464227 ✓

→ 820000418

(DEL)DPSP 57-25-15

DELETED VERSION

HEALTH PHYSICS REGIONAL MONITORING

Semi-Annual Report, July through December 1956

WORKS TECHNICAL DEPARTMENT

E. I. du Pont de Nemours and Company
Explosives Department - Atomic Energy Division
Savannah River Plant

[redacted]

DPSP 57-25-15

DELETED VERSION

HEALTH PHYSICS REGIONAL MONITORING

Semi-Annual Report, July through December 1956

. . . .

H. G. Mealing, Jr.

June 27, 1957

RESTRICTED DATA

This document contains Restricted Data as defined in the Atomic Energy Act of 1954. Its transmittal or the disclosure in any manner of its contents to an unauthorized person is prohibited.

E. I. du Pont de Nemours and Company
Explosives Department - Atomic Energy Division
Savannah River Plant

[redacted]

Distribution

Wilmington

1 J. E. Cole
2 J. B. Tinker
3 H. Worthington
4 W File

Savannah River Plant

6 D. A. Miller - J. D. Ellett
7 W. P. Overbeck
8 R. B. Fenninger
9 K. W. Millett
10 F. H. Endorf
11 J. K. Lower
12-13 C. M. Patterson
14 H. A. McClearen
15 E. C. Morris
16 W. C. Reinig
17 E. L. Albenesius
18 J. H. Horton
19 M. H. Wahl
20 J. W. Morris
21 D. E. Waters
22 TIS File
23 TPO File
25-35 PRD Extra Copies
36 PRD Record Copy

Atomic Energy Commission

24 H. L. Kilburn, SROO

Contents

Introduction

Under a program established by the Du Pont Company in June 1951, the Savannah River Plant Site and the surrounding region are systematically monitored for radioactive contaminants. The regional monitoring program accumulates information that is useful both as a measure of the effectiveness of Plant controls and as an authoritative record of environmental conditions. This report, covering the period from July through December 1956, is one of a series of reports concerning the regional monitoring program at the Savannah River Plant.

Data Reporting

Survey data were averaged for the 6-month period and compared with the previous 6-month averages (as presented by J. H. Horton and H. G. Mealing, Jr. in the "Health Physics Regional Monitoring Semi-Annual Report," DPSP 57-25-4, February 26, 1957).

In reporting data, "average" or "total" refers to that of the 6-month report period, and "previous average" or "previous total" to the average or total for the preceding 6-month period. "Maximum" refers to the highest individual sample collected during the 6-month period.

Summary

- Waste Released by Plant Operations. Radioactivity released to the environment was approximately 0.35 curie alpha, 170 curies nonvolatile beta, 580 curies radioiodine and 247,000 curies tritium.

- Vegetation. Alpha contamination of vegetation was negligible, although monthly variations in concentrations, possibly due to seasonal effects, were observed. Bomb fallout caused increases in nonvolatile beta concentrations in all groups of samples. The highest 6-month beta average was 140×10^{-12} c/g in the vegetation collected at the inner perimeter, and the maximum single beta concentration observed was 790×10^{-12} c/g, also at the inner perimeter.

  Although stack releases of radioiodine decreased, radioiodine contamination of vegetation increased (see "Radioactivity on Vegetation," p 5). The greatest radioiodine contamination of vegetation at regular sampling locations was near the 200-F Area, where the 6-month average was 67×10^{-12} c/g, with a maximum of 530×10^{-12} c/g in a sample collected on October 26. Special samples collected near the 200-Area seepage basins contained more radioiodine than those collected at the regular locations. See "Radioactivity in Seepage Basins," p 25.

Abstract

Radioactive contamination from both Plant operations and bomb fall-out was detectable throughout most of the period from July 1956 through December 1956. As compared to the previous report period, radioactive bomb fallout was more noticeable during this period.

- Atmosphere. Concentrations of alpha activity in the atmosphere remained essentially the same as during the previous 6-month period. Bomb fallout caused a general increase in the concentrations of beta activity in the atmosphere. The highest 6-month beta average was 260×10^{-14} μc/cc at the 200-F Area. Maximum weekly concentrations of 1200×10^{-14} μc/cc beta were observed at both the 200-F Area and the Williston Gate.

  Because of decreased stack releases of radioiodine, the atmospheric concentrations on the Plant Site decreased but increased bomb fallout prevented decreases at off-plant locations.

  The number of radioactive particles suspended in the atmosphere increased, and was greatest at the Aiken Airport, where the average concentration was 66 particles per 1000 cubic meters of air. The maximum weekly concentration was 460 particles per 1000 cubic meters of air and occurred at the Aiken Airport during the week ending September 18 as the result of bomb fallout.

  Ground deposition of radioactive particles increased greatly because of the large number of particles in bomb debris which arrived during the week ending July 18. The greatest deposition of radioactive particles occurred at the 200-F Area, where the average deposition was 510 particles/ft^2/6 months.

  Tritium was not detected in the atmosphere during the period. All samples contained less than 1×10^{-8} c/ml of atmospheric water.

  Because of bomb fallout, radiation dosage increased at all locations. The highest average dose for the 6-month period was 1.22 mrad/24 hours at the Dunbarton Fire Tower.

- Rainwater. In general, concentrations of alpha activity in rainwater decreased slightly. The highest 6-month average was 2.1×10^{-3} d/m/ml at the 700-A Area, and the maximum individual sample, collected at the 200-H Area, contained 8.1×10^{-3} d/m/ml.

  Nonvolatile beta concentrations increased because of bomb fallout and were highest at the 700-A Area, where the 6-month average was 690×10^{-15} c/ml, with a maximum of 5900×10^{-15} c/ml in a single sample. Both the maximum ground deposition of radioactive particles and the maximum concentrations of nonvolatile beta in rainwater occurred during the week ending July 18.

  Because of decreased stack releases of radioiodine, average concentrations of radioiodine in rainwater decreased at the 200-F and 200-H Areas. Average concentrations at the other locations remained approximately the same, indicating the presence of fallout from weapons tests.

• Streams. Alpha concentrations in water remained at or near background levels throughout Pen Branch, Steel Creek, Lower Three Runs and the Savannah River; and concentrations in Tims Branch, Upper Three Runs and Four Mile Creek decreased. The highest concentration of alpha activity in water continued to be in Tims Branch. Alpha concentrations in mud increased at some locations in Tims Branch, Upper Three Runs, and Four Mile Creek.

Nonvolatile beta concentrations in water increased at locations influenced by the effluents from 200-F, 200-H, 100-P, and 100-R Areas. The greatest concentration of nonvolatile beta in water was in the 200-H Area effluent, where the average concentration was 8.1×10^{-13} c/ml, with a maximum of 4.1×10^{-12} c/ml.

• Ground Water. Minor variations in concentrations of radioactivity in ZW wells (3"-diameter drillings) near the 200 Areas and open wells were observed, but none appeared to have resulted from Plant operations. The highest average concentration of alpha was 4×10^{-3} d/m/ml in K Area. The highest average and maximum concentrations of nonvolatile beta were 39×10^{-15} c/ml (100-P Area), and 58×10^{-15} c/ml (100-R Area).

• Plant Drinking Water. Plant drinking water continued free of contamination from Plant operations. The highest average and maximum concentrations of alpha were 9×10^{-3} d/m/ml (at Barricade No. 2 and TC-1) and 14×10^{-3} d/m/ml (at Barricade No. 2). The highest average and maximum concentrations of nonvolatile beta occurred at the 200-H Area and were 14×10^{-15} c/ml and 26×10^{-15} c/ml.

• Public Water Supplies. Alpha concentrations remained essentially the same, and the highest concentration continued to be at Aiken, where the 6-month average was 6×10^{-3} d/m/ml, and the maximum concentration in a single sample was 12×10^{-3} d/m/ml.

Nonvolatile beta concentrations, however, appeared to be influenced by bomb fallout at Langley, Clearwater, and North Augusta. The highest average and maximum nonvolatile beta concentrations were 16×10^{-15} c/ml (Langley), and 60×10^{-15} c/ml (Langley and Clearwater).

• Seepage Basins. Discharges to the 700-Area seepage basins totalled 0.01 curie of alpha and 0.11 curie of beta. As compared to the previous report period, the average concentration in the 700-Area No. 1 seepage basin decreased from 6 d/m/ml to 1 d/m/ml, while the concentration of nonvolatile beta decreased from 7.9×10^{-12} c/ml to 6×10^{-12} c/ml. Maximum concentrations in the basins during the report period were 6 d/m/ml alpha and 19×10^{-12} c/ml nonvolatile beta. A maximum thorium concentration of 187 μg/ℓ was detected in the basin in November.

Discharges to the 200-Area seepage basins included an estimated 0.6 curie of alpha, 30 curies of nonvolatile beta and 200 curies of radioiodine in F Area; and 0.4 curie of alpha, 20 curies of nonvolatile beta and 250 curies of radioiodine in H Area. Alpha, nonvolatile beta and radioiodine concentrations increased both in the 200-F and 200-H Area seepage basins.

Average alpha, nonvolatile beta and radioiodine concentrations in wells surrounding the 200-H Area basins were as high as 690×10^{-3} d/m/ml, 41×10^{-12} c/ml, and 2.1×10^{-9} c/ml, respectively, and individual samples collected from the wells contained as much as 3.1 d/m/ml alpha, 1.2×10^{-10} c/ml nonvolatile beta, and 7.9×10^{-9} c/ml radioiodine.

Evolution of radioiodine from the basins produced average atmospheric concentrations as high as 7.0×10^{-9} μc/cc at the 200-H Area basin, and the maximum air concentration observed ~~at the~~ basin was 2.7×10^{-8} μc/cc. Average radioiodine vegetation contamination 150 feet from the 200-H Area basin was as high as 4.6×10^{-9} c/g with a maximum of 3.4×10^{-8} c/g.

- Zoological Specimens. The number of zoological specimens containing detectable concentrations of alpha or beta activity increased. However, the concentrations in edible portions was negligible. The maximum alpha concentration observed was 108 d/m/g in the gonads of a catfish collected from the mouth of Steel Creek on August 27, and the maximum nonvolatile beta concentration was 470×10^{-12} c/g in the gonads of a catfish collected from the Savannah River near the mouth of Lower Three Runs Creek on July 30.

Iodine concentrations in the thyroid of small animals generally decreased, but still showed definite evidence of contamination. The maximum radioiodine concentration observed was 2250×10^{-12} c/g in the thyroid of a rabbit collected near TNX on November 22.

Survey Results

Radioactivity Released By Plant Operations

100 Areas

The major sources of liquid waste from the 100 Areas were the thermal shield water, purged at the rate of 4 to 10 gallons per minute, and the disassembly basin water, purged at the rate of 1200 to 1500 gallons per minute. Alpha activity from these two sources was negligible (estimated to be 160 mc), while the nonvolatile beta activity increased as compared to the previous period. The maximum monthly release in thermal shield water was 16.1 curies from 100-P Area in December and the maximum monthly release in disassembly basin water was 10.7 curies from 100-R Area in July. The latter release was attributed to a slug rupture. Approximately 110 curies were released in thermal shield water and 59 curies from disassembly basin water.

The tritium released from the 100-Area stacks was estimated at 16,400 curies. A maximum monthly release of 2300 curies occurred at the 100-P Area in July.

200 Areas

Stack-released nonvolatile beta from 200-H Area increased because of increased releases from the process vent. All other Purex process stack releases (291-F and 291-H) decreased.

	Stack-Released Radioactivity					
	Alpha, mc		Nonvolatile Beta, c		Radioiodine, c	
Area →	F	H	F	H	F	H
Total	50	1.9	1.7	2.0	277	304
Previous Total	90	8.4	3.6	1.2	411	584

300 Area

Radioactive liquid waste discharged from the 300 Area to Tims Branch is shown below.

	Pounds	mc
Total	490	140
Previous Total	1240	370

Monthly totals of uranium discharged decreased sharply from July through October, followed by an increase in November and December.

Radioactivity On Vegetation

There were 802 vegetation samples analyzed for alpha and nonvolatile beta activity, and 1702 were analyzed for radioiodine. The sampling locations, except those near the 200-F and 200-H Areas, are shown in figure 1.

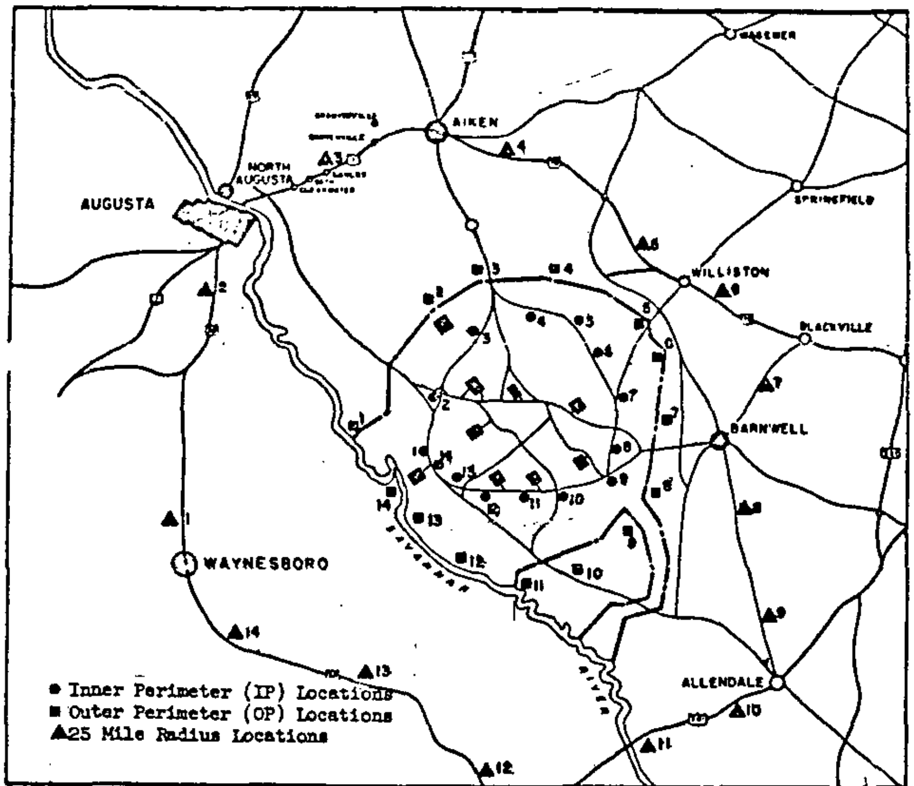

Figure 1. Vegetation Sample Locations

The 6-month average concentrations of alpha on the various groups of vegetation samples are listed below.

Location	Alpha, d/m/g		
	Max	Avg	Previous Avg
200-F Area (at 1-mile radius)	1.5	0.3	0.7
200-H Area (at 1-mile radius)	1.7	0.3	0.8
Inner Perimeter (IP)	1.3	0.3	0.4
Outer Perimeter (OP)	1.1	0.3	0.4
25-Mile Radius (25MR)	1.6	0.3	0.3

The decreases at 200-F and 200-H Areas were the result of continued decreases in stack-released alpha.

Monthly averages show that alpha activity at all locations was highest in December. Pulse-height analyses of 20 samples showed that the increase was not due to uranium or plutonium, but appeared likely to be the daughters of radium and thorium.

A summary of nonvolatile beta on vegetation is listed below:

	Nonvolatile Beta, 1×10^{-12} c/g		
Location	Max	Avg	Previous Avg
200-F Area	700	110	43
200-H Area	330	110	48
IP	790	140	43
OP	550	100	44
25 MR	650	100	39

The increase in nonvolatile beta on vegetation at all locations was caused by fallout from weapons tests. The maximum concentrations occurred in the samples collected during the period July 18 through 20, except for the maximum at 200-H Area, which occurred in a sample collected on August 10. Monthly averages of nonvolatile beta on vegetation are shown in figure 2.

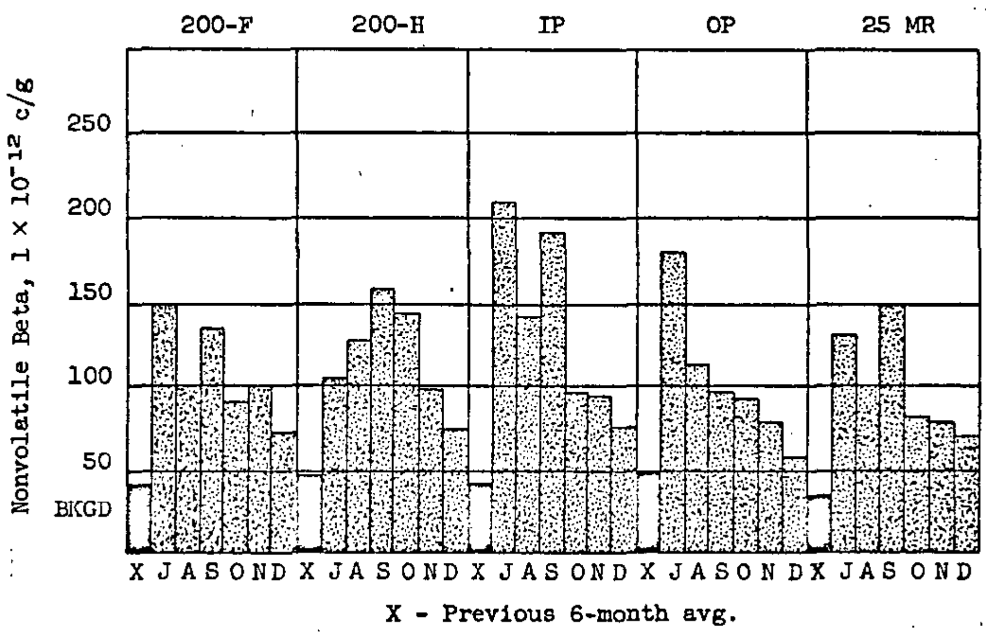

Figure 2. Radioactivity on Vegetation July through December 1956

Bomb fallout was also apparent in the atmosphere during July and September. (See "Radioactivity in the Atmosphere," p 9.)

A summary of the radioiodine on vegetation is given below.

	Radioiodine, 1×10^{-12} c/g		
Location	Max	Avg	Previous Avg
200-F Area	530	67	16
200-H Area	390	46	11
IP	43	6	2
OP	49	4	2
25 MR	26	2	1

Although stack releases of radioiodine decreased there were increases on vegetation. The increases were probably due to a variety of causes, including bomb fallout, meteorological conditions, and a decrease in the moisture content of vegetation with subsequent increase in the ratio of surface area to unit of weight. The highest monthly averages for the inner perimeter (IP), outer perimeter (OP), and 25-mile radius (25-MR) locations occurred in July, while the highest monthly averages at 200-F and 200-H Areas occurred in November.

An estimated iso-activity map for radioiodine on vegetation during the 6-month period is shown in figure 3. The elongation of the pattern of contamination towards Waynesboro and Blackville was the result of wind direction.

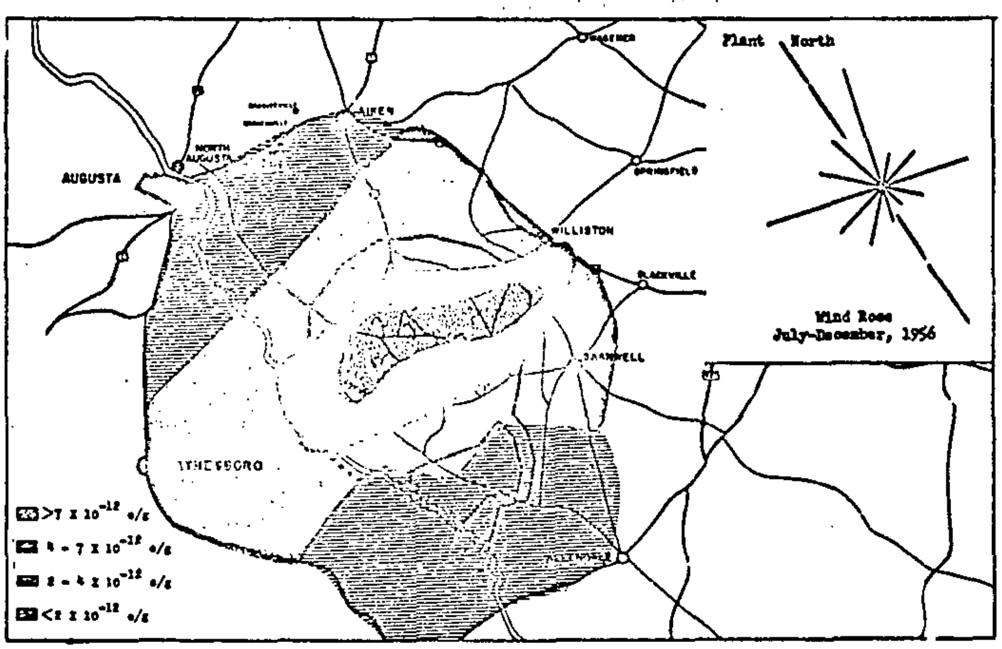

Figure 3. Estimated Iso-Activity Map of Radioiodine on Vegetation

Radioactivity In The Atmosphere

Radioactivity in the atmosphere was determined by counting 254 two-inch-diameter air filters for alpha and beta activity, and 278 two-inch diameter silver nitrate impregnated air filters for radioiodine, by determining by radioautograph the number of radioactive particles collected on 196 eight-inch by ten-inch air filters and 2028 eight-inch by ten-inch adhesive papers, and by the collection and analysis of 136 water vapor samples for tritium. Radiation dosage was determined by 1759 ionization chamber readings and 130 film badge readings. The air filters and film badges were collected from the constant air monitoring stations and the ionization chambers were located in each of the Plant areas and constant air monitoring stations. These locations are shown in figure 4.

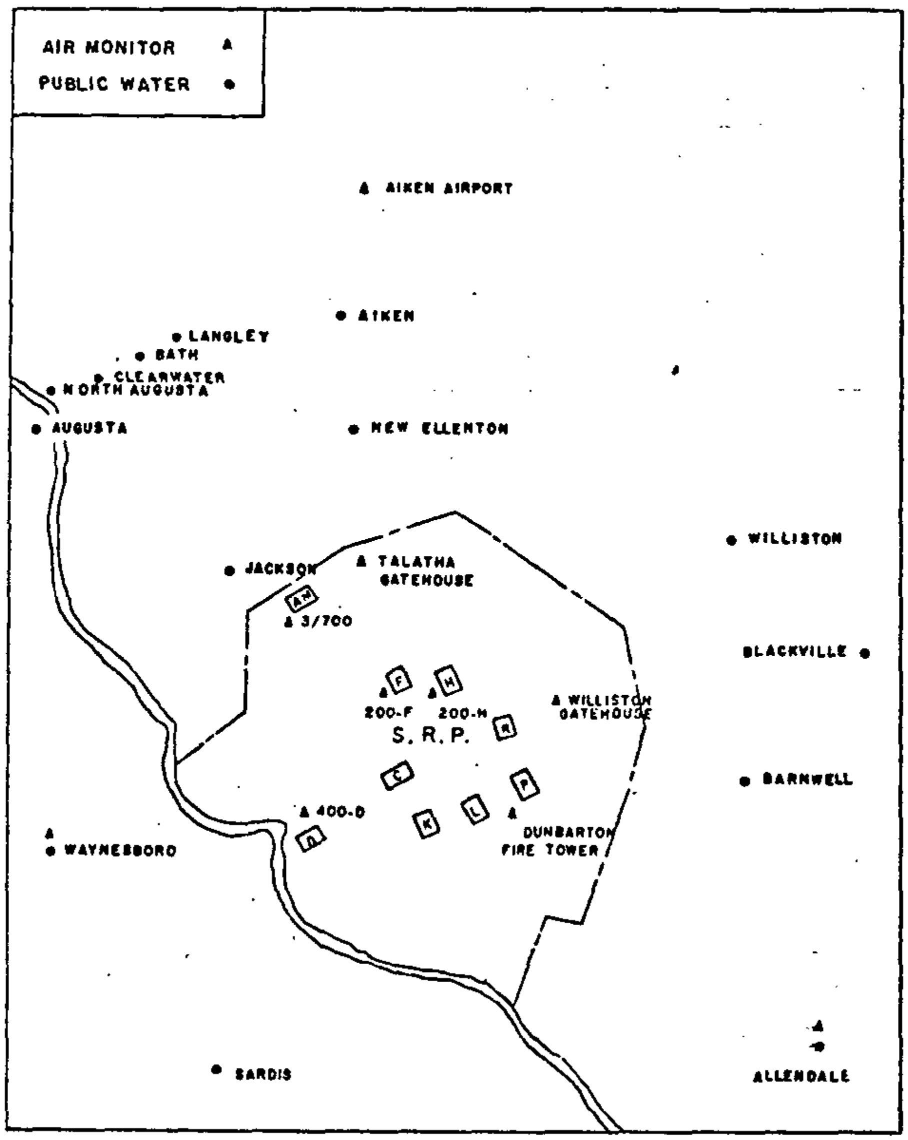

Figure 4. Constant Air Monitoring Stations and Public Water Sampling Locations

Atmospheric Radioactivity as Determined by Counting Air Filters

Three days were allowed for the decay of radon and thoron daughters before counting the filters for alpha and beta activity.

Location	Alpha Max	Alpha Avg	Alpha Previous Avg	Beta Max	Beta Avg	Beta Previous Avg	Radioiodine Max	Radioiodine Avg	Radioiodine Previous Avg
	Atmospheric Radioactivity, 1×10^{-14} μc/cc								
200-F Area	0.5	0.4	0.5	1200	260	210	2300	580	700
200-H Area	.9	.2	.2	1100	250	190	2600	470	570
400-D Area	.4	.1	.2	940	210	190	200	47	60
Talatha Gatehouse	.4	.1	.2	930	200	210	110	38	67
Williston Gatehouse	.3	.1	.2	1200	240	210	130	36	64
700-A Area	.5	.4	.2	1000	220	170	130	54	70
Dunbarton Fire Tower	.3	.3	.2	850	200	190	81	20	-
Waynesboro	.4	.2	.2	1100	240	250	97	19	14
Aiken Airport	.4	.2	.1	780	190	170	86	16	19
Allendale	0.3	0.1	0.2	1100	200	160	66	12	13

The increased alpha activity in the 700-A Area atmosphere appeared to be uranium from Building 773-A roof vents.

The slight general increase of nonvolatile beta in the atmosphere is due to fallout from weapons tests. The greatest nonvolatile beta contamination of the air occurred during the week ending September 25. Decay studies of the filters in use during this week showed that the half-life of the beta activity was less than 23 days.

The decreased radioiodine concentrations at the "on-Plant" locations reflect the decreased stack releases of radioiodine from the 200 Areas, while the essentially unchanged concentrations at the "off-Plant" locations reflect the radioiodine present from bomb fallout.

Suspended Radioactive Particles

Location	Max	Avg	Previous Avg
	Particles per 1000 Cubic Meters of Air		
200-H Area	420	61	35
Talatha Gatehouse	220	41	33
Williston Gatehouse	230	45	23
Dunbarton Fire Tower	290	50	29
400-D Area	220	46	31
Aiken Airport	460	66	32
Allendale	300	48	27
Waynesboro	280	35	23

The greatest concentration of suspended particles was observed in September, when the monthly average for all locations was 150 particles per 1000 cubic meters of air.

To determine the magnitude of radioactivity of particles collected during the 6-month period, 499 particles were counted individually with an end window GM tube. The activity of 32% of these particles was below the sensitivity of the counters (approximately 35 d/m), while the average activity of the remaining particles was 110 d/m/particle, with a maximum of 1600 d/m in a particle collected at the Aiken Airport on September 18. Monthly averages showed that the particles collected in September were the most radioactive.

Decay studies of 113 particles collected during the 6-month period showed that 73% of the particles had radioactive half-lives of less than thirty days, indicating that weapons tests were the source.

Particulate Fallout

Location	Avg Number of Particles per ft^2/6 mo	Previous Avg Number of Particles per ft^2/6 mo
IP	300	5.4
200-F Area	510	4.1
200-F Area 1-mile Radius	350	6.8
200-H Area	250	5.4
200-H Area 1-mile Radius	270	2.7
Building 221-H	280	10.4*
Burial Ground Fence (Vertical Position)	140	4.0

* Based on 9 week's samples from May through June.

Of all of the particles collected on gummed papers during the 6 months, 90% of them were collected during the week ending July 18. The source of these particles was bomb fallout. Decay studies of 30 particles collected at the IP during this week showed that one particle had a half-life of 40 days while the remaining 29 particles had half-lives of less than 25 days.

Of 6695 particles collected during the 6-month period, 616 of the most radioactive particles were counted with an end window GM tube. The activity of 34% of these particles was below the sensitivity of the counters (approximately 35 d/m), while the average activity of the remaining 64% was 150 d/m/particle, with a maximum of 3900 d/m in a particle collected at IP No. 1 on September 12.

Tritium In Atmospheric Water Vapor

Four containers containing silica gel were exposed to the atmosphere at the 200-F Area one-mile radius perimeter. All weekly samples of water collected in this manner contained less than 1×10^{-9} c/ml of tritium (sensitivity).

Beginning in August, dehumidifier condensates from 614-F and 614-H were analyzed weekly for tritium. All samples contained less than 1×10^{-9} c/ml (sensitivity).

Radiation Dosage

	Radiation Dosage, mrad/24 hr	
Location	Avg	Previous Avg
200-H Area	1.18	0.97
200-F Area	1.06	.79
TC Area	1.05	.76
300/700 Area	1.04	.76
200-F Area 1-mile Radius	1.04	.73
100-L Area	1.02	.84
200-H Area 1-mile Radius	1.02	.79
100-K Area	1.01	.80
100-C Area	1.00	.78
100-R Area	0.99	.75
400-D Area	0.99	.67
100-P Area	0.95	0.72
Dunbarton Fire Tower	1.22	-
Talatha Gatehouse	0.83	-
Williston Gatehouse	0.77	-
Allendale	1.12	-
Aiken Airport	1.09	-
Waynesboro	1.07	-

The general increase in radiation dosage was the result of fallout from weapons tests.

Radioactivity In Rain Water

The results of analyses of 170 weekly rain water samples collected at air monitoring locations shown in figure 4 are summarized below.

Location	No. of Samples	Alpha, 1×10^{-3} d/m/ml Max	Avg	Prev Avg	Nonvolatile Beta, 1×10^{-15} c/ml Max	Avg	Prev Avg	Radioiodine, 1×10^{-15} c/ml Max	Avg	Prev Avg
200-H Area	17	8.1	1.9	3.3	2300	490	310	970	310	530
200-F Area	20	3.2	1.5	2.5	2200	360	190	720	240	510
400-D Area	16	4.4	1.5	1.6	630	220	160	340	100	140
Williston Gatehouse	18	2.5	1.4	1.9	540	160	96	410	98	120
700-A Area	17	7.2	2.1	2.3	5900	690	240	710	86	69
Talatha Gatehouse	19	2.9	0.9	1.4	4000	450	210	400	64	54
Dunbarton Fire Tower	14	1.4	0.8	1.3	380	160	95	110	36	72
Aiken Airport	19	5.8	1.3	1.7	2000	380	200	330	53	46
Waynesboro	18	1.7	0.8	1.0	1100	270	190	250	45	37
Allendale	13	2.0	1.2	1.5	360	160	80	180	43	31

Alpha concentrations were highest in December, when the average for all locations was 2.1×10^{-3} d/m/ml. The maximum alpha concentration in a single sample was 8.1×10^{-3} d/m/ml in a sample collected at the 200-H Area on July 10. The high 6-month average of 2.1×10^{-3} d/m/ml in the 700-A Area most likely resulted from Building 773-A roof vent releases of uranium.

Nonvolatile beta contamination was greatest in July, when as a result of fallout from weapons tests, the average concentration for all locations was 680×10^{-15} c/ml. The maximum nonvolatile beta concentration in a single sample was 5.9×10^{-12} c/ml in a sample collected at the 700-A Area on July 17.

Because of decreased stack releases, the average radioiodine concentrations in rain water decreased at the 200-F and 200-H Areas. Average concentrations at other locations remained approximately the same, indicating the presence of fallout from weapons tests. The maximum concentrations at the 200-F Area, Waynesboro, Aiken Airport, the 300/700 Area, Williston Gatehouse, Talatha Gatehouse, and Dunbarton Fire Tower all occurred on July 17. A decay study of radioiodine in the sample collected at the 700-A Area on July 17 showed that the radioiodine contained approximately 70% I^{131}, 27% I^{132}, and 3% I^{133}.

[redacted]

Radioactivity In Streams

Water samples were collected weekly from the locations shown in figure 5. Mud samples were collected weekly at the Savannah River locations and monthly at the "on-Plant" stream locations. A total of 1022 water samples and 471 mud samples was analyzed for alpha and nonvolatile beta activity. Of these, 494 water samples and 393 mud samples were analyzed for uranium and plutonium. Samples from Tims Branch No. 2 (700-Area effluent), and Tims Branch No. 3 (300-Area effluent) were analyzed weekly for thorium.

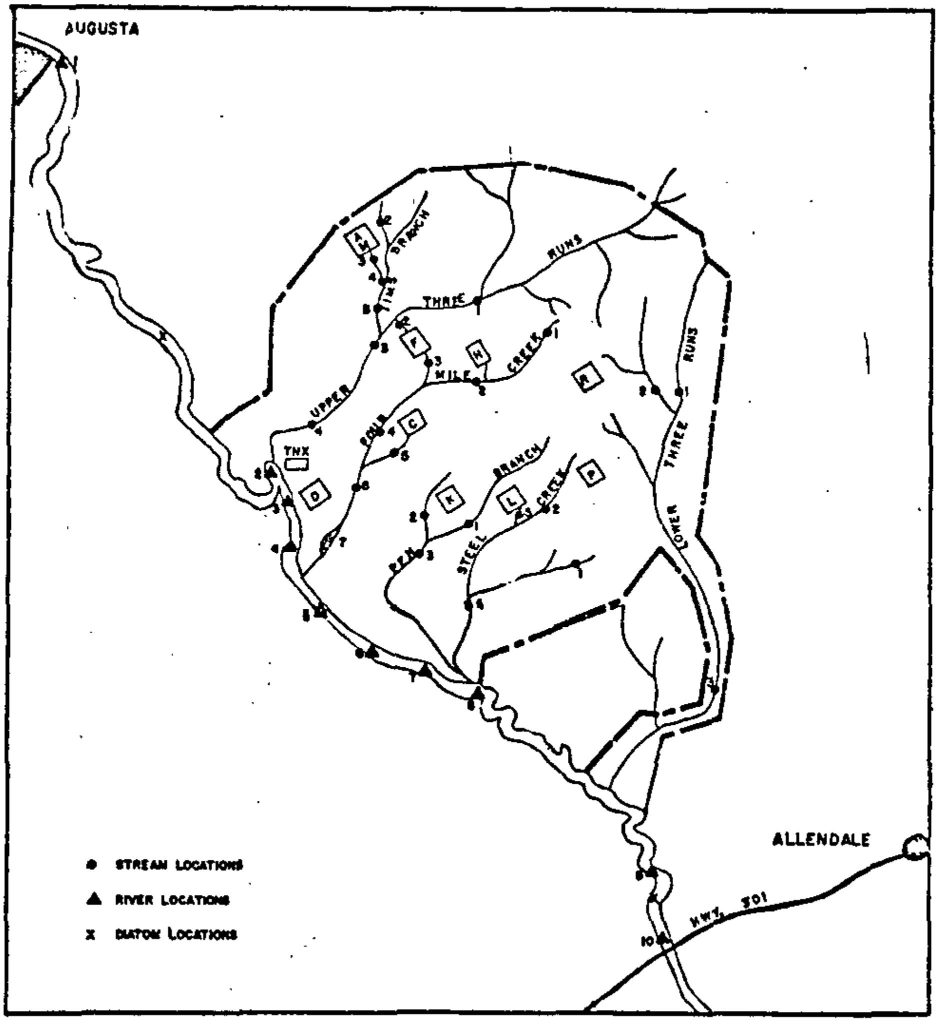

Figure 5. Stream, River, and Diatom Sampling Locations

[redacted]

Tims Branch

Radioactivity in Water

Location	Uranium or Plutonium, 1 × 10^{-3} d/m/ml Max	Avg	Previous Avg	Nonvolatile Beta, 1 × 10^{-15} c/ml Max	Avg	Previous Avg
2	1100	180	240	480	110	62
3	7500	1890	3740	970	440	740
4	2300	820	1030	240	150	170
5	480	190	330	120	52	65

Radioactivity in Mud

Location	Uranium or Plutonium, d/m/g Max	Avg	Previous Avg	Nonvolatile Beta, 1 × 10^{-12} c/g Max	Avg	Previous Avg
2	3700	1700	476	560	290	100
3	4100	1600	4144	1500	270	1060
4	390	120	82	32	23	14
5	270	150	45	35	22	11

As a result of decreased uranium release from the 300 Area, radioactivity in the water at locations 3, 4, and 5 decreased from July through October. However, this was followed by an increase in November and December. The increase in concentrations in mud at locations 4 and 5 is probably the result of previously discharged uranium moving downstream.

On August 23, November 22, and November 29, the thorium concentrations in the water at Tims Branch No. 2 (700 Area effluent) were 23, 56 and 16 μg/ℓ, respectively. Results of all other thorium analyses were less than 4 μg/ℓ.

Upper Three Runs

Radioactivity in Water

Location	Uranium or Plutonium, 1×10^{-3} d/m/ml			Nonvolatile Beta, 1×10^{-15} c/ml		
	Max	Avg	Previous Avg	Max	Avg	Previous Avg
1	2	1	2	22	8	10
2	330	30	340	440	39	1700
3	21	7	19	29	11	13
4	9	4	7	30	11	11

Radioactivity in Mud

Location	Uranium or Plutonium, d/m/g			Nonvolatile Beta, 1×10^{-12} c/g		
	Max	Avg	Previous Avg	Max	Avg	Previous Avg
1	26	18	12	12	9	11
2	330	100	36	45	25	17
3	43	26	22	22	12	13
4	92	39	25	18	13	13

The maximum concentrations of uranium or plutonium and nonvolatile beta in water at location 2 (200-F Area storm sewer) occurred on December 20. Pulse-height analysis showed the activity to be due to natural uranium. The increase of uranium or plutonium concentrations in mud at locations 3 and 4 is probably the result of previously discharged uranium moving downstream from Tims Branch.

Four Mile Creek

Radioactivity in Water

Location	Uranium or Plutonium, 1×10^{-3} d/m/ml			Nonvolatile Beta, 1×10^{-15} c/ml		
	Max	Avg	Previous Avg	Max	Avg	Previous Avg
1	1	1	2	26	11	10
2	7	3	6	4100	809	49
3	120	17	150	1100	179	144
4	9	3	17	780	166	36
5	3	1	3	840	133	140
6	7	1	2	170	42	55
7	6	1	2	140	45	51

Radioactivity in Mud

Location	Uranium or Plutonium, d/m/g			Nonvolatile Beta, 1×10^{-12} c/g		
	Max	Avg	Previous Avg	Max	Avg	Previous Avg
1	14	10	7	11	8	8
2	20	8	8	70	29	8
3	400	70	41	76	23	18
4	97	22	6	9	7	8
5	34	16	9	52	22	47
6	18	8	9	16	11	10
7	13	7	6	12	9	11

The decrease in uranium or plutonium in water at location 3 (200-F Area effluent) was the result of the repairing of a leak in the B-Line recovery dissolver on January 24. (The high previous average was due to this leak.) The maximum concentration of uranium or plutonium at this location occurred on August 9, and was the result of a leak in a low level evaporator. The increased nonvolatile beta in water at locations 2, 3, and 4 was a result of several evaporator coil leaks in the 200-H and 200-F Areas.

The nonvolatile beta in water samples collected from the 100-C Area effluent (location 5) had an average half-life of 460 hours.

Pen Branch

Radioactivity in Water

Location	Alpha, 1×10^{-3} d/m/ml			Nonvolatile Beta, 1×10^{-15} c/ml		
	Max	Avg	Previous Avg	Max	Avg	Previous Avg
1	4	1	1	25	10	9
2	4	1	1	140	62	84
3	3	1	1	140	45	44

Radioactivity in Mud

Location	Alpha, d/m/g			Nonvolatile Beta, 1×10^{-12} c/g		
	Max	Avg	Previous Avg	Max	Avg	Previous Avg
1	2	1	1	24	13	9
2	3	2	2	79	38	21
3	2	1	1	48	34	14

The average half-life of the nonvolatile beta in water samples collected at location 2 (100-K Area effluent) was 590 hours.

Steel Creek

Radioactivity in Water

	Alpha, 1×10^{-3} d/m/ml			Nonvolatile Beta, 1×10^{-15} c/ml		
Location	Max	Avg	Previous Avg	Max	Avg	Previous Avg
1	1	1	1	10	7	10
2	2	1	1	190	72	59
3	2	1	1	170	64	74
4	4	1	1	140	42	27

Radioactivity in Mud

	Alpha, d/m/g			Nonvolatile Beta, 1×10^{-12} c/g		
Location	Max	Avg	Previous Avg	Max	Avg	Previous Avg
1	1	1	1	10	7	8
2	3	1	2	75	35	37
3	2	1	1	37	19	11
4	2	1	1	28	18	20

The slight increased nonvolatile beta in water at location 2 was caused by an increase of radioactivity discharged in disassembly basin water from the 100-P Area. The slight decrease at location 3 was caused by a decrease in radioactivity discharged in disassembly basin water from the 100-L Area.

The average half-life of nonvolatile beta in water samples collected from locations 2 and 3 were 390 hours and 570 hours, respectively.

Lower Three Runs

Radioactivity in Water

	Alpha, 1×10^{-3} d/m/ml			Nonvolatile Beta, 1×10^{-15} c/ml		
Location	Max	Avg	Previous Avg	Max	Avg	Previous Avg
1	2	1	1	22	9	11
2	2	1	1	450	230	170
3	3	1	1	50	28	18

Radioactivity in Mud

	Alpha, d/m/g			Nonvolatile Beta, 1×10^{-12} c/g		
Location	Max	Avg	Previous Avg	Max	Avg	Previous Avg
1	2	1	1	13	9	11
2	2	1	1	160	37	16
3	2	1	1	23	16	9

The increased nonvolatile beta in water at locations 2 and 3 was the result of an increase of the nonvolatile beta discharged in disassembly basin water from the 100-R Area. The average half-life of nonvolatile beta in water samples collected at location 2 was 570 hours.

TNX Effluent

Radioactivity in Water

Uranium or Plutonium, 1×10^{-3} d/m/ml			Nonvolatile Beta, 1×10^{-15} c/ml		
Max	Avg	Previous Avg	Max	Avg	Previous Avg
220	16	5	77	16	12

Radioactivity in Mud

Uranium or Plutonium, d/m/g			Nonvolatile Beta, 1 × 10^{-12} c/g		
Max	Avg	Previous Avg	Max	Avg	Previous Avg
84	27	15	14	11	13

The maximum uranium or plutonium concentration in water occurred on August 23 and was identified as uranium.

Savannah River

Radioactivity in Water

	Uranium or Plutonium, 1 × 10^{-3} d/m/ml			Nonvolatile Beta, 1 × 10^{-15} c/ml		
Location	Max	Avg	Previous Avg	Max	Avg	Previous Avg
1	4	1	1	36	14	10
2	5	1	2	130	16	10
3	2	1	3	180	18	12
4	3	1	2	160	17	10
5	1	1	4	220	23	9
6	2	1	2	120	16	10
7	2	1	1	230	24	12
8	1	1	1	70	29	14
9	4	1	2	42	15	13
10	2	1	1	82	17	11

The maximum nonvolatile beta concentrations, with the exception of that at location 9, occurred on July 17. Decay studies of the samples collected on this date from locations 2 and 5 showed the radioactive components to have half-lives of 170 hours and 100 hours, respectively. Stream water samples collected on July 12 and 19 did not indicate that the river contamination was due to Plant operations.

The increase in the average nonvolatile beta concentration in water at location 8, however, is more than can be accounted for by the high maximum sample, and could be the result of increases in the amounts of short half-lived isotopes released by the 100-P and 100-L Areas.

Radioactivity in Mud

Location	Uranium or Plutonium, d/m/g			Nonvolatile Beta, 1×10^{-12} c/g		
	Max	Avg	Previous Avg	Max	Avg	Previous Avg
1	15	8	5	42	23	26
2	12	8	6	38	25	29
3	15	8	6	36	23	25
4	13	8	6	38	20	23
5	13	8	7	41	29	32
6	22	9	6	44	28	23
7	18	7	8	28	17	22
8	17	8	5	40	25	27
9	15	8	5	30	12	17
10	23	9	6	26	15	14

Radioactivity In Ground Water

Ground water was monitored for radioactivity by the analyses of water samples from two types of wells; ZW and open wells. The ZW wells are drilled wells located near the 200-F and 200-H Areas, as shown in figure 6, while the open wells were selected near each of the Plant areas.

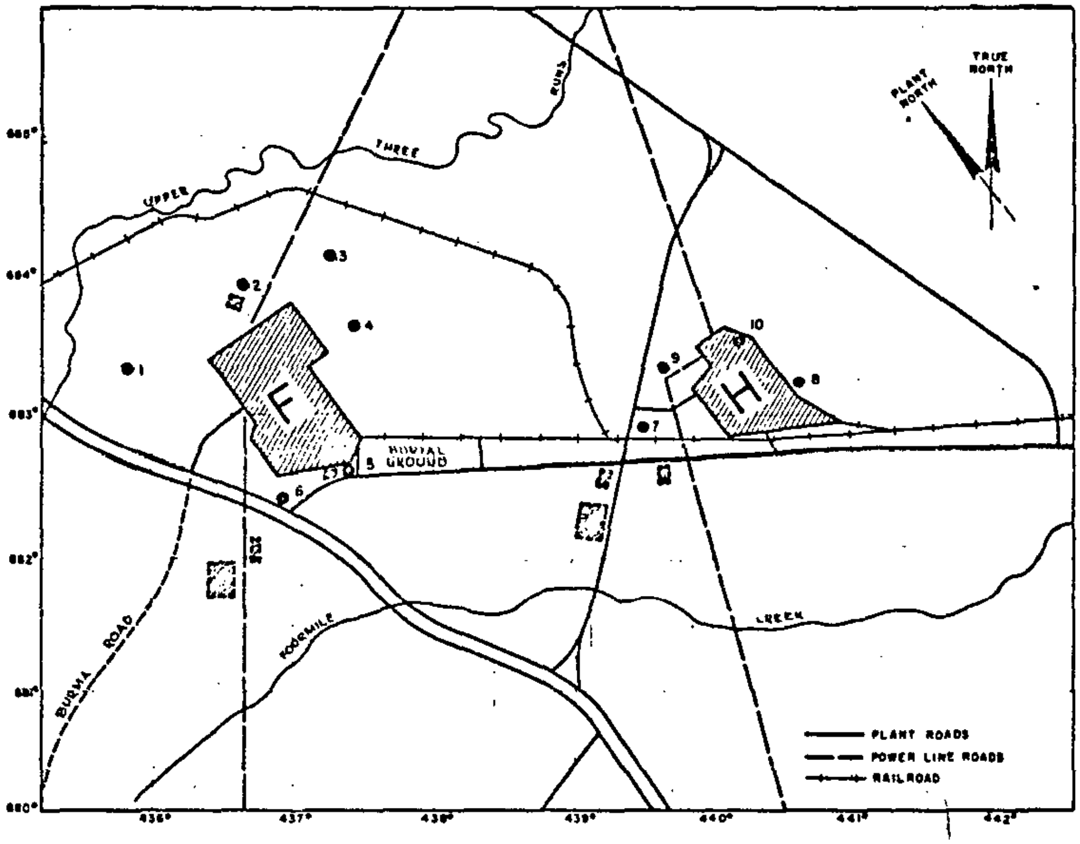

Figure 6. ZW Well Locations

ZW Wells

Location	No. of Samples	Alpha, 1 × 10⁻³ d/m/ml			Nonvolatile Beta, 1 × 10⁻¹⁵ c/ml		
		Max	Avg	Previous Avg	Max	Avg	Previous Avg
1	5	4	3	-	22	11	-
2	6	3	2	2	21	12	12
3	6	3	2	3	28	12	18
4	6	4	3	2	14	8	8
5	6	4	3	2	19	10	10
6	6	4	3	3	11	9	9
7	6	1	1	1	14	8	11
8	6	2	1	1	10	8	9
9	6	3	1	2	20	11	8
10	5	4	3	-	13	10	-

Open Wells

Location	No. of Samples	Alpha, 1 × 10⁻³ d/m/ml			Nonvolatile Beta, 1 × 10⁻¹⁵ c/ml		
		Max	Avg	Previous Avg	Max	Avg	Previous Avg
C-1	2	2	2	2	15	13	8
H-4	3	2	2	2	38	27	9
H-8	2	4	3	2	29	29	17
K-1	2	1	1	3	26	19	8
K-9	2	4	4	2	33	22	12
K-10	3	3	2	1	17	15	44
L-1	3	3	2	1	49	36	17
L-4	1	1	1	1	17	17	24
L-11	2	2	1	4	50	36	32
L-15	2	1	1	1	16	12	8
P-14	2	3	3	1	37	24	16
P-16	2	1	1	2	56	39	38
P-19	3	3	2	2	33	26	13
R-1	3	4	2	1	58	33	19
R-3	2	2	2	2	37	30	13

There was no definite explanation for the slight increases of nonvolatile beta in the open wells, but there was no reason to suspect that the radioactivity was the result of Plant operations. The most likely source was bomb fallout.

Radioactivity In Plant Drinking Water

Samples of drinking water were collected monthly from 19 locations on the Plant Site. The results of the analyses of 133 samples collected during the 6-month period are summarized below.

	Alpha, 1×10^{-3} d/m/ml			Nonvolatile Beta, 1×10^{-15} c/ml		
Location	Max	Avg	Previous Avg	Max	Avg	Previous Avg
Barricade No. 2	14	9	16	17	10	13
TC-1	13	9	11	15	11	10
200-H Area	13	8	11	26	14	14
Barricade No. 4	7	5	4	8	7	10
200-F Area	7	4	8	16	9	9
Barricade No. 1	5	3	4	8	7	8
400-D Area	3	2	2	8	7	8
300/700 Area	3	2	2	8	7	8
TNX	2	2	1	15	9	8
Pump House No. 2	3	1	1	10	8	11
Pump House No. 1	1	1	1	10	8	9
100-K Area	1	1	1	8	7	8
Barricade No. 3	1	1	1	8	7	8
100-C Area	1	1	1	8	7	8
Central Shops	1	1	1	8	7	8
100-L Area	1	1	1	13	8	8
100-R Area	1	1	1	10	8	8
100-P Area	1	1	1	10	8	8
Barricade No. 5	1	1	1	9	7	8

Radioactivity In Public Water Supplies

Samples of public drinking water were collected monthly from the 14 surrounding towns shown in figure 5, with the exception of Waynesboro, Clearwater, and Aiken, where there are open water supplies, and samples were collected weekly. The results of analyses of 155 samples collected during the 6-month period are summarized on the following page.

Location	Alpha, 1×10^{-3} d/m/ml			Nonvolatile Beta, 1×10^{-15} c/ml		
	Max	Avg	Previous Avg	Max	Avg	Previous Avg
Aiken	12	6	9	19	9	9
Langley	7	5	3	60	16	8
Jackson	7	4	5	11	9	8
Bath	6	4	3	10	8	8
Williston	3	2	2	11	10	8
New Ellenton	2	2	2	11	8	8
North Augusta	4	1	1	30	12	8
Barnwell	2	1	1	7	7	8
Allendale	2	1	1	13	9	8
Blackville	1	1	1	22	10	8
Clearwater	2	1	1	60	11	8
Sardis	1	1	1	8	7	8
Waynesboro	1	1	1	13	8	9
Augusta	1	1	1	14	9	8

The increases in nonvolatile beta at Langley, Clearwater, and North Augusta are due to relatively high activity in the samples collected on July 17. The source of the activity was probably bomb fallout.

Radioactivity In Seepage Basins

700-A Area

The 700-A Area seepage basin receives waste from the low level drains of the 700-Area laboratories. During the 6-month period, radioactivity discharged to the basin included 0.01 curie of alpha and 0.11 curie of beta. The average seepage and evaporation rate for the 6-month period was approximately 3600 gallons per day.

The results of analyses of 44 water samples are summarized below.

Location	Alpha, d/m/ml			Nonvolatile Beta, 1×10^{-12} c/ml		
	Max	Avg	Previous Avg	Max	Avg	Previous Avg
Basin No. 1	2	1	6	19	6	7.9
Basin No. 2	6	1	3*	8	5	4.1*

* 4-month average

Greater than 95% of the alpha activity in basin No. 1 was due to uranium. Monthly analyses of samples for thorium showed that the basin contained 14 μg/ℓ, 187 μg/ℓ, and 66 μg/ℓ in October, November, and December, respectively. The thorium concentration from July through September was less than 4 μg/ℓ.

200 Areas

Each of the 200 Areas discharges liquid waste into seepage basins at the rate of approximately 70,000 gallons per day. An additional 10 to 12 million gallons of contaminated segregated water was discharged to the 200-H Area seepage basins in October. Each 200 Area has its own system of seepage basins, as shown in figure 7. The basins are arranged so that the liquid waste fills basin No. 1 first, then overflows into basin No. 2, and finally overflows into basin No. 3.

200-F Area. During the 6-month period, the average seepage and evaporation rate from the 200-F Area system was 68,000 gallons per day. During the 6-month period the estimated radioactivity discharged to the basins included 0.6 curie of alpha, 30 curies of nonvolatile beta, and 200 curies of radioiodine. The results of the analyses of 102 water samples are listed below.

	Alpha, d/m/ml			Nonvolatile Beta, 1×10^{-12} c/ml			Radioiodine, 1×10^{-12} c/ml		
Location	Max	Avg	Prev Avg	Max	Avg	Prev Avg	Max	Avg	Prev Avg
Basin No. 1	50	20	3	2800	730	120	18,000	4200	2900
Basin No. 2	29	16	2	1700	550	70	2,500	1100	1200
Basin No. 3	9	3	1	510	150	30	270	220	100

Specific analyses of monthly composite samples from each basin showed that the nonvolatile beta in all 3 basins contained an average of 30% rare earths, 30% Zr-Nb, 20% Ru, and 20% Sr; considerable variations in composition occurred from month to month. The average alpha activity in basins No. 1, No. 2, and No. 3 was 45%, 35%, and 27% plutonium, respectively.

Monthly averages of the alpha, nonvolatile beta and radioiodine concentrations in the three basins are shown in figure 8.

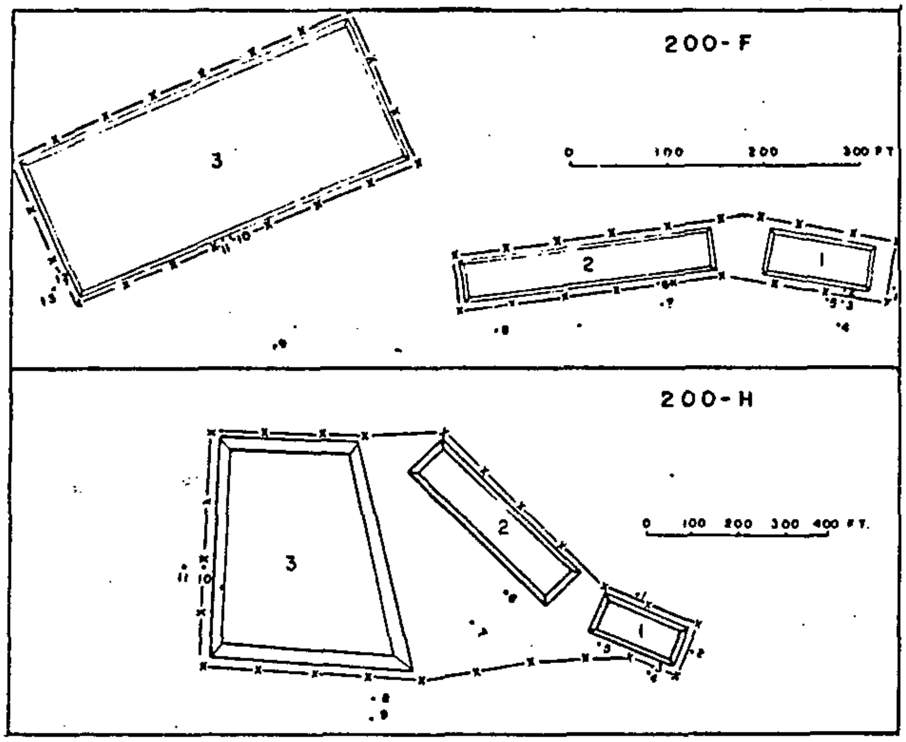

Figure 7. Seepage Basin Wells

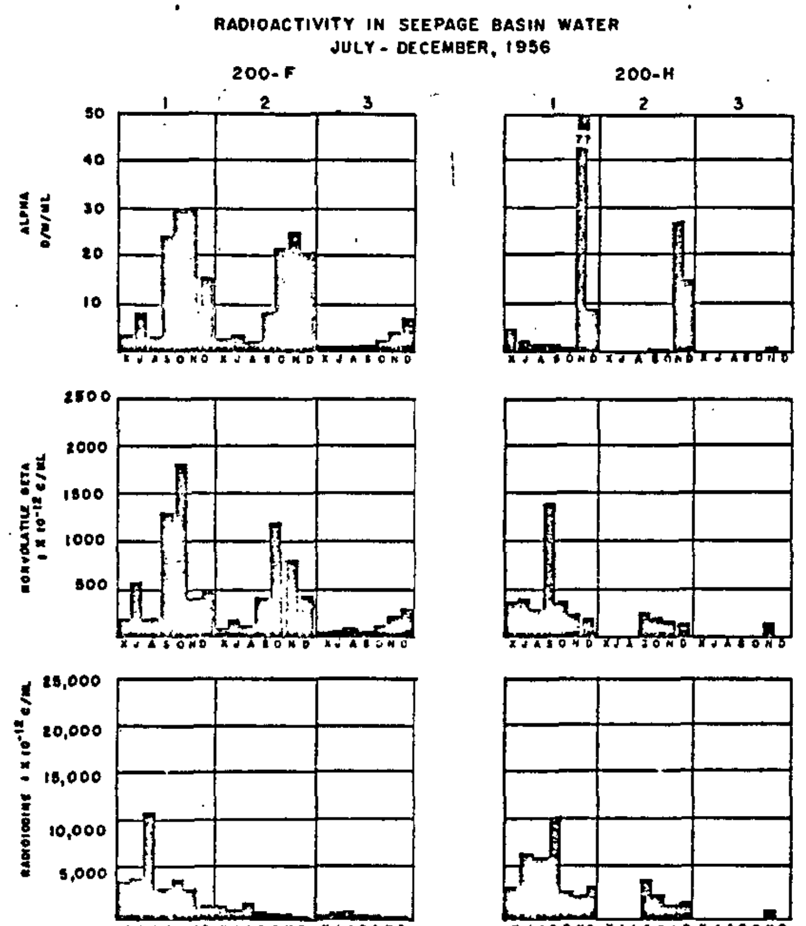

Figure 8. Radioactivity in Seepage Basin Water

The increase in alpha concentrations in September was probably because of a decreased pH of the basin, causing plutonium which had precipitated on the basin floor to redissolve. Plutonium was responsible for greater than 80% of the alpha activity in samples collected in September. The increases in October and November, however, were due to increased input of uranium caused by routing of A-Line waste streams to the basins.

The increase in nonvolatile beta concentrations in July was attributed to the discarding of waste directly to the basins from catch tanks in the Cold Feed Preparation Area. The increase in September and November is the result of routing additional waste streams directly to the basins, bypassing the GP evaporators.

As a result of processing unusually "green" material, radioiodine concentrations continued to increase through August, when an unprecedented concentration of 1.8×10^{-8} c/ml was observed in basin No. 1.

200-H Area. Waste overflowed into basin No. 2 on September 13 because of decreased seepage in basin No. 1 resulting from high concentrations of NaOH (pH 10 to 12), and into basin No. 3 on October 18 when contaminated segregated cooling water was temporarily routed to the basin. After one month, however, basin No. 3 became dry again. The average seepage and evaporation rate for the system was 129,000 gallons per day. During the 6-month period the estimated radioactivity discharged to the basins included 0.4 curie of alpha, 20 curies of nonvolatile beta, and 250 curies of radioiodine. The results of the analyses of 58 water samples are listed below.

	Alpha, d/m/ml			Nonvolatile Beta, 1×10^{-12} c/ml			Radioiodine, 1×10^{-12} c/ml		
Location	Max	Avg	Prev Avg	Max	Avg	Prev Avg	Max	Avg	Prev Avg
Basin No. 1	160	15	4	2200	470	300	16,000	5500	3300
Basin No. 2*	36	11	-	1500	190	-	5,800	2200	-
Basin No. 3**	0.4	0.4	-	160	130	-	620	550	-

* 4 months' sample.
** 1 month's sample.

Specific analyses of monthly composite samples showed that the average composition of the nonvolatile beta in basin No. 1 was approximately 20% rare earths, 50% Ru, 7% Sr, and 40% Zr.

Plutonium accounted for 80% of the alpha activity in the No. 1 basin.

Monthly averages of the alpha, nonvolatile beta and radioiodine concentrations in the three basins are shown in figure 8. The increase in alpha concentrations in the basins began between October 22 and 25, and was the result of process difficulties in the solvent extraction and waste handling facilities in the 200-H Area. The concentration in basin No. 1 continued to increase until November 5, at which time it was estimated that basins No. 1 and No. 2 contained 0.3 curie and 0.1 curie of plutonium, respectively. The release was greatly reduced on November 5.

Radioiodine concentrations in basin No. 1 continued the increases observed during the previous 6-month period. The sharp increase in basin No. 1 in September is the result of the rerouting of the head-end evaporator condensate to the acidic high activity evaporators.

Seepage Basin Wells

Ground water surrounding the 200-Area seepage basins was monitored by analysis of water samples from wells near the basins. The locations of these wells are shown in figure 7.

200-F Area. Results of the analyses of 143 water samples are tabulated below.

			Alpha, 1×10^{-3} d/m/ml			Nonvolatile Beta, 1×10^{-15} c/ml			Radioiodine, 1×10^{-15} c/ml		
Well	Depth, feet	Distance From Basin Water, feet	Max	Avg	Prev* Avg	Max	Avg	Prev* Avg	Max	Avg	Prev* Avg
1	27	34	14	5	1	21,000	2,600	68	60,000	15,000	400
2	68	5	10	5	3	480	180	57	1,300	370	200
3	67	29	12	4	3	39	20	29	630	190	100
4	68	73	5	3	3	51	18	25	390	120	100
5**	19	24	17	6	2	12,000	4,600	1000	26,000	9,300	200
6	3	6	980	130	5	67,000	15,000	1900	140,000	71,000	34,000
7	5	46	55	13	2	16,000	6,000	2700	98,000	46,000	18,000
8	67	63	6	3	2	22	12	10	430	100	200
9	60	258	5	2	2	53	15	9	550	91	200
10	6	9	130	66	200	11,000	5,800	4600	57,000	25,000	44,000
11	68	9	7	3	4	22	14	16	350	95	100
12	12	29	16	7	12	5,400	3,000	1900	52,000	22,000	57,000
13†	12	58	2	2	4	1,100	1,000	1000	15,000	9,000	5,900

* 4-month average.

** 3 months' samples; well was dry for 3 months during the period.

† 1 month's samples; well was dry for 5 months during the period.

200-H Area. Results of the analyses of 135 water samples are tabulated below.

Well	Depth, feet	Distance From Basin Water, feet	Alpha, 1×10^{-3} d/m/ml Max	Avg	Prev* Avg	Nonvolatile Beta, 1×10^{-15} c/ml Max	Avg	Prev* Avg	Radioiodine, 1×10^{-14} c/ml Max	Avg	Prev* Avg
1	21	24	2900	690	1900	120,000	37,000	53,000	510,000	150,000	421,400
2	21	25	6	5	4	130	32	10	74	600	40
3	18	15	3	2	1	170	42	20	13,000	1,300	80
4	19	45	4	2	1	35	15	10	4,200	410	10
5	18	13	3100	600	1600	110,000	41,000	30,000	790,000	210,000	430,500
6	25	6	9	2	2	55	21	30	210	22	80
7	24	66	4	2	3	40	23	10	180	31	10
8	19	18	4	1	1	59	23	10	75	21	4
9**	16	78	2	1	-	99	38	-	21	11	-
10**	20	19	2	1	-	88	32	-	59	18	-
11**	17	79	2	1	-	80	140	-	70	21	-

* 1-month average.
** 4 months' samples; wells were dry for 2 months during the period.

Airborne Radioactivity at the 200-Area Seepage Basins

Atmospheric Radioiodine. Results of the analyses of 134 samples collected on silver nitrate impregnated air filters located 25 feet downwind from the seepage basins are shown below.

Location	Radioiodine, 1×10^{-8} μc/cc Max	Avg	Previous Avg
200-F Basin No. 1	10	1.3	2.3
200-H Basin No. 1	27	7.0	3.5

Particulate Contamination. Gummed papers were placed in a vertical position near the fence at the sides of the three seepage basins at the 200-F Area and the two basins in use at the 200-H Area. The results of 420 radioautographs of these papers and 233 countings of individual particles are shown below.

	F Area			H Area	
Location	SB No. 1	SB No. 2	SB No. 3	SB No. 1	SB No. 2
Max Number Particles/ft^2/wk (single location)	126	108	155	2340	180
Avg Number Particles/ft^2/6 mo	113	64	82	1360	105
Previous Avg Number Particles/ft^2/6 mo	62	0.6	1.8	145	-
Max Beta Activity/particle, d/m	740	1800	380	5100	1600
Avg Beta Activity/particle, d/m	45	69	25	43	57

Some of the particles collected in the vicinity of the seepage basins undoubtedly originated from fallout from weapons tests. Large numbers of particles were collected during the week ending July 18, when particulate fallout was heavy at other locations (see "Particulate Fallout," p 11).

Decay studies of 39 particles collected from the papers surrounding the 200-H Area seepage basins showed that 23 of the particles had half-lives of approximately 8 days. Pulse-height analysis of the most radioactive particle from 200-H Area SB No. 1 (5100 d/m) showed the activity to be due to I^{131}.

Throughout the period, radioautographs of some of the papers collected near 200-H Area SB No. 1 showed fogged outlines of the paper, indicating the deposition of gaseous radioiodine on the papers.

Radioiodine on Vegetation at the 200-Area Seepage Basins. Evolution of radioiodine from the 200-Area seepage basins produced contamination of vegetation in the vicinity of the basins, as shown by the results of analyses of 104 samples collected during the 6-month period.

	Radioiodine, 1×10^{-10} c/g	
Location	Max	Avg
150 ft from H Basin No. 1	340	46
1600 ft from H Basin No. 1	9	2
1600 ft from F Basin No. 1	14	5
2100 ft from F Basin No. 1	4	1

Monthly averages showed that contamination from the 200-H Area seepage basin was greatest in October, when the vegetation collected 100 feet from the basin contained an average of 183×10^{-10} c/g.

Because of varied wind direction, differences in topography at the two basins, and vegetation contamination from sources other than the seepage basins, no attempt should be made to correlate the above concentrations with each other or with radioiodine evolution from the basins.

Radioactivity In Zoological Specimens

During the 6-month period, various organs of 44 zoological specimens were analyzed for radioactivity. The locations from which these specimens were collected are shown in figure 9.

The spleen, intestinal track and content, muscle, liver, lungs or gills, kidneys, bone and gonads of 1 opossum, 1 raccoon, 2 rabbits, 1 bobcat, 3 foxes, 13 catfish, 3 sunfish, 1 perch, and 4 turtles, and the lungs of 1 opossum, 4 raccoons, 3 rabbits, 2 bobcats, and 5 foxes were counted for alpha and beta activity.

The thyroids of 2 opossums, 5 raccoons, 4 rabbits, 2 bobcats, and 7 foxes were analyzed for radioiodine.

Except for very low concentrations (<1.2 d/m/g) in the lungs of the land animals detectable alpha activity was confined to fish and turtles. Twenty percent of the fish samples and 30% of the turtle samples contained detectable concentrations. The gonads of fish contained higher concentrations than any other organ with an average for four samples of 38 d/m/g and a maximum of 108 d/m/g in a catfish collected in the Savannah River near the mouth of Steel Creek on August 27. No alpha activity could be detected in the bones of fish, while in turtles the average concentration for four samples was 17 d/m/g (not extractable with tributylphosphate).

Detectable gross beta activity was more evenly distributed among the different animals than was the alpha activity. Twenty percent of all samples contained detectable concentrations and the positive samples included a large number of intestinal track, bone, muscle, and gonad samples. The highest concentrations were in the gonads of fish with an average for four samples of 360×10^{-12} c/g and a maximum of 470×10^{-12} c/g in a catfish collected in the Savannah River near the mouth of Lower Three Runs on July 30.

Both alpha and beta activity in the edible portions of the zoological specimens were negligible.

Radioiodine in the thyroid of animals was quite widespread. The concentrations ranged from 24×10^{-12} c/g (1 mrad/wk) in a raccoon collected at location 8 (figure 9) on November 21, to 2250×10^{-12} c/g (110 mrad/wk) in a rabbit collected at location 2 (figure 9) on November 22.

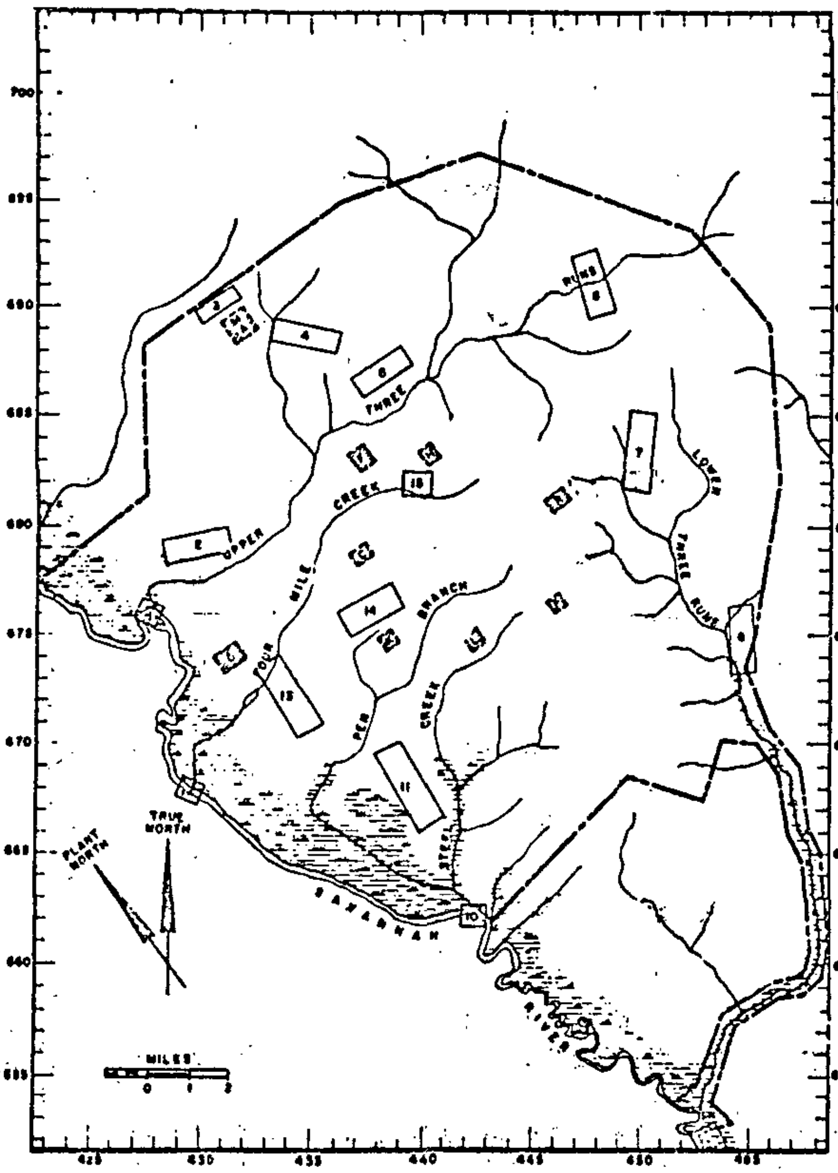

Figure 9. Zoological Specimen Locations

Diatoms

Diatom samples were collected every two weeks at three locations, shown in figure 6. During the 6-month period, 66 samples were collected and analyzed for alpha and nonvolatile beta activity.

Location	Alpha, d/m/g		Nonvolatile Beta, 1×10^{-12} c/g	
	Max	Avg	Max	Avg
Savannah River, above Plant	25	12	220	140
Savannah River, below Plant	36	12	410	96
Four Mile Creek	145	26	1150	520