the raw data and analysis thereof, and states several conclusions and recommendations.

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JS:sas

Encl: As above

cc: J2, JTG
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ple locations, divide each sum by the number of observations, then divide soil by IMP to obtain the ratio of the means.) The ratio of the means does not readily convert to graphic form so Fig. 1 is included to show the distribution of individual ratios using the same input as was used to compute the ratio of the means.

Rather than arbitrarily correct the IMP results to match the soil sample results or vice versa, it seemed appropriate to investigate some of the factors that contribute to the comparisons.

II. FACTORS INFLUENCING COMPARISONS

There are a number of factors that influence the comparison of soil sample and IMP readings. Some of these are listed below and briefly discussed.

1. Background subtraction in ^{241}Am photopeak IMP readings. The background subtraction routine in the IMP data reduction program considers channels on both sides of the ^{241}Am photopeak. The influence of this routine in the calibration data as related to the actual field conditions should be investigated.
2. Soil Density. Does the fact of different soil densities affect the IMP and soil sample calibration?
3. ^{241}Am vertical distribution in the soil. What is the vertical distribution of ^{241}Am in the soil and how does this influence the soil sample-IMP comparisons.
4. Field-of-View. Does the soil sampling procedure adequately sample the IMP's field-of-view? Several items in this category are:
    a. Effect of rocks in the field-of-view.
    b. What is the variability from point to point? Are enough soil samples being taken?
    c. What is the effect of changing the sampling board and rope knots.
    d. What are the road way effects?

The location was divided into two areas, one for detailed measurements and one for a control area. A sketch of these two areas is shown in Fig. 3. Access lanes were chosen for minimum disturbance of the soil.

samples were taken (0 - 2.5 cm and 2.5 to 5 cm). For the other six locations, 6 samples were taken (0 - 1.5, 1.5 - 3, 3 - 4.5, 4.5 - 6, 6 - 8, 8 - 10 cm). The locations circled in Fig. 4 correspond to the latter 6 locations.

For the 6 locations where only 2 samples were taken, the cookie cutter was used. For the other locations (circled in Fig. 4), a different method was used. Two pieces of tin, about 20 x 30 cm in size, were taped (yellow) with 1.5 cm strips for reference. The two pieces of tin were then "sawed" into the soil to a depth of 10 cm forming a 90^{o} angle with each other. Soil was then removed from the perimeter of the sample area and placed into a plastic bag. With a 3rd piece of tin a 1.5 cm layer was "cut" off the top and removed. Successive layers were then removed in like manner. After sampling was completed, the soil from the bag was placed back into the hole.

All sampling locations were in undisturbed soil. At only one location was it necessary to stop short of 10 cm depth due to a ledge of old beach rock.

V. RESULTS

The IMP results are tabulated in Table 2 and summarized in Table 3. The control area appears to contain a little higher ^{241}Am activity than the experimental area. The decrease in values with increase in height is as expected (approximately 10%) for the control area, but is not consistent for the experimental area. Little significance should be placed on this, however, because of several factors that could contribute to these values. Some of these are (1) activity within the area is not likely to be uniform, and (2) brush is not uniform within the area.

It is noted that IMP I, detector #496, requires a correction of 1.1 because of detector size. It is also noted, after applying the detector correction factor, that the results of IMP III appear to be slightly greater in value than those of IMP I. The averages are within counting statistics.

The soil sample results are given in Tables 4 and 5 and plotted in Figs. 5(a), 5(b) and 6.

Several conclusions are noted:

1. The activity is highly variable from point to point and as a function of depth. The surface ^{241}Am activity varied from 2.25 to 14.14 pCi/g.

2. Six out of 12 sample locations showed the surface concentrations to be greater than subsurface. The other six showed subsurface activity to be greater.

3. The average surface activity (0 - 1.5 cm) was 6.98 pCi/g; the average for 0 - 2.5 cm was 7.99 pCi/g; the average for 0 - 3 cm was 9.55 pCi/g, and the average for the IMP reading was 5.44 pCi/g.

variability present in this data, six samples are not enough to develop a stabilized mean.

VI. CONCLUSIONS AND RECOMMENDATIONS

There appears to be variability in ^{241}Am activity at any point of measurement (before mixing). Variability has been observed within a given soil sample, as well as within a given area. This means that if soil sample data are to be compared to the IMP data, (for a given measurement) a multitude of samples are required. Data in Fig. 6 illustrate this problem.

It is recommended that the same experiment be repeated in two additional areas:

1. An undisturbed area containing heavy brush, and

2. An area heavily disburbed or deliberately disturbed where the top cm is expected to be uniform in activity.

More general recommendations are as follows:

1. As time permits, factors should be examined which contribute to biasing the IMP and/or soil sample results.

2. The surface soil activity relating to the cleanup criteria should be more clearly defined. Are we talking about activity per gram of dry soil, less than a certain particle size, containing no rocks, averaged over the top 3 cm? Or are we talking about activity per gram of in-situ material averaged over the area and depth of whatever the IMP sees?

3. If the definition relates more closely to the soil samples, then it is recommended that all the IMP measurements be multiplied by an imperically determined correction factor according to Table 1, providing that factors leading to biasing in the soil sample results have been examined and resolved.

4. If the definition relates more closely to the IMP readings, then it is recommended that no corrections be made unless biasing of greater than 10% in one direction has been verified.

Table 1. RESULTS OF SOIL SAMPLE/IMP RATIOS

Island	No. of Locations	No. of Composites	Min.	Max.	Ratio* Avg.	Standard Deviation
Alice	4	8	1.02	2.51	1.39	0.51
Belle	5	10	0.18	1.78	1.17	0.47
Clara	4	8	0.41	1.84	1.28	0.46
Daisy	4	8	0.33	1.34	0.93	0.40
Irene	10	20	0.61	2.78	1.45	0.63
Janet	29	58	0.27	1.91	1.09	0.40
Kate	5	10	0.59	1.58	0.98	0.32
Lucy	5	10	0.31	2.93	1.67	0.78
Mary	5	10	0.64	1.91	1.20	0.46
Nancy	5	10	0.65	2.75	1.43	0.71
Olive	4	8	0.60	1.97	1.24	0.39
Pearl	10	20	0.40	1.84	1.10	0.39
Ruby**	3	6	0.57	1.63	0.94	0.36
Sally **	3	6	0.50	3.08	1.41	0.95
Tilda	6	12	0.55	2.14	1.21	0.46
Vera	4	8	1.05	2.39	1.48	0.42
Wilma**	3	6	0.84	3.21	1.88	0.79

* Includes detector and brush corrections
** Used only data points greater than 1 pCi/g

Table 2. IMP Data* from DOE Test Plot - May 17 & 18

Area	Height (cm)	Run No.	Net Count** ^{241}Am	^{241}Am** pCi/g	^{137}Cs (pCi/g)
IMP I, Detector 496					
Exp.	740	11055	585	5.1	5.8
Exp.	740	11056	635	5.5	6.0
Exp.	460	11057	600	5.17	5.8
Exp.	460	11058	581	5.0	5.6
Control	460	11059	703	6.1	7.7
Control	460	11060	573	5.0	7.4
Control	740	11061	602	5.2	6.8
Control	740	11062	634	5.4	6.9
IMP III, Detector 513					
Exp.	740	32151	608	5.2	6.3
Exp.	740	32152	609	5.2	6.2
Exp.	460	32153	635	5.4	6.0
Exp.	460	32154	639	5.5	5.7
Control	460	32147	786	6.7	7.0
Control	460	32148	762	6.5	7.0
Control	740	32149	722	6.2	7.0
Control	740	32150	673	5.8	6.9

* 900 sec counting time

** A detector sensitivity correction factor of 1.1 was applied to data from detector 496.

Table 3. Summary* of IMP Data from DOE Test Plot

IMP	Avg pCi/g in Exp. Area 740 cm Height	Avg pCi/g in Exp. Area 460 cm Height	Avg pCi/g in control area 740 cm Height	Avg pCi/g in control area 460 cm Height
I	5.48	5.25	5.68	5.91
II	5.40	5.65	6.45	7.10
Both	5.44	5.45	6.07	6.51

* Includes brush corrections but not height corrections.

Table 4. Lab Results of Soil Samples From Experimental Plot

Location	Depth (cm)	Gross Alpha (pCi/g)	^{241}Am Gamma N.B.M.[1] pCi/g	B.M.[2] pCi/g	Chemistry ^{239}Pu pCi/g	^{238}Pu pCi/g	^{241}Am pCi/g
A-1	0-1.5	36	7.52	7.21	15.08	0.04	9.80
	1.5-3.0	68	13.91	14.50	30.38	0.04	16.78
	3.0-4.5	185	25.31	31.18	51.07	0.08	32.02
	4.5-6	155	28.41	19.22	38.11	0.08	22.50
	6-8	3	2.18	2.18	3.53	0.03	2.06
	8-10	-*	1.27	-*	-*	-*	-*
A-2	0-2.5	50	14.14	13.57	29.22	0.10	17.18
	2.5-5	-*	1.60	*	*	*	*
A-3	0-1.5	53	8.87	36.60	19.96	0.03	13.04
	1.5-3	68	18.20	14.76	23.37	0.04	17.17
	3-4.5	107	10.82	12.26	16.83	0.08	10.79
	4.5-6	-*	1.47	*	-*	-*	-*
	6-7	-*	0.76	*	*	*	*
A-4	0-1.5	22	5.51	5.78	9.64	0.05	5.85
	1.5-3	-	1.22	*	*	*	*
	3-4.5	*	0.90	*	*	*	*
	4.5-6	*	0.19	*	*	*	*
	6-8	*	MDA	*	*	*	*
	8-10	*	MDA	*	*	*	*
A-5	0-1.5	35	7.62	6.56	11.42	0.06	6.74
	1.5-3	*	0.70	*	*	*	*
	3-4.5	50	5.85	10.13	16.52	0.02	10.79
	4.5-6	59	10.28	9.99	17.06	0.02	10.79
	6-8	40	16.77	4.51	7.75	0.02	5.10
	8-10	8	4.17	1.70	3.16	0.01	2.05

[1]N.B.M. means not Ballmilled
[2]B.M. means Ballmilled

Table 4. Lab Results of Soil Samples From Experimental Plot (continued)

Location	Depth (cm)	Alpha (pCi/g)	^{241}Am Gamma N.B.M. pCi/g	^{241}Am Gamma B.M. pCi/g	Chemistry ^{239}Pu pCi/g	Chemistry ^{238}Pu pCi/g	Chemistry ^{241}Am pCi/g
A-6	0-1.5	29	3.27	2.90	6.91	0.05	3.94
	1.5-3	74	11.13	12.71	23.29	0.09	14.95
	3-4.5	-	0.86	*	*	*	*
	4.5-6	-	0.22	*	*	*	*
	6-8	-	MDA	*	*	*	*
	8-10	-	0.26	*	*	*	*
B-1	0-2.5	7	7.01	3.45	7.12	0.02	5.21
	2.5-5	7	4.16	3.32	6.43	0.04	4.30
B-2	0-2.5	22	3.79	3.16	5.70	0.03	3.59
	2.5-5	*	0.74	*	*	*	*
B-3	0-1.5	47	9.06	8.93	16.89	0.01	8.93
	1.5-3	54	14.92	13.86	24.15	0.06	14.89
	3-4.5	60	6.18	5.34	10.72	0.01	7.41
	4.5-6	*	1.64	*	*	*	*
	6-8	*	0.67	*	*	*	*
	8-10	*	0.22	*	*	*	*
B-4	0-2.5	40	13.34	7.32	14.59	0.04	8.77
	2.5-5	-	1.02				
B-5	0-2.5	19	7.38	5.74	10.42	0.05	5.91
	2.5-5	9	2.81	2.62	5.50	0.03	3.24
B-6	0-2.5	6	2.25	1.83	2.96	0.02	2.09
	2.5-5	3	2.93	3.45	6.67	0.05	3.81
Control	(A)0-2.5	39	9.39	9.05	16.10	0.03	9.55
Control	(B)0-2.5	43	9.52	8.14	16.16	0.03	11.59

* Less than 2pCi/g, not laboratory processed

Table 5. Lab Results of Soil Samples from Experimental Plot

Location	Depth (cm)	TRU[1] Chem (pCi/g)	TRU Chem Am (N.B.M.)	^{241}Am B.M. / N.B.M.	^{241}Am Chem / N.B.M.	Chem / B.M.
A-1	0-1.5	24.92	3.31	0.96	1.30	1.35
	1.5-3.0	47.20	3.39	1.04	1.21	1.16
	3.0-4.5	83.17	3.29	1.23	1.27	1.03
	4.5-6	60.69	2.14	0.68	0.79	1.16
	6-8	5.62	2.58	1.00	0.94	0.94
A-2	0-2.5	46.50	3.29	0.96	1.21	1.26
A-3	0-1.5	33.03	3.72	4.13	1.47	0.36
	1.5-3	40.58	2.23	0.81	0.94	1.16
	3-4.5	27.20	2.56	1.13	1.00	0.88
A-4	0-1.5	15.54	2.82	1.05	1.06	1.01
A-5	0-1.5	18.22	2.39	0.86	0.88	1.02
	3-4.5	27.33	4.67	1.73	1.84	1.06
	4.5-6	27.87	2.71	0.97	1.05	1.08
	6-8	12.87	0.77	0.27	0.30	1.11
	8-10	5.22	1.25	0.41	0.49	1.20
A-6	0-1.5	10.80	3.30	0.89	2.20	1.35
	1.5-3	38.33	3.44	1.14	1.34	1.18
B-1	0-2.5	12.35	1.76	0.49	0.74	1.51
	2.5-5	10.77	2.59	0.80	1.03	1.29
B-2	0-2.5	9.32	2.46	0.83	0.95	1.14
B-3	0-1.5	25.83	2.85	0.99	0.99	1.00
	1.5-3	39.10	2.62	0.93	1.00	1.08
	3-4.5	18.14	2.94	0.86	1.20	1.40
B-4	0-2.5	23.40	1.75	0.55	0.66	1.20

[1]TRU means Total Transuranics

Table 5. Lab Results of Soil Samples from Experimental Plot, continued

Location	Depth (cm)	TRU Chem (pCi/g)	Chem Am (N.B.M.)	^{241}Am B.M. / N.B.M.	^{241}Am Chem / N.B.M.	Chem / B.M.
B-5	0-2.5	16.38	2.22	0.78	0.80	1.03
	2.5-5	8.77	3.12	0.93	1.15	1.24
	0-2.5	5.07	2.25	0.81	0.93	1.15
	2.5-5	10.53	3.59	1.18	1.30	1.10
Control	(A)0-2.5	25.68	2.73	0.96	1.02	1.06
	(B)0-2.5	27.78	2.92	0.86	1.22	1.42
						1.13 ± 0.21

Figure 1. Histogram of individual values used to compute ratio of the means.

```
EACH X = 0.70 %
      0.0000 . *
             .*
      0.2000 .  *
             .  *
      0.4000 .    *
             .XX    *
      0.6000 .         *
             .XXXXXXXXXXXX*XXX
      0.8000 .                 *
             .XXXXXXXXXXXXXXXXXXX*
      1.0000 .                       *
             .XXXXXXXXXXXXXXXXXXXXXXXXX*XXXXXXXXXXXXXX
      1.2000 .                           *
             .XXXXXXXXXXXXXXXXXXXXXXXXX *
      1.4000 .                         *
             .XXXXXXXXXXXXXXXXXXX    *
      1.6000 .                    *
             .XXXXXXX        *
      1.8000 .             *
             .XX        *
      2.0000 .       *
             .XXX *
      2.2000 .    *
             .X *
      2.4000 . *
             .X*X
      2.6000 .*
             .*
      2.8000 .*
             .*
      3.0000 .*
```

CELL STATISTICS:

CELL#	LOWER LIMIT	NUMBER OF OBS.	%RELATIVE FREQUENCY
3	0.4000	2	1.74
4	0.6000	13	11.30
5	0.8000	16	13.91
6	1.0000	32	27.83
7	1.2000	20	17.39
8	1.4000	15	13.04
9	1.6000	6	5.22
10	1.8000	2	1.74
11	2.0000	3	2.61
12	2.2000	1	0.87
13	2.4000	3	2.61
14	2.6000	1	0.87
15	2.8000	1	0.87

Atch #1

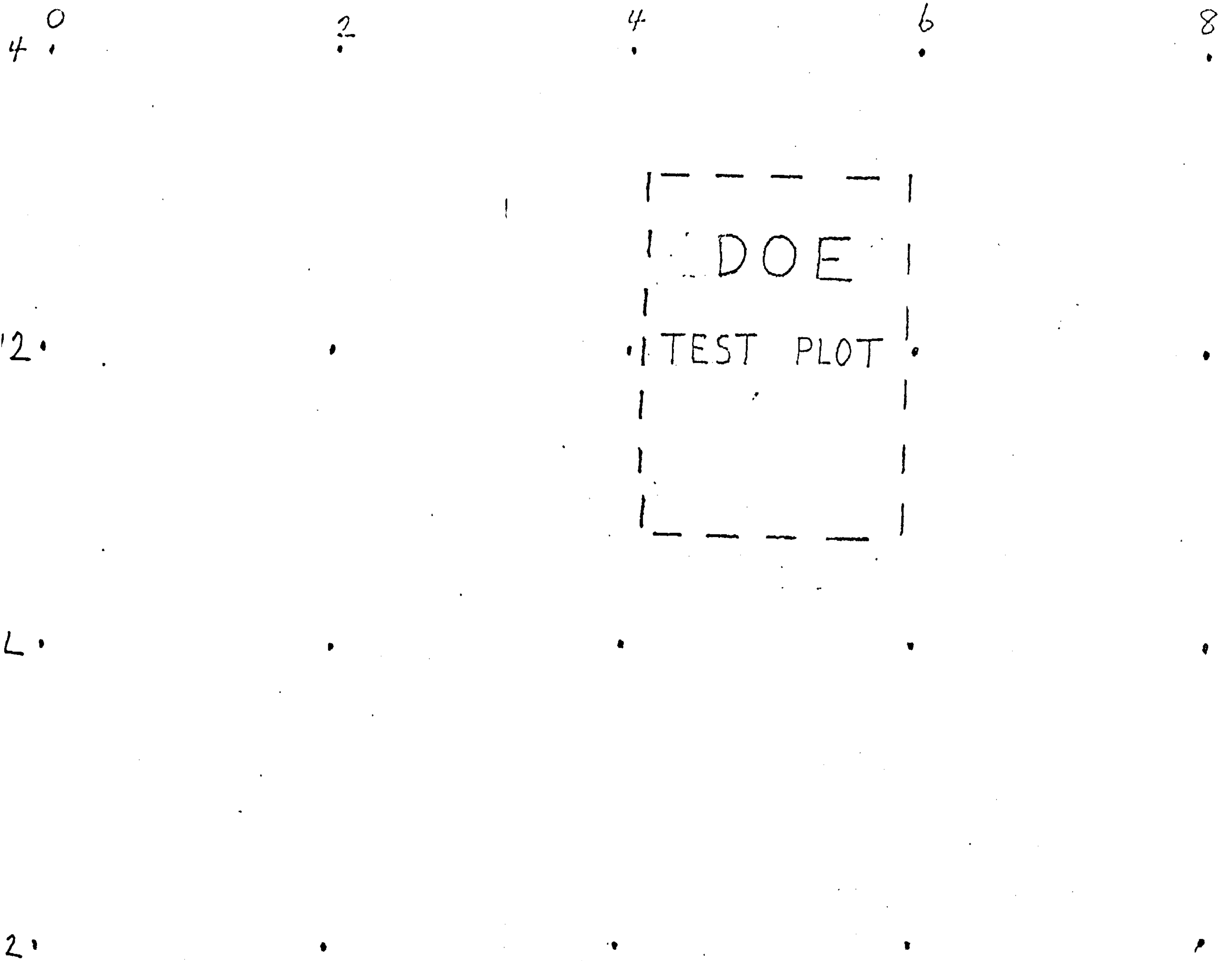


Figure 2. DOE test plot location on Bijire (Tilda).

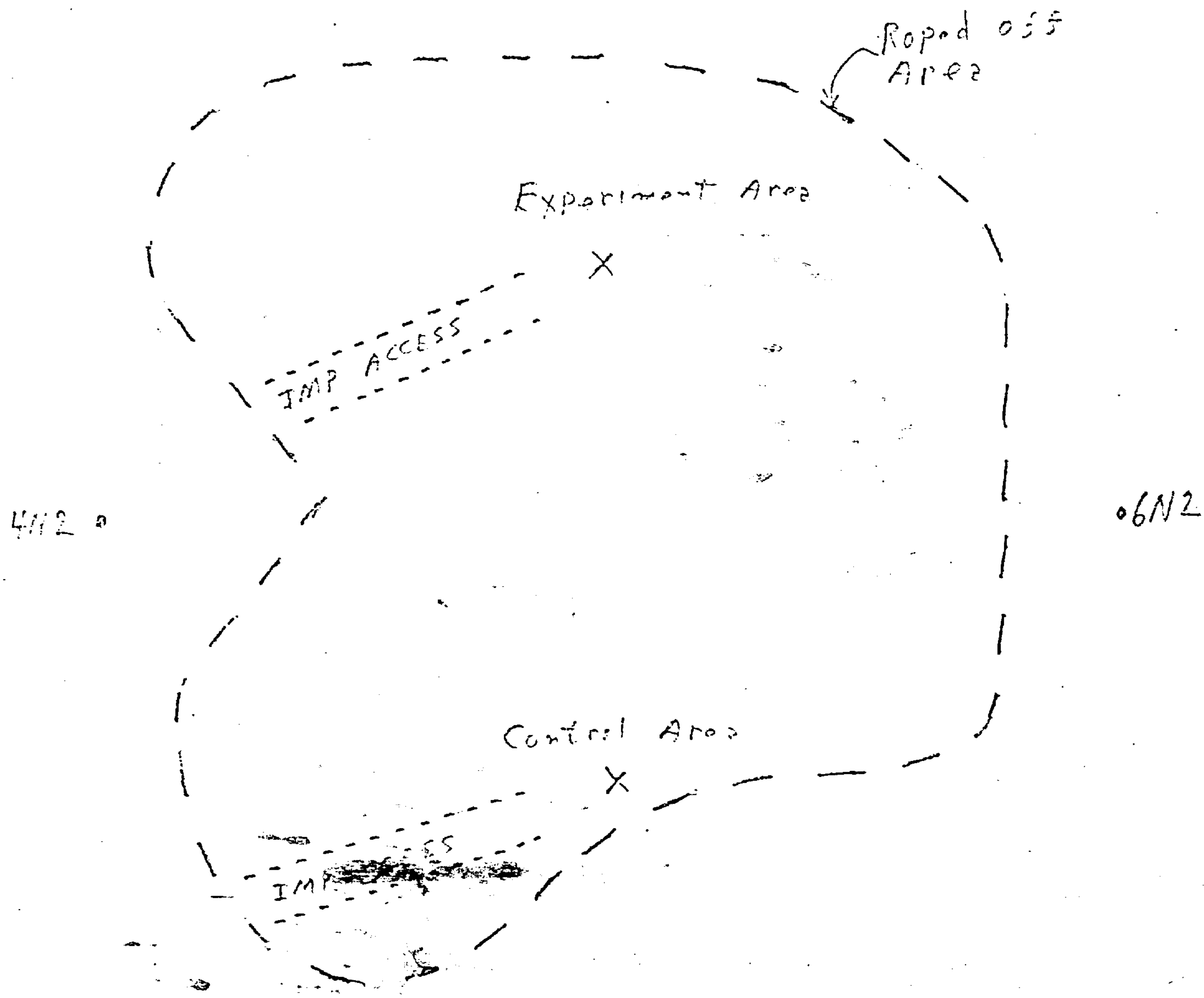
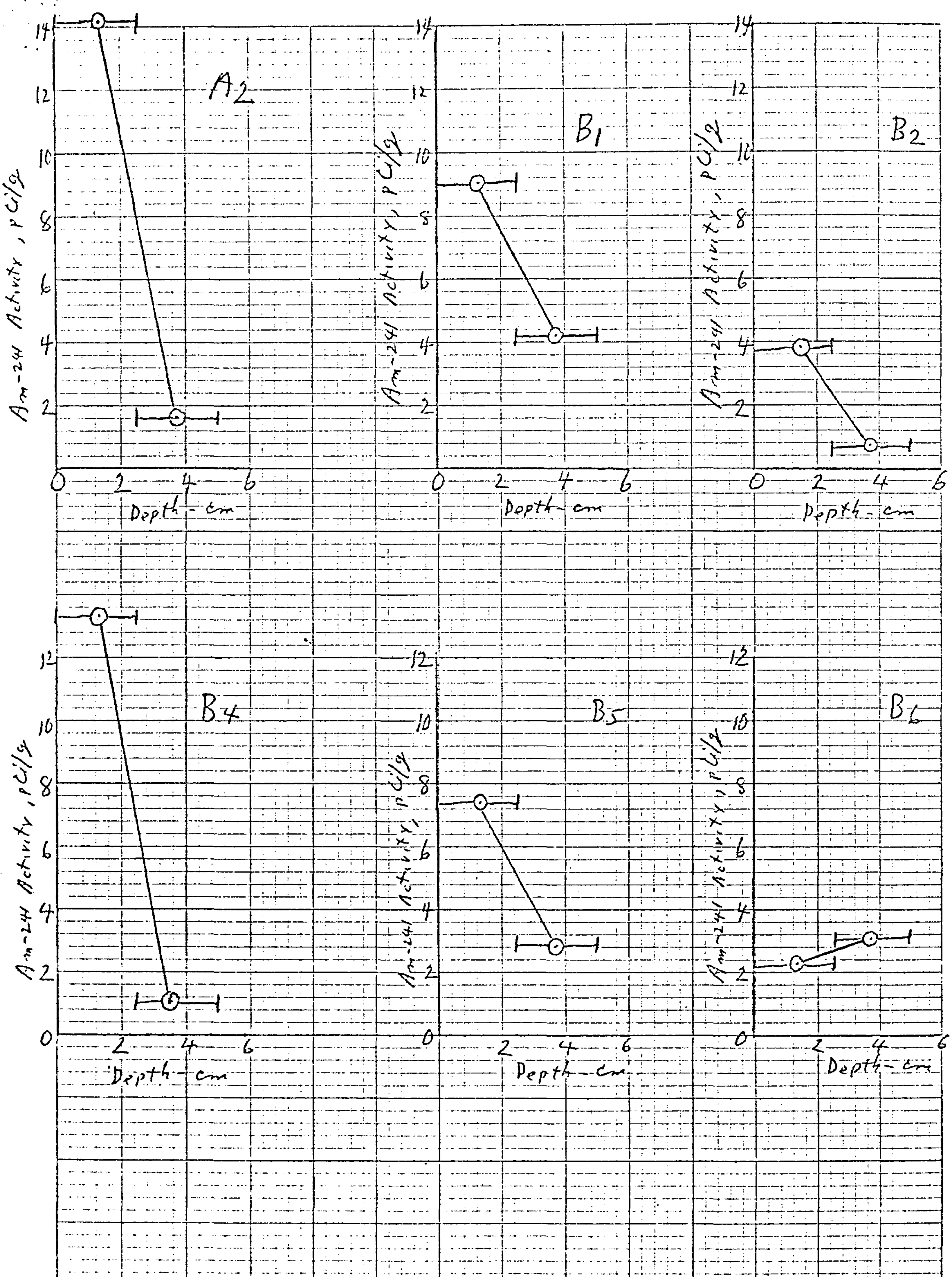
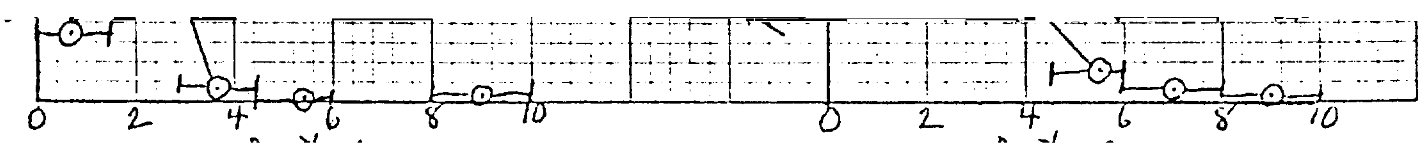


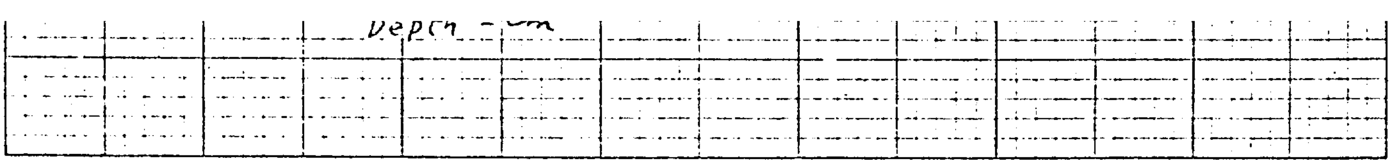
Figure 3. Details of DOE Test Plot.

Figure 4. Detailed Soil Sample Locations in Experimental Areas.


A2
B1
B2
B4
B5
B6
Am-241 Activity, pCi/g
Depth - cm
0
2
4
6
8
10
12
14



0 2 4 6 8 10
0 2 4 6 8 10



241

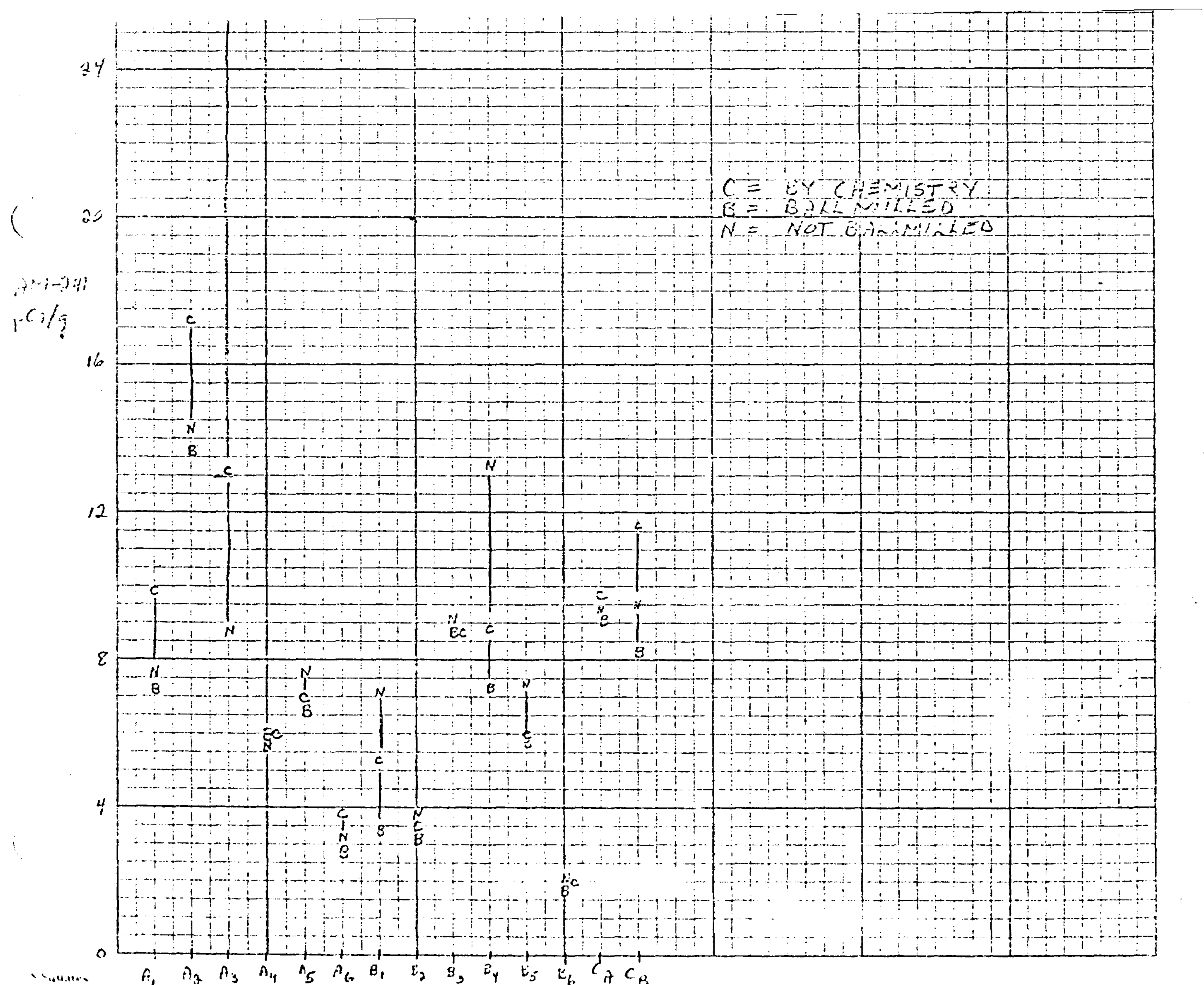

C = BY CHEMISTRY
B = BALL MILLED
N = NOT BALL MILLED
24
20
16
12
8
4
0
A1 A2 A3 A4 A5 A6 B1 B2 B3 B4 B5 B6 CA CB

Figure 8. Plots of the Progressive Accumulated Means of ^{241}Am Values from 3 Stages of Analysis.

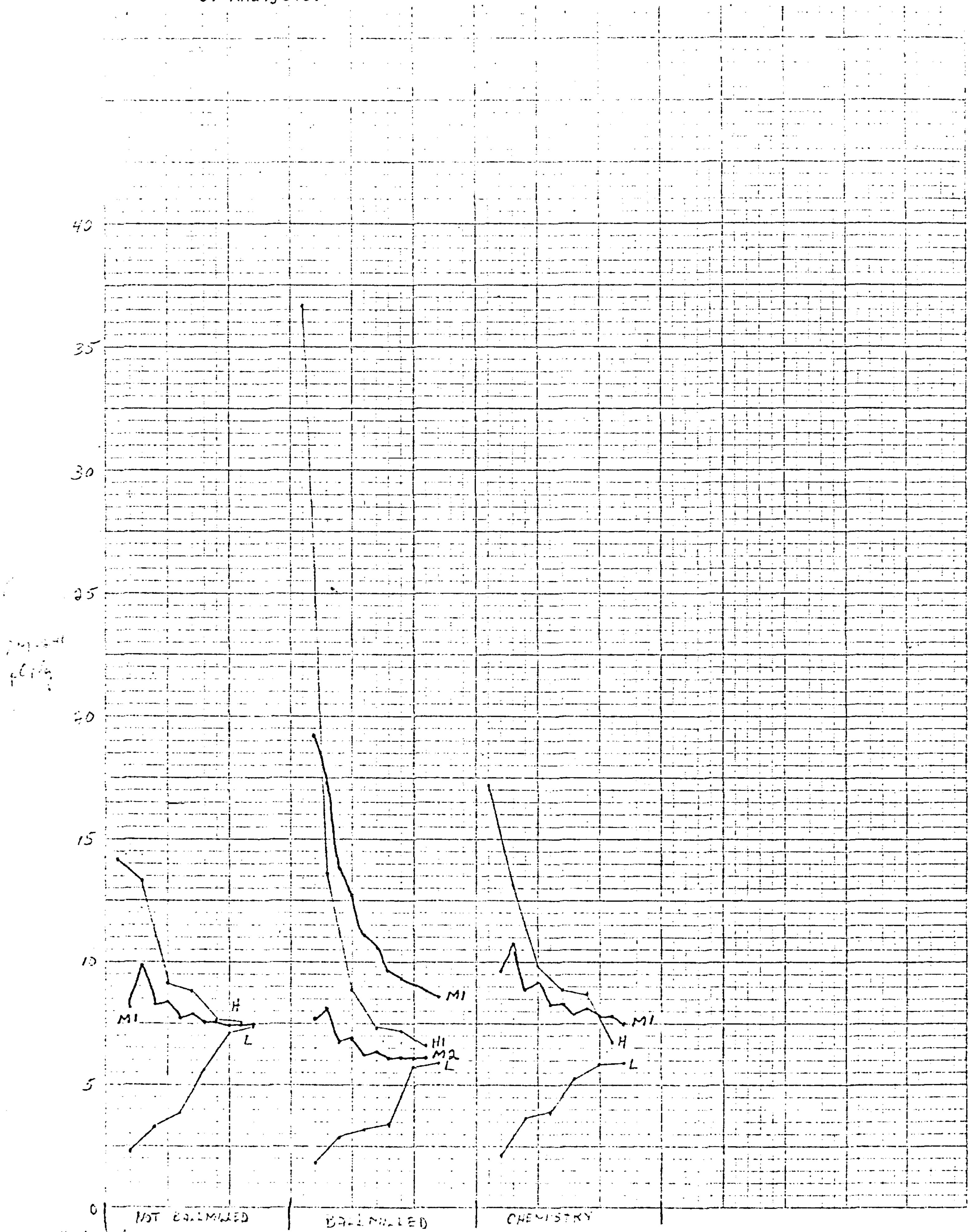
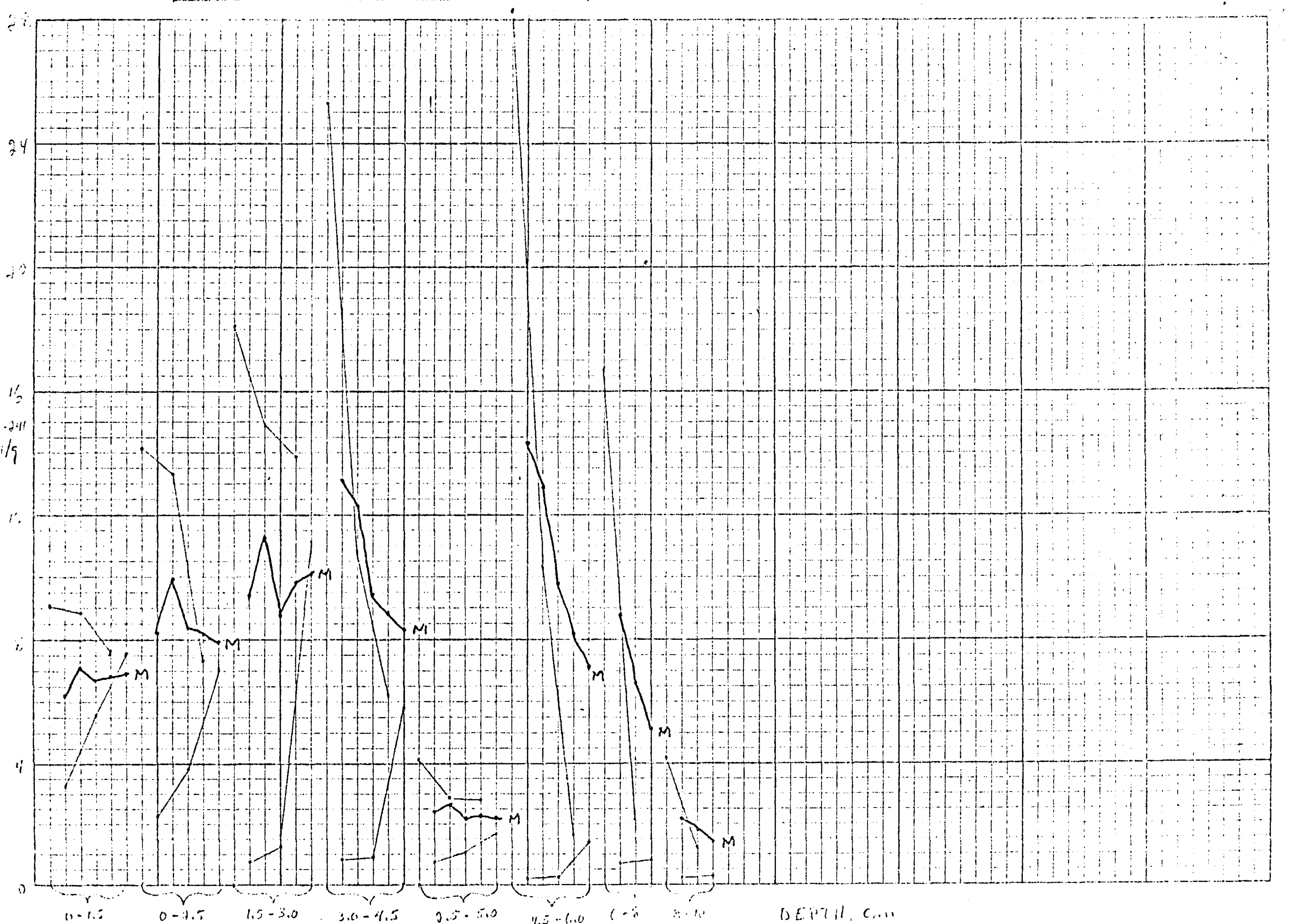
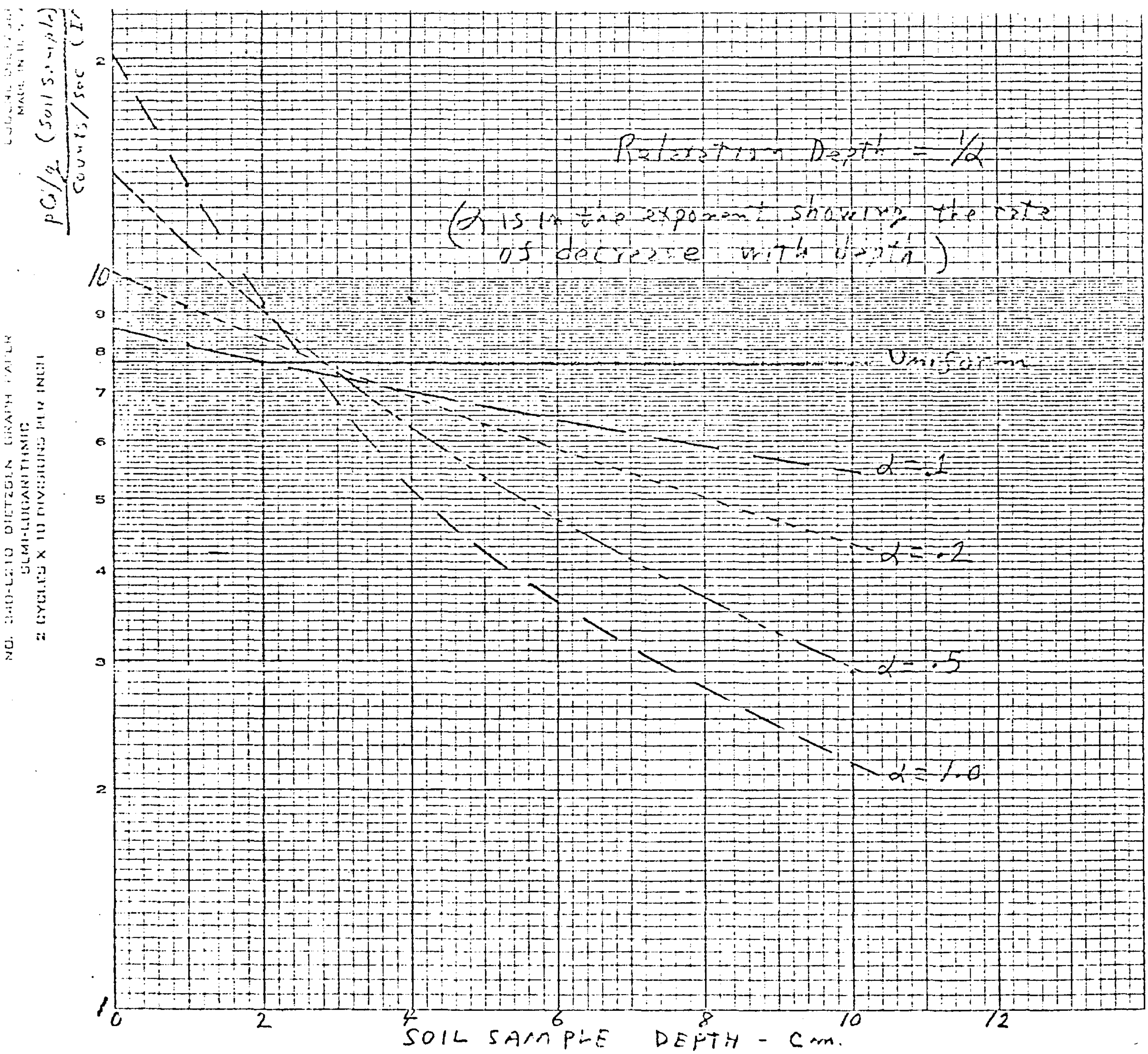


Figure 9. Plots of ^{241}Am, pCi/g from 3 Depths in Experimental Area.





Relaxation Depth = 1/α
(α is in the exponent showing the rate of decrease with depth)
Uniform
α = .1
α = .2
α = .5
α = 1.0
pCi/g (Soil Sample) / Counts/sec (I)
SOIL SAMPLE DEPTH - Cm.
0
2
4
6
8
10
12
1
2
3
4
5
6
7
8
9
10
NO. 340-L210 DIETZGEN GRAPH PAPER
SEMI-LOGARITHMIC
2 CYCLES X 10 DIVISIONS PER INCH

Reviewed by ~~[signature]~~ Date 7/30/11