1	22 ± 2	22 ± 2
3 - 4	4.4 ± 1.2	"	"	< 0.2	30 ± 1	30 ± 1
4 - 5	4.2 ± 0.8	"	"	"	24 ± 4	24 ± 4
5 - 7.5	7.2 ± 1.5	"	"	"	26 ± 2	26 ± 2
7.5 - 10	6.3 ± 2.3	"	"	"	--	--
10 - 15	3.2 ± 1.1	"	"	"	27 ± 6	27 ± 6
15 - 25	2.3 ± 0.8	"	"	"	17 ± 3	17 ± 3
25 - 35	0.7 ± 0.1	"	"	"	24 ± 4	24 ± 4
35 - 45	--	--	--	--	--	--
45 - 55	0.9 ± 0.5	"	"	"	19 ± 6	19 ± 6

Table H-99. Nickel in Acid CL Lysimeters

September, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	3.7 ± 11	0.3 ± 0.1	0.6 ± 0.3	3.3 ± 1.1	118 ± 23	122 ± 23
0 - 1	6.8 ± 1.9	< 0.3	< 0.3	1.4 ± 0.3	70 ± 9	71 ± 9
1 - 2	4.7 ± 1.2	"	"	1.1 ± 0.2	39 ± 14	40 ± 14
2 - 3	4.6 ± 1.0	"	"	1.3 ± 0.2	82 ± 3	83 ± 3
3 - 4	4.0 ± 1.1	"	"	< 0.4	78 ± 26	78 ± 26
4 - 5	3.4 ± 1.0	"	"	"	69 ± 17	69 ± 17
5 - 7.5	4.5 ± 1.0	"	"	"	92 ± 9	92 ± 9
7.5 - 10	3.5 ± 0.2	"	"	"	—	—
10 - 15	1.6 ± 0.4	"	"	"	49 ± 17	49 ± 17
15 - 25	1.2 ± 0.3	"	"	"	71 ± 25	71 ± 25
25 - 35	0.6 ± 0.2	"	"	"	43 ± 4	43 ± 4
35 - 45	--	--	--	--	--	--
45 - 55	0.5 ± 0.2	--	--	--	35 ± 4	35 ± 4

Table H-100. Zinc in Acid CL Soil Lysimeters

September, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	46.0 ± 10.0	< 0.1	0.3 ± 0.1	0.7 ± 0.3	148 ± 21	149 ± 21
0 - 1	10.0 ± 5.0	"	< 0.1	0.4 ± 0.1	118 ± 12	118 ± 12
1 - 2	4.6 ± 1.6	"	"	0.3 ± 0.2	80 ± 12	80 ± 12
2 - 3	4.0 ± 1.0	"	"	0.4 ± 0.1	85 ± 5	85 ± 5
3 - 4	3.2 ± 0.8	"	"	< 0.2	103 ± 12	103 ± 12
4 - 5	2.2 ± 0.6	"	"	"	116 ± 41	116 ± 41
5 - 7.5	3.3 ± 1.1	"	"	"	118 ± 8	118 ± 8
7.5 - 10	1.4 ± 0.9	"	"	"	--	--
10 - 15	0.7 ± 0.2	"	"	"	78 ± 14	78 ± 14
15 - 25	0.8 ± 0.3	"	"	"	65 ± 8	65 ± 8
25 - 35	0.4 ± 0.0	"	"	"	93 ± 7	93 ± 7
35 - 45	--	--	--	--	--	--
45 - 55	1.3 ± 0.0	--	--	--	78 ± 5	78 ± 5

Table H-101. Cadmium in Basic CL Soil Lysimeters

September 1974

(in ppm-dry wt.)

	Fraction I	Fraction II				
Depth (in.)	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	34.0 ± 31.0	0.6 ± 0.9	9.3 ± 3.0	1.6 ± 0.8	39.0 ± 18.0	50.0 ± 18.0
0 - 1	4.7 ± 3.5	0.1 ± 0.0	1.3 ± 0.6	0.6 ± 0.2	4.9 ± 2.2	6.9 ± 2.3
1 - 2	1.6 ± 1.2	0.1 ± 0.1	0.5 ± 0.3	0.4 ± 0.2	1.1 ± 0.9	2.1 ± 1.0
2 - 3	0.7 ± 0.4	0.1 ± 0.0	0.4 ± 0.1	< 0.1	0.5 ± 0.2	1.0 ± 0.2
3 - 4	0.5 ± 0.1	< 0.1	< 0.1	"	0.8 ± 0.1	0.8 ± 0.1
4 - 5	0.4 ± 0.3	"	"	"	0.6 ± 0.2	0.6 ± 0.2
5 - 7.5	0.2 ± 0.1	"	"	"	--	--
7.5 - 10	0.2 ± 0.1	"	"	"	--	--
10 - 15	0.2 ± 0.1	"	"	"	0.2 ± 0.0	0.2 ± 0.0
15 - 25	0.2 ± 0.1	"	"	"	0.2 ± 0.0	0.2 ± 0.0
25 - 35	0.2 ± 0.0	"	"	"	0.2 ± 0.0	0.2 ± 0.0
35 - 45	--	--	--	--	--	--
45 - 55	0.1 ± 0.0	--	--	--	0.2 ± 0.0	0.2 ± 0.0

Table H-102. Copper in Basic CL Soil Lysimeters

September, 1974

(in ppm-dry wt.)

	Fraction I	Fraction II				
Depth (in.)	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	18.0 ± 12.0	0.2 ± 0.1	0.9 ± 0.6	3.5 ± 2.7	36 ± 14	41 ± 14
0 - 1	6.8 ± 1.8	0.1 ± 0.0	0.2 ± 0.0	0.7 ± 0.1	16 ± 3	17 ± 3
1 - 2	4.1 ± 2.1	< 0.1	0.2 ± 0.1	0.4 ± 0.2	11 ± 2	12 ± 2
2 - 3	3.4 ± 1.3	"	0.1 ± 0.0	0.3 ± 0.2	10 ± 1	10 ± 1
3 - 4	2.7 ± 0.3	"	< 0.1	< 0.1	11 ± 1	11 ± 1
4 - 5	2.5 ± 0.3	"	"	"	11 ± 1	11 ± 1
5 - 7.5	2.3 ± 0.3	"	"	"	11 ± 1	11 ± 1
7.5 - 10	2.1 ± 0.4	"	"	"	—	—
10 - 15	2.1 ± 0.0	"	"	"	9.8 ± 1.7	9.8 ± 1.7
15 - 25	2.0 ± 0.2	"	"	"	8.6 ± 1.7	8.6 ± 1.7
25 - 35	1.3 ± 0.3	"	"	"	6.9 ± 0.7	6.9 ± 0.7
35 - 45	—	--	--	--	--	--
45 - 55	1.7 ± 0.5	< 0.1	< 0.1	< 0.1	6.2 ± 0.8	6.2 ± 0.8

Table H-103. Lead in Basic CL Soil Lysimeters

September, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	32.0 ± 17.0	0.3 ± 0.1	0.5 ± 0.1	0.3 ± 0.2	49.0 ± 25.0	50.0 ± 25.0
0 - 1	10.0 ± 4.0	< 0.2	0.5 ± 0.1	0.3 ± 0.1	13.0 ± 2.0	14.0 ± 2.0
1 - 2	5.9 ± 2.4	0.3 ± 0.1	0.4 ± 0.1	0.3 ± 0.1	9.3 ± 1.5	10.0 ± 1.5
2 - 3	6.3 ± 2.1	< 0.2	0.4 ± 0.0	0.3 ± 0.1	7.5 ± 1.1	8.2 ± 1.1
3 - 4	6.4 ± 1.8	"	< 0.2	< 0.2	11.0 ± 1.0	11.0 ± 1.0
4 - 5	5.6 ± 1.1	"	"	"	9.5 ± 0.9	9.5 ± 0.9
5 - 7.5	3.8 ± 1.4	"	"	"	8.8 ± 1.7	8.8 ± 1.7
7.5 - 10	2.5 ± 0.7	"	"	"	--	--
10 - 15	2.0 ± 0.0	"	"	"	7.0 ± 0.7	7.0 ± 0.7
15 - 25	2.0 ± 0.0	"	"	"	6.4 ± 0.0	6.4 ± 0.0
25 - 35	1.7 ± 0.1	"	"	"	6.3 ± 1.5	6.3 ± 0.5
35 - 45	--	--	--	--	--	--
45 - 55	2.4 ± 0.5	< 0.2	< 0.2	< 0.2	5.8 ± 0.6	5.8 ± 0.6

Table H-104. Nickel in Basic CL Soil Lysimeter

September, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	31.0 ± 13.0	< 0.4	< 0.4	< 0.4	58 ± 14	58 ± 14
0 - 1	6.7 ± 2.2	"	"	"	23 ± 5	23 ± 5
1 - 2	2.5 ± 1.3	"	"	"	11 ± 1	11 ± 1
2 - 3	1.9 ± 0.5	"	"	"	22 ± 6	22 ± 6
3 - 4	1.8 ± 0.2	"	"	"	16 ± 3	16 ± 3
4 - 5	1.7 ± 0.2	"	"	"	19 ± 3	19 ± 3
5 - 7.5	1.7 ± 0.1	"	"	"	18 ± 2	18 ± 2
7.5 - 10	1.3 ± 0.2	"	"	"	--	--
10 - 15	1.4 ± 0.2	"	"	"	12 ± 2	12 ± 2
15 - 25	1.8 ± 0.3	"	"	"	13 ± 1	13 ± 1
25 - 35	0.6 ± 0.1	"	"	"	9.8 ± 1.0	9.8 ± 1.0
35 - 45	--	--	--	--	--	--
45 - 55	0.6 ± 0.1	"	"	"	9.2 ± 1.2	9.2 ± 1.2

Table H-105. **Zinc in Basic CL Soil Lysimeter**

September, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	30.0 ± 24.0	< 0.1	0.4 ± 0.2	0.3 ± 0.1	78 ± 24	79 ± 24
0 - 1	6.8 ± 2.7	"	0.1 ± 0.0	< 0.2	37 ± 4	37 ± 4
1 - 2	3.4 ± 1.7	"	< 0.1	"	25 ± 1	25 ± 1
2 - 3	1.8 ± 0.7	"	"	"	22 ± 2	22 ± 2
3 - 4	1.6 ± 0.2	"	"	"	30 ± 2	30 ± 2
4 - 5	1.4 ± 0.1	"	"	"	37 ± 7	37 ± 7
5 - 7.5	0.9 ± 0.2	"	"	"	29 ± 2	29 ± 2
7.5 - 10	0.8 ± 0.2	"	"	"	--	—
10 - 15	0.8 ± 0.1	"	"	"	21 ± 5	21 ± 5
15 - 25	0.9 ± 0.2	"	"	"	26 ± 3	26 ± 3
25 - 35	0.4 ± 0.0	"	"	"	21 ± 2	21 ± 2
35 - 45	--	--	--	--	--	--
45 - 55	0.4 ± 0.0	< 0.1	< 0.1	< 0.2	19 ± 3	19 ± 3

Table H-106. Cadmium in SM (d/u) Soil Lysimeters

September, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	75.0 ± 23.0	3.0 ± 3.0	21.0 ± 2.0	1.2 ± 0.7	36.0 ± 10.0	61.0 ± 11.0
0 - 1	7.0 ± 5.4	1.0 ± 0.9	6.7 ± 5.0	0.6 ± 0.3	4.6 ± 2.2	13.0 ± 5.5
1 - 2	0.9 ± 0.4	0.6 ± 0.4	0.3 ± 0.1	0.2 ± 0.1	0.2 ± 0.0	1.3 ± 0.4
2 - 3	0.3 ± 0.1	0.2 ± 0.1	0.1 ± 0.0	0.3 ± 0.1	0.2 ± 0.0	0.8 ± 0.1
3 - 4	0.3 ± 0.0	< 0.1	< 0.1	< 0.1	0.2 ± 0.0	0.2 ± 0.0
4 - 5	0.3 ± 0.1	"	"	"	0.2 ± 0.1	0.2 ± 0.1
5 - 7.5	2.1 ± 1.0	"	"	"	0.4 ± 0.1	0.4 ± 0.1
7.5 - 10	0.4 ± 0.1	"	"	"	--	--
10 - 15	0.3 ± 0.0	"	"	"	0.2 ± 0.0	0.2 ± 0.0
15 - 25	0.3 ± 0.0	"	"	"	0.2 ± 0.0	0.2 ± 0.0
25 - 35	0.5 ± 0.2	"	"	"	0.4 ± 0.2	0.4 ± 0.2
35 - 45	--	--	--	--	--	--
45 - 55	0.4 ± 0.2	< 0.1	< 0.1	< 0.1	0.3 ± 0.1	0.3 ± 0.1

Table H-107. Copper SM(d/u) Soil Lysimeters

September, 1974

(in ppm-dry wt.)

	Fraction I	Fraction II				
Depth (in.)	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	32.0 ± 6.0	0.2 ± 0.2	1.6 ± 0.4	9.9 ± 4.8	34 ± 8	46 ± 9
0 - 1	9.1 ± 5.6	0.3 ± 0.2	0.4 ± 0.1	3.1 ± 1.5	13 ± 4	17 ± 4
1 - 2	2.0 ± 0.8	0.5 ± 0.4	0.1 ± 0.0	0.5 ± 0.2	2.2 ± 0.4	3.3 ± 0.6
2 - 3	0.8 ± 0.2	0.4 ± 0.4	< 0.1	0.4 ± 0.1	2.8 ± 0.2	3.6 ± 0.5
3 - 4	0.7 ± 0.2	< 0.1	"	< 0.1	3.1 ± 0.3	3.1 ± 0.3
4 - 5	0.6 ± 0.1	"	"	"	3.1 ± 0.4	3.1 ± 0.4
5 - 7.5	1.6 ± 2.0	"	"	"	5.4 ± 1.0	5.4 ± 1.0
7.5 - 10	0.9 ± 0.4	"	"	"	--	--
10 - 15	0.5 ± 0.2	"	"	"	3.4 ± 0.6	3.4 ± 0.6
15 - 25	0.5 ± 0.2	"	"	"	3.1 ± 0.5	3.1 ± 0.5
25 - 35	0.5 ± 0.2	"	"	"	3.7 ± 0.3	3.7 ± 0.3
35 - 45	--	--	--	--	--	--
45 - 55	0.7 ± 0.1	< 0.1	< 0.1	< 0.1	3.4 ± 0.5	3.4 ± 0.5

AD-A043 363 TEXAS A AND M RESEARCH FOUNDATION COLLEGE STATION F/G 13/2
FATE OF METALS APPLIED IN SEWAGE TO LAND WASTEWATER DISPOSAL SI--ETC(U)
SEP 75 K W BROWN, C WOODS, J F SLOWEY DADA17-73-C-3102
UNCLASSIFIED TAMRF-74-256 NL

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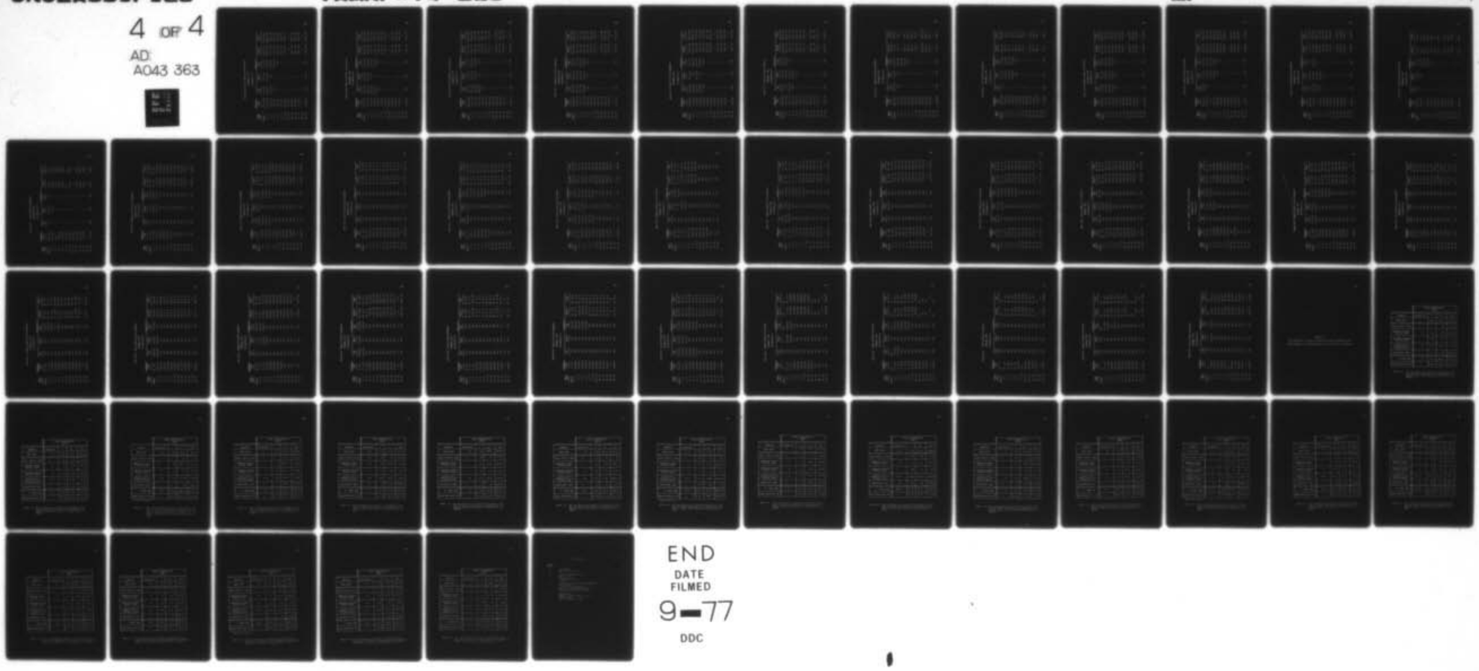
A043 363



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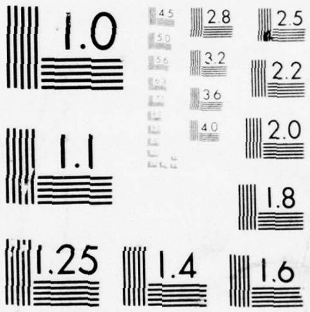

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Table H-108. Lead in SM(d/u) Soil Lysimeters

September, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	57.0 ± 10.0	0.3 ± 0.1	2.3 ± 1.0	1.0 ± 0.5	63.0 ± 12.0	67.0 ± 12.0
0 - 1	11.0 ± 5.0	0.3 ± 0.1	0.5 ± 0.1	0.4 ± 0.1	19.0 ± 6.0	20.0 ± 6.0
1 - 2	3.6 ± 1.2	0.4 ± 0.1	< 0.2	0.3 ± 0.1	4.3 ± 0.6	5.0 ± 0.6
2 - 3	3.9 ± 1.0	< 0.2	"	0.3 ± 0.1	4.3 ± 0.5	4.6 ± 0.5
3 - 4	2.7 ± 0.6	"	"	< 0.2	6.1 ± 0.4	6.1 ± 0.4
4 - 5	2.8 ± 0.7	"	"	"	4.7 ± 0.7	4.7 ± 0.7
5 - 7.5	4.0 ± 0.8	"	"	"	7.6 ± 1.4	7.6 ± 1.4
7.5 - 10	3.5 ± 0.7	"	"	"	--	--
10 - 15	2.0 ± 0.0	"	"	"	4.8 ± 1.6	4.8 ± 1.6
15 - 25	2.0 ± 0.0	"	"	"	3.6 ± 0.6	3.6 ± 0.6
25 - 35	1.2 ± 0.3	"	"	"	4.8 ± 0.0	4.8 ± 0.0
35 - 45	--	--	--	--	--	--
45 - 55	1.2 ± 0.6	< 0.2	< 0.2	< 0.2	5.8 ± 0.6	5.8 ± 0.6

Table H-109. Nickel in SM (d/u) Soil Lysimeters

September, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	35.0 ± 8.0	1.4 ± 1.0	3.8 ± 1.3	9.2 ± 4.9	48.0 ± 12.0	62.0 ± 13.1
0 - 1	6.1 ± 3.3	0.5 ± 0.1	0.8 ± 0.6	3.2 ± 2.0	15.0 ± 5.0	19.0 ± 5.0
1 - 2	1.4 ± 0.4	0.5 ± 0.3	< 0.2	0.6 ± 0.1	5.4 ± 0.1	6.5 ± 0.3
2 - 3	0.9 ± 0.2	0.2 ± 0.1	"	0.5 ± 0.2	5.3 ± 1.7	6.0 ± 1.7
3 - 4	0.7 ± 0.2	< 0.2	"	< 0.4	4.6 ± 0.5	4.6 ± 0.5
4 - 5	0.7 ± 0.2	"	"	"	4.4 ± 0.5	4.4 ± 0.5
5 - 7.5	1.3 ± 0.5	"	"	"	6.1 ± 0.7	6.1 ± 0.7
7.5 - 10	0.9 ± 0.3	"	"	"	--	--
10 - 15	0.7 ± 0.2	"	"	"	3.0 ± 0.7	3.0 ± 0.7
15 - 25	0.7 ± 0.3	"	"	"	5.5 ± 1.4	5.5 ± 1.4
25 - 35	0.7 ± 0.1	"	"	"	2.0 ± 0.8	2.0 ± 0.8
35 - 45	--	--	--	--	--	--
45 - 55	1.0 ± 0.4	< 0.2	< 0.2	< 0.4	3.5 ± 1.3	3.5 ± 1.3

Table H-110. Zinc in SM(d/u) Soil Lysimeters

September, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	46.0 ± 10.0	1.4 ± 1.4	4.8 ± 2.9	1.2 ± 1.2	77.0 ± 15.0	84.0 ± 15.0
0 - 1	8.1 ± 5.4	0.7 ± 0.5	1.1 ± 1.0	0.3 ± 0.2	22.0 ± 7.0	24.0 ± 24.0
1 - 2	2.2 ± 0.7	1.0 ± 0.5	0.1 ± 0.0	0.2 ± 0.0	3.5 ± 0.4	4.8 ± 0.6
2 - 3	1.2 ± 0.2	0.8 ± 0.2	< 0.1	< 0.2	3.4 ± 0.6	4.2 ± 0.0
3 - 4	1.4 ± 0.5	< 0.1	"	"	6.5 ± 0.0	6.5 ± 0.0
4 - 5	1.0 ± 0.3	"	"	"	6.3 ± 1.7	6.3 ± 1.7
5 - 7.5	2.9 ± 1.9	"	"	"	7.3 ± 1.2	7.3 ± 1.2
7.5 - 10	0.6 ± 0.2	"	"	"	--	--
10 - 15	6.5 ± 0.2	"	"	"	4.3 ± 0.6	4.3 ± 0.6
15 - 25	0.4 ± 0.2	"	"	"	3.7 ± 0.5	3.7 ± 0.5
25 - 35	0.4 ± 0.2	"	"	"	5.0 ± 0.0	5.0 ± 0.0
35 - 45	--	--	--	--	--	--
45 - 55	0.6 ± 0.2	< 0.1	< 0.1	< 0.2	4.5 ± 1.0	4.5 ± 1.0

Table H-111. Cadmium in SC Soil Lysimeters

September, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	50.0 ± 22.0	0.2 ± 0.0	11.2 ± 3.0	2.6 ± 0.7	52.0 ± 19.0	56.0 ± 19.0
0 - 1	5.5 ± 2.8	0.2 ± 0.1	1.8 ± 1.6	0.7 ± 0.3	3.4 ± 2.2	6.1 ± 2.7
1 - 2	1.1 ± 0.7	0.2 ± 0.1	0.3 ± 0.0	0.5 ± 0.3	0.2 ± 0.0	1.2 ± 0.3
2 - 3	1.1 ± 0.5	0.1 ± 0.0	0.4 ± 0.2	0.3 ± 0.2	0.2 ± 0.0	1.0 ± 0.2
3 - 4	0.7 ± 0.4	< 0.1	< 0.1	< 0.1	0.5 ± 0.3	0.5 ± 0.3
4 - 5	1.0 ± 0.5	"	"	"	0.6 ± 0.3	0.6 ± 0.3
5 - 7.5	0.4 ± 0.1	"	"	"	0.4 ± 0.2	0.4 ± 0.2
7.5 - 10	0.2 ± 0.1	"	"	"	--	--
10 - 15	0.3 ± 0.1	"	"	"	0.2 ± 0.0	0.2 ± 0.0
15 - 25	0.2 ± 0.1	"	"	"	0.2 ± 0.0	0.2 ± 0.0
25 - 35	0.2 ± 0.0	"	"	"	0.2 ± 0.0	0.2 ± 0.0
35 - 45	--	--	--	--	--	--
45 - 55	0.2 ± 0.1	< 0.1	< 0.1	< 0.1	0.2 ± 0.0	0.2 ± 0.0

Table H-112. Copper in SC Soil Lysimeters

September, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	27.0 ± 9.0	0.4 ± 0.2	0.5 ± 0.3	2.1 ± 0.1	47.0 ± 11.0	50.0 ± 11.0
0 - 1	4.4 ± 1.6	0.1 ± 0.0	< 0.1	0.2 ± 0.1	11.0 ± 2.0	11.0 ± 2.0
1 - 2	2.3 ± 0.6	0.1 ± 0.1	0.1 ± 0.0	0.2 ± 0.2	5.3 ± 0.6	5.7 ± 0.6
2 - 3	2.4 ± 0.5	0.1 ± 0.0	< 0.1	0.2 ± 0.1	6.8 ± 0.6	7.1 ± 0.6
3 - 4	1.9 ± 0.6	< 0.1	"	< 0.1	7.3 ± 0.8	7.3 ± 0.8
4 - 5	2.1 ± 0.6	"	"	"	6.2 ± 2.0	6.2 ± 2.0
5 - 7.5	1.6 ± 0.4	"	"	"	9.3 ± 0.9	9.3 ± 0.9
7.5 - 10	1.3 ± 0.5	"	"	"	--	--
10 - 15	1.3 ± 0.3	"	"	"	7.3 ± 1.2	7.3 ± 1.2
15 - 25	1.3 ± 0.0	"	"	"	6.2 ± 0.6	6.2 ± 0.6
25 - 35	1.0 ± 0.2	"	"	"	7.2 ± 0.8	7.2 ± 0.8
35 - 45	--	--	--	--	--	--
45 - 55	1.6 ± 0.2	< 0.1	< 0.1	< 0.1	7.3 ± 0.7	7.3 ± 0.7

Table H-113. Lead in SC Soil Lysimeters

September, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	35.0 ± 19.0	0.2 ± 0.1	0.8 ± 0.3	0.3 ± 0.1	61.0 ± 19.0	62.0 ± 19.0
0 - 1	6.5 ± 0.6	< 0.2	0.5 ± 0.1	0.2 ± 0.1	12.0 ± 3.0	13.0 ± 3.0
1 - 2	5.6 ± 2.2	0.2 ± 0.1	0.4 ± 0.2	< 0.2	8.0 ± 2.0	8.6 ± 2.0
2 - 3	5.0 ± 1.9	< 0.2	0.3 ± 0.1	"	7.1 ± 1.1	7.4 ± 1.1
3 - 4	4.8 ± 1.5	"	< 0.2	"	11.0 ± 1.0	11.0 ± 1.1
4 - 5	4.2 ± 1.1	"	"	"	8.2 ± 1.9	8.2 ± 1.9
5 - 7.5	4.0 ± 1.2	"	"	"	8.9 ± 1.0	8.9 ± 1.0
7.5 - 10	3.5 ± 1.1	"	"	"	--	--
10 - 15	2.0 ± 0.0	"	"	"	7.8 ± 2.0	7.8 ± 2.0
15 - 25	2.1 ± 0.2	"	"	"	6.1 ± 1.0	6.1 ± 1.0
25 - 35	2.3 ± 1.2	"	"	"	6.9 ± 1.7	6.9 ± 1.7
35 - 45	--	--	--	--	--	--
45 - 55	1.9 ± 0.0	< 0.2	< 0.2	< 0.2	8.3 ± 2.7	8.3 ± 2.7

Table H-114. **Nickel in SC Soil Lysimeters**

September, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	31.0 ± 6.1	0.4 ± 0.2	1.4 ± 0.3	3.3 ± 1.7	77 ± 19	82 ± 19
0 - 1	5.3 ± 2.1	< 0.4	< 0.4	2.0 ± 1.0	17 ± 3	17 ± 3
1 - 2	2.6 ± 0.5	"	"	1.7 ± 0.6	--	--
2 - 3	2.5 ± 0.5	"	"	1.5 ± 0.4	18 ± 2	19 ± 2
3 - 4	2.3 ± 0.2	"	"	< 0.4	13 ± 2	13 ± 2
4 - 5	2.8 ± 0.8	"	"	"	12 ± 2	12 ± 2
5 - 7.5	2.5 ± 0.5	"	"	"	15 ± 2	15 ± 2
7.5 - 10	2.0 ± 0.5	"	"	"	--	--
10 - 15	2.3 ± 0.5	"	"	"	9.9 ± 2.4	9.9 ± 2.4
15 - 25	2.1 ± 0.5	"	"	"	18 ± 2	18 ± 2
25 - 35	0.9 ± 0.2	"	"	"	8.2 ± 2	8.2 ± 2
35 - 45	--	--	--	--	--	--
45 - 55	2.1 ± 0.5	< 0.4	< 0.4	< 0.4	10 ± 2	10 ± 2

Table A-115. Zinc in SC Soil Lysimeters

September, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	29.0 ± 12.0	< 0.1	0.3 ± 0.1	0.4 ± 0.1	102 ± 30	103 ± 30
0 - 1	4.9 ± 2.4	"	0.1 ± 0.1	0.5 ± 0.3	28 ± 6	29 ± 6
1 - 2	2.8 ± 2.0	"	0.2 ± 0.2	0.4 ± 0.3	12 ± 3	13 ± 3
2 - 3	1.5 ± 0.3	"	0.1 ± 0.0	0.4 ± 0.1	13 ± 1	13 ± 1
3 - 4	1.0 ± 0.3	"	< 0.1	< 0.2	21 ± 3	21 ± 3
4 - 5	1.3 ± 0.5	"	"	"	18 ± 4	18 ± 4
5 - 7.5	0.6 ± 0.2	"	"	"	25 ± 2	25 ± 2
7.5 - 10	0.3 ± 0.0	"	"	"	--	--
10 - 15	0.3 ± 0.0	"	"	"	12 ± 0	12 ± 0
15 - 25	0.2 ± 0.1	"	"	"	22 ± 3	22 ± 3
25 - 35	0.1 ± 0.0	"	"	"	20 ± 4	20 ± 4
35 - 45	--	--	--	--	--	--
45 - 55	0.3 ± 0.1	< 0.1	< 0.1	< 0.2	26 ± 3	26 ± 3

Table H-116. Cadmium in Basic CL Land Plot

September, 1974

(in ppm-dry wt.)

	Fraction I	Fraction II				
Depth (in.)	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	19.0 ± 0.7	0.1 ± 0.0	1.8 ± 0.6	0.9 ± 0.1	23.6 ± 2.0	26.0 ± 2.0
0 - 1	6.9 ± 1.2	0.1 ± 0.0	0.9 ± 0.3	0.5 ± 0.1	5.1 ± 2.5	6.6 ± 2.5
1 - 2	1.8 ± 0.0	0.2 ± 0.0	0.5 ± 0.0	0.4 ± 0.0	1.1 ± 0.3	2.2 ± 0.3
2 - 3	2.2 ± 0.4	0.1 ± 0.0	0.4 ± 0.1	0.3 ± 0.0	1.0 ± 0.4	1.8 ± 0.4
3 - 4	2.1 ± 0.1	< 0.1	< 0.1	< 0.1	1.5 ± 0.5	1.5 ± 0.5
4 - 5	1.7 ± 0.0	"	"	"	1.1 ± 0.4	1.1 ± 0.4
5 - 7.5	0.4 ± 0.0	"	"	"	0.3 ± 0.0	0.3 ± 0.0
7.5 - 10	0.5 ± 0.1	"	"	"	--	--
10 - 15	0.3 ± 0.1	"	"	"	0.2 ± 0.1	0.2 ± 0.1
15 - 25	0.3 ± 0.1	"	"	"	0.2 ± 0.0	0.2 ± 0.0
25 - 35	0.3 ± 0.1	"	"	"	0.2 ± 0.0	0.2 ± 0.0
35 - 45	--	--	--	--	--	--
45 - 55	0.1 ± 0.0	< 0.1	< 0.1	< 0.1	0.2 ± 0.0	0.2 ± 0.0

Table H-117. Copper in Basic CL Land Plot

September, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	14.0 ± 1.0	0.1 ± 0.0	0.3 ± 0.1	1.5 ± 0.1	24.0 ± 1.0	26.0 ± 1.0
0 - 1	6.9 ± 0.6	< 0.1	0.1 ± 0.0	0.5 ± 0.1	16.0 ± 2.0	17.0 ± 2.0
1 - 2	4.3-	"	0.2 ± 0.0	0.3 + 0.0	12.0 ± 1.0	12.0 ± 1.0
2 - 3	5.2 ± 1.0	"	0.1 ± 0.0	0.6 ± 0.1	11.0 ± 2.0	12.0 ± 2.0
3 - 4	4.9 ± 0.2	"	< 0.1	< 0.1	13.0 ± 1.0	13.0 ± 1.0
4 - 5	4.3 ± 0.5	"	"	"	12.0 ± 1.0	12.0 ± 1.0
5 - 7.5	2.8 ± 0.1	"	"	"	10.0 ± 1.0	10.0 ± 1.0
7.5 - 10	2.5 ± 0.1	"	"	"	--	--
10 - 15	2.8 ± 0.2	"	"	"	8.9 ± 0.8	8.9 ± 0.8
15 - 25	1.7 ± 0.4	"	"	"	6.4 ± 0.8	6.4 ± 0.8
25 - 35	1.0 ± 0.0	"	"	"	6.8 ± 0.1	6.8 ± 0.1
35 - 45	--	--	--	--	--	--
45 - 55	1.7 ± 0.5	< 0.1	< 0.1	< 0.1	6.7 ± 0.8	6.7 ± 0.8

Table H-118. Lead in Basic CL Land Plot

September, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	21.0 ± 6.0	< 0.2	0.4 ± 0.1	< 0.2	27 ± 3.0	27.0 ± 3.0
0 - 1	8.5 ± 1.2	0.4 ± 0.1	0.4 ± 0.0	0.5 ± 0.1	16 ± 2.0	17.0 ± 2.0
1 - 2	3.4	0.3 ± 0.2	0.4 ± 0.1	< 0.2	9.9 ± 0.0	11.0 ± 0.2
2 - 3	7.2 ± 1.7	< 0.2	0.3 ± 0.1	"	8.2 ± 0.2	8.5 ± 0.2
3 - 4	7.1 ± 3.3	"	< 0.2	"	14 ± 1.0	14.0 ± 1.0
4 - 5	6.1 ± 1.6	"	"	"	10 ± 1.0	10.0 ± 1.0
5 - 7.5	3.6 ± 1.4	"	"	"	8 ± 0.4	8.0 ± 0.4
7.5 - 10	3.1 ± 0.9	"	"	"	--	--
10 - 15	2.0 ± 0.0	"	"	"	7.6 ± 0.0	7.6 ± 0.0
15 - 25	2.0 ± 0.0	"	"	"	6.4 ± 0.0	6.4 ± 0.0
25 - 35	1.7 ± 0.0	"	"	"	6.6 ± 0.6	6.6 ± 0.6
35 - 45	--	--	--	--	--	--
45 - 55	2.0 ± 0.5	< 0.2	< 0.2	< 0.2	7.8 ± 0.7	7.8 ± 0.7

Table H-119. Nickel in Basic CL Land Plot

September, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	23.0 ± 2.0	< 0.4	0.7 ± 0.2	2.5 ± 0.1	44 ± 8	47 ± 8
0 - 1	6.9 ± 1.3	"	< 0.4	1.3 ± 0.5	25 ± 2	26 ± 2
1 - 2	3.4	"	"	0.7 ± 0.1	12 ± 1	13 ± 1
2 - 3	3.3 ± 0.4	"	"	0.9 ± 0.0	23 ± 9	24 ± 9
3 - 4	3.5 ± 0.3	"	"	< 0.4	17 ± 1	17 ± 1
4 - 5	2.7 ± 0.1	"	"	"	19	19
5 - 7.5	1.7 ± 0.1	"	"	"	16 ± 1	16 ± 1
7.5 - 10	2.2 ± 0.2	"	"	"	--	--
10 - 15	1.8 ± 0.4	"	"	"	13 ± 0	13 ± 0
15 - 25	1.7 ± 0.3	"	"	"	11 ± 0	11 ± 0
25 - 35	0.7 ± 0.0	"	"	"	9 ± 0.1	9 ± 0.1
35 - 45	--	--	--	--	--	--
45 - 55	0.8 ± 0.2	--	--	--	10 ± 1	10 ± 1

Table H-120. Zinc in Basic CL Land Plot

September 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	16.0 ± 1.0	< 0.1	0.1 ± 0.0	< 0.2	55 ± 2	55 ± 2
0 - 1	6.1 ± 1.2	"	< 0.1	"	41 ± 5	41 ± 5
1 - 2	3.2 ±	"	"	"	27 ± 0	27 ± 0
2 - 3	3.6 ± 0.8	"	"	"	24 ± 2	24 ± 2
3 - 4	2.7 ± 0.2	"	"	"	33 ± 3	33 ± 3
4 - 5	2.1 ± 0.3	"	"	"	31	31
5 - 7.5	0.8 ± 0.2	"	"	"	28 ± 3	28 ± 3
7.5 - 10	0.9 ± 0.3	"	"	"	—	—
10 - 15	0.9 ± 0.6	"	"	"	21 ± 0	21 ± 0
15 - 25	0.6 ± 0.0	"	"	"	24 ± 2	24 ± 2
25 - 35	0.1 ± 0.0	"	"	"	18 ± 2	18 ± 2
35 - 45	--	--	--	--	--	--
45 - 55	0.4 ± 0.0	< 0.1	< 0.1	< 0.1	20 ± 4	20 ± 4

Table H-121. Cadmium in Acid CL Soil Lysimeters

November, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	30. ± 14.	<0.1	3. ± 2.	1.7 ± 0.9	28. ± 14.	33. ± 14.
0 - 1	9. ± 3.6	<0.1	0.6 ± 0.2	0.5 ± 0.2	11. ± 2.	12. ± 2.
1 - 2	5.3 ± 2.5	<0.1	0.5 ± 0.3	0.2 ± 0.2	6. ± 3.9	6.7 ± 3.9
2 - 3	1.3 ± 0.9	<0.1	<0.1	<0.1	2.1 ± 0.6	2.1 ± 0.6
3 - 4	0.8 ± 0.2	<0.1	<0.1	<0.1	1.2 ± 0.2	1.2 ± 0.2
4 - 5	0.5 ± 0.3	<0.1	<0.1	<0.1	1.1 ± 0.2	1.1 ± 0.2
5 - 7.5	0.7 ± 0.2	<0.1	<0.1	<0.1	1.0 ± 0.0	1.0 ± 0.0
7.5 - 10	<0.3	<0.1	<0.1	<0.1	1.1 ± 0.6	1.1 ± 0.6
10 - 15	<0.3	<0.1	<0.1	<0.1	1.1 ± 0.1	1.1 ± 0.1
15 - 25	<0.3	<0.1	<0.1	<0.1	0.9 ± 0.6	0.9 ± 0.6
25 - 35	<0.3	<0.1	<0.1	<0.1	0.9 ± 0.2	0.9 ± 0.2
35 - 45	----	----	----	----	----	----
45 - 55	<0.3	<0.1	<0.1	<0.1	0.6 ± 0.5	0.6 ± 0.5

Table H-122. Copper in Acid CL Soil Lysimeters

November, 1974

(in ppm-dry wt.)

	Fraction I	Fraction II				
Depth (in.)	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	19. ± 7.	0.5 ± 0.2	0.5 ± 0.2	2.0 ± 1.2	60. ± 22.	63. ± 22.
0 - 1	9.3 ± 2.9	0.4 ± 0.2	<0.1	0.7 ± 0.4	39. ± 6.	40. ± 6.
1 - 2	5.3 ± 1.5	0.1 ± 0.1	<0.1	0.3 ± 0.2	26. ± 9.	26. ± 9.
2 - 3	2.2 ± 1.1	0.1 ± 0.1	<0.1	0.1 ± 0.0	8.6 ± 1.4	8.8 ± 1.4
3 - 4	1.7 ± 0.7	<0.1	<0.1	<0.1	6.4 ± 0.8	6.4 ± 0.8
4 - 5	0.9 ± 0.1	<0.1	<0.1	<0.1	5.0 ± 0.6	5.0 ± 0.6
5 - 7.5	1.4 ± 0.3	<0.1	<0.1	<0.1	4.3 ± 0.5	4.3 ± 0.5
7.5 - 10	0.4 ± 0.1	<0.1	<0.1	<0.1	4.3 ± 1.7	4.3 ± 1.7
10 - 15	0.3 ± 0.1	<0.1	<0.1	<0.1	3.9 ± 0.4	3.9 ± 0.4
15 - 25	0.4 ± 0.2	<0.1	<0.1	<0.1	2.3 ± 0.7	2.3 ± 0.7
25 - 35	0.4 ± 0.3	<0.1	<0.1	<0.1	4.1 ± 0.5	4.1 ± 0.5
35 - 45	----	----	----	----	----	---
45 - 55	0.3 ± 0.1	<0.1	<0.1	<0.1	3.5 ± 1.1	3.5 ± 1.1

Table H-123. **Lead in Acid CL Soil Lysimeters**

November, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	24. ± 12.	<0.2	<0.2	<0.2	51. ± 16.	51. ± 16.
0 - 1	11. ± 2.	<0.2	<0.2	<0.2	46. ± 3.	46. ± 3.
1 - 2	7.4 ± 2.4	<0.2	<0.2	<0.2	33. ± 8.	33. ± 8.
2 - 3	4.4 ± 1.2	<0.2	<0.2	<0.2	35. ± 2.	35. ± 2.
3 - 4	3.2 ± 0.6	<0.2	<0.2	<0.2	27. ± 3.	27. ± 3.
4 - 5	2.8 ± 0.2	<0.2	<0.2	<0.2	27. ± 4.	27. ± 4.
5 - 7.5	3.9 ± 0.7	<0.2	<0.2	<0.2	25. ± 4.	25. ± 4.
7.5 - 10	1.9 ± 0.2	<0.2	<0.2	<0.2	28. ± 12.	28. ± 12.
10 - 15	1.2 ± 0.5	<0.2	<0.2	<0.2	28. ± 5.	28. ± 5.
15 - 25	0.9 ± 0.1	<0.2	<0.2	<0.2	19. ± 3.	19. ± 3.
25 - 35	0.7 ± 0.2	<0.2	<0.2	<0.2	20. ± 4.	20. ± 4.
35 - 45	----	----	----	----	----	----
45 - 55	1.0 ± 0.3	<0.2	<0.2	<0.2	16. ± 3.	16. ± 3.

Table H-124. **Nickel in Acid CL Soil Lysimeters**

November, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	19. ± 7.	0.8 ± 0.4	0.5 ± 0.4	3.9 ± 2.9	68. ± 20.	73. ± 20.
0 - 1	7.6 ± 3.	<0.4	<0.4	1.3 ± 0.8	64. ± 3.	64. ± 3.
1 - 2	6.3 ± 2.5	<0.4	<0.4	1.1 ± 0.6	46. ± 9.	47. ± 9.
2 - 3	2.8 ± 0.5	<0.4	<0.4	0.8 ± 0.2	50. ± 5.	51. ± 5.
3 - 4	2.4 ± 0.8	<0.4	<0.4	0.7 ± 0.4	42. ± 6.	43. ± 6.
4 - 5	2.1 ± 0.4	<0.4	<0.4	0.4 ± 0.1	41. ± 6.	41. ± 6.
5 - 7.5	2.1 ± 0.4	<0.4	<0.4	<0.4	43. ± 7.	43. ± 7.
7.5 - 10	<0.6	<0.4	<0.4	<0.4	47. ± 2.	47. ± 2.
10 - 15	<0.6	<0.4	<0.4	<0.4	50. ± 5.	50. ± 5.
15 - 25	<0.6	<0.4	<0.4	<0.4	31. ± 5.	31. ± 5.
25 - 35	<0.6	<0.4	<0.4	<0.4	34. ± 2.	34. ± 2.
35 - 45	----	----	----	----	----	----
45 - 55	<0.6	<0.4	<0.4	<0.4	31. ± 8.	31. ± 8.

Table H-125. Zinc in Acid C1 Soil Lysimeters

November, 1975

(in ppm-dry wt.)

	Fraction I	Fraction II				
Depth (in.)	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	26. ±11.	0.7 ± 0.2	0.3 ± 0.2	1.0 ± 0.5	141 ± 35	143 ± 35
0 - 1	12. ± 5.	0.3 ± 0.3	0.1 ± 0.0	0.5 ± 0.2	154 ± 14	155 ± 14
1 - 2	8.0 ± 2.0	0.3 ± 0.1	0.1 ± 0.0	0.4 ± 0.2	114 ± 20	115 ± 20
2 - 3	3.8 ± 0.4	0.3 ± 0.1	< 0.1	0.4 ± 0.2	114 ± 10	115 ± 10
3 - 4	3.0 ± 0.7	0.2 ± 0.1	< 0.1	0.4 ± 0.1	93 ± 15	94 ± 15
4 - 5	2.3 ± 0.4	0.2 ± 0.1	< 0.1	0.2 ± 0.1	89 ± 14	89 ± 14
5 - 7.5	2.7 ± 1.4	< 0.2	< 0.1	< 0.2	101 ± 26	101 ± 26
7.5 - 10	0.6 ± 0.1	< 0.2	< 0.1	< 0.2	115 ± 31	115 ± 31
10 - 15	0.7 ± 0.4	< 0.2	< 0.1	< 0.2	109 ± 18	109 ± 18
15 - 25	0.7 ± 0.2	< 0.2	< 0.1	< 0.2	103 ± 28	103 ± 28
25 - 35	0.7 ± 0.0	< 0.2	< 0.1	< 0.2	98 ± 22	98 ± 22
35 - 45	---	---	---	---	---	---
45 - 55	0.8 ± 0.0	< 0.2	< 0.1	< 0.2	85 ± 24	85 ± 24

Table H-126. Cadmium in SM(d/u) Soil Lysimeters

November, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	42. ± 27.	<0.1	17. ± 9.	1.1 ± 0.8	17. ± 11.	35. ± 14.
0 - 1	20. ± 12.	<0.1	5. ± 2.	0.2 ± 0.2	6. ± 4.	11. ± 4.
1 - 2	2. ± 2.	<0.1	0.9 ± 0.9	<0.1	1.1 ± 0.8	2. ± 1.
2 - 3	2. ± 1.	<0.1	0.6 ± 0.7	<0.1	1. ± 1.	1.6 ± 1.6
3 - 4	0.7 ± 0.6	<0.1	<0.1	<0.1	0.4 ± 0.3	0.4 ± 0.3
4 - 5	0.5 ± 0.4	<0.1	<0.1	<0.1	0.4 ± 0.3	0.4 ± 0.3
5 - 7.5	0.3 ± 0.2	<0.1	<0.1	<0.1	0.6 ± 0.6	0.6 ± 0.6
7.5 - 10	0.3 ± 0.2	<0.1	<0.1	<0.1	<0.3	<0.3
10 - 15	0.3 ± 0.3	<0.1	<0.1	<0.1	<0.3	<0.3
15 - 25	0.4 ± 0.2	<0.1	<0.1	<0.1	<0.3	<0.3
25 - 35	<0.2	<0.1	<0.1	<0.1	<0.3	<0.3
35 - 45	----	----	----	----	----	----
45 - 55	<0.2	<0.1	<0.1	<0.1	<0.2	<0.3

Table H-127. Copper in SM(d/u) Soil Lysimeters

November, 1974

(in ppm-dry wt.)

	Fraction I	Fraction II				
Depth (in.)	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	29. ± 13.	0.5 ± 0.2	2.1 ± 0.6	6.4 ± 4.8	40. ± 17.	49. ± 18.
0 - 1	17. ± 9.	0.3 ± 0.0	0.6 ± 0.3	3.7 ± 1.7	32. ± 9.	37. ± 9.
1 - 2	6. ± 4.	<0.1	<0.1	1.0 ± 0.4	12. ± 5.	13. ± 5.
2 - 3	3. ± 1.8	<0.1	<0.1	0.7 ± 0.6	5. ± 2.	5.7 ± 2.
3 - 4	1.7 ± 0.7	<0.1	<0.1	0.3 ± 0.2	3.9 ± 1.0	4.2 ± 1.
4 - 5	1.2 ± 0.4	<0.1	<0.1	0.2 ± 0.1	2.6 ± 0.8	2.8 ± 0.8
5 - 7.5	1.5 ± 0.7	<0.1	<0.1	<0.1	5.8 ± 2.8	5.8 ± 2.8
7.5 - 10	1.1 ± 0.4	<0.1	<0.1	<0.1	3.4 ± 0.2	3.4 ± 0.2
10 - 15	0.9 ± 0.4	<0.1	<0.1	<0.1	2.6 ± 0.2	2.6 ± 0.2
15 - 25	1.1 ± 0.3	<0.1	<0.1	<0.1	2.7 ± 0.1	2.7 ± 0.1
25 - 35	0.8 ± 0.4	<0.1	<0.1	<0.1	3.0 ± 0.0	3.0 ± 0.0
35 - 45	----	----	----	----	----	----
45 - 55	0.8 ± 0.5	<0.1	<0.1	<0.1	2.6 ± 0.0	2.6 ± 0.0

Table H-128. Lead in SM(d/u) Soil Lysimeters

November, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	40. ± 24.	<0.2	0.4 ± 0.4	<0.2	36. ± 16.	36. ± 16.
0 - 1	22. ± 11.	<0.2	<0.2	<0.2	21. ± 8.	21. ± 8.
1 - 2	5.4 ± 3.0	<0.2	<0.2	<0.2	6.7 ± 1.9	6.7 ± 1.9
2 - 3	3.0 ± 1.4	<0.2	<0.2	<0.2	7.2 ± 1.6	7.2 ± 1.6
3 - 4	1.9 ± 0.6	<0.2	<0.2	<0.2	4.9 ± 1.8	4.9 ± 1.8
4 - 5	1.4 ± 0.7	<0.2	<0.2	<0.2	5.7 ± 0.9	5.7 ± 0.9
5 - 7.5	1.2 ± 0.6	<0.2	<0.2	<0.2	5.3 ± 1.4	5.3 ± 1.4
7.5 - 10	1.1 ± 0.6	<0.2	<0.2	<0.2	5.3 ± 0.2	5.3 ± 0.2
10 - 15	1.2 ± 0.4	<0.2	<0.2	<0.2	3.4 ± 0.7	3.4 ± 0.7
15 - 25	1.4 ± 0.5	<0.2	<0.2	<0.2	4.0 ± 1.3	4.0 ± 1.3
25 - 35	1.0 ± 0.1	<0.2	<0.2	<0.2	4.7 ± 0.8	4.7 ± 0.8
35 - 45	----	----	----	----	----	----
45 - 55	1.1 ± 0.4	<0.2	<0.2	<0.2	2.8 ± 0.0	2.8 ± 0.0

Table H-129. Nickel in SM(d/u) Soil Lysimeters

November, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	21. ± 14.	0.4 ± 0.1	2.5 ± 1.6	8.3 ± 5.3	25. ± 14.	36. ± 15.
0 - 1	9. ± 4.	<0.4	0.4 ± 0.2	2.1 ± 0.8	14. ± 6.	16. ± 6.
1 - 2	2.4 ± 2.	<0.4	<0.4	1.0 ± 0.2	4.2 ± 1.5	5.2 ± 1.5
2 - 3	1.1 ± 0.4	<0.4	<0.4	0.6 ± 0.3	4.2 ± 1.8	4.8 ± 1.8
3 - 4	0.7 ± 0.2	<0.4	<0.4	1.7 ± 0.3	3.7 ± 1.2	5.4 ± 1.2
4 - 5	0.4 ± 0.1	<0.4	<0.4	0.5 ± 0.2	3.4 ± 0.0	3.9 ± 0.2
5 - 7.5	0.4 ± 0.1	<0.4	<0.4	<0.4	4.1 ± 0.8	4.1 ± 0.8
7.5 - 10	0.5 ± 0.1	<0.4	<0.4	<0.4	4.4 ± 1.0	4.4 ± 1.0
10 - 15	0.4 ± 0.1	<0.4	<0.4	<0.4	3.9 ± 1.0	3.9 ± 1.0
15 - 25	0.5 ± 0.1	<0.4	<0.4	<0.4	3.4 ± 0.0	3.4 ± 0.0
25 - 35	0.2 ± 0.1	<0.4	<0.4	<0.4	3.2 ± 0.6	3.2 ± 0.6
35 - 45	----	----	----	----	----	----
45 - 55	0.3 ± 0.1	<0.4	<0.4	<0.4	2.3 ± 0.0	2.3 ± 0.0

Table H-130. Zinc in SM(d/u) Soil Lysimeters

November, 1974

(in ppm-dry wt.)

	Fraction I	Fraction II				
Depth (in.)	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	29. ± 14.	0.2 ± 0.0	4.2 ± 1.8	0.5 ± 0.2	43. ± 21.	48. ± 21.
0 - 1	16. ± 8.	<0.2	1.3 ± 0.6	<0.2	18. ± 6.	19. ± 6.
1 - 2	4.7 ± 3.1	<0.2	0.3 ± 0.2	<0.2	8.1 ± 1.9	8.4 ± 1.9
2 - 3	2.3 ± 1.0	<0.2	0.2 ± 0.1	<0.2	8.4 ± 2.7	8.6 ± 2.7
3 - 4	1.6 ± 0.5	<0.2	<0.1	<0.2	7.2 ± 1.7	7.2 ± 1.7
4 - 5	1.1 ± 0.2	<0.2	<0.1	<0.2	5.2 ± 0.0	5.2 ± 0.0
5 - 7.5	1.2 ± 0.4	<0.2	<0.1	<0.2	6.0 ± 1.3	6.0 ± 1.3
7.5 - 10	0.6 ± 0.2	<0.2	<0.1	<0.2	4.9 ± 0.6	4.9 ± 0.6
10 - 15	0.5 ± 0.2	<0.2	<0.1	<0.2	4.0 ± 0.5	4.0 ± 0.5
15 - 25	0.6 ± 0.1	<0.2	<0.1	<0.2	3.4 ± 0.5	3.4 ± 0.5
25 - 35	0.4 ± 0.1	<0.2	<0.1	<0.2	3.9 ± 0.0	3.9 ± 0.0
35 - 45	----	----	----	----	----	----
45 - 55	0.4 ± 0.2	<0.2	<0.1	<0.2	3.4 ± 0.0	3.4 ± 0.0

Table H-131. Cadmium in Basic CL Soil Lysimeters

November, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	16. ± 4.	<0.1	2. ± 2.	0.8 ± 0.2	10. ± 7.	13. ± 7.
0 - 1	5. ± 4.	<0.1	0.9 ± 0.7	0.3 ± 0.1	5. ± 4.	6. ± 4.
1 - 2	1.0 ± 0.5	<0.1	0.2 ± 0.1	<0.1	1.2 ± 0.5	1.4 ± 0.5
2 - 3	0.7 ± 0.6	<0.1	<0.1	<0.1	0.6 ± 0.2	0.6 ± 0.2
3 - 4	1.0 ± 1.0	<0.1	<0.1	<0.1	0.8 ± 0.5	0.8 ± 0.5
4 - 5	0.4 ± 0.3	<0.1	<0.1	<0.1	0.6 ± 0.3	0.6 ± 0.3
5 - 7.5	0.6 ± 0.3	<0.1	<0.1	<0.1	0.8 ± 0.3	0.8 ± 0.3
7.5 - 10	<0.2	<0.1	<0.1	<0.1	0.5 ± 0.2	0.5 ± 0.2
10 - 15	0.4 ± 0.2	<0.1	<0.1	<0.1	0.5 ± 0.2	0.5 ± 0.2
15 - 25	<0.2	<0.1	<0.1	<0.1	0.3 ± 0.1	0.3 ± 0.1
25 - 35	<0.2	<0.1	<0.1	<0.1	0.6 ± 0.2	0.6 ± 0.2
35 - 45	----	----	----	----	----	----
45 - 55	<0.2	<0.1	<0.1	<0.1	<0.3	<0.3

Table H-T32. Copper in Basic CL Soil Lysimeters

November, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	14. ± 0.8	0.2 ± 0.1	0.4 ± 0.2	1.4 ± 0.6	38. ± 10.	40. ± 10.
0 - 1	6.2 ± 3.5	0.3 ± 0.1	0.2 ± 0.1	0.7 ± 0.3	34. ± 9.	35. ± 9.
1 - 2	3.6 ± 1.0	<0.1	<0.1	0.4 ± 0.1	24. ± 5.	24. ± 5.
2 - 3	3.2 ± 0.8	<0.1	<0.1	0.3 ± 0.0	8.7 ± 0.9	9.0 ± 0.9
3 - 4	3.8 ± 1.1	<0.1	<0.1	0.2 ± 0.1	11. ± 0.5	11. ± 0.5
4 - 5	2.8 ± 0.5	<0.1	<0.1	0.2 ± 0.0	10. ± 0.9	10. ± 0.9
5 - 7.5	2.8 ± 0.3	<0.1	<0.1	<0.1	9.5 ± 0.5	9.5 ± 0.5
7.5 - 10	2.8 ± 0.7	<0.1	<0.1	<0.1	9.5 ± 0.9	9.5 ± 0.9
10 - 15	2.8 ± 0.5	<0.1	<0.1	<0.1	8.9 ± 2.8	8.9 ± 2.8
15 - 25	2.3 ± 0.6	<0.1	<0.1	<0.1	7.8 ± 2.0	7.8 ± 2.0
25 - 35	1.9 ± 0.7	<0.1	<0.1	<0.1	8.5 ± 1.7	8.5 ± 1.7
35 - 45	----	----	----	----	----	---
45 - 55	1.8 ± 0.9	<0.1	<0.1	<0.1	10. ± 3.5	10. ± 3.5

Table H-133. Lead in Basic CL Soil Lysimeters

November, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	16. ± 6.	<0.2	<0.2	<0.2	19. ± 6.	19. ± 6.
0 - 1	8. ± 4.	<0.2	<0.2	<0.2	18. ± 5.	18. ± 5.
1 - 2	4. ± 2.	<0.2	<0.2	<0.2	11. ± 1.	11. ± 1.
2 - 3	4. ± 0.9	<0.2	<0.2	<0.2	10. ± 1.	10. ± 1.
3 - 4	4. ± 1.	<0.2	<0.2	<0.2	11. ± 1.	11. ± 1.
4 - 5	3. ± 1.	<0.2	<0.2	<0.2	11. ± 1.	11. ± 1.
5 - 7.5	3. ± 0.8	<0.2	<0.2	<0.2	9.6 ± 1.	9.6 ± 1.
7.5 - 10	3. ± 1.	<0.2	<0.2	<0.2	11. ± 0.6	11. ± 0.6
10 - 15	3. ± 1.	<0.2	<0.2	<0.2	8.5 ± 2.	8.5 ± 2.
15 - 25	2. ± 0.6	<0.2	<0.2	<0.2	10. ± 2.	10. ± 2.
25 - 35	2. ± 1.	<0.2	<0.2	<0.2	12. ± 2.	12. ± 2.
35 - 45	----	----	----	----	----	----
45 - 55	2. ± 2.	<0.2	<0.2	<0.2	10. ± 3.	10. ± 3.

Table H-134. Nickel in Basic CL Soil Lysimeters

November, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	12. ± 6.	<0.4	<0.4	1.3 ± 0.7	26. ± 9.	28. ± 9.
0 - 1	4. ± 2.	<0.4	<0.4	1.0 ± 0.6	20. ± 5.	21. ± 5.
1 - 2	1.4 ± 0.3	<0.4	<0.4	0.6 ± 0.2	13. ± 2.	14. ± 2.
2 - 3	1.7 ± 1.1	<0.4	<0.4	<0.4	11. ± 0.9	11. ± 0.9
3 - 4	1.5 ± 0.5	<0.4	<0.4	0.5 ± 0.2	15. ± 1.	16. ± 1.
4 - 5	1.4 ± 0.9	<0.4	<0.4	<0.4	14. ± 1.	14. ± 1.
5 - 7.5	1.3 ± 0.5	<0.4	<0.4	<0.4	14. ± 1.	14. ± 1.
7.5 - 10	1.3 ± 1.2	<0.4	<0.4	<0.4	15. ± 2.	15. ± 2.
10 - 15	1.3 ± 0.9	<0.4	<0.4	<0.4	12. ± 2.	12. ± 2.
15 - 25	1.1 ± 0.8	<0.4	<0.4	<0.4	12. ± 0.5	12. ± 0.5
25 - 35	0.9 ± 0.7	<0.4	<0.4	<0.4	14. ± 0.9	14. ± 0.9
35 - 45	----	----	----	----	----	----
45 - 55	0.5 ± 0.2	<0.4	<0.4	<0.4	13. ± 5.	13. ± 5.

Table H-135. Zinc in Basic CL Soil Lysimeters

November, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	17. ± 8.	0.3 ± 0.1	0.4 ± 0.2	0.2 ± 0.1	51. ± 11.	52. ± 11.
0 - 1	6.1 ± 2.7	0.2 ± 0.0	0.2 ± 0.1	<0.2	41. ± 7.	41. ± 7.
1 - 2	3.6 ± 2.8	<0.2	<0.1	<0.2	24. ± 12.	24. ± 12.
2 - 3	2.5 ± 1.5	<0.2	<0.1	<0.2	24. ± 2.	24. ± 2.
3 - 4	2.1 ± 0.8	<0.2	<0.1	<0.2	27. ± 2.	27. ± 2.
4 - 5	1.5 ± 0.9	<0.2	<0.1	<0.2	25. ± 2.	25. ± 2.
5 - 7.5	1.5 ± 0.6	<0.2	<0.1	<0.2	26. ± 2.	26. ± 2.
7.5 - 10	0.9 ± 0.1	<0.2	<0.1	<0.2	27. ± 3.	27. ± 3.
10 - 15	1. ± 0.2	<0.2	<0.1	<0.2	25. ± 4.	25. ± 4.
15 - 25	0.6 ± 0.1	<0.2	<0.1	<0.2	27. ± 6.	27. ± 6.
25 - 35	0.5 ± 0.2	<0.2	<0.1	<0.2	26. ± 4.	26. ± 4.
35 - 45	----	----	----	----	----	----
45 - 55	0.4 ± 0.1	<0.2	<0.1	<0.2	24. ± 7.	24. ± 7.

Table H-136. Cadmium in SC Soil Lysimeters

November, 1974

(in ppm-dry wt.)

	Fraction I	Fraction II				
Depth (in.)	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	10. ± 6.	<0.1	3. ± 3.	1.4 ± 0.6	8. ± 9.	12. ± 10.
0 - 1	5. ± 2.	<0.1	2. ± 1.	0.9 ± 0.1	5. ± 1.	8. ± 1.
1 - 2	2. ± 1.	<0.1	0.2 ± 0.2	0.2 ± 0.2	0.7 ± 0.4	1.1 ± 0.5
2 - 3	0.7 ± 0.3	<0.1	0.1 ± 0.1	<0.1	0.5 ± 0.2	0.6 ± 0.2
3 - 4	0.5 ± 0.2	<0.1	<0.1	<0.1	0.3 ± 0.1	0.3 ± 0.1
4 - 5	0.4 ± 0.2	<0.1	<0.1	<0.1	0.4 ± 0.2	0.4 ± 0.2
5 - 7.5	0.6 ± 0.6	<0.1	<0.1	<0.1	0.8 ± 0.3	0.8 ± 0.3
7.5 - 10	0.2 ± 0.2	<0.1	<0.1	<0.1	0.3 ± 0.3	0.3 ± 0.3
10 - 15	<0.2	<0.1	<0.1	<0.1	0.3 ± 0.3	0.3 ± 0.3
15 - 25	<0.2	<0.1	<0.1	<0.1	0.4 ± 0.3	0.4 ± 0.3
25 - 35	<0.2	<0.1	<0.1	<0.1	0.5 ± 0.1	0.5 ± 0.1
35 - 45	----	----	----	----	----	----
45 - 55	<0.2	<0.1	<0.1	<0.1	0.4 ± 0.0	0.4 ± 0.0

Table H-137. Copper in SC Soil Lysimeters

November, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	8. ± 4.	0.5 ± 0.3	0.3 ± 0.2	0.8 ± 0.6	29. ± 18.	31. ± 18.
0 - 1	5. ± 1.3	0.4 ± 0.2	<0.1	0.3 ± 0.1	26. ± 5.	27. ± 5.
1 - 2	4. ± 1.7	<0.1	<0.1	<0.1	13. ± 2.	13. ± 2.
2 - 3	1.9 ± 0.4	<0.1	<0.1	<0.1	5.7 ± 0.7	5.7 ± 0.7
3 - 4	1.6 ± 0.1	<0.1	<0.1	<0.1	5.3 ± 0.5	5.3 ± 0.5
4 - 5	1.6 ± 0.4	<0.1	<0.1	<0.1	6.3 ± 1.6	6.3 ± 1.6
5 - 7.5	1.6 ± 0.4	<0.1	<0.1	<0.1	8.0 ± 1.4	8.0 ± 1.4
7.5 - 10	1.5 ± 0.3	<0.1	<0.1	<0.1	6.8 ± 1.0	6.8 ± 1.0
10 - 15	1.5 ± 0.4	<0.1	<0.1	<0.1	7.2 ± 1.8	7.2 ± 1.8
15 - 25	1.2 ± 0.1	<0.1	<0.1	<0.1	7.6 ± 1.3	7.6 ± 1.3
25 - 35	1.2 ± 0.2	<0.1	<0.1	<0.1	9.2 ± 1.4	9.2 ± 1.4
35 - 45	----	----	----	----	----	----
45 - 55	1.2 ± 0.2	<0.1	<0.1	<0.1	8.4 ± 2.3	8.4 ± 2.3

Table H-138. Lead in SC Soil Lysimeters

November, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	9. ± 3.	<0.2	<0.2	<0.2	18. ± 10.	18. ± 10.
0 - 1	6. ± 2.	<0.2	<0.2	<0.2	16. ± 2.	16. ± 2.
1 - 2	4. ± 2.	<0.2	<0.2	<0.2	9.4 ± 0.2	9.4 ± 0.2
2 - 3	2.7 ± 0.7	<0.2	<0.2	<0.2	9. ± 1.	9. ± 1.
3 - 4	2.9 ± 0.9	<0.2	<0.2	<0.2	9. ± 2.	9. ± 2.
4 - 5	2.7 ± 1.4	<0.2	<0.2	<0.2	8. ± 2.	8. ± 2.
5 - 7.5	1.9 ± 0.5	<0.2	<0.2	<0.2	10. ± 1.	10. ± 1.
7.5 - 10	1.6 ± 0.6	<0.2	<0.2	<0.2	10. ± 1.	10. ± 1.
10 - 15	1.8 ± 0.6	<0.2	<0.2	<0.2	10. ± 1.	10. ± 1.
15 - 25	1.5 ± 0.3	<0.2	<0.2	<0.2	11. ± 0.8	11. ± 0.8
25 - 35	1.6 ± 0.2	<0.2	<0.2	<0.2	12. ± 1.	12. ± 1.
35 - 45	----	----	----	----	----	----
45 - 55	1.6 ± 0.5	<0.2	<0.2	<0.2	10. ± 1.	10. ± 1.

Table H-139. Nickel in SC Soil Lysimeters

November, 1974

(in ppm-dry wt.)

	Fraction I	Fraction II				
Depth (in.)	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	5. ± 2.	<0.4	<0.4	3.0 ± 2.1	19. ± 13.	22. ± 13.
0 - 1	3.0 ± 0.6	<0.4	<0.4	2.2 ± 0.5	16. ± 3.	19. ± 3.
1 - 2	1.7 ± 0.7	<0.4	<0.4	1.0 ± 0.3	9.1 ± 1.6	10. ± 2.
2 - 3	1.2 ± 0.3	<0.4	<0.4	0.7 ± 0.5	8.7 ± 1.0	9.4 ± 1.
3 - 4	1.2 ± 0.3	<0.4	<0.4	1.2 ± 0.9	9.2 ± 1.7	10. ± 2.
4 - 5	1.1 ± 0.4	<0.4	<0.4	<0.4	10. ± 1.	10. ± 1.
5 - 7.5	1.4 ± 0.5	<0.4	<0.4	<0.4	11. ± 1.	11. ± 1.
7.5 - 10	1.0 ± 0.1	<0.4	<0.4	<0.4	11. ± 3.	11. ± 3.
10 - 15	1.2 ± 0.2	<0.4	<0.4	<0.4	11. ± 3.	11. ± 3.
15 - 25	0.9 ± 0.1	<0.4	<0.4	<0.4	12. ± 4.	12. ± 4.
25 - 35	1.1 ± 0.1	<0.4	<0.4	<0.4	13. ± 1.	13. ± 1.
35 - 45	----	----	----	----	----	----
45 - 55	0.6 ± 0.2	<0.4	<0.4	<0.4	13. ± 1.	13. ± 1.

Table H-140. Zinc in SC Soil Lysimeters

November, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	7.9 ± 2.3	0.5 ± 0.2	0.3 ± 0.2	0.8 ± 0.4	30. ± 15.	32. ± 15.
0 - 1	4.4 ± 1.	0.4 ± 0.2	0.2 ± 0.1	0.6 ± 0.3	28. ± 6.	29. ± 6.
1 - 2	4.8 ± 3.4	0.3 ± 0.4	0.1 ± 0.1	0.4 ± 0.3	20. ± 8.	21. ± 8.
2 - 3	1.4 ± 0.4	0.4 ± 0.3	<0.1	0.4 ± 0.2	13. ± 0.8	14. ± 0.9
3 - 4	1.4 ± 0.6	0.2 ± 0.2	<0.1	0.4 ± 0.3	13. ± 2.	14. ± 2.
4 - 5	1.0 ± 0.4	0.2 ± 0.1	<0.1	0.2 ± 0.1	11. ± 2.	11. ± 2.
5 - 7.5	0.6 ± 0.1	<0.2	<0.1	<0.2	22. ± 3.	22. ± 3.
7.5 - 10	0.4 ± 0.1	<0.2	<0.1	<0.2	21. ± 3.	21. ± 3.
10 - 15	0.5 ± 0.3	<0.2	<0.1	<0.2	22. ± 2.	22. ± 2.
15 - 25	0.4 ± 0.1	<0.2	<0.1	<0.2	27. ± 2.	27. ± 2.
25 - 35	0.4 ± 0.3	<0.2	<0.1	<0.2	27. ± 3.	27. ± 3.
35 - 45	----	----	----	----	----	----
45 - 55	0.3 ± 0.1	<0.2	<0.1	<0.2	26. ± 2.	26. ± 2.

Table H-141. Cadmium in Basic CL Land Plot

November, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	5.4	<0.1	3.	0.2	16.	19.
0 - 1	11. ± 6.	<0.1	2.1 ± 0.8	0.4 ± 0.1	9. ± 4.	12. ± 4.
1 - 2	7. ± 4.	<0.1	0.2 ± 0.2	0.1 ± 0.1	2.2 ± 0.8	2.5 ± 0.8
2 - 3	3.3 ± 0.3	<0.1	<0.1	<0.1	1.0 ± 0.2	1.0 ± 0.2
3 - 4	1.0 ± 0.6	<0.1	<0.1	<0.1	1.2 ± 0.4	1.2 ± 0.4
4 - 5	0.9 ± 0.1	<0.1	<0.1	<0.1	0.8 ± 0.6	0.8 ± 0.6
5 - 7.5	1.8 ± 0.2	<0.1	<0.1	<0.1	0.9 ± 0.6	0.9 ± 0.6
7.5 - 10	0.4 ± 0.1	<0.1	<0.1	<0.1	0.3 ± 0.1	0.3 ± 0.1
10 - 15	0.4 ± 0.2	<0.1	<0.1	<0.1	0.5	0.5
15 - 25	<0.2	<0.1	<0.1	<0.1	0.4	0.4
25 - 35	<0.2	<0.1	<0.1	<0.1	0.4	0.4
35 - 45	----	----	----	----	----	----
45 - 55	<0.2	<0.1	<0.1	<0.1	0.4 ± 0.1	0.4 ± 0.1

Table H-142. Copper in Basic CL Land Plot

November, 1974

(in ppm-dry wt.)

	Fraction I	Fraction II				
Depth (in.)	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	11.	0.6	0.6	3.2	67.	71.
0 - 1	11. ± 6.	0.3 ± 0.1	<0.1	0.8 ± 0.2	41. ± 6.	42. ± 6.
1 - 2	7. ± 4.	0.1 ± 0.0	<0.1	0.4 ± 0.1	31. ± 3.	31. ± 3.
2 - 3	6. ± 1.7	<0.1	<0.1	0.3 ± 0.0	12. ± 1.	12. ± 1.
3 - 4	3. ± 1.2	<0.1	<0.1	0.4 ± 0.1	13. ± 0.8	13. ± 0.8
4 - 5	3. ± 0.3	<0.1	<0.1	0.3 ± 0.0	11. ± 0.7	11. ± 0.7
5 - 7.5	4.4 ± 1.8	<0.1	<0.1	<0.1	11. ± 0.0	11. ± 0.0
7.5 - 10	2.8 ± 0.1	<0.1	<0.1	<0.1	7.4 ± 0.0	7.4 ± 0.0
10 - 15	2.4 ± 0.1	<0.1	<0.1	<0.1	11.	11.
15 - 25	2.6 ± 0.2	<0.1	<0.1	<0.1	9.0	9.0
25 - 35	2.7 ± 1.9	<0.1	<0.1	<0.1	6.2	6.2
35 - 45	----	----	----	----	----	----
45 - 55	1.0 ± 0.4	<0.1	<0.1	<0.1	11.	11.

Table H-143. Lead in Basic CL Land Plot

November, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	10.	<0.2	<0.2	<0.2	33.	33.
0 - 1	13. ± 7.	<0.2	<0.2	<0.2	21. ± 3.	21. ± 3.
1 - 2	9. ± 6.	<0.2	<0.2	<0.2	14. ± 1.	14. ± 1.
2 - 3	6. ± 1.	<0.2	<0.2	<0.2	12. ± 1.	12. ± 1.
3 - 4	3. ± 1.	<0.2	<0.2	<0.2	13. ± 0.0	13. ± 0.0
4 - 5	3.1 ± 0.1	<0.2	<0.2	<0.2	12. ± 0.1	12. ± 0.1
5 - 7.5	3.2	<0.2	<0.2	<0.2	12. ± 0.5	12. ± 0.5
7.5 - 10	2.6 ± 0.4	<0.2	<0.2	<0.2	10. ± 0.5	10. ± 0.5
10 - 15	2.7 ± 0.4	<0.2	<0.2	<0.2	10. ± 1.	10. ± 1.
15 - 25	2.2 ± 0.2	<0.2	<0.2	<0.2	12. ± 2.	12. ± 2.
25 - 35	1.9 ± 0.1	<0.2	<0.2	<0.2	9.	9.
35 - 45	----	----	----	----	----	----
45 - 55	1.5 ± 0.0	<0.2	<0.2	<0.2	8.1 ± 0.1	8.1 ± 0.1

Table H-144. Nickel in Basic CL Land Plot

November, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	3.	<0.4	<0.4	0.8	43.	44.
0 - 1	4. ± 1.7	<0.4	<0.4	1.5 ± 0.3	26. ± 5.	28. ± 5.
1 - 2	3. ± 1.2	<0.4	<0.4	0.7 ± 0.5	18. ± 2.	19. ± 2.
2 - 3	1.8 ± 0.1	<0.4	<0.4	<0.4	14. ± 0.6	14. ± 0.6
3 - 4	0.8 ± 0.3	<0.4	<0.4	1.0 ± 0.0	16. ± 1.	17. ± 1.
4 - 5	0.8 ± 0.2	<0.4	<0.4	<0.4	15. ± 0.2	15. ± 0.2
5 - 7.5	1.2 ± 0.4	<0.4	<0.4	<0.4	18. ± 2.	18. ± 2.
7.5 - 10	0.7 ± 0.1	<0.4	<0.4	<0.4	12. ± 0.5	12. ± 0.5
10 - 15	0.6 ± 0.2	<0.4	<0.4	<0.4	14.	14.
15 - 25	0.6 ± 0.1	<0.4	<0.4	<0.4	12.	12.
25 - 35	0.4 ± 0.0	<0.4	<0.4	<0.4	12. ± 2.	12. ± 2.
35 - 45	----	----	----	----	----	----
45 - 55	0.3 ± 0.1	<0.4	<0.4	<0.4	10. ± 0.0	10. ± 0.0

Table H-145. Zinc in Basic CL Land Plot

November, 1974

(in ppm-dry wt.)

Depth (in.)	Fraction I	Fraction II				
	DTPA	H_2O	NH_4OAc	H_2O_2	HNO_3-HF	Total
Surface	4.7	0.3	0.5	0.4	66.	66.
0 - 1	7.3 ± 4.8	<0.2	0.3 ± 0.1	0.2 ± 0.2	43. ± 4.	44. ± 4.
1 - 2	4.6 ± 2.4	<0.2	<0.1	<0.2	34. ± 4.	34. ± 4.
2 - 3	3.2 ± 0.5	<0.2	<0.1	<0.2	27. ± 2.	27. ± 2.
3 - 4	1.4 ± 0.5	<0.2	<0.1	<0.2	28. ± 3.	28. ± 3.
4 - 5	1.1 ± 0.2	<0.2	<0.1	<0.2	29. ± 0.4	29. ± 0.4
5 - 7.5	1.2	<0.2	<0.1	<0.2	30. ± 0.7	20. ± 0.7
7.5 - 10	0.9 ± 0.1	<0.2	<0.1	<0.2	22. ± 0.7	22. ± 0.7
10 - 15	1. ± 0.1	<0.2	<0.1	<0.2	25. ± 3.	25. ± 3.
15 - 25	0.8 ± 0.0	<0.2	<0.1	<0.2	33. ± 0.5	33. ± 0.5
25 - 35	0.6 ± 0.5	<0.2	<0.1	<0.2	21. ± 2.	21. ± 2.
35 - 45	----	----	----	----	----	----
45 - 55	0.4 ± 0.3	<0.2	<0.1	<0.2	18. ± 0.5	18. ± 0.5

Appendix I

The quantities of metals recovered from each individual soil after spiking it with known amounts of each of the five metals.

	SPIKE CONCENTRATION (ppm)			
FRACTION	Background	1	10	100
DTPA (ppm)	0	10.20	89.37	170.00
water extract (ppm)	0	0	.60	22.20
ammonium acetate extract (ppm)	.03	3.64	74.80	144.00
hydrogen peroxide extract (ppm)	0	1.08	2.47	7.40
nitric acid + hydroflouric acid extract (ppm)	.30	1.50	22.00	17.00
supernatant (mg)	0	0	9.83	680.00
Σ - DTPA (mg)	.33	6.22	109.70	870.60
Spike Recovered (%)	---	58.90	109.30	87.00

Table I-1. The concentration of metals in the SM(d/u) soil and the amount remaining in the supernatant for samples spiked with different concentrations of cadmium.

	SPIKE CONCENTRATION (ppm)			
FRACTION	Background	1	10	100
DTPA (ppm)	.55	6.95	87.87	565.00
water extract (ppm)	0	.08	.23	10.00
ammonium acetate extract (ppm)	.09	.21	8.78	144.00
hydrogen peroxide extract (ppm)	.30	3.36	22.90	139.20
nitric acid + hydroflouric acid extract (ppm)	1.90	4.00	39.00	80.65
supernatant (mg)	0	.20	1.74	453.20
Σ - DTPA (mg)	2.29	7.85	72.65	827.05
Spike Recovered (%)	---	55.60	70.30	82.40

Table I-2. The concentration of metals in the SM(d/u) soil and the amount remaining in the supernatant for samples spiked with different concentrations of copper.

	SPIKE CONCENTRATION (ppm)			
FRACTION	Background	1	10	100
DTPA (ppm)	.80	5.97	72.26	58.27
water extract (ppm)	0	0	.05	.56
ammonium acetate extract (ppm)	0	.18	10.41	272.10
hydrogen peroxide extract (ppm)	.06	.15	.07	2.25
nitric acid + hydroflouric acid extract (ppm)	8.50	23.60	97.40*	714.38*
supernatant (mg)	0	0	.63	19.27
Σ - DTPA (mg)	8.56	23.93	108.56*	1008.56
Spike Recovered (%)	---	153.70	100.00	100.00

* Back calculated

Table I-3. The concentration of metals in the SM(d/u) soil and the amount remaining in the supernatant for samples spiked with different concentrations of lead.

	SPIKE CONCENTRATION (ppm)			
FRACTION	Background	1	10	100
DTPA (ppm)	0	6.57	72.02	130.00
water extract (ppm)	0	0	1.13	30.30
ammonium acetate extract (ppm)	0	.45	26.16	53.00
hydrogen peroxide extract (ppm)	.21	4.80	22.27	32.30
nitric acid + hydroflouric acid extract (ppm)	2.20	3.30	21.00	12.00
supernatant (mg)	0	0	16.72	975.00
Σ - DTPA (mg)	2.41	8.55	87.28	1102.60
Spike Recovered (%)	---	61.40	84.80	110.00

Table I-4. The concentration of metals in the SM(d/u) soil and the amount remaining in the supernatant for samples spiked with different concentrations of nickel.

	SPIKE CONCENTRATION (ppm)			
FRACTION	Background	1	10	100
DTPA (ppm)	6.50	15.37	89.50	147.50
water extract (ppm)	.04	.03	.52	27.20
ammonium acetate extract (ppm)	.50	2.38	37.70	72.00
hydrogen peroxide extract (ppm)	1.73	2.19	2.03	6.60
nitric acid + hydroflouric acid extract (ppm)	4.80	8.50	36.00	18.00
supernatant (mg)	.10	.15	17.61	945.00
Σ - DTPA (mg)	7.17	13.25	93.86	1068.80
Spike Recovered (%)	---	60.80	86.60	106.10

Table I-5. The concentration of metals in the SM(d/u) soil and the amount remaining in the supernatant for samples spiked with different concentrations of zinc.

	SPIKE CONCENTRATION (ppm)			
FRACTION	Background	1	10	100
DTPA (ppm)	.20	7.35	88.66	605.00
water extract (ppm)	0	.03	.07	11.50
ammonium acetate extract (ppm)	0	1.67	44.53	480.00
hydrogen peroxide extract (ppm)	0	.62	1.95	29.70
nitric acid + hydroflouric acid extract (ppm)	.10	5.15	43.66	132.00
supernatant (mg)	0	.15	.78	360.00
Σ - DTPA (mg)	.10	7.62	90.99	1013.20
Spike Recovered (%)	---	75.20	90.80	101.30

Table I-6. The concentration of metals in the basic CL soil and the amount remaining in the supernatant for samples spiked with different concentrations of cadmium.

	SPIKE CONCENTRATION (ppm)			
FRACTION	Background	1	10	100
DTPA (ppm)	.95	7.27	80.18	557.50
water extract (ppm)	0	.11	.14	.25
ammonium acetate extract (ppm)	0	.16	3.56	179.00
hydrogen peroxide extract (ppm)	.17	.88	4.24	39.70
nitric acid + hydroflouric acid extract (ppm)	4.80	14.20	74.90	408.50
supernatant (mg)	0	.25	.25	3.25
Σ - DTPA (mg)	4.97	15.60	83.09	630.70
Spike Recovered (%)	---	106.30	78.10	62.50

Table I-7. The concentrations of metals in the basic CL soil and the amount remaining in the supernatant for samples spiked with different concentrations of copper.

	SPIKE CONCENTRATION (ppm)			
FRACTION	Background	1	10	100
DTPA (ppm)	1.17	7.80	77.51	3.12
water extract (ppm)	0	.05	.14	.05
ammonium acetate extract (ppm)	.23	.23	2.48	158.60
hydrogen peroxide extract (ppm)	.13	.17	.14	1.54
nitric acid + hydroflouric acid extract (ppm)	9.30	17.50	75.00	848.97*
supernatant (mg)	0	.50	.55	.50
Σ - DTPA (mg)	9.66	18.45	78.31	1009.66*
Spike Recovered (%)	---	87.90	68.60	100.00*

*Back calculated.

Table I-8. The concentration of metals in the basic CL soil and the amount remaining in the supernatant for samples spiked with different concentrations of lead.

	SPIKE CONCENTRATION (ppm)			
FRACTION	Background	1	10	100
DTPA (ppm)	0	3.55	41.76	472.50
water extract (ppm)	0	.05	.05	10.90
ammonium acetate extract (ppm)	.16	.44	9.82	230.00
hydrogen peroxide extract (ppm)	.19	1.31	5.56	35.60
nitric acid + hydroflouric acid extract (ppm)	13.60	17.75	79.93	171.00
supernatant (mg)	0	.25	1.60	426.25
Σ - DTPA (mg)	13.95	19.80	96.96	873.75
Spike Recovered (%)	---	58.50	83.00	85.90

Table I-9. The concentration of metals in the basic CL soil and the amount remaining in the supernatant for samples spiked with different concentrations of nickel.

	SPIKE CONCENTRATION (ppm)			
FRACTION	Background	1	10	100
DTPA (ppm)	2.37	5.45	63.33	400.00
water extract (ppm)	0	.04	.04	5.10
ammonium acetate extract (ppm)	.60	.19	4.73	191.00
hydrogen peroxide extract (ppm)	0	.08	.22	8.10
nitric acid + hydroflouric acid extract (ppm)	26.00	33.00	108.66	266.00
supernatant (mg)	.30	.25	.50	380.00
Σ - DTPA (mg)	26.90	33.56	114.15	850.20
Spike Recovered (%)	---	66.60	87.20	82.30

Table I-10. The concentration of metals in the basic CL soil and the amount remaining in the supernatant for samples spiked with different concentrations of zinc.

	SPIKE CONCENTRATION (ppm)			
FRACTION	Background	1	10	100
DTPA (ppm)	.15	8.35	93.16	175.00
water extract (ppm)	0	.03	.12	19.30
ammonium acetate extract (ppm)	0	2.21	35.06	364.00
hydrogen peroxide extract (ppm)	0	.55	1.16	6.30
nitric acid + hydroflouric acid extract (ppm)	.30	4.30	33.00	99.50
supernatant (mg)	0	.15	2.75	477.50
Σ - DTPA (mg)	.30	7.24	72.09	966.60
Spike Recovered (%)	---	69.40	71.70	96.60

Table I-11. The concentration of metals in the acid CL soil and the amount remaining in the supernatant for samples spiked with different concentrations of cadmium.

	SPIKE CONCENTRATION (ppm)			
FRACTION	Background	1	10	100
DTPA (ppm)	.97	7.32	95.67	357.50
water extract (ppm)	0	.05	.05	4.04
ammonium acetate extract (ppm)	0	.22	1.45	71.10
hydrogen peroxide extract (ppm)	.17	1.25	6.82	83.00
nitric acid + hydroflouric acid extract (ppm)	4.80	6.45	38.56	245.00
supernatant (mg)	0	.25	.25	109.00
Σ - DTPA (mg)	4.97	8.22	47.13	512.14
Spike Recovered (%)	---	32.50	42.10	50.70

Table I-12. The concentration of metals in the acid CL soil and the amount remaining in the supernatant for samples spiked with different concentrations of copper.

	SPIKE CONCENTRATION (ppm)			
FRACTION	Background	1	10	100
DTPA (ppm)	2.15	7.02	68.15	4.97
water extract (ppm)	0	.05	.10	.41
ammonium acetate extract (ppm)	0	.05	1.39	68.40
hydrogen peroxide extract (ppm)	.06	.07	.05	.48
nitric acid + hydroflouric acid extract (ppm)	27.60	28.15	70.40	398.77*
supernatant (mg)	.40	.50	.50	560.00
Σ - DTPA (mg)	28.06	28.82	72.44	1028.06*
Spike Recovered (%)	---	7.60	44.30	100.00

*Back calculated.

Table I-13. The concentration of metals in the acid CL soil and the amount remaining in the supernatant for samples spiked with different concentrations of lead.

	SPIKE CONCENTRATION (ppm)			
FRACTION	Background	1	10	100
DTPA (ppm)	2.57	9.80	72.81	335.00
water extract (ppm)	0	.05	.22	25.90
ammonium acetate extract (ppm)	0	.65	14.10	190.00
hydrogen peroxide extract (ppm)	.79	3.56	9.46	38.10
nitric acid + hydroflouric acid extract (ppm)	36.50	45.75	76.10	122.00
supernatant (mg)	0	.25	4.88	585.00
Σ - DTPA (mg)	37.29	50.26	104.76	961.00
Spike Recovered (%)	---	129.70	67.40	92.30

Table I-14. The concentration of metals in the acid CL soil and the amount remaining in the supernatant for samples spiked with different concentrations of nickel.

	SPIKE CONCENTRATION (ppm)			
FRACTION	Background	1	10	100
DTPA (ppm)	4.05	10.25	84.33	170.00
water extract (ppm)	.10	.06	.16	23.20
ammonium acetate extract (ppm)	.02	.43	9.20	128.00
hydrogen peroxide extract (ppm)	.28	.96	1.50	7.30
nitric acid + hydroflouric acid extract (ppm)	100.00	85.00	117.66	190.00
supernatant (mg)	.40	.85	4.51	560.00
Σ - DTPA (mg)	100.80	87.30	133.03	908.50
Spike Recovered (%)	---	-135.00	32.20	80.70

Table I-15. The concentration of metals in the acid CL soil and the amount remaining in the supernatant for samples spiked with different concentrations of zinc.

	SPIKE CONCENTRATION (ppm)			
FRACTION	Background	1	10	100
DTPA (ppm)	.07	5.85	105.00	385.00
water extract (ppm)	0	0	.11	18.22
ammonium acetate extract (ppm)	.07	3.92	66.80	530.00
hydrogen peroxide extract (ppm)	0	.96	2.06	22.20
nitric acid + hydroflouric acid extract (ppm)	0	3.40	27.00	95.00
supernatant (mg)	0	0	1.87	456.25
Σ - DTPA (mg)	.07	8.28	97.84	1121.67
Spike Recovered (%)	---	82.10	97.70	112.10

Table I-16. The concentration of metals in the SC soil and the amount remaining in the supernatant for samples spiked with different concentrations of cadmium.

	SPIKE CONCENTRATION (ppm)			
FRACTION	Background	1	10	100
DTPA (ppm)	.80	5.85	84.00	497.50
water extract (ppm)	0	0	.18	6.54
ammonium acetate extract (ppm)	.16	.14	4.63	234.00
hydrogen peroxide extract (ppm)	.04	.35	3.22	58.30
nitric acid + hydroflouric acid extract (ppm)	5.80	11.00	61.75	330.00
supernatant (mg)	0	0	.57	177.25
Σ - DTPA (mg)	6.00	11.49	70.35	806.09
Spike Recovered (%)	---	54.90	64.30	80.00

Table I-17. The concentration of metals in the SC soil and the amount remaining in the supernatant for samples spiked with different concentrations of copper.

	SPIKE CONCENTRATION (ppm)			
FRACTION	Background	1	10	100
DTPA (ppm)	.95	7.12	96.87	6.42
water extract (ppm)	0	0	.05	.18
ammonium acetate extract (ppm)	.23	.44	14.47	356.80
hydrogen peroxide extract (ppm)	.22	.32	.05	1.35
nitric acid + hydroflouric acid extract (ppm)	10.00	12.20	72.05	646.14*
supernatant (mg)	0	0	.75	5.98
Σ - DTPA (mg)	10.45	12.96	87.37	1010.45*
Spike Recovered (%)	---	25.10	76.90	100.00*

* Back calculated.

Table I-18. The concentration of metals in the SC soil and the amount remaining in the supernatant for samples spiked with different concentrations of lead.

	SPIKE CONCENTRATION (ppm)			
FRACTION	Background	1	10	100
DTPA (ppm)	.70	7.60	77.15	515.00
water extract (ppm)	0	0	.25	19.20
ammonium acetate extract (ppm)	.17	1.55	42.07	400.00
hydrogen peroxide extract (ppm)	.70	2.66	7.35	54.00
nitric acid + hydroflouric acid extract (ppm)	5.10	10.50	46.50	103.00
supernatant (mg)	0	0	3.70	507.50
Σ - DTPA (mg)	5.97	14.71	99.87	1083.70
Spike Recovered (%)	---	87.40	93.90	107.70

Table I-19. The concentration of metals in the SC soil and the amount remaining in the supernatant for samples spiked with different concentrations of nickel.

FRACTION	SPIKE CONCENTRATION (ppm) Background	1	10	100
DTPA (ppm)	.87	6.32	85.00	412.50
water extract (ppm)	.23	.17	.36	19.68
ammonium acetate extract (ppm)	.80	1.25	27.00	356.00
hydrogen peroxide extract (ppm)	.12	.80	.46	9.90
nitric acid + hydroflouric acid extract (ppm)	17.00	17.40	70.00	146.00
supernatant (mg)	.50	.60	4.62	512.50
Σ - DTPA (mg)	18.65	20.22	102.44	1044.08
Spike Recovered (%)	---	15.70	83.70	102.50

Table I-20. The concentration of metals in the SC soil and the amount remaining in the supernatant for samples spiked with different concentrations of zinc.

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