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RAINFALL TOTAL PHOSPHORUS CONCENTRATIONS AND LOADINGS IN EVERGLADES NATIONAL PARK

prepared for

Environ Corporation
and
U.S. Department of Justice

by

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Atmospheric phosphorus loadings (rainfall + dry deposition) are relevant to computation of historical nutrient balances for the Water Conservation Areas and Everglades National Park. These balances provide important frames of reference for evaluating historical trends and for projecting impacts of alternative nutrient control schemes. Rainfall phosphorus concentration has been suggested as an appropriate target level for treatment of agricultural runoff to avoid adverse impacts on the WCA/ENP ecosystems. Results described below indicate that average total phosphorus concentrations of .005, .009, and .014 ppm are appropriate for computing annual atmospheric loadings (wet, dry, and total deposition, respectively) in the vicinity of the Everglades National Park Research Center, based upon data collected by SFWMD primarily in 1988.

Estimates of rainfall phosphorus concentrations in Florida vary widely, depending upon region, monitoring location, sampling period, data-collection technique, data-reduction technique, and investigator. Figure 1 shows estimates reported by Richardson (1989). Average concentrations range from .01 to .10 ppm for various stations. Note that the reported confidence ranges for individual values are wide; for example, the average concentration at S5A (Loxahatcheee) is .09 +/- .13 ppm (not significantly different from 0 ppm). The basis for the "State-Wide Average" concentration of .10 +/- .08 ppm is unknown. This estimate seems inconsistent with the other values shown; how could the average exceed all of the values reported for individual sites?

Figure 2 shows annual-average concentrations and loadings used by SFWMD in computing phosphorus balances for the Water Conservation Areas between 1978 and 1986 (SFWMD, undated). Annual average phosphorus concentrations range from .006 to .119 ppm and loadings range from 6.5 to 153 mg/m^2-yr.

More detailed discussion of the above estimates is precluded by lack of documentation, including sampling techniques, raw data values, data screening procedures, precipitation volumes, and computation techniques. It is possible that differences in computation techniques (for a given data set) account for a significant portion of the variability in the results. As demonstrated below, estimates of average concentration and annual atmospheric loading may vary by as much as a factor 2.4, depending upon whether or not the sample concentrations are volume-weighted.

A systematic analysis of factors contributing to variability in atmospheric phosphorus sources would involve compilation of raw data values from various locations, application of consistent data screening procedures, and use of appropriate computation methods to develop unbiased load estimates and confidence intervals. In this way, "true" variability associated with location and year could be distinguished from variability associated with inadequate sampling, errant observations, and inappropriate computation methods. Additional effort would be required to compile the appropriate data sets.

Rainfall and dustfall data collected by the South Florida Water Management District at the Everglades National Park Research Center between November 1987 and April 1989 are analyzed below. Results provide quantitative estimates of wet and dry atmospheric phosphorus loadings in this region of Florida, which may be representative of loadings to ENP as a whole. Results also demonstrate the importance of considering rainfall volumes in calculating annual-average concentrations and loadings.

Table 1 lists total phosphorus measurements obtained from the SFWMD computer for 25 dates between November 1987 and April 1989. "Wet" concentrations refer to direct measurements of rainfall collected (and refrigerated) between each sampling date. The "wet" sampling container was closed during periods of no rainfall. "Dry" concentrations refer to dry deposition between each sampling date. The "dry" sampling container was closed during periods of rainfall. A volume of distilled water equal to that collected in the wet container was added to the dry container prior to analysis. The sum of the wet and dry concentrations times the interval rainfall volume determines the total atmospheric phosphorus load per unit area during each sampling interval. As noted in Table 1, one phosphorus measurement (.948 ppm on April 4, 1989) has been excluded from the analysis, based upon the fact that it is inconsistent with the other values, which range from .001 to .102 ppm.

Rainfall volumes associated with each phosphorus sample were not provided with the SFWMD concentration data. These have been derived independently from the continuous rainfall gauge in Homestead, as recorded in the SFWMD hydrologic data base (Station = "HOMES.FS"). Daily rainfall data for the sampling period are listed in the Appendix. "Interval Rainfall" values listed in Table 1 refer to the total rainfall between successive sampling dates, as derived from the daily rainfall record.

Phosphorus concentrations (wet, dry, total) are plotted vs. sampling date in Figure 3. Figure 4 shows corresponding interval rainfall values. Figure 3 shows that phosphorus variations are not random with respect to time, but vary with season and/or rainfall volume. Lower phosphorus concentrations (.004-.010 ppm) were observed during the wet months of June, July, and August 1988, which accounted for 65% of the total rainfall volume during the sampling period. In contrast, concentrations ranged from .01 to .11 ppm during other, drier periods.

The tendency for lower concentrations to occur during wet periods may reflect cleansing of the atmosphere under heavy rainfall and/or greater atmospheric sources (dust generation) during dry periods. Reckhow and Chapra (1983) note that there is "a general consensus among investigators that storms off the ocean are low in phosphorus, and the major source of phosphorus in rain is most often dust from the land".

A scatter plot of phosphorus concentrations against interval rainfall volume is shown in Figure 5. It is apparent that sampled concentrations are negatively correlated with rainfall volume. In this situation, the concentration/volume relationship must be considered in order to develop unbiased estimates of annual atmospheric load and annual average concentration, just as flow/concentration relationships must be considered in developing unbiased estimates of annual loadings from stream sampling data (Walker, 1981; 1987). The simplest approach is to weight each concentration measurement based upon interval rainfall volume, as recommended by Reckhow and Chapra (1983) for calculation of atmospheric loadings. Weighted-mean and simple-mean concentrations are computed from the following equations:

$$C_w = \text{SUM}\ (C_i\ R_i)\ /\ \text{SUM}\ (R_i)$$

$$C_m = \text{SUM}\ (C_i)\ /\ n$$

where,

C_w = weighted-mean concentration (ppm)

C_m = simple-mean concentration (ppm)

C_i = sample concentration (wet, dry, or total) (ppm)

R_i = interval rainfall (inches)

SUM = sum over all samples

n = number of samples

Estimates of simple and weighted means and standard errors are given in Table 2 for each component (wet, dry, and total). The first set

of estimates is based upon all observations. The second set is based upon data from one complete year (November 12, 1987 -November 11, 1988). The latter provides seasonally balanced estimates, as summarized in Figure 6. The importance of volume-weighting is reflected by the difference between the unweighted (.035 +/- .0074 ppm) and weighted (.014 +/- .0031 ppm) mean concentrations for total deposition. An estimate of annual phosphorus loading in rainfall based upon unweighted sample means would be biased by a factor of 2.4 (= .034/.014).

Cumulative loadings for wet and total deposition are plotted vs. time in Figure 7. The slopes of these lines are proportional to rates of deposition per unit area, typically expressed in milligrams/m^2-yr. For the period from November 12, 1987 to November 11, 1988, average deposition rates were 8 mg/m^2-yr (wet), 15.7 mg/m^2-yr (dry), and 23.7 mg/m^2-yr (total). Wet deposition accounted for approximately one third of the total. The total precipitation over this year-long period was 65 inches. The total deposition rate is within the range reported by Reckhow et al. (1980) for atmospheric deposition rates in 15 forested watersheds in North America (7 to 54 mg/m^2-yr, median = 26 mg/m^2-yr).

Assumptions regarding atmospheric sources of phosphorus have important impacts on phosphorus loading computations for the Water Conservation Areas. As indicated in Figure 2, rainfall concentrations and areal loadings used by SFWMD in computing phosphorus budgets for 1978-1986 varied considerably and often exceeded values derived above from the monitoring station at the ENP Research Center. The extent to which these differences are due to improper calculation methods (failure to volume-weight) is unknown. The extent to which similar concentration vs. volume relationships are characteristic of data from other monitoring stations is also unknown.

As shown in Figure 8, rainfall loads account for a significant fraction of the total loads to the WCA's, particularly in 1984-1986, when assumed rainfall concentrations were relatively high (.05-.12 ppm). WCA loading estimates for these years may be seriously in error and provide a poor basis for designing or evaluating remedial measures. In particular, they may provide a poor basis for evaluating the sensitivity of total loadings (atmospheric + surface flows) to assumed target concentrations for treatment of agricultural runoff.

Compilation and analysis of the entire SFWMD precipitation data base is recommended as a basis for evaluating site-to-site variations in rainfall quality and loading using appropriate data screening and calculation methods. Similar computation problems may exist in loading estimates for other terms in the nutrient balances (gate inflows and outflows). The best possible technical fix on historical nutrient and water balances of the WCA's should be developed to provide an improved basis for evaluating remedies.

REFERENCES

Reckhow, K.H., M.N. Beaulac, J.T. Simpson, "Modeling Phosphorus Loading and Lake Response Under Uncertainty: A Manual and Compilation of Export Coefficients", prepared for Clean Lakes Section, U.S. Environmental Protection Agency, Washington, DC, June 1980.

Reckhow, K.H. and S.C. Chapra, Engineering Approaches for Lake Management, Vol. 1: Data Analysis and Empirical Modeling, Butterworth Publishers, Boston, 1983.

Richardson, C.J., "Ecological Analysis of the Water Conservation Areas: A Preliminary Analysis", presentation before Governing Board of Directors, SFWMD, Workshop, August 5,1989.

SFWMD, "WCA Material Budget Methodology", Data Tables, Water and Nutrient Balances for WCA's, 1978-1986, undated.

Walker, W.W., "Empirical Methods for Predicting Eutrophication in Impoundments, Report 1, Data Base Development", prepared for Office of the Chief, U.S. Army Corps of Engineers, Technical Report E-81-9, USAE Waterways Experiment Station, Vicksburg, Mississippi, 1981.

Walker, W.W., "Empirical Methods for Predicting Eutrophication in Impoundments, Report 4, Applications Manual", prepared for Office of the Chief, U.S. Army Corps of Engineers, Technical Report E-81-9, USAE Waterways Experiment Station, Vicksburg, Mississippi, 1987.

Table 1
Rainfall Total Phosphorus Measurements
Collected by SFWMD at ENP Research Center

DATE	TOTAL PHOSPHORUS (PPM) DRY	WET	TOTAL	INTERVAL RAIN INCHES
11/17/87	0.019	0.015	0.034	3.15[a]
12/01/87	0.038	0.016	0.054	0.43
12/15/87	0.024	0.007	0.031	1.77
01/12/88	0.102	0.009	0.111	1.04
01/27/88	0.007	0.007	0.014	1.00
03/25/88		0.025		1.42
04/06/88	0.007	0.008	0.015	0.30
05/03/88	0.006	0.004	0.010	5.03
05/20/88	0.024	0.009	0.033	2.11
06/08/88	0.002	0.002	0.004	8.81
06/29/88	0.007	0.003	0.010	9.24
07/12/88	0.001	0.003	0.004	6.06
08/26/88	0.006	0.004	0.010	18.16
09/08/88	0.026	0.007	0.033	2.40
09/22/88	0.016	0.006	0.022	2.36
10/07/88	0.006	0.004	0.010	4.40
10/21/88	0.051	0.040	0.091	0.40
11/04/88	0.032	0.014	0.046	0.07
11/17/88	0.017	0.079	0.096	0.01
01/11/89				1.05
01/27/89	0.009	0.027	0.036	0.88
02/07/89	0.025			0.00
03/09/89	0.025			1.39
03/30/89	0.053			0.00
04/04/89	0.033	(0.948)[b]		1.35

a 11/01/87 starting date assumed
b sample value excluded from analysis

Table 2

Estimates of Mean Total Phosphorus in Rainfall at ENP Research Center

Total Phosphorus Concentration (ppm)

Comp.	Samples	Simple Means Mean	Std. Error.	Volume-Weighted Means Mean	Std. Error	Precip. Inches
---------- All Data, Nov 11, 1987 - April 4, 1989 ----------						
DRY	23	.023	.0047	.011	.0026	70.4
WET	20	.015	.0040	.006	.0011	69.0
TOTAL	19	.035	.0074	.015	.0032	67.6
---------- One Year, Nov 18 1987-Nov 17, 1988 ----------						
DRY	18*	.021	.0057	.009	.0025	65.0
WET	18	.014	.0044	.005	.0008	65.0
TOTAL	18	.035	.0078	.014	.0031	65.0

* one missing sample value estimated by interpolation

Figure 1
Florida Rainfall Phosphorus Concentrations
Reported by Richardson (1989)

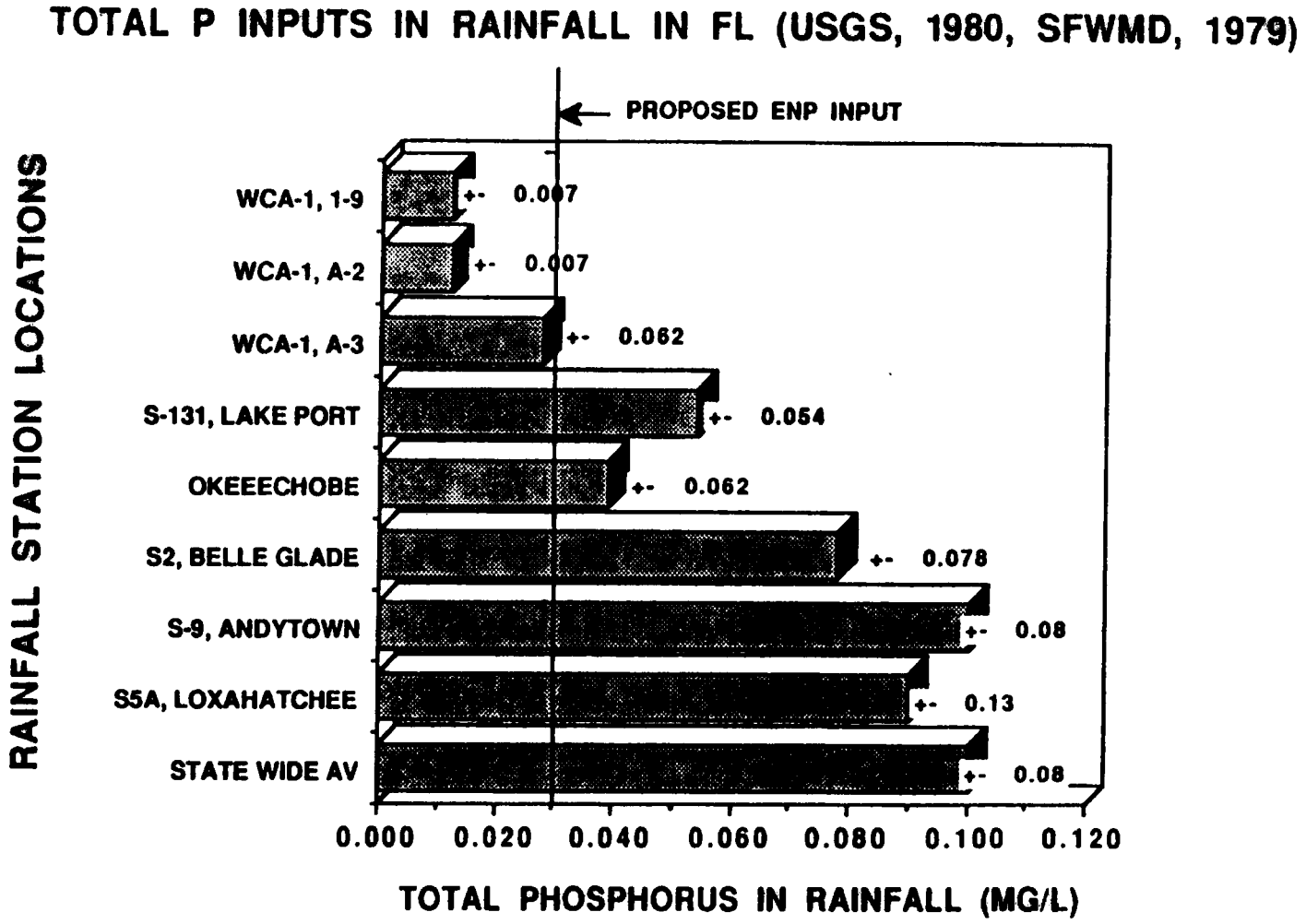


Figure 2
Rainfall Phosphorus Concentrations and Loadings Assumed by SFWMD in Developing Phosphorus Budgets for the Water Conservation Areas (SFWMD, undated)

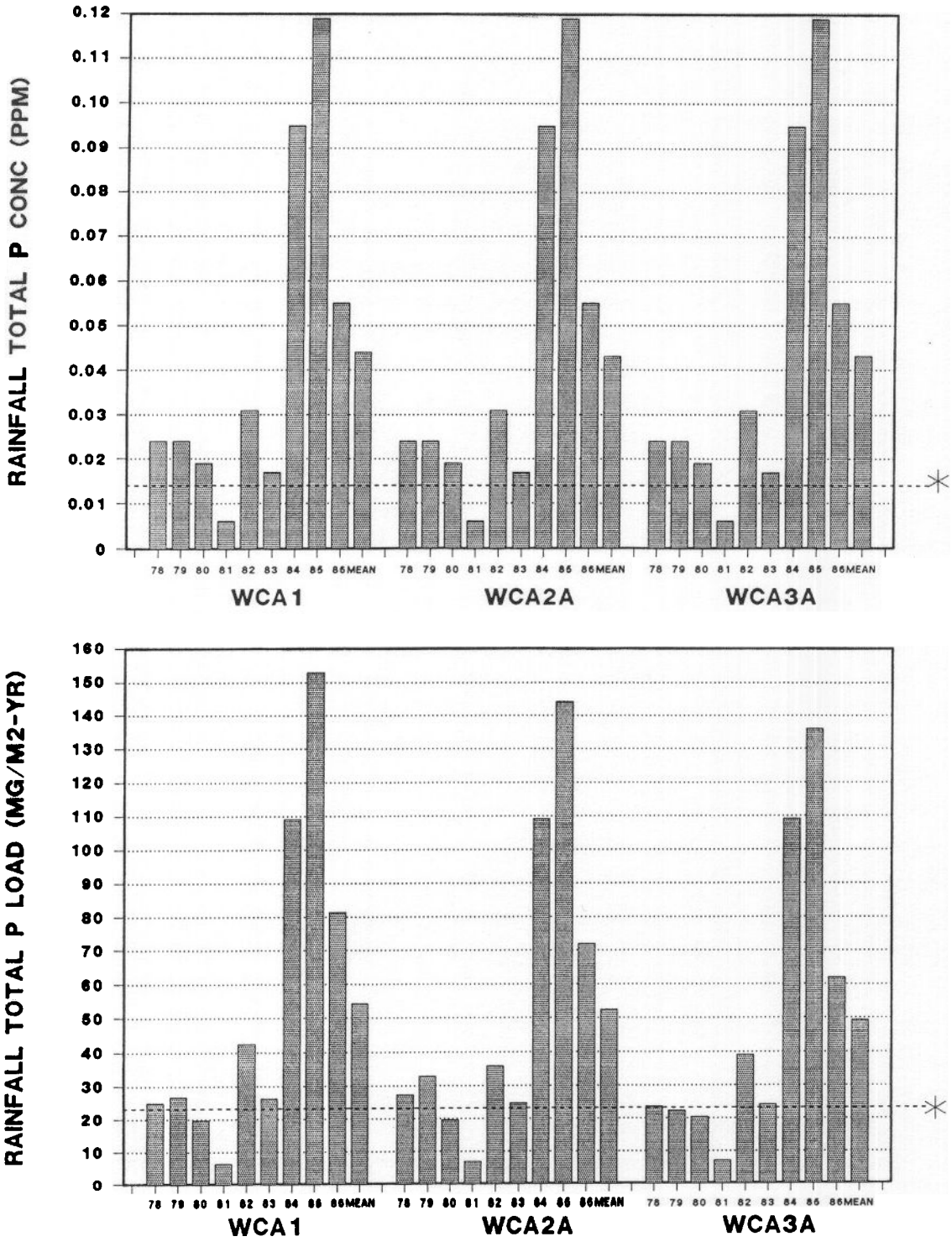


Figure 3
Rainfall Total Phosphorus Concentrations at ENP Research Center

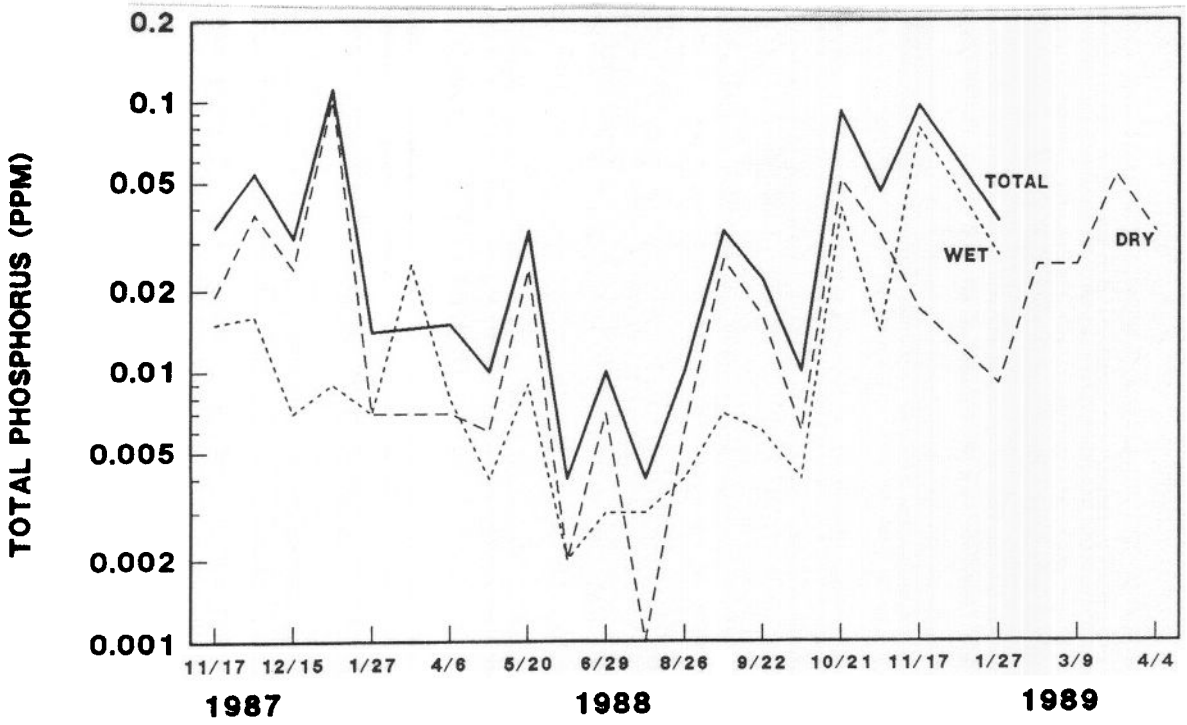


Figure 4
Interval Rainfall vs. Time

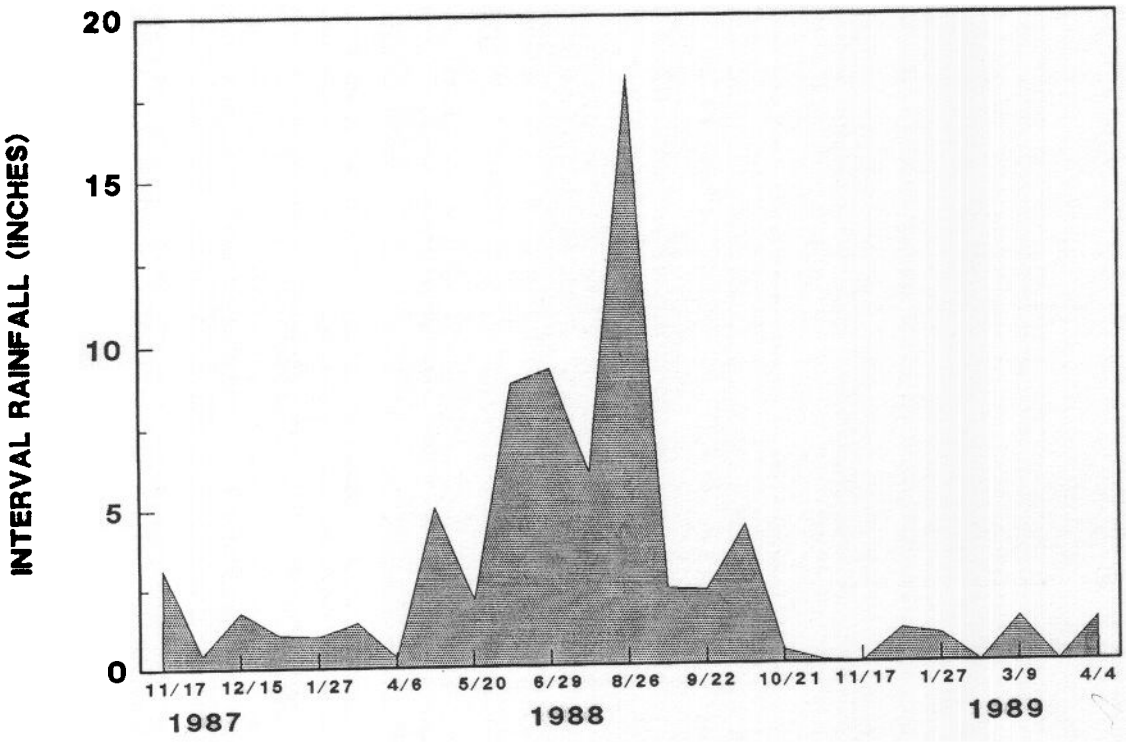


Figure 5
Scatter Plot of Rainfall Total Phosphorus vs. Interval Rainfall

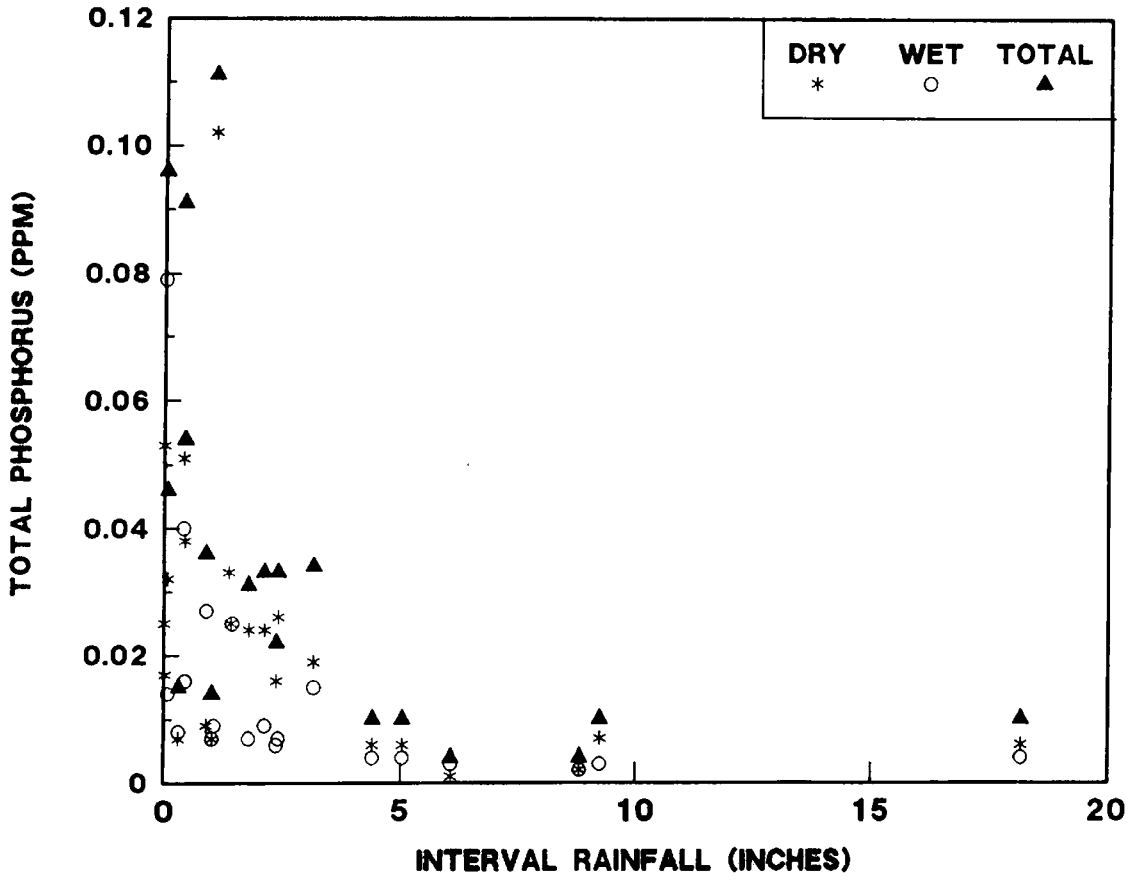


Figure 6
Estimates of Mean Total Phosphorus Concentration in Rainfall
ENP Research Center

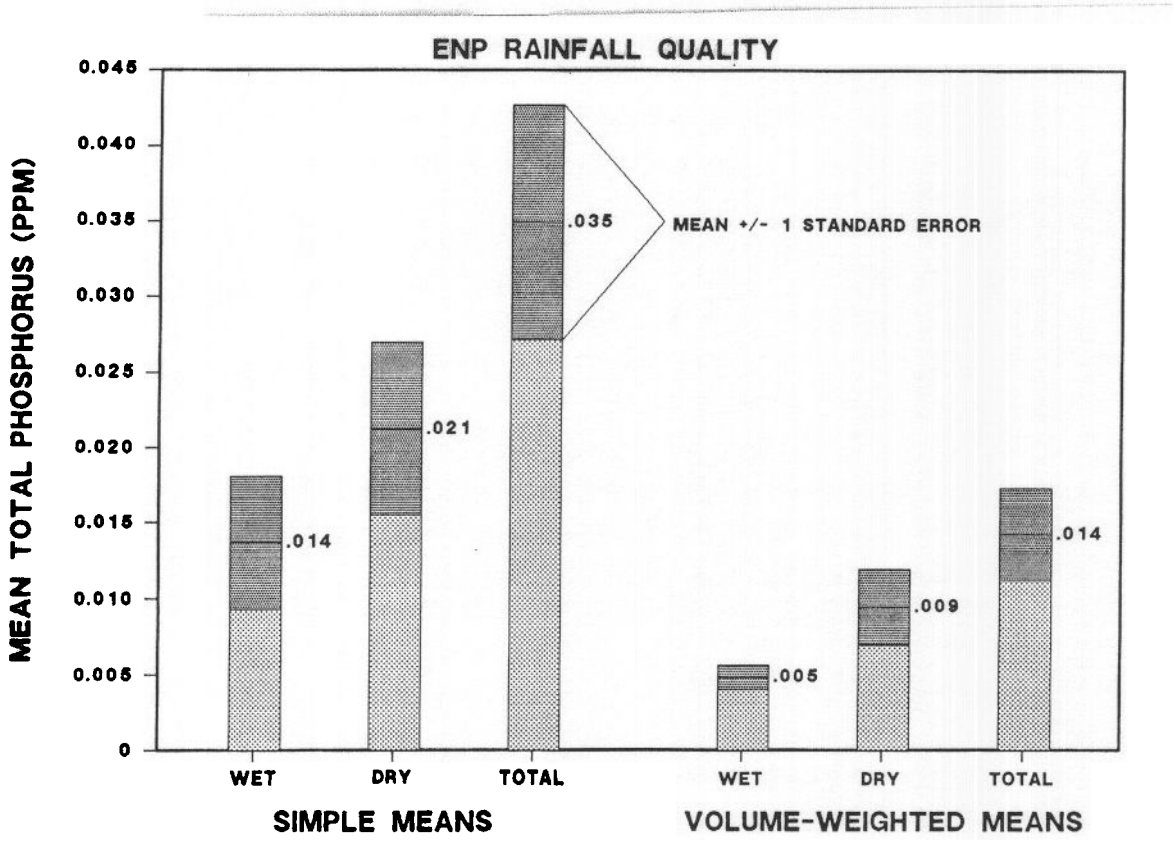


Figure 7
Cumulative Atmospheric Phosphorus Load vs. Time
ENP Research Center

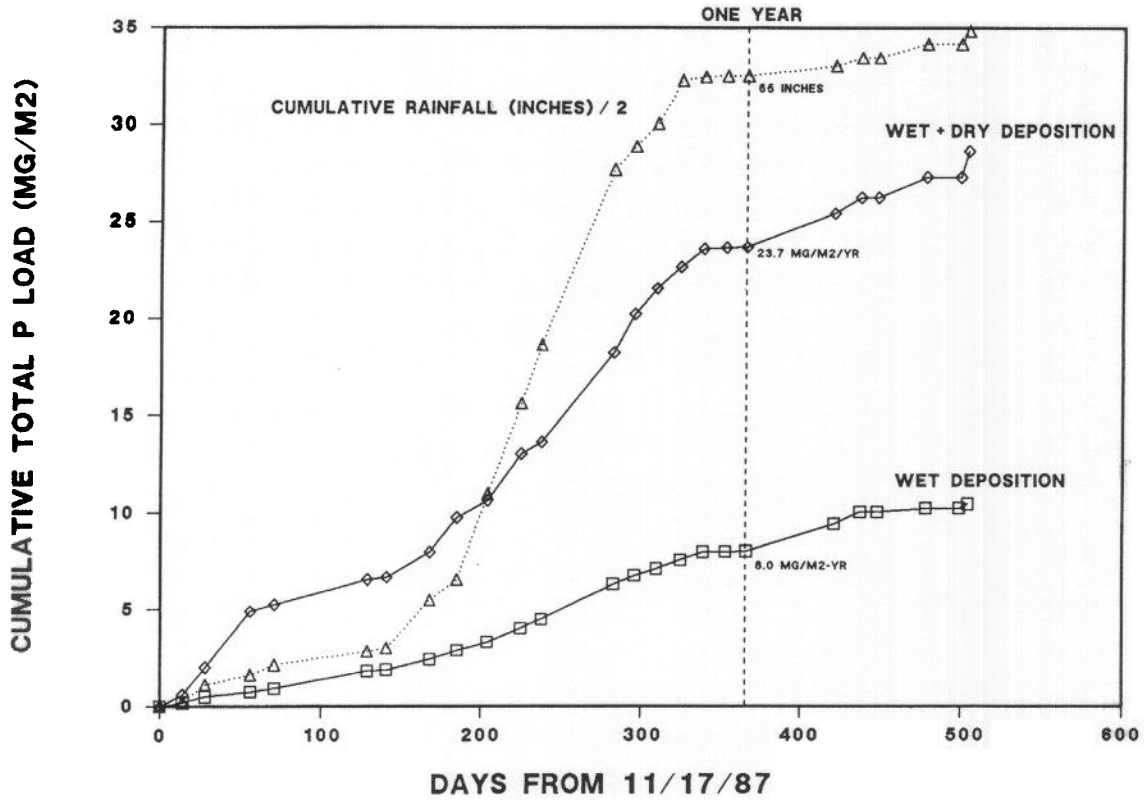
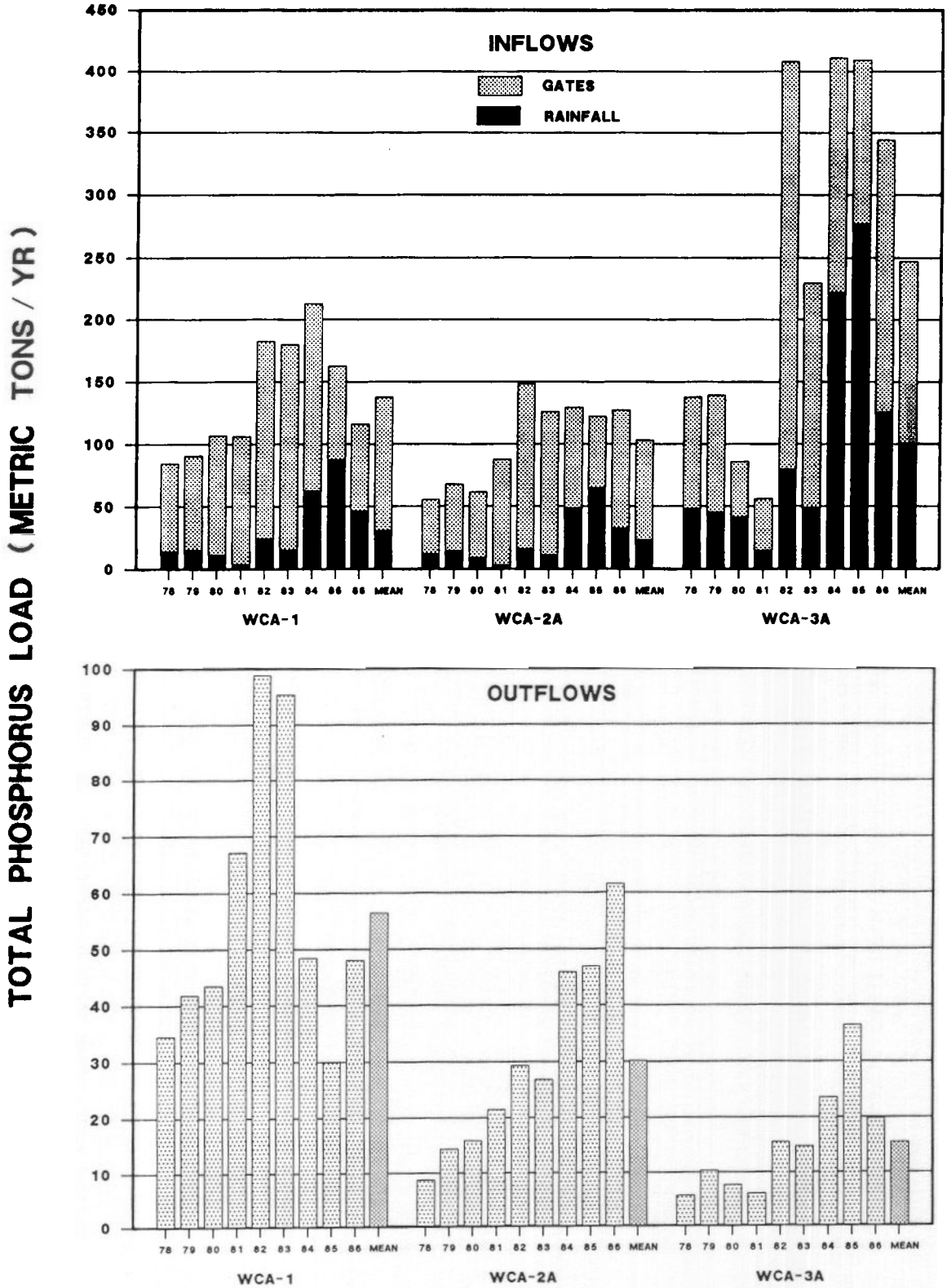


Figure 8
Phosphorus Inflow Load and Outflow Load Estimates for Water Conservation Areas, 1978-1986



REFERENCE: "WCA MATERIAL BUDGET METHODOLOGY", SFWMD
NUTRIENT AND WATER BALANCE TABLES, 1978-1986, UNDATED.

APPENDIX

Daily Rainfall Data for Sampling Period

*** STATION: HOMES.FS *** HOMESTEAD FIELD STATION 89/08/14.

LATITUDE : 252838 RAINFALL INCHES AGENCY: WMD

LONGITUDE : 802655 SUM FOR SPECIFIED INTERVAL COUNTY: DADE

DAY	1987 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	1.40	.00	.00X	.15	.00	.14A	.00	.00X	.00	2.48	.00X	.02	1
2	.02	.00	.10A	.00	.00	.00	.02	.00X	.13	.04	1.74A	.00	2
3	.00X	.00	.90	.00	.00	.00	.00X	.02A	.02	.00	.58	.00	3
4	.00X	.00	.45	.00	.00	.00	.00X	1.35	.18	.00	.12	.00	4
5	.77A	.00	.00	.00	.00	.00	.00X	.03	.00X	.00	.38	.00	5
6	.00	.00	.05	.00	.00	.00X	.69A	.04	.00X	.00	.07	.00	6
7	.00	.00X	.00X	.00	.00	.00X	.07	.00	.00X	.00	.00X	.00	7
8	.00	.00X	.00X	.01	1.06	.14A	.00	.00X	1.73A	.00	.00X	.00	8
9	.00	.29A	.28A	.00	.00X	.00	.00	.00X	.10	.00	.24A	1.56	9
10	.00	.00	.00	.00	.00X	.72	.10	.07A	.00	1.66	.02	.19	10
11	.00	.00	.00	.00	.72A	.17	.00X	2.75	.00X	.74	.00	.00	11
12	.00	.00	.00	.00	.64	.00	.00X	.14	.00X	1.36	.00	.00X	12
13	.00	.00	.00	.00	.00	.00	.44A	.61	.00X	1.03	.00	.00X	13
14	.00	.00	.00	.01	.57	.00	.00	.02	.34A	.01	.00	.02A	14
15	.00	.00	.00	.00	.02	.00	.04	.00	.06	.43	.00	.00	15
16	.00	.00	.00	.07	.00X	.00	.85	.00	.05	.13	.00	.02	16
17	.00	.30	.00	.00	.00X	.00	.44	.00	.02	.00	.00	.00	17
18	.00	.02	.00	.00X	.09A	.00	.00X	.00	.69	.00	.00	.00	18
19	.00	1.50	.00	.00X	.11	.00	.00X	.00	.00X	.00	.11	.00	19
20	.00	.00	.00	.09A	.62	.00X	3.05A	.00	.00X	.00	.16	.00	20
21	.00	.00	.00X	.00	.08	.00X	.05	.00	.53A	.00	.00X	.00	21
22	.00	.00	.00X	.00	.00	2.02A	.78	.00X	1.03	.00	.00X	.00	22
23	.21	.00	.34A	.00	.00X	.00	.00	.00X	.00	.00	.02A	.00	23
24	.00X	.00	.00	.00	.00X	.00	.00	.02A	.13	.00X	.05	.00	24
25	.00X	.27	.94	.00	.00X	.10	.00X	.14	.03	.00X	.00	.00	25
26	.05A	.16	.01	.00	.01A	.28	.00X	.02	.00X	.30A	.00X	.00	26
27	.00	.00	.00	.00	.03	.00X	.30A	.33	.00X	.00	.00X	.00	27
28	.00	.00X	.00	.00	.15	.00X	.00	.04	2.96A	.00	.00X	.00	28
29	.00		.00	.00	.13	1.09A	.13	.00X	1.43	.00	.00X	.00	29
30	.00		.00	.00	.00X	.02	.00	.00X	.01	.00	.07A	.01	30
31	.00		.23		.00X		.03	.27A		.00		.00	31
MAX	1.40	1.50	.94	.15	1.06	2.02A	3.05A	2.75	2.96A	2.48	1.74A	1.56	
MEAN	.08	.09	.11	.01	.14	.16	.23	.19	.31	.26	.12	.06	
MIN	.00X	.00	.00X	.00	.00	.00	.00	.00X	.00	.00	.00X	.00	
SUM	2.45	2.54	3.30	.33	4.23	4.68	6.99	5.85	9.44	8.18	3.56	1.82	

D A T A T A G L E G E N D

M - MISSING DATA
S - ORIGINAL HAD MORE THAN 4 SIG DIGITS
L - LINE-AVERAGE
? - QUESTIONABLE
> - GREATER THAN
T - TRACE AMOUNT
G - AMOUNT ACCUMULATED WAS GREATER THAN

D A T A T A G L E G E N D

V - NO DATA COLLECTED
P - SUMMARY COMPUTED FROM PARTIAL RECORD
E - ESTIMATED
< - LESS THAN
A - INCLUDES PREVIOUS DAYS WITH X
X - INCLUDED IN NEXT AMOUNT TAGGED A

*** STATION: HOMES.FS *** HOMESTEAD FIELD STATION 89/08/14.

LATITUDE : 252838 RAINFALL INCHES AGENCY: WMD

LONGITUDE : 802655 SUM FOR SPECIFIED INTERVAL COUNTY: DADE

DAY	1988 JAN	FEB	MAR	APR	1988 MAY	JUN	JUL	1988 AUG	SEP	OCT	1988 NOV	DEC	DAY
1	.00X	.00	.00	.00	.00X	.06	.07	.34A	.67	.00X	.07	.07	1
2	.00X	.01	.00	.00	2.65A	1.07	.00X	.18	.68	2.50A	.00	.00	2
3	.00X	.00	.00	.00	.05	.02	.00X	.00	.00X	.03	.00	.00	3
4	.24A	.00	.03	.00	.00X	.00	.00X	.00	.00X	.00	.00	.00	4
5	.01	.00	.00X	.00	.00X	.00	3.15A	.00	.00X	.44	.00	.00	5
6	.02	.00	.00X	.00	.00X	.00	.04	.00X	.02A	.16	.00	.00	6
7	.00	.00	.01A	.00	.00X	.83	.00	.00X	.21	.00X	.00	.00	7
8	.09	.00	.00	.00	.00X	2.10	.01	.14A	.01	.00X	.00	.00	8
9	.00X	.24	.00	.00	.00X	3.36	.00X	1.02	.28	.00X	.00	.00	9
10	.00X	.05	.00	.00	.00X	.00X	.00X	.00	.00X	.28A	.00	.00	10
11	.65A	.00	.12	.00	.00X	.00X	1.21A	1.17	.00X	.00	.00	.00	11
12	.00	.00	.00	.00	.00X	.00X	.46	.68	.48A	.00	.00	.00	12
13	.00	.00	.00	.02	.00X	1.53A	.00	.00X	.00	.00	.01	.01	13
14	.00	.00	.00	.00	.00X	.59	.05	.00X	.11	.00	.00	.00	14
15	.20	.00	.08	.00	.00X	.93	.00	5.03A	.07	.00	.00	.00	15
16	.00X	.00	.00	.00	.72A	.01	.00X	2.80	.03	.00	.00	.00	16
17	.00X	.00	.00	.00	.27	.00	.00X	.00	.00X	.00	.00	.00	17
18	.00X	.00	.00	.00	.33	.00X	.98A	.00	.00X	.00	.00	.00	18
19	.19A	.01	.00X	.00	.05	.00X	1.15	.43	.07A	.12	.00	.00	19
20	.00	.00X	.00X	.00	.74	.36A	1.37	.00X	.00	.00	.00	.00	20
21	.00	.00X	.38A	.03	.00X	2.46	.00	.00X	.00	.00	.02	.02	21
22	.53	.48A	.00	.00	.00X	.00	.00X	1.13A	1.32	.00	.03	.03	22
23	.00X	.00	.00	.00	.23A	.00	.00X	.00	.00	.00	.02	.02	23
24	.00X	.00	.00	.00	.00	.00	.00X	.00	.00X	.00	.00X	.00X	24
25	.02A	.00	.00	.00	.00	.00	.20A	.00	.00X	.00	.00X	.00X	25
26	.06	.00	.00X	2.28	1.32	.00	.17	.00	.84A	.00	.00X	.00X	26
27	.00	.00X	.00X	.00	.81	.00	.00	.00X	.00	.00	.31A	.31A	27
28	.00	.00X	.30A	.00	.00X	.00	.93	.00X	.32	.00	.00	.00	28
29	.00	.01A	.00	.00	.00X	.00	.39	.41A	.00	.00	.00	.00	29
30	.00		.00	.00X	.00X	1.12	.00X	.02	.11	.00	.00	.00	30
31	.00		.00		2.37A		.00X	.38		.00		.00	31
MAX	.65A	.48A	.38A	2.28	2.65A	3.36	3.15A	5.03A	1.32	2.50A	.31A	.31A	
MEAN	.06	.03	.03	.08	.31	.48	.33	.44	.17	.11	.02	.01	
MIN	.00X	.00	.00	.00	.00X	.00	.00X	.00	.00X	.00X	.00	.00	
SUM	2.01	.80	.92	2.33	9.54	14.44	10.18	13.73	5.22	3.53	.46	.46	

D A T A T A G L E G E N D

M - MISSING DATA
S - ORIGINAL HAD MORE THAN 4 SIG DIGITS
L - LINE-AVERAGE
? - QUESTIONABLE
> - GREATER THAN
T - TRACE AMOUNT
G - AMOUNT ACCUMULATED WAS GREATER THAN

D A T A T A G L E G E N D

V - NO DATA COLLECTED
P - SUMMARY COMPUTED FROM PARTIAL RECORD
E - ESTIMATED
< - LESS THAN
A - INCLUDES PREVIOUS DAYS WITH X
X - INCLUDED IN NEXT AMOUNT TAGGED A

*** STATION: HOMES.FS ***
LATITUDE : 252838
LONGITUDE : 802655

HOMESTEAD FIELD STATION
RAINFALL INCHES
SUM FOR SPECIFIED INTERVAL

AGENCY: WMD
COUNTY: DADE

89/08/14.

DAY	1989 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	.00	.00	.04	.77	1.15	.00	V	V	V	V	V	V	1
2	.00	.00X	.00	.00	.17	.00	V	V	V	V	V	V	2
3	.00	.00X	.00	.00	.00	.00	V	V	V	V	V	V	3
4	.00	.00X	.00	.56	.00	.00	V	V	V	V	V	V	4
5	.00	.00X	.00	.02	.04	.00	V	V	V	V	V	V	5
6	.00	.00X	.00	.14	.00X	.00	V	V	V	V	V	V	6
7	.00	.00X	.58	.00X	.00X	1.24	V	V	V	V	V	V	7
8	.00	.00X	.00	.00X	.38A	.30	V	V	V	V	V	V	8
9	.00	.00X	.05	.00X	.00	.00X	V	V	V	V	V	V	9
10	.01	.00X	.00	.00X	.00	.00X	V	V	V	V	V	V	10
11	.20	.00X	.00	.00X	.00	.00X	V	V	V	V	V	V	11
12	.00	.00X	.00	.00X	.00	.00X	V	V	V	V	V	V	12
13	.00	.00X	.00	.00X	.00	.00X	V	V	V	V	V	V	13
14	.00	.00X	.00	.00X	.00	.00X	V	V	V	V	V	V	14
15	.00	.00X	.00	.00X	.00	.00X	V	V	V	V	V	V	15
16	.00	.00X	.00	.00X	.24	.00X	V	V	V	V	V	V	16
17	.00	.00X	.00	.80A	.43	.00X	V	V	V	V	V	V	17
18	.00	.00X	.00	.94	.17	.00X	V	V	V	V	V	V	18
19	.00	.00X	.00	.02	.21	.11A	V	V	V	V	V	V	19
20	.01	.00X	.00	.00	.00	.00	V	V	V	V	V	V	20
21	.00X	.48A	.00	.25	.00	.02	V	V	V	V	V	V	21
22	.00X	.14	.00	.00X	.00	.03	V	V	V	V	V	V	22
23	.85A	.10	.00	.00X	.00	.02	V	V	V	V	V	V	23
24	.00	.00	.00	.67A	.00	.00X	V	V	V	V	V	V	24
25	.00	.00	.00	.00	.40	.00X	V	V	V	V	V	V	25
26	.02	.00	.00	.00	.00X	.17A	V	V	V	V	V	V	26
27	.00	.00	.00	.00	.00X	2.47	V	V	V	V	V	V	27
28	.00	.00	.00	.00	.00X	.45	V	V	V	V	V	V	28
29	.00		.00	.00	.00X	.57	V	V	V	V	V	V	29
30	.00		.00	.00	.06A	.02	V	V	V	V	V	V	30
31	.00		.00		.17		V	V		V		V	31
MAX	.85A	.48A	.58	.94	1.15	2.47							
MEAN	.04	.03	.02	.14	.11	.18							
MIN	.00	.00	.00	.00	.00	.00							
SUM	1.09	.72	.67	4.17	3.42	5.40							

D A T A T A G L E G E N D

M - MISSING DATA
S - ORIGINAL HAD MORE THAN 4 SIG DIGITS
L - LINE-AVERAGE
? - QUESTIONABLE
> - GREATER THAN
T - TRACE AMOUNT
G - AMOUNT ACCUMULATED WAS GREATER THAN

D A T A T A G L E G E N D

V - NO DATA COLLECTED
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