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ENVIRONMENTAL MONITORING

SEMIANNUAL REPORT

JANUARY 1, 1962 TO JUNE 30, 1962

AEC Research and Development Report

ATOMICS INTERNATIONAL

A DIVISION OF NORTH AMERICAN AVIATION, INC.

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JANUARY 1, 1962 TO JUNE 30, 1962

By
J. D. MOORE
W. L. FISHER
P. A. ROWE

ATOMICS INTERNATIONAL

A DIVISION OF NORTH AMERICAN AVIATION, INC.
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ABSTRACT

Environmental Monitoring at Atomics International is performed by the Laboratory Unit of the Health and Safety Section. Soil, vegetation, air, and water are routinely sampled up to a distance of 10 miles from Atomics International property. Data gathered during the period January 1, 1962 to June 30, 1962 have been summarized and compared with previous data. During this period, a general increase was observed in environmental radioactivity levels. This increase is attributed to nuclear weapons tests and not to Atomics International operations. The effect of nuclear weapons tests is readily shown in the air sample data. A general description of the environmental monitoring program and procedures is included.

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Figure 1. Atomics International World Headquarters

Figure 2. Atomics International Nuclear Development Field Laboratory

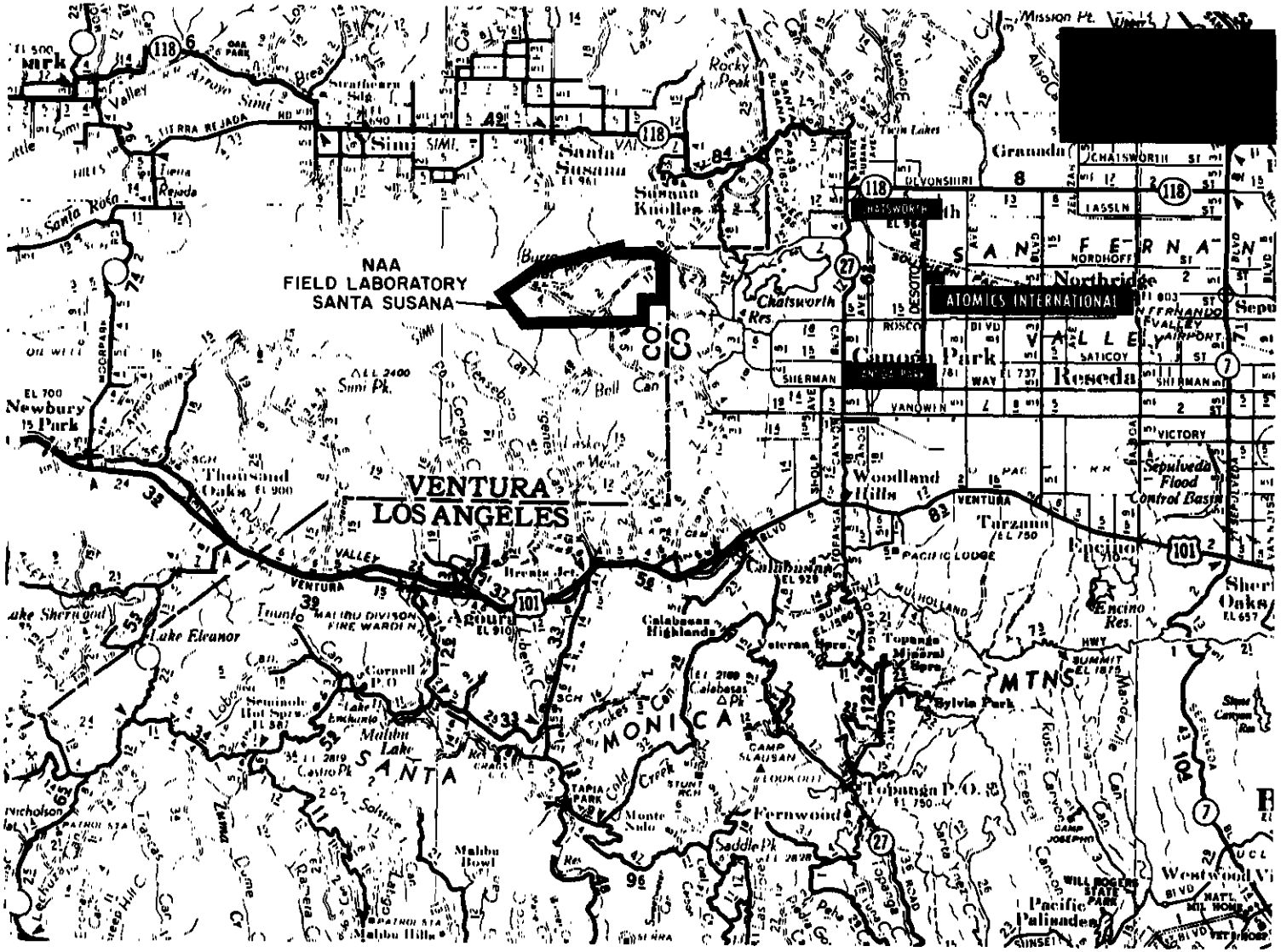


Figure 3. Map of Headquarters and Nuclear Development Field Laboratory Environs

I. SUMMARY

Atomics International, a Division of North American Aviation, Incorporated, has been engaged in the atomic energy field 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 a modern plant 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 within Ventura County in the Santa Susana mountains. The site is 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 hazards control at Atomics International encourages total containment of radioactive materials and, through rigid operational controls, minimizes effluent releases and external radiation levels. The environmental monitoring program serves to ensure the effectiveness of radiological safety procedures and of engineering safeguards incorporated into facility design.

The environs of Atomics International's Headquarters and the Nuclear Development Field Laboratory are periodically surveyed to determine the concentration of radioactivity in typical surface soil, vegetation, and water samples. In addition, continuous environmental air samples taken at the above sites provide information concerning airborne particulate radioactivity. This report summarizes environmental monitoring results for the first six months of 1962.

Soil and vegetation are sampled monthly at 51 locations. Thirteen sampling stations are located within the boundaries of Atomics International sites and are referred to as "on-site" stations. The remaining 38 stations, located within a 10-mile radius of the sites, are referred to as "off-site" stations. The average activities of the 592 soil and vegetation samples collected during the first six months of 1962 are shown in Tables I and II.

A. ENVIRONMENTAL RADIOACTIVITY DATA

TABLE I

SOIL ACTIVITY DATA

Area	Activity	1961		First Half 1962	
		No. Samples	Average $\mu\mu$c/Gram	No. Samples	Average $\mu\mu$c/Gram
On-site	α	120	0.30 to 0.37	69	0.40 to 0.42
	$\beta - \gamma$	120	34	69	43
Off-site	α	458	0.24 to 0.33	227	0.31 to 0.38
	$\beta - \gamma$	458	23	227	42

TABLE II

VEGETATION ACTIVITY DATA

Area	Activity	1961		First Half 1962	
		No. Samples	Average $\mu\mu$c/Gram Ash	No. Samples	Average $\mu\mu$c/Gram Ash
On-site	α	120	0.32 to 0.35	69	0.37 to 0.39
	$\beta - \gamma$	120	224	69	702
Off-site	α	459	0.26 to 0.29	227	0.30 to 0.32
	$\beta - \gamma$	459	246	227	558

Process water at the NDFL is obtained from wells and stored in 50,000-gal tanks. Potable water is obtained in bottles regularly delivered to the site by a vendor. Therefore, it is not analyzed. Well water is sampled monthly from the supply line at two locations. The average well water activity during the first six months of 1962 is shown in Table III.

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 activity data for the reservoir is averaged into the data

TABLE III

WELL WATER ACTIVITY DATA

Location	Activity	1961		First Half 1962	
		No. Samples	Average $\mu\mu$c/Liter	No. Samples	Average $\mu\mu$c/Liter
NDFL	α	24	0.06 to 0.09	12	0.09 to 0.11
	$\beta - \gamma$	24	2.2 to 3.6	12	3.1 to 3.2

presented in Tables I and II. Normally, four water samples are obtained from the lake surface and a fifth sample is taken at the reservoir supply inlet. The average water activity for both surface and supply samples is shown in Table IV

TABLE IV

CHATSWORTH RESERVOIR WATER ACTIVITY DATA

Sample Type	Activity	1961		First Half 1962	
		No. Samples	Average $\mu\mu$c/Liter	No. Samples	Average $\mu\mu$c/Liter
Lake surface	α	38	0.52	21	0.46 to 0.47
	$\beta - \gamma$	38	11	21	20
Supply inlet	α	10	0.28	6	0.50
	$\beta - \gamma$	10	7.9	6	12

Some of the data shown in Tables I, II, III, and IV are given as a range within which lies the true average. This occurs when one or more of the samples contains an "undetectable" amount of radioactivity. In these instances, two averages are determined. The lowest value assumes that the "undetectable" samples contain no radioactivity. The highest value assumes that these samples contain radioactivity equal to the appropriate minimum detection limit specified in Table VII.

Sampling of environmental air for particulate radioactivity is performed continuously at both the Headquarters and NDFL sites. Air is drawn through a filter which is counted, after a 72-hr decay period, for long lived activity. The average concentration of long-lived beta emitters is shown in Table V.

TABLE V

AIRBORNE ACTIVITY DATA

Location	Activity	1961		First Half 1962	
		No. Samples	Average $\mu\mu c/M^3$	No. Samples	Average $\mu\mu c/M^3$
Headquarters	$\beta-\gamma$	313	4.2	163	8.5
NDFL	$\beta-\gamma$	176	3.6	148	6.3

B. CONCLUSIONS AND DISCUSSION OF DATA

Table I shows a slight increase over the 1961 average values in soil alpha radioactivity for on-site samples, and a probable increase in soil alpha radioactivity for off-site samples. A distinct increase in soil beta-gamma radioactivity is evident for both on-site and off-site samples.

Table II shows that vegetation alpha radioactivity increased slightly while vegetation beta-gamma radioactivity increased considerably in both on-site and off-site samples.

Table III shows a slight increase in well water alpha radioactivity, and a probable increase in beta-gamma radioactivity.

Table IV shows that alpha radioactivity in Chatsworth Reservoir lake surface water decreased slightly from the 1961 average, and increased in supply inlet samples. Beta-gamma radioactivity shows a definite increase over the 1961 value for both sample types.

Table V shows that the average airborne radioactivity detected at both Headquarters and the NDFL increased over the 1961 average. This increase is attributed to fission debris produced by the 1961 nuclear weapons tests.

The resumption of nuclear weapons testing by the USSR on September 1, 1961 resulted in the release of fission products to the atmosphere of the northern hemisphere. The beta-gamma radioactivity increases in all sample types reflect this contribution to the environment. This contamination is most readily apparent in vegetation and airborne radioactivity concentrations. The increase in environmental radioactivity levels during the reporting period is attributed entirely to nuclear weapons testing.

II. GENERAL DESCRIPTION OF PROGRAM

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

Due to the effect of topography on environmental radioactivity, comparison between widely spread sampling locations is difficult. Useful information can be obtained, however, by observing the trend of individual or closely related groups of sampling locations. For this reason, samples are collected monthly in six general survey areas including Canoga Park (two areas), Santa Susana, Simi Valley, Russell Valley and vicinity, and the Chatsworth Reservoir, which is operated by the Los Angeles Department of Water and Power. Fifty-one soil and vegetation sampling stations are currently established within the indicated areas. The maximum sampling station distance from the Nuclear Development Field Laboratory at Santa Susana is approximately ten miles, and the total survey area comprises approximately 150 sq miles. Sampling station locations are indicated on Figures 4, 5, 6, 7, and in Table VI.

During each semiannual reporting period, approximately 306 soil, 306 vegetation, 42 water, and 360 environmental air samples are normally obtained and analyzed by the Health and Safety Laboratory for gross alpha and/or beta-gamma radioactivity. Since environmental radioactivity levels are low and there is seldom any evidence of contribution by Atomics International's operations, specific isotopic analyses are not routinely performed on environmental samples. Such analyses would be performed if warranted.

SAMPLING AND PREPARATION METHODS

Water

Samples of well water are obtained monthly at the NDFL. The water is drawn into 1-liter polyethelene bottles for transfer to the laboratory. Samples

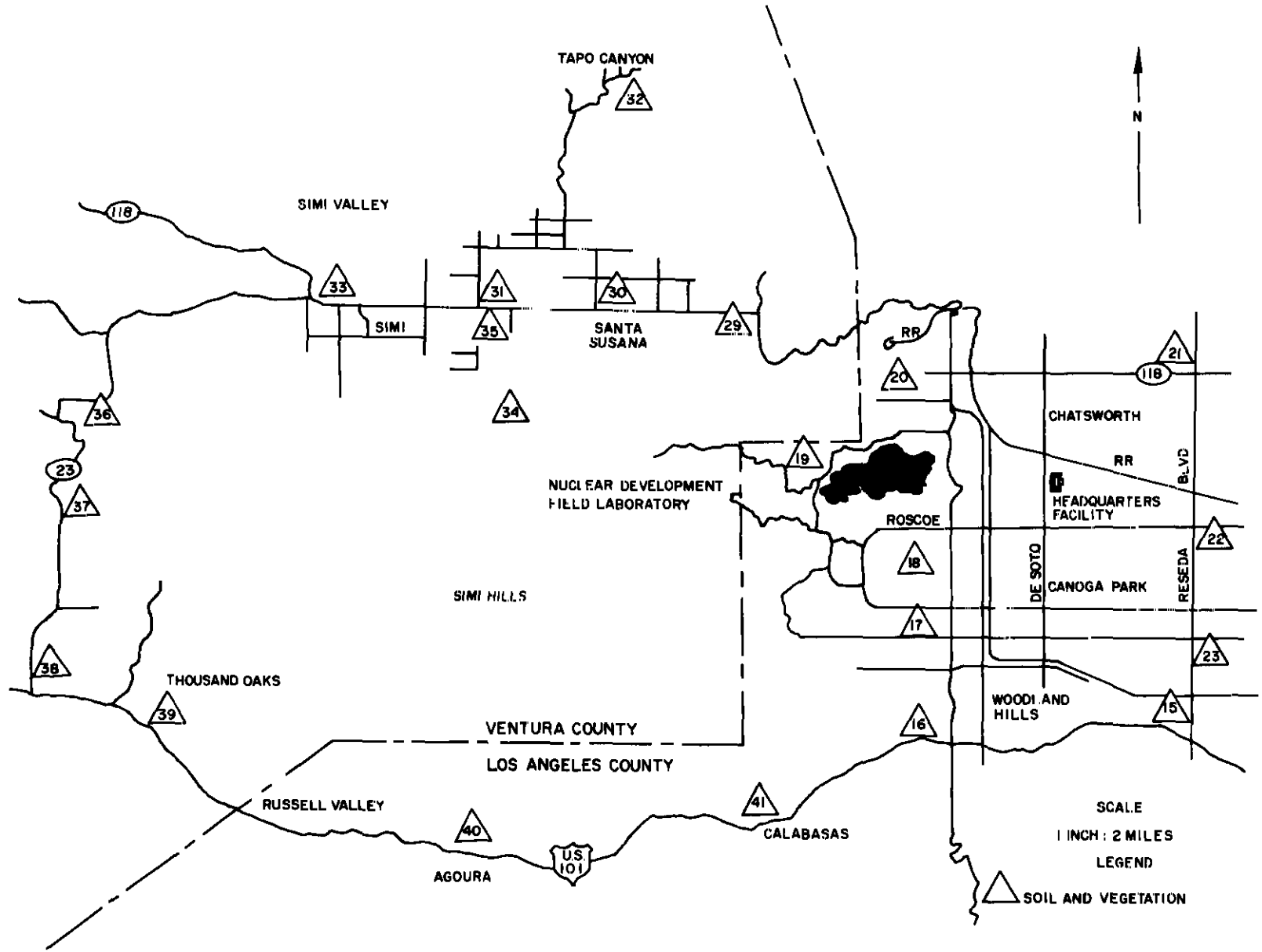


Figure 4. Map of Reseda, Canoga Park, Simi Valley, and Russell Valley Sampling Stations

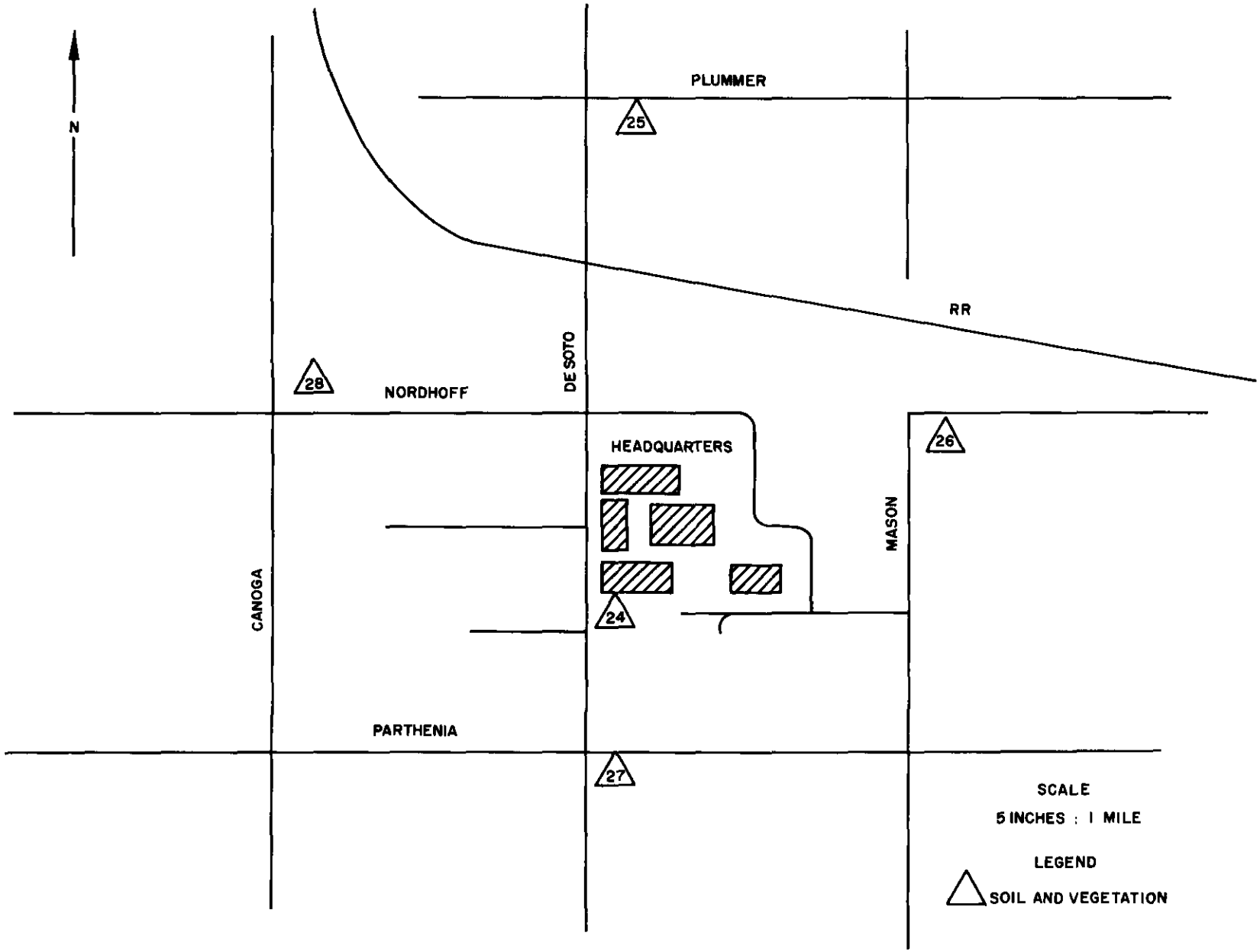


Figure 5. Map of Headquarters Vicinity Sampling Stations

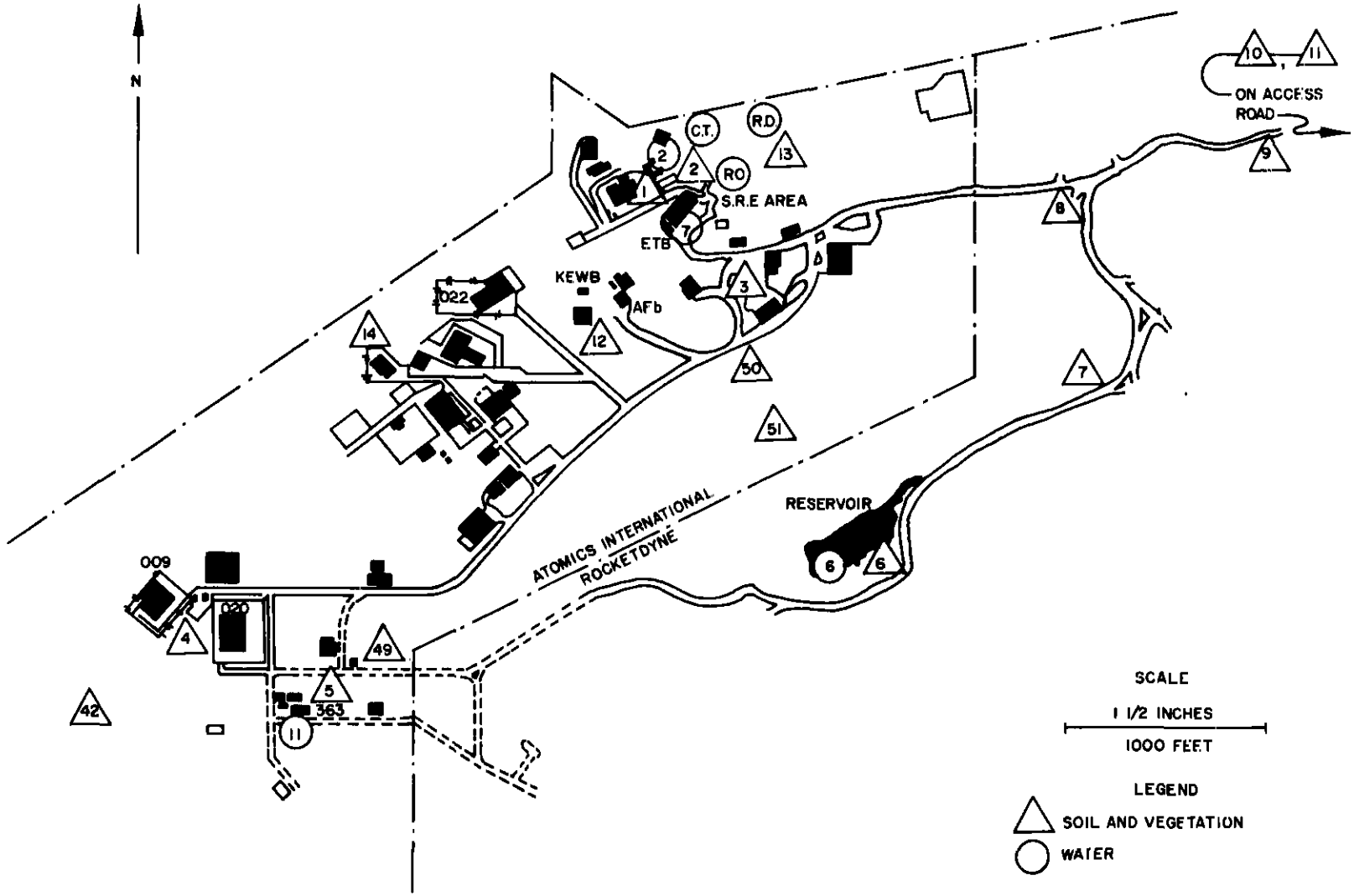


Figure 6. Map of NDFL Sampling Stations

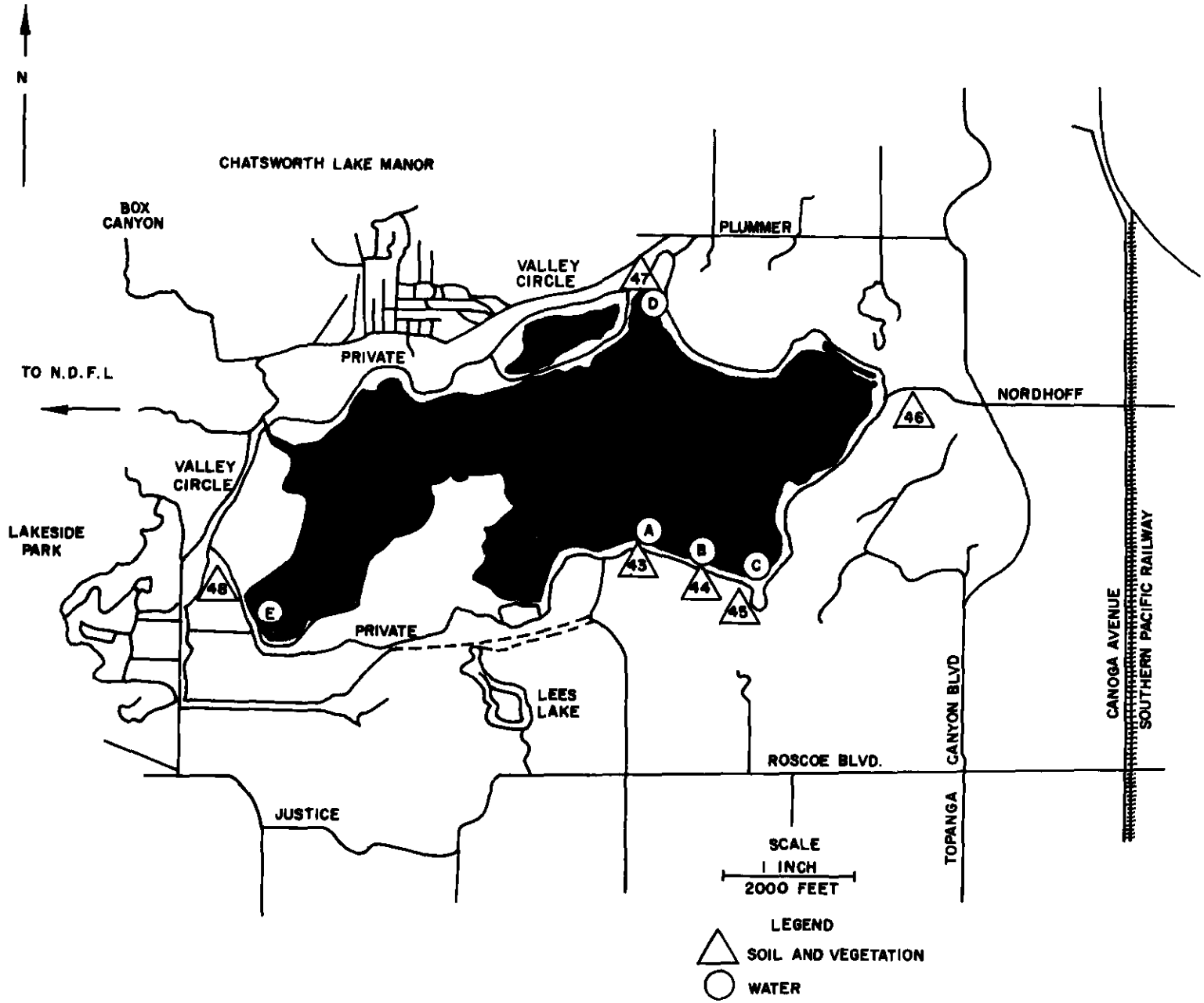


Figure 7. Map of Chatsworth Reservoir Sampling Stations

TABLE VI

SAMPLE STATION LOCATIONS

Station	Location
SV-1	SRE Reactor
SV-2	SRE Perimeter Drainage Ditch
SV-3	Building 064 Parking Lot
SV-4	West of Building 020
SV-5	Building 363
SV-6	Rocketdyne Retention Reservoir, PFL
SV-7	Rocketdyne PFL
SV-8	Rocketdyne PFL
SV-9	Rocketdyne PFL
SV-10	Santa Susana Site Access Road
SV-11	Santa Susana Site Access Road
SV-12	KEWB Reactor
SV-13	Sodium Burning Pad
SV-14	Canyon below Building 022
SV-15	Reseda Blvd. and Ventura Blvd.
SV-16	Topanga Canyon Blvd. and Ventura Blvd.
SV-17	Topanga Canyon Blvd. and Vanowen St.
SV-18	Topanga Canyon Blvd. and Saticoy St.
SV-19	Santa Susana Facility Entrance
SV-20	Topanga Canyon Blvd. and Devonshire St.
SV-21	Reseda Blvd. and Devonshire St.
SV-22	Reseda Blvd. and Nordhoff St.
SV-23	Reseda Blvd. and Sherman Way
SV-24	Headquarters
SV-25	DeSoto Ave. and Plummer St.
SV-26	Nordhoff St. and Mason Ave.
SV-27	DeSoto Ave. and Parthenia St.
SV-28	Canoga Ave. and Nordhoff St.
SV-29	Santa Susana Knolls
SV-30	Los Angeles Ave. at Bridge
SV-31	Los Angeles Ave. and Sycamore Road
SV-32	Tapo Canyon

TABLE VI (Continued)

Station	Location
SV-33	Los Angeles Ave. and Sinaloa Road
SV-34	Meier Canyon
SV-35	Brandeis Camp Entrance
SV-36	Moorpark Road and Camarillo Road
SV-37	Moorpark Road at Oil Pumping Station
SV-38	Moorpark Road and Ventura Blvd.
SV-39	Ventura Blvd. at Potrero Road
SV-40	Ventura Blvd. at Cornell Corners (Agoura)
SV-41	Ventura Blvd. at Calabasas
SV-42	Nonradioactive Materials Disposal Area, Nuclear Development Field Laboratory
SV-43	Chatsworth Reservoir Dam - West Side
SV-44	Chatsworth Reservoir Dam - Mid Point
SV-45	Chatsworth Reservoir Dam - East Side
SV-46	Chatsworth Reservoir Perimeter Road - Northeast Side
SV-47	Chatsworth Reservoir Perimeter Road - North Side
SV-48	Chatsworth Reservoir Perimeter Road - West Side
SV-49	Adjacent to Rocketdyne Boundary
SV-50	Burro Flats Access Road
SV-51	Storage Area Adjacent to Calibration Facility
W 2	SRE Perimeter Drainage Ditch
W 6	Rocketdyne Retention Reservoir, PFL
W 7	Well Water from Engineering Test Building
W 11	Well Water from Building 363
W R.O.	Run Off Collection Sump
W C.T.	Edison Cooling Tower
W R.D.	SRE Retention Dam
W A	Chatsworth Reservoir - Lake Surface
W B	Chatsworth Reservoir - Lake Surface
W C	Chatsworth Reservoir - Lake Surface
W D	Chatsworth Reservoir - Supply Inlet
W E	Chatsworth Reservoir - Lake Surface

SV — Soil and Vegetation
W — Water

of lake surface and supply inlet water from the Chatsworth Reservoir are similarly obtained. In the laboratory, 500 ml of the water is evaporated to dryness in crystallizing dishes at approximately 90°C. The residue salts are transferred to stainless-steel planchets, wetted to produce an even sample distribution, redried under infrared lamps, and counted.

Soil

Surface soil types available for sampling range from decomposed granite to clay and loam. Samples are collected from the top 1/2-in. 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 hr. After cooling, the soil is sieved to obtain uniform particle sizes for counting. One-gram aliquots of the soil are weighed and transferred to 3 cm diameter by 3 mm deep stainless-steel planchets. The soil is wetted in the planchet with acetone, agitated to obtain uniform thickness, redried, and counted.

Vegetation

Vegetation samples obtained in the field at each station are of the same plant type wherever possible and are generally sunflower or wild tobacco plant leaves. These plant types maintain an active rate of growth during the dry season, a characteristic uncommon to most plant types indigenous to the area. Vegetation leaves are stripped from the plant and placed in individual ice cream cartons for transfer to the laboratory for analysis. Plant root systems are not routinely sampled.

Preparation of vegetation samples for analysis includes washing to remove foreign matter, followed by a distilled water rinse. The vegetation is placed in porcelain crucibles and ashed in a muffle furnace at 500°C, for approximately 8 hr, producing a fine, completely oxidized ash of uniform density. Three-hundred-milligram aliquots of ground ash from each crucible are weighed and transferred to stainless-steel planchets for counting.

Air

Environmental air sampling is conducted continuously at the Headquarters and NDFL sites with automatic air samplers operating on 24-hr sampling cycles.

Airborne particulate radioactivity is collected on a stationary filter tape which is automatically changed at the end of each sampling period. The filter tape is removed from the sampler, allowed to decay for at least 72 hr, and counted in a an automatic proportional counting system. 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 $\mu\mu$ c/m^3.

When abnormally high airborne activities are observed, the activity decay rates are plotted to determine the presence of short-lived isotopes other than naturally occurring radon and thoron daughters. If fallout is suspected, the sample decay characteristics are observed for a period of from several days to several weeks. If the activity decays as a function of $t^{-1.2}$, the data are extrapolated in order to determine the date of origin. This date is then compared with the dates of publicized nuclear detonations in order to demonstrate that the abnormal airborne radioactivity is not caused by Atomics International.

A graph of long-lived airborne radioactivity concentrations detected at the Headquarters facility during 1961 and the 1962 reporting period is shown in Figure 8. Airborne radioactivity concentrations subsequent to the nuclear weapons test series in Nevada during the fall of 1958 had decreased to relatively insignificant values prior to resumption of nuclear weapons testing by the USSR in the fall of 1961. The graph shows the rapid increase in airborne radioactivity in mid-September to a maximum in November. Subsequent concentrations had decreased considerably at the end of June 1962 although two transient peaks occurred, one in February and one in April. 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 activity values. In general, during periods of precipitation, the airborne activity decreased somewhat due to combined effects of particulate removal, and the wind conditions generally associated with precipitation in the local area.

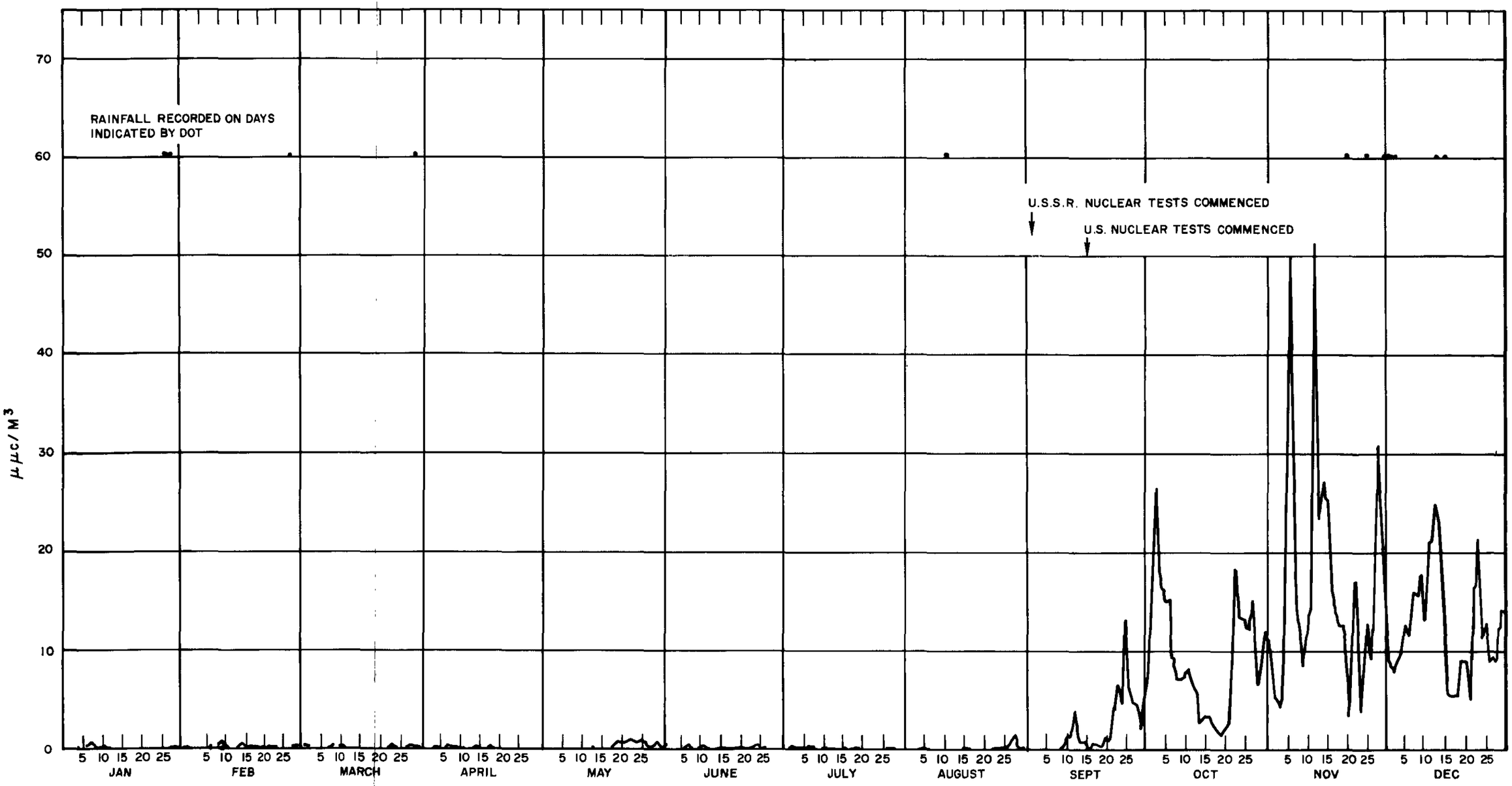
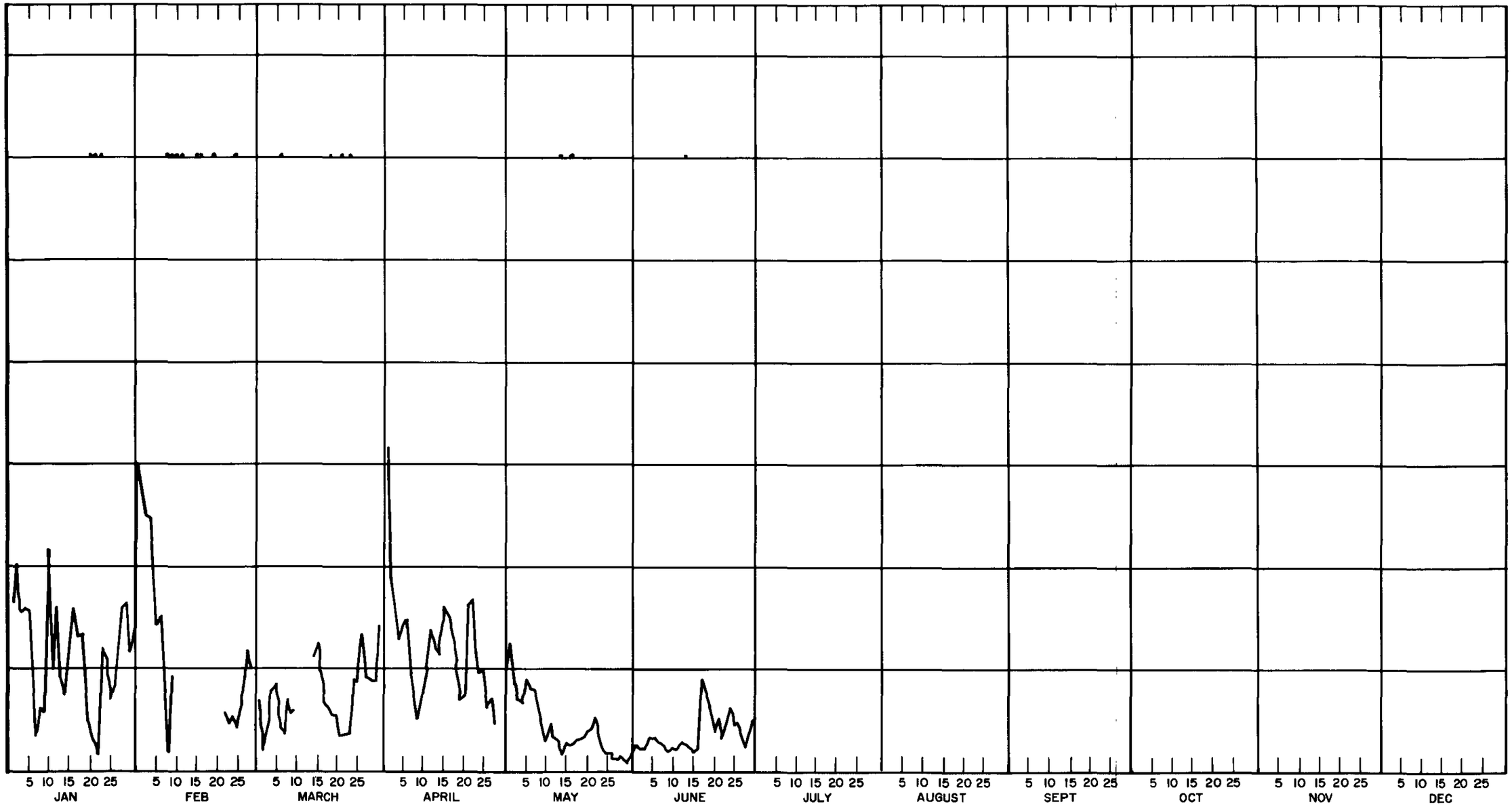


Figure 8. Long-Lived Airborne Particulate Radioactivity Atomics International Headquarters – 1961



LONG LIVED AIRBORNE PARTICULATE RADIOACTIVITY

ATOMICS INTERNATIONAL HEADQUARTERS–1962

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

APPENDIX
COUNTING SYSTEMS AND CALIBRATION PROCEDURES

Environmental soil, vegetation, air, and water samples are analyzed 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 Mylar window and is continually purged with a 90% argon, 10% methane counting gas. A preset count mode of operation is used for all sample types; however, an overriding preset time is also used for alpha counting to prevent the unreasonably long counting of samples with extremely low-level activities. The minimum detection limits shown in Table VII were determined using typical values for preset count, preset time, system efficiencies, background counting rates (approximately 0.03 c/m α and 12 c/m β-γ), sample size, etc.

TABLE VII

MINIMUM DETECTION LIMITS

Sample	Activity	Minimum Detection Limit*
Soil	α	0.24 ± 0.048 ($\mu\mu$c/gram)
	β-γ	6.9 ± 1.1 ($\mu\mu$c/gram)
Vegetation	α	0.086 ± 0.089 ($\mu\mu$c/gram)
	β-γ	13.8 ± 2.1 ($\mu\mu$c/gram)
Water	α	0.052 ± 0.054 ($\mu\mu$c/liter)
	β-γ	2.5 ± 1.3 ($\mu\mu$c/liter)

*Standard error

Counting system efficiencies are measured 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 d/m per gram KCl and a beta energy of 1.33 Mev. Its obvious advantages are its purity, long half-life, crystalline form, and inexpensiveness. 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 proved insignificant.

In practice, KCl is sieved and divided into aliquots increasing in 100 milligram increments from 100 to 1200 milligrams. These aliquots are transferred to stainless-steel planchets of the type used for soil and vegetation samples, and counted in the proportional counting systems. 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 (d/m). This method has been proved usable by applying it to various sized aliquots of uniformly mixed environmental samples and observing that the resultant specific activities fall within the expected statistical counting error.

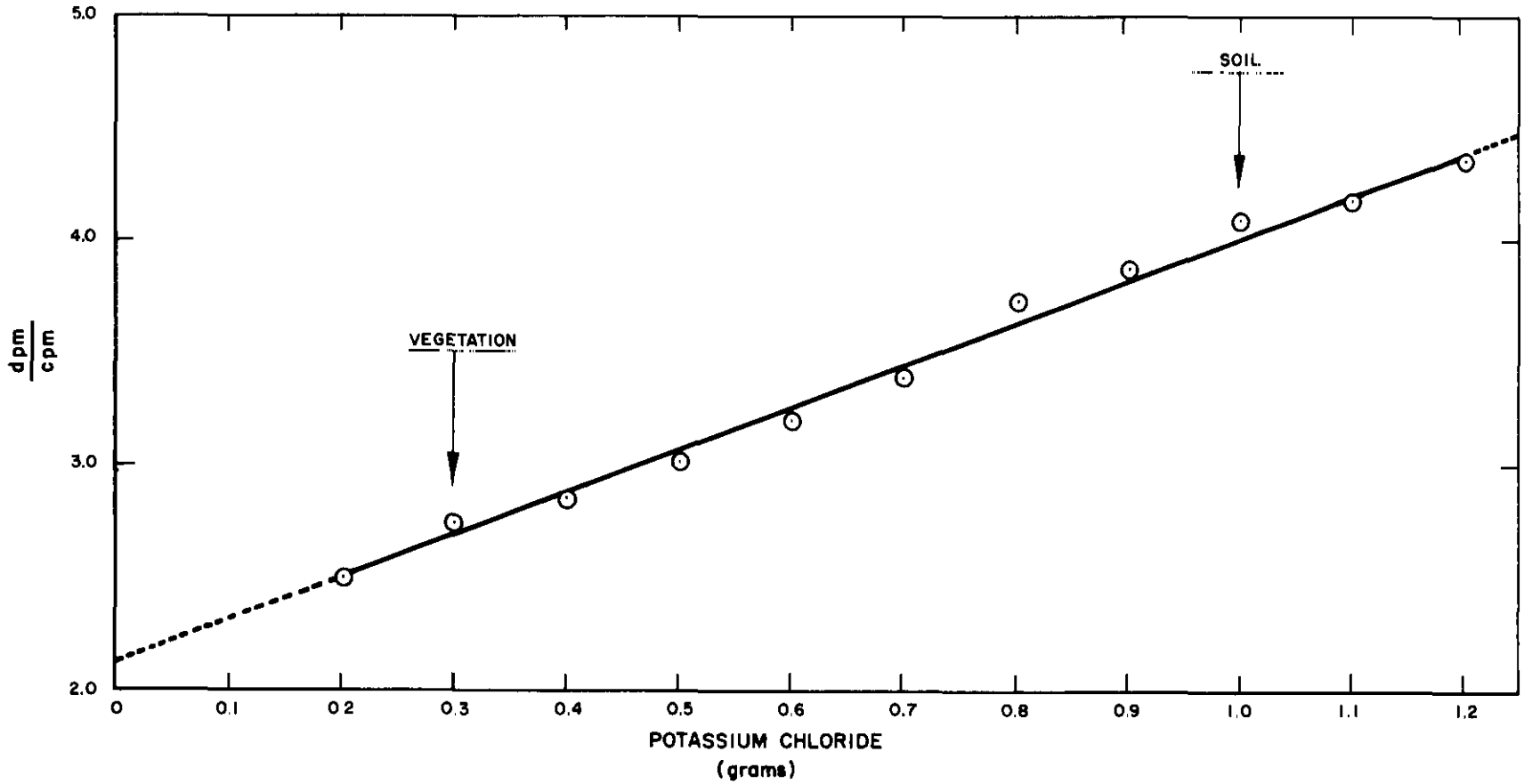


Figure 9. Self-Absorption Correction Graph