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EVALUATION OF RADIOLOGICAL CONDITIONS IN THE VICINITY OF HANFORD FOR 1964

By

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Radiation Protection Department

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SUMMARY STATEMENT

The evaluation of results obtained from the Hanford environmental surveillance program for 1964 indicates that most of the environmental radiation exposure for the majority of persons living in the neighborhood of the Hanford project was due to natural sources and world-wide fallout rather than to Hanford operations.

Of the low-level wastes that are released to the environment from the Hanford plants, neutron-induced radionuclides present in reactor cooling water discharged to the Columbia River continued to be the source of greatest potential exposure to people in the environs. The primary pathways of exposure from this source are drinking water derived from the river, consumption of fish and waterfowl which inhabit the river, and foodstuffs grown on land irrigated with water pumped from the Columbia downstream from Hanford.

Residents of Richland were supplied throughout the year with drinking water from the new treatment plant that draws water from the Columbia River. The radiation exposure from drinking this water was estimated to be about 10% of the appropriate limit. The gastrointestinal tract is the limiting organ for the mixutre of radionuclides present in drinking water pumped from the Columbia River. In Pasco and Kennewick, which are further downriver, the estimated exposures from drinking water were respectively about 5% and 1% of the limit for the GI Tract. The only persons who received radiation exposures attributable to Hanford that were greater than those that resulted from the drinking water were the people who ate local fish or waterfowl or who regularly consumed produce from nearby farms irrigated with water taken from the Columbia River below the reactors.

The highly unlikely, but plausible combination of circumstances that would result in the greatest exposure to an individual from the radionuclides released by the Hanford plants is postulated as:

- The consumption of some 200 meals per year of fish caught downstream from the reactors

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- The consumption of meat, milk, fruit, and vegetables grown on irrigated farms in the Riverview District
- The consumption of drinking water from the Pasco system.

An individual with such habits could conceivably ingest enough radioactive materials of Hanford origin (mostly P^{32}) to supply about 25% of the annual permissible amount. For this "maximum" individual the bone is the most restrictive organ. This same individual could also ingest enough Sr^{90} of world-wide fallout origin to equal about 2% of the permissible amount--substantially less than the amount estimated for 1963.

I^{131} in the Hanford environs remained at very low concentrations in 1964. The Chinese nuclear test on October 16 caused a brief increase in I^{131}, but concentrations soon returned to the low levels experienced during most of 1964. The postulated "maximum" exposure from I^{131} to the thyroid of a small child amounted to only about 5% of the Radiation Protection Guide recommended for individuals by the Federal Radiation Council.

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EVALUATION OF RADIOLOGICAL CONDITIONS IN THE VICINITY OF HANFORD FOR 1964

I. INTRODUCTION

The Hanford project* (Figure 1) is located in a semiarid region of Southeastern Washington State where the average annual rainfall is about 7 in. This section of the state has a sparse covering of natural vegetation, primarily suited for grazing, although large areas near the project have gradually been put under irrigation during the past few years. The plant site (Figure 2) covers an area of about 500 mi^2. The Columbia River flows through the northern edge of the project and forms part of the eastern boundary. Near the plant production sites the prevailing winds are from the northwest with strong drainage and cross winds causing distorted flow patterns. The meteorology of the region is typical of desert areas with frequent strong inversions occuring at night and breaking during the day to provide unstable and turbulent conditions.

The populated area of primary interest is the Tri-Cities (Richland, Pasco, and Kennewick) situated on the Columbia River directly downstream from the plant. Smaller communities in the vicinity are Benton City, West Richland, Mesa, and Othello, and these, together with the surrounding agricultural area, bring the total population near the plant to about 80,000 people.

During the course of operation, various radioactive wastes are generated by the several plant facilities. High level wastes are concentrated and retained in storage within the project boundaries. Controlled releases of low-level wastes, for which concentration and storage is not feasible, are made to the ground. The Hanford practices governing radioactive waste disposal are described in the Hearings on Industrial Radioactive Waste Disposal held by the Joint Congressional Committee on Atomic Energy in 1959.[1]

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* Operated during 1964 for the Atomic Energy Commission by the General Electric Company under Contract Number AT(45-1)-1350.

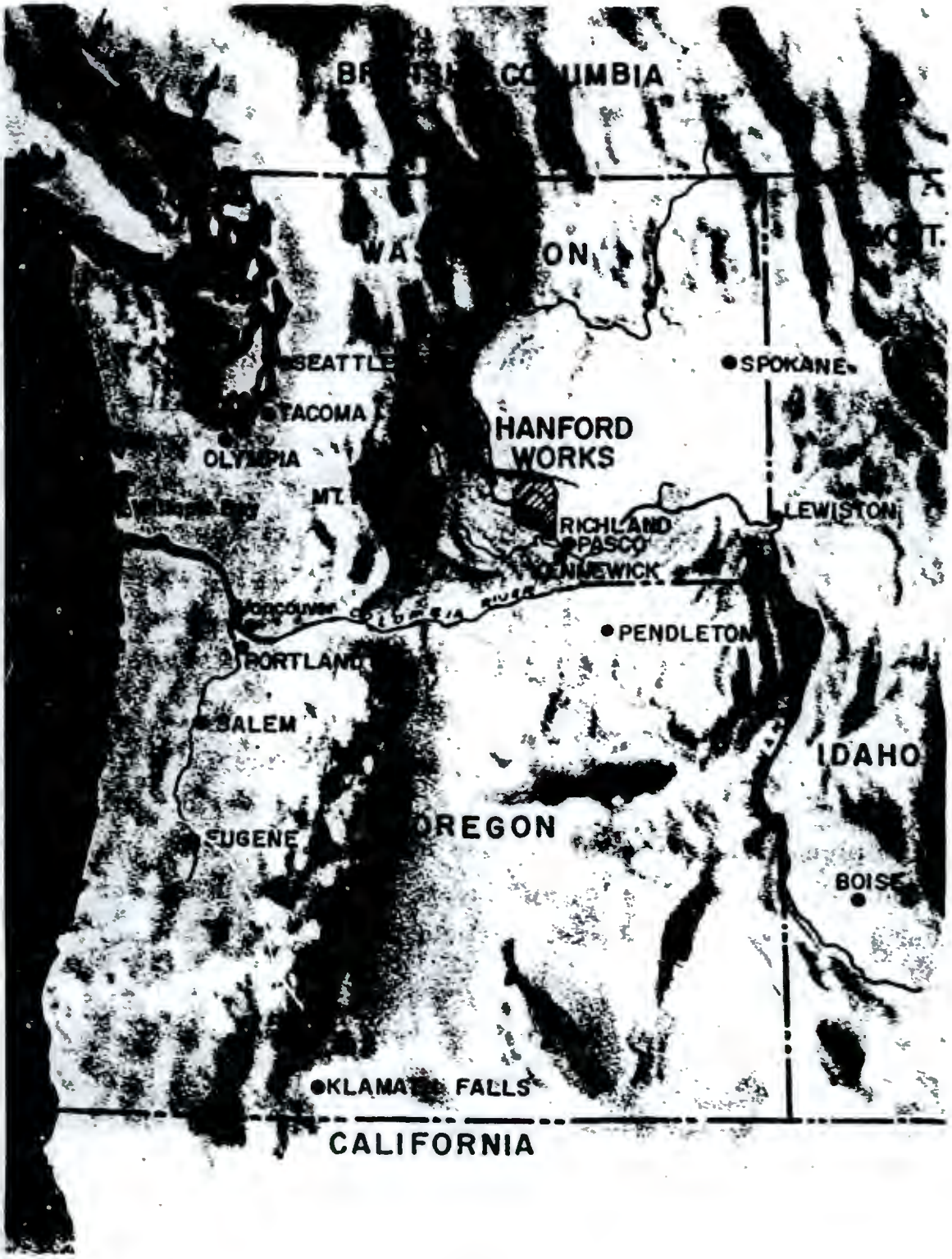

FIGURE 1

Geographical Relationship
of Hanford Works to Pacific Northwest

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FIGURE 2

Features of Hanford Project and Vicinity

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The AEC Manual Chapters[2] and the recommendations of the Federal Radiation Council (FRC),[3] the National Committee on Radiation Protection and Measurement (NCRP),[4] the International Committee on Radiation Protection and Measurement (ICRP),[5] and the results of Hanford research programs form the basis of radiation protection practices at Hanford. The recommendations of these organizations in the form of permissible rates of intake of specific nuclides and guides for radiation exposure constitute criteria against which radiation exposures estimated from measurements of the Hanford environmental surveillance program are compared. The results of these comparisons indicate the effectiveness of Hanford waste control and radiation protection practices and point out any conditions requiring attention.

This report presents estimates of the annual exposure received by the individuals judged to have received the greatest amount of radiation from environmental sources and the exposure received by people who are considered typical of this region. These exposures are compared with the recommendations of the FRC and NCRP. The Radiation Protection Guides established by the FRC for individuals are 1500 mrem/yr to the thyroid, 1500 mrem/yr to the bone, and 500 mrem to the whole body. The Radiation Protection Guides for the "average of a suitable sample of an exposed population group" are one-third of those for individuals. The NCRP recommendation, in the form of maximum permissible exposures for individuals that are not employed in radiation work are 1500 mrem/yr to the GI tract, 500 mrem/yr to the total body, and 3000 mrem/yr to the thyroid. The limits for bone-seeking nuclides are calculated with reference to biological effects observed from deposition of radium and are most readily applied in the form of maximum permissible rates of intake (MPRI). *

---

* The MPRI is taken as the maximum permissible concentration in water for a given radionuclide, as recommended by the NCRP for persons in the neighborhood of controlled areas, multiplied by the rate of water intake as defined for the standard man. This amounts to one-tenth of the MPC's for continuous exposure of occupational workers multiplied by 2200 cm^3/day, or by 800 liter/yr in the case of annual estimates.

II. ENVIRONMENTAL CONDITIONS

A discussion and interpretation of the results of the several Hanford environmental sampling programs are presented in the following text and figures. The raw data for many of the programs and brief descriptions of analytical methods used in determining the concentration of radionuclides in various samples are presented in the appendices.

A. Radionuclides in the Columbia River

Hanford's eight production reactors and the new N-Reactor use Columbia River water for cooling. The new N-Reactor was operated according to a power ascension program during 1964. In contrast with the old production reactors that circulate water once through as a coolant before it is returned to the river, the new reactor uses recirculating demineralized water as a primary coolant. Only a very small amount of radionuclides generated in auxiliary systems, such as the control rod cooling water, are released to the river. At the old reactors, stable elements present in the cooling water are transformed into radionuclides during passage through the reactors. In addition, radioactive materials formed on the surfaces of fuel elements and channels are eventually carried away by the cooling water to the river. One of the old production reactors, 105-DR, was shut down permanently on December 30, 1964.

The relative abundance of the radionuclides found in the cooling water of the old production reactors, as adjusted to 4 hr after leaving the reactor, is shown in Table I.

Many of the radionuclides formed in reactor cooling water are short-lived and decay rapidly after formation. In addition to radioactive decay, some portion of the radionuclides is removed from the water by sediments and by uptake by aquatic organisms. The radionuclides in the river also include some contribution of fallout from weapons tests.

The sampling program for Columbia River and sanitary water was generally revised during 1964. The major changes were a shift from Pasco

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TABLE I

RELATIVE ABUNDANCE
OF REACTOR EFFLUENT RADIONUCLIDES

Reference Time: 4 hr Postirradiation

Major, 90%	Minor, 8%	Trace, 2%		
Na^{24}	P^{32}	H^{3}	Ag^{111}	Pm^{147}
Si^{31}	Zn^{65}	C^{14}	Cd^{115}	Nd^{149}
Cr^{51}	Zn^{69m}	S^{35}	I^{131}	Pm^{149}
Mn^{56}	Ga^{72}	Ca^{45}	I^{132}	Pm^{151}
Cu^{64}	Y^{90}	Sc^{46}	Cs^{137}	Eu^{152}
As^{76}	Sr^{91}	Sc^{47}	Ba^{140}	Sm^{153}
Np^{239}	Sr^{92}	Mn^{54}	La^{140}	Eu^{156}
	Y^{92}	Fe^{59}	Ce^{141}	Sm^{156}
	Y^{93}	Co^{60}	La^{141}	Eu^{157}
	Nb^{97}	Sr^{85}	Pr^{142}	Tb^{160}
	I^{133}	Sr^{90}	Ce^{143}	W^{187}
	I^{135}	Y^{91}	Pr^{143}	Po^{210}
	U^{239}	Zr^{95}	$Ce\text{-}Pr^{144}$	Ac^{227}
		Mo^{99}	Pr^{145}	U^{238}
		Ru^{103}	Nd^{147}	Pu^{239}

(Trace nuclide composition based on analyses by the Radiological Chemistry Operation made in 1958.)

to Richland as the principal river monitoring point and a change from occasional "grab" samples to cumulative samples at several locations. Yearly averages, where shown, are weighted averages of the best data available.

Samples of river water were collected above the production areas at Vernita Ferry, and below the areas at the Richland and Pasco water plant intakes, McNary Dam, The Dalles Dam, and Bonneville Dam. Routine sample collection at Vancouver, Washington was discontinued during the first half of 1964 and replaced by the Bonneville Dam sampling site. Where possible, cumulative sampling equipment was installed which provided a more representative sample than the infrequent "grab" samples obtained in the past. This sampling technique, however, makes it impractical to calculate the amounts of very short-lived nuclides, and these must still be measured from "grab" samples. The average concentrations of radionuclides measured routinely at Richland, Pasco, and Bonneville Dam are shown in Table II, and the results of analyses for several nuclides in river water samples are shown in Appendix A, Tables 1-10.

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TABLE II

ANNUAL AVERAGE CONCENTRATIONS
OF SEVERAL RADIONUCLIDES
IN COLUMBIA RIVER WATER-1964

Units of pCi/liter

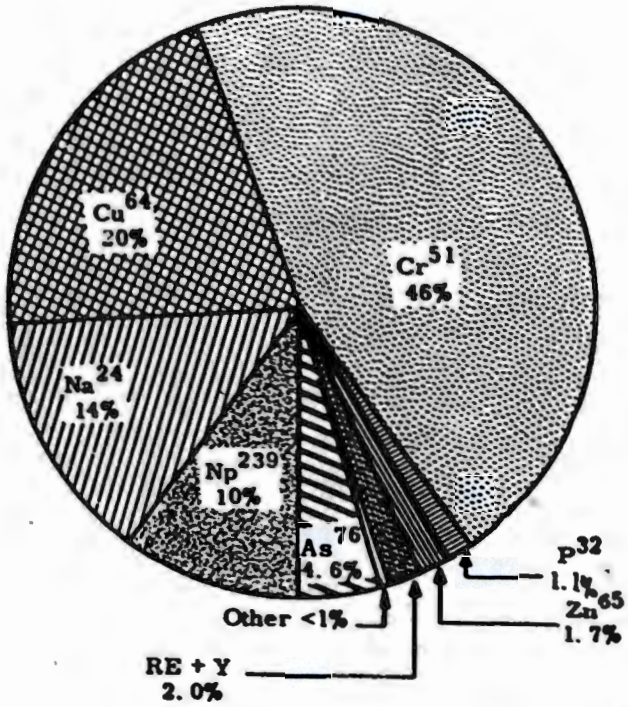
Radionuclide	Richland	Pasco	Bonneville Dam
Total Beta	(16 counts/min/ml)	-*	-
RE + Y	520	230	-
Na^{24}	3,500	1,500	-
P^{32}	300	200	28
Cr^{51}	12,000	6,800	2,400
Cu^{64}	5,300	2,100	-
Zn^{65}	450	240	63
As^{76}	1,200	670	-
Sr^{90}	1	1	-
I^{131}	19	12	<5
Np^{239}	2,600	1,300	-

* The (-) indicates insufficient sampling data to provide a a reasonable annual average.

The significant radionuclides measured at Richland, Pasco, and Bonneville Dam are illustrated in Figure 3. The areas of the circles are proportional to the total activity measured at these locations.

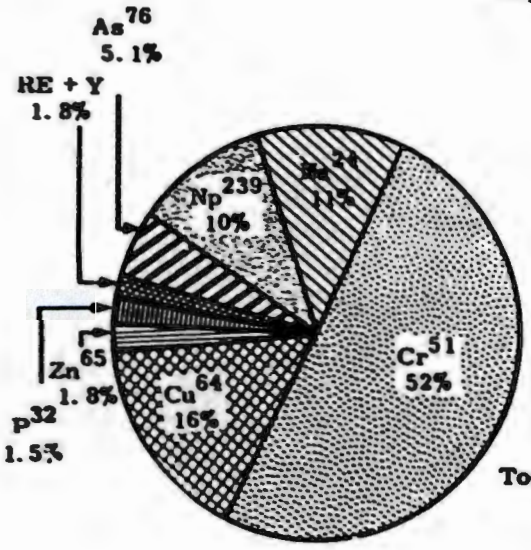
Measurements on a traverse across the river at Richland indicated slightly nonuniform distribution of the longer-lived radioisotopes throughout the river at this point. At Pasco, the distribution was also slightly nonuniform primarily because of the entry of the Yakima River some 10 mi upstream. Similarly, the distribution of radionuclides at McNary Dam is influenced by the Snake River whose confluence with the Columbia River is about 30 mi above the dam. The Dalles Dam and Bonneville Dam are approximately 190 mi and 240 mi, respectively, below the Hanford reactors and represent the farthest downstream locations where river water is is routinely sampled for Hanford's environmental surveillance program.

The seasonal variation in flow rate of the Columbia River markedly affects the quantity of water available for dilution of reactor effluent released to the river. Also affected by the flow rate is the time required



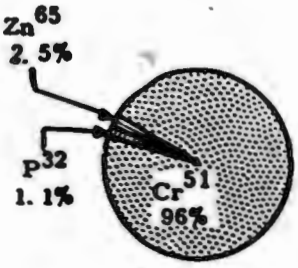
Richland

Total Activity Represented
26,000 pCi/liter



Pasco

Total Activity Represented
13,000 pCi/liter



Bonneville

Total Activity Represented
2500 pCi/liter

FIGURE 3

Relative Abundance of Radionuclides in Columbia River Water at Several Locations, Annual Averages, 1964

for a specific volume of water to move from one location to another. The flow rates (data supplied by the U. S. G. S.) of the Columbia River at Richland and Bonneville Dam are shown in Figure 4, and the variation in concentrations of several radionuclides in river water at Richland are shown in Figure 5. The rate of transport of these same radionuclides past Richland is shown in Figure 6 and Appendix A, Tables 11 and 12. The rate of transport of certain radionuclides passing Bonneville Dam provides an upper limit on the quantities entering the Pacific Ocean from the Columbia River. The annual average rate of transport of selected radionuclides is given in Table III and detailed measurements are tabulated in Appendix A, Tables 15 and 16.

TABLE III

ANNUAL AVERAGE RATE OF TRANSPORT OF SELECTED RADIONUCLIDES PAST BONNEVILLE DAM

Ci/day

Radionuclides	1964	1963*	1962*	1961*
P^{32}	12	12	13	29
Cr^{51}	860	860	650	840
Zn^{65}	44	28	29	44

* Rate of transport at Vancouver, Washington

An estimate of the inventory of these radionuclides which exist in the ocean may be calculated by assuming an equilibrium between the rate of addition through the river and the rate of decay in the ocean. A constant rate of entry into the ocean equivalent to that indicated by the 1964 Bonneville Dam measurements would imply an inventory of about 250 Ci of P^{32}, 30,000 Ci of Cr^{51} and 14,000 Ci of Zn^{65}.

There is no known instance of untreated river water being consumed routinely by humans. For comparative purposes, however, the relationship between the concentrations of radionuclides in untreated Columbia River water and "maximum permissible concentrations" in water is shown in Table IV. In this instance the comparison is with the MPC's listed in Column 2, Table II of Annex I of AEC Manual Chapter Appendix 0524.[2]

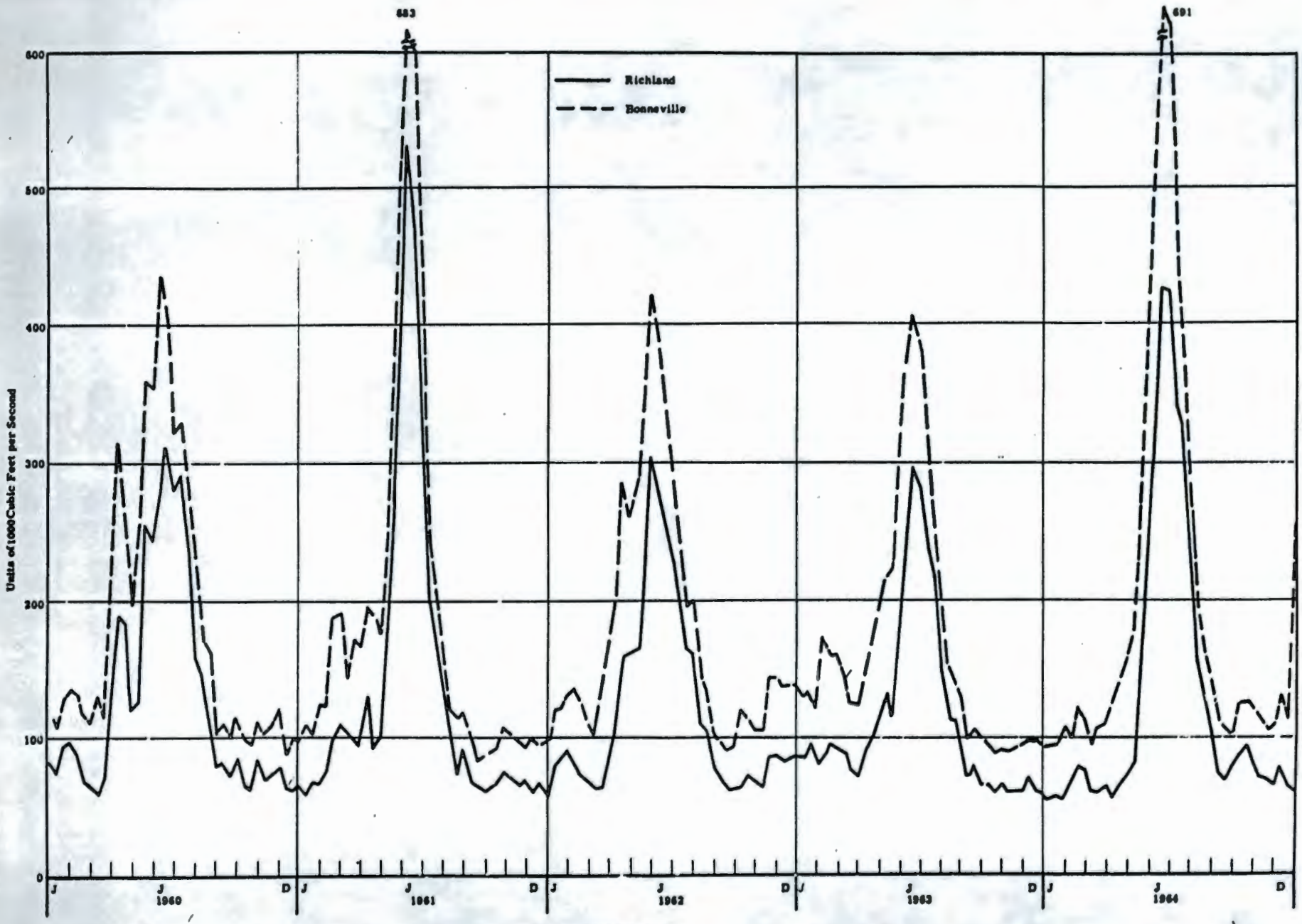


FIGURE 4

Columbia River Flow at Richland and Bonneville Dam

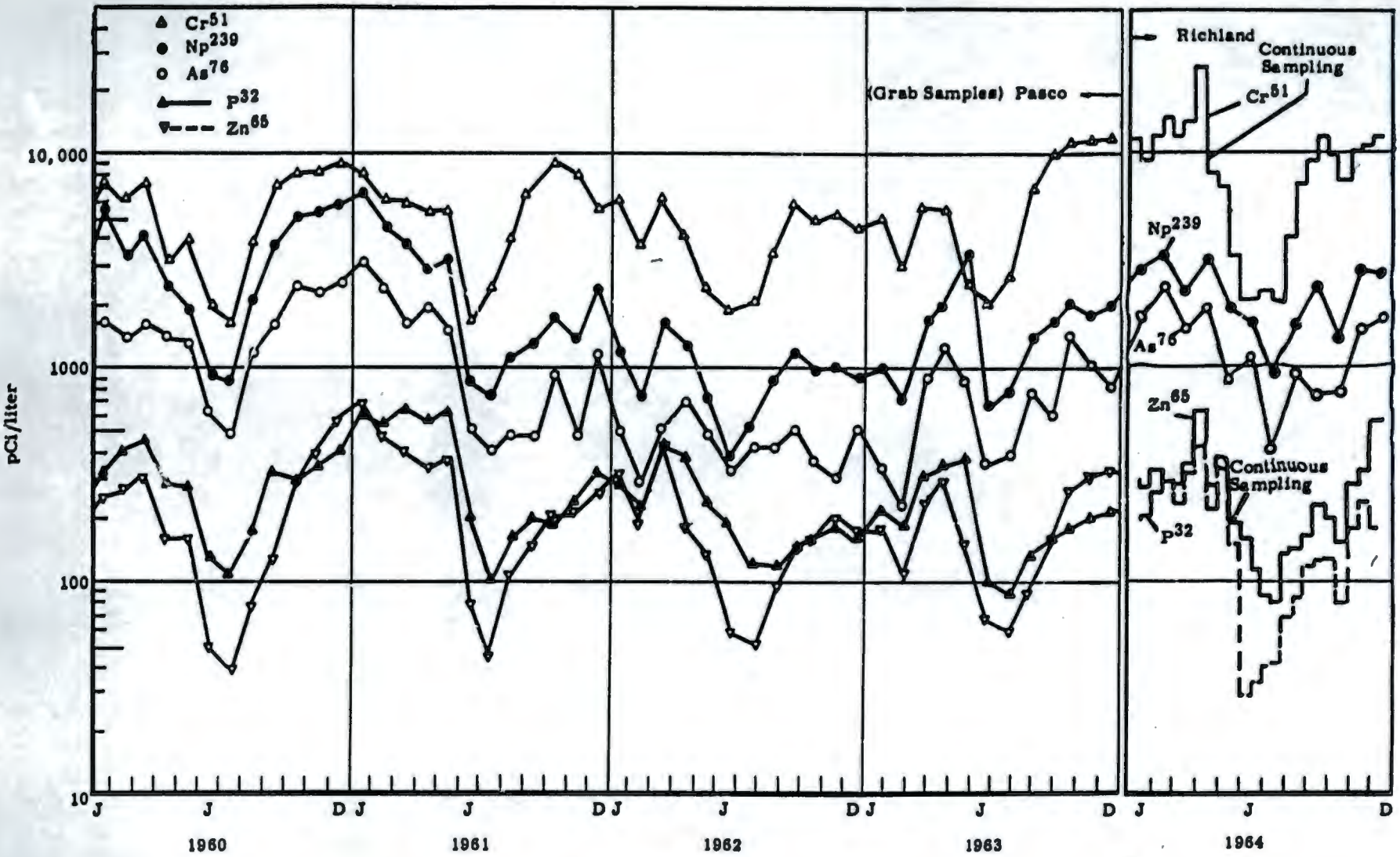


FIGURE 5

Concentration of Radionuclides in Columbia River Water at Pasco and Richland, Washington

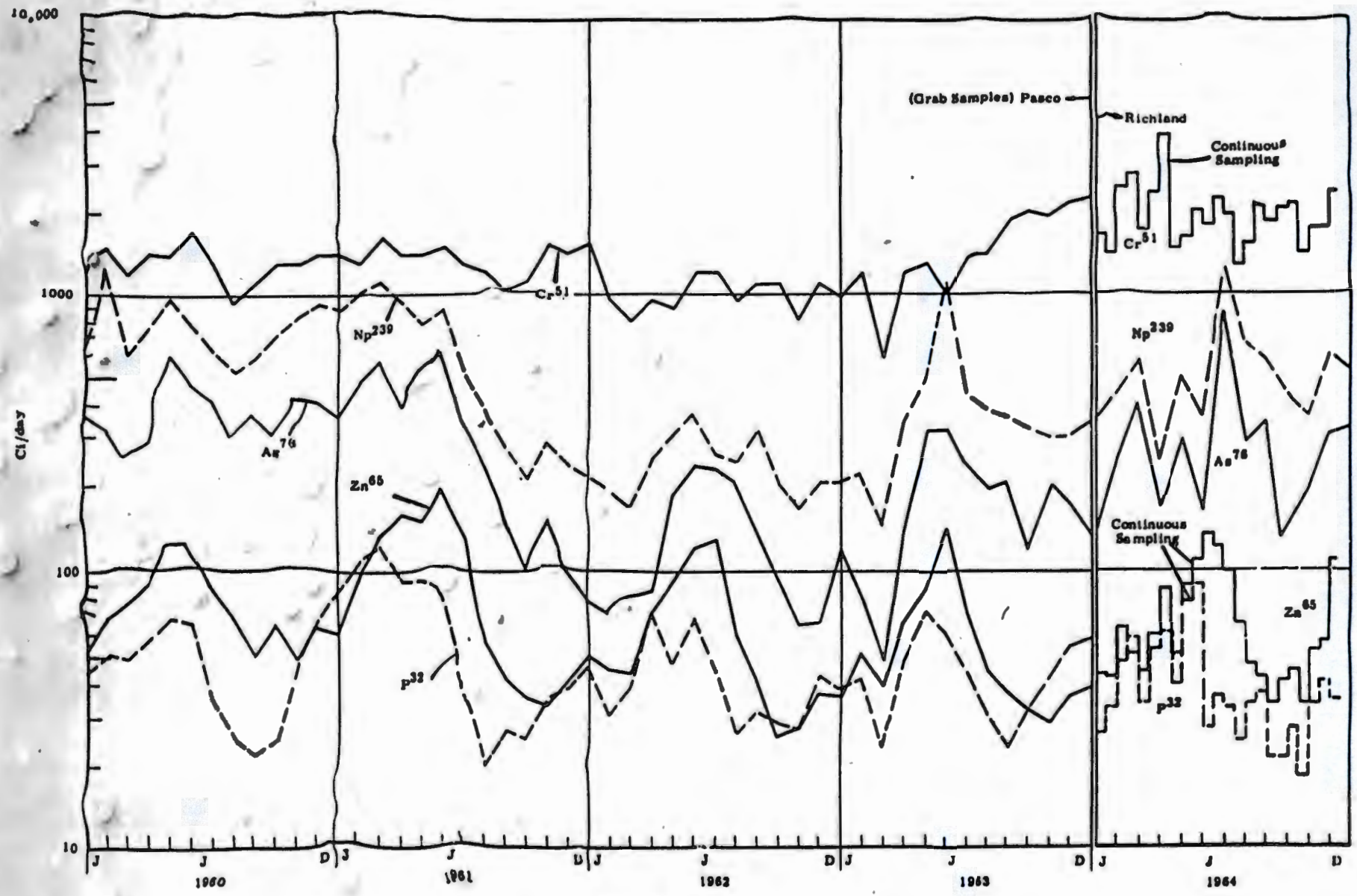


FIGURE 6

Rate of Transport of Radionuclides at Pasco and Richland, Washington

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TABLE IV

RELATIONSHIP BETWEEN THE CONCENTRATIONS OF RADIONUCLIDES IN UNTREATED COLUMBIA RIVER WATER AND MAXIMUM PERMISSIBLE CONCENTRATIONS

Sampling Location	MPC, %*
Richland	15
Pasco	7
Bonneville Dam	<1

* This is a summation of the percents of MPC's contributed by the several individual radionuclides measured routinely in the river water. The MPC's used and the method of summation are taken from AEC Manual Chapter 0524.

For the most part, these MPC's are equivalent to one-tenth of the most limiting values recommended by the NCRP[4] for occupational workers. The marked reduction in percent of MPC_w that occurs with distance downstream from the reactors results principally from radioactive decay of the shorter-lived nuclides.

B. Radionuclides in Drinking Water

The city of Richland is the first community downstream from the Hanford reactors that uses the Columbia River as a source of sanitary water supply. The year 1964 was the first full year of operation for Richland's new water treatment plant. Previously, Richland's sanitary water was obtained from wells, but now these wells are used only during peak demand periods. Pasco and Kennewick, a few miles further downstream, continued to use the Columbia River as a source of sanitary water during 1964. Continuous sanitary water samples were collected at the Richland water plant and periodic sampling was accomplished at Pasco and Kennewick. All of these samples were analyzed for the important individual radionuclides. The detailed results of analysis of sanitary water from these three cities are presented in Appendix B, Tables 1 through 5, and are summarized in Table V.

The concentrations of short-lived radionuclides in the water at the time it is consumed is less than shown in Table V because there is a

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TABLE V

ANNUAL AVERAGE CONCENTRATION
OF SEVERAL RADIONUCLIDES
MEASURED IN SANITARY WATER-1964

Units of pCi/liter

Radionuclide	Richland	Pasco	Kennewick
Total Beta	(10 counts/min/ml)	(3.4 counts/min/ml)	(0.54 counts/min/ml)
RE + Y	70	60	10
Na^{24}	2500	700	150
P^{32}	40	40	<10
Cr^{51}	8000	6000	3000
Cu^{64}	2000	400	90
Zn^{65}	90	70	<20
As^{76}	450	200	<50
Sr^{90}	2	1	<0.5
I^{131}	10	8	<3
Np^{239}	2000	450	50

significant flow time between the water plant and most consumers. The flow time may vary from hours to days depending upon the location of the customers on the distribution system and the water demand.

Table VI shows the apparent removal of several radionuclides by the water treatment at Pasco and Richland. These data include the radioactive decay of the short-lived radionuclides during travel through the water treatment plant.

The calculated annual average dose to the GI tract, total body, and the percentage MPRI for bone from sustained consumption of sanitary water throughout the year at the three cities is presented in Table VII.

The relative contribution of several radionuclides in the Richland sanitary water to the calculated annual dose to the GI tract is shown in Figure 7 and long-term trends in the GI tract dose for Pasco and Richland are shown in Figure 8.

The dose received by the GI tract of Pasco residents continued at approximately the same level as experienced during 1963. The dose received by the GI tract of Richland residents was somewhat lower in 1964

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than was predicted from the initial results obtained following start-up of the new water treatment plant in the latter part of 1963.

TABLE VI

DEPLETION OF RADIONUCLIDES FROM COLUMBIA RIVER WATER BY TREATMENT AT THE RICHLAND AND PASCO WATER PLANTS-1964

Radionuclide	Depletion, % Pasco	Richland
RE + Y	80	90
Cu^{64}	80	70
As^{76}	70	70
Zn^{65}	70	80
P^{32}	60	90
Na^{24}	50	30
Np^{239}	40	30
Cr^{51}	10	30

TABLE VII

CALCULATED ANNUAL DOSE FOR SELECTED ORGANS FROM ROUTINE INGESTION OF SANITARY WATER*-1964

	Total Body, mrem	GI Tract, mrem	Bone, % MPRI	Thyroid (Small Child, 1 liter/day), mrem
Richland	3.5	50	1	75
Pasco	<2	20	0.8	40
Kennewick	<1	<5	<0.5	<20

* Here and elsewhere in this report where a dose from an ingested nuclide is expressed in mrem units, the determination is made from parameters used by the ICRP to translate dose rates into Maximum Permissible Concentrations for drinking water. In most cases, the estimated annual intakes of individual radionuclides were multiplied by conversion factors derived from the ICRP parameters and published by Vennart, et al.[8] The "standard man"[5] average intake of 1.2 liter/day was used in this calculation.

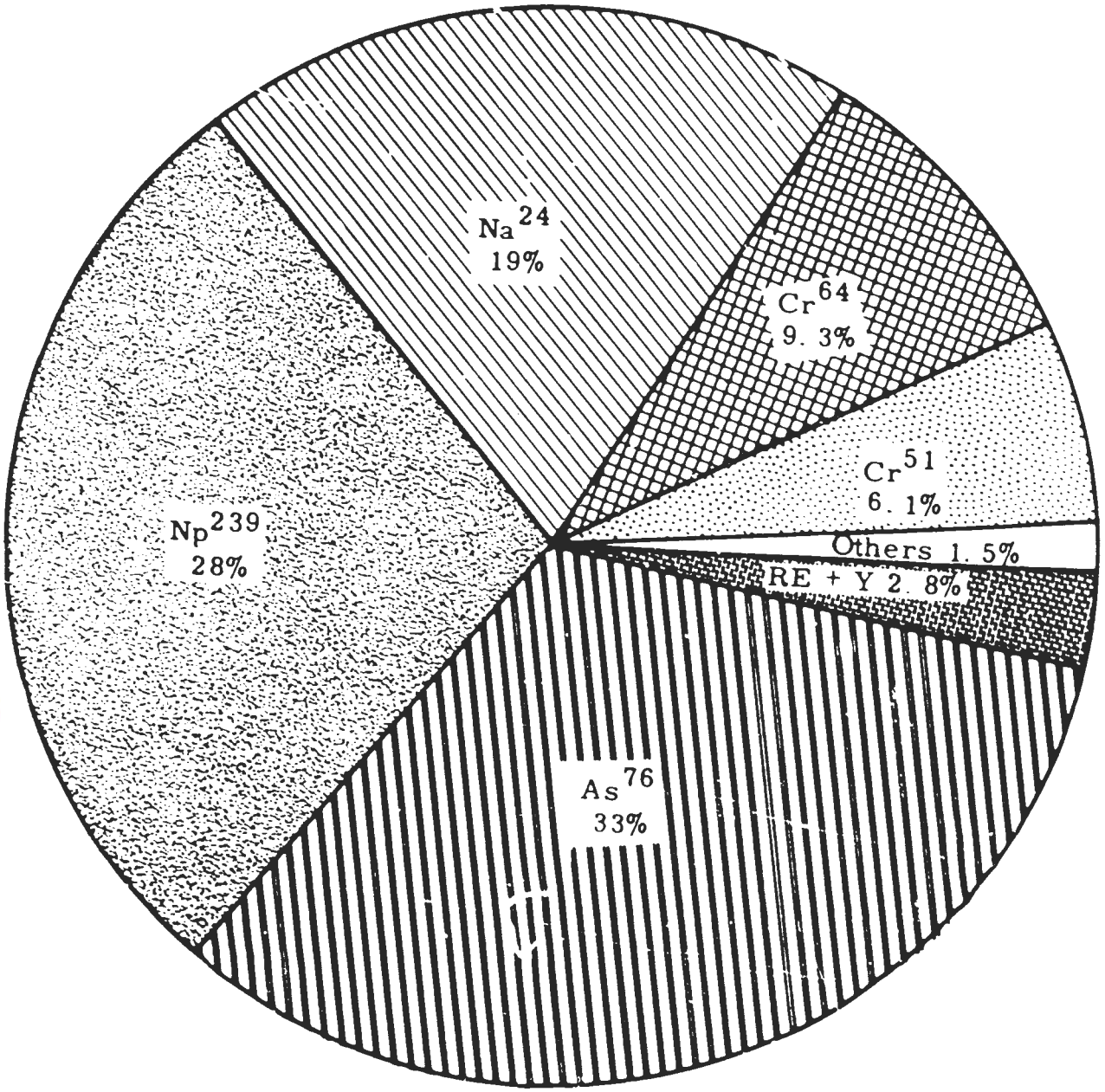

FIGURE 7

Relative Contributions of Radionuclides to GI Tract Dose
Richland Sanitary Water, 1964

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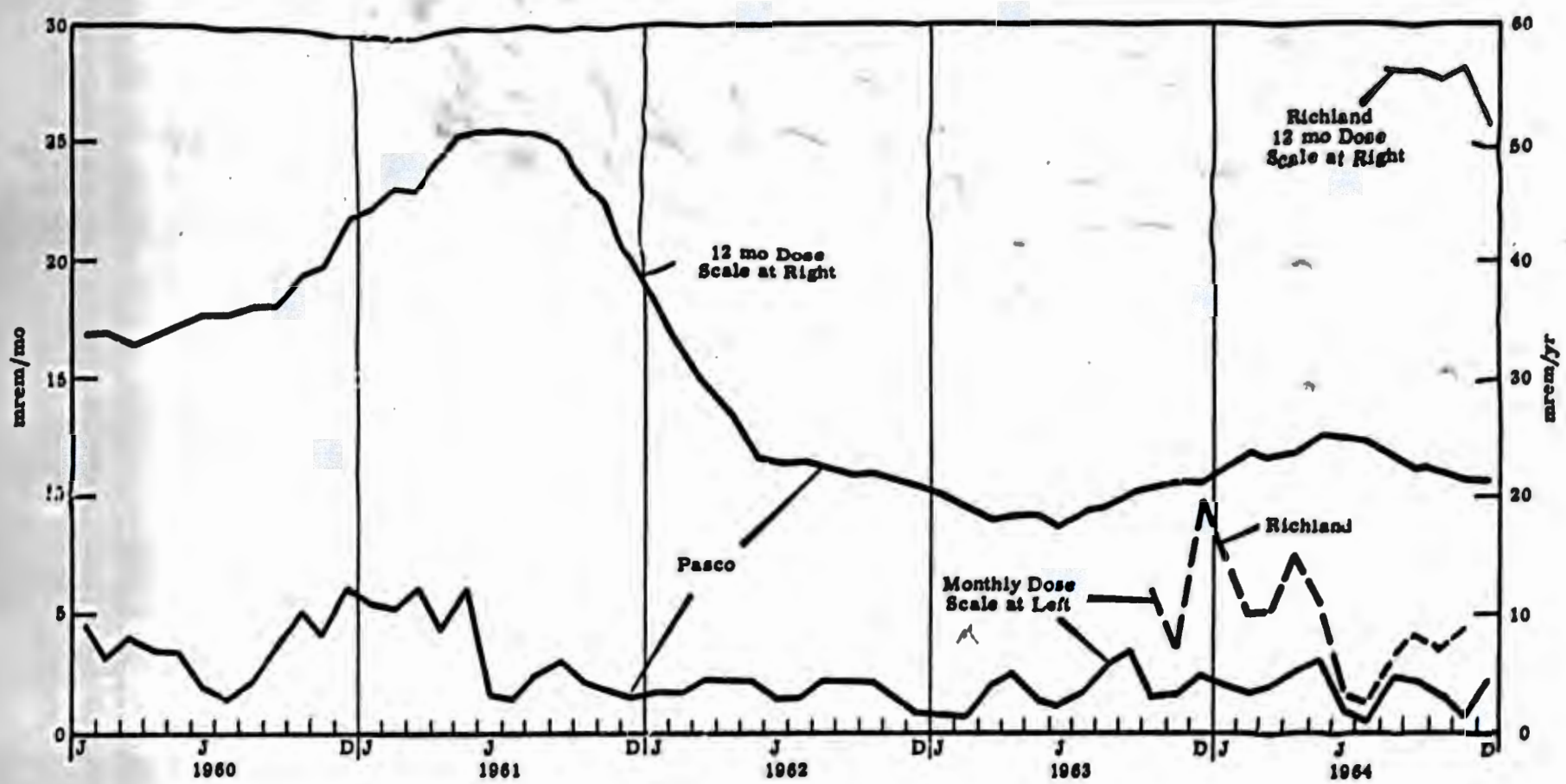

FIGURE 8

Calculated Dose to GI Tract from Pasco and Richland Sanitary Water

C. Radionuclides in Fish and Waterfowl

The Columbia River is popular for sports fishing both above and below the Hanford plant, and the fish that feed downstream from the reactors acquire some radionuclides from the reactor effluent. The concentration of several radionuclides measured in the different kinds of fish from several locations on the river are shown in Appendix C, Tables 1 through 12. Whitefish are the sports fish that usually contain the greatest concentration of radioactive materials, and P^{32} is the radionuclide of greatest significance. Further, they can be caught during winter months when other sports fish are difficult to sample. For these reasons, whitefish are sampled most intensively to follow trends. The results of the measurements are illustrated in Figure 9.

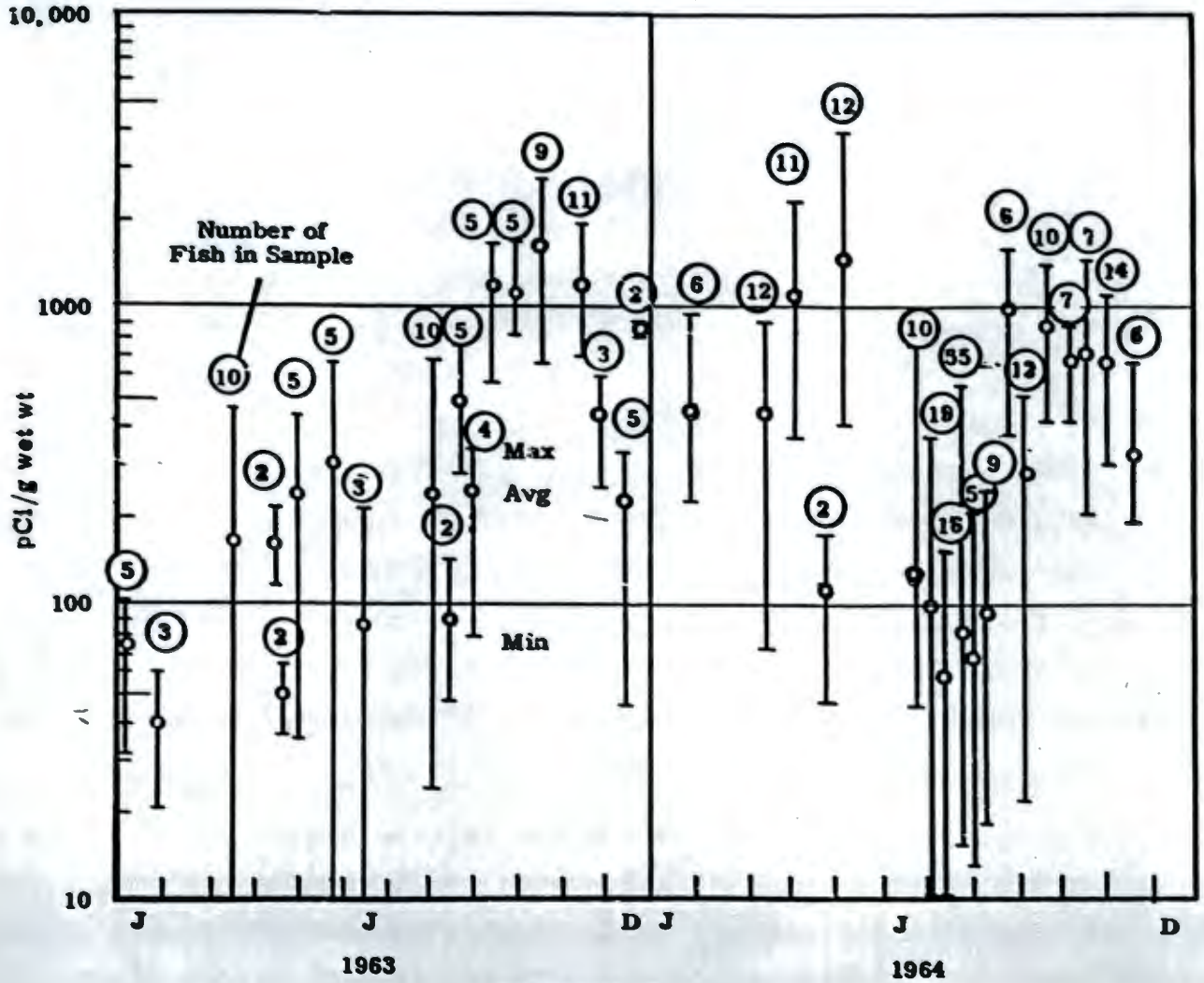

FIGURE 9

P^{32} in Whitefish Caught in Columbia River Between Ringold and Richland

Usually the peak concentrations of P^{32} in whitefish occur during the fall months. During 1964, however, below normal river flow rates in the spring, and below normal river temperatures in the fall, resulted in peak concentrations during the first half of the year. The overall effect of these unusual conditions was an annual average concentration in whitefish of about 470 pCi P^{32}/g and 37 pCi Zn^{65}/g—virtually the same as in 1963. If whitefish were eaten fresh at the rate of one meal per week (about 25 lb/yr), the intake during 1964 would have been approximately 5 pCi of P^{32} and 0.4 pCi of Zn^{65}. The resulting exposure would have been about 100 mrem to the GI tract, 40 mrem to the total body, and 30% of the MPRI for bone. Many of the fishermen that catch whitefish prefer to smoke them, and radioactive decay of the P^{32} (2 wk half-life) during storage of the preserved fish reduces the potential intake of this nuclide.

The quantities and kinds of fish caught by local fishermen have been estimated previously from surveys carried out by personnel of the State of Washington, Department of Game, and no additional dietary data were collected during 1964 that would change these estimates. Those individuals who probably ingest the largest amounts of P^{32} are fishermen who claim to eat bass, crappie, perch, and catfish as often as three to five times a week. This number of fish meals indicates an annual intake of about 90 lb of fish. Analyses of these species of fish from locations fishermen claimed to visit most frequently indicated no peak concentration in the spring and generally lower P^{32} concentrations than found in whitefish (used as reference for estimating dose in the preceding paragraph). On the basis of the 90 lb of fish consumption claimed by the "maximum individual," (~200 fish meals/ year), the intake of P^{32} during 1964 could have been approximately 3μCi.

Many persons have been counted in the Hanford Whole Body Counter, including some avid fishermen. Amounts of Zn^{65} detected in these people were much less than expected on the basis of their stated fish consumption. These results supported the findings of 1963 which suggested that fishermen

tend to overestimate their fish consumption. Therefore, the actual ingestion rates of both P^{32} and Zn^{65} are substantially lower than postulated from the fishermen's estimates.

Migratory waterfowl, such as ducks and geese, that have utilized the Hanford section of the Columbia River and the swamps and ponds within the project boundaries may contain P^{32}, Zn^{65}, and other radionuclides. Some of these waterfowl remain in this general area throughout the year. Results of the radioassay of 147 samples collected during the hunting season within the Hanford project and in the environs, and of 71 samples contributed by hunters from areas adjacent to the plant, are tabulated in Appendix C, Tables 13-15. Only five samples contributed by hunters contained concentrations of P^{32} greater than the detectable level of 50 pCi/g of flesh (wet weight), and the highest concentration found was 650 pCi/g. Of all waterfowl samples collected in the Hanford environs, about one-third contained detectable levels of P^{32}, and about one in ten contained 500 pCi/g or greater. The maximum concentration measured during the hunting season was 1700 pCi P^{32}/g of flesh.

D. Radionuclides in Marine Organisms

Zn^{65} and P^{32} are the only radionuclides in the reactor effluent that are found in sufficient abundance beyond the mouth of the Columbia River to be of radiological interest. Oysters have been found to contain higher concentrations of Zn^{65} than other common sea food organisms. Concentrations of Zn^{65} and P^{32} measured in oysters grown in the Willapa Bay area are shown in Figure 10, and the analytical results are tabulated in Appendix D, Table 1. Concentrations of Zn^{65} have gradually decreased over the past 2 yr while P^{32} concentrations have remained at about the same level. The average concentrations in samples taken periodically throughout the year were 56 pCi Zn^{65}/g and 4 pCi P^{32}/g.

Consumption of oysters containing these concentrations at the rate of one meal per week (1/2 lb) would result in an annual exposure of about 7 mrem to the GI tract, 4 mrem to the total body, and about 0.5% of the MPRI for bone.

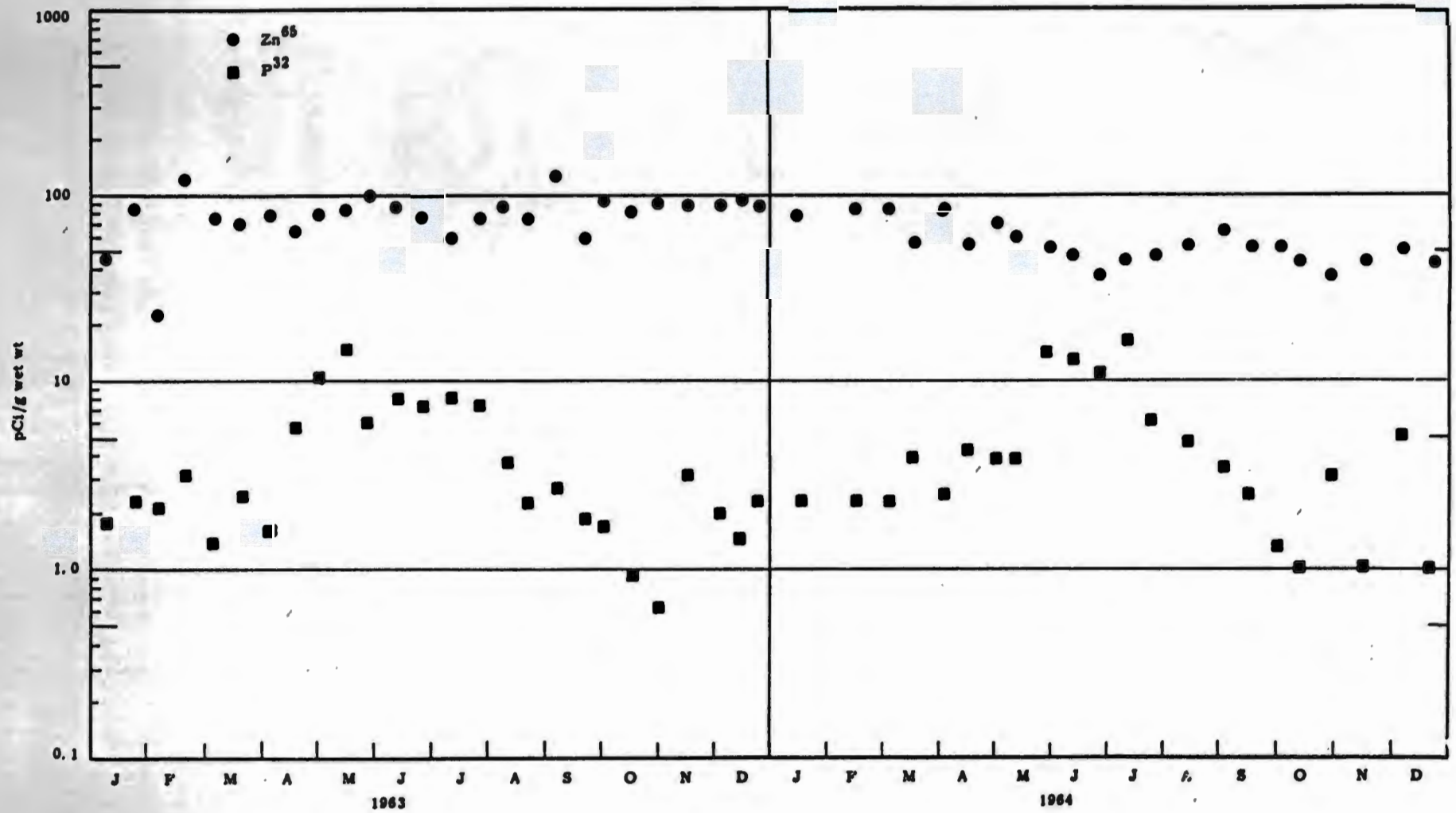

FIGURE 10

Zn^{65} and P^{32} in Willapa Bay Oysters

E. Radionuclides in the Atmosphere

At Hanford, gaseous waste from the chemical separations facilities is released to the atmosphere through 200-ft high stacks after most of the radioactive materials have been removed by filters and scrubbers. These radioactive materials are primarily associated with process vessel off-gases. Ventilation air from laboratory and reactor buildings contain comparatively minor amounts of radioactive materials under normal operating conditions.

I^{131} is the radionuclide of principal interest in the separations facilities process off-gases. Gross beta measurements are continuously made to detect any change in emission rates of other radionuclides. Measurements of I^{131} during 1964 are tabulated in Appendix E, Table 1, and the average release rates are shown in Figure 11. The results for the past 4 yr are summarized in Table VIII. Fission product recovery facilities operating at Hanford contributed negligible amounts of radionuclides to the environs during 1964. The average emission rate of Sr^{90} from these facilities was less than 0.002 Ci/day.

TABLE VIII

ANNUAL AVERAGE EMISSION RATES OF SEVERAL RADIONUCLIDES FROM SEPARATIONS PLANT STACKS

Ci/day

Radionuclide	1964	1963	1962	1961
I^{131}	0.22	0.38	0.35	0.7
$Zr\text{-}Nb^{95}$	-	-	0.0024	0.005
Ru^{103}	-	-	0.0009	0.003
Ru^{106}	-	-	0.0036	0.005
Ce^{141}	-	-	0.0002	0.006
Ce^{144}	-	-	0.015	0.01
Filterable Gross Beta	0.030	0.013	-	-

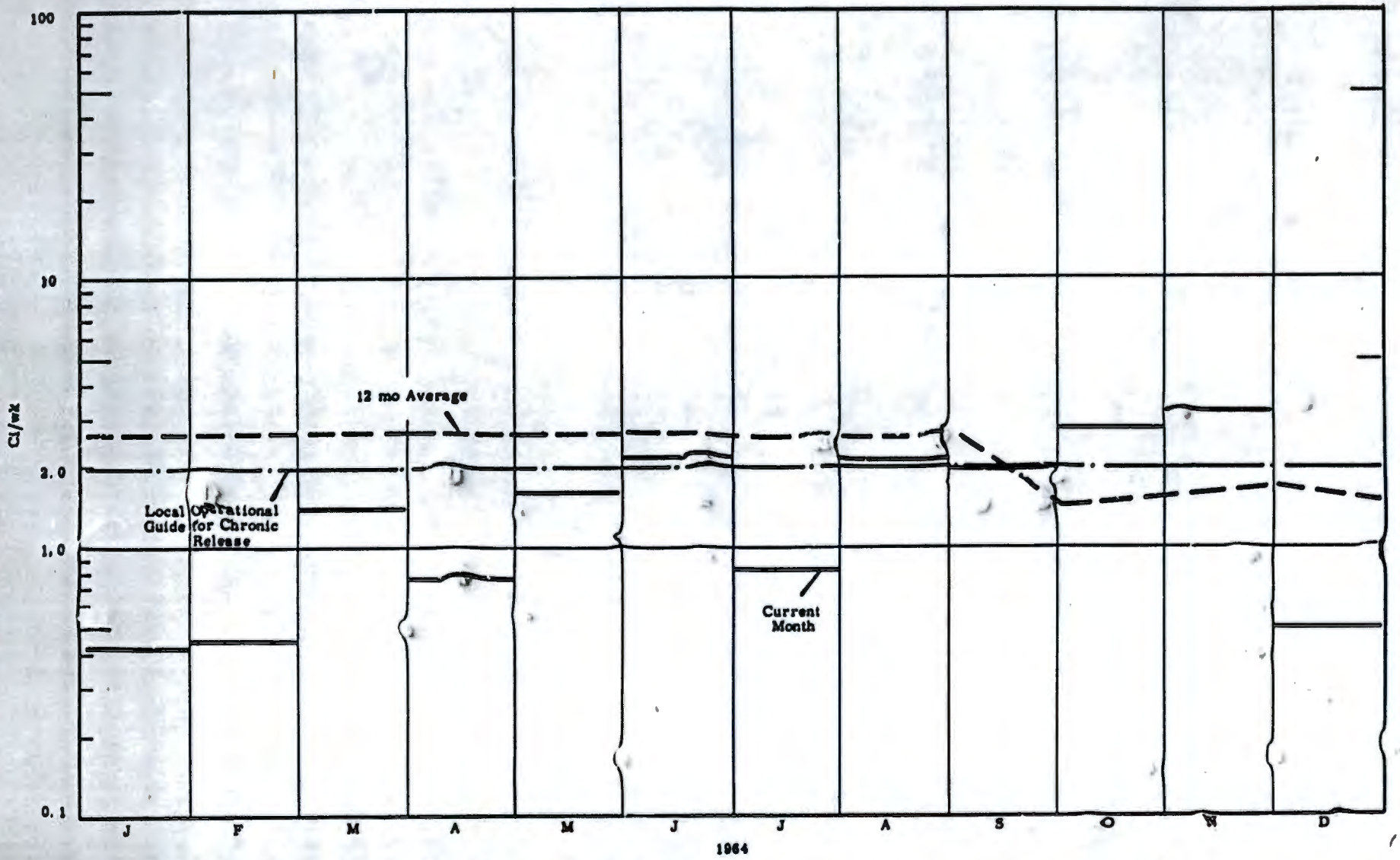

FIGURE 11

Release of I^{131} to the Atmosphere

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Measurements of airborne I^{131} were made routinely at several locations within the Hanford reservation and at several locations around the plant perimeter. The results of I^{131} measurements for the past few years are summarized in Table IX and in Appendix E, Table 2.

TABLE IX

AVERAGE I^{131} CONCENTRATIONS IN THE ATMOSPHERE

Units of pCi/m^3

Location	Distance from Separation Stacks, mi	1964	1963	1962	1961
Benton City	20	0.06	0.03	0.08	0.02
Prosser Barricade*	14	0.02	-	-	-
Richland	23	0.02	0.02	0.04	0.02
Pasco	32	0.01	0.02	0.08	0.04

* Installed during October, 1963

The four locations listed in Table IX lie within a 45° sector southeast to south of the separations center. The annual average concentrations of I^{131} in air about the Hanford plant during 1964 were generally 0.05 pCi/m^3 or less. Such concentrations sustained in inspired air imply an annual dose to the thyroid of the "standard man" of less than 1 mrem.

Air sampling stations are maintained at several locations within the Hanford reservation and at several locations situated around the plant perimeter. Early in 1964 the remote sampling stations (Boise and Lewiston, Idaho; Klamath Falls and Meacham, Oregon; Great Falls, Montana; and Seattle, Washington) were discontinued and replaced by stations forming a closer ring about the perimeter of the Hanford reservation. The sampling stations now in operation include Pendleton and McNary Dam, Oregon; Spokane, Walla Walla, Yakima, Moses Lake, Ellensburg, Wenatchee, Sunnyside, and Washtucna, Washington. The results of air sampling at these locations are shown in Figure 12 and are tabulated in Appendix E, Table 3. During the early part of 1964 beta activity on air filters was less than 1 pCi β/m^3 but increased to about 3 pCi β/m^3 in May during the spring influx of worldwide fallout. The airborne activity then decreased steadily

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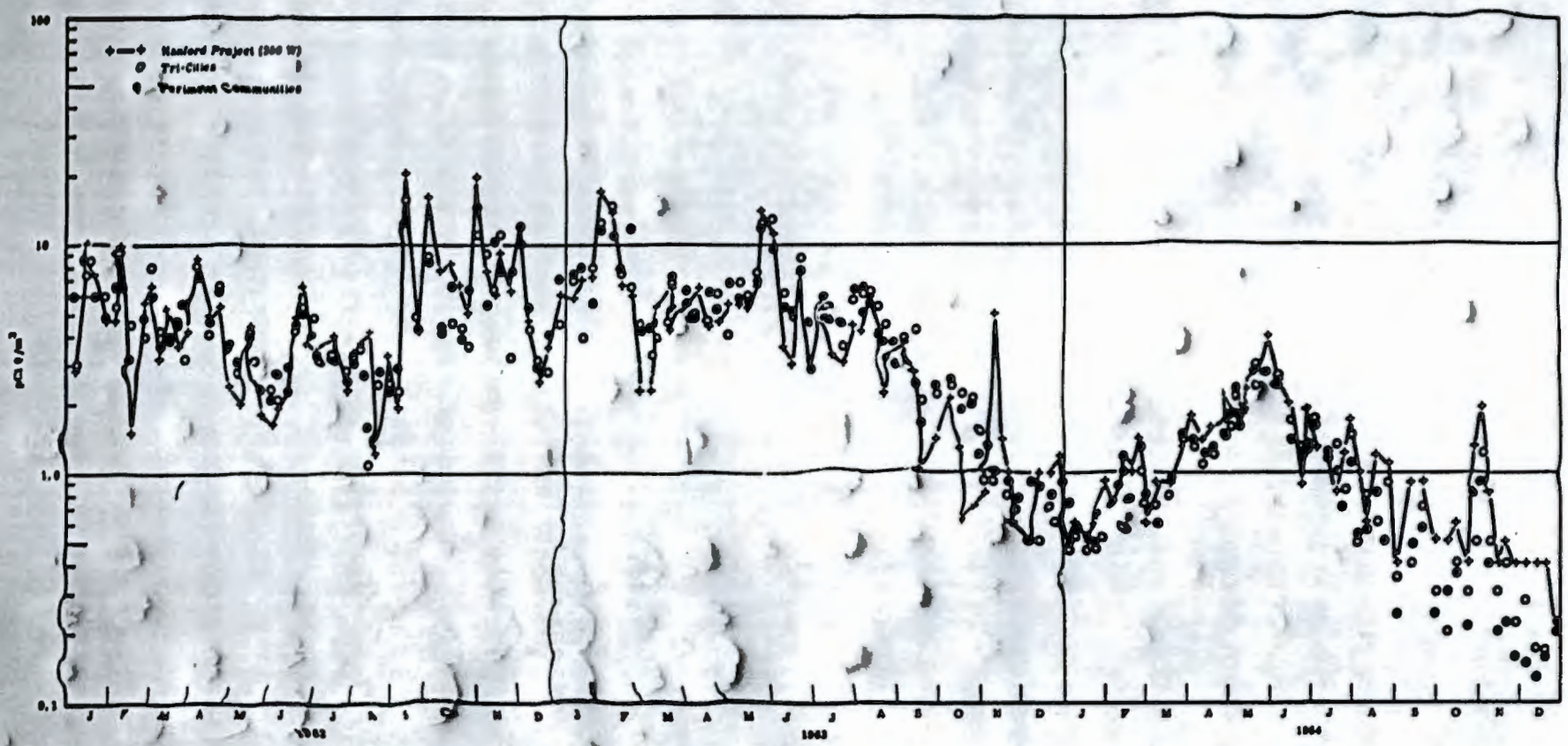

FIGURE 12

Concentrations of Radioactive Particulates in the Air in the Hanford Environs

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to less than 1 pCi β/m^3 except for a very brief period at the end of October when fallout from the Chinese nuclear test caused a slight increase.

Results of air filters are not used in estimating exposure but serve to illustrate the trends in atmospheric contamination. Sudden changes in concentration are used to signal the need for shifted emphasis in other portions of the environmental monitoring program related to atmospheric contamination.

F. Radionuclides in Milk and Produce

The radioactivity found in locally grown agricultural produce can be influenced by deposition of airborne radionuclides, or by irrigation with river water containing reactor effluent radionuclides. The chemical separations facilities are generally considered to be the principal local source of airborne radionuclides. Ventilation stacks of the reactors or laboratory facilities possibly could, under certain conditions, become of some small interest. The closest farming area to the separations facilities is about 13 mi away.

Most irrigated farms near the Hanford plant use water from the Yakima River, or from the Columbia River above the project. There are, however, two small areas which take water regularly from the Columbia River downstream from the reactors for irrigation. They are the Ringold farms and the Riverview district west of Pasco located 15 and 30 mi, respectively, downstream from the reactors. The Ringold farms, approximately 13 mi east of the production areas involve about 20 people working some 500 acres of land with fruit as the principal product. The Riverview farm area consists of about 5300 acres supporting about 1000 families, the majority of which live on plots of an acre or less and raise family gardens. The principal products from the larger farm plots are hay, fruit, beef, and dairy products. This area is located 30 mi southeast of the chemical separations plants. Another agricultural area near the project is Benton City, located on the Yakima River about 20 mi directly south of the separations facilities.

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A comprehensive milk surveillance program maintained during 1964 included samples from local farms and dairies and from commercial supplies available to people in the Tri-Cities. The concentrations of radionuclides found in milk sold by commercial outlets were similar to that reported by the U. S. Public Health Service and the Washington State Department of Health.[10] Milk from local farms irrigated with water from the river downstream from the reactors contained P^{32} and Zn^{65} as well as several fission products of fallout origin.

The concentrations of I^{131} measured in milk samples collected during 1964 are shown in Figure 13. Generally, the average concentration of I^{131} in both local and commercial milk was at or below the reporting limit of 3 pCi/liter except for a brief increase during the summer months and again briefly following the Chinese nuclear test in the fall. The maximum concentration of I^{131} observed in milk was 36 pCi/liter on November 10, 1964. Activity levels then decreased rapidly in December to 3 pCi/liter or less.

Concentrations of Sr^{90} measured in milk produced locally ranged from less than 2 pCi/liter to 16 pCi/liter as shown in Figure 14. These values are similar to concentrations found in commercial milk produced in areas that are remote from the Hanford plant. Sr^{90} found in milk from local farms averaged about 8 pCi Sr^{90}/liter, and a generally decreasing trend was observed throughout the year Concentrations of Sr^{89} and Cs^{137} in milk analyzed at Hanford were generally at or below the detection levels of 2 pCi Sr^{89}/liter and 30 pCi Cs^{137}/liter. Worldwide fallout is the principal source of these radionuclides in milk.

Dairy farms in the Ringold and Riverview area that utilize the Columbia River for irrigation of pasture land and hay fields produce milk containing both P^{32} and Zn^{65} (Figures 15 and 16). During 1964 the average concentration of P^{32} in milk from these farms was about 1600 pCi/liter and the concentration of Zn^{65} was 550 pCi/liter. The highest concentrations of P^{32} in milk (5700 pCi/liter) was observed during August, a period of heavy

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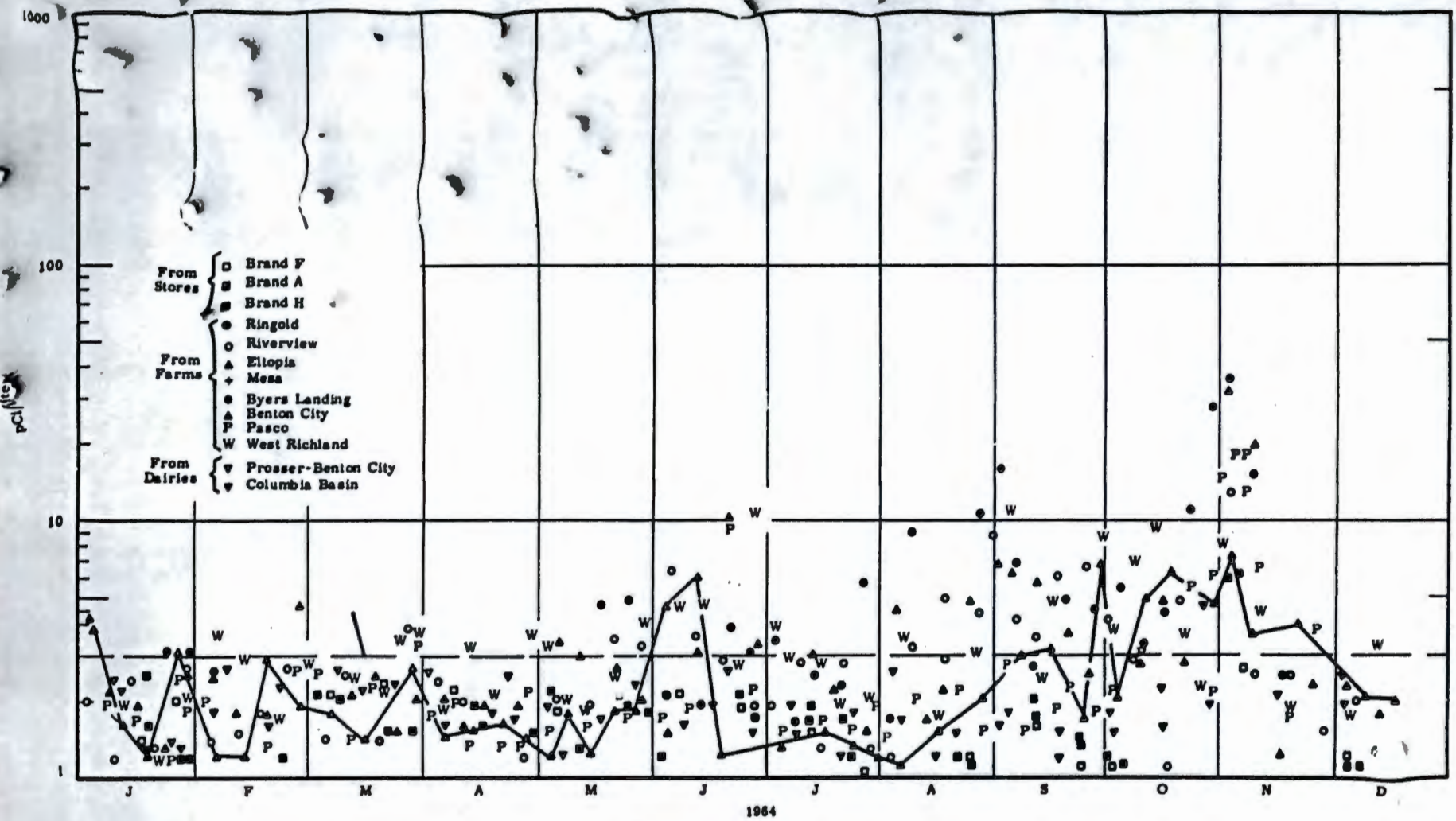

FIGURE 13

I^{131} in Local Milk, 1964

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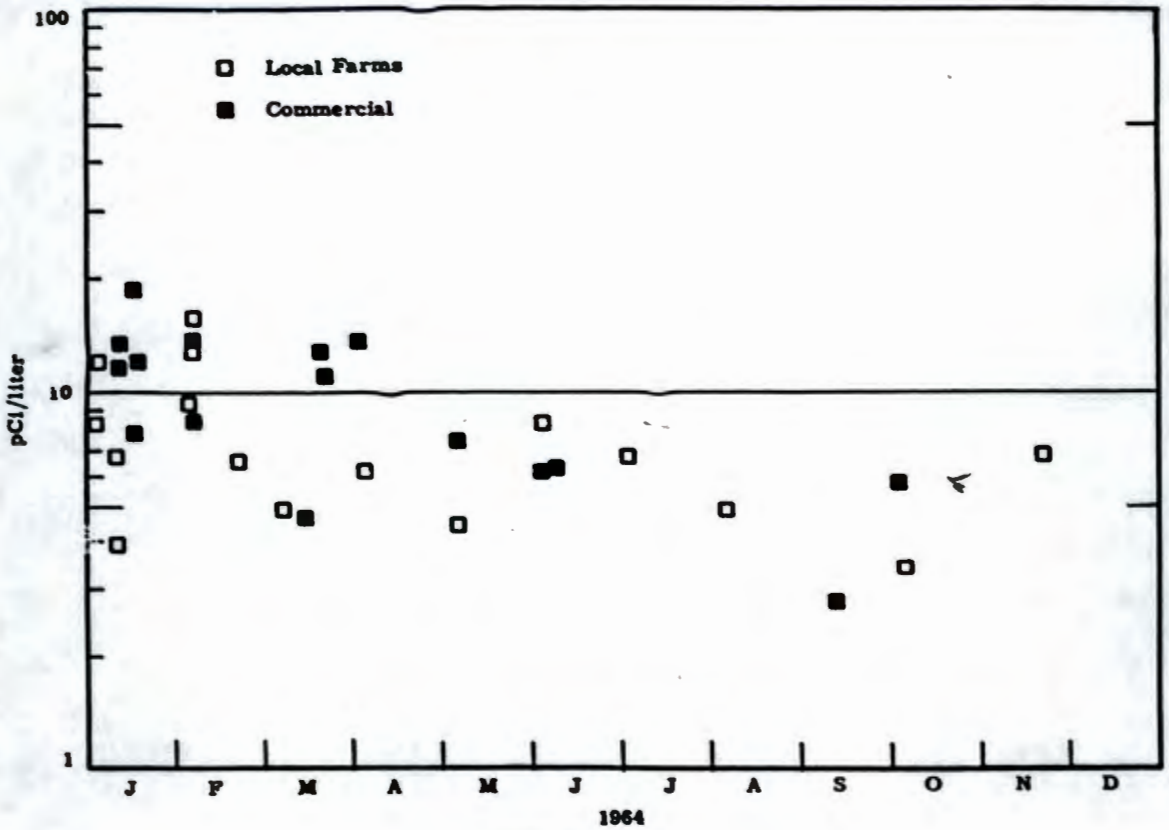

FIGURE 14

Sr^{90} in Local Milk, 1964

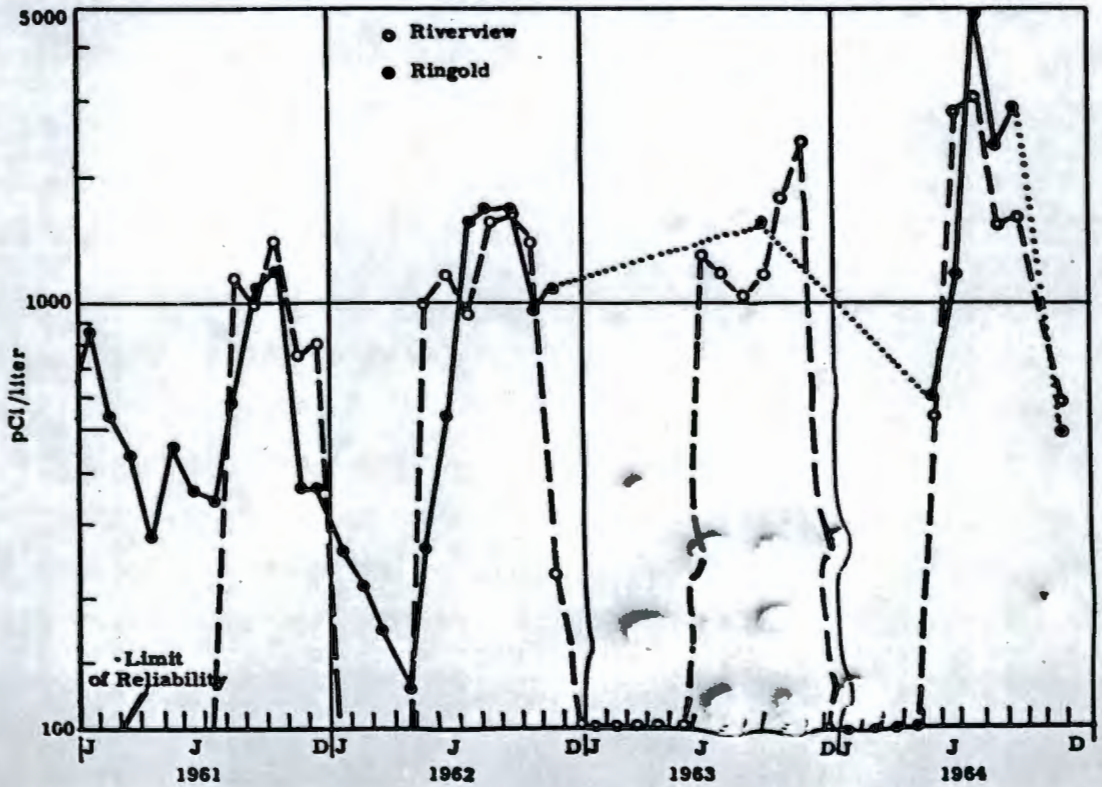

FIGURE 15

P^{32} in Locally Produced Milk

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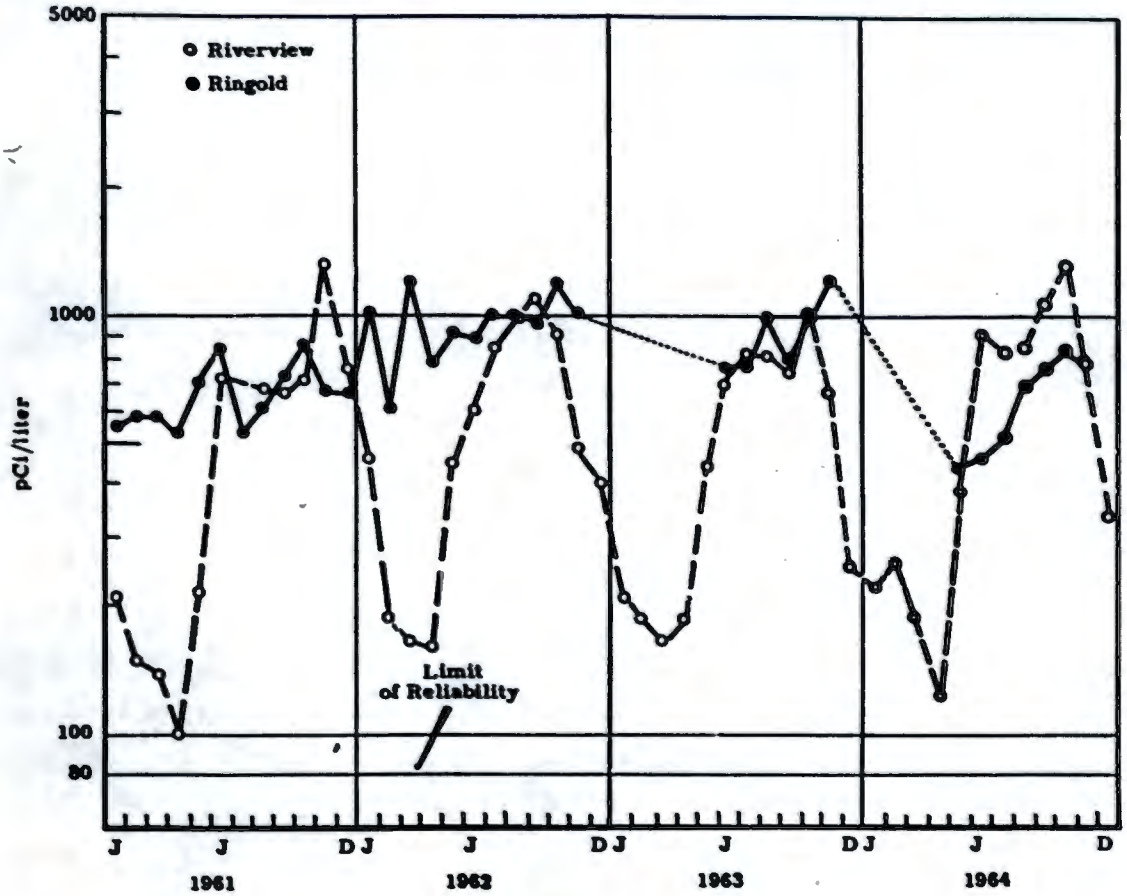

FIGURE 16
Zn^{65} in Locally Produced Milk

irrigation and rapid growth of pasture grass. Commercial milk distributed in the Tri-Cities usually does not contain P^{32} and Zn^{65} because it is obtained principally from areas not irrigated with Columbia River water.

If the commercially available milk were consumed at the rate of 1 liter/day, the "fallout" radionuclides would contribute an annual average dose of less than 1 mrem to the GI tract, about 4 mrem to the total body, and about 3% of the FRC rate of intake guide for bone. * Residents consuming milk obtained from the Ringold-Riverview area would receive some additional exposure from P^{32} and Zn^{65} amounting to about 12 mrem to the GI tract, 5 mrem to the total body, and about 4% of the MPRI for bone. Concentrations of radionuclides measured in milk are tabulated in Appendix F, Table 1.

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* The Federal Radiation Council does not consider fallout from the testing of weapons to be from "normal peacetime operations" for which the Radiation Protection Guides were developed.

Miscellaneous fresh farm produce was sampled periodically during the 1964 growing season from local farms and commercial outlets for radioanalysis. Results of these measurements, tabulated in Appendix F, Tables 3-6, were similar to those of previous years and indicated that only small quantities of radionuclides are present in locally grown products.

The concentrations of I^{131} found on samples of fresh vegetables collected from local farms and markets during the period of May through September were less than or approximately at the detection level of 0.05 pCi/g. There was no significant difference noted in concentrations found on local farm produce and on produce purchased from commercial outlets. If these fresh vegetables had been consumed at the rate of 100 g/day throughout the 5 mo growing season, the average annual intake from this source would have been about 750 pCi I^{131}. Such an intake would imply an annual exposure of about 1 mrem to the thyroid of a "standard man".

G. Concentrations of I^{131} in Cattle Thyroids

The thyroids of cattle are collected periodically from slaughter houses by cooperating veterinarians in Moses Lake, Toppenish, Walla Walla, Wenatchee, and Pasco and sent to Hanford for radioanalysis. Since the concentration of I^{131} in bovine thyroids is about two orders of magnitude higher than that in the pasture grass or in milk, it is advantageous to use thyroid measurements to follow probable trends in concentrations of I^{131} in milk and farm produce when the levels in milk and vegetables are too low for practical measurement. The average concentrations (Figure 17) measured in beef thyroids were generally at or below the reporting level of 5 pCi I^{131}/g during most of 1964 except for brief periods in the summer and again following the Chinese nuclear test on October 16. The maximum concentration observed in November was only 60 pCi I^{131}/g from one sample collected at Pasco. By the end of the year concentrations of I^{131} in beef thyroids were again near the reporting level of 5 pCi/g.

Data obtained from the cattle thyroid program for 1964 are tabulated in Appendix G, Table 1.

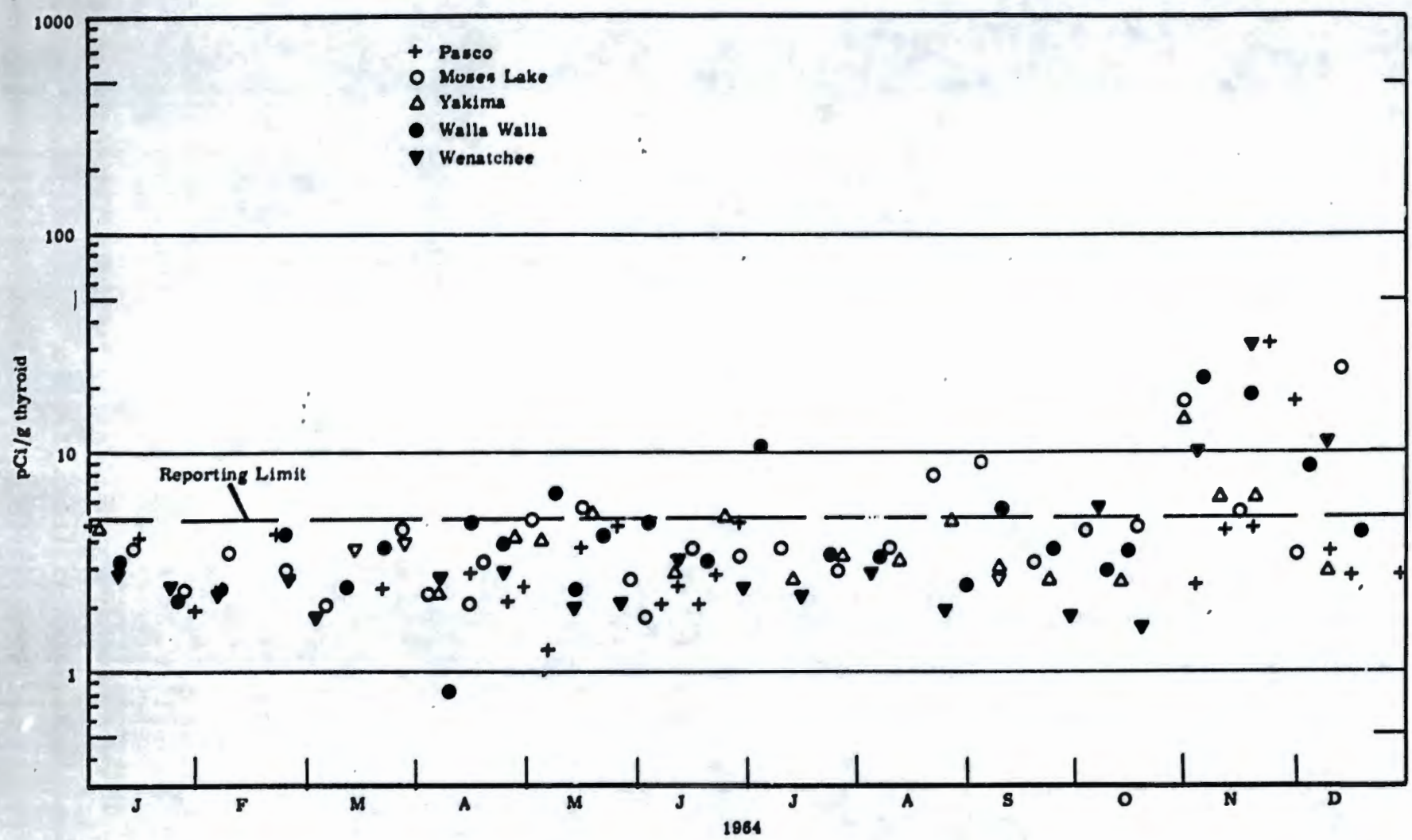

FIGURE 17

Average Concentrations of I^{131} in Beef Cattle Thyroids, 1964

H. External Radiation

Ionization chambers are stationed on the Hanford reservation and are submerged in the Columbia River to estimate the gamma radiation dose from external sources. Measurements in air over the ground during 1964 averaged about 0.41 mR/day or 150 mR/yr (Figure 18), somewhat lower than measured during the past 2 yr. Essentially, all of this exposure is from natural background and worldwide fallout from nuclear testing. Measurements of external radiation are tabulated in Appendix H, Table 1.

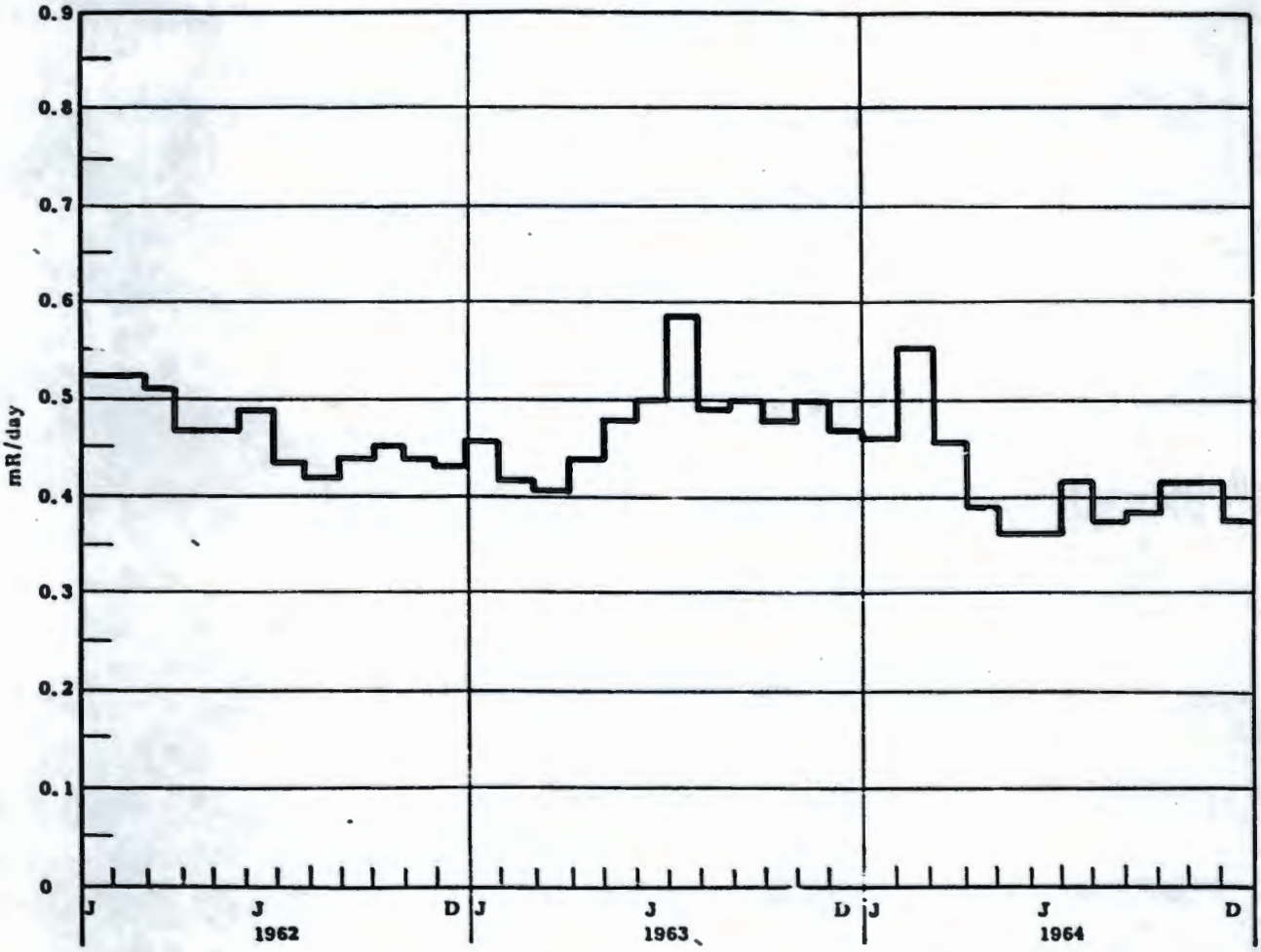

FIGURE 18

External Dose Rate as Measured at Hanford External Dose Test Location

Direct radiation measurements are made in the Columbia River at several locations with pocket-type ionization chambers submerged 2 to 5 ft below the surface of the water. Exposure rates are higher in the river than

over ground because of the presence of gamma emitters, especially Na^{24}, in reactor effluent. In the vicinity of Pasco and Richland the average dose rates in the water during the months of April through October were about 1.5 and 2 mR/day, respectively. A person swimming or boating in the river for a total of 240 hr during the year would receive about 15 mR total body exposure near Pasco and about 20 mR near Richland. Measurements of immersion dose in the river are tabulated in Appendix H, Table 2.

Radiation measurements [9] made along the shoreline of the river indicate the exposure rate may be about 0.25 mR/hr from radionuclides deposited with debris and in the mud and sand by fluctuating water levels. If an ardent fisherman spent as many as 200 hr fishing along the river's edge, the annual whole body exposure received from these materials would be about 50 mR.

An aerial radiation surveillance program conducted during 1964 included several flight patterns both over the Hanford reservation and the surrounding area. Background gamma radiation measurements were made during these flights over the predesignated ground check points for comparison with previous measurements. No significant changes in radiation levels were detected over the ground covered by these flight patterns.

I. Radioactive Wastes Released to Ground

Liquid wastes from the Chemical Separations areas are routed to various facilities dependent upon their burden of radionuclides. High level wastes (normally containing concentrations greater than 100 $\mu Ci/cm^3$) are stored in underground concrete tanks lined with steel. Intermediate level wastes, ordinarily containing concentrations in the range of 5×10^{-5} $\mu Ci/cm^3$ to 100 $\mu Ci/cm^3$, are sent to underground "cribs" from which they percolate into the soil. The areas selected for intermediate waste disposal and high level waste storage have soil with good ion exchange capacity and depths of 150 to 350 ft to ground water. Low level wastes usually containing less than 10^{-5} $\mu Ci/cm^3$, are sent to depressions in the ground where surface ponds or "swamps" have been formed as a result of the continuous addition of the relatively large volumes of water.

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One important objective in the management of wastes placed in the ground is the prevention of radiologically important radionuclides from reaching the ground water in quantities that could ultimately cause significant human exposure should they migrate to the Columbia River. For this reason wells have been drilled in and around crib and tank storage areas to detect any leaks in the tanks and for measuring radionuclides that have reached the ground water. Virtually all of the radionuclides present in the ground water have been introduced with liquids sent to the cribs.

The quantity of radioactive material sent to ground during 1964 (excluding tritium and materials sent to storage tanks) was about 155,000 Ci. This is a considerably greater quantity than is normally discharged during a 12 mo period and was primarily caused by an accidental discharge of approximately 10^5 Ci of fission products to a specific retention facility and a process equipment failure which allowed approximately 10^4 Ci to be discharged to an open pond. Neither release will cause significant ground water contamination. The historical total of radioactive materials sent to ground is estimated to be approximately 2.8×10^6 Ci. Because of radioactive decay, the current total is estimated to be only 3.0×10^5 Ci. In order of abundance, the bulk of the material is Ru^{106}, Cs^{137}, and Sr^{90}. Figure 19 shows the probable extent and concentration of radioactive materials (excluding tritium) in the ground water.

The detectable beta contamination (not including tritium) in the ground water beneath the 200 W Area was less extensive in 1964 than in previous years. This resulted from a reduction in the amount of contaminants discharged to ground, radioactive decay, and further dilution in the ground water.

A substantial amount of tritium has been sent to the ground with the intermediate level liquid wastes from the separations plants. Figure 20 shows the probable extent and concentration of tritium in the ground water in December, 1964.[11] In all probability, some tritium and Ru^{106} originating at the chemical processing areas is now entering the Columbia River. However, the contribution of these nuclides is too small to be detectable in the river water and any exposure from them is negligible.

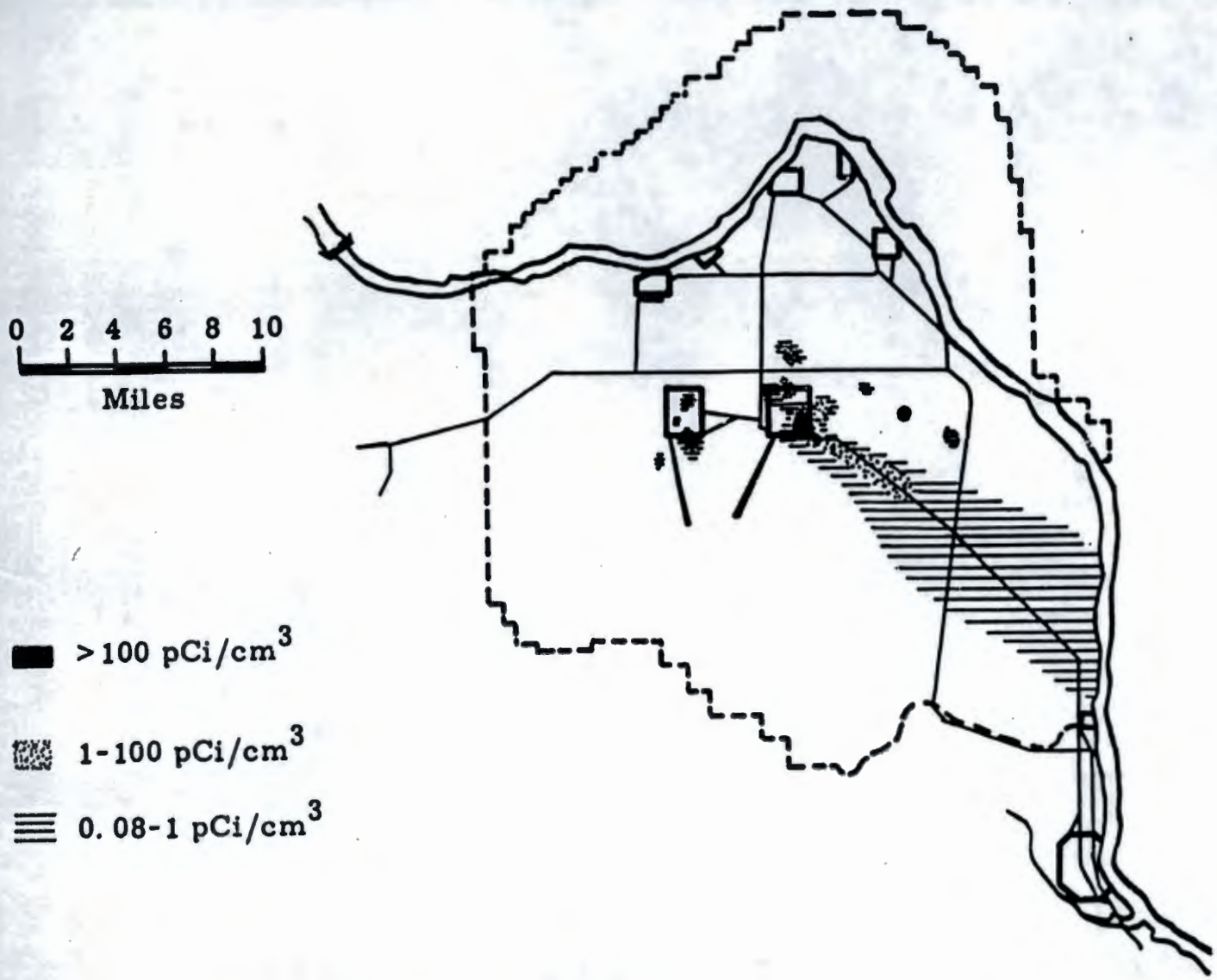

FIGURE 19

Probable Extent of Beta Emitters in Ground Water, 1964

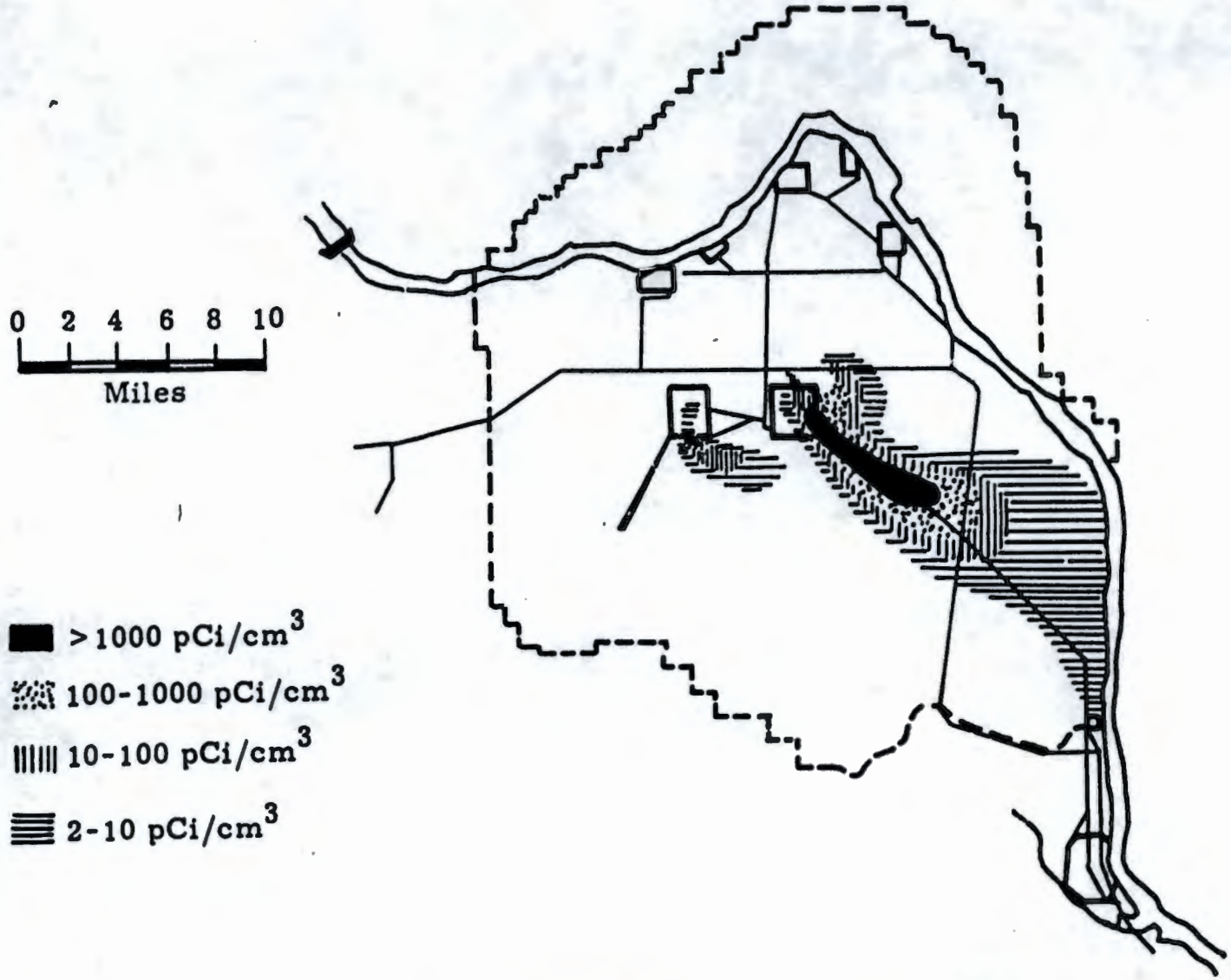

FIGURE 20

Probable Extent of Tritium in Ground Water, 1964

III. RADIATION EXPOSURE

It is not possible to determine the precise radiation exposure received by every individual because of variations in the kinds and quantity of food consumed, sources of food supply, and many variations in personal living habits. These inherent variations between individuals require a somewhat subjective approach when estimating the probable radiation exposure in relation to various established limits. The Federal Radiation Council has provided two sets of guides against which exposures from environmental sources may be judged, i.e., one for the individuals that receive the greatest exposure, and the other for the average exposure received by the general population (taken as one-third of that set for individuals). For the Hanford environs, exposures from the various sources described in the preceding sections have been compiled in two ways to allow comparisons with guides for both the individual and the general population. In one case a hypothetical, but plausible, individual has been assigned dietary and other habits that would result in what would seem to be the greatest rational exposure. For the general population, an exposure has been estimated for what is called the "average" Tri-City resident. Some residents may receive more exposure than calculated for the "average" Tri-City resident but very few, if any, receive as much as that calculated for the "maximum" individual. Included in this intermediate group are families that subsist largely on foodstuffs produced on farms irrigated with water taken from the Columbia River downstream from the reactors.

A. The Maximum Individual

Attempts have been continued to identify the individuals living in the Hanford environs that receive the greatest exposure. Experience accumulated from the environmental surveillance program indicates such individuals are undoubtedly persons that frequently eat fish caught locally in the Columbia River and foodstuffs grown on farms irrigated with Columbia River water. Additional data collected during 1964 continued to support the assumption that fish, consisting mainly of crappie, perch, bass, and catfish

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caught near Burbank (Figure 2) are the most important source of radionuclides for the "maximum" individual. On the basis of an assumed consumption of 200 meals per year and radiochemical analyses of such fish, the intake of P^{32} for the "maximum" individual during 1964 would have amounted to about 3 μCi (about 20% of the NCRP limit). Whether this amount of fish was actually eaten by the individual was not confirmed. However, other persons reporting an unusually high consumption of local fish were counted in the Whole Body Counter and they were found to have far less Zn^{65} deposited than predicted on the basis of their estimates of the quantities of fish eaten.

A maximum reported consumption of 200 fish meals per year is used as a basis for calculating the intake of radionuclides from this source. The consumption rates of other foods for the hypothetical maximum individual are based on the maximum intakes described in various dietary surveys. It is assumed that this individual consumes each day over 2 qt of water from the Pasco system, and about 1 qt of milk, 1/2 lb of beef, and nearly 1/2 lb of fresh leafy vegetables (in season), all produced on river irrigated farms in the Riverview District. The composite exposure from these sources are illustrated in Figures 21, 22, 23, and 24. The exposures amount to about 10% of the appropriate limit for the GI tract, 25% of the limit for bone, 1% of the limit for the thyroid, and 20% of the limit for the total body. Included with the estimate of total body exposure is 50 mR received from the river bank while fishing. The estimated exposure to the total body from Sr^{90} is more than was actually received because the method of calculation assumes that the rate of intake experienced in 1964 had been sustained for many years.

In case of the thyroid gland, it is possible that the maximum exposure occurred in small children because of the relatively small thyroid mass in which the I^{131} accumulates. The thyroid of a small child is assumed to weigh 2 g compared with 20 g for the adult. On the basis of a daily intake of 1 liter of milk, 50 g of fresh leafy vegetables produced in the Riverview

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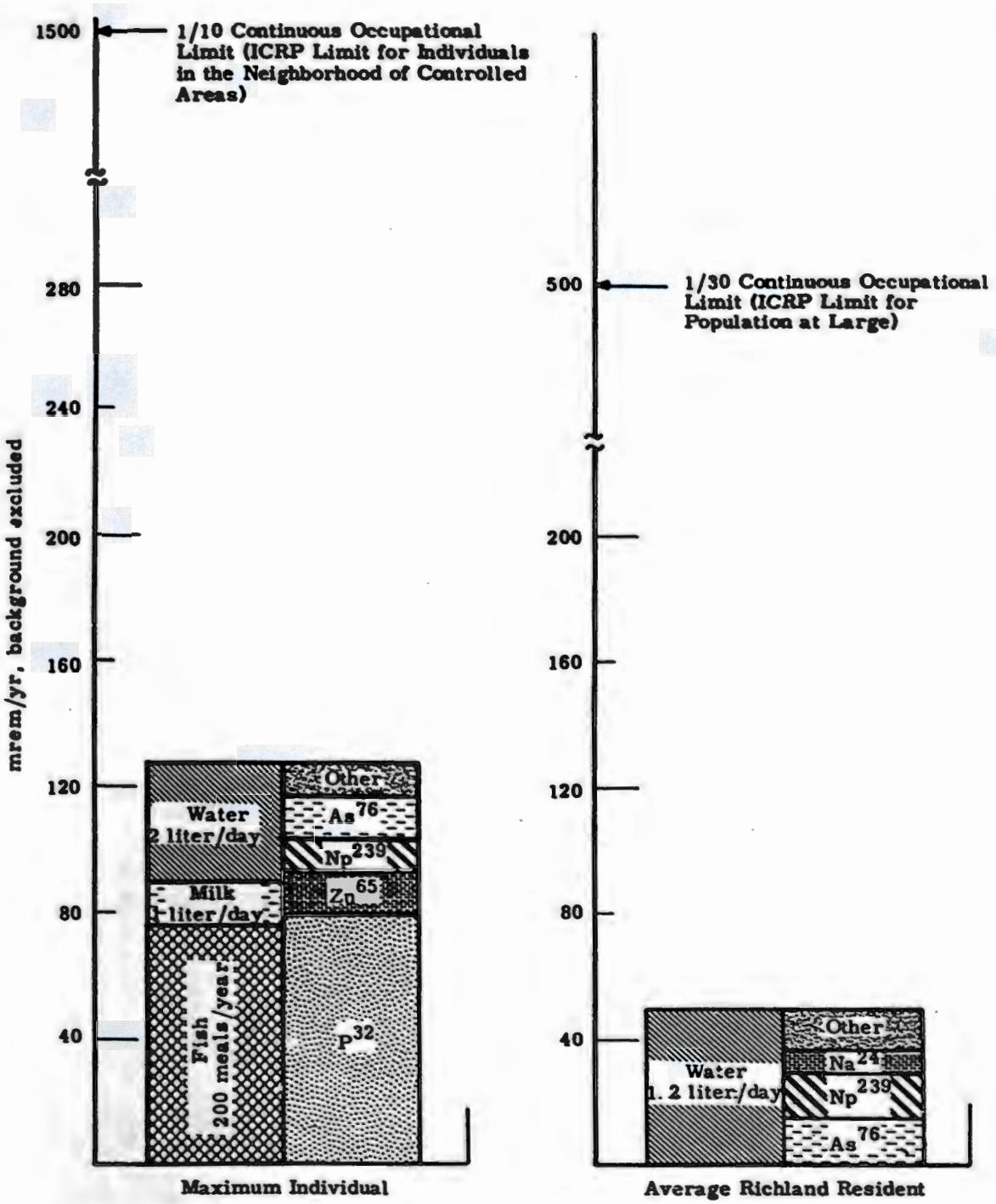

FIGURE 21

Calculated Dose to the GI Tract, 1964

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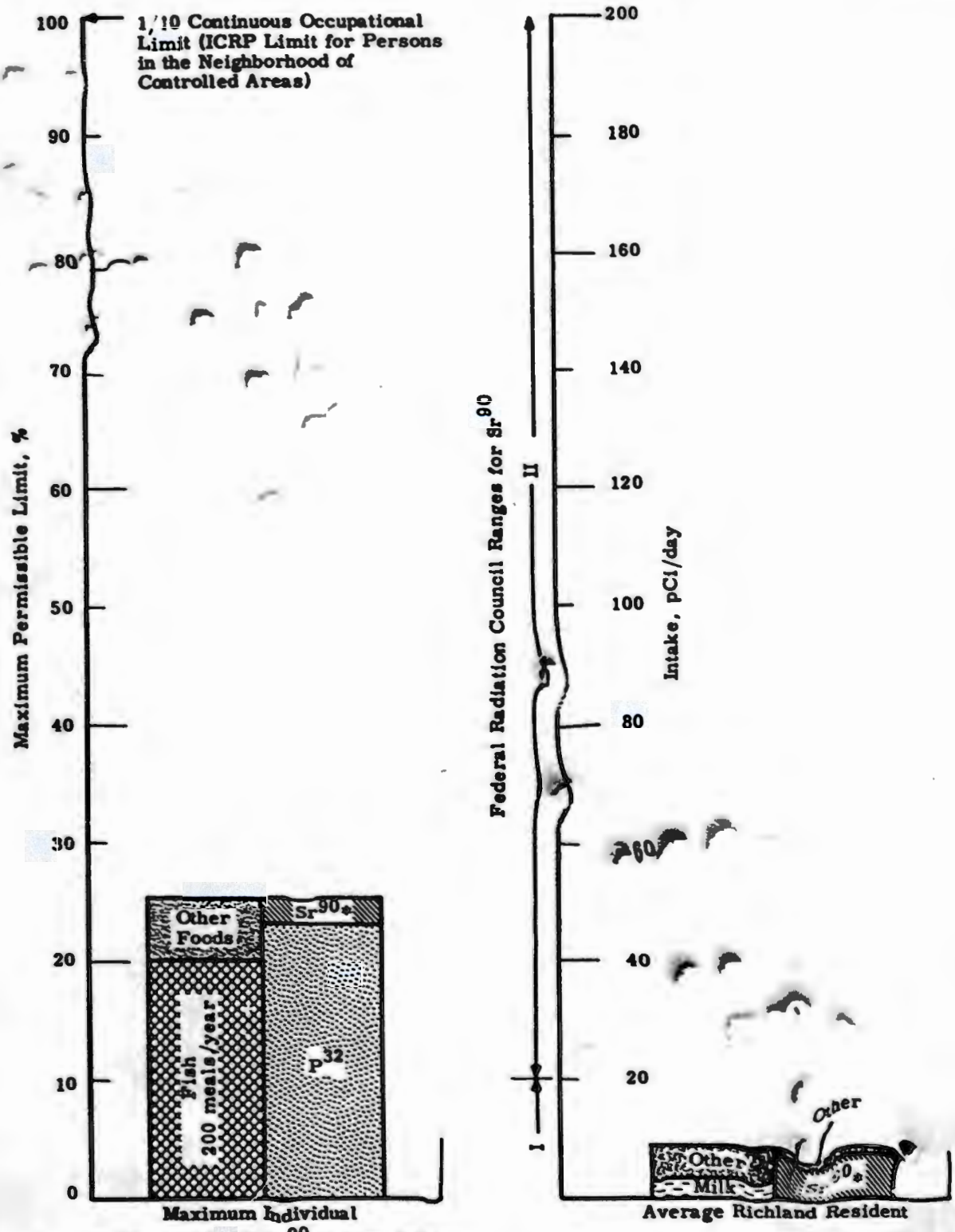

* Essentially all Sr^{90} is from fallout.

FIGURE 22

Calculated Dose to Bone, 1964

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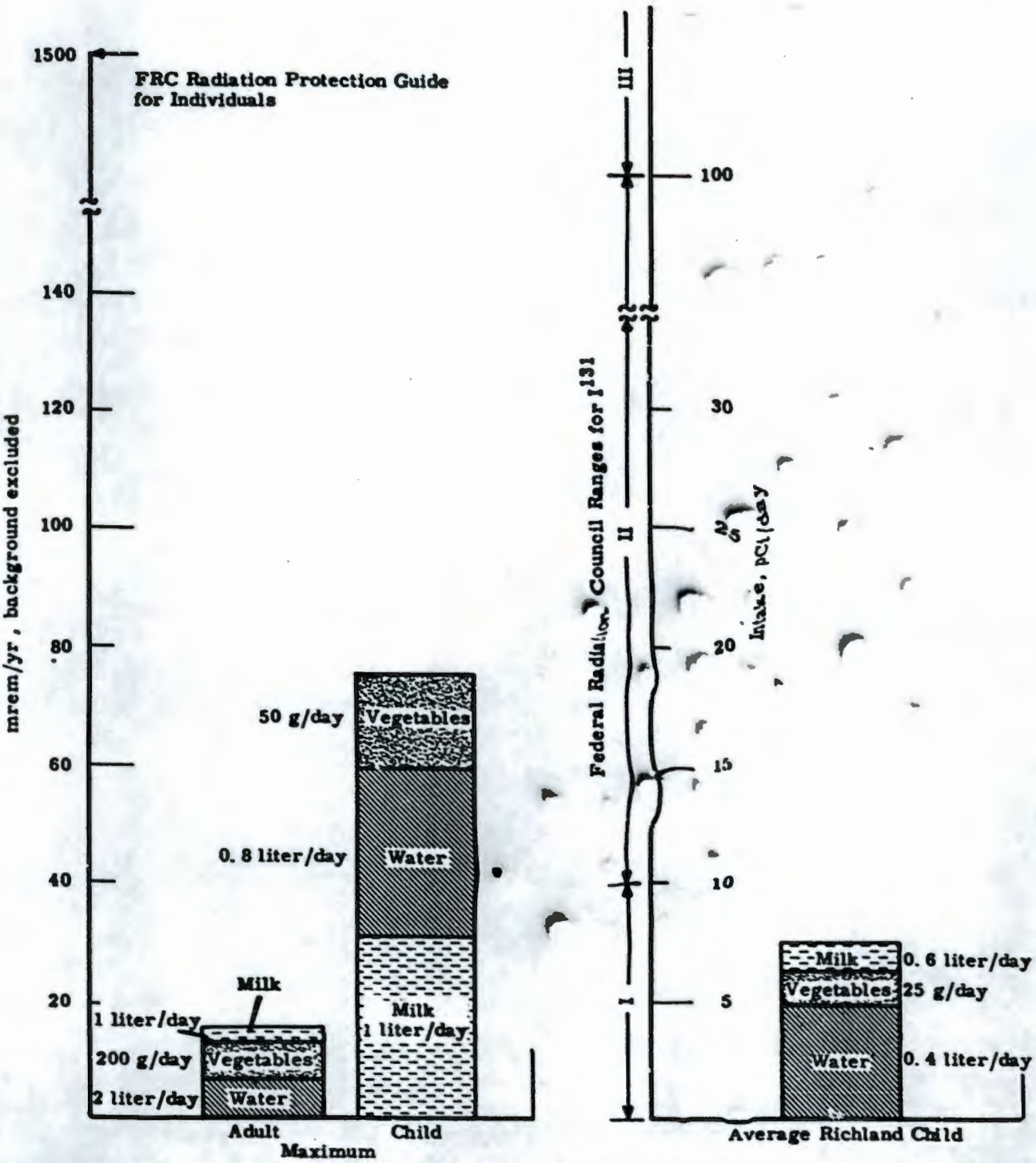

FIGURE 23

Calculated Dose to Thyroid, 1964

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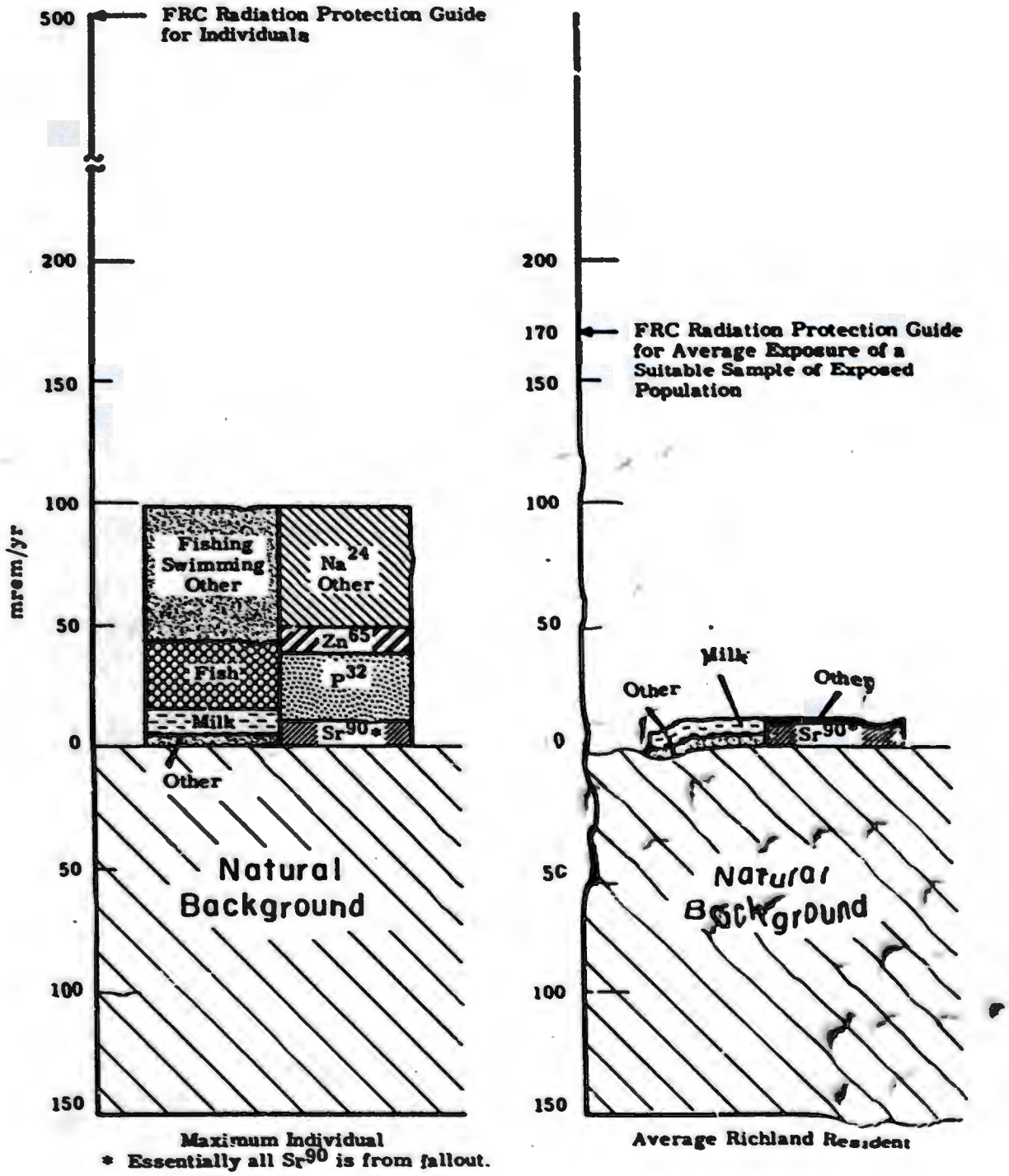

FIGURE 24

Calculated Dose to Total Body, 1964

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District, and 0.8 liter of water from the Pasco system, the estimated annual intake of I^{131} was about 4400 pCi for a small child in 1964. Such an intake would result in a thyroid dose of 75 mrem or 5% of the FRC Radiation Protection Guide for individuals.

B. The Average Tri-City Resident

The vast majority of people who live in Richland, Pasco, and Kennewick obtain their food from local commercial stores (rather than directly from farms) and consume little or no fish caught from the Columbia River. The principal sources of radionuclides to these people are worldwide fallout and drinking water obtained from the Columbia River. It is assumed that the contribution from fallout of I^{131} and Sr^{90} is the same in all three cities. The intake of Sr^{90} is estimated with the use of data obtained from dietary surveys made elsewhere in the U.S. and reported by the Federal Radiation Council,[3] but adjusted on the basis of the concentration in milk sold in local stores during 1964. The estimated annual intake of Sr^{90} during 1964 was about 0.006 μCi, approximately 8% of the FRC guide for the general population exposed to Sr^{90} from normal peacetime sources. Figure 22 shows the relationship to the intake guide based on exposure to the bone.

The contribution from Hanford created radionuclides in drinking water is substantially different for the three cities as discussed previously in Section II-B. In Richland, the GI tract exposure was greater than in the cities further downriver because the short-lived nuclides are in greater abundance. As shown in Figure 21, the estimated exposure for 1964 was about 50 mrem or 10% of the population limit. This exposure is significantly below that predicted on the basis of data collected in the last quarter of 1963 following start-up of the new water treatment plant. The contribution to the GI tract dose from other sources was relatively insignificant and, conversely, the concentration of bone seekers, such as P^{32} and Sr^{90}, in water was so low that drinking water did not contribute any significant dose to the bone.

For dose to the thyroid gland, the most appropriate sample of the exposed population would appear to be small children living in Richland who drank water from the municipal system (0.4 liter/day), milk (0.6 liter/day) obtained from the local stores, and fresh vegetables (25 g/day) obtained from local markets. The total intake of I^{131} during the year from these sources would be about 2600 pCi or an average of about 7 pCi/day (Figure 23). This is in the middle of the FRC Range I, the most favorable range.

The estimated total body exposure (Figure 24) of the average Richland resident from artificial radionuclides was about 12 mrem, the major portion of which was assigned to Sr^{90} from fallout. The method used to calculate the dose from Sr^{90} yields a value that is unrealistically high, however, because the parameters used are based on equilibrium conditions which would exist in the body only after many years of ingesting Sr^{90} at the rate estimated for 1964. The contribution to total dose by nuclides of Hanford origin (principally Na^{24} and Zn^{65}) ingested mainly with drinking water was estimated at about 3 mrem. This total body exposure may be compared with the FRC guide of 170 mrem for the average of a suitable sample of an exposed population. Exposure from natural background sources (excluded from the FRC guide) in this region is estimated at about 150 mrem/yr.

IV. CONCLUSIONS

During 1964 the environmental surveillance program of the Hanford environs again showed that the amounts of radioactive materials present were well within nationally accepted limits at all times, and that releases of radioactive wastes were well controlled.

P^{32} released to the Columbia River in reactor effluent continued to be the most significant source of exposure from the Hanford project. This P^{32} is concentrated by fish that inhabit the river downstream from the reactors. Individuals who regularly eat such fish as a major part of their diet throughout the year could conceivably have taken in as much as 20% of the

annual permissible amount of this bone seeker. Other foods, such as milk, and other nuclides, such as Sr^{90} could have increased the total intake of bone seekers by this "maximum individual" to as much as 25% of the annual limit. The use of similar dietary assumption last year resulted in an estimate of 50% for 1963.

There were no unusual releases of radionuclides from the Hanford plants during 1964 that warranted special assessment of the radiation dose to persons in the environs. The deposition of Sr^{90} from worldwide fallout was significantly less in 1964 than in 1962 or 1963, and consequently, this nuclide contributed less exposure.

V. ACKNOWLEDGEMENTS

The cooperation of many Hanford personnel who collected samples, performed the many tedious radioassays, prepared and provided data and reviewed this document is gratefully acknowledged.

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Kennewick, Washington

Pasco Water Department
Pasco, Washington

Richland Water Department
Richland, Washington

Yakima State Patrol
Yakima, Washington

Washington State Department of Game
Olympia, Washington

U. S. Public Health Service
Portland, Oregon

Federal Aviation Agency
Walla Walla, Washington
Spokane, Washington
Boise, Idaho
Great Falls, Montana

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Dr. P. M. Aldrich Walla Walla, Washington	(beef thyroids)
Dr. Leon Bodie Moses Lake, Washington	(beef thyroids)
Dr. Christopher Pasco, Washington	(beef thyroids)
Dr. R. J. Donahue Toppenish, Washington	(beef thyroids)
Dr. W. E. Welsh Wenatchee, Washington	(beef thyroids)
Coast Oyster Company South Bend, Washington	(oysters)
Mr. N. Atterberry Benton City, Washington	(milk)
Mr. Barker Richland, Washington	(milk)
Mr. H. G. Bleazard Eltopia, Washington	(milk)
Mr. F. Buckingham Pasco, Washington	(milk)
Mr. M. Kinne Eltopia, Washington	(milk)
Mr. W. Harris Pasco, Washington	(milk)
Mr. Tedro Pasco, Washington	(milk)
Twin City Creamery Kennewick, Washington	(milk)

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VII. APPENDIX A

RADIONUCLIDES IN COLUMBIA RIVER WATER

APPENDIX A
TABLE 1

CONCENTRATIONS OF RADIONUCLIDES IN
COLUMBIA RIVER AT 300 AREA (Grab Samples) - 1964
Units of pCi/L of water

Date	RE+Y	Na^{24}	P^{32}	Cr^{51}	Cu^{64}	Zn^{65}	As^{76}	Sr^{90}	I^{131}	Np^{239}
1-8	920	6300	500	14,000	12,000	340	1900	2.0	15	3200
1-22	500	4700	300	7,800	7,100	240	1400	1.7	11	2500
2-5	610	6500	400	13,000	11,000	380	2500	2.0	14	3800
2-19	780	5200	370	12,000	10,000	280	2200	2.1	26	3100
3-11	480	5700	Lost	8,400	6,700	270	1500	1.2	12	2200
4-8	920	5700	380	10,000	8,000	460	1900	1.5	14	3200
5-6	670	4600	120	4,400	5,000	260	880	1.0	14	1900
6-3	940	2800	170	3,800	5,500	93	1100	1.0	6.1	1600
7-21	540	1900	66	2,400	2,700	93	400	Lost	6.1	910
8-11	1000	3400	150	6,500	8,300	100	930	1.3	8.5	1600

APPENDIX A
TABLE 2

CONCENTRATIONS OF RADIONUCLIDES IN
COLUMBIA RIVER WATER AT 300 AREA (Cumulative Samples)-1964
Units of pCi/l of water

Date	P^{32}	Cr^{51}	Mn^{54}	Co^{60}	Zn^{65}	Sr^{90}	I^{131}
12/30/63-1/6/64	120	12,000			270	2.2	14
1/6-1/13	260	11,000			330	1.7	9.4
1/13-1/20	300	10,000			290	1.9	20
1/20-1/27	97	8,400			260	1.9	12
1/27-2/3	280	11,000			320	1.7	12
2/3-2/10	260	9,800			280	1.7	13
2/10-2/17	240	15,000	31		390	1.1	8.1
2/17-2/24	300	14,000	10		270	1.8	11
2/24-3/2	310	15,000	16		270	1.7	21
3/2-3/9	150	13,000	15		290	1.7	16
3/9-3/16	310	11,000	14		300	1.7	23
3/16-3/23	250	15,000	19		360	1.5	14
3/23-3/30	390	13,000	13		360	1.5	13
3/30-4/6	430	12,000	15		300	1.1	67
4/6-4/13	410	39,000	18		900	1.2	22
4/13-4/17	280	7,500			270	0.91	19
4/17-4/27	150	8,600	18		290	0.99	20
4/27-5/4	440	10,000	40		530	1.2	19
5/4-5/9	340	6,200	17		350	1.3	13
5/9-5/18	210	4,700	12		250	0.73	10
5/18-5/25	180	3,700	8.9		250	0.92	7.4
5/25-6/1	120	2,900	10		120	0.94	6.9
6/1-6/8	13	2,000	9.4		180	0.86	3.3
6/8-6/15	46	2,100	6.5	<7.9	140	1.0	4.1
6/15-6/22	17	2,000	9.8	<7.9	120	0.73	3.3
6/22-6/29	49	2,100	8.1	<8.0	110	1.0	3.4
6/29-7/6	26	2,500	8.6	<8.0	160	0.78	<4.3
7/6-7/13	50	1,900	5.0	<8.0	68	1.0	<2.7
7/13-7/20	32	1,700	8.6	<8.0	110	0.98	<4.3
7/20-7/27	37	2,000	5.5	<8.0	68	0.76	<5.6
7/27-8/3	78	3,800	6.0	<8.0	140	1.1	11
8/3-8/10	89	4,200	8.7	<8.0	85	1.3	7.9

No entry indicates no analysis made.

APPENDIX A
TABLE 3

CONCENTRATIONS OF RADIONUCLIDES IN
COLUMBIA RIVER WATER AT RICHLAND (Grab Samples) - 1964
Units of pCi/l of water

Date	RE+Y	Na^{24}	P^{32}	Cr^{51}	Cu^{64}	Zn^{65}	As^{76}	Sr^{90}	I^{131}	Np^{239}
1-20	380	2200	420	12,000	3,300	780	880	1.7	13	3100
2-17	820	4600	560	25,000	10,000	1800	2200	1.9	9.3	4200
3-2	390	4600	370	15,000	7,000	320	2300	2.6	34	3200
3-16	920	4800	360	11,000	5,300	460	1700	1.7	23	3000
4-13	1400	5600	630	22,000	7,400	1000	2400	1.8	21	5600
4-27		5500		15,000	5,800	600	2200	1.2	31	4800
5-4	740	5300	470	9,200	5,600	770	1300	1.0	16	3600
5-18	950	4300	270	5,500	5,300	150	1100	0.89	10	2800
6-15	420	1100	84	1,800	2,100	170	450	0.92	4.0	970
6-29	540	1400	140	2,700	2,400	63	460	0.88	3.9	860
7-14	430	1300	73	2,000	1,700	130	370	0.52	4.9	760
7-20	400	1200	60	1,900	2,300	256	300	1.4	3.5	640
8-17	450	3300	110	7,900	5,700	130	900	1.4	14	1600
9-21	79	2700	98	14,000	990	140	740	1.2	57	2400
10-19	170	2400	130	8,500	4,300	160	760	1.6	13	1400
11-9	260	4700	350	15,000	6,300	210	1500	1.8	24	2900
12-7	280	5200	440	16,000	10,000	370	1700	1.4	23	2800

No entry indicates no analysis made.

APPENDIX A
TABLE 4

CONCENTRATIONS OF RADIONUCLIDES IN
COLUMBIA RIVER WATER AT RICHLAND (Cumulative Samples)-1964
Units of pCi/l of water

Date	P^{32}	Cr^{51}	Zn^{65}	I^{131}	Co^{60}
6/15-6/22	55	2,300	120	3.4	
6/22-6/29	61	2,500	110	3.7	
6/29-7/6	28	2,100	83	<4.0	
7/6-7/13	53	2,300	90	<3.5	
7/13-7/20	42	1,800	70	4.6	
7/20-7/27	43	2,200	90	5.3	
7/27-8/3	54	4,100	140	5.7	
8/3-8/10	75	4,200	120	7.4	
8/10-8/17	73	6,900	140	8.8	
8/17-8/24	85	7,000	150	9.2	
8/24-8/31	90	7,400	130	6.6	< 48
8/31-9/2		9,000	130	45	
9/2-9/8	140	9,600	140	19	
9/8-9/14	97	9,400	220	12	< 21
9/14-9/21	140	14,000	270	29	<110
9/21-9/28	110	9.900	200	13	<120
9/28-10/5	150	10,000	220	9.7	< 48
10/5-10/12	100	9,600	190	11	< 56
10/12-10/19	100	6,000	170	11	< 61
10/19-10/26	62	7,000	130	13	< 96
10/26-11/2	120	7,400	220	12	< 48
11/2-11/9	200	9,800	290	26	< 54
11/9-11/16	230	12,000	360	18	< 69
11/16-11/23	220	10,000	280	11	< 58
11/23-11/30	260	11,000	380	13	< 62
11/30-12/7	180	12,000	570	12	< 60
12/7-12/14	210	11,000	370	12	
12/14-12/21	270			11	
12/21-12/28	280	12,000	370	18	

No entry indicates no analysis made.

APPENDIX A
TABLE 5

CONCENTRATIONS OF RADIONUCLIDES IN
COLUMBIA RIVER WATER AT PASCO (Grab Samples) - 1964
Units of pCi/l of water

Date	RE+Y	Na^{24}	P^{32}	Cr^{51}	Cu^{64}	Zn^{65}	As^{76}	Sr^{90}	I^{131}	Np^{239}
1-13	190	810	250	6,800	790	190	560	2.1	9.7	1200
1-27	180	1000	300	9,300	830	240	530	1.7	13	1700
2-10	190	1200	240	7,400	1,300	170	750	1.6	7.8	1500
2-24	140	1300	210	8,800	1,900	180	730	1.1	8.1	1500
3-9	230	1900	310	11,000	2,600	250	920	1.4	14	2100
3-23	500	2600	400	11,000	3,100	280	1200	1.5	14	2300
4-6	360	1000	380	9,700	1,300	320	860	1.4	17	2200
4-20	380	1800	360	8,000	1,800	250	1200	1.3	13	1900
5-11	560	2300	370	5,600	3,100	610	850	1.2	8.6	1700
5-24	490	1900	160	3,200	4,800	230	670	0.53	4.9	1300
6-8	330	1100	78	1,700	1,900	90	440	0.93	3.2	710
6-22	300	930	54	1,900	1,700	94	350	0.93	1.9	550
7-13	220	680	39	1,000	1,200	30	200	0.93	< 3.1	310
7-27	140	750	40	1,400	1,200	36	180	1.1	< 3.7	420
8-10	390	1700	73	4,000	2,200	130	470	1.3	4.8	990
8-24	240	2500	70	6,100	2,500	56	640	1.1	13	1300

APPENDIX A
TABLE 6

CONCENTRATIONS OF RADIONUCLIDES IN
COLUMBIA RIVER WATER AT PASCO (Cumulative Samples)-1964
Units of pCi/l of water

Date	P^{32}	Cr^{51}	Zn^{65}	I^{131}
12/30/63-1/6/64	170	9,400	250	14
1/6-1/13	110	8,500	240	9.4
1/13-1/20	270	9,500	460	12
5/5-5/11	230	6,800	280	12
5/11-5/18	110	3,400	130	6.0
5/18-5/25	78	2,600	160	5.5
5/25-6/1	51	2,100	68	4.1
6/1-6/8	46	1,500	87	2.5
6/8-6/15	37	1,300	95	2.6
6/25-6/29	33	1,200	39	2.0
6/29-7/6	50	1,600	57	<4.0
7/6-7/13	34	1 300	27	<3.6
7/13-7/20	27	1,200	51	<3.4
7/20-7/27	17	1,300	39	<4.8
7/27-8/3	45	2,400	69	4.8
8/3-8/10	48	3 500	54	6.6
8/10-8/17	48	4,600	100	4.9
8/17-8/24	75	4,900	99	6.7
8/24-8/31	62	5,900	82	7.0
8/31-9/1		8,200	90	8.1
9/1-9/2	24	6,100	63	10
9/2-9/8	82	6,800	140	9.2
9/8-9/14	66	7,700	120	8.8
9/14-9/21	59	9,900	140	14
9/21-9/28	100	8,600	120	11
9/28-10/5	98	8,400	160	7.3
10/5-10/12	60	7,100	140	8.4
10/12-10/19	72	4,200	100	13
10/19-10/26	86	5,600	120	9.9
10/26-11/2	100	5,800	150	<7.6
~~11/2-~~11/9	140	7,400	160	13
11/9-11/16	170	10,000	210	16
11/16-11/23	23	8,000	200	12
11/23-11/30	110	9,600	280	7.8
11/30-12/7	180	11 000	250	8.8
12/14-12/21		9,000	270	
12/21-12/28		9,000	220	

No entry indicates no analysis made.

APPENDIX A
TABLE 7

CONCENTRATIONS OF RADIONUCLIDES IN
COLUMBIA RIVER WATER AT MCNARY DAM (Cumulative Samples)-1964
Units of pCi/l of water

Date	P^{32}	Cr^{51}	Zn^{65}	I^{131}	Co^{60}
2/24-2/28	92	6,000	120		
2/28-3/6	82	5,300	120		
3/6-3/13	130	6,900	130		
3/13-3/20	98	5,800	150		
3/20-3/27	160	6,300	160		
3/27-4/3	140	5,500	130		
4/3-4/6	160	5,200	140	3.7	
4/6-4/7	100	3,500	84	3.0	
4/7-4/8	100	3,000	71	3.2	
4/8-4/9	100	3,000	65	3.1	
4/9-4/10	100	4,100	100	20	
4/10-4/17	120	4,400	96	9.1	
4/17-4/24	110	3,100	91		
4/24-5/1	110	3,600	65		
5/1-5/8	81	2,700	60		
5/8-5/15	79	2,400	47		
5/15-5/22	62	1,800	71		
5/22-5/28	32	810	55		
5/28-6/1	14	650	26		
6/1-6/5	17	530	42		
6/5-6/10	8.9	360	34		
6/10-6/19	9.5	510	31		
6/19-6/26	8.1	250	16		
6/26-7/2	16	950	30		
7/2-7/10	28	1,400	44		
7/10-7/17	22	980	50		
7/17-7/24	24	1,200	22		
7/24-7/30	23	1,300	29		
7/30-8/7	30	2,100	41		
8/7-8/14	37	2,700	51		
8/14-8/20	29	3,700	47		
8/20-8/26	44	4,100	38		
8/28-9/4	32	3,700	21	<5.5	
9/4-9/11	21	3,700	32	<4.9	
9/11-9/25	54	6,000	46	<4.9	<96
9/25-10/2	61	5,300	56	6.5	<96
10/2-10/9	65	5,800	69	<5.3	<96

No entry indicates no analysis made.

APPENDIX A
TABLE 7 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN
COLUMBIA RIVER WATER AT MCNARY DAM (Cumulative Samples)-1964
Units of pCi/l of water

Date	P^{32}	Cr^{51}	Zn^{65}	I^{131}	Co^{60}
10/9-10/16	39	3,200	53	< 4.4	<140
10/16-10/23	46	3,300	52	< 8.3	<130
10/23-10/30	67	3,500	63	< 8.9	<100
10/30-11/6	67	2,900	120	< 5.9	<170
11/6-11/13	85	5,000	110	< 8.4	<140
11/13-11/20	140	4,700	100	7.1	<170
11/20-11/25	130	4,200	96	9.4	<310
11/25-12/4	190	4,500	95	5.9	<240
12/4-12/11		5,600	140		
12/11-12/18		5,700	150		
12/18-12/25		6,400	190		
12/28-12/31		2,800	100		

No entry indicates no analysis made.

APPENDIX A
TABLE 8

CONCENTRATIONS OF RADIONUCLIDES IN
COLUMBIA RIVER WATER AT THE DALLES DAM (Cumulative Samples)-1964
Units of pCi/l of water

Date	P^{32}	Cr^{51}	Zn^{65}	I^{131}
5/8-5/15	62	2,600	49	
5/15-5/22	54	1,800	71	
5/22-5/28	39	1,400	79	
5/28-6/5	20	1,500	110	
6/5-6/12	10	930	74	
6/12-6/18	53	1,200	310	
6/18-6/25	20	1,000	75	
6/25-7/2	16	1,000	66	
7/2-7/9	18	1,200	26	
7/9-7/16	19	1,100	60	
7/16-7/23	11	1,000	23	
7/23-7/30	16	1,200	36	
7/30-8/6	20	1,700	25	
8/6-8/13	20	1,800	36	
8/13-8/20	30	3,000	19	
8/20-8/27	29	3,400	49	
8/27-9/3	11	3,300	14	< 5.6
9/3-9/10	20	3,800	43	< 5.5
9/10-9/17	12	3,500	63	< 5.2
9/17-9/24	30	4,200	86	<17
9/24-10/1	37	5,700	130	6.4
10/1-10/8	40	5,000	61	< 5.4
10/8-10/15	40	4,700	140	< 5.2
10/15-10/22	39	3,200	38	< 5.7
10/22-10/29	26	3,100	43	<10
10/29-11/5	46	2,900	52	< 7.7
11/5-11/12	50	3,600	52	< 6.6
11/12-11/19	50	4,400	60	7.5
11/19-11/25	58	4,500	94	< 5.6
11/25-12/2	78	4,900	120	< 6.4
12/2-12/9		4,700	110	
12/9-12/16		5,000	110	
12/16-12/23		4,900	110	
12/23-12/31		2,100	80	

No entry indicates no analysis made.

APPENDIX A
TABLE 9

CONCENTRATIONS OF RADIONUCLIDES IN
COLUMBIA RIVER WATER AT BONNEVILLE DAM (Cumulative Samples)-1964
Units of pCi/l of water

Date	P^{32}	Cr^{51}	Zn^{65}	I^{131}
5/19-5/26	11	1,400	190	
5/26-6/2	14	820	130	
6/2-6/9	15	610	170	
6/9-6/16	36	600	150	
6/16-6/22	14	660	110	
6/22-6/29	15	700	93	
6/30-7/7	17	630	54	
7/7-7/14	22	590	32	
7/14-7/21	13	600	65	
7/21-7/26	7.1	930	44	
7/26-8/4	11	870	44	
8/4-8/11	26	1,900	92	
8/11-8/18	8.9	2,000	45	
8/18-8/25	21	2,600	52	
8/25-9/1	12	2,900	26	< 5.0
9/1-9/8	8.0	2,500	17	< 5.3
9/8-9/15	11	2,800	23	< 5.4
9/15-9/22	13	2,900	30	< 5.9
9/22-9/29	4.4	3,100	25	< 6.1
9/29-10/6	17	3,500	40	< 5.3
10/6-10/13	30	3,900	55	< 5.1
10/13-10/20	15	2,900	29	< 5.5
10/20-10/27	19	2,100	26	< 5.3
10/27-11/3	13	2,400	38	< 5.7
11/3-11/10	19	2,200	38	< 6.6
11/10-11/17	17	2,900	36	< 5.6
11/17-11/24	21	3,600	38	< 6.0
11/24-12/1	24	3,200	36	3.0
12/1-12/8	24	3,400	77	< 5.6
12/8-12/15		3,800	72	
12/15-12/22		4,300	95	
12/22-12/29		2,800	160	

No entry indicates no analysis made.

APPENDIX A
TABLE 10

CONCENTRATIONS OF RADIONUCLIDES IN
COLUMBIA RIVER WATER AT VANCOUVER (Grab Samples) - 1964
Units of pCi/l of water

Date	P^{32}	Cr^{51}	Zn^{65}	Mn^{54}	I^{131}	Np^{239}
1-6	61	3,500	51		< 3.1	
2-10	55	3,800	66		< 5.7	
2-24	60	4,200	75	< 2.4	< 6.7	1.3
3-9	31	2,400	43	2.2	3.2	
3-23	53	3,600	50	1.2	4.2	47
4-20	42	2,400	50	1.9	2.5	28

No entry indicates no analysis made.

APPENDIX A
TABLE 11

ESTIMATED RATE OF TRANSPORT OF RADIONUCLIDES
IN COLUMBIA RIVER WATER AT RICHLAND (Grab Samples) - 1964
Units of curies/day

Date	RE+Y	Na^{24}	P^{32}	Cr^{51}	Cu^{64}	Zn^{65}	As^{76}	Sr^{90}	I^{131}	Np^{239}
1-20	72	420	79	2,300	620	150	170	0.32	2.4	590
2-17	190	1100	130	5,700	2,300	410	500	0.44	2.1	970
3-2	73	870	70	2,800	1,300	60	430	0.49	6.4	600
3-16	150	770	58	1,800	850	74	270	0.27	3.7	480
4-13	270	1100	120	4,200	1,400	190	460	0.34	4.0	1100
4-27		1300		3,700	1,400	150	540	0.29	7.6	1200
5-4	150	1100	99	1,900	1,200	160	270	0.21	3.4	760
5-18	400	1800	110	2,300	2,200	62	460	0.37	4.2	1200
6-15	440	1200	88	1,900	2,200	180	470	0.97	4.2	1000
6-29	530	1400	140	2,700	2,400	62	450	0.86	3.8	840
7-14	350	1100	60	1,600	1,400	110	300	0.43	4.0	620
7-20	310	920	46	1,500	1,800	43	230	1.1	2.7	490
8-17	170	1200	41	3,000	2,100	49	340	0.52	5.2	600
9-21	14	480	18	2,500	180	25	130	0.22	10	430
10-19	44	620	34	2,200	1,100	42	200	0.42	3.4	360
11-9	53	960	72	3,100	1,300	43	310	0.37	4.9	600
12-7	54	1000	84	3,100	1,900	71	320	0.27	4.4	540

No entry indicates no analysis made.

APPENDIX A
TABLE 12

ESTIMATED RATE OF TRANSPORT OF RADIONUCLIDES IN COLUMBIA RIVER WATER AT RICHLAND (Cumulative Samples) - 1964

Units of curies/day

Date	P^{32}	Cr^{51}	Zn^{65}	I^{131}	Co^{60}
6/15-6/22	59	2,500	130	3.7	
6/22-6/29	64	2,600	120	3.9	
6/29-7/6	25	1,900	74	<3.6	
7/6-7/13	44	1,900	74	<2.9	
7/13-7/20	33	1,400	56	3.7	
7/20-7/27	28	1,400	58	3.4	
7/27-8/3	24	1,800	63	2.6	
8/3-8/10	26	1,500	41	2.6	
8/10-8/17	25	2,300	47	3.0	
8/17-8/24	25	2,000	44	2.7	
8/24-8/31	22	1,800	31	1.6	<12
8/31-9/2		2,100	30	10	
9/2-9/8	23	1,500	23	3.1	
9/8-9/14	19	1,800	43	2.3	< 4.1
9/14-9/21	22	2,200	43	4.6	<18
9/21-9/28	20	1,800	37	2.4	<22
9/28-10/5	33	2,200	49	2.1	<11
10/5-10/12	21	2,000	40	2.3	<12
10/12-10/19	23	1,400	39	2.6	<14
10/19-10/26	13	1,400	27	2.7	<20
10/26-11/2	23	1,400	42	2.3	< 9.1
11/2-11/9	35	1,700	51	4.6	< 9.5
11/9-11/16	41	2,100	63	3.2	<12
11/16-11/23	35	1,600	44	1.7	< 9.1
11/23-11/30	46	1,900	66	2.3	<11
11/30-12/7	34	2,300	110	2.3	<11
12/7-12/14	35	1,800	61	2.0	
12/14-12/21	48			1.9	
12/21-12/28	39	1,700	52	2.5	

No entry indicates no analysis made.

APPENDIX A
TABLE 13

ESTIMATED RATE OF TRANSPORT OF RADIONUCLIDES
IN COLUMBIA RIVER WATER AT PASCO (Grab Samples) - 1964
Units of curies/day

Date	RE+Y	Na^{24}	P^{32}	Cr^{51}	Cu^{64}	Zn^{65}	As^{76}	Sr^{90}	I^{131}	Np^{239}
1-13	35	150	47	1,300	150	35	100	0.39	1.8	220
1-27	31	170	51	1,600	140	41	91	0.29	2.2	290
2-10	46	290	58	1,800	320	41	180	0.39	1.9	370
2-24	27	250	40	1,700	360	34	140	0.21	1.5	280
3-9	46	380	62	2,200	520	50	190	0.28	2.8	420
3-23	100	530	81	2,200	630	57	240	0.30	2.8	470
4-6	56	160	59	1,500	200	50	130	0.22	2.7	340
4-20	82	390	78	1,700	390	54	260	0.28	2.8	410
5-11	180	730	120	1,800	990	190	270	0.38	2.7	540
5-25	290	1100	94	1,900	2,800	140	390	0.31	2.9	760
6-8	250	850	60	1,300	1,500	69	340	0.72	2.5	550
6-22	320	990	58	2,000	1,800	100	370	0.99	2.0	590
7-13	180	570	33	840	1,000	25	170	0.78	< 2.6	260
7-27	82	440	24	830	710	21	110	0.65	< 2.2	250
8-10	140	620	27	1,500	810	48	170	0.48	1.8	360
8-24	78	810	23	2,000	810	18	210	0.36	4.2	420

APPENDIX A
TABLE 14

ESTIMATED RATE OF TRANSPORT OF RADIONUCLIDES IN COLUMBIA RIVER WATER AT PASCO (Cumulative Samples) - 1964
Units of curies/day

Date	P^{32}	Cr^{51}	Zn^{65}	I^{131}
12/30/63-1/6/64	23	1,300	34	1.9
1/6-1/13	16	1,300	36	1.4
1/13-1/20	41	1,400	70	1.8
5/5-5/11	56	1,700	68	2.9
5/11-5/18	43	1,300	50	2.3
5/18-5/25	44	1,500	90	3.1
5/25-6/1	34	1,400	45	2.7
6/1-6/8	36	1,200	68	2.0
6/8-6/15	35	1,200	91	2.5
6/25-6/29	34	1,200	40	2.1
6/29-7/6	44	1,400	50	<3.5
7/6-7/13	29	1,100	23	<3.1
7/13-7/20	21	950	40	<2.7
7/20-7/27	11	810	24	<3.0
7/27-8/3	20	1,100	31	2.2
8/3-8/10	17	1,200	19	2.3
8/10-8/17	16	1,600	34	1.7
8/17-8/24	22	1,500	29	2.0
8/24-8/31	15	1,400	20	1.7
8/31-9/1		2,100	23	2.1
9/1-9/2	5.4	1,400	14	2.3
9/2-9/8	14	1,100	23	1.5
9/8-9/14	13	1,500	24	1.8
9/14-9/21	9.7	1,600	23	2.3
9/21-9/28	19	1,600	23	2.1
9/28-10/5	22	1,900	36	1.7
10/5-10/12	13	1,500	30	1.8
10/12-10/19	17	1,000	24	3.1
10/19-10/26	18	1,200	26	2.1
10/26-11/2	20	1,100	29	<1.5
11/2-11/9	26	1,400	29	2.4
11/9-11/16	31	1,800	38	2.9
11/16-11/23	3.7	1,300	32	1.9
11/23-11/30	20	1,800	51	1.4
11/30-12/7	36	2,200	50	1.7
12/14-12/21		1,600	50	
12/21-12/28		1,400	34	

No entry indicates no analysis made.

APPENDIX A
TABLE 15

ESTIMATED RATE OF TRANSPORT OF RADIONUCLIDES IN COLUMBIA RIVER WATER AT VANCOUVER (Grab Samples) - 1964
Units of curies/day

Date	P^{32}	Cr^{51}	Zn^{65}	Mn^{54}	I^{131}	Np^{239}
1-6	14	790	11		< 0.7	
2-10	15	1,100	19		< 1.6	
2-24	17	1,200	21	0.66	< 1.9	0.4
3-9	7.6	590	11	0.54	0.8	
3-23	13	900	12	0.30	1.0	12
4-20	13	760	16	0.60	0.8	8.9

No entry indicates no analysis made.

APPENDIX A
TABLE 16

ESTIMATED RATE OF TRANSPORT OF RADIONUCLIDES IN COLUMBIA RIVER WATER AT BONNEVILLE DAM (Cumulative Samples) - 1964

Units of curies/day

Date	P^{32}	Cr^{51}	Zn^{65}	I^{131}
5/19-5/26	11	1,400	190	
5/26-6/2	14	840	130	
6/2-6/9	19	770	220	
6/9-6/16	54	1,000	240	
6/16-6/22	25	1,400	180	
6/23-6/29	24	1,500	150	
6/30-7/7	22	1,100	67	
7/7-7/14	24	970	36	
7/14-7/21	12	540	58	
7/21-7/26	5.3	690	33	
7/26-8/4	6.2	490	25	
8/4-8/11	12	860	41	
8/11-8/18	3.6	810	18	
8/18-8/25	7.7	950	19	
8/25-9/1	4.1	980	8.8	< 1.7
9/1-9/8	2.2	690	4.7	< 1.5
9/8-9/15	3.0	760	6.2	< 1.5
9/15-9/22	3.2	720	7.5	< 1.5
9/22-9/29	1.1	760	6.1	< 1.5
9/29-10/6	4.9	1,000	12	< 1.5
10/6-10/13	9.1	1,200	17	< 1.5
10/13-10/20	4.7	900	9.0	< 1.7
10/20-10/27	5.8	650	8.0	< 1.6
10/27-11/3	3.7	680	11	< 1.6
11/3-11/10	5.4	630	11	< 1.9
11/10-11/17	4.3	730	9.1	< 1.4
11/17-11/24	5.1	880	9.3	< 1.5
11/24-12/1	6.9	920	10	0.9
12/1-12/8	8.1	1,200	26	< 1.9
12/8-12/15		1,100	20	
12/15-12/22		1,200	27	
12/22-12/29		2,100	120	

No entry indicates no analysis made.

VIII. APPENDIX B

RADIONUCLIDES IN SANITARY WATER

APPENDIX B
TABLE 1

CONCENTRATIONS OF RADIONUCLIDES IN
RICHLAND SANITARY WATER (Grab Samples) - 1964
Units of pCi/l of water

Date	RE+Y	Na^{24}	P^{32}	Cr^{51}	Cu^{64}	Zn^{65}	As^{76}	Sr^{90}	I^{131}	Np^{239}
1-6	87	3200	110	16,000	3,000	140	900	2.0	19	3000
2-3	67	3100	57	11,000	2,000	160	690	2.0	12	3000
3-2	36	2400	23	11,000	1,700	100	380	1.5	18	2000
3-16	52	3000	32	7,700	1,700	130	330	1.8	21	1900
4-6	290	3000	170	13,000	2,500	150	1200	2.0	340	3500
4-20	200	2900	180	7,400	1,900	110	970	1.5	19	1900
5-4	230	3300	170	5,900	2,000	100	730	1.2	16	2000
5-18	160	3300	48	5,600	1,600	150	180	0.98	9.6	2200
6-1	33	2700	< 8.5	3,500	1,700	65	< 100	0.90	6.6	1300
6-15	16	960	< 2.6	1,800	610	< 36	< 55	1.0	3.2	620
7-6	31	1300	< 6.7	2,100	1,500	22	< 53	1.1	3.5	600
7-20	15	1000	< 5.6	1,600	650	14	< 51	0.84	< 2.8	410
8-3	32	2300	6	3,400	1,000	25	56	1.5	9.6	1000
8-17	53	2200	21	6,500	3,000	< 23	200	1.3	9.2	1300
9-21	41	2300	55	14,000	1,200		580			2100
10-19	27	2000	15	7,100	1,900		230			1200
11-2	15	2600	38	8,600	1,800		170			1500
11-30	28	5300	34	16,000	2,900		420			2600

No entry indicates no analysis made.

APPENDIX B
TABLE 2

CONCENTRATIONS OF RADIONUCLIDES IN
RICHLAND SANITARY WATER (Cumulative Samples) - 1964
Units of pCi/l of water

Date	P^{32}	Cr^{51}	Zn^{65}	I^{131}
12/30/63-1/6/64	38	12,000	140	16
1/6-1/13	80	11,000	160	12
1/13-1/20	32	9,400	140	16
1/20-1/27	13	6,900	140	10
1/27-2/3	11	10,000	120	10
2/3-2/10	20	10,000	150	7.6
2/10-2/17	12	15,000	120	9.6
2/17-2/24	11	12,000	110	9.5
2/24-3/2	17	10,000	100	16
3/2-3/9	19	13,000	140	20
3/9-3/16	36	11,000	120	16
3/16-3/23	79	13,000	140	14
3/23-3/30	160	12,000	170	11
3/30-4/6	110	11,000	130	33
4/6-4/13	230	33,000	440	28
4/13-4/20	150	8,100	130	14
4/20-4/27	160	7,600	110	20
4/27-5/4	160	8,500	110	16
5/4-5/11	69	7,600	82	15
5/11-5/18	39	5,100	99	8.7
5/18-5/25	12	3,600	97	7.6
5/25-6/1	6.0	2,900	88	5.9
6/1-6/8	2.9	2,200	48	4.4
6/8-6/15	2.2	1,900	60	3.0
6/18-6/29	2.8	2,200	42	2.7
6/29-7/6	< 2.8	2,100	23	< 3.7
7/6-7/13	3.4	2,000	6.8	< 3.5
7/20-7/27	3.8	2,200	31	3.9
7/27-8/3	4.9	3,800	39	5.2
8/3-8/10	5.5	4,400	14	7.4
8/10-8/17	9.4	6,200	27	7.5
8/17-8/24	38	6,700	27	8.2
8/24-8/31	23	6,700	19	7.8
8/31-9/2	16	9,200	30	17
9/2-9/8	36		24	17
9/8-9/14	25		39	13

No entry indicates no analysis made.

APPENDIX B
TABLE 2 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN
RICHLAND SANITARY WATER (Cumulative Samples) - 1964
Units of pCi/l of water

Date	P^{32}	Cr^{51}	Zn^{65}	I^{131}
9/14-9/21	45		54	15
9/21-9/28	39		39	14
9/28-10/5	31		56	8.3
10/5-10/12	29		76	10
10/12-10/19	17		51	17
10/19-10/26	16		47	13
10/26-11/2	15			7.8
11/2-11/9	14		80	29
11/9-11/16	28		100	16
11/16-11/23	21		140	11
11/23-11/30	30		150	11
11/30-12/7	23		160	10
12/7-12/14	46	12,000	180	11
12/14-12/21	35	10,000	180	11
12/21-12/28	35	12,000	180	19

No entry indicates no analysis made.

APPENDIX B
TABLE 3

CONCENTRATIONS OF RADIONUCLIDES IN
PASCO SANITARY WATER (Grab Samples) - 1964
Units of pCi/l of water

Date	RE+Y	Na^{24}	P^{32}	Cr^{51}	Cu^{64}	Zn^{65}	As^{76}	Sr^{90}	I^{131}	Np^{239}
1-7	67	380	200	11,000	130	130	290	1.9	12	1300
1-13	64	260	130	8,400	100	140	120	Lost	6.4	890
1-20	43	260	130	8,500	140	120	220	1.7	8.6	1000
1-27	47	170	120	6,800	54	120	190	1.8	9.1	740
2-3	46	270	120	8,900	140	130	260	1.9	14	1200
2-10	39	210	130	7,400	45	110	220	1.5	8.4	860
2-17	26	260	99	7,500	85	100	210	1.4	7.1	960
2-24	22	190	89	7,200	33	110	130	1.4	4.6	560
3-9	84	380	170	8,000	220	110	230	1.4	11	860
3-23	78	140	170	7,000	67	110	150	1.3	5.2	790
4-13	350	1400	270	11,000	800	110	650	1.3	13	2000
4-27	97	1000	69	5,100	360	46	310	0.79	14	1200
5-11	100	1700	91	6,300	840	90	360	1.1	7.8	1700
5-25	20	1100	15	2,200	280	57	< 130	0.90	7.0	750
6-8	38	640	16	1,300	420	26	140	0.93	2.8	390
6-22	17	540	3.8	1,200	250	19	< 51	< 0.68	2.0	300
7-13	19	600	< 4.7	1,100	370	20	< 52	1.1	< 3.0	280
7-27	21	620	6.8	1,300	320	< 16	< 46	0.94	< 3.8	310
8-10	50	1300	20	4,100	850	31	140	1.3	6.6	720
8-24	56	1100	36	5,600	780	35	410	1.2	6.8	690
9-28	42	1100	36	9,000	530	36	120			930
10-26	25	580	24	6,400	270	50	100			720
11-2	13	530	32	8,300	190	100				760
11-30	17	200	54	6,700	94	120	71			510

No entry indicates no analysis made.

APPENDIX B
TABLE 4

CONCENTRATIONS OF RADIONUCLIDES IN
PASCO SANITARY WATER (Cumulative Samples) - 1964
Units of pCi/l of water

Date	P^{32}	Cr^{51}	Zn^{65}	Sr^{90}	I^{131}
1/20-1/27	15	6,900	140	1.5	8.0
1/27-2/3	26	7,600	120	1.6	7.3
2/3-2/10	38	7,200	140	1.4	4.2
2/10-2/17	74	8,900	130	0.92	5.4
2/17-2/24	48	7,600	110		4.7
2/24-3/2	88	7,200	110		11
3/2-3/9	160	9,700	98		12
3/9-3/16	130	9,800	100		14
3/16-3/23	140	9,600	140		10
3/23-3/30	130	8,500	140		7.7
3/30-4/6	150	7,800	140		6.8
4/6-4/13	200	27,000	400		24
4/13-4/20	92	6,800	85		11
4/20-4/27	37	5,700	56		12
4/27-5/4	54	6,300	80		12
5/4-5/11	45	6,000	63		11
5/11-5/18	24	3,500	61		6.0
5/18-5/25	14	2,300	74		4.7
5/25-6/1	13	2,000	57		3.7
6/1-6/8	10	1,400	48		2.6
6/8-6/15	5.7	1,200	47		2.3
6/15-6/22	2.1	900	< 9.4		1.6
6/22-6/29	2.9	1,100	16		2.0
6/29-7/6	7.4	1,300	< 8.9		<4.0
7/6-7/13	3.9	1,200	< 9.1		<3.6
7/13-7/20	4.0	960	12		<3.4
7/20-7/27	2.9	1,200	6.1		<4.9
7/27-8/3	5.1	2,100	11		<3.4
8/3-8/10	6.3	4,700	6.0		5.3
8/10-8/17	13	4,000	<24		6.2
8/17-8/24	25	4,900	21		6.2
8/24-8/31	14	5,000	12		5.8
8/31-9/1		7,500	<20		<5.0
9/1-9/3	4.5		11		6.0
9/3-9/8	16		13		10
9/8-9/14	12		7.9	1.4	9.4
9/14-9/21	17		22	1.6	7.8
9/21-9/28	23		34	2.0	12

No entry indicates no analysis made.

APPENDIX B
TABLE 4 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN
PASCO SANITARY WATER (Cumulative Samples) - 1964
Units of pCi/l of water

Date	P^{32}	Cr^{51}	Zn^{65}	Sr^{90}	I^{131}
10/12-10/19	8.2	3,700	24	1.3	9.6
10/19-10/26	16	5,300	26	1.5	10
10/26-11/2	12		53	1.4	< 7.6
11/2-11/9	18		60	1.2	13
11/9-11/16	39		82	1.6	10
11/16-11/23	23		87	1.5	13
11/23-11/30	24		100	1.7	8.8
11/30-12/7	51		130	1.5	8.6
12/21-12/28		7,200	160		

No entry indicates no analysis made.

APPENDIX B
TABLE 5

CONCENTRATIONS OF RADIONUCLIDES IN
KENNEWICK SANITARY WATER (Grab Samples) - 1964
Units of pCi/l of water

Date	RE+Y	Na^{24}	P^{32}	Cr^{51}	Cu^{64}	Zn^{65}	As^{76}	Sr^{90}	I^{131}	Np^{239}
1-20	< 4.9	< 65	12	4,400	< 150	< 27	< 58	< 0.70	< 3.2	
2-24	5.3	540	8.0	3,800	81	< 37	< 62	< 0.90	< 2.5	69
3-30	7.8	54	9.1	3,300		< 16	< 61	0.60	< 2.6	
4-27	36	220	34	3,200	140	23	66	0.50	3.6	200
5-25	12	120	11	1,200	140	< 17	< 51	0.33	5.7	53
6-29	6.9	51	< 4.9	590	58	< 16	< 51	< 0.43	1.2	22
7-27	7.2	56	< 4.7	800	71	< 16	< 44	0.39	< 3.7	31
8-31		51	5.4	2,500	40	< 16	< 44		< 3.2	26
9-29			6.2	4,300		< 16	18		4.1	36
10-26		47	< 8.0	3,100	36	< 16	< 15		< 4.2	29
11-16		77	<15	3,200	60	< 19	31		< 4.1	59

No entry indicates no analysis made.

APPENDIX B
TABLE 6

BETA ACTIVITY IN RICHLAND SANITARY WATER - 1964
Units of c/m/ml

Date	c/m/ml	Date	c/m/ml	Date	c/m/ml
1-2	11	3-17	12	5-22	6.2
1-3	18	3-18	13	5-25	6.4
1-7	18	3-19	15	5-26	5.6
1-8	12	3-20	17	5-27	6.3
1-9	17	3-23	17	5-28	5.7
1-10	12	3-24	18	6-2	6.4
1-13	15	3-25	18	6-3	7.3
1-14	18	3-26	15	6-4	8.8
1-15	12	3-27	11	6-5	3.7
1-16	11	3-30	14	6-8	4.7
1-17	13	3-31	18	6-9	1.8
1-21	4.6	4-1	16	6-10	4.2
1-22	10	4-2	9.5	6-11	4.5
1-23	7.3	4-3	10	6-12	3.6
1-24	10	4-7	15	6-16	3.9
1-27	8.1	4-8	12	6-17	3.7
1-28	12	4-9	12	6-18	2.8
1-29	8.8	4-10	15	6-19	3.4
1-30	8.1	4-13	17	6-22	4.3
1-31	4.5	4-14	24	6-23	4.3
2-4	13	4-15	13	6-24	4.1
2-5	15	4-16	12	6-25	4.2
2-6	9.5	4-17	8.8	6-26	4.8
2-7	4.0	4-21	18	6-29	3.7
2-10	10	4-23	15	6-30	4.5
2-12	12	4-24	10	7-1	2.6
2-14	9.5	4-27	15	7-2	3.0
2-17	12	4-28	20	7-7	3.4
2-18	6.2	4-29	14	7-8	4.8
2-20	12	4-30	15	7-9	4.4
2-24	9.5	5-1	13	7-10	5.5
2-25	2.9	5-5	14	7-13	2.7
2-26	7.1	5-6	8.8	7-14	3.0
2-27	5.8	5-7	12	7-15	2.5
2-28	11	5-8	15	7-16	4.0
3-3	5.3	5-11	13	7-17	3.7
3-4	13	5-12	12	7-21	5.3
3-5	12	5-13	11	7-22	6.7
3-6	9.5	5-14	9.5	7-23	3.6
3-9	7.3	5-15	8.8	7-24	1.7
3-11	7.3	5-19	6.9	7-28	4.2
3-12	8.8	5-20	8.8	7-29	5.0
3-13	12	5-21	6.5	7-30	6.2

APPENDIX B
TABLE 6 (Continued)

BETA ACTIVITY IN RICHLAND SANITARY WATER - 1964
Units of c/m/ml

Date	c/m/ml	Date	c/m/ml	Date	c/m/ml
7-31	8.8	10-6	8.1	12-3	9.5
8-4	7.2	10-7	13	12-4	9.5
8-5	5.8	10-8	10	12-7	8.8
8-7	3.8	10-9	7.3	12-8	8.8
8-10	6.3	10-12	6.3	12-9	8.1
8-11	5.7	10-13	6.2	12-10	8.1
8-12	6.4	10-14	6.0	12-11	8.1
8-13	6.4	10-15	4.8	12-14	7.3
8-14	8.1	10-16	6.2	12-15	13
8-18	7.0	10-20	5.9	12-16	10
8-21	7.0	10-21	7.3	12-17	9.5
8-24	9.5	10-22	8.1	12-18	7.3
8-25	6.6	10-23	8.8	12-22	12
8-26	8.8	10-26	8.1	12-23	8.1
8-27	8.1	10-27	9.5	12-28	9.5
8-28	5.6	10-28	6.7	12-29	11
8-31	7.3	10-29	7.3	12-30	11
9-2	6.8	10-30	8.8	12-31	8.8
9-4	8.1	11-3	8.8		
9-8	11	11-4	9.5		
9-10	8.8	11-5	10		
9-11	12	11-6	8.8		
9-14	9.5	11-9	8.8		
9-15	14	11-10	14		
9-16	15	11-11	11		
9-17	11	11-12	12		
9-18	12	11-13	12		
9-22	14	11-16	8.8		
9-23	13	11-17	11		
9-24	11	11-18	8.1		
9-25	12	11-19	10		
9-28	11	11-20	7.3		
9-29	14	11-23	9.5		
9-30	14	11-24	13		
10-1	13	11-25	9.5		
10-2	15	12-1	11		
10-5	11	12-2	9.5		

APPENDIX B
TABLE 7

BETA ACTIVITY IN PASCO SANITARY WATER - 1964
Units of c/m/ml

Date	c/m/ml	Date	c/m/ml	Date	c/m/ml
1-1	3.0	3-30	6.4	6-5	1.7
1-3	2.7	3-31	10	6-9	4.5
1-8	4.8	4-1	8.1	6-10	2.3
1-9	4.2	4-2	6.7	6-11	2.1
1-10	3.2	4-3	4.6	6-12	1.6
1-14	2.3	4-6	4.2	6-15	1.4
1-15	4.1	4-7	8.1	6-16	0.81
1-16	3.2	4-8	8.1	6-17	1.2
1-22	5.1	4-9	6.6	6-18	0.95
1-23	2.9	4-10	5.6	6-19	0.95
1-24	2.7	4-14	8.8	6-23	2.1
1-28	3.0	4-15	5.4	6-24	2.2
1-29	3.7	4-16	5.2	6-25	1.1
1-30	3.5	4-17	3.7	6-26	1.5
1-31	2.1	4-20	4.3	6-29	2.0
2-4	3.7	4-21	6.6	6-30	2.4
2-5	3.7	4-23	4.8	7-1	2.1
2-6	4.1	4-24	4.2	7-2	1.8
2-7	2.7	4-28	8.1	7-6	1.8
2-12	3.7	4-29	6.3	7-7	2.3
2-14	3.4	4-30	6.4	7-8	2.9
2-18	3.4	5-1	5.1	7-9	2.3
2-20	2.9	5-4	5.9	7-10	1.8
2-25	3.5	5-5	5.3	7-14	1.2
2-26	3.2	5-6	4.5	7-15	1.2
2-27	3.5	5-7	5.7	7-16	1.1
2-28	3.5	5-8	5.6	7-17	1.3
3-3	3.7	5-12	6.4	7-20	1.8
3-4	0.88	5-13	4.0	7-21	0.73
3-5	3.7	5-14	3.8	7-22	2.9
3-6	5.5	5-15	4.3	7-23	1.7
3-11	4.6	5-18	3.7	7-24	4.0
3-12	3.8	5-19	3.4	7-28	2.5
3-13	4.1	5-20	3.3	7-29	2.2
3-16	4.2	5-21	3.2	7-30	3.0
3-17	3.7	5-22	3.3	7-31	3.7
3-18	5.2	5-26	3.9	8-3	1.9
3-19	5.3	5-27	3.9	8-4	3.0
3-20	5.0	5-28	3.6	8-5	3.7
3-24	5.1	6-1	3.6	8-7	3.2
3-25	7.0	6-2	2.4	8-11	3.6
3-26	5.1	6-3	3.8	8-12	3.2
3-27	7.3	6-4	2.6	8-13	3.1

APPENDIX B
TABLE 7 (Continued)

BETA ACTIVITY IN PASCO SANITARY WATER - 1964
Units of c/m/ml

Date	c/m/ml	Date	c/m/ml	Date	c/m/ml
8-14	3.4	10-14	1.7	12-11	2.5
8-17	4.8	10-15	1.6	12-14	1.9
8-18	3.4	10-16	1.8	12-15	2.2
8-21	3.8	10-19	1.8	12-16	2.8
8-25	3.2	10-20	1.8	12-17	3.0
8-26	3.9	10-21	1.7	12-18	3.5
8-27	4.0	10-22	2.6	12-22	2.6
8-28	3.1	10-23	2.2	12-28	2.1
8-31	3.8	10-27	2.7	12-29	1.5
9-2	3.3	10-28	2.5	12-30	3.3
9-4	4.2	10-29	1.8	12-31	2.3
9-8	5.6	10-30	1.8		
9-10	4.1	11-3	1.9		
9-11	4.6	11-4	2.6		
9-14	4.3	11-5	2.7		
9-15	5.0	11-6	2.5		
9-16	6.4	11-9	2.3		
9-17	5.9	11-10	1.9		
9-18	5.9	11-12	2.3		
9-21	4.7	11-13	3.7		
9-22	8.8	11-16	2.8		
9-23	6.7	11-17	2.3		
9-24	4.5	11-18	2.5		
9-25	6.6	11-19	2.3		
9-29	4.8	11-20	2.3		
9-30	6.2	11-23	2.1		
10-1	6.0	11-25	3.8		
10-2	6.0	12-1	2.3		
10-5	4.2	12-2	2.4		
10-6	4.4	12-3	2.2		
10-7	3.4	12-4	2.2		
10-8	6.2	12-7	2.2		
10-9	3.2	12-8	1.8		
10-12	2.2	12-9	2.3		
10-13	2.2	12-10	2.7		

APPENDIX B
TABLE 8

BETA ACTIVITY IN KENNEWICK SANITARY WATER - 1964
Units of c/m/ml

Date	c/m/ml	Date	c/m/ml	Date	c/m/ml
1-2	0.55	3-18	0.70	5-26	0.33
1-3	0.73	3-19	0.68	5-27	0.40
1-7	0.40	3-20	0.56	5-28	0.37
1-8	0.57	3-23	0.53	6-1	0.50
1-9	0.95	3-24	0.62	6-2	0.64
1-10	0.58	3-25	0.51	6-3	0.62
1-13	0.42	3-26	0.60	6-4	0.64
1-14	0.40	3-27	0.45	6-5	0.31
1-15	0.70	3-31	0.73	6-8	0.21
1-16	0.51	4-1	0.64	6-9	0.28
1-17	0.68	4-2	0.59	6-10	0.40
1-22	0.51	4-3	0.50	6-11	0.22
1-23	0.58	4-6	0.40	6-12	0.60
1-24	0.52	4-7	0.56	6-15	0.36
1-27	0.53	4-8	0.59	6-16	0.34
1-28	0.59	4-9	0.61	6-17	0.63
1-29	0.81	4-10	0.43	6-18	0.38
1-30	0.81	4-13	0.37	6-19	0.31
1-31	0.64	4-14	0.95	6-22	0.53
2-3	0.63	4-15	0.57	6-23	0.54
2-4	0.68	4-16	0.53	6-24	0.45
2-5	0.88	4-17	0.81	6-25	0.42
2-6	0.88	4-20	0.55	6-26	0.34
2-7	0.95	4-21	0.95	6-30	0.21
2-10	0.64	4-23	1.8	7-1	0.39
2-12	0.73	4-24	0.95	7-2	0.14
2-14	0.69	4-30	0.32	7-6	0.34
2-17	0.40	5-1	0.24	7-7	0.37
2-18	0.34	5-4	0.95	7-8	0.35
2-20	0.73	5-5	0.95	7-9	0.26
2-25	0.51	5-6	0.81	7-10	0.33
2-26	0.70	5-7	0.59	7-13	0.26
2-27	0.54	5-8	0.95	7-14	0.21
2-28	0.45	5-11	0.95	7-15	0.14
3-3	0.54	5-19	0.73	7-16	0.23
3-4	0.57	5-13	0.56	7-17	0.30
3-5	0.68	5-14	1.1	7-20	0.28
3-6	0.59	5-15	1.0	7-21	0.41
3-11	0.48	5-18	0.95	7-22	0.40
3-12	0.53	5-19	0.72	7-23	0.26
3-13	0.40	5-20	0.81	7-24	0.34
3-16	0.43	5-21	0.39	7-28	0.43
3-17	0.63	5-22	0.42	7-79	0.22

APPENDIX B
TABLE 8 (Continued)

BETA ACTIVITY IN KENNEWICK SANITARY WATER - 1964
Units of c/m/ml

Date	c/m/ml	Date	c/m/ml	Date	c/m/ml
7-30	0.22	10-6	0.37	12-7	0.47
7-31	0.45	10-7	0.37	12-8	0.62
8-3	0.41	10-8	0.40	12-9	0.58
8-4	0.44	10-9	0.37	12-10	0.53
8-5	0.41	10-12	0.37	12-11	0.41
8-7	0.73	10-13	0.37	12-14	0.56
8-10	0.73	10-14	0.28	12-15	0.62
8-11	0.33	10-15	0.28	12-17	0.61
8-12	0.64	10-16	0.26	12-18	0.42
8-13	0.32	10-19	0.27	12-22	0.62
8-14	0.53	10-20	0.34	12-23	0.50
8-17	0.43	10-21	0.40	12-28	0.56
8-18	0.65	10-22	0.95	12-29	0.50
8-21	0.38	10-23	0.34	12-30	0.81
8-24	0.35	10-27	0.36	12-31	0.70
8-25	0.60	10-28	0.36		
8-26	0.33	10-29	0.40		
8-27	0.46	10-30	0.39		
8-28	0.37	11-2	0.34		
8-31	0.37	11-3	0.49		
9-2	0.54	11-4	0.58		
9-4	0.45	11-5	0.61		
9-8	0.53	11-6	0.73		
9-10	0.43	11-9	0.38		
9-11	0.47	11-10	0.81		
9-14	0.39	11-11	0.53		
9-15	0.81	11-12	0.73		
9-16	0.62	11-13	0.55		
9-17	0.62	11-17	0.49		
9-18	0.46	11-18	0.42		
9-21	0.37	11-19	0.52		
9-22	0.47	11-20	0.50		
9-23	0.65	11-23	0.52		
9-24	0.42	11-24	0.71		
9-25	0.45	11-25	0.60		
9-28	0.45	11-30	0.58		
9-30	0.48	12-1	0.51		
10-1	0.51	12-2	0.64		
10-2	0.61	12-3	0.70		
10-5	0.37	12-4	0.60		

IX. APPENDIX C

RADIONUCLIDES IN FISH AND WATERFOWL

APPENDIX C
TABLE 1

CONCENTRATIONS OF RADIONUCLIDES IN MUSCLE
OF WHITEFISH TAKEN FROM THE COLUMBIA RIVER AT PRIEST RAPIDS - 1964
Units of picocuries per gram

Date	Total Beta	P^{32}	Co^{60}	K^{40}	Zn^{65}	Co^{58}	Cs^{137}
Reporting Limits		2	0.6	1	5	0.7	0.7
1-14		52	3.2	6	42	1.8	0.7
1-14	130	110	2.7	4	38	2.1	1.0
1-14	34	25	-	5	38	-	-
1-14	30	17	4.0	5	28	2.3	1.1
1-14	47	33	1.1	5	41	6.5	-
1-14	50	27	-	3	55	-	-
1-14	17	< 4	-	5	20	-	-
1-14	83	56	2.1	7	54	1.6	0.8
1-14	43	20	2.2	4	49	1.2	0.8
1-14	48	25	1.1	4	53	1.2	0.8
1-14	110	87	2.1	6	75	1.5	0.9
1-14	63	37	2.0	5	58	0.9	1.1
1-14	100	88	3.1	3	43	2.2	0.8
1-14	22	7	-	5	12	-	-
1-14	29	17	1.7	5	35	1.0	1.0
1-14	42	28	1.3	6	38	0.9	0.7
1-14	37	26	1.1	4	30	0.9	-
1-14	40	30	1.0	4	37	0.8	-
1-14	71	49	1.1	5	38	0.8	-
1-14	120	100	4.9	4	46	3.0	1.0
1-14	47	27	1.5	3	34	0.7	-
1-14	150	130	1.5	5	57	0.8	-
1-14	11	< 6	1.2	5	31	-	-
1-14	21	14	-	4	34	-	-
1-14	59	58	0.9	3	37	-	-
1-14	15	11	-	3	37	-	0.7
1-14	20	10	0.8	4	23	-	-
1-14	40	35	1.8	5	28	1.2	0.8
1-14	9	< 7	-	4	12	-	-
1-14	72	72	2.1	5	65	1.2	0.8
1-14	29	20	1.7	7	31	1.1	1.0
1-14	63	50	2.4	6	43	1.4	-
1-14	74	61	4.4	4	56	2.8	-
1-14	68	54	1.2	4	17	1.2	-
1-14	71	42	-	5	70	0.9	-
1-14	58	45	1.1	4	37	1.0	-
1-14	52	35	2.0	4	39	1.0	-
1-14	210	220	0.7	5	29	0.8	0.9
1-14	290	270	3.0	5	88	1.9	0.8
1-14	50	40	1.1	3	34	-	-
1-14	25	20	1.0	6	19	0.7	-

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX C
TABLE 1 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN MUSCLE
OF WHITEFISH TAKEN FROM THE COLUMBIA RIVER AT PRIEST RAPIDS - 1964
Units of picocuries per gram

Date	Total Beta	P^{32}	Co^{60}	K^{40}	Zn^{65}	Co^{58}	Cs^{137}
Reporting Limits		2	0.6	1	5	0.7	0.7
1-14	56	43	1.0	6	41	0.8	0.9
1-14	31	23	1.2	5	52	-	0.9
1-14	19	9	-	6	26	-	-
1-14	55	41	1.9	5	54	1.0	1.1
1-14	22	16	-	3	13	-	-
1-14	48	38	-	5	50	-	-
1-14	17	10	-	3	26	-	-
1-14	27	20	1.1	5	27	0.7	-
1-14	25	17	-	3	22	-	-
1-14	42	36	0.7	5	39	-	-
1-14	24	15	-	3	12	-	-
1-14	25	10	1.1	3	35	-	0.8
1-14	120	120	3.9	5	43	2.7	-
1-14	120	100	1.5	18	86	1.1	-
1-14	54	36	1.5	5	54	0.8	1.0
1-14	53	36	1.2	5	66	0.9	0.7
1-14	< 8	< 6	-	4	23	-	-
1-14	340	350	1.9	4	82	1.8	-
1-14	180	190	2.1	5	68	1.4	0.7
1-14	54	36	-	5	56	0.7	-
1-14	100	89	0.9	5	65	0.8	-
1-14	62	51	1.3	8	64	1.1	-
1-14	24	< 8	-	7	15	-	-
1-14	20	< 7	1.8	5	29	-	0.7
1-14	35	23	1.6	6	41	1.1	0.9
1-14	33	26	-	5	60	-	-
1-14	21	< 6	-	4	35	-	-
1-14	< 8	< 7	-	5	-	-	-
1-14	82	71	0.9	4	88	1.1	-
1-14	93	70	-	6	94	0.7	-
1-14	35	24	-	6	47	-	-
1-14	56	40	-	3	63	-	-
1-14	32	13	-	4	52	-	-
1-14	180	170	0.6	5	56	-	-
1-14	21	13	-	10	43	-	0.8
1-14	38	22	-	4	39	-	-
1-14	18	< 7	-	8	40	-	-
1-14	67	65	0.7	5	25	-	-
1-14	27	14	1.0	5	33	-	-
1-14	77	52	1.2	3	50	0.8	-

Results less than reporting limit are indicated by a (-).

APPENDIX C
TABLE 1 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN MUSCLE
OF WHITEFISH TAKEN FROM THE COLUMBIA RIVER AT PRIEST RAPIDS - 1964
Units of picocuries per gram

Date	Total Beta	P^{32}	Co^{60}	K^{40}	Zn^{65}	Co^{58}	Cs^{137}
Reporting Limits		2	0.6	1	5	0.7	0.7
1-14	17	6	1.3	5	25	-	1.0
1-14	< 9	< 7	-	5	-	-	
1-14	< 7	< 6	-	5	-	-	-
1-14	< 8	< 7	-	6	-	-	-
1-14	< 11	< 9	-	6	-	-	-
1-14	< 11	< 8	-	5	-	-	-
1-14	11	< 7	-	5	-	-	-
1-14	< 13	< 10	-	6	9	-	-
1-14	12	< 6	-	5	-	-	-
1-14	< 9	< 7	-	4	-	-	-
1-14	13	< 7	-	4	-	-	-
1-14	< 9	< 7	-	6	-	-	-
1-14	< 10	< 8	-	5	-	-	-
1-14	< 9	< 7	-	5	-	-	-
1-14	15	< 9	-	8	-	-	-
1-14	7	< 4	-	3	-	-	-
1-14	7	< 5	-	3	-	-	-
1-14	< 11	< 8	-	6	-	-	-
1-14	10	< 7	-	4	-	-	-
1-14	< 10	< 7	-	5	-	-	-
1-14	10	< 6	-	4	-	-	-
1-14	19	< 7	-	5	-	-	-
1-14	82	63	2.2	4	32	1.1	-
1-14	< 10	< 7	-	6	-	-	-
1-14	12	< 7	-	-	-	-	-
1-14	14	< 8	-	4	-	-	-
1-14	11	< 7	-	4	-	-	-
1-14	13	< 9	-	4	-	-	-
1-14	< 10	< 7	-	4	8	-	-
1-14	< 8	< 6	-	5	-	-	-
1-14	11	< 7	-	3	-	-	-
1-14	15	< 7	-	3	-	-	-
1-14	< 20	< 14	-	-	-	-	-
1-14	< 14	< 9	-	-	-	-	-
1-14	10	< 7	-	-	-	-	-
1-14	< 13	< 9	-	5	-	-	-
1-14	16	< 8	-	3	-	-	-
1-14	14	< 8	-	6	9	-	-
1-14	16	< 7	-	4	-	-	-
1-14	22	12	-	3	11	-	-

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX C
TABLE 1 (Continued

CONCENTRATIONS OF RADIONUCLIDES IN MUSCLE
OF WHITEFISH TAKEN FROM THE COLUMBIA RIVER AT PRIEST RAPIDS - 1964
Units of picocuries per gram

Date	Total Beta	P^{32}	Co^{60}	K^{40}	Zn^{65}	Co^{58}	Cs^{137}
Reporting Limits		2	0.6	1	5	0.7	0.7
1-14	< 13	< 9	-	-	-	-	-
1-14	11	< 7	-	3	-	-	-
1-14	15	< 8	-	6	-	-	-
1-14	18	< 12	-	-	-	-	-
1-14	< 12	< 8	-	4	-	-	-
1-14	11	< 7	-	3	-	-	-
1-14	17	8	-	4	-	-	-
1-14	< 16	< 11	-	-	7	-	-
1-14	< 12	< 8	-	4	-	-	-
1-14	27	< 11	-	-	10	-	-
1-14	12	5	-	5	-	-	-
1-14	< 10	< 7	-	5	-	-	-
1-14	< 10	< 7	-	-	-	-	-
1-14	< 11	< 8	-	5	-	-	-
2-5		-	-	4	-	-	-
2-5		-	-	3	-	-	-
2-5		18	3.4	5	36	1.8	1.1
2-5		< 3	-	4	-	-	-
2-5		9	-	5	27	-	-
2-5		< 3	-	4	-	-	-
2-5		< 3	-	5	7	-	-
2-5		< 4	-	4	-	-	-
3-3		-	-	-	-	-	-
3-3		< 4	-	-	-	-	-
3-3		-	-	3	5	-	-
3-3		-	-	-	-	-	-
3-5		-	-	-	-	-	-
3-5		< 3	-	-	-	-	-
4-24		9	1.5	3	28	-	-
4-24		9	-	4	44	-	-
8-1		3	-	3	-	-	-
8-1		-	-	3	-	-	-
8-1		-	-	4	-	-	-
8-1		10	-	-	-	-	-
8-9		2	-	5	-	-	-
8-9		15	-	4	6	-	-
8-9		26	-	3	5	-	-
8-9		110	-	4	8	-	-
8-9		19	-	4	-	-	-
8-9		560	-	-	10	0.7	-

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX C
TABLE 1 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN MUSCLE
OF WHITEFISH TAKEN FROM THE COLUMBIA RIVER AT PRIEST RAPIDS - 1964
Units of picocuries per gram

Date	Total Beta	P^{32}	Co^{60}	K^{40}	Zn^{65}	Co^{58}	Cs^{137}
Reporting Limits		2	0.6	1	5	0.7	0.7
8-9		440	-	-	28	1.4	-
8-9		1100	-	4	31	1.9	-
10-1		-	-	4	-	-	-
10-1		280	1.2	4	24	-	0.9
10-1		-	-	4	-	-	-
10-1		-	-	4	-	-	-
10-1		10	-	5	-	-	-
10-1		-	-	4	-	-	-
10-1		-	-	3	-	-	-
10-1		250	0.7	3	18	-	-
10-1		230	0.9	4	27	0.9	0.7
11-10		-	-	3	-	-	-
11-10		3	-	4	-	-	-
11-10		280	2.9	4	33	3.4	0.7
11-10		190	1.7	3	37	1.2	0.8
11-10		190	1.8	4	30	3.0	-
12-7		92	1.6	3	24	2.9	-

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX C
TABLE 1 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN MUSCLE
OF WHITEFISH TAKEN FROM THE COLUMBIA RIVER AT PRIEST RAPIDS - 1964
Units of picocuries per gram

Date	Total Beta	P^{32}	Co^{60}	K^{40}	Zn^{65}	Co^{58}	Cs^{137}
Reporting Limits		2	0.6	1	5	0.7	0.7
8-9		440	-	-	28	1.4	-
8-9		1100	-	4	31	1.9	-
10-1		-	-	4	-	-	-
10-1		280	1.2	4	24	-	0.9
10-1		-	-	4	-	-	-
10-1		-	-	4	-	-	-
10-1		10	-	5	-	-	-
10-1		-	-	4	-	-	-
10-1		-	-	3	-	-	-
10-1		250	0.7	3	18	-	-
10-1		230	0.9	4	27	0.9	0.7
11-10		-	-	3	-	-	-
11-10		3	-	4	-	-	-
11-10		280	2.9	4	33	3.4	0.7
11-10		190	1.7	3	37	1.2	0.8
11-10		190	1.8	4	30	3.0	-
12-7		92	1.6	3	24	2.9	-

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX C
TABLE 2

CONCENTRATIONS OF RADIONUCLIDES IN MUSCLE
OF WHITEFISH TAKEN FROM THE COLUMBIA RIVER AT HANFORD - 1964
Units of picocuries per gram

Date	Total Beta	P^{32}	Co^{60}	K^{40}	Zn^{65}	Co^{58}	Cs^{137}
Reporting Limits		2	0.6	1	5	0.7	0.7
1-3	290	250	3.1	4	43	2.1	-
1-3	160	150	2.9	3	35	1.2	-
1-3	84	59	-	3	34	-	-
1-3	280	150	3.4	6	51	1.7	0.7
2-3	83	89	2.7	1	33	1.7	-
2-3	170	160	4.4	3	56	2.5	0.9
2-3	99	83	2.7	3	40	1.6	0.8
2-3	100	84	3.1	2	38	1.6	1.0
2-3	140	120	1.8	-	35	0.8	-
2-3	140	140	2.1	4	34	1.1	-
2-3	270	300	0.8	2	20	-	-
2-3	230	210	1.3	2	32	0.9	0.9
2-13	170	150	5.4	1	49	2.3	-
2-13	110	100	5.6	3	53	3.2	-
2-13	290	260	1.3	8	44	0.7	1.0
2-13	61	52	3.0	5	31	1.4	0.8
2-13	110	92	6.0	5	47	3.0	1.1
2-13	110	99	1.8	6	31	0.9	0.7
2-13	100	80	3.3	5	31	1.4	0.8
2-13	170	110	3.5	4	43	1.5	0.8
2-13	470	420	2.0	9	62	1.3	0.9
2-13	140	110	2.5	6	40	1.5	0.8
2-13	100	86	3.5	5	30	1.6	0.8
3-10	43	28	2.2	2	22	0.9	0.7
3-10	92	79	1.6	4	31	0.8	0.7
4-7		390	2.3	4	34	0.8	0.8
4-7		530	2.8	2	38	0.8	0.7
4-7		200	1.9	4	34	-	-
4-7		200	4.5	3	38	1.6	1.1
4-7		430	2.5	1	33	0.8	-
4-7		660	1.3	3	43	0.8	0.8
4-7		350	1.6	3	36	-	-
4-7		830	1.3	4	32	0.8	0.9
4-7		700	1.6	4	37	-	-
5-11		170	3.7	1	25	1.3	-
5-11		230	3.1	3	31	1.1	-
5-11		570	2.1	3	31	0.8	-

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX C
TABLE 2 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN MUSCLE
OF WHITEFISH TAKEN FROM THE COLUMBIA RIVER AT HANFORD - 1964
Units of picocuries per gram

Date	Total Beta	P^{32}	Co^{60}	K^{40}	Zn^{65}	Co^{58}	Cs^{137}
Reporting Limits		2	0.6	1	5	0.7	0.7
5-11		320	5.4	4	29	1.8	-
5-11		130	2.6	5	38	1.4	-
5-11		330	2.8	3	29	1.0	-
5-11		380	3.8	6	30	1.6	0.7
5-11		1220	1.8	4	29	0.8	0.8
5-11		600	1.8	8	28	1.0	0.8
5-11		710	2.3	4	33	1.3	-
6-5		180	3.8	5	40	1.5	1.0
6-5		720	2.4	5	53	1.0	0.9
6-5		22	0.7	5	7	-	-
6-5		4	-	5	-	-	-
6-5		190	4.3	4	30	2.1	1.2
6-5		770	2.2	6	58	1.2	1.3
6-5		220	3.0	4	26	1.4	1.0
6-5		610	1.9	5	41	1.2	1.0
6-5		320	4.6	4	47	1.7	1.1
6-5		810	2.2	8	45	1.3	0.8
6-5		440	2.7	3	40	0.8	0.8
6-5		510	3.7	7	50	0.8	1.0
6-5		440	0.8	5	67	-	-
7-9		49	2.6	5	25	0.9	0.7
7-9		14	1.4	4	24	-	0.9
7-9		69	5.9	2	36	1.4	0.8
7-9		9	6.1	3	30	1.4	1.2
7-9		28	4.6	5	25	1.2	-
7-9		7	2.4	5	25	-	0.9
7-9		36	1.2	2	21	-	1.4
7-9		43	2.1	4	29	0.7	0.9
7-9		35	3.1	5	20	1.0	1.0
7-9		100	2.2	5	34	-	-
7-9		130	3.6	4	46	1.1	1.1
7-9		73	2.9	4	28	-	-
7-9		210	1.7	4	28	1.0	-
7-9		4	-	4	-	-	-
7-9		80	1.6	5	29	-	0.9
7-9		8	4.0	4	28	1.3	0.8
7-31		13	-	5	-	-	-
7-31		16	-	3	-	-	-
7-31		200	1.1	4	29	1.1	1.1
7-31		44	1.4	4	15	-	-

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX C
TABLE 2 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN MUSCLE
OF WHITEFISH TAKEN FROM THE COLUMBIA RIVER AT HANFORD - 1964
Units of picocuries per gram

Date	Total Beta	P^{32}	Co^{60}	K^{40}	Zn^{65}	Co^{58}	Cs^{137}
Reporting Limits		2	0.6	1	5	0.7	0.7
7-31		58	2.9	5	28	0.7	0.7
8-5		140	1.7	4	19	-	-
8-5		27	2.3	3	37	0.9	1.9
8-5		18	-	3	-	-	-
8-5		130	2.2	4	25	0.8	1.1
8-5		65	1.5	5	17	-	0.7
8-5		110	2.9	4	24	1.6	0.9
8-5		240	0.7	4	9	-	-
8-5		33	1.7	5	16	0.8	-
8-5		55	1.4	4	10	-	-
9-2		230	4.9	9	23	1.4	0.8
9-2		50	2.1	6	20	-	1.9
9-2		22	2.8	4	22	-	1.1
9-2		440	2.5	1	20	1.2	0.8
9-2		440	2.9	3	24	1.0	-
9-2		160	0.6	3	7	-	-
9-2		490	1.8	5	23	1.0	-
9-2		230	-	2	7	-	-
9-2		170	1.3	3	13	-	0.7
9-2		360	1.4	5	18	0.7	-
9-2		450	2.9	4	19	1.0	0.9
9-2		360	1.6	1	22	-	-
11-4		300	2.1	6	28	2.2	0.9
11-4		290	1.8	4	27	1.4	0.8
11-4		470	1.5	8	31	1.7	0.9
11-11		200	2.7	6	27	3.2	1.0
11-11		220	1.7	5	26	1.9	0.7
11-11		660	-	5	37	0.8	-
11-11		270	1.7	5	28	2.1	0.8

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX C
TABLE 3

CONCENTRATIONS OF RADIONUCLIDES IN MUSCLE
OF WHITEFISH TAKEN FROM THE COLUMBIA RIVER AT RINGOLD - 1964
Units of picocuries per gram

Date	Total Beta	P^{32}	Co^{60}	K^{40}	Zn^{65}	Co^{58}	Cs^{137}
Reporting Limits		2	0.6	1	5	0.7	0.7
1-29	230	220	6.4	4	41	3.3	1.1
1-29	670	680	2.8	3	60	1.5	1.2
1-29	350	330	3.5	4	52	2.2	1.2
1-29	280	260	4.6	6	48	2.4	1.4
1-29	280	260	3.8	5	54	2.2	1.4
1-29	1100	990	1.8	5	82	1.8	1.4
2-20			4.0	5	50	1.7	1.3
2-20			1.6	4	64	1.0	1.0
2-20			2.4	3	36	1.1	0.8
2-20			1.2	6	39	1.3	-
2-20			2.5	3	34	1.3	1.0
2-20			2.7	3	45	1.6	0.9
2-20			4.8	3	54	2.6	1.2
2-20			5.0	4	43	2.6	0.9
2-20			3.1	4	46	1.5	0.9
2-20			4.8	3	51	2.5	1.4
2-20			2.3	3	46	1.2	1.1
2-20			2.3	4	54	1.3	0.9
3-13	160	140	5.2	3	54	3.3	1.7
3-13	95	71	3.7	6	24	1.7	0.8
3-13	580	540	4.9	5	53	2.4	1.5
3-13	370	350	3.6	8	52	2.0	1.1
3-13	320	290	3.7	5	47	1.4	1.1
3-13	280	250	2.3	5	33	1.1	-
3-13	740	650	4.1	7	54	1.5	1.1
3-13	540	500	2.2	2	54	1.0	1.2
3-13	910	900	4.7	3	61	2.1	1.2
3-13	720	780	4.2	6	57	1.9	1.3
3-13	710	580	1.7	7	49	1.2	1.0
3-13	380	300	2.8	5	47	1.4	1.3
4-2		680	7.3	3	44	3.1	1.0
4-2		600	2.4	4	42	1.0	-
4-2		920	2.2	4	30	1.0	0.7
4-2		2300	1.4	3	57	1.2	0.9
4-2		420	4.0	6	45	2.2	1.0
4-2		370	5.9	3	35	2.4	1.0
4-2		1800	1.3	5	66	1.4	0.8
4-2		1000	1.4	7	49	0.9	0.8

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX C
TABLE 3 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN MUSCLE
OF WHITEFISH TAKEN FROM THE COLUMBIA RIVER AT RINGOLD - 1964
Units of picocuries per gram

Date	Total Beta	P^{32}	Co^{60}	K^{40}	Zn^{65}	Co^{58}	Cs^{137}
Reporting Limits		2	0.6	1	5	0.7	0.7
4-2		930	3.1	4	34	1.8	1.0
4-2		1100	2.8	6	67	1.7	0.8
4-2		1560	2.6	9	72	2.0	1.0
4-27		51	1.3	5	13	-	-
4-27		170	3.0	5	36	1.4	0.9
5-6		1100	3.4	3	52	1.5	1.3
5-6		2700	1.9	7	70	1.4	1.2
5-6		1800	1.7	4	74	0.9	1.2
5-6		840	4.8	5	50	2.8	1.6
5-6		2100	1.4	5	59	1.0	0.9
5-6		2400	1.3	5	73	1.4	1.2
5-6		1400	2.8	8	49	1.5	1.3
5-6		560	3.9	4	42	1.2	0.9
5-6		1300	0.9	6	45	0.8	-
5-6		1200	3.6	5	56	1.8	1.4
5-6		1500	3.8	9	100	1.6	1.4
5-6		4900	0.8	9	84	2.5	1.6
6-26		50	3.2	3	23	1.1	-
6-26		46	0.6	3	7	-	-
6-26		250	2.8	2	34	1.4	0.8
6-26		160	3.1	3	32	1.5	0.8
6-26		180	2.8	2	36	1.5	1.1
6-26		530	1.3	4	39	1.1	0.8
6-26		44	1.5	3	8	1.0	-
6-26		160	0.9	-	27	1.1	-
6-26		730	1.4	3	58	1.0	-
6-26		120	3.1	3	24	1.5	-
7-6		20	1.4	4	11	0.9	-
7-6		8	-	3	-	-	-
7-6		12	-	-	-	-	-
7-6		26	0.6	2	10	-	-
7-6		7	-	4	-	-	-
7-6		91	0.9	2	11	-	-
7-6		11	-	2	-	-	-
7-6		16	-	3	5	-	-
7-6		33	0.6	3	5	-	-
7-6		80	3.1	2	35	0.9	1.0
7-6		97	1.1	2	9	-	-
7-6		190	1.7	4	41	0.8	1.1
7-6		70	3.0	4	30	1.2	1.0
7-6		120	0.8	4	10	-	-
7-6		120	5.1	4	38	1.6	0.9

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX C
TABLE 3 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN MUSCLE
OF WHITEFISH TAKEN FROM THE COLUMBIA RIVER AT RINGOLD - 1964
Units of picocuries per gram

Date	Total Beta	P^{32}	Co^{60}	K^{40}	Zn^{65}	Co^{58}	Cs^{137}
Reporting Limits		2	0.6	1	5	0.7	0.7
7-6		370	0.9	3	16	-	-
7-6		290	1.6	4	41	1.0	0.8
7-6		27	-	3	5	-	-
7-6		270	2.2	3	48	1.4	1.4
7-21		77	3.1	5	27	1.0	0.8
7-21		52	2.2	6	28	0.9	0.9
7-21		150	1.0	5	13	-	-
7-21		62	2.8	6	34	1.5	0.8
7-21		44	0.7	4	10	-	-
7-21		21	-	4	5	-	-
7-21		63	2.4	4	32	0.8	0.9
7-21		68	4.0	6	22	2.1	1.2
7-21		43	0.6	5	6	-	-
7-21		59	0.9	5	11	-	-
7-21		56	2.7	4	35	0.9	0.8
7-21		63	2.5	6	33	1.3	1.4
7-21		260	1.1	4	14	0.7	-
7-21		120	2.2	7	32	1.3	1.3
7-21		150	1.3	6	31	0.9	0.8
7-21		17	-	6	-	0.7	-
7-21		91	3.0	7	31	1.7	1.3
7-21		48	2.2	2	29	1.2	1.2
7-21		120	2.5	6	32	1.6	1.3
8-11		290	-	2	11	1.0	-
8-24		580	2.6	4	16	2.2	0.7
8-24		1100	3.2	4	29	2.1	1.1
8-24		430	2.0	4	25	1.2	1.0
8-24		370	1.4	4	21	1.6	0.7
8-24		1900	2.1	4	43	3.8	1.3
8-24		1500	1.4	5	42	2.9	1.1
9-23		400	0.6	2	10	-	-
9-23		1400	5.5	4	48	5.5	0.7
9-23		570	2.1	6	29	1.8	1.2
9-23		1100	2.8	4	38	2.6	1.1
9-23		990	3.8	5	31	2.6	1.0
9-23		690	2.5	5	29	2.0	1.2
9-23		880	2.1	5	40	2.3	1.3
9-23		1100	2.6	5	38	2.2	1.1
9-23		500	2.6	4	35	2.1	0.9
9-23		730	1.6	5	34	1.4	0.9

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX C
TABLE 3 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN MUSCLE
OF WHITEFISH TAKEN FROM THE COLUMBIA RIVER AT RINGOLD - 1964
Units of picocuries per gram

Date	Total Beta	P^{32}	Co^{60}	K^{40}	Zn^{65}	Co^{58}	Cs^{137}
Reporting Limits		2	0.6	1	5	0.7	0.7
10-15		670	2.2	5	32	1.9	1.2
10-15		700	3.1	3	37	2.9	1.2
10-15		710	3.8	4	44	4.5	1.1
10-15		610	3.3	3	42	3.2	1.3
10-15		410	1.4	4	28	1.1	-
10-15		860	2.0	3	43	2.1	1.0
10-15		730	2.2	3	38	2.0	1.1
11-5		1100	3.2	11	76	5.3	1.1
11-5		890	3.2	8	49	3.7	1.1
11-5		1100	2.2	9	53	4.4	1.1
11-5		710	1.8	6	59	2.5	1.3
11-5		650	3.7	-	44	4.8	1.2
11-5		790	3.3	6	59	4.9	1.1
11-5		470	2.7	5	47	3.4	1.3
11-5		300	1.2	4	30	-	-
12-3		330	2.1	8	34	6.0	0.9

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX C
TABLE 4

CONCENTRATIONS OF RADIONUCLIDES IN MUSCLE
OF WHITEFISH TAKEN FROM THE COLUMBIA RIVER AT RICHLAND - 1964
Units of picocuries per gram

Date	Total Beta	P^{32}	Co^{60}	K^{40}	Zn^{65}	Co^{58}	Cs^{137}
Reporting Limits		2	0.6	1	5	0.7	0.7
7-7		15	-	3	-	-	-
7-7		48	-	3	6	-	-
7-7		80	4.8	3	32	1.6	-
7-7		40	0.6	4	6	-	-
7-7		31	1.1	3	7	-	-
7-7		53	1.2	4	9	-	-
7-7		38	-	4	9	-	-
7-7		12	-	4	8	-	-
7-7		54	0.7	4	16	-	-
7-7		220	2.5	4	42	1.2	0.9
7-7		180	2.3	3	30	1.1	1.2
7-7		240	0.8	2	7	0.8	-
7-22		17	0.8	5	6	-	-
7-22		23	0.7	5	29	-	-
7-22		34	2.3	5	27	0.9	1.2
7-22		110	0.6	4	7	-	-
7-22		100	1.2	6	7	-	-
7-22		26	0.7	6	5	-	-
7-22		49	1.9	4	19	0.7	0.8
7-22		52	0.8	5	30	-	-
7-22		220	2.0	11	24	1.2	0.8
7-22		100	-	7	14	-	-
7-22		89	0.7	5	10	0.7	-
7-22		23	1.1	4	8	-	-
7-22		550	1.0	7	19	-	-
7-23		47	2.4	4	36	-	0.8
7-23		490	2.8	8	16	1.3	0.7
7-23		29	1.1	5	7	-	-
7-23		64	1.2	4	8	0.8	-
7-23		44	3.0	3	27	1.0	0.8
7-23		23	0.8	5	6	-	-
7-24		18	2.1	4	14	1.0	0.9
7-24		20	0.7	4	-	-	-
7-24		44	1.4	4	10	-	-
7-24		43	-	5	-	-	-
7-24		17	0.8	3	-	-	-
7-24		15	-	4	-	-	-

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX C
TABLE 4 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN MUSCLE
OF WHITEFISH TAKEN FROM THE COLUMBIA RIVER AT RICHLAND - 1964
Units of picocuries per gram

Date	Total Beta	P^{32}	Co^{60}	K^{40}	Zn^{65}	Co^{58}	Cs^{137}
Reporting Limits		2	0.6	1	5	0.7	0.7
7-24		140	0.7	6	11	-	-
7-24		27	0.8	3	9	-	-
7-24		21	-	4	4	-	-
7-24		35	-	5	13	-	-
7-24		92	1.6	5	27	-	0.8
7-24		17	0.7	3	6	0.7	-
7-24		36	3.7	6	28	1.4	1.1
7-24		44	1.6	4	10	0.7	-
7-24		85	0.8	4	6	-	-
7-24		93	0.7	2	12	-	-
7-24		53	1.2	4	12	0.8	-
10-22		1300	1.2	2	54	1.9	0.9
10-22		1400	1.8	4	60	3.1	0.7
10-22		680	2.2	4	40	2.6	1.2
10-22		540	2.1	2	44	3.0	0.8
10-22		310	1.7	2	48	1.4	0.8
10-22		410	2.9	4	32	3.4	0.8
10-22		200	2.9	3	33	1.5	0.7
11-13		240	1.4	5	31	2.8	0.9
11-13		290	1.9	7	29	2.2	0.9

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX C
TABLE 5

CONCENTRATIONS OF RADIONUCLIDES IN MUSCLE
OF WHITEFISH TAKEN FROM THE COLUMBIA RIVER AT ISLAND VIEW - 1964
Units of picocuries per gram

Date	Total Beta	P^{32}	Co^{60}	K^{40}	Zn^{65}	Co^{58}	Cs^{137}
Reporting Limits		2	0.6	1	5	0.7	0.7
1-25	< 9	< 6	-	-	-	-	-
3-27	7	< 2	0.6	4	5	-	-
4-21		-	-	3	5	-	-
4-21		-	-	3	28	-	-
4-21		-	-	4	13	-	-
4-21		-	-	5	12	-	-
4-21		-	0.8	4	5	-	-
4-21		-	-	4	6	-	-
4-21		-	-	4	7	-	-
4-21		-	-	3	5	-	-
4-21		-	-	4	10	-	-
4-21		-	1.0	3	17	-	-
4-21		-	-	4	18	-	-
4-21		-	0.8	3	13	-	-
6-2		-	-	4	11	-	-
6-2		7	-	3	-	-	-
6-2		3	-	4	6	-	-
6-2		2	-	5	-	-	-
6-2		-	-	4	-	-	-
6-2		5	-	5	8	-	-
6-2		-	-	4	-	-	-
6-2		-	-	4	-	-	-
6-2		-	-	4	-	-	-
6-2		-	-	4	-	-	-
6-2		-	-	4	-	-	-
6-2		-	-	4	-	-	-
6-2		3	-	4	-	-	-
6-2		-	-	4	6	-	-
6-2		-	-	4	-	-	-
6-2		-	-	4	-	-	-
6-2		-	-	4	-	-	-
6-2		6	-	3	5	-	-
6-2		-	-	4	-	-	-
6-2		3	-	4	-	-	-
6-2		48	-	4	22	-	-
6-2		-	-	4	6	-	-
6-2		2	-	4	7	-	-
6-2		3	-	5	5	-	-

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX C
TABLE 6

CONCENTRATIONS OF RADIONUCLIDES IN MUSCLE
OF WHITEFISH TAKEN FROM THE COLUMBIA RIVER AT MISCELLANEOUS LOCATIONS - 1964
Units of picocuries per gram

Date	Total Beta	P^{32}	Co^{60}	K^{40}	Zn^{65}	Co^{58}	Cs^{137}
Reporting Limits		2	0.6	1	5	0.7	0.7
Burbank							
1-20	35	27	2.7	4	30	1.6	0.9
1-20	77	56	1.3	3	55	1.0	0.9
4-16		19	0.7	5	15	-	-
6-14		170	2.2	2	24	1.0	-
10-7		400	-	3	20	-	-
10-7		210	-	4	18	-	-
11-18		65	-	3	19	-	-
11-18		150	-	4	21	-	-
11-18		78	-	4	24	-	-
11-18		250	-	4	28	-	-
11-18		50	-	3	15	-	-
11-18		300	-	5	34	-	-
11-18		120	-	-	34	-	-
McNary							
7-29		59	-	3	20	-	-
7-29		95	-	3	15	-	-
7-29		120	-	5	28	-	-
7-29		48	-	4	20	-	-
12-11		62	-	2	16	-	-

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX C
TABLE 7

CONCENTRATIONS OF RADIONUCLIDES IN MUSCLE
OF BASS TAKEN FROM THE COLUMBIA RIVER - 1964

Units of picocuries per gram

Date	Total Beta	P^{32}	Co^{60}	K^{40}	Zn^{65}	Co^{58}	Cs^{137}
Reporting Limits		2	0.6	1	5	0.7	0.7
Hanford							
4-7		19	-	3	27	-	1.1
4-7		17	-	4	24	-	1.1
4-7		18	-	4	28	-	0.8
4-7		20	-	4	35	-	1.1
5-6		65	-	4	34	-	1.0
5-11		70	-	5	38	-	1.0
6-5		84	-	7	27	-	0.9
6-5		22	-	5	43	-	1.1
10-14		580	-	3	34	-	1.3
10-14		510	-	4	32	-	1.2
10-14		630	-	3	25	-	0.8
10-14		740	-	4	25	-	0.8
10-14		710	-	4	24	-	0.9
10-14		1100	-	3	24	-	-
10-14		1630	-	5	44	-	1.4
Ringold							
4-10		6	-	4	25	-	1.0
4-10		9	-	4	26	-	1.2
4-10		9	-	4	29	-	1.0
4-10		24	-	3	24	-	1.0
4-10		5	-	3	20	-	1.0
4-10		6	-	2	18	-	1.1
4-10		15	-	4	29	-	1.1
4-10		18	-	4	23	-	0.8
4-10		6	-	4	24	-	0.9
4-10		9	-	4	20	-	0.7
4-10		12	-	4	18	-	0.9
4-10		24	-	4	26	-	0.8
4-10		12	-	3	23	-	0.9
4-10		16	-	3	21	-	1.1
4-10		11	-	4	31	-	0.9
4-10		13	-	4	33	-	1.0
4-10		14	-	3	26	-	1.3
4-10		40	-	3	42	-	1.0
4-10		12	-	3	30	-	1.0
4-10		30	-	3	28	-	0.8
4-10		9	-	5	15	-	1.0

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX C
TABLE 7 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN MUSCLE
OF BASS TAKEN FROM THE COLUMBIA RIVER - 1964
Units of picocuries per gram

Date	Total Beta	P^{32}	Co^{60}	K^{40}	Zn^{65}	Co^{58}	Cs^{137}
Reporting Limits		2	0.6	1	5	0.7	0.7
Ringold (Continued)							
4-10		11	-	4	14	-	0.8
4-10		9	-	3	16	-	0.8
4-10		15	-	4	23	-	0.9
4-10		15	-	4	26	-	1.0
4-10		8	-	5	25	-	1.0
4-10		18	-	5	29	-	1.0
4-10		15	-	4	21	-	1.1
4-10		14	-	5	26	-	1.0
4-10		12	-	4	32	-	0.8
4-10		31	-	5	31	-	0.9
4-10		25	-	5	27	-	1.0
4-27		15	-	4	12	-	0.9
4-27		23	-	5	26	-	1.1
4-27		60	-	3	22	-	1.3
4-27		44	-	4	22	-	1.0
4-27		32	-	4	24	-	1.0
4-27		36	-	4	22	-	1.0
4-27		44	-	8	27	-	0.9
8-24		1500	-	5	30	-	1.0
Richland							
6-2		-	-	4	-	-	-
6-2		20	-	5	16	-	-
Burbank							
1-20	11	6	-	5	28	-	-
6-12		-	-	4	13	-	-
6-12		13	-	4	16	-	-
6-12		4	-	-	17	-	0.8
7-14		16	-	5	13	-	-
8-20		96	-	3	13	-	-
9-16		150	-	4	15	-	-
McNary							
4-30		13	-	3	14	-	-
4-30		8	-	3	15	-	-

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX C
TABLE 8

CONCENTRATIONS OF RADIONUCLIDES IN MUSCLE
OF BULLHEADS TAKEN FROM THE COLUMBIA RIVER - 1964

Units of picocuries per gram

Date	Total Beta	P^{32}	Co^{60}	K^{40}	Zn^{65}	Co^{58}	Cs^{137}
Reporting Limits		2	0.6	1	5	0.7	0.7
Hanford							
3-11	10	< 3	-	3	21	-	0.9
3-11	12	< 4	-	3	24	-	0.7
4-7		23	-	4	28	-	0.7
4-7		75	2.2	4	26	3.4	1.1
5-5		49	-	6	18	-	-
5-5		49	-	5	16	-	-
6-5		53	1.0	7	18	-	-
10-14		320	-	8	23	-	-
Richland							
3-27	< 16	< 7	-	-	5	-	-
3-27	< 8	< 3	-	4	7	-	-
3-27	< 16	< 7	-	-	8	-	-
3-27	< 19	< 8	-	-	5	-	-
3-27	30	<12	-	-	7	-	-
4-21		11	-	-	-	-	-
6-2		11	-	8	7	-	-
6-2		10	-	4	-	-	-
6-2		-	-	-	-	-	-
6-2		8	-	-	-	-	-
6-2		13	-	-	-	-	-
6-2		2	-	6	5	-	-
6-2		25	-	-	7	-	-
6-2		-	-	-	-	-	-
6-2		6	-	-	-	-	-
Burbank							
6-12		10	-	-	13	-	-
6-12		9	-	2	13	-	-
6-12		13	-	-	10	-	-
9-16		200	-	-	14	-	-
9-16		150	-	-	16	-	-
9-16		140	-	-	12	-	-

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX C
TABLE 9

CONCENTRATIONS OF RADIONUCLIDES IN MUSCLE
OF CATFISH TAKEN FROM THE COLUMBIA RIVER - 1964
Units of picocuries per gram

Date	Total Beta	P^{32}	Co^{60}	K^{40}	Zn^{65}	Co^{58}	Cs^{137}
Reporting Limits		2	0.6	1	5	0.7	0.7
Richland							
3-27	8	-	-	4	16	-	1.0
Burbank							
1-20	11	8	-	2	10	-	-
1-20	7	3	-	1	12	-	-
1-20	8	3	-	2	11	-	-
2-11	10	-	-	3	25	-	0.9
2-11	5	2	-	3	10	-	-
3-31		11	-	2	10	-	-
3-31		-	-	2	10	-	-
3-31		-	-	4	11	-	-
3-31		3	-	3	-	-	-
3-31		4	-	3	13	-	-
3-31		10	-	2	10	-	-
4-16		-	-	3	14	-	-
4-16		-	-	3	15	-	-
4-16		-	-	3	11	-	-
4-16		2	-	3	9	-	-
4-16		-	-	4	15	-	-
4-16		14	-	2	17	-	-
4-16		-	-	3	18	-	-
4-16		-	-	3	6	-	-
4-16		-	-	2	23	-	-
4-16		-	-	2	15	-	-
4-16		-	-	2	15	-	-
4-16		2	-	3	19	-	-
4-16		5	-	3	7	-	-
4-16		3	-	3	18	-	-
4-16		-	-	3	9	-	-
4-16		-	-	3	7	-	-
4-16		10	-	2	13	-	-
4-16		14	-	4	11	-	-
4-16		13	-	-	10	-	-
4-16		2	-	2	11	-	-
4-16		16	-	3	15	-	-
4-16		12	-	-	-	-	-

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX C
TABLE 9 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN MUSCLE
OF CATFISH TAKEN FROM THE COLUMBIA RIVER - 1964
Units of picocuries per gram

Date	Total Beta	P^{32}	Co^{60}	K^{40}	Zn^{65}	Co^{58}	Cs^{137}
Reporting Limits		2	0.6	1	5	0.7	0.7
Burbank (Continued)							
4-16		9	-	-	9	-	-
4-16		9	-	-	9	-	-
4-16		8	-	-	9	-	-
5-13		-	-	3	15	-	-
5-13		7	-	3	15	-	-
5-13		7	-	-	16	-	-
5-13		3	-	3	15	-	-
5-13		5	-	2	12	-	-
5-13		-	-	4	16	-	-
5-13		6	-	3	12	-	-
5-13		5	-	3	12	-	-
5-13		7	-	4	22	-	-
6-12		3	-	3	14	-	-
6-12		22	-	3	12	-	-
6-12		6	-	4	13	-	-
6-12		3	-	2	15	-	-
6-12		6	-	3	11	-	-
6-12		-	-	2	13	-	-
6-12		14	-	2	11	-	-
6-12		17	-	-	15	-	-
6-12		10	-		15	-	-
6-12		5	-	-	8	-	-
6-19		34	-	2	9	-	-
6-19		16	-	-	17	-	-
6-19		16	-	3	19	-	-
6-19		17	-	3	20	-	-
6-19		4	-	3	14	-	-
6-19		-	-	2	13	-	-
6-19		-	-	5	11	-	-
6-19		65	-	-	13	-	-
6-19		15	-	2	21	-	-
6-19		11	-	-	12	-	-
6-19		16	-	3	15	-	-
6-19		-	-	3	13	-	-
6-19		10	-	2	21	-	-
6-19		10	-	2	16	-	-

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX C
TABLE 9 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN MUSCLE
OF CATFISH TAKEN FROM THE COLUMBIA RIVER - 1964

Units of picocuries per gram

Date	Total Beta	P^{32}	Co^{60}	K^{40}	Zn^{65}	Co^{58}	Cs^{137}
Reporting Limits		2	0.6	1	5	0.7	0.7
Burbank (Continued)							
7-14		4	-	3	13	-	-
7-14		7	-	2	15	-	-
7-14		16	-	3	12	-	-
7-14		14	-	2	11	-	-
7-14		17	-	-	15	-	-
7-14		17	-	4	14	-	-
7-14		13	-	2	11	-	-
7-14		15	-	-	13	-	-
7-14		48	-	4	19	-	-
7-14		27	-	-	13	-	-
7-14		20	-	3	14	-	-
7-14		27	-	-	15	-	-
7-14		17	-	-	12	-	-
7-14		14	-	3	14	-	-
7-14		17	-	2	16	-	-
7-14		22	-	2	12	-	-
7-14		7	-	4	13	-	-
7-14		17	-	-	15	-	-
8-20		46	-	-	15	-	-
8-20		14	-	-	12	-	-
8-20		48	-	-	14	-	-
8-20		36	-	4	16	-	-
8-20		54	-	5	15	-	-
8-20		31	-	4	12	-	-
8-20		150	-	3	15	-	-
8-20		-	-	3	9	-	-
8-20		34	-	-	14	-	-
8-20		62	-	5	16	-	-
8-20		42	-	4	16	-	-
8-20		45	-	-	12	-	-
8-20		18	-	5	17	-	-
8-20		34	-	3	10	-	-
8-20		57	-	-	11	-	-
8-20		31	-	-	7	-	-
8-20		75	-	4	13	-	-
8-20		67	-	3	13	-	-
8-20		56	-	-	16	-	-
8-20		100	-	2	11	-	-

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX C
TABLE 9 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN MUSCLE
OF CATFISH TAKEN FROM THE COLUMBIA RIVER - 1964

Units of picocuries per gram

Date	Total Beta	P^{32}	Co^{60}	K^{40}	Zn^{65}	Co^{58}	Cs^{137}
Reporting Limits		2	0.6	1	5	0.7	0.7
Burbank (Continued)							
8-20		83	-	-	13	-	-
9-16		80	-	2	16	-	-
9-16		160	-	5	18	-	-
9-16		83	-	3	12	-	-
9-16		71	-	-	14	-	-
9-16		100	-	-	17	-	-
10-7		73	-	5	15	-	-
10-7		77	-	3	14	-	-
10-7		50	-	4	13	-	-

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX C
TABLE 10

CONCENTRATIONS OF RADIONUCLIDES IN MUSCLE
OF CRAPPIE TAKEN FROM THE COLUMBIA RIVER - 1964

Units of picocuries per gram

Date	Total Beta	P^{32}	Co^{60}	K^{40}	Zn^{65}	Co^{58}	Cs^{137}
Reporting Limits		2	0.6	1	5	0.7	0.7
Hanford							
9-3		1000	-	5	21	-	1.1
Richland							
1-25	< 25	< 16	-	-	7	-	-
2-10	< 12	< 6	-	-	5	-	-
4-21		92	-	-	17	-	-
6-2		250	-	5	21	-	-
Burbank							
3-31		11	-	4	23	-	-
4-16		17	-	3	22	-	-
4-16		9	-	4	20	-	-
4-16		18	-	-	19	-	-
4-16		19	-	2	19	-	-
4-16		18	-	3	14	-	-
4-16		22	-	-	20	-	-
4-16		13	-	2	17	-	-
4-16		17	-	3	17	-	-
4-16		19	-	3	20	-	-
4-16		4	-	2	16	-	-
4-16		12	-	3	18	-	-
4-16		22	-	4	18	-	-
4-16		15	-	5	19	-	-
4-16		15	-	5	17	-	-
4-16		12	-	3	18	-	-
4-16		23	-	4	15	-	-
4-16		53	-	3	11	-	-
4-16		5	-	3	13	-	-
5-13		15	-	-	20	-	-
5-13		17	-	-	16	-	-
5-13		15	-	-	22	-	-
5-13		6	-	3	11	-	-
5-13		7	-	4	15	-	-
5-13		11	-	-	20	-	-
5-13		-	-	4	11	-	-
5-13		-	-	4	13	-	-

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX C
TABLE 10 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN MUSCLE
OF CRAPPIE TAKEN FROM THE COLUMBIA RIVER - 1964
Units of picocuries per gram

Date	Total Beta	P^{32}	Co^{60}	K^{40}	Zn^{65}	Co^{58}	Cs^{137}
Reporting Limits		2	0.6	1	5	0.7	0.7
Burbank (Continued)							
5-13		3	-	-	18	-	-
5-13		18	-	-	17	-	-
6-11		23	-	3	16	-	-
6-11		16	-	4	14	-	-
6-11		18	-	2	14	-	-
6-11		-	-	3	15	-	-
6-11		2	-	3	14	-	-
6-11		5	-	3	12	-	-
6-11		4	-	-	14	-	-
6-12		16	-	-	11	-	-
6-12		15	-	3	10	-	-
6-12		11	-	-	13	-	-
6-12		9	-	-	11	-	-
6-12		2	-	3	10	-	-
6-12		13	-	-	11	-	-
6-12		11	-	-	18	-	-
6-12		16	-	2	12	-	-
6-12		17	-	3	14	-	-
6-12		9	-	3	11	-	-
6-12		12	-	-	11	-	-
6-12		14	-	2	13	-	-
6-12		13	-	3	13	-	-
6-12		12	-	3	14	-	-
6-12		9	-	-	15	-	-
6-12		12	-	-	14	-	-
6-12		12	-	-	16	-	-
6-12		2	-	3	13	-	-
6-19		18	-	3	13	-	-
7-14		7	-	-	22	-	-
7-14		7	-	-	12	-	-
7-14		9	-	-	14	-	-
7-14		12	-	-	16	-	-
7-14		6	-	-	13	-	-
7-14		22	-	-	16	-	-
7-14		19	-	-	15	-	-
7-14		8	-	-	11	-	-
7-14		14	-	-	12	-	-
7-14		16	-	-	15	-	-
8-20		6	-	3	6	-	-

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX C
TABLE 10 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN MUSCLE
OF CRAPPIE TAKEN FROM THE COLUMBIA RIVER - 1964
Units of picocuries per gram

Date	Total Beta	P^{32}	Co^{60}	K^{40}	Zn^{65}	Co^{58}	Cs^{137}
Reporting Limits		2	0.6	1	5	0.7	0.7
Burbank (Continued)							
8-20		27	-	-	7	-	-
8-20		8	-	-	6	-	-
8-20		33	-	-	10	-	-
8-20		44	-	2	12	-	-
8-20		110	-	3	13	-	-
8-20		48	-	3	10	-	-
8-20		72	-	-	13	-	-
8-20		58	-	-	11	-	-
8-20		54	-	2	11	-	-
8-20		67	-	5	13	-	-
9-16		180	-	5	18	-	-
9-16		150	-	4	15	-	-
9-16		180	-	-	19	-	-
10-7		72	-	4	10	-	-
10-7		400	-	5	30	-	-
10-7		300	-	3	23	-	-
11-18		30	-	-	13	-	-

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX C
TABLE 11

CONCENTRATIONS OF RADIONUCLIDES IN MUSCLE
OF PERCH TAKEN FROM THE COLUMBIA RIVER - 1964

Units of picocuries per gram

Date	Total Beta	P^{32}	Co^{60}	K^{40}	Zn^{65}	Co^{58}	Cs^{137}
Reporting Limits		2	0.6	1	5	0.7	0.7
Hanford							
9-3		1700	-	3	29	0.7	1.2
Richland							
1-25	22	15	-	-	34	-	1.0
1-25	32	15	-	-	36	-	-
1-25	19	11	-	-	33	-	-
1-25	23	12	-	-	35	-	-
1-25	13	< 7	-	-	23	-	-
1-25	18	< 5	-	-	22	-	-
1-25	15	< 9	-	-	29	-	-
1-25	20	11	-	-	29	-	-
1-25	< 9	< 6	-	4	14	-	-
1-25	<15	<10	-	-	19	-	-
2-10	20	10	-	-	52	-	1.2
2-10	22	9	-	4	58	-	1.3
2-10	18	12	-	4	50	-	1.4
2-10	6	3	-	5	29	-	-
2-10	12	7	-	-	30	-	-
2-10	8	< 3	-	4	23	-	-
3-27	<20	< 9	-	-	21	-	-
3-27	<14	< 6	-	-	5	-	-
Burbank							
1-20	< 9	14	-	6	13	-	-
1-20	7	8	-	4	11	-	-
1-20	11	8	-	-	12	-	-
1-20	8	7	-	-	19	-	-
1-20	10	6	-	-	16	-	-
1-20	10	6	-	-	21	-	-
1-20	13	< 5	-	-	17	-	-
1-20	13	< 6	-	7	32	-	-
1-20	< 8	< 4	-	-	15	-	-
1-20	<12	< 7	-	-	11	-	-
3-31		16	-	3	17	-	-
3-31		11	-	3	28	-	-
3-31		2	-	4	17	-	-
3-31		17	-	3	22	-	-

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX C
TABLE 11 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN MUSCLE
OF PERCH TAKEN FROM THE COLUMBIA RIVER - 1964
Units of picocuries per gram

Date	Total Beta	P^{32}	Co^{60}	K^{40}	Zn^{65}	Co^{58}	Cs^{137}
Reporting Limits		2	0.6	1	5	0.7	0.7
Burbank (Continued)							
3-31		10	-	2	14	-	-
3-31		5	-	3	16	-	-
4-16		-	-	5	21	-	-
4-16		2	-	3	12	-	-
4-16		-	-	4	18	-	-
4-16		3	-	3	14	-	-
4-16		2	-	4	14	-	-
4-16		-	-	4	15	-	-
4-16		-	-	5	16	-	-
4-16		9	-	5	17	-	-
4-16		9	-	4	14	-	-
4-16		5	-	4	14	-	-
5-13		-	-	4	12	-	-
5-13		3	-	3	11	-	-
6-12		10	-	-	19	-	-
6-12		5	-	-	16	-	-
6-12		8	-	3	16	-	-
6-12		12	-	5	16	-	-
6-12		-	-	-	12	-	-
6-12		11	-	-	12	-	-
6-12		12	-	3	15	-	-
6-12		14	-	-	10	-	-
6-12		13	-	3	17	-	-
8-20		26	-	-	8	-	-
8-20		45	-	3	11	-	-
8-20		39	-	3	9	-	-
10-7		230	-	6	22	-	-
10-7		230	-	-	26	-	-
10-7		95	-	-	12	-	-

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX C
TABLE 12

CONCENTRATIONS OF RADIONUCLIDES IN MUSCLE
OF MISCELLANEOUS FISH TAKEN FROM THE COLUMBIA RIVER - 1964
Units of picocuries per gram

Date	Specie	Total Beta	P^{32}	Co^{60}	K^{40}	Zn^{65}	Co^{58}	Cs^{137}
Reporting Limits			2	0.6	1	5	0.7	0.7
Priest Rapids								
1-14	Sturgeon		< 4	-	3	-	-	-
1-14	Trout	20	11	-	4	13	-	-
2-5	Sucker		-	-	5	6	-	0.8
3-4	Sucker		-	-	3	-	-	-
3-5	Trout		-	-	4	-	-	-
4-24	Sucker		-	-	3	-	-	-
4-24	Sucker		-	-	4	16	-	1.0
4-24	Sucker		-	-	2	5	-	-
4-24	Sucker		-	-	4	-	-	-
4-24	Carp		3	-	4	-	-	-
8-11	Sturgeon		10	-	4	13	-	-
8-11	Sturgeon		15	-	4	11	-	-
8-11	Sturgeon		7	-	3	12	-	-
8-11	Sturgeon		-	-	4	-	-	-
8-11	Trout		-	-	3	-	-	-
12-7	Sturgeon		-	-	-	-	-	-
12-7	Sturgeon		-	-	-	-	-	-
Coyote Rapids								
1-30	Steelhead		-	-	5	-	-	-
2-27	Steelhead		-	-	3	-	-	-
3-20	Steelhead		-	-	4	-	-	-
8-28	Steelhead		-	-	3	-	-	-
8-28	Steelhead		3	-	4	-	-	-
8-28	Steelhead		5	-	4	7	-	-
9-17	Steelhead		7	-	3	-	-	-
9-28	King Salmon		16	-	6	-	-	-
Hanford								
1-3	Sucker	470	390	0.9	3	58	0.8	1.2
1-3	Sucker	1700	1600	1.7	5	190	1.9	1.0
1-3	Sucker	780	650	0.8	6	57	1.3	1.5
1-3	Sucker	350	280	0.9	3	51	0.8	1.1
1-3	Sucker	320	270	0.9	5	61	1.2	1.2
1-3	Sturgeon	44	24	-	4	13	-	-
3-10	Sucker	100	100	-	2	19	-	1.3

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX C
TABLE 12 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN MUSCLE
OF MISCELLANEOUS FISH TAKEN FROM THE COLUMBIA RIVER - 1964
Units of picocuries per gram

Date	Specie	Total Beta	P^{32}	Co^{60}	K^{40}	Zn^{65}	Co^{58}	Cs^{137}
Reporting Limits			2	0.6	1	5	0.7	0.7
Hanford (Continued)								
3-11	Sturgeon	19	9	-	3	16	-	-
3-11	Sucker	280	250	-	4	34	-	1.4
3-11	Sucker	370	360	0.6	4	46	-	1.3
3-11	Sucker	370	350	1.2	3	33	0.9	1.2
3-11	Sucker	520	530	-	5	50	0.8	1.5
3-11	Sucker	570	540	1.3	4	69	-	1.3
4-7	Trout		290	1.1	3	74	-	-
4-7	Carp		9	-	3	55	-	0.7
5-11	Trout		550	2.5	6	100	0.7	-
5-11	Sucker		1500	1.1	5	77	-	1.8
5-11	Sucker		660	0.7	2	57	0.7	1.6
9-3	Carp		540	0.7	6	10	1.0	-
10-14	Carp		850	-	3	61	0.8	1.3
10-14	Steelhead		5	-	3	-	-	-
Ringold								
1-29	Sucker	620	590	-	3	47	-	0.9
2-20	Sucker	820	760	1.1	4	43	1.1	1.4
2-20	Sucker	1030	1030	1.2	3	53	0.9	1.3
3-13	Sucker		710	1.1	3	43	1.1	1.3
4-10	Trout		32	0.9	3	63	0.8	-
8-24	Steelhead		550	1.2	5	70	0.8	1.5
8-24	Steelhead		2200	0.8	7	44	1.7	-
12-3	Steelhead		420	0.6	6	65	1.5	-
12-3	Steelhead		580	0.6	7	62	1.1	-
Richland								
1-25	Carp	7	< 3	-	3	15	-	-
2-10	Bluegill	30	12	-	-	24	-	-
2-10	Sucker	57	44	-	4	37	-	-
2-10	Carp	5	-	-	2	17	-	0.8
2-10	Carp	23	4	-	3	130	-	-
2-10	Carp	5	-	-	2	-	-	-
2-10	Carp	6	-	-	3	7	-	-
2-10	Carp	6	-	-	-	6	-	-
2-10	Carp	5	< 3	-	3	5	-	-

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX C
TABLE 12 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN MUSCLE
OF MISCELLANEOUS FISH TAKEN FROM THE COLUMBIA RIVER - 1964
Units of picocuries per gram

Date	Specie	Total Beta	P^{32}	Co^{60}	K^{40}	Zn^{65}	Co^{58}	Cs^{137}
Reporting Limits			2	0.6	1	5	0.7	0.7
Richland (Continued)								
2-10	Carp	5	-	-	2	-	-	-
2-10	Carp	< 5	< 3	-	4	16	-	-
2-10	Carp	< 7	< 4	-	-	8	-	-
3-27	Sucker	210	180	-	3	33	-	1.0
3-27	Sucker	17	11	-	4	6	-	-
3-27	Sucker	490	480	-	4	62	0.7	1.1
3-27	Sucker	73	58	-	3	27	-	0.7
3-27	Carp	10	-	-	3	36	-	-
3-27	Carp	5	-	-	3	-	-	-
3-27	Carp	17	-	-	3	77	-	-
3-27	Carp	12	< 3	-	-	64	-	-
3-27	Carp	5	-	-	3	15	-	-
3-27	Carp	13	-	-	3	66	-	-
3-27	Carp	6	2	-	2	7	-	-
3-27	Carp	7	-	-	3	7	-	-
4-21	Sturgeon		9	-	3	5	-	-
4-21	Trout		15	-	-	-	-	-
6-2	Carp		9	-	4	29	-	-
6-2	Carp		18	-	4	47	-	-
6-2	Carp		48	-	-	-	-	-
6-2	Carp		51	-	-	-	-	-
6-2	Carp		100	-	4	34	-	-
6-2	Sturgeon		140	-	-	-	-	-
Burbank								
1-20	Carp	8	3	-	-	24	-	-
1-20	Sucker	33	35	-	3	19	-	-
1-20	Sucker	98	100	3.6	2	22	-	-
1-20	Sucker	170	150	-	3	26	-	0.8
1-20	Sucker	17	13	-	2	9	-	-
1-20	Sucker	32	29	-	2	19	-	-
2-11	Sucker	22	20	-	3	20	-	-
2-11	Sucker	78	65	-	3	35	-	0.8
2-11	Sucker	39	34	-	4	38	-	-
2-11	Sucker	45	43	-	4	13	1.1	1.6
2-11	Sucker	75	79	-	3	28	-	-
2-11	Sucker	95	95	-	4	31	-	-
2-11	Carp	8	2	-	2	30	-	-
2-11	Carp	14	3	-	2	45	-	-

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX C
TABLE 12 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN MUSCLE
OF MISCELLANEOUS FISH TAKEN FROM THE COLUMBIA RIVER - 1964

Units of picocuries per gram

Date	Specie	Total Beta	P^{32}	Co^{60}	K^{40}	Zn^{65}	Co^{58}	Cs^{137}
Reporting Limits			2	0.6	1	5	0.7	0.7
Burbank (Continued)								
3-31	Carp	6	3	-	3	14	-	-
3-31	Carp		14	-	2	35	-	-
3-31	Sucker		19	-	3	12	-	-
3-31	Sucker		15	-	4	11	-	-
3-31	Sucker		85	-	3	19	-	-
3-31	Sucker		27	-	3	10	-	-
4-16	Carp		-	-	1	37	-	-
4-16	Carp		-	-	3	34	-	-
4-16	Carp		-	-	2	33	-	-
4-16	Carp		-	-	2	6	-	-
4-16	Carp		-	-	3	28	-	-
4-16	Carp		-	-	4	40	-	-
5-13	Carp		14	-	4	34	-	-
5-13	Carp		-	-	3	32	-	-
5-13	Carp		59	-	3	36	-	-
5-13	Carp		-	-	4	43	-	-
5-13	Carp		-	-	3	29	-	-
5-13	Carp		130	-	3	38	-	-
5-13	Carp		4	-	2	41	-	-
5-13	Carp		3	-	4	22	-	-
5-13	Carp		-	-	3	44	-	-
5-13	Carp		4	-	4	31	-	-
5-13	Carp		5	-	4	22	-	-
5-13	Carp		7	-	4	27	-	-
6-12	Bluegill		5	-	-	15	-	-
6-12	Bluegill		10	-	-	16	-	-
6-12	Bluegill		16	-	-	18	-	-
6-12	Bluegill		7	-	-	10	-	-
6-12	Carp		8	-	3	18	-	-
6-12	Carp		-	-	4	19	-	-
6-12	Carp		12	-	3	38	-	-
6-12	Carp		13	-	2	64	-	-
6-12	Carp		11	-	2	46	-	-
6-12	Carp		56	-	3	32	-	-
6-12	Carp		18	-	2	30	-	-
6-12	Carp		14	-	3	47	-	-
6-12	Carp		29	-	2	39	-	-
6-12	Carp		-	-	2	50	-	-

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX C
TABLE 12 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN MUSCLE
OF MISCELLANEOUS FISH TAKEN FROM THE COLUMBIA RIVER - 1964
Units of picocuries per gram

Date	Specie	Total Beta	P^{32}	Co^{60}	K^{40}	Zn^{65}	Co^{58}	Cs^{137}
Reporting Limits			2	0.6	1	5	0.7	0.7
Burbank (Continued)								
6-19	Sturgeon		12	-	-	28	-	-
6-19	Carp		20	-	4	46	-	-
6-19	Carp		-	-	3	43	-	-
6-19	Carp		-	-	3	45	-	-
6-19	Carp		6	-	4	38	-	-
7-14	Carp		6	-	2	30	-	-
7-14	Carp		-	-	4	35	-	-
8-20	Carp		59	-	2	46	-	-
8-20	Carp		60	-	3	36	-	-
8-20	Carp		25	-	2	26	-	-
8-20	Carp		33	-	2	12	-	-
8-20	Carp		44	-	-	25	-	-
8-20	Bluegill		48	-	-	9	-	-
8-20	Bluegill		63	-	-	12	-	-
8-20	Bluegill		110	-	3	12	-	-
8-20	Bluegill		94	-	-	10	-	-
8-20	Bluegill		65	-	-	10	-	-
9-16	Carp		37	-	2	16	-	-
9-16	Carp		19	-	4	50	-	-
9-16	Carp		43	-	3	21	-	-
9-16	Carp		43	-	-	21	-	-
9-16	Bluegill		200	-	-	13	-	-
10-7	Carp		280	-	3	38	-	-
McNary								
1-28	Sucker		35	-	4	18	-	-
1-28	Sucker		47	-	4	23	-	-
1-28	Sucker		70	-	3	24	-	-
1-28	Sucker		50	-	3	19	-	-
1-28	Sucker		65	-	4	23	-	-
1-28	Sucker		17	-	4	28	-	-
1-28	Sucker		17	-	4	26	-	-
1-28	Sturgeon		3	-	3	10	-	-
2-25	Steelhead		-	-	3	-	-	-
2-25	Sturgeon		7	-	3	21	-	-
2-25	Sucker		99	-	4	28	-	-
2-25	Sucker		51	-	4	25	-	-
2-25	Sucker		71	-	3	36	-	-
2-25	Sucker		51	-	4	37	-	-

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX C
TABLE 12(Continued)

CONCENTRATIONS OF RADIONUCLIDES IN MUSCLE
OF MISCELLANEOUS FISH TAKEN FROM THE COLUMBIA RIVER - 1964
Units of picocuries per gram

Date	Specie	Total Beta	P^{32}	Co^{60}	K^{40}	Zn^{65}	Co^{58}	Cs^{137}
Reporting Limits			2	0.6	1	5	0.7	0.7
McNary (Continued)								
2-25	Sucker		40	-	3	23	-	-
2-25	Sucker		50	-	5	24	-	-
2-25	Sucker		52	-	4	24	-	-
2-25	Sucker		79	-	4	34	-	-
4-30	Sturgeon		23	-	4	11	-	-
4-30	Sturgeon		26	-	-	11	-	-
4-30	Sucker		56	-	4	19	-	-
4-30	Sucker		57	-	3	21	-	-
4-30	Sucker		45	-	3	20	-	-
4-30	Sucker		180	-	4	37	-	-
7-29	Sucker		140	-	3	28	-	-
7-29	Sucker		280	-	2	22	-	-
7-29	Sucker		110	-	3	-	0.7	0.9
7-29	Sturgeon		5	-	4	5	-	-
7-29	Sturgeon		9	-	-	6	-	-
7-29	Sturgeon		7	-	4	-	-	-
11-20	Sucker		85	-	4	13	-	-
11-20	Sucker		100	-	4	20	-	-
11-20	Sturgeon		7	-	5	17	-	-
11-20	Sturgeon		61	-	5	9	-	-
11-20	Sturgeon		5	-	-	16	-	-
12-11	Sturgeon		9	-	-	6	-	-

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX C
TABLE 13

CONCENTRATIONS OF RADIONUCLIDES
IN WATERFOWL CONTRIBUTED BY HUNTERS - 1964
picocuries/gram

Date	Specie	P^{32}	Zn^{65}	K^{40}	Cs^{137}
Reporting Limits		50	5	1	0.7
Othello					
11-8	Mallard	-	-	-	-
11-8	Mallard	-	-	-	-
11-8	Mallard	-	-	-	-
11-8	Mallard	-	5	3	-
11-8	Mallard	-	-	-	-
11-8	Teal	650	160	-	-
11-8	Teal	130	-	-	-
Benton City					
1-4	Mallard	-	9	4	-
1-4	Mallard	-	7	5	-
1-4	Mallard	-	-	-	-
1-4	Mallard	-	-	4	-
1-4	Mallard	-	-	-	-
1-4	Mallard	-	18	-	-
1-4	Mallard	-	7	4	-
1-4	Mallard	-	-	-	-
1-4	Mallard	-	-	5	-
1-4	Mallard	-	-	-	-
Bailies Ranch					
1-3	Widgeon	-	-	-	-
1-3	Widgeon	-	-	-	-
1-3	Widgeon	-	-	-	-
1-3	Pintail	-	-	-	-
1-3	Mallard	-	-	-	-
1-3	Mallard	-	9	-	-
1-3	Mallard	-	10	-	-
1-3	Mallard	-	-	4	-
1-3	Mallard	-	12	-	-
1-3	Mallard	-	11	-	-
1-3	Mallard	-	18	-	-
1-3	Mallard	-	14	-	-
1-3	Mallard	-	17	-	-
1-3	Mallard	-	7	-	-
1-3	Mallard	-	58	3	-

Results less than reporting limit are indicated by a (-).

APPENDIX C
TABLE 13 (Continued)

CONCENTRATIONS OF RADIONUCLIDES
IN WATERFOWL CONTRIBUTED BY HUNTERS - 1964
picocuries/gram

Date	Specie	P^{32}	Zn^{65}	K^{40}	Cs^{137}
Reporting Limits		50	5	1	0.7
Bailies Ranch (Continued)					
1-3	Mallard	-	21	3	-
1-3	Mallard	-	18	4	-
1-3	Teal	-	-	-	-
1-3	Teal	-	-	-	-
1-3	Mallard	-	-	-	-
1-3	Mallard	-	29	-	-
1-3	Mallard	-	8	3	-
1-3	Mallard	-	25	-	-
1-3	Mallard	-	12	-	-
1-3	Mallard	-	-	4	-
1-3	Mallard	-	12	-	-
1-3	Mallard	-	-	4	-
1-3	Mallard	-	7	-	-
1-3	Mallard	-	-	4	-
1-3	Mallard	-	-	-	-
1-3	Mallard	-	17	5	-
1-3	Mallard	-	5	2	-
1-3	Mallard	-	-	-	-
1-3	Mallard	-	-	-	-
1-3	Mallard	130	45	-	-
1-3	Mallard	-	-	3	-
1-3	Mallard	-	23	3	-
1-3	Mallard	-	14	5	-
Yakima River					
1-2	Mallard	-	-	-	-
1-2	Mallard	-	-	-	-
1-2	Mallard	-	-	-	-
1-2	Mallard	-	-	3	-
1-2	Mallard	-	7	-	-
1-2	Mallard	-	8	3	-
1-2	Mallard	-	-	-	-
1-2	Mallard	-	28	3	-
1-2	Mallard	-	-	-	-
1-2	Mallard	-	40	-	-
1-2	Mallard	92	23	-	-
1-2	Mallard	130	30	-	-

Results less than reporting limit are indicated by a (-).

APPENDIX C
TABLE 13 (Continued)

CONCENTRATIONS OF RADIONUCLIDES
IN WATERFOWL CONTRIBUTED BY HUNTERS - 1964
picocuries/gram

Date	Specie	P^{32}	Zn^{65}	K^{40}	Cs^{137}
Reporting Limits		50	5	1	0.7
Yakima River (Continued)					
1-2	Mallard	-	22	3	-
1-2	Mallard	-	-	-	-
1-2	Mallard	-	31	2	-
1-2	Mallard	-	30	2	-

Results less than reporting limit are indicated by a (-).

APPENDIX C
TABLE 14

CONCENTRATIONS OF RADIONUCLIDES IN WATERFOWL
SAMPLED IN THE HANFORD ENVIRONS - 1964

picocuries/gram

Date	Specie	Muscle P^{32}	Muscle Zn^{65}	Muscle K^{40}	Muscle Cs^{137}	Head P^{32}	Head Zn^{65}	Head K^{40}	Head Cs^{137}
Reporting Limits		50	5	1	0.7	50	5	1	0.7
Upper River*									
1-3	Mallard	-	8	4	-	-	-	110	4.0
1-3	Mallard	-	-	4	-	-	10	5	-
1-3	Mallard	-	-	4	-	-	-	3	-
1-3	Mallard	86	14	4	-	58	21	4	-
1-3	Mallard	72	23	4	-	-	41	4	-
1-3	Mallard	-	10	3	-	-	20	5	-
1-3	Mallard	-	9	4	-	-	19	4	-
1-3	Mallard	-	5	4	-	-	8	3	-
1-3	Mallard	51	9	4	-	-	17	5	-
1-3	Mallard	-	52	4	-	-	9	4	-
1-3	Mallard	-	-	4	-	-	6	3	-
1-3	Widgeon	-	-	3	-	-	5	6	-
10-8	Gadwall	1200	48	4	-	3300	160	3	-
10-13	Mallard	370	-	3	0.7	440	6	4	-
10-13	Mallard	-	-	3	-	55	5	-	-
10-13	Mallard	-	-	3	-	-	6	-	-
10-13	Mallard	-	-	3	-	-	9	-	-
10-23	Golden Eye	-	-	2	-	-	6	-	-
10-23	Golden Eye	-	-	2	0.9	-	-	3	-
10-23	Golden Eye	-	-	2	1.1	-	5	3	-
10-23	Golden Eye	-	-	2	3.4	-	-	3	1.3
10-23	Golden Eye	-	-	-	-	-	6	-	-
11-15	Mallard	1100	22	4	-	870	77	-	-
11-15	Mallard	740	23	4	-	1100	110	-	-

Results less than reporting limit are indicated by a (-).
* Area within the plant boundary from Vernita Ferry to Hanford.

APPENDIX C
TABLE 14 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN WATERFOWL
SAMPLED IN THE HANFORD ENVIRONS - 1964

picocuries/gram

Date	Specie	Muscle P^{32}	Muscle Zn^{65}	Muscle K^{40}	Muscle Cs^{137}	Head P^{32}	Head Zn^{65}	Head K^{40}	Head Cs^{137}
Reporting Limits		50	5	1	0.7	50	5	1	0.7
Upper River (Continued)									
11-15	Mallard	-	8	-	440	-	27	-	110
11-15	Golden Eye	-	6	3	-	81	6	1	-
11-15	Golden Eye	91	-	3	-	96	11	-	-
11-15	Golden Eye	62	-	3	1.3	96	8	1	-
11-15	Golden Eye	65	-	4	1.7	83	27	-	-
12-4	Canadian Goose	-	-	3	-	-	6	2	-
12-4	Canadian Goose	-	-	3	-	-	7	1	-
12-4	Canadian Goose	-	-	3	-	-	-	1	-
12-4	Canadian Goose	-	-	3	-	-	-	1	-
12-4	Mallard	-	-	3	-	-	5	1	-
12-4	Golden Eye	1700	84	-	0.9	-			
12-4	Golden Eye	1200	49	-	0.8	1200	130	-	-
12-4	Golden Eye	1200	56	-	-	1500	150	-	-
12-4	Golden Eye	1200	56	1	0.7	1600	200	-	-
12-4	Golden Eye	1200	50	2	0.9	810	92	2	-
Lower River *									
10-15	Mallard	76	-	3	-	67	9	4	-
10-15	Mallard	1000	12	3	-	640	27	-	-
10-15	Mallard	-	-	2	14	-	5	3	-
10-15	Mallard	-	-	3	-	-	-	-	-
10-15	Mallard	-	-	2	-	-	7	-	-
10-15	Mallard	740	10	3	-	500	28	-	-

No entry indicates no analysis made.
Results less than reporting limit are indicated by a (-).
* Area within the plant boundary from Hanford to 300 Area.

APPENDIX C
TABLE 14 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN WATERFOWL
SAMPLED IN THE HANFORD ENVIRONS - 1964
picocuries/gram

		Muscle				Head			
Date	Specie	P^{32}	Zn^{65}	K^{40}	Cs^{137}	P^{32}	Zn^{65}	K^{40}	Cs^{137}
Reporting Limits		50	5	1	0.7	50	5	1	0.7
Lower River (Continued)									
10-15	Mallard	110	-	3	-	86	16	-	-
10-15	Canada Goose	-	22	4	-	96	57	3	-
10-15	Merganser	1600	59	3	-	1100	93	3	-
10-21	Mallard	53	6	5	-	-	15	2	-
10-21	Mallard	190	-	5	-	200	11	3	-
10-21	Mallard	220	-	3	-	190	15	5	-
10-21	Mallard	910	19	3	-	560	40	3	-
10-21	Mallard	100	5	3	-	150	12	4	-
10-21	Mallard	-	-	3	-	-	8	2	-
10-21	Mallard	810	21	3	-	660	49	3	-
10-21	Mallard	-	-	3	-	120	6	2	-
10-21	Mallard	98	-	3	-	78	6	3	-
10-28	Mallard	210	-	3	-	130	11	2	-
10-28	Mallard	-	-	-	-	-	-	4	-
10-28	Mallard	740	16	2	-	420	47	1	-
10-28	Mallard	-	-	3	-	-	-	-	-
10-28	Pintail	-	-	2	-	150	13	7	-
10-28	Golden Eye	100	6	3	-	92	19	4	-
10-28	Goose	140	44	3	-	150	74	4	-
11-4	Mallard					170	19	1	-
11-4	Mallard	-				-	7	2	-
11-4	Mallard					340	32	2	-
11-4	Mallard	-				-	-	2	-
11-4	Mallard	50				-	5	2	-

No entry indicates no analysis made.
Results less than reporting limit are indicated by a (-).

APPENDIX C
TABLE 14 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN WATERFOWL
SAMPLED IN THE HANFORD ENVIRONS - 1964
picocuries/gram

Date	Specie	Muscle P^{32}	Muscle Zn^{65}	Muscle K^{40}	Muscle Cs^{137}	Head P^{32}	Head Zn^{65}	Head K^{40}	Head Cs^{137}
Reporting Limits		50	5	1	0.7	50	5	1	0.7
Lower River (Continued)									
11-4	Mallard					430	22	2	-
11-4	Mallard					66	14	2	-
11-4	Mallard	130	9	3	-	130	24	3	-
11-4	Mallard					98	11	2	-
11-5	Mallard	-	-	3	-	-	7	3	-
11-5	Mallard	-	-	4	-	-	5	3	-
11-5	Mallard	-	-	3	-	-	6	-	-
11-13	Lesser Goose	-	-	3	-	-	-	2	-
11-13	Mallard	110	10	4	-	88	18	-	-
11-13	Mallard	-	-	3	-	-	9	-	-
11-13	Mallard	52	-	5	1.0	70	7	-	-
11-13	Mallard	76	-	4	-	-	11	-	-
11-13	Mallard	56	30	3	-	61	9	2	-
Ringold									
12-3	Mallard	-	-	4		-	6	2	-
12-3	Mallard	-	-	3		-	10	2	-
12-3	Mallard	-	-	4		-	6	1	-
12-3	Mallard	-	-	5		-	5	-	-
12-3	Mallard	-	6	4		-	15	1	-
12-3	Mallard	-	-	3					
12-3	Mallard	-	-	4		-	6	-	-
12-3	Teal	250	15	5		460	6	-	-

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX C
TABLE 14 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN WATERFOWL
SAMPLED IN THE HANFORD ENVIRONS - 1964
picocuries/gram

		Muscle				Head			
Date	Specie	P^{32}	Zn^{65}	K^{40}	Cs^{137}	P^{32}	Zn^{65}	K^{40}	Cs^{137}
Reporting Limits		50	5	1	0.7	50	5	1	0.7
Burbank									
11-18	Canadian Goose	70	37	3	-	-	39	1	-
McNary									
11-20	Canadian Goose	-	-	3	-	-	-	-	-
11-20	Lesser Goose	-	8	4	-	-	12	3	-
11-20	Lesser Goose	-	5	3	-	-	10	3	-
11-20	Mallard	-	-	4	-	-	-	-	-
11-20	Mallard	220	27	3	-	93	58	-	-
11-20	Mallard	-	-	3	-	-	-	-	-
11-20	Golden Eye	500	10	3	-				

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX C
TABLE 15

CONCENTRATIONS OF RADIONUCLIDES IN WATERFOWL
SAMPLED WITHIN THE HANFORD PROJECT - 1964
picocuries/gram

		Muscle				Head			
Date	Specie	P^{32}	Zn^{65}	K^{40}	Cs^{137}	P^{32}	Zn^{65}	K^{40}	Cs^{137}
Reporting Limits		50	5	1	0.7	50	5	1	0.7
Gable Swamp									
10-13	Coot	-	-	5	130				
11-3	Lesser Scaup		-	8	98		-		39
11-3	Lesser Scaup		-	8	85		-		15
11-3	Lesser Scaup		-	10	20		10		19
11-3	Lesser Scaup		-	6	110		-		55
11-3	Greater Scaup		-	3	120		-		69
11-3	Greater Scaup		-	8	54		-		33
11-3	Greater Scaup		-	3	18		-		13
11-3	Greater Scaup						-		1.0
11-3	Mallard		22	-	3000		180		680
11-3	Mallard			-	870		100		480
11-3	Mallard		480	-	1800		180		820
11-3	Pintail		5	2	14		-		19
11-3	Green Wing Teal		5	3	24		-		7.0
11-3	Green Wing Teal		-	7	23		-		4.0
11-3	Coot	-	260	-	950		220		490
11-3	Coot		240	-	340		150		140
11-3	Coot		30	-	53		57		130
11-3	Coot		-	-	47		51		89
11-3	Coot		8	-	10		51		19

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX C
TABLE 15 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN WATERFOWL
SAMPLED WITHIN THE HANFORD PROJECT - 1964
picocuries/gram

Date	Specie	Muscle P^{32}	Muscle Zn^{65}	Muscle K^{40}	Muscle Cs^{137}	Head P^{32}	Head Zn^{65}	Head K^{40}	Head Cs^{137}
Reporting Limits		50	5	1	0.7	50	5	1	0.7
Gable Swamp (Continued)									
11-30	Golden Eye		-	-	32		-		15
11-30	Golden Eye	-	-	-	260		-	3	180
11-30	Golden Eye	-	130	3	310		10	3	44
11-30	Golden Eye	-	-	4	88		-	4	59
11-30	Golden Eye	-	-	-	26		-	-	12
11-30	Coot	-	-	-	0.8	-	-	-	-
11-30	Coot	-		5	53	-	35	-	14
11-30	Coot	-	-	-	57	-	25	-	25
11-30	Coot	-		-	310	-	-	-	110
B Swamp									
11-30	Golden Eye	-	-	10	19	-	-		28
11-30	Golden Eye	-	-	8	32	-	-		43
11-30	Golden Eye	-	-	5	56	-	-		23
S Swamp									
11-24	Golden Eye			-	72		-		29
11-24	Golden Eye						35		230
11-24	Golden Eye		-	-	23		-		12

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX C
TABLE 15 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN WATERFOWL
SAMPLED WITHIN THE HANFORD PROJECT - 1964
picocuries/gram

Date	Specie	Muscle P^{32}	Muscle Zn^{65}	Muscle K^{40}	Muscle Cs^{137}	Head P^{32}	Head Zn^{65}	Head K^{40}	Head Cs^{137}
Reporting Limits		50	5	1	0.7	50	5	1	0.7
U Swamp									
11-24	Scaup		-	-	42		-		41
Redox Swamp									
10-27	Golden Eye	-		1	220	-		1	260
10-27	Ruddy Duck			6	87			-	54
10-29	Coot	-	-	3	380	-	5	-	280
10-29	Coot	-	-	4	450	-	-	-	300
10-29	Coot	-	-	7	10	-	-	15	37
10-29	Coot	-	-	2	350	-	-	-	210
10-29	Golden Eye	-	-	-	160	-	-	-	77
10-29	Golden Eye		-	3	4.0	-		3	3.6
10-29	Ruddy Duck		-	2	210	-	7	-	150
10-29	Shoveler		-	2	200		-	-	86
300 Area Pond									
10-22	Mallard	370	8	3	-	230	18	-	-
10-22	Mallard	66	-	3	-	-	-	-	-
10-22	Mallard	-	-	3	-	-	-	-	-

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

X. APPENDIX D

RADIONUCLIDES IN MARINE ORGANISMS

APPENDIX D
TABLE 1

CONCENTRATIONS OF RADIONUCLIDES IN
OYSTERS FROM WILLAPA BAY, WASHINGTON - 1964
picocuries/gram

Date	K^{40}	Zn^{65}	Cs^{137}	P^{32}	Co^{58}	Co^{60}
Reporting Limits	1.0	5	0.7	2.0	0.7	0.6
1-13	1.6	77	-	2.3	-	-
2-17	2.2	81	-	2.2	-	-
3-2	3.2	86	-	2.2	-	-
3-16	1.4	54	-	3.8	-	-
3-24		49		3.1		
4-1	2.2	86	-	2.4	-	-
4-13	1.4	55	-	4.3	-	-
4-28	3.5	70	-	3.8	-	-
5-11	1.9	58	-	3.8	-	-
5-27	2.6	53	-	14	-	-
6-8	1.8	47	-	13	-	-
6-24	1.6	37	-	11	-	-
7-7	2.3	47	-	16	-	-
7-24	2.0	48	-	6.2	-	-
8-10	1.5	53	-	4.5	-	-
9-4	1.6	63	-	3.4	-	-
9-16	2.0	53	-	2.5	-	-
10-1	1.5	52	-	1.3	-	-
10-15	2.2	44	-	1.0	-	-
10-26	1.8	37	-	3.2	-	-
11-12	1.4	45	-	-	-	-
12-1	2.1	50	-	-	-	-
12-14	1.4	45	-	-	-	-
12-23	2.0	5.4	-	-		

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

XI. APPENDIX E

RADIONUCLIDES IN THE ATMOSPHERE

APPENDIX E
TABLE 1

QUANTITY OF I^{131} RELEASED
FROM THE SEPARATIONS AREAS - 1964

Month	Average curies/day
January	0.06
February	0.06
March	0.20
April	0.11
May	0.23
June	0.31
July	0.12
August	0.30
September	0.28
October	0.30
November	0.46
December	0.07

APPENDIX E
TABLE 2

CONCENTRATIONS OF I^{131} IN AIR
OF THE HANFORD ENVIRONS - 1964
picocuries per cubic meter

Date	200 West	Richland	Kennewick	Pasco	Wahluke	Mesa	Eltopia	Benton City
1-7	-	-	-	-	-	0.02	-	-
1-14	-	0.05	0.02	-	0.03	-	-	-
1-21	-	-	-	0.02	-	-	-	-
1-28	-	-	-	-	-	0.02	0.02	-
2-4	-	-	-	-	-	-	-	-
2-11	0.02	-	-	-	-	-	-	0.02
2-18	0.02	-	-	-	-	-	-	-
2-25	-	0.02	-	-	-	0.02	-	-
3-3	0.06	0.02	-	0.02	0.04	0.02	-	0.02
3-10	0.06	-	-	-	-	-	-	-
3-17	-	0.02	-	0.02	0.02	-	-	0.03
3-24	-	0.03	-	-	-	-	-	-
3-31	-	0.03	0.02	-	-	0.02	0.02	-
4-7	-	-	-	-	0.08	-	0.02	0.02
4-14	-	0.02	-	-	-	-	0.02	-
4-21	-	0.02	-	-	-	-	-	0.02
4-28	-	0.04	0.04	0.02	-	0.02	-	-
5-5	0.05	-	-	-	0.05	-	-	0.14
5-12	-	0.05	-	-	0.04	-	-	-
5-19	0.02	0.05	0.02	-	-	-	-	-
5-26	0.02	-	-	0.02	-	0.02	0.02	0.02
6-2	-	-	-	-	-	0.02	-	-
6-9	0.03	0.02	-	0.02	-	0.02	-	-
6-16	0.04	-	0.02	-	-	0.03	-	-
6-23	0.02	0.02	-	0.05	-	-	-	-
6-30	0.02	-	-	0.03	-	-	-	-
7-7	-	-	-	-	-	0.18	-	-
7-14	-	-	-	-	0.02	-	-	-
7-21	-	-	-	0.02	0.02	-	0.03	-
7-28	0.02	-	-	0.02	0.02	0.03	0.04	0.02
8-4	0.05	0.03	-	-	0.03	0.04	0.03	0.02
8-11	0.85	0.04	0.02	0.02	-	0.03	0.02	0.04
8-17	0.04	-	0.02	0.02	0.03	0.04	0.02	0.82
8-24	0.03	-	0.02	-	-	0.03	-	-
8-31	0.03	0.05	-	0.02	0.02	0.02	0.02	1.15
9-7	0.02	0.02	0.02	0.02	-	-	-	-
9-14	-	-	-	-	0.02	0.02	-	0.02
9-21	-	0.02	-	-	-	-	0.02	0.04
9-28	0.09	-	-	-	0.02	-	-	-
10-5	0.03	0.04	0.03	0.05	-	-	-	-

Results less than reporting limit of 0.02 are indicated by a (-).

APPENDIX E
TABLE 2 (Continued)

CONCENTRATIONS OF I^{131} IN AIR
OF THE HANFORD ENVIRONS - 1964
picocuries per cubic meter

Date	200 West	Richland	Kennewick	Pasco	Wahluke	Mesa	Eltopia	Benton City
10-12	-	0.02	0.02	0.02	-	0.02	-	0.03
10-19	-	0.02	0.02	-	-	-	-	-
10-26	0.03	0.02	-	-	0.02	-	-	-
11-2	0.05		-	-				0.02
11-9	0.09		0.03	-				-
11-16	0.02		0.03	0.02				-
11-23	0.02		-	-				-
11-30	0.04		-	-				-
12-7	0.02		-	-				-
12-14	-		-	-				-
12-21	0.03			-				-
12-28	0.02			-				-

Results less than reporting limit of 0.02 are indicated by a (-).
No entry indicates no analysis made.

APPENDIX B
TABLE 3

CONCENTRATIONS OF RADIOACTIVE PARTICULATES
IN THE AIR OF THE PACIFIC NORTHWEST - 1964
picocuries/cubic meter

Week Ending Date	Project (100 W)	Tri-Cities*	Perimeter Communities									
			Spokane, Washington	Walla Walla, Washington	Yakima, Washington	Wenatchee, Washington	Seattle, Washington	Lewiston, Idaho	Boise, Idaho	Meacham, Oregon	Pendleton, Oregon	Klamath Falls, Oregon
1-3	0.5	0.5	0.8	0.6	0.2	0.7	0.7	0.8	1.3	0.7		0.3
1-10	0.6	0.5	0.8	0.9	0.4	0.6	0.5	0.6	0.7	0.4		0.6
1-17	0.5	0.5	0.6	0.5	0.4	0.5	0.5	0.5	0.6	0.4		0.5
1-24	0.6	0.5	0.5	0.7	0.5	0.6	0.5	0.5	0.7	0.3		0.2
1-31	0.9	0.5	0.6	0.9	0.6	0.8	0.8	0.5	1.1	0.4		0.5
2-7	0.7	0.7	1.0	0.9	0.6	0.9	1.1	0.4	0.9	0.7		1.3
2-14	1.2	1.2	1.3	1.0	1.0	0.9	1.1	0.7	1.1	1.2		0.9
2-21	1.0	0.6	1.3	0.6	1.0	0.9	0.6			0.5	0.5	0.8
2-28	1.4	1.0	1.4	1.8	1.1	1.6	1.1			2.0	1.4	0.9
												McNary Dam, Oregon
3-6	0.6	0.7	1.6	0.5	1.1	0.5	0.4			0.6	0.4	0.7
3-13	0.9	0.7	0.8	0.6	0.7	0.8	0.7			0.7	0.4	0.7
3-20	0.9	0.8	0.8	0.8	1.4	0.8		Sunnyside, Washington		1.2	0.9	0.9
3-27	1.3	1.4	1.8	1.1	1.3	1.4		1.6		1.2	2.1	1.5
4-3	1.9	1.3	1.3	1.4	1.0	1.4		1.3		1.3	3.1	1.5
4-10	1.4	1.1	2.0	1.0	1.0	1.3		1.4		1.1	1.7	1.2
4-17	1.6	1.2	1.3	1.2	1.1	1.4		1.8		1.0	2.2	1.5
4-24	1.7	1.5	1.9	1.2	1.0	1.4		2.1		0.6	2.2	1.8
5-1	2.2	1.6	2.0	1.5	1.8	1.9		2.0			2.3	1.7
5-8	1.6	1.6	2.0	1.8	1.5	1.9		2.7			1.6	1.6
5-15	2.8	2.1	1.3	2.1	2.1	1.9		3.1			1.9	2.4
5-22	3.2	2.9	2.1	2.7	2.6	1.9		3.9			2.7	2.6
5-29	4.0	2.4	2.3	3.6	2.2	2.4		2.3			3.2	3.8
6-5	2.5	2.5	1.9	1.7	1.9	2.4		1.6			1.7	1.9
6-12	2.0	1.7	2.0	1.4	1.0	2.4		1.3			1.1	1.3
6-19	0.9	1.2	0.9	1.2	1.1	1.3		2.1			1.0	1.2
6-26	1.9	1.3	0.7	1.4	1.1	2.2		1.4			1.6	2.0
7-3	1.3	1.5	1.9	1.4	1.1	1.6		1.5			1.0	1.8
7-10	1.2	1.2	1.0	1.4	1.1			1.1			1.0	1.5
7-17	0.8	1.3	1.3	1.1	0.8	0.4		1.1			0.8	1.2
7-24	1.2	0.8	0.6	0.9	0.8	0.6		1.5			0.8	0.9
7-31	1.7	1.5	0.8	1.2	1.1	1.0		0.6			0.9	1.6
8-7	1.0	0.5	0.6	0.6	0.5	0.5	Wenatchee, Washington	0.8	Moses Lake, Washington	Ellensburg, Washington	0.5	0.5
8-14	0.6	0.8	0.6	0.6	0.5	0.5		0.8			0.5	0.5
8-21	1.2	0.6	0.7	0.8	0.2	0.4		0.9			0.7	0.7
8-28	1.1	0.9	0.7	0.8	0.2	0.4	0.1	0.3	0.1		0.6	0.8
9-4	0.4	0.3	0.3	0.3	0.2	0.4	0.2	0.5	0.2	0.3	0.2	0.2
9-11	0.9	0.4	0.4	0.4	0.4	0.3	0.5	0.7	0.7	0.7	0.3	0.4
9-18	0.9	0.7	0.5	0.6	0.4	0.3	0.2	0.7	0.9	0.7	0.5	0.5
9-25	0.5	0.3	0.3	0.2	0.2	0.3	0.3	0.3	0.3	0.2	0.2	0.2
10-2	0.5	0.2	0.2	0.3	0.2	0.3	0.3	0.5	0.3	0.3	0.3	0.3
10-9	0.6	0.4	0.3	0.4	0.2	0.4	0.5	0.3	0.5	0.4	0.2	0.4
10-16	0.4	0.3	0.2	0.2	0.2	0.4	0.2	0.2	0.3	0.2	0.2	0.2
10-23	1.3	0.5	0.2	0.7	1.6	0.4	1.3	1.3	1.4	1.3	0.3	0.6
10-30	1.9	1.2	1.2	1.1	0.4	0.5	0.8	0.9	1.1	0.8	1.2	0.9
11-6	0.8	0.5	0.3	0.6	0.4	0.5	0.3	0.3	0.5	0.3	0.4	0.3
11-13	0.4	0.3	0.2	0.2	0.2	0.2	0.3	0.2	0.2	0.2	0.1	0.1
11-20	0.5	0.3	0.1	0.4	0.2	0.2	0.2	0.2	0.3	0.2	0.2	0.2
11-27	0.4	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.2	0.1	0.1	0.1
12-4	0.4	0.3	0.2	0.2	0.1	0.1	0.2	0.1	0.2	0.1	0.1	0.2
12-11	0.4	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2
12-18	0.4	0.2	0.1	0.1	0.1	0.1	0.3	0.3	0.3	0.2	0.1	0.2
12-25	0.2	0.2	0.2	0.2	0.1		0.3	0.3	0.3	0.3	0.1	0.2
12-31	0.5	0.3	0.1	0.2	0.1		0.1	0.3	0.2	0.1	0.2	0.1

* Tri-Cities are Richland, Kennewick, and Pasco.
No entry indicates no analysis made.

APPENDIX F
TABLE 1

CONCENTRATIONS OF RADIONUCLIDES IN MILK - 1964
picocuries per liter

Date	I^{131}	K^{40}	Zn^{65}	Cs^{137}	P^{32}	Sr^{90}
Reporting Limits	3	400	100	30	200	2.0
Riverview Irrigation District						
1-2	-	1500	220	120	-	12
1-9	-	1500	220	160	-	4.0
1-15	-	1300	200	130		
1-23	-	1200	200	130		
1-29	-	1200	280	110		
2-4	-	1100	350	140	-	16
2-12	-	1400	260	76		
2-18	-	1200	190	110		
2-26	-	1300	230	150		
3-3	-	1500	180	140	-	
3-11	-	1500	220	100		
3-17	-	1500	200	82		
3-25	3	1100	160	120		
4-14	-	1500	140	130		
4-22	-	1200	100	120		
4-28	-	1500	120	130	-	
5-6	-	1400	190	100	540	
5-12	-	1200	530	46		
5-20	4	1300	780	110		
5-26	3	1300	-	62		
6-3	6	1200	810	110	2700	
6-11	4	1200	880	83		
6-17	3	1600	850	62		
6-25	-	1400	1100	100		
7-1	-	1400	900	59	3200	6.9
7-7	3	1300	890	-		
7-15	-	1300	760	64		
7-21	-	1000	850	61		
7-29	-	1500	690	43		
8-4	-	1200	650	52	530	
8-12	-	1300	750	38		
8-18	3	1300	930	59		
8-26	4	1300	1000	42	2600	
9-3	9	1600	940	39	1700	
9-9	4	1300	890	56		
9-17	4	1900	900	44	1900	

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX F
TABLE 1 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN MILK - 1964
picocuries per liter

Date	I^{131}	K^{40}	Zn^{65}	Cs^{137}	P^{32}	Sr^{90}
Reporting Limits	3	400	100	30	200	2.0
Riverview Irrigation District (Continued)						
9-23	6	1300	1100	68	1300	
9-29	7	1200	1400	-		
10-7	4	1300	1400	33		
10-13	3	1100	1500	-		
10-21	-	1400	1200	-		
10-27	5	1300	1200	-		
11-4	13	1100	1200	58		
11-10	3	1400	730	99		
11-18	3	1200	640	44	590	
11-24	-	1300	620	44		
12-2	-	1400	370	-		
12-8	-	1400	300	61		
Ringold						
5-18	5	1400	400	-	590	
5-26	5	1600	460	-		
6-3	-	1500	540	-	1100	
6-10	-	1400	510	35		
6-17	4	1900	480	-		
6-25	3	1600	330	45		
7-1	3	1500	470	-	5700	
7-7	-	1400	510	-		
7-15	-	1500	480	45		
7-21	-	1500	570	-		
7-29	6	1600	500	34		
8-4	-	1500	650	-	1600	
8-12	9	1600	650	38		
8-18	5	1500	770	54		
8-26	11	1400	670	32	3300	4.9
9-3	16	1400	740	46	3000	
9-10	7	1300	670	47		
9-17	3	1400	510	53		
9-23	5	1800	940	67	6200	
9-29	4	1500	920	36		
10-7	5	1400	560	-		
10-13	3	1500	890	45		
10-21	4	1300	960	65		

Results less than reporting level are indicated by a (-).
No entry indicates no analysis made.

APPENDIX F
TABLE 1 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN MILK - 1964
picocuries per liter

Date	I^{131}	K^{40}	Zn^{65}	Cs^{137}	P^{32}	Sr^{90}
Reporting Limits	3	400	100	30	200	2.0
Ringold (Continued)						
10-27	11	1200	930	42		
11-4	28	1200	1100	65	500	
11-10	36	1200	1100	110		
11-18	15	1200	920	91		
11-24	-	1100	-	47		
Pasco						
1-2	-	1000	170	57		
1-3	3	1400	230	83		
1-6	3	1600	250	62		
1-7	-	1600	260	82		
1-8	-	1400	330	92		
1-9	-	1400	300	70		
1-10	-	1400	250	78		
1-13	-	1300	330	86		
1-14	-	1500	320	91		
1-15	3	1500	280	89		
1-16	-	1200	280	70		
1-17	-	1600	300	68		
1-20	-	1400	310	72		
1-22	-	1300	250	63		
1-23	-	1400	200	55		
1-24	-	1500	230	50		
1-27	-	1400	300	76		
1-28	-	1500	230	56		
1-29	-	1300	280	65		
1-30	-	1500	250	60		
1-31	-	1500	270	56		
2-3	-	1400	260	100		
2-4	-	1300	270	52		
2-5	-	1400	230	71		
2-12	-	1400	140	51		
2-18	-	1300	110	85		
2-26	3	1700	170	120		
3-3	-	1400	100	50	-	
3-11	-	1500	120	70		
3-17	-	1600	160	71		
3-25	3	1200	180	61		

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX F
TABLE 1 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN MILK - 1964
picocuries per liter

Date	I^{131}	K^{40}	Zn^{65}	Cs^{137}	P^{32}	Sr^{90}
Reporting Limits	3	400	100	30	200	2.0
Pasco (Continued)						
4-1	-	1300	290	-		
4-7	-	1200	180	62		
4-14	-	1400	-	71		
4-22	-	1000	100	42		
4-28	-	1300	-	52	-	
5-6	-	1300	-	32	200	
5-12	-	1200	-	-		
5-20	-	1300	-	100		
5-26	-	1300	-	59		
6-3	-	1500	-	96	-	8.3
6-11	-	1300	-	120		
6-17	9	1600	-	94		
6-25	-	1300	-	140		
7-10	-	1000	-	89		
7-15	-	1300	-	94		
7-21	-	1400	-	56		
7-29	-	1400	-	60		
8-4	-	1400	-	32	-	
8-12	-	1300	-	49		
8-18	-	1500	-	35		
8-26	-	1400	-	41	-	
9-3	3	1100	-	49	260	
9-9	-	1200	-	70		
9-17	-	1300	-	57		
9-23	-	820	-	64		
9-29	-	1400	-	31		
10-7	-	1000	-	47		
10-13	3	1100	-	41		
10-21	-	1300	-	45		
10-27	5	1400	-	42		
10-28	6	1200	-	33		
10-29	3	1200	-	-		
10-30	-	1200	-	51		
11-2	3	1300	-	57		
11-3	6	1300	-	61		
11-4	8	990	-	62		
11-5	10	1200	-	68		
11-6	14	1100	-	55		
11-9	18	1200	-	46		

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX F
TABLE 1 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN MILK - 1964
picocuries per liter

Date	I^{131}	K^{40}	Zn^{65}	Cs^{137}	P^{32}	Sr^{90}
Reporting Limits	3	400	100	30	200	2.0
Pasco (Continued)						
11-10	18	1400	-	37		
11-11	13	1300	-	64		
11-12	8	1500	-	66		
11-13	6	1200	-	68		
11-16	-	1200	-	61		
11-17	-	1400	-	52		
11-18	-	1000	-	-	-	
11-19	-					
11-20	-	1200	-	-		
11-24	4	1200	-	30		
12-4	8	1300	-	36		
12-11		1400	-	66		
West Richland						
1-3	4	1600	-	80		
1-10	-	1400	-	51		
1-24	-	1400	-	39		
1-31	-	1400	-	31		
2-7	4	1200	-	46		
2-14	3	1200	-	52		
2-21	-	1600	-	72		
2-28	-	1300	-	150		
3-6	-	1600	-	95		
3-13	-	1400	-	92		
3-20	3	1400	-	100		
3-27	-	1300	-	79		
4-3	-	1400	-	100		6.2
4-10	-	1600	-	100		
4-17	-	1200	-	140		
4-24	-	1400	-	110		
5-1	-	1400	-	130		
5-8	-	1200	-	140		
5-15	-	1400	-	110		
5-22	3	1600	-	120		
5-27	4	1400	-	85		
6-5	5	1600	-	110		
6-12	5	1600	-	170		
6-19	-	1500	-	140		

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX F
TABLE 1 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN MILK - 1964
picocuries per liter

Date	I^{131}	K^{40}	Zn^{65}	Cs^{137}	P^{32}	Sr^{90}
Reporting Limits	3	400	100	30	200	2.0
West Richland (Continued)						
6-26	10	1600	-	150		
7-2	4	1400	-	120		
7-10	-	1400	-	140		
7-17	-	1300	-	56		
7-24	-	1500	-	92		
7-31	-	1700	-	98		
8-7	-	1400	-	61		
8-21	-	1600	-	110		
8-28	3	1500	-	62		
9-4	10	1600	-	82		
9-10	-	1300	-	68		
9-18	5	1400	-	57		
9-25	8	1500	-	65		
10-2	4	1600	180	56		
10-9	7	1500	120	51		3.4
10-16	9	1600	270	56		
10-23	-	1800	430	95		
10-30	-	1600	210	82		
11-6	8	1600	140	110		
11-13	4	1600	300	75		
11-20	-	1600	330	48		
12-4	-	1800	260	52		
12-11	-	1400	170	43		
Benton City						
1-3	4	1600	-	170		
1-10	-	1600	-	160		
1-24	-	1500	-	140		
1-31	3	1400	-	140		
2-7	-	1300	-	140		
2-14	-	1500	110	120		
2-21	3	1300	-	74		6.6
2-28	-	1300	-	110		
3-6	-	1400	-	92		4.9
3-13	-	1200	-	99		
3-27	3	1300	-	100		
4-3	-	1400	-	110		
4-10	-	1400	-	140		
4-17	-	1500	-	130		

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX F
TABLE 1 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN MILK - 1964
picocuries per liter

Date	I^{131}	K^{40}	Zn^{65}	Cs^{137}	P^{32}	Sr^{90}
Reporting Limits	3	400	100	30	200	2.0
Benton City (Continued)						
4-24	-	1400	-	140		
5-1	-	1400	-	110		
5-8	-	1000	-	140		
5-15	-	1200	-	100		
5-22	-	1600	-	130		
5-27	-	1500	-	91		
6-5	5	1200	-	60		
6-12	6	1200	-	84		
6-19	-	1100	-	79		
7-10	-	1100	-	70		
7-17	-	1400	-	110		
7-24	-	1300	-	54		
8-7	-	1100	-	59		
8-21	-	1100	-	73		
8-28	-	1300	-	59		
9-4	3	1400	-	54		
9-10	3	1300	-	58		
9-18	-	1300	-	53		
9-25	7	1300	-	62		
10-2	-	1300	-	45		
10-16	5	1100	-	40		
10-23	6	1600	-	80		
10-30	5	1300	-	35		
11-6	7	1100	-	49		
11-13	4	1400	-	57		
11-20	4	1100	-	35		
12-4	-	1600	-	36		
12-11	-	1400	-	47		
Byers Landing						
1-23	3	1400	-	140		
1-29	3	1200	-	170		
2-4	3	1500	-	160		13

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX F
TABLE 1 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN MILK - 1964
picocuries per liter

Date	I^{131}	K^{40}	Zn^{65}	Cs^{137}	P^{32}	Sr^{90}
Reporting Limits	3	400	100	30	200	2.0
Eltopia						
1-2	4	1800	-	83		8.4
1-9	-	1300	-	94		6.8
1-15	-	1200	-	74		
1-23	-	1200	-	77		
1-29	3	1300	-	87		
2-4	-	1300	-	88		9.3
2-12	-	1400	-	70		
2-18	-	1200	-	95		
2-26	5	1600	-	130		
3-3	-	1300	-	90		
3-11	-	1300	-	81		
3-17	-	1300	-	110		
3-25	-	1200	-	110		
4-1	-	1200	-	86		
4-7	-	1300	-	110		
4-22	-	1300	-	68		
4-28	-	1300	-	72		
5-6	3	1000	-	55	-	4.5
5-12	3	1200	-	-		
5-20	3	1300	-	130		
5-26	-	1500	-	86		
6-3	-	1200	-	110		
6-11	3	1200	-	67		
6-17	10	1700	-	56		
6-25	3	1000	-	78		
7-1	-	2100	-	79	260	
7-7	3	1600	-	-		
7-15	-	1300	-	51		
7-21	-	1300	-	44		
8-4	5	1500	-	55		
8-12	-	1500	-	42		
8-18	-	1500	-	73		
8-26	5	1400	-	42		
9-3	7	1200	-	52		
9-9	6	1200	-	58		
9-17	6	1300	-	-		
9-23	4	1400	-	50		

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX F
TABLE 1 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN MILK - 1964
picocuries per liter

Date	I^{131}	K^{40}	Zn^{65}	Cs^{137}	P^{32}	Sr^{90}
Reporting Limits	3	400	100	30	200	2.0
Eltopia (Continued)						
9-29	3	1300	-	-		
10-7	3	1300	-	46		
10-13	5	1300	-	-		
10-21	3	1500	-	58		
11-4	32	1300	-	49		
11-10	20	1400	-	48		
11-18	-	1500	-	65	-	6.9
11-24	-	1200	-	61		
12-2	-	1400	-	38		
12-8	-	1500	-	58		
Milk Shed Samples						
Columbia Basin						
1-8	-	1500	-	78		13
1-22	-	1300	-	93		
2-6	-	1200	-	92		13
2-19	-	1400	-	79		
3-5	-	1200	-	77		
3-18	-	1400	-	100		13
4-1	-	1100	-	70		14
4-20	-	1300	-	78		
5-1	-	1400	-	85		
5-13	-	1300	-	58		
5-28	-	1400	130	77		
6-10	-	1500	-	90		
6-24	3	1500	-	89		
7-8	-	1600	-	84		
7-22	-	1300	-	-		
8-7	-	1100	-	-		
8-21	-	1200	-	87		
9-2	-	1200	-	57		
9-16	-	1400	-	30		
10-1	-	1400	-	59		5.9
10-14	-	1200	-	63		
10-28	5	1300	110	-		
11-11	6	1200	120	43		
12-2	-	1500	-	54		

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX F
TABLE 1 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN MILK - 1964
picocuries per liter

Date	I^{131}	K^{40}	Zn^{65}	Cs^{137}	P^{32}	Sr^{90}
Reporting Limits	3	400	100	30	200	2.0
Milk Shed Samples						
Prosser, Benton City						
1-8	-	1400	-	83		11
1-22	-	1200	-	58		
2-6	3	1300	-	97		8.4
2-19	-	1200	-	86		
3-18	-	1200	-	100		11
4-1	3	1200	-	87		
4-20	-	1300	-	79		
5-1	-	1400	-	93		
5-13	-	1200	-	61		
6-1	-	1400	-	54	-	6.3
6-10	-	1200	-	98		
6-24	-	1300	-	110		
7-8	-	1600	-	86		
7-22	-	1400	-	91		
8-7	-	1200	-	57		
8-19	-	1500	-	89		
9-2	-	1300	-	75		
9-16	-	1100	-	77		
10-1	-	1300	-	52		
10-14	-	1200	-	40		
10-28	-	1200	-	39		
11-13	-	1200	-	71		
12-2	-	1300	-	36		
Local Purchase - Commerical Milk						
Brand A						
1-14	-	1300	-	120	-	11
1-29	-	1400	-	87		
3-11	-	1200	-	76		
3-31	-	1100	-	76		
4-9	-	1400	-	47		
5-4	-	1400	-	85		7.4
5-22	-	1500	-	66		
6-2	-	1300	-	100		6.3
6-29	-	1600	-	84		

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX F
TABLE 1 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN MILK - 1964
picocuries per liter

Date	I^{131}	K^{40}	Zn^{65}	Cs^{137}	P^{32}	Sr^{90}
Reporting Limits	3	400	100	30	200	2.0
Local Purchase - Commercial Milk						
Brand A (Continued)						
7-16	-	1200	-	100		
7-23	-	1200	-	83		
8-26	-	1300	-	50		
9-10	-	1100	-	71		
9-21	-	1500	-	51		
10-1	-	1400	-	58		
11-6	6	1200	-	57		
12-4	-	1400	-	39		
Brand F						
1-14	-	1400	-	110	-	7.6
1-29	-	1200	-	83		
3-11	-	1100	-	77		4.6
3-31	-	1100	-	110		
4-9	-	1400	-	77		
5-4	-	1500	-	82		
5-22	-	1500	-	60		
6-2	-	1400	-	71		
6-29	-	1400	-	68		
7-16	-	1200	-	58		
7-23	-	1400	-	61		
8-25	-	1300	-	53		
9-10	-	1200	-	60		2.8
9-21	-	1400	-	46		
10-1	-	1200	-	53		
11-6	3	1100	-	43		
12-4	-	1500	-	46		
Brand H						
1-14	-	1500	-	170	-	19
1-29	-	1300	-	140		
2-21	-	1600	-	140		
3-11	-	1200	-	120		
3-31	-	1000	-	150		

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX F
TABLE 1 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN MILK - 1964
picocuries per liter

Date	I^{131}	K^{40}	Zn^{65}	Cs^{137}	P^{32}	Sr^{90}
Reporting Limits	3	400	100	30	200	2.0
Local Purchase - Commercial Milk						
Brand H (Continued)						
4-9	-	1400	-	140		
5-4	-	1400	-	240		
5-22	-	1400	-	340		
6-2	-	1300	-	330		
6-29	-	1300	-	320		
7-16	-	1400	-	210		
7-23	-	1200	-	220		
8-26	-	1300	-	140		
9-10	-	1400	-	190		
9-21	-	1300	-	120		
10-1	-	1500	-	160		
11-4	6	1000	-	170		
12-4	-	1500	-	96		

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX F
TABLE 2

CONCENTRATIONS OF RADIONUCLIDES IN PASTURE GRASS - 1964
picocuries/gram

Date	P^{32}	K^{40}	Zn^{65}	$Zr\text{-}Nb^{95}$	Cs^{137}	I^{131}	$Ce\text{-}Pr^{144}$	Ru^{106}	Sr^{90}
Reporting Limits	0.2	0.4	0.1	0.05	0.03	0.05	1.0	0.6	0.002
Riverview Irrigation District, Farm No. 1									
4-14		9.6	0.58	-	0.10	-	6.2	4.6	
4-22		6.7	-	0.16	0.26	-	3.4	1.8	
4-22		7.0	-	0.17	0.32	0.07	2.9	3.8	
5-6	1.9	6.3	0.61	0.11	0.19	-	2.3	1.2	
5-6	2.4	6.7	1.8	0.14	0.83	0.92	5.9	1.5	
5-12		9.9	3.8	0.35	2.0	0.80	13	2.1	
5-12		5.9	-	-	0.04	-	-	1.8	
5-12		10	-	0.32	0.55	0.13	4.5	12	
5-20		6.8	-	0.06	0.05	-	2.3	1.9	
5-26		9.4	-	0.49	0.95	-	5.8	14	
5-26		7.6	-	0.15	0.31	0.11	1.5	5.0	
6-3	0.86	9.0	-	0.21	0.61	0.09	7.1	8.2	
6-3	0.71	8.4	-	0.26	0.46	-	3.6	8.3	
6-11		7.0	1.5	0.32	1.1	-	6.7	11	
6-11		7.6	0.16	0.24	0.65	-	3.9	3.3	
6-17		6.1	0.74	0.29	1.0	-	9.5	1.1	
6-17		5.9	-	0.16	0.80	-	11	6.9	
6-25		6.1	0.22	0.16	0.65	-	5.5	5.2	
6-25		9.3	-	0.14	0.64	0.09	4.4	8.2	
7-1	0.62	7.3	-	0.15	0.33	-	2.9	11	0.41
7-1	-	10	-	0.19	0.80	0.18	3.0	7.9	0.35
7-7		7.8	0.33	0.31	1.2	-	4.1	7.4	
7-7		9.0	-	0.23	1.1	0.05	5.0	9.2	
7-15		9.1	-	-	0.34	0.15	-	4.8	
7-15		10	-	0.13	0.74	-	2.1	8.9	

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX F
TABLE 2 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN PASTURE GRASS - 1964
picocuries/gram

Date	P^{32}	K^{40}	Zn^{65}	$Zr\text{-}Nb^{95}$	Cs^{137}	I^{131}	$Ce\text{-}Pr^{144}$	Ru^{106}	Sr^{90}
Reporting Limits	0.2	0.4	0.1	0.05	0.03	0.05	1.0	0.6	0.002
Riverview Irrigation District, Farm No. 1, (Continued)									
7-21		10	-	0.13	0.38	-	3.6	4.0	
7-21		8.3	-	0.15	0.60	-	5.5	6.4	
8-4		8.1	-	0.16	0.74	-	6.7	5.4	
8-4		6.8	0.24	0.13	0.81	0.16	-	7.8	
8-12		7.6	-	-	0.75	-	6.9	9.8	
8-12		8.8	-	-	0.55	0.06	3.4	4.0	
8-18		7.1	-	0.09	0.48	0.14	2.7	7.9	
8-18		8.9	-	0.15	0.68	0.15	2.5	5.9	
8-26	7.0	6.1	1.0	0.05	0.37	0.10	4.6	3.2	
8-26	13	8.3	-	0.06	0.54	0.08	6.5	4.8	
9-3	5.9	8.3	-	0.05	0.53	0.10	6.2	5.0	
9-17	15	5.7	19	0.08	0.31	0.08	6.5	-	
9-23	39	7.8	42	2.2	0.66	1.7	9.2	-	
9-29		7.0	-	0.06	0.94	0.41	4.0	9.0	
10-7		6.4	0.79	-	0.05	-	1.9	3.6	
10-13		4.0	1.5	-	0.27	0.12	2.6	-	
10-21		7.7	0.79	-	0.54	0.08	4.1	4.0	
10-27		18	0.15	-	0.20	0.11	2.7	2.1	
11-4		19	-	-	0.36	0.11	-	2.6	
11-10		11	-	-	0.12	0.10	1.1	2.3	
11-18		28	-	-	0.47	-	-	6.2	
11-24		12	-	-	0.35	0.09	2.5	3.5	
12-2		11	-	-	0.49	-	4.0	3.8	
12-8		14	-	-	0.49	-	2.6	3.3	

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX F
TABLE 2 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN PASTURE GRASS - 1964
picocuries/gram

Date	P^{32}	K^{40}	Zn^{65}	$Zr\text{-}Nb^{95}$	Cs^{137}	I^{131}	$Ce\text{-}Pr^{144}$	Ru^{106}	Sr^{90}
Reporting Limits	0.2	0.4	0.1	0.05	0.03	0.05	1.0	0.6	0.002
Riverview Irrigation District, Farm No. 2									
8-26	2.3	8.8	3.3	0.26	0.52	0.46	7.4	6.8	
8-26	2.2	6.7	3.9	-	0.12	0.35	1.1	1.6	
9-17	4.7	5.8	7.5	0.12	0.07	-	-	4.9	
9-29		6.8	7.1	-	0.18	0.15	4.3	-	
10-13		6.1	7.6	0.11	0.29	-	3.3	-	
10-21		6.7	5.8	0.11	0.11	0.08	4.4	-	
10-27		28	-	-	0.84	-	2.0	4.5	
11-4		5.8	2.8	0.09	0.16	0.39	2.0	1.7	
11-10		28	-	-	1.3	-	4.2	14	
11-18		23	-	0.05	1.1	-	7.1	7.1	
11-24		21	5.6	0.51	0.51	-	6.4	1.1	
12-2		16	5.8	-	0.39	-	3.7	-	
Ringold									
5-18	6.4	7.6	0.53	0.12	0.19	-	2.4	1.2	
5-26		7.2	0.39	0.14	0.38	0.05	2.1	-	
5-26		7.0	-	0.05	0.11	0.06	-	1.5	
6-17		6.0	0.13	-	0.27	-	1.8	2.4	
6-17		6.4	0.12	0.08	0.27	-	1.7	2.5	
6-25		7.2	0.13	0.07	0.29	-	2.6	2.8	
6-25		7.9	0.49	0.10	0.36	-	3.5	-	
7-1	0.69	8.7	-	-	-	-	-	8.0	
7-1	0.55	5.3	0.51	0.06	0.11	0.26	3.0	1.6	
7-7		8.8	0.20	0.06	0.40	0.17	3.9	5.2	

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX F
TABLE 2 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN PASTURE GRASS - 1964
picocuries/gram

Date	P^{32}	K^{40}	Zn^{65}	$Zr\text{-}Nb^{95}$	Cs^{137}	I^{131}	$Ce\text{-}Pr^{144}$	Ru^{106}	Sr^{90}
Reporting Limits	0.2	0.4	0.1	0.05	0.03	0.05	1.0	0.6	0.002
Ringold (Continued)									
7-7		8.2	-	-	0.36	-	-	7.4	
7-15		3.7	-	0.09	0.37	0.06	2.9	6.3	
7-15		8.1	-	0.10	0.47	-	2.0	5.8	
7-21		9.9	0.47	0.06	0.34	-	2.1	1.4	
7-21		8.2	-	-	0.19	-	2.8	7.2	
7-29		6.0	0.63	0.05	0.34	-	3.4	2.6	
7-29		6.2	-	0.05	0.29	-	1.1	1.6	
8-4	1.4	10	1.0	-	0.30	0.06	4.1	3.8	
8-4	1.0	10	0.40	-	0.35	-	3.5	4.0	
8-12		7.8	0.31	-	0.07	-	-	4.7	
8-12		8.2	0.83	-	0.32	-	1.9	2.4	
8-18		8.6	-	0.05	0.35	-	1.0	5.3	
8-18		8.9	0.36	0.07	0.40	-	3.2	2.3	
8-26	4.2	7.7	0.98	-	0.29	0.09	4.0	2.4	0.093
8-26	2.6	7.7	0.87	-	0.23	0.07	2.9	-	
9-3	6.4	7.7	0.46	-	0.35	0.19	4.2	3.4	
9-17		8.1	0.62	-	0.32	0.14	4.4	3.5	
9-29		8.9	2.4	0.05	0.50	0.12	9.6	1.8	
10-7		11	1.4	0.33	0.40	-	4.2	8.4	
10-13		8.2	0.64	-	0.77	-	6.5	2.6	
10-21		11	1.5	-	0.69	0.07	5.5	2.9	
10-27		4.9	0.57	0.16	0.79	0.46	6.3	4.9	
11-4		4.4	0.36	0.17	0.27	0.38	3.2	3.4	
11-10		5.2	0.52	0.10	0.47	0.20	4.4	2.7	
12-18		18	0.76	-	0.47	0.06	1.2	5.1	

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX F
TABLE 2 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN PASTURE GRASS - 1964
picocuries/gram

Date	P^{32}	K^{40}	Zn^{65}	$Zr\text{-}Nb^{95}$	Cs^{137}	I^{131}	$Ce\text{-}Pr^{144}$	Ru^{106}	Sr^{90}
Reporting Limits	0.2	0.4	0.1	0.05	0.03	0.05	1.0	0.6	0.002
Pasco									
4-14		7.6	0.12	0.13	0.28	-	4.6	-	
4-22		6.1	-	0.17	0.27	-	2.6	1.1	
4-22		6.9	-	0.22	0.32	-	2.4	2.2	
5-6	-	6.7	-	0.06	0.14	-	-	-	
5-6	-	5.1	-	0.06	0.08	-	-	-	
5-12		6.8	-	0.14	0.17	1.1	2.0	1.2	
5-12		9.1	-	0.06	0.93	1.0	2.0	1.1	
5-20		7.0	-	0.11	0.16	-	1.3	1.7	
5-20		6.6	-	0.09	0.16	0.11	2.1	1.2	
5-26		5.6	-	0.08	0.10	0.09	1.7	2.9	
5-26		7.3	-	0.16	0.27	-	1.7	4.4	
6-3	-	7.1	-	0.15	0.28	-	1.6	4.2	0.099
6-3	-	6.1	-	0.08	0.21	-	1.5	2.6	0.059
6-11		8.3	-	0.12	0.33	0.11	8.2	7.3	
6-11		5.0	-	0.16	0.37	-	3.6	1.4	
6-17		7.2	-	0.17	0.59	-	5.1	3.5	
6-17		4.6	-	0.12	0.26	-	3.8	2.1	
6-25		7.3	-	0.07	0.25	-	3.3	4.2	
6-25		6.1	-	0.05	0.21	0.10	3.3	3.6	
7-10		18	-	0.36	1.2	0.05	6.4	16	
7-10		9.6	-	0.29	0.80	0.06	5.4	8.2	
7-15		7.9	-	0.12	0.41	-	4.7	4.0	
7-15		8.8	-	0.08	0.24	-	1.1	4.8	
7-21		7.4	-	-	0.05	-	1.0	2.6	
7-21		7.4	-	-	0.07	-	1.7	2.9	

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX F
TABLE 2 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN PASTURE GRASS - 1964
picocuries/gram

Date	P^{32}	K^{40}	Zn^{65}	$Zr\text{-}Nb^{95}$	Cs^{137}	I^{131}	$Ce\text{-}Pr^{144}$	Ru^{106}	Sr^{90}
Reporting Limits	0.2	0.4	0.1	0.05	0.03	0.05	1.0	0.6	0.002
Pasco (Continued)									
7-29		5.8	-	-	0.21	-	1.4	1.0	
7-29		6.3	-	-	0.19	-	-	2.2	
8-4	-	6.6	-	0.10	0.37	-	4.2	3.9	
8-4	1.3	7.4	-	0.07	0.24	-	-	2.5	
8-12		8.8	-	-	0.17	-	2.8	0.63	
8-12		7.0	-	-	0.09	-	3.3	1.6	
8-18		8.2	-	-	0.15	-	-	2.4	
8-18		6.8	-	-	0.18	-	-	2.7	
8-26	-	7.5	-	0.05	0.17	0.07	2.2	1.2	
8-26	-	6.8	-	0.06	0.43	0.05	3.8	3.2	
9-3	-	6.9	-	-	0.17	-	-	1.1	
9-17		7.4	-	-	0.15	-	1.8	1.6	
9-29		8.2	0.34	0.05	0.34	-	2.7	-	
10-7		7.1	-	-	0.04	0.07	-	4.9	
10-13		7.1	-	-	0.20	0.06	1.0	-	
10-21		9.6	-	-	0.35	-	4.7	2.5	
10-27		21	-	-	0.53	0.21	1.9	3.5	
10-30		18	-	-	0.62	-	2.2	4.0	
11-4		6.2	0.36	0.11	0.34	0.22	3.0	-	
11-5		25	-	-	0.76	-	3.8	1.6	
11-6		6.0	0.10	0.18	0.13	0.42	2.2	1.0	
11-10		22	-	-	0.58	-	4.2	1.1	
11-18		16	0.93	0.05	0.41	-	1.6	-	
11-24		23	-	-	0.50	0.09	1.4	5.2	

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX F
TABLE 2 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN PASTURE GRASS - 1964
picocuries/gram

Date	P^{32}	K^{40}	Zn^{65}	$Zr\text{-}Nb^{95}$	Cs^{137}	I^{131}	$Ce\text{-}Pr^{144}$	Ru^{106}	Sr^{90}
Reporting Limits	0.2	0.4	0.1	0.05	0.03	0.05	1.0	0.6	0.002
Eltopia									
4-14		5.8		-	0.08	-	5.0	-	
4-22		5.3		0.13	0.23	-	3.0	0.93	
4-22		6.4		0.10	0.20	-	2.8	0.92	
5-6	-	4.8		-	0.09	0.07	1.1	-	0.022
5-6	-	4.6		0.05	0.09	0.08	2.3	-	0.052
5-12		23		0.27	2.6	1.6	3.5	5.1	
5-12		5.6		-	0.04	1.0	-	0.65	
5-26		7.5		0.07	0.12	0.09	2.1	-	
5-26		22		0.69	2.2	-	12	6.6	
5-26		6.7		0.12	0.23	0.07	1.3	-	
6-3		6.6		0.21	0.48	-	2.7	1.7	
6-3		21		0.41	0.97	0.05	4.1	4.1	
6-11		17		0.61	1.6	-	8.6	8.1	
6-17		5.8		0.05	0.16	0.06	1.5	-	
6-17		5.4		0.08	0.15	-	1.7	-	
6-25		28		0.36	1.7	-	15	3.1	
6-25		7.1		0.31	0.88	0.07	8.2	2.7	
7-1	-	23		0.59	1.9	0.05	13	5.9	
9-17		5.3		-	0.04	-	-	-	
10-13		9.0		-	0.10	0.11	1.0	-	
10-27		27	-	-	0.49	0.12	-	4.0	
11-4		13		-	0.44	-	3.1	0.95	
11-10		8.1		-	0.41	-	2.8	1.1	
11-18		23		-	0.39	-	1.0	0.79	0.009
11-24		22		-	0.57	0.09	4.8	1.4	
12-2		23		-	0.25	-	2.9	0.60	
12-8		9.2		-	0.78	-	5.5	0.60	

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX F
TABLE 2 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN PASTURE GRASS - 1964
picocuries/gram

Date	P^{32}	K^{40}	Zn^{65}	$Zr\text{-}Nb^{95}$	Cs^{137}	I^{131}	$Ce\text{-}Pr^{144}$	Ru^{106}	Sr^{90}
Reporting Limits	0.2	0.4	0.1	0.05	0.03	0.05	1.0	0.6	0.002
West Richland									
5-1		6.5		0.07	0.14	-	-	0.80	
5-8		12		0.12	0.22	-	1.6	-	
5-8		5.9		0.40	1.8	1.7	4.6	3.4	
5-22		7.2		0.06	0.19	-	1.6	-	
5-22		5.1		-	0.10	-	-	0.76	
5-27		5.3		0.08	0.16	0.09	1.2	0.62	
6-5		6.8		0.36	1.1	-	7.3	6.0	
6-5		5.3		0.20	0.54	-	4.8	4.0	
6-5		5.4		0.18	0.65	-	7.4	1.4	
6-12		7.6		0.21	0.65	-	4.6	1.6	
6-26		6.6		0.15	0.36	0.15	4.7	1.2	
6-26		9.4		0.37	1.3	-	10	2.8	
7-2		7.6		0.32	0.11	-	5.6	3.4	
7-2		8.3		0.20	0.08	-	2.7	1.2	
7-10		7.7		0.22	0.81	-	4.5	2.3	
7-17		8.7		0.09	0.43	0.06	2.6	0.98	
7-24		6.9		0.28	0.80	-	6.5	2.5	
7-31		6.0		0.05	0.31	-	-	0.90	
7-31		7.0		0.16	0.82	-	4.3	2.9	
8-21		8.1		0.05	0.29	-	3.9	-	
8-21		7.9		0.13	0.72	0.08	4.4	2.8	
9-4		6.4		-	0.25	0.11	-	0.85	
9-10		6.4		-	0.36	0.11	1.4	0.97	
9-18		7.4		-	0.24	-	1.7	-	
10-2		6.2		-	0.35	-	3.7	0.81	0.073
10-16		5.7		-	0.26	0.10	2.8	0.63	

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX F
TABLE 2 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN PASTURE GRASS - 1965
picocuries/gram

Date	P^{32}	K^{40}	Zn^{65}	$Zr\text{-}Nb^{95}$	Cs^{137}	I^{131}	$Ce\text{-}Pr^{106}$	Ru^{106}	Sr^{90}
Reporting Limits	0.2	0.4	0.1	0.05	0.03	0.05	1.0	0.6	0.002
West Richland (Continued)									
10-23	11	7.1	0.36	0.07	0.64	0.15	6.1	3.9	
10-30		4.6	-	0.22	0.39	0.37	2.8	1.9	
11-6		6.3	0.62	0.17	0.60	0.28	1.7	1.3	
11-13		17	3.0	0.09	0.27	-	1.1	-	
Benton City									
5-1		6.3		0.16	0.30	0.06	2.5	1.9	
5-8		3.2			0.06	-	-	-	
5-8		7.0		0.12	0.24	-	3.4	-	
5-22		5.8		0.06	0.20	-	1.7	-	
5-22		6.2		-	0.10	-	-	-	
5-27		4.4		-	0.07	-	-	-	
5-27		4.7		-	0.11	0.08	-	-	
6-5		5.3		0.07	0.22	-	2.8	1.7	
6-5		8.7		0.09	0.25	-	4.1	2.1	
6-12		7.4		-	0.15	-	1.2	0.88	
6-12		6.2		0.08	0.29	0.07	5.3	0.64	
6-19		6.9		0.13	0.40	-	3.7	0.82	
6-19		5.3		0.08	0.25	-	1.7	-	
7-10		7.6		0.15	0.47	0.09	4.7	1.2	
7-10		10.		0.12	0.39	0.06	2.5	0.97	
7-17		6.8		0.08	0.39	0.07	2.1	1.0	
7-24		7.9		-	0.15	-	-	-	
7-24		8.0		-	0.09	-	-	-	
8-21		4.4		0.09	0.40	0.06	1.3	0.76	

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX F
TABLE 2 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN PASTURE GRASS - 1965
picocuries/gram

Date	P^{32}	K^{40}	Zn^{65}	$Zr\text{-}Nb^{95}$	Cs^{137}	I^{131}	$Ce\text{-}Pr^{106}$	Ru^{106}	Sr^{90}
Reporting Limits	0.2	0.4	0.1	0.05	0.03	0.05	1.0	0.6	0.002
Benton City (Continued)									
8-21		7.7		0.09	0.51	-	4.2	1.2	
8-28		7.2		-	0.08	0.05	-	-	
8-28		6.6		0.05	0.26	0.05	2.6	-	
9-4		7.4		-	0.39	-	3.2	-	
9-10		8.0		-	0.21	0.09	1.4	0.61	
9-18		9.4		-	0.33	0.07	-	0.90	
9-25		9.6		-	0.15	0.17	3.6	1.6	
10-2		8.5		-	0.19	-	1.9	-	0.073
10-30		32		-	0.53	0.29	4.4	1.2	
11-6		28	-	-	0.43	0.09	-	4.0	
11-13		27		-	0.77	-	2.0	1.5	

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX F
TABLE 3

CONCENTRATIONS OF RADIONUCLIDES IN MEATS
PURCHASED FROM LOCAL MARKETS - 1964
picocuries/gram

Date	Produce	P^{32}	K^{40}	Zn^{65}	I^{131}	Cs^{137}	Sr^{90}
Reporting Limits		0.2	0.4	0.1	0.05	0.03	0.002
1-14	Ground Beef	-	3.2	-	-	0.14	<0.008
1-14	Ground Beef	-	2.8	-	-	0.29	<0.007
1-14	Ground Beef	-	3.1	-	-	0.51	<0.009
3-5	Pork Chops		2.9	-	-	0.36	0.009
3-5	Pork Chops		3.0	-	-	0.49	0.007
3-5	Pork Chops		2.7	-	-	0.25	0.003
3-5	Pork Chops		3.1	-	-	0.54	0.003
4-9	Beef Liver		2.3	-	-	0.05	-
4-9	Beef Liver		2.1	-	-	0.12	<0.053
4-9	Beef Liver		1.9	-	-	0.26	0.004
5-4	Chicken		1.7	-	-	0.05	0.013
5-4	Chicken		2.0	-	-	0.07	0.007
5-4	Chicken		2.3	-	-	0.08	0.003
5-4	Chicken		2.5	0.11	-	0.07	0.005
6-2	Ground Round		2.7	-	0.07	0.32	<0.012
6-2	Ground Round		2.8	-	-	0.99	<0.008
6-2	Ground Round		2.7	-	-	0.33	<0.008
6-2	Ground Round		2.3	-	-	0.24	<0.012
8-26	Lamb Chops		2.4	-	-	0.59	
8-26	Lamb Chops		2.9	-	-	0.74	
8-26	Lamb Chops		2.5	-	-	1.4	
8-26	Lamb Chops		2.4	-	-	1.5	
9-10	Pork Chops		2.7	-	-	0.10	
9-10	Pork Chops		2.5	-	-	0.26	
9-10	Pork Chops		2.8	-	0.06	0.32	
9-10	Pork Chops		2.7	-	0.16	0.30	
10-1	Round Steak		2.6	-	-	0.15	0.002
10-1	Ground Round		3.0	-	-	0.63	<0.88
10-1	Round Steak		3.1	-	-	0.40	<0.006
10-1	Round Steak		2.8	-	-	0.47	<0.006
11-3	Chicken Flesh		1.4	-	-	0.05	0.008
11-3	Chicken Giblets		1.4	0.12	0.10	-	<0.005
11-13	Chicken Flesh		1.4	-	-	0.03	
11-13	Chicken Giblets		1.4	0.10	-	0.04	-
11-13	Chicken Flesh		1.6	-	-	0.06	
11-13	Chicken Giblets		2.0	0.14	-	-	<0.008
11-13	Chicken Flesh		2.0	-	-	-	
11-13	Chicken Giblets		2.0	-	-	0.06	

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX F
TABLE 4

CONCENTRATIONS OF RADIONUCLIDES IN MEATS
PURCHASED FROM LOCAL FARMS - 1964
picocuries/gram

Date	Produce	P^{32}	K^{40}	Zn^{65}	I^{131}	Cs^{137}	Sr^{90}
Reporting Limits		0.2	0.4	0.1	0.05	0.03	0.002
4-8	Short Ribs		1.4	6.0		0.21	
4-8	Short Ribs		1.6	13		0.15	
6-3	Chicken	-	2.3	-	-	0.15	<0.007
6-10	Chicken	1.2	5.9	6.3	0.24	0.30	
7-15	Beef Steak		2.6	3.3	-	0.38	

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX F
TABLE 5

CONCENTRATIONS OF RADIONUCLIDES IN LOCALLY GROWN FARM PRODUCE - 1964
picocuries/gram

Date	Produce	P^{32}	K^{40}	Zn^{65}	Zr^{95} Nb^{95}	I^{131}	Cs^{137}	Ce^{144} Pr^{144}	Sr^{90}
Reporting Limits		0.2	0.4	0.1	0.05	0.05	0.03	1.0	0.002
5-19	Onion Tops		2.4		-	-	-	-	
5-19	Radish Tops		3.5		-	0.16	0.12	1.5	
5-20	Asparagus		2.6	-	-	0.07	-	-	
5-20	Asparagus		3.0		-	0.06	-	-	
5-20	Asparagus		4.6		-	-	0.05	-	
5-21	Radishes	-	2.5	0.35	-	-	0.04	-	
5-21	Lettuce	0.34	4.8	0.37	-	0.05	0.07	-	
5-21	Mustard Greens	-	2.9	0.15	-	-	-	1.1	
5-21	Asparagus	-	4.5	0.30	-	0.05	0.06	1.4	
5-21	Asparagus	-	2.8	0.15	-	-	-	-	
5-21	Asparagus	-	3.8	0.11	-	-	0.06	-	
6-3	Eggs	-	1.2	-			0.03		0.007
6-10	Strawberries	0.63	2.4	-	-	-	-	-	0.016
6-10	Eggs	1.5	1.2	1.6		-	-	1.0	0.011
6-10	Lettuce	0.32	3.3	0.14	-	-	0.06	2.0	0.023
6-10	Radishes	-	5.5	-	-	-	0.03	1.2	
6-25	Rhubarb	-	3.7		-	-	0.03	-	
6-29	Cherries		2.3		-	-	-	-	0.004
6-29	Romaine Lettuce		2.1		-	-	-	-	0.003
6-29	Strawberries		1.9		-	-	-	-	0.003
6-29	Leaf Lettuce		3.2		-	-	0.05	-	0.003
6-29	Fresh Peas		2.2		-	-	-	-	0.003
6-30	Cherries		1.9		-	-	-	-	0.007
6-30	Raspberries		1.6		-	-	0.05	-	0.007
6-30	Strawberries		1.6		-	-	0.03	-	0.007
6-30	Beans		2.1		-	-	-	1.2	0.002
6-30	Onions		1.5		-	-	-	1.1	0.002
6-30	Lettuce		4.2		-	-	0.03	-	0.002

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX F
TABLE 5 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN LOCALLY GROWN FARM PRODUCE - 1964
picocuries/gram

Date	Produce	P^{32}	K^{40}	Zn^{65}	Zr^{95} Nb^{95}	I^{131}	Cs^{137}	Ce^{144} Pr^{144}	Sr^{90}
Reporting Limits		0.2	0.4	0.1	0.05	0.05	0.03	1.0	0.002
6-30	Blackberries		1.2		-	-	0.08	-	0.002
7-7	Carrots	-	5.0	-	-	-	0.09	2.2	0.025
7-7	Beets	-	4.3	-	-	-	-	-	0.034
7-7	Apples	-	1.1	-	-	-	-	-	0.005
7-15	Rhubarb	-	3.2	-	-	-	-	-	0.008
7-17	Apples	-	1.2	-	-	-	-	-	0.004
7-15	Carrot Tops	-	7.0	-	-	0.14	0.13	-	0.043
7-15	Carrot Roots	-	4.3	-	-	-	-	-	0.011
7-15	Green Beans	-	2.5	-	-	0.05	-	-	0.010
7-31	Peppers	-	1.9	-	-	-	-	-	0.018
7-31	Beans	-	2.2	-	-	-	-	-	0.018
7-31	Corn	-	2.3	-	-	0.07	-	-	0.018
7-31	Tomatoes	-	2.4	-	-	-	-	-	0.018
7-31	Cabbage	-	3.0	-	-	0.05	-	-	0.018
7-31	Cucumbers	-	1.8	-	-	-	-	-	0.018
7-31	Sweet Corn	0.24	3.2	1.1	-	-	0.26	1.7	0.018
7-31	Field Corn	-	1.8	-	-	0.05	-	-	0.018
7-31	Beans	-	4.3	-	-	-	-	-	0.018
7-31	Carrots	-	3.7	-	-	0.08	-	-	0.018
7-31	Lettuce	-	1.0	-	-	-	-	-	0.018
7-31	Onions	-	1.6	-	-	-	-	-	0.018
7-31	Cucumbers	-	2.1	-	-	0.09	-	-	0.018
7-31	Potatoes	-	4.5	-	-	-	-	-	0.018
7-31	Tomatoes	-	2.1	-	-	-	-	-	0.018
7-31	Lettuce	-	2.5	-	-	0.09	-	-	0.018
7-31	Cabbage	-	2.0	-	-	-	-	-	0.018
7-31	Squash	-	1.5	-	-	-	-	-	0.018

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX F
TABLE 5 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN LOCALLY GROWN FARM PRODUCE - 1964
picocuries/gram

Date	Produce	P^{32}	K^{40}	Zn^{65}	Zr^{95} Nb^{95}	I^{131}	Cs^{137}	Ce^{144} Pr^{144}	Sr^{90}
Reporting Limits		0.2	0.4	0.1	0.05	0.05	0.03	1.0	0.002
7-31	Carrots	-	4.1	0.58	-	0.12	-	-	0.018
7-31	Cucumbers	-	1.7	0.21	-	-	-	-	0.018
7-31	Melons	-	1.9	-	-	-	-	-	0.018
7-31	Rhubarb	-	4.8	-	-	-	-	-	0.018
7-31	Onions	0.22	1.4	-	-	-	-	-	0.018
7-31	Sugar Beets	-	1.7	-	-	0.06	-	-	0.018
7-31	Carrots	-	3.0	0.26	-	-	-	-	0.018
7-31	Beets	-	3.6	0.29	-	-	-	-	0.018
7-31	Cucumbers	-	1.3	-	-	-	-	-	0.018
7-31	Squash	-	1.2	-	-	-	-	-	0.018
7-31	Beans	0.28	4.1	0.38	-	-	-	-	0.018
8-4	String Beans	0.20	4.0	0.53	-	-	0.31	2.0	0.008
8-4	Peaches	-	1.7	-	-	-	-	-	0.017
8-10	Wheat		2.9		-	-	0.13	1.0	0.016
8-10	Wheat		3.9		-	-	0.14	1.0	
8-11	Wheat		3.2		-	-	0.13	1.7	0.014
8-18	Corn		2.5		-	-	-	-	<0.007
8-18	Watermelon	-	1.3	-	-	-	-	-	0.004
8-18	Peaches		2.0		-	-	-	-	<0.006
8-18	Cucumbers		2.2		-	-	-	-	0.006
8-18	Tomatoes		2.6		-	-	-	-	0.006
8-18	Kohlrabi		3.3		-	-	-	-	0.006
8-18	Beans		2.6		-	-	-	-	0.006
8-18	Carrots		2.9		-	-	-	-	0.006
8-18	Corn		2.8		-	-	-	-	0.006
8-26	Potatoes	-	3.7	-	-	-	-	-	0.005

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX F
TABLE 5 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN LOCALLY GROWN FARM PRODUCE - 1964
picocuries/gram

Date	Produce	P^{32}	K^{40}	Zn^{65}	Zr^{95} Nb^{95}	I^{131}	Cs^{137}	Ce^{144} Pr^{144}	Sr^{90}
Reporting Limits		0.2	0.4	0.1	0.05	0.05	0.03	1.0	0.002
8-26	Green Peppers	-	1.7	-	-	-	-	-	0.005
8-26	Cucumbers	-	1.7	-	-	-	-	-	0.005
8-26	Hot Peppers	-	2.5	0.18	-	-	-	-	0.005
8-26	Green Beans	0.73	2.1	-	-	-	-	-	0.005
8-26	Cantaloupes	-	2.4	-	-	-	-	-	0.005
8-26	Tomatoes	<3.40	1.6	-	-	0.06	-	-	0.005
8-26	Tomatoes	-	2.5	-	-	-	-	-	0.003
8-26	Hale Peaches	-	2.1	-	0.06	-	-	-	0.003
8-26	Elberta Peaches	-	1.8	1.0	-	-	0.04	-	0.003
8-26	Apples		1.0		-	-	-	-	
9-3	Green Peppers	-	1.1	-	-	0.09	-	-	0.005
9-3	Potatoes	-	2.9	-	-	0.05	-	-	0.005
9-3	Tomatoes	-	1.9	-	-	-	-	-	0.005
9-3	Peaches	-	2.0	-	-	-	-	-	0.005
9-3	String Beans	0.63	2.2	0.14	-	-	-	-	0.005
9-3	Cantaloupe	-	1.8	-	-	-	-	-	0.005
9-3	Peaches	-	2.2	-	-	-	-	-	0.004
9-3	String Beans	0.66	4.1	0.12	-	-	-	-	0.004
9-3	Tomatoes	-	2.8	-	-	-	-	-	0.004
9-3	Beets	-	4.5		-	-	-	-	0.004
9-3	Cucumbers	-	2.0	-	-	-	-	-	0.004
9-9	Apples	-	0.87	-	-	-	0.03	-	
9-9	Tomatoes	-	2.3	-	-	-	-	-	
9-9	Cantaloupe	-	0.86	-	-	-	-	-	<0.006
9-9	Tomatoes	-	1.8	-	-	-	-	-	<0.006
9-9	Grapes	0.34	2.3	-	-	-	0.04	-	0.009

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX F
TABLE 5 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN LOCALLY GROWN FARM PRODUCE - 1964
picocuries/gram

Date	Produce	P^{32}	K^{40}	Zn^{65}	Zr^{95} Nb^{95}	I^{131}	Cs^{137}	Ce^{144} Pr^{144}	Sr^{90}
Reporting Limits		0.2	0.4	0.1	0.05	0.05	0.03	1.0	0.002
9-9	Cabbage	-	1.9	-	-	-	0.04	-	0.009
9-9	Beans	0.84	3.7	0.37	-	-	-	-	0.006
9-9	Squash	-	1.3	-	-	-	-	-	0.006
9-9	Raspberries	0.51	1.3	-	-	-	-	-	0.006
9-9	Cucumbers	-	1.4	0.16	-	-	-	-	0.006
9-9	Hot Peppers	-	2.2	-	-	-	-	-	0.006
9-10	Plums		2.7		-	-	-	-	0.002
9-10	Tomatoes		2.2		-	-	-	-	0.002
9-10	Peaches		1.8		-	-	0.03	-	0.002
9-10	Green Peppers		3.3		-	-	-	1.5	0.002
9-10	Corn		2.9		-	-	0.03	-	0.002
9-10	Peaches		1.8		-	-	-	-	0.002
9-10	Cucumbers		1.5		-	-	-	-	0.002
9-10	Pears		1.2		-	0.05	-	-	0.002
9-10	Apples		0.86		-	-	-	-	0.002
9-10	Squash		1.4		-	-	-	-	0.002
9-10	Rhubarb		-		-	-	-	-	0.002
9-10	Corn		2.2		-	0.10	0.03	-	0.002
9-10	Apples		1.4		-	-	0.06	-	0.004
9-10	Squash		1.2		-	-	0.04	-	0.004
9-10	Tomatoes		2.1		-	-	0.18	-	0.004
9-10	Tomatoes		2.2		-	-	-	-	0.004
9-21	Grapes		2.4		-	-	-	-	0.003
9-21	Plums		1.9		-	-	-	-	0.002
9-23	Raspberries	-	1.4	-	-	-	0.03	-	0.003

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX F
TABLE 5 (Continued)

CONCENTRATIONS OF RADIONUCLIDES IN LOCALLY GROWN FARM PRODUCE - 1964
picocuries/gram

Date	Produce	P^{32}	K^{40}	Zn^{65}	Zr^{95} Nb^{95}	I^{131}	Cs^{137}	Ce^{144} Pr^{144}	Sr^{90}
Reporting Limits		0.2	0.4	0.1	0.05	0.05	0.03	1.0	0.002
9-23	Strawberries	0.21	0.66	-	-	-	-	-	0.003
9-23	Tomatoes	-	2.5	-	-	-	-	-	0.003
9-23	Cucumbers	-	1.9	0.17	-	-	-	-	0.003
9-23	Squash	-	3.8	-	-	0.19	-		0.003
9-23	Yams	0.21	4.2	0.75	-	-	-		0.003
9-23	Peppers	-	2.9	-	-	0.11	-		0.003
9-23	Apples	-	1.2	-	-	-	-	-	0.003
9-23	Grapes	-	3.0	-	-	-	-	-	0.003
9-23	Melon	-	3.5	-	-	-	-		0.003
9-23	Corn	-	3.2	-	-	0.13	-	-	0.003

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

APPENDIX F
TABLE 6

CONCENTRATIONS OF RADIONUCLIDES IN FOOD PURCHASED FROM LOCAL STORES - 1964
picocuries/gram

Date	Produce	P^{32}	K^{40}	Zn^{65}	Zr^{95} Nb^{95}	I^{131}	Cs^{137}	Ce^{144} Pr^{144}	Sr^{90}
Reporting Limits		0.2	0.4	0.1	0.05	0.05	0.03	1.0	0.002
3-5	Eggs		0.99	-			0.04		0.014
3-5	Eggs		1.0	-			0.03		0.007
6-2	Lettuce		1.8		-	-	-	-	
6-2	Asparagus		3.2		-	-	0.03	-	
6-2	Carrots		3.1		-	0.11	-	-	
6-2	Cabbage		1.8		-	-	0.05	-	
6-2	Carrots		3.2		-	0.16	-	2.2	
6-2	Lettuce		1.6		-	-	0.04	-	
6-2	Cabbage		2.0		-	-	-	-	
6-2	Asparagus		3.1		-	0.05	0.04	-	
6-29	Green Onions		2.0		-	0.06	-	-	0.037
6-29	Rhubarb		2.3		-	-	-	-	0.037
6-29	Mustard Greens		4.3		0.05	-	0.09	-	0.037
6-29	Radishes		2.3		-	-	-	-	0.037
6-29	Beets		4.2		0.05	-	0.04	-	0.037
6-29	Broccoli		2.3		-	0.05	-	-	-
6-29	Tomatoes								-
6-29	Cucumbers								-
6-29	Green Pepers								-
6-29	Lettuce		1.9		-	-	-	-	-
6-29	Zuccini Squash		3.6		-	-	-	-	-
6-29	Cauliflower		2.5		-	-	-	-	-
7-16	Eggs		0.86	-		-	-		0.006
7-16	Eggs		1.0	-		-	-		0.005
9-23	Cucumbers		1.6		-	-	-	-	0.005

Results less than reporting limit are indicated by a (-).
No entry indicates no analysis made.

XIII. APPENDIX G

I^{131} IN CATTLE THYROIDS

APPENDIX G
TABLE 1

I^{131} IN BEEF THYROIDS FROM
CATTLE SLAUGHTERED AT SEVERAL LOCATIONS - 1964
picocuries per gram

Date Sampled	Thyroid Wt (g)	I^{131} Concentration	Grazing Area
Pasco, Washington			
1-2	44	5	Pasco
1-15	47	4	Warden
1-15	31	4	Pasco
1-30	37	<2	Othello
1-31	63	<1	Warden
2-20	20	<4	Pasco
3-18	68	3	Prosser
3-18	32	<3	Pasco
3-24	52	<2	Pasco
3-24	54	<2	Pasco
4-15	42	3	Kennewick
4-22	68	<2	Burbank
4-22	51	<2	Burbank
4-22	45	<2	Connell
4-29	79	<2	Kennewick
4-29	61	<2	Kennewick
4-29	50	<3	Kahlotus
5-7	66	<1	Connell
5-7	67	<1	Connell
5-7	70	<1	Connell
5-20	75	2	Mesa
5-20	79	<1	Pasco
5-20	37	8	Kiona
5-26	42	<3	Nine Mile Ranch
5-26	27	<5	Nine Mile Ranch
5-26	30	<5	Nine Mile Ranch
6-9	45	<2	Pasco
6-9	62	<1	Pasco
6-9	51	<2	Pasco
6-13	48	<2	Pasco
6-16	52	<2	Nine Mile Ranch
6-16	62	<2	Nine Mile Ranch
6-16	48	<2	Nine Mile Ranch
6-22	68	<2	Kennewick
6-22	40	<3	Kennewick
6-22	44	<3	Kennewick

APPENDIX G
TABLE 1 (Continued)

I^{131} IN BEEF THYROIDS FROM
CATTLE SLAUGHTERED AT SEVERAL LOCATIONS - 1964
picocuries per gram

Date Sampled	Thyroid Wt (g)	I^{131} Concentration	Grazing Area
Pasco, Washington (Continued)			
6-27	27	<5	Pasco
11-4	43	<2	Burbank
11-10	33	<4	Hermiston
11-12	40	5	Kennewick
11-12	24	5	Prosser
11-16	41	<4	Burbank
11-18	25	<6	Kennewick
11-19	41	<3	Eltopia
11-24	37	60	Pasco
11-25	41	<3	Burbank
12-1	48	<2	Burbank
12-1	33	<3	Pasco
12-1	44	<46	Eltopia
12-8	34	<3	Pasco
12-9	48	2	Burbank
12-9	22	5	Pasco
12-15	55	2	Pasco
12-16	29	<3	Pasco
12-16	40	<3	Prosser
12-22	36	<3	Pasco
12-22	47	<2	Mesa
12-24	40	<3	Pasco
12-24	32	<4	Pasco
12-28	44	<2	Walla Walla
12-28	51	<2	Walla Walla
Moses Lake, Washington			
1-11	43	<3	Wilson Creek
1-11	60	<2	Moses Lake
1-11	52	9	Othello
1-11	54	<2	Ephrata
1-11	44	<3	Ellensburg
1-24	43	<3	Connell
1-24	54	<2	Moses Lake
1-24	48	<2	Moses Lake
1-24	49	<2	Warden
1-24	51	<2	Ephrata
2-7	45	<5	Mesa

APPENDIX G
TABLE 1 (Continued)

I^{131} IN BEEF THYROIDS FROM
CATTLE SLAUGHTERED AT SEVERAL LOCATIONS - 1964
picocuries per gram

Date Sampled	Thyroid Wt (g)	I^{131} Concentration	Grazing Area
Moses Lake, Washington (Continued)			
2-8	43	<3	Othello
2-8	26	<5	Hartline
2-8	48	<3	Moses Lake
2-8	81	<2	Mesa
2-8	47	<3	Ephrata
2-22	81	<2	Moses Lake
2-22	42	<3	Warden
2-22	31	<4	Moses Lake
2-22	60	<2	Lamona
2-22	37	<4	Warden
3-7	74	<2	Othello
3-7	54	<2	Coulee City
3-7	60	<2	Moses Lake
3-7	56	<2	Marlin
3-7	70	<2	Royal City
3-21	21	<6	Moses Lake
3-21	44	<3	Moses Lake
3-21	36	<4	Moses Lake
3-21	31	<4	Coeur d'Alene
4-4	48	3	Winona
4-4	51	<2	Warden
4-4	52	<2	Cheney
4-4	70	<2	Lind
4-4	55	<2	Cheney
4-15	51	<2	Othello
4-15	68	2	Othello
4-17	39	<3	Othello
4-17	46	<3	Quincy
4-17	35	<4	Moses Lake
4-17	62	<2	Warden
4-17	39	<4	Quincy
5-2	30	<6	Waterville
5-2	25	<8	Moses Lake
5-2	76	<2	Moses Lake
5-2	63	<3	Moses Lake
5-2	36	<5	Moses Lake

APPENDIX G
TABLE 1 (Continued)

I^{131} IN BEEF THYROIDS FROM
CATTLE SLAUGHTERED AT SEVERAL LOCATIONS - 1964
picocuries per gram

Date Sampled	Thyroid Wt (g)	I^{131} Concentration	Grazing Area
Moses Lake, Washington (Continued)			
5-16	36	<4	Warden
5-16	41	<4	Kittitas
5-16	30	<5	Kittitas
5-16	33	<5	Wilson Creek
5-16	30	11	Hartline
5-28	66	<2	Warden
5-28	45	<2	Davenport
5-28	28	<5	Davenport
5-28	89	<2	Moses Lake
5-28	73	<2	Moses Lake
6-3	53	<2	Othello
6-3	66	<2	Othello
6-3	57	<2	Othello
6-13	32	<4	Othello
6-13	26	<4	Othello
6-13	45	4	Moses Lake
6-13	50	3	Govan
6-27	47	<3	Kittitas
6-27	43	4	Wilson Creek
6-27	51	<2	Othello
6-27	27	<5	Ritzville
7-9	48	<3	Royal City
7-9	31	<4	Moses Lake
7-9	28	<5	Othello
7-9	46	<3	Royal City
7-9	36	<4	Othello
7-23	43	<3	Moses Lake
7-23	67	<2	Othello
7-23	46	<3	Othello
7-23	38	<4	Othello
7-23	50	<3	Othello
8-8	28	<5	Moses Lake
8-8	36	<4	Othello
8-8	31	<4	Ritzville
8-8	32	<4	Quincy
8-8	58	<2	Ritzville
8-22	10	24	Moses Lake
8-22	30	4	Soap Lake
8-22	39	<3	Othello

APPENDIX G
TABLE 1 (Continued)

I^{131} IN BEEF THYROIDS FROM
CATTLE SLAUGHTERED AT SEVERAL LOCATIONS - 1964
picocuries per gram

Date Sampled	Thyroid Wt (g)	I^{131} Concentration	Grazing Area
Moses Lake, Washington (Continued)			
8-22	62	6	Moses Lake
8-22	36	<3	Marlin
9-4	60	<3	Warden
9-4	39	28	Othello
9-4	35	6	Quincy
9-4	45	6	Davenport
9-4	46	<3	Othello
9-19	39	<3	Warden
9-19	43	<3	Warden
9-19	47	<3	Moses Lake
9-19	36	<3	Moses Lake
9-19	29	<4	Othello
10-3	77	<1	Moses Lake
10-3	41	4	Moses Lake
10-3	30	5	Sprague
10-3	41	<3	Moses Lake
10-3	28	9	Ritzville
10-17	24	<5	Pasco
10-17	34	<4	Coulee City
10-17	26	<5	Coulee City
10-17	45	6	Moses Lake
10-17	39	<3	Ritzville
10-31	63	23	Moses Lake
10-31	72	<2	Ritzville
10-31	52	<2	Ritzville
10-31	49	23	Coulee City
10-31	73	34	Moses Lake
11-14	29	<5	Warden
11-14	36	<4	Warden
11-14	30	<5	Warden
11-14	30	<5	Warden
11-14	20	<8	Moses Lake
11-28	49	<3	Irby
11-28	42	<3	Warden
11-28	19	<7	Moses Lake
11-28	40	<3	Cunningham
11-28	73	<2	Warden
12-12	46	<3	Moses Lake
12-12	46	<80	Moses Lake
12-12	36	<4	Moses Lake
12-12	41	<8	Grand Coulee
12-12	34	<4	Warden
12-29	40	8	Othello

APPENDIX G
TABLE 1 (Continued)

I^{131} IN BEEF THYROIDS FROM
CATTLE SLAUGHTERED AT SEVERAL LOCATIONS - 1964
picocuries per gram

Date Sampled	Thyroid Wt (g)	I^{131} Concentration	Grazing Area
Walla Walla, Washington			
1-8	29	<3	Walla Walla
1-8	50	<2	Walla Walla
1-8	21	<5	Lowden
1-8	32	<3	Lowden
1-8	31	<3	Walla Walla
1-23	44	<2	Lowden
1-23	36	<3	Milton-Freewater
1-23	49	<2	Milton-Freewater
1-23	43	<2	Lowden
2-5	36	<3	Touchet
2-5	29	<3	Lowden
2-5	44	<2	Lowden
2-5	57	<2	Walla Walla
2-5	35	<3	Lowden
2-26	62	<2	Walla Walla
2-26	24	<6	Lowden
2-26	18	<7	Walla Walla
2-26	35	<4	Touchet
2-26	45	<3	Walla Walla
3-11	34	<3	Walla Walla
3-11	28	<3	Walla Walla
3-11	31	<1	Touchet
3-11	41	<2	Walla Walla
3-11	35	<3	Touchet
3-11	83	<1	Connell
3-11	67	<1	Milton-Freewater
3-19	37	<4	Touchet
3-19	56	<2	Walla Walla
3-19	26	<5	Walla Walla
3-19	62	<2	Walla Walla
3-19	29	<5	Walla Walla
3-21	34	<4	Walla Walla
4-8	52	<1	Walla Walla
4-8	34	<1	Walla Walla
4-8	44	<1	Walla Walla
4-14	26	<4	Walla Walla
4-14	19	<6	Walla Walla
4-14	24	<5	Walla Walla
4-14	20	<6	Waitsburg
4-14	31	<4	Walla Walla

APPENDIX G
TABLE 1 (Continued)

I^{131} BEEF THYROIDS FROM CATTLE
SLAUGHTERED AT SEVERAL LOCATIONS - 1964
picocuries per gram

Date Sampled	Thyroid Wt (g)	I^{131} Concentration	Grazing Area
Walla Walla, Washington (Continued)			
4-23	20	<6	Walla Walla
4-23	43	<3	Walla Walla
4-23	47	<3	Walla Walla
4-23	52	<2	Walla Walla
4-23	42	5	Walla Walla
5-6	20	<7	Waitsburg
5-6	22	<6	Walla Walla
5-6	20	<7	Walla Walla
5-6	14	<9	Walla Walla
5-6	26	<5	Walla Walla
5-12	56	<2	Touchet
5-12	45	<2	Touchet
5-12	42	<3	Touchet
5-20	28	<4	Walla Walla
5-20	39	<3	Walla Walla
5-20	29	<4	Lowden
5-20	30	<4	Lowden
5-20	31	7	Snake River
6-4	57	4	Walla Walla
6-4	41	3	Walla Walla
6-4	36	4	Touchet
6-4	17	<7	Milton-Freewater
6-4	27	5	Walla Walla
6-18	24	<4	Walla Walla
6-18	50	4	Walla Walla
6-18	32	<3	Walla Walla
6-18	44	<2	Walla Walla
6-18	33	<3	Walla Walla
7-3	30	6	Walla Walla
7-3	34	24	Walla Walla
7-3	47	<3	Walla Walla
7-3	32	15	Walla Walla
7-3	19	<7	Walla Walla
7-23	21	<5	Walla Walla
7-23	42	<2	Walla Walla
7-23	30	<3	Walla Walla
7-23	36	<3	Walla Walla
7-23	26	<4	Walla Walla
8-6	47	<2	Walla Walla
8-6	36	<3	Walla Walla
8-6	40	<3	Walla Walla

APPENDIX G
TABLE 1 (Continued)

I^{131} BEEF THYROIDS FROM CATTLE
SLAUGHTERED AT SEVERAL LOCATIONS - 1964
picocuries per gram

Date Sampled	Thyroid Wt (g)	I^{131} Concentration	Grazing Area
Walla Walla, Washington (Continued)			
8-6	20	<6	Walla Walla
8-6	43	<3	Whitman Station
9-1	38	<2	Lowden
9-1	40	<2	Lowden
9-1	90	<1	Lowden
9-1	31	<3	Lowden
9-1	31	<3	Lowden
9-10	70	4	Walla Walla
9-10	29	<4	Starbuck
9-10	31	6	Starbuck
9-10	76	3	Walla Walla
9-10	21	10	Starbuck
9-25	33	<4	Walla Walla
9-25	30	<4	Walla Walla
9-25	39	<3	Walla Walla
9-25	65	2	Walla Walla
9-25	44	5	Heppner
10-8	34	<3	Walla Walla
10-8	26	4	Walla Walla
10-8	51	<2	Walla Walla
10-8	37	<3	Walla Walla
10-8	32	<3	Blue Mts.
10-16	28	<4	Walla Walla
10-16	178	<1	Walla Walla
10-16	30	4	Walla Walla
10-16	22	<5	Walla Walla
10-16	39	4	Lowden
11-4	23	46	Walla Walla
11-4	40	18	Walla Walla
11-4	31	12	Walla Walla
11-4	43	33	Walla Walla
11-4	54	<2	Blue Mts.
11-17	46	10	Lowden
11-17	33	13	Walla Walla
11-17	32	19	Lowden
11-17	27	27	Lowden
11-17	26	22	Lowden
12-3	37	6	Walla Walla
12-3	27	ND	Walla Walla

APPENDIX G
TABLE 1 (Continued)

I^{131} BEEF THYROIDS FROM CATTLE
SLAUGHTERED AT SEVERAL LOCATIONS - 1964
picocuries per gram

Date Sampled	Thyroid Wt (g)	I^{131} Concentration	Grazing Area
Walla Walla, Washington (Continued)			
12-3	46	22	Walla Walla
12-3	48	12	Walla Walla
12-18	26	6	Walla Walla
12-18	42	5	Walla Walla
12-18	48	4	Walla Walla
12-18	36	4	Walla Walla
12-18	37	3	Walla Walla
Wenatchee, Washington			
1-7	38	<3	Grant Co.
1-7	31	<3	Grant Co.
1-7	46	<2	Grant Co.
1-7	40	<2	Adams Co.
1-7	26	<4	Adams Co.
1-21	44	<2	Chelan Co.
1-21	56	<2	Chelan Co.
1-21	53	<2	Chelan Co.
1-21	30	<4	Chelan Co.
1-21	39	<3	Chelan Co.
2-4	53	<2	Douglas Co.
2-4	42	<2	Adams Co.
2-4	62	<2	Adams Co.
2-4	41	<2	Adams Co.
2-4	36	<3	Kittitas Co.
2-25	37	<3	Grant Co.
2-25	28	<4	Grant Co.
2-25	39	<3	Douglas Co.
2-25	55	<2	Chelan Co.
2-25	40	<2	Chelan Co.
3-3	58	<2	Grant Co.
3-3	68	<1	Grant Co.
3-3	60	<2	Chelan Co.
3-3	38	<2	Grant Co.
3-3	49	<2	Grant Co.
4-6	38	<3	Chelan Co.
4-6	35	<3	Chelan Co.
4-6	32	<3	Grant Co.

APPENDIX G
TABLE 1 (Continued)

I^{131} BEEF THYROIDS FROM CATTLE
SLAUGHTERED AT SEVERAL LOCATIONS - 1964
picocuries per gram

Date Sampled	Thyroid Wt (g)	I^{131} Concentration	Grazing Area
Wenatchee, Washington (Continued)			
4-6	34	<3	Grant Co.
4-6	48	<2	Grant Co.
4-21	48	<2	Chelan Co.
4-21	29	<4	Chelan Co.
4-21	37	<3	Chelan Co.
4-21	42	<2	Chelan Co.
4-21	31	<3	Chelan Co.
5-13	97	<1	Chelan Co.
5-13	50	<2	Chelan Co.
5-13	51	<2	Douglas Co.
5-13	48	<2	Eltopia
5-13	69	3	Douglas Co.
5-26	25	<4	Douglas Co.
5-26	52	<2	Douglas Co.
5-26	55	<2	Douglas Co.
5-26	64	<2	Douglas Co.
5-26	138	<1	Chelan Co.
6-9	45	3	Chelan Co.
6-9	27	<4	Grant Co.
6-9	36	<3	Douglas Co.
6-9	39	<3	Douglas Co.
6-29	47	<2	Grant Co.
6-29	63	<2	Chelan Co.
6-29	45	<2	Douglas Co.
6-29	70	<2	Chelan Co.
6-29	48	4	Grant Co.
7-14	63	<2	Grant Co.
7-14	40	<3	Grant Co.
7-14	60	<2	Douglas Co.
7-14	36	<3	Grant Co.
7-14	42	<2	Grant Co.
8-4	53	<2	Douglas Co.
8-4	52	<2	Grant Co.
8-4	71	<2	Adams Co.
8-4	33	<4	Douglas Co.
8-4	37	<3	Douglas Co.
8-24	58	<2	Chelan Co.
8-24	57	<2	Chelan Co.
8-24	41	<2	Chelan Co.
8-24	58	<2	Douglas Co.

APPENDIX G
TABLE 1 (Continued)

I^{131} BEEF THYROIDS FROM CATTLE
SLAUGHTERED AT SEVERAL LOCATIONS - 1964

picocuries per gram

Date Sampled	Thyroid Wt (g)	I^{131} Concentration	Grazing Area
Wenatchee, Washington (Continued)			
8-24	67	<2	Douglas Co.
9-9	35	<3	Chelan Co.
9-9	37	<3	Chelan Co.
9-9	34	<3	Chelan Co.
9-9	32	<3	Chelan Co.
9-9	73	2	Douglas Co.
9-28	49	<2	Chelan Co.
9-28	85	<1	Chelan Co.
9-28	43	<2	Chelan Co.
9-28	51	<2	Chelan Co.
9-28	99	<1	Chelan Co.
10-7	13	<7	Grant Co.
10-7	26	12	Adams Co.
10-7	32	<3	Adams Co.
10-7	26	<4	Grant Co.
10-7	32	3	Grant Co.
10-19	54	<2	Douglas Co.
10-19	59	<2	Douglas Co.
10-19	70	<1	Chelan Co.
10-19	71	<1	Chelan Co.
10-19	77	<1	Chelan Co.
11-3	44	<2	Grant Co.
11-3	43	3	Chelan Co.
11-3	45	27	Douglas Co.
11-3	65	7	Chelan Co.
11-3	42	11	Chelan Co.
11-19	42	37	Douglas Co.
11-19	49	32	Douglas Co.
11-19	28	<5	Grant Co.
11-19	52	37	Douglas Co.
11-19	37	51	Grant Co.
12-8	54	34	Douglas Co.
12-8	42	4	Chelan Co.
12-8	38	<3	Chelan Co.
12-8	23	10	Chelan Co.
12-8	57	5	Douglas Co.

APPENDIX G
TABLE 1 (Continued)

I^{131} BEEF THYROIDS FROM CATTLE
SLAUGHTERED AT SEVERAL LOCATIONS - 1964
picocuries per gram

Date Sampled	Thyroid Wt (g)	I^{131} Concentration	Grazing Area
Yakima, Washington			
1-2	25	5	Yakima
3-13	25	<5	Ahtanum
3-13	47	<3	Cowiche
3-13	41	<3	Cowiche
3-13	33	<4	Ahtanum
3-13	40	<4	Wenas-Selah
3-23	21	<6	Ahtanum
3-23	40	<3	Ahtanum
3-23	30	<3	Ahtanum
3-23	24	<4	Ahtanum
3-23	40	<3	Ahtanum
4-2	41	<2	Moxee
4-2	38	<2	Moxee
4-2	75	<2	Moxee
4-2	42	<2	Moxee
4-2	33	<3	Moxee
4-22	26	<4	White Swan
4-22	40	<3	Moxee
4-22	32	<3	Moxee
4-22	28	<5	Mabton
4-22	28	<5	Ahtanum
5-2	23	<6	Selah Valley
5-2	26	<5	West of Yakima
5-2	41	<3	West of Yakima
5-2	37	<4	Selah Valley
5-2	29	<5	West of Yakima
5-18	31	6	West of Yakima
5-18	38	<3	Wide Hollow
5-18	14	<9	Moxee
5-18	73	<2	Cowiche
5-18	25	<5	Selah Gap
6-9	41	<2	Tieton
6-9	52	<2	West of Yakima
6-9	32	<3	Union Gap
6-9	40	<2	Cowiche-Tieton
6-9	25	<4	Union Gap
6-23	27	<4	Sunnyside
6-23	27	<4	Sunnyside
6-23	29	6	Sunnyside
6-23	34	<3	Sunnyside
6-23	12	<9	Selah

APPENDIX G
TABLE 1 (Continued)

I^{131} BEEF THYROIDS FROM CATTLE
SLAUGHTERED AT SEVERAL LOCATIONS - 1964
picocuries per gram

Date Sampled	Thyroid Wt (g)	I^{131} Concentration	Grazing Area
Yakima, Washington (Continued)			
7-13	34	<3	Sunnyside
7-13	42	<2	Sunnyside
7-13	34	<3	Cowiche
7-13	27	<4	Sunnyside
7-13	50	<2	Cowiche
7-24	33	<4	Yakima
7-24	62	<2	Yakima
7-24	36	<4	Grandview
7-24	31	<4	Grandview
7-24	33	<4	Sunnyside
8-11	41	<3	Yakima
8-11	41	<3	Selah
8-11	28	<4	Moxee
8-11	31	<3	Moxee
8-11	29	<4	Wenas Valley
8-24	32	<3	Selah Dist.
8-24	24	<4	Selah Dist.
8-24	17	<6	Selah Dist.
8-24	37	<3	Selah Dist.
8-24	29	<8	Odessa
9-9	54	<2	Selah
9-9	48	<2	Moxee
9-9	41	<2	West Yakima
9-9	32	<3	Selah
9-9	24	<4	Selah
9-22	44	<2	Cowiche
9-22	32	<3	Cowiche
9-22	45	<2	Selah
9-22	65	<2	Yakima
9-22	28	<4	Yakima
10-13	44	<2	Moxee
10-13	34	<3	Selah
10-13	36	<3	Moxee
10-13	38	<3	Moxee
10-13	52	<2	Tieton
10-28	71	<2	Yakima
10-28	20	31	Selah Dist.
10-28	33	25	Selah
10-28	28	4	Selah
10-28	24	6	Selah

APPENDIX G
TABLE 1 (Continued)

I^{131} BEEF THYROIDS FROM CATTLE
SLAUGHTERED AT SEVERAL LOCATIONS 1964
picocuries per gram

Date Sampled	Thyroid Wt (g)	I^{131} Concentration	Grazing Area
Yakima, Washington (Continued)			
11-10	36	<3	Yakima
11-10	46	<2	Wapato
11-10	45	21	Moxee
11-10	62	<2	Selah
11-10	52	<2	Selah
11-17	23	<5	Moxee
11-17	30	11	Selah
11-17	21	<3	Selah
11-17	33	7	Selah
11-17	35	5	East of Yakima
12-8	40	3	Yakima
12-8	30	<3	Moxee
12-8	39	3	Wenas Valley
12-8	32	<3	East of Yakima
12-8	40	2	East of Yakima
12-29	38	9	Cowiche
12-29	27	8	Selah
12-29	37	5	Moxee

XIV. APPENDIX H

MEASUREMENTS OF EXTERNAL RADIATION EXPOSURE

APPENDIX H
TABLE 1

IONIZATION CHAMBER MEASUREMENTS
FOR THE HANFORD RESERVATION AND RICHLAND - 1964

Measurement Period	mR/day Hanford	mR/day Richland	Measurement Period	mR/day Hanford	mR/day Richland
12/30/63-1/2/64	0.49	0.49	4/3-4/6	0.49	0.45
1/2-1/3	0.40	0.42	4/6-4/9	0.42	0.43
1/3-1/6	0.43	0.46	4/9-4/10	0.39	0.38
1/6-1/8	0.47	0.50	4/10-4/13	0.37	0.41
1/8-1/10	0.45	0.46	4/13-4/15	0.39	0.35
1/10-1/13	0.54	0.48	4/15-4/17	0.37	0.52
1/13-1/16	0.35	0.37	4/17-4/20	0.43	0.33
1/16-1/17	0.37	0.47	4/20-4/22	0.38	0.42
1/17-1/20	0.46	0.50	4/22-4/24	0.38	0.35
1/20-1/22	0.50	0.50	4/24-4/27	0.37	0.36
1/22-1/24	0.45	0.49	4/27-4/29	0.39	0.33
1/24-1/27	0.48	0.50	4/29-5/1	0.36	0.33
1/27-1/29	0.47	0.49	5/1-5/4	0.40	0.36
1/29-1/31	0.48	0.52	5/4-5/6	0.35	0.33
1/31-2/3	0.48	0.51	5/6-5/8	0.39	0.30
2/3-2/5	0.50	0.51	5/8-5/11	0.36	0.37
2/5-2/7	0.48	0.51	5/11-5/13	0.41	0.32
2/7-2/10	0.60	0.51	5/13-5/15	0.33	0.31
2/10-2/12	0.48	0.43	5/15-5/18	0.40	0.37
2/12-2/14	0.52	0.47	5/18-5/20	0.34	0.34
2/14-2/17	0.45	0.45	5/20-5/22	0.40	0.43
2/17-2/19	0.43	0.33	5/22-5/25	0.37	0.37
2/19-2/22	0.53	0.49	5/25-5/27	0.38	0.33
2/22-2/24	0.63	0.53	5/27-5/28	0.29	0.32
2/24-2/26	0.47	0.49	5/28-5/30	0.48	0.37
2/26-2/28	0.57	0.49	5/30-6/1	0.37	0.40
2/28-3/2	0.43	0.44	6/1-6/3	0.39	0.34
3/2-3/4	0.50	0.44	6/3-6/5	0.32	0.36
3/4-3/6	0.41	0.47	6/5-6/8	0.44	0.36
3/6-3/9	0.47	0.43	6/8-6/10	0.35	0.38
3/9-3/11	0.43	0.42	6/10-6/12	0.39	0.33
3/11-3/13	0.45	0.42	6/12-6/15	0.37	0.37
3/13-3/16	0.41	0.47	6/15-6/17	0.43	0.38
3/16-3/18	0.47	0.41	6/17-6/19	0.38	0.37
3/18-3/20	0.49	0.47	6/19-6/22	0.45	0.37
3/20-3/23	0.54	0.49	6/22-6/24	0.40	0.39
3/23-3/25	0.46	0.48	6/24-6/26	0.39	0.34
3/25-3/27	0.46	0.44	6/26-6/29	0.39	0.42
3/27-3/30	0.45	0.48	6/29-7/2	0.48	0.39
3/30-4/1	0.47	0.49	7/2-7/4	0.59	0.40
4/1-4/3	0.40	0.47	7/4-7/6	0.52	0.47

APPENDIX H
TABLE 1 (Continued)

IONIZATION CHAMBER MEASUREMENTS
FOR THE HANFORD RESERVATION AND RICHLAND - 1964

Measurement Period	mR/day Hanford	mR/day Richland	Measurement Period	mR/day Hanford	mR/day Richland
7/6-7/8	0.41	0.39	10/7-10/9	0.41	0.47
7/8-7/10	0.50	0.59	10/9-10/12	0.40	0.38
7/10-7/13	0.40	0.44	10/12-10/14	0.42	0.33
7/13-7/15	0.42	0.38	10/14-10/16	0.33	0.37
7/15-7/17	0.38	0.42	10/16-10/19	0.43	0.38
7/17-7/20	0.44	0.37	10/19-10/21	0.50	0.49
7/20-7/22	0.36	0.33	10/21-10/23	0.49	0.45
7/22-7/24	0.41	0.33	10/23-10/26	0.44	0.43
7/24-7/28	0.36	0.38	10/26-10/28	0.41	0.37
7/28-7/29	0.32	0.29	10/28-10/30	0.37	0.39
7/29-7/31	0.34	0.36	10/30-11/2	0.46	0.39
7/31-8/3	0.41	0.38	11/2-11/4	0.40	0.40
8/3-8/5	0.36	0.36	11/4-11/6	0.47	0.40
8/5-8/7	0.40	0.27	11/6-11/9	0.43	0.46
8/7-8/10	0.36	0.36	11/9-11/11	0.38	0.37
8/10-8/12	0.43	0.33	11/11-11/13	0.38	0.39
8/12-8/14	0.35	0.35	11/13-11/16	0.47	0.42
8/14-8/17	0.41	0.36	11/16-11/18	0.48	0.45
8/17-8/21	0.34	0.37	11/18-11/20	0.43	0.34
8/21-8/24	0.42	0.38	11/20-11/23	0.44	0.43
8/24-8/26	0.35	0.37	11/23-11/25	0.34	0.32
8/26-8/28	0.40	0.47	11/30-12/2	0.32	0.39
8/28-8/31	0.36	0.38	12/2-12/4	0.43	0.34
8/31-9/4	0.41	0.35	12/4-12/7	0.41	0.41
9/4-9/8	0.38	0.37	12/7-12/9	0.41	0.37
9/8-9/11	0.42	0.38	12/9-12/11	0.37	0.36
9/11-9/14	0.47	0.45	12/11-12/14	0.43	0.39
9/14-9/16	0.42	Lost Reading	12/14-12/16	0.39	0.41
9/16-9/18	0.33	0.32	12/16-12/18	0.42	0.42
9/18-9/21	0.40	0.36	12/18-12/22	No Reading	0.40
9/21-9/23	0.31	0.35	12/22-12/23	No Reading	0.25
9/23-9/25	0.39	0.37	12/23-12/28	No Reading	0.34
9/30-10/2	0.32	0.33	12/28-12/30	0.31	0.25
10/2-10/5	0.44	0.45	12/30-12/31	0.26	0.26
10/5-10/7	0.47	0.50			

APPENDIX H
TABLE 2

IONIZATION CHAMBER MEASUREMENTS
OF IMMERSION DOSE IN THE COLUMBIA RIVER - 1964

Measurement Period	mR/Day	Measurement Period	mR/Day	Measurement Period	mR/Day
Vernita Ferry					
1/1-1/15	Lost	6/2-6/9	0.20	9/15-9/22	0.18
1/15-1/23	0.33	6/9-6/23	0.05	9/22-9/29	0.15
1/23-1/31	0.31	6/23-6/30	0.10	9/29-10/6	0.31
1/31-2/5	0.86	6/30-7/7	0.14	10/6-10/13	0.29
2/5-2/7	0.85	7/7-7/21	0.10	10/13-10/20	0.35
2/7-2/19	0.64	7/21-7/28	0.45	10/20-10/27	0.25
2/19-3/3	0.21	7/28-8/4	0.30	10/27-11/3	0.47
3/3-3/10	0.24	8/4-8/11	0.78	11/3-11/10	0.26
3/10-3/24	0.18	8/11-8/18	0.28	11/10-11/17	0.29
4/21-5/5	0.19	8/18-8/25	0.31	11/17-11/24	0.07
5/5-5/12	0.51	8/25-9/1	0.44	11/24-12/1	0.28
5/12-5/26	0.21	9/1-9/8	0.56	12/1-12/8	0.64
5/26-6/2	0.29	9/8-9/15	0.17	12/8-12/15	0.41
				12/15-12/29	0.50
Hanford Ferry					
1/1-1/7	6.95	3/27-3/31	8.81	6/26-7/2	3.57
1/7-1/11	5.16	3/31-4/3	5.86	7/2-7/10	1.17
1/11-1/14	10.8	4/3-4/7	5.26	7/10-7/14	2.96
1/14-1/17	3.16	4/7-4/10	5.25	7/14-7/21	2.86
1/17-1/21	4.28	4/10-4/14	9.48	7/21-7/28	5.21
1/21-1/24	5.37	4/14-4/17	5.01	7/28-8/4	3.73
1/24-1/28	3.78	4/17-4/21	5.49	8/4-8/11	4.25
1/28-1/31	6.31	4/21-4/25	6.13	8/11-8/18	6.22
1/31-2/5	6.69	4/25-4/28	Lost	8/18-9/1	2.55
2/5-2/7	7.71	4/28-5/1	7.59	9/1-9/4	5.19
2/7-2/11	6.16	5/1-5/5	6.29	9/4-9/8	6.75
2/11-2/14	11.6	5/5-5/8	7.05	9/8-9/15	3.76
2/14-2/18	4.74	5/8-5/12	10.4	9/15-9/22	6.70
2/18-2/20	6.54	5/12-5/15	13.0	9/22-9/29	6.73
2/20-2/25	6.35	5/15-5/19	10.6	9/29-10/6	6.41
2/25-2/28	4.18	5/19-5/22	12.1	10/6-11/3	Lost
2/28-3/3	6.53	5/22-5/26	5.38	11/3-11/10	5.88
3/3-3/10	2.66	5/26-5/28	7.77	11/10-11/17	6.72
3/10-3/13	4.72	5/28-6/2	7.37	11/17-11/24	4.17
3/13-3/17	5.62	6/2-6/5	3.35	11/24-12/1	6.01
3/17-3/20	7.10	6/5-6/8	3.80	12/1-12/8	6.32
3/20-3/24	8.35	6/8-6/15	Lost	12/8-12/15	5.44
3/24-3/27	7.60	6/15-6/26	1.54		

APPENDIX H
TABLE 2 (Continued)

IONIZATION CHAMBER MEASUREMENTS
OF IMMERSION DOSE IN THE COLUMBIA RIVER - 1964

Measurement Period	mR/Day	Measurement Period	mR/Day	Measurement Period	mR/Day
300 Area (PRTR Submerged)					
12/27/63-1/8/64	4.41	5/1-5/8	6.21	8/28-9/4	5.06
1/8-1/17	2.86	5/8-5/15	5.69	9/4-9/11	5.31
1/17-1/24	4.29	5/15-5/22	6.73	9/11-9/18	5.20
1/24-1/31	3.82	5/22-5/28	5.48	9/18-9/25	4.00
1/31-2/7	Lost	5/28-6/4	Lost	9/25-10/2	4.41
2/7-2/14	4.27	6/4-6/12	1.54	10/2-10/9	3.27
2/14-2/28	Lost	6/12-6/19	1.83	10/9-10/16	4.22
2/28-3/6	4.70	6/19-6/26	1.59	10/16-10/23	1.41
3/6-3/13	3.42	6/26-7/2	1.44	10/23-10/30	2.49
3/13-3/20	5.73	7/2-7/10	1.56	10/30-11/6	2.42
3/20-3/27	6.62	7/10-7/17	1.91	11/6-11/13	3.02
3/27-4/3	6.65	7/17-7/31	2.19	11/13-11/20	2.43
4/3-4/10	5.79	7/31-8/7	4.66	11/20-11/30	Lost
4/10-4/17	6.18	8/7-8/17	4.83	12/1-12/11	1.69
4/17-4/24	5.83	8/17-8/21	4.77	12/11-12/18	3.05
4/24-5/1	6.79	8/21-8/28	4.03	12/18-12/31	1.38
Richland Marina					
12/27/63-1/10/64	2.56	5/1-5/8	2.48	9/4-9/11	1.48
1/10-1/17	1.70	5/8-5/15	2.42	9/11-9/25	1.10
1/17-1/31	2.57	5/15-5/26	2.02	9/25-10/2	1.69
1/31-2/7	3.28	5/28-6/5	1.46	10/2-10/9	1.34
2/7-2/14	2.42	6/5-6/12	1.58	10/9-10/16	1.35
2/14-2/28	2.79	6/12-6/26	1.16	10/16-10/23	1.42
2/28-3/6	2.77	6/26-7/2	2.49	10/23-10/30	1.98
3/6-3/13	2.67	7/2-7/10	Lost	10/30-11/6	2.11
3/13-3/20	3.09	7/10-7/17	1.32	11/6-11/13	2.74
3/20-3/27	3.53	7/17-7/24	1.03	11/13-11/20	2.40
3/27-4/3	3.21	7/24-7/31	1.72	11/20-12/8	Lost
4/3-4/10	2.78	7/31-8/7	1.68	12/8-12/11	3.87
4/10-4/17	2.69	8/7-8/17	2.29	12/11-12/18	2.47
4/17-4/24	2.53	8/17-8/28	1.36	12/18-12/31	1.94
4/24-5/1	2.56	8/28-9/4	1.81		
Columbia Park Marina					
12/27/63-1/10/64	1.32	2/7-2/14	0.61	3/6-3/13	0.93
1/10-1/17	0.36	2/14-2/28	0.62	3/13-3/20	1.22
1/17-2/7	Lost	2/28-3/6	0.75	3/20-5/1	Lost
				5/22-5/28	Lost

APPENDIX H
TABLE 2 (Continued)

IONIZATION CHAMBER MEASUREMENTS
OF IMMERSION DOSE IN THE COLUMBIA RIVER - 1964

Measurement Period	mR/Day	Measurement Period	mR/Day	Measurement Period	mR/Day
Pasco Pump House					
12/27/63-1/3/64	1.96	4/3-4/10	1.87	7/17-7/24	0.80
1/3-1/10	0.70	4/10-4/17	1.73	7/24-7/31	0.71
1/10-1/17	1.23	4/17-4/24	1.74	7/31-8/7	0.55
1/17-1/24	1.61	4/24-5/1	1.96	8/7-8/17	1.26
1/24-2/7	Lost	5/1-5/8	1.90	8/17-8/21	1.53
2/7-2/14	1.54	5/8-5/15	1.99	8/21-8/28	1.17
2/14-2/20	1.55	5/15-5/22	1.63	8/28-9/4	1.45
2/20-2/28	1.89	5/22-5/28	1.60	9/4-9/11	0.67
2/28-3/6	1.81	5/28-6/5	1.28	9/11-9/18	1.57
3/6-3/13	1.90	6/5-6/19	2.28		
3/13-3/20	2.20	6/19-6/26	0.59		
3/20-3/27	2.05	6/26-7/2	0.52		
3/27-4/3	1.84	7/2-7/17	Lost		

XV. APPENDIX I

ANALYTICAL METHODS

XV. APPENDIX I
ANALYTICAL METHODS

1. Water Analyses

Samples are analyzed for their alpha, beta, and selected radionuclide concentrations according to procedures specified in "Standard Practices Radiochemical Procedures for Off-Site Environmental Samples," HW-81277, April 16, 1964.

Alpha emitting nuclides are extracted into diethyl ether from evaporated sample solutions made 9N in nitric acid. Alpha activities are measured by counting in a ZnS(Ag) scintillation counter.

Gross beta activities of non-volatile materials are determined by evaporating and plating duplicate, acidified sample volumes onto stainless steel dishes. These are counted at 2 hr intervals the first day and three times a day on the second and third days. A decay curve is constructed from the higher counting rate dish, and activity at sampling time is estimated from this decay curve.

Radioactive rare earths plus yttrium, I^{131}, P^{32}, and Sr^{90} contents are determined from beta counts after chemical separations. The RE + Y group is separated by successive hydroxide, fluoride and oxalate precipitations; iodine is separated by extraction into carbon tetrachloride followed by precipitation as silver iodine; phosphorus, as phospho-molybdic acid, is extracted into butanol-ether. Strontium is separated from concentrated nitric acid solutions in the same manner described in the next section. After secular equilibrium is established, Sr^{90}'s daughter, Y^{90} is separated by successive precipitations of the hydroxide and oxalate salts, ignited to the oxide, and counted in a thin-window, gas-flow, beta proportional counter.

Daily counts are made following each of the above separations from which decay curves are constructed. These are used to extrapolate to sampling time and to check radiochemical purities. The thin-window, gas-flow, proportional counters are used for all measurements.

The methods used for determining Na^{24}, Cr^{51}, Cu^{64}, Zn^{65}, As^{76}, and Np^{239} concentrations were altered at about mid-year to take advantage of better counting techniques. The methods previously used are outlined in Evaluation of Radiological Conditions in the Vicinity of Hanford for 1963, HW-80991. The more recent methods are outlined below.

Measurements of Na^{24}, Cr^{51}, Cu^{64}, Zn^{65}, and Np^{239} are made by successive countings of evaporated (down to 500 ml) samp e volumes in the well of a large NaI (Tl) crystal which feeds pulses to a 400 channel analyzer. The first count is made on the day the sample is received and is used to measure Na^{24} from the counts obtained in the 2.74 MeV region of the spectrum. Two or three days after sampling, the same solution is recounted for measuring the Cu^{64} and Np^{239} activities. The Np^{239} is calculated from the counts obtained in the 0.10 MeV region of the spectrum. For the Cu^{64} determination, the second spectrum is "stripped" or subtracted from the first day's spectrum which serves to remove electronically interferences from the longer-lived nuclides. Radio-copper contents are then calculated from the counts obtained in the 1.02 MeV (sum peak) region of the spectrum. Seven to ten days after sampling, a third count is made and the data obtained is used for computing the Cr^{51} and Zn^{65} concentrations from the counts in the 0.32 and 1.12 MeV regions, respectively.

As^{76} concentrations are measured by separating arsenic from other emitters followed by gamma counting. Sample aliquots are evaporated to ~50 ml, acidified with concentrated HCl, and As^{+3} is extracted with benzene. After back extraction with water, the sample is diluted to 500 ml and counted each day for 2 or 3 days in the well of the large NaI(Tl) crystal. Duplicate aliquots and a "spike" are processed simultaneously for characterizing the precision and error of each reported result.

2. Vegetation and Produce Analysis

Gamma emitting nuclides such as Ce-$Pr^{141-144}$, Zr-Nb^{95}, Zn^{65}, K^{40}, and I^{131} have their abundances measured in samples of pasture grass

and farm products, including milk, by means of direct gamma ray spectrometry techniques. Two hundred and fifty to three hundred gram amounts of sample are packed into 16-oz polyethylene bottles. These are counted after being placed in the well of the large NaI(Tl) crystal.

More sensitive measurements of I^{131} in milk are accomplished by passing 1- to 3-gal volumes of samples through 345 ml of strong-base anion resin. The sorbed radioiodine is measured by counting the res n column in the well of the large NaI(Tl) crystal and calculating its concentration from the number of counts obtained in the 0.36 MeV region of the spectrum.

Radio-strontiums and -phosphorus measurements are obtained from beta counts of appropriate sample amounts after chemically separating those elements from interfering elements in the samples.

Strontium is separated, after the addition of barium and strontium carriers, by precipitating the carbonates from the solution of an ashed sample. Following dissolution of the carbonates, fuming nitric acid is used to precipitate the alkaline earth metals. Calciu is removed by washing the precipitate with acetone. The nitrates are then dissolved and reprecipitated. Ferric hydroxide and barium chromate precipitations from the nitrate solution remove rare earths and barium. Strontium is finally precipitated as the carbonate, transferred to a tared, 1 in., stainless steel counting dish and dried to a constant weight. The beta particles from the remaining Sr^{89} and Sr^{90} are counted using thin-window, low-background (anticoincidence), beta counters.

Sr^{90} is allowed to reach equilibrium with Y^{90}. The yttrium is extracted into buffered TTA. The organic phase is transferred to a 1 in. counting dish and the beta activity from Y^{90} is counted in the low background beta counters daily for 3 days. A decay curve is used to obtain the activity at separation time.

The Sr^{90} concentration is obtained from the Y^{90} count data. The Sr^{89} concentration is computed from the difference in counting rates between total strontium and Sr^{90}.

The chemical separation of radiophosphorus is performed on sample volumes containing 40 to 50 mg of stable phosphorus:

The sample is dry ashed for 24 hr at 500 C and the salts are dissolved with nitric acid. Phosphorus is precipitated from the acid solution as ammonium phosphomolybdate. The precipitate is dissolved in ammonium hydroxide, ammonium citrate is added to complex most of the remaining interfering elements, and the phosphorus is precipitated as magnesium ammonium phosphate. After dissolving the precipitate in hydrochloric acid, ammonium citrate is again added and phosphorus is reprecipitated with ammonium hydroxide as magnesium ammonium phosphate. The precipitate is dried in a 1 1/2 in. stainless steel counting dish under heat lamps and counted in a low background, beta counter.

3. Fish and Oyster Analyses

P^{32} and Zn^{65} may be measured in fish and oysters by gamma counting techniques. Weighed samples are packed into 8-oz polystyrene jars and counted in the well of a large NaI(Tl) crystal. In the absence of other beta and low-energy gamma emitters, 2 nCi or more of P^{32} are measured by summing the counts in a portion of the Bremsstrahlung spectrum. For smaller amounts, P^{32} is separated as described previously and is measured by beta counting. Zn^{65} is measured by counts in the 1.12 MeV region of the spectrum.

4. Air Sample Analyses

Airborne concentrations of radioactive materials are determined from measurements of I^{131} contained in scrubber samples. A sampler consists of a calibrated, electrically-driven vacuum pump which draws 1.5 ft^3/min of air through a solution which is 0.05N in NaOH, 0.05N in Na_2CO_3 and contains 20 mg of I^- carrier. A balancing platform and siphon arrangement permits introduction of distilled water into the scrubber at a rate equal to the rate of evaporation. The water feeder helps maintain constant liquid head, air flow rate, and scrubber efficiency.

After 1 wk of operation the bottle is replaced and taken to the laboratory for determination of the I^{131} content. The radioiodine may be determined by placing 500 ml of the solution in the well of the large NaI(Tl) crystal and using the counts in the 0.36 MeV region of the spectrum to calculate its content. The radioiodine may also be determined by adding $NaHSO_3$ to the solution, acidifying with HNO_3 and precipitating AgI with $AgNO_3$. The radioactivity of the precipitate is then measured with a thin window beta counter. Atmospheric concentrations of I^{131} are then calculated from these counting rates by applying factors for counter calibration, chemical recovery, scrubber efficiency and the volume of air sampled.

Measurements for concentrations of radioactive particulates in the atmosphere are made by drawing 1.5 ft^3/min of air through a 2 x 4 in. HV-70 filter paper with a vacuum pump. The filters are changed on either a daily or weekly schedule, allowed to decay for 48 hr, and then counted with a gas-flow proportional counter for gross beta radioactivity. Selected filters are also counted with a ZnS(Ag) scintillation counter for gross alpha measurements.