



A Division of RMI Titanium Company

40-2384

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RMI-MGR:97-020
Docket #040-02384
License #SMB-602

January 30, 1997

Federal Express

Mr. Ron Uleck
Mail Stop T-7F27
U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, MD 20852-2738

Subject: Thorium Levels at RMI

Dear Mr. Uleck:

Enclosed is RMI's position and rationale demonstrating that thorium is not a contaminant of concern at the RMI site. We have attached analytical data to support the argument. Also enclosed please find an updated Table 3-13B, which is to replace the current Table 3-13B in your copy of RDP-ESH-005, *Site Characterization Report for the RMI Titanium Company Extrusion Plant*. The correction is explained in the section entitled, "Evaporator Pond" on page 2 of the position statement.

If you have any questions or comments or if we can be of further assistance, please do not hesitate to contact Eric Marsh of my staff at (216) 993-1909.

Very truly yours,

RMI ENVIRONMENTAL SERVICES

J. W. Henderson
Division Manager

030076

JWH/XJS:bm

Enclosures

cc: E. P. Marsh
X. J. Sroka
R. L. Mason - Niles
P. Lee - US NRC Region III

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PDR ADDOCK 04002384
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Date

1/30/97

From the desk of... Eric Marsh

To Low Uleck

Here are copies of the
Figures you are missing.

3-1A

3-4A

3-4B

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THANKS

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Natural Thorium Levels at the RMI Extrusion Plant

Background Thorium Level

During soil sampling campaigns conducted in 1995, 1996, and 1997, RMI collected background samples from offsite locations outside the influence of the RMI Extrusion Plant. Thorium results for these eleven samples ranged from 1.5 to 2.7 pCi/g⁽¹⁾, and averaged 2.0 ± 0.37 pCi/g (Table 1).

Sampling Throughout the RMI Site

RMI collected sixteen soil samples from onsite locations, the site fenceline, and locations near East 21st Street during the 1996 annual sampling campaign (in addition to the four background samples). Results from these sixteen samples ranged from 1.1 to 3.1 pCi/g, and averaged 2.0 ± 0.45 pCi/g (Table 2). These results were compared to the background results using the Wilcoxon Rank-Sum test⁽²⁾. The results of this test demonstrate that the on-site and background sample thorium results are not statistically different (see Table 9).

RMI also collected 82 samples from Area D in November 1996, and analyzed each sample via gamma spectroscopy for uranium and thorium. The uranium concentrations ranged from 1.7 pCi/g to 360 pCi/g, while the thorium concentrations ranged from 0.8 pCi/g to 2.6 pCi/g and averaged 1.8 ± 0.38 pCi/g (Table 3). This thorium concentration is slightly less than the background concentration of 2.2 pCi/g determined during the 1996 annual soil sampling campaign. When compared to the background, the Area D data are not statistically different (see Table 9).

More significantly is the fact that the thorium results are constant throughout Area D and do not increase with increasing uranium concentrations. This demonstrates that the thorium levels are indeed at background levels. If the thorium contamination were due to RMI operations, the contamination would very likely be nonuniformly distributed, in much the same way the uranium contamination (which is due to RMI operations) is nonuniformly distributed.

A similar comparison between uranium and thorium results was conducted for soil sample results from Areas A (83 samples), C/C-West (290 samples), E (34 samples), and G (37 samples) obtained through prior sampling campaigns. These areas had average thorium contamination levels of 2.0 ± 0.75 , 2.0 ± 0.89 , 1.8 ± 0.44 , and 2.7 ± 1.54 pCi/g respectively (see Tables 4 and 5), and are all not statistically different from the background results (see Table 9). In addition, results for Area C/C-West, for which the maximum uranium concentrations (580 pCi/g) exceeds the 30 pCi/g cleanup level, showed no correlation between thorium results and uranium results over the entire range of uranium results, demonstrating (as above) that the thorium contamination that is present in these areas is background thorium.

As indicated in Section 3.2.3.1 of the SCR, RMI also has thorium data for soil piles containing soil from the Front Yard area and other portions of Area B, and for asphalt taken from the site. The average thorium result for soil from piles containing soil from the Front Yard area and piles

containing soil from other areas of the site are 1.7 ± 0.23 and 2.0 ± 0.79 pCi/g, respectively (Table 6). The *maximum* asphalt thorium concentration was 1.38 pCi/g (Table 7). A statistical comparison with background results confirms that all of these results are not statistically different from background (see Table 9).

Evaporator Pond

The pond sediment thorium results presented in Table 3-13B of the Site Characterization Report (SCR) indicate an average thorium concentration of 6.30 ± 3.63 pCi/g for the evaporation pond area (in Area B), which is measurably above the 2.2 pCi/g background levels. However, a review of the data used to generate Table 3-13B indicates that the thorium values calculated include Th-230 as well as Th-228 and Th-232. Since natural thorium consists only of Th-228 and Th-232, and Th-230 is part of the uranium decay chain, it should not have been included in calculations of natural thorium. In addition, the Th-230 contribution to the thorium results in Table 3-13B is significant, representing more than half the total thorium content in ten out of eleven pond sediment samples.

The corrected pond sediment thorium results (excluding Th-230) range from 1.55 to 3.58 pCi/g, with an average concentration of 2.2 ± 0.58 pCi/g (Table 8), and is not statistically different from background thorium concentrations. It should be noted that these thorium results are equal to background results, even though the total uranium results for pond sediment samples ranged from a *minimum* of 160 pCi/g to 6258 pCi/g.

Summary

The process history of the site, as summarized in the beginning of Section 3.2.3.1 and other sections of the SCR, indicates that a very small percentage - 0.02% - of the radioactive material processed at the RMI Extrusion Plant was thorium. In addition, when thorium operations ceased in 1972 all remaining scrap thorium was removed from the site.

Numerous sampling campaigns over the past few years provide abundant data to show near-constant thorium results, not statistically different from background, throughout the site and in surrounding areas. The thorium concentrations remain constant even though these are areas with widely different uranium concentrations, into hundreds of pCi/g. This suggests a uniform thorium concentration throughout and around the site, and is demonstrably equivalent to a uniform background concentration, not a uniform contamination as a result of plant operations.

Based on the above, thorium levels have been demonstrated to be equivalent to background levels and thorium should **not** be considered a contaminant of concern at the RMI site.

Footnotes

1 - For results based on gamma spectroscopy analyses, total uranium values are based on the U-235 activity plus twice the Th-234 activity, and total thorium results are based on the Ac-228 activity plus the Tl-208 activity divided by 0.36 (to account for a branching ratio in the decay of Tl-208). For results based on alpha spectroscopy, total uranium values are the sum of U-234, U-235, and U-238 results, while total thorium values are the sum of Th-228 and Th-232 results.

2 - Statistical comparisons between thorium results from the various site areas and the background thorium results were performed using the Wilcoxon Rank-Sum test, as described in *Elementary Statistics*, by Mario F. Triola (Addison-Wesley Publishing Company, New York; 1992). With this test, the two sample groups being compared are ranked as a single group, and calculations are performed based on the rankings of the data from one of the sample groups within the combined group. Results of these calculations for all comparisons are presented in Table 9. The Wilcoxon Rank-Sum test was selected because it does not require any assumptions about the shape of distributions being compared; the only requirement for performing the test is that each of the two samples being compared have at least eleven data points. All statistical comparison results are presented at the 95% confidence level.

Table 1: Background Soil Sample Results

Samples collected in 1995, 1996, and 1997

All samples analyzed via gamma spectroscopy.

All results in pCi/g.

Location	Year collected	U-235	Th-234	Total U	Ac-228	Tl-208	Total Th
S-ENE-0.5	1995	0.12	1.00	2.11	0.83	0.31	1.70
S-NNE-0.5	1995	0.13	1.77	3.68	1.30	0.49	2.66
S-S-0.5	1995	0.07	1.38	2.83	0.81	0.33	1.74
S-WSW-0.5	1995	0.12	1.01	2.14	1.10	0.35	2.07
S-ENE-0.5	1996	0.16	1.17	2.50	1.04	0.36	2.05
S-NNE-0.5	1996	0.21	2.01	4.22	1.38	0.39	2.47
S-S-0.5	1996	0.14	1.98	4.10	1.12	0.33	2.03
S-WSW-0.5	1996	0.12	1.54	3.20	1.25	0.36	2.26
Lake Shore Park	1997	0.09	0.83	1.75	0.96	0.24	1.63
Lake Shore Park	1997	0.12	1.05	2.22	0.93	0.31	1.78
Middle Road	1997	0.14	1.03	2.20	0.70	0.28	1.47
Average				2.81			1.99
Standard Deviation				0.86			0.37
Maximum				4.22			2.66
Minimum				1.75			1.47

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Date

1/30/97

From the desk of . . . Eric Marsh

To

Row Uleck

Here are copies of the
Figures you are missing.

3-1A

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THANKS

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2 - Statistical comparisons between thorium results from the various site areas and the background thorium results were performed using the Wilcoxon Rank-Sum test, as described in *Elementary Statistics*, by Mario F. Triola (Addison-Wesley Publishing Company, New York; 1992). With this test, the two sample groups being compared are ranked as a single group, and calculations are performed based on the rankings of the data from one of the sample groups within the combined group. Results of these calculations for all comparisons are presented in Table 9. The Wilcoxon Rank-Sum test was selected because it does not require any assumptions about the shape of distributions being compared; the only requirement for performing the test is that each of the two samples being compared have at least eleven data points. All statistical comparison results are presented at the 95% confidence level.

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All samples analyzed via gamma spectroscopy.
All results in pCi/g.

Location	Year collected	U-235	Th-234	Total U	Ac-228	Tl-208	Total Th
S-ENE-0.5	1995	0.12	1.00	2.11	0.83	0.31	1.70
S-NNE-0.5	1995	0.13	1.77	3.68	1.30	0.49	2.66
S-S-0.5	1995	0.07	1.38	2.83	0.81	0.33	1.74
S-WSW-0.5	1995	0.12	1.01	2.14	1.10	0.35	2.07
S-ENE-0.5	1996	0.16	1.17	2.50	1.04	0.36	2.05
S-NNE-0.5	1996	0.21	2.01	4.22	1.38	0.39	2.47
S-S-0.5	1996	0.14	1.98	4.10	1.12	0.33	2.03
S-WSW-0.5	1996	0.12	1.54	3.20	1.25	0.36	2.26
Lake Shore Park	1997	0.09	0.83	1.75	0.96	0.24	1.63
Lake Shore Park	1997	0.12	1.05	2.22	0.93	0.31	1.78
Middle Road	1997	0.14	1.03	2.20	0.70	0.28	1.47
Average				2.81			1.99
Standard Deviation				0.86			0.37
Maximum				4.22			2.66
Minimum				1.75			1.47

Table 2: 1996 Annual On-Site Soil Sample Results

Samples collected in December 1996

All samples analyzed via gamma spectroscopy.

All results in pCi/g.

SITE #	Location	U-235	TH-234	Total U	AC-228	TL-208	Total Th
S-X-13	East yard	0.46	5.19	10.8	1.27	0.42	2.42
S-X-14	East yard	0.15	3.18	6.51	1.31	0.37	2.33
S-X-6	East yard	1.46	25.6	52.6	1.11	0.38	2.18
S-X-7	East yard	1.56	35.2	71.9	1.00	0.28	1.79
S-OA-1	Fenceline	0.23	2.65	5.53	0.88	0.28	1.66
S-OA-2	Fenceline	0.28	4.44	9.16	0.97	0.26	1.68
S-OA-3	Fenceline	3.64	101	205	0.87	0.27	1.63
S-OA-4	Fenceline	1.12	17.5	36.2	1.09	0.37	2.10
S-OA-5	Fenceline	2.27	47.8	97.9	1.04	0.32	1.92
S-OA-6	Fenceline	0.26	3.04	6.34	1.04	0.45	2.28
S-X-15	Front of site	0.47	5.05	10.6	1.15	0.43	2.35
S-X-16	Front of site	0.10	2.31	4.72	1.58	0.54	3.08
S-X-17	Front yard	0.73	11.4	23.5	0.92	0.33	1.83
S-X-2	Front yard	0.65	10.9	22.4	0.99	0.28	1.78
S-X-4	Front yard	0.13	2.07	4.27	0.63	0.17	1.10
S-X-5	Front yard	2.79	48.1	99.0	0.86	0.33	1.77
Average		1.02	20.33	41.67	1.04	0.34	1.99
Standard Deviation		1.06	26.73	54.50	0.22	0.09	0.45
Maximum		3.64	101	205	1.58	0.54	3.08
Minimum		0.10	2.07	4.27	0.63	0.17	1.10

Table 3: Area D Uranium and Thorium comparison

Samples collected in November 1996.

Samples analyzed via gamma spectroscopy.

All results in pCi/g.

Location	U-235	Th-234	Total U	Ac-228	Tl-208	Total Th
AA-27	0.12	0.91	1.93	1.18	0.33	2.09
GG-3	0.11	1.05	2.21	1.02	0.40	2.13
EE-1	0.12	1.12	2.36	1.09	0.37	2.12
AA-17	0.16	1.13	2.42	0.36	0.26	1.07
CC-27	0.18	1.17	2.52	1.09	0.26	1.80
EE-27	0.11	1.23	2.57	1.14	0.41	2.29
EE-29	0.23	1.24	2.71	1.08	0.41	2.21
AA-25	0.15	1.28	2.71	1.15	0.37	2.19
CC-29	0.18	1.29	2.76	1.18	0.40	2.30
GG-1	0.10	1.35	2.80	0.76	0.22	1.38
Y-25	0.16	1.36	2.88	0.80	0.26	1.53
CC-23	0.14	1.40	2.94	0.27	0.36	1.26
EE-25	0.15	1.41	2.97	1.11	0.41	2.24
BB-28	0.17	1.43	3.03	1.09	0.39	2.17
GG-7	0.19	1.45	3.09	0.98	0.29	1.77
EE-23	0.14	1.57	3.28	0.27	0.35	1.23
EE-3	0.12	1.59	3.29	1.00	0.30	1.84
EE-7	0.21	1.58	3.37	0.98	0.37	2.02
AA-3	0.21	1.67	3.55	1.18	0.44	2.40
EE-5	0.20	1.77	3.74	1.20	0.27	1.95
X-16	0.12	1.90	3.92	0.25	0.23	0.88
AA-29	0.13	2.04	4.22	1.01	0.31	1.87
CC-1	0.15	2.24	4.62	0.97	0.34	1.90
Y-1	0.12	2.29	4.70	0.92	0.30	1.76
EE-13	0.17	2.34	4.84	1.09	0.32	2.00
Y-3	0.14	2.43	4.99	1.18	0.41	2.30
AA-23	0.20	2.41	5.01	1.09	0.31	1.95
AA-5	0.20	2.40	5.01	0.83	0.31	1.70
AA-21	0.16	2.43	5.02	0.99	0.34	1.94
EE-17	0.16	2.47	5.10	0.90	0.31	1.75
CC-21	0.13	2.53	5.18	0.87	0.30	1.71
Y-23	0.19	2.52	5.23	0.87	0.29	1.68
Z-14	0.20	2.55	5.31	1.09	0.30	1.92
EE-19	0.21	2.58	5.36	0.30	0.26	1.02
CC-7	0.18	2.65	5.48	0.91	0.26	1.62
EE-21	0.14	2.69	5.53	0.86	0.32	1.76
CC-19	0.15	2.73	5.60	0.84	0.30	1.68
GG-5	0.24	2.74	5.72	0.84	0.25	1.53
Z-4	0.27	2.82	5.91	0.99	0.33	1.89
CC-25	0.19	2.95	6.08	1.29	0.36	2.29
Z-3	0.26	3.13	6.52	1.23	0.45	2.47
GG-9	0.20	3.17	6.54	1.08	0.27	1.84
Y-19	0.15	3.26	6.68	0.66	0.20	1.22
AA-7	0.27	3.22	6.71	0.82	0.31	1.68
EE-15	0.25	3.52	7.30	0.92	0.37	1.95
CC-9	0.25	3.58	7.40	0.87	0.31	1.74
AA-1	0.28	3.89	8.06	1.35	0.46	2.62
Y-15	0.29	3.91	8.11	1.11	0.30	1.93
EE-9	0.28	4.37	9.02	1.08	0.39	2.16
CC-15	0.32	4.37	9.06	0.93	0.30	1.78
CC-17	0.25	4.44	9.13	0.95	0.33	1.86

Table 3: Area D Uranium and Thorium comparison

Samples collected in November 1996.

Samples analyzed via gamma spectroscopy.

All results in pCi/g.

Location	U-235	Th-234	Total U	Ac-228	Tl-208	Total Th
CC-3	0.30	4.61	9.51	0.94	0.32	1.82
EE-11	0.29	4.97	10.2	1.09	0.34	2.05
AA-19	0.22	5.16	10.5	0.10	0.26	0.82
Y-17	0.31	5.20	10.7	0.67	0.18	1.18
AA-15	0.25	5.60	11.5	0.78	0.18	1.29
AA-9	0.35	5.83	12.0	0.95	0.31	1.82
Y-8	0.33	5.94	12.2	1.02	0.28	1.80
CC-5	0.32	5.98	12.3	1.20	0.38	2.25
CC-11	0.33	6.00	12.3	0.96	0.37	1.97
Y-5	0.32	6.46	13.2	0.86	0.29	1.65
Y-21	0.35	7.24	14.8	0.87	0.21	1.45
AA-11	0.42	7.23	14.9	0.72	0.26	1.44
X-7	0.40	7.88	16.2	0.90	0.26	1.63
Y-4	0.46	9.19	18.8	1.14	0.30	1.99
CC-13	0.51	9.20	18.9	0.22	0.30	1.04
X-14	0.44	9.61	19.7	1.04	0.39	2.12
Y-9	0.57	10.3	21.2	0.84	0.28	1.61
BB-12	0.53	11.2	23.0	1.03	0.33	1.94
X-11-12	0.84	11.1	23.0	0.87	0.23	1.49
X-15	0.52	11.2	23.0	0.93	0.29	1.74
Y-13	0.82	14.6	30.0	1.11	0.35	2.07
AA-13	0.78	16.9	34.6	0.83	0.36	1.84
Z-10	1.12	24.0	49.1	1.08	0.32	1.96
X-13-12	1.12	29.3	59.6	1.16	0.41	2.31
Z-12	1.80	36.3	74.4	0.92	0.28	1.70
X-11	3.81	57.0	118	0.80	0.29	1.59
X-12	5.01	81.3	168	1.21	0.35	2.20
Y-11-12	6.46	102	210	0.97	0.33	1.90
X-13	4.76	143	291	1.29	0.34	2.24
Y-11	10.5	175	360	1.26	0.46	2.53

# of data points	81	81
Average	24.0	1.82
Standard deviation	58.5	0.38
Minimum	1.93	0.82
Maximum	360	2.62

Regression Output:

Constant	1.788113
Std Err of Y Est	0.369878
R Squared	0.055805
No. of Observations	81
Degrees of Freedom	79

X Coefficient(s)	0.001527
Std Err of Coef.	0.000706

Table 4: Area C/C-West Uranium and Thorium comparison
 Samples collected in Spring and Summer 1993, and in June 1995.
 Samples analyzed via gamma spectroscopy.
 All results in pCi/g.

Location	U-235	Th-234	Total U	Ac-228	Tl-208	Total Th
T-22-18	0.08	0.34	0.77	0.58	0.23	1.22
R-22-24	0.13	0.72	1.58	1.07	0.28	1.84
V-18-24	0.09	0.79	1.67	0.57	0.18	1.07
C-15-24	0.14	0.81	1.76	1.16	0.33	2.08
D-22-12	0.10	0.83	1.77		0.75	2.08
N-20-18	0.10	0.97	2.03	0.89	0.28	1.68
B-24-24	0.12	0.96	2.04	0.81	0.28	1.59
V-24-18	0.12	0.97	2.05	1.15	0.30	2.00
OG-01	0.12	0.99	2.09	1.36	0.43	2.56
V-18-18	0.08	1.01	2.10	0.48	0.19	1.00
B-22-24	0.11	1.05	2.21	1.02	0.34	1.98
N-22-18	0.11	1.07	2.25	0.89	0.28	1.66
U-21-18	0.12	1.08	2.28	1.01	0.31	1.86
L-18-24	0.15	1.08	2.31	1.06	0.37	2.08
H-18-18	0.09	1.12	2.33	0.93	0.30	1.76
T-22-12	0.12	1.11	2.34	0.93	0.31	1.78
M-16-24	0.14	1.11	2.36	1.24	0.35	2.21
R-22-12	0.18	1.10	2.38	0.20	0.24	0.87
T-20-18	0.10	1.15	2.40	1.01	0.27	1.76
U-21-12	0.13	1.17	2.47	0.99	0.27	1.75
-B-26	0.21	1.14	2.49	1.18	0.36	2.19
D-16-18	0.15	1.18	2.51	1.01	0.30	1.84
N-22-24	0.13	1.21	2.55	0.97	0.25	1.68
H-26-18	0.09	1.23	2.55	0.91	0.30	1.73
B-20-24	0.10	1.24	2.58	1.36	0.42	2.51
D-16-24	0.09	1.26	2.61	0.84	0.31	1.69
N-24-24B	0.20	1.21	2.62	1.15	0.35	2.13
L-20-18	0.15	1.24	2.63	1.11	0.30	1.96
L-20-12	0.18	1.24	2.66	0.90	0.33	1.81
N-16-24	0.18	1.24	2.66	1.13	0.33	2.06
M-18-18	0.13	1.27	2.67	0.87	0.30	1.71
N-16-18	0.19	1.26	2.71	1.02	0.26	1.74
N-26-18	0.10	1.31	2.72	1.06	0.28	1.84
C-15-12	0.14	1.29	2.72	0.87	0.25	1.57
B-16-24	0.14	1.29	2.73	0.97	0.34	1.91
A-25	0.25	1.26	2.77	0.93	0.29	1.75
B-20	0.10	1.34	2.78	1.30	0.33	2.21
X-15-12	0.14	1.32	2.78	0.72	0.24	1.38
P-16-24	0.16	1.31	2.78	0.88	0.27	1.63
D-20	0.15	1.32	2.79	0.22	0.25	0.92
P-16-18	0.16	1.32	2.80	0.25	0.31	1.12
-C-27	0.31	1.27	2.85	1.47	0.48	2.80
V-24-24	0.10	1.39	2.88	0.97	0.34	1.92
D-20-B	0.18	1.35	2.88	1.00	0.30	1.84
O-22-24	0.13	1.38	2.89	1.08	0.37	2.09
N-21-18	0.18	1.36	2.90	0.98	0.31	1.85
P-22-24	0.15	1.39	2.93	0.96	0.32	1.86
N-21	1.25	0.84	2.93		0.68	1.89
N-22	0.17	1.39	2.95	0.82	0.19	1.34
-B-27	0.24	1.41	3.06	1.29	0.42	2.46
B-26-18	0.22	1.42	3.06	1.03	0.35	2.01
S-25-12	0.16	1.46	3.08	0.96	0.28	1.74
J-18-18B	0.21	1.45	3.11	0.78	0.29	1.57
H-18-12	0.14	1.49	3.11	0.79	0.24	1.46
I-15-24	0.25	1.43	3.11	1.10	0.37	2.14
D-22-12B	0.09	1.51	3.11	1.09	0.35	2.06
R-20-12	0.17	1.48	3.13	0.82	0.26	1.54
OG-18	0.27	1.44	3.15	1.13	0.36	2.13
T-20	0.29	1.45	3.19	0.79	0.23	1.44
R-20	0.25	1.50	3.25	1.12	0.31	1.98
D-16	0.25	1.53	3.31	0.93	0.36	1.92
N-26-12	0.09	1.63	3.35	0.97	0.34	1.93
X-15-18	0.10	1.63	3.36	0.53	0.19	1.06
D-22-18	0.14	1.62	3.38	1.13	0.27	1.88

Table 4: Area C/C-West Uranium and Thorium comparison
 Samples collected in Spring and Summer 1993, and in June 1995.
 Samples analyzed via gamma spectroscopy.
 All results in pCi/g.

Location	U-235	Th-234	Total U	Ac-228	Tl-208	Total Th
U-21-24	0.10	1.65	3.41	1.07	0.32	1.97
R-22-18	0.09	1.66	3.41	1.10	0.34	2.05
V-24-12	0.16	1.63	3.42	0.11	0.06	0.28
OG-17	0.17	1.63	3.43	0.94	0.35	1.91
C-15-18	0.21	1.64	3.48	1.22	0.34	2.15
B-20-12	0.10	1.69	3.49	1.09	0.39	2.17
L-26-24	0.15	1.67	3.49	0.96	0.33	1.88
N-26-24	0.10	1.70	3.50	0.98	0.33	1.89
-C-20	0.24	1.64	3.52	1.28	0.50	2.67
-C-24	0.21	1.66	3.53	1.10	0.32	1.99
L-20-24	0.17	1.69	3.56	1.24	0.35	2.21
B-22	0.17	1.71	3.59	0.98	0.28	1.77
H-26-24	0.18	1.71	3.60	1.00	0.28	1.79
-B-22	0.05	1.78	3.62	0.77	0.22	1.37
M-16-18B	0.13	1.75	3.63	0.99	0.33	1.91
T-20-12	0.12	1.76	3.64	0.23	0.30	1.05
N-20-12	0.09	1.79	3.67	0.85	0.28	1.63
B-24-18	0.15	1.76	3.68	0.88	0.27	1.63
B-22-18	0.20	1.76	3.72	0.92	0.37	1.96
N-22-12	0.09	1.82	3.73	0.91	0.22	1.53
S-25-18	0.15	1.79	3.73	0.97	0.30	1.81
R-24-12	0.16	1.81	3.77	0.99	0.30	1.82
A-24	0.21	1.80	3.82	0.90	0.28	1.68
L-24-24	0.09	1.88	3.85	1.03	0.33	1.95
H-24-12	0.13	1.86	3.85	0.75	0.32	1.65
O-22-12	0.30	1.78	3.86	0.81	0.30	1.63
N-20-12B	0.16	1.86	3.88	0.80	0.07	0.99
-C-22	0.27	1.81	3.89	0.79	0.27	1.53
K-27	0.15	1.90	3.94	0.25	0.31	1.09
V-24	0.16	1.89	3.94	1.11	0.28	1.88
L-20-18-B	0.18	1.89	3.96	1.06	0.36	2.05
S-23-24	0.18	1.94	4.06	1.00	0.31	1.87
P-20-18	0.23	1.93	4.09	0.97	0.32	1.86
T-20-24	0.14	1.98	4.09	0.77	0.27	1.53
B-20-18	0.13	2.03	4.19	1.14	0.36	2.15
N-24-24	0.20	2.04	4.28	1.06	0.36	2.05
M-27-18	0.03	2.15	4.33	0.17	0.03	0.24
L-26-18	0.23	2.08	4.39	1.05	0.46	2.33
OG-12	0.39	2.01	4.41	3.30	1.06	6.24
O-22-18	0.14	2.15	4.44	0.86	0.31	1.70
L-24-12	0.16	2.15	4.46	0.80	0.33	1.72
F-26-12	0.14	2.18	4.51	1.04	0.28	1.83
B-16-18	0.13	2.20	4.52	0.97	0.34	1.91
B-18	0.14	2.20	4.54	0.80	0.31	1.67
J-26	0.16	2.28	4.72	1.02	0.27	1.77
D-18	0.20	2.26	4.73	0.88	0.32	1.78
P-22-12	0.19	2.27	4.73	0.78	0.30	1.61
S-25	0.23	2.25	4.73	1.03	0.30	1.86
P-22-18	0.15	2.33	4.80	0.95	0.25	1.64
C-27	0.26	2.27	4.80	1.19	0.37	2.22
M-27-12	0.26	2.28	4.82	0.81	0.30	1.63
B-24	0.19	2.32	4.83	1.04	0.07	1.23
B-22-12	0.09	2.38	4.85	1.08	0.47	2.38
V-18-12	0.21	2.33	4.87	0.71	0.06	0.88
R-22-12B	0.20	2.35	4.89	0.81	0.23	1.46
L-26-12	0.34	2.43	5.20	1.27	0.44	2.49
D-16-12	0.13	2.54	5.21	0.99	0.31	1.86
F-18	0.23	2.53	5.29	1.04	0.35	2.02
-D-22	0.43	2.47	5.37	1.56	0.47	2.88
S-20-12	0.23	2.59	5.41	0.90	0.29	1.70
F-16	0.20	2.67	5.53	1.09	0.32	1.98
A-23	0.24	2.67	5.58	1.22	0.44	2.44
U-21	0.19	2.77	5.74	0.82	0.24	1.50
M-18-12	0.18	2.81	5.81	1.02	0.30	1.85

Table 4: Area C/C-West Uranium and Thorium comparison
 Samples collected in Spring and Summer 1993, and in June 1995.
 Samples analyzed via gamma spectroscopy.
 All results in pCi/g.

Location	U-235	Th-234	Total U	Ac-228	Tl-208	Total Th
-B-24	0.25	2.78	5.81	1.11	0.31	1.97
F-15	0.23	2.84	5.92	0.83	0.35	1.79
M-16-18	0.21	2.87	5.96	1.03	0.34	1.97
S-22-18	0.26	2.91	6.09	0.94	0.28	1.73
S-17-12	0.21	2.97	6.15	0.68	0.25	1.37
H-20-12	0.15	3.06	6.26	0.96	0.07	1.17
D-22	0.16	3.19	6.54	1.16	0.41	2.30
A-20	0.27	3.14	6.55	1.08	0.32	1.97
J-18-18	0.19	3.24	6.67	1.01	0.30	1.85
L-24	0.14	3.34	6.83	0.81	0.27	1.56
J-16	0.26	3.34	6.94	0.18	0.07	0.38
S-23-18	0.29	3.33	6.96	0.80	0.37	1.82
-D-28	0.35	3.36	7.07	1.30	0.40	2.41
H-16B	0.23	3.67	7.58	0.90	0.31	1.75
L-22	0.21	3.74	7.69	0.88	0.33	1.79
A-27	0.42	3.66	7.74	1.51	0.44	2.75
V-22	0.26	3.75	7.76	0.86	0.28	1.63
N-16-12	0.23	3.82	7.87	0.82	0.30	1.65
P-16-12	0.23	3.93	8.10	0.82	0.25	1.52
OG-07	0.49	3.81	8.10	1.60	0.45	2.84
T-22	0.25	3.96	8.16	0.22	0.07	0.41
P-22	0.27	3.96	8.20	0.15	0.05	0.30
B-16-12	0.22	4.04	8.31	0.23	0.26	0.95
N-26	0.17	4.09	8.34	1.10	0.25	1.80
H-26	0.28	4.05	8.39	0.96	0.32	1.85
T-18	0.20	4.10	8.40	0.95	0.23	1.60
B-24-12	0.07	4.20	8.47	0.89	0.25	1.59
P-24	0.24	4.13	8.51	0.86	0.25	1.56
B-28	0.55	4.06	8.67	1.56	0.47	2.86
B-26	0.39	4.17	8.73	1.28	0.47	2.58
-E-27	0.50	4.24	8.98	1.40	0.48	2.73
R-18	0.26	4.42	9.09	0.83	0.25	1.52
H-16	0.31	4.40	9.11	0.81	0.27	1.55
M-20	0.32	4.40	9.13	0.87	0.29	1.69
OG-14	0.61	4.39	9.39	1.85	0.66	3.69
-B-28	0.65	4.44	9.52	1.61	0.58	3.21
N-24-18	0.21	4.68	9.57	1.03	0.07	1.22
U-24	0.27	4.69	9.64	0.29	0.25	1.00
K-20	0.31	4.67	9.66	1.23	0.36	2.22
H-24	0.21	4.79	9.80	1.00	0.28	1.79
OG-13	0.36	4.72	9.80	2.91	0.91	5.43
OG-21	0.68	4.63	9.94	1.63	0.58	3.25
U-20	0.29	4.90	10.1	0.71	0.25	1.41
A-B20	0.34	4.95	10.2	1.05	0.32	1.92
OG-05	0.81	4.74	10.3	0.37	0.62	2.09
OG-23	0.59	4.85	10.3	1.96	0.47	3.27
T-24	0.27	5.06	10.4	0.23	0.25	0.94
L-16-24	0.01	5.28	10.6	0.74	0.29	1.56
Q-23	0.30	5.37	11.0	0.81	0.29	1.61
F-26B	0.56	5.38	11.3	1.20	0.32	2.10
J-20	0.29	5.55	11.4	0.06	0.02	0.12
OG-15	0.60	5.42	11.4	2.18	0.64	3.96
A-21	0.40	5.56	11.5	1.13	0.35	2.10
-B-20	0.42	5.58	11.6	0.98	0.34	1.94
OG-08	0.72	5.51	11.7	2.16	0.63	3.90
-E-26	0.39	5.87	12.1	0.44	0.48	1.79
H-20	0.29	5.98	12.2	0.98	0.25	1.69
P-20-12	0.03	6.44	12.9	0.23	0.05	0.36
-D-26	0.49	6.30	13.1	1.23	0.41	2.36
OG-22	0.73	6.43	13.6	1.93	0.64	3.70
R-24	0.30	7.00	14.3	0.89	0.26	1.61
L-18-18	0.36	7.04	14.4	1.09	0.30	1.93
I-15-18B	0.44	7.27	15.0	0.84	0.33	1.75
K-18	0.28	7.41	15.1	0.79	0.26	1.52

Table 4: Area C/C-West Uranium and Thorium comparison
 Samples collected in Spring and Summer 1993, and in June 1995.
 Samples analyzed via gamma spectroscopy.
 All results in pCi/g.

Location	U-235	Th-234	Total U	Ac-228	Tl-208	Total Th
-D-27	1.01	7.07	15.1	2.66	0.92	5.22
OG-10	0.98	7.31	15.6	2.33	0.68	4.21
X-17	0.34	7.73	15.8	0.59	0.20	1.14
R-24B	0.33	7.96	16.3	1.06	0.26	1.78
L-20	0.33	7.99	16.3	0.88	0.32	1.70
C-15	0.37	8.01	16.4	0.91	0.29	1.71
H-18	0.42	8.12	16.7	0.91	0.22	1.52
-F-28	0.77	8.00	16.8	2.16	0.64	3.93
H-26-12	0.45	8.28	17.0	1.04	0.39	2.14
M-27	0.87	8.19	17.3	1.52	0.58	3.14
H-15-12	0.01	9.06	18.1	0.03	0.01	0.06
A-28	1.30	8.53	18.4	2.42	0.67	4.27
-C-25	0.07	9.21	18.5	1.31	0.33	2.23
L-26	0.76	9.14	19.0	2.01	0.51	3.41
B-16	0.56	9.55	19.7	0.85	0.35	1.78
M-18	0.42	9.74	19.9	1.10	0.21	1.68
OG-04	0.97	9.49	19.9	1.58	0.61	3.28
I-15-18	0.44	9.86	20.1	1.06	0.30	1.89
-C-23	0.66	9.86	20.4	1.41	0.49	2.77
P-18	0.50	10.1	20.7	0.62	0.26	1.35
-C-21	0.49	10.2	21.0	1.23	0.42	2.40
F-26	1.00	10.1	21.2	2.00	0.71	3.97
N-18B	0.51	10.4	21.2	0.97	0.28	1.74
OG-11	0.66	10.4	21.4	2.82	0.86	5.21
V-18	0.48	10.6	21.6	0.59	0.24	1.26
S-22-12	0.51	10.7	21.9	0.83	0.36	1.83
OG-19	1.11	10.7	22.5	4.27	0.98	7.00
V-16	0.49	11.4	23.3	0.54	0.14	0.94
N-21-12B	0.40	11.9	24.2	0.77	0.31	1.64
S-20	0.80	12.0	24.7	0.94	0.32	1.84
N-24-12	0.47	12.2	24.8	0.88	0.30	1.72
-F-26	0.70	12.3	25.3	0.23	0.39	1.32
N-18	0.49	12.5	25.4	0.79	0.27	1.54
M-16-12	0.50	12.8	26.2	0.90	0.38	1.94
OG-03	0.98	12.8	26.5	2.12	0.61	3.81
OG-24	1.32	12.7	26.7	1.81	0.59	3.44
Q-20	0.60	13.1	26.9	0.25	0.06	0.40
X-15	0.62	13.2	27.0	0.97	0.33	1.88
J-18-12	0.62	13.2	27.0	1.12	0.37	2.15
OG-06	1.36	12.8	27.0	2.06	0.60	3.73
OG-20	1.42	12.9	27.1	2.20	0.80	4.41
N-16	0.69	13.4	27.6	0.94	0.25	1.65
O-15-18	0.47	13.6	27.7	1.06	0.26	1.77
L-18-12	0.60	13.7	28.0	0.87	0.33	1.77
P-16	0.65	13.9	28.4	0.83	0.25	1.53
-D-24	0.84	14.7	30.2	0.94	0.28	1.71
OG-16	1.48	14.4	30.3	2.72	0.71	4.68
O-22	0.66	15.7	32.0	0.81	0.28	1.59
X-16	0.64	16.1	32.9	0.67	0.22	1.30
O-21	0.62	16.1	32.9	0.27	0.30	1.10
-E-25	0.89	16.2	33.4	1.59	0.46	2.85
K-16-18	0.64	16.5	33.6	0.94	0.36	1.94
-D-25	1.31	16.4	34.0	2.00	0.60	3.60
N-21-12	0.53	16.8	34.0	0.73	0.25	1.42
S-15-24	0.86	17.7	36.3	0.98	0.28	1.76
OG-09	1.55	17.7	36.9	2.30	0.71	4.27
K-16	1.05	18.6	38.2	0.77	0.30	1.60
OG-02	0.85	18.8	38.4	1.01	0.28	1.79
A-26	0.76	19.3	39.4	0.95	0.30	1.78
T-16	0.82	20.0	40.8	0.59	0.22	1.21
X-15B	0.69	21.0	42.7	0.90	0.29	1.72
S-23-12	0.93	21.1	43.1	0.92	0.29	1.74
R-16	0.07	21.9	43.9	0.30	0.30	1.12
U-15-24	1.16	21.7	44.7	0.90	0.31	1.76

Table 4: Area C/C-West Uranium and Thorium comparison
 Samples collected in Spring and Summer 1993, and in June 1995.
 Samples analyzed via gamma spectroscopy.
 All results in pCi/g.

Location	U-235	Th-234	Total U	Ac-228	Tl-208	Total Th
S-15-18	1.42	22.3	45.9	0.90	0.26	1.63
I-15-12	1.22	23.7	48.6	0.93	0.33	1.86
U-15-18	1.75	26.7	55.2	0.68	0.20	1.23
R-15	1.31	29.3	59.9	0.68	0.23	1.33
L-16-18	1.13	30.1	61.3	0.84	0.25	1.52
L-15-18	1.16	30.2	61.6	0.81	0.23	1.44
L-26-12B	1.02	30.4	61.7	0.12	0.10	0.40
N-24	1.00	34.5	69.9	0.91	0.29	1.71
H-15	1.41	36.1	73.6	1.06	0.35	2.03
O-15-12	1.69	40.1	81.9	0.80	0.32	1.70
J-18	1.90	40.9	83.6	0.96	0.36	1.95
-C-26	2.67	46.5	95.6	1.50	0.40	2.61
L-18	1.66	47.2	96.2	0.95	0.36	1.97
S-22	1.97	48.0	98.0	0.94	0.37	1.97
M-16	1.56	50.9	103	0.74	0.27	1.48
K-16-12	1.67	51.4	105	1.04	0.08	1.25
A-26	2.49	51.4	105	1.58	0.58	3.19
P-20	2.30	62.3	127	1.00	0.31	1.87
O-18	2.40	65.8	134	0.86	0.27	1.61
I-15	2.52	68.6	140	0.92	0.39	1.99
L-15-12	2.57	71.9	146	1.08	0.31	1.95
B-26	3.67	79.5	163	1.63	0.57	3.21
L-16-12	3.47	80.4	164	1.12	0.32	1.99
I-21-12	3.26	85.9	175	1.06	0.33	1.97
L-15	3.00	93.0	189	1.00	0.24	1.66
U-15-12	5.96	113	233	0.78	0.26	1.50
S-23B	5.55	128	262	1.02	0.30	1.85
S-23	5.58	133	271	0.97	0.35	1.94
S-15	4.80	134	272	0.67	0.24	1.33
O-15	4.68	139	283	0.79	0.28	1.57
L-16	6.06	173	352	1.22	0.26	1.93
I-21B	7.55	173	354	1.00	0.37	2.04
I-21	9.98	261	531	1.33	0.48	2.66
U-15	14.76	283	581	1.14	0.38	2.19

# of data points	290	290
Average	29.0	1.96
Standard deviation	67.9	0.88
Minimum	0.77	0.06
Maximum	581	7.00

Regression Output:

Constant	1.955944
Std Err of Y Est	0.884656
R Squared	0.000494
No. of Observations	290
Degrees of Freedom	288

X Coefficient(s)	0.000289
Std Err of Coef.	0.000766

Table 5: Natural Thorium Results for Areas A, E, and G

All samples analyzed via gamma spectroscopy
All results are in pCi/g

Area A

Samples collected in June 1993

Site	Ac-228	Tl-208	Total Th
A-1	1.19	0.39	2.28
-A-10		0.26	0.72
-A-10-12	1.05	0.34	1.99
-A-10-18	0.89	0.34	1.84
-A-10-18B	0.96	0.39	2.04
A-1-12	0.90	0.25	1.60
A-14-12		0.34	0.95
-A-15	1.29	0.38	2.36
-A-15-12	1.07	0.32	1.96
-A-15-12B	1.04	0.32	1.92
-A-4	1.00	0.24	1.66
-A-4-12	0.80	0.25	1.50
-B-1	0.90	0.26	1.61
-B-1-12	0.80	0.23	1.43
-B-13	0.44	0.15	0.87
-B-16	1.04	0.33	1.96
-B-17	1.02	0.37	2.05
-C-1	0.35	0.11	0.67
-C-1-12		0.23	0.64
-C-1-18	1.12	0.40	2.23
-C-1-24	1.25	0.45	2.51
-C-14		0.11	0.29
-C-14-12	0.79	0.24	1.46
-C-14-18	0.98	0.36	1.97
-C-14-24	1.22	0.33	2.13
-C-8	0.79	0.29	1.61
-C-8-12	1.13	0.39	2.22
-C-8-18	1.10	0.40	2.21
-C-8-24	1.11	0.32	2.01
-D-0	1.41	0.45	2.66
-D-0-12		0.31	0.86
-D-0-18	1.22	0.39	2.29
-D-0-24	1.03	0.50	2.41
-D-15	0.83	0.29	1.63
-D-15-12	1.09	0.32	1.98
-D-15-18	0.79	0.32	1.67
-D-17	1.46	0.34	2.41
-D-17-12	0.93	0.34	1.89
-D-17B	1.36	0.41	2.49
-E-10		0.11	0.31
-E-12	0.56	0.25	1.25
-E-12-12	1.07	0.31	1.92
-E-12-18	1.39	0.48	2.72
-E-12-24	1.13	0.39	2.22
-E-7	0.83	0.31	1.70
-F-0	1.14	0.40	2.26
-F-0-12	1.24	0.45	2.49
-F-0-18	1.34	0.40	2.45
-F-0-24	1.09	0.40	2.20

Area A (continued)

Samples collected in June 1993

Site	Ac-228	Tl-208	Total Th
-F-0B	1.13	0.37	2.17
-F-4		0.11	0.31
-G-12	0.67	0.22	1.27
-G-12-12	0.20	0.31	2.07
-G-12-18	0.94	0.37	1.99
-G-12-18B	1.08	0.36	2.09
-G-12-24	1.15	0.40	2.25
-G-2	1.36	0.31	2.21
-G-9	0.68		0.68
-G-9-12	0.97	0.35	1.96
-G-9-18	1.03	0.39	2.11
-G-9-18B	0.93	0.29	1.72
-G-9-24	1.24	0.43	2.43
-H-10	1.07	0.33	1.98
-H-11	0.94	0.33	1.84
-H-11-12	1.07	0.31	1.94
-H-11-18	1.02	0.31	1.88
-H-11-24	1.09	0.36	2.10
-H-11B	1.03	0.37	2.04
-I-12	1.18	0.37	2.22
-I-3	1.98	0.65	3.78
-I-3-12	2.95	1.11	6.03
-I-3-18	1.40	0.42	2.58
-J-11	1.37	0.50	2.75
-J-13	1.16	0.29	1.95
-J-15	1.26	0.33	2.18
-J-15-12	1.49	0.36	2.49
-J-15-12B	1.00	0.32	1.88
-J-15-18	1.10	0.37	2.12
-J-2	1.18	0.39	2.25
-J-2-12	1.13	0.39	2.22
-J-3	1.19	0.36	2.19
-J-4	1.33	0.41	2.47
-J-4-12	1.25	0.40	2.37
-K-17	1.06	0.33	1.98
-M-16	1.79	0.48	3.13
-M-7	1.27	0.37	2.30
-O12	1.34	0.51	2.75
-O-9	1.20	0.40	2.32
-O-9-12	1.38	0.34	2.32
-O-9-18	1.65	0.63	3.40
-O-9-24	1.26	0.47	2.56
-O-9B	1.38	0.39	2.48

Statistical Calculations

# Samples	76	82	82
Average	1.13	0.36	2.02
Std. Dev.	0.34	0.13	0.75
Minimum	0.35	0.11	0.29
Maximum	2.95	1.11	6.03

Table 5: Natural Thorium Results for Areas A, E, and G (continued)

All samples analyzed via gamma spectroscopy

All results are in pCi/g

Area E

Samples collected in August 1994

Location	Ac-228	Tl-208	Total Th
FF-20	1.39	0.38	2.44
FF-22	1.30	0.37	2.03
FF-24	0.81	0.24	1.48
GG-18	0.99	0.36	1.98
HH-17	0.90	0.29	1.70
HH-26	0.80	0.29	1.60
II-17	1.08	0.32	1.96
II-18	1.03	0.32	1.91
II-18B	1.17	0.30	2.01
II-29	0.85	0.28	1.61
JJ-19	1.17	0.35	2.15
JJ-25	0.68	0.23	1.31
KK-22	0.84	0.25	1.54
KK-24	0.57	0.22	1.17
KK-25	0.21	0.20	0.77
KK-25B	0.66	0.19	1.20
LL-18	1.07	0.31	1.94
LL-21	0.93	0.31	1.80
MM-19	1.01	0.34	1.95
MM-22	0.94	0.28	1.72
MM-25	0.27	0.29	1.08
NN-19	0.89	0.31	1.75
NN-24	0.97	0.33	1.89
PP-29	0.71	0.28	1.50
QQ-30	0.75	0.28	1.54
RR-31	1.09	0.38	2.15
SS-19	0.97	0.41	2.12
SS-20	1.12	0.27	1.86
SS-22	1.02	0.29	1.84
TT-17	0.94	0.32	1.83
TT-17B	1.07	0.40	2.17
TT-18	1.03	0.39	2.12
UU-21	0.95	0.32	1.84
UU-23	1.74	0.57	3.32
UU-26	0.95	0.37	1.97
UU-31	0.25	0.30	1.08
UU-39	0.98	0.32	1.87

Statistical Calculations

# Samples	37	37	37
Average	0.91	0.31	1.79
Std. Dev.	0.29	0.07	0.44
Minimum	0.21	0.19	0.77
Maximum	1.74	0.57	3.32

Area G

Samples collected in August 1994

Location	Ac-228	Tl-208	Total Th
A-1	1.32	0.45	2.56
A-1D	1.33	0.51	2.74
B-00	2.09	0.68	3.97
B-1	1.64	0.68	3.52
C-1	1.60	0.49	2.96
D-00	3.20	1.16	6.42
D-2	1.10	0.41	2.23
D-3	1.03	0.40	2.14
E-1	1.72	0.49	3.07
E-3	1.05	0.44	2.27
F-2	1.42	0.49	2.79
F-3	0.73	0.23	1.37
H-00	2.05	0.81	4.30
H-2	1.17	0.46	2.44
J-1	1.23	0.39	2.31
J-1D	1.06	0.40	2.17
J-3	0.64	0.23	1.27
K-3	1.05	0.29	1.86
L-00	2.51	1.03	5.37
L-1	0.81	0.36	1.79
N-2	0.19	0.07	0.38
O-2	1.13	0.37	2.15
O-2D	1.10	0.41	2.23
P-00	2.09	0.74	4.15
P-0.5	3.97	1.34	7.69
Q-2	1.12	0.10	1.39
R-00	2.55	0.96	5.21
R-1	1.02	0.36	2.02
R-1D	1.10	0.35	2.08
S-2	1.21	0.38	2.27
S-3	0.82	0.24	1.49
T-00	2.47	0.92	5.03
T-2	1.21	0.38	2.27
U-2	0.91	0.37	1.94
U-3	0.21	0.33	1.12
V-1	0.51	0.18	1.01
W-00	2.55	0.84	4.87
W-1	0.91	0.37	1.93
W-3	0.95	0.30	1.77
X-00	1.98	0.61	3.66
X-1	1.19	0.41	2.34

Statistical calculations

# Samples	41	41	41
Average	1.41	0.50	2.79
Std. Dev.	0.78	0.28	1.54
Minimum	0.19	0.07	0.38
Maximum	3.97	1.34	7.69

Table 6: Isotopic Thorium and Uranium Results for Soil Piles

Samples collected in May 1993.

Samples analyzed via alpha spectroscopy.

All results are in pCi/g.

Piles Containing Soils from the Front Yard Area

Sample #	Pile	Th-228	Th-232	Total Th	U-234	U-235	U-238	Total U
930527237	5	0.55	0.53	1.08	5.05	0.39	7.68	13.1
930527245	6	1.07	1.17	2.24	1.35	0.06	1.54	2.95
930526221	12	0.99	0.73	1.72	5.19	0.22	6.59	12.0
930526218	13	0.97	0.90	1.87	1.83	0.32	2.36	4.51
930526113	14	0.84	0.73	1.57	15.0	0.95	14.9	30.9
930526116	14	0.91	0.84	1.75	7.75	0.48	8.51	16.7
930526119	14	0.92	0.74	1.67	20.0	0.88	18.0	38.8
930526122	14	0.87	0.94	1.82	12.2	0.54	12.3	25.0
930526125	14	0.85	0.90	1.75	14.6	3.67	12.7	31.0
930526128	14	0.91	0.80	1.70	16.4	0.94	15.6	32.9
930526132	14	0.99	0.95	1.94	22.2	1.32	29.7	53.2
930526135	14	0.91	0.90	1.81	30.3	1.60	46.1	78.0
930526138	14	0.91	0.89	1.73	19.3	1.56	18.6	39.5
930526141	14	0.83	0.88	1.72	16.7	2.20	16.6	35.5
930526224	14	0.81	0.89	1.70	14.3	1.16	19.0	34.5
930526227	14	0.89	0.74	1.43	11.1	0.49	11.7	23.3
930526230	14	0.98	0.91	1.88	12.3	0.58	12.7	25.6
930526236	14	0.75	0.82	1.57	10.1	0.78	16.6	33.5
930526239	14	0.98	1.00	1.98	8.93	0.41	8.54	17.9
930526242	14	0.74	0.84	1.58	11.1	0.90	11.3	23.3
930527103	15	0.94	1.02	1.96	8.66	0.32	8.23	17.2
930527107	16	0.76	0.75	1.51	6.34	0.38	6.28	13.0
930527203	17	1.00	0.74	1.74	201	1.31	26.6	229
930527206	17	0.70	0.75	1.45	10.7	0.75	14.8	26.2
930527209	17	1.10	0.95	2.05	21.3	1.21	38.2	60.7

Number of results	25	25	25	25	25	25	25
Average	0.88	0.85	1.73	20.4	0.94	15.4	36.7
Standard Deviation	0.13	0.13	0.23	38.2	0.76	10.4	43.5
Minimum	0.55	0.53	1.08	1.35	0.06	1.54	2.95
Maximum	1.10	1.17	2.24	201	3.67	46.1	229

Piles Containing Soils not from the Front Yard Area

Sample #	Pile	Th-228	Th-232	Total Th	U-234	U-235	U-238	Total U
930527111	1	0.83	1.02	1.85	36.3	2.44	89.9	129
930527114	1	0.88	0.95	1.83	131	9.04	192	332
930527117	1	0.93	0.80	1.73	151	19.6	617	788
930527120	1	0.85	0.88	1.73	42.8	5.38	137	185
930527124	2	1.06	1.09	2.15	1.18	0.05	1.37	2.6
930527127	2	1.01	0.96	1.97	1.25	0.06	1.08	2.4
930527131	2	1.07	1.03	2.10	1.03	0.05	1.14	2.2
930527131	3	0.92	0.86	1.78	2.93	0.20	3.05	6.2
930527137	3	1.12	1.10	2.22	1.46	0.05	1.46	3.0
930527141	4	1.15	0.93	2.09	1.74	0.15	2.42	4.3
930527144	4	0.59	0.46	1.05	3.25	0.20	3.56	7.0
930527241	7	0.15	0.21	0.35	0.37	0.07	0.26	0.7
930527227	8	2.32	2.21	4.53	254	23.7	471	749
930527230	8	1.92	1.72	3.64	207	42.2	376	625
930527233	8	1.83	1.62	3.45	148	16.3	224	388
930527223	9	0.89	0.81	1.70	143	58.5	626	828
930527213	10	1.26	1.02	2.28	8.90	0.44	19.2	28.5
930527216	10	0.93	0.95	1.88	30.4	2.11	70.5	103
930527219	10	0.90	0.82	1.72	16.7	1.07	40.2	58.0
930526212	11	0.89	0.97	1.87	4.49	0.27	5.70	10.5
930526215	11	0.90	0.88	1.78	4.77	0.22	5.90	10.9
930526103	18	0.81	0.75	1.56	7.71	0.32	7.92	15.9
930526106	18	0.84	0.81	1.65	6.90	0.39	7.53	14.8
930526109	18	0.83	0.82	1.65	7.82	1.21	7.55	16.6
930526203	18	0.79	0.74	1.51	4.94	0.30	5.25	10.5
930526206	18	1.01	1.17	2.18	5.15	0.24	5.26	10.6
930526209	18	0.93	0.95	1.88	5.84	0.37	6.35	12.6

Number of results	27	27	27	27	27	27	27
Average	1.02	0.98	2.00	45.6	6.85	108	161
Standard Deviation	0.42	0.38	0.79	73.0	14.2	190	269
Minimum	0.15	0.21	0.35	0.37	0.05	0.26	0.7
Maximum	2.32	2.21	4.53	254	58.5	626	828

Table 7: 1996 Asphalt Isotopic Thorium and Uranium Results

Samples collected in March 1996

Samples analyzed via alpha spectroscopy.

All results in pCi/g.

RMI #	Th-228	Th-232	Total Th	U-234	U-235	U-238	Total U
960318015	0.69	0.47	1.16	17.4	2.30	20.8	40.5
960318017	0.67	0.20	0.87	10.6	1.32	18.7	30.6
960318008	0.55	0.26	0.81	18.8	2.77	29.3	50.9
960318012	0.75	0.21	0.96	22.6	4.08	26.7	53.3
960318006	0.54	0.30	0.84	32.3	5.63	42.5	80.4
960318004	0.74	0.23	0.97	15.4	2.16	22.0	39.6
960318010	0.66	0.31	0.98	65.6	9.15	81.9	157
960319003	0.86	0.53	1.38	130	12.3	163	305
Average	0.68	0.31	1.00	39.1	4.97	50.6	94.6
Std. Dev.	0.10	0.12	0.19	40.6	3.90	49.8	94.1
Minimum	0.54	0.20	0.81	10.6	1.32	18.7	30.6
Maximum	0.86	0.53	1.38	130	12.3	163	305

Table 8: Pond Sediment Isotopic Thorium and Uranium Results

Samples collected in February 1996.

All samples analyzed via alpha spectroscopy.

All results are in pCi/g.

RMI ID	Th-228	Th-230	Th-232	Total natural Th		U-234	U-235	U-238	Total U
				Old	Corrected				
960227002	1.01	2.68	0.53	4.22	1.55	569	145	1110	1824
960227003	1.13	1.52	0.73	3.39	1.86	389	234	816	1440
960227004	1.13	2.35	0.96	4.44	2.09	746	402	2244	3392
960227005	1.17	4.64	0.97	6.78	2.14	473	130	965	1567
960227006	1.52	12.9	2.06	16.4	3.58	722	248	1497	2468
960228002	0.93	2.89	0.62	4.44	1.55	466	192	1315	1973
960228003	0.97	2.93	1.00	4.90	1.97	240	53	527	819
960228004	1.42	4.17	1.21	6.79	2.63	518	106	1057	1681
960228005	1.19	4.79	1.48	7.46	2.67	1169	485	2830	4484
960228006	1.31	1.64	0.97	3.92	2.28	640	258	1928	2827
960228007	1.17	4.38	0.93	6.48	2.10	2335	990	2933	6258
Average	1.18	4.08	1.04	6.30	2.22	752	295	1566	2612
St. Dev.	0.18	3.13	0.43	3.63	0.58	578	263	812	1583
Minimum	0.93	1.52	0.53	3.39	1.55	240	53	527	819
Maximum	1.52	12.9	2.06	16.4	3.58	2335	990	2933	6258

Table 9 : Wilcoxon Rank-Sum Test Results

Comparison of Thorium Results to 1995, 1996, and 1997 background results

A z-value of less than -1.96 or greater than +1.96 indicates the two groups come from different populations.

NOTE: This test was not performed on asphalt results because there are less than 11 asphalt sample results for thorium.

1996 Indicators vs Background

n1 = 11
n2 = 16
R = 152
uR = 154.0
oR = 20.26
z = -0.099

Area D vs Background

n1 = 11
n2 = 81
R = 592
uR = 511.5
oR = 83.10
z = 0.969

Area A vs Background

n1 = 11
n2 = 43
R = 221
uR = 302.5
oR = 46.56
z = -1.750

Area C/C-West vs Background

n1 = 11
n2 = 290
R = 1932
uR = 1661.0
oR = 283.34
z = 0.956

Area E vs Background

n1 = 11
n2 = 37
R = 323
uR = 269.5
oR = 40.77
z = 1.312

Area G vs Background

n1 = 11
n2 = 41
R = 210
uR = 291.5
oR = 44.63
z = -1.826

Front Yard Piles vs Background

n1 = 11
n2 = 25
R = 260
uR = 203.5
oR = 29.12
z = 1.940

Other Piles vs Background

n1 = 11
n2 = 27
R = 225
uR = 214.5
oR = 31.07
z = 0.338

Pond Sediment vs Background

n1 = 11
n2 = 11
R = 110
uR = 126.5
oR = 15.23
z = -1.083

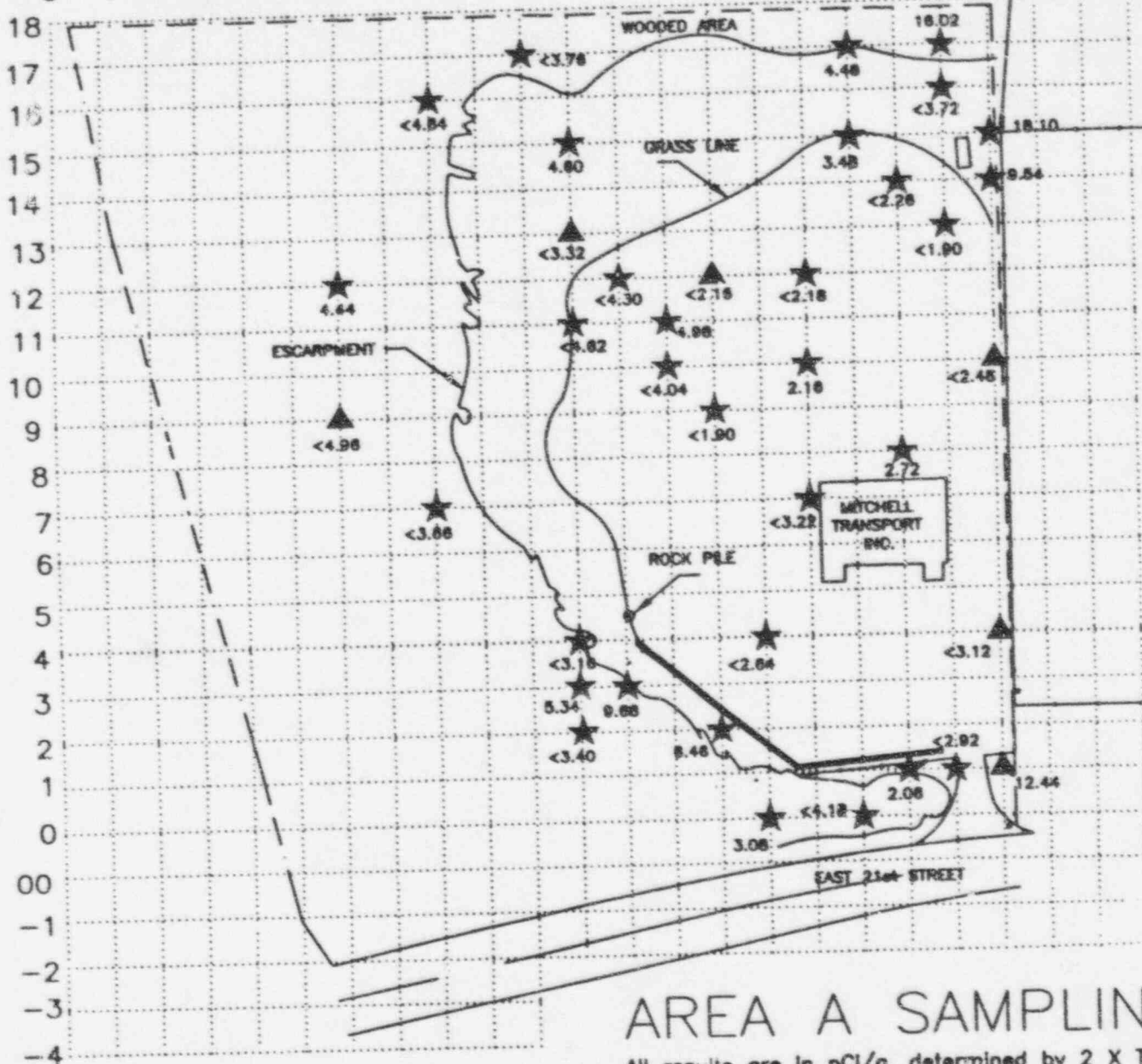
Table 3-13B - Radionuclide Data from Evaporator Pond Sediment Drums

Drums sampled	Uranium (pCi/g)	Thorium (pCi/g)	Tc-99 (pCi/g)
372 & 369	497	1.55	1030
011 & 513	236	1.86	1070
177 & 209	160	2.09	943
008 & 500	321	2.14	835
493 & 126	2760	3.58	1090
356 & 304	1580	1.55	556
038 & 291	671	1.97	739
282 & 300	1350	2.63	5130
046 & 098	1740	2.67	2160
159 & 158	1350	2.28	1210
100	1420	2.10	1700
Average	1200	2.22	1500
Standard dev. (1σ)	738	0.58	1200
Maximum	2760	3.58	5130

Notes

1 - Most samples consisted of sediments collected from two separate drums.

-U -T-S-R-Q-P-O-N-M-L-K-J-I -H-G-F-E-D-C-B A B C D E



EXTRUSION
PLANT

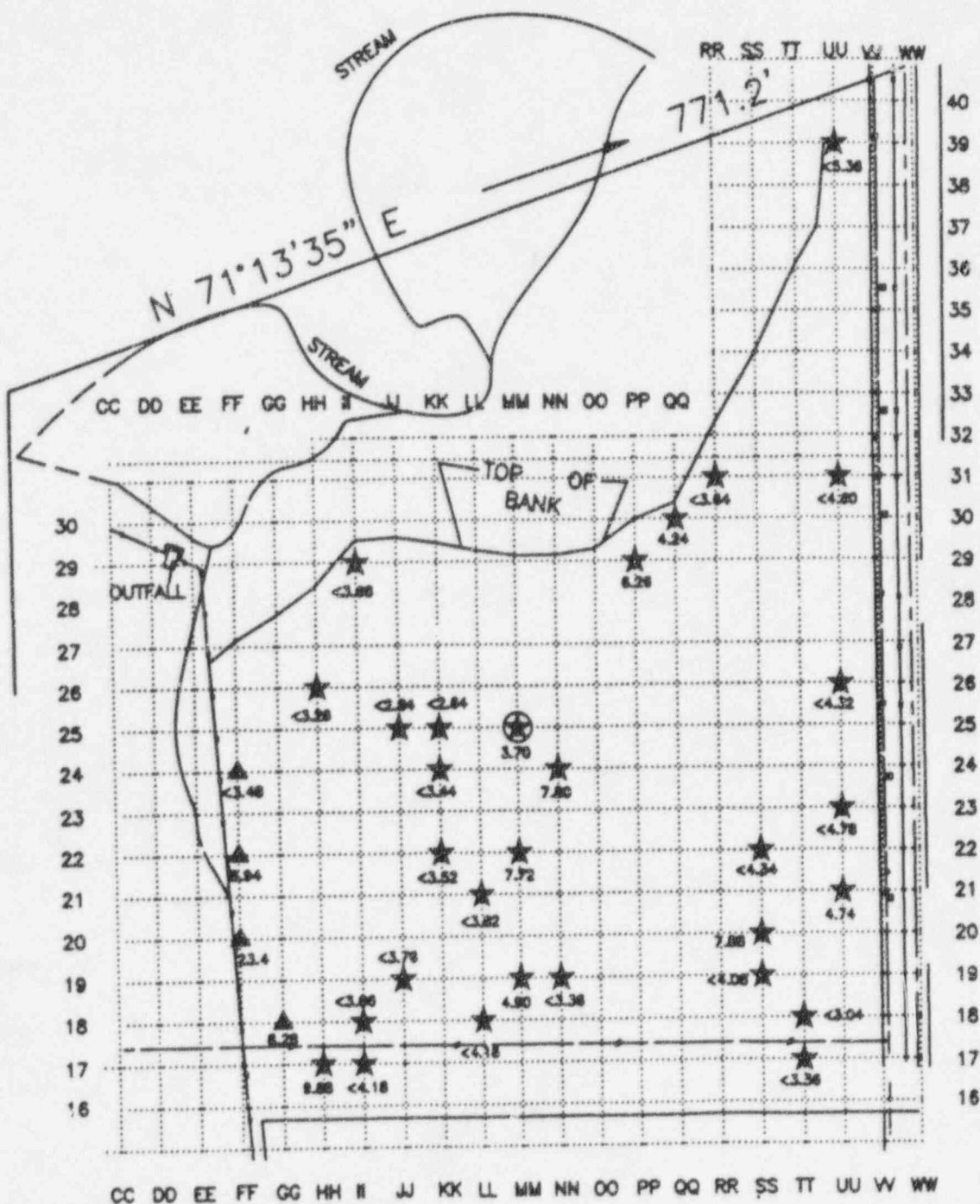
RDP-ESH-005 ICN #1
Figure 3-4a
Sampling Results

AREA A SAMPLING RESULTS

All results are in pCi/g. determined by 2 X Tn234 method.

A2072AEG.DWG

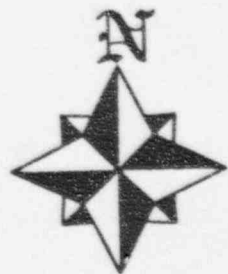
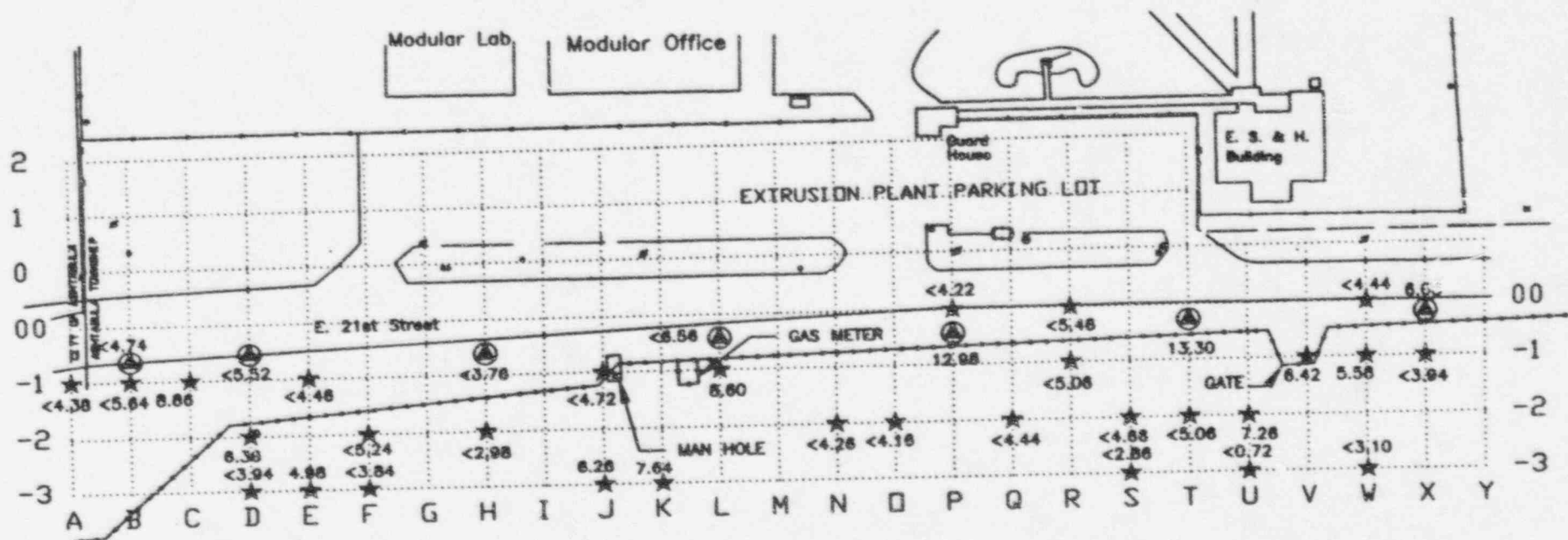
Area E Sampling Results



AREA E SAMPLING RESULTS

All results are in $\mu\text{Ci/g}$, determined by 2 X Th234 method.

A2077AEC.DWG



AREA G SAMPLING RESULTS

All results are in pCi/g, determined by 2 X Th234 method.