ENVIRONMENTAL MONITORING

SEMIANNUAL REPORT

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by

J. D. Moore

APPROVED: W. F. Heine

W. F. Heine
Manager
Operational Safety Unit

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ABSTRACT

Environmental monitoring at Atomics International is performed by the Operational Safety Unit of the Health, Safety and Radiation Services Department. 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 natural causes and to nuclear weapons testing, rather than to Atomics International operations.

I. SUMMARY

Atomics International, A Division of North American Rockwell Corporation, 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 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 hazards control at Atomics International requires adequate containment of radioactive materials, and, through rigid operational controls, minimizes effluent releases and external radiation levels. The environmental monitoring program provides a measure of the effectiveness of the Company's radiological safety procedures and of engineering safeguards incorporated into facility designs.

Environmental 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. The on-site environs of Atomics International's Headquarters and Nuclear Development Field Laboratory (NDFL) facilities are sampled monthly to determine the concentration of radioactivity in typical surface soil, vegetation, and water samples. The off-site environs are also sampled monthly; however, since January, 1966, analysis of off-site soil and vegetation samples has been performed only quarterly. Continuous on-site environmental air sampling provides information concerning long-lived airborne particulate radioactivity. A site perimeter radiation monitoring program utilizing thermoluminescent dosimetry (TLD) was begun in 1971 with initial results being presented in this report. This report summarizes environmental monitoring results for the first six months of 1971.

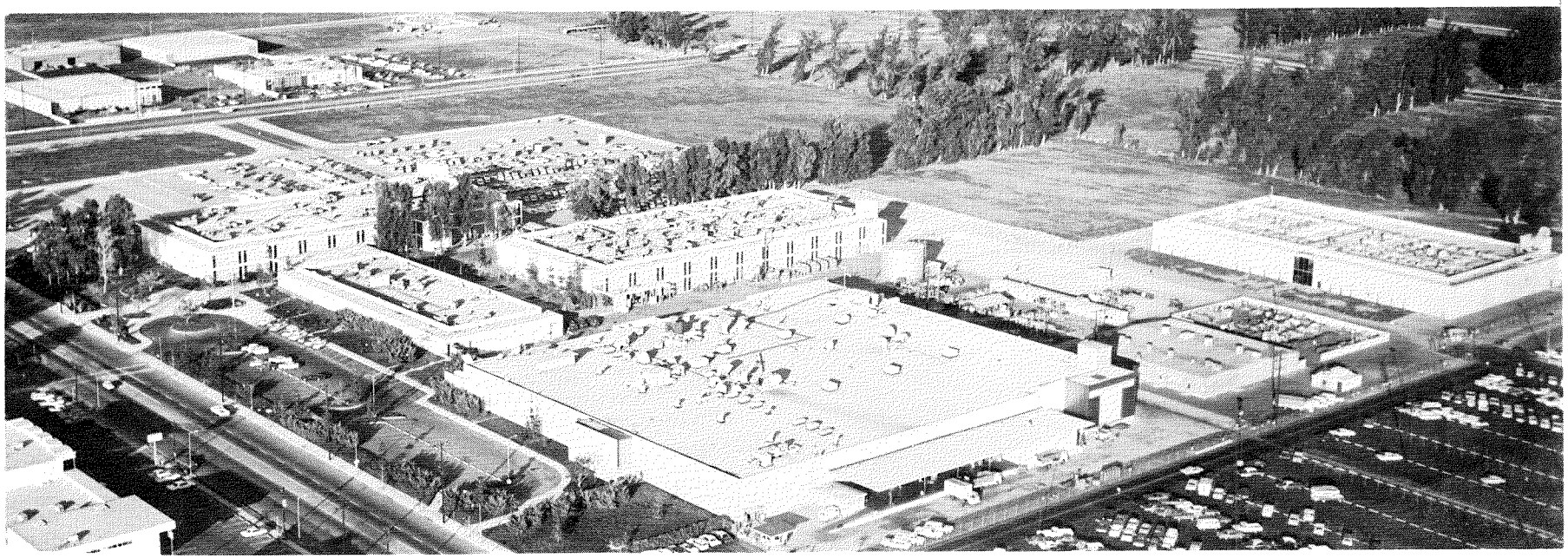

Figure 1. Atomics International Headquarters

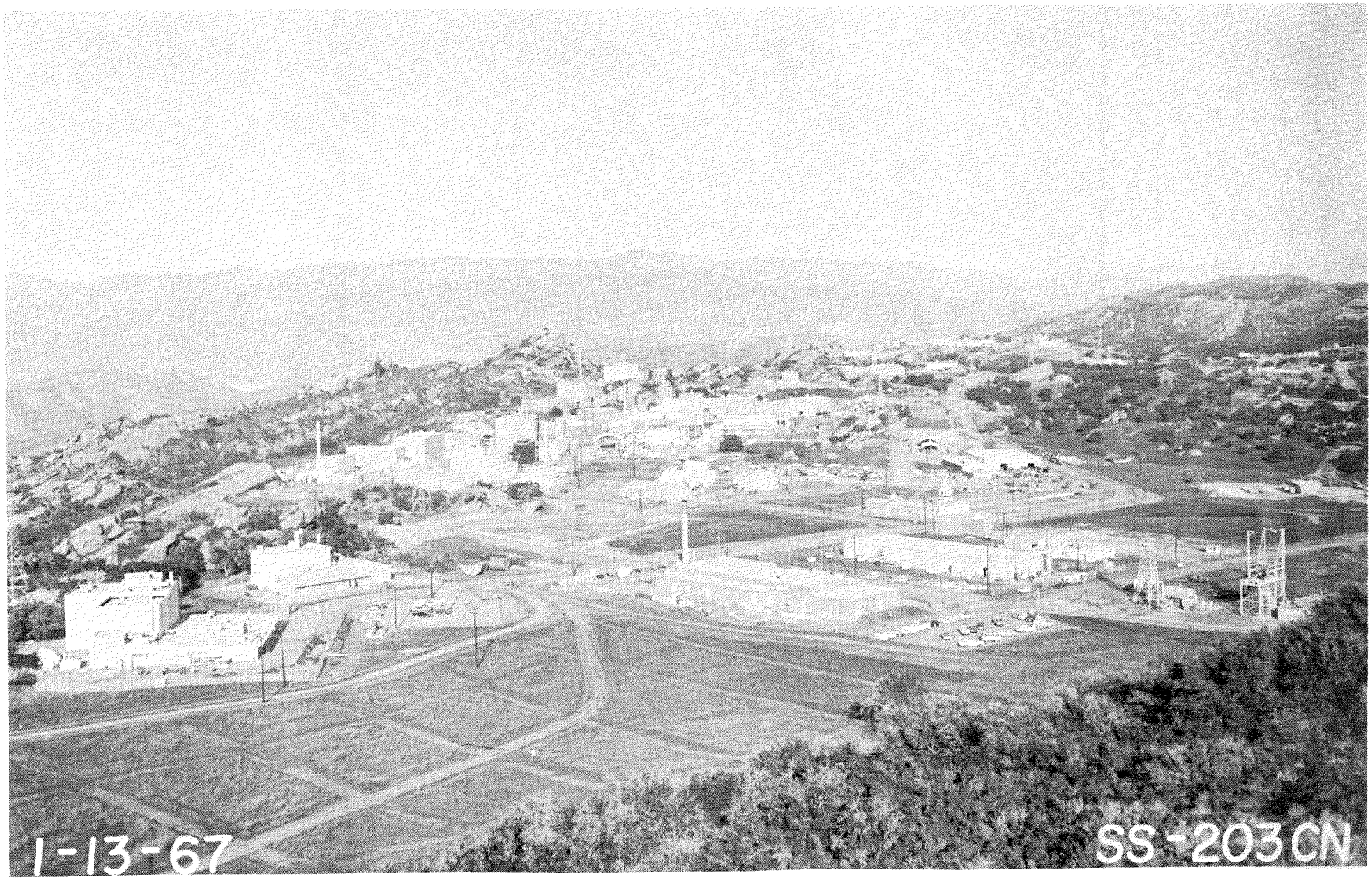

Figure 2. Atomics International Nuclear Development Field Laboratory.

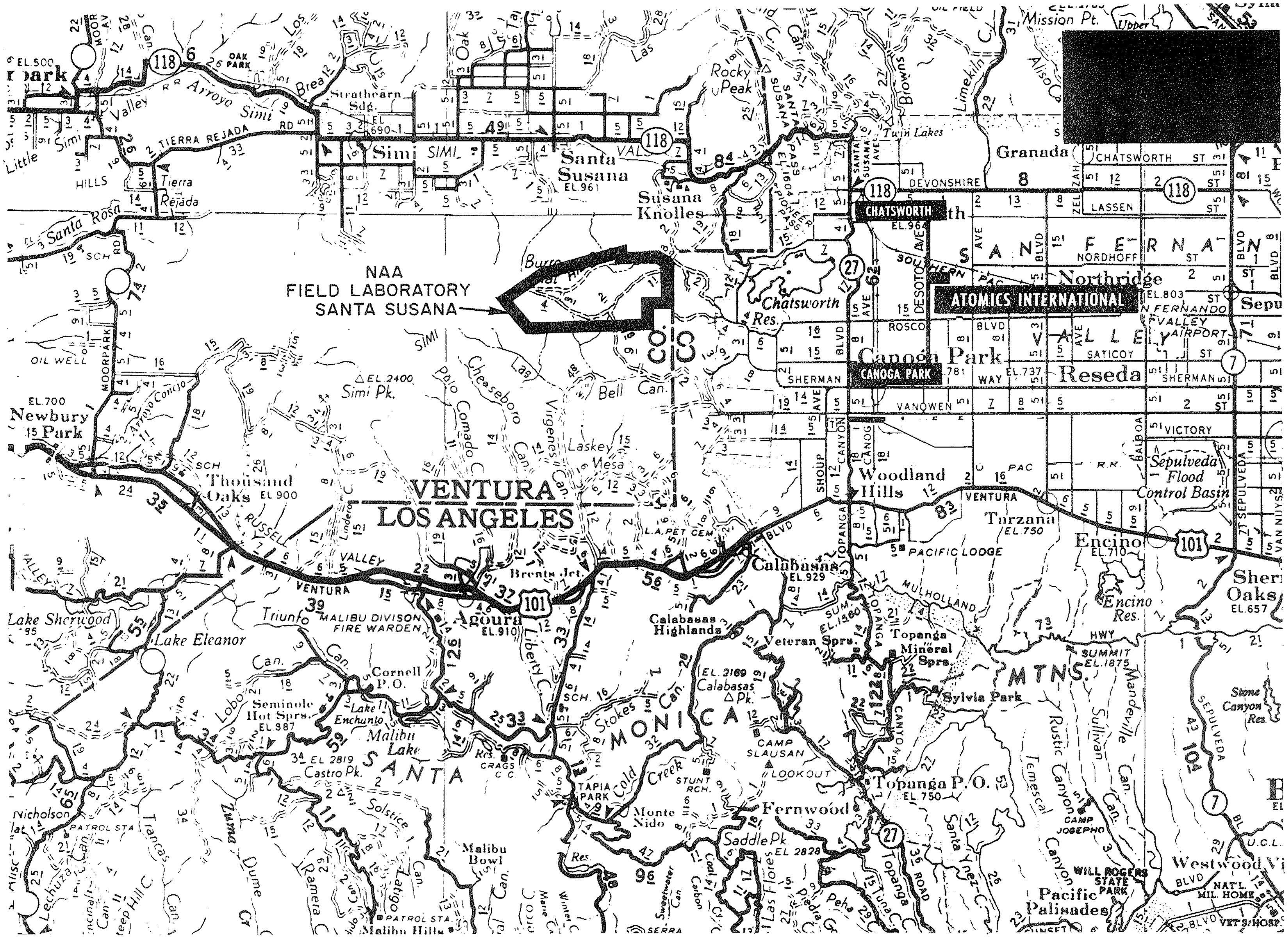

Figure 3. Map of Headquarters and Nuclear Development Field Laboratory Environs.

A. ENVIRONMENTAL RADIOACTIVITY DATA

The average radioactivity concentrations in soil and vegetation samples are presented in Tables I and II.

TABLE I

SOIL RADIOACTIVITY DATA

Area	Activity	1970		First Half - 1971	
		No. Samples	Average pCi/gram	No. Samples	Average pCi/gram
On Site	α	144	0.47	72	0.57
	$\beta\gamma$	144	27	72	25
Off Site	α	48	0.48	24	0.55
	$\beta\gamma$	48	25	24	24

TABLE II

VEGETATION RADIOACTIVITY DATA

Area	Activity	1970		First Half - 1971	
		No. Samples	Average pCi/gram-ash	No. Samples	Average pCi/gram-ash
On Site	α	144	0.33	72	0.23 to 0.27
	$\beta\gamma$	144	159	72	165
Off Site	α	48	0.30	24	0.25 to 0.28
	$\beta\gamma$	48	142	24	134

Process water used at the NDFL is obtained from Ventura County Water District No. 10 and distributed on-site by the same piping system previously used when process water was supplied by on-site wells. Pressure is provided by elevated storage tanks, one 50,000-gallon and one 500,000-gallon tank on-site. While clinically potable, the water is not used for drinking. Bottled potable water is delivered by a vendor and is not analyzed. Water from the pipe system is sampled monthly at two locations. The average process water radioactivity concentration is presented in Table III.

TABLE III

NDFL PROCESS WATER RADIOACTIVITY DATA

Location	Activity	1970		First Half - 1971	
		No. Samples	Average pCi/liter	No. Samples	Average pCi/liter
NDFL	α	24	0.15 to 0.20	12	0.30 to 0.35
	$\beta\gamma$	24	5.3	12	4.9

Surface discharged waters from NDFL facilities drain into holding reservoirs on Rocketdyne SSFL property. When full, the main reservoir may be drained into Bell Creek, a tributary of the Los Angeles River in the San Fernando Valley, Los Angeles County. Pursuant to the requirements of Los Angeles Regional Water Quality Control Board Resolution 66-49 of September 21, 1966, an environmental sampling station has been established in Bell Creek Canyon approximately 2.5 miles downstream from the south North American Rockwell Corporation boundary. Samples, obtained and analyzed monthly, include stream bed mud, vegetation, and water. Average radioactivity concentrations in Rocketdyne reservoir and Bell Creek samples are presented in Table IV.

TABLE IV

BELL CREEK AND ROCKETDYNE SSFL RESERVOIR
RADIOACTIVITY DATA

Sample Description	1970			First Half - 1971		
	No. Samples	α	$\beta\gamma$	No. Samples	α	$\beta\gamma$
Bell Creek Mud 54 (pCi/gram)	12	0.44	24	6	0.31	23
Bell Creek Vegetation 54 (pCi/gram-ash)	12	0.23	165	6	0.19	161
Bell Creek Water 16 (pCi/liter)	12	0.11 to 0.19	3.7	6	0.14 to 0.27	3.9
Reservoir Station 6 Water (pCi/liter)	12	0.12 to 0.18	6.9	6	0.22 to 0.25	6.1
Reservoir Station 12 Water (pCi/liter)	12	0.08 to 0.15	7.4	6	0.07 to 0.24	6.2

Soil, vegetation, and water are sampled monthly at the Chatsworth Reservoir, which is owned and operated by the Los Angeles City Department of Water and Power. Soil and vegetation radioactivity data for the reservoir are averaged into the off-site data presented in Tables I and II. Normally, one water sample is obtained from the lake surface and another obtained from the reservoir water supply inlet located on the north side of the lake. The lake was drained in July, 1969 for construction thereby precluding surface sampling for the current reporting period. The average radioactivity concentration in reservoir supply water is presented in Table V.

TABLE V

CHATSWORTH RESERVOIR WATER RADIOACTIVITY DATA

Sample Type	Activity	1970		First Half - 1971	
		No. Samples	Average pCi/liter	No. Samples	Average pCi/liter
Lake Surface	α	0	-	0	-
	$\beta\gamma$	0	-	0	-
Supply Inlet	α	12	0.36	6	0.47 to 0.50
	$\beta\gamma$	12	5.4	6	6.1

Environmental air sampling for long-lived particulate alpha and beta-gamma radioactivity is performed continuously with automatic sequential samplers at both the Headquarters and NDFL sites. Air is drawn through an HV-70 filter which is analyzed, after a minimum 72-hour decay period, for long-lived radioactivity. The average concentration of long-lived alpha and beta-gamma radioactivity is presented in Table VI.

TABLE VI

AIRBORNE RADIOACTIVITY DATA

Location	Activity	1970		First Half - 1971	
		No. Samples	Average pCi/m^3	No. Samples	Average pCi/m^3
Headquarters	α	*	-	362	0.0087
	$\beta\gamma$	668	0.34	362	0.40
NDFL	α	*	-	1249	0.0086
	$\beta\gamma$	2434	0.36	1249	0.44

*No data prior to current reporting period.

Site boundary radiation monitoring is performed with Calcium Fluoride thermoluminescent dosimeters (TLD) placed at selected locations on or near the perimeters of the Headquarters and NDFL sites. Each dosimeter, sealed in a light-proof plastic holder, is installed in a polyethylene vial which is permanently mounted at each monitoring location. The dosimeters are exchanged and analyzed quarterly. The radiation dose monitored at each dosimeter location is presented in Table VII.

TABLE VII

SITE PERIMETER RADIATION DOSIMETRY DATA

FIRST HALF - 1971

Location	Dose mRem	Average Dose Rate mRem/hour	Location	Dose mRem	Average Dose Rate mRem/hour
TLD-1	97	0.024	TLD-6	84	0.021
TLD-2	67	0.016	TLD-7	99	0.024
TLD-3	90	0.022	TLD-8	108	0.027
TLD-4	99	0.024	TLD-9*	39	0.018
TLD-5	81	0.020	TLD-10	132	0.032

*Second quarter only.

Some of the data in the tables 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 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 IX.

Table I shows that for the first six months of 1971 soil alpha radioactivity increased while soil beta-gamma radioactivity did not change significantly over the 1970 average. Table II shows a decrease in vegetation alpha radioactivity and in off-site vegetation beta-gamma radioactivity and a slight increase in on-site vegetation beta-gamma radioactivity. Table III shows that NDFL process water alpha radioactivity increased and that beta-gamma radioactivity decreased slightly. Table IV shows no significant changes in Bell Creek stream-bed mud, vegetation, and water radioactivity. The table also shows that reservoir stations 6 and 12 water alpha radioactivity increased and that beta-gamma radioactivity decreased. Table V

shows that Chatsworth Reservoir supply inlet water radioactivity increased. Table VI shows a slight increase in long-lived airborne beta-gamma radioactivity. Table VII shows that site boundary radiation levels are generally commensurate with natural background radiation levels. Since this program and airborne long-lived alpha radioactivity monitoring, were initiated in 1971, no comparative data are available for inclusion in this report. The environmental radioactivity discussed above for the preceeding tables is not attributed to Atomics International's operations; rather it is felt to have been produced after September 1, 1961, by several world-wide nuclear detonations and also due to natural causes.

II. ENVIRONMENTAL MONITORING PROGRAM

A. GENERAL DESCRIPTION

Soil and vegetation collection and analysis for radioactivity 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 the Simi Hills in May of 1954. In addition, sampling was conducted in the Burro Flats area, southwest of SRE, where many nuclear 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 survey environmental radioactivity adequately to ensure that Atomics International operations do not contribute significantly to environmental radioactivity. The locations of sampling stations are shown in Figures 4, 5, 6, and 7, and in Table VIII.

B. SAMPLING AND SAMPLE PREPARATION METHODS

SOIL

Surface soil types available for sampling range from decomposed granite to clay and loam. Samples are taken from the top 1/2 inch layer of undisturbed 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 approximately 500°C for eight hours. After cooling, the soil is sieved to obtain uniform particle size. Two-gram aliquots of the sieved soil are weighed and transferred to copper planchets. The soil is wetted in the planchet with alcohol, evenly distributed to obtain uniform sample thickness, re-dried, and counted.

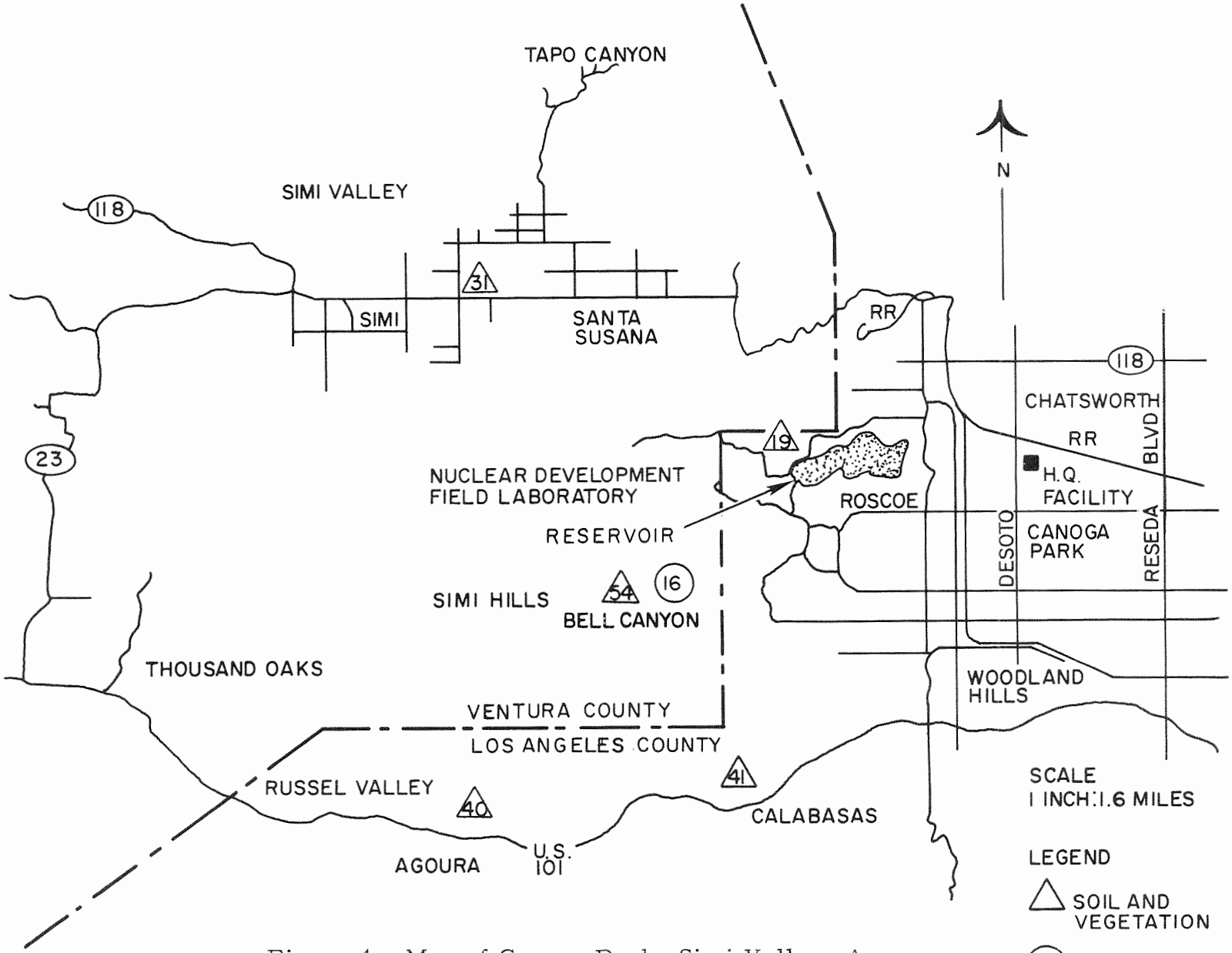

Figure 4. Map of Canoga Park, Simi Valley, Agoura, and Calabasas Sampling Stations

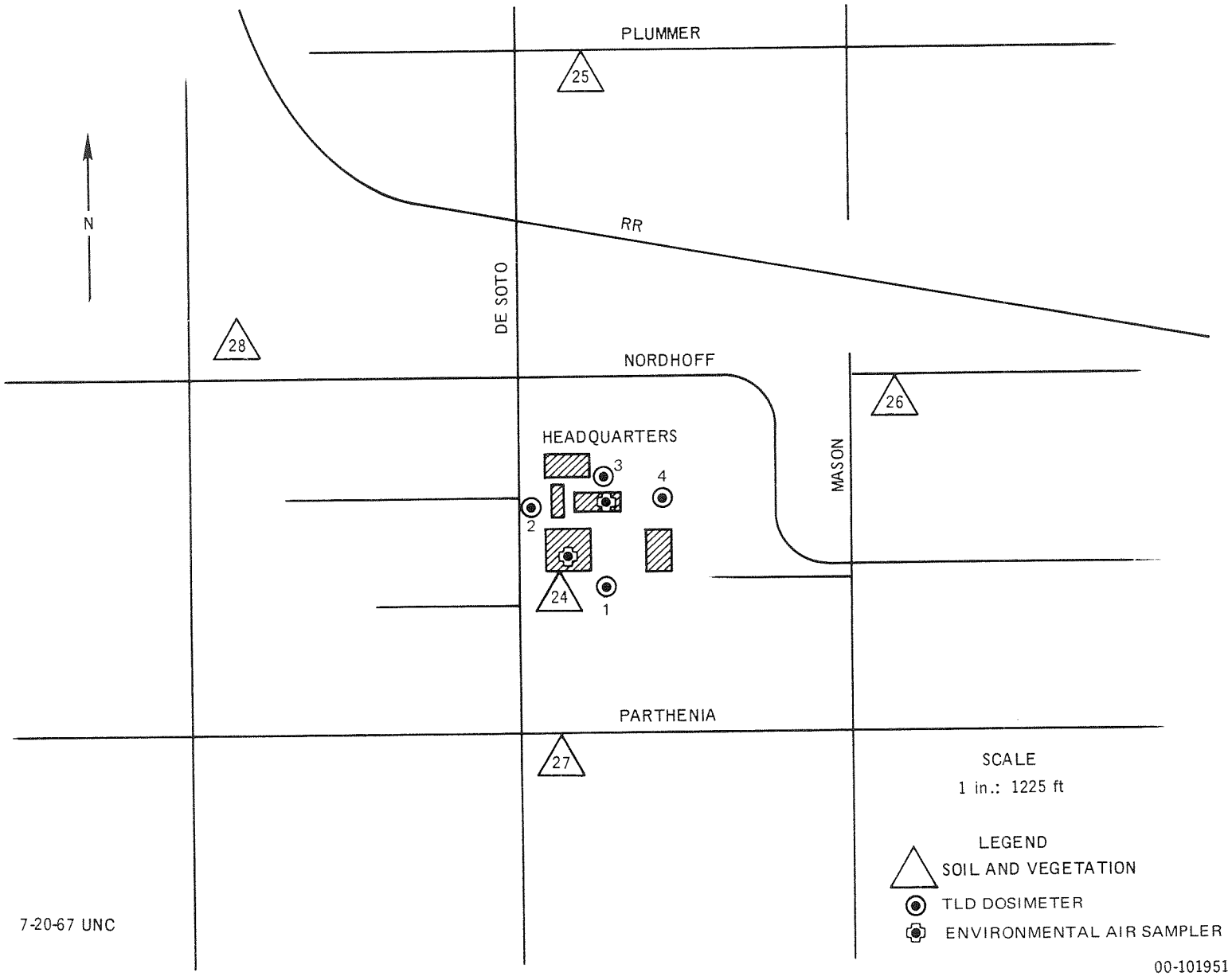

Figure 5. Map of Headquarters Vicinity Sampling Stations

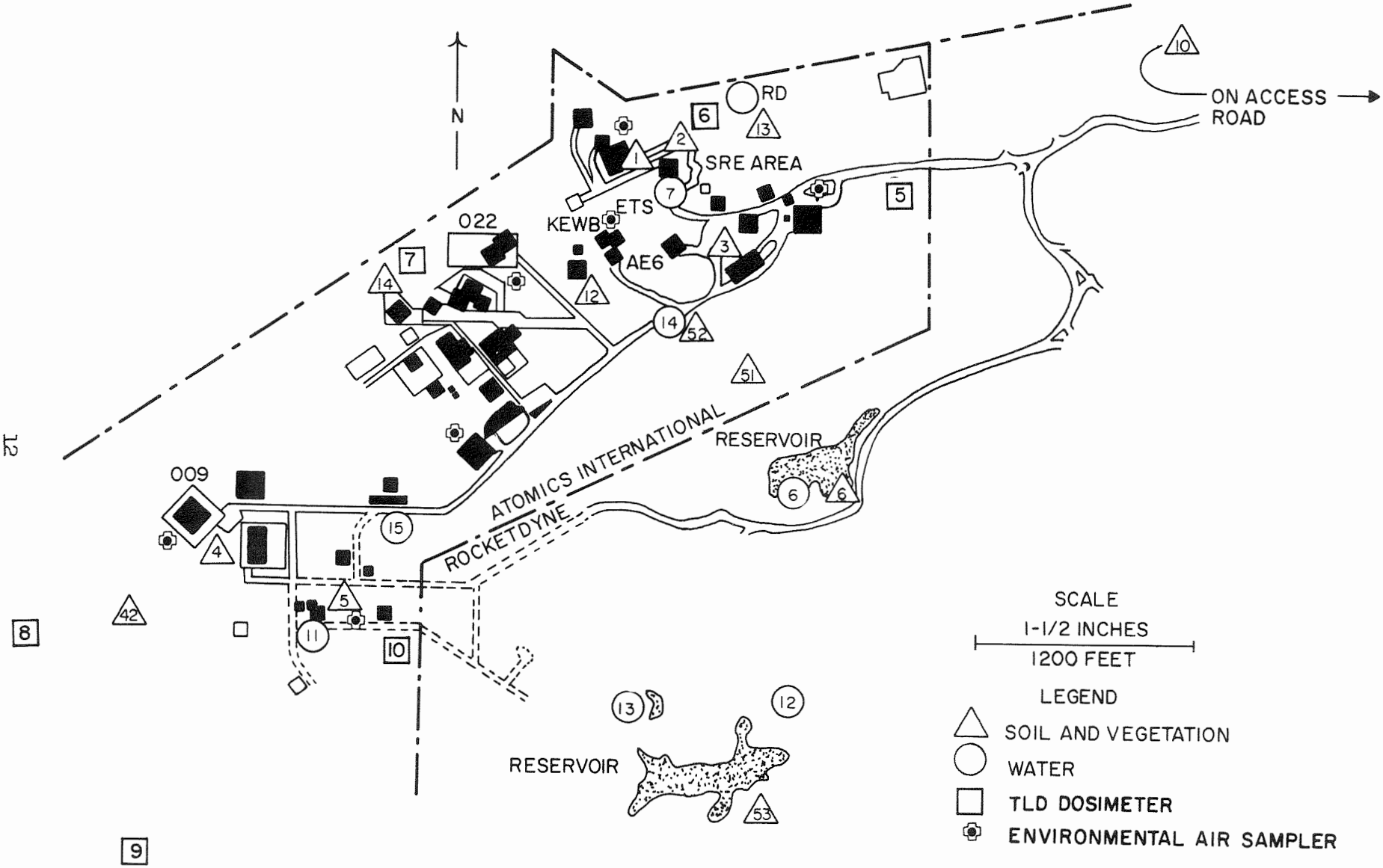

Figure 6. Map of NDFL Sampling Stations

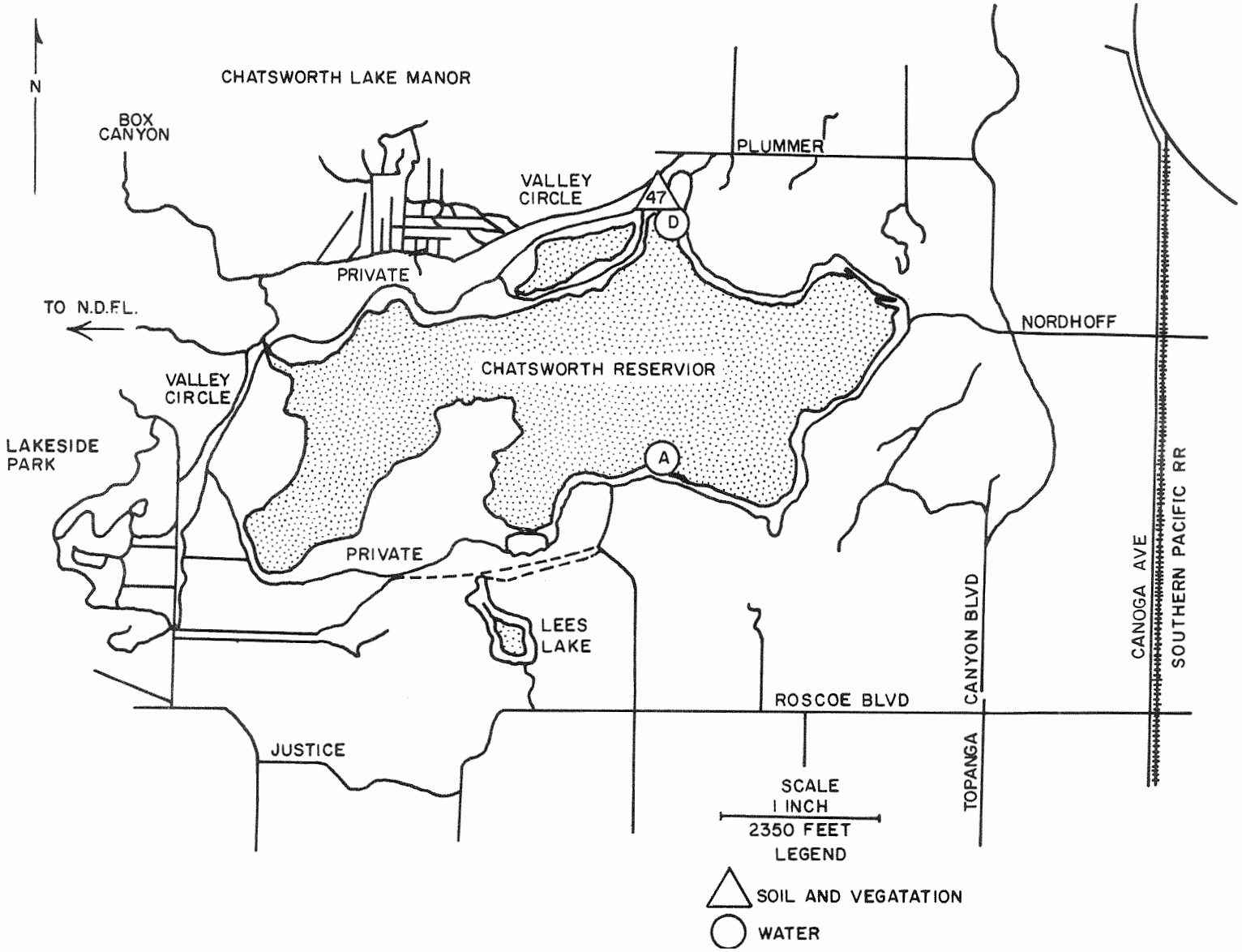

Figure 7. Map of Chatsworth Reservoir Sampling Stations

TABLE VIII

SAMPLE STATION LOCATIONS

STATION	LOCATION
SV-1	SRE Reactor, NDFL
SV-2	SRE Perimeter Drainage Ditch, NDFL
SV-3	Building 064 Parking Lot, NDFL
SV-4	Building 020, NDFL
SV-5	Building 363, NDFL
SV-6	Rocketdyne Reservoir, SSFL
SV-10	Santa Susana Site Access Road
SV-12	L-85 Reactor, NDFL
SV-13	Sodium Cleaning Pad, NDFL
SV-14	Canyon Below Building 022, NDFL
SV-19	Santa Susana Site Entrance, Woolsey Canyon
SV-24	Atomics International 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, Alamo Avenue and Sycamore Road
SV-40	Agoura-Kanan Road and Ventura Freeway
SV-41	Calabasas-Parkway Calabasas and Ventura Freeway
SV-42	Non-Radioactive Materials Disposal Area, NDFL
SV-47	Chatsworth Reservoir, North Side
SV-51	Building 029, NDFL
SV-52	Burro Flat Drainage Control Pond, G. Street and 17th Street, NDFL
SV-53	Top of Bell Canyon Below Rocketdyne Delta Pond Spillway, SSFL
SV-54	Bell Creek
W-6	Rocketdyne Reservoir, SSFL
W-7	Process Water From Building 003, NDFL
W-11	Process Water From Building 363, NDFL
W-12	Rocketdyne Reservoir, SSFL
W-16	Bell Creek
W-A	Chatsworth Reservoir Surface, South Side
W-D	Chatsworth Reservoir, Supply Inlet

STATION	LOCATION
A-1	Atomics International Headquarters, Building 001 Roof
A-2	Atomics International Headquarters, Building 004 Roof
A-3	Building 009, NDFL
A-4	Building 011, NDFL
A-5	Building 012, NDFL
A-6	Building 040, NDFL
A-7	Building 074, NDFL
A-8	Building 143, NDFL
A-9	Building 363, NDFL
TLD-1	Atomics International Headquarters, South of Building 102 on Fence
TLD-2	Atomics International Headquarters, West of Building 001 on Gate to Plant Water Supply Enclosure
TLD-3	Atomics International Headquarters, Guard Post #1, Building 201
TLD-4	Atomics International Headquarters, East Fence Gate
TLD-5	Building 113, NDFL
TLD-6	SRE Retention Dam, NDFL
TLD-7	Electric Sub-Station #719, NDFL
TLD-8	Property Line Gate, West End of H. Street, NDFL
TLD-9	Water Tank #701, NDFL
TLD-10	Building 854, NDFL

VEGETATION

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

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

WATER

Samples of process water are obtained monthly at the NDFL, from Bell Creek, and from the Chatsworth Reservoir. The water is drawn into one-liter polyethylene bottles and transferred to the laboratory.

Five hundred ml. of water are evaporated to dryness in crystallizing dishes at approximately 90°C. The residue salts are redissolved into distilled water and transferred to copper planchets, redried 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 HV-70 filter paper which is automatically changed at the end of each sampling period. The filters are removed from the sampler and counted for long-lived radioactivity following a minimum 72-hour decay period. The volume of a typical daily environmental air sample is approximately 20 cubic meters.

When abnormally high airborne radioactivities are observed, the beta-gamma radioactivity decay data are plotted to determine the presence of shortlived isotopes other than naturally occurring radon, thoron and daughters. If fall-out is suspected, the decay characteristics are observed. 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 daily averaged airborne long-lived alpha and beta-gamma radioactivity concentrations detected at the Headquarters and NDFL facilities during the first six months of 1971 is presented in Figure 8. The average beta-gamma concentration for each month is also indicated by horizontal bars. The graph shows a generally increasing trend in airborne beta-gamma radioactivity through the Spring months with a prominent peak noted in May.

C. COUNTING AND CALIBRATION PROCEDURES

Environmental soil, vegetation, water, and air samples are counted for alpha and beta-gamma radioactivity with a low-background proportional counting system capable of the simultaneous counting of both alpha and net beta radioactivity. The sample-detector configuration provides a nearly 2π geometry. The thin-window detector is continually purged with methane counting gas. A pre-set time mode of operation is used for all samples; however, an overriding pre-set count mode is available to limit the counting time for high activity samples. The minimum detection limits shown in Table IX were determined by using typical values for counting time, system efficiency, background count rates (approximately 0.05 cpm α and 1.0 cpm $\beta\gamma$) and sample size. In addition, the minimim statistically significant amount of radioactivity, irrespective of sample configuration, is established as that amount equal in count rate to three times the standard deviation of the system background count rate.

TABLE IX

MINIMUM RADIOACTIVITY DETECTION LIMITS

Sample	Activity	Minimum Detection Limits*
Soil	α	0.05±0.03 (pCi/gram)
	$\beta\gamma$	0.22±0.11 (pCi/gram)
Vegetation	α	0.10±0.06 (pCi/gram-ash)
	$\beta\gamma$	0.35±0.18 (pCi/gram-ash)
Water	α	0.20±0.12 (pCi/liter)
	$\beta\gamma$	0.63±0.32 (pCi/liter)
Air	α	0.0085±0.0053 (pCi/m^3)
	$\beta\gamma$	0.018±0.0093 (pCi/m^3)

*Standard Error

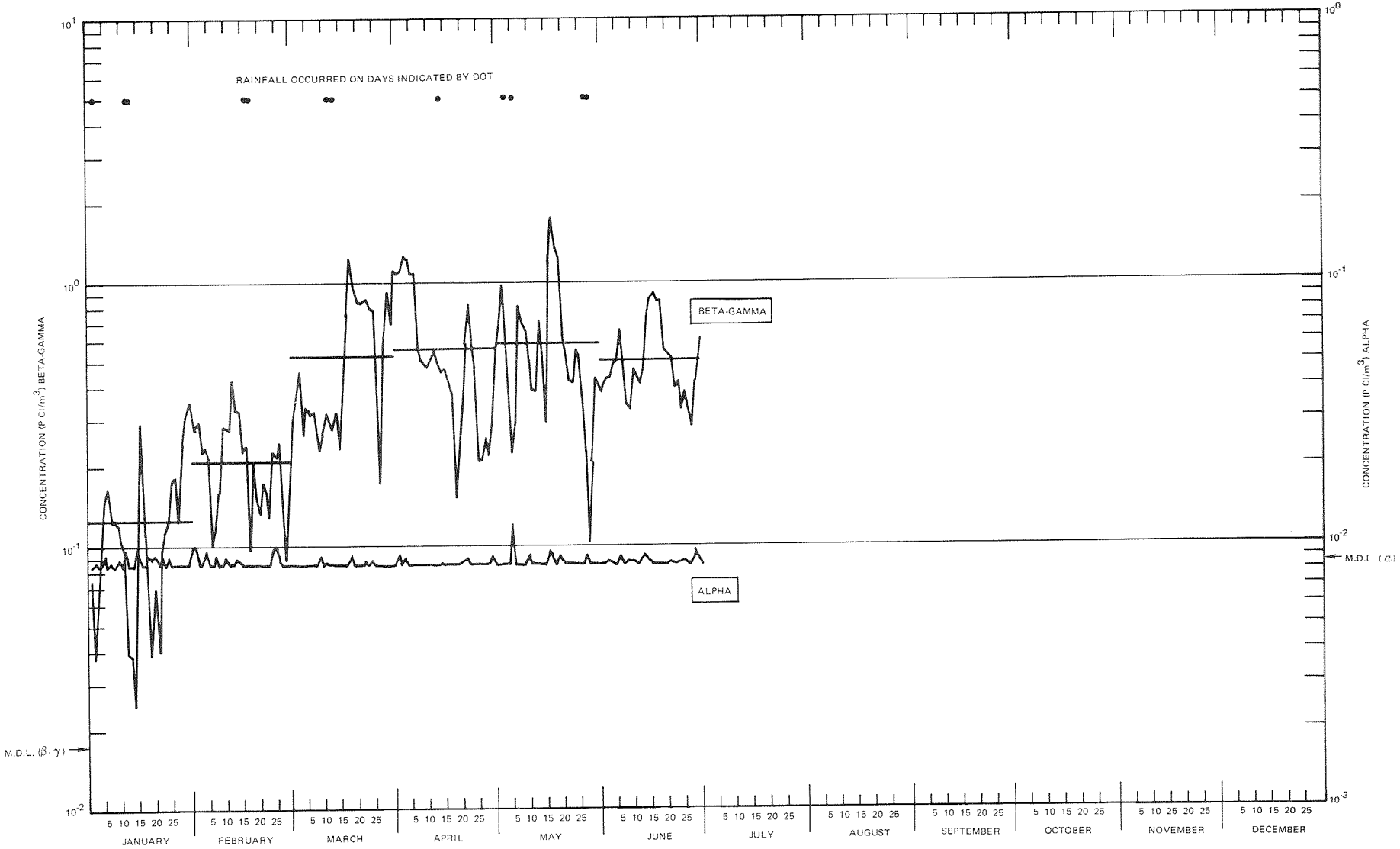

FIGURE 8. LONG-LIVED AIRBORNE RADIOACTIVITY HEADQUARTERS AND NDFL – 1971

Counting system efficiencies are determined routinely with RaD+E+F (with alpha absorber), Th^{230}, and U^{235} standard sources, and with K^{40} in the form of standard reagent grade KCl, which is used to simulate soil and vegetation samples. Self-absorption standards are made by dividing sieved KCl into samples increasing in mass by 200-milligram increments from 100 to 3000 milligrams. The samples are placed in copper planchets of the type used for environmental samples and counted. The ratio of sample activity to the observed net count rate for each sample is plotted as a function of sample weight (see Figure 9). The correction factor (ratio) corresponding to sample weight is obtained from the graph. The product of the correction factor and the net sample count rate yields the 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.

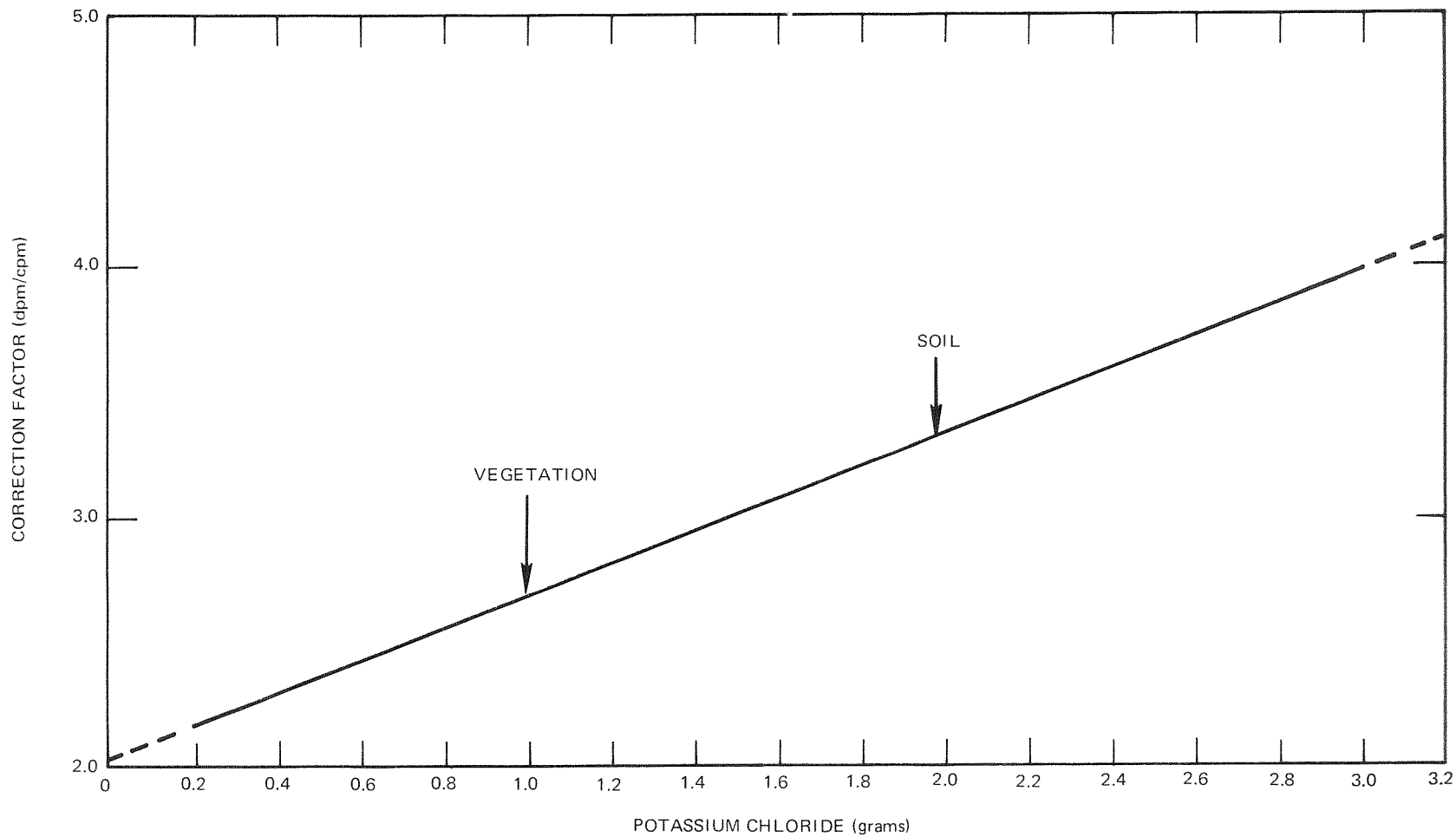

Figure 9. Sample Self-Absorption Correction Graph