NVO-269-31

Environmental
and Earth Sciences

AMCHITKA RADIOBIOLOGICAL PROGRAM PROGRESS REPORT JANUARY 1976 TO DECEMBER 1976

By

Victor A. Nelson and Allyn H. Seymour

MAY 1977

University of Washington
College of Fisheries
Laboratory of Radiation Ecology
Seattle, Washington 98195

Prepared for the U. S. Energy Research & Development Administration
Nevada Operations Office under Contract No. EY-76-S-08-0269

DISCLAIMER

ABSTRACT

Begun in 1970, the Amchitka Radiobiological Program is a continuing program to collect biological and environmental samples for radiometric analyses. An account of the program from July, 1970, to December, 1975, has been given in six previous progress reports from the Laboratory of Radiation Ecology to the Nevada Operations Office of the U. S. Energy Research and Development Administration. This report is an account of the program for calendar year 1976.

Results of analyses for samples collected in August, 1976, have been added to the tables in Nelson and Seymour (1976) that summarize the results of analyses of samples collected from 1970 to 1976, and include analyses for: (1) gamma-emitting radionuclides in air filters, freshwater, birds, lichens, marine algae, marine invertebrates, fish, aufwuchs, and freshwater moss and plants; (2) strontium-90 (^{90}Sr) in rats, birds, and soil; (3) $^{239,240}Pu$ in sand, soil, marine algae and fish; and (4) tritium (^{3}H) in seawater, freshwater, and biological organisms. Monitoring of background radiation with survey instruments was added to the Laboratory's program in 1974, and the results of the 1974, 1975, and 1976 surveys are included in this report.

Conclusions from the results of the recent analyses are a reiteration of the results stated in Nelson and Seymour (1975); namely, "(1) no new radionuclides are present; (2) the most abundant radionuclides are naturally occurring beryllium-7 [^{7}Be] and potassium-40 [^{40}K]; (3) the trace quantities of fission products and induced radionuclides are from world fallout; and (4) a trace of ^{3}H contamination remains in some Long Shot ponds, as previously reported." It is concluded from the results of analyses of samples collected between September, 1969, and August, 1976, as reported in this and the six previous progress reports, that there were no radionuclides of Milrow or Cannikin origin in the water, plants, or animals of Amchitka Island.

TABLE OF CONTENTS

FIGURES

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

TABLES

1. INTRODUCTION

The present Amchitka radiobiological program began in 1970 but was preceded by the Long Shot radiobiological program in 1965. A relevant description of the present program is given in the 1972 Progress Report (Held et al., 1973), and selected portions from that report follow.

> "The present Amchitka Radiobiological Program was initiated in July, 1970, by the University of Washington's Laboratory of Radiation Ecology at the request of the U.S. Atomic Energy Commission, Nevada Operations Office. The program is designed to provide a periodic documentation of radionuclides, both naturally occurring and man-made, in biological and environmental samples from Amchitka and its environs. Seafoods and radionuclides potentially available to man through the food web are emphasized. However, organisms other than food organisms are also collected and analyzed. These indicator organisms are species that significantly concentrate one or more radionuclides. Concentrations of radionuclides other than those potentially hazardous to man are measured as a means of providing clues to the origin of radionuclides at Amchitka. Unexpected combinations or concentrations of radionuclides would indicate the presence of newly added radionuclides to the environment, presumably from fresh fallout, nuclear-powered vessels, or from nuclear detonations at Amchitka Island."

The first two Amchitka Radiobiological Program Progress Reports covered the period July 1970 to February 1972. These reports have been summarized by Held (1972), who concluded, "Artificial or man-made radionuclides (found at Amchitka) did not originate at Amchitka except for tritium, which has previously been reported to be present in pond water and test holes near the Long Shot SGZ site."

The third to sixth progress reports reiterated the above conclusion and extended the account of the program through August, 1975. Major conclusions of the sixth report, as stated by Nelson and Seymour (1976) are as follows:

> "a. Some of the ponds in the immediate vicinity of the Long Shot Surface Ground Zero remain contaminated with ^{3}H.
>
> "b. An extensive search with sensitive instruments for radionuclides in biological and environmental samples-marine, terrestrial, freshwater--collected during the first 45 months after the Cannikin detonation of November 6, 1971, indicates that no radionuclides from the Cannikin or Milrow events have escaped to the surface environment."

In this, the seventh progress report, the format is the same as for the sixth progress report except that new data from the analyses of the samples collected in August, 1976, were added to the appropriate tables of the previous report. Figure 1 of this progress report shows the geographical location of Amchitka Island. Figure 2 shows general collection sites for the radiobiological program, while Figures 3 through 6 present the specific collection sites for the shaded areas shown in Figure 2.

2. METHODS

Most samples collected prior to July, 1972, and fish, marine invertebrates, and birds collected through 1976 were analyzed by gamma spectrometry with systems using 3x3 inch NaI (Tl) crystals and 200-channel, pulse-height analyzers. Samples (except fish, marine invertebrates, and birds as noted above) collected since July, 1972, have been analyzed with systems using Ge(Li) diode detectors and 4096-channel, pulse-height analyzers. To determine the ^{90}Sr content of selected samples, ^{90}Y was chemically separated from ^{90}Sr, collected on filter paper and counted with a low-level beta counting system. Plutonium was extracted by ion exchange, electroplated on platinum discs, and analyzed by alpha spectrometry with systems using surface barrier alpha detectors and pulse-height analyzers. Chemical yield was determined by use of ^{242}Pu as a tracer. Tritium in seawater and freshwater samples was determined by vacuum distillation of the samples and liquid scintillation counting of the distillate, as discussed in Held et al.(1973); free and bound ^{3}H in water samples from fish, ptarmigan, and aquatic plant samples was determined by azeotropic distillation and liquid scintillation counting. A discussion of the procedure for processing biological samples for analysis of ^{3}H in bound water was given in Nelson and Seymour (1975a and 1976).

Freshwater samples (50 liters or more) for analyses of radionuclides other than ^{3}H were collected from four lakes or ponds. The water was evaporated and the residue counted for gamma-emitting radionuclides.

All data presented in the tables have been corrected to the date of collection; this correction will introduce little or no error in the calculated values except for ^{95}Nb if the ^{95}Zr in the sample was produced at various unknown times and is not in equilibrium with its daughter, ^{95}Nb. In this case, an accurate decay correction factor cannot be made for ^{95}Nb, and the application of the standard decay correction factor for ^{95}Zr to the amount of ^{95}Nb present at the time of counting gives an estimate of the maximum possible amount of ^{95}NB present at the time of collection. The problems of ^{95}Zr-^{95}Nb analysis have been discussed in Held *et al.* (1973).

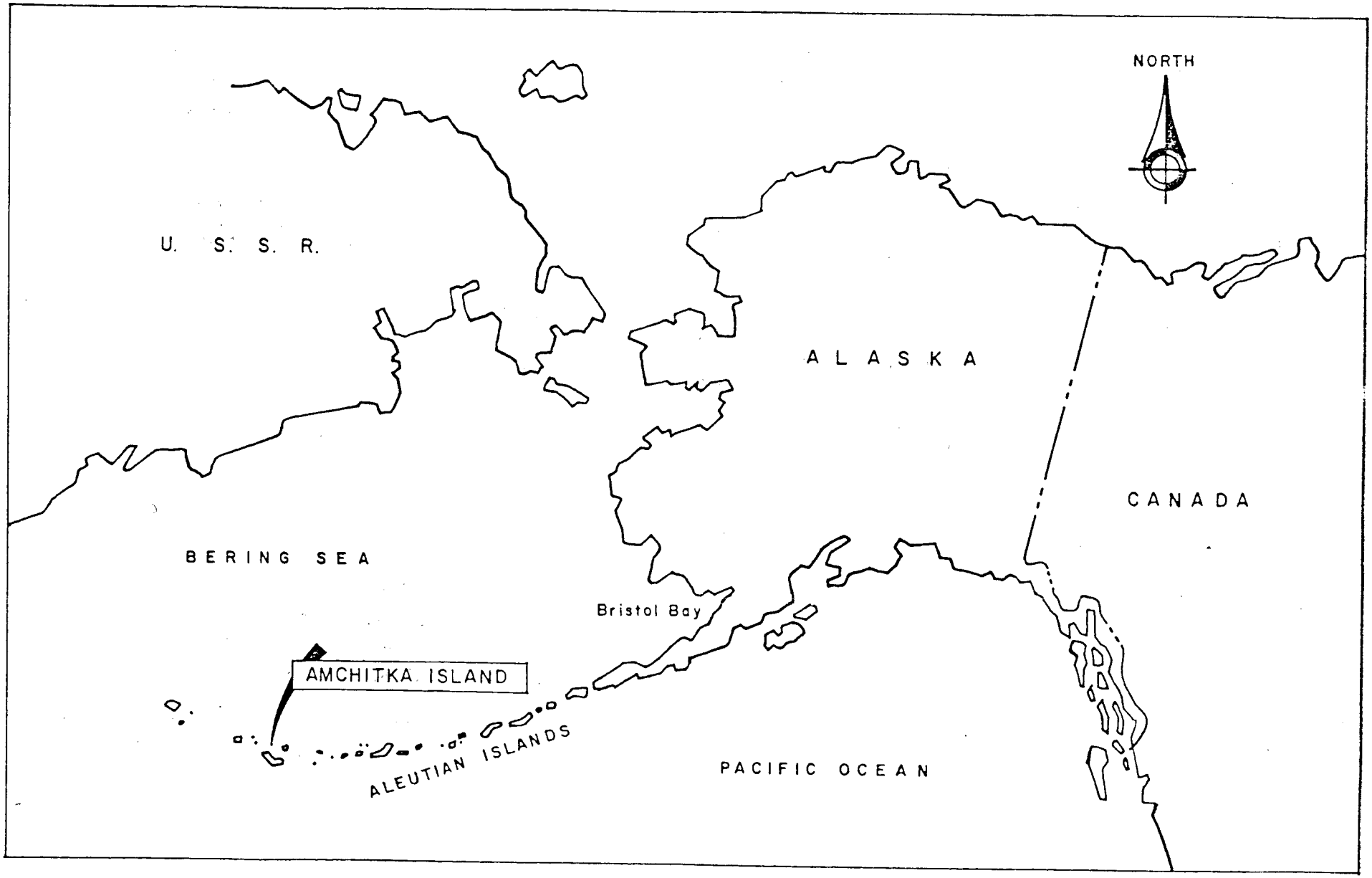

FIGURE 1. Location Map

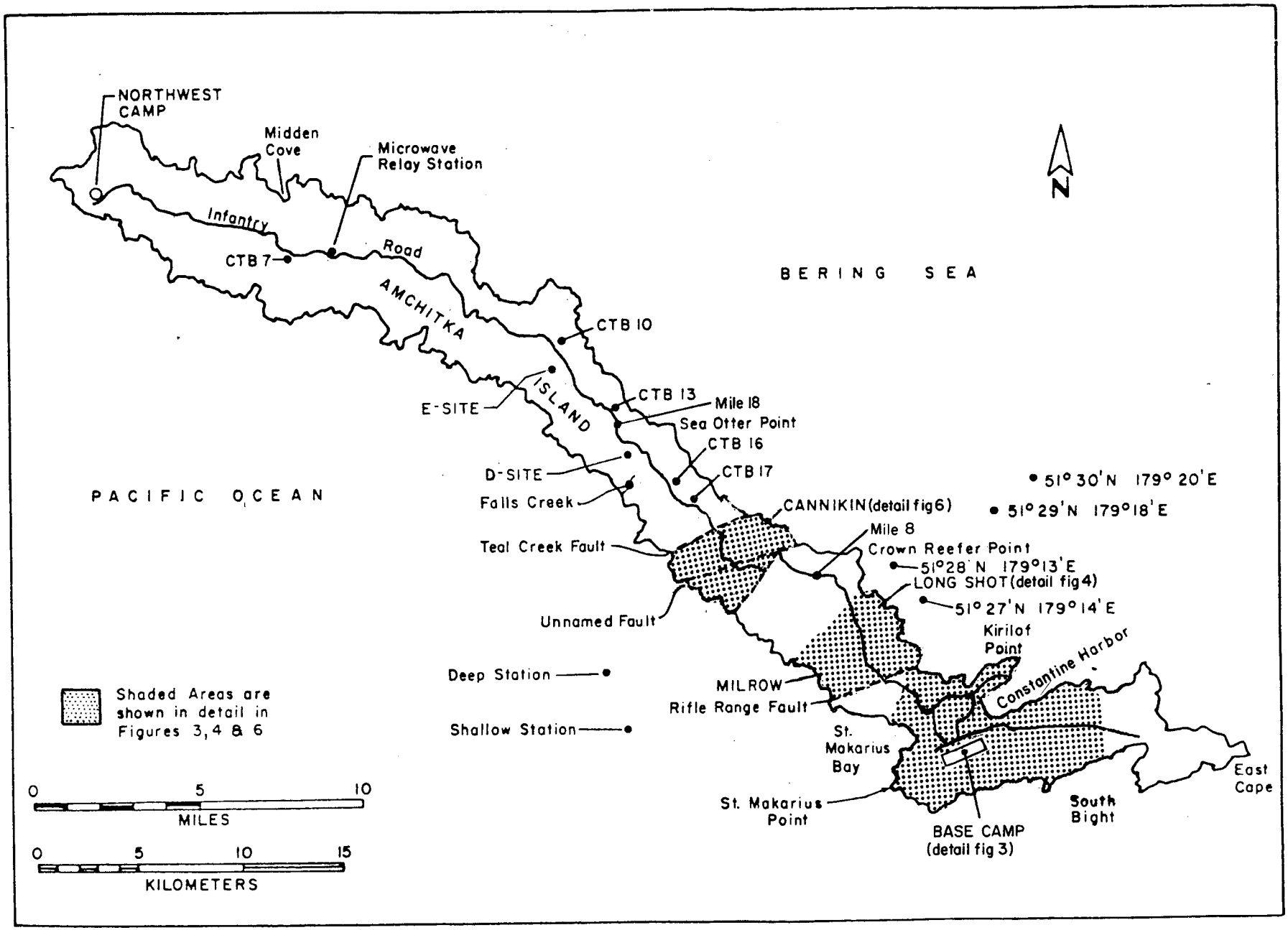

FIGURE 2. Location of Collection Sites on and near Amchitka Island, Alaska

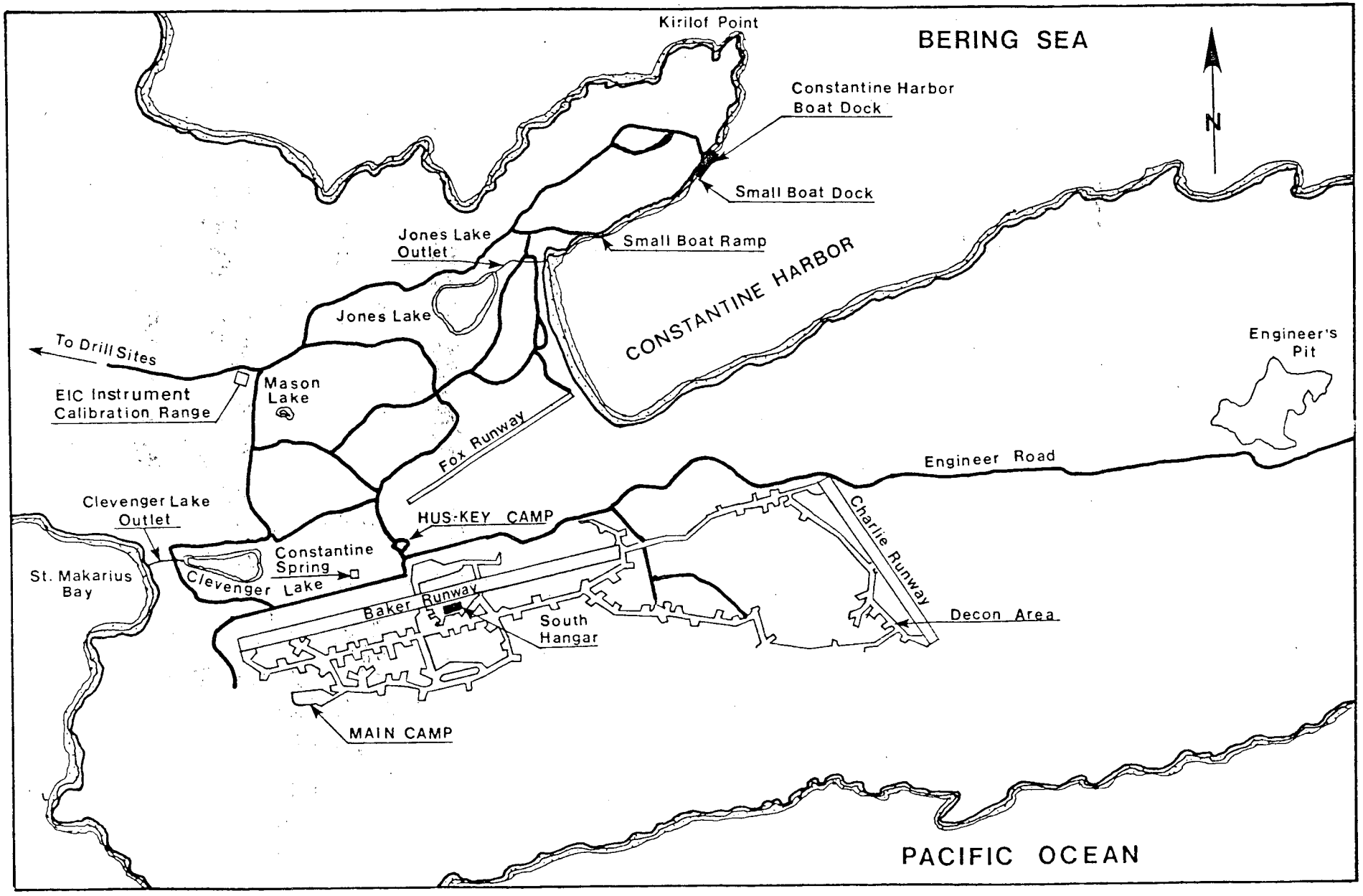

FIGURE 3. Collection Sites and Other Prominent Features in the Amchitka Island Base Camp Area

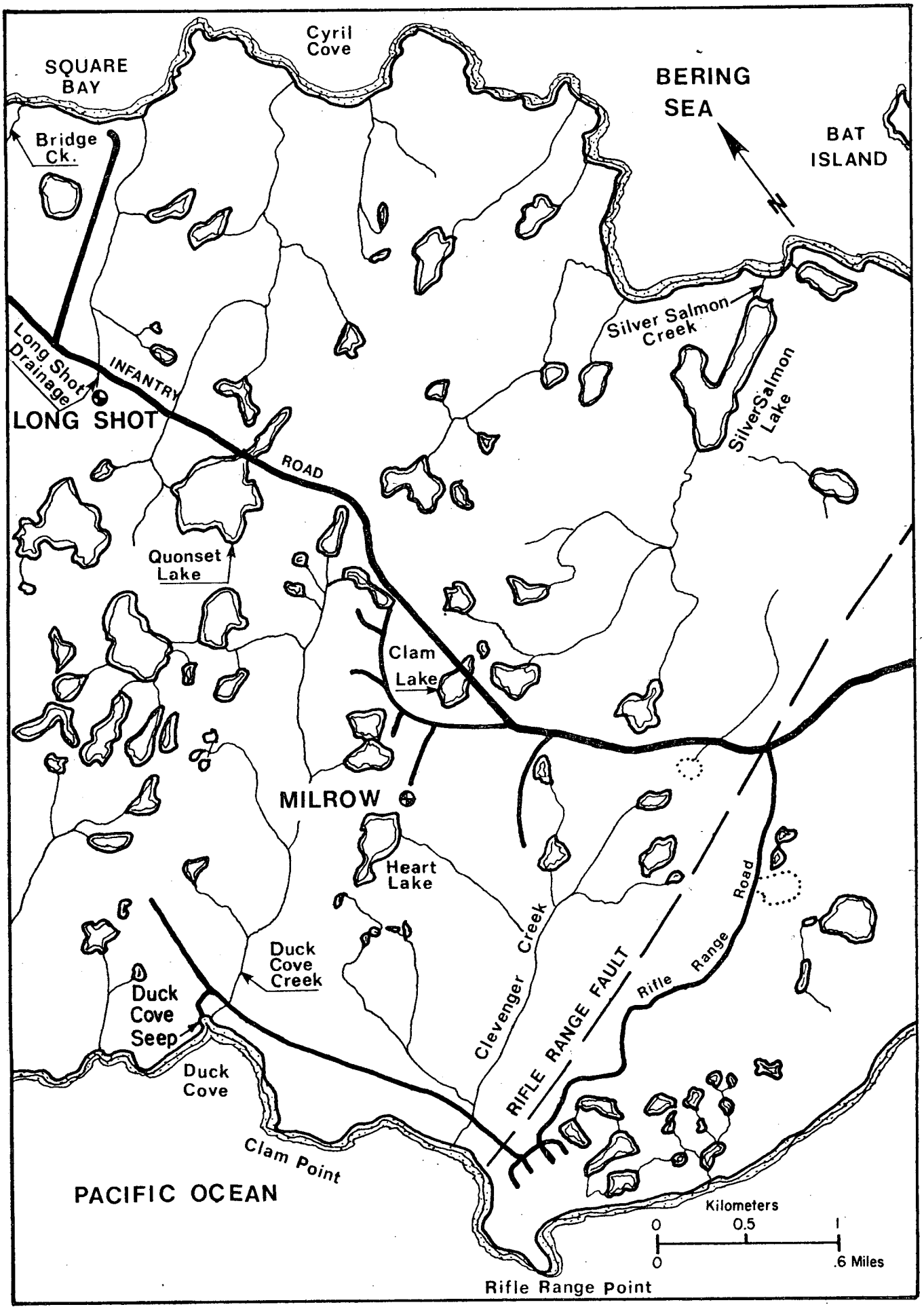

FIGURE 4. Collection Sites and Other Prominent Features in the Milrow Area.

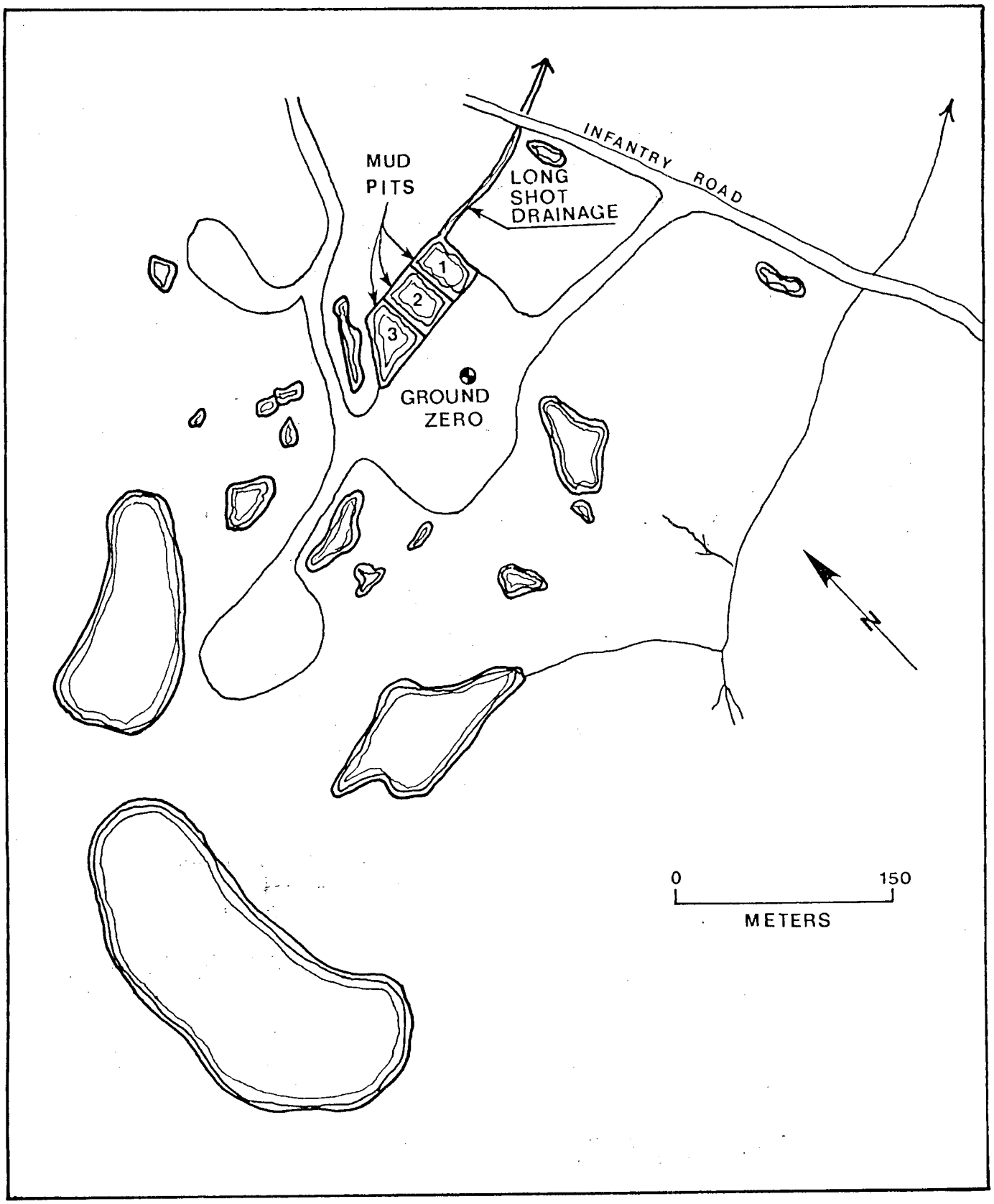

FIGURE 5. Collection Sites and Other Prominent Features in the Long Shot Ground Zero Vicinity.

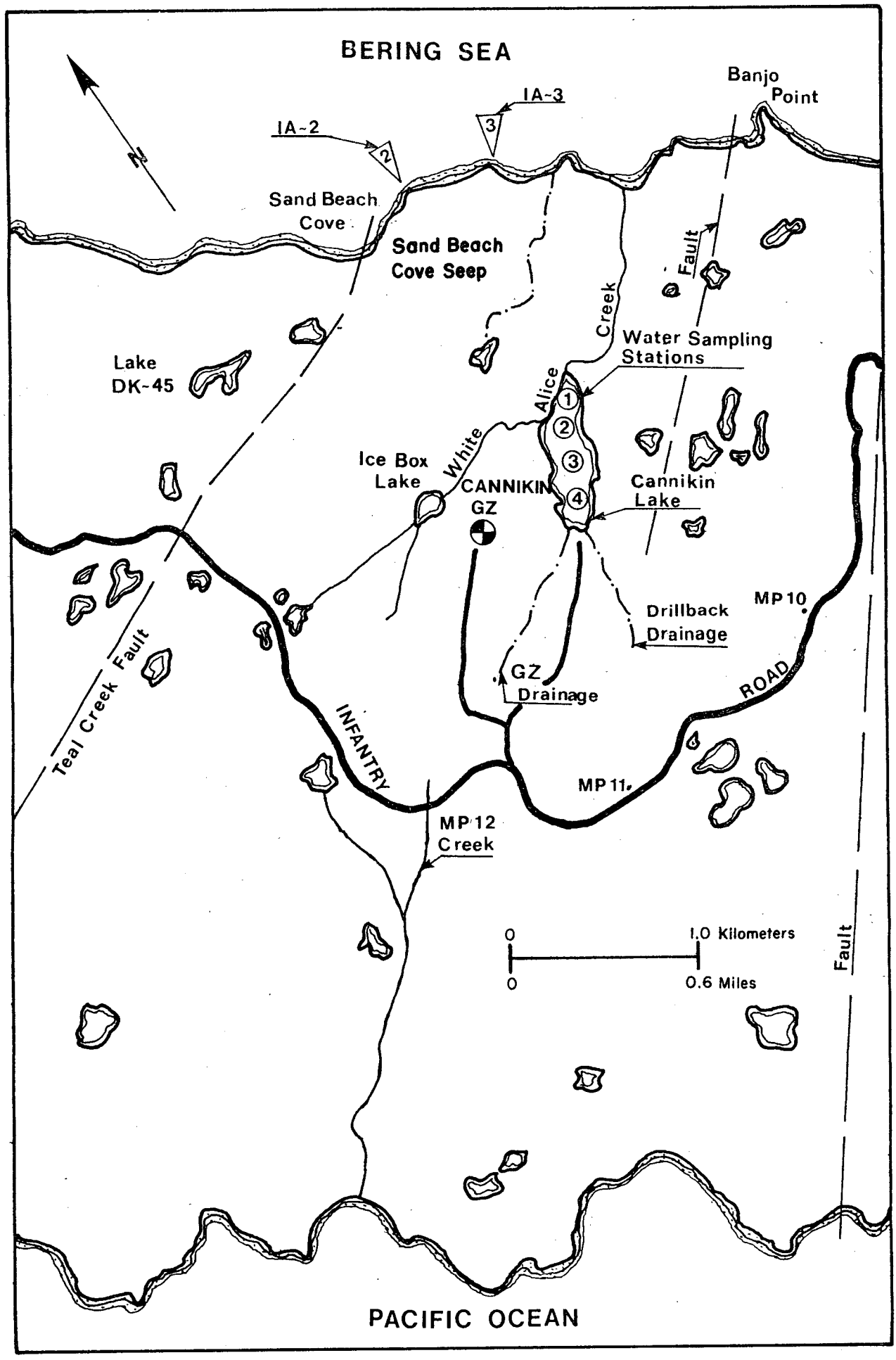

FIGURE 6. Collection Sites and Other Prominent Features in the Cannikin Area

The error term in radionuclide concentration values for single samples is the combined counting error for the background, standard, and sample: hence, the term "propagated error." The error limits for the gamma-emitting radionuclides in single samples are "two-sigma" or two-standard deviation counting errors, while for the ^{3}H data, error limits are one-standard deviation counting errors. Errors for ^{90}Sr in single samples analyzed before 1976 are one-sigma counting errors, while errors for the 1976 ^{90}Sr analyses and all Pu analyses are two-sigma counting errors plus an analytical error which is the standard deviation of the blank value subtracted from the gross amount of ^{90}Sr or Pu. The error term for the mean of more than one sample is one-standard deviation of the mean.

Limits of detection are important since they govern the amount of a radionuclide that can be detected if it is present in a sample. Many factors influence the limit of detection, including the type of detector and analyzer, the presence of other radionuclides, the duration of the counting period, the size and density of the sample, and the geometry relationship of the sample and detector. Hence, the actual limits of detection can vary considerably for various radionuclides and types of samples, but can be summarized by stating that the detection limits were approximately as follows:

By gamma detection	
^{40}K	2.1 pCi/g or less
$^{7}Be, ^{103}Ru, ^{106}Ru, ^{144}Ce, ^{228}Th, ^{238}U$	0.41 " "
$^{95}Nb, ^{95}Zr, ^{125}Sb, ^{137}Cs, ^{155}Eu, ^{226}Ra$	0.12 " "
By beta detection	
^{3}H	48 pCi/liter or less
^{90}Sr	0.2 pCi/g or less
By X-ray detection	
^{55}Fe	0.04 " "
By alpha detection	
$^{239,240}Pu$	0.02 " "

In addition to the radiometric analyses made on the biological and environmental samples, environmental radiation surveys of selected areas on Amchitka Island were made in August 1974, 1975 and 1976, with an Eberline survey meter, Model E-510, and a pancake probe with a 2 mg/cm^2 window.

3. RESULTS AND DISCUSSION

The results of the analyses of the samples collected in 1976 are presented in Tables 2 through 18. These tables also contain data for samples collected and analyzed from 1970 through 1975. Results of these earlier analyses were presented in greater detail in previous progress reports.

The air sampling program at Amchitka which had been continuous since February, 1972, was discontinued in August, 1973, prior to closing the camp in September. One air particulate sampler (three were formerly used) was reactivated for an eight-day period during the August-September 1974 field trip. No radionuclides were detected by gamma-spectrum analysis of this sample (Table 2). Air samples were not collected during the August 1976 field trip.

Results of the analyses of biological samples are given in Tables 3 through 13, and in 17 and 18. The concentration of many of the gamma-emitting fallout radionuclides in the biological samples collected in August, 1975, was less than in 1974, but often greater than values for similar samples collected in 1973. Radionuclides usually detected in the 1976 samples of freshwater moss, *Fontinalis*, (Table 3) and the freshwater plant, *Ranunculus*,(Table 4) were the naturally occurring radionuclides ^{7}Be and ^{40}K and the fallout radionuclides ^{125}Sb,^{137}Cs,^{144}Ce, and ^{155}Eu. Of these radionuclides, ^{7}Be and ^{40}K were present in the greatest concentration (1 to 26 pCi/g, dry tissue). Radionuclides commonly detected in aquatic vegetation samples collected prior to 1975, but only sporadically in 1976, include ^{95}Zr, ^{95}Nb, ^{103}Ru and ^{106}Ru. The radionuclide species and concentration values for *Fontinalis* and *Ranunculus* samples in 1976 were also seen in aufwuchs and filamentous algae (Table 5) and in the lichens (Table 6), except that higher concentrations of ^{144}Ce($\sim$2.2 pCi/g, dry) and ^{137}Cs(7 to 11 pCi/g, dry) were present in the lichen samples and lower concentrations of ^{155}Eu were in the aufwuchs. Cesium-137 levels in the *Ranunculus*, aufwuchs, lichen, soil, and ptarmigan samples collected from the Cannikin area in 1976 were similar to ^{137}Cs levels in similar samples collected elsewhere on Amchitka. In 1975 higher ^{137}Cs levels in several sample types from the Cannikin area may have been due to a local increase in world fallout prior to our sampling trip, since several short-lived radionuclides such as ^{95}Zr and ^{95}Nb were also present in greater concentrations in some samples (i.e., soil and aufwuchs) from the Cannikin area compared to samples from other areas of Amchitka. It is unlikely that the elevated ^{137}Cs values in some

Cannikin area samples collected in 1975 was due to leakage from the Cannikin detonation, since ^{3}H levels in water samples from this area were comparable to ^{3}H levels in water from other areas on Amchitka. Increased ^{3}H levels are expected to be the first indicator of leakage from a test site on Amchitka.

The marine algae, *Fucus*, had fewer fallout radionuclides present in 1976 and at lower concentrations than freshwater and terrestrial vegetation samples (Table 7). The naturally occurring radionuclide, ^{40}K, was present in concentrations that ranged from 22 to 30 pCi/g, dry, which is from 20 to over 100 times greater than the values for either of the two fallout radionuclides, ^{95}Nb and ^{137}Cs, detected in *Fucus* samples.

Maximum radionuclide values for the green sponge, a marine invertebrate, in terms of pCi per gram of dry sample were 0.22 for ^{144}Ce, 4.3 for ^{7}Be, and 20 for ^{40}K (Table 8).

As in previous years, naturally occurring ^{40}K and fission-produced ^{137}Cs were the two radionuclides usually detected in fish (Tables 9-11). No ^{55}Fe analyses were made on fish collected in 1976. In the three species analyzed--halibut, Dolly Varden, and greenling--^{137}Cs concentrations were low (0.22 pCi/g, dry). Potassium-40 was, as in 1975, the predominant radionuclide in all fish samples analyzed and was usually present in concentrations 50 to 250 times higher than ^{137}Cs concentrations.

The ^{137}Cs value in the muscle of Dolly Varden collected in DK-45 Lake in 1972 was significantly greater than expected, although we have no other samples of land-locked Dolly Varden from that time period for comparison. The land-locked races of these fish may have been exposed to different ^{137}Cs concentrations than the anadromous populations of Dolly Varden from other sites on Amchitka. Other than fish, ptarmigan and rats were the only other vertebrates analyzed. Potassium-40, ^{137}Cs and ^{90}Sr were the predominant radionuclides in birds (Tables 12 and 13). Potassium-40 concentrations in birds were usually greater than ^{137}Cs concentrations by about a factor of ten. Rat bone samples had ^{90}Sr concentrations (Table 13) of less than 1.3 pCi/g, dry, a value less than in samples collected in 1974 or 1975.

Surface (0-2.5 cm) soil samples were taken from the main camp and Cannikin areas. Besides the naturally occurring radionuclides ^{40}K, ^{226}Ra, ^{228}Th, and ^{238}U, the fallout radionuclides ^{141}Ce, ^{144}Ce, ^{90}Sr, and $^{239,240}Pu$ were detected in some soil samples (Tables 13, 14 and 18). The same naturally occurring radionuclides, were present in samples of beach sand from Constantine Harbor and Sand Beach Cove. Cesium-137 and $^{239,240}Pu$ in the sample from Constantine Harbor were the only fallout radionuclides present in the sand samples in 1976. Similar types and levels of fallout radionuclides were seen in soil samples collected in Washington State during 1974 and 1975 (Nelson and Seymour, 1975b).

Water samples for gamma-spectrum analysis were collected in 1976 from four freshwater sites. Whole water samples were evaporated and the residue counted. Previous to 1975, samples were filtered and the raidonuclides which had collected on the filter paper or in the resin beds were measured. In 1976 seawater samples were not analyzed for gamma-emitting radionuclides. Of the four sites, Long Shot Mud Pit No. 1 had the greatest number of fallout radionuclides in water samples (Table 15). As previously reported by Held (1972), the Long Shot Mud Pits have an unusually high concentration of suspended organic material which may accumulate radionuclides by adsorption. Concentrations of ^{137}Cs, the only radionuclide detected at all four sites, were similar at all sites and were 0.13 pCi/liter or less.

The ^{3}H values in freshwater samples collected in August, 1976 were slightly less than the 1975 LRE values and were also lower than the limit of detection value (480 pCi/liter) reported by Thordarson and Balance (1976a and 1976b) for freshwater samples collected on Amchitka in 1974 by the U.S. Geological Survey. These authors also reported a mean value of 64 ± 43* pCi/liter in seawater. Values (<45 to 65 pCi/liter) measured by LRE in 1976 remained about the same as the 1975 values (Table 16). Seawater values averaged less than 48 pCi/liter (15 tritium units), while freshwater samples, excluding those from the Long Shot area, averaged 90 pCi/liter. Tritium concentrations in water samples from stations other than the Long Shot area are within the range of values expected for tritium in rainwater collected at other locations in the northern hemisphere at the same latitute as Amchitka.

In the Long Shot Mud Pits and drainage system, ^{3}H values decreased with distance from Mud Pit #3 (3700 pCi/liter) until the ^{3}H values near the mouth of the stream draining the mud pits were within the range of ambient values (45 to 168 pCi/liter). Tritium values in the Long Shot Mud Pits increased from concentrations measured in 1975, primarily because the value of ^{3}H in Mud Pit #1 was low for reasons given in Nelson and Seymour (1976).

Table16 indicates that the mean yearly values approached 2050 TU in Mud Pit #1 and 3500 TU in Mud Pit #3 during the early 70's and have now (1976) declined to a lower level. As Seymour and Nelson (in prep.) note:

"Although some single sample values for Mud Pit #1 exceeded 5000 TU, all the values are well below the Maximum Permissible Concentration for ^{3}H in water, MPC_w, for occupational exposure. This value is 3×10^{-2} μCi/ml, equivalent to 9×10^{6} TU, and was established by the International Commission on Radiological Protection (ICRP, 1959) and the U.S. National Committee on Radiation Protection (NCRP, 1959). For an individual member of the population in an uncontrolled area, the Radiation

*One standard deviation

Protection Guide (RPG) value is 1/10 the MPC for occupational exposure or 3×10^{-3} μCi/ml for ^{3}H, which is equivalent to 9×10^{5} TU (ERDA, 1975). The average value for the general population is less than the value for the individual and for isotopes that concentrate in organs other than the gonads, a value 1/30 of the MPC value for continuous occupational exposure or 10^{-3} μCi of ^{3}H (3×10^{5} TU) has been established by the ICRP (1964). Another perspective on the significance of ^{3}H in the Amchitka samples is obtained by a comparison of the maximum values of 5000+ TU at Amchitka (Long Shot Mud Pit #1) to values for ^{3}H in rainfall at other areas. At nearby Adak in the Aleutian Islands, where the concentration of ^{3}H in precipitation can be assumed to be about the same as at Amchitka, monthly samples have been collected, and in 1963 the mean value was 1860 TU and the maximum, 3900 TU (International Atomic Energy Agency, 1971). Although the tritium concentration in Mud Pit #1 at Amchitka was somewhat greater than in precipitation at Adak in 1963, it was comparable to the tritium concentration in precipitation in the Central United States (Stewart and Farnsworth, 1968), a continental location where the concentration of ^{3}H in precipitation is expected to be significantly greater than at a coastal location such as Adak or Amchitka. Also in 1963, the tritium concentration in precipitation at another continental site--Vienna, Austria--ranged from 800 to almost 6000 TU (Schell et al., 1974)."

Free and bound water was extracted from samples of aquatic vegetation, marine algae, greenling, Dolly Varden and ptarmigan. The results of the analyses of the free water samples for ^{3}H are presented in Table 17. The bound water samples are being analyzed by a new method and results of these analyses will be given in a later report.

Amounts of ^{3}H in the free water from Fucus and Greenling samples are similar to those measured in 1975, while ^{3}H in the free water from Fontinalis and the muscle tissue of Dolly Varden was present in higher amounts in 1976 than in the same type of samples collected from similar sites in 1975. Samples of Ranunculus and ptarmigan were not analyzed for ^{3}H in 1975. Tritium values (± counting error) in the marine organisms or in freshwater organisms from sites other than Clevenger and White Alice creeks were similar to the amounts of ^{3}H (± counting error) measured in seawater or freshwater samples collected at the same place and time as the biological samples. Tritium values in the freshwater organisms from Clevenger and White Alice creeks were about twice as high as values measured in water samples taken at the same location as the biological samples. The reason for the higher than expected ^{3}H values in biological samples from these two streams cannot be known for certain, but contamination of these samples in the laboratory or analytical errors are the most likely causes of the higher values since analysis of water samples for ^{3}H and biological samples for gamma-emitting radionuclides do not indicate any increased amounts of radionuclides in these two areas. The amount of ^{3}H in samples of Ranunculus and Fontinalis from Long Shot Creek reflects the high ^{3}H concentration of the water flowing from the Long Shot Mud Pits into the Creek.

Soil, sand, *Fucus*, and greenling samples were also analyzed for $^{239,240}Pu$ (Table 18). Concentrations (<0.002 to 0.009 pCi/g, dry) of $^{239,240}Pu$ in sand and soil from Amchitka were similar to concentrations (0.005 to 0.012 pCi/g, dry) in soil collected in the coastal area of Washington State in September, 1974 (LRE unpublished data). The brown alga, *Fucus distichus*, from Amchitka Island had less $^{239,240}Pu$ (1 dpm/kg, dry wt.) by a factor of ten than did *Sargassum sp.* collected in 1970 from the Atlantic Ocean but more than in *Fucus vessaculosus* (0.14 dpm/kg, wet wt.) collected at Woods Hole in 1971 (Noshkin *et al.*, 1973) or in *Pelagophycus porra* (0.3 dpm/kg, wet wt.) collected along the California Coast in 1971 (Wong, Hodge and Folsom, 1972). The surface tissue of *P. porra* had a higher ^{239}Pu concentration (4.8 dpm/kg, wet wt.) than the average concentration of either the entire *P. porra* from California or the *F. distichus* from Amchitka. Muscle tissue of greenling from Amchitka had less than 0.002 pCi of $^{239,240}Pu$ per gram of dry weight, our limits of detection for the sample size and counting time used in these analyses.

The $^{239,240}Pu$ in the Washington soil and in the Atlantic and California algae was assumed to be from worldwide fallout, and the similarity of levels in soil and algae at Amchitka and these other sites points to the same source for the $^{239,240}Pu$ at Amchitka.

Results of the radiation survey are given in Table 19. The survey was performed with an Eberline survey meter (Model E-510), using a probe with a window thickness of less than 2 mg/cm^2. Measurements were made with an unshielded probe. This instrument was capable of detecting beta energies down to 40 keV and has a gamma sensitivity of about 5000 cpm/mR/hr for ^{60}Co. Tritium, which has a beta energy of about 19 keV, was not detectable with this probe. The 13 locations surveyed were between Charlie Runway and E-site and included the Long Shot, Milrow, and Cannikin surface ground zeros and adjacent areas. The Cannikin drill-back site and Sand Beach Cove were also surveyed. Maximum values recorded while holding the survey instrument one meter above the ground ranged from 0.03 to 0.05 mR/hr without a beta shield. Average levels at all sites were about 0.01 mR/hr or less. These values are similar to results of comparable surveys in other areas of the United States.

The additions to the old tables, plus the new tables, extend the record of radiological data from July 1970 through August 1976. These data in no way change the major conclusions of the previous progress reports; namely, the radionuclides present in the biological and environmental samples analyzed are not of Cannikin or Milrow origin, and only some ponds, mud pits and their drainage system in the immediate vicinity of the Long Shot surface ground zero remain contaminated with ^{3}H. The amounts and types of fission products and induced radionuclides detected point to their origin from worldwide fallout.

4. SUMMARY AND CONCLUSIONS

The present program for periodical collection of biological and environmental samples at Amchitka and for analyses of these samples for radionuclide content began in July 1970. Previous progress reports give an account of the results of this program through August 1975, 45 months after the Cannikin detonation. In this progress report, the account of the program is extended through August, 1976. In addition, the results of radiation surveys performed in August 1974, 1975 and 1976 are given.

Concentrations of gamma-emitting fallout radionuclides in samples collected in 1976 were generally less than concentrations in samples collected in 1975, and were less than the values for naturally occurring ^{40}K. This continued a trend of decreasing abundance which had been evident from 1970 to 1973, but had been reversed in 1974, due to an increase in worldwide fallout. Levels of naturally occurring ^{7}Be and ^{40}K in 1976 were similar to levels present in previous years. The new data acquired during 1975 do not change the important conclusions of the previous progress reports, namely:

a. Naturally occurring ^{7}Be and ^{40}K were the most abundant radionuclides present in most sample types.

b. Trace quantities of fission products, induced radionuclides and plutonium have been detected in amounts that would be expected from world fallout at that latitude.

c. No unexpected radionuclides or radionuclide ratios have been detected.

d. Tritium values in seawater and freshwater are not significantly different than the values that would be expected at island stations at the same latitude in the northern hemisphere.

e. Some of the ponds and mud pits in the vicinity of the Long Shot Surface Ground Zero remain contaminated with ^{3}H. The drainage from the mud pits is also contaminated. The concentration is less than the amount of ^{3}H in the rainfall at Vienna, Austria, in 1963, and about twice as great as the amount in rainwater samples from Valentia, Ireland, in the same year.

f. An extensive search with sensitive instruments for radionuclides in biological and environmental samples--marine, terrestrial, and freshwater--collected during the first 57 months after the Cannikin detonation of November 6, 1971, indicates that no radionuclides from the Cannikin or Milrow events have escaped to the surface environment.

TABLE 1

Scientific and Common Names and Wet Weight to Dry Weight Ratios of Some Amchitka Island Organisms

Species	Tissue	Wet/Dry Ratio	Standard Deviation
	VERTEBRATES		
MAMMALS			
Rattus norvegicus			
Rat	Bone	____	____
FISH[a]			
Salvelinus malma			
Dolly Varden	Muscle	3.62	0.70
	Viscera	4.20	0.42
Oncorhynchus gorbuscha			
Pink Salmon	Gonad	4.51	____
	Muscle	4.33	____
	Liver	4.49	0.69
Hippoglossus stenolepis			
Halibut	Muscle	4.01	0.58
	Liver	3.63	0.04
Hexagrammos lagocephalus			
Rock Greenling	Liver	3.43	0.41
	Muscle	4.83	0.14
	Viscera	2.13	0.04
BIRDS			
Lagopus mutus			
Rock Ptarmigan	Liver	3.52	0.32
	Muscle	3.54	0.08
	INVERTEBRATES		
Sponge (green)	Entire	9.5	____
	MARINE ALGAE		
Fucus distichus			
Marine algae	Entire	4.94	1.4
	FRESHWATER VEGETATION		
Cladophora sp.			
Filamentous algae	Entire	5.1	____
Fontinalis sp.			
Moss	Entire	4.83	0.89
Ranunculus sp.			
Freshwater plant	Entire	12.2	4.10

TABLE 1 (continued)

Species	Tissue	Wet/Dry Ratio	Standard Deviation
	AUFWUCHS		
Periphyton and other organisms	Entire	7.27	2.40
	TERRESTRIAL VEGETATION		
Cladonia sp. Lichens	Entire	3.75	0.87
Empetra sp. Crowberry	Entire	____	_____

(a) Names are from "Common and Scientific Names of Fishes from the United States and Canada" (Third Edition), 1970 American Fisheries Society Special Pub. No. 6.

Table 2

Some Gamma-Emitting Radionuclides on Air Filters at Ground Level at the Amchitka Island Base Camp

Collection Period	n[b]	Mean Volume $10^3 m^3$	Gamma-Emitting Radionuclides (pCi/thousand cubic meters)[a] ^{7}Be	^{95}Zr	^{95}Nb	^{103}Ru	^{137}Cs	^{144}Ce
Pre-Cannikin								
1970–71	28	24.5 ± 3.7	20 ± 9	2.8 ± 2.1	5.9 ± 4.5	0.7 ± 1.1	0.7 ± 0.3	NA
Post-Cannikin								
1972	45	11.3 ± 1.6	17 ± 11	0.7 ± 1.2	1.3 ± 1.6	0.37± 0.59	0.24± 0.24	NA
1973	34	11.1 ± 1.4	16 ± 10	---	0.04± 0.09	0.04± 0.07	0.16± 0.13	0.42 ± 0.53
1974	1	~ 3	---	---	---	---	---	---

a. Radionuclide values for a single sample (n = 1) are a single count for the sample (± the two-sigma, propagated, counting error). The radionuclide value shown for more than one (n>1) sample is the mean (± one standard deviation) of two or more single sample counts. Dashes in the table indicate the sample count is not significant and N. A. indicates the radionuclide was not inlcuded in the analyses.

b. Number of pooled samples.

Table 3

Gamma-Emitting Radionuclides in the Freshwater Moss Fontinalis sp. Collected at Amchitka Island

Location and Date	n	Gamma-Emitting Radionuclides (pCi/g, dry)[a]									
		^{7}Be	^{40}K	^{95}Zr	^{95}Nb	^{103}Ru	^{106}Ru	^{125}Sb	^{137}Cs	^{144}Ce	^{155}Eu
Clevenger Creek											
1970-71[b]	4	8 ± 4	5.8±3.0	1.4±1.0	2.9 ±2.3	0.28±0.54	3.2 ±1.2	1.4 ±.6	4.0±1.5	NA	NA
1971-72	5	2.7± 4.3	6.2±2.1	0.6±0.3	2.0 ±2.0	0.67±0.87	0.54±0.75	0.18±.4	1.9±1.2	1.1 ±1.6	---
1973	2	4.5± 1.1	5.4±0.2	---	0.15±0.21	0.07±0.10	0.74±0.18	0.23±.03	2.3±1.1	0.84±0.37	0.22±.01
May '74	1	17 ±11	3.9±1.8	2.4±1.2	3.4 ±0.8	---	3.1 ±0.9	0.55±.16	1.2±0.1	2.8 ±0.3	0.26±.10
Aug '74	1	4.3± 1.9	5.7±1.4	0.7±0.3	1.5 ±0.2	---	2.5 ±0.5	0.31±.10	1.5±0.1	3.9 ±0.3	0.27±.06
Aug '75	1	4.2± 2.0	6.3±1.4	---	0.44±0.18	---	0.88±0.47	0.17±.09	0.7±0.1	2.3±0.3	0.08±.06
Aug '76	3	4.0± 2.4	9.2±3.2	---	---	0.21±0.36	0.15±0.27	---	1.2±0.8	0.52±0.21	0.05±.08
Bridge Creek											
1970-71[b]	3	10 ± 5	7.3±3.2	1.7±1.4	3.9 ±3.1	---	4.4 ±2.5	1.2 ±.8	4.1±3.0	NA	NA
1971-72	5	6.2± 2.8	6.8±1.0	1.0±0.6	2.2 ±1.5	0.6 ±0.8	1.1 ±1.3	0.4 ±.6	3.3±1.3	0.52±1.2	---
1973	2	5.1± 1.4	5.8±0.4	---	0.08±0.11	---	---	0.14±.19	2.3±1.9	1.1 ±0.5	0.11±.15
May '74	1	5.2± 0.9	7.9±1.6	2.1±0.2	4.4 ±0.2	0.24±0.10	3.5 ±0.6	0.33±.11	1.9±0.1	4.5 ±0.3	0.18±.06
Aug '74	1	3.6± 2.5	5.2±1.8	1.0±0.3	2.1 ±0.3	---	2.3 ±0.7	0.20±.15	1.0±0.1	4.6 ±0.4	0.23±.09
Aug '75	1	3.3± 2.2	5.8±1.7	0.3±0.3	0.6 ±0.23	---	1.7 ±0.7	0.25±.14	1.1±0.1	3.1 ±0.4	0.10±.08
Aug '76	2	5.2± 0.6	6.0±0.3	---	0.10±0.13	0.24±0.34	0.4 ±0.6	0.08±.11	1.4±0.4	0.9 ±0.6	0.08±.11
Duck Cove Creek											
1970-71[b]	3	8 ± 3	6.6±2.6	1.3±1.1	2.7 ±2.3	0.5 ±0.6	2.8 ±1.5	1.4 ±.5	2.6±1.1	NA	NA
1971-72	5	6.4± 5.4	6.1±0.8	0.5±0.2	1.3 ±0.8	0.9 ±1.2	1.2 ±1.0	1.1 ±.5	1.7±0.9	0.32±0.72	---
1973	2	7.1± 7.0	6.4±0.4	---	---	---	0.65±0.92	0.32±.23	1.2±0.5	0.9 ±1.3	0.09±.13
May '74	1	7.4± 1.0	5.4±1.2	1.6±0.2	3.5 ±0.2	0.36±0.11	3.4 ±0.6	0.53±.13	2.2±0.1	5.7 ±0.3	1.16±.05
Aug '74	1	1.4± 0.8	<6	---	0.21±0.08	---	0.29±0.19	---	0.8±0.1	0.34±0.1	---
Aug '75	1	1.9± 1.2	5.4±1.1	0.2±0.2	0.65±0.15	---	0.69±0.44	0.26±.09	0.8±0.1	2.4 ±0.26	0.09±.05
Aug '76	1	4.7± 2.2	7.0±1.3	---	---	---	---	0.18±.09	1.4±0.1	---	---
Long Shot Drainage											
Aug '75	1	4.4± 1.2	4.0±1.3	0.2±0.1	0.61±0.13	---	2.3 ±0.4	0.27±.01	1.2±0.1	3.2 ±0.2	0.2 ±.08
Aug '76	1	4.7± 1.6	5.3±1.2	---	---	---	---	0.12±.09	0.7±0.1	0.26±0.21	0.10±.05

Table 3 (continued)

Location and Date	n	Gamma-Emitting Radionuclides (pCi/g, dry)[a]									
		^{7}Be	^{40}K	^{95}Zr	^{95}Nb	^{103}Ru	^{106}Ru	^{125}Sb	^{137}Cs	^{144}Ce	^{155}Eu
Mp-12 Creek											
1973	2	9.0± 8.6	4.7±2.0	---	0.17±0.23	---	0.7 ±0.9	0.12±.17	2.0±1.2	1.4 ±0.8	0.09±.12
May '74	1	13 ± 1.0	6.0±1.1	1.4±0.13	3.4 ±0.18	0.20±0.05	4.1 ±0.6	0.23±.10	2.1±0.1	6.0 ±0.3	0.16±.04
Aug '74	1	4.5± 2.0	5.8±1.2	0.8±0.3	1.3 ±0.3	---	1.9 ±0.6	---	0.7±0.1	3.9 ±0.3	0.13±.06
Aug '75	1	6.5± 1.8	4.5±1.7	0.3±0.2	0.67±0.18	---	2.7 ±0.7	---	0.5±0.1	5.2 ±0.3	0.21±.11
Aug '76	1	8.7± 1.9	5.3±1.5	0.3±0.3	---	---	1.6 ±0.5	0.15±.10	0.9±0.1	1.7 ±0.2	0.16±.09
Ice Box Lake Inlet											
1973	2	4.1±0.8	5.7±1.0	---	0.08±0.11	---	0.5±0.0	0.28±.06	1.5±0.6	0.87±.12	0.17±.08
May '74	1	3.7±0.6	5.0±1.0	0.70±.09	1.2 ±0.11	---	1.0±0.4	0.20±.09	3.1±0.1	2.4 ±.21	0.13±.04
Aug '74	1	2.3±0.8	5.9±0.5	0.17±.14	0.6 ±0.1	---	0.9±0.3	0.23±.08	1.0±0.1	1.6 ±.2	---
Aug '75	1	---	4.7±1.3	---	0.27±0.16	---	0.7±0.5	0.20±.11	1.3±0.1	1.8 ±.3	0.09±.07
Aug '76	3	4.8±1.8	4.0±0.8	0.15±.26	---	---	0.2±0.4	0.21±.08	1.4±0.5	0.75±.13	0.13±.05
Cannikin Lake Outlet											
1973	2	7.3±0.5	6.2±0.7	0.09±.12	0.16±0.23	0.07±.09	0.6±0.8	0.30±.18	3.9±4.6	1.1 ±.4	0.15±.21
May '74	1	10 ±1.0	2.4±0.6	1.2 ±.12	2.7 ±0.15	0.24±.13	2.2±0.3	0.29±.05	1.1±0.1	6.3 ±.2	0.13±.03
Aug '74	1	---	4.2±0.6	1.2 ±.15	2.3 ±0.17	0.21±.11	2.6±0.5	0.33±.12	1.6±0.1	6.4 ±.3	---
Aug '75	1	7.9±1.9	5.1±1.1	---	0.52±0.16	---	1.8±0.5	0.24±.09	2.0±0.1	2.1 ±.3	---
Aug '76	3	3.8±0.6	3.6±0.3	---	---	0.15±.27	0.3±0.3	0.05±.09	1.0±0.4	---	0.06±.05

a. *Radionuclide values for a single sample (n = 1) are a single count of the sample (± the two-sigma, propagated, counting error). The radionuclide value shown for more than one (n>1) sample is the mean (± one standard deviation) of two or more single sample counts. Dashes in the table indicate the sample count is not significant and N.A. indicates the radionuclide was not included in the analyses.*

b. Pre-Cannikin.

Table 4

Gamma-Emitting Radionuclides in the Freshwater Plant Ranunculus sp.
Collected at Amchitka Island

Location and Date	n	Gamma-Emitting Radionuclides (pCi/g, dry)[a]									
		^{7}Be	^{40}K	^{95}Zr	^{95}Nb	^{103}Ru	^{106}Ru	^{125}Sb	^{137}Cs	^{144}Ce	^{155}Eu
Clevenger Creek											
1970-71[b]	4	4.1± 4.7	21 ±4	0.6 ±0.8	1.3 ±1.6	---	1.9 ±1.8	0.3 ±.6	1.7 ±1.1	NA	NA
1971-72	5	5.0± 8.7	16 ±1.6	0.36±0.49	0.99±0.96	0.54±0.53	0.6 ±0.8	0.5 ±.54	1.6 ±0.7	NA	NA
1973	2	1.9± 2.7	22 ±3.5	---	---	---	---	---	0.8 ±0.5	0.3 ±0.4	---
May '74	1	3.1± 0.6	24 ±1.6	0.80±0.10	1.8 ±0.1	0.12±0.08	1.0 ±0.4	0.14±.09	0.87±0.07	2.3 ±0.2	---
Aug '74	1	1.4± 1.4	15 ±1.3	---	---	---	---	---	0.24±0.07	0.5 ±0.3	---
Aug '75	1	---	19 ±2.3	---	---	---	---	---	0.52±0.09	0.34±0.3	---
Aug '76	3	1.2± 1.0	17 ±2.3	---	---	0.09±0.16	---	---	0.39±0.15	---	---
Bridge Creek											
1970-71[b]	3	8.4± 5.8	17 ±3	1.0 ±0.4	2.3 ±1.0	---	2.1 ±0.5	0.5 ±.5	3.2 ±0.2	NA	NA
1971-72	5	3.6± 5.0	21 ±7.6	0.36±0.22	0.78±0.48	0.19±0.30	0.62±0.91	0.3 ±.4	2.2 ±1.4	NA	NA
1973	1	4.7± 1.5	29 ±2.3	---	---	---	---	---	1.2 ±0.1	0.7 ±0.2	0.15±0.10
May '74	1	3.8± 0.8	19 ±2.5	1.1 ±0.2	2.4 ±0.2	0.15±0.09	1.5 ±0.6	0.23±.12	1.6 ±0.1	3.4 ±0.3	---
Aug '74	1	2.0± 0.8	19 ±0.8	0.4 ±0.1	0.7 ±0.1	---	0.94±0.32	0.16±.08	0.85±0.06	1.7 ±0.2	---
Aug '75	1	2.5± 1.2	21 ±2.2	---	0.35±0.13	---	0.67±0.46	---	1.2 ±0.1	1.0 ±0.23	---
Aug '76	3	0.9± 1.6	19 ±0.6	---	---	---	---	0.04±.08	1.8 ±0.6	0.3 ±0.2	---
Duck Cove Creek											
1970-71[b]	2	4.0± 3.5	15 ±8	0.41±0.15	0.86±0.32	---	1.0 ±1.0	0.7 ±.5	1.3 ±0.4	NA	NA
1971-72	5	6.2± 8.9	20 ±5	0.42±0.24	0.94±0.57	0.52±0.66	0.87±0.80	0.6 ±.4	1.6 ±0.9	NA	NA
1973	1	6.0± 1.5	20 ±1.5	---	---	---	---	0.26±.09	2.9 ±0.1	0.9 ±0.2	0.14±0.08
May '74	1	3.1± 0.7	14 ±1.5	0.46±0.09	1.2 ±0.1	0.16±0.08	0.81±0.36	---	4.0 ±0.2	1.8 ±0.2	---
Aug '74	1	---	21 ±2	---	0.47±0.19	---	---	---	0.67±0.08	0.78±0.22	---
Aug '75	1	---	13 ±1.8	---	---	---	0.63±0.43	---	1.6 ±0.13	0.85±0.24	---
Aug '76	1	3.5 ±2.9	18 ±2.3	---	---	---	---	---	1.5 ±0.1	0.25±0.24	---

Table 4 (continued)

Location and Date	n	Gamma-Emitting Radionuclides (pCi/g, dry)[a]									
		^{7}Be	^{40}K	^{95}Zr	^{95}Nb	^{103}Ru	^{106}Ru	^{125}Sb	^{137}Cs	^{144}Ce	^{155}Eu
Clevenger Creek Outlet											
1970-71[b]	2	2.5± 2.2	5.3±3.5	0.39±0.07	0.81±0.16	0.4 ±0.5	0.5 ±0.6	0.6 ±.1	0.6 ±0.8	NA	NA
1971-72	5	12 ±14	10 ±9	0.78±0.86	2.5 ±2.4	0.9 ±1.3	1.2 ±0.4	0.1 ±.2	1.1 ±0.1	NA	NA
1973	1	3.4± 1.0	20 ±2.1	---	---	---	---	---	0.3 ±0.1	---	---
Aug '74	1	---	24 ±1.1	0.45±0.20	0.80±0.19	---	---	---	0.7 ±0.1	1.4 ±0.3	---
Aug '75	1	1.9± 0.7	18 ±1.5	---	0.07±0.07	---	0.5±0.3	---	0.8 ±0.1	0.6 ±0.2	---
Long Shot Drainage											
Aug '75	1	5.3±2.4	19 ±3.0	---	0.42±0.26	---	1.3±0.8	---	1.0 ±0.1	1.4 ±0.4	---
Aug '76	2	1.8±2.5	26 ±5		---	---	---	---	0.6 ±0.3	0.2 ±0.3	
Cannikin Lake Outlet											
May '74	1	13 ± 1.2	17 ±1.8	1.6 ±0.2	3.9 ±0.2	0.45±0.13	3.4±0.6	---	1.3 ±0.1	6.4 ±0.3	0.20±0.06
Aug '74	1	3.5± 1.3	28 ±3.3	0.31±0.19	0.60±0.16	---	1.2±0.8	---	1.4 ±0.1	2.0 ±0.3	---
Aug '75	1	2.3± 0.9	10 ±1.5	---	0.18±0.09	---	---	0.22±0.1	2.9 ±0.2	1.5 ±0.2	0.14±0.06
Aug '76	1	---	11 ±1.9	---	---	---	---	---	1.8 ±0.1	---	---

a. Radionuclide values for a single sample (n = 1) are a single count of the sample (± the two-sigma, propagated, counting error). The radionuclide value shown for more than one (n>1) sample is the mean (± one standard deviation) of two or more single sample counts. Dashes in the table indicate the sample count is not significant and N.A. indicates the radionuclide was not included in the analyses.

b. Pre-Cannikin

Table 5

Gamma-Emitting Radionuclides in Freshwater Aufwuchs and Filamentous Algae Collected at Amchitka Island[a]

Location and Date	n	Gamma-Emitting Radionuclides (pCi/g, dry)[b]								
		^{7}Be	^{40}K	^{95}Zr	^{95}Nb	^{103}Ru	^{106}Ru	^{125}Sb	^{137}Cs	^{144}Ce
Long Shot Mud Pit #3										
1970-71[c]	7	15 ±12	9 ±4	3.1 ±1.9	6.7 ±3.9	2.1 ±2.7	5.8 ±4.1	1.5 ±0.9	1.8 ±0.9	NA
1971-72	5	3.2± 3.4	10 ±1.4	0.8 ±1.0	2.2 ±2.9	0.39±0.56	0.2 ±0.4	0.4 ±0.3	0.5 ±0.1	1.1 ±1.6
1973	2	3.7± 2.1	9.8±0.4	---	0.09±0.12	---	---	---	0.27±0.02	0.42±0.26
May '74	1	26 ± 9	4.9±1.4	---	4.6 ±1.0	---	2.5 ±0.8	0.39±0.13	0.40±0.07	7.7 ±0.6
Aug '74	1	3.4± 1.0	9.4±0.8	0.55±0.15	0.92±0.14	---	1.3 ±0.4	0.24±0.09	0.34±0.05	1.2 ±0.2
Aug '75	1	2.8± 1.8	9.8±1.6	---	0.28±0.19	---	---	0.21±0.09	0.19±0.05	1.4 ±0.3
Aug '76	1	1.8± 1.4	8.6±1.6	---	---	---	---	0.16±0.08	0.25±0.05	---
MP-12 Creek										
July '72	1	7.8± 1.7	5.2±0.5	3.5 ±0.4	6.4 ±0.5	1.7 ±0.3	0.76±0.28	---	2.0 ±0.2	3.8 ±0.4
Aug '73	1	8.3± 0.9	9.6±1.6	0.29±0.11	0.34±0.08	0.24±0.09	---	---	2.7 ±0.1	0.36±0.17
May '74	1	9.1± 1.1	8.9±1.6	4.0 ±0.2	7.6 ±0.3	0.28±0.13	2.9 ±0.7	0.79±0.13	2.5 ±0.2	12 ±0.5
Aug '75	1	13 ± 1.2	6.2±1.5	0.36±0.11	0.97±0.12	---	2.3 ±0.5	0.26±0.10	2.3 ±0.1	3.2 ±0.2
White Alice Inlet to Cannikin Lake										
Aug '73	1	23 ± 1.5	6.1±1.4	0.59±0.13	1.1 ±0.14	0.91±0.15	---	---	0.72±0.09	1.4 ±0.2
Aug '74	1	12 ± 1.2	9.8±0.6	0.99±0.14	2.0 ±0.15	0.43±0.08	1.7 ±0.4	---	1.1 ±0.08	4.3 ±0.2
Aug '75	1	3.8± 0.9	5.1±1.3	---	0.2 ±0.08	---	0.89±0.4	0.16±0.09	0.75±0.09	2.0 ±0.3
Aug '76	1	3.3± 1.9	10 ±1.7	---	---	---	---	---	0.17±0.04	0.23±.20

a. Aufwuchs samples were collected from Long Shot Pond and MP-12 Creek, while the algae samples were collected from White Alice Inlet to Cannikin Lake.

b. Radionuclide values for a single sample (n = 1) are a single count of the sample (± the two-sigma, propagated, counting error). The radionuclide value shown for more than one (n>1) sample is the mean (± one standard deviation of two or more single sample counts. Dashes in the tables indicate the sample count is not significant and N.A. indicates the radionuclide was not included in the analyses.

c. Pre-Cannikin.

Table 6

Gamma-Emitting Radionuclides in Lichens Collected at Amchitka Island

Location and Date	n	Gamma-Emitting Radionuclides (pCi/g, dry)[a]									
		^{7}Be	^{40}K	^{95}Zr	^{95}Nb	^{103}Ru	^{106}Ru	^{125}Sb	^{137}Cs	^{144}Ce	^{155}Eu
Clam Lake											
1970-71[b]	7	15 ±6.1	4.5±6.4	1.0 ±1.0	2.1±1.9	1.5 ±3.1	5.4±3.2	5.6 ±7.2	37±39	NA	NA
1971-72	5[c]	9.7±8.2	6.2±5.5	0.7 ±0.7	1.7±1.4	0.5 ±0.7	3.6±3.8	3.4 ±3.5	27±23	9 ±0.4	1.5 ±0.14
1973	3	5.3±0.5	3.5±0.3	0.03±0.05	0.1±0.1	0.03±0.06	1.1±0.2	0.60±0.12	7±6.9	3.7±1.3	0.56±0.32
May '74	1	4.5±0.9	2.4±0.9	0.48±0.09	1.2±0.1	---	1.4±0.5	0.56±0.11	12±0.3	4.0±0.3	0.38±0.05
Aug '74	1	5.2±1.2	3.7±0.4	0.23±0.18	0.9±0.1	---	1.3±0.4	0.33±0.09	9±0.2	4.1±0.2	0.33±0.09
Aug '75	1	4.6±1.7	2.5±1.1	---	0.5±0.1	---	1.0±0.6	0.28±0.14	6±0.2	5.5±0.4	0.23±0.08
Aug '76	1	8.0±1.5	2.0±1.5	---	---	---	0.6±0.4	0.41±0.11	7±0.2	2.0±0.3	0.11±0.10
Ice Box Lake											
Oct '72	1	---	2.8±1.2	0.7 ±0.1	1.4±0.3	3.8 ±2.0	---	2.6 ±0.7	14±0.2	NA	NA
1973	2	5.7±0.3	0.6±0.8	---	---	---	1.3±0.1	0.86±0.12	16±0.7	4.3±1.1	0.63±0.18
May '74	1	8.6±1.1	1.4±0.9	0.80±0.12	2.1±0.2	---	2.1±0.5	0.59±0.13	13±0.3	8.1±0.4	0.40±0.06
Aug '74	1	5.7±1.5	1.3±0.5	0.49±0.19	0.8±0.1	---	2.2±0.5	0.64±0.13	9±0.2	6.0±0.3	0.43±0.07
Aug '75	1	5.2±1.5	1.9±1.6	---	0.4±0.1	---	1.5±0.6	0.48±0.14	11±0.3	5.4±0.3	0.38±0.13
Aug '76	1	8.1±3.7	---	---	0.2±0.2	---	0.87±0.55	0.56±0.13	11±0.3	2.1±0.3	0.48±0.12
Cannikin Lake											
July '72	1	5.3±1.7	2.0±0.7	0.7 ±0.1	1.6±0.1	0.6 ±0.3	---	0.2 ±0.4	21±0.2	NA	NA
1973	2	5.3±1.3	2.3±0.1	---	---	0.07±0.09	1.3±0.1	0.90±0.06	16±0.7	4.1±1.6	0.73±0.17
May '74	1	6.7±0.6	1.6±0.6	0.62±0.07	1.6±0.1	0.09±0.06	1.6±0.3	0.65±0.08	11±0.2	5.8±0.2	0.39±0.03
Aug '74	1	5.1±1.3	2.5±0.6	0.30±0.15	0.7±0.1	---	1.7±0.5	0.34±0.12	8±0.2	4.3±0.3	0.30±0.06
Aug '75	1	6.1±2.1	---	---	0.4±0.2	---	1.4±0.5	0.40±0.10	7±0.2	4.6±0.3	0.26±0.11
Aug '76	1	6.4±1.6	1.4±1.0	---	---	---	0.52±0.45	0.40±0.11	5±0.2	2.4±0.3	0.19±0.07

a. Radionuclide values for a single sample (n = 1) are a single count of the sample (± the two-sigma, propagated, counting error). The radionuclide value shown for more than one (n>1) sample is the mean (± one standard deviation) of two or more single sample counts. Dashes in the table indicate the sample count is not significant and N. A. indicates the radionuclide was not included in the analyses.

b. Pre-Cannikin

c. n equals 1 for ^{144}Ce and ^{155}Eu.

Table 7

Some Gamma-Emitting Radionuclides in the Marine Alga Fucus Collected at Amchitka Island

Location and Date	n	Gamma-Emitting Radionuclides (pCi/g, dry)[a]					
		^{7}Be	^{40}K	^{95}Zr	^{95}Nb	^{137}Cs	^{144}Ce
Constantine Harbor							
1970-71[b]	3	0.52±0.18	25±6	0.10±0.08	0.21±0.17	0.05±0.02	NA
1972	4	2.5 ±2.0	34±2	0.04±0.04	0.07±0.08	---	---
1973	2	---	34±0.7	---	---	0.03±0.04	---
May '74	1	1.0 ±0.4	32±2.0	0.36±0.04	0.73±0.09	0.05±0.03	1.5 ±0.2
Aug '75	1	1.7 ±1.3	32±2.3	---	---	0.04±0.04	---
Aug '76	1	---	28±2.2	---	---	0.05±0.04	---
Duck Cove							
1970-71[b]	3	0.8 ±0.3	23±2	0.07±0.04	0.15±0.10	0.04±0.02	NA
1971-72	5	1.9 ±1.5	35±4.5	0.05±0.03	0.10±0.07	0.01±0.03	---
1973	3	0.47±0.41	35±9.9	---	---	0.03±0.05	0.08±0.14
May '74	1	---	38±1.2	0.08±0.06	0.22±0.05	0.07±0.02	0.91±0.10
Aug '74	1	---	36±2.3	---	---	0.07±0.04	0.35±0.21
Aug '75	1	---	33±2.3	---	---	---	---
Aug '76	1	---	30±2.2	---	0.13±0.10	---	---
Square Bay							
Aug '75	1	---	38±2.4	---	---	---	---
Aug '76	1	---	22±2.0	---	---	---	---
Sand Beach Cove							
1970-71[b]	5	0.09±0.09	26±6	0.08±0.06	0.17±0.14	0.06±0.03	NA
1971-72	6	3.8 ±3.2	26±4.6	0.22±0.20	0.45±0.43	0.01±0.02	---
1973	2	---	35±2.1	---	---	---	0.16±0.23
May '74	1	0.61±0.45	39±2.3	0.23±0.09	0.34±0.08	---	0.92±0.19
Aug '74	1	---	27±1.4	---	---	---	0.25±0.19
Aug '75	1	---	34±2.2	---	0.16±0.12	0.04±0.04	---
Aug '76	1	---	24±2.1	---	---	---	---

a. Radionuclide values for a single sample (n = 1) are a single count of the sample (± the two-sigma, propagated, counting error). The radionuclide value shown for more than one (n>1) sample is the mean (± one standard deviation) of two or more single sample counts. Dashes in the table indicate the sample count is not significant and N.A. indicates the radionuclide was not included in the analyses.

b. Pre-Cannikin

Table 8

Some Gamma-Emitting Radionuclides in Green Sponge Collected at Amchitka Island

Location and Date	n	Gamma-Emitting Radionuclides (pCi/g, dry)[a]				
		^{7}Be	^{40}K	^{95}Zr	^{95}Nb	^{144}Ce
Duck Cove						
1971-72	4	2.7±2.7	11 ±3	0.05±0.07	0.11±0.14	NA
1973	2	1.5±0.6	9.8±0.1	---	---	0.42±0.04
May '74	1	1.0±0.4	10 ±1.5	0.16±0.07	0.36±0.07	1.1 ±0.17
Aug '74	1	---	7.2±1.3	---	---	1.2 ±0.23
Aug '75	1	---	7.7±1.4	---	---	0.73±0.20
Aug '76	1	4.3±4.2	20 ±1.3	---	---	---
Sand Beach Cove						
June '72	1	---	6.8±1.7	0.24±0.13	0.54±0.28	NA
April '73	1	---	12 ±1.7	---	---	0.31±0.17
May '74	1	1.1±0.4	9.0±1.5	0.10±0.07	0.26±0.07	0.60±0.16
Aug '74	1	---	9.6±1.4	---	---	1.2 ±0.2
Aug '75	1	---	10.0±1.6	---	---	0.56±0.2
Aug '76	1	1.0±0.7	8.5±1.4	---	---	0.22±0.16
Square Bay						
1973	2	0.7±0.9	9.7±0.5	---	---	0.35±0.12
Aug '75	1	1.2±0.9	9.5±1.7	---	0.11±0.09	0.61±0.20
Aug '76	1	---	10 ±1.7	---	---	0.21±0.18

a. Radionuclide values for a single sample (n = 1) are a single count of the sample (± the two-sigma, propagated, counting error). The radionuclide value shown for more than one (n>1) sample is the mean (± one standard deviation) of two or more single sample counts. Dashes in the table indicate the sample count is not significant and N.A. indicates the radionuclide was not included in the analyses.

Table 9

^{40}K and ^{137}Cs in Halibut Collected off Amchitka Island

Location and Date	Tissue	n[b]	Gamma-Emitting Radionuclides (pCi/g, dry)[2] ^{40}K	^{137}Cs
Bering Sea (Off C-Site)				
1971[c]	Muscle	4/4	18 ± 1.7	0.06 ± 0.08
1971-72	"	9/9	17 ± 1.7	0.02 ± 0.03
1973	"	5/5	18 ± 1.1	0.11 ± 0.02
Aug '75	"	1/1	18 ± 1.6	0.06 ± 0.04
1971[c]	Liver	4/4	13 ± 5.9	0.27 ± 0.28
1971-72	"	8/8	6.7 ± 2.1	---
1973	"	5/5	6.9 ± 1.3	0.04 ± 0.05
Aug '75	"	1/8	11 ± 1.5	0.05 ± 0.03
(Constantine Harbor)				
Aug '74[d]	Liver	5/5	7.5 ± 2.6	0.06 ± 0.07
(Midden Cove)				
Aug '75	Muscle	2/2	19 ± 1.9	0.05 ± 0.04
" "	Liver	4/4	10 ± 1.5	---
(Square Bay)				
Aug '76	Muscle	1/1	18 ± 0.5	0.05 ± 0.03

a. Radionuclide values for a single sample (n = 1) are a single count of the sample (± the two-sigma, propagated, counting error). The radionuclide values shown for more than one (n>1) sample is the mean (± one standard deviation) of two or more single sample counts. Dashes in the table indicate the sample count is not significant and N.A. indicates the radionuclide was not included in the analyses.

b. Number of pooled samples/total number of fish in all samples.

c. Pre-Cannikin

d. Cobalt-60 was present (0.03 ± 0.02 pCi/g, dry) in one liver sample.

Table 10

^{40}K and ^{137}Cs in Greenling Collected off Amchitka Island

Location and Date	Tissue	n[b]	Gamma-Emitting Radionuclides (pCi/g, dry)[a] ^{40}K	^{137}Cs
Constantine Harbor				
1971[c]	Muscle	2/19	16 ± 0.7	0.37 ± 0.42
1971-72	"	15/29	15 ± 1.3	0.04 ± 0.04
1973	"	2/9	17 ± 2.8	0.05 ± 0.06
May '74	"	1/5	18 ± 1.5	0.06 ± 0.03
Aug '74	"	1/5	16 ± 0.8	0.07 ± 0.05
Aug '75	"	1/4	21 ± 2.5	0.49 ± 0.07
Aug '76	"	1/1	9.8 ± 0.8	---
1971[c]	Viscera	2/19	13 ± 0.7	0.15 ± 0.05
Dec '71	Liver	1/10	13 ± 1.6	0.21 ± 0.12
1973	Viscera	1/4	9.1 ± 0.6	---
May '74	"	1/5	15 ± 1.0	0.03 ± 0.02
Aug '74	"	1/5	9.2± 0.8	---
Aug '75	"	1/4	11 ± 2.2	0.06 ± 0.05
Aug '76	"	1/1	10 ± 0.9	0.20 ± 0.06
Sand Beach Cove				
1971[c]	Muscle	3/27	15 ± 1.2	0.07 ± 0.02
1971-72	"	15/26	15 ± 1.6	0.03 ± 0.05
1973	"	2/12	17 ± 1.4	0.05 ± 0.06
May '74[d]	"	1/5	21 ± 1.9	0.05 ± 0.04
Aug '74	"	1/4	15 ± 0.7	---
Aug '75	"	1/8	25 ± 2.7	0.08 ± 0.06
Aug '76	"	1/1	18 ± 0.8	---
1971[c]	Viscera	3/27	13 ± 0.6	0.02 ± 0.02
1972	Liver	1/6	21 ± 2.9	---
1973	Viscera	1/6	11 ± 0.4	---
1973	Liver	1/6	13 ± 0.6	---
May '74	Viscera	1/5	9.1 ± 1.1	---
Aug '74	"	1/4	8.1 ± 2.1	---
Aug '75	"	1/8	6.3 ± 1.4	0.06 ± 0.04
Aug '76	"	1/1	9.6 ± 0.4	---

Table 10 (continued)

Location and Date	Tissue	n[b]	Gamma-Emitting Radionuclides (pCi/g, dry)[a] ^{40}K	^{137}Cs
Square Bay				
Aug '75	Muscle	1/5	16 ± 1.6	---
Aug '75	Viscera	1/5	7.8 ± 1.4	0.07 ± 0.04
Aug '76	Muscle	1/1	18 ± 0.9	---
Aug '76	Viscera	1/1	11 ± 0.8	0.10 ± 0.05
Duck Cove				
1972	Muscle	8/14	16 ± 1.1	0.06 ± 0.06
1973	"	2/8	15 ± 2.8	0.08 ± 0.01
May '74	"	1/3	18 ± 1.6	0.06 ± 0.03
Aug '74[e]	"	2/6	15 ± 1.8	0.07 ± 0.02
Aug '75	"	1/6	17 ± 1.8	0.09 ± 0.04
Aug '76	"	1/8	18 ± 0.4	0.07 ± 0.02
1973	Viscera	1/4	12 ± 0.5	0.13 ± 0.03
May '74	"	1/3	7.7 ± 0.8	0.04 ± 0.02
Aug '74	"	2/6	9.5 ± 0.1	0.15 ± 0.05
Aug '75	"	1/6	9.5 ± 1.2	0.04 ± 0.03
Aug '76	"	1/8	9.6 ± 0.4	---

a. Radionuclide values for a single sample (n = 1) are a single count of the sample (± the two-sigma, propagated, counting error). The radionuclide values shown for more than one (n>1) sample is the mean (± one standard deviation) of two or more single sample counts. Dashes in the table indicate the sample count is not significant and N.A. indicates the radionuclide was not included in the analyses.

b. Number of pooled samples/total number of fish in all samples.

c. Pre-Cannikin.

d. Cobalt-60 (0.07 ± 0.04 pCi/g) was also detected in this sample.

e. Cobalt-60 (0.03 ± 0.02 pCi/g) was also detected in this sample.

Table 11

Potassium-40 and ^{137}Cs in Muscle of Dolly Varden Collected at Amchitka Island

Collection Date	Location	n[b]	Gamma-Emitting Radionuclides (pCi/g, dry)[a] ^{40}K	^{137}Cs
1971[c]	Jones Lake	1/1	15±0.8	0.35±0.05
1972	DK-45 Lake	3/8	16±1.0	5.7 ±3.9
1973	d	3/7	16±0.6	0.18±0.09
1974	e	6/28	15±1.7	0.28±0.08
1975	f	5/19	12±4.4	0.17±0.12
Aug '76	Cannikin Lake	1/2	14±0.5	0.19±0.03
"	Jones Lake	1/9	15±0.4	0.22±0.02
"	Duck Cove	1/6	15±1.8	0.10±0.04

a. Radionuclide values for a single sample (n = 1) are a single count of the sample (± the two-sigma, propagated, counting error). The radionuclide values shown for more than one (n>1) sample is the mean (± one standard deviation) of two or more single sample counts. Dashes in the table indicate the sample count is not significant and N.A. indicates the radionuclide was not included in the analyses.

b. Number of samples pooled/total number of fish in all samples.

c. Pre-Cannikin.

d. Jones Lake, Bridge Creek, Silver Salmon Lake Outlet

e. Jones Lake, Cannikin Lake, Duck Cove.

f. Jones Lake, Cannikin Lake, Bridge Creek, Duck Cove, Clevenger Creek.

Table 12

Some Gamma-Emitting Radionuclides in Rock Ptarmigan
Collected at Amchitka Island

Collection Date	Collection Location	Tissue	Number of Birds	Radionuclides (pCi/g, dry)[a] ^{40}K	^{137}Cs
1970-71[b]	South Bight	Muscle	4	11 ± 0.5	1.0 ± 0.6
1971-72	C-Site	"	3	11 ± 1.6	0.70 ± 0.04
1973	c	"	5	11 ± 0.8	0.43 ± 0.25
May '74	C-Site	"	2	11 ± 1.2	0.42 ± 0.05
Aug '74	C-Site	"	4	11 ± 1.5	0.90 ± 0.35
Aug '75	C-Site	"	4	14 ± 2	3.4 ± 0.2
Aug '75	Mile 8	"	2	11 ± 2	1.4 ± 0.1
Aug '75	Milrow Area	"	2	12 ± 2	1.8 ± 0.6
Aug '76	C-Site	"	4	12 ± 0.5	1.7 ± 0.1
Aug '76	Milrow/Long Shot	"	3	10 ± 4.5	<0.3
Aug '76	Camp Area	"	1	10 ± 0.6	1.5 ± 0.1
Aug '76	Mile 18	"	1	9.4± 0.6	0.75 ± 0.04
1970-71[b]	South Bight	Liver	1	---	---
Aug '74	C-Site	Viscera	1	13 ± 1.2	1.6 ± 0.8

a. Values for radionuclides in samples collected from 1970 through 1973 are given as a mean (± one standard deviation) of two or more single sample counts. Values for radionuclides in birds collected from 1974 to 1976 are from a single count of a sample of one or more birds (± a two-sigma, propagated, counting error). The dashes in the body of the table indicate the sample counts were not significant.

b. Pre-Cannikin.

c. One each from Mason Lake, C-Site, and Mile 16; two from Mile 5.

Table 13

Strontium-90 in Bone from Rats and Ptarmigan, and in Soil Collected at Amchitka Island.

Collection Date	n[a]	Location	Sample Type	pCi ^{90}Sr/g, dry
1971[c]	2	Sand Beach Cove	Rat, bone	1.6 ± 1.3
1971	2	"	"	5.8 ± 5.9
1973	1	"	"	1.9 ± 1.0
1975	1	"	"	0.5 ± 0.2
1976	1	"	"	<1.3
1973	1	Other Sites[d]	Rat, bone	1.8 ± 0.2
1974	2	"	"	1.6 ± 1.1
1975	2	"	"	1.4 ± 0.3
1976	5	"	"	<1.3
1971	1	Cannikin Area	Ptarmigan, bone	31 ± 1.8
1975	1	"	"	13 ± 1.0
1976	1	"	"	14 ± 2.6
1971[c]	1	Milrow/Long Shot	Ptarmigan, bone	27 ± 1.6
1973	1	"	"	11 ± 0.4
1975	1	"	"	14 ± 1.4
1976	1	"	"	19 ± 2.4
1971	2	Other Sites[e]	Ptarmigan, bone	27 ±12
1973	1	"	"	14 ± 0.4
1974	1	"	"	16 ± 4.6
1975	1	"	"	19 ± 2.8
1976	2	"	"	26 ± 0.4
1975	1	Main Camp	Soil	0.03 ± 0.02
1976		"	"	<0.03
1975	1	Cannikin Area	Soil	<0.16
1976		"	"	<0.04

a. Each sample (n) of bone was obtained from 2 to 4 individuals.

b. Radionuclide values for single samples (n = 1) collected before 1976 are a single count of the sample (± the two-sigma, propagated, counting error). The error on the radionuclide values for single samples analyzed in 1976 is the sum of the counting error and an analytical error. The radionuclide value shown for more than one (n>1) samples is the mean (± one standard deviation) of two or more single sample counts.

c. Pre-Cannikin

d. Main dump, Duck Cove, Constantine Harbor, Camp Area, Bridge Creek and Clevenger Creek (mouth).

e. Main camp, mile post 8, Silver Salmon Lake, Mile 18.

Table 14

Gamma-emitting Radionuclides in Sand and Soil Collected at Amchitka Island

Sample Type	Collection Location	n	Radionuclide Concentration in pCi/g, dry[a]						
			^{40}K	^{137}Cs	^{141}Ce	^{144}Ce	^{226}Ra	^{228}Th	^{238}U
I. August 1975									
Soil	Main Camp	1	8.0±1.2	---	0.20±0.13	0.14±0.13	0.18±0.04	0.14±0.05	---
Soil	Cannikin Area	1	11 ±1.3	0.32±0.05	0.22±0.15	0.97±0.18	0.11±0.05	0.08±0.04	---
Sand	Constantine Harbor	1	13 ±1.2	0.07±0.03	---	---	0.18±0.04	0.09±0.04	0.44±0.36
Sand	Sand Beach Cove	1	9.8±1.1	0.06±0.03	---	0.2 ±0.1	0.22±0.04	0.11±0.03	0.48±0.20
II. August 1976									
Soil	Main Camp	3	11 ±1.0	0.82±0.60	0.27±0.24	---	0.26±0.06	0.11±0.04	0.17±0.30
Soil	Cannikin Area	3	10 ±2.5	0.34±0.21	---	0.09±0.12	0.21±0.03	0.11±0.02	0.64±0.18
Sand	Constantine Harbor	1	16 ±1.6	0.22±0.04	---	---	0.28±0.05	0.11±0.05	0.88±0.47
Sand	Sand Beach Cove	1	8.6±1.1	---	---	---	0.28±0.04	0.13±0.04	0.64±0.33

a. Radionuclide values for a single sample (n = 1) are a single count of the sample (± the two-sigma, propagated, counting error). The radionuclide value shown for more than one (n>1) sample is the mean (± one standard deviation) of two or more single sample counts. Dashes in the table indicate the sample count is not significant and N.A. indicates the radionuclide was not included in the analyses.

Table 15

Gamma-Emitting Radionuclides in Samples Collected from Lakes on Amchitka Island

Location and Date	Liters Sampled	Fraction	n	Gamma-Emitting Radionuclides (pCi/liter)[a] ^{7}Be	^{95}Zr	^{95}Nb	^{137}Cs
Jones Lake							
1971[b]	278±240	Particulate	4	---	0.05 ±0.04	0.11 ±0.08	0.02 ±0.04
"	"	Soluble	4	---	0.01 ±0.01	0.02 ±0.02	0.02 ±0.02
1971-72	154±103	Particulate	5	0.2 ±0.3	0.008±0.011	0.02 ±0.02	0.004±0.009
"	"	Soluble	5	1.3 ±2.9	0.07 ±0.15	0.16 ±0.33	0.05 ±0.10
1973	172±30	Particulate	2	---	---	---	0.042±0.015
"	"	Soluble	2	---	---	---	---
May '74[c]	53	Particulate	1	---	0.084±0.062	0.19 ±0.06	0.039±0.029
"	"	Soluble	1	---	---	---	---
Aug '74	413	Particulate	1	---	---	---	---
"	"	Soluble	1	---	---	---	---
Aug '75	56	Entire	1	1.1 ± 0.3	---	0.05 ± 0.03	0.12 ± 0.03
Aug '76	50	Entire	1	1.9 ± 0.5	---	---	0.08 ± 0.04
Heart Lake							
Aug '75[d]	52	Entire	1	2.3 ± 0.4	0.09 ± 0.05	0.15 ± 0.04	0.25 ± 0.04
Aug '76	48	Entire	1	1.9 ± 0.5	---	---	0.13 ± 0.05
Cannikin Lake							
1972	9± 1.4	Particulate	2	---	0.17 ±0.23	0.34 ±0.48	---
1973	84±16	Particulate	2	---	---	---	0.04 ±0.057
"	"	Soluble	2	---	---	---	0.08 ±0.11
May '74[e]	314	Particulate	1	---	0.20 ±0.04	0.25 ±0.03	0.019±0.013
"	"	Soluble	1	---	---	---	---
Aug '74	99	Particulate	1	---	---	---	---
"	"	Soluble	1	---	---	---	---
Aug '75	53	Entire	1	---	---	---	0.21 ±0.04
Aug '76	50	Entire	1	---	---	---	0.10 ±0.04

Table 15 (continued)

Location and Date	Liters Sampled	Fraction	n	Gamma-Emitting Radionuclides (pCi/liter)[a] ^{7}Be	^{95}Zr	^{95}Nb	^{137}Cs
Long Shot Mud Pit No. 1							
1970-71[b]	418±398	Particulate	6	4.0 ± 4.7	0.4 ±0.6	0.9 ±1.2	0.02 ±0.03
"	"	Soluble	6	11 ±18	0.002±0.003	0.006±0.009	0.08 ±0.18
1971-72	56±41	Particulate	5	1.2 ± 1.3	0.25 ±0.29	0.48 ±0.55	0.03 ±0.07
"	"	Soluble	5	0.44± 0.98	---	---	---
1973	35±5	Particulate	2	2.0 ± 1.0	---	---	0.04 ±0.06
"	"	Soluble	2	---	---	---	---
May '74[f]	48	Particulate	1	4.0 ± 0.7	1.3 ±0.1	2.7 ±0.2	0.034±0.028
"	48	Soluble	1	---	---	---	---
Aug '74	189	Particulate	1	0.7 ± 0.2	0.06 ±0.03	0.14 ±0.02	---
"	189	Soluble	1	---	---	0.21 ±0.10	---
Aug '75[g]	50	Entire	1	1.2 ± 0.3	---	---	0.08 ±0.03
Aug '76	52	Entire	1	1.3 ± 0.4	---	---	0.05 ±0.03

a. Radionuclide values for a single sample (n = 1) are a single count of the sample (± the two-sigma, propagated, counting error). The radionuclide value shown for more than one (n>1) sample is the mean (± one standard deviation) of two or more single sample counts. Dashes in the table indicate the sample count is not significant and N.A. indicates the radionuclide was not included in the analyses.

b. Pre-Cannikin.

c. Cerium-144 also present, 0.44 ± 0.14 pCi/liter.

d. Ruthenium-106 (0.45±0.25 pCi/liter), ^{125}Sb (0.09±0.06 pCi/liter) and ^{144}Ce (0.24±0.11 pCi/liter) were also present in this sample.

e. Cerium-144 also present, 0.41 ± 0.07 pCi/liter.

f. Cerium-144 also present, 4.9 ± 0.3 pCi/liter.

g. Barium-140 also present, 0.43 ± 0.37 pCi/liter.

Table 16. Tritium Concentration in Water Samples Collected at Amchitka Island, 1970-1976.

Date	Collection Site	Number of Samples	Tritium Units[a]	pCi/liter[b]
I Seawater				
1970-71[c]	d	10	32 ± 19	103 ± 61
1972	d	16	28 ± 25	90 ± 81
1973	d	6	22 ± 13	71 ± 42
1974	d	6	<13	<42
1975	d	6	<15	<48
1976	d	6	<15	<50
August 1976	Constantine Harbor	1	<14	<45
"	Square Bay	1	<14	<45
"	Sand Beach Cove	1	<14	<45
"	St. Makarius Bay	1	<14	<45
"	Rifle Range Pt.	1	<16	<52
"	Duck Cove	1	20 ± 11	65 ± 36
II Freshwater, except Long Shot Area				
1970-71[c]	d	12	92 ± 46	298 ±149
1972	d	18	49 ± 14	158 ± 45
1973	d	46	50 ± 17	162 ± 55
1974	d	44	32 ± 18	103 ± 58
1975	d	29	34 ± 14	110 ± 45
1976	d	33	30 ± 12	97 ± 39
August 1976	Main Camp (rainfall)	1	23 ± 14	74 ± 45
"	Constantine Spring	1	52 ± 11	168 ± 36
"	Jones Lake Outlet	1	12 ± 11	39 ± 31
"	Clevenger Lake Outlet	1	20 ± 14	65 ± 45
"	Clevenger Creek (mouth)	1	36 ± 11	116 ± 36
"	Clevenger Creek (headwaters)	1	36 ± 11	116 ± 36
"	Heart Lake	1	29 ± 12	94 ± 39
"	Clam Lake	1	30 ± 11	97 ± 36
"	Duck Cove Creek (mouth)	1	25 ± 11	81 ± 36
"	Seep-Duck Cove	1	38 ± 11	123 ± 36
"	Quonset Creek (at road)	1	<17	<55
"	Bridge Creek (at road)	1	29 ± 11	94 ± 36
"	Mile Post 12 Creek	1	39 ± 11	126 ± 36

Table 16(continued)

Date	Collection Site	Number of Samples	Tritium Units[a]	pCi/liter[b]
II. Freshwater (cont)				
August 1976	Cannikin Lake Inlet from Ground Zero	3	50 ± 23	162 ± 74
"	Cannikin Lake Inlet from Drillback	1	40 ± 11	129 ± 36
"	Cannikin Lake White Alice Inlet	1	29 ± 13	94 ± 42
"	Cannikin Lake Station #1 Surface	1	<14	<45
"	Cannikin Lake Station #1 Bottom	2	26 ± 12	84 ± 39
"	Cannikin Lake Station #2 Surface	1	<15	<48
"	Cannikin Lake Station #2 Bottom	1	20 ± 16	65 ± 52
"	Cannikin Lake Station #3 Surface	1	23 ± 13	74 ± 42
"	Cannikin Lake Station #3 Bottom	1	33 ± 11	107 ± 36
"	Cannikin Lake Station #4 Surface	1	<15	<48
"	Cannikin Lake Station #4 Bottom	1	27 ± 13	87 42
"	Cannikin Lake Outlet	2	29 ± 19	94 ± 61
"	Ice Box Lake Inlet[e]	1	49 ± 11	158 ± 36
"	Ice Box Lake Outlet[e]	1	43 ± 14	139 ± 45
"	DK-45 Lake	1	17 ± 11	55 ± 36
"	Seep-Sand Beach Cove	1	21 ± 12	68 ± 39
III. Long Shot Mud Pits				
1970-1971[c]	Mud Pit #3	3	3500 ± 460	11300±1500
1974	"	1	2900 ± 460	9400 ± 160
1975	"	1	867 ± 19	2800 ± 61
1976	"	1	1150 ± 23	3710 ± 74
1976	Mud Pit #2	1	1140 ± 23	3680 ± 74
1970-71[c]	Mud Pit #1	3	1800 ±260	5800 ±840
1972	"	4	2050 ± 240	6600 ± 780
1973	"	2	1900 ± 420	6100±1400
1974	"	2	1300 ± 250	4200 ± 810
1975	"	1	122 ± 11	395 ± 36
1976	"	2	716 ± 12	2310 ± 39

Table 16(continued)

Date	Collection Site	Number of Samples	Tritium Units[a]	pCi/liter[b]
IV. Long Shot Mud Pit Drainage				
August 1975	3 meters below Mud Pit #1	1	872 ± 19	2820 ± 61
"	Infantry Road	1	666 ± 16	2150 ± 52
"	100 meters below road	1	424 ± 15	1370 ± 48
"	500 meters below road	1	82 ± 13	264 ± 42
"	200 meters above Sq. Bay	1	121 ± 13	390 ± 47
"	Mouth of creek	1	107 ± 13	347 ± 42
August 1976	3 meters below Mud Pit #1	1	739 ± 18	2390 ± 58
"	Infantry Road	1	342 ± 14	1100 ± 45
"	100 meters below road	1	278 ± 14	898 ± 45
"	200 meters below road[f]	1	252 ± 13	814 ± 42
"	400 meters below road[g]	1	103 ± 12	333 ± 39
"	500 meters below road	1	53 ± 11	171 ± 36
"	200 meters above Sq.Bay	1	48 ± 11	155 ± 36
"	20 meters above Sq. Bay	1	27 ± 11	87 ± 36

a. Radionuclide values for a single sample (n = 1) are a single count of the sample (± the two-sigma, propagated, counting error). The radionuclide value shown for more than one (n>1) sample is the mean (± one standard deviation) of two or more single sample counts. Dashes in the table indicate the sample count is not significant and N. A. indicates the radionuclide was not included in the analyses.

b. One TU equals 3.23 pCi/liter.

c. Pre-Cannikin.

d. Mean of all collection sites.

e. A small lake formed in the north fork of While Alice Creek after surface subsidence occurred at the Cannikin site.

f. Ranunculus collection site #2.

g. Ranunculus collection site #1.

Table 17. Tritium in Free Water from Biological Samples Collected at Amchitka Island

Organism	Tissue	Collection Site	n[a] 1975	n[a] 1976	Tritium Units[b] 1975	Tritium Units[b] 1976	pCi/liter[b] 1975	pCi/liter[b] 1976
Fucus	Entire	Constantine Harbor	2	1	<35 ± 18	35 ± 11	<110 ± 58	110 ± 36
"	"	Square Bay	3	2	<26 ± 12	25 ± 3	<84 ± 39	81 ± 10
"	"	Sand Beach Cove	2	3	<21 ± 1	31 ± 4	<68 ± 3	100 ± 13
"	"	Duck Cove	-	3	na[c]	23 ± 3	na	74 ± 10
Greenling	Muscle	Constantine Harbor	1	1	<14	<21	<45	<68
"	"	Square Bay	4	1	<20 ± 2	<19	<65 ± 6	<62
"	"	Sand Beach Cove	2	3	<20 ± 1	20 ± 7	<65 ± 3	65 ± 23
"	"	Duck Cove	-	1	na	<46	na	<150
Dolly Varden	Muscle	Bridge Creek[d]	2		16 ± 2	na	51 ± 6	na
"	"	Duck Cove	-	2	na	43 ± 9	na	140 ± 29
"	"	Jones Lake	4	1	26 ± 16	58 ± 13	85 ± 52	190 ± 42
"	"	Cannikin Lake	1	1	39 ± 12	72 ± 17	130 ± 39	230 ± 55
Ranunculus	Entire	Bridge Creek	-	2	na	<67	na	<220
"	"	Long Shot Creek[e]	-	1	na	120 ± 17	na	390 ± 55
Fontinalis	Entire	Clevenger Creek #1	-	2	na	106 ± 18	na	340 ± 58
"	"	" " #2	-	2	na	97 ± 14	na	310 ± 45
"	"	White Alice Creek #1	2	1	39 ± 28	72 ± 17	126 ± 91	230 ± 55
"	"	" " " #2	-	2	na	86 ± 11	na	280 ± 36
"	"	" " " #3	-	2	na	56 ± 48	na	180 ±160
"	"	Ice Box Lake Inlet #1	-	1	na	<21	na	<68
"	"	" " " " #2	-	1	na	39 ± 19	na	130 ± 61
"	"	" " " " #3	-	1	na	52 ± 18	na	170 ± 58
"	"	Long Shot Creek	2	1	85 ± 14	150 ± 15	275 ± 45	480 ± 48

Table 17 Continued

Organism	Tissue	Collection Site	n[a] 1975	n[a] 1976	Tritium Units[b] 1975	Tritium Units[b] 1976	pCi/liter[b] 1975	pCi/liter[b] 1976
Ptarmigan	Muscle	Camp Area	-		na	<21	na	<68
"	"	Milrow/Long Shot	-	2	na	40 ± 17	na	130 ± 55
"	"	Cannikin Area	-	1	na	36 ± 18	na	120 ± 58

a. n equals the number of free water samples from a single tissue sample.

b. Radionuclide values for a single sample (n = 1) are a single count of the sample (± the two-sigma, propagated, counting error). The radionuclide value shown for more than one (n>1) sample is the mean (± one standard deviation) of two or more single sample counts. Dashes in the table indicate the sample count is not significant and N. A. indicates the radionuclide was not included in the analyses.

c. na = not analyzed.

d. Intertidal area at the mouth of the creek.

e. Site #1 is 400 meters below Infantry Road.

Table 18. Plutonium-239,240 in *Fucus*, Greenling, Sand and Soil Collected at Amchitka Island in August, 1975 and 1976.

Sample Type	Collection Location	pCi/g, dry[a]	dpm/kg, wet
I. August 1975			
Fucus, entire	Sand Beach Cove	0.006 ± 0.002	3.0 ± 1.0
Fucus, entire	Constantine Harbor	0.002 ± 0.002	0.8 ± 0.8
Greenling,muscle	Sand Beach Cove	<0.002	<0.8
Greenling,muscle	Constantine Harbor	<0.003	<1.2
Sand, surface[b]	Sand Beach Cove	0.004 ± 0.002	-
Sand, surface	Constantine Harbor	<0.002	-
Soil, surface	Cannikin Area	0.015 ± 0.004	-
Soil, surface	Main Camp	0.001 ± 0.001	
II. August 1976			
Fucus, entire	Sand Beach Cove	0.003 ± 0.002	1 ± 0.8
Fucus, entire	Constantine Harbor	<0.002	<0.8
Fucus, entire	Square Bay	0.003 ± 0.002	1 ± 0.8
Greenling,muscle	Sand Beach Cove	<0.002	<0.8
Greenling,muscle	Constantine Harbor	<0.002	<0.8
Sand, surface	Sand Beach Cove	<0.001	-
Sand, surface	Constantine Harbor	0.003 ± 0.002	-
Soil, surface	Cannikin Area #1	0.008 ± 0.002	-
Soil, surface	Cannikin Area #2	<0.002	-
Soil, surface	Cannikin Area #3	0.009 ± 0.005	-
Soil, surface	Camp Area #1	<0.002	-
Soil, surface	Camp Area #2	0.005 ± 0.003	-
Soil, surface	Camp Area #3	0.006 ± 0.004	-

a. The radionuclide value for these single samples is a single count of the sample (± the sum of a two-sigma, propagated, counting error and an analytical error).

b. Surface samples were the 0 to 2.5 cm layer.

Table 19. Radiation Survey of Selected Sites on Amchitka Island

Location	Radiation Level [a], mR/hr					
	Average Reading			Maximum Reading		
	1974	1975	1976	1974	1975	1976
Decon Facility	0.01	0.01	0.01	0.05	0.04	0.03
Inside "D" Barracks	0.01	<0.01	0.01	0.04	0.04	0.04
Husky Camp	<0.01	0.01	0.01	0.04	0.05	0.04
Jones Creek Effluence	<0.01	<0.01	0.01	0.04	0.04	0.03
EIC Calibration Range	<0.01	0.01	0.01	0.04	0.04	0.05
Rifle Range Target Area	0.01	0.01	0.01	0.04	0.05	0.04
Duck Cove	<0.01	<0.01	0.01	0.03	0.04	0.04
Milrow SGZ & Vicinity	<0.01	0.01	0.01	0.04	0.04	0.06
Long Shot SGZ & Vicinity	0.01	0.01	0.01	0.05	0.05	0.05
Cannikin SGZ & Vicinity	0.01	0.01	0.01	0.04	0.04	0.04
Cannikin Drillback	0.01	0.01	0.01	0.05	0.04	0.05
Sand Beach Cove	<0.01	<0.01	0.01	0.04	0.04	0.04
D-Site	0.01	<0.01	0.01	0.05	0.03	0.04
E-Site	0.01	<0.01	0.01	0.03	0.04	0.04

(a) Eberline G-M detector, Model 510, probe window thickness less than 2 mg/cm^2.

5. REFERENCES

Bogen, D. C. and G. A. Welford. 1976. "Fallout Tritium" Distribution in the Environment. Health Physics, 30:203-208.

Bruner, H. O. 1973. Distribution of Tritium between the Hydrosphere and Invertebrates. P. 303-314 in Tritium, A. A. Moghissi and M. W. Carter (eds). Messenger Graphics, Phoenix, Arizona.

Cohen, L. K. and T. J. Kneip. 1973. Environmental Tritium Studies at a PWR Power Plant. P. 623-639 in Tritium, A. A. Moghissi and M.W. Carter (eds). Messenger Graphics, Phoenix, Arizona.

Feinendegen, L. E. 1967. Tritium-Labeled Molecules in Biology and Medicine. Academic Press, New York.

Harrison, F. L., J. J. Koranda and J. S. Tucker. 1973. Tritiation of Aquatic Animals in an Experimental Marine Pool. P. 363-378 in Tritium, A. A. Moghissi and M. W. Carter (eds). Messenger Graphics, Phoenix, Arizona.

Held, E. E. 1971. Amchitka Radiobiological Program Progress Report, July 1970 to April 1971. NVO-269-11. University of Washington, College of Fisheries, Laboratory of Radiation Ecology. 36 p.

Held, E. E. 1972. Amchitka Radiobiological Program Progress Report, May 1971 to February 1972. NVO-269-17. University of Washington, College of Fisheries, Laboratory of Radiation Ecology. 50 p.

Held, E. E., V. A. Nelson, W. R. Schell, and A. H. Seymour. 1973. Amchitka Radiobiological Program Progress Report, March 1972 to December 1972. NVO-269-19. University of Washington, College of Fisheries, Laboratory of Radiation Ecology. 92 p.

International Atomic Energy Agency. 1971. Environmental Isotope Data No. 3: World Survey of Isotope Concentration in Precipitation (1966-1967). Technical Report Series No. 129. IAEA, Vienna. 402 p.

International Commission on Radiological Protection. 1959. Recommendations of the International Commission on Radiological Protection (Adopted 9 September 1958). ICRP Publication No. 1, Pergamon Press.

International Commission on Radiological Protection. 1964. Recommendations of the International Commission on Radiological Protection (as amended 1959 and revised 1962). ICRP Publication No. 6, Pergamon Press.

National Committee on Radiation Protection. 1959. Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air and in Water for Occupational Exposure. National Bureau of Standards Handbook 69. 95 p.

Nelson, V.A. 1975. Bioenvironmental Studies, Amchitka Island, Alaska, 1975 Task Force Report. University of Washington, College of Fisheries, Laboratory of Radiation Ecology. U.S. ERDA Report, NVO-269-26. 18 p.

Nelson, V. A., and A. H. Seymour. 1974. 1974. Amchitka Radiobiological Program Progress Report, January 1973 to December 1973. NVO-269-21. University of Washington, College of Fisheries, Laboratory of Radiation Ecology. 98 p.

Nelson, V.A. and A.H. Seymour. 1975a. Amchitka Radiobiological Program Progress Report, January 1974 to December 1974. NVO-269-23. University of Washington, College of Fisheries, Laboratory of Radiation Ecology. 49 p.

Nelson, V.A. and A.H. Seymour. 1975b. Preliminary Radiological Surveillance Program, Washington Public Power Supply System Reactor Site #3. Annual Report to EBASCO Services, Inc. University of Washington, College of Fisheries, Laboratory of Radiation Ecology. 44 p.

Nelson, V.A. and A.H. Seymour. 1976. Amchitka Radiobiological Program Progress Report, January 1975 to December 1975. NVO-269-27. University of Washington, College of Fisheries, Laboratory of Radiation Ecology. 47 p.

Noshkin, V.E., V.T. Bowen, K.M. Wong, and J.C. Burke. 1973. Plutonium in North Atlantic Ocean Organisms; Ecological Relationships. pp. 681-688 in Proc. Third National Symposium on Radioecology, D.J. Nelson (ed.). CONF-710501, P 2. National Technical Information Service, Springfield, Virginia.

Robertson, J.S. 1973. Tritium Turnover Rates in Mammals. P. 322-327 in Tritium. A.A. Moghissi and M.W. Carter (eds). Messenger Graphics, Phoenix, Arizona.

Schell, W.R., G. Sauzay and B.R. Payne. 1974. World Distribution of Tritium. In Physical Behavior of Radioactive Contaminants in the Atmosphere. International Atomic Energy Agency, Vienna, Austria. IAEA-SM-181/34. P. 375-400.

Seymour, A. H. and V. A. Nelson. (In press). Radionuclides in Air, Water, and Biota. In "The Environment of Amchitka Island, " M. L. Merritt (ed.) USERDA book TID-26712.

Stewart, G.L. and R.K. Farnsworth. 1968. United States Tritium: Rainout and its Hydrologic Implications. Water Resources Research 4 (2):273-289.

Stewart, M.L., G.M. Rosenthal and J.R. Kline. 1973. Tritium: Discrimination and Concentration in Freshwater Microcosms. P. 452-460 in D.J. Nelson (ed) Radionuclides in Ecosystems, Proc. Third Nat. Symp. Radioecology, May 10-12, 1971, Oak Ridge, Tenn. CONF-710501.

Thordarson, W. and W.C. Ballance. 1976a. Radiochemical Monitoring of Water after the Cannikin Event, Amchitka Island, Alaska, August 1974 and Chemical Monitoring from July 1972 to June 1974. U.S. Geological Survey Report USGS-474-225. 19 p.

Thordarson, W. and W.C. Ballance. 1976b. Radiochemical Monitoring of Water after the Cannikin Event, Amchitka Island, Alaska, May 1974. U.S. Geological Survey Report USGS-474-226. 19 p.

United States Energy Research and Development Administration. 1975. Standards for Radiation Protection. ERDA Manual, Chapter 0524.

Wong, K.M., V.F. Hodge and T.R. Folsom. 1972. Plutonium and Polonium inside Giant Brown Algae. Nature, 237:460-462.

6. TABLE AND MAP INDEX

Collection Site	Figure No.(s)	Table No.(s)	Remarks
Baker Runway	3	13	Part of Base Camp
Base Camp	2 & 3	2, 13, 19	
Bering Sea	1 & 2	9, 11	Collection sites located:
Bridge Creek	4	3, 4, 11, 16, 17	a) Off C-Site
Cannikin Lake Inlet From Drillback	6	16	
Cannikin Lake	6	6, 11, 15, 16, 17	
Cannikin Lake Outlet	6	3, 4, 16, 17	
Cannikin Lake Inlet From GZ	6	16	
Cannikin Lake Inlet From White Alice Inlet	6	5, 16	
Cannikin Site	2 & 6	12, 13, 14, 18, 19	
Chapel Cove Stream	2	11	
Clam Lake	4	6, 13, 16	
Clevenger Creek	4	3, 4, 11, 13, 16	
Clevenger Lake Outlet	3	4, 16	
Constantine Harbor	2 & 3	7, 9, 10, 13, 14, 16, 17, 18	
Constantine Harbor	3	16	
Crown Reefer Point	2 & 4	7	
D-Site	2	19	
Decon Area	3	19	
Duck Cove	4	7, 8, 10, 11, 13,17	
Duck Cove Creek	4	3, 4, 11, 16	
Duck Cove Seep	4	16	
E-Site	2	19	
EIC Calibration Range	3	19	
Heart Lake	4	15, 16	
Hus-Key Camp	3	19	
IA-2	6	None	
IA-3	6	"	
Ice Box Lake	6	6, 16	Lake 05-46
Ice Box Lake Inlet	6	3, 16, 17	
Infantry Road	2,4-6	None	
Jones Lake	3	11, 15, 16, 17, 18	
Jones Lake Outlet	3	16, 19	
Lake DK-45	6	11	
Lake DK-45 Outlet	6		
Long Shot	2, 4, 5	5, 15, 16, 19	Collection sites located at: a) Mud Pits Nos. 1, 2 & 3;
Long Shot Drainage	4 & 5	3, 4, 16, 17	
Main Camp	3	12,13,14,18,19	Part of Base Camp
Midden Cove	2	9	
Mile 8	2	12,13	
Mile 18	2	12,13	

TABLE AND MAP INDEX (continued)

Collection Site	Figure No.(s)	Table No.(s)	Remarks
Milrow	2 & 4	12, 19, 13, 17	
MP 12 Creek	6	3, 16	
Quonset Creek	4	16	
Rifle Range Target Area	4	19	
Sand Beach Cove	6	7, 8, 10, 13, 14, 16, 17, 19	
Sand Beach Cove Seep	6	16	
Signal Cove Stream	2	1	
Silver Salmon Lake	4	13	
Small Boat Dock	3		Located in Constantine Harbor
South Bight	2	12	
South Hangar	3	16	
Square Bay	4	7, 8, 9, 10, 16, 17	

DISTRIBUTION LIST

Maj. Gen. J. K. Bratton, Dir., DMA, ERDA-HQ (10)
G. C. Facer, DMA, ERDA-GQ
J. L. Liverman, Dir., DBER, ERDA-HQ (3)
W. S. Osburn, DBER, ERDA-HQ
I. L. Brisbin, SREL, Aiken, S.C.
J. Haugh, DBER, ERDA-HQ
J. Swinebroad, DBER, ERDA-HQ
H. Hollister, Acting Director, DSSC, ERDA-HQ (2)
R. F. Pigeon, OPA, ERDA-HQ
J. King, Dir., OPA, ERDA-HQ
R. A. Brechbill, SAN, Oakland, CA
J. J. Davis, NRC, Bethesda, MD
R. L. Ballard, NRC, Bethesda, MD
S. R. Ruby, ARPA, Washington, DC
Assistant Secretary, Fish, Wildlife & Parks, Dept. of the Interior, Washington, D.C.
Director, National Marine Fisheries Service, Dept. of Commerce, Washington, DC
Director, Fish & Wildlife Service, Dept. of the Interior, Washington, DC
R. E. Johnson, Fish & Wildlife Service, Washington, DC
J. D. Findlay, Fish & Wildlife Service, Portland, OR
D. R. Klein, Leader, Alaska Cooperative Wildlife Research Unit, College, AK
G. W. Watson, U. S. Fish & Wildlife Service, Anchorage, AK (3)
J. Martin, US Fish & Wildlife Service, Adak, AK (3)
G. V. Byrd, U. S. Fish & Wildlife Service, Adak, AK (2)
J. B. Kirkwood, U. S. Fish & Wildlife Service, Atlanta, GA
Refuge Manager, U. S. Fish & Wildlife Service, Cold Bay, AK
H. L. Rietze, National Marine Fisheries Service, Dept. of Commerce, Juneau, AK
T. R. Merrell, Jr., National Marine Fisheries Service, Dept. of Commerce, Auke, Bay, AK
Commissioner of Fish and Game, State of Alaska, Juneau, AK (2)
Commissioner of Environmental Conservation, Alaska State Capitol, Juneau, AK
F. S. L. Williamson, Commissioner, Health & Social Services, State of Alaska, Juneau, AK
K. B. Schneider, Alaska Dept. of Fish & Game, Anchorage, AK
District Engineer, Corps of Engineers, Anchorage, AK
W. E. Ogle, Anchorage, AK
J. C. Hopkins, J-DO, LASL, Los Alamos, NM (2)
R. L. Wagner, L-7, LLL, Livermore, CA (3)
J. J. Koranda, L-613, LLL, Livermore, CA (2)
C. D. Broyles, Sandia Laboratories, Albuquerque, NM
M. L. Merritt, Sandia Laboratories, Albuquerque, NM
W. S. Twenhofel, USGS, Denver, CO (3)
G. B. Morgan, Acting Director, NERC-LV, USEPA, Las Vegas, NV (5)
Regional Director, Pollution Control Administration, Environmental Protection Agency, Seattle, WA
W. S. Johnson, Eberline Instrument Corporation, Santa Fe, NM (2)

L. K. Bustad, College of Veterinary Medicine, Washington State University, Pullman, WA
A. P. McCartney, Univ. of Arkansas, Fayetteville, AR
W. W. Mitchell, Univ. of Alaska Ag. Expt. Station, Palmer, AK
Vincent Schultz, Dept. of Zoology, Washington State University, Pullman, WA
A. H. Seymour, Laboratory of Radiation Ecology, University of Washington, Seattle, WA (150)
C. C. Amundsen, University of Tennessee, Knoxville, TN
N. S. Smith, University of Arizona, Tucson, AZ
J. M. Neuhold, Utah State University, Logan, UT
R. L. Burgner, Fisheries Research Institute, University of Washington, Seattle, WA
K. R. Everett, Ohio State University, Columbus, OH
R. S. Davidson, Battelle Columbus Laboratories, Columbus, OH
R. G. Fuller, Battelle Columbus Laboratories, Oracle, AZ
H. F. Mueller, NOAA/ARL, Las Vegas, NV
P. R. Fenske, Desert Research Institute, University of Nevada, Reno, NV
C. E. Williams, Manager, ID, Idaho Falls
M. E. Gates, Manager, NV
R. Ray, Assistant Manager for Environment and Safety, NV
R. W. Taft, ASsistant Manager for Plans, Engineering and Budgets, NV
T. E. Wade, Asst. Manager for Operation, LV
P. J. Mudra, Dir., Operations Support Division, NV
J. R. Gilpin, Director, Plans & Budgets, LV
M. G. White, Chief, TUB, NV
Leon Silverstrom, Chief Counsel, NV
D. G. Jackson, Dir., Office of Public Affairs, NV (5)
R. R. Loux, Chief, Technical Information Branch, OPA, NV (10)
Elaine Bickerstaff, Librarian, Technical Library, NV (2)
E. M. Douthett, Dir., Physical Sciences Division, NV
P. B. Dunaway, Dir., Bioenvironmental Science Division, NV
B. W. Church, Radiological Branch, NV
T. M. Humphrey, Physical Sciences Division, NV
E. D. Campbell, Chief, Life Sciences Branch, NV (10)
John Hardison, USDA-ARS, Corvallis, OR
ERDA/Technical Information Center, Oak Ridge, TN, for ERDA Standard Distribution in Category UC-11 (Environmental and Earth Sciences) (233)