ENVIRONMENTAL MONITORING

SEMIANNUAL REPORT

JULY 1, 1964 TO DECEMBER 31, 1964

AND

ANNUAL REPORT

1964

by

R. R. Garcia

J. D. Moore

C. J. Schwering

W. L. Fisher

Approved

ABSTRACT

Environmental monitoring at Atomics International is performed by the Health Physics Unit of the Health and Safety Section. Soil, vegetation, water, and air are routinely sampled up to a distance of 10 miles from Atomics International property. The environmental radioactivity reported herein is attributed to naturally occurring fluctuations, not to Atomics International operations.

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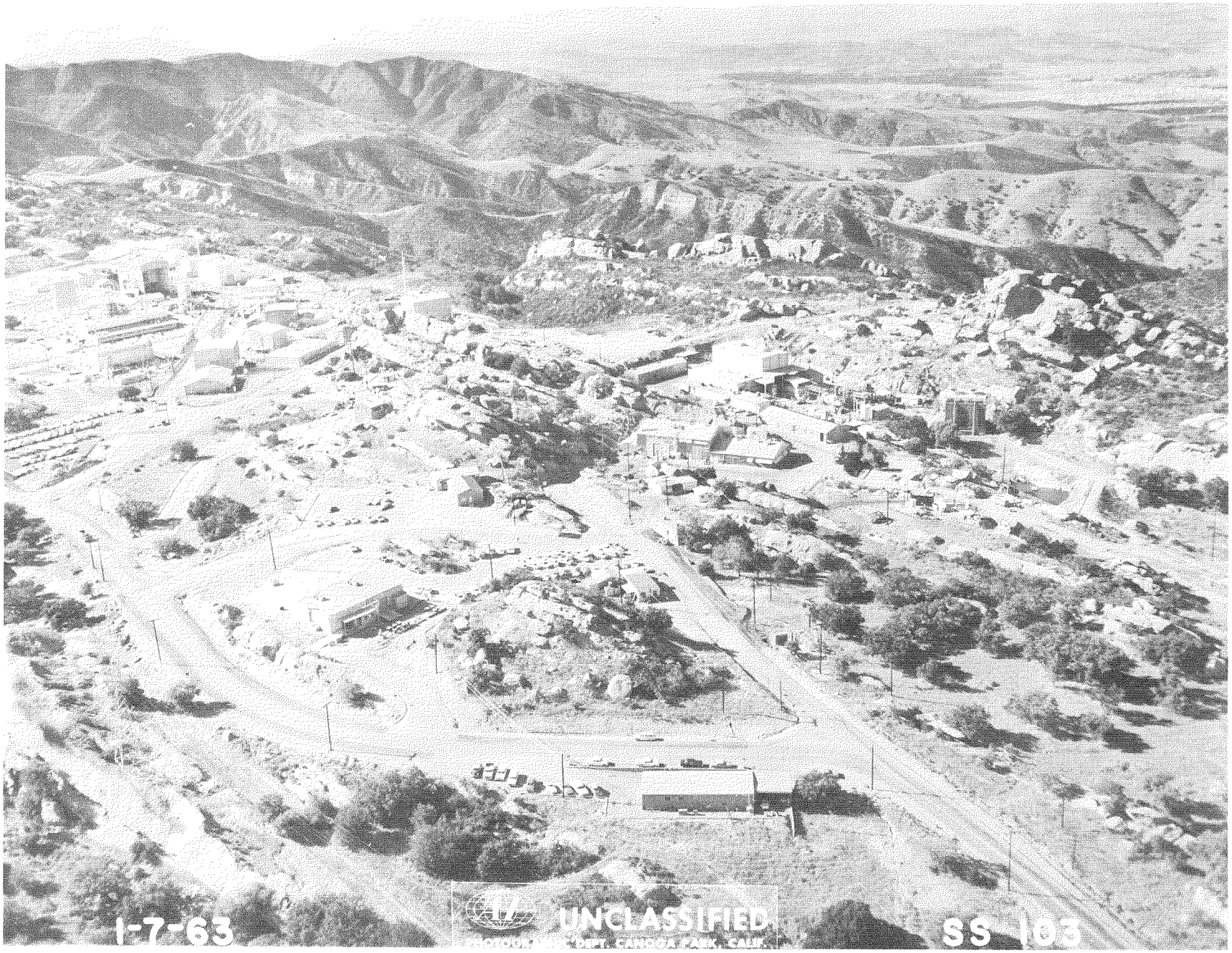


Figure 2. Atomics International Nuclear Development Field Laboratory

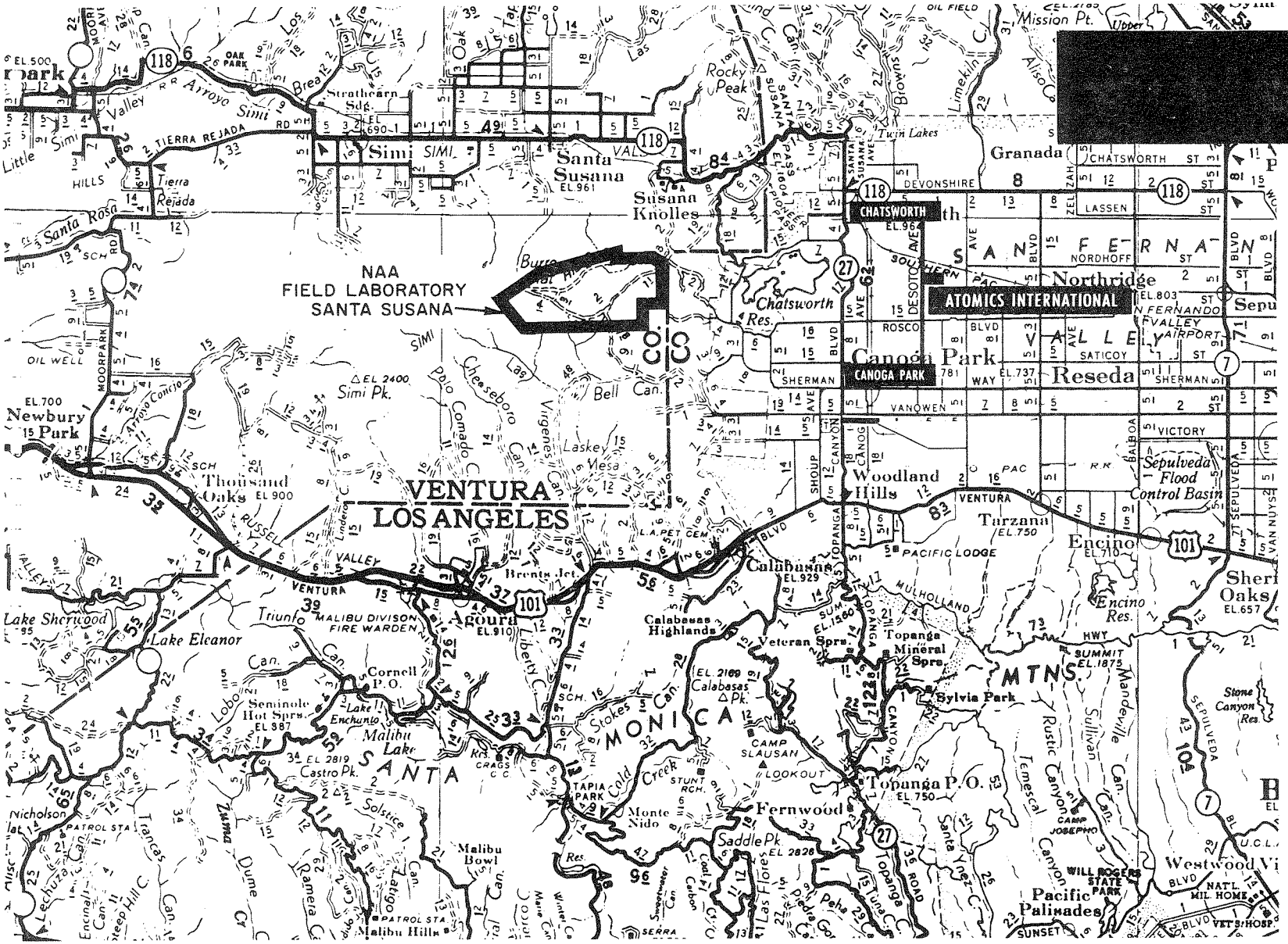


Figure 3. Map of Headquarters and Nuclear Development Field Laboratory Environs

I. SUMMARY

Atomics International, a Division of North American Aviation, Incorporated, has been engaged in atomic energy research and development since 1946. The Company designs, develops, and constructs nuclear reactors for central station and compact power plants and for medical, industrial, and scientific applications.

The company occupies modern facilities in Canoga Park, California, approximately 23 miles northwest of downtown Los Angeles (Figure 1). The 290-acre Nuclear Development Field Laboratory (Figure 2), equipped with extensive testing facilities for the support of advanced nuclear studies, is located in the Simi Hills of Ventura County approximately 29 miles northwest of downtown Los Angeles. The location of the above sites in relation to nearby communities is shown in Figure 3.

The basic concept of radiological hazard control at Atomics International requires total containment of radioactive materials and, through rigid operational controls, minimizes effluent releases and external radiation levels. The environmental monitoring program provides a check on the effectiveness of the company's radiological safety procedures and of engineering safeguards incorporated into facility design.

The environs of Atomics International Headquarters and the Nuclear Development Field Laboratory (NDFL) are surveyed monthly to determine the concentration of radioactivity in typical surface soil, vegetation, and water samples. Also, continuous environmental air monitoring at the sites provides information concerning airborne particulate radioactivity. This report summarizes environmental monitoring results for the last six months of 1964 and compares the data with previous years.

Soil and vegetation are sampled monthly. Sampling stations located within the boundaries of Atomics International's sites are referred to as "on-site" stations. The remaining stations, located within a 10 mile radius of the sites, are referred to as "off-site" stations.

A. ENVIRONMENTAL RADIOACTIVITY DATA - 1964

The average radioactivity concentration in soil and vegetation samples is presented in Tables I and II.

TABLE I
SOIL RADIOACTIVITY DATA - 1964
I.a. SEMIANNUAL AVERAGES

Area	Activity	First Half - 1964		Last Half - 1964	
		No. Samples	Average µµc/gram	No. Samples	Average µµc/gram
On Site	α	74	0.33 to 0.37	78	0.54 to 0.55
	β-γ	74	35	72	29
Off Site	α	221	0.35 to 0.38	78	0.45 to 0.49
	β-γ	221	33	72	19

I.b. MONTHLY AVERAGES
µµc/gram

	Activity	J	F	M	A	M	J	J	A	S	O	N	D
On Site	α	0.38 to 0.42	0.25 to 0.33	0.35 to 0.37	0.42 to 0.44	0.40 to 0.41	0.30 to 0.34	0.37 to 0.41	0.43	0.81	0.58	0.61	0.44 to 0.46
	β-γ	43	32	31	38	39	27	27	28	36	34	24	26
Off Site	α	0.34 to 0.38	0.32 to 0.37	0.33 to 0.37	0.43 to 0.44	0.32 to 0.37	0.32 to 0.36	0.21 to 0.26	0.31	1.01	0.47	0.41	0.46
	β-γ	35	32	31	34	35	32	19	22	19	19	17	19

TABLE II
VEGETATION RADIOACTIVITY DATA - 1964
II.a. SEMIANNUAL AVERAGES

Area	Activity	First Half - 1964		Last Half - 1964	
		No. Samples	Average µµc/gram/ash	No. Samples	Average µµc/gram/ash
On Site	α	76	0.38 to 0.39	78	0.61 to 0.62
	β-γ	76	247	72	175
Off Site	α	227	0.38 to 0.39	66	0.63 to 0.64
	β-γ	227	231	72	130

II.b. MONTHLY AVERAGES
µµc/gram/ash

	Activity	J	F	M	A	M	J	J	A	S	O	N	D
On Site	α	0.44	0.41 to 0.42	0.48	0.35	0.39 to 0.40	0.20 to 0.22	0.20 to 0.23	0.65 to 0.67	0.91	0.48	0.57	0.86
	β-γ	161	175	162	396	402	211	203	169	189	173	167	146
Off Site	α	0.32 to 0.33	0.36 to 0.37	0.42	0.39	0.38	0.42 to 0.43	0.28 to 0.30	0.34 to 0.35	0.94	0.83	0.67	0.74 to 0.75
	β-γ	173	191	147	315	361	204	155	133	124	112	133	131

Process water used at the NDFL is obtained from wells and stored in 50,000 gallon tanks. Potable water is delivered to the site by a vendor and is not analyzed. Well water is sampled monthly from the supply system at two locations. The average well water radioactivity is presented in Table III.

TABLE III
WELL WATER RADIOACTIVITY DATA - 1964
III.a. - SEMIANNUAL AVERAGES

Location	Activity	First Half-1964		Last Half-1964	
		No. Samples	Average μμc/liter	No. Samples	Average μμc/liter
NDFL	α	11	0.11 to 0.13	12	0.22
	β-γ	11	3.6 to 5.8	12	6.8 to 7.0

III.b. - MONTHLY AVERAGES
μμc/liter

Activity	J	F	M	A	M	J	J	A	S	O	N	D
α	0.18	0.03 to 0.06	0.05	0.10	0.29	0.05	0.08	0.10	0.13	0.88	0.05 to 0.08	0.07
β-γ	2.9	6.4	2.5	3.9	4.7	1.9	3.7 to 5.0	5.0	8.6	12.1	6.8	4.3

Soil, vegetation, and water are sampled monthly at Chatsworth Reservoir, which is operated by the Los Angeles City Department of Water and Power. Soil and vegetation radioactivity data for the reservoir are averaged into data presented in Tables I, II, VI, and VII. The average radioactivity concentration in surface and supply water samples is presented in Table IV.

TABLE IV
CHATSWORTH RESERVOIR WATER RADIOACTIVITY DATA - 1964
IV.a. - SEMIANNUAL AVERAGES

Sample	Activity	First Half - 1964		Last Half - 1964	
		No. Samples	Average μμc/liter	No. Samples	Average μμc/liter
Lake Surface	α	12	0.60	6	0.83
	β-γ	12	12.6	6	8.8
Supply Inlet	α	6	0.40 to 0.41	6	0.59
	β-γ	6	10	6	7.8

IV.b. - MONTHLY AVERAGES
μμc/liter

	Activity	J	F	M	A	M	J	J	A	S	O	N	D
Lake Surface	α	*	*	*	0.27	0.30	0.74	0.81	0.79	1.00	0.59	0.82	0.94
	$\beta-\gamma$	*	*	*	18	12	10	7.3	11	10	9.2	8.3	6.8
Supply Inlet	α	0.18	0.05	0.71	0.65	0.66	0.21	0.55	0.07	0.61	0.54	0.93	0.72
	$\beta-\gamma$	64	4.4	11	11	17	8.6	7.3	6.3	9.1	10	7.6	7.3

* No samples due to dry reservoir

Sampling of environmental air for particulate radioactivity is performed continuously at the Canoga site. Air is drawn through a filter which is counted, after a 72-hour decay period, for long-lived radioactivity. The average concentration of long-lived beta emitters is presented in Table V.

TABLE V
AIRBORNE RADIOACTIVITY DATA - 1964
SEMIANNUAL AVERAGES

Site	Activity	First Half - 1964		Last Half - 1964	
		No. Samples	Average μμc/M^3	No. Samples	Average μμc/M^3
Canoga	$\beta-\gamma$	182	2.0	173	0.71

Tables I and II show increase, during the last six months of 1964, in alpha radioactivity and a considerable decrease in beta-gamma radioactivity.

Table III shows that NDFL well water radioactivity increased during the last six months of the year. Table IV shows that alpha radioactivity in Chatsworth Reservoir lake surface and supply water increased and that beta-gamma radioactivity decreased during the same period. Reservoir water originates as run-off from the Sierra Mountains at a considerable distance from the local area, and, since both NDFL well water and reservoir water radioactivities are similar, the radioactivity in well water is not attributed to Atomics International operations.

Table V shows decreases in averaged airborne radioactivity. This decrease is attributed to a reduction in fallout from nuclear weapons testing.

B. COMPARISON OF ENVIRONMENTAL RADIOACTIVITY DATA FOR 1964 WITH PREVIOUS YEARS

This section summarizes the environmental monitoring results for the calendar year 1964. Also, the annual averages for the years 1957 through 1963 are included for comparison. The averaged annual radioactivity in soil and vegetation is presented in Tables VI and VII.

TABLE VI
SOIL RADIOACTIVITY DATA - 1957 THROUGH 1964
VI.a. - ALPHA RADIOACTIVITY

Year	On Site		Off Site	
	No. Samples	Average μμc/gram	No. Samples	Average μμc/gram
1964	152	0.44 to 0.46	299	0.40 to 0.44
1963	156	0.41 to 0.43	455	0.38 to 0.42
1962	147	0.42 to 0.44	453	0.35 to 0.41
1961	120	0.30 to 0.37	458	0.24 to 0.33
1960	115	0.34 to 0.41	362	0.27 to 0.37
1959	107	0.43	377	0.32
1958	80	0.27	309	0.26
1957	64	0.32	318	0.35

VI.b. - BETA-GAMMA RADIOACTIVITY

Year	On Site		Off Site	
	No. Samples	Average μμc/gram	No. Samples	Average μμc/gram
1964	146	32	293	26
1963	156	45	455	42
1962	147	48	453	47
1961	120	34	458	23
1960	114	23	360	19
1959	107	15	379	14
1958	84	21	318	10
1957	72	11	354	10

TABLE VII
VEGETATION RADIOACTIVITY DATA - 1957 THROUGH 1964
VII.a. - ALPHA RADIOACTIVITY

Year	On Site		Off Site	
	No. Samples	Average μμc/gram/ash	No. Samples	Average μμc/gram/ash
1964	154	0.49 to 0.50	293	0.50 to 0.51
1963	156	0.43 to 0.44	456	0.36 to 0.37
1962	147	0.44 to 0.45	453	0.42 to 0.44
1961	120	0.32 to 0.35	459	0.26 to 0.29
1960	115	0.31 to 0.35	362	0.21 to 0.25
1959	96	0.29	293	0.18
1958	65	0.57	250	0.39
1957	58	1.1	304	0.89

VII.b. - BETA-GAMMA RADIOACTIVITY

Year	On Site		Off Site	
	No. Samples	Average μμc/gram/ash	No. Samples	Average μμc/gram/ash
1964	148	211	299	181
1963	156	465	456	388
1962	147	500	453	406
1961	120	224	459	246
1960	113	137	358	136
1959	107	212	380	168
1958	84	683	318	356
1957	70	208	351	200

The annual radioactivity average in NDFL well water is presented in Table VIII.

TABLE VIII
WELL WATER RADIOACTIVITY DATA - 1957 THROUGH 1964

Year	Alpha		Beta-Gamma	
	No. Samples	Average μμc/liter	No. Samples	Average μμc/liter
1964	23	0.16 to 0.18	23	5.1 to 5.3
1963	24	0.17 to 0.18	24	6.9 to 7.0
1962	24	0.20 to 0.21	24	12
1961	24	0.06 to 0.09	24	2.2 to 3.6
1960	22	0.06 to 0.09	22	1.0 to 2.7
1959	18	0.08	16	1.6
1958	13	0.16	18	4.7
1957	-	-	17	13

The annual radioactivity average in Chatsworth Reservoir water is presented in Table IX.

TABLE IX
CHATSWORTH RESERVOIR WATER RADIOACTIVITY DATA - 1961 THROUGH 1964

Year	Lake Surface			Supply Inlet		
	No. Samples	Average μμc/liter α	β-γ	No. Samples	Average μμc/liter α	β-γ
1964	18	0.71	10	12	0.49	8.8
1963	37	0.84	18	12	0.57 to 0.58	9.0 to 9.2
1962	41	0.66 to 0.67	19	12	0.50	13
1961	38	0.52	11	10	0.28	7.7 to 8.0

Some of the data presented in Tables I, II, III, IV, VI, VII, VIII, and IX are presented as a range within which lies the true average. This is necessary when one or more of the samples contains an "undetectable" amount of radioactivity. In these instances, two values are determined. The lowest assumes that the "undetectable" samples contain no radioactivity; the highest assumes that these samples contain radioactivity equal to the appropriate minimum detection limit specified in Table XII.

The annual average concentration of airborne radioactivity at Headquarters and the NDFL is presented in Table X.

TABLE X
AIRBORNE RADIOACTIVITY DATA - 1957 THROUGH 1964

	Headquarters		NDFL	
Year	No. Samples	Average uuc/M^3	No. Samples	Average uuc/M^3
1964	355	2.7	Insufficient Data	
1963	360	6.6	292	4.7
1962	343	7.3	314	5.6
1961	313	4.2	176	3.6
1960	182	0.24	44	0.44
1959	215	2.5	257	0.93
1958	366	4.9	164	2.7
1957	63	1.6	141	2.7

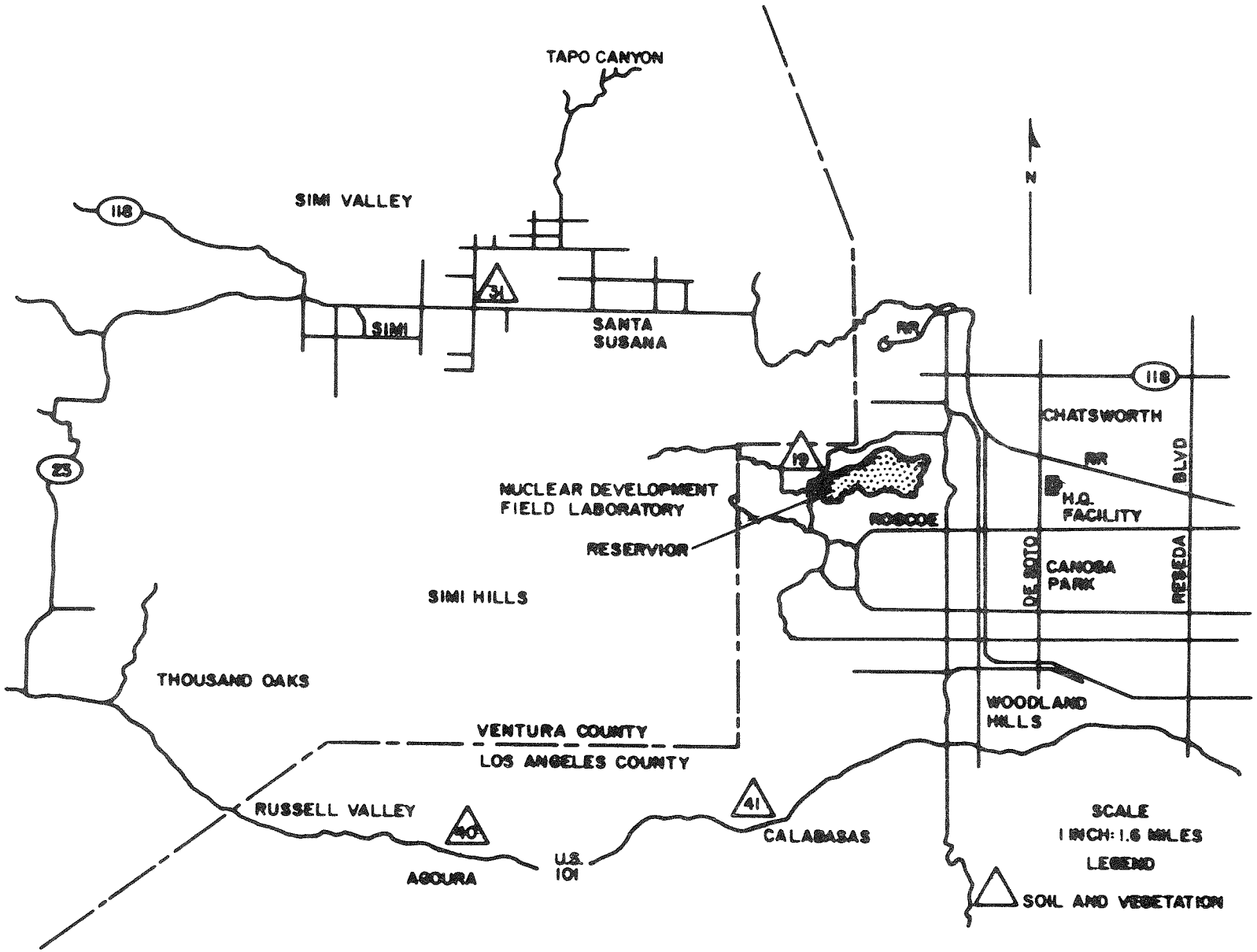
Decreased beta-gamma radioactivity in all sample types during 1964 is apparent from Tables VI, VII, VIII, IX, and X. Alpha radioactivity may have increased slightly except for Chatsworth Reservoir water in which it decreased. As indicated in the discussion of data for the last half of 1964, the radioactivity detected during 1964 is not attributed to Atomics International operations; rather, it is felt to have been produced after September 1, 1961 by nuclear detonations.

II ENVIRONMENTAL MONITORING PROGRAM

A. GENERAL DESCRIPTION

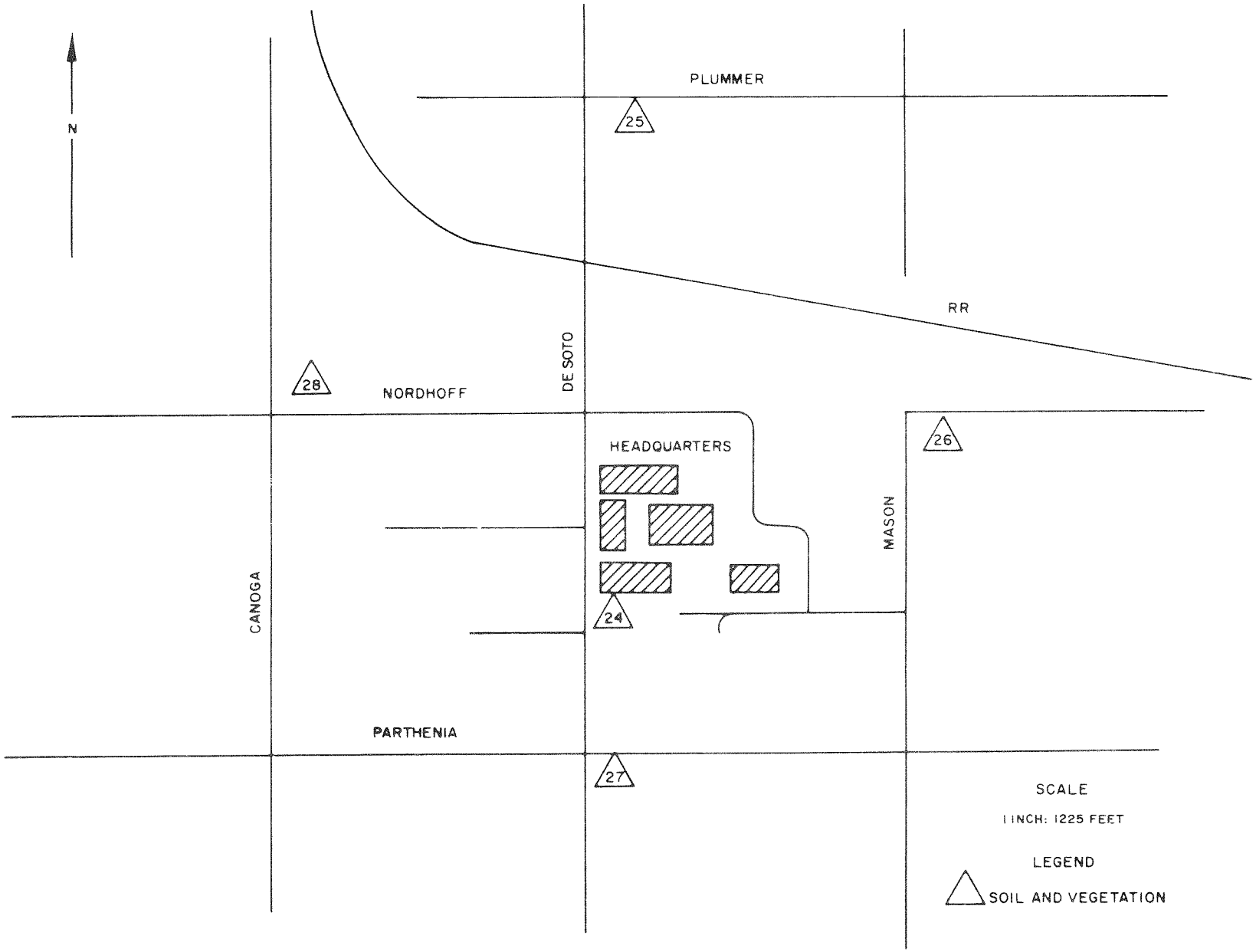
Soil and vegetation sample collection and analysis was initiated in 1952 in the Downey, California area where the company was initially located. Environmental sampling was subsequently extended to the proposed Sodium Reactor Experiment (SRE) site in May of 1954. In addition, sampling was conducted in the Burro Flat area, southwest of SRE, where many radiological installations are currently in operation. The Downey area survey was terminated when the company relocated to Canoga Park. The primary purpose of the environmental monitoring program is to adequately survey environmental radioactivity to ensure that Atomics International operations do not contribute measurably to environmental radioactivity.

A recent study of past data showed that this purpose could be achieved with a less extensive environmental monitoring program than existed until July, 1964. Therefore, beginning with that month, the number of sampling stations was reduced considerably, as indicated in the data tables in this report. The location of sampling stations is shown in Figures 4, 5, 6 and 7, and in Table XI.



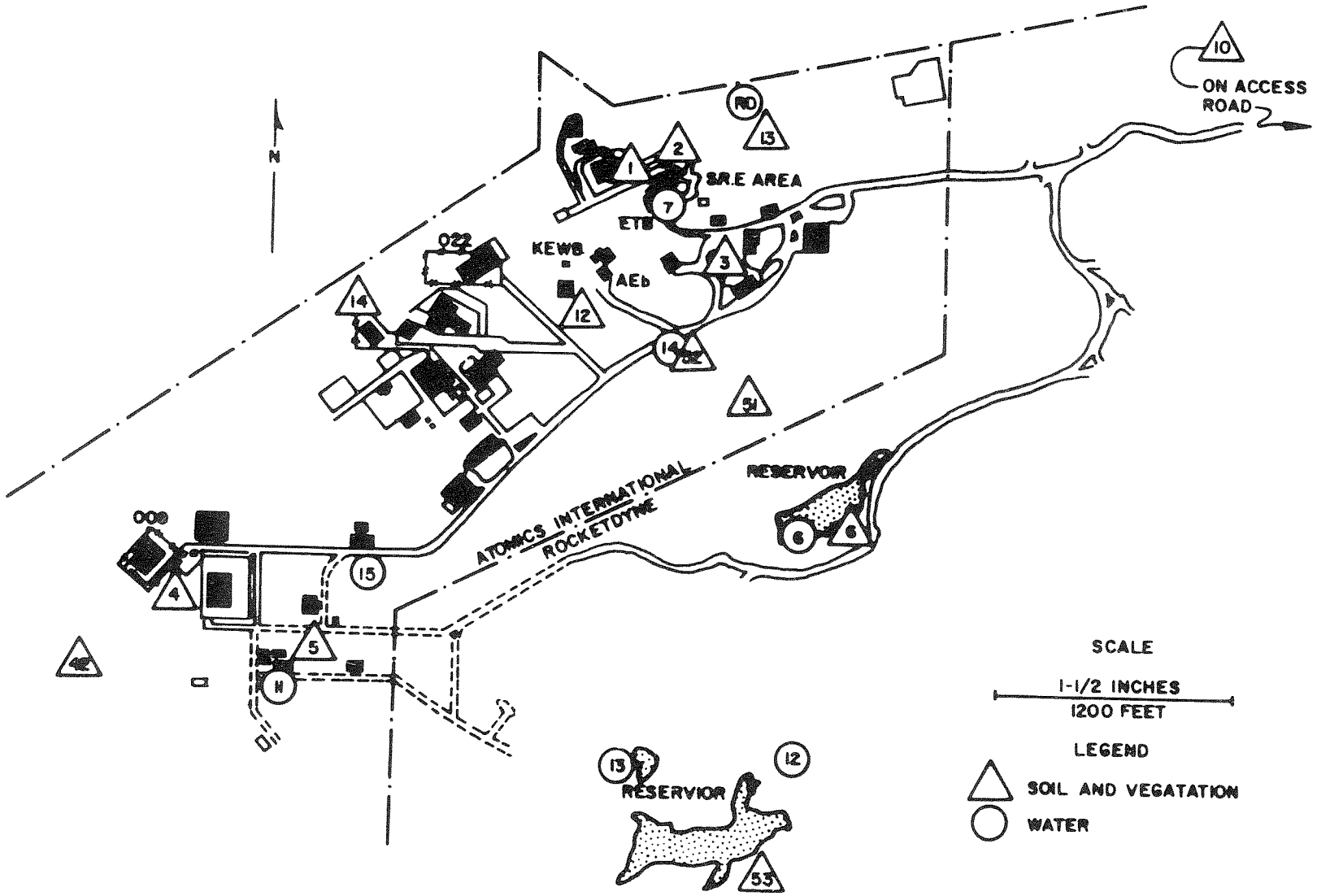
Map of Simi Valley and Russell Valley Sampling Stations

Figure 4



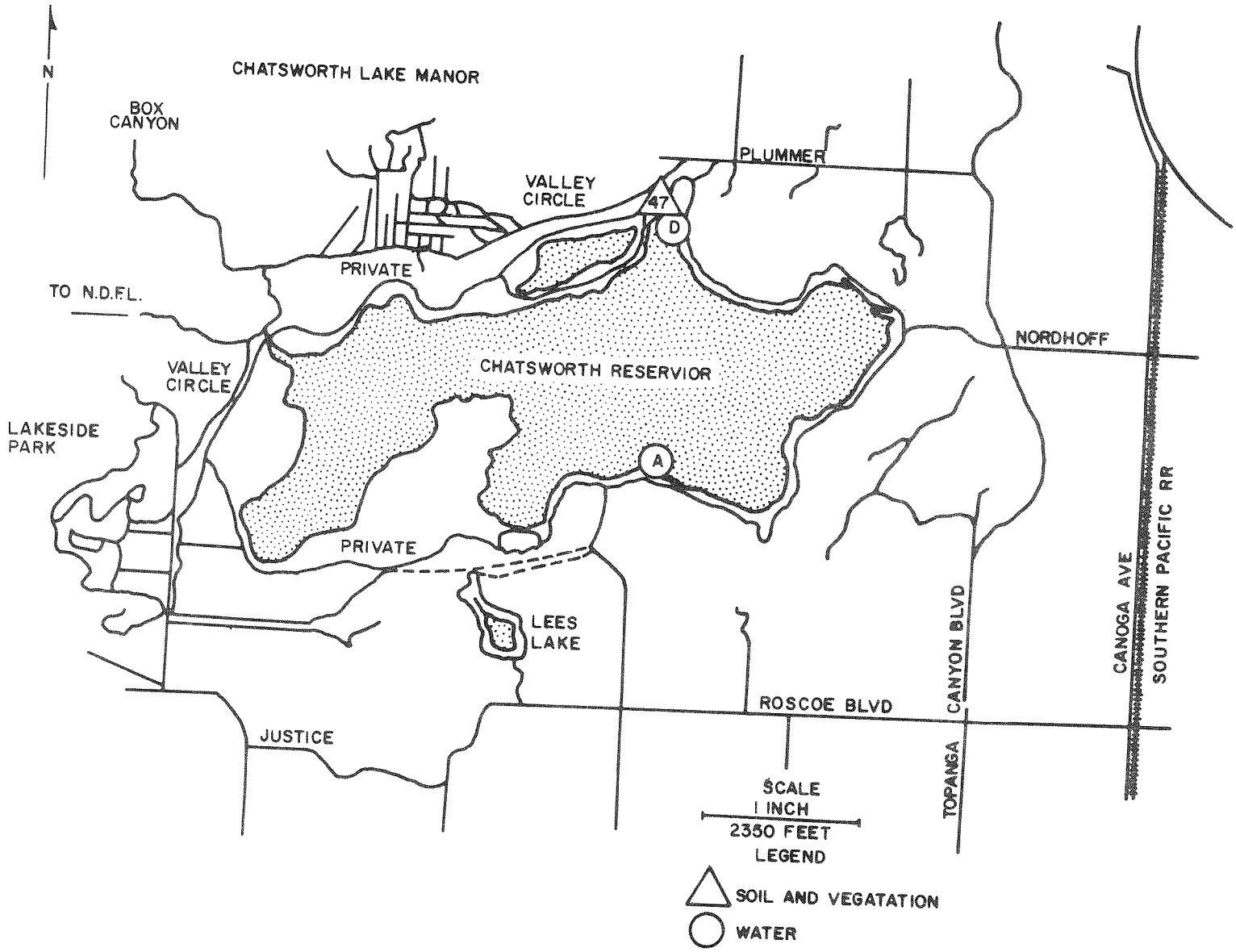
Map of Headquarters Vicinity Sampling Stations

Figure 5



Map of NDFL Sampling Stations

Figure 6



Map of Chatsworth Reservoir Sampling Stations

Figure 7

TABLE XI

SAMPLE STATION LOCATIONS

STATION	LOCATION
SV-1	SRE Reactor, NDFL
SV-2	SRE Perimeter Drainage Ditch, NDFL
SV-3	Bldg. 064 Parking Lot, NDFL
SV-4	Bldg. 020, NDFL
SV-5	Bldg. 0363, NDFL
SV-6	Rocketdyne, PFL
SV-10	Santa Susana Site Access Road
SV-12	KEWB Reactor, NDFL
SV-13	Sodium Cleaning Pad, NDFL
SV-14	Canyon Below Bldg. 022, NDFL
SV-19	Santa Susana Site Entrance
SV-24	Headquarters
SV-25	DeSoto Avenue and Plummer Street
SV-26	Nordhoff Street and Mason Avenue
SV-27	DeSoto Avenue and Parthenia Street
SV-28	Canoga Avenue and Nordhoff Street
SV-31	Simi Valley, Los Angeles Avenue and Sycamore Road
SV-40	Agoura
SV-41	Calabasas
SV-42	Non-Radioactive Materials Disposal Area, NDFL
SV-47	Chatsworth Reservoir - North Side
SV-51	Adjacent to Bldg. 029, NDFL
SV-52	Burro Flat Drainage Control Pond G. St. and 17th St., NDFL
SV-53	Top of Bell Canyon Below Rocketdyne Delta Pond Spillway, PFL
W R.D.	SRE Retention Dam, NDFL
W 6	Rocketdyne Retention Reservoir, PFL
W 7	Well Water From E.T.B., NDFL
W 11	Well Water From Bldg. 363, NDFL
W 12	Rocketdyne Retention Reservoir, PFL
W 13	Rocketdyne Retention Reservoir, PFL
W 14	Burro Flat Drainage Control Pond, G. Street and 17th Street, NDFL
W 15	Burro Flat Drainage Channel Adjacent to Bldg. 383. (Collects drainage from Bldg. 009, 020, and 100 areas)
W A	Chatsworth Reservoir, South Side
W D	Chatsworth Reservoir, Supply Inlet

B. SAMPLING AND PREPARATION METHODS

SOIL

Surface soil types available for sampling range from decomposed granite to clay and loam. Samples are taken from the top $\frac{1}{2}$-inch layer of ground surface. The soil samples are packaged and sealed in plastic containers and returned to the laboratory for analysis.

Sample preparation consists of transferring the soils to pyrex beakers and drying in a muffle furnace at 500°C for approximately 8 hours. After cooling, the soil is sieved to obtain a uniform particle size. One-gram aliquots of the sieved soil are weighed and transferred to stainless-steel planchets. The soil is wetted in the planchet with acetone, agitated to obtain uniform sample thickness, re-dried, and counted.

VEGETATION

Vegetation samples obtained in the field are of the same plant type wherever possible, generally sunflower or wild tobacco plant leaves. These types maintain a more active growth rate during the dry season than does most natural vegetation indigenous to the local area. Vegetation leaves are stripped from plants and placed in ice cream cartons for transfer to the laboratory for analysis. Plant root systems are not routinely sampled.

Vegetation samples are first washed with tap water to remove foreign matter, and then thoroughly rinsed in distilled water. Washed vegetation is placed in porcelain crucibles and ashed in a muffle furnace at 500°C for approximately eight hours, producing a completely oxidized ash. Three-hundred milligram aliquots of pulverized ash from each crucible are weighed and transferred to stainless-steel planchets for counting.

WATER

Samples of well water are obtained monthly at the NDFL and water is also obtained from the Chatsworth Reservoir. The water is drawn into 1-liter polyethylene bottles and transferred to the laboratory.

Five-hundred ml. of water is evaporated to dryness in crystallizing dishes at approximately 90°C. The residue salts are transferred to stainless-steel planchets, wetted with distilled water to produce a uniform sample distribution, re-dried under infra-red lamps, and counted.

AIR

Environmental air sampling is conducted continuously at the Headquarters and NDFL sites with automatic air samplers operating on 24-hour sampling cycles. Airborne particulate radioactivity is collected on a filter tape which is automatically changed at the end of each sampling period. The filter is removed from the sampler and counted after the radioactivity is allowed to decay for at least 72 hours. The volume of a typical daily environmental air sample is approximately 21 cubic meters. The minimum detection limit, which varies somewhat between samplers due to differences in airflow, is on the order of 0.02 uuc/M^3.

When abnormally high airborne activities are observed, the radioactivity decay is plotted to determine the presence of short-lived isotopes other than naturally occurring radon, thoron, and daughters. If fallout is suspected, the decay characteristics are observed for a period of from several days to several weeks. If the radioactivity decays as a function of $t^{-1.2}$, the data curve is extrapolated in order to determine the date of origin. This date is compared with the dates of publicized nuclear detonations to determine if the abnormal airborne radioactivity was caused by such detonations.

A graph of long-lived airborne radioactivity concentrations detected at the Headquarters facility during 1961, 1962, 1963 and the 1964 reporting period is presented in Figure 8. Airborne radioactivity concentrations present subsequent to the nuclear weapons tests series in 1958 had decreased to relatively insignificant levels until the resumption of atmospheric testing of nuclear weapons by the USSR in the fall of 1961. The graph shows a rapid increase from mid-September to November, 1961. Concentrations during 1962 decreased considerably by the end of June

and remained low until mid-October when transient peaks occurred and continued through July, 1963. Currently, airborne radioactivity concentrations are remaining low with little daily variations.

Also indicated on the graph are days on which rainfall was recorded at the Headquarters facility weather station. This illustrates the effect of precipitation on airborne radioactivity levels. In general, during periods of precipitation the airborne radioactivity decreased somewhat due to the combined effects of particulate removal from the air by rainfall and wind conditions associated with precipitation in the local area.

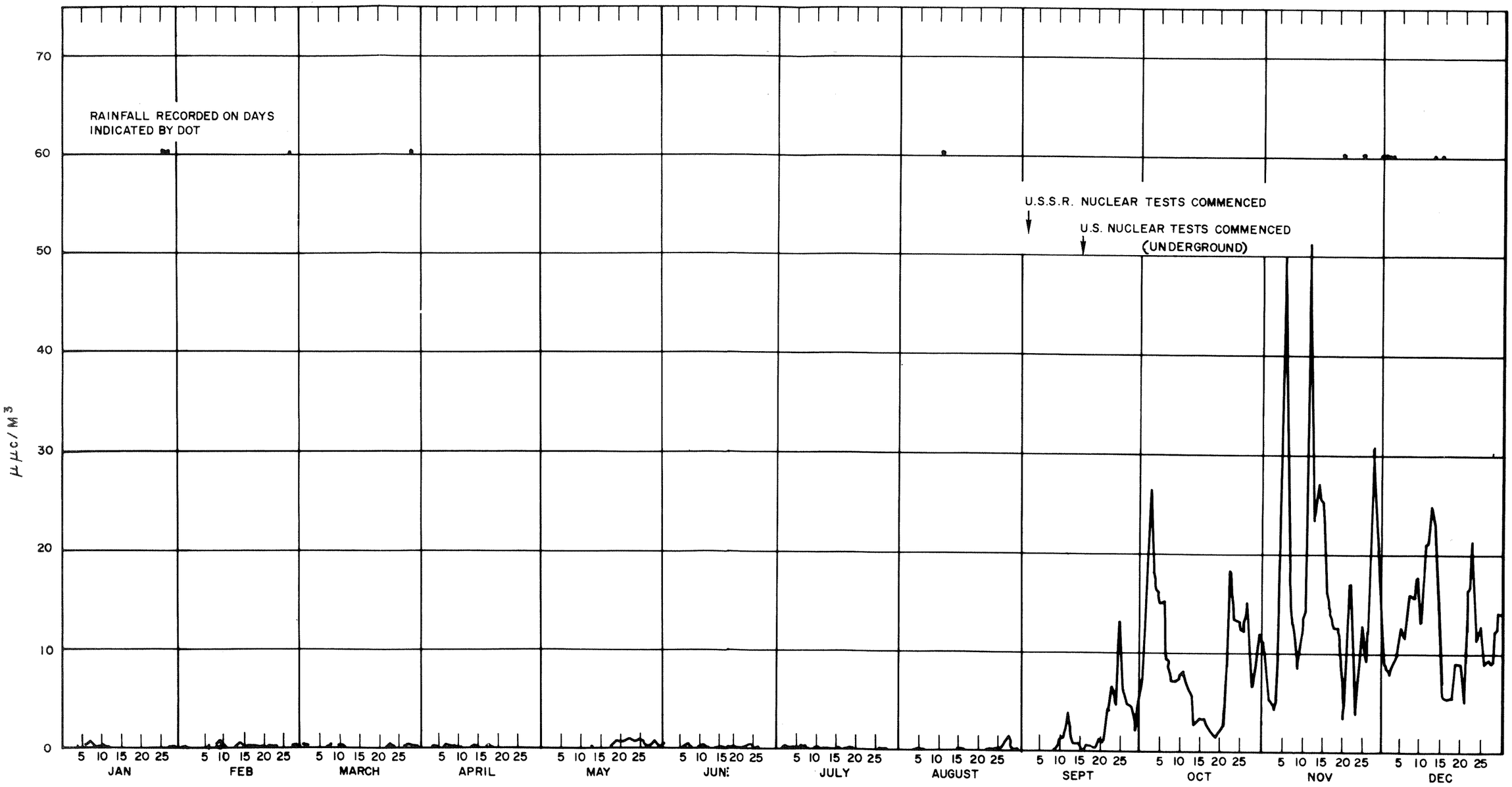


Figure 8. Long-Lived Airborne Particulate Radioactivity Atomics International Headquarters – 1961

C. COUNTING AND CALIBRATION PROCEDURES

Environmental soil, vegetation, air, and water samples are counted for alpha and beta-gamma radioactivity in automatic proportional counting systems. The sample-detector configuration provides nearly a 2π geometry. The detector has a thin window and is continually purged with a 90% argon, 10% methane counting gas. A preset count mode of operation is used for all samples; however, an overriding preset time is also used for alpha counting to prevent the unnecessarily long counting of samples with extremely low activities. The minimum detection limits shown in Table XII were determined using typical values for preset count, preset time, system efficiencies, background count rates (approximately 0.03 cpm α and 12 cpm β-γ), and sample size.

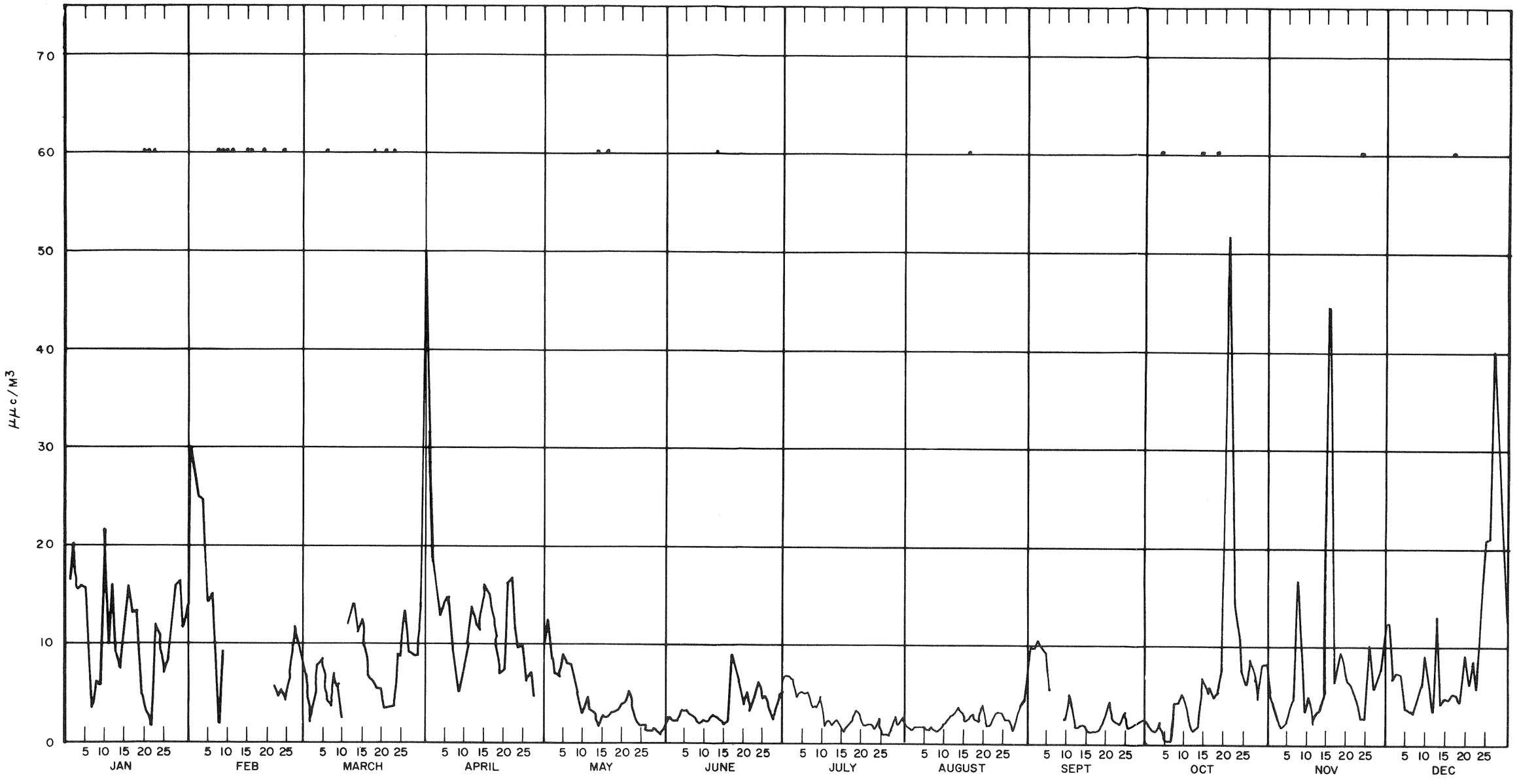
TABLE VII
MINIMUM DETECTION LIMITS

Sample	Activity	Minimum Detection Limits*
Soil	α	0.24 ± 0.048 (μμc/gram)
	β-γ	6.9 ± 1.1 (μμc/gram)
Vegetation	α	0.086 ± 0.089 (μμc/gram ash)
	β-γ	13.8 ± 2.1 (μμc/gram ash)
Water	α	0.052 ± 0.054 (μμc/liter)
	β-γ	2.5 ± 1.3 (μμc/liter)

* Standard Error

Counting system efficiencies are determined routinely using Ra D+E+F (with and without alpha absorbers) and K^{40}. Potassium-40, in the form of standard reagent grade KCl, is used to simulate soil and vegetation samples for purposes of calibration. It has a specific activity of approximately 830 dpm per gram of KCl and a beta energy of 1.33 mev. Its advantages are purity, long half-life, crystalline form, and low cost. A seeming disadvantage is its beta energy which is somewhat higher than that expected in environmental samples; however, the error introduced by this higher energy has been proven insignificant.

In practice, KCl is sieved and divided into aliquots, increasing each in 100 milligram increments from 100 to 1200 milligrams. These aliquots are placed in stainless-steel planchets of the type used for soil and vegetation samples and counted in the proportional counting system. The ratio of sample activity to observed net counting rate for each aliquot is plotted as a function of aliquot weight (See Figure 9). The correction factor (ratio) corresponding to each soil or vegetation sample weight is obtained from this graph and multiplied by the net sample counting rate to obtain sample activity (dpm). This method has been proved usable by applying it to variously sized aliquots of uniformly mixed environmental samples and observing that the resultant specific activities fall within the expected statistical counting error.



LONG LIVED AIRBORNE PARTICULATE RADIOACTIVITY

ATOMICS INTERNATIONAL HEADQUARTERS–1962

Figure 8. Long-Lived Airborne Particulate Radioactivity Atomics International Headquarters – 1962

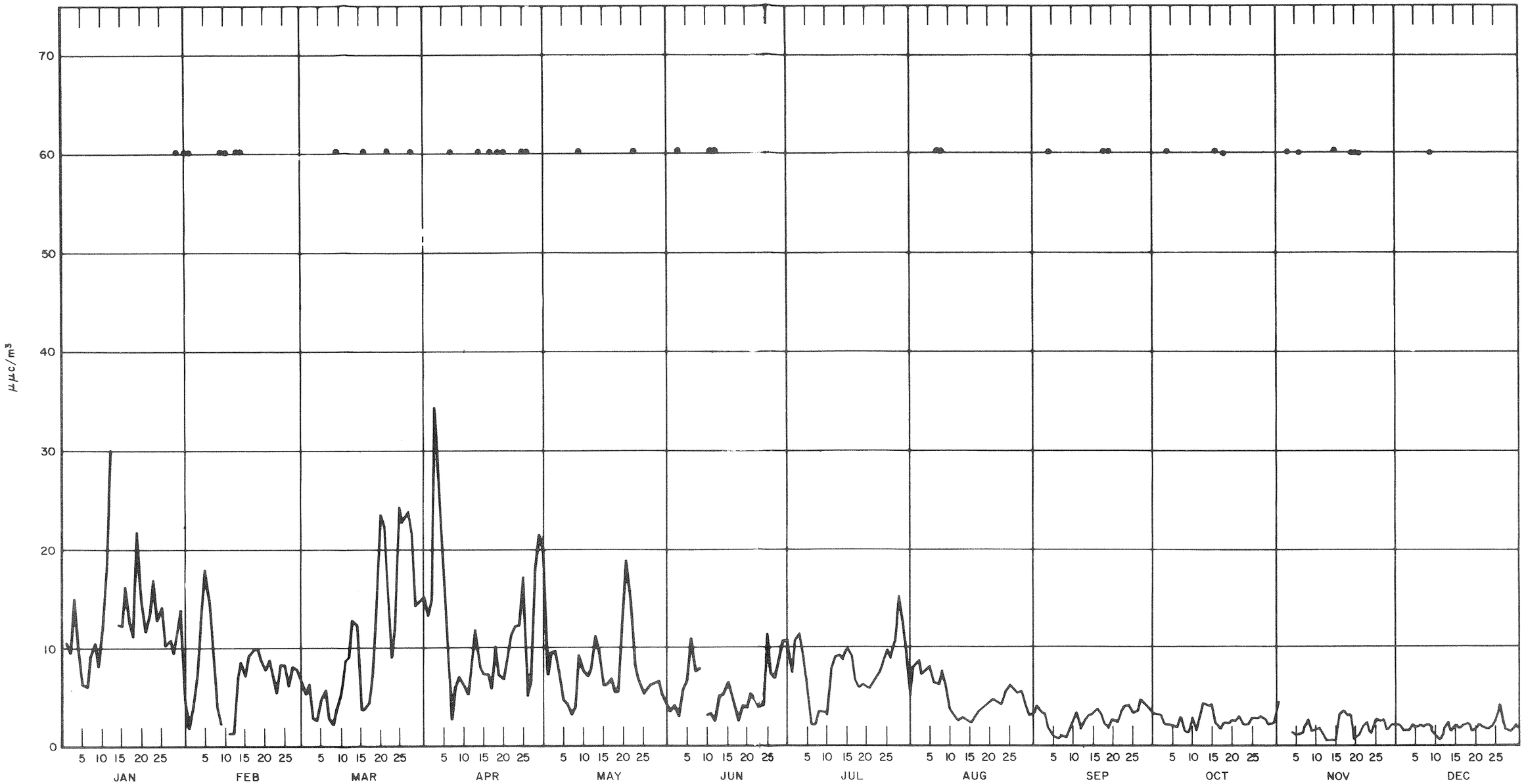
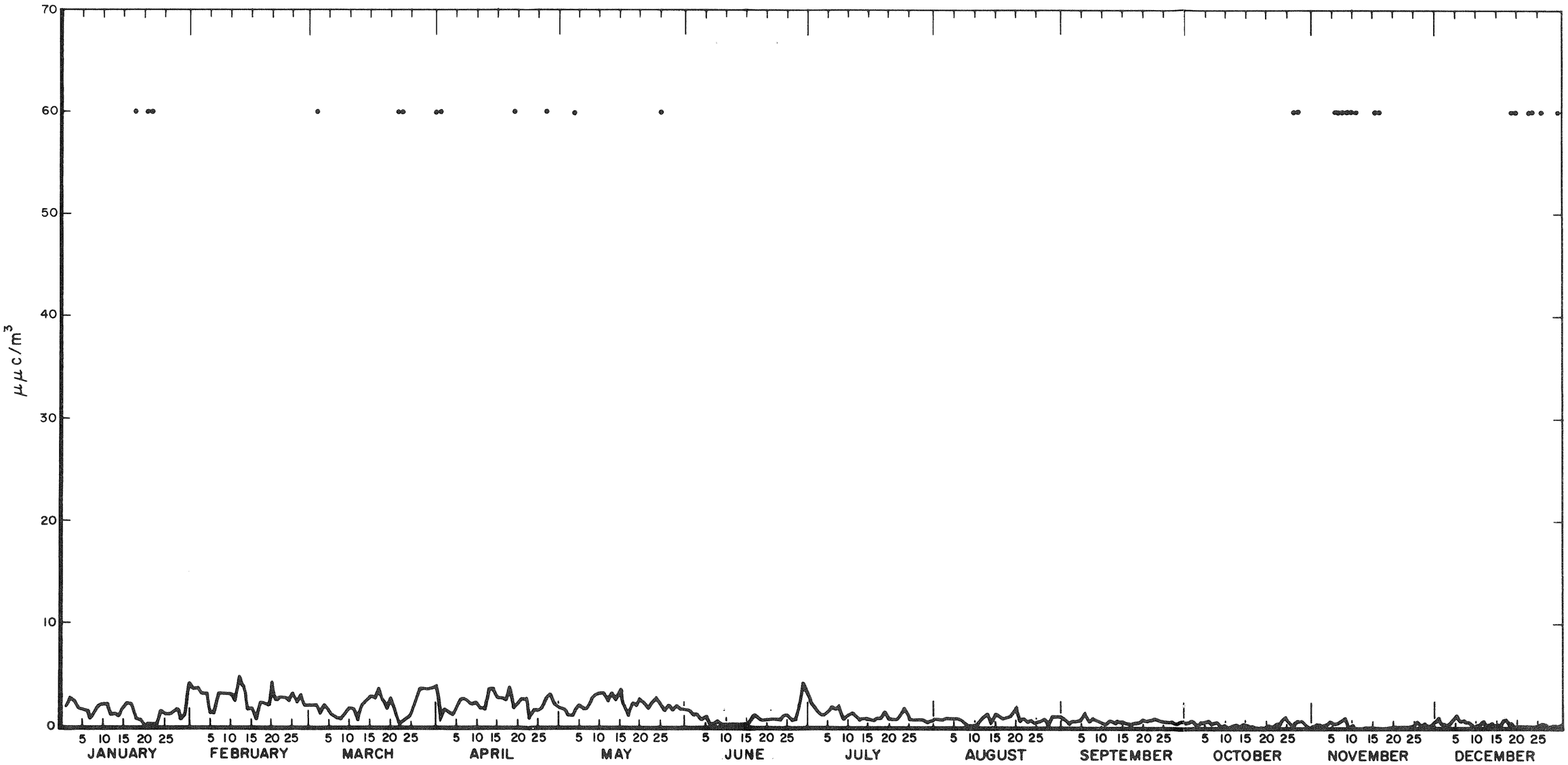


Figure 8. Long-Lived Airborne Particulate Radioactivity Atomics International Headquarters — 1963



LONG-LIVED AIRBORNE PARTICULATE RADIOACTIVITY
ATOMICS INTERNATIONAL HEADQUARTERS - 1964

FIGURE 8 LONG-LIVED AIRBORNE PARTICULATE RADIOACTIVITY
ATOMICS INTERNATIONAL HEADQUARTERS - 1964

C. COUNTING AND CALIBRATION PROCEDURES

Environmental soil, vegetation, air, and water samples are counted for alpha and beta-gamma radioactivity in automatic proportional counting systems. The sample-detector configuration provides nearly a 2π geometry. The detector has a thin window and is continually purged with a 90% argon, 10% methane counting gas. A preset count mode of operation is used for all samples; however, an overriding preset time is also used for alpha counting to prevent the unnecessarily long counting of samples with extremely low activities. The minimum detection limits shown in Table XII were determined using typical values for preset count, preset time, system efficiencies, background count rates (approximately 0.03 cpm α and 12 cpm β-γ), and sample size.

TABLE XII
MINIMUM DETECTION LIMITS

Sample	Activity	Minimum Detection Limits*
Soil	α	0.24 ± 0.048 (μμc/gram)
	β-γ	6.9 ± 1.1 (μμc/gram)
Vegetation	α	0.086 ± 0.089 (μμc/gram ash)
	β-γ	13.8 ± 2.1 (μμc/gram ash)
Water	α	0.052 ± 0.054 (μμc/liter)
	β-γ	2.5 ± 1.3 (μμc/liter)

* Standard Error

Counting system efficiencies are determined routinely using Ra D+E+F (with and without alpha absorbers) and K^{40}. Potassium-40, in the form of standard reagent grade KCl, is used to simulate soil and vegetation samples for purposes of calibration. It has a specific activity of approximately 830 dpm per gram of KCl and a beta energy of 1.33 mev. Its advantages are purity, long half-life, crystalline form, and low cost. A seeming disadvantage is its beta energy which is somewhat higher than that expected in environmental samples; however, the error introduced by this higher energy has been proven insignificant.