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ENVIRONMENTAL MONITORING REPORT FOR THE NEVADA TEST SITE AND OTHER TEST AREAS USED FOR UNDERGROUND NUCLEAR DETONATIONS

January through December 1975

by

Monitoring Operations Division
Environmental Monitoring and Support Laboratory
U.S. ENVIRONMENTAL PROTECTION AGENCY
Las Vegas, Nevada 89114

APRIL 1976

This work performed under a Memorandum of
Understanding No. AT(26-1)-539
for the
U.S. ENERGY RESEARCH & DEVELOPMENT ADMINISTRATION

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PREFACE

The Atomic Energy Commission (AEC) used the Nevada Test Site (NTS) from January 1951 through January 19, 1975, as an area for conducting nuclear detonations, nuclear rocket-engine development, nuclear medicine studies, and miscellaneous nuclear and non-nuclear experiments. Beginning on January 19, 1975, these responsibilities were transferred to the newly-formed U.S. Energy Research and Development Administration (ERDA). Atmospheric nuclear tests were conducted periodically from 1951 through October 30, 1958, at which time a testing moratorium was implemented. Since September 1, 1961, in accordance with the limited test ban treaty, all nuclear detonations have been conducted underground with the expectation of containment except for four slightly above-ground or shallow underground tests of Operation Dominic II and five nuclear earth-cratering experiments conducted under the Plowshare program.

The U.S. Public Health Service (PHS), from 1953 through 1970, and the U.S. Environmental Protection Agency (EPA), from 1970 to the present, have maintained facilities at the NTS or in Las Vegas, Nevada, for the purpose of providing an Off-Site Radiological Safety Program for the nuclear testing program. In addition, off-site surveillance has been provided by the PHS/EPA for nuclear explosive tests at places other than the NTS. Prior to 1953, the surveillance program was performed by the Los Alamos Scientific Laboratory and U.S. Army personnel.

The objective of the Program since 1953 has been to measure levels and trends of radioactivity in the off-site environment surrounding testing areas to assure that the testing is in compliance with existing radiation protection standards. To assess off-site radiation levels, routine sampling networks for milk, water, and air are maintained along with a dosimetry network and special sampling of food crops, soil, etc., as required. For the purpose of implementing protective actions, providing immediate radiation monitoring, and obtaining environmental samples rapidly after a release of radioactivity, mobile monitoring personnel are also placed in areas downwind of NTS or other test areas prior to each test.

In general, analytical results showing radioactivity levels above naturally occurring levels have been published in reports covering a test series or test project. Beginning in 1959 for reactor tests, and in 1962 for weapons tests, surveillance data for each individual test which released radioactivity off-site were reported separately. Commencing in January 1964, and continuing through December 1970, these individual reports for nuclear tests were also summarized and reported every 6 months. The individual analytical results for all routine or special milk samples were also included in the 6-month summary reports.

In 1971, the AEC implemented a requirement (ERDA Manual, Chapter 0513) for a comprehensive radiological monitoring report from each of the several contractors or agencies involved in major nuclear activities. The compilation

of these various reports since that time and their entry into the general literature serve the purpose of providing a single source of information concerning the environmental impact of nuclear activities. To provide more rapid dissemination of data, the monthly report of analytical results of all air data collected since July 1971, and all milk and water samples collected since January 1972, were submitted to the appropriate state health departments involved, and were also published in Radiation Data and Reports, a monthly publication of the EPA which was discontinued at the end of 1974.

Beginning with the first quarter of 1975, air and milk sample data have been reported quarterly. Dosimetry data were included beginning with the third quarter 1975.

Since 1962, PHS/EPA aircraft have also been used during nuclear tests to provide rapid monitoring and sampling for releases of radioactivity. Early aircraft monitoring data obtained immediately after a test are used to position mobile radiation monitoring personnel on the ground, and the results of airborne sampling are used to quantitate the inventories, diffusion, and transport of the radionuclides released. Beginning in 1971, all monitoring and sampling results by aircraft have been reported in effluent monitoring data reports in accordance with the ERDA Manual, Chapter 0513.

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INTRODUCTION

Under a Memorandum of Understanding, No. AT(26-1)-539, with the U.S. Energy Research and Development Administration (ERDA), the U.S. Environmental Protection Agency (EPA), Environmental Monitoring and Support Laboratory-Las Vegas (EMSL-LV), continued its Off-Site Radiological Safety Program within the environment surrounding the Nevada Test Site (NTS) and at other sites designated by the ERDA during 1975. This report, prepared in accordance with the ERDA Manual, Chapter 0513, contains summaries of EMSL-LV sampling methods, analytical procedures, and the analytical results of environmental samples collected in support of ERDA nuclear testing activities. Where applicable, sampling data are compared to appropriate guides for external and internal exposures to ionizing radiation. In addition, a brief summary of pertinent and demographical features of the NTS and the NTS environs is presented for background information.

NEVADA TEST SITE

The major programs conducted at the NTS in the past have been nuclear weapons development, proof-testing and weapons safety, testing for peaceful uses of nuclear explosives (Project Plowshare), reactor/engine development for nuclear rocket and ram-jet applications (Projects Pluto and Rover), basic high-energy nuclear physics research, and seismic studies (Vela-Uniform). During this report period these programs were continued with the exception of Project Pluto, discontinued in 1964, and Project Rover, which was terminated in January 1973. No Plowshare nuclear tests were conducted at the NTS or any other site during this period. All nuclear weapons tests were conducted underground to minimize the possibility of the release of fission products to the atmosphere.

Site Location

The Nevada Test Site (Figures 1 and 2) is located in Nye County, Nevada, with its southeast corner about 90 km northwest of Las Vegas. The NTS has an area of about 3500 km^2 and varies from 40-56 km in width (east-west) and from 64-88 km in length (north-south). This area consists of large basins or flats about 900-1200 m above mean sea level (MSL) surrounded by mountain ranges 1800-2100 m MSL.

The NTS is nearly surrounded by an exclusion area collectively named the Nellis Air Force Range. The Range, particularly to the north and east, provides a buffer zone between the test areas and public lands. This buffer zone varies from 24-104 km between the test area and land that is open to the public. Depending upon wind speed and direction, this provides a delay of from 1/2 to more than 6 hours before any accidental release of airborne radioactivity could pass over public lands.

Climate

The climate of the NTS and surrounding area is variable, primarily due to altitude and the rugged terrain. Generally, the climate is referred to as Continental Arid. Throughout the year there is not sufficient water to support tree or crop growth without irrigation.

The climate may be classified by the types of vegetation which grow under these conditions. According to Houghton et al., this method, developed by Köppen in 1918, recognizes five basic climatic conditions as humid tropical, dry, humid mesothermal, humid microthermal, and polar (five-sixths of Nevada falls in the dry category). Köppen's classification of dry conditions is further subdivided on the basis of temperature and severity of drought. Table 1, from Houghton et al., summarizes the different characteristics of these climatic types in Nevada.

TABLE 1. CHARACTERISTICS OF CLIMATIC TYPES IN NEVADA

Climatic Type	Mean Temperature °C (°F) Winter	Summer	Annual Precipitation cm (inches) Total*	Snowfall	Dominant Vegetation	Percent of Area
Alpine tundra	-18° - -9° (0° - 15°)	4° - 10° (40° - 50°)	38 - 114 (15 - 45)	Medium to heavy	Alpine meadows	--
Humid Continental	-12° - -1° (10° - 30°)	10° - 21° (50° - 70°)	64 - 114 (25 - 45)	Heavy	Pine-fir forest	1
Subhumid continental	-12° - -1° (10° - 30°)	10° - 21° (50° - 70°)	30 - 64 (12 - 25)	Moderate	Pine or scrub woodland	15
Mid-latitude steppe	-7° - 4° (20° - 40°)	18° - 27° (65° - 80°)	15 - 38 (6 - 15)	Light to moderate	Sagebrush, grass, scrub	57
Mid-latitude desert	-7° - 4° (20° - 40°)	18° - 27° (65° - 80°)	8 - 20 (3 - 8)	Light	Greasewood, shadscale	20
Low-latitude desert	4° - 10° (40° - 50°)	27° - 32° (80° - 90°)	5 - 25 (2 - 10)	Negligible	Creosote bush	7

*Limits of annual precipitation overlap because of variations in temperature which affect the water balance.

As pointed out by Houghton et al., 90 percent of Nevada's population lives in areas with less than 25 cm of rain per year or in areas which would be classified as mid-latitude steppe to low-latitude desert regions.

According to Quiring, 1968, the NTS average annual precipitation ranges from about 10 cm at the 900-m altitude to around 25 cm on the plateaus. During the winter months, the plateaus may be snow-covered for periods of several days or weeks. Snow is uncommon on the flats. Temperatures vary considerably with elevation, slope, and local air currents. The average daily high (low) temperatures at the lower altitudes are around 10° (-4°) C in January and 35° (12°) C in July, with extremes of 44° and -26° C. Corresponding temperatures on the plateaus are 2° (-4°) C in January and 26° (18°) C in July with extremes of 38° and -29° C. Temperatures as low as -34° C and higher than 46° C have been observed at the NTS.

The direction from which winds blow, as measured on a 30-m tower at the Yucca observation station, is predominantly northerly except for the months of May through August when winds from the south-southwest predominate. Because of the prevalent mountain/valley winds in the basins, south to southwest winds predominate during daylight hours during most months. During the winter months southerly winds have only a slight edge over northerly winds for a few hours during the warmest part of the day. These wind patterns may be quite different at other locations on the NTS because of local terrain effects and differences in elevation (Quiring, 1968).

Geology and Hydrology

Geological and hydrological studies of the NTS have been in progress by the U.S. Geological Survey and various other institutions since 1956. Because of this continuing effort, including subsurface studies of numerous boreholes, the surface and underground geological and hydrological characteristics for much of the NTS are known in considerable detail. This is particularly true for those areas in which underground experiments are conducted. A comprehensive summary of the geology and hydrology of the NTS was published in 1968 as Memoir 110 by the Geological Society of America, entitled "Nevada Test Site."

There are two major hydrologic systems on the NTS (Figure 3). Groundwater in the northwestern part of NTS or in the Pahute Mesa has been reported (WASH-DRAFT, 1975) to travel somewhere between 2 and 80 m per year to the south and southwest toward the Ash Meadows discharge area in the Amargosa Desert. It is estimated that the groundwater to the east of the NTS moves from north to south at a rate not less than 2 nor greater than 220 m per year. Carbon-14 analyses of this eastern groundwater indicate that the lower velocity is nearer the true value. At Mercury Valley, in the extreme southern part of the NTS, the groundwater flow direction shifts to the southwest toward the Ash Meadows discharge area in the southeastern Amargosa Valley.

Depths of water on the NTS vary from about 100 m beneath the valleys in the southeastern part of the site to more than 600 m beneath the highlands to the north. Although much of the valley fill is saturated, downward movement of water is extremely slow. The primary aquifer in these formations is the Paleozoic carbonates which underlie the more recent tuffs and alluviums.

Land Use of NTS Environs

Figure 4 is a map of the off-NTS area showing general land use. A wide variety of uses, such as farming, mining, grazing, camping, fishing, and hunting, exists due to the variable terrain. For example, within a 300-km radius west of the NTS, elevations range from below sea level in Death Valley to 4420 m above MSL in the Sierra Nevada Range. Additionally, parts of two valleys of major agricultural importance (the Owens and San Joaquin) are included. The areas south of the NTS are more uniform since the Mojave Desert ecosystem (mid-latitude desert) comprises most of this portion of Nevada, California, and Arizona. The areas east of the NTS are primarily mid-latitude steppe with some of the older river valleys, such as the Virgin River Valley and Moapa Valley, supporting small-scale but intensive farming of a variety of crops by irrigation. Grazing is also common in this area, particularly to the northeast. The area north of the NTS is also mid-latitude steppe where the major agricultural-related activity is grazing of both cattle and sheep. Only areas of minor agricultural importance, primarily the growing of alfalfa hay, are found in this portion of the State within a distance of 300 km.

In the summer of 1974, a brief survey of home gardens around the NTS found that a majority of the residents grow or have access to locally grown fruits and vegetables. Approximately two dozen of the surveyed gardens within 30-80 km of the NTS boundary were selected for sampling. These gardens produce a variety of root, leaf, seed, and fruit crops.

The only industrial enterprises within the immediate off-NTS area are 25 active mines, as shown in Figure 4, and several chemical processing plants located near Henderson, Nevada. The number of employees for these operations varies from one person at several small mines to several hundred workers for the chemical plants at Henderson. Most of the individual mining operations involve less than 10 workers per mine; however, a few operations employ up to 100-150 workers.

The major body of water close to the NTS is Lake Mead, a man-made lake supplied by water from the Colorado River. Lake Mead supplies about 60 percent of the water used for domestic, recreational, and industrial purposes in the Las Vegas Valley and a portion of the water used by Southern California. Smaller reservoirs and lakes located in the area are primarily for irrigation and for livestock. In California, the Owens River and Haiwee Reservoir feed into the Los Angeles Aqueduct and are the major sources of domestic water for the Los Angeles area.

As indicated by Figure 4, there are many places scattered in all directions from the NTS where such recreational activities as hunting, fishing, and camping are enjoyed by both local residents and tourists. In general, the camping and fishing sites to the northwest, north, and northeast of the NTS are utilized throughout the year except for the winter months. Camping and fishing at locations southeast, south, and southwest are utilized throughout the year with the most extensive activities occurring during all months except the hot summer months. All hunting is generally restricted to various times during the last 6 months of the year.

Dairy farming is not extensive within the 300-km-radius area under discussion. From a survey of milk cows during this report period, 8700 dairy cows, 370 family goats, and 600 family cows were located. The family cows and goats are found in all directions around the test site (Figure 5), whereas the dairy cows (Figure 6) are located southeast of the test site (Moapa River Valley, Nevada; Virgin River Valley, Nevada; and Las Vegas, Nevada), northeast (Hiko and Alamo, Nevada, area), west-northwest (near Bishop, California), and southwest (near Barstow, California).

Population Distribution

The populated area of primary concern around the NTS is shown in Figure 7 as the area within a 300-km radius of the NTS Control Point (CP-1), except for the areas west of the Sierra Nevada Mountains and in the southern portion of San Bernardino County. Based upon the 1970 census and the projections for 1973 and 1974 by the U.S. Census Bureau, Figure 7 shows the population of counties in Nevada and pertinent portions of the States of Arizona, California, and Utah. Las Vegas and vicinity are the only major population centers within the inscribed area of Figure 7. With the assumption that the total populations of the counties bisected by the 300-km radius lie within the inscribed area, there is a population of about 520,000 people living within the area of primary concern, about 50 percent of which lives in the Las Vegas urbanized area. If the urbanized area is not considered in determining population density, there are about 0.7 people per km^2 (2 people per mi^2). For comparison, the United States (50 states, 1970 census) has a population density of 22 people per km^2, and the overall Nevada average is 1.5 people per km^2.

The off-site areas within about 80 km of NTS are predominantly rural. Several small communities are located in the area, the largest being in the Pahrump Valley. This rural community, with an estimated population of about 1800, is located about 72 km south of the NTS. The Amargosa Farm area has a population of about 300 and is located about 50 km southwest of the center of the NTS. The Spring Meadows Farm area is a relatively new development consisting of approximately 4000 m^2 with a population of about 60. This area is about 55 km south-southwest of the NTS. The largest town in the near off-site area is Beatty with a population of about 500; it is located about 65 km to the west of the site.

In the adjacent states, the Mojave Desert of California, which includes Death Valley National Monument, lies along the southwestern border of Nevada. The population in the Monument boundaries varies considerably from season to season with fewer than 200 permanent residents and tourists in the area during any given period in the summer months. However, during the winter as many as 12,000 tourists and campers can be in the area on any particular day during the major holiday periods. The largest town in this general area is Barstow, located 265 km south-southwest of the NTS, with a population of about 18,200. The Owens Valley, where numerous small towns are located, lies about 50 km west of Death Valley. The largest town in Owens Valley is Bishop, located 225 km west-northwest of the NTS, with a population of about 3600.

The extreme southwestern region of Utah is more developed than the adjacent part of Nevada. The largest town, Cedar City, with a population of 9900, is located 280 km east-northeast of the NTS. The next largest community is St. George, located 220 km east of the NTS, with a population of 8000.

The extreme northwestern region of Arizona is mostly undeveloped range land with the exception of that portion in the Lake Mead Recreation Area.

Several small retirement communities are found along the Colorado River, primarily at Lake Mojave and Lake Havasu. The largest town in the area is Kingman, located 280 km southeast of the NTS, with a population of about 7500.

OTHER TEST SITES

Table 2 lists the names, dates, locations, yields, depths, and purposes of all underground nuclear tests conducted at locations other than the NTS. No off-NTS nuclear tests were conducted during this report period.

SUMMARY

During 1975, the monitoring of gamma radiation levels in the environs of the NTS was continued through the use of an off-site network of radiation dosimeters and gamma-rate recorders. Concentrations of radionuclides in pertinent environmental media were also continuously or periodically monitored by established air, milk, and water sampling networks. Before each underground nuclear detonation, mobile radiation monitors, equipped with radiation monitoring instruments and sampling equipment, were on standby in off-NTS locations to respond to any accidental release of airborne radioactivity. An airplane was airborne near the test area at detonation time to undertake tracking and sampling of any release which might occur.

A total of about 22 curies (Ci) of radioactivity, primarily radioxenon, was reported by ERDA/NV as being released intermittently throughout the year. The only off-NTS indications of this radioactivity from test operations were low concentrations of xenon-133, krypton-85, and tritium (hydrogen-3) in various combinations, measured in air samples collected at Beatty, Diablo, Hiko, Indian Springs, and Las Vegas, Nevada. The concentrations at these locations when averaged over the year were less than 0.01 percent of the Concentration Guide of 1×10^{-7} microcuries per millilitre (μCi/ml) as listed in the ERDA Manual, Chapter 0524, for exposure to a suitable sample of the population. Based upon time-integrated concentrations of the nuclides at these locations, dose calculations, and population information, the whole-body gamma dose commitment to persons within 80 km of the NTS Control Point for test operations during this year was estimated to be 0.00065 man-rem. The highest dose commitment,* 0.062 man-rem occurred beyond 80 km of NTS at Las Vegas, Nevada, a location with a much higher population density than any within 80 km of NTS.

All other measurements of radioactivity made by the Off-Site Radiological Safety Program were attributed to naturally occurring radioactivity or atmospheric fallout and not related to underground nuclear test operations during this report period. Due to the absence of atmospheric tests by the People's Republic of China during 1975 and the reduction in fallout from all previous atmospheric tests, no radionuclides were detected in samples of the Air Surveillance Network (ASN). A decrease in the range and average of gamma radiation levels monitored by thermoluminescent dosimeters of the off-NTS Dosimetry Network was observed as compared to previous years. The decrease in average exposures was attributed to a combination of factors: the slightly lower response of the new 2271-G2 dosimeters which replaced the TL-12 dosimeters used previously; the unusually low levels of world-wide fallout observed during the year by the ASN; and the continuing decay of old fallout from atmospheric testing at the NTS during 1951 - 1958.

*The dose commitment (product of estimated average dose and population) at Las Vegas from 1 year's exposure to natural background radiation is about 9700 man-rem.

The Long-Term Hydrological Monitoring Program used for the monitoring of radionuclide concentrations in surface and groundwaters which are down the hydrologic gradient from sites of past underground nuclear tests was continued for the NTS and six other sites located elsewhere in Nevada, Colorado, New Mexico, and Mississippi. Naturally occurring radionuclides, such as uranium isotopes and radium-226, were detected in samples collected at most locations at levels which were comparable to concentrations measured for previous years. Tritium was measured in all surface water samples at levels less than 2.5×10^{-6} μCi/ml, a concentration considered from past experience to be the highest one would expect from atmospheric fallout. Except for samples collected at wells known to be contaminated by the injection of high concentrations of radioactivity for tracer studies, no radioactivity related to past underground tests or to the contaminated wells was identified.

MONITORING DATA COLLECTION, ANALYSIS, AND EVALUATION

The major portion of the Off-Site Radiological Safety Program for the NTS consisted of continuously-operated dosimetry and air sampling networks and scheduled collections of milk and water samples at locations surrounding the NTS. Before each nuclear test, mobile monitors were positioned in the off-site areas most likely to be exposed to a possible release of radioactive material. These monitors, equipped with radiation survey instruments, rate recorders, thermoluminescent dosimeters, portable air samplers, and supplies for collecting environmental samples, were prepared to conduct a monitoring program directed from the NTS Control Point via two-way radio communications. In addition, for each event at the NTS, a U.S. Air Force aircraft with two Reynolds Electrical and Engineering Company monitors equipped with portable radiation survey instruments was airborne near surface ground zero to detect and track any radioactive effluent. Two EMSL-LV cloud sampling and tracking aircraft were also available to obtain in-cloud samples, assess total cloud volume, and provide long-range tracking in the event of a release of airborne radioactivity.

During this report period, only underground nuclear detonations were conducted. All detonations were contained. However, during re-entry drilling operations, occasional low level releases of airborne radioactivity, primarily radioxenon, did occur. According to information provided by the Nevada Operations Office, ERDA, the following quantities of radionuclides were released into the atmosphere during CY 1975:

Radionuclide	Quantity Released (Ci)
^{133}Xe	19.6
^{133m}Xe	0.3
^{3}H	2.2
Total	22.1

Continuous low-level releases of ^{3}H and ^{85}Kr occur on the NTS. Tritium is released primarily from the Sedan crater and by evaporation from ponds formed by drainage of water from tunnel test areas in the Rainier Mesa. Krypton-85 slowly seeps to the surface from underground test areas. The quantities of radioactivity from seepage are not quantitated, but are detected at on-site sampling locations.

Contained within the following sections of this report are descriptions for each surveillance network and interpretations of the analytical results which are summarized (maximum, minimum, and average concentrations) in tables. Where appropriate, the average values in the tables are compared to the applicable Concentration Guides (CG's) listed in Appendix A.

For "grab" type samples, radionuclide concentrations were extrapolated to the appropriate collection date. Concentrations determined over a period of time were extrapolated to the midpoint of the collection period. Concentration averages were calculated assuming that each concentration less than the minimum detectable concentration (MDC) was equal to the MDC.

All radiological analyses referred to within the text are briefly described in Table 3 and listed with the minimum detectable concentrations (MDC's). To assure validity of the data, analytical personnel routinely calibrate equipment, split selected samples (except for the Air Surveillance Network) for replicate analyses, and analyze spiked samples prepared by the Quality Assurance Branch, EMSL-LV, on a bi-monthly basis. All quality assurance checks for the year identified no problems which would affect the results reported here.

For the purpose of routinely assessing the total error (sampling replication error plus analytical/counting errors) associated with the collection and analysis of the different types of network samples, plans were made during this report period to initiate a duplicate sampling program for all sample types during CY 1976. The program was initiated in some of the networks near the end of this report period; but the data generated are not sufficient to be included in this report. Information on the total error associated with the different sample types will allow more complete analysis of variance in sample results and develop greater confidence in identifying results which are higher than normal.

AIR SURVEILLANCE NETWORK

The Air Surveillance Network, operated by the EMSL-LV, consisted of 48 active and 73 standby sampling stations located in 21 Western States (Figure 8). Samples of airborne particulates were collected continuously at each active station on 10-cm-diameter, glass-fiber filters at a flow rate of about 350 m^3 of air per day. The filters were collected three times per week, resulting in 48- or 72-hour samples from each active station. Activated charcoal cartridges directly behind the glass-fiber filters were used regularly for the collection of gaseous radioiodines at 21 stations near the NTS. Charcoal cartridges could have been added to all other stations, if necessary, by a telephone request to station operators. All air samples (filters and cartridges) were mailed to the EMSL-LV for analysis. Special retrieval could have been arranged at selected locations in the event a release of radioactivity was believed to have occurred.

From gamma spectrometry results, no radionuclides were identified on any filters or charcoal cartridges during this report period. Normally, radionuclides from the atmospheric testing of nuclear devices by the People's Republic of China are detected by the ASN; however, no tests were conducted during CY 1975 and apparently the atmospheric concentrations from previous tests were below the minimum detectable concentration for gamma spectrometry analyses.

NOBLE GAS AND TRITIUM SURVEILLANCE NETWORK

The Noble Gas and Tritium Surveillance Network, which was first established in March and April 1972, was operated to monitor the airborne levels of radiokrypton, radioxenon, and tritium (^3H) in the forms of tritiated hydrogen (HT), tritiated water (HTO), and tritiated methane (CH_3T). Originally, the Network consisted of four on-NTS and six off-NTS stations. For the purpose of ensuring that the sampling locations on or near the NTS are situated at population centers, a station was added at Indian Springs, Nevada, on April 1, 1975, and starting at the beginning of the year, the stations at Desert Rock and Gate 700 were moved to Mercury and Area 51, respectively (Figure 9).

The equipment used in this Network is composed of two separate systems, a compressor-type air sampler and a molecular sieve sampler. The compressor-type equipment continuously samples air over a 7-day period and stores it in two pressure tanks. The tanks together hold approximately 2 m^3 of air at atmospheric pressure. They are replaced weekly and returned to the EMSL-LV where the tank contents are separated and analyzed for ^{85}Kr, radioxenons, and CH_3T by gas chromatography and liquid-scintillation counting techniques (Table 3). The molecular sieve equipment samples air through a filter to remove particulates and then through a series of molecular sieve columns. Approximately 5 m^3 of air are passed through each sampler over a 7-day sampling period. From the HTO absorbed on the first molecular sieve column, the concentration of ^3H in μCi/ml of recovered moisture and in μCi/ml of sampled air is determined by liquid-scintillation counting techniques. The ^3H, passing through the first column as free hydrogen (HT), is oxidized and collected on the last molecular sieve column. From the concentration of ^3H for the moisture recovered from the last column, the ^3H (in μCi/ml of sampled air) as HT is determined.

Table 4 summarizes the results of this Network by listing the maximum, minimum, and average concentrations for ^{85}Kr, total Xe or ^{133}Xe, ^3H as CH_3T, ^3H as HTO, and ^3H as HT. The annual average concentrations for each station were calculated over the time period sampled assuming that all values less than MDC were equal to the MDC. All concentrations of ^{85}Kr, Xe or ^{133}Xe, ^3H as CH_3T, ^3H as HTO, and ^3H as HT are expressed in the same unit, μCi/ml of air. Since the ^3H concentration in air may vary by factors of 15-20 while the concentration in atmospheric water varies by factors up to about 7, the ^3H concentration in μCi/ml of atmospheric moisture is also given in the table as a more reliable indicator in cases when background concentrations of HTO are exceeded.

As shown by Table 4, the average ^{85}Kr concentrations for the year were nearly the same for all stations, ranging from 1.7×10^{-11} μCi/ml to 2.0×10^{-11} μCi/ml, with an overall average of 1.81×10^{-11} μCi/ml. This compares with overall averages of 1.60×10^{-11} μCi/ml in 1972, the first year of network operation, and 1.76×10^{-11} μCi/ml in 1974. The ambient concentration is increasing world-wide, primarily as a result of nuclear reactor operations. The maximum concentrations for all stations ranged from 2.3×10^{-11} μCi/ml to 3.8×10^{-11} μCi/ml. Based upon a review of all past ^{85}Kr data, those concentrations equal to or greater than 2.5×10^{-11} μCi/ml were considered to be above ambient background concentrations and attributable to some outside source or to anomalous variations. The sampling locations and dates for all concentrations above this level during CY 1975 are as follows:

Location	Collection Period Start	Stop	^{85}Kr Concentration (10^{-11} µCi/ml)
Death Valley Jct., California	06/17	06/24	2.7
Beatty, Nevada	12/09	12/16	2.5
Diablo, Nevada	12/10	12/17	2.5
Indian Springs, Nevada	06/02	06/09	2.7
	12/08	12/15	2.8
	12/15	12/22	3.0
Las Vegas, Nevada	04/02	04/09	2.6
	12/10	12/17	2.9
	12/17	12/24	3.0
NTS, Nevada (Mercury)	05/19	05/27	2.6
	12/08	12/15	3.4
NTS, Nevada (Area 51)	05/05	05/12	2.5
	06/02	06/09	2.5
NTS, Nevada (BJY)	03/03	03/10	2.5
	03/10	03/17	3.4
	12/08	12/15	3.8
NTS, Nevada (Area 12)	12/15	12/22	2.6
	12/08	12/15	2.7

As shown by these data, higher than normal ^{85}Kr concentrations for the sampling stations at Beatty, Diablo, Indian Springs, Las Vegas, Mercury, BJY, and Area 12 occurred during the period December 8-24. The highest of the concentrations, occurring at the NTS, were at BJY (3.8×10^{-11} µCi/ml) and Mercury (3.4×10^{-11} µCi/ml). These concentrations, and the 3.4×10^{-11} µCi/ml sample from March 10-17 at BJY, are attributed to current testing operations or seepage from the ground around the sites of past underground nuclear detonations. The highest concentration averages, either on-NTS or off-NTS, were less than 0.01 percent of the Concentration Guides for on- and off-site exposures (see Appendix A). Since all the other higher than normal ^{85}Kr concentrations in the above table occurred at different times during the year, they do not appear to be associated with NTS operations.

The concentrations of ^{3}H as HTO were at background levels at all locations except for the off-NTS stations at Beatty and Diablo and at the on-NTS stations at Area 51, BJY, and Area 12. Concentrations of ^{3}H as HT were above normal background levels only occasionally at the on-NTS station at Area 12. The concentrations of ^{3}H as CH_3T at all locations were less than the MDC. The higher than normal concentrations of ^{3}H as HT and HTO were probably the result of seepage from the ground near the sites of past tests, such as the Sedan cratering test and the Area 12 tunnel tests. The total of the average ^{3}H concentrations (HTO+HT+CH_3T) for either of the off-NTS locations identified with above background concentrations was less than 0.01 percent of the Concentration Guide for ^{3}H in air.

Concentrations of radioxenon greater than the MDC were detected at all Network locations during the year except for Death Valley Junction, Beatty,

and Tonopah. Since all off-NTS concentrations occurred in November at the same time that on-NTS concentrations were measured, they were attributable to NTS operations. The maximum concentration of radioxenon, identified as ^{133}Xe, was 3.1×10^{-11} μCi/ml at the on-NTS station at BJY. In the off-NTS area, the highest concentration was 2.5×10^{-11} μCi/ml at Diablo. At any of the off-NTS locations, the ^{133}Xe concentrations, when averaged over the total sampling times for the year, were less than 0.01 percent of the Concentration Guide for this nuclide.

DOSIMETRY NETWORK

The Dosimetry Network during 1975 consisted of 69 locations surrounding the Nevada Test Site which were monitored continuously with thermoluminescent dosimeters (TLD's). The locations of these stations, shown in Figure 10, are all within a 270-km radius of the center of the NTS and include both inhabited and uninhabited locations. Each Dosimetry Network station was routinely equipped with three Harshaw Model 2271-G2 (TLD-200) dosimeters which replaced the EG&G TL-12 dosimeters previously used. These dosimeters were exchanged on a quarterly basis. Within the general area covered by the dosimetry stations, 25 cooperating off-site residents each wore a dosimeter which was exchanged at the same time as the station dosimeters.

The 2271-G2 dosimeters consist of two small "chips" of dysprosium-activated calcium fluoride, designated TLD-200 by Harshaw, mounted within a window of Teflon plastic and attached to an aluminum card. The card is 4.4 by 3.2 cm and is about the size of the standard personnel dosimetry film packet. An energy compensation shield of about 1.2-mm-thick cadmium metal is placed over the chips and the whole card is sealed in an opaque plastic container. These dosimeters have no source of self-exposure and exhibit both sensitivity and precision superior to dosimeter types previously used by the EMSL-LV.

The smallest exposure in excess of background radiation which may be determined from these dosimeter readings depends primarily on variations in the natural background at the particular station location. Experience has shown these variations to be significant from one monitoring period to another and greater than the precision of the dosimeters themselves. Typically, however, the smallest net exposure observable for a 90-day monitoring period would be 5-15 mR in excess of background. The term "background," as used in this context, refers to naturally occurring radioactivity plus a contribution from residual man-made fission products.

After appropriate corrections were made for background exposure accumulated during shipment between the Laboratory and the monitoring location, the dosimeter readings for each station were averaged. This average value for each monitoring period and station was compared to values from the past 3 years to determine if the new value was within the range of previous background values for that station. Any values significantly greater than previous values would have led to calculations of net exposure, while values significantly less than previous values would have been examined to determine possible reader or handling errors producing invalid data. The results from each of the personnel dosimeters were compared to the background value of the nearest station to determine if a net exposure had occurred.

Table 5 lists the maximum, minimum, and average dose equivalent rate (mrem/y) measured at each station in the network during 1975. All doses are due to environmental background radiation. As noted in the summary of environmental radiation doses below, the average environmental background dose for all stations for 1975 is significantly lower than in previous years. This is believed to be due to three factors: the lesser response to low energy photons of the new 2271-G2 dosimeters relative to the older TL-12 dosimeters used previously, the unusually low levels of world-wide radiation fallout observed during 1975, and the continuing decay of old fallout from atmospheric testing at NTS. Each of these factors, while small in themselves, has had an effect which in summary is significant.

	Environmental Radiation Dose (mrem/y)		
Year	Maximum	Minimum	Average
1975	130	44	90
1974	160	62	114
1973	180	80	123
1972	200	84	144
1971	303	102	163

Independent measurements of the photon energy response to the 2271-G2 dosimeters (with the cadmium shield) and the TL-12 dosimeters reveal a relatively decreased sensitivity of the new dosimeters to photons less than 80 keV. In a year long side-by-side comparison, the 2271-G2 dosimeters showed a small, consistently lower average dose than did the TL-12. This is to be expected, since a significant fraction of the photon spectrum comprising environmental background is due to scattered photons of relatively low energy. Since the data from 1971 through 1974 were obtained with the older dosimeters, this effect tends to depress the apparent average for 1975. Although a small difference has been observed between the two TLD types, it is not known yet which measurement is a truer measure of background exposure dose. Both types give a similar response for net exposures above background. A more thorough investigation of the background response of the TLD's will be conducted by making comparisons to field measurements obtained with a pressurized ionization chamber.

During 1975 the Air Surveillance Network reported unusually low levels of radioactivity in air attributable to world-wide fallout from previous atmospheric tests. While it is difficult to quantify the external gamma-ray dose from this source, its decrease during 1975 undoubtedly contributed to the lower overall average dose measured by the Dosimetry Network, just as the occurrence of fallout from nuclear tests by the People's Republic of China in 1973 and 1974 tended to raise the network average in those years.

Probably the most significant effect in decreasing the average dose measured by the Dosimetry Network is the decay of old fallout from atmospheric testing at NTS. Figure 10 clearly shows that most network stations are concentrated in areas which received fallout from these tests, particularly to the north and northeast of NTS, and thus the network average is significantly affected by changes at those stations. As was noted in the previous summary of

environmental radiation doses, the average annual dose for the Dosimetry Network has steadily decreased over the last 4 years by an average of nearly 20 mrem per year.

It is difficult to make comparisons of Dosimetry Network data with other dose estimates, as these are usually population dose estimates, weighted by geographic location and population. For example, one report (ORP/CSD 7201, 1972) estimated the population doses for Nevada, California, and Utah to be 125, 90, and 155 mrem/y per person, respectively. The average doses for the Dosimetry Network stations in these States are 90, 80, and 72 mrem/y, and it is felt that this discrepancy is the result of locating the network stations by criteria other than population density. A study conducted by the Lawrence Livermore Laboratory (LLL) in March-June 1971 (Lindeken et al., 1972) may be more applicable for comparison. In this study, TLD's were placed at 107 weather stations around the United States for roughly 3 months. Several of these locations were close to Dosimetry Network stations and thus a direct comparison is possible. The locations monitored and the dose estimates are as follows:

Total Ionizing Radiation Dose at Selected Locations

Location	Annual Dose Equivalent (mrem/y) (LLL,1971)	(EPA,1971)	(EPA,1975)
Las Vegas, Nevada	57.8	110	52
Ely, Nevada	109	150*	91
Elko, Nevada	110	180	(not monitored)
Bishop, California	174	150	88

*1970 value; 1971 value invalid due to check source left in place.

Although an annual exposure based on a 3-month exposure dose measurement is not directly comparable to a measured 1-year exposure, the results show the large variation in exposure rates that occur in the NTS environs. Considerable variations may occur in different parts of the same city, as shown by the Las Vegas results in Table 5.

The function of the Dosimetry Network is to monitor for radiation exposures due to releases of radioactivity from the NTS. It is necessary to establish an accurate baseline for each monitoring station so that net exposure doses can be determined. This important function is served by the Dosimetry Network. The ability to measure the true background exposure rate or the average population exposure to background radiation is an added benefit derived from the use of TLD's and is of secondary importance.

A network of 30 stationary gamma exposure rate recorders placed at selected air sampling locations was used to document gamma exposure rates at fixed locations (Figure 8). These recorders use a 2.5- by 30.5-cm constant-current ionization chamber detector filled with methane, and operate on either 110 V a.c. or on a self-contained battery pack. They have a range of 0.004 mR/h to

40 mR/h with an accuracy of about ±10 percent. During this report period, no increase in exposure rates attributable to NTS operations was detected by the network of gamma rate recorders.

MILK SURVEILLANCE NETWORK

Milk is only one of the sources of dietary intake of environmental radioactivity. However, it is a very convenient indicator of the general population's intake of biologically significant radionuclide contaminants. For this reason it is monitored on a routine basis. Few of the fission product radionuclides become incorporated into the milk due to the selective metabolism of the cow. However, those that are incorporated are very important from a radiological health standpoint. The amount transferred to milk is a very sensitive measure of their concentrations in the environment. The six most common fission product radionuclides which can occur in milk are ^{3}H, $^{89,90}Sr$, ^{131}I, ^{137}Cs, and ^{140}Ba. A seventh radionuclide, ^{40}K, also occurs in milk at a reasonably constant concentration of about 1.2×10^{-6} µCi/ml. Since this is a naturally occurring radionuclide, it was not included in the analytical results summarized in this section.

The milk surveillance networks operated by the EMSL-LV were the routine Milk Surveillance Network (MSN) and the Standby Milk Surveillance Network (SMSN). The MSN, during 1975 (Figure 11), consisted of 24 different locations where 3.8-litre milk samples were collected from family cows, commercial pasteurized milk producers, Grade A raw milk intended for pasteurization, and Grade A raw milk for local consumption. In the event of a release of activity from the NTS, intensive sampling would have been conducted in the affected area within a 480-km radius of CP-1, NTS, to assess the radionuclide concentrations in milk, the radiation doses that could result from the ingestion of the milk, and the need for protective action. Samples are collected from milk suppliers and producers beyond 480 km within the SMSN.

During 1975, 87 milk samples were collected from the MSN on a quarterly collection schedule. Usually milk could not be obtained at all locations at any one collection time. Cows not lactating, no one home, or no milk on the day that field personnel arrived at the ranch were some of the reasons why some of the samples were not collected. During the year, milk sampling points also changed as dairies were closed, cows were sold, or cows were otherwise unavailable for regular milkings.

The SMSN consisted of about 175 Grade A milk processing plants in all States west of the Mississippi River. Managers of these facilities could be requested by telephone to collect raw milk samples representing milk sheds supplying milk to the plants. Since there were no releases of radioactivity from the NTS or other test locations, this network was not activated except to request one sample from each location to check the readiness and reliability of the network. Each sample was analyzed for ^{3}H and $^{89,90}Sr$ for the purpose of comparing the results with the results of the MSN.

Each MSN milk sample was analyzed for gamma-emitters and $^{89,90}Sr$. Samples collected at six locations from the MSN were also analyzed for ^{3}H. Table 3

lists the general analytical procedures and detection limits for these analyses.

The analytical results of milk samples collected from the MSN during 1975 are summarized in Table 6. The maximum, minimum, and average concentrations of the ^{137}Cs, $^{89,90}Sr$, and ^{3}H in samples collected during the year are shown for each sampling location. Although ^{137}Cs and ^{90}Sr were observed in the samples, the concentrations of these radionuclides were similar to levels found in samples collected for the SMSN. Therefore, they were attributed to world-wide fallout and not to NTS operations.

Shown below are the maximum, minimum, and average concentrations of ^{3}H, ^{90}Sr, and ^{137}Cs in the area surrounding the NTS and other areas of the Western United States. As indicated by this table, the concentrations of these radionuclides for both the MSN and the SMSN are commensurate.

Network	Radionuclide	No. of Samples	Concentration (10^{-9} µCi/ml) C_{Max}	C_{Min}	C_{Avg}
MSN	^{137}Cs	86	18	<3	<6
	^{90}Sr	87	8.7	<0.6	<3
	^{3}H	24	1000	<200	<400
SMSN	^{137}Cs	124	20	<3	<7
	^{90}Sr	33	9.2	<1	<4
	^{3}H	36	4100	<200	<700

WATER SURVEILLANCE NETWORK

Beginning January 1, 1975, the routine Water Surveillance Network (WSN) was discontinued. Ten locations (Figure 13) near the NTS were selected from the WSN, added to the Long-Term Hydrological Monitoring Program for the NTS, and sampled on an annual basis.

LONG-TERM HYDROLOGICAL MONITORING PROGRAM

During this reporting period, EMSL-LV personnel continued the collection and analysis of water samples from wells, springs, and spring-fed surface water sources which are down the hydrologic gradient of the groundwater at the NTS and at off-NTS sites of underground nuclear detonations to monitor for any migration of test-related radionuclides through the movement of groundwater. The water samples were collected from well heads or spring discharge points wherever possible. If pumps were not available, an electrical-mechanical water sampler capable of collecting 3-litre samples at depths to 1800 m was used.

Nevada Test Site

For the NTS, attempts were made to sample 12 stations monthly and 17 stations semi-annually (Figures 12 and 13). Additionally, samples were also collected annually from 10 locations selected from the discontinued WSN. Not all stations could be sampled with the desired frequency because of inclement weather conditions and inoperative pumps.

For each sampled location, samples of raw water, filtered water, and filtered and acidified water were collected. The raw water samples were analyzed for ^{3}H. Portions of the filtered and acidified samples were given radiochemical analyses by the criteria summarized in Table 7. Table 3 summarizes the analytical techniques used. Each filter was also analyzed by gamma spectrometry.

Tables 8, 9, and 10 list the analytical results for all samples collected and analyzed during this reporting period. As in the past, ^{3}H was detected in NTS Wells C and C-1 due to tracer experiments conducted prior to the commencement of this surveillance program. All ^{3}H concentrations were below 0.01 percent of the Concentration Guide for an occupationally-exposed person.

The ^{226}Ra and $^{234,235,238}U$ detected in most of the water samples occur naturally in groundwater. The concentrations of these radionuclides for this reporting period were similar to the concentrations reported for previous years.

Tables 8, 9, and 10 show concentrations of ^{90}Sr, ^{238}Pu, and ^{239}Pu which were above their respective MDC's. These concentrations, with a two-sigma counting error and percentage of the appropriate Concentration Guide, are as follows:

Location	Radionuclide	Concentration (10^{-9} µCi/ml)	% of Conc. Guide
Well A	^{238}Pu	0.092 ± 0.024	<0.01
	^{239}Pu	0.031 ± 0.022	<0.01
Crystal Spring	^{90}Sr	1.1 ± 1.0	0.37
Well C	^{90}Sr	2.6 ± 1.4	<0.01

Since these concentrations are either below or near the three-sigma counting error of each measurement, the concentrations are considered to be due to statistical error.

Due to the absence of information on background levels of ^{3}H in deep wells, the ^{3}H concentrations measured by the program can only be compared to previous determinations. Such a comparison for each location indicated that there are no significant increases in concentrations which could be the result of ^{3}H migration from the sites of underground nuclear detonations.

Other Test Sites

The annual collection and radiological analysis of water samples were continued for this program at all off-NTS sites of underground nuclear detonations except for Project Cannikin on Amchitka Island, Alaska, and Project Rio Blanco near Meeker, Colorado. The latter two sites are the responsibility of other agencies. The project sites at which samples were collected are Project Gnome near Carlsbad, New Mexico; Project Faultless in Central Nevada; Project Shoal near Fallon, Nevada; Project Gasbuggy in Rio Arriba County, New Mexico; Project Rulison near Rifle, Colorado; and Project Dribble at Tatum Dome, Mississippi. Figures 14 through 20 identify the sampling locations, and Table 2 lists additional information on the location of each site and tests performed at these locations.

A contaminated well, Well HT-2M, at the Project Dribble site was plugged from total depth to surface in July 1975. No contaminated fluid was released to the environment during the plugging operation. As a result of the plugging operation, the sample collection at all other wells at Project Dribble will be quarterly for 1 year from July 1975, semi-annually for the second year, and annually thereafter unless the analytical results of samples indicate more frequent sampling is necessary.

All samples were analyzed using the same criteria (Table 7) as for samples from the NTS Programs. The analytical results of all water samples collected during CY 1975 are summarized in Table 11.

The only sample results showing radioactivity concentrations significantly above background levels were for USGS Wells Nos. 4 and 8 near Malaga, New Mexico. As mentioned in previous reports, these wells, which are fenced, posted, and locked to prevent their use by unauthorized personnel, were contaminated by the injection of high concentrations of radioactivity for a radioactive tracer study. All surface water samples had ^{3}H concentrations below 2.5×10^{-6} µCi/ml, a level considered from past experience to be the highest one would expect from atmospheric fallout. All ^{3}H concentrations in well samples were similar to concentrations measured during previous years.

Several samples had concentrations of ^{90}Sr and ^{239}Pu above their respective MDC. The locations, concentrations with two-sigma counting errors, and percentages of the Concentration Guides for these samples are as follows:

Location	Radionuclide	Concentration (10^{-9} µCi/ml)	% of Conc. Guide
Malaga, New Mexico USGS Well No. 1	^{90}Sr	1.3 ± 0.9	0.4
Malaga, New Mexico USGS Well No. 8	^{239}Pu	0.047 ± 0.040	<0.01
Malaga, New Mexico PHS Well No. 6	^{239}Pu	0.024 ± 0.023	<0.01
Baxterville, Mississippi Well HT-1	^{239}Pu	0.048 ± 0.019	<0.01
Blanco, New Mexico San Juan River	^{90}Sr	1.9 ± 1.1	0.6

All of the preceding concentrations are less or only slightly greater than their respective three-sigma counting errors; therefore, all the concentrations are considered to be the result of statistical error and not necessarily true indications of above background measurements.

WHOLE-BODY COUNTING

During 1975, the measurements of body burdens of radioactivity in selected off-site residents were continued. The whole-body counting facility was described previously (NERC-LV-539-31, 1974).

One hundred and eleven individuals from 14 locations were examined. These locations were Pahrump, Springdale, Beatty, Moapa, Caliente, Pioche, Nyala, Diablo, Goldfield, Lathrop Wells, Ely, Tonopah, Twin Springs, and Spring Meadows Farms, Nevada. When possible, all members of a family are included.

The minimum detectable concentrations for ^{137}Cs by whole-body counting was $5x10^{-9}$ µCi/g for a body weight of 70 kg and a 40-minute count. Each individual was also given a complete hematological examination and a thyroid profile. A urine sample was collected from each individual for ^{3}H analysis and composite urine samples from each family were analyzed for $^{238,239}Pu$.

From the results of whole-body counting, the fission product ^{137}Cs was detected above the detection limit in 82 individuals. The maximum, minimum, and average concentrations for this radionuclide were $4.3x10^{-8}$, $5.0x10^{-9}$, and $1.4x10^{-8}$ µCi/g body weight, respectively.

These concentrations are comparable to those found by the Los Alamos Scientific Laboratory (LASL), Albuquerque, New Mexico. According to LASL personnel (Smale and Umbarger, 1976), the average body burden of ^{137}Cs measured in workers at that Laboratory was 1 nCi. Based upon the 70-kg body weight of a standard man, this is equivalent to $1.4x10^{-8}$ µCi/g.

In regard to the hematological examinations and thyroid profiles, no abnormal results were observed which could be attributed to past or present NTS testing operations. The concentrations of ^{238}Pu and ^{239}Pu in all urine samples were $<3x10^{-10}$ µCi/ml and $<1x10^{-10}$ µCi/ml, respectively. Concentrations of ^{3}H in urine samples were observed above the MDC of the measurement; however, the levels observed—average of $0.4x10^{-9}$ µCi/ml with a range of $0.2x10^{-9}$ to $1.5x10^{-9}$ µCi/ml—were within the range of background concentrations normally observed in surface waters or atmospheric moisture.

DOSE ASSESSMENT

The only radionuclides ascribed to NTS operations detected in off-NTS areas were ^{133}Xe (at Beatty, Diablo, Hiko, Indian Springs, and Las Vegas), ^{3}H (at Beatty and Diablo), and ^{85}Kr (at Beatty, Diablo, Indian Springs, and Las Vegas) in air samples. From the analytical results of samples collected at these locations and the dose calculations described in Appendix B, the whole-body gamma dose equivalents (D.E.) to off-NTS residents and the 80-km dose commitment in man-rem were calculated. The results, shown below, indicate that the D.E.'s at these locations were 2.1 μrem or less, which is

Location	Total Whole-Body Dose (μrem)	Percent of Radiation Protection Standard	Population	Dose Commitment Within 80 km (man-rem)
Beatty	0.15	0.00009	500	0.000075
Diablo	2.1	0.002	5	0*
Hiko	0.97	0.0006	52	0*
Indian Springs	0.34	0.0002	1670	0.00057
Las Vegas	0.32	0.0002	194,000	0*
			Total	0.00065

*Diablo, Hiko, and Las Vegas are beyond 80 km. The dose commitments for these locations are 0.000011 man-rem, 0.000050 man-rem, and 0.062 man-rem, respectively.

0.002 percent of the Radiation Protection Standard of 170 mrem/y (Appendix A) or 0.04-0.07 percent of the dose one could receive from cosmic radiation (3-5 mrem) during a round-trip flight between Washington, D.C. and the West Coast at 11,000 m above mean sea level (ERDA, 1973).

The dose commitment, which is the product of the estimated D.E. at a given location and the exposed population, was determined as a gross measurement of potential biological damage from radiation exposure, assuming that the calculated D.E. was the average dose to the population and that the relationship between dose and effects is linear. Although the maximum dose commitment occurred at Las Vegas, the dose commitment within 80 km of NTS is reported as required by the ERDA Manual, Chapter 0513. For comparison, the dose commitment at Las Vegas from 1 year's exposure to natural background radiation (about 50 mrem/y, Table 5), would be 9700 man-rem.

Since the critical organ for persons exposed to ^{85}Kr is the skin of the total body, the D.E.'s calculated from the ^{85}Kr concentrations were excluded from the whole-body gamma D.E. estimates and the 80-km, man-rem dose estimates. The skin D.E.'s for the four off-NTS locations, Beatty, Diablo, Indian Springs, and Las Vegas, were all $<3\times10^{-4}$ percent of the Radiation Protection Standard of 0.5 rem/y for a suitable sample of the exposed population.

In the derivation of the Concentration Guide for ^{85}Kr listed in the ERDA Manual, Chapter 0524, the exposure to airborne ^{85}Kr is assumed to result in a whole-body gamma dose equivalent instead of a total body skin D.E. If one applies this assumption to the previous D.E. estimates for Beatty, Diablo, Indian Springs, and Las Vegas (locations where above background ^{85}Kr concentrations were detected), the 80-km dose commitment estimate would be increased to 0.0022 man-rem, a factor of 3.4 times the first estimate. The dose commitments at Diablo, Hiko, and Las Vegas (beyond 80-km of NTS) would also be increased to 0.000037 man-rem, 0.00017 man-rem, and 0.21 man-rem, respectively.

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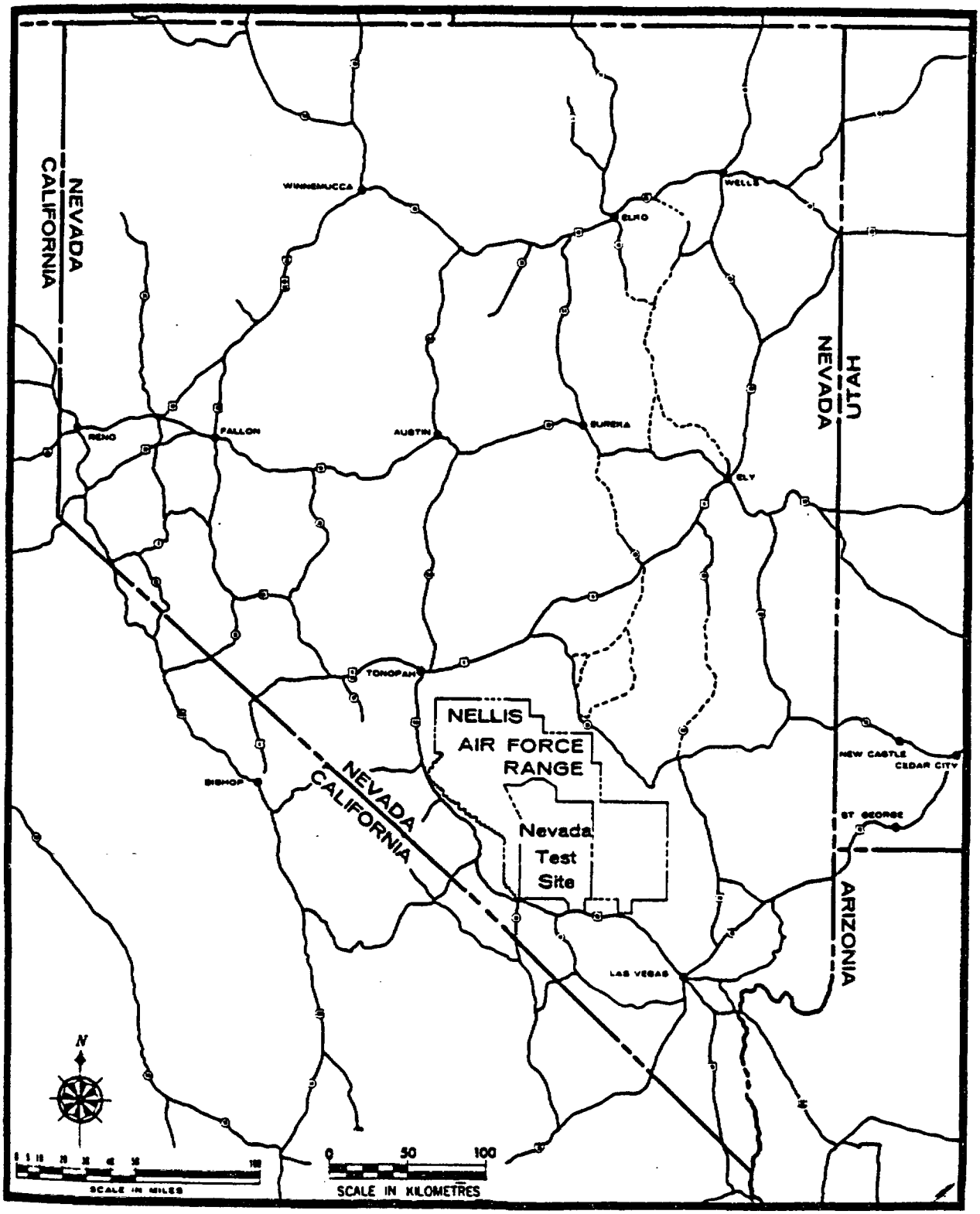

Figure 1. Nevada Test Site Location

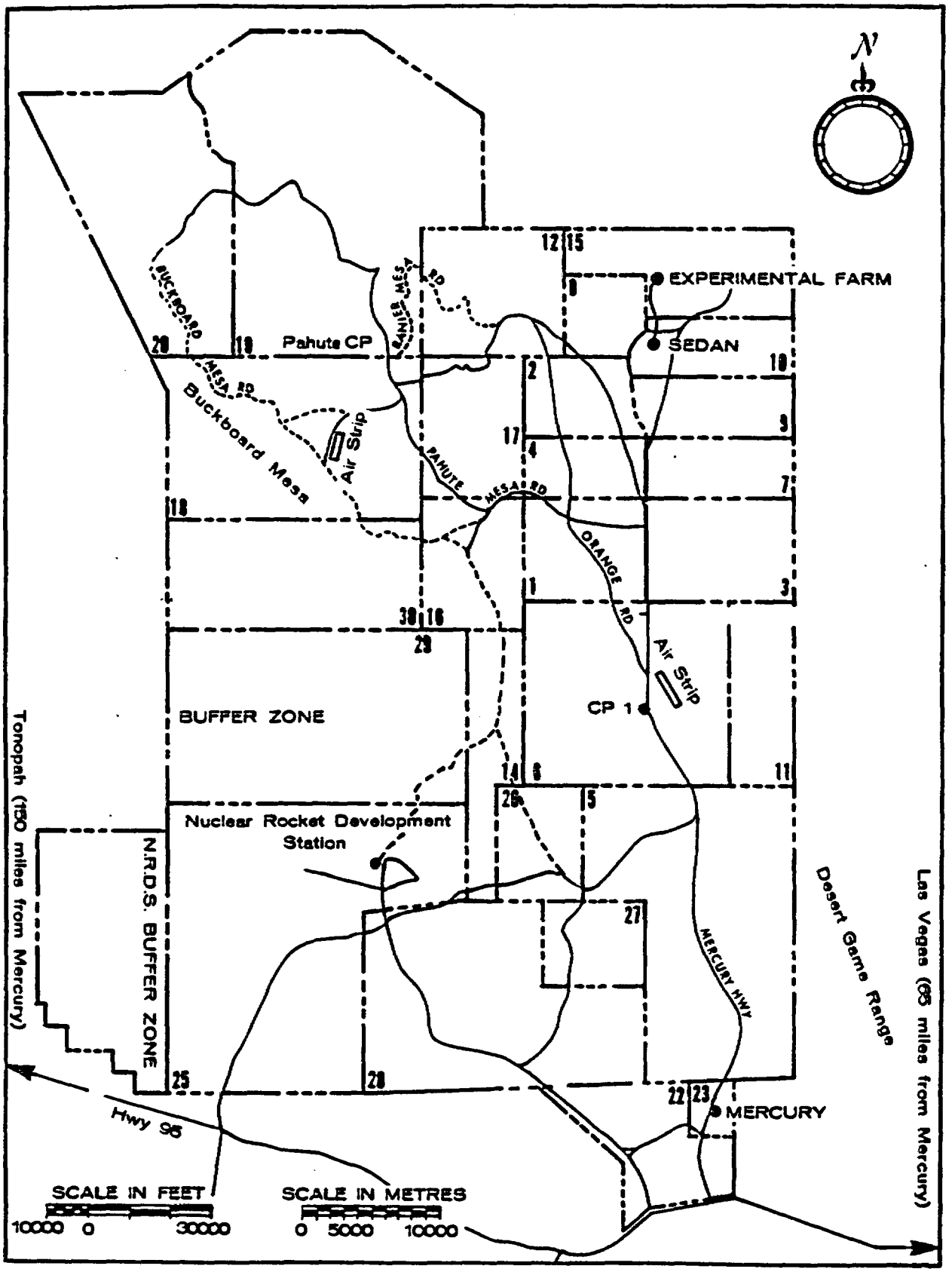

Figure 2. Nevada Test Site Road and Facility Map

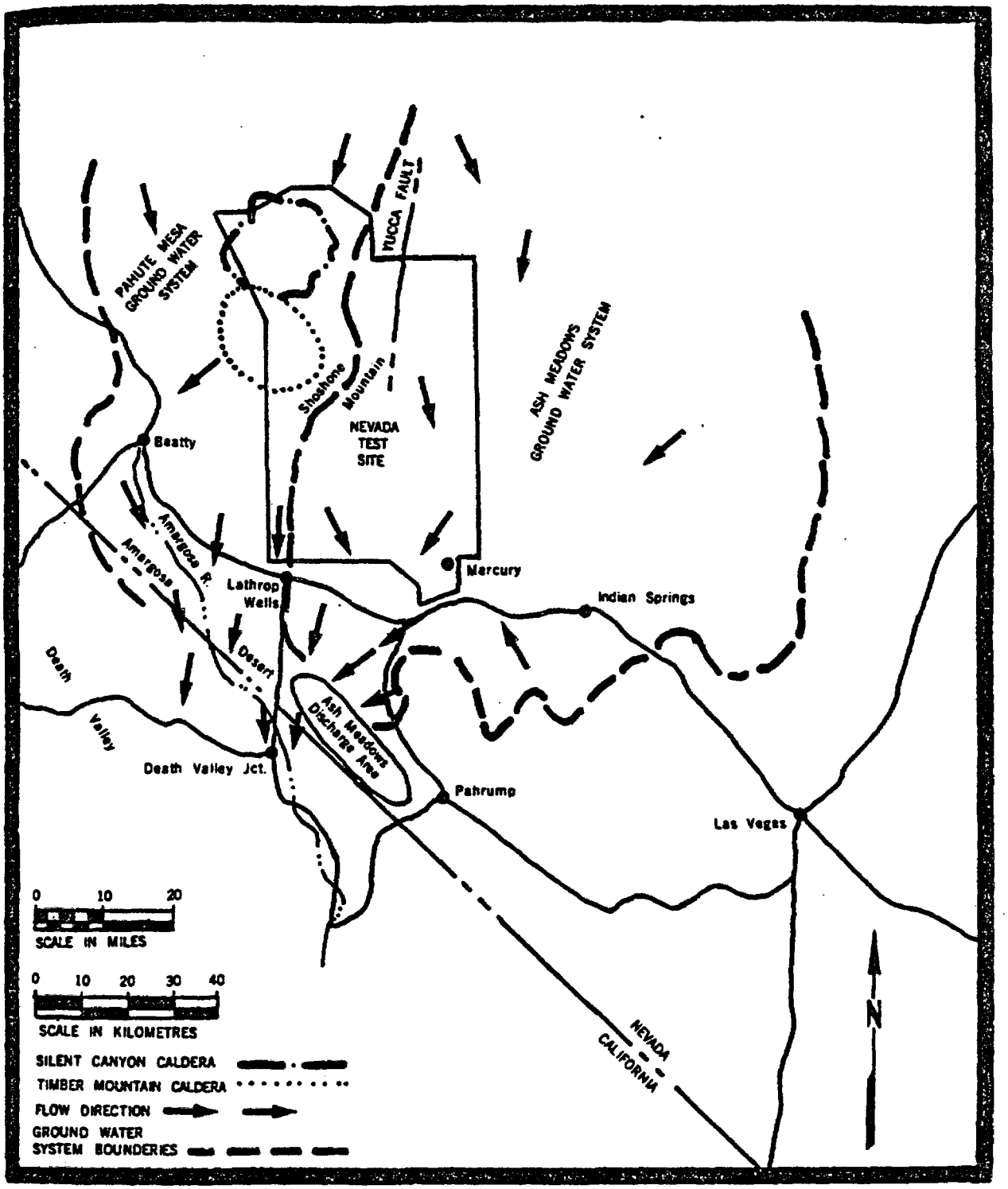

Figure 3. Groundwater Flow Systems - Nevada Test Site

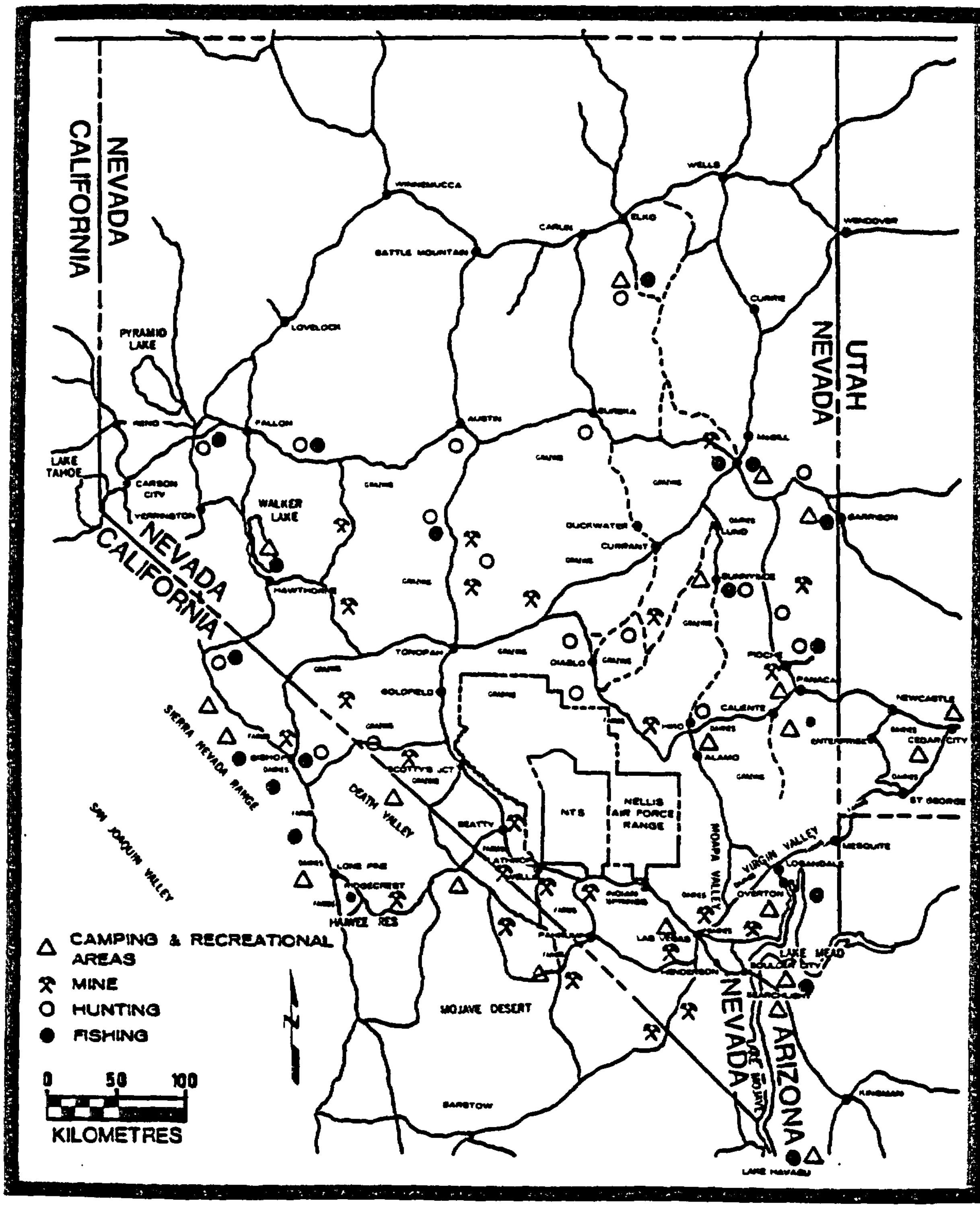

Figure 4. General Land Use, Nevada Test Site Vicinity

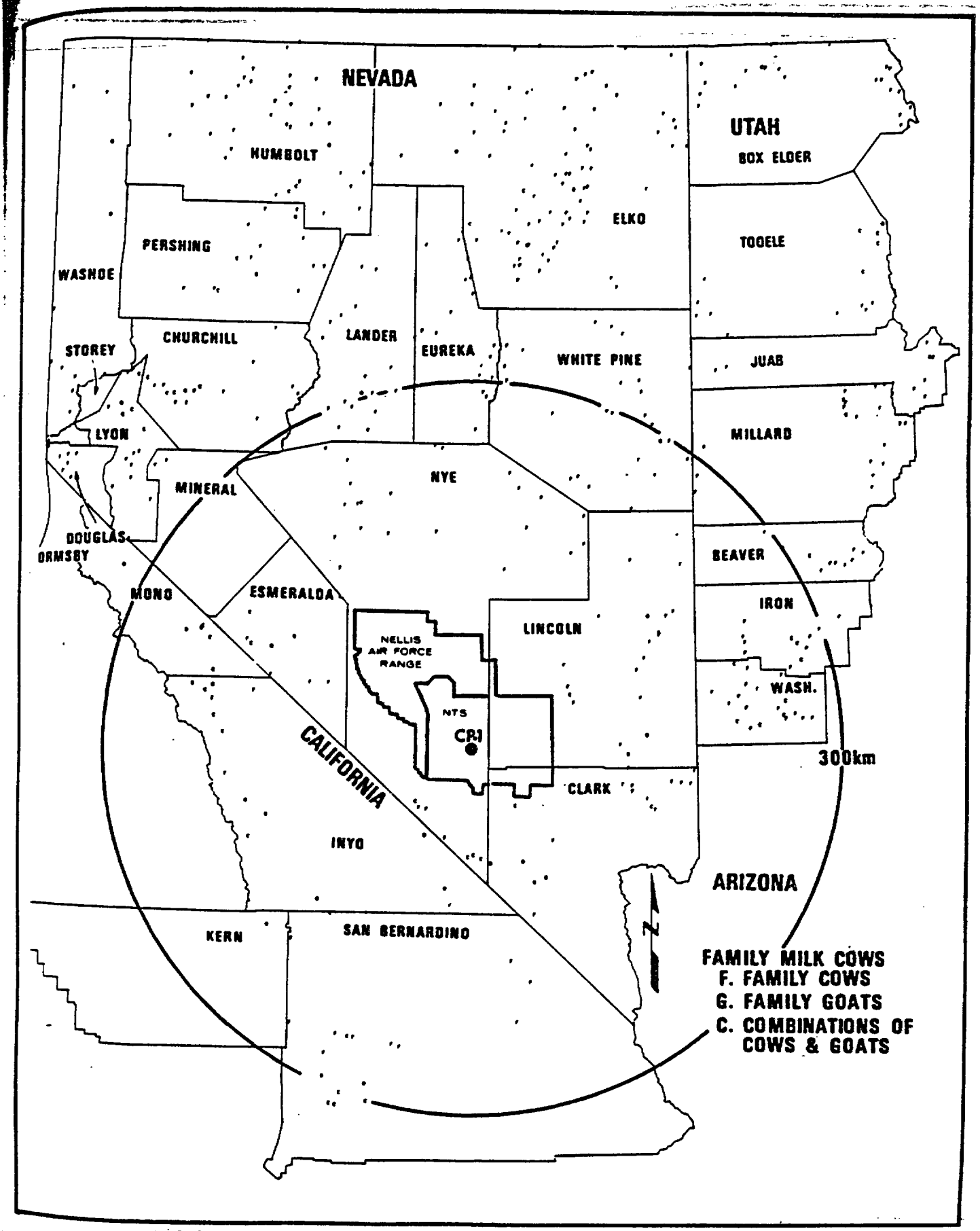

Figure 5. Location of Family Milk Cows and Goats

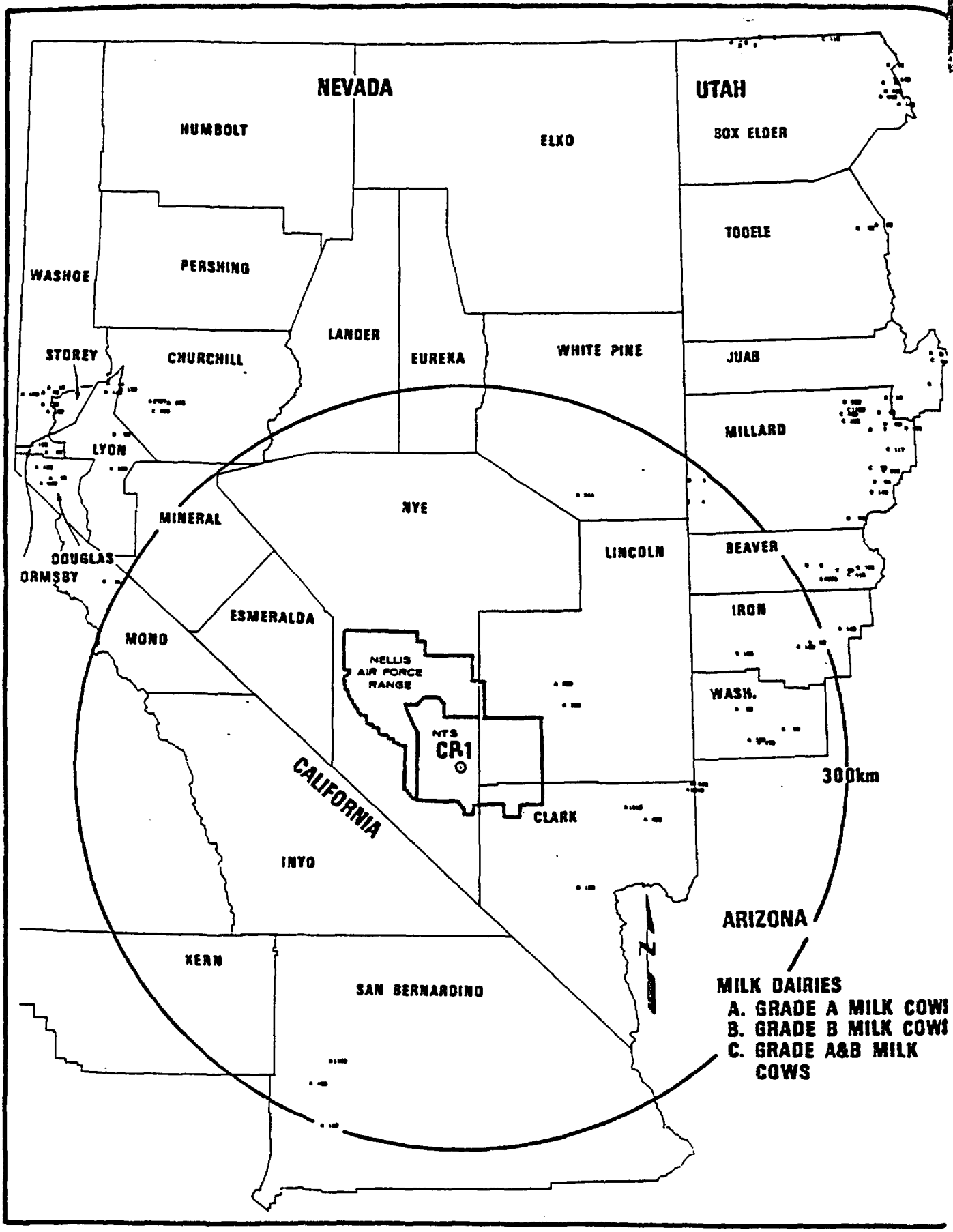

Figure 6. Location of Dairy Cows

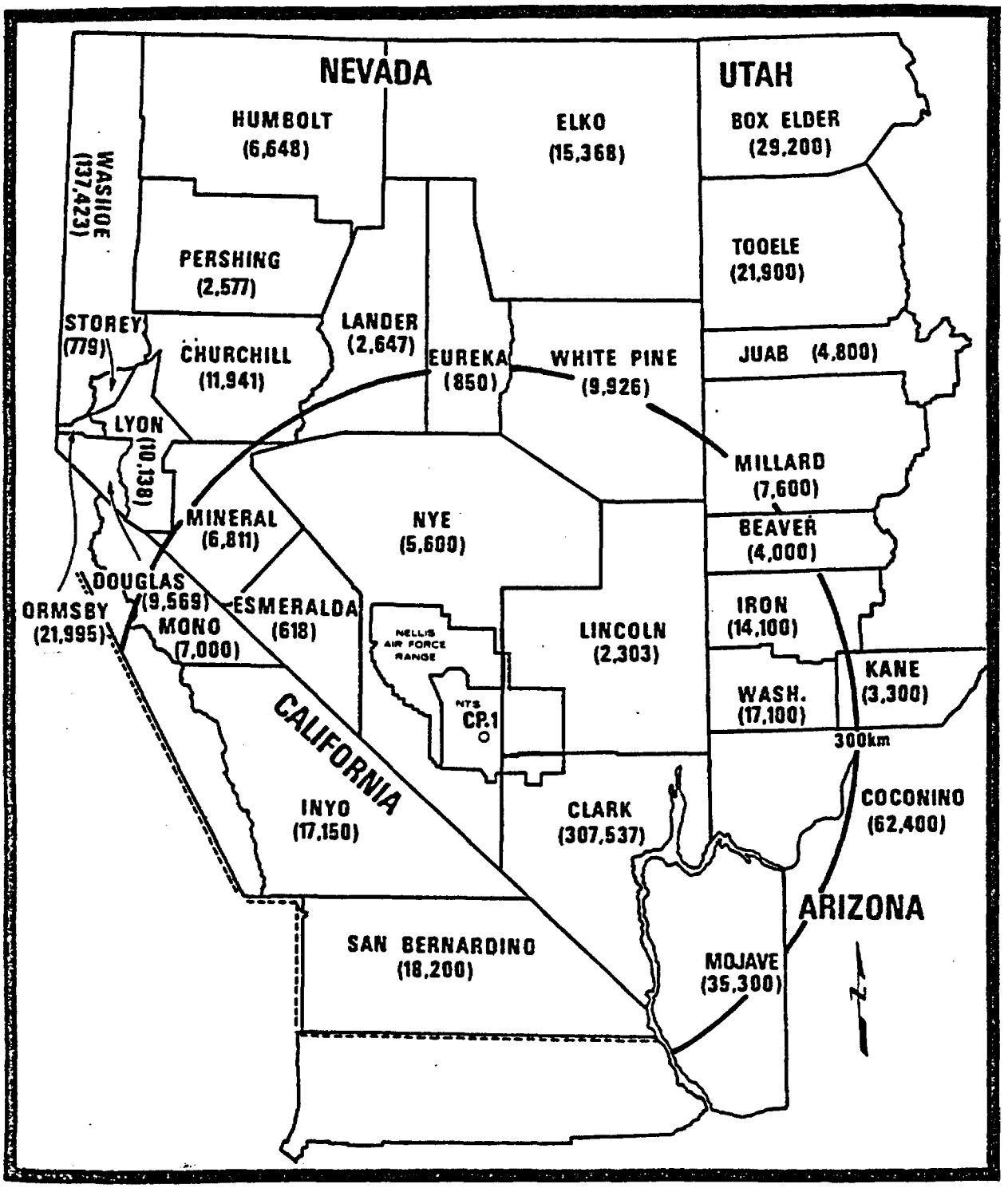

Figure 7. Population of Arizona, California, Nevada, and Utah Counties Near the Nevada Test Site

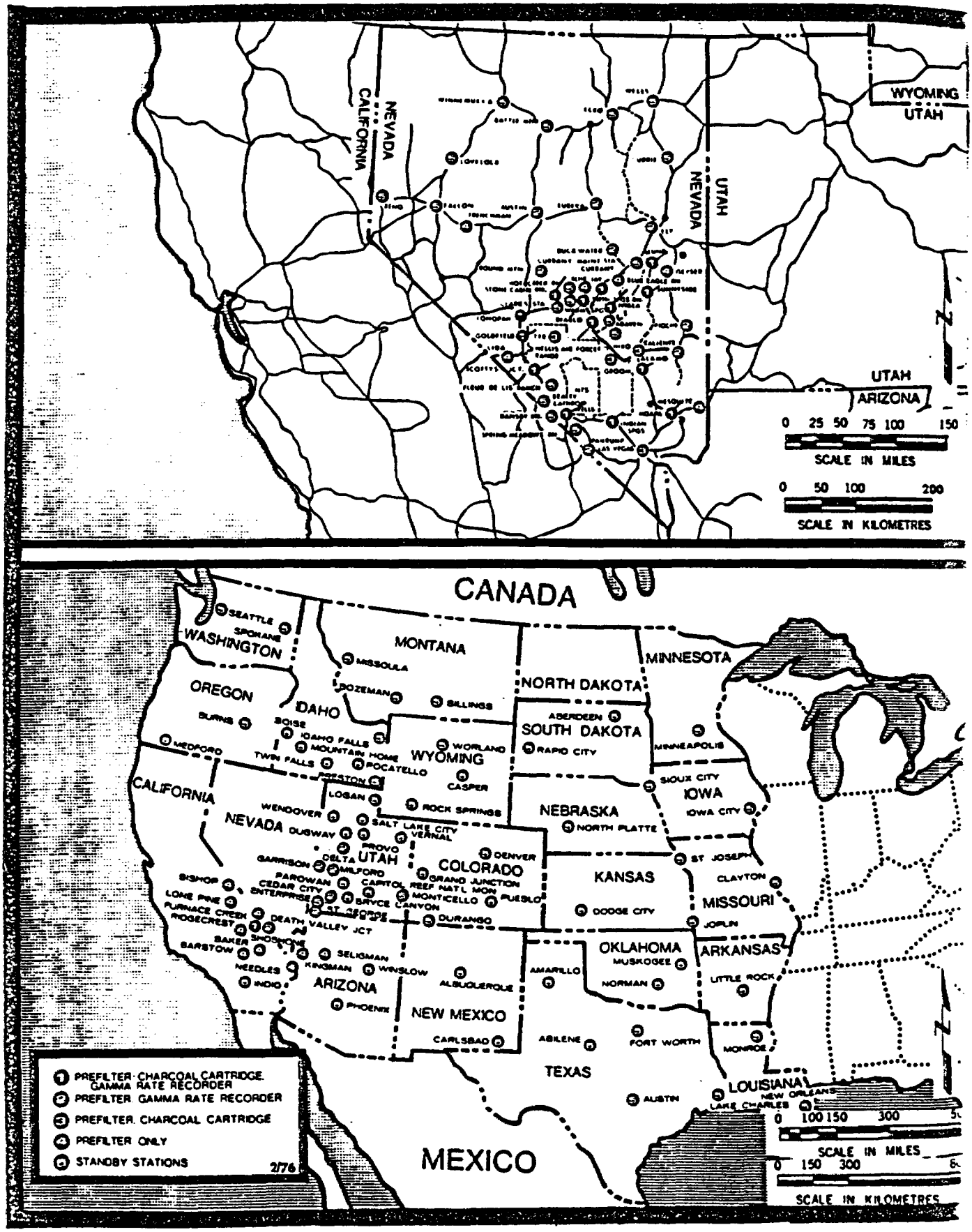

Figure 8. Air Surveillance Network

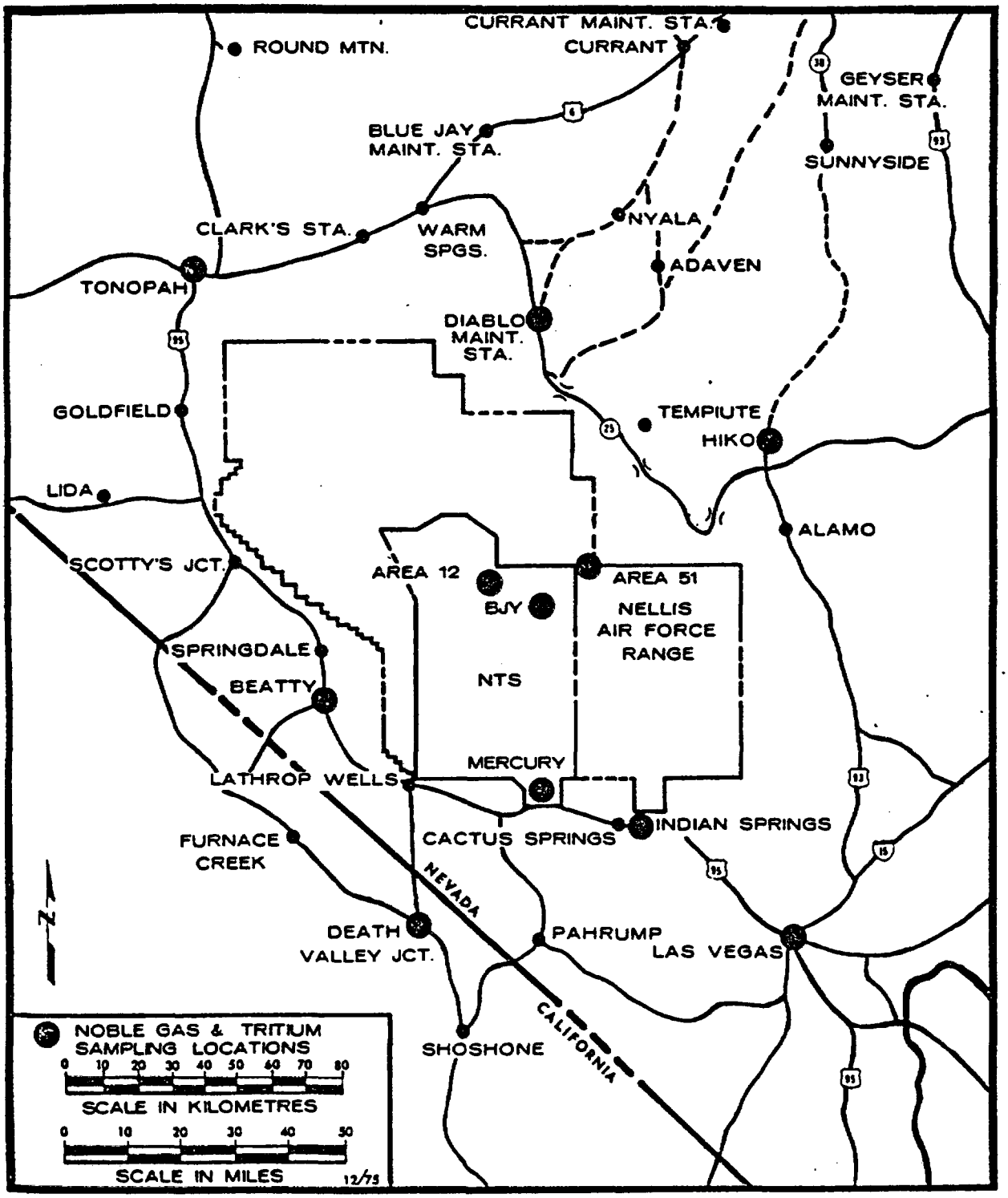

Figure 9. Noble Gas and Tritium Surveillance Network

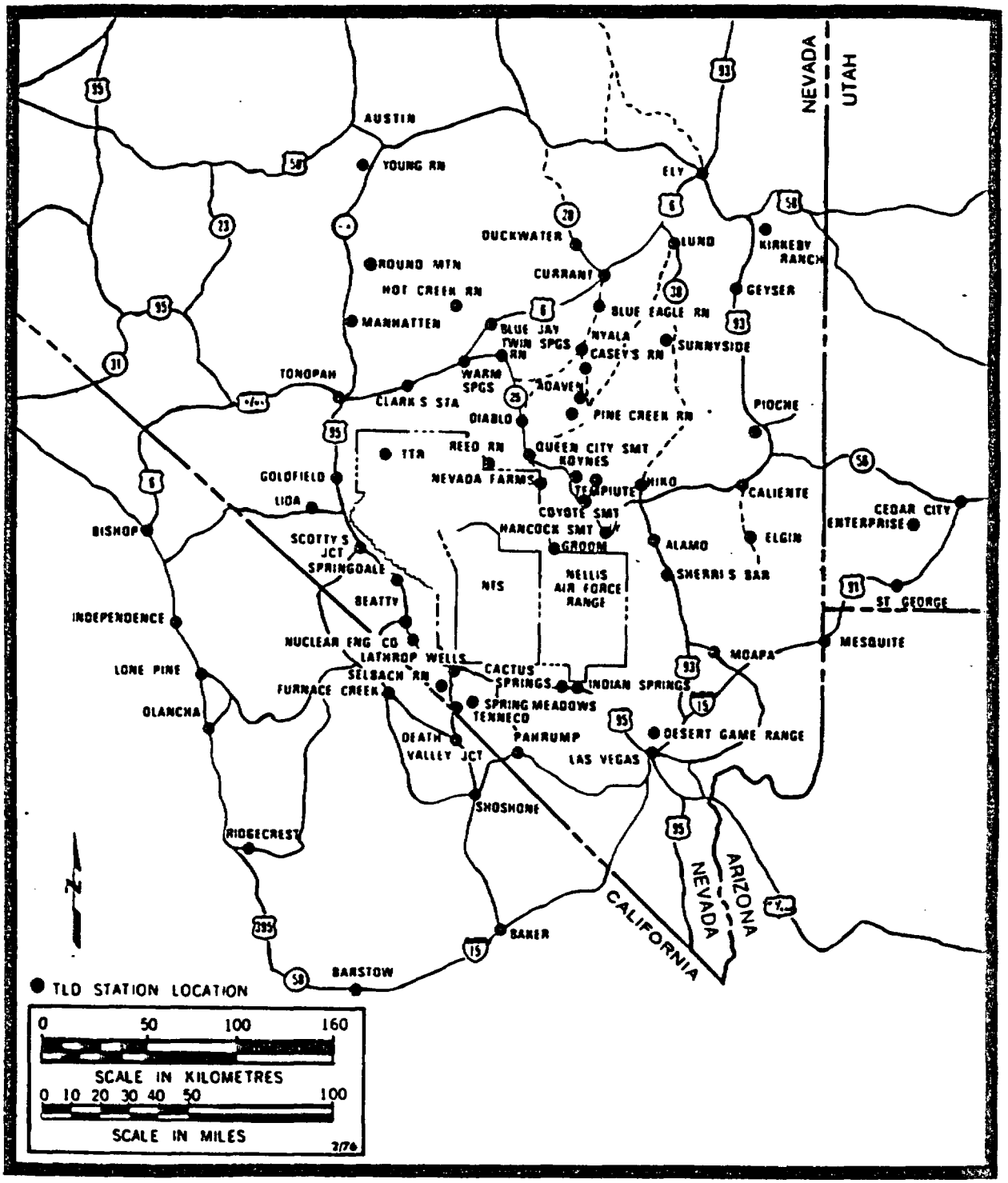

Figure 10. Dosimetry Network

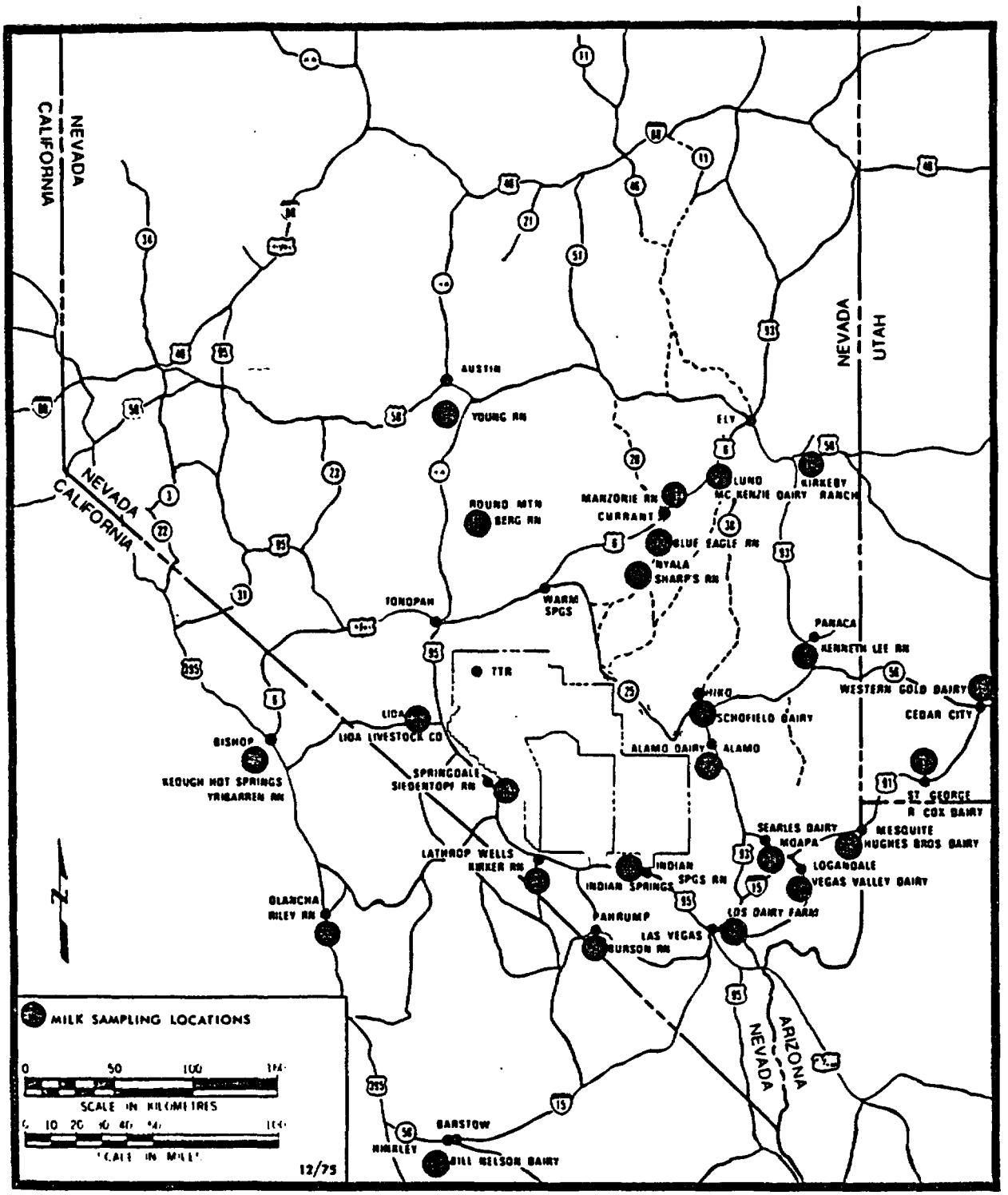

Figure 11. Milk Surveillance Network

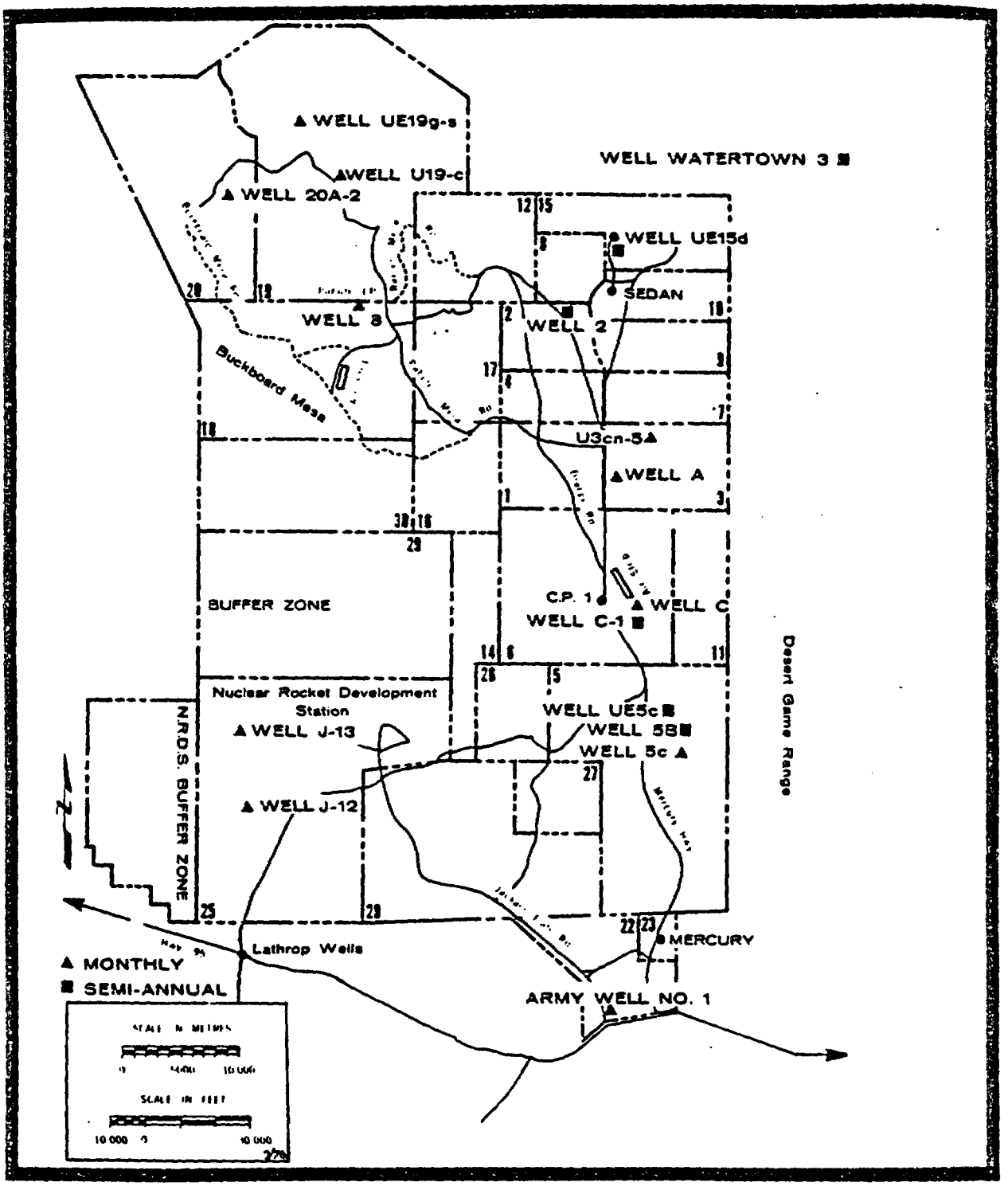

Figure 12. On-Site Long-Term Hydrological Monitoring Program, Nevada Test Site

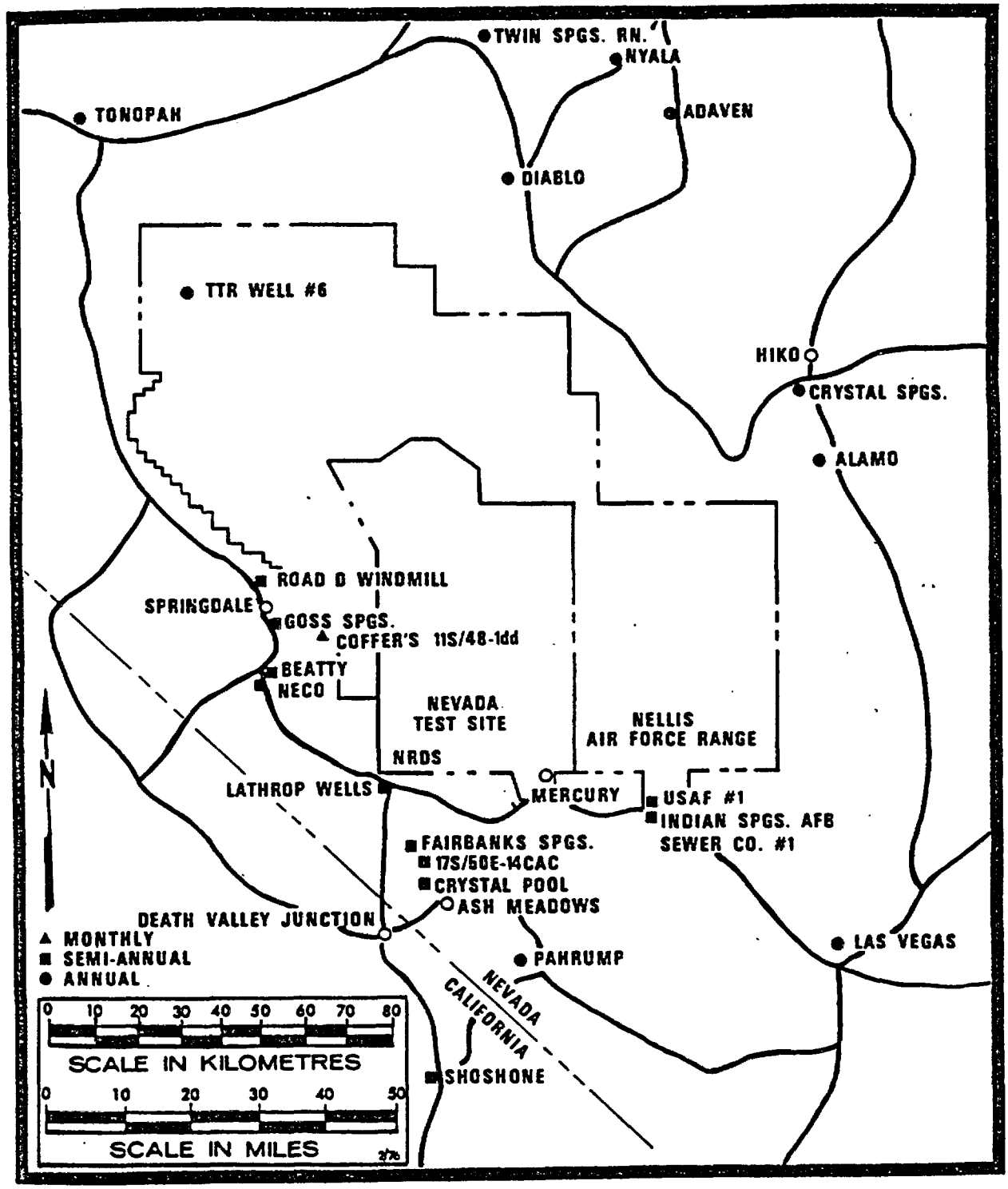

Figure 13. Off-Site Long-Term Hydrological Monitoring Program, Nevada Test Site

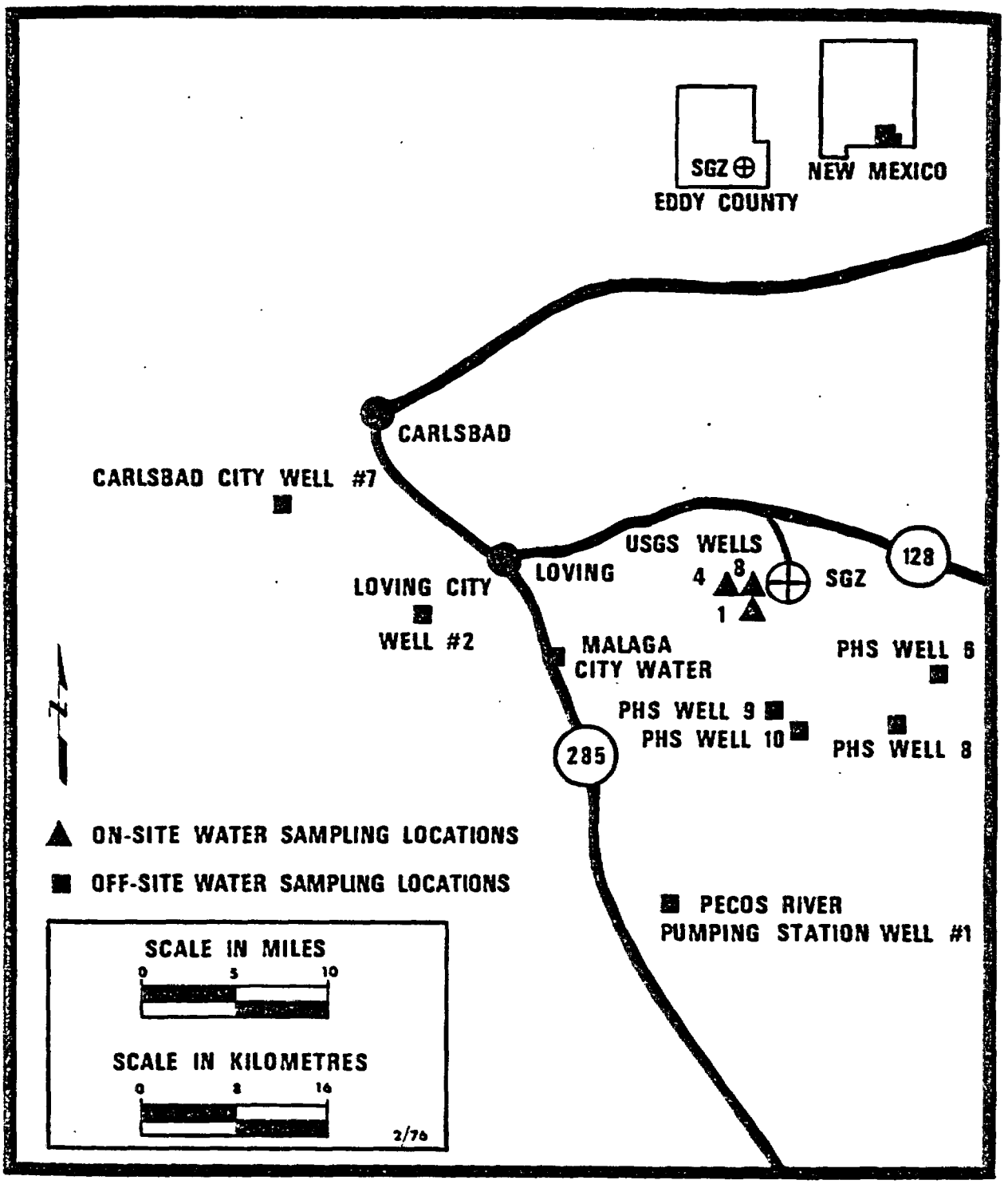

Figure 14. Long-Term Hydrological Monitoring Locations, Carlsbad, New Mexico, Project Gnome/Coach

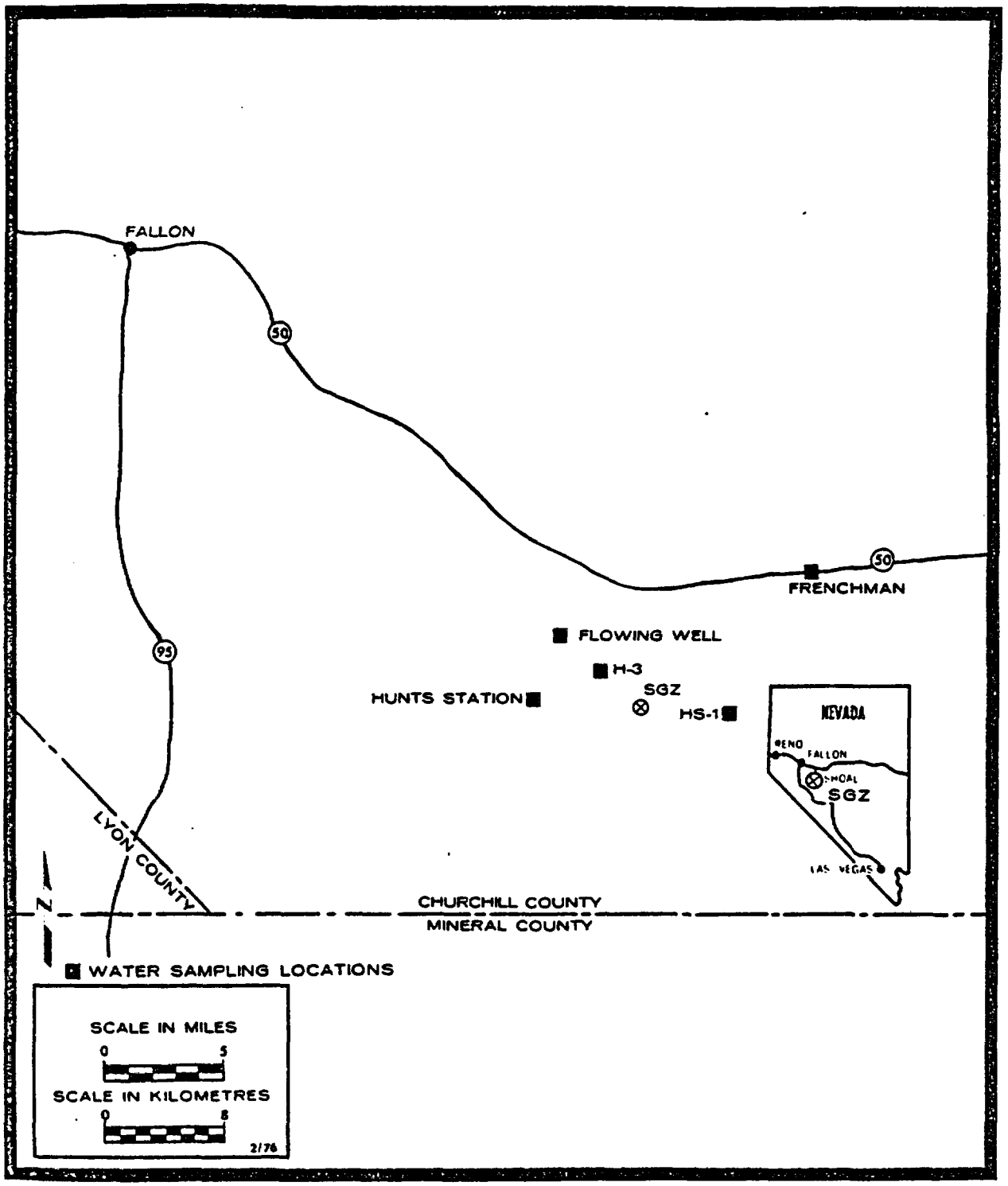

Figure 15. Long-Term Hydrological Monitoring Locations, Fallon, Nevada, Project Shoal

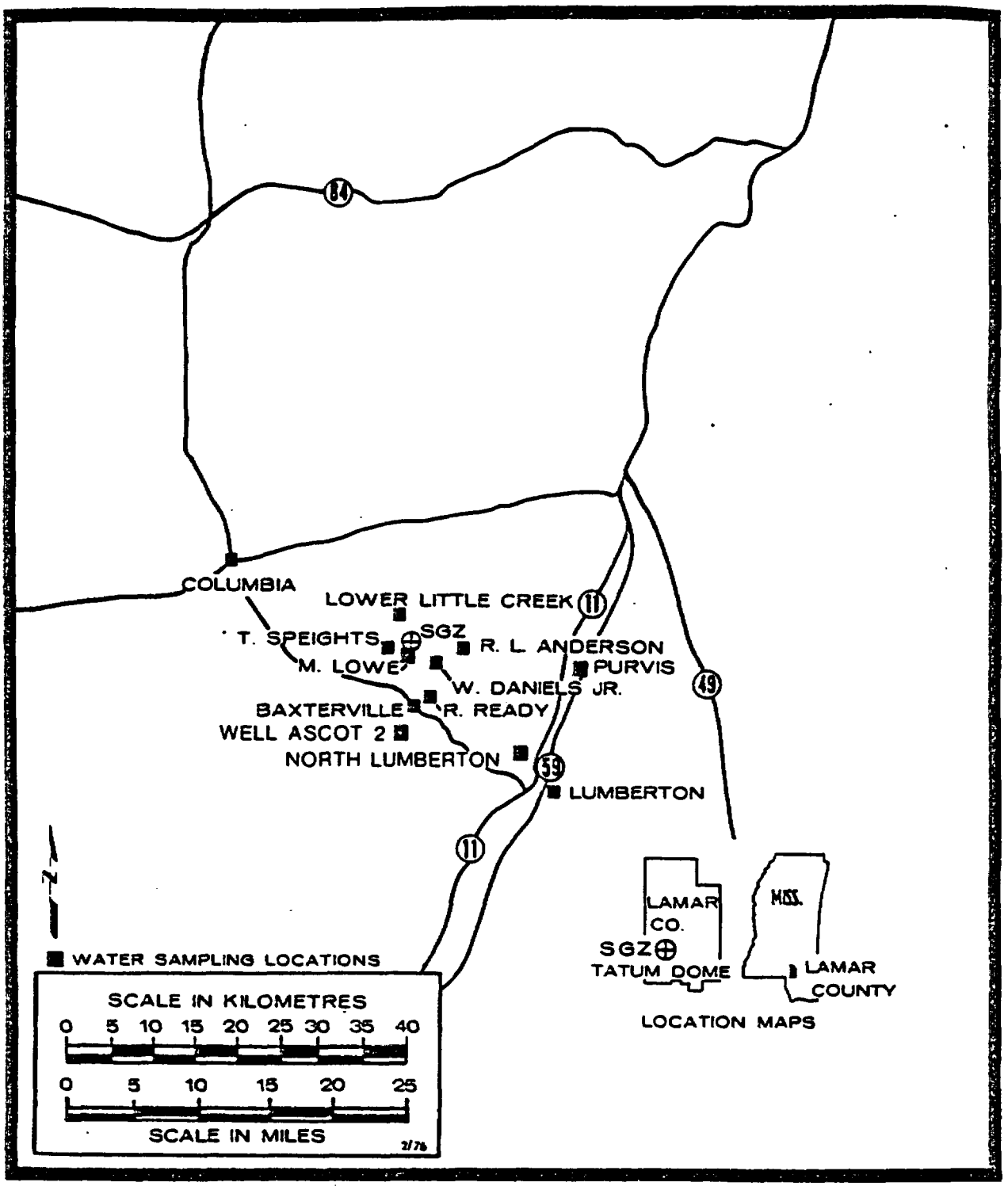

Figure 16. Long-Term Hydrological Monitoring Locations, Project Dribble/Miracle Play (Vicinity of Tatum Salt Dome, Mississippi)

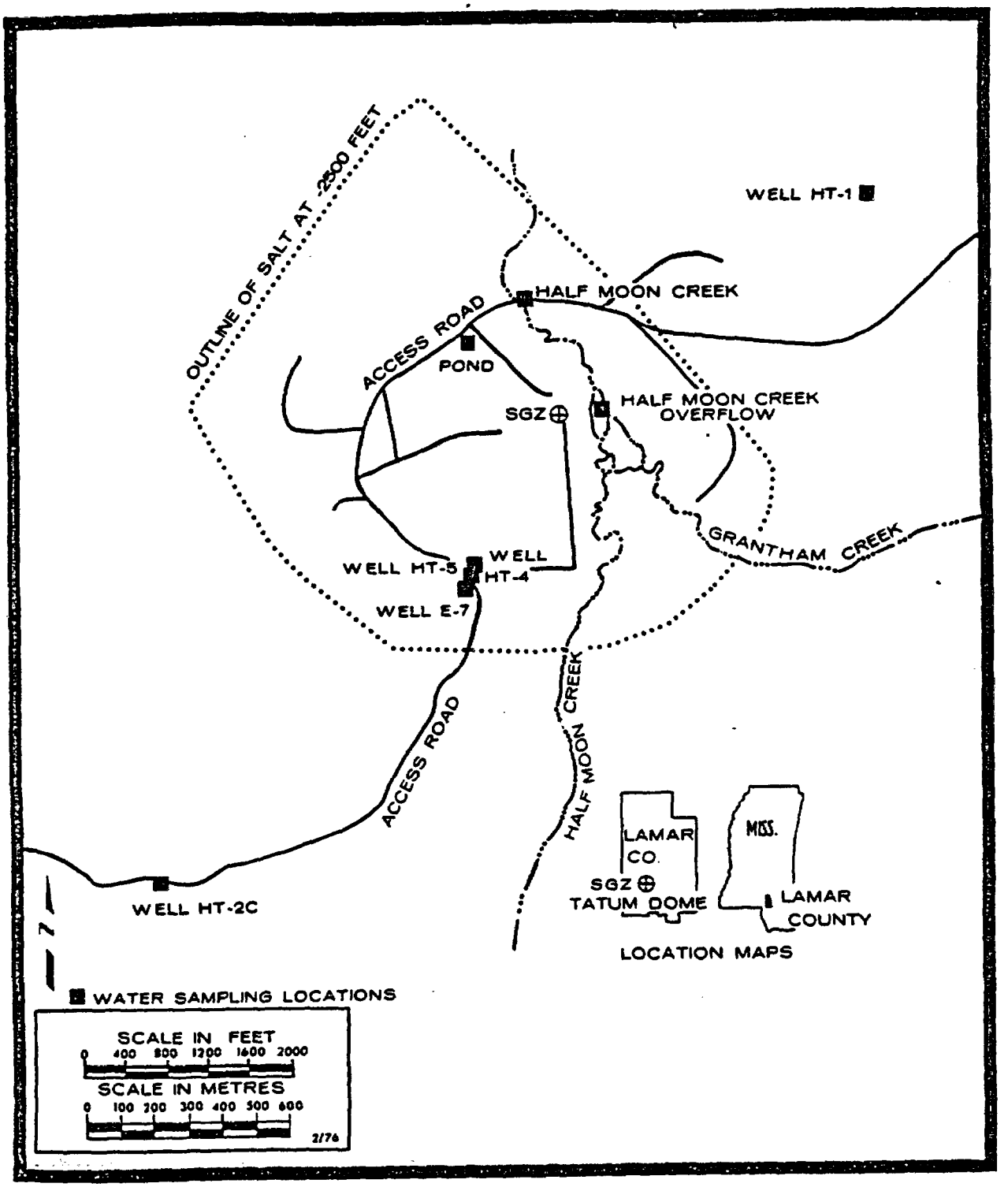

Figure 17. Long-Term Hydrological Monitoring Locations, Project Dribble/Miracle Play (Tatum Salt Dome, Mississippi)

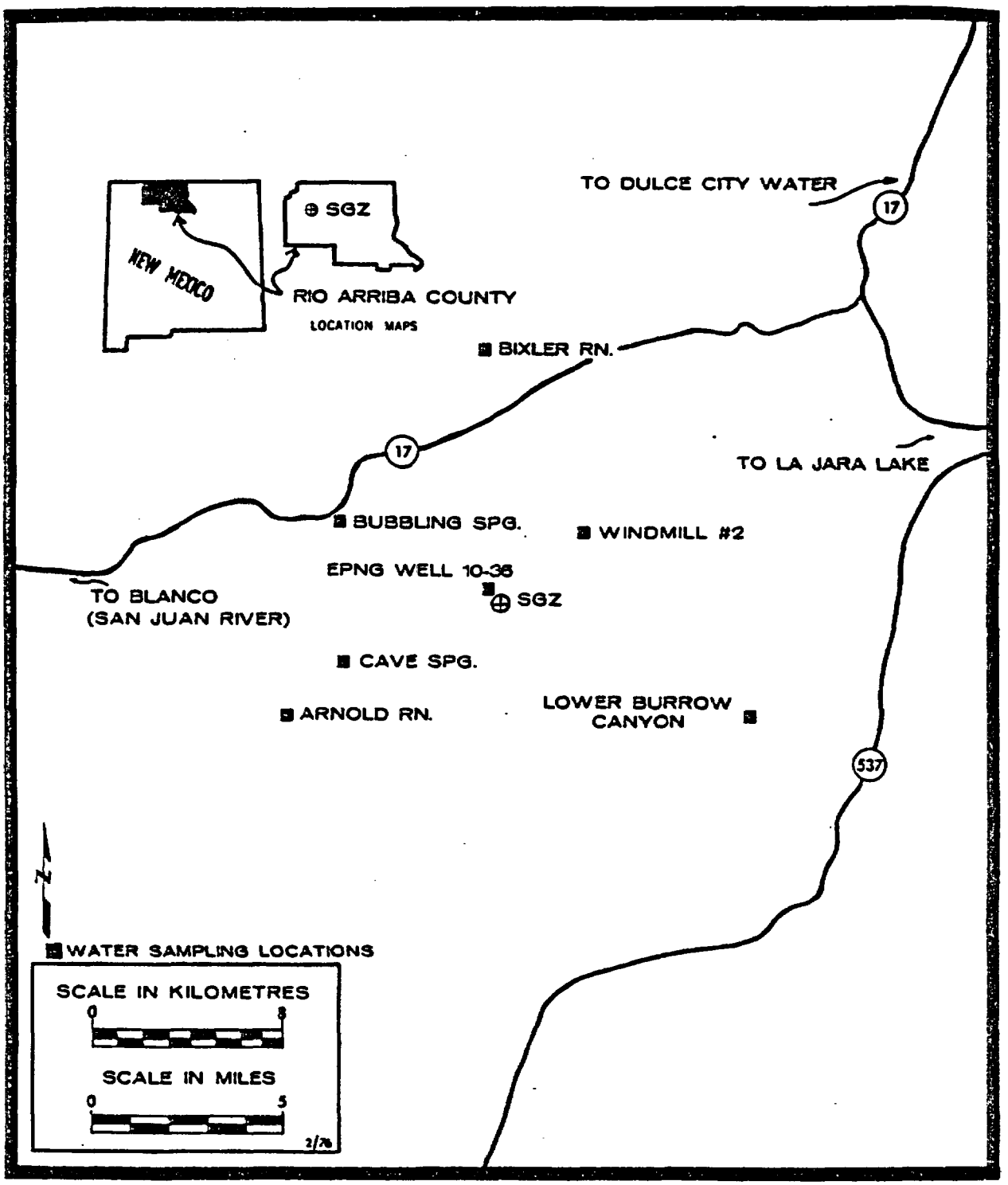

Figure 18. Long-Term Hydrological Monitoring Locations, Rio Arriba County, New Mexico, Project Gasbuggy

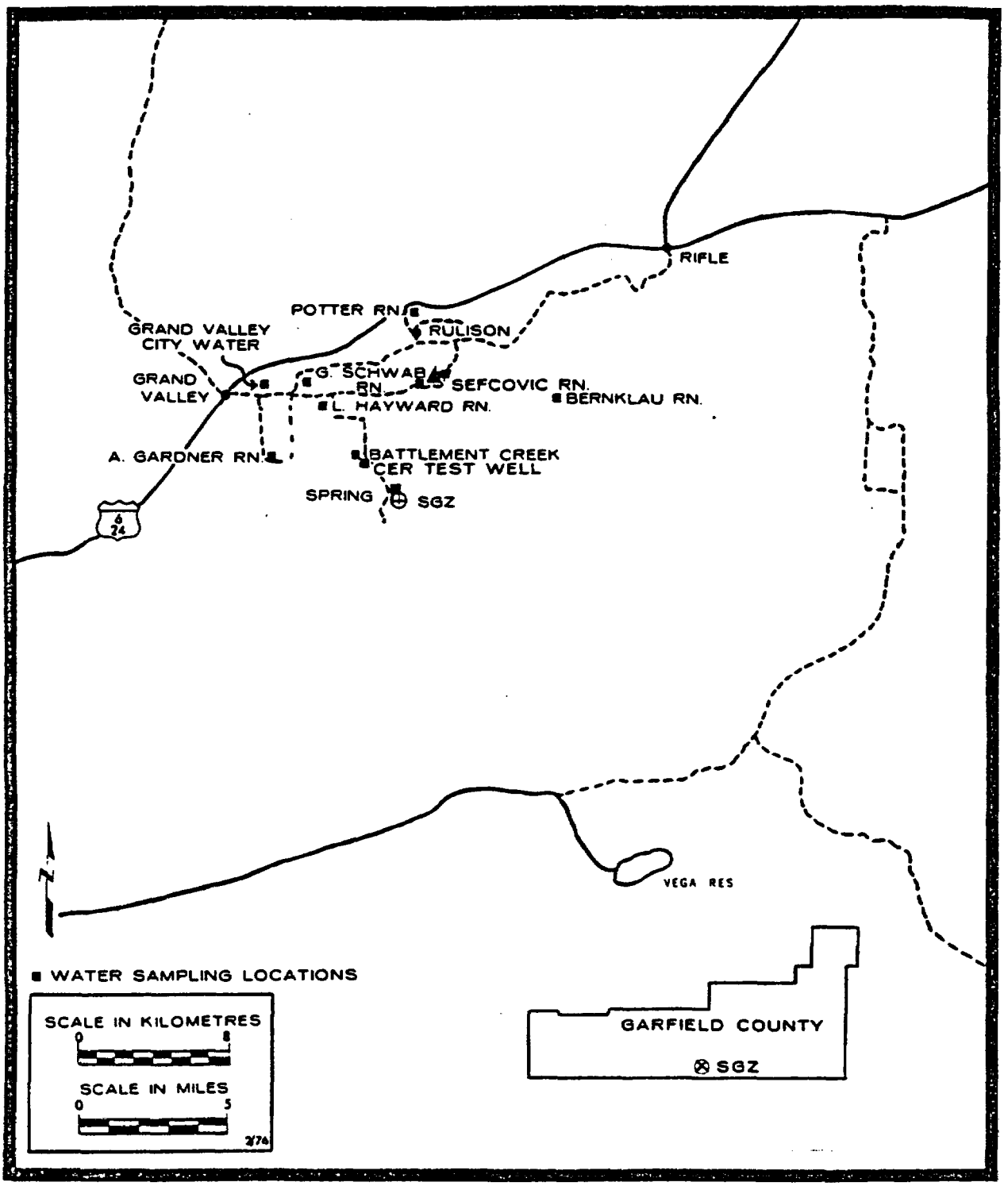

Figure 19. Long-Term Hydrological Monitoring Locations, Rulison, Colorado, Project Rulison

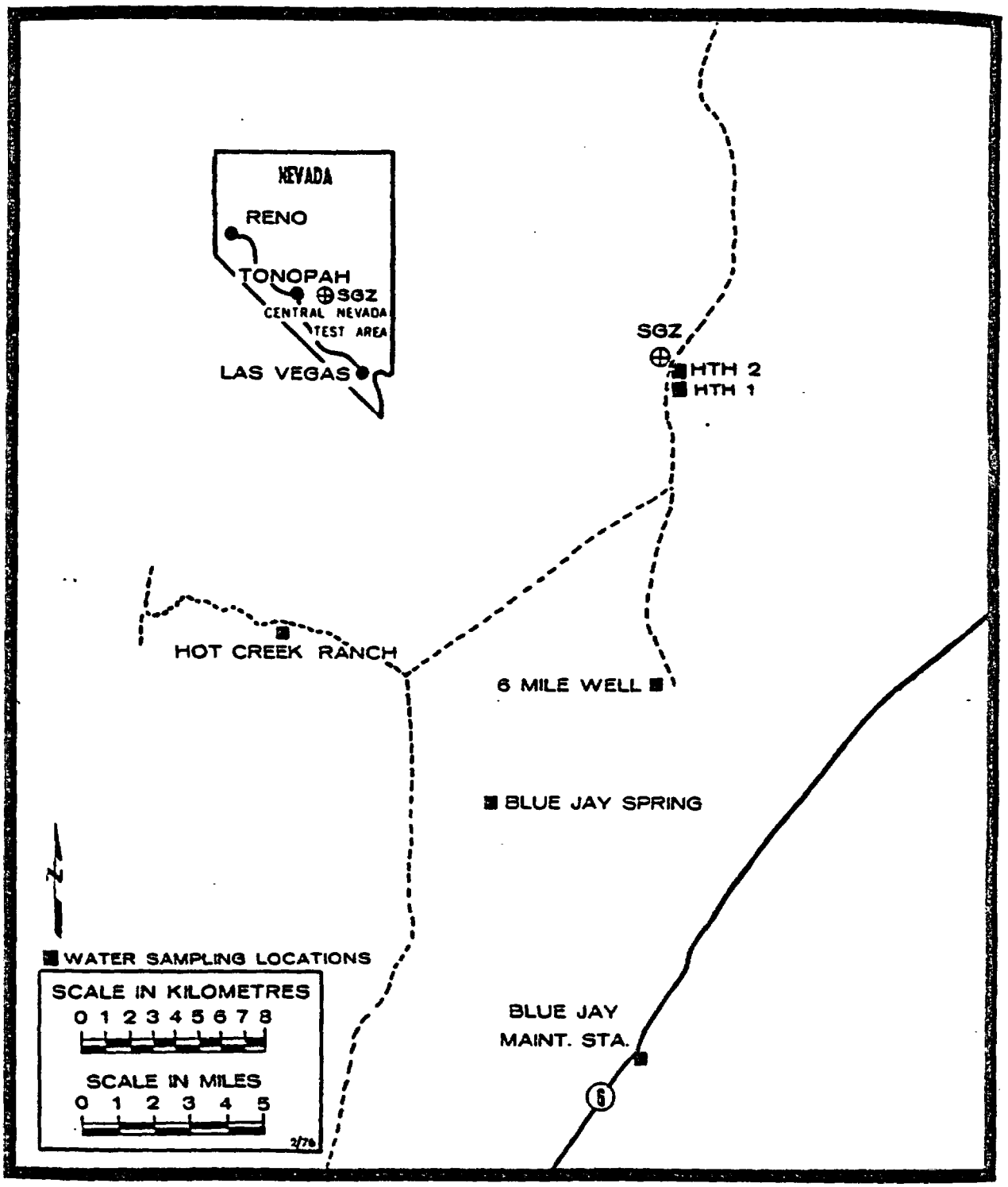

Figure 20. Long-Term Hydrological Monitoring Locations Central Nevada Test Area, Faultless Event

Table 2. Underground Testing Conducted Off the Nevada Test Site

Name of Test, Operation or Project	Date	Location	Yield[d] (kt)	Depth m (ft)	Purpose of the Event[d,e]
Project Gnome/ Coach[a]	12/10/61	48 km (30 mi) SE of Carlsbad, N.M.	3.1[f]	360 (1184)	Multi-purpose experiment.
Project Shoal[b]	10/26/63	45 km (28 mi) SE of Fallon, Nev.	12	366 (1200)	Nuclear test detection research experiment
Project Dribble[b] (Salmon Event)	10/22/64	34 km (21 mi) SW of Hattiesburg, Miss.	5.3	823 (2700)	Nuclear test detection research experiment.
Operation Long Shot[b]	10/29/65	Amchitka Island, Alaska	~80	716 (2350)	DOD nuclear test detection experiment.
Project Dribble[b] (Sterling Event)	12/03/66	34 km (21 mi) SW of Hattiesburg, Miss.	0.38	823 (2700)	Nuclear test detection research experiment.
Project Gasbuggy[a]	12/10/67	88 km (55 mi) E of Farmington, N.M.	29	1292 (4240)	Joint Government-Industry gas stimulation experiment.
Faultless Event[c]	01/19/68	Central Nevada Test Area 96 km (60 mi) E of Tonopah, Nev.	200-1000	914 (3000)	Calibration test.
Project Miracle Play (Diode Tube)[b]	02/02/69	34 km (21 mi) SW of Hattiesburg, Miss.	Non-nuclear explosion	823 (2700)	Detonated in Salmon/Sterling cavity. Seismic studies.
Project Rulison[a]	09/10/69	19 km (12 mi) SW of Rifle, Colorado	40	2568 (8425)	Gas stimulation experiment.
Operation Milrow[c]	10/02/69	Amchitka Island, Alaska	~1000	1219 (4000)	Calibration test.
Project Miracle Play (Humid Water)[b]	04/19/70	34 km (21 mi) SW of Hattiesburg, Miss.	Non-nuclear explosion	823 (2700)	Detonated in Salmon/Sterling cavity. Seismic studies.

Table 2. (continued)

Name of Test, Operation or Project	Date	Location	Yield[d] (kt)	Depth m (ft)	Purpose of the Event[d,e]
Operation Cannikin[c]	11/06/71	Amchitka Island, Alaska	<5000	1829 (6000)	Test of warhead for Spartan missle.
Project Rio Blanco[a]	05/17/73	48 km (30 mi) SW of Meeker, Colorado	3x30	1780 to 2040 (5840 to 6690)	Gas stimulation experiment.

[a]Plowshare Events

[b]Vela Uniform Events

[c]Weapons Tests

[d]Information from "Revised Nuclear Test Statistics," distributed on September 20, 1974, by David G. Jackson, Director, Office of Information Services, U.S. Atomic Energy Commission, Las Vegas, Nevada.

[e]News release AL-62-50, AEC Albuquerque Operations Office, Albuquerque, New Mexico. December 1, 1961

[f]"The Effects of Nuclear Weapons" Rev. Ed. 1964.

Table 3. Summary of Analytical Procedures

Type of Analysis	Analytical Equipment	Counting Period (Min)	Analytical Procedures	Sample Size (Litre)	Detection Limit[b]
Gamma Spectroscopy[a]	Gamma spectrometer with 10-cm-thick by 10-cm-diameter NaI (Tl-activated) crystal with input to 200 channels (0-2 MeV) of 400-channel, pulse-height analyzer.	100 min for milk, water, Long-Term Hydro. suspended solids and air filters; 10 min for air charcoal cartridges.	Radionuclide concentrations quantitated from gamma spectrometer data by computer using a least squares technique.	0.4-3.5 for routine milk and water samples; 700-1050m^3 for air filter samples; 7.3 litre for Long-Term Hydro. Water suspended solids.	For routine milk and water generally ≈ $1x10^{-8}$ µCi/ml for most common fallout radionuclides in a simple spectrum. For air filters, ≈ $3x10^{-14}$ µCi/ml. For Long-Term Hydro. suspended solids, ≈ $3.0x10^{-9}$ µCi/ml.
$^{89-90}Sr$[c]	Low-background thin-window, gas-flow proportional counter with a 5.7-cm diameter window (80 µg/cm^2).	50	Chemical separation by ion exchange. Separated sample counted successively; activity calculated by simultaneous equations.	1.0	^{89}Sr ≈ $2x10^{-9}$µCi/ml ^{90}Sr ≈ $1x10^{-9}$µCi/ml
^{3}H[c]	Automatic liquid scintillation counter with output printer.	200	Sample prepared by distillation.	0.005	≈$2x10^{-7}$ µCi/ml
^{3}H Enrichment (Long-Term Hydrological Samples)[c]	Automatic scintillation counter with output printer.	200	Sample concentrated by electrolysis followed by distillation.	0.25	≈$6x10^{-9}$ µCi/ml
$^{238,239}Pu$ ^{234,235}, ^{238}U[c]	Alpha spectrometer with 45 mm^2, 300-µm depletion depth silicon surface barrier detectors operated in vacuum chambers.	1000 - 1400	Sample is digested with acid, separated by ion exchange, electroplated on stainless steel planchet and counted by alpha spectrometer.	1	^{238}Pu ≈ $4x10^{-11}$ µCi/ml ^{239}Pu, ^{234}U, ^{235}U ^{238}U ≈ $2x10^{-11}$ µCi/ml

Table 3. (continued)

Type of Analysis	Analytical Equipment	Counting Period (Min)	Analytical Procedures	Sample Size (Litre)	Detection Limit[b]
^{226}Ra[c]	Single channel analyzer coupled to P.M. tube detector.	30	Precipitated with Ba, converted to chloride. Stored for 30 days for ^{222}Ra ^{226}Ra to equilibrate. Radon gas pumped into scintillation cell for alpha scintillation counting.	1.5	$\approx 1 \times 10^{-10}$ µCi/ml
Gross alpha Gross beta in liquid samples[c]	Low-background thin-window, gas-flow proportional counter with a 5.7-cm-diameter window (80 µg/cm^2).	50	Sample evaporated; residue counted.	0.2	$\alpha = 3 \times 10^{-9}$ µCi/ml $\beta = 2 \times 10^{-9}$ µCi/ml
Gross beta on air filters[a]	Low-level end window, gas flow proportional counter with a 12.7-cm-diameter window (100 mg/cm^2).	20	Filters counted upon receipt and at 5 and 12 days after collection; last two counts used to extrapolate concentration to mid-collection time assuming $T^{-1.2}$ decay or using experimentally derived decay.	10-cm diameter glass fiber filter; sample collected from 700-1050m^3.	$\approx 3 \times 10^{-14}$ µCi/ml

Table 3. (continued)

Type of Analysis	Analytical Equipment	Counting Period (Min)	Analytical Procedures	Sample Size (Litre)	Detection Limit[b]
^{85}Kr Xe CH_3T[c]	Automatic liquid scintillation counter with output printer.	200	Physical separation by gas chromatography; dissolved in toluene "cocktail" for counting.	400-1000	$^{85}Kr = 2 \times 10^{-12}$ µCi/ml Xe = 2×10^{-12} µCi/ml $CH_3T = 2 \times 10^{-12}$ µCi/ml

[a] Lem, P. N. and Snelling, R. N. "Southwestern Radiological Health Laboratory Data Analysis and Procedures Manual," SWRHL-21. Southwestern Radiological Health Laboratory, U.S. Environmental Protection Agency, Las Vegas, NV. March 1971

[b] The detection limit for all samples is defined as that radioactivity which equals the 2-sigma counting error.

[c] Johns, F. B. "Handbook of Radiochemical Analytical Methods," EPA 680/4-75-001. U.S. Environmental Protection Agency, NERC-LV, Las Vegas, NV. February 1975.

Table 4. 1975 Summary of Analytical Results for the Noble Gas and Tritium Surveillance Network

Sampling Location	No. Days Sampled	Radio-nuclide	Radioactivity Concentrations Units	C_{Max}	C_{Min}	C_{Avg}	C
Death Valley Jct., CA	340.2	^{85}Kr	$10^{-12}\mu Ci/ml$ air	27	11	17	C
	340.2	Total Xe	$10^{-12}\mu Ci/ml$ air	< 7	< 4	< 5	<C
	326.0	^{3}H as HTO	$10^{-6}\mu Ci/ml$ H_2O	0.97	< 0.2	< 0.4	<C
	340.2	^{3}H as CH_3T	$10^{-12}\mu Ci/ml$ air	< 3	< 2	< 2	
	318.9	^{3}H as HTO	$10^{-12}\mu Ci/ml$ air	6.1	< 0.4	< 2	<0.
	326.0	^{3}H as HT	$10^{-12}\mu Ci/ml$ air	9.4	< 0.4	< 3	
Beatty, NV	368.4	^{85}Kr	$10^{-12}\mu Ci/ml$ air	25	11	19	0.
	368.4	Total Xe	$10^{-12}\mu Ci/ml$ air	< 7	< 4	< 5	<0.
	348.4	^{3}H as HTO	$10^{-6}\mu Ci/ml$ H_2O	2.2	< 0.2	< 0.5	<0.
	368.4	^{3}H as CH_3T	$10^{-12}\mu Ci/ml$ air	< 3	< 2	< 2	
	348.4	^{3}H as HTO	$10^{-12}\mu Ci/ml$ air	8.4	< 0.5	< 3	<0.
	341.5	^{3}H as HT	$10^{-12}\mu Ci/ml$ air	9.3	< 0.4	< 3	
Diablo, NV	346.2	^{85}Kr	$10^{-12}\mu Ci/ml$ air	29	11	18	0.
	346.3	^{133}Xe	$10^{-12}\mu Ci/ml$ air	25	< 4	< 6	<0.
	347.4	^{3}H as HTO	$10^{-6}\mu Ci/ml$ H_2O	2.4	< 0.2	< 0.5	<0.
	346.2	^{3}H as CH_3T	$10^{-12}\mu Ci/ml$ air	< 3	< 2	< 2	
	347.4	^{3}H as HTO	$10^{-12}\mu Ci/ml$ air	22	< 0.2	< 3	<0.
	347.4	^{3}H as HT	$10^{-12}\mu Ci/ml$ air	8.2	< 0.4	< 2	
Hiko, NV	346.5	^{85}Kr	$10^{-12}\mu Ci/ml$ air	23	10	17	0.
	353.4	^{133}Xe	$10^{-12}\mu Ci/ml$ air	20	< 4	< 5	<0.
	313.6	^{3}H as HTO	$10^{-6}\mu Ci/ml$ H_2O	1.4	< 0.2	< 0.4	<0.
	353.4	^{3}H as CH_3T	$10^{-12}\mu Ci/ml$ air	< 3	< 2	< 2	
	313.6	^{3}H as HTO	$10^{-12}\mu Ci/ml$ air	11	< 0.4	< 2	<0.
	313.6	^{3}H as HT	$10^{-12}\mu Ci/ml$ air	6.7	< 0.3	< 2	

Table 4. (continued)

Sampling Location	No. Days Sampled	Radio-nuclide	Radioactivity Concentration Units	C_{Max}	C_{Min}	C_{Avg}	% of Conc. Guide*
Indian Springs, NV **	252.7	^{85}Kr	$10^{-12}\mu Ci/ml$ air	30	9	20	0.02
	259.7	^{133}Xe	$10^{-12}\mu Ci/ml$ air	12	< 4	< 5	<0.01
	259.7	^{3}H as HTO	$10^{-6}\mu Ci/ml$ H_2O	1.4	< 0.2	< 0.4	<0.01
	259.7	^{3}H as CH_3T	$10^{-12}\mu Ci/ml$ air	< 3	< 2	< 2	
	259.7	^{3}H as HTO	$10^{-12}\mu Ci/ml$ air	7.5	< 0.2	< 3	<0.01
	259.7	^{3}H as HT	$10^{-12}\mu Ci/ml$ air	6	0.42	2.5	
Las Vegas, NV-NV00	361.4	^{85}Kr	$10^{-12}\mu Ci/ml$ air	30	9.6	18	0.02
	361.5	^{133}Xe	$10^{-12}\mu Ci/ml$ air	11	< 4	< 5	<0.01
	354.6	^{3}H as HTO	$10^{-6}\mu Ci/ml$ H_2O	1.2	< 0.2	< 0.4	<0.01
	361.4	^{3}H as CH_3T	$10^{-12}\mu Ci/ml$ air	< 3	< 2	< 2	
	354.6	^{3}H as HTO	$10^{-12}\mu Ci/ml$ air	4.4	< 0.4	< 2	<0.01
	354.6	^{3}H as HT	$10^{-12}\mu Ci/ml$ air	4.7	< 0.3	< 1	
NTS, NV Bldg. 790	343.2	^{85}Kr	$10^{-12}\mu Ci/ml$ air	34	8.2	18	0.02
	349.3	^{133}Xe	$10^{-12}\mu Ci/ml$ air	13	< 4	< 5	<0.01
	341.3	^{3}H as HTO	$10^{-6}\mu Ci/ml$ H_2O	1.4	< 0.2	< 0.5	<0.01
	349.3	^{3}H as CH_3T	$10^{-12}\mu Ci/ml$ air	< 3	< 2	< 3	
	341.3	^{3}H as HTO	$10^{-12}\mu Ci/ml$ air	6.3	< 0.4	< 2	<0.01
	341.3	^{3}H as HT	$10^{-12}\mu Ci/ml$ air	5.4	0.23	< 2	
NTS, NV Area 51	328.3	^{85}Kr	$10^{-12}\mu Ci/ml$ air	25	12	18	0.02
	328.3	^{133}Xe	$10^{-12}\mu Ci/ml$ air	12	< 4	< 5	<0.01
	342.2	^{3}H as HTO	$10^{-6}\mu Ci/ml$ H_2O	7.3	< 0.2	< 0.6	<0.01
	321.3	^{3}H as CH_3T	$10^{-12}\mu Ci/ml$ air	< 3	< 2	< 2	
	342.2	^{3}H as HTO	$10^{-12}\mu Ci/ml$ air	20	< 0.2	< 3	<0.01
	342.2	^{3}H as HT	$10^{-12}\mu Ci/ml$ air	4.5	< 0.2	< 2	

Table 4. (continued)

Sampling Location	No. Days Sampled	Radio-nuclide	Radioactivity Concentration Units	C_{Max}	C_{Min}	C_{Avg}	% of Conc Guic
NTS, NV BJY	363.4	^{85}Kr	$10^{-12}\mu Ci/ml$ air	38	9.8	19	0.02
	363.4	^{133}Xe	$10^{-12}\mu Ci/ml$ air	31	< 4	< 6	<0.01
	363.4	^{3}H as HTO	$10^{-6}\mu Ci/ml$ H_2O	3.6	< 0.3	< 2	<0.01
	363.4	^{3}H as CH_3T	$10^{-12}\mu Ci/ml$ air	< 3	< 2	< 2	
	363.4	^{3}H as HTO	$10^{-12}\mu Ci/ml$ air	20	< 1	< 7	<0.01
	363.4	^{3}H as HT	$10^{-12}\mu Ci/ml$ air	9.2	< 0.4	< 1	
NTS, NV Area 12	335.2	^{85}Kr	$10^{-12}\mu Ci/ml$ air	27	12	18	0.02
	335.2	^{133}Xe	$10^{-12}\mu Ci/ml$ air	13	< 4	< 5	<0.01
	363.2	^{3}H as HTO	$10^{-6}\mu Ci/ml$ H_2O	58	0.25	6	<0.01
	342.2	^{3}H as CH_3T	$10^{-12}\mu Ci/ml$ air	< 3	< 2	< 2	
	363.2	^{3}H as HTO	$10^{-12}\mu Ci/ml$ air	210	0.71	25	<0.01
	363.2	^{3}H as HT	$10^{-12}\mu Ci/ml$ air	25	< 0.2	< 2	
Tonopah, NV	355.4	^{85}Kr	$10^{-12}\mu Ci/ml$ air	24	10	17	0.02
	361.3	Total Xe	$10^{-12}\mu Ci/ml$ air	< 9	< 4	< 5	<0.01
	368.3	^{3}H as HTO	$10^{-6}\mu Ci/ml$ H_2O	1.3	< 0.2	< 0.4	<0.01
	361.3	^{3}H as CH_3T	$10^{-12}\mu Ci/ml$ air	< 3	< 2	< 2	
	368.3	^{3}H as HTO	$10^{-12}\mu Ci/ml$ air	5.6	< 0.4	< 2	<0.01
	368.3	^{3}H as HT	$10^{-12}\mu Ci/ml$ air	4.2	< 0.2	< 2	

* Concentration Guides used for NTS stations are those applicable to exposures to radiation workers. Those used for off-NTS stations are for exposure to a suitable sample of the population in an uncontrolled area. See Appendix A for Concentration Guides.

**Although the Indian Springs station was installed for only 9 months of the year (April-December), the concentration average over the 9 months was assumed to be representative of levels at that location for the entire year.

Table 5. 1975 Summary of Radiation Doses for the Dosimetry Network

Station Location	Measurement Period	Dose Equivalent Rate (mrem/d) Max.	Min.	Avg.	Annual Adjusted Dose Equivalent* (mrem/y)
Adaven, NV	1/08/75 - 1/21/76	0.36	0.32	0.34	120
Alamo, NV	1/06/75 - 1/13/76	0.25	0.23	0.24	88
Baker, CA	1/06/75 - 1/12/76	0.22	0.19	0.21	77
Barstow, CA	1/06/75 - 1/12/76	0.25	0.23	0.25	91
Beatty, NV	1/14/75 - 1/20/76	0.31	0.26	0.28	100
Bishop, CA	1/08/75 - 1/14/76	0.24	0.21	0.24	88
Blue Eagle Rch., NV	1/07/75 - 1/22/76	0.17	0.15	0.16	58
Blue Jay, NV	1/08/75 - 1/21/76	0.33	0.27	0.31	110
Cactus Springs, NV	1/13/75 - 1/19/76	0.17	0.14	0.16	58
Caliente, NV	1/08/75 - 1/14/76	0.28	0.26	0.27	99
Casey's Ranch, NV	1/07/75 - 1/21/76	0.21	0.16	0.19	69
Cedar City, UT	1/13/75 - 1/21/76	0.23	0.18	0.19	69
Clark Station, NV	1/08/75 - 1/21/76	0.31	0.29	0.30	110
Coyote Summit, NV	1/06/75 - 1/20/76	0.33	0.28	0.31	110
Currant, NV	1/07/75 - 1/22/76	0.25	0.23	0.23	84
Death Valley Jct., CA	1/15/75 - 1/15/76	0.22	0.20	0.21	77
Desert Game Range, NV	1/13/75 - 1/19/76	0.16	0.12	0.13	48
Desert Oasis, NV	1/13/75 - 1/19/76	0.18	0.14	0.16	58
Diablo Maint. Sta., NV	1/09/75 - 1/20/76	0.38	0.30	0.33	120
Duckwater, NV	1/07/75 - 1/22/76	0.29	0.23	0.27	99
Elgin, NV	1/08/75 - 1/14/76	0.30	0.28	0.27	110
Ely, NV	1/06/75 - 1/20/76	0.27	0.23	0.25	91
Enterprise, UT	1/15/75 - 1/21/76	0.30	0.23	0.24	88
Furnace Creek, CA	1/08/75 - 1/15/76	0.19	0.17	0.18	66
Geyser Maint. Sta., NV	1/06/75 - 1/20/76	0.26	0.23	0.24	88
Goldfield, NV	1/13/75 - 1/20/76	0.26	0.23	0.24	88
Groom Lake, NV	1/06/75 - 1/20/76	0.19	0.18	0.18	66

Table 5. (continued)

Station Location	Measurement Period	Dose Equivalent Rate (mrem/d) Max.	Min.	Avg.	Annual Adjusted Dose Equivalent* (mrem/y)
Hancock Summit, NV	1/06/75 - 1/20/76	0.40	0.33	0.35	130
Hiko, NV	1/06/75 - 1/13/76	0.23	0.18	0.20	73
Hot Creek Ranch, NV	1/08/75 - 1/21/76	0.25	0.21	0.20	84
Independence, CA	1/07/75 - 1/14/76	0.26	0.23	0.24	88
Indian Springs, NV	1/13/75 - 1/19/76	0.18	0.16	0.18	66
Kirkeby Ranch, NV	1/06/75 - 1/20/76	0.21	0.19	0.20	73
Koynes, NV	1/09/75 - 1/20/76	0.25	0.22	0.24	88
Las Vegas (McCarran), NV	1/10/75 - 1/08/76	0.13	0.11	0.12	44
Las Vegas (Placak), NV	1/10/75 - 1/08/76	0.14	0.12	0.13	48
Las Vegas (USDI), NV	1/10/75 - 1/08/76	0.17	0.15	0.16	58
Lathrop Wells, NV	1/15/75 - 1/20/76	0.27	0.23	0.24	88
Lida, NV	1/13/75 - 1/19/76	0.29	0.26	0.27	99
Lone Pine, CA	1/07/75 - 1/13/76	0.24	0.23	0.23	84
Lund, NV	1/08/75 - 1/21/76	0.22	0.21	0.21	77
Manhattan, NV	1/14/75 - 1/21/76	0.37	0.28	0.31	110
Mesquite, NV	1/13/75 - 1/19/76	0.21	0.15	0.17	62
Nevada Farms, NV	1/06/75 - 1/20/76	0.33	0.27	0.29	110
Nuclear Eng. Co., NV	1/15/75 - 1/20/76	0.37	0.30	0.34	120
Nyala, NV	1/07/75 - 1/21/76	0.24	0.19	0.22	80
Olancha, CA	1/07/75 - 1/13/76	0.24	0.20	0.22	80
Pahrump, NV	1/16/75 - 1/22/76	0.19	0.17	0.18	66
Pine Creek Ranch, NV	1/08/75 - 1/21/76	0.32	0.29	0.30	110
Pioche, NV	1/07/75 - 1/14/76	0.32	0.28	0.29	106
Queen City Summit, NV	1/06/75 - 1/20/76	0.36	0.30	0.34	120
Reed Ranch, NV	1/06/75 - 1/20/76	0.31	0.25	0.28	102
Ridgecrest, CA	1/07/75 - 1/13/76	0.22	0.18	0.20	73
Round Mountain, NV	1/14/75 - 1/21/76	0.32	0.26	0.29	106

Table 5. (continued)

Station Location	Measurement Period	Dose Equivalent Rate (mrem/d) Max.	Min.	Avg.	Annual Adjusted Dose Equivalent* (mrem/y)
Scotty's Junction, NV	1/10/75 - 1/19/76	0.31	0.27	0.29	106
Selbach Ranch, NV	1/16/75 - 1/21/76	0.30	0.26	0.27	99
Sherri's Bar, NV	1/06/75 - 1/13/76	0.19	0.15	0.18	66
Shoshone, CA	1/15/75 - 1/15/76	0.27	0.25	0.26	95
Spring Meadows, NV	1/16/75 - 1/21/76	0.18	0.13	0.15	55
Springdale, NV	1/14/75 - 1/21/76	0.32	0.28	0.30	110
St. George, UT	1/13/75 - 1/22/76	0.20	0.15	0.16	58
Sunnyside, NV	1/08/75 - 1/21/76	0.25	0.18	0.22	80
Tempiute, NV	1/06/75 - 1/20/76	0.31	0.27	0.28	100
Tenneco, NV	1/16/75 - 1/21/76	0.29	0.24	0.25	91
Tonopah Test Range, NV	1/09/75 - 1/20/76	0.28	0.24	0.26	95
Tonopah, NV	1/09/75 - 1/20/76	0.31	0.25	0.28	100
Twin Springs Ranch, NV	1/08/75 - 1/21/76	0.31	0.25	0.28	102
Warm Springs, NV	1/08/75 - 1/21/76	0.32	0.25	0.27	99
Young's Ranch, NV	1/14/75 - 1/21/76	0.26	0.21	0.23	84

* Annual adjusted dose equivalent is average dose equivalent rate (mrem/d) times 365 d.

Table 6. 1975 Summary of Analytical Results for the Milk Surveillance Network

Sampling Location	Sample Type[a]	No. of Samples	Radio-nuclide	Radioactivity Conc. (10^{-9} µCi/ml) C_{Max}	C_{Min}	C_{Avg}
Bishop, CA Sierra Creamery	11	1	^{137}Cs	<4	<4	<4
		1	^{89}Sr	<3	<3	<3
		1	^{90}Sr	4.3	4.3	4.3
Hinkley, CA Bill Nelson Dairy	12	4	^{137}Cs	<6	<4	<5
		4	^{89}Sr	<4	<1	<2
		4	^{90}Sr	4.9	<1	<3
Keough Hot Spgs., CA[b] Yribarren Ranch	13	2	^{137}Cs	<5	<4	<5
		2	^{89}Sr	<2	<1	<2
		2	^{90}Sr	2.2	<2	<2
Olancha, CA Hunter Ranch	13	1	^{137}Cs	<4	<4	<4
		1	^{89}Sr	<4	<4	<4
		1	^{90}Sr	4.0	4.0	4.0
Olancha, CA[c] Riley Ranch	13	2	^{137}Cs	<5	<4	<5
		2	^{89}Sr	<2	<2	<2
		2	^{90}Sr	2.7	2.0	2.4
Alamo, NV Alamo Dairy	12	4	^{137}Cs	<8	<4	<5
		4	^{89}Sr	<4	<1	<2
		4	^{90}Sr	4.5	<1	<3
Austin, NV Young's Ranch	13	4	^{137}Cs	<7	<3	<6
		4	^{89}Sr	<3	<2	<2
		4	^{90}Sr	5.3	2.0	2.9
		4	^{3}H	1000	350	590

Table 6. (continued)

Sampling Location	Sample Type[a]	No. of Samples	Radio-nuclide	Radioactivity Conc. (10^{-9} µCi/ml) C_{Max}	C_{Min}	C_{Avg}
Currant, NV Blue Eagle Ranch	13	4	^{137}Cs	18	<4	<10
		4	^{89}Sr	<5	<2	<3
		4	^{90}Sr	5.2	<1	<3
Currant, NV Manzonie Ranch	13	4	^{137}Cs	<8	<3	<5
		4	^{89}Sr	<4	<2	<2
		4	^{90}Sr	2.4	<1	<2
Hiko, NV Schofield Dairy	12	4	^{137}Cs	<8	<4	<5
		4	^{89}Sr	<4	<1	<2
		4	^{90}Sr	2.4	<1	<2
		4	^{3}H	450	<300	<400
Las Vegas, NV LDS Dairy Farms	12	4	^{137}Cs	5	<3	<4
		4	^{89}Sr	<3	<1	<2
		4	^{90}Sr	3.8	<0.9	<2
		4	^{3}H	740	<300	<400
Lathrop Wells, NV Kirker Ranch	13	3	^{137}Cs	<5	<4	<5
		3	^{89}Sr	<2	<1	<2
		3	^{90}Sr	1.5	<0.7	<2
Lida, NV Lida Livestock Company	13	4	^{137}Cs	<5	<3	<4
		4	^{89}Sr	<3	<1	<2
		4	^{90}Sr	3.8	<2	<2
Logandale, NV Vegas Valley Dairy	12	4	^{137}Cs	<7	<4	<5
		4	^{89}Sr	<3	<1	<2
		4	^{90}Sr	4.5	<0.8	<3

Table 6. (continued)

Sampling Location	Sample Type[a]	No. of Samples	Radionuclide	Radioactivity Conc. (10^{-9} µCi/ml) C_{Max}	C_{Min}	C_{Avg}
Lund, NV McKenzie Dairy	12	4	^{137}Cs	<7	<4	<5
		4	^{89}Sr	<4	<2	<2
		4	^{90}Sr	2.9	1.4	2.0
		4	^{3}H	490	<300	<400
Mesquite, NV Hughes Bros. Dairy	12	4	^{137}Cs	<7	<4	<5
		4	^{89}Sr	<3	<1	<2
		4	^{90}Sr	3.9	<2	<3
		4	^{3}H	360	<300	<300
Moapa, NV Searles Dairy	12	4	^{137}Cs	<8	<4	<6
		4	^{89}Sr	<3	<2	<2
		4	^{90}Sr	5.7	1.3	2.7
Nyala, NV Sharp's Ranch	13	4	^{137}Cs	<6	<4	<5
		4	^{89}Sr	<2	<1	<2
		4	^{90}Sr	4.2	<0.1	<2
		4	^{3}H	700	<300	<400
Pahrump, NV Burson Ranch	13	4	^{137}Cs	<7	<4	<5
		4	^{89}Sr	<3	<2	<2
		4	^{90}Sr	2.2	<1	<2
Panaca, NV Kenneth Lee Ranch	13	3	^{137}Cs	<6	<4	<5
		3	^{89}Sr	<4	<2	<2
		3	^{90}Sr	5.1	1.5	2.8
Round Mountain, NV Berg Ranch	13	4	^{137}Cs	<10	<4	<7
		4	^{89}Sr	<4	<2	<2
		4	^{90}Sr	8.7	2.8	4.7

Table 6. (continued)

Sampling Location	Sample Type[a]	No. of Samples	Radio-nuclide	Radioactivity Conc. (10^{-9} µCi/ml) C_{Max}	C_{Min}	C_{Avg}
Shoshone, NV Kirkeby Ranch	13	4	^{137}Cs	<4	<4	<4
		4	^{89}Sr	<3	<1	<2
		4	^{90}Sr	5.5	<0.9	<3
Springdale, NV Siedentopf Ranch	13	4	^{137}Cs	<7	<4	<5
		4	^{89}Sr	<4	<2	<2
		4	^{90}Sr	<2	<1	<2
Cedar City, UT Western Gold Dairy	12	3	^{137}Cs	<9	<4	<6
		3	^{89}Sr	<3	<2	<2
		3	^{90}Sr	4.5	1.2	2.5
St. George, UT R. Cox Dairy	12	4	^{137}Cs	<5	<3	<4
		4	^{89}Sr	<3	<1	<2
		4	^{90}Sr	4.5	<1	<2

[a] 11 = Pasteurized Milk
12 = Raw Milk from Grade A Producer(s)
13 = Raw Milk from family cow(s)

[b] New sampling location; the Sierra Creamery closed.

[c] New sampling location; replaces the Hunter Ranch

Table 7. Analytical Criteria for Long-Term Hydrological Monitoring Program Samples

	Monthly Samples	Semi-Annual Samples	Annual Samples
Gross alpha	All samples	All samples	All samples
Gross beta	All samples	All samples	All samples
Gamma scan	All samples	All samples	All samples
^{3}H[a]	All samples	All samples	All samples
$^{89,90}Sr$	Jan. and July samples. Any other sample if gross beta exceeds 1×10^{-8} µCi/ml.	Jan. sample only. July sample if gross beta exceeds 1×10^{-8} µCi/ml.	All samples collected at locations for the first time within CY75. Subsequent samples if gross beta exceeds 1×10^{-8} µCi/ml.
^{226}Ra	Any sample if gross alpha exceeds 3×10^{-9} µCi/ml.	Any sample if gross alpha exceeds 3×10^{-9} µCi/ml.	Any sample if gross alpha exceeds 3×10^{-9} µCi/ml.
U	Jan. and July samples in CY75.	Jan. sample only in CY75.	Only samples collected at locations for the first time during CY75.
$^{238,239}Pu$	Jan. and July samples in CY75.	Jan. sample only in CY75.	Only samples collected at locations for the first time during CY75.

[a] Starting in January 1975, all samples were first analyzed by the conventional technique (MDC$\sim 2 \times 10^{-7}$ µCi/ml) as a screening method to determine if a sample should be analyzed by the enrichment technique (MDC$\sim 6 \times 10^{-9}$ µCi/ml).

Table 8. 1975 Summary of Analytical Results for the NTS Monthly Long-Term Hydrological Monitoring Program

Sampling Location	No. Samples Collected[a]	No. Samples Analyzed	Radionuclide	Radioactivity Conc. 10^{-9} µCi/ml C_{Max}	C_{Min}	C_{Avg}	% of Conc. Guide
NTS	11	11	^{3}H	<10	<6	<8	<0.01
Well 20 A-2		2	^{89}Sr	<2	<2	<2	<0.01
		2	^{90}Sr	<2	<1	<1	<0.01
		11	^{226}Ra	0.32	0.031	0.12	0.03
		2	^{234}U	4.1	3.8	4.0	<0.01
		2	^{235}U	0.049	0.023	0.036	<0.01
		2	^{238}U	0.99	0.98	0.99	<0.01
		2	^{238}Pu	<0.04	<0.03	<0.04	<0.01
		2	^{239}Pu	<0.04	<0.04	<0.04	<0.01
NTS	10	10	^{3}H	<9	<6	<8	<0.01
Well 8		2	^{89}Sr	<2	<2	<2	<0.01
		2	^{90}Sr	<10	<2	<6	<0.05
		2	^{234}U	0.52	0.35	0.44	<0.01
		2	^{235}U	<0.04	<0.02	<0.03	<0.01
		2	^{238}U	0.13	<0.07	<0.1	<0.01
		2	^{238}Pu	<0.03	<0.02	<0.03	<0.01
		2	^{239}Pu	<0.03	<0.02	<0.03	<0.01
NTS	6	6	^{3}H	<9	<6	<8	<0.01
Well J-12		1	^{89}Sr	<2	<2	<2	<0.01
		1	^{90}Sr	<1	<1	<1	<0.01
		1	^{226}Ra	0.27	0.27	0.27	<0.07
		1	^{234}U	1.1	1.1	1.1	<0.01
		1	^{235}U	<0.01	<0.01	<0.01	<0.01
		1	^{238}U	0.18	0.18	0.18	<0.01
		1	^{238}Pu	<0.06	<0.06	<0.06	<0.01
		1	^{239}Pu	<0.04	<0.04	<0.04	<0.01
NTS	5	4[b]	^{3}H	10	<7	<9	<0.01
Well U3CN-5		5	^{89}Sr	<2	<2	<2	<0.01
		5	^{90}Sr	<2	<0.8	<0.9	<0.01
		5	^{226}Ra	2.4	0.78	1.8	0.5
		2	^{234}U	1.7	0.39	1.0	<0.01
		2	^{235}U	0.02	<0.02	<0.02	<0.01
		2	^{238}U	0.37	0.11	0.24	<0.01
		2	^{238}Pu	<0.06	<0.05	<0.05	<0.01
		2	^{239}Pu	<0.05	<0.03	<0.04	<0.01

Table 8. (continued)

Sampling Location	No. Samples Collected[a]	No. Samples Analyzed	Radio-nuclide	Radioactivity Conc. 10^{-9} µCi/ml C_{Max}	C_{Min}	C_{Avg}	% of Conc Guid
NTS	5	5	^{3}H	8	<7	<8	<0.0
Well J-13		1	^{89}Sr	<2	<2	<2	<0.0
		1	^{90}Sr	<0.9	<0.9	<0.9	<0.0
		1	^{226}Ra	0.067	0.067	0.067	0.0
		1	^{234}U	1.7	1.7	1.7	<0.0
		1	^{235}U	<0.02	<0.02	<0.02	<0.0
		1	^{238}U	0.22	0.22	0.22	<0.0
		1	^{238}Pu	<0.03	<0.03	<0.03	<0.0
		1	^{239}Pu	<0.04	<0.04	<0.04	<0.0
NTS	10	10	^{3}H	18	<6	<9	<0.0
Well UE 19g-s		2	^{89}Sr	<2	<2	<2	<0.0
		2	^{90}Sr	<2	<0.9	<1	<0.0
		10	^{226}Ra	0.3	0.056	0.14	0.0
		2	^{234}U	14	9.1	12	<0.0
		2	^{235}U	0.16	0.089	0.12	<0.0
		2	^{238}U	4	2.2	3.1	<0.0
		2	^{238}Pu	<0.03	<0.03	<0.03	<0.0
		2	^{239}Pu	<0.07	<0.02	<0.05	<0.0
Beatty, NV	9	9	^{3}H	14	<6	<8	<0.0
Well 11S/48-1dd		2	^{89}Sr	<2	<2	<2	<0.0
		2	^{90}Sr	<1	<0.9	<1	<0.0
		8	^{226}Ra	0.32	0.056	0.17	0.0
		2	^{234}U	9	9	9	<0.0
		2	^{235}U	0.088	0.081	0.085	<0.0
		2	^{238}U	1.8	1.7	1.8	<0.0
		2	^{238}Pu	<0.04	<0.02	<0.03	<0.0
		2	^{239}Pu	<0.03	<0.03	<0.03	<0.0
NTS	1	1	^{3}H	<10	<10	<10	<0.0
Well U 19-c							

Table 8. (continued)

Sampling Location	No. Samples Collected[a]	No. Samples Analyzed	Radionuclide	Radioactivity Conc. 10^{-9} µCi/ml C_{Max}	C_{Min}	C_{Avg}	% of Conc. Guide
NTS Well A	11	10[b]	^{3}H	<10	<7	<8	<0.01
		4	^{89}Sr	<2	<1	<2	<0.01
		4	^{90}Sr	<0.9	<0.8	<0.9	<0.01
		11	^{226}Ra	0.50	0.017	0.13	0.03
		2	^{234}U	5.4	5.1	5.3	<0.01
		2	^{235}U	0.067	0.048	0.058	<0.01
		2	^{238}U	1.7	1.5	1.6	<0.01
		2	^{238}Pu	0.092	<0.04	<0.07	<0.01
		2	^{239}Pu	0.031	<0.03	<0.03	<0.01
NTS Well C	11	11	^{3}H	150	40	90	<0.01
		10	^{89}Sr	<3	<1	<2	<0.01
		10	^{90}Sr	3	<1	<1	<0.01
		12	^{226}Ra	1.3	0.062	0.83	0.2
		2	^{234}U	9.2	8.7	9	<0.01
		2	^{235}U	0.10	0.099	0.01	<0.01
		2	^{238}U	2.6	2.4	2.5	<0.01
		2	^{238}Pu	<0.05	<0.03	<0.04	<0.01
		2	^{239}Pu	<0.08	<0.03	<0.05	<0.01
NTS Well 5C	11	11	^{3}H	15	<6	<9	<0.01
		3	^{89}Sr	<3	<1	<2	<0.01
		3	^{90}Sr	<1	<0.9	<1	<0.01
		11	^{226}Ra	0.29	0.061	0.14	0.035
		2	^{234}U	5.4	2.4	3.9	<0.01
		2	^{235}U	0.093	<0.08	<0.09	<0.01
		2	^{238}U	2.7	1.2	2	<0.01
		2	^{238}Pu	<0.05	<0.04	<0.04	<0.01
		2	^{239}Pu	<0.05	<0.04	<0.04	<0.01
NTS Well Army No. 1	9	8[b]	^{3}H	18	<7	<10	< 0.01
		3	^{89}Sr	<1	<1	<1	<0.01
		3	^{90}Sr	<2	<1	<2	<0.02
		8	^{226}Ra	0.59	0.0094	0.30	0.075
		2	^{234}U	2.4	2.4	2.4	<0.01
		2	^{235}U	0.031	<0.02	<0.03	<0.01
		2	^{238}U	0.78	0.72	0.75	<0.01
		2	^{238}Pu	<0.03	<0.03	<0.03	<0.01
		2	^{239}Pu	<0.06	<0.02	<0.04	<0.01

[a]Samples could not be collected every month due to weather conditions or inoperative pumps.

[b]Sample lost in analysis.

Table 9. 1975 Summary of Analytical Results

for the NTS Semi-Annual Long-Term Hydrological Monitoring Program

Sampling Location	Date	Sample Type[a]	Radio-nuclide	Radioactivity Conc. (10^{-9} µCi/ml)	% of Conc. Guide[b]
NTS Well UE 15d	1/15	23	^{3}H	<7	<0.01
			^{89}Sr	<2	<0.01
			^{90}Sr	<2	<0.01
			^{226}Ra	1.5	0.4
			^{234}U	4.7	<0.01
			^{235}U	0.026	<0.01
			^{238}U	1.2	<0.01
			^{238}Pu	<0.05	<0.01
			^{239}Pu	<0.04	<0.01
NTS Well UE 15d	7/08	23	^{3}H	<7	<0.01
			^{89}Sr	<1	<0.01
			^{90}Sr	<0.9	<0.01
NTS Well 2	1/14	23	^{3}H	<9	<0.01
			^{89}Sr	<1	<0.01
			^{90}Sr	<0.08	<0.01
			^{226}Ra	0.21	0.05
			^{234}U	1.7	<0.01
			^{235}U	<0.01	<0.01
			^{238}U	0.34	<0.01
			^{238}Pu	<0.04	<0.01
			^{239}Pu	<0.04	<0.01
NTS Well 2	7/08	23	^{3}H	8.3	<0.01
NTS Well C-1	1/14	23	^{3}H	70	<0.01
			^{89}Sr	<1	<0.01
			^{90}Sr	<0.8	<0.01
			^{226}Ra	0.067	0.02
			^{234}U	7.7	<0.01
			^{235}U	0.23	<0.01
			^{238}U	2	<0.01
			^{238}Pu	<0.04	<0.01
			^{239}Pu	<0.03	<0.01

Table 9. (continued)

Sampling Location	Date	Sample Type[a]	Radionuclide	Radioactivity Conc. (10^{-9} µCi/ml)	% of Conc. Guide[b]
NTS Well C-1	7/08	23	^{3}H	51	<0.01
			^{89}Sr	<1	<0.01
			^{90}Sr	<1	<0.01
NTS Well UE 5c	1/14[c]	23	^{3}H	<8	<0.01
			^{89}Sr	<1	<0.01
			^{90}Sr	<0.9	<0.01
			^{226}Ra	0.36	0.09
			^{234}U	3.4	<0.01
			^{235}U	0.056	<0.01
			^{238}U	1.6	<0.01
			^{238}Pu	<0.03	<0.01
			^{239}Pu	<0.01	<0.01
NTS Well 5B	1/15	23	^{3}H	<8	<0.01
			^{89}Sr	<3	<0.01
			^{90}Sr	<2	<0.01
			^{226}Ra	0.10	0.03
			^{234}U	2.7	<0.01
			^{235}U	0.091	<0.01
			^{238}U	1.8	<0.01
			^{238}Pu	<0.06	<0.01
			^{239}Pu	<0.04	<0.01
NTS Well 5B	7/09	23	^{3}H	10	<0.01
			^{89}Sr	<1	<0.01
			^{90}Sr	<0.9	<0.01
NTS Watertown No. 3	1/14	23	^{3}H	<8	<0.01
			^{89}Sr	<1	<0.01
			^{90}Sr	<0.9	<0.01
			^{234}U	1.4	<0.01
			^{235}U	0.024	<0.01
			^{238}U	0.52	<0.01
			^{238}Pu	<0.04	<0.01
			^{239}Pu	<0.04	<0.01

Table 9. (continued)

Sampling Location	Date	Sample Type[a]	Radio-nuclide	Radioactivity Conc. (10^{-9} µCi/ml)	% of Conc.[b] Guide
NTS Watertown No. 3	7/08	23	^{3}H	<7	<0.01
Ash Meadows, NV Crystal Pool	1/22	27	^{3}H	<8	<0.01
			^{89}Sr	<2	<0.07
			^{90}Sr	<1	<0.3
			^{226}Ra	0.22	0.7
			^{234}U	11	0.04
			^{235}U	0.23	<0.01
			^{238}U	4.5	0.01
			^{238}Pu	<0.04	<0.01
			^{239}Pu	<0.04	<0.01
Ash Meadows, NV Crystal Pool	7/15	27	^{3}H	<8	<0.01
			^{89}Sr	<1	<0.03
			^{90}Sr	<0.9	<0.3
Ash Meadows, NV Well 17S/50E-14CAC	1/22	23	^{3}H	<8	<0.01
			^{89}Sr	<2	<0.07
			^{90}Sr	<2	<0.4
			^{226}Ra	0.089	0.3
			^{234}U	2.4	<0.01
			^{235}U	0.033	<0.01
			^{238}U	0.89	<0.01
			^{238}Pu	<0.03	<0.01
			^{239}Pu	<0.04	<0.01
Ash Meadows, NV Well 17S/50E-14CAC	7/15	23	^{3}H	11	<0.01
			^{226}Ra	0.47	2
Ash Meadows, NV Fairbanks Springs	1/22	27	^{3}H	<9	<0.01
			^{89}Sr	<2	<0.07
			^{90}Sr	<1	<0.3
			^{226}Ra	0.44	2
			^{234}U	2.2	<0.01
			^{235}U	0.029	<0.01
			^{238}U	0.89	<0.01
			^{238}Pu	<0.03	<0.01
			^{239}Pu	<0.03	<0.01

Table 9. (continued)

Sampling Location	Date	Sample Type[a]	Radionuclide	Radioactivity Conc. (10^{-9} µCi/ml)	% of Conc. Guide[b]
Ash Meadows, NV Fairbanks Springs	7/15	27	^{3}H	<8	<0.01
Beatty, NV City Supply	1/21	23	^{3}H	17	<0.01
			^{89}Sr	<2	<0.07
			^{90}Sr	<1	<0.3
			^{226}Ra	0.16	0.5
			^{234}U	8.2	0.3
			^{235}U	0.18	<0.01
			^{238}U	2.6	<0.01
			^{238}Pu	<0.04	<0.01
			^{239}Pu	<0.02	<0.01
Beatty, NV City Supply	7/15	23	^{3}H	<7	<0.01
			^{89}Sr	<2	<0.05
			^{90}Sr	<0.8	<0.3
			^{226}Ra	0.13	0.43
Beatty, NV Nuclear Engineering Co.	1/21	23	^{3}H	<7	<0.01
			^{89}Sr	<2	<0.07
			^{90}Sr	<1	<0.3
			^{226}Ra	0.078	0.3
			^{234}U	6.1	0.02
			^{235}U	0.95	<0.01
			^{238}U	2.3	<0.01
			^{238}Pu	<0.04	<0.01
			^{239}Pu	<0.03	<0.01
Beatty, NV Nuclear Engineering Co.	7/14	23	^{3}H	<8	<0.01
			^{226}Ra	0.033	0.1
Indian Springs, NV USAF No. 1	1/23	23	^{3}H	11	<0.01
			^{89}Sr	<7	<0.2
			^{90}Sr	<1	<0.3
			^{226}Ra	0.22	0.7
			^{234}U	4.2	0.01
			^{235}U	0.034	<0.01
			^{238}U	0.75	<0.01
			^{238}Pu	<0.04	<0.01
			^{239}Pu	<0.04	<0.01

Table 9. (continued)

Sampling Location	Date	Sample Type[a]	Radionuclide	Radioactivity Conc. (10^{-9} µCi/ml)	% of Conc. Guide[b]
Indian Springs, NV USAF No. 1	7/14	23	^{3}H	35	<0.01
			^{226}Ra	0.23	0.8
Indian Springs, NV Sewer Co. Inc. Well No. 1	1/23	23	^{3}H	<7	<0.01
			^{89}Sr	<2	<0.07
			^{90}Sr	<1	<0.3
			^{226}Ra	0.095	0.32
			^{234}U	3.4	0.01
			^{235}U	0.021	<0.01
			^{238}U	0.73	<0.01
			^{238}Pu	<0.04	<0.01
			^{239}Pu	<0.02	<0.01
Indian Springs, NV Sewer Co. Inc. Well No. 1	7/14	23	^{3}H	<40	<0.01
			^{226}Ra	0.072	0.2
Lathrop Wells, NV City Supply	1/22	23	^{3}H	<8	<0.01
			^{89}Sr	<1	<0.03
			^{90}Sr	<1	<0.3
			^{234}U	1.1	<0.01
			^{235}U	<0.01	<0.01
			^{238}U	0.44	<0.01
			^{238}Pu	<0.03	<0.01
			^{239}Pu	<0.03	<0.01
Lathrop Wells, NV City Supply	7/14	23	^{3}H	<7	<0.01
			^{226}Ra	4.6	15
Springdale, NV Goss Springs	1/21	27	^{3}H	<8	<0.01
			^{89}Sr	<2	<0.07
			^{90}Sr	<1	<0.3
			^{226}Ra	0.15	0.5
			^{234}U	3.6	0.01
			^{235}U	0.057	<0.01
			^{238}U	1.1	<0.01
			^{238}Pu	<0.03	<0.01
			^{239}Pu	<0.03	<0.01

Table 9. (continued)

Sampling Location	Date	Sample Type[a]	Radio-nuclide	Radioactivity Conc. (10^{-9} µCi/ml)	% of Conc. Guide[b]
Springdale, NV Goss Springs	7/14	27	^{3}H	<7	<0.01
Springdale, NV Road D Windmill	1/21	23	^{3}H	<6	<0.01
			^{89}Sr	<2	<0.07
			^{90}Sr	<2	<0.4
			^{234}U	1.9	<0.01
			^{235}U	0.062	<0.01
			^{238}U	1.1	<0.01
			^{238}Pu	<0.04	<0.01
			^{239}Pu	<0.03	<0.01
Springdale, NV Road D Windmill	7/14	23	^{3}H	<7	<0.01
Shoshone, CA Shoshone Spring	1/22	27	^{3}H	<8	<0.01
			^{89}Sr	<1	<0.03
			^{90}Sr	<1	<0.3
			^{226}Ra	0.17	0.6
			^{234}U	3.3	0.01
			^{235}U	0.041	<0.01
			^{238}U	1.2	<0.01
			^{238}Pu	<0.05	<0.01
			^{239}Pu	<0.06	<0.01
Shoshone, CA Shoshone Spring	7/15	27	^{3}H	<8	<0.01
			^{89}Sr	<1	<0.03
			^{90}Sr	<0.9	<0.3

[a] 23 - Well
27 - Spring

[b] All on-NTS percentages are for radiation workers. All off-NTS percentages are for an individual in an uncontrolled area.

[c] Only one sample was collected during the year due to an inoperative pump.

Table 10. 1975 Summary of Analytical Results for the NTS Annual Long Term Hydrological Monitoring Program

Sampling Location	Date	Sample Type[a]	Radio-nuclide	Radioactivity Conc. (10^{-9} µCi/ml)	% of Conc. Guide
Hiko, NV Crystal Springs	8/25	27	^{3}H	300	0.01
			^{89}Sr	<2	<0.06
			^{90}Sr	1.1	0.4
			^{226}Ra	0.79	2.6
			^{234}U	4.3	0.01
			^{235}U	0.059	<0.01
			^{238}U	1.3	<0.01
			^{238}Pu	<0.03	<0.01
			^{239}Pu	<0.04	<0.01
Alamo, NV City Supply	8/25	23	^{3}H	17	<0.01
			^{89}Sr	<2	<0.05
			^{90}Sr	<1	<0.3
			^{234}U	3.6	0.01
			^{235}U	0.016	<0.01
			^{238}U	1.8	<0.01
			^{238}Pu	<0.03	<0.01
			^{239}Pu	<0.02	<0.01
Warm Springs, NV Twin Springs Ranch	8/25	27	^{3}H	<8	<0.01
			^{89}Sr	<2	<0.05
			^{90}Sr	<0.9	<0.3
			^{226}Ra	0.22	0.7
			^{234}U	4.6	0.02
			^{235}U	0.087	<0.01
			^{238}U	1.8	<0.01
			^{238}Pu	<0.04	<0.01
			^{239}Pu	<0.03	<0.01
Diablo, NV Highway Maint. Station	8/25	23	^{3}H	10	<0.01
			^{89}Sr	<2	<0.05
			^{90}Sr	<1	<0.3
			^{234}U	1.7	<0.01
			^{235}U	0.034	<0.01
			^{238}U	0.78	<0.01
			^{238}Pu	<0.04	<0.01
			^{239}Pu	<0.04	<0.01

Table 10. (continued)

Sampling Location	Date	Sample Type[a]	Radionuclide	Radioactivity Conc. (10^{-9} µCi/ml)	% of Conc. Guide
Nyala, NV	9/03	23	^{3}H	22	<0.01
Sharp Ranch			^{89}Sr	<1	<0.04
			^{90}Sr	<2	<0.7
			^{234}U	1.9	<0.01
			^{235}U	0.02	<0.01
			^{238}U	0.6	<0.01
			^{238}Pu	<0.03	<0.01
			^{239}Pu	<0.03	<0.01
Adaven, NV	8/26	27	^{3}H	130	<0.01
Adaven Spring			^{89}Sr	<2	<0.06
			^{90}Sr	<1	<0.4
			^{226}Ra	<0.05	<0.2
			^{234}U	3.3	0.01
			^{235}U	0.087	<0.01
			^{238}U	1.2	<0.01
			^{238}Pu	<0.03	<0.01
			^{239}Pu	<0.02	<0.01
Pahrump, NV	8/27	23	^{3}H	16	<0.01
Calvada Well No. 3			^{89}Sr	<2	<0.05
			^{90}Sr	<1	<0.3
			^{226}Ra	0.31	1.0
			^{234}U	6.9	0.02
			^{235}U	0.15	<0.01
			^{238}U	2.2	<0.01
			^{238}Pu	<0.03	<0.01
			^{239}Pu	<0.02	<0.01
Tonopah, NV	8/27	23	^{3}H	10	<0.01
City Supply			^{89}Sr	<2	<0.06
			^{90}Sr	<1	<0.4
			^{234}U	2.9	<0.01
			^{235}U	0.088	<0.01
			^{238}U	1.1	<0.01
			^{238}Pu	<0.05	<0.01
			^{239}Pu	<0.03	<0.01

Table 10. (continued)

Sampling Location	Date	Sample Type[a]	Radionuclide	Radioactivity Conc. (10^{-9} µCi/ml)	% of Conc. Guide
Clark Station, NV	8/27	23	^{3}H	12	<0.01
Tonopah Test Range			^{89}Sr	<2	<0.06
Well No. 6			^{90}Sr	<1	<0.4
			^{234}U	3.4	0.01
			^{235}U	0.062	<0.01
			^{238}U	1.9	<0.01
			^{238}Pu	<0.03	<0.01
			^{239}Pu	<0.02	<0.01
Las Vegas, NV	8/27	23	^{3}H	16	<0.01
Well No. 28			^{89}Sr	<2	<0.07
			^{90}Sr	<2	<0.5
			^{234}U	2.1	<0.01
			^{235}U	0.032	<0.01
			^{238}U	0.61	<0.01
			^{238}Pu	<0.03	<0.01
			^{239}Pu	<0.04	<0.01

[a] 23 - Well
27 - Spring

Table 11. 1975 Summary of Analytical Results

for the Off-NTS Long-Term Hydrological Monitoring Program

Sampling Location	Date	Sample Type[c]	Depth (Metres[a])	Radionuclide	Radioactivity Conc. (10^{-9} µCi/ml)	% of Conc. Guide
			PROJECT GNOME			
Malaga, NM	3/23	23	161	^{3}H	<8	<0.01
USGS Well No. 1				^{89}Sr	<2	<0.07
				^{90}Sr	1.3	0.4
				^{226}Ra	6	20
				^{234}U	5.5	0.02
				^{235}U	0.055	<0.01
				^{238}U	1.8	<0.01
				^{238}Pu	<0.6	<0.01
				^{239}Pu	<2	<0.04
Malaga, NM	3/23	23	148	^{3}H	960,000	30
USGS Well No. 4				^{89}Sr	<1,800	<60
				^{90}Sr	11,000	4000
				^{226}Ra	0.13	0.4
				^{234}U	2.9	<0.01
				^{235}U	0.055	<0.01
				^{238}U	0.74	<0.01
				^{238}Pu	<0.6	<0.01
				^{239}Pu	<2	<0.05
Malaga, NM	3/23	23	144	^{3}H	1,200,000	40
USGS Well No. 8				^{89}Sr	<900	<30
				^{90}Sr	11,000	4000
				^{137}Cs	<20	<0.1
				^{226}Ra	1.6	5
				^{234}U	2.7	<0.01
				^{235}U	<0.1	<0.01
				^{238}U	0.88	<0.01
				^{238}Pu	<0.05	<0.01
				^{239}Pu	0.047	<0.01
Malaga, NM	3/22	23		^{3}H	<200	<0.01
PHS Well No. 6				^{89}Sr	<2	0.05
				^{90}Sr	<0.9	<0.3
				^{234}U	1.2	<0.01
				^{235}U	0.045	<0.01
				^{238}U	0.99	<0.01
				^{238}Pu	<0.04	<0.01
				^{239}Pu	0.024	<0.01

Table 11. (continued)

Sampling Location	Date	Sample Type[c]	Depth (Metres[a])	Radio-nuclide	Radioactivity Conc. (10^{-9} µCi/ml)	% of Conc. Guide
Malaga, NM PHS Well No. 8	3/22	23		^{3}H	<8	<0.01
				^{89}Sr	<3	<0.09
				^{90}Sr	<0.9	<0.3
				^{234}U	3.9	0.01
				^{235}U	0.092	<0.01
				^{238}U	1.8	<0.01
				^{238}Pu	<0.5	<0.01
				^{239}Pu	<0.9	<0.02
Malaga, NM PHS Well No. 9	3/22	23		^{3}H	<8	<0.01
				^{89}Sr	<3	<0.1
				^{90}Sr	<0.9	<0.3
				^{234}U	1.4	<0.01
				^{235}U	0.046	<0.01
				^{238}U	0.62	<0.01
				^{238}Pu	<0.03	<0.01
				^{239}Pu	<0.04	<0.01
Malaga, NM PHS Well No. 10	3/22	23		^{3}H	<8	<0.01
				^{89}Sr	<2	<0.07
				^{90}Sr	<0.7	<0.2
				^{234}U	9.6	0.03
				^{235}U	0.079	<0.01
				^{238}U	1.5	<0.01
				^{238}Pu	<0.6	<0.01
				^{239}Pu	<1	<0.02
Malaga, NM[b] City Water	3/21	23		^{3}H	<7	<0.01
				^{89}Sr	<2	<0.06
				^{90}Sr	<0.9	<0.3
				^{234}U	0.04	<0.01
				^{235}U	<0.01	<0.01
				^{238}U	0.056	<0.01
				^{238}Pu	<0.04	<0.01
				^{239}Pu	<0.04	<0.01

Table 11. (continued)

Sampling Location	Date	Sample Type[c]	Depth (Metres)[a]	Radio-nuclide	Radioactivity Conc. (10^{-9} µCi/ml)	% of Conc. Guide
Malaga, NM	3/21	23		^{3}H	<9	<0.01
Pecos River				^{89}Sr	<2	<0.05
Pumping Station				^{90}Sr	<0.8	<0.3
Well No. 1				^{234}U	4.2	0.01
				^{235}U	0.054	<0.01
				^{238}U	1.3	<0.01
				^{238}Pu	<0.04	<0.01
				^{239}Pu	<0.05	<0.01
Loving, NM	3/21	23		^{3}H	<8	<0.01
City Well No. 2				^{89}Sr	<2	<0.05
				^{90}Sr	<0.9	<0.3
				^{234}U	1.8	<0.01
				^{235}U	0.032	<0.01
				^{238}U	0.63	<0.01
				^{238}Pu	<0.05	<0.01
				^{239}Pu	<0.03	<0.01
Carlsbad, NM	3/21	23		^{3}H	<8	<0.01
City Well No. 7				^{89}Sr	<1	<0.05
				^{90}Sr	<0.7	<0.2
				^{234}U	0.65	<0.01
				^{235}U	<0.01	<0.01
				^{238}U	0.3	<0.01
				^{238}Pu	<0.04	<0.01
				^{239}Pu	<0.03	<0.01
PROJECT SHOAL						
Frenchman, NV	2/21	23		^{3}H	<10	<0.01
Well H-3				^{89}Sr	<6	<0.2
				^{90}Sr	<4	<2
				^{234}U	0.8	<0.01
				^{235}U	0.022	<0.01
				^{238}U	0.66	<0.01
				^{238}Pu	<0.03	<0.01
				^{239}Pu	<0.04	<0.01

Table 11. (continued)

Sampling Location	Date	Sample Type[c]	Radio-nuclide	Radioactivity Conc. (10^{-9} µCi/ml)	% of Conc. Guide
Frenchman, NV Flowing Well	2/20	23	^{3}H	<9	<0.01
			^{89}Sr	<5	<0.2
			^{90}Sr	<4	<1
			^{226}Ra	0.26	0.9
			^{234}U	0.36	<0.01
			^{235}U	<0.02	<0.01
			^{238}U	0.23	<0.01
			^{238}Pu	<0.2	<0.01
			^{239}Pu	<0.09	<0.01
Frenchman, NV Hunts Station	2/20	23	^{3}H	<8	<0.01
			^{89}Sr	<6	<0.2
			^{90}Sr	<4	<1
			^{234}U	0.73	<0.01
			^{235}U	0.035	<0.01
			^{238}U	0.41	<0.01
			^{238}Pu	<0.05	<0.01
			^{239}Pu	<0.02	<0.01
Frenchman, NV Frenchman Station	2/19	23	^{3}H	<7	<0.01
			^{89}Sr	<6	<0.2
			^{90}Sr	<4	<1
			^{226}Ra	0.17	0.6
			^{234}U	23	0.08
			^{235}U	0.55	<0.01
			^{238}U	11	0.03
			^{238}Pu	<0.05	<0.01
			^{239}Pu	<0.05	<0.01
Frenchman, NV Well HS-1	2/19	23	^{3}H	<7	<0.01
			^{89}Sr	<6	<0.2
			^{90}Sr	<4	<2
			^{226}Ra	0.067	0.2
			^{234}U	3.3	0.01
			^{235}U	0.098	<0.01
			^{238}U	2.2	<0.01
			^{238}Pu	<0.04	<0.01
			^{239}Pu	<0.02	<0.01

Table 11. (continued)

Sampling Location	Date	Sample Type[c]	Depth (Metres[a])	Radio-nuclide	Radioactivity Conc. (10^{-9} µCi/ml)	% of Conc. Guide
			PROJECT DRIBBLE			
Baxterville, MS City Supply	7/18	23		^{3}H	38	<0.01
				^{89}Sr	<1	<0.05
				^{90}Sr	<0.9	<0.3
				^{234}U	0.034	<0.01
				^{235}U	<0.01	<0.01
				^{238}U	<0.03	<0.01
				^{238}Pu	<0.03	<0.01
				^{239}Pu	<0.02	<0.01
	10/17	23		^{3}H	93	<0.01
Baxterville, MS Lower Little Creek	7/21	22		^{3}H	110	<0.01
				^{89}Sr	<2	<0.06
				^{90}Sr	<1	<0.3
				^{234}U	0.032	<0.01
				^{235}U	<0.009	<0.01
				^{238}U	0.03	<0.01
				^{238}Pu	<0.03	<0.01
				^{239}Pu	<0.04	<0.01
	10/19	22		^{3}H	130	<0.01
Baxterville, MS Well HT-1	7/03	23	399	^{3}H	<6	<0.01
	7/20	23	358	^{3}H	8.6	<0.01
				^{89}Sr	<2	<0.05
				^{90}Sr	<1	<0.4
				^{226}Ra	15	0.5
				^{234}U	17	0.06
				^{235}U	1.1	<0.01
				^{238}U	29	0.07
				^{238}Pu	<0.03	<0.01
				^{239}Pu	0.048	<0.01
	10/15	23	389	^{3}H	74	<0.01

Table 11. (continued)

Sampling Location	Date	Sample Type[c]	Depth (Metres[a])	Radio-nuclide	Radioactivity Conc. (10^{-9} µCi/ml)	% of Conc. Guide
Baxterville, MS Well HT-2c	7/03	23	108	^{3}H	15	<0.01
	7/20	23	108	^{3}H	29	<0.01
				^{89}Sr	<2	<0.05
				^{90}Sr	<1	<0.3
				^{234}U	0.045	<0.01
				^{235}U	<0.009	<0.01
				^{238}U	0.025	<0.01
				^{238}Pu	<0.03	<0.01
				^{239}Pu	<0.02	<0.01
	10/18	23	108	^{3}H	35	<0.01
Baxterville, MS Well HT-4	7/02	23	122	^{3}H	16	<0.01
	7/20	23	122	^{3}H	9.3	<0.01
				^{89}Sr	<2	<0.05
				^{90}Sr	<1	<0.3
				^{234}U	0.032	<0.01
				^{235}U	<0.01	<0.01
				^{238}U	<0.01	<0.01
				^{238}Pu	<0.04	<0.01
				^{239}Pu	<0.02	<0.01
	10/18	23	122	^{3}H	20	<0.01
Baxterville, MS Well HT-5	7/02	23	183	^{3}H	8.3	<0.01
	7/20	23	183	^{3}H	24	<0.01
				^{89}Sr	<2	<0.06
				^{90}Sr	<1	<0.4
				^{234}U	0.027	<0.01
				^{235}U	0.02	<0.01
				^{238}U	<0.03	<0.01
				^{238}Pu	<0.04	<0.01
				^{239}Pu	<0.03	<0.01
	10/18	23	183	^{3}H	12	<0.01

Table 11. (continued)

Sampling Location	Date	Sample Type[c]	Depth (Metres[a])	Radio-nuclide	Radioactivity Conc. (10^{-9} µCi/ml)	% of Conc. Guide
Baxterville, MS Well E-7	7/03	23	282	^{3}H	<7	<0.01
	7/20	23	282	^{3}H	<8	<0.01
				^{89}Sr	<1	<0.04
				^{90}Sr	<0.9	<0.3
				^{234}U	<0.02	<0.01
				^{235}U	<0.01	<0.01
				^{238}U	0.017	<0.01
				^{238}Pu	<0.03	<0.01
				^{239}Pu	<0.02	<0.01
	10/18	23	282	^{3}H	<7	<0.01
Baxterville, MS Well Ascot No. 2	7/19	23	638	^{3}H	18	<0.01
				^{89}Sr	<2	<0.05
				^{90}Sr	<0.8	<0.3
				^{234}U	0.026	<0.01
				^{235}U	<0.01	<0.01
				^{238}U	0.017	<0.01
				^{238}Pu	<0.03	<0.01
				^{239}Pu	<0.02	<0.01
	10/15	23	651	^{3}H	20	<0.01
				^{89}Sr	<3	<0.1
				^{90}Sr	<2	<0.5
Baxterville, MS Half Moon Creek	7/01	22		^{3}H	90	<0.01
	7/19	22		^{3}H	67	0.01
				^{89}Sr	<2	<0.05
				^{90}Sr	<1	<0.3
				^{234}U	<0.02	<0.01
				^{235}U	<0.01	<0.01
				^{238}U	<0.02	<0.01
				^{238}Pu	<0.04	<0.01
				^{239}Pu	<0.04	<0.01
	10/19	22		^{3}H	64	<0.01

Table 11. (continued)

Sampling Location	Date	Sample Type[c]	Depth (Metres[a])	Radio-nuclide	Radioactivity Conc. (10^{-9} µCi/ml)	% of Conc. Guide
Baxterville, MS Half Moon Creek Overflow	7/02	22		^{3}H	480	0.02
	7/19	22		^{3}H	2200	0.07
				^{89}Sr	<2	<0.05
				^{90}Sr	<2	<0.4
				^{234}U	<0.02	<0.01
				^{235}U	<0.01	<0.01
				^{238}U	<0.02	<0.01
				^{238}Pu	<0.04	<0.01
				^{239}Pu	<0.02	<0.01
	10/19	22		^{3}H	380	0.01
Baxterville, MS T. Speights Residence	7/01	23		^{3}H	110	<0.01
	7/18	23		^{3}H	48	<0.01
				^{89}Sr	<2	<0.06
				^{90}Sr	<1	<0.4
				^{234}U	0.048	<0.01
				^{235}U	<0.01	<0.01
				^{238}U	0.036	<0.01
				^{238}Pu	<0.02	<0.01
				^{239}Pu	<0.03	<0.01
	10/20	23		^{3}H	96	<0.01
Baxterville, MS R. L. Anderson Residence	7/01	23		^{3}H	58	<0.01
	7/21	23		^{3}H	93	<0.01
				^{89}Sr	<2	<0.06
				^{90}Sr	<1	<0.4
				^{226}Ra	0.53	2
				^{234}U	0.044	<0.01
				^{235}U	<0.01	<0.01
				^{238}U	<0.01	<0.01
				^{238}Pu	<0.03	<0.01
				^{239}Pu	<0.02	<0.01
	10/20	23		^{3}H	74	<0.01

Table 11. (continued)

Sampling Location	Date	Sample Type[c]	Depth (Metres[a])	Radio-nuclide	Radioactivity Conc. (10^{-9} µCi/ml)	% of Conc. Guide
Baxterville, MS Mark Lowe Residence	7/22	23		^{3}H	220	<0.01
				^{89}Sr	<2	<0.05
				^{90}Sr	<0.8	<0.3
				^{234}U	<0.01	<0.01
				^{235}U	<0.007	<0.01
				^{238}U	0.012	<0.01
				^{238}Pu	<0.04	<0.01
				^{239}Pu	<0.03	<0.01
	10/17	23		^{3}H	160	<0.01
Baxterville, MS R. Ready Residence	7/22	23		^{3}H	64	<0.01
				^{89}Sr	<2	<0.05
				^{90}Sr	<1	<0.3
				^{234}U	0.034	<0.01
				^{235}U	<0.02	<0.01
				^{238}U	<0.03	<0.01
				^{238}Pu	<0.01	<0.01
				^{239}Pu	<0.01	<0.01
	10/20	23		^{3}H	64	<0.01
Baxterville, MS W. Daniels, Jr. Residence	7/01	23		^{3}H	130	<0.01
	7/22	23		^{3}H	80	<0.01
				^{89}Sr	<2	<0.06
				^{90}Sr	<1	<0.3
				^{234}U	0.029	<0.01
				^{235}U	<0.01	<0.01
				^{238}U	0.031	<0.01
				^{238}Pu	<0.04	<0.01
				^{239}Pu	<0.03	<0.01
	10/17	23		^{3}H	80	<0.01
Lumberton, MS City Supply Well No. 2	7/21	23		^{3}H	<7	<0.01
				^{89}Sr	<2	<0.06
				^{90}Sr	<1	<0.4
				^{234}U	<0.02	<0.01
				^{235}U	<0.02	<0.01
				^{238}U	<0.02	<0.01
				^{238}Pu	<0.04	<0.01
				^{239}Pu	<0.03	<0.01

Table 11. (continued)

Sampling Location	Date	Sample Type[c]	Depth (Metres[a])	Radio-nuclide	Radioactivity Conc. (10^{-9} µCi/ml)	% of Conc. Guide
Lumberton, MS City Supply Well No. 2 (continued)	10/20	23		^{3}H	<6	<0.01
Purvis, MS City Supply	7/18	23		^{3}H	<8	<0.01
				^{89}Sr	<1	<0.04
				^{90}Sr	<0.9	<0.3
				^{234}U	<0.02	<0.01
				^{235}U	<0.008	<0.01
				^{238}U	<0.01	<0.01
				^{238}Pu	<0.03	<0.01
				^{239}Pu	<0.02	<0.01
	10/17	23		^{3}H	14	<0.01
Columbia, MS City Supply	7/22	23		^{3}H	Lost Sample	
				^{89}Sr	<1	<0.05
				^{90}Sr	<0.9	<0.3
				^{234}U	0.027	<0.01
				^{235}U	<0.007	<0.01
				^{238}U	0.029	<0.01
				^{238}Pu	<0.04	<0.01
				^{239}Pu	<0.04	<0.01
	10/17	23		^{3}H	35	<0.01
Lumberton, MS North Lumberton City Supply	7/21	23		^{3}H	<7	<0.01
				^{89}Sr	<2	<0.05
				^{90}Sr	<1	<0.3
				^{234}U	<0.02	<0.01
				^{235}U	<0.01	<0.01
				^{238}U	0.018	<0.01
				^{238}Pu	<0.03	<0.01
				^{239}Pu	<0.02	<0.01
	10/17	23		^{3}H	<7	<0.01
Baxterville, MS Pond W of GZ	7/02	21		^{3}H	Lost Sample	

Table 11. (continued)

Sampling Location	Date	Sample Type[c]	Depth (Metres[a])	Radio-nuclide	Radioactivity Conc. (10^{-9} µCi/ml)	% of Conc. Guide
Baxterville, MS Pond W of GZ (continued)	7/22	21		^{3}H	120	<0.01
				^{89}Sr	<1	<0.05
				^{90}Sr	<0.8	<0.3
				^{234}U	0.023	<0.01
				^{235}U	<0.01	<0.01
				^{238}U	0.019	<0.01
				^{238}Pu	<0.04	<0.01
				^{239}Pu	<0.03	<0.01
	10/19	21		^{3}H	61	<0.01
PROJECT GASBUGGY						
Gobernador, NM Arnold Ranch	5/25	27		^{3}H	<10	<0.01
				^{89}Sr	<2	<0.07
				^{90}Sr	<0.9	<0.3
				^{234}U	2.3	<0.01
				^{235}U	0.052	<0.01
				^{238}U	1.0	<0.01
				^{238}Pu	<0.2	<0.01
				^{239}Pu	<0.1	<0.01
Gobernador, NM Lower Burro Canyon	5/25	23		^{3}H	<8	<0.01
				^{89}Sr	<2	<0.07
				^{90}Sr	<1	<0.3
				^{234}U	0.12	<0.01
				^{235}U	<0.01	<0.01
				^{238}U	<0.01	<0.01
				^{238}Pu	<0.1	<0.01
				^{239}Pu	<0.06	<0.01
Gobernador, NM Fred Bixler Ranch	5/24	23		^{3}H	13	<0.01
				^{89}Sr	<2	<0.06
				^{90}Sr	<0.9	<0.3
				^{234}U	0.27	<0.01
				^{235}U	<0.02	<0.01
				^{238}U	0.055	<0.01
				^{238}Pu	<0.04	<0.01
				^{239}Pu	<0.03	<0.01

Table 11. (continued)

Sampling Location	Date	Sample Type[c]	Depth (Metres[a])	Radio-nuclide	Radioactivity Conc. (10^{-9} uCi/ml)	% of Conc. Guide
Blanco, NM San Juan River	5/26	22		^{3}H	510	0.02
				^{89}Sr	<2	<0.08
				^{90}Sr	1.9	0.6
				^{234}U	0.50	0.02
				^{235}U	0.018	<0.01
				^{238}U	0.30	<0.01
				^{238}Pu	<0.03	<0.01
				^{239}Pu	<0.04	<0.01
Gobernador, NM Cave Springs	5/25	27		^{3}H	9.3	<0.01
				^{89}Sr	<1	<0.04
				^{90}Sr	<0.9	<0.3
				^{226}Ra	0.16	0.5
				^{234}U	3.1	0.01
				^{235}U	0.13	<0.01
				^{238}U	2.0	<0.01
				^{238}Pu	<0.03	<0.01
				^{239}Pu	<0.05	<0.01
Gobernador, NM Windmill No. 2	5/24	23		^{3}H	8	<0.01
				^{89}Sr	<2	<0.06
				^{90}Sr	<0.9	<0.3
				^{234}U	0.38	<0.01
				^{235}U	<0.009	<0.01
				^{238}U	0.14	<0.01
				^{238}Pu	<0.2	<0.01
				^{239}Pu	<0.2	<0.01
Gobernador, NM Bubbling Springs	5/24	27		^{3}H	<10	<0.01
				^{89}Sr	<2	<0.06
				^{90}Sr	<0.9	<0.3
				^{226}Ra	0.75	0.3
				^{234}U	3.1	0.01
				^{235}U	0.065	<0.01
				^{238}U	1.6	<0.01
				^{238}Pu	<0.03	<0.01
				^{239}Pu	<0.02	<0.01

Table 11. (continued)

Sampling Location	Date	Sample Type[c]	Depth (Metres[a])	Radionuclide	Radioactivity Conc. (10^{-9} µCi/ml)	% of Conc. Guide
Dulce, NM City Water	5/24	21		^{3}H	260	<0.01
				^{89}Sr	<1	<0.04
				^{90}Sr	<0.8	<0.3
				^{234}U	0.28	<0.01
				^{235}U	<0.01	<0.01
				^{238}U	0.15	<0.01
				^{238}Pu	<0.03	<0.01
				^{239}Pu	<0.02	<0.01
Dulce, NM La Jara Lake	5/24	21		^{3}H	280	<0.01
				^{89}Sr	<2	<0.06
				^{90}Sr	<0.9	<0.3
				^{234}U	0.91	<0.01
				^{235}U	0.03	<0.01
				^{238}U	0.59	<0.01
				^{238}Pu	<0.09	<0.01
				^{239}Pu	<0.05	<0.01
Gobernador, NM EPNG Well 10-36	5/26	23	1097	^{3}H	13	<0.01
				^{89}Sr	<0.9	<0.03
				^{90}Sr	<0.8	<0.3
				^{226}Ra	0.25	0.8
				^{234}U	0.042	<0.01
				^{235}U	<0.007	<0.01
				^{238}U	0.027	<0.01
				^{238}Pu	<2	<0.05
				^{239}Pu	<6	<0.1
PROJECT RULISON						
Rulison, CO Lee L. Hayward Ranch	5/21	23		^{3}H	350	0.01
				^{89}Sr	<2	<0.06
				^{90}Sr	<0.8	<0.3
				^{226}Ra	<0.05	<0.2
				^{234}U	8.1	0.03
				^{235}U	0.14	<0.01
				^{238}U	3.9	<0.01
				^{238}Pu	<0.04	<0.01
				^{239}Pu	<0.03	<0.01

Table 11. (continued)

Sampling Location	Date	Sample Type[c]	Depth (Metres[a])	Radio-nuclide	Radioactivity Conc. (10^{-9} µCi/ml)	% of Conc. Guide
Rulison, CO	5/22	23		^{3}H	380	0.01
Glen Schwab				^{89}Sr	<2	<0.08
Ranch				^{90}Sr	<1	<0.4
				^{226}Ra	0.13	0.4
				^{234}U	12	0.04
				^{235}U	0.25	<0.01
				^{238}U	6	0.02
				^{238}Pu	<0.03	<0.01
				^{239}Pu	<0.02	<0.01
Grand Valley, CO	5/21	23		^{3}H	510	0.02
Albert Gardner				^{89}Sr	<2	<0.07
Ranch				^{90}Sr	<1	<0.3
				^{234}U	2.4	<0.01
				^{235}U	0.056	<0.01
				^{238}U	1.1	<0.01
				^{238}Pu	<0.03	<0.01
				^{239}Pu	<0.02	<0.01
Grand Valley, CO	5/22	27		^{3}H	130	<0.01
City Water				^{89}Sr	<2	<0.07
Supply				^{90}Sr	<1	<0.3
				^{234}U	2.5	<0.01
				^{235}U	0.059	<0.01
				^{238}U	0.92	<0.01
				^{238}Pu	<0.03	<0.01
				^{239}Pu	<0.04	<0.01
Grand Valley, CO	5/21	27		^{3}H	480	0.02
Spring 300 Yds.				^{89}Sr	<2	<0.05
NW of GZ				^{90}Sr	<0.9	<0.3
				^{234}U	1.3	<0.01
				^{235}U	0.037	<0.01
				^{238}U	0.66	<0.01
				^{238}Pu	<0.03	<0.01
				^{239}Pu	<0.04	<0.01

Table 11. (continued)

Sampling Location	Date	Sample Type[c]	Depth (Metres[a])	Radionuclide	Radioactivity Conc. (10^{-9} µCi/ml)	% of Conc. Guide
Rulison, CO Felix Sefcovic Ranch	5/22	23		^{3}H	580	0.02
				^{89}Sr	<2	<0.06
				^{90}Sr	<0.8	<0.3
				^{234}U	0.49	<0.01
				^{235}U	0.017	<0.01
				^{238}U	0.26	<0.01
				^{238}Pu	<0.04	<0.01
				^{239}Pu	<0.03	<0.01
Anvil Points, CO Bernklau Ranch	5/21	27		^{3}H	510	0.02
				^{89}Sr	<1	<0.04
				^{90}Sr	<0.8	<0.3
				^{234}U	2.4	<0.01
				^{235}U	0.039	<0.01
				^{238}U	1.0	<0.01
				^{238}Pu	<0.03	<0.01
				^{239}Pu	<0.02	<0.01
Grand Valley, CO Battlement Creek	5/21	22		^{3}H	300	0.01
				^{89}Sr	<2	<0.05
				^{90}Sr	<1	<0.4
				^{234}U	0.36	<0.01
				^{235}U	0.024	<0.01
				^{238}U	0.18	<0.01
				^{238}Pu	<0.02	<0.01
				^{239}Pu	<0.02	<0.01
Grand Valley, CO CER Well	5/22	23	13.6	^{3}H	540	0.02
				^{89}Sr	<2	<0.07
				^{90}Sr	<1	<0.3
				^{234}U	0.24	<0.01
				^{235}U	<0.009	<0.01
				^{238}U	0.18	<0.01
				^{238}Pu	<0.04	<0.01
				^{239}Pu	<0.02	<0.01
Rulison, CO Potter Ranch	5/21	27		^{3}H	420	0.01
				^{89}Sr	<2	<0.07
				^{90}Sr	<1	<0.3
				^{226}Ra	0.089	0.3
				^{234}U	4.7	0.02
				^{235}U	0.13	<0.01
				^{238}U	3.1	<0.01
				^{238}Pu	<0.04	<0.01
				^{239}Pu	<0.02	<0.01

Table 11. (continued)

Sampling Location	Date	Sample Type[c]	Depth (Metres[a])	Radio-nuclide	Radioactivity Conc. (10^{-9} µCi/ml)	% of Conc. Guide
			FAULTLESS EVENT			
Blue Jay, NV Highway Maint. Station	3/11	23		^{3}H	<8	<0.01
				^{89}Sr	<2	<0.07
				^{90}Sr	<1	<0.4
				^{234}U	3.3	0.01
				^{235}U	0.07	<0.01
				^{238}U	1.3	<0.01
				^{238}Pu	<0.03	<0.01
				^{239}Pu	<0.04	<0.01
Warm Springs, NV Hot Creek Ranch	3/11	27		^{3}H	26	<0.01
				^{89}Sr	<2	<0.07
				^{90}Sr	<1	<0.4
				^{234}U	1.8	<0.01
				^{235}U	0.035	<0.01
				^{238}U	1.1	<0.01
				^{238}Pu	<0.02	<0.01
				^{239}Pu	<0.02	<0.01
Blue Jay, NV Blue Jay Spring	3/11	27		^{3}H	11	<0.01
				^{89}Sr	<1	<0.03
				^{90}Sr	<1	<0.3
				^{234}U	3.9	0.01
				^{235}U	0.073	<0.01
				^{238}U	2.1	<0.01
				^{238}Pu	<0.03	<0.01
				^{239}Pu	<0.05	<0.01
Blue Jay, NV Sixmile Well	3/11	23		^{3}H	<8	<0.01
				^{89}Sr	<2	<0.05
				^{90}Sr	<0.9	<0.3
				^{234}U	1.9	<0.01
				^{235}U	0.019	<0.01
				^{238}U	0.74	<0.01
				^{238}Pu	<0.02	<0.01
				^{239}Pu	<0.02	<0.01

Table 11. (continued)

Sampling Location	Date	Sample Type[c]	Depth (Metres[a])	Radio-nuclide	Radioactivity Conc. (10^{-9} µCi/ml)	% of Conc. Guide
Well HTH-1	3/12	23	259	^{3}H	<7	<0.01
				^{89}Sr	<2	<0.08
				^{90}Sr	<1	<0.4
				^{234}U	1.7	<0.01
				^{235}U	0.059	<0.01
				^{238}U	1.0	<0.01
				^{238}Pu	<0.05	<0.01
				^{239}Pu	<0.03	<0.01
	8/14	23	259	^{3}H	<7	<0.01
Well HTH-2	3/12	23	184	^{3}H	<8	<0.01
				^{89}Sr	<2	<0.05
				^{90}Sr	<0.7	<0.2
				^{234}U	2.5	<0.01
				^{235}U	<0.02	<0.01
				^{238}U	0.75	<0.01
				^{238}Pu	<0.04	<0.01
				^{239}Pu	<0.03	<0.01
	8/14	23	184	^{3}H	<8	<0.01

[a] If depth not shown, water was collected at surface.

[b] Sample collected from tap in Malaga. Water originates from Loving City Well No. 2.

[c] 21 - Pond, Lake, Reservoir, Stock Tank, Stock Pond
22 - Stream, River, Creek
23 - Well
27 - Spring

APPENDIX A. RADIATION PROTECTION STANDARDS FOR EXTERNAL AND INTERNAL EXPOSURE*

ANNUAL DOSE COMMITMENT

Type of Exposure	Dose Limit to Critical Individuals in Uncontrolled Area at Points of Maximum Probable Exposure (rem)	Dose Limit to Suitable Sample of the Exposed Population in an Uncontrolled Area (rem)
Whole Body, gonads or bone marrow	0.5	0.17
Other organs	1.5	0.5

CONCENTRATION GUIDES (CG's)

Network or Program	Sampling Medium	Radionuclide	CG (μCi/ml)	Basis of Exposure
Air Surveillance Network	air	^{7}Be	$1.1x10^{-8}$	Suitable sample of the exposed population in uncontrolled area.
		^{95}Zr	$3.3x10^{-10}$	
		^{103}Ru	$1.0x10^{-9}$	
		^{106}Ru	$6.7x10^{-11}$	
		^{140}Ba	$3.3x10^{-10}$	
		^{141}Ce	$1.7x10^{-9}$	
		^{144}Ce	$6.7x10^{-11}$	
Noble Gas and Tritium Surveillance Network, On-NTS	air	^{85}Kr	$1.0x10^{-5}$	Individual in controlled area.
		^{3}H	$5.0x10^{-6}$	
		^{133}Xe	$1.0x10^{-5}$	
Noble Gas and Tritium Surveillance Network, Off-NTS	air	^{85}Kr	$1.0x10^{-7}$	Suitable sample of the exposed population in uncontrolled area.
		^{3}H	$6.7x10^{-8}$	
		^{133}Xe	$1.0x10^{-7}$	
Water Surveillance Network	water	^{3}H	$1.0x10^{-3}$	Suitable sample of the exposed population in an uncontrolled area.
		^{89}Sr	$1.0x10^{-6}$	
		^{90}Sr	$1.0x10^{-7}$	
		^{238}Pu	$1.7x10^{-6}$	
		^{239}Pu	$1.7x10^{-6}$	
		^{226}Ra	$1.0x10^{-8}$	

*"Radiation Protection Standards," ERDA Manual, Chapter 0524.

CONCENTRATION GUIDES (CG's) continued

Network or program	Sampling Medium	Radio-nuclide	CG (μCi/ml)	Basis of Exposure
Long-Term Hydrological Program	water	^{3}H	3.0×10^{-3}	Individual in uncontrolled area.
		^{89}Sr	3.0×10^{-6}	
		^{90}Sr	3.0×10^{-7}	
		^{238}Pu	5.0×10^{-6}	
		^{239}Pu	5.0×10^{-6}	
		^{234}U	3.0×10^{-5}	
		^{235}U	3.0×10^{-5}	
		^{238}U	4.0×10^{-5}	
		^{226}Ra	3.0×10^{-8}	
		^{137}Cs	2.0×10^{-5}	
		^{3}H	1.0×10^{-1}	Individual in controlled area.
		^{89}Sr	3.0×10^{-4}	
		^{90}Sr	1.0×10^{-5}	
		^{238}Pu	1.0×10^{-4}	
		^{239}Pu	1.0×10^{-4}	
		^{234}U	9.0×10^{-4}	
		^{235}U	8.0×10^{-4}	
		^{238}U	1.0×10^{-3}	
		^{226}Ra	4.0×10^{-7}	

APPENDIX B. DOSE ASSESSMENT CALCULATIONS

METHOD

The radionuclides detected in off-NTS air samples and attributed to NTS operations were ^{133}Xe, ^{85}Kr, and ^{3}H. Based upon the time-integrated concentrations of ^{133}Xe and ^{3}H at each location where the nuclide(s) were detected, whole-body dose estimates were calculated from the following equations.

D.E. = $0.25\ E\psi$*, where D.E. is the whole-body dose equivalent resulting from exposure to airborne ^{133}Xe, rem;

E is the effective energy of the radiations released per disintegration of ^{133}Xe, 0.19 MeV/dis;

ψ is the time-integrated concentration of ^{133}Xe, $Ci \cdot sec/m^3$.

D.E. = $0.47\ E\chi$**, where D.E. is the whole-body dose equivalent resulting from exposure to airborne ^{3}H, rem;

E is the effective energy released per disintegration of ^{3}H, 0.010 MeV/ dis;

χ is the time-integrated concentration of ^{3}H in air, $\mu Ci \cdot d/m^3$.

The 80-km, man-rem dose was calculated from the product of these dose equivalents and the population at each sampling location.

Since the gamma radiation per disintegration of ^{85}Kr is negligible (0.514 MeV, 0.41 percent abundance) the major hazard from this nuclide is beta radiation to the skin of the total body. Skin dose equivalents were calculated from the time-integrated concentration of ^{85}Kr at each sampling location where ^{85}Kr was detected and the same equation for ^{133}Xe, except an effective energy of 0.24 MeV/dis was used instead of the 0.19 MeV/dis which was for ^{133}Xe.

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* "Meteorology and Atomic Energy," U.S. Atomic Energy Commission, Division of Technical Information, Oak Ridge, Tennessee. p 339. July 1968

** Based upon the assumptions of "Report of Committee IV on Evaluation of Radiation Doses to Body Tissues from Internal Contamination Due to Occupational Exposures." Recommendation of the International Committee on Radiological Protection, ICRP Publication 10. Pergamon Press, New York. pp 29-30. 1968

RESULTS

The results of the whole-body dose calculations are summarized, as follows:

Location	Radio-nuclide	Time-Integrated Concentration ($\mu Ci\text{-}s/m^3$)	Whole-Body Dose (μrem)	Population	Dose Commitment Within 80 km (man-rem)
Beatty	^{3}H	2.7	0.15	500	0.000075
Diablo	^{3}H	8.6	0.46	5	0*
	^{133}Xe	34	1.6		0*
Hiko	^{133}Xe	20	0.97	52	0.000570*
Indian Springs	^{133}Xe	7.2	0.34	1670	0.00057
Las Vegas	^{133}Xe	6.6	0.32	194,000	0*
				Total	0.00065

* Diablo, Hiko, and Las Vegas are beyond 80 km. Dose commitments at these locations were calculated as 0.000010 man-rem, 0.000050 man-rem, and 0.062 man-rem, respectively.

Although the total body skin dose equivalents calculated from the ^{85}Kr concentrations are not appropriate for inclusion with the 80-km dose commitment estimates, the results of this calculation are summarized as follows for comparison to the Radiation Protection Standard of 0.5 rem/y for exposures to the skin at a suitable sample of the population.

Location	Time-Integrated Concentration of ^{85}Kr ($\mu Ci\text{-}s/m^3$)	Total Body Skin Dose (μrem)	Percent of Radiation Protection Standard
Beatty	4.8	0.29	$6x10^{-5}$
Diablo	12	0.72	$1x10^{-4}$
Indian Springs	15	0.87	$2x10^{-4}$
Las Vegas	15	0.90	$2x10^{-4}$

If one used the conservative assumption of the ERDA Manual, Chapter 0524, that exposure to airborne ^{85}Kr results in a whole-body gamma exposure, the doses at Beatty, Diablo, Indian Springs, and Las Vegas would be increased by the doses above. This would result in a 80-km dose commitment of 0.0022 man-rem, a factor of 3.4 times the first estimate, and dose commitments at Diablo and Las Vegas of 0.000014 man-rem and 0.22 man-rem, respectively.

APPENDIX C. LIST OF ABBREVIATIONS AND SYMBOLS

μrem	Micro-roentgen-equivalent-man.
μCi/g	Microcurie per gram.
μCi/ml	Microcurie per millilitre.
AEC	Atomic Energy Commission.
ASN	Air Surveillance Network.
C	Temperature in Celsius.
CG	Concentration Guide.
Ci	Curie.
cm	Centimetre.
CP-1	Control Point One.
CY	Calendar year.
D.E.	Dose Equivalent.
EMSL-LV	Environmental Monitoring and Support Laboratory-Las Vegas.
EPA	Environmental Protection Agency.
ERDA	Energy Research and Development Administration.
ERDA/NV	Energy Research and Development Administration/Nevada Operations Office.
ft	Feet.
kg	Kilogram.
kt	Kiloton.
LLL	Lawrence Livermore Laboratory
m	Metre.
MDC	Minimum detectable concentration.
mrem/y	Milli-roentgen-equivalent-man per year.
mrem/d	Milli-roentgen-equivalent-man per day.

mR	Milli-roentgen.
mR/h	Milli-roentgen per hour.
MSL	Mean sea level.
MSN	Milk Surveillance Network.
nCi	Nanocurie.
NTS	Nevada Test Site.
PHS	Public Health Service.
SMSN	Standby Milk Surveillance Network.
TLD	Thermoluminescent dosimeter.
USGS	United States Geological Society.
WSN	Water Surveillance Network.
^{3}H	Tritium or Hydrogen-3.
HT	Tritiated Hydrogen.
HTO	Tritiated Water.
CH_3T	Tritiated Methane.
Ba	Barium.
Cs	Cesium.
K	Potassium.
Kr	Krypton.
Pu	Plutonium.
Ra	Radium.
Sr	Strontium.
U	Uranium.
Xe	Xenon.

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