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ENVIRONMENTAL RADIOACTIVITY AT THE NEVADA TEST SITE

July, 1966 through June, 1967

#49

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AN EG&G COMPANY

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The Environmental Surveillance group of the Radiological Sciences Department collected all samples, prepared the initial text and provided technical guidance during the final preparation of the report. Laboratory analysis was performed by the Department's Laboratory Operations group and the Reports Coordination group prepared the various figures, edited the text, and coordinated the final preparation of the report.

ABSTRACT

This report contains a summary of the data obtained concerning the radiological conditions in the environment of the Nevada Test Site (NTS) from July, 1966 through June, 1967.

The Environmental Surveillance Group performed routine and special surveys of the NTS. Samples of air and water were collected for laboratory analysis from living quarters, administrative buildings, and cafeterias. Additionally, samples of water from waste ponds, sewage basins, reservoirs, springs, and wells were collected on a routine basis to determine normal levels of radioactivity or any change of radioactivity. Air samples were also routinely collected at selected locations throughout NTS for the same purpose as for water samples. All environmental samples were analyzed routinely for gross alpha, beta, and gamma radioactivity. Significant increases or changes in the radioactivity levels of these samples were reported to the appropriate field monitoring groups for investigation and remedial action. All samples were documented by the Environmental Surveillance Branch for record purposes and for comparison with previous results to determine trend and correlation where feasible.

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SECTION 1

AIR SAMPLING

1.1 Introduction

The Environmental Surveillance Group maintains low-volume, continuously-operating air samplers at 20 permanent locations (Figure 1 and Table 1) situated to provide monitoring of the particulate airborne radioactivity 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 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. The flow rate of air through the filter is maintained at approximately four cubic feet per 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 occurring 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 each. A Baird Atomic SPECTROMETER was used for determination of 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 Measurements Laboratory, were compared with an established "alert level." The determination of the alert level is based on the radiation concentration guide (RCG) as outlined in AEC Manual Chapter 0524. The alert level for beta activity 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 RCG 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 high concentration is valid.

1.4 Data Discussion

The means and ranges of gross beta radioactivity in weekly collections of air samples from the 20 permanent locations from July, 1966 through June, 1967 are tabulated in Table 2 and plotted in Figure 2. During this fiscal year (July, 1966 through June, 1967) no sample activity value exceeded the alert level of 1×10^{-11} μCi/cc in air. The highest value recorded for beta radioactivity occurred in the air sample collected from Area 28, HENRE Site (Figure 1) for the third week in January, 1967. This value, 2.55×10^{-11} μCi/cc, is above the established limit. However, investigations of the circumstances of this sample indicate that fallout from foreign weapons testing was the principal contributor. Fluctuations for this fiscal year followed a trend of decrease in activity values from July, 1966 until about November which were periods of reduced testing operations. There were significant peaks in activity values in November, 1966 and in January, 1967. The high activity values in November may be correlated with fallout from foreign weapons tests. The high activity values in January were also due to foreign weapons tests plus some contribution from NTS testing activities.

Figure 3 and Table 3 show the plotted means and ranges for each of the mean values of all 20 sampling locations averaged 1.02×10^{-13} μCi/cc. This value is lower than the mean value observed for all samples collected for the previous year which averages 1.37×10^{-13} μCi/cc.*

The highest observed mean value for a sampling location was 3.60×10^{-13} μCi/cc in Area 16, Tunnel Pad, and the lowest was 1.89×10^{-14} μCi/cc in the Area 1 Gravel Pit. 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 usually the result of a single high or low value. These extreme values did not drastically affect the mean values 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. Although 23% 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 this report period indicated levels less than background. Except for the sampling periods in November, 1966 and January, 1967, 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 the samples in November and January indicated that their origin was from foreign weapons testing. 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 895 air samples collected this year was 1.02×10^{-13} μCi/cc. For the same sampling period during the previous year, this value was 1.37×10^{-13} μCi/cc based upon a total of 613 air samples collected from 14 locations within the NTS.

1.5 Summary

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

Results of environmental surveillance in sampling activity values obviously cannot be used in calculating personnel exposure doses. They are instead used as an index and in the detection of trends, and emphasis is either sustained or shifted to other sample types whenever significant changes in levels are noted.

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*Staff report, "Environmental Radioactivity at the Nevada Test Site July, 1965 through June, 1966," NVO-162-25, Radiological Sciences Department, Reynolds Electrical & Engineering Co., Inc., November, 1966.

SECTION 2

Water Sampling

2.1 Introduction

Water samples were collected from selected waste ponds, reservoirs, sewage basins, natural springs, wells, 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 water was collected near the inlet points of the reservoirs, while the natural spring water samples were "grab" samples obtained by dipping at the surface.

2.3 Sample Preparation

All water samples were analyzed for gross beta and tritium concentrations. 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 counted. 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 preparation laboratory, the samples were sent to the counting laboratory and counted for beta. When indicated, one-liter samples of water are submitted for gamma spectrum analysis.

2.4 Counting Procedures

All routine environmental water samples were analyzed for beta radioactivity by gas proportional counting. The water samples were analyzed by a Beckman WIDEBETA system equipped with an automatic sample changer. The efficiency, i.e., the ratio of observed counts to known disintegrations, on the WIDEBETA system, was 57% for beta. The average background count rate was 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 Potable Water Samples

The statistical breakdown for potable water samples for fiscal year 1967 was based upon nine sampling locations (Table 4 and Figure 4), taken on a weekly basis.

Table 5 and Figure 5, and Table 6 and Figure 6 give the means and ranges for gross beta activity from July, 1966 through June, 1967. The means ranged from 2.66×10^{-9} μCi/cc recorded on January 8, 1967 to 1.65×10^{-8} μCi/cc recorded on September 18, 1966. The maximum value for the year was 5.67×10^{-7} μCi/cc recorded September 18, 1966, at the Area 20 Dispensary. The average mean for fiscal year 1967 was 3.77×10^{-9} μCi/cc as compared with the mean for fiscal year 1966 of 6.29×10^{-9} μCi/cc. The current year's value is smaller than that of last year and is also well below the RCG level of 1.0×10^{-7} μCi/cc. This value is based on the guides listed in AEC Manual chapter 0524. There was a total of three potable water samples collected during the year which were at or slightly exceeded the recommended guide level.

2.5.2 Natural Springs Water Samples

The term "natural springs" encompasses most of the naturally occurring spring-fed pools occurring within the NTS. Although these springs may be used infrequently as drinking water by some individuals, they are considered as a separate classification from potable water sources. Such water may also be used from time to time for such industrial purposes as watering roads, washing down equipment, and for mixing drilling mud. In an effort to adequately cover the Test Site, eight sampling locations have been selected (Figure 7 and Table 7). All of these stations were sampled once a month.

Table 8 and Figure 8 show the means and ranges for gross beta activity over a twelve month period. The means ranged from 7.40×10^{-9} μCi/cc recorded on December 18, 1966, to 1.46×10^{-8} μCi/cc recorded on March 19, 1967. The maximum value for the twelve

month period was 7.81×10^{-8} μCi/cc which was recorded on September 18, 1966, in Area 12, Gold Meadows Spring. The average mean for fiscal year 1967 was computed at 1.27×10^{-8} μCi/cc which was higher than the average mean for fiscal year 1966 which was 1.02×10^{-8} μCi/cc. (Refer to footnote at the end of Section 1.)

No natural springs water sample collected during fiscal year 1967 exceeded the RCG of 1.0×10^{-7} μCi/cc. However, it is noteworthy that the maximum sample value recorded for Gold Meadow Springs was in an area where there is a maximum potential for Test Site originated fallout due to venting, and also would be expected to collect the maximum fallout from foreign weapons testing since it is completely open to the atmosphere.

2.5.3 Open Reservoir Water Samples

Open reservoirs have been created throughout the NTS to furnish a ready supply of water for various industrial purposes. Twelve of these reservoirs have been selected as sampling locations (Figure 10 and Table 10). All of these locations are routinely sampled once a month.

Table 11 and Figure 11 give the means and ranges for gross beta activity over the twelve month period of fiscal year 1967. The means ranged from a low of 4.49×10^{-9} μCi/cc recorded on September 18, 1966, to a high of 1.37×10^{-8} recorded on April 16, 1967. The maximum recorded value for this reporting period was 3.94×10^{-8} μCi/cc which was recorded in May of 1967 at Groom Lake, Well 4 Reservoir. The average mean for fiscal year 1967 was computed at 8.00×10^{-9} μCi/cc which was lower than the mean for fiscal year 1966 which was 1.02×10^{-8} μCi/cc.

All open reservoir water samples collected during fiscal year 1967 were well below the RCG of 1.0×10^{-7} μCi/cc.

2.5.4 Supply Wells Water Samples

Thirteen supply wells were sampled on the NTS during fiscal year 1967 (Figure 13 and Table 13). Water from these and other wells throughout the Test Site is used for a variety of purposes ranging from sanitary water supply to drilling mud preparation. The criteria for selecting particular wells to be sampled was based not only upon their potential use for human

consumption but also upon their value as an index for measuring the possible movement of radioactive contamination in the aquifer. Most of these wells are located in areas where the movement of water in the aquifer is from known contaminated underground test sites. To date no data have been obtained that would indicate that the ground water at any well sampling location has been significantly affected by movement of contamination through the aquifer.

Table 14 and Figure 14 give the means and ranges for gross beta activity over a ten month period from September, 1966 through June, 1967. Samples for July and August, 1966 were lost due to cross-contamination during laboratory analysis. The means of sample activity for the ten month period ranged from a low of 4.91×10^{-9} μCi/cc recorded on January 5, 1967 to a high of 1.28×10^{-8} μCi/cc recorded on April 9, 1967. The maximum sample value for the ten month period was 3.24×10^{-8} μCi/cc recorded on March 19, 1967 in Area 15, Well Ue15d. The average mean for fiscal year 1967 was computed at 7.26×10^{-9} μCi/cc which is substantially lower than the average mean of 1.02×10^{-8} μCi/cc for fiscal year 1966.

As was pointed out previously, all sample values were well below any level of concern and did not exceed the RCG of 1.0×10^{-7} μCi/cc.

2.5.5 Final Effluent Water Samples

Four locations were sampled (Table 16 and Figure 16) all in NTS living areas, to determine what, if any, levels of radioactivity were present in sewage. This program was initiated in October, 1966, and terminated in April, 1967.

Figure 17 and Table 17 give the means and ranges for gross beta activity over the seven month period. The means ranged from a minimum of 1.14×10^{-8} μCi/cc recorded in December, 1966, to a maximum of 2.77×10^{-8} μCi/cc recorded in March, 1967. The maximum value for the seven month period was 5.55×10^{-8} μCi/cc recorded in April, 1967, at the Groom Lake Sewage Pond. The average mean for the sampling period was computed to be 1.56×10^{-8} μCi/cc. This value is well below the RCG of 1.0×10^{-7} μCi/cc.

2.5.6 Miscellaneous Water Samples

There were six mixcellaneous water sampling locations

sampled during fiscal year 1967. Each location had some unique characteristics that removed it from the preceding groups, and, because of this, each location has been treated separately.

The first two areas to be discussed are the Mercury swimming pool in Area 23 and the Groom Lake Station 2. Both pools are unique in that the water is constantly being filtered. The swimming pool in Mercury is open to atmospheric fallout at all times, while the Station 2 at Groom Lake is enclosed but dust from the outside can still be carried in and dispersed in the water.

The next group of related sample locations comprises 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 in 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 also in 1967. It has continued to discharge contaminated seepage water. Like the CP waste pond, these reservoirs are controlled radiation zones. Papoose Lake is the only natural drainage basin on the Test Site which is continually sampled. Any contamination which shows up there is the result of airborne surface material or atmospheric fallout from past atmospheric detonations.

Table 19 gives the means and ranges for all six locations based on samples collected once a month over a twelve-month sampling period except for the CP waste pond. This location was sampled on a quarterly basis only.

SECTION 3

Background Radiation Measurements

3.1 Introduction

Background radiation measurements were obtained at weekly intervals from five sample locations. For a map of these locations see Figure 20. Methods and procedures followed were similar to those used in environmental surveillance programs at other atomic energy sites. The results are similar in that the ranges of values observed correlate well.

3.2 Measurement Methods

Background measurements were obtained using Victoreen Model 239 indirect reading ionization chambers. Five of these chambers were located in a small semi-protective enclosure at each location. The locations chosen were in NTS living areas. This particular model instrument has an effective range of 0-10 mR.

As a back-up for the ionization chambers, standard NTS film dosimeters were also included in each sample location. It is possible that, should a test vent, high levels of radioactivity would be encountered beyond the range of the ionization chambers. Therefore, a higher range dose-measuring device was felt necessary. However, all results from these film dosimeters for the fiscal year 1967 were either zero or lost due to light or heat damage. (No venting problems occurred which would subject the sampling location to dose rates above the ~30 mR minimum detection level of the film dosimeter.)

In view of the extreme environmental conditions at the NTS which adversely affected the film dosimeter response, and since there are other measurement programs available to assess high dose rates from inadvertant venting problems, the use of film dosimeters has been discontinued.

3.3 Analysis Procedures

The ionization chambers were collected on a weekly basis and read on a Victoreen Minometer II reader. Corrections were made for background and for drift - non-radiation induced discharge of the chambers. Two sets of chambers were involved, one set being used at the sample locations for measurements and another set fully charged stored in the laboratory. Each week these sets were exchanged, the fresh set being recharged and a record kept of the amount of "drift" while stored in the laboratory. A specially designed shock proof box was used to transport the chambers to minimize accidental discharge due to mechanical shock.

Readings from the five chambers in each location were averaged to obtain a mean value for each location per week, hence the lack of ranges for observed values in the accompanying figures and tables. Readings from individual chambers which were grossly higher than the others at a particular location were not used in compiling the data since they most probably were the result of shock or other malfunctions and not representative measurements.

3.4 Measurement Results

The statistical breakdown for the background measurements for fiscal year 1967 was based on five sample locations on a weekly basis (Table 20 and Figure 20). Individual sample location results are plotted in Figures 20 through 24. Results are tabulated in Table 21.

The results presented in Table 21 reflect a reasonably stable ambient background for each of the sampling locations. Unusual fluctuations of the results were attributable to (1) foreign weapons tests, (2) NTS tests which vented, or (3) NRDS reactor runs which contributed measurable airborne contamination in some instances.

Evaluation of these results indicates that no significant radiation hazard existed in the vicinity of the ion chamber locations during the fiscal year 1967. The average gamma radiation measurement for each of the sampling locations was less than 1 mR/day.

TABLE 1

ENVIRONMENTAL SURVEILLANCE
AIR SAMPLING STATION LOCATIONS

AREA	SAMPLE STATION LOCATION	MAP CODE FOR FIGURE 1
1	Gravel Pit	1a
2	Camp Compound	2a
3	North of Cafeteria	3a
5	West of Well 5B Reservoir	5a
	Guard Station 250	5b
6	Aid Station	6a
9	9-300 Bunker	9a
10	Guard Station 700	10a
11	Guard Station 293	11a
12	Changehouse	12a
16	Tunnel Site Maintenance	16a
18	East of Cafeteria	18a
	North of Airstrip	18b
19	Echo Peak	19a
	Stake 19C-10	19b
20	West of Aid Station	20a
23	Building 214	23a
27	West of Dispensary	27a
28	Project HENRE	28a
Groom Lake	East of Station 1	Groom Lake

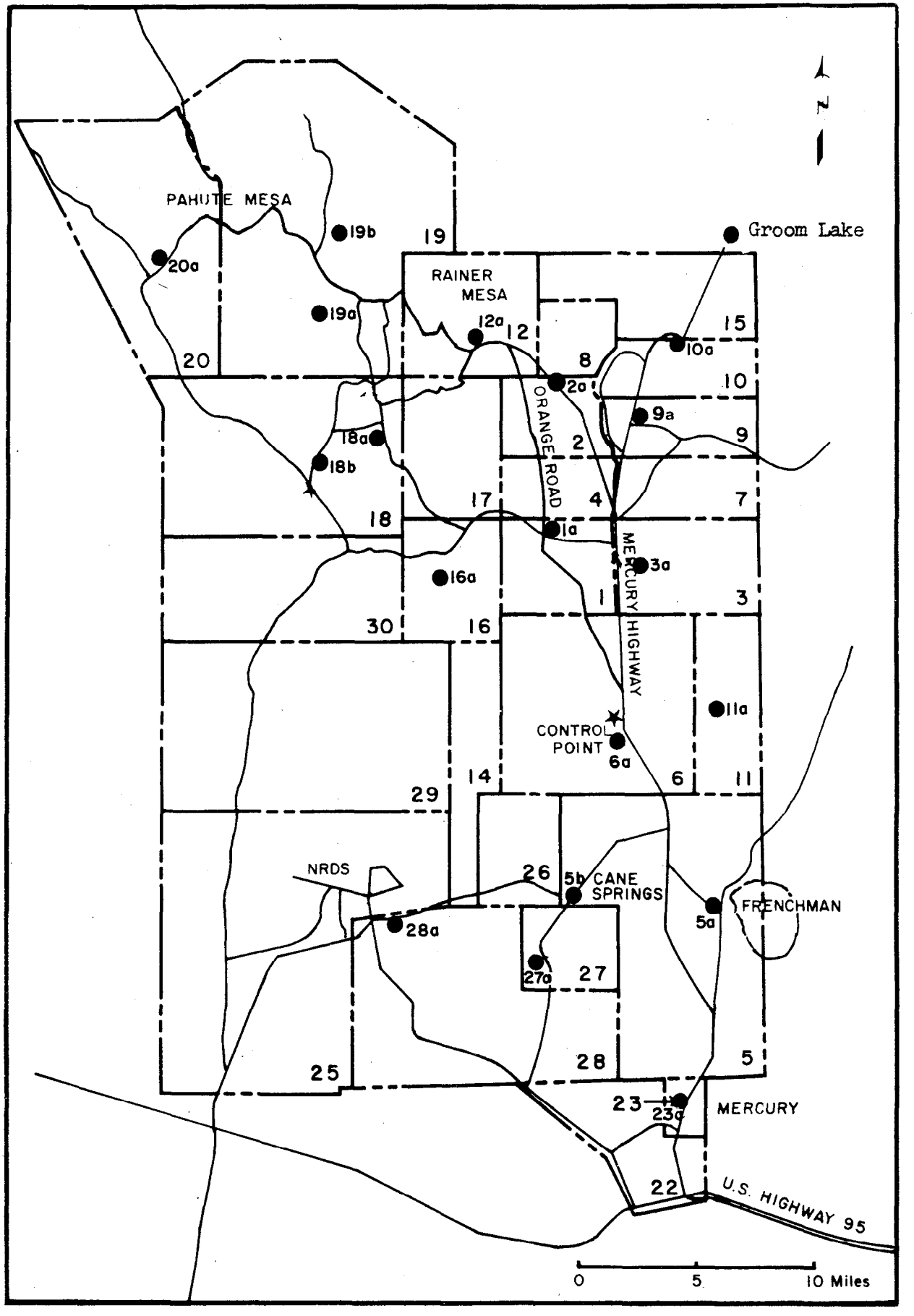

Fig. 1 NTS Environmental Surveillance Air Sampling Locations

TABLE 2

SAMPLING PERIOD MEANS AND RANGES OF
GROSS BETA RADIOACTIVITY IN ENVIRONMENTAL
AIR SAMPLES FROM NTS
JULY, 1966 THROUGH JUNE, 1967

AIR SAMPLES (Values in terms of μCi/cc)			
DATE (Week ending)	MEAN	RANGE	
		MAXIMUM	MINIMUM
07/03/66	3.73×10^{-13}	1.36×10^{-12}	8.21×10^{-14}
07/10/66	1.55×10^{-13}	1.92×10^{-13}	8.46×10^{-14}
07/17/66	1.08×10^{-13}	1.26×10^{-13}	9.37×10^{-14}
07/24/66	1.50×10^{-13}	1.78×10^{-13}	1.25×10^{-13}
07/31/66	9.34×10^{-14}	1.20×10^{-13}	7.95×10^{-14}
08/07/66	6.81×10^{-14}	2.34×10^{-12}	1.36×10^{-14}
08/14/66	5.86×10^{-14}	9.27×10^{-13}	2.24×10^{-14}
08/21/66	9.18×10^{-14}	1.48×10^{-12}	2.26×10^{-14}
08/28/66	6.91×10^{-14}	1.08×10^{-12}	2.16×10^{-14}
09/04/66	9.83×10^{-14}	9.15×10^{-13}	2.37×10^{-14}
09/11/66	5.95×10^{-14}	8.89×10^{-13}	2.05×10^{-14}
09/18/66	5.30×10^{-14}	3.77×10^{-13}	2.16×10^{-14}
09/25/66	5.74×10^{-14}	7.48×10^{-13}	1.61×10^{-14}
10/02/66	7.14×10^{-14}	7.84×10^{-12}	1.27×10^{-14}
10/09/66	6.81×10^{-14}	1.16×10^{-12}	1.31×10^{-14}
10/16/66	4.76×10^{-14}	3.33×10^{-13}	1.90×10^{-14}
10/23/66	4.36×10^{-14}	3.55×10^{-13}	1.46×10^{-14}
10/30/66	6.07×10^{-14}	1.08×10^{-12}	1.85×10^{-14}
11/06/66	7.24×10^{-14}	1.53×10^{-12}	1.73×10^{-14}
11/13/66	2.36×10^{-12}	2.56×10^{-12}	4.29×10^{-13}
11/20/66	2.54×10^{-13}	1.01×10^{-12}	2.65×10^{-14}
11/27/66	7.60×10^{-14}	6.33×10^{-13}	3.38×10^{-14}
12/04/66	1.11×10^{-13}	9.44×10^{-13}	6.38×10^{-14}
12/11/66	7.65×10^{-14}	1.57×10^{-12}	1.45×10^{-14}
12/18/66	4.41×10^{-14}	1.06×10^{-13}	2.12×10^{-14}
12/25/66	4.91×10^{-14}	1.05×10^{-13}	2.79×10^{-14}
01/01/67	7.43×10^{-14}	3.75×10^{-13}	1.12×10^{-14}
01/08/67	2.53×10^{-12}	1.08×10^{-11}	3.14×10^{-13}
01/15/67	8.95×10^{-13}	2.55×10^{-11}	1.69×10^{-13}
01/22/67	8.55×10^{-13}	1.54×10^{-12}	4.63×10^{-13}
01/29/67	3.68×10^{-13}	7.35×10^{-13}	2.11×10^{-13}
02/05/67	2.79×10^{-13}	8.00×10^{-13}	7.11×10^{-14}
02/12/67	2.28×10^{-13}	1.51×10^{-12}	4.20×10^{-14}
02/19/67	3.07×10^{-13}	4.86×10^{-13}	4.33×10^{-14}
02/26/67	1.59×10^{-13}	3.70×10^{-13}	1.77×10^{-14}
03/05/67	1.01×10^{-12}	2.92×10^{-12}	2.05×10^{-14}
03/12/67	2.31×10^{-13}	3.37×10^{-13}	1.55×10^{-13}

TABLE 2 (Contd)

AIR SAMPLES (Values in terms of $\mu Ci/cc$)

DATE (Week ending)	MEAN	RANGE	
		MAXIMUM	MINIMUM
03/19/67	2.47×10^{-13}	1.19×10^{-12}	3.10×10^{-14}
03/26/67	1.75×10^{-13}	2.26×10^{-13}	1.31×10^{-13}
04/02/67	2.34×10^{-13}	3.01×10^{-13}	1.85×10^{-13}
04/09/67	1.82×10^{-13}	1.83×10^{-13}	8.63×10^{-14}
04/16/67	1.61×10^{-13}	6.55×10^{-13}	5.54×10^{-14}
04/23/67	1.14×10^{-13}	2.59×10^{-13}	7.31×10^{-14}
04/30/67	8.39×10^{-14}	1.05×10^{-13}	1.70×10^{-14}
05/07/67	8.26×10^{-14}	1.21×10^{-13}	4.52×10^{-14}
05/14/67	9.32×10^{-14}	6.44×10^{-13}	3.08×10^{-14}
05/21/67	1.07×10^{-13}	1.23×10^{-13}	2.83×10^{-14}
05/28/67	5.64×10^{-14}	7.32×10^{-14}	2.80×10^{-14}
06/04/67	5.77×10^{-14}	1.07×10^{-13}	1.01×10^{-14}
06/11/67	1.13×10^{-13}	3.05×10^{-12}	5.31×10^{-14}
06/18/67	9.62×10^{-14}	2.95×10^{-13}	3.04×10^{-14}
06/25/67	4.09×10^{-14}	7.83×10^{-14}	2.56×10^{-14}

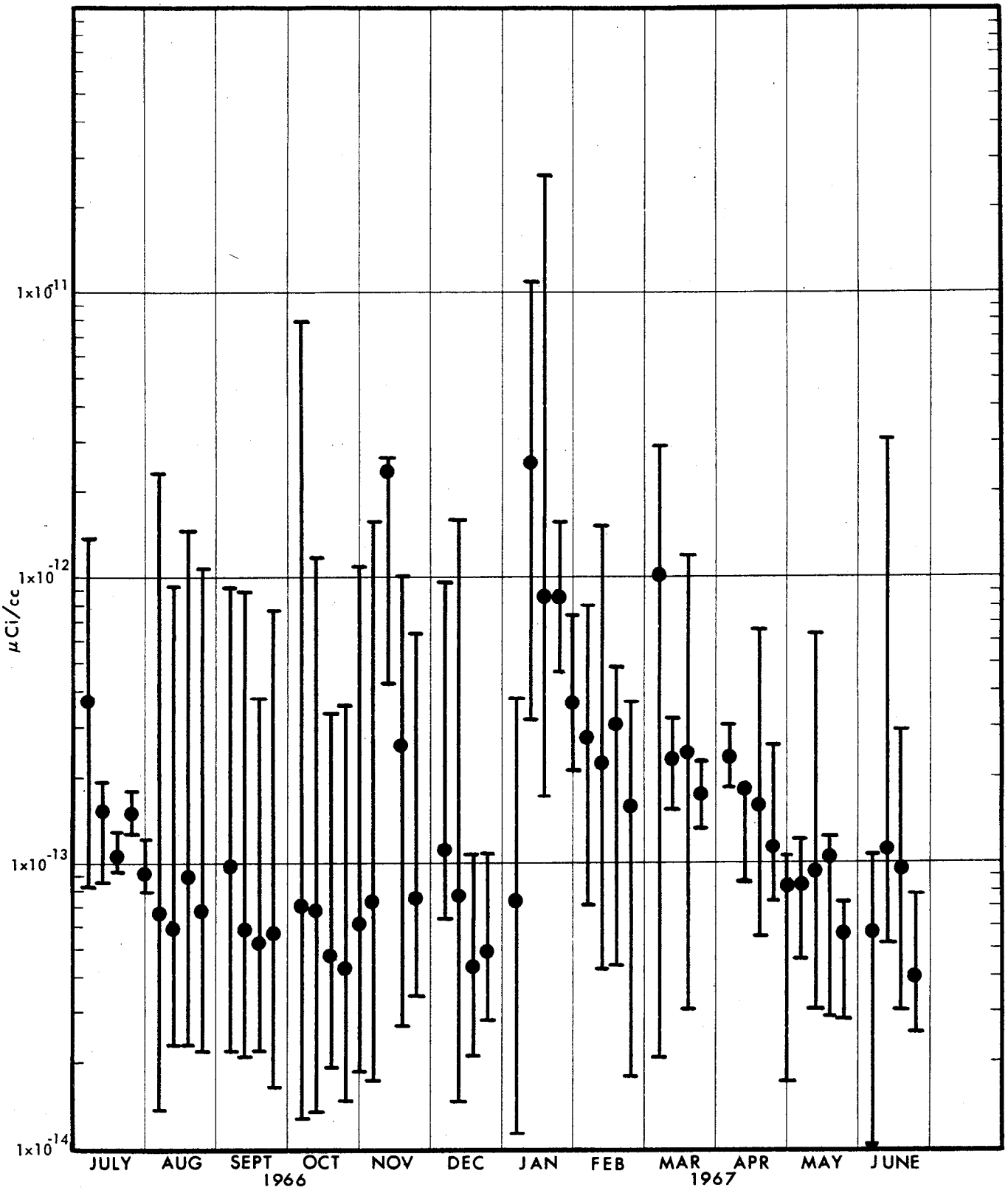

Fig. 2 Weekly Means and Ranges of Gross Beta Radioactivity From July 1966 Through June 1967; Air Sampling

TABLE 3

MEANS AND RANGES OF GROSS BETA RADIOACTIVITY
IN NTS ENVIRONMENTAL AIR SAMPLING STATION LOCATIONS
FROM JULY, 1966 THROUGH JUNE, 1967

AIR SAMPLES (Values in terms of μCi/cc)

STATION NUMBER AND LOCATION	MEAN	RANGE	
		MAXIMUM	MINIMUM
1. Area 1 Gravel Pit	1.89×10^{-14}	2.28×10^{-13}	1.01×10^{-14}
2. Area 2 Compound	1.48×10^{-13}	3.39×10^{-12}	2.86×10^{-14}
3. Area 3 Cafeteria	1.14×10^{-13}	3.69×10^{-12}	1.61×10^{-14}
4. Area 5 Well 5B	7.47×10^{-14}	1.34×10^{-12}	1.61×10^{-14}
5. Area 5 Gate 250	6.49×10^{-14}	3.05×10^{-12}	1.31×10^{-14}
6. Area 6 Campsite	9.89×10^{-14}	3.25×10^{-12}	2.46×10^{-14}
7. Area 9 9-300 Bunker	6.19×10^{-14}	3.01×10^{-12}	2.87×10^{-14}
8. Area 10 Gate 700	1.28×10^{-13}	3.05×10^{-12}	2.42×10^{-14}
9. Area 11 Gate 293	3.61×10^{-14}	2.51×10^{-12}	1.12×10^{-14}
10. Area 12 Changehouse	1.10×10^{-13}	2.58×10^{-12}	2.12×10^{-14}
11. Area 16 Tunnel PAD	3.60×10^{-13}	7.84×10^{-12}	2.68×10^{-14}
12. Area 18 Dispensary	1.06×10^{-13}	2.92×10^{-12}	1.46×10^{-14}
13. Area 18 Airstrip	6.81×10^{-14}	2.15×10^{-12}	1.36×10^{-14}
14. Area 19 Echo Peak	2.17×10^{-14}	7.09×10^{-12}	1.91×10^{-14}
15. Area 19 Stake 196-10	7.01×10^{-14}	2.45×10^{-12}	2.66×10^{-14}
16. Area 20 Dispensary	1.11×10^{-13}	2.70×10^{-12}	1.45×10^{-14}
17. Area 23 Building 214	8.60×10^{-14}	1.41×10^{-12}	1.85×10^{-14}
18. Area 27 Dispensary	9.42×10^{-14}	2.62×10^{-12}	2.87×10^{-14}
19. Area 28 HENRE Site	1.55×10^{-13}	2.55×10^{-11}	2.56×10^{-14}
20. Groom Lake, Station 1	1.12×10^{-13}	4.74×10^{-12}	2.03×10^{-14}

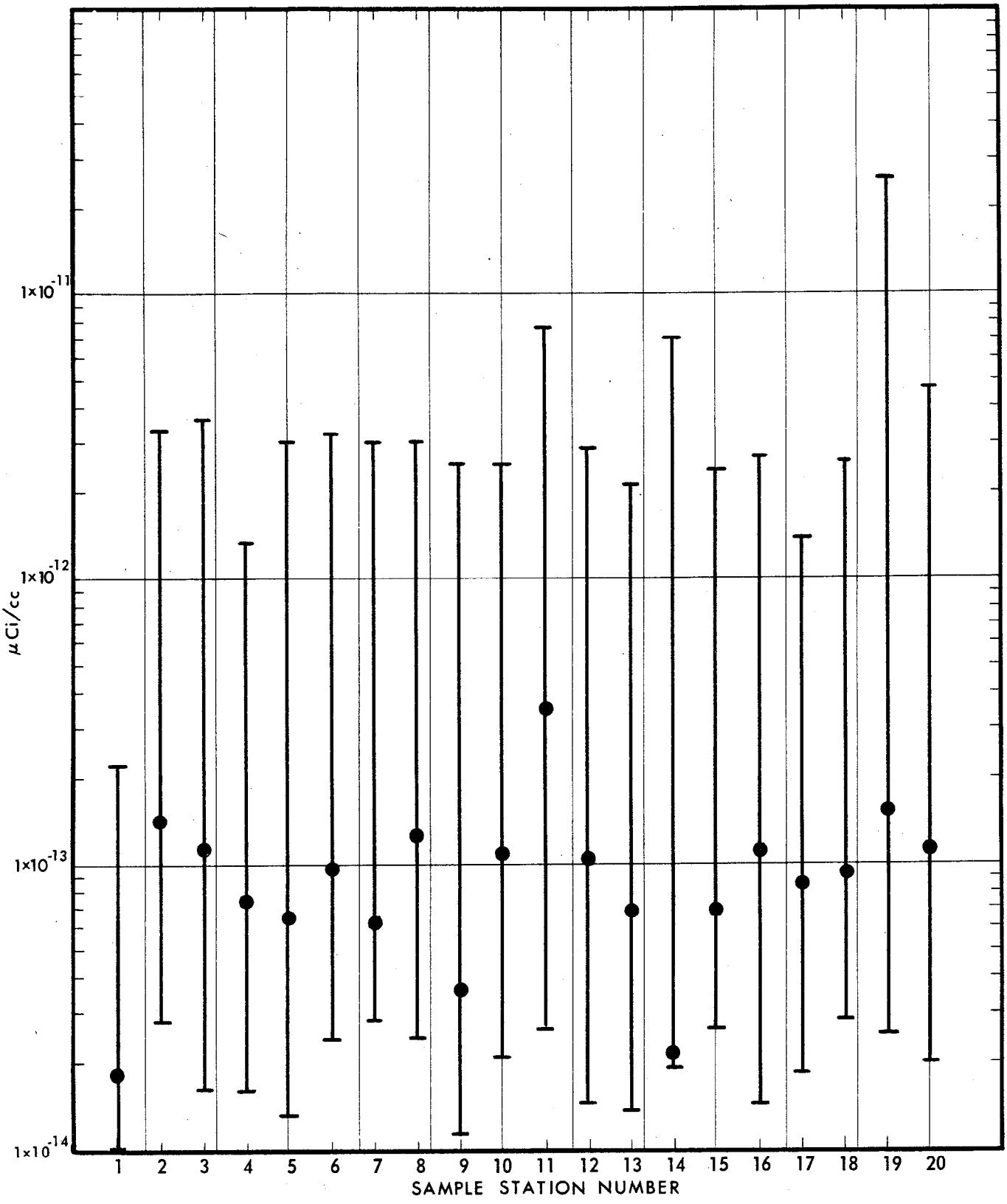

Fig. 3 Means and Ranges of Gross Beta Radioactivity From July 1966 Through June 1967; Air Sampling

TABLE 4

ENVIRONMENTAL SURVEILLANCE
POTABLE WATER SAMPLING STATION LOCATIONS

AREA	SAMPLING STATION LOCATION	MAP CODE FOR FIGURE 4
2	Men's Rest Room	2a
3	Cafeteria	3a
6	Cafeteria	6a
12	Cafeteria	12a
18	Fire Station	18a
20	Dispensary	20a
23	Cafeteria	23a
27	Cafeteria	27a
Groom Lake	Station 1	Groom Lake

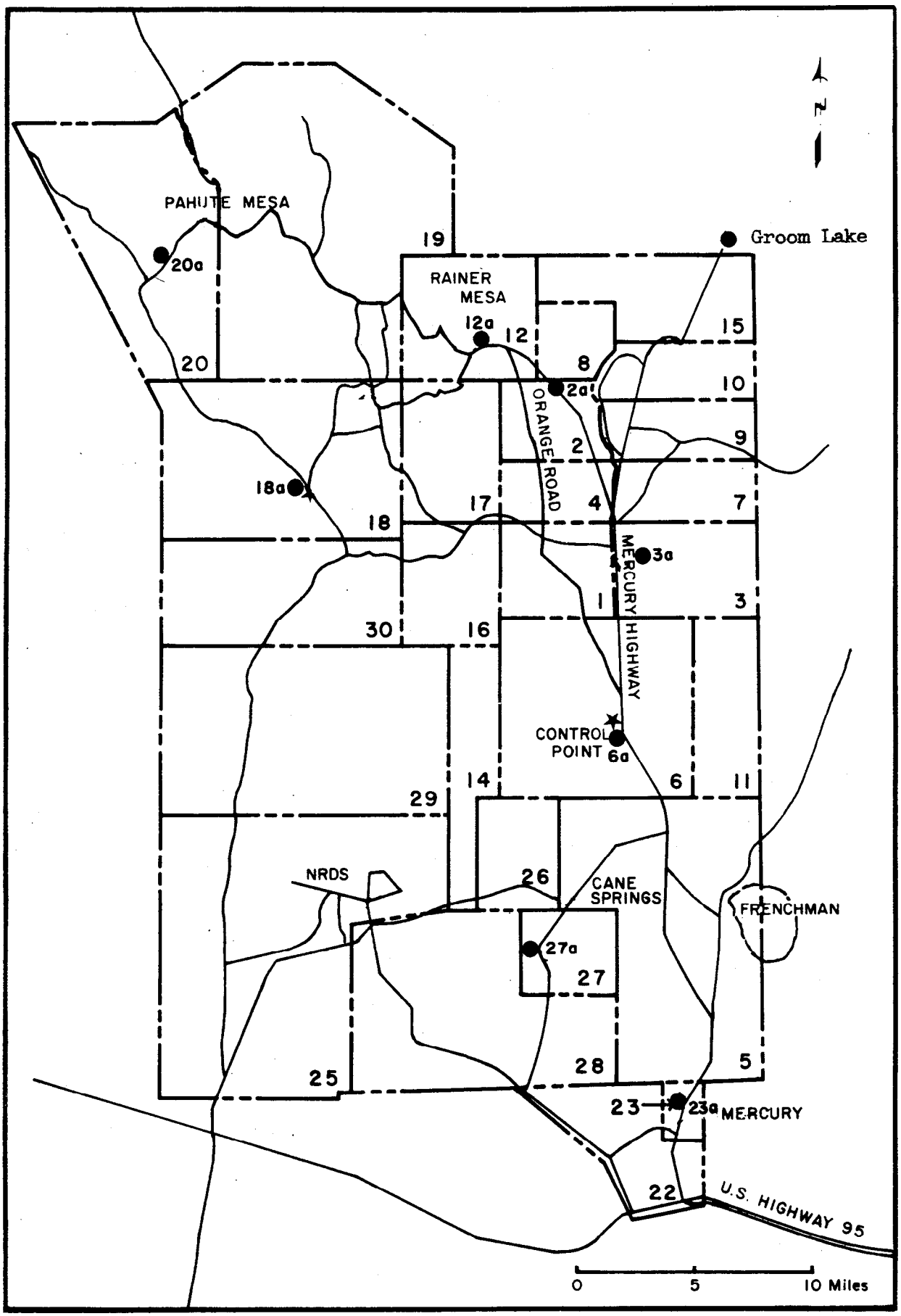

Fig. 4 NTS Environmental Surveillance Potable Water Sampling Locations

TABLE 5

MEANS AND RANGES OF GROSS BETA RADIOACTIVITY
AT NTS ENVIRONMENTAL POTABLE WATER SAMPLING STATION LOCATIONS
FROM JULY, 1966 THROUGH JUNE, 1967

(Values in terms of μCi/cc)

STATION NUMBER AND LOCATION	MEAN	RANGE	
		MINIMUM	MAXIMUM
1. Area 2 Men's Rest Room	3.80×10^{-9}	1.92×10^{-9}	7.38×10^{-9}
2. Area 3 Cafeteria	5.65×10^{-9}	2.52×10^{-9}	1.43×10^{-8}
3. Area 6 Cafeteria	6.79×10^{-9}	1.58×10^{-9}	4.44×10^{-8}
4. Area 12 Cafeteria	3.12×10^{-9}	1.58×10^{-9}	8.92×10^{-9}
5. Area 18 Fire Station	1.87×10^{-9}	1.51×10^{-9}	7.28×10^{-9}
6. Area 20 Dispensary	2.63×10^{-9}	1.59×10^{-9}	1.03×10^{-7}
7. Area 23 Cafeteria	2.42×10^{-9}	2.01×10^{-9}	9.94×10^{-9}
8. Area 27 Cafeteria	2.61×10^{-9}	1.50×10^{-9}	6.94×10^{-9}
9. Groom Lake, Station 1	5.06×10^{-9}	2.15×10^{-9}	1.01×10^{-8}

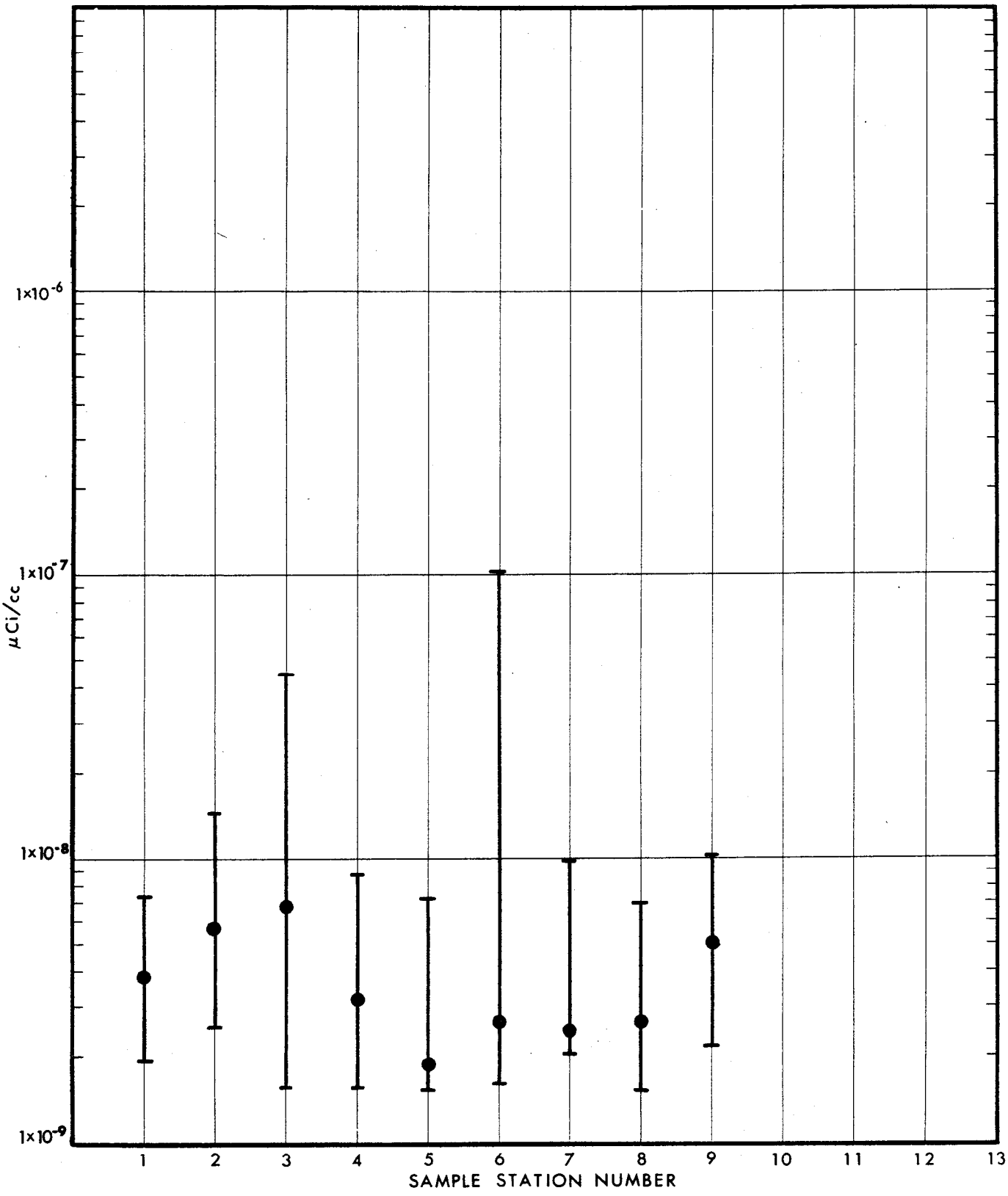

Fig. 5 Means and Ranges of Gross Beta Radioactivity at NTS Environmental Potable Water Sampling Locations From July 1966 Through June, 1967

TABLE 6

MEANS AND RANGES OF GROSS BETA RADIOACTIVITY
AT NTS ENVIRONMENTAL POTABLE WATER SAMPLING STATION LOCATIONS
FROM JULY, 1966 THROUGH JUNE, 1967

(Values in terms of μCi/cc)

DATE (Week ending)	MEAN	RANGE	
		MAXIMUM	MINIMUM
07/03/66	5.61×10^{-9}	9.94×10^{-9}	2.50×10^{-9}
07/10/66	5.19×10^{-9}	8.36×10^{-9}	2.58×10^{-9}
07/17/66	5.43×10^{-9}	8.15×10^{-9}	2.58×10^{-9}
07/24/66	4.25×10^{-9}	8.68×10^{-9}	1.58×10^{-9}
07/31/66	1.21×10^{-8}	1.03×10^{-7}	2.93×10^{-9}
08/07/66	2.96×10^{-9}	5.42×10^{-9}	1.59×10^{-9}
08/14/66	7.21×10^{-9}	4.44×10^{-8}	2.20×10^{-9}
08/21/66	3.66×10^{-9}	6.46×10^{-9}	1.50×10^{-9}
08/28/66	4.06×10^{-9}	8.46×10^{-9}	1.68×10^{-9}
09/04/66	3.38×10^{-9}	7.29×10^{-9}	2.33×10^{-9}
09/11/66	4.25×10^{-9}	6.05×10^{-9}	2.70×10^{-9}
09/18/66	1.65×10^{-8}	5.67×10^{-7}	1.52×10^{-9}
09/25/66	3.67×10^{-9}	6.37×10^{-9}	1.88×10^{-9}
10/02/66	4.33×10^{-9}	7.46×10^{-9}	2.40×10^{-9}
10/09/66	4.76×10^{-9}	1.01×10^{-8}	1.69×10^{-9}
10/16/66	3.75×10^{-9}	6.53×10^{-9}	2.50×10^{-9}
10/23/66	3.71×10^{-9}	6.64×10^{-9}	2.16×10^{-9}
10/30/66	3.42×10^{-9}	6.19×10^{-9}	2.27×10^{-9}
11/06/66	3.53×10^{-9}	7.13×10^{-9}	2.28×10^{-9}
11/13/66	3.42×10^{-9}	5.99×10^{-9}	2.38×10^{-9}
11/20/66	3.30×10^{-9}	4.80×10^{-9}	2.56×10^{-9}
11/27/66	3.46×10^{-9}	7.15×10^{-9}	1.85×10^{-9}
12/04/66	4.21×10^{-9}	8.60×10^{-9}	2.24×10^{-9}
12/11/66	3.37×10^{-9}	4.89×10^{-9}	2.57×10^{-9}
12/18/66	3.58×10^{-9}	7.11×10^{-9}	1.58×10^{-9}
12/25/66	3.42×10^{-9}	5.65×10^{-9}	2.04×10^{-9}
01/01/67	4.74×10^{-9}	6.20×10^{-9}	3.73×10^{-9}
01/08/67	2.66×10^{-9}	4.91×10^{-9}	2.15×10^{-9}
01/15/67	3.42×10^{-9}	7.28×10^{-9}	3.05×10^{-9}
01/22/67	3.80×10^{-9}	7.70×10^{-9}	1.63×10^{-9}
01/29/67	4.02×10^{-9}	6.80×10^{-9}	2.02×10^{-9}
02/05/67	3.88×10^{-9}	8.90×10^{-9}	2.36×10^{-9}
02/12/67	3.83×10^{-9}	5.45×10^{-9}	2.29×10^{-9}
02/19/67	5.29×10^{-9}	7.84×10^{-9}	2.18×10^{-9}
02/26/67	3.29×10^{-9}	7.21×10^{-9}	2.07×10^{-9}
03/05/67	5.05×10^{-9}	7.28×10^{-9}	3.69×10^{-9}
03/12/67	4.10×10^{-9}	5.58×10^{-9}	1.92×10^{-9}
03/19/67	6.42×10^{-9}	1.96×10^{-8}	3.57×10^{-9}

TABLE 6 (Contd)

POTABLE WATER SAMPLES (Values in terms of μCi/cc)

DATE (Week ending)	MEAN	RANGE	
		MAXIMUM	MINIMUM
03/26/67	5.77×10^{-9}	1.21×10^{-8}	2.49×10^{-9}
04/02/67	6.66×10^{-9}	1.42×10^{-8}	2.86×10^{-9}
04/09/67	5.22×10^{-9}	1.06×10^{-8}	3.38×10^{-9}
04/16/67	5.15×10^{-9}	1.01×10^{-8}	1.88×10^{-9}
04/23/67	4.75×10^{-9}	1.02×10^{-8}	2.09×10^{-9}
04/30/67	6.10×10^{-9}	9.14×10^{-9}	3.90×10^{-9}
05/07/67	7.37×10^{-9}	1.59×10^{-8}	4.16×10^{-9}
05/14/67	4.05×10^{-9}	1.01×10^{-8}	1.78×10^{-9}
05/21/67	3.82×10^{-9}	1.09×10^{-8}	1.51×10^{-9}
05/28/67	4.16×10^{-9}	1.08×10^{-8}	1.59×10^{-9}
06/04/67	3.32×10^{-9}	7.24×10^{-9}	1.50×10^{-9}
06/11/67	4.11×10^{-9}	1.18×10^{-8}	2.07×10^{-9}
06/18/67	3.63×10^{-9}	1.31×10^{-8}	1.83×10^{-9}
06/25/67	4.91×10^{-9}	1.11×10^{-8}	1.82×10^{-9}

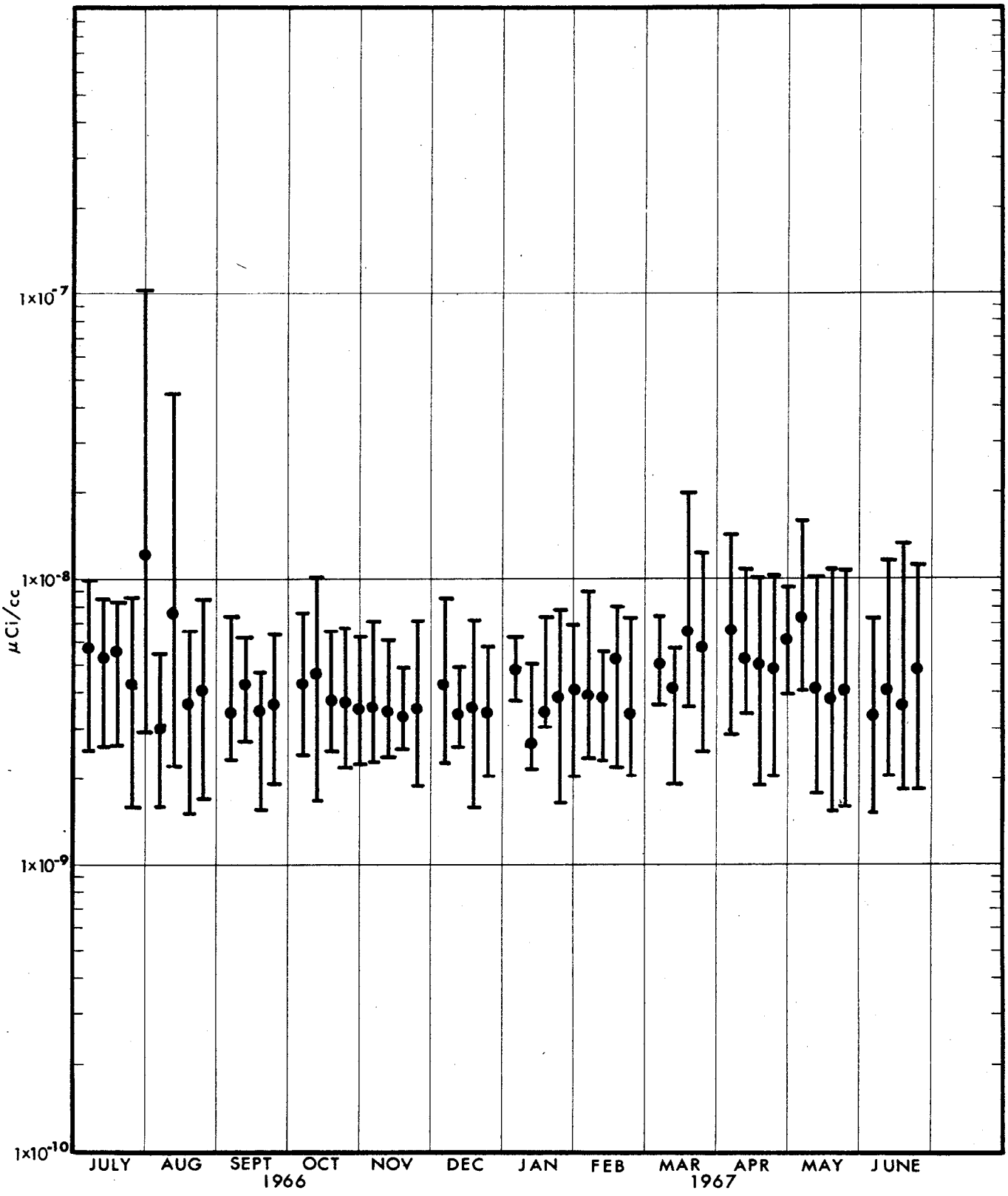

Fig. 6 Weekly Means and Ranges of Gross Beta Radioactivity in Potable Water Samples From July 1966 Through June 1967

TABLE 7

ENVIRONMENTAL SURVEILLANCE
NATURAL SPRING SAMPLING STATION LOCATIONS

AREA	SAMPLE STATION LOCATION	MAP CODE FOR FIGURE 7
5	Cane Springs	5a
12	Captain Jack Spring	12a
	White Rock Spring	12b
	Gold Meadows	12c
15	Oak Spring	15a
	Tub Spring	15b
	John's Spring	15c
16	Tippipah Spring	16a

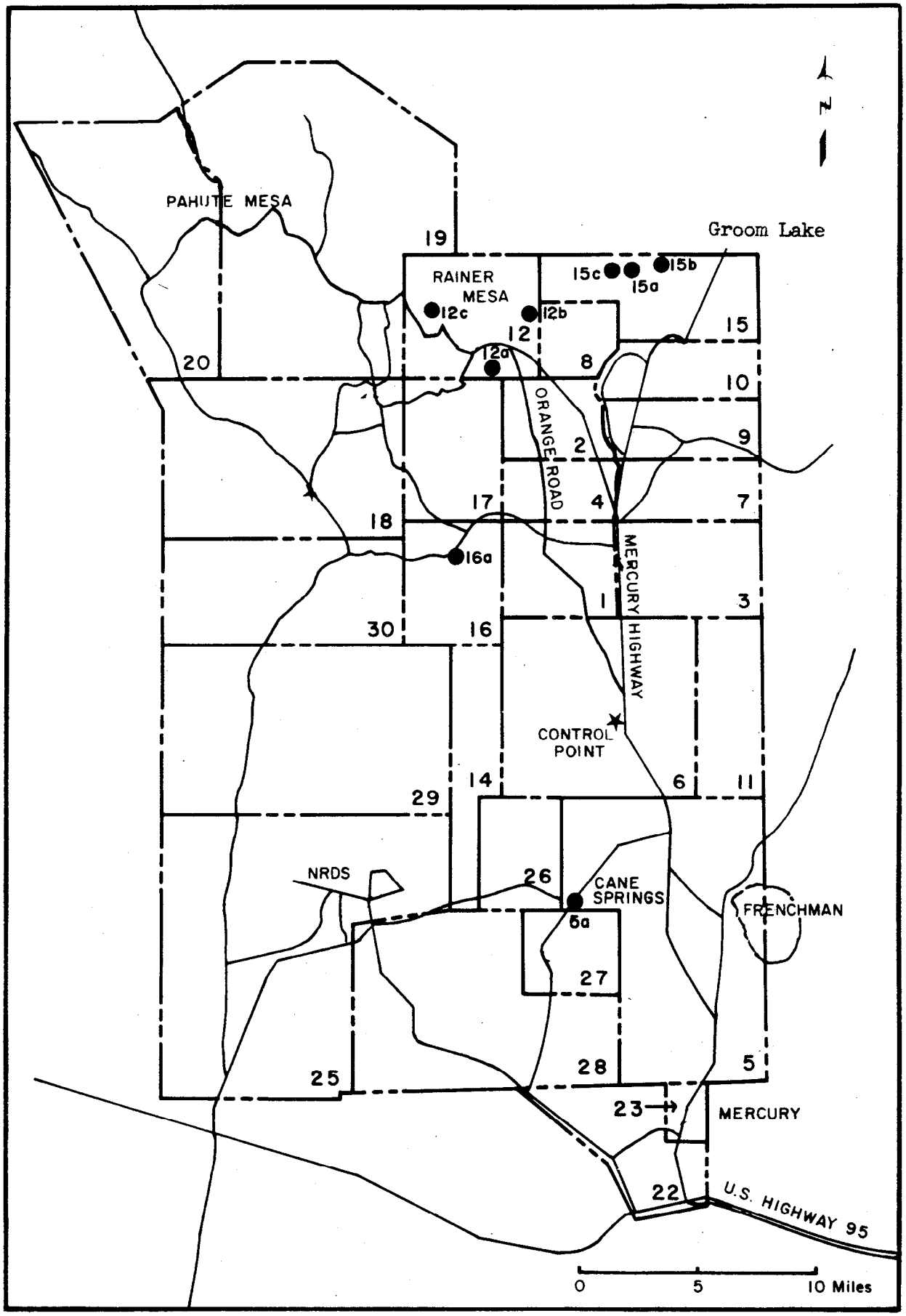

Fig. 7 NTS Environmental Surveillance Natural Springs Sampling Locations

TABLE 8

MONTHLY MEANS AND RANGES OF GROSS BETA RADIOACTIVITY
AT NTS NATURAL SPRING SAMPLING STATION LOCATIONS
FROM JULY, 1966 THROUGH JUNE, 1967

(Values in terms of μCi/cc)

DATE (Week ending)	MEAN	RANGE	
		MAXIMUM	MINIMUM
07-17-66	9.62×10^{-9}	2.29×10^{-8}	4.46×10^{-9}
08/14/66	1.13×10^{-8}	1.52×10^{-8}	5.47×10^{-9}
09/18/66	9.93×10^{-9}	7.81×10^{-8}	1.53×10^{-9}
10/16/66	9.48×10^{-9}	6.80×10^{-8}	2.33×10^{-9}
11/20/66	9.75×10^{-9}	6.83×10^{-8}	3.77×10^{-9}
12/18/66	7.40×10^{-9}	1.68×10^{-8}	1.61×10^{-9}
01/15/67	1.06×10^{-8}	3.27×10^{-8}	4.56×10^{-9}
02/19/67	1.10×10^{-8}	1.24×10^{-8}	4.33×10^{-9}
03/19/67	1.46×10^{-8}	6.24×10^{-8}	2.68×10^{-9}
04/16/67	1.43×10^{-8}	6.99×10^{-8}	5.43×10^{-9}
05/14/67	1.37×10^{-8}	6.13×10^{-8}	4.48×10^{-9}
06/11/67	1.35×10^{-8}	4.14×10^{-8}	5.52×10^{-9}

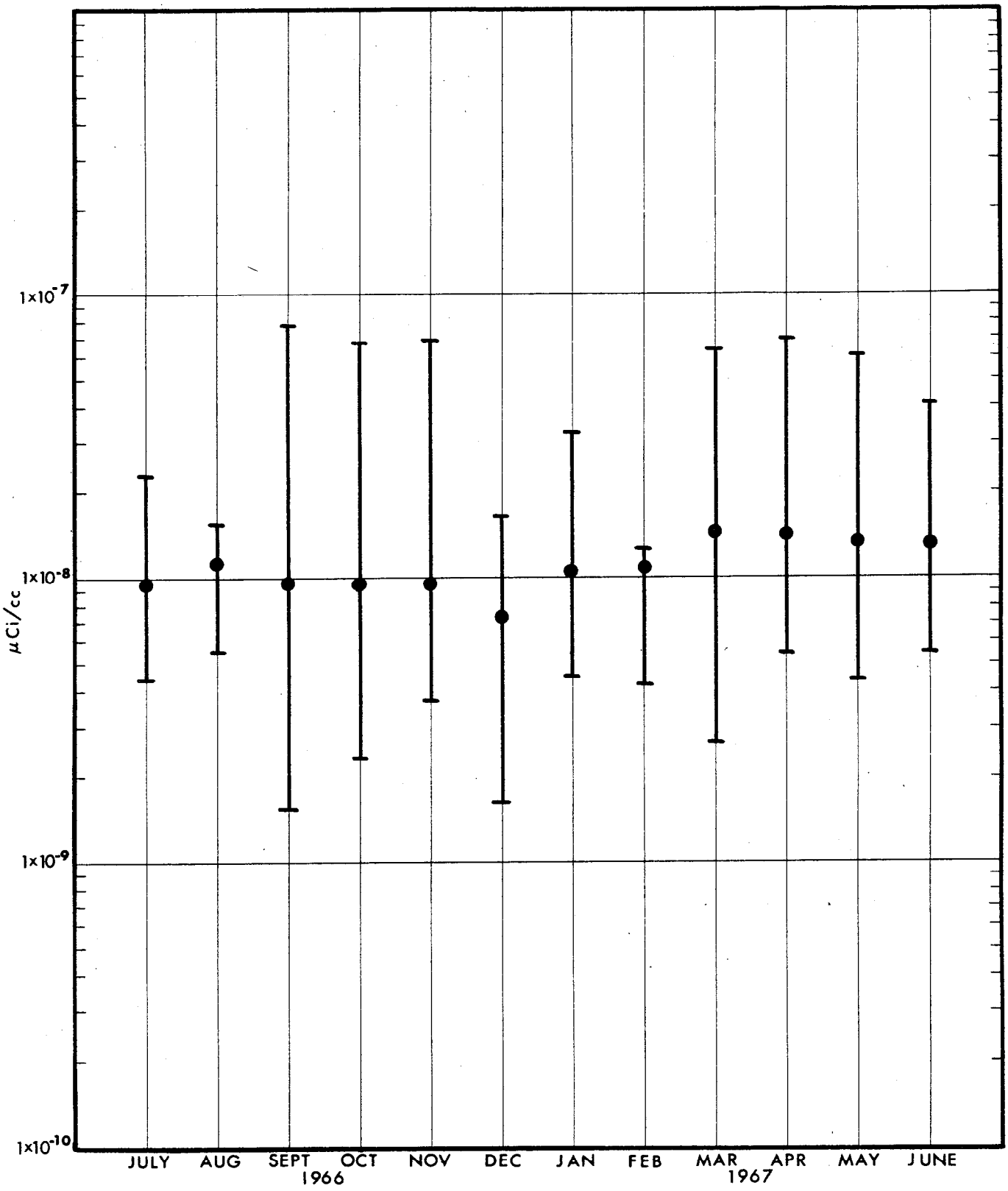

Fig. 8 Monthly Means and Ranges of Gross Beta Radioactivity in Natural Springs Water Samples From July 1966 Through June 1967

TABLE 9

MEANS AND RANGES OF GROSS BETA RADIOACTIVITY
AT NTS ENVIRONMENTAL NATURAL SPRING SAMPLING STATION LOCATIONS
FROM JULY, 1966 THROUGH JUNE, 1967

(Values in terms of μCi/cc)

STATION NUMBER AND LOCATION	MEAN	RANGE	
		MAXIMUM	MINIMUM
1. Area 5, Cane Spring	7.21×10^{-9}	1.60×10^{-8}	1.53×10^{-9}
2. Area 12, White Rock Spring	1.23×10^{-8}	2.29×10^{-8}	8.96×10^{-9}
3. Area 12, Captain Jack Spring	7.22×10^{-9}	1.16×10^{-8}	1.61×10^{-9}
4. Area 12, Gold Meadow Spring	4.85×10^{-8}	7.81×10^{-8}	2.29×10^{-8}
5. Area 15, Oak Butte Spring	6.33×10^{-9}	1.33×10^{-8}	4.30×10^{-9}
6. Area 15, Tub Spring	6.57×10^{-9}	1.23×10^{-8}	3.73×10^{-9}
7. Area 15, John's Spring	6.39×10^{-9}	2.61×10^{-8}	2.33×10^{-9}
8. Area 16, Tippipah Spring	7.05×10^{-9}	1.40×10^{-8}	2.43×10^{-9}

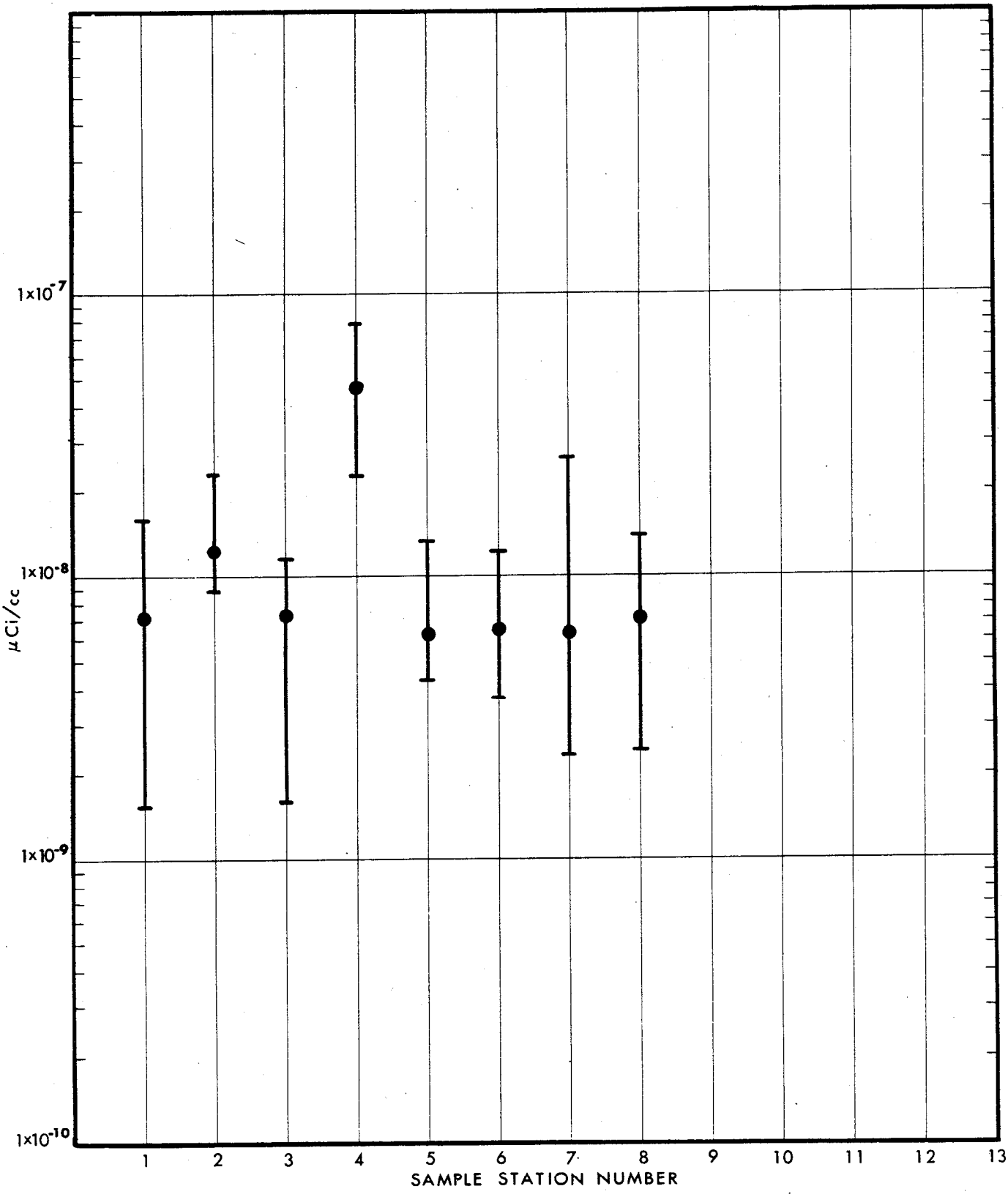

Fig. 9 Means and Ranges of Gross Beta Radioactivity From July 1966 Through June 1967; Natural Springs Sampling Locations

TABLE 10

ENVIRONMENTAL SURVEILLANCE
OPEN RESERVOIR SAMPLING STATION LOCATIONS

AREA	SAMPLING STATION LOCATION	MAP CODE FOR FIGURE 10
2	Well 2 Reservoir	2a
3	Well "A" Reservoir	3a
5	Well 5B Reservoir	5a
	Well Ue5c Reservoir	5b
6	Well C1 Reservoir	6a
15	Well Ue15d Reservoir	15a
17	Well 1 Reservoir	17a
18	Camp 17 Reservoir	18a
19	Well Ue19e Reservoir	19a
	Well Ue19gs Reservoir	19b
20	Well U20a Reservoir	20a
Groom Lake	Well 4 Reservoir	Groom Lake

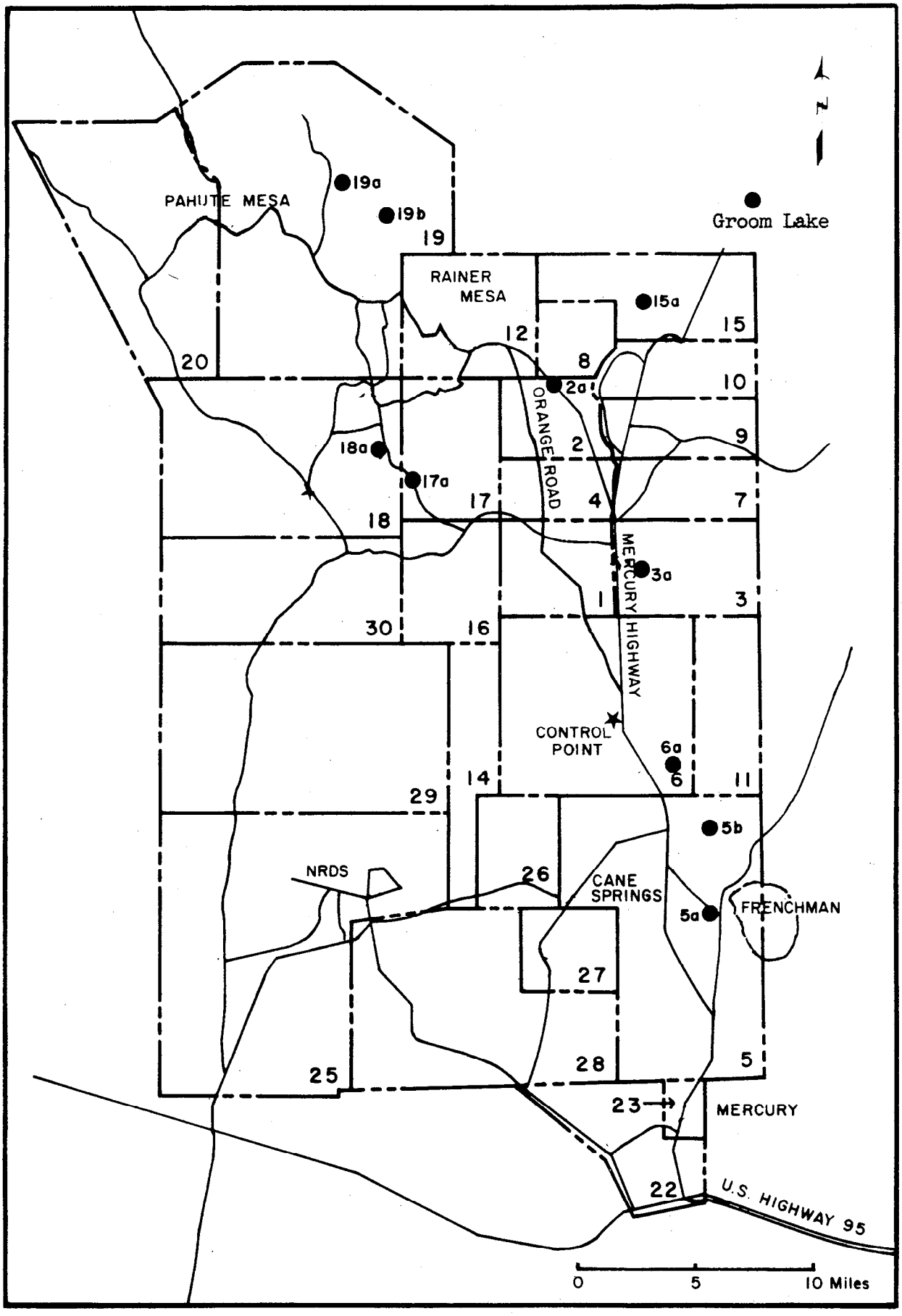

Fig. 10 NTS Environmental Surveillance Open Reservoirs Sampling Locations

TABLE 11

MONTHLY MEANS AND RANGES OF GROSS BETA RADIOACTIVITY
AT NTS OPEN RESERVOIR WATER SAMPLING STATION LOCATIONS
FROM JULY, 1966 THROUGH JUNE, 1967

(Values in terms of μCi/cc)

DATE (Week ending)	MEAN	RANGE	
		MAXIMUM	MINIMUM
07-10-66	8.84×10^{-9}	1.34×10^{-8}	4.67×10^{-9}
08-07-66	8.15×10^{-9}	1.15×10^{-8}	2.62×10^{-9}
09-18-66	4.49×10^{-9}	8.75×10^{-9}	2.24×10^{-9}
10-16-66	7.88×10^{-9}	2.88×10^{-8}	2.44×10^{-9}
11-13-66	4.94×10^{-9}	1.19×10^{-8}	1.99×10^{-9}
12-11-66	5.52×10^{-9}	2.26×10^{-8}	2.19×10^{-9}
01-15-67	6.80×10^{-9}	1.44×10^{-8}	1.78×10^{-9}
02-12-67	7.09×10^{-9}	1.05×10^{-8}	2.19×10^{-9}
03-12-67	5.78×10^{-9}	1.69×10^{-8}	1.79×10^{-9}
04-16-67	1.37×10^{-8}	3.94×10^{-8}	4.85×10^{-9}
05-07-67	1.28×10^{-8}	3.94×10^{-8}	4.41×10^{-9}
06-11-67	9.92×10^{-9}	1.88×10^{-8}	2.18×10^{-9}

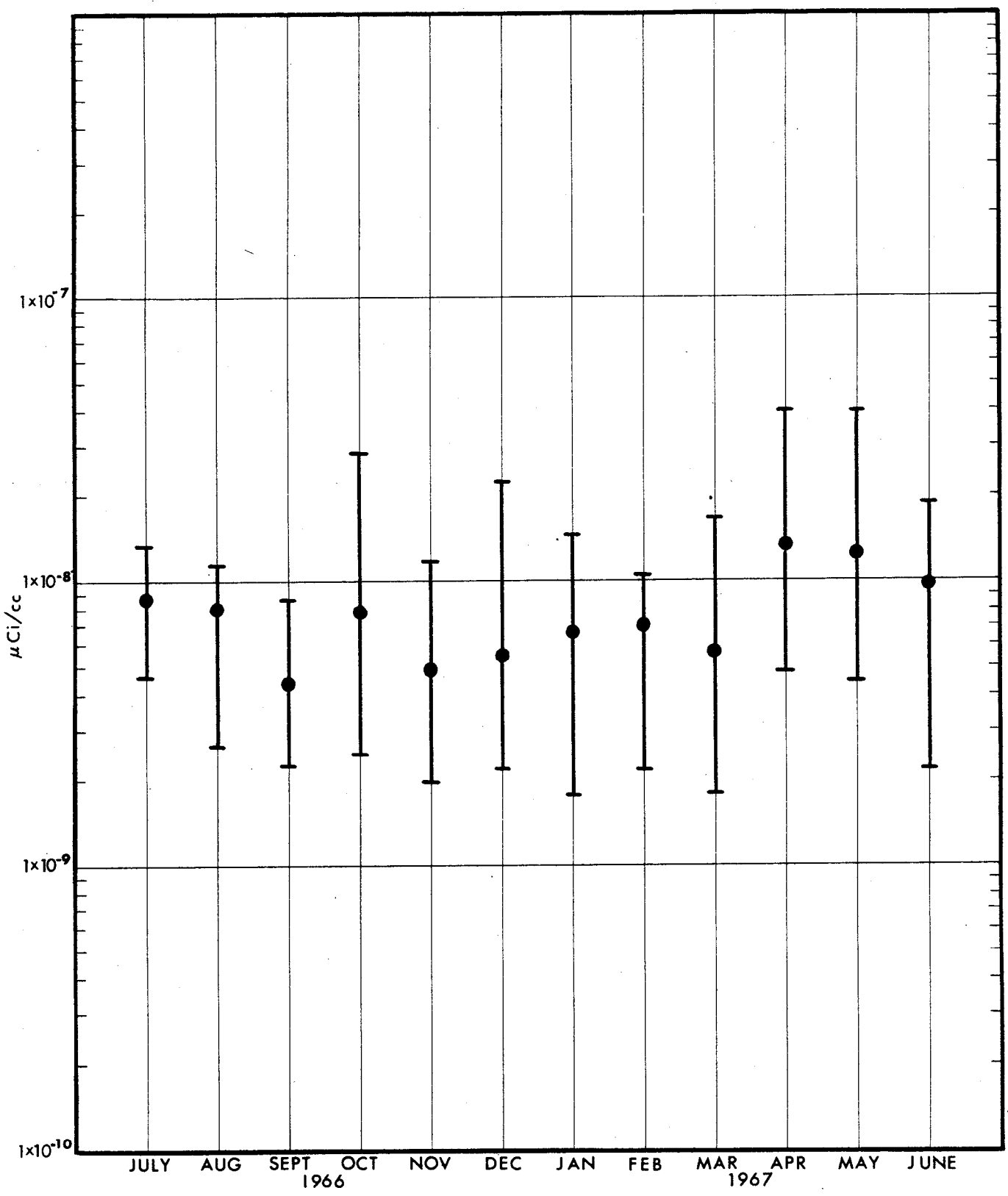

Fig. 11 Monthly Means and Ranges of Gross Beta Radioactivity in Open Reservoir Water Samples From July 1966 Through June 1967

TABLE 12

MEANS AND RANGES OF GROSS BETA RADIOACTIVITY
AT NTS ENVIRONMENTAL OPEN RESERVOIR SAMPLING LOCATIONS
FROM JULY, 1966 THROUGH JUNE, 1967

(Values in terms of μCi/cc)

STATION NUMBER AND LOCATION	MEAN	RANGE	
		MAXIMUM	MINIMUM
1. Area 2, Well 2 Reservoir	5.51×10^{-9}	1.53×10^{-8}	2.19×10^{-9}
2. Area 3, Well A Reservoir	9.76×10^{-9}	1.94×10^{-8}	3.28×10^{-9}
3. Area 5, Well 5B Reservoir	7.71×10^{-9}	1.35×10^{-8}	2.58×10^{-9}
4. Area 5, Well Ue5c Reservoir	5.32×10^{-9}	8.77×10^{-9}	3.08×10^{-9}
5. Area 6, Well 3 Reservoir	8.63×10^{-9}	2.88×10^{-8}	3.58×10^{-9}
6. Area 6, Well C1 Reservoir	1.21×10^{-8}	2.26×10^{-8}	7.15×10^{-9}
7. Area 15, Well Ue15d Reservoir	1.12×10^{-8}	2.12×10^{-8}	1.79×10^{-9}
8. Area 17, Well 1 Reservoir	5.66×10^{-9}	2.86×10^{-8}	2.36×10^{-9}
9. Area 18, Camp 17 Reservoir	2.45×10^{-9}	1.02×10^{-8}	1.78×10^{-9}
10. Area 18, Well 8 Reservoir	5.33×10^{-9}	8.77×10^{-9}	4.64×10^{-9}
11. Area 19, Well Ue19e Reservoir	3.43×10^{-9}	5.19×10^{-9}	2.18×10^{-9}
12. Area 20, Well U20a Reservoir	3.53×10^{-9}	5.42×10^{-9}	1.99×10^{-9}
13. Groom Lake, Well 4 Reservoir	2.38×10^{-8}	3.94×10^{-8}	1.53×10^{-8}

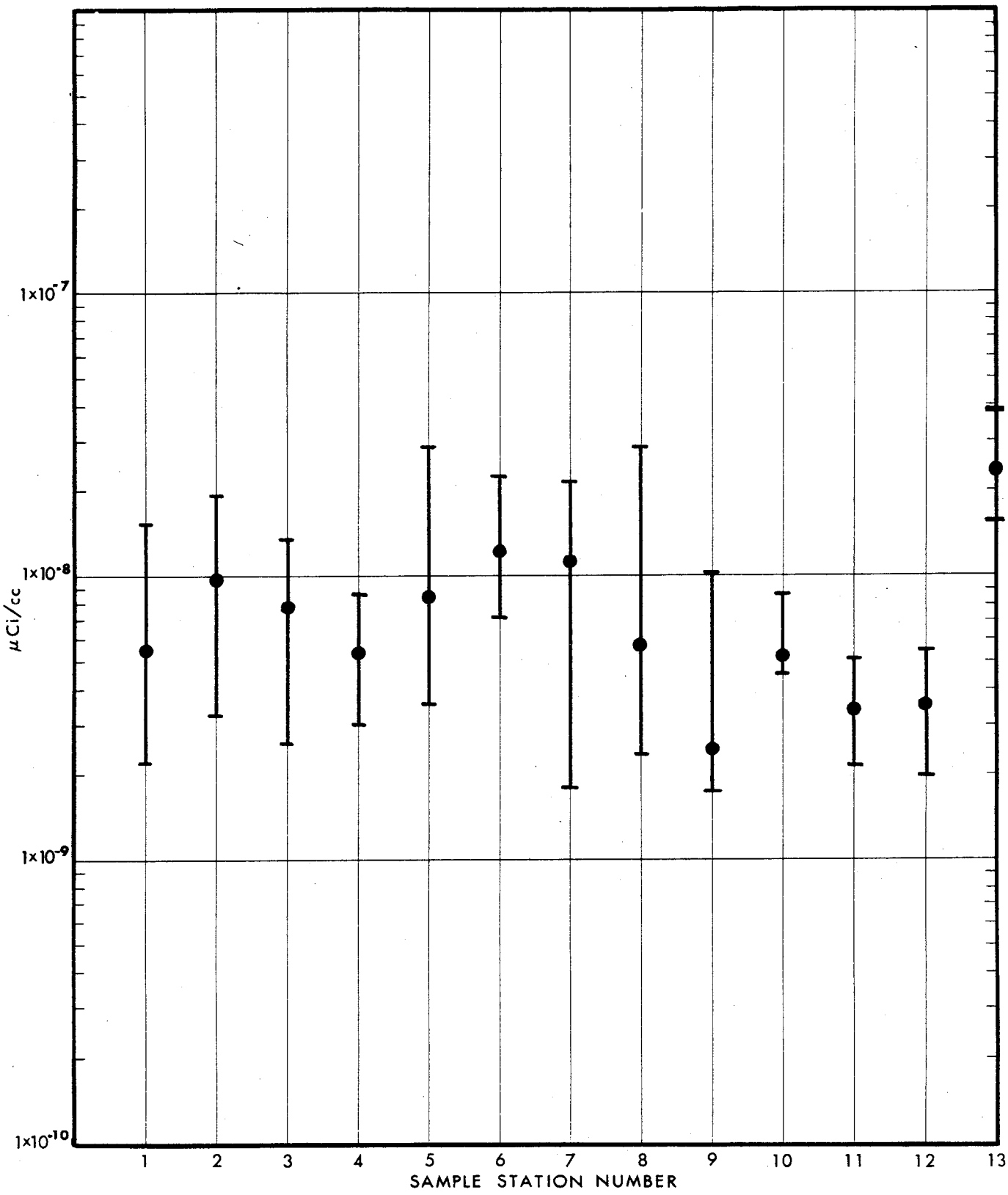

Fig. 12 Means and Ranges of Gross Beta Radioactivity From July 1966 Through June 1967; Open Reservoir Sampling

TABLE 13

ENVIRONMENTAL SURVEILLANCE
SUPPLY WELLS SAMPLING STATION LOCATIONS

AREA	SAMPLING STATION LOCATION	MAP CODE FOR FIGURE 13
3	Well A	3a
5	Well 5A	5a
	Well 5B	5b
	Well 5C	5c
	Well Ue5c	5d
6	Well C1	6a
15	Well Ue15d	15a
17	Well 1	17a
19	Well Ue19gs	19a
	Well Ue19e	19b
20	Well U20a	20a
22	Army Well #1	22a
Groom Lake	Well 3	Groom Lake
Groom Lake	Well 4	Groom Lake

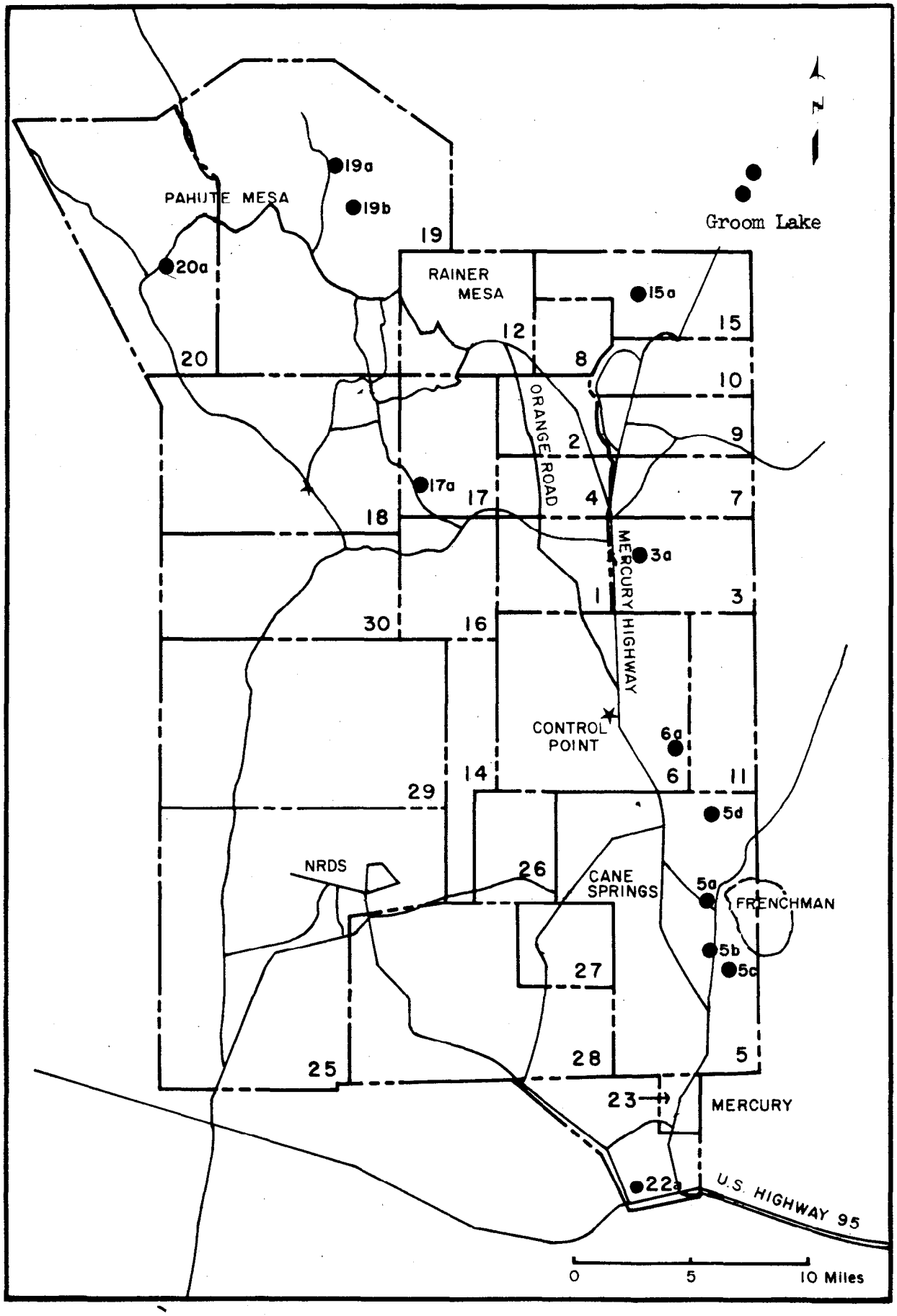

Fig. 13 NTS Environmental Surveillance Supply Wells Sampling Locations

TABLE 14

MONTHLY MEANS AND RANGES OF GROSS BETA RADIOACTIVITY
IN NTS SUPPLY WELLS WATER SAMPLES
FROM JULY, 1966 THROUGH JUNE, 1967

(Values in terms of μCi/cc)

DATE (Week ending)	MEAN	RANGE	
		MAXIMUM	MINIMUM
July	No Data		
August	No Data		
09/11/66	9.07×10^{-9}	1.29×10^{-8}	6.33×10^{-9}
10/16/66	6.43×10^{-9}	1.41×10^{-8}	1.64×10^{-9}
11/20/66	4.97×10^{-9}	1.12×10^{-8}	2.49×10^{-9}
12/18/66	6.97×10^{-9}	1.22×10^{-8}	4.00×10^{-9}
01/15/67	4.91×10^{-9}	2.48×10^{-8}	1.56×10^{-9}
02/19/67	6.58×10^{-9}	1.79×10^{-8}	3.20×10^{-9}
03/19/67	1.10×10^{-8}	3.24×10^{-8}	3.04×10^{-9}
04/09/67	1.28×10^{-8}	3.23×10^{-8}	6.41×10^{-9}
05/07/67	9.82×10^{-9}	2.20×10^{-8}	3.58×10^{-9}
06/11/67	7.33×10^{-9}	1.69×10^{-8}	3.81×10^{-9}

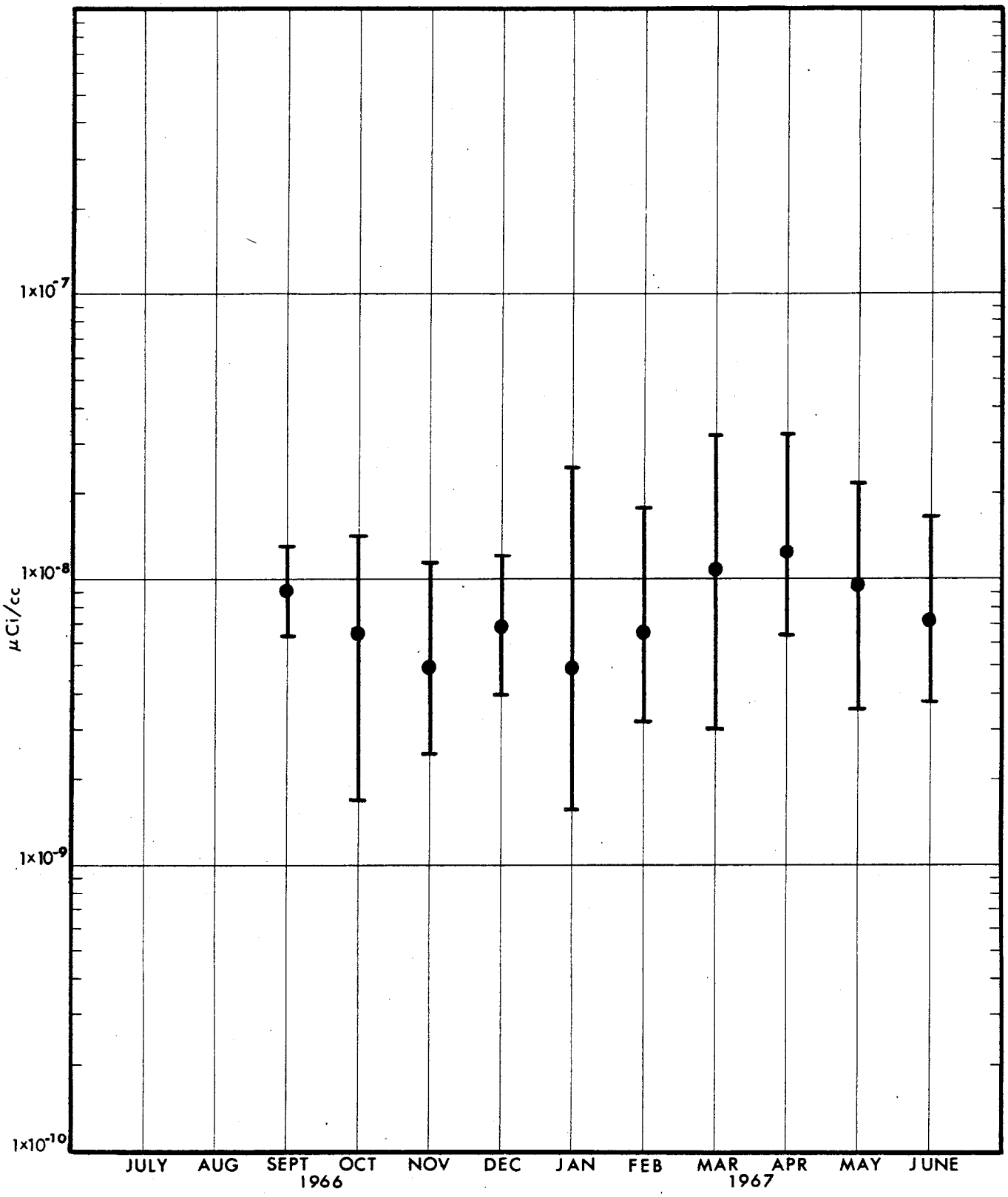

Fig. 14 Monthly Means and Ranges of Gross Beta Radioactivity From September 1966 Through June 1967; Supply Wells Sampling

TABLE 15

MEANS AND RANGES OF GROSS BETA RADIOACTIVITY
AT NTS ENVIRONMENTAL SUPPLY WELLS SAMPLING LOCATIONS
FROM JULY, 1966 THROUGH JUNE, 1967

(Values in terms of μCi/cc)

STATION NUMBER AND LOCATION	MEAN	RANGE	
		MAXIMUM	MINIMUM
1. Area 3, Well A	8.02×10^{-9}	1.45×10^{-8}	5.51×10^{-9}
2. Area 5, Well 5A	7.32×10^{-9}	1.06×10^{-8}	4.72×10^{-9}
3. Area 5, Well 5B	7.11×10^{-9}	1.15×10^{-8}	3.58×10^{-9}
4. Area 5, Well 5C	5.99×10^{-9}	1.10×10^{-8}	4.14×10^{-9}
5. Area 5, Well Ue5c	6.59×10^{-9}	8.06×10^{-9}	4.71×10^{-9}
6. Area 6, Well C1	1.05×10^{-8}	2.15×10^{-8}	3.82×10^{-9}
7. Area 15, Well Ue15d	1.75×10^{-8}	3.24×10^{-8}	6.85×10^{-9}
8. Area 17, Well 1	2.86×10^{-9}	4.98×10^{-9}	1.64×10^{-9}
9. Area 19, Well Ue19e	2.83×10^{-9}	3.04×10^{-9}	2.63×10^{-9}
10. Area 20, Well U20a	2.58×10^{-9}	2.67×10^{-9}	2.49×10^{-9}
11. Area 23, Army Well #1	6.04×10^{-9}	9.49×10^{-9}	3.20×10^{-9}
12. Groom Lake, Well 3	5.26×10^{-9}	1.10×10^{-8}	2.60×10^{-9}
13. Groom Lake, Well 4	1.18×10^{-8}	2.20×10^{-8}	2.68×10^{-9}

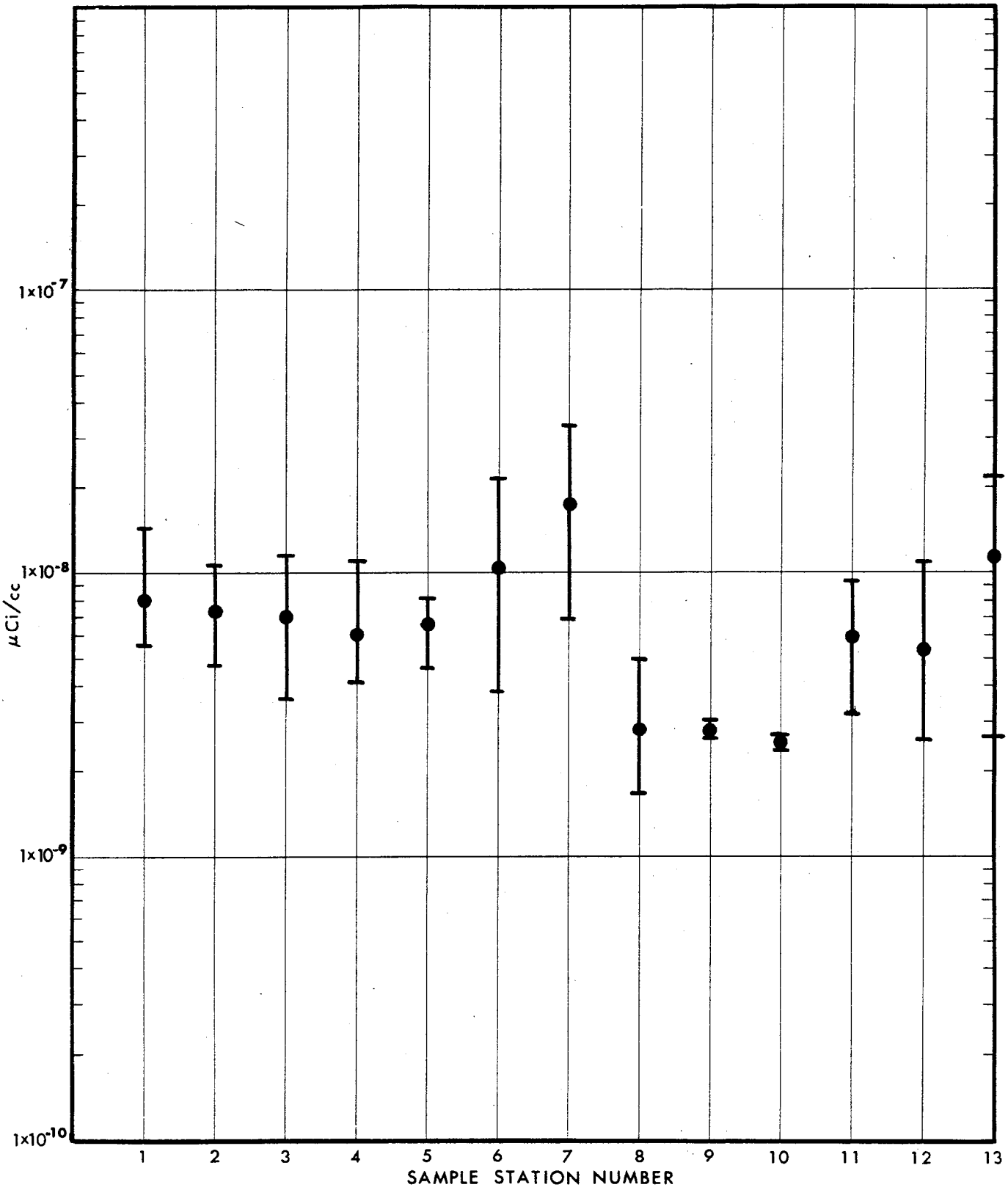

Fig. 15 Means and Ranges of Gross Beta Radioactivity From July 1966 Through June 1967; Supply Wells Sampling

TABLE 16

ENVIRONMENTAL SURVEILLANCE
FINAL EFFLUENT STATION LOCATIONS

AREA	SAMPLING STATION LOCATION	MAP CODE FOR FIGURE 16
6	Final Effluent Pond	6a
12	Final Effluent Pond	12a
23	Final Effluent Pond	23a
Groom Lake	Pond	Groom Lake

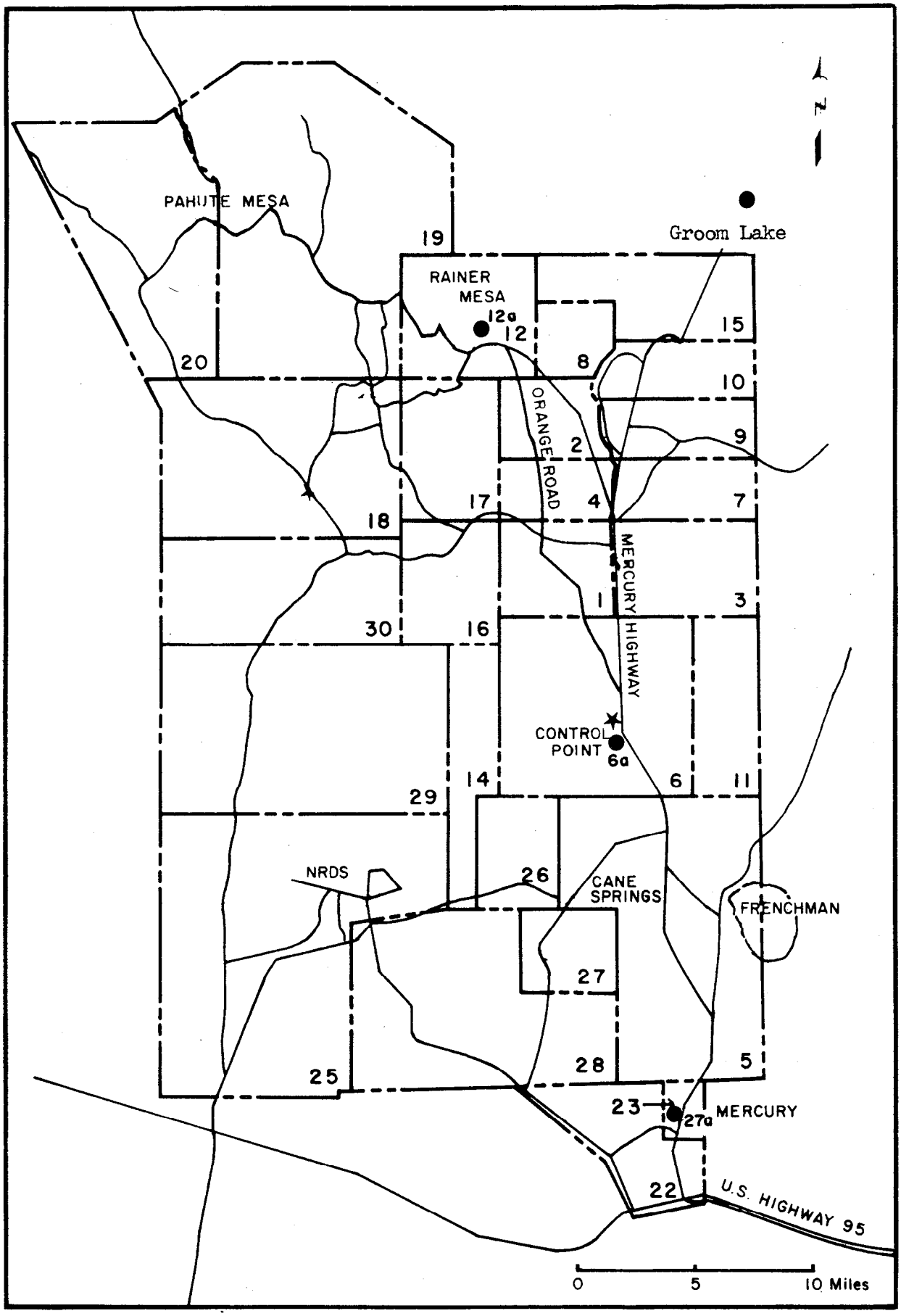

Fig. 16 NTS Environmental Surveillance Final Effluent Sampling Locations

TABLE 17

MONTHLY MEANS AND RANGES OF GROSS BETA RADIOACTIVITY
IN ENVIRONMENTAL FINAL EFFLUENT SAMPLES
FROM OCTOBER, 1966 THROUGH APRIL, 1967

(Values in terms of $\mu Ci/cc$)

DATE	MEAN	RANGE	
		MAXIMUM	MINIMUM
October, 1966	1.31×10^{-8}	1.87×10^{-8}	1.05×10^{-8}
November, 1966	1.63×10^{-8}	1.09×10^{-8}	7.43×10^{-9}
December, 1966	1.14×10^{-8}	1.84×10^{-8}	5.96×10^{-9}
January, 1967	1.45×10^{-8}	1.81×10^{-8}	1.17×10^{-8}
February, 1967	1.53×10^{-8}	4.77×10^{-8}	5.96×10^{-9}
March, 1967	2.77×10^{-8}	4.69×10^{-8}	1.77×10^{-8}
April, 1967	1.92×10^{-8}	5.55×10^{-8}	1.00×10^{-8}

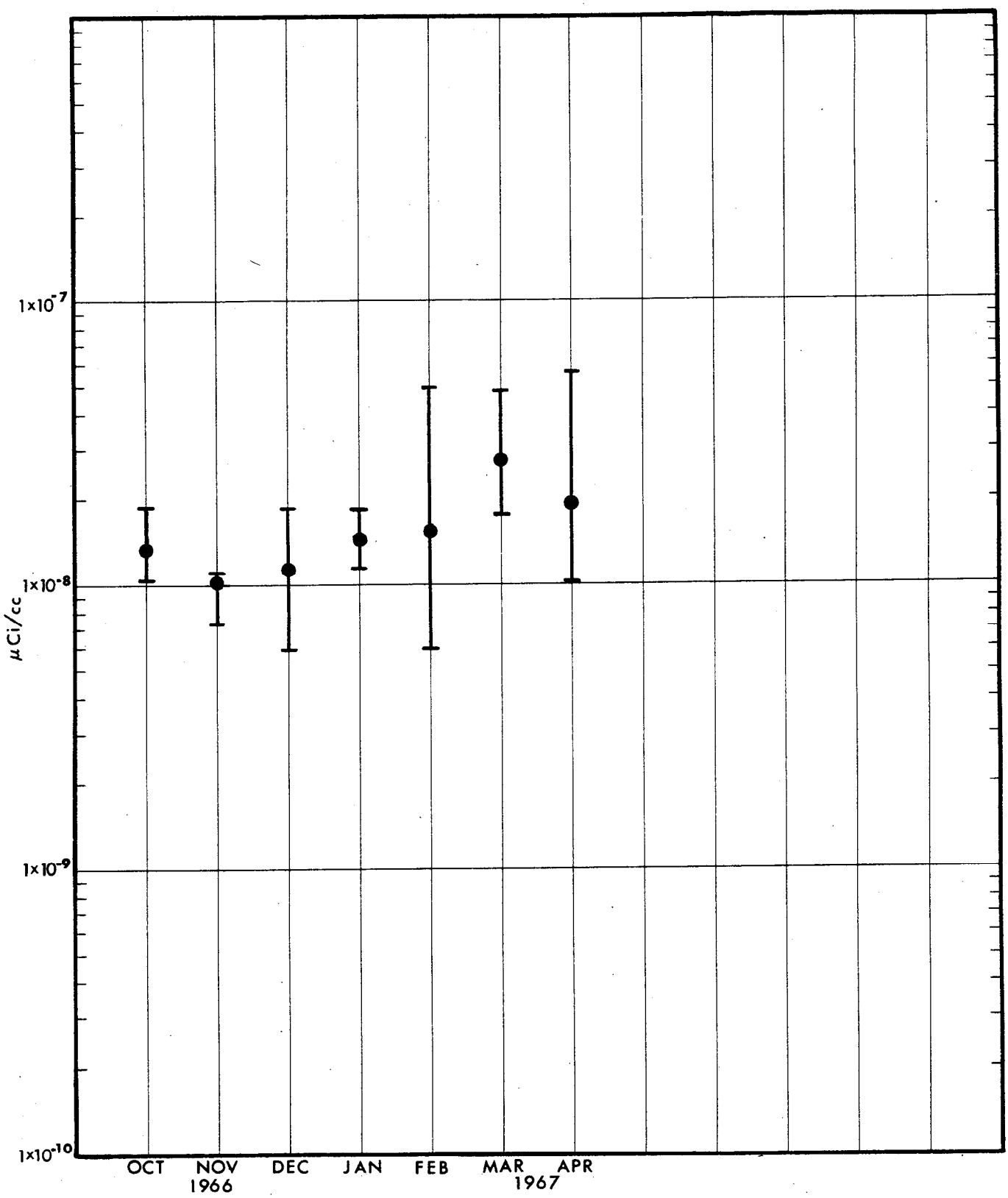

Fig. 17 Means and Ranges of Gross Beta Radioactivity From October 1966 Through April 1967; Final Effluent Sampling

TABLE 18

MEANS AND RANGES OF GROSS BETA RADIOACTIVITY
AT NTS ENVIRONMENTAL FINAL EFFLUENT SAMPLING STATION LOCATIONS
FROM OCTOBER, 1966 THROUGH APRIL, 1967

(Values in terms of $\mu Ci/cc$)

STATION NUMBER AND LOCATION	MEAN	RANGE	
		MAXIMUM	MINIMUM
1. Area 6, Sewage Pond	1.63×10^{-8}	2.29×10^{-8}	1.23×10^{-8}
2. Area 12, Sewage Pond	1.77×10^{-8}	4.77×10^{-8}	1.00×10^{-8}
3. Area 23, Sewage Pond	9.59×10^{-9}	1.77×10^{-8}	5.86×10^{-9}
4. Groom Lake, Sewage Pond	1.89×10^{-8}	5.55×10^{-8}	1.09×10^{-8}

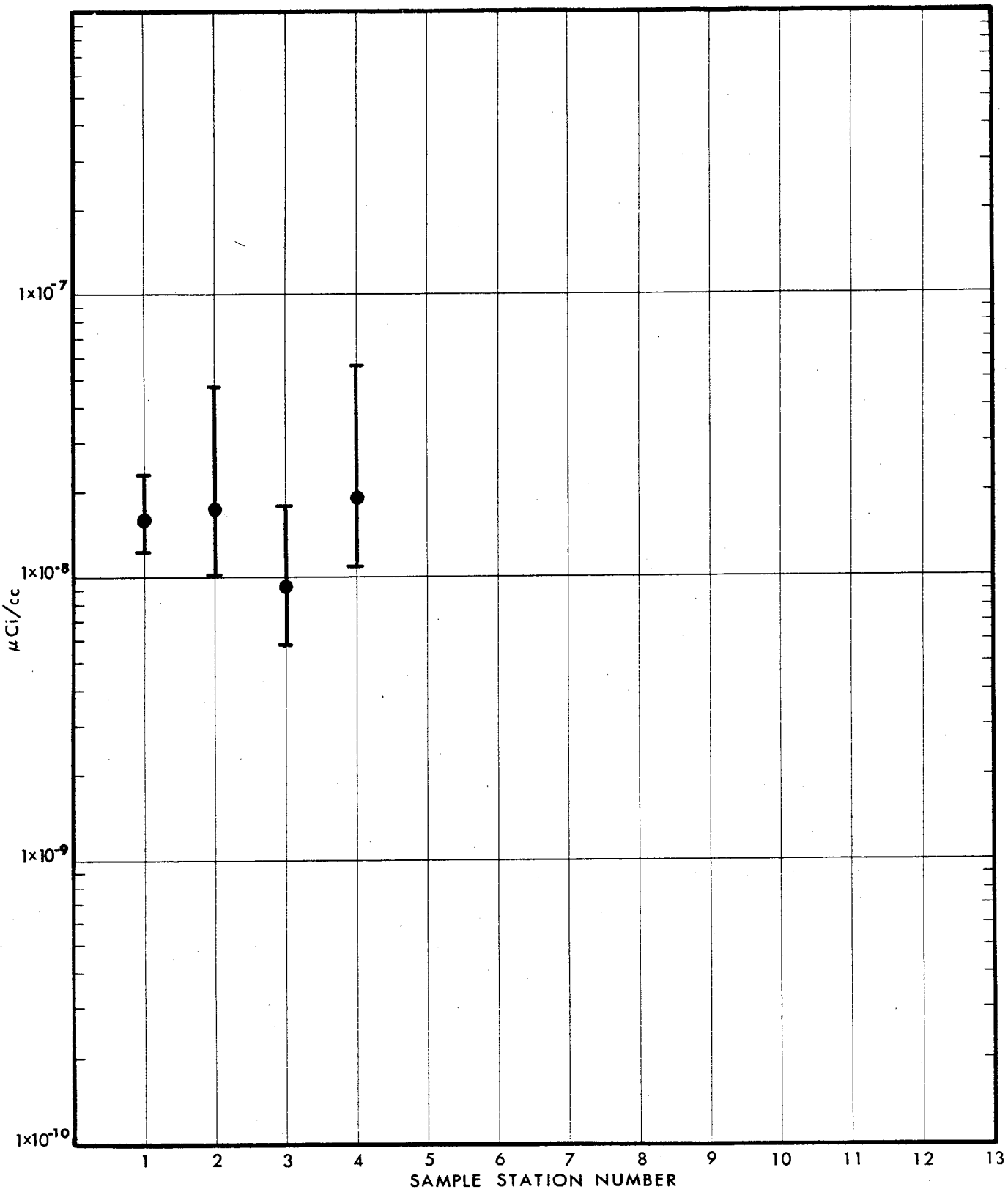

Fig. 18 Means and Ranges of Gross Beta Radioactivity From October 1966 Through April 1967; Final Effluent Sampling

TABLE 19

MEANS AND RANGES OF GROSS BETA RADIOACTIVITY
AT NTS MISCELLANEOUS SAMPLING LOCATIONS
FROM JULY, 1966 THROUGH JUNE, 1967

(Values in terms of $\mu Ci/cc$)

SAMPLING LOCATION	MEAN	RANGE	
		MAXIMUM	MINIMUM
1. Area 51, Papoose Lake	7.54×10^{-8}	5.00×10^{-7}	2.13×10^{-8}
2. Area 6, CP-2 Waste Pond	4.62×10^{-6}	3.21×10^{-5}	4.89×10^{-7}
3. Area 12, Upper Haines Lake	4.32×10^{-6}	4.74×10^{-5}	9.58×10^{-7}
4. Area 12, Lower Haines Lake	1.98×10^{-6}	3.65×10^{-6}	8.54×10^{-7}
5. Area 23, Swimming Pool	5.87×10^{-9}	1.22×10^{-8}	3.91×10^{-9}
6. Groom Lake, Station 2	7.23×10^{-9}	2.43×10^{-8}	2.95×10^{-9}

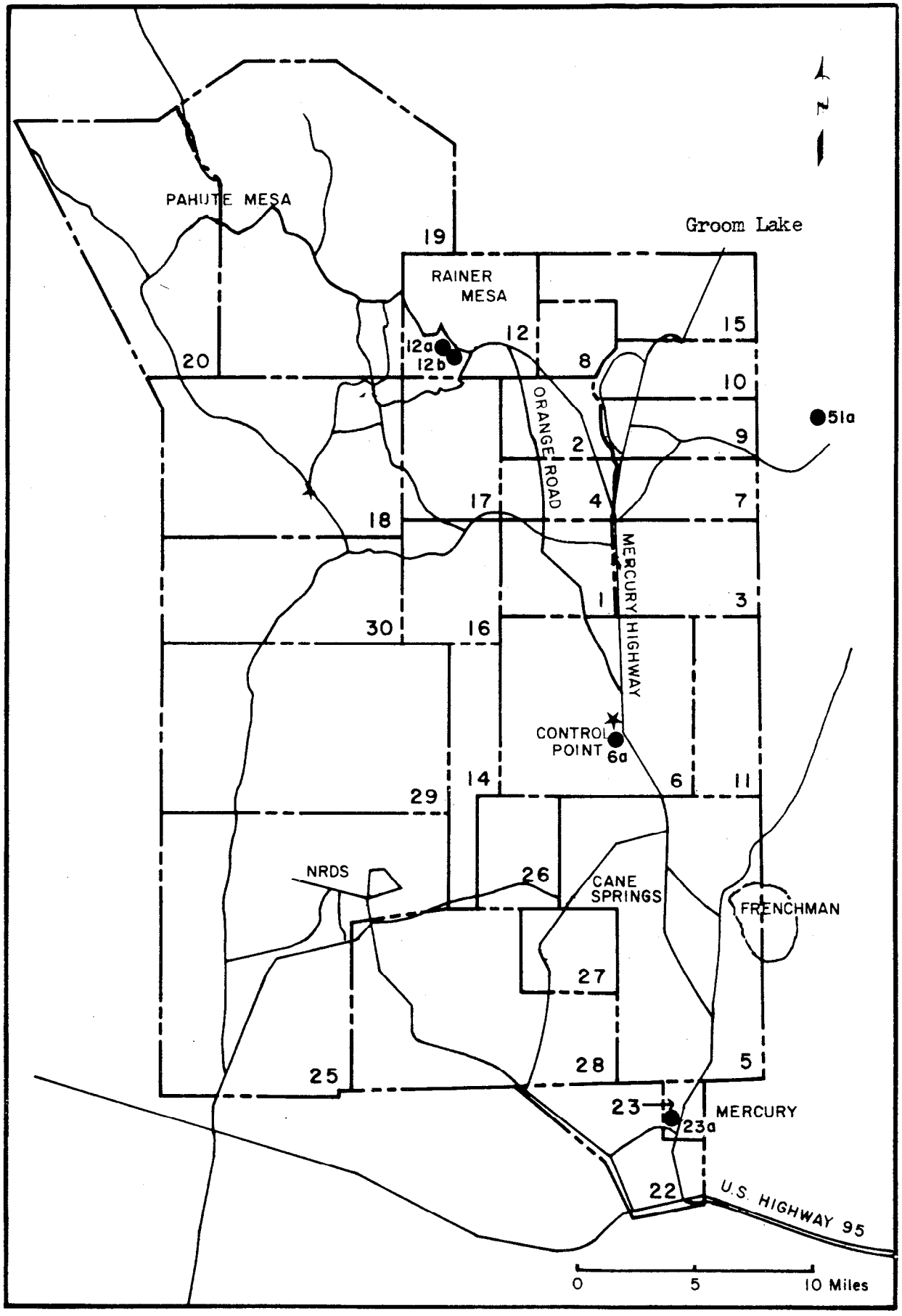

Fig. 19 NTS Environmental Surveillance Miscellaneous Water Sampling Locations

TABLE 20

ENVIRONMENTAL SURVEILLANCE
IONIZATION CHAMBER SAMPLING STATION LOCATIONS

AREA	SAMPLING STATION LOCATION	MAP CODE FOR FIGURE 20
3	North of Cafeteria	3a
6	North of Icehouse	6a
12	East of Dispensary	12a
23	South of Dispensary	23a
27	Security Station 561	27a

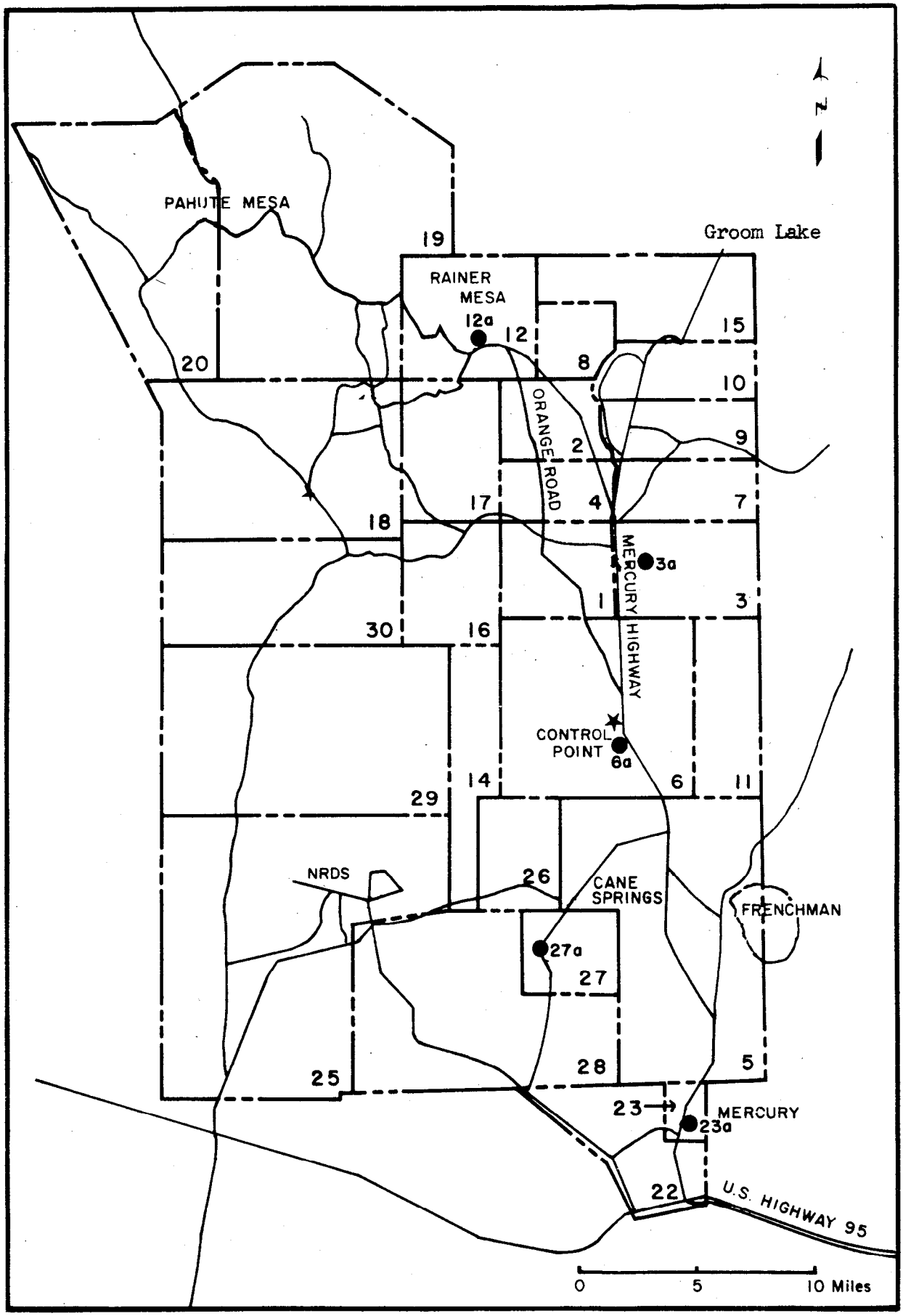

Fig. 20 Environmental Surveillance Ionization Chamber Sampling Locations

TABLE 21

SUMMARY OF BACKGROUND RADIATION MEASUREMENTS (mR/day)

DATE (Week Ending)	AREA 3 North of Cafe	AREA 6 West of Icehouse	AREA 12 South of Camp	AREA 23 South of Dispensary	AREA 27 Gate 561	REMARKS
07/03/66	0.86	0.36	>1.43	0.35	0.44	NRX
07/10/66	1.09	0.49	>1.43	0.37	0.50	
07/17/66	1.26	0.39	0.64	0.39	0.46	
07/24/66	0.85	0.37	0.40	0.30	0.40	
07/31/66	0.85	0.58	0.49	0.31	0.42	
08/07/66	0.79	0.52	0.47	0.31	0.41	
08/14/66	0.91	0.54	0.53	0.34	0.43	
08/21/66	0.76	0.44	0.39	0.30	0.44	
08/28/66	0.73	0.44	0.49	0.39	0.43	
09/04/66	1.23	0.57	0.46	0.37	0.54	
09/11/66	0.71	0.74	0.47	0.31	0.42	
09/18/66	1.20	0.45	0.47	0.39	0.45	Area 5
09/25/66	0.93	0.44	0.48	0.33	0.42	
10/02/66	0.75	0.52	0.46	0.30	0.45	
10/09/66	0.69	0.46	0.48	0.36	0.46	
10/16/66	0.82	0.53	0.46	0.30	0.48	
10/23/66	0.72	0.97	0.58	0.43	0.49	
10/30/66	0.70	0.30	0.40	0.28	0.42	
11/06/66	0.73	0.54	0.51	0.37	0.44	
11/13/66	1.17	0.63	0.49	0.38	0.49	
11/20/66	0.75	0.42	0.51	0.31	0.50	
11/27/66	0.92	0.56	0.47	0.36	0.47	
12/04/66	0.76	0.39	0.52	0.35	0.51	
12/11/66	0.95	0.44	0.49	0.50	0.52	
12/18/66	0.67	0.56	0.48	0.34	0.46	
12/25/66	0.76	0.58	0.47	0.37	0.50	
01/01/67	0.70	0.53	0.54	0.32	0.48	
01/08/67	0.93	0.75	0.58	0.42	0.52	
01/15/67	0.74	0.71	0.58	0.43	0.54	
01/22/67	0.81	1.08	0.51	0.42	0.47	
01/29/67	>1.43	>1.43	>1.43	0.56	0.64	Area 2
02/05/67	0.62	0.51	0.39	0.30	0.42	
02/12/67	0.70	0.80	0.52	0.40	0.54	
02/19/67	0.98	0.60	0.48	0.46	0.46	
02/26/67	0.71	0.79	0.50	0.38	0.47	Phoebus Run
03/05/67	0.84	0.49	0.59	0.35	0.44	
03/12/67	1.04	0.45	0.54	0.46	0.50	
03/19/67	1.19	0.54	0.50	0.64	0.46	
03/26/67	0.74	0.38	0.49	0.37	0.46	
04/02/67	>1.43	0.33	0.48	0.48	0.49	
04/09/67	0.73	0.41	0.51	0.50	0.47	
04/16/67	1.04	0.43	0.48	0.44	0.45	
04/23/67	0.64	0.37	0.53	0.49	0.35	

TABLE 21 (Contd)

SUMMARY OF BACKGROUND RADIATION MEASUREMENTS (mR/day)

DATE (Week Ending)	AREA 3 North of Cafe	AREA 6 West of Icehouse	AREA 12 South of Camp	AREA 23 South of Dispensary	AREA 27 Gate 561	REMARKS
04/30/67	1.01	0.37	0.45	0.39	0.48	
05/07/67	0.73	0.33	0.52	0.42	0.45	
05/14/67	0.89	0.37	0.41	0.31	1.00	
05/21/67	0.66	0.49	1.04	0.91	0.60	
05/28/67	0.78	0.45	0.38	0.26	0.40	
06/04/67	0.64	0.28	0.47	0.29	0.45	
06/11/67	1.39	0.39	0.43	0.38	0.50	
06/18/67	0.74	0.51	0.79	0.33	0.44	
06/25/67	0.74	0.46	0.44	0.34	0.46	

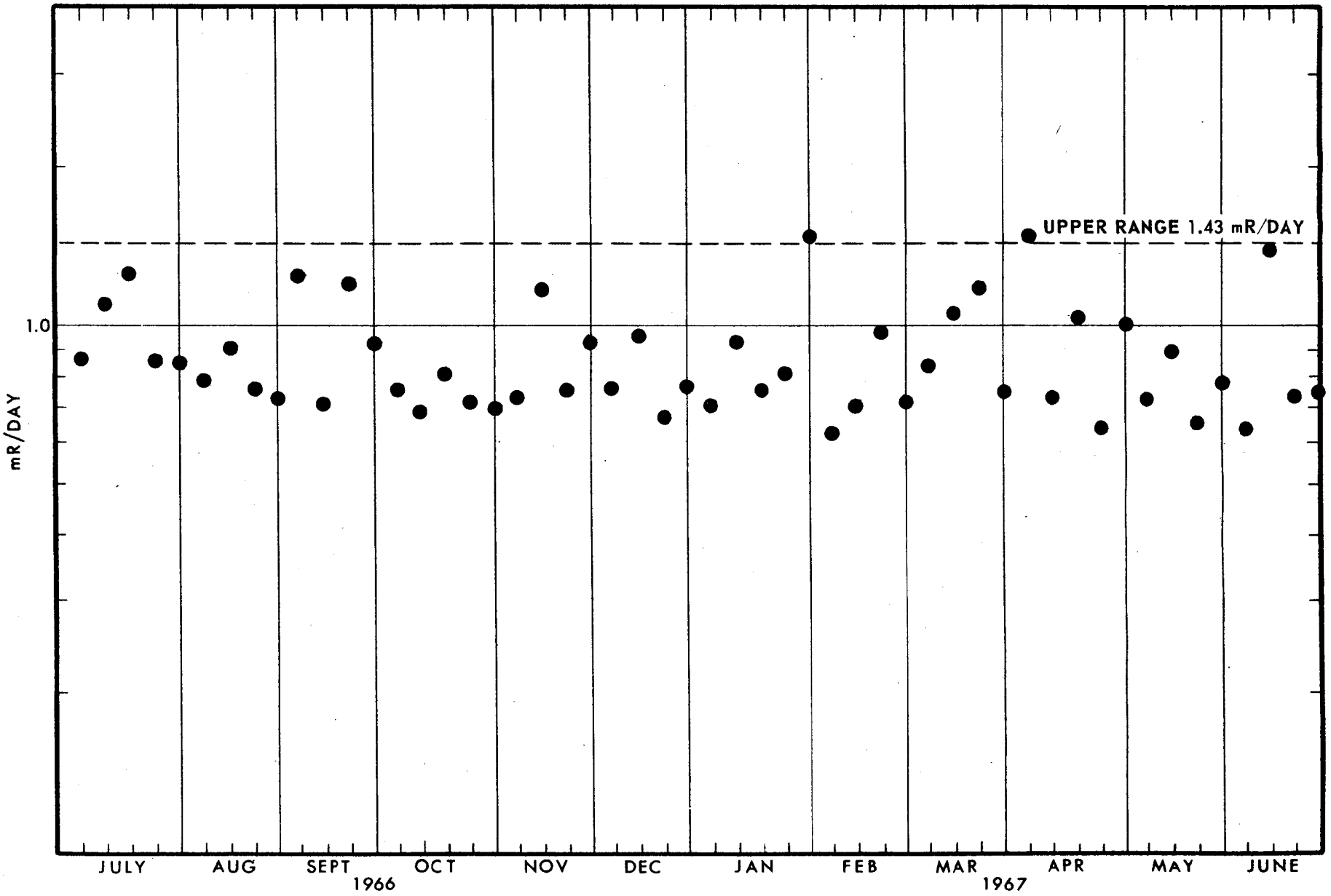

Fig. 21 Weekly Exposure Readings for Period July 1966 Through June 1967 for Area 3 (North of Cafeteria); Ionization Chambers - Victoreen Model 239

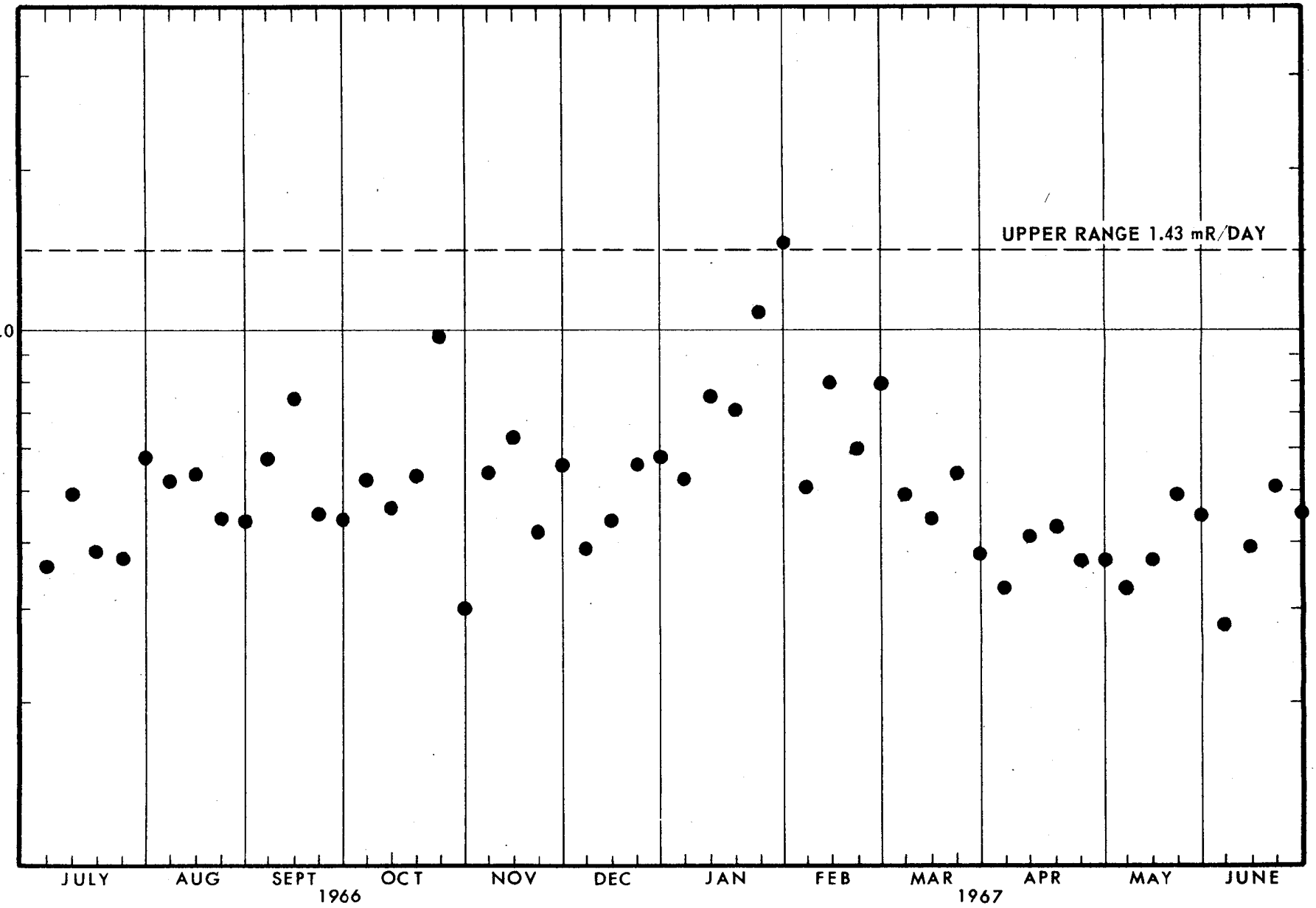

Fig. 22 Weekly Exposure Readings for Period July 1966 Through June 1967 for Area 6 (West of Ice House); Ionization Chambers - Victoreen Model 239

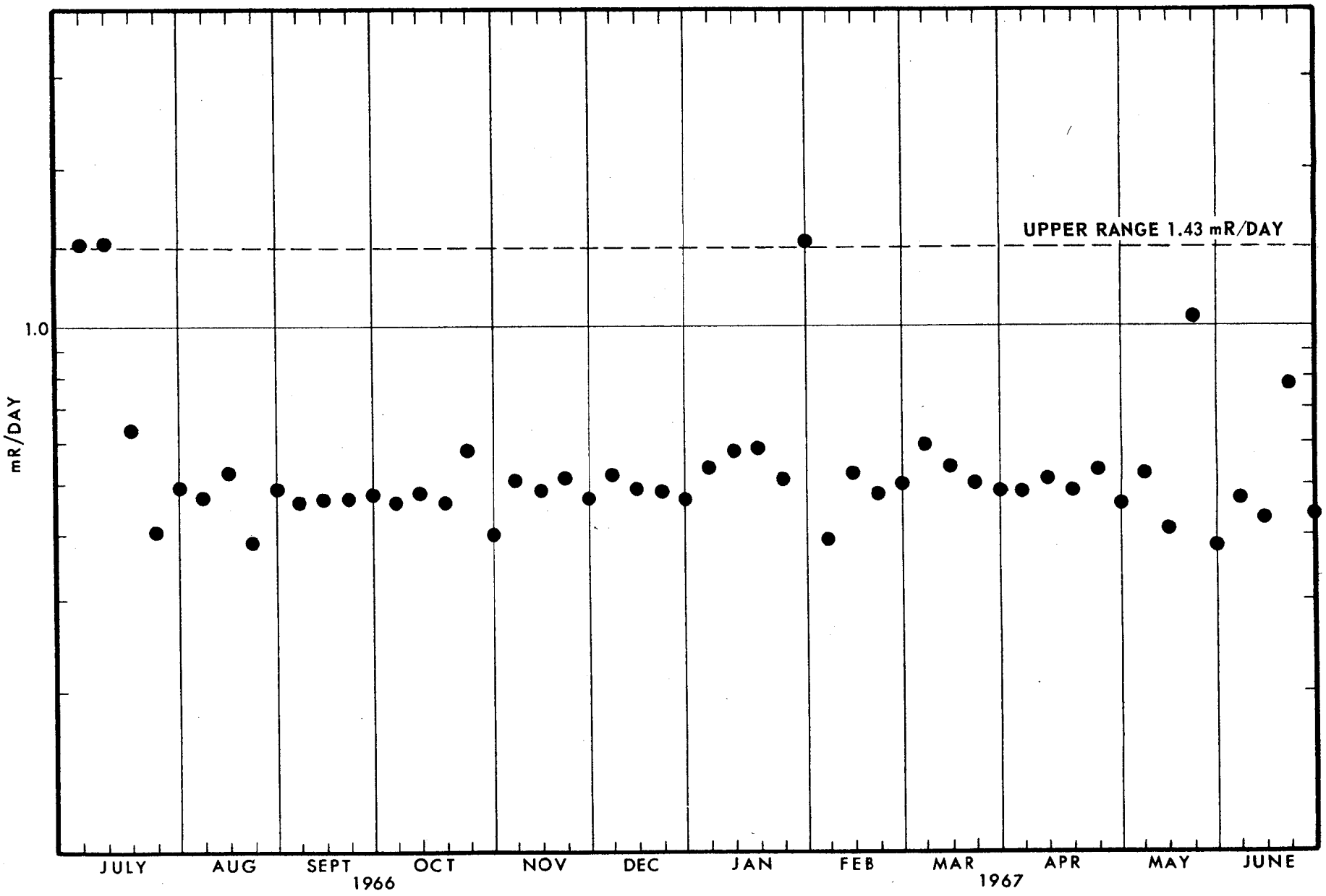

Fig. 23 Weekly Exposure Readings for Period July 1966 Through June 1967 for Area 12 (South of Campsite); Ionization Chambers - Victoreen Model 239

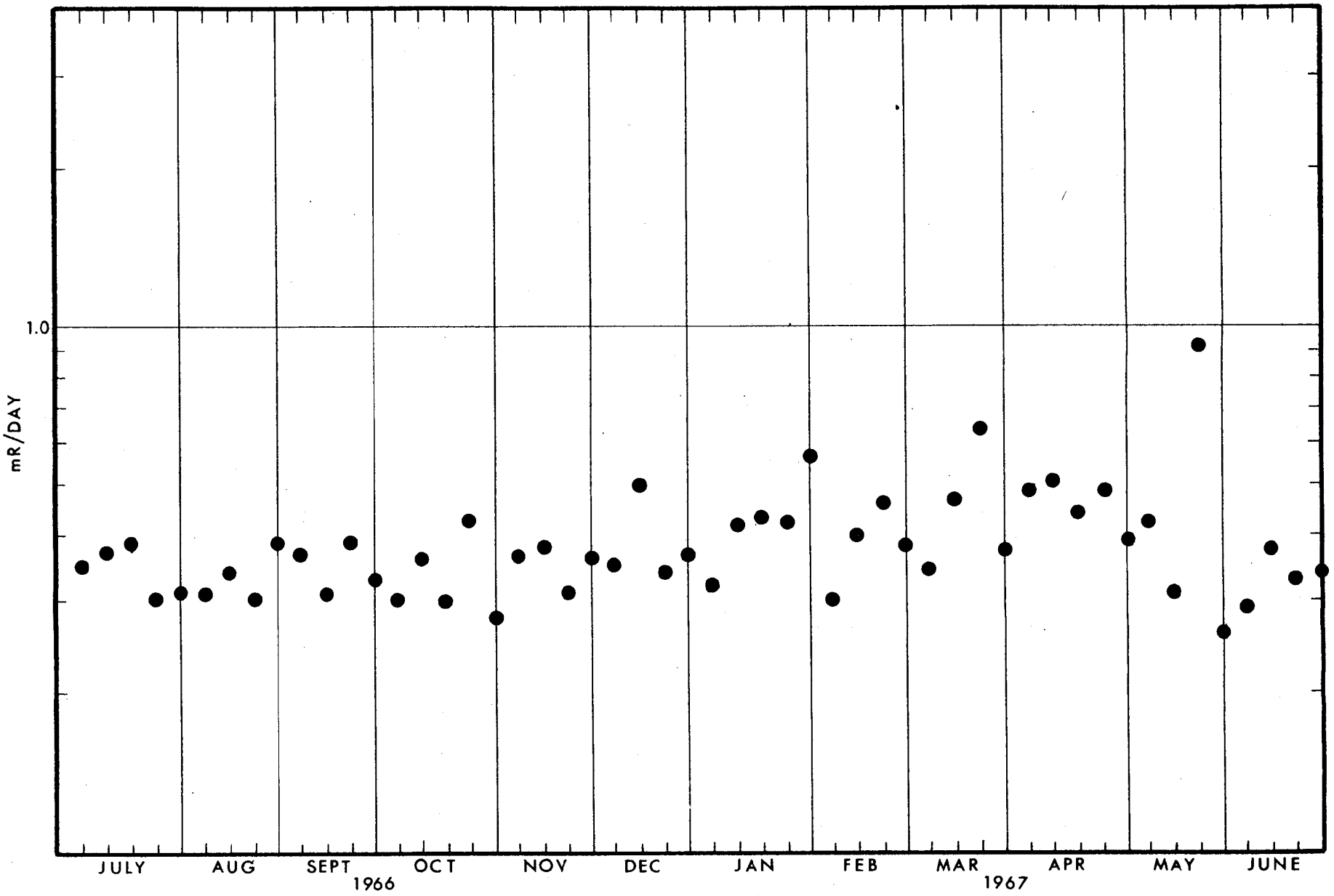

Fig. 24 Weekly Exposure Readings for Period July 1966 Through June 1967 at Area 23 (South of Dispensary); Ionization Chambers - Victoreen Model 239

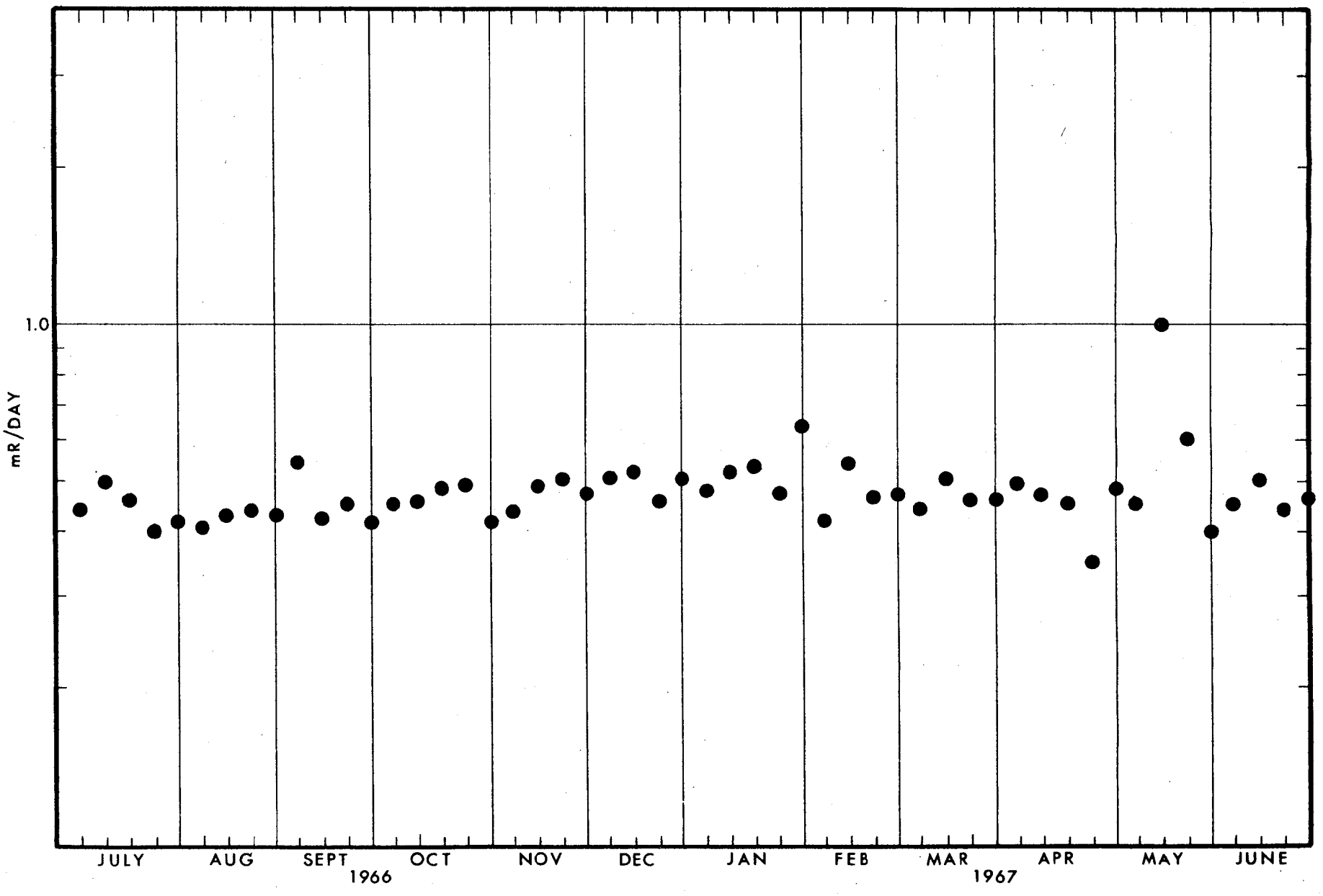

Fig. 25 Weekly Exposure Readings for Period July 1966 Through June 1967 at Area 27 (West of Guard Station 561); Ionization Chambers - Victoreen Model 239

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:

$$\bar{X} = \log^{-1} \left[\frac{\sum \log X_i}{N} + \frac{S^2}{2} \right]$$

when: X_i = 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:

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

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 2-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.

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