ENVIRONMENTAL MONITORING
SEMIANNUAL REPORT
JULY 1, 1971 to DECEMBER 31, 1971
AND
ANNUAL REPORT
1971

by

J. D. MOORE

APPROVED: W. F. Heine

W. F. Heine
Manager
Operational Safety and
Waste Management

CONTENTS

Page

Abstract i

I. Summary 1

A. Environmental Radioactivity Data - 1971 5

B. Comparison of Environmental Radioactivity Data . . . 10
for 1971 with Previous Years

II. Environmental Monitoring Program 15

A. General Description 15

B. Sampling and Sample Preparation Methods 22

C. Counting and Calibration Procedures 24

TABLES

I. Soil Radioactivity Data - 1971 5

II. Vegetation Radioactivity Data - 1971 5

III. NDFL Process Water Radioactivity Data - 1971 6

IV. Bell Creek and Rocketdyne SSFL Reservoir. 7
Radioactivity Data - 1971

V. Chatsworth Reservoir Water Radioactivity 8
Data - 1971

VI. Airborne Radioactivity Data - 1971 8

VII. Site Perimeter Radiation Dosimetry Data - 1971 9

VIII. Soil Radioactivity Data- 1962 through 1971 10

IX. Vegetation Radioactivity Data - 1962 through 1971 11

X. NDFL Process Water Radioactivity Data 12
1962 through 1971

XI. Bell Creek and Rocketdyne SSFL Reservoir 13
Radioactivity Data - 1966 through 1971

XII. Chatsworth Reservoir Water Radioactivity 14
Data - 1962 through 1971

XIII. Airborne Radioactivity Data - 1962 through 1971 14

XIV. Sample Station Locations 16

XV. Minimum Radioactivity Detection Limits 24

FIGURES

1. Atomics International Headquarters 2

CONTENTS - FIGURES (continued)

2. Atomics International Nuclear Development Field Laboratory 3
3. Map of Headquarters and Nuclear Development Field Laboratory Environs 4
4. Map of Canoga Park, Simi Valley, Agoura, and Calabasas Sampling Stations 17
5. Map of Headquarters Vicinity Sampling Stations 18
6. Map of NDFL Sampling Stations 19
7. Map of Chatsworth Reservoir Sampling Stations 20
8. Long-Lived Airborne Radioactivity, Headquarters and NDFL 25
9. Sample Self-Absorption Correction Graph 27

ABSTRACT

Environmental monitoring at Atomics International is performed by the Operational Safety and Waste Management 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 sites. Site perimeters are monitored for radiation levels by means of thermoluminescent dosimeters. 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 miles radius of the sites, are referred to as "off-site" stations. The on-site environs of Atomic 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 presented in

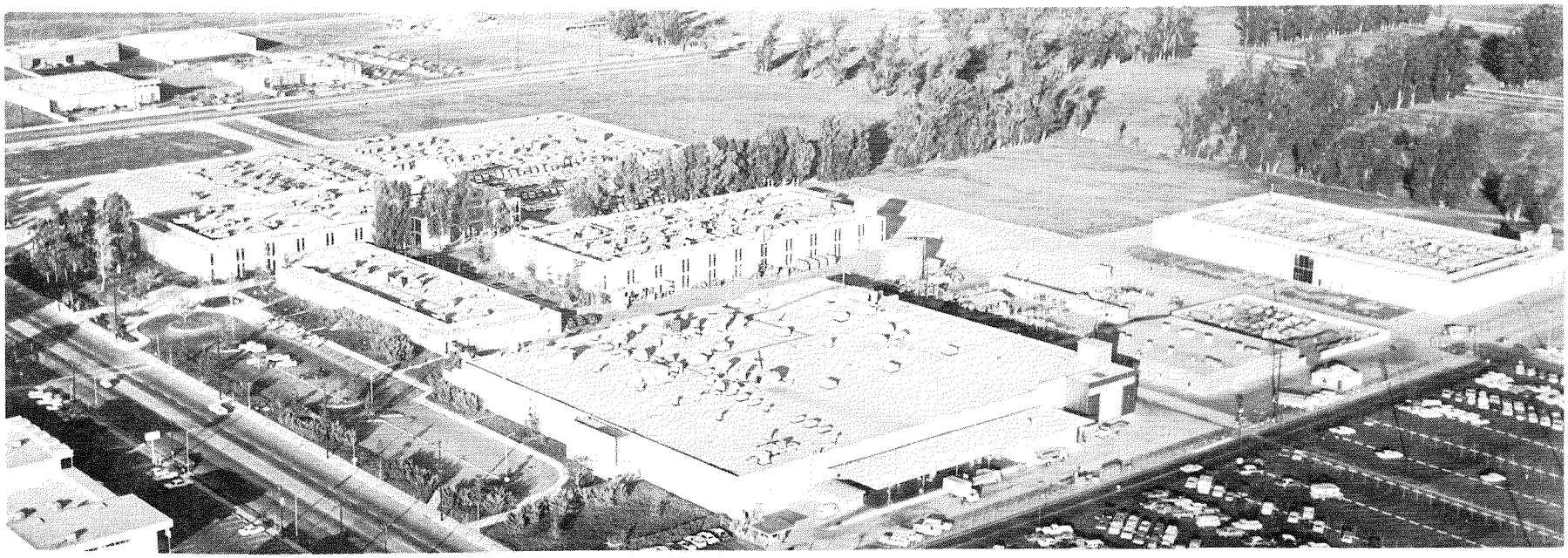

Figure 1. Atomics International Headquarters

Figure 2. Atomics International Nuclear Development Field Laboratory.

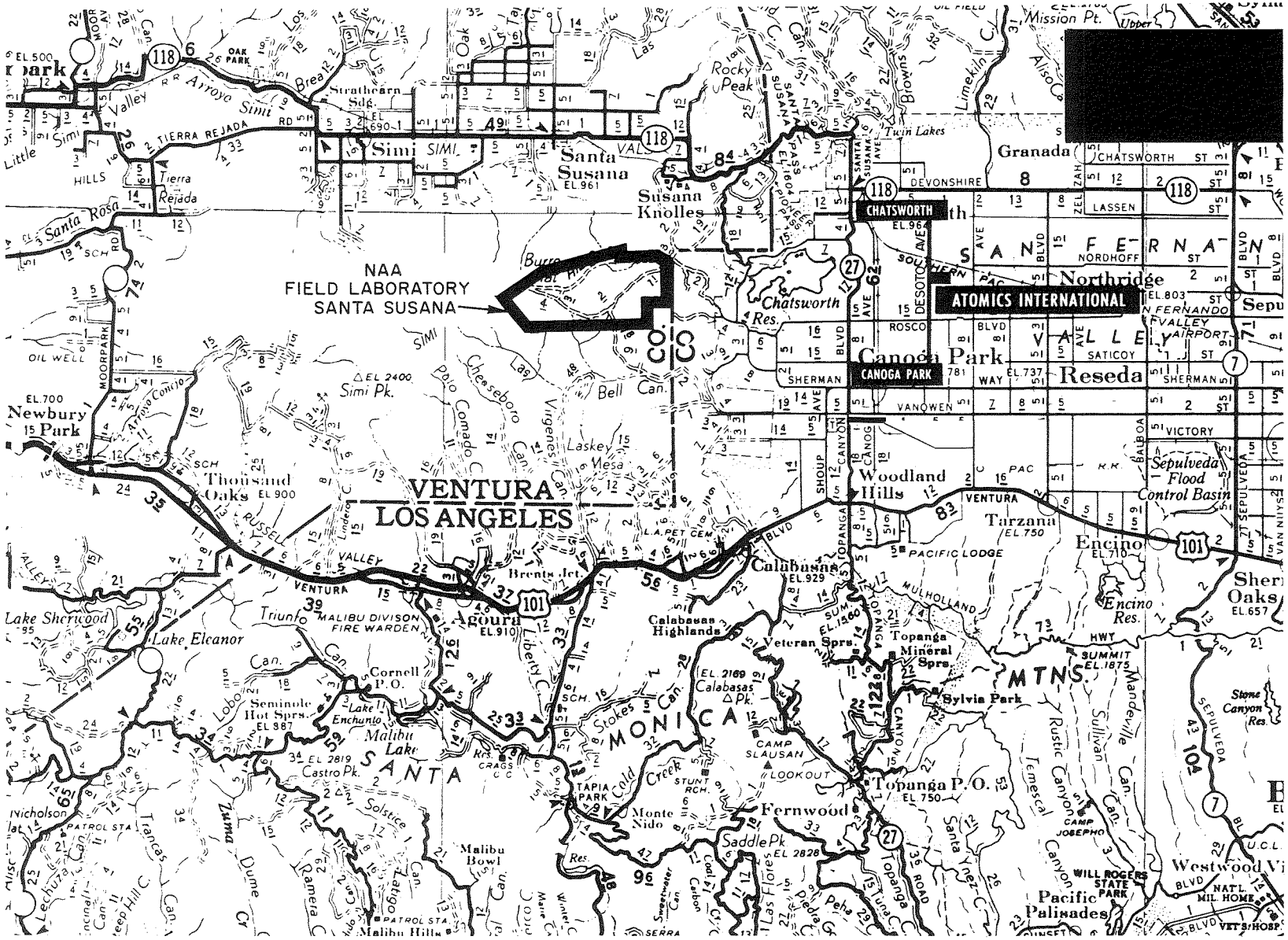

Figure 3. Map of Headquarters and Nuclear Development Field Laboratory Environs.

this report. This report summarizes environmental monitoring results for the last six months of 1971 and compares the 1971 results with previous years.

A. ENVIRONMENTAL RADIOACTIVITY DATA - 1971

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

TABLE I

SOIL RADIOACTIVITY DATA - 1971

Area	Activity	First Half - 1971		Last Half - 1971	
		No. Samples	Average pCi/gram	No. Samples	Average pCi/gram
On Site	α	72	0.57	72	0.55
	$\beta\gamma$	72	25	72	25
Off Site	α	24	0.55	24	0.50
	$\beta\gamma$	24	24	24	23

TABLE II

VEGETATION RADIOACTIVITY DATA - 1971

Area	Activity	First Half - 1971		Last Half - -971	
		No. Samples	Average pCi/gram-ash	No. Samples	Average pCi/gram-ash
On Site	α	72	0.23 to 0.27	72	0.19 to 0.22
	$\beta\gamma$	72	165	72	164
Off Site	α	24	0.25 to 0.28	24	0.32 to 0.35
	$\beta\gamma$	24	134	24	130

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 - 1971

Area	Activity	First Half - 1971		Last Half - 1971	
		No. Samples	Average pCi/liter	No. Samples	Average pCi/liter
NDFL	α	12	0.30 to 0.35	12	0.20 to 0.28
	$\beta\,\gamma$	12	4.9	12	4.8

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 - 1971

Sample Description	First Half - 1971			Last Half - 1971		
	No. Samples	α	$\beta\gamma$	No. Samples	α	$\beta\gamma$
Bell Creek Mud 54 (pCi/gram)	6	0.31	23	6	0.40	23
Bell Creek Vegetation 54 (pCi/gram-ash)	6	0.19	161	6	0.20	96
Bell Creek Water 16 (pCi/liter)	6	0.14 to 0.27	3.9	6	0 to 0.20	3.7
Reservoir Station 6 Water (pCi/liter	6	0.22 to 0.25	6.1	6	0.04 to 0.21	6.2
Reservoir Station 12 Water (pCi/liter)	6	0.07 to 0.24	6.2	6	0.10 to 0.24	6.5

Soil, vegetation, and water are sampled 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, II, VIII, and IX. 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 water sampling since that time. Also, construction at the supply water outfall has precluded water sampling at that location during most of the reporting period. The average radioactivity concentration in reservoir supply water is presented in Table V.

TABLE V

CHATSWORTH RESERVOIR WATER RADIOACTIVITY DATA - 1971

Sample Type	Activity	First Half - 1971		Last Half - 1971	
		No. Samples	Average pCi/liter	No. Samples	Average pCi/liter
Lake Surface	α	0	--	0	--
	$\beta\gamma$	0	--	0	--
Supply Inlet	α	6	0.47 to 0.50	2	0.26
	$\beta\gamma$	6	6.1	2	6.3

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 - 1971

Location	Activity	First Half - 1971		Last Half - 1971	
		No. Samples	Average pCi/m^3	No. Samples	Average pCi/m^3
Head-quarters	α	362	0.0087	368	0.0087
	$\beta\gamma$	362	0.40	368	0.20
NDFL	α	1249	0.0086	1227	0.0086
	$\beta\gamma$	1249	0.44	1227	0.22

Site perimeter 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 - 1971

Location	First Half - 1971		Last Half - 1971 **	
	Dose mRem	Average Dose Rate mRem/hour	Dose mRem	Average Dose Rate mRem/hour
TLD-1	97	0.024	102	0.044
TLD-2	67	0.016	80	0.034
TLD-3	90	0.022	42	0.018
TLD-4	99	0.024	416	0.179
TLD-5	81	0.020	42	0.018
TLD-6	84	0.021	32	0.014
TLD-7	99	0.024	48	0.021
TLD-8	108	0.027	51	0.022
TLD-9	39*	0.018	35	0.015
TLD-10	132	0.032	42	0.018

* Second Quarter only

** Fourth Quarter only - TLD reader malfunction resulted in anamolous data.

Table I shows slight decreases in soil radioactivity during the last six months of 1971. Table II shows a decrease in vegetation radioactivity, although off-site alpha radioactivity increased slightly. Table III shows that NDFL process water radioactivity also decreased slightly. Table IV shows that Bell Creek mud beta-gamma radioactivity did not change and that vegetation and water beta-gamma radioactivity decreased. Alpha radioactivity increased in mud and vegetation and decreased in Bell Creek water. Table IV also shows decreased alpha radioactivity in reservoir Station 6 water, no significant change in reservoir Station 12 water alpha radioactivity, and slight increases in beta-gamma radioactivity in water for both sample stations. Table V shows a decrease in Chatsworth Reservoir's supply water alpha radioactivity and a slight increase in beta-gamma radioactivity. Table VI shows a significant decrease in airborne beta-gamma radioactivity during the last half of 1971. Table VII shows that site perimeter radiation levels are generally equivalent to the natural background radiation levels.

B. COMPARISON OF ENVIRONMENTAL RADIOACTIVITY DATA FOR 1970 WITH PREVIOUS YEARS

This section summarizes the environmental monitoring results for the calendar year 1971. Also, annual averages for the years 1962 through 1971 are included with the exception of the Rocketdyne Reservoir and Bell Canyon. The annual average radioactivity in soil and vegetation is presented in Tables VIII and IX.

TABLE VIII

SOIL RADIOACTIVITY DATA 1962 THROUGH 1971

VIII a. ALPHA RADIOACTIVITY

Year	On Site		Off Site	
	No. Samples	Average pCi/gram	No. Samples	Average pCi/gram
1971	144	0.55	48	0.53
1970	144	0.47	48	0.48
1969	144	0.42	48	0.42
1968	144	0.47	48	0.48
1967	144	0.41 to 0.42	48	0.38 to 0.39
1966	144	0.40 to 0.41	48	0.43 to 0.44
1965	144	0.46	142	0.46 to 0.47
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

TABLE VIII

SOIL RADIOACTIVITY DATA 1962 THROUGH 1971

VIII b. BETA-GAMMA RADIOACTIVITY

Year	On Site		Off Site	
	No. Samples	Average pCi/gram	No. Samples	Average pCi/gram
1971	144	25	48	23
1970	144	27	48	25
1969	144	27	48	25
1968	144	26	48	26
1967	144	28	48	24
1966	142	29	48	25
1965	144	36	142	29
1964	146	32	293	26
1963	156	45	455	42
1962	147	48	453	47

TABLE IX

VEGETATION RADIOACTIVITY DATA - 1962 THROUGH 1971

IX a. ALPHA RADIOACTIVITY

Year	On Site		Off Site	
	No. Samples	Average pCi/gram - ash	No. Samples	Average pCi/gram-ash
1971	144	0.21 to 0.24	48	0.28 to 0.31
1970	144	0.33	48	0.30
1969	144	0.40	48	0.36
1968	144	0.51	48	0.51
1967	144	0.61 to 0.62	48	0.38 to 0.39
1966	144	0.37	48	0.37
1965	144	0.55 to 0.56	142	0.61
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

TABLE IX

VEGETATION RADIOACTIVITY DATA - 1962 THROUGH 1971

IX b. BETA-GAMMA RADIOACTIVITY

Year	On Site		Off Site	
	No. Samples	Average pCi/gram-ash	No. Samples	Average pCi/gram-ash
1971	144	165	48	132
1970	144	159	48	142
1969	144	165	48	144
1968	144	158	48	205
1967	144	286	48	413
1966	144	169	48	123
1965	144	162	142	138
1964	148	211	299	181
1963	156	465	456	388
1962	147	500	453	406

The annual average radioactivity in NDFL process water is presented in Table X.

TABLE X

NDFL PROCESS WATER RADIOACTIVITY DATA - 1962 THROUGH 1971

Year	Alpha		Beta-Gamma	
	No. Samples	Average pCi/liter	No. Samples	Average pCi/liter
1971	24	0.25 to 0.32	24	4.9
1970	24	0.15 to 0.20	24	5.3
1969	24	0.11	24	5.0
1968	24	0.16	24	5.0
1967	24	0.12 to 0.13	24	6.1
1966	24	0.12 to 0.13	24	4.4 to 4.8
1965	24	0.21 to 0.22	24	5.9 to 6.0
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

TABLE XI

BELL CREEK AND ROCKETDYNE SSFL RESERVOIR RADIOACTIVITY DATA

Sample	Bell Creek Mud 54			Bell Creek Vegetation 54			Bell Creek Water 16			Reservoir No. 6 Water			Reservoir No. 12 Water		
	No.	pCi/gram		No.	pCi/gram-ash		No.	pCi/liter		No.	pCi/liter		No.	pCi/liter	
Year		α	$\beta\gamma$		α	$\beta\gamma$		α	$\beta\gamma$		α	$\beta\gamma$		α	$\beta\gamma$
1971	12	0.36	23	12	0.19	128	12	0.07 to 0.24	3.8	12	0.13 to 0.23	6.2	12	0.09 to 0.24	6.4
1970	12	0.44	24	12	0.23	165	12	0.11 to 0.19	3.7	12	0.12 to 0.18	6.9	12	0.08 to 0.15	7.4
1969	12	0.34 to 0.36	27	12	0.28	166	12	0.04	3.8 to 4.2	12	0.06 to 0.08	5.9	11	0.10	5.7
1968	11	0.32	24	11	0.39	170	8	0.04 to 0.06	4.5 to 4.8	11	0.23	8.1	12	0.33	7.7
1967	12	0.40	24	12	0.37 to 0.38	180	12	0.06 to 0.08	5.7 to 5.9	12	0.19	6.6	10	0.16 to 0.17	7.0
1966	3	0.39	25	3	1.12 to 1.14	108	3	0.60 to 0.90	0 to 2.5	9	0.10 to 0.12	5.8	8	1.0 to 1.1	6.3

The annual average radioactivity in the Bell Creek and Rocketdyne SSFL Reservoir samples is presented in Table XI.

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

TABLE XII

CHATSWORTH RESERVOIR WATER RADIOACTIVITY DATA
1962 THROUGH 1971

Year	Lake Surface			Supply Inlet		
	No. Samples	Average pCi/liter		No. Samples	Average pCi/liter	
		α	$\beta\gamma$		α	$\beta\gamma$
1971	0	-	-	8	0.43	6.1
1970	0	-	-	12	0.36	5.4
1969	8	0.33	6.6	12	0.13	5.4
1968	12	0.32	7.0	12	0.23	4.6 to 4.8
1967	12	0.31	8.1	12	0.28	6.0
1966	12	0.32	5.9	12	0.42	5.9
1965	11	0.65	8.7	12	0.61	8.8 to 9.1
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

The annual average concentrations of long-lived airborne radioactivity at Headquarters and the NDFL are presented in Table XIII.

TABLE XIII a.

AIRBORNE RADIOACTIVITY DATA

ALPHA RADIOACTIVITY

Year	Headquarters		NDFL	
	No. Samples	Average pCi/m^3	No. Samples	Average pCi/m^3
1971	730	0.0087	2476	0.0086

TABLE XIII b.

BETA-GAMMA RADIOACTIVITY

	Headquarters		NDFL	
Year	No. Samples	Average pCi/m^3	No. Samples	Average pCi/m^3
1971	730	0.30	2476	0.33
1970	668	0.34	2434	0.36
1969	687	0.27	2364	0.26
1968	650	0.32	2157	0.32
1967	712	0.38 to 0.40	2400	0.40 to 0.41
1966	706	0.17 to 0.18	2205	0.16 to 0.17
1965	483	0.83	1062	0.21
1964	355	2.7	Insufficient Data	
1963	360	6.6	292	4.7
1962	343	7.3	314	5.6

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 XV.

Radioactivity concentrations in most sample types are generally commensurate with the concentrations experienced in 1970, with the general trend in radioactivity concentration levels to be downward. The environmental sample radioactivity concentrations reported and discussed herein are 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 sample 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 Flat 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 XIV.

TABLE XIV

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. 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 Bldg. 022, NDFL
SV-19	Santa Susana Site Entrance, Woolsey Canyon
SV-24	Atomics International Headquarters
SV-25	DeSoto Avenue and Plummer Street
SV-26	Mason Avenue and Nordhoff Street
SV-27	DeSoto Avenue and Parthenia Street
SV-28	Canoga Avenue and Nordhoff Street
SV-31	Simi Valley, Alamo Avenue and Sycamore Rd.
SV-40	Agoura - Kanan Road and Ventura Freeway
SV-41	Calabasas - Parkway Calabasas and Ventura Freeway
SV-42	Non-Radioactive Materials Disposal Area, NDFL

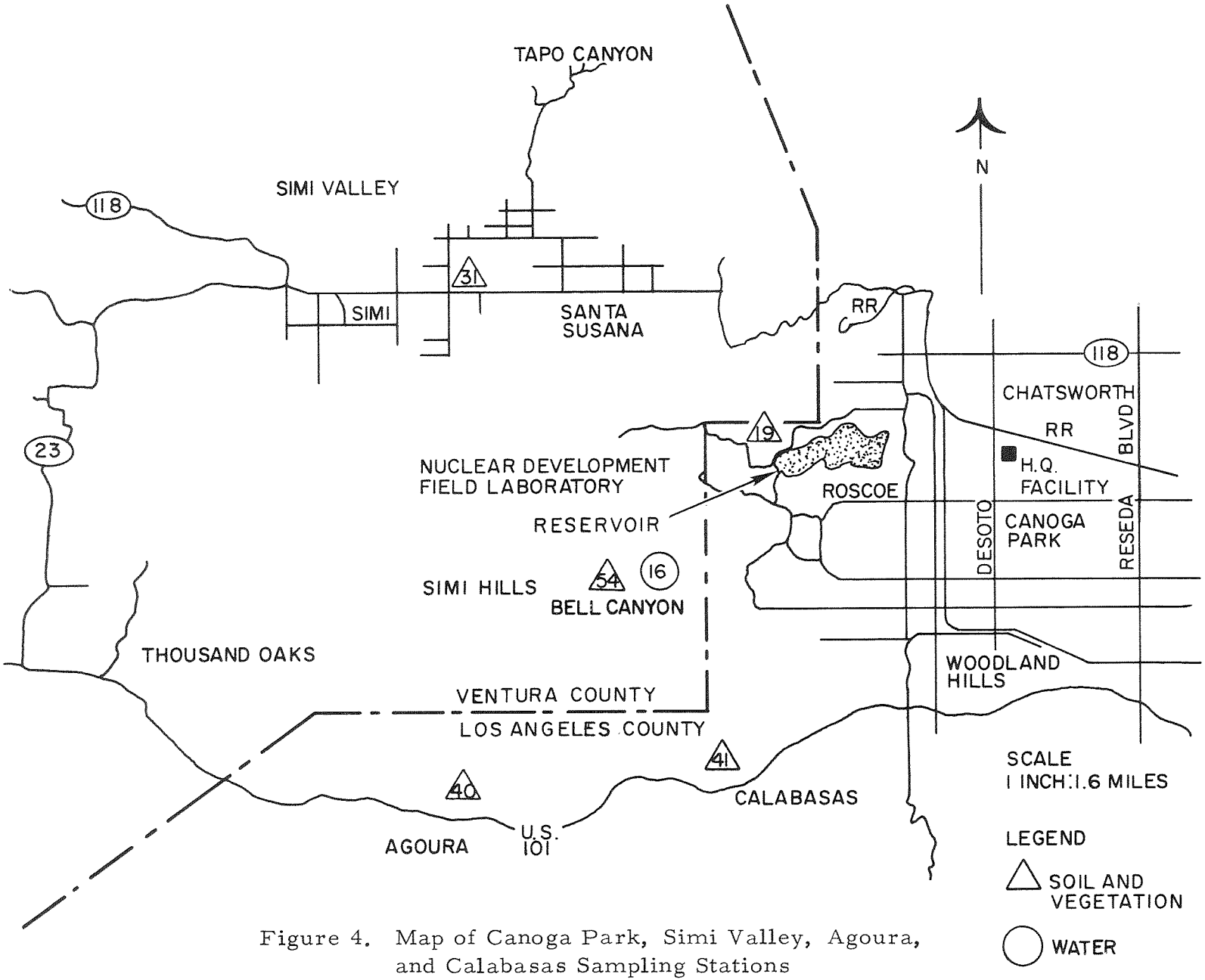

Figure 4. Map of Canoga Park, Simi Valley, Agoura, and Calabasas Sampling Stations

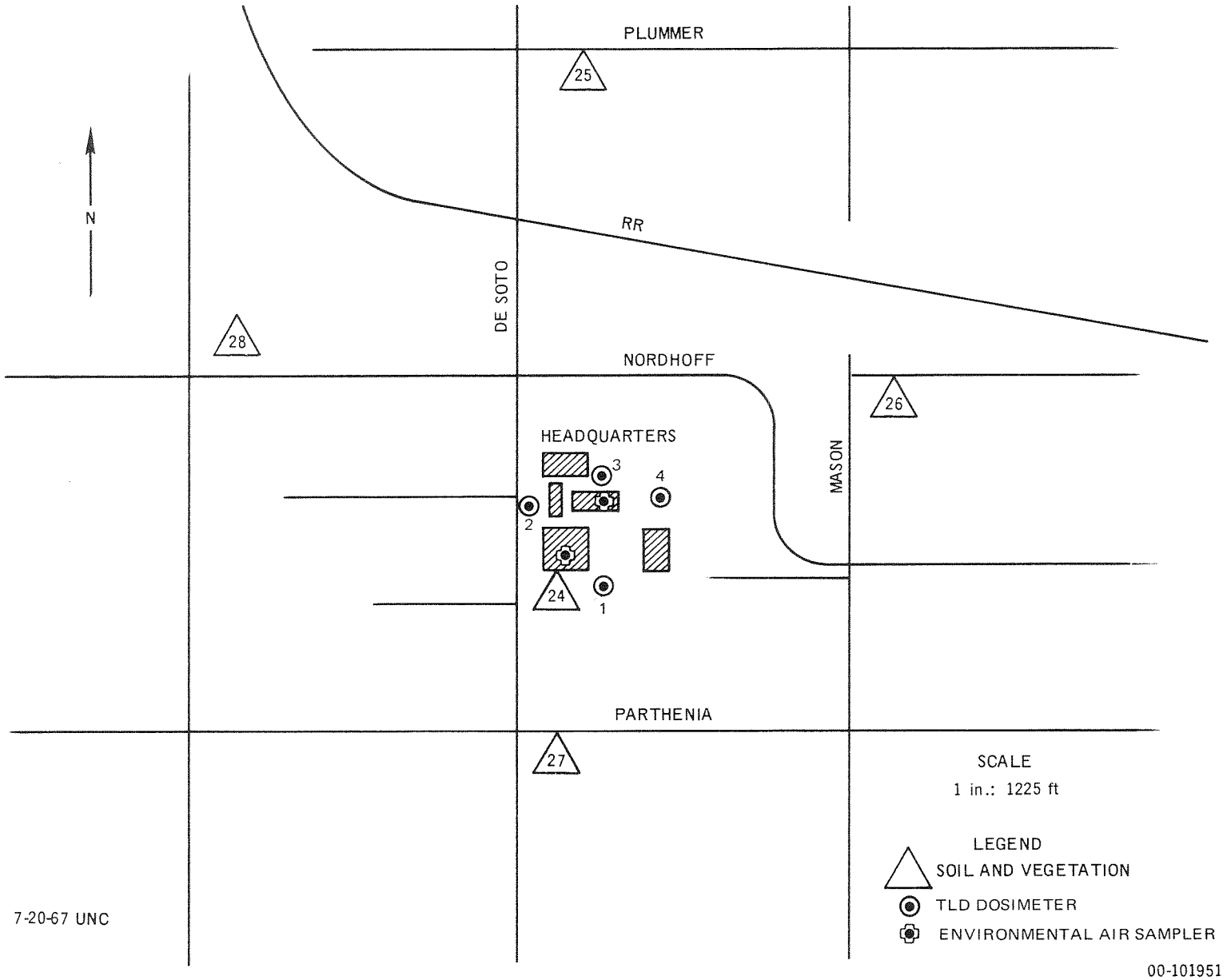

Figure 5. Map of Headquarters Vicinity Sampling Stations

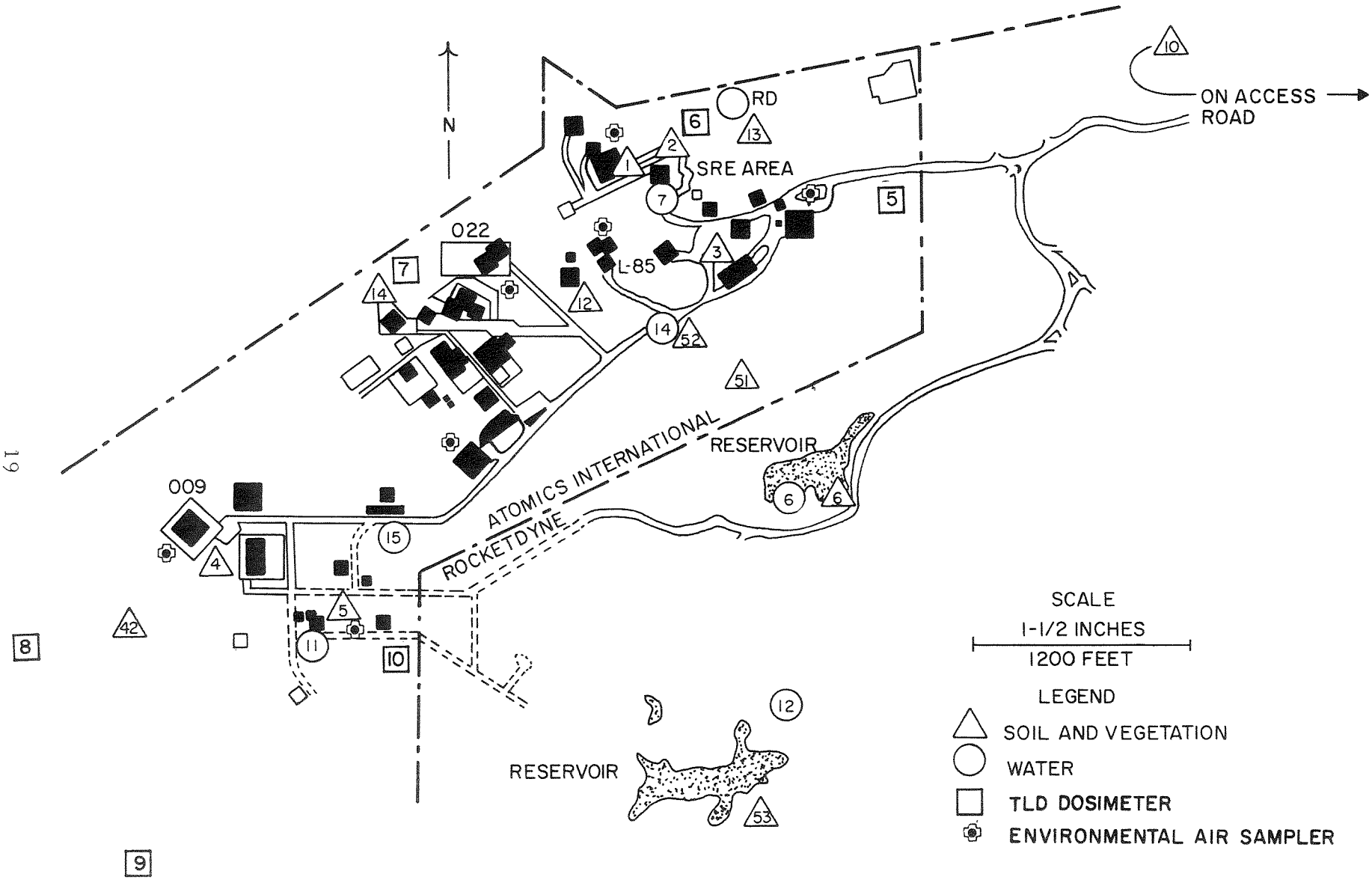

Figure 6. Map of NDFL Sampling Stations

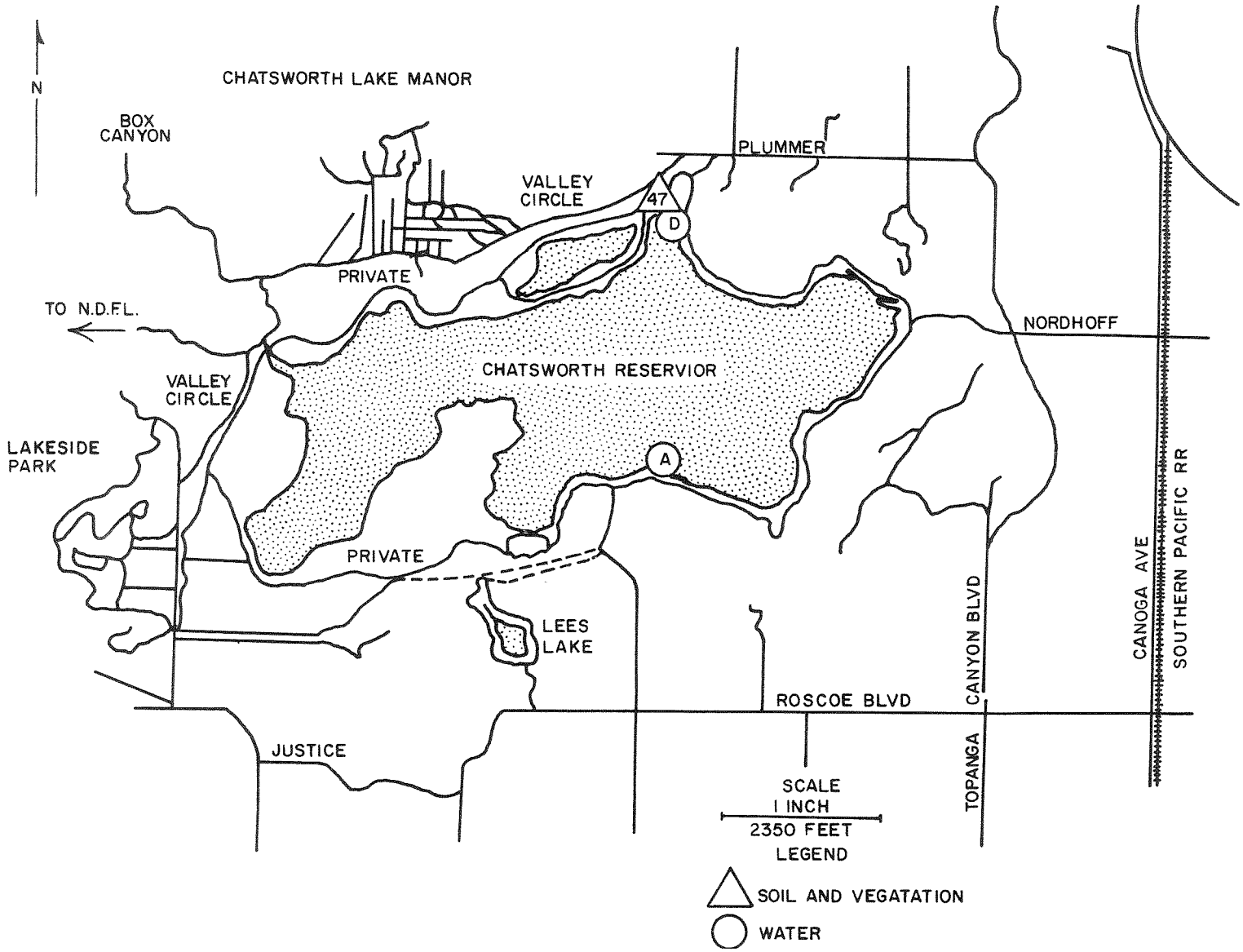

Figure 7. Map of Chatsworth Reservoir Sampling Stations

TABLE XIV (Continued)

STATION	LOCATION
SV-47	Chatsworth Reservoir, North Side
SV-51	Bldg. 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 Bldg. 003, NDFL
W-11	Process Water from Bldg. 363, NDFL
W-12	Rocketdyne Reservoir, SSFL
W-16	Bell Creek
W-A	Chatsworth Reservoir surface, South Side
W-D	Chatsworth Reservoir, Supply Inlet
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 No. 1, Building 201
TLD-4	Atomics International Headquarters, East Fence Gate

TABLE XIV (Continued)

STATION	LOCATION
TLD-5	Building 113, NDFL
TLD-6	SRE Retention Dam, NDFL
TLD-7	Electric Sub-Station No. 719, NDFL
TLD-8	Property Line Gate, West End of H. Street, NDFL
TLD-9	Water Tank No. 701, NDFL
TLD-10	Building 854, NDFL

SV - Soil and Vegetation Sample Station

W - Water Sample Station

A - Air Sample Station

TLD - Thermoluminescent Dosimeter Location

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 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, dried, and counted.

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. The vegetation ash is wetted in the planchet with alcohol, evenly distributed to obtain uniform sample thickness, dried, and counted.

WATER

Water samples 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, re-dried under heat 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 short-lived isotopes other than naturally occurring radon, thoron, and daughters. If fallout 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 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 concentration trend through the Spring months and diminshing through Fall. Prominent peaks are noted in May and in November.

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 XV 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 minimum 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 XV

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

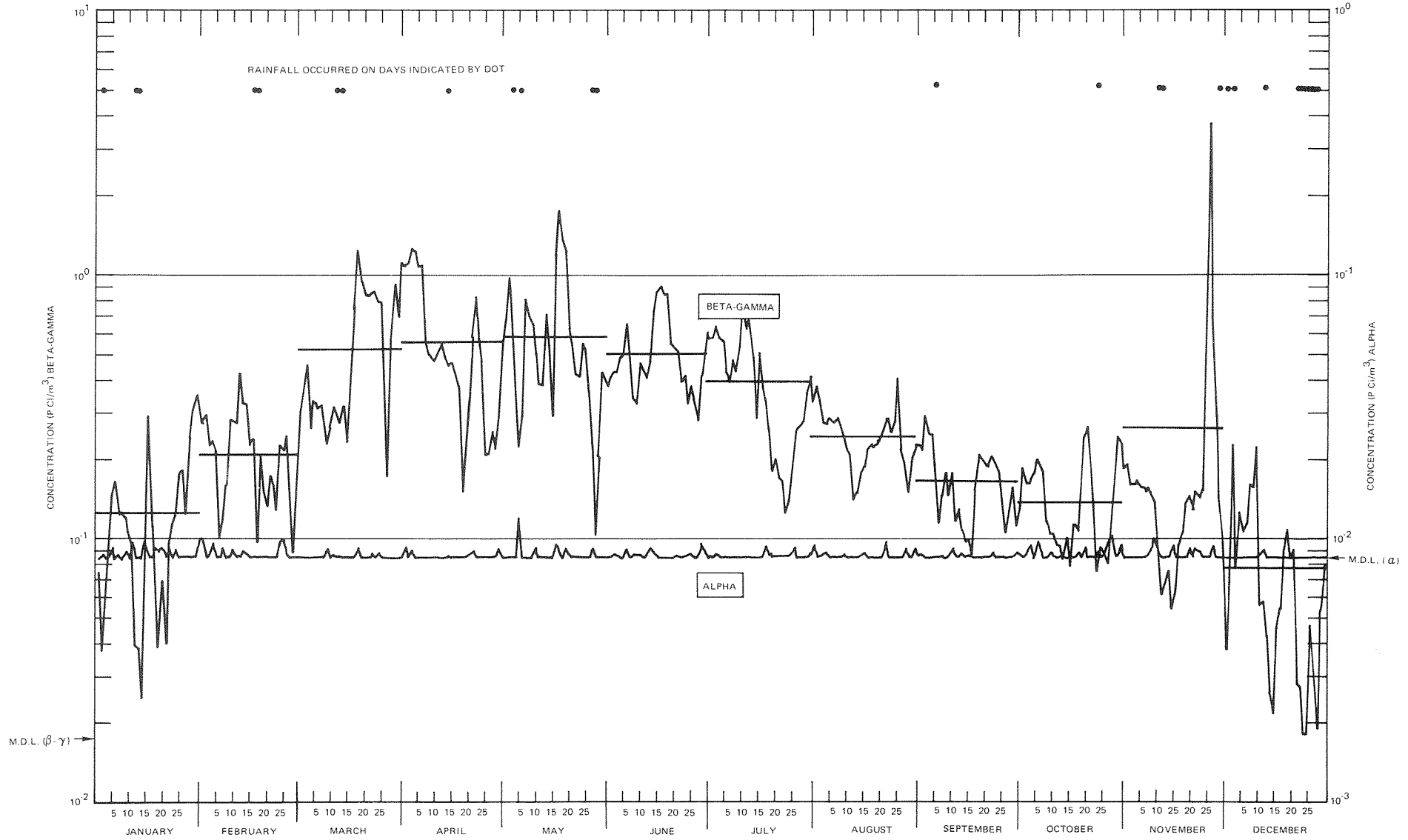

FIGURE 8. LONG-LIVED AIRBORNE RADIOACTIVITY HEADQUARTERS AND NDFL – 1971

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.

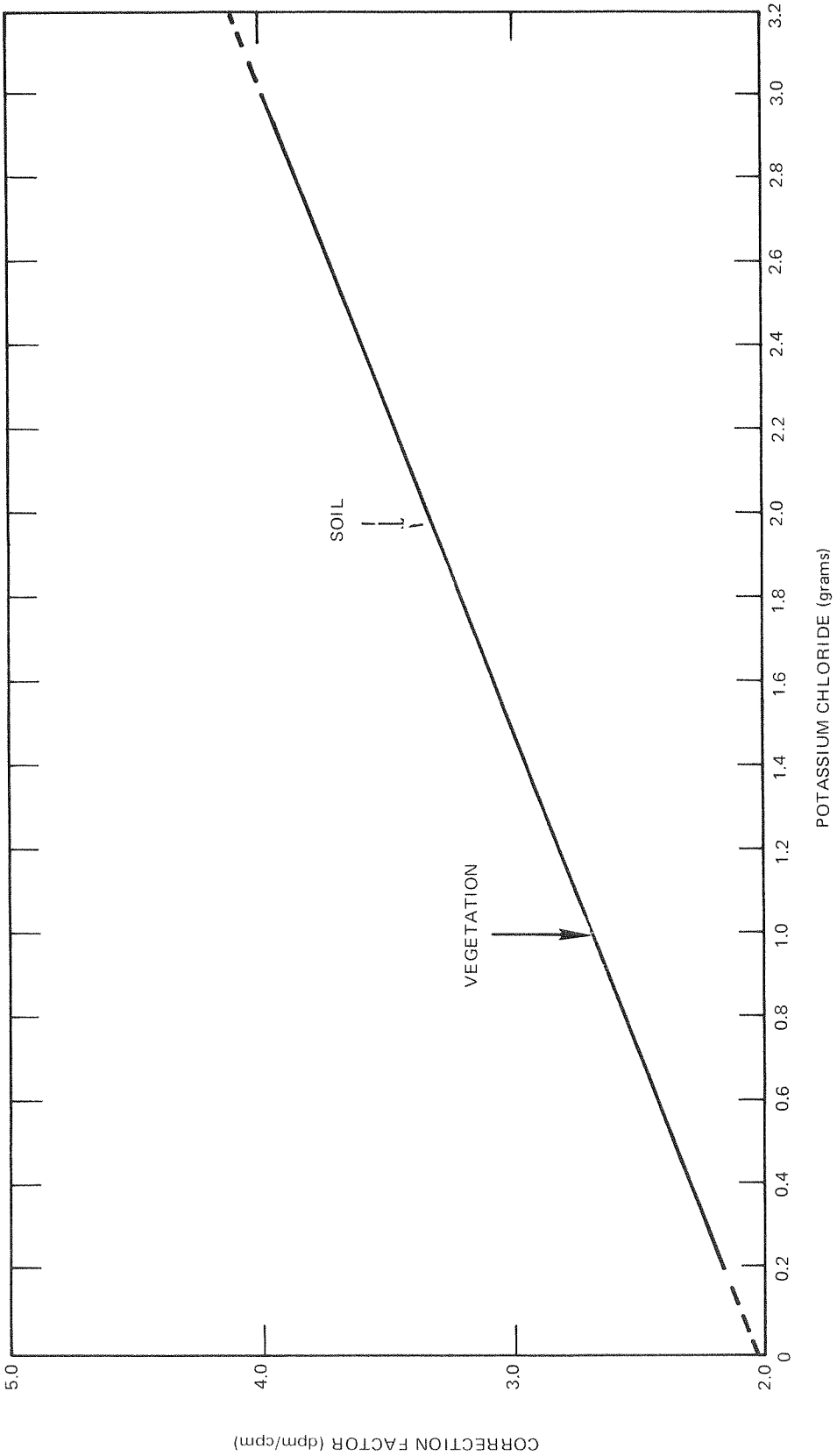

Figure 9. Sample Self-Absorption Correction Graph