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4451

ENVIRONMENTAL RADIOACTIVITY

AT THE NEVADA TEST SITE

JULY 1965 THROUGH JUNE 1966

#50

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RADIOLOGICAL SCIENCES DEPARTMENT
SITE FACILITIES DIVISION
REYNOLDS ELECTRICAL & ENGINEERING CO., INC.

ENVIRONMENTAL RADIOACTIVITY

AT THE

NEVADA TEST SITE

JULY 1965 THROUGH JUNE 1966

by

The staff of

The Environmental Surveillance
Group

RADIOLOGICAL SCIENCES DEPARTMENT
SITE FACILITIES DIVISION

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LEGAL NOTICE

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INTRODUCTION

This report contains a summary of the data obtained concerning the radiological conditions in the environment of the Nevada Test Site (NTS), performed under contract to the AEC by the Radiological Sciences Department of the Reynolds Electrical & Engineering Co., Inc.

The Environmental Surveillance Branch performs routine radiation surveys using portable instruments in non-radiation zone areas of the Test Site such as living quarters, administrative buildings, and cafeterias. Surface swipes and samples of air and water are collected for laboratory analysis. Additionally, samples of water from waste ponds, sewage basins, reservoirs, springs, and wells are collected on a routine basis to determine normal levels of radioactivity or any changes of radioactivity. Air, soil, and vegetation samples are also routinely collected at selected locations throughout NTS for the same purpose as the water samples. All environmental samples are analyzed routinely for gross alpha and beta radioactivity. Significant increases or changes in the radioactivity levels of these samples are reported to the appropriate field monitoring groups for investigation and remedial action where appropriate. All samples are documented by the Environmental Surveillance Branch for record purposes and for comparison with previous results to determine trend and correlation where feasible.

This report presents the data derived from the sampling program for the period July 1965 through June 1966.

SECTION 1

AIR SAMPLING

1.1 Introduction

The Environmental Surveillance Branch maintains low-volume, constantly-operating air samplers at 14 permanent locations (Figure 1 and Table 1) placed to provide monitoring of the particulate airborne contamination within the Nevada Test Site (NTS) boundaries.

1.2 Description of Equipment

The sampling equipment used consists of a positive displacement Gast pump that pulls air through a 4" (Whatman 41) filter paper which is mounted in a disposable plastic filter head. A dry gas meter is utilized to measure the total volume of displaced air over a period of seven days. The total volume of air sampled during a regular seven day sampling period is approximately 1×10^3 cubic meters (m^3). The flow rate of air through the filter is maintained at approximately four cubic feet/minute.

1.3 Counting Procedures

All collected air samples were held in storage for at least five days before counting. This time interval allows the naturally occuring radon and thoron daughters to decay to insignificant levels. Air samples were analyzed for gross alpha and beta using a Nuclear Chicago ULTRASCALER gas proportional system having an efficiency (the ratio of observed counts to known disintegrations) of 22% for alpha and 51% for beta. Background counts for alpha and beta on this instrument were determined by counting for 100 minutes. The samples were counted for 20 minutes. A Baird Atomic SPECTROMETER was used in determining gross gamma activity. If the activity for gamma was such that the apparent 2σ counting error was less than 50%, then the sample was transferred to a 400-channel gamma-spectrum analyzer to qualitatively determine the contributing radionuclides.

Sample activity results, reported by the Radiological Measurement Laboratory, were compared with an established "alert level". The determination of the alert level is based on the maximum permissible concentrations of unknown radionuclides in air for a period of 168 hours, (MPCU)a as outlined in the National Bureau of Standards Handbook 69, page 94. The alert level for beta has been maintained at 1×10^{-11} μCi/cc of air after a five day decay period and at 1×10^{-14} μCi/cc for alpha activity. Though a sample may exceed this alert level, it does not necessarily mean that the actual MPC has been exceeded. Whenever a sample does approach or exceed this established guide, more intensive sampling and more involved analyses are performed to determine if the contamination is valid.

1.4 Data Discussion

The means and ranges of gross beta radioactivity in weekly collections of air samples from the 14 permanent locations from July 1965 through June 1966 are tabulated in Table 2 and plotted in Figure 2. During this fiscal year (July 1965 through June 1966) no sample activity value exceeded the "alert level" of 1×10^{-11} μCi/cc in air. The highest value recorded for beta radioactivity occured in the air sample collected from Area 18 Camp 17 (Figure 1) for the first week in June, 1966. This value, 3.93×10^{-12} μCi/cc, is below the established limit. Fluctuations for this fiscal year followed a trend of decrease in activity values during July through December which were periods of reduced testing operations and an obvious increase from March through June which coincided with a period of intensive testing at both the Nuclear Reactor Development Station (NRDS) and NTS. During this latter period of intensive testing, some detonations occurred which released radioactivity to the atmosphere. Additions of contamination to the environment occured when tests were conducted with the nuclear reactors at NRDS.

Figure 3 and Table 3 show the plotted means and ranges for each of the mean values of all 14 sampling locations averaged 1.37×10^{-13} μCi/cc. This value is lower than the mean value observed for all samples collected for the previous year which averaged 6.6×10^{-13} μCi/cc.[1]

The highest observed mean value for a sampling location was 2.19×10^{-13} μCi/cc at Area 18, Camp 17 and the lowest was 7.75×10^{-14} μCi/cc at Area 25, NRDS. The wide range of values encountered during this sampling period, as shown in Figure 3 and Table 3 (greater than a factor of 100), was the result of a single high or low value. These extreme values did not drastically effect the mean due to logarithmic transformation of the observed activity results. (The statistical treatment of data for this report is presented in Appendix A).

Detectable alpha activity values for air during this period occurred infrequently and at isolated locations. Though 48% of the total number of air samples collected during this report period showed activity levels over background, a statistical summary of this data would not be meaningful because of the uncertainty associated with results uncorrected for self absorption and the low activity values which result in a high relative 2σ counting error.

Routine gamma counting of all environmental air filters was initiated in February 1966. The majority of air samples which were counted for gross gamma during part of this report period indicated levels less than background. Except for the sampling period ending the first week in June, when all stations indicated the presence of short-lived gamma emitting radionuclides, all other isolated cases were associated with an individual test operation. Gamma spectrum and decay analyses of these samples in June indicated that their origin was from a nuclear detonation on the Chinese mainland on May 9, 1966. In all cases, the presence of gamma emitting radionuclides, as determined qualitatively by spectrum analysis, did not pose a health hazard due to failure of identification in the succeeding week's samples.

The observed mean of gross beta radioactivity for a total of 613 air samples collected this year was 1.37×10^{-13} μCi/cc. For the same sampling period during the previous year, it was 6.6×10^{-13} μ Ci/cc and 1×10^{-12} μCi/cc for the semi-annual period, January through June 1964.[2]

1.5 Summary

These results indicate a gradual decrease in mean values since preceding periods. This can be attributed to a number of contributing variables: less intensive testing operations, fewer venting problems, refined air volume measurements, more careful laboratory preparation methods, and improved counting procedures.

Results of environmental surveillance air sampling activity values obviously cannot be used in calculating exposure doses. They are instead used in the determination of trends, and emphasis is either sustained or shifted to other sample types whenever a significant increase in levels is noted.

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[1]Lewis, Gary B., Glora, Michael A., and Aoki, Isamu, "Environmental Radioactivity at the Nevada Test Site, July 1965 through June 1966," NVO-162-18, Radiological Sciences Department, Reynolds Electrical & Engineering Co., Inc. December 1965.

[2]Glora, M. A. and Brown, B. L. "Environmental Surveillance, January-June 1965: A Semiannual Report." NVO-162-16. Reynolds Electrical & Engineering Co., Inc., Radiological Sciences Department. August 1964.

SECTION 2

WATER SAMPLING

2.1 Introduction

Water samples were collected from selected waste ponds, reservoirs, sewage basins, natural springs, and potable water sources, such as cafeterias, swimming pools, etc., on a "grab sample" basis.

2.2 Collection Methods

Water samples were collected in one liter glass bottles on a weekly, monthly, and special basis depending upon the potential for radioactive contamination. The potable water samples were collected from taps at the point of consumption after allowing the water to run for a length of time. All industrial reservoir waters were collected near the inlet points of the reservoirs; while the natural spring waters were "grab" samples taken by dipping at the surface.

2.3 Sample Preparation

All water samples were prepared for gross alpha, beta, gamma, and tritium analyses. A 15 ml aliquot was first taken from the original sample in a 5 dram plastic vial and submitted to the counting laboratory to be gamma scanned. A 1 ml sample was taken for tritium analysis which was performed using standard liquid scintillation counting techniques. The remainder of the one-liter sample was evaporated to 15 ml, transferred to a two-inch stainless steel planchet, and evaporated to dryness under infra-red lamps. A wetting agent was added during final evaporation to provide even distribution of the sample on the planchet. From the preparations laboratory, the samples were sent to the counting laboratory and counted for alpha and beta.

2.4 Counting Procedures

All routine environmental samples were analyzed for gross alpha and beta radioactivity by gas proportional counting. The water samples were analyzed by a Beckman WIDEBETA system equipped with an automatic sample changer. The efficiencies, i.e., the ratio of observed counts to known disintegrations, on the WIDEBETA system, were 27% for alpha and 57% for beta. The average background count rate was 0.03 counts per minute for alpha and 1.8 counts per minute for beta.

The tritium analyses were performed using a Packard Tri-Carb Liquid Scintillation Spectrometer with an efficiency of 18% and an average background of 16 counts per minute.

2.5 Statistical Summary of Results for Water

2.5.1 Industrial Water Samples

Industrial water is used for construction and maintenance operations, such as watering roads, washing down equipment, drilling wells, and other interrelated activities. In an effort to adequately cover the Nevada Test Site, twelve sampling stations were selected at predetermined locations (Figure 4 and Table 4). All of the stations were sampled once a month.

Table 5A and Figure 5 give the means and ranges for gross beta activity over a 17-month period. The means, for the period February 1965 to June 1966, ranged from 4.5×10^{-9} μCi/cc, recorded in September of 1965 to 2.04×10^{-8} μCi/cc, recorded in August of 1965. The maximum value for the 17-month period was 1.14×10^{-7} μCi/cc which was recorded in August of 1965 at Area 25, CP Water Tower. The average mean for fiscal year 1966 was computed at 1.02×10^{-8} μCi/cc which was higher than the mean for fiscal year 1965 which was 1.00×10^{-8} μCi/cc. (Refer to footnote #1, page 2.) The 1965 data prior to February 1965 is not presented here due to the fact that all of the water samples that were collected exceeded MPC_W values because of small sample size. This invalidated the data for the beginning of fiscal year 1965, thus making it meaningless as far as actual comparison with the data collected in the latter half of fiscal year 1965, as well as with the 1966 data, is concerned.

Table 5B and Figure 6 show the descending means of the 12 sampling locations. The values were quite low, with Area 3, Well A reservoir and Area 5, Well 5B reservoir representing the mid-points along the descending line.

The percent frequency distribution of gross beta activity in the industrial water samples of NTS can be seen in Figure 7. The curve in this case is skewed to the right indicating the majority of the activity was in the lower ranges, well below $(MPCU)_W$ levels.

2.5.2 Potable Water Samples

The statistical breakdown for potable water samples for fiscal year 1966 was based on ten sampling locations (Table 4 and Figure 4), taken on a weekly basis.

Table 2A and Figure 8 give the means and ranges for gross beta activity over a 17-month period covering the latter half of fiscal year 1965, February 1965 to June 1965, and all of fiscal year 1966, July 1965 to June 1966. The means ranged from 2.17×10^{-9} μCi/cc recorded February 20, 1966 to 5.13×10^{-8} μCi/cc recorded April 24, 1966. The maximum value for the 17-month period was 3.41 x 10^{-7} μCi/cc recorded April 24, 1966 at the Area 3, Cafeteria. The average mean for fiscal year 1966 was 6.29 x 10^{-9} μCi/cc as compared with the mean for fiscal year 1965 which was 5.6 x 10^{-9} μCi/cc. The complete data presentation was not given for fiscal year 1965 for the same reasons as were outlined in section 2.5.1. Even though larger than last year's mean the average for potable water is still well below the $(MPCU)_W$ levels. which is set at 1 x 10^{-7} μCi/cc and is based on the exposure guides recommended by the National Bureau of Standards, Handbook 69. This holds, even though water samples from three locations in Areas 18, 20, and 51 were above MPC_W levels.

Figure 9 indicates that the frequency distribution curve for gross beta activity in potable water samples at NTS is skewed to the right. This indicates that the majority of the activity values are well below $(MPCU)_W$ levels.

2.5.3. Miscellaneous Water Samples

There were eight miscellaneous water sampling locations for fiscal year June 1965 through July 1966. Each location has some unique characteristic that removes it from the industrial and potable water groups and because of this each location will be treated separately.

The first two areas to be discussed are the Mercury swimming pool in Area 23 and the Groom Lake swimming pool in Area 51 (Table 4 and Figure 4). Both swimming pools are unique in that the water is constantly being filtered. The swimming pool in Mercury is open to atmospheric fall-out at all times while the swimming pool at Groom Lake is enclosed; but dust from the outside can still be carried in and dispersed in the water.

The next two locations which are related are Well J-12 and Well 3 in Area 51. Both wells were sampled directly from the well stem and because of this represent totally closed systems. In other words, there is no chance of atmospheric contamination since both wells are completely closed with no openings between the well water and the air. All of the other well samples, throughout the Site, were taken from associated reservoirs rather than the wells themselves.

The third group of related sample locations are the permanent bodies of contaminated water located at the Control Point (CP) decontamination pad in Area 6 and the Upper and Lower Haines Lakes in Area 12. The waste pond at the CP area was constructed to contain liquid radioactive waste from the decontamination operations performed in the area. The Haines Lakes were established as reservoirs for industrial water when a water source was exposed during construction of tunnel U12e (E tunnel). This latter water source became contaminated during a test in E tunnel in 1961 and has continued to discharge contaminated seepage water. Like the CP waste pond, these reservoirs are controlled radiation zones. Papoose Lake, in Area 51, is the only natural drainage basin on the Test Site which is continually sampled. Any contamination which shows up there is the result of air-borne surface material or atmospheric fall-out from past atmospheric detonations.

Table 5C gives the geometric means and ranges for all eight locations based on samples collected once-a-month over a twelve-month sampling period. The table is broken down into location, number of samples, mean and range of alpha (μCi/cc), mean and range of beta (μCi/cc).

SECTION 3

SOIL AND VEGETATION SAMPLING

3.1 Introduction

Soil and vegetation samples were collected at monthly intervals from 23 sample locations. For a map of these locations see Figure 10. Routine collection of soil and vegetation samples was discontinued March 1, 1966 for reasons discussed later.

Methods and procedures followed in collecting, preparing, and counting these samples were similar to those used in prior years. The methods are also similar to the environmental surveillance programs followed at other atomic energy installations and the results are similar in that the Test Site experiences the same heterogeneity in soil and plant samples as reported from other installations. At NTS, routine sampling has been discontinued until improved procedures can be developed that will reduce the heterogeneity that has plagued this part of the program. This is discussed more fully in Section 3.6.

3.2 Sample Collection

Soil and vegetation samples were collected at the same time and place. Vegetation samples were collected from the top portions of the dominant perennial shrubs found at each station. Vegetation samples were brought to the laboratory in size-12 Kraft paper bags closed at the top and secured by masking tape.

Soil samples were taken from a 64-square inch area of "clear" ground to a depth of 1/4 inch. The effect of this requirement of "clear" ground on the heterogeneity of soil samples is discussed in Section 3.6. Soil samples were taken to the laboratory in sealed, one-quart ice cream cartons.

3.3 Sample Preparation

Vegetation samples are logged in when received by the laboratory, surveyed with portable instruments, and weighed in an aluminum pan to obtain the wet weight which is recorded. The samples are then dried for 24 hours at 190°F, cooled, reweighed, and the dry weight recorded. The dried sample is then pulverized in a Waring-type blender. The sample thus contains leaves, twigs, bark, flower parts, and fruit. All of the plant material collected by the monitor in the field becomes part of the pulverized sample from which a 5-gram aliquot is weighed into a 5-dram plastic vial for gamma counting.

A 25-gram aliquot of this pulverized sample is ashed in a muffle furnace.

The ashing process begins at 200^{o}C and the muffle is gradually raised to 600^{o}C and held at this temperature until the sample has been in the muffle for 24 hours, of which about 20 hours have been at the 600^{o} temperature. The ashed sample is cooled in a desicator and a one-gram aliquot is weighed into a small beaker. Nitric acid is added to the beaker and the ash is leached for three hours. The leach is then filtered through a Whatman No. 42 filter paper using gravity flow. The filtrate is reduced in volume under a heat lamp and then transferred onto a standard planchet where it is slowly and carefully evaporated to dryness. The sample is then surveyed, placed in a petri dish for protection, logged out, and counted for gross alpha and beta.

Soil samples are logged in, surveyed, and wet weighed obtained following the same procedures as for vegetation samples. The samples are then dried for 24 hours at 190^{o}F, and after cooling the dry weight is made and recorded. The samples are pulverized with a mortar and pestle until a majority of the sample will pass through a 100 mesh screen. Five grams are weighed into a small beaker for the gross alpha, gross beta counting, and leached for three hours in the same manner as were the vegetation samples. The sample is transferred quantitatively to a planchet, surveyed, logged out and sent to counting. For gross gamma counting, the pulverized soil is weighed into a tared 5 dram plastic vial, surveyed, logged out and sent for counting.

3.4 Counting Procedures

Counting procedures for soil and vegetation samples were the same as previously described for samples analyzed with the Beckman WIDEBETA system.

Results were reported by the laboratory in μCi/gm of dry soil and as μCi/gm of plant ash. The effect that this method of data reporting has on the heterogeneity of the results is discussed in the next Section.

3.5 Results of Analyses

Soil and vegetation analysis data for gross beta activity are summarized in Table 6. Sample station numbers in the table correspond to the numbers on the map (Figure 10). The figures in the table are picocuries per gram of dried soil and per gram of dried plant material. The monthly means and extreme for these data are plotted in Figure 11.

The original data, as received from the laboratory, is reported in μCi/gm of plant ash in accordance with uniform reporting procedure. As mentioned in Section 3.2, there was considerable variation in the nature of the plant samples submitted to the laboratory for anaylsis. The proportion of leaves to twigs differed with different species. These proportions may also vary considerably between samples of the same species depending upon stage of growth and vigor of the particular shrubs selected for sampling. These variations in the nature of the samples resulted in ash contents that ranged from as little as 4% to as much as 72% of the dry weight of the plant material. The usual range for any small group of samples was approximately 5 to 25%.

Reporting of the data as activity per gram of ash instead of per gram of plant material thus added to the heterogeneity of the results. Therefore, the data on beta activity of the vegetation samples were converted to activity per gram of dried plant material.

Since soil data are reported as activitv per gram of dried soil, soil and vegetation data are directly comparable. As illustrated in Figures 12 and 13, soil and vegetation activity are often closely correlated and occasionally are numerically equivalent. However, the close correlations often obtained emphasize the wide discrepancies sometimes reported. These are discussed in the next Section.

3.6 Discussion

A certain amount of heterogeneity in radioactivity of soil and vegetation samples is to be expected under the conditions that prevail at NTS. The topography is rough and varied ranging in altitude from less than 4,000 feet at Mercury to over 7,000 feet on Pahute and Ranier Mesas. Climate, soil, and vegetation conditions at various sampling stations are not uniform. In planning these stations, there was no attempt to obtain uniformity of conditions and comparability of results between stations. On the other hand, an attempt was made to sample all of the varied soil and vegetation conditions existing at NTS. In other words, these stations are not replications and each can be thought of as a bench mark for measuring changes in environmental contamination for the particular set of conditions where the sampling station is located.

Besides this variation in the physical factors of the environment between sampling stations, there is an even greater variation in the nature and amount of radioactive contamination to be sampled at the various stations. This is due to the effect of the topography on the climate[1] in the immediate area of interest and because radioactive contamination at NTS originates from several sources at a number of different locations.

The nuclear rocket engines at NRDS are tested at irregular intervals under varying test conditions as to duration and power resulting in occasional releases of radioactive contamination into the environment. Fallout from these tests may extend for miles as a narrow plume downwind from the reactor. Therefore, while much of NTS has been contaminated in the past by reactor

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[1]Martin, William E. "Notes on the Deposition of Fallout in Relation to Topography and Local Meterological Conditions," UCLA Laboratory of Nuclear Medicine and Radiation Biology, TID-4500 20th Ed. No. 513, 1963.

tests, large areas of the Test Site have escaped significant contamination. Normally only a very few sampling stations will be affected by any particular reactor test.

Nuclear devices are tested underground in several areas at a number of locations. Most of these tests contribute no significant contamination to the environment. Nevertheless, small amounts of radioactive materials escape occasionally releasing contamination into the environment. As in the reactor tests, contamination is confined to a very narrow fallout pattern affecting, at the most, only a few of the 23 sampling stations.

The USPHS occasionally releases radionuclides in Area 15 in carefully controlled field experiments. This normally affects only Station 8.

Plowshare events in past years have contributed some contamination and above ground tests prior to the test-ban treaty created a number of contaminated ground zeros. Much of this contaminated material is still on the ground surface where it can be picked up by the wind and redeposited.

These same winds can affect the correlation between soil and vegetation samples. In sampling soil and vegetation at NTS, an attempt is made principally to measure close-in fallout. Close-in fallout particles are mostly too large to be held effectively by foliage. Winds strong enough to whip the branches of shrubs, shake off most of the fallout particles. With recent fallout and after a high wind, the shrubs may be relatively free of contamination, but as the data show, even greater heterogeneity is found with soil samples than with vegetation.

Fallout is deposited on the soil surface and in a desert environment moves very slowly downward through the soil profile. Therefore, the sample is confined to the surface soil. However, in a land with scanty vegetation and copious wind, the soil surface is not stable. What was the soil surface at the time the fallout was deposited might not be the surface when the sample was collected. It might be buried by drifting sand or eroded away by the wind. Since sample collecting personnel looked for a spot of "clear" ground to collect samples, they thus selected areas with the least stable surface.

Procedures are being developed for collecting and preparing soil and vegetation samples that will reduce the heterogeneity past samples have shown.

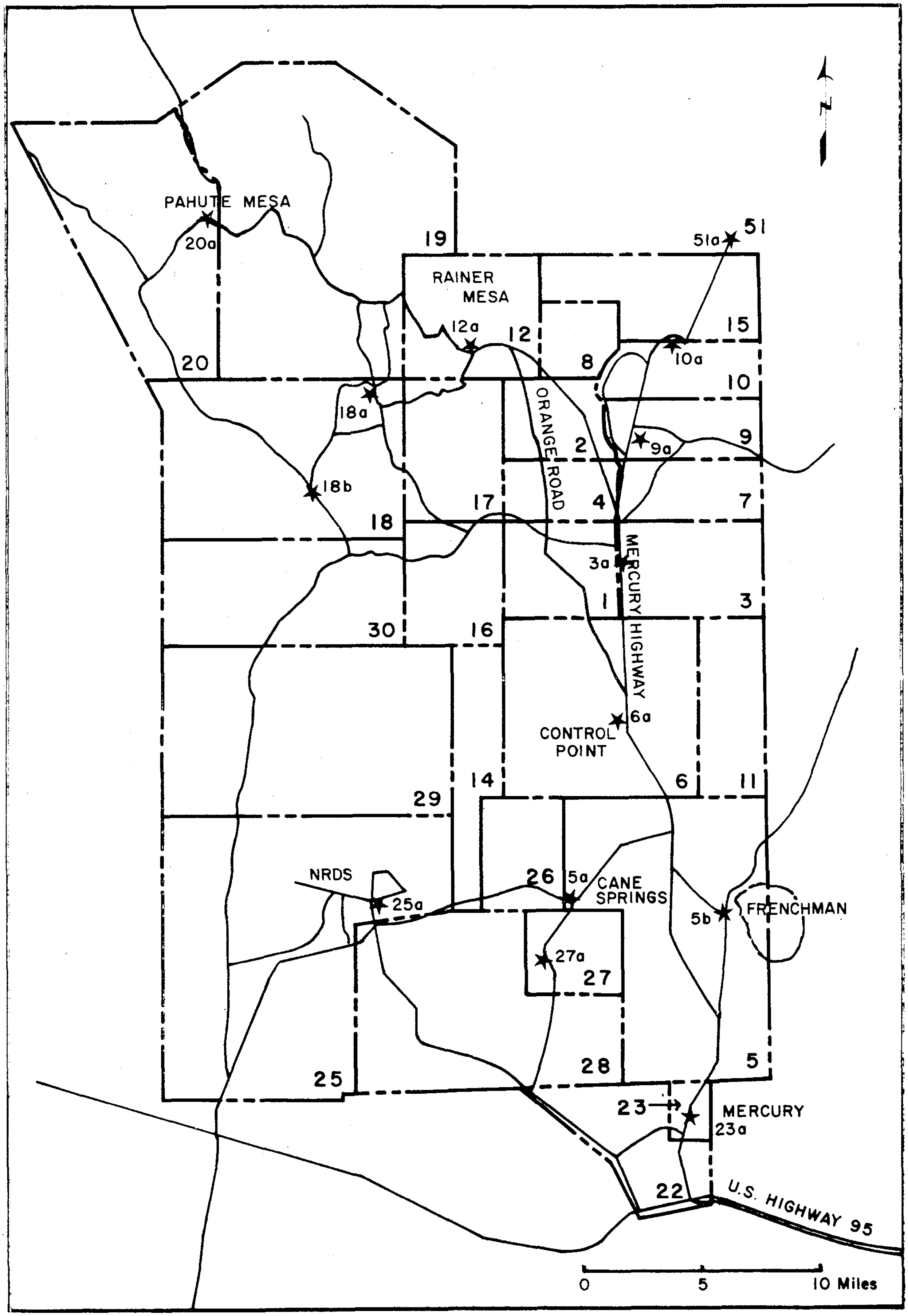

Figure 1 - NTS Environmental Surveillance Air Sampling Locations

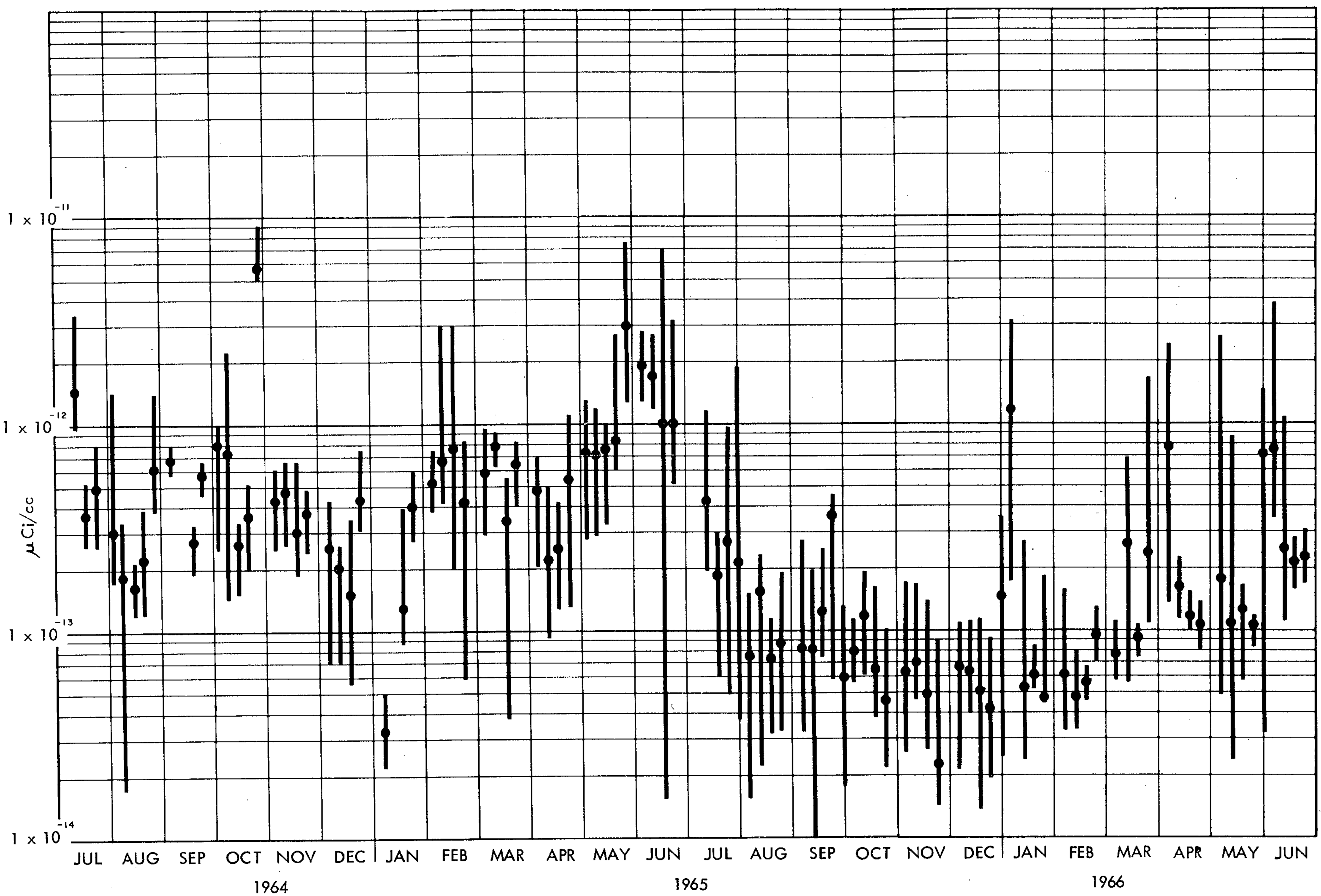

Figure 2 - Weekly Means and Ranges of Gross Beta Radioactivity from July, 1964 through June, 1966; Air Sampling

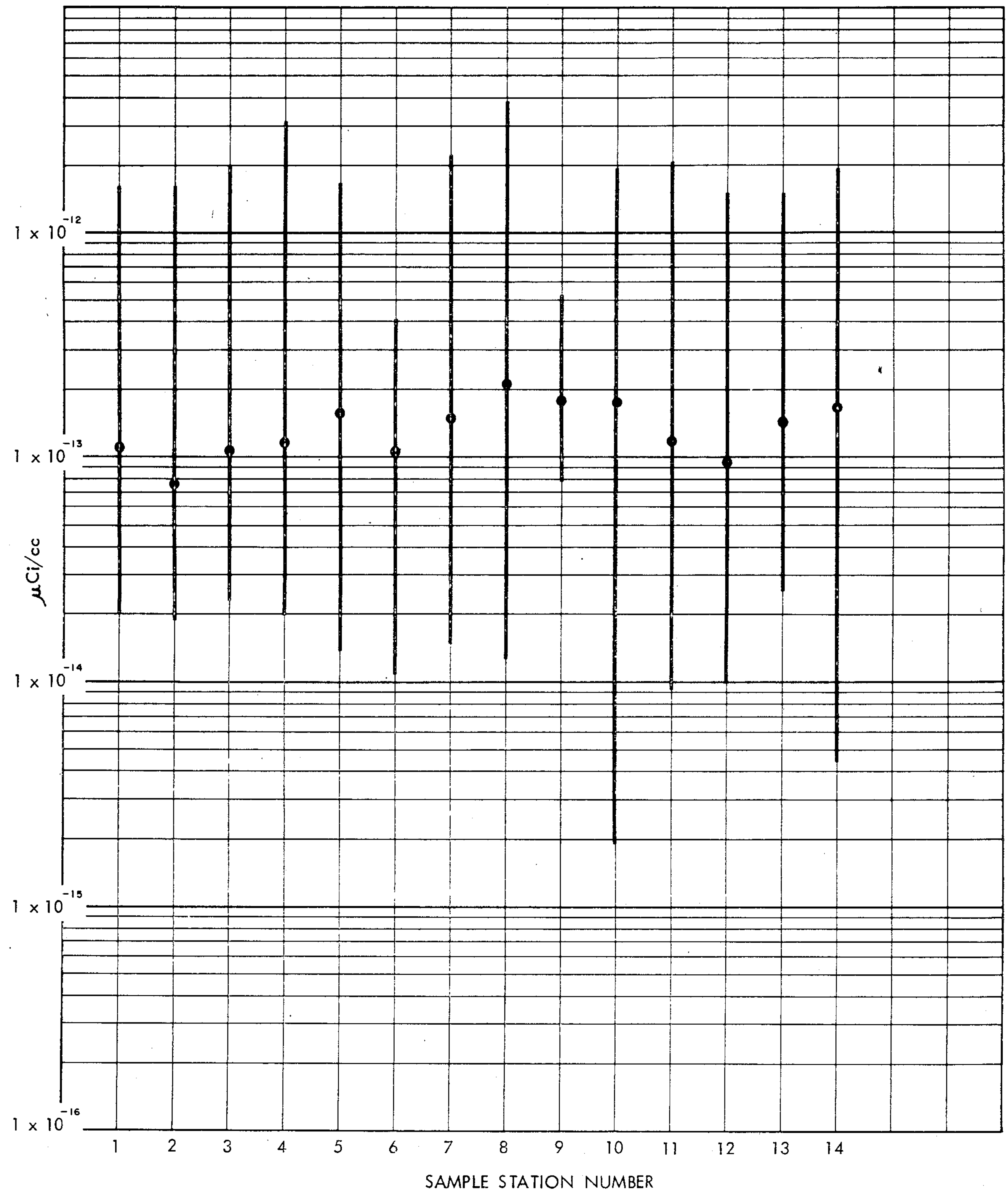

Figure 3 - Means and Ranges of Gross Beta Radioactivity from July, 1965 through June, 1966; Air Sampling

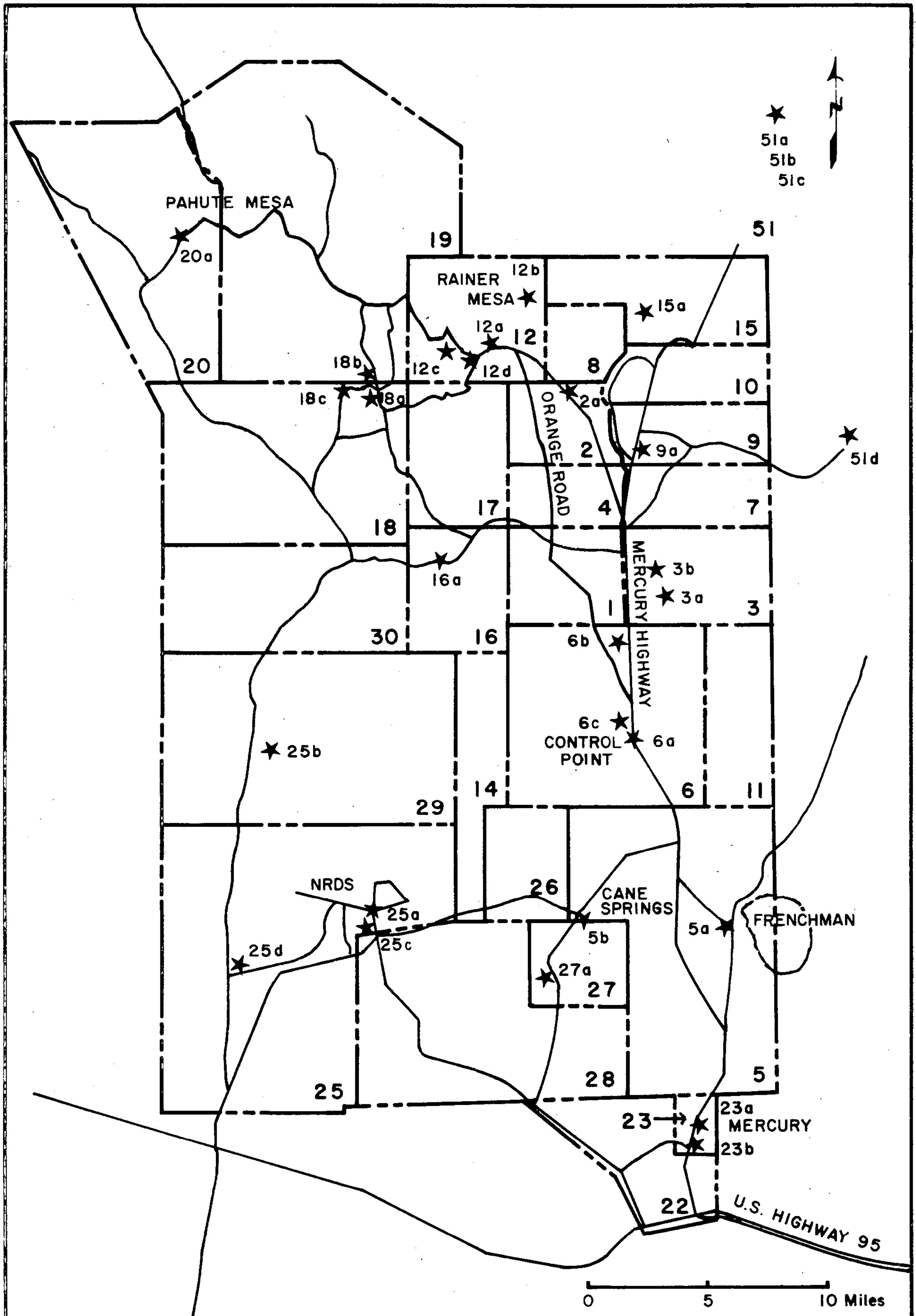

Figure 4 - Water Sampling Station Locations

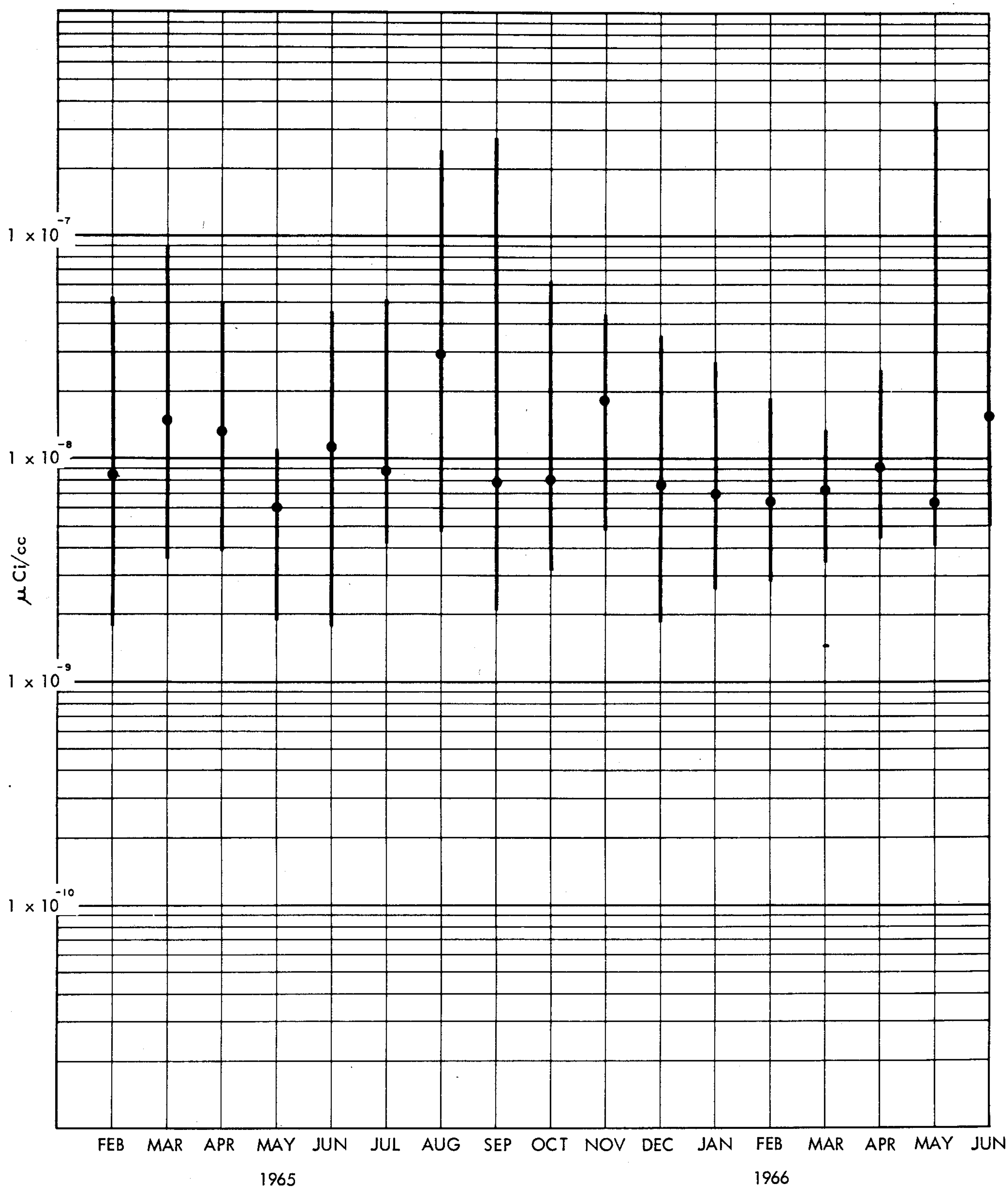

Figure 5 - Means and Ranges of Gross Beta Radioactivity from February, 1965 to June, 1966; Industrial Water

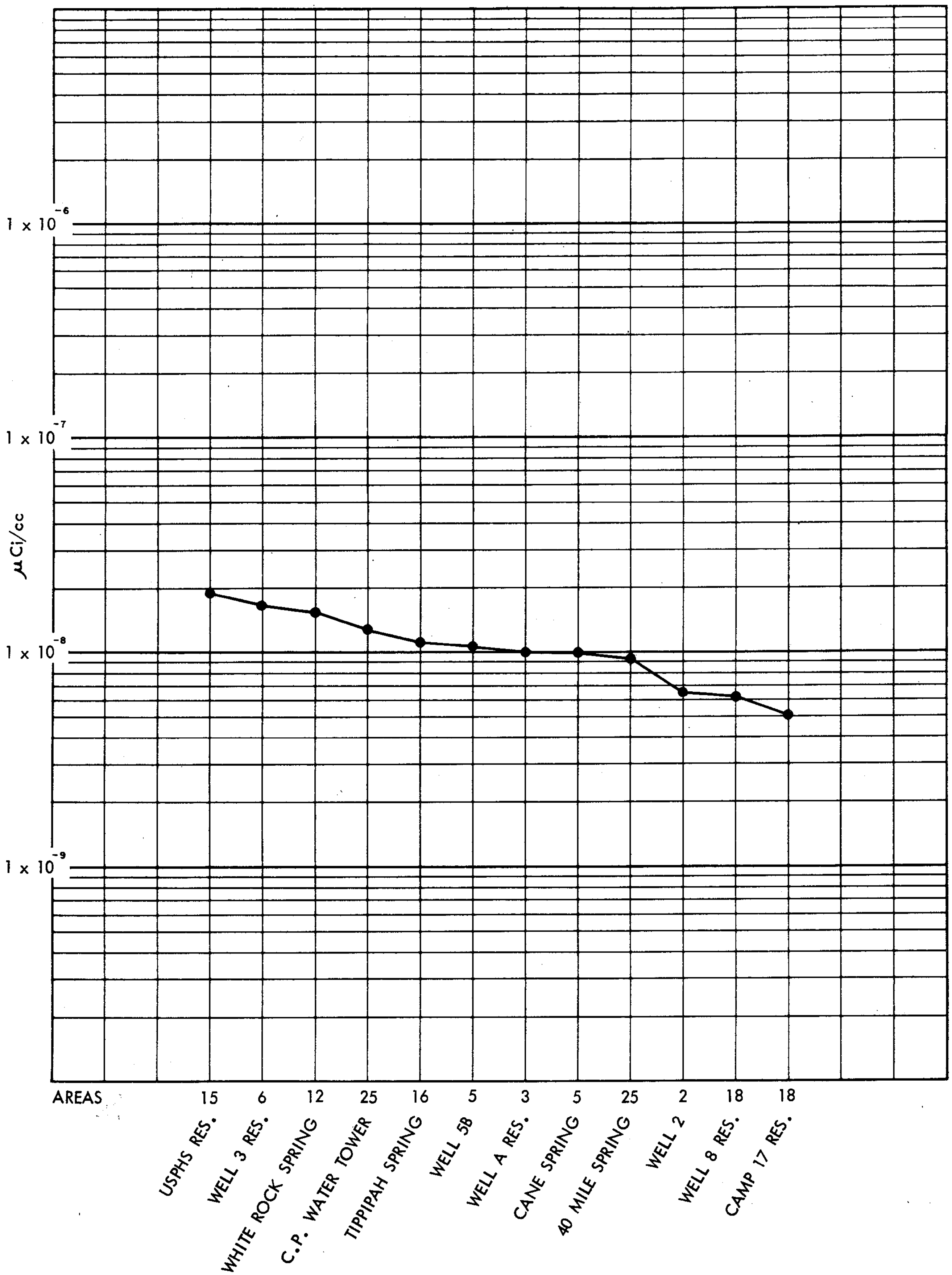

Figure 6 - Descending Means of Twelve Sampling Locations; Industrial Water

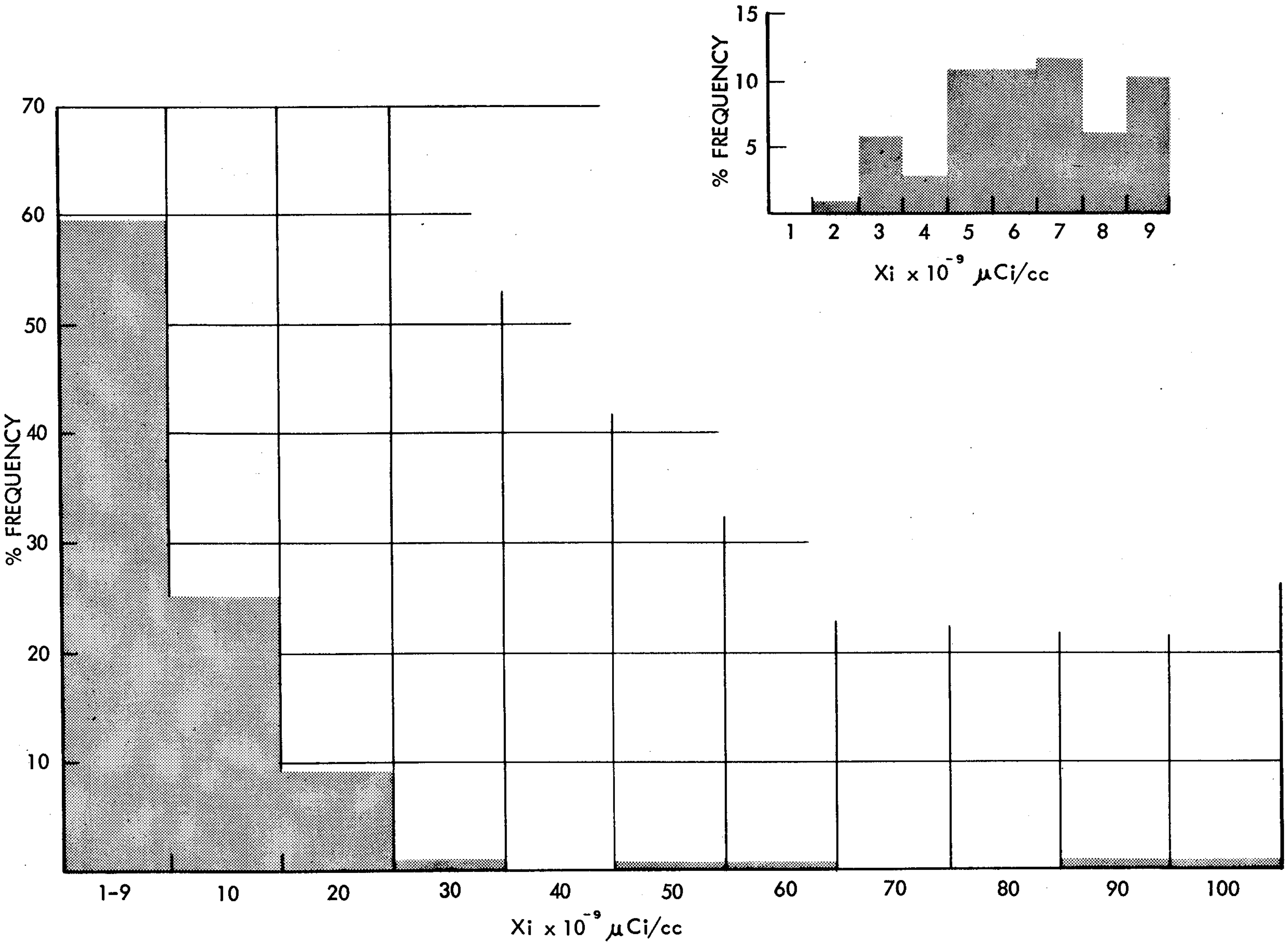

Figure 7 - Percent Frequency Distribution of Gross Beta Radioactivity; Industrial Water

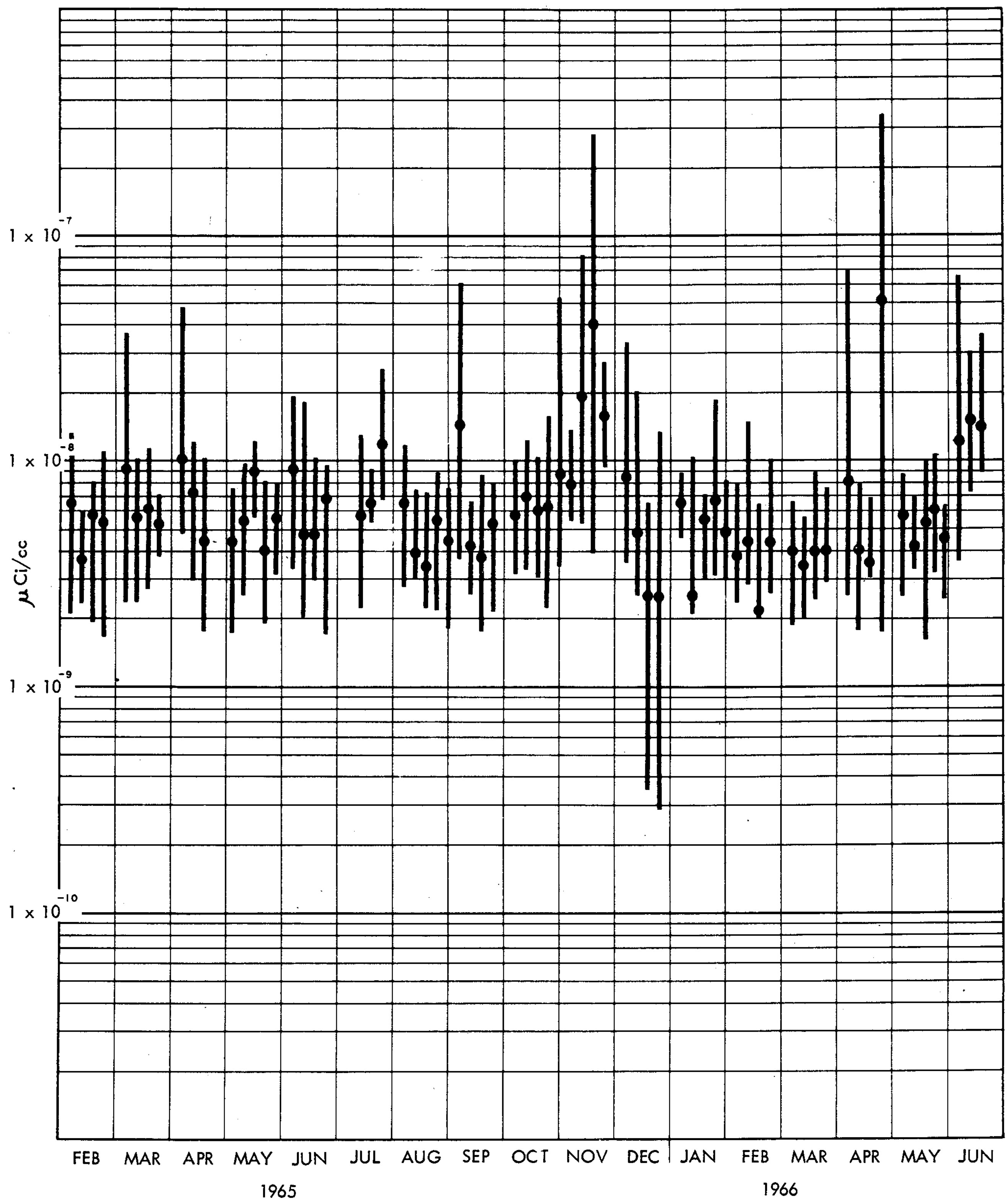

Figure 8 - Means and Ranges of Gross Beta Radioactivity in Potable Water Samples from February, 1965 through June, 1966

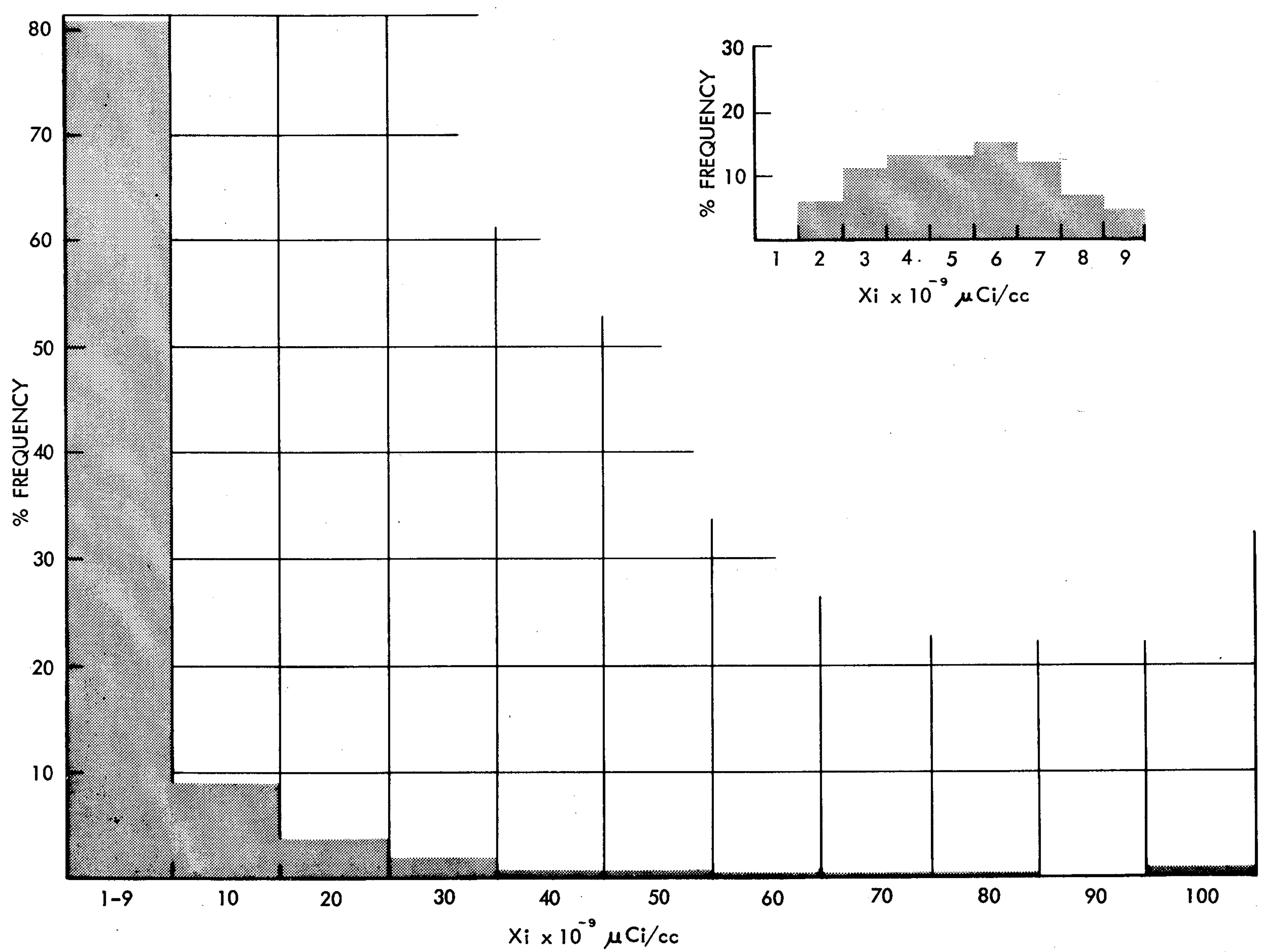

Figure 9 - Percent Frequency Distribution for Gross Beta Radioactivity in Potable Water

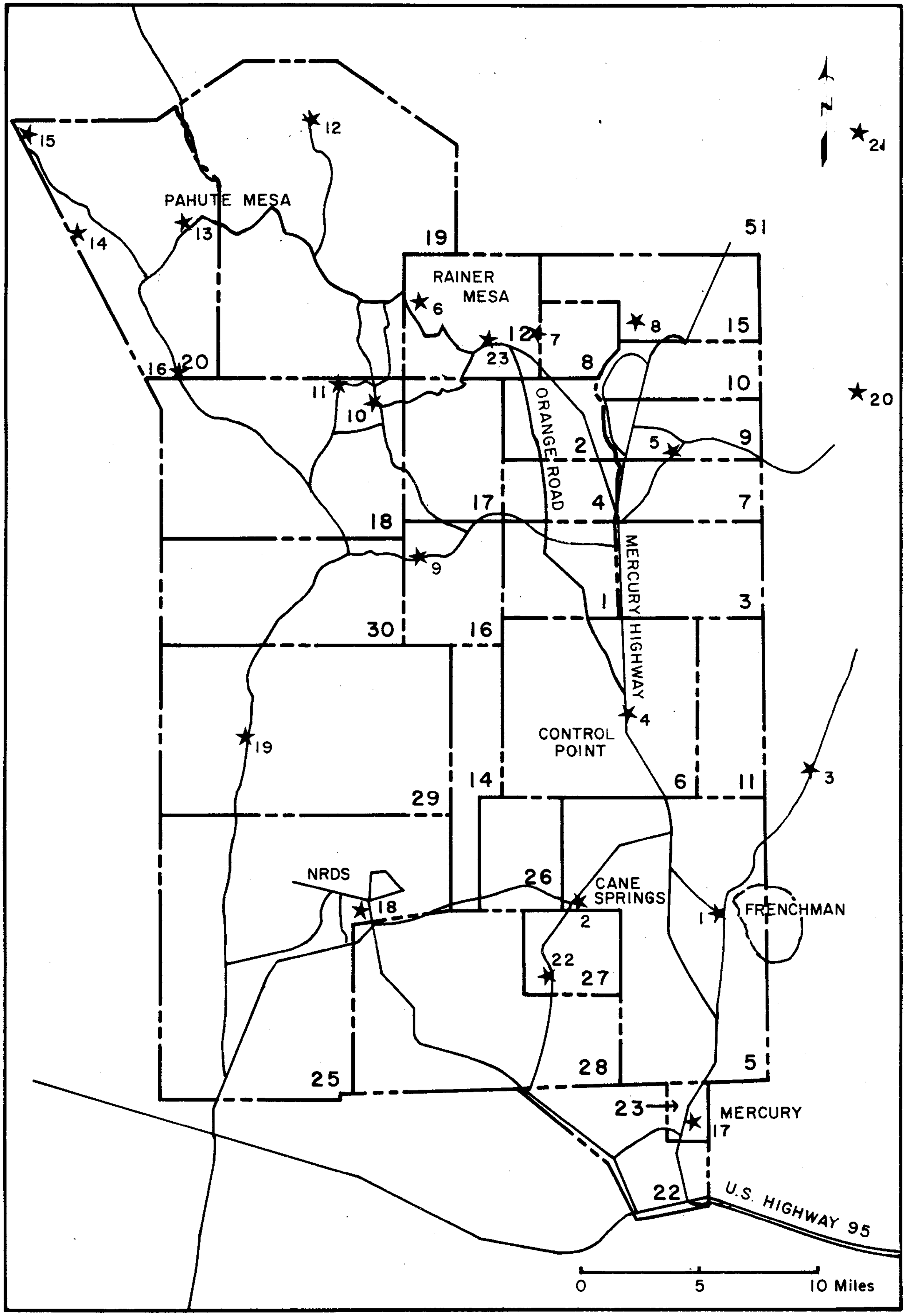

Figure 10 - Soil and Vegetation Sample Stations

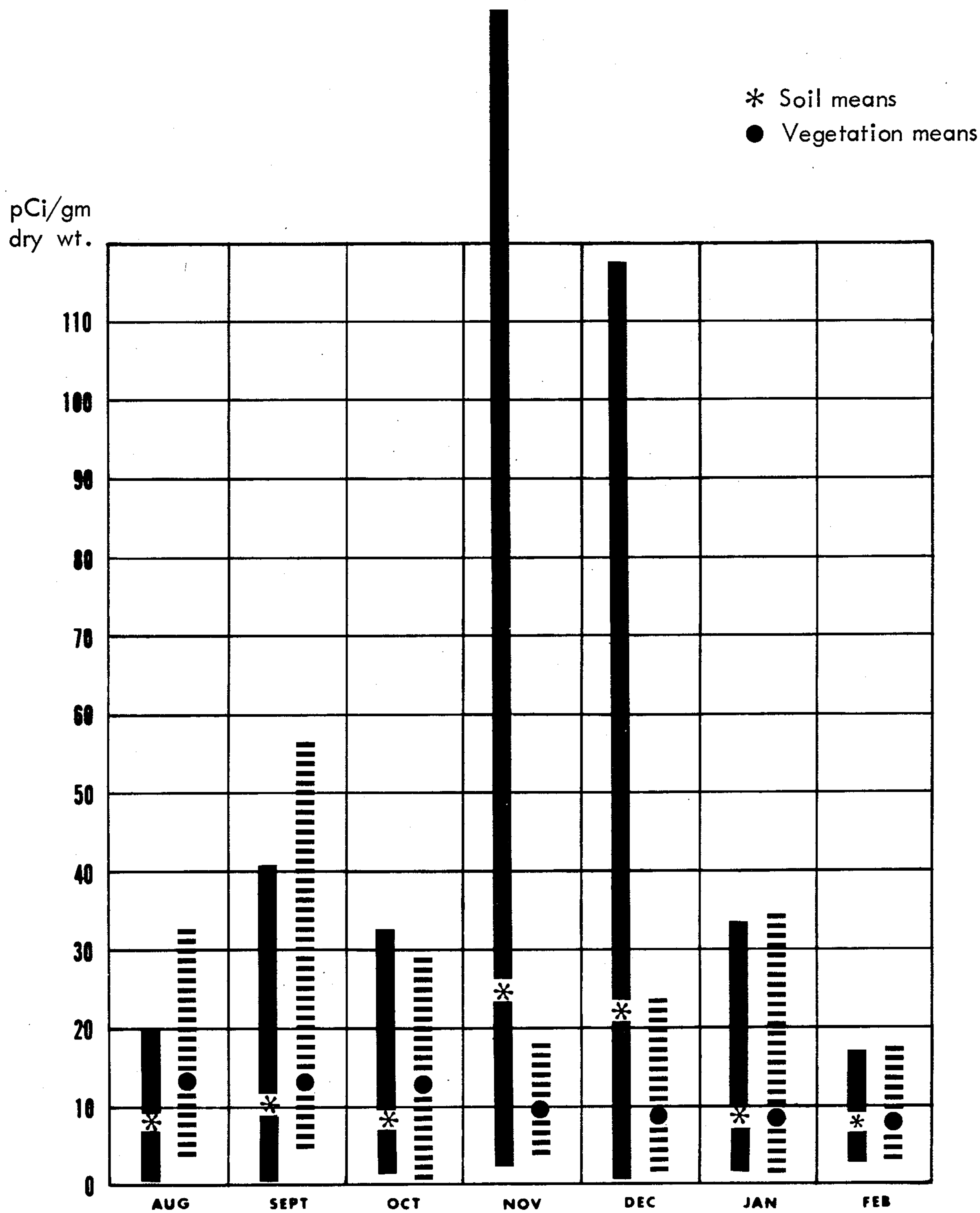

Figure 11 - Means and Extremes of Soil and Vegetation Samples

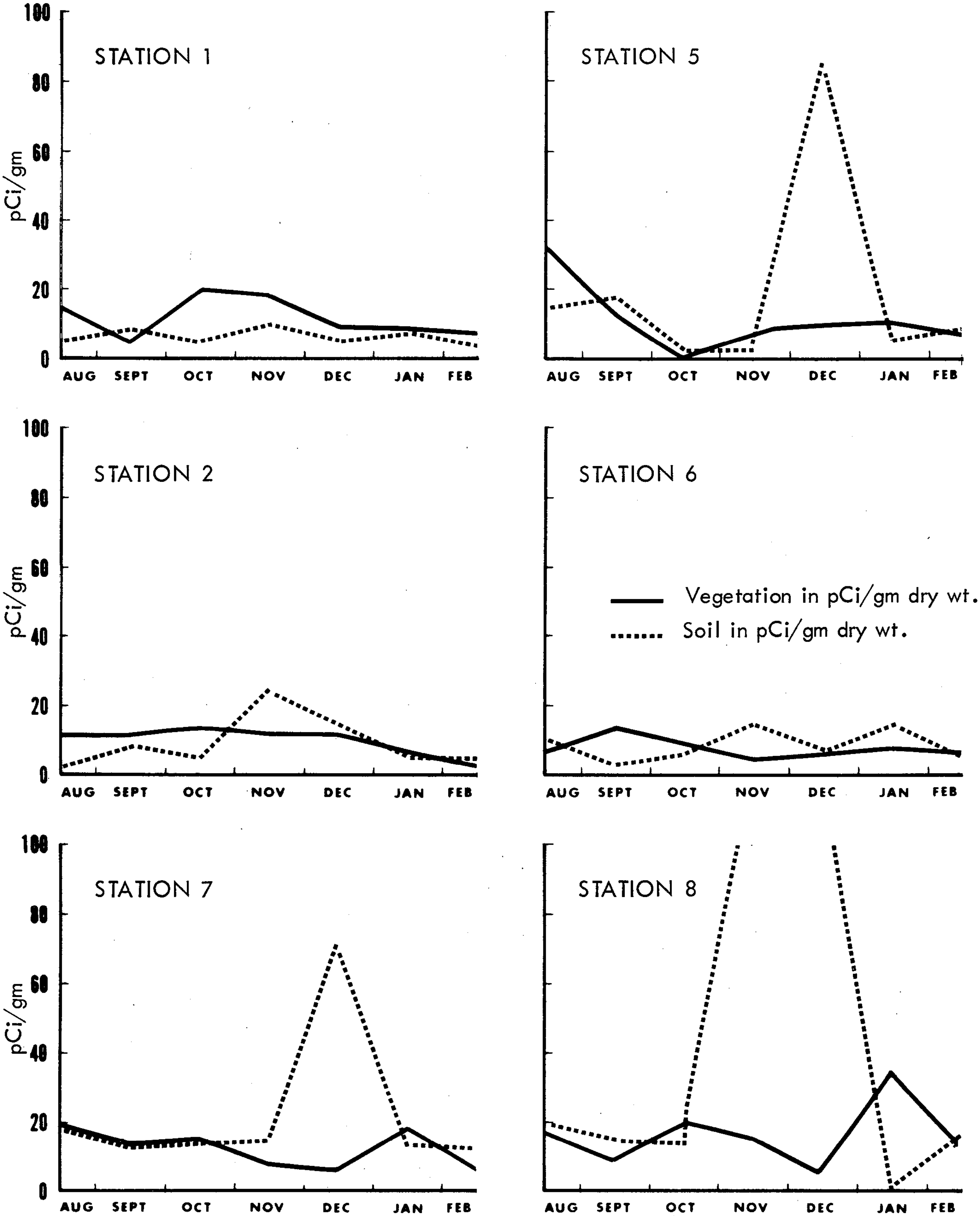

Figure 12 • Soil and Vegetation Radioactivity

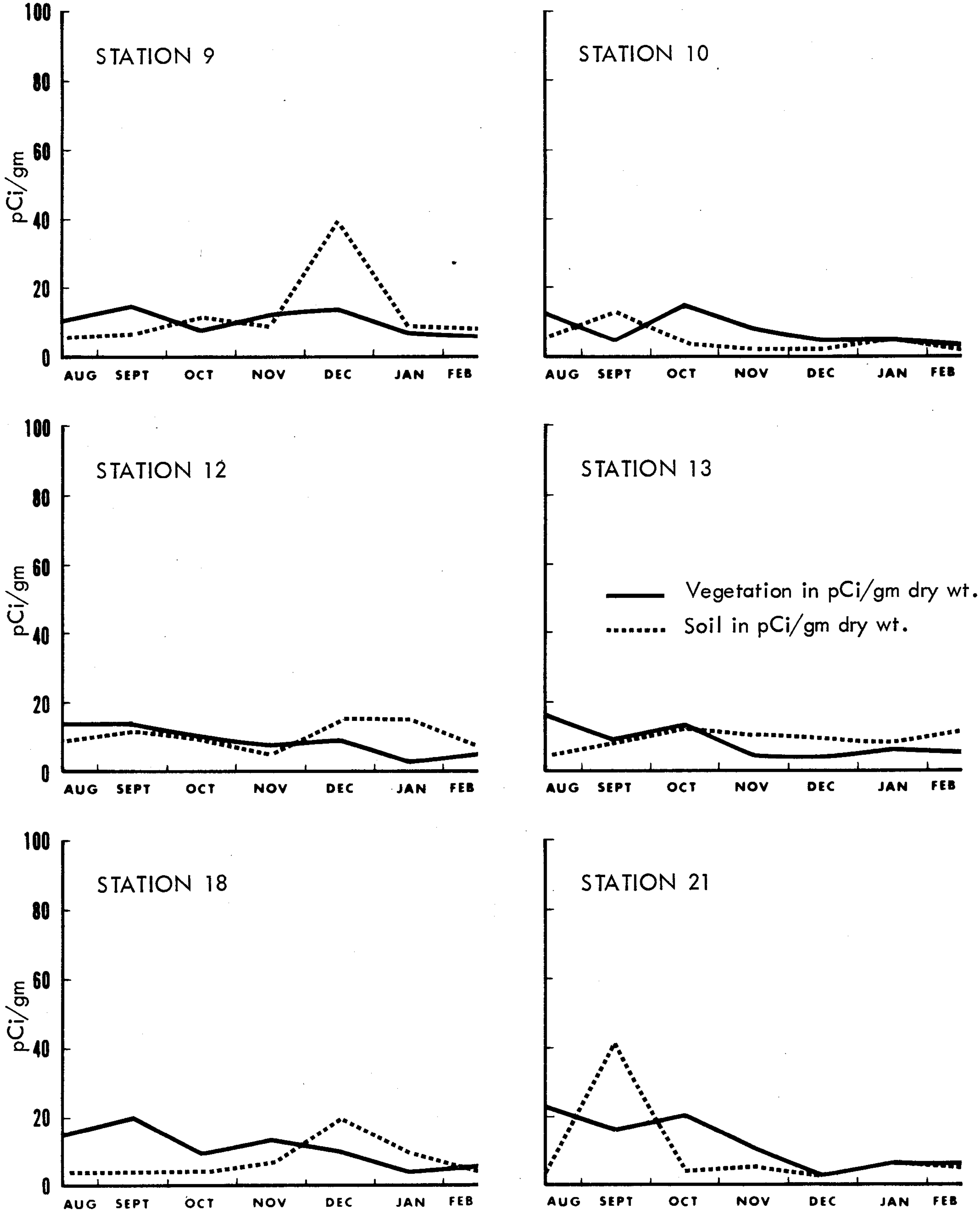

Figure 13 - Soil and Vegetation Radioactivity

TABLE 1

ENVIRONMENTAL SURVEILLANCE AIR SAMPLING STATION LOCATIONS

AREA	SAMPLE STATION LOCATION	MAP CODE FOR FIGURE 1
3	Northwest of field cafeteria	3/a
5	Gate 250, guard station, East of well 5B reservoir	5/a 5/b
6	Housing complex, adjacent to aid station	6/a
9	9-300 bunker area	9/a
10	Gate 700, guard station	10/a
12	"Changehouse"	12/a
18	Adjacent to Camp 17 cafeteria firestation trailer at airstrip	18/a 18/b
20	Dispensary	20/a
23	Building 214,	23/a
25	NRDS H-8 complex	25/a
27	North of cafeteria	27/a
51	Groom Lake cafeteria	51/a

TABLE 2

SAMPLING PERIOD MEANS AND RANGES OF GROSS BETA RADIOACTIVITY IN ENVIRONMENTAL AIR SAMPLES FROM NTS JULY 1964 THROUGH JUNE 1966

AIR SAMPLES (Values in terms of μCi/cc)			
DATE (Week ending)	MEAN	RANGE	
		MAXIMUM	MINIMUM
7/11/64	1.4×10^{-12}	3.4×10^{-12}	9.8×10^{-13}
7/18/64	3.6×10^{-13}	5.1×10^{-13}	2.6×10^{-13}
7/25/64	4.8×10^{-13}	7.8×10^{-13}	2.6×10^{-13}
8/1/64	3.0×10^{-13}	1.4×10^{-12}	1.7×10^{-13}
8/8/64	1.8×10^{-13}	3.3×10^{-13}	1.7×10^{-14}
8/15/64	1.6×10^{-13}	2.1×10^{-13}	1.2×10^{-13}
8/22/64	2.2×10^{-13}	3.8×10^{-13}	1.2×10^{-13}
8/29/64	6.1×10^{-13}	1.4×10^{-12}	3.8×10^{-13}
9/5/64	6.8×10^{-13}	7.8×10^{-13}	5.7×10^{-13}
9/12/64	Sample	not collected	
9/19/64	2.7×10^{-13}	3.2×10^{-13}	1.9×10^{-13}
9/26/64	5.8×10^{-13}	6.5×10^{-13}	4.6×10^{-13}
10/3/64	7.8×10^{-13}	9.4×10^{-13}	2.4×10^{-13}
10/10/64	7.2×10^{-13}	2.2×10^{-12}	1.4×10^{-13}
10/17/64	2.6×10^{-13}	3.3×10^{-13}	1.5×10^{-13}
10/24/64	3.5×10^{-13}	5.1×10^{-13}	2.0×10^{-13}
10/31/64	5.7×10^{-12}	(max) 9.1×10^{-12}	4.9×10^{-12}
11/7/64	4.2×10^{-13}	6.0×10^{-13}	2.5×10^{-13}
11/14/64	4.7×10^{-13}	6.5×10^{-13}	2.6×10^{-13}
11/21/64	3.0×10^{-13}	6.5×10^{-13}	1.9×10^{-13}
11/28/64	3.7×10^{-13}	4.8×10^{-13}	2.4×10^{-13}
12/5/64	2.5×10^{-13}	4.3×10^{-13}	7.1×10^{-14}
12/12/64	2.0×10^{-13}	2.6×10^{-13}	7.1×10^{-14}
12/19/64	1.5×10^{-13}	3.4×10^{-13}	5.6×10^{-14}
12/26/64	4.3×10^{-13}	7.5×10^{-13}	3.2×10^{-13}
1/2/65	Sample	not collected	
1/9/65	3.3×10^{-14}	4.9×10^{-14}	2.2×10^{-14}
1/16/65	Sample	not collected	
1/23/65	1.3×10^{-13}	3.9×10^{-13}	8.7×10^{-14}
1/30/65	3.9×10^{-13}	5.8×10^{-13}	2.7×10^{-13}
2/6/65	5.2×10^{-13}	7.3×10^{-13}	3.8×10^{-13}
2/13/65	6.6×10^{-13}	3.0×10^{-12}	4.1×10^{-13}
2/20/65	7.6×10^{-13}	3.0×10^{-12}	2.0×10^{-13}
2/27/65	4.2×10^{-13}	8.2×10^{-13}	5.8×10^{-14}
3/6/65	5.8×10^{-13}	9.6×10^{-13}	3.0×10^{-13}
3/13/65	7.9×10^{-13}	9.1×10^{-13}	6.3×10^{-13}
3/20/65	3.4×10^{-13}	5.6×10^{-13}	3.7×10^{-14}
3/27/65	6.5×10^{-13}	8.3×10^{-13}	4.2×10^{-13}
4/3/65	4.9×10^{-13}	6.9×10^{-13}	2.1×10^{-13}
4/10/65	2.2×10^{-13}	5.0×10^{-13}	9.4×10^{-14}

TABLE 2 (Cont'd)

AIR SAMPLES (Values in terms of μCi/cc)			
DATE (Week ending)	MEAN	RANGE	
		MAXIMUM	MINIMUM
4/17/65	2.5×10^{-13}	4.3×10^{-13}	1.3×10^{-13}
4/24/65	5.4×10^{-13}	1.1×10^{-12}	1.3×10^{-13}
5/1/65	7.3×10^{-13}	1.3×10^{-12}	2.8×10^{-13}
5/8/65	7.1×10^{-13}	1.2×10^{-12}	2.9×10^{-13}
5/15/65	7.6×10^{-13}	1.0×10^{-12}	3.3×10^{-13}
5/22/65	8.3×10^{-13}	2.7×10^{-12}	6.1×10^{-13}
5/29/65	3.0×10^{-12}	7.6×10^{-12}	1.3×10^{-12}
6/5/65	1.9×10^{-12}	2.8×10^{-12}	1.3×10^{-12}
6/12/65	1.7×10^{-12}	2.7×10^{-12}	1.2×10^{-12}
6/19/65	1.0×10^{-12}	6.9×10^{-12}	1.5×10^{-14}
6/26/65	1.0×10^{-12}	3.1×10^{-12}	5.1×10^{-13}
7/4/65	Sample	not collected	
7/11/65	4.20×10^{-13}	1.18×10^{-12}	1.97×10^{-13}
7/18/65	1.89×10^{-13}	3.04×10^{-13}	6.09×10^{-14}
7/25/65	2.75×10^{-13}	9.91×10^{-13}	5.30×10^{-14}
8/1/65	2.14×10^{-13}	1.94×10^{-12}	3.75×10^{-14}
8/8/65	7.61×10^{-14}	1.55×10^{-13}	1.58×10^{-14}
8/15/65	1.55×10^{-13}	3.93×10^{-13}	2.24×10^{-14}
8/22/65	7.25×10^{-14}	1.70×10^{-13}	3.25×10^{-14}
8/29/65	8.72×10^{-14}	1.94×10^{-13}	3.36×10^{-14}
9/5/65	8.19×10^{-14}	2.80×10^{-13}	3.63×10^{-14}
9/12/65	8.27×10^{-14}	2.00×10^{-13}	9.67×10^{-15}
9/19/65	1.24×10^{-13}	2.55×10^{-13}	7.10×10^{-14}
9/26/65	3.65×10^{-13}	4.62×10^{-13}	6.04×10^{-14}
10/3/65	5.87×10^{-14}	1.35×10^{-13}	1.81×10^{-14}
10/10/65	7.88×10^{-14}	1.44×10^{-13}	5.67×10^{-14}
10/17/65	1.18×10^{-13}	1.97×10^{-13}	6.30×10^{-14}
10/24/65	6.49×10^{-14}	1.61×10^{-13}	3.89×10^{-14}
10/31/65	4.68×10^{-14}	1.03×10^{-13}	2.39×10^{-14}

TABLE 2 (Cont'd)

AIR SAMPLES (Values in terms of μCi/cc)			
DATE (Week ending)	MEAN	RANGE	
		MAXIMUM	MINIMUM
11/7/65	6.34×10^{-14}	1.73×10^{-13}	2.66×10^{-14}
11/14/65	6.99×10^{-14}	1.72×10^{-13}	4.80×10^{-14}
11/21/65	4.88×10^{-14}	1.40×10^{-13}	2.73×10^{-14}
11/28/65	2.28×10^{-14}	9.07×10^{-14}	1.45×10^{-14}
12/5/65	6.76×10^{-14}	1.12×10^{-13}	2.13×10^{-14}
12/12/65	6.38×10^{-14}	1.12×10^{-13}	4.07×10^{-14}
12/19/65	5.02×10^{-14}	1.15×10^{-13}	1.38×10^{-14}
12/26/65	4.18×10^{-14}	9.37×10^{-14}	1.99×10^{-14}
1/2/66	1.47×10^{-13}	3.67×10^{-13}	2.55×10^{-14}
1/9/66	1.17×10^{-12}	3.17×10^{-12}	1.74×10^{-13}
1/16/66	5.29×10^{-14}	2.15×10^{-13}	2.34×10^{-14}
1/23/66	6.04×19^{-14}	8.49×10^{-14}	5.19×10^{-14}
1/30/66	4.67×10^{-14}	1.83×10^{-13}	4.46×10^{-14}
2/6/66	6.11×10^{-14}	1.59×10^{-13}	3.27×10^{-14}
2/13/66	4.80×10^{-14}	7.01×10^{-14}	3.31×10^{-14}
2/20/66	5.53×10^{-14}	6.67×10^{-14}	4.62×10^{-14}
2/27/66	9.26×10^{-14}	1.30×10^{-13}	7.10×10^{-14}
3/6/66	7.00×10^{-14}	1.00×10^{-13}	5.61×10^{-14}
3/13/66	1.26×10^{-13}	6.97×10^{-13}	5.54×10^{-14}
3/20/66	9.29×10^{-14}	1.06×10^{-13}	7.53×10^{-14}
3/27/66	2.39×10^{-13}	1.69×10^{-12}	1.10×10^{-13}
4/3/66	7.78×10^{-13}	2.42×10^{-12}	1.36×10^{-13}
4/10/66	1.61×10^{-13}	2.28×10^{-13}	1.28×10^{-13}
4/17/66	1.17×10^{-13}	1.54×10^{-13}	1.00×10^{-13}
4/24/66	1.07×10^{-13}	1.38×10^{-13}	8.02×10^{-14}
5/1/66	1.76×10^{-13}	2.67×10^{-12}	4.87×10^{-14}
5/8/66	1.75×10^{-13}	8.69×10^{-13}	2.35×10^{-14}
5/15/66	1.23×10^{-13}	1.69×10^{-13}	5.79×10^{-14}
5/22/66	1.03×10^{-13}	1.18×10^{-13}	8.20×10^{-14}
5/29/66	7.06×10^{-13}	1.47×10^{-12}	3.16×10^{-14}
6/5/66	7.47×10^{-13}	3.93×10^{-12}	3.54×10^{-13}
6/12/66	2.46×10^{-13}	1.09×10^{-12}	1.11×10^{-13}
6/19/66	2.13×10^{-13}	2.80×10^{-13}	1.60×10^{-13}
6/26/66	2.26×10^{-13}	3.02×10^{-13}	1.74×10^{-13}

TABLE 2A

SAMPLING PERIOD MEANS AND RANGES OF GROSS BETA RADIOACTIVITY IN ENVIRONMENTAL POTABLE WATER SAMPLES FROM NTS FEBRUARY 1965 THROUGH JUNE 1966

WATER SAMPLES (Values in terms of μCi/cc)			
DATE	MEAN	RANGE	
(Week ending)		MAXIMUM	MINIMUM
2/06/65	6.4×10^{-9}	1.3×10^{-8}	2.1×10^{-9}
2/13/65	3.7×10^{-9}	6.0×10^{-9}	2.3×10^{-9}
2/20/65	5.7×10^{-9}	8.0×10^{-9}	1.9×10^{-9}
2/27/65	5.4×10^{-9}	1.1×10^{-8}	1.7×10^{-9}
3/06/65	9.0×10^{-9}	3.6×10^{-8}	2.3×10^{-9}
3/13/65	5.3×10^{-9}	1.0×10^{-8}	2.3×10^{-9}
3/20/65	6.0×10^{-9}	1.1×10^{-8}	2.6×10^{-9}
3/27/65	5.2×10^{-9}	7.2×10^{-9}	3.7×10^{-9}
4/03/65	1.0×10^{-8}	4.7×10^{-8}	4.7×10^{-9}
4/10/65	7.2×10^{-9}	1.2×10^{-8}	2.9×10^{-9}
4/17/65	4.5×10^{-9}	1.0×10^{-8}	1.7×10^{-9}
4/24/65	No Samples Taken		
5/01/65	4.2×10^{-9}	7.4×10^{-9}	1.7×10^{-9}
5/08/65	5.3×10^{-9}	9.5×10^{-9}	2.5×10^{-9}
5/15/65	8.6×10^{-9}	1.2×10^{-8}	5.6×10^{-9}
5/22/65	3.9×10^{-9}	7.9×10^{-9}	1.9×10^{-9}
5/29/65	5.4×10^{-9}	7.8×10^{-9}	3.1×10^{-9}
6/05/65	8.8×10^{-9}	1.9×10^{-8}	3.3×10^{-9}
6/12/65	4.7×10^{-9}	1.8×10^{-8}	2.0×10^{-9}
6/19/65	4.7×10^{-9}	1.0×10^{-8}	3.0×10^{-9}
6/26/65	6.6×10^{-9}	9.2×10^{-9}	1.7×10^{-9}
7/04/65	No Samples Taken		
7/11/65	5.69×10^{-9}	$1.3. \times 10^{-8}$	2.25×10^{-9}
7/18/65	6.59×10^{-9}	9.08×10^{-9}	5.47×10^{-9}
7/25/65	1.19×10^{-8}	2.54×10^{-8}	6.73×10^{-9}
8/01/65	6.41×10^{-9}	1.18×10^{-8}	2.79×10^{-9}
8/08/65	3.90×10^{-9}	7.56×10^{-9}	3.16×10^{-9}
8/15/65	3.38×10^{-9}	7.31×10^{-9}	2.31×10^{-9}
8/22/65	5.56×10^{-9}	8.83×10^{-9}	2.17×10^{-9}
8/29/65	4.46×10^{-9}	7.57×10^{-9}	1.81×10^{-9}
9/05/65	1.47×10^{-8}	6.36×10^{-8}	3.72×10^{-9}
9/12/65	4.26×10^{-9}	6.72×10^{-9}	2.57×10^{-9}
9/19/65	3.71×10^{-9}	8.61×10^{-9}	1.76×10^{-9}
9/26/65	5.35×10^{-9}	8.09×10^{-9}	2.14×10^{-9}
10/03/65	5.75×10^{-9}	1.00×10^{-8}	3.18×10^{-9}
10/10/65	6.97×10^{-9}	1.24×10^{-8}	3.35×10^{-9}
10/17/65	6.01×10^{-9}	1.06×10^{-8}	3.11×10^{-9}
10/24/65	6.27×10^{-9}	1.58×10^{-8}	2.26×10^{-9}
10/31/65	8.94×10^{-9}	5.31×10^{-8}	3.43×10^{-9}
11/07/65	7.99×10^{-9}	1.37×10^{-8}	5.46×10^{-9}
11/14/65	1.93×10^{-8}	8.08×10^{-8}	5.31×10^{-9}
11/21/65	4.08×10^{-8}	2.85×10^{-7}	3.90×10^{-9}
11/28/65	1.58×10^{-8}	2.73×10^{-8}	9.63×10^{-9}

TABLE 2A Cont.

WATER SAMPLES (Values in terms of $\mu Ci/cc$)			
DATE (Week ending)	MEAN	RANGE	
		MAXIMUM	MINIMUM
12/05/65	8.51×10^{-9}	3.37×10^{-8}	3.50×10^{-9}
12/12/65	4.83×10^{-9}	2.00×10^{-8}	2.52×10^{-9}
12/19/65	2.51×10^{-9}	6.55×10^{-9}	3.49×10^{-10}
12/26/65	2.50×10^{-9}	1.34×10^{-8}	2.96×10^{-10}
1/02/66	6.61×10^{-9}	8.83×10^{-9}	4.62×10^{-9}
1/09/66	2.52×10^{-9}	1.06×10^{-8}	2.10×10^{-9}
1/16/66	5.51×10^{-9}	7.03×10^{-9}	3.07×10^{-9}
1/23/66	6.67×10^{-9}	1.85×10^{-8}	3.12×10^{-9}
1/30/66	4.83×10^{-9}	8.19×10^{-9}	3.05×10^{-9}
2/06/66	3.82×10^{-9}	7.94×10^{-9}	2.35×10^{-9}
2/13/66	4.43×10^{-9}	1.49×10^{-8}	2.89×10^{-9}
2/20/66	2.17×10^{-9}	6.42×10^{-9}	2.00×10^{-9}
2/27/66	4.45×10^{-9}	1.01×10^{-8}	2.61×10^{-9}
3/06/66	4.01×10^{-9}	6.76×10^{-9}	1.90×10^{-9}
3/13/66	3.42×10^{-9}	5.64×10^{-9}	2.01×10^{-9}
3/20/66	4.08×10^{-9}	8.96×10^{-9}	2.47×10^{-9}
3/27/66	4.03×10^{-9}	7.45×10^{-9}	2.96×10^{-9}
4/03/66	8.10×10^{-9}	6.99×10^{-8}	2.57×10^{-9}
4/10/66	4.04×10^{-9}	7.80×10^{-9}	1.77×10^{-9}
4/17/66	3.57×10^{-9}	6.88×10^{-9}	3.13×10^{-9}
4/24/66	5.13×10^{-8}	3.41×10^{-7}	1.77×10^{-9}
5/01/66	5.65×10^{-9}	8.68×10^{-9}	2.53×10^{-9}
5/08/66	4.19×10^{-9}	6.98×10^{-9}	3.38×10^{-9}
5/15/66	5.32×10^{-9}	9.97×10^{-9}	1.61×10^{-9}
5/22/66	6.07×10^{-9}	1.06×10^{-8}	3.15×10^{-9}
5/29/66	4.35×10^{-9}	6.40×10^{-9}	2.56×10^{-9}
6/05/66	1.23×10^{-8}	6.57×10^{-8}	3.59×10^{-9}
6/12/66	1.50×10^{-8}	3.08×10^{-8}	7.39×10^{-9}
6/19/66	1.40×10^{-8}	3.67×10^{-8}	8.87×10^{-9}

TABLE 3

MEANS AND RANGES OF GROSS BETA RADIOACTIVITY IN NTS ENVIRONMENTAL AIR SAMPLING STATION LOCATIONS FROM JULY 1965 THROUGH JUNE 1966

STATION NUMBER AND LOCATION	MEAN	RANGE	
		MAXIMUM	MINIMUM
1. Old Mousehouse	1.10×10^{-13}	1.63×10^{-12}	1.99×10^{-14}
2. NRDS H-8 Complex	7.75×10^{-14}	1.63×10^{-12}	1.81×10^{-14}
3. Area 3 Cafeteria	1.06×10^{-13}	2.05×10^{-12}	2.28×10^{-14}
4. Area 5 Reservoir	1.16×10^{-13}	3.17×10^{-12}	1.92×10^{-14}
5. Area 6 Cafeteria	1.57×10^{-13}	1.69×10^{-12}	1.38×10^{-14}
6. Area 9 Dispensary	1.08×10^{-13}	4.16×10^{-13}	1.05×10^{-14}
7. Area 12 Cafeteria	1.49×10^{-13}	2.24×10^{-12}	1.45×10^{-14}
8. Area 18 Camp 17	2.19×10^{-13}	3.93×10^{-12}	2.02×10^{-14}
9. Area 18 Airstrip	1.80×10^{-13}	5.23×10^{-13}	7.97×10^{-14}
10. Area 20 Dispensary	1.77×10^{-13}	1.95×10^{-12}	1.81×10^{-15}
11. Area 51 Cafeteria	1.20×10^{-13}	2.17×10^{-12}	9.15×10^{-15}
12. 250 Guard Station	9.79×10^{-14}	1.51×10^{-12}	9.66×10^{-15}
13. Area 27 Cafeteria	1.47×10^{-13}	1.52×10^{-12}	2.58×10^{-14}
14. 700 Guard Station	1.76×10^{-13}	1.99×10^{-12}	4.46×10^{-15}

TABLE 4

WATER SAMPLING STATION LOCATIONS

AREA	STATION LOCATION	SAMPLE TYPE[(a)]	FREQUENCY[(b)]	MAP CODE
2	Well 2 Reservoir	IW	Mo	2/a
3	Cafeteria	PW	Wk	3/a
	Well "A" Reservoir	IW	Mo	3/b
5	Well 5B	IW	Mo	5/a
	Cane Springs	IW	Mo	5/b
6	Camp Cafeteria	PW	Wk	6/a
	Well 3 Reservoir	IW	Mo	6/b
	CP Waste Pond	MW	Mo	6/c
9	Dispensary	PW	Wk	9/a
12	Cafeteria	PW	Wk	12/a
	White Rock Springs	IW	Mo	12/b
	Upper Haines Lake	MW	Mo	12/c
	Lower Haines Lake	MW	Mo	12/d
15	USPHS Reservoir	IW	Mo	15/a
16	Tippipah Spring	IW	Mo	16/a
18	Dispensary	PW	Wk	18/a
	Camp 17 Reservoir	IW	Mo	18/b
	Well 8 Reservoir	IW	Mo	18/c
20	Dispensary	PW	Wk	20/a
23	Cafeteria	PW	Wk	23/a
	Swimming Pool	MW	Mo	23/b
25	NRDS Cafeteria	PW	Wk	25/a
	Fortymile Canyon Spring	IW	Mo	25/b
	CP Water Tower	IW	Mo	25/c
	Well J-12	MW	Mo	25/d
27	Cafeteria	PW	Wk	27/a
51	Cafeteria	PW	Wk	51/a
	Swimming Pool	MW	Mo	51/b
	Well 3	MW	Mo	51/c
	Papoose Lake	MW	Mo	51/d

(a) IW = Industrial Water, PW = Potable Water, MW = Miscellaneous Water

(b) WK = Weekly, Mo = Monthly

TABLE 5A

SAMPLING PERIOD MEANS AND RANGES OF
GROSS BETA RADIOACTIVITY IN MONTHLY ENVIRONMENTAL
INDUSTRIAL WATER SAMPLES FROM NTS
FEBRUARY 1965 THROUGH JUNE 1966

WATER SAMPLES (Values in terms of μCi/cc)			
DATE (Month)	MEAN	RANGE	
		MAXIMUM	MINIMUM
2/65	8.70×10^{-9}	5.2×10^{-8}	1.7×10^{-9}
3/65	1.40×10^{-8}	9.0×10^{-8}	3.5×10^{-9}
4/65	1.30×10^{-8}	5.0×10^{-8}	3.8×10^{-9}
5/65	6.20×10^{-9}	1.1×10^{-8}	1.8×10^{-9}
6/65	1.10×10^{-8}	4.7×10^{-8}	1.7×10^{-9}
7/65	8.90×10^{-9}	5.23×10^{-8}	4.21×10^{-9}
8/65	2.05×10^{-8}	1.14×10^{-7}	4.76×10^{-9}
9/65	4.47×10^{-9}	1.34×10^{-8}	2.09×10^{-9}
10/65	6.06×10^{-9}	1.58×10^{-8}	3.07×10^{-9}
11/65	1.51×10^{-8}	2.51×10^{-8}	4.82×10^{-9}
12/65	6.40×10^{-9}	1.39×10^{-8}	1.82×10^{-9}
1/66	5.96×10^{-9}	1.51×10^{-8}	2.62×10^{-9}
2/66	5.65×10^{-9}	1.12×10^{-8}	2.89×10^{-9}
3/66	6.38×10^{-9}	1.18×10^{-8}	3.44×10^{-9}
4/66	9.40×10^{-9}	2.52×10^{-8}	4.51×10^{-9}
5/66	9.39×10^{-9}	2.16×10^{-8}	4.19×10^{-9}
6/66	1.03×10^{-8}	4.48×10^{-8}	6.12×10^{-9}

TABLE 5B

DESCENDING MEANS OF GROSS BETA RADIOACTIVITY IN MONTHLY ENVIRONMENTAL INDUSTRIAL WATER SAMPLES FROM NTS JULY 1965 THROUGH JUNE 1966

SAMPLE LOCATION	MEAN
AREA 15, USPHS RESERVOIR	1.85×10^{-8}
AREA 6, WELL 3 RESERVOIR	1.61×10^{-8}
AREA 12, WHITE ROCK SPRING	1.52×10^{-8}
AREA 25, CP WATER TOWER	1.28×10^{-8}
AREA 16, TIPPIPAH SPRING	1.10×10^{-8}
AREA 5, WELL 5B RESERVOIR	1.09×10^{-8}
AREA 3, WELL "A" RESERVOIR	9.65×10^{-9}
AREA 5, CANE SPRING	9.64×10^{-9}
AREA 25, FORTY-MILE CANYON SPRING	9.38×10^{-9}
AREA 2, WELL 2 RESERVOIR	6.50×10^{-9}
AREA 18, WELL 8 RESERVOIR	6.36×10^{-9}
AREA 18, CAMP 17 RESERVOIR	5.04×10^{-9}

TABLE 5C

DETECTABLE ALPHA AND BETA ACTIVITY

Means and ranges of detectable alpha and beta activity in eight miscellaneous water sample locations for fiscal year July 1965 through June 1966.

LOCATION	NO. OF SAMPLES	ALPHA (μCi/cc) MEAN	ALPHA (μCi/cc) RANGE	BETA (μCi/cc) MEAN	BETA (μCi/cc) RANGE
MERCURY SWIMMING POOL	9	None	Detected	4.72×10^{-9}	3.22×10^{-9} through 7.51×10^{-9}
GROOM LAKE SWIMMING POOL	11	None	Detected	1.58×10^{-8}	3.31×10^{-9} through 1.96×10^{-7}
WELL J-12	8	None	Detected	8.14×10^{-9}	3.05×10^{-9} through 5.30×10^{-8}
WELL 3	10	None	Detected	9.12×10^{-9}	5.19×10^{-9} through 6.30×10^{-7}
CP WASTE POND	11	None	Detected	6.82×10^{-7}	2.69×10^{-7} through 3.33×10^{-6}
UPPER HAINES LAKE	12	2.82×10^{-9}	9.52×10^{-10} through 7.60×10^{-9}	2.94×10^{-6}	4.88×10^{-7} through 7.22×10^{-6}
LOWER HAINES LAKE	12	2.56×10^{-9}	1.55×10^{-10} through 1.23×10^{-8}	3.21×10^{-6}	4.22×10^{-7} through 5.36×10^{-6}
PAPOOSE LAKE	11	None	Detected	8.48×10^{-8}	7.58×10^{-9} through 3.99×10^{-7}

TABLE 6

GROSS BETA ACTIVITY[1]

(of Soil and Vegetation Samples for Fiscal Year 1966)

SAMPLE(2) STATION	AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MEAN		MEAN	
	Soil	Veg.	Soil	Veg.	Soil	Veg.	Soil	Veg.	Soil	Veg.	Soil	Veg.	Soil	Veg.	Soil	S.D.	Veg.	S.D.
1	6	15	9	5	5	20	10	18	5	9	7	9	4	7	6	2	12	5
2	3	12	8	11	5	14	24	11	14	12	5	2	5	7	9	7	10	4
3	3	9		19		11	37	10	4	5	5	9	4	8	11	15	10	4
4	6	22	2	18	9	13			3		2	13	3	6	4	3	14	6
5	15	32	18	13	3	1	3	8	86	10	6	11	9	8	20	21	12	8
6	10	7	4	14	6	9	15	5	7	7	15	8	6	7	9	4	8	3
7	18	19	13	13	14	15	15	8	72	5	13	18	12	6	22	20	12	5
8	20	17	17	9	12	20	118	15	118	5	2	35	16	14	43	53	16	9
9	6	11	7	17	11	8	9	13	39	14	9	7	8	6	13	11	11	4
10	5	13	13	5	4	16	2	8	2	5	5	5	2	3	5	4	8	4
11	9	12	9	12	13	8	8	8	8	2	4	6			8	2	8	4
12	9	14	11	14	10	11	5	8	14	9	15	3	8	5	10	3	9	4
13	4	16	9	9	12	14	10	5	9	4	8	6	12	6	9	3	9	5
14	5	12	10	12	9	9	11	11	15	13	7	9			9	3	11	2
15	9	5	7	7		6		8	5	9	4	4			6	2	7	2
16	10	10	1	12	4	8	6	4	8	8	4	8			5	4	8	2
17	1	4	1	7	1	8	5	8	1	23	7	9			3	3	10	7
18	4	15	4	20	4	10	6	14	19	10	9	4	5	6	8	5	11	5
19	8	13	10	13	6	12	10	6	25	8	8	4	6	7	11	6	9	4
20	16	5	5	33	32	29	36	5	34	6	33	4	15	17	24	10	14	11
21	5	22	41	16	4	20	5	11	3	3	6	6	6	6	10	13	12	7
22	4	13	9	11	3	7	169	10	4	9	12	3			34	66	9	4
23	8	12	11	14	9	27	6	11	10	5	16	2	8	9	10	2	11	8
Mean	8	14	10	13	8	13	24	9	22	8	9	8	8	8	13		11	
S.D.	5	6	8	6	6	7	41	4	29	5	7	7	4	4				

(1) Activity is expressed as picocuries per gram of soil and plant material (dry weight).

(2) For location see Figure 10.

APPENDIX A

STATISTICAL TREATMENT OF DATA

A. 1 Geometric Mean

The frequency distribution of radioactivity results for air and water samples indicated a positive skew, a degree of distortion from symmetry of a normal curve. This type of asymmetrical distribution is caused by the extremes in the higher values distorting the curve towards the right.

The data must therefore be handled by logarithmic transformation to obtain normality, and treated as normally distributed random variables.

Hence, an estimate of the true mean of a sample type is calculated by:

$$\overline{X} = \log^{-1}\left[\frac{\Sigma \log X_1}{N} + \frac{S^2}{2}\right]$$

when: X_1 = observed value

N = number of observations

S^2 = variance of log value

Though the geometric mean is not widely known and is relatively tedious to compute, its relative advantage is that it is a more typical average than the arithmetic mean since it is less affected by extremes.

A. 2 Radioactivity of a Sample

The radioactivity of a sample (X) is indicated in the equation:

$$X = \frac{R_s - R_b}{A\ B\ C}$$

where:
- R_s = gross count rate of sample, c/m
- R_b = background count rate, c/m
- A = counting efficiency for a particular counter (cpm/dpm)
- B = conversion factor (2.22 dpm — pCi or 2.22×10^6 dpm — μCi)
- C = subsample amount, cc, liter, or gram

The associated percent counting error at the 2-sigma confidence level ($\%E_{2\sigma}$) for each radioactivity value (X) was:

$$\%E_{2\sigma} = \frac{100Z}{R_s - R_b}\left[\frac{R_s}{T_s} + \frac{R_b}{T_b}\right]^{1/2}$$

where: Z = 2, the number of standard deviations for the confidence interval (95.4%)

T_s = sample count interval, minutes

T_b = background count interval, minutes

The radioactivity of a sample was considered statistically significant if the net count rate of the sample was greater than the detection limit, i.e., two times the net count for which the two-sigma error was 100 percent.

The detection limit was computed by formula:

$$DL = \frac{2Z}{A\ \ B\ \ C}\left[\frac{d + R_b}{T_s} + \frac{R_b}{T_b}\right]^{1/2}$$

where: d = net count rate for which the 2-sigma error is 100.

Any activity value which was equal to or less than the detection limit was recorded as zero.