Filtration preservation study of groundwater samples. [DNR-021a] 1987?

Schwalbe, John; Sauer, David

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Wisconsin Groundwater Management Practice Monitoring Project No. 23

GROUNDWATER
Wisconsin's buried treasure

Wisconsin Department of Natural Resources

Filtration Preservation Study of Groundwater Samples

John Schwalbe, Environmental Specialist
David Sauer, Environmental Engineer, P.E.
Division of Environmental Standards
Wisconsin Department of Natural Resources
Madison, Wisconsin 53707

Introduction

Since 1977, industrial and municipal facilities have been required to monitor groundwater according to their specific Wisconsin Pollutant Discharge Elimination System Permit. Department guidelines for groundwater sampling contain specific recommendations for proper purging of wells, thorough rinsing, and equipment used, etc. (see Groundwater Sampling Procedures Guidance Document, Dave Sauer, et.al.). This guideline recognized that considerable time and expense is required to perform in-field filtering. As a result, the option to filter nonmetal samples in the laboratory has been accepted, provided it is done as soon as possible.

A study was conducted to analyze the validity of this policy during the summer of 1986. The specific purpose of the study was to determine effects on laboratory analytical results of groundwater when sample filtration and/or preservation is done immediately on the site as compared to results obtained when filtering and/or preservation is done 24 hours later. Parameters analyzed in the study were ammonia nitrogen, Kjeldahl nitrogen, nitrate plus nitrite nitrogen, chlorides, total dissolved solids (TDS), and chemical oxygen demand (COD).

Methodology

Three separate field sites were chosen for the study to represent the various soil types, wastewater effluent qualities, and groundwater qualities found throughout the state. Field site 1 was an absorption pond system receiving untreated dairy wastewater. Field site 2 was an absorption pond system receiving pretreated meat processing wastewater. Field site 3 was a ridge and furrow system receiving untreated dairy wastewater. Site 1 has silt loam soils, while sites 2 and 3 have sandy soils. Two wells were chosen at each of the three sites. Wells upgradient and downgradient from the wastewater disposal system were selected to ensure that a range of groundwater parameter concentrations were obtained. Average groundwater parameter concentrations for each well at each site over the last two years are listed in Table 1. This data was used only to ensure a range of parameter concentrations were obtained during the study.

Table 1: Average Groundwater Parameter Concentrations (mg/l)

	Site 1		Site 2		Site 3	
Well	1	2	3	4	5	6
COD	15	40	23	18	6	40
TDS	730	1250	1200	800	400	1000
Kjeldahl-N	3.2	14	12	4	.2	80
NH_3-N	2.8	12	11	3	.1	60
NO_2 & NO_3	.1	.1	.1	.1	20	.1
Chlorides	164	430	600	250	80	120

The data set for this study was generated by sampling each of the six wells for ten consecutive weeks. Sample collection time was from June 1986 to August 1986. Well purging and groundwater sample collection were performed using a PVC flow through bailer. Three well volumes were purged from each well prior to collection of the samples. Collected samples were deposited in a 2-liter polyethylene container. Following collection, the groundwater sample was divided into three identical portions. Portion 1 was field filtered immediately with 250 ml being preserved with sulfuric acid for COD and nitrogen series analysis, and 500 ml separately contained for total dissolved solids and chloride analysis. Upon completion, the sample was cooled to 4°C for transportation to the State Laboratory of Hygiene (SLOH). Portion 2 was cooled to 4°C and not filtered until 24 hours later. 24 hours later 250 ml of this portion was preserved with sulfuric acid for COD and nitrogen series analysis, and a 500 ml sample was seperately contained for TDS and chloride analysis. The sample was then taken to the State Laboratory of Hygiene for analysis. Portion 3 was preserved with sulfuric acid immediately, cooled to 4°C and not filtered until 24 hours later. The sample was then taken to the State Laboratory of Hygiene for analysis. For the comparison between filtering times, Portion 1 (immediately filtered) was compared to Portion 2 (filtered 24 hours later). For the comparison between preservation time, Portion 2 (preserved 24 hours later) was compared to Portion 3 (preserved immediately in the field). Filtering of samples was performed using a peristallic pump, a commercially available field filtering unit, and a 0.45 micron size cellulose nitrate membrane filter with a glass fiber prefilter. A minimum of 500 ml of distilled deionized water was flushed through the filter and the filter paper prior to filtering each sample.

Data Analysis

Two methods were used to analyze the data. By method 1, each parameter was analyzed independently at each well. To test if a significant difference exists between filtering in the field and filtering 24 hours later a standard hypothesis test was used. The test states that the difference between filtering procedures is significant if the test statistic calculated for the data is greater than the critical value chosen for the test. The test statistic was calculated from the data by taking the average value of the difference between filtering in the field and filtering 24 hours later for each sampling date. Critical values were taken from the Wisconsin Administrative Code, NR 140, Groundwater Quality, (see Tables 2 and 3, page 4).

The critical values were chosen to ensure that a significant difference would be substantial enough to affect decisions regarding compliance with NR 140. By choosing 10% of the [enforcement standard minus the preventive action limit] for the health and welfare related parameters, the critical value will be related to the establishment of the preventive action limit (PALs). The PALs for health and welfare related parameters range from 10 to 50% of the corresponding enforcement standard.

Table 2. Critical Values for Health and Welfare Parameters

Total Dissolved Solids' critical value = 10% x (enforcement standard - preventive action limit) = 25 mg/l.

Chlorides' critical value = 10% x (enforcement standard - preventive action limit) = 12.5 mg/l.

Nitrates + Nitrites' critical value = 10% x (enforcement standard - preventive action limit) = .8 mg/l.

Table 3. Critical Values for the Indicator Parameters

COD critical value = 50% x (minimum increase in Table 3 of NR 140) = 12.5 mg/l.

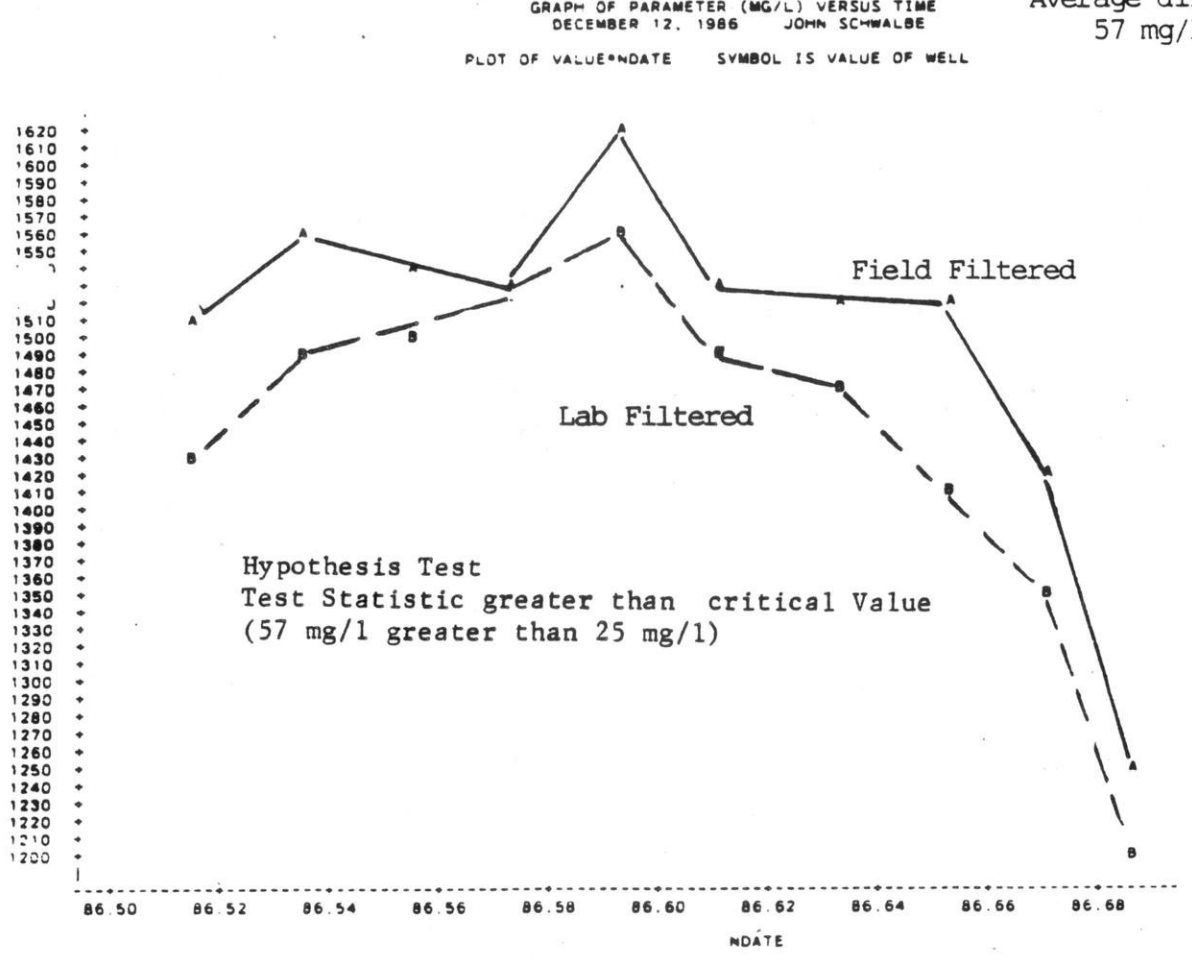
Ammonia Nitrogen critical value = 50% x (minimum increase in Table 3 of NR 140) = 1 mg/l.

Kjeldahl Nitrogen critical value = 50% x (minimum increase in Table 3 of NR 140) = 1 mg/l.

The following example shows the most significant case where the hypothesis test showed that a significant difference did exist between filtering in the field and filtering 24 hours later. The parameter of concern was total dissolved solids at well 5.

PARAM	VALUE	YEAR	MONTH	DAY		Differences
360-DIS SOLIDS,TOT	1510	86	7	7		
360-DIS SOLIDS,TOT	1560	86	7	14		
360-DIS SOLIDS,TOT	1540	86	7	21		
360-DIS SOLIDS,TOT	1530	86	7	28		
360-DIS SOLIDS,TOT	1620	86	8	4	Field Filtered	80
360-DIS SOLIDS,TOT	1530	86	8	11		70
360-DIS SOLIDS,TOT	1520	86	8	19		40
360-DIS SOLIDS,TOT	1520	86	8	26		0
360-DIS SOLIDS,TOT	1420	86	9	2		60
360-DIS SOLIDS,TOT	1250	86	9	8		40
360-DIS SOLIDS,TOT	1430	86	7	7		50
360-DIS SOLIDS,TOT	1490	86	7	14		110
360-DIS SOLIDS,TOT	1500	86	7	21		70
360-DIS SOLIDS,TOT	1530	86	7	28		50
360-DIS SOLIDS,TOT	1560	86	8	4	Lab Filtered	
360-DIS SOLIDS,TOT	1490	86	8	11		
360-DIS SOLIDS,TOT	1470	86	8	19		
360-DIS SOLIDS,TOT	1410	86	8	26		
360-DIS SOLIDS,TOT	1350	86	9	2		
360-DIS SOLIDS,TOT	1200	86	9	8		

Average difference
57 mg/l



To test if a significant difference exists between preserving in the field with sulferic acid and waiting 24 hours to preserve with sulfuric acid, the same hypothesis test was used. Lab procedures dictate that samples analyzed for chlorides and TDS not be preserved with sulferic acid before filtering. As a result only Kjeldahl nitrogen, ammonia nitrogen and nitrate plus nitrite nitrogen could be compared. All hypothesis tests comparing preservation time showed an insignificant difference.

Summary of Method One

Table 4 contains a summary of the calculated test statistics for each well by parameter. Appendix B contains the graphs of parameter concentration versus time for each well by parameter.

By method one each parameter was analyzed individually by well. This allowed any specific conditions at a given well to influence the hypothesis test. The specific conditions of concern in the study were the effect of soil type and parameter concentration. For the parameters Kjeldahl nitrogen, chloride, chemical oxygen demand, and ammonia the hypothesis tests showed that neither waiting 24 hours to filter or waiting 24 hours to preserve the sample produced a significant difference that would affect decisions regarding NR 140 and groundwater quality. In the case of nitrate plus nitrite only well 4 had sufficient levels to analyze. The hypothesis test showed that the difference between filtering times as well as preservation time was insignificant.

Only total dissolved solids showed a significant difference between filtering times. The previous example of well 5 with a test statistic of 57 mg/l was double the critical value of 25 mg/l. However the average parameter elevation was 1500 mg/l which is three times the enforcement standard of 500 mg/l specified in NR 140. Both filtering procedures would have shown exceedances of the 500 mg/l enforcement standard and the difference of 57 mg/l is insignificant in view of this. However, well 3 at an average value of 450 mg/l had a calculated test statistic of 29 mg/l and well 4 at an average value of 650 mg/l had a test statistic of 22 mg/l just below the chosen 25 mg/l critical value. An analysis of these differences is discussed in the following section.

Table 4

Summary Table of Test Statistics

SITE Well	Chlorides Field-Lab	COD Field-Lab	TDS Field-Lab	Kjeldahl Field-Lab	NH3 Field-Lab	NO3 & NO2 Field-Lab
1	102.1-96.4	12.9-9.3	592-586.4	7-6.85	6.26-6.06	- -
Test Statistic 1	5.7	3.6	5.6	.15	.2	-
2	420.3-414	32.2-32.5	1238-1235	14.3-14.33	13.14-12.4	- -
Test Statistic	5.7	-.7	3	.03	.74	-
3	59.7-56.6	18.5-16.7	450.8-422.2	58.7-58.8	58.6-57.7	- -
Test Statistic 2	3.1	1.8	29	-.01	.9	-
4	62.9-61.9	8.6-7.3	652.2-630.2	.53-.47	- -	12.78-12.74
Test Statistic	1	1.3	22	.06	-	.04
5	542-539	17.53-15.6	1500-1443	17.9-18.8	17.11-17.44	- -
Test Statistic 3	3	1.63	57	-.9	.33	-
6	873-878	35.9-32.9	2477-2475	35.7-35.4	34.11-33.88	- -
Test Statistic	-5	3	2	.3	.23	-
Critical Value	12.5	12.5	25	1	1	.8

For the second method of analysis all samples for a given parameter were combined to form a single data set. The samples were then arranged in increasing order independent of which site they were from or what date they were collected on. This was justified since the analysis of the data by method 1 showed that there was no relationship between the site the sample was collected from and the degree of difference between sampling procedures. To view the data set, the field filtered portion of the sample was plotted against the lab filtered portion as X and Y coordinates on a graph. See Graph 1.

The line Y = X on the graph shows where the points would lie if there was no difference between filtering times. For total dissolved solids ninety percent of the samples were above or on the line Y equals X. This shows that the field filtered portion of the sample analyzed at a higher level of parameter concentration than the corresponding portion filtered 24 hours later.

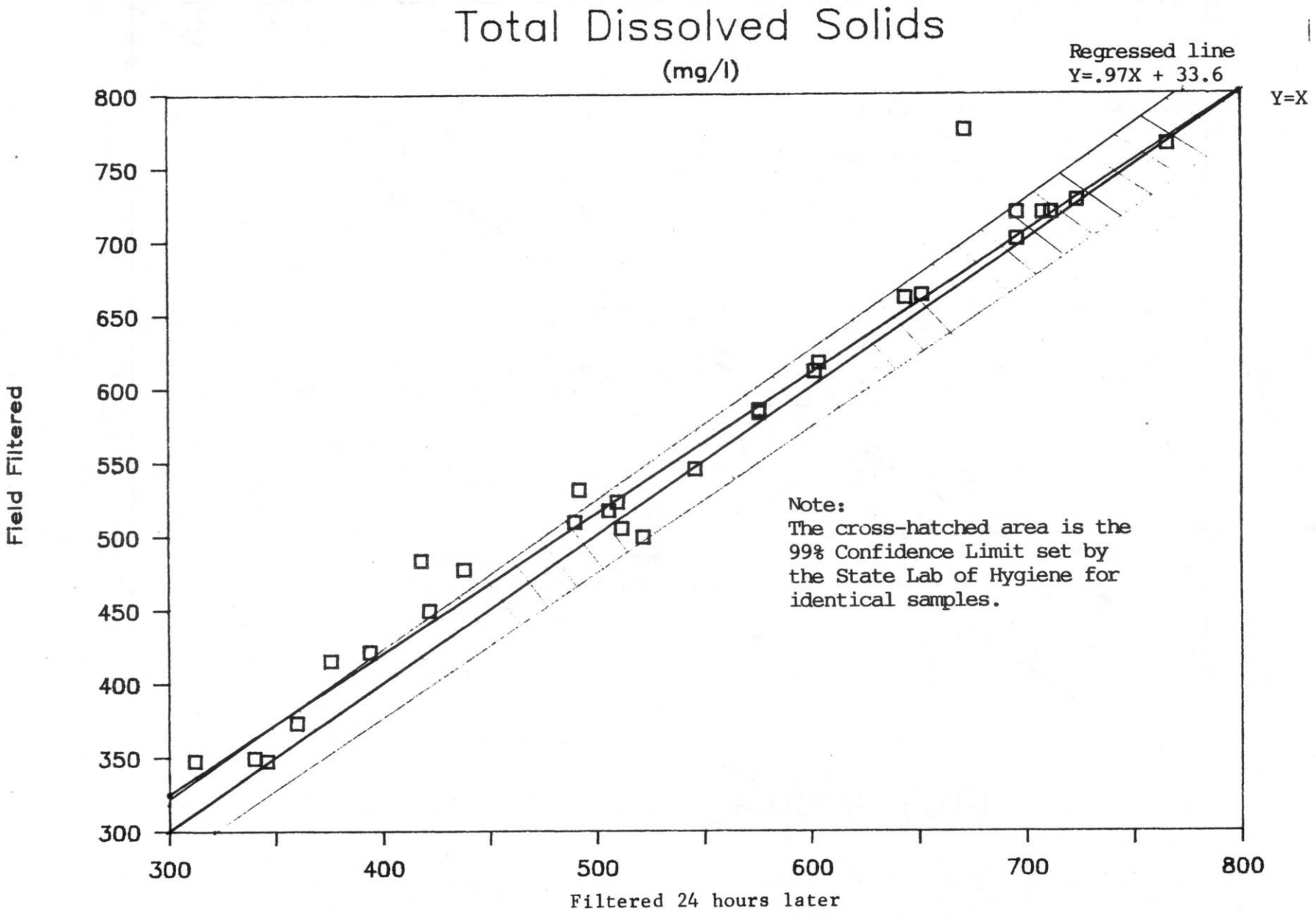
To test if this difference was significant a linear regression was performed on the coordinates for each sample. For total dissolved solids the points regressed onto the line (Y = .97X + 33.6 mg/l) with a correlation of 0.98 (shown on Graph 1). To test the significance, the regression line was compared to the lab variability for total dissolved solids lab analysis. The State Lab of Hygiene currently sets a 99% confidence level as a control for the difference between identical samples.

Graph 1 shows that the regressed line as well as most of the sample points lie within the 99% confidence level set by the State Lab of Hygiene. This indicates that with the information available, there is no significant difference between filtering times when lab variability is considered. In reference to NR 140, no data was available in the range of the preventive action limit (250 mg/l) and thus no conclusions can be drawn at the lower concentrations.

Graph 2 for chemical oxygen demand shows a high degree of variability above and below the line Y = X. This is explained by the large confidence level determined by the State Laboratory of Hygiene indicating the relative inaccuracies of this particular lab analysis. No differences between filtering times for COD was found.

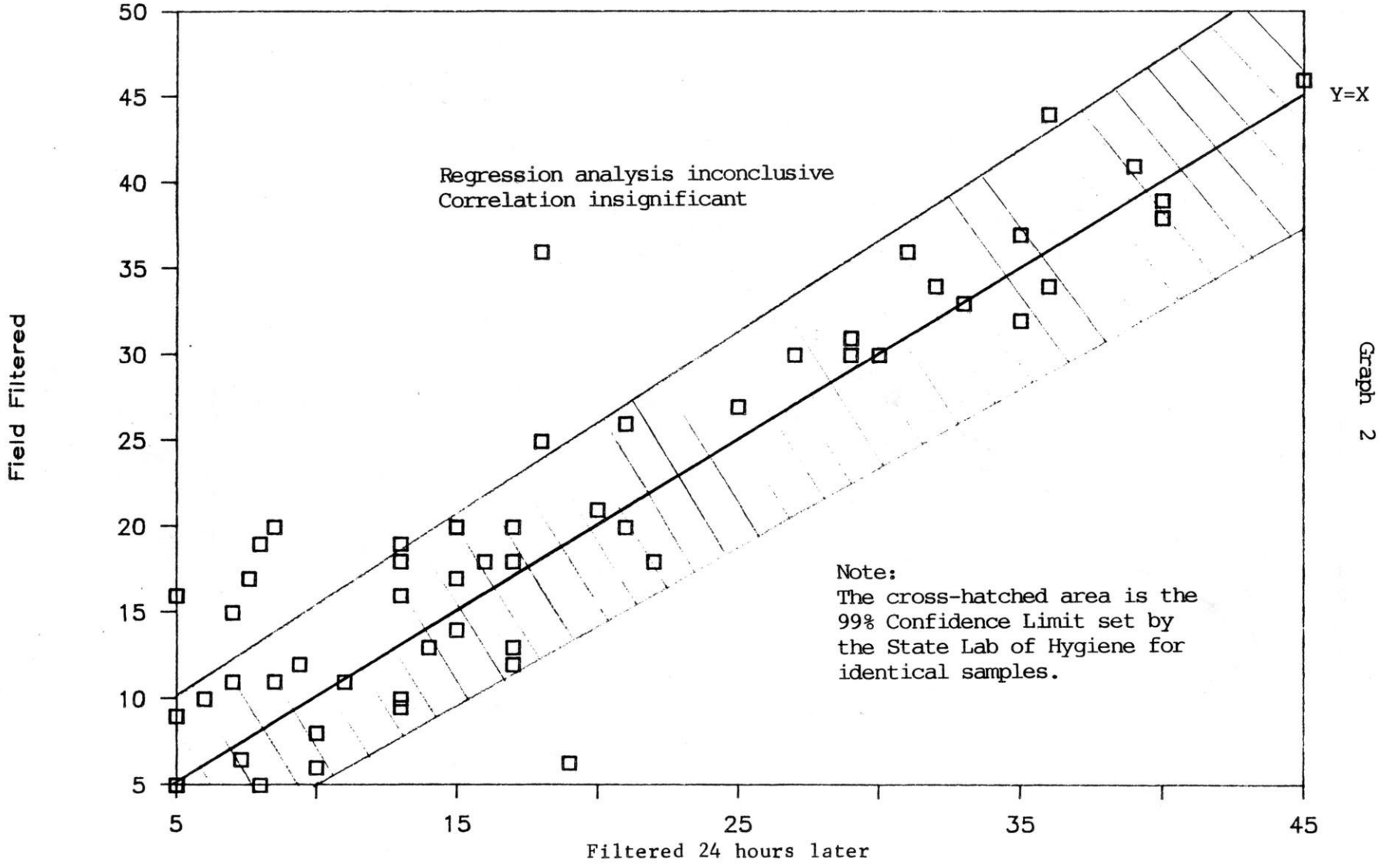
For chlorides, Graph 3, the sample points regressed onto the line Y = .99X + 5.8. This means that at a concentration of 250 mg/l (enforcement standard) the regression line indicates the field filtered portion would be 253 mg/l. This difference is insignificant when lab and field variabilities are considered. (See Graph 3)

For the parameters ammonia, nitrate plus nitrite, and Kjeldahl nitrogen the sample points regressed onto the line Y = X for both the filtering time comparison as well as the comparison between preservation time. This is shown on Graphs 4 through 9.

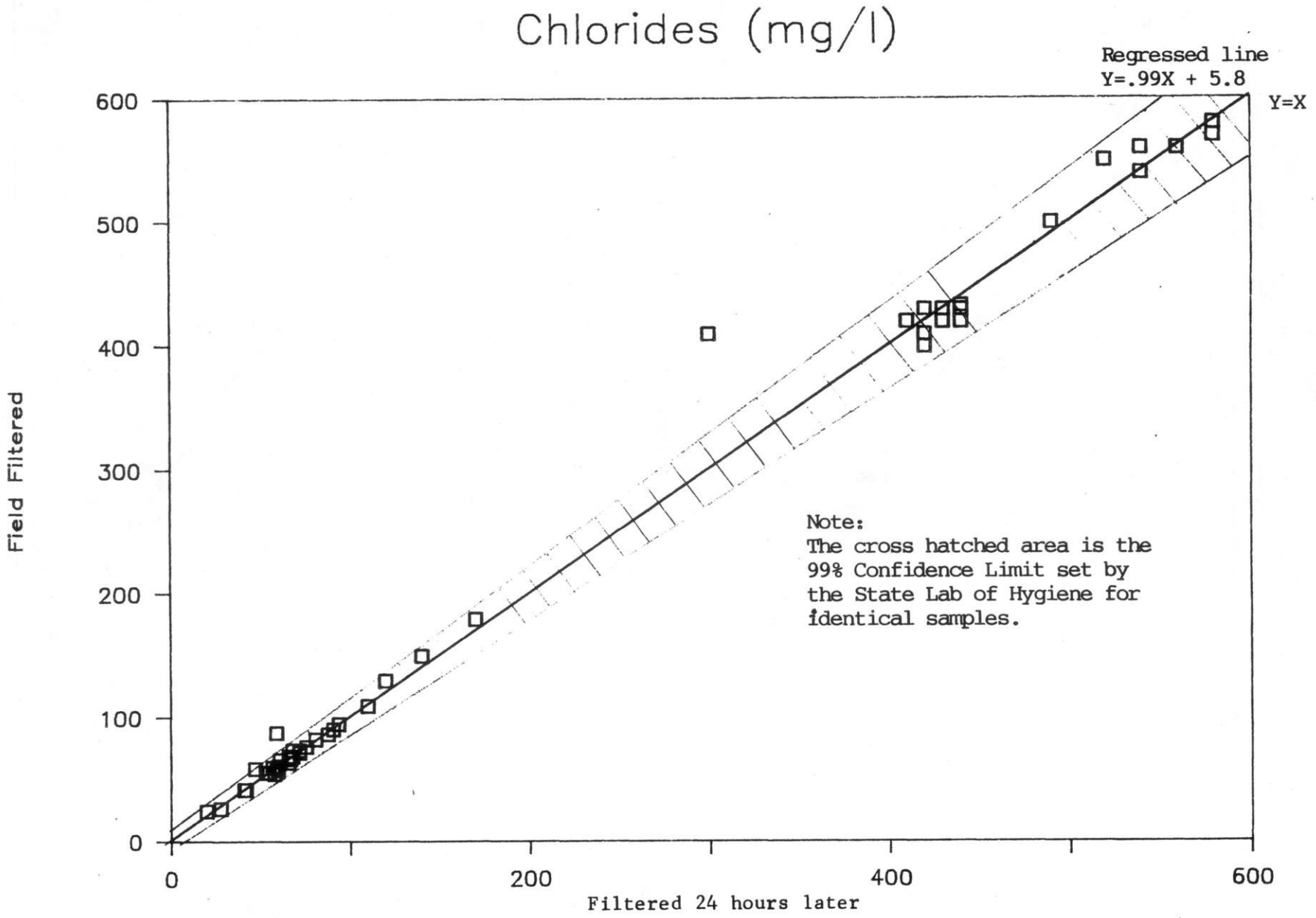

Total Dissolved Solids
(mg/l)
Regressed line
Y=.97X + 33.6
Y=X
Field Filtered
Filtered 24 hours later
800
750
700
650
600
550
500
450
400
350
300
300
400
500
600
700
800
Note:
The cross-hatched area is the
99% Confidence Limit set by
the State Lab of Hygiene for
identical samples.

Graph 1

Chemical Oxygen Demand (mg/l)



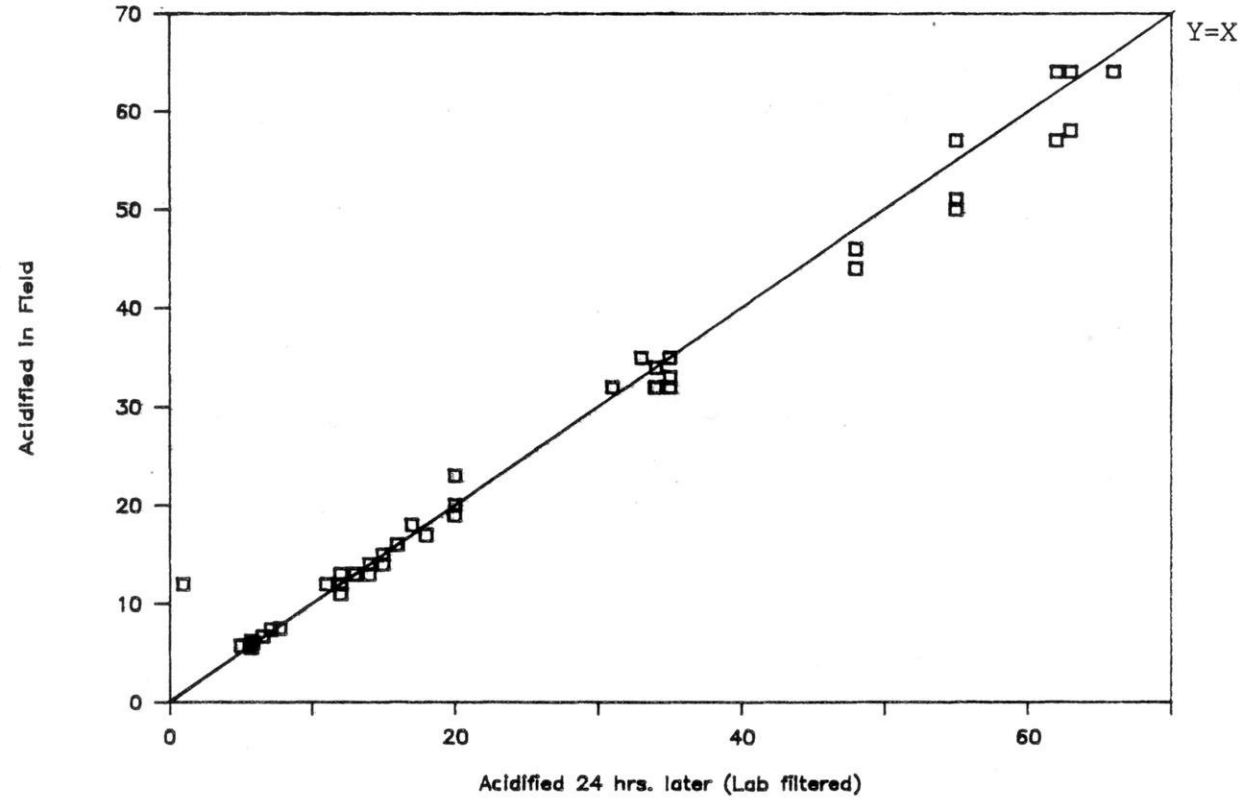
Graph 2


Chlorides (mg/l)
Regressed line
Y=.99X + 5.8
Y=X
Field Filtered
Filtered 24 hours later
0
100
200
300
400
500
600
0
200
400
600
Note:
The cross hatched area is the
99% Confidence Limit set by
the State Lab of Hygiene for
identical samples.

Graph 3

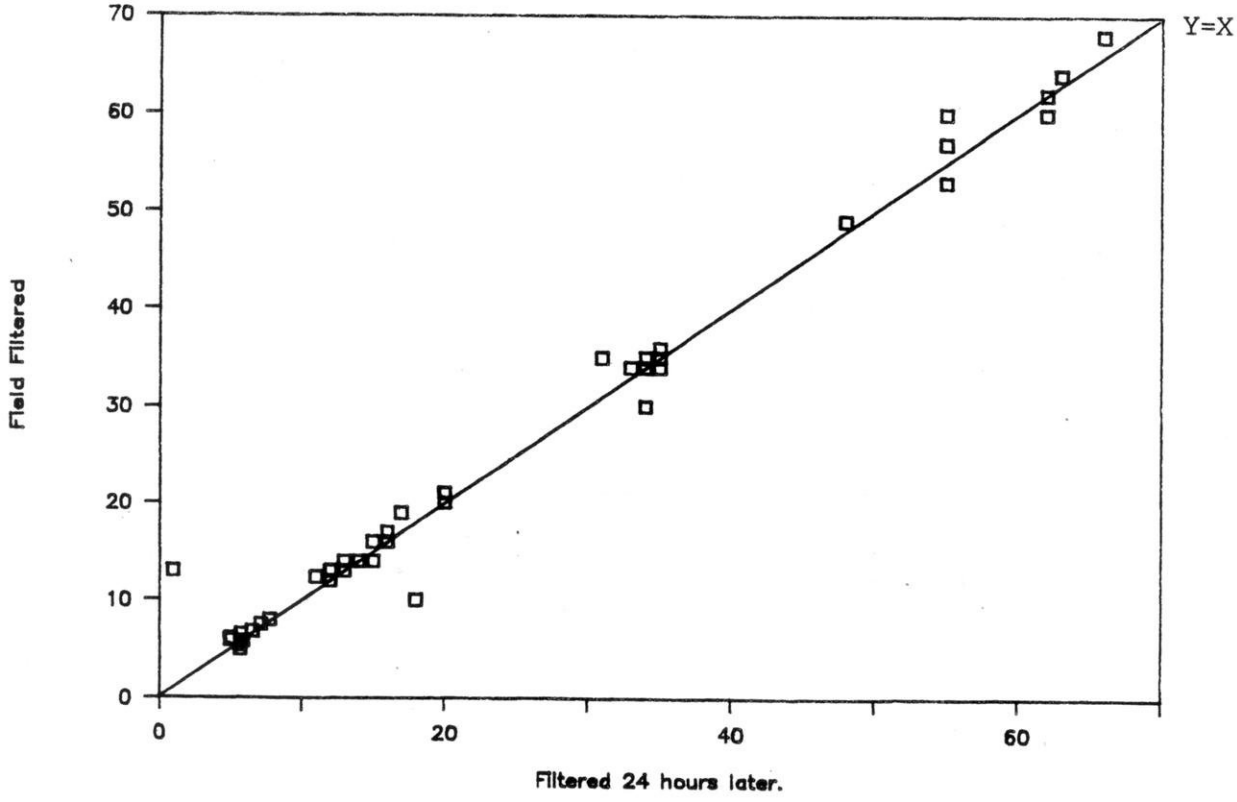
Graph 4

Ammonia (mg/l)

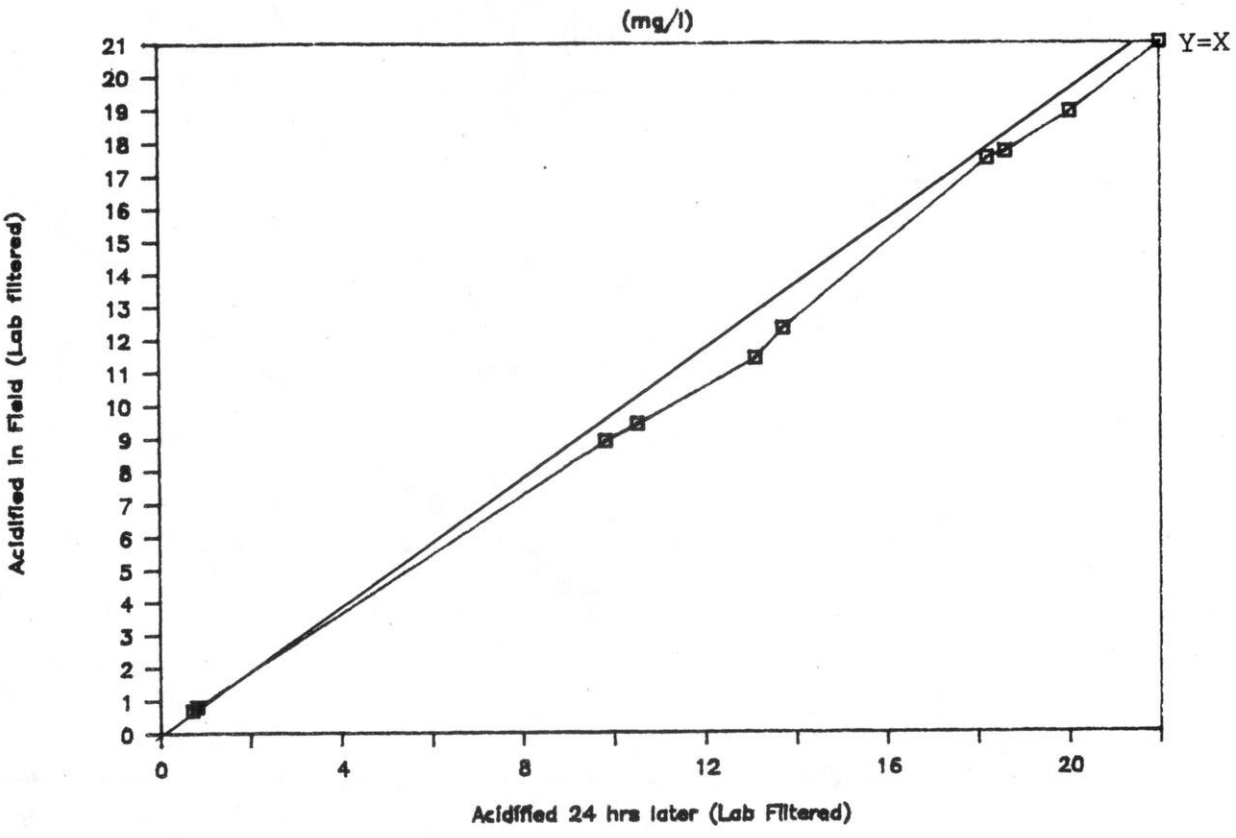


Graph 5

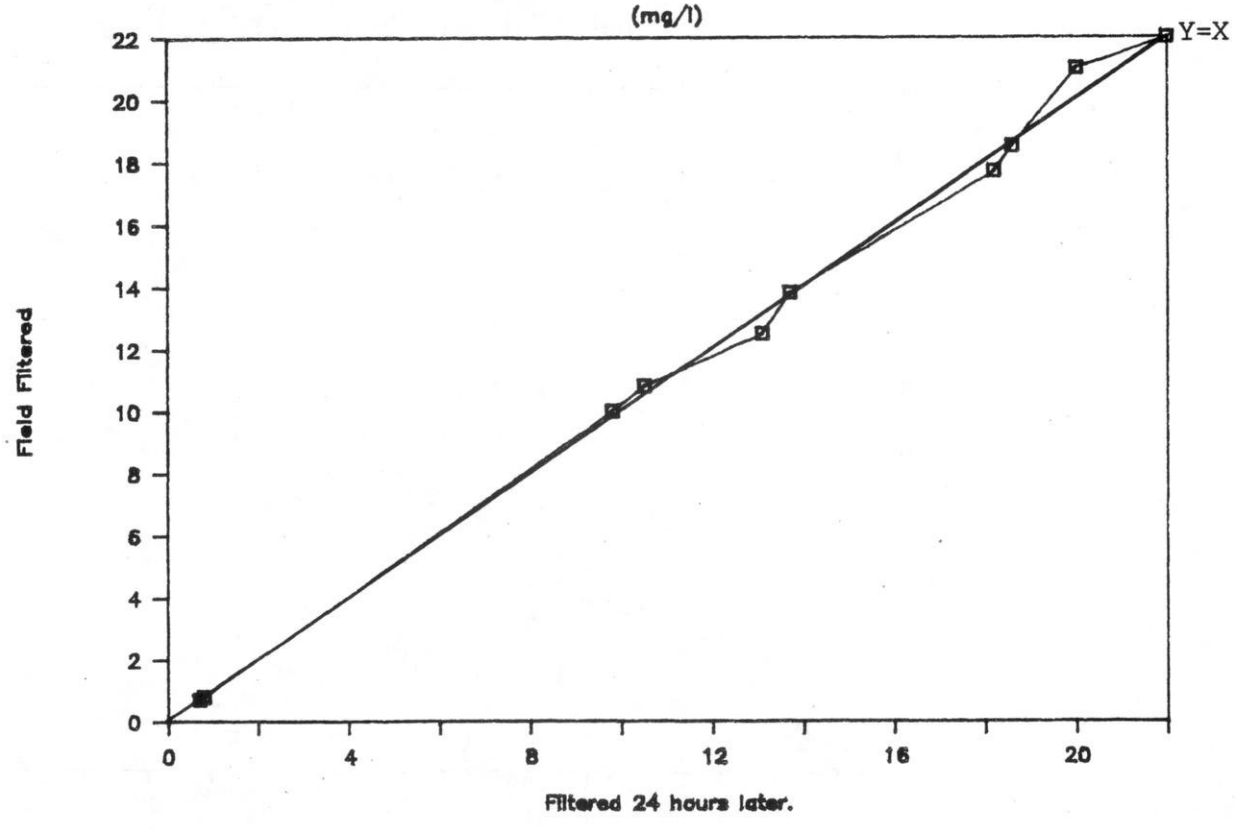
Ammonia (mg/l)



Graph 6

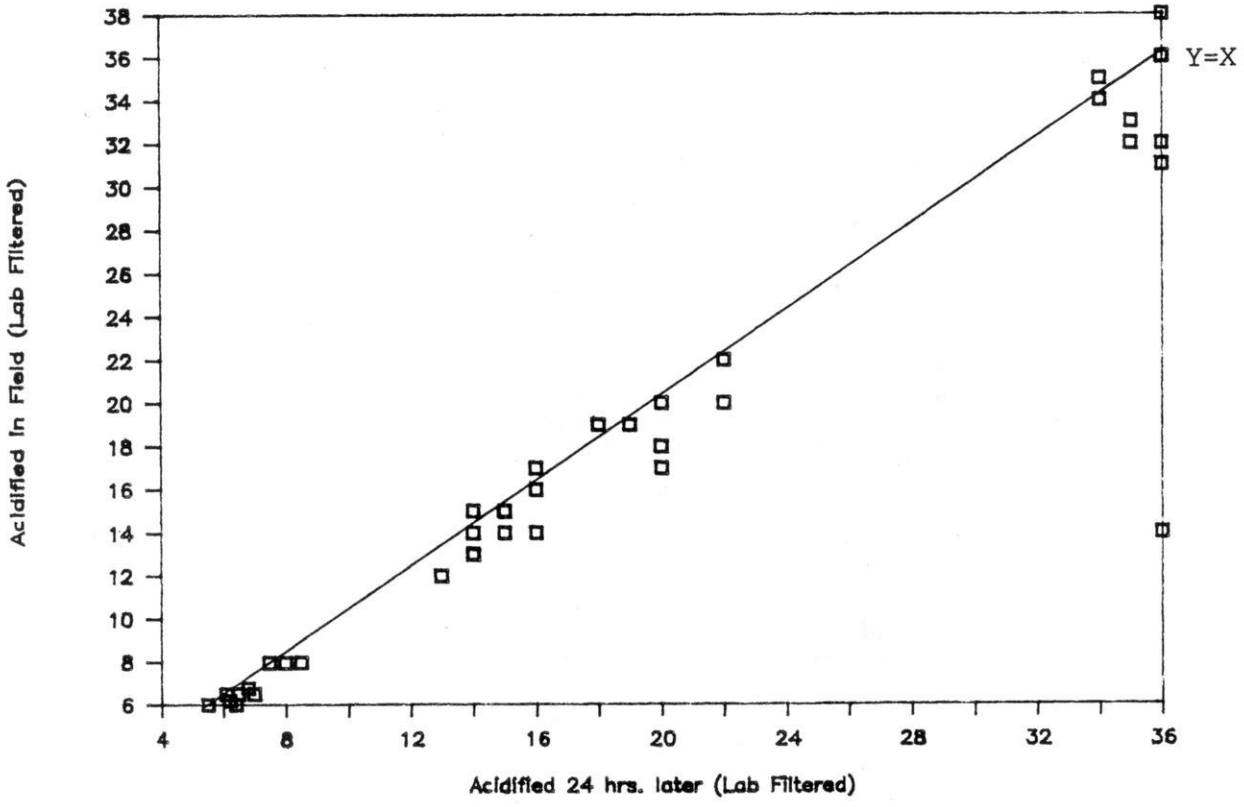


Graph 7



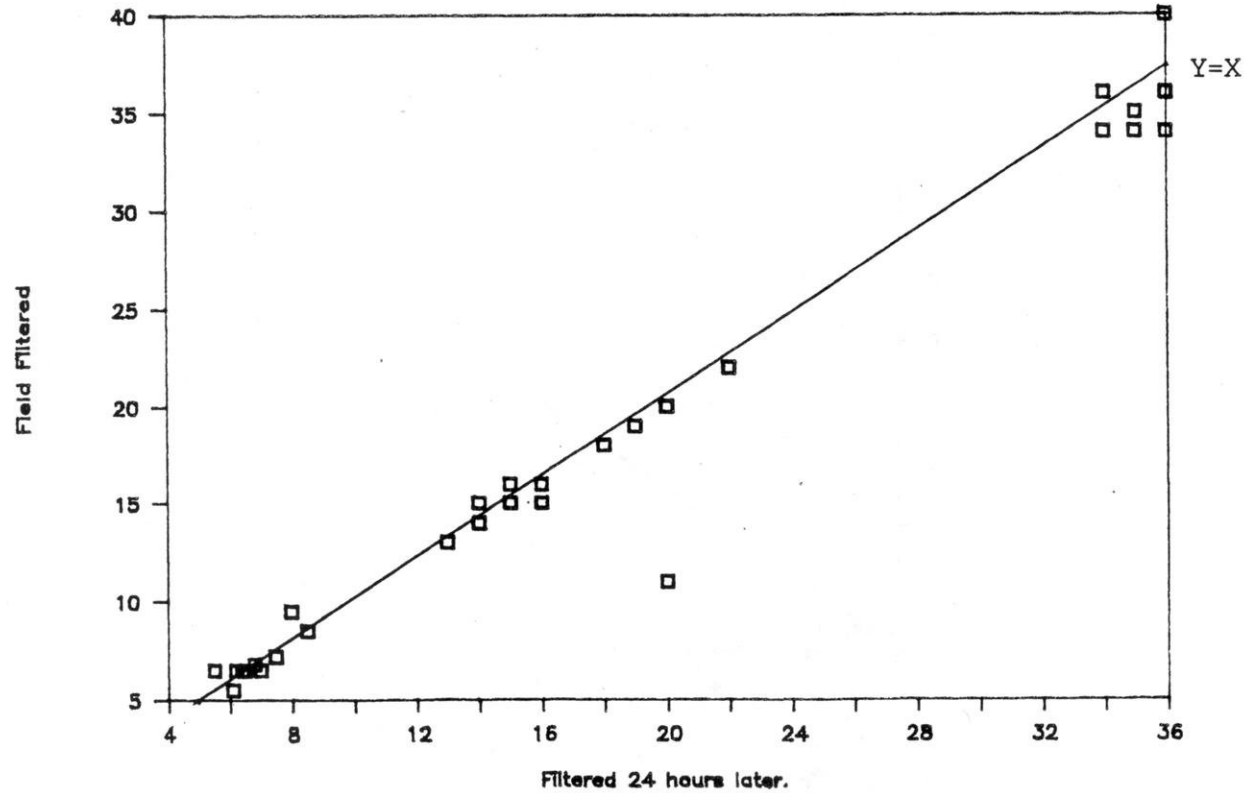
Graph 8

Kjeldahl Nitrogen (mg/l)



Graph 9

Kjeldahl Nitrogen (mg/l)



Conclusions

It is apparent from this study that a decrease in chloride and total dissolved solids concentration occurs by waiting to filter in the lab. However, this difference is not significant when compared to lab variability or the standards contained in NR 140. For chemical oxygen demand, the lab analysis contains sufficient variability to conceal any difference between filtering time. For the parameters ammonia, Kjeldahl nitrogen, and nitrate plus nitrite, no difference was found between filtering in the field and filtering 24-hours later or preserving in the field and preserving 24-hours later, provided the sample was immediately cooled to 4°C.

Recommendations

Current sampling procedures involve considerable variabilities in the field and in the laboratory. All efforts need to be made to ensure that these variabilities are limited. Although the study was limited to filtration and preservation, the following priority listing for minimizing variabilities is proposed:

1. Properly purge the wells.

2. Immediately cool the collected sample to 4°C.

3. Filter as soon as possible (within 24 hours).

4. Perform sulfuric Acid preservation for Nitrogen and COD analysis either before or after filtering the sample.

At the present time, filtering in the field would be preferred, but the study indicates lab filtering is allowable, provided all procedures are followed for proper sampling. Following the procedures already documented in the guidelines recommended by the Department will have the greatest effect on improving the quality of the collected groundwater. Requiring field filtering in cases were economics or qualified labor are limiting is unnecessary. In cases where field filtering is already being done, no changes need to be made.

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REFERENCES

1. "Standard Methods for the Examination of Water and Wastewater", 16th Edition Washington D.C.: American Public Health Association, (1986).

2. "Groundwater Sampling Procedures Guidelines" Wisconsin Department of Natural Resources, (1987).

3. "State Laboratory of Hygiene" University of Wisconsin Center for Health Sciences. "Manual of Analytical Methods, Water Chemistry Unit", (1980).

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Appendix A
Data Summary

Summary Table for Filtering Project Data
Data is arranged in increasing order by parameter

Chemical Oxygen Demand

Well	Lab Filtered	Date	Field Filtered	Differen
108B	5	860811	5	0
108B	8	860819	5	3
108B	5	860716	5	0
108B	5	860710	5	0
104B	10	860804	6	4
110AB	19	860908	6.3	12.7
108B	7.3	860826	6.5	0.8
104B	10	860728	8	2
104B	10	860727	8	2
104B	5	860811	9	-4
108B	13	860807	9.5	3.5
103B	13	860826	10	3
108B	6	860731	10	-4
104B	11	860721	11	0
104B	8.5	860819	11	-2.5
108B	7	860722	11	-4
108B	9.4	860903	12	-2.6
103B	17	860811	12	5
103B	14	860819	13	1
110AB	17	860819	13	4
104B	15	860707	14	1
104B	7	860826	15	-8
104B	5	860714	16	-11
103B	13	860903	16	-3
108B	7.6	860909	17	-9.4
103B	15	860909	17	-2
110AB	17	860902	18	-1
103B	22	860722	18	4
103B	16	860807	18	-2
110AB	13	860804	18	-5
104B	13	860902	19	-6
110AB	8	860811	19	-11
110AB	17	860707	20	-3
103B	21	860710	20	1
110AB	15	860728	20	-5
104B	8.5	860908	20	-11.5
110AB	15	860714	20	-5
110AB	15	860721	20	-5
110AB	20	860826	21	-1
103B	18	860731	25	-7

109B	21	860811	26	-5
117B	25	860811	27	-2
117B	29	860721	30	-1
109B	27	860804	30	-3
109B	30	860728	30	0
109B	30	860727	30	0
117B	29	860714	31	-2
117B	29	860804	31	-2
109B	35	860714	32	3
109B	33	860721	33	0
109B	32	860902	34	-2
109B	36	860707	34	2
103B	18	860716	36	-18
109B	31	860819	36	-5
117B	35	860819	37	-2
109B	40	860908	38	2
109B	40	860826	39	1
117B	39	860826	41	-2
117B	36	860902	44	-8
117B	45	860908	46	-1

Average difference 1.85(mg/l)
Standard Deviation 4.77

Total Dissolved Solids

Well	Lab	Date	Field	Difference
103B	346	860909	348	-2
108B	312	860710	348	-36
103B	340	860903	350	-10
108B	360	860716	374	-14
103B	376	860826	416	-40
103B	394	860819	422	-28
103B	422	860716	450	-28
103B	438	860710	478	-40
103B	418	860811	484	-66
104B	522	860902	500	22
104B	512	860908	506	6
103B	490	860722	510	-20
103B	506	860807	518	-12
104B	510	860826	524	-14
103B	492	860731	532	-40
104B	546	860819	546	0
108B	576	860722	584	-8
104B	576	860811	586	-10
104B	602	860804	612	-10
104B	604	860728	618	-14
104B	644	860721	662	-18
104B	652	860714	664	-12
104B	696	860707	702	-6

108B	708	860807	720	-12
108B	712	860826	720	-8
108B	696	860731	720	-24
108B	724	860819	728	-4
108B	766	860903	766	0
108B	672	860811	776	-104
109B	1240	860826	1150	90
109B	1200	860819	1180	20
109B	1220	860902	1210	10
109B	1210	860707	1240	-30
110AB	1200	860908	1250	-50
109B	1250	860908	1260	-10
109B	1260	860804	1260	0
109B	1260	860811	1260	0
109B	1230	860728	1270	-40
109B	1250	860721	1270	-20
109B	1230	860714	1280	-50
110AB	1350	860902	1420	-70
110AB	1430	860707	1510	-80
110AB	1410	860826	1520	-110
110AB	1470	860819	1520	-50
110AB	1530	860728	1530	0
110AB	1490	860811	1530	-40
110AB	1500	860721	1540	-40
110AB	1490	860714	1560	-70
110AB	1560	860804	1620	-60
117B	2430	860707	2410	20
117B	2480	860721	2440	40
117B	2550	860902	2450	100
117B	2500	860908	2460	40
117B	2480	860826	2490	-10
117B	2420	860811	2490	-70
117B	2460	860819	2500	-40
117B	2480	860714	2500	-20
117B	2460	860728	2500	-40
117B	2490	860804	2530	-40

Average value of the Difference 23.5 (mg/l)
Standard deviation 4.33

Ammonia Preservation Comparison

Well	Field Pres.	Date	Lab Pres.	Difference
104A	5.5	860902	5.7	-0.2
104A	5.5	860908	5.8	-0.3
104A	5.7	860811	5	0.7
104A	5.7	860707	5.1	0.6
104A	5.8	860826	5.7	0.1
104A	6	860819	5.9	0.1

104A	6.2	860714	5.8	0.4
104A	6.7	860804	6.6	0.1
104A	7.4	860728	7.2	0.2
104A	7.5	860721	7.8	-0.3
109A	11	860819	12	-1
109A	11	860902	12	-1
109A	12	860826	12	0
109A	12	860908	1	11
109A	12	860811	11	1
109A	13	860714	12	1
109A	13	860728	13	0
109A	13	860707	13	0
109A	13	860804	14	-1
110AA	14	860902	15	-1
109A	14	860721	14	0
110AA	15	860908	15	0
110AA	16	860714	16	0
110AA	16	860826	16	0
110AA	17	860819	18	-1
110AA	18	860811	17	1
110AA	19	860804	20	-1
110AA	20	860728	20	0
110AA	23	860721	20	3
117A	32	860811	34	-2
117A	32	860819	34	-2
117A	32	860714	31	1
117A	32	860902	34	-2
117A	32	860804	35	-3
117A	33	860826	35	-2
117A	34	860707	34	0
117A	35	860728	35	0
117A	35	860721	33	2
103A	44	860909	48	-4
103A	46	860903	48	-2
103A	50	860819	55	-5
103A	51	860826	55	-4
103A	57	860811	55	2
103A	57	860807	62	-5
103A	58	860731	63	-5
103A	64	860716	62	2
103A	64	860710	63	1
103A	64	860722	66	-2

Average Value of Diff. for preserv. times -.33mg/

Ammonia Filtering Comparison

	Field		Lab	
109	13	860908	1	12
104	5.9	860811	5	0.9

104	6.1	860707	5.1	1
104	4.9	860826	5.7	-0.8
104	5.4	860902	5.7	-0.3
104	6.5	860714	5.8	0.7
104	5.7	860908	5.8	-0.1
104	5.8	860819	5.9	-0.1
104	6.8	860804	6.6	0.2
104	7.5	860728	7.2	0.3
104	8	860721	7.8	0.2
109	12.4	860811	11	1.4
109	13	860826	12	1
109	13	860714	12	1
109	12	860902	12	0
109	13	860819	12	1
109	14	860707	13	1
109	13	860728	13	0
109	14	860804	14	0
109	14	860721	14	0
110A	16	860908	15	1
110A	14	860902	15	-1
110A	16	860714	16	0
110A	17	860826	16	1
110A	19	860811	17	2
110A	10	860819	18	-8
110A	21	860721	20	1
110A	21	860728	20	1
110A	20	860804	20	0
117	35	860714	31	4
117	34	860721	33	1
117	34	860819	34	0
117	34	860902	34	0
117	30	860811	34	-4
117	35	860707	34	1
117	34	860826	35	-1
117	35	860804	35	0
117	36	860728	35	1
103	49	860909	48	1
103	49	860903	48	1
103	57	860819	55	2
103	53	860826	55	-2
103	60	860811	55	5
103	60	860807	62	-2
103	62	860716	62	0
103	64	860731	63	1
103	64	860710	63	1
103	68	860722	66	2

Average difference between filtering tim

Standard Deviation 2.46

Kjeldahl Nitrogen Preservation compari

	Field A		Lab A	
104A	6	860707	5.5	0.5
104A	6.5	860826	6.1	0.4
104A	6.2	860908	6.2	0
104A	6	860902	6.4	-0.4
104A	6.5	860819	6.5	0
104A	6.8	860804	6.8	0
104A	6.5	860811	7	-0.5
104A	8	860714	7.5	0.5
104A	8	860728	8	0
104A	8	860721	8.5	-0.5
109A	12	860902	13	-1
109A	14	860707	14	0
109A	13	860819	14	-1
109A	13	860826	14	-1
109A	13	860908	14	-1
109A	15	860811	14	1
109A	15	860714	15	0
109A	14	860728	15	-1
110AA	15	860908	15	0
109A	17	860721	16	1
110AA	16	860826	16	0
110AA	14	860902	16	-2
110AA	19	860714	18	1
110AA	19	860707	19	0
110AA	18	860804	20	-2
110AA	17	860811	20	-3
110AA	20	860819	20	0
110AA	20	860728	22	-2
110AA	22	860721	22	0
117A	35	860908	34	1
117A	34	860707	34	0
117A	32	860902	35	-3
117A	33	860826	35	-2
117A	36	860721	36	0
117A	38	860728	36	2
117A	31	860804	36	-5
117A	32	860819	36	-4
117A	36	860811	36	0
117A	36	860714	36	0
109A	14	860804	36	-22

Average diff. for preservation times 1.1 mg/l

Standard Deviation 3.6

Kjeldahl Nitrogen Filtering Comparison

Field Lab

104	6.5	860707	5.5	1
104	5.5	860826	6.1	-0.6
104	6.5	860908	6.2	0.3
104	6.5	860902	6.4	0.1
104	6.5	860819	6.5	0
104	6.8	860804	6.8	0
104	6.5	860811	7	-0.5
104	7.2	860714	7.5	-0.3
104	9.5	860728	8	1.5
104	8.5	860721	8.5	0
109	13	860902	13	0
109	15	860707	14	1
109	14	860819	14	0
109	14	860811	14	0
109	14	860826	14	0
109	15	860728	15	0
110A	16	860908	15	1
109	15	860714	15	0
110A	15	860902	16	-1
109	15	860721	16	-1
110A	16	860826	16	0
110A	18	860714	18	0
110A	19	860707	19	0
110A	20	860804	20	0
110A	20	860811	20	0
110A	11	860819	20	-9
110A	22	860721	22	0
110A	22	860728	22	0
117	34	860707	34	0
117	36	860908	34	2
117	34	860902	35	-1
117	35	860826	35	0
117	40	860804	36	4
117	36	860728	36	0
117	34	860819	36	-2
117	36	860811	36	0
117	36	860721	36	0
117	36	860714	36	0

Average diff. for filtering comparison .11 mg/l
Standard Deviation 1.72

NO3 and NO2 Preservation comparison

	Field A.		Lab A.	
108A	0.7	860710	0.7	0
108A	0.8	860716	0.8	0
108A	8.9	860807	9.8	-0.9
108A	9.4	860722	10.5	-1.1
108A	11.4	860811	13.1	-1.7
108A	12.3	860731	13.7	-1.4

108A	17.5	860819	18.2	-0.7
108A	17.7	860826	18.6	-0.9
108A	18.9	860903	20	-1.1
108A	21	860909	22	-1

Average difference between pres. time .
Standard Deviation .51

NO2 and NO3 Filtering comparison

	Field		Lab	
108	0.7	860710	0.7	0
108	0.8	860716	0.8	0
108	10	860807	9.8	0.2
108	10.8	860722	10.5	0.3
108	12.5	860811	13.1	-0.6
108	13.8	860731	13.7	0.1
108	17.7	860819	18.2	-0.5
108	18.5	860826	18.6	-0.1
108	21	860903	20	1
108	22	860909	22	0

Average difference between filtering time
Standard Deviation .42

Chlorides Filtering Comparison

	Lab Filtered		Field Filtered	
108B	20	860710	25	-5
108B	28	860716	27	1
103B	42	860903	42	0
103B	41	860909	42	-1
104B	58	860908	55	3
108B	55	860722	56	-1
103B	53	860819	56	-3
104B	60	860902	58	2
103B	47	860826	59	-12
103B	57	860716	60	-3
103B	59	860710	60	-1
108B	60	860807	61	-1
103B	66	860807	64	2
103B	61	860811	66	-5
108B	67	860811	67	0
108B	68	860819	69	-1
108B	66	860731	69	-3
104B	72	860819	72	0
103B	68	860731	74	-6
103B	72	860722	74	-2
108B	76	860826	77	-1
104B	81	860811	83	-2
108B	88	860903	87	1

104B	59	860826	88	-29
108B	91	860909	91	0
104B	94	860804	95	-1
104B	110	860728	110	0
104B	120	860721	130	-10
104B	140	860714	150	-10
104B	170	860707	180	-10
109B	420	860804	400	20
109B	300	860826	410	-110
109B	420	860819	410	10
109B	430	860714	420	10
109B	410	860728	420	-10
109B	430	860811	420	10
110AB	440	860908	420	20
109B	430	860707	430	0
109B	420	860721	430	-10
109B	440	860902	430	10
109B	440	860908	433	7
110AB	490	860902	500	-10
110AB	540	860819	540	0
110AB	520	860826	550	-30
110AB	560	860714	560	0
110AB	560	860811	560	0
110AB	540	860707	560	-20
110AB	580	860728	570	10
110AB	580	860804	580	0
110AB	580	860721	580	0
117B	880	860908	850	30
117B	910	860902	860	50
117B	850	860811	860	-10
117B	870	860804	870	0
117B	870	860826	870	0
117B	880	860721	870	10
117B	880	860707	880	0
117B	860	860819	880	-20
117B	880	860728	890	-10
117B	900	860714	900	0

Average difference for filtering comparison 3.82

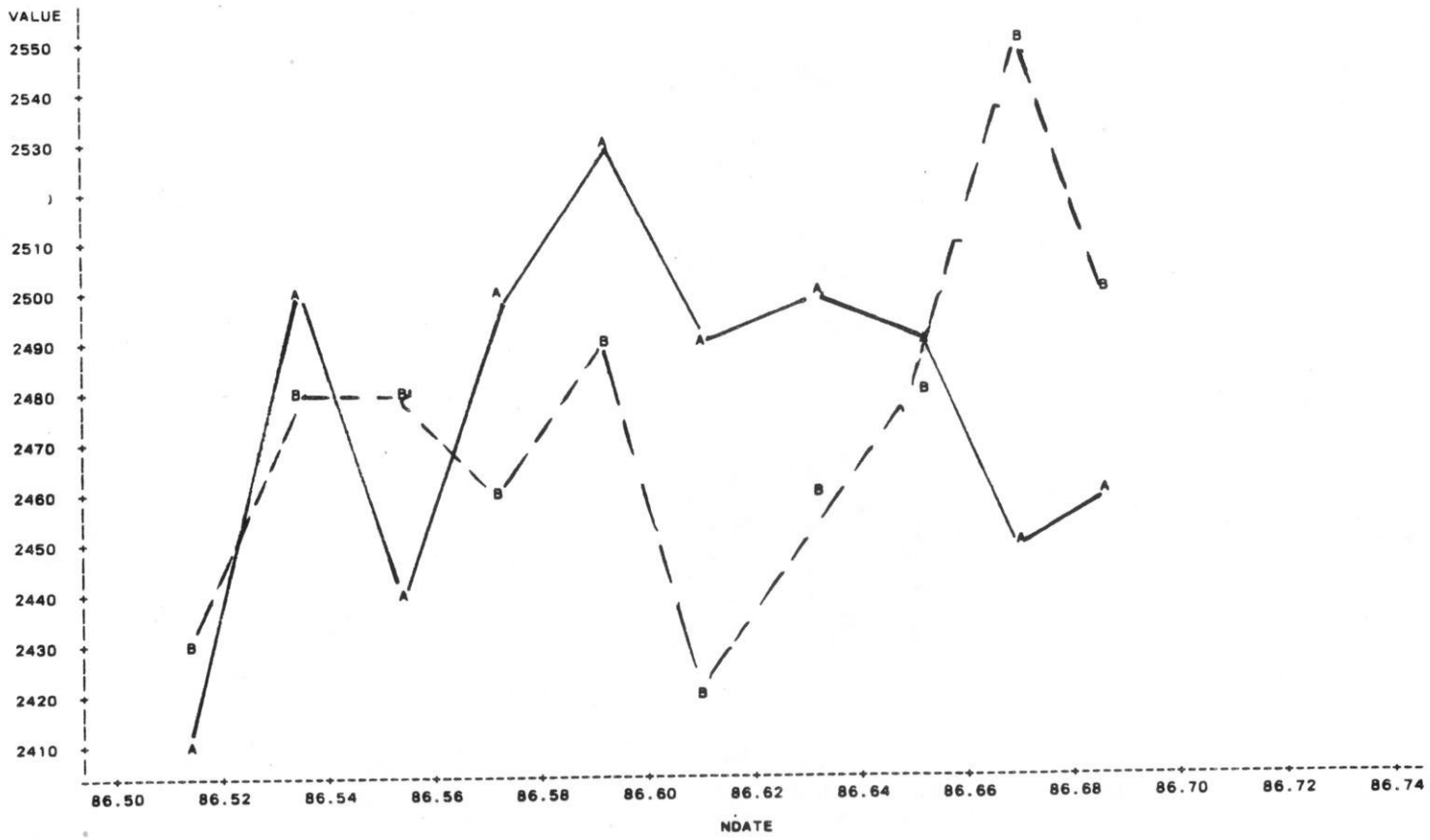
Standard Deviation 17.7

Appendix B
Graphs of each parameter
by well.

OBS	POINT	COMNAME	PARAM	VALUE	YEAR	MONTH	DAY	NDATE	WELL
1	114	117	360-DIS SOLIDS,TOT	2410	86	7	7	86.514	A
2	114	117	360-DIS SOLIDS,TOT	2500	86	7	14	86.534	A
3	114	117	360-DIS SOLIDS,TOT	2440	86	7	21	86.553	A
4	114	117	360-DIS SOLIDS,TOT	2500	86	7	28	86.572	A
5	114	117	360-DIS SOLIDS,TOT	2530	86	8	4	86.591	A
6	114	117	360-DIS SOLIDS,TOT	2490	86	8	11	86.610	A
7	114	117	360-DIS SOLIDS,TOT	2500	86	8	19	86.632	A
8	114	117	360-DIS SOLIDS,TOT	2490	86	8	26	86.651	A
9	114	117	360-DIS SOLIDS,TOT	2450	86	9	2	86.670	A
10	114	117	360-DIS SOLIDS,TOT	2460	86	9	8	86.686	A
11	115	117B	360-DIS SOLIDS,TOT	2430	86	7	7	86.514	B
12	115	117B	360-DIS SOLIDS,TOT	2480	86	7	14	86.534	B
13	115	117B	360-DIS SOLIDS,TOT	2480	86	7	21	86.553	B
14	115	117B	360-DIS SOLIDS,TOT	2460	86	7	28	86.572	B
15	115	117B	360-DIS SOLIDS,TOT	2490	86	8	4	86.591	B
16	115	117B	360-DIS SOLIDS,TOT	2420	86	8	11	86.610	B
17	115	117B	360-DIS SOLIDS,TOT	2460	86	8	19	86.632	B
18	115	117B	360-DIS SOLIDS,TOT	2480	86	8	26	86.651	B
19	115	117B	360-DIS SOLIDS,TOT	2550	86	9	2	86.670	B
20	115	117B	360-DIS SOLIDS,TOT	2500	86	9	8	86.686	B

FILTERING PROJECT
GRAPH OF PARAMETER (MG/L) VERSUS TIME
DECEMBER 12, 1986 JOHN SCHWALBE

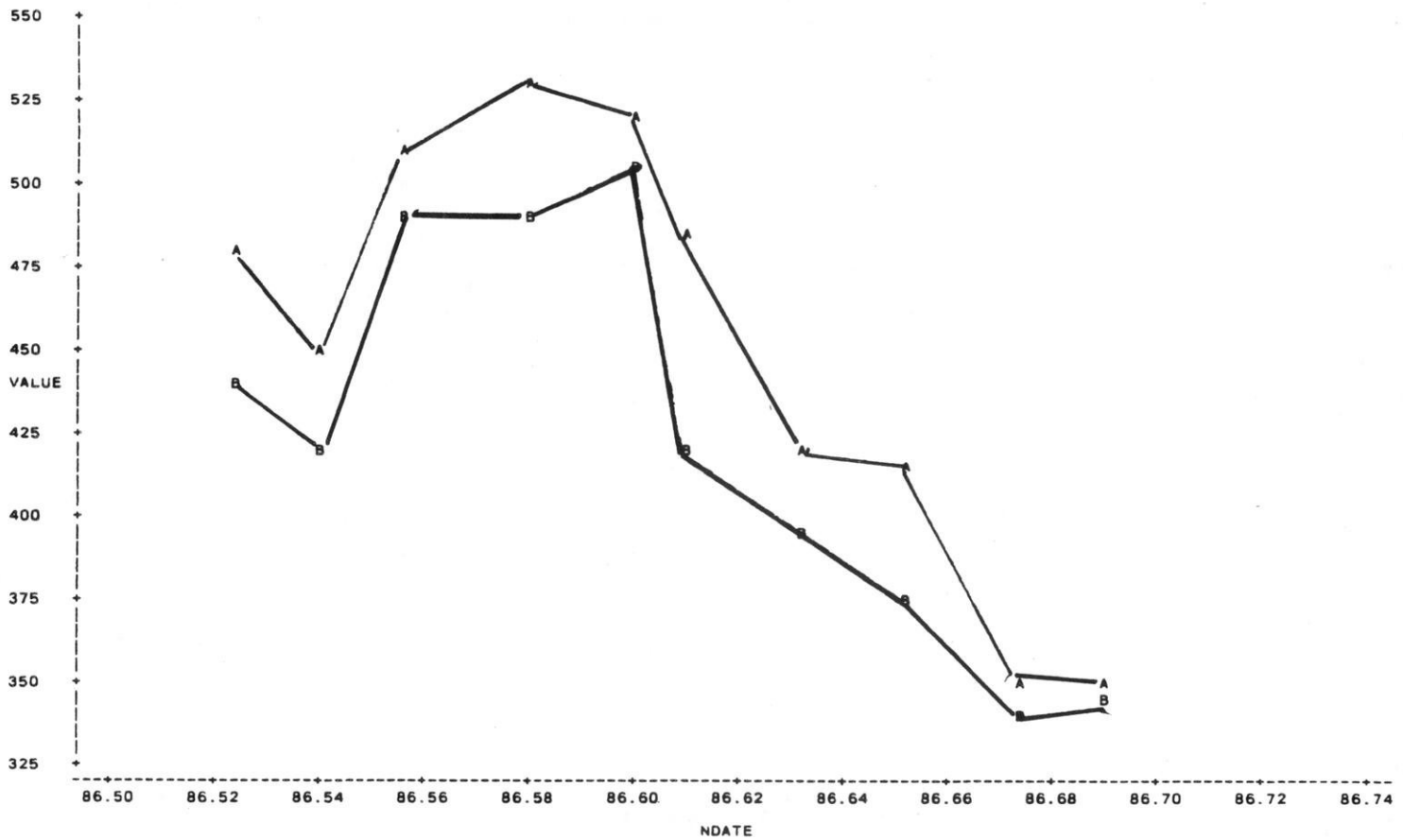
PLOT OF VALUE*NDATE SYMBOL IS VALUE OF WELL



1	101	103	360-DIS SOLIDS,TOT	478	86	7	16	86.523	A
2	101	103	360-DIS SOLIDS,TOT	450	86	7	16	86.539	A
3	101	103	360-DIS SOLIDS,TOT	510	86	7	22	86.555	A
4	101	103	360-DIS SOLIDS,TOT	532	86	7	31	86.580	A
5	101	103	360-DIS SOLIDS,TOT	518	86	8	7	86.599	A
6	101	103	360-DIS SOLIDS,TOT	484	86	8	11	86.610	A
7	101	103	360-DIS SOLIDS,TOT	422	86	8	19	86.632	A
8	101	103	360-DIS SOLIDS,TOT	416	86	8	26	86.651	A
9	101	103	360-DIS SOLIDS,TOT	350	86	9	3	86.673	A
10	101	103	360-DIS SOLIDS,TOT	348	86	9	9	86.689	A
11	102	103B	360-DIS SOLIDS,TOT	438	86	7	10	86.523	B
12	102	103B	360-DIS SOLIDS,TOT	422	86	7	16	86.539	B
13	102	103B	360-DIS SOLIDS,TOT	490	86	7	22	86.555	B
14	102	103B	360-DIS SOLIDS,TOT	492	86	7	31	86.580	B
15	102	103B	360-DIS SOLIDS,TOT	506	86	8	7	86.599	B
16	102	103B	360-DIS SOLIDS,TOT	418	86	8	11	86.610	B
17	102	103B	360-DIS SOLIDS,TOT	394	86	8	19	86.632	B
18	102	103B	360-DIS SOLIDS,TOT	376	86	8	26	86.651	B
19	102	103B	360-DIS SOLIDS,TOT	340	86	9	3	86.673	B
20	102	103B	360-DIS SOLIDS,TOT	346	86	9	9	86.689	B

FILTERING PROJECT
GRAPH OF PARAMETER (MG/L) VERSUS TIME
DECEMBER 12, 1986 JOHN SCHWALBE

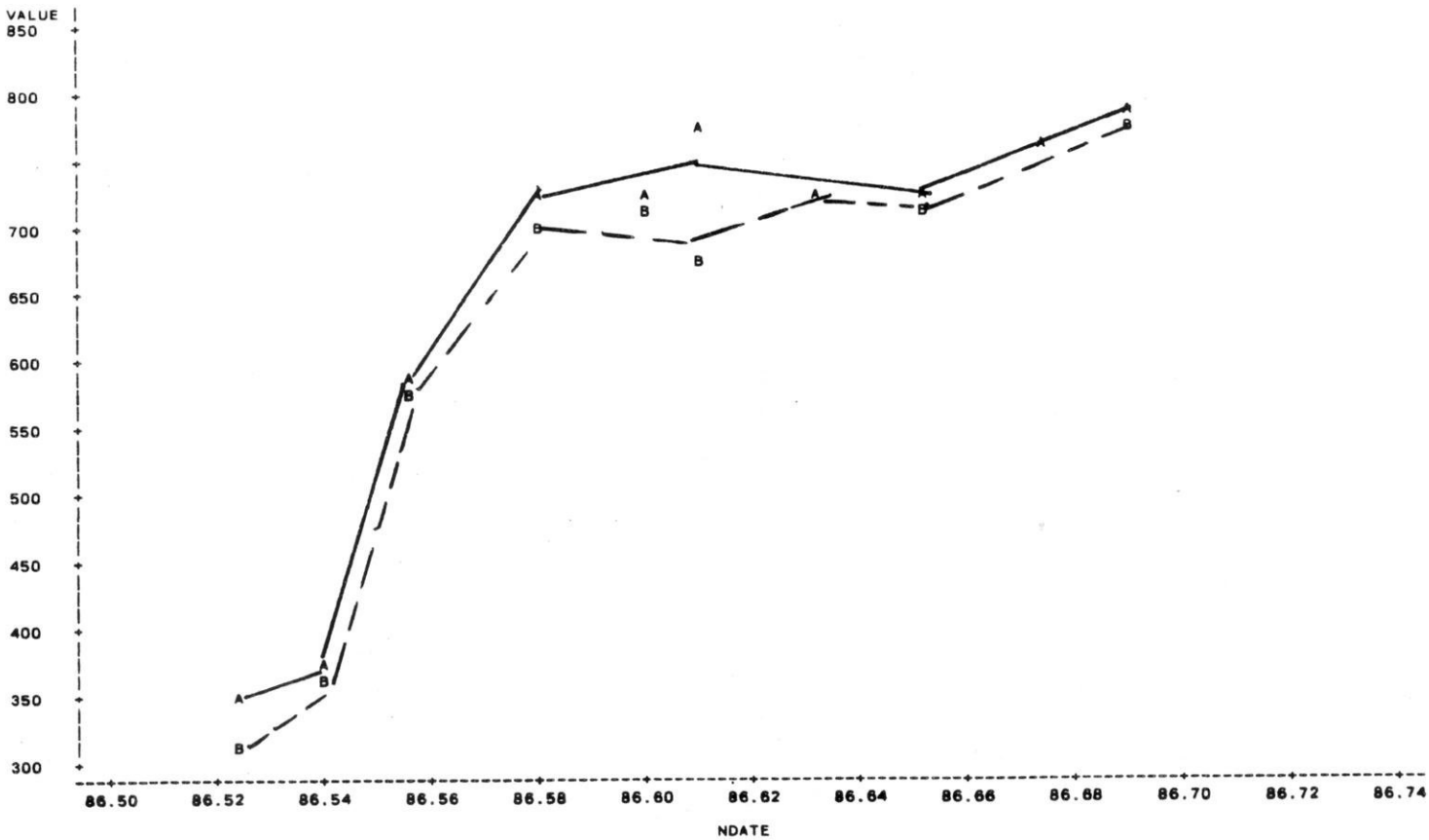
PLOT OF VALUE*NDATE SYMBOL IS VALUE OF WELL



OBS	POINT	COMNAME	PARAM	VALUE	YEAR	MONTH	DAY	NDATE	WELL
1	104	108	360-DIS SOLIDS,TOT	348	86	7	10	86.523	A
2	104	108	360-DIS SOLIDS,TOT	374	86	7	16	86.539	A
3	104	108	360-DIS SOLIDS,TOT	584	86	7	22	86.555	A
4	104	108	360-DIS SOLIDS,TOT	720	86	7	31	86.580	A
5	104	108	360-DIS SOLIDS,TOT	720	86	8	7	86.599	A
6	104	108	360-DIS SOLIDS,TOT	776	86	8	11	86.610	A
7	104	108	360-DIS SOLIDS,TOT	728	86	8	19	86.632	A
8	104	108	360-DIS SOLIDS,TOT	720	86	8	26	86.651	A
9	104	108	360-DIS SOLIDS,TOT	766	86	9	3	86.673	A
10	104	108	360-DIS SOLIDS,TOT	786	86	9	9	86.689	A
11	105	108B	360-DIS SOLIDS,TOT	312	86	7	10	86.523	B
12	105	108B	360-DIS SOLIDS,TOT	360	86	7	16	86.539	B
13	105	108B	360-DIS SOLIDS,TOT	576	86	7	22	86.555	B
14	105	108B	360-DIS SOLIDS,TOT	696	86	7	31	86.580	B
15	105	108B	360-DIS SOLIDS,TOT	708	86	8	7	86.599	B
16	105	108B	360-DIS SOLIDS,TOT	672	86	8	11	86.610	B
17	105	108B	360-DIS SOLIDS,TOT	724	86	8	19	86.632	B
18	105	108B	360-DIS SOLIDS,TOT	712	86	8	26	86.651	B
19	105	108B	360-DIS SOLIDS,TOT	766	86	9	3	86.673	B
20	105	108B	360-DIS SOLIDS,TOT	776	86	9	9	86.689	B

FILTERING PROJECT
GRAPH OF PARAMETER (MG/L) VERSUS TIME
DECEMBER 12, 1986 JOHN SCHWALBE

PLOT OF VALUE*NDATE SYMBOL IS VALUE OF WELL



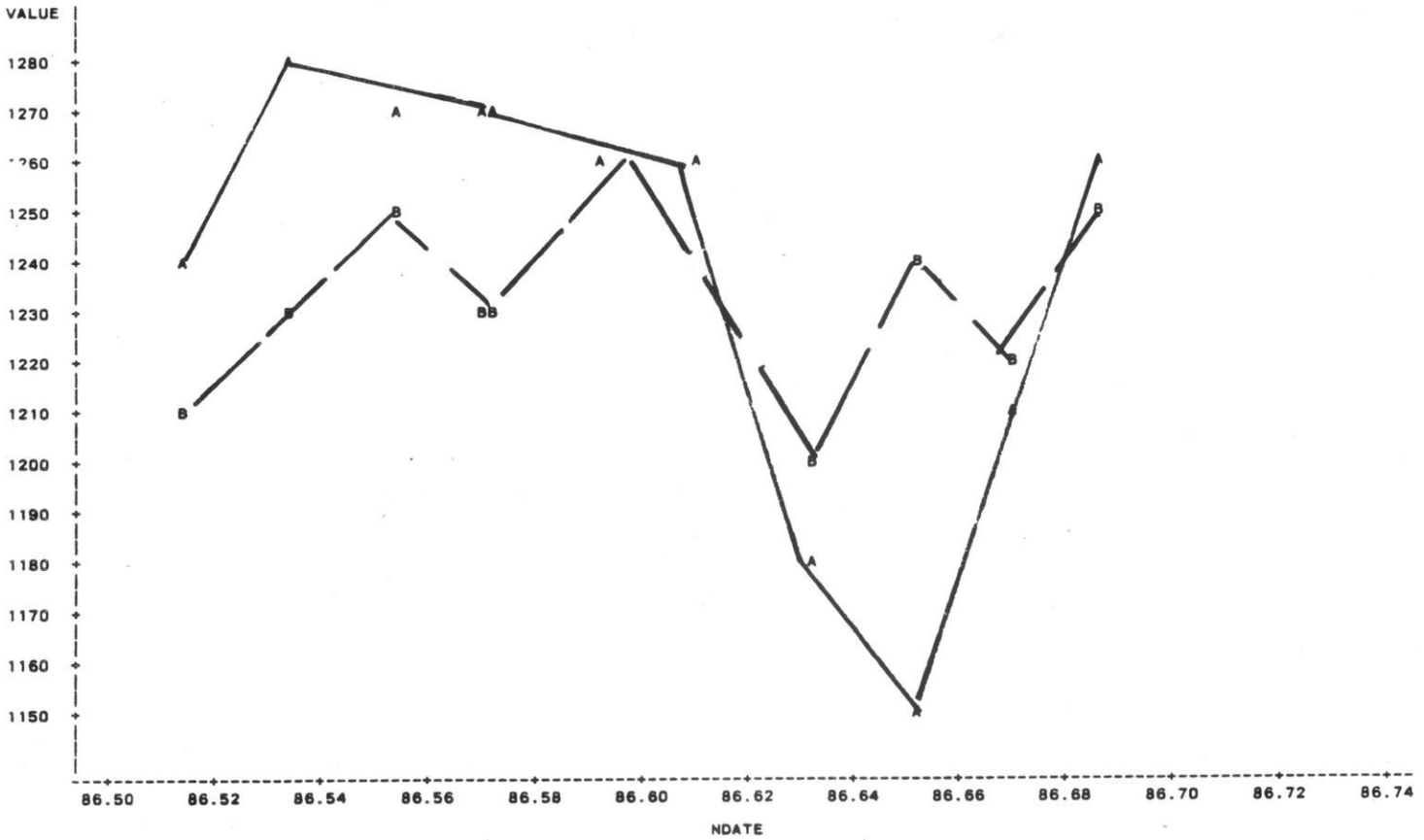
NOTE: 2 OBS HIDDEN

PARAMETER VALUES IN MG/L

OBS	POINT	COMNAME	PARAM	VALUE	YEAR	MONTH	DAY	NDATE	WELL
1	124	109	360-DIS SOLIDS,TOT	1240	86	7	7	86.514	A
2	124	109	360-DIS SOLIDS,TOT	1280	86	7	14	86.534	A
3	124	109	360-DIS SOLIDS,TOT	1270	86	7	21	86.553	A
4	124	109	360-DIS SOLIDS,TOT	1270	86	7	27	86.569	A
6	124	109	360-DIS SOLIDS,TOT	1260	86	8	4	86.591	A
7	124	109	360-DIS SOLIDS,TOT	1260	86	8	11	86.610	A
8	124	109	360-DIS SOLIDS,TOT	1180	86	8	19	86.632	A
9	124	109	360-DIS SOLIDS,TOT	1150	86	8	26	86.651	A
10	124	109	360-DIS SOLIDS,TOT	1210	86	9	2	86.670	A
11	124	109	360-DIS SOLIDS,TOT	1260	86	9	8	86.686	A
12	125	109B	360-DIS SOLIDS,TOT	1210	86	7	7	86.514	B
13	125	109B	360-DIS SOLIDS,TOT	1230	86	7	14	86.534	B
14	125	109B	360-DIS SOLIDS,TOT	1250	86	7	21	86.553	B
15	125	109B	360-DIS SOLIDS,TOT	1230	86	7	27	86.569	B
17	125	109B	360-DIS SOLIDS,TOT	1260	86	8	4	86.591	B
18	125	109B	360-DIS SOLIDS,TOT	1260	86	8	11	86.610	B
19	125	109B	360-DIS SOLIDS,TOT	1200	86	8	19	86.632	B
20	125	109B	360-DIS SOLIDS,TOT	1240	86	8	26	86.651	B
21	125	109B	360-DIS SOLIDS,TOT	1220	86	9	2	86.670	B
22	125	109B	360-DIS SOLIDS,TOT	1250	86	9	8	86.686	B

FILTERING PROJECT
GRAPH OF PARAMETER (MG/L) VERSUS TIME
DECEMBER 12, 1986 JOHN SCHWALBE

PLOT OF VALUE*NDATE SYMBOL IS VALUE OF WELL

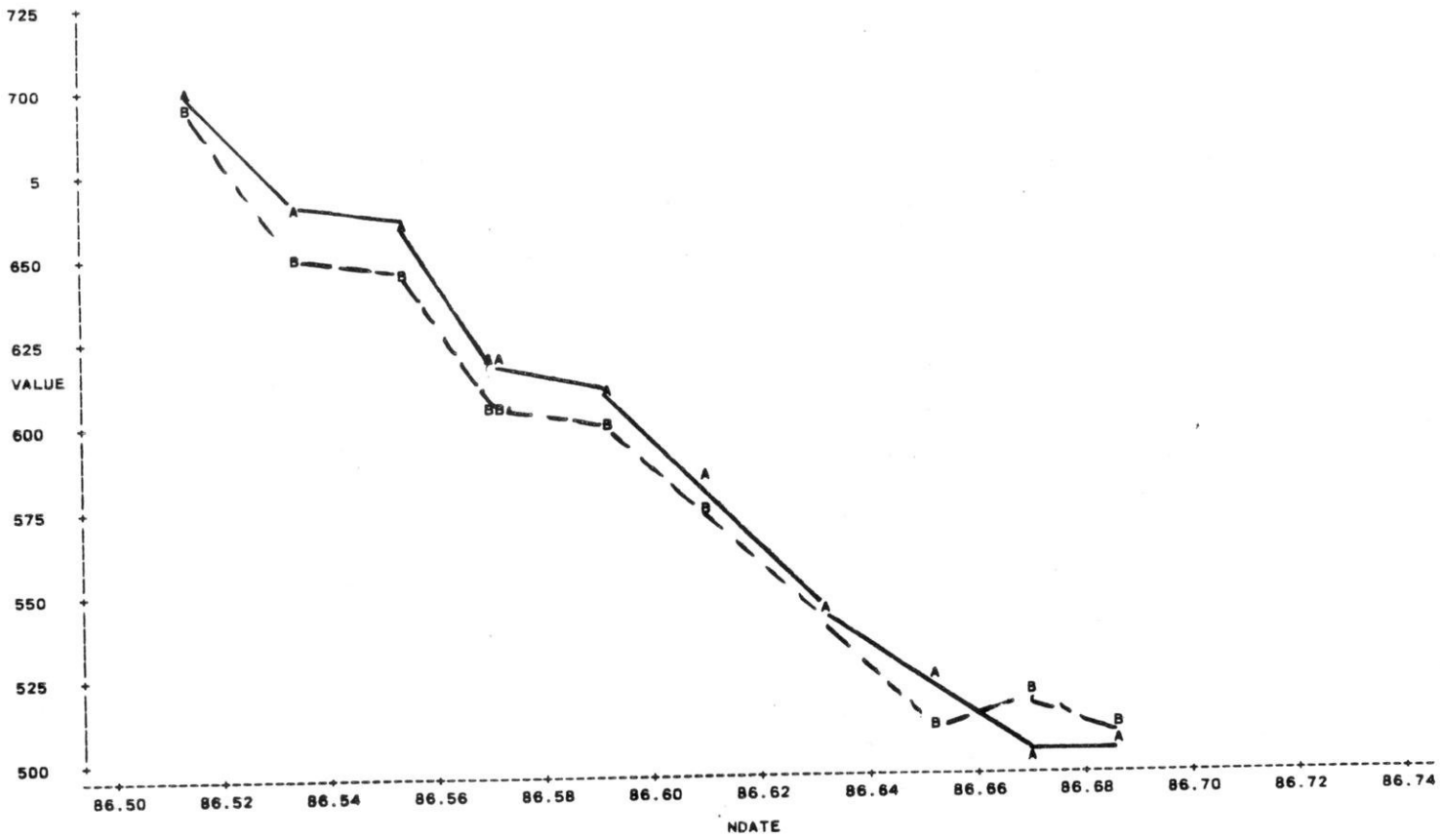


NOTE: 2 OBS HIDDEN

OBS	POINT	COMNAME	PARAM	VALUE	YEAR	MONTH	DAY	NDATE	WELL
1	121	104	360-DIS SOLIDS,TOT	702	86	7	7	86.514	A
2	121	104	360-DIS SOLIDS,TOT	664	86	7	14	86.534	A
3	121	104	360-DIS SOLIDS,TOT	662	86	7	21	86.553	A
4	121	104	360-DIS SOLIDS,TOT	618	86	7	27	86.569	A
6	121	104	360-DIS SOLIDS,TOT	612	86	8	4	86.591	A
7	121	104	360-DIS SOLIDS,TOT	586	86	8	11	86.610	A
8	121	104	360-DIS SOLIDS,TOT	546	86	8	19	86.632	A
9	121	104	360-DIS SOLIDS,TOT	524	86	8	26	86.651	A
10	121	104	360-DIS SOLIDS,TOT	500	86	9	2	86.670	A
11	121	104	360-DIS SOLIDS,TOT	506	86	9	8	86.686	A
12	122	104B	360-DIS SOLIDS,TOT	696	86	7	7	86.514	B
13	122	104B	360-DIS SOLIDS,TOT	652	86	7	14	86.534	B
14	122	104B	360-DIS SOLIDS,TOT	644	86	7	21	86.553	B
15	122	104B	360-DIS SOLIDS,TOT	604	86	7	27	86.569	B
17	122	104B	360-DIS SOLIDS,TOT	602	86	8	4	86.591	B
18	122	104B	360-DIS SOLIDS,TOT	576	86	8	11	86.610	B
19	122	104B	360-DIS SOLIDS,TOT	546	86	8	19	86.632	B
20	122	104B	360-DIS SOLIDS,TOT	510	86	8	26	86.651	B
21	122	104B	360-DIS SOLIDS,TOT	522	86	9	2	86.670	B
22	122	104B	360-DIS SOLIDS,TOT	512	86	9	8	86.686	B

FILTERING PROJECT
GRAPH OF PARAMETER (MG/L) VERSUS TIME
DECEMBER 12, 1986 JOHN SCHWALBE

PLOT OF VALUE*NDATE SYMBOL IS VALUE OF WELL

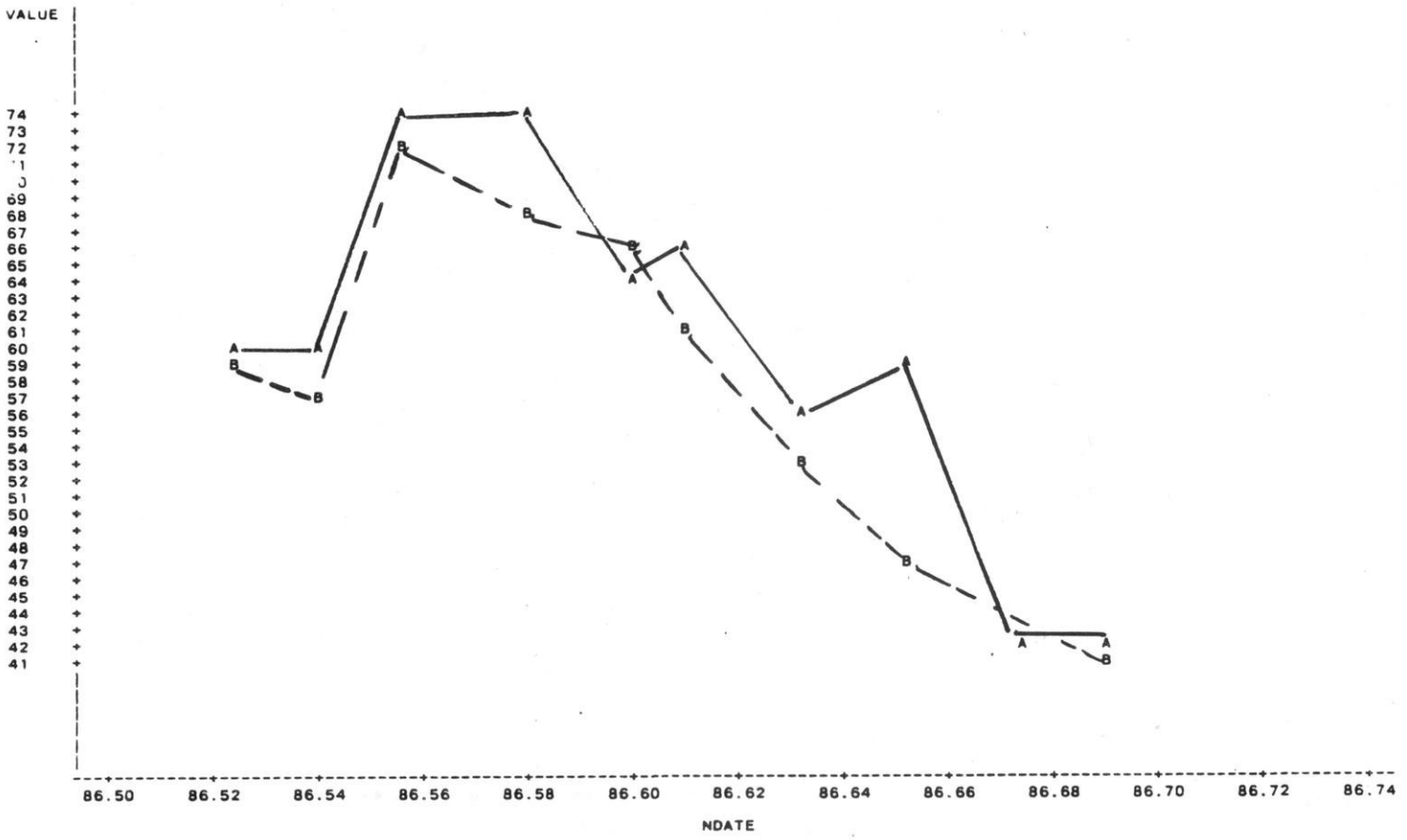


NOTE: 1 OBS HIDDEN

1	101	103	82295-CHLORIDE,DIS	60	86	7	10	86.523	A
2	101	103	82295-CHLORIDE,DIS	60	86	7	16	86.539	A
3	101	103	82295-CHLORIDE,DIS	74	86	7	22	86.555	A
4	101	103	82295-CHLORIDE,DIS	74	86	7	31	86.580	A
5	101	103	82295-CHLORIDE,DIS	64	86	8	7	86.599	A
6	101	103	82295-CHLORIDE,DIS	66	86	8	11	86.610	A
7	101	103	82295-CHLORIDE,DIS	56	86	8	19	86.632	A
8	101	103	82295-CHLORIDE,DIS	59	86	8	26	86.651	A
9	101	103	82295-CHLORIDE,DIS	42	86	9	3	86.673	A
10	101	103	82295-CHLORIDE,DIS	42	86	9	9	86.689	A
11	102	103B	82295-CHLORIDE,DIS	59	86	7	10	86.523	B
12	102	103B	82295-CHLORIDE,DIS	57	86	7	16	86.539	B
13	102	103B	82295-CHLORIDE,DIS	72	86	7	22	86.555	B
14	102	103B	82295-CHLORIDE,DIS	68	86	7	31	86.580	B
15	102	103B	82295-CHLORIDE,DIS	66	86	8	7	86.599	B
16	102	103B	82295-CHLORIDE,DIS	61	86	8	11	86.610	B
17	102	103B	82295-CHLORIDE,DIS	53	86	8	19	86.632	B
18	102	103B	82295-CHLORIDE,DIS	47	86	8	26	86.651	B
19	102	103B	82295-CHLORIDE,DIS	42	86	9	3	86.673	B
20	102	103B	82295-CHLORIDE,DIS	41	86	9	9	86.689	B

GRAPH OF PARAMETER (MG/L) VERSUS TIME
DECEMBER 12, 1986 JOHN SCHWALBE

PLOT OF VALUE*NDATE SYMBOL IS VALUE OF WELL

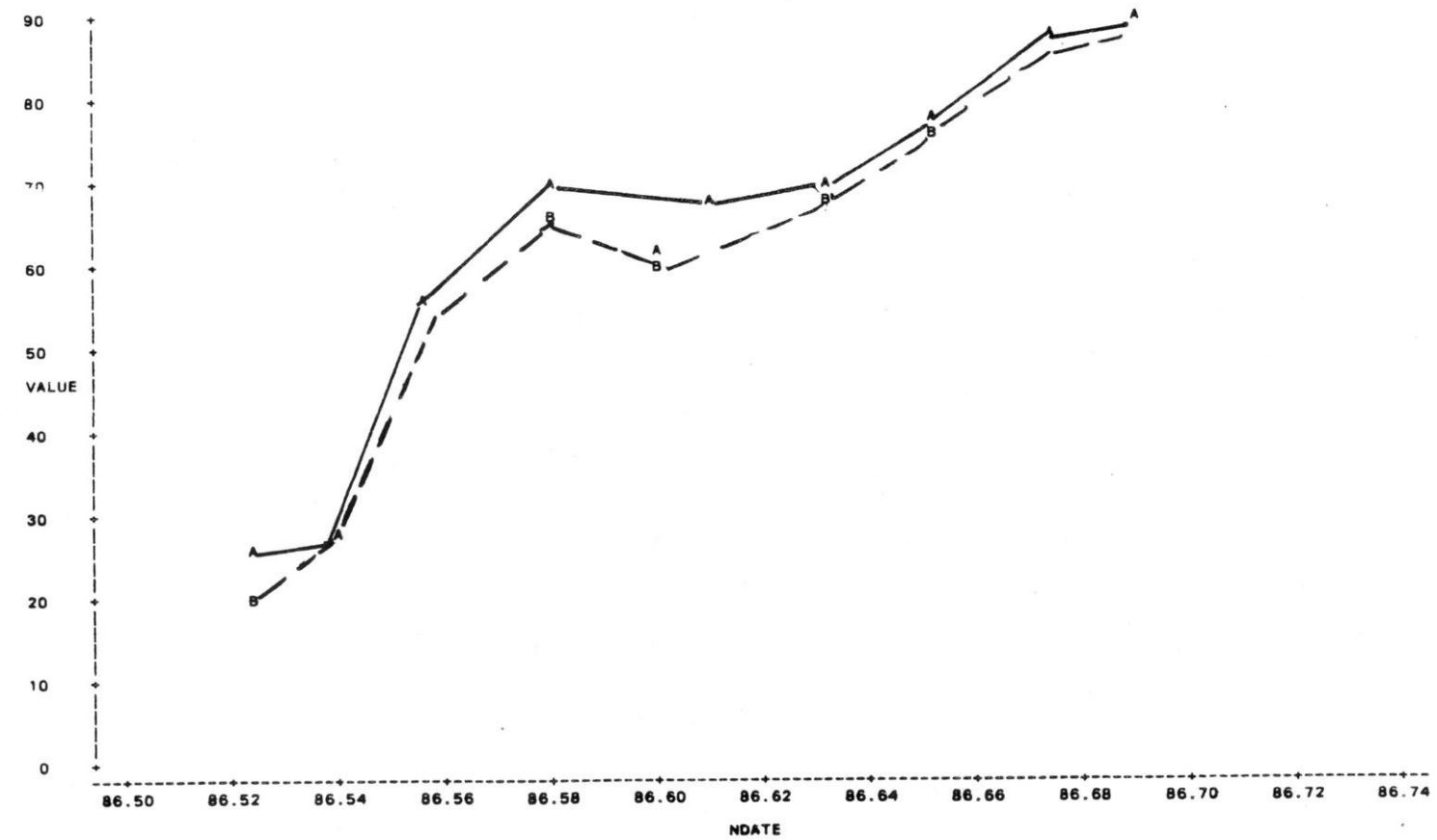


NOTE: 1 OBS HIDDEN

OBS	POINT	COMNAME	PARAM	VALUE	YEAR	MONTH	DAY	NDATE	WELL
1	104	108	82295-CHLORIDE,DIS	25	86	7	10	86.523	A
2	104	108	82295-CHLORIDE,DIS	27	86	7	16	86.539	A
3	104	108	82295-CHLORIDE,DIS	56	86	7	22	86.555	A
4	104	108	82295-CHLORIDE,DIS	69	86	7	31	86.580	A
5	104	108	82295-CHLORIDE,DIS	61	86	8	7	86.599	A
6	104	108	82295-CHLORIDE,DIS	67	86	8	11	86.610	A
7	104	108	82295-CHLORIDE,DIS	69	86	8	19	86.632	A
8	104	108	82295-CHLORIDE,DIS	77	86	8	26	86.651	A
9	104	108	82295-CHLORIDE,DIS	87	86	9	3	86.673	A
10	104	108	82295-CHLORIDE,DIS	91	86	9	9	86.689	A
11	105	108B	82295-CHLORIDE,DIS	20	86	7	10	86.523	B
12	105	108B	82295-CHLORIDE,DIS	28	86	7	16	86.539	B
13	105	108B	82295-CHLORIDE,DIS	55	86	7	22	86.555	B
14	105	108B	82295-CHLORIDE,DIS	66	86	7	31	86.580	B
15	105	108B	82295-CHLORIDE,DIS	60	86	8	7	86.599	B
16	105	108B	82295-CHLORIDE,DIS	67	86	8	11	86.610	B
17	105	108B	82295-CHLORIDE,DIS	68	86	8	19	86.632	B
18	105	108B	82295-CHLORIDE,DIS	76	86	8	26	86.651	B
19	105	108B	82295-CHLORIDE,DIS	88	86	9	3	86.673	B
20	105	108B	82295-CHLORIDE,DIS	91	86	9	9	86.689	B

FILTERING PROJECT
GRAPH OF PARAMETER (MG/L) VERSUS TIME
DECEMBER 12, 1986 JOHN SCHWALBE

PLOT OF VALUE*NDATE SYMBOL IS VALUE OF WELL



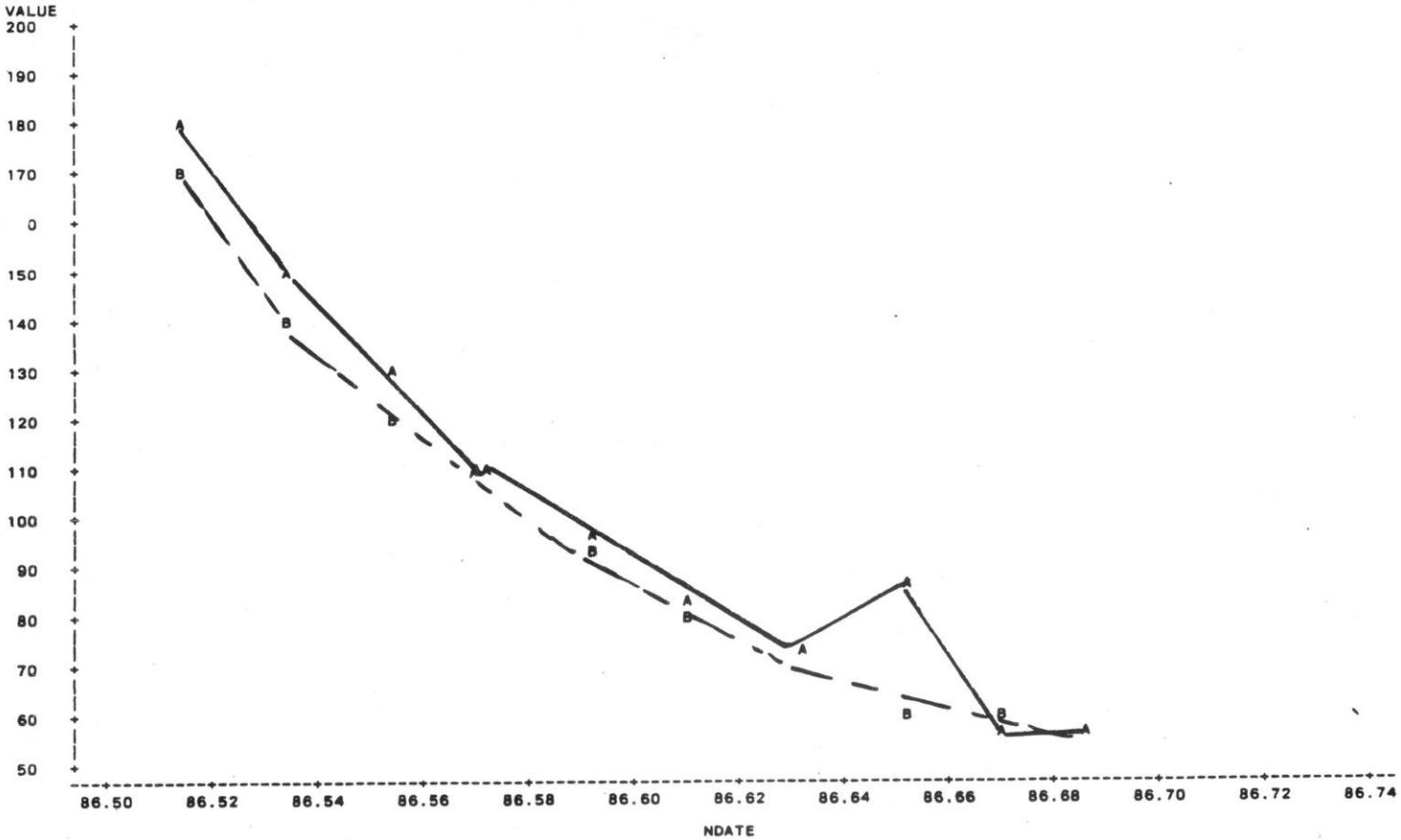
NOTE: 5 OBS HIDDEN

PARAMETER VALUES IN MG/L

OBS	POINT	COMNAME	PARAM	VALUE	YEAR	MONTH	DAY	NDATE	WELL
1	121	104	82295-CHLORIDE,DIS	180	86	7	7	86.514	A
2	121	104	82295-CHLORIDE,DIS	150	86	7	14	86.534	A
3	121	104	82295-CHLORIDE,DIS	130	86	7	21	86.553	A
4	121	104	82295-CHLORIDE,DIS	110	86	7	27	86.569	A
6	121	104	82295-CHLORIDE,DIS	95	86	8	4	86.591	A
7	121	104	82295-CHLORIDE,DIS	83	86	8	11	86.610	A
8	121	104	82295-CHLORIDE,DIS	72	86	8	19	86.632	A
9	121	104	82295-CHLORIDE,DIS	88	86	8	26	86.651	A
10	121	104	82295-CHLORIDE,DIS	58	86	9	2	86.670	A
11	121	104	82295-CHLORIDE,DIS	55	86	9	8	86.686	A
12	122	104B	82295-CHLORIDE,DIS	170	86	7	7	86.514	B
13	122	104B	82295-CHLORIDE,DIS	140	86	7	14	86.534	B
14	122	104B	82295-CHLORIDE,DIS	120	86	7	21	86.553	B
15	122	104B	82295-CHLORIDE,DIS	110	86	7	27	86.569	B
17	122	104B	82295-CHLORIDE,DIS	94	86	8	4	86.591	B
18	122	104B	82295-CHLORIDE,DIS	81	86	8	11	86.610	B
19	122	104B	82295-CHLORIDE,DIS	72	86	8	19	86.632	B
20	122	104B	82295-CHLORIDE,DIS	59	86	8	26	86.651	B
21	122	104B	82295-CHLORIDE,DIS	60	86	9	2	86.670	B
22	122	104B	82295-CHLORIDE,DIS	58	86	9	8	86.686	B

FILTERING PROJECT
GRAPH OF PARAMETER (MG/L) VERSUS TIME
DECEMBER 12, 1986 JOHN SCHWALBE

PLOT OF VALUE*NDATE SYMBOL IS VALUE OF WELL

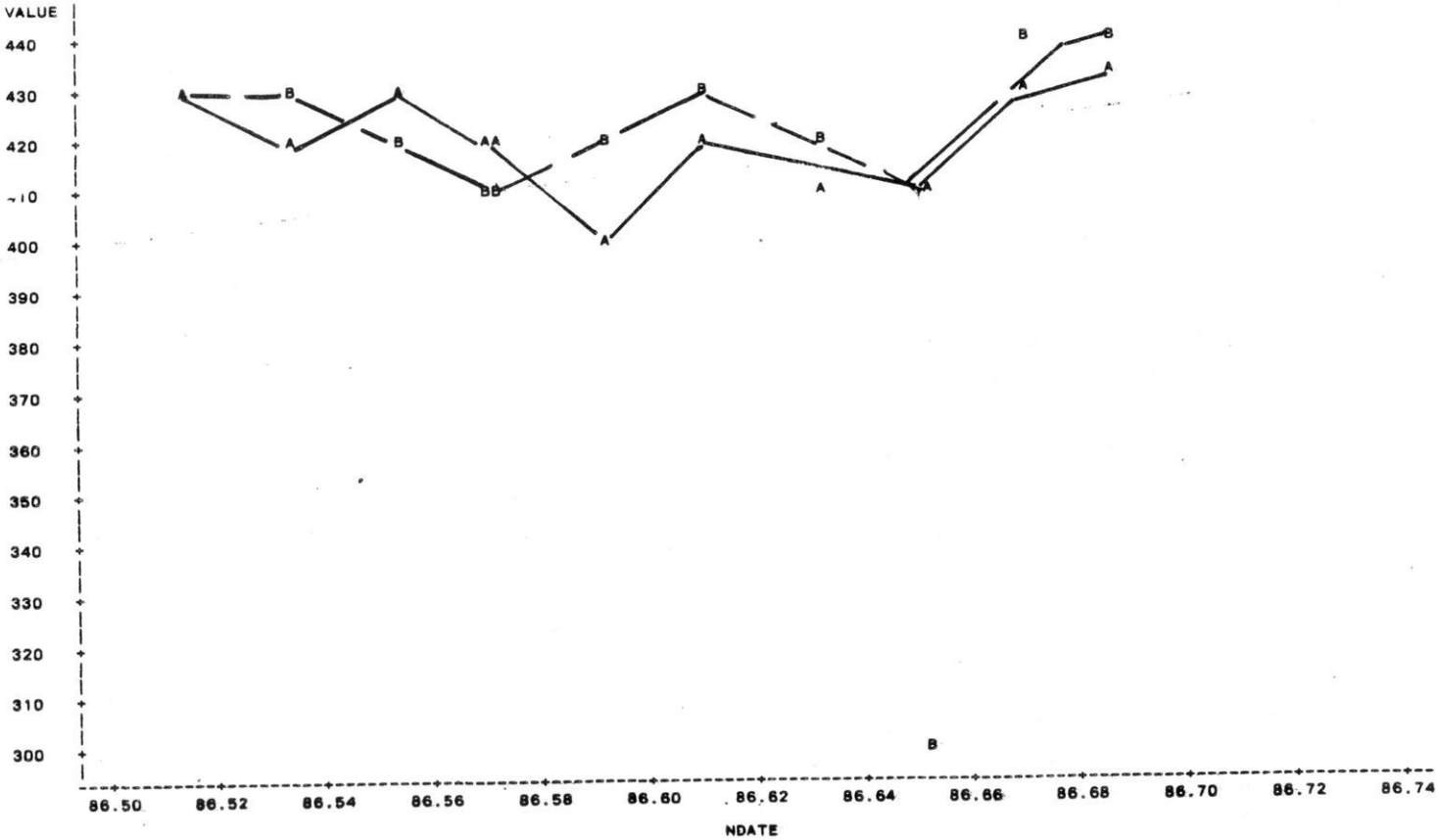


NOTE: 4 OBS HIDDEN

OBS	POINT	COMNAME	PARAM	VALUE	YEAR	MONTH	DAY	NDATE	WELL
1	124	109	82295-CHLORIDE,DIS	430	86	7	7	86.514	A
2	124	109	82295-CHLORIDE,DIS	420	86	7	14	86.534	A
3	124	109	82295-CHLORIDE,DIS	430	86	7	21	86.553	A
4	124	109	82295-CHLORIDE,DIS	420	86	7	27	86.569	A
6	124	109	82295-CHLORIDE,DIS	400	86	8	4	86.591	A
7	124	109	82295-CHLORIDE,DIS	420	86	8	11	86.610	A
8	124	109	82295-CHLORIDE,DIS	410	86	8	19	86.632	A
9	124	109	82295-CHLORIDE,DIS	410	86	8	26	86.651	A
10	124	109	82295-CHLORIDE,DIS	430	86	9	2	86.670	A
11	124	109	82295-CHLORIDE,DIS	433	86	9	8	86.686	A
12	125	109B	82295-CHLORIDE,DIS	430	86	7	7	86.514	B
13	125	109B	82295-CHLORIDE,DIS	430	86	7	14	86.534	B
14	125	109B	82295-CHLORIDE,DIS	420	86	7	21	86.553	B
15	125	109B	82295-CHLORIDE,DIS	410	86	7	27	86.569	B
17	125	109B	82295-CHLORIDE,DIS	420	86	8	4	86.591	B
18	125	109B	82295-CHLORIDE,DIS	430	86	8	11	86.610	B
19	125	109B	82295-CHLORIDE,DIS	420	86	8	19	86.632	B
20	125	109B	82295-CHLORIDE,DIS	300	86	8	26	86.651	B
21	125	109B	82295-CHLORIDE,DIS	440	86	9	2	86.670	B
22	125	109B	82295-CHLORIDE,DIS	440	86	9	8	86.686	B

FILTERING PROJECT
GRAPH OF PARAMETER (MG/L) VERSUS TIME
DECEMBER 12, 1986 JOHN SCHWALBE

PLOT OF VALUE*NDATE SYMBOL IS VALUE OF WELL

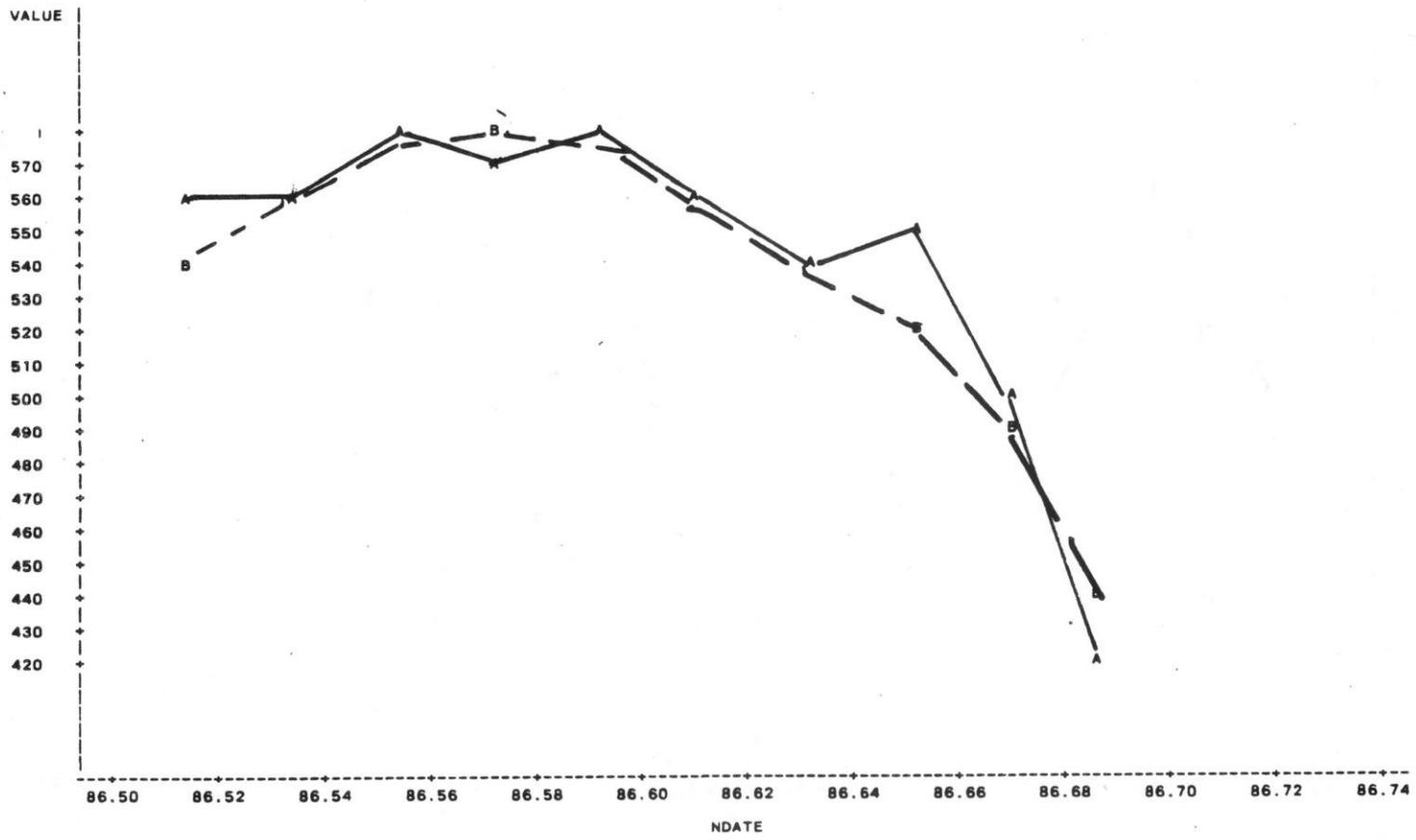


NOTE: 1 OBS HIDDEN

OBS	POINT	COMNAME	PARAM	VALUE	YEAR	MONTH	DAY	NDATE	WELL
1	111	110A	82295-CHLORIDE,DIS	560	86	7	7	86.514	A
2	111	110A	82295-CHLORIDE,DIS	560	86	7	14	86.534	A
3	111	110A	82295-CHLORIDE,DIS	580	86	7	21	86.553	A
4	111	110A	82295-CHLORIDE,DIS	570	86	7	28	86.572	A
5	111	110A	82295-CHLORIDE,DIS	580	86	8	4	86.591	A
6	111	110A	82295-CHLORIDE,DIS	560	86	8	11	86.610	A
7	111	110A	82295-CHLORIDE,DIS	540	86	8	19	86.632	A
8	111	110A	82295-CHLORIDE,DIS	550	86	8	26	86.651	A
9	111	110A	82295-CHLORIDE,DIS	500	86	9	2	86.670	A
10	111	110A	82295-CHLORIDE,DIS	420	86	9	8	86.686	A
11	112	110AB	82295-CHLORIDE,DIS	540	86	7	7	86.514	B
12	112	110AB	82295-CHLORIDE,DIS	560	86	7	14	86.534	B
13	112	110AB	82295-CHLORIDE,DIS	580	86	7	21	86.553	B
14	112	110AB	82295-CHLORIDE,DIS	580	86	7	28	86.572	B
15	112	110AB	82295-CHLORIDE,DIS	580	86	8	4	86.591	B
16	112	110AB	82295-CHLORIDE,DIS	560	86	8	11	86.610	B
17	112	110AB	82295-CHLORIDE,DIS	540	86	8	19	86.632	B
18	112	110AB	82295-CHLORIDE,DIS	520	86	8	26	86.651	B
19	112	110AB	82295-CHLORIDE,DIS	490	86	9	2	86.670	B
20	112	110AB	82295-CHLORIDE,DIS	440	86	9	8	86.686	B

FILTERING PROJECT
GRAPH OF PARAMETER (MG/L) VERSUS TIME
DECEMBER 12, 1986 JOHN SCHWALBE

PLOT OF VALUE*NDATE SYMBOL IS VALUE OF WELL

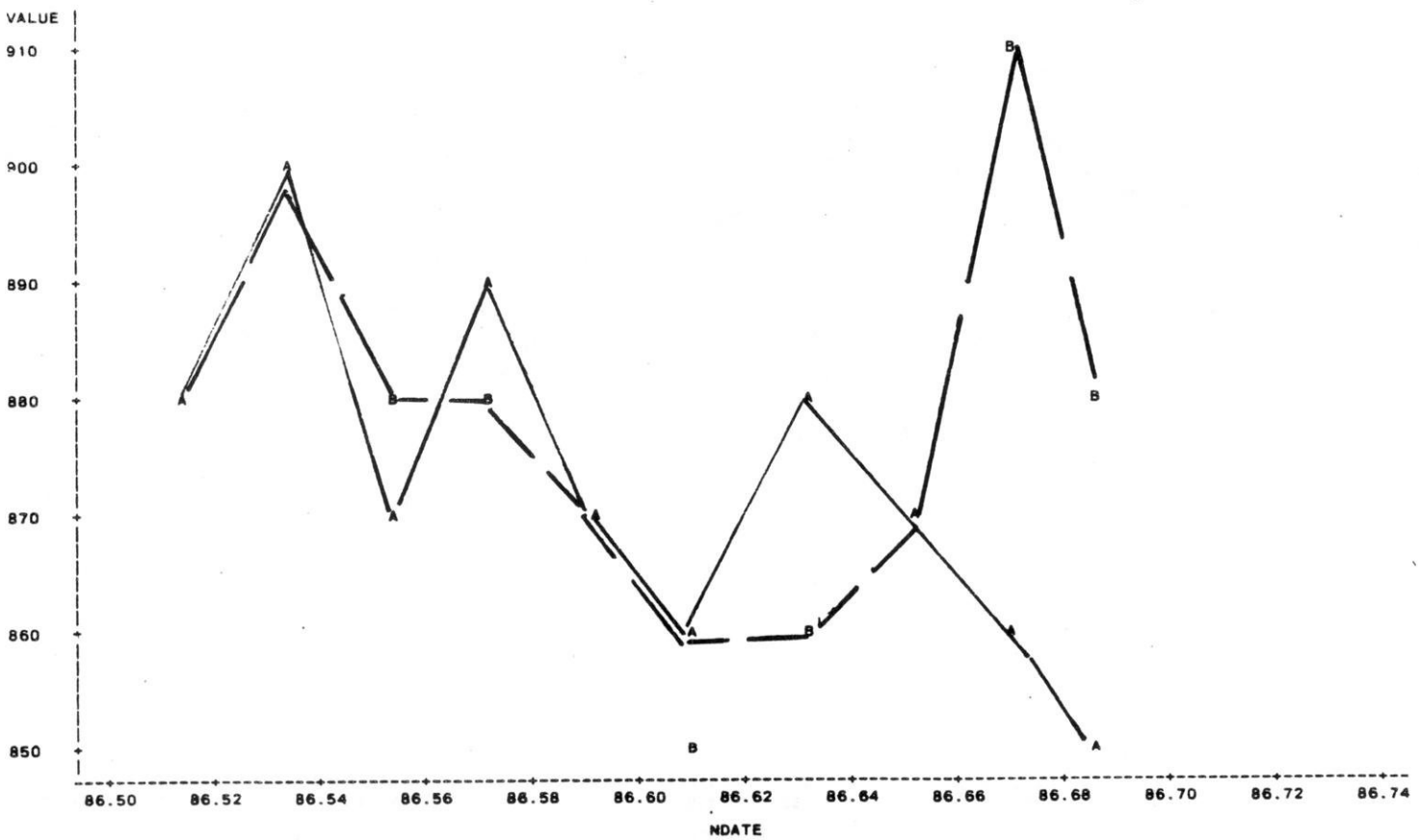


NOTE: 5 OBS HIDDEN

OBS	POINT	COMNAME	PARAM	VALUE	YEAR	MONTH	DAY	NDATE	WELL
1	114	117	82295-CHLORIDE,DIS	880	86	7	7	86.514	A
2	114	117	82295-CHLORIDE,DIS	900	86	7	14	86.534	A
3	114	117	82295-CHLORIDE,DIS	870	86	7	21	86.553	A
4	114	117	82295-CHLORIDE,DIS	890	86	7	28	86.572	A
5	114	117	82295-CHLORIDE,DIS	870	86	8	4	86.591	A
6	114	117	82295-CHLORIDE,DIS	860	86	8	11	86.610	A
7	114	117	82295-CHLORIDE,DIS	880	86	8	19	86.632	A
8	114	117	82295-CHLORIDE,DIS	870	86	8	26	86.651	A
9	114	117	82295-CHLORIDE,DIS	860	86	9	2	86.670	A
10	114	117	82295-CHLORIDE,DIS	850	86	9	8	86.686	A
11	115	117B	82295-CHLORIDE,DIS	880	86	7	7	86.514	B
12	115	117B	82295-CHLORIDE,DIS	900	86	7	14	86.534	B
13	115	117B	82295-CHLORIDE,DIS	880	86	7	21	86.553	B
14	115	117B	82295-CHLORIDE,DIS	880	86	7	28	86.572	B
15	115	117B	82295-CHLORIDE,DIS	870	86	8	4	86.591	B
16	115	117B	82295-CHLORIDE,DIS	850	86	8	11	86.610	B
17	115	117B	82295-CHLORIDE,DIS	860	86	8	19	86.632	B
18	115	117B	82295-CHLORIDE,DIS	870	86	8	26	86.651	B
19	115	117B	82295-CHLORIDE,DIS	910	86	9	2	86.670	B
20	115	117B	82295-CHLORIDE,DIS	880	86	9	8	86.686	B

GRAPH OF PARAMETER (MG/L) VERSUS TIME
DECEMBER 12, 1986 JOHN SCHWALBE

PLOT OF VALUE*NDATE SYMBOL IS VALUE OF WELL

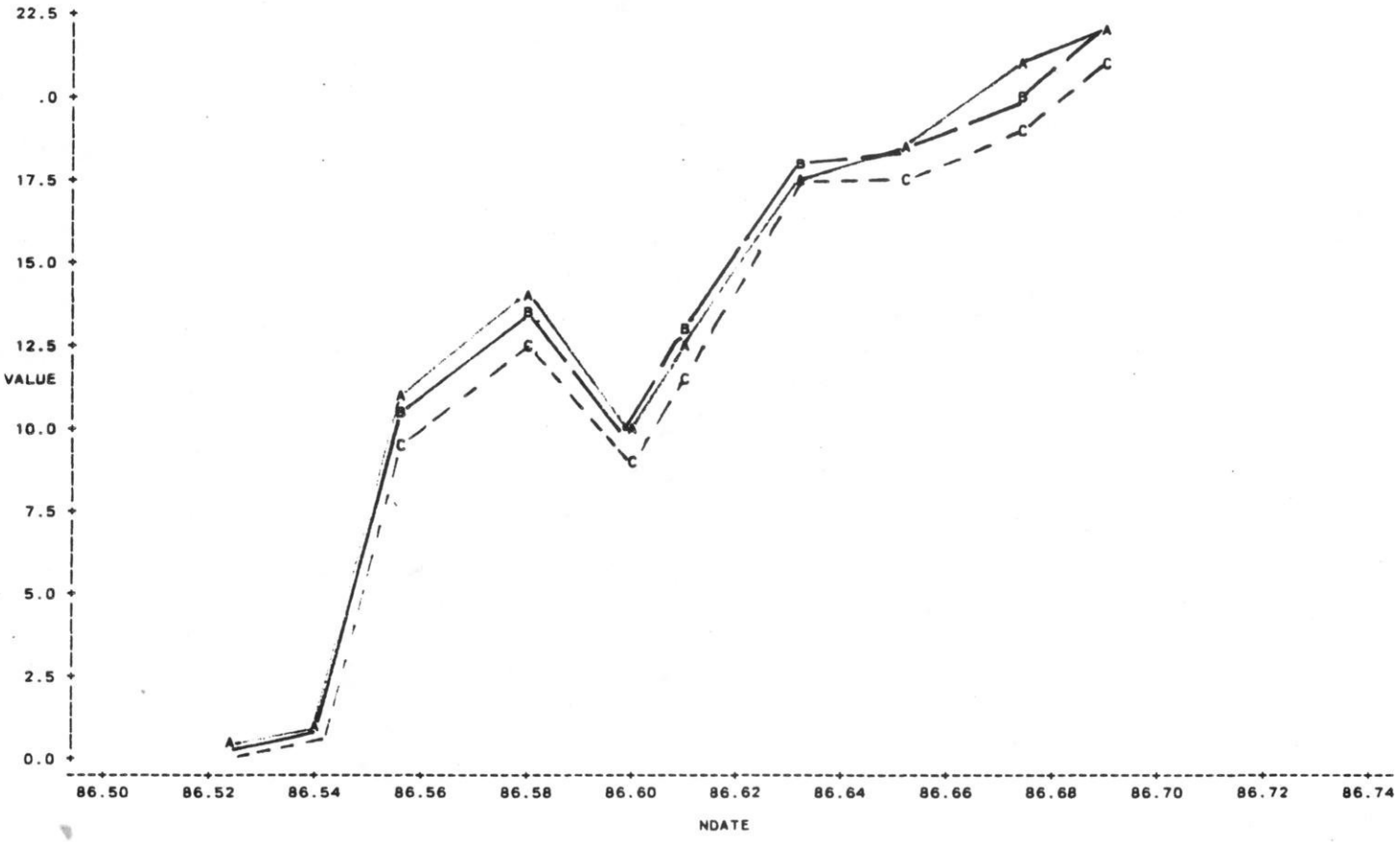


NOTE: 4 OBS HIDDEN

OBS	POINT	COMNAME	PARAM	VALUE	YEAR	MONTH	DAY	NDATE	WELL
1	104	108	631-NO2&NO3,N-DIS	0.7	86	7	10	86.523	A
2	104	108	631-NO2&NO3,N-DIS	0.8	86	7	16	86.539	A
3	104	108	631-NO2&NO3,N-DIS	10.8	86	7	22	86.555	A
4	104	108	631-NO2&NO3,N-DIS	13.8	86	7	31	86.580	A
5	104	108	631-NO2&NO3,N-DIS	10.0	86	8	7	86.599	A
6	104	108	631-NO2&NO3,N-DIS	12.5	86	8	11	86.610	A
7	104	108	631-NO2&NO3,N-DIS	17.7	86	8	19	86.632	A
8	104	108	631-NO2&NO3,N-DIS	18.5	86	8	26	86.651	A
9	104	108	631-NO2&NO3,N-DIS	21.0	86	9	3	86.673	A
10	104	108	631-NO2&NO3,N-DIS	22.0	86	9	9	86.689	A
11	105	108B	631-NO2&NO3,N-DIS	0.7	86	7	10	86.523	B
12	105	108B	631-NO2&NO3,N-DIS	0.8	86	7	16	86.539	B
13	105	108B	631-NO2&NO3,N-DIS	10.5	86	7	22	86.555	B
14	105	108B	631-NO2&NO3,N-DIS	13.7	86	7	31	86.580	B
15	105	108B	631-NO2&NO3,N-DIS	9.8	86	8	7	86.599	B
16	105	108B	631-NO2&NO3,N-DIS	13.1	86	8	11	86.610	B
17	105	108B	631-NO2&NO3,N-DIS	18.2	86	8	19	86.632	B
18	105	108B	631-NO2&NO3,N-DIS	18.6	86	8	26	86.651	B
19	105	108B	631-NO2&NO3,N-DIS	20.0	86	9	3	86.673	B
20	105	108B	631-NO2&NO3,N-DIS	22.0	86	9	9	86.689	B
21	106	108A	631-NO2&NO3,N-DIS	0.7	86	7	10	86.523	C
22	106	108A	631-NO2&NO3,N-DIS	0.8	86	7	16	86.539	C
23	106	108A	631-NO2&NO3,N-DIS	9.4	86	7	22	86.555	C
24	106	108A	631-NO2&NO3,N-DIS	12.3	86	7	31	86.580	C
25	106	108A	631-NO2&NO3,N-DIS	8.9	86	8	7	86.599	C
26	106	108A	631-NO2&NO3,N-DIS	11.4	86	8	11	86.610	C
27	106	108A	631-NO2&NO3,N-DIS	17.5	86	8	19	86.632	C
28	106	108A	631-NO2&NO3,N-DIS	17.7	86	8	26	86.651	C
29	106	108A	631-NO2&NO3,N-DIS	18.9	86	9	3	86.673	C
30	106	108A	631-NO2&NO3,N-DIS	21.0	86	9	9	86.689	C

GRAPH OF PARAMETER (MG/L) VERSUS TIME
DECEMBER 12, 1986 JOHN SCHWALBE

PLOT OF VALUE*NDATE SYMBOL IS VALUE,OF WELL

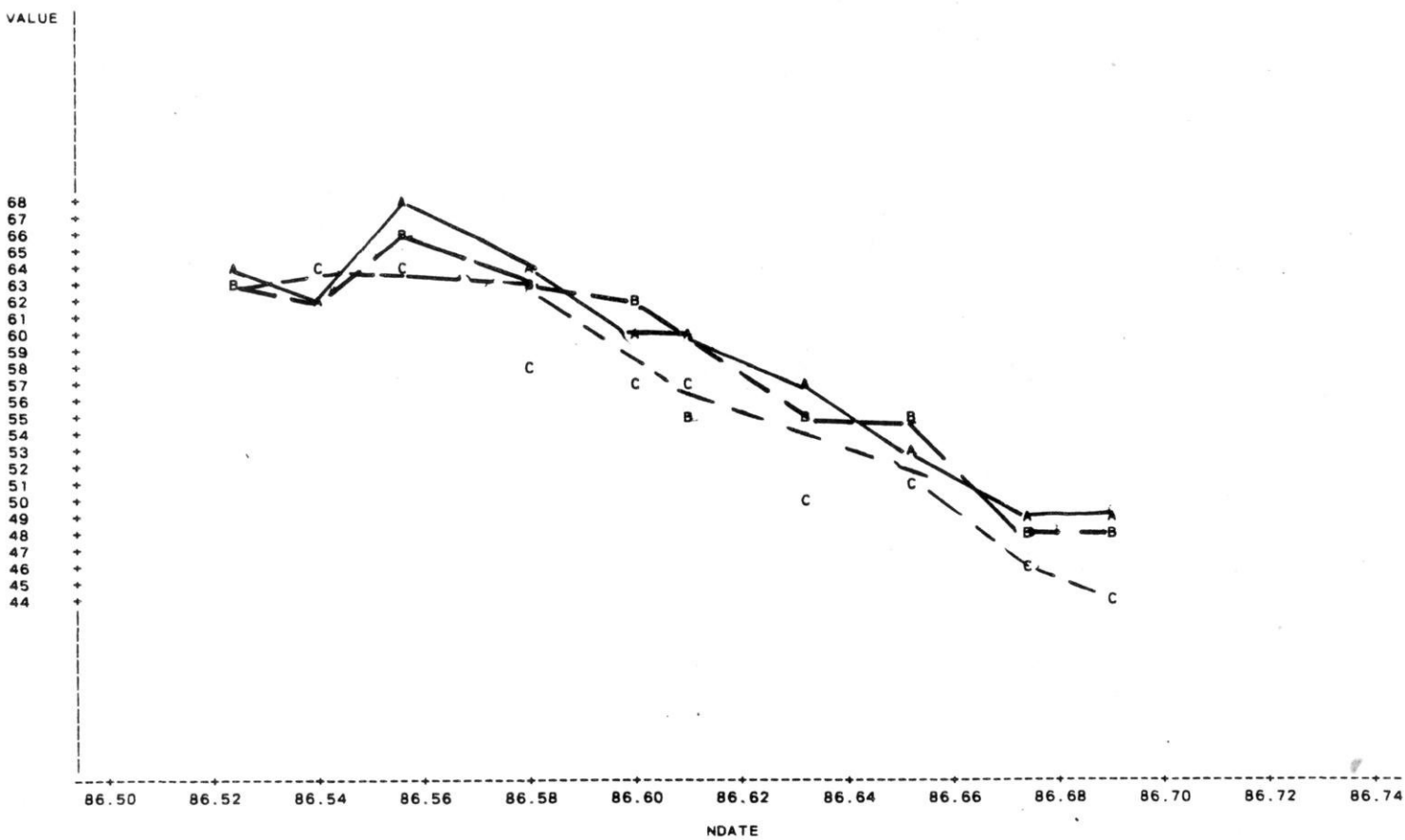


NOTE: 8 OBS HIDDEN

1	101	103	608-NH3-N,DIS	64	86	7	10	86.523	A
2	101	103	608-NH3-N,DIS	62	86	7	16	86.539	A
3	101	103	608-NH3-N,DIS	68	86	7	22	86.555	A
4	101	103	608-NH3-N,DIS	64	86	7	31	86.580	A
5	101	103	608-NH3-N,DIS	60	86	8	7	86.599	A
6	101	103	608-NH3-N,DIS	60	86	8	11	86.610	A
7	101	103	608-NH3-N,DIS	57	86	8	19	86.632	A
8	101	103	608-NH3-N,DIS	53	86	8	26	86.651	A
9	101	103	608-NH3-N,DIS	49	86	9	3	86.673	A
10	101	103	608-NH3-N,DIS	49	86	9	9	86.689	A
11	102	103B	608-NH3-N,DIS	63	86	7	10	86.523	B
12	102	103B	608-NH3-N,DIS	62	86	7	16	86.539	B
13	102	103B	608-NH3-N,DIS	66	86	7	22	86.555	B
14	102	103B	608-NH3-N,DIS	63	86	7	31	86.580	B
15	102	103B	608-NH3-N,DIS	62	86	8	7	86.599	B
16	102	103B	608-NH3-N,DIS	55	86	8	11	86.610	B
17	102	103B	608-NH3-N,DIS	55	86	8	19	86.632	B
18	102	103B	608-NH3-N,DIS	55	86	8	26	86.651	B
19	102	103B	608-NH3-N,DIS	48	86	9	3	86.673	B
20	102	103B	608-NH3-N,DIS	48	86	9	9	86.689	B
21	103	103A	608-NH3-N,DIS	64	86	7	10	86.523	C
22	103	103A	608-NH3-N,DIS	64	86	7	16	86.539	C
23	103	103A	608-NH3-N,DIS	64	86	7	22	86.555	C
24	103	103A	608-NH3-N,DIS	58	86	7	31	86.580	C
25	103	103A	608-NH3-N,DIS	57	86	8	7	86.599	C
26	103	103A	608-NH3-N,DIS	57	86	8	11	86.610	C
27	103	103A	608-NH3-N,DIS	50	86	8	19	86.632	C
28	103	103A	608-NH3-N,DIS	51	86	8	26	86.651	C
29	103	103A	608-NH3-N,DIS	46	86	9	3	86.673	C
30	103	103A	608-NH3-N,DIS	44	86	9	9	86.689	C

GRAPH OF PARAMETER (MG/L) VERSUS TIME
DECEMBER 12, 1986 JOHN SCHWALBE

PLOT OF VALUE*NDATE SYMBOL IS VALUE OF WELL

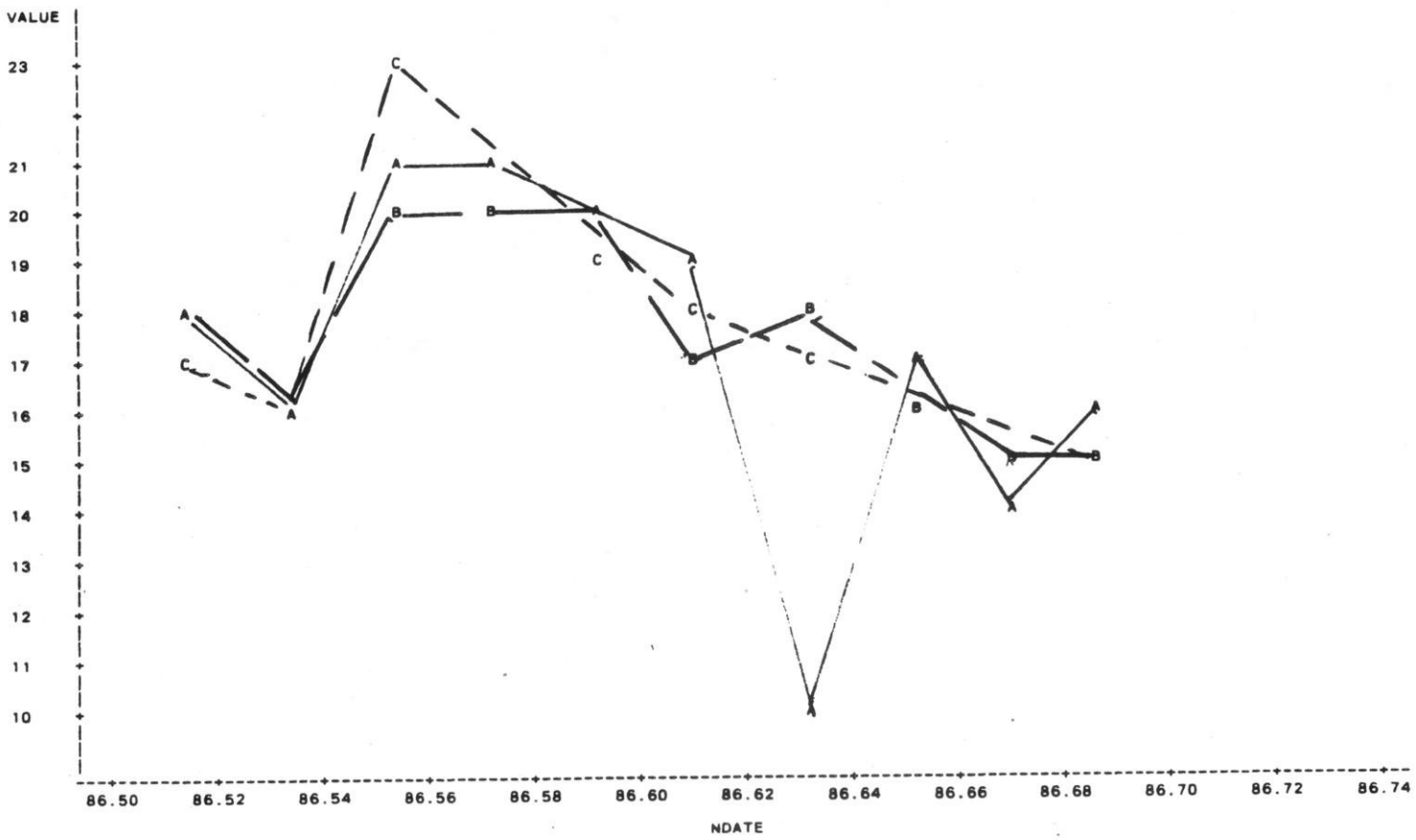


NOTE: 2 OBS HIDDEN

OBS	POINT	COMNAME	PARAM	VALUE	YEAR	MONTH	DAY	NDATE	WELL
1	111	110A	608-NH3-N,DIS	18	86	7	7	86.514	A
2	111	110A	608-NH3-N,DIS	16	86	7	14	86.534	A
3	111	110A	608-NH3-N,DIS	21	86	7	21	86.553	A
4	111	110A	608-NH3-N,DIS	21	86	7	28	86.572	A
5	111	110A	608-NH3-N,DIS	20	86	8	4	86.591	A
6	111	110A	608-NH3-N,DIS	19	86	8	11	86.610	A
7	111	110A	608-NH3-N,DIS	10	86	8	19	86.632	A
8	111	110A	608-NH3-N,DIS	17	86	8	26	86.651	A
9	111	110A	608-NH3-N,DIS	14	86	9	2	86.670	A
10	111	110A	608-NH3-N,DIS	16	86	9	8	86.686	A
11	112	110AB	608-NH3-N,DIS	16	86	7	14	86.534	B
12	112	110AB	608-NH3-N,DIS	20	86	7	21	86.553	B
13	112	110AB	608-NH3-N,DIS	20	86	7	28	86.572	B
14	112	110AB	608-NH3-N,DIS	20	86	8	4	86.591	B
15	112	110AB	608-NH3-N,DIS	17	86	8	11	86.610	B
16	112	110AB	608-NH3-N,DIS	18	86	8	19	86.632	B
17	112	110AB	608-NH3-N,DIS	16	86	8	26	86.651	B
18	112	110AB	608-NH3-N,DIS	15	86	9	2	86.670	B
19	112	110AB	608-NH3-N,DIS	15	86	9	8	86.686	B
20	113	110AA	608-NH3-N,DIS	17	86	7	7	86.514	C
21	113	110AA	608-NH3-N,DIS	16	86	7	14	86.534	C
22	113	110AA	608-NH3-N,DIS	23	86	7	21	86.553	C
23	113	110AA	608-NH3-N,DIS	20	86	7	28	86.572	C
24	113	110AA	608-NH3-N,DIS	19	86	8	4	86.591	C
25	113	110AA	608-NH3-N,DIS	18	86	8	11	86.610	C
26	113	110AA	608-NH3-N,DIS	17	86	8	19	86.632	C
27	113	110AA	608-NH3-N,DIS	16	86	8	26	86.651	C
28	113	110AA	608-NH3-N,DIS	14	86	9	2	86.670	C
29	113	110AA	608-NH3-N,DIS	15	86	9	8	86.686	C

FILTERING PROJECT
GRAPH OF PARAMETER (MG/L) VERSUS TIME
DECEMBER 12, 1986 JOHN SCHWALBE

PLOT OF VALUE*NDATE SYMBOL IS VALUE OF WELL

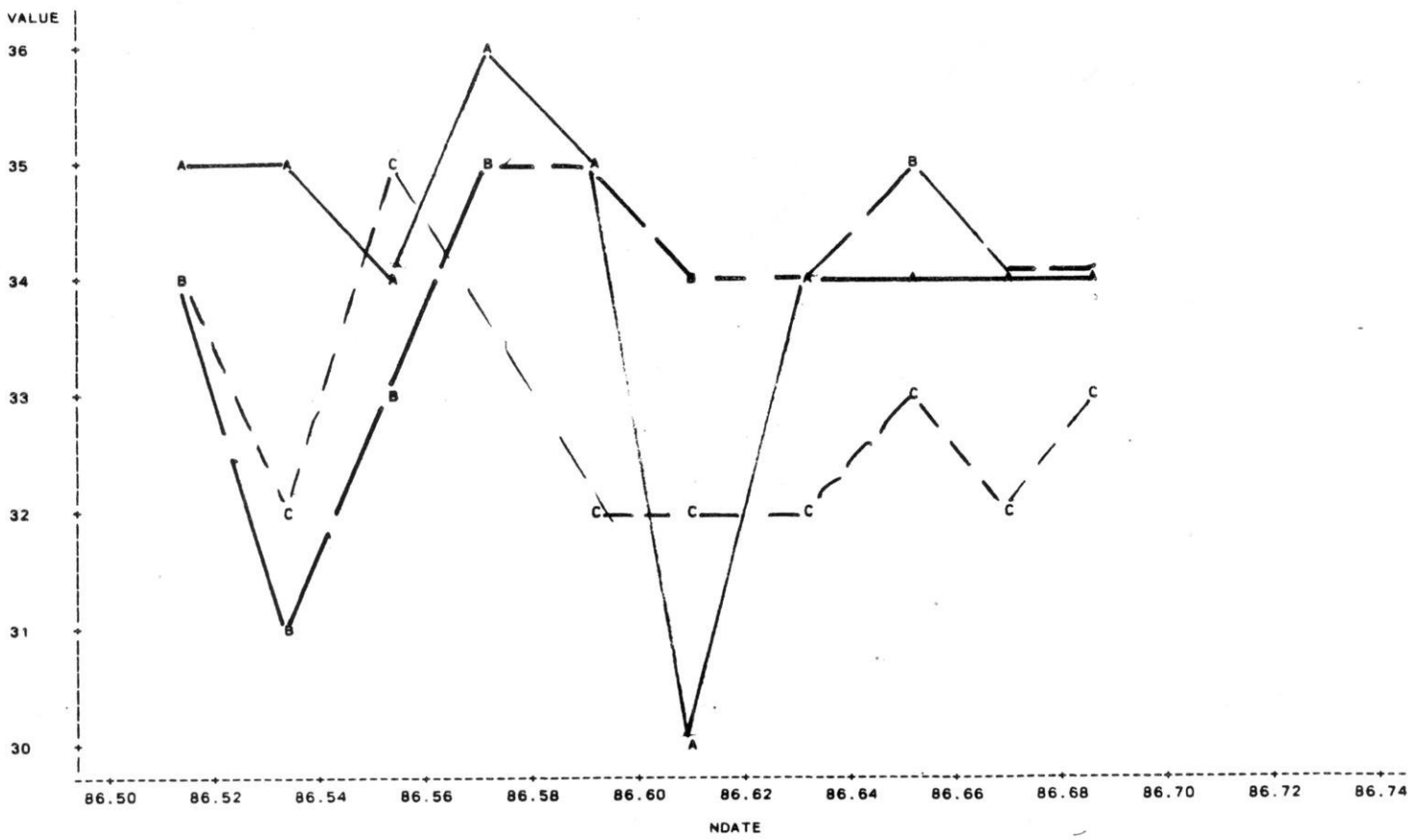


NOTE: 7 OBS HIDDEN

OBS	POINT	COMNAME	PARAM	VALUE	YEAR	MONTH	DAY	NDATE	WELL
1	114	117	608-NH3-N,DIS	35	86	7	7	86.514	A
2	114	117	608-NH3-N,DIS	35	86	7	14	86.534	A
3	114	117	608-NH3-N,DIS	34	86	7	21	86.553	A
4	114	117	608-NH3-N,DIS	36	86	7	28	86.572	A
5	114	117	608-NH3-N,DIS	35	86	8	4	86.591	A
6	114	117	608-NH3-N,DIS	30	86	8	11	86.610	A
7	114	117	608-NH3-N,DIS	34	86	8	19	86.632	A
8	114	117	608-NH3-N,DIS	34	86	8	26	86.651	A
9	114	117	608-NH3-N,DIS	34	86	9	2	86.670	A
10	114	117	608-NH3-N,DIS	34	86	9	8	86.686	A
11	115	117B	608-NH3-N,DIS	34	86	7	7	86.514	B
12	115	117B	608-NH3-N,DIS	31	86	7	14	86.534	B
13	115	117B	608-NH3-N,DIS	33	86	7	21	86.553	B
14	115	117B	608-NH3-N,DIS	35	86	7	28	86.572	B
15	115	117B	608-NH3-N,DIS	35	86	8	4	86.591	B
16	115	117B	608-NH3-N,DIS	34	86	8	11	86.610	B
17	115	117B	608-NH3-N,DIS	34	86	8	19	86.632	B
18	115	117B	608-NH3-N,DIS	35	86	8	26	86.651	B
19	115	117B	608-NH3-N,DIS	34	86	9	2	86.670	B
20	116	117A	608-NH3-N,DIS	34	86	7	7	86.514	C
21	116	117A	608-NH3-N,DIS	32	86	7	14	86.534	C
22	116	117A	608-NH3-N,DIS	35	86	7	21	86.553	C
23	116	117A	608-NH3-N,DIS	35	86	7	28	86.572	C
24	116	117A	608-NH3-N,DIS	32	86	8	4	86.591	C
25	116	117A	608-NH3-N,DIS	32	86	8	11	86.610	C
26	116	117A	608-NH3-N,DIS	32	86	8	19	86.632	C
27	116	117A	608-NH3-N,DIS	33	86	8	26	86.651	C
28	116	117A	608-NH3-N,DIS	32	86	9	2	86.670	C
29	116	117A	608-NH3-N,DIS	33	86	9	8	86.686	C

FILTERING PROJECT
GRAPH OF PARAMETER (MG/L) VERSUS TIME
DECEMBER 12, 1986 JOHN SCHWALBE

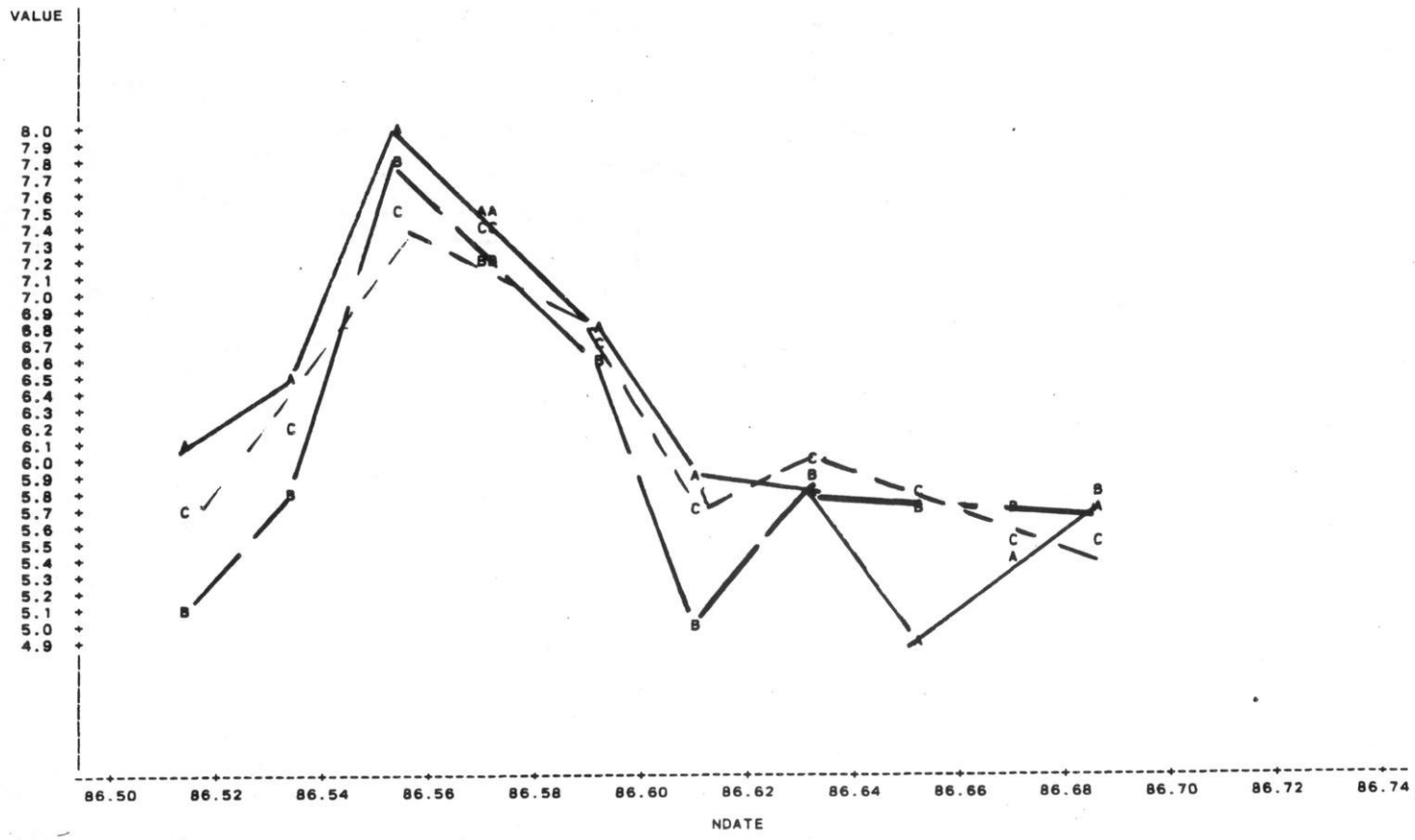
PLOT OF VALUE*NDATE SYMBOL IS VALUE OF WELL



1	121	104	608-NH3-N,DIS	6.1	86	7	7	86.514	A
2	121	104	608-NH3-N,DIS	6.5	86	7	14	86.534	A
3	121	104	608-NH3-N,DIS	8.0	86	7	21	86.553	A
4	121	104	608-NH3-N,DIS	7.5	86	7	27	86.569	A
6	121	104	608-NH3-N,DIS	6.8	86	8	4	86.591	A
7	121	104	608-NH3-N,DIS	5.9	86	8	11	86.610	A
8	121	104	608-NH3-N,DIS	5.8	86	8	19	86.632	A
9	121	104	608-NH3-N,DIS	4.9	86	8	26	86.651	A
10	121	104	608-NH3-N,DIS	5.4	86	9	2	86.670	A
11	121	104	608-NH3-N,DIS	5.7	86	9	8	86.686	A
12	122	104B	608-NH3-N,DIS	5.1	86	7	7	86.514	B
13	122	104B	608-NH3-N,DIS	5.8	86	7	14	86.534	B
14	122	104B	608-NH3-N,DIS	7.8	86	7	21	86.553	B
15	122	104B	608-NH3-N,DIS	7.2	86	7	27	86.569	B
17	122	104B	608-NH3-N,DIS	6.6	86	8	4	86.591	B
18	122	104B	608-NH3-N,DIS	5.0	86	8	11	86.610	B
19	122	104B	608-NH3-N,DIS	5.9	86	8	19	86.632	B
20	122	104B	608-NH3-N,DIS	5.7	86	8	26	86.651	B
21	122	104B	608-NH3-N,DIS	5.7	86	9	2	86.670	B
22	122	104B	608-NH3-N,DIS	5.8	86	9	8	86.686	B
23	123	104A	608-NH3-N,DIS	5.7	86	7	7	86.514	C
24	123	104A	608-NH3-N,DIS	6.2	86	7	14	86.534	C
25	123	104A	608-NH3-N,DIS	7.5	86	7	21	86.553	C
26	123	104A	608-NH3-N,DIS	7.4	86	7	27	86.569	C
28	123	104A	608-NH3-N,DIS	6.7	86	8	4	86.591	C
29	123	104A	608-NH3-N,DIS	5.7	86	8	11	86.610	C
30	123	104A	608-NH3-N,DIS	6.0	86	8	19	86.632	C
31	123	104A	608-NH3-N,DIS	5.8	86	8	26	86.651	C
32	123	104A	608-NH3-N,DIS	5.5	86	9	2	86.670	C
33	123	104A	608-NH3-N,DIS	5.5	86	9	8	86.686	C

FILTERING PROJECT
GRAPH OF PARAMETER (MG/L) VERSUS TIME
DECEMBER 12, 1986 JOHN SCHWALBE

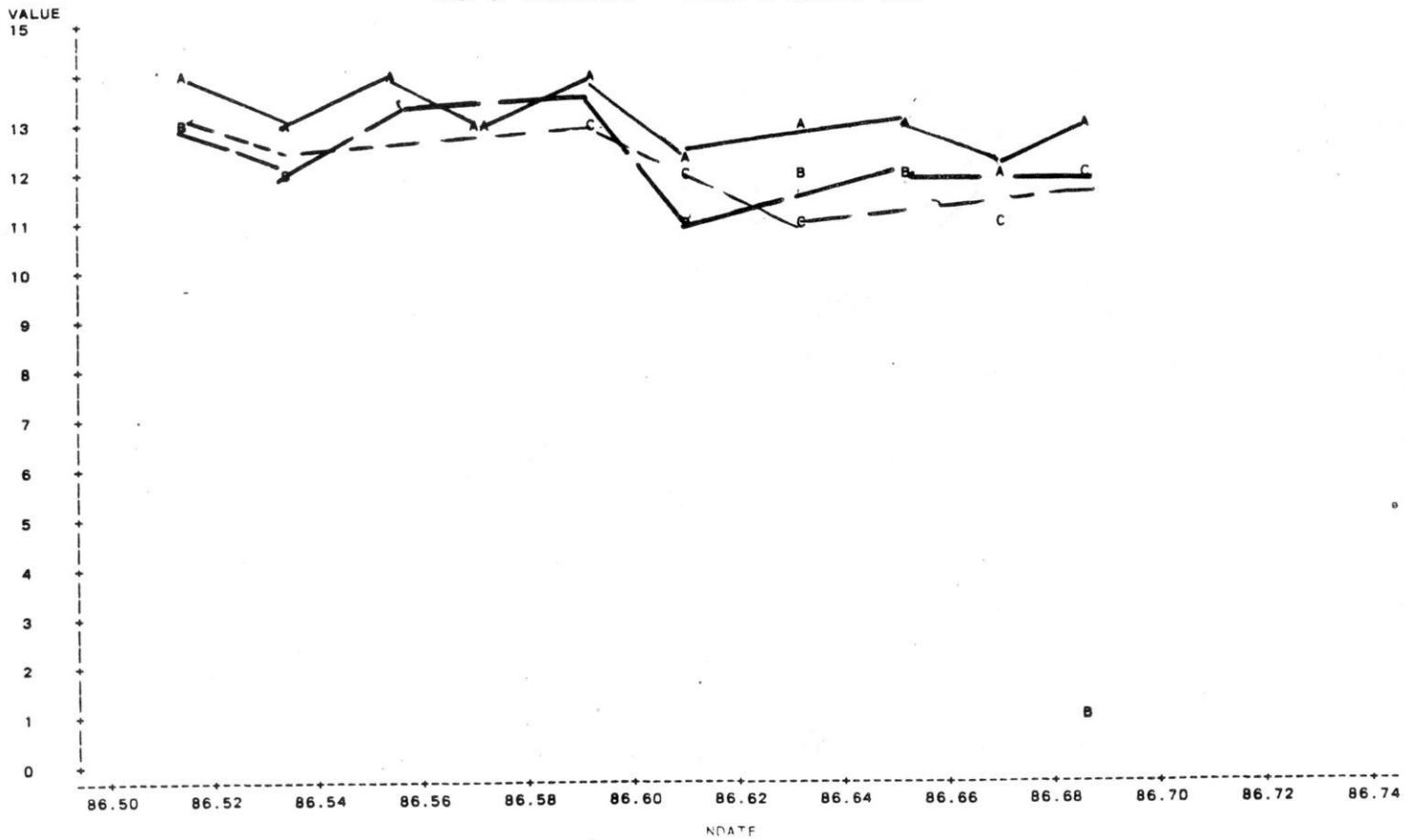
PLOT OF VALUE*NDATE SYMBOL IS VALUE OF WELL



OBS	POINT	COMNAME	PARAM	VALUE	YEAR	MONTH	DAY	NDATE	WELL
1	124	109	608-NH3-N,DIS	14.0	86	7	7	86.514	A
2	124	109	608-NH3-N,DIS	13.0	86	7	14	86.534	A
3	124	109	608-NH3-N,DIS	14.0	86	7	21	86.553	A
4	124	109	608-NH3-N,DIS	13.0	86	7	27	86.569	A
6	124	109	608-NH3-N,DIS	14.0	86	8	4	86.591	A
7	124	109	608-NH3-N,DIS	12.4	86	8	11	86.610	A
8	124	109	608-NH3-N,DIS	13.0	86	8	19	86.632	A
9	124	109	608-NH3-N,DIS	13.0	86	8	26	86.651	A
10	124	109	608-NH3-N,DIS	12.0	86	9	2	86.670	A
11	124	109	608-NH3-N,DIS	13.0	86	9	8	86.686	A
12	125	109B	608-NH3-N,DIS	13.0	86	7	7	86.514	B
13	125	109B	608-NH3-N,DIS	12.0	86	7	14	86.534	B
14	125	109B	608-NH3-N,DIS	14.0	86	7	21	86.553	B
15	125	109B	608-NH3-N,DIS	13.0	86	7	27	86.569	B
17	125	109B	608-NH3-N,DIS	14.0	86	8	4	86.591	B
18	125	109B	608-NH3-N,DIS	11.0	86	8	11	86.610	B
19	125	109B	608-NH3-N,DIS	12.0	86	8	19	86.632	B
20	125	109B	608-NH3-N,DIS	12.0	86	8	26	86.651	B
21	125	109B	608-NH3-N,DIS	12.0	86	9	2	86.670	B
22	125	109B	608-NH3-N,DIS	1.0	86	9	8	86.686	B
23	126	109A	608-NH3-N,DIS	13.0	86	7	7	86.514	C
24	126	109A	608-NH3-N,DIS	13.0	86	7	14	86.534	C
25	126	109A	608-NH3-N,DIS	14.0	86	7	21	86.553	C
26	126	109A	608-NH3-N,DIS	13.0	86	7	27	86.569	C
28	126	109A	608-NH3-N,DIS	13.0	86	8	4	86.591	C
29	126	109A	608-NH3-N,DIS	12.0	86	8	11	86.610	C
30	126	109A	608-NH3-N,DIS	11.0	86	8	19	86.632	C
31	126	109A	608-NH3-N,DIS	12.0	86	8	26	86.651	C
32	126	109A	608-NH3-N,DIS	11.0	86	9	2	86.670	C
33	126	109A	608-NH3-N,DIS	12.0	86	9	8	86.686	C

FILTERING PROJECT
GRAPH OF PARAMETER (MG/L) VERSUS TIME
DECEMBER 12, 1986 JOHN SCHWALBE

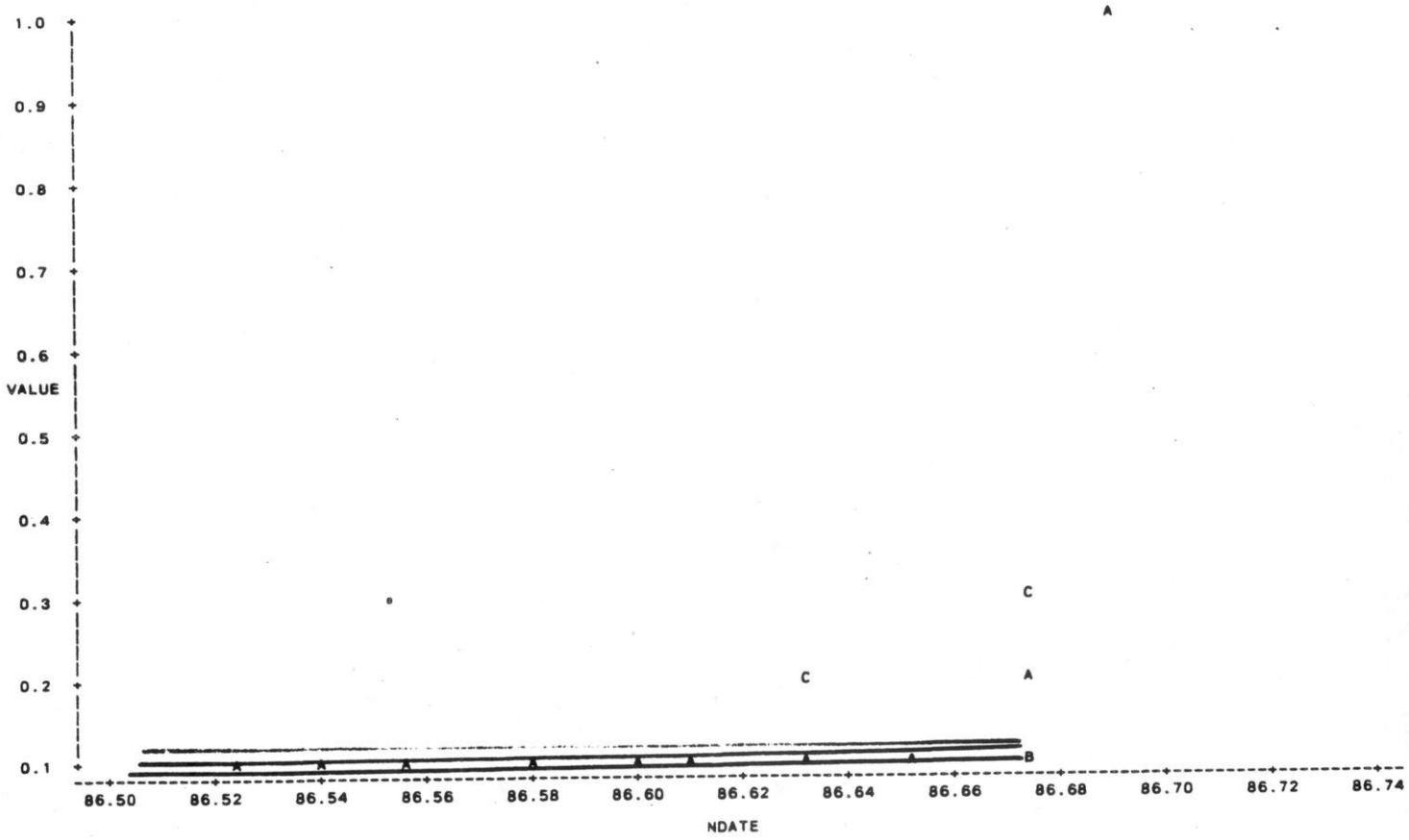
PLOT OF VALUE*NDATE SYMBOL IS VALUE OF WELL



OBS	POINT	COMNAME	PARAM	VALUE	YEAR	MONTH	DAY	NDATE	WELL
1	104	108	608-NH3-N,DIS	0.1	86	7	10	86.523	A
2	104	108	608-NH3-N,DIS	0.1	86	7	16	86.539	A
3	104	108	608-NH3-N,DIS	0.1	86	7	22	86.555	A
4	104	108	608-NH3-N,DIS	0.1	86	7	31	86.580	A
5	104	108	608-NH3-N,DIS	0.1	86	8	7	86.599	A
6	104	108	608-NH3-N,DIS	0.1	86	8	11	86.610	A
7	104	108	608-NH3-N,DIS	0.1	86	8	19	86.632	A
8	104	108	608-NH3-N,DIS	0.1	86	8	26	86.651	A
9	104	108	608-NH3-N,DIS	0.2	86	9	3	86.673	A
10	104	108	608-NH3-N,DIS	1.0	86	9	9	86.689	A
11	105	108B	608-NH3-N,DIS	0.1	86	7	10	86.523	B
12	105	108B	608-NH3-N,DIS	0.1	86	7	16	86.539	B
13	105	108B	608-NH3-N,DIS	0.1	86	7	22	86.555	B
14	105	108B	608-NH3-N,DIS	0.1	86	7	31	86.580	B
15	105	108B	608-NH3-N,DIS	0.1	86	8	7	86.599	B
16	105	108B	608-NH3-N,DIS	0.1	86	8	11	86.610	B
17	105	108B	608-NH3-N,DIS	0.1	86	8	19	86.632	B
18	105	108B	608-NH3-N,DIS	0.1	86	8	26	86.651	B
19	105	108B	608-NH3-N,DIS	0.1	86	9	3	86.673	B
20	105	108B	608-NH3-N,DIS	1.0	86	9	9	86.689	B
21	106	108A	608-NH3-N,DIS	0.1	86	7	10	86.523	C
22	106	108A	608-NH3-N,DIS	0.1	86	7	16	86.539	C
23	106	108A	608-NH3-N,DIS	0.1	86	7	22	86.555	C
24	106	108A	608-NH3-N,DIS	0.1	86	7	31	86.580	C
25	106	108A	608-NH3-N,DIS	0.1	86	8	7	86.599	C
26	106	108A	608-NH3-N,DIS	0.1	86	8	11	86.610	C
27	106	108A	608-NH3-N,DIS	0.2	86	8	19	86.632	C
28	106	108A	608-NH3-N,DIS	0.1	86	8	26	86.651	C
29	106	108A	608-NH3-N,DIS	0.3	86	9	3	86.673	C
30	106	108A	608-NH3-N,DIS	1.0	86	9	9	86.689	C

FILTERING PROJECT
GRAPH OF PARAMETER (MG/L) VERSUS TIME
DECEMBER 12, 1986 JOHN SCHWALBE

PLOT OF VALUE*NDATE SYMBOL IS VALUE OF WELL

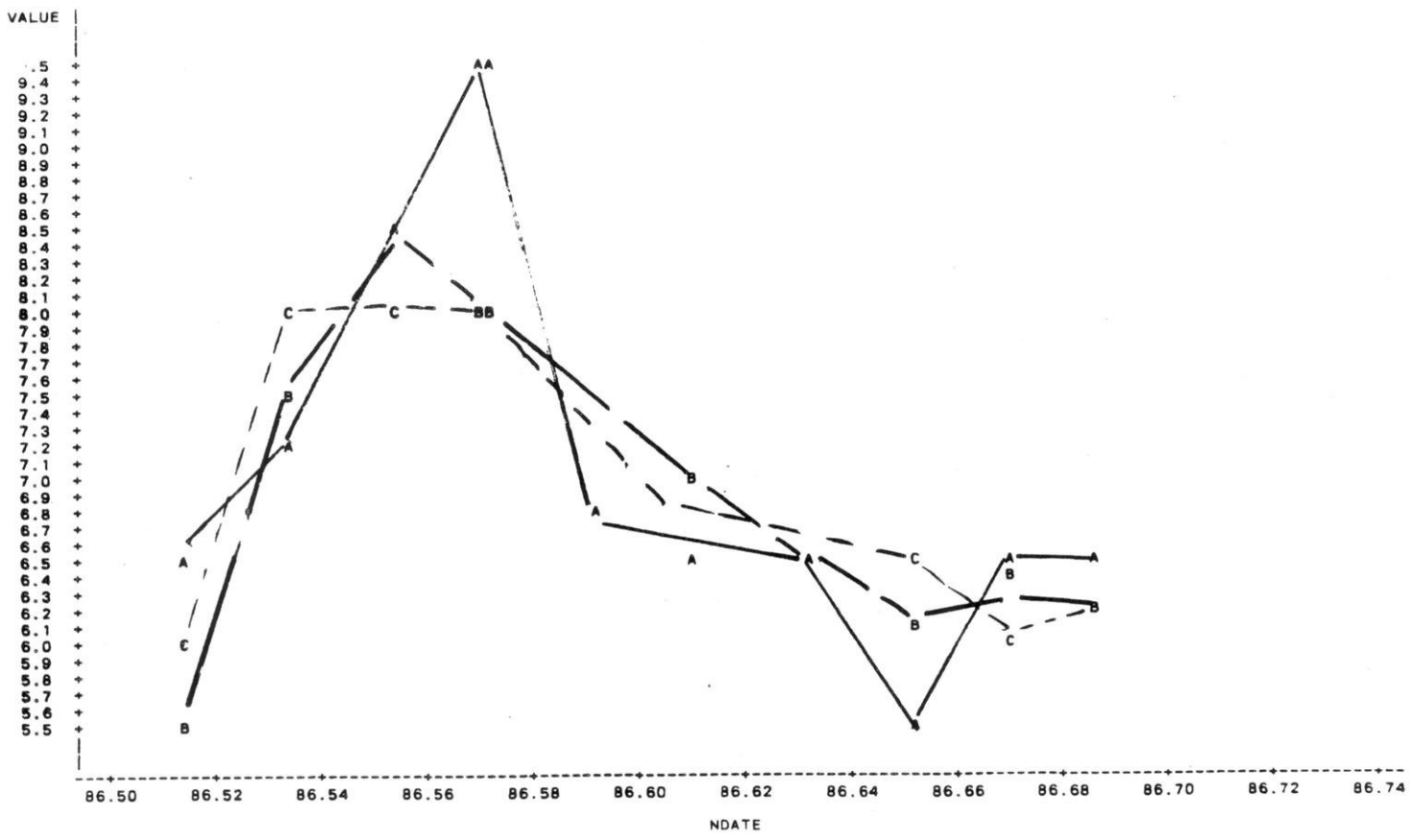


NOTE: 17 OBS HIDDEN

1	121	104	623-N KJELDAHL,DIS	6.5	86	7	7	86.514	A
2	121	104	623-N KJELDAHL,DIS	7.2	86	7	14	86.534	A
3	121	104	623-N KJELDAHL,DIS	8.5	86	7	21	86.553	A
4	121	104	623-N KJELDAHL,DIS	9.5	86	7	27	86.569	A
6	121	104	623-N KJELDAHL,DIS	6.8	86	8	4	86.591	A
7	121	104	623-N KJELDAHL,DIS	6.5	86	8	11	86.610	A
8	121	104	623-N KJELDAHL,DIS	6.5	86	8	19	86.632	A
9	121	104	623-N KJELDAHL,DIS	5.5	86	8	26	86.651	A
10	121	104	623-N KJELDAHL,DIS	6.5	86	9	2	86.670	A
11	121	104	623-N KJELDAHL,DIS	6.5	86	9	8	86.686	A
12	122	104B	623-N KJELDAHL,DIS	5.5	86	7	7	86.514	B
13	122	104B	623-N KJELDAHL,DIS	7.5	86	7	14	86.534	B
14	122	104B	623-N KJELDAHL,DIS	8.5	86	7	21	86.553	B
15	122	104B	623-N KJELDAHL,DIS	8.0	86	7	27	86.569	B
17	122	104B	623-N KJELDAHL,DIS	6.8	86	8	4	86.591	B
18	122	104B	623-N KJELDAHL,DIS	7.0	86	8	11	86.610	B
19	122	104B	623-N KJELDAHL,DIS	6.5	86	8	19	86.632	B
20	122	104B	623-N KJELDAHL,DIS	6.1	86	8	26	86.651	B
21	122	104B	623-N KJELDAHL,DIS	6.4	86	9	2	86.670	B
22	122	104B	623-N KJELDAHL,DIS	6.2	86	9	8	86.686	B
23	123	104A	623-N KJELDAHL,DIS	6.0	86	7	7	86.514	C
24	123	104A	623-N KJELDAHL,DIS	8.0	86	7	14	86.534	C
25	123	104A	623-N KJELDAHL,DIS	8.0	86	7	21	86.553	C
26	123	104A	623-N KJELDAHL,DIS	8.0	86	7	27	86.569	C
28	123	104A	623-N KJELDAHL,DIS	6.8	86	8	4	86.591	C
29	123	104A	623-N KJELDAHL,DIS	6.5	86	8	11	86.610	C
30	123	104A	623-N KJELDAHL,DIS	6.5	86	8	19	86.632	C
31	123	104A	623-N KJELDAHL,DIS	6.5	86	8	26	86.651	C
32	123	104A	623-N KJELDAHL,DIS	6.0	86	9	2	86.670	C
33	123	104A	623-N KJELDAHL,DIS	6.2	86	9	8	86.686	C

FILTERING PROJECT
GRAPH OF PARAMETER (MG/L) VERSUS TIME
DECEMBER 12, 1986 JOHN SCHWALBE

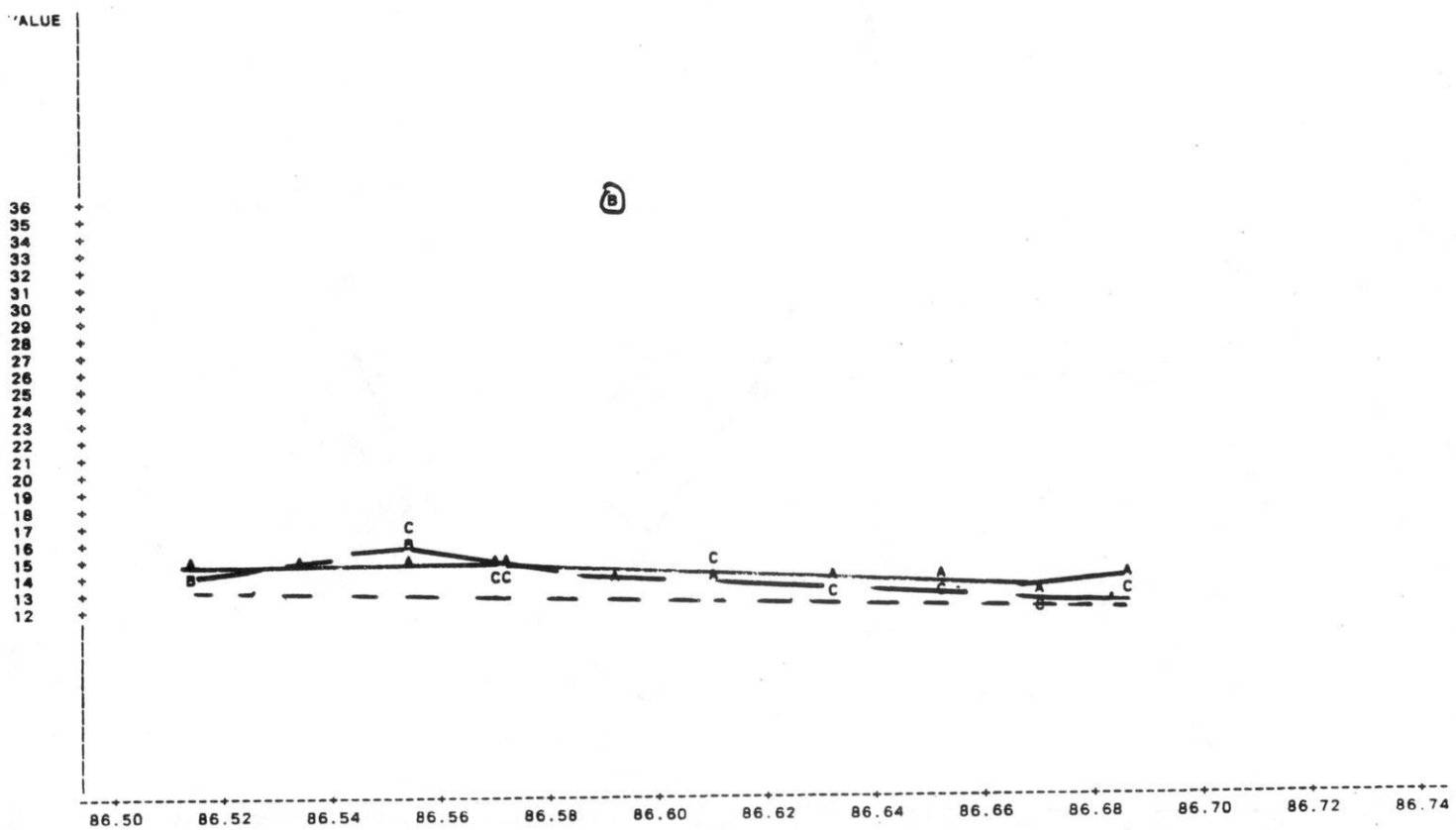
PLOT OF VALUE*NDATE SYMBOL IS VALUE OF WELL



OBS	POINT	COMNAME	PARAM	VALUE	YEAR	MONTH	DAY	NDATE	WELL
1	124	109	623-N KJELDAHL,DIS	15	86	7	7	86.514	A
2	124	109	623-N KJELDAHL,DIS	15	86	7	14	86.534	A
3	124	109	623-N KJELDAHL,DIS	15	86	7	21	86.553	A
4	124	109	623-N KJELDAHL,DIS	15	86	7	27	86.569	A
6	124	109	623-N KJELDAHL,DIS	14	86	8	4	86.591	A
7	124	109	623-N KJELDAHL,DIS	14	86	8	11	86.610	A
8	124	109	623-N KJELDAHL,DIS	14	86	8	19	86.632	A
9	124	109	623-N KJELDAHL,DIS	14	86	8	26	86.651	A
10	124	109	623-N KJELDAHL,DIS	13	86	9	2	86.670	A
11	124	109	623-N KJELDAHL,DIS	14	86	9	8	86.686	A
12	125	109B	623-N KJELDAHL,DIS	14	86	7	7	86.514	B
13	125	109B	623-N KJELDAHL,DIS	15	86	7	14	86.534	B
14	125	109B	623-N KJELDAHL,DIS	16	86	7	21	86.553	B
15	125	109B	623-N KJELDAHL,DIS	15	86	7	27	86.569	B
17	125	109B	623-N KJELDAHL,DIS	36	86	8	4	86.591	B
18	125	109B	623-N KJELDAHL,DIS	14	86	8	11	86.610	B
19	125	109B	623-N KJELDAHL,DIS	14	86	8	19	86.632	B
20	125	109B	623-N KJELDAHL,DIS	14	86	8	26	86.651	B
21	125	109B	623-N KJELDAHL,DIS	13	86	9	2	86.670	B
22	125	109B	623-N KJELDAHL,DIS	14	86	9	8	86.686	B
23	126	109A	623-N KJELDAHL,DIS	14	86	7	7	86.514	C
24	126	109A	623-N KJELDAHL,DIS	15	86	7	14	86.534	C
25	126	109A	623-N KJELDAHL,DIS	17	86	7	21	86.553	C
26	126	109A	623-N KJELDAHL,DIS	14	86	7	27	86.569	C
28	126	109A	623-N KJELDAHL,DIS	14	86	8	4	86.591	C
29	126	109A	623-N KJELDAHL,DIS	15	86	8	11	86.610	C
30	126	109A	623-N KJELDAHL,DIS	13	86	8	19	86.632	C
31	126	109A	623-N KJELDAHL,DIS	13	86	8	26	86.651	C
32	126	109A	623-N KJELDAHL,DIS	12	86	9	2	86.670	C
33	126	109A	623-N KJELDAHL,DIS	13	86	9	8	86.686	C
34	126	109A	623-N KJELDAHL,DIS	13	86	9	8	86.686	C

FILTERING PROJECT
GRAPH OF PARAMETER (MG/L) VERSUS TIME
DECEMBER 12, 1986 JOHN SCHWALBE

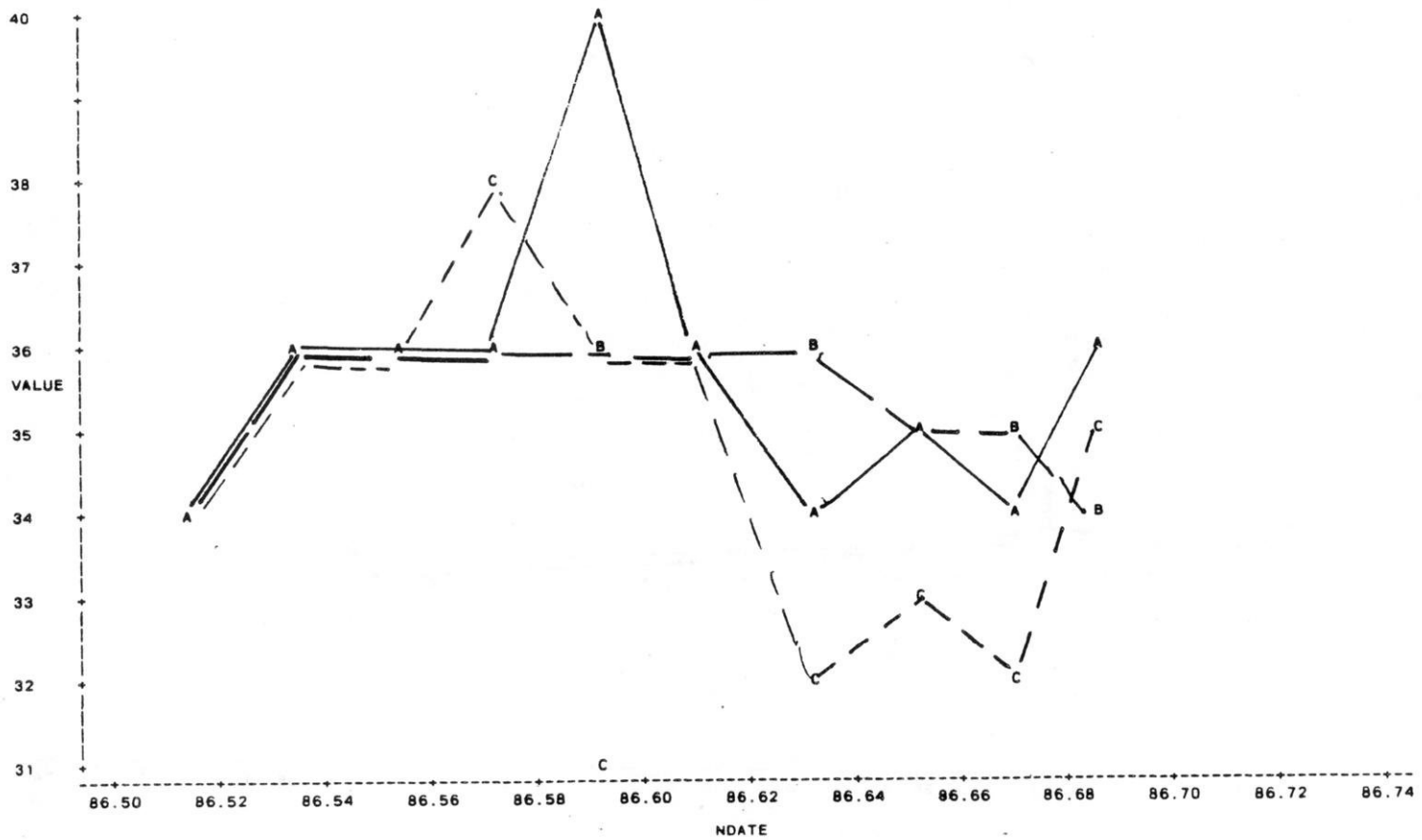
PLOT OF VALUE*NDATE SYMBOL IS VALUE OF WELL



OBS	POINT	COMNAME	PARAM	VALUE	YEAR	MONTH	DAY	NDATE	WELL
1	114	117	623-N KJELDAHL,DIS	34	86	7	7	86.514	A
2	114	117	623-N KJELDAHL,DIS	36	86	7	14	86.534	A
3	114	117	623-N KJELDAHL,DIS	36	86	7	21	86.553	A
4	114	117	623-N KJELDAHL,DIS	36	86	7	28	86.572	A
5	114	117	623-N KJELDAHL,DIS	40	86	8	4	86.591	A
6	114	117	623-N KJELDAHL,DIS	36	86	8	11	86.610	A
7	114	117	623-N KJELDAHL,DIS	34	86	8	19	86.632	A
8	114	117	623-N KJELDAHL,DIS	35	86	8	26	86.651	A
9	114	117	623-N KJELDAHL,DIS	34	86	9	2	86.670	A
10	114	117	623-N KJELDAHL,DIS	36	86	9	8	86.686	A
11	115	117B	623-N KJELDAHL,DIS	34	86	7	7	86.514	B
12	115	117B	623-N KJELDAHL,DIS	36	86	7	14	86.534	B
13	115	117B	623-N KJELDAHL,DIS	36	86	7	21	86.553	B
14	115	117B	623-N KJELDAHL,DIS	36	86	7	28	86.572	B
15	115	117B	623-N KJELDAHL,DIS	36	86	8	4	86.591	B
16	115	117B	623-N KJELDAHL,DIS	36	86	8	11	86.610	B
17	115	117B	623-N KJELDAHL,DIS	36	86	8	19	86.632	B
18	115	117B	623-N KJELDAHL,DIS	35	86	8	26	86.651	B
19	115	117B	623-N KJELDAHL,DIS	35	86	9	2	86.670	B
20	115	117B	623-N KJELDAHL,DIS	34	86	9	8	86.686	B
21	116	117A	623-N KJELDAHL,DIS	34	86	7	7	86.514	C
22	116	117A	623-N KJELDAHL,DIS	36	86	7	14	86.534	C
23	116	117A	623-N KJELDAHL,DIS	36	86	7	21	86.553	C
24	116	117A	623-N KJELDAHL,DIS	38	86	7	28	86.572	C
25	116	117A	623-N KJELDAHL,DIS	31	86	8	4	86.591	C
26	116	117A	623-N KJELDAHL,DIS	36	86	8	11	86.610	C
27	116	117A	623-N KJELDAHL,DIS	32	86	8	19	86.632	C
28	116	117A	623-N KJELDAHL,DIS	33	86	8	26	86.651	C
29	116	117A	623-N KJELDAHL,DIS	32	86	9	2	86.670	C
30	116	117A	623-N KJELDAHL,DIS	35	86	9	8	86.686	C

FILTERING PROJECT
GRAPH OF PARAMETER (MG/L) VERSUS TIME
DECEMBER 12, 1986 JOHN SCHWALBE

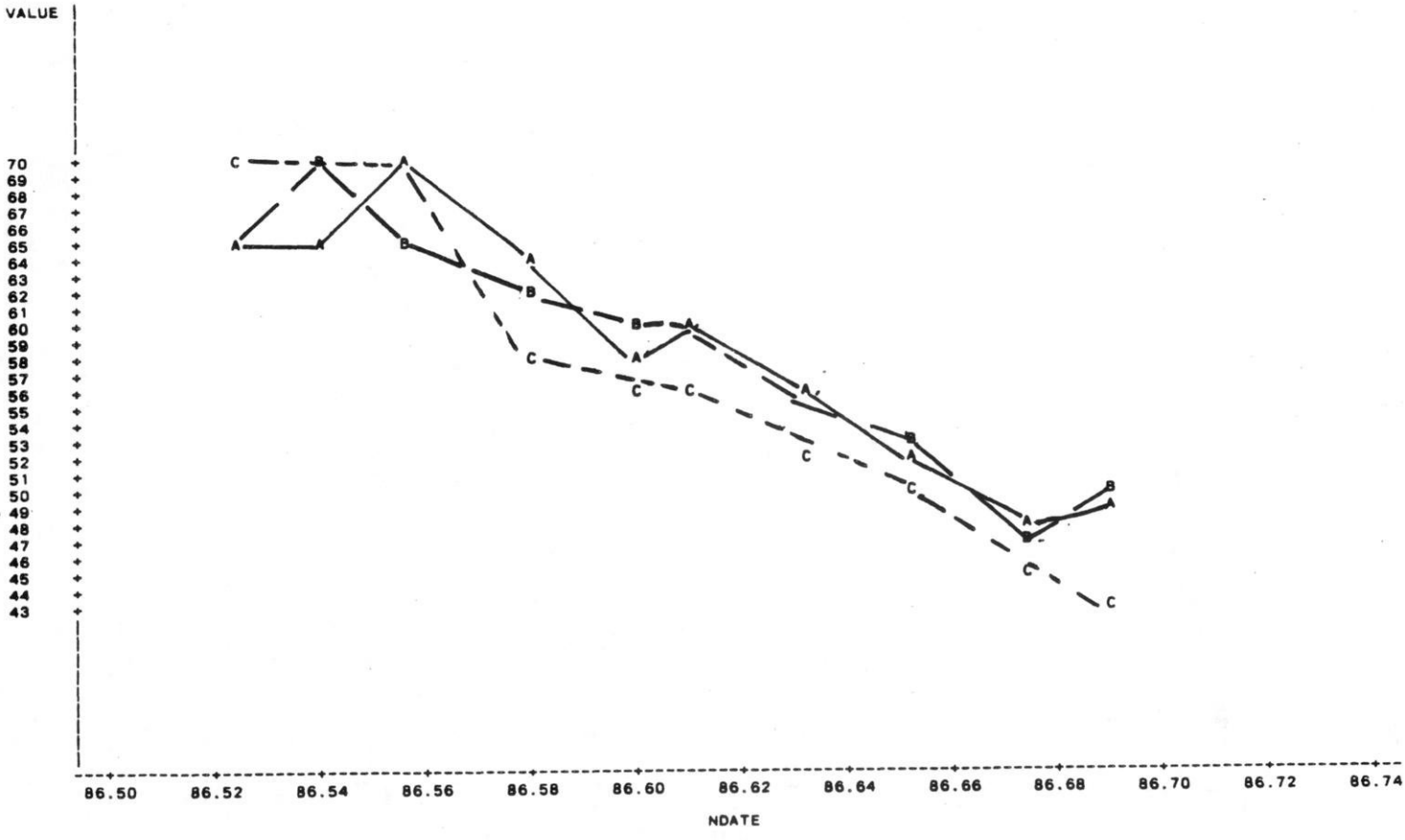
PLOT OF VALUE*NDATE SYMBOL IS VALUE OF WELL



OBS	POINT	COMNAME	PARAM	VALUE	YEAR	MONTH	DAY	NDATE	WELL
1	101	103	623-N KJELDAHL,DIS	65	86	7	10	86.523	A
2	101	103	623-N KJELDAHL,DIS	65	86	7	16	86.539	A
3	101	103	623-N KJELDAHL,DIS	70	86	7	22	86.555	A
4	101	103	623-N KJELDAHL,DIS	64	86	7	31	86.580	A
5	101	103	623-N KJELDAHL,DIS	58	86	8	7	86.599	A
6	101	103	623-N KJELDAHL,DIS	60	86	8	11	86.610	A
7	101	103	623-N KJELDAHL,DIS	56	86	8	19	86.632	A
8	101	103	623-N KJELDAHL,DIS	52	86	8	26	86.651	A
9	101	103	623-N KJELDAHL,DIS	48	86	9	3	86.673	A
10	101	103	623-N KJELDAHL,DIS	49	86	9	9	86.689	A
11	102	103B	623-N KJELDAHL,DIS	65	86	7	10	86.523	B
12	102	103B	623-N KJELDAHL,DIS	70	86	7	16	86.539	B
13	102	103B	623-N KJELDAHL,DIS	65	86	7	22	86.555	B
14	102	103B	623-N KJELDAHL,DIS	62	86	7	31	86.580	B
15	102	103B	623-N KJELDAHL,DIS	60	86	8	7	86.599	B
16	102	103B	623-N KJELDAHL,DIS	60	86	8	11	86.610	B
17	102	103B	623-N KJELDAHL,DIS	56	86	8	19	86.632	B
18	102	103B	623-N KJELDAHL,DIS	53	86	8	26	86.651	B
19	102	103B	623-N KJELDAHL,DIS	47	86	9	3	86.673	B
20	102	103B	623-N KJELDAHL,DIS	50	86	9	9	86.689	B
21	103	103A	623-N KJELDAHL,DIS	70	86	7	10	86.523	C
22	103	103A	623-N KJELDAHL,DIS	70	86	7	16	86.539	C
23	103	103A	623-N KJELDAHL,DIS	70	86	7	22	86.555	C
24	103	103A	623-N KJELDAHL,DIS	58	86	7	31	86.580	C
25	103	103A	623-N KJELDAHL,DIS	56	86	8	7	86.599	C
26	103	103A	623-N KJELDAHL,DIS	56	86	8	11	86.610	C
27	103	103A	623-N KJELDAHL,DIS	52	86	8	19	86.632	C
28	103	103A	623-N KJELDAHL,DIS	50	86	8	26	86.651	C
29	103	103A	623-N KJELDAHL,DIS	45	86	9	3	86.673	C
30	103	103A	623-N KJELDAHL,DIS	43	86	9	9	86.689	C

FILTERING PROJECT
GRAPH OF PARAMETER (MG/L) VERSUS TIME
DECEMBER 12, 1986 JOHN SCHWALBE

PLOT OF VALUE*NDATE SYMBOL IS VALUE OF WELL

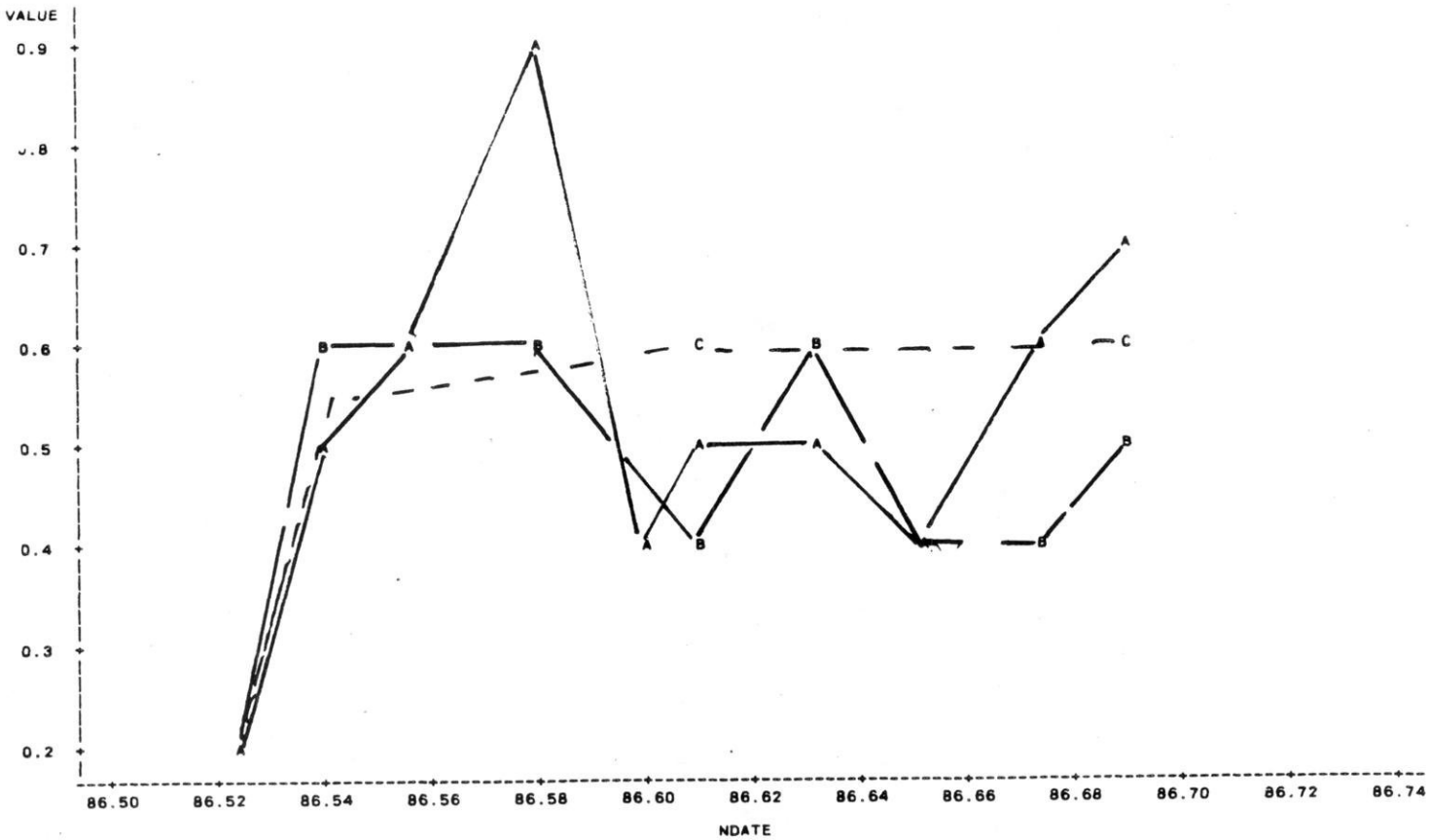


NOTE: 1 OBS HIDDEN

OBS	POINT	GUMNAME	PARAM	VALUE	YEAR	MONTH	DAY	NDATE	WELL
1	104	108	623-N KJELDAHL,DIS	0.2	86	7	10	86.523	A
2	104	108	623-N KJELDAHL,DIS	0.5	86	7	16	86.539	A
3	104	108	623-N KJELDAHL,DIS	0.6	86	7	22	86.555	A
4	104	108	623-N KJELDAHL,DIS	0.9	86	7	31	86.580	A
5	104	108	623-N KJELDAHL,DIS	0.4	86	8	7	86.599	A
6	104	108	623-N KJELDAHL,DIS	0.5	86	8	11	86.610	A
7	104	108	623-N KJELDAHL,DIS	0.5	86	8	19	86.632	A
8	104	108	623-N KJELDAHL,DIS	0.4	86	8	26	86.651	A
9	104	108	623-N KJELDAHL,DIS	0.6	86	9	3	86.673	A
10	104	108	623-N KJELDAHL,DIS	0.7	86	9	9	86.689	A
11	105	108B	623-N KJELDAHL,DIS	0.2	86	7	10	86.523	B
12	105	108B	623-N KJELDAHL,DIS	0.6	86	7	16	86.539	B
13	105	108B	623-N KJELDAHL,DIS	0.6	86	7	22	86.555	B
14	105	108B	623-N KJELDAHL,DIS	0.6	86	7	31	86.580	B
15	105	108B	623-N KJELDAHL,DIS	0.4	86	8	7	86.599	B
16	105	108B	623-N KJELDAHL,DIS	0.4	86	8	11	86.610	B
17	105	108B	623-N KJELDAHL,DIS	0.6	86	8	19	86.632	B
18	105	108B	623-N KJELDAHL,DIS	0.4	86	8	26	86.651	B
19	105	108B	623-N KJELDAHL,DIS	0.4	86	9	3	86.673	B
20	105	108B	623-N KJELDAHL,DIS	0.5	86	9	9	86.689	B
21	106	108A	623-N KJELDAHL,DIS	0.2	86	7	10	86.523	C
22	106	108A	623-N KJELDAHL,DIS	0.5	86	7	16	86.539	C
23	106	108A	623-N KJELDAHL,DIS	0.6	86	7	22	86.555	C
24	106	108A	623-N KJELDAHL,DIS	0.6	86	7	31	86.580	C
25	106	108A	623-N KJELDAHL,DIS	0.4	86	8	7	86.599	C
26	106	108A	623-N KJELDAHL,DIS	0.6	86	8	11	86.610	C
27	106	108A	623-N KJELDAHL,DIS	0.6	86	8	19	86.632	C
28	106	108A	623-N KJELDAHL,DIS	0.4	86	8	26	86.651	C
29	106	108A	623-N KJELDAHL,DIS	0.6	86	9	3	86.673	C
30	106	108A	623-N KJELDAHL,DIS	0.6	86	9	9	86.689	C

FILTERING PROJECT
GRAPH OF PARAMETER (MG/L) VERSUS TIME
DECEMBER 12, 1986 JOHN SCHWALBE

PLOT OF VALUE*NDATE SYMBOL IS VALUE OF WELL

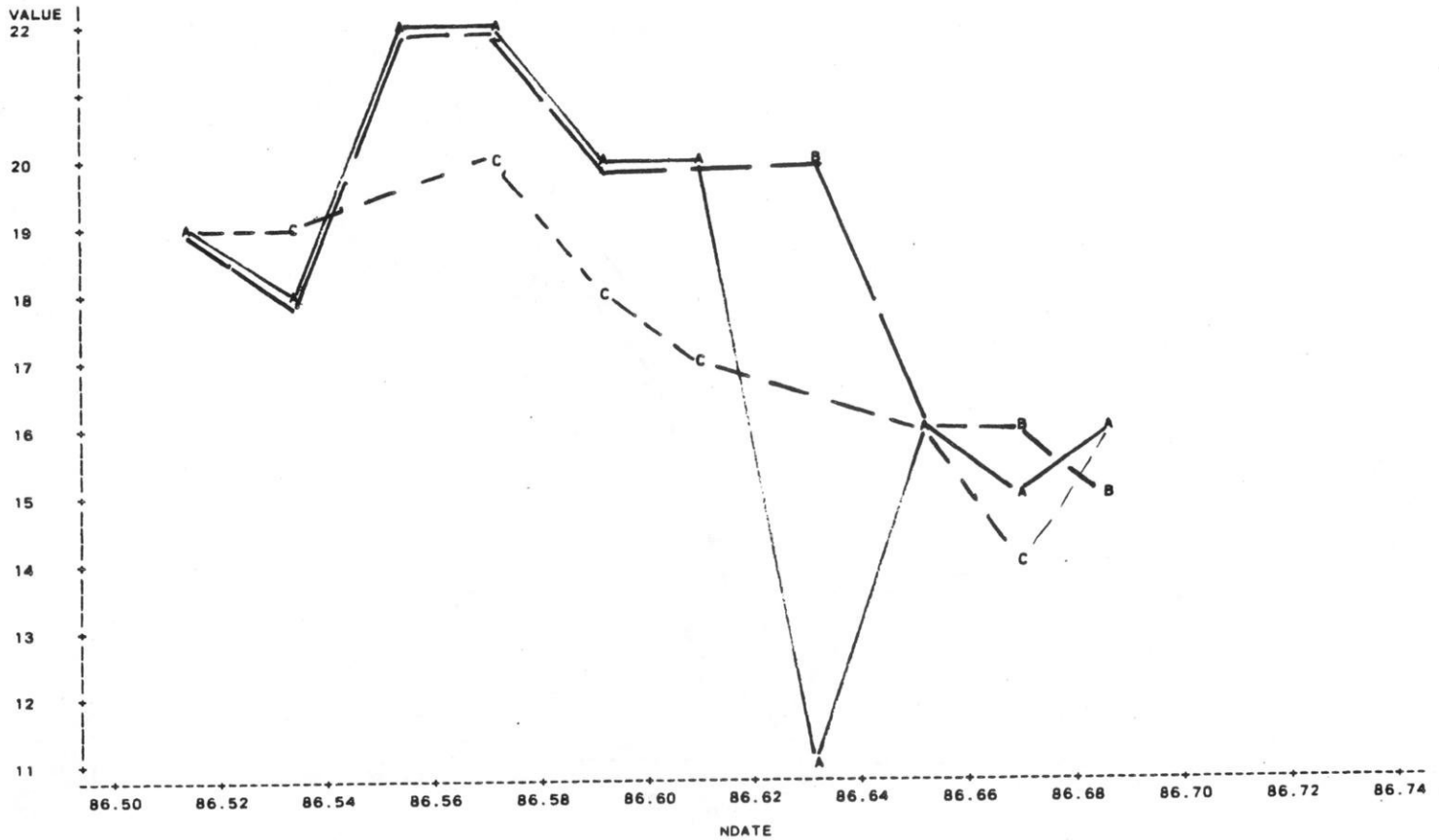


NOTE: 12 OBS HIDDEN

OBS	POINT	COMNAME	PARAM	VALUE	YEAR	MONTH	DAY	NDATE	WELL
1	111	110A	623-N KJELDAHL,DIS	19	86	7	7	86.514	A
2	111	110A	623-N KJELDAHL,DIS	18	86	7	14	86.534	A
3	111	110A	623-N KJELDAHL,DIS	22	86	7	21	86.553	A
4	111	110A	623-N KJELDAHL,DIS	22	86	7	28	86.572	A
5	111	110A	623-N KJELDAHL,DIS	20	86	8	4	86.591	A
6	111	110A	623-N KJELDAHL,DIS	20	86	8	11	86.610	A
7	111	110A	623-N KJELDAHL,DIS	11	86	8	19	86.632	A
8	111	110A	623-N KJELDAHL,DIS	16	86	8	26	86.651	A
9	111	110A	623-N KJELDAHL,DIS	15	86	9	2	86.670	A
10	111	110A	623-N KJELDAHL,DIS	16	86	9	8	86.686	A
11	112	110AB	623-N KJELDAHL,DIS	19	86	7	7	86.514	B
12	112	110AB	623-N KJELDAHL,DIS	18	86	7	14	86.534	B
13	112	110AB	623-N KJELDAHL,DIS	22	86	7	21	86.553	B
14	112	110AB	623-N KJELDAHL,DIS	22	86	7	28	86.572	B
15	112	110AB	623-N KJELDAHL,DIS	20	86	8	4	86.591	B
16	112	110AB	623-N KJELDAHL,DIS	20	86	8	11	86.610	B
17	112	110AB	623-N KJELDAHL,DIS	20	86	8	19	86.632	B
18	112	110AB	623-N KJELDAHL,DIS	16	86	8	26	86.651	B
19	112	110AB	623-N KJELDAHL,DIS	16	86	9	2	86.670	B
20	112	110AB	623-N KJELDAHL,DIS	15	86	9	8	86.686	B
21	113	110AA	623-N KJELDAHL,DIS	19	86	7	7	86.514	C
22	113	110AA	623-N KJELDAHL,DIS	19	86	7	14	86.534	C
23	113	110AA	623-N KJELDAHL,DIS	22	86	7	21	86.553	C
24	113	110AA	623-N KJELDAHL,DIS	20	86	7	28	86.572	C
25	113	110AA	623-N KJELDAHL,DIS	18	86	8	4	86.591	C
26	113	110AA	623-N KJELDAHL,DIS	17	86	8	11	86.610	C
27	113	110AA	623-N KJELDAHL,DIS	20	86	8	19	86.632	C
28	113	110AA	623-N KJELDAHL,DIS	16	86	8	26	86.651	C
29	113	110AA	623-N KJELDAHL,DIS	14	86	9	2	86.670	C
30	113	110AA	623-N KJELDAHL,DIS	15	86	9	8	86.686	C

FILTERING PROJECT
GRAPH OF PARAMETER (MG/L) VERSUS TIME
DECEMBER 12, 1986 JOHN SCHWALBE

PLOT OF VALUE*NDATE SYMBOL IS VALUE OF WELL

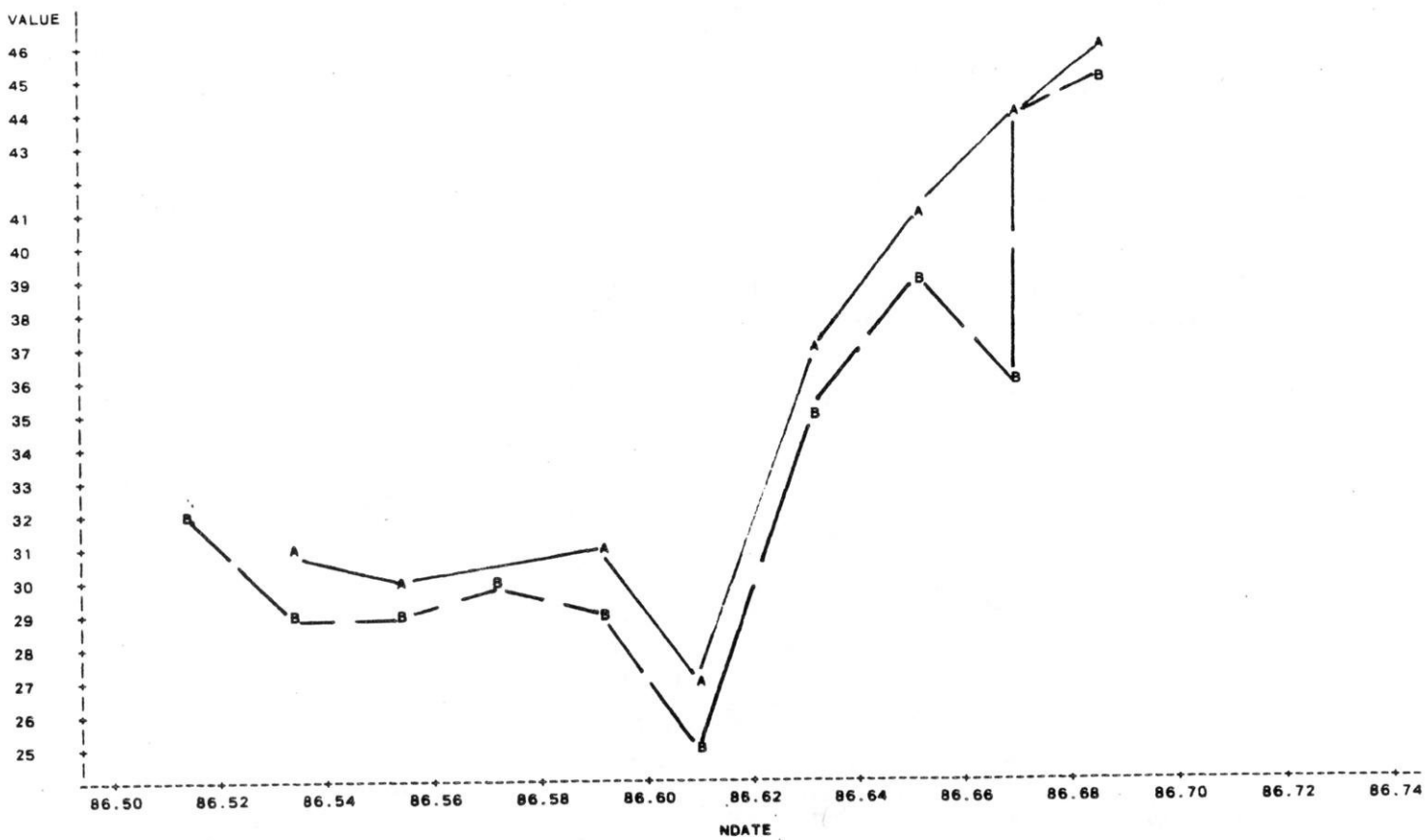


NOTE: 12 OBS HIDDEN

OBS	POINT	COMNAME	PARAM	VALUE	YEAR	MONTH	DAY	NDATE	WELL
1	114	117	341-COD,DIS	31	86	7	14	86.534	A
2	114	117	341-COD,DIS	30	86	7	21	86.553	A
3	114	117	341-COD,DIS	31	86	8	4	86.591	A
4	114	117	341-COD,DIS	27	86	8	11	86.610	A
5	114	117	341-COD,DIS	37	86	8	19	86.632	A
6	114	117	341-COD,DIS	41	86	8	26	86.651	A
7	114	117	341-COD,DIS	44	86	9	2	86.670	A
8	114	117	341-COD,DIS	46	86	9	8	86.686	A
9	115	117B	341-COD,DIS	32	86	7	7	86.514	B
10	115	117B	341-COD,DIS	29	86	7	14	86.534	B
11	115	117B	341-COD,DIS	29	86	7	21	86.553	B
12	115	117B	341-COD,DIS	30	86	7	28	86.572	B
13	115	117B	341-COD,DIS	29	86	8	4	86.591	B
14	115	117B	341-COD,DIS	25	86	8	11	86.610	B
15	115	117B	341-COD,DIS	35	86	8	19	86.632	B
16	115	117B	341-COD,DIS	39	86	8	26	86.651	B
17	115	117B	341-COD,DIS	36	86	9	2	86.670	B
18	115	117B	341-COD,DIS	45	86	9	8	86.686	B

FILTERING PROJECT
GRAPH OF PARAMETER (MG/L) VERSUS TIME
DECEMBER 12, 1986 JOHN SCHWALBE

PLOT OF VALUE*NDATE SYMBOL IS VALUE OF WELL

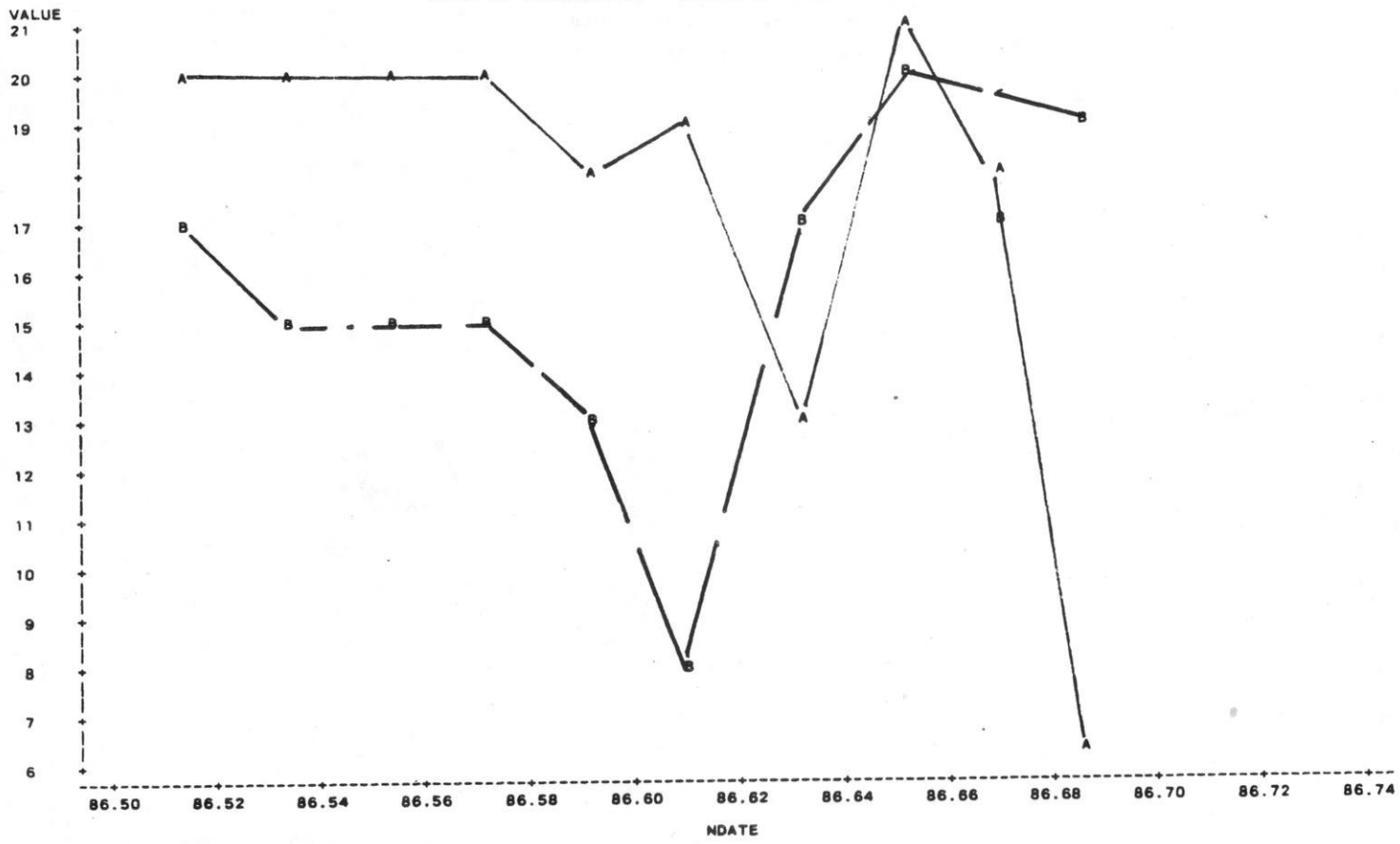


PARAMETER VALUES IN MG/L

OBS	POINT	COMNAME	PARAM	VALUE	YEAR	MONTH	DAY	NDATE	WELL
1	111	110A	341-COD,DIS	20.0	86	7	7	86.514	A
2	111	110A	341-COD,DIS	20.0	86	7	14	86.534	A
3	111	110A	341-COD,DIS	20.0	86	7	21	86.553	A
4	111	110A	341-COD,DIS	20.0	86	7	28	86.572	A
5	111	110A	341-COD,DIS	18.0	86	8	4	86.591	A
6	111	110A	341-COD,DIS	19.0	86	8	11	86.610	A
7	111	110A	341-COD,DIS	13.0	86	8	19	86.632	A
8	111	110A	341-COD,DIS	21.0	86	8	26	86.651	A
9	111	110A	341-COD,DIS	18.0	86	9	2	86.670	A
10	111	110A	341-COD,DIS	6.3	86	9	8	86.686	A
11	112	110AB	341-COD,DIS	17.0	86	7	7	86.514	B
12	112	110AB	341-COD,DIS	15.0	86	7	14	86.534	B
13	112	110AB	341-COD,DIS	15.0	86	7	21	86.553	B
14	112	110AB	341-COD,DIS	15.0	86	7	28	86.572	B
15	112	110AB	341-COD,DIS	13.0	86	8	4	86.591	B
16	112	110AB	341-COD,DIS	8.0	86	8	11	86.610	B
17	112	110AB	341-COD,DIS	17.0	86	8	19	86.632	B
18	112	110AB	341-COD,DIS	20.0	86	8	26	86.651	B
19	112	110AB	341-COD,DIS	17.0	86	9	2	86.670	B
20	112	110AB	341-COD,DIS	19.0	86	9	8	86.686	B

FILTERING PROJECT
GRAPH OF PARAMETER (MG/L) VERSUS TIME
DECEMBER 12, 1986 JOHN SCHWALBE

PLOT OF VALUE*NDATE SYMBOL IS VALUE OF WELL

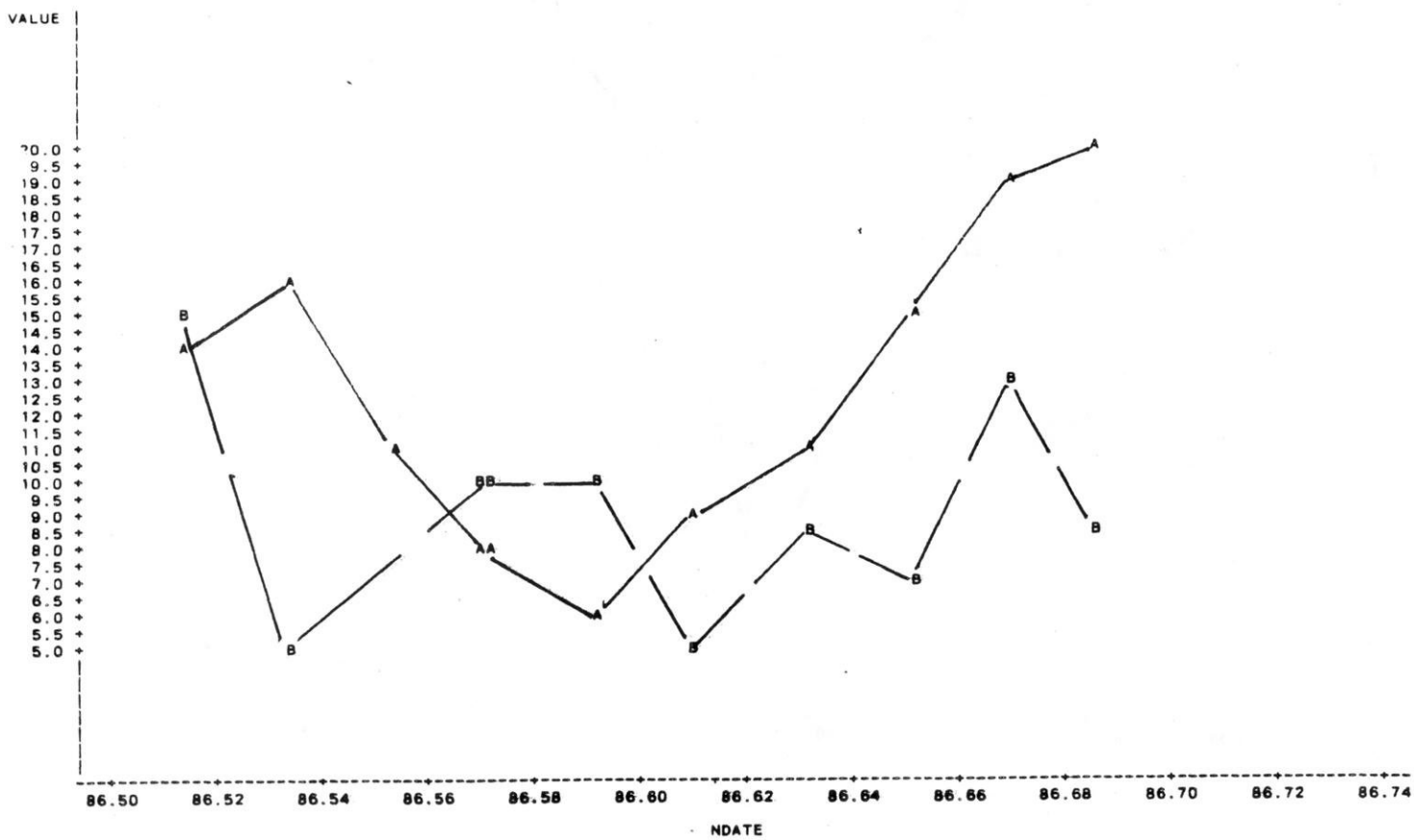


PARAMETER VALUES IN MG/L

OBS	POINT	COMNAME	PARAM	VALUE	YEAR	MONTH	DAY	NDATE	WELL
1	121	104	341-COD,DIS	14.0	86	7	7	86.514	A
2	121	104	341-COD,DIS	16.0	86	7	14	86.534	A
3	121	104	341-COD,DIS	11.0	86	7	21	86.553	A
4	121	104	341-COD,DIS	8.0	86	7	27	86.569	A
6	121	104	341-COD,DIS	6.0	86	8	4	86.591	A
7	121	104	341-COD,DIS	9.0	86	8	11	86.610	A
8	121	104	341-COD,DIS	11.0	86	8	19	86.632	A
9	121	104	341-COD,DIS	15.0	86	8	26	86.651	A
10	121	104	341-COD,DIS	19.0	86	9	2	86.670	A
11	121	104	341-COD,DIS	20.0	86	9	8	86.686	A
12	122	104B	341-COD,DIS	15.0	86	7	7	86.514	B
13	122	104B	341-COD,DIS	5.0	86	7	14	86.534	B
14	122	104B	341-COD,DIS	11.0	86	7	21	86.553	B
15	122	104B	341-COD,DIS	10.0	86	7	27	86.569	B
17	122	104B	341-COD,DIS	10.0	86	8	4	86.591	B
18	122	104B	341-COD,DIS	5.0	86	8	11	86.610	B
19	122	104B	341-COD,DIS	8.5	86	8	19	86.632	B
20	122	104B	341-COD,DIS	7.0	86	8	26	86.651	B
21	122	104B	341-COD,DIS	13.0	86	9	2	86.670	B
22	122	104B	341-COD,DIS	8.5	86	9	8	86.686	B

FILTERING PROJECT
GRAPH OF PARAMETER (MG/L) VERSUS TIME
DECEMBER 12, 1986 JOHN SCHWALBE

PLOT OF VALUE*NDATE SYMBOL IS VALUE OF WELL

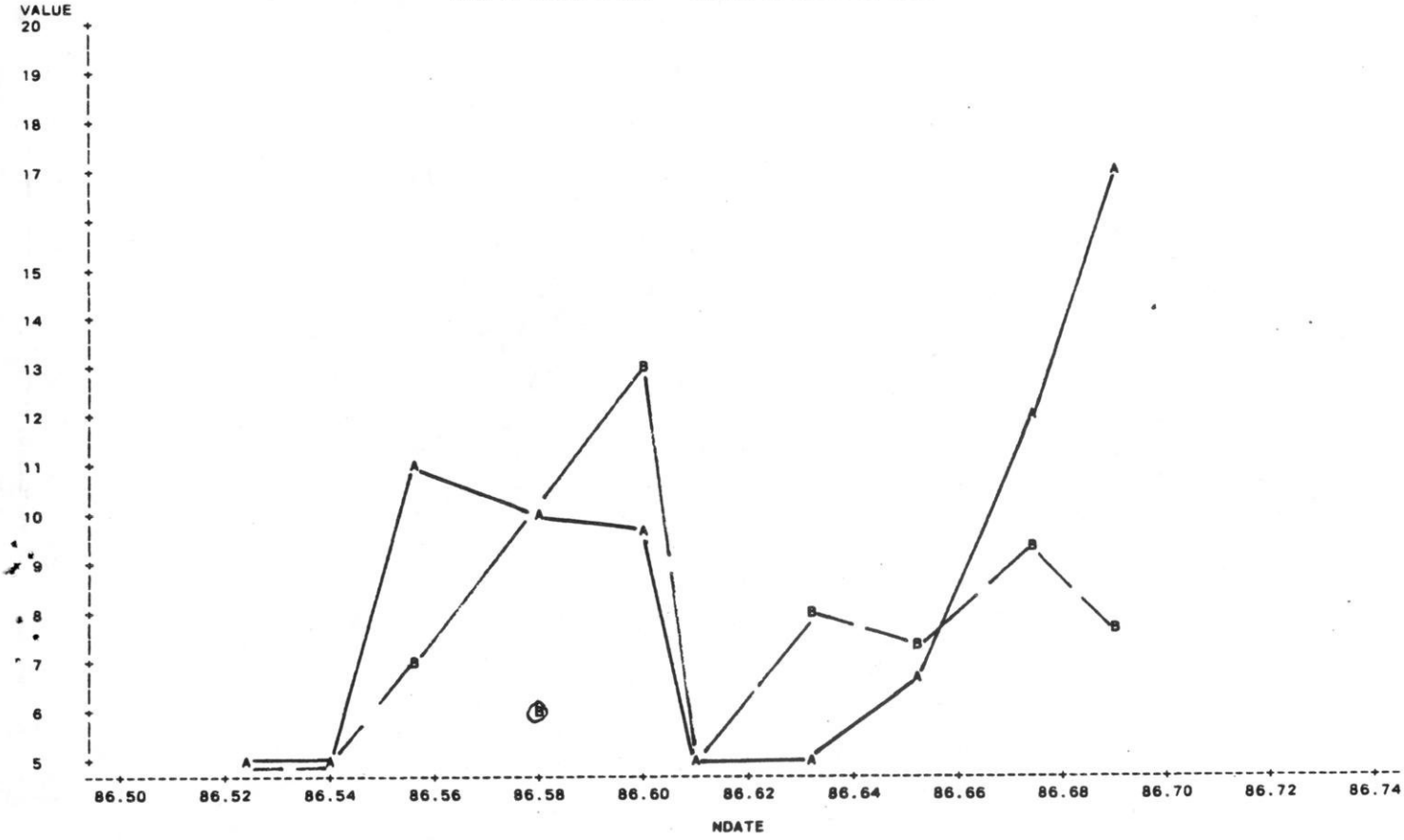


NOTE: 1 OBS HIDDEN

OBS	POINT	COMNAME	PARAM	VALUE	YEAR	MONTH	DAY	NDATE	WELL
1	104	108	341-COD,DIS	5.0	86	7	10	86.523	A
2	104	108	341-COD,DIS	5.0	86	7	16	86.539	A
3	104	108	341-COD,DIS	11.0	86	7	22	86.555	A
4	104	108	341-COD,DIS	10.0	86	7	31	86.580	A
5	104	108	341-COD,DIS	9.5	86	8	7	86.599	A
6	104	108	341-COD,DIS	5.0	86	8	11	86.610	A
7	104	108	341-COD,DIS	5.0	86	8	19	86.632	A
8	104	108	341-COD,DIS	6.5	86	8	26	86.651	A
9	104	108	341-COD,DIS	12.0	86	9	3	86.673	A
10	104	108	341-COD,DIS	17.0	86	9	9	86.689	A
11	105	108B	341-COD,DIS	5.0	86	7	10	86.523	B
12	105	108B	341-COD,DIS	5.0	86	7	16	86.539	B
13	105	108B	341-COD,DIS	7.0	86	7	22	86.555	B
14	105	108B	341-COD,DIS	6.0	86	7	31	86.580	B
15	105	108B	341-COD,DIS	13.0	86	8	7	86.599	B
16	105	108B	341-COD,DIS	5.0	86	8	11	86.610	B
17	105	108B	341-COD,DIS	8.0	86	8	19	86.632	B
18	105	108B	341-COD,DIS	7.3	86	8	26	86.651	B
19	105	108B	341-COD,DIS	9.4	86	9	3	86.673	B
20	105	108B	341-COD,DIS	7.6	86	9	9	86.689	B

FILTERING PROJECT
GRAPH OF PARAMETER (MG/L) VERSUS TIME
DECEMBER 12, 1986 JOHN SCHWALBE

PLOT OF VALUE*NDATE SYMBOL IS VALUE OF WELL

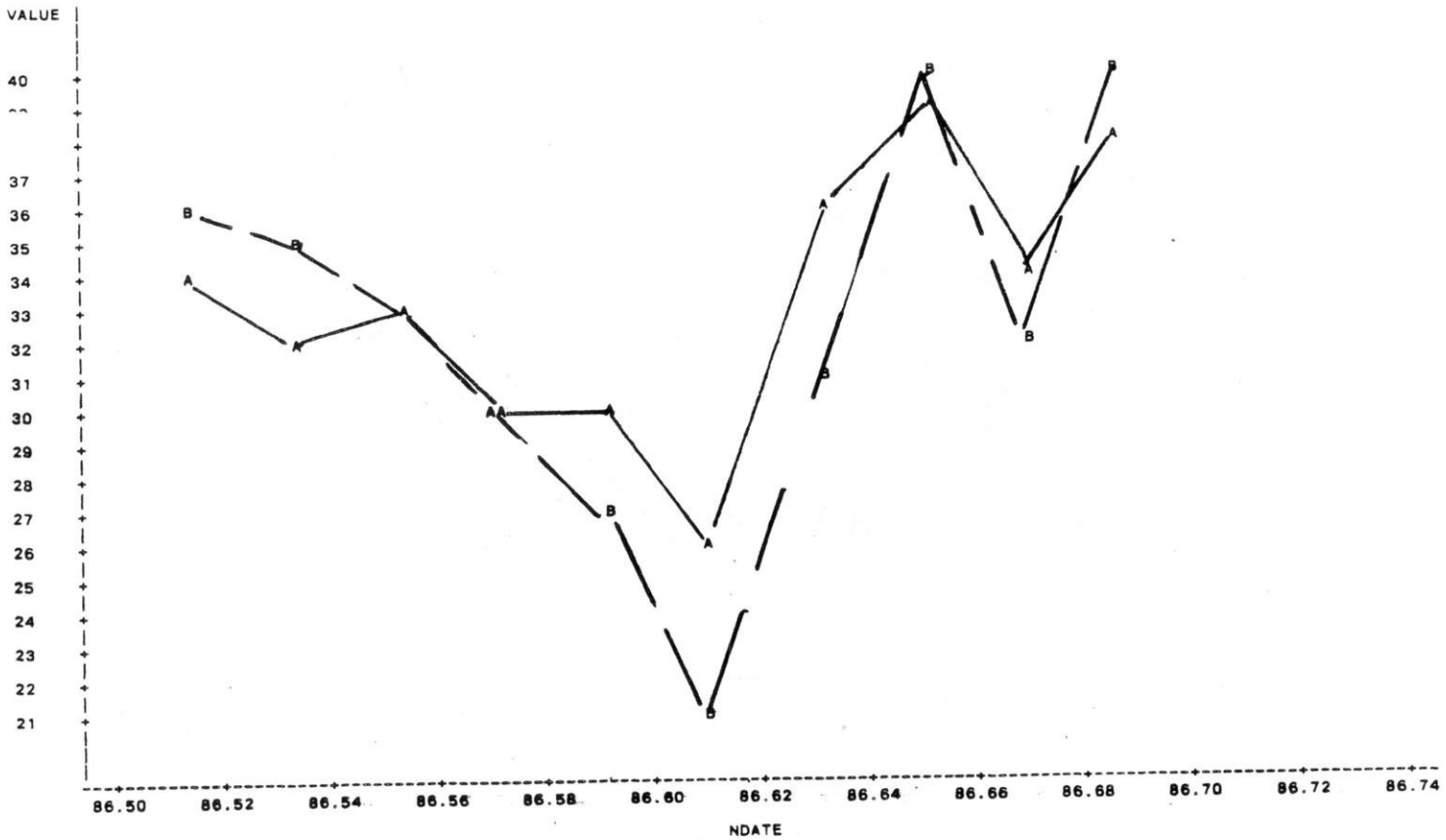


NOTE: 3 OBS HIDDEN

OBS	POINT	COMNAME	PARAM	VALUE	YEAR	MONTH	DAY	NDATE	WELL
1	124	109	341-COD,DIS	34	86	7	7	86.514	A
2	124	109	341-COD,DIS	32	86	7	14	86.534	A
3	124	109	341-COD,DIS	33	86	7	21	86.553	A
4	124	109	341-COD,DIS	30	86	7	27	86.569	A
6	124	109	341-COD,DIS	30	86	8	4	86.591	A
7	124	109	341-COD,DIS	26	86	8	11	86.610	A
8	124	109	341-COD,DIS	36	86	8	19	86.632	A
9	124	109	341-COD,DIS	39	86	8	26	86.651	A
10	124	109	341-COD,DIS	34	86	9	2	86.670	A
11	124	109	341-COD,DIS	38	86	9	8	86.686	A
12	125	109B	341-COD,DIS	36	86	7	7	86.514	B
13	125	109B	341-COD,DIS	35	86	7	14	86.534	B
14	125	109B	341-COD,DIS	33	86	7	21	86.553	B
15	125	109B	341-COD,DIS	30	86	7	27	86.569	B
17	125	109B	341-COD,DIS	27	86	8	4	86.591	B
18	125	109B	341-COD,DIS	21	86	8	11	86.610	B
19	125	109B	341-COD,DIS	31	86	8	19	86.632	B
20	125	109B	341-COD,DIS	40	86	8	26	86.651	B
21	125	109B	341-COD,DIS	32	86	9	2	86.670	B
22	125	109B	341-COD,DIS	40	86	9	8	86.686	B

FILTERING PROJECT
GRAPH OF PARAMETER (MG/L) VERSUS TIME
DECEMBER 12, 1986 JOHN SCHWALBE

PLOT OF VALUE*NDATE SYMBOL IS VALUE OF WELL

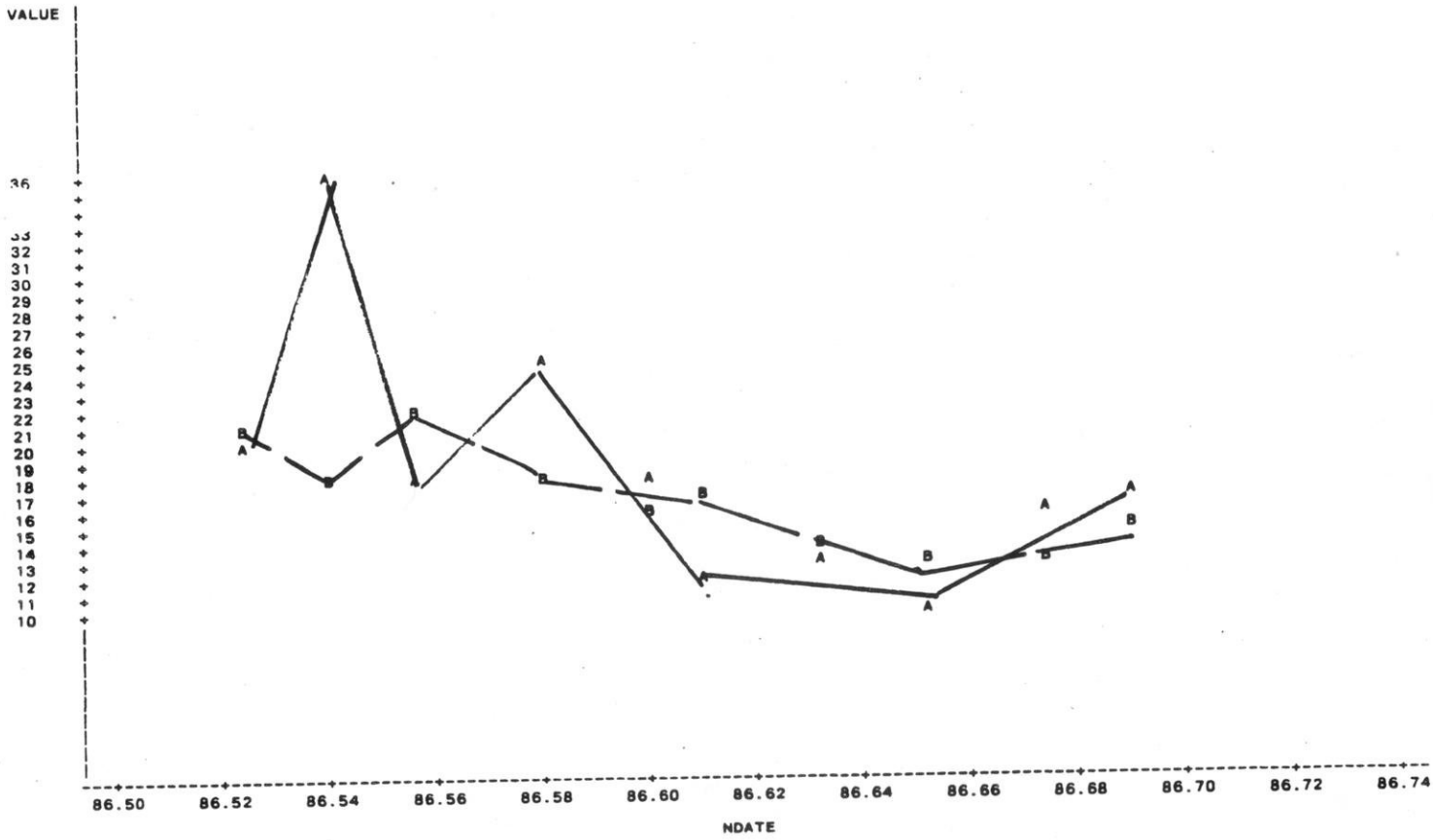


NOTE: 3 OBS HIDDEN

OBS	POINT	COMNAME	PARAM	VALUE	YEAR	MONTH	DAY	NDATE	WELL
1	101	103	341-COD,DIS	20	86	7	10	86.523	A
2	101	103	341-COD,DIS	36	86	7	16	86.539	A
3	101	103	341-COD,DIS	18	86	7	22	86.555	A
4	101	103	341-COD,DIS	25	86	7	31	86.580	A
5	101	103	341-COD,DIS	18	86	8	7	86.599	A
6	101	103	341-COD,DIS	12	86	8	11	86.610	A
7	101	103	341-COD,DIS	13	86	8	19	86.632	A
8	101	103	341-COD,DIS	10	86	8	26	86.651	A
9	101	103	341-COD,DIS	16	86	9	3	86.673	A
10	101	103	341-COD,DIS	17	86	9	9	86.689	A
11	102	103B	341-COD,DIS	21	86	7	10	86.523	B
12	102	103B	341-COD,DIS	18	86	7	16	86.539	B
13	102	103B	341-COD,DIS	22	86	7	22	86.555	B
14	102	103B	341-COD,DIS	18	86	7	31	86.580	B
15	102	103B	341-COD,DIS	16	86	8	7	86.599	B
16	102	103B	341-COD,DIS	17	86	8	11	86.610	B
17	102	103B	341-COD,DIS	14	86	8	19	86.632	B
18	102	103B	341-COD,DIS	13	86	8	26	86.651	B
19	102	103B	341-COD,DIS	13	86	9	3	86.673	B
20	102	103B	341-COD,DIS	15	86	9	9	86.689	B

FILTERING PROJECT
GRAPH OF PARAMETER (MG/L) VERSUS TIME
DECEMBER 12, 1986 JOHN SCHWALBE

PLOT OF VALUE*NDATE SYMBOL IS VALUE OF WELL



Appendix C

Quality Control Limits
State Lab of Hygiene

QUALITY CONTROL LIMITS

Quality Control (QC) limits define the precision and accuracy of all reported data. Routine systematic daily QC audits insure that the data being reported are valid within the defined limits.

Our laboratory uses modified Shewhart quality control charts to establish precision and accuracy control limits for most parameters. When insufficient data are available to define control limits using the Shewhart technique, reasonable fixed limits are arbitrarily assigned. Results are considered valid only if they fall within the defined control limits. If the control limits are exceeded, the data are considered invalid and are not reported.

1. Precision Control Limits

Precision is defined as the degree of mutual agreement among individual measurements made under defined conditions (USEPA, 1979). Precision limits are based upon the absolute difference (range) between duplicated analyses performed during a given period of time; generally a year. These limits are updated yearly, or when the test conditions change, and are summarized in the Quality Assurance (QA) Manual (Tables 2-1 and 2-3). Outliers or atypical data are edited from the data sets before generating the yearly summary.

Precision may be concentration and technique dependent. In some instances the control limits are established for a series of sequential concentration ranges. Some control limits may also be set at wider confidence levels if imprecision is inherent with the particular analytical technique. For example, automated tests are generally more precise than manual techniques and would tend to have tighter controls (i.e., 95% confidence level (CL) limits for automated, and 99% CL limits for manual).

Control limits are defined at an approximated CL appropriate to the particular parameter, technique and concentration range. The more precise techniques utilize control limits which approximate the 95% confidence level (95% CL limits) while the others rely on limits which approximate the 99% confidence level (99% CL limits). However, in some instances the control limits are repeatedly calculated using data sets edited to remove outliers. If repeatedly calculated, these limits will tighten considerably until they become unreasonable. For example, nitrate control limits, determined yearly for several years using edited data sets, provide reasonable limits at the 99% CL. However, 95% CL limits would be analytically unattainable. For this reason, the precision limits vary among parameters, and may not necessarily change after reviewing the yearly summaries. Limits are changed only when methods are modified, or when more data are available to better define the limits with a particular concentration range.

As a general rule, 99% CL limits are used for most parameters as the maximum upper acceptable limit for the absolute difference (range) between duplicate

analyses. The confidence levels are calculated using the Shewhart formula (USEPA, 1972); where the 95% CL and 99% CL correspond to the upper warning limit and upper control limit respectively.

The 99% CL limit is calculated according to the formula:

$$99\%\ CL = D_4\ R$$

where:

R = the average difference between duplicate analyses in a given concentration range.
D_4 = A constant (3.27 for duplicate analyses; USEPA, 1979)

Then 95% CL limit is calculated according to the formula:

$$95\%\ CL = 2/3\ (D_4R-R)+R$$

Modified Shewhart precision control charts are constructed for most parameters. The 95% CL, 99% CL, R, parameter, method, and date of preparation are indicated on each chart (Figure 2-1). The control limit is indicated on the chart by an asterick (*) on the appropriate CL line. The difference between duplicate analyses (R) are plotted on the charts daily. If R exceeds the precision limit, another set of duplicates will be analyzed. If subsequent R values exceed the precision limit, the analytical system or technique is considered out-of-control and the data invalid. Analyses will then be terminated until the problem is identified and corrected. Data collected during the out-of-control situation will be discarded, and, if possible, the analyses repeated.

If the daily R values plotted on the chart show trends in any direction, the problem will be investigated and corrected before the precision limits are exceeded.

When few data are available to adequately define limits for a particular concentration range, precision limits are arbitrarily set at a reasonable fixed percent difference consistent with the method. For example, total lead determined on solid material can range from 0.10-10 µg Pb/g. Fewer than 20 analyses may be performed yearly. Control limits determined on these few data, over such a wide concentration range, would not represent analytically fair limits. Thus, as a reasonable alternative for these parameters, a fixed percent difference is used until enough data are available to define the concentration range. Generally 25 sets of duplicate samples analyzed over a reasonable concentration range (size of range varies depending on the technique) will adequately define a precision limit.

When a fixed percentage limit (F%L) is used to define a precision control limit, the average percent difference (A%D) between a set of duplicate analyses cannot exceed the F%L.

Table 2-1

Precision Confidence Levels and Control Limits for Non-RCRA Samples[1]; Determined from Duplicate Analyses (Control Limit Designated By *)

Parameter	Method #	Concentration Range (mg/L)	95% Confidence Level (mg/L)	99% Confidence Level (mg/L)	Fixed Limit[2] (%)
Alkalinity	110.1	2-100	2. *	2.	
Alkalinity	110.1	100-500	2.	3. *	
Alkalinity	110.1	>500	-	-	15%*
Boron, Carmine Method	440.2	1.0-10	-	-	20%*
Boron, Curcumin Method	440.1	>0.1	-	-	20%*
Calcium, Titrat.	460.2	2-200	1.0*	1.0	
Calcium, Titrat.	460.3	>200	5.0	6.0*	
Chloride, Automated	140.2	0.1-10	0.1	0.2*	
Chloride, Automated	140.2	10-50	0.5	1.0*	
Chlorophyll a, uncorrected	150.1	2-25 µg/L	1. µg/L	2. µg/L*	
Chlorophyll a, uncorrected	150.1	26-100 µg/L	5. µg/L	7. µg/L*	
Sulfide, Titrimetric	375.1	>1	-	-	15%*
Sulfide, Methylene Blue	375.2	0.2-2.0	-	-	15%*
Sulfite, Titrimetric	376.1	>3	-	-	15%*
Residue, Susp.	340.1	2-10	4.	5. *	
Residue, Susp.	340.1	11-50	8.	10. *	
Residue, Susp.	340.1	50-200	19.	25. *	
Residue, Susp.	340.1	200-1000	43. *	55.	
Residue, Susp.	340.1	>1000			10%*
Residue, Susp., Volatile	350.1	>2	-	-	15%*
Residue, Total	330.1	10-100	12.	15. *	
Residue, Total	330.1	100-500	21.	28. *	
Residue, Total	330.1	500-1000	30.	38. *	
Residue, Total	330.1	>1000	-	-	10%*
Residue, Total, Dissolved	320.1	300-400	12-	15	
	320.1	400-1200	20	23 *	
Hardness	200.1	100-500	4.	5. *	
Hardness	200.1	>500	-	-	10%*
NH_3-N	220.1	0.02-1.00	0.01	0.02 *	
NH_3-N	220.1	0.2-10.	0.1	0.2 *	
Tot. Kjeldahl N	230.1	0.2-10.	0.3 *	0.3	
NO_2+NO_3-N	240.1	0.02-2.00	0.02 *	0.02	
NO_2+NO_3-N	240.1	0.2-20.	0.1	0.2 *	
NO_2+NO_3-N, SDWA	240.1	0.2-20.	0.2	0.3 *	
COD, LL, Color	280.2	5-25	4.	5. *	
COD, LL, Color	280.2	26-80	6.	8. *	
COD, ML, Color	270.2	80-1000	-	-	10%*
BOD_5	260.1	0-5	0.9	1.1 *	
BOD_5	260.1	6-10	1.2	1.6 *	
BOD_5	260.1	11-20	2. *	2.	
BOD_5	260.1	21-100	8.	11. *	
BOD_5	260.1	100-300	20.	26. *	
BOD_5	260.1	>300	-	-	15%*

050855- Filtration Preservation Study of Groundwater Samples