CEBAF
The Continuous Electron Beam Accelerator Facility

RCG Note 93-016
June 23 ,1993

Summary of Ground Water Sample Results September 1989 to March 1993

C. Wells

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Introduction

The ground water monitoring program has been in place at CEBAF since the issuance of pollution abatement permit number VPA01001 on June 16, 1989. Samples have been taken from 6 wells and a dewater point at regular intervals since the program's inception. Each sample is analyzed for a variety of analytes including radionuclides. The results from these samples comprise the documentation of the preoperational ground water quality for compliance with the State Water Control Board's antidegradation policy.

The results of these analyses have been examined in past years for trends and evidence of ground water quality degradation. In addition to the visual examination of the data, a statistical analysis comparing the detection ratios in the up and down gradient wells of several analytes was done. The results of these examinations can be found in previous RCG Notes (May91, Wel92). This note will extend the data analysis previously performed, and further document CEBAF's compliance with the SWCB's antidegradation policy.

Ground Water Quality Monitoring Points

The ground water quality is determined from samples taken from a series of monitoring wells and a site dewatering point. In addition to the regularly sampled points, samples may be taken as needed or desired from other wells.

The regularly sampled wells include one well that is hydraulically up gradient from the site (GW-15), four wells that are hydraulically down gradient from the site (GW-2, 3, 7, 8), and one well located near the center of the west arc of the tunnel (GW-17). These wells (with the execption of GW-17) are located along the perimeter of the site. The site dewatering point is located in the experimental hall complex. An additional or duplicate sample is specified at the time of sampling.

Operations in the Past Year

Operation of the accelerator during the period of March 1992 to March 1993 consisted of testing the components that comprise the north linac. Most of the testing occured in the 40 - 100 MeV range at fairly low current levels using both pulsed and "continuous" beam, and the maximum conditions reached during the testing were 125 MeV at 125 μA CW.

The possibility of production of activated ground water constituents did

exist during the testing operations. The distance from the beam dump to the monitoring wells on the south site boundary is great enough that any radionuclides produced during operations would not have been seen in the ground water removed from these wells. Moreover, the majority of neutrons produced in the dumps as a result of these operations can be characterized as having relatively low energies, so most would have been removed by the dump shielding and concrete of the tunnel enclosure and thus not have activated any ground water constituents.

Construction activities were confined to completion of the interior of the tunnel and experimental halls, and to completion of the above grade earth works covering the experimental halls. In addition to the construction activities, landscaping of the site was performed throughout the period. Due to the scope of construction activity, it is anticipated that the ground water flow has started to establish it's new steady state pattern. Selection of a contractor to perform a new site hydrogeological study is nearly completed. The study will characterize the post construction ground water flow regime.

Data Trend Analysis

The sample analysis results for the period of March 1992 to March 1993 were examined to identify any potential anomalies, and compared to the data collected since the inception of the sampling program to determine if any observable trends exist. Most of the data continue to show little variation, and thus confirm the "trend" previously established for these analytes. The data for the period are presented in Tables 2 through 8.

As previously discussed (May91, Wel92) five analytes or analytye groups were selected for detailed trend analysis. The selected analytes were: pH, conductivity, total metals, gross alpha, and gross beta. For purposes of the comparison, analysis results for the four down gradient wells were averaged, and the average was compared to the up gradient well. The well located inside linac ring near the center of the west arc of the tunnel (GW-17) was compared separately to the up gradient well. The average values for each sampling period were graphically displayed, and visually inspected for trends (see Figures 1 through 5.)

Examination of Figures 2 through 5 seems to indicate that the ground water flow regime is continuing to establish a new steady state pattern. The variation seen in the individual analytes has been reduced significantly, and there is an indication that an new steady state average will be established when gound water flow recovers from any disruption caused by construction activities. This is especially evident in the cases of gross alpha and gross beta where the up and down gradient levels are seen to become and remain approximately equal.

The pH of the only regularly sampled up gradient well continues to be significantly lower than the other wells, and to exhibit a fair amount of variability.

For amplification of the trends of these analytes, please refer to comments made in RCG Notes 91-006 and 92-009.

The data were examined to determine if any seasonal influence could be detected. The method used to deseasonalize the data is found in section 7.2 of EPA89. The result of the deseasonalization showed no significant of seasonal environmental variations on the analysis results. Figure 6 shows the effect of the deseasonalizing calculation on the ground water pH for the upgradient well. The figure readily shows that the seasonally adjusted values for pH follows the same trend at almost the same levels as the unadjusted values. This shows that there is no indication at the present time of a correlation between the season and the pH value. The figure is representative of all analytes trended.

Statistical Analysis

The radionuclide data were subjected to a statistical analysis to determine if there is evidence of contamination of the ground water as it crossed the site. All of the data collected since the inception of the ground water monitoring program were used. Since there were large numbers of "non-detects" in the data, the method employed was a test of proportions. The methodology is found in Section 8.1.2 of EPA89. For a discussion of this method please refer to the applicable portions of EPA89 or May91.

The test of proportions was performed only for analytes having a significant number of results greater than the detection limit or reporting limit as applicable. Analytes not subjected to this examination were assumed to have had no significant change in concentration across the site. The test of proportions was performed for gross alpha, gross beta, calcium 45, total radium, strontium 90, thorium 230, and thorium 232.

Table 1: Test of Proportions Data

Analyte	Number of Detections in the Background Well	Number of Detections in the Down Grad. Wells	Number of Detections in the Background Well	Number of Detections in the Down Grad. Wells	Computed Statistic Z
Gross Alpha	13	70	26	135	0.52
Gross Beta	14	73	26	135	0.54
Total Ra	10	52	26	135	0.39
Sr^{90}	2	17	26	137	0.12
Th^{230}	3	25	25	130	0.18
Th^{232}	4	19	26	135	0.14

Table 1 lists the analytes and values for the calculation variables and the value of the computed statistic Z. It should be noted that the data were checked for conformance to a normal distribution prior to performing the test of proportions. The computed statistic Z was within ≤ 1.96 for each of the analytes tested. It can be said therefore that, within the 95%

confidence level, there exists no radioactive contamination being added to the ground water by CEBAF.

Analysis Problems

Analysis of the ground water samples is currently divided between two labs. The non-radionuclide or cold analyses are performed by Bionetics in their local facility. The radionuclide analyses are performed by Controls for Environmental Polution, Inc. (CEP) in New Mexico.

During the period of March 1991 to March 1992, a tritium analysis result of greater than 1000 pCi/l was reported. Upon reanalysis the result was revised to be less than 1000 pCi/l. (This incident is discussed in May92 and Wel92.) This occurence was repeated 4 times during the period of March 1992 to March 1993. The results of the reanalysis of each sample have been less than the reporting limit of 1000 pCi/l. Investigation of the causes of the initially reported high values will be included in an onsite inspection and review of procedures by the CEBAF Operational Health Physicist in the near future.

Summary and Future

The examination of the ground water data accumulated since the commencement of the monitoring program shows that for parameters having variations in their reported analysis results no significant amounts of contaminants have been added to the ground water as it passed through the CEBAF site. The trend analysis revealed that the initially noted wide variations in the reported analysis results were due in large part to disturbances in the ground water flow caused by the below grade construction activities. Since the cessation of the major construction activities, the analysis results have shown signs that the ground water flow is approaching a steady state condition. The statistical analysis of the radionuclide results verifies that there is no radioactive contamination attributable to CEBAF operations.

In depth audits of the analytical services vendors are planned to occur in the near future. These audits will assess the vendor's capabilities and compliance with procedures for the analyses performed. The audit of CEP will also examine the reasons for the recent false positive tritium results.

While the current use of one up gradient well shows that there is no contamination being added to the ground water as it crosses the site, the addition of at least one other up gradient well would provide a more sensitive and positive indication of possible added contamination. This will be increasingly important as the accelerator becomes fully operational. The upcoming site hydrogeology study will aid in determining which wells are best suited for use as the source of the up gradient samples.

Data collected in the future will be used to complete the background characterization of the ground water at the CEBAF site, and to determine the possible effects of seasonal variations. A control chart will be constructed to aid in monitoring the ground water quality.

Figure 1: Graph of Gross Alpha Concentration

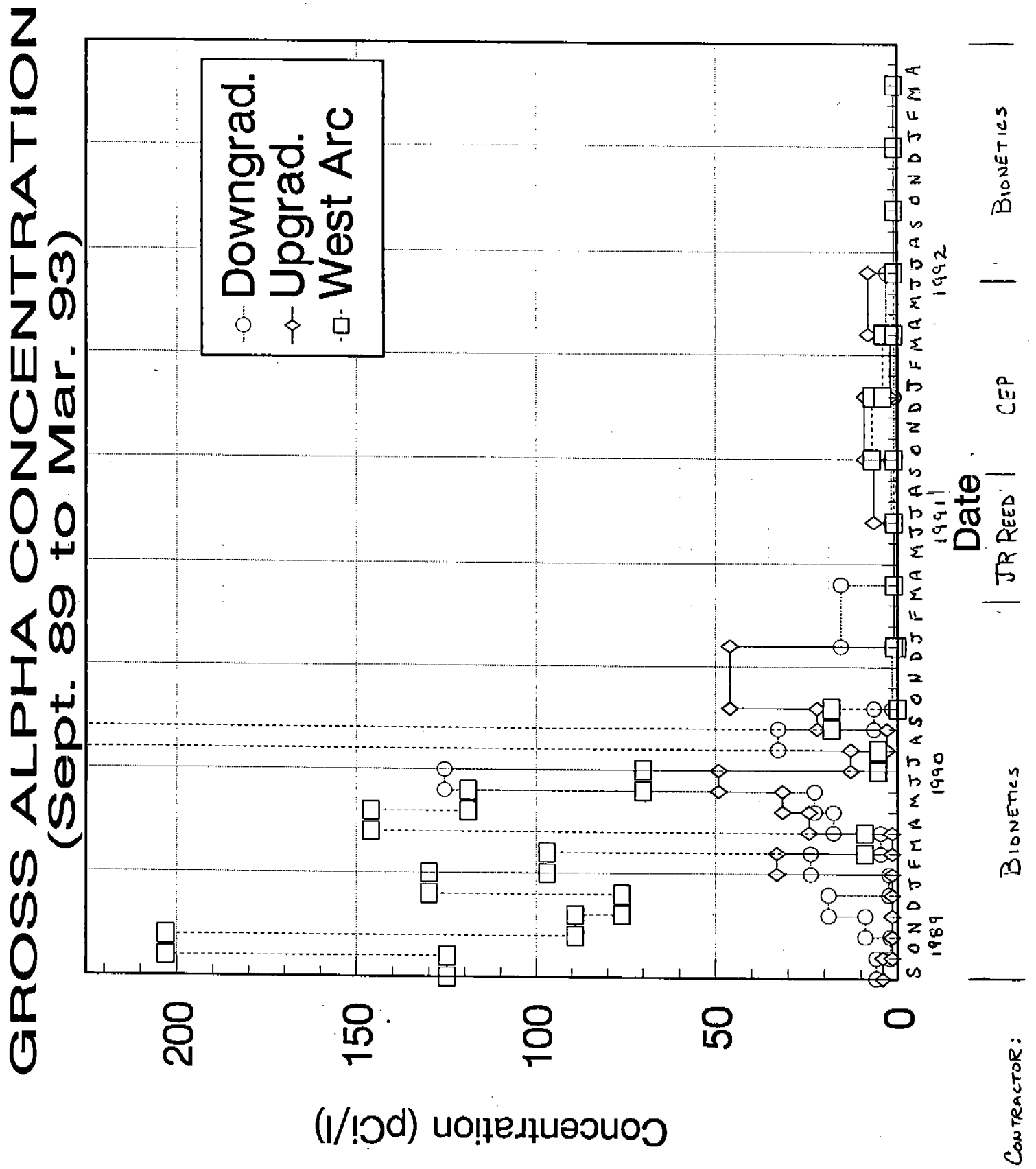

Figure 2: Graph of Gross Beta Concentration

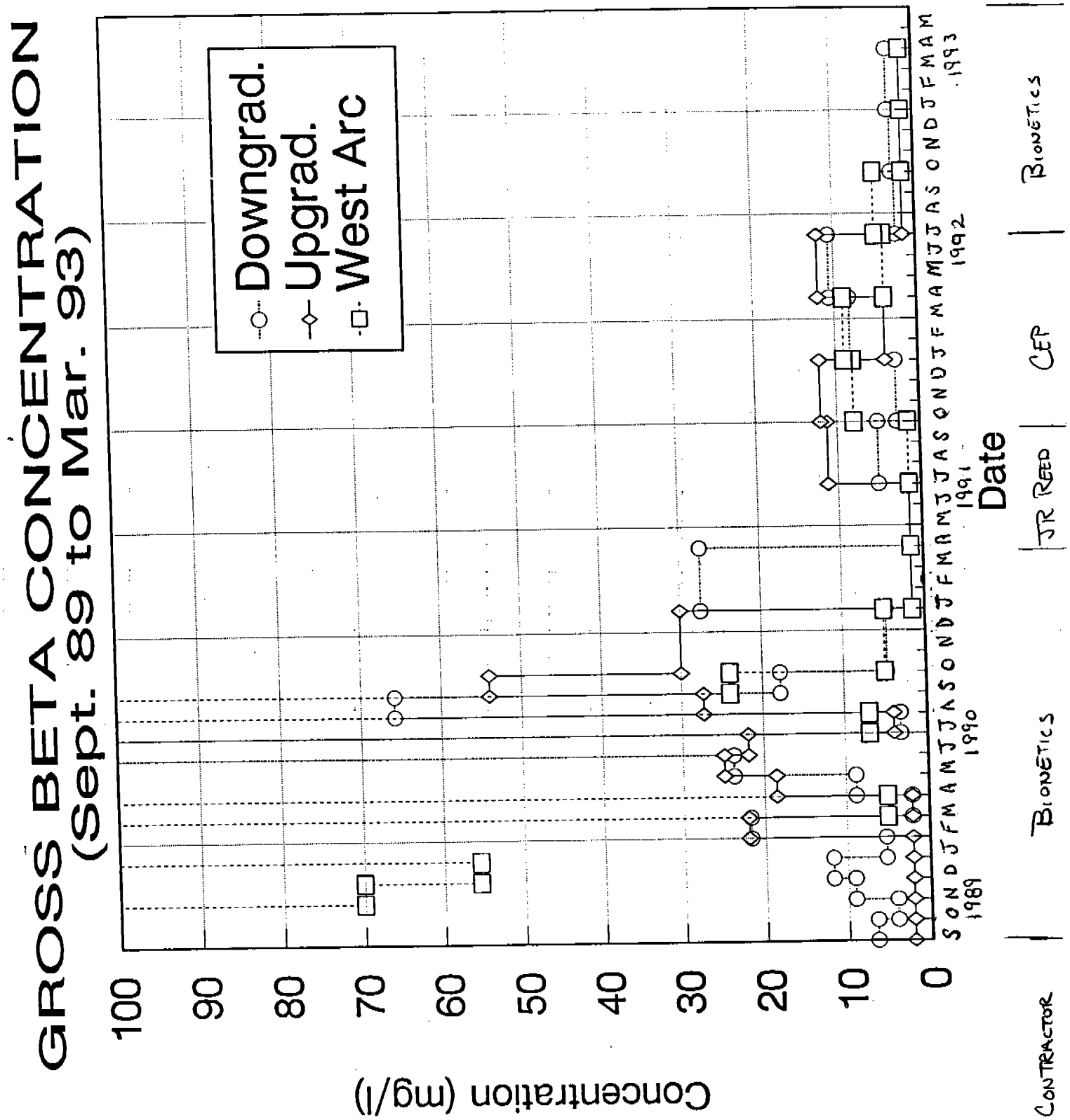

Figure 3: Graph of Ground Water pH

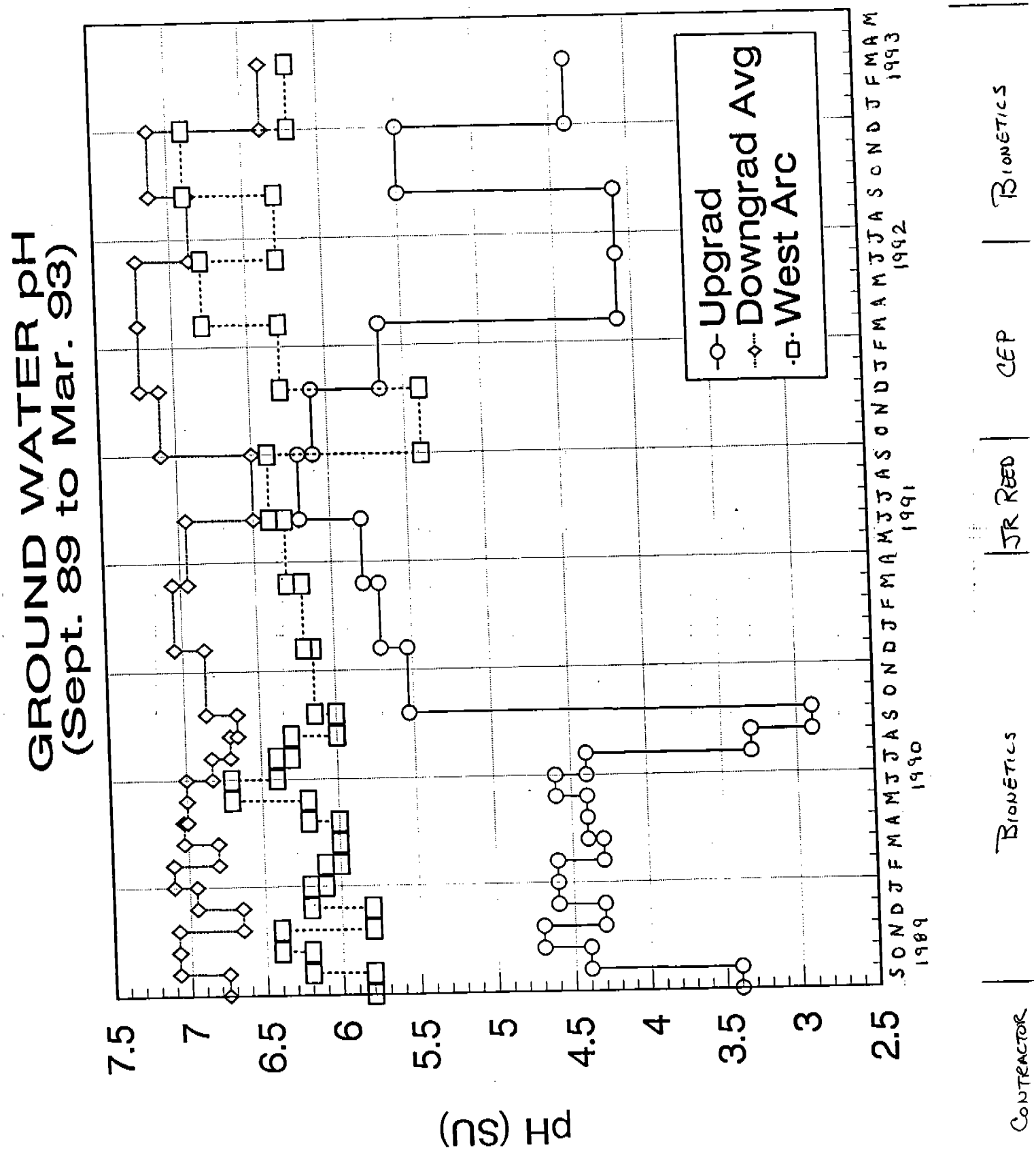

Figure 4: Graph of Ground Water Conductivity

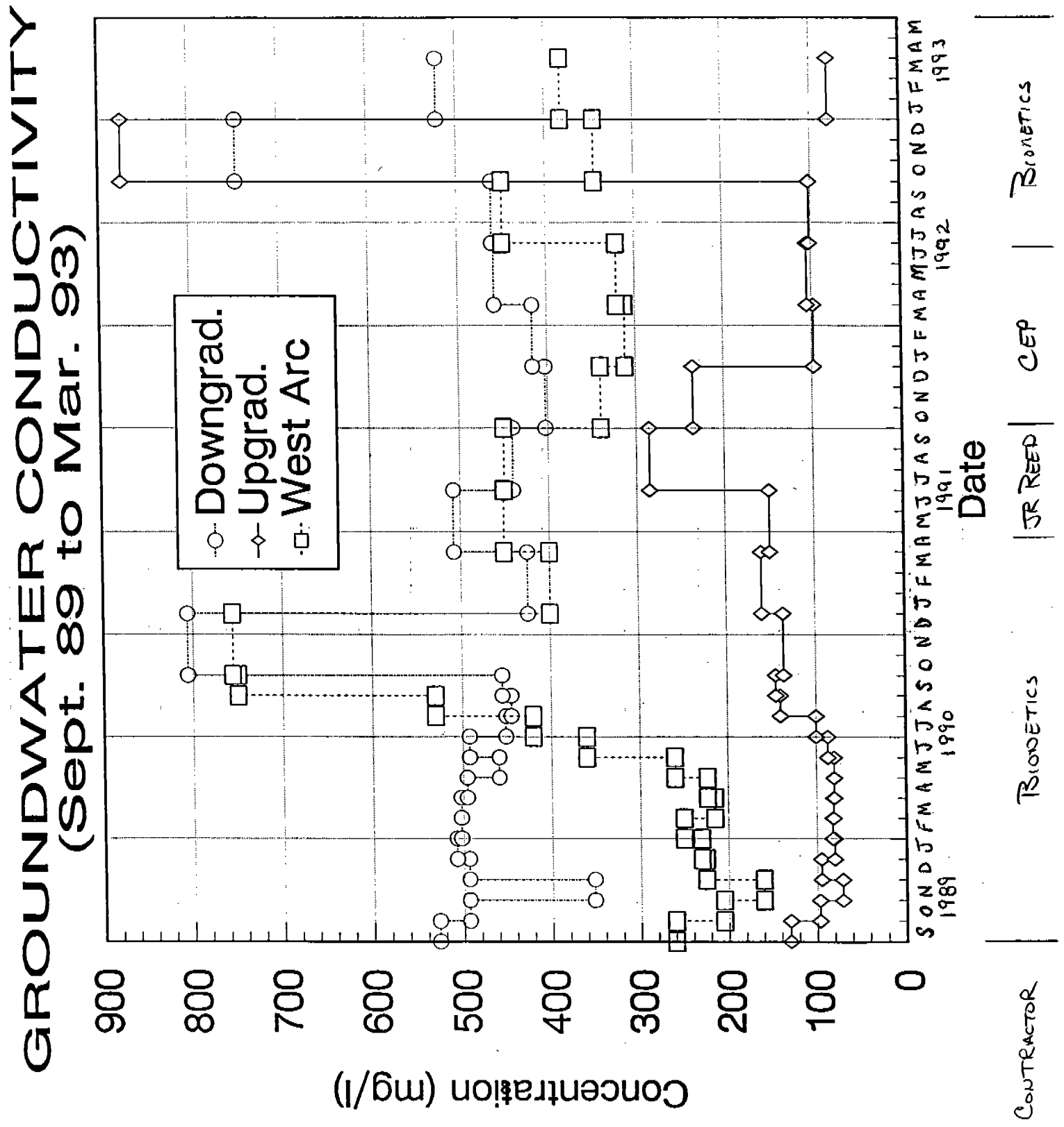

Figure 5: Graph of Total Metals Concentration

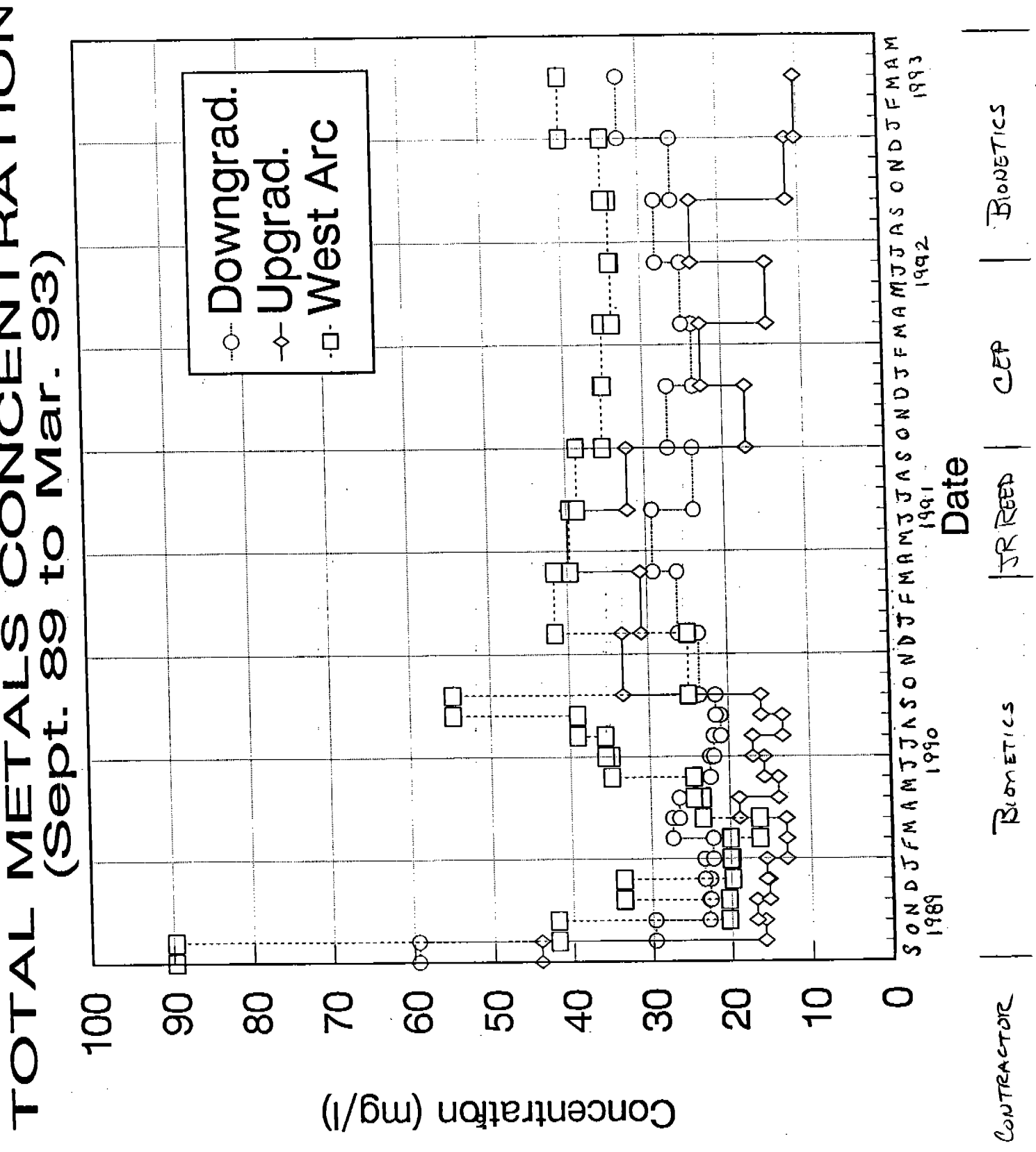

Figure 6: Typical Graph of Seasonally Adjusted Values

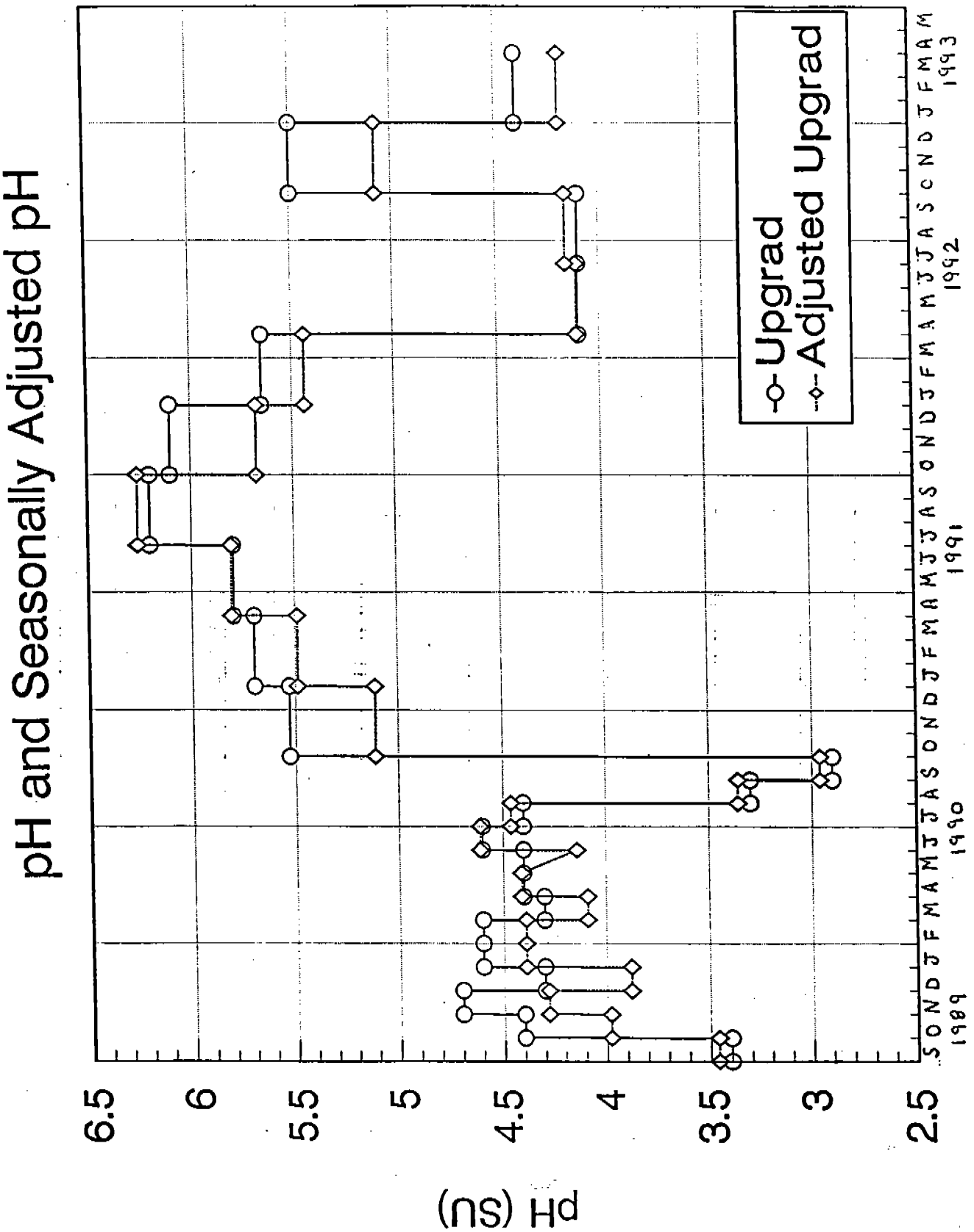

Table 2: Analysis Data for Well GW2 - March 1992 to March 1993

MONTH	YEAR	pH	COND	TOC	GR ALPHA	(±)	GR BETA	(±)	TRITIUM	Na-22	Na-24	Be-7	Ca-45	(±)
MAR	92	7.70	423.00	1.36	< 2.00		7.00	(3.00)	< 1000.00	< 5.00	< 20.00	< 40.00	< 5.00	
JUL	92	7.50	410.00	2.55	< 2.00		8.00	(3.00)	< 1000.00	< 24.00	< 20.00	<229.00	< 5.00	
SEP	92	7.00	569.00	2.71	< 2.00		< 3.00		< 1000.00	< 20.00	< 20.00	<101.00	< 5.00	
DEC	92	7.30	550.00	1.94	< 2.00		< 3.00		< 1000.00	< 14.00	< 17.00	<156.00	< 5.00	
MAR	93	6.80	620.00	2.74	< 2.00		< 3.00		< 1000.00	< 21.00	< 20.00	<158.00	< 5.00	

MONTH	YEAR	TOTAL Ra	(±)	Sr-90	(±)	Mn-54	Co-60	Cs-134	Th-230	(±)	Th232	(±)	CaCO3	COD	Cu	Fe
MAR	92	< 1.00		< 0.70		< 4.00	< 4.00	< 4.00	< 1.00		< 1.00		230.00	53.00	<0.001	2.50
JUL	92	< 1.00		< 0.70		< 23.00	< 25.00	< 20.00	< 1.00		< 1.00		260.00	33.00	<0.001	2.74
SEP	92	< 1.00		< 0.70		< 11.00	< 12.00	< 11.00	< 0.60		< 0.60		340.00	110.00	0.002	7.09
DEC	92	< 1.00		< 0.70		< 14.00	< 15.00	< 12.00	< 0.60		< 0.60		330.00	50.00	0.001	5.41
MAR	93	< 1.00		< 0.50		< 18.00	< 19.00	< 16.00	< 0.60		< 0.60		330.00	<25.00	<0.001	22.00

MONTH	YEAR	Pb	Mn	Ni	Zn	Na	GWELEV
MAR	92	<0.050	0.100	<0.04	0.01	30.00	23.25
JUL	92	<0.050	0.060	<0.04	0.01	29.80	22.68
SEP	92	<0.010	0.375	<0.01	0.02	34.50	21.52
DEC	92	<0.010	0.301	<0.01	<0.01	30.30	24.02
MAR	93	<0.010	0.608	0.02	0.04	34.30	20.80

Table 3: Analysis Data for Well GW3 - March 1992 to March 1993

MONTH	YEAR	pH	COND	TOC	GR ALPHA	(±)	GR BETA	(±)	TRITIUM	Na-22	Na-24	Be-7	Ca-45	(±)
MAR	92	7.40	422.00	1.41	< 2.00		14.00	(3.00)	< 1000.00	< 13.00	< 20.00	<113.00	< 5.00	
JUL	92	7.60	432.00	2.62	< 2.00		29.00	(4.00)	< 1000.00	< 18.00	< 20.00	<162.00	< 5.00	
SEP	92	7.20	452.00	2.32	< 2.00		5.00	(3.00)	< 1000.00	< 27.00	< 20.00	<101.00	< 5.00	
DEC	92	7.00	432.00	1.58	< 2.00		< 3.00		< 1000.00	< 13.00	< 14.00	<141.00	< 5.00	
MAR	93	7.30	438.00	1.75	< 2.00		8.00	(3.00)	< 1000.00	< 29.00	< 20.00	<237.00	< 5.00	

MONTH	YEAR	TOTAL Ra	(±)	Sr-90	(±)	Mn-54	Co-60	Cs-134	Th-230	(±)	Th232	(±)	CaCO3	COD	Cu	Fe
MAR	92	< 1.00		< 0.70		< 11.00	< 12.00	< 22.00	< 1.00		< 1.00		280.00	38.00	<0.001	1.11
JUL	92	< 1.00		< 0.70		< 16.00	< 17.00	< 28.00	< 1.00		< 1.00		264.00	38.00	<0.001	1.17
SEP	92	< 1.00		< 0.70		< 19.00	< 13.00	< 10.00	< 0.60		< 0.60		264.00	39.00	<0.001	1.60
DEC	92	< 1.00		< 0.70		< 12.00	< 13.00	< 11.00	< 0.60		< 0.60		230.00	52.00	<0.001	1.28
MAR	93	< 1.00		0.90	(0.8)	< 26.00	< 25.00	< 22.00	< 0.60		< 0.60		240.00	<25.00	<0.001	1.17

MONTH	YEAR	Pb	Mn	Ni	Zn	Na	GWELEV
MAR	92	<0.050	0.040	<0.04	<0.01	27.00	3.25
JUL	92	<0.050	0.020	<0.04	0.01	29.60	0.75
SEP	92	<0.010	0.040	<0.01	<0.01	29.60	0.75
DEC	92	<0.010	0.034	<0.01	<0.01	29.30	18.42
MAR	93	<0.010	0.034	<0.01	0.02	28.40	-2.92

Table 4: Analysis Data for Well GW7 - March 1992 to March 1993

MONTH	YEAR	pH	COND	TOC	GR ALPHA	(±)	GR BETA	(±)	TRITIUM	Na-22	Na-24	Be-7	Ca-45	(±)
MAR	92	6.70	320.00	3.40	< 2.00		10.00	(3.00)	< 1000.00	< 12.00	< 20.00	<193.00	< 1.00	
JUL	92	7.30	373.00	3.34	5.00	(2.00)	6.00	(3.00)	< 1000.00	< 34.00	< 20.00	<200.00	< 5.00	
SEP	92	6.40	262.00	3.47	< 2.00		< 3.00		< 1000.00	< 11.00	< 20.00	< 99.00	< 5.00	
DEC	92	7.00	1450.00	2.50	< 2.00		7.00	(4.00)	< 1000.00	< 15.00	< 17.00	<212.00	< 5.00	
MAR	93	4.50	330.00	2.37	< 2.00		< 3.00		< 1000.00	< 20.00	< 21.00	<180.00	< 5.00	

MONTH	YEAR	TOTAL Ra	(±)	Sr-90	(±)	Mn-54	Co-60	Cs-134	Th-230	(±)	Th232	(±)	CaCO3	COD	Cu	Fe
MAR	92	< 1.00		< 0.70		< 10.00	< 21.00	< 19.00	< 1.00		< 1.00		150.00	42.00	<0.001	3.50
JUL	92	< 1.00		< 0.70		< 32.00	< 16.00	< 28.00	< 1.00		1.80	(1.2)	212.00	<25.00	0.002	1.48
SEP	92	< 1.00		< 0.70		< 11.00	< 12.00	< 10.00	< 0.60		< 0.60		96.00	<25.00	0.002	4.89
DEC	92	< 1.00		< 0.70		< 14.00	< 17.00	< 13.00	< 0.60		< 0.60		132.00	52.00	<0.001	4.98
MAR	93	< 1.00		< 0.50		< 38.00	< 35.00	< 35.00	< 0.60		< 0.60		180.00	27.00	<0.001	2.59

MONTH	YEAR	Pb	Mn	Ni	Zn	Na	GWELEV
MAR	92	<0.050	0.170	<0.04	0.05	14.00	20.19
JUL	92	<0.050	0.170	<0.04	0.04	12.80	20.19
SEP	92	<0.010	0.180	0.01	0.11	13.90	20.78
DEC	92	<0.010	0.120	<0.01	0.02	12.40	11.28
MAR	93	<0.010	0.153	<0.01	0.06	13.70	17.36

Table 5: Analysis Data for Well GW8 - March 1992 to March 1993

MONTH	YEAR	pH	COND	TOC	GR ALPHA	(±)	GR BETA	(±)	TRITIUM	Na-22	Na-24	Be-7	Ca-45	(±)
MAR	92	6.80	550.00	3.42	< 2.00		< 3.00		< 1000.00	< 12.00	< 20.00	<187.00	< 5.00	
JUL	92	6.50	620.00	4.14	5.00	(3.00)	< 3.00		< 1000.00	< 4.00	< 20.00	<171.00	< 5.00	
SEP	92	6.90	561.00	2.97	< 2.00		< 3.00		< 1000.00	< 20.00	< 20.00	< 68.00	< 5.00	
DEC	92	7.20	555.00	2.40	< 2.00		< 3.00		< 1000.00	< 10.00	< 11.00	<201.00	< 5.00	
MAR	93	6.90	700.00	2.52	< 2.00		< 3.00		< 1000.00	< 23.00	< 22.00	<173.00	< 5.00	

MONTH	YEAR	TOTAL Ra	(±)	Sr-90	(±)	Mn-54	Co-60	Cs-134	Th-230	(±)	Th232	(±)	CaCO3	COD	Cu	Fe
MAR	92	< 1.00		< 0.70		< 21.00	< 4.00	< 11.00	< 1.00		< 1.00		380.00	25.00	<0.001	9.70
JUL	92	< 1.00		< 0.70		< 3.00	< 4.00	< 3.00	< 1.00		< 1.00		392.00	33.00	0.001	9.32
SEP	92	< 1.00		< 0.70		< 16.00	< 18.00	< 15.00	< 0.60		< 0.60		364.00	38.00	<0.001	9.51
DEC	92	< 1.00		< 0.70		< 12.00	< 19.00	< 16.00	< 0.60		< 0.60		372.00	42.00	<0.001	9.40
MAR	93	< 1.00		< 0.50		< 20.00	< 20.00	< 18.00	< 0.60		< 0.60		480.00	<25.00	<0.001	9.42

MONTH	YEAR	Pb	Mn	Ni	Zn	Na	GWELEV
MAR	92	<0.050	0.320	<0.04	0.01	13.00	20.67
JUL	92	<0.050	0.280	<0.04	0.01	12.80	20.58
SEP	92	<0.010	0.294	<0.01	<0.01	10.30	21.50
DEC	92	<0.010	0.265	<0.01	0.02	9.90	22.17
MAR	93	<0.010	0.315	<0.01	0.03	17.10	20.25

Table 6: Analysis Data for Well GW15 - March 1992 to March 1993

MONTH	YEAR	pH	COND	TOC	GR ALPHA	(±)	GR BETA	(±)	TRITIUM	Na-22	Na-24	Be-7	Ca-45	(±)
MAR	92	5.00	81.00	1.05	< 2.00		4.00	(3.00)	< 1000.00	< 12.00	< 20.00	<106.00	< 5.00	
JUL	92	4.10	105.00	2.19	8.00	(2.00)	12.00	(3.00)	< 1000.00	< 21.00	< 20.00	<115.00	< 5.00	
SEP	92	4.10	102.00	2.25	< 2.00		< 3.00		< 1000.00	< 28.00	< 20.00	<217.00	< 5.00	
DEC	92	5.50	875.00	1.25	< 2.00		< 3.00		< 1000.00	< 29.00	< 20.00	<216.00	< 5.00	
MAR	93	4.40	80.00	1.38	< 2.00		< 3.00		< 1000.00	< 20.00	< 20.00	<173.00	< 5.00	

MONTH	YEAR	TOTAL Ra	(±)	Sr-90	(±)	Mn-54	Co-60	Cs-134	Th-230	(±)	Th232	(±)	CaCO3	COD	Cu	Fe
MAR	92	< 1.00		< 0.70		< 11.00	< 13.00	< 11.00	< 1.00		< 1.00		230.00	53.00	<0.001	2.50
JUL	92	< 1.00		< 0.70		< 20.00	< 18.00	< 17.00	< 1.00		4.60	(1.10)	28.00	31.00	0.004	0.09
SEP	92	< 1.00		< 0.70		23.00	< 13.00	< 22.00	< 0.60		< 0.60		8.00	25.00	0.010	0.16
DEC	92	< 1.00		< 0.70		< 26.00	< 16.00	< 22.00	< 0.60		1.00	(0.70)	16.00	46.00	0.009	0.14
MAR	93	2.00	(1.0)	< 0.50		< 38.00	< 17.00	< 34.00	< 0.60		< 0.60		8.00	<25.00	0.006	0.06

MONTH	YEAR	Pb	Mn	Ni	Zn	Na	GWELEV
MAR	92	<0.050	0.100	<0.04	0.02	11.00	23.39
JUL	92	0.080	0.030	<0.04	0.03	14.00	22.23
SEP	92	0.230	0.064	0.04	0.14	23.00	21.81
DEC	92	<0.010	0.056	0.01	0.05	11.20	30.14
MAR	93	<0.010	0.076	<0.01	0.13	10.00	19.89

Table 7: Analysis Data for Well GW17 - March 1992 to March 1993

MONTH	YEAR	pH	COND	TOC	GR ALPHA	(±)	GR BETA	(±)	TRITIUM	Na-22	Na-24	Be-7	Ca-45	(±)
MAR	92	6.30	312.00	2.27	4.00	(2.00)	9.00	(3.00)	< 1000.00	< 22.00	< 20.00	<127.00	< 5.00	
JUL	92	6.80	321.00	3.58	< 2.00		4.00	(2.00)	< 1000.00	< 20.00	< 20.00	<160.00	< 5.00	
SEP	92	6.30	449.00	3.08	< 2.00		5.00	(3.00)	< 1000.00	< 16.00	< 20.00	<125.00	< 5.00	
DEC	92	6.90	345.00	2.62	< 2.00		< 3.00		< 1000.00	< 17.00	< 12.00	<210.00	< 5.00	
MAR	93	6.20	382.00	2.44	< 2.00		< 3.00		< 1000.00	< 22.00	< 15.00	<164.00	< 5.00	

MONTH	YEAR	TOTAL Ra	(±)	Sr-90	(±)	Mn-54	Co-60	Cs-134	Th-230	(±)	Th232	(±)	CaCO3	COD	Cu	Fe
MAR	92	< 1.00		< 0.70		< 21.00	< 3.00	< 4.00	< 1.00		< 1.00		130.00	44.00	<0.001	12.80
JUL	92	< 1.00		< 0.70		< 19.00	< 29.00	< 16.00	< 1.00		< 1.00		160.00	38.00	<0.001	14.00
SEP	92	< 1.00		< 0.70		< 15.00	< 15.00	< 14.00	< 0.60		1.70	(1.2)	136.00	51.00	<0.001	14.00
DEC	92	< 1.00		< 0.70		< 14.00	< 15.00	< 11.00	< 0.60		< 0.60		144.00	44.00	0.001	15.00
MAR	93	< 1.00		< 0.50		< 20.00	< 22.00	< 18.00	< 0.60		< 0.60		160.00	<25.00	<0.001	17.90

MONTH	YEAR	Pb	Mn	Ni	Zn	Na	GWELEV
MAR	92	<0.050	0.140	<0.04	0.01	22.00	23.88
JUL	92	<0.050	0.110	<0.04	0.01	19.60	22.72
SEP	92	0.010	0.120	<0.01	0.01	19.80	22.05
DEC	92	0.010	0.125	<0.01	<0.01	19.60	23.22
MAR	93	<0.010	0.149	<0.01	0.03	21.80	21.10

Table 8: Analysis Data for Site Dewater Samples - March 1992 to March 1993

MONTH	YEAR	pH	COND	TOC	GR ALPHA	(±)	GR BETA	(±)	TRITIUM	Na-22	Na-24	Be-7	Ca-45	(±)
MAR	92	7.20	750.00	2.76	6.00	(2.00)	22.00	(4.00)	< 1000.00	< 15.00	< 20.00	<128.00	< 5.00	
JUL	92	7.60	820.00	4.90	14.00	(4.00)	32.00	(4.00)	< 1000.00	< 17.00	< 20.00	<198.00	< 5.00	
SEP	92	7.00	601.00	3.99	9.00	(3.00)	19.00	(4.00)	< 1000.00	< 13.00	< 20.00	<105.00	< 5.00	
DEC	92	7.40	990.00	4.21	6.00	(5.00)	13.00	(7.00)	< 1000.00	< 15.00	< 12.00	<212.00	< 5.00	
MAR	93	5.00	700.00	3.40	9.00	(5.00)	17.00	(4.00)	< 1000.00	< 21.00	< 21.00	<162.00	< 5.00	

MONTH	YEAR	TOTAL Ra	(±)	Sr-90	(±)	Mn-54	Co-60	Cs-134	Th-230	(±)	Th232	(±)	CaCO3	COD	Cu	Fe
MAR	92	< 1.00		< 0.70		< 15.00	< 5.00	< 4.00	< 1.00		< 1.00		230.00	53.00	<0.001	2.50
JUL	92	< 1.00		< 0.70		< 18.00	< 19.00	< 28.00	< 1.00		1.80	(0.7)	568.00	54.00	0.002	1.51
SEP	92	< 1.00		< 0.70		< 11.00	< 12.00	< 11.00	< 0.60		< 0.60		572.00	52.00	<0.001	0.07
DEC	92	2.00	(1.0)	< 0.70		< 13.00	< 14.00	< 11.00	< 0.60		< 0.60		692.00	56.00	0.008	9.33
MAR	93	5.00	(1.0)	< 0.50		< 18.00	< 21.00	< 16.00	< 0.60		< 0.60		660.00	77.00	0.033	81.70

MONTH	YEAR	Pb	Mn	Ni	Zn	Ba	GWELEV
MAR	92	<0.050	0.280	<0.04	0.06	29.00	0.00
JUL	92	<0.050	0.270	<0.04	0.02	28.90	0.00
SEP	92	<0.010	0.055	<0.01	<0.01	29.00	0.00
DEC	92	<0.010	0.539	<0.01	0.21	31.30	0.00
MAR	93	0.060	0.892	0.03	0.60	33.00	0.00

Table 9: Units

Analyte	Units
pH	Standard pH units
Conductivity	µmhos/cm
TOC, CaCO3, COD, metals (Cu, Fe, Pb, Mn, Ni, Zn, Ba)	mg/l
radio-isotopes	pCi/l
GW Elevation	feet above sea level

References

EPA89 Statistical Analysis of Ground-water Monitoring at RCRA Facilities; USEPA Publication; 1989

May91 Statistical Evaluation of CEBAF Ground Water Analyses of Samples Collected September 1989 - March 1991; RCG Note 91-006; R. May and C. Wells

May92 Radiation Control Office Memorandum to file dated 3/25/92

Wel92 Evaluation of Ground Water Analyses for Samples Collected From September 1989 to March 1992; RCG Note 92-009; C. Wells