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HEALTH PHYSICS REGIONAL MONITORING

Semiannual Report,

January through June 1961

February 1962

CLASSIFICATION CANCELLED
BY AUTHORITY OF
[signature] 11-28-73
NAME TITLE DATE

Report Declassified with Deletions on Pages 5, 50, 52, & 62.

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WORKS TECHNICAL DEPARTMENT
E. I. du PONT de NEMOURS & COMPANY
EXPLOSIVES DEPARTMENT - ATOMIC ENERGY DIVISION
SAVANNAH RIVER PLANT

RESTRICTED DATA

E. I. du PONT de NEMOURS & COMPANY
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[redacted]

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Written and Approved - December 1961
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E. I. du Pont de Nemours and Company
Explosives Department - Atomic Energy Division
Savannah River Plant

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Abstract

Radioactivity in the Plant environs was measured during the six-month period ending June 30, 1961. Releases of alpha emitters, non-volatile beta emitters, and tritium to effluent streams increased, while such releases to the atmosphere decreased. Radioiodine released to the atmosphere - the highest six-month total observed since 1957 - was attributed almost entirely to that released from the Building 291-F stack.

Introduction

Under a program established by the Du Pont Company in June 1951, the Savannah River Plant site and surrounding region are systematically monitored for radioactivity. The environmental 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 January through June 1961, is one of a series of reports relating to the environmental monitoring program.

Data Reporting

Survey data were averaged for the six-month period and compared with the previous six-month averages ("Health Physics Regional Monitoring Semiannual Report," DPSP 61-25-4, October 1961). In reporting data, "Avg" or "Total" refers to the average or total for this six-month report period, while "Prev Avg" or "Prev Total" refers 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 the report period.

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 techniques 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, calculated from spike recovery values, are applicable to the six-month averages of data in this report.

Where samples were analyzed by gamma spectrometry, the lower level of detection of a given isotope varied with: (1) background of each individual channel grouping, and (2) geometry and volume of sample

analyzed. For this reason no average sensitivities are given. Furthermore, using gamma spectrometry, it is not practical to differentiate 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; and such notation does not mean that both isotopes were necessarily present. The differentiation between numbers of most of such groupings can be made, if required, by: (1) approximate age estimates of the radioactive material at the time of release, (2) chemical separations, and (3) decay and beta absorption studies.

Analysis	Sample	Sensitivity	Standard Deviation, %	Spike Value
Alpha	Water	$0.19 \pm 0.08 \times 10^{-15}$ c/ml	8.7	45×10^{-15} c/ml
	Mud	$0.19 \pm 0.08 \times 10^{-12}$ c/g	-	-
	Vegetation	$0.10 \pm 0.04 \times 10^{-12}$ c/g	-	-
	Air	$0.03 \pm 0.01 \times 10^{-14}$ µc/cc	-	-
Beta	Water	$4.1 \pm 2.7 \times 10^{-15}$ c/ml	-	-
	Mud	$4.1 \pm 2.7 \times 10^{-12}$ c/g	-	-
	Vegetation	$2.1 \pm 1.3 \times 10^{-12}$ c/g	-	-
	Biological Specimens	$2.2 \pm 2 \times 10^{-12}$ c/g*	-	-
	Air	$0.69 \pm 0.45 \times 10^{-14}$ µc/cc	-	-
TBP Extraction	Water	$0.27 \pm 0.12 \times 10^{-15}$ c/ml	15	45×10^{-15} c/ml
	Mud	$0.28 \pm 0.13 \times 10^{-12}$ c/g	17	45×10^{-12} c/g
	Vegetation	$0.035 \pm 0.18 \times 10^{-12}$ c/g	22	4.5×10^{-12} c/g
Radioiodine	Water	$7.8 \pm 5.1 \times 10^{-15}$ c/ml	9.3	300×10^{-15} c/ml
	Vegetation	$0.67 \pm 0.43 \times 10^{-12}$ c/g	17	20×10^{-12} c/g
	Air	$1.8 \pm 1.2 \times 10^{-14}$ µc/cc	-	-
	Milk	$9.8 \pm 1.5 \times 10^{-15}$ µc/cc	11	3000×10^{-15} c/ml
Tritium	Water	4×10^{-12} c/ml	5	2500×10^{-12} c/ml
	Air	0.04×10^{-9} µc/cc**	-	-
Radiocesium	Water	$4.3 \pm 2.8 \times 10^{-15}$ c/ml	14	600×10^{-15} c/ml
Radiostrontium	Water	$6.5 \pm 4.2 \times 10^{-15}$ c/ml	16	230×10^{-15} c/ml
Strontium-90	Water	$0.10 \pm 0.06 \times 10^{-15}$ c/ml	27	230×10^{-15} c/ml
	Milk	$1.58 \pm 0.33 \times 10^{-15}$ c/ml	11	47×10^{-15} c/ml

* Approximate average; sample size varied

** Approximate average; varied with absolute humidity.

Summary

The total quantity of radioactive waste released by the Savannah River Plant into the atmosphere, effluent streams, and earthen seepage basins during the six-month period is shown in the following table.

	Atmosphere	Effluent Stream	Seepage Basins
Alpha, mc	15.6	88	446
Nonvolatile Beta, c	4.0	230	165
Radioiodine, c	160	19	157*
Tritium, kc	412.5	27.4	12.2

* Value reflects radioiodine measured in F-Area basins on 6/14/61.

The radioiodine released to the atmosphere (the highest six-month total observed since 1957) was attributed almost entirely to the Building 291-F stack. The abnormal release occurred mostly during the period May 30 through June 3. Investigation of the source of the large amount of radioiodine in the F-Area canyon process was inconclusive but there is a probability that short-cooled uranium was unintentionally dissolved.

Atmosphere sampling yielded no evidence of Plant released alpha at any location, while filterable beta concentrations were slightly higher at F and H Areas than those at more distant locations. The Plant perimeter average concentration of filterable beta in air (7×10^{-14} μc/cc) was, however, no higher than concentrations observed at locations approximately 100 miles from the Plant. Atmospheric radioiodine and tritium were detected at locations out to and including the 25-mile radius locations. During the period of increased radioiodine release in June, Plant perimeter samples of air, vegetation and milk contained maximum concentrations of 1.0×10^{-12} μc/cc, 56×10^{-12} c/g, and 5500×10^{-15} c/ml, respectively.

The disassembly basin discharges from the reactor areas accounted for practically all of the radioactivity released to effluent streams. Of the beta activity (247 curies, excluding tritium)

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released from this source, approximately 36% was due to isotopes having half lives greater than 15 days. Plant released alpha activity had negligible effects on concentrations of alpha activity in stream water and was generally detectable only in the low volume effluents from the 200 Areas, 300 Area, and 700 Area. Concentrations of alpha emitters in river water were no higher at downstream locations than those at the upstream control location. Radioiodine was occasionally detectable in river water at the Highway 301 Crossing (10 miles downstream from the Plant), and the maximum concentration observed at this location was 42×10^{-15} c/ml. Nonvolatile beta and tritium were detectable in the river at the Highway 301 Crossing, and the flow of Plant contributed radioactivity at this location during the six-month period was calculated to be approximately 82 curies of nonvolatile beta and 47,000 curies of tritium.

F-Area releases accounted for approximately 79, 56, and 100% of the alpha, nonvolatile beta and radioiodine activity, respectively, discharged to the seepage basins. Radiostrontium released to the 200-Area basins was detectable in the surrounding ground water at distances up to 450 feet from the basins. All the alpha activity detectable in the ground water was attributed to uranium. As observed in the past, no movement of plutonium into the ground water was detected in either F or H Areas.

Radioactivity was detected in biological samples, including terrestrial animals, avian and aquatic specimens. The uptake of radioactivity by Savannah River fish was generally confined to low level concentrations of radiostrontium in the bones. However, at some locations, detectable concentrations of radiocesium and radiozinc were found in the bones and flesh. These isotopes, in higher concentrations, were found in fish in the reactor effluents. Open seepage basins served as a source of radioactivity found in terrestrial animals, while Par Pond was the source of radioactivity in waterfowl.

Radioactivity Releases and Environmental Effects

Atmosphere

Releases of alpha emitters, nonvolatile beta emitters, radioiodine, and tritium from individual Plant areas to the atmosphere during the report period are compared to releases during the previous six-month period in the following table. The individual isotopes comprising the F and H-Area beta releases are reported in Appendix A, table 1.

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Radioactivity Released to the Atmosphere

	Alpha, mc		Nonvolatile Beta, mc		Radioiodine, c		Tritium, c	
Area	Total	Prev Total	Total	Prev Total	Total	Prev Total	Total	Prev Total
F	14.2	69	1006	5441	160	1.1		
H	1.3	1	2923	102	0.05	-		
R	-	-	0.22	0.30	-	-	9,450	17,800
P	-	-	0.51	0.21	-	-	17,600	24,400
L	-	-	0.61	0.37	-	-	19,700	17,600
K	-	-	0.64	1.84	-	-	17,200	26,000
C	-	-	0.19	1.00	-	-	22,800	33,300
TNX	-	-	-	-	-	-	1,450	400
773-A	0.11	0.098	61	47	0.33	0.01	2,300	2,000
Total →	15.6	70	3992	5594	160	1.4	412,500	457,500

A substantial increase in the daily rate of release of I-131 from Building 291-F stack occurred on May 29 when 5.5 curies of I-131 were released, compared to 0.2 curie on the previous day. Release rates exceeding 10 curies/day were experienced in F Area, during the period May 30 through June 3, with a maximum daily release of 24 curies on May 30. Investigation of the source of the abnormally large amount of radioiodine in the F-Area canyon process was inconclusive but there is a probability that short-cooled uranium was unintentionally dissolved (see Special Incident Report, DPSPU 61-11-21).

Stack released radioactivity from Building 235-F, a special product facility which began operations in February 1961, was very low (0.07 mc nonvolatile beta and 0.5 μc alpha through June). Isotopes identifiable by gamma spectrometry were Fe^{59}/Co^{60}, Zn-65, Cs-137, $Zr\text{-}Nb^{95}$, and $Ce^{141,144}$.

Radionuclides identified in the Reactor Area stack releases included $Ru^{103,106}$, Cr-51, I-131, Cs-137, Mn-54, and Fe^{59}/Co^{60}.

Samples of air were collected from 20 air monitoring stations shown in figure 1. The radioactive content in air was measured by counting 319 two-inch diameter filters for alpha and beta activity and by radiochemical analysis of 269 two-inch-diameter silver nitrate impregnated filters for radioiodine. Tritium concentrations in air moisture were converted to concentrations in air by use of appropriate humidity values. The concentrations of radioactivity in air are summarized in Apendix B, table 2.

Although Plant contributed filterable beta was detected at the F and H-Area monitoring stations (average concentrations of 13×10^{-14} μc/cc and 18×10^{-14} μc/cc, respectively), the concentrations at the Plant perimeter (7×10^{-14} μc/cc average) were no higher than those at locations 100 miles distant from the Plant. Several weekly samples collected during the latter part of the report period showed concentrations as low as 2×10^{-14} μc/cc, the lowest level observed in Plant history. Gamma spectrometry of air filters identified traces of $Ce^{141,144}$, $Ru^{103,106}$, and Cs-137; the previously present $Zr\text{-}Nb^{95}$ was no longer identifiable. Routine gamma pulse height analyses of air filters also revealed a 0.48 Mev photopeak not associated with previously observed radionuclides. Identification of the nuclide as naturally occurring Be-7 was made by the Chemistry Methods Group of the Health Physics Section. Previously, the low concentrations of Be-7 were effectively masked by the radioruthenium in fallout from weapons tests. The decrease in fallout and a new gamma spectrometer crystal with its improved resolution allowed the spectrometric detection.

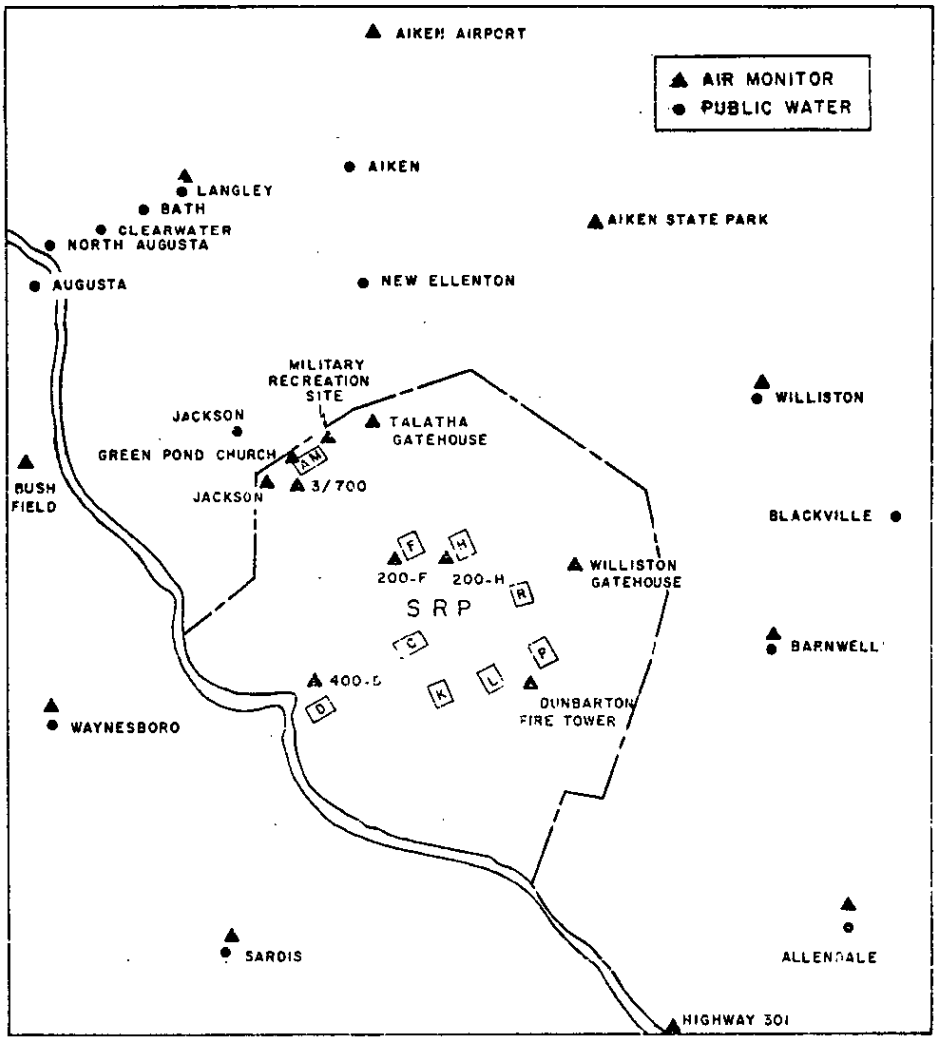


FIGURE 1. CONSTANT AIR MONITORING STATIONS AND PUBLIC WATER SAMPLING LOCATIONS

The increased radioiodine concentrations in air were due to F-Area stack releases (see "Radioiodine Levels During June 1961" in this report).

Gamma Radiation Levels

A summary of 489 readings of environmental gamma radiation, made with Landsverk L-65 pocket chambers and a modified L-60 electrometer, is given in Appendix B, table 1. The average dose rate recorded at the 25-mile radius locations (shown in figure 1) was 0.33 mr/24 hours, as compared to an average of 0.36 mr/24 hours during the previous six-month period. Slightly higher rates were measured during the first half of 1961 in the Separations Areas, the 3/700 Area, and four of the Reactor Areas. The six-month average dose rate at these locations ranged from 0.78 mr/24 hours at H Area to 0.48 mr/24 hours at P Area.

Rainwater

Results of analyses of 420 weekly samples collected continuously at each monitoring station shown in figure 1 are summarized in Appendix B, table 3. Effects of Plant released radioactivity in rainwater generally paralleled those seen in air. Radioactivity deposited on the Plant site, estimated from the analyses of rainwater samples and rainfall measurements at five monitoring stations, is shown in the following table. During weeks in which no rain occurred, nonvolatile beta deposition was estimated from radioactivity collected in an open pan of water located near Building 735-A. Total alpha radioactivity deposited on the Plant in rainwater during the six-month period was 0.93 $mc/mile^2$.

	Nonvolatile Beta, mc/mile^2	Radioiodine, mc/mile^2	Tritium, c/mile^2
January	3.6	1.5	1.9
February	6.8	-	2.5
March	2.2	-	2.7
April	8.6	-	5.3
May	3.4	-	2.6
June	5.5	6.7	2.4
Total →	30.1	8.2	17.4
Previous Total →	40.4	-	22.9

Cesium and strontium fallout in rainwater at the F-Area and Green Pond Church monitoring stations were collected by an ion exchange method and analyzed. See the following table for cumulative data for the six-month period.

	Cs^{137}, mc/mile^2	$Sr^{89,90}$, mc/mile^2
F Area	4.5	2.1
Green Pond Church (Plant Perimeter)	1.4	1.1

Vegetation

Concentration of alpha and nonvolatile beta activity on 168 vegetation samples, collected from locations shown in figures 2 and 3, represent negligible Plant contribution to environmental radioactivity. Analytical results of these samples are shown in Appendix B, table 4. Radioiodine became detectable on vegetation samples during the latter part of the report period as a result of I-131 releases from F Area. Numerous special vegetation samples were collected during this period of increased I-131 release, and are reported in the section, "Radioiodine Levels During June 1961."

Milk

Samples of milk were collected weekly from Talatha, Snelling, Aiken North Augusta and Langley, S. C. In the 77 samples analyzed for

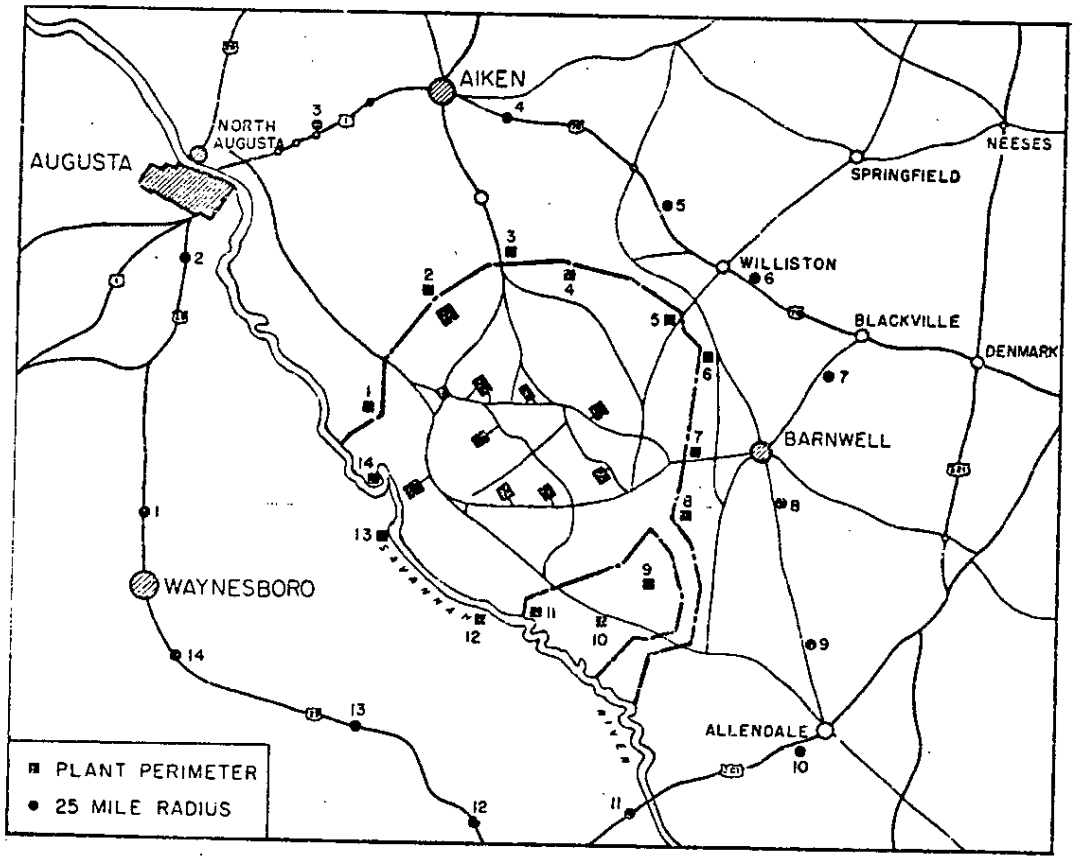


FIGURE 2. VEGETATION SAMPLE LOCATIONS

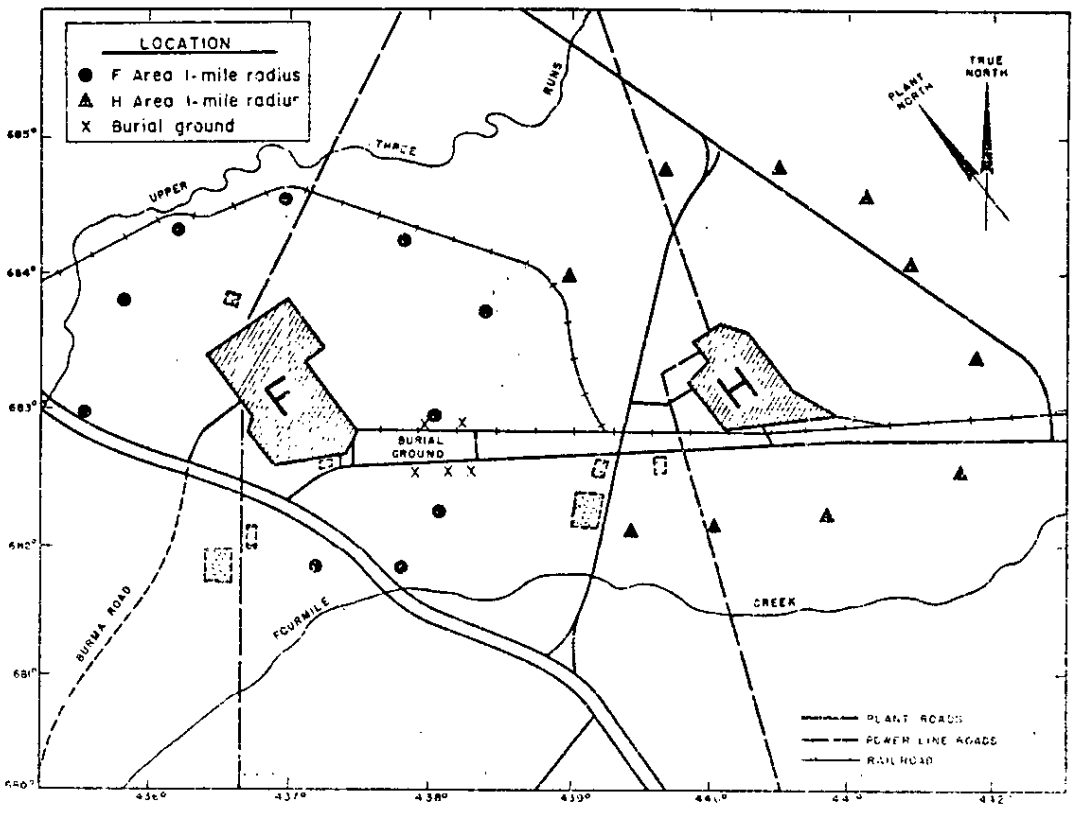


FIGURE 3. VEGETATION SAMPLE LOCATIONS IN F AND H AREAS

radioiodine, the average concentration was 31×10^{-15} c/ml (maximum of 760×10^{-15} c/ml) as compared with less than 9×10^{-15} c/ml during the previous six-months as shown in Appendix B, table 5. Radioiodine levels in special milk samples collected during the period of increased I-131 release are given in the section, "Radioiodine Levels During June 1961."

Regional milk produced by dairy herds and by family-owned cows was analyzed quarterly for Sr-90 content. The average concentrations shown in Appendix B, table 5, are essentially the same as those observed during the two previous quarters. A maximum concentration of 51 $\mu\mu c/\ell$ was measured in milk collected from a family-owned cow at Snelling. The unusual Snelling result was attributed to fallout Sr-90. Analyses of soil and vegetation of pastureland where the Snelling cow grazed indicated an accumulation of Sr-90 in low lying areas because of poor drainage.

Radioiodine Levels During June 1961

The release of 154 curies of I-131 from Building 291-F stack, most of which was discharged during the period May 30 through June 3, temporarily caused increased concentrations of I-131 in the vicinity of the Plant. A substantial increase in the daily rate of release occurred on May 29 when 5.5 curies of I-131 were released, compared to 0.2 curie on the previous day. Release rates exceeding 10 curies/day were experienced in F Area during the period May 30 through June 3 with a maximum daily release of 24 curies on May 30 (see Special Incident Report, DPSPU 61-11-21).

Meteorological conditions during the release period were such that the pattern of environmental radioiodine deposition extended primarily in a north-easterly direction from the point of release (see figure 4). Atmospheric inversions resulted in poor dispersion conditions and environmental concentrations were generally higher than would be expected from the amount of I-131 released.

The extent of environmental contamination is discussed in the following paragraphs.

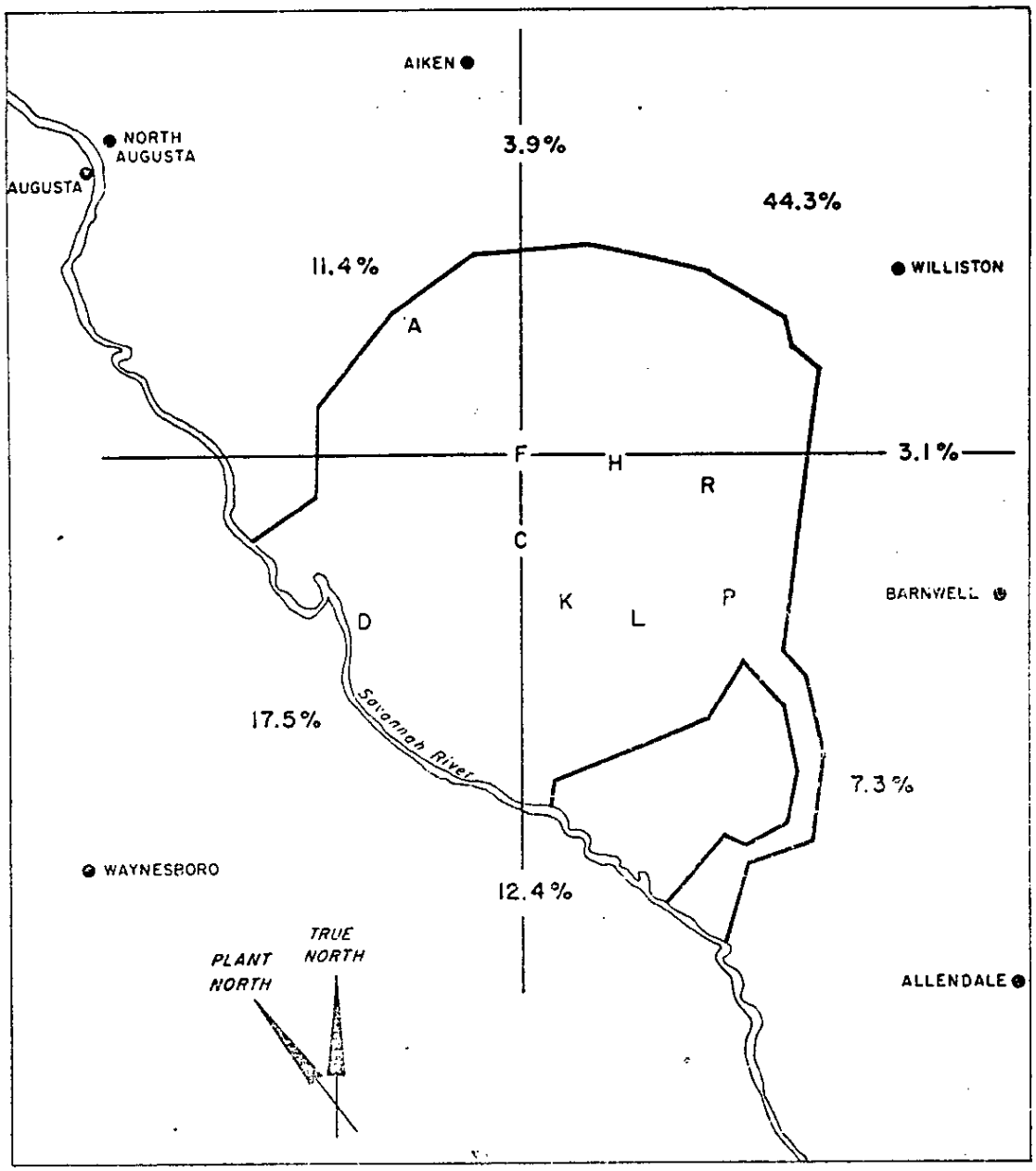


FIGURE 4. DISPERSION OF RADIOIODINE (May 29 Through June 4)

AIR

Concentrations of radioiodine in air observed out to the 25-mile radius circle, and projected concentrations (calculated from the amount of I-131 released and local meteorological data) are summarized in figure 5. Since the calculated and observed data compared favorably, it is assumed that the projected data are representative of actual conditions. The maximum concentrations of I-131 in air, as measured at the off and on-Plant monitoring stations, are shown in the following table:

	Week Ending	Radioiodine in Air, 1×10^{-14} µc/cc
On Plant		
F Area	6/7	2800
H Area	6/7	660
A Area	6/7	79
Dunbarton Fire Tower	6/7	20
D Area	5/31	78
TNX	5/31	180
Plant Perimeter		
Talatha Gate	6/7	130
Williston Gate	6/7	110
Jackson, S. C.	5/31	28
Green Pond Church	5/31	14
Military Recreation Site	6/7	83
25-Mile Radius		
Langley, S. C.	5/31	14
Aiken Air Port	5/31	64
Aiken State Park	6/7	10
Williston, S. C.	6/7	100
Allendale, S. C.	6/7	18
Highway 301 Bridge	5/31	20
Sardis, Ga.	6/7	6
Waynesboro, Ga.	6/7	4
Bush Field, Augusta, Ga.	5/31	19

The Radioactivity Concentration Guide (RCG) for I-131 in air for chronic exposure of off-Plant population is $10,000 \times 10^{-14}$ µc/cc (based on the recommendation of the International Commission on Radiological Protection). At no location did the I-131 concentration in air exceed the RCG.

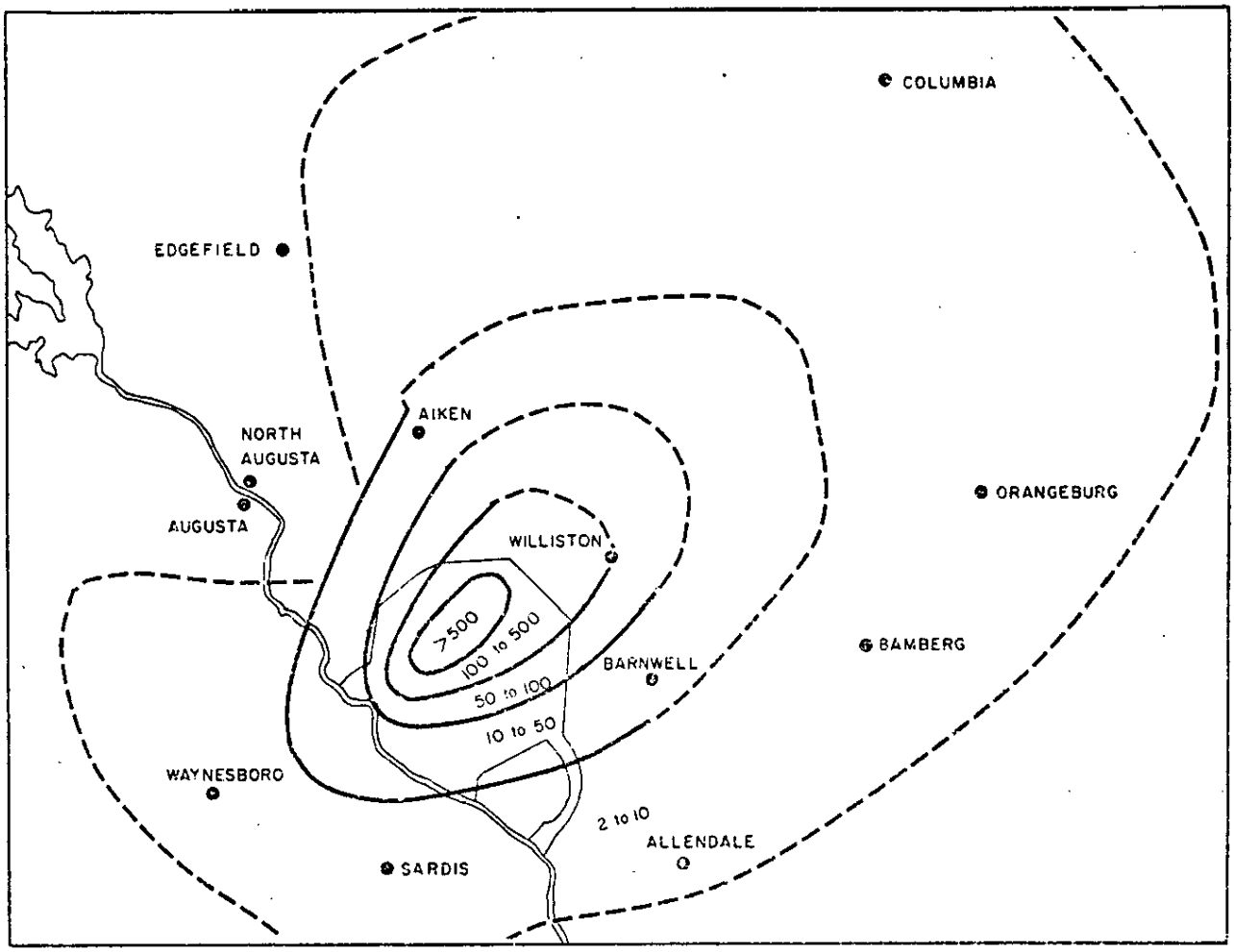


FIGURE 5. ISO-ACTIVITY MAP OF RADIOIODINE IN AIR (Period Ending June 7)

Observed
Theoretical
Multiply all values by 10^{-14} μc/cc

[redacted]

VEGETATION AND FOOD

Special samples of Bermuda grass were collected at the Plant Perimeter and at 25-mile radius locations on June 5, in order to determine the extent of radioiodine deposition. Radioiodine concentrations in grass are shown in figure 6. The maximum public zone concentration of radioiodine in grass of 56×10^{-12} c/g was detected in a sample obtained at the Plant perimeter near the Williston Gate. Activity on vegetation near the F-Area seepage basins was caused by the high I-131 concentrations in air in the vicinity of the basins (see figure 7) and this, in turn, was due to the radioiodine discharged to the seepage basin system (136 curies of I-131 was measured in the basins on June 14). Radioactivity on vegetation decreased with an apparent half life of 5 days compared to the physical half life of 8 days for I-131. This was primarily attributed to dilution of the activity by new vegetative growth. Laboratory tests indicated that little or no iodine was removed from vegetation by rainfall.

MILK

Extensive milk sampling in the vicinity of the Plant started on June 5. A total of 122 milk samples from 48 individual farms and dairies were analyzed. The maximum concentration of I-131 (5500×10^{-15} c/ml) was found in milk obtained from a farm one mile west of New Ellenton, S. C. Concentrations of radioiodine found in milk from the various farms and dairies are shown in figure 8. The distribution of milk samples in the various concentration ranges is shown in the following table.

Concentration Range, 1×10^{-15} c/ml	Number of Farms or Dairies Initially in Range
5000 - 6000	1
4000 - 5000	1
3000 - 4000	0
2000 - 3000	1
1000 - 2000	12
800 - 1000	2
600 - 800	3
400 - 600	5
200 - 400	13
0 - 200	10
	Total → 48

[redacted]

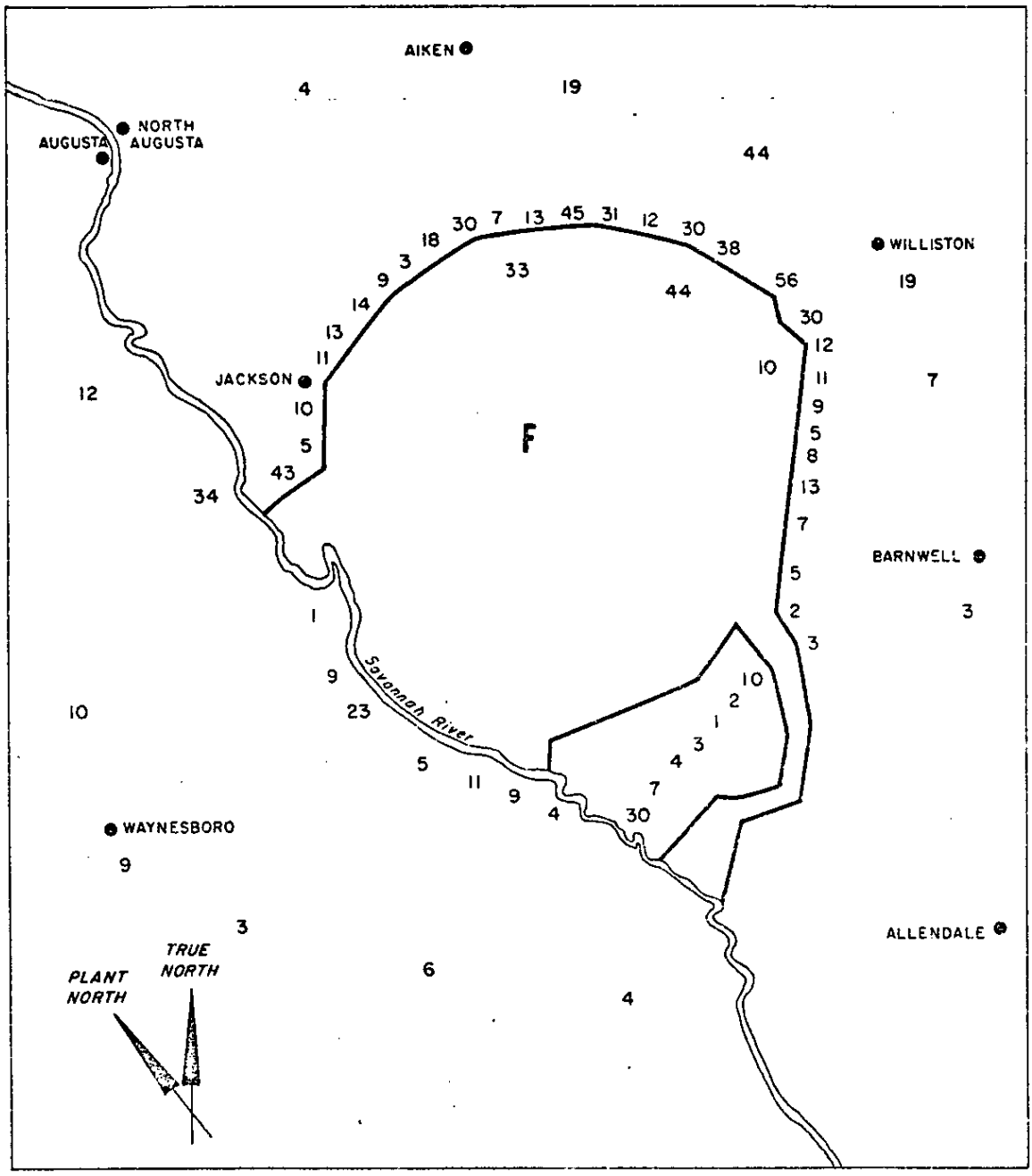


FIGURE 6. RADIOIODINE IN BERMUDA GRASS, 1 X 10^{-12} c/g
(Samples Collected on June 5)

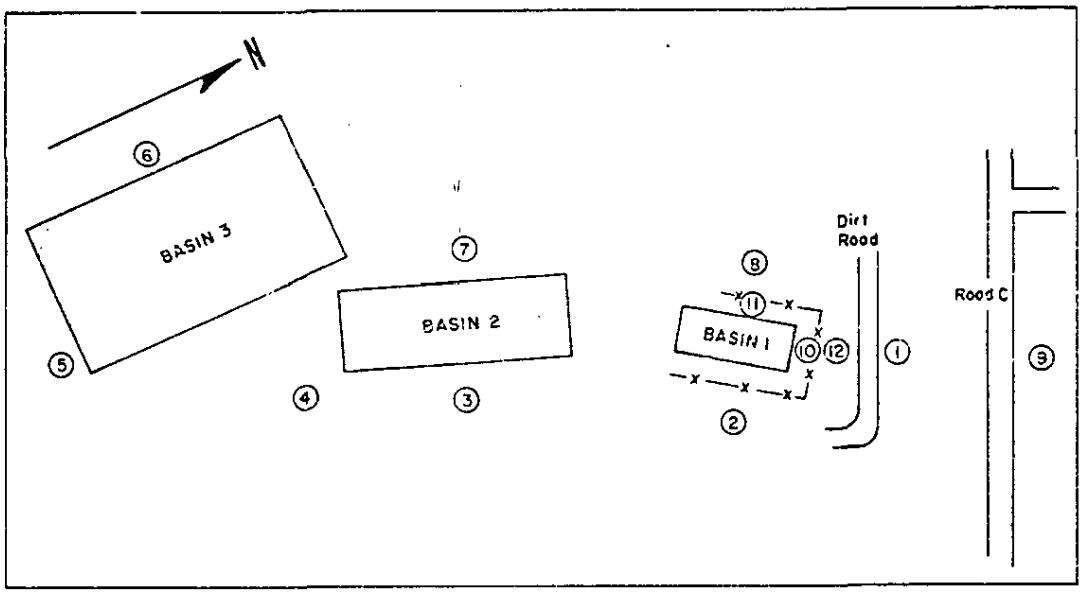


FIGURE 7. RADIOIODINE ON VEGETATION IN F-AREA SEEPAGE BASINS (June 15)

Sample Location	Radioiodine*
①	38,000
②	30,000
③	7,700
④	1,080
⑤	450
⑥	1,090
⑦	1,800
⑧	16,300
⑨	2,890
⑩	721,000
⑪	450,000
⑫	485,000

* Multiply values by 10^{-12} c/g.

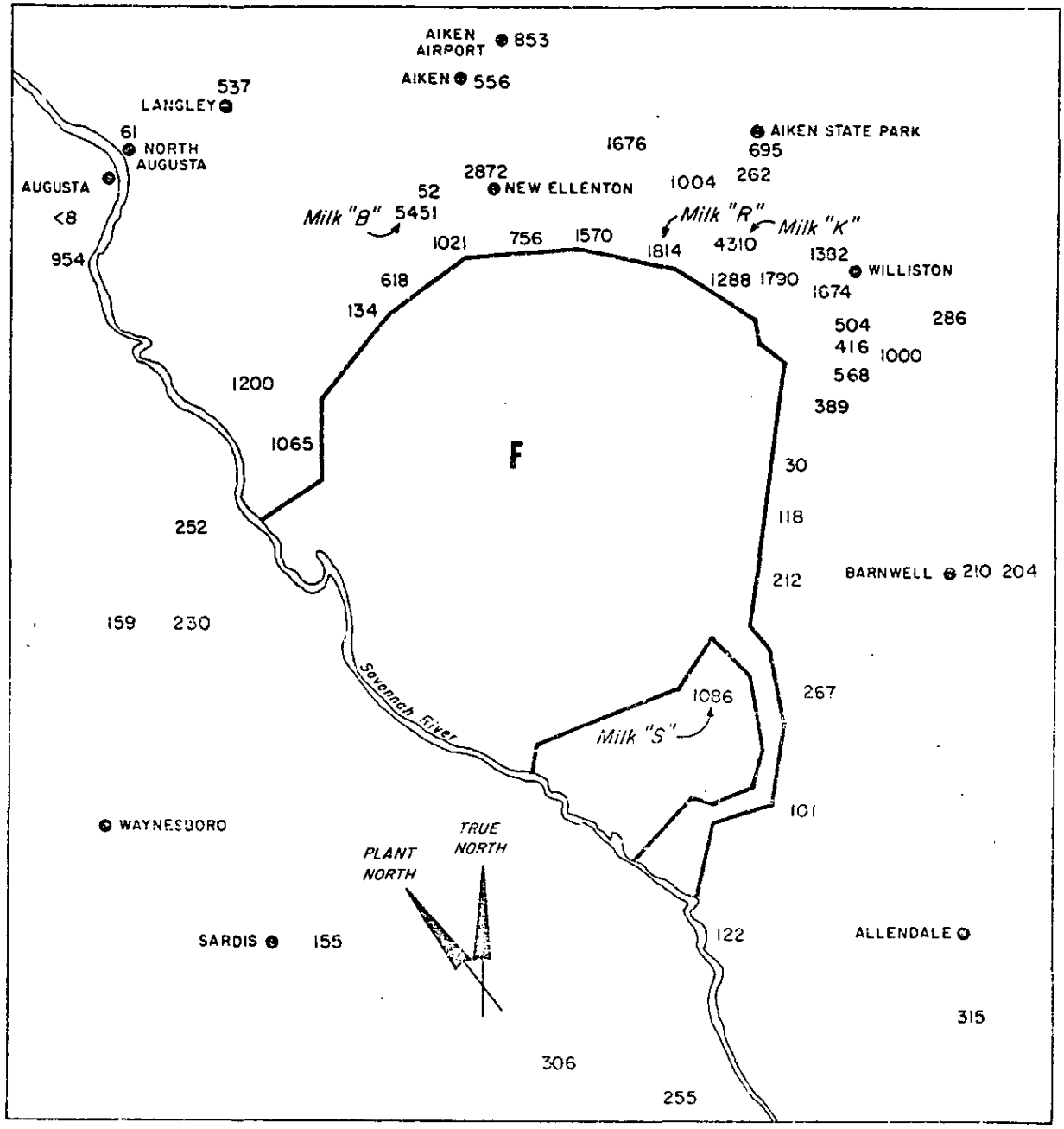


FIGURE 8. RADIOIODINE IN MILK, 1×10^{-15} c/ml
(Samples Collected June 5 Through June 7)

The apparent half life of radioiodine in milk followed closely the decrease of I-131 in vegetation. The average value exhibited an apparent half life of 4 to 5 days.

EGGS AND PEACHES

Fresh eggs from the farm which exhibited the highest iodine activity in milk (Milk "B" in figure 8) contained an average of 33×10^{-12} c/egg, as compared to an RCG value of 1.4×10^{-10} c/egg. Peaches obtained from a farm several miles north of Aiken showed no evidence of radioiodine.

ESTIMATED EXPOSURE FROM THE I-131 RELEASE

The maximum dose rate from external sources to the whole body or gonads due to the release was calculated to be 2.3×10^{-3} mrem/week for a person who continuously remained in this area 168 hr/week. ICRP recommends a weekly limit of 3.2 mrem/week (based on 5 rem per 30 years) for the population at large.

Approximately 30% of the radioiodine present in consumed milk is quickly concentrated in the human thyroid. This vital organ varies in size depending upon age; a 1-year-old child's thyroid will weigh about 2 grams while a mature adult's thyroid will weigh approximately 20 grams. The same quantity of I-131 in the thyroids of a child and adult will result in a radiation dose to the child which is larger by a factor of 10. The amount of radioiodine introduced into the body is primarily a function of the amount of milk consumed. In the calculations of the thyroid dose resulting from Building 291-F stack releases the following assumptions were made.

- Thyroid weights were 2 grams and 20 grams for child and adult, respectively.
- 0.9 liter and 1.0 liter of milk per day were consumed by a child and adult, respectively.
- Half-life of I-131 in milk was either that observed or 8 days.

The total thyroid dose for a child consuming Milk "B" (one mile west of New Ellenton, S. C.) which was contaminated to 5451 × 10^{-15} curie of I-131/ml was 1280 mrem. The dose to an adult consuming this milk was 140 mrem. The average concentration of radioiodine in milk collected on June 5 and June 6 was 888 × 10^{-15} c/ml. The dose to a child consuming this milk would be 205 mrem while to an adult it would be 23 mrem. Over 98% of this dose would be accumulated in the first 2 months after the release. The Federal Radiation Council recommends that the nonoccupational thyroid dose be limited to a maximum of 1500 mrem per year for individuals and 500 mrem per year to be applied to the average of suitable samples of an exposed group in the general population.

Isodose curves representing the dose received from milk consumption in the vicinity of the Plant are shown in figure 9. The values represent the total dose due to I-131 released from the F-Area stack during the period May 29 through June 19. Contributions to the total dose to man from inhaled air, drinking water, or the consumption of other foods was less than 10% of the dose resulting from radioiodine in milk.

Plant Drinking Water

Samples of drinking water were collected monthly from operating areas and quarterly from other domestic water systems. Analyses of 112 samples are summarized in Appendix B, table 9. As in previous six-month periods, higher concentrations of radioactivity were observed in F Area, H Area, and Barricade 2 drinking water. The six-month average concentrations at these three locations ranged from 4.4 to 28 × 10^{-15} c/ml of alpha, and 15 to 52 × 10^{-15} c/ml of nonvolatile beta. These concentrations were attributed primarily to naturally occurring radioactivity. Plant drinking water samples contained no detectable tritium.

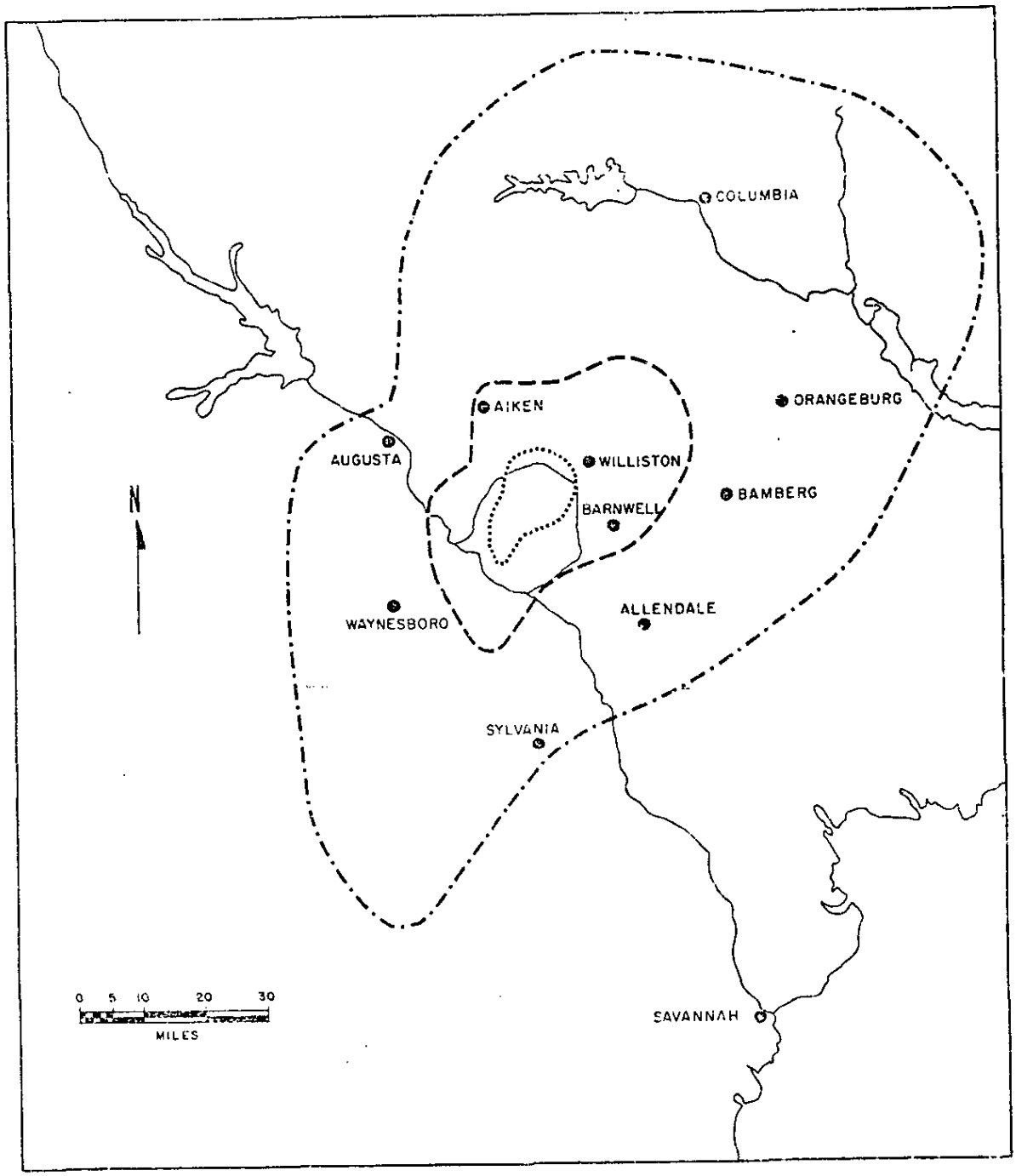


FIGURE 9. INFINITE DOSE FROM CONSUMPTION OF MILK DUE TO RADIOIODINE RELEASED MAY 29 THROUGH JUNE 19

	Dose, mrem	
	To Adult	To Child
-·-	1	9
– –	10	80
·····	100	900

Public Water Supplies

Samples of public drinking water were collected monthly from the 14 surrounding towns shown in figure 1. Analytical results of 84 samples, shown in Appendix B, table 10, are essentially the same as those observed prior to the startup of the Plant. Public drinking water samples contained no detectable tritium activity.

Streams and the Savannah River

The amount of alpha emitters, nonvolatile beta emitters, radiciodine, and tritium released from individual Plant areas to effluent streams during the six-month report period are compared to releases during the previous report period in the following table. The individual isotopes comprising the releases from the Reactor Areas are reported in Appendix A, table 2.

Radioactivity Released to Effluent Streams

	Alpha, mc		Nonvolatile Beta, c		Radioiodine, c		Tritium, c	
Area	Total	Prev Total	Total	Prev Total	Total	Prev Total	Total	Prev Total
F	3.7	3.4	1.13	4.9	-	-	5	-
H	4.3	2.4	0.2	0.3	-	-	710	1,100
R	*	-	22.44	29.20	1.41	8.25	5,300	3,370
P	*	-	39.47	32.97	2.20	4.45	5,880	4,870
L	*	-	71.46	25.79	6.55	3.30	7,080	4,880
K	*	-	36.52	54.80	5.04	6.02	5,630	4,580
C	*	-	58.13	18.97	3.56	2.32	4,780	4,130
300	80	30	-	-	-	-	-	-
Total →	88	36	229.4	166.9	18.76	24.34	27,385	22,930

* Naturally occurring alpha emitters in Savannah River water pass through the Reactor Areas in cooling water. The total alpha discharged by way of the Reactor Area effluents during the six-month period was estimated to be 400 millicuries. Since this activity did not originate from Plant operations, it is not included in the table.

The nonvolatile beta release from F Area was associated with canyon evaporator operation and was identified as predominantly $Ce^{141,144}$. Radiostrontium and radiocesium were also present, and the discharge of these isotopes from F Area was estimated to be 0.02 and 0.03 curie, respectively. Tritium released from H Area is attributed to movement of tritium from the H-Area seepage basins. The sources of nonvolatile beta released from the Reactor Areas was disassembly basin water, purged at a rate of 1000 to 2000 gpm. Periodic increases in activity discharged during the six-month period were associated with the discharge of fuel elements. Of the total nonvolatile beta released from all Reactor Areas approximately 39% was due to long lived isotopes (half life greater than 15 days.)

The 300 Area discharge represents approximately 230 pounds of natural uranium.

Maximum concentrations of both nonvolatile beta and tritium in Four Mile Creek, Pen Branch, and Steel Creek at the Road A locations coincided with fuel element discharge operations in the Reactor Areas. Higher concentrations of longer lived activity were evident in stream and river water following disassembly basin releases from reactors containing enriched uranium than those associated with reactors containing natural uranium.

Results of water samples collected at the Road A intersection of each reactor effluent stream showed the following curies of radioactivity passed these locations. The flow of radioactivity passing river locations 2 (Control) and 10 (10 miles below Plant) is presented for comparison.

Location	Radioactivity in Water, curies/six months				
	Nonvolatile Beta	Tritium	Radioiodine	Radiostrontium	Radiocesium
Four Mile Creek	32.5	9,200	2.6	1.9	1.7
Pen Branch	30.6	12,200	9.0	3.3	1.1
Steel Creek	53.0	27,500	5.9	3.3	3.4
Lower Three Runs	1.2	1,120	-	0.3	0.3
Total at Road A Locations	→ 117.3	50,020	17.5	8.8*	6.5
River 2	25.3	3,200			
River 10	107.2	50,000			
Apparent Plant Contribution					
At Road A Stream Locations**	113.8	49,600			
At River 10	81.9	46,600			

* Includes 1.17 curies of Sr-90 distributed as follows: Four Mile Creek, 0.18 curie; Pen Branch, 0.18 curie; Steel Creek, 0.59 curie; and Lower Three Runs, 0.22 curie.

** Compensation was made for the estimated volume of river water used by the Plant facilities in calculating the Plant contributions at the Road A stream locations.

For measurement of radioactivity in Plant effluent streams and in the Savannah River, water and mud samples are collected weekly at 16 stream locations and 7 river locations as shown in figure 10. Continuous water sampling is maintained at all locations. Monthly river mud samples from 5 locations and weekly samples from 2 locations (10 and 11) were analyzed for TBP extractable alpha activity. Analysis results of 668 water samples and 465 mud samples are summarized in Appendix B, tables B-8.

Increased six-month average concentrations of radioactivity (mainly natural uranium) were noted in the 300-Area effluent to the Tims Branch - Upper Three Runs system. This activity was not detected at locations further downstream. An approximate four fold decrease in nonvolatile beta activity was observed in both the F-Area storm sewer effluent draining to Upper Three Runs Creek and in the F-Area segregated cooling water effluent to Four Mile Creek. The radioactivity in the storm sewer effluent was attributed to leakage from an A-Line collection sump, while that in segregated cooling water

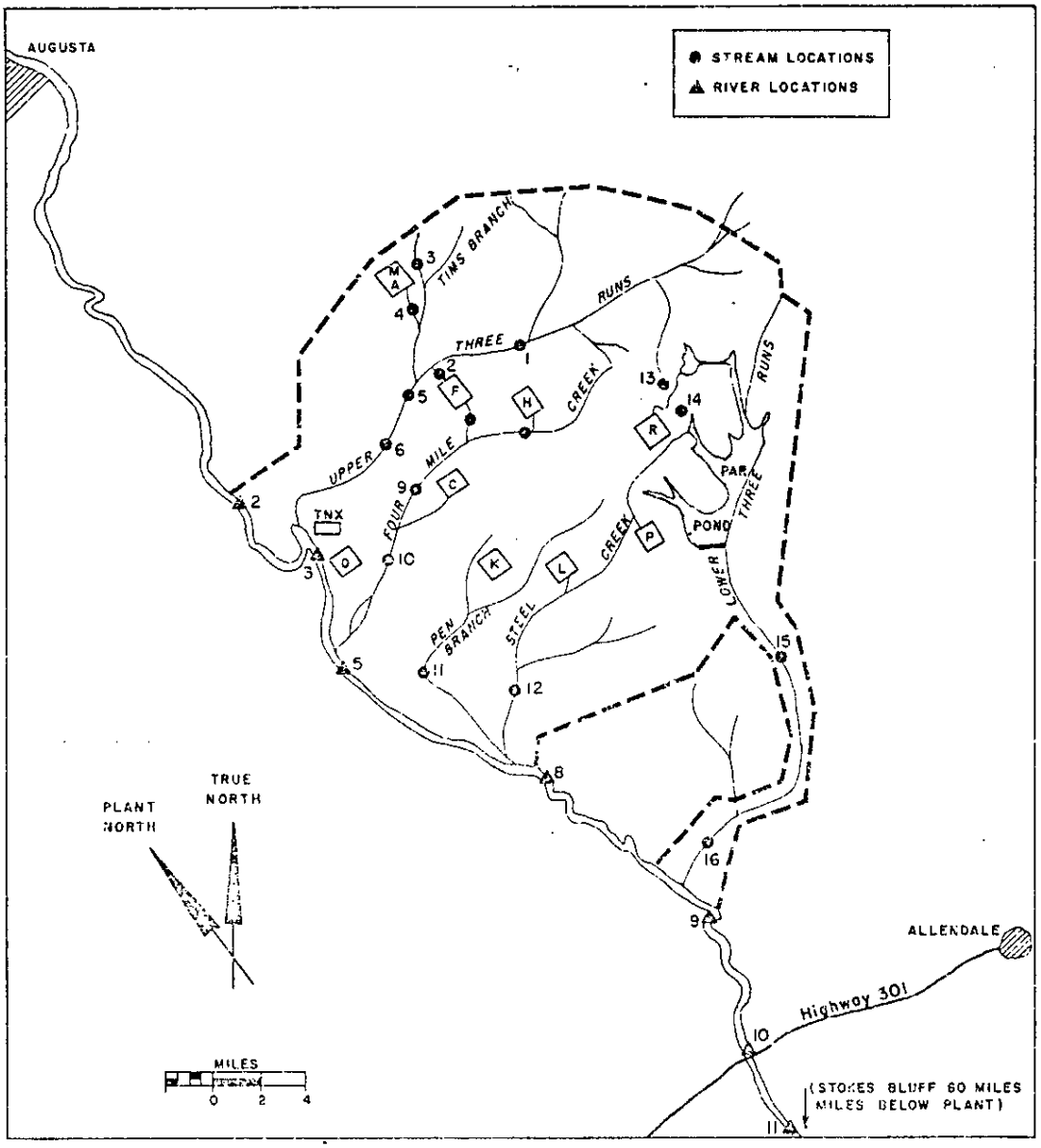


FIGURE 10. STREAM AND RIVER LOCATIONS

was associated with canyon evaporator operation. The major radioactive constituent in these effluents were $Ru^{103,105}$ and $Ce^{141,144}$, respectively.

Seepage Basins

Alpha emitters, nonvolatile beta emitters, radioiodine, and tritium discharged to earthen seepage basins during the report period are compared to the previous six-month discharges in the following table. Isotopic distribution of the nonvolatile beta discharged to the F and H-Area basins are shown in Appendix A, table 3.

Radioactivity Discharged to Seepage Basins

	Alpha, mc		Nonvolatile Beta, c		Radioiodine, c		Tritium, c	
Area	Total	Prev Total	Total	Prev Total	Total	Prev Total	Total	Prev Total
F	351	320	92.6	245.9	157	1.8		
H	85	63	36.8	10.9	0.1	0.02		
R	-	-	-	-	-	-	322	4786
P	-	-	18.6	3	-	-	1,860	96
L	-	-	0.02	0.7	-	-	-	-
K	-	-	-	-	-	-	-	-
C		-	16.8	2.5	-	-	42	86
3/700	10	30	0.03	-	-	-	-	-
Total	→ 446	413	164.8	261	157	1.8	12,248	9898

Liquid volume inputs and seepage and evaporation rates for the F and H-Area basins are given in the following table.

	F Area*	H Area*
Waste Input, liters/day	3.5	1.2
Rain Input, liters/day	1.0	0.8
Seepage and evaporation, liters/day	4.5	1.9

* Multiply these values by 10^5.

The radioactivity in Separations, 700, and TNX Areas seepage basins is shown in Appendix B, table 11.

The sources of radioactivity released to the Reactor Area seepage basins included discharges from sumps in R Area, material released while vacuum cleaning disassembly basin floors in P and C Areas, and material released during the flushing of a filter charge tank in L-Area. Releases of radioactivity to the P-Area seepage basin also resulted from handling of Chalk River reactor components. No radioactivity was released to the K-Area seepage basin during the report period. The maximum concentrations of radioactivity observed in Reactor Area seepage basin water were as follows: alpha, 0.2×10^{-12} c/ml in C-Area basin 2; nonvolatile beta, 144×10^{-12} c/ml in P-Area basin 1; and tritium, $231,000 \times 10^{-12}$ c/ml in C-Area basin 1.

Ground Water

Ground water was monitored by analysis of samples collected from: (1) wells surrounding seepage basins in F, H, and R Areas (see figures 11 and 12), (2) drilled, cased wells near F and H Areas (Z and ZW wells, see figures 13 and 14), and (3) wells at the burial ground (see figure 15). The maximum nonvolatile beta concentration from analyses of 85 samples collected from the R-Area seepage basin wells was 44×10^{-15} c/ml in well A-11, which is adjacent to backfilled basin 5. Radioactivity in Z, ZW, F-Area and H-Area seepage basin well water is shown in Appendix B, tables 12 and 13.

Continued high concentrations of nonvolatile beta were observed in the perched water table underneath the F-Area seepage basins. Specific chemical analyses indicated that approximately 8% of the nonvolatile beta activity was attributable to $Sr^{89,90}$. As observed in the past, seepage basin wells 1 and 5, in H Area, continued to show the most significant concentrations of radioactivity. All of the nonvolatile beta radioisotopes released in basins in F and H Areas were detectable in the seepage basin wells. All of the alpha activity detectable in the ground water was attributed to natural uranium. No movement of plutonium into the ground water was detected in either F or H Areas.

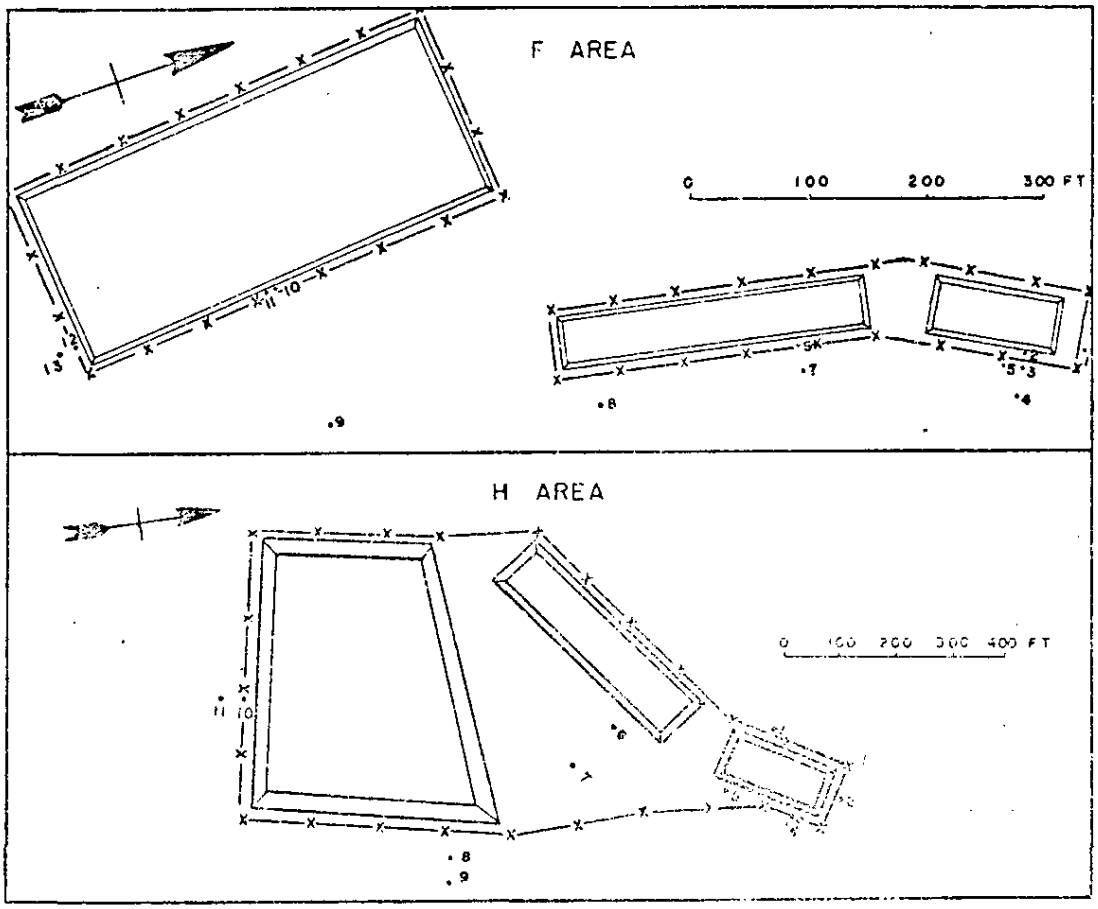


FIGURE 11. SEEPAGE-BASIN MONITORING WELLS IN F AND H AREAS

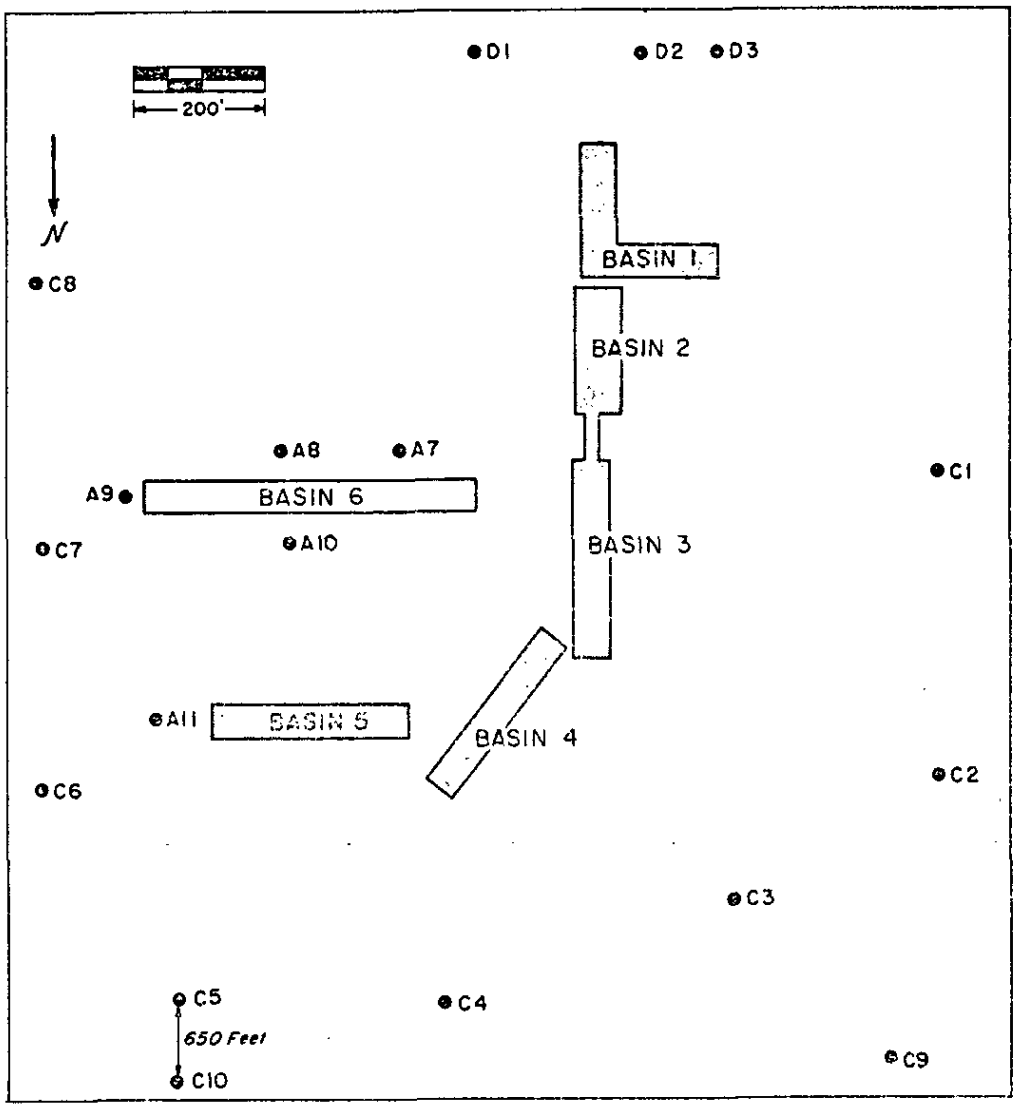


FIGURE 12. R-AREA SEEPAGE BASINS AND MONITORING WELLS

Denotes Backfilled Basins

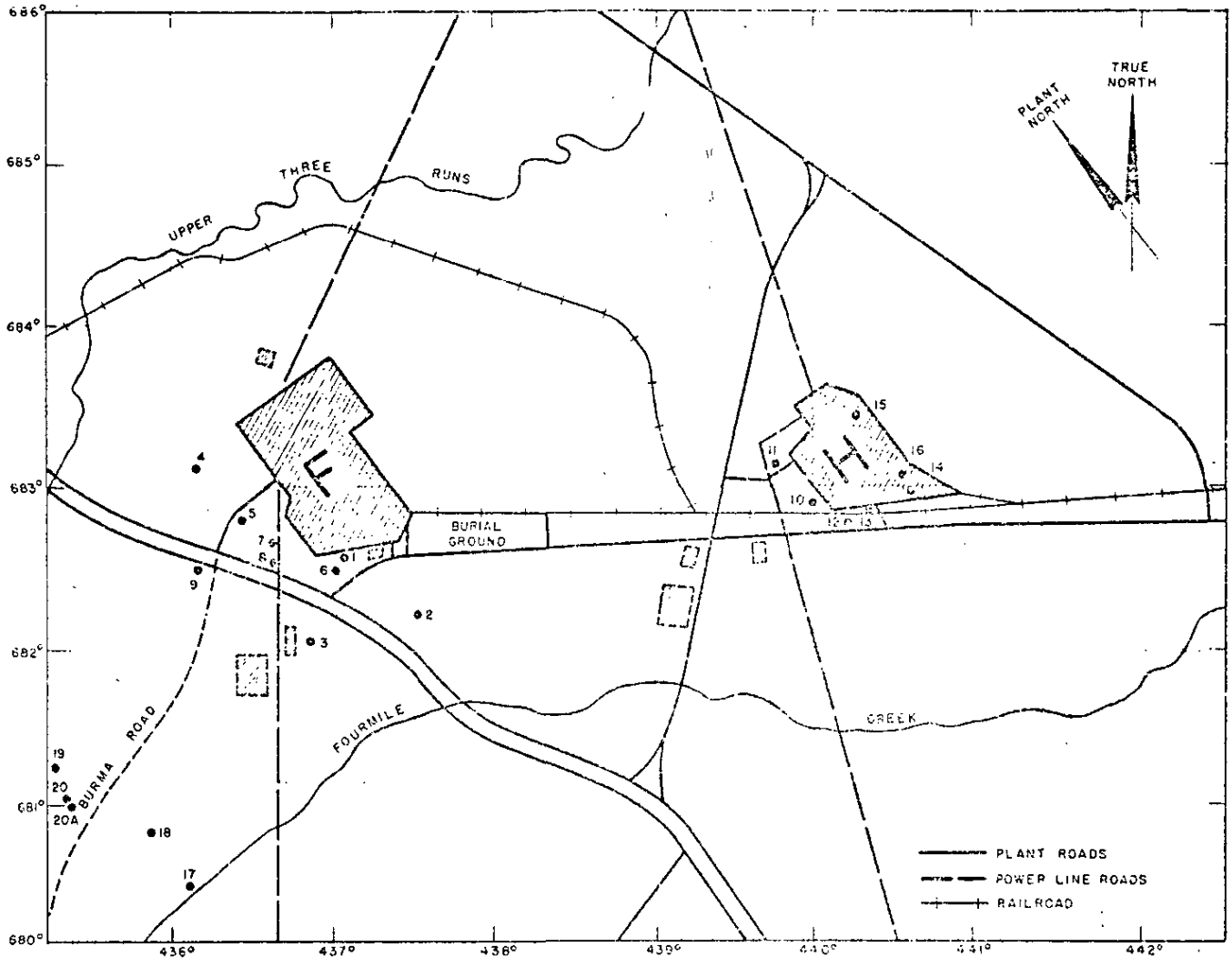


FIGURE 13. Z WELL LOCATIONS

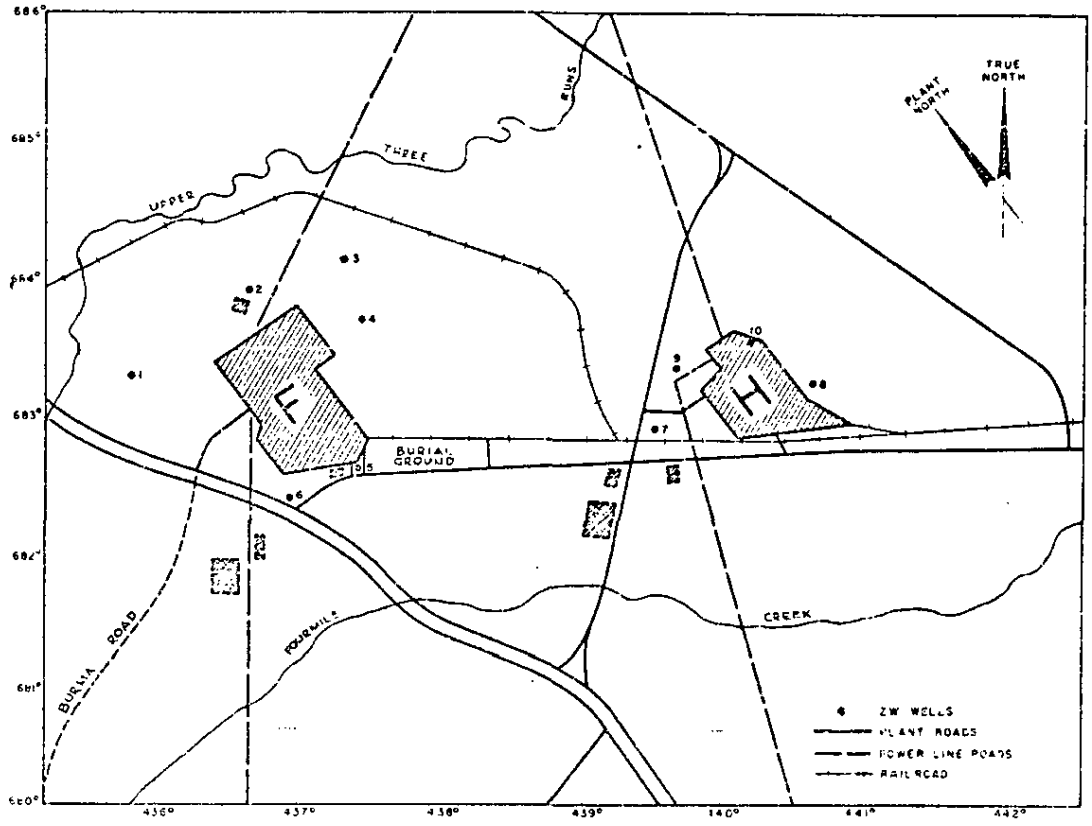


FIGURE 14. ZW WELLS, F AND H AREAS

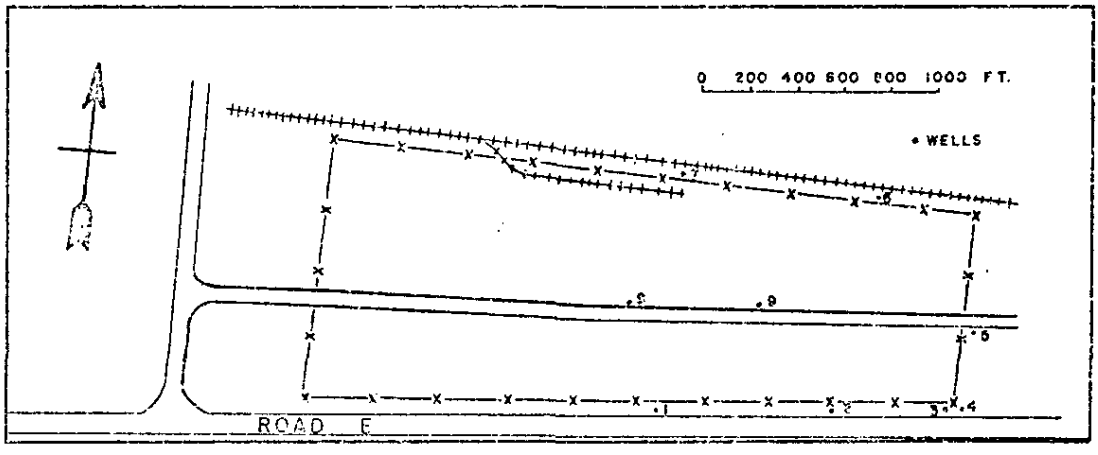


FIGURE 15. BURIAL GROUND WELLS

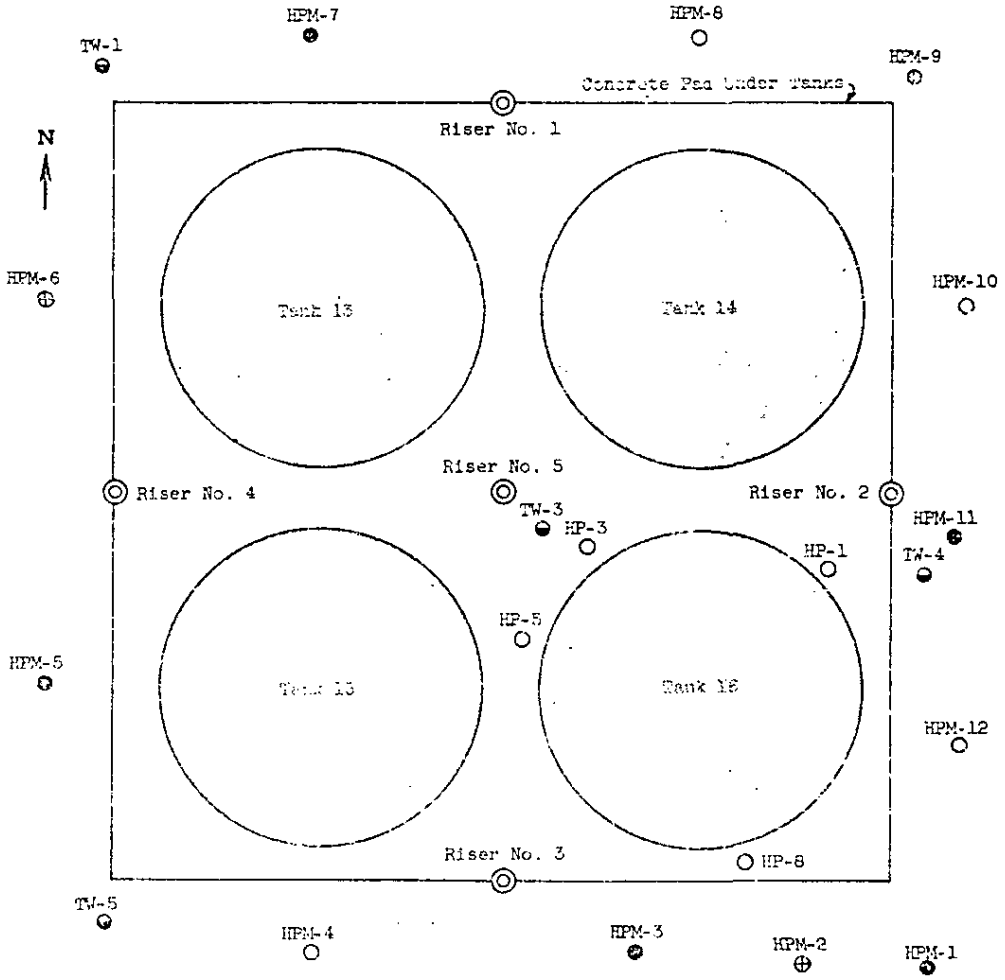
In April, water outcropping approximately 300' east of basin 3 in F Area and extending downhill for a distance of 300' (before re-entering the soil) contained a tritium concentration of 3200×10^{-12} c/ml. The presence of tritium in such high concentrations indicated that some basin water was present in the outcropping. Water encountered in 5 shallow holes (3' and 4' depths) dug in the vicinity of the outcrop (east of basin 3) contained radioactivity in lesser amounts. The outcrop may be attributed to an increase in the level of perched water at seepage basin 3. The water level in F-Area seepage basins 1 and 2 is constant because of the catenated basin system and probably would not cause these conditions.

Well A-37 is located in a swamp bordering the H-Area effluent. It is installed in the zone of the most rapid movement of seepage basin water into the swamp. The tritium concentration in this well averaged $34,000 \times 10^{-12}$ c/ml with a maximum of $61,000 \times 10^{-12}$ c/ml. Radiochemical analyses indicated that practically all of the nonvolatile beta activity in well A-37 could be accounted for by isotopes of strontium.

241-H Tank Farm

Ground water at 241-H Upper Tank Farm was monitored from water samples collected from 17 wells shown in figure 16. No significant nonvolatile beta activity was found in the 12 wells (HPM) installed at 20-foot intervals at a distance one foot from the outer edge of the concrete pad. The weekly average nonvolatile beta concentration in these wells did not exceed 33×10^{-15} c/ml.

While the nonvolatile beta activity in two pre-existing wells (TW3 and TW4) reached maximum concentrations of $46,000 \times 10^{-15}$ c/ml and 2500×10^{-15} c/ml, respectively, negligible concentrations of radioactivity were observed in water collected weekly from a pre-existing test well situated in the center of the Lower Tank Farm. Maximum nonvolatile beta concentrations observed in Wells HP1, HP5, and HP8 (Upper Tank Farm) were 300×10^{-15} c/ml, 400×10^{-15} c/ml, and 900×10^{-15} c/ml, respectively. The HP wells are the initial wells



Scale: 1" = 60'

- ⊕ Wells With 4" Screens
- ◒ Wells With 6" Screens
- ○ Wells With 4' Screens
- ◎ Wells With 10' Screens

FIGURE 16. BUILDING 241-H UPPER TANK FARM

which were drilled five feet from the tank 16 encasement (down to the concrete pad) following the detection of radioactivity loss from the annulus of tank 16 in September 1960.

Biological Specimens

TERRESTRIAL

Open seepage basins served as a source of radioactivity for terrestrial animals in the vicinity of R Area until the basins were back-filled late in 1960. The primary isotopes in the basin were radiostrontium (Sr-89, Sr-Y^{90}) and radiocesium ($Cs^{134,137}$). Data obtained from the analysis of animals collected during the report period indicate a general reduction in both the bone and flesh radioactivity during the past six months. All of the animals reported below were collected within a half-mile radius of the R-Area seepage basin system.

		Nonvolatile Beta, 1×10^{-12} c/g					
		Bone			Flesh		
Species	No. of Samples	Max	Avg	Prev Avg	Max	Avg	Prev Avg
Rabbit	2	30	25	40	6	5	7
Raccoon	2	35	20	210	9	6	8
Fox	4	15	10	130	8	4	10
Bobcat	2	4	4	20	7	5	10

AVIAN

Fifty-six specimens of aquatic waterfowl, including 26 ring-necks, 22 green-winged teals, and 8 mallards were collected from Par Pond for radioanalysis during the report period. The nonvolatile beta found in the bones and flesh of the three species during the past three years are shown in the following table. Only the green-winged teal has shown an increased uptake of radioactivity. Radiostrontium and radiocesium were the primary isotopes in the bones and flesh, respectively. Trace concentrations of radiozinc (Zn-65) were present in the fleshy tissues. Primarily vegetarians, the diets of the three species consist of from 10 to 20% animal matter. Although

the species represented generally feed along the shore in shallow water, the ring-neck is capable of diving to depths of 40 feet.

Nonvolatile Beta in Aquatic Waterfowl, 1×10^{-12} c/g

	Bone				Flesh			
	1961		1960	1959	1961		1960	1959
Species	Max	Avg	Avg	Avg	Max	Avg	Avg	Avg
Ring-neck	25	10	*	20	20	7	*	30
Teal	50	25	15	*	40	20	10	*
Mallard	10	6	15	10	15	8	7	15

* No samples.

AQUATIC

A total of 860 aquatic samples, including 516 fish, 310 algae samples, 14 clams, 10 crayfish and 10 shrimp were collected from the reactor effluents and the Savannah River. The algae and fish collected from the reactor effluents were radioanalyzed to determine the maximum uptake of Plant contributed radioactivity by aquatic specimens. Samples from the Savannah River were routinely collected to determine the concentrations of radioactivity contained in aquatic specimens accessible to the public.

REACTOR EFFLUENT. Radiostrontium (Sr-89, $Sr\text{-}Y^{90}$) was the primary beta emitter in the bones of fish collected from all four reactor effluents; no significant concentrations were found in the fleshy tissues. Radiozinc (Zn-65) and radiocesium ($Cs^{134,137}$) were the main gamma emitters present in the bones and fleshy tissues. In fish collected from Par Pond and Lower Three Runs (R-Area effluent), radiocesium was the primary isotope in both the bones and flesh. In Lower Three Runs fish, collected 6 and 14 miles below the Par Pond dam, no significant concentrations of radiozinc were found in the bones or fleshy tissues. In Steel Creek (provides effluents for L, P, and K Areas) and Four Mile Creek (C-Area effluent), radiozinc was the predominant isotope.

The nonvolatile beta concentrations in both the bones and flesh of fish from Steel Creek and Four Mile Creek increased during the report period. Despite a decrease in bone radioactivity, the nonvolatile beta content in Par Pond fish flesh and in the bones and

flesh of fish from Lower Three Runs did not change significantly during the report period, as shown in the following table. The semiannaul average concentrations of nonvolatile beta contained in the flesh and bones of fish from Par Pond, Lower Three Runs, and Steel Creek are presented graphically in figures 17 and 18.

Nonvolatile Beta in Effluent Fish, 1×10^{-12} c/g

Location	No. of Samples	Bone			Flesh		
		Max	Avg	Prev Avg	Max	Avg	Prev Avg
Upper Three Runs (Control)	16	25	10	10	7	4	4
Four Mile Creek	9	250	85	15	30	10	4
Pen Branch	32	850	150	*	110	20	*
Steel Creek	30	615	175	115	105	30	15
Par Pond	149	700	115	155	80	30	30
Lower Three Runs							
1 Mile Below Dam	57	235	100	115	85	35	25
6 Miles Below Dam	32	245	100	95	170	30	25
14 Miles Below Dam	30	150	55	60	35	20	20

* No samples collected.

Radiostrontium (Sr-89, $Sr\text{-}Y^{90}$) was the main isotope present in the shell structures of the clams, crayfish, and shrimp collected from Lower Three Runs (6 miles below the dam) in March. $Ce^{141,144}$, $Cs^{134,137}$, Co-60, and/or Fe-59 were the main gamma emitters in the fleshy tissues of clams. Radiocesium was the only isotope found in the fleshy tissues of crayfish and shrimp.

Nonvolatile Beta in Molluscs and Crustaceans, 1×10^{-12} c/g

Isotope	Clam		Crayfish		Shrimp	
	Shell	Flesh	Shell	Flesh	Shell	Flesh
Sr-89, Sr-90	175	*	15	*	5	*
Cs-137	*	4	*	24	*	9
$Ce^{141,144}$	*	9	*	*	*	*
Co-60 and/or Fe-59	*	3	*	*	*	*

* Less than sensitivity of procedure.

The nonvolatile beta concentrations in reactor effluent algae, collected at Road A, decreased during the report period. However, the concentrations in effluent algae remained higher by a factor

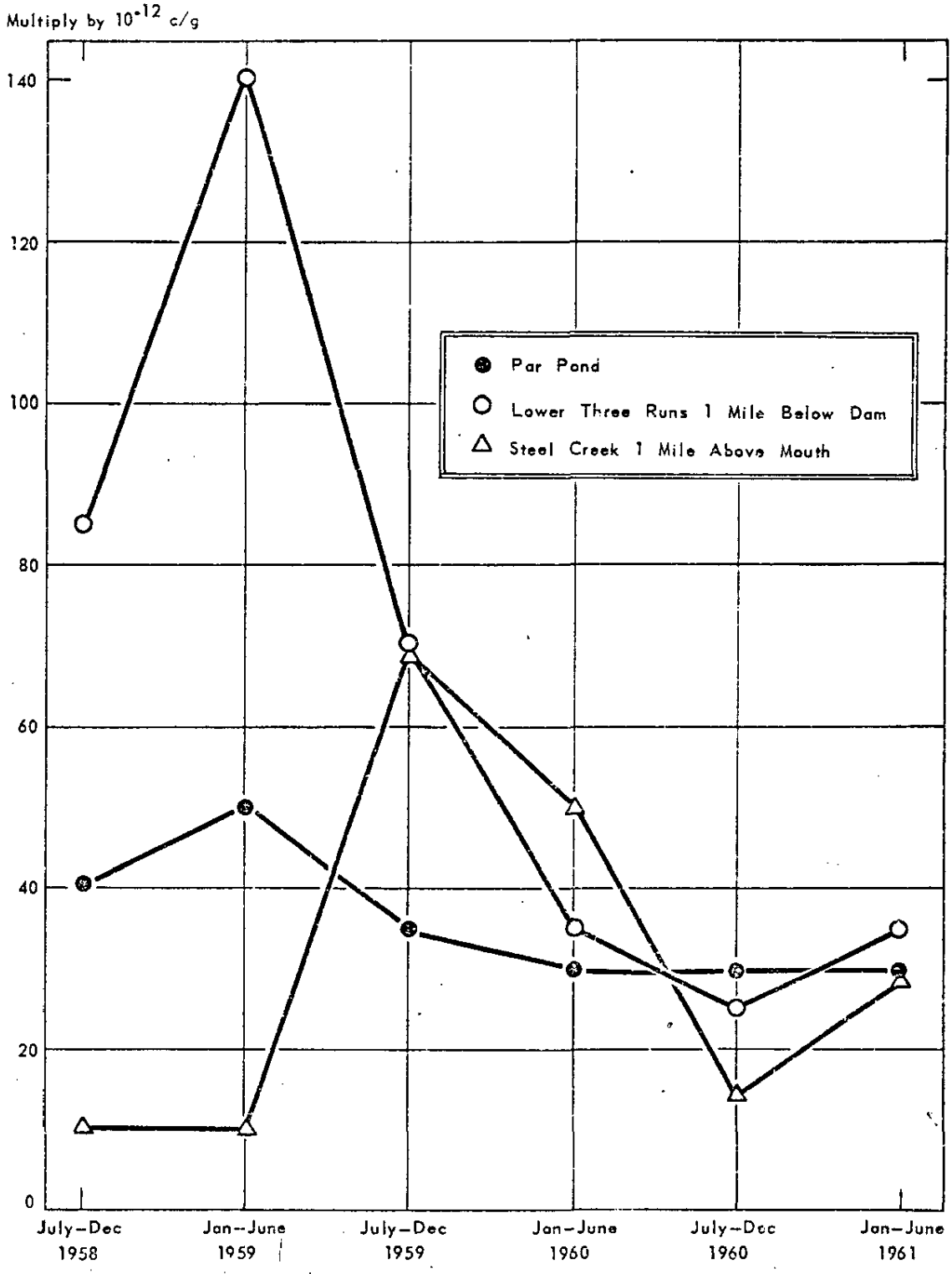


FIGURE 17. NONVOLATILE BETA IN FLESH OF REACTOR EFFLUENT FISH

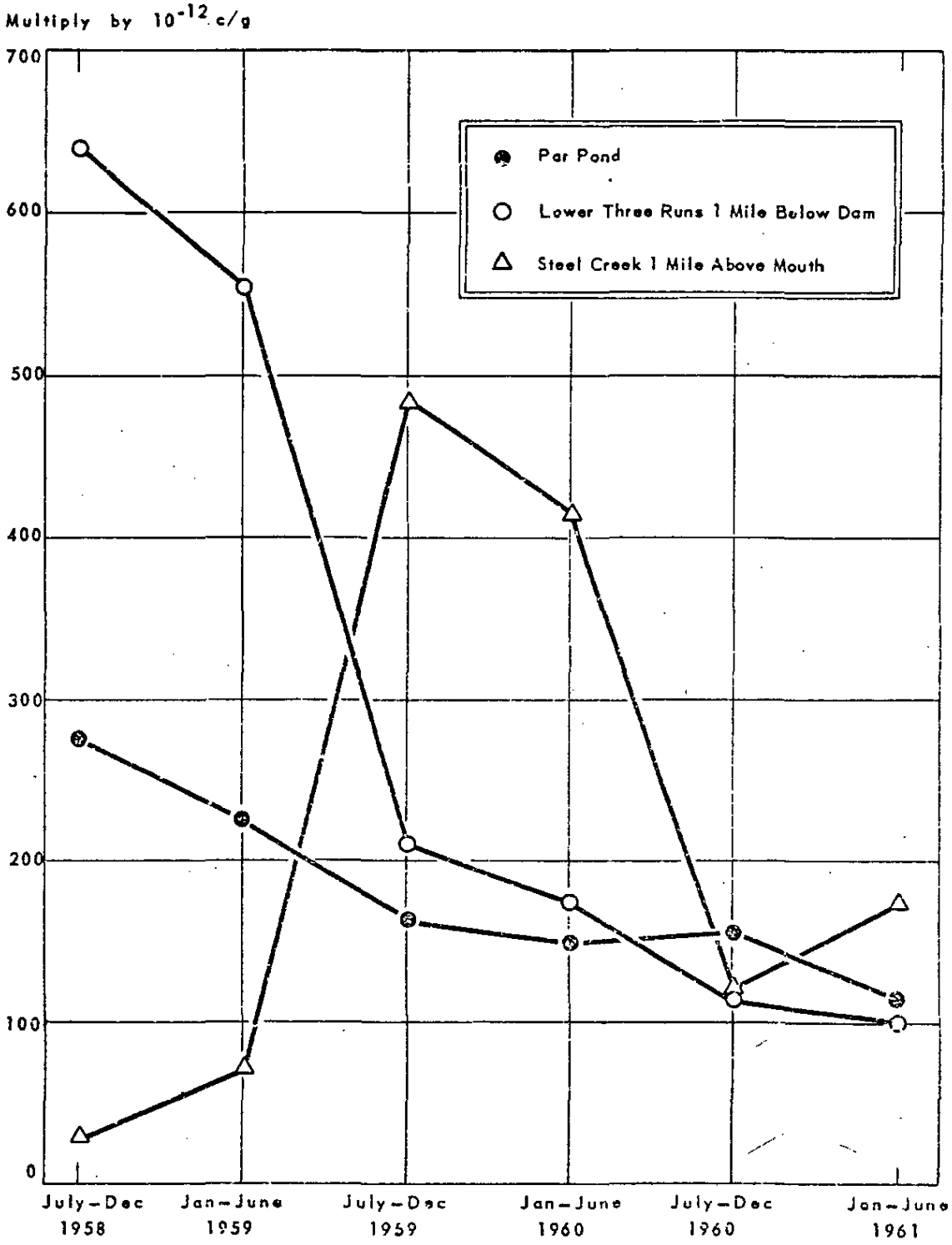


FIGURE 18. NONVOLATILE BETA IN BONES OF REACTOR EFFLUENT FISH

of 10^3 than found in effluent water. The average concentrations found in weekly samples are presented in the following table.

Effluent	Nonvolatile Beta in Effluent Algae, 1×10^{-12} c/g		
	Max	Avg	Prev Avg
Upper Three Runs (Control)	50	35	35
Four Mile Creek	755	355	920
Pen Branch	2200	765	1335
Steel Creek	575	300	1500
Lower Three Runs	130	85	110

Larger algae samples (3 to 15 grams dry weight) were collected from each Road A location in May and June for gamma spectrometry. The average concentrations of gamma emitters found in these samples are presented in the following table.

Isotope	Nonvolatile Beta in Effluent Algae, 1×10^{-12} c/g				
	Four Mile	Pen Branch	Steel Creek	Lower Three Runs	Par Pond
$Ce^{141,144}$	136	720	35	*	15
Cr-51	170	820	90	*	35
$Ru^{103,106}$	34	64	*	*	5
Cs-137	4	*	13	22	13
$Zr-Nb^{95}$	9	20	3	3	*
Mn-54	11	3	5	2	26
Zn-65	38	69	37	*	40
Fe^{59}/Co^{60}	18	8	14	*	8

* Concentrations below the sensitivity of the procedure.

SAVANNAH RIVER. The uptake of radioactivity by Savannah River fish, collected near the mouth of each reactor effluent, at the Highway 301 bridge, and at Stokes Bluff, was generally confined to low level concentrations in the bones with an occasional fish containing trace concentrations in the fleshy tissues. The average nonvolatile beta concentrations found in river fish during the report period are presented in the following table. Six-month average concentrations contained in the bones and flesh of river fish collected above 60 miles below the Plant site are presented graphically in figure 19.

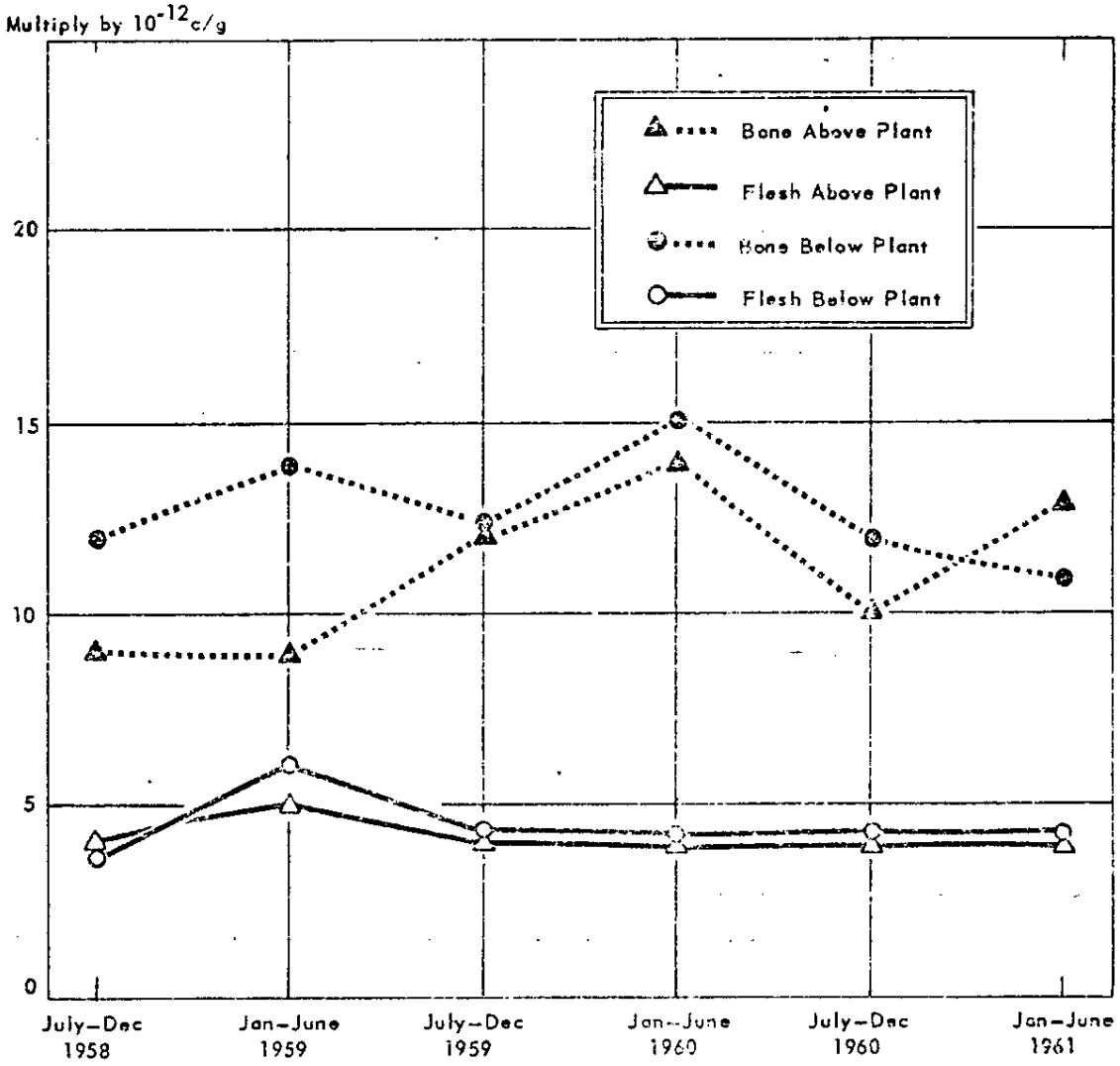


FIGURE 19. NONVOLATILE BETA IN RIVER FISH. (SIX-MONTH AVERAGES)

Nonvolatile Beta in Savannah River Fish, 1×10^{-12} c/g

River Location	No. of Samples	Bone Max	Bone Avg	Bone Prev Avg	Flesh Max	Flesh Avg	Flesh Prev Avg
Above Upper Three Runs (Control)	16	30	13	10	8	4	4
Upper Three Runs	7	20	12	13	6	4	3
Four Mile Creek	35	30	13	20	9	5	4
Steel Creek & Pen Branch	13	55	23	21	9	5	8
Lower Three Runs	22	135	20	16	40	6	5
Highway 301	26	20	11	17	9	4	4
Stokes Bluff	42	35	11	12	9	4	4

Radiostrontium, radiozinc, and radiocesium were the main isotopes found in the bones of river fish. Radiozinc and radiocesium were the main gamma emitters in the fleshy tissues. The maximum concentrations of gamma emitters found in composite samples collected adjacent to and below the Plant site are presented in the following table.

Nonvolatile Beta in River Fish, 1×10^{-12} c/g

Isotope	Adjacent to Plant Bone	Adjacent to Plant Flesh	Below Plant Bone	Below Plant Flesh
Cs-137	2.0	3.7	1.3	1.8
Zn-65	3.6	1.3	2.6	*

* Less than sensitivity of procedure.

The nonvolatile beta concentrations found in Savannah River algae collected near the mouth of each reactor effluent were lower than those measured during the previous report period. However, radioactivity released by Plant operations continued to be detectable in river algae as far downstream as Stokes Bluff, 60 miles below the Plant site. The radioactivity measured in river algae is shown in the following table.

River Location	Nonvolatile Beta in River Algae, 1×10^{-12} c/g		
	Max	Avg	Prev Avg
Above Upper Three Runs (Control)	25	20	25
Upper Three Runs	30	20	25
Four Mile Creek	250	85	95
Steel Creek & Pen Branch	755	255	550
Lower Three Runs	105	65	140
Highway 301	50	45	105
Stokes Bluff	45	35	35

Since algae are known to concentrate radioactivity in the water by factors up to 10^4, large algae samples (6 to 20 grams dry weight) were collected from the Savannah River in May for quantitative analysis by gamma spectrometry. The data show that Cr-51 was the predominant radionuclide found in river algae, only trace concentrations of $Ce^{141,144}$, Cs-137, and Zn-65 were present. Samples were collected near the mouths of the reactor effluents and at distances of 10 and 60 miles below the Plant site.

Isotope	Nonvolatile Beta in River Algae, 1×10^{-12} c/g				
	Four Mile	Steel Creek & Pen Branch	Lower Three Runs	Highway 301	Stokes Bluff
$Ce^{141,144}$	4	*	10	*	10
Cr-51	30	200	195	170	60
Cs-137	1	7	4	*	2
Zn-65	3	5	5	*	2

* Concentration less than sensitivity of analysis.

Clams collected in June from the Savannah River, 10 miles below the Plant site, contained trace concentrations of radiostrontium (maximum 6×10^{-12} c/g) in the shells. The only gamma emitter found in the fleshy tissues was Zn-65 (maximum 3.6×10^{-12} c/g). The concentrations of gamma emitters in shells and flesh of clams collected above the Plant site were below the sensitivity of analysis.

Chemical Quality of Water

Lower Three Runs and Savannah River

The chemical quality of the Savannah River both upstream (location 2) and downstream (location 10) from the Plant site during the past six months is presented in the following table. Water quality analyses at location 3 on Lower Three Runs Creek are also presented. All data except those for dissolved oxygen and BOD represent the average analyses of composite water samples which are collected weekly. The dissolved oxygen and BOD values reflect the average of weekly determinations of the oxygen at the time of collection.

The data indicate that SRP operations have almost undetectable effect on the health of the river.

Chemical Quality of Water

	Lower Three Runs			River Upstream			River Downstream		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
Color (APHA)	45	15	29	80	15	35	70	15	33
pH	9.0	7.0	7.9	7.7	6.8	7.1	7.7	6.6	7.1
Methyl Orange, ppm $CaCo_3$	60	18	31	60	12	18	22	9	16
Dissolved Oxygen, ppm	13	7	10	12	7	9.7	12	8	10
Sulfide, ppm S	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Hardness, ppm $CaCO_3$	34	19	26	18	8	13	21	11	14
Conductivity, µmhos	85	39	66	61	37	47	65	32	50
Total Dissolved Solids, ppm	97	26	50	52	31	43	70	24	43
BOD, ppm	3.4	0	0.80	3.7	0	0.87	3.6	0	0.81
Lignin, ppm	6.1	1.7	3.3	4.4	1.0	2.6	3.7	0.9	2.2
Surfactant, ppm	<0.02	<0.02	<0.02	0.03	<0.01	<0.02	<0.02	<0.02	<0.02
Total Iron, ppm Fe	0.86	0.05	0.38	1.6	0.11	0.77	1.7	0.20	0.85
Chloride, ppm Cl	3.6	0.7	1.5	2.2	0.8	1.3	3.0	0.3	1.1
Nitrite, ppm N	0.004	0.001	0.001	0.004	0.001	0.002	0.003	0.001	0.002
Nitrate, ppm N	0.04	0.01	0.03	0.10	0.02	0.05	0.09	0.02	0.04
Sulfate, ppm SO_4	3.2	<2.0	<2.0	3.5	<2.0	<2.4	4.0	<2.0	<2.6

Lower Three Runs and Wool Scouring Effluent

The Allendale wool scouring mill began discharging waste on January 9 into Lower Three Runs Creek approximately one-half mile above the Road A sampling location. Special chemical quality surveys of water were made on May 12 and June 15 to determine the nature of the woolen mill waste and its effect on the chemical quality of Lower Three Runs water during periods of high and low flow. The data show that the woolen mill waste had no apparent deleterious effect on the chemical quality of water at the Road A sampling location during either instance.

	Chemical Quality of Water					
	Lower Three Runs*		Woolen Mill Waste Effluent		Lower Three Runs**	
	Flow		Flow		Flow	
	High	Low	High	Low	High	Low
Dissolved Oxygen, ppm	7.2	7.4	2.9	1.3	6.7	6.2
Color (APHA)	40.0	25.0	80.0	100.0	50.0	30.0
pH	6.9	7.0	7.0	6.5	7.0	6.9
Methyl Orange, ppm $CaCO_3$	21.1	34.7	45.5	121.0	23.9	40.0
Sulfide, ppm S	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Hardness, ppm $CaCO_3$	20.0	34.3	22.0	79.0	21.2	28.4
Conductivity, µmhos	58.8	80.0	200.0	390.0	62.5	84.0
Total Dissolved Solids, ppm	39.0	53.8	193.4	372.2	53.4	57.4
BOD, ppm	0.2	<0.01	4.3	<0.01	1.2	0.05
Lignin, ppm	4.9	2.3	12.5	36.6	4.7	2.8
Total Iron, ppm Fe	0.9	0.5	1.9	0.3	0.9	0.6
Chloride, ppm Cl	1.1	1.0	2.7	5.0	0.9	1.1
Nitrite, ppm N	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nitrate, ppm N	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sulfate, ppm SO_4	<2.0	<2.0	12.3	111.2	<2.0	<2.0
Surfactant, ppm	<0.02	<0.02	4.4	<0.02	<0.02	<0.02

* 2.5 miles above waste effluent.
** 0.5 miles below waste effluent.

DISSOLVED OXYGEN PROFILE OF THE SAVANNAH RIVER. Surveys of the Savannah River, from Butler Creek entry to the Highway 301 bridge (see figure 20) are made each quarter to obtain dissolved oxygen profiles of the river during seasonal variations of flow and temperature. This report compares data obtained on March 15, 1961, under conditions of high river flow and low water temperature with data obtained on June 14, 1961, under conditions of normal river flow and median water temperature.

The data show that the dissolved oxygen content of river water was depressed slightly during each period as it flowed past the Plant site due to increased water temperature. The data also show that the oxygen content of river water near Augusta, Georgia was depressed slightly, during the period of normal river flow and median temperature (June 14, 1961), due to the discharge of sewage and industrial wastes. However, the river recovered its oxygen content approximately 20 miles upstream from the Plant site. The minor depressions noted above and adjacent to the Plant site are not deleterious to the general health of the river. Compensation for water temperature variation was made in calculating the percent saturation data presented in the following table.

River Location	River Mile	Water Temp, °C		Dissolved Oxygen, ppm		Percent Saturation	
		3/15	6/14	3/15	6/14	3/15	6/14
Butler Creek	203	13	22	9.8	7.4	92	84
Spirit Creek	198	13	24	10.2	6.1	96	72
Silver Bluff	189	12	23	10.9	8.3	100	96
Grays Landing	184	12	23	10.6	8.3	98	93
SR-2	175	13	24	10.1	8.2	95	96
Hancock Landing	165	13	24	9.8	7.2	92	84
Griffin's Landing	160	13	25	10.1	7.4	95	88
Brigham's Landing	157	13	25	10.2	7.7	96	92
Steel Creek	155	15	27	9.0	6.2	89	77
Little Hell Landing	144	23	28	8.2	6.9	94	87
Lower Three Runs	140	15	28	9.6	7.2	95	91
Johnson's Landing	139	15	27	9.8	7.0	97	87
Highway 301	129	15	27	9.1	7.4	90	92

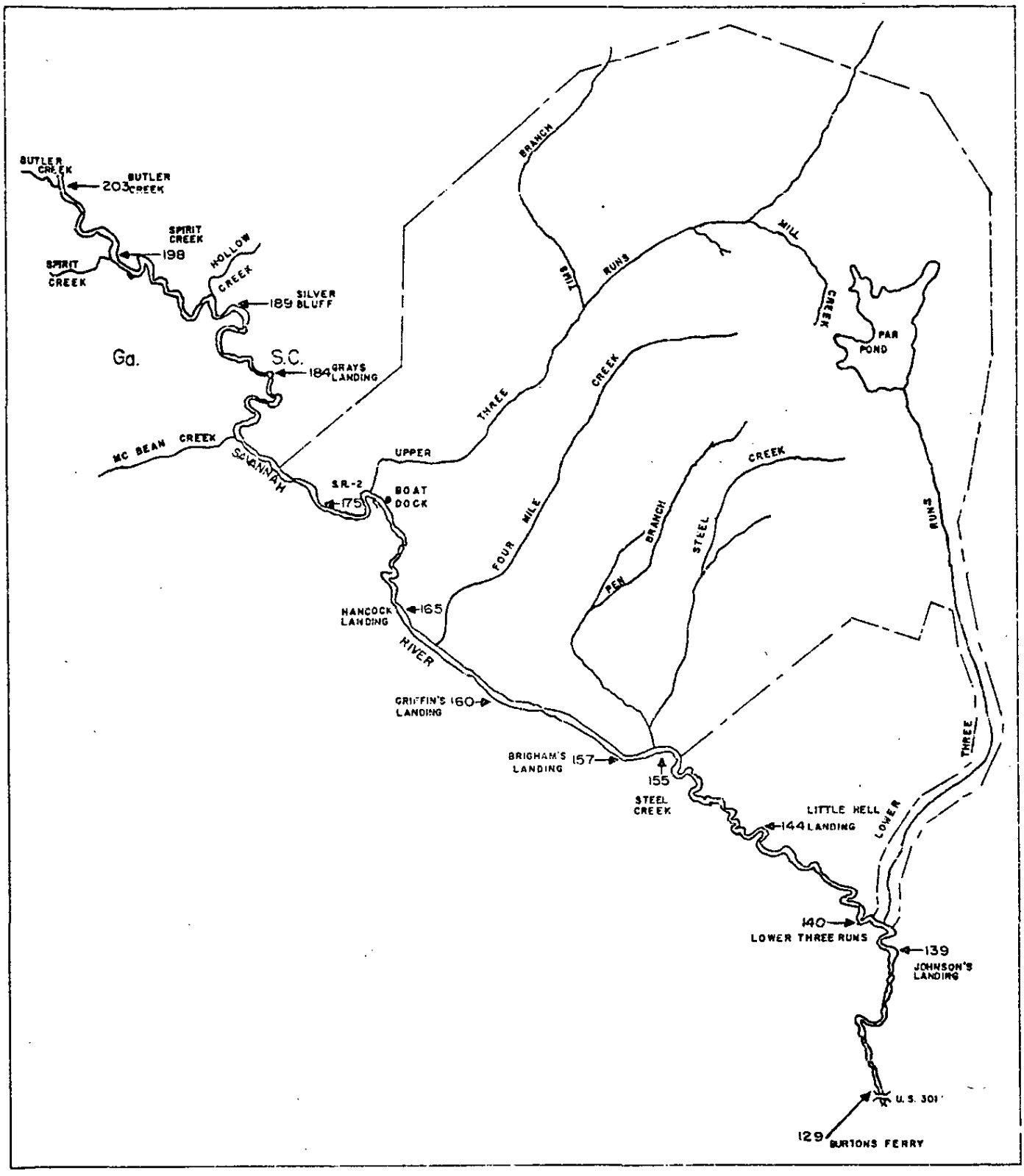


FIGURE 20. DISSOLVED OXYGEN SAMPLING LOCATIONS ALONG THE SAVANNAH RIVER. Numerical designations associated with sampling locations are number of river miles from Savannah, Georgia.

DISSOLVED OXYGEN CONTENT OF REACTOR EFFLUENTS. The dissolved oxygen content of each Plant effluent is measured weekly at the Road A sample location to determine the minimum dissolved oxygen content of water returned to the river. Upper Three Runs, which is not a reactor effluent, is sampled as a control. Compensation for water temperature variation was made in calculating the percent saturation. Data obtained during the report period are presented in the following table.

	Dissolved Oxygen, ppm		Percent Saturation	
Effluent	Minimum	Average	Minimum	Average
Upper Three Runs	7.6	9.5	85	90
Four Mile Creek	4.5	6.1	82	92
Pen Branch	4.9	6.1	92	95
Steel Creek	4.9	6.0	88	92
Lower Three Runs	6.1	9.3	79	88

Appendix

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APPENDIX A

Table 1. Separations Areas Stack Releases

	Alpha, mc	Nonvolatile Beta, mc						Radioiodine, mc	Tritium, curies
		$Ru^{103,106}$	$Sr^{89,90}$	Zr-Nb^{95}	Cs-137	$Ce^{141,144}$	Total		
F Area									
January	5.12	4.87	0.41	2.48	0.75	4.49	13.0	-	
February	1.00	13.40	0.05	0.67	0.17	2.84	17.1	-	
March	0.73	49.60	0.43	86.25	0.38	6.03	142.9	4.99	
April	1.17	35.64	4.38	13.4	6.52	32.77	92.7	51.30	
May	2.33	270.8	19.71	117.4	5.39	95.1	508.4	47,100	
June	3.82	218.8	1.23	1.20	2.59	8.59	232.4	113,000	
Total →	14.2	597.3	26.2	221.4	15.8	149.8	1006.5	160,156	
H Area									
January	0.17	1103	6.22	24.99	1.81	30.60	1167	16.6	37,800
February	.10	771	0.22	0.65	0.67	5.14	778	20.6	50,300
March	.26	221	.18	0.79	0.31	6.11	228	10.5	74,600
April	.19	236	.50	3.44	1.35	7.94	249	-	60,100
May	.23	159	.39	1.09	0.25	7.14	168	-	56,100
June	0.34	329	0.14	0.51	0.84	2.88	333	-	43,100
Total →	1.29	2819	7.65	31.5	5.2	59.8	2923	47.7	322,000*

APPENDIX A

Table 2. Reactor Areas Disassembly Basin Releases to Effluent Streams, curies

	Long-Lived Isotopes Exclusive of Tritium									Short-Lived Isotopes					
	Ce-141	Cr-51	Ru-103	$Zr-Nb^{95}$	Mn-54	Co-60	$Sr^{89,90}$	Cs-137	Total	Mo-99	Np-239	I-131	$Ba-La^{140}$	Total	Tritium
R Area															
January	0.15	0.53	0.03	0.05	0.28	0.07	0.52	1.61	3.24	0.04	1.84	0.68	0.10	2.66	930
February	.04	.02	.02	.03	0.07	.04	.05	0.43	0.71	-	0.05	.02	-	0.05	31
March	.24	.13	.03	.11	0.35	.17	.11	.37	1.51	-	1.34	.05	.04	1.43	660
April	.36	.48	.03	.22	1.81	.34	.07	.24	3.61	-	1.91	.18	.14	2.23	341
May	.42	.44	.09	.14	0.95	.20	.08	.28	2.60	0.01	2.44	.35	.61	3.40	1245
June	0.23	0.19	0.05	0.09	0.51	0.14	0.08	0.18	1.47	0.01	0.54	0.13	0.26	0.94	76
Total →	1.44	1.79	0.31	0.64	3.97	0.96	0.92*	3.11	13.14	0.06	8.10	1.41	1.15	10.71	3303
P Area															
January	0.09	0.67	0.04	0.04	0.10	0.07	0.14	0.32	1.47	-	3.06	0.26	0.07	3.39	1592
February	.08	.18	-	.03	.10	.08	.09	.21	0.77	-	0.10	.03	.01	0.14	24
March	.21	.89	.09	.06	.33	.08	.05	.15	1.86	0.08	11.75	.81	.53	13.17	1733
April	.13	.23	.05	.04	.18	.04	.04	.08	0.79	.05	3.98	.22	.35	4.60	1345
May	.17	.69	.07	.07	.49	.08	.10	.19	1.86	.14	5.97	.37	.46	6.94	419
June	0.25	0.46	0.13	0.11	0.54	0.14	0.03	0.18	1.84	0.04	3.57	0.51	0.72	4.84	764
Total →	0.93	3.12	0.38	0.35	1.74	0.49	0.45**	1.13	8.59	0.31	28.43	2.20	2.14	33.08	5879
L Area															
January	0.03	0.01	-	-	0.06	0.07	0.15	0.16	0.46	-	0.03	0.02	0.01	0.06	25
February	-	-	-	-	0.08	.03	-	.06	0.17	-	-	-	0.01	0.01	935
March	15.03	0.81	1.70	0.93	2.47	.56	1.40	.05	23.80	5.93	18.87	4.54	3.17	32.57	2436
April	0.56	.07	0.15	.20	0.57	.13	0.15	.02	1.85	-	3.09	0.06	0.31	3.48	170
May	0.30	0.05	.05	.10	0.32	.08	.08	.03	1.02	-	0.94	0.08	0.27	1.29	204
June	1.58	1.17	0.20	0.37	1.18	0.19	0.26	0.10	5.06	0.28	4.31	1.83	2.02	8.44	3311
Total →	16.15	2.11	2.10	1.60	4.68	1.06	2.04†	0.42	32.16	6.27	27.24	6.55	5.79	45.85	7061
K Area															
January	0.07	0.38	0.02	0.07	0.14	0.05	0.02	0.17	2.34	-	1.36	0.36	0.09	1.65	2423
February	1.00	.55	.07	.24	.17	.17	.24	.05	2.49	0.14	0.88	.30	.13	1.45	578
March	0.47	.11	.06	.13	.29	.14	.89	.06	2.14	-	.41	.03	.09	0.53	45
April	0.14	0.04	0.04	.04	.11	.06	0.07	.04	0.54	-	0.30	0.05	.19	0.54	26
May	3.28	4.96	1.69	.13	.27	.21	1.50	.07	12.31	-	11.21	4.27	.28	15.76	1923
June	0.46	0.11	0.04	0.10	0.12	0.02	0.07	0.08	1.00	-	0.66	0.03	0.12	0.81	633
Total →	6.05	5.15	2.12	0.71	1.10	0.65	3.59††	0.47	20.82	0.14	14.82	5.04	0.90	20.74	5628
C Area															
January	0.29	0.30	0.03	0.06	0.20	0.05	0.22	0.19	1.35	-	0.15	0.08	0.04	0.27	555
February	.30	1.73	.07	.09	.28	.09	.05	.09	2.72	-	6.63	.61	.21	7.45	2714
March	.12	0.28	.03	.04	.29	.07	.02	.05	0.89	-	0.40	.08	.14	0.62	704
April	.08	0.05	.03	.06	.33	.06	.02	.03	0.67	-	0.53	.04	0.16	0.73	9
May	0.74	0.23	.24	.33	.64	.48	0.03	.06	2.74	-	2.06	0.28	1.34	3.68	5
June	3.55	1.37	0.30	0.26	0.21	0.08	1.11	0.03	6.90	-	29.48	2.47	1.72	33.67	792
Total →	5.08	3.96	0.70	0.84	1.95	0.84	1.45‡	0.14	15.27	-	39.25	3.56	3.61	46.42	4779

- No significant release.
* Includes 0.48 curie Sr-90 with a maximum monthly release of 0.16 curie.
** Includes 0.44 curie Sr-90 with a maximum monthly release of 0.18 curie (March $Sr^{89,90}$ results were less than Sr-90 results).
† Includes 0.55 curie Sr-90 with a maximum monthly release of 0.21 curie.
†† Includes 0.19 curie Sr-90 with a maximum monthly release of 0.06 curie.
‡ Includes 0.21 curie Sr-90 with a maximum monthly release of 0.06 curie.

APPENDIX A

Table 3. Separations Areas Releases to Seepage Basin System, curies

	Alpha, mc	Nonvolatile Beta, curies							Radioiodine, curies	Tritium, curies
		Sr-90*	$Sr^{89,90}$	$Cs^{134,137}$	$Ce^{141,144}$	$Ru^{103,106}$	$Zr\text{-}Nb^{95}$	Total		
F Area										
January	44.5	0.21	1.89	1.31	14.2	4.2	13.2	34.8	-	
February	30.6	.09	0.23	0.18	3.7	2.0	4.7	10.8	-	
March	52	.41	.89	.83	5.6	3.8	4.2	15.3	-	
April	66	.27	.40	.39	3.1	3.9	1.4	9.2	-	
May	116	.09	.47	.33	2.9	12.2	0.9	16.8	4	
June	42	0.07	0.17	0.12	0.4	3.8	1.1	5.6	153	
Total →	351	1.14	4.05	3.16	29.9	29.9	25.5	92.5	157	
H Area										
January	25	0.37	1.83	0.15	4.1	5.8	11.3	23.2	0.05	
February	8	.06	0.13	.04	0.3	0.8	5.9	7.2	0.04	
March	8	.05	.05	.01	.09	.21	0.24	0.6	-	
April	13	.58	.74	.02	.09	.32	.24	1.6	-	
May	12	.52	.59	.08	0.49	.26	.15	1.6	-	
June	19	0.93	0.86	0.18	1.16	0.21	0.22	2.6	-	
Total →	85	2.51	4.20	0.48	6.23	7.60	18.0	36.8	0.09	

* Results included in $Sr^{89,90}$ column.

APPENDIX B

Table 1. Gamma Radiation Levels

	Dose Rate, mr/24 hours	
	Average	Previous Average
F Area	0.64	1.22
H Area	.78	0.66
R Area	.33	.52
P Area	.48	.51
L Area	.49	.60
K Area	.56	.43
C Area	.57	.52
TC Area	.44	.54
300/700 Area	.63	.67
Talatha Gatehouse	.26	.36
Williston Gatehouse	.31	.33
Dunbarton Fire Tower	.28	.36
400 Area	.42	.46
Green Pond Church	.30	.34
Military Recreation Site	.28	.29
Jackson	.26	.43
Aiken Airport	.43	.36
Allendale	.32	.38
Waynesboro	.35	.39
Bush Field	.29	.31
Langley	.29	.30
Williston	.32	.36
Barnwell	.35	.40
Sardis	.30	0.36
Aiken State Park	.30	-
Highway 301	0.34	-

[redacted]

APPENDIX B

Table 2. Radioactivity in Air

Location	Alpha, 1×10^{-14} uc/cc			Filterable Beta, 1×10^{-14} uc/cc			Radioiodine, 1×10^{-14} uc/cc			Tritium, 1×10^{-8} uc/cc		
	Max	Avg	Prev Avg	Max	Avg	Prev Avg	Max	Avg	Prev Avg	Max	Avg	Prev Avg
F Area	0.23	0.10	0.27	130	13	20	2800	160	6	0.57	0.21	0.47
H Area	.19	.07	.13	140	18	11	660	36	2	11.5	2.64	2.87
3/700 Area	.12	.06	.12	11	6	8	79	6	2	1.97	0.25	0.30
Talatha Gatehouse	.15	.08	.10	14	7	9	130	8	2	0.40	.15	.33
Williston Gatehouse	.14	.07	.07	19	8	7	110	6	*	1.16	.26	.24
Dunbarton Fire Tower	.16	.08	.10	15	7	8	20	2	2	0.41	.20	.29
400 Area	.20	.11	.11	16	7	8	78	7	2	.40	.41	.35
Aiken Airport	.15	.07	.11	18	7	7	78	4	*	.39	.08	.14
Allendale	.14	.07	.07	32	8	7	8	3	*	.39	.07	.10
Waynesboro	.14	.06	.09	17	7	8	11	2	2	.19	.06	.13
Langley	.12	.06	.08	24	6	6	6	*	2	.13	.06	.19
Williston	.15	.08	.05	14	7	6	24	5	2	.43	.11	.11
Barnwell	.17	.08	.08	25	8	6	18	*	2	.26	.07	.17
Sardis	.12	.04	.03	10	5	4	7	*	2	.28	.04	.08
Bush Field	.14	.05	.09	15	7	6	47	3	*	.21	.05	.13
Green Pond Church	.15	.07	.06	14	6	6	14	2	*	.43	.13	.31
Military Recreation Site	.10	.05	.07	12	5	8	83	5	*	.40	.12	.32
Jackson	.11	.06	.09	13	7	10	28	4	*	.76	.13	0.30
Aiken State Park	.11	.06	-	15	6	-	10	*	-	.18	.07	-
Highway 301	.15	.07	-	26	7	-	6	*	-	0.17	0.05	-
Columbia, S. C.	.18	.10	.12	13	5	6	-	-	-	-	-	-
Greenville, S. C.	.22	.10	.13	18	8	6	-	-	-	-	-	-
Macon, Ga.	.19	.11	.12	19	8	7	-	-	-	-	-	-
Savannah, Ga.	0.18	0.07	0.08	15	6	7	-	-	-	-	-	-

\- Sample not taken.
* Less than sensitivity of analysis.

[redacted]

APPENDIX B

Table 3. Radioactivity in Rainwater

Location	Alpha, 1×10^{-15} c/ml			Nonvolatile Beta, 1×10^{-15} c/ml			Radioiodine, 1×10^{-15} c/ml			Tritium, 1×10^{-12} c/ml		
	Max	Avg	Prev Avg	Max	Avg	Prev Avg	Max	Avg	Prev Avg	Max	Avg	Prev Avg
F Area	6.2	1.2	0.8	970	180	135	3400	270	6	180	22	29
H Area	1.4	0.7	1.0	230	54	35	1100	110	5	8200	430	167
3/700 Area	1.2	.5	0.6	47	24	38	34	9	6	56	13	21
Talatha Gatehouse	1.0	.4	.5	37	19	24	43	8	6	130	11	13
Williston Gatehouse	0.9	.6	.6	32	15	24	23	6	7	13	6	12
Dunbarton Fire Tower	1.1	.5	.4	49	18	20	170	14	5	22	9	25
400 Area	0.7	.4	.4	54	18	18	170	16	4	31	9	12
Aiken Airport	1.0	.4	.4	44	22	26	76	9	6	17	4	4
Allendale	0.7	.4	.7	30	16	28	100	8	5	13	*	5
Waynesboro	0.7	.3	.3	30	18	21	34	5	4	14	4	4
Langley	1.4	.4	.7	20	13	21	10	4	8	12	*	8
Williston	1.1	.3	.3	90	18	13	120	8	7	11	.4	6
Barnwell	0.8	.3	.2	73	24	16	18	5	7	17	4	6
Sardis	0.9	.3	.3	78	20	24	21	4	5	8	*	5
Bush Field	0.8	.3	.3	38	22	27	11	3	5	27	5	8
Green Pond Church	1.6	.5	.5	43	17	18	21	4	8	150	18	24
Military Recreation Site	1.1	.3	.3	47	22	14	11	3	8	70	7	14
Jackson	1.5	.3	0.3	38	18	13	8	3	5	28	7	16
Aiken State Park	0.6	.2	-	29	14	-	9	3	-	9	4	-
Highway 301	0.5	0.2	-	27	14	-	10	3	-	8	*	-

- Sample not taken.
* Less than sensitivity of analysis.

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Table 4. Radioactivity in Vegetation

Location	Alpha, 1×10^{-12} c/g			Nonvolatile Beta, 1×10^{-12} c/g			Radioiodine, 1×10^{-12} c/g		
	Max	Avg	Prev Avg	Max	Avg	Prev Avg	Max	Avg	Prev Avg
F Area (at 1 mile radius)	0.6	0.2	0.1	39	15	17	1000	250*	1.0
H Area (at 1 mile radius)	0.7	0.3	0.1	40	14	14	35	12*	0.6
Plant Perimeter	1.0	0.2	0.1	56	13	15	56	1.9	0.4
25-Mile Radius	1.0	0.2	0.1	20	11	15	44	1.5	0.5

* Samples analyzed for radioiodine only in June.

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Table 5. Radioactivity in Milk

	Radioiodine, 1×10^{-15} c/ml			Tritium, 1×10^{-12} c/ml		
	Max	Avg	Prev Avg	Max	Avg	Prev Avg
Talatha	760	62	*	10	4	7
Snelling	16	10	*	64	11	6
Aiken	370	33	*	7	*	4
North Augusta	76	13	*	11	4	4
Langley	470	35	*	7	*	4

Average Sr-90 in Milk, $\mu\mu c/\ell$

Type Sample	1960		1961	
	October	December	March	June
Family Cow	37	20	20	30
Local Dairy	15	12	12	12
Major Distributor	13	11	12	13

* Less than sensitivity of analysis.

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Table 6. Radioactivity in Plant Stream Water

Sample No.	Location	Alpha, 1×10^{-15} c/ml			Nonvolatile Beta, 1×10^{-15} c/ml			Tritium, 1×10^{-12} c/ml		
		Max	Avg	Prev Avg	Max	Avg	Prev Avg	Max	Avg	Prev Avg
	Tims Branch - Upper Three Runs									
1	Control	2.4	1.5	1.9	1.5	7	10	-	-	-
2	F Area Storm Sewer	230	32	350	50,000	4600	19,500	-	-	-
3	700 Area Effluent	69	20	64	300	120	290	17	*	4
4	300 Area Effluent	1700	220	160	4,800	980	560	-	-	-
5	Road C	5.2	1.4	1.6	19	6	8	-	-	-
6	Road A	1.6	0.8	0.7	11	4	7	10	5	6
	Four Mile Creek									
7	F Area Effluent	56	7.6	7	7,300	2300	10,000	76	11	13
8	H Area Effluent	2.1	1.1	0.6	140	50	82	300	180	250
9	Road 3	1.4	0.6	1.0	820	270	1,500	-	-	-
10	Road A	0.7	0.4	0.2	4,200	260	260	690	65	67
	Pen Branch									
11	Road A	0.5	0.1	0.3	3,600	190	260	630	53	80
	Steel Creek									
12	Road A	1.3	0.4	0.2	1,600	220	200	380	110	62
	Par Pond									
13	R Area Effluent	1.1	0.6	0.4	670	170	180	520	110	120
14	Pump House	0.6	0.2	0.2	170	65	120	120	94	120
	Lower Three Runs									
15	Patterson's Mill	0.8	0.2	0.2	74	38	78	140	37	65
16	Road A	0.4	0.1	0.1	42	24	40	58	17	39

		Radioiodine, 1×10^{-15} c/ml			Radiostrontium, 1×10^{-15} c/ml			Radiocesium, 1×10^{-15} c/ml		
		Max	Avg	Prev Avg	Max	Avg	Prev Avg	Max	Avg	Prev Avg
	Four Mile Creek									
8	F Area Effluent	-	-	-	380	46	840	1000	98	280
9	Road 3	220	26	-	-	-	-	-	-	-
10	Road A	320	21	26	130	13	11	220	14	7
	Pen Branch									
10	Road A	1000	57	83	150	22	14	30	6	7
	Steel Creek									
10	Road A	330	24	14	58	12	8	110	14	9
	Par Pond									
13	R Area Effluent	220	19	6	37	9**	12†	58	24**	53†
14	Pump House	-	-	-	55	9	9	38	14	22
	Lower Three Runs									
15	Patterson's Mill	-	-	-	23	8	9	24	12	23
16	Road A	-	-	-	16	8	9	14	9	12

* Less than sensitivity of analysis.
** Five month average.
† Three month average.

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Table 7. Radioactivity in Plant Stream Mud

Sample No.	Location	Alpha, 1×10^{-12} c/g			Nonvolatile Beta, 1×10^{-12} c/g		
		Max	Avg	Prev Avg	Max	Avg	Prev Avg
	Upper Three Runs						
1	Control	5.0	0.6	0.5	12	7	10
2	F Area Storm Sewer	2.5	0.9	1.8	1000	370	1200
3	700 Area Effluent	96*	38*	20*	180	29	40
4	300 Area Effluent	340*	140*	110*	480	120	71
5	Road C	4.0	1.1	1.3	44	13	16
6	Road A	1.3	0.3	0.6	16	7	9
	Four Mile Creek						
7	F Area Effluent	0.7	0.4	0.6	1100	170	860
8	H Area Effluent	1.3	0.2	0.2	18	6	14
9	Road 3	1.1	0.4	0.2	99	48	200
10	Road A	2.0	0.9	0.5	210	56	47
	Pen Branch						
11	Road A	0.9	0.3	0.2	350	43	47
	Steel Creek						
12	Road A	0.9	0.5	0.6	240	45	73
	Par Pond						
13	R Area Effluent	0.5	0.2	0.2	16	6	26
14	Pump House	0.4	0.2	0.1	10	4	6
	Lower Three Runs						
15	Patterson's Mill	0.6	0.2	0.2	12	4	20
16	Road A	0.6	0.2	0.2	42	7	6

* TBP extractable alpha.

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Table 8. Radioactivity in Savannah River Water

Location	Alpha, 1 × 10^{-15} c/ml			Nonvolatile Beta, 1 × 10^{-15} c/ml			Tritium, 1 × 10^{-12} c/ml		
	Max	Avg	Prev Avg	Max	Avg	Prev Avg	Max	Avg	Prev Avg
2	0.5	0.2	0.1	11	5	4	7	2	5
3	0.7	0.3	0.2	23	6	5	-	-	-
5	0.5	0.2	0.2	530	39	10	-	-	-
8	1.8	0.3	0.2	260	47	64	-	-	-
9	0.8	0.2	0.2	100	27	22	-	-	-
10	0.8	0.2	0.1	110	26	28	34	13	11
11	0.7	0.3	0.3	110	25	26	29	11	10

Location	Radioiodine, 1 × 10^{-15} c/ml			Radiostrontium, 1 × 10^{-15} c/ml			Radiocesium, 1 × 10^{-15} c/ml		
	Max	Avg	Prev Avg	Max	Avg	Prev Avg	Max	Avg	Prev Avg
2	-	-	-	7	2	-	-	-	-
8	-	-	-	50	12	5	22	6	7
9	-	-	-	39	9	5	24	6	5
10	42	7	6	52	8	5	13	4	6
11	-	-	-	44	9	4	20	5	5

Location	Radioactivity in Mud: TBP Extractable Alpha, 1 × 10^{-12} c/g			Nonvolatile Beta, 1 × 10^{-12} c/g		
	Max	Avg	Prev Avg	Max	Avg	Prev Avg
2	4	2	1	22	15	10
3	4	2	2	22	15	15
5	10	4	3	40	18	17
8	5	3	3	24	16	17
9	6	3	1	21	10	8
10	4	2	3	23	13	15
11	4	1	1	17	6	6

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Table 9. Radioactivity in Plant Drinking Water

Location	Alpha, 1×10^{-15} c/ml			Nonvolatile Beta, 1×10^{-15} c/ml		
	Max	Avg	Prev Avg	Max	Avg	Prev Avg
F Area	16.5	7.8	4.3	48	25	26
H Area	6.2	4.4	4.8	22	15	24
3/700 Area	1.6	1.1	1.4	4	*	8
400 Area	1.6	1.3	1.1	9	7	8
TNX	2.7	1.7	0.7	10	7	7
Pump House 1	0.3	*	0.6	6	5	5
Pump House 2	0.2	*	0.5	6	5	5
R Area	0.6	0.3	0.3	4	*	*
P Area	5.9	1.5	0.5	4	*	8
L Area	0.3	*	*	5	*	6
K Area	0.3	*	*	5	4	5
C Area	0.5	0.2	*	4	*	4
Par Pond - Pump House	0.6	0.4	0.2	10	4	5
TC Area	1.7	1.4	3.1	7	4	10
Classification Yards	0.9	0.7	0.6	7	4	4
Central Shops	0.7	0.6	0.5	4	4	6
Barricade 1	1.7	1.2	0.8	5	*	*
Barricade 2	37	28	33	66	52	52
Barricade 3	0.5	0.3	0.2	4	*	4
Barricade 4	7.1	4.0	2.9	7	6	6
Barricade 5	0.3	*	*	5	*	*
Donora Station Well	0.2	*	*	7	*	5

* Less than sensitivity of analysis.

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Table 10. Radioactivity in Public Drinking Water

Location	Alpha, 1×10^{-15} c/ml			Nonvolatile Beta, 1×10^{-15} c/ml		
	Max	Avg	Prev Avg	Max	Avg	Prev Avg
Allendale	0.4	0.1	0.1	10	3.0	4.1
Sardis	1.1	0.2	*	5	2.7	4.8
Waynesboro	0.2	0.1	0.1	7	1.6	3.7
Augusta	0.1	*	0.1	8	2.4	3.7
North Augusta	0.2	0.1	0.2	10	4.6	4.4
Clearwater	0.2	0.2	0.2	17	3.3	4.5
Bath	2.7	1.7	1.6	12	6.1	7.0
Langley	2.0	1.7	1.6	9	5.8	7.5
Jackson	4.7	3.4	3.2	16	10.6	6.9
New Ellenton	1.6	0.9	0.5	12	5.4	4.8
Aiken	4.5	2.2	1.1	9	4.4	2.6
Williston	1.9	1.4	0.9	7	4.3	4.6
Blackville	0.3	0.2	0.2	4	1.9	3.2
Barnwell	0.3	0.2	0.2	8	4.2	3.9

* Less than sensitivity of analysis.

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Table 11. Radioactivity in Seepage Basin Water

Basin No.	Alpha, 1×10^{-12} c/ml			Nonvolatile Beta, 1×10^{-12} c/ml			Radioiodine, 1×10^{-12} c/ml			Tritium, 1×10^{-12} c/ml		
	Max	Avg	Prev Avg	Max	Avg	Prev Avg	Max	Avg	Prev Avg	Max	Avg	Prev Avg
F Area												
1	13	5.3	7.9	8700	3000	860	170	38	25			
2	3.6	2.9	5.2	1500	1200	480	50	20	5			
3	4	2.5	4.2	590	380	280	6	5	4			
H Area												
1	7	1.4	4	2200	700	860	8	4	4			
2	1	0.4	0.2	410	280	70	5	4	2			
3	1	0.4	0.2	94	34	27	5	3	0.4			
A Area												
1	5.3	1.4	0.3	73	15	2	-	-	-	2,600	1,200	290
TNX												
1	11.8	5.7	3.2	33	16	12	-	-	-	400	80	24

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Table 12. Radioactivity in Ground Water

Well No.	Alpha, 1×10^{-15} c/ml Max	Avg	Prev Avg	Nonvolatile Beta, 1×10^{-15} c/ml Max	Avg	Prev Avg
			ZW Wells			
1	0.2	0.2	0.6	13	13	5
2	.2	.1	.2	7	4	18
3	.5	.4	.5	4	2	6
4	.2	.1	.4	29	15	6
5	.2	.1	.3	20	20	4
6	0.2	0.2	.4	11	6	4
7	*	*	0.0	18	10	2
8	0.1	0.1	.3	13	7	5
9	0.0	0.0	0.2	8	6	6
10	0.3	0.2	1.1	9	6	9
			Burial Ground Wells			
1	0.7	0.2	0.3	18	8	10
2	1.1	.3	.3	25	10	5
3	0.7	.2	.3	83	16	5
4	1.0	.6	.8	24	15	8
5	0.6	.2	.3	11	7	8
6	.4	.2	.3	20	9	6
7	.4	.2	.3	34	10	7
8	.5	.4	.6	16	7	12
9	0.5	0.3	0.3	18	9	6

Tritium in Ground Water, 1×10^{-12}

Well No.	Z Wells Max	Avg	Prev Avg	ZW Wells Max	Avg	Prev Avg	Burial Ground Wells Max	Avg	Prev Avg
1	19	19	14	6	3	4	5	1	10
2	24	18	4	1	1	5	45	9	12
3	15	10	4	36	24	27	30	8	4
4	**	**	**	111	76	35	310	220	128
5	**	**	**	38	30	31	60	40	37
6	31	31	**	32	17	40	9	3	11
7	**	**	**	140	95	28	4	1	4
8	33	28	12	7	4	17	52	26	76
9	25	24	20	205	192	58	12	3	8
10	**	**	**	114	104	15			
11	54	53	25						
12	36	33	32						
13	7	6	4						
14	**	**	**						
15	108	102	94						
16	**	**	**						
17	2	2	3						
18	30	29	23						
19	3	2	64						
20	2	2	4						
20A	**	**	**						

* Less than sensitivity of analysis.
** Water sample unobtainable.

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Table 13. Radioactivity in 200-Area Seepage Basin Wells

Distance from Basin, ft		Alpha, 1×10^{-15} c/ml			Nonvolatile Beta, 1×10^{-15} c/ml			Radiostrontium, 1×10^{-15} c/ml		
		Max	Avg	Prev Avg	Max	Avg	Prev Avg	Max	Avg	Prev Avg
					F Area					
1*	34	7000	2100	1800	210,000	130,000	300,000	690	180	1,600
2	5	0.9	0.5	0.7	190	95	93			
3	29	1.3	0.6	0.2	890	580	700			
4	73	0.5	0.2	0.2	2,000	1,100	350			
5*	24	3.0	1.5	0.1	42,000	9,300	9,800			
6*	6	1300	460	1100	169,000	66,000	100,000	44,000	3,600	800
7*	46	390	220	500	13,000	8,100	19,000	4,900	2,300	600
8	83	0.9	0.6	0.6	490	130	10			
9	150	1.0	0.6	0.6	59	24	29			
10*	9	1300	580	410	216,000	143,000	110,000	73,000	14,000	14,000
11	9	1.2	0.9	1.1	48	29	33			
12*	29	3000	900	320	118,000	69,000	86,000	970	720	14,000
13*	58	50	43	440	84,000	41,000	56,000	1,830	760	11,000
					H Area					
1	24	40	15	20	700	590	6,000			
2	25	1	0.8	0.5	540	120	16			
3	15	1.1	1.0	0.4	710	290	130			
4	45	1.6	0.8	0.4	23	17	8			
5	13	137	41	20	230,000	76,000	15,000	43,000	13,000	
6	6	0.6	0.4	0.4	460	220	130			
7	66	0.8	0.4	0.4	57	24	8			
8	18	0.6	0.3	0.4	152	91	43			
9	78	0.2	0.2	0.2	103	35	17			
10	19	1.0	0.4	0.4	290	120	15			
11	79	0.6	0.2	0.1	230	100	170			
A-37		4.0	2.0	2.5	680	250	440			

* Wells in perched water table.