APPENDIX 18

SAMPLE STATION 18

SUBSURFACE MONITORING ZONE - 165' FT.

BIG BERTHA ARTESIAN WELL

PA STATE GAME LANDS #95

PROJECT SL-110-7-101.5

MONITORING POINT 18

MONITORING POINT 18

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 21- Relationship of Hydrologic Parameters
Appendix 17 - Subsurface Monitoring Zone

Narrative exhibits contained on the following pages.

This monitoring point is 165’ 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. (.01c.f.s.)

This monitoring point is representative of conditions in flow system B5. The sample zone is the base sample for this flow system representing unmixed conditions.

2. Pre Closure Analysis (Monitoring Point 18)

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 1 - which shows the sample data plotted using a tine 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 18 - 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 6.31- 6.53 the mean value being 6.40. A strong relationship exists.

2. Specific Conductance Relationship
The specific conductance at this monitoring point varied front 1600-2000; the mean value calculated as 1758

3. Acidity/Alkalinity Balance (mg/l)
The alkalinity varied from 117 - 198 ; the mean value was 146. Regression analysis of the alkalinity values showed: A strong relationship exists where alkalinity concentrations increased as conductance increased. 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 440 - 543; the mean value was 509. Regression analysis of the sulphate values showed: A moderate relationship exists where sulphate concentrations decrease as conductance increases.

5.Total Iron Relationship (mg/l)
The total, iron varied from 57- 65; the mean value was 60 Regression analysis of the ferrous iron values showed: A moderate relationship exists where total iron concentrations increase as conductance increases.

6. Ferrous Iron Relationship (mg/l)
The ferrous iron varied from 55 - 65 ; the mean value was 58. Regression analysis of the ferrous iron values showed: A weak relationship exists where ferrous iron concentrations increase as conductance increases.

7.Ferric Iron Relationship (mg/l)
The ferric iron varied from 0.l - 3.5 ; the mean value was 2. Regression analysis of the ferric iron values showed: A moderate relationship exists where ferric iron concentrations increase as conductance increases.

3. Post Closure Analysis

The reviewer is referred to sheet 21 which shows the post-closure data plotted using a time reference basis with pre-closure data for comparative purposes.

Closure increased the specific conductance, however the conductance fluctuated after the well was opened. This is attributed to effects of the lower zone mixing.

pH was only slightly depressed as a result of closure, and recovered very rapidly after the well was opened.

The zone was alkaline prior to closure, and closure caused a reduction in the concentration of alkalinity. Acidity was never present prior to closure, yet a short term presence of acidity was observed in the initial post closure sampling but this quickly dissipated and the zone returned to effective "non acidic" conditions

There was a slight increase in sulphate concentration which quickly returned to pre closure levels.

There was a dramatic increase in total iron concentration following closure; however, this also returned quickly to pre closure levels.

There was a similar dramatic increase in ferrous iron concentration following closure; however, the ferrous iron values also quickly returned to pre closure levels.

Ferric iron showed little or no response to closure effects.

4. Summary of Monitoring Point 18 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 conditions similar to pre closure values. This indicates a short terra or local effect of closure.

SAMPLE 18 PROJECT SL110-7-101.5:BIG BERTHA

DATE	SPEC COND UMHOS/CM	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 #
022883	1800	.02	6.44	167	00	533	65.6	65.2	.4	1
030783	1650	.02	6.31	123	00	523	57.0	55.0	2.0	2
031483	1650	.02	6.43	164	00	543	60.1	60.0	.1	3
033183	1600	.02	6.37	125	00	536	55.4	55.1	.3	4
041383	2000	.02	6.53	198	00	500	59.0	57.0	2.0	5
042083	1750	.02	6.36	117	00	440	61.0	57.5	3.5	6
042683	1850	.02	6.35	126	00	487	61.5	58.5	3.0	7

SAMPLE.EIGHTEEN SPECIFIC CONDUCTANCE VS. PH

COEFFICIENT MATRIX AND AUGMENTED MATRIX

	1230	44.7900
1230	2173000	78742.5000

REGRESSION COEFFICIENTS OF NORMAL EQUATION

5.797500000000
0.000342073171

ORIGINAL X	Y PAIRS	PREDICTED VALUES	DEVIATION
1800.0000	6.4400	6.4132	0.0268
1650.0000	6.3100	6.3619	0.0519
1650.0000	6.4300	6.3619	0.0681
1600.0000	6.3700	6.3448	0.0252
2000.0000	6.5300	6.4816	0.0484
1750.0000	6.3600	6.3961	0.0361
1850.0000	6.3500	6.4303	0.0803

STATISTICAL ANALYSIS WITH ORDER OF EQUATION= 1
NUMBER OF X - Y PAIRS= 7
TOTAL SUMS OF SQUARE= .032486
SUMS OF SQUARES DUE TO REGRESSION= .013707
SUMS OF SQUARES DUE TO DEVIATION= .018778
GOODNESS OF FIT= .42195
MULTIPLE CORRELATION COEFFICIENT 0.64956
STANDARD DEVIATION .055944

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE
LIN. REGRESSION	.01	1	.01
DEVIATION	.02	5	.00
TOTAL VARIATION	.03	6	

F-TEST FOR EQUALITY OF SAMPLE/REGRESSION VARIANCE
F TEST - SIGNIFICANCE OF REGRESSION = 3.65
LEVEL .05% - CRITICAL VALUE = 6.61

SAMPLE.EIGHTEEN SPECIFIC CONDUCTANCE VS. ALKALINITY

COEFFICIENT MATRIX AND AUGMENTED MATRIX

		1230	1020.0000
	1230	2173000	1808000.0000

REGRESSION COEFFICIENTS OF NORMAL EQUATION

-	90.000000000001
	0.134146341463

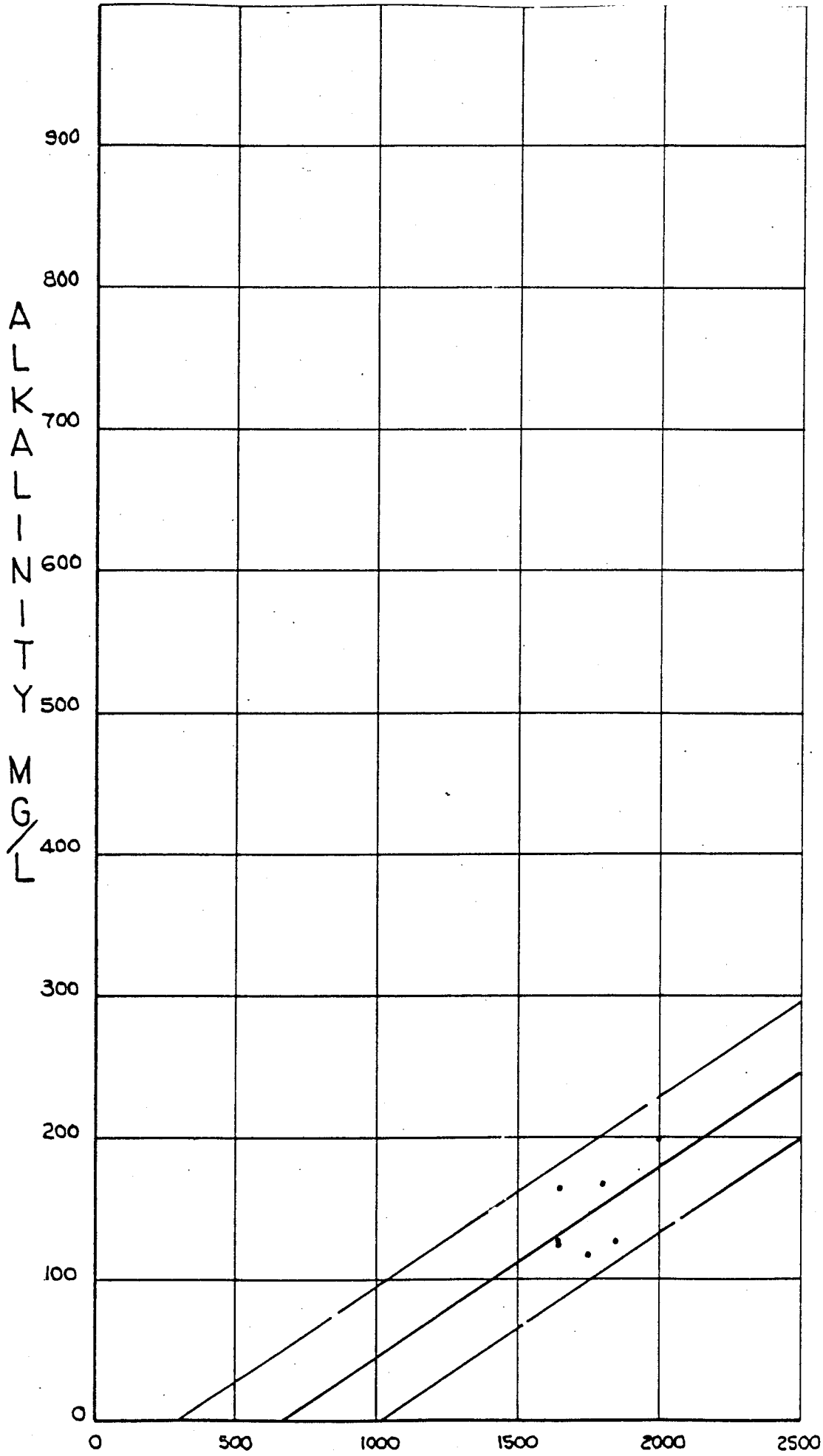
ORIGINAL X - Y PAIRS		PREDICTED VALUES	DEVIATION
1800.0000	167.0000	151.4634	15.5366
1650.0000	123.0000	131.3415	8.3415
1650.0000	164.0000	131.3415	32.6585
1600.0000	125.0000	124.6341	0.3659
2000.0000	198.0000	178.2927	19.7073
1750.0000	117.0000	144.7561	27.7561
1850.0000	126.0000	158.1707	32.1707

STATISTICAL ANALYSIS WITH ORDER OF EQUATION= 1
NUMBER OF X - Y PAIRS= 7
TOTAL SUMS OF SQUARE= 5679.428571
SUMS OF SQUARES DUE TO REGRESSION= 2108.013937
SUMS OF SQUARES DUE TO DEVIATION= 3571.414634
GOODNESS OF FIT= .371167
MULTIPLE CORRELATION COEFFICIENT 0.60923
STANDARD DEVIATION 24.397454

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE
LIN. REGRESSION	2108.01	1	2108.01
DEVIATION	3571.41	5	714.28
TOTAL VARIATION	5679.43	6	

F-TEST FOR EQUALITY OF SAMPLE/REGRESSION VARIANCE
F TEST - SIGNIFICANCE OF REGRESSION = 2.95
LEVEL .05% - CRITICAL VALUE = 6.61


ALKALINITY MG/L
900
800
700
600
500
400
300
200
100
0
0
500
1000
1500
2000
2500
SPECIFIC CONDUCTANCE (umhos/cm)
BIG BERTHA - SAMPLE ZONE 18

SAMPLE.EIGHTEEN SPECIFIC CONDUCTANCE VS. ACIDITY

COEFFICIENT MATRIX AND AUGMENTED MATRIX

	1230	0.0000
1230	2173000	0.0000

REGRESSION COEFFICIENTS OF NORMAL EQUATION

0.000000000000
0.000000000000

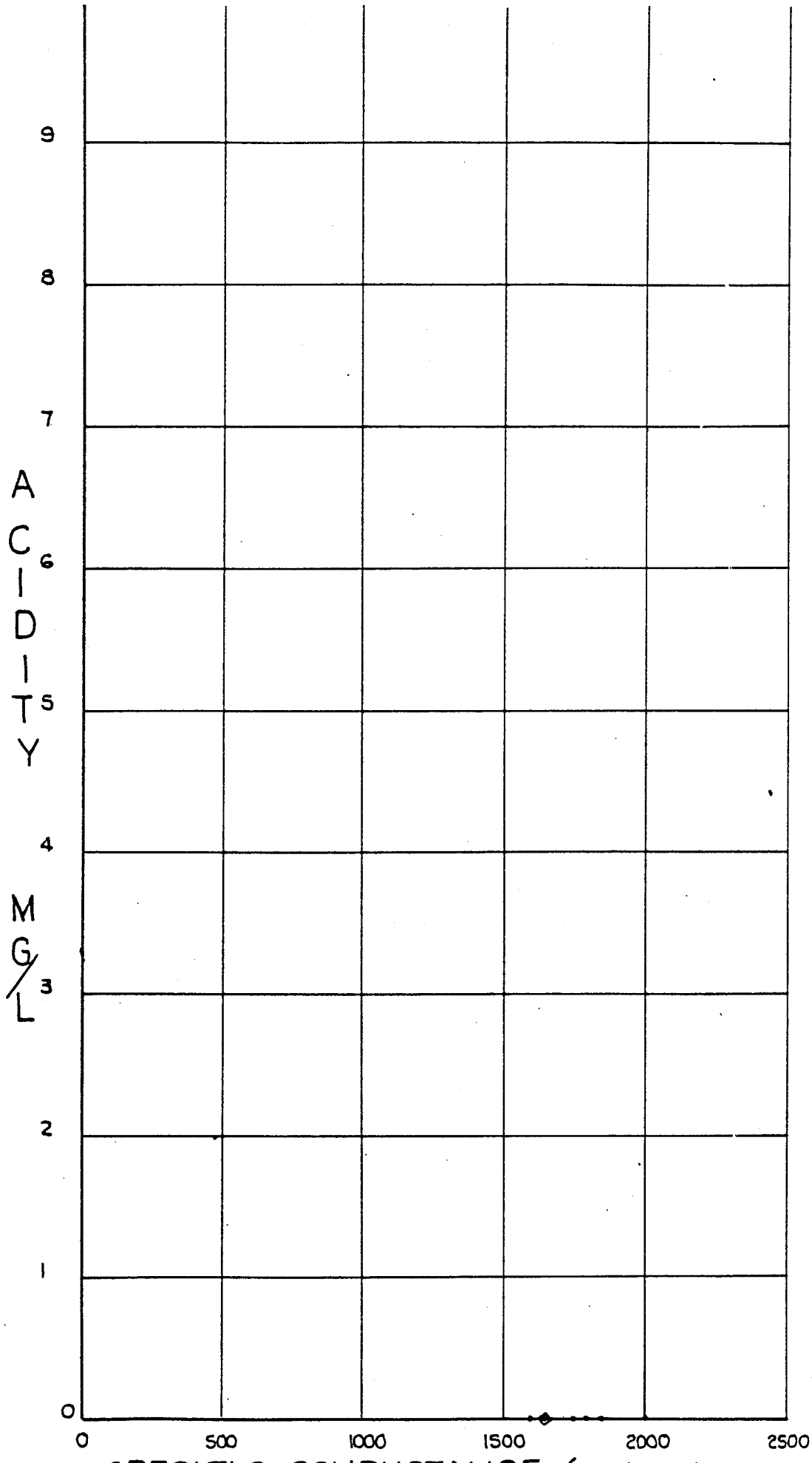
ORIGINAL X - Y PAIRS		PREDICTED VALUES	DEVIATION
1800.0000	0.0000	0.0000	0.0000
1650.0000	0.0000	0.0000	0.0000
1650.0000	0.0000	0.0000	0.0000
1600.0000	0.0000	0.0000	0.0000
2000.0000	0.0000	0.0000	0.0000
1750.0000	0.0000	0.0000	0.0000
1850.0000	0.0000	0.0000	0.0000

STATISTICAL ANALYSIS WITH ORDER OF EQUATION= 1
NUMBER OF X - Y PAIRS= 7
TOTAL SUMS OF SQUARE= 0
SUMS OF SQUARES DUE TO REGRESSION= 0
SUMS OF SQUARES DUE TO DEVIATION= 0
GOODNESS OF FIT= 0
MULTIPLE CORRELATION COEFFICIENT 0.00000
STANDARD DEVIATION 0

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE
LIN. REGRESSION	.00	1	.00
DEVIATION	.00	5	.00
TOTAL VARIATION	.00	6	

F-TEST FOR EQUALITY OF SAMPLE/REGRESSION VARIANCE
F TEST - SIGNIFICANCE OF REGRESSION = 0.00
LEVEL .05% - CRITICAL VALUE = 6.61



BIG BERTHA - SAMPLE ZONE 18

SAMPLE.EIGHTEEN SPECIFIC CONDUCTANCE VS. SULPHATES

COEFFICIENT MATRIX AND AUGMENTED MATRIX

	1230	3562.0000
1230	2173000	6246850.0000

REGRESSION COEFFICIENTS OF NORMAL EQUATION

690.249999999993

- 0.103231707317

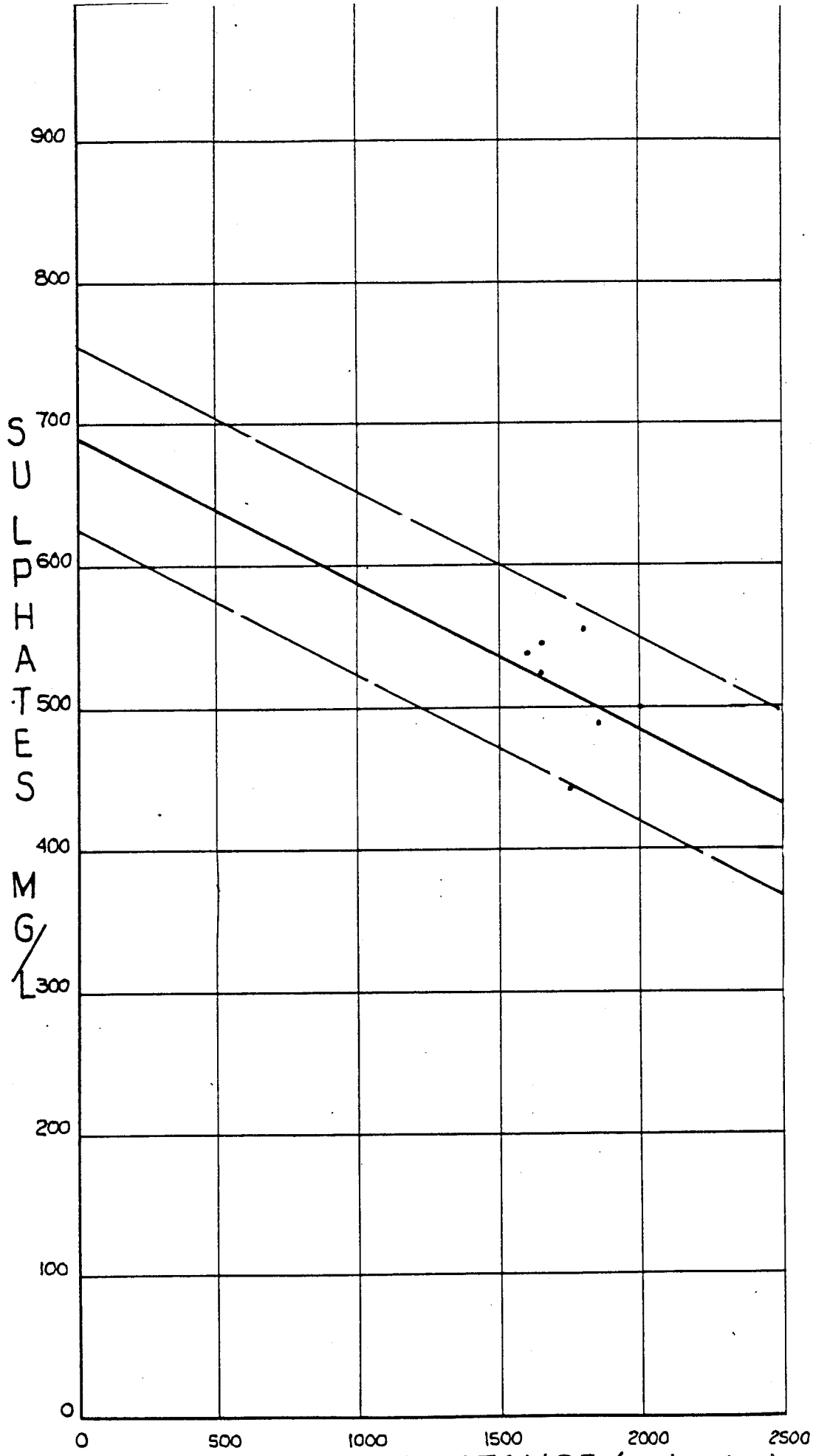
ORIGINAL X - Y PAIRS		PREDICTED VALUES	DEVIATION
1800.0000	533.0000	504.4329	28.5671
1650.0000	523.0000	519.9177	3.0823
1650.0000	543.0000	519.9177	23.0823
1600.0000	536.0000	525.0793	10.9207
2000.0000	500.0000	483.7866	16.2134
1750.0000	440.0000	509.5945	69.5945
1850.0000	487.0000	499.2713	12.2713

STATISTICAL ANALYSIS WITH ORDER OF EQUATION= 1
NUMBER OF X - Y PAIRS= 7
TOTAL SUMS OF SQUARE= 7982.857143
SUMS OF SQUARES DUE TO REGRESSION= 1248.366289
SUMS OF SQUARES DUE TO DEVIATION= 6734.490854
GOODNESS OF FIT= .156381
MULTIPLE CORRELATION COEFFICIENT 0.39545
STANDARD DEVIATION 33.502465

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE
LIN. REGRESSION	1248.37	1	1248.37
DEVIATION	6734.49	5	1346.90
TOTAL VARIATION	7982.86	6	

F-TEST FOR EQUALITY OF SAMPLE/REGRESSION VARIANCE
F TEST - SIGNIFICANCE OF REGRESSION = 0.93
LEVEL .05% - CRITICAL VALUE = 6.61



BIG BERTHA - SAMPLE ZONE 18

SAMPLE.EIGHTEEN SPECIFIC CONDUCTANCE VS. TOTAL IRON

COEFFICIENT MATRIX AND AUGMENTED MATRIX

	1230	419.6000
1230	2173000	738460.0000

REGRESSION COEFFICIENTS OF NORMAL EQUATION

42.499999999999
0.009926829268

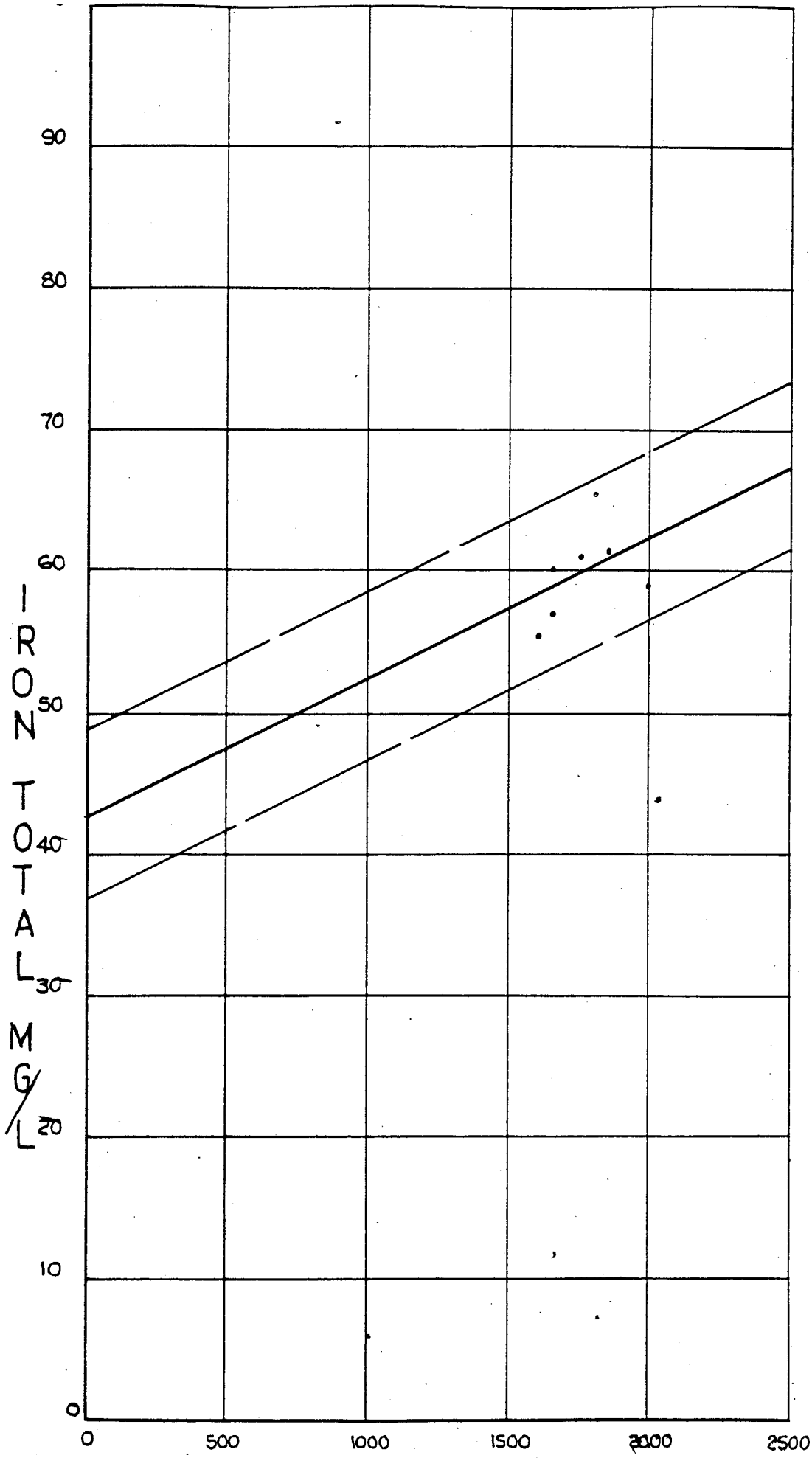
ORIGINAL X - Y PAIRS		PREDICTED VALUES	DEVIATION
1800.0000	65.6000	60.3683	5.2317
1650.0000	57.0000	58.8793	1.8793
1650.0000	60.1000	58.8793	1.2207
1600.0000	55.4000	58.3829	2.9829
2000.0000	59.0000	62.3537	3.3537
1750.0000	61.0000	59.8720	1.1280
1850.0000	61.5000	60.8646	0.6354

STATISTICAL ANALYSIS WITH ORDER OF EQUATION= 1
NUMBER OF X - Y PAIRS= 7
TOTAL SUMS OF SQUARE= 65.757143
SUMS OF SQUARES DUE TO REGRESSION= 11.543484
SUMS OF SQUARES DUE TO DEVIATION= 54.213659
GOODNESS OF FIT= .175547
MULTIPLE CORRELATION COEFFICIENT 0.41898
STANDARD DEVIATION 3.005929

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE
LIN. REGRESSION	11.54	1	11.54
DEVIATION	54.21	5	10.84
TOTAL VARIATION	65.76	6	

F-TEST FOR EQUALITY OF SAMPLE/REGRESSION VARIANCE
F TEST - SIGNIFICANCE OF REGRESSION = 1.06
LEVEL .05% - CRITICAL VALUE = 6.61



BIG BERTHA - SAMPLE ZONE 18

SAMPLE.EIGHTEEN SPECIFIC CONDUCTANCE VS. FERROUS IRON

COEFFICIENT MATRIX AND AUGMENTED MATRIX

		1230	408.3000
	1230	2173000	718120.0000

REGRESSION COEFFICIENTS OF NORMAL EQUATION

48.149999999999
0.005792682927

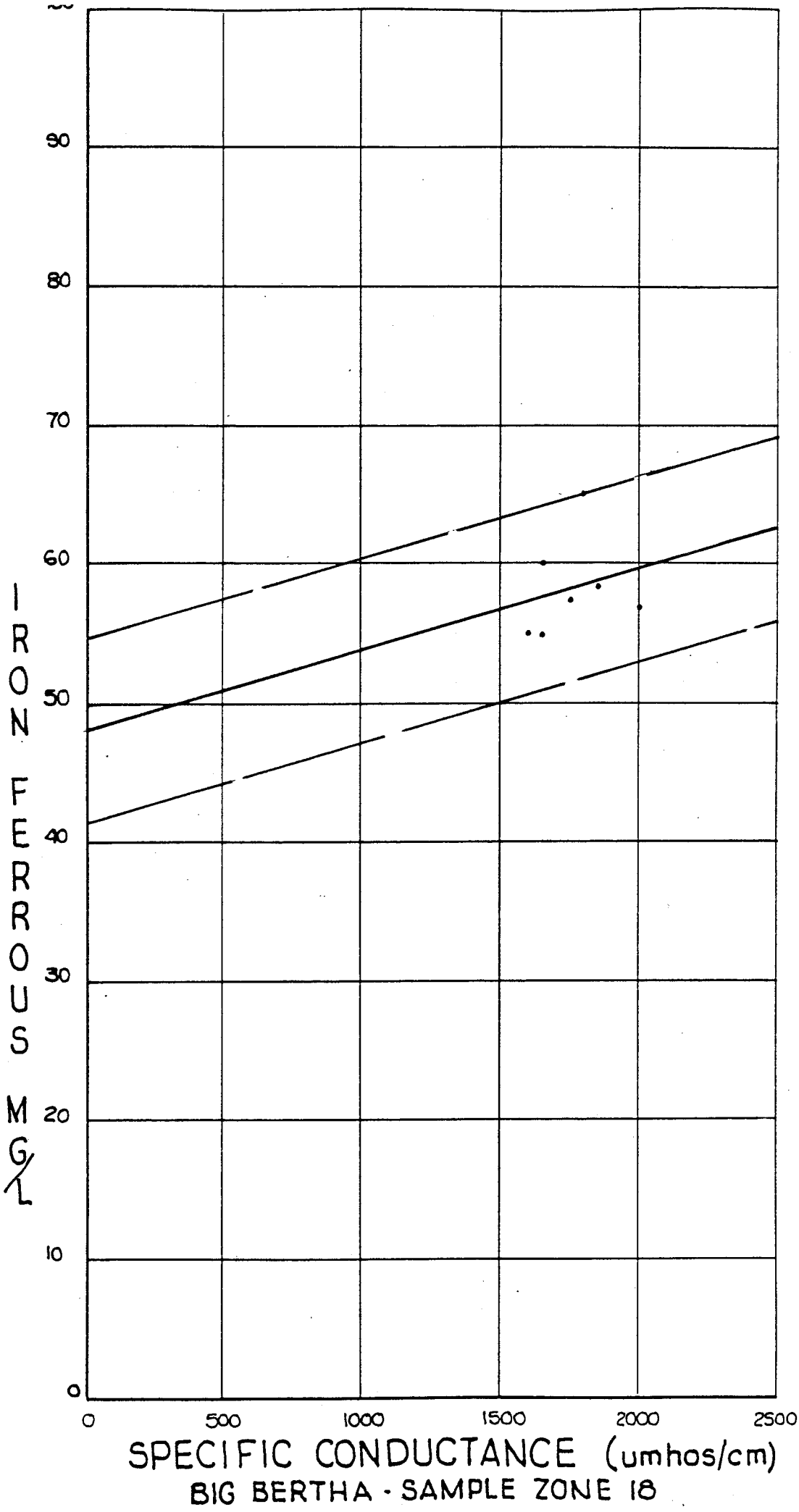
ORIGINAL X - Y PAIRS		PREDICTED VALUES	DEVIATION
1800.0000	65.2000	58.5768	6.6232
1650.0000	55.0000	57.7079	2.7079
1650.0000	60.0000	57.7079	2.2921
1600.0000	55.1000	57.4183	2.3183
2000.0000	57.0000	59.7354	2.7354
1750.0000	57.5000	58.2872	0.7872
1850.0000	58.5000	58.8665	0.3665

STATISTICAL ANALYSIS WITH ORDER OF EQUATION= 1
NUMBER OF X - Y PAIRS= 7
TOTAL SUMS OF SQUARE= 73.994286
SUMS OF SQUARES DUE TO REGRESSION= 3.930749
SUMS OF SQUARES DUE TO DEVIATION= 70.063537
GOODNESS OF FIT= .053122
MULTIPLE CORRELATION COEFFICIENT 0.23048
STANDARD DEVIATION 3.4172

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE
LIN. REGRESSION	3.93	1	3.93
DEVIATION	70.06	5	14.01
TOTAL VARIATION	73.99	6	

F-TEST FOR EQUALITY OF SAMPLE/REGRESSION VARIANCE
F TEST - SIGNIFICANCE OF REGRESSION = 0.28
LEVEL .05% - CRITICAL VALUE = 6.61


90
80
70
60
50
40
30
20
10
0
IRON FERROUS MG/L
0
500
1000
1500
2000
2500
SPECIFIC CONDUCTANCE (umhos/cm)
BIG BERTHA - SAMPLE ZONE 18

SAMPLE.EIGHTEEN SPECIFIC CONDUCTANCE VS. FERRIC IRON

COEFFICIENT MATRIX AND AUGMENTED MATRIX

		1230	11.3000
	1230	2173000	20340.0000

REGRESSION COEFFICIENTS OF NORMAL EQUATION

- 5.650000000000
0.004134146341

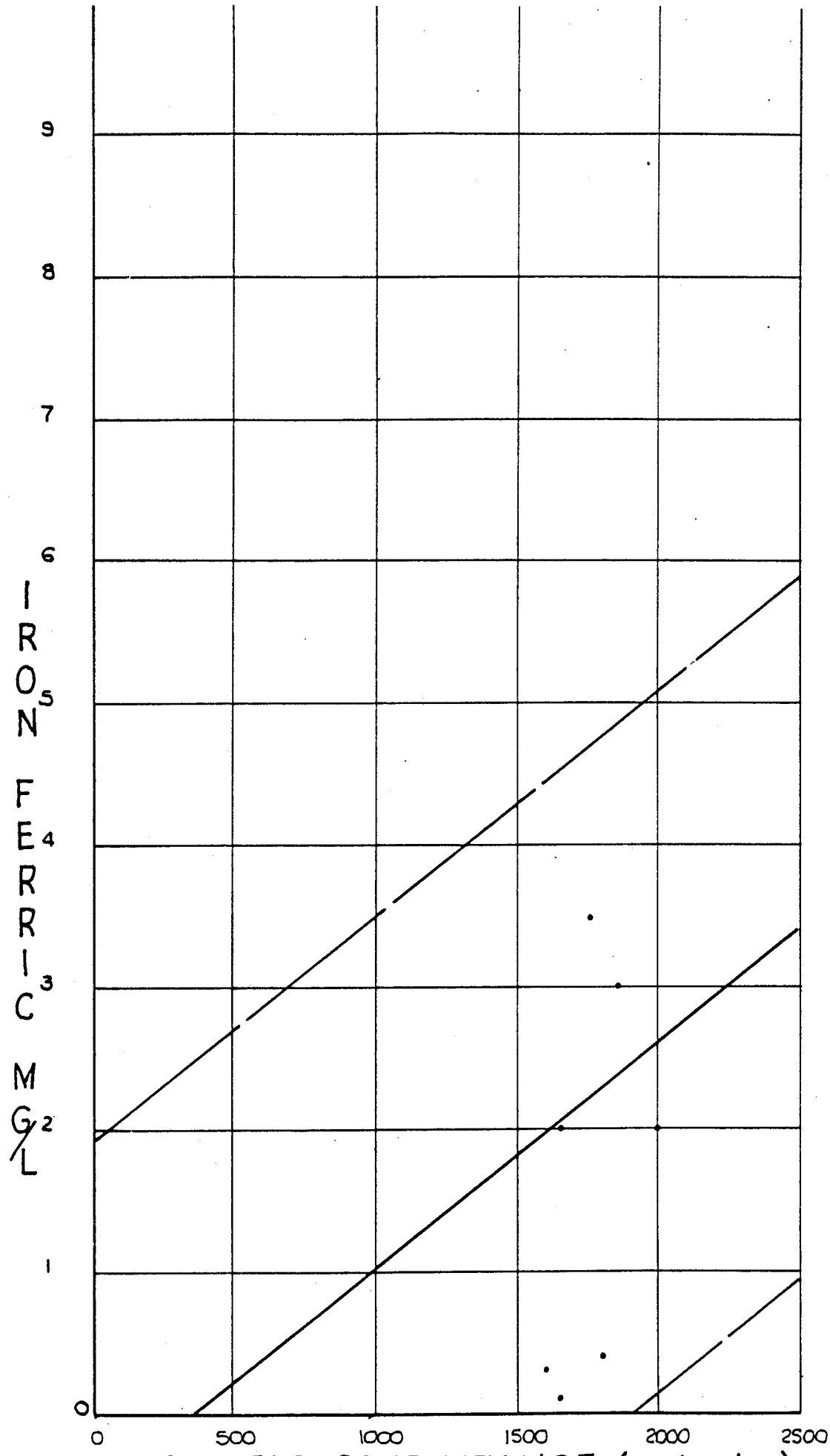
ORIGINAL X - Y PAIRS		PREDICTED VALUES	DEVIATION
1800.0000	0.4000	1.7915	1.3915
1650.0000	2.0000	1.1713	0.8287
1650.0000	0.1000	1.1713	1.0713
1600.0000	0.3000	0.9646	0.6646
2000.0000	2.0000	2.6183	0.6183
1750.0000	3.5000	1.5848	1.9152
1850.0000	3.0000	1.9982	1.0018

STATISTICAL ANALYSIS WITH ORDER OF EQUATION= 1
NUMBER OF X - Y PAIRS= 7
TOTAL SUMS OF SQUARE= 11.268571
SUMS OF SQUARES DUE TO REGRESSION= 2.002108
SUMS OF SQUARES DUE TO DEVIATION= 9.266463
GOODNESS OF FIT= .177672
MULTIPLE CORRELATION COEFFICIENT 0.42151
STANDARD DEVIATION 1.242743

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE
LIN. REGRESSION	2.00	1	2.00
DEVIATION	9.27	5	1.85
TOTAL VARIATION	11.27	6	

F-TEST FOR EQUALITY OF SAMPLE/REGRESSION VARIANCE
F TEST - SIGNIFICANCE OF REGRESSION = 1.08
LEVEL .05% - CRITICAL VALUE = 6.61



BIG BERTHA - SAMPLE ZONE 18

POST CLOSURE DATA LISTING *

SAMPLE EIGHTEEN

DATE	SPEC. COND.	DISCHARGE	pH	ALKALINITY	ACIDITY	SULPHATES	TOTAL IRON	FERROUS IRON	FERRIC IRON
6/12	2100	.016	5.58	22	340	572	186.0	183.0	3.0
6/16	1800	.016	5.67	26	94	811	107.0	103.0	4.0
6/21	1500	.016	5.00	54	11	655	76.6	72.8	3.8
6/29	1400	.016	5.96	36	6	430	67.3	60.1	7.2
7/10	1800	.016	6.03	52	7	270	69.4	65.4	4.0
8/6	1500	.016	6.02	54	2	470	57.0	51.0	6.9
8/21	1300	.016	6.04	51	3	438	72.8	62.2	10.6

* Units are as follows:

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