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HEALTH PHYSICS
ENVIRONMENTAL MONITORING

Semiannual Report,
July Through December 1962

June 1963

Works Technical Department

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EXPLOSIVES DEPARTMENT - ATOMIC ENERGY DIVISION
SAVANNAH RIVER PLANT

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HEALTH PHYSICS ENVIRONMENTAL MONITORING

Semiannual Report,

July through December 1962

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June 1963

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

CONFIDENTIAL

Contents

Introduction

This is the last in a series of semiannual reports summarizing the results obtained from the environmental monitoring program at the Savannah River Plant (SRP). In the future these reports will be issued annually.

Additional information pertaining to SRP releases of radioactive materials and their dispersion in the environment between July and December 1962 may be obtained from two sources: Ashley, C., 1962 Audit of SRP Radioactive Waste, DPSP 63-25-1, May 1963; and a Health Physics Semiannual Report for the AEC, The Effect of the Savannah River Plant on Environmental Radioactivity, DPSPU 63-30-12, January 1963.

Summary

- The separations areas (through releases to the atmosphere and to the seepage basins) and the reactor areas (through releases of disassembly basin purge water to effluent streams) remain the primary sources of radioactive materials released to the Plant environs. Releases in 1962 are summarized in the following tables.

Separations Areas Releases

To	Alpha, millicuries		Nonvolatile Beta, curies		Radioiodine, curies	
	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec
F Area						
Atmosphere	10.3	3.4	1.5	1.2	2.8	3.6
Seepage Basins	521	336	110.1	59.30	3.43	3.48
H Area						
Atmosphere	1.6	4.2	0.06	0.45	4.5	5.6
Seepage Basins	237	163	15.20	42.50	0.10	0.17

Reactor Areas Disassembly Basin Releases, curies

	Jan-Jun	Jul-Dec
Short-Lived Radionuclides (<30-day half life)*	211.3	162.0
Long-Lived Radionuclides (>30-day half life)**	87.7	82.0
Iodine-131	82.2	4.8
Sulfur-35	261.7	249.9
Tritium	24,690	21,990

* Short-lived radionuclides included Mo^{99}, Np^{239}, Cr^{51}, and Ba-La^{140}.

** Long-lived radionuclides included $Ce^{141,144}$, $Ru^{103,106}$, Zr-Nb^{95}, Co^{60}, $Sr^{89,90}$, Zn^{65}, and Cs^{137}.

- Releases of I-131 and nonvolatile beta to the atmosphere were obscured by weapons-test fallout. Large increases in the concentration of nonvolatile beta in the atmosphere occurred in the fall due to this fallout. The average concentration in November was 6.1 $\mu\mu c/m^3$ of air; maximum for any month since the resumption of weapons testing was 6.2 $\mu\mu c/m^3$ in September 1961.

- Average concentrations of Sr-90 and I-131 (16 $\mu\mu c/\ell$ and 26 $\mu\mu c/\ell$, respectively) in milk samples collected from local dairies and major distributors were consistent with the levels for Charleston, S. C., and Atlanta, Ga., reported by the U. S. Public Health Service.

- Predominant radionuclides in seepage basin releases were $Ru^{103,106}$ (20 c) and Cs^{137} (20 c) in F Area, and $Ru^{103,106}$ (29 c) in H Area. Radiocesium releases in F Area were attributed to operation of the Building 242-F evaporator. $Ru^{103,106}$ releases in both areas were attributed to the waste handling facilities in Buildings 211-F and 211-H.

- Levels of radioactivity in stream and river samples (water, fish, and algae) generally reflected reactor discharges.

- Sulfur-35 (250 c) and chromium-51 (112 c) were the predominant radionuclides (excluding tritium) in disassembly basin purge water. Sulfur releases were attributed to degradation products resulting from radiation damage to cation resin beds. Chromium-51 releases throughout 1962 were substantially higher than those experienced previously.

- 20 curies of radiostrontium (including 0.3 curie Sr-90) were released to Steel Creek during an L-Area reactor discharge in August. The release caused a maximum Sr-89 concentration of 79 $\mu\mu c/\ell$ in a standard weekly sample of river water obtained downstream from the Plant.

- Plant-released alpha activity had negligible effect on levels of alpha in stream and river water; alpha concentrations in river water at downstream locations were no higher than those at the upstream control location. Increased six-month average concentrations of alpha and nonvolatile beta activity in M-Area effluent were attributed to rupture of fuel slugs during autoclave pressure tests in Building 313-M.

- SRP operations had no effect on the chemical quality of Savannah River water. Although the effluent from a wool scouring plant appears to have caused a depressed insect population in Lower Three Runs, no significant effect on the chemical quality of this water was noted. Dissolved oxygen concentrations above and adjacent to the Plant were generally depressed slightly due to the discharge of sewage from Augusta, Georgia, and increased water temperatures from Plant operations. However, at all times the dissolved oxygen content of the water was suitable for growth and maintenance of diverse populations of aquatic organisms.

- Survey results for the six-month period ending December 31, 1962, appear in the Appendixes. All tabular data are related to values previously reported semiannually.

APPENDIX A

Environmental Monitoring Results

Survey data were averaged for the six-month period and compared with the previous six-month averages (Health Physics Envorinmental Monitoring Semiannual Report, January Through June, 1962, DPSP 63-25-3, February 1963). In reporting data, "Avg" or "Total" refer to the average or total for the six-month period covered by this report, while "Prev Avg" or "Prev Total" refer to the average or total for the preceding six-month period. Unless otherwise specified, "Max" refers to the greatest concentration observed in a single sample collected during this report period.

APPENDIX A

Table 1. Radioactivity in Air, μμc/m³

Location	Alpha*			Filterable Beta			Radioiodine			Tritium		
	Max	Avg	Prev Avg	Max	Avg	Prev Avg	Max	Avg	Prev Avg	Max	Avg	Prev Avg
F Area	0.23	0.13	0.14	10.4	3.6	3.9	0.67	0.13	0.07	1480	420	600
H Area	.16	.12	.10	9.6	3.7	3.9	.23	.08	.08	3880	1460	1600
700 Area	.19	.08	.07	11.3	3.5	3.7	.29	.09	.05	490	170	220
Talatha Gatehouse	.13	.07	.08	8.5	3.0	4.2	.13	.04	**	470	160	340
Williston Gatehouse	.14	.06	.08	9.9	3.4	3.9	.22	.07	.04	650	270	330
Dunbarton Fire Tower	.15	.08	.08	11.2	3.4	4.1	.26	.07	**	800	320	310
400 Area	.19	.08	.10	10.4	3.1	3.7	.20	.07	.06	500	220	270
Aiken Airport	.13	.08	.09	7.0	2.9	3.7	.21	.06	.04	280	100	120
Allendale	.19	.08	.08	10.9	3.6	4.0	.22	.07	.04	160	60	100
Waynesboro	.23	.10	.08	19.9	4.5	4.0	.29	.07	**	260	80	80
Langley	.24	.10	.10	9.8	3.2	3.7	.19	.06	**	300	80	70
Williston	.17	.09	.08	9.1	3.3	4.0	.20	.06	.08	530	130	180
Barnwell	.16	.08	.09	9.7	3.2	3.8	.15	.04	.04	280	110	120
Sardis	.15	.08	.09	7.7	3.4	4.1	.18	.05	.04	250	90	110
Bush Field	.21	.08	.09	10.3	3.2	3.8	.16	.05	.07	290	80	100
Jackson	.12	.08	.08	9.8	3.2	3.5	.15	.05	**	410	130	260
Aiken State Park	.14	.07	.07	7.7	3.2	3.9	.23	.06	.07	200	100	110
Highway 301	.15	.08	.07	9.8	3.2	3.9	.19	.06	**	190	80	110
Columbia, S. C.	.37	.14	.11	8.3	3.8	4.2	.20	.06	**	-	-	-
Greenville, S. C.	.18	.11	.09	10.8	4.2	4.0	.24	.08	**	-	-	-
Macon, Ga.	.18	.10	.09	12.1	3.5	3.6	.22	.06	0.04	-	-	-
Savannah, Ga.	0.21	0.09	0.12	12.4	3.9	3.9	0.20	0.07	**	-	-	-

* Multiply by 10^{-2}.

** Less than sensitivity of analysis.

APPENDIX A

Table 2. Gamma Radiation Levels*

Location	Dose Rate, mr/24 hours Avg	Prev Avg
F Area	0.62	0.56
H Area	.81	.65
R Area	.63	.55
P Area	.68	.50
L Area	.63	.56
K Area	.63	.54
C Area	.63	.50
TC Area	.66	.58
300/700 Area	.88	.66
Talatha Gatehouse	.42	.46
Williston Gatehouse	.42	.41
Dunbarton Fire Tower	.45	.40
400 Area	.62	.57
Jackson	.37	.24
Aiken Airport	.42	.40
Allendale	.45	.59
Waynesboro	.44	.52
Bush Field	.39	.42
Langley	.44	.35
Williston	.38	.41
Barnwell	.34	.55
Sardis	.40	.33
Aiken State Park	.33	.33
Highway 301	0.35	0.46

* Variations among these values are due largely to differences in normal background and in instrument response characteristics under changing conditions of heat and moisture. Area values were obtained from pocket chambers placed in open stations; at other locations the chambers were placed in closed monitoring stations.

APPENDIX A

Table 3. Radioactivity in Rainwater, μμc/liter

Location	Alpha			Nonvolatile Beta			Radioiodine			Tritium*		
	Max	Avg	Prev Avg	Max	Avg	Prev Avg	Max	Avg	Prev Avg	Max	Avg	Prev Avg
F Area	0.6	0.2	0.2	5100	1500	690	130	37	20	160	30	34
H Area	0.9	.4	.8	2100	490	1300	110	22	16	550	100	150
700 Area	1.4	.6	.3	3100	920	1400	120	26	18	37	10	20
Talatha Gatehouse	1.7	.5	.4	4200	1200	1300	180	57	14	41	14	13
Williston Gatehouse	0.9	.3	.3	4600	910	1200	90	29	20	53	18	11
Dunbarton Fire Tower	.6	.4	.3	1400	610	1400	180	37	30	110	30	22
400 Area	0.6	.4	.5	1100	520	1500	70	32	13	160	21	15
Aiken Airport	2.8	.5	.4	10900	1300	1300	100	26	15	66	13	6
Allendale	1.9	.4	.3	3500	800	1200	95	27	16	100	8	5
Waynesboro	6.6	.6	.3	11700	1300	1300	100	24	15	21	5	6
Langley	3.9	.6	.4	6200	840	1300	130	30	18	59	10	9
Williston	1.0	.3	.4	2300	670	1300	120	37	22	22	8	8
Barnwell	1.5	.3	.4	1900	680	1400	150	36	19	33	6	14
Sardis	1.0	.3	.3	1500	540	1300	150	27	15	19	5	6
Bush Field	1.6	.4	.3	6100	1300	1300	120	29	26	32	7	7
Aiken State Park	3.9	.4	.3	3200	700	1200	70	24	21	21	7	7
Highway 301	2.9	.4	.2	5400	1100	1200	140	32	20	9	3	5
Jackson	0.6	0.2	0.3	4300	1400	1400	-	-	22	28	8	8

* Multiply by 10^3.

APPENDIX A

Table 4. Deposition of Radionuclides on Plant Site, mc/mi^2

	Nonvolatile Beta	I^{131}	Cs^{137}	$Sr^{89,90}$	Sr^{90}	Tritium*
July	130	8.7	7.6	24.4	2.2	1.6
August	100	1.7	5.4	16.4	3.3	2.5
September	32	1.8	1.0	4.8	.4	2.4
October	67	2.6	1.3	9.3	1.0	4.6
November	170	12.0	1.6	34.9	.8	6.6
December	102	2.8	1.6	11.3	.6	1.4
Total →	601	29.6	18.5	101.1	8.3	19.1
Previous Total →	2100	32	57	274	18	34.8

* Expressed in c/mi^2

Table 5. Radioactivity in Vegetation, μμc/gram

	Alpha			Nonvolatile Beta			Radioiodine		
Location	Max	Avg	Prev Avg	Max	Avg	Prev Avg	Max	Avg	Prev Avg
F Area (at 1 mile radius)	0.2	0.1	0.3	550	120	350	*	*	6
H Area (at 1 mile radius)	.3	.1	.3	360	110	510	3	*	7
Plant Perimeter	.7	.1	.2	420	90	290	*	*	7
25-Mile Radius	0.3	0.1	0.2	380	80	320	6	*	7

* Less than sensitivity of analysis.

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Table 6. Radioactivity in Milk, μμc/liter

	Radioiodine			Tritium		
	Max	Avg	Prev Avg	Max	Avg	Prev Avg
Farms						
Pleasant Mount	265	117	10	13,000	5000	5000
Snelling	255	63	15	18,000	7000	8000
Talatha	39	24	8	5,500	3000	6000
Waynesboro, Ga.	460	140	-	8,000	4000	-
Dairies						
Aiken	36	17	8	8,000	4000	4000
North Augusta	84	22	7	8,000	3000	4000
Barnwell	581	61	9	8,600	4000	4000
Williston	64	23	6	13,000	5000	4000
Allendale	42	10	6	8,000	*	4000
Waynesboro, Ga.	63	28	7	8,200	3000	4000
Augusta, Ga.	88	24	-	6,400	3000	-

Sr-90 in Milk (average), μμc/liter

Type Sample	July	Aug	Sept	Oct	Nov	Dec
Farms	48	48	49	37	31	34
Small Dairy	18	15	18	14	14	13
Major Distributor	19	17	15	15	14	14

* Less than sensitivity of analysis.

APPENDIX A

Table 7. Radioactivity in Plant Drinking Water, μμc/liter

Location	Alpha			Nonvolatile Beta		
	Max	Avg	Prev Avg	Max	Avg	Prev Avg
F Area	8.9	4.4	7.4	25	16	23
H Area	10.0	6.0	5.9	112	24	18
300/700 Area	1.6	0.8	1.0	11	5	8
400 Area	2.2	1.3	1.9	13	9	14
TNX	2.2	1.3	1.8	10	8	10
Pump House 1	0.7	0.4	0.7	4	*	6
Pump House 2	.8	.7	.5	7	6	4
R Area	0.4	.2	.4	6	4	5
P Area	1.0	.5	.7	7	5	7
L Area	0.4	.2	*	13	8	16
K Area	.5	*	.2	20	9	16
C Area	.6	.3	.2	9	7	17
Par Pond - Pump House	0.8	0.3	0.3	6	4	5
TC Area	8.1	4.5	3.9	23	15	13
Classification Yards	1.3	0.8	0.9	8	6	5
Central Shops	1.2	0.9	0.5	4	*	5
Barricade 1	1.6	1.1	1.2	6	5	8
2	28	23	32	51	46	55
3	0.5	0.5	0.4	11	8	7
4	3.8	3.6	4.0	6	6	12
5	*	*	*	3	*	7
Robbins Station	0.8	0.3	0.4	9	6	6
Donora Station Well	0.4	0.2	0.2	6	4	4

* Less than sensitivity of analysis.

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Table 8. Radioactivity in Public Drinking Water, μμc/liter

Location	Alpha			Nonvolatile Beta		
	Max	Avg	Prev Avg	Max	Avg	Prev Avg
Allendale	1.0	0.2	*	8	4	5
Sardis, Ga.	1.0	.2	*	8	4	6
Waynesboro, Ga.	0.2	*	*	13	6	18
Augusta, Ga.	.2	*	*	46	14	11
North Augusta	.6	.2	0.2	13	6	13
Clearwater	0.6	0.2	0.2	20	9	14
Bath	3.3	2.3	3.4	13	10	12
Langley	2.4	1.7	2.0	12	10	11
Jackson	8.6	6.0	4.8	22	16	16
New Ellenton	1.8	1.2	0.9	8	5	5
Aiken	4.4	2.2	2.8	8	6	8
Williston	2.7	1.5	1.4	13	5	10
Blackwell	0.4	0.2	0.3	9	5	5
Barnwell	0.3	*	0.2	8	4	6

* Less than sensitivity of analysis.

APPENDIX A

Table 9. Radioactivity in Plant Stream Water, μμc/liter

Location**	Alpha Max	Alpha Avg	Alpha Prev Avg	Nonvolatile Beta Max	Nonvolatile Beta Avg	Nonvolatile Beta Prev Avg	Tritium* Max	Tritium* Avg	Tritium* Prev Avg
Tims Branch - Upper Three Runs									
1 Control	3.5	1.8	2.2	27	12	31	-	-	-
2 F-Area Storm Sewer	19.8	7.3	110	4000	434	1400	-	-	-
3 700-Area Effluent	160	55	140	950	200	480	80	6	4
4 300-Area Effluent	1500	435	280	3500	890	620	-	-	-
5 Road C	6.8	1.2	1.2	41	12	27	-	-	-
6 HWCTR Effluent	18.0	5.2	2.8	48	21	18	-	-	-
7 Road A	3.1	0.9	0.9	30	11	22	14	4	5
Four Mile Creek									
8 F-Area Effluent	4.2	2.2	3.7	2500	390	1200	130	11	8
9 H-Area Effluent	2.5	1.0	1.2	40	22	45	330	270	160
10 Road C	3.2	1.0	0.7	810	130	99	350	250	200
11 Road A	1.6	0.3	0.3	360	78	120	180	24	48
Pen Branch									
12 Road A	0.8	0.2	†	680	110	540	240	28	75
Steel Creek									
13 Road A	1.0	0.3	0.2	2000	270	210	530	96	66
Par Pond									
14 R-Area Effluent	0.7	0.2	-	1400	210	-	470	110	-
15 Pump House	.4	†	†	220	99	140	110	90	110
16 P-Area Cooling Water	0.4	†	0.2	110	74	140	100	70	85
Lower Three Runs									
17 Patterson's Mill	0.9	0.2	0.2	110	57	85	100	53	59
18 Road A	0.4	†	†	45	30	50	80	37	34

Location**	Radioiodine Max	Radioiodine Avg	Radioiodine Prev Avg	Radiostrontium Max	Radiostrontium Avg	Radiostrontium Prev Avg	Radiocesium Max	Radiocesium Avg	Radiocesium Prev Avg
Four Mile Creek									
8 F-Area Effluent	-	-	-	52	20	24	300	46	120
10 Road C	19	†	†	-	-	-	-	-	-
11 Road A	16	†	†	16	†	8	340	37	12
Pen Branch									
12 Road A	17	†	21	52	10	25	73	12	10
Steel Creek									
13 Road A	150	14	190	990	84	26	120	31	26
Par Pond									
14 R-Area Effluent	14	†	18	29	16	26	220	66	36
15 Pump House	-	-	-	28	16	23	56	44	29
16 P-Area Cooling Water	-	-	-	-	-	-	-	-	-
Lower Three Runs									
17 Patterson's Mill	-	-	-	24	12	12	54	24	21
18 Road A	-	-	-	19	9	11	16	10	11

* Multiply by 10^3.
** Numbers refer to points on figure 4.
† Less than sensitivity of analysis.

APPENDIX A

Table 10. Radioactivity in Plant Stream Mud, μμc/gram

Location	Alpha			Nonvolatile Beta		
	Max	Avg	Prev Avg	Max	Avg	Prev Avg
Upper Three Runs						
Control	0.4	0.3	0.5	6	4	8
F-Area Storm Sewer	1.0	1.0	1.0	160	140	300
700-Area Effluent	0.8*	0.8*	4.1*	28	27	60
300-Area Effluent	12.0*	6.2*	2.6*	130	78	55
Road C	1.5	1.1	0.8	17	14	13
HWCTR Effluent	1.1	0.9	.3	14	11	5
Road A	0.4	0.2	0.4	8	5	6
Four Mile Creek						
F-Area Effluent	0.6	0.5	0.5	150	98	130
H-Area Effluent	.2	**	.3	4	3	8
Road C	.3	.2	.4	42	29	31
Road A	0.8	0.7	0.6	33	32	20
Pen Branch						
Road A	**	**	0.3	21	16	12
Steel Creek						
Road A	0.4	0.4	0.7	28	26	26
Par Pond						
R-Area Effluent	0.5	0.5	0.2	16	13	9
Pump House	**	**	**	11	8	6
P-Area Cooling Water Effluent	0.3	0.3	0.4	20	13	17
Lower Three Runs						
Patterson's Mill	0.3	0.2	0.3	7	4	7
Road A	0.2	**	0.2	5	5	6

* TBP extractable alpha.
** Less than sensitivity of analysis.

APPENDIX A

Table 11. Radioactivity in Savannah River Water, μμc/liter

	Alpha			Nonvolatile Beta			Tritium		
Location	Max	Avg	Prev Avg	Max	Avg	Prev Avg	Max	Avg	Prev Avg
2	0.4	*	0.3	25	12	38	7,000	2,000	2000
3	.4	*	.2	37	12	30	-	-	-
5	.7	*	.2	46	16	37	-	-	-
8	.5	*	.2	210	46	62	-	-	-
9	.4	0.2	.2	150	40	52	-	-	-
10	.5	*	.2	130	35	52	38,000	15,000	9000
11	0.5	0.2	0.2	130	37	48	48,000	14,000	9000

	Radioiodine			Radiostrontium			Radiocesium		
Location	Max	Avg	Prev Avg	Max	Avg	Prev Avg	Max	Avg	Prev Avg
2**	-	-	-	5	3	6	11	3	2
8	-	-	-	17	7	8	30	8	5
9	-	-	-	58	11	9	10	5	4
10	13	6	11	79	10	*	17	5	8
11	-	-	-	89	11	*	20	*	5

Radioactivity in River Mud, μμc/gram

	TBP Extractable Alpha			Nonvolatile Beta		
Location	Max	Avg	Prev Avg	Max	Avg	Prev Avg
2	2.6	2.4	2.5	13	10	18
3	8.4	5.4	2.3	19	17	21
5	2.7	1.7	2.0	17	16	23
8	2.5	1.7	2.3	10	8	16
9	2.3	1.8	2.2	21	15	15
10	1.4	1.1	2.1	21	15	20
11	4.2	2.4	2.0	17	13	6

* Less than sensitivity of analysis.
** Concentrated by ion exchange.

APPENDIX A

Table 12. Radionuclides in Transport in Stream and River Water, curies/6 months

Location	Nonvolatile Beta	Tritium	I^{131}	$Sr^{89,90}$	Sr^{90}	Cs^{137}
Four Mile Creek	12.6	3,700	0.55	1.06	0.30	6.16
Pen Branch	19.4	4,900	1.16	1.81	0.22	2.01
Steel Creek	56.5	22,300	3.23	20.47	1.26	6.08
Lower Three Runs	1.4	2,000	-	0.39	0.22	0.42
Total →	89.9	32,900	4.94	23.73	2.00	14.67
River Control	30.9	2,000	-	-	2.06	-
River Downstream from Plant	94.0	35,100	-	-	4.55	-
Apparent Plant Contribution At Stream Locations*	83	32,300	-	-	1.59	-
Apparent Plant Contribution In River Downstream from Plant	63	33,100	-	-	2.49	-

* Compensated for river water used by the Plant.

Table 13. Input and Seepage Rates for 200-Areas Seepage Basins, liters/day

	July - December 1962	
	F Area	H Area
Waste Input	3.0×10^5	3.3×10^5
Rain Input	0.6×10^5	0.5×10^5
Seepage and Evaporation	4.1×10^5	3.6×10^5

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Table 14. Radioactivity in Seepage Basin Water, μμc/ml

Basin No.	Alpha			Nonvolatile Beta			Radioiodine			Tritium		
	Max	Avg	Prev Avg	Max	Avg	Prev Avg	Max	Avg	Prev Avg	Max	Avg	Prev Avg
200-F												
1	20.0	7.5	5.8	1600	830	1000	150	46	15			
2	9.3	5.3	10.6	1200	630	650	66	22	10			
3	5.1	2.9	5.6	650	420	550	17	7	6			
200-H												
1	1.0	0.3	0.3	490	180	200	4	2	4			
2	1.5	0.4	0.6	220	130	200	3	1	4			
3	0.2	*	*	46	27	30	3	1	1			
700-A												
1	0.4	0.3	0.6	640	130	2	-	-	-	9,600	6,300	3,300
TNX												
1	50	8.2	5.3	349	32	19	-	-	-	78	33	48

* Less than sensitivity of analysis.

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Table 15. Radioactivity in Burial Ground and R-Area Seepage Basin Wells

Well No.	Alpha			Nonvolatile Beta			Tritium*		
	Max	Avg	Prev Avg	Max	Avg	Prev Avg	Max	Avg	Prev Avg
Burial Ground Wells									
1	0.5	0.3	0.4	11	7	9	5	**	**
2	1.0	.4	.2	14	8	8	9	**	**
3	1.8	.5	.3	9	5	7	5	**	**
4	1.4	.8	.7	20	10	8	140	95	150
5	3.3	.8	.3	10	6	8	21	17	22
6	0.6	.2	.2	22	10	12	**	**	**
7	0.8	.2	**	18	12	13	5	**	**
8	1.1	.7	.7	9	8	8	57	44	14
9	0.5	.4	.5	8	6	9	6	**	**
12	1.0	0.8	0.7	16	10	12	8	**	**
18	6.4	4.7	2.4	20	19	19	19	14	30
23	1.4	1.2	-	12	11	-	25	10	-
24	2.2	2.0	-	14	12	-	14	5	-
25	2.0	1.9	-	14	11	-	74	50	-
R-Area Seepage Basin Wells									
A-6	0.5	0.3	0.3	24	18	31	18	10	8
A-7	.4	.3	.4	30	16	15	32	16	18
A-8	.3	.2	.5	10	7	15	22	15	15
A-9	.5	.4	.5	42	24	19	23	19	17
A-10	.3	.2	.4	27	19	28	9	6	10
C-1	-	-	.5	-	-	63	-	-	11
C-2	0.5	.3	.3	45	19	18	28	22	19
C-3	1.0	.5	.4	36	16	30	14	6	4
C-4	0.6	.5	.7	35	22	27	23	15	17
C-5	.9	.5	.5	87	31	25	42	22	10
C-6	.8	.6	.8	36	23	23	58	46	74
C-7	0.5	.3	0.4	26	15	21	26	9	4
C-8	1.2	.8	1.0	30	15	15	33	24	31
C-9	0.6	.4	0.4	23	10	13	11	13	15
C-10	.4	.2	.3	17	10	31	34	16	14
D-1	.8	.3	.2	24	19	25	44	40	30
D-2	.8	.3	.4	79	65	81	49	44	48
D-3	0.5	0.3	0.4	24	17	34	36	29	32

* Multiply by 10^3.
** Less than sensitivity of analysis.

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Table 16. Radioactivity in 200-Areas Seepage Basin Wells, μμc/liter

Well No.	Distance from Basin, ft	Alpha			Nonvolatile Beta		
		Max	Avg	Prev Avg	Max	Avg	Prev Avg
			F Area				
1	34	8900	2900	930	270,000	158,000	100,000
3	29	20	3.7	0.4	390	210	280
8	63	0.7	0.6	0.8	30	19	50
9	150	0.6	0.4	0.3	26	16	17
10	9	3400	1500	4200	200,000	168,000	41,000
14	180	2.2	1.5	-	1,600	1,200	-
15	480	0.6	0.3	-	94	74	-
16	340	0.6	.4	-	160	120	-
17	580	1.1	.7	-	46	33	-
18	690	1.8	0.7	-	33	19	-
19	830	1.5	1.0	-	38	19	-
23	180	2.4	2.1	-	58	31	-
24	300	3.1	1.9	-	29	21	-
25	420	2.4	1.6	-	28	21	-
			H Area				
1	24	26	20	50	9,200	5,600	8,400
2	25	0.4	0.2	0.9	42	29	270
3	15	2.0	1.2	4.0	3,500	2,600	15,000
4	45	1.1	0.8	0.8	120	95	100
5	13	211	141	422	38,000	19,000	84,000
6	6	1.7	0.6	1.1	2,200	650	150
7	66	1.0	.7	0.3	23	15	50
8	18	0.2	.1	.1	120	74	120
9	78	.2	.1	.2	45	33	110
10	19	.2	.2	.1	42	25	75
11	79	0.3	0.2	0.2	110	64	79
12	500	4.2	2.1	2.5	130	96	170
13	220	0.7	0.4	-	58	35	-
14	220	1.0	.6	-	32	21	-
15	260	0.7	.5	-	17	13	-
16	330	1.6	0.9	-	91	55	-
17	260	1.7	1.4	-	48	28	-
18	400	1.5	1.2	-	37	23	-
19	310	0.7	0.3	-	19	11	-

Well No.	Radiostrontium			Tritium*		
	Max	Avg	Prev Avg	Max	Avg	Prev Avg
			F Area			
1	360,000	89,000	23,000	118	74	47
3	680	440	-	63	49	56
8				12	11	8
9				8	4	2
10	9,400	8,700	22,000	111	89	75
14				25	25	-
15				3	2	-
16				14	14	-
17				0.2	0.1	-
18				6	2	-
19				0.2	0.2	-
23				6	5	-
24				0.09	0.05	-
25				0.8	0.6	-
			H Area			
1				38	14	10
2				58	56	41
3				124	118	140
4				11	9	3
5	1,100	490	1,000	160	89	130
6				70	68	63
7				4	2	6
8				19	16	17
9				15	13	12
10				11	10	11
11				19	18	18
12	130	110	130	52	47	42
13				4	3	-
14				3	2	-
15				0.4	0.2	-
16				5	5	-
17				0.2	0.2	-
18				0.1	0.1	-
19				0.2	0.2	-

* Multiply by 10^6.

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Table 17. Radioactivity in 241-H Tank Farm Wells, μμc/liter

Well	Nonvolatile Beta		
	Max	Avg	Prev Avg
HPM	128	32	54
HP1	329	280	300
HP5	57	46	52
HP8	158	133	140
TW3	91,000	47,000	62,000
TW4	388	240	330

Table 18. Radioactivity in Terrestrial Animals, μμc/gram (wet weight)

Species	No. of Samples	Nonvolatile Beta					
		Bone			Flesh		
		Max	Avg	Prev Avg	Max	Avg	Prev Avg
Rabbit	10	1030	150	45	10	4	8
Raccoon	3	35	30	20	10	7	6
Domestic Cat	5	30	15	*	15	8	*
Deer	1	-	10	13	-	2	6

* No sample during previous period.

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Table 19. Radioactivity in Waterfowl from Par Pond, μμc/gram (wet weight)

Species	No. and Type of Samples	$Sr^{89,90}$ Max	$Sr^{89,90}$ Avg	$Sr^{89,90}$ Prev Avg	Cs^{137} Max	Cs^{137} Avg	Cs^{137} Prev Avg	Zn^{65} Max	Zn^{65} Avg	Zn^{65} Prev Avg
Teal	7									
	Bone	37	15	3	*	*	5	40	6	*
	Flesh	*	*	*	7	3	4	9	4	*
Ringneck	27									
	Bone	7	5	4	8	2	2	56	14	16
	Flesh	*	*	*	11	7	4	17	7	11
Wood Duck	6									
	Bone	9	6	**	*	*	**	12	2	**
	Flesh	*	*	**	18	5	**	15	2	**
Mallard	3									
	Bone	2	2	3	*	*	*	12	8	*
	Flesh	*	*	*	7	7	2	4	3	*

* Less than sensitivity of analysis.
** No samples during previous period.

Table 20. Radioactivity in Fish from Effluent Streams, μμc/gram (wet weight)

Source	Type of Samples	$Sr^{89,90}$ Max	$Sr^{89,90}$ Avg	$Sr^{89,90}$ Prev Avg	Cs^{137} Max	Cs^{137} Avg	Cs^{137} Prev Avg	Zn^{65} Max	Zn^{65} Avg	Zn^{65} Prev Avg
Par Pond										
	Bone	55	45	30	30	20	15	80	50	75
	Flesh	*	*	*	65	55	35	25	10	20
Lower Three Runs										
	Bone	70	45	35	55	15	10	*	*	5
	Flesh	*	*	*	60	25	25	*	*	*
Steel Creek										
	Bone	195	115	30	10	5	3	95	65	285
	Flesh	*	*	*	10	10	10	7	2	20

* Less than sensitivity of analysis.

Table 21. Radioactivity in Algae from Effluent Streams, μμc/gram (dry weight)

Source	$Sr^{89,90}$ Max	Avg	Prev Avg*	Cs^{137} Max	Avg	Prev Avg*	Zn^{65} Max	Avg	Prev Avg*
Par Pond	130	55	55	1560	290	230	3870	1100	730
Lower Three Runs	40	20	15	90	25	5	**	**	**
Steel Creek	260	75	50	1650	550	255	4160	830	410

Table 22. Radioactivity in Fish from the Savannah River, μμc/gram (wet weight)

Source	Sample	$Sr^{89,90}$ Max	Avg	Prev Avg	Cs^{137} Max	Avg	Prev Avg	Zn^{65} Max	Avg	Prev Avg
3 Miles Above Plant										
	Bone	15	8	9	**	**	**	**	**	
	Flesh	**	**	**	**	**	**	**	**	
Month of Steel Creek										
	Bone	135	43	15	**	**	**	105	18	5
	Flesh	**	**	**	11	2	1	28	6	1
10 Miles Below Plant										
	Bone	24	14	10	**	**	**	16	3	
	Flesh	**	**	**	2	1	**	**	**	

Table 23. Radioactivity in Algae from the Savannah River, μμc/gram (dry weight)

Source	$Sr^{89,90}$ Max	Avg	Prev Avg*	Cs^{137} Max	Avg	Prev Avg*	Zn^{65} Max	Avg	Prev Avg*
Above Plant (Control)	16	6	15	9	1	3	**	**	**
Adjacent to Plant	415	56	24	305	40	11	755	135	19
10 Miles Below Plant	57	8	20	110	30	5	120	30	13

* For May and June 1962.
** Less than sensitivity of analysis.

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Table 24. Chemical Quality of Savannah River Water

	Upstream				Downstream			
	Max	Min	Avg	Prev Avg	Max	Min	Avg	Prev Avg
Color, APHA	55	5	25	34	50	5	25	33
pH	7.4	6.8	7.1	7.1	8.0	6.8	7.1	7.1
Methyl Orange, ppm $CaCO_3$	23	11	17	16	51	12	18	17
Dissolved Oxygen, ppm	12.4	7.2	9.2	9.6	12.0	6.7	8.5	9.1
Sulfide, ppm S	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Hardness, ppm $CaCO_3$	26	5	14	13	28	15	9	13
Conductivity, µmhos	57	35	48	47	60	40	49	47
TDS, ppm	50	20	36	38	52	11	37	38
BOD, ppm	1.60	0.00	0.50	0.70	1.70	0.00	0.40	0.50
Lignin, ppm	6.6	0.7	2.9	3.6	7.0	1.2	3.0	3.8
Total Iron, ppm Fe	1.9	.1	0.7	1.0	1.4	0.2	0.8	1.0
Chloride, ppm Cl	4.2	.6	2.2	2.6	4.8	.7	2.1	2.3
Nitrite, ppm N	0.004	< .002	<0.002	<0.002	0.025	< .002	0.003	0.003
Nitrate, ppm N	0.10	0.02	0.04	0.04	0.10	0.01	0.04	0.04
Sulfate, ppm SO_4	3.7	<2.0	2.0	<2.0	8.6	<2.0	2.1	<2.0
Phosphate, ppm PO_4	0.8	<0.3	<0.3	4.8	0.7	<0.3	<0.3	6.2
Surfactant, ppm	0.15	<0.02	<0.02	<0.02	0.05	<0.02	<0.02	<0.02

Chemical Quality of Lower Three Runs Water

	Above Mill Effluent				Below Mill Effluent			
	Max	Min	Avg	Prev Avg	Max	Min	Avg	Prev Avg
Color, APHA	40	10	21	35	40	10	23	36
pH	7.9	6.8	7.3	7.2	8.3	6.8	7.3	7.2
Methyl Orange, ppm $CaCO_3$	36	22	30	24	91	25	37	24
Dissolved Oxygen, ppm	11.4	6.1	8.2	8.8	11.4	5.5	8.0	8.8
Sulfide, ppm S	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Hardness, ppm $CaCO_3$	42	21	31	24	54	25	33	27
Conductivity, µmhos	81	55	69	59	99	32	71	61
TDS, ppm	66	30	48	42	81	31	51	43
BOD, ppm	1.06	0.00	0.35	0.60	3.22	0.00	0.56	0.50
Lignin, ppm	4.8	1.3	2.5	4.4	5.8	1.6	3.0	4.6
Total Iron, ppm Fe	0.80	0.20	0.39	0.50	1.50	0.30	0.54	0.70
Chloride, ppm Cl	3.3	.1	2.0	1.5	3.2	.1	2.0	1.6
Nitrite, ppm N	<0.002	<0.002	<0.002	<0.002	0.009	< .002	<0.002	<0.002
Nitrate, ppm N	0.05	0.01	0.03	0.03	0.06	0.01	0.04	0.03
Sulfate, ppm SO_4	2.2	<2.0	<2.0	<2.0	2.6	<2.0	2.3	<2.0
Phosphate, ppm PO_4	<0.3	<0.3	<0.3	3.6	0.8	<0.3	<0.3	3.6
Surfactant, ppm	0.20	<0.02	0.04	<0.02	0.50	<0.02	0.05	<0.02

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Table 24, contd

Dissolved Oxygen Content of Reactor Effluent Streams

Stream	Dissolved Oxygen, ppm			Saturation, %		
	Min	Avg	Prev Avg	Min	Avg	Prev Avg
Upper Three Runs	7.1	8.9	9.3	80	90	91
Four Mile Creek	4.6	5.6	6.1	88	90	93
Pen Branch	4.2	5.6	6.1	87	91	98
Steel Creek	4.8	6.3	6.7	90	93	98
Lower Three Runs	5.5	7.9	8.8	75	80	88

Dissolved Oxygen Content of Savannah River

Location	Water Temp, °C		Dissolved Oxygen, ppm		Saturation, %	
	9/19	12/19	9/19	12/19	9/19	12/19
Butler Creek	23	11	6.6	11.7	76	100
Spirit Creek	23	10	6.2	10.1	71	89
Silver Bluff	23	10	6.7	11.4	77	100
Gray's Landing	23	9	6.9	10.6	79	91
SR 2	23	9	6.7	11.5	77	99
Hancock Landing	24	10	6.9	10.3	81	91
Griffin's Landing	25	11	7.0	10.3	83	93
Brigham's Landing	25	10	7.4	10.4	88	91
Steel Creek	29	11	6.1	9.4	78	85
Little Hell Landing	27	11	6.7	10.2	83	92
Lower Three Runs	23	7	7.0	10.6	80	87
Johnson's Landing	25	11	6.6	10.2	79	92
U. S. 301	25	11	6.7	10.4	80	94

APPENDIX B

Sensitivity and Standard Deviation of Laboratory Analyses

The sensitivity of laboratory analyses refers to the minimum amount of radioactivity that can be detected by the radiochemical analytical technique in use. It is based on statistical counting error (90% confidence level) and is influenced by sample size, counter efficiency, and counter background. No self-absorption corrections have been applied to the alpha and nonvolatile beta results. The standard deviations given in the following table were calculated from spike recovery values and are applicable to the six-month average data in this report.

Where samples were analyzed by gamma spectrometry, the lower level of detection of a given isotope varied with the background of each individual channel grouping and with the geometry and volume of sample analyzed. Because of this variation, no average sensitivities are given. Furthermore, in most cases no differentiation was made between nuclides emitting gamma rays of nearly the same energy. Thus, data are reported as $Ru^{103,106}$, $Ce^{141,144}$, Fe^{59}/Co^{60}, etc, but this notation does not mean that both isotopes were necessarily present. Differentiation between individual isotopes in most groupings can be made, if required, by approximate age estimates of the radioactive materials at the time of release, by chemical separations, or by decay and beta absorption studies.

Analysis	Samples	Sensitivity	Standard Deviation, %	Spike Value
Alpha	Water	0.22 ± 0.05 μμc/ℓ	9	45 μμc/ℓ
	Mud	0.22 ± 0.05 μμc/g	-	-
	Vegetation	0.11 ± 0.02 μμc/g	-	-
	Air	$0.04 \pm 0.01 \times 10^{-2}$ μμc/m³	-	-
Beta	Water	4.2 ± 0.3 μμc/ℓ	-	-
	Mud	4.2 ± 0.3 μμc/g	-	-
	Vegetation	2.1 ± 0.2 μμc/g	-	-
	Biological Specimens	2.0 ± 0.1 μμc/g*	-	-
	Air	$0.6 \pm 0.04 \times 10^{-2}$ μμc/m³	-	-
TBP Extraction	Water	0.28 ± 0.06 μμc/ℓ	20	45 μμc/ℓ
	Mud	0.26 ± 0.06 μμc/g	25	45 μμc/g
	Vegetation	0.03 ± 0.01 μμc/g	10	4.5 μμc/g
Radioiodine	Water	9.3 ± 0.7 μμc/ℓ	9	300 μμc/ℓ
	Vegetation	0.2 ± 0.01 μμc/g	-	-
	Air	$1.8 \pm 0.2 \times 10^{-2}$ μμc/m³	-	-
	Milk	2.2 ± 0.05 μμc/ℓ	10	200 μμc/ℓ
Tritium	Water	3000 ± 200 μμc/ℓ	3	2500×10^{3} μμc/ℓ
	Air	60 μμc/m³**	-	-
Radiocesium	Water	5.0 ± 0.3 μμc/ℓ	9	600 μμc/ℓ
Radiostrontium	Water	8.0 ± 0.6 μμc/ℓ	7	230 μμc/ℓ
Strontium-90	Water	0.1 ± 0.01 μμc/ℓ	8	230 μμc/ℓ
	Milk	1.0 ± 0.1 μμc/ℓ	7	47 μμc/ℓ

* Approximate; sample size varied.
** Approximate; varied with absolute humidity.

APPENDIX C

Sampling Locations

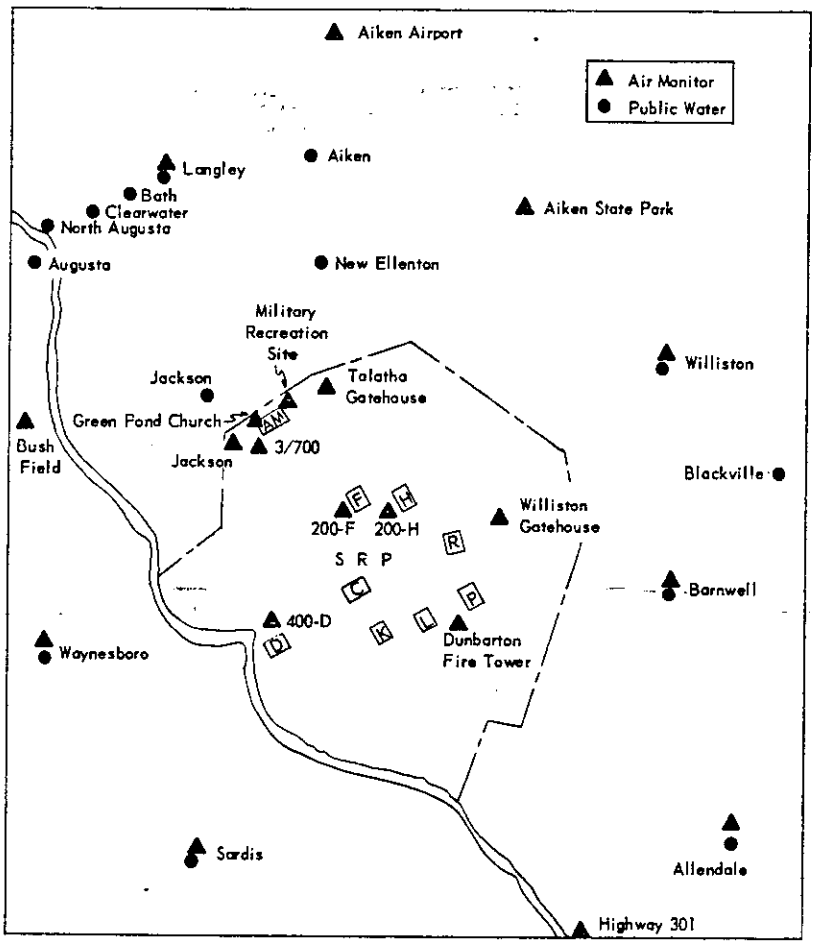

FIGURE 1. CONTINUOUS AIR MONITORING STATIONS AND PUBLIC WATER SAMPLING LOCATIONS

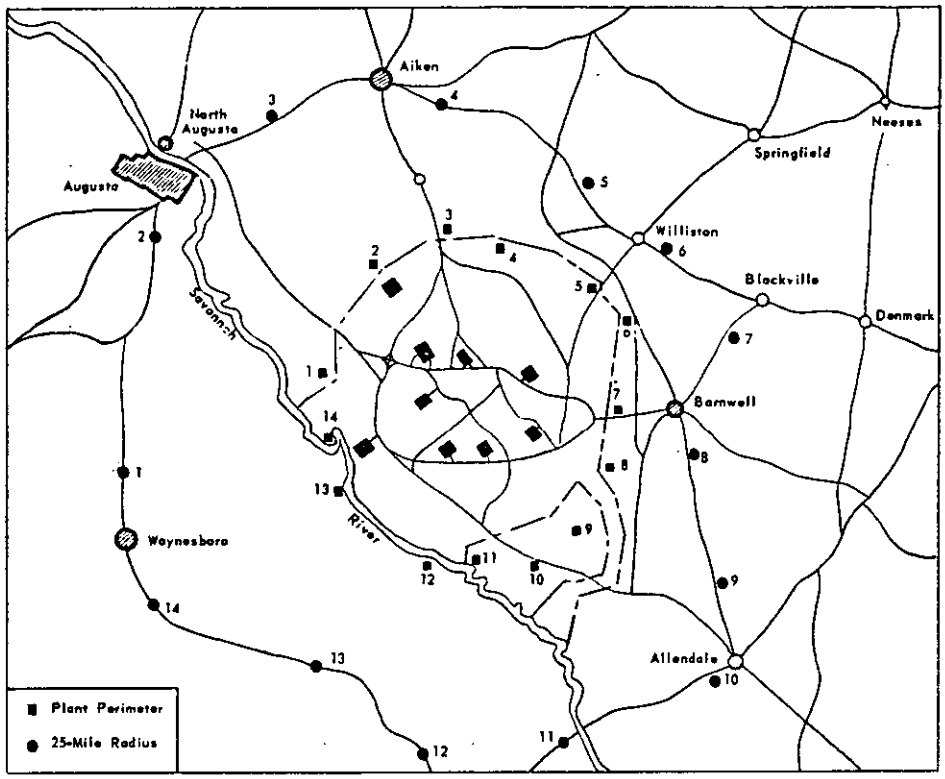

FIGURE 2. VEGETATION SAMPLE LOCATIONS

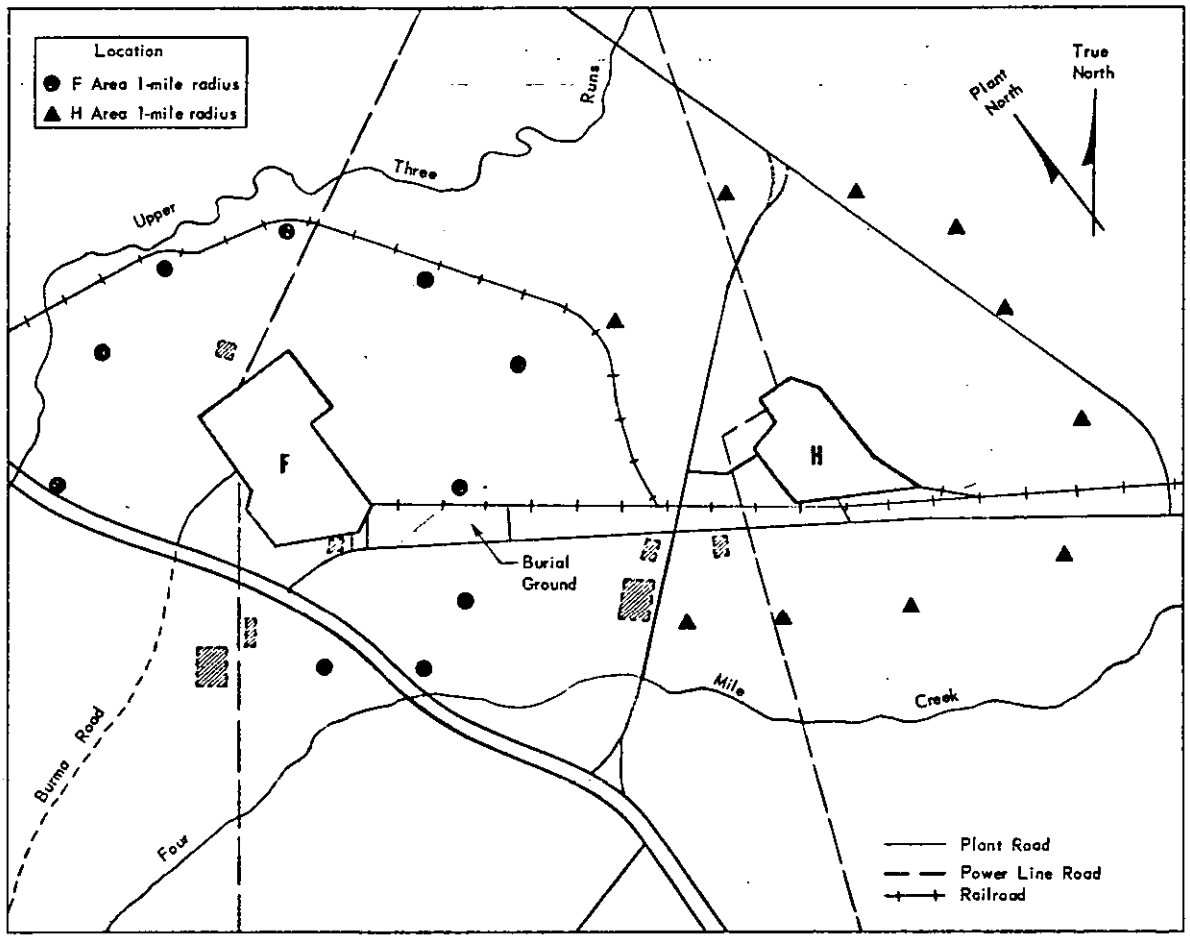

FIGURE 3. VEGETATION SAMPLE LOCATIONS IN F AND H AREAS

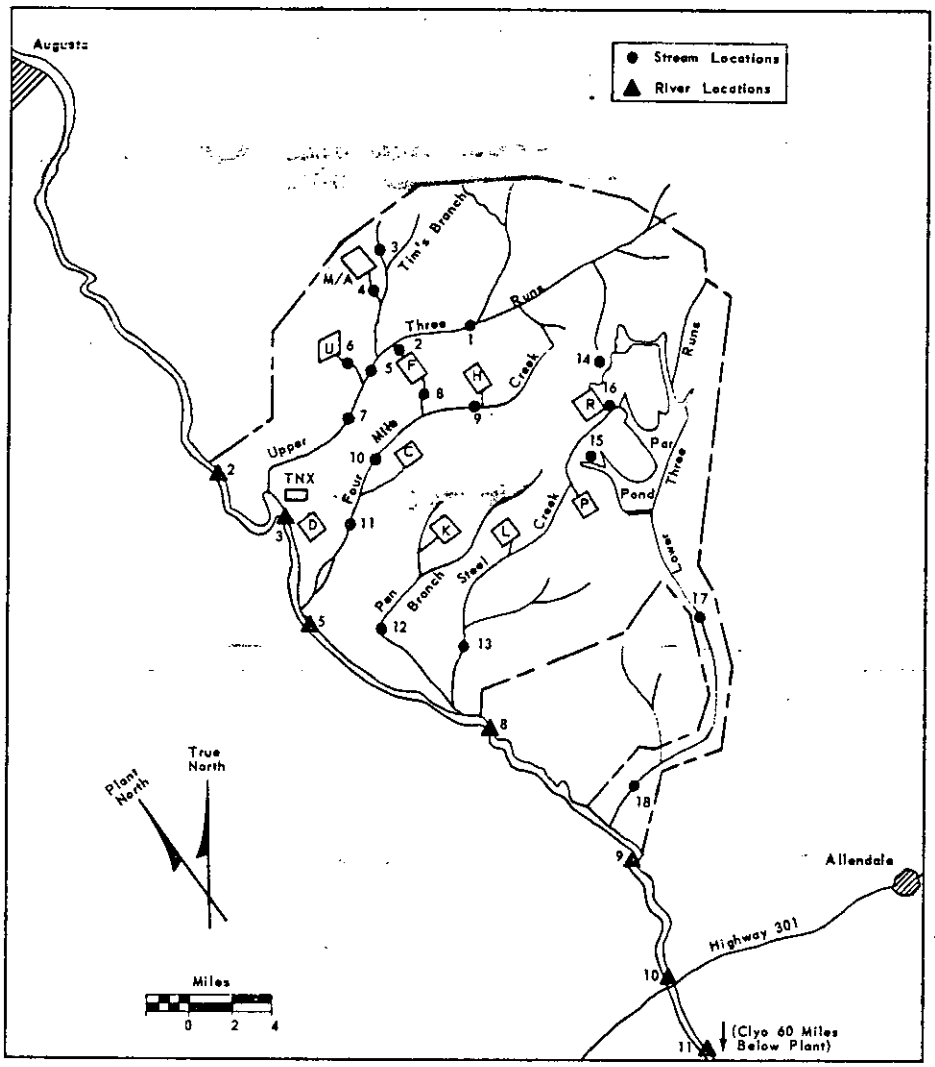

FIGURE 4. STREAM AND RIVER SAMPLE POINTS

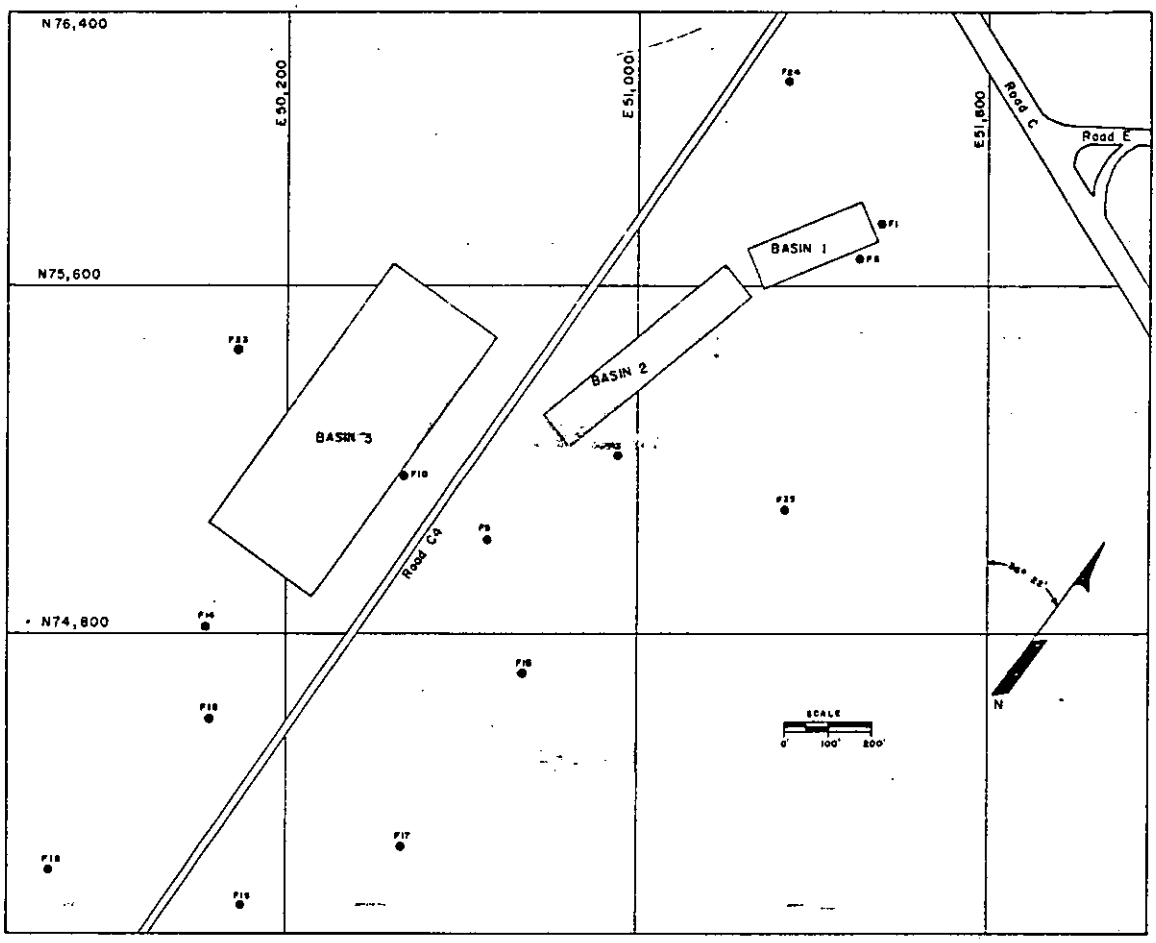

FIGURE 5. SEEPAGE BASIN MONITORING WELLS IN F AREA

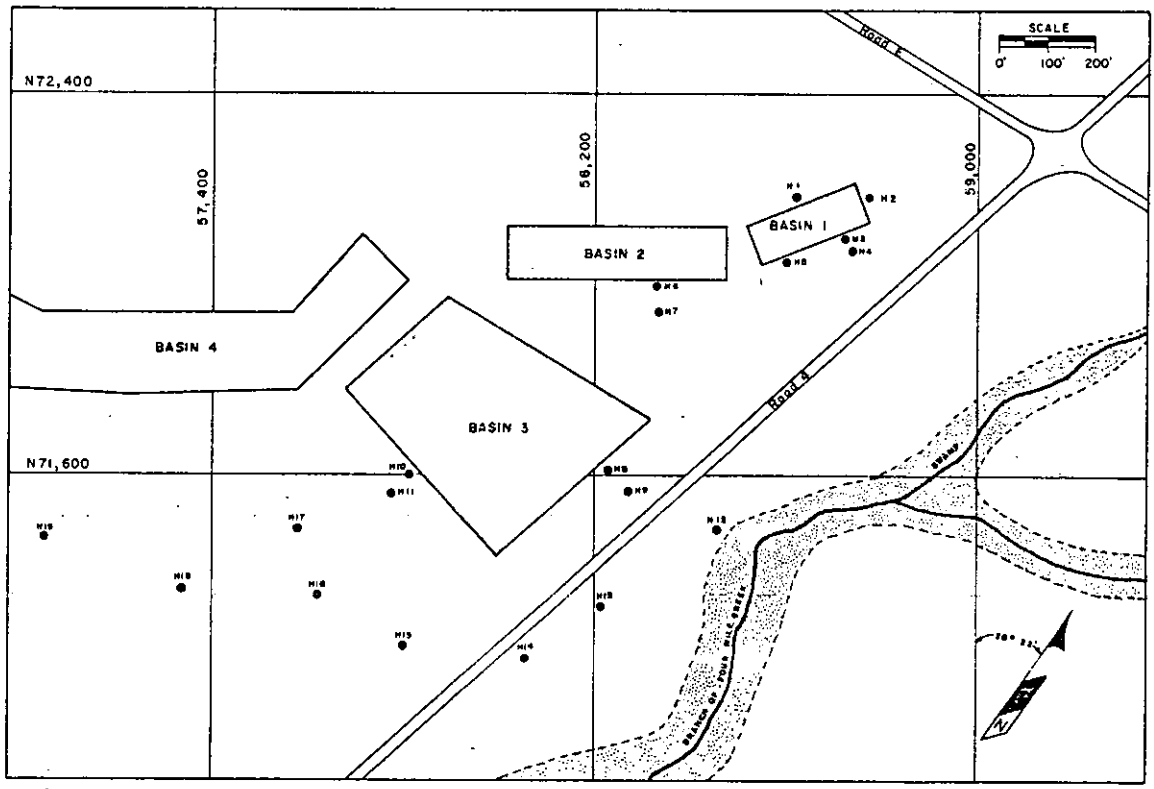

FIGURE 6. SEEPAGE BASIN MONITORING WELLS IN H AREA

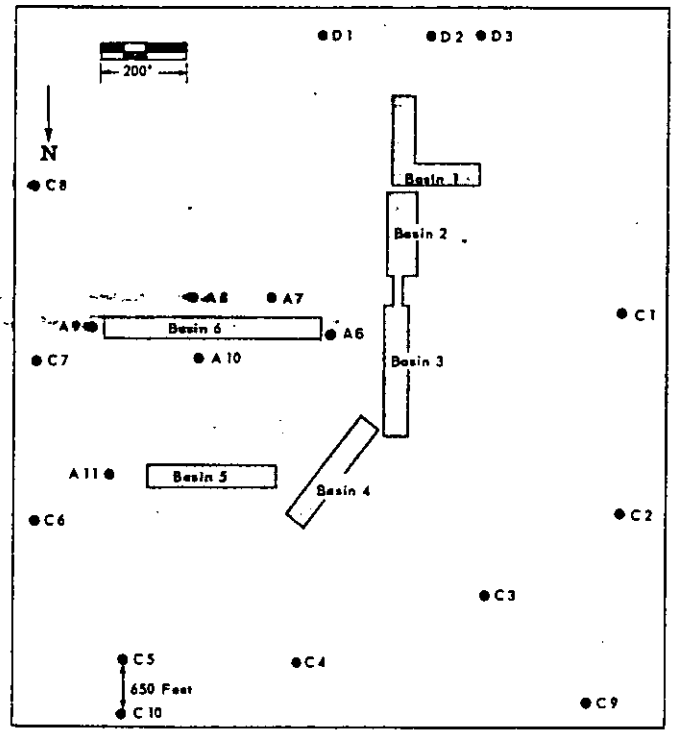

FIGURE 7. R-AREA SEEPAGE BASINS AND MONITORING WELLS

Backfilled Basins

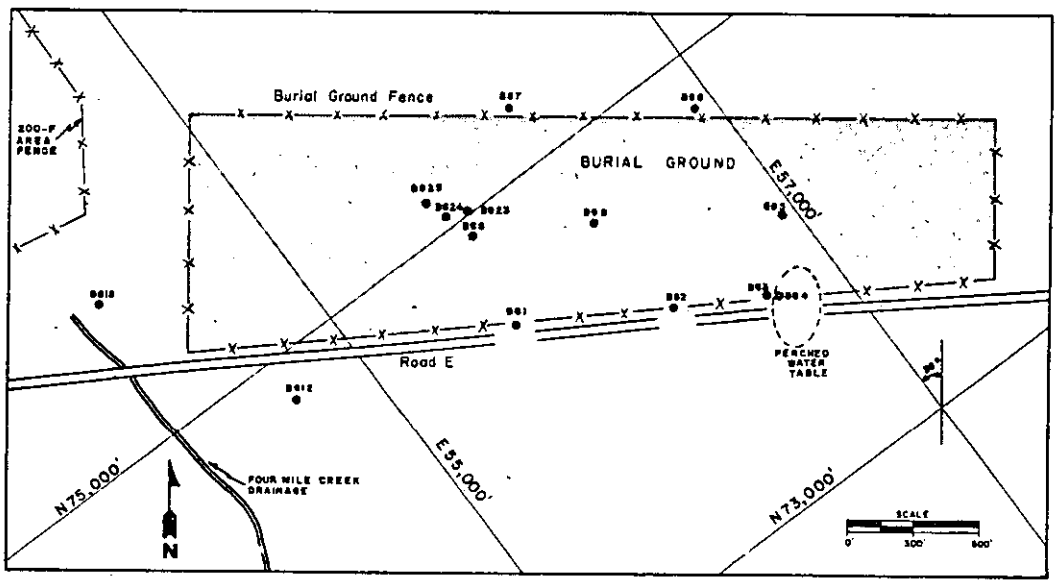

FIGURE 8. BURIAL GROUND WELLS

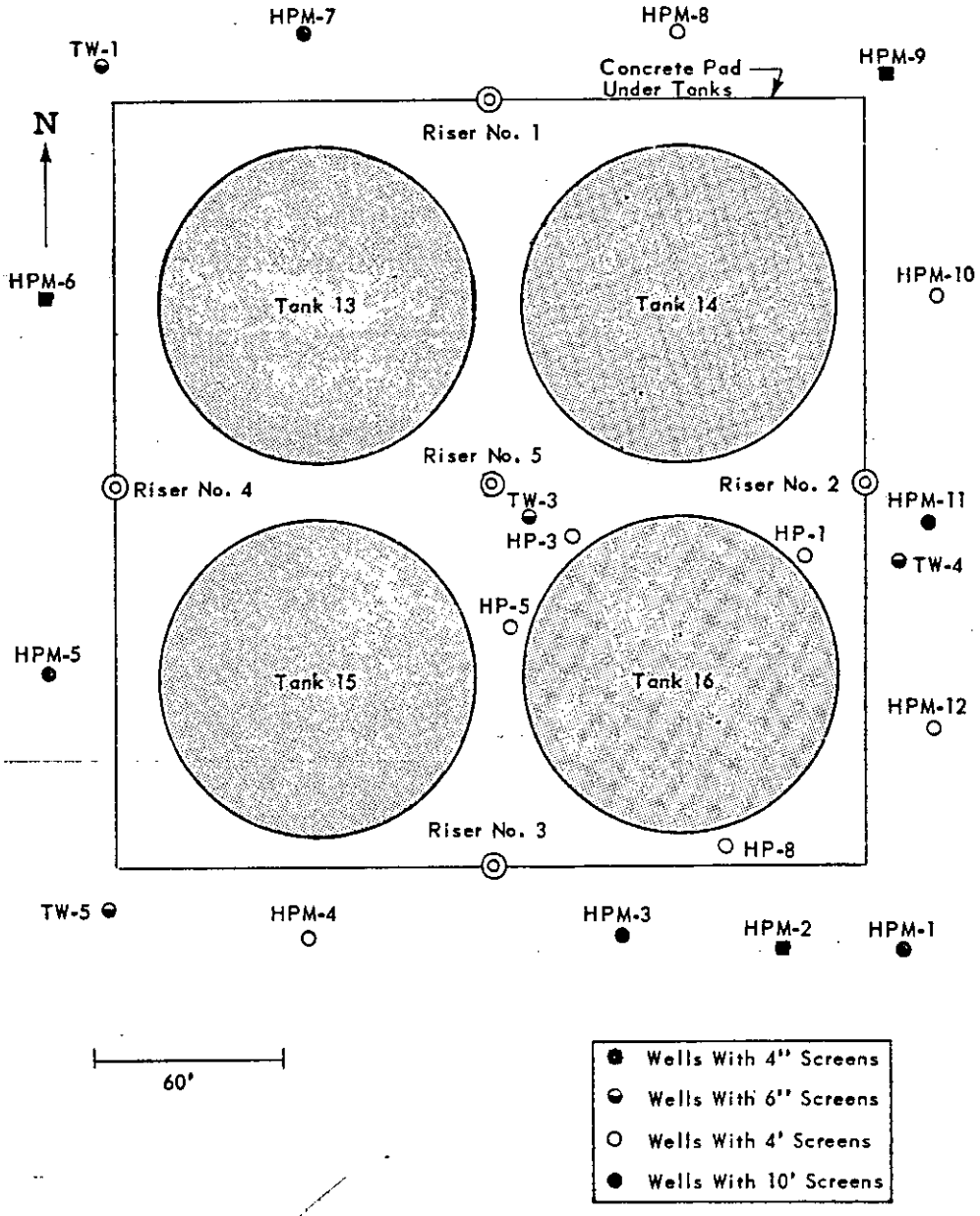

FIGURE 9. UPPER TANK FARM WELLS, 241-H

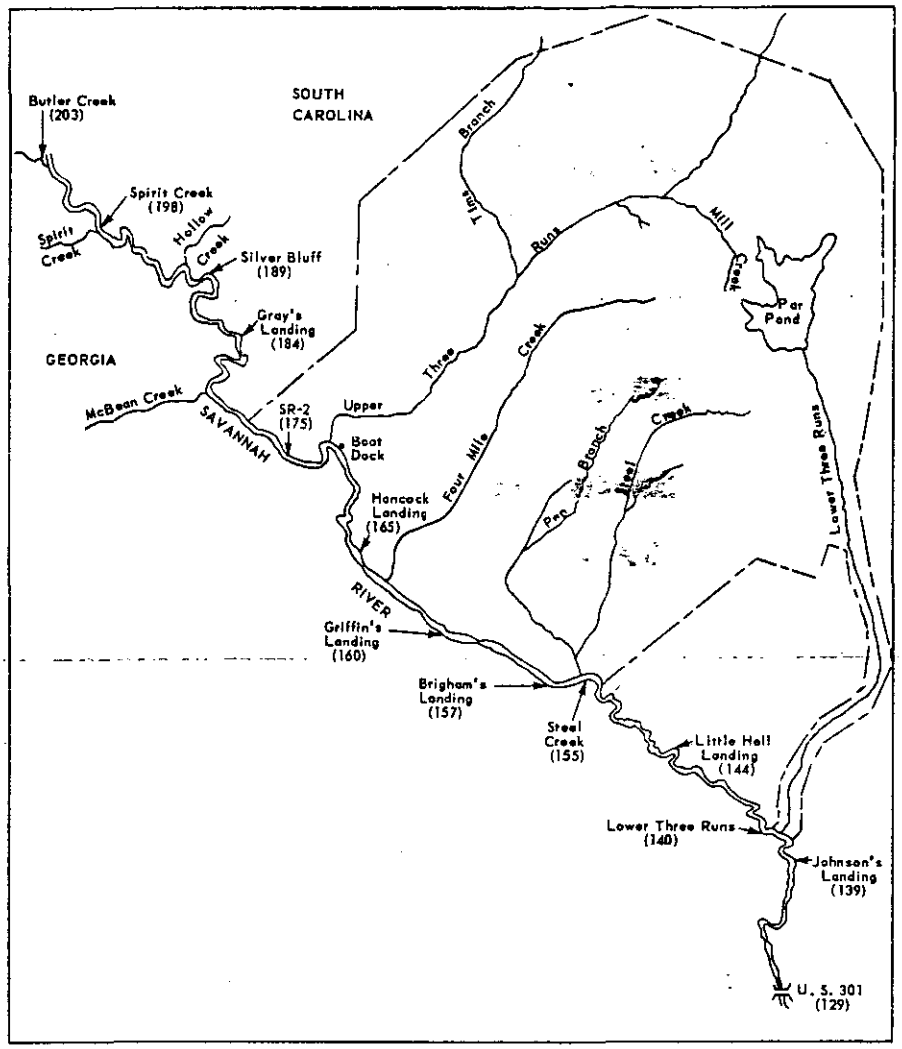

FIGURE 10. DISSOLVED OXYGEN SAMPLE POINTS ON THE SAVANNAH RIVER. Numbers in parentheses are river miles from Savannah, Georgia.