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Environmental Monitoring Report: July-December 1970 and 1970 Summary

April 15, 1971

AEC Research and Development Report

MOUND LABORATORY
Miamisburg, Ohio
operated by

MONSANTO RESEARCH CORPORATION
a subsidiary of Monsanto Company
for the

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A Subsidiary of Monsanto Company

MOUND LABORATORY
Miamisburg, Ohio 45342

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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 second half of 1970 and for the entire year. (The data for the first half of 1970 were presented in Mound Laboratory document MLM-1784.) The average concentrations of these radioisotopes in the Great Miami River and at the air sampling stations were well within the stringent standards adopted by the Atomic Energy Commission. The highest average concentration of these radioisotopes at any of the water sampling stations during the second half of 1970 was less than during the first half of 1970 by as much as 36%. The highest average concentration of polonium-210 at the air sampling stations during the second half of 1970 was 14% more than during the first half of 1970 (0.08% of RCG vs. 0.07% of RCG), however, the highest average concentration of the other two radioisotopes was less by as much as 57%.

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 noble 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 releases 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 and Monitoring 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 and water samples are collected in a 1,250 square mile area to determine the concentrations of radioactive materials. The sampling techniques 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 Radiation Office 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 for these radioisotopes are:

Polonium-210

Air: 2×10^{-11} microcuries per cubic centimeter (μCi/cc)
Water: 7×10^{-7} microcuries per cubic centimeter (μCi/cc)

Plutonium-238

Air 1×10^{-12} microcuries per cubic centimeter (μCi/cc)
Water: 5×10^{-6} microcuries per cubic centimeter (μCi/cc)

Tritium

Air: 2×10^{-7} microcuries per cubic centimeter (μCi/cc)
Water: 3×10^{-3} microcuries per cubic centimeter (μCi/cc)

OFF-SITE AIR SAMPLING

Air samples are collected weekly to a distance of 20 miles from the Laboratory--an area of 1250 square miles--with sampling equipment. In August 1970, the sampling frequency was increased from once per week to three times per week. Analysis of these samples is performed using equipment which is capable of detecting traces of radioactivity significantly less than the concentration standards that have been adopted by Federal agencies. These standards are called Radioactivity Concentration Guides and are abbreviated as RCG. Weekly samples are collected upwind and downwind from the Laboratory. 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. diam 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. diam 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 A 2-in. diam circle is cut from the center of the filter paper and 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. The solution is then stirred for 2 hr and the polonium-210 is 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 shows that the average concentration of polonium-210 measured at all locations upwind and downwind in all zones was only slightly above the limit of detection. 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 areas were well below that level. The highest average concentration for the second half of 1970 was 8/100 of 1% of the RCG in the 0-to-3 mile range upwind. Results are shown in Figure 2. The highest average concentration for the year 1970 was 7/100 of 1% of the RCG in the 0-to-3 mile range upwind. Results for the entire year are shown in Figure 3.

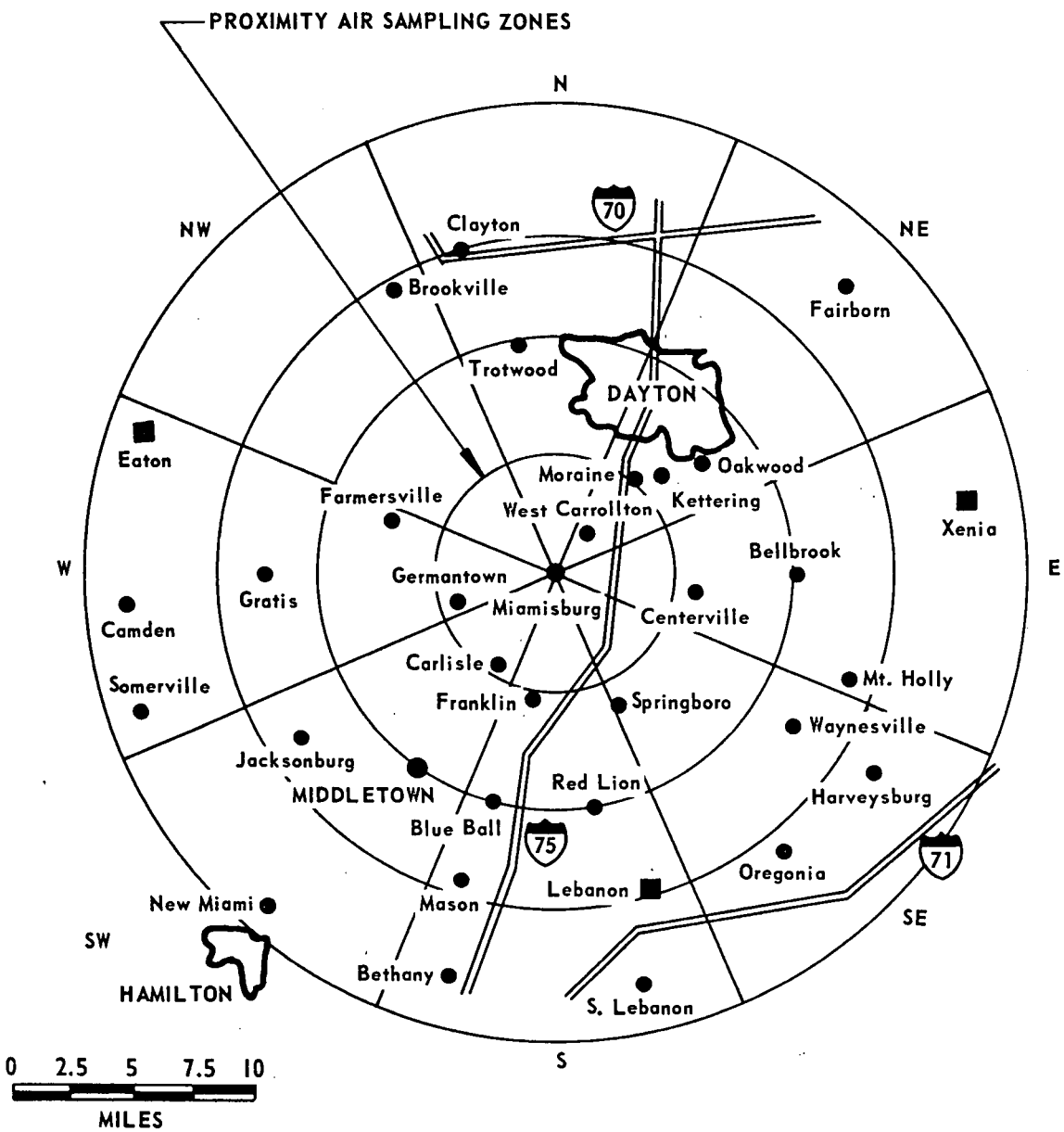

FIGURE 1 - Off-site air sampling zones.

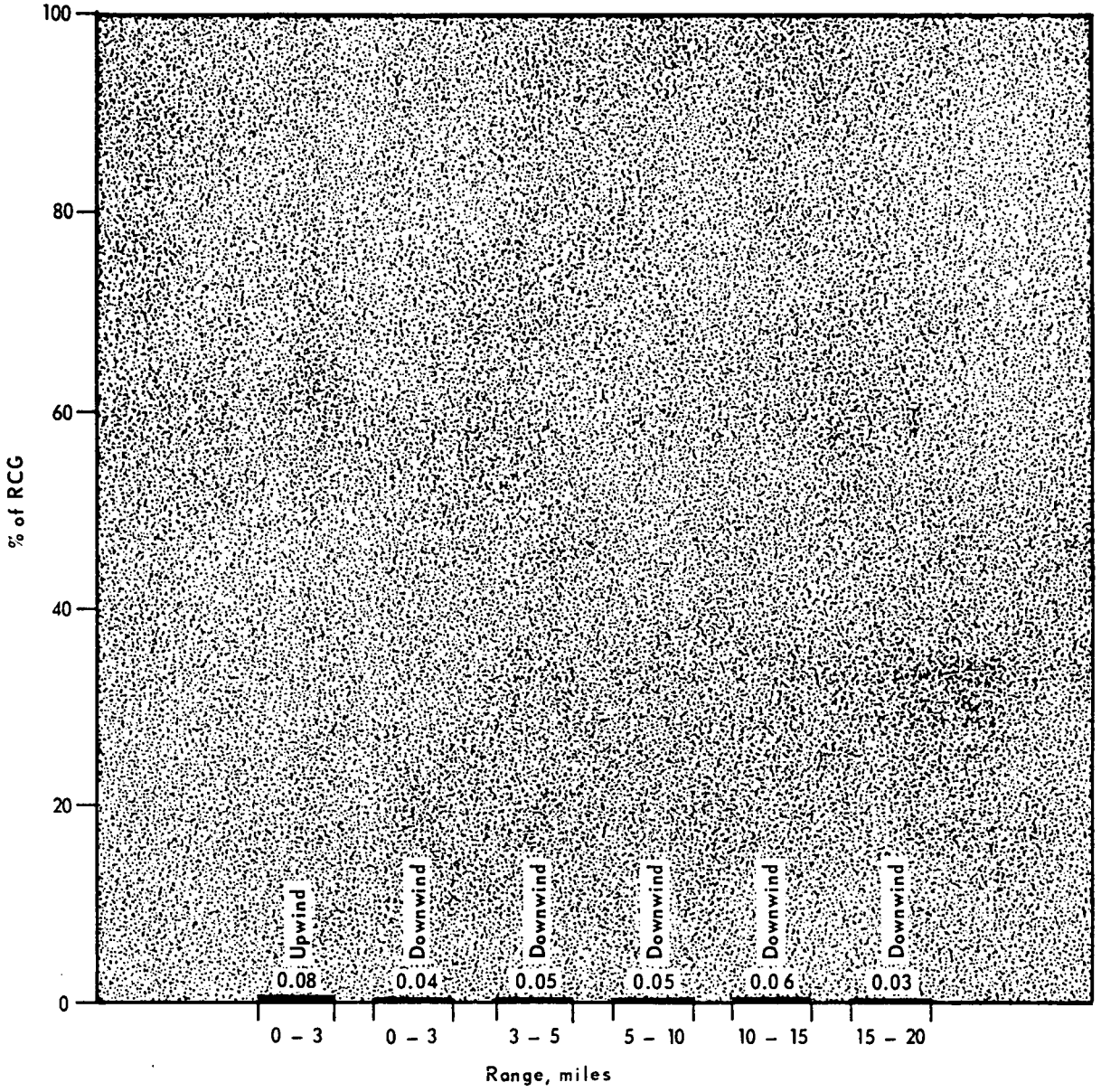

FIGURE 2 - Off-site air monitoring data for polonium-210--July-December 1970.

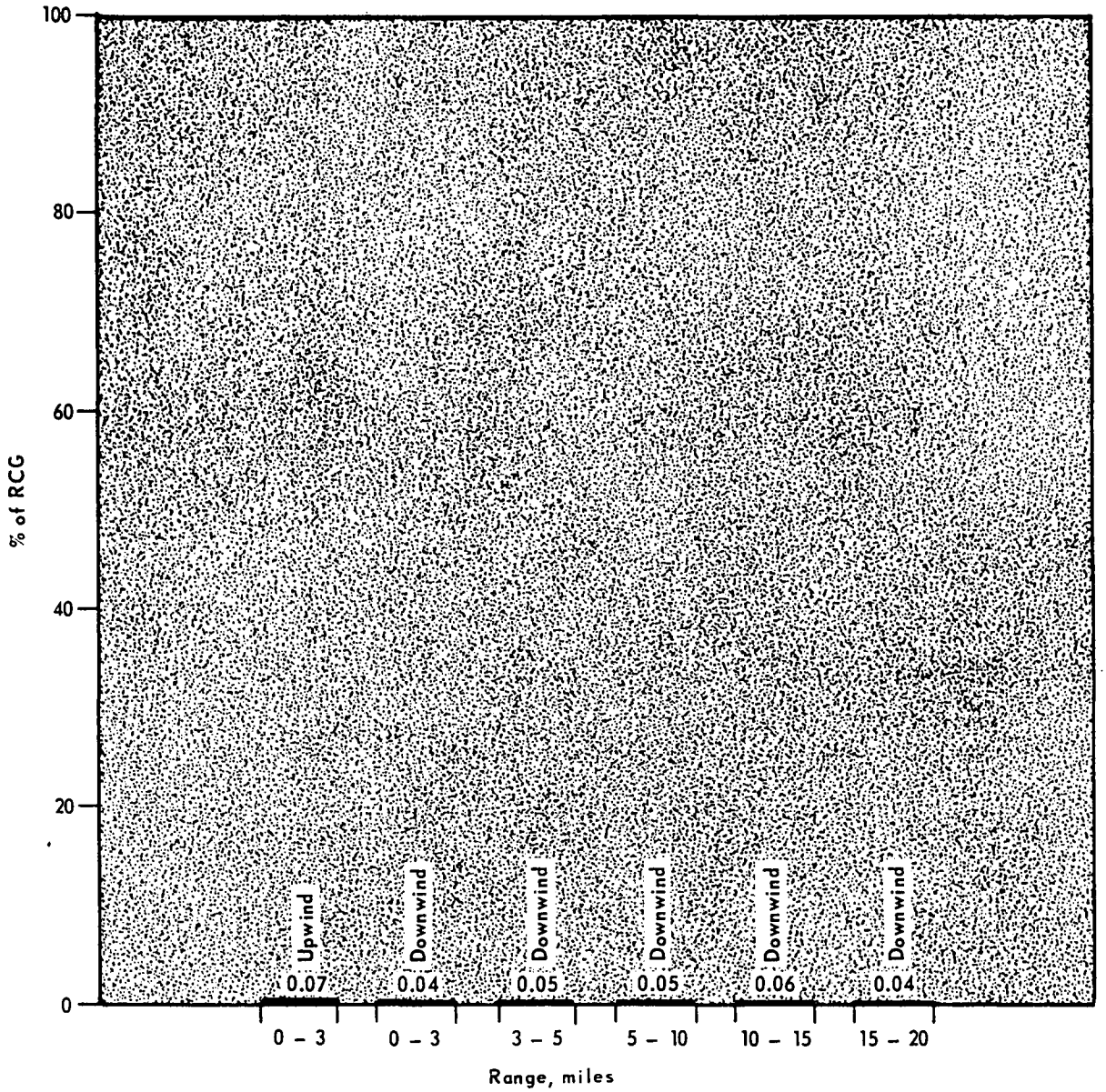

FIGURE 3 - Off-site air monitoring data for polonium-210--January-December 1970.

Plutonium-238 Analysis The remaining filter paper, after a 2-in. diam circle is removed for the polonium-210 analysis, is charred at 800°C for a minimum of 2 hr in a muffle furnace. A solution of concentrated nitric and 0.1 M hydrofluoric acid is added (20 ml total), and this solution is then evaporated to a low volume. The sample is transferred quantitatively to a 50-ml capacity centrifuge tube containing 1 ml of concentrated nitric acid, 2 mg of radiochemically pure cerium carrier, and 1 drop of concentrated phosphoric acid. Plutonium-238 is coprecipitated from this solution with cerium phosphate. The cerium phosphate precipitate is then dissolved in dilute hydrochloric acid and reprecipitated as cerium fluoride with hydrofluoric acid. The cerium fluoride precipitate, which selectively coprecipitates the plutonium-238, is plancheted directly and dried under a heat lamp. The plancheted sample is then flamed and alpha counted in a low background, gas flow proportional counter for a minimum of 16 hr. When a positive result is obtained, the sample is counted with alpha pulse height equipment to confirm the possible presence of plutonium-238.

Results Plutonium-238 concentrations measured in all zones, both for the second half of 1970 and for the year, were less than 1% of the RCG with a maximum of 3/10 of 1% occurring in the 0-to-3 mile range upwind. As in the case of polonium-210, the measured average concentrations only approached the limit of detection. 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 areas were well below that level. Results are shown in Figures 4 and 5 for the second half of 1970 and the entire year, respectively.

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 by 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 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 during the second half of 1970 in the environment measured 1.70% of the RCG in the 0-to-3 mile range downwind. The concentration diminished to 4/10 of 1% in the 3-to-5 mile range downwind. The highest average concentration of tritium oxide for the entire year was 1.95% of the RCG measured in the 0-to-3 mile range downwind. The concentration diminished to 3/10 of 1% in the 3-to-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. Thus, the data demonstrate that the average concentrations in all sampling areas were well below that level. Results are shown in Figures 6 and 7 for the second half of 1970 and the entire year, respectively.

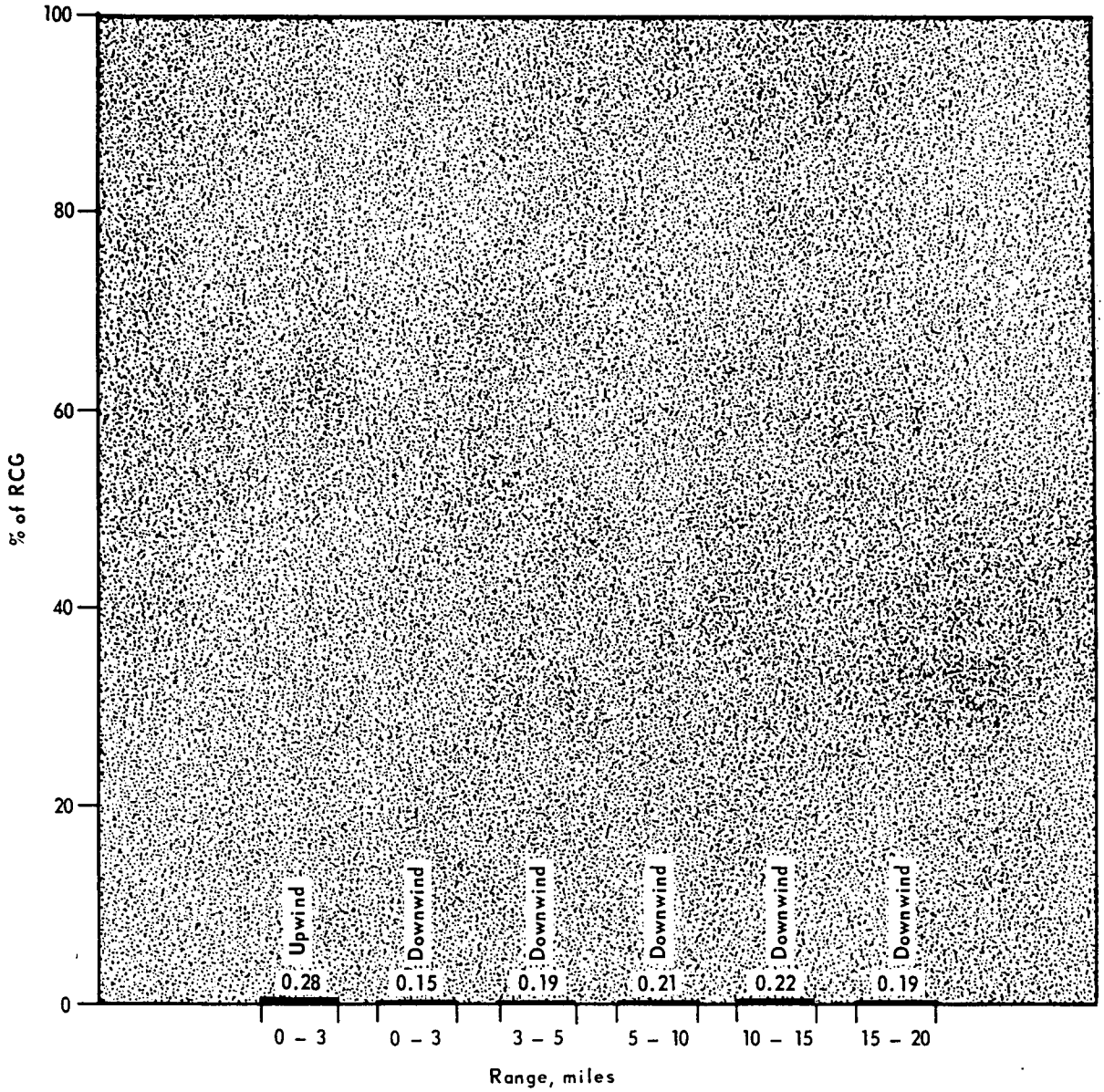

FIGURE 4 - Off-site air monitoring data for plutonium-238--July-December 1970.

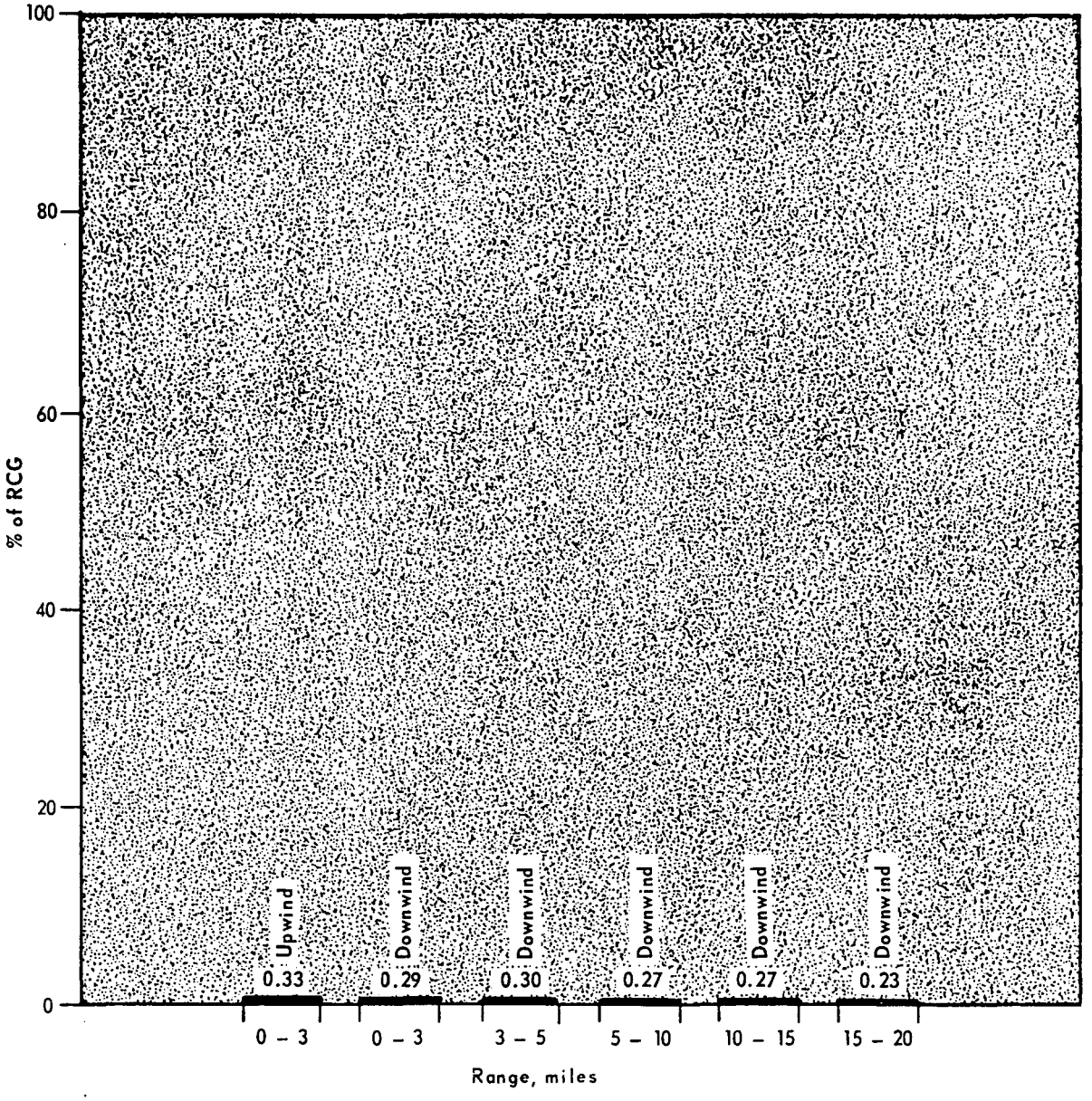

FIGURE 5 - Off-site air monitoring data for plutonium-238--January-December 1970.

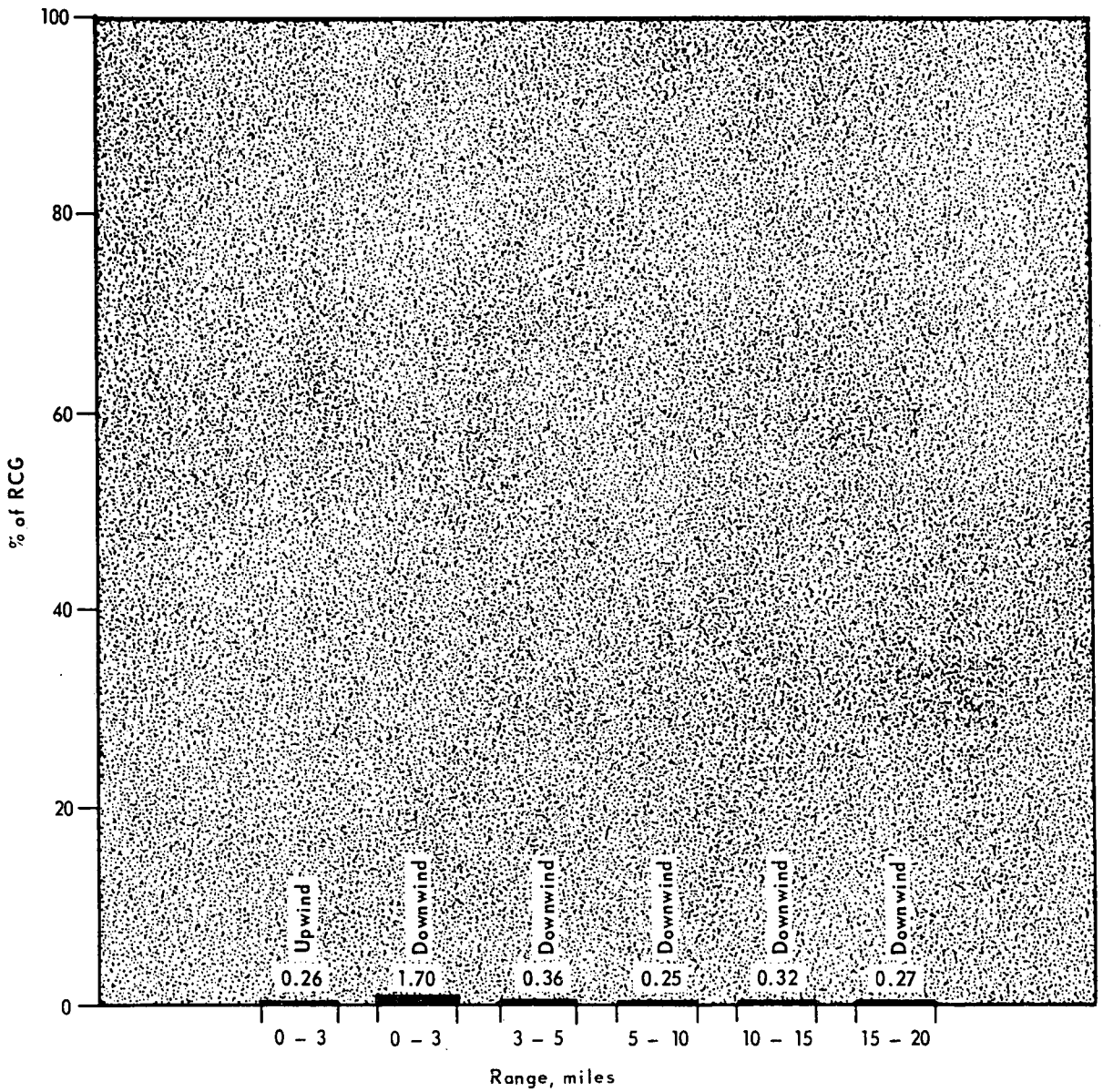

FIGURE 6 - Off-site air monitoring data for tritium oxide - July-December 1970.

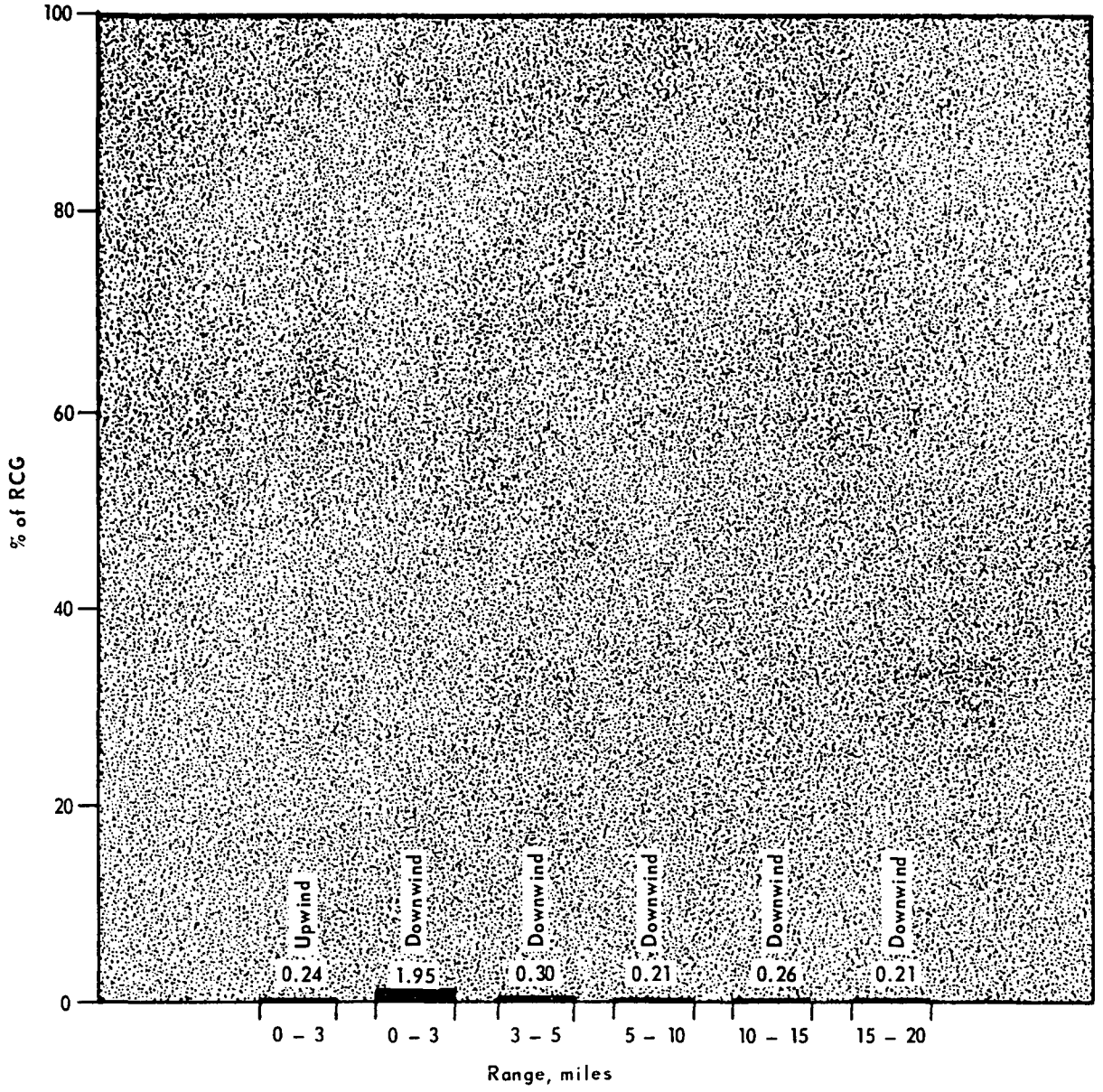

FIGURE 7 - Off-site air monitoring data for tritium oxide - January-December 1970.

OFF-SITE WATER SAMPLING

Water samples are collected weekly along the bank of the Great Miami River, a drainage ditch running through Mound Laboratory, and two ponds northeast of the Laboratory. In August 1970, the sampling frequency was increased from once per week to twice per week. 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. A sample of approximately 200 ml is taken at each of 9 sampling locations. These locations are shown in Figure 8.

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. diam stainless steel disc. The solution in the cell is made approximately 1 M in hydrochloric acid. The solution is then stirred for 2 hr, and the polonium-210 is 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 Figure 9 shows that the highest average concentration for the second half of 1970 for polonium-210 at any sampling location was 7.41% of the RCG. This was at the point the Mound Laboratory effluent enters the Great Miami River (location 3 in Figure 8). The average concentration rapidly decreased to 3/10 of 1% of the RCG at location 4, 250 yd downstream. The highest average concentration of polonium-210 for the year 1970 was 9.63% of the RCG, also at location 3. The average concentrations for the year 1970 for all locations are shown in Figure 10. 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.

Plutonium-238 Analysis A 25-ml aliquot from each water sample (representing a water sampling location) is transferred quantitatively to a 50-ml capacity centrifuge tube containing 1 ml of concentrated nitric acid, 2 mg of radiochemically pure cerium carrier, and 1 drop of concentrated phosphoric acid. Plutonium-238 is coprecipitated from this solution with cerium phosphate. The cerium phosphate precipitate is then dissolved in dilute hydrochloric acid and reprecipitated as cerium fluoride with hydrofluoric acid. The cerium fluoride precipitate, which selectively coprecipitates the plutonium-238, is plancheted directly and dried under a heat lamp. The plancheted sample is then flamed and alpha counted in a low background, gas flow proportional counter for a minimum of 4 hr. When a positive result is obtained, the sample is counted with alpha pulse height equipment to confirm the possible presence of plutonium-238.

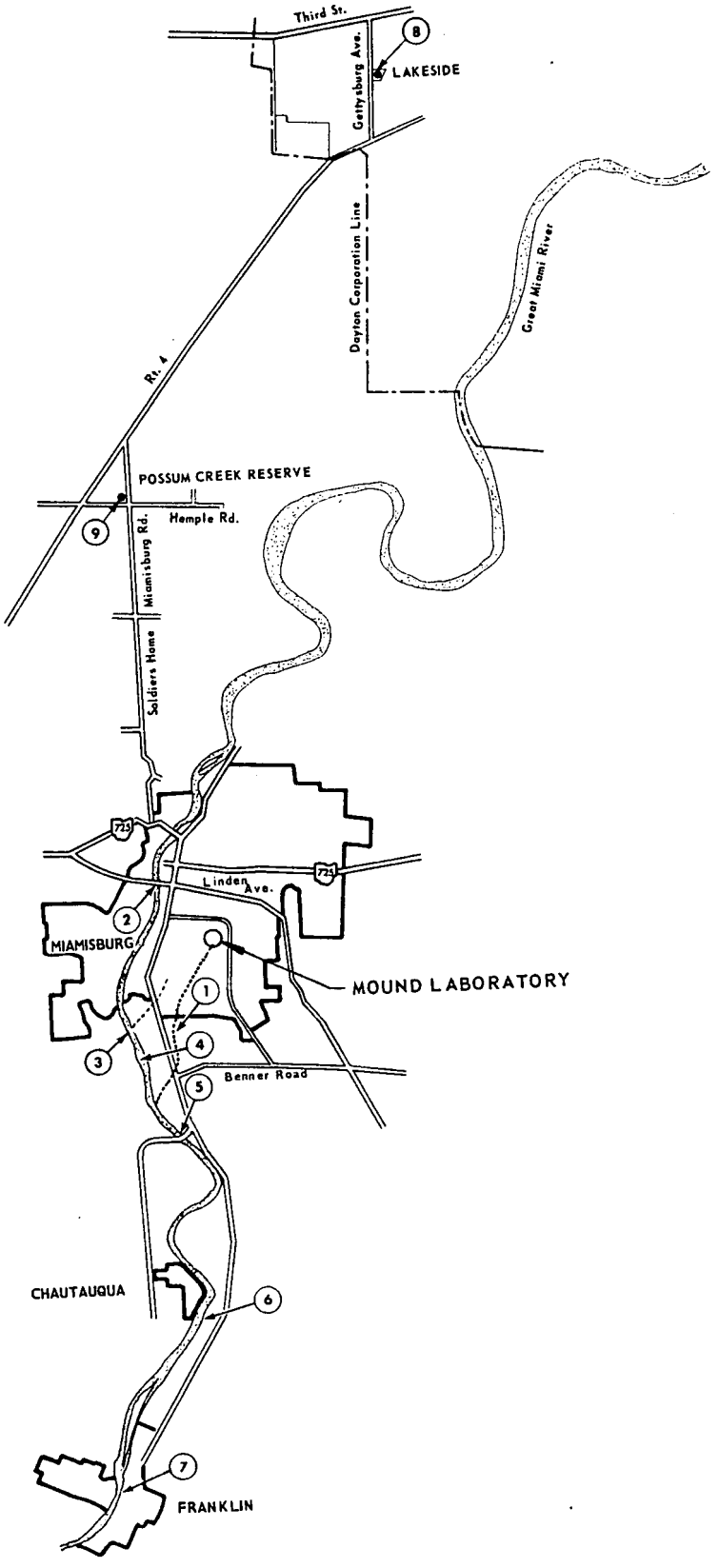

FIGURE 8 - Off-site water sampling locations.

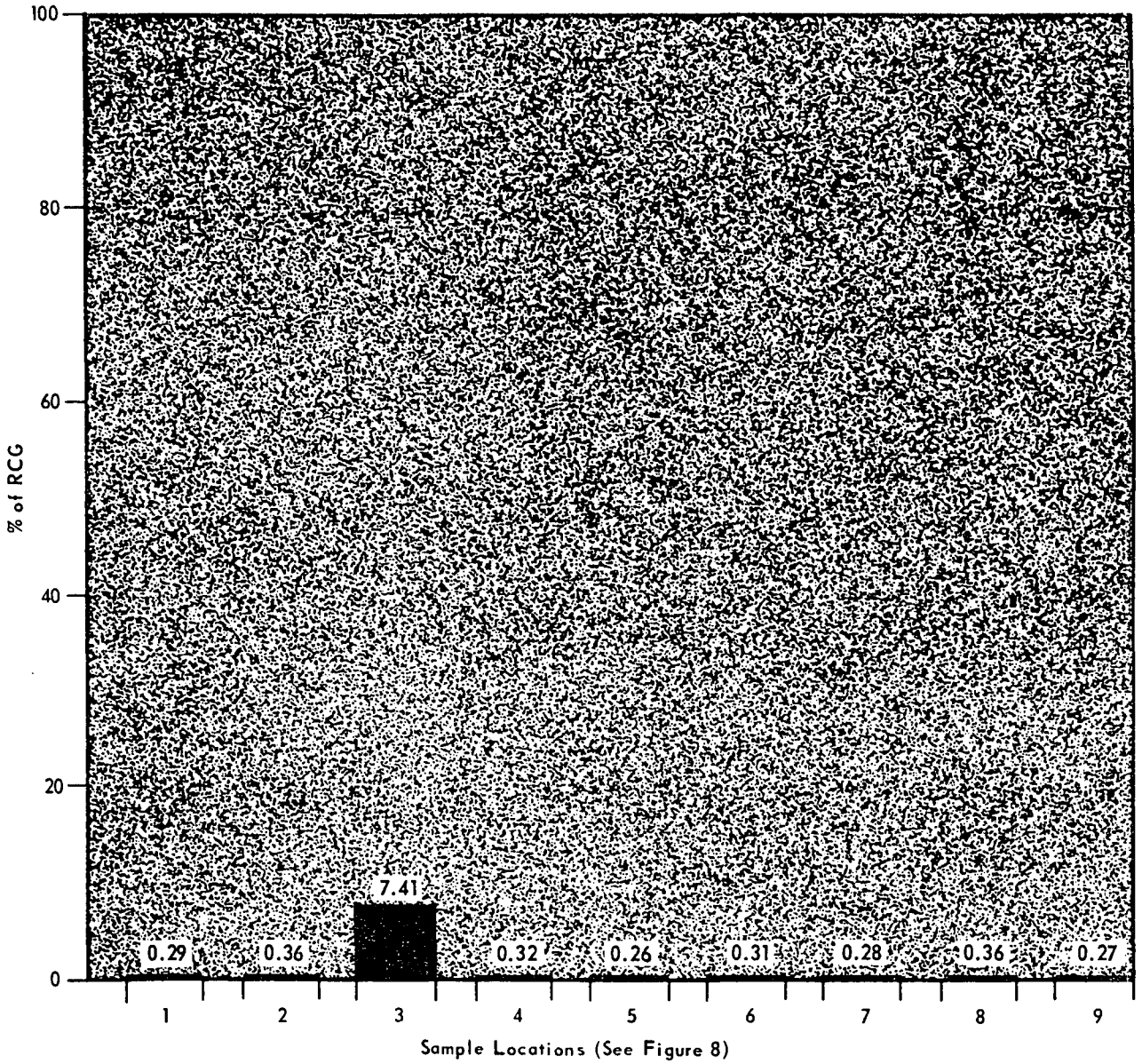

FIGURE 9 - Off-site water monitoring data for polonium-210--July-December 1970.

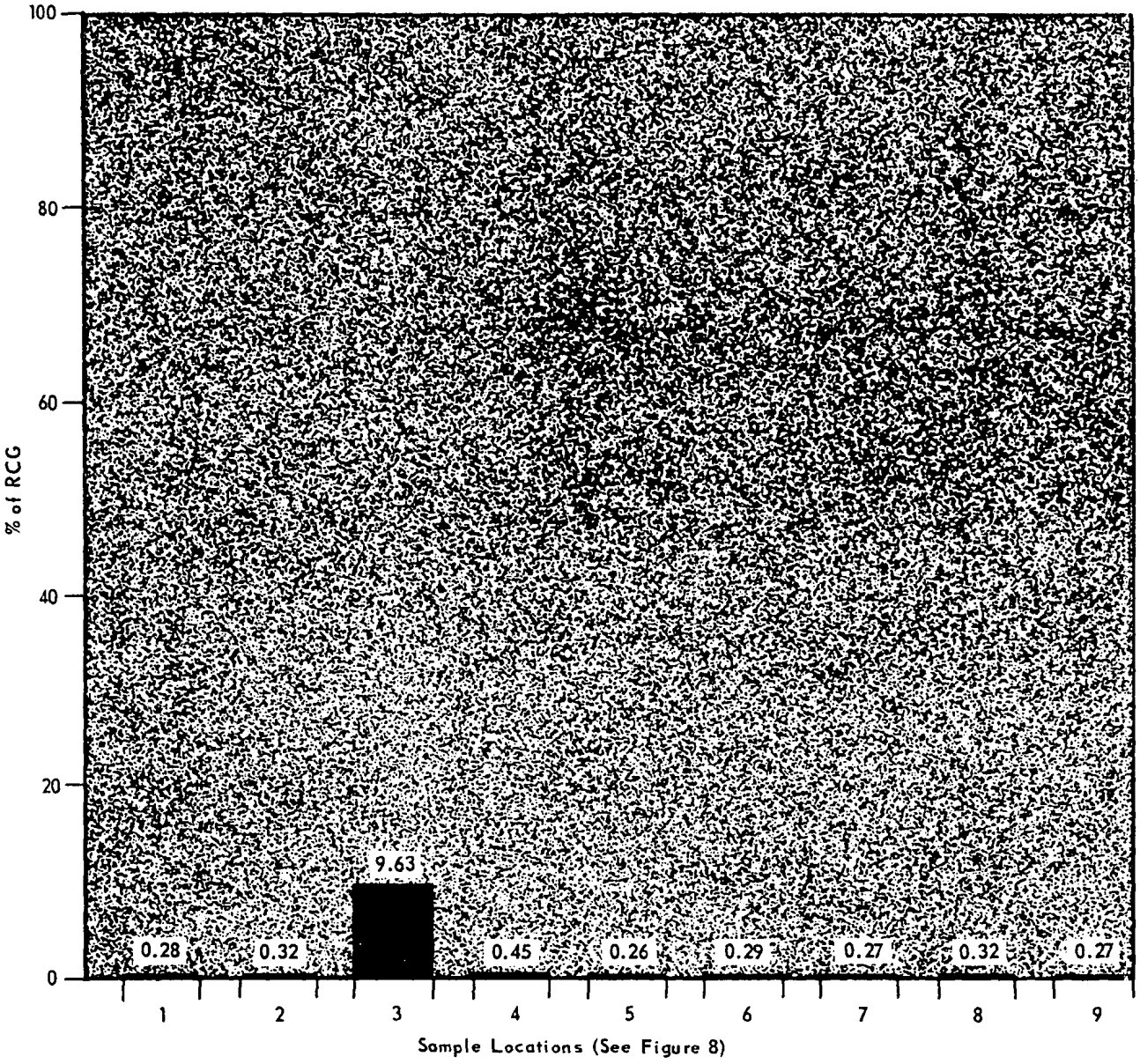

FIGURE 10 - Off-site water monitoring data for polonium-210--January-December 1970.

Results Figure 11 shows that the highest average concentration of plutonium-238 at any sampling location was 7/10 of 1% of the RCG for the second half of 1970. The next highest average concentration at any sampling site was 2/10 of 1% of the RCG. The highest average concentration of plutonium-238 at any sampling location for the entire year was 5/10 of 1% of the RCG. This concentration was detected in the Laboratory drainage ditch (location 1 in Figure 8). The highest average concentration in the Great Miami River for the year 1970 was 2/10 of 1% of the RCG at Chautauqua Dam (location 6 in Figure 8). The average concentrations for the entire year for all sampling sites are shown in Figure 12. 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.

Tritium Oxide Analysis A 1-ml aliquot from each water sample 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 10 min for tritium.

Results Figure 13 shows that the highest average concentration of tritium oxide for the second half of 1970 was 11.73% of the RCG at location 1 in the Laboratory drainage ditch. The average concentration at location 3, where the Laboratory effluent enters the Great Miami River, was 5.90% of the RCG. The average concentration rapidly decreased to 3/10 of 1% of the RCG 250 yards downstream at location 4 and further downstream at location 5. The highest average concentration of tritium oxide for the year 1970 was 14.23% of the RCG at location 1. The next highest average concentration was detected at location 3 and was 7.9% of the RCG. The highest average concentration in the Great Miami River for the year 1970 was 4/10 of 1% of the RCG 250 yards downstream at location 4. The average concentrations for all sampling locations are shown in Figure 14. 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.

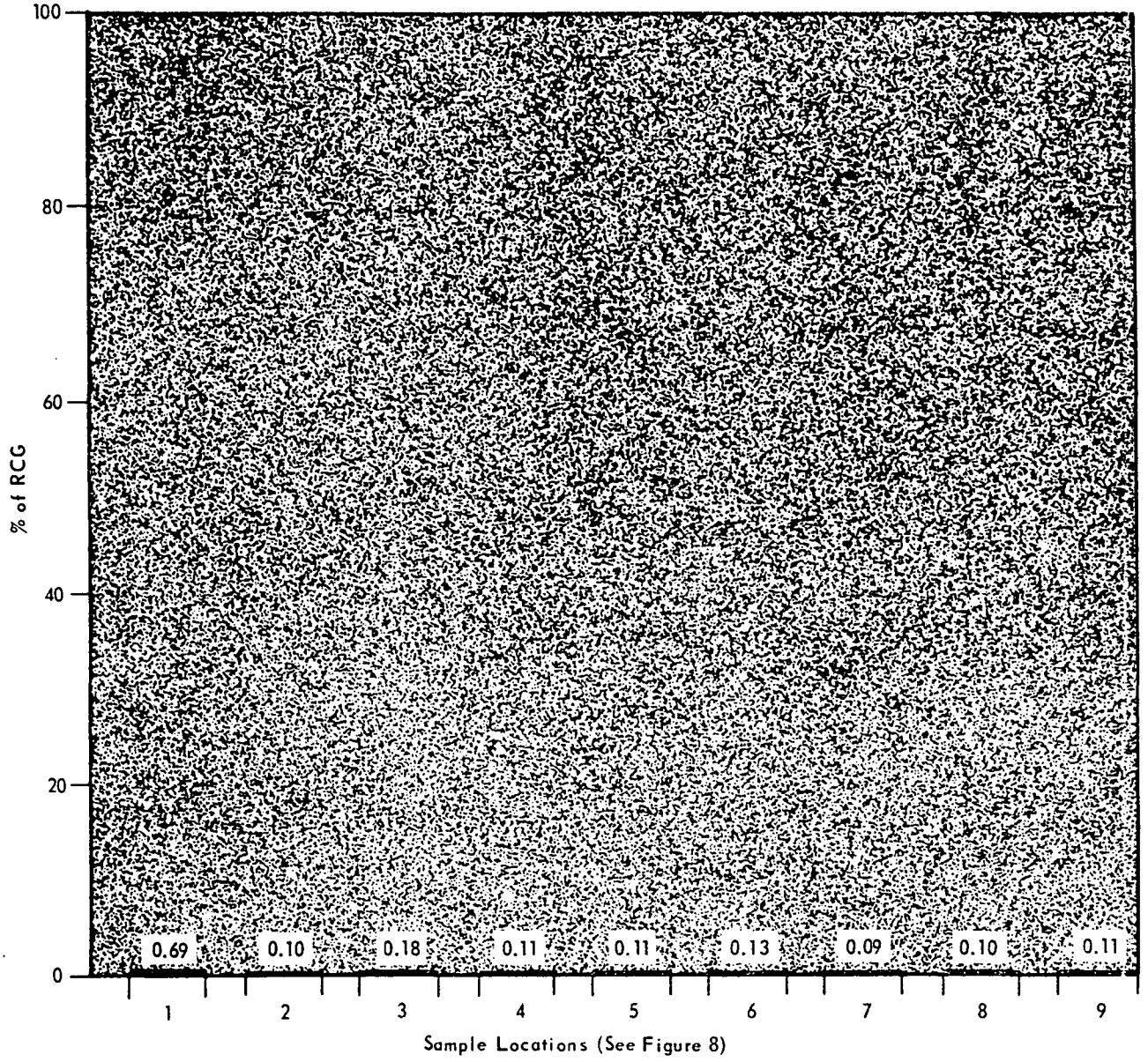

FIGURE 11 - Off-site water monitoring data for plutonium-238--July-December 1970.

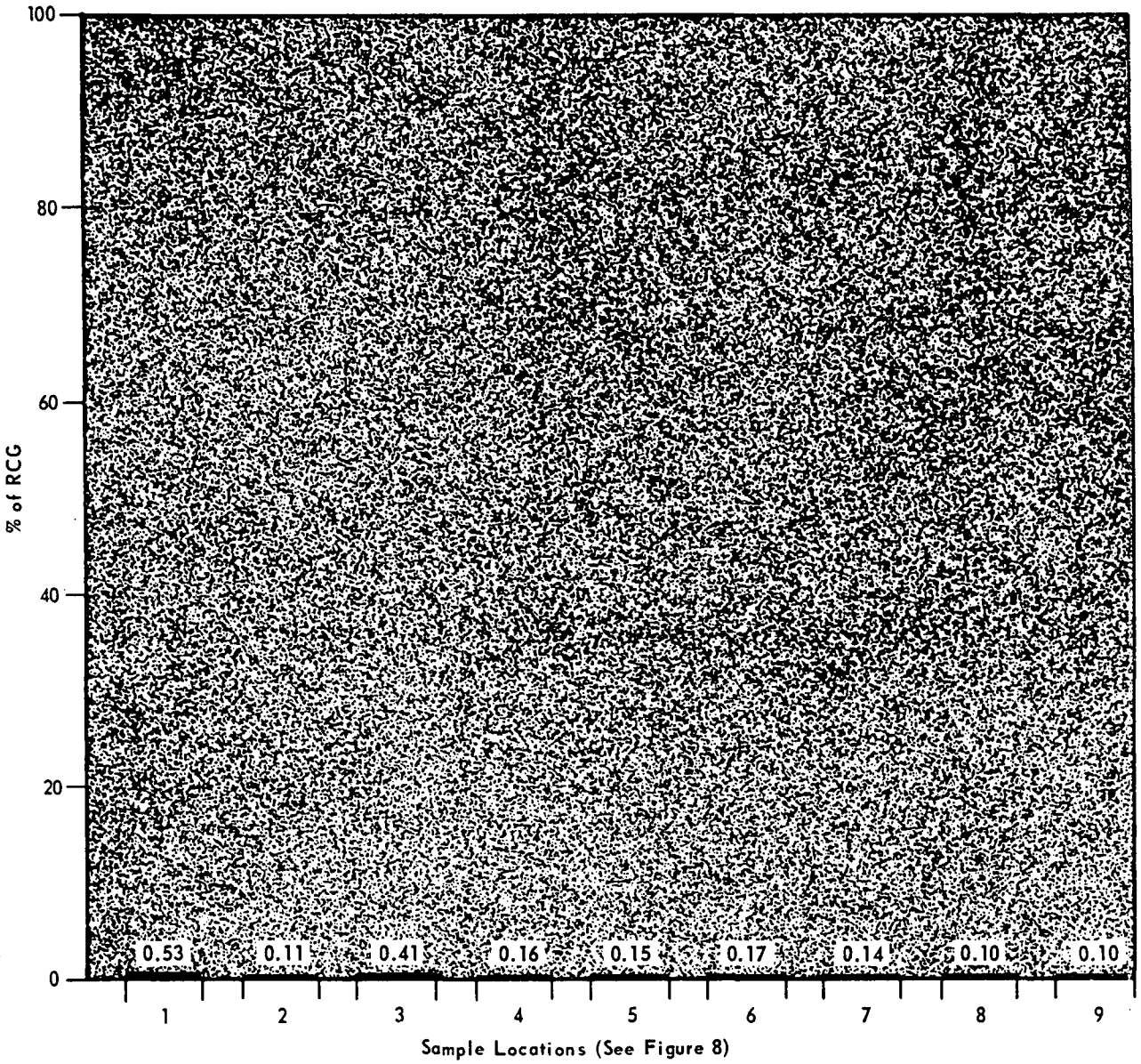

FIGURE 12 - Off-site water monitoring data for plutonium-238--January-December 1970.

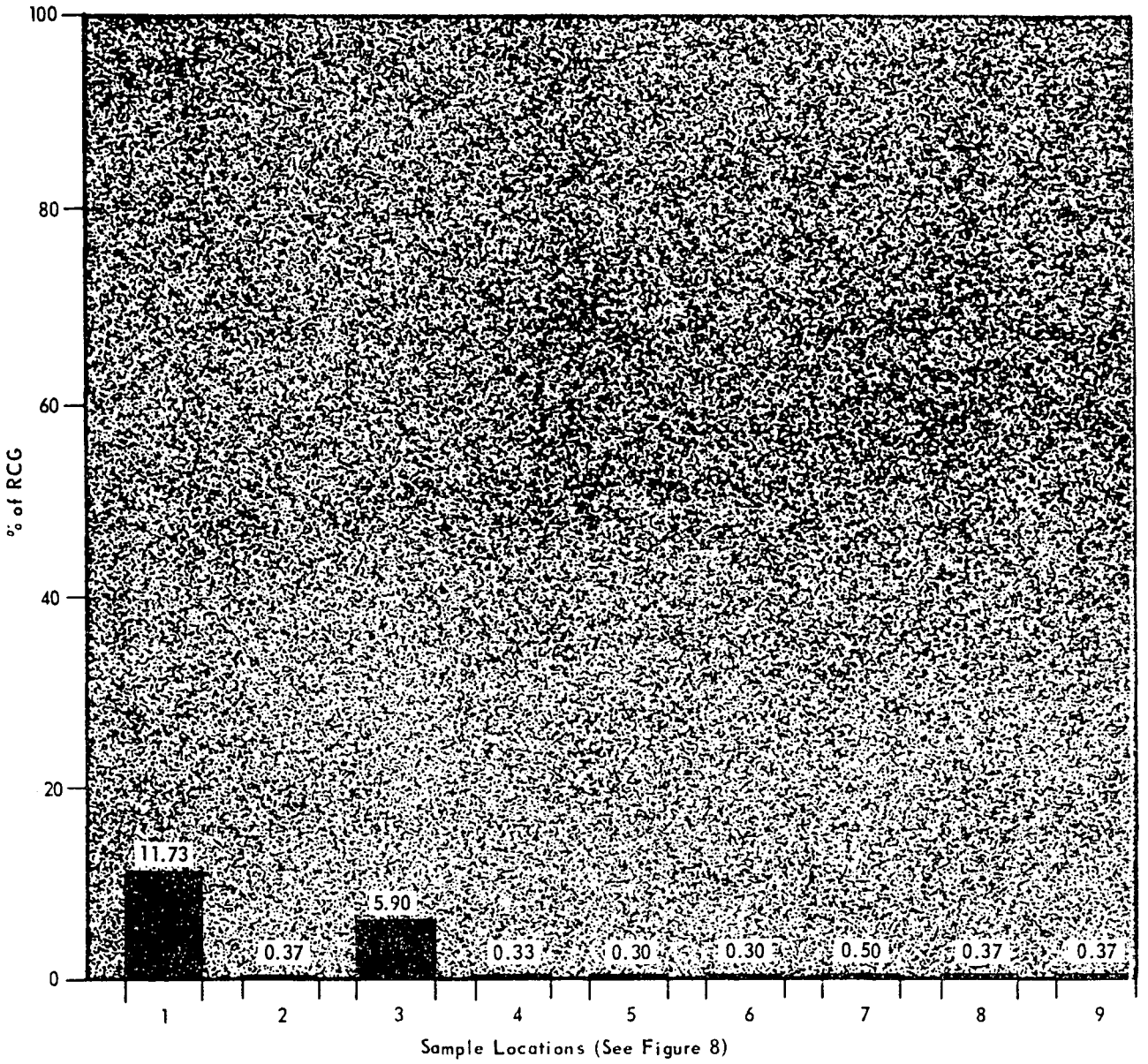

FIGURE 13 - Off-site water monitoring data for tritium oxide - July-December 1970.

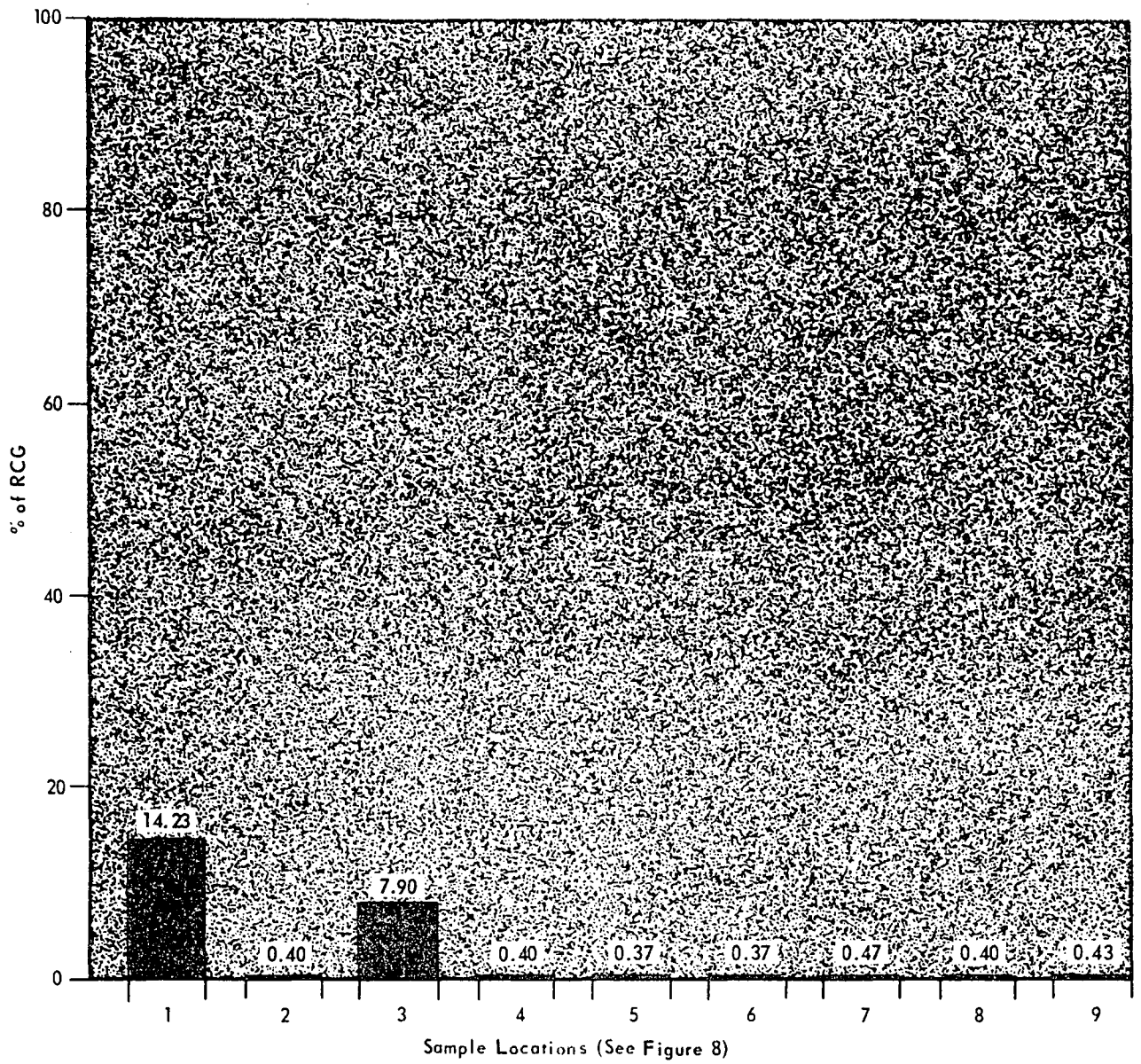

FIGURE 14 - Off-site water monitoring data for tritium oxide - January-December 1970.

APPENDIX

Table 1

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM-210

JANUARY-JUNE 1970, ALL ZONES

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-11} microcurie/cc)	Percent of RCG** for Average
0 - 3 (upwind)	25	0.0011	0.05
0 - 3 (downwind)	25	0.0008	0.04
3 - 5 (downwind)	25	0.0012	0.06
5 - 10 (downwind)	25	0.0015	0.07
10 - 15 (downwind)	25	0.0014	0.07
15 - 20 (downwind)	25	0.0012	0.06

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM-210

JULY-DECEMBER 1970, ALL ZONES

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-11} microcurie/cc)	Percent of RCG** For Average
0 - 3 (upwind)	59	0.0015	0.08
0 - 3 (downwind)	59	0.0008	0.04
3 - 5 (downwind)	58	0.0010	0.05
5 - 10 (downwind)	59	0.0009	0.05
10 - 15 (downwind)	59	0.0011	0.06
15 - 20 (downwind)	59	0.0006	0.03

Table 2 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR PLUTONIUM-238

JANUARY-DECEMBER 1970, ALL ZONES

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-12} microcurie/cc)	Percent of RCG** For Average
0 - 3 (upwind)	81	0.0033	0.33
0 - 3 (downwind)	81	0.0029	0.29
3 - 5 (downwind)	81	0.0030	0.30
5 - 10 (downwind)	81	0.0027	0.27
10 - 15 (downwind)	81	0.0027	0.27
15 - 20 (downwind)	81	0.0023	0.23

*Lowest detectable limit (LDL) for plutonium in air is 0.0013×10^{-12} microcurie/cc for samples collected 0-3 miles upwind, 3-5 miles downwind, 5-10 miles downwind and 10-15 miles downwind. The LDL is 0.0009×10^{-12} microcurie/cc for samples collected 0-3 miles downwind and 15-20 miles downwind.

**RCG - Radioactivity concentration guide = 1×10^{-12} microcurie/cc.

Note: Two LDL's are expressed above for the ranges in which plutonium-238 samples are collected. Air is sampled at three locations within the 0-3 and 15-20 mile downwind ranges, and the filter papers are combined to form one composite sample for each range. Air samples in other ranges are comprised of samples collected at two locations within each range. Since the volume of air analyzed in the 0-3 and 15-20 mile downwind ranges is 33% greater than in the other ranges, the sensitivity expressed as LDL is proportionately lower.

Table 3

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

JANUARY-JUNE 1970, ALL ZONES

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-7} microcurie/cc)	Percent of RCG** For Average
0 - 3 (upwind)	25	0.0044	0.22
0 - 3 (downwind)	25	0.0442	2.21
3 - 5 (downwind)	25	0.0049	0.24
5 - 10 (downwind)	25	0.0034	0.17
10 - 15 (downwind)	25	0.0040	0.20
15 - 20 (downwind)	25	0.0032	0.16

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

JULY-DECEMBER 1970, ALL ZONES

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-7} microcurie/cc)	Percent of RCG** For Average
0 - 3 (upwind)	57	0.0053	0.26
0 - 3 (downwind)	58	0.0340	1.70
3 - 5 (downwind)	58	0.0073	0.36
5 - 10 (downwind)	59	0.0050	0.25
10 - 15 (downwind)	59	0.0064	0.32
15 - 20 (downwind)	59	0.0054	0.27

Table 3 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

JANUARY-DECEMBER 1970, ALL ZONES

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-7} microcurie/cc)	Percent of RCG** For Average
0 - 3 (upwind)	82	0.0048	0.24
0 - 3 (downwind)	83	0.0391	1.95
3 - 5 (downwind)	83	0.0061	0.30
5 - 10 (downwind)	84	0.0042	0.21
10 - 15 (downwind)	84	0.0052	0.26
15 - 20 (downwind)	84	0.0043	0.21

*Lowest detectable limit for tritium in air is 0.0020×10^{-7} microcuries/cc.

**RCG - Radioactivity concentration guide = 2×10^{-7} microcurie/cc.

Table 4

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM-210

JULY-DECEMBER 1970

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-11} microcurie/cc)	Percent of RCG** For Average
		North Zone	
0 - 3 (upwind)	15	0.0012	0.06
0 - 3 (downwind)	15	0.0006	0.03
3 - 5 (downwind)	15	0.0009	0.04
5 - 10 (downwind)	15	0.0009	0.04
10 - 15 (downwind)	15	0.0012	0.06
15 - 20 (downwind)	15	0.0006	0.03
		Northeast Zone	
0 - 3 (upwind)	9	0.0011	0.06
0 - 3 (downwind)	9	0.0009	0.04
3 - 5 (downwind)	9	0.0009	0.04
5 - 10 (downwind)	9	ND	ND
10 - 15 (downwind)	9	ND	ND
15 - 20 (downwind)	9	0.0006	0.03

Table 4 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM-210

JULY-DECEMBER 1970

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-11} microcurie/cc)	Percent of RCG** For Average
		East Zone	
0 - 3 (upwind)	9	0.0009	0.04
0 - 3 (downwind)	9	ND	ND
3 - 5 (downwind)	9	0.0009	0.04
5 - 10 (downwind)	9	0.0011	0.05
10 - 15 (downwind)	9	0.0011	0.05
15 - 20 (downwind)	9	ND	ND
		Southeast Zone	
0 - 3 (upwind)	4	0.0047	0.23
0 - 3 (downwind)	4	0.0019	0.09
3 - 5 (downwind)	4	0.0018	0.09
5 - 10 (downwind)	4	0.0010	0.05
10 - 15 (downwind)	4	0.0030	0.15
15 - 20 (downwind)	4	0.0006	0.03

Table 4 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM-210

JULY-DECEMBER 1970

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-11} microcurie/cc)	Percent of RCG** For Average
		South Zone	
0 - 3 (upwind)	3	ND	ND
0 - 3 (downwind)	3	0.0006	0.03
3 - 5 (downwind)	3	0.0020	0.10
5 - 10 (downwind)	3	ND	ND
10 - 15 (downwind)	3	ND	ND
15 - 20 (downwind)	3	ND	ND
		Southwest Zone	
0 - 3 (upwind)	1	0.0033	0.17
0 - 3 (downwind)	1	ND	ND
3 - 5 (downwind)	1	ND	ND
5 - 10 (downwind)	1	ND	ND
10 - 15 (downwind)	1	0.0014	0.07
15 - 20 (downwind)	1	ND	ND

Table 4 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR POLONIUM-210

JULY-DECEMBER 1970

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-11} microcurie/cc)	Percent of RCG** For Average
		West Zone	
0 - 3 (upwind)	6	0.0015	0.08
0 - 3 (downwind)	6	ND	ND
3 - 5 (downwind)	6	0.0009	0.04
5 - 10 (downwind)	6	0.0009	0.04
10 - 15 (downwind)	6	0.0010	0.05
15 - 20 (downwind)	6	ND	ND
		Northwest Zone	
0 - 3 (upwind)	12	0.0017	0.09
0 - 3 (downwind)	12	0.0009	0.04
3 - 5 (downwind)	11	0.0010	0.05
5 - 10 (downwind)	12	0.0009	0.04
10 - 15 (downwind)	12	ND	ND
15 - 20 (downwind)	12	0.0006	0.03

*Lowest detectable limit (LDL) for polonium in air is 0.0008×10^{-11} microcurie/cc for samples collected 0-3 miles upwind, 3-5 miles downwind, 5-10 miles downwind and 10-15 miles downwind. The LDL is 0.0005×10^{-11} microcurie/cc for samples collected 0-3 miles downwind and 15-20 miles downwind.

**RCG - Radioactivity concentration guide = 2×10^{-11} microcurie/cc.

ND - Less than lowest detectable limit = Less than 0.04 percent and 0.025 percent (see LDL above) of the RCG.

Note: Two LDL's are expressed above for the ranges in which polonium-210 samples are collected. Air is sampled at three locations within the 0-3 and 15-20 mile downwind ranges, and the filter papers are combined to form one composite sample for each range. Air samples in other ranges are comprised of samples collected at two locations within each range. Since the volume of air analyzed in the 0-3 and 15-20 mile downwind ranges is 33% greater than in the other ranges, the sensitivity expressed as LDL is proportionately lower.

Table 5

SUMMARY OF OFF-SITE AIR MONITORING FOR PLUTONIUM-238

JULY-DECEMBER 1970

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-12} microcurie/cc)	Percent of RCG** For Average
		North Zone	
0 - 3 (upwind)	14	0.0017	0.17
0 - 3 (downwind)	14	0.0011	0.11
3 - 5 (downwind)	14	0.0019	0.19
5 - 10 (downwind)	14	0.0016	0.16
10 - 15 (downwind)	14	0.0021	0.21
15 - 20 (downwind)	14	0.0012	0.12
		Northeast Zone	
0 - 3 (upwind)	10	0.0060	0.60
0 - 3 (downwind)	10	0.0025	0.25
3 - 5 (downwind)	10	0.0025	0.25
5 - 10 (downwind)	10	0.0023	0.23
10 - 15 (downwind)	10	0.0027	0.27
15 - 20 (downwind)	10	0.0022	0.22

Table 5 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR PLUTONIUM-238

JULY-DECEMBER 1970

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-12} microcurie/cc)	Percent of RCG** For Average
		East Zone	
0 - 3 (upwind)	8	0.0019	0.19
0 - 3 (downwind)	8	0.0013	0.13
3 - 5 (downwind)	8	0.0011	0.11
5 - 10 (downwind)	8	0.0014	0.14
10 - 15 (downwind)	8	0.0019	0.19
15 - 20 (downwind)	8	0.0052	0.52
		Southeast Zone	
0 - 3 (upwind)	4	0.0029	0.29
0 - 3 (downwind)	4	0.0021	0.21
3 - 5 (downwind)	4	0.0022	0.22
5 - 10 (downwind)	4	0.0058	0.58
10 - 15 (downwind)	4	0.0030	0.30
15 - 20 (downwind)	4	0.0019	0.19

Table 5 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR PLUTONIUM-238

JULY-DECEMBER 1970

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-12} microcurie/cc)	Percent of RCG** For Average
		South Zone	
0 - 3 (upwind)	3	0.0025	0.25
0 - 3 (downwind)	3	0.0017	0.17
3 - 5 (downwind)	3	0.0016	0.16
5 - 10 (downwind)	3	ND	ND
10 - 15 (downwind)	3	0.0033	0.33
15 - 20 (downwind)	3	0.0013	0.13
		Southwest Zone	
0 - 3 (upwind)	1	0.0071	0.71
0 - 3 (downwind)	1	ND	ND
3 - 5 (downwind)	1	ND	ND
5 - 10 (downwind)	1	0.0038	0.38
10 - 15 (downwind)	1	ND	ND
15 - 20 (downwind)	1	ND	ND

Table 5 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR PLUTONIUM-238

JULY-DECEMBER 1970

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-12} microcurie/cc)	Percent of RCG** For Average
		West Zone	
0 - 3 (upwind)	6	0.0019	0.19
0 - 3 (downwind)	6	0.0013	0.13
3 - 5 (downwind)	6	0.0023	0.23
5 - 10 (downwind)	6	0.0017	0.17
10 - 15 (downwind)	6	0.0028	0.28
15 - 20 (downwind)	6	0.0013	0.13
		Northwest Zone	
0 - 3 (upwind)	11	0.0019	0.19
0 - 3 (downwind)	11	0.0011	0.11
3 - 5 (downwind)	11	0.0017	0.17
5 - 10 (downwind)	11	0.0019	0.19
10 - 15 (downwind)	11	0.0014	0.14
15 - 20 (downwind)	11	0.0010	0.10

*Lowest detectable limit (LDL) for plutonium in air is 0.0013×10^{-12} microcurie/cc for samples collected 0-3 miles upwind, 3-5 miles downwind, 5-10 miles downwind and 10-15 miles downwind. The LDL is 0.0009×10^{-12} microcurie/cc for samples collected 0-3 miles downwind and 15-20 miles downwind.

**RCG - Radioactivity concentration guide = 1×10^{-12} microcurie/cc.

ND - Less than lowest detectable limit = Less than 0.13 percent and 0.09 percent (see LDL above) of the RCG.

Note: Two LDL's are expressed above for the ranges in which polonium-210 samples are collected. Air is sampled at three locations within the 0-3 and 15-20 mile downwind ranges, and the filter papers are combined to form one composite sample for each range. Air samples in other ranges are comprised of samples collected at two locations within each range. Since the volume of air analyzed in the 0-3 and 15-20 mile downwind ranges is 33% greater than in the other ranges, the sensitivity expressed as LDL is proportionately lower.

Table 6

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

JULY-DECEMBER 1970

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-7} microcurie/cc)	Percent of RCG** For Average
		North Zone	
0 - 3 (upwind)	15	0.0086	0.43
0 - 3 (downwind)	15	0.0542	2.71
3 - 5 (downwind)	15	0.0184	0.92
5 - 10 (downwind)	15	0.0046	0.23
10 - 15 (downwind)	15	0.0039	0.19
15 - 20 (downwind)	15	0.0036	0.18
		Northeast Zone	
0 - 3 (upwind)	9	0.0085	0.42
0 - 3 (downwind)	8	0.0180	0.90
3 - 5 (downwind)	9	0.0139	0.69
5 - 10 (downwind)	9	0.0048	0.24
10 - 15 (downwind)	9	0.0048	0.24
15 - 20 (downwind)	9	0.0055	0.27

Table 6 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

JULY-DECEMBER 1970

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-7} microcurie/cc)	Percent of RCG** For Average
		East Zone	
0 - 3 (upwind)	6	0.0035	0.17
0 - 3 (downwind)	8	0.0116	0.58
3 - 5 (downwind)	8	0.0067	0.33
5 - 10 (downwind)	8	0.0098	0.49
10 - 15 (downwind)	8	0.0052	0.26
15 - 20 (downwind)	8	0.0117	0.58
		Southeast Zone	
0 - 3 (upwind)	4	0.0028	0.14
0 - 3 (downwind)	4	0.0165	0.82
3 - 5 (downwind)	4	0.0033	0.16
5 - 10 (downwind)	4	0.0032	0.16
10 - 15 (downwind)	4	0.0186	0.93
15 - 20 (downwind)	4	0.0028	0.14

Table 6 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

JULY-DECEMBER 1970

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-7} microcurie/cc)	Percent of RCG** For Average
		South Zone	
0 - 3 (upwind)	4	0.0046	0.23
0 - 3 (downwind)	4	0.0444	2.22
3 - 5 (downwind)	4	0.0058	0.29
5 - 10 (downwind)	4	0.0052	0.26
10 - 15 (downwind)	4	0.0049	0.24
15 - 20 (downwind)	4	0.0042	0.21
		Southwest Zone	
0 - 3 (upwind)	1	0.0046	0.23
0 - 3 (downwind)	1	0.0777	3.88
3 - 5 (downwind)	1	ND	ND
5 - 10 (downwind)	1	ND	ND
10 - 15 (downwind)	1	ND	ND
15 - 20 (downwind)	1	ND	ND

Table 6 (continued)

SUMMARY OF OFF-SITE AIR MONITORING FOR TRITIUM

JULY-DECEMBER 1970

Range (miles)	Number of Samples Collected	Average Concentration* (10^{-7} microcurie/cc)	Percent of RCG** For Average
		West Zone	
0 - 3 (upwind)	6	0.0081	0.40
0 - 3 (downwind)	6	0.0205	1.02
3 - 5 (downwind)	6	0.0025	0.12
5 - 10 (downwind)	6	0.0073	0.36
10 - 15 (downwind)	6	0.0021	0.10
15 - 20 (downwind)	6	0.0063	0.31
		Northwest Zone	
0 - 3 (upwind)	12	ND	ND
0 - 3 (downwind)	12	0.0290	1.45
3 - 5 (downwind)	11	0.0059	0.29
5 - 10 (downwind)	12	0.0037	0.18
10 - 15 (downwind)	12	0.0095	0.47
15 - 20 (downwind)	12	0.0068	0.34

*Lowest detectable limit for tritium in air is 0.0020×10^{-7} microcurie/cc.

**RCG - Radioactivity concentration guide = 2×10^{-7} microcurie/cc.

ND - Less than lowest detectable limit = less than 0.1 percent of RCG.

Table 7

SUMMARY OF OFF-SITE WATER MONITORING FOR POLONIUM-210

JANUARY-JUNE 1970

Sample Location	Number of Samples Collected	Average Concentration* (10^{-7} microcurie/cc)	Percent of RCG** For Average
Mound Lab Drainage Ditch Effluent No. 2 (location No.1 on map)	24	0.0190	0.27
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	23	ND	ND
Mound Lab Effluent No. 1 (location No. 3 on map)	23	0.9300	13.28
250 yd. downstream from Mound Lab effluent (location No. 4 on map)	23	0.0470	0.67
Chautauqua Road Bridge (location No. 5 on map)	23	ND	ND
Chautauqua Dam (location No. 6 on map)	23	ND	ND
Franklin, Ohio (location No. 7 on map)	23	ND	ND
Pond - opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab, location 8 on map)	23	ND	ND
Pond - Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab, location 9 on map)	24	ND	ND

*Lowest detectable limit for polonium in water is 0.0180×10^{-7} microcurie/cc.

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

ND - Less than the lowest detectable limit = Less than 0.26 percent of the RCG.

Table 7 (continued)

SUMMARY OF OFF-SITE WATER MONITORING FOR POLONIUM-210

JULY-DECEMBER 1970

Sample Location	Number of Samples Collected	Average Concentration* (10^{-7} microcurie/cc)	Percent of RCG** For Average
Mound Lab Drainage Ditch Effluent No. 2 (location No. 1 on map)	38	0.0201	0.29
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	38	0.0251	0.36
Mound Lab Effluent No. 1 (location No. 3 on map)	38	0.5190	7.41
250 yd. downstream from Mound Lab effluent (location No. 4 on map)	38	0.0225	0.32
Chautauqua Road Bridge (location No. 5 on map)	38	0.0185	0.26
Chautauqua Dam (location No. 6 on map)	38	0.0218	0.31
Franklin, Ohio (location No. 7 on map)	38	0.0194	0.28
Pond - opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab, location 8 on map)	38	0.0254	0.36
Pond - Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab, location 9 on map)	38	0.0192	0.27

*Lowest detectable limit for polonium in water is 0.0180×10^{-7} microcurie/cc.

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

Table 7 (continued)

SUMMARY OF OFF-SITE WATER MONITORING FOR POLONIUM-210

JANUARY-DECEMBER 1970

Sample Location	Number of Samples Collected	Average Concentration* (10^{-7} microcurie/cc)	Percent of RCG** For Average
Mound Lab Drainage Ditch Effluent No. 2 (location No. 1 on map)	62	0.0196	0.28
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	61	0.0224	0.32
Mound Lab Effluent No. 1 (location No. 3 on map)	61	0.6739	9.63
250 yd. downstream from Mound Lab effluent (location No. 4 on map)	61	0.0317	0.45
Chautauqua Road Bridge (location No. 5 on map)	61	0.0183	0.26
Chautauqua Dam (location No. 6 on map)	61	0.0204	0.29
Franklin, Ohio (location No. 7 on map)	61	0.0189	0.27
Pond - opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab, location 8 on map)	61	0.0227	0.32
Pond - Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab, location 9 on map)	62	0.0187	0.27

*Lowest detectable limit for polonium in water is 0.0180×10^{-7} microcurie/cc.

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

Table 8

SUMMARY OF OFF-SITE WATER MONITORING FOR PLUTONIUM-238

JANUARY-JUNE 1970

Sample Location	Number of Samples Collected	Average Concentration* (10^{-6} microcurie/cc)	Percent of RCG** For Average
Mound Lab Drainage Ditch Effluent No. 2 (location No.1 on map)	24	0.0142	0.28
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	23	0.0053	0.11
Mound Lab Effluent No. 1 (location No. 3 on map)	23	0.0391	0.78
250 yd. downstream from Mound Lab effluent (location No. 4 on map)	23	0.0118	0.24
Chautauqua Road Bridge (location No. 5 on map)	23	0.0111	0.22
Chautauqua Dam (location No. 6 on map)	23	0.0116	0.23
Franklin, Ohio (location No. 7 on map)	23	0.0114	0.23
Pond - opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab, location 8 on map)	23	0.0050	0.10
Pond - Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab, location 9 on map)	24	0.0046	0.09

*Lowest detectable limit for plutonium in water is 0.0045×10^{-6} microcurie/cc.

**RCG - Radioactivity concentration guide = 5×10^{-6} microcurie/cc.

Table 8 (continued)

SUMMARY OF OFF-SITE WATER MONITORING FOR PLUTONIUM-238

JULY-DECEMBER 1970

Sample Location	Number of Samples Collected	Average Concentration* (10^{-6} microcurie/cc)	Percent of RCG** For Average
Mound Lab Drainage Ditch Effluent No. 2 (location No. 1 on map)	37	0.0344	0.69
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	37	0.0052	0.10
Mound Lab Effluent No. 1 (location No. 3 on map)	37	0.0092	0.18
250 yd. downstream from Mound Lab effluent (location No. 4 on map)	38	0.0054	0.11
Chautauqua Road Bridge (location No. 5 on map)	36	0.0053	0.11
Chautauqua Dam (location No. 6 on map)	38	0.0064	0.13
Franklin, Ohio (location No. 7 on map)	38	0.0046	0.09
Pond - opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab, location 8 on map)	38	0.0051	0.10
Pond - Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab, location 9 on map)	37	0.0057	0.11

*Lowest detectable limit for plutonium in water is 0.0045×10^{-6} microcurie/cc.

**RCG - Radioactivity concentration guide = 5×10^{-6} microcurie/cc.

Table 8 (continued)

SUMMARY OF OFF-SITE WATER MONITORING FOR PLUTONIUM-238

JANUARY-DECEMBER 1970

Sample Location	Number of Samples Collected	Average Concentration* (10^{-6} microcurie/cc)	Percent of RCG** For Average
Mound Lab Drainage Ditch Effluent No. 2 (location No. 1 on map)	61	0.0265	0.53
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	60	0.0053	0.11
Mound Lab Effluent No. 1 (location No. 3 on map)	60	0.0207	0.41
250 yd. downstream from Mound Lab effluent (location No. 4 on map)	61	0.0078	0.16
Chautauqua Road Bridge (location No. 5 on map)	59	0.0076	0.15
Chautauqua Dam (location No. 6 on map)	61	0.0084	0.17
Franklin, Ohio (location No. 7 on map)	61	0.0072	0.14
Pond - opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab, location 8 on map)	61	0.0050	0.10
Pond - Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab, location 9 on map)	61	0.0052	0.10

*Lowest detectable limit for plutonium in water is 0.0045×10^{-6} microcurie/cc.

**RCG - Radioactivity concentration guide = 5×10^{-6} microcurie/cc.

Table 9

SUMMARY OF OFF-SITE WATER MONITORING FOR TRITIUM

JANUARY-JUNE 1970

Sample Location	Number of Samples Collected	Average Concentration* (10^{-3} microcurie/cc)	Percent of RCG** For Average
Mound Lab Drainage Ditch Effluent No. 2 (location No.1 on map)	24	0.5460	18.20
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	23	0.0140	0.47
Mound Lab Effluent No. 1 (location No. 3 on map)	23	0.3360	11.20
250 yd. downstream from Mound Lab effluent (location No. 4 on map)	23	0.0150	0.50
Chautauqua Road Bridge (location No. 5 on map)	23	0.0150	0.50
Chautauqua Dam (location No. 6 on map)	23	0.0120	0.40
Franklin, Ohio (location No. 7 on map)	23	0.0120	0.40
Pond - opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab, location 8 on map)	23	0.0140	0.47
Pond - Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab, location 9 on map)	24	0.0160	0.53

*Lowest detectable limit for tritium in water is 0.0060×10^{-3} microcurie/cc.

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

Table 9 (continued)

SUMMARY OF OFF-SITE WATER MONITORING FOR TRITIUM

JULY-DECEMBER 1970

Sample Location	Number of Samples Collected	Average Concentration* (10^{-3} microcurie/cc)	Percent of RCG** For Average
Mound Lab Drainage Ditch Effluent No. 2 (location No. 1 on map)	38	0.3520	11.73
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	38	0.0110	0.37
Mound Lab Effluent No. 1 (location No. 3 on map)	38	0.1770	5.90
250 yd. downstream from Mound Lab effluent (location No. 4 on map)	38	0.0100	0.33
Chautauqua Road Bridge (location No. 5 on map)	38	0.0090	0.30
Chautauqua Dam (location No. 6 on map)	38	0.0090	0.30
Franklin, Ohio (location No. 7 on map)	38	0.0150	0.50
Pond - opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab, location 8 on map)	38	0.0110	0.37
Pond - Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab, location 9 on map)	38	0.0110	0.37

*Lowest detectable limit for tritium in water is 0.0060×10^{-3} microcurie/cc.

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

Table 9 (continued)

SUMMARY OF OFF-SITE WATER MONITORING FOR TRITIUM

JANUARY-DECEMBER 1970

Sample Location	Number of Samples Collected	Average Concentration* (10^{-3} microcurie/cc)	Percent of RCG** For Average
Mound Lab Drainage Ditch Effluent No. 2 (location No. 1 on map)	62	0.4270	14.23
Linden Ave. Bridge, Miamisburg, Ohio (upstream-location No. 2 on map)	61	0.0120	0.40
Mound Lab Effluent No. 1 (location No. 3 on map)	61	0.2370	7.90
250 yd. downstream from Mound Lab effluent (location No. 4 on map)	61	0.0120	0.40
Chautauqua Road Bridge (location No. 5 on map)	61	0.0110	0.37
Chautauqua Dam (location No. 6 on map)	61	0.0110	0.37
Franklin, Ohio (location No. 7 on map)	61	0.0140	0.47
Pond - opposite V.A. Hospital, Dayton, Ohio (8 mi. NE of Mound Lab, location 8 on map)	61	0.0120	0.40
Pond - Possum Creek Reserve, Dayton, Ohio (6 mi. NE of Mound Lab, location 9 on map)	62	0.0130	0.43

*Lowest detectable limit for tritium in water is 0.0060×10^{-3} microcurie/cc.

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