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ATOMICS INTERNATIONAL

A DIVISION OF NORTH AMERICAN AVIATION, INC.

ABSTRACT

Environmental monitoring at Atomics International is performed by the Laboratory 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. Average radioactivity concentrations measured during the first 6 months of 1963 differed only slightly from the 1962 averages, except for vegetation and air both of which showed a significant increase in beta-gamma radioactivity. These increases are attributed to nuclear weapons tests, not to Atomics International operations.

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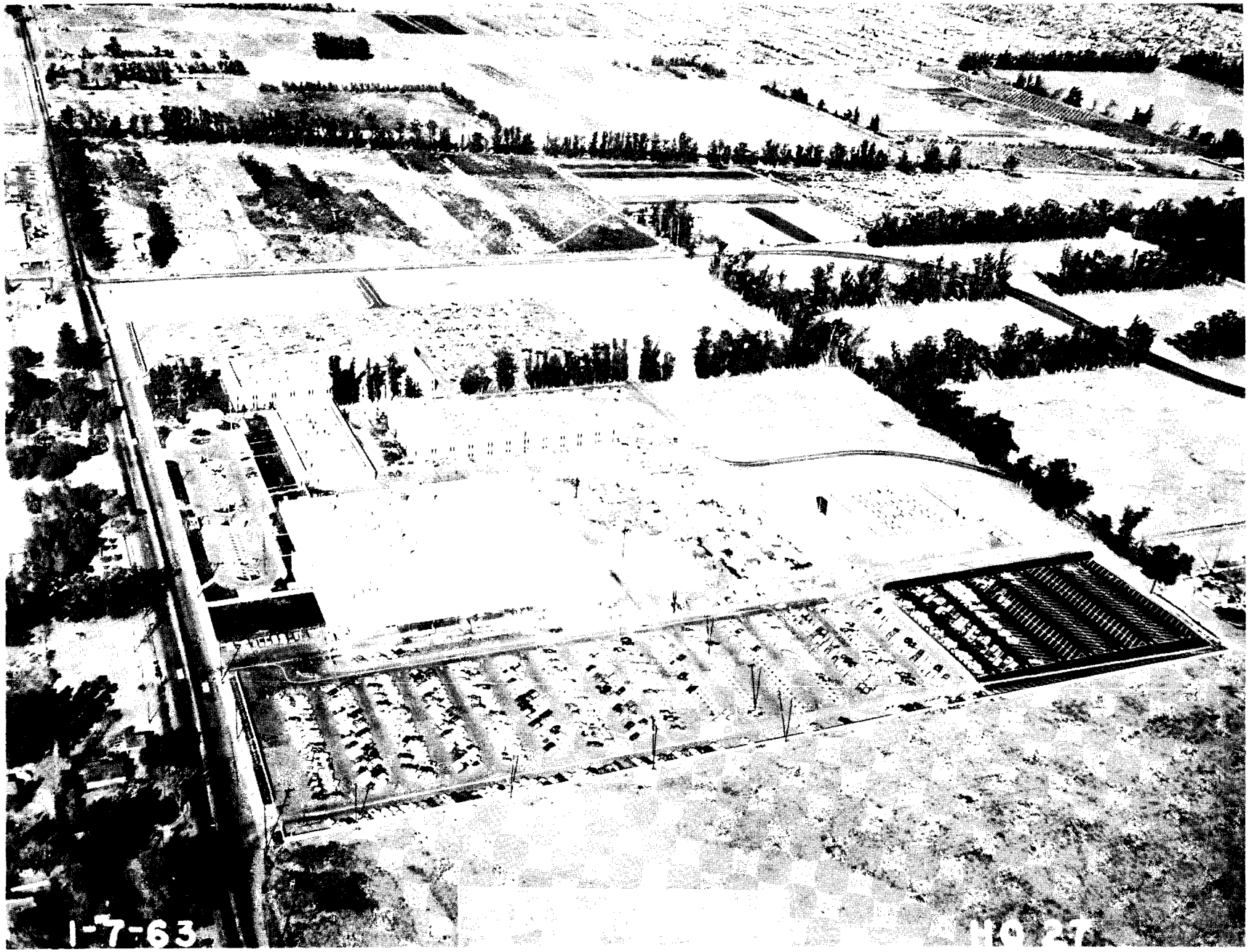


Figure 1. Atomics International World Headquarters

Figure 2. Atomics International Nuclear Development Field Laboratory

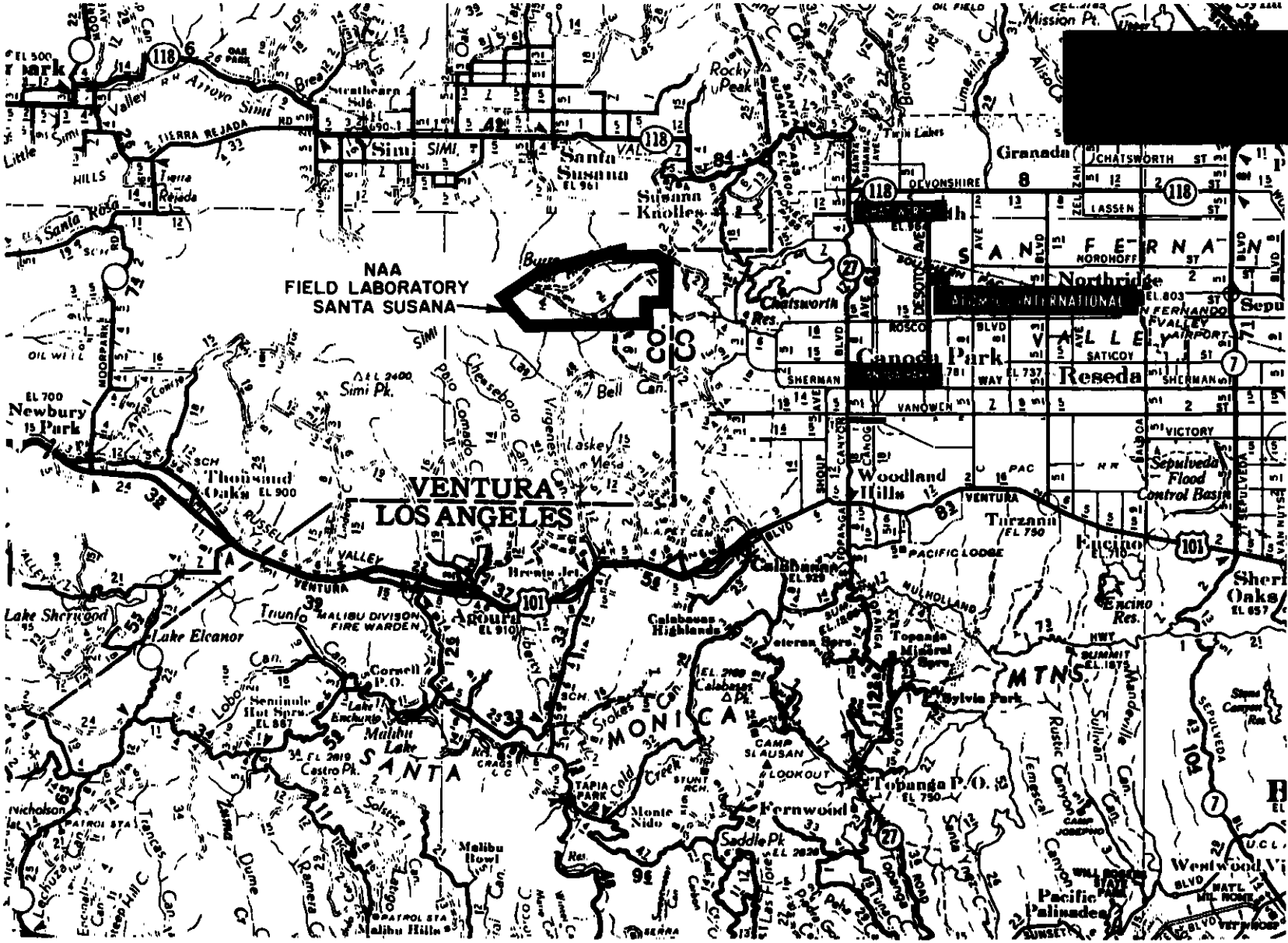


Figure 3. Map of Headquarters and Nuclear Development Field Laboratory Environs

I. SUMMARY

Atomics International, a Division of North American Aviation, Incorporated, has been engaged in 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 in Ventura County in the Simi Hills 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 encourages 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 radiological safety procedures and of engineering safeguards incorporated into facility design.

The environs of Atomics International Headquarters and 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 first six months of 1963.

Soil and vegetation are sampled monthly at 51 locations. Thirteen sampling stations are located within the boundaries of Atomics International's 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.

A. ENVIRONMENTAL RADIOACTIVITY DATA

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

TABLE I
SOIL RADIOACTIVITY DATA

Area	Activity	1962		First Half 1963	
		No. Samples	Average uuc/gram	No. Samples	Average uuc/gram
On Site	α	147	0.42 to 0.44	78	0.42 to 0.45
	β-γ	147	48	78	44
Off Site	α	453	0.35 to 0.41	227	0.39 to 0.43
	β-γ	453	47	227	41

TABLE II
VEGETATION RADIOACTIVITY DATA

Area	Activity	1962		First Half 1963	
		No. Samples	Average uuc/gram ash	No. Samples	Average uuc/gram ash
On Site	α	147	0.44 to 0.45	78	0.51 to 0.52
	β-γ	147	500	78	558
Off Site	α	453	0.42 to 0.44	228	0.44 to 0.45
	β-γ	453	406	228	489

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 radicanalyzed. Well water is sampled monthly from the supply line at two locations. The average well water radioactivity is presented in Table III.

TABLE III
WELL WATER RADIOACTIVITY DATA

Location	Activity	1962		First Half 1963	
		No. Samples	Average uuc/liter	No. Samples	Average uuc/liter
NDFL	α	24	0.20 to 0.21	12	0.22 to 0.23
	β-γ	24	12	12	10

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 is averaged into data presented in Tables I and II. Normally, four water samples are obtained from the lake surface and a fifth sample is obtained from the reservoir supply inlet located on the north side of the lake. The average radioactivity for both surface and supply water samples is presented in Table IV.

TABLE IV
CHATSWORTH RESERVOIR WATER RADIOACTIVITY DATA

Sample Type	Activity	1962		First Half 1963	
		No.Samples	Average uuc/liter	No.Samples	Average uuc/liter
Lake Surface	α	41	0.66 to 0.67	24	0.75
	β-γ	41	19	24	19
Supply Inlet	α	12	0.50	6	0.46
	β-γ	12	13	6	10 to 11

Some of the data in Tables I, II, III, and IV are presented as a range within which lies the true average. The ranges occur when one or more of the samples contain 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 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-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

Location	Activity	1962		First Half 1963	
		No.Samples	Average uuc/m^3	No.Samples	Average uuc/m^3
Head-quarters	$\beta-\gamma$	343	7.3	179	9.6
NDFL	$\beta-\gamma$	314	5.6	141	6.9

B. CONCLUSIONS AND DISCUSSION OF DATA

Table I shows possible slight increases over the 1962 average in alpha radioactivity and distinct decreases in beta-gamma radioactivity for both on-site and off-site soil samples.

Table II shows a slight increase in on-site and off-site vegetation alpha radioactivity. Beta-gamma radioactivity increased significantly in both on-site and off-site vegetation. The per cent increase in off-site vegetation beta-gamma radioactivity is slightly higher than for on-site vegetation, indicating a general increase throughout the local area.

Table III shows a slight increase and decrease in NDFL well water alpha and beta-gamma radioactivity, respectively. Table IV shows that alpha radioactivity in Chatsworth Reservoir surface water increased and that beta-gamma radioactivity remained constant, while supply inlet water alpha and beta-gamma radioactivity decreased slightly. Reservoir supply water originates in the Sierra Mountains and is transported to Los Angeles by rivers and aqueducts. Radioactivity in NDFL well water is generally less than in reservoir water, both surface and supply, thereby indicating a negligible contribution to ground water radioactivity by Atomics International operations.

Table V shows increases in airborne radioactivity at both the NDFL and Headquarters sites. The per cent increase being nearly equal at both sites and past decay analysis having shown the radioactivity to be weapon-produced fission products, the increases are not attributed to Atomics International operations.

The resumption of nuclear weapons testing on September 1, 1961 resulted in the release of fresh fission products to the atmosphere of the northern hemisphere. The beta-gamma radioactivity in all sample types reflects this contribution to the environment, the contamination being most readily apparent in vegetation and air samples.

Atomics International does not release radioactivity into the environment in concentrations exceeding the established permissible levels. Therefore, the increased beta-gamma radioactivity noted throughout the local area is attributed to fission products produced by nuclear testing, not to Atomics International operations. The slight increases in alpha radioactivity are attributed to natural causes.

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. It was subsequently extended to the then proposed Sodium Reactor Experiment (SRE) site 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 maintain surveillance of environmental radioactivity to ensure that Atomics International operations do not contribute measurably to environmental radioactivity levels.

Due to the effect of topography on environmental radioactivity, comparison of values between widely-spread, individual sampling locations is difficult. Useful information can be obtained 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 the west San Fernando Valley (Canoga Park and Reseda areas), Simi Hills, Simi Valley,

Russell Valley and vicinity, and the Chatsworth Reservoir. Fifty-one soil and vegetation sampling stations are currently established within these areas. The maximum sampling station distance from the Nuclear Development Field Laboratory is approximately 10 miles, and the total survey area comprises approximately 150 square miles. Sampling station locations are indicated on Figures 4, 5, 6, 7, and in Table VI.

During each semiannual reporting period approximately 305 soil, 305 vegetation, 42 water, and 365 environmental air samples are 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, specific isotopic analyses are not routinely performed on environmental samples. Such analysis would be performed if warranted.

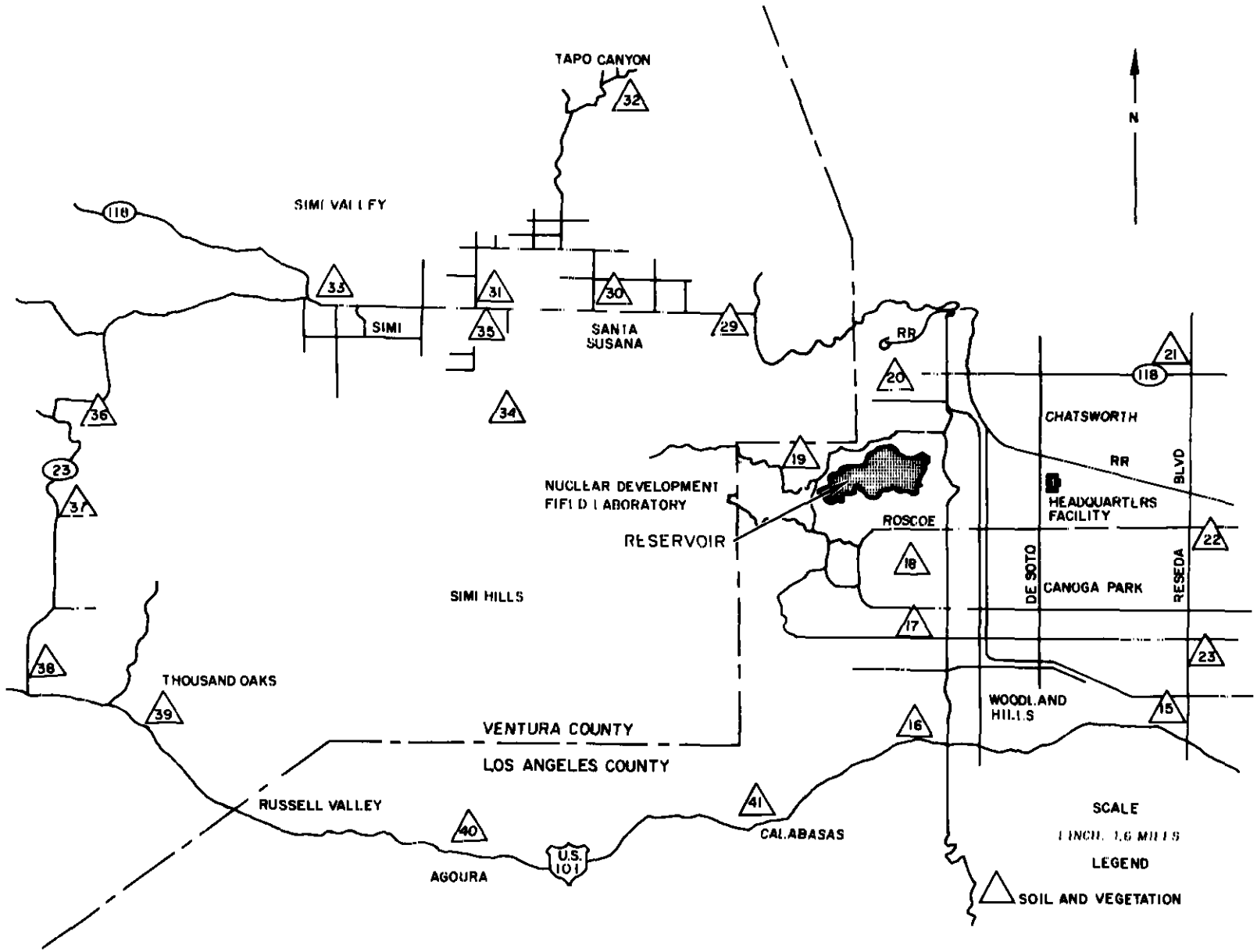


Figure 4. Map of Reseda, Canoga Park, Simi Valley, and Russell Valley Sampling Stations

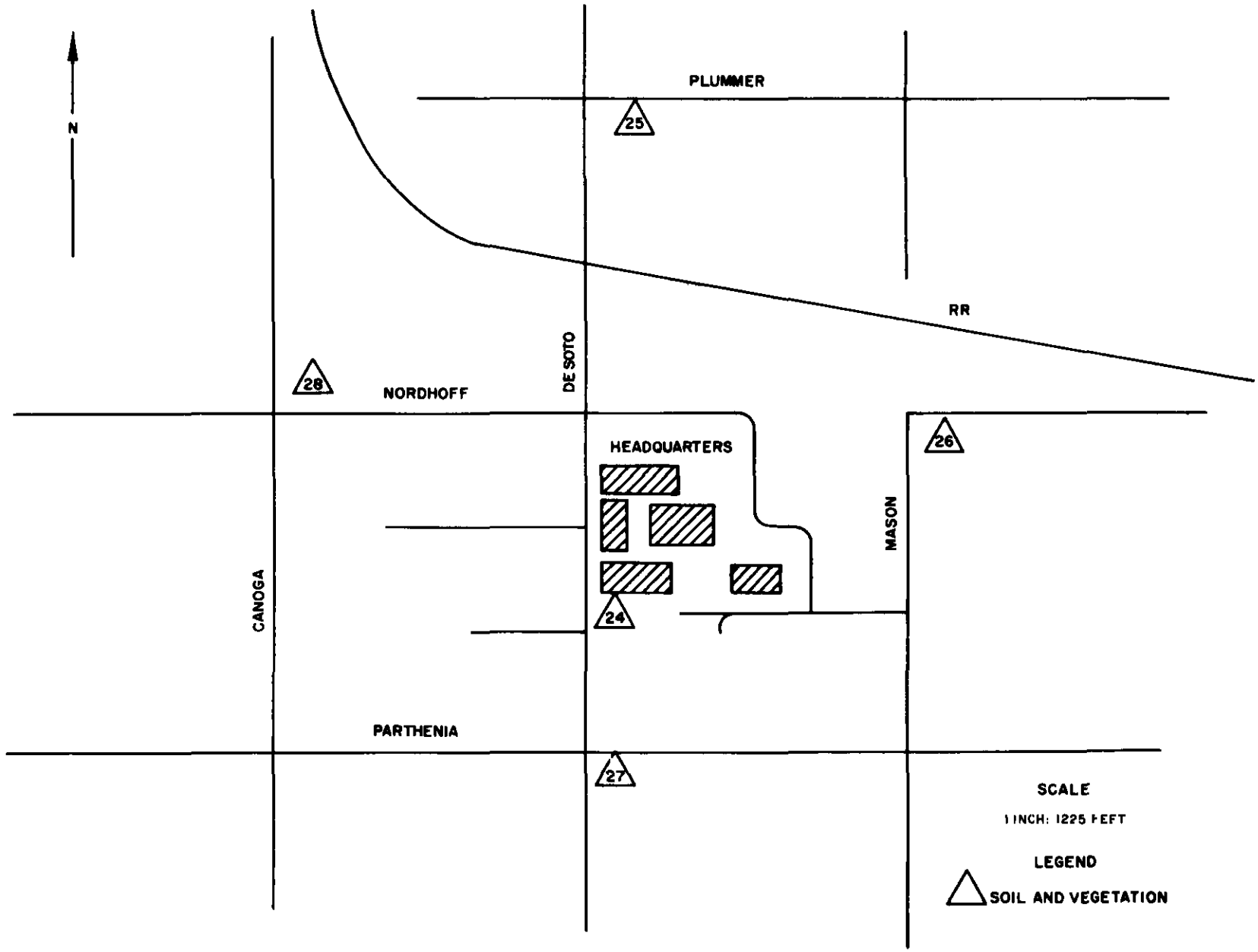


Figure 5. Map of Headquarters Vicinity Sampling Stations

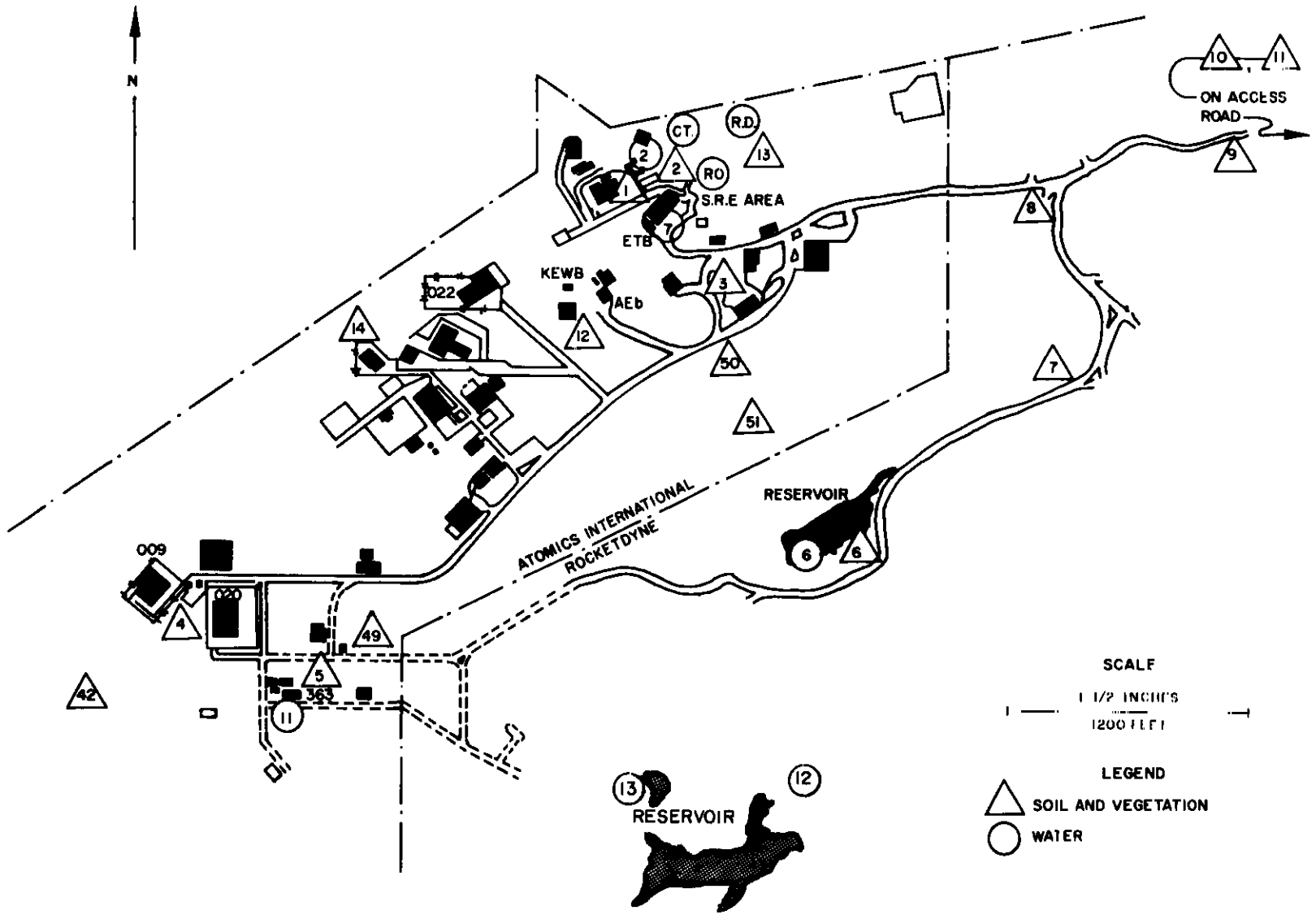


Figure 6. Map of NDFL Sampling Stations

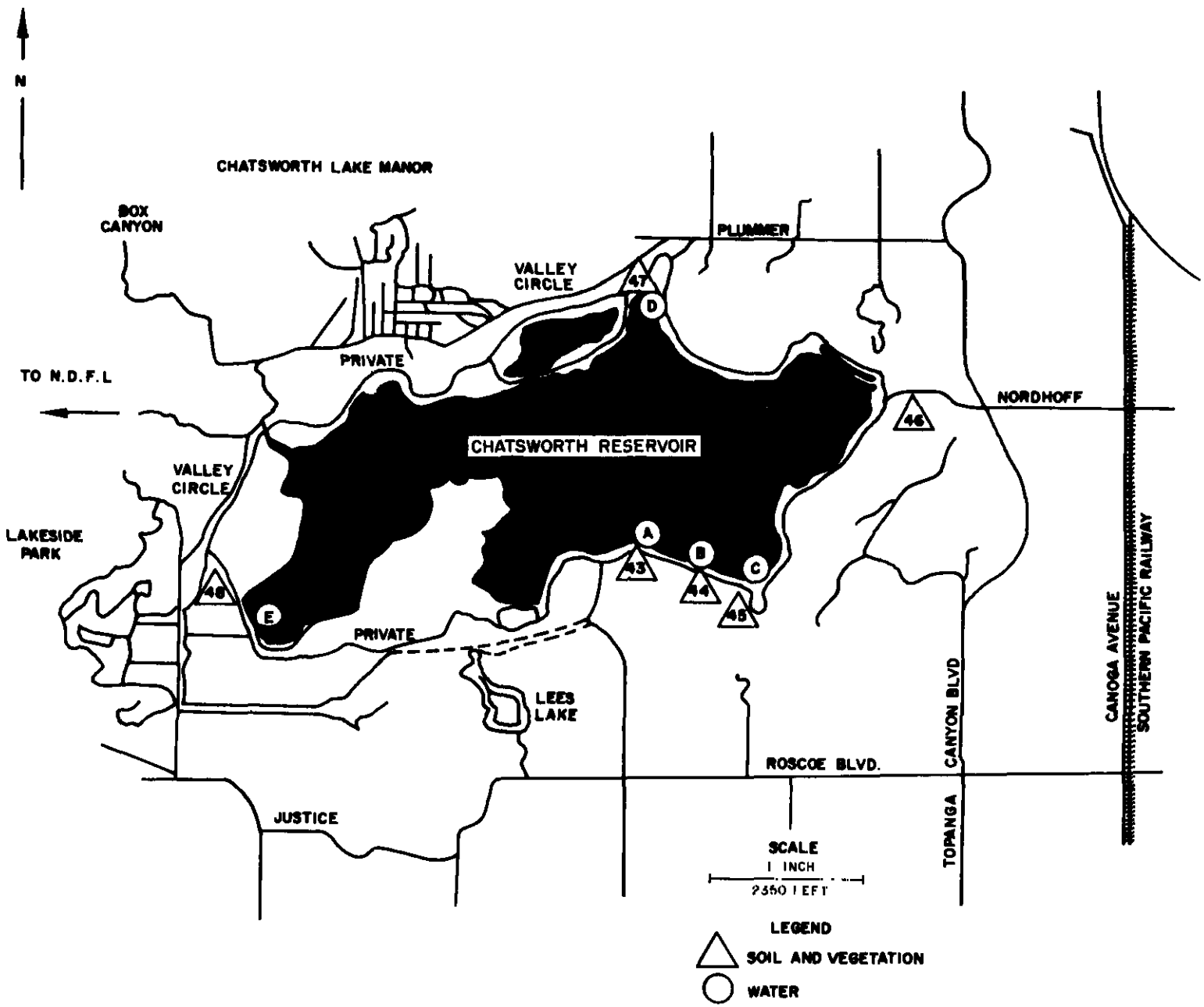


Figure 7. Map of Chatsworth Reservoir Sampling Stations

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 Cleaning 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 Site 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
SV-33	Los Angeles Ave. and Sinaloa Road
SV-34	Meier Canyon
SV-35	Brandeis Camp Entrance

STATION CON'T	LOCATION CON'T
SV-36	Moorpark Road and Camarillo Road
SV-37	Moorpark Road at Arcturus St.
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	Non-Radioactive 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 (G Street)
SV-51	Area Adjacent to Calibration Facility, Bldg. 029
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 12	Rocketdyne Retention Reservoir, PFL
W 13	Rocketdyne Retention Reservoir, PFL
W R.O.	Run Off Collection Sump, ETB and SRE Area
W C.T.	Edison Cooling Tower
W R.D.	SRE Retention Dam
W A	Chatsworth Reservoir
W B	Chatsworth Reservoir
W C	Chatsworth Reservoir
W D	Chatsworth Reservoir
W E	Chatsworth Reservoir

SV - Soil and Vegetation

W - Water

B. SAMPLING AND PREPARATION METHODS

SOIL

Surface soil types available for sampling range from decomposed granite to clay and loam. Samples are collected from the top half inch layer of ground surface. The soil samples are packaged and sealed in plastic containers and returned to the laboratory for analysis.

Sample preparation for counting 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 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 plant types maintain a more active rate of growth during the dry season than do most plant types indigenous to the local area. Vegetation leaves are stripped from the plant and placed in individual ice cream cartons and returned to the laboratory for analysis. Plant root systems are not routinely sampled.

Vegetation samples are first washed with tap water to remove foreign matter, followed by a thorough distilled water rinse. The vegetation is placed in porcelain crucibles and ashed in a muffle furnace at 500°C for approximately 8 hours, producing a fine, completely oxidized ash. Three-hundred milligram aliquots of pulverized ash from each crucible are weighed and transferred to stainless-steel planchets for counting.

WATER

Water samples are obtained monthly from NDFL wells and from Chatsworth Reservoir. The water is drawn into 1 liter polyethylene bottles and returned to the laboratory for analysis.

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 to produce an even sample distribution, re-dried under infra-red lamps, and counted.

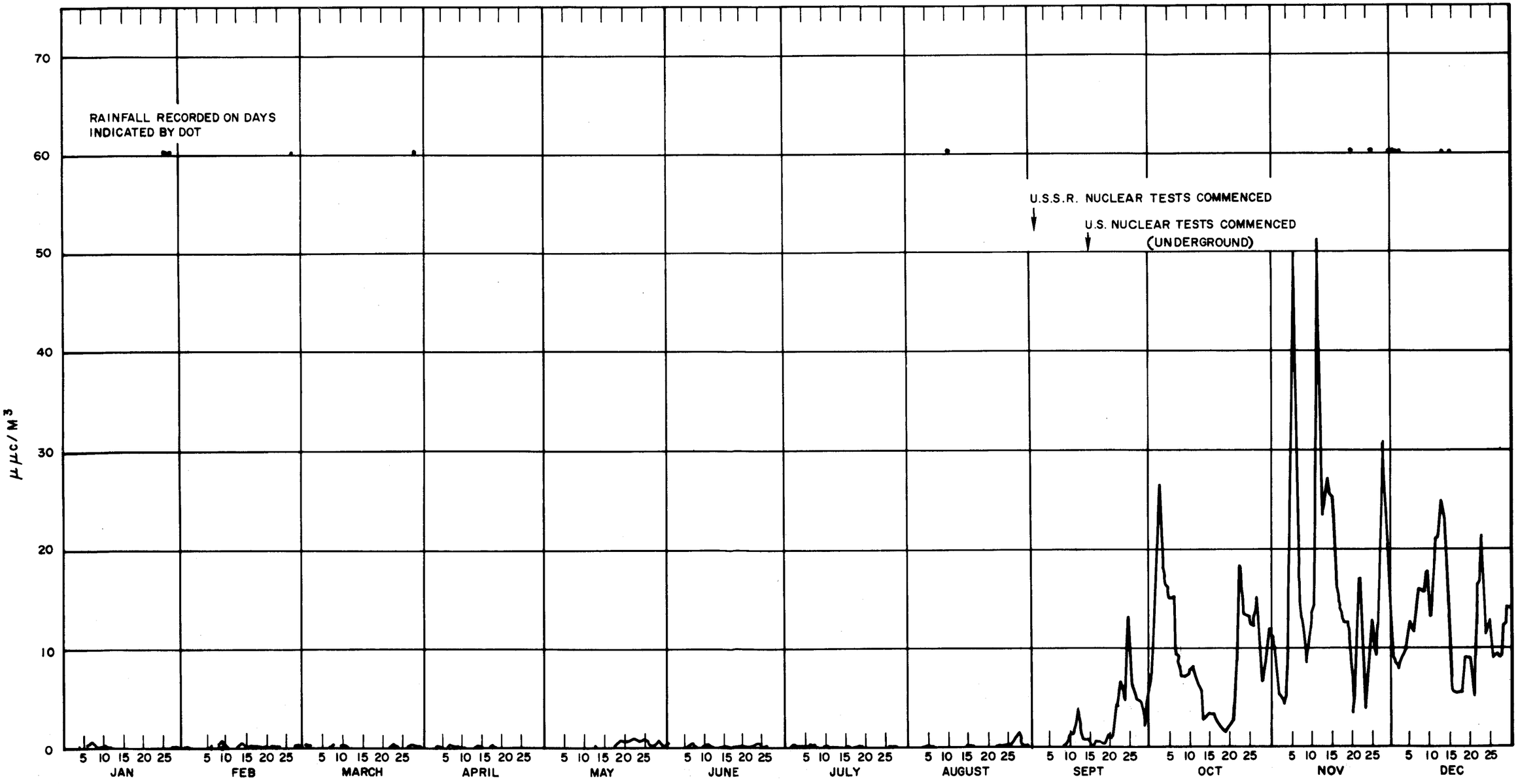
AIR

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 rates are 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 then 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, and the 1963 reporting period is presented in Figure 8. Airborne radioactivity concentrations subsequent to the nuclear weapons test 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 abnormally high airborne radioactivity beginning in September 1961 and continuing to the present.

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.



LONG LIVED AIRBORNE PARTICULATE RADIOACTIVITY

ATOMICS INTERNATIONAL HEADQUARTERS– 1961

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

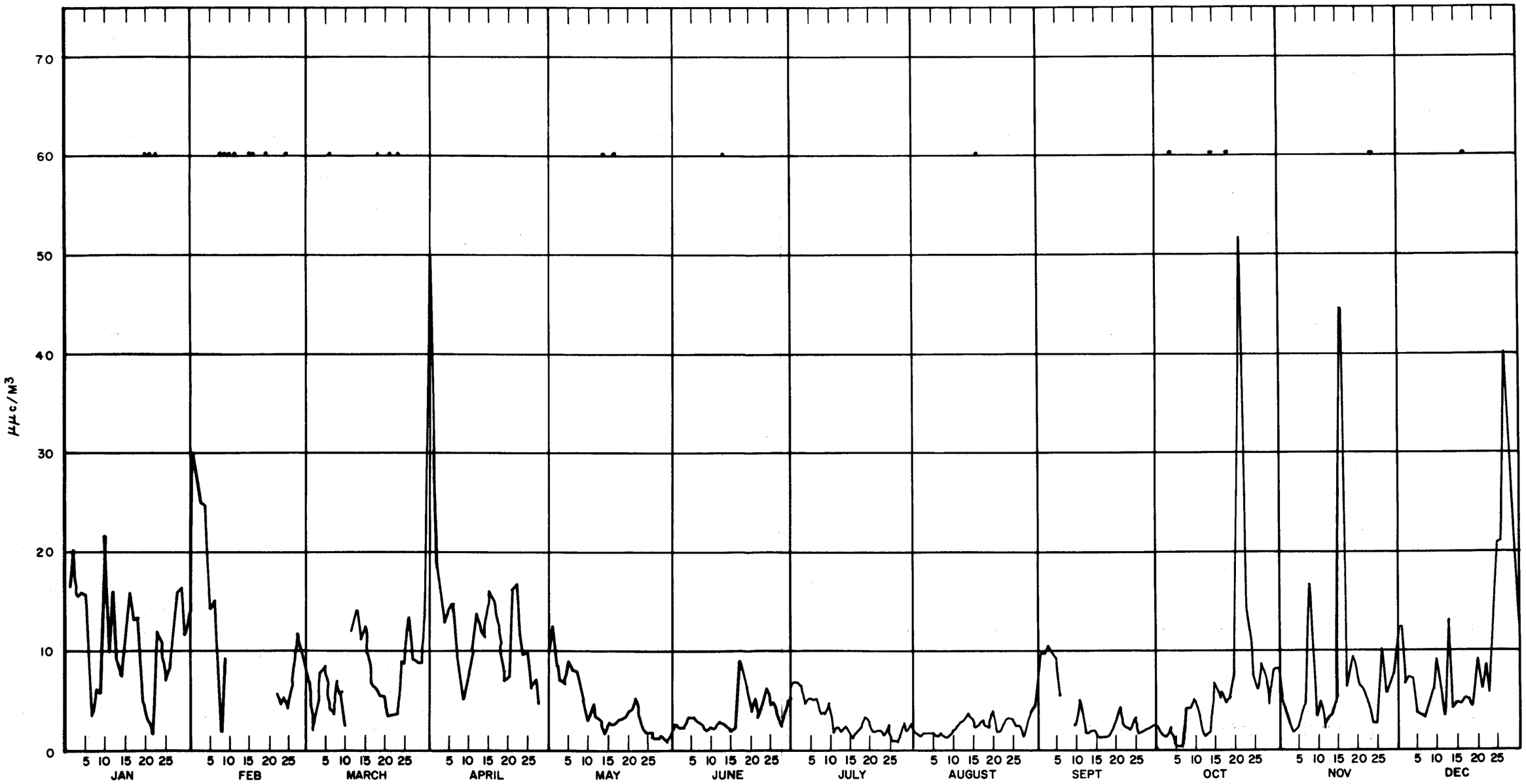
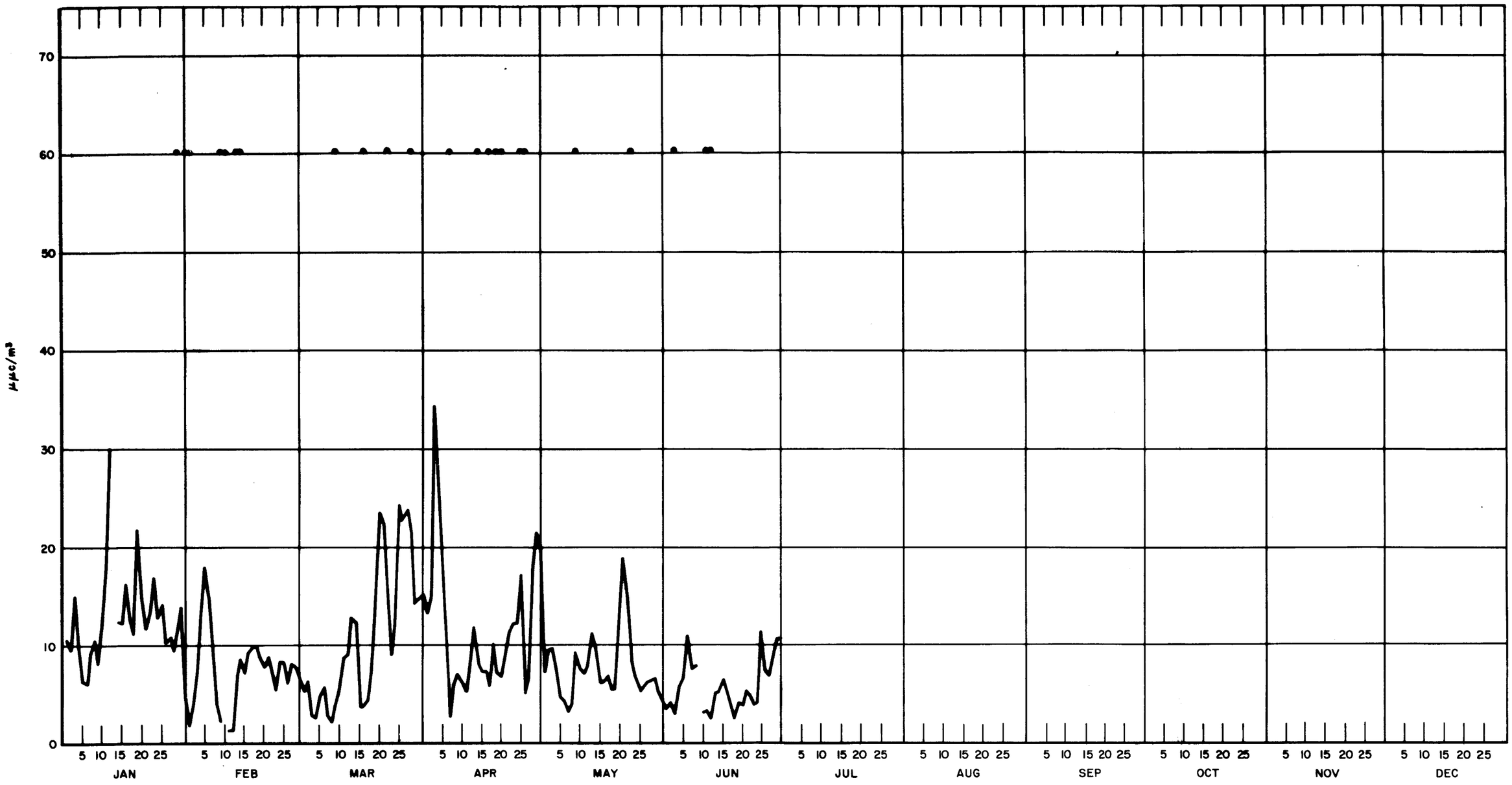


Figure 8. Long-Lived Airborne Particulate Radioactivity Atomics International Headquarters – 1962

LONG LIVED AIRBORNE PARTICULATE RADIOACTIVITY

ATOMICS INTERNATIONAL HEADQUARTERS–1962



LONG-LIVED AIRBORNE PARTICULATE RADIOACTIVITY

ATOMICS INTERNATIONAL HEADQUARTERS – 1963

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

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 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 unnecessarily long counting of samples with extremely low activities. The minimum detection limits shown in Table VII 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 $\pm$ 0.048 (uuc/gram)
	β-γ	6.9 $\pm$ 1.1 (uuc/gram)
Vegetation	α	0.086 $\pm$ 0.089 (uuc/gram ash)
	β-γ	13.8 $\pm$ 2.1 (uuc/gram ash)
Water	α	0.052 $\pm$ 0.054 (uuc/liter)
	β-γ	2.5 $\pm$ 1.3 (uuc/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 transferred to 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.

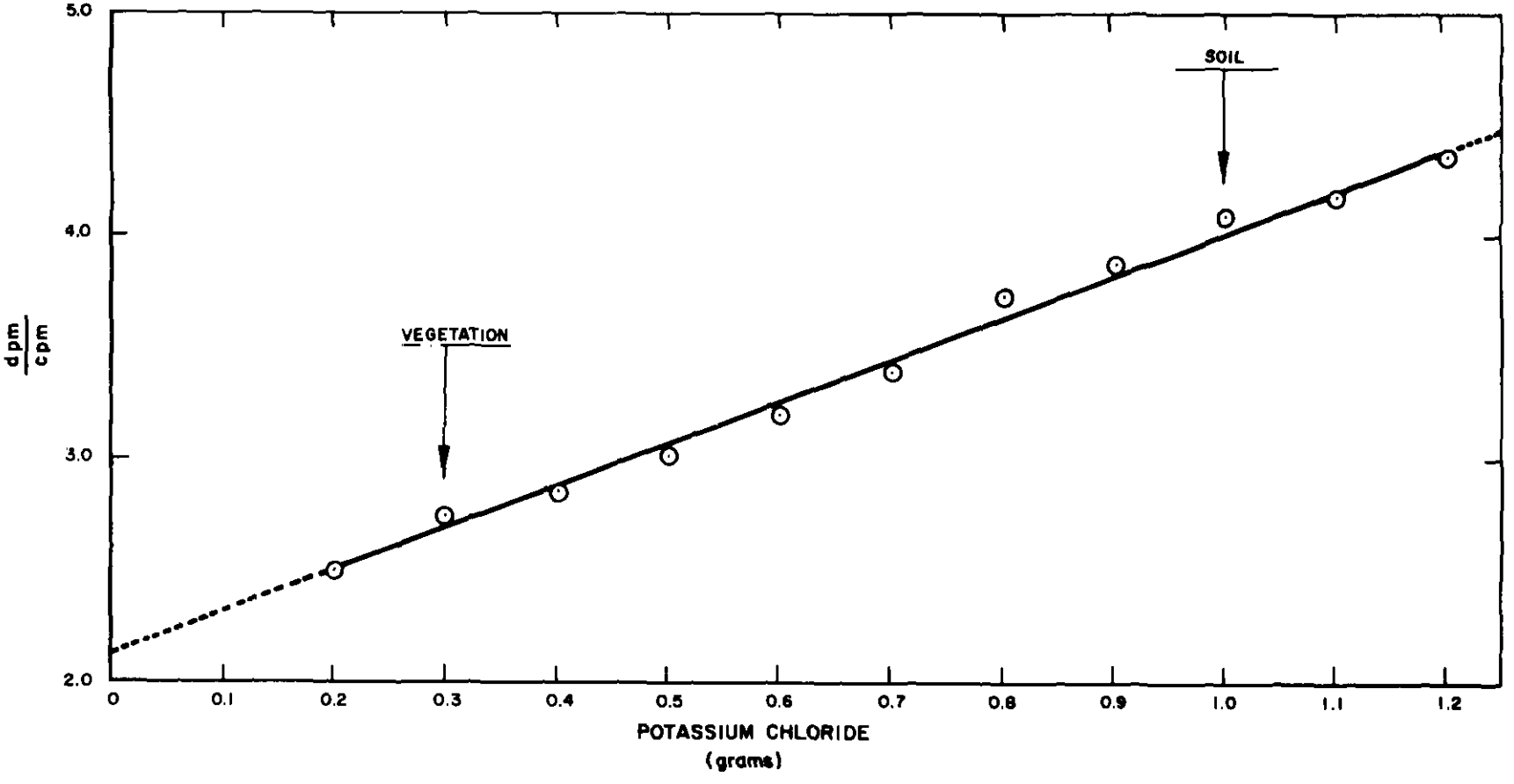


Figure 9. Self-Absorption Correction Graph