AN ASSESSMENT OF THE VARIABILITY IN PERFORMANCE OF WET ATMOSPHERIC DEPOSITION SAMPLERS

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U.S. GEOLOGICAL SURVEY

Water-Resources Investigations Report 87-4125

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West Point, New York
27 June, 1987

DEPARTMENT OF THE INTERIOR

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U.S. GEOLOGICAL SURVEY

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METRIC CONVERSION TABLE

For the reader who may prefer to use inch-pound units, conversion factors for Metric (International System) units used in this report are:

Multiply Metric units	By	To obtain inch-pound units
kilometer	0.6214	mile
liter (L)	1.057	quart
milliliter (ml)	0.03382	ounce, fluid
micrometer (μm)	3.937×10^{-5}	inch
millimeter (mm)	3.937×10^{-2}	inch
meter (m)	39.37	inch

Water-quality terms and abbreviations used in this report:

Microsiemens per centimeter at 25 degrees Celsius (μS/cm at 25°C)

kilo-ohms (KΩ)

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ABSTRACT

The variability in performance of two brands of wet/dry atmospheric deposition samplers were compared for 1 year at a single site. A total of nine samplers were used. Samples were collected weekly and analyzed for pH, specific conductance, common chemical constituents, and sample mass. Additionally, data on the duration of each sampler opening were recorded using a microdatalogger. These data disprove the common perception that samplers remain open throughout a precipitation event. The sensitivity of sampler sensors within the range tested did not have a definable impact on sample collection. The nonnormal distribution within the data set necessitated the application of the nonparametric Friedman test to assess comparability of sample chemical composition and volume between and within sample brands. Statistically significant differences existed for most comparisons, however, the test does not permit quantification of their magnitudes. Differences in analyte concentrations between samplers were small.

SPONSORSHIP

The research reported here has been funded as part of the National Acid Precipitation Assessment Program by the U.S. Geological Survey under interagency agreement number WRD-4000-4352-84. The performing agency was the Science Research Laboratory of the U.S. Military Academy at West Point, New York. Principal Investigators were Richard C. Graham PhD and John K. Robertson PhD. The agreement was monitored by Paul Kapinos and Bernard Malo of the Office of Atmospheric Deposition Analysis, Water Resources Division, U.S. Geological Survey, Reston, Virginia, and Leroy Schroder, U.S. Geological Survey, Arvada, Colorado. The performance period was from July 1984 through September 1986. The original submission date of the report was October 1, 1986.

INTRODUCTION

History

One of the earliest uses of automatic precipitation collectors was the design by Volchock and Graveson (1976). Since that time other designs have been promulgated. The Aerochem Metrics 301[1] and the Leonard Mold and Die Geotech 650 are fashioned after the Volchock collector. The Aerochem Metrics 301 was chosen by the National Atmospheric Deposition Program (NADP), organized in 1977 to determine spatial and temporal trends in atmospheric precipitation, to be the collector to be used in the network (Bigelow 1982, Cowling 1978). In 1982, the National Trends Network (NTN) adopted the same sampler. Several studies (Bogen, and others 1980, DePena and others 1980, Galloway and Likens 1976, Goodison 1980, Schroder and others 1985) have been designed to determine the collection efficiency of various collectors.

Objectives of Study

The project was designed to study the small distance spatial variability of sample weight and chemistry of wet atmospheric deposition and the collection efficiency of two brands of atmospheric deposition collectors; it was also intended to study the sensor sensitivity. Three clusters of samplers were placed such that each cluster would contain a sampler which was controlled by a common sensor set to a moderate sensitivity; a sampler which had its sensor set at a moderate sensitivity; and a sampler which had its sensor set at a low sensitivity. It was assumed that small-scale differences in amount of rainfall might be observed over the study area. The study was designed to evaluate whether differences in

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1. The use of trade names in this report is for descriptive purposes only and does not constitute endorsement by the U.S. Geological Survey nor by the U.S. Army.

sample weight (precipitation amount) or chemistry might exist. The intent of having three samplers activated by a common sensor was to ensure that any observed differences were because of differences in the rain coverage as opposed to differences caused by sensor sensitivity characteristics. Sensor sensitivity also was to be investigated by having two different sensitivities preset during the study. The study also was used to compare the chemical variability from several non-NADP/NTN standard samplers. Data was collected from August 1984 through September 1985.

Purpose and Scope of Report

The purpose of the report is to describe the results of a one year collection of wet atmospheric deposition amount and chemistry data. The data analysis will include a description of the failings of the 2-way ANOVA of a randomized block design of data and the subsequent use of the nonparametric Friedman test to ascertain differences which exist between different types of atmospheric deposition samplers. Additionally, the analysis of data from the recorded data on the times of opening and closing of the sampler will be included. Some reasons will be suggested for the disparity in performance of the collectors.

Description of the Study Site

The monitoring site is located at the US Military Academy at West Point, New York. The site is also a part of the NADP/NTN network and is identified as site number 335141, WEST POINT (NY99). The site is partially surrounded by a swamp (fig. 1). Photographs of the site looking west and east are shown in figure 2. The soil at the site is gravel fill. The topographic relief in the vicinity of the site is relatively low. The site is located next to a flowing stream that is the outflow of a moderate sized watershed. The latitude of the site is 41° 21′ 03" and the longitude of the site is 74° 02′ 54" . The elevation of the site is 203 meters above sea level. The site is classified as rural (Robertson and Wojciechowski 1986). The average annual precipitation is 1193 mm (Hesson and Robertson 1982). The study site is in the Eastern Highland physical division and the Adirondack-New England Highland subdivision (Hammond 1965). The site also is in the Appalachian Oak Forest Section of the Eastern Deciduous Forest Province (Bailey 1976). Geomorphically, the site is in the Reading Prong of the New England province (Hesson and Robertson 1982). Meteorological, particulate, and gas monitoring equipment are also located at the site. Meteorological parameters routinely recorded are wind speed, wind direction, temperature (10 m above the soil surface) temperature (2 m above the soil surface), barometric pressure, relative humidity, rainfall amount, and solar radiation. Rainfall is recorded with tipping bucket, weighing bucket, and National Weather Service standard 8" rain gages. Six power plants are located within 50 km of the site. The monitoring site also is the location of two of the US Environmental Protection Agency dry deposition pilot monitoring stations. The Atmospheric Turbulence Diffusion Laboratory (National Oceanographic Atmospheric Administration) of Oak Ridge, Tennessee has also sited one of their dry-deposition monitoring stations at this study area.

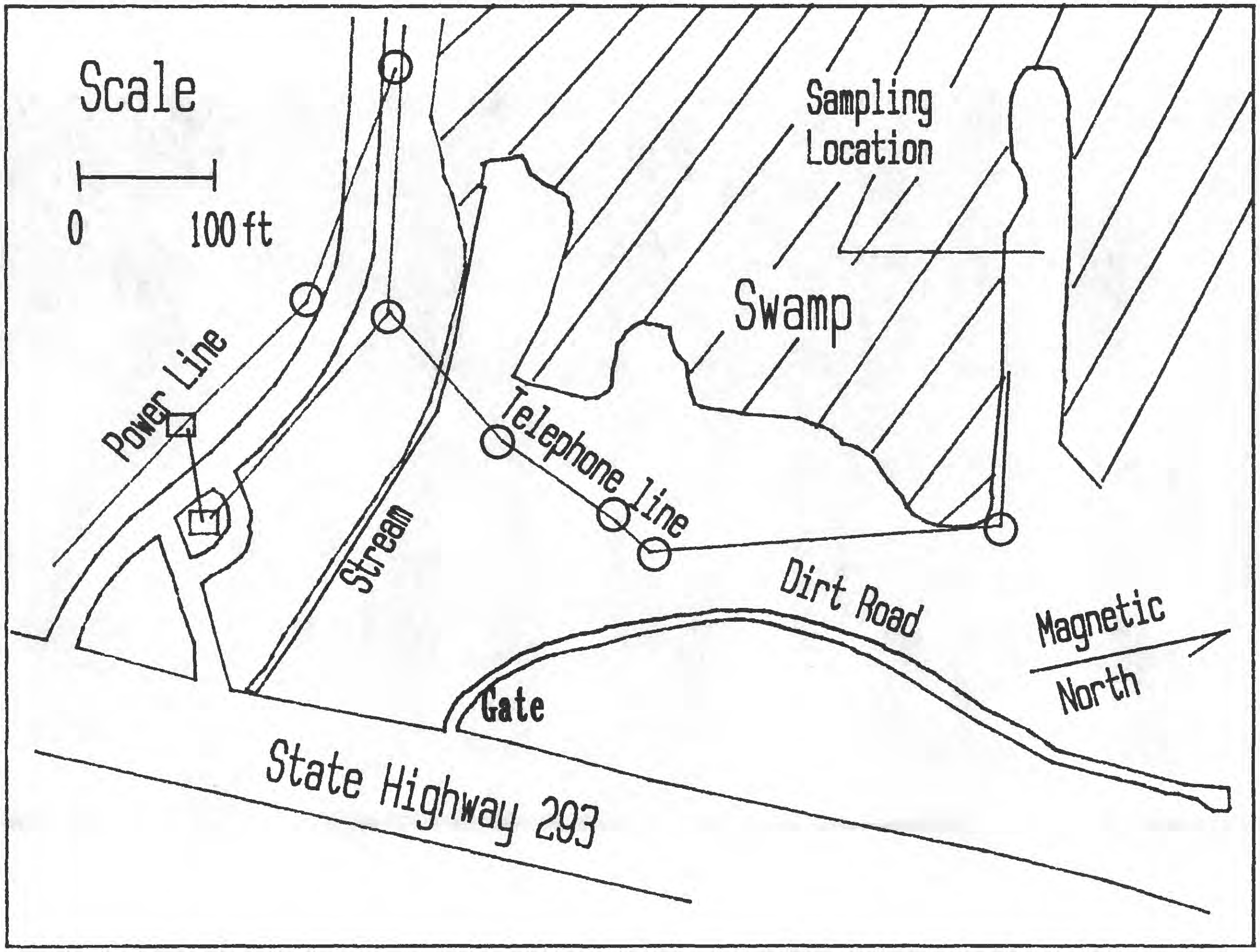

Figure 1.-- Local setting of the West Point sampling site.

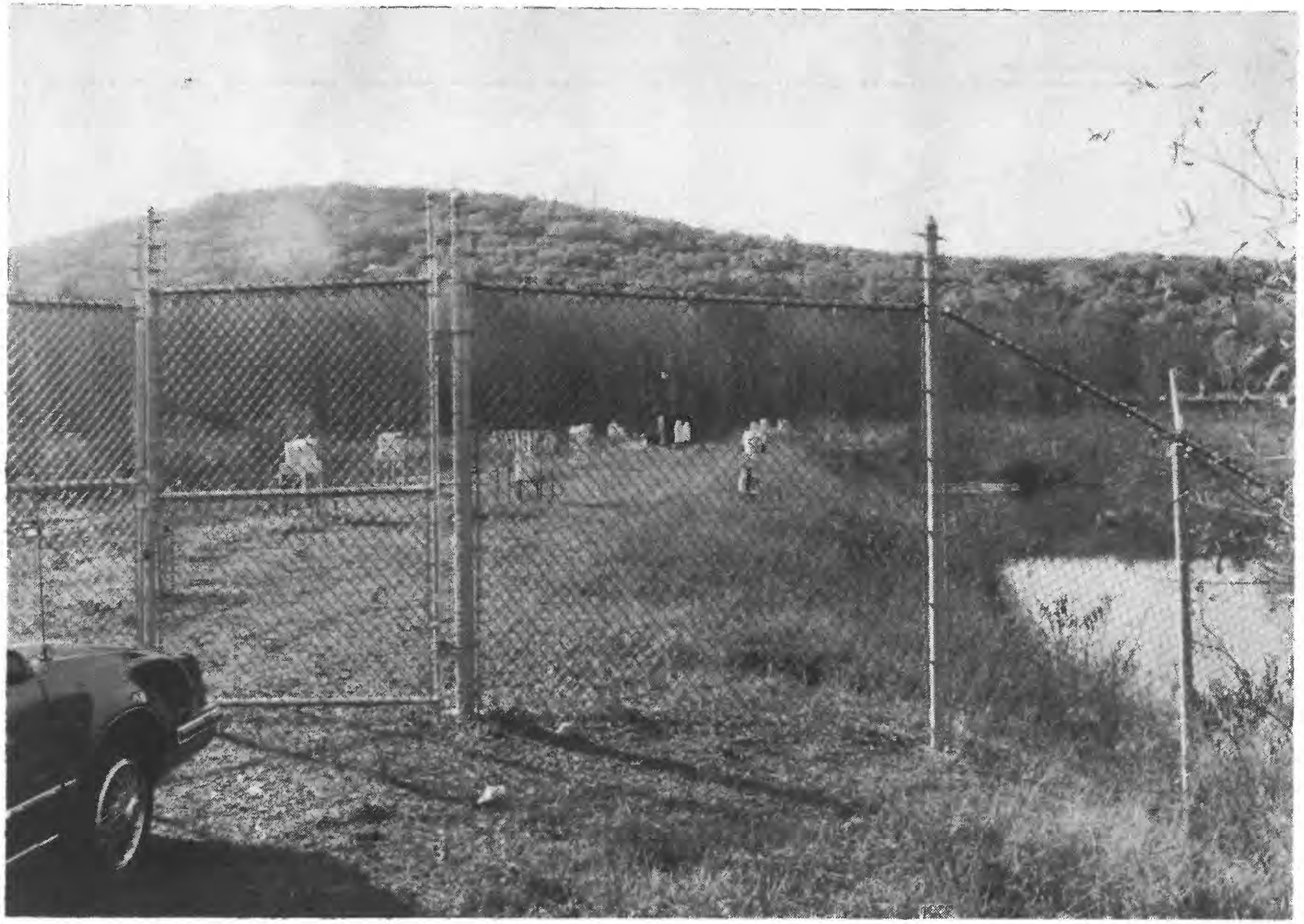

Figure 2a.-- Collector placement showing local topography. Photograph is taken looking west.

Figure 2b.-- Collector placement showing local topography. Photograph is taken looking east.

DATA COLLECTION AND SAMPLE PREPARATION PROCEDURES

Nine precipitation samplers were used in the study. Six of the samplers were Aerochem Metrics model 301 precipitation collectors. The remaining three were Leonard Mold and Die GeoTech 650 precipitation collectors. The samplers were dispersed in an approximately linear fashion in three groups (fig. 3). The middle group had a fourth collector, from which samples were sent to the Illinois State Water Survey for chemical analysis. This last sampler (also an Aerochem Metrics 301 precipitation collector) is part of the NADP/NTN. The sensitivity of each precipitation sensor was set by placing a 100 KΩ variable resistor in the sensor circuit and adjusting the variable resistor with a preset decade resistance box shunted across the sensor grid until the sensor just activated the sampler motor. Three samplers, one from each group, were activated by a common sensor, which was nominally set at 70 KΩ. The sampler labeled A-1 in figure 3 was the master and samplers L-1 and A-2 were the slaves to complete the set of three. One other sampler in each group also had its sensor nominally set at 70 KΩ and the last sampler had its sensor nominally set at 55 KΩ (Table 1). Also, in this table are the temperatures of the surface of the sensor taken at the top, middle and bottom of the sensor. The letter prefix for each sampler designates the sampler manufacturer; A for Aerochem Metrics 301 and L for GeoTech 650. Each group of samplers had a Belfort model 5-780 weighing rain gage located in its vicinity (fig. 3). The position of the lid on the collector was monitored by checking the voltage at the event pen output terminal strip on each sampler. The voltage was checked every minute by a Campbell (Campbell Scientific Inc. Logan, Utah) model CR-7 microdatalogger. A set of values was recorded only if the voltage of any one of the samplers indicated a change of lid position, that is, the lid went from covering the dry bucket to covering the wet bucket or vice versa. A threshold of 8 volts was used to indicate that a change of lid position had occurred. The voltage when the lid is covering the wet bucket (indicating that it is not raining) was near zero. A small offset of 0.2 volts was added to the value read by the microdatalogger because some of the voltages were sometimes slightly negative. The value of the voltage when the lid was covering the dry bucket would be in the range from 11 to 13 volts for the Aerochem Metric 301 samplers and from 17 to 18 volts for the GeoTech 650 samplers.

Sample buckets were changed each Tuesday at approximately 0900 local time (Eastern Standard Time or Eastern Daylight as appropriate to the time of year). The sample collection vessels were white high-density polyethylene (HDPE) buckets of approximately 10-liters volume. Lids were placed on buckets prior to removal from the sampler and after removal of the bucket from the sampler, the bucket and lid were placed in a plastic bag for transport to the laboratory. The under-side of the foam-lined and plastic-sealed sampler lid and the lip of the dry bucket were washed with a laboratory tissue soaked in deionized water and dried with a laboratory tissue weekly. The technician wore surgeon's gloves during the changing of all sample buckets. All buckets and lids had been previously scrubbed with

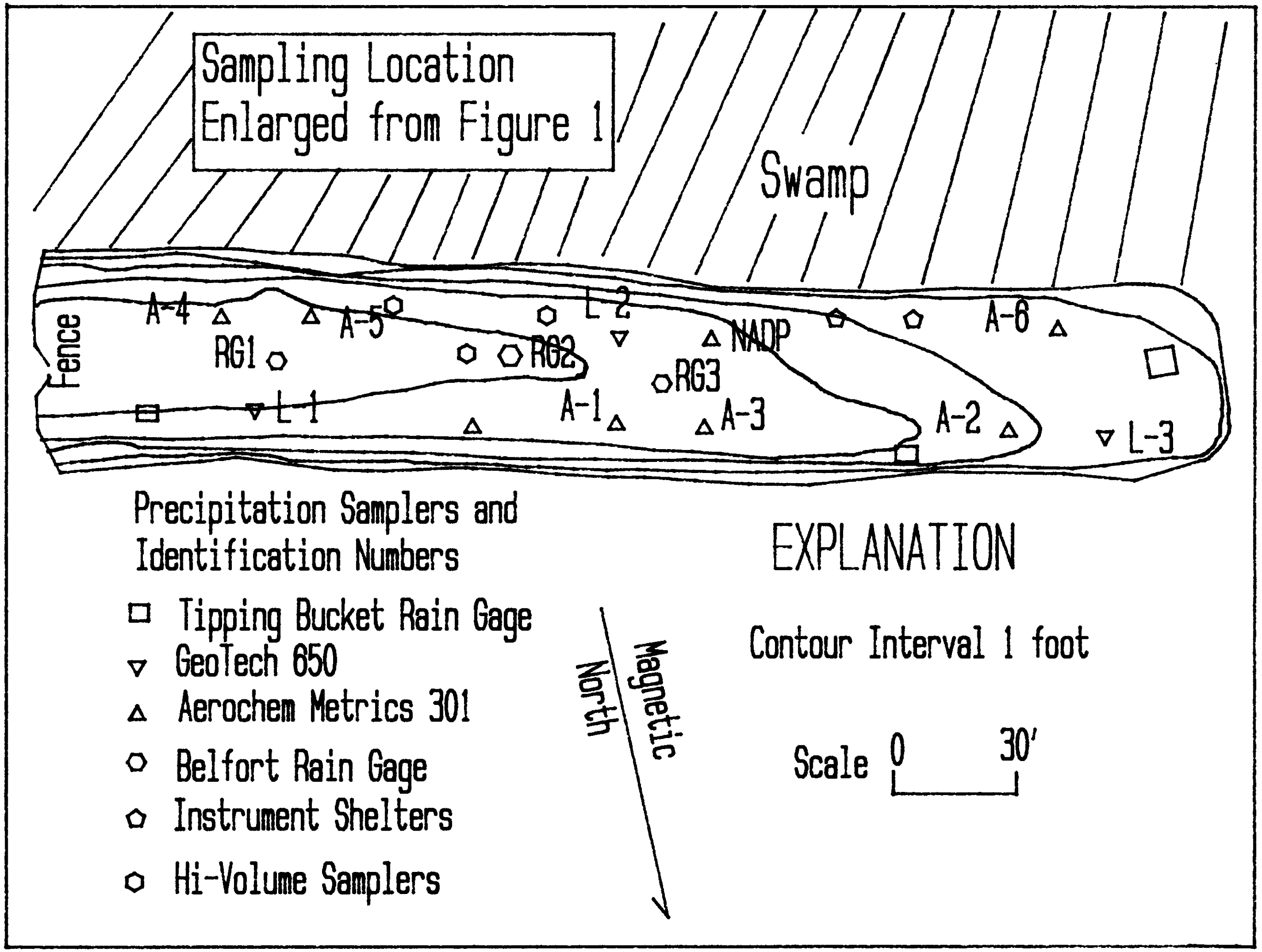

Figure 3.-- Sampling site and spatial relation of collectors.

Table 1.-- *Electrical resistances and surface temperatures of collector sensors*

[Resistance required to open the collector; units: KΩ, *kiloohms; oC, degrees Celsius]*

Collector	*Electrical Resistance* (*KΩ*)	*Temperature Bottom* (°C)	*Temperature Middle* (°C)	*Temperature Top* (°C)
A-1, A-2, L-1	69	52.8	64.4	52.8
A-3	55	46.1	49.4	35.0
A-4	55	60.0	82.8	46.1
A-5	70	43.3	60.6	52.2
A-6	70	34.4	35.0	35.0
L-2	55	47.2	60.0	62.8
L-3	70	52.2	54.4	57.8
NADP	75	41.1	70.0	50.6

a plastic bristle brush and deionized water, then rinsed three times with deionized water and allowed to air dry. Buckets and lids were weighed empty then placed in individual plastic bags for storage and transport to the field site. The sample collection vessels and contents were weighed upon return to the laboratory.

The mass of rain in each collection vessel was recorded and compared to rain gage readings at the site. Three Belfort model 5-780 weighing/recording rain gages and one Weathermeasure model P511-E tipping bucket rain gage measured and recorded the amount of precipitation which fell. The amount ofprecipitation collected in each rain gage was used as the standard to which the amount of precipitation collected in the sampler was compared. The signal from the tipping bucket rain gage was also recorded by the Campbell CR-7 data logger. A National Weather Service standard 8" rain gage was also located at the site and the rain amount was measured and recorded daily.

After the buckets were weighed, a sample aliquot was removed and the pH and conductance of the precipitation in each bucket were determined. pH was determined by placing 4 ml of sample in a 4-ml plastic cup. An Orion 701 pH meter with a Beckman 13013 pH probe, calibrated by the NADP/NTN protocol (Bigelow 1982), was used for the analysis. A Barnstead specific conductance meter with a Yellow Springs Instrument 5301 specific conductance probe, calibrated according to the NADP/NTN protocol (Bigelow 1982), was used in the inverted mode to determine the specific conductance of each sample. Treatment of the samples in the laboratory consisted of withdrawing three 50-ml aliquots of sample and filtering each aliquot through a 0.45-μm ACRODISK filter into a 125-ml high density polyethylene plastic bottle. The filter was prerinsed with a 5-ml aliquot of deionized water followed by a 5-ml aliquot of the sample. Two aliquots were left untreated, and the third was preserved with 20 μliter of American Chemical Society reagent grade nitric acid. The three bottles were then sealed and placed in a small, labeled plastic bag. The set of all nine bags were then placed in a large plastic bag in an insulated mailer. Ice was added to maintain temperature at 4°C during shipment.

Quality control samples, submitted on alternate weeks, were of two types: U.S. Geological Survey diluted Standard Reference Water Samples (SRWS) and split samples. The split sample was always the sample from sampler A-4. Both types of samples were submitted to the laboratory as blind samples. In addition to these quality-control samples, aliquots of deionized water, which had been placed in clean buckets were also submitted on a routine basis to ensure cleanliness of buckets.

Samples were mailed to the U.S. Geological Survey analytical laboratory in Arvada, Colorado for analysis. The laboratory determined calcium, magnesium, potassium, and sodium by atomic absorption spectrophotometry. Colorimetric methods were used to determine chloride, nitrate plus nitrite, ammonium, sulfate, and ortho-phosphate. The laboratory determined pH and specific conductance potentiometrically (Fishman and Friedman 1985).

Tables A-1 through A-9 in Appendix A represent the results of the chemical analyses conducted on each sample by the U.S. Geological Survey. Missing values in the tables are indicated by --- whereas table entries that are blank indicate that no rain or insufficient rain for analysis fell that week. Table A-10 in Appendix A gives the results of analysis for samples taken at the same time intervals, but submitted to the NADP Central Analytical Laboratory at the Illinois State Water Survey. Included in these tables are concentrations of sulfate, ammonia, nitrate plus nitrite, chloride, sodium, potassium, calcium, magnesium, field (determined at U.S. Military Academy) and lab (determined at U.S. Geological Survey) pH, and field and lab determined specific conductance. Also included in these tables are the weight of each sample and the efficiency of sampler collection for that sample period. The efficiency of collection, expressed as a percentage, was calculated by dividing the equivalent mm of rain (sample weight * .014732) collected by the sampler by the depth of rain, in mm, determined from the rain gage data and expressed as a percentage. The rain gage (a Belfort model 5-780 weighing rain gage) which was used for calculation is labelled RG-3 in figure 3. Table A-11 in Appendix A gives the amount of rainfall for each rain gage in equivalent mm of water. Also included in this table are the rainfall amounts as determined from a National Weather Service 8" standard rain gage. Tables B-1 through B-10 in Appendix B represent percentile summaries of the ion concentrations of selected ions. Represented in these tables are the 10-, 25-, 50-, 75-, and 90- percentiles for the selected ions.

Line graphs of the time variation of the analytes, collector efficiency, and sample weights are shown in the graphs displayed in the appendices[2]. The data is presented for each analyte and for each sampler. These graphs are presented to show the marked variation of the data with time. It should be noted that the plots and tables of the percent collection efficiency of each sampler seems to indicate that a negative bias (that is the amount of precipitation collected by the sampler is less than the amount of precipitation collected by the rain gage) is exhibited by each sampler, regardless of the manufacturer.

Measurements of precipitation weight by sampler were taken over a period of 57 weeks from August 1984 through September 1985. The relation of collection week (x-axis of all plots) to the date of collection is shown in Table A-12 in Appendix A.

METHODS OF ANALYSIS

Statistical Model for Evaluation of Sample Weights

On initial consideration of the data and the manner in which it was recorded, the statistical model used for the analysis was an Analysis of Variance (ANOVA) randomized complete block design. This model was selected because the desired goal of the analysis was to detect differences in the performance characteristics of the nine different samplers. In using this technique, the precipitation measurements made by the samplers could be compared without an excess of unwanted effects caused by the variability of rainfall amounts from week to week. The desired effect was to make the conditions for comparison as homogeneous as possible within the weekly measurements and to make the different weeks as heterogeneous as possible with respect to the recorded sample weight. In the proposed statistical model, the sampler itself was designated as the treatment effect of concern and the week in which the measurement was made was chosen as the blocking variable.

There were initially 9 levels of samplers(k) and 57 blocks(weeks)(b) in the data base. The linear statistical model that represents the weekly sample weight observed (y_{ij}) is

$$y_{ij} = \mu + \tau_i + \beta_j + \epsilon_{ij}, \qquad (1)$$

where $i = 1,2,...9$ (the number of samplers);
$j = 1,2,...57$ (the number of weeks);
μ is an overall mean sample weight;
τ_i is the effect of the i th sampler;
β_j is the effect of the j th week;
ϵ_{ij} is the random error term associated with the ij th observation.

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2. Appendix C NH_4^+, Ca^{++}, Cl^-, Mg^{+2}, NO_3^-, PO_4^{3-}, K^+, Na^+, and SO_4^{2-} : Appendix D Lab and Field pH and Conductivity: Appendix E Collector Efficiency : Appendix F Sample Weight

Data Editing and Estimation

Before the aptness of the model could be investigated, the recorded data had to be edited. There were 11 measurement periods where no rainfall was recorded and a period of 5 consecutive weeks where the sample weight measurements for all collectors were not available. These 16 periods would not contribute any useful information to the analysis and were deleted from the data base.

Within the remaining 41 weekly periods, there were 23 occasions in which a recorded sample weight was missing. This occurred during the weeks when specific samplers were inoperative because of mechanical malfunction. Elimination of the weeks containing the missing values was not done because of the useful information provided by the observations present during the period. The missing values were estimated by using a weighted average procedure (Hicks, 1973). The weighting procedure took into account both the relation to other samplers and the relation of the collector to itself. It should be noted that the estimation procedure will tend to make rejection of the null hypothesis slightly more favored than if the missing values were not included. The reason for this is that as the number of observations increases, the corresponding F-Statistic to which test statistics are compared decreases. As the F-statistic decreases, a smaller test statistic could lead to an easier rejection of the null hypothesis.

Appropriateness of Statistical Model

To statistically determine if the collectors performed identically, the validity of the assumptions of the 2-way ANOVA using randomized complete block design had to be verified. One such assumption is that the variances of the sample weights for the nine collectors are equal. The Hartley Test (Neter and others, 1985) was used to test the equality of sample weight variances. The test statistic, H, was calculated to be 3.43. At a level of significance of 0.05, the critical value for the test is 3.2. Because the test statistic is larger than the critical value, the hypothesis of equality of variances can be rejected.

An additional assumption requires that the computed random error terms must be normally distributed, with a mean of zero and a constant variance. Examination of a residual plot (fig. 4) showed a marked heteroscedasticity at predicted sample weights beyond 1,500 grams. A plot of the normalized error terms (fig. 5) indicated a significant departure from the normality assumption.

For these reasons, use of the randomized complete block as the model for analysis was dropped and a nonparametric approach, the Friedman Test, was chosen.

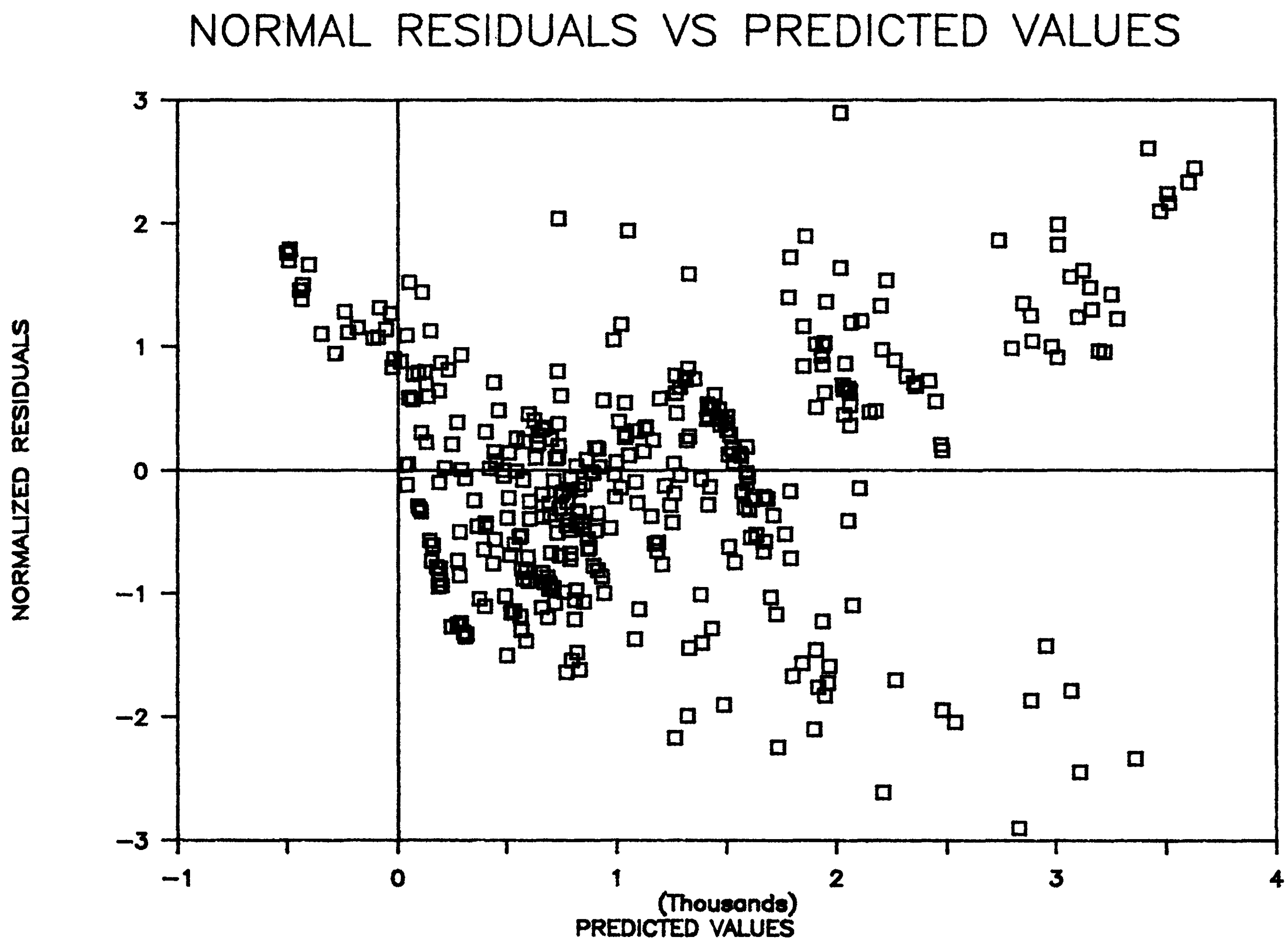

Figure 4.-- Residuals of the predicted sample weights versus predicted sample weights.

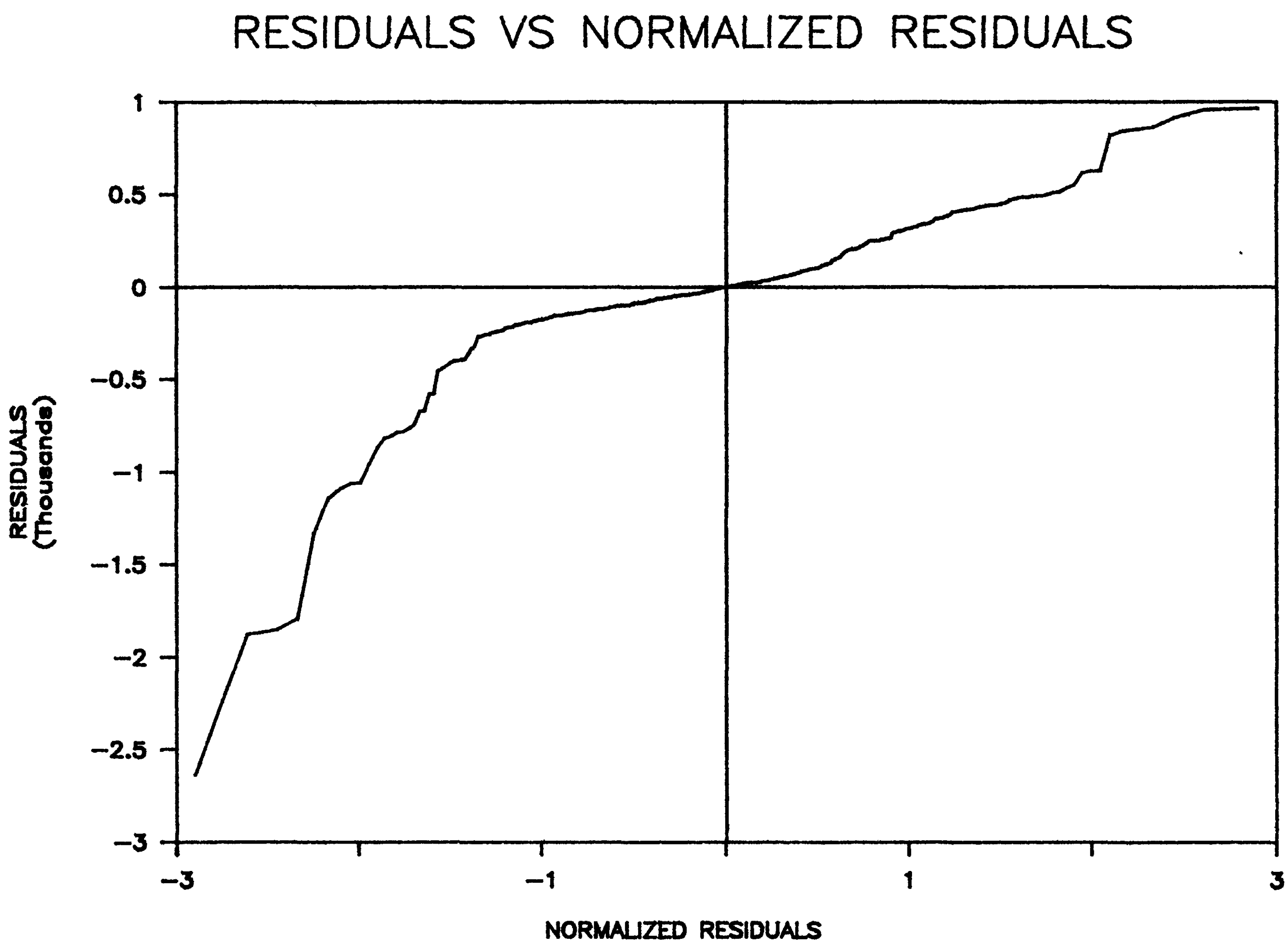

Figure 5.-- Normalized error terms (normalized residuals) plotted against residuals for the determination of normality of residuals.

The Friedman Test

The Friedman Test (Conover, 1980) is a nonparametric test that can be used with block designs in which the underlying assumptions are not as restrictive as an ANOVA procedure. The technique is based on the ranks of the observations within each block (week). The assumptions pertaining to this test are:

1. The results within one block (week) do not influence the results within the other blocks (weeks).

2. Within each block (week), the observations may be ranked according to some criteria of interest.

The hypotheses to be tested are:

H_0 : The samplers (treatments) have identical effects
H_1 : At least one of the samplers (treatments) tends to yield larger observed values than at least one other sampler (treatment).

To conduct the test, the sample weight observations (X_{ij}) for each sampler within each week were assigned a rank (R_{ij}); with the smallest sample weight given a rank of 1, the second smallest a rank of 2, and so forth. The quantities necessary to test the hypothesis are:

$$R_j = \sum_i R(X_{ij}), \qquad (2)$$

$$A_2 = \sum_i \sum_j R_{ij}^2, \qquad (3)$$

$$B_2 = \frac{1}{b} \sum_j R_j^2, \qquad (4)$$

where: $i=1,2,\ldots b$ the number of degrees of freedom in the weeks;

$j=1,2,\ldots k$ the number of degrees of freedom in the samplers;

$R(X_{ij})$ is the rank of the sampler according to the sample weight for the jth week;

R_{ij} is the rank of the *j*th sampler in the *i*th week;

R_j is the sum of the ranks over the weeks for the *j*th sampler.

The test statistic, T_2, is defined as:

The test statistic, T_2, is defined as:

$$T_2 = \frac{(b-1)\left[B_2 - \frac{b\ k\ (k+1)^2}{4}\right]}{A_2 - B_2}, \qquad (5)$$

where A_2 is defined in equation (3), B_2 is defined in equation (4), and b and k are as described above.

The decision rule is to reject the null hypothesis if:

$T_2 > F_\alpha$ with (k-1), (b-1)*(k-1) degrees of freedom.

Test of Sampler Performance

All nine samplers were considered in the initial hypothesis test. The ranking procedure yielded the following results:

A_2 : 11682.85, (6)
B_2 : 10669.95, (7)
T_2 : 57.06, (8)

In general, the F-statistics in this report will be reported to worst case the acceptance or rejection of hypotheses. Thus, if the number of degrees of freedom is b-1 and (b-1)*(k-1) and (b-1)*(k-1) is greater than the largest table value (usually 120), the F-statistic will be reported for b-1 and 120 degrees of freedom. It is recognized that the actual F-statistic will be smaller than this value and should lie in the range for degrees of freedom of 120 and degrees of freedom infinity.

At a significance level of 0.05, the corresponding F-statistic is 2.02, which is considerably less than T_2 of 57.06; and the hypothesis of identical performance is rejected. It can be concluded that there is a tendency for some samplers to record larger sample weights than others. The plots of collection efficiency in Appendix E show qualitatively that samplers A-6, L-2 and L-3 had an average efficiency of about 50 percent; whereas the other samplers recorded average efficiencies near 90 percent or greater. Plots of the time variation of the sample weight are shown in Appendix F. The weeks when substantially lower collection efficiencies were recorded were those weeks when the amount of precipitation was largely contributable to either a rain events with very fine droplets or snow. Both of these types of events would tend to contribute to poor collection efficiency if the sensor were unable to adequately respond to these situations.

Pairwise Comparisons

The Friedman Test also allows pairwise comparison when the null hypothesis is rejected. A significant pairwise difference between samplers i and j is indicated if:

$$| R_i - R_j | > t_{\alpha/2} \left[\frac{2\ b\ (A_2 - B_2)}{(b-1)(k-1)} \right]^{1/2} , \qquad (9)$$

where: $t_{\alpha/2}$ is the student t value for a significance level of $\alpha/2$ with $(b-1)*(k-1)$ degrees of freedom, and

R_i and R_j are the sampler ranks summed over the weeks as noted previously.

In the examination of all nine samplers, the comparison value for pairwise differences is 31.88. A value in the rank difference greater than the comparison value indicates a significant difference in the two samplers. The rank differences for all pairs of samplers is listed at Table 2.

Table 2.-- *Rank differences for all samplers based on sample weights*

[Comparison value 31.88; *, denotes a significant difference between the pair. CLCTR = collector]

	Samplers								
CLCTR	A-1	A-2	A-3	A-4	A-5	A-6	L-1	L-2	L-3
A-1	-	15.5	21	80*	105*	29.5	23.5	153*	137.5*
A-2		-	36.5*	59*	120.5*	14	8	137.5*	122*
A-3			-	59*	84*	50.5*	44.5*	174*	158.5*
A-4				-	25	109.5*	103.5*	233*	217.5*
A-5					-	134.5*	128.5*	258*	242.5*
A-6						-	6	123.5*	108*
L-1							-	129.5*	114*
L-2								-	15.5
L-3									-

Within Manufacturer Comparisons

The Friedman Test was also performed on the six Aerochem and three GeoTech samplers. This permitted within brand comparison of performance.

Calculation of the Friedman test variables for the Aerochem Metrics samplers yields:

$$A_2 \quad : 3,731 \qquad (10)$$
$$B_2 \quad : 3,270.7 \qquad (11)$$
$$T_2 \quad : 22.35 \qquad (12)$$

Because T_2 is greater than the F ($\alpha = 0.05$) statistic of 2.21, the hypothesis of identical performance can be rejected at a significance level of 0.05. The comparison value for pairwise differences was computed using equation 9 to be 27.2. Rank differences are given in Table 3.

Table 3.-- *Aerochem sampler rank differences for sample weight*

[Comparison value is 27.2; *, denotes a significant difference between the pair; CLCTR=collector]

	Samplers					
CLCTR	A-1	A-2	A-3	A-4	A-5	A-6
A-1	-	10	19	67*	89*	28*
A-2		-	27	77*	99*	18
A-3			-	50*	72*	45*
A-4				-	22	95*
A-5					-	117*
A-6						-

As would be expected from the examination of the plots of collector efficiencies (Appendix E) for the Aerochem Metrics samplers, A-1 and A-2 perform comparably but do not compare well with A-4 and A-5. However, A-4 and A-5 compare favorably using the Friedman test. and this is also evidenced from the collector efficiency plots (Appendix E).Calculation of the Friedman test variables for the GeoTech 650 samplers yields:

$$A_2 \quad : 573 \qquad (13)$$
$$B_2 \quad : 529.22 \qquad (14)$$
$$T_2 \quad : 34.01 \qquad (15)$$

Since T_2 is greater than the F (α=0.05) statistic of 3.00, the hypothesis of identical performance can be rejected at a significance level of 0.05. It should be noted that earlier in this paper the effect of estimating missing data values would tend to lead to easier rejection of the null hypothesis was discussed. However, it should be pointed out at this stage that this would only be critical if the calculated T_2 value were near to either the F-statistic with the number of degrees of freedom with the estimated data points or the F-statistic without the estimated data points. In nearly all of the calculations presented in this paper, the F-statistic is considerably smaller than the calculated T_2; thus this distinction is probably a moot point at best. The comparison value for pairwise differences was evaluated using equation 9 to be 13.4. Rank differences are given at Table 4.

Table 4.-- *GeoTech 650 Sampler rank differences based on sample weights*

[Comparison value 13.4; *, denotes a significant difference between the pair.]

CLCTR	L-1	L-2	L-3
L-1	-	53*	40*
L-2		-	13
L-3			-

The plots of collection efficiency (Appendix E) qualitatively show that L-1 has a significantly higher average collection efficiency than L-2 or L-3, but that L-2 and L-3 have comparable collection efficiencies.

VARIABILITY OF WET ATMOSPHERIC DEPOSITION

Chemistry Differences

Each of the concentration of analytes that were determined by the U.S. Geological Survey Laboratory in Arvada were subjected to the Friedman test as described above. The Friedman test variables calculated for magnesium are:

$$A_2 : 11{,}291.3 \qquad (16)$$
$$B2 : 9{,}529.9 \qquad (17)$$
$$T_2 : 1.86 \qquad (18)$$

The Friedman test failed to show a significant difference in concentration for magnesium in samples collected by all samplers because T_2 is less than the F (α =0.05 with 8 and 384 degrees of freedom) statistic of 2.02. A summary of the results of the Friedman test for the chemistry of the samples is given in Table 5.The results of the Friedman test applied to the remainder of the analyte concentration are given in Tables 6-13. All the remaining analytes (except for pH and specific conductances for which the Friedman analysis has not yet been performed), show significant differences in concentration when the Friedman test is applied.

Deposition Differences

In addition to the calculation of Friedman variables for the differences in concentration, the Friedman variables have been calculated for the deposition load of the various ions. The deposition was calculated as the product of the concentration of the ion times the sample volume (density of the precipitation was assumed to be unity). The units of the

Table 5.-- *Results of Friedman test applied to analyte concentration*

[The F statistic (α=0.01) for comparison of all T_2 values is 2.51. The F-statistic for α=0.05) is 1.94. A_2, B_2 and T_2 are the calculated Friedman statistics.]

Analyte	A_2	B_2	T_2	Reject equal performance[3]
Magnesium	11,291.3	9,259.95	1.86	No
Sulfate	11,552.85	9,484.95	5.02	Yes
Calcium	11,331.85	9,660.81	5.17	Yes
Phosphate	10,737.8	9,561.85	3.89	Yes
Chloride	11,429.25	9,393.65	3.15	Yes
Nitrate	11,852.8	10,049.46	13.64	Yes
Potassium	11,309.9	9,557.96	2.50	No
Sodium	11,397.65	9,601.26	3.45	Yes
Ammonium	11,435.8	9,358.61	2.57	Yes

3. Equal performance is rejected when hypothesis H0 is rejected. Alternatively, at least one sampler pair has a significant pairwise difference.

Table 6.-- *Comparison of ammonium-nitrogen chemical analytical results using the Friedman test*

[Comparison value 59.43; *, denotes a significant difference between the pair.]

CLCTR	A-1	A-2	A-3	A-4	A-5	A-6	L-1	L-2	L-3
A-1	-	29.5	39.0	43.5	77.5*	32.5	2.0	41.0	4.0
A-2		-	9.5	14.0	48.0	3.0	27.5	11.5	33.5
A-3			-	4.5	38.5	6.5	37.0	2.0	43.0
A-4				-	34.0	11.0	41.5	2.5	47.5
A-5					-	45.0	75.5*	36.5	81.5*
A-6						-	30.5	8.5	36.5
L-1							-	39.0	6.0
L-2								-	45.0
L-3									-

Table 7.-- *Comparison of sodium chemical analytical results using the Friedman test*

[Comparison value is 55.25; *, denotes a significant difference between the pair.]

CLCTR	A-1	A-2	A-3	A-4	A-5	A-6	L-1	L-2	L-3
A-1	-	25.0	0.0	44.0	31.5	5.0	5.0	4.0	54.0
A-2		-	25.0	19.0	6.5	30.0	30.0	21.0	79.0*
A-3			-	45.0	31.5	5.0	5.0	4.0	54.0
A-4				-	12.5	49.0	49.0	40.0	98.0*
A-5					-	36.5	36.5	27.5	85.5*
A-6						-	0.0	9.0	49.0
L-1							-	9.0	49.0
L-2								-	58.0*
L-3									-

Table 8.-- *Comparison of potassium chemical analytical results using the Friedman test*

[Comparison value is 54.56; *, denotes a significant difference between the pair.]

CLCTR	A-1	A-2	A-3	A-4	A-5	A-6	L-1	L-2	L-3
A-1	-	8.0	9.5	15.0	8.0	26.0	2.5	13.0	57.0*
A-2		-	17.5	23.0	16.0	34.0	10.5	21.0	49.0
A-3			-	5.5	1.5	16.5	7.0	3.5	66.5*
A-4				-	7.0	11.0	12.5	2.0	72.0*
A-5					-	18.0	5.5	5.0	65.0*
A-6						-	23.5	13.0	83.0*
L-1							-	10.5	59.5*
L-2								-	70.0*
L-3									-

Table 9.-- *Comparison of chloride chemical analytical results using the Friedman test*

[Comparison value is 60.26; *, denotes a significant difference between the pair.]

CLCTR	A-1	A-2	A-3	A-4	A-5	A-6	L-1	L-2	L-3
A-1	-	35.0	8.5	10.0	12.5	45.5	24.0	47.0	74.0*
A-2		-	26.5	45.0	47.5	10.5	11.0	12.0	39.0
A-3			-	18.5	21.0	37.0	15.5	38.5	65.5*
A-4				-	2.5	55.5	34.0	57.0	84.0*
A-5					-	58.0	36.5	59.5	86.5*
A-6						-	21.5	1.5	28.5
L-1							-	23.0	50.0
L-2								-	27.0
L-3									-

Table 10.-- *Comparison of nitrate/nitrite chemical analytical results using the Friedman test*

[Comparison value is 55.35; *, denotes a significant difference between the pair.]

CLCTR	A-1	A-2	A-3	A-4	A-5	A-6	L-1	L-2	L-3
A-1	-	53.5	54.5	46.0	50.0	69.0*	72.5*	39.0	118.0*
A-2		-	1.0	98.5*	102.5*	15.5	19.0	14.5	64.5*
A-3			-	100.5*	104.5*	14.5	18.0	15.5	63.5*
A-4				-	4.0	115.0*	118.5*	85.0*	164.0*
A-5					-	119.0*	122.5*	89.0*	168.0*
A-6						-	3.5	30.0	49.0
L-1							-	23.5	45.5
L-2								-	79.0*
L-3									-

Table 11.-- *Comparison of phosphate chemical analytical results using the Friedman test*

[Comparison value is 44.70; *, denotes a significant difference between the pair.]

CLCTR	A-1	A-2	A-3	A-4	A-5	A-6	L-1	L-2	L-3
A-1	-	9.5	11.0	54.0*	36.0	38.5	27.0	43.5	59.0*
A-2		-	20.5	44.5	26.5	29.0	17.5	34.0	49.5*
A-3			-	65.0*	47.0*	49.5*	38.0	54.5*	70.0*
A-4				-	18.0	15.5	27.0	10.5	5.0
A-5					-	2.5	9.0	7.5	23.0
A-6						-	11.5	5.0	20.5
L-1							-	16.5	32.0
L-2								-	15.5
L-3									-

Table 12.-- *Comparison of calcium chemical analytical results using the Friedman test*

[Comparison value is 53.29; *, denotes a significant difference between the pair.]

CLCTR	A-1	A-2	A-3	A-4	A-5	A-6	L-1	L-2	L-3
A-1	-	55.5*	78.0*	37.0	17.5	73.0*	77.5*	70.0*	105.5*
A-2		-	23.5	17.5	37.0	18.5	23.0	15.5	51.0
A-3			-	41.0	60.5*	5.0	0.5	8.0	26.5
A-4				-	19.5	36.0	40.5	33.0	68.5*
A-5					-	55.5*	60.0*	52.5	88.0*
A-6						-	4.5	3.0	32.5
L-1							-	7.5	28.0
L-2								-	35.5
L-3									-

Table 13.-- *Comparison of sulfate chemical analytical results using the Friedman test*

[Comparison value is 45.19; *, denotes a significant difference between the pair.]

CLCTR	A-1	A-2	A-3	A-4	A-5	A-6	L-1	L-2	L-3
A-1	-	35.0	35.0	40.5	57.5*	1.0	10.5	0.5	58.0*
A-2		-	70.0*	75.5*	92.5*	34.0	45.5*	35.5	23.5
A-3			-	5.5	22.5	36.0	24.5	34.5	93.5*
A-4				-	17.0	41.5	30.0	40.0	99.0*
A-5					-	58.5*	47.0*	57.0*	106.0*
A-6						-	11.5	1.5	57.5*
L-1							-	10.0	69.0*
L-2								-	59.0*
L-3									-

deposition would then be mg/week. The area over which the deposition occurred was the area of the cross section of the bucket at the rim (627 cm^2). The comparison F-statistic (α = 0.05 and 8;288 degrees of freedom) is 2.02 for all comparisons. At a significance level of 0.01 and 8;288 degrees of freedom, the null hypothesis may also be rejected because the F-statistic is 2.66.

The number of pairwise differences for the Friedman test applied to deposition is very striking and reflects the interdependence of total deposition on both chemistry and amount of the rainfall. Significant differences exist for all analytes using deposition as the analysis variable.

The hypotheses that are tested are as before:

H_0 : The samplers (treatments) have identical effects (deposition), and

H_1 : At least one of the samplers (treatments) tends to yield larger observed values than at least one other sampler (treatment).

The summary of results of the Friedman test for deposition load of each of the analytes is given in Table 14. The results for pairwise comparisons for each of the analytes are given in Tables 15-23. Many of these differences are even more striking than when sample weight or concentration data are taken individually.

In realistic terms, the reasons for the differences need to be determined, if possible. Some of the things which could have lead to these

Table 14.-- *Results of Friedman test applied to analyte deposition*

[The F-statistic (α=0.05) for comparison of all T_2 values is 1.94. The F-statistic (α=0.01) for comparison of all T_2 values is 2.51. A_2, B_2 and T_2 are the calculated Friedman statistics.]

Analyte	A_2	B_2	T_2	Reject equal performance#
Calcium	10,526.9	8,615.71	5.476	Yes
Magnesium	10,524.5	9,272.85	27.263	Yes
Sodium	10,540.5	9,336.31	30.235	Yes
Potassium	10,533.9	8,887.65	12.304	Yes
Ammonium	10,257.5	9,149.18	33.134	Yes
Chloride	10,254.4	9,120.7	31.510	Yes
Nitrate	10,534.5	9,680.15	57.102	Yes
Phosphate	10,495.5	9,008.23	16.538	Yes
Sulfate	10,257.5	9,310.93	44.775	Yes

#Equal performance is rejected when hypothesis H0 is rejected. Alternatively, at least one sampler pair has a significant pairwise difference.

Table 15.-- *Comparison of calcium deposition results using the Friedman test*

[Comparison value is 57.09; *, denotes a significant difference between the pair.]

CLCTR	A-1	A-2	A-3	A-4	A-5	A-6	L-1	L-2	L-3
A-1	-	55.0	36.5	7.0	22.0	64.5*	74.5*	165.5*	173.0*
A-2	-	-	18.5	62.0*	77.0*	9.5	19.5	110.5*	118.0*
A-3	-	-	-	43.5	58.5*	28.0	38.0	129.0*	136.5*
A-4	-	-	-	-	15.0	71.5*	81.5*	172.5*	180.0*
A-5					-	86.5*	96.5*	187.5*	195.0*
A-6						-	10.0	101.0*	108.5*
L-1							-	91.0*	98.5*
L-2								-	7.5

Table 16.-- *Comparison of magnesium deposition results using the Friedman test* [Comparison value is 46.20; *, denotes a significant difference between the pair.]

CLCTR	A-1	A-2	A-3	A-4	A-5	A-6	L-1	L-2	L-3
A-1	-	40.5	13.0	40.0	36.0	46.0	45.0	139.0*	143.5*
A-2		-	27.5	80.5*	76.5*	5.5	4.5	98.5*	103.0*
A-3			-	53.0*	49.0*	33.0	32.0	126.0*	130.5*
A-4				-	4.0	86.0*	85.0*	179.0*	183.5*
A-5					-	82.0*	81.0*	175.0*	178.5*
A-6						-	11.0	93.0*	97.5*
L-1							-	94.0*	98.5*
L-2								-	4.5

Table 17.-- *Comparison of sodium deposition results using the Friedman test* [Comparison value is 45.31; *, denotes a significant difference between the pair.]

CLCTR	A-1	A-2	A-3	A-4	A-5	A-6	L-1	L-2	L-3
A-1	-	15.5	6.0	69.0*	78.0*	26.0	12.0	104.0*	125.5*
A-2		-	9.5	53.5*	62.5*	41.5	27.5	119.5*	141.0*
A-3			-	63.0*	72.0*	32.0	18.0	110.0*	131.5*
A-4				-	9.0	95.0*	81.0*	173.0*	194.5*
A-5					-	104.0*	90.0*	182.0*	203.5*
A-6						-	14.0	78.0*	99.5*
L-1							-	92.0*	113.5*
L-2								-	21.5

Table 18.-- *Comparison of potassium deposition results using the Friedman test* [Comparison value is 52.98; *, denotes a significant difference between the pair.]

CLCTR	A-1	A-2	A-3	A-4	A-5	A-6	L-1	L-2	L-3
A-1	-	2.5	14.0	2.5	20.0	51.5	30.0	131.0*	99.5*
A-2		-	11.5	5.0	22.5	49.0	27.5	128.5*	97.0*
A-3			-	17.5	34.0	37.5	16.0	117.0*	85.5*
A-4				-	17.5	54.0*	32.5	133.5*	102.0*
A-5					-	71.5*	50.0	151.0*	119.5*
A-6						-	21.5	79.5*	48.0
L-1							-	101.0*	69.5*
L-2								-	31.5

Table 19.-- *Comparison of ammonium deposition results using the Friedman test*

[Comparison value is 43.49; *, denotes a significant difference between the pair.]

CLCTR	A-1	A-2	A-3	A-4	A-5	A-6	L-1	L-2	L-3
A-1	-	16.5	53.0*	72.0*	99.0*	18.0	17.0	96.0*	100.5*
A-2		-	36.5	55.5*	82.5*	1.5	33.5	112.5*	117.0*
A-3			-	19.0	46.0*	35.0	70.0*	149.0*	153.5*
A-4				-	27.0	54.0*	89.0*	168.0*	172.5*
A-5					-	81.0*	116.0*	195.0*	199.5*
A-6						-	35.0	114.0*	118.5*
L-1							-	79.0*	83.5*
L-2								-	4.5

Table 20.-- *Comparison of chloride deposition results using the Friedman test*

[Comparison value is 43.98; *, denotes a significant difference between the pair.]

CLCTR	A-1	A-2	A-3	A-4	A-5	A-6	L-1	L-2	L-3
A-1	-	43.5	6.0	11.0	34.0	54.5*	47.5*	147.5*	160.0*
A-2		-	37.5	54.5*	77.5*	11.0	4.0	104.0*	116.5*
A-3			-	17.0	40.0	48.5*	41.5	141.5*	154.0*
A-4				-	23.0	65.5*	58.5*	158.5*	171.0*
A-5					-	88.5*	81.5*	181.5*	194.0*
A-6						-	7.0	93.0*	105.5*
L-1							-	100.0*	112.5*
L-2								-	12.5

Table 21.-- *Comparison of nitrate/nitrite deposition results using the Friedman test*

[Comparison value is 38.17; *, denotes a significant difference between the pair.]

CLCTR	A-1	A-2	A-3	A-4	A-5	A-6	L-1	L-2	L-3
A-1	-	48.5*	14.0	62.0*	73.0*	63.0*	76.0*	148.0*	145.5*
A-2		-	34.5	110.5*	121.5*	14.5	27.5	99.5*	97.0*
A-3			-	76.0*	87.0*	49.0*	62.0*	134.0*	131.5*
A-4				-	11.0	125.0*	138.0*	210.0*	207.5*
A-5					-	136.0*	149.0*	221.0*	218.5*
A-6						-	13.0	85.0*	82.5*
L-1							-	72.0*	69.5*
L-2								-	2.5

Table 22.-- *Comparison of phosphate deposition results using the Friedman test*

[Comparison value is 50.36; *, denotes a significant difference between the pair.]

CLCTR	A-1	A-2	A-3	A-4	A-5	A-6	L-1	L-2	L-3
A-1	-	27.0	19.0	16.0	17.5	50.5*	54.0*	131.0*	127.0*
A-2		-	46.0	11.0	44.5	23.5	27.0	104.0*	100.0*
A-3			-	35.0	1.5	69.5*	73.0*	150.0*	146.0*
A-4				-	33.5	34.5	38.0	115.0*	111.0*
A-5					-	68.0*	71.5*	148.5*	144.5*
A-6						-	3.5	80.5*	76.5*
L-1							-	77.0*	73.0*
L-2								-	4.0

Table 23.-- *Comparison of sulfate deposition results using the Friedman test*

[Comparison value is 40.19; *, denotes a significant difference between the pair.]

CLCTR	A-1	A-2	A-3	A-4	A-5	A-6	L-1	L-2	L-3
A-1	-	27.5	51.0*	52.0*	79.0*	21.0	13.0	122.0*	133.5*
A-2		-	78.5*	79.5*	106.5*	6.5	14.5	94.5*	106.0*
A-3			-	1.0	28.0	72.0*	64.0*	173.0*	184.5*
A-4				-	27.0	73.0*	65.0*	174.0*	185.5*
A-5					-	100.0*	92.0*	201.0*	212.5*
A-6						-	8.0	101.0*	112.5*
L-1							-	109.0*	120.5*
L-2								-	11.5

differences are the sensitivity of the sensor to precipitation, the temperature to which the sensor is heated during activation, the number of times which the sampler opens and closes during a precipitation event, the length of time which the sampler is open during the event, and possibly the amount of time which is required to open or close the collector, that is the cycle time of the collector. Each of these possibilities is discussed in the next few paragraphs.

PERFORMANCE OF WET ATMOSPHERIC DEPOSITION SAMPLERS

Sensor Sensitivity

Table 1 gives a tabulation of the sensor sensitivities and surface temperatures. Each of the sensors was tested for the resistance which caused the motor to open the collector using a decade resistance box and successively lowering the resistance until the sensor caused the motor to be activated, thus opening the collector. As can be seen there were only two resistances with slight variations, 70 KΩ and 55 KΩ. Although one might be inclined to postulate that sensor sensitivity might be a controlling factor in differences in performance, this study seems to indicate that with a 15 KΩ difference the comparison results were independent of sensor resistance.

Table 1 shows that the sensors on samplers L-2 and L-3 do not have the same resistance nor are the sensor temperatures disparately different than the other sensors. Therefore, the resistances and temperatures appear to match the Aerochem Metrics 301 samplers, but their performance does not.

The collector efficiency of samplers A-1, A-2, and L-1 (the collectors tied together with a common sensor) appear to be comparable by examination of the plots of collection efficiency shown in Appendix E. The histograms and cumulative frequency plots for the length of time that samplers remained open once activated for the same three samplers also show qualitatively that samplers A-1, A-2 and L-1 performed comparably. The histograms and the cumulative frequency plots for samplers L-2 and L-3 show that the length of time they were open is highly skewed to lower values. In fact, L-2 had a maximum length of time of opening of only 32 minutes, compared to the other collectors that had maximum lengths of time of openings in excess of 300 minutes.

Because there is no common characteristic between the poor performance of L-2 and L-3 except the sensor and the fact that L-1 performed adequately seems to indicate that the sensor design (and not anything inherent in the rest of the GeoTech 650 sampler) is a major contributor to the poor efficiency.

Other interesting results are noted from the examination of tables 3 and 4. Samplers of the same sensitivity (that is the same resistance required to open the collector) do not show a correlation as to whether a significant pairwise difference exists between two collectors. For example, in table 3 it is noted that samplers A-3 and A-4 show a significant pairwise difference, but the resistance of the sensor are the same. However, A-3 (resistance 55KΩ) and A-5 (resistance 70KΩ) also exhibit a significant pairwise difference but have different sensitivities. It is not clear whether this phenomenon occurs because the differences in sensitivity is not great enough to exhibit differences or whether the sensitivity of the sensor has little effect on the performance of the collector. It is interesting that no significant pairwise differences are noted between L-2 and L-3 for deposition of any of the analytes; this same pair also shows four differences for chemistry. The sensor sensitivity is different for these two samplers as seen in Table 1.

Length of Time of Opening

In addition to the chemical and sample weight data, additional data on sampler performance was also collected. As indicated in the experimental section, the voltage on the event strip of each collector was monitored. The resulting data tables collected and recorded by the Campbell were evaluated by calculating the length of time that each collector was open throughout the duration of the study. Unfortunately, each collector did not open or close at the same time as each of the other collectors, nor did each stay open the same amount of time. The length of time was calculated using the program at Attachment 1. This program was written to be run using the F77 language on a PRIME 850 computer. There are several PRIME specific subroutines which are used. Manufacturer specific subroutines may need to be substituted for other computers.

The logic behind the program was to determine if the lid position of the collector had changed from one recorded value to the next. If the lid position had changed, a decision was made whether the state had changed from the lid covering the dry (closed) or wet (open) bucket to the opposite position. If the state change was from wet bucket closed to open, a variable to record the time at which the collector opened was initialized. If the change was from open to closed, the beginning time is subtracted from the ending time and the difference recorded. The histograms[3] and percent cumulative frequency plots[4] in Appendices G and H were constructed from the resulting data files.

The plots of cumulative frequency as a function of length of time that the collector is open and the corresponding histograms reveal some striking differences in the performance of the collectors. The data is summarized in Table 24. The means and standard deviations of the length of time that a sampler was open have little meaning. The percentiles of the distributions reveal very striking differences between the collectors and the amount of time that a sampler was open. As would be expected, the length of time for each of the percentiles for collectors A-1, A-2 and L-1 are comparable. One would expect this since these three collectors were activated by a common sensor. The maximum length that each of these three collectors was open was also the same. What is rather surprising about these three collectors is the number of openings that each exhibited. This can, however, be explained by realizing that each collector had a certain amount of down-time because of equipment inoperability. And even though down-time was experienced, the frequency distribution of length of time that the collector was open for each of the three samplers was the same.

The other collectors seem to show no pattern as to the length of time that each is open that can be correlated to other variables such as the electrical resistance or the temperature of the sensor. One pattern which is evident is that the GeoTech 650 collectors (collectors L-2 and L-3) which are activated by sensors on the GeoTech 650 samplers have a significantly fewer number of openings and also that the distribution of length of time is highly skewed towards considerably shorter periods of opening. Ninety percent of the openings of L-2 were less than or equal to 9 minutes duration and 90 percent of the openings of L-3 were less than 13 minutes. The maximum amount of time that L-2 was open was only 32 minutes. It is felt that this discrepancy is largely related to the sensor design of the GeoTech sampler. With the separation distance and the minimal surface area over which a drop of water could activate the opening circuit, the GeoTech sensor tends to be less sensitive to the presence of rain. Additionally, the GeoTech sampler because of the sensor design tends to "lose" the drop of water which activates the sensor much more quickly than the Aerochem samplers.

Part of the disparity in performance of the GeoTech samplers may be understood by considering the differences in the sensor design of the Aerochem Metrics and the GeoTech sensors. In particular, consider an effective contact volume of the sensor which is defined as the total volume

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3. The histograms represent the number of times that a collector was open for a given length of time.

4. The percent cumulative frequency plots represent the cumulative sum of number of times a collector was open for less than a given time. Each of the cumulative frequencies is then normalized to a percent of the total number of openings.

Table 24.— Summary of collector performance based on length of time (minutes) that the collector is open

Collector	Number of openings	Percentile					Maximum	Mean	Standard deviation
		10	25	50	75	90			
A-1	764	2	4	7	14	39	436	17.64	38.99
A-2	855	2	4	7	15	40	436	17.93	38.69
A-3	540	1	7	10	33	86	393	30.86	56.85
A-4	522	3	7	13	40	122	642	43.79	81.14
A-5	1226	1	2	4	10	41	517	19.22	53.55
A-6	730	1	1	1	24	55	417	19.00	47.20
L-1	602	1	4	8	14	40	436	19.16	41.11
L-2	384	1	2	4	7	9	32	4.96	3.98
L-3	481	1	3	4	6	13	339	6.62	16.23
NADP	587	2	4	11	35	188	809	57.47	122.19

between the contact plate and the contact bars separated from the contact plate. This effective contact volume when filled with water over any portion of a bar will cause the sensor to activate the motor thus causing the sampler to expose the wet bucket.Obviously, the larger the contact volume, the harder the collector is to open, and once open, the easier it will be to close. The effective contact volume of the Aerochem Metrics sensor is 336 mm^3 and the effective contact volume of the GeoTech sensor is 729 mm^3. The ratio of the contact volume of the GeoTech to the contact volume of the Aerochem is 2.17. The plots of cumulative frequency show that the GeoTech 650 samplers are greatly shifted to shorter lengths of opening. The difference in contact volume may be part of the reason for that shift.

The graphs of cumulative frequency and histograms from which they were derived (Appendix G and H) indicate that there are substantial differences in the collector performance between the Aerochem Metrics 301 (A-1 through A-6 and NADP) collectors and the GeoTech 650 collectors. There are also significant variations among collectors of the same design and these can be rationalized through consideration of the sensor parameters. Taking the results of collector A-5 (longest collection times) and collectors A-1, A-2 and L-1 as our standard, the performance of A-6 is understood in light of the low sensor temperature. When there is a non-trivial amount of precipitation, the low sensor temperature causes the collector to remain open longer, hence the cumulative frequency is skewed towards longer time. On the other hand, the performance of collectors A-3 and A-4 may be attributable to the lower resistance needed to open the collector. Once open, the low sensor temperature of A-3 insures that the collector remains open and again the frequency curve is skewed to longer time. The large temperature variations in A-4, however, suggest that it is the top temperature which is most important.

Cycle Time

The cycle time of each collector has been measured, and although, the average cycle time of collection differs for each type of collector (42 seconds for GeoTech collectors, and 22 seconds for Aerochem Metrics collectors), the fact that each type of collector cycles a different number of times during an event is felt to be the more predominant factor in defining collector performance.

CONCLUSIONS

The report has discussed the aspects of data analysis by parametric and nonparametric means; the small scale spatial variability of precipitation amount and chemistry; the causes for disparity in performance of Aerochem Metrics 301 and GeoTech 650 samplers; and a need to perform research for better preservation techniques for nitrate/nitrate determination.

A nonparametric approach in the analysis of sampler performance is advantageous because it is not as restrictive in its assumptions as the traditional ANOVA approach. The procedures of the Friedman test are simple to apply and pairwise comparisons of samplers are possible. Because the Friedman test is nonparametric, the difference in precision between clusters or the precision within clusters cannot be calculated. Although significant differences in the chemistry exist between pairs of samplers for each analyte, many of these differences are caused only by the very small concentrations of the analyte.

Small differences exist between the chemistry of rain samples obtained over a short distance (less than 100 meters from one collector to the farthest collector) such as in this study; but, the Friedman test when applied to deposition shows a substantially larger number of pairwise differences. The pairwise differences in deposition are affected by both the chemistry of the precipitation and the collection efficiency of the samplers.

In addition to the use of the nonparametric Friedman test, the Aerochem Metrics 301 samplers have been shown to remain open for significantly longer periods of time than the GeoTech samplers. The common conception that the collector remains open until the termination of the rain event is invalid. The collectors were seen to cycle (sometimes very frequently) during a precipitation event depending upon the design of the sensor. The GeoTech 650 samplers were much more likely to cycle during the event than were the Aerochem Metrics 301 samplers.

Preservation of samples for nitrate/nitrite analysis is critically important. The differences which were evident for most species were small and probably not very critical. However, the number of differences which existed for nitrate/nitrite indicates that sample preservation is important and further research is needed to determine more effective preservation techniques.

There is much more analysis to be done with this data. In the interests of getting these initial results in the literature, several of the data analyses have not been performed but will be in the future. These include the analysis of seasonal differences between collectors; effect of sample weight stratified by amount and differences in field and lab pH and specific conductance.

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APPENDIX A: Tables of Chemical Data for Precipitation Samplers

Table A-1.-- Tabular chemical data for sampler A-1

[Units for all concentrations are mg/l, except specific conductance, which is microsiemens per centimeter at 25 degrees Celsius. --- missing data No entry no rainfall for that week]

Date On on	Time on	Date off	Time off	Sample Weight	Ca	Mg	Na	K	NH_4	Cl
840821	1208	840828	1030	281.7	0.15	0.01	0.05	0.02	0.97	0.19
840828	1070	840904	931	2,558.2	.12	.01	.18	.01	.28	.11
840904	931	840911	939							
840911	939	840918	1001	309.2	.10	.05	.05	.03	.33	.16
840918	1001	840925	915							
840925	915	841002	926	636.2	.08	.06	.07	.02	.33	.08
841002	926	841009	917	41.0						
841009	917	841016	914							
841016	914	841023	920	1,145.0	.16	.04	.08	.02	.35	.15
841023	920	841030	846	618.8	.20	.04	.06	.02	.17	.12
841030	846	841106	1010	1,366.9	.10	.03	.27	.02	.01	.54
841106	1010	841113	916	473.4	.10	.06	.27	.02	.15	.97
841113	916	841120	924							
841120	924	841127	908							
841127	908	841204	920	3,507.6	.10	.21	.59	.03	.07	1.40
841204	920	841211	833	1,549.0	.10	.01	.02	.06	.03	.23
841211	833	841218	916							
841218	916	841226	800	1,589.3	.07	.02	.10	.02	.32	.37
841226	800	850102	910	644.1	.20	.10	.10	.01	.22	.59
850102	927	850108	1021	808.8	.04	.04	.02	.01	.03	.10
850108	1021	850115	951							
850115	951	850122	910	449.0	.82	.28	.24	.01	.03	.24
850122	910	850129	908							
850129	908	850205	940	594.8	.07	.05	.05	.02	.03	.14
850205	940	850212	934	429.1	.06	.01	.08	.02	.01	.20

850212	934	850219	947	2,257.4	.05	.05	.47	.02	.03	.78
850219	947	850226	956	55.0						
850226	956	850305	917	941.7	.19	.12	1.40	.06	.44	3.10
850305	917	850312	934	1,573.6	.20	.05	.08	.01	.36	.16
850312	934	850319	917							
850319	917	850326	927	—	.05	.03	.02	.01	.08	.34
850326	927	850402	924	—	.30	.09	.23	.04	.40	.64
850402	924	850409	920	—	.10	.04	.06	.02	.48	.34
850409	920	850416	913	—	.38	.14	.65	.06	1.41	1.80
850416	913	850423	914	—	.52	.11	.06	.04	1.23	.19
850423	914	850430	920							
850430	920	850507	925	4,359.7	.11	.04	.01	.05	.13	.05
850507	925	850514	925							
850514	925	850521	700							
850521	—	850528	—							
850528	912	850604	904	1,139.9	.20	.04	.12	.7	1.29	.29
850604	904	850611	922	1,064.0	.08	.01	.01	.03	.30	.10
850611	922	850618	927	3,295.2	.03	.01	.01	.04	.31	.10
850618	927	850625	941	1,540.6	.10	.03	.03	.06	.37	.32
850625	941	850702	933	1,205.5	.09	.05	.04	.03	.08	.06
850702	933	850709	1015	690.2	.05	.02	.03	.06	.26	.14
850709	1015	850716	850	2,228.7	.13	.08	.03	.07	.48	—
850716	850	850723	928	1,494.4	.11	.03	.01	.04	—	.38
850723	928	850730	919	3,604.9	.01	.01	.01	.03	.10	.09
850730	919	850806	905	1,981.6	.01	.01	.01	.03	.15	.47
850806	905	850813	911	890.2	.22	.04	.04	.04	.15	.20
850813	900	850820	919	26.0						
850820	919	850827	850	1,084.7	.02	.01	.02	.05	.19	.40
850827	850	850903	844	704.0	.07	.04	.01	.01	.44	.10
850903	844	850910	700	1,551.4	.07	.03	.02	.04	.44	.30
850910	700	850917	652	738.9	.05	.01	.01	.02	.37	.06
850917	652	850924	633	151.6	.02	.07	.67	.06	.58	1.00

Table A-1.— Tabular Chemical Data for Sampler A-1 (continued)

Date On on	Time on	Date off	Time off	NO_3	PO_4	SO_4	Lab pH	Field pH	Lab Cond	Field Cond	Coll Eff
840821	1208	840828	1030	3.95	0.004	10.0	3.7	3.7	103	94	116.70
840828	1070	840904	931	2.20	.005	3.3	4.2	4.2	34	30	85.77
840904	931	840911	939								
840911	939	840918	1001	1.90	.002	3.5	4.2	4.1	37	34	89.67
840918	1001	840925	915								
840925	915	841002	926	1.11	.002	1.8	4.7	4.6	15	17	85.81
841002	926	841009	917								47.56
841009	917	841016	914								
841016	914	841023	920		.002	2.3	3.7		—	28	96.25
841023	920	841030	846	3.99	.002	3.9	3.9	3.9	56	52	81.57
841030	846	841106	1010	.27	.002	.7	4.6	4.7	13	11	95.52
841106	1010	841113	916	1.73	.002	2.5	4.4	4.2	29	27	80.76
841113	916	841120	924								
841120	924	841127	908								
841127	908	841204	920	.58	.002	7.1	5.3	4.3	19	16	97.81
841204	920	841211	833	.71	.002	.9	4.7	4.7	12	10	99.82
841211	833	841218	916								
841218	916	841226	800	2.26	.003	2.8	4.1	4.1	41	38	96.02
841226	800	850102	910	2.39	.002	3.1	4.0	4.0	49	45	95.79
850102	927	850108	1021	.62	.002	1.2	4.6	4.5	17	12	104.25
850108	1021	850115	951								
850115	951	850122	910	2.57	.001	.2	4.5	—	22	20	78.92
850122	910	850129	908								
850129	908	850205	940	1.91	.001	1.0	4.5	4.5	24	19	63.04
850205	940	850212	934	2.40	.002	.6	4.4	4.4	41	16	78.04

850212	934	850219	947	.35	.001	.8	4.7	4.6	12	11	98.39
850219	947	850226	956								62.33
850226	956	850305	917	3.63	.001	5.2	4.2	4.0	52	62	86.71
850305	917	850312	934	2.83	.003	2.6	4.1	4.4	34	33	97.40
850312	934	850319	917								
850319	917	850326	927	.49	.001	1.9	4.3	5.5	24	9	—
850326	927	850402	924	2.66	.001	4.8	4.1	4.8	47	24	—
850402	924	850409	920	3.23	.002	2.5	4.2	4.1	39	32	—
850409	920	850416	913	9.30	.001	11.0	3.6	3.7	158	115	—
850416	913	850423	914	3.98	.001	8.4	3.9	3.8	70	67	—
850423	914	850430	920								
850430	920	850507	925	.80	.001	1.2	4.5	4.7	13	14	93.63
850507	925	850514	925								
850514	925	850521	700								
850521		850528									
850528	912	850604	904	2.11	.195	4.0	6.4	4.7	21	26	45.88
850604	904	850611	922	2.08	.003	4.0	4.1	4.2	43	44	101.13
850611	922	850618	927	1.73	.001	2.4	4.2	4.3	30	27	99.07
850618	927	850625	941	1.68	.001	3.9	4.4	4.3	26	30	93.02
850625	941	850702	933	1.59	.001	1.3	4.5	4.5	19	17	88.80
850702	933	850709	1015	2.92	—	4.9	4.0	4.0	48	54	88.42
850709	1015	850716	850	3.45	.002	—	4.0	4.0	56	51	96.47
850716	850	850723	928	4.43	.001	8.4	3.7	3.8	96	87	93.20
850723	928	850730	919	.66	.001	1.5	4.2	4.4	16	16	97.25
850730	919	850806	905	1.33	.002	2.3	4.2	4.2	34	32	87.73
850806	905	850813	911	2.17	.001	2.1	4.2	4.3	34	26	92.20
850813	900	850820	919								15.08
850820	919	850827	850	2.61	.004	2.4	—	4.1	—	36	69.13
850827	850	850903	844	2.70	.005	4.7	3.9	4.0	58	54	90.74
850903	844	850910	700	2.66	.001	4.4	4.0	4.0	52	47	85.70
850910	700	850917	652	1.82	.002	3.2	4.2	4.2	33	30	109.89
850917	652	850924	633	1.73	.008	3.7	4.1	4.3	47	37	38.23

Table A-2.— Tabular Chemical Data for Sampler A-2

[Units for all concentrations are mg/l, except specific conductance, which is microsiemens per centimeter at 25 degrees Celsius. --- missing data No entry no rainfall for that week]

Date On on	Time on	Date off	Time off	Sample Weight	Ca	Mg	Na	K	NH_4	Cl
840821	1224	840828	1055	279.7	0.15	0.01	0.10	0.01	0.96	0.17
840828	1055	840904	1002	2,550.7	.10	.01	.04	.02	.31	.09
840904	1002	840911	926							
840911	926	840918	945	321.3	.09	.04	.05	.03	.31	.09
840918	945	840925	903							
840925	903	841002	910	633.7	.09	.06	.07	.01	.31	.10
841002	910	841009	900	44.5						
841009	900	841016	900							
841016	900	841023	915	1,145.8	.15	.04	.08	.02	.35	.14
841023	915	841030	830	730.2	.10	.04	.03	.01	.17	.11
841030	830	841106	955	1,366.2	.10	.03	.23	.02	.01	.57
841106	955	841113	900	466.9	.10	.05	.27	.02	.17	.48
841113	900	841120	929							
841120	929	841127	911							
841127	911	841204	925	3,545.8	.10	.07	.58	.03	.09	1.20
841204	925	841211	819	1,538.1	.10	.01	.02	.01	.03	.08
841211	819	841218	900							
841218	920	841226	810	1,583.3	.07	.04	.10	.04	.32	.36
841226	810	850102	913	619.4	.15	.04	.10	.01	.18	.46
850102	913	850108	1023	744.6	.04	.04	.02	.01	.04	.13
850108	1023	850115	935							
850115	935	850122	916	459.2	.01	.04	.03	.01	.03	.25
850122	916	850129	908							
850129	915	850205	950	648.8	.01	.02	.05	.01	.03	.14
850205	950	850212	917	430.3	.13	.02	.09	.05	.01	.22

850212	950	850219	930	2,228.3	.04	.05	.47	.02	.04	.80
850219	930	850226	938	53.5						
850226	938	850305	929	881.1	.19	.19	1.50	.06	.58	3.10
850305	929	850312	923	1,569.0	.13	.02	.10	.01	.44	.16
850312	923	850319	930							
850319	930	850326	935	---	.06	.02	.03	.01	.08	.39
850326	935	850402	910	---	.32	.09	.35	.04	.41	.60
850402	910	850409	934	---	.05	.01	.07	.02	.48	.44
850409	934	850416	927	---	.38	.12	.60	.06	1.54	2.30
850416	927	850423	926	---						
850423	926	850430	940							
850430	940	850507	946							
850507	946	850514	934							
850514	934	850521								
850521		850528								
850528	913	850604	916	1,133.4	.17	.03	.09	.07	.51	.20
850604	916	850611	932	1,075.8	.18	.06	.01	.30	1.22	.20
850611	932	850618	938	3,276.7	.04	.01	.01	.05	.31	.10
850618	938	850625	937	1,549.0	.06	.01	.03	.06	.39	1.10
850625	937	850702	937	1,201.6	.11	.05	.04	.04	.09	.06
850702	937	850709	1017	684.7	.06	.02	.03	.06	.35	.40
850709	1017	850716	830	812.8	.34	.08	1.10	.45	1.80	---
850716	830	850723	933							
850723	933	850730	916	3,611.4	.01	.01	.01	.02	.10	.05
850730	916	850806	908	2,988.0	.01	.01	.01	.05	.13	.53
850806	908	850813	903	877.4	.08	.04	.05	.07	.50	.20
850813	903	850820	923	28.7						
850820	923	850827	908	1,092.7	.02	.01	.02	.07	.19	.20
850827	908	850903	851	695.0	.07	.05	.01	.01	.45	.08
850903	851	850910	640	1,541.1	.07	.02	.04	.04	.46	.20
850910	640	850917	702	751.0	.02	.01	.01	.02	.35	.05
850917	702	850924	636	---	.02	.07	.66	.05	.57	.80

Table A-2.— Tabular Chemical Data for Sampler A-2 (continued)

Date On on	Time on	Date off	Time off	NO_3	PO_4	SO_4	Lab pH	Field pH	Lab Cond	Field Cond	Coll Eff
840821	1224	840828	1055	3.97	0.005	11.0	3.7	3.7	105	97	115.88
840828	1055	840904	1002	2.27	.005	3.1	4.2	4.3	35	30	85.51
840904	1002	840911	926								
840911	926	840918	945	1.82	.002	3.4	4.2	4.1	36	34	93.18
840918	945	840925	903								
840925	903	841002	910	1.06	.002	1.8	4.6	4.5	16	18	85.48
841002	910	841009	900								51.62
841009	900	841016	900								
841016	900	841023	915	2.61	.002	2.0	4.1	—	36	29	96.31
841023	915	841030	830	3.54	.002	3.5	4.0	3.9	50	48	96.25
841030	830	841106	955	.22	.002	.6	4.6	4.7	13	11	95.47
841106	955	841113	900	1.73	.002	2.6	4.4	4.1	29	27	79.65
841113	900	841120	929								
841120	929	841127	911								
841127	911	841204	925	.58	.002	1.6	5.9	4.5	21	18	98.87
841204	925	841211	819	.71	.002	.7	4.6	4.6	12	10	99.12
841211	819	841218	900								
841218	920	841226	810	2.26	.002	2.8	4.1	4.1	44	37	95.66
841226	810	850102	913	1.99	.002	2.8	4.1	4.1	41	40	92.12
850102	913	850108	1023	.62	.002	1.2	4.5	4.5	18	13	95.97
850108	1023	850115	935								
850115	935	850122	916	2.52	.001	.8	4.3	—	21	20	80.71
850122	916	850129	908								
850129	915	850205	950	1.96	.001	1.1	4.3	4.4	31	20	68.76
850205	950	850212	917	2.41	.002	.6	4.4	4.5	28	15	78.26

850212	950	850219	930	.36	.002	.9	4.8	4.8	12	12	97.12
850219	930	850226	938								60.63
850226	938	850305	929	3.68	.001	5.1	4.3	4.0	53	63	81.13
850305	929	850312	923	2.75	.001	2.7	4.1	4.3	34	31	97.12
850312	923	850319	930								
850319	930	850326	935	.49	.001	1.8	4.3	5.8	23	9	—
850326	935	850402	910	2.67	.001	4.8	4.1	5.1	47	23	—
850402	910	850409	934	3.21	.006	2.8	4.2	4.2	40	33	—
850409	934	850416	927	10.19	.001	11.0	3.6	3.7	150	115	—
850416	927	850423	926								
850423	926	850430	940								
850430	940	850507	946								
850507	946	850514	934								
850514	934	850521									
850521		850528									
850528	913	850604	916	2.11	.004	3.8	4.3	4.3	31	35	45.62
850604	916	850611	932	2.04	.199	5.2	4.5	4.5	29	31	102.25
850611	932	850618	938	1.68	.001	2.2	4.2	4.3	30	27	98.51
850618	938	850625	937	1.68	.001	3.5	4.4	4.3	26	30	93.52
850625	937	850702	937	1.59	—	1.3	4.5	4.5	19	18	88.5
850702	937	850709	1017	3.01	—	4.7	4.0	4.0	51	51	87.71
850709	1017	850716	830	5.31	.053	—	3.7	3.9	72	89	35.18
850716	830	850723	933								
850723	933	850730	916	.62	.001	1.7	4.5	4.5	16	15	97.42
850730	916	850806	908	1.28	.002	2.7	4.2	4.2	35	32	132.29
850806	908	850813	903	2.17	.001	2.2	4.3	4.5	29	22	90.87
850813	903	850820	923								16.65
850820	923	850827	908	2.61	.001	2.2	4.1	4.2	35	37	69.64
850827	908	850903	851	2.66	.004	4.7	3.9	4.0	57	53	89.58
850903	851	850910	640	2.83	.001	4.0	4.0	4.0	54	51	85.13
850910	640	850917	702	1.82	.004	3.1	4.2	4.2	33	30	111.69
850917	702	850924	636	1.73	.005	3.9	4.2	4.2	37	34	

Table A-3.— Tabular Chemical Data for Sampler A-3

[Units for all concentrations are mg/l, except specific conductance, which is microsiemens per centimeter at 25 degrees Celsius. —— missing data No entry no rainfall for that week]

Date On on	Time on	Date off	Time off	Sample Weight	Ca	Mg	Na	K	NH_4	Cl
840821	1219	840828	1039	325.5	0.13	0.01	0.08	0.02	0.94	0.17
840828	1039	840904	941	2,563.5	.09	.01	.04	.02	.30	.11
840904	941	840911	942							
840911	942	840918	1010	344.5	.11	.07	.05	.02	.33	.09
840918	1010	840925	924							
840925	924	841002	935	765.5	.11	.06	.11	.02	.44	.14
841002	935	841009	925	31.7						
841009	925	841016	919							
841016	919	841023	930	1,190.8	.16	.04	.08	.02	.41	.16
841023	930	841030	902	823.1	.10	.04	.04	.01	.18	.12
841030	902	841106	902	1,393.8	.10	.03	.31	.02	.01	.65
841106	1020	841113	931	532.9	.10	.05	.29	.02	.17	.62
841113	931	841120	940							
841120	940	841127	922							
841127	922	841204	937	1,256.9	.10	.12	.95	.04	.06	2.30
841204	937	841211	800							
841211	800	841218	853							
841218	853	841226								
841226		850102								
850102		850108								
850108		850115								
850115	922	850122	945	442.1	.01	.03	.05	.01	.03	.28
850122	945	850129	926							
850129	926	850205	1002	514.8	.02	.01	.04	.01	.01	.10
850205	1002	850212	938	——	.07	.02	.07	.02	.01	.17

850212	1002	850219	953	2,271.6	.05	.04	.41	.02	.04	.73
850219	953	850226	953	45.2						
850226	953	850305	942	926.0	.15	.16	1.30	.06	.62	2.90
850305	942	850312	932	1,565.3	.13	.03	.09	.01	.46	.16
850312	932	850319	953							
850319	953	850326	953	—	.01	.01	.01	.01	.03	.36
850326	924	850402	928	—	.28	.08	.23	.05	.40	.59
850402	928	850409	923	—	.03	.03	.07	.02	.46	.36
850409	923	850416	920	—	.31	.11	.61	.07	1.41	2.00
850416	920	850423	917	—	.42	.14	.05	.04	1.00	.14
850423	917	850430	929							
850430	929	850507	928	4,356.7	.07	.02	.01	.03	.15	.05
850507	928	850514	927							
850514	927	850521	712	2,499.6	.05	.01	.06	.07	.15	.30
850521	712	850528	910	2,110.9	.2	.04	.01	.05	.77	.20
850528	920	850604	911	2,382.5	.08	.01	.04	.03	.48	.21
850604	911	850611	925	1,044.5	.04	.01	.01	.03	.28	.10
850611	925	850618	915	3,221.2	.04	.01	.01	.05	.30	.10
850618	915	850625	926	1,565.8	.06	.01	.03	.06	.39	1.10
850625	926	850702	919	1,069.2	.08	.04	.04	.04	.09	.10
850702	919	850709	1014	709.0	.05	.01	.03	.05	.31	.54
850709	1014	850716	837	2,197.5	.18	.03	.03	.04	.45	—
850716	837	850723	917	1,511.2	.11	.03	.01	.05	—	.32
850723	917	850730	906	3,584.3	.01	.01	.01	.03	.12	.07
850730	906	850806	921	2,131.6	.03	.01	.01	.03	.19	.24
850806	921	850813	909	929.7	.08	.04	.05	.05	.21	.30
850813	909	850820	906	51.2						
850820	906	850827	853	1,331.0	.02	.01	.03	.06	.21	.20
850827	853	850903	842	716.9	.11	.05	.02	.01	.44	.09
850903	842	850910	703	1,575.5	.05	.02	.04	.04	.46	.20
850910	703	850917	645	764.6	.02	.02	.01	.21	.63	.50
850917	645	850924	640	192.7	.03	.10	1.10	.06	.63	1.40

Table A-3.— Tabular Chemical Data for Sampler A-3 (Continued)

Date On on	Time on	Date off	Time off	NO_3	PO_4	SO_4	Lab pH	Field pH	Lab Cond	Field Cond	Coll Eff
840821	1219	840828	1039	3.76	0.004	11.0	3.7	3.7	98	91	134.85
840828	1039	840904	941	2.24	.004	3.3	4.2	4.2	35	30	85.94
840904	941	840911	942								
840911	942	840918	1010	1.99	.002	4.0	4.2	4.1	41	39	99.90
840918	1010	840925	924								
840925	924	841002	935	1.28	.002	2.2	4.6	4.6	18	19	103.25
841002	935	841009	925								36.77
841009	925	841016	919								
841016	919	841023	930	2.83	.002	2.1	4.2	—	34	30	100.10
841023	930	841030	902	3.90	.002	3.7	3.9	3.9	54	52	108.50
841030	902	841106	902	.31	.002	.8	4.5	4.7	12	13	97.40
841106	1020	841113	931	1.77	.002	2.7	4.4	4.1	31	30	90.91
841113	931	841120	940								
841120	940	841127	922								
841127	922	841204	937	.53	.002	7.9	5.6	4.6	21	20	35.05
841204	937	841211	800								
841211	800	841218	853								
841218	853	841226									
841226		850102									
850102		850108									
850108		850115									
850115	922	850122	945	2.44	.001	.5	4.3	—	21	19	97.70
850122	945	850129	926								
850129	926	850205	1002	1.60	.001	.9	4.4	4.5	23	17	54.56
850205	1002	850212	938	2.44	.002	.7	4.4	—	23	—	

850212	1002	850219	953	.31	.001	.9	4.7	4.8	12	11	99.01
850219	953	850226	953								51.22
850226	953	850305	942	3.54	.005	5.1	4.1	4.0	54	64	85.26
850305	942	850312	932	2.79	.003	2.9	4.1	4.3	36	33	96.89
850312	932	850319	953								
850319	953	850326	953	.31	.001	1.6	4.3	5.6	22	8	—
850326	924	850402	928	2.65	.001	4.6	4.1	4.9	46	24	—
850402	928	850409	923	3.14	.002	2.5	4.2	4.2	39	31	—
850409	923	850416	920	9.74	.001	12.0	3.6	3.7	152	122	—
850416	920	850423	917	3.10	.001	6.5	4.1	4.0	52	53	—
850423	917	850430	929								
850430	929	850507	928	.53	.001	1.4	4.5	4.7	11	10	93.56
850507	928	850514	927								
850514	927	850521	712	.75	.004	1.4	4.6	4.1	17	19	90.70
850521	712	850528	910	3.10	.001	6.8	3.9	4.0	63	63	97.79
850528	920	850604	911	2.43	.003	3.5	4.2	4.2	36	36	95.90
850604	911	850611	925	1.99	.003	4.0	4.1	4.1	42	45	99.27
850611	925	850618	915	1.64	.001	2.2	4.2	4.3	28	27	96.85
850618	915	850625	926	1.69	.001	3.5	4.4	4.3	26	30	94.54
850625	926	850702	919	1.59	—	1.3	4.5	4.5	19	18	78.76
850702	919	850709	1014	2.70	—	4.7	4.0	4.0	51	51	90.83
850709	1014	850716	837	3.32	.007	—	4.0	4.0	54	50	95.12
850716	837	850723	917	4.38	.001	8.3	3.7	3.8	93	88	94.25
850723	917	850730	906	.66	.001	1.5	4.5	4.5	16	14	96.69
850730	906	850806	921	1.77	.001	2.7	4.1	4.2	41	38	94.38
850806	921	850813	909	2.17	.001	2.8	4.2	4.4	32	25	96.29
850813	909	850820	906								29.70
850820	906	850827	853	3.06	.002	2.5	—	4.1	49	42	84.83
850827	853	850903	842	2.88	.003	4.6	3.9	4.0	58	55	92.40
850903	842	850910	703	2.83	.001	4.1	4.0	4.0	54	51	87.03
850910	703	850917	645	1.82	.090	3.9	4.2	4.3	35	26	113.71
850917	645	850924	640	2.26	.004	4.5	4.1	4.1	48	47	48.59

Table A-4.— Tabular Chemical Data for Sampler A-4

[Units for all concentrations are mg/l, except specific conductance, which is microsiemens per centimeter at 25 degrees Celsius. — missing data No entry no rainfall for that week]

Date on	Time on	Date off	Time off	Sample Weight	Ca	Mg	Na	K	NH_4	Cl
840821	1145	840828	1017	315.0	0.13	0.01	0.09	0.02	0.91	0.16
840828	1017	840904	916	2,572.4	.11	.01	.17	.02	.31	.08
840904	916	840911	948							
840911	948	840918	1024	329.8	.10	.07	.05	.03	.31	.09
840918	1024	840925	937							
840925	937	841002	952	767.0	.10	.06	.09	.01	.40	.14
841002	952	841009	938	33.4						
841009	938	841016	923	—	—	—	—	—	—	—
841016	923	841023	941	1,188.5	.16	.04	.09	.02	.41	.16
841023	941	841030	921	818.1	.10	.04	.04	.02	.18	.13
841030	921	841106	1034	1,405.5	.10	.04	.33	.02	.03	.67
841106	1034	841113	941	538.2	.10	.05	.29	.02	.17	.58
841113	941	841120	947							
841120	947	841127	929							
841127	929	841204	952	3,503.7	.10	.07	.61	.03	.09	1.30
841204	952	841211	833	1,519.0	.10	.01	.03	.01	.04	.08
841211	833	841218	836							
841218	923	841226	812	1,646.1	.07	.03	.10	.02	.33	.38
841226	812	850102	917	670.1	.11	.03	.11	.02	.22	.83
850102	917	850108	1015	251.4	.12	.27	.04	.02	.04	.19
850108	1015	850115	922							
850115	900	850122	958	537.2	.01	.04	.05	.01	.03	.30
850122	958	850129	944							
850129	944	850205	1016	584.8	.01	.01	.08	.01	.05	.19
850205	1016	850212	850	522.8	.08	.01	.06	.02	.01	.15

850212	1016	850219	1006	2,227.1	.03	.04	.46	.02	.04	.80
850219	1006	850226	930	52.5						
850226	930	850305	951	1,089.5	.18	.19	1.50	.07	.60	3.20
850305	951	850312	942	1,571.4	.13	.03	.10	.01	.45	.17
850312	942	850319	950							
850319	950	850326	1005	—	.04	.02	.01	.01	.04	.38
850326	1005	850402	940	—	.32	.10	.26	.05	.41	.67
850402	940	850409	951	—	.08	.02	.07	.02	.48	.33
850409	951	850416	905	—	.35	.11	.58	.06	1.41	2.20
850416	905	850423	909	—	.48	.11	.05	.04	1.17	.15
850423	909	850430	913							
850430	913	850507	917	4,466.3	.08	.02	.01	.05	.12	.04
850507	917	850514	915							
850514	915	850521	706	2,622.1	.04	.01	.06	.03	.14	.26
850521	706	850528	910	2,129.4	.20	.30	.01	.03	.72	.19
850528	910	850604	930	2,302.7	.09	.02	.05	.04	.46	.24
850604	930	850611	915	1,064.7	.04	.01	.01	.02	.26	.10
850611	915	850618	905	3,300.6	.03	.01	.01	.01	.31	.10
850618	905	850625	915	1,589.7						
850625	915	850702	912	1,222.8	.09	.04	.04	.03	.09	.06
850702	912	850709	1010	755.8	.05	.02	.05	.06	.31	.14
850709	1010	850716	845	2,234.6	.18	.04	.03	.04	.46	—
850716	845	850723	923	1,531.1	.11	.03	.01	.05	—	.22
850723	923	850730	901	3,696.8	.01	.01	.01	.02	.12	.06
850730	901	850806	915	2,250.7	.01	.01	.01	.04	.22	.17
850806	915	850813	912	985.4	.10	.04	.05	.06	.19	.20
850813	912	850820	855	140.3	—	—	—	—	—	—
850820	855	850827	845	1,486.2	.02	.01	.05	.04	.21	.20
850827	845	850903	835	767.8	.11	.04	.01	.01	.45	.14
850903	835	850910	650	1,670.3	.07	.03	.05	.01	.46	.20
850910	650	850917	654	775.4	.02	.01	.01	.03	.35	.10
850917	654	850924	615	189.3	.04	.13	1.30	.08	.78	1.70

Table A-4.— Tabular Chemical Data for Sampler A-4 (Continued)

Date on	Time on	Date off	Time off	NO_3	PO_4	SO_4	Lab pH	Field pH	Lab Cond	Field Cond	Coll Eff
840821	1145	840828	1017	3.72	0.005	11.0	3.7	3.7	101	91	130.50
840828	1017	840904	916	2.25	.004	3.1	4.2	4.2	35	44	86.24
840904	916	840911	948								
840911	948	840918	1024	1.99	.002	4.0	4.2	4.1	39	39	95.64
840918	1024	840925	937								
840925	937	841002	952	1.37	.002	2.2	4.6	4.4	19	20	103.46
841002	952	841009	938								38.74
841009	938	841016	923								
841016	923	841023	941	2.83	.002	1.7	4.2	—	33	30	99.90
841023	941	841030	921	3.85	.002	3.9	3.9	3.9	56	52	107.84
841030	921	841106	1034	.31	.002	.7	4.5	4.7	15	14	98.22
841106	1034	841113	941	1.82	.002	2.7	4.3	4.1	31	28	91.81
841113	941	841120	947								
841120	947	841127	929								
841127	929	841204	952	.66	.002	1.1	5.2	4.5	22	19	97.70
841204	952	841211	833	.75	.002	.7	4.6	4.6	12	11	97.89
841211	833	841218	836								
841218	923	841226	812	2.30	.002	2.7	4.1	4.1	43	37	99.45
841226	812	850102	917	2.39	.002	3.4	4.0	4.0	51	46	99.66
850102	917	850108	1015	.93	.002	3.4	4.3	4.2	28	29	32.40
850108	1015	850115	922								
850115	900	850122	958	2.52	.001	.2	4.3	—	22	19	94.42
850122	958	850129	944								
850129	944	850205	1016	2.28	.001	1.6	4.2	4.3	33	26	61.98
850205	1016	850212	850	2.39	.001	.6	4.4	4.5	27	18	95.09

850212	1016	850219	1006	.36	.005	.9	4.7	4.7	13	12	97.07
850219	1006	850226	930								59.49
850226	930	850305	951	3.59	.005	5.3	4.1	4.0	55	65	100.32
850305	951	850312	942	2.88	.001	2.7	4.1	4.3	36	35	97.27
850312	942	850319	950								
850319	950	850326	1005	.40	.001	1.5	4.3	5.5	22	8	—
850326	1005	850402	940	2.83	.001	5.0	4.0	4.5	51	30	—
850402	940	850409	951	3.27	.002	2.8	4.2	4.2	40	34	—
850409	951	850416	905	9.30	.001	11.0	3.6	3.7	150	125	—
850416	905	850423	909	3.59	.001	7.0	4.1	4.0	56	56	—
850423	909	850430	913								
850430	913	850507	917	.62	.001	1.0	5.2	4.9	13	10	95.91
850507	917	850514	915								
850514	915	850521	706	.81	.001	1.8	4.5	4.1	19	19	95.14
850521	706	850528	910	3.19	.001	7.3	3.9	4.0	68	63	98.65
850528	910	850604	930	2.46	.003	3.8	4.2	4.2	36	38	92.69
850604	930	850611	915	2.08	.001	4.1	4.0	4.1	43	44	101.19
850611	915	850618	905	1.73	.001	2.5	4.2	4.3	30	29	99.23
850618	905	850625	915	1.64	—	1.1	4.5	4.5	19	18	95.98
850625	915	850702	912	2.70	—	4.7	4.1	4.1	43	43	90.07
850702	912	850709	1010	—	—	—	—	—	—	—	96.82
850709	1010	850716	845	3.41	.004	—	4.0	4.0	55	51	96.72
850716	845	850723	923	4.43	.001	7.6	3.7	3.8	101	90	95.49
850723	923	850730	901	.71	.001	1.5	4.6	4.5	17	15	99.73
850730	901	850806	915	2.13	.001	3.4	4.0	4.1	48	44	99.65
850806	915	850813	912	2.26	.001	2.3	4.2	4.4	35	27	102.06
850813	912	850820	855	—	—	—	—	—	—	—	81.37
850820	855	850827	845	3.37	.001	2.9	4.0	4.0	43	44	94.72
850827	845	850903	835	3.14	.003	5.0	3.9	4.0	60	58	98.96
850903	835	850910	650	3.06	.001	4.2	4.0	4.0	56	52	92.26
850910	650	850917	654	1.90	.003	3.3	4.2	4.2	34	31	115.32
850917	654	850924	615	2.88	—	5.7	4.0	4.0	61	59	47.74

Table A-5.— Tabular Chemical Data for Sampler A-5

[Units for all concentrations are mg/l, except specific conductance, which is microsiemens per centimeter at 25 degrees Celsius. --- missing data No entry no rainfall for that week]

Date on	Time on	Date off	Time off	Sample Weight	Ca	Mg	Na	K	NH_4	Cl
840821	1148	840828	1021	305.2	0.16	0.01	0.04	0.02	1.00	0.15
840828	1021	840904	920	2,507.1	.10	.01	.03	.01	.30	.09
840904	920	840911	953							
840911	953	840918	1019	343.6	.12	.07	.05	.03	.32	.09
840918	1019	840925	931							
840925	925	841002	946	764.9	.09	.06	.08	.01	.40	.16
841002	946	841009	935	42.1						
841009	935	841016	926							
841016	926	841023	937	1,192.2	.15	.04	.08	.01	.39	.16
841023	937	841030	916	785.4	.10	.04	.05	.01	.19	.11
841030	916	841106	1031	1,412.0	.10	.03	.32	.02	.03	.67
841106	1031	841113	936	527.8	.10	.05	.28	.04	.17	.51
841113	936	841120	943							
841120	943	841127	926							
841127	926	841204	947	3,528.2	.10	.07	.64	.03	.09	1.30
841204	947	841211	804	1,513.3	.10	.01	.02	.01	.03	.08
841211	804	841218	942							
841218	927	841226	815	1,651.7	.05	.03	.10	.02	.33	.37
841226	815	850102	920	647.9	.11	.04	.10	.02	.22	.74
850102	920	850108	1017	829.3	.07	.08	.02	.01	.03	.12
850108	1017	850115	907							
850115	907	850122	951	548.8	.01	.03	.06	.01	.04	.29
850122	951	850129	948							
850129	948	850205	1020	697.4	.02	.02	.08	.01	.05	.21
850205	1020	850212	857	523.5	.08	.01	.07	.02	.01	.17

850212	1020	850219	1009	2,236.9	.02	.04	.48	.02	.04	.85
850219	1009	850226	933	49.0						
850226	933	850305	953	1,083.5	.19	.18	1.50	.06	.57	3.20
850305	953	850312	944	1,577.3	.14	.03	.10	.01	.49	.18
850312	944	850319	953							
850319	953	850326	1010	—	.06	.02	.04	.01	.10	.33
850326	1010	850402	943	—	.35	.11	.39	.07	.53	.91
850402	943	850409	953	—	.83	.10	.07	.14	.93	.50
850409	953	850416	908	—	.40	.18	.47	.06	1.27	1.80
850416	908	850423	906	—	.62	.12	08	.05	1.29	.76
850423	906	850430	915							
850430	915	850507	920	4,544.7	.08	.03	.01	.02	.13	.16
850507	920	850514	918							
850514	915	850521	708	2,694.9	.05	.02	.06	.03	.14	.30
850521	708	850528	913	2,174.4	.21	.06	.01	.17	1.18	.24
850528	913	850604	933	2,450.6	.09	.02	.04	.03	.48	.25
850604	933	850611	918	1,076.1	.04	.01	.01	.03	.28	.10
850611	918	850618	907	3,304.3	.04	.01	.01	.06	.33	.10
850618	917	850625	918	1,622.4						
850625	918	850702	915	1,280.3	.09	.05	.03	.03	.09	.06
850702	915	850709	1011	759.9	.06	.02	.02	.05	.24	.19
850709	1011	850716	847	2,249.5	.16	.04	.03	.08	.51	—
850716	847	850723	925	1,546.6	.11	.03	.01	.03	—	.27
850723	925	850730	903	3,675.9	.01	.01	.01	.03	.12	.05
850730	903	850806	918	2,278.9	.01	.01	.01	.04	.22	.41
850806	918	850813	915	984.5	.12	.04	.05	.05	.19	.20
850813	915	850820	900	42.4						
850820	900	850827	847	1,527.7	.02	.01	.05	.04	.21	.20
850827	847	850903	837	768.0	.11	.05	.01	.01	.42	.09
850903	837	850910	652	1,668.6	.05	.02	.05	.03	.45	.20
850910	652	850917	656	766.3	.02	.01	.01	.02	.36	.06
850917	656	850924	617	202.0	.07	.17	1.60	.09	.84	2.30

Table A-5.— Tabular Chemical Data for Sampler A-5 (Continued)

Date on	Time on	Date off	Time off	NO_3	PO_4	SO_4	Lab pH	Field pH	Lab Cond	Field Cond	Coll Eff
840821	1148	840828	1021	3.96	0.005	11.0	3.7	3.7	108	89	126.44
840828	1021	840904	920	2.25	.004	3.3	4.2	4.2	35	30	84.05
840904	920	840911	953								
840911	953	840918	1019	2.08	.002	4.1	4.1	4.0	43	39	99.64
840918	1019	840925	931								.00
840925	925	841002	946	1.24	.002	2.0	4.6	4.5	18	19	103.17
841002	946	841009	935								48.84
841009	935	841016	926								
841016	926	841023	937	2.79	.002	1.6	4.2	—	35	30	100.21
841023	937	841030	916	3.99	.002	4.2	3.9	3.9	58	55	103.53
841030	916	841106	1031	.31	.002	.8	4.6	4.6	15	12	98.67
841106	1031	841113	936	1.86	.002	2.8	4.3	4.2	30	26	90.04
841113	936	841120	943								
841120	943	841127	926								
841127	926	841204	947	.66	.002	1.5	5.2	4.5	23	21	98.38
841204	947	841211	804	.71	.002	.7	4.6	4.6	12	11	97.52
841211	804	841218	942								
841218	927	841226	815	2.26	.002	2.7	4.1	4.1	43	32	99.79
841226	815	850102	920	2.13	.002	3.2	4.0	4.1	46	35	96.35
850102	920	850108	1017	.71	.002	1.3	4.5	4.4	18	16	106.89
850108	1017	850115	907								
850115	907	850122	951	2.57	.001	.6	4.3	—	25	21	96.46
850122	951	850129	948								
850129	948	850205	1020	2.22	.001	1.5	4.3	4.3	31	24	73.91
850205	1020	850212	857	2.36	.001	.6	4.4	4.5	25	19	95.21

850212	1020	850219	1009	.38	.001	.9	4.6	4.8	13	11	97.50
850219	1009	850226	933								55.53
850226	933	850305	953	3.59	.001	5.4	4.1	4.0	53	65	99.76
850305	953	850312	944	2.97	.003	2.9	4.1	4.3	37	35	97.63
850312	944	850319	953								
850319	953	850326	1010	.62	.001	1.8	4.3	5.5	23	9	—
850326	1010	850402	943	3.13	.001	5.6	4.0	4.5	58	36	—
850402	943	850409	953	3.42	.002	4.7	4.7	4.5	26	29	—
850409	953	850416	908	8.86	.001	10.0	3.6	3.7	140	118	—
850416	908	850423	906	4.43	.001	7.8	3.9	3.9	76	75	—
850423	906	850430	915								
850430	915	850507	920	.66	.001	1.0	4.6	4.5	12	11	97.60
850507	920	850514	918								
850514	915	850521	708	.89	.001	1.7	4.5	4.1	20	22	97.79
850521	708	850528	913	3.23	—	7.6	4.0	4.1	58	59	100.73
850528	913	850604	933	2.45	.003	3.7	4.2	4.3	37	36	98.64
850604	933	850611	918	2.13	.001	4.1	4.0	4.1	42	44	102.28
850611	918	850618	907	1.77	.001	2.4	4.2	4.4	31	28	99.34
850618	917	850625	918								97.96
850625	918	850702	915	1.59	—	1.5	4.5	4.5	18	18	94.31
850702	915	850709	1011	2.97	—	4.8	4.0	4.0	50	50	97.35
850709	1011	850716	847	3.45	.004		4.0	4.1	56	51	97.37
850716	847	850723	925	4.43	.001	8.4	3.7	3.8	94	89	96.45
850723	925	850730	903	.66	.001	1.7	4.5	4.5	17	15	99.16
850730	903	850806	918	2.04	.001	2.9	4.0	4.1	46	43	100.90
850806	918	850813	915	2.35	.001	2.4	4.2	4.2	36	29	101.97
850813	915	850820	900								24.59
850820	900	850827	847	3.32	.001	2.8	4.0	4.0	45	45	97.37
850827	847	850903	837	3.14	.003	5.1	3.9	4.0	62	57	98.99
850903	837	850910	652	2.97	.001	4.1	4.0	4.0	55	51	92.17
850910	652	850917	656	1.86	.001	3.2	4.2	4.2	34	31	113.96
850917	656	850924	617	3.45	.004	6.5	3.9	3.9	71	68	50.94

Table A-6.— Tabular Chemical Data for Sampler A-6

[Units for all concentrations are mg/l, except specific conductance, which is microsiemens per centimeter at 25 degrees Celsius. --- missing data No entry no rainfall for that week]

Date on	Time on	Date off	Time off	Sample Weight	Ca	Mg	Na	K	NH_4	Cl
840821	1234	840828	1050	294.0	0.15	0.03	0.09	0.01	0.98	0.18
840828	1050	840904	950	2,530.4	.11	.01	.03	.02	.30	.09
840904	950	840911	935							
840911	935	840918	957	304.5	.08	.04	.05	.03	.28	.11
840918	957	840925	911							
840925	911	841002	921	677.0	.07	.06	.12	.02	.33	.08
841002	921	841009	921	38.5						
841009	921	841016	908							
841016	908	841023	911	1,156.7	.14	.03	.08	.02	.35	.15
841023	911	841030	840	738.2	.10	.04	.04	.02	.15	.13
841030	840	841106	1004	1,376.9	.10	.03	.27	.02	.01	.66
841106	1004	841113	911	466.8	.10	.05	.26	.02	.14	.49
841113	911	841120	920							
841120	920	841127	904							
841127	904	841204	932	3,528.3	.10	.06	.57	.02	.07	1.30
841204	932	841211	827	1,570.7	.10	.01	.01	.01	.04	.07
841211	827	841218	909							
841218	909	841226	818	1,594.6	.08	.02	.10	.03	.33	.36
841226	818	850102	923	559.5	.11	.04	.10	.01	.19	.47
850102	923	850108	1028	694.4	.06	.10	.02	.01	.01	.13
850108	1028	850115	958							
850115		850122								
850122		850129								
850129		850205								
850205	1025	850212	922	481.3						

850212	922	850219	935	2,223.6	.03	.04	.44	.02	.04	.76
850219	935	850226	942	45.3						
850226	942	850305	933	794.3	.18	.20	1.70	.07	.71	3.40
850305	933	850312	918	1,530.1	.13	.03	.09	.01	.45	.16
850312	918	850319	939							
850319	939	850326	939	—	.01	.01	.02	.01	.03	.35
850326	939	850402	917	—	.28	.10	.22	.06	.39	.59
850402	917	850409	945	—	.08	.02	.15	.02	.44	.29
850409	925	850416	930	—	.38	.13	.62	.06	1.41	1.90
850416	930	850423	933	—	.40	.08	.03	.02	1.02	.11
850423	933	850430	936							
850430	936	850507	943	4,378.2	.06	.03	.01	.03	.12	.06
850507	943	850514	939							
850514	939	850521	716	2,504.9	.05	.02	.06	.04	.19	.30
850521	716	850528	930	2,107.6	.20	.02	.01	.02	.77	.24
850528	930	850604	920	2,410.7	.08	.02	.04	.04	.46	.22
850604	920	850611	931	1,011.2	.04	.01	.01	.03	.33	.10
850611	931	850618	920	3,116.0	.10	.02	.01	.05	.32	.10
850618	920	850625	934	1,023.9						
850625	934	850702	929	758.3	.10	.05	.04	.05	.09	.07
850702	929	850709	1025	464.8	.06	.01	.02	.06	.40	.25
850709	1025	850716	832	1,392.0	.16	.04	.05	.05	.54	—
850716	832	850723	913	932.4	.11	.03	.01	.06	—	.25
850723	916	850730	916	2,285.5	.01	.01	.01	.04	.10	.05
850730	916	850806	924	1,392.4	.01	.01	.01	.03	.31	.18
850806	924	850813	918	574.4	.10	.05	.05	.06	.18	.20
850813	918	850820	915	43.0						
850820	915	850827	905	897.5	.02	.01	.02	.03	.19	.30
850827	905	850903	849	458.3						
850903	849	850910	645	1,528.6	.05	.02	.04	.01	.45	.20
850910	645	850917	704	752.1	.02	.01	.01	.03	.84	.05
850917	704	850924	624	168.0	.02	.09	.91	.05	.67	1.10

Table A-6.— Tabular Chemical Data for Sampler A-6 (Continued)

Date on	Time on	Date off	Time off	NO_3	PO_4	SO_4	Lab pH	Field pH	Lab Cond	Field Cond	Coll Eff
840821	1234	840828	1050	3.94	0.005	10.0	3.7	3.7	103	91	121.80
840828	1050	840904	950	2.16	.004	3.0	4.2	4.3	33	28	84.83
840904	950	840911	935								
840911	935	840918	957	1.86	.002	3.4	4.1	4.1	35	34	88.30
840918	957	840925	911								
840925	911	841002	921	1.11	.002	2.0	4.6	4.4	17	18	91.32
841002	921	841009	921								44.66
841009	921	841016	908								
841016	908	841023	911	2.57	.002	2.1	4.2	———	32	28	97.23
841023	911	841030	840	3.72	.002	3.8	3.9	3.9	53	51	97.31
841030	840	841106	1004	.22	.002	.8	4.6	4.7	13	10	96.22
841106	1004	841113	911	1.68	.002	2.5	4.3	4.2	27	24	79.63
841113	911	841120	920								
841120	920	841127	904								
841127	904	841204	932	.58	.002	7.3	5.2	4.5	21	19	98.39
841204	932	841211	827	.66	.002	.6	4.6	4.6	10	10	101.22
841211	827	841218	909								
841218	909	841226	818	2.21	.002	2.7	4.1	4.1	43	38	96.34
841226	818	850102	923	1.99	.002	3.0	4.0	4.0	44	41	83.21
850102	923	850108	1028	.62	.002	1.5	4.4	4.4	19	16	89.50
850108	1028	850115	958								
850115		850122									
850122		850129									
850129		850205									
850205	1025	850212	922								87.54

850212	922	850219	935	.33	.001	.8	4.7	4.8	12	11	96.92
850219	935	850226	942								51.34
850226	942	850305	933	3.81	.005	5.8	4.1	4.0	56	67	73.14
850305	933	850312	918	2.70	.002	2.8	4.1	4.3	35	33	94.71
850312	918	850319	939								
850319	939	850326	939	.31	.001	1.6	4.3	5.4	23	8	—
850326	939	850402	917	2.54	.001	4.5	4.1	4.5	46	29	—
850402	917	850409	945	3.00	.002	2.4	4.2	4.3	37	30	—
850409	925	850416	930	9.30	.001	11.0	3.6	3.7	142	111	—
850416	930	850423	933	3.01	.001	6.3	4.1	4.0	52	52	—
850423	933	850430	936								
850430	936	850507	943	.58	.001	.9	4.6	4.5	11	10	94.02
850507	943	850514	939								
850514	939	850521	716	.77	.004	1.6	4.5	4.2	18	18	90.89
850521	716	850528	930	3.14	.001	7.2	3.9	4.0	63	66	97.64
850528	930	850604	920	2.36	.003	3.5	4.2	4.3	34	36	97.03
850604	920	850611	931	1.82	.001	3.5	4.1	4.2	34	37	96.11
850611	931	850618	920	1.59	.001	2.3	4.3	4.4	28	24	93.68
850618	920	850625	934								61.82
850625	934	850702	929	1.86	—	1.7	4.4	4.5	22	20	55.86
850702	929	850709	1025	2.88	—	4.5	4.1	4.0	45	47	59.54
850709	1025	850716	832	3.50	.010	—	4.0	4.0	56	53	60.25
850716	832	850723	913	4.87	.001	8.6	3.7	3.8	97	87	58.15
850723	916	850730	916	.75	.001	1.7	4.5	4.5	18	15	61.66
850730	916	850806	924	2.17	.001	3.1	4.0	4.1	47	41	61.65
850806	924	850813	918	2.39	.001	2.4	4.2	4.3	36	25	59.49
850813	918	850820	915								24.94
850820	915	850827	905	3.23	.002	2.6	4.0	4.0	43	42	57.20
850827	905	850903	849								59.07
850903	849	850910	645	2.83	.001	4.1	4.0	4.0	54	51	84.44
850910	645	850917	704	1.77	.004	3.1	4.2	4.2	33	30	111.85
850917	704	850924	624	2.17	.003	4.7	4.2	4.1	48	47	42.37

Table A-7.— Tabular Chemical Data for Sampler L-1

[Units for all concentrations are mg/l, except specific conductance, which is microsiemens per centimeter at 25 degrees Celsius. --- missing data No entry no rainfall for that week]

Date on	Time on	Date off	Time off	Sample Weight	Ca	Mg	Na	K	NH_4	Cl
840821	1203	840828	1026	283.9	0.23	0.03	0.22	0.11	0.93	0.41
840828	1026	840904	925	2,516.4	.07	.01	.04	.02	.30	.11
840904	925	840911	943							
840911	943	840918	1006	292.2	.10	.06	.07	.03	.31	.15
840918	1006	840925	920							
840925	920	841002	930	618.3	.09	.06	.10	.01	.33	.17
841002	930	841009	921	38.5						
841009	921	841016	930							
841016	930	841023	924	988.9	.12	.03	.08	.02	.31	.15
841023	924	841030	853	724.5	.10	.03	.04	.01	.17	.12
841030	853	841106	1016	1,368.3	.10	.04	.27	.02	.01	.51
841106	1016	841113	920	463.5	.10	.05	.27	.02	.15	.54
841113	920	841120	932							
841120	932	841127	915							
841127	915	841204	915	2,563.3	.10	.07	.50	.02	.10	1.10
841204	915	841211	808	1,546.7	.10	.01	.02	.01	.03	.07
841211	808	841218	846							
841218	934	841226	821	1,603.5	.07	.06	.10	.02	.33	.38
841226	821	850102	927	589.8	.11	.05	.10	.01	.18	.48
850102	927	850108	1026	252.0	.18	.22	.04	.03	.03	.19
850108	1026	850115	943							
850115	943	850122	933	467.0	.01	.01	.06	.01	.03	.25
850122	933	850129	939							
850129	939	850205	1025	394.3	.01	.01	.18	.01	.05	.18
850205	1025	850212	943	422.9	.05	.03	.07	.06	.01	.24

850212	1025	850219	1014	2,284.5	.01	.03	.45	.02	.04	.78
850219	1014	850226	1002	54.7						
850226	1002	850305	946	99.5	.18	.16	1.40	.06	.59	3.00
850305	946	850312	939	1,574.7	.13	.02	.09	.01	.46	.19
850312	939	850319	946							
850319	946	850326	957	—	.04	.01	.02	.01	.08	.36
850326	957	850402	936	—	.30	.10	.24	.06	.40	.59
850402	936	850409	927	—	.04	.03	.05	.02	.46	.36
850409	927	850416	923	—	.48	.16	.59	.06	1.41	2.00
850416	923	850423	940	—						
850423	940	850430	910							
850430	910	850507	1005							
850507	1005	850514	921							
850514	921	850521								
850521		850528								
850528	911	850604	928	1,127.7	.16	.01	.10	.04	.54	.19
850604	928	850611	945	1,068.5	.08	.04	.01	.02	.27	.10
850611	945	850618	932	3,274.7	.06	.01	.01	.05	.33	.10
850618	932	850625	946	1,577.0						
850625	946	850702	941	1,393.0	.09	.04	.04	.05	.08	.07
850702	941	850709	1025	707.4	.09	.02	.05	.12	.31	.35
850709	1025	850716	853	2,222.5	.16	.04	.05	.07	.54	—
850716	853	850723	930	1,502.1	.09	.03	.01	.04	—	.45
850723	930	850730	923	3,637.2	.01	.01	.01	.04	.12	.22
850730	923	850806	911	2,015.5	.01	.01	.01	.06	.17	.10
850806	911	850813	906	902.2	.10	.04	.05	.06	.19	.20
850813	906	850820	927	12.7						
850820	927	850827	858	1,093.9	.02	.01	.02	.02	.19	.30
850827	858	850903	855	696.8	.19	.06	.03	.52	1.02	.11
850903	855	850910	655	1,550.0	.05	.02	.04	.02	.45	.10
850910	655	850917	712	735.1	.02	.01	.01	.02	.35	.05
850917	712	850924	630	166.0	.01	.07	.69	.05	.59	.80

Table A-7.— Tabular Chemical Data for Sampler L-1 (Continued)

Date on	Time on	Date off	Time off	NO_3	PO_4	SO_4	Lab pH	Field pH	Lab Cond	Field Cond	Coll Eff
840821	1203	840828	1026	3.96	0.005	11.0	3.7	3.7	104	90	117.62
840828	1026	840904	925	2.17	.005	3.2	4.2	4.3	34	30	84.36
840904	925	840911	943								
840911	943	840918	1006	1.86	.002	3.5	4.2	4.1	37	34	84.74
840918	1006	840925	920								
840925	920	841002	930	1.11	.002	2.0	4.6	4.6	17	18	83.40
841002	930	841009	921								44.66
841009	921	841016	930								
841016	930	841023	924	2.44	.002	2.1	4.2	—	32	27	83.12
841023	924	841030	853	3.54	.002	3.6	4.0	3.9	51	49	95.50
841030	853	841106	1016	.22	.002	.7	4.6	4.7	14	12	95.62
841106	1016	841113	920	1.73	.002	2.5	4.3	4.2	29	24	79.07
841113	920	841120	932								
841120	932	841127	915								
841127	915	841204	915	.71	.002	3.4	5.0	4.4	24	26	71.48
841204	915	841211	808	.71	.002	.8	4.6	4.6	12	10	99.68
841211	808	841218	846								
841218	934	841226	821	2.17	.002	2.9	4.1	4.1	45	39	96.88
841226	821	850102	927	1.99	.002	2.9	4.1	4.1	40	38	87.71
850102	927	850108	1026	.84	.002	3.2	4.2	4.2	29	30	32.48
850108	1026	850115	943								
850115	943	850122	933	2.44	.001	.3	4.3	—	22	20	82.08
850122	933	850129	939								
850129	939	850205	1025	1.86	.001	1.5	4.3	4.3	28	23	41.79
850205	1025	850212	943	2.36	.001	.7	4.4	4.5	25	16	76.92

850212	1025	850219	1014	.35	.001	.9	4.7	4.8	13	11	99.57
850219	1014	850226	1002								61.99
850226	1002	850305	946	3.50	.005	5.0	4.1	4.0	53	62	9.16
850305	946	850312	939	2.79	.003	2.7	4.1	4.3	36	35	97.47
850312	939	850319	946								
850319	946	850326	957	.49	.001	1.9	4.3	5.5	24	9	—
850326	957	850402	936	2.60	.001	4.6	4.1	5.3	47	22	—
850402	936	850409	927	3.29	.002	2.9	4.2	4.3	40	33	—
850409	927	850416	923	10.19	.001	12.0	3.6	3.7	146	118	—
850416	923	850423	940								—
850423	940	850430	910								
850430	910	850507	1005								
850507	1005	850514	921								
850514	921	850521									
850521		850528									
850528	911	850604	928	2.08	.003	3.8	4.3	4.3	32	35	45.39
850604	928	850611	945	2.08	.001	3.9	4.1	4.2	40	43	101.56
850611	945	850618	932	1.73	.001	2.4	4.3	4.4	30	27	98.45
850618	932	850625	946								95.21
850625	946	850702	941	1.59	—	1.3	4.5	4.5	18	18	102.61
850702	941	850709	1025	2.88	—	4.7	4.1	4.1	41	43	90.62
850709	1025	850716	853	3.41	.006	—	4.0	4.1	54	51	96.20
850716	853	850723	930	4.38	.001	7.6	3.7	3.8	94	85	93.68
850723	930	850730	923	.66	.001	9.8	4.5	4.5	16	14	98.12
850730	923	850806	911	1.28	.001	2.1	4.2	4.2	34	30	89.24
850806	911	850813	906	2.21	.001	2.4	4.2	4.3	35	27	93.44
850813	906	850820	927								7.37
850820	927	850827	858	2.57	.001	2.4	4.1	4.1	42	35	69.72
850827	858	850903	855	2.66	.173	5.8	4.1	4.1	48	49	89.81
850903	855	850910	655	2.66	.001	3.9	4.0	4.0	52	47	85.62
850910	655	850917	712	1.77	.004	4.4	4.2	4.2	33	30	109.32
850917	712	850924	630	1.77	.003	3.8	4.2	4.2	33	39	41.86

Table A-8.— Tabular Chemical Data for Sampler L-2

[Units for all concentrations are mg/l, except specific conductance, which is microsiemens per centimeter at 25 degrees Celsius. --- missing data No entry no rainfall for that week]

Date on	Time on	Date off	Time off	Sample Weight	Ca	Mg	Na	K	NH_4	Cl
840821		840828		20.4						
840828	541	840904	936	1,629.2	0.10	0.01	0.05	0.01	0.35	0.10
840904	936	850911	953							
840911	1006	840918	1014	173.4	.08	.02	.06	.03	.24	.14
840918	1014	840925	928							
840925	928	841002	942	195.4	.11	.07	.14	.03	.37	.11
841002	942	841009	931							
841009	931	841016	933							
841016	933	841023	933	651.1	.14	.03	.08	.06	.33	.16
841023	933	841030	910	335.7	.10	.05	.08	.03	.15	.15
841030	910	841106	1025	1,367.2	.10	.07	.42	.06	.01	.96
841106	1025	841113	925	335.7	.10	.10	.54	.05	.22	1.10
841113	925	841120	935							
841120	935	841127	918							
841127	918	841204	942	2,632.5	.10	.05	.44	.02	.10	.93
841204	942	841211	837	1,047.4	.10	.01	.02	.01	.04	.07
841211	837	841218	824							
841218	938	841226	825	851.1	.08	.02	.10	.02	.35	.36
841226	825	850102	930	277.9	.11	.04	.07	.02	.15	.39
850102	930	850108	1030	510.9	.11	.05	.02	.01	.03	.12
850108	1030	850115	915							
850115	915	850122	940	251.3	.01	.01	.03	.01	.03	.23
850122	940	850129	933							
850129	933	850205	1010	249.2	.01	.01	.05	.01	.08	.12
850205	1010	850212	910	227.2	.06	.01	.03	.02	.01	.10

850212	910	850219	1000	117.5	—	—	—	—	—	—
850219	1000	850226	950	23.9						
850226	950	850305	938	486.9	.17	.17	1.40	.06	.62	3.00
850305	938	850312	928	419.1	.13	.04	.11	.01	.41	.20
850312	928	850319	925							
850319	925	850326	920	—	—	—	—	—	—	—
850326	920	850402	931	—	.16	.10	.42	.06	.35	.93
850402	931	850409	917	—	.06	.06	.07	.01	.49	.22
850409	917	850416	916	—	—	—	—	—	—	—
850416	916	850423	921	—	.29	.05	.02	.03	.66	.11
850423	921	850430	932							
850430	932	850507	932	190.8	.22	.06	.01	.06	.78	.07
850507	932	850514	930							
850514	930	850521	719	1,529.3						
850521	719	850528	917	1,269.5	.20	.02	.01	.02	.77	.20
850528	917	850604	907	1,425.3	.08	.01	.05	.03	.53	.19
850604	907	850611	928	462.5	.04	.01	.01	.02	.03	.10
850611	928	850618	912	328.4	.08	.01	.01	.06	.49	.20
850618	912	850625	923	777.8						
850625	923	850702	922	477.5	.15	.06	.04	.06	.15	.06
850702	922	850709	1023	343.4	.09	.01	.03	.05	.41	.11
850709	1023	850716	839	1,175.9	.16	.04	.04	.05	.59	—
850716	839	850723	920	983.3	.11	.03	.01	.05	—	.49
850723	920	850730	908	1,519.0	.01	.01	.01	.01	.13	.07
850730	908	850806	927	939.5	.01	.01	.01	.05	.23	.11
850806	927	850813	921	217.5	.16	.09	.17	.09	.51	.50
850813	921	850820	909							
850820	909	850827	855	532.2	.02	.01	.03	.04	.18	.20
850827	855	850903	840	196.4	.15	.04	.05	.01	.57	.16
850903	840	850910	635	948.6	.07	.03	.05	.02	.46	.20
850910	635	850917	648	287.7	.02	.01	.01	.03	.69	.02
850917	648	850924	642	88.2	.06	.11	.94	.09	.77	1.20

Table A-8.— Tabular Chemical Data for Sampler L-2 (Continued)

Date on	Time on	Date off	Time off	NO_3^-	PO_4^{3-}	$SO_4^{=}$	Lab pH	Field pH	Lab Cond	Field Cond	Coll Eff
840821		840828									8.45
840828	541	840904	936	.04	.004	3.2	4.2	4.2	35	29	54.62
840904	936	850911	953								
840911	1006	840918	1014	1.37	.002	2.4	4.4	4.2	27	25	50.29
840918	1014	840925	928								
840925	928	841002	942	1.37	.002	1.9	4.5	5.5	19	19	26.36
841002	942	841009	931								
841009	931	841016	933								
841016	933	841023	933	2.52	.002	2.5	4.2	—	34	30	54.73
841023	933	841030	910	4.03	.002	4.1	3.9	3.9	56	54	44.25
841030	910	841106	1025	.27	.003	.7	4.7	4.7	12	11	95.54
841106	1025	841113	925	2.13	.002	3.7	4.2	4.1	39	34	57.27
841113	925	841120	935								
841120	935	841127	918								
841127	918	841204	942	.84	.002	1.6	5.1	4.4	25	22	73.41
841204	942	841211	837	.62	.002	.7	4.7	4.7	11	11	67.50
841211	837	841218	824								
841218	938	841226	825	2.13	.002	2.9	4.1	4.1	42	36	51.42
841226	825	850102	930	1.77	.002	3.5	4.1	4.1	43	38	41.33
850102	930	850108	1030	.62	.002	1.5	4.5	4.5	16	14	65.85
850108	1030	850115	915								
850115	915	850122	940	2.48	.001	.4	4.3	—	22	20	44.17
850122	940	850129	933								
850129	933	850205	1010	1.79	.001	1.6	4.3	4.4	30	23	26.41
850205	1010	850212	910	2.31	.001	.6	4.4	4.5	25	15	41.32

850212	910	850219	1000								5.12
850219	1000	850226	950								27.08
850226	950	850305	938	3.59	.005	5.0	4.2	4.0	52	63	44.83
850305	938	850312	928	3.01	.004	2.9	4.1	4.2	38	47	25.94
850312	928	850319	925								
850319	925	850326	920								—
850326	920	850402	931	1.67	.001	4.0	4.1	5.3	42	20	—
850402	931	850409	917	3.22	.003	1.9	4.2	4.3	38	30	—
850409	917	850416	916								—
850416	916	850423	921	2.17	.001	4.8	4.2	4.2	39	40	—
850423	921	850430	932								
850430	932	850507	932	2.35	.001	5.1	4.1	4.1	42	36	4.10
850507	932	850514	930								
850514	930	850521	719								55.49
850521	719	850528	917	3.06	.001	6.6	3.9	4.1	62	60	58.81
850528	917	850604	907	2.58	.003	3.8	4.2	4.2	37	40	57.37
850604	907	850611	928	1.64	.001	3.3	4.2	4.2	34	35	43.96
850611	928	850618	912	3.01	.001	4.4	4.0	4.2	50	45	9.87
850618	912	850625	923								46.96
850625	923	850702	922	1.68	—	1.5	4.7	4.5	17	18	35.17
850702	922	850709	1023	2.70	—	5.8	4.1	4.0	48	40	43.99
850709	1023	850716	839	3.68	.004	—	3.9	4.0	61	56	50.90
850716	839	850723	920	5.31	.001	9.3	3.7	3.7	108	104	61.32
850723	920	850730	908	.75	.001	1.7	4.5	4.4	19	16	40.98
850730	908	850806	927	1.68	.001	2.8	4.1	4.2	41	38	41.60
850806	927	850813	921	4.43	.001	4.9	3.9	4.0	70	54	22.53
850813	921	850820	909								
850820	909	850827	855	3.10	.001	2.6	4.1	4.1	39	39	33.92
850827	855	850903	840	3.32	.001	7.4	3.8	3.9	74	69	25.31
850903	840	850910	635	2.79	.001	4.2	4.0	4.0	54	49	52.40
850910	635	850917	648	1.95	.003	3.0	4.2	4.2	34	31	42.79
850917	648	850924	642	2.52	.008	5.0	4.1	4.1	50	48	22.24

Table A-9.— Tabular Chemical Data for Sampler L-3

[Units for all concentrations are mg/l, except specific conductance, which is microsiemens per centimeter at 25 degrees Celsius. --- missing data No entry no rainfall for that week]

Date on	Time on	Date off	Time off	Sample Weight	Ca	Mg	Na	K	NH_4	Cl
840821	1229	840828	1044	123.3	0.15	0.02	0.10	0.03	0.95	0.23
840828	1044	840904	956	397.7	.17	.03	.08	.02	.36	.14
840904	956	840911	931							
840911	931	840918	952	187.1	IDL	.02	.05	.03	.23	.10
840918	952	840925	928							
840925	908	841002	915	163.0	.14	.08	.14	.03	.41	.17
841002	915	841009	905							
841009	905	841016	904							
841016	904	841023	905	89.0	.36	.11	.26	.07	.42	.29
841023	905	841030	835	370.2	.10	.04	.06	.02	.14	.16
841030	835	841106	1000	355.5	.10	.06	.56	.04	.06	1.40
841106	1000	841113	905	227.4	.10	.07	.27	.02	.17	.54
841113	905	841120	915							
841120	915	841127	900							
841127	900	841204	925	2,504.7	.10	.07	.61	.03	.09	1.30
841204	928	841211	824	1,320.3	.10	.01	.01	.01	.04	.07
841211	824	841218	905							
841218	905	841226	933	884.7	.06	.03	.08	.01	.39	.35
841226	933	850102	933	311.4	.12	.10	.08	.02	.19	.43
850102	933	850108	1024	555.0	.07	.01	.02	.01	.01	.12
850108	1024	850115	930							
850115	930	850122	923	380.1	.01	.03	.02	.01	.03	.22
850122	923	850129	920							
850129	920	850205	956	383.6	.03	.01	.03	.02	.03	.12
850205	956	850212	928	315.7	.07	.01	.03	.02	.01	.12

850212	928	850219	941	258.6	—	—	—	—	—	—
850219	941	850226	945	22.6						
850226	945	850305	925	592.3	.17	.18	1.50	.07	.66	3.00
850305	925	850312	928	766.3	.13	.04	.09	.01	.40	.17
850312	928	850319	935							
850319	935	850326	943	—	—	—	—	—	—	—
850326	943	850402	913	—	.30	.10	.30	.06	.45	.66
850402	913	850409	937	—	.30	.25	.02	1.4	1.41	.56
850409	937	850416	933	—	—	—	—	—	—	—
850416	933	850423	930	—	.21	.03	.03	.03	.85	.15
850423	930	850430	925							
850430	925	850507	938	2,067.2	.08	.03	.01	.04	.13	.06
850507	938	850514	935							
850514	930	850521	719	—	.05	.02	.09	.02	.18	.39
850521	719	850528	926	1,356.6	.14	.02	.01	.02	.71	.18
850528	926	850604	923	1,805.0	.05	.02	.04	.02	.44	.14
850604	923	850611	934	566.1	.04	.01	.01	.02	.32	.10
850611	934	850618	923	1,523.9	.05	.01	.01	.07	.31	.10
850618	923	850625	931	658.8	.05	.01	.01	.07	.31	.10
850625	931	850702	926	542.1	.15	.06	.04	.03	.08	.06
850702	926	850709	1019	506.6	.04	.01	.03	.04	.28	.17
850709	1019	850716	834	1,536.1	.15	.04	.04	.03	.44	—
850716	834	850723	910	665.0	.13	.03	.01	.05	—	.28
850723	910	850730	914	1,476.3	.01	.01	.01	.02	.14	.04
850730	914	850806	924	1,181.0	.01	.01	.01	.04	.18	.09
850806	924	850813	924	350.0	.08	.04	.05	.05	.21	.20
850813	924	850820	913							
850820	913	850827	902	310.8	.03	.01	.05	.02	.24	.30
850827	902	850903	847	375.5	.15	.01	.01	.01	.46	.09
850903	847	850910	643	1,666.1	.17	.06	.07	.28	.57	.40
850910	643	850917	707	460.0	.02	.01	.01	.01	.76	.05
850917	707	850924	626							

Table A-9.— Tabular Chemical Data for Sampler L-3 (Continued)

Date on	Time on	Date off	Time off	NO_3	PO_4	SO_4	Lab pH	Field pH	Lab Cond	Field Cond	Coll Eff
840821	1229	840828	1044	3.86	0.006	11.0	3.7	3.7	100	87	51.08
840828	1044	840904	956	3.05	.005	4.3	4.1	4.1	47	42	13.33
840904	956	840911	931								
840911	931	840918	952	1.15	.002	1.9	4.5	4.3	19	19	54.26
840918	952	840925	928								
840925	908	841002	915	6.64	.002	2.5	4.3	4.5	20	25	21.99
841002	915	841009	905								
841009	905	841016	904								
841016	904	841023	905	3.41	.002	3.0	—	—	35	33	7.48
841023	905	841030	835	3.50	.002	3.4	4.0	3.9	51	48	48.80
841030	835	841106	1000	.53	.002	1.2	4.3	4.6	26	20	24.84
841106	1000	841113	905	1.64	.002	2.4	4.3	4.3	28	24	38.79
841113	905	841120	915								
841120	915	841127	900								
841127	900	841204	925	.62	.002	1.5	5.3	4.5	23	20	69.84
841204	928	841211	824	.62	.002	.7	4.7	4.6	11	9	85.09
841211	824	841218	905								
841218	905	841226	933	2.13	.002	2.7	4.0	4.1	46	39	53.45
841226	933	850102	933	1.77	.002	4.1	4.0	4.1	47	44	46.31
850102	933	850108	1024	.58	.002	.9	4.6	4.6	17	12	71.53
850108	1024	850115	930								
850115	930	850122	923	2.44	.001	.3	4.3	—	21	19	66.81
850122	923	850129	920								
850129	920	850205	956	1.78	.001	1.4	4.3	4.4	29	21	40.66
850205	956	850212	928	2.27	.004	.6	4.4	4.5	22	15	57.42

850212	928	850219	941								11.27
850219	941	850226	945								25.61
850226	945	850305	925	3.45	.005	5.2	4.1	4.0	54	55	54.54
850305	925	850312	928	2.75	.003	2.7	4.1	4.3	35	33	47.43
850312	928	850319	935								
850319	935	850326	943	—	—	—	—	—	—	—	—
850326	943	850402	913	2.93	.001	4.9	4.1	5.1	50	26	—
850402	913	850409	937	3.45	.170	5.7	5.5	4.9	22	25	—
850409	937	850416	933	—	—	—	—	—	—	—	—
850416	933	850423	930	2.31	.001	5.5	4.1	4.1	48	51	—
850423	930	850430	925								
850430	925	850507	938	.58	.001	.8	4.6	4.4	5	11	44.39
850507	938	850514	935								
850514	930	850521	719	1.12	.001	2.0	4.3	4.0	24	25	—
850521	719	850528	926	2.88	.001	6.8	3.9	4.0	60	61	62.85
850528	926	850604	923	2.28	.003	3.4	4.3	4.3	32	34	72.65
850604	923	850611	934	1.90	.001	3.3	4.1	4.2	33	40	53.81
850611	934	850618	923	1.64	.001	2.2	4.2	4.4	29	27	39.78
850618	923	850625	931								
850625	931	850702	926	1.77	—	1.6	4.4	4.5	24	21	39.93
850702	926	850709	1019	2.04	.001	4.1	4.2	4.2	35	32	64.90
850709	1019	850716	834	3.32	.005	—	4.0	4.0	55	52	66.49
850716	834	850723	910	5.31	.001	9.6	3.7	3.7	104	105	41.47
850723	910	850730	914	.71	.001	1.7	4.5	4.4	19	18	39.83
850730	914	850806	924	1.11	.001	1.7	4.3	4.3	29	27	52.29
850806	924	850813	924	2.26	.001	1.9	4.2	4.3	33	26	36.25
850813	924	850820	913								
850820	913	850827	902	3.10	.001	4.0		4.0	40	42	19.81
850827	902	850903	847	2.75	.001	4.8	3.9	4.0	56	54	48.40
850903	847	850910	643	3.63	.026	5.9	4.0	4.0	62	58	92.03
850910	643	850917	707	1.95	.003	3.4	4.3	4.3	31	24	68.41
850917	707	850924	626								

Table A-10.— Tabular Chemical Data for National Atmospheric Depositon Program Sampler

[Time on/ Time off are Greenwich Times. Units for all concentrations are mg/l, except specific conductance, which is microsiemens/centimeter at 25 degrees Centigrade. --- missing data; No entry no rainfall for that week]

Date on	Time on	Date off	Time off	Sample Weight	Ca	Mg	Na	K	NH_4	Cl
840821	1444	840828	1345	281.8	0.32	0.10	0.09	0.03	1.06	0.27
840828	1345	840904	1331	2,657.1	.09	.02	.04	.01	.29	.11
840904	1331	840911	1340							
840911	1340	840918	1346	312.3	.21	.15	.19	.04	.25	.22
840918	1346	840925	1317	10.4						
840925	1317	841002	1348	652.8	.13	.09	.07	.01	.40	.12
841002	1348	841009	1305	37.0	1.00	.54	.96	.15	.25	.66
841009	1305	841016	1336							
841016	1336	841023	1307	1,197.5	.18	.07	.13	.03	.50	.29
841023	1307	841030	1437	744.4	.17	.06	.09	.05	.25	.22
841030	1437	841106	1450	1,398.1	.03	.04	.26	.01	.02	.65
841106	1450	841113	1406	436.0	.17	.09	.43	.06	.16	.64
841113	1406	841120	1412							
841120	1412	841127	1405	.6						
841127	1405	841204	1424	3,433.7	.05	.08	.59	.03	.08	1.24
841204	1424	841211	1410	734.6	.04	.02	.09	.01	.02	.05
841211	1410	841218	1440	97.6	.44	.34	1.60	.11	.31	2.17
841218	1440	841226	1417	1,124.3	.05	.03	.13	.02	.33	.36
841226	1417	850102	1415	486.4	.17	.05	.15	.02	.22	.61
850102	1415	850108	1434	253.9	.12	.32	.15	.02	.02	.18
850108	1434	850115	1420	34.8	.97	.55	1.44	.17	.06	1.23
850115	1420	850122	1445	544.2	.06	.02	.11	.01	.02	.29
850122	1445	850129	1427	22.3	1.48	.41	1.33	.12	.28	2.15
850129	1427	850205	1452	768.0	.09	.03	.11	.01	LDL	.17
850205	1452	850212	1410	550.0	.15	.05	.16	.02	LDL	.22

850212	1410	850219	1422	2,250.0	.06	.08	.52	.03	LDL	.85
850219	1422	850226	1416	76.2	.86	.30	1.09	.10	1.10	1.46
850226	1416	850305	1428	1,088.7	.21	.20	1.44	.07	.59	3.23
850305	1428	850312	1701	1,597.2	.17	.04	.11	.02	.38	.24
850312	1701	850319	1424	46.2	.39	.08	.14	.39	.38	.35
850319	1424	850326	1417	559.1	.10	.04	.03	.01	.04	.36
850326	1417	850402	1413	716.3	.42	.12	.43	.06	.53	.85
850402	1413	850409	1430	1,523.1	.12	.05	.11	.02	.48	.39
850409	1430	850416	1417	220.1	.70	.24	.74	.07	1.15	1.70
850416	1417	850423	1414	395.3	.69	.14	.09	.06	1.40	.34
850423	1414	850430	1311	2.9						
850430	1311	850507	1320	4,575.8	.08	.03	.05	.02	.13	.12
850507	1320	850514	1354	1.9						
850514	1354	850521	1301	2,746.8	.10	.12	.39	.52	.61	.57
850521	1301	850528	1320	2,158.3	.12	.05	.04	.33	1.85	.31
850528	1320	850604	1310	2,472.6	.26	.03	.07	.02	.45	.27
850604	1310	850611	1333	1,066.7	.15	.02	.04	.43	1.54	.18
850611	1333	850618	1328	3,295.6	.07	.02	.04	.03	.32	.18
850618	1328	850625	1335	1,593.6	.12	.03	.04	.02	.41	.12
850625	1335	850702	1310	1,340.0	.13	.06	.04	.01	.07	.11
850702	1310	850709	1426	711.1	.31	.09	.21	.19	1.26	.46
850709	1426	850716	1245	2,246.8	.24	.07	.05	.05	.68	.19
850716	1245	850723	1313	1,531.5	.20	.05	.09	.01	.73	.29
850723	1313	850730	1301	3,646.2	.04	.02	.02	.01	.11	.06
850730	1301	850806	1300	2,238.4	.04	.02	.04	.01	.17	.22
850806	1300	850813	1300	965.0						
850813	1300	850820	1305	144.6	.27	.15	.10	.01	.27	.23
850820	1305	850827	1243	1,451.2	.09	.03	.08	.03	.21	.35
850827	1243	850903	1255	768.7	.16	.06	.04	.01	.42	.23
850903	1255	850910	1230	1,753.8	.08	.02	.05	.01	.41	.36
850910	1230	850917	1315	678.6	.10	.07	.02	.02	.42	.08
850917	1315	850924	1255	249.9	.16	.20	1.07	.04	.50	1.83

Table A-10.— Tabular Chemical Data for NADP Sampler (Continued)

Date on	Time on	Date off	Time off	NO_3	PO_4	SO_4	Lab pH	Field pH	Lab Cond	Field Cond	Coll Eff
840821	1444	840828	1345	4.28	LDL	11.67	3.69	3.68	107	107	116.
840828	1345	840904	1331	2.22	LDL	2.78	4.10	4.20	34	34	89.
840904	1331	840911	1340								
840911	1340	840918	1346	1.76	LDL	3.33	4.20	4.30	30	30	90.
840918	1346	840925	1317								30.
840925	1317	841002	1348	1.11	LDL	1.88	4.70	4.60	14	18	88.
841002	1348	841009	1305	.71	.008	3.41	6.60		33		43.
841009	1305	841016	1336								
841016	1336	841023	1307	2.78	LDL	2.99	4.20		36	31	100.
841023	1307	841030	1437	3.72	LDL	3.29	4.00		50	48	98.
841030	1437	841106	1450	.29	LDL	.94	4.70	5.50	11	11	97.
841106	1450	841113	1406	1.87	LDL	2.36	4.60	4.10	21	28	74.
841113	1406	841120	1412								
841120	1412	841127	1405								
841127	1405	841204	1424	.58	LDL	1.42	4.50	4.50	20	18	95.
841204	1424	841211	1410	.43	LDL	1.03	4.70	4.60	11	10	47.
841211	1410	841218	1440	5.20	LDL	5.89	4.00		72		70.
841218	1440	841226	1417	2.67	LDL	3.27	4.10	4.10	43	38	67.
841226	1417	850102	1415	3.63	LDL	2.85	4.10		45	42	72.
850102	1415	850108	1434	.87	.01	3.69	4.30		29	27	32.
850108	1434	850115	1420	5.77	.008	2.12	5.60		22		33.
850115	1420	850122	1445	2.80	LDL	.55	4.40		23	20	95.
850122	1445	850129	1427	6.16	.024	2.39	4.80		38		43.
850129	1427	850205	1452	2.24		1.18	4.32	4.36	24	22	81.
850205	1452	850212	1410	2.52	LDL	.70	4.50	4.34	18	20	100.

850212	1410	850219	1422	.44	LDL	.94	4.84	4.59	11	11	98.
850219	1422	850226	1416	5.54	.008	7.91	3.95	—	80		86.
850226	1416	850305	1428	3.54	LDL	4.32	3.96	3.95	71	66	100.
850305	1428	850312	1701	2.84	.011	2.32	4.18	4.21	37	33	98.
850312	1701	850319	1424	4.65	LDL	3.52	4.02		55		85.
850319	1424	850326	1417	.63	.006	1.84	4.36	4.16	21	19	98.
850326	1417	850402	1413	3.23	LDL	4.95	4.01	3.94	56	57	99.
850402	1413	850409	1430	3.42	.011	2.31	4.12	4.17	38	38	99.
850409	1430	850416	1417	9.39	.011	8.23	3.60	3.68	126	111	98.
850416	1417	850423	1414	4.65	—	7.73	3.97	3.49	67	73	100.
850423	1414	850430	1311								
850430	1311	850507	1320	.69	LDL	1.44	4.58	4.47	13	17	98.
850507	1320	850514	1354								
850514	1354	850521	1301	—	.041	2.31	6.41	5.00	18	13	99.
850521	1301	850528	1320	3.36	.194	7.52	4.09	4.12	56	60	99.
850528	1320	850604	1310	2.62	LDL	3.68	4.07	4.20	44	41	99.
850604	1310	850611	1333	1.89	.387	5.47	4.69	4.07	29	53	101.
850611	1333	850618	1328	1.83	LDL	2.83	4.16	4.23	34	33	99.
850618	1328	850625	1335	1.63	LDL	3.09	4.16	4.22	32	32	96.
850625	1335	850702	1310	1.91	LDL	1.83	4.34	4.36	23	23	98.
850702	1310	850709	1426	3.56	.027	5.77	4.31	4.08	40	53	91.
850709	1426	850716	1245	3.50	LDL	4.60	4.03	4.03	51	51	97.
850716	1245	850723	1313	4.50	LDL	7.99	3.75	3.75	88	93	95.
850723	1313	850730	1301	.58	LDL	1.54	4.53	4.53	15	14	98.
850730	1301	850806	1300	1.95	LDL	3.60	4.04	4.06	40	42	99.
850806	1300	850813	1300	—	LDL	—	4.05	—	29	—	99.
850813	1300	850820	1305	2.31	LDL	6.12	3.97	3.95	54	57	83.
850820	1305	850827	1243	3.47	LDL	2.94	4.00	4.03	41	43	92.
850827	1243	850903	1255	3.15	LDL	5.46	7.00	3.93	61	61	99.
850903	1255	850910	1230	2.90	LDL	4.12	4.00	3.99	51	50	96.
850910	1230	850917	1315	1.93	—	3.33	4.27	4.19	31	31	100.
850917	1315	850924	1255	3.04	—	5.66	4.10	4.01	53	56	63.

Table A-11.— Comparison of rain gage performance

[All measurements are recorded as equivalent inches of water. * Equipment not yet operable ** Equipment inoperative *** Data not recorded T=trace]

Begin Date	End Date	RG-1	RG-2	RG-3	RG-4	National Weather Service 8"
840821	840828	0.16	0.17	**	*	0.23
840828	840904	1.50	1.53	**	*	1.53
840904	840911	.00	.00	.00	*	.00
840911	840918	.15	.21	.21	*	.20
840918	840925	.00	.02	.02	*	T
840925	841002	.39	.46	.43	*	.51
841002	841009	.00	.02	.05	*	.025
841009	841016	.00	.00	.00	*	.00
841016	841023	.68	.69	.69	*	.78
841023	841030	.43	.46	.44	*	.52
841030	841106	.81	.83	.83	*	.85
841106	841113	.34	.37	.34	*	.31
841113	841120	.00	.00	.00	*	.00
841120	841127	.01	.01	.01	*	T
841127	841204	2.09	2.09	2.08	*	2.12
841204	841211	.98	.09	**	.89	.97
841211	841218	.07	.08	**	.10	.07
841218	841226	.86	.86	.96	.97	.855
841226	850102	.38	.38	.39	.38	.41
850102	850108	**	.44	.45	.45	.44
850108	850115	.04	.06	.06	.06	***
850115	850122	.28	.32	.33	.35	***
850122	850129	.03	.05	.03	.04	***
850129	850205	.62	.55	.55	.57	***
850205	850212	.30	.29	.32	.29	***

850212	850219	1.33	1.30	1.33	1.47	1.295
850219	850226	.02	.03	.05	.04	.03
850226	850305	.67	.61	.63	.60	.56
850305	850312	.88	.94	.94	1.04	.95
850312	850319	.01	.03	.04	.03	***
850319	850326	.29	.32	.30	.31	.29
850326	850402	.42	.42	.42	.41	.43
850402	850409	.90	.87	.89	.97	.89
850409	850416	.08	.14	.13	.13	.21
850416	850423	.19	.24	.23	.23	.22
850423	850430	T	T	T	T	T
850430	850507	2.65	2.70	2.70	3.04	2.80
850507	850514	.00	.00	.00	.00	.00
850514	850521	1.57	1.60	1.60	1.60	1.60
850521	850528	1.25	1.25	1.25	1.26	1.31
850528	850604	1.41	1.44	1.44	1.50	1.51
850604	850611	mice	.61	mice	.68	.70
850611	850618	1.91	1.92	1.93	2.07	2.02
850618	850625	.93	.96	.94	.97	.955
850625	850702	mice	**	.79	.78	.76
850702	850709	mice	.45	.44	.44	.47
850709	850716	1.33	mice	1.34	1.43	1.39
850716	850723	.89	.92	.93	1.00	.94
850723	850730	2.18	2.17	2.15	2.40	2.22
850730	850806	1.33	1.31	1.31	1.41	1.35
850806	850813	.55	.56	mice	.60	.58
850813	850820	mice	mice	.11	.07	.08
850820	850827	.90	mice	mice	.91	.88
850827	850903	.44	.44	.45	.51	.46
850903	850910	mice	1.09	1.05	1.16	1.07
850910	850917	**	.37	.39	.39	.41
850917	850924	mice	.23	.23	.21	.17
850924	851001	4.25	4.22	4.20	4.10	4.29

Table A-12.— Relation between the collection week and time period of collection

Collection week	Date Sample On	Date Sample Off
1	840821	840828
2	840828	840904
3	840904	840911
4	840911	840918
5	840918	840925
6	840925	841002
7	841002	841009
8	841009	841016
9	841016	841023
10	841023	841030
11	841030	841106
12	841106	841113
13	841113	841120
14	841120	841127
15	841127	841204
16	841204	841211
17	841211	841218
18	841218	841226
19	841226	850102
20	850102	850108
21	850108	850115
22	850115	850122
23	850122	850129
24	850129	850205
25	850205	850212

26	850212	850219
27	850219	850226
28	850226	850305
29	850305	850312
30	850312	850319
31	850319	850326
32	850326	850402
33	850402	850409
34	850409	850416
35	850416	850423
36	850423	850430
37	850430	850507
38	850507	850514
39	850514	850521
40	850521	850528
41	850528	850604
42	850604	850611
43	850611	850618
44	850618	850625
45	850625	850702
46	850702	850709
47	850709	850716
48	850716	850723
49	850723	850730
50	850730	850806
51	850806	850813
52	850813	850820
53	850820	850827
54	850827	850903
55	850903	850910
56	850910	850917
57	850917	850924
58	850924	851001

(p. 83 follows)

APPENDIX B: Percentile Summaries of Selected Ion Concentrations

Table B-1.-- *Percentile Summary of Sample Weight Data* [Units: milligram/liter]

Collector	Number of samples	Percentiles 10	25	50	75	90
A-1	40	151.6	618.8	1,084.7	1,589.3	3,507.6
A-2	37	279.7	619.4	1,075.8	1,569.0	3,276.7
A-3	37	192.7	532.9	1,190.8	2,131.6	2,563.5
A-4	41	189.3	538.2	1,188.5	2,234.6	3,503.7
A-5	41	202.0	647.9	1,192.2	2,249.5	3,528.2
A-6	39	168.0	481.3	1,011.2	2,107.6	3,116.0
L-1	40	99.5	422.9	988.9	1,577.0	2,563.3
L-2	40	117.5	249.2	462.5	983.3	1,519.0
L-3	37	163.0	311.4	506.6	1,320.3	1,666.1

Table B-2.-- *Percentile Summary of Calcium Ion Concentration Data* [Units: milligram/liter]

Collector	Number of samples	Percentiles 10	25	50	75	90
A-1	40	0.02	0.07	0.10	0.20	0.38
A-2	35	.01	.04	.09	.15	.32
A-3	34	.02	.03	.09	.13	.28
A-4	38	.01	.04	.10	.12	.20
A-5	39	.02	.05	.10	.12	.35
A-6	35	.02	.05	.10	.13	.20
L-1	35	.01	.04	.10	.14	.20
L-2	34	.01	.06	.10	.14	.20
L-3	39	.01	.03	.10	.15	.21

Table B-3.-- *Percentile Summary of Magnesium Ion Concentration Data* [Units: milligram/liter]

Collector	Number of samples	Percentiles 10	25	50	75	90
A-1	38	0.01	0.02	0.04	0.06	0.11
A-2	35	.01	.01	.04	.05	.08
A-3	35	.01	.01	.03	.05	.11
A-4	38	.01	.01	.03	.06	.13
A-5	39	.01	.01	.03	.06	.12
A-6	35	.01	.02	.03	.05	.10
L-1	35	.01	.01	.03	.05	.10
L-2	34	.01	.01	.04	.06	.10
L-3	38	.01	.01	.03	.06	.10

Table B-4.-- *Percentile Summary of Sodium Ion Concentration Data* [Units: milligram/liter]

Collector	Number of samples	Percentiles 10	25	50	75	90
A-1	39	0.01	0.02	0.06	0.18	0.59
A-2	35	.01	.02	.07	.23	.60
A-3	35	.01	.02	.05	.11	.61
A-4	38	.01	.03	.05	.11	.58
A-5	39	.01	.02	.05	.10	.48
A-6	35	.01	.01	.05	.15	.57
L-1	35	.01	.02	.06	.22	.50
L-2	34	.01	.02	.05	.11	.44
L-3	39	.01	.01	.04	.09	.30

Table B-5.-- *Percentile Summary of Potassium Ion Concentration Data* [Units: milligram/liter]

Collector	Number of samples	Percentiles 10	25	50	75	90
A-1	39	0.01	0.02	0.03	0.04	0.06
A-2	35	.01	.01	.02	.05	.07
A-3	35	.01	.02	.03	.05	.06
A-4	38	.01	.02	.02	.04	.06
A-5	39	.01	.01	.03	.05	.08
A-6	35	.01	.02	.02	.04	.06
L-1	35	.01	.02	.02	.06	.06
L-2	34	.01	.01	.03	.05	.06
L-3	37	.01	.02	.03	.04	.07

Table B-6.-- *Percentile Summary of Ammonium Ion Concentration Data* [Units: milligram/liter]

Collector	Number of samples	Percentiles 10	25	50	75	90
A-1	38	0.03	0.08	0.28	0.44	0.98
A-2	35	.03	.09	.31	.46	.96
A-3	35	.03	.12	.21	.46	.77
A-4	37	.04	.12	.26	.45	.78
A-5	38	.03	.12	.30	.49	1.00
A-6	34	.04	.14	.32	.46	.84
L-1	34	.03	.10	.27	.46	.59
L-2	34	.03	.13	.35	.53	.69
L-3	36	.03	.13	.28	.45	.71

Table B-7.-- *Percentile Summary of Chloride Ion Concentration Data* [Units: milligram/liter]

Collector	Number of samples	Percentiles 10	25	50	75	90
A-1	38	0.08	0.11	0.20	0.47	1.00
A-2	34	.08	.11	.20	.53	1.10
A-3	34	.09	.12	.20	.50	1.40
A-4	37	.08	.15	.19	.38	1.30
A-5	38	.09	.12	.20	.47	1.30
A-6	34	.07	.11	.20	.47	1.10
L-1	34	.10	.12	.20	.45	.80
L-2	34	.07	.11	.19	.34	.96
L-3	36	.06	.10	.17	.39	.66

Table B-8.-- *Percentile Summary of Nitrate Ion Concentration Data* [Units: milligram/liter]

Collector	Number of samples	Percentiles 10	25	50	75	90
A-1	38	0.58	1.11	2.11	2.83	3.98
A-2	35	.58	1.28	2.11	2.67	3.68
A-3	35	.53	1.60	2.41	3.10	3.76
A-4	38	.62	1.37	2.39	3.19	3.72
A-5	39	.62	.89	2.25	3.32	3.99
A-6	35	.58	.77	2.16	3.00	3.81
L-1	35	.66	1.28	2.08	2.66	3.54
L-2	34	.62	1.64	2.31	3.06	3.68
L-3	37	.62	1.15	2.26	3.32	3.63

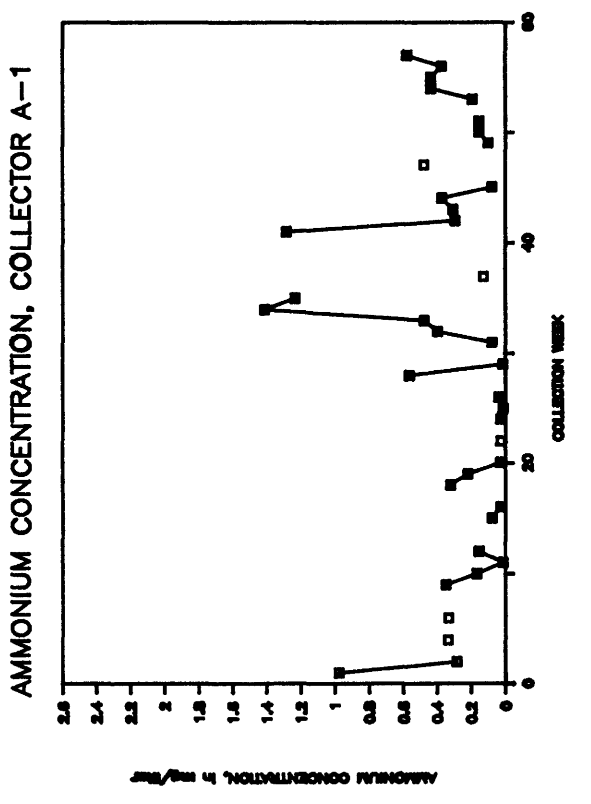
Table B-9.-- *Percentile Summary of Sulfate Ion Concentration Data* [Units: milligram/liter]

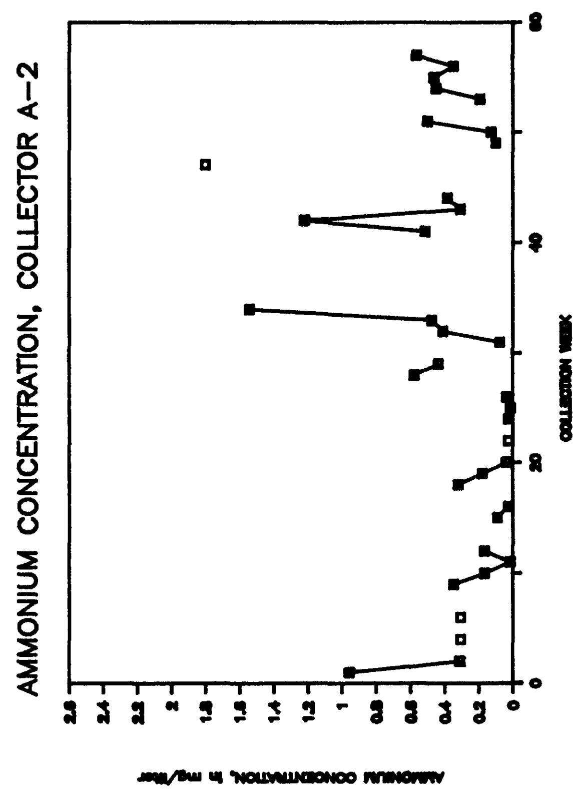
Collector	Number of samples	Percentiles 10	25	50	75	90
A-1	38	0.80	1.80	2.60	4.00	8.40
A-2	34	.80	1.70	2.70	3.80	5.10
A-3	34	.90	1.60	2.90	4.50	7.90
A-4	38	.70	1.60	2.90	4.20	7.30
A-5	38	.80	1.60	2.80	4.70	7.80
A-6	34	.90	2.00	2.60	4.50	7.30
L-1	34	.80	2.10	2.90	3.90	7.60
L-2	34	.70	1.90	3.00	4.40	5.10
L-3	36	.80	1.60	2.70	4.80	5.90

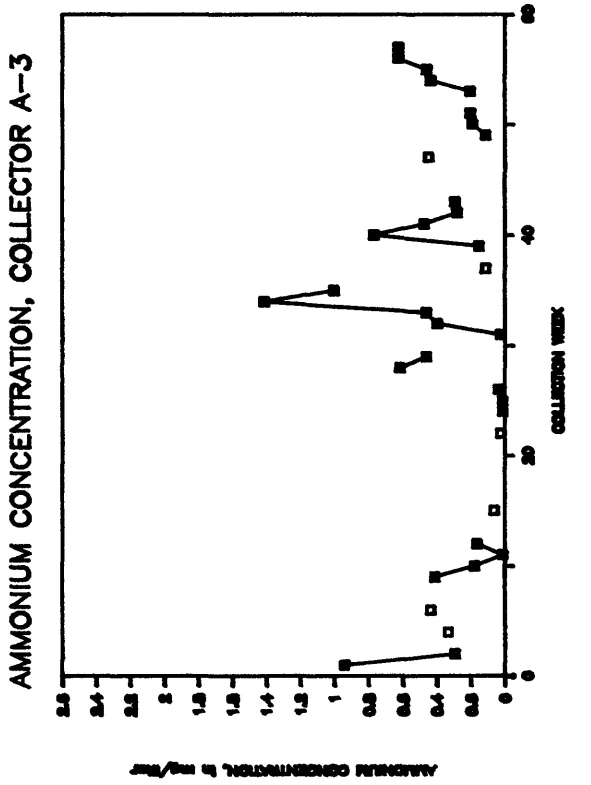
Table B-10.-- *Percentile Summary of Lab Specific Conductance Data* [Units: microsiemens/centimeter]

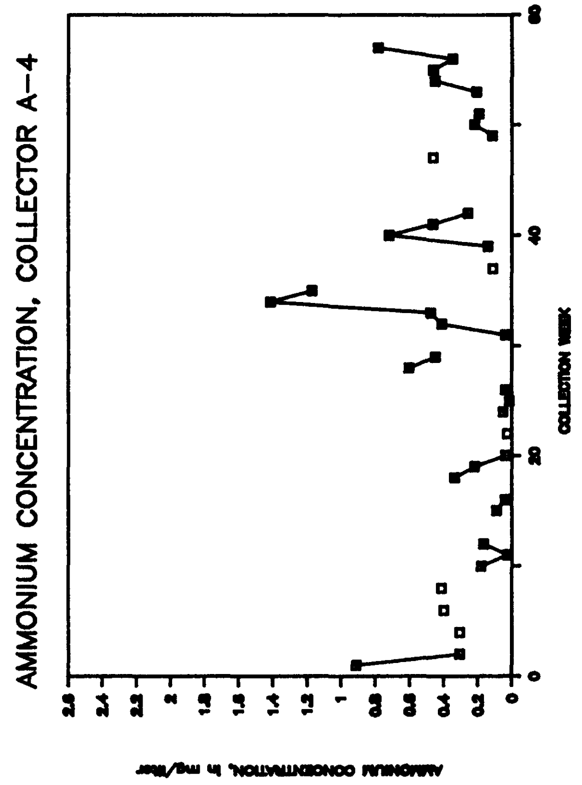
Collector	Number of samples	Percentiles 10	25	50	75	90
A-1	38	13.0	22.0	34.0	52.0	96.0
A-2	35	16.0	23.0	34.0	44.0	57.0
A-3	35	16.0	22.0	36.0	54.0	63.0
A-4	38	15.0	27.0	39.0	56.0	101.0
A-5	39	15.0	25.0	36.0	56.0	76.0
A-6	35	13.0	23.0	35.0	52.0	63.0
L-1	35	16.0	25.0	34.0	45.0	54.0
L-2	34	19.0	27.0	39.0	50.0	62.0
L-3	37	19.0	22.0	33.0	50.0	60.0

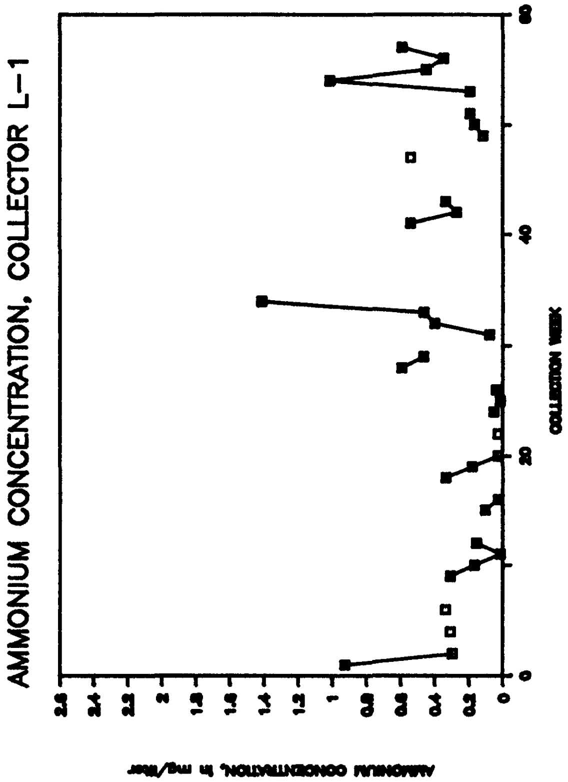
APPENDIX C: Time plots of Analytes

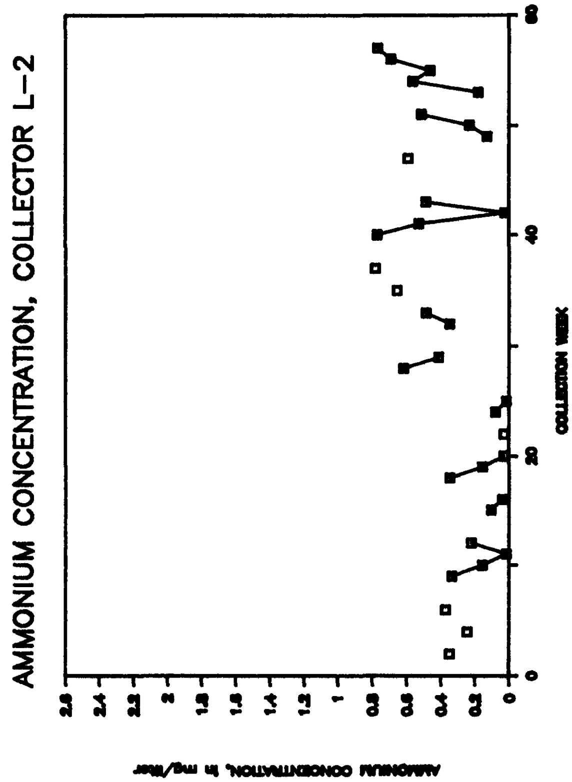

AMMONIUM CONCENTRATION, COLLECTOR A–1
COLLECTION WEEK

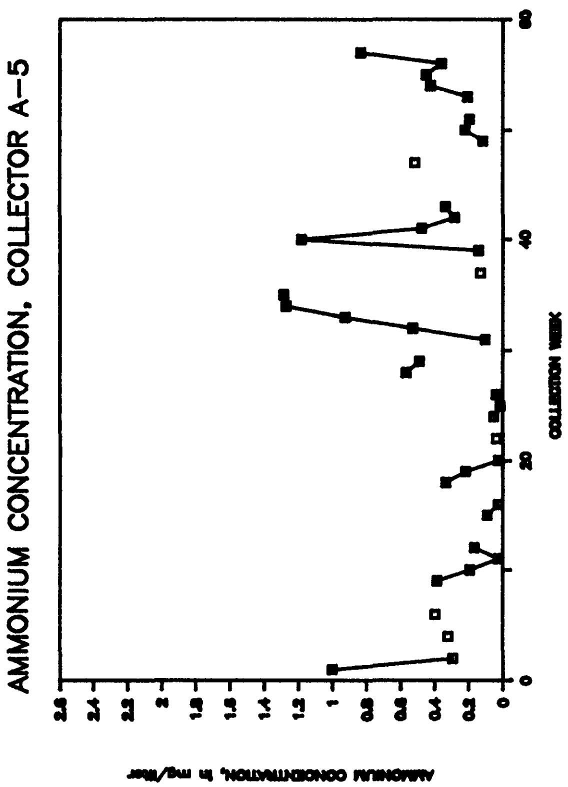

AMMONIUM CONCENTRATION, COLLECTOR A–2
COLLECTION WEEK

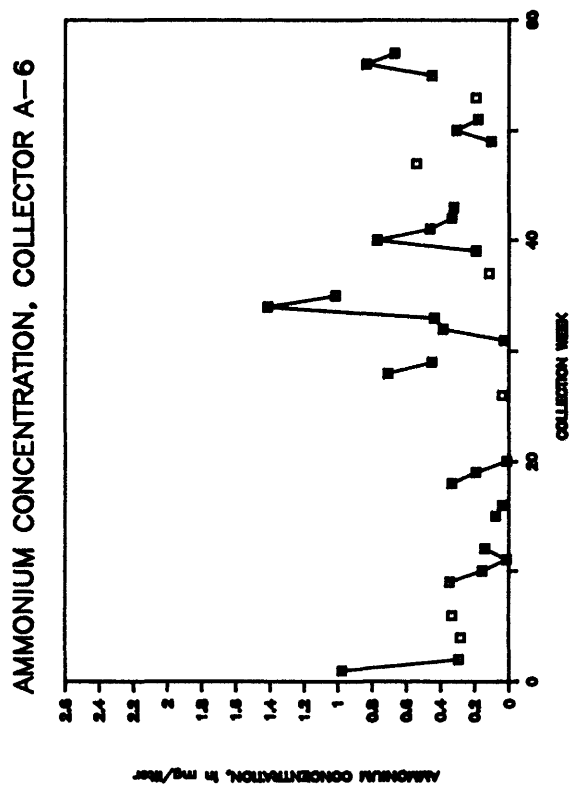

AMMONIUM CONCENTRATION, COLLECTOR A–3
COLLECTION WEEK

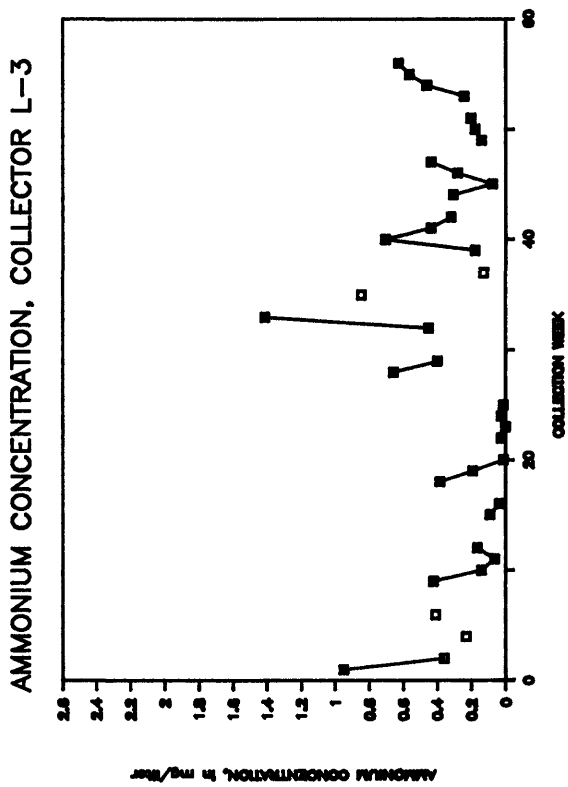

AMMONIUM CONCENTRATION, COLLECTOR A–4
COLLECTION WEEK

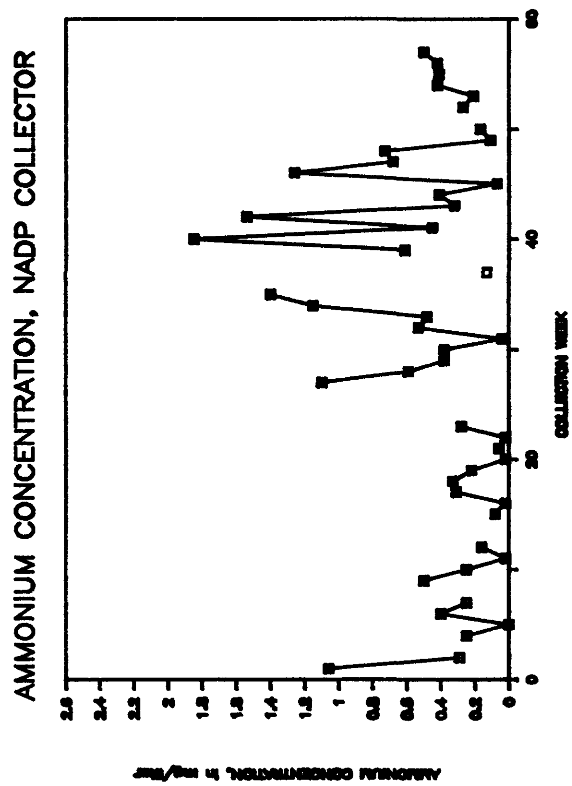

AMMONIUM CONCENTRATION, COLLECTOR L–1
AMMONIUM CONCENTRATION, in mg/liter
COLLECTION WEEK


AMMONIUM CONCENTRATION, COLLECTOR L–2
AMMONIUM CONCENTRATION, in mg/liter
COLLECTION WEEK

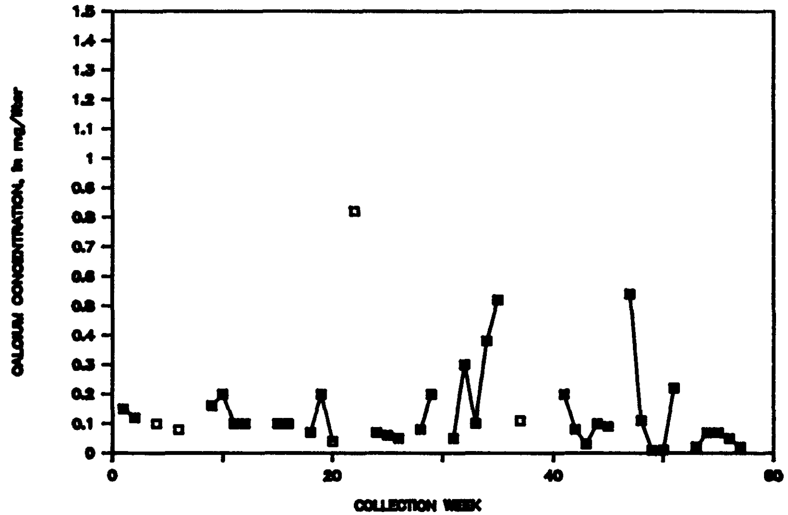

AMMONIUM CONCENTRATION, COLLECTOR A–5
AMMONIUM CONCENTRATION, in mg/liter
COLLECTION WEEK


AMMONIUM CONCENTRATION, COLLECTOR A–6
AMMONIUM CONCENTRATION, in mg/liter
COLLECTION WEEK

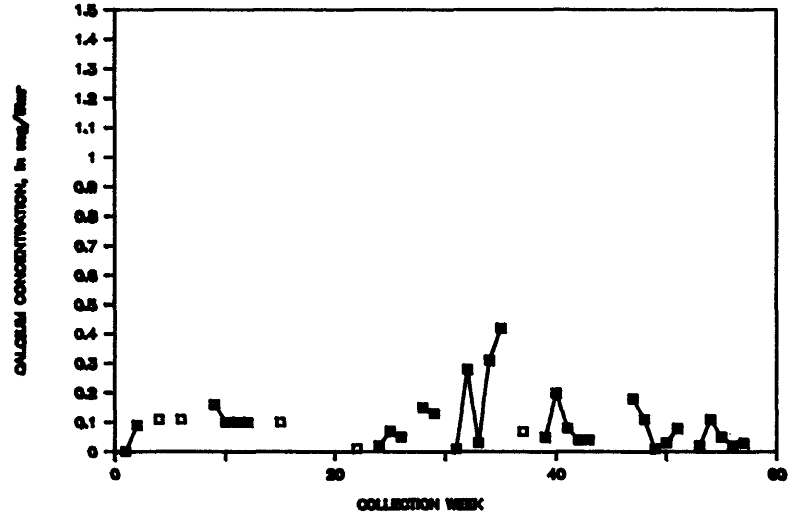

AMMONIUM CONCENTRATION, COLLECTOR L-3
COLLECTION WEEK


AMMONIUM CONCENTRATION, NADP COLLECTOR
COLLECTION WEEK

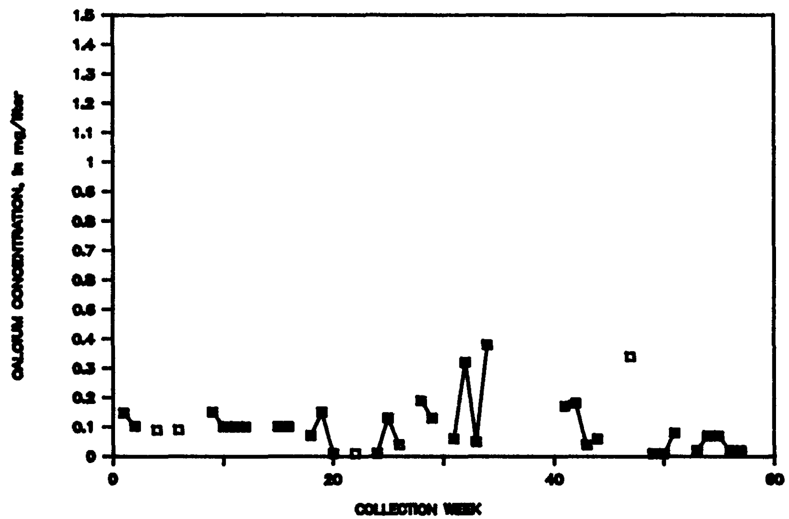
CALCIUM CONCENTRATION, COLLECTOR A–1



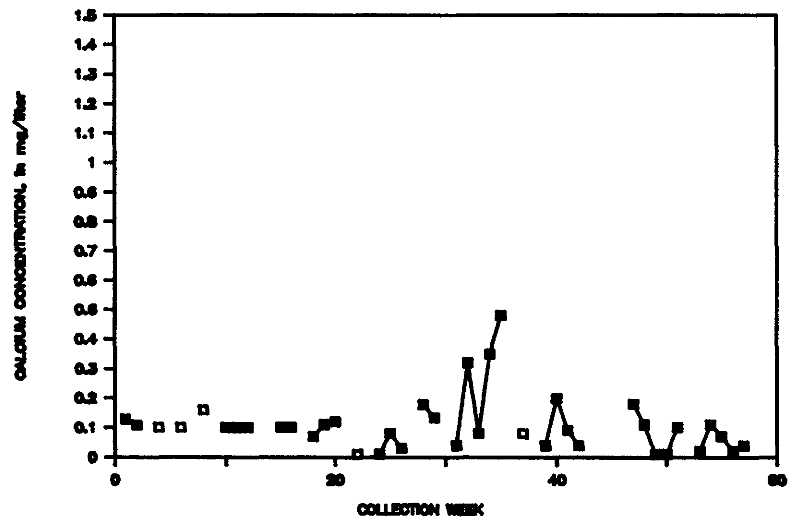
CALCIUM CONCENTRATION, COLLECTOR A–3



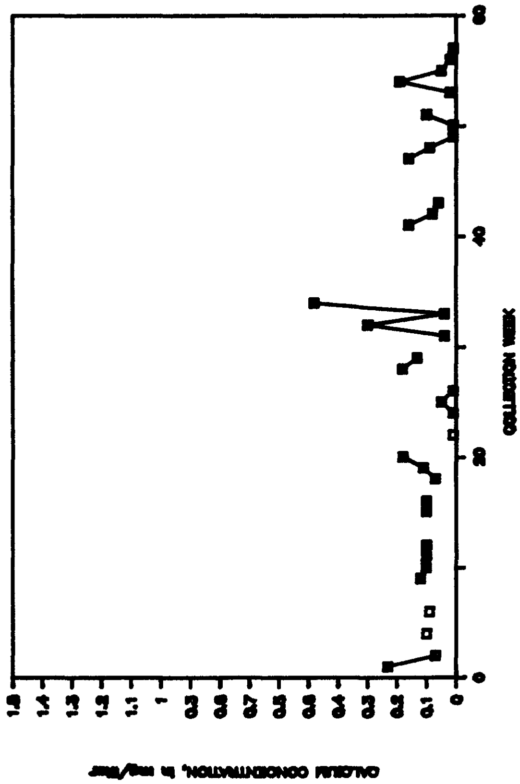
CALCIUM CONCENTRATION, COLLECTOR A–2



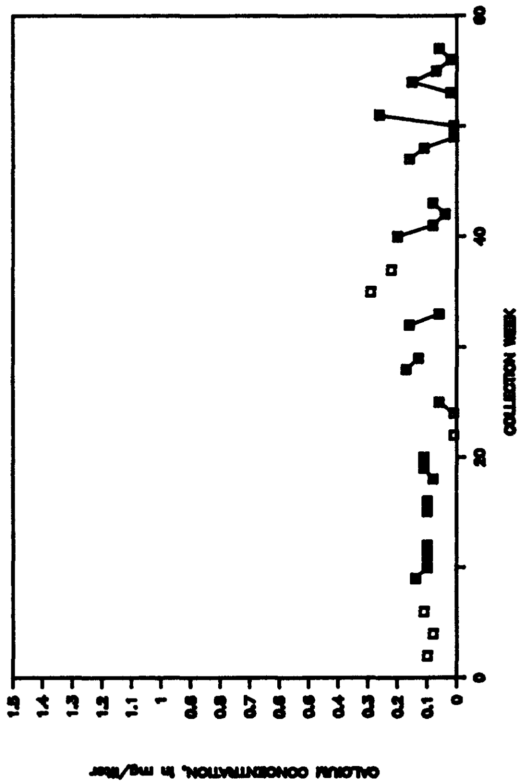
CALCIUM CONCENTRATION, COLLECTOR A–4



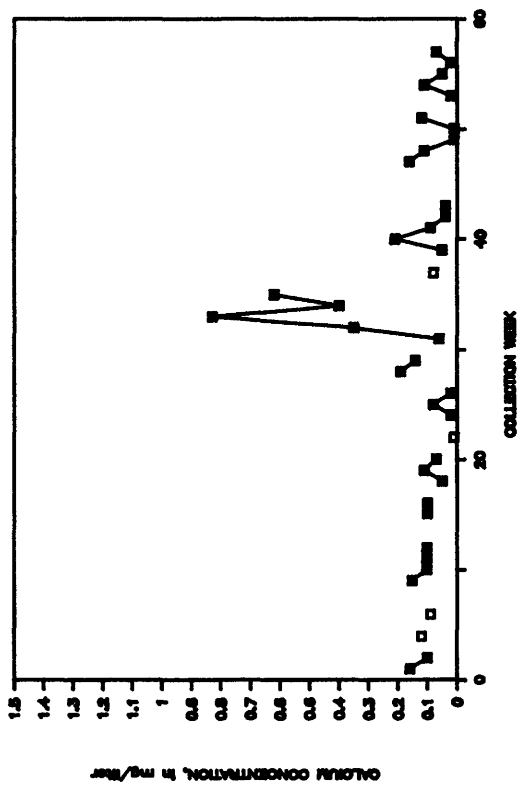
CALCIUM CONCENTRATION, COLLECTOR L–1



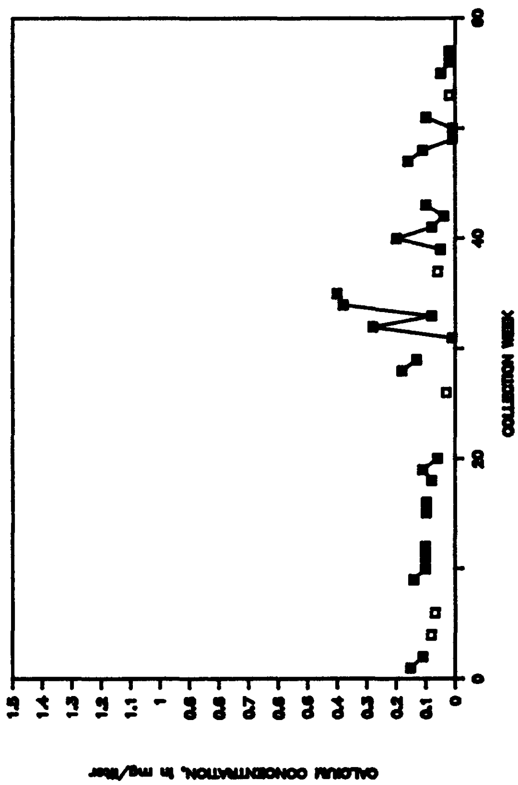
CALCIUM CONCENTRATION, COLLECTOR L–2

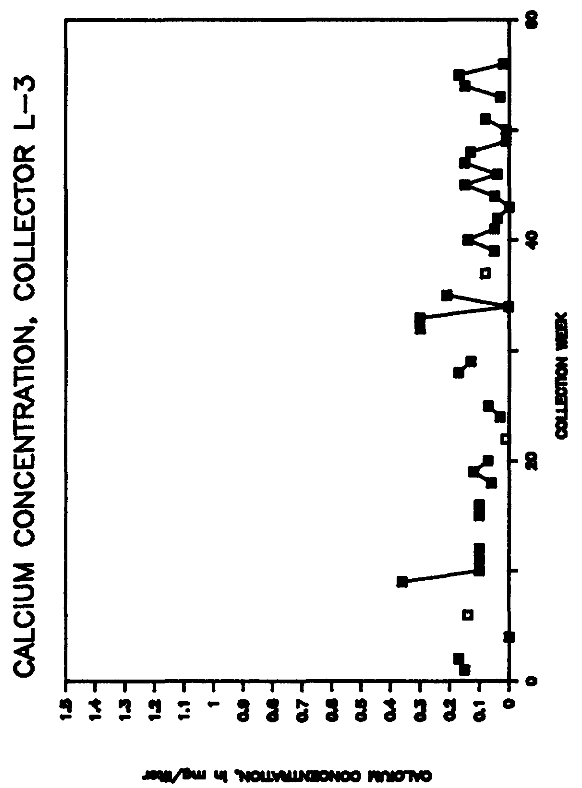


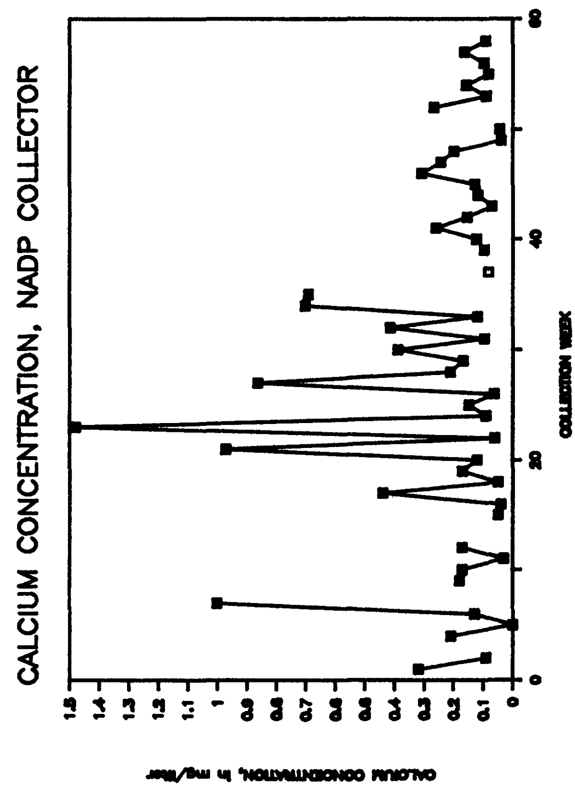
CALCIUM CONCENTRATION, COLLECTOR A–5



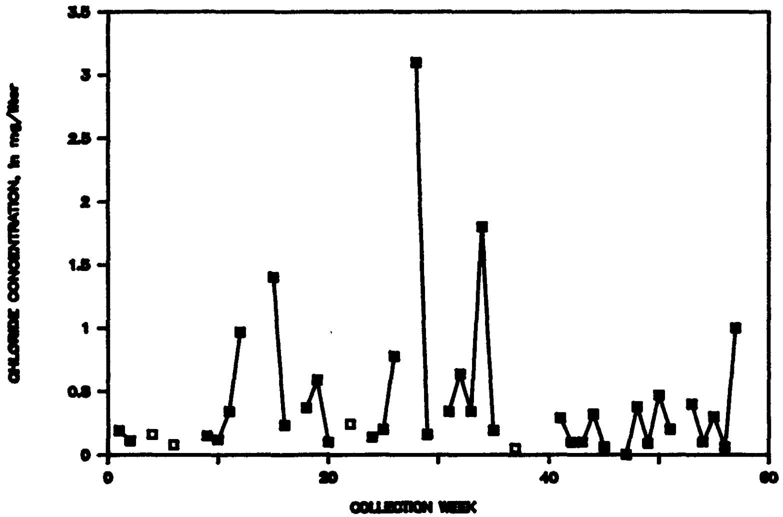
CALCIUM CONCENTRATION, COLLECTOR A–6



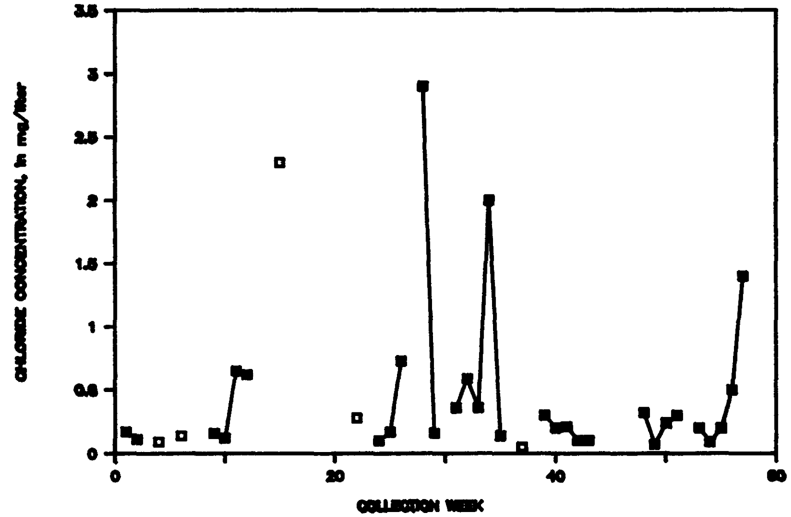

CALCIUM CONCENTRATION, COLLECTOR L—3
CALCIUM CONCENTRATION, in mg/liter
COLLECTION WEEK
0
20
40
60
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5


CALCIUM CONCENTRATION, NADP COLLECTOR
CALCIUM CONCENTRATION, in mg/liter
COLLECTION WEEK
0
20
40
60
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5

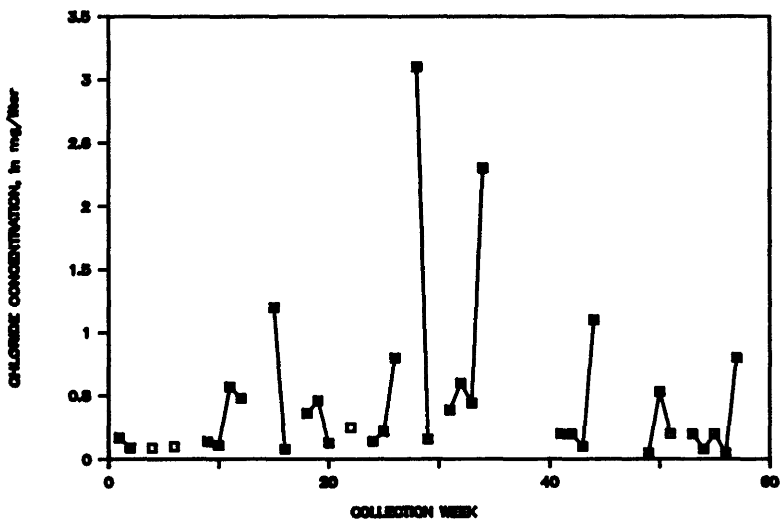
CHLORIDE CONCENTRATION, COLLECTOR A–1



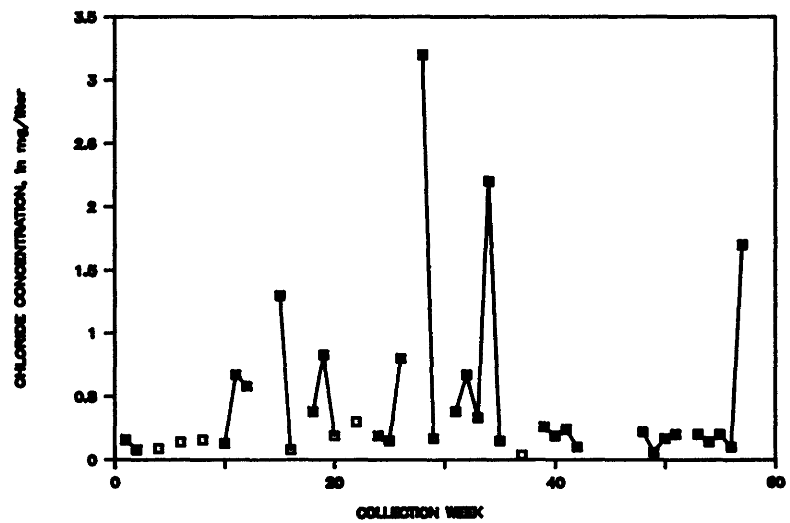
CHLORIDE CONCENTRATION, COLLECTOR A–3

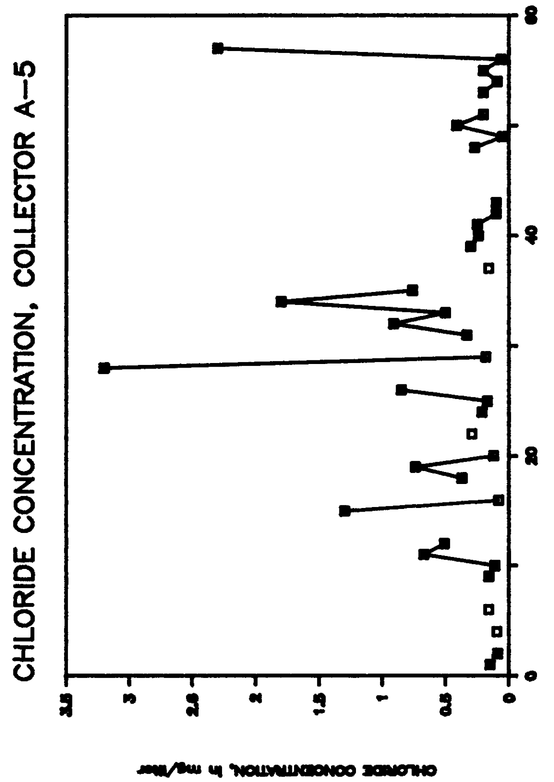


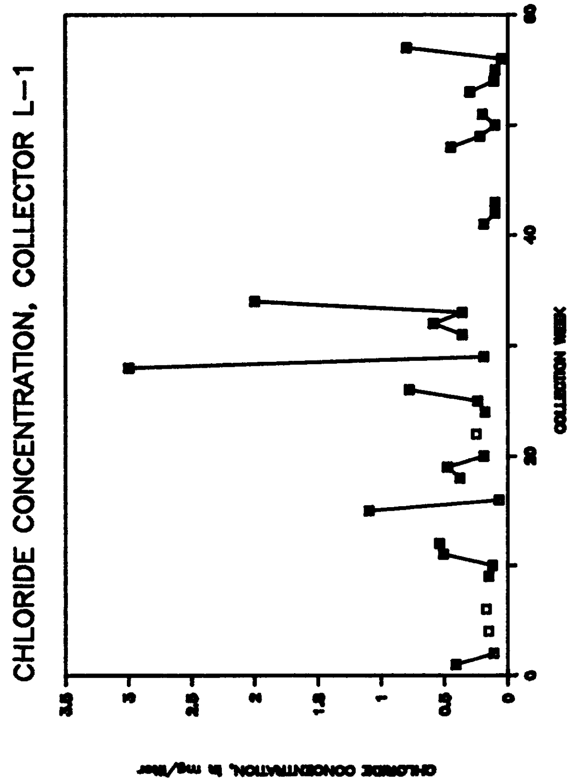
CHLORIDE CONCENTRATION, COLLECTOR A–2

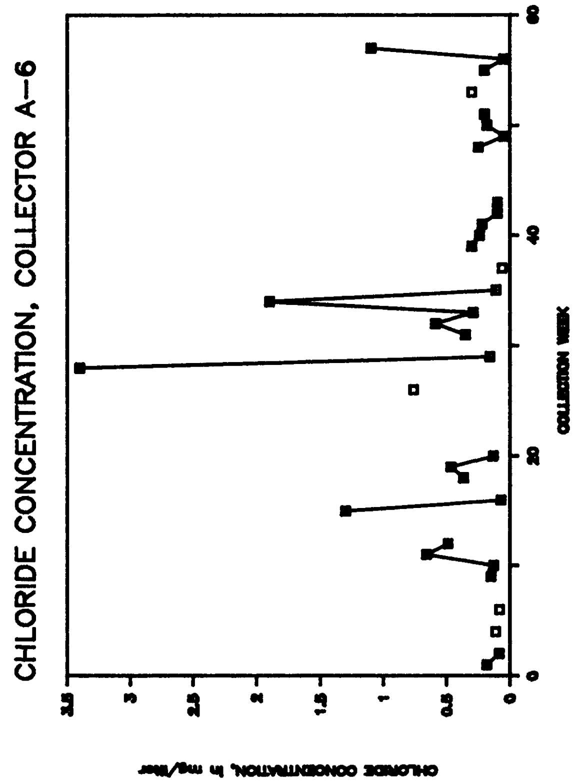


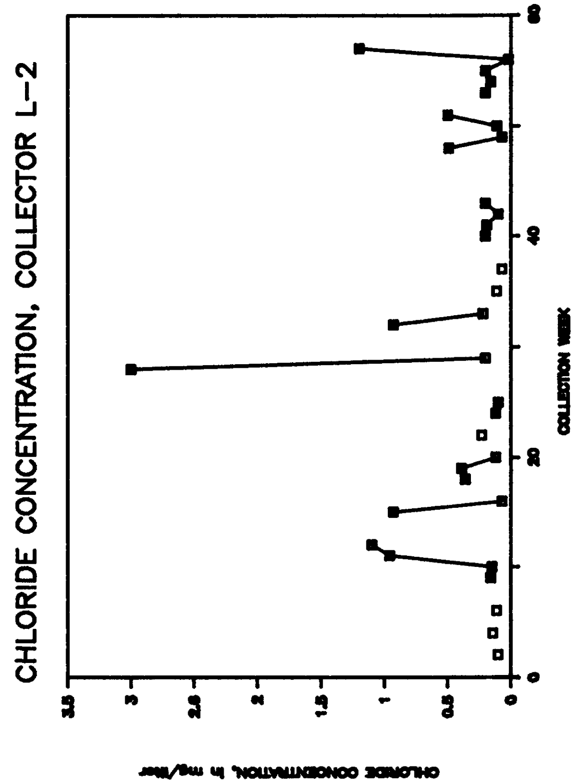
CHLORIDE CONCENTRATION, COLLECTOR A–4

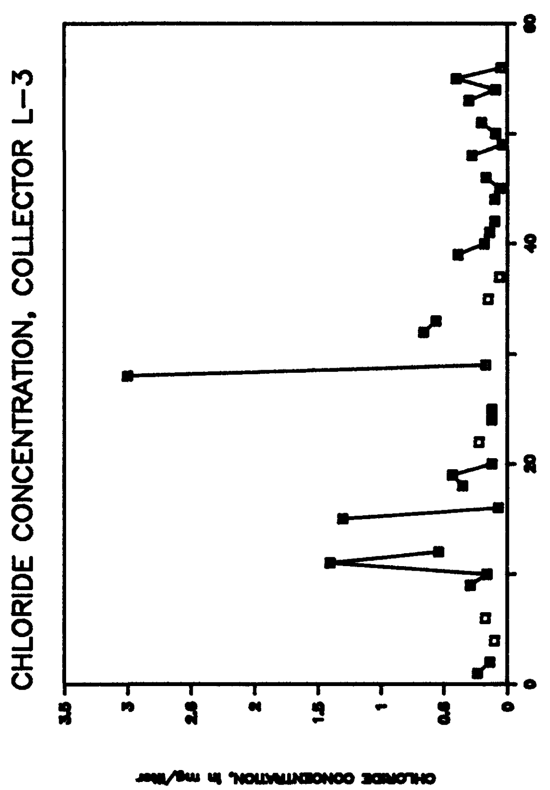


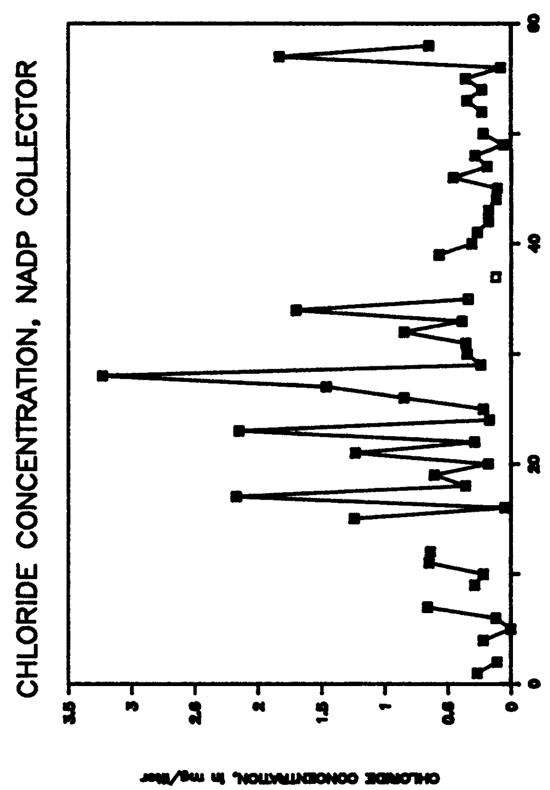

CHLORIDE CONCENTRATION, COLLECTOR A–5
CHLORIDE CONCENTRATION, in mg/liter
COLLECTION WEEK

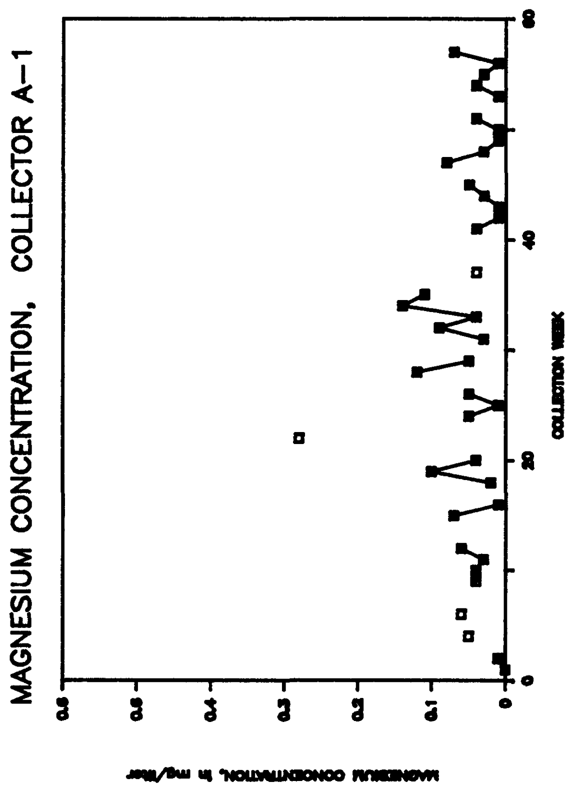

CHLORIDE CONCENTRATION, COLLECTOR L–1
CHLORIDE CONCENTRATION, in mg/liter
COLLECTION WEEK

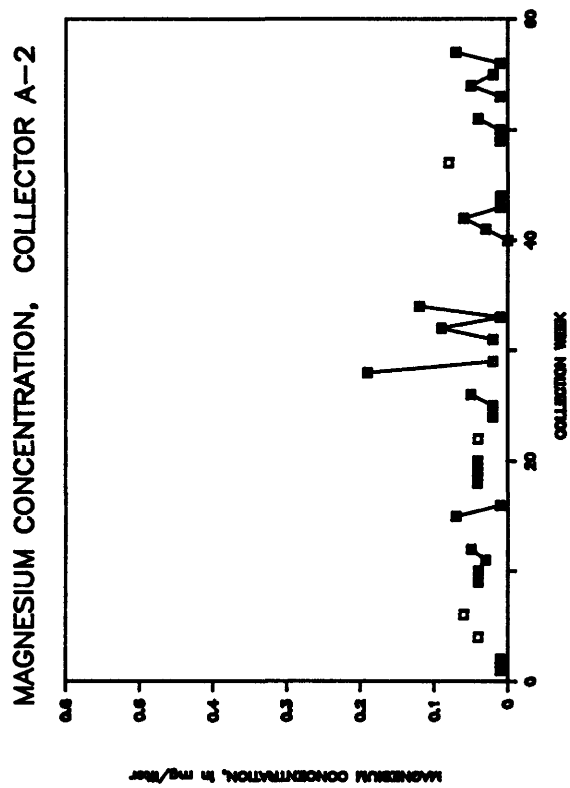

CHLORIDE CONCENTRATION, COLLECTOR A–6
CHLORIDE CONCENTRATION, in mg/liter
COLLECTION WEEK

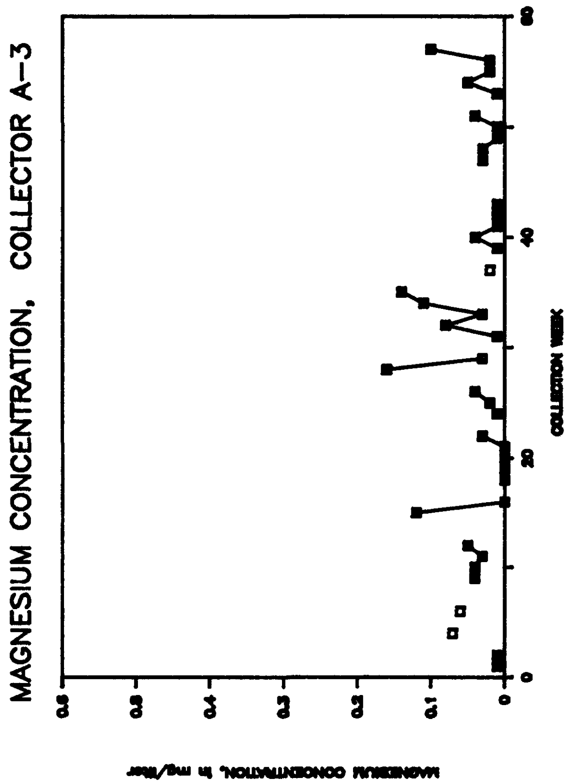

CHLORIDE CONCENTRATION, COLLECTOR L–2
CHLORIDE CONCENTRATION, in mg/liter
COLLECTION WEEK

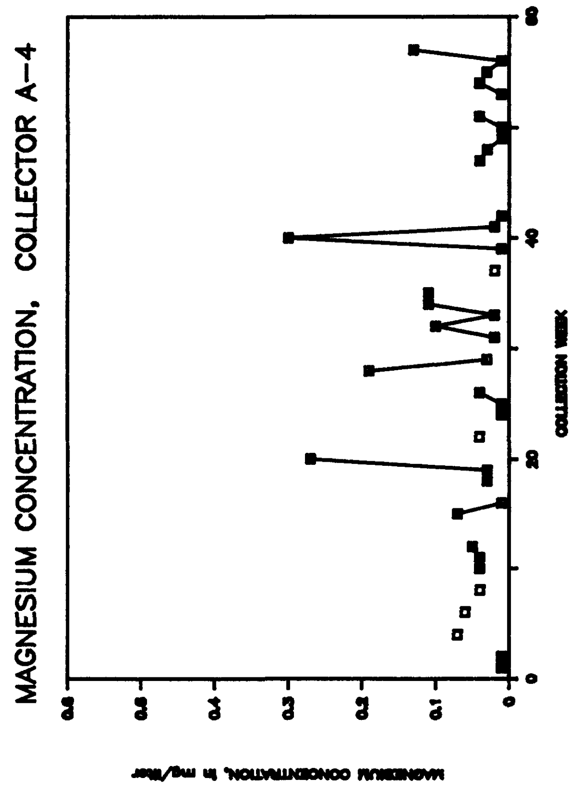

CHLORIDE CONCENTRATION, COLLECTOR L-3
CHLORIDE CONCENTRATION, in mg/liter
3.5
3
2.5
2
1.5
1
0.5
0
COLLECTION WEEK
0
20
40
60

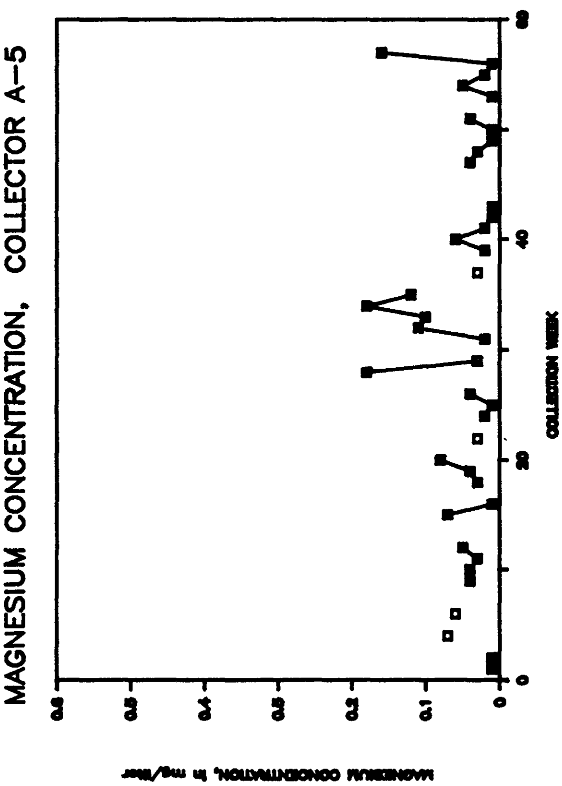

CHLORIDE CONCENTRATION, NADP COLLECTOR
CHLORIDE CONCENTRATION, in mg/liter
3.5
3
2.5
2
1.5
1
0.5
0
COLLECTION WEEK
0
20
40
60

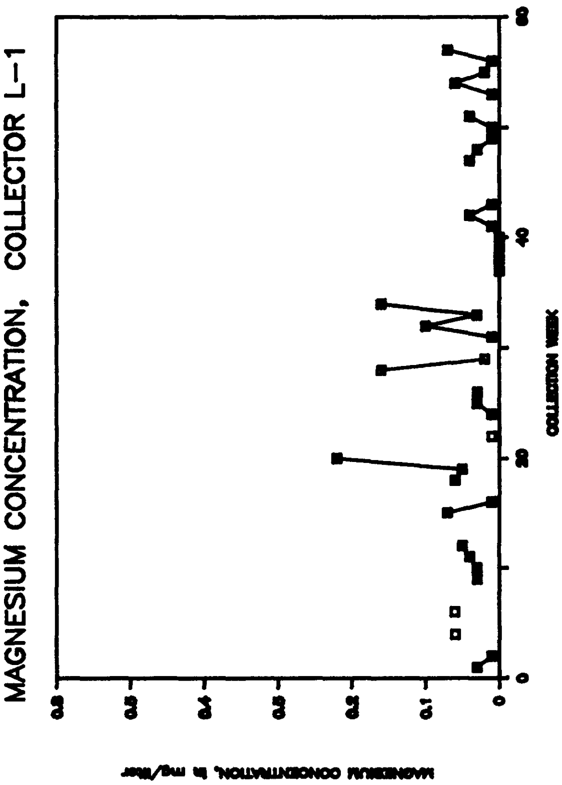

MAGNESIUM CONCENTRATION, COLLECTOR A–1
MAGNESIUM CONCENTRATION, in mg/liter
COLLECTION WEEK

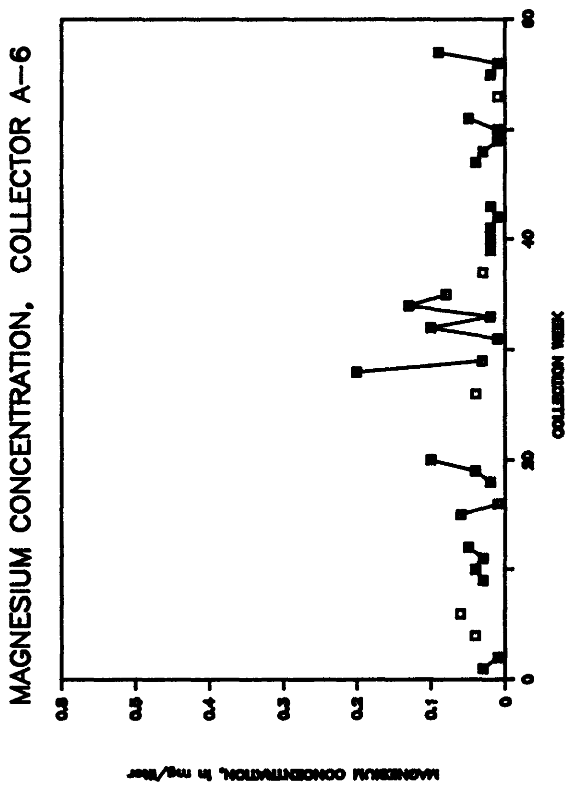

MAGNESIUM CONCENTRATION, COLLECTOR A–2
MAGNESIUM CONCENTRATION, in mg/liter
COLLECTION WEEK

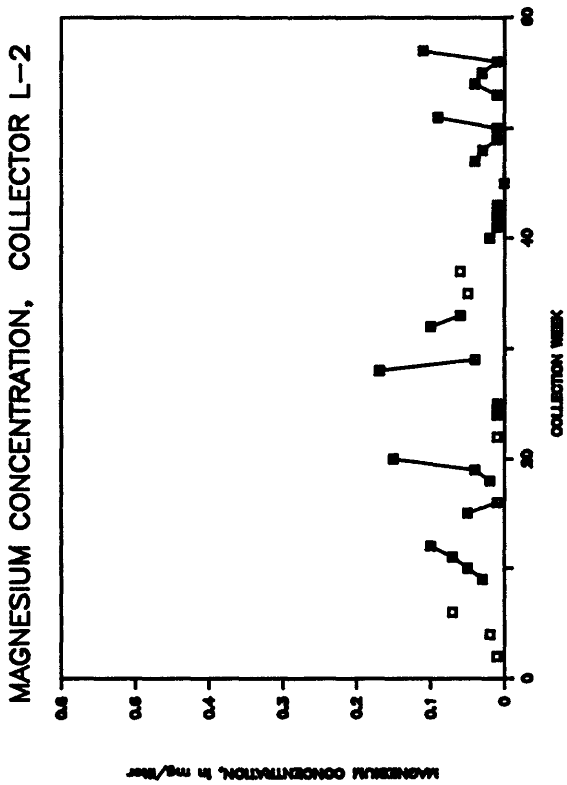

MAGNESIUM CONCENTRATION, COLLECTOR A–3
MAGNESIUM CONCENTRATION, in mg/liter
COLLECTION WEEK


MAGNESIUM CONCENTRATION, COLLECTOR A–4
MAGNESIUM CONCENTRATION, in mg/liter
COLLECTION WEEK

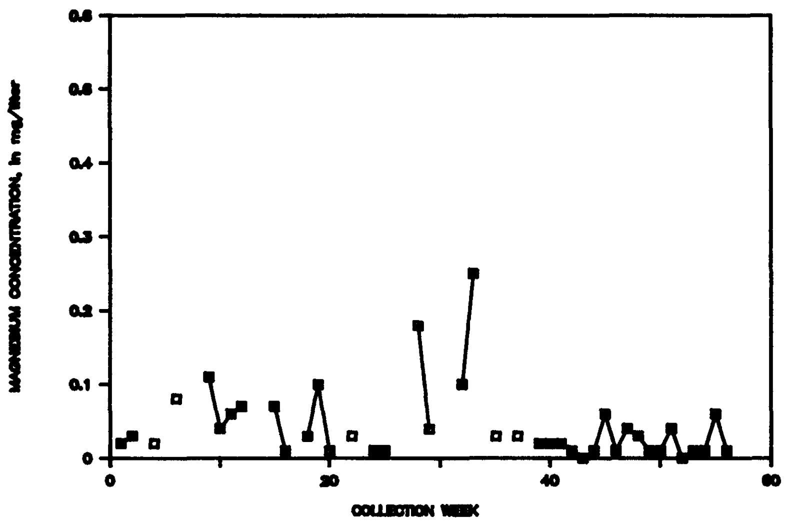

MAGNESIUM CONCENTRATION, COLLECTOR A–5
MAGNESIUM CONCENTRATION, in mg/liter
COLLECTION WEEK


MAGNESIUM CONCENTRATION, COLLECTOR L–1
MAGNESIUM CONCENTRATION, in mg/liter
COLLECTION WEEK

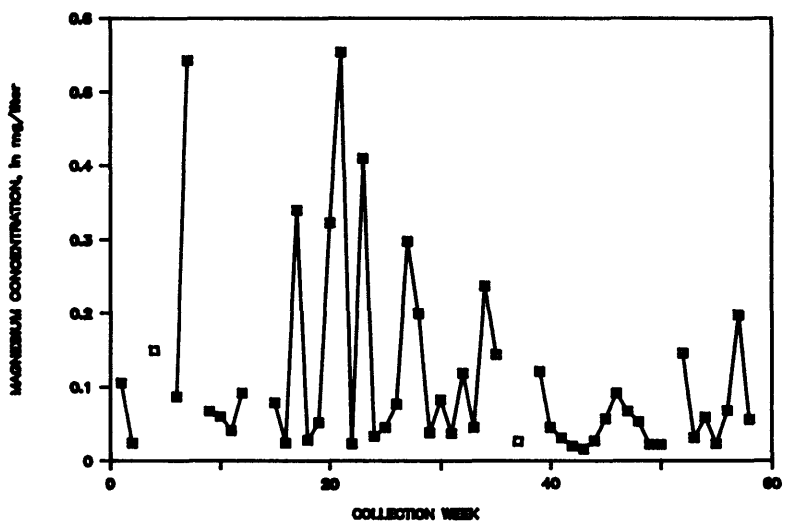

MAGNESIUM CONCENTRATION, COLLECTOR A–6
MAGNESIUM CONCENTRATION, in mg/liter
COLLECTION WEEK

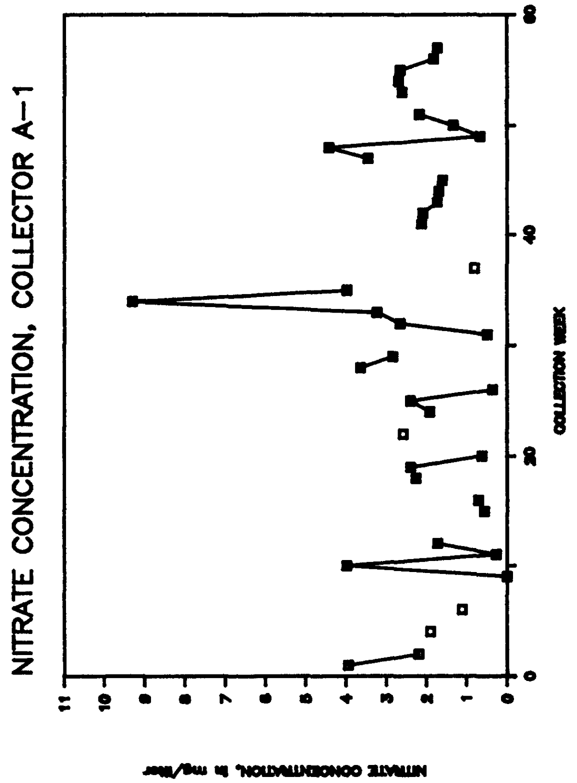

MAGNESIUM CONCENTRATION, COLLECTOR L–2
MAGNESIUM CONCENTRATION, in mg/liter
COLLECTION WEEK

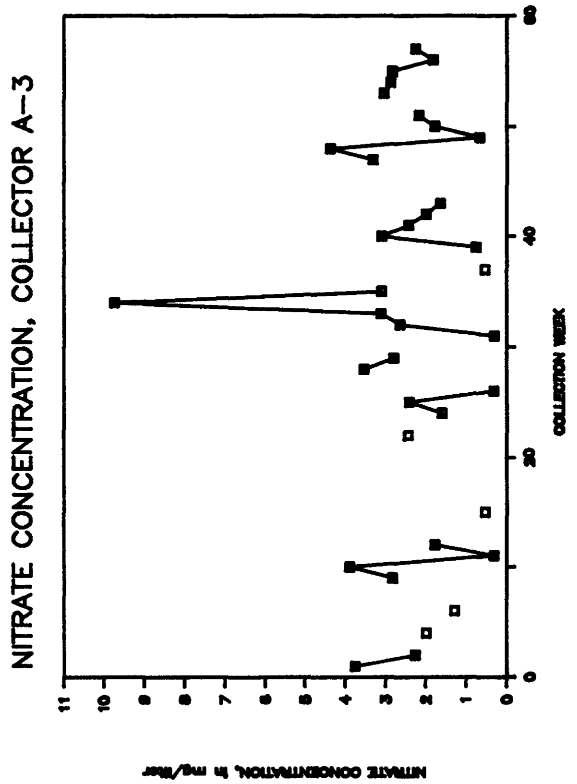
MAGNESIUM CONCENTRATION, COLLECTOR L-3

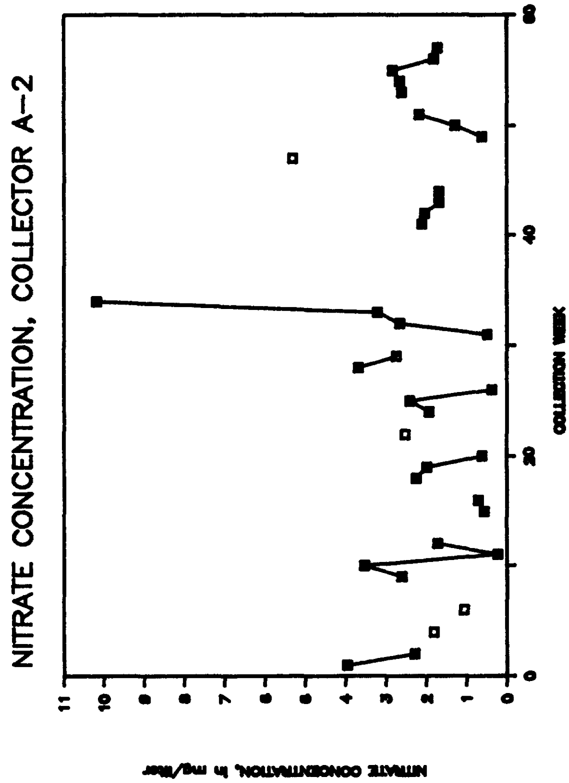


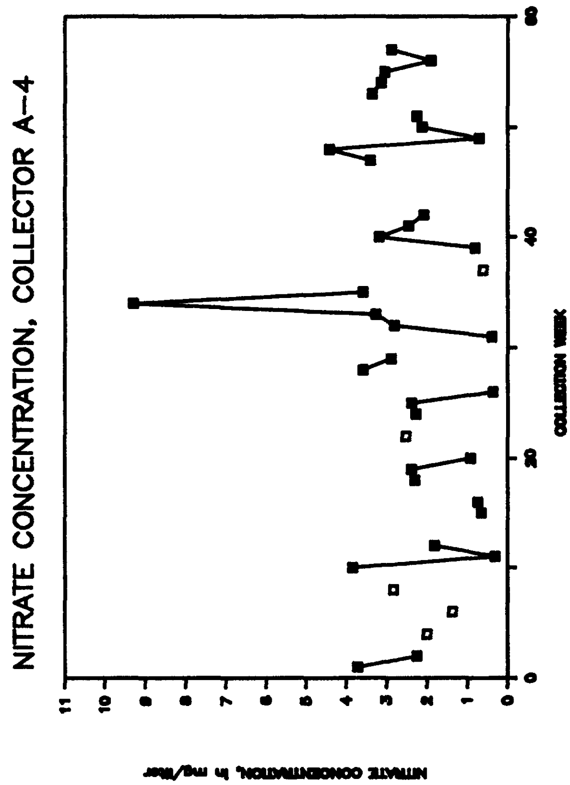
MAGNESIUM CONCENTRATION, NADP COLLECTO

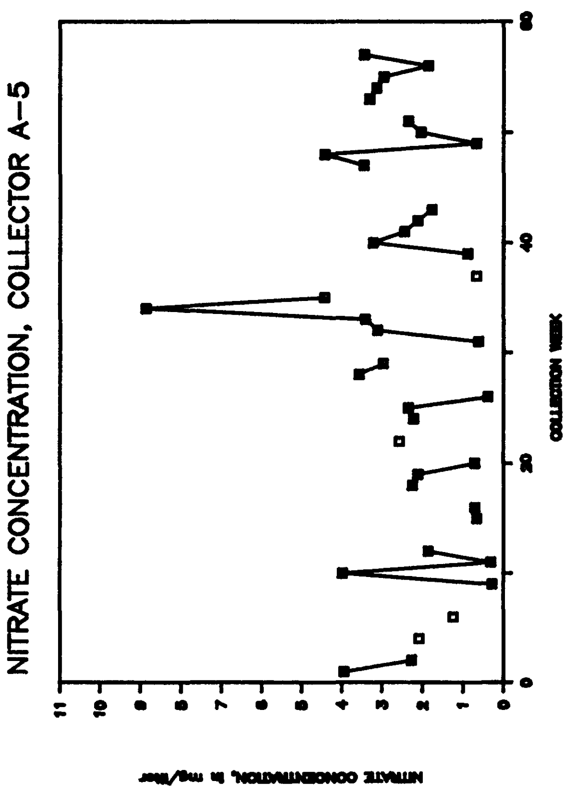


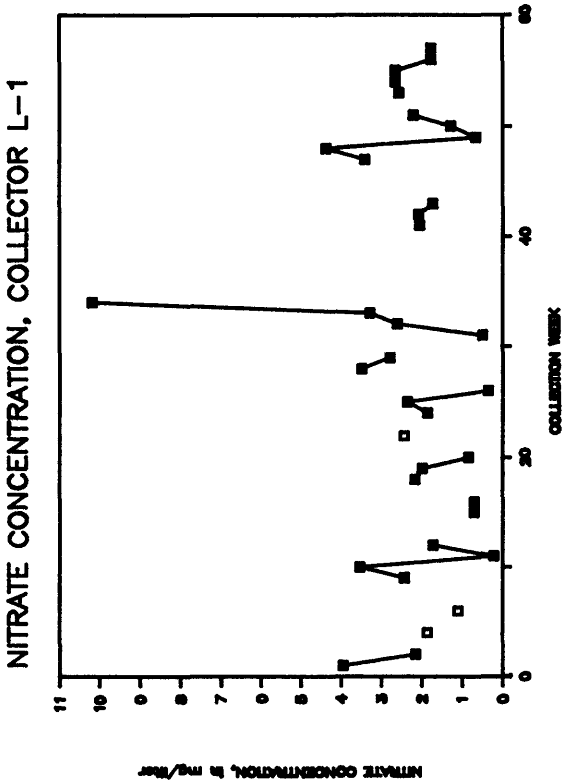

NITRATE CONCENTRATION, COLLECTOR A–1
NITRATE CONCENTRATION, in mg/liter
COLLECTION WEEK
0 1 2 3 4 5 6 7 8 9 10 11
0 20 40 60

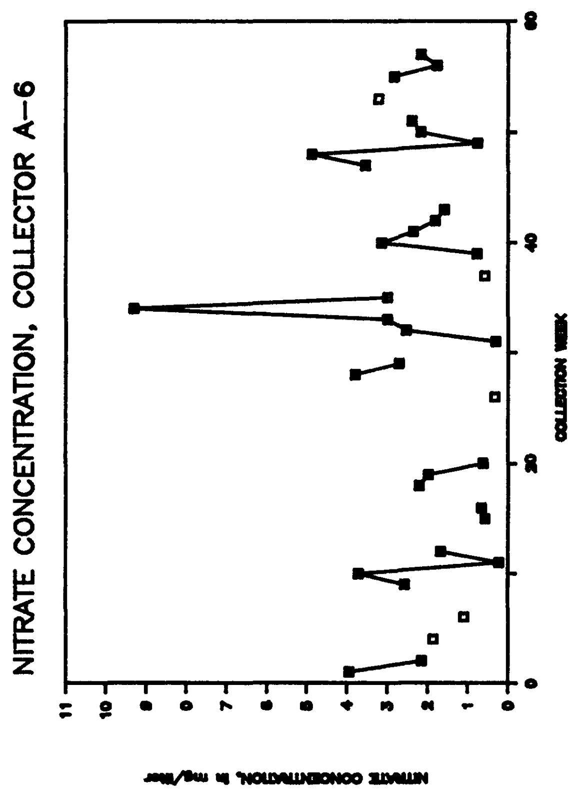

NITRATE CONCENTRATION, COLLECTOR A–3
NITRATE CONCENTRATION, in mg/liter
COLLECTION WEEK
0 1 2 3 4 5 6 7 8 9 10 11
0 20 40 60

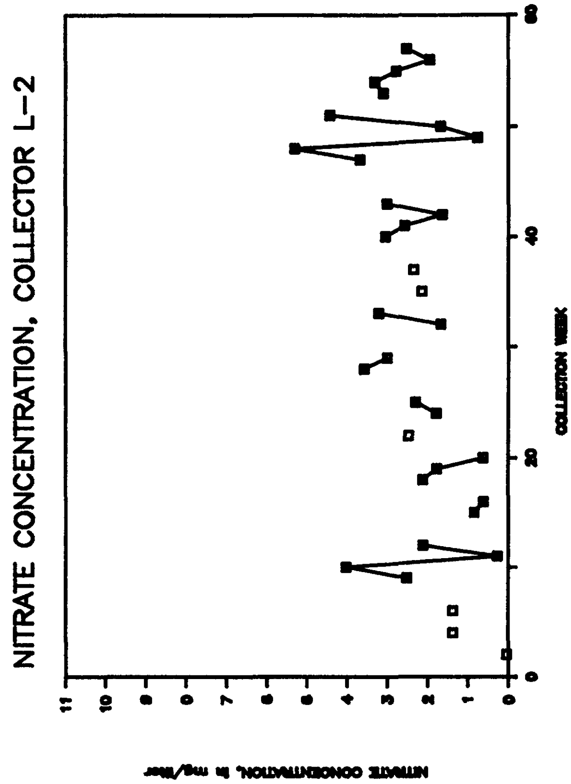

NITRATE CONCENTRATION, COLLECTOR A–2
NITRATE CONCENTRATION, in mg/liter
COLLECTION WEEK
0 1 2 3 4 5 6 7 8 9 10 11
0 20 40 60

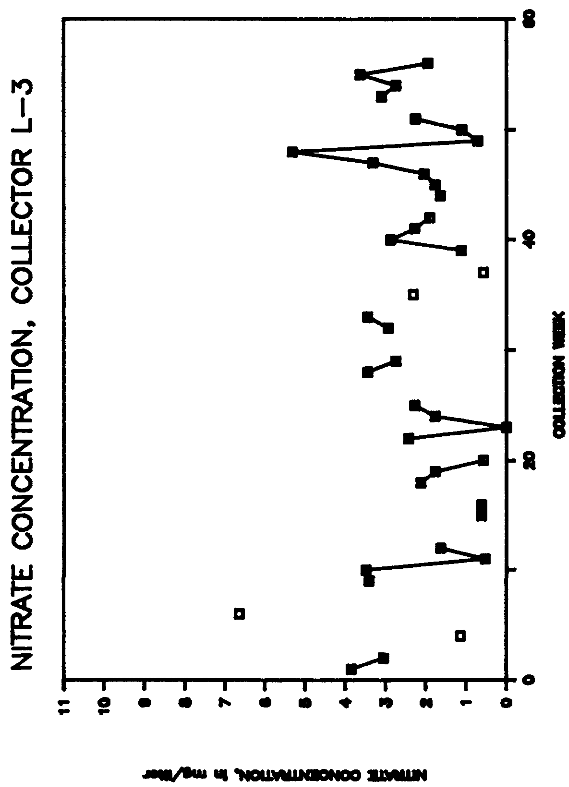

NITRATE CONCENTRATION, COLLECTOR A–4
NITRATE CONCENTRATION, in mg/liter
COLLECTION WEEK
0 1 2 3 4 5 6 7 8 9 10 11
0 20 40 60

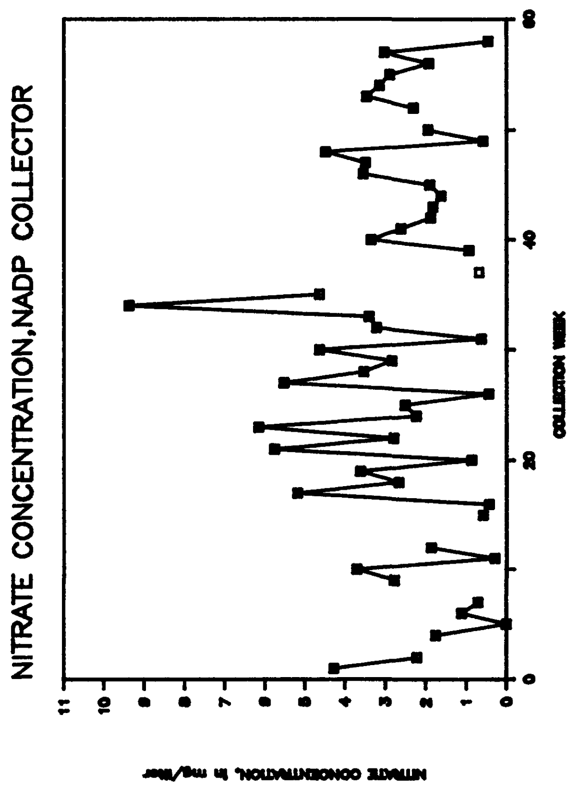

NITRATE CONCENTRATION, COLLECTOR A-5
NITRATE CONCENTRATION, in mg/liter
COLLECTION WEEK


NITRATE CONCENTRATION, COLLECTOR L-1
NITRATE CONCENTRATION, in mg/liter
COLLECTION WEEK

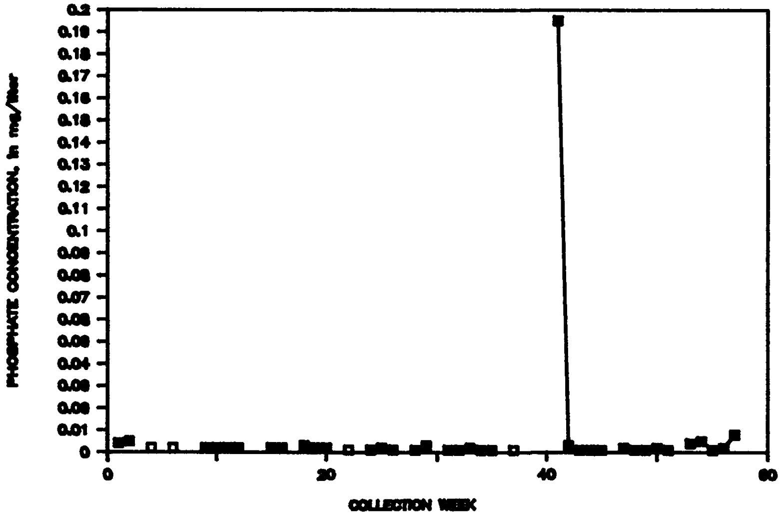

NITRATE CONCENTRATION, COLLECTOR A-6
NITRATE CONCENTRATION, in mg/liter
COLLECTION WEEK


NITRATE CONCENTRATION, COLLECTOR L-2
NITRATE CONCENTRATION, in mg/liter
COLLECTION WEEK

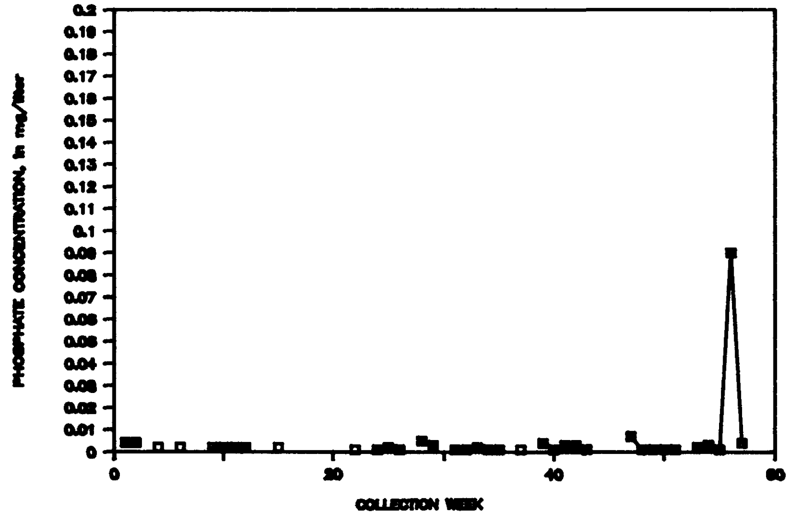

NITRATE CONCENTRATION, COLLECTOR L-3
NITRATE CONCENTRATION, in mg/liter
COLLECTION WEEK
0
20
40
60
0
1
2
3
4
5
6
7
8
9
10
11


NITRATE CONCENTRATION,NADP COLLECTOR
NITRATE CONCENTRATION, in mg/liter
COLLECTION WEEK
0
20
40
60
0
1
2
3
4
5
6
7
8
9
10
11

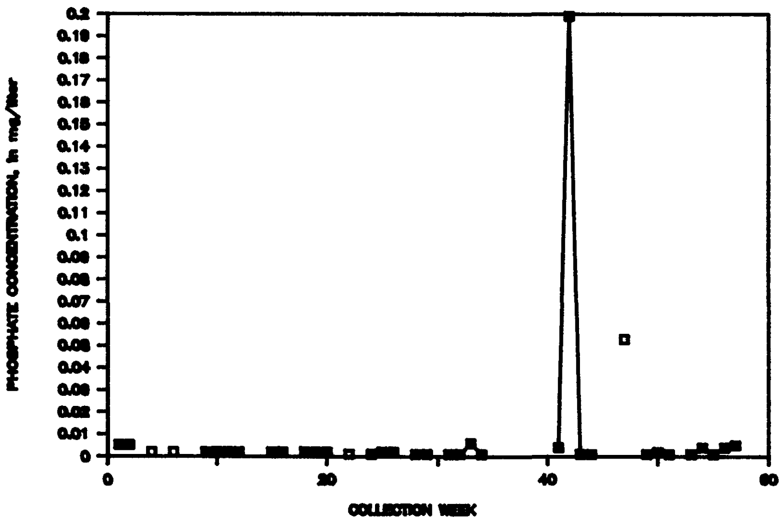
PHOSPHATE CONCENTRATION, COLLECTOR A–1



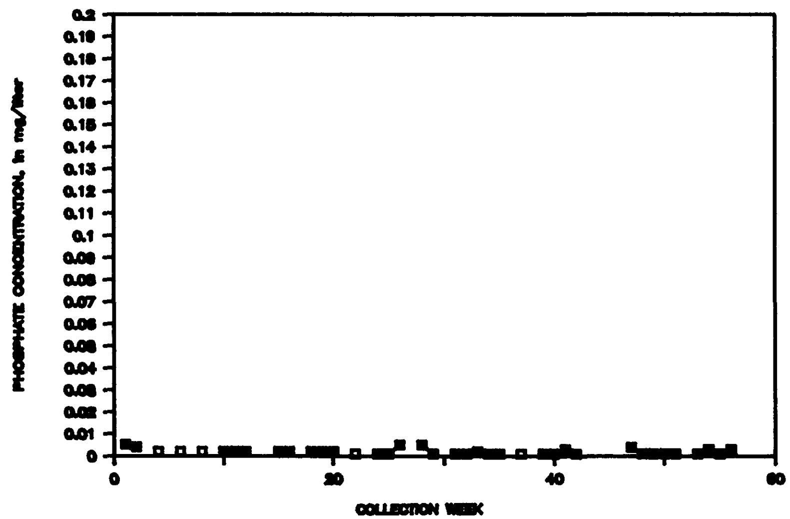
PHOSPHATE CONCENTRATION, COLLECTOR A–3



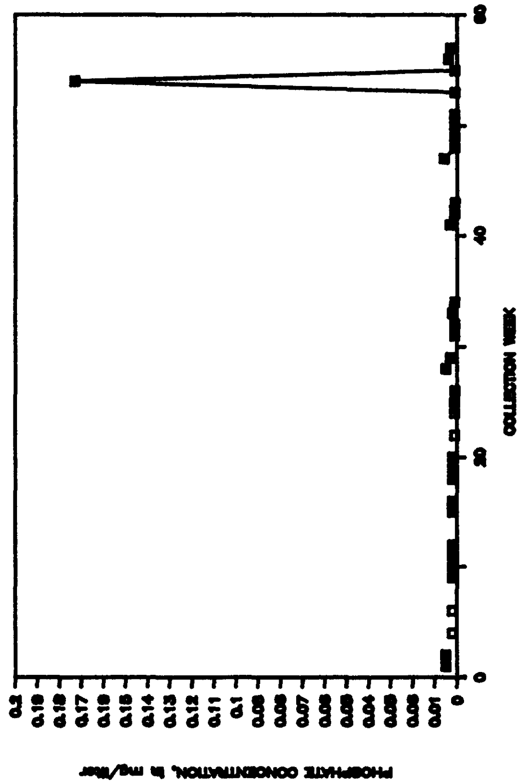
PHOSPHATE CONCENTRATION, COLLECTOR A–2



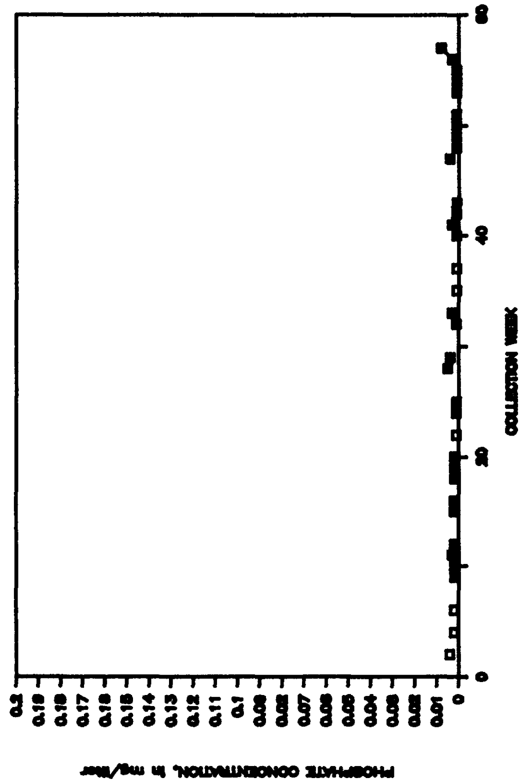
PHOSPHATE CONCENTRATION, COLLECTOR A–4



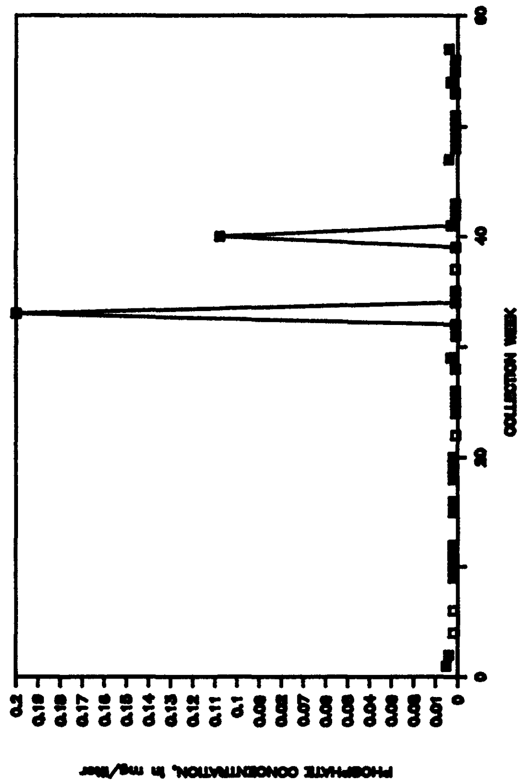
PHOSPHATE CONCENTRATION, COLLECTOR L–1



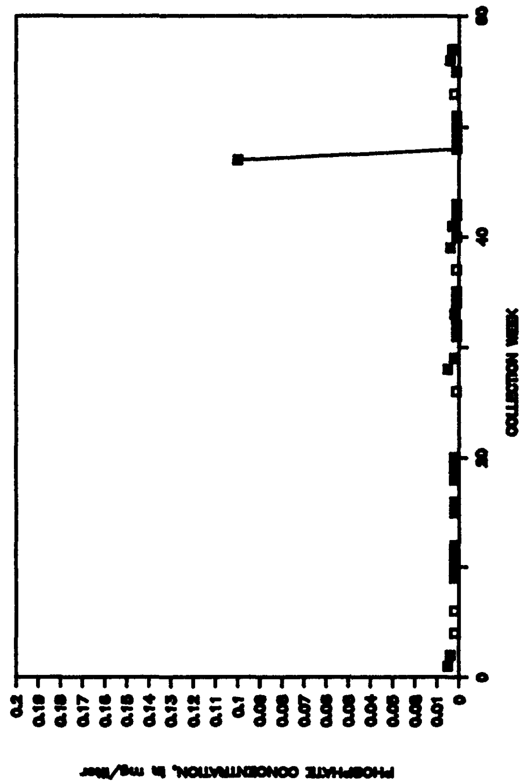
PHOSPHATE CONCENTRATION, COLLECTOR L–2

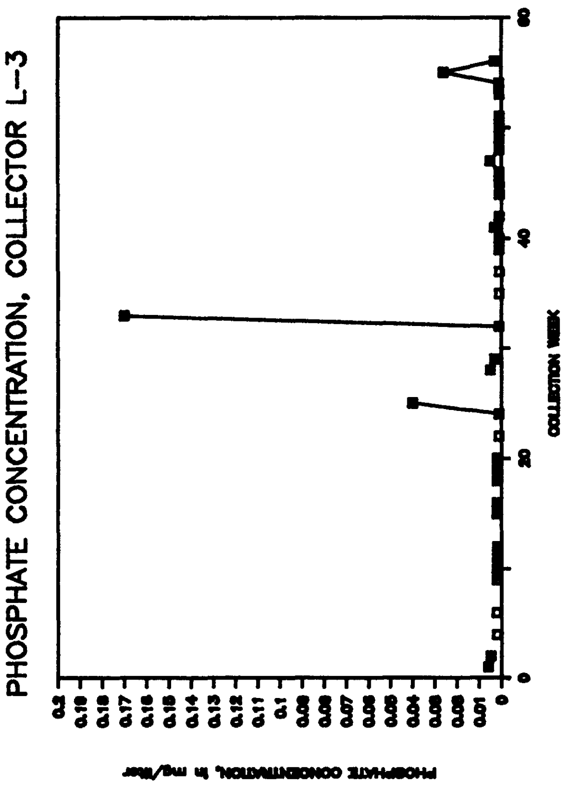


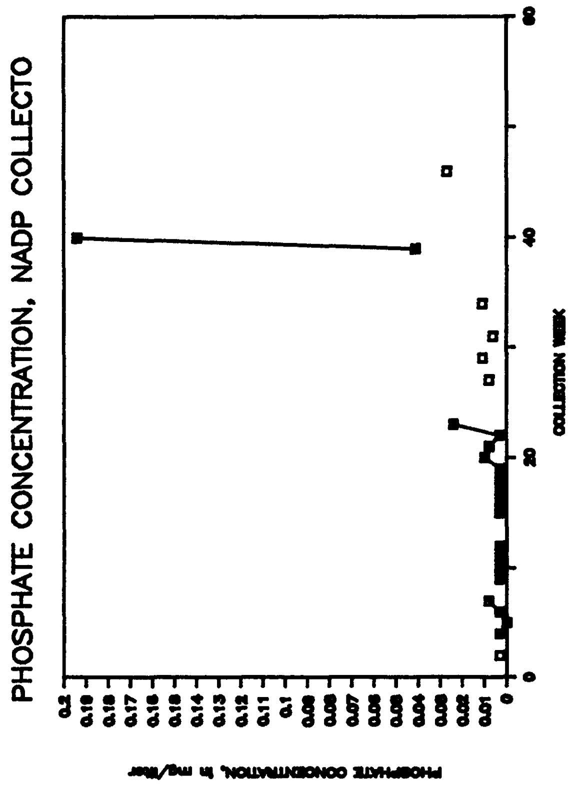
PHOSPHATE CONCENTRATION, COLLECTOR A–5

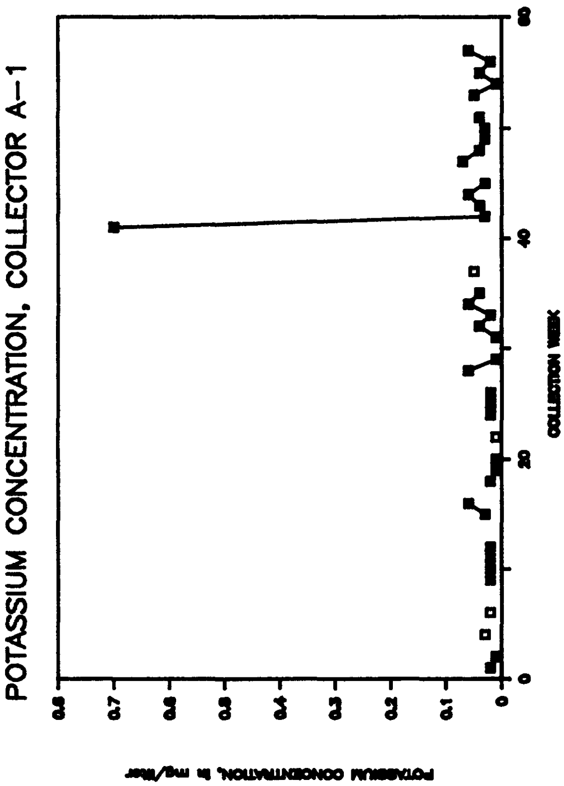


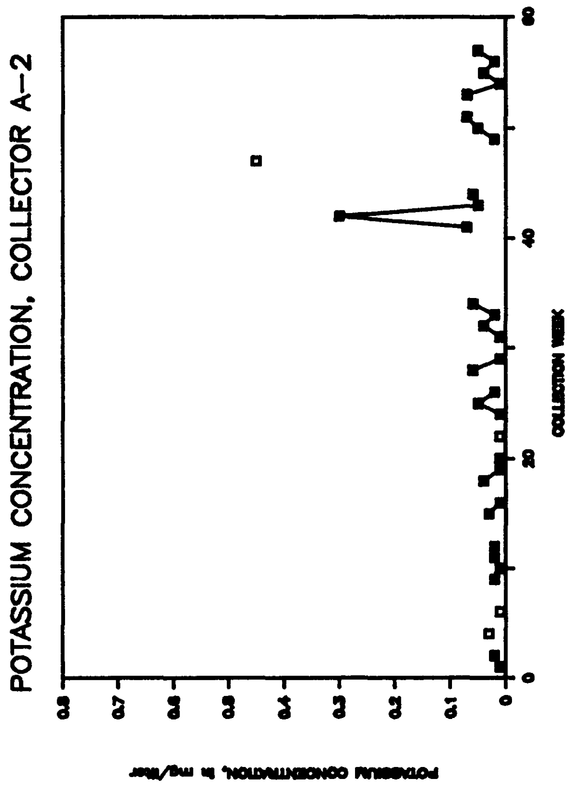
PHOSPHATE CONCENTRATION, COLLECTOR A–6

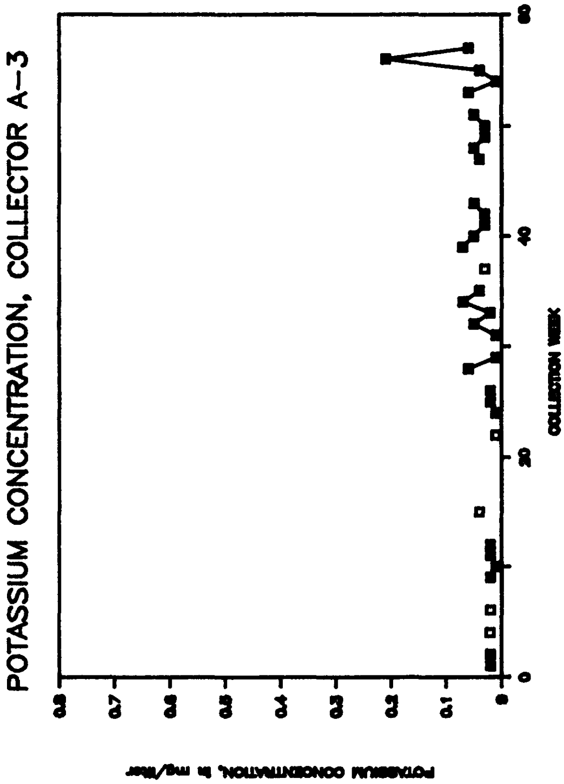


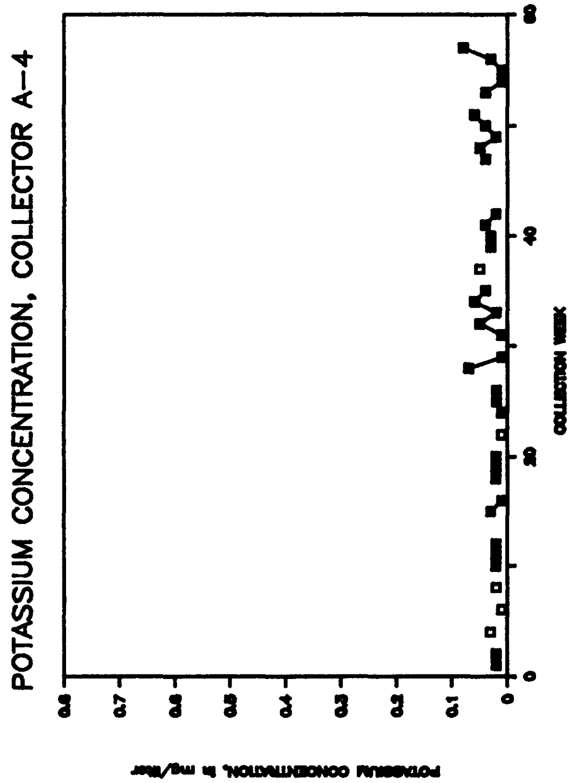

PHOSPHATE CONCENTRATION, COLLECTOR L-3
PHOSPHATE CONCENTRATION, in mg/liter
COLLECTION WEEK

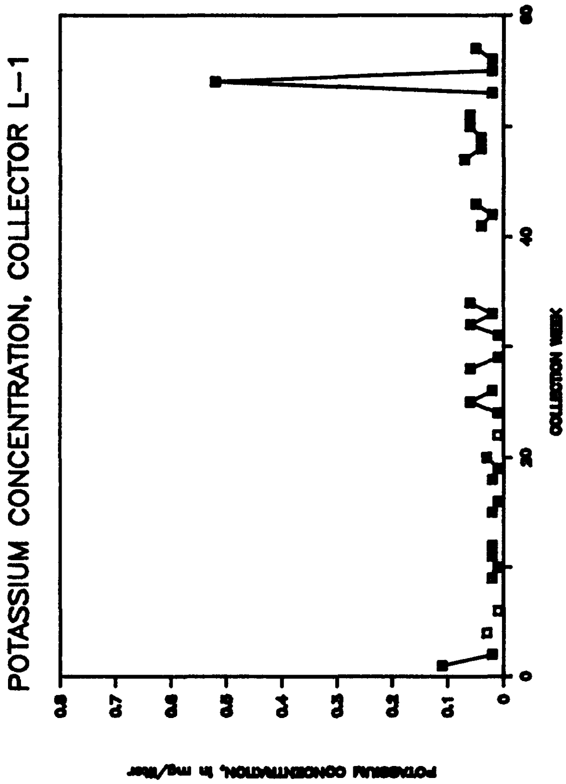

PHOSPHATE CONCENTRATION, NADP COLLECTO
PHOSPHATE CONCENTRATION, in mg/liter
COLLECTION WEEK

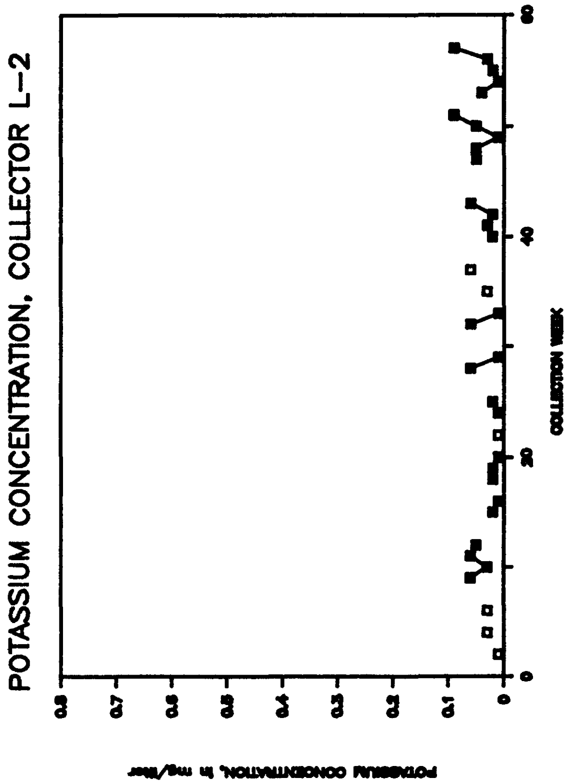

POTASSIUM CONCENTRATION, COLLECTOR A-1
POTASSIUM CONCENTRATION, in mg/liter
COLLECTION WEEK

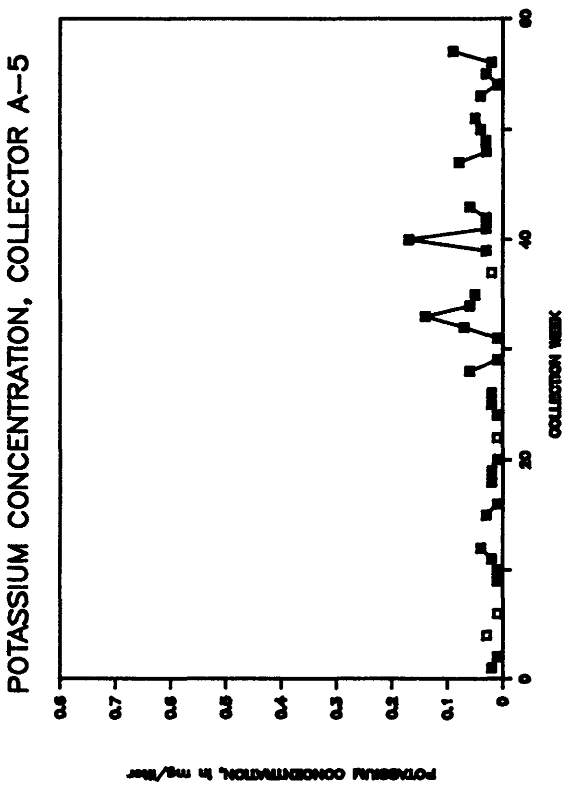

POTASSIUM CONCENTRATION, COLLECTOR A-2
POTASSIUM CONCENTRATION, in mg/liter
COLLECTION WEEK

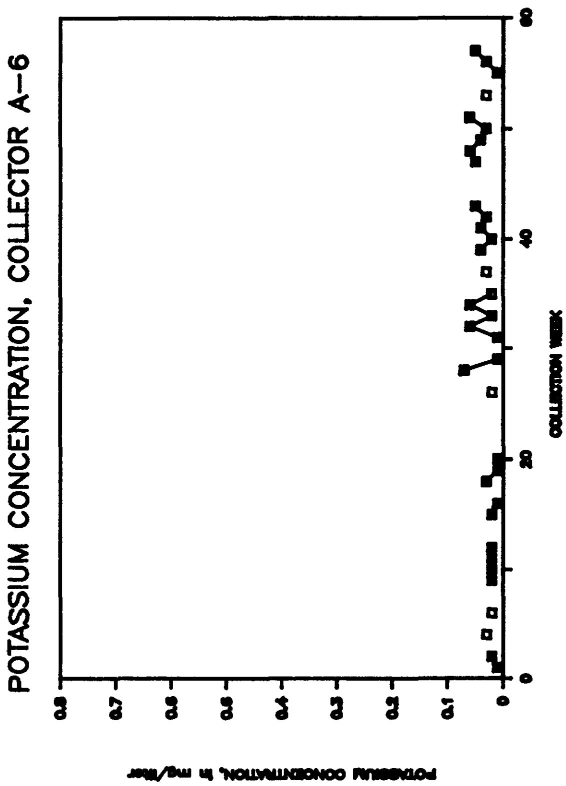

POTASSIUM CONCENTRATION, COLLECTOR A-3
POTASSIUM CONCENTRATION, in mg/liter
COLLECTION WEEK

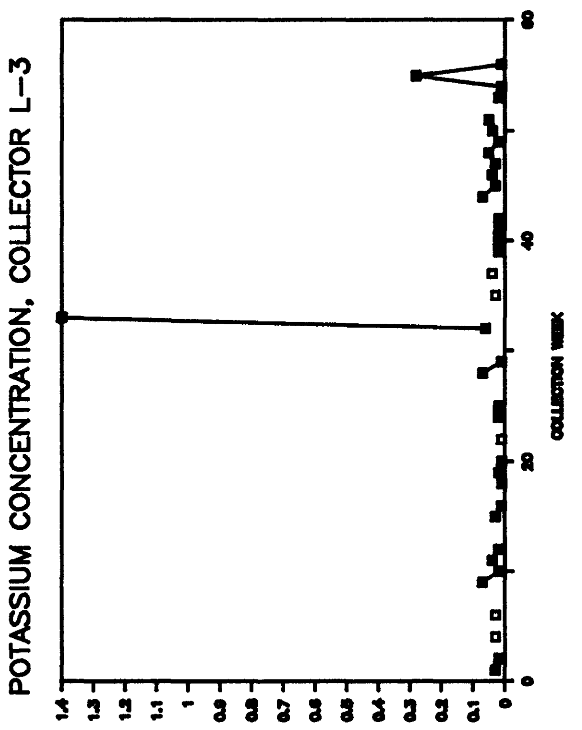

POTASSIUM CONCENTRATION, COLLECTOR A-4
POTASSIUM CONCENTRATION, in mg/liter
COLLECTION WEEK

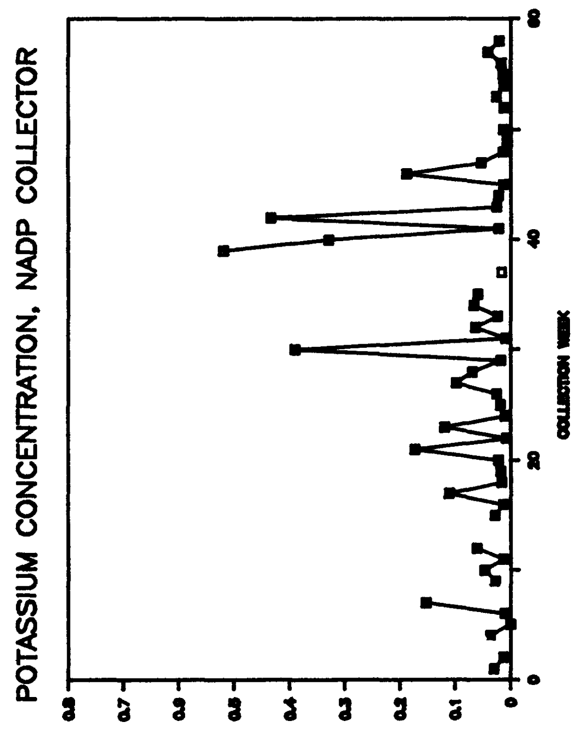

POTASSIUM CONCENTRATION, COLLECTOR L–1
POTASSIUM CONCENTRATION, in mg/liter
COLLECTION WEEK


POTASSIUM CONCENTRATION, COLLECTOR L–2
POTASSIUM CONCENTRATION, in mg/liter
COLLECTION WEEK

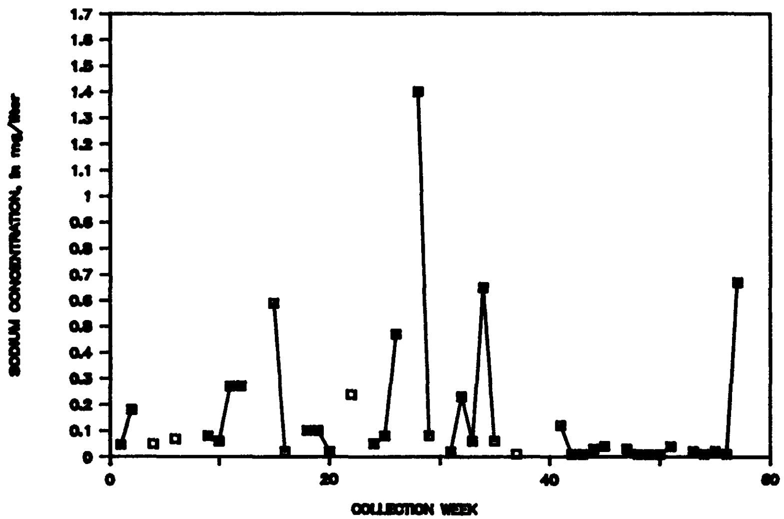

POTASSIUM CONCENTRATION, COLLECTOR A–5
POTASSIUM CONCENTRATION, in mg/liter
COLLECTION WEEK


POTASSIUM CONCENTRATION, COLLECTOR A–6
POTASSIUM CONCENTRATION, in mg/liter
COLLECTION WEEK

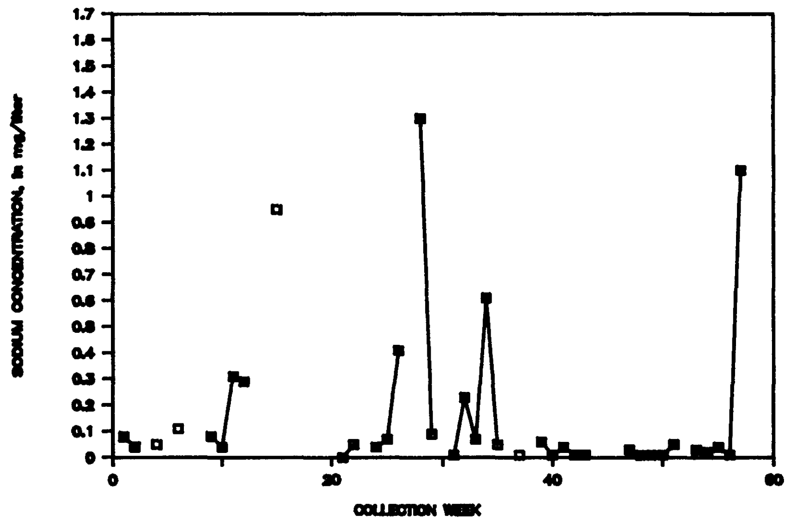

POTASSIUM CONCENTRATION, COLLECTOR L–3
COLLECTION WEEK
POTASSIUM CONCENTRATION, in mg/liter


POTASSIUM CONCENTRATION, NADP COLLECTOR
COLLECTION WEEK
POTASSIUM CONCENTRATION, in mg/liter

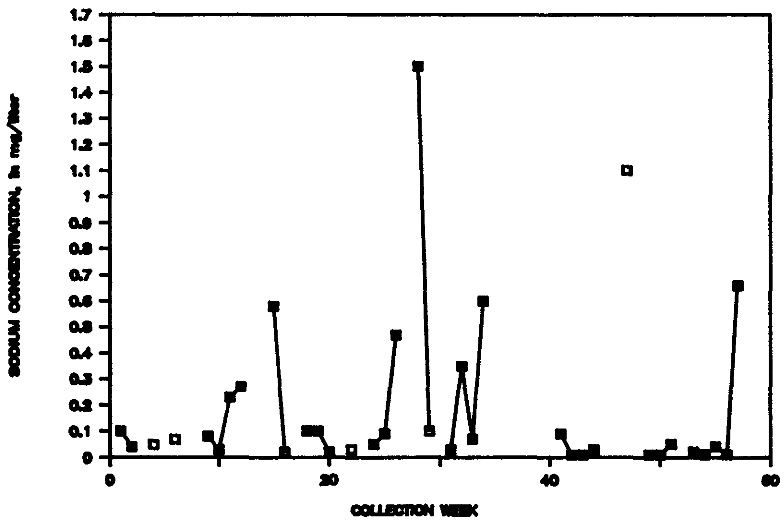
SODIUM CONCENTRATION, COLLECTOR A-1



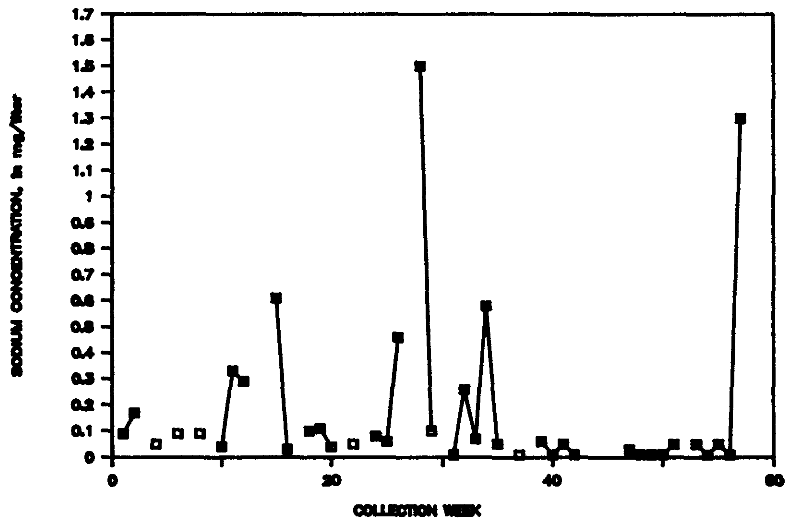
SODIUM CONCENTRATION, COLLECTOR A-3

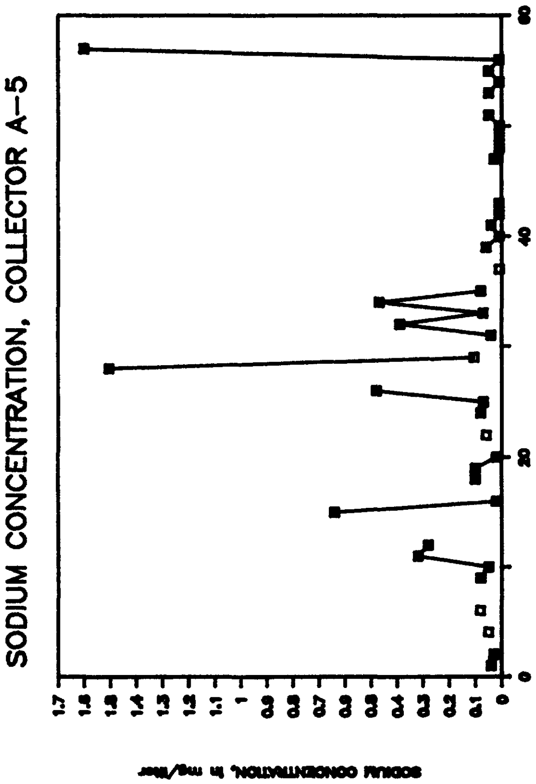


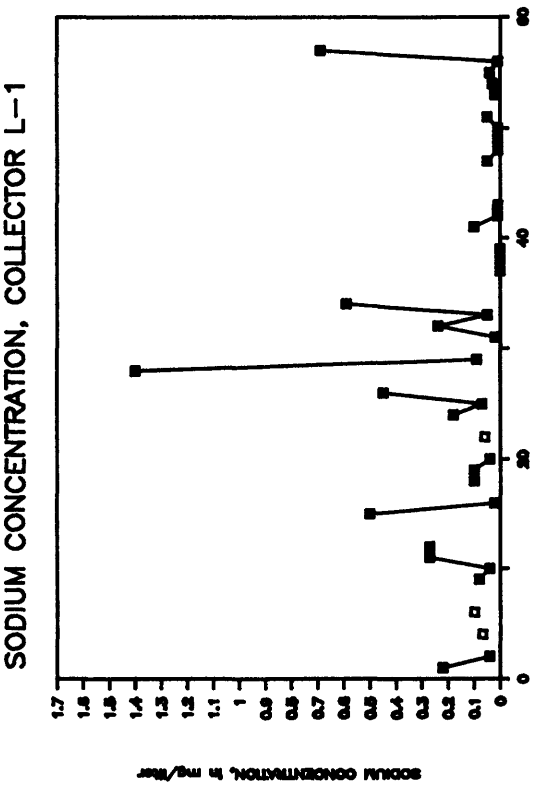
SODIUM CONCENTRATION, COLLECTOR A-2

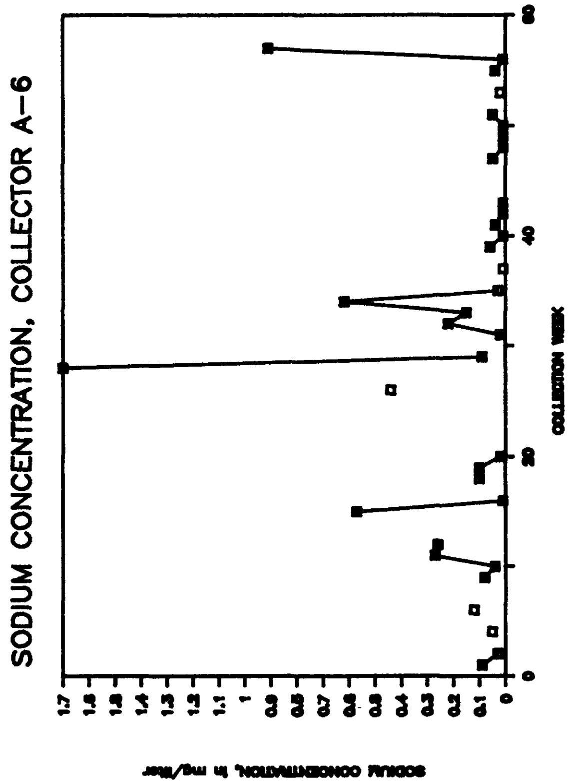


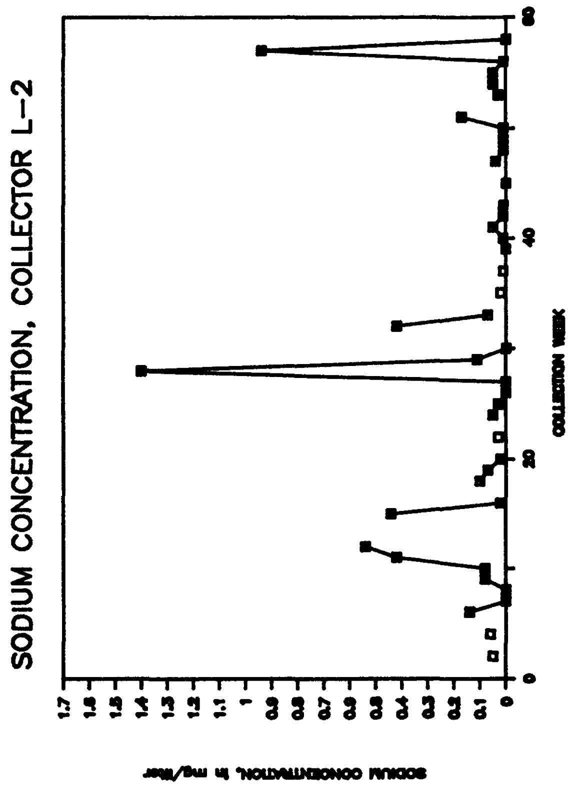
SODIUM CONCENTRATION, COLLECTOR A-4

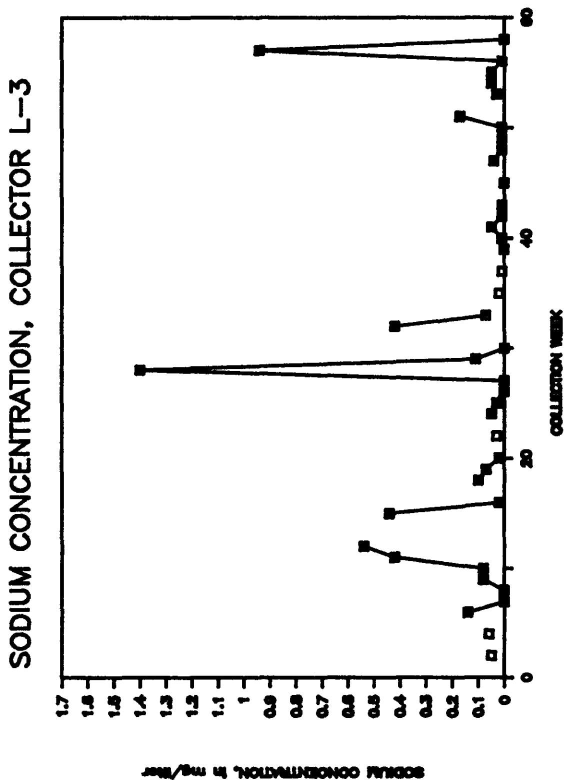


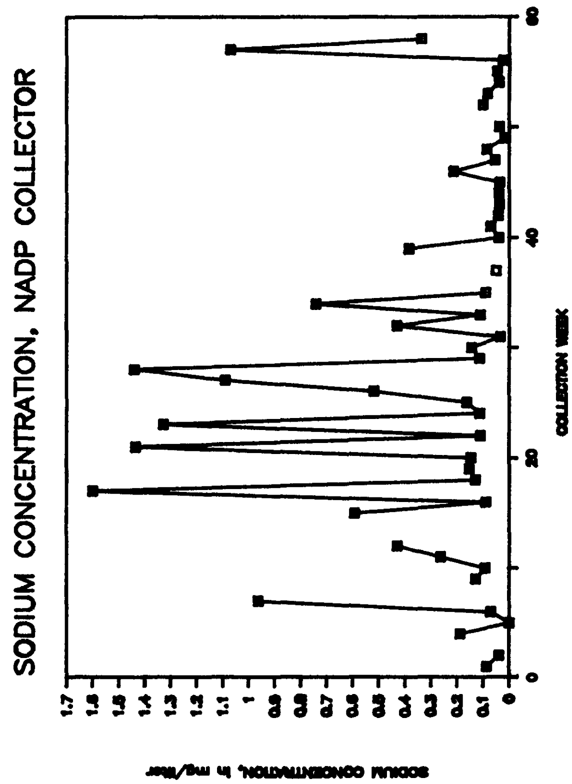

SODIUM CONCENTRATION, COLLECTOR A–5
SODIUM CONCENTRATION, in mg/liter
COLLECTION WEEK

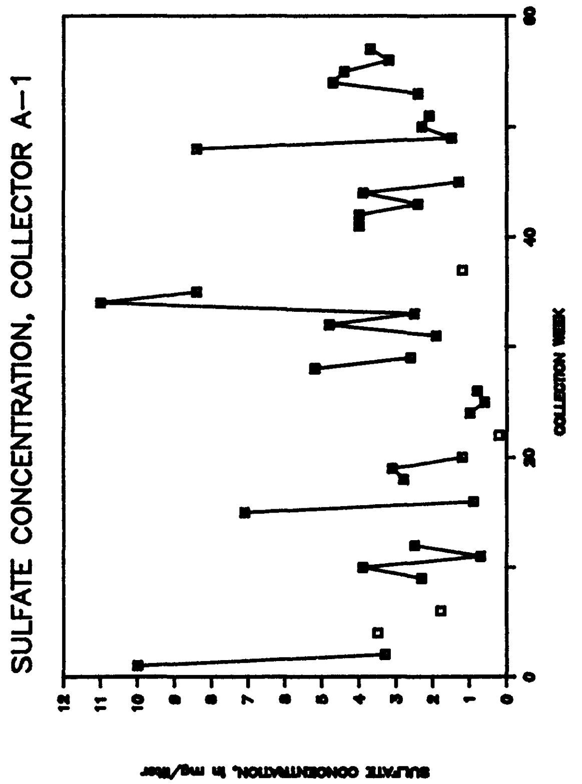

SODIUM CONCENTRATION, COLLECTOR L–1
SODIUM CONCENTRATION, in mg/liter
COLLECTION WEEK

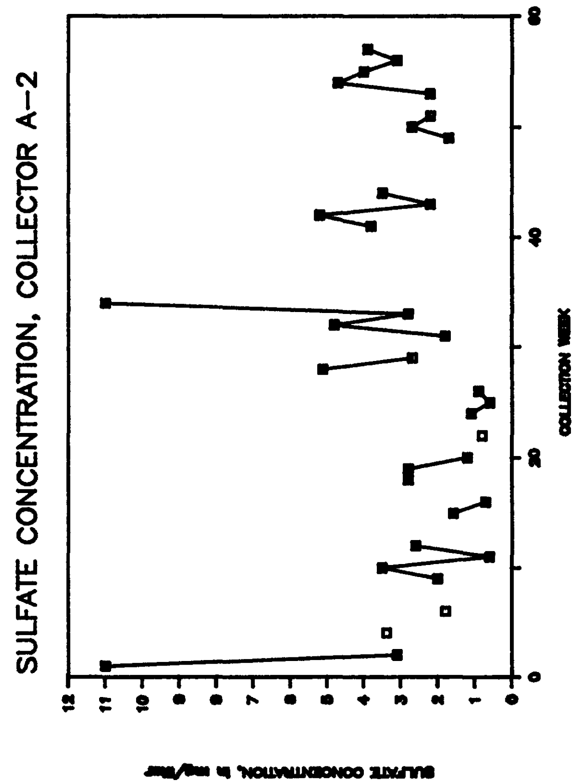

SODIUM CONCENTRATION, COLLECTOR A–6
SODIUM CONCENTRATION, in mg/liter
COLLECTION WEEK

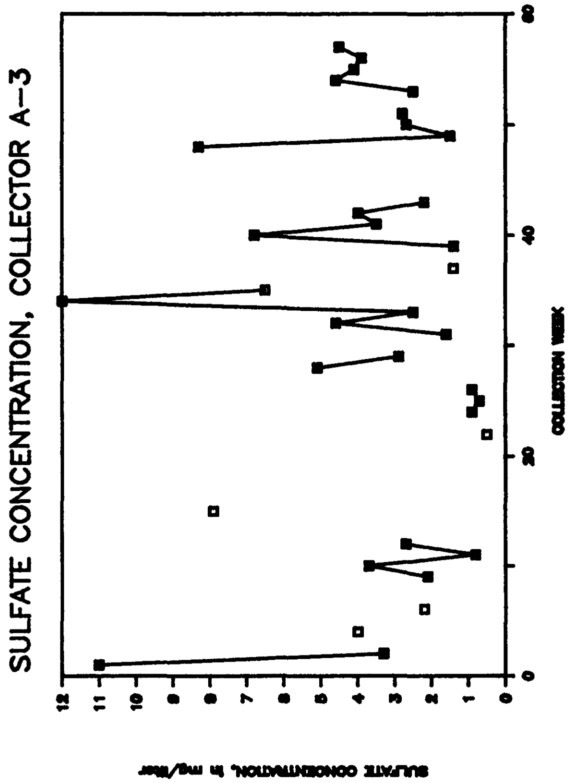

SODIUM CONCENTRATION, COLLECTOR L–2
SODIUM CONCENTRATION, in mg/liter
COLLECTION WEEK

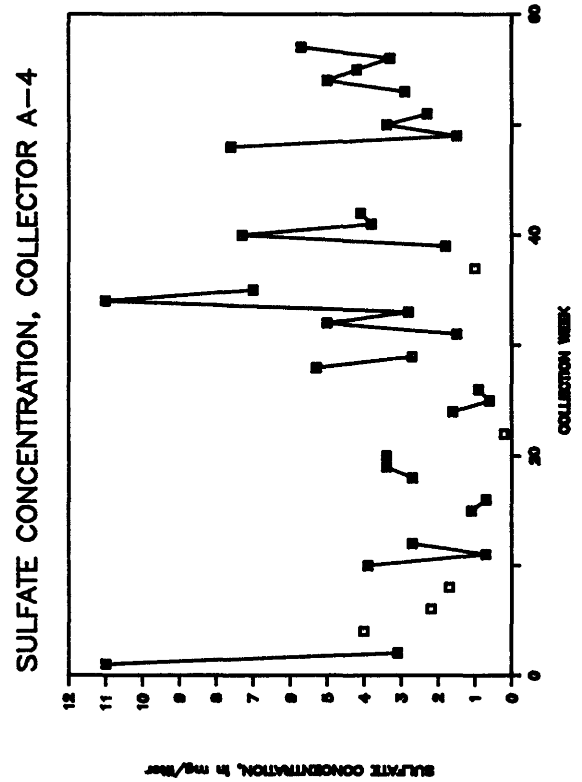

SODIUM CONCENTRATION, COLLECTOR L–3
SODIUM CONCENTRATION, in mg/liter
COLLECTION WEEK


SODIUM CONCENTRATION, NADP COLLECTOR
SODIUM CONCENTRATION, in mg/liter
COLLECTION WEEK

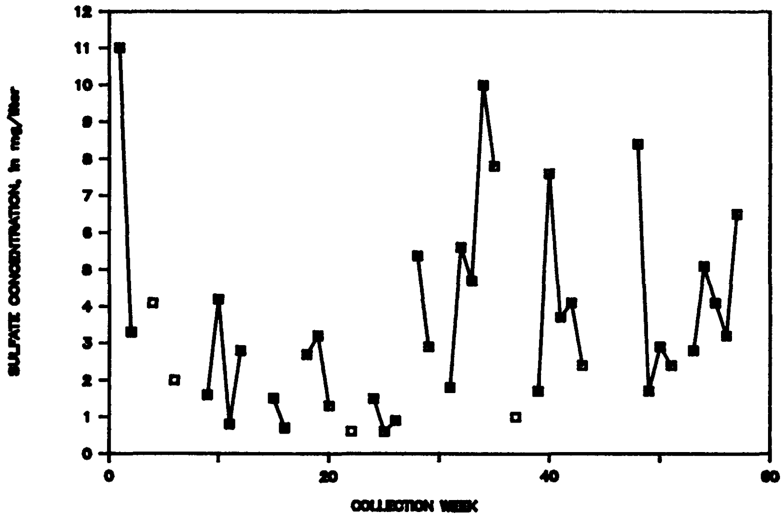

SULFATE CONCENTRATION, COLLECTOR A-1
SULFATE CONCENTRATION, in mg/liter
COLLECTION WEEK


SULFATE CONCENTRATION, COLLECTOR A-2
SULFATE CONCENTRATION, in mg/liter
COLLECTION WEEK

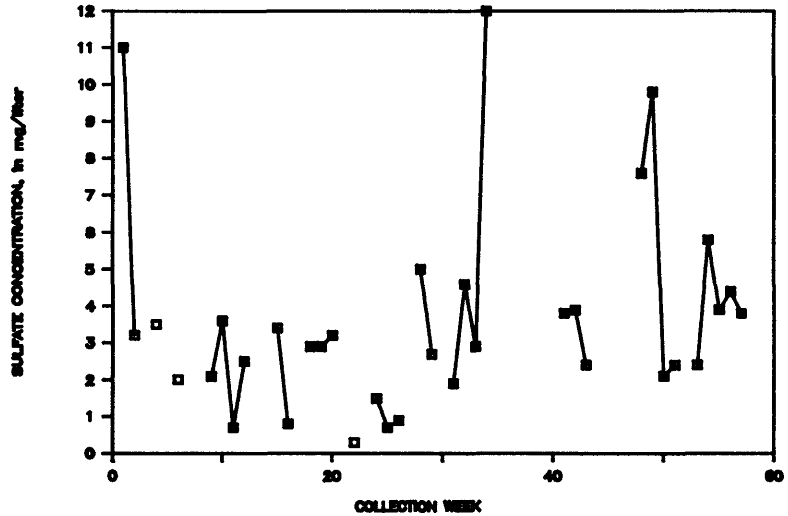

SULFATE CONCENTRATION, COLLECTOR A-3
SULFATE CONCENTRATION, in mg/liter
COLLECTION WEEK


SULFATE CONCENTRATION, COLLECTOR A-4
SULFATE CONCENTRATION, in mg/liter
COLLECTION WEEK

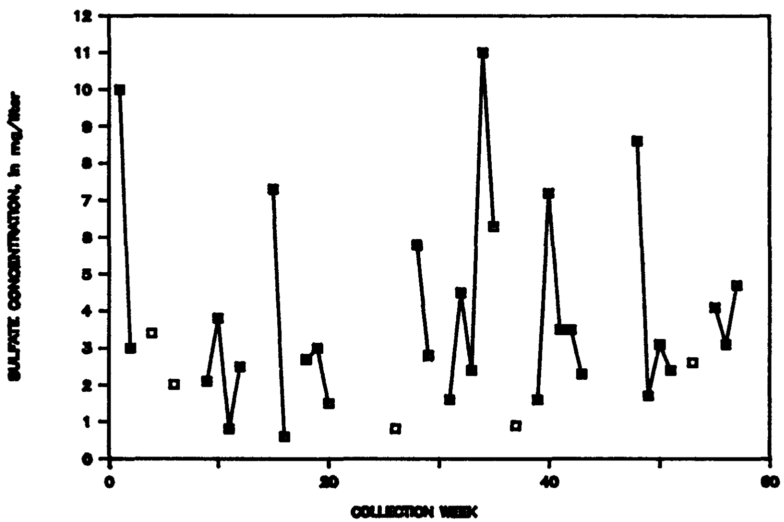
SULFATE CONCENTRATION, COLLECTOR A-5



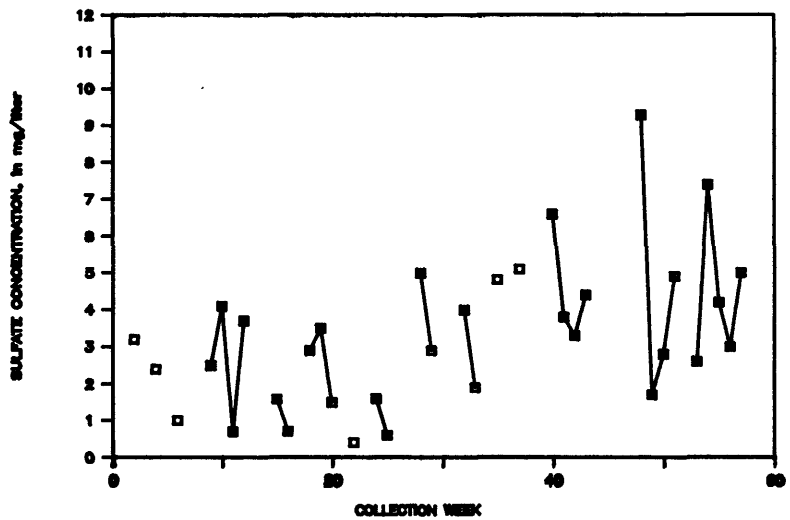
SULFATE CONCENTRATION, COLLECTOR L-1

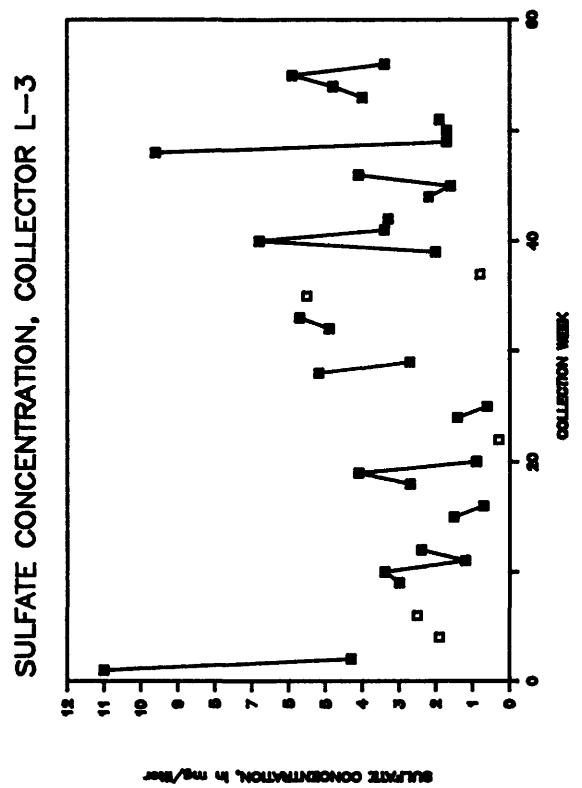


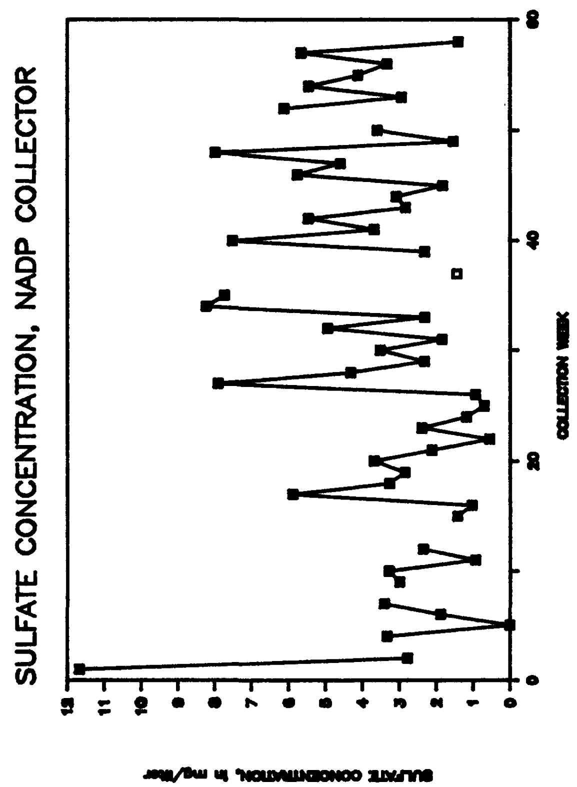
SULFATE CONCENTRATION, COLLECTOR A-6



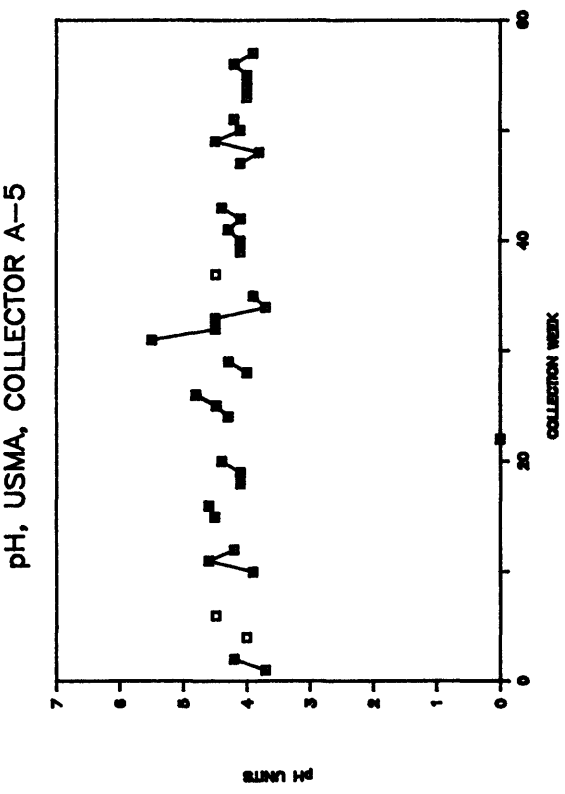
SULFATE CONCENTRATION, COLLECTOR L-2

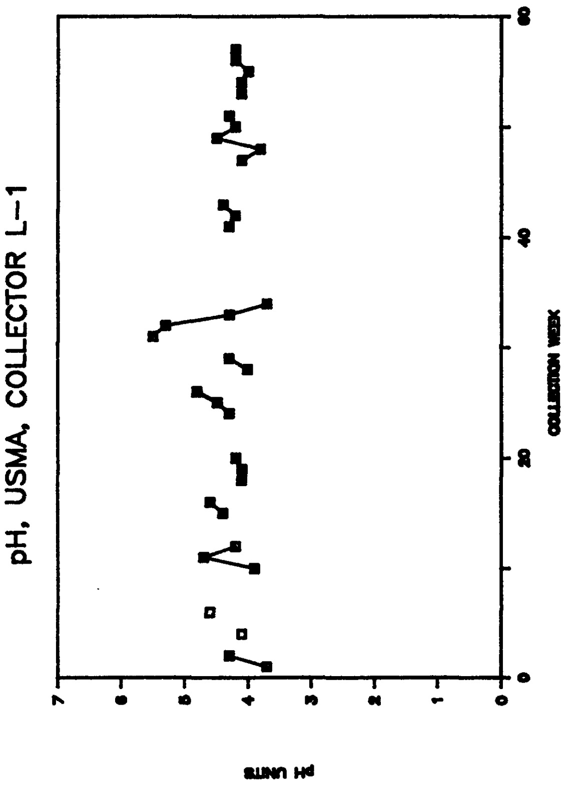


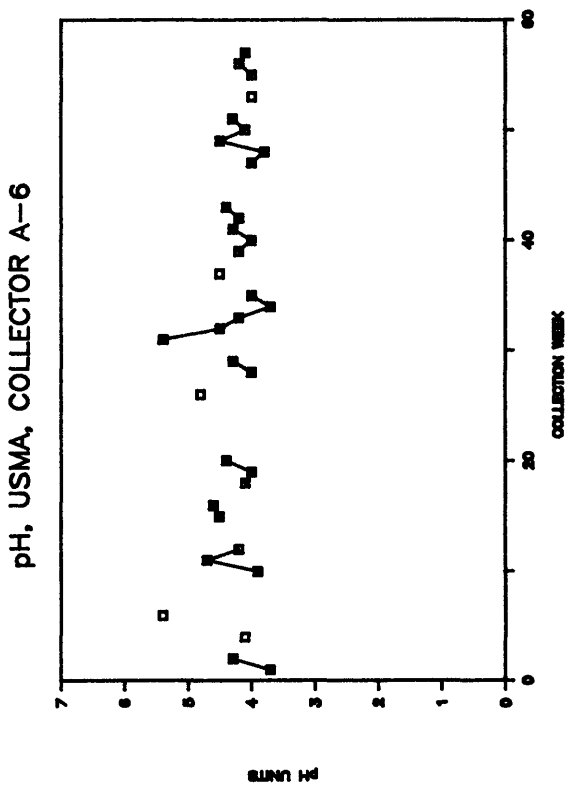

SULFATE CONCENTRATION, COLLECTOR L-3
SULFATE CONCENTRATION, in mg/liter
COLLECTION WEEK
0
20
40
60
0
1
2
3
4
5
6
7
8
9
10
11
12

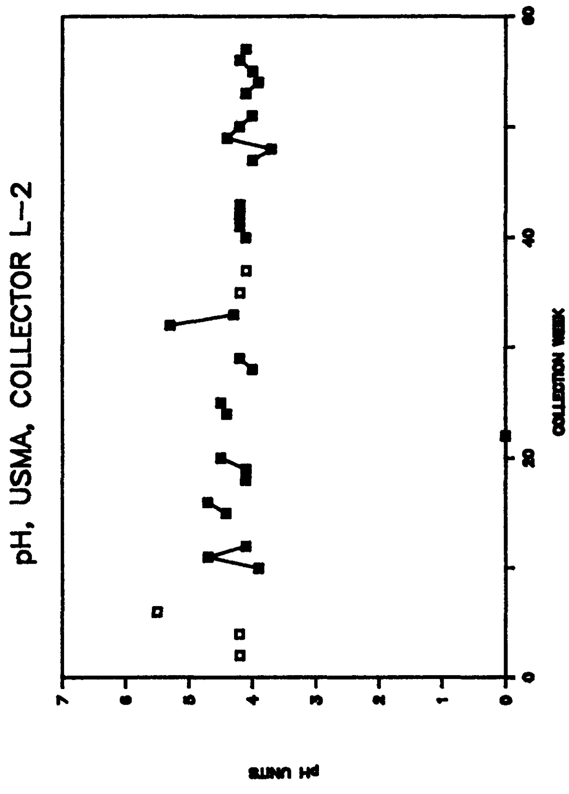

SULFATE CONCENTRATION, NADP COLLECTOR
SULFATE CONCENTRATION, in mg/liter
COLLECTION WEEK
0
20
40
60
0
1
2
3
4
5
6
7
8
9
10
11
12

APPENDIX D: Time Plots of pH and Specific conductance

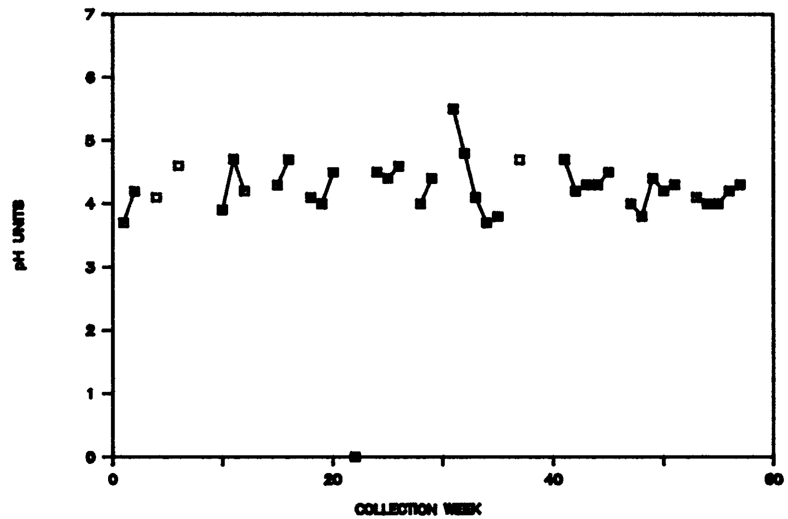

pH, USMA, COLLECTOR A–5
pH UNITS
COLLECTION WEEK


pH, USMA, COLLECTOR L–1
pH UNITS
COLLECTION WEEK

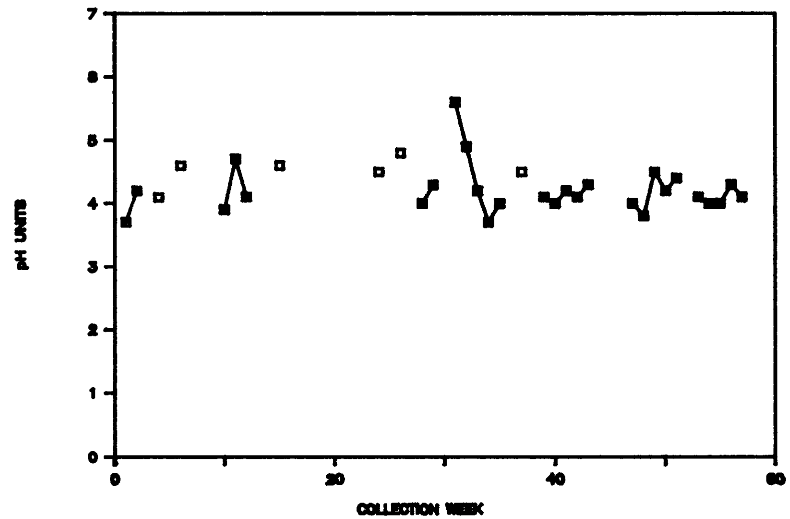

pH, USMA, COLLECTOR A–6
pH UNITS
COLLECTION WEEK


pH, USMA, COLLECTOR L–2
pH UNITS
COLLECTION WEEK

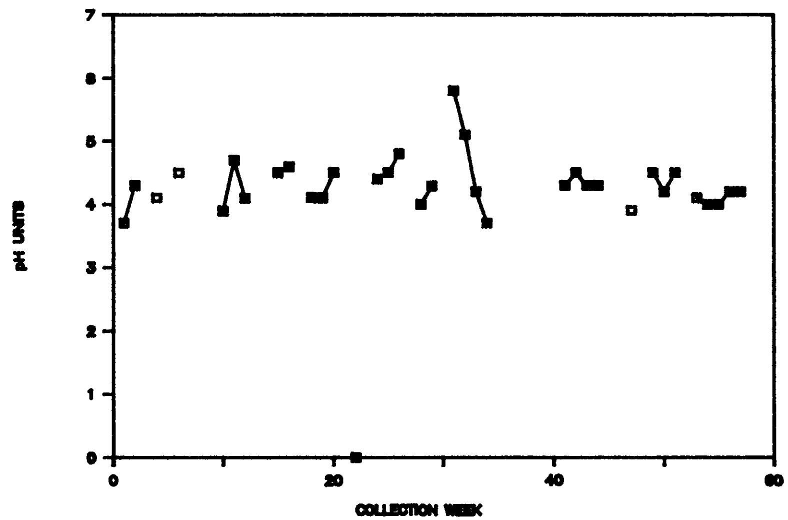
pH, USMA, COLLECTOR A-1



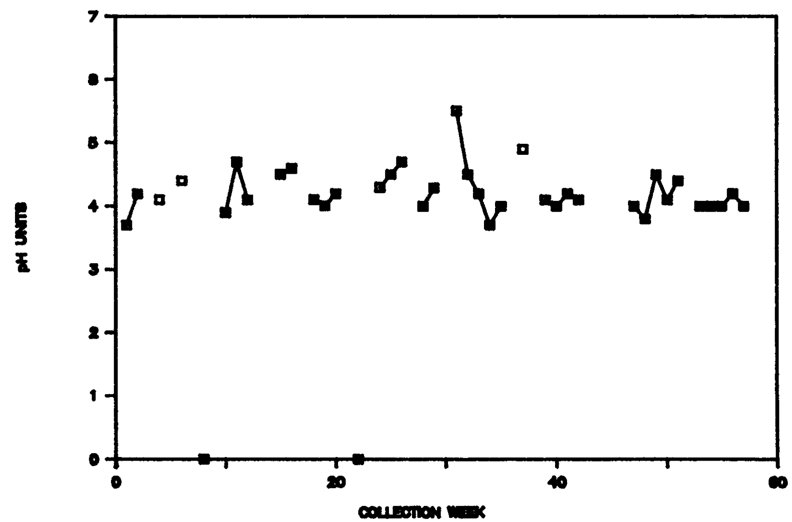
pH, USMA, COLLECTOR A-3

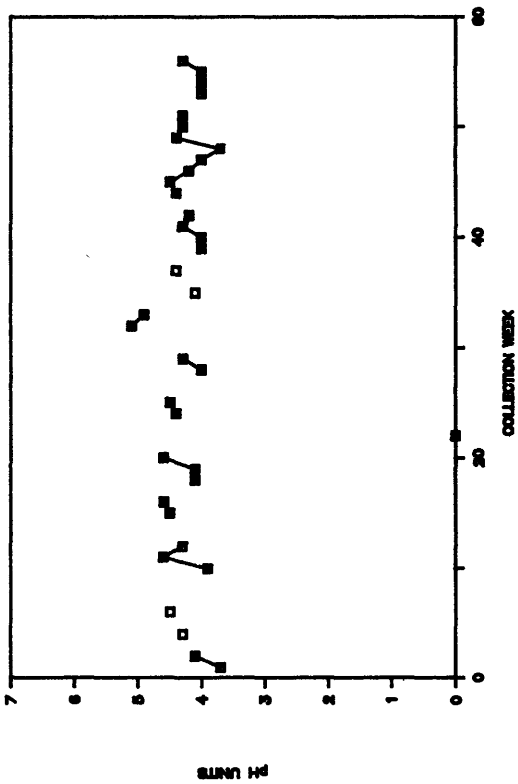


pH, USMA, COLLECTOR A-2

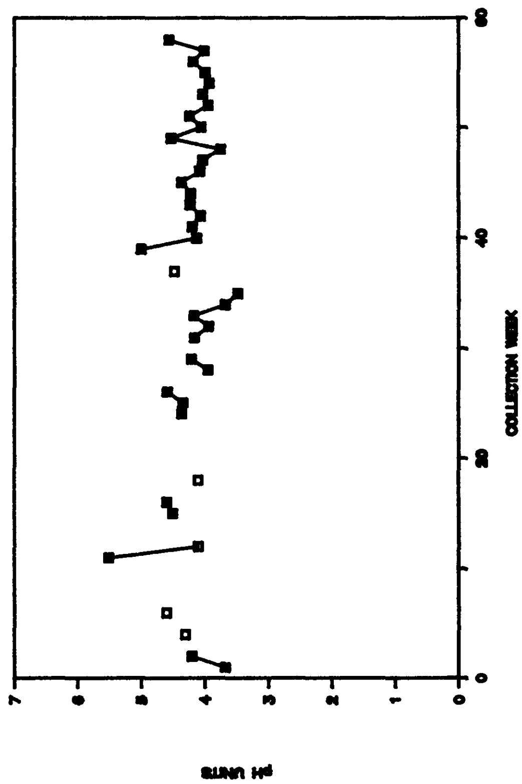


pH, USMA, COLLECTOR A-4



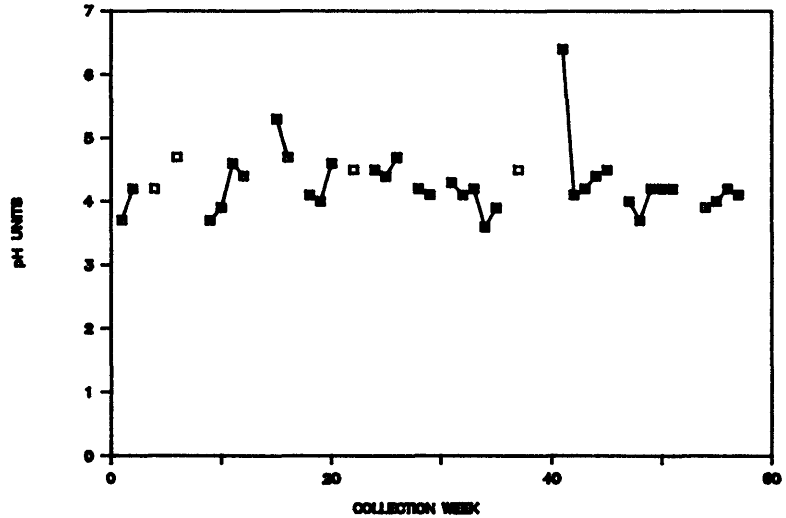


pH, USMA, COLLECTOR L-3

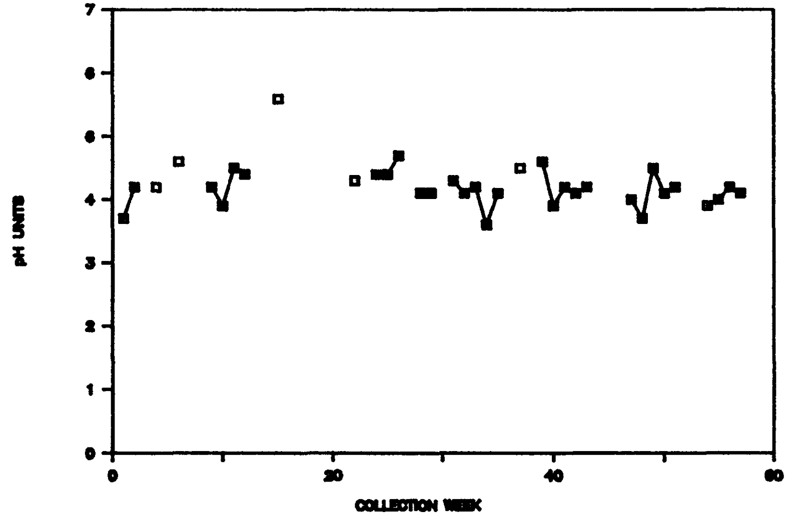


pH, USMA, NADP COLLECTOR

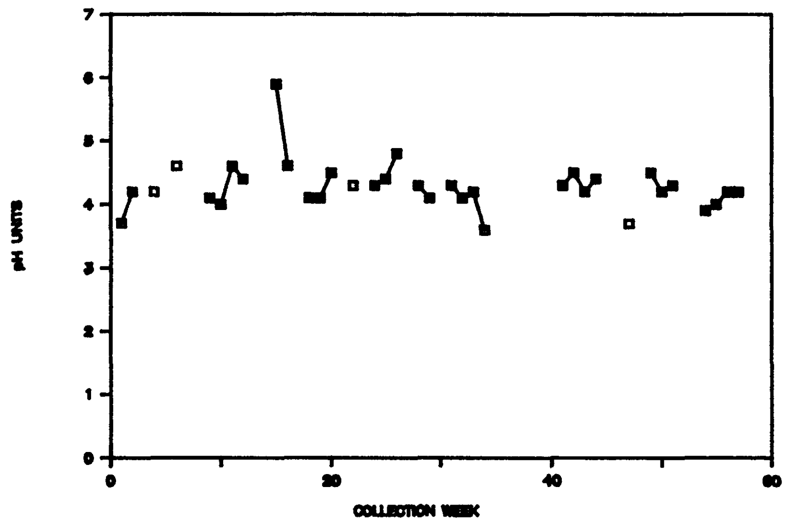
pH, USGS, COLLECTOR A–1



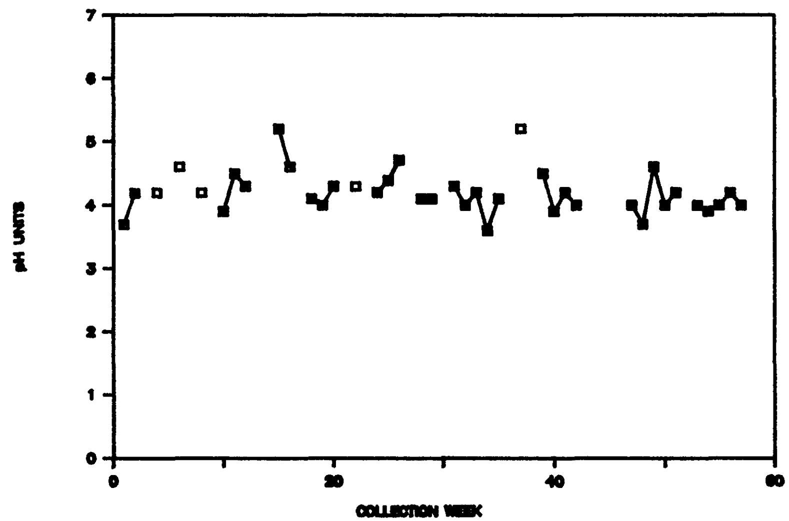
pH, USGS, COLLECTOR A–3

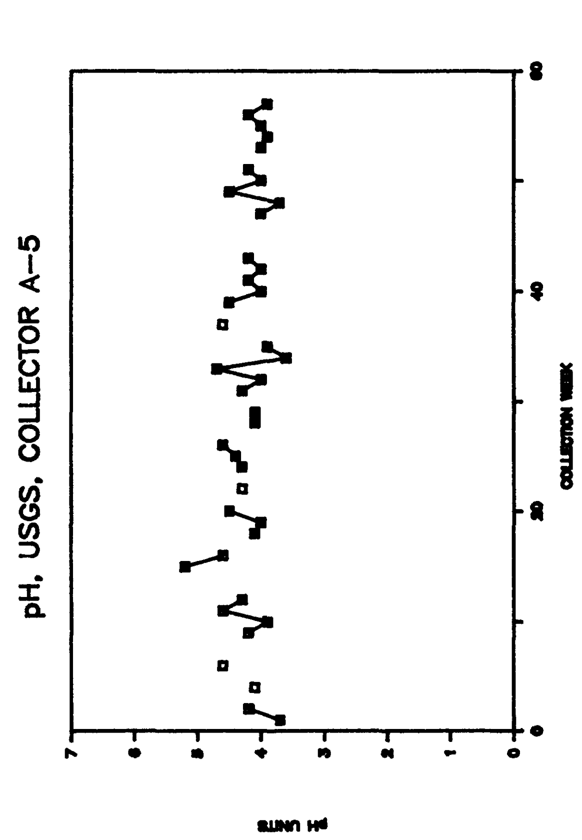


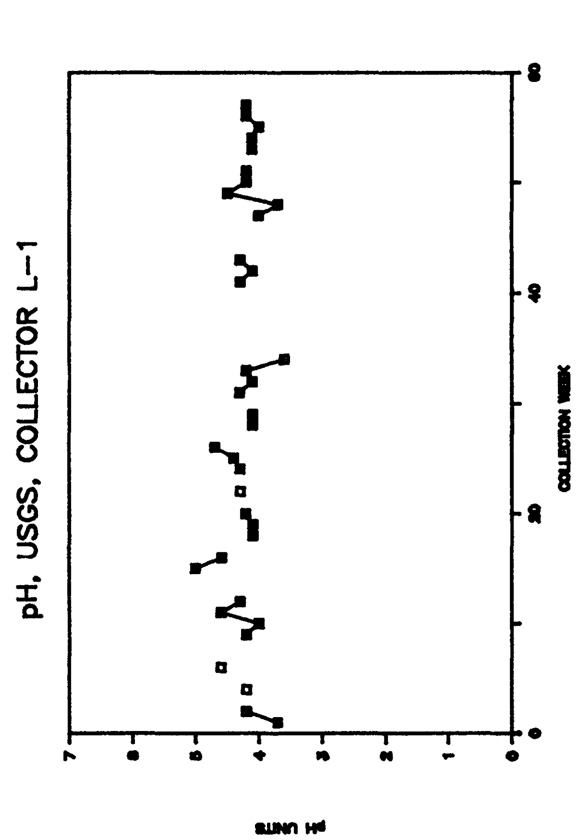
pH, USGS, COLLECTOR A–2

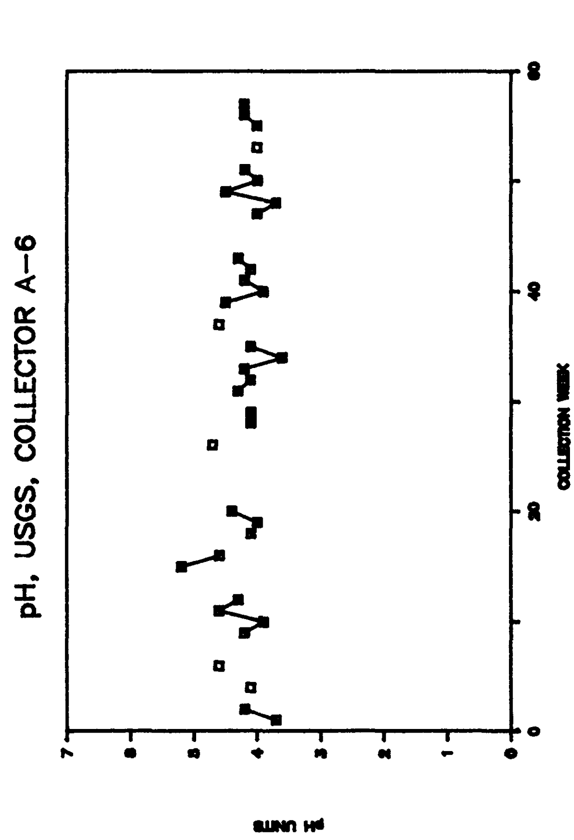


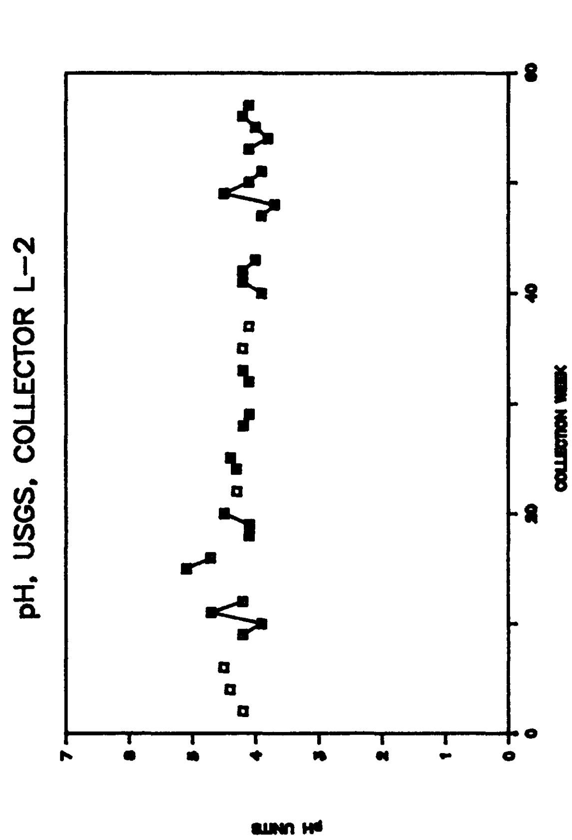
pH, USGS, COLLECTOR A–4

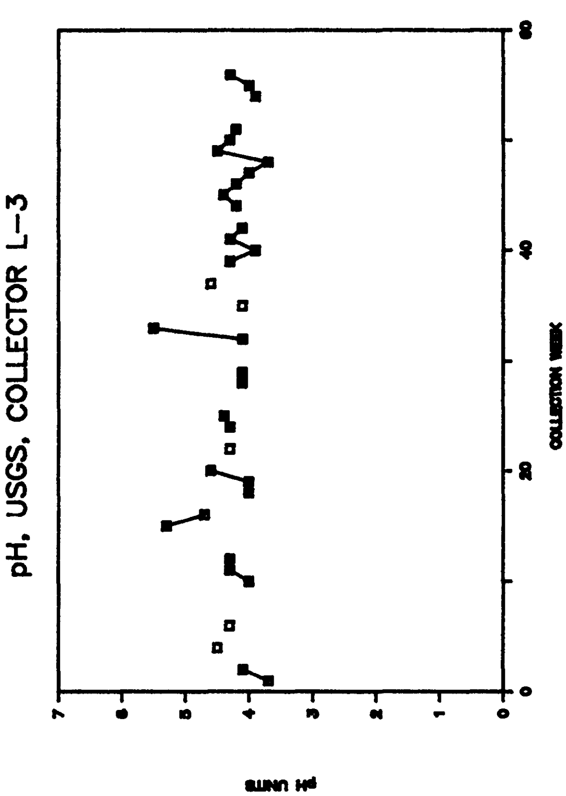


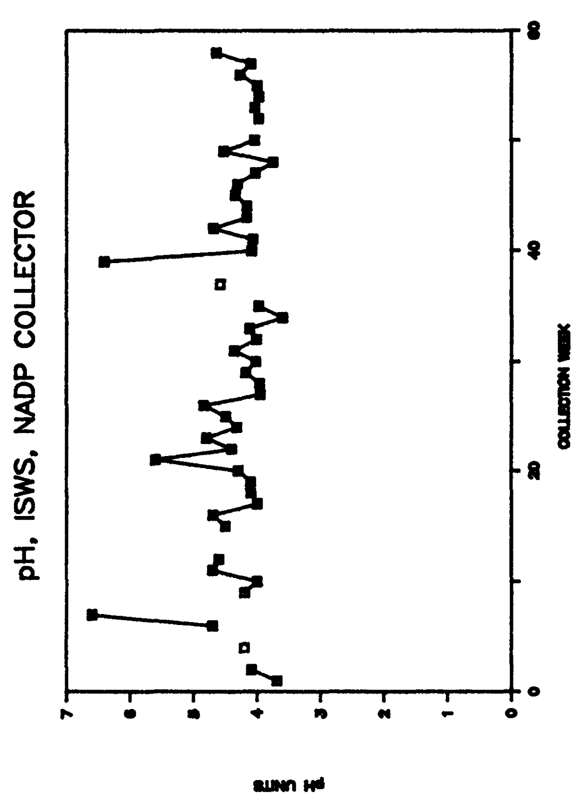

pH, USGS, COLLECTOR A-5
pH UNITS
COLLECTION WEEK

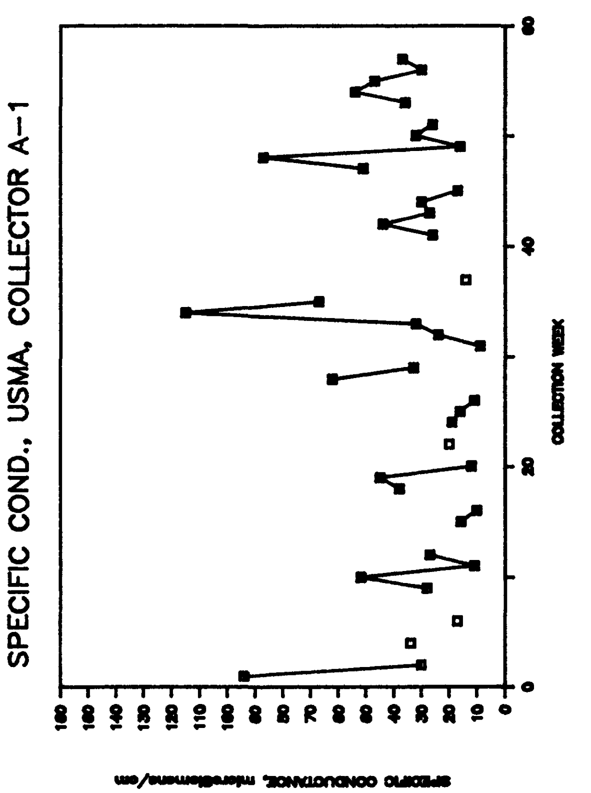

pH, USGS, COLLECTOR L-1
pH UNITS
COLLECTION WEEK

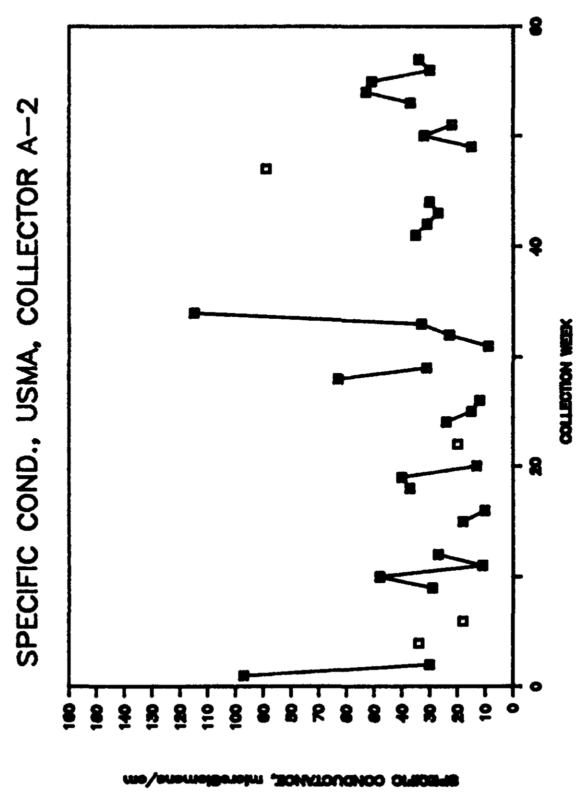

pH, USGS, COLLECTOR A-6
pH UNITS
COLLECTION WEEK

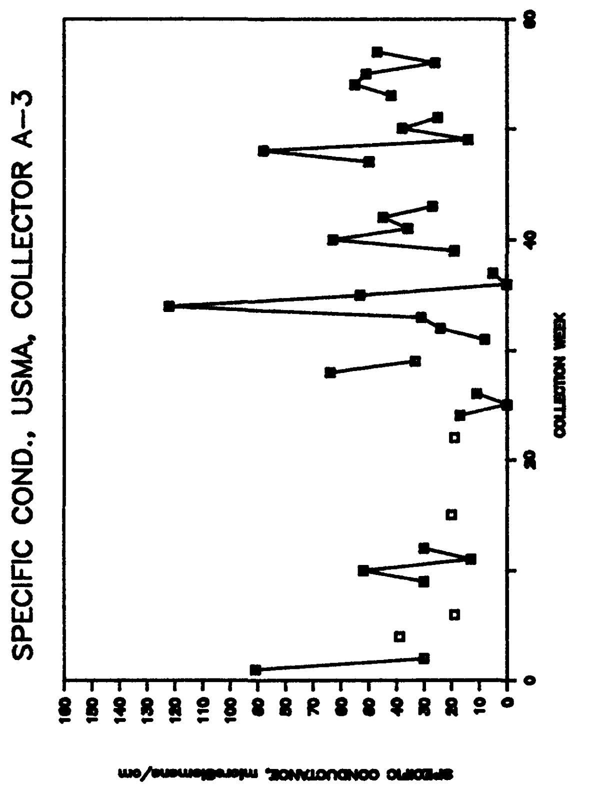

pH, USGS, COLLECTOR L-2
pH UNITS
COLLECTION WEEK

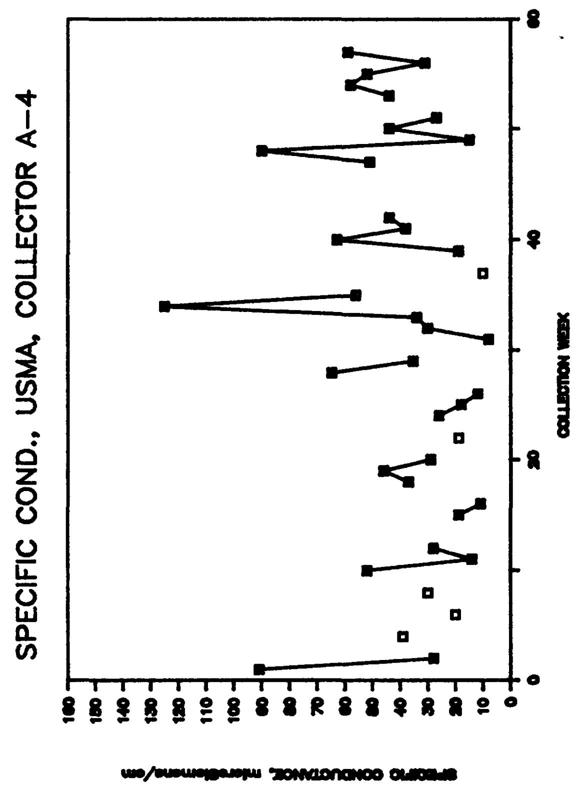

pH, USGS, COLLECTOR L-3
pH UNITS
COLLECTION WEEK
0
1
2
3
4
5
6
7
20
40
60

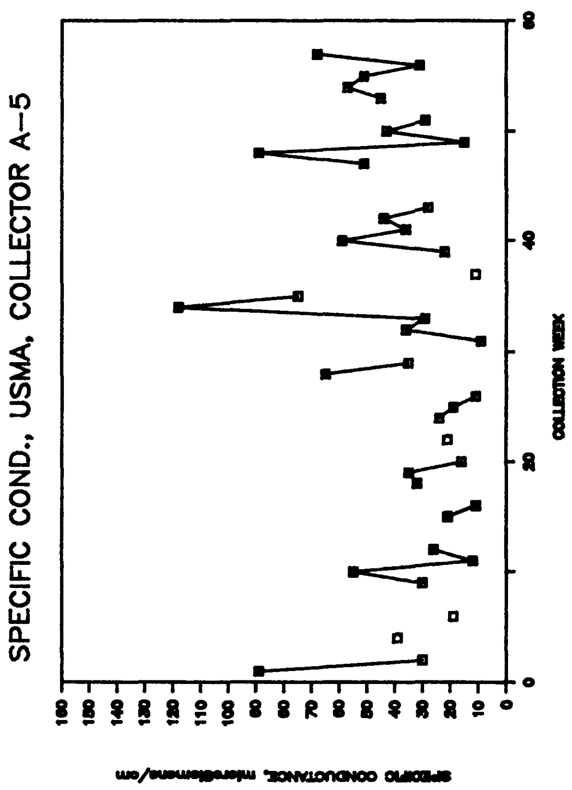

pH, ISWS, NADP COLLECTOR
pH UNITS
COLLECTION WEEK
0
1
2
3
4
5
6
7
20
40
60

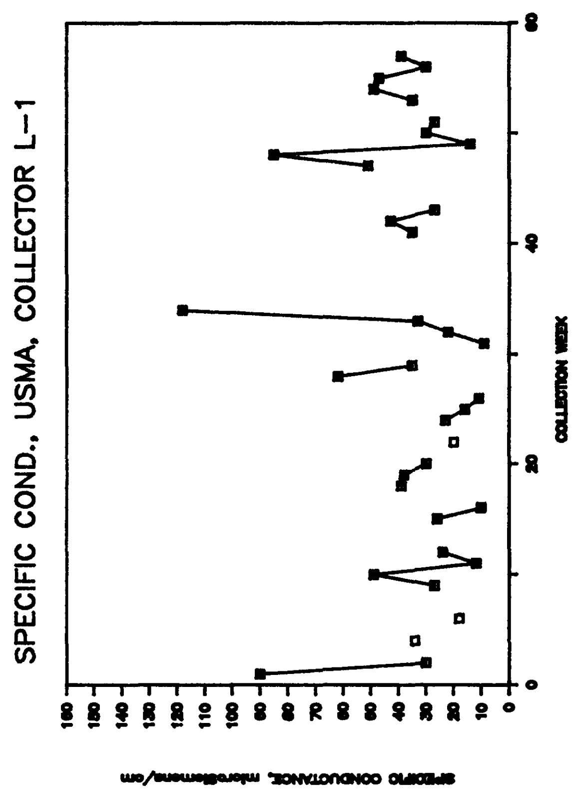

SPECIFIC COND., USMA, COLLECTOR A-1
SPECIFIC CONDUCTANCE, microSiemens/cm
COLLECTION WEEK

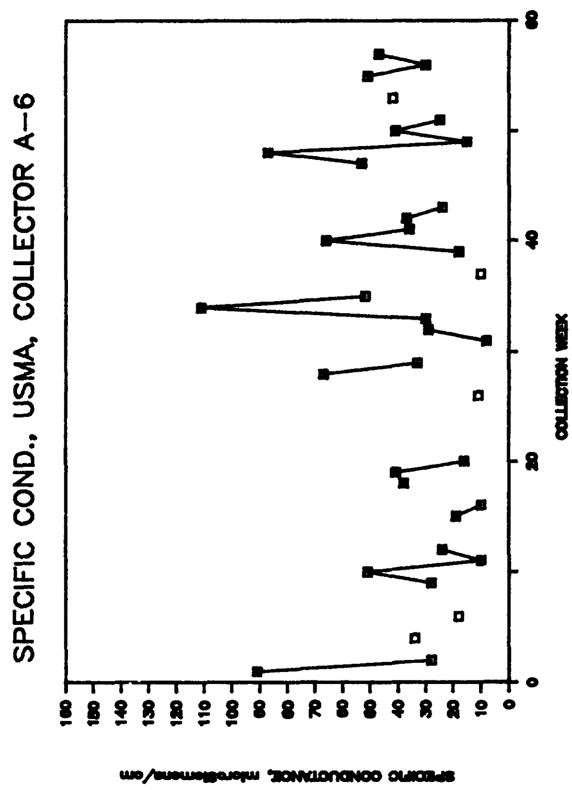

SPECIFIC COND., USMA, COLLECTOR A-2
SPECIFIC CONDUCTANCE, microSiemens/cm
COLLECTION WEEK

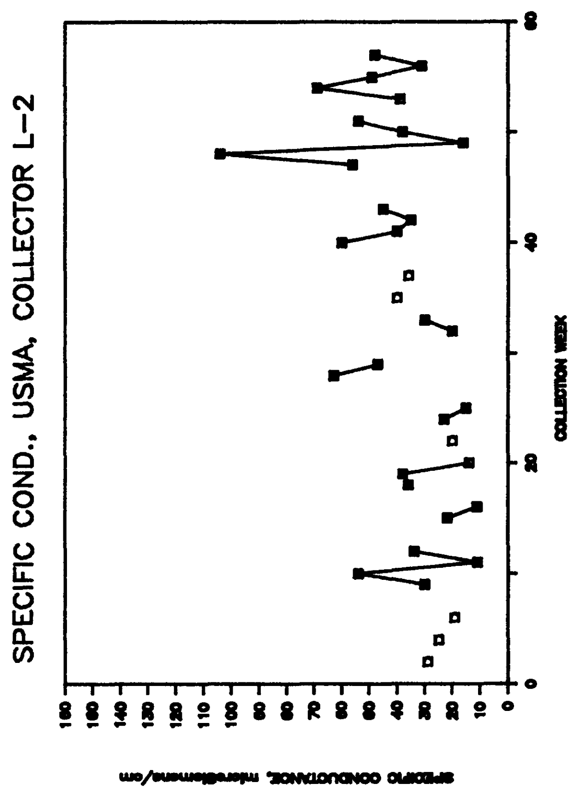

SPECIFIC COND., USMA, COLLECTOR A-3
SPECIFIC CONDUCTANCE, microSiemens/cm
COLLECTION WEEK

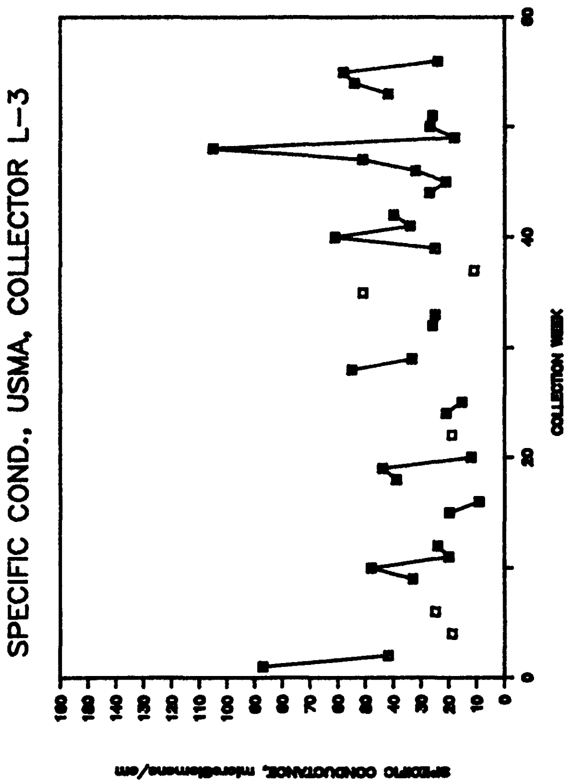

SPECIFIC COND., USMA, COLLECTOR A-4
SPECIFIC CONDUCTANCE, microSiemens/cm
COLLECTION WEEK

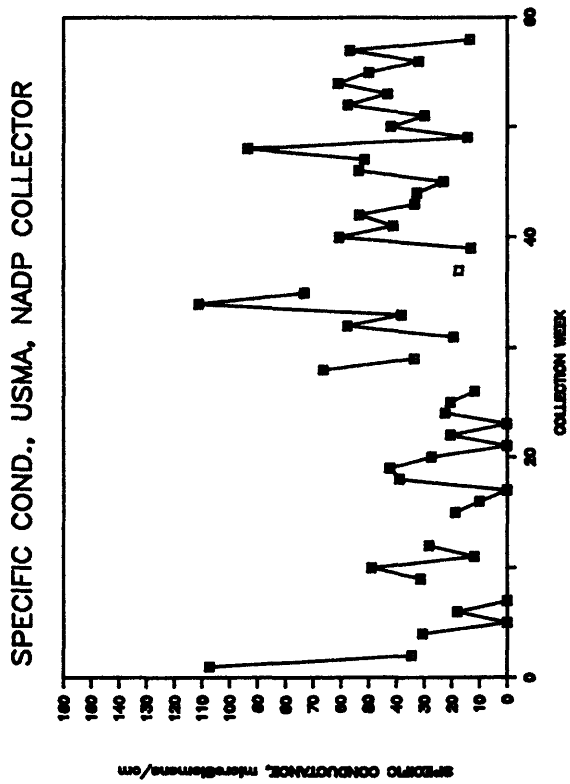

SPECIFIC COND., USMA, COLLECTOR A-5
SPECIFIC CONDUCTANCE, microSiemens/cm
COLLECTION WEEK

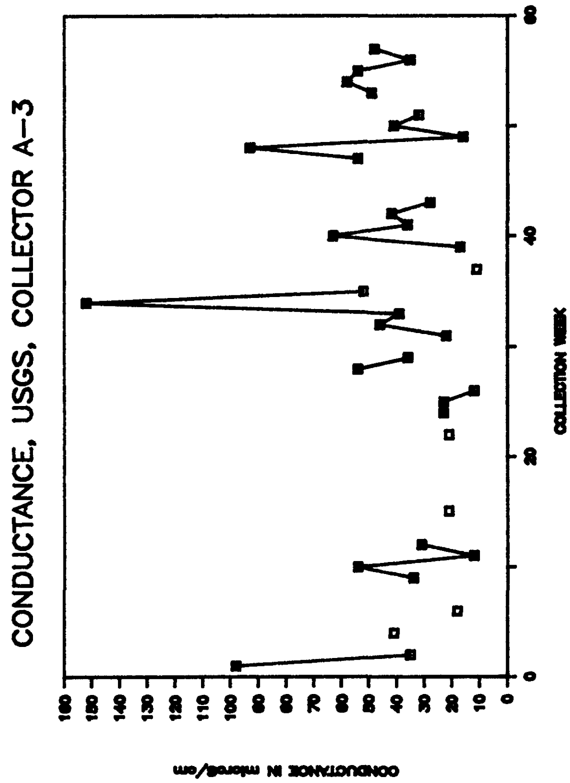

SPECIFIC COND., USMA, COLLECTOR L-1
SPECIFIC CONDUCTANCE, microSiemens/cm
COLLECTION WEEK

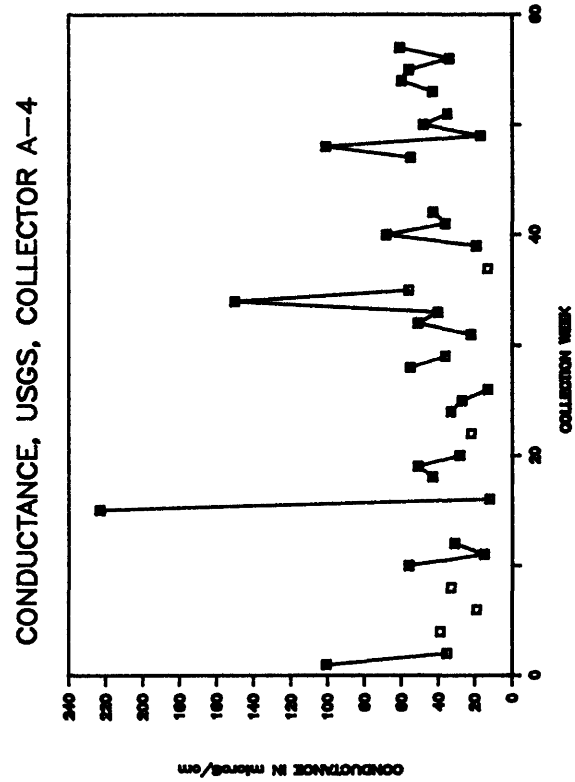

SPECIFIC COND., USMA, COLLECTOR A-6
SPECIFIC CONDUCTANCE, microSiemens/cm
COLLECTION WEEK

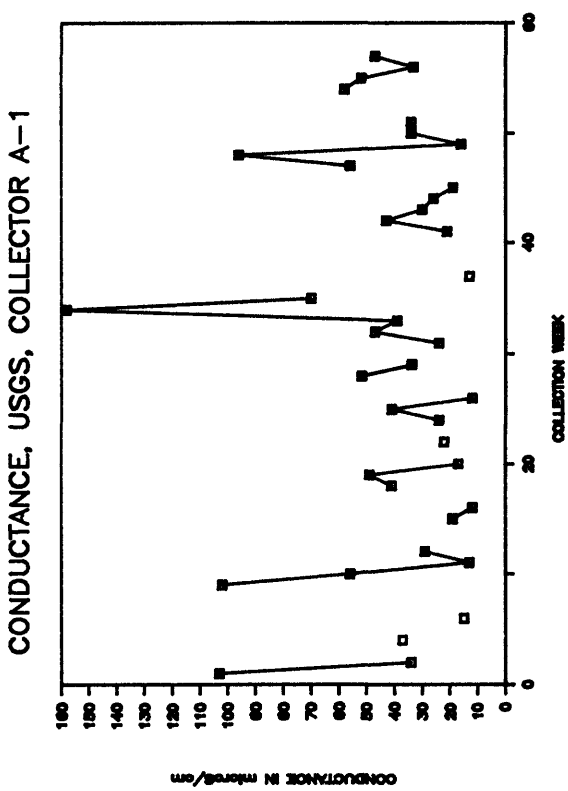

SPECIFIC COND., USMA, COLLECTOR L-2
SPECIFIC CONDUCTANCE, microSiemens/cm
COLLECTION WEEK

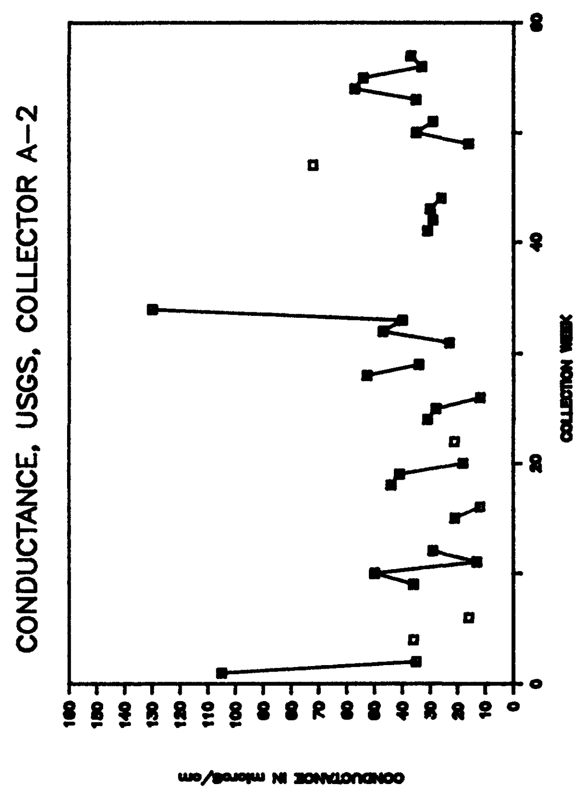

SPECIFIC COND., USMA, COLLECTOR L-3
COLLECTION WEEK
SPECIFIC CONDUCTANCE, microSiemens/cm


SPECIFIC COND., USMA, NADP COLLECTOR
COLLECTION WEEK
SPECIFIC CONDUCTANCE, microSiemens/cm

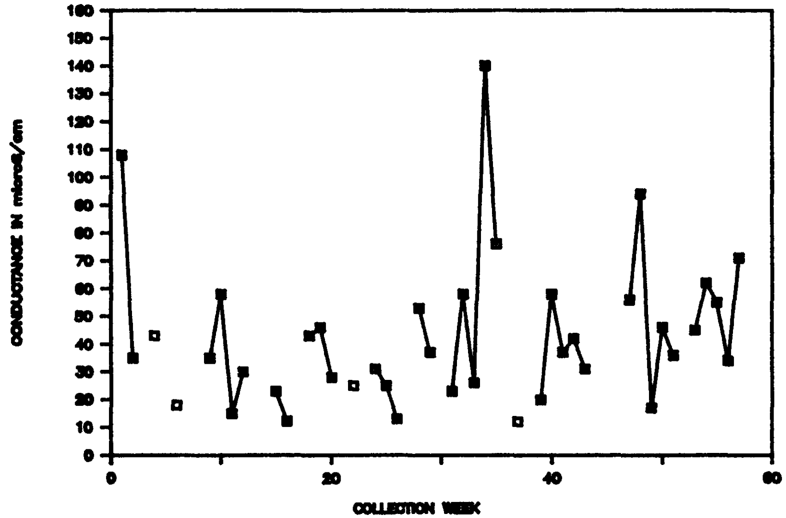

CONDUCTANCE, USGS, COLLECTOR A–3
CONDUCTANCE IN microS/cm
COLLECTION WEEK


CONDUCTANCE, USGS, COLLECTOR A–4
CONDUCTANCE IN microS/cm
COLLECTION WEEK

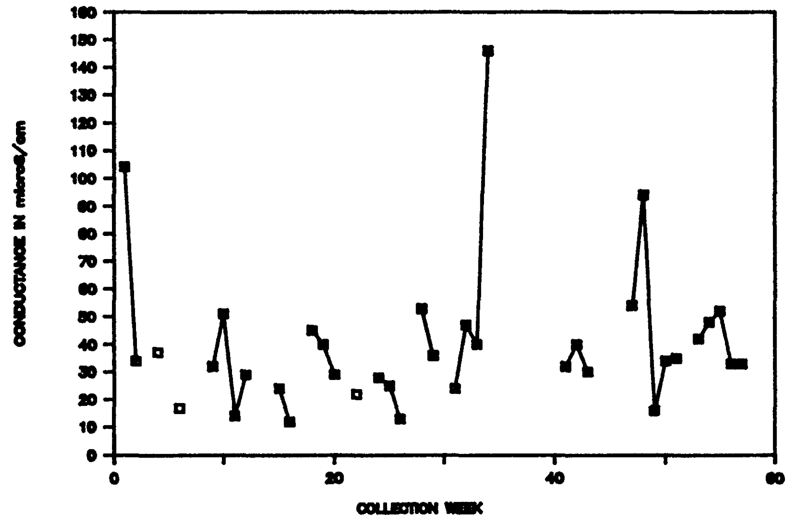

CONDUCTANCE, USGS, COLLECTOR A–1
CONDUCTANCE IN microS/cm
COLLECTION WEEK


CONDUCTANCE, USGS, COLLECTOR A–2
CONDUCTANCE IN microS/cm
COLLECTION WEEK

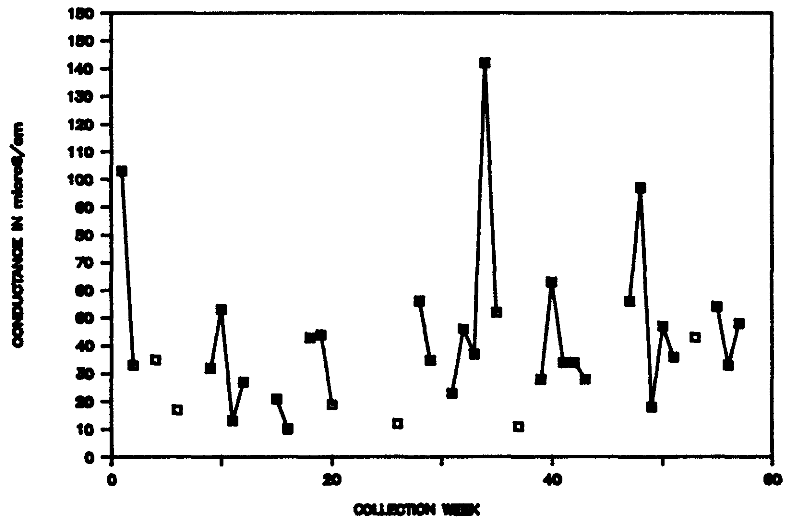
CONDUCTANCE, USGS, COLLECTOR A-5



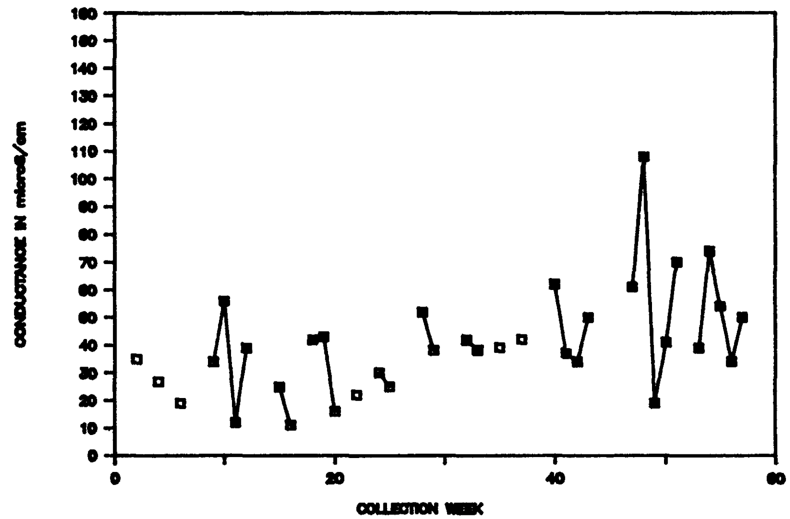
CONDUCTANCE, USGS, COLLECTOR L-1



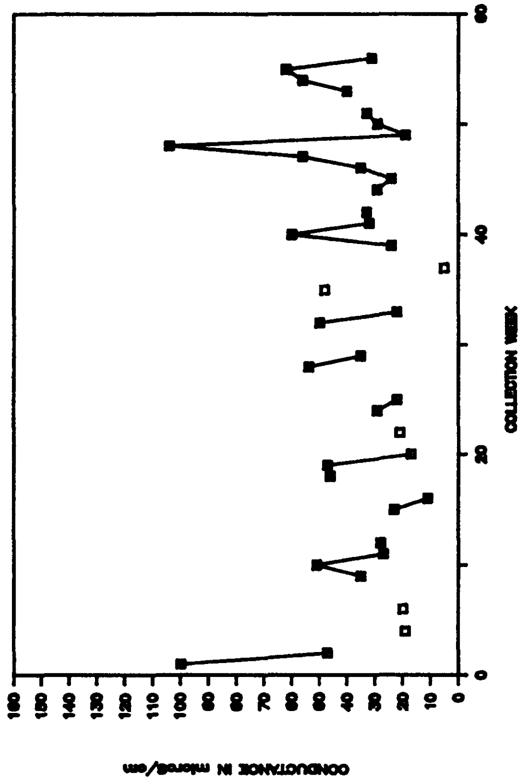
CONDUCTANCE, USGS, COLLECTOR A-6



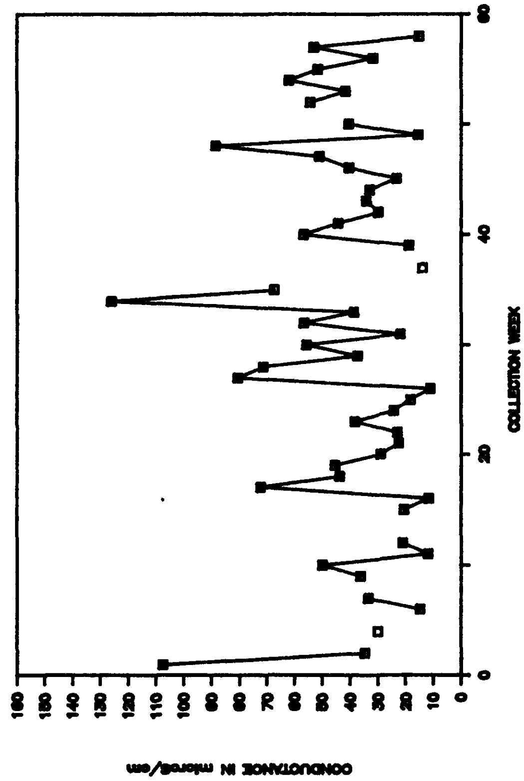
CONDUCTANCE, USGS, COLLECTOR L-2



CONDUCTANCE, USGS, COLLECTOR L-3

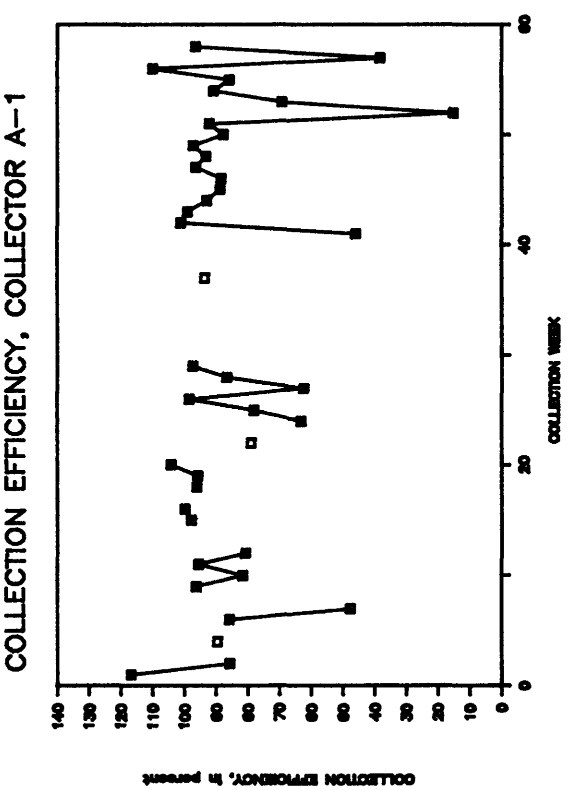


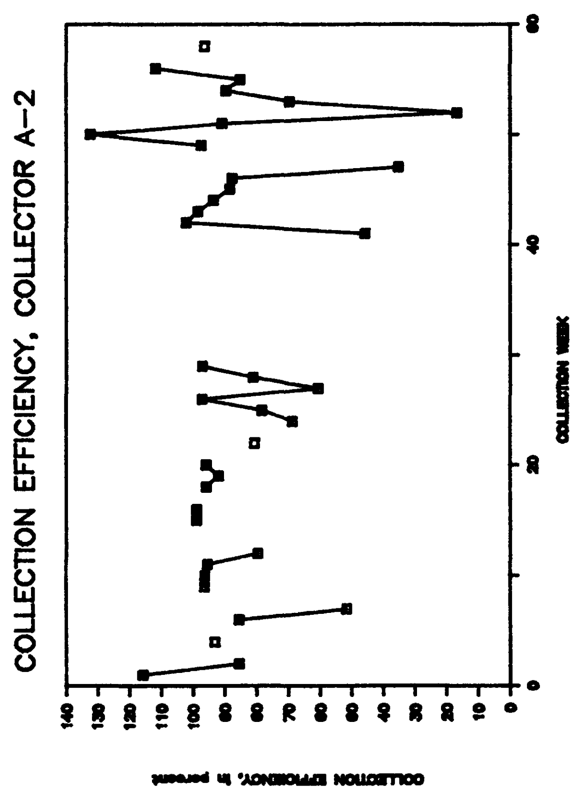
CONDUCTANCE, ISWS, NADP COLLECTOR

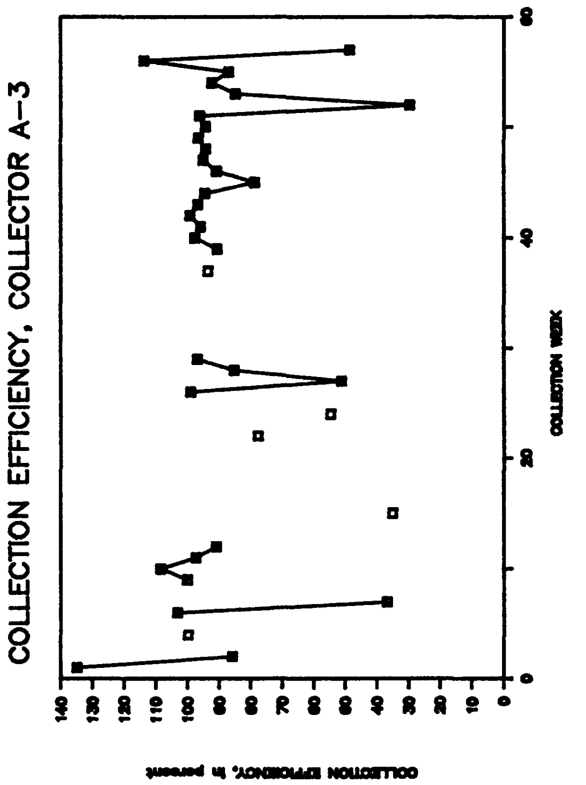


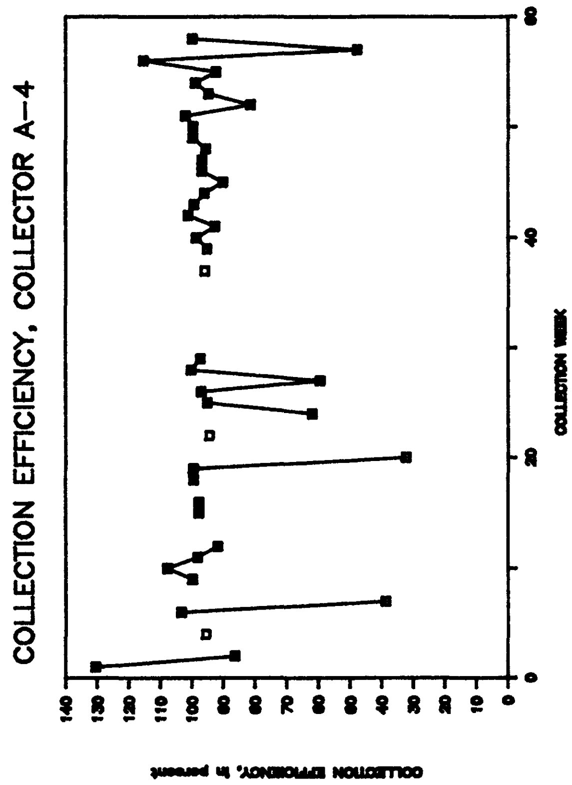
(p. 131 follows)

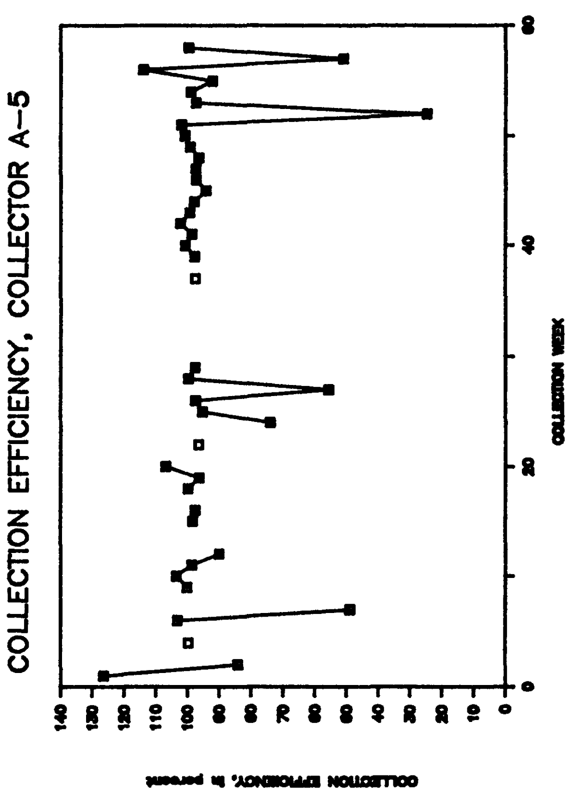
APPENDIX E: Collector efficiency

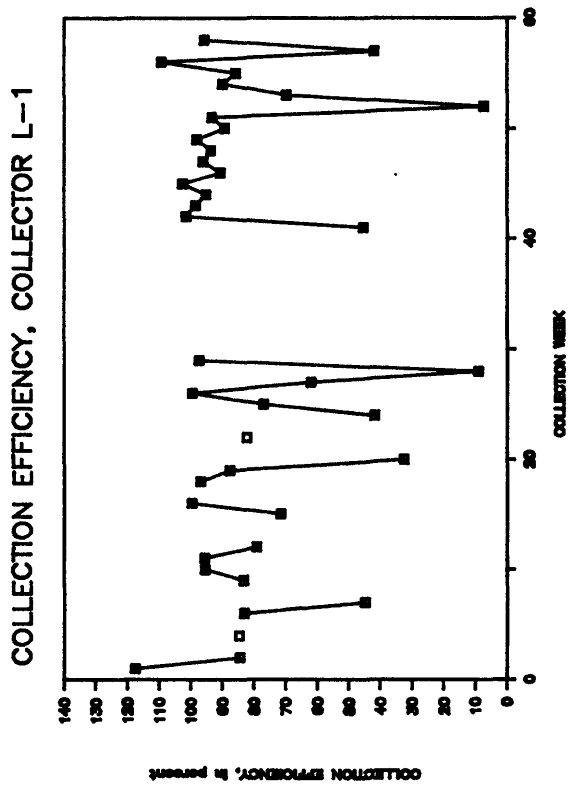

COLLECTION EFFICIENCY, COLLECTOR A-1
COLLECTION EFFICIENCY, in percent
COLLECTION WEEK

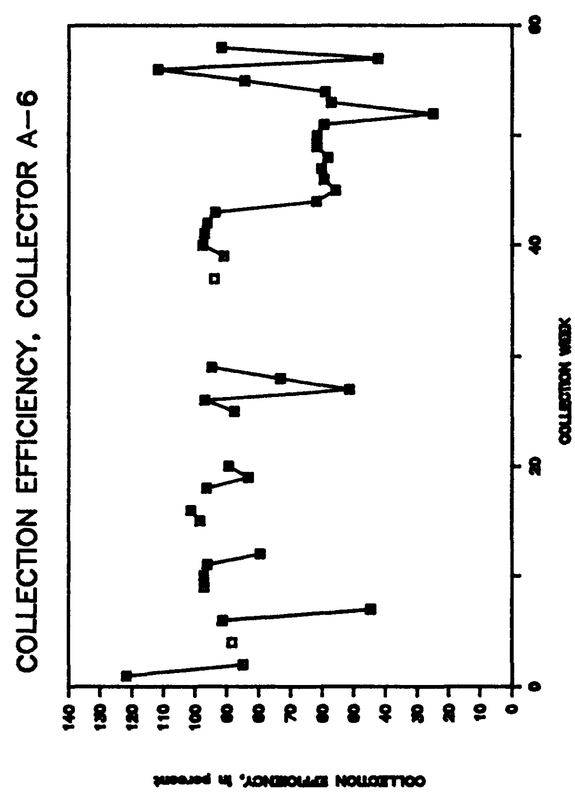

COLLECTION EFFICIENCY, COLLECTOR A-2
COLLECTION EFFICIENCY, in percent
COLLECTION WEEK

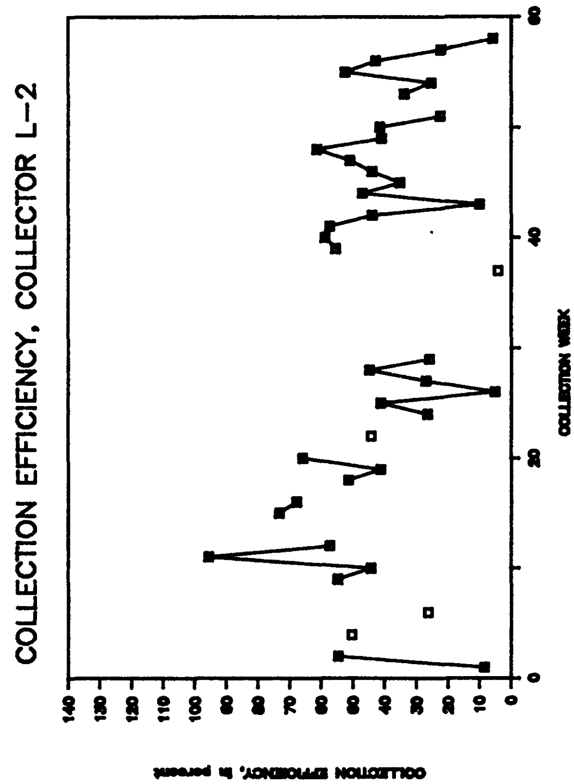

COLLECTION EFFICIENCY, COLLECTOR A-3
COLLECTION EFFICIENCY, in percent
COLLECTION WEEK

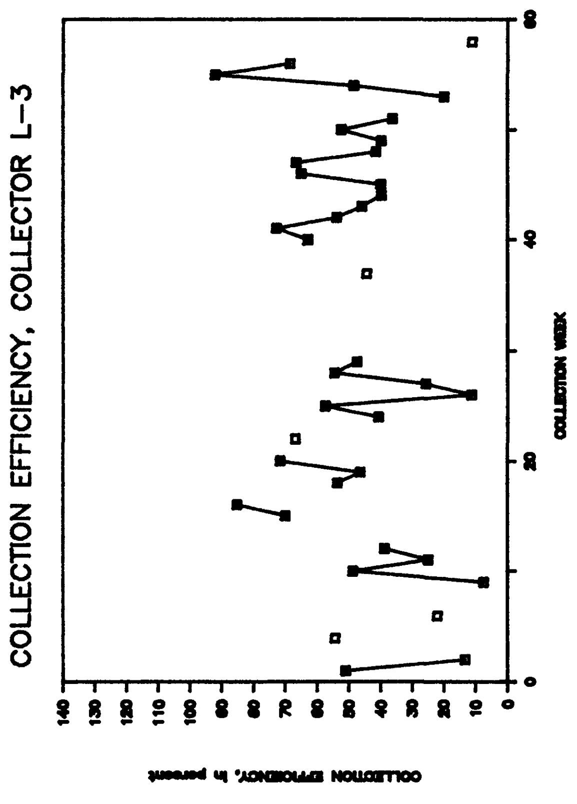

COLLECTION EFFICIENCY, COLLECTOR A-4
COLLECTION EFFICIENCY, in percent
COLLECTION WEEK

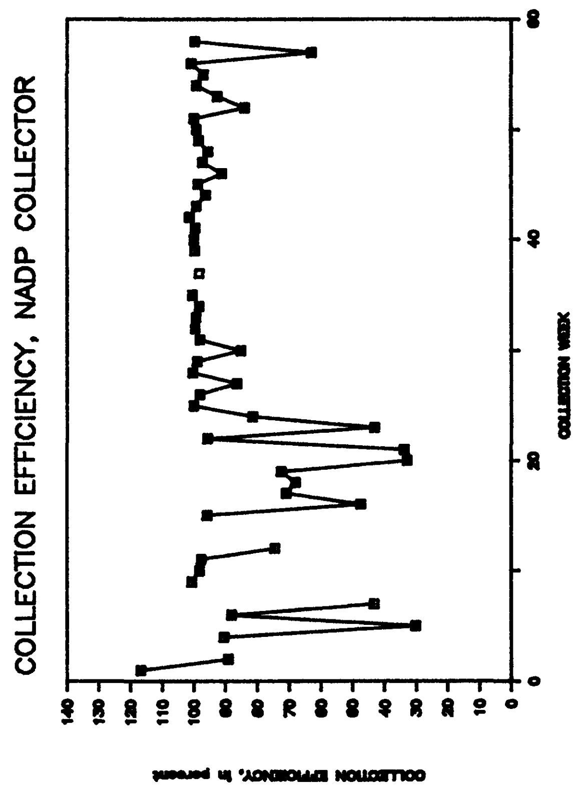

COLLECTION EFFICIENCY, COLLECTOR A-5
COLLECTION EFFICIENCY, in percent
COLLECTION WEEK


COLLECTION EFFICIENCY, COLLECTOR L-1
COLLECTION EFFICIENCY, in percent
COLLECTION WEEK

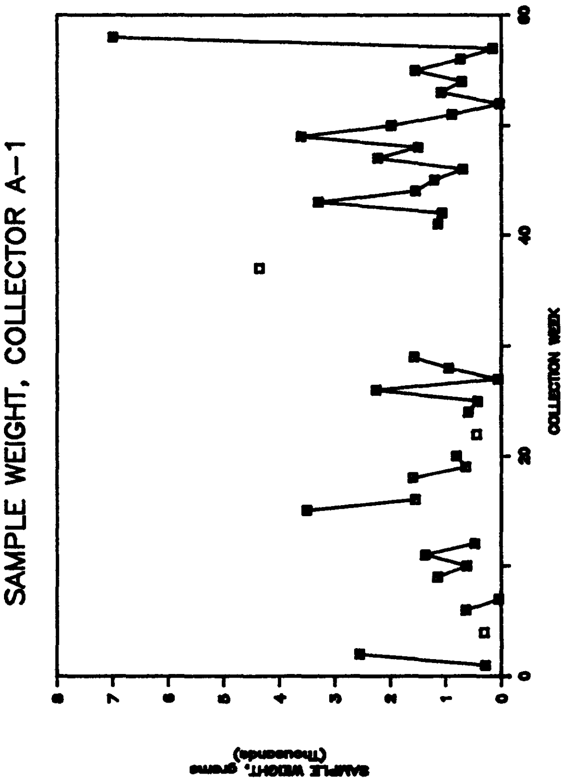

COLLECTION EFFICIENCY, COLLECTOR A-6
COLLECTION EFFICIENCY, in percent
COLLECTION WEEK

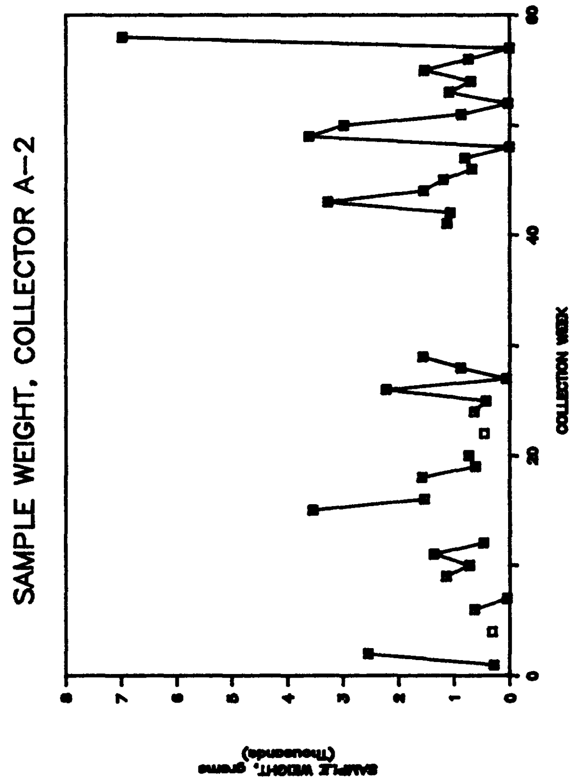

COLLECTION EFFICIENCY, COLLECTOR L-2
COLLECTION EFFICIENCY, in percent
COLLECTION WEEK

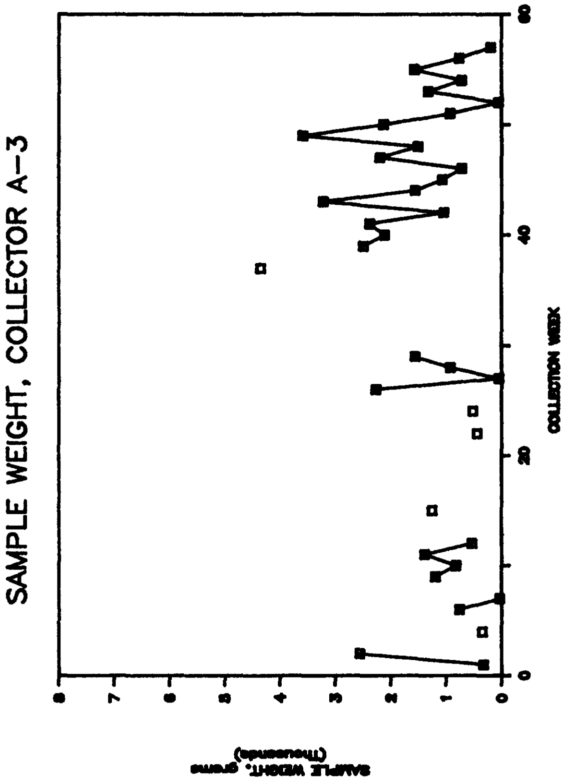

COLLECTION EFFICIENCY, COLLECTOR L-3
COLLECTION EFFICIENCY, in percent
COLLECTION WEEK
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
0
20
40
60

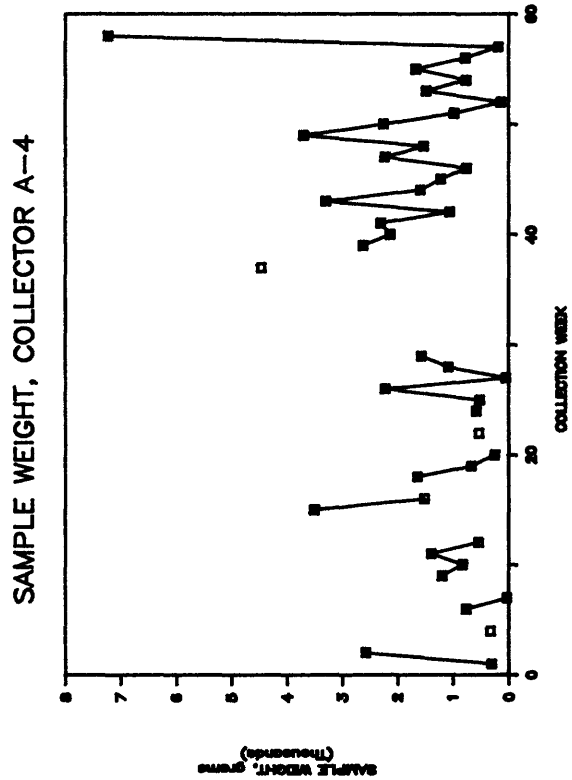

COLLECTION EFFICIENCY, NADP COLLECTOR
COLLECTION EFFICIENCY, in percent
COLLECTION WEEK
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
0
20
40
60

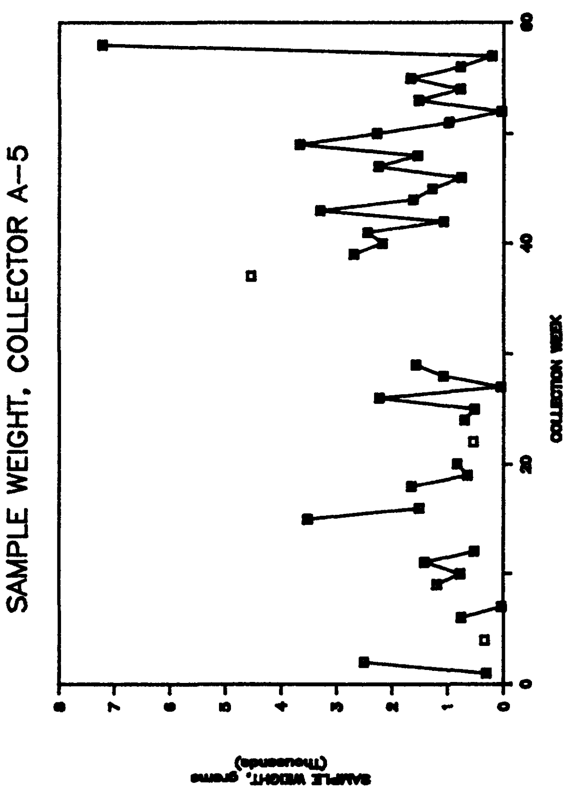
APPENDIX F: Sample Weights

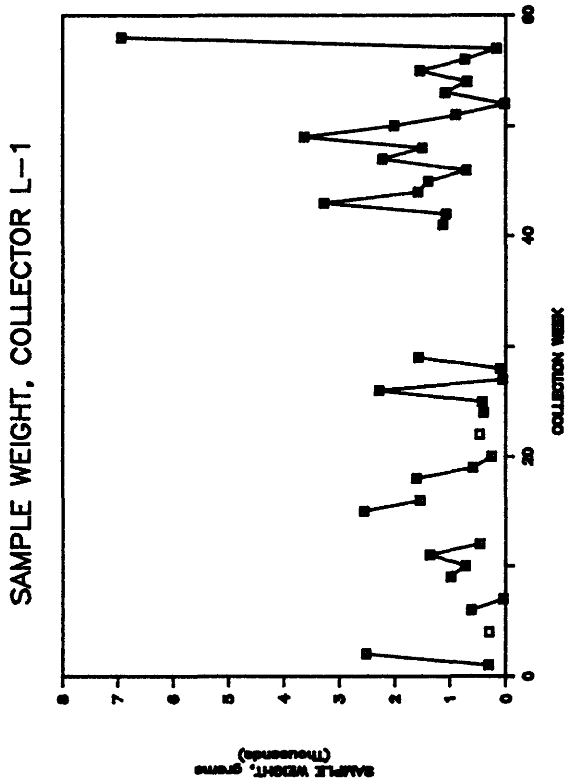

SAMPLE WEIGHT, COLLECTOR A–1
SAMPLE WEIGHT, grams (Thousands)
COLLECTION WEEK

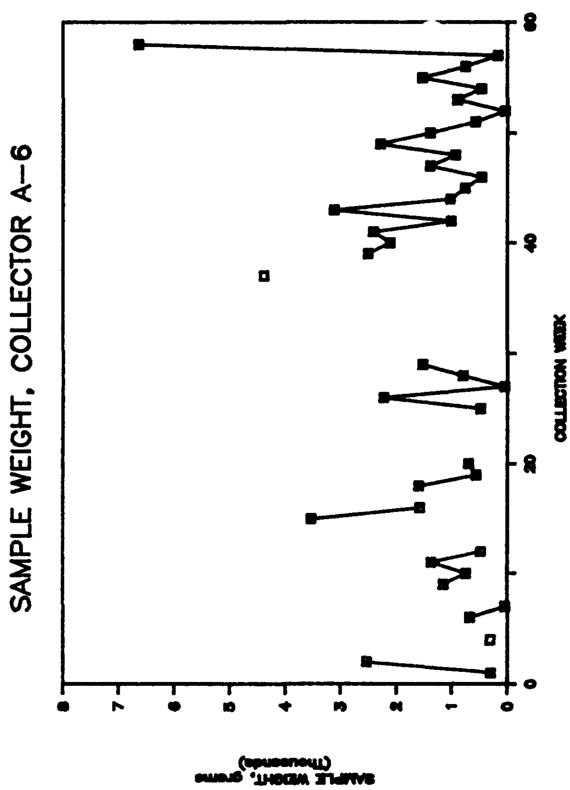

SAMPLE WEIGHT, COLLECTOR A–2
SAMPLE WEIGHT, grams (Thousands)
COLLECTION WEEK

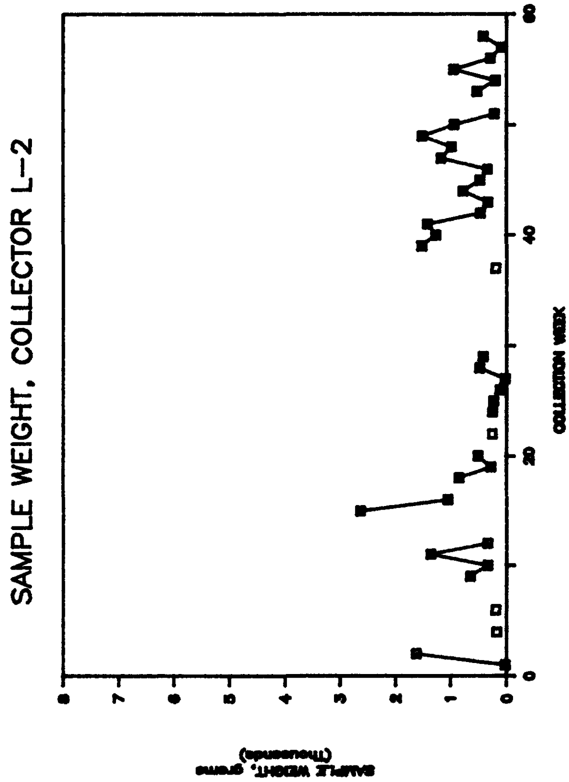

SAMPLE WEIGHT, COLLECTOR A–3
SAMPLE WEIGHT, grams (Thousands)
COLLECTION WEEK


SAMPLE WEIGHT, COLLECTOR A–4
SAMPLE WEIGHT, grams (Thousands)
COLLECTION WEEK

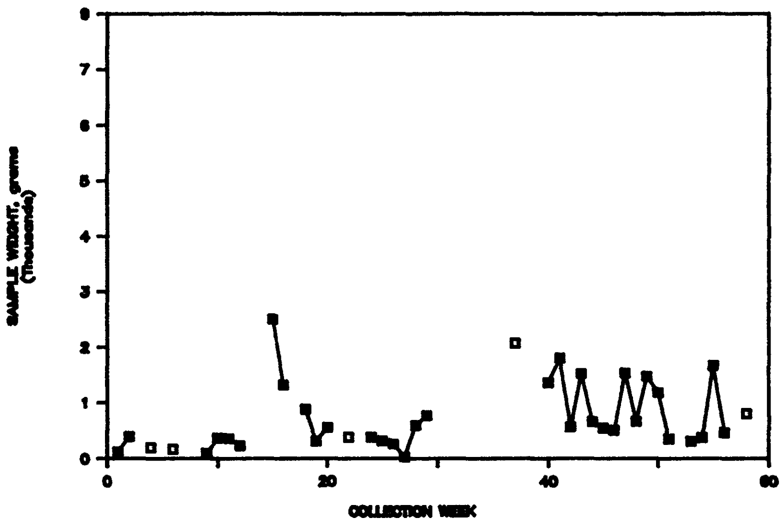

SAMPLE WEIGHT, COLLECTOR A—5
SAMPLE WEIGHT, grams (Thousands)
COLLECTION WEEK


SAMPLE WEIGHT, COLLECTOR L—1
SAMPLE WEIGHT, grams (Thousands)
COLLECTION WEEK

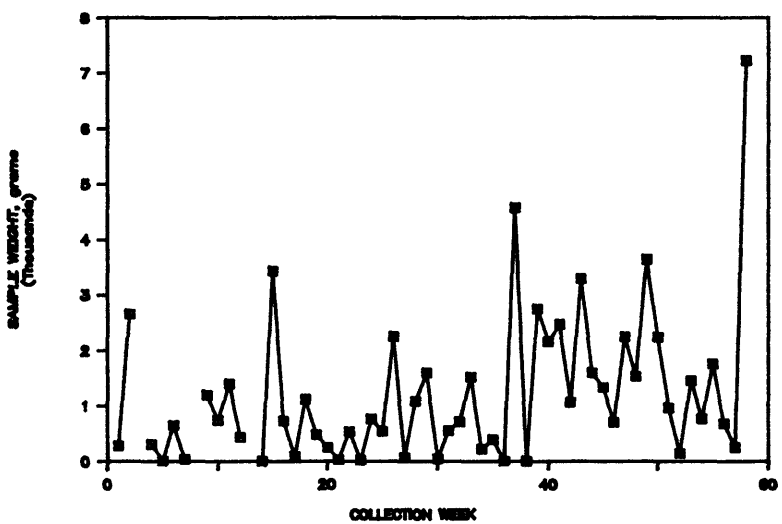

SAMPLE WEIGHT, COLLECTOR A—6
SAMPLE WEIGHT, grams (Thousands)
COLLECTION WEEK


SAMPLE WEIGHT, COLLECTOR L—2
SAMPLE WEIGHT, grams (Thousands)
COLLECTION WEEK

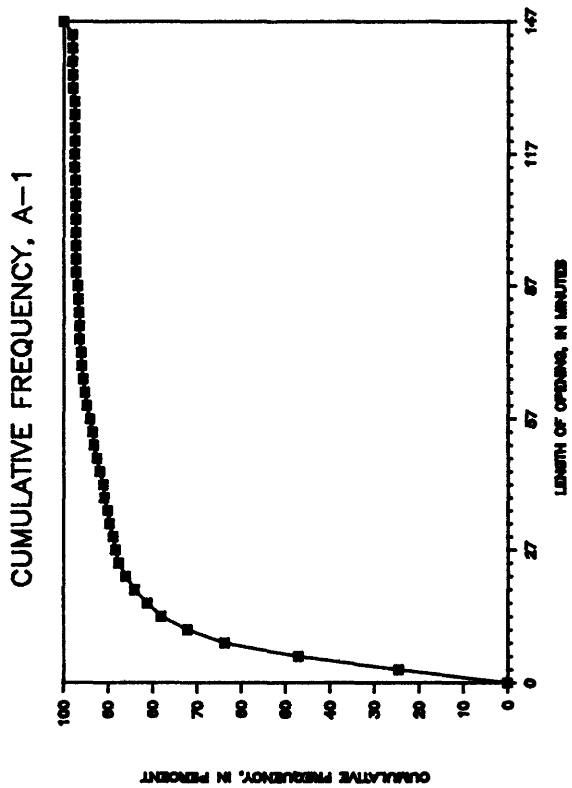
SAMPLE WEIGHT, COLLECTOR L-3

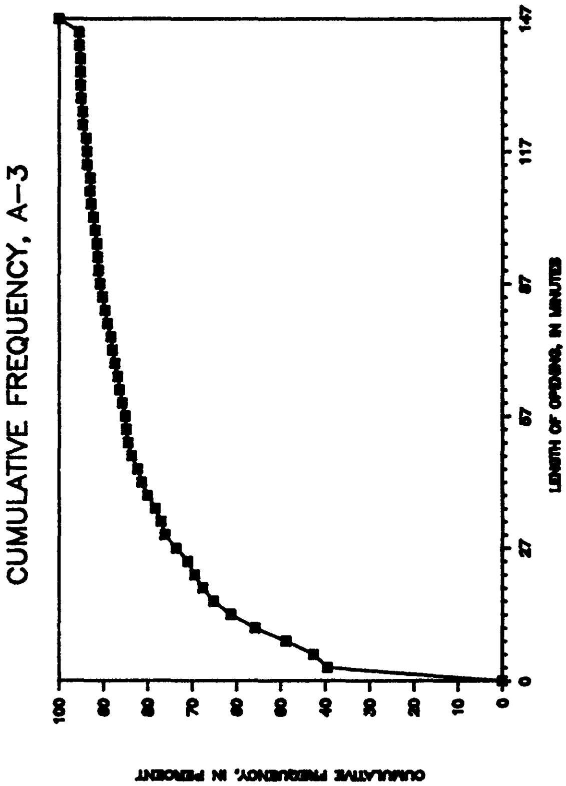


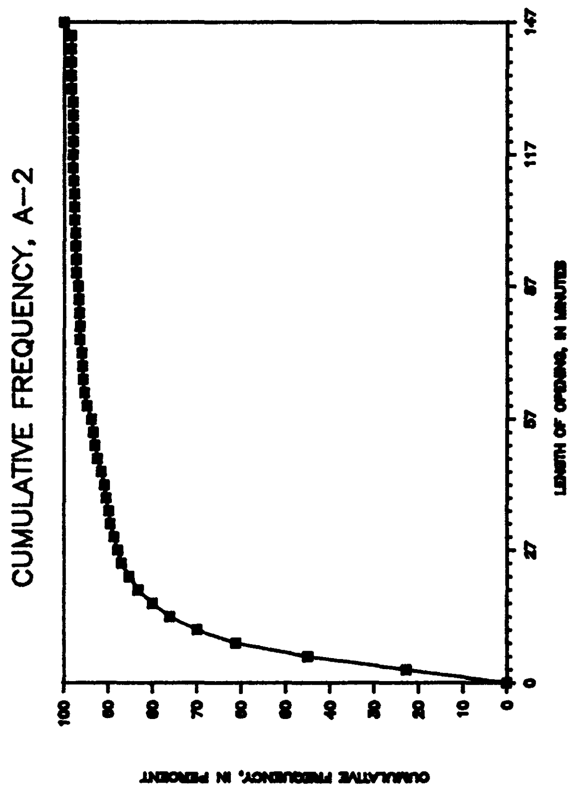
SAMPLE WEIGHT, NADP COLLECTOR

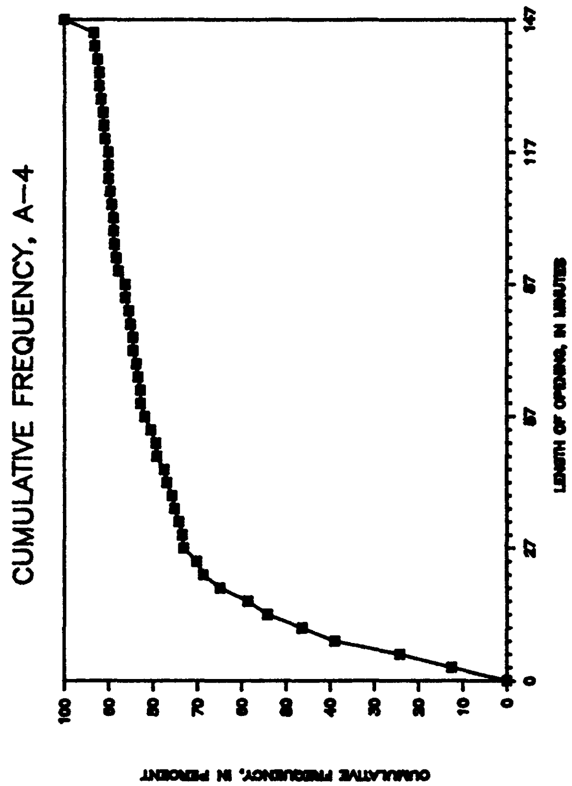


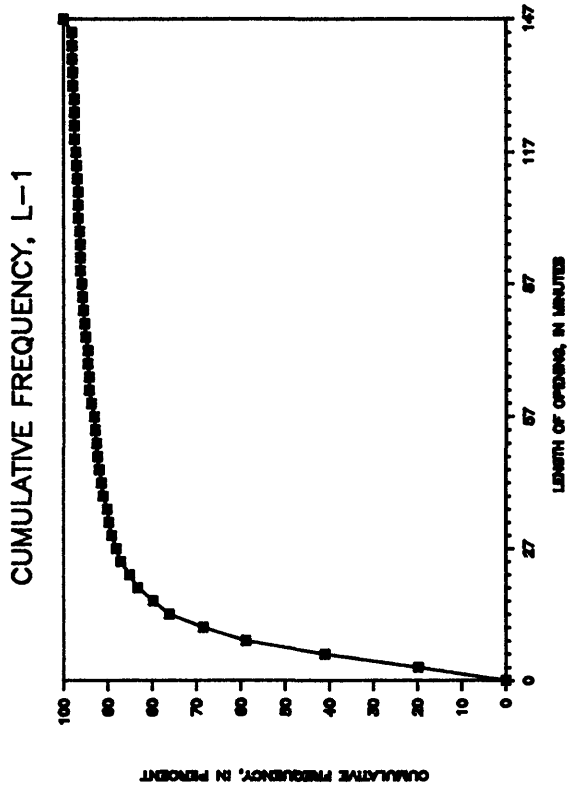
APPENDIX G: Cumulative Frequency of collector open times

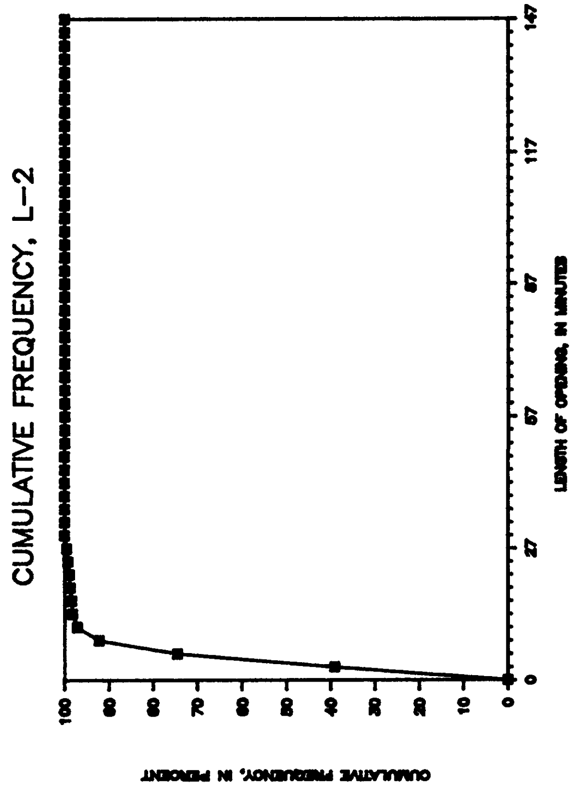

CUMULATIVE FREQUENCY, A-1
CUMULATIVE FREQUENCY, IN PERCENT
100 90 80 70 60 50 40 30 20 10 0
LENGTH OF OPENING, IN MINUTES
0 27 57 87 117 147

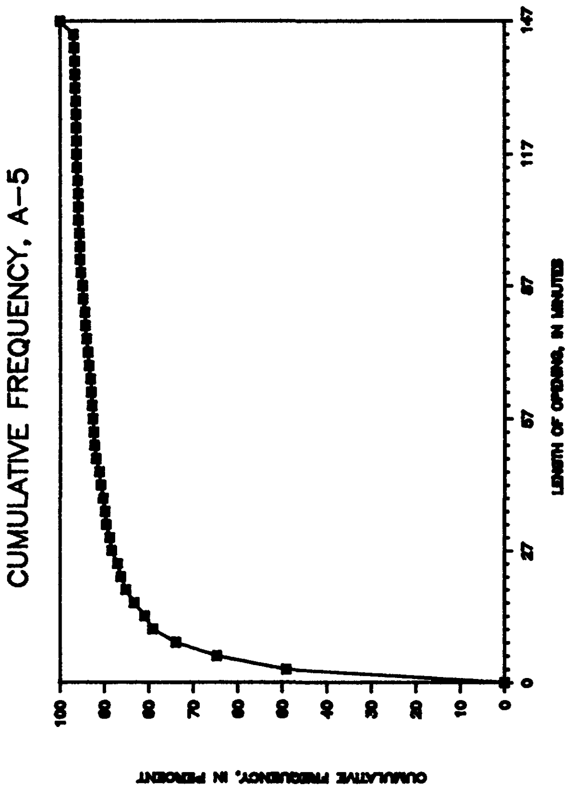

CUMULATIVE FREQUENCY, A-3
CUMULATIVE FREQUENCY, IN PERCENT
100 90 80 70 60 50 40 30 20 10 0
LENGTH OF OPENING, IN MINUTES
0 27 57 87 117 147

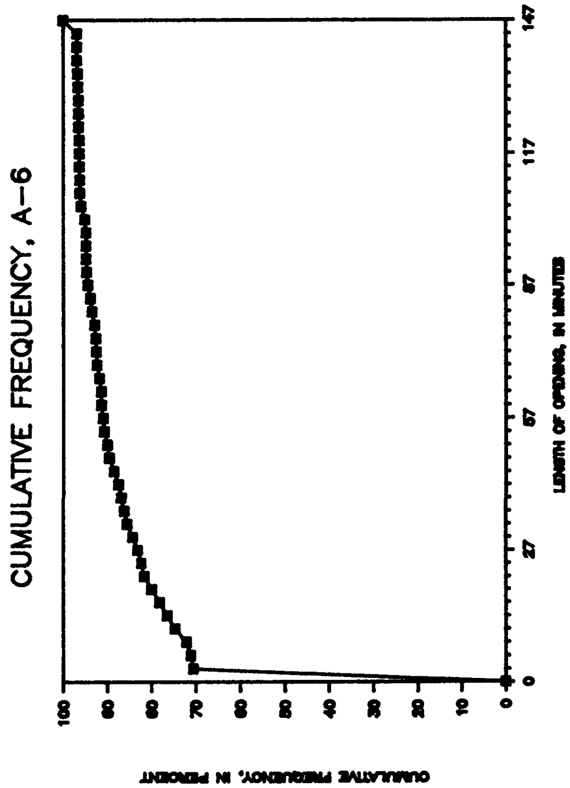

CUMULATIVE FREQUENCY, A-2
CUMULATIVE FREQUENCY, IN PERCENT
100 90 80 70 60 50 40 30 20 10 0
LENGTH OF OPENING, IN MINUTES
0 27 57 87 117 147

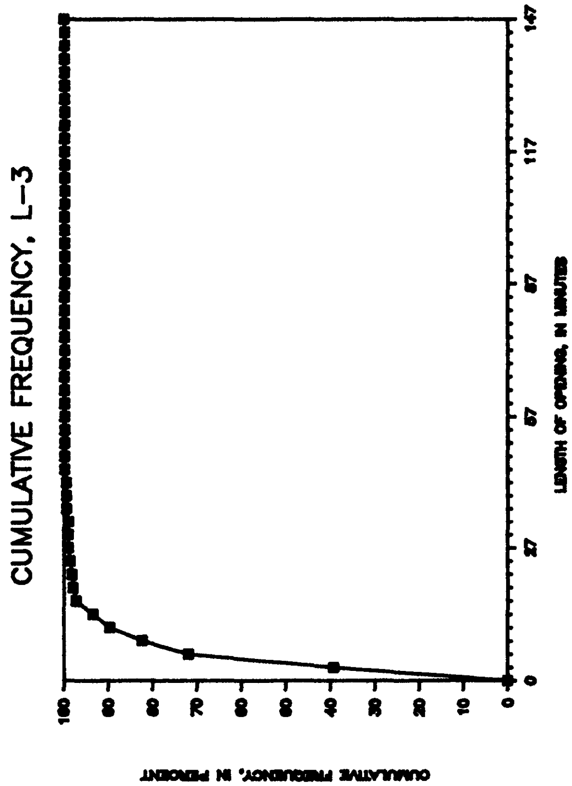

CUMULATIVE FREQUENCY, A-4
CUMULATIVE FREQUENCY, IN PERCENT
100 90 80 70 60 50 40 30 20 10 0
LENGTH OF OPENING, IN MINUTES
0 27 57 87 117 147

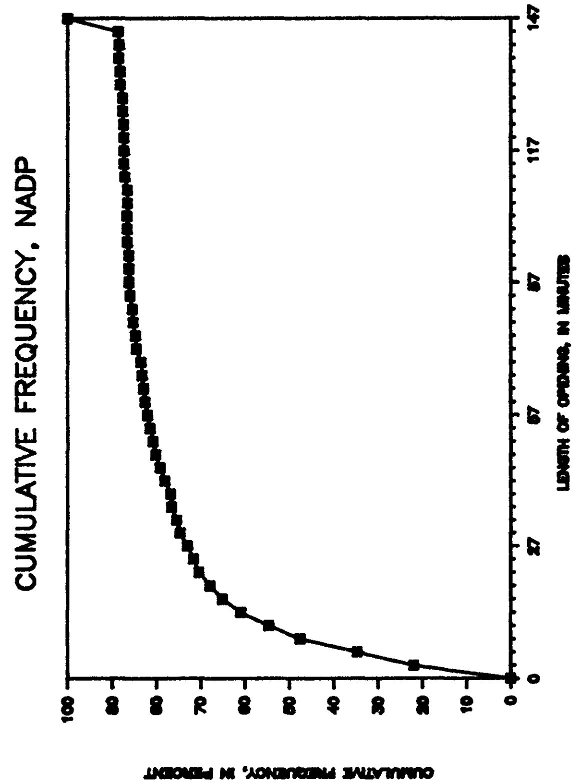

CUMULATIVE FREQUENCY, L–1
CUMULATIVE FREQUENCY, IN PERCENT
LENGTH OF OPENING, IN MINUTES
0 27 57 87 117 147
0 10 20 30 40 50 60 70 80 90 100


CUMULATIVE FREQUENCY, L–2
CUMULATIVE FREQUENCY, IN PERCENT
LENGTH OF OPENING, IN MINUTES
0 27 57 87 117 147
0 10 20 30 40 50 60 70 80 90 100

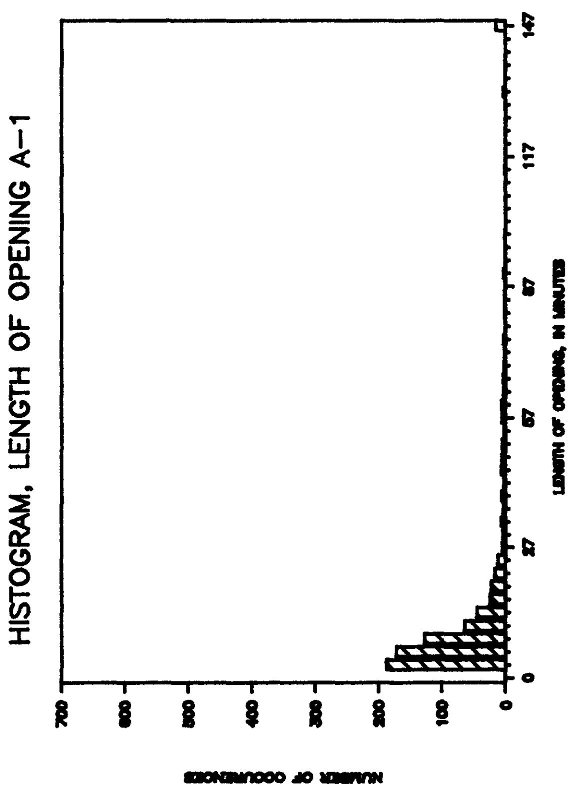

CUMULATIVE FREQUENCY, A–5
CUMULATIVE FREQUENCY, IN PERCENT
LENGTH OF OPENING, IN MINUTES
0 27 57 87 117 147
0 10 20 30 40 50 60 70 80 90 100

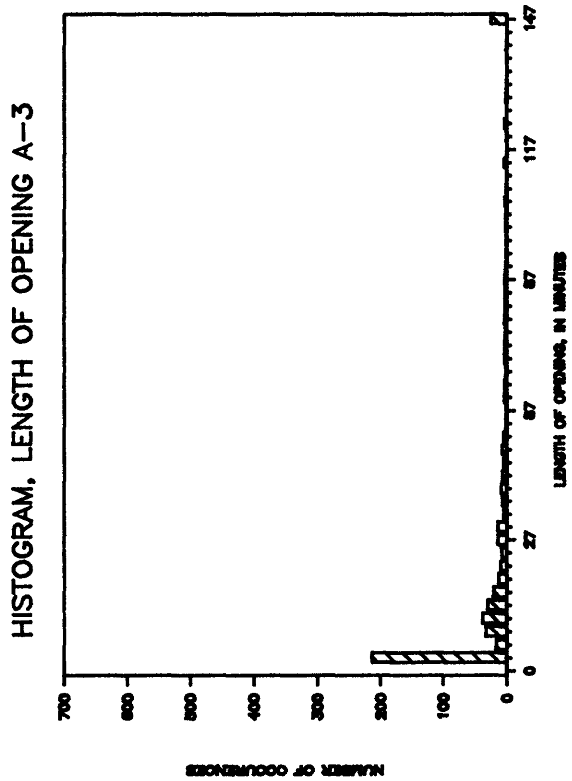

CUMULATIVE FREQUENCY, A–6
CUMULATIVE FREQUENCY, IN PERCENT
LENGTH OF OPENING, IN MINUTES
0 27 57 87 117 147
0 10 20 30 40 50 60 70 80 90 100

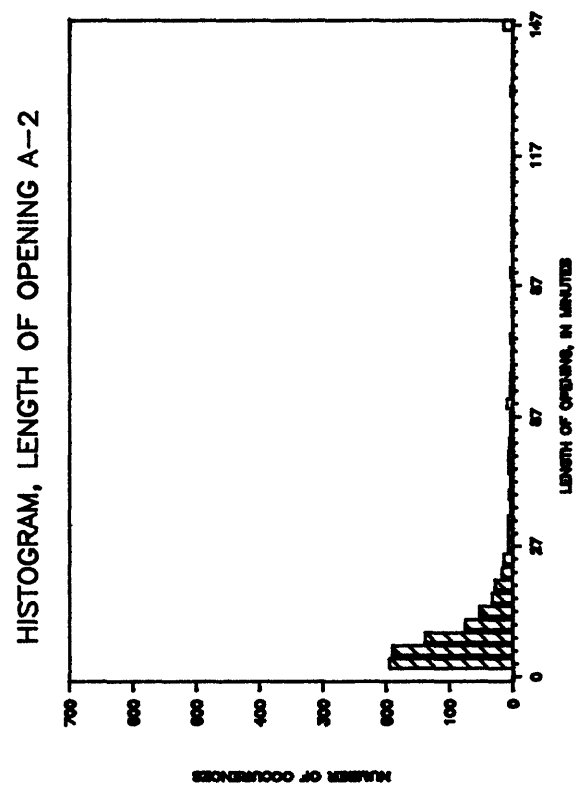

CUMULATIVE FREQUENCY, L–3
CUMULATIVE FREQUENCY, IN PERCENT
LENGTH OF OPENING, IN MINUTES
0
27
57
87
117
147

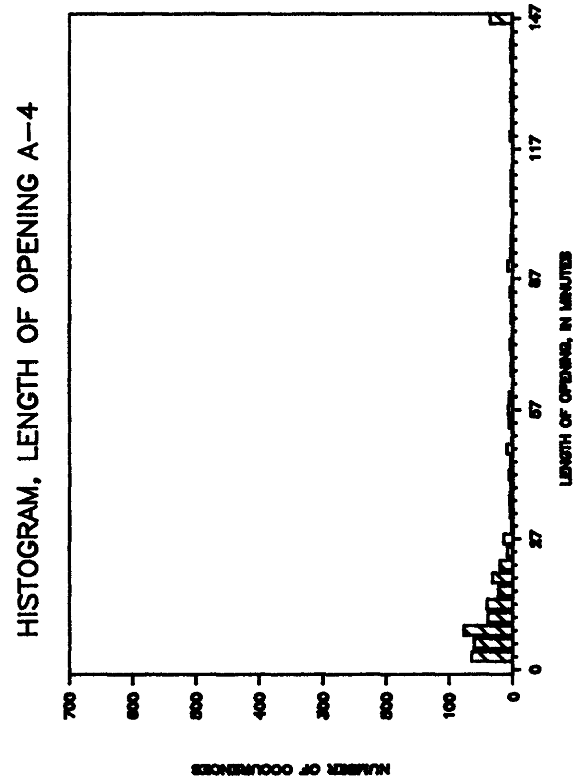

CUMULATIVE FREQUENCY, NADP
CUMULATIVE FREQUENCY, IN PERCENT
LENGTH OF OPENING, IN MINUTES
0
27
57
87
117
147

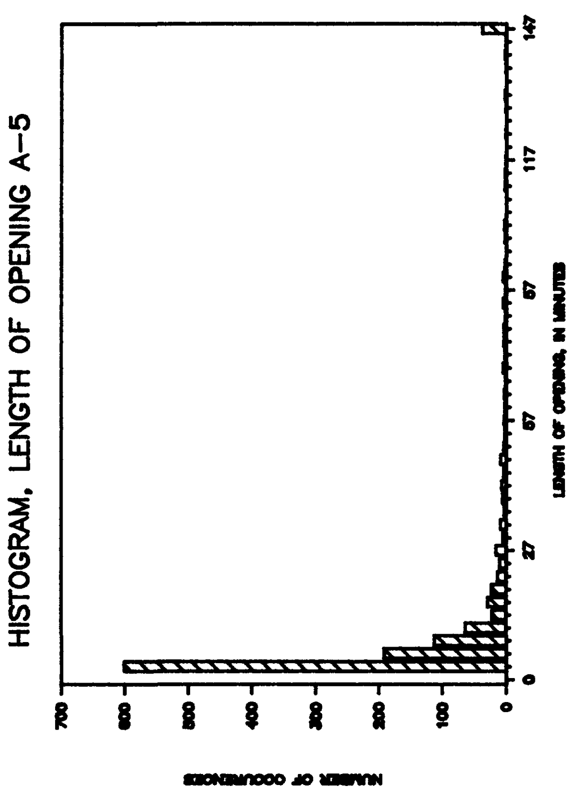
APPENDIX H: Histograms of length of opening

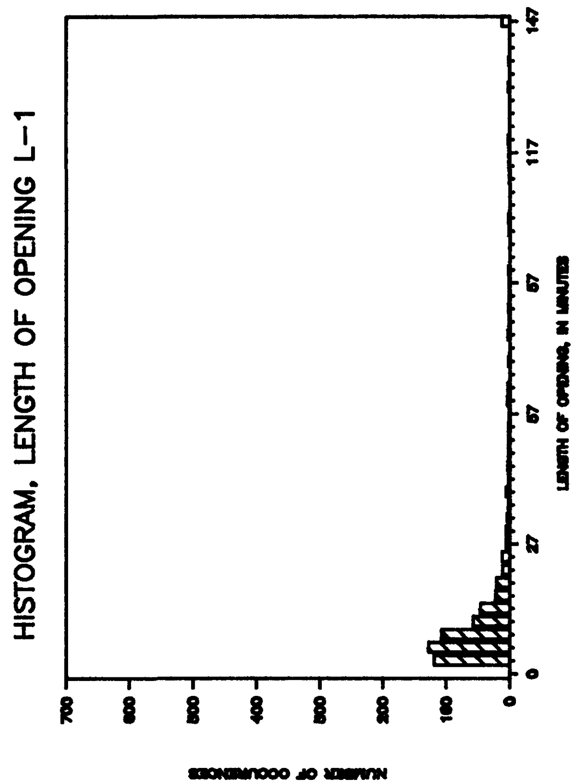

HISTOGRAM, LENGTH OF OPENING A-1
NUMBER OF OCCURRENCES
0
100
200
300
400
500
600
700
LENGTH OF OPENING, IN MINUTES
0
27
57
87
117
147

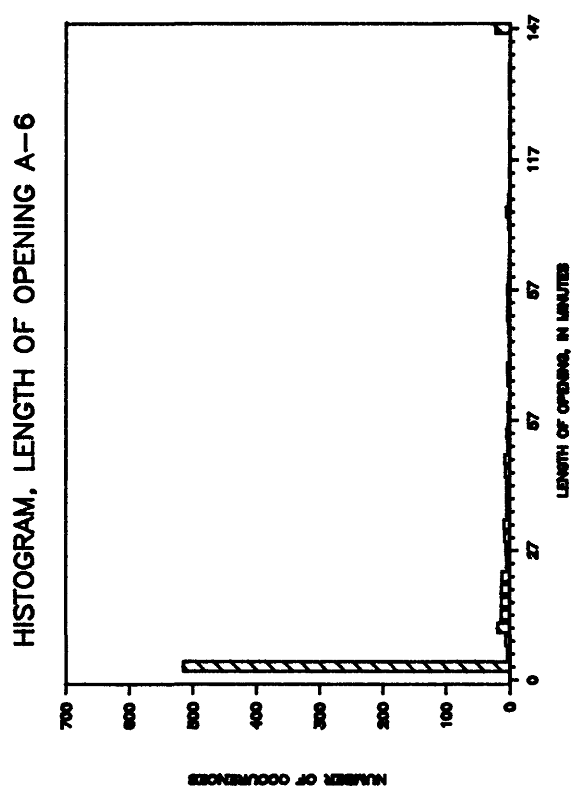

HISTOGRAM, LENGTH OF OPENING A-3
NUMBER OF OCCURRENCES
0
100
200
300
400
500
600
700
LENGTH OF OPENING, IN MINUTES
0
27
57
87
117
147

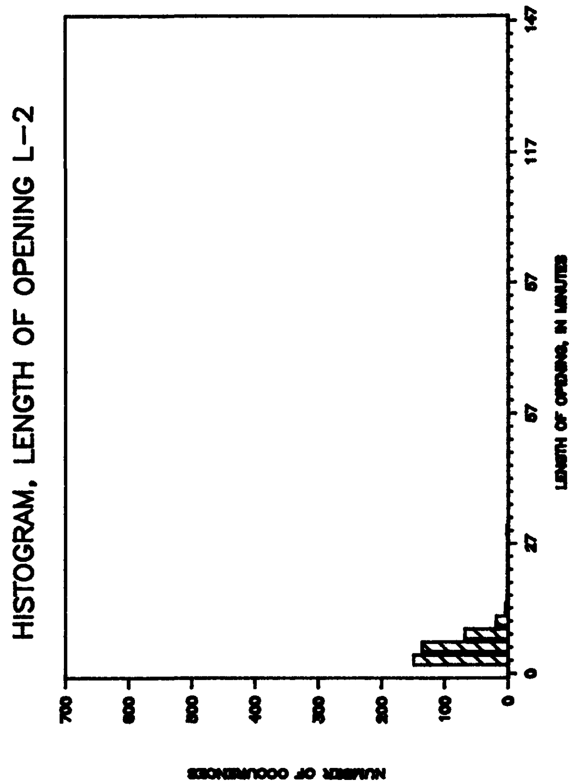

HISTOGRAM, LENGTH OF OPENING A-2
NUMBER OF OCCURRENCES
0
100
200
300
400
500
600
700
LENGTH OF OPENING, IN MINUTES
0
27
57
87
117
147

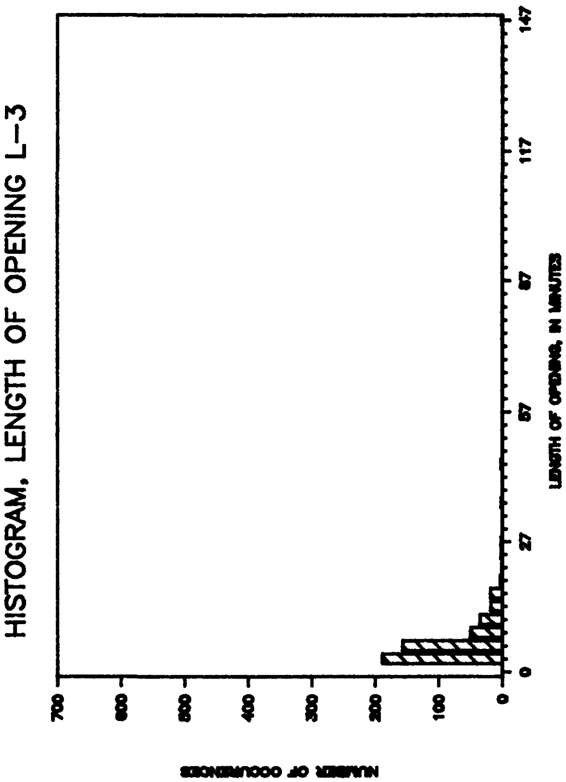

HISTOGRAM, LENGTH OF OPENING A-4
NUMBER OF OCCURRENCES
0
100
200
300
400
500
600
700
LENGTH OF OPENING, IN MINUTES
0
27
57
87
117
147

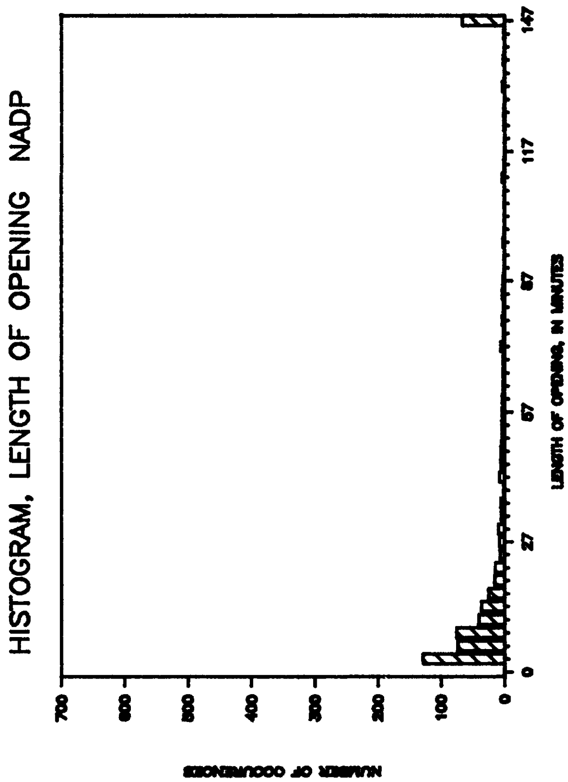

HISTOGRAM, LENGTH OF OPENING A—5
NUMBER OF OCCURRENCES
LENGTH OF OPENING, IN MINUTES


HISTOGRAM, LENGTH OF OPENING L—1
NUMBER OF OCCURRENCES
LENGTH OF OPENING, IN MINUTES


HISTOGRAM, LENGTH OF OPENING A—6
NUMBER OF OCCURRENCES
LENGTH OF OPENING, IN MINUTES


HISTOGRAM, LENGTH OF OPENING L—2
NUMBER OF OCCURRENCES
LENGTH OF OPENING, IN MINUTES


HISTOGRAM, LENGTH OF OPENING L—3
LENGTH OF OPENING, IN MINUTES
NUMBER OF OCCURRENCES
0
27
57
87
117
147
0
100
200
300
400
500
600
700


HISTOGRAM, LENGTH OF OPENING NADP
LENGTH OF OPENING, IN MINUTES
NUMBER OF OCCURRENCES
0
27
57
87
117
147
0
100
200
300
400
500
600
700

Attachment 1: Listing of computer program to convert voltages to length of time that samplers are open.

```
C    RCG 23 JAN 86
C    ONE INPUT FILE AND TWO OUTPUT FILES ARE REQUIRED.  THE INPUT
C    FILE HAS THE FOLLOWING VARIABLES IN TABULAR FORM:
C               JDATE . . . .  JULIAN DATE OF DATA
C               TIME . . . . . TIME OF DATA COLLECTION
C               COLL(I) . . .  COLLECTORS DATA IN THE ORDER
C                    A1   AEROCHEM METRICS
C                    A2   AEROCHEM METRICS
C                    A3   AEROCHEM METRICS
C                    A4   AEROCHEM METRICS
C                    A5   AEROCHEM METRICS
C                    A6   AEROCHEM METRICS
C                    L1   LEONARD MOLD AND DIE GeoTech 650
C                    L2   LEONARD MOLD AND DIE GeoTech 650
C                    L3   LEONARD MOLD AND DIE GeoTech 650
C                    NADP AEROCHEM METRICS
C    FORMAT FOR THE DATA ENTRIES:
C               JDATE . . .  I5
C               ITIME . . .  1X,I4
C               COLL(I) . .  10(2X,F4.2)
C
C    THE FOLLOWING SUMMARIES ARE MADE OF THE COLLECTOR OPENING AND
C    CLOSING DATA:  recorded in file: outfil
C               NUMBER OF TIMES THAT EACH COLLECTOR OPENED DURING
C               A DAY.
C
C               NUMBER OF DAYS IN THE MONTH THAT EACH COLLECTOR
C               OPENED.
C
C               AVERAGE LENGTH OF TIME THAT THE COLLECTOR WAS OPEN
C
C               THE STANDARD DEVIATION FOR THE LENGTH OF TIME
C               THAT A COLLECTOR WAS OPEN.
C
C               A FREQUENCY DISTRIBUTION FOR THE LENGTH OF TIME
C               THAT A COLLECTOR WAS OPEN.
C
C
C
C    IN ADDITION TO THE ENTRIES IN FILE: OUTFIL, THE COLLECTOR, DATE, TIME OF
C    OPENING, TIME OF CLOSING, AND LENGTH OF TIME COLLECTOR IS OPEN IS RECORDED
C    IN FILE:  RBFIL
      IMPLICIT INTEGER*4 (A-Z)
      CHARACTER*40 INFIL,OUTFIL,COLLA(10)*4,MONTH*3,ASCVALOL(10)*8,
     1ASCVALNE(10)*8,RBFIL*40
      LOGICAL*2 OPENOLD(10),OPENNEW(10)
      REAL*4  COLL(10), SDTIM(31,10), AVGTIM(31,10),JTIMOPN(31,10),JTIMO
     1PN2(31,10),ARGMT,XTIME(31,10,80)
      INTEGER*4 JDATE,ITIME,JTIME(31,10),JDAYS(10),EFLG,OLDDAY,
     1OLDTIME(10), TIMENEW(10)
      DATA COLLA/' A-1',' A-2',' A-3',' A-4',' A-5',' A-6',' L-1',' L-2'
```

```
     1,' L-3','NADP'/
110   FORMAT(I5,1X,I4,10(2X,F4.2))
      CALL TNOUA('ENTER MONTH AND YEAR (MMMYY)',INTS(28))
      READ(1,100) INFIL
100   FORMAT(A40)
      OUTFIL='OUT_'//INFIL
      RBFIL='RB_'//INFIL
      OPEN(UNIT=10,FILE=INFIL)
      OPEN(UNIT=11,FILE=RBFIL)
      OPEN(UNIT=12,FILE=OUTFIL)
C
C *********************************************************************
C
C INITIALIZE ARRAYS
C
C *********************************************************************
C
      DO 200 K=1,31
      DO 200 J=1,10
      JTIMOPN(K,J)=0.
      JTIMOPN2(K,J)=0.
      JTIME(K,J)=0
      SDTIM(K,J)=0.
      AVGTIM(K,J)=0.
      DO 200 JK=1,70
      XTIME(K,J,JK)=0.0
200   CONTINUE
C
C *********************************************************************
C
C INITIAL SET UP OF OPENNEW AND OPENOLD ARRAYS.  THE ARRAYS ARE 1 X 10
C AND INDICATE WHETHER THE COLLECTORS IN THE CURRENT LINE AND THE
C COLLECTORS IN THE PREVIOUS LINE(S) ARE OPEN OR CLOSED.  THEY ARE USED
C TO AID IN CALCULATING HOW LONG A COLLECTOR IS OPEN.
C
C *********************************************************************
C
      LINECT=1
C
C *********************************************************************
C
C BEGIN READING DATA FILE. SAVE NEW TIME IN THE ARRAY TIMENEW. THE ARRAY
C OPENOLD AND OPENNEW ARE COMPARED TO SEE IF COLLECTORS ARE OPEN OR
C CLOSED IN SUCCESSIVE DATA LINES. IF THE SAME VALUE IN BOTH ARRAYS, NO
C CHANGE IS MADE IN ARRAY TIMEOLD.
10    READ(10,110,ERR=5000,END=990) JDATE, ITIME,(COLL(J),J=1,10)
      IF(JDATE.NE.OLDDAY) THEN
              OLDDAY=JDATE
      DO 291 J=1,10
      OLDTIME(J)=ITIME
291   CONTINUE
      CALL DATCON(JDATE,K,MONTH,IYEAR,EFLG)
      IF(EFLG.EQ.1) THEN
                 WRITE(1,995)JDATE,ITIME
```

```
995             FORMAT(' ERROR IN DATA FILE AT ',I5,' TIME ',I5)
                GOTO 990
      ENDIF
      CALL COLLOG(COLL,OPENOLD,ASCVALOL)
      DO 286 J=1,10
      IF(OPENOLD(J).EQV..TRUE.) JTIME(K,J)=JTIME(K,J)+1
286   CONTINUE
178   FORMAT('DATE  TIME ',2(1X,I5))
      GOTO 10
      ELSE
C      CALL DATCON(JDATE,K,MONTH,IYEAR,EFLG)
C      IF(EFLG.EQ.1) THEN
C                WRITE(1,995)JDATE,ITIME
C                GOTO 990
C      ENDIF
      ENDIF
      CALL COLLOG(COLL,OPENNEW,ASCVALNE)
      DO 230 J=1,10
      IF((OPENNEW(J).EQV..TRUE.).AND.(OPENOLD(J).EQV..FALSE.))THEN
              OLDTIME(J)=ITIME
              JTIME(K,J)=JTIME(K,J)+1
      OPENOLD(J)=.TRUE.
                GO TO 230
      ENDIF
      IF((OPENNEW(J).EQV..FALSE.).AND.(OPENOLD(J).EQV..TRUE.)) THEN
              CALL TIMECONV(OLDTIME(J),ITIME,DIFF,EFLG)
              IF (EFLG.EQ.1) THEN
                        WRITE(1,15) JDATE, ITIME
15                      FORMAT('ERROR IN DATA FILE.. TIME2 LT TIME1',
     13X,'DATE ',2X,I5,2X,' TIME  ',I4)
                       GO TO 990
              ENDIF
      WRITE(11,486) COLLA(J),JDATE,OLDTIME(J),ITIME,DIFF
486   FORMAT(2X,A4,4(2X,I4))
                JTIMOPN(K,J)=JTIMOPN(K,J)+FLOAT(DIFF)
                JTIMOPN2(K,J)=JTIMOPN2(K,J)+FLOAT(DIFF)*FLOAT(DIFF)
                OPENOLD(J)=OPENNEW(J)
      IF((JTIME(K,J).GT.80).OR.(JTIME(K,J).LE.0)) THEN
                WRITE(1,387) K,J,JTIME(K,J)
387             FORMAT(1X,'JTIME(',I2,',',I2,')= ',I3)
                GOTO 990
      ENDIF
                XTIME(K,J,JTIME(K,J))=FLOAT(DIFF)
      ENDIF
230   CONTINUE
      LINECT=LINECT+1
      GOTO 10
990   CLOSE(10)
      CLOSE(11)
      WRITE(1,876)
876   FORMAT(' AT LABEL 990')
      DO 258 J=1,31
      WRITE(12,878) (JTIMOPN(J,K),K=1,10)
878   FORMAT(10(1X,F7.1))
```

```
258   CONTINUE
      DO 879 J=1,31
      WRITE(12,892) (JTIMOPN2(J,K),K=1,10)
892   FORMAT(10(1X,F10.1))
879   CONTINUE
      DO 880 J=1,31
      WRITE(12,875) (JTIME(J,K),K=1,10)
880   CONTINUE
875   FORMAT(10(1X,I4))
      WRITE(12,510)
510   FORMAT(3X,'DAY OF MONTH',2X,'COLLECTOR',2X,'STD DEV TIME',2X,
     1'AVERAGE TIME',2X,'NUMBER OF OPENINGS')
      DO 500 K=1,31
      DO 500 J=1,10
      IF(JTIME(K,J).EQ.0)GO TO 485
      AVGTIM(K,J)=JTIMOPN(K,J)/JTIME(K,J)
      IF(JTIME(K,J).LE.4) GOTO 485
      ARGMT=(JTIMOPN2(K,J)-JTIMOPN(K,J)*JTIMOPN(K,J)/FLOAT(JTIME(K,J)))/
     1(FLOAT(JTIME(K,J)-1))
      IF(ARGMT.LE.0.) GOTO 485
      SDTIM(K,J)=SQRT(ARGMT)
485   WRITE(12,520) K,COLLA(J),SDTIM(K,J),AVGTIM(K,J),JTIME(K,J)
520   FORMAT(9X,I4,8X,A4,7X,F7.3,5X,F7.3,12X,I3)
500   CONTINUE
      DO 509 K=1,31
      WRITE(12,519) K,INFIL
519   FORMAT(' LENGTH OF TIME SAMPLERS WERE OPEN ON ',I2,1X,A5)
      DO 509 J=1,10
      WRITE(12,529) COLLA(J)
529   FORMAT(' SAMPLER ',A4)
      WRITE(12,539) (XTIME(K,J,N),N=1,JTIME(K,J))
539   FORMAT(10(1X,F6.0),/)
509   CONTINUE
      CLOSE(12)
      STOP
5000  WRITE(1,5001) INFIL, LINECT
5001  FORMAT('ERROR IN FILE ',A40,' AT LINE NUMBER ',I5,//,'PROGRAM TER
     1MINATED')
      CLOSE(10)
      GO TO 990
999   WRITE(1,140) INFIL
140   FORMAT('NO DATA IN FILE  ',A40)
      STOP
1999  WRITE(1,1920) INFIL
1920  FORMAT('NO DATA IN FILE, (SECOND LINE READ)',A40)
      STOP
      END
      SUBROUTINE TIMECONV(TIME1,TIME2,DIFF,EFLG)
C
C
C ***********************************************************************
C
C
C CONVERTS TWO TIMES THAT ARE IN INTEGER FORMAT (E.G. 1458) TO A TIME
```

```
C DIFFERENCE IN MINUTES BETWEEN THE TWO TIMES.
C
C ********************************************************************
C
      IMPLICIT INTEGER*4 (T,D,M,E)
      EFLG=0
      IF(TIME2.LT.TIME1) THEN
              EFLG=1
              RETURN
      ENDIF
      TIMHR1=INT(TIME1/100)
      TIMHR2=INT(TIME2/100)
      TIMMIN1=TIME1-100*TIMHR1
      TIMMIN2=TIME2-100*TIMHR2
      IF(TIMMIN2.GE.TIMMIN1) THEN
              MINDIF=TIMMIN2-TIMMIN1
              HRDIF=(TIMHR2-TIMHR1)*60
              DIFF=MINDIF+HRDIF
      ELSE
              HRDIF=(TIMHR2-TIMHR1-1)*60
              MINDIF=TIMMIN2+(60-TIMMIN1)
              DIFF=MINDIF+HRDIF
      ENDIF
      RETURN
      END
      SUBROUTINE DATCON(JDATE,KDAY,MNTH,IYEAR,EFLG)
      INTEGER*4 DINMNTHL(12),DINMNTH(12),EFLG,IYEAR,KDAY,JDATE,JDAY
      CHARACTER*3 MNTHI(12),MNTH
      DATA DINMNTHL/31,29,31,30,31,30,31,31,30,31,30,31/
      DATA DINMNTH/31,28,31,30,31,30,31,31,30,31,30,31/
      DATA MNTHI/'JAN','FEB','MAR','APR','MAY','JUN','JUL','AUG','SEP',
     1'OCT','NOV','DEC'/
      EFLG=0
      IYEAR=INT(JDATE/1000)
      KDAY=MOD(JDATE,1000)
      IF(KDAY.GT.366.OR.KDAY.LE.0) THEN
                 EFLG=1
                 RETURN
      ENDIF
      JDAY=MOD((JDATE/1000),4)
      IF(JDAY.EQ.0) THEN
              DO 100 J=1,12
              IF(KDAY.GT.DINMNTHL(J)) THEN
                   KDAY=KDAY-DINMNTHL(J)
              ELSE
                   MNTH=MNTHI(J)
                   RETURN
              ENDIF
100           CONTINUE
      ELSE
              DO 200 J=1,12
              IF(KDAY.GT.DINMNTH(J)) THEN
                   KDAY=KDAY-DINMNTH(J)
              ELSE
```

```
                MNTH=MNTHI(J)
                RETURN
            ENDIF
200         CONTINUE
      ENDIF
      END
      SUBROUTINE COLLOG(VOLT,VALUE,ASCIVAL)
C     SUBROUTINE TO DETERMINE WHETHER A COLLECTOR IS OPEN OR CLOSED.
C     IF COLLECTOR VOLTAGE IS GREATER THAN 8, IT IS ASSUMED TO BE OPEN,
C     AND IS ASSIGNED A LOGICAL VALUE OF .TRUE.  IF THE VOLTAGE IS LT THAN
C     8, VALUE IS ASSIGNED A LOGICAL VALUE OF .FALSE.
      REAL*4 VOLT(10)
      LOGICAL*2 VALUE(10)
      CHARACTER*8 ASCIVAL(10)
      DO 100 J=1,10
      IF(VOLT(J).GE.6.) THEN
               VALUE(J)=.TRUE.
               ASCIVAL(J)='TRUE'
      ELSE
               VALUE(J)=.FALSE.
               ASCIVAL(J)='FALSE'
      ENDIF
100   CONTINUE
      RETURN
      END
```

*U.S. G.P.O. 1987-181-407:60029