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Report of

Water Quality
and
Heavy Metals Analysis

for

February 24, - November 2, 1976

and

April 6 - October 19, 1976

to

Metropolitan Edison Company
Three-Mile Island Nuclear Station

(TMI-1)

by

1565 009

Millersville State College

January 1977

Thomas Greco

THOMAS G. GRECO, Ph.D.

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Introduction

Section 4.2.1. of the Environmental Technical Specifications (E.T.S.) for Three-Mile Island (TMI-1) Nuclear Station requires the monthly sampling of surface water from invertebrate monitoring stations 2 and 3 (Figure 1) and analysis for heavy metals (Cu, Cr, Fe, Mn, Ni and Zn). Station 2 serves as the upstream site, while station 3 serves as the plant discharge site. This report presents the above-required data for samples collected by Ichthyological Associates, Inc. (I.A.) from February 24, 1976 to November 2, 1976. Unfavorable weather conditions prevented sample collection during both January and December.

As required by section 4.2.2 of the E.T.S., surface samples from all five stations were collected semi-monthly by I.A. from April 6, 1976 to October 19, 1976. Samples were analyzed for heavy metals (see above), calcium, magnesium, sodium, potassium, and phenols. The analytical results are presented below.

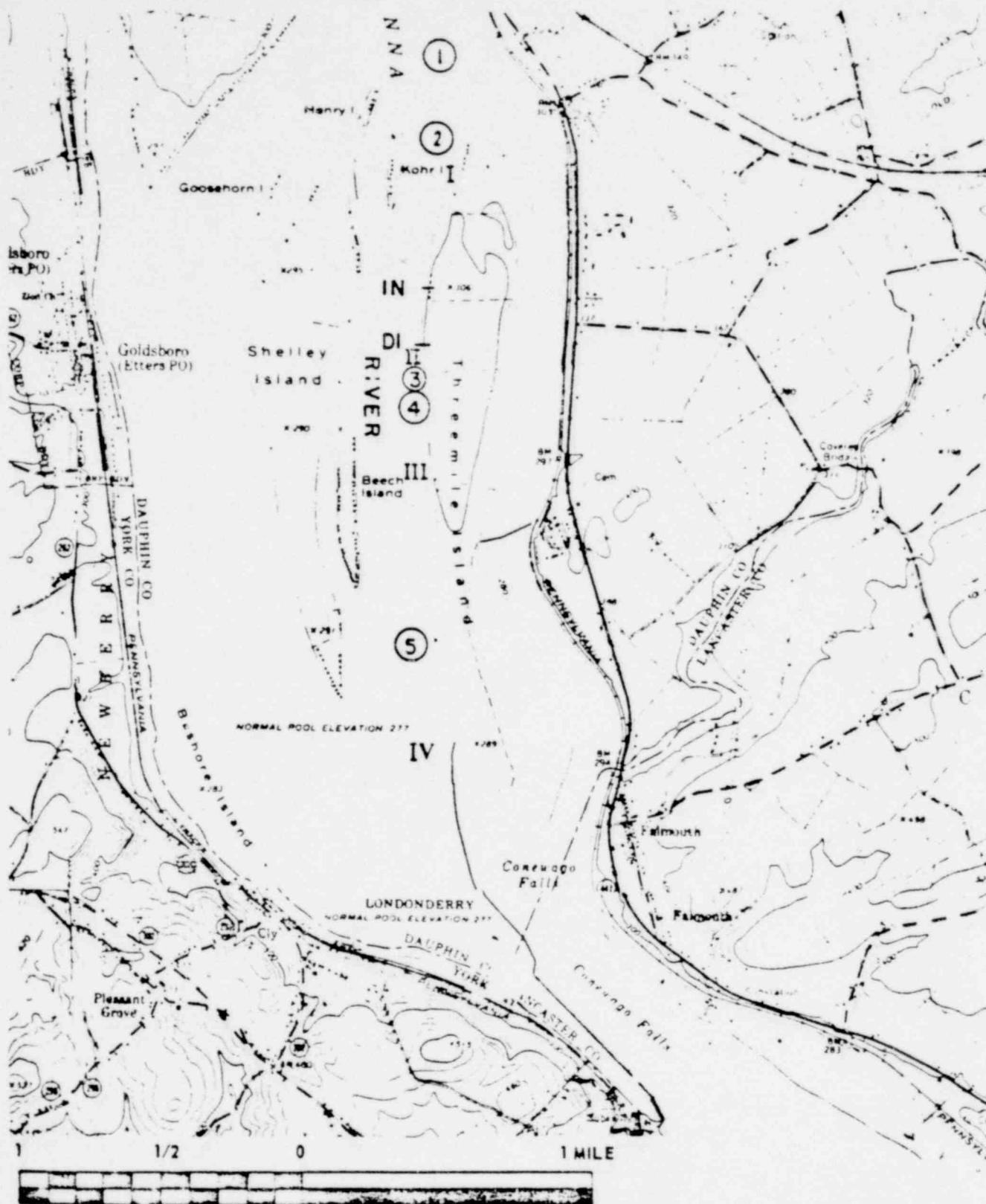
All results have been forwarded on a monthly basis to personnel of the Radiation Safety and Environmental Engineering Section of the Metropolitan Edison Company.

Procedures

All procedures used were those from the U.S.E.P.A. Manual of Methods for the Chemical Analysis of Water and Wastes⁽¹⁾. Metals were analyzed via atomic absorption, and phenols were done using the 4-aminoantipyrine-distillation method.

1565 011

FIGURE 1



I TO IV FISH LOCATIONS
① TO ⑤ INVERTEBRATE

IN - INTAKE
DI - DISCHARGE

AQUATIC ENVIRONMENTAL
MONITORING STATIONS

POOR ORIGINAL

Results

A. E.T.S., Section 4.2.1: Monthly Heavy Metals Analysis

The results of the monthly heavy metals analysis for 1976 are shown in Table 1. The "above intake" results are those found for samples collected at invertebrate station 2, and the "discharge" results are those for samples collected at station 3.

Table 2 lists the mean concentration, the highest and lowest values, and the standard deviation from the mean for each metal at the two stations for 1976. Also shown are the data from previous reports for 1974⁽²⁾ and 1975⁽³⁾. Data below concentration reporting limits were not used to calculate the mean values.

In 1976, for all metals except iron, the mean values at the intake and discharge were within the standard deviations of the range of values at each station. This indicates that no major difference in metal concentration exists between the two stations. For iron, the mean concentration of 1.34 ppm at discharge is slightly above the upper range of the mean standard deviation above intake value, which is $1.03 + 0.28 \text{ ppm} = 1.31 \text{ ppm}$. Also, the mean concentration at intake, 1.03 ppm, is slightly below the mean standard deviation at discharge, $1.34 - 0.21 = 1.13 \text{ ppm}$. This difference is so small, however, that one can say that the increase in the iron concentration at the discharge is virtually insignificant. As can be seen

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TABLE 1
Monthly Heavy Metals Results, 1976
Values in ppm

<u>Date</u>	<u>Location</u>	<u>Cu</u>	<u>Cr</u>	<u>Fe</u>	<u>Mn</u>	<u>Ni</u>	<u>Zn</u>
Jan., '76		NA	NA	NA	NA	NA	NA
2/24/76							
	Above Intake	0.0044	0.0180	1.30	0.26	0.0075	0.025
	Discharge	0.0064	0.0210	1.40	0.32	0.0012	0.034
3/18/76							
	Above Intake	0.0081	0.0052	1.25	0.44	0.45	0.083
	Discharge	0.012	0.0068	1.40	0.51	0.48	0.036
4/6/76							
	Above Intake	0.0048	<.0020	0.95	0.29	0.017	0.0092
	Discharge	0.0055	<.0020	1.30	0.29	0.016	0.0096
5/4/76							
	Above Intake	0.011	0.0030	1.32	0.34	0.022	0.085
	Discharge	0.013	0.0044	1.28	0.34	0.024	0.038
6/1/76							
	Above Intake	0.0087	<.0020	0.86	0.31	0.031	0.018
	Discharge	0.0067	<.0020	0.87	0.28	0.027	0.027
7/6/76							
	Above Intake	0.011	<.0020	0.86	0.17	0.022	0.0092
	Discharge	0.025	<.0020	1.50	0.25	0.027	0.026
8/3/76							
	Above Intake	0.0094	0.0012	0.44	0.16	0.040	0.037
	Discharge	0.023	0.0022	1.10	0.20	0.053	0.046
9/7/76							
	Above Intake	0.009	0.0086	1.00	0.34	0.036	0.0086
	Discharge	0.013	0.0088	1.40	0.32	0.056	0.017
10/5/76							
	Above Intake	0.012	<.0020	1.00	0.29	0.030	0.032
	Discharge	0.014	<.0020	1.50	0.26	0.052	0.057
11/2/76							
	Above Intake	0.0063	<.0020	1.30	0.40	0.095	0.011
	Discharge	0.012	<.0020	1.60	0.40	0.11	0.012
Dec., '76		NA	NA	NA	NA	NA	NA

NA = data not available.

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in Table 4, page 10, this slight increase in iron is easily diluted by the stream, and no problems can be seen.

Comparing data from the three years, it can be seen that the copper and zinc results for 1976 fall in the same range as those for the two previous years. Manganese and iron data show a slight decrease in 1976, but the standard deviations of the mean for manganese indicate that the difference in values is only slight. Note also, that for iron, the large "high" values of 1974 and 1975 are not present in 1976, but the "low" values of all three years generally fall into similar ranges. The data for chromium and nickel show an increase in concentration in 1976 from both 1974 and 1975, mainly because of the larger "high" values in 1976. Once again, however, the standard deviation of the range of 1976 data indicates that the increase in 1976 may only be slight at most. It also should be noted that the chromium concentration was below reporting limit* (0.002 ppm) for five (5) samplings, so the "true" mean values should be lower than those shown in Table 2, in which values below .002 ppm were omitted from computation.

POOR ORIGINAL

*reporting limit = lowest concentration of standard used.

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TABLE 2

POOR ORIGINAL

1974, 1975 and 1976 Mean (average) Values, ppm
Monthly Heavy Metals

		<u>Cu</u>	<u>Cr</u>	<u>Fe</u>	<u>Mn</u>	<u>Ni</u>	<u>Zn</u>
1974	Above Intake						
	Mean	0.010	0.0029	2.40	0.40	0.012	0.031
	High	0.029	0.0057	11.0	1.70	0.051	0.13
	Low	0.0020	0.0011	0.42	0.16	0.0029	0.0098
	Discharge						
	Mean	0.012	0.0039	2.40	0.40	0.011	0.041
	High	0.029	0.0080	8.00	1.30	0.041	0.12
	Low	0.0020	0.0016	0.66	0.21	0.0026	0.017
1975	Above Intake						
	Mean	0.0058	0.0028	1.60	0.43	0.024	0.020
	High	0.011	0.0068	3.10	0.82	0.032	0.042
	Low	0.0027	0.0004	0.60	0.24	0.0051	0.0060
	Discharge						
	Mean	0.0098	0.0038	2.00	0.40	0.031	0.033
	High	0.021	0.0071	3.20	0.77	0.11	0.10
	Low	0.0039	0.0008	1.40	0.18	0.0073	0.0092
1976	Above Intake						
	Mean	0.0085	0.0072	1.03	0.30	0.075	0.032
	Std.dev.	0.0026	0.0066	0.28	0.09	0.13	0.029
	High	0.012	0.018	1.32	0.44	0.45	0.085
	Low	0.0044	0.0012	0.44	0.16	0.0075	0.0086
	Discharge						
	Mean	0.013	0.0086	1.34	0.32	0.085	0.030
	Std.dev.	0.0070	0.0073	0.21	0.09	0.140	0.015
	High	0.025	0.021	1.60	0.51	0.48	0.057
	Low	0.0055	0.0022	0.87	0.20	0.0012	0.0096

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D. F.T.S., Section 4.2.2: Invertebrate Stations - Water Quality Results

The individual results of each semi-monthly sampling at the five stations are given in Appendix A at the end of this discussion. Appendix B shows the minimum reporting concentration for each parameter for 1976. Figures 2 through 12 display the plots of yearly average concentration vs. station number for each parameter. Stations 1 and 2 are upstream of the discharge (station 3), and stations 4 and 5 are downstream of the discharge. Table 3 shows a summary of the 1976 mean concentrations of the parameters at each station. The number of values used to calculate the mean, the mean value itself, and the standard deviation of the values from the mean are given. Also shown is the mean and standard deviation values, which were calculated after omitting the high and low values. This data should help eliminate any effects due to unusually high or low values in the set. It can be seen that the mean values change only slightly when the high and low values are discarded, indicating that all the values in the range may be considered to fall within the normal range.

Table 4 shows the comparison of the 1976 mean values with the mean values from 1974(2) and 1975(3).

POOR ORIGINAL

reporting limit = lowest concentration of standard used.

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Discussion

Comparisons of upstream and downstream values in Table 3 show little difference (also see Figures 2-11). This indicates that even relatively large increases in concentration at the discharge, such as those shown by Fe, Cu, Ni, Zn, Ca, Na and K, are easily accommodated by the stream, and that there is no overall effect on the elemental levels in the stream. In fact, all the mean values downstream are well within the standard deviations from the mean values upstream. This also is an indication that the downstream concentrations are the same as those upstream.

The large range in values can be seen to originate from the variation of stream conditions with time and weather. This is best observed by referring to the data in Appendix A. Even in most of the individual results, the downstream and upstream concentrations are very close.

Table 4 indicates no appreciable differences between mean values for the three years for all but iron, which has a generally lower concentration in 1976 than the previous years. In general, however, the water parameters have remained relatively constant on a year-to-year basis.

In summary, the data indicate no unusual discharges or influences on the water quality at TMI.

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TABLE 3

Summary of Semi-Monthly Results, ppm
April, 1976 - October, 1976

Station 1		Cu	Cr	Fe	Mn	Ni	Zn	Ca	Mg	Na	K	phenol
# of values*		14	8	14	14	14	13	14	14	14	14	11
Mean		0.0082	0.0038	0.88	0.26	0.028	0.023	27.6	8.9	8.5	2.0	0.0047
Std. dev.		0.0029	0.0023	0.50	0.11	0.014	0.024	8.7	2.8	3.0	0.6	0.0035
Mean**		0.0081	0.0034	0.86	0.25	0.026	0.022	27.3	9.1	8.3	1.9	0.0040
Std. dev.**		0.0025	0.0017	0.42	0.07	0.008	0.025	8.0	2.2	2.5	0.4	0.0029
Station 2												
# of values*		14	7	14	14	14	13	14	14	14	14	8
Mean		0.0087	0.0038	0.94	0.29	0.031	0.024	26.7	7.8	8.1	2.1	0.0042
Std. dev.		0.0022	0.0022	0.38	0.12	0.012	0.022	6.2	2.7	2.4	0.6	0.0020
Mean**		0.0087	0.0031	0.91	0.28	0.029	0.020	26.7	7.9	7.9	2.1	0.0043
Std. dev.**		0.0019	0.0004	0.28	0.09	0.008	0.014	6.0	1.9	1.7	0.5	0.0016
Station 3												
# of values*		14	9	14	14	14	14	14	14	14	14	9
Mean		0.0140	0.0042	1.22	0.31	0.040	0.033	32.6	9.9	11.9	3.0	0.0034
Std. dev.		0.0050	0.0022	0.44	0.10	0.019	0.018	10.7	3.7	5.9	1.2	0.0018
Mean**		0.0140	0.0038	1.21	0.31	0.038	0.032	32.2	9.9	10.9	3.0	0.0030
Std. dev.**		0.0040	0.0013	0.36	0.08	0.015	0.015	8.8	2.7	2.7	1.0	0.0011
Station 4												
# of values*		14	8	14	14	14	14	14	14	14	14	8
Mean		0.0100	0.0040	0.90	0.27	0.039	0.018	24.7	8.2	8.2	2.2	0.0042
Std. dev.		0.0050	0.0025	0.38	0.10	0.024	0.012	9.3	2.6	2.1	0.7	0.0011
Mean**		0.0100	0.0035	0.90	0.26	0.035	0.018	24.7	8.2	8.1	2.2	0.0040
Std. dev.**		0.0020	0.0017	0.30	0.07	0.012	0.009	7.1	1.8	1.6	0.6	0.0008
Station 5												
# of values*		13	6	14	14	14	13	14	14	14	14	9
Mean		0.0100	0.0042	0.86	0.25	0.036	0.018	25.8	8.2	8.2	2.1	0.0039
Std. dev.		0.0040	0.0022	0.39	0.10	0.017	0.011	10.0	2.6	2.0	0.7	0.0014
Mean**		0.0100	0.0040	0.83	0.24	0.034	0.017	26.2	8.1	8.2	2.2	0.0038
Std. dev.**		0.0040	0.0017	0.24	0.08	0.013	0.008	8.3	1.6	1.9	0.6	0.0011

* Values below reporting limits are not included.

**High and Low values are omitted from calculation.

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TABLE 4

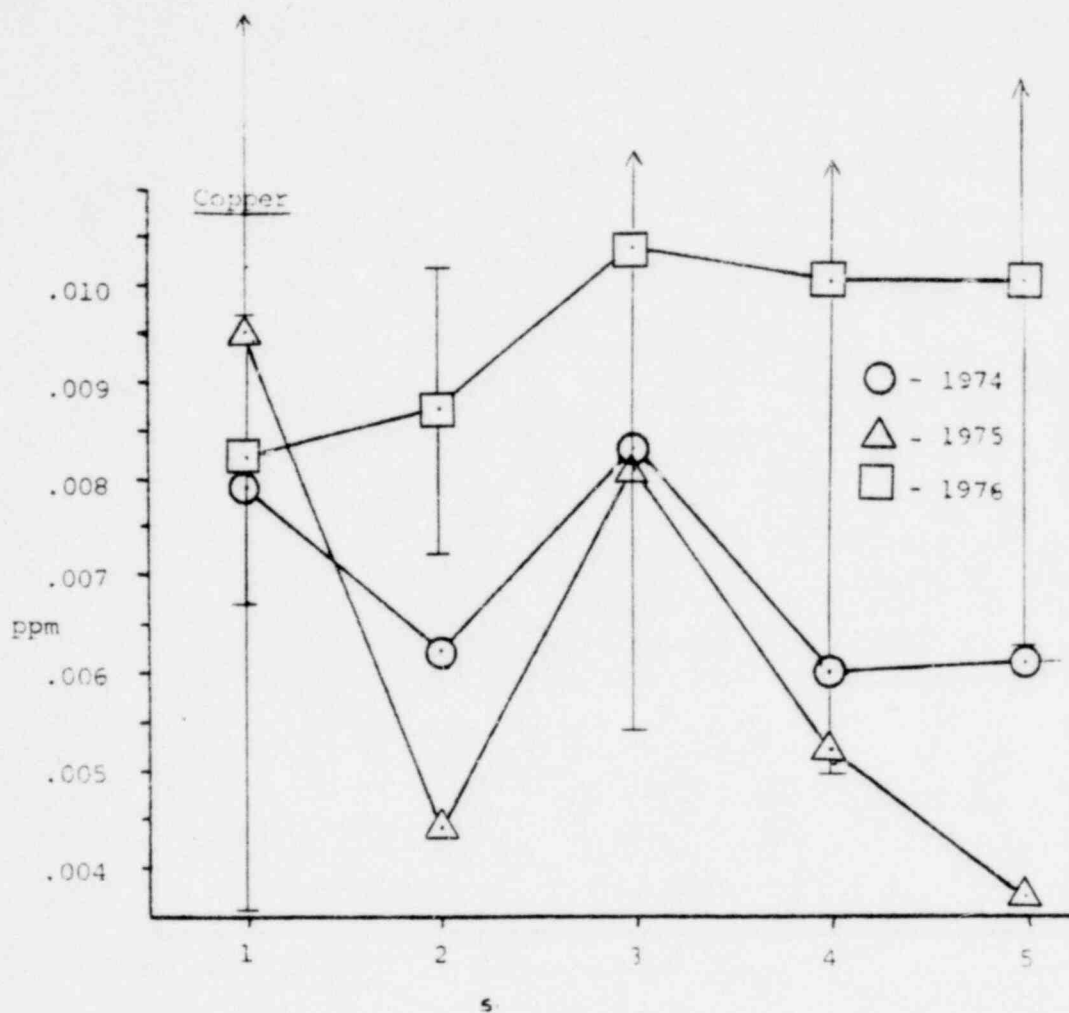
Comparison of 1976 Semi-monthly averages with
1974 and 1975 averages, ppm.

		<u>Cu</u>	<u>Cr</u>	<u>Fe</u>	<u>Mn</u>	<u>Ni</u>	<u>Zn</u>	<u>Ca</u>	<u>Mg</u>	<u>Na</u>	<u>K</u>	<u>phenol</u>
Station 1	1974	0.0079	0.0067	1.70	0.31	0.0110	0.031	26.0	9.9	8.5	2.5	0.0060
	1975	0.0095	0.0050	2.10	0.41	0.0230	0.021	19.0	9.9	8.1	2.5	0.0062
	1976	0.0082	0.0038	0.88	0.26	0.0280	0.023	27.6	8.9	8.5	2.0	0.0047
Station 2	1974	0.0062	0.0061	1.20	0.26	0.0066	0.021	25.0	8.5	7.6	2.6	0.0031
	1975	0.0044	0.0046	2.00	0.33	0.0240	0.019	20.0	8.5	7.3	2.6	0.0065
	1976	0.0087	0.0038	0.94	0.29	0.0310	0.024	26.7	7.8	8.1	2.1	0.0042
Station 3	1974	0.0083	0.0065	1.40	0.29	0.0080	0.027	28.0	9.4	8.8	2.8	0.0041
	1975	0.0081	0.0052	2.50	0.32	0.0300	0.031	24.0	11.0	10.0	3.4	0.0062
	1976	0.0140	0.0042	1.22	0.31	0.0400	0.033	32.6	9.8	11.9	3.0	0.0034
Station 4	1974	0.0060	0.0064	1.30	0.26	0.0074	0.025	26.0	9.1	8.1	2.5	0.0043
	1975	0.0052	0.0046	2.10	0.31	0.0260	0.022	20.0	9.1	8.3	2.7	0.0059
	1976	0.0100	0.0040	0.90	0.27	0.0390	0.018	24.7	8.2	8.2	2.2	0.0042
Station 5	1974	0.0061	0.0070	0.99	0.24	0.0082	0.023	25.0	9.2	8.2	2.4	0.0034
	1975	0.0037	0.0042	1.80	0.25	0.0260	0.016	20.0	9.4	8.0	2.6	0.0051
	1976	0.0100	0.0042	0.86	0.25	0.0360	0.018	25.8	8.2	8.2	2.1	0.0039

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FIGURE 2

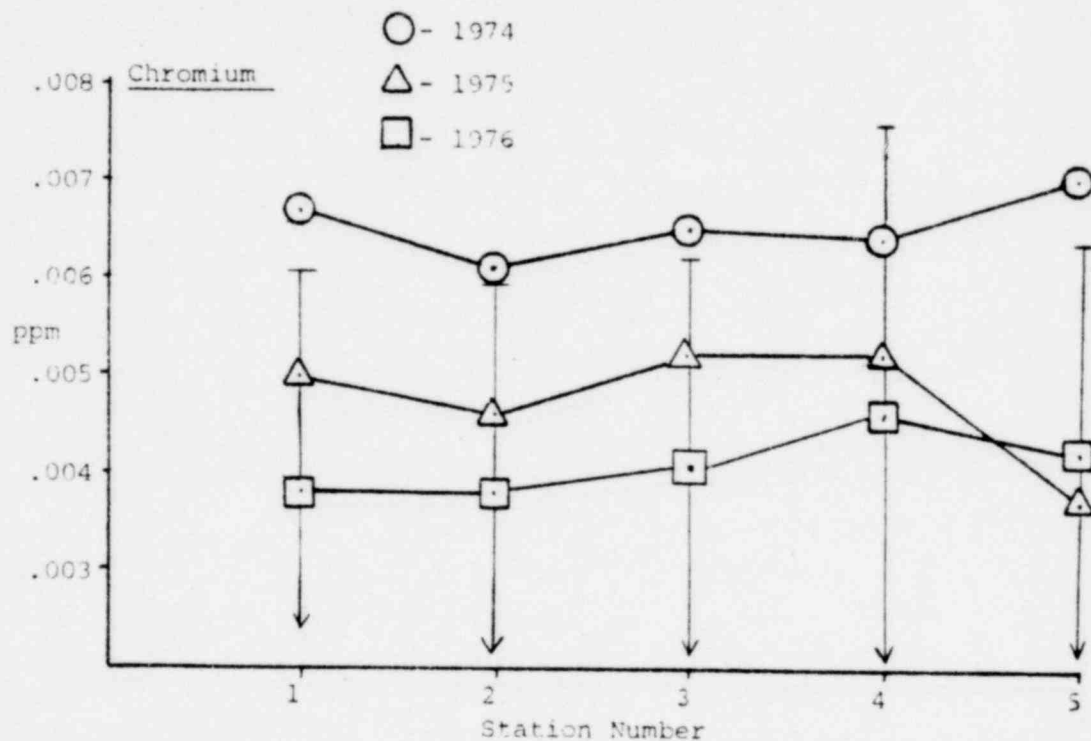
Yearly Average Copper Concentration for Water
Quality Sampling Stations. 1-5.



1565 021

FIGURE 3

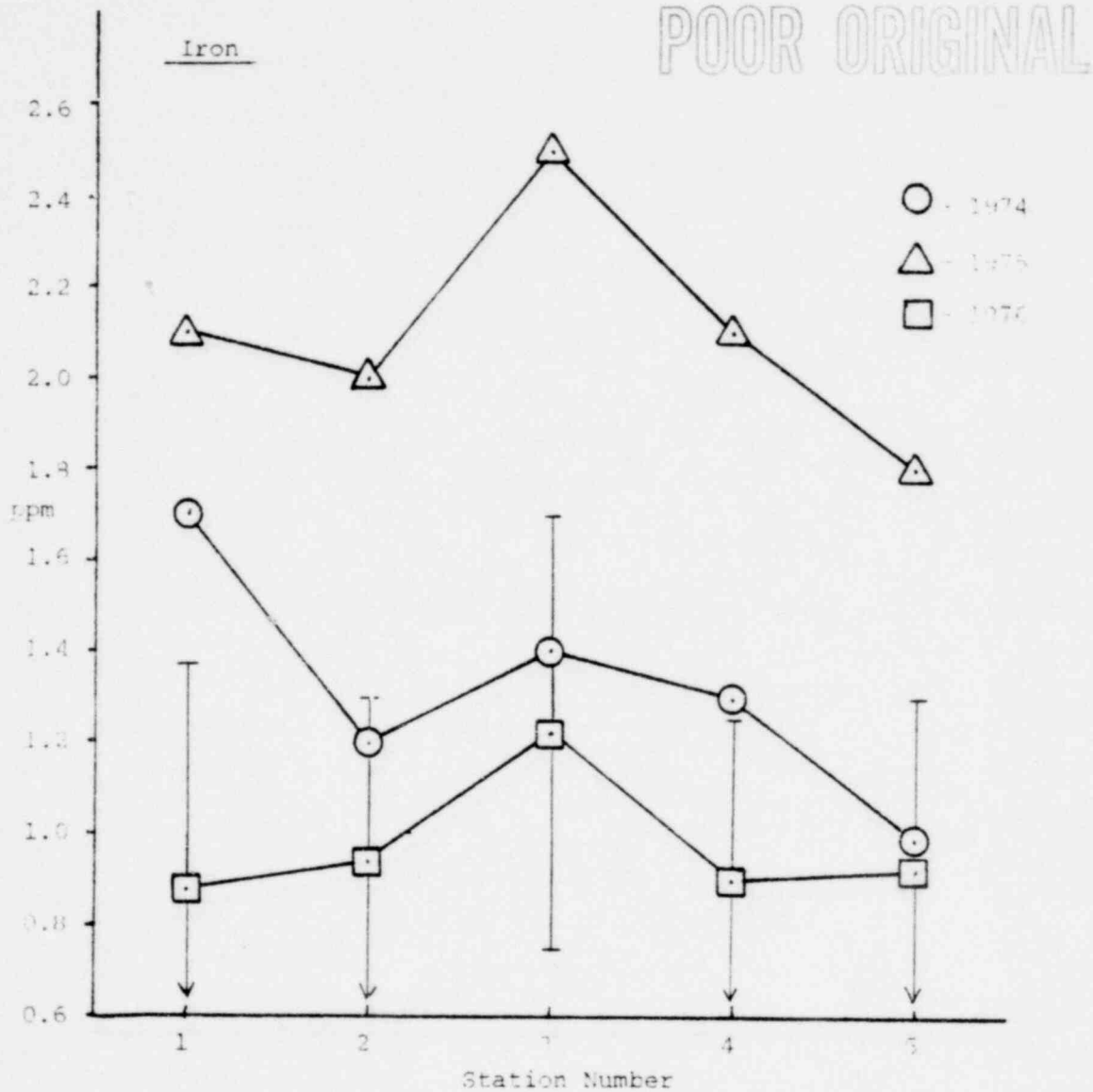
Yearly Average Chromium Concentrations for Water
Quality Sampling Stations. 1-5.



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FIGURE 4

Yearly Average Iron Concentration for Water
Quality Sampling Stations. 1-5.

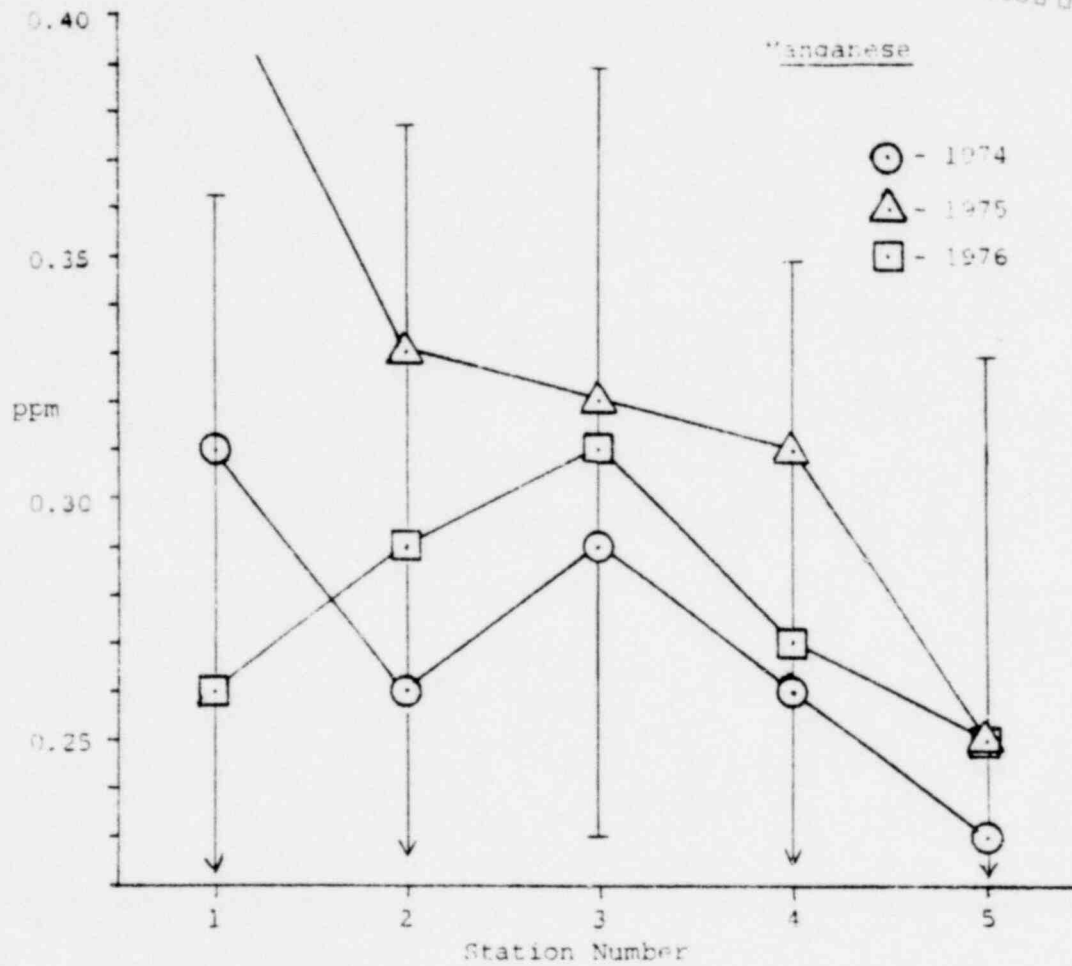


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FIGURE 5

Yearly Average Manganese Concentration for Water
Quality Sampling Stations. 1-5.

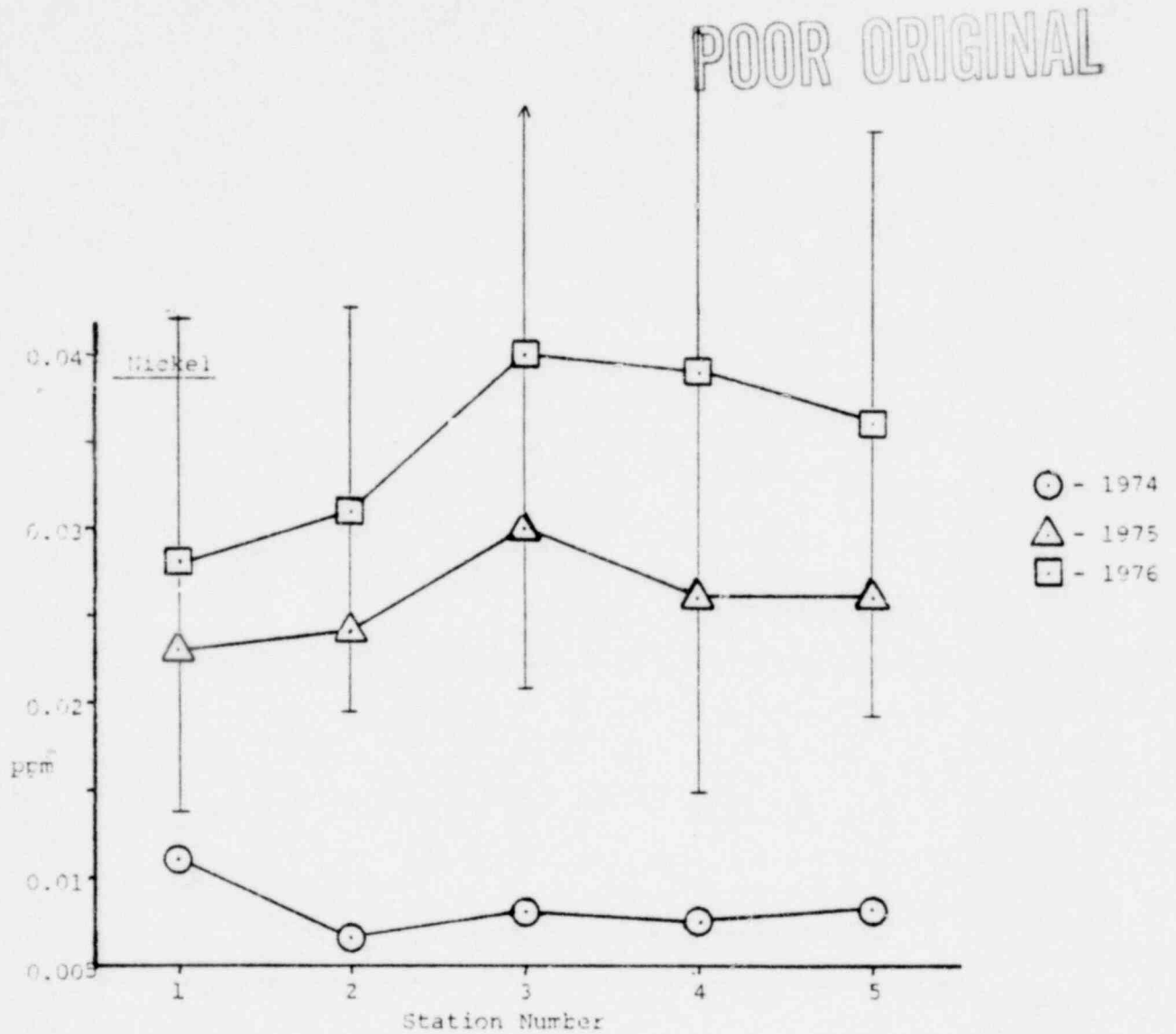
POOR ORIGINAL



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FIGURE 6

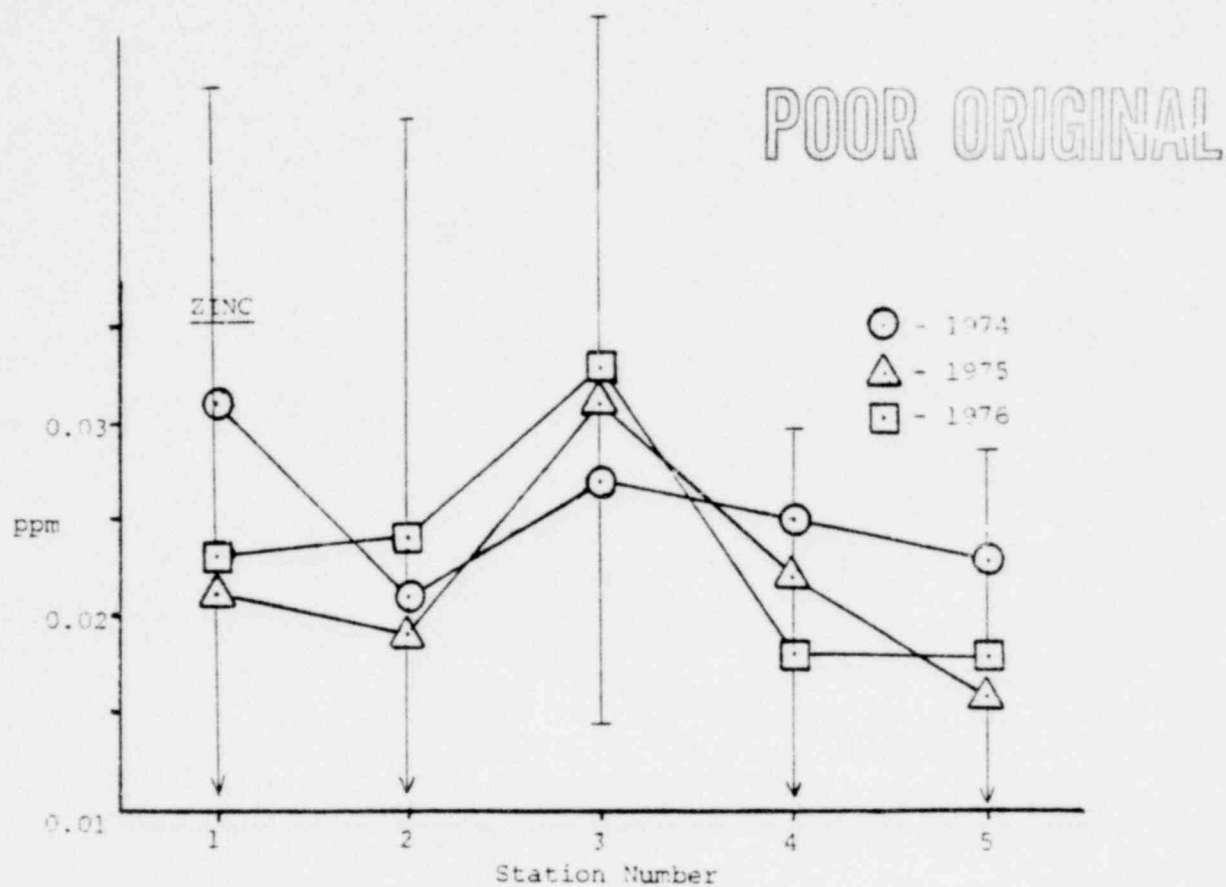
Yearly Average Nickel Concentration for Water
Quality Sampling Stations. 1-5.



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FIGURE 7

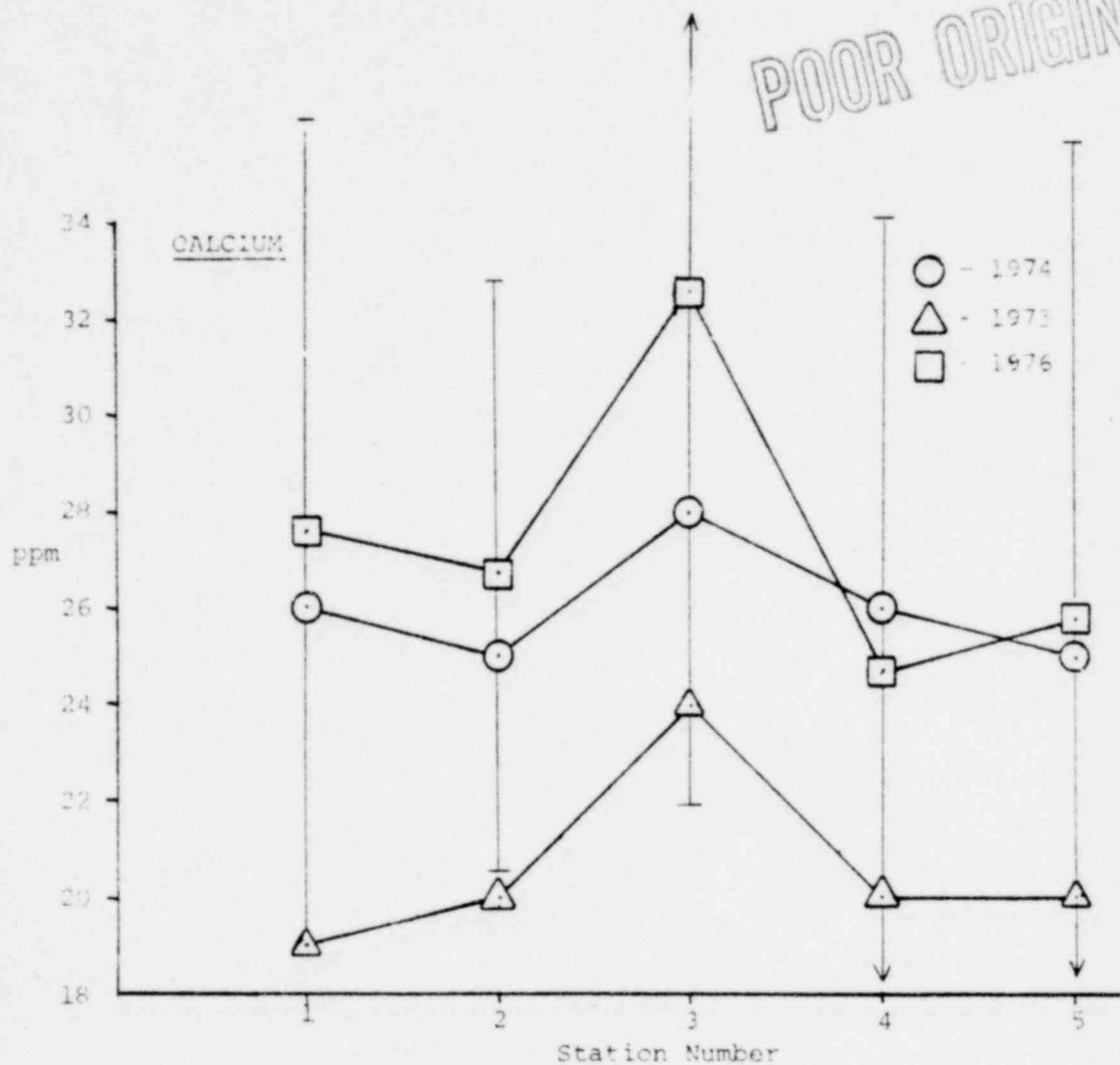
Yearly Average Zinc Concentration for Water
Quality Sampling Stations. 1-5.



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FIGURE 8

Yearly Average Calcium Concentration for Water
Quality Sampling Stations. 1-5.

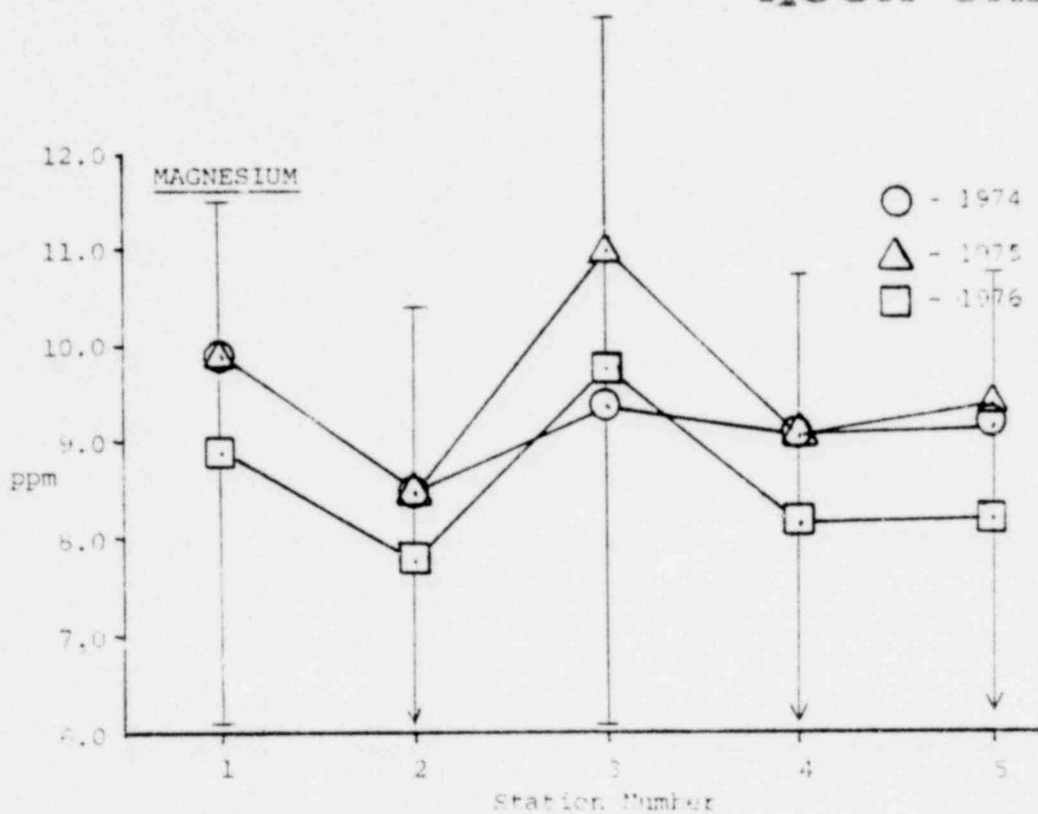


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FIGURE 9

Yearly Average Magnesium Concentration for Water
Quality Sampling Stations. 1-5.

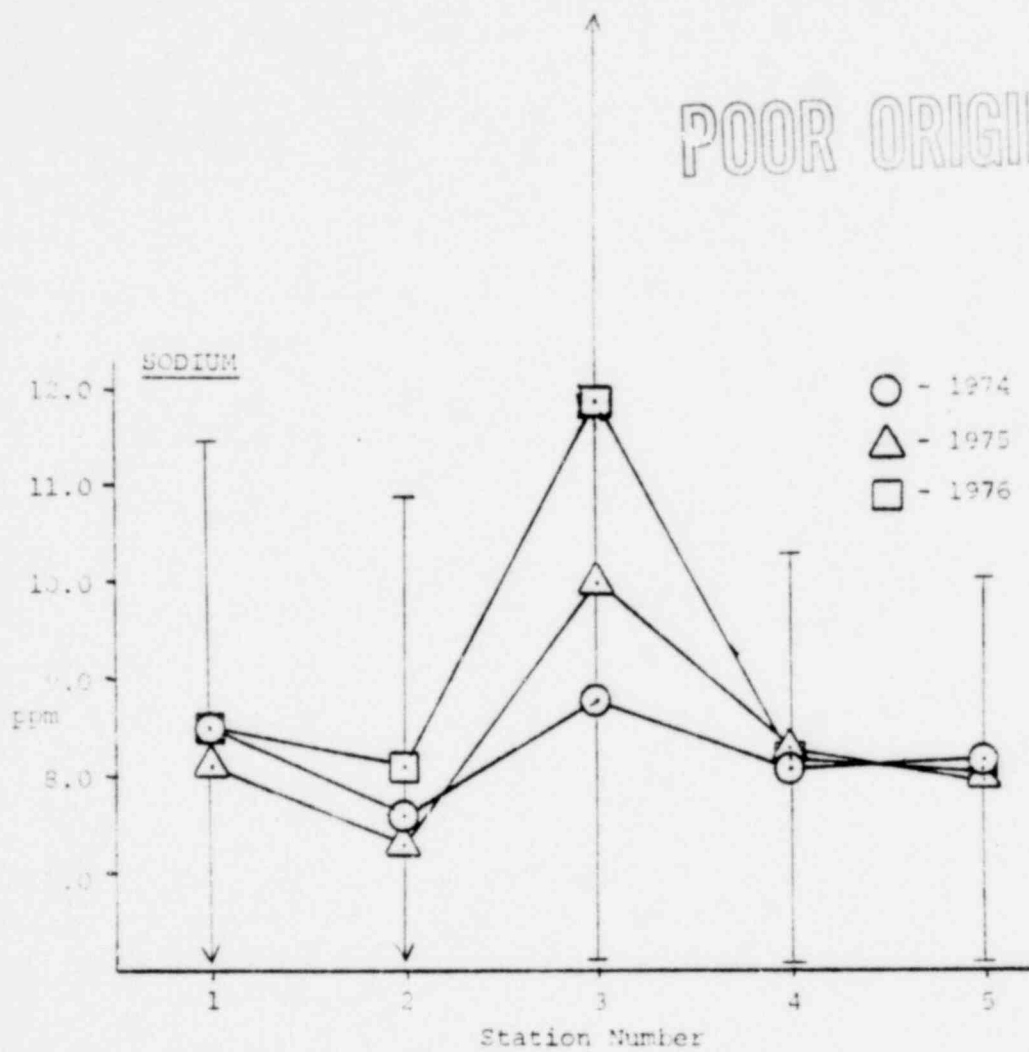
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FIGURE 10

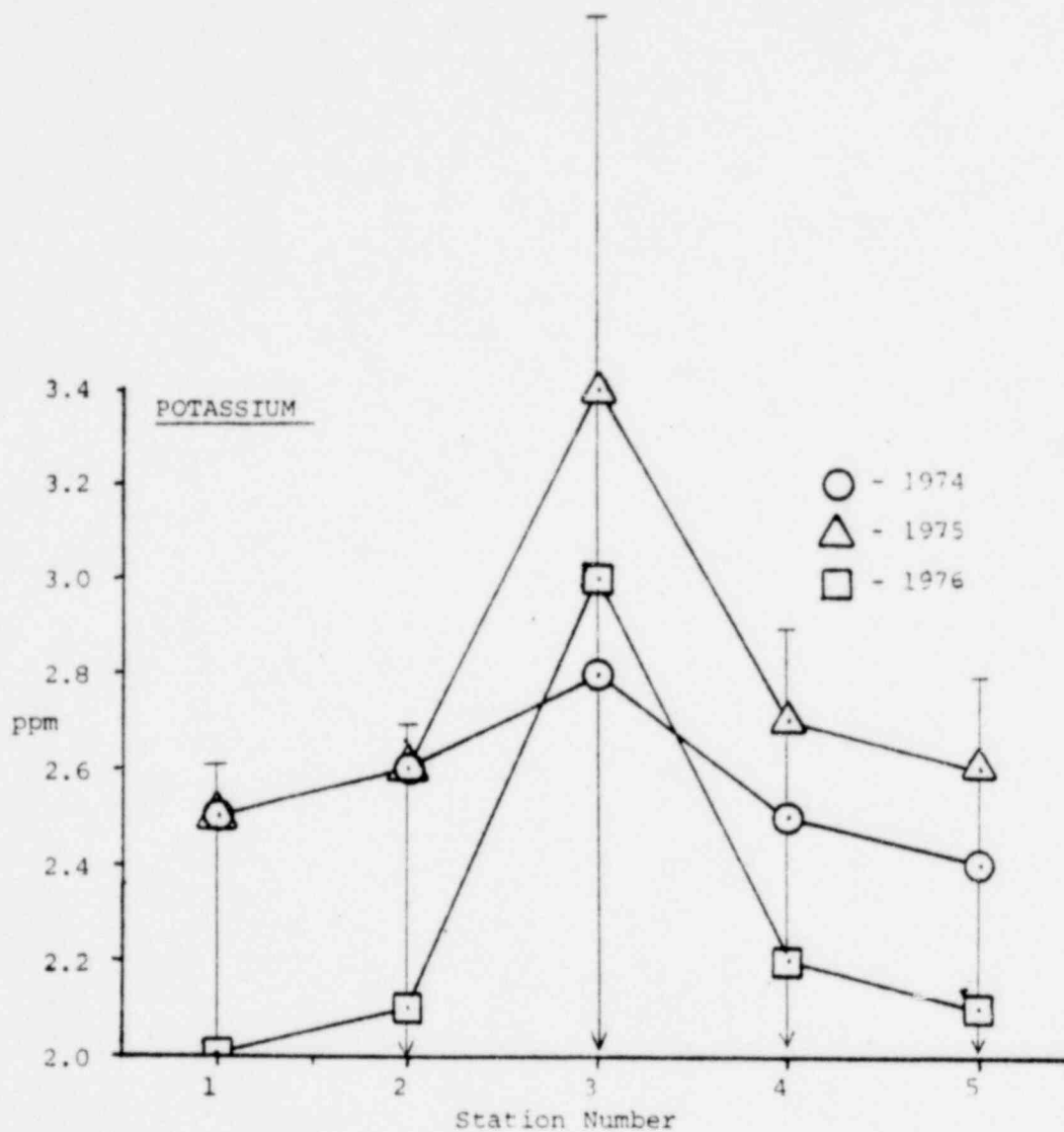
Yearly Average Sodium Concentration for Water
Quality Sampling Stations. 1-5.



1565 029

FIGURE 11

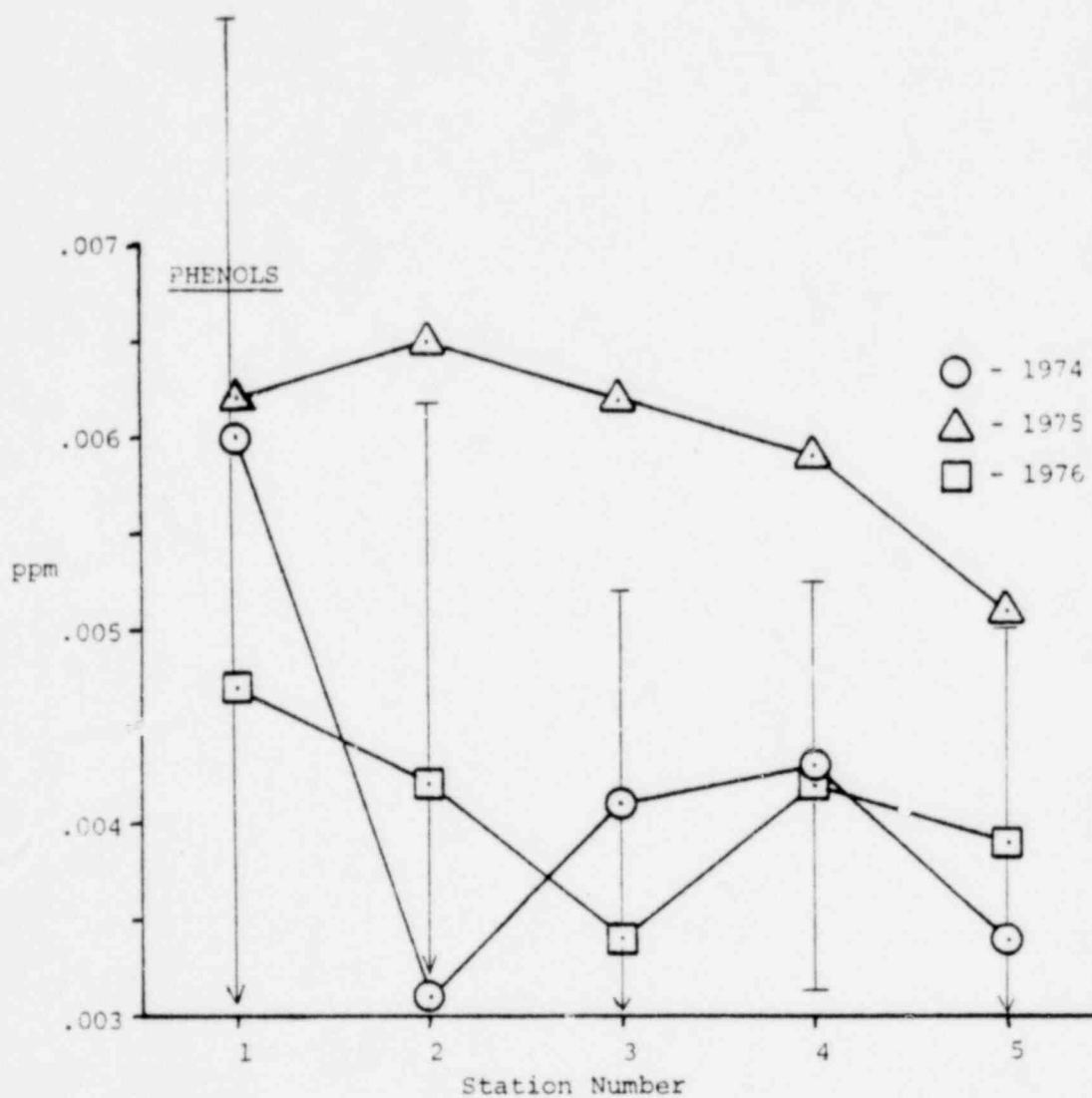
Yearly Average Potassium Concentration for Water
Quality Sampling Stations. 1-5.



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FIGURE 12

Yearly Average Phenols Concentration for Water
Quality Sampling Stations. 1-5.



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Statistical Analysis

A. Section 4.2.1 Samples above intake and at discharge

The data collected above the intake (station 2) was statistically compared to the data collected at discharge (station 3) by both the paired comparison Student t Test and the non-parametric Wilcoxon signed rank test.

The results are shown in Table A. The superscripts above the elements indicate the appropriate test and level of significance at which the data above intake differs significantly from that at discharge. It would be expected to see some increase in concentration at discharge, and this is shown by Cu, Cr, Fe and Ni. Neither Mn nor Zn show significant difference at any significant level. Agreement is shown between both tests.

Table A

Mean concentration values (ppm) of monthly samples for 1976

<u>Sample</u>	<u>Cu^{a,z}</u>	<u>Cr^{a,x}</u>	<u>Fe^{c,z}</u>	<u>Mn</u>	<u>Ni^{a,x}</u>	<u>Zn</u>
Above Intake	0.0085	0.0072	1.03	0.30	0.0750	0.032
At Discharge	0.0131	0.0086	1.34	0.32	0.0846	0.030

1. Paired Comparison Student t Test - Intake differs

significantly from discharge at:

a - p < 0.05

b - p < 0.02

c - p < 0.01

2. Non-Parametric Wilcoxon Signed Rank Test - Intake differs

significantly from discharge at:

x - p < 0.05

y - p < 0.02

z - p < 0.01

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B. Section 4.2.2

The chemical assays of semi-monthly samples from stations 1, 2, 3, 4 and 5 were analyzed statistically using a randomized block analysis of variance. Sample data served as blocks. The Student-Newman-Kuels multirange test was employed to identify station means which differed significantly.

The results are shown in Table B. Means with the same subscript do not differ significantly ($p < 0.05$). Data for Cr and phenol were not analyzed since determinations were frequently below the limit of detection. There are essentially no significant differences between the metal concentrations of the water above the discharge and that below the discharge.

Table B

Mean concentrations (ppm) of semi-monthly metals for April-October, 1976

<u>Station*</u>	<u>Cu</u>	<u>Fe</u>	<u>Mn</u>	<u>Ni</u>	<u>Zn</u>	<u>Ca</u>	<u>Mg</u>	<u>Na</u>	<u>K</u>
1	0.0082 _{a**}	0.88 _a	0.26 _a	0.028 _a	0.0229 _a	27.6 _a	8.9 _a	8.5 _a	2.0 _a
2	0.0088 _a	0.94 _a	0.29 _a	0.035 _{a,b}	0.0240 _a	26.7 _a	7.8 _a	8.1 _a	2.1 _a
3	0.0137 _b	1.22 _b	0.31 _a	0.040 _{a,b}	0.0318 _a	32.6 _b	9.7 _b	11.9 _b	3.0 _b
4	0.0103 _a	0.90 _a	0.27 _a	0.032 _{a,b}	0.0196 _a	24.7 _a	8.2 _a	8.2 _a	2.2 _a
5	0.0104 _a	0.86 _a	0.25 _a	0.036 _b	0.0182 _a	25.7 _a	8.2 _a	8.2 _a	2.1 _a

*Station 1 and 2 are above discharge and stations 4 and 5 below discharge.

**For a given metal, means with the same subscript do not differ significantly.

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Appendix

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APPENDIX A

Semi-Monthly Heavy Metals & Phenol Results

April 6, 1976 - October 19, 1976

Values in ppm

<u>Se</u>	<u>Station</u>	<u>Cu</u>	<u>Cr</u>	<u>Fe</u>	<u>Mn</u>	<u>Ni</u>	<u>Zn</u>	<u>Ca</u>	<u>Mg</u>	<u>Na</u>	<u>K</u>	<u>phenol</u>
4/6/76	1	0.0057	<.0020	0.86	0.34	0.016	0.0180	18.6	2.5	4.7	1.7	0.0016
	2	0.0048	<.0020	0.95	0.29	0.017	0.0092	20.4	2.2	6.9	1.5	<.0010
	3	0.0055	<.0020	1.30	0.29	0.016	0.0096	17.8	2.0	6.7	1.3	<.0010
	4	0.0034	<.0020	1.00	0.30	0.018	0.0130	18.0	3.1	6.5	1.2	<.0010
	5	0.0040	<.0020	0.98	0.32	0.018	0.0068	18.4	3.0	6.2	1.0	<.0010
4/20/76	1	0.0092	0.0020	0.64	0.26	0.020	0.0180	40.8	11.2	14.0	1.1	<.0010
	2	0.0100	0.0020	0.70	0.26	0.022	0.0082	36.0	8.2	14.0	1.3	<.0010
	3	0.0120	0.0024	0.86	0.25	0.022	0.0650	32.8	7.0	11.0	1.4	<.0010
	4	0.0120	0.0025	0.84	0.26	0.024	0.0100	32.8	7.2	11.0	1.5	<.0010
	5	0.0120	0.0028	0.74	0.25	0.022	0.0140	36.0	7.2	10.0	1.4	<.0010
5/4/76	1	0.0120	0.0028	1.30	0.35	0.024	0.0960	25.0	7.2	6.1	1.6	0.0024
	2	0.0110	0.0030	1.32	0.34	0.022	0.0850	24.0	6.8	5.4	1.3	0.0012
	3	0.0130	0.0044	1.28	0.34	0.024	0.0380	26.0	7.6	12.1	1.7	0.0024
	4	0.0120	0.0032	1.14	0.32	0.022	0.0260	24.0	7.2	5.5	1.5	0.0060
	5	0.0110	0.0032	1.22	0.34	0.022	0.0340	25.0	7.6	6.0	1.4	0.0062
5/18/76	1	0.0063	<.0020	0.46	0.16	0.028	0.0068	37.0	9.6	7.7	2.0	0.0092
	2	0.0067	0.0037	0.74	0.15	0.028	0.0480	33.0	7.2	7.8	2.5	0.0015
	3	0.0090	0.0057	1.10	0.15	0.036	0.0200	33.0	6.4	7.8	2.6	<.0010
	4	0.0088	0.0059	0.65	0.15	0.043	0.0420	32.0	6.8	7.5	2.2	0.0042
	5	0.0120	0.0074	0.72	0.17	0.051	0.0180	34.0	6.8	8.1	2.8	0.0022
6/1/76	1	0.0052	<.0020	0.75	0.28	0.023	0.0100	37.5	7.0	7.2	1.3	0.0010
	2	0.0087	<.0020	0.86	0.31	0.031	0.0180	32.5	8.0	7.3	1.3	0.0064
	3	0.0067	<.0020	0.87	0.28	0.027	0.0270	37.5	7.0	7.1	1.3	0.0032
	4	0.0065	<.0020	0.73	0.25	0.028	0.0260	26.0	8.0	7.4	1.3	0.0034
	5	0.0075	<.0020	0.74	0.24	0.030	0.0410	36.0	7.5	7.2	1.4	0.0024

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APPENDIX A
(cont'd)

<u>Date</u>	<u>Station</u>	<u>Cu</u>	<u>Cr</u>	<u>Fe</u>	<u>Mn</u>	<u>Ni</u>	<u>Zn</u>	<u>Ca</u>	<u>Mg</u>	<u>Na</u>	<u>K</u>	<u>phenol</u>
6/15/76	1	0.0040	<.0020	0.18	0.18	0.023	0.0140	22.0	9.0	8.5	1.6	0.0070
	2	0.0055	<.0020	0.61	0.47	0.035	0.0080	25.5	9.0	10.0	2.3	0.0040
	3	0.0140	<.0020	0.67	0.47	0.055	0.0160	39.0	13.0	14.6	3.4	0.0030
	4	0.0075	0.0020	0.50	0.43	0.048	0.0070	26.5	9.0	9.6	2.4	0.0030
	5	0.0065	0.0035	0.43	0.43	0.054	0.0100	27.5	9.5	10.3	2.3	0.0030
7/6/76	1	0.0120	<.0020	1.10	0.18	0.020	0.0130	22.0	11.0	7.3	1.7	<.0010
	2	0.0110	<.0020	0.86	0.17	0.022	0.0092	24.0	12.0	7.4	1.8	<.0010
	3	0.0250	0.0020	1.50	0.25	0.027	0.0260	40.0	16.0	12.0	3.6	0.0018
	4	0.0250	<.0020	0.88	0.14	0.024	0.0090	11.0	11.0	7.4	1.7	<.0010
	5	0.0150	<.0020	0.76	0.13	0.022	0.0057	10.0	11.0	7.4	1.7	<.0010
7/20/76	1	0.0063	0.0025	0.62	0.15	0.044	<.0020	22.0	11.0	7.7	1.8	0.0018
	2	0.0066	0.0031	0.57	0.19	0.042	<.0020	22.0	10.0	7.7	2.1	<.0010
	3	0.0140	0.0041	0.53	0.46	0.056	0.0430	9.5	12.0	9.5	3.5	0.0019
	4	0.0098	0.0053	0.24	0.28	0.052	0.0024	8.0	9.5	8.5	2.7	0.0049
	5	reject	<.0020	0.22	0.21	0.048	<.0020	7.0	9.0	8.0	2.3	0.0030
8/3/76	1	0.0062	0.0020	0.48	0.15	0.032	0.015	35.0	12.0	10.0	2.0	0.0026
	2	0.0094	<.0020	0.44	0.16	0.040	0.037	33.0	8.0	8.0	2.6	<.0010
	3	0.0230	0.0022	1.10	0.20	0.053	0.046	42.0	11.0	10.0	3.9	<.0010
	4	0.0120	<.0020	0.55	0.18	0.044	0.018	34.0	9.0	8.1	2.8	<.0010
	5	0.0170	<.0020	0.81	0.16	0.037	0.026	34.0	9.0	8.2	2.7	<.0010
8/17/76	1	0.0067	0.0043	1.80	0.24	0.012	0.022	18.0	5.0	5.8	3.2	0.0067
	2	0.0110	0.0033	1.50	0.22	0.019	0.024	18.0	5.0	5.7	2.8	0.0046
	3	0.0180	0.0047	2.00	0.26	0.027	0.055	32.0	9.0	11.0	4.8	0.0042
	4	0.0096	0.0022	1.50	0.24	0.021	0.024	17.0	5.0	5.8	2.9	0.0035
	5	0.0150	0.0020	1.80	0.15	0.021	0.023	18.0	5.5	6.3	3.0	0.0037

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APPENDIX A
(cont'd)

<u>Date</u>	<u>Station</u>	<u>Cu</u>	<u>Cr</u>	<u>Fe</u>	<u>Mn</u>	<u>Ni</u>	<u>Zn</u>	<u>Ca</u>	<u>Mg</u>	<u>Na</u>	<u>K</u>	<u>phenol</u>
9/7/76	1	0.0082	0.0065	0.52	0.25	0.030	0.0120	38.0	12.0	14.0	2.7	0.0063
	2	0.0090	0.0086	1.00	0.34	0.036	0.0086	36.0	13.0	12.0	3.0	0.0041
	3	0.0130	0.0088	1.40	0.32	0.056	0.0170	53.0	15.0	16.0	4.4	0.0046
	4	0.0110	0.0088	0.92	0.29	0.049	0.0110	42.0	13.0	13.0	3.3	0.0051
	5	0.0100	0.0065	0.63	0.22	0.043	0.0098	40.0	14.0	13.0	2.8	0.0056
9/21/76	1	0.0083	0.0023	0.52	0.25	0.024	0.0160	33.0	11.0	12.0	2.5	0.0110
	2	0.0074	0.0026	0.75	0.27	0.020	0.0130	28.0	7.0	8.2	2.8	0.0057
	3	0.0130	0.0031	0.97	0.28	0.025	0.0240	38.0	10.0	12.0	3.9	<.0010
	4	0.0098	0.0020	0.78	0.22	0.022	0.017	31.0	8.0	8.8	2.7	<.0010
	5	0.0130	<.0020	0.73	0.23	0.022	0.014	30.0	8.0	9.3	2.7	0.0046
10/5/76	1	0.0110	0.0080	1.40	0.32	0.036	0.045	18.0	7.5	7.4	2.2	<.0010
	2	0.0120	<.0020	1.00	0.29	0.030	0.032	21.0	5.5	7.5	2.4	0.0060
	3	0.0140	<.0020	1.50	0.26	0.052	0.057	30.0	9.0	30.0	3.2	0.0073
	4	0.0080	<.0020	1.30	0.23	0.040	0.039	22.0	6.5	9.7	2.4	<.0010
	5	0.0042	<.0020	0.94	0.16	0.031	0.024	22.0	6.5	9.1	2.3	0.0040
10/19/76	1	0.0130	<.0020	1.70	0.57	0.066	0.012	20.0	8.0	6.0	2.1	0.0020
	2	0.0082	<.0020	1.80	0.55	0.063	0.012	21.0	8.0	6.0	2.1	<.0010
	3	0.0120	<.0020	2.00	0.50	0.081	0.013	26.0	12.0	7.4	2.7	0.0020
	4	0.0090	<.0020	1.60	0.48	0.011	0.012	22.0	11.0	6.3	2.1	0.0031
	5	0.0077	<.0020	1.30	0.46	0.078	0.011	23.0	10.0	6.2	2.1	<.0010

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