

APPENDIX 16 SAMPLE STATION 16

SUBSURFACE MONITORING ZONE - 110' FT.

BIG BERTHA ARTESIAN WELL

PA STATE GAME LANDS #95

PROJECT SL-110-7-101.5

MONITORING POINT 16

The discussion of this monitoring point will be divided into four (4) phases as outlined below:

1. General Conditions
2. Pre Closure Analysis
3. Post Closure Analysis
4. Summary of Analysis

1. General Conditions

The data and associated graphical materials relevant to and utilized in describing the relationships at this monitoring location are outlined below:

- Sheet 7 - Relationship of Geophysical Parameters
 - Sheet 8 - Geologic Cross Sections
 - Sheet 23 - Relationship of Hydrologic Parameters
 - Appendix 16 - Subsurface Monitoring Zone
- Narrative exhibits contained on the following pages.

This monitoring point is 110' below the surface of the artesian well (Big Bertha), as shown on Sheets 7 and 8.

The flow relationships of the artesian well at this monitoring zone are given below:

- a. Velocity - the average velocity of water at this monitoring zone was 2.74 ft/min upward.
- b. Cumulative Quantity - the cumulative quantity of water contributed by this flow system was 7.2 gal/min
- c. Flow System Quantity - the average quantity of water contributed by this flow system was 4.4 gal/min. (.01 c.f.s)

This monitoring point is representative of conditions in flow system B4. This sample represents conditions at the base of this flow system where mixing is incomplete between lower zones and this zone.

2. Pre Closure Analysis (Monitoring Point 16)

The reviewer is directed to refer to the following materials during the discussion of the chemical analyses and trends at this monitoring-point:

- a. Sheet 23 - which shows the sample data plotted using a time reference basis.
- b. The corresponding graphs (on the 6 pages immediately following the pre closure analysis) which show the data, the regression mean line, and the field of variance.
- c. Appendix 16 - which contains the raw sample data during pre closure which was utilized to develop the means, ranges, and regression analysis results.

1. pH Relationship

The pH at this monitoring point varied from 6.32 - 6.43 the mean value being 6.37. A strong relationship exists.

2. Specific Conductance Relationship

The specific conductance at this monitoring point varied from 1250-1350. the mean value calculated as 1294.

3. Acidity/Alkalinity Balance (mg/l)

The alkalinity varied from 81 – 131 ; the mean value was 117. Regression analysis of the alkalinity values showed: A weak relationship exists where alkalinity concentration increases as conductance increases. The acidity varied from 00 - 00; the mean value was N.A. Regression analysis of the sulphate values showed: No relationship is possible as no acidity was measured.

4. Sulphate Relationship (mg/l)

The sulphates varied from 302 - 466 ; the mean value was 403. Regression analysis of the sulphate values showed: A moderate relationship exists where sulphate concentrations increase as conductance increases.

5. Total Iron Relationship (mg/l)

The total iron varied from 29 - 41 ; the mean value was 36. Regression analysis of the ferrous iron values showed: A strong relationship exists where total iron concentration decreases as conductance increases.

6. Ferrous Iron Relationship (mg/l)

The ferrous iron varied from 28 – 40 ; the mean value was 34. Regression analysis of the ferrous iron values showed: A strong relationship exists where ferrous iron concentration decreases as conductance increases

7. Ferric Iron Relationship (mg/l)

The ferric iron varied from 0.1 - 5.5; the mean value was 2. Regression analysis of the ferric iron values showed: A very weak relationship exists where ferric iron concentration decreases as conductance increases.

3. Post Closure Analysis

The reviewer is referred to sheet 23 which shows the post-closure data plotted using a time reference basis with pre-closure data for comparative purposes.

Specific conductance values increased dramatically as a result of closure, but rapidly returned to pre closure values.

pH was slightly depressed as a result of closure but recovered rapidly after the well was opened.

The zone was alkaline prior to closure and post closure analysis indicates a reduction in the alkalinity concentrations. While no acidity was present prior to closure, a significant concentration occurred after closure but quickly dissipated, with values returning to pre closure levels (non acidic conditions).

A significant increase in sulphate concentration occurred as a result of closure, but quickly returned to pre closure levels after the well was opened.

Total iron concentrations dramatically increased during closure, but rapidly returned to pre closure concentrations after the well was opened.

Ferrous iron concentrations dramatically increased during closure also, and subsequently rapidly returned to preclosure values after the well was opened.

A very slight increase in ferric iron concentration occurred following closure.

4. Summary of Monitoring Point 16 Analysis

Closure allowed a free mixing of the flow systems between the lower zones and the upper zones (with higher permeabilities, higher recharge capacities and poorer quality). The upper zones dominated the lower zones and caused a depression in the water quality of the lower zones.

This zone was affected by upper zones during closure but rapidly returned to pre closure values. This indicates a short-term or local effect due to closure.

SAMPLE 16

PROJECT SL110-7-101.5:BIG BERTHA

DATE	SPEC COND UMHO5/CH	DISCHARGE C.F.S.	PH SU	ALKALINITY MG/L	ACIDITY MG/L	SULPHATES MG/L	TOTAL IRON MG/L	FERROUS IRON MG/L	FERRIC IRON MG/L	REC #
021783	1300	.02	6.32	127	00	466	35.5	30.0	5.5	1
022883	1300	.02	6.37	131	00	389	35.0	32.0	3.0	2
030793	1300	.02	6.38	117	00	432	29.6	28.0	1.6	3
031483	1350	.02	6.43	131	00	460	32.4	31.4	1.0	4
040793	1250	.02	6.34	120	00	434	40.0	36.0	4.0	5
041383	1300	.02	6.39	130	00	357	37.5	35.0	2.5	6
042083	1250	.02	6.36	95	00	302	41.6	40.8	.8	7
042683	1300	.02	6.38	81	00	382	36.1	36.0	.1	8

SAMPLE.SIXTEEN

SPECIFIC CONDUCTANCE VS. PH

COEFFICIENT MATRIX AND AUGMENTED MATRIX

	1035	1035	50.9700
		1339750	65947.5000
REGRESSION COEFFICIENTS OF NORMAL EQUATION	5.460000000000		
	0.000704347826		

ORIGINAL X - Y PAIRS		PREDICTED VALUES	DEVIATION
1300.0000	6.3200	6.3757	0.0557
1300.0000	6.3700	6.3757	0.0057
1300.0000	6.3800	6.3757	0.0043
1350.0000	6.4300	6.4109	0.0191
1250.0000	6.3400	6.3404	0.0004
1300.0000	6.3900	6.3757	0.0143
1250.0000	6.3600	6.3404	0.0196
1300.0000	6.3800	6.3757	0.0043

STATISTICAL ANALYSIS WITH ORDER OF EQUATION= 1
 NUMBER OF X - Y PAIRS= 8
 TOTAL SUMS OF SQUARE= 7.6875E-3
 SUMS OF SQUARES DUE TO REGRESSION= 3.565761E-3
 SUMS OF SQUARES DUE TO DEVIATION= 4.121739E-3
 GOODNESS OF FIT= .463839
 MULTIPLE CORRELATION COEFFICIENT 0.68106
 STANDARD DEVIATION .024266

SOURCE OF VARIATION	ANALYSIS OF VARIANCE SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE
LIN. REGRESSION	.00	1	.00
DEVIATION	.00	6	.00
TOTAL VARIATION	.01	7	

F-TEST FOR EQUALITY OF SAMPLE/REGRESSION VARIANCE
 F TEST - SIGNIFICANCE OF REGRESSION = 5.19
 LEVEL .05% - CRITICAL VALUE = 5.99

SAMPLE.SIXTEEN

SPECIFIC CONDUCTANCE VS. ALKALINITY

COEFFICIENT MATRIX AND AUGMENTED MATRIX

		1035	932.0000
	1035	1339750	1207400.0000
REGRESSION COEFFICIENTS OF NORMAL EQUATION			
-	176.000000000000		
	0.226086956522		

ORIGINAL X - Y PAIRS	PREDICTED VALUES	DEVIATION
1300.0000 127.0000	117.9130	9.0870
1300.0000 131.0000	117.9130	13.0870
1300.0000 117.0000	117.9130	0.9130
1350.0000 131.0000	129.2174	1.7826
1250.0000 120.0000	106.6087	13.3913
1300.0000 130.0000	117.9130	12.0870
1250.0000 95.0000	106.6087	11.6087
1300.0000 81.0000	117.9130	36.9130

STATISTICAL ANALYSIS WITH ORDER OF EQUATION= 1

NUMBER OF X - Y PAIRS= 8

TOTAL SUMS OF SQUARE= 2448

SUMS OF SQUARES DUE TO REGRESSION= 367.391004

SUMS OF SQUARES DUE TO DEVIATION= 2080.608596

GOODNESS OF FIT= .150078

MULTIPLE CORRELATION COEFFICIENT 0.38740

STANDARD DEVIATION 17.240354

ANALYSIS OF VARIANCE			
SOURCE OF VARIATION	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE
LIN. REGRESSION	367.39	1	367.39
DEVIATION	2080.61	6	346.77
TOTAL VARIATION	2448.00	7	

F-TEST FOR EQUALITY OF SAMPLE/REGRESSION VARIANCE

F TEST - SIGNIFICANCE OF REGRESSION = 1.06

LEVEL .05% - CRITICAL VALUE = 5.99

SAMPLE.SIXTEEN

SPECIFIC CONDUCTANCE VS. TOTAL IRON

COEFFICIENT MATRIX AND AUGMENTED MATRIX

REGRESSION COEFFICIENTS OF NORMAL EQUATION

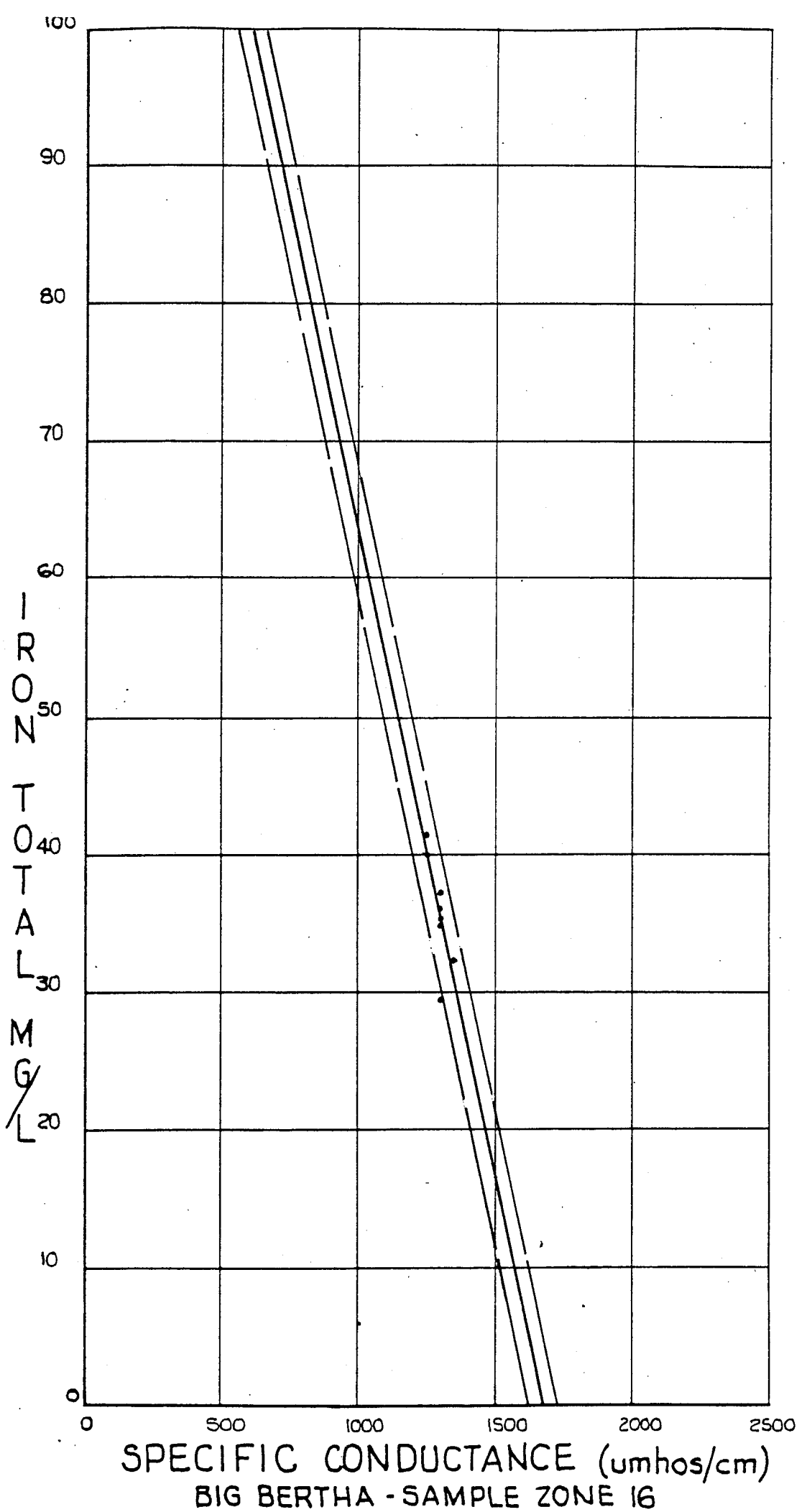
	1035	1035	287.7000
		1339750	371550.0000
	155.1000000000005		
-	0.092086956522		

ORIGINAL X - Y PAIRS		PREDICTED VALUES	DEVIATION
1300.0000	35.5000	35.3870	0.1130
1300.0000	35.0000	35.3870	0.3870
1300.0000	29.6000	35.3870	5.7870
1350.0000	32.4000	30.7826	1.6174
1250.0000	40.0000	39.9913	0.0087
1300.0000	37.5000	35.3870	2.1130
1250.0000	41.6000	39.9913	1.6087
1300.0000	36.1000	35.3870	0.7130

STATISTICAL ANALYSIS WITH ORDER OF EQUATION= 1
NUMBER OF X - Y PAIRS= 8
TOTAL SUMS OF SQUARE= 104.77875
SUMS OF SQUARES DUE TO REGRESSION= 60.950054
SUMS OF SQUARES DUE TO DEVIATION= 43.828696
GOODNESS OF FIT= .581702
MULTIPLE CORRELATION COEFFICIENT 0.76269
STANDARD DEVIATION 2.502247

SOURCE OF VARIATION	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE
LIN. REGRESSION	60.95	1	60.95
DEVIATION	43.83	6	7.30
TOTAL VARIATION	104.78	7	

F-TEST FOR EQUALITY OF SAMPLE/REGRESSION VARIANCE
F TEST - SIGNIFICANCE OF REGRESSION = 8.34
LEVEL .05% - CRITICAL VALUE = 5.99



SAMPLE SIXTEEN

SPECIFIC CONDUCTANCE VS. FERROUS IRON

COEFFICIENT MATRIX AND AUGMENTED MATRIX

REGRESSION COEFFICIENTS OF NORMAL EQUATION

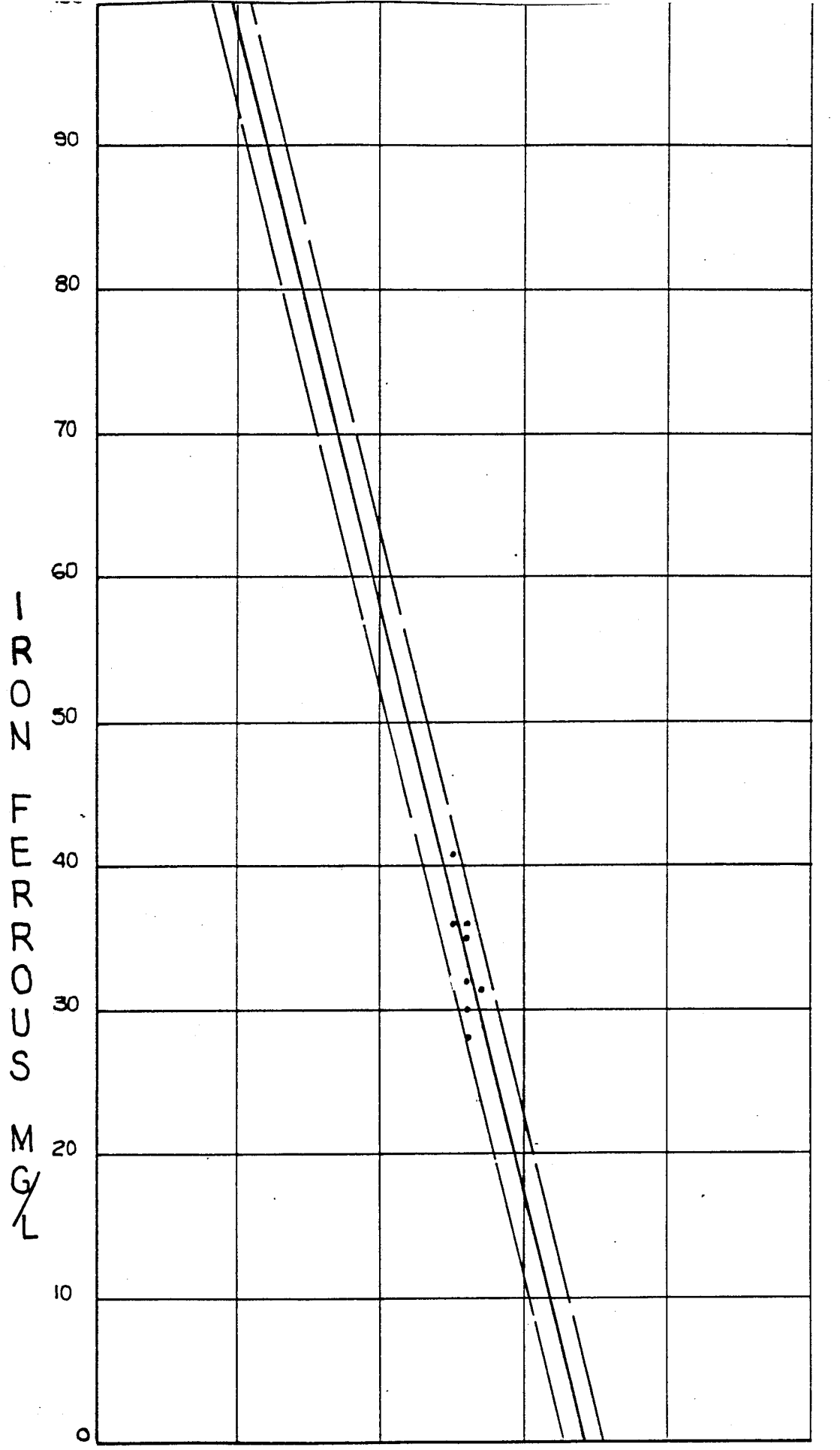
	1035	1035	269.2000
	139.400000000000	1339750	347690.0000
	0.081739130435		

ORIGINAL X - Y PAIRS		PREDICTED VALUES	DEVIATION
1300.0000	30.0000	33.1391	3.1391
1300.0000	32.0000	33.1391	1.1391
1300.0000	28.0000	33.1391	5.1391
1350.0000	31.4000	29.0522	2.3478
1250.0000	34.0000	37.2261	1.2261
1300.0000	35.0000	33.1391	1.8609
1250.0000	40.8000	37.2261	3.5739
1300.0000	36.0000	33.1391	2.8609

STATISTICAL ANALYSIS WITH ORDER OF EQUATION= 1
NUMBER OF X - Y PAIRS= 8
TOTAL SUMS OF SQUARE= 117.02
SUMS OF SQUARES DUE TO REGRESSION= 48.021739
SUMS OF SQUARES DUE TO DEVIATION= 68.998261
GOODNESS OF FIT= .410372
MULTIPLE CORRELATION COEFFICIENT 0.64060
STANDARD DEVIATION 3.139569

SOURCE OF VARIATION	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE
LIN. REGRESSION	48.02	1	48.02
DEVIATION	69.00	6	11.50
TOTAL VARIATION	117.02	7	

F-TEST FOR EQUALITY OF SAMPLE/REGRESSION VARIANCE
F TEST - SIGNIFICANCE OF REGRESSION = 4.18
LEVEL .05% - CRITICAL VALUE = 5.99



BIG BERTHA - SAMPLE ZONE 16

SAMPLE.SIXTEEN

SPECIFIC CONDUCTANCE VS. FERRIC IRON

COEFFICIENT MATRIX AND AUGMENTED MATRIX

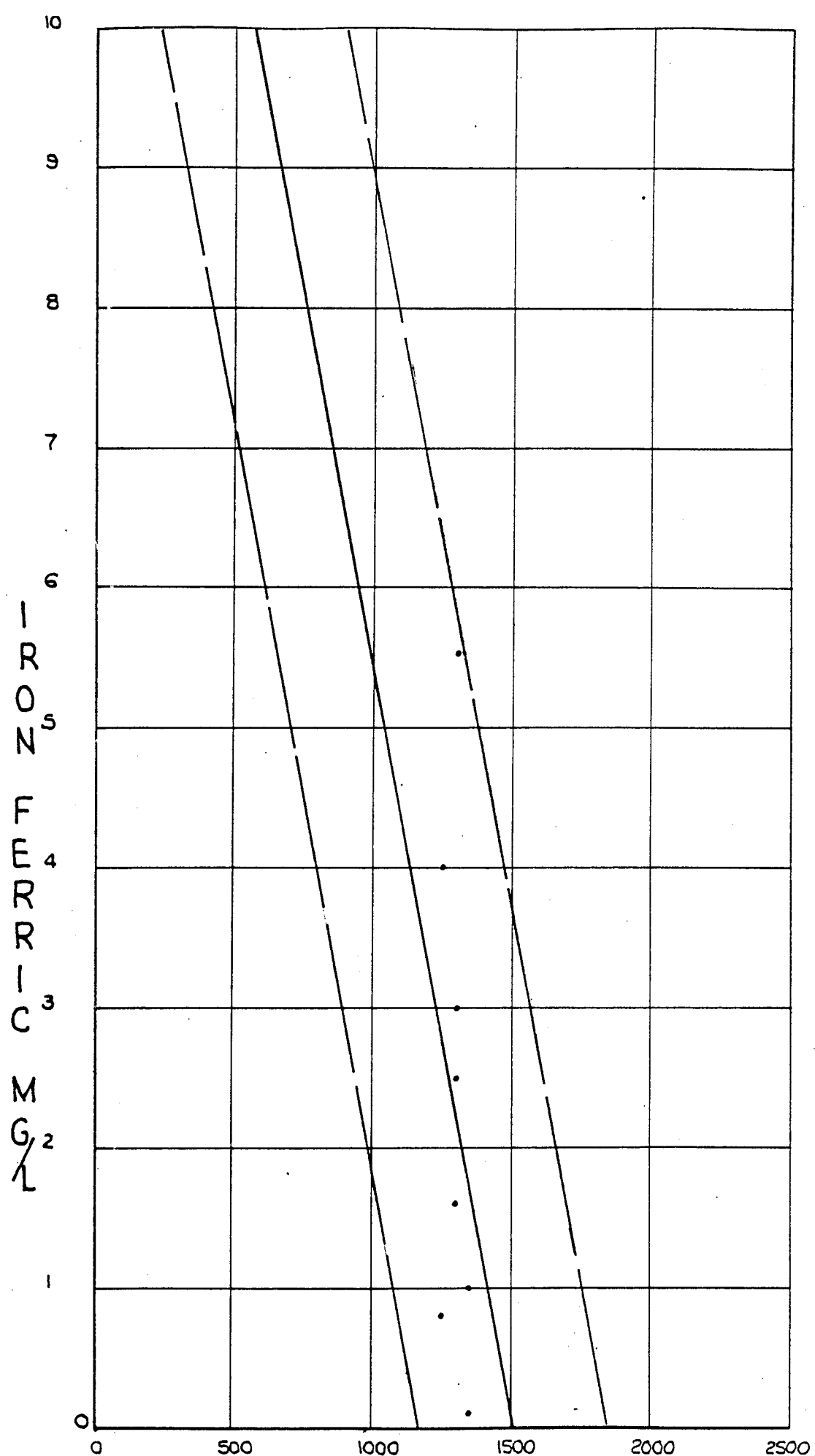
		1035	18.5000
	1035	1339750	23860.0000
REGRESSION COEFFICIENTS OF NORMAL EQUATION	15.6999999999999		
-	0.010347826087		

ORIGINAL X - Y PAIRS		PREDICTED VALUES	DEVIATION
1300.0000	5.5000	2.2478	3.2522
1300.0000	3.0000	2.2478	0.7522
1300.0000	1.6000	2.2478	0.6478
1350.0000	1.0000	1.7304	0.7304
1250.0000	4.0000	2.7652	1.2348
1300.0000	2.5000	2.2478	0.2522
1250.0000	0.8000	2.7652	1.9652
1300.0000	0.1000	2.2478	2.1478

STATISTICAL ANALYSIS WITH ORDER OF EQUATION= 1
 NUMBER OF X - Y PAIRS= 8
 TOTAL SUMS OF SQUARE= 22.92875
 SUMS OF SQUARES DUE TO REGRESSION= .76962
 SUMS OF SQUARES DUE TO DEVIATION= 22.15913
 GOODNESS OF FIT= .033566
 MULTIPLE CORRELATION COEFFICIENT 0.18321
 STANDARD DEVIATION 1.779211

SOURCE OF VARIATION	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE
LIN. REGRESSION	.77	1	.77
DEVIATION	22.16	6	3.69
TOTAL VARIATION	22.93	7	

F-TEST FOR EQUALITY OF SAMPLE/REGRESSION VARIANCE
 F TEST - SIGNIFICANCE OF REGRESSION = 0.21
 LEVEL .05% - CRITICAL VALUE = 5.99



SPECIFIC CONDUCTANCE (umhos/cm)
BIG BERTHA - SAMPLE ZONE 16

POST CLOSURE DATA LISTING *

SAMPLE SIXTEEN

DATE	SPEC. COND.	DISCHARGE	pH	ALKALINITY	ACIDITY	SULPHATES	TOTAL IRON	FERROUS IRON	FERRIC IRON
6/12	2100	.023	5.56	21	336	1498	190.0	185.0	5.0
6.16	1700	.023	5.60	26	103	705	87.0	76.6	10.4
6/21	1400	.023	5.89	39	70	712	70.0	64.8	5.2
6/29	1300	.023	5.96	35	5	605	48.7	41.8	6.9
7/10	1500	.023	6.01	51	7	542	57.9	55.4	2.5
8/6	1400	.023	6.20	50	0	502	43.0	30.8	12.2
8/21	1200	.023	6.18	49	3	566	45.8	43.0	2.8

* Units are as follows:

- specific conductance - umhos/cm
- discharge - C.f.s.
- pH - Standard units
- all others - mg/L