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Environmental Monitoring Report: January-June 1971

January 18, 1972

AEC Research and Development Report

MOUND LABORATORY
Miamisburg, Ohio
operated by

Monsanto

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for the

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ABSTRACT

The average concentrations of polonium-210, plutonium-238 and tritium detected in the environment surrounding Mound Laboratory, Miamisburg, Ohio, are presented for the first half of 1971. The average concentrations of these radioisotopes at the water sampling locations and the air sampling stations were well within the stringent standards adopted by the Atomic Energy Commission. The highest average concentrations of polonium, plutonium and tritium detected in the air sampling areas during the first half of 1971 were 39, 48 and 60% lower, respectively, than those measured during 1970. The highest average concentrations of polonium, plutonium and tritium measured at any of the water sampling locations during the first half of 1971 were 92, 75, and 89% lower, respectively, than those measured during 1970. The highest level of plutonium-238 found during the first half of 1971 in soil surface scrapings was approximately 2% of the most restrictive levels suggested by Kathren for urban areas. Soil core samples taken during the same period were considerably lower than those reported by Krey and Hardy in an independent Health and Safety Laboratory (HASL) study.

INTRODUCTION

Mound Laboratory is situated on 180 acres of land in Miamisburg, Ohio. This location is 12 miles southwest of Dayton. The Laboratory began operation in 1949. Its mission currently includes research, development, engineering, and production of components for the AEC weapons program; separation, purification, and sale of stable isotopes of the nobel gases; and development, design, and fabrication of radioisotopic heat sources for medical application and space exploration.

Interest in the health and safety of employes and the public is manifested by the fact that Laboratory operations have as a fundamental objective the containment of radioactive waste as a part of its environmental control program. Any release of low-level gaseous and liquid wastes to the environment are carefully controlled and dispersed to ensure that concentrations are well within recommended standards.

An Environmental Control Program has been in existence continuously during the Laboratory's history. As part of the Program's control function, all effluents containing radioisotopes are controlled at each operating step. Radioisotopes are removed from air effluents by the use of high-efficiency particulate absolute (HEPA) filters. Radioisotopes are removed from liquid effluent by chemical processing. As part of the Program's monitoring function, air, water, and soil samples are collected in a 1,250 square mile area to determine the concentrations of radioactive materials. The sampling techniques, analyses, and counting methods are those best suited for the detection and measurement of the radioactive materials involved.

Concentrations of radionuclides in air and water are compared with the Radioactivity Concentration Guide (RCG) values as promulgated by the Office of Radiation Programs of the Environmental Protection Agency and can be interpreted as the concentration of radioactivity in the environment which is determined to result in whole body or organ doses which should not be exceeded without careful consideration. The RCG values[1] for these radioisotopes are:

Polonium-210

Air: 7×10^{-12} microcuries per milliliter (μCi/ml)
Water: 2×10^{-7} microcuries per milliliter (μCi/ml)

[1]The RCG values listed above reflect a reduction by a factor of three as recommended by the Standards for Radiation Protection (AEC Chapter 0524, II, C, 1).

Plutonium-238

Air: 3×10^{-13} microcuries per milliliter (μCi/ml)
Water: 2×10^{-6} microcuries per milliliter (μCi/ml)

Tritium

Air: 7×10^{-8} microcuries per milliliter (μCi/ml)
Water: 1×10^{-3} microcuries per milliliter (μCi/ml)

The Standards for Radiation Protection (AEC Chapter 0524) guidelines for a mixture of radionuclides does not apply for the data presented in this report as discussed within.

OFF-SITE AIR SAMPLING

Air samples are collected three times per week to a distance of 20 miles from the Laboratory--an area of 1250 square miles. The samples are collected upwind and downwind from the Laboratory. Analysis of these samples is performed using equipment which is capable of detecting traces of radioactivity less than 0.1% of the concentration standards that have been adopted by Federal agencies. These standards are called Radioactivity Concentration Guides and are abbreviated as RCG. Figure 1 shows the zones routinely sampled.

AIRBORNE SAMPLE HANDLING AND RESULTS

Polonium-210 and Plutonium-238 Samples are collected using a high volume air sampler. Particulates are collected on 4-in. diameter Whatman No. 41 filter paper through which air is passed at a rate of 20 ft^3/min (5.7×10^5 cc/min). The sampling port is atop a mobile unit, in which the apparatus is contained. This mobile unit--a truck--is parked safely off the road while the sample is taken. A 2-in. diameter circle cut from the center of the filter paper is processed and analyzed for polonium-210, while plutonium-238, due to its lower specific activity, is analyzed using the remaining filter paper.

Polonium-210 Analysis The 2-in. diameter circle cut from the center of the filter paper is digested by heating with 5.8 M hydrochloric acid. After cooling, the solution is transferred quantitatively to a plastic plating cell that accommodates a 1 7/8-in. diam stainless steel disc. The solution in the cell is made approximately 1 M in hydrochloric acid, stirred for 2 hr, and the polonium-210 spontaneously plated by simple replacement onto the stainless steel disc. The disc is then removed from the cell, rinsed, dried, and alpha counted in a low background, gas flow proportional counter.

Results Analysis of the monitoring data for this report period shows that the average concentration of the polonium-210 measured at all locations upwind and downwind in all zones was only slightly above one-tenth of 1% of the RCG. The RCG is the concentration of radioactivity in the environment which is determined to result in whole body or organ doses which should not be exceeded without careful consideration. The data demonstrate that the average concentrations in all sampling areas were well below that level. The highest average concentration for this report period was 13/100 of 1% of the RCG in the 0-3 mile range upwind and 5-10 mile range downwind. Results for this report period are shown in Figure 2.

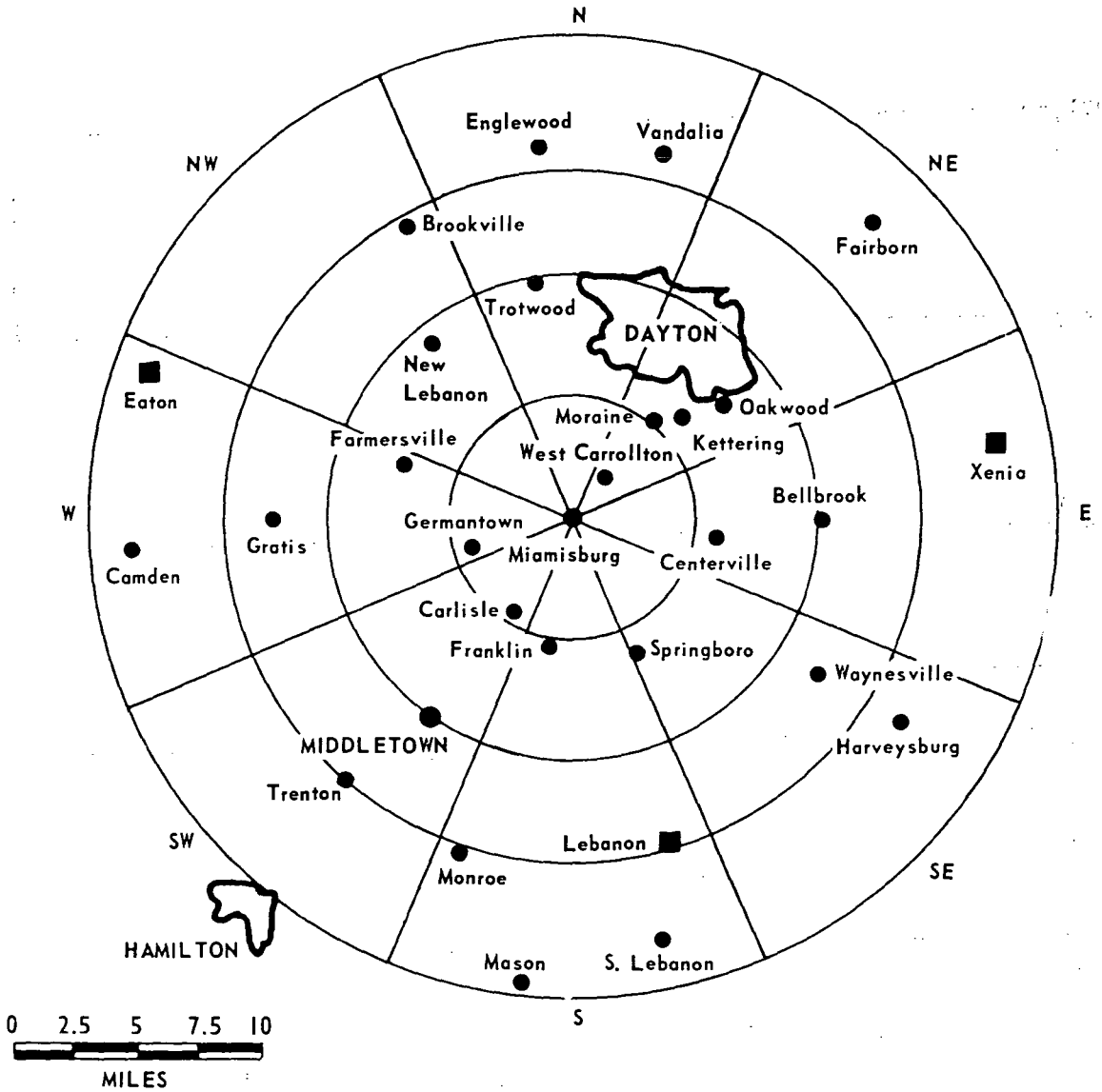

FIGURE 1 - Off-site air sampling zones.

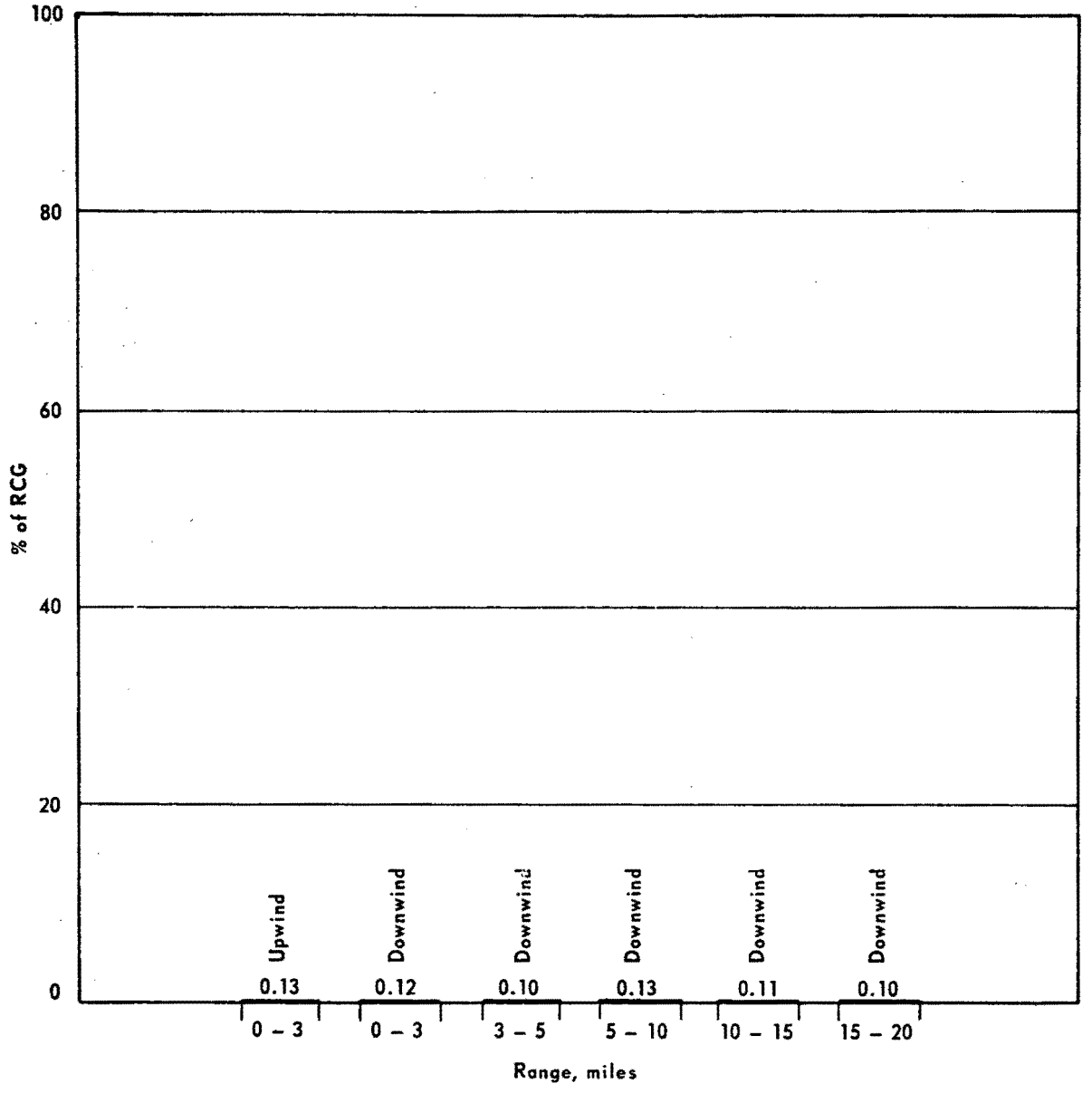

FIGURE 2 - Off-site air monitoring data for polonium-210--January-July 1971.

Plutonium-238 Analysis The remaining filter paper, after removal of the 2 in. diameter circle for polonium analysis, is spiked with a known amount of plutonium-236 tracer. The filter paper is ashed at 600°C in a muffle furnace for a minimum of 2 hr. The filter residue is taken up in concentrated HNO_3 with a trace of HF and evaporated to dryness. The residue is taken up in 10 M HCl and passed over a chloride anion exchange column. The plutonium is selectively eluted from the column and electroplated. After electroplating, the plutonium-238 content is determined by alpha pulse height analysis by means of counting for 1000 min. in a low background, high resolution surface barrier detector. The plutonium-238 content is corrected for chemical and counting losses as determined by the recovery of the added plutonium-236 tracer.

Results Plutonium-238 concentrations measured in all zones for this report period were less than 1% of the RCG with a maximum of 57/100 of 1% occurring in the 0-3 mile range upwind. The RCG is the concentration of radioactivity in the environment which is determined to result in whole body or organ doses which should not be exceeded without careful consideration. The data demonstrate that the average concentrations in all sampling areas were well below that level. Results for this report period are shown in Figure 3.

Tritium Oxide Analysis Samples are collected (at the same time that particulate samples of plutonium-238 and polonium-210 are taken) by bubbling air through 100 ml of p-dioxane-based scintillation fluid at a rate of 0.35 ft^3/min (0.99×10^4 cc/min). Tritium oxide is collected in the p-dioxane solution, and a 20 ml aliquot of the resulting solution is counted directly for 10 min in a liquid scintillation spectrometer. The sampling and analysis is directed to tritium oxide rather than the gas since the RCG for the oxide is 200 times more restrictive.

Results The highest average concentration of tritium oxide detected in the environment during this report period was 2.24% of the RCG in the 0-3 mile range downwind. The concentration diminished to less than 7/10 of 1% in the 3-5 mile range downwind. The RCG is the concentration of radioactivity in the environment which is determined to result in whole body or organ doses which should not be exceeded without careful consideration. The data demonstrate that the average concentrations in all sampling areas were well below that level. Results for this report period are shown in Figure 4.

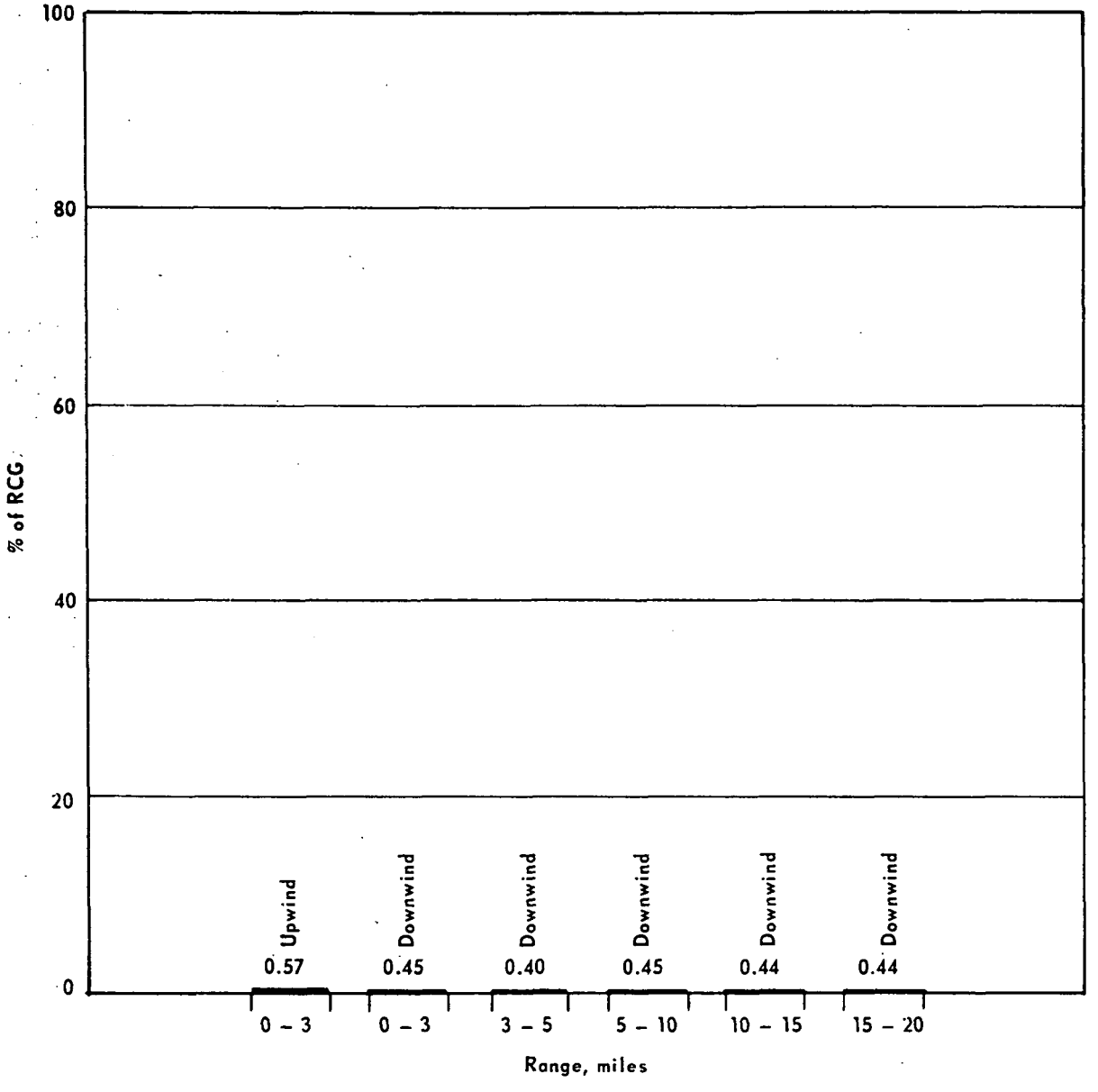

FIGURE 3 - Off-site air monitoring data for plutonium-238--January-July 1971.

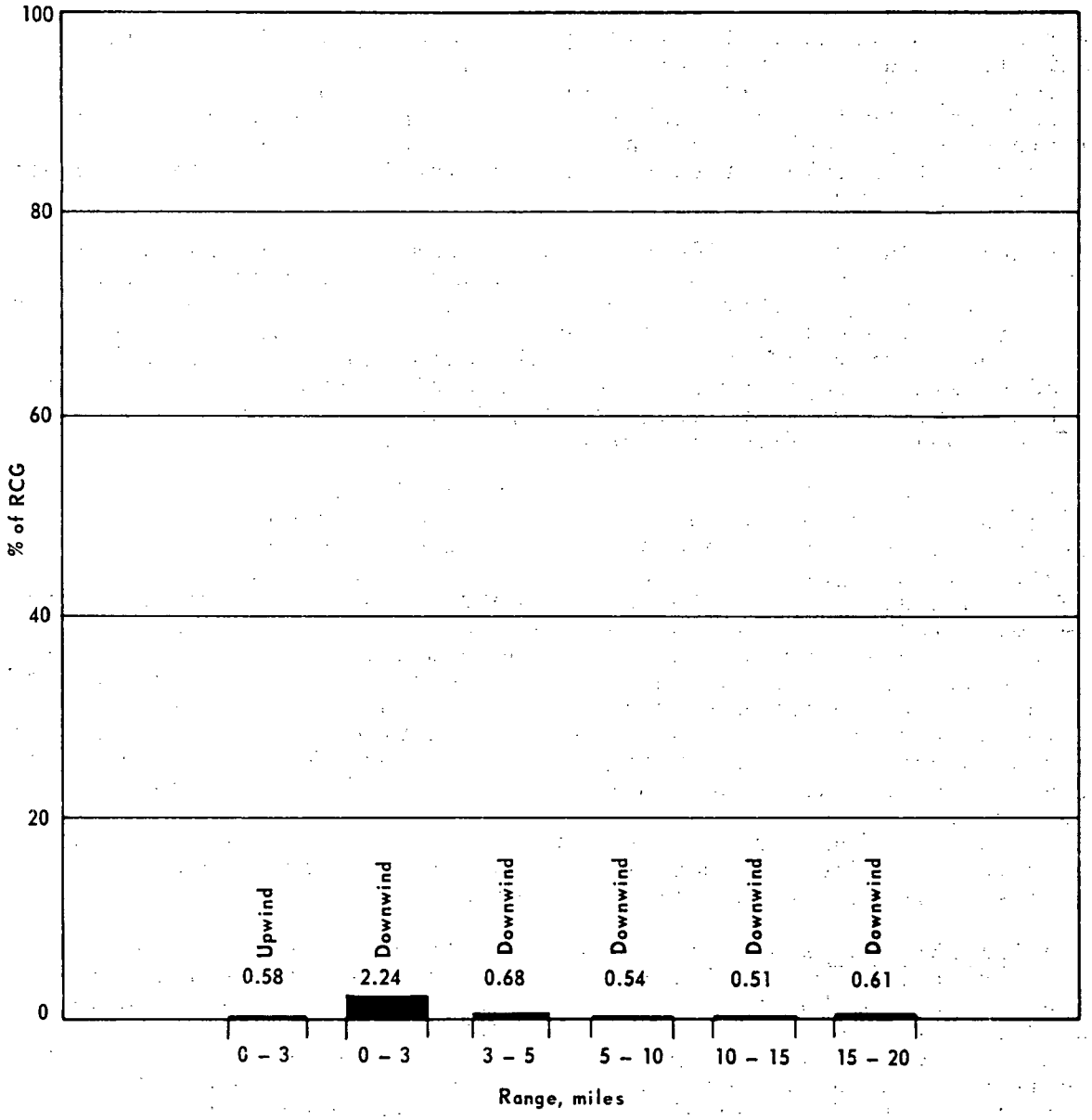

FIGURE 4 - Off-site air monitoring data for tritium oxide--January-July 1971.

OFF-SITE WATER SAMPLING

Water samples are collected twice per week along the bank of the Great Miami River and two ponds northeast of the Laboratory. Analysis of these samples is performed using equipment which is capable of detecting traces of radioactivity far below the RCG. All samples are analyzed for polonium-210, plutonium-238, and tritium oxide. A sample of approximately 200 ml is taken at each of 9 sampling locations. These locations are shown in Figure 5.

Polonium-210 Analysis A 100-ml aliquot from each water sample (representing a water sampling location) is quantitatively transferred to a plastic plating cell that accommodates a 1 7/8-in. diameter stainless steel disc. The solution in the cell is made approximately 1 M in hydrochloric acid, stirred for 2 hr, and the polonium-210 spontaneously plated by simple replacement onto the stainless steel disc. The disc is then removed from the cell, rinsed, dried, and alpha counted in a low background, gas flow proportional counter.

Results The highest average concentration of polonium-210 detected during this report period at any sampling location was 2.82% of the RCG. This was detected 250 yd downstream from the Mound Laboratory effluent (location 4 in Figure 5). The average concentration at the next sampling location downstream (location 5) as reported in Table 7 is below the limit of detection. A number is reported in the table because a value was assigned to those samples which were determined to be below the detectable limit. The number assigned to those samples was arrived at by multiplying the lowest detectable limit for polonium by a fraction which was the number of samples above the limit divided by the total number of samples analyzed. The average concentrations for this report period for all locations are shown in Figure 6. The RCG is the concentration of radioactivity in the environment which is determined to result in whole body or organ doses which should not be exceeded without careful consideration. The data demonstrate that the average concentrations in all sampling locations were well below that level.

Plutonium-238 Analysis A 100 ml aliquot from each water sample (representing a water sampling location) is analyzed for plutonium using an anion exchange method that is specific for plutonium. The plutonium eluted from the column is planchetted directly on a 1 7/8 in. diameter stainless steel disk and alpha counted in a low background, gas flow proportional alpha counter for a minimum of 4 hr. When a positive result is obtained the sample is counted by alpha pulse height equipment to confirm the presence of plutonium-238.

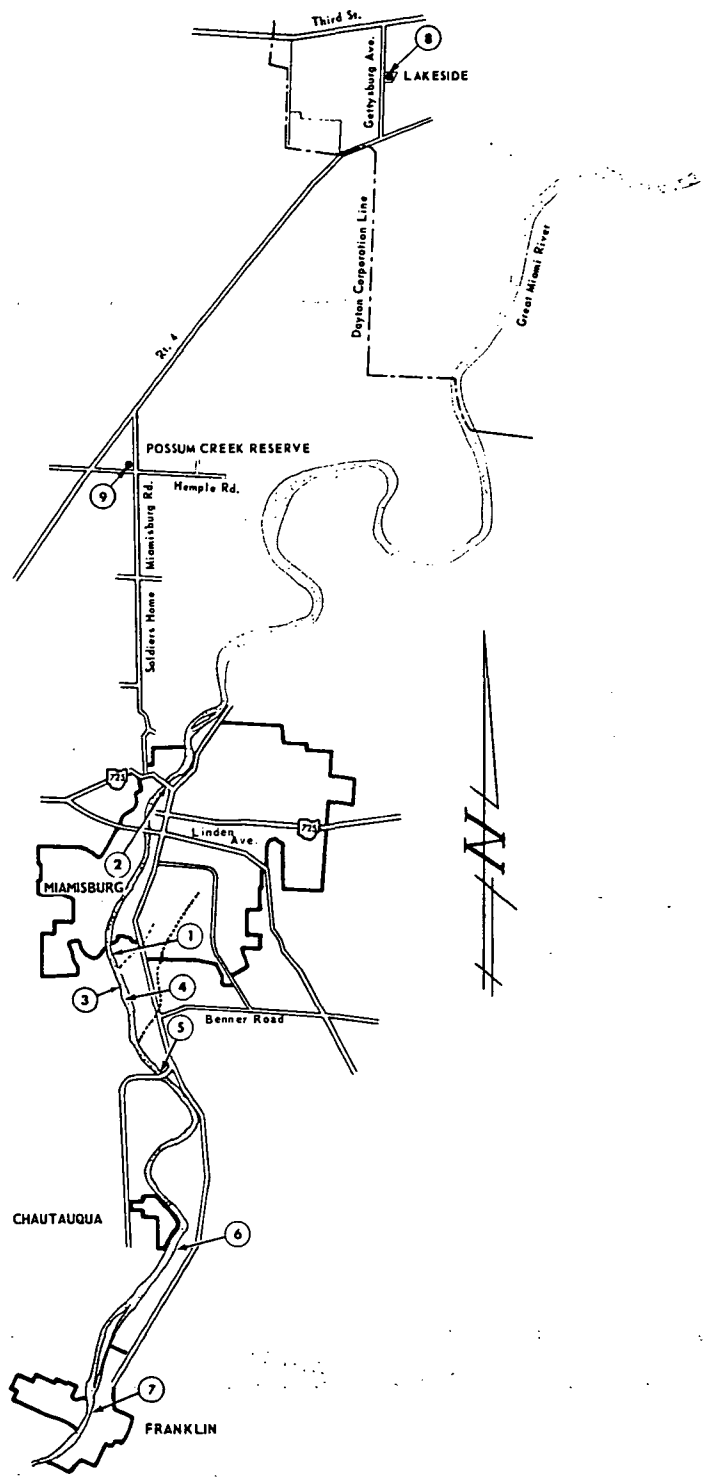

FIGURE 5 - Off-site water sampling locations.

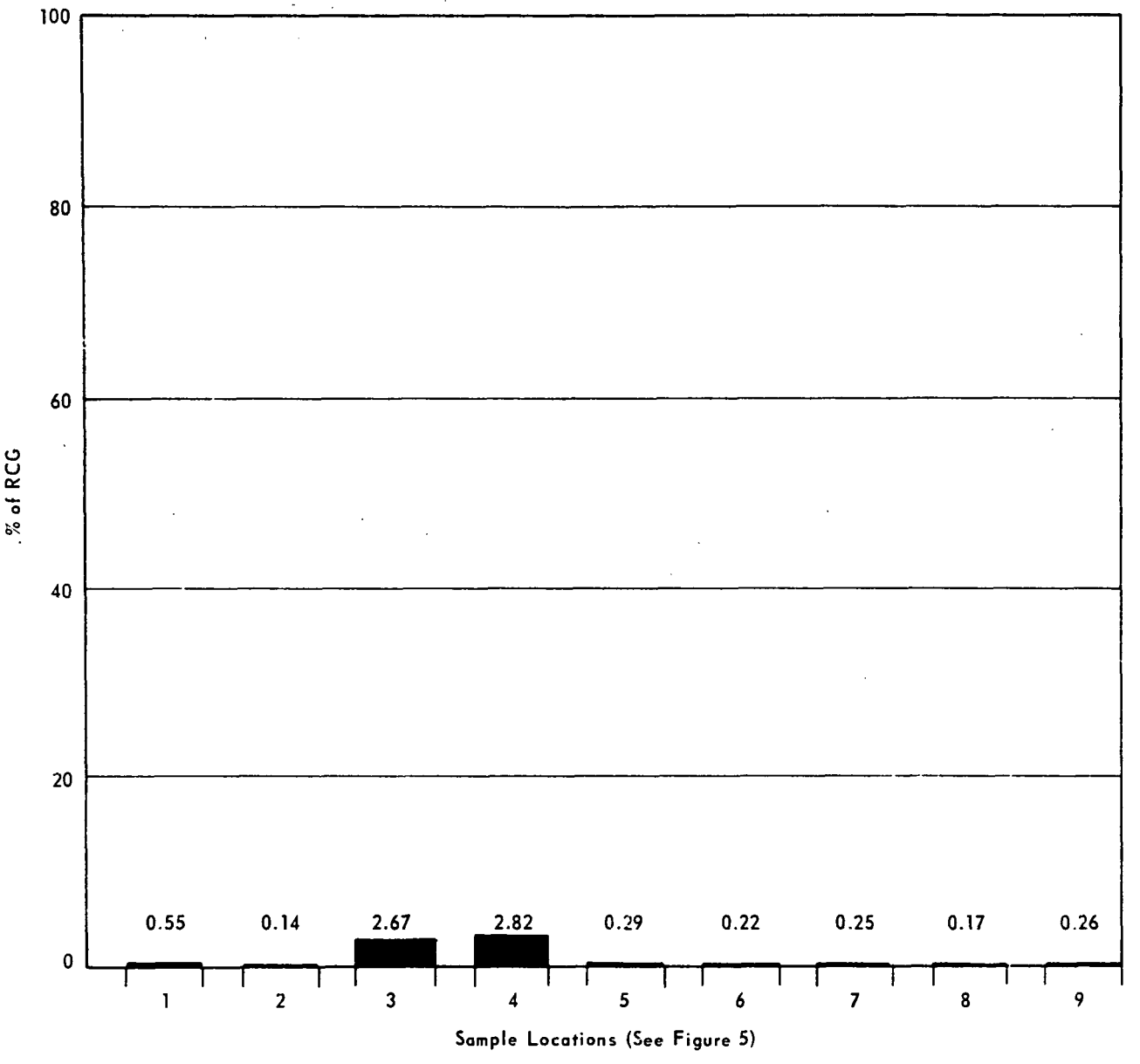

FIGURE 6 - Off-site water monitoring data for polonium-210--January-July 1971.

Results Plutonium-238 concentrations measured at all locations were much less than 1% of the RCG with the maximum being 26/100 of 1% of the RCG. This was detected 10 ft downstream from the point the Mound Laboratory effluent enters the Great Miami River (location 3 in Figure 5). The average concentrations found at the remainder of the Great Miami River locations downstream from the Mound Laboratory outfall were at approximately the same concentration level as found at the sampling location upstream from Mound Laboratory outfall (location 2 in Figure 5). The average concentrations for this report period for all locations are shown in Figure 7. The RCG is the concentration of radioactivity in the environment which is determined to result in whole body or organ doses which should not be exceeded without careful consideration. The data demonstrate that the average concentrations in all sampling locations were well below that level.

Tritium Oxide Analysis A 1-ml aliquot from each water sample (representing a water sampling location) is pipetted into a vial containing 17 ml of p-dioxane-based scintillation fluid. The vial is then placed in a liquid scintillation counter and counted for a minimum of 10 min for tritium.

Results The highest average concentration of tritium oxide for this report period was 4.74% of the RCG detected 10 ft downstream from the Mound Laboratory effluent (location 3). The next highest average concentration detected was 2.74% of the RCG 250 yd downstream from the Laboratory effluent (location 4). The average concentrations found at the remainder of the Miami River sampling locations downstream from the Laboratory outfall were below the concentration detected upstream from the outfall. The average concentrations for all sampling locations are shown in Figure 8. The RCG is the concentration of radioactivity in the environment which is determined to result in whole body or organ doses which should not be exceeded without careful consideration. Thus, the data demonstrate that the average concentrations in all sampling locations were well below that level.

Additive Levels Due to Radionuclide Mixture

The Standards for Radiation Protection (AEC Chapter 0524) states that a radionuclide should not be considered part of the mixture if the ratio of the concentrations of the radionuclide to its RCG is not greater than 1/10 provided that the sum of all such excluded ratios does not exceed 1/4. The sum of the ratios of the concentration of radionuclides to their respective RCG's for the first half of 1971 are listed below. The sum is presented for the maximum levels detected in both air and water

	Air	Water
Concentration of Po/RCG for Po	0.001	0.027
Concentration of ^{238}Pu/RCG for ^{238}Pu	0.006	0.003
Concentration of tritium/RCG for tritium	0.022	0.047
SUM	0.029	0.077

As can be seen from the data the Standards for a mixture do not apply.

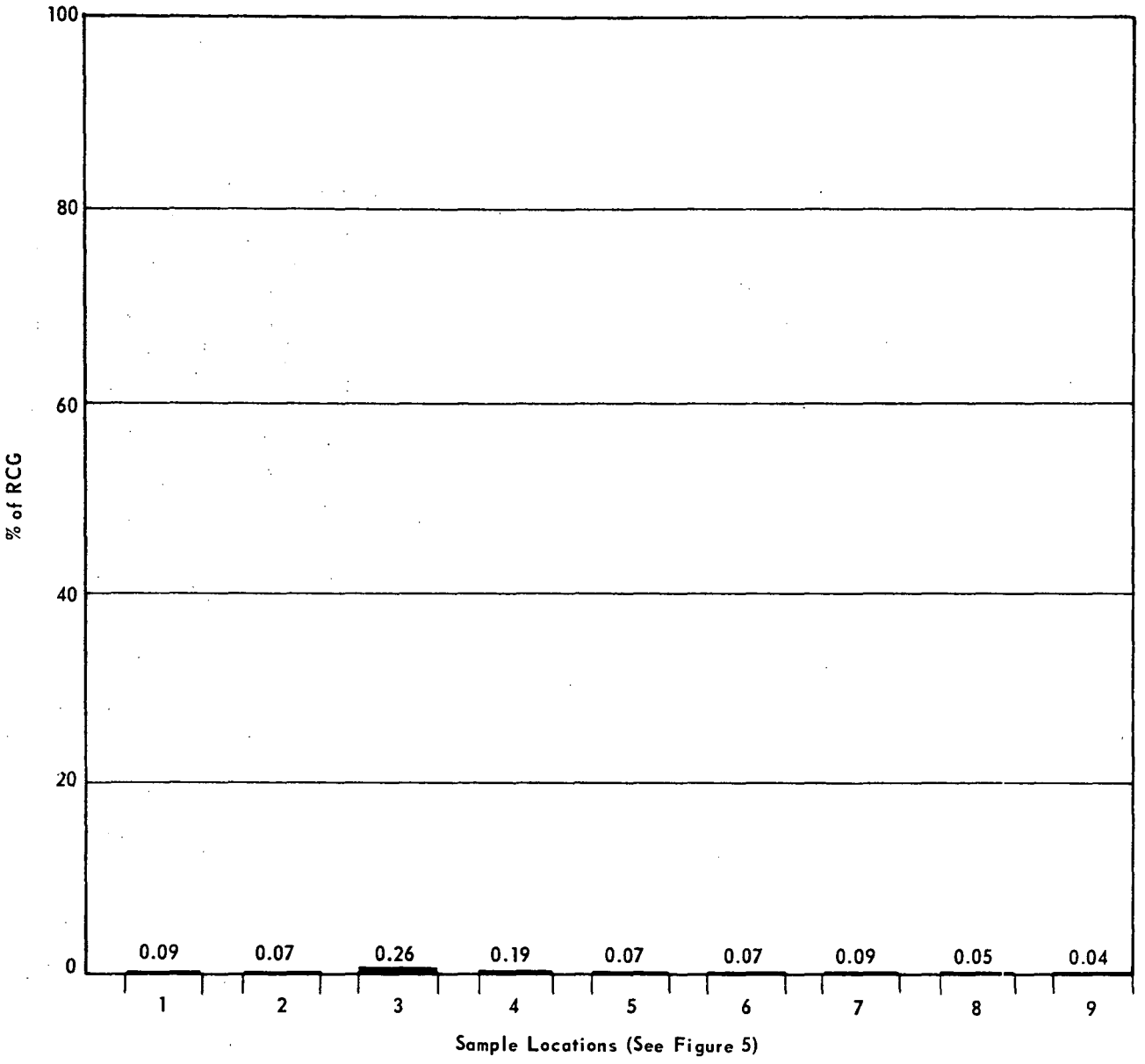

FIGURE 7 - Off-site water monitoring data for plutonium-238--January-July 1971.

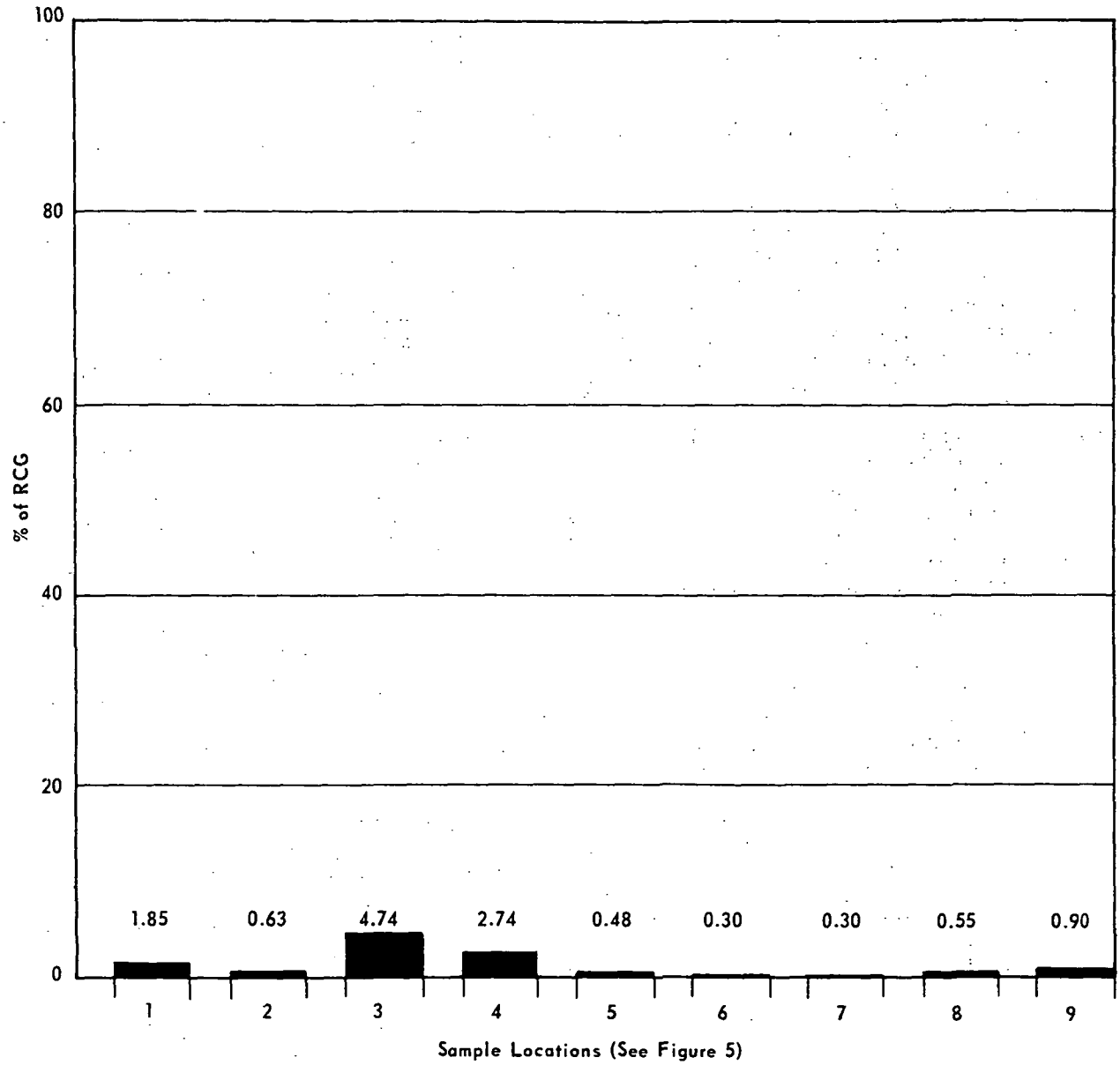

FIGURE 8 - Off-site water monitoring data for tritium oxide--January-July 1971.

SOIL SAMPLING

This section represents a new area of environmental reporting and indicates further efforts to evaluate the environmental impact of Mound Laboratory operations. No standards have been established as yet for comparison of concentration of radioactive species in soil. The sampling and analysis techniques described represent the state of the art in this area of environmental monitoring.

Two types of soil samples from areas surrounding the Laboratory have been analyzed for plutonium-238. One type of sample is used to evaluate the resuspendible amounts of plutonium-238 in the soil surrounding Mound Laboratory. Surface scrapings (approximately 1/8 in. deep) of undisturbed soil were collected for this evaluation. The second type of sample is used to determine the inventory amounts of plutonium-238 in the soil surrounding Mound Laboratory. A 3-1/2 in. diameter core of soil approximately 1-1/2 in. deep is taken for this determination.

Surface Scraping Analysis Surface scraping samples were taken from twenty sectors surrounding Mound Laboratory to a distance of ten miles. These sectors are shown in Figure 9. In addition, surface scrapings were taken fifty miles northwest, southeast, southwest, and northwest of the Laboratory to serve as background control samples. Twenty-five scrapings are composited to form a sample for each sector. The soil is digested with an acid mixture to extract the plutonium. The solution is then passed over an ion exchange column specific for plutonium and analyzed in the same manner as the particulate air samples previously discussed in this report. This leach method has been compared with a fusion method for soil analysis.[2] Good agreement was obtained between the two methods of analysis. The leach method was chosen for the soil analysis because larger samples, which minimize sampling and aliquoting errors, and increase sensitivity can be handled with this method.

Results The results of the surface scraping study for 1971 are shown in Table 10. There are no guidelines established by the Office of Radiation Programs of the Environmental Protection Agency or the AEC for radioactive species in soil. There have been several studies published which suggest maximum surface contamination levels. Of these, the levels suggested by Kathren[3] are the most restrictive. Kathren gives the following as acceptable levels for occupancy by the general public:

[2] C. T. Bishop, W. E. Sheehan, R. K. Gillette, and B. Robinson, "Comparison of a Leaching Method and a Fusion Method for the Determination of of Plutonium-238 in Soil," presented at a meeting on "Distribution and Measurement of Plutonium in the Environment," at Los Alamos Scientific Laboratory, August 4-5, 1971.

[3] R. L. Kathren, Towards Interim Acceptable Surface Contamination Levels for Environmental PuO_2, BNWL-SA-1510, Battelle Memorial Institute, Pacific Northwest Laboratory, Richland, Washington (Mar. 14, 1968), p. 10.

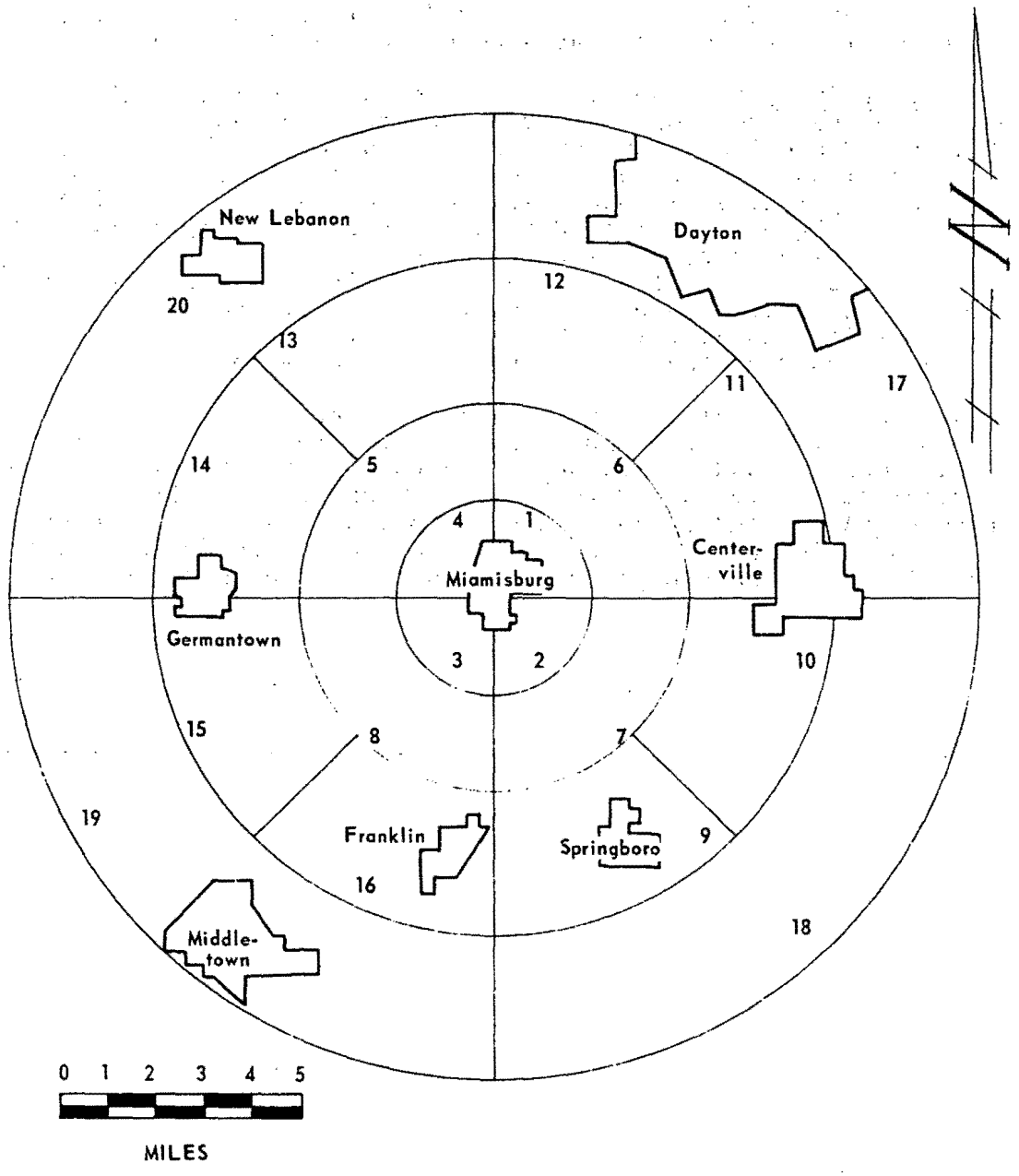

FIGURE 9 - Soil sampling sectors.

	Average	Maximum
Urban Areas	10 d/m/cm^2	100 d/m/cm^2 (for ≤ 10% of area)
Rural Areas	100 d/m/cm^2	

The highest level of plutonium-238 found in 1971 was approximately 2% of the most restrictive levels suggested by Kathren for urban areas.

Core Sampling Analysis The site selection and sampling techniques used in core sampling were adopted from the criteria given for "Soil Sampling for Plutonium Analysis"[4] as distributed by the AEC Division of Operational Safety. Core samples were collected from various locations within approximately one mile from the Laboratory. Additional samples for background control data were taken from locations fifty miles from the laboratory. Five cores were collected from a twenty foot square area at each location and composited to form one sample. The background control samples consisted of twenty cores, four cores from each of five locations. The soil from the core samples is analyzed in the same manner as the surface scraping samples previously discussed.

Results The results of the core sampling program are given in Table 11. The sectors referred to are those shown in Figure 9. The levels of plutonium found around Mound Laboratory were considerably lower than those reported by Krey and Hardy[5] in an independent Health and Safety Laboratory (HASL) study. Additional sample analyses are necessary before a total inventory can be calculated and these are continuing as part of Mound Laboratory's comprehensive Environmental Control Program.

[4] Memorandum, AEC/DAO to MRC, Mound Laboratory dated October 27, 1970, "Soil Sampling for Plutonium Analysis."
[5] P. W. Krey and E. P. Hardy, Plutonium in Soil Around the Rocky Flats Plant, HASL-235, Health and Safety Laboratory, New York, N. Y., (August, 1970), p. 20.

APPENDIX

Table 1

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM-210
JANUARY-JUNE 1971,
ALL ZONES

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-12} microcurie/ml)	Percent of RCG**
0 - 3 (upwind)	70	0.0095	0.13
0 - 3 (downwind)	70	0.0081	0.12
3 - 5 (downwind)	70	0.0073	0.10
5 - 10 (downwind)	70	0.0094	0.13
10 - 15 (downwind)	70	0.0077	0.11
15 - 20 (downwind)	70	0.0067	0.10

*Lowest detectable limit (LDL) for polonium in air is 0.002×10^{-12} microcurie/ml. The LDL = 0.03 percent of the RCG.

**RCG - Radioactivity concentration guide = 7×10^{-12} microcurie/ml.

Table 2

SUMMARY OF OFF-SITE AIR MONITORING FOR PLUTONIUM-238
JANUARY-JUNE 1971,
ALL ZONES

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-13} microcurie/ml)	Percent of RCG**
0 - 3 (upwind)	72	0.0170	0.57
0 - 3 (downwind)	72	0.0136	0.45
3 - 5 (downwind)	71	0.0121	0.40
5 - 10 (downwind)	66	0.0135	0.45
10 - 15 (downwind)	68	0.0132	0.44
15 - 20 (downwind)	64	0.0133	0.44

*Lowest detectable limit (LDL) for plutonium in air is 0.0003×10^{-13} microcurie/ml. The LDL = 0.01 percent of the RCG.

**RCG - Radioactivity concentration guide = 3×10^{-13} microcurie/ml.

Table 3

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM
JANUARY-JUNE 1971,
ALL ZONES

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-8} microcurie/ml)	Percent of RCG**
0 - 3 (upwind)	71	0.0409	0.58
0 - 3 (downwind)	71	0.1557	2.24
3 - 5 (downwind)	71	0.0473	0.68
5 - 10 (downwind)	71	0.0378	0.54
10 - 15 (downwind)	71	0.0357	0.51
15 - 20 (downwind)	71	0.0428	0.61

*Lowest detectable limit (LDL) for tritium in air is 0.005×10^{-8} microcurie/ml. The LDL = 0.07 percent of the RCG.

**RCG - Radioactivity concentration guide = 7×10^{-8} microcurie/ml.

Table 4

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM-210
JANUARY-JUNE 1971

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-12} microcurie/ml)	Percent of RCG**
	North Zone		
	No samples collected.		
	Northeast Zone		
0 - 3 (upwind)	8	0.0121	0.17
0 - 3 (downwind)	8	0.0072	0.10
3 - 5 (downwind)	8	0.0105	0.15
5 - 10 (downwind)	8	0.0067	0.10
10 - 15 (downwind)	8	0.0114	0.16
15 - 20 (downwind)	8	0.0082	0.12
	East Zone		
0 - 3 (upwind)	7	0.0112	0.16
0 - 3 (downwind)	7	0.0072	0.10
3 - 5 (downwind)	7	0.0082	0.12
5 - 10 (downwind)	7	0.0127	0.18
10 - 15 (downwind)	7	0.0090	0.13
15 - 20 (downwind)	7	0.0090	0.13

Table 4 (continued)

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-12} microcurie/ml)	Percent of RCG**
		South Zone	
0 - 3 (upwind)	9	0.0100	0.14
0 - 3 (downwind)	9	0.0054	0.08
3 - 5 (downwind)	9	0.0066	0.09
5 - 10 (downwind)	9	0.0060	0.09
10 - 15 (downwind)	9	0.0103	0.15
15 - 20 (downwind)	9	0.0060	0.09
		Southwest Zone	
0 - 3 (upwind)	14	0.0141	0.20
0 - 3 (downwind)	14	0.0130	0.19
3 - 5 (downwind)	14	0.0149	0.21
5 - 10 (downwind)	14	0.0157	0.22
10 - 15 (downwind)	14	0.0101	0.14
15 - 20 (downwind)	14	0.0083	0.12

Table 4 (continued)

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-12} microcurie/ml)	Percent of RCG**
		Southeast Zone	
0 - 3 (upwind)	4	0.0013	0.02
0 - 3 (downwind)	4	0.0059	0.08
3 - 5 (downwind)	4	0.0034	0.05
5 - 10 (downwind)	4	0.0031	0.04
10 - 15 (downwind)	4	0.0027	0.04
15 - 20 (downwind)	4	0.0037	0.05
		West Zone	
0 - 3 (upwind)	14	0.0063	0.09
0 - 3 (downwind)	14	0.0058	0.08
3 - 5 (downwind)	14	0.0053	0.08
5 - 10 (downwind)	14	0.0118	0.17
10 - 15 (downwind)	14	0.0069	0.10
15 - 20 (downwind)	14	0.0059	0.08

Table 5 (continued)

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-13} microcurie/ml)	Percent of RCG**
	Northwest Zone		
0 - 3 (upwind)	14	0.0232	0.77
0 - 3 (downwind)	14	0.0140	0.47
3 - 5 (downwind)	14	0.0189	0.63
5 - 10 (downwind)	14	0.0233	0.78
10 - 15 (downwind)	14	0.0192	0.64
15 - 20 (downwind)	10	0.0208	0.69

*Lowest detectable limit (LDL) for plutonium in air is 0.0003×10^{-13} microcurie/ml. The LDL = 0.01 percent of the RCG.

**RCG - Radioactivity concentration guide = 3×10^{-13} microcurie/ml.

Table 6

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM
JANUARY-JUNE 1971

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-8} microcurie/ml)	Percent of RCG**
North Zone			
No samples collected.			
Northeast Zone			
0 - 3 (upwind)	8	0.0106	0.15
0 - 3 (downwind)	8	0.0629	0.90
3 - 5 (downwind)	8	0.0189	0.27
5 - 10 (downwind)	8	0.0041	0.06
10 - 15 (downwind)	8	0.0069	0.10
15 - 20 (downwind)	8	0.0027	0.04
East Zone			
0 - 3 (upwind)	8	0.0349	0.50
0 - 3 (downwind)	8	0.1802	2.57
3 - 5 (downwind)	8	0.0145	0.21
5 - 10 (downwind)	8	0.0108	0.15
10 - 15 (downwind)	8	0.0177	0.25
15 - 20 (downwind)	8	0.0283	0.40

Table 6 (continued)

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-8} microcurie/ml)	Percent of RCG**
		Southeast Zone	
0 - 3 (upwind)	4	0.1166	1.67
0 - 3 (downwind)	4	0.1400	2.00
3 - 5 (downwind)	4	0.1187	1.70
5 - 10 (downwind)	4	0.0384	0.55
10 - 15 (downwind)	4	0.1049	1.50
15 - 20 (downwind)	4	0.0595	0.85
		South Zone	
0 - 3 (upwind)	8	0.0246	0.35
0 - 3 (downwind)	8	0.4964	7.09
3 - 5 (downwind)	8	0.0419	0.60
5 - 10 (downwind)	8	0.0437	0.62
10 - 15 (downwind)	8	0.0230	0.33
15 - 20 (downwind)	8	0.0688	0.98

Table 6 (continued)

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-8} microcurie/ml)	Percent of RCG**
		Southwest Zone	
0 - 3 (upwind)	15	0.0811	1.16
0 - 3 (downwind)	15	0.1028	1.47
3 - 5 (downwind)	15	0.0804	1.15
5 - 10 (downwind)	15	0.0837	1.20
10 - 15 (downwind)	15	0.0935	1.34
15 - 20 (downwind)	15	0.0798	1.14
		West Zone	
0 - 3 (upwind)	14	0.0161	0.23
0 - 3 (downwind)	14	0.1674	2.39
3 - 5 (downwind)	14	0.0707	1.01
5 - 10 (downwind)	14	0.0308	0.44
10 - 15 (downwind)	14	0.0113	0.16
15 - 20 (downwind)	14	0.0507	0.72

Table 8

SUMMARY OF OFF-SITE WATER MONITORING FOR PLUTONIUM-238
JANUARY-JUNE 1971

Sample Location	Number of Samples Collected	Average Concentration* (10^{-6} microcurie/ml)	Percent of RCG**
The river, 25 yd upstream from Mound Lab Effluent (location No. 1 on map)	50	0.0018	0.09
Sycamore St. Bridge Miamisburg, Ohio (upstream-location No. 2 on map)	50	0.0013	0.07
The river, 10 ft downstream from Mound Lab Effluent (location No. 3 on map)	50	0.0052	0.26
250 yd downstream from Mound Lab Effluent (location No. 4 on map)	50	0.0038	0.19
Chautauqua Road Bridge (location No. 5 on map)	50	0.0015	0.07
Chautauqua Dam (location No. 6 on map)	50	0.0014	0.07
Franklin, Ohio (location No. 7 on map)	50	0.0018	0.09
Pond-opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab, Location 8 on map)	50	0.0010	0.05
Pond-Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab, Location 9 on map)	50	0.0008	0.04

*Lowest detectable limit for plutonium in water is 0.00013×10^{-6} microcurie/ml. The LDL = 0.007 percent of the RCG.

**RCG - Radioactivity concentration guide = 2×10^{-6} microcurie/ml.

Table 9

SUMMARY OF OFF-SITE WATER MONITORING FOR TRITIUM
JANUARY-JUNE 1971

Sample Location	Number of Samples Collected	Average Concentration* (10^{-3} microcurie/ml)	Percent of RCG**
The river, 25 yd upstream from Mound Lab Effluent (location No. 1 on map)	50	0.0185	1.85
Sycamore St. Bridge Miamisburg, Ohio (upstream-location No. 2 on map)	50	0.0063	0.63
The river, 10 ft downstream from Mound Lab Effluent (location No. 3 on map)	50	0.0474	4.74
250 yd downstream from Mound Lab Effluent (location No. 4 on map)	50	0.0274	2.74
Chautauqua Road Bridge (location No. 5 on map)	50	0.0048	0.48
Chautauqua Dam (location No. 6 on map)	50	0.0030	0.30
Franklin, Ohio (location No. 7 on map)	50	0.0030	0.30
Pond-opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab, Location 8 on map)	50	0.0055	0.55
Pond-Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab, Location 9 on map)	50	0.0090	0.90

*Lowest detectable limit for tritium in water is 0.0002×10^{-3} microcurie/ml. The LDL = 0.02 percent of the RCG.

**RCG - Radioactivity concentration guide = 1×10^{-3} microcurie/ml.