

APPENDIX 14

SAMPLE STATION 14

SUBSURFACE MONITORING ZONE - 80' FT.

BIG BERTHA ARTESIAN WELL

PA STATE GAME LANDS #95

PROJECT SL-110-7-101.5

## MONITORING POINT 14

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

### I. 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 25 - Relationship of Hydrologic Parameters
  - Appendix 14 - Subsurface Monitoring Zone
- Narrative exhibits contained on the following pages.

This monitoring point is 80' 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 6.66 ft/min upward.
- b. Cumulative Quantity - the cumulative quantity of water contributed by this flow system was 17.4 gal/min
- c. Flow System Quantity - the average quantity of water contributed by this flow system was 6.8 gal/min. ( .015 c.f.s.)

This monitoring point is representative of conditions in flow system B3. This sample zone represents conditions of the base of this flow system and indicates unmixed waters combined from lower zones and this zone.

## 2. Pre Closure Analysis (Monitoring Point 14)

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 25 - 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 14 - 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 5.82 - 5.95 the mean value being 5.88. An extremely strong relationship exists.

### 2. Specific Conductance Relationship

The specific conductance at this monitoring point varied from 1400 - 1550 .the mean value calculated as 1464.

### 3. Acidity/Alkalinity Balance (mg/l)

The alkalinity varied from 38- 50 ; the mean value was 46. Regression analysis of the alkalinity values showed: An extremely weak relationship exists where alkalinity concentration increases as conductance increases. The acidity varied from 215 - 271 ; the mean value was 233. Regression analysis of the sulphate values showed: A strong relationship exists where acidity concentration increases as conductance increases.

### 4. Sulphate Relationship (mg/l)

The sulphates varied from 634 - 1039 ; the mean value was 831. Regression analysis of the sulphate values showed: A strong relationship exists where sulphates concentration decrease as conductance increases.

### 5. Total Iron Relationship (mg/l)

The total iron varied from 129 - 151 ; the mean value was 142. Regression analysis of the ferrous iron values showed: A strong relationship exists where total iron concentration increases as conductance increases.

### 6. Ferrous Iron Relationship (mg/l)

The ferrous iron varied from 121 - 146 ; the mean value was 134. Regression analysis of the ferrous iron values showed: A moderate relationship exists where ferrous iron concentration increases as conductance increases.

### 7. Ferric Iron Relationship (mg/l)

The ferric iron varied from 3- 12 ; the mean value was 8. Regression analysis of the ferric iron values showed: A weak relationship exists where ferric iron concentration increases as conductance increases.

### 3. Post Closure Analysis

The reviewer is referred to sheet 25 which shows the post-closure data plotted using a time reference basis with pre-closure data for comparative purposes.

Closure caused a significant increase in specific conductance; which recovered to values similar to pre closure levels after the well was opened.

pH was slightly depressed as a result of closure, and remained slightly depressed.

Alkalinity was present prior to closure at very low concentrations in this zone and closure caused a significant reduction to nearly non-alkaline conditions. Acidity was present in moderate concentrations prior to closure and increased slightly as a result of closure. This is perceived as storage effects accruing during closure.

A slight increase in sulphates occurred during closure, but returned rapidly to pre closure levels.

A slight increase in total iron concentration occurred during closure, with values returning rapidly to pre closure levels after the well was opened.

A slight increase in ferrous iron concentration occurred during closure, with values returning rapidly to pre closure levels after the well was opened.

Ferric iron levels increased slightly during closure but quickly returned to pre closure levels.

### 4. Summary of Monitoring Point 14 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.

Closure caused only a slight modification of the characteristics of this flow system. These were perceived to be storage related. The reason for the similarity between pre and post closure values is because this flow system dominated hydrologic interactions during closure.

SAMPLE 14

PROJECT SL110-7-101.5:BIG PERTHA

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	1500	.04	5.83	50	223	871	151.0	146.0	5.0	1
030783	1400	.04	5.91	48	216	916	132.0	126.0	6.0	2
031483	1550	.04	5.85	48	271	1039	147.0	135.0	12.0	3
033183	1500	.04	5.82	38	230	1007	139.0	136.0	3.0	4
040783	1500	.04	5.87	49	201	687	145.0	134.0	11.0	5
041383	1400	.04	5.95	50	232	665	146.0	138.0	8.0	6
042083	1400	.04	5.93	39	215	634	129.0	121.0	8.0	7

SAMPLE.FOURTEEN

SPECIFIC CONDUCTANCE VS. PH

COEFFICIENT MATRIX AND AUGMENTED MATRIX

	1025	1025	41.1600
		1503250	60253.5000
REGRESSION COEFFICIENTS OF NORMAL EQUATION			
	6.904999999999		
	0.000700000000		

ORIGINAL X - Y PAIRS		PREDICTED VALUES	DEVIATION
1500.0000	5.8300	5.8550	0.0250
1400.0000	5.9100	5.9250	0.0150
1550.0000	5.8500	5.8200	0.0300
1500.0000	5.8200	5.8550	0.0350
1500.0000	5.8700	5.8550	0.0150
1400.0000	5.9500	5.9250	0.0250
1400.0000	5.9300	5.9250	0.0050

STATISTICAL ANALYSIS WITH ORDER OF EQUATION= 1

NUMBER OF X - Y PAIRS= 7

TOTAL SUMS OF SQUARE= .0154

SUMS OF SQUARES DUE TO REGRESSION= .01155

SUMS OF SQUARES DUE TO DEVIATION= 3.85E-3

GOODNESS OF FIT= .75

MULTIPLE CORRELATION COEFFICIENT 0.86603

STANDARD DEVIATION .025331

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

F-TEST FOR EQUALITY OF SAMPLE/REGRESSION VARIANCE

F TEST - SIGNIFICANCE OF REGRESSION = 15.00

LEVEL .05% - CRITICAL VALUE = 6.61

SAMPLE.FOURTEEN

SPECIFIC CONDUCTANCE VS. ALKALINITY

COEFFICIENT MATRIX AND AUGMENTED MATRIX

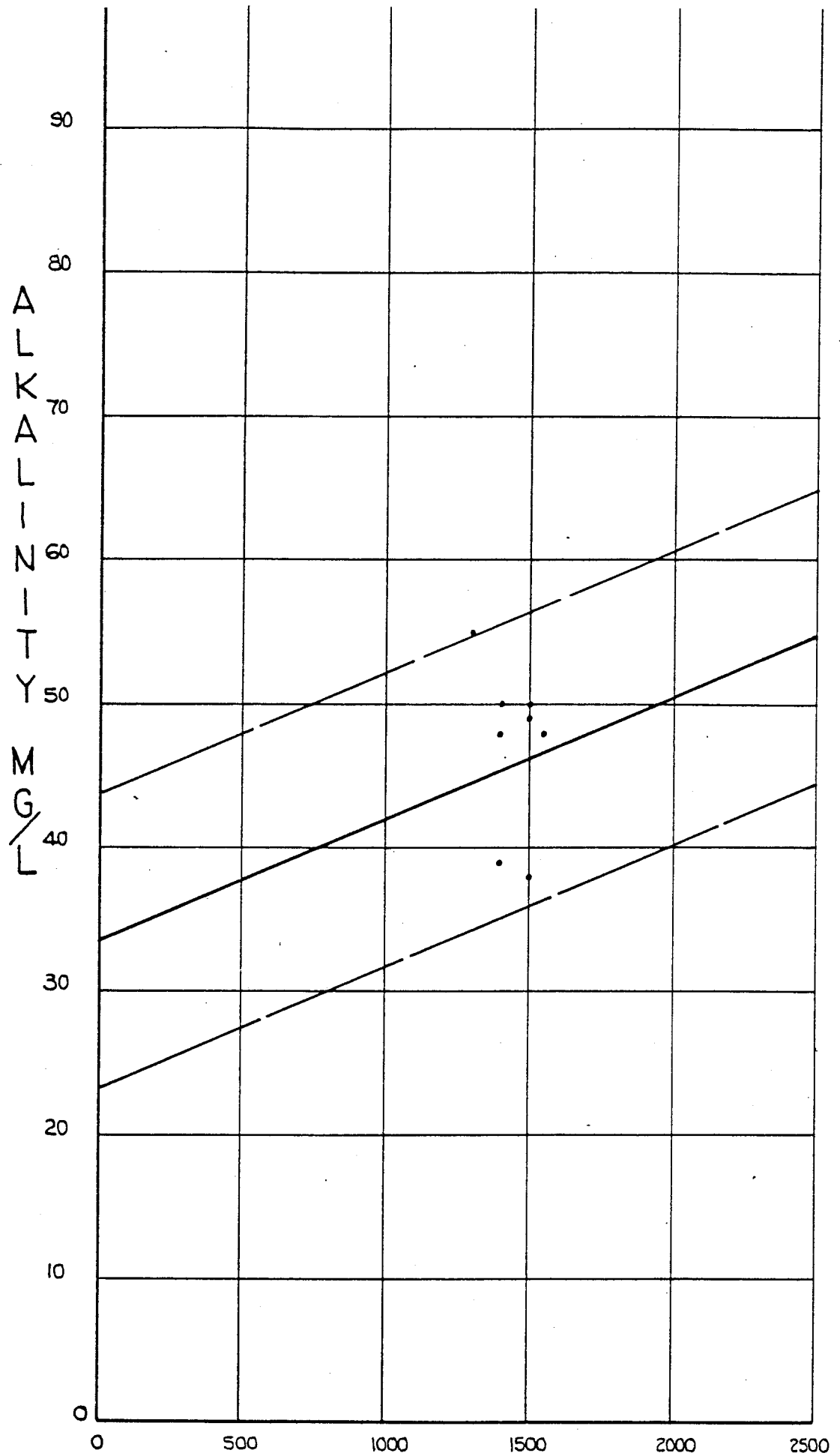
		1025	322.0000
	1025	1503250	471700.0000
REGRESSION COEFFICIENTS OF NORMAL EQUATION			
	33.575757575758		
	0.008484848485		

ORIGINAL X - Y PAIRS		PREDICTED VALUES	DEVIATION
1500.0000	50.0000	46.3030	3.6970
1400.0000	48.0000	45.4545	2.5455
1550.0000	48.0000	46.7273	1.2727
1500.0000	38.0000	46.3030	8.3030
1500.0000	49.0000	46.3030	2.6970
1400.0000	50.0000	45.4545	4.5455
1400.0000	39.0000	45.4545	6.4545

STATISTICAL ANALYSIS WITH ORDER OF EQUATION= 1  
 NUMBER OF X - Y PAIRS= 7  
 TOTAL SUMS OF SQUARE= 162  
 SUMS OF SQUARES DUE TO REGRESSION= 1.69697  
 SUMS OF SQUARES DUE TO DEVIATION= 160.30303  
 GOODNESS OF FIT= .010475  
 MULTIPLE CORRELATION COEFFICIENT 0.10235  
 STANDARD DEVIATION 5.168866

ANALYSIS OF VARIANCE			
SOURCE OF VARIATION	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE
LIN. REGRESSION	1.70	1	1.70
DEVIATION	160.30	5	32.06
TOTAL VARIATION	162.00	6	

F-TEST FOR EQUALITY OF SAMPLE/REGRESSION VARIANCE  
 F TEST - SIGNIFICANCE OF REGRESSION = 0.05  
 LEVEL .05% - CRITICAL VALUE = 6.61



SPECIFIC CONDUCTANCE ( $\mu\text{mhos/cm}$ )  
 BIG BERTHA - SAMPLE ZONE 14



SAMPLE.FOURTEEN

SPECIFIC CONDUCTANCE VS. ACIDITY

COEFFICIENT MATRIX AND AUGMENTED MATRIX

		1025	1628.0000
	1025	1503250	2389250.0000
REGRESSION COEFFICIENTS OF NORMAL EQUATION			
-	102.439393939398		
	0.228787878788		

ORIGINAL X - Y PAIRS		PREDICTED VALUES	DEVIATION
1500.0000	223.0000	240.7424	17.7424
1400.0000	216.0000	217.8636	1.8636
1550.0000	271.0000	252.1818	18.8182
1500.0000	230.0000	240.7424	10.7424
1500.0000	241.0000	240.7424	0.2576
1400.0000	232.0000	217.8636	14.1364
1400.0000	215.0000	217.8636	2.8636

STATISTICAL ANALYSIS WITH ORDER OF EQUATION= 1

NUMBER OF X - Y PAIRS= 7

TOTAL SUMS OF SQUARE= 2229.714286

SUMS OF SQUARES DUE TO REGRESSION= 1233.820346

SUMS OF SQUARES DUE TO DEVIATION= 995.893939

GOODNESS OF FIT= .553354

MULTIPLE CORRELATION COEFFICIENT 0.74388

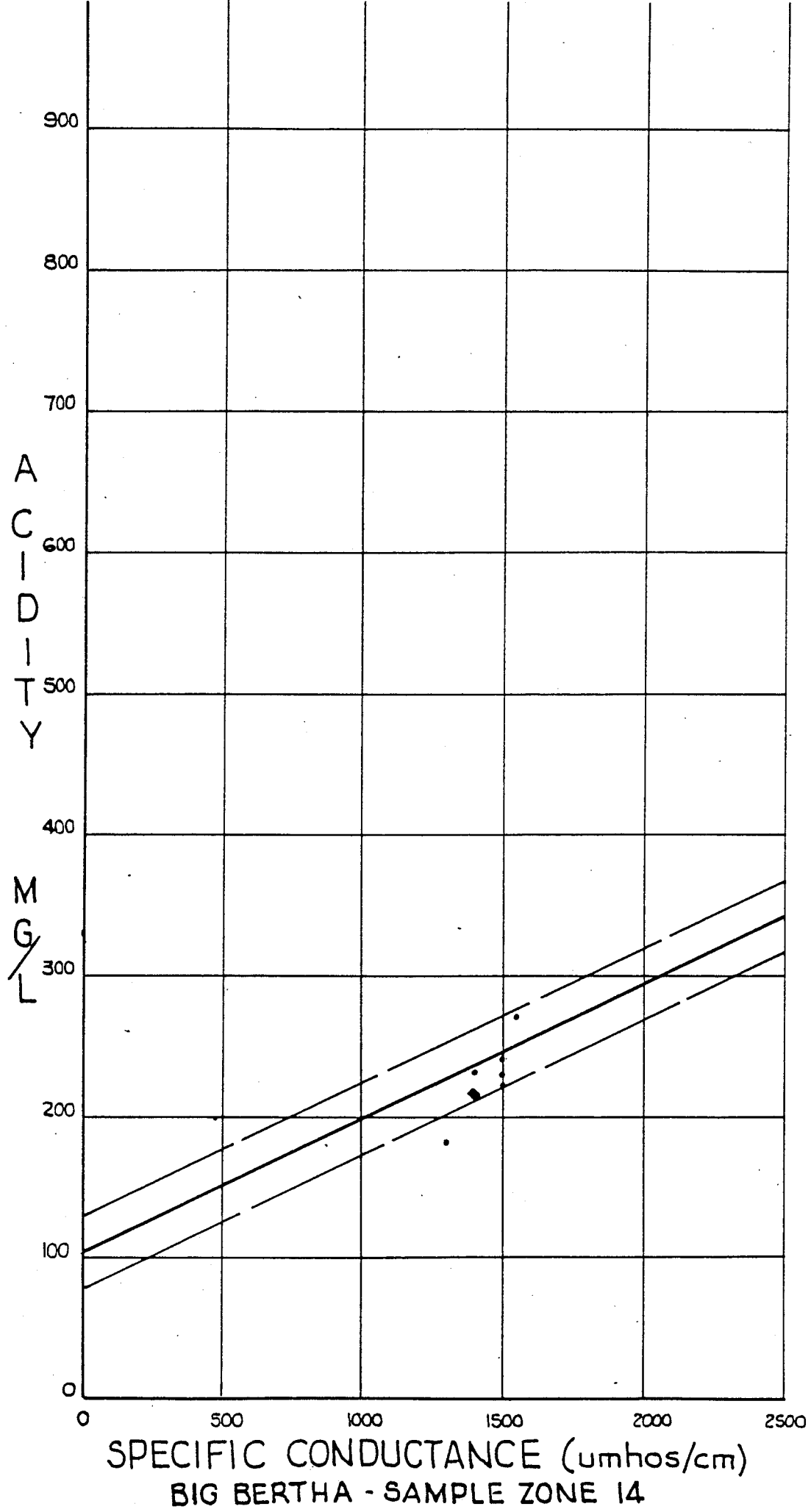
STANDARD DEVIATION 12.883413

ANALYSIS OF VARIANCE			
SOURCE OF VARIATION	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE
LIN. REGRESSION	1233.82	1	1233.82
DEVIATION	995.89	5	199.18
TOTAL VARIATION	2229.71	6	

F-TEST FOR EQUALITY OF SAMPLE/REGRESSION VARIANCE

F TEST - SIGNIFICANCE OF REGRESSION = 6.19

LEVEL .05% - CRITICAL VALUE = 6.61



SAMPLE FOURTEEN

SPECIFIC CONDUCTANCE VS. SULPHATES

COEFFICIENT MATRIX AND AUGMENTED MATRIX

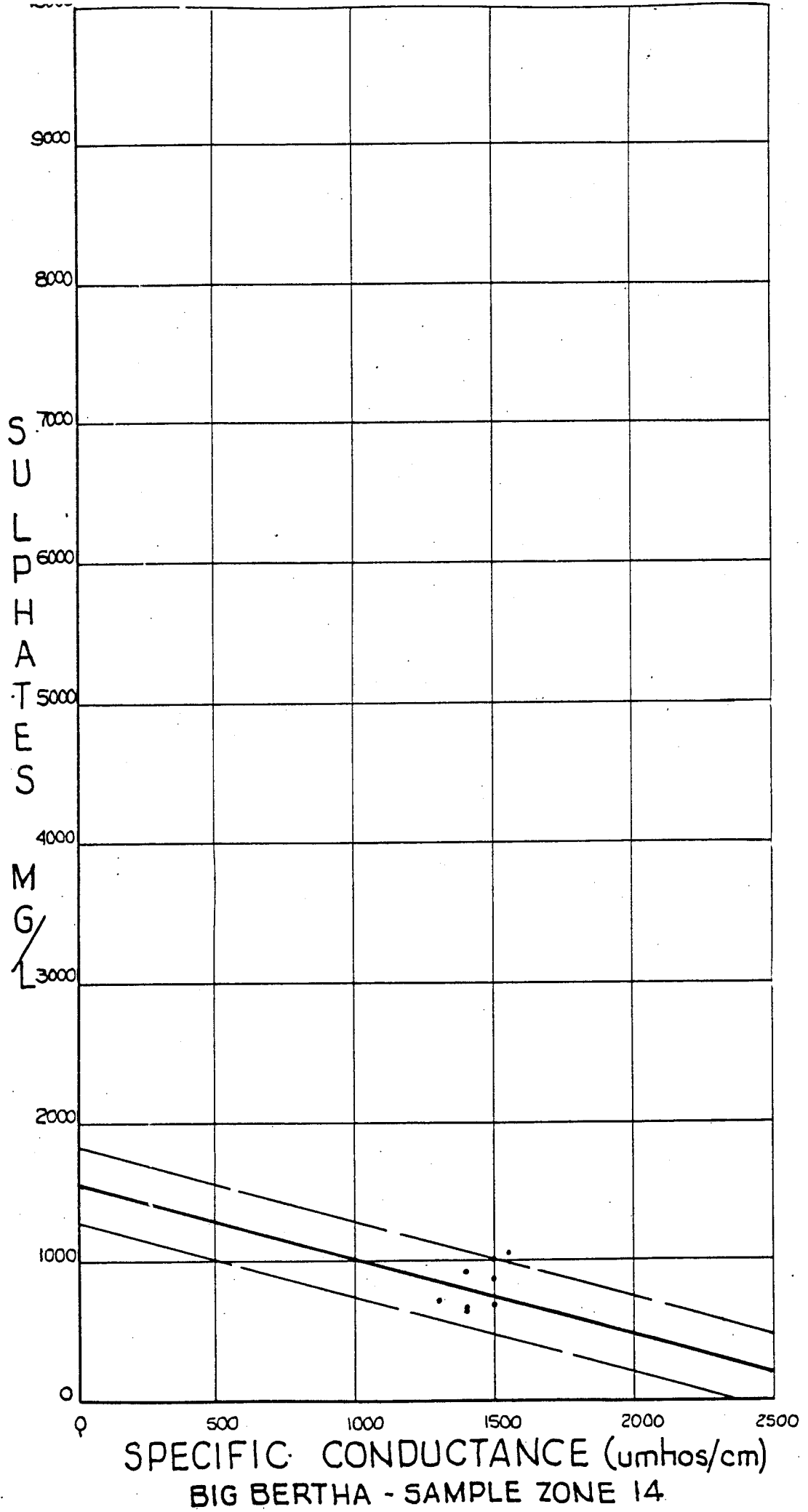
1025 5819.0000  
1025 1503250 8558950.0000  
REGRESSION COEFFICIENTS OF NORMAL EQUATION  
- 1546.181818181806  
1.623636363636

ORIGINAL X - Y PAIRS	PREDICTED VALUES	DEVIATION
1500.0000 871.0000	889.2727	18.2727
1400.0000 916.0000	726.9091	189.0909
1550.0000 1039.0000	970.4545	68.5455
1500.0000 1007.0000	889.2727	117.7273
1500.0000 687.0000	889.2727	202.2727
1400.0000 665.0000	726.9091	61.9091
1400.0000 634.0000	726.9091	92.9091

STATISTICAL ANALYSIS WITH ORDER OF EQUATION= 1  
NUMBER OF X - Y PAIRS= 7  
TOTAL SUMS OF SQUARE= 170165.428571  
SUMS OF SQUARES DUE TO REGRESSION= 62138.883117  
SUMS OF SQUARES DUE TO DEVIATION= 108026.545455  
GOODNESS OF FIT= .365167  
MULTIPLE CORRELATION COEFFICIENT 0.60429  
STANDARD DEVIATION 134.180566

SOURCE OF VARIATION	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE
LIN. REGRESSION	62138.88	1	62138.88
DEVIATION	108026.55	5	21605.31
TOTAL VARIATION	170165.43	6	

F-TEST FOR EQUALITY OF SAMPLE/REGRESSION VARIANCE  
F TEST - SIGNIFICANCE OF REGRESSION = 2.88  
LEVEL .05% - CRITICAL VALUE = 6.61



SPECIFIC CONDUCTANCE (umhos/cm)  
 BIG BERTHA - SAMPLE ZONE 14

SAMPLE.FOURTEEN

SPECIFIC CONDUCTANCE VS. TOTAL IRON

COEFFICIENT MATRIX AND AUGMENTED MATRIX

		1025	989.0000
	1025	1503250	1450150.0000

REGRESSION COEFFICIENTS OF NORMAL EQUATION  
 18.818181818179  
 0.083636363636

ORIGINAL X - Y PAIRS		PREDICTED VALUES	DEVIATION
1500.0000	151.0000	144.2727	6.7273
1400.0000	132.0000	135.9091	3.9091
1550.0000	147.0000	148.4545	1.4545
1500.0000	139.0000	144.2727	5.2727
1500.0000	145.0000	144.2727	0.7273
1400.0000	146.0000	135.9091	10.0909
1400.0000	129.0000	135.9091	6.9091

STATISTICAL ANALYSIS WITH ORDER OF EQUATION= 1

NUMBER OF X - Y PAIRS= 7

TOTAL SUMS OF SQUARE= 405.428571

SUMS OF SQUARES DUE TO REGRESSION= 164.883117

SUMS OF SQUARES DUE TO DEVIATION= 240.545455

GOODNESS OF FIT= .406688

MULTIPLE CORRELATION COEFFICIENT 0.63772

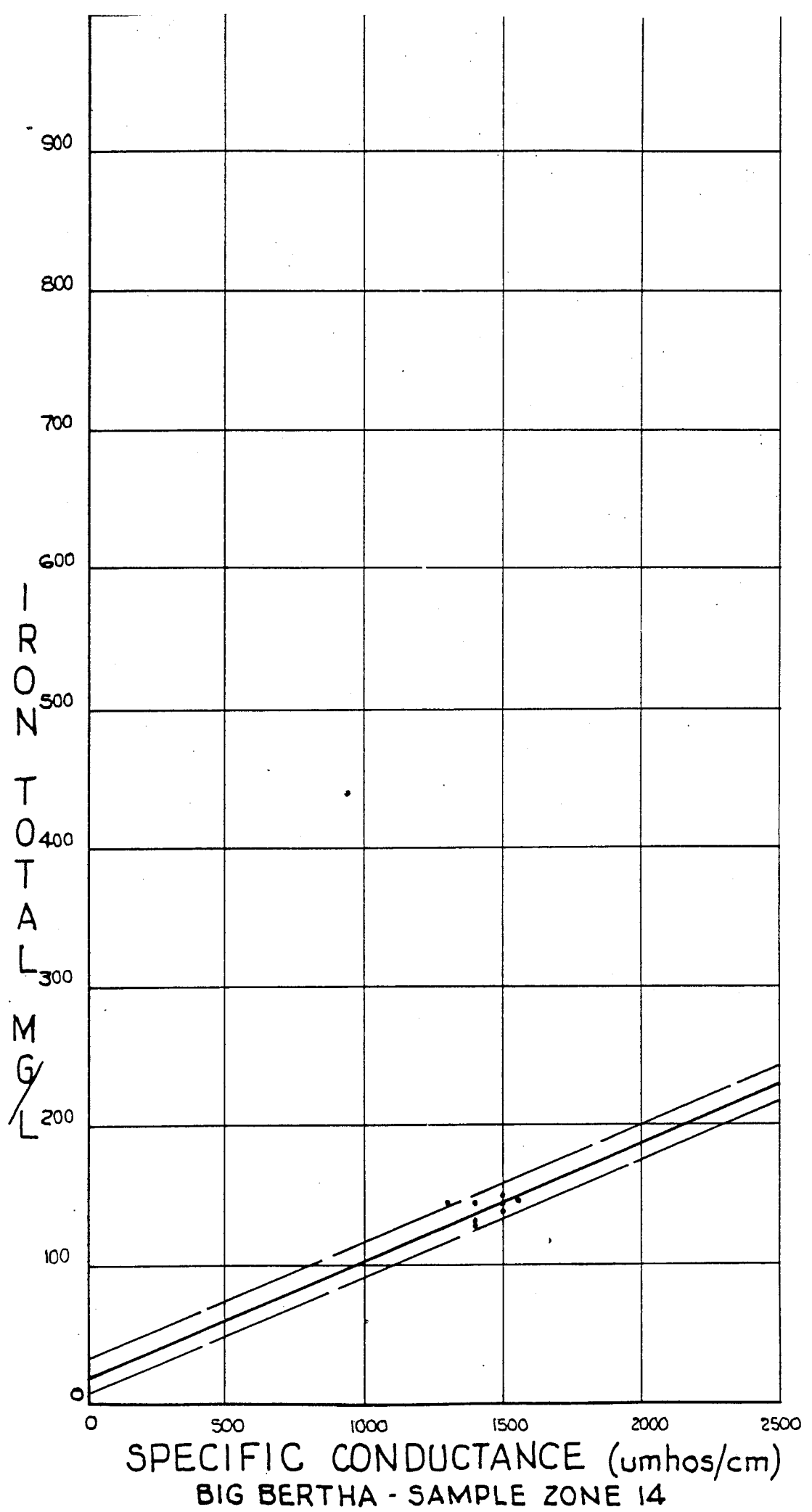
STANDARD DEVIATION 6.331738

SOURCE OF VARIATION	ANALYSIS OF VARIANCE			MEAN SQUARE
	SUM OF SQUARES	DEGREES OF FREEDOM		
LIN. REGRESSION	164.88	1		164.88
DEVIATION	240.55	5		48.11
TOTAL VARIATION	405.43	6		

F-TEST FOR EQUALITY OF SAMPLE/REGRESSION VARIANCE

F TEST - SIGNIFICANCE OF REGRESSION = 3.43

LEVEL .05% - CRITICAL VALUE = 6.61



SAMPLE.FOURTEEN

SPECIFIC CONDUCTANCE VS. FERROUS IRON

COEFFICIENT MATRIX AND AUGMENTED MATRIX

1025 1025 936.0000  
1503250 1372250.0000  
REGRESSION COEFFICIENTS OF NORMAL EQUATION  
29.439393939385  
0.07121212121212

ORIGINAL X - Y PAIRS	PREDICTED VALUES	DEVIATION
1500.0000 146.0000	136.2576	9.7424
1400.0000 126.0000	129.1364	3.1364
1550.0000 135.0000	139.8182	4.8182
1500.0000 136.0000	136.2576	0.2576
1500.0000 134.0000	136.2576	2.2576
1400.0000 138.0000	129.1364	8.8636
1400.0000 121.0000	129.1364	8.1364

STATISTICAL ANALYSIS WITH ORDER OF EQUATION= 1

NUMBER OF X - Y PAIRS= 7

TOTAL SUMS OF SQUARE= 397.428571

SUMS OF SQUARES DUE TO REGRESSION= 119.534632

SUMS OF SQUARES DUE TO DEVIATION= 277.893939

GOODNESS OF FIT= .30077

MULTIPLE CORRELATION COEFFICIENT 0.54843

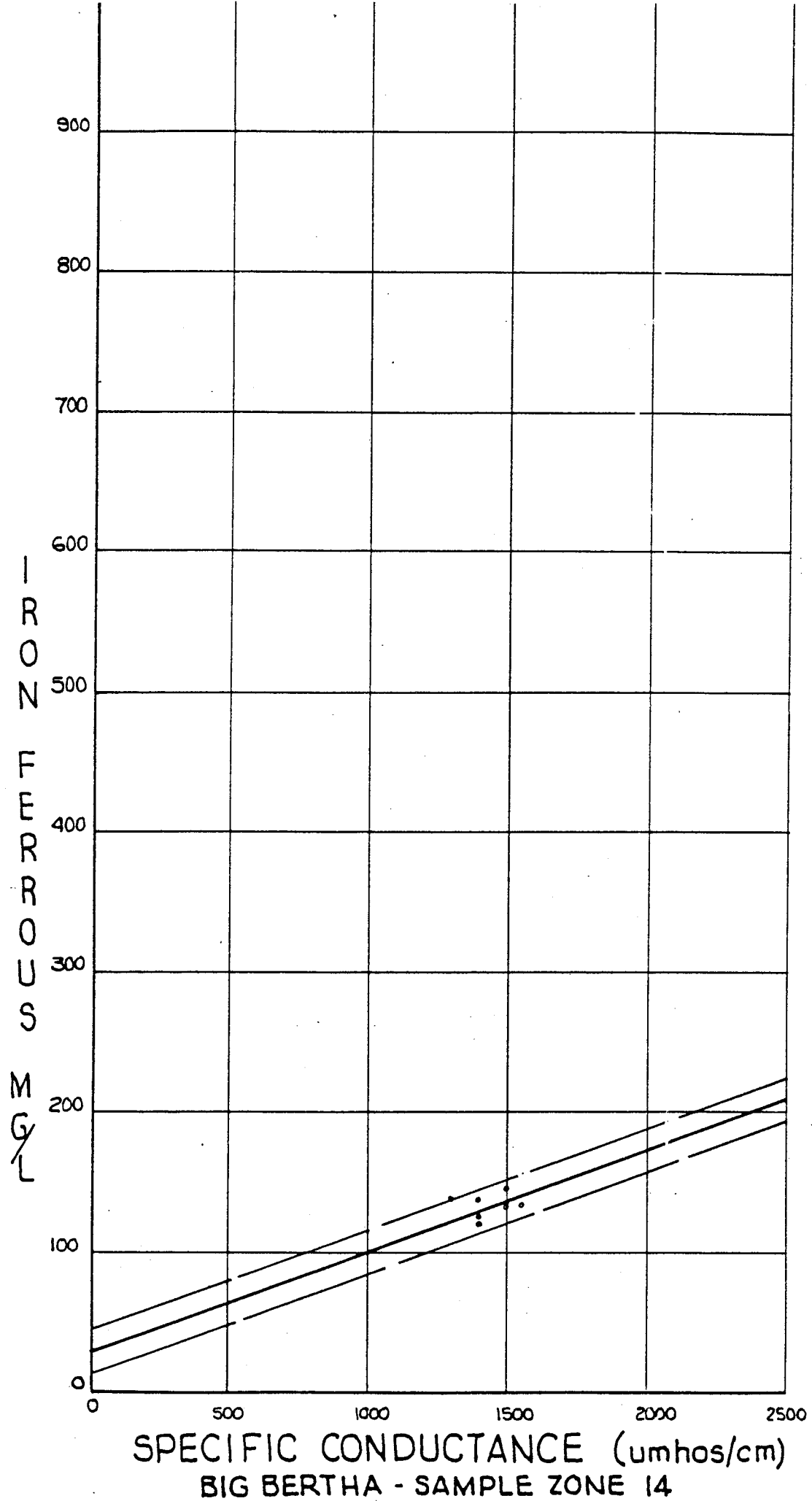
STANDARD DEVIATION 6.805561

SOURCE OF VARIATION	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE
LIN. REGRESSION	119.53	1	119.53
DEVIATION	277.89	5	55.58
TOTAL VARIATION	397.43	6	

F-TEST FOR EQUALITY OF SAMPLE/REGRESSION VARIANCE

F TEST - SIGNIFICANCE OF REGRESSION = 2.15

LEVEL .05% - CRITICAL VALUE = 6.61





SAMPLE.FOURTEEN

SPECIFIC CONDUCTANCE VS. FERRIC IRON

COEFFICIENT MATRIX AND AUGMENTED MATRIX

1025 1025 53.0000  
1503250 77900.0000  
REGRESSION COEFFICIENTS OF NORMAL EQUATION  
- 10.62121212121212  
0.012424242424

ORIGINAL X - Y PAIRS	PREDICTED VALUES	DEVIATION
1500.0000 5.0000	8.0152	3.0152
1400.0000 6.0000	6.7727	0.7727
1550.0000 12.0000	8.6364	3.3636
1500.0000 3.0000	8.0152	5.0152
1500.0000 11.0000	8.0152	2.9848
1400.0000 8.0000	6.7727	1.2273
1400.0000 8.0000	6.7727	1.2273

STATISTICAL ANALYSIS WITH ORDER OF EQUATION= 1

NUMBER OF X - Y PAIRS= 7

TOTAL SUMS OF SQUARE= 61.714286

SUMS OF SQUARES DUE TO REGRESSION= 3.638528

SUMS OF SQUARES DUE TO DEVIATION= 58.075758

GOODNESS OF FIT= .058958

MULTIPLE CORRELATION COEFFICIENT 0.24281

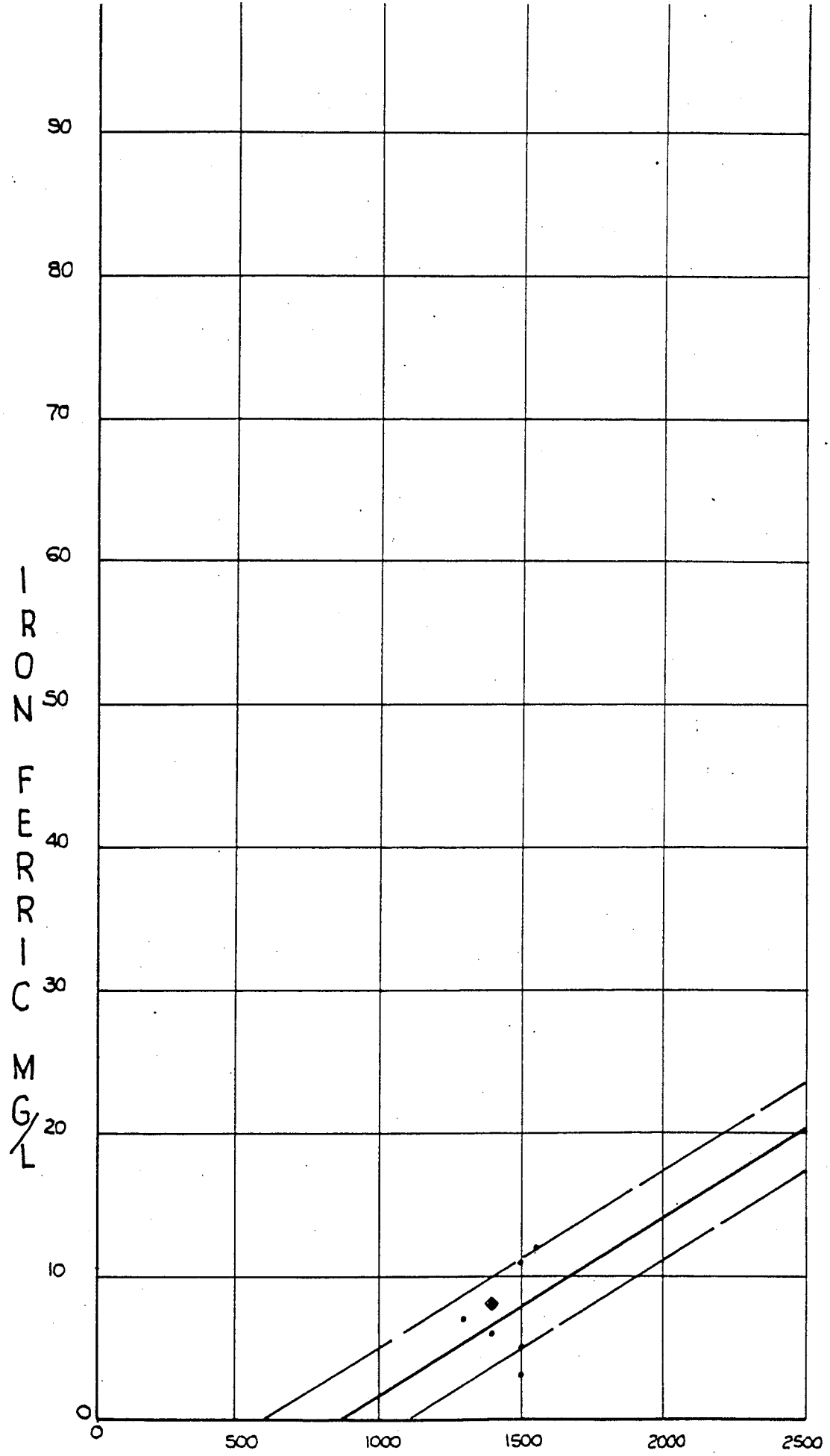
STANDARD DEVIATION 3.111156

SOURCE OF VARIATION	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE
LIN. REGRESSION	3.64	1	3.64
DEVIATION	58.08	5	11.62
TOTAL VARIATION	61.71	6	

F-TEST FOR EQUALITY OF SAMPLE/REGRESSION VARIANCE

F TEST - SIGNIFICANCE OF REGRESSION = 0.31

LEVEL .05% - CRITICAL VALUE = 6.61



SPECIFIC CONDUCTANCE (umhos/cm)  
 BIG BERTHA SAMPLE ZONE 14

POST CLOSURE DATA LISTING \*

SAMPLE FOURTEEN

DATE	SPEC. COND.	DISCHARGE	pH	ALKALINITY	ACIDITY	SULPHATES	TOTAL IRON	FERROUS IRON	FERRIC IRON
6/12	1900	.039	5.63	15	322	1374	177	172	5
6/16	1700	.039	5.43	11	291	1102	168	152	16
6/21	1600	.039	5.60	18	273	1214	170	164	6
6/29	1500	.039	5.28	6	256	799	160	141	19
7/10	1800	.039	5.68	22	278	706	173	171	2
7/26	1600	.039	5.24	9	292	883	168	160	8
8/6	1600	.039	5.49	14	300	958	175	166	9
8/21	1400	.039	5.72	18	309	1187	168	164	4

\* Units are as follows:

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