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Environmental Surveillance Data Report for the Third Quarter of 1987

K. L. Daniels
P. Y. Goldberg
B. M. Horwedel
I. L. McCollough
A. E. Osborne-Lee
R. K. Owenby
J. B. Watson
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EXECUTIVE SUMMARY

During the third quarter of 1987, over 1600 samples which represent more than 5,000 analyses and measurements were collected by the Environmental Monitoring and Compliance (EMC) Department. Ten real-time monitoring stations, which telemeter 10-minute averaged readings on radiation levels, total rainfall, flows, and water quality parameters around ORNL also reported data. In addition, three meteorological towers sent climatological data to a host computer every 15 minutes.

Uranium concentrations measured on air filters near the Y-12 plant (stations 40, 45 and 46) were higher than normal due to a release from that facility in May.

More than 60% of the noncompliances with the NPDES permit for the third quarter occurred in July. These were primarily in total suspended solids at the Sewage Treatment Plant. The cause of these high concentrations has been explored with the plant operating staff but is currently unresolved.

Because of past noncompliances in fecal coliform and chlorine concentrations at the Sewage Treatment Plant, an engineering review has been initiated to examine the present chlorination system. This review is intended to provide a permanent solution to these types of problems.

Maximum concentrations of total radioactive strontium ($^{89}Sr + ^{90}Sr$) in bluegill were lower than those measured during the second quarter. There were not significant differences in the total radioactive strontium in bluegill at any of the Clinch River locations.

INTRODUCTION

The Environmental Monitoring and Compliance (EMC) Department within the Environmental Compliance and Health Protection Division (EC&HP) at the Oak Ridge National Laboratory (ORNL) is responsible for environmental surveillance to: (1) assure compliance with all Federal, State, and DOE requirements for the prevention, control, and abatement of environmental pollution, (2) monitor the adequacy of containment and effluent controls, and (3) assess impacts of releases from ORNL facilities on the environment.

To meet these objectives, the EMC Department has implemented a surveillance program that consists of both monitoring and sampling of environmental constituents. Monitoring provides continuous data for rapid screening of parameters. Sampling followed by laboratory analyses is usually recommended for routine surveillance rather than continuous monitoring. In general, monitoring systems are less sensitive and as a result have much higher detection levels than laboratory analysis. Laboratory analysis provides a quantitative estimate of concentrations or activities at environmental levels.

The surveillance program for 1987 includes sampling and monitoring of air, water from surface streams and point sources, groundwater, fish, and milk for radioactive and nonradioactive materials. The groundwater sites are currently being sampled semi-annually; therefore, no data will be included in this quarterly report. Surveillance points are located on-site to quantify discharges from ORNL facilities, and off-site to determine public exposures and to establish background reference levels.

The purpose of this report is to provide Laboratory and Central Management personnel with the most recent information on environmental conditions. It is intended strictly as a data report. Each quarter a report that summarizes all environmental monitoring data from the various media will be prepared.

Summaries of data will be presented for each month and quarter where there are multiple observations. The summary tables give the number of samples collected at each station or location and the maximum, minimum, and average values of parameters for which analyses were done. The 95% confidence coefficients (CCs) were calculated and where possible, average values were compared with applicable guidelines, criteria, or standards as a means of evaluating the impact of effluent releases on environmental concentrations. Some averages have been rounded and reported to only two significant digits.

Results which may be negative (values less than instrument background) are reported. Using this system, apparent decreases may be attributed to the reporting of negative values and the subsequent inclusion of these data into the averaging. For radionuclides measured by gamma spectroscopy, such as ^{60}Co and ^{137}Cs, the program software is not designed for the calculation of negative values and thus "less than" values are being reported for these

radionuclides. Modification of the program software to allow for the calculation of negative values for radionuclides determined by gamma spectroscopy is currently underway. These modifications should be completed during the fourth quarter of 1987.

Nonradionuclide results that are below the analytical detection limit are expressed as "less than" (<). In computing average values, less than results are assigned the detection limit. The average value is expressed as less than the computed value when all samples for the period are less than the detection limit.

AIR

Most gaseous wastes from ORNL are released to the atmosphere through stacks. Radioactivity may be present in gaseous waste streams as a solid (particulates), as an absorbable gas (iodine), or as a nonabsorbable species (noble gas). Gaseous wastes that may contain radioactivity are processed to reduce the radioactivity to acceptable levels before they are discharged. In addition to monitoring stack effluents, atmospheric concentrations of materials occurring in the general environment around ORNL, the Oak Ridge Reservation, and the vicinity are monitored continuously by an air monitoring network of 24 stations. Relative locations of these stations are shown in Figures 1 and 2. These air monitoring stations are categorized into three groups according to their geographical locations:

(1) The ORNL perimeter air monitoring network (ORNL PAMs) consists of stations 3, 7, 9, 21, and 22. These stations are located at or near the ORNL boundary (shown in Figure 1). Previously, stations 21 and 22 were used only for external gamma radiation measurements; there was no sampling equipment. However, sampling equipment has now been installed at station 22 and this station began operating in March. Station 21 is currently being upgraded to provide sampling capability.

(2) The DOE Oak Ridge reservation network (Reservation PAMs) consists of stations 8, 23, 31, 33, 34, 36, and 40-46 (Figure 1). Stations 31 through 45 have the capability to perform both sampling and continuous monitoring. Station 46 is currently being redeveloped to collect real-time data.

(3) The remote air monitoring network (RAMs) consists of stations 51-53 and 55-57. These stations are located within a 120 km radius of ORNL outside the DOE Oak Ridge Reservation (Figure 2).

At each real-time monitoring station, there are monitors for five radiation parameters (gross alpha, gross beta, iodine, gross gamma, and noble gas), a rain gauge, and three process sensors that are used to calculate the volume of the sample collected. A central processor collects 10-minute average readings and transmits the data to a VAX computer for further analysis and reporting. The central processor checks the values against alarm limits. All alarms are reported to a printer as they occur. The primary purpose of the monitoring system is to determine if radiation levels on the Reservation are above background levels. If radiation levels appear to be higher than normal, additional sampling can be initiated to provide quantitative measures of concentrations in the atmosphere. In addition, sampling is done at each station to quantify levels of iodine, gross alpha, and gross beta. The real-time monitoring system is the only measure of noble gases in the area.

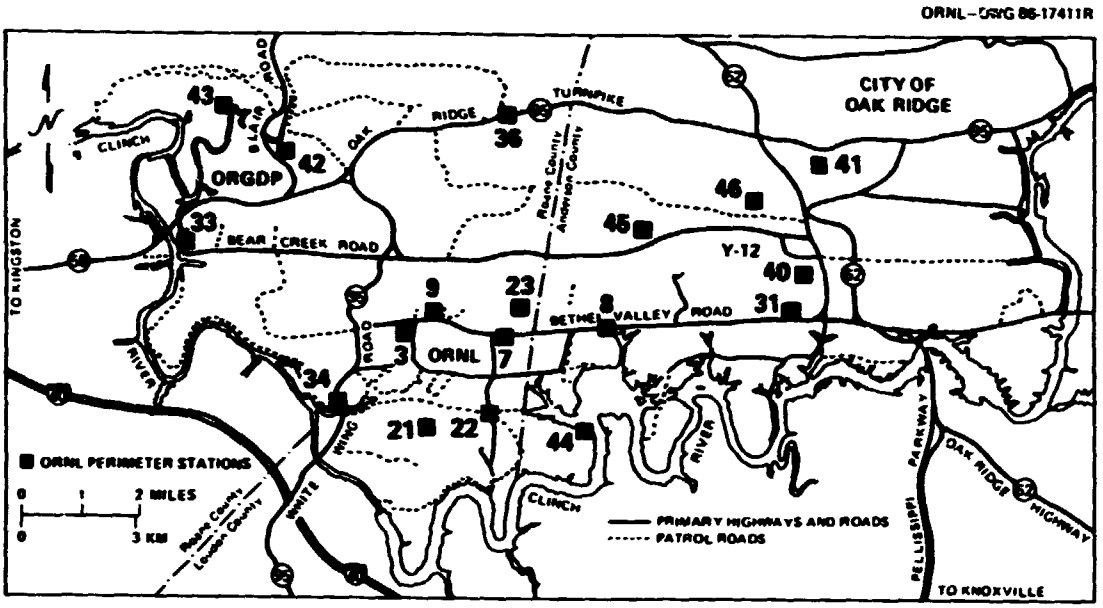

Fig. 1 Location map of the ORNL perimeter and Oak Ridge Reservation air monitoring stations.

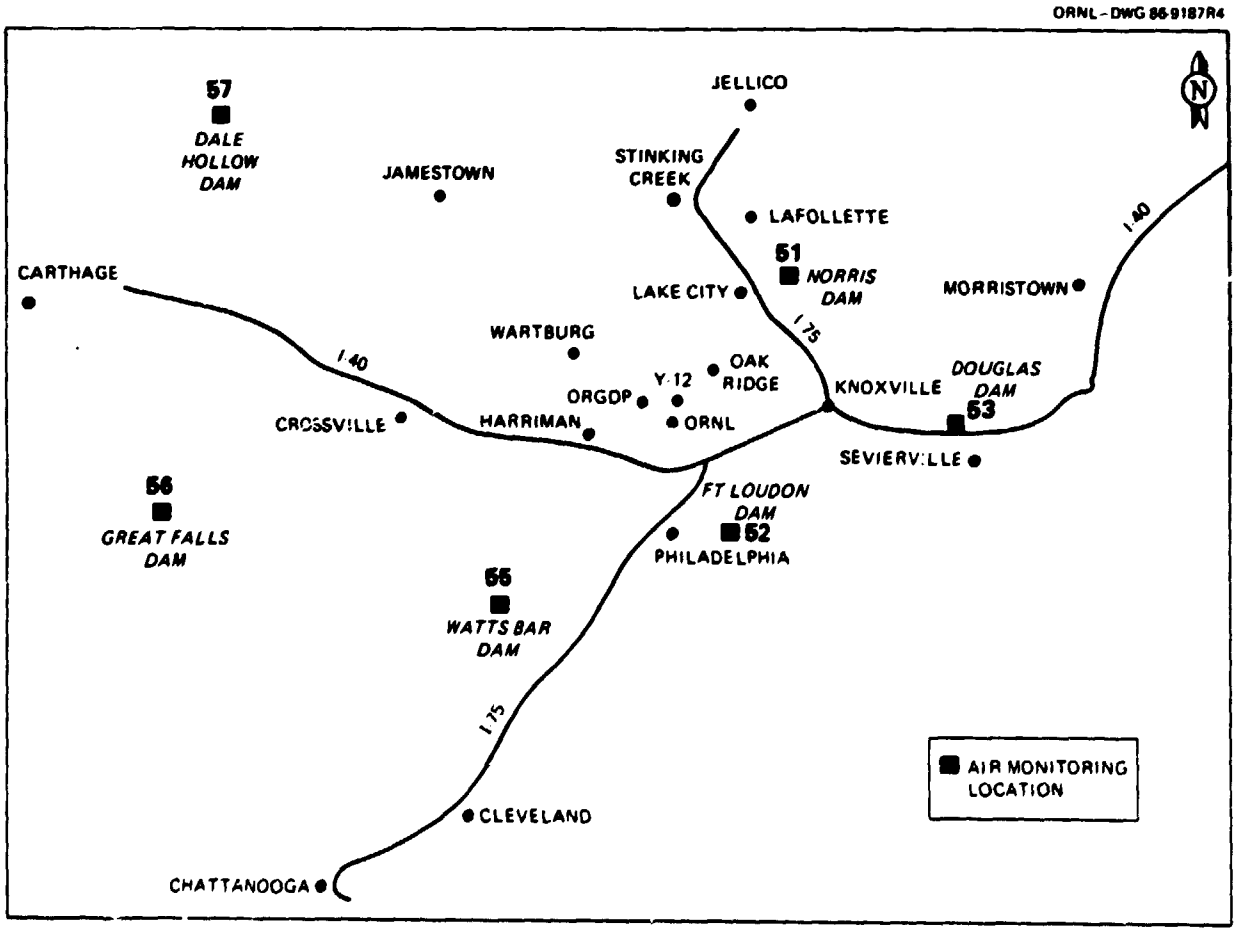

Fig. 2 Location map of the remote air monitoring stations

Airborne radioactive particulates are collected weekly by pumping a continuous flow of air through a paper filter and then through a charcoal cartridge. The filter papers are collected and analyzed weekly for gross alpha and gross beta activities. To minimize artifacts from short-lived radionuclides, the filter papers are analyzed 3-4 days after collection. The airborne ^{131}I is collected weekly using a cartridge that is packed with activated charcoal. The charcoal cartridges are analyzed within 24 hours after collection. The initial and final dates, time on and off, and flowrates are recorded when a sampler is mounted or removed. The total volume of air which flowed through the sampler at each station is calculated using this information. The flowrates at stations 3-45 are set between 1.5 and 3.0 CFM to minimize artifacts from extremely high or low flowrates. The concentration of radionuclides in air is calculated by dividing the total activity per sample by the total volume of air.

Monthly (July-September) concentrations of gross alpha, gross beta, and atmospheric ^{131}I are summarized in Tables 1-9. Instrument background concentrations of ^{131}I, gross alpha, and gross beta have been subtracted from the measured concentrations in Tables 1-9. Negative values represent concentrations below the instrument background level. Beginning with the third quarter of 1986, a new counter has been used for analyzing weekly gross alpha and gross beta activities on filter papers. This new instrument gives a higher efficiency and is more sensitive. This improvement in sensitivity has significantly lowered the maximum and minimum values for gross alpha and minimum values for gross beta (Tables 1-6).

There appears to be little or no alpha activity at any of the stations during the quarter. There was no significant difference in the beta activity among the three networks during July. However, during August and September, the Reservation PAMs and the RAMs were significantly higher than the ORNL PAMs.

During August and September, the RAM average was higher due to increased beta activity at Douglas Dam. The average beta activity at the Reservation PAMs was higher for these two months due to higher averages among several of the stations. Although beta activity was higher during August and September than in July, it was within the normal background levels for East Tennessee.

The charcoal samples collected weekly at the air monitoring stations showed no significant differences in iodine concentrations from the first quarter of 1987 (Tables 7-9). There were no significant differences in iodine concentrations at either of the two monitoring networks from July to September 1987.

Monthly samples for atmospheric tritium are routinely collected from ORNL PAM stations 3, 7, and Reservation PAM station 8. Samples were not collected at ORNL PAM station 7 this period because the station is currently being upgraded and was therefore not operational during the third quarter. Atmospheric tritium in the form of water vapor is removed from the air by silica gel. The silica gel is heated in a distillation flask to remove the moisture and the distillate is counted in a liquid scintillation counter. The concentration of tritium in the air is calculated by dividing total activity accumulated per month by total volume of air sampled. A quarterly

Table 1. Long-lived gross alpha activity in air

July 1987

Location	No. of Samples	Concentration (10^{-8} Bq/L) Max	Min	Av	95% cc[a]
		ORNL PAM Stations[b]			
3	5	12	-10	0.69	10
7	3	0	-10	-3.5	6.9
9	5	12	-10	2.8	11
22	3	0	-10	-3.5	6.9
Network summary	16	12	-10	-0.22	4.7
		Reservation PAM Stations[b]			
8	5	0	-10	-6.2	5.1
23	5	0	-12	-6.9	5.7
31	5	0	-12	-4.4	5.4
33	4	12	-10	6.0	11
34	5	13	-10	0.29	9.4
36	5	0	-15	-11	5.7
40	5	0	-12	-9.0	4.6
41	5	0	-10	-2.1	4.1
42	5	10	-12	-2.8	8.5
43	5	13	-13	-2.6	9.7
44	5	16	-12	-1.7	10
45	5	0	-12	-9.0	4.6
46	5	-10	-12	-11	0.85
Network summary	64	16	-15	-4.8	2.1
		RAM Stations[c]			
51	4	19	-12	3.9	13
52	5	13	-12	0.16	10
53	4	19	0	10	9.4
55	5	10	0	3.8	3.8
56	5	16	0	5.2	5.9

Table 1. (continued)

July 1987

Location	No. of Samples	Concentration (10^{-8} Bq/L) Max	Min	Av	95% cc[a]
57	5	22	0	8.3	10
Network summary	28	22	-12	5.3	3.5
Overall summary	108	22	-15	-1.6	1.9

[a] 95% confidence coefficient about the average of more than two samples.

[b] See Figure 1.

[c] See Figure 2.

Table 2. Long-lived gross alpha activity in air

August 1987

Location	No. of Samples	Concentration (10^{-8} Bq/L) Max	Min	Av	95% cc[a]
		ORNL PAM Stations[b]			
3	4	0	-10	-7.8	5.2
7	3	0	-10	-6.9	6.9
9	4	0	-10	-2.6	5.2
22	4	0	-10	-5.2	6.0
Network summary	15	0	-10	-5.5	2.8
		Reservation PAM Stations[b]			
8	4	-10	-10	-10	0
23	4	0	-10	-5.2	6.0
31	4	-10	-10	-10	0
33	4	0	-10	-7.8	5.2
34	4	10	-10	0	8.5
36	4	19	-13	-1.6	15
40	4	0	-10	-7.8	5.2
41	4	0	-10	-5.2	6.0
42	4	10	-10	-2.6	9.9
43	4	0	-13	-9.7	6.5
44	4	21	-10	0	15
45	4	0	-10	-5.2	6.0
46	4	0	-10	-5.2	6.0
Network summary	52	21	-13	-5.5	2.2
		RAM Stations[c]			
51	4	0	-10	-4.5	5.3
52	2	5.1	-10	-2.6	15
53	4	0	-10	-5.2	6.0
55	4	19	-9.3	6.9	14
56	4	16	-19	0.73	14

Table 2. (continued)

August 1987

Location	No. of Samples	Concentration (10^{-8} Bq/L) Max	Min	Av	95% cc[a]
57	4	39	0	9.7	19
Network summary	22	39	-19	1.2	5.4
Overall summary	89	39	-19	-3.8	2.0

[a] 95% confidence coefficient about the average of more than two samples.

[b] See Figure 1.

[c] See Figure 2.

Table 3. Long-lived gross alpha activity in air

September 1987

Location	No. of Samples	Concentration (10^{-8} Bq/L) Max	Min	Av	95% cc[a]
ORNL PAM Stations[b]					
3	4	0	-6.0	-4.1	2.8
7	3	-5.2	-6.0	-5.5	0.58
9	4	0	-6.0	-2.8	3.3
22	3	0	-9.1	-3.0	6.0
Network summary	14	0	-9.1	-3.8	1.7
Reservation PAM Stations[b]					
8	4	0	-9.1	-3.6	4.4
23	4	0	-9.1	-4.9	3.7
31	4	0	-9.1	-4.5	3.8
33	4	0.52	-9.1	-2.1	4.6
34	4	0	0	0	0
36	4	-3.6	-11	-6.6	3.3
40	4	0	-9.1	-4.7	3.7
41	4	0	-9.1	-3.6	4.4
42	4	0	-9.1	-2.9	4.3
43	4	0	-11	-5.3	4.8
44	4	0	-5.2	-2.1	2.5
45	4	0	-9.1	-3.0	4.3
46	4	9.1	-5.2	0.065	6.4
Network summary	52	9.1	-11	-3.3	1.1
RAM Stations[c]					
51	4	0	-5.2	-3.5	2.4
52	4	0	-5.2	-2.6	3.0
53	2	-4.5	-5.2	-4.9	0.65
55	3	0	-3.5	-1.8	2.0
56	4	0	-6.0	-3.2	2.7

Table 3. (continued)

September 1987

Location	No. of Samples	Concentration (10^{-8} Bq/L) Max	Min	Av	95% cc[a]
57	4	0	-3.7	-1.3	1.8
Network summary	20	0	-6.0	-2.7	0.98
Overall summary	86	9.1	-11	-3.3	0.77

[a] 95% confidence coefficient about the average of more than two samples.

[b] See Figure 1.

[c] See Figure 2.

Table 4. Long-lived gross beta activity in air

July 1987

Location	No. of Samples	Concentration (10^{-8} Bq/L) Max	Min	Av	95% cc[a]
		ORNL PAM Stations[b]			
3	5	88	18	40	26
7	3	30	26	29	2.9
9	5	110	18	44	34
22	3	100	52	85	33
Network summary	16	110	18	47	16
		Reservation PAM Stations[b]			
8	5	78	12	46	28
23	5	150	48	80	36
31	5	76	31	56	18
33	4	88	42	65	26
34	5	110	30	65	35
36	5	78	13	55	22
40	5	150	36	83	53
41	5	73	47	67	10
42	5	83	30	55	24
43	5	52	23	34	11
44	5	100	12	58	38
45	5	100	41	60	22
46	5	99	12	42	32
Network summary	64	150	12	59	8.2
		RAM Stations[c]			
51	4	130	3.2	35	62
52	5	91	0	23	45
53	4	130	-6.8	30	65
55	5	9.3	0	2.8	3.7
56	5	55	0	20	21

Table 4. (continued)

July 1987

Location	No. of Samples	Concentration (10^{-8} Bq/L) Max	Min	Av	95% cc[a]
57	5	43	0	17	16
Network summary	28	130	-6.8	20	14
Overall summary	108	150	-6.8	47	7.2

[a] 95% confidence coefficient about the average of more than two samples.

[b] See Figure 1.

[c] See Figure 2.

Table 5. Long-lived gross beta activity in air

August 1987

Location	No. of Samples	Concentration (10^{-8} Bq/L) Max	Min	Av	95% cc[a]
		ORNL PAM Stations[b]			
3	4	36	16	30	9.8
7	3	31	5.2	17	15
9	4	83	36	60	20
22	4	110	36	58	34
Network summary	15	110	5.2	43	14
		Reservation PAM Stations[b]			
6	4	110	47	78	25
23	4	110	47	83	28
31	4	88	16	47	31
33	4	160	47	82	54
34	4	170	43	110	53
36	4	190	45	110	68
40	4	78	16	51	30
41	4	67	52	61	6.5
42	4	88	36	62	21
43	4	58	32	45	11
44	4	160	83	120	39
45	4	130	41	70	41
46	4	83	36	58	20
Network summary	52	190	16	75	11
		RAM Stations[c]			
51	4	110	67	88	20
52	2	25	10	18	15
53	4	150	130	140	7.8
55	4	140	0	47	66
56	4	99	0	52	43

Table 5. (continued)

August 1987

Location	No. of Samples	Concentration (10^{-8} Bq/L) Max	Min	Av	95% cc[a]
57	4	180	0	84	74
Network summary	22	180	0	76	24
Overall summary	89	190	0	70	9.3

[a] 95% confidence coefficient about the average of more than two samples.

[b] See Figure 1.

[c] See Figure 2.

Table 6. Long-lived gross beta activity in air

September 1987

Location	No. of Samples	Concentration (10^{-8} Bq/L) Max	Min	Av	95% cc[a]
		ORNL PAM Stations[b]			
3	4	47	32	39	6.6
7	3	36	24	31	7.0
9	4	73	64	69	4.5
22	3	86	42	69	27
Network summary	14	86	24	52	11
		Reservation PAM Stations[b]			
8	4	99	47	75	21
23	4	97	59	82	16
31	4	79	4.5	45	31
33	4	140	91	120	24
34	4	130	73	110	28
36	4	110	79	97	15
40	4	62	47	54	7.7
41	4	91	45	68	19
42	4	120	85	100	15
43	4	110	68	87	20
44	4	100	73	81	13
45	4	120	77	100	17
46	4	78	54	66	9.8
Network summary	52	140	4.5	84	7.6
		RAM Stations[c]			
51	4	150	99	120	24
52	3	140	73	100	42
53	2	100	77	90	27
55	3	59	26	43	19
56	4	150	76	110	30

Table 6. (continued)

September 1987

Location	No. of Samples	Concentration (10^{-8} Bq/L) Max	Min	Av	95% cc[a]
57	4	130	99	110	13
Network summary	20	150	26	99	15
Overall summary	86	150	4.5	82	6.7

[a] 95% confidence coefficient about the average of more than two samples.

[b] See Figure 1.

[c] See Figure 2.

Table 7. ^{131}Iodine concentrations in air

July 1987

Location	No. of Samples	Concentration (10^{-8} Bq/L) Max	Min	Av	95% cc[a]
		ORNL PAM Stations[b]			
3	5	4.9	0	1.9	1.8
7	3	2.5	-5.7	-1.9	4.8
9	5	2.5	-7.7	-2.4	3.5
22	3	6.3	0	2.8	3.7
Network summary	16	6.3	-7.7	0.027	1.9
		Reservation PAM Stations[b]			
8	5	7.4	-6.3	2.0	4.6
23	5	5.7	-2.5	1.5	3.0
31	5	11	-8.6	1.2	6.4
33	4	19	-4.9	3.1	11
34	5	16	-4.1	2.7	6.9
36	5	14	-2.5	6.9	6.0
40	5	2.5	-2.5	0	1.6
41	5	4.9	-2.2	1.7	2.6
42	5	3.8	-6.9	-1.9	4.4
43	5	0	-6.1	-2.7	2.5
44	5	4.9	-2.5	1.3	2.4
45	5	6.3	-4.9	2.9	4.1
46	5	9.1	-5.7	2.9	5.9
Network summary	64	19	-8.6	1.6	1.4
Overall summary	80	19	-8.6	1.3	1.2

[a] 95% confidence coefficient about the average of more than two samples.

[b] See Figure 1.

Table 8. ^{131}Iodine concentrations in air

August 1987

Location	No. of Samples	Concentration (10^{-8} Bq/L) Max	Min	Av	95% cc[a]
		ORNL PAM Stations[b]			
3	4	8.3	-4.2	2.1	5.4
7	3	12	0	6.3	7.2
9	4	6.3	-2.1	2.6	3.6
22	4	4.2	2.1	3.2	1.2
Network summary	15	12	-4.2	3.3	2.1
		Reservation PAM Stations[b]			
8	4	6.3	0	3.7	2.6
23	4	4.2	-4.2	-1.1	4.0
31	4	4.2	0	1.6	2.0
33	4	10	-6.3	2.6	6.9
34	4	8.3	-1.8	3.6	4.5
36	4	7.9	2.6	4.6	2.5
40	4	10	0	3.6	4.6
41	4	0	-4.2	-1.6	2.0
42	4	-2.1	-6.3	-4.7	2.0
43	4	5.3	-5.3	-0.66	5.4
44	4	6.3	-4.2	1.6	4.3
45	4	4.2	0	2.1	1.7
46	4	4.2	-4.2	-0.53	4.3
Network summary	52	10	-6.3	1.1	1.2
Overall summary	67	12	-6.3	1.6	1.1

[a] 95% confidence coefficient about the average of more than two samples.

[b] See Figure 1.

Table 9. ^{131}Iodine concentrations in air

September 1987

Location	No. of Samples	Concentration (10^{-8} Bq/L) Max	Min	Av	95% cc[a]
		ORNL PAM Stations[b]			
3	4	8.3	-5.5	2.1	7.2
7	3	2.1	-4.2	-0.70	3.7
9	4	4.2	-4.2	-0.46	3.6
22	3	15	0	7.6	8.4
Network summary	14	15	-5.5	2.0	3.2
		Reservation PAM Stations[b]			
8	4	19	0	7.4	8.5
23	4	4.9	-5.5	0.90	4.8
31	4	6.3	-2.5	1.9	3.9
33	4	5.5	-4.2	0.94	4.1
34	4	6.3	0	2.6	2.7
36	4	17	2.3	8.0	6.3
40	4	4.9	-3.7	1.4	4.0
41	4	1.8	-2.5	-1.2	2.0
42	4	9.1	-6.3	2.0	7.4
43	4	9.0	-3.1	2.2	6.0
44	4	4.9	-2.1	1.8	3.4
45	4	8.3	-4.9	1.7	6.2
46	4	8.3	0	3.0	3.9
Network summary	52	19	-6.3	2.5	1.4
Overall summary	66	19	-6.3	2.4	1.3

[a] 95% confidence coefficient about the average of more than two samples.

[b] See Figure 1.

Table 10. Tritium activity in air

July - September 1987

Location[a]	No. of Samples	Concentration (10^{-4} Bq/L) Max	Min	Av	95% cc[b]
3	3	8.4	7.8	8.2	0.41
8	3	5.5	2.7	4.4	1.7
Overall summary	6	8.4	2.7	6.3	1.9

[a] See Figure 1.

[b] 95% confidence coefficient about the average of more than two samples.

summary of the atmospheric tritium concentrations is presented in Table 10. Tritium concentration in air showed no significant differences from the past three years' values.

Air filters are composited quarterly from ORNL PAMs (stations 3, 7, 9, and 22), Reservation PAMs (excluding stations 34, 36, 40, 41, 45, and 46), RAMs (stations 51-53 and 55-57), and from individual stations (34, 36, 40, 41, 45 and 46) and are analyzed for specific radionuclides. Results of these analyses for the third quarter were not available at the time of publication of this report. Second quarter results are provided in this report (Tables 11 and 12). No ^{60}Co or ^{137}Cs were detected on any of the quarterly air filters. Although the total radioactive Sr concentration at station 34 appears to be high (Table 12), this concentration is not justified due to the large instrument background (see value of -180 at station 45). Uranium concentrations at stations near Y-12 (40, 45 and 46) were elevated due to a release from Y-12 during May.

Table 11. Long-lived radioactivity in composited air filters from air monitoring networks

April - June 1987

Radionuclide	Concentration (10^{-10} Bq/L) Location[a] ORNL PAMs	Reservation PAMs	RAMs
^{60}Cs	< 20	< 10	< 10
^{137}Cs	< 24	< 14	< 39
^{238}Pu	-0.28	1.8	-0.14
^{239}Pu	-0.85	-1.6	-0.14
^{228}Th	0.28	0.36	0.28
^{230}Th	0.57	0.18	0.14
^{232}Th	0.28	0.18	0.14
Total Sr[b]	-23	9.1	2.8
^{234}U	65	140	14
^{235}U	19	39	0.70
^{238}U	31	39	14

[a] See Figure 1 and 2.

[b] Total radioactive Sr (^{89}Sr + ^{90}Sr).

Table 12. Long-lived radioactivity in composited air filters from individual stations

April - June 1987

	Concentration (10^{-10} Bq/L)					
	Location[a]					
Radionuclide	34	36	40	41	45	46
^{60}Co	< 92	< 84	< 84	< 76	< 100	< 93
^{137}Cs	< 52	< 68	< 56	< 50	< 85	< 66
^{238}Pu	-4.3	-1.5	-1.2	1.2	-1.3	1.4
^{239}Pu	-4.3	-1.5	1.2	-2.3	-10	-6.8
^{228}Th	-1.1	1.5	-1.2	1.2	-2.6	5.5
^{230}Th	-1.1	3.0	-2.4	1.2	-1.3	4.1
^{232}Th	1.1	-1.5	1.2	1.2	1.3	-1.4
Total Sr[b]	54	44	47	-13	44	-82
^{234}U	53	25	640	62	450	720
^{235}U	4.6	-0.83	35	5.7	33	130
^{238}U	48	7.5	13	9.4	170	110

[a] See Figure 1.

[b] Total radioactive Sr (^{89}Sr + ^{90}Sr).

EXTERNAL GAMMA RADIATION

External gamma radiation measurements are made to confirm that routine radioactive effluents from ORNL are not increasing external radiation levels significantly above normal background.

Currently, external gamma radiation measurements are made monthly at the ORNL PAM stations (Figure 1) and at Reservation PAM stations 8 and 23 (Figure 1), quarterly at sites along the bank of the Clinch River (Figure 3), and semiannually at the RAM stations (Figure 2). Third quarter Clinch River TLD's were placed in the field on July 31, 1987, and retrieved for exposure reading on October 2, 1987. This represented a two-month period instead of the normal 3-month, quarterly, exposure period. Measurements along the bank of the Clinch River, from the mouth of White Oak Creek for several hundred yards downstream, are made to evaluate gamma radiation levels resulting from ORNL effluent releases and "sky shine" (air scattered gamma radiation) from an experimental radioactive cesium plot located near the river bank. Measurements at these sites are made using thermoluminescent dosimeters (TLDs). Three dosimeters are placed in each container and the containers are suspended one meter above the ground. Measurements from each dosimeter are averaged for the month, quarter, or semiannual period. No real-time data was collected at many of the Reservation PAM stations due to the installation of new monitoring hardware and software. Summaries of external gamma radiation measurements are provided in Tables 13 and 14. Results for this quarter and future quarters will be expressed in SI units (nGy/h) instead of μR/h. To convert μR/h to nGy/h, multiply μR/h by 10.

There were no significant differences in the external gamma radiation among the ORNL PAM network and the Reservation PAM network.

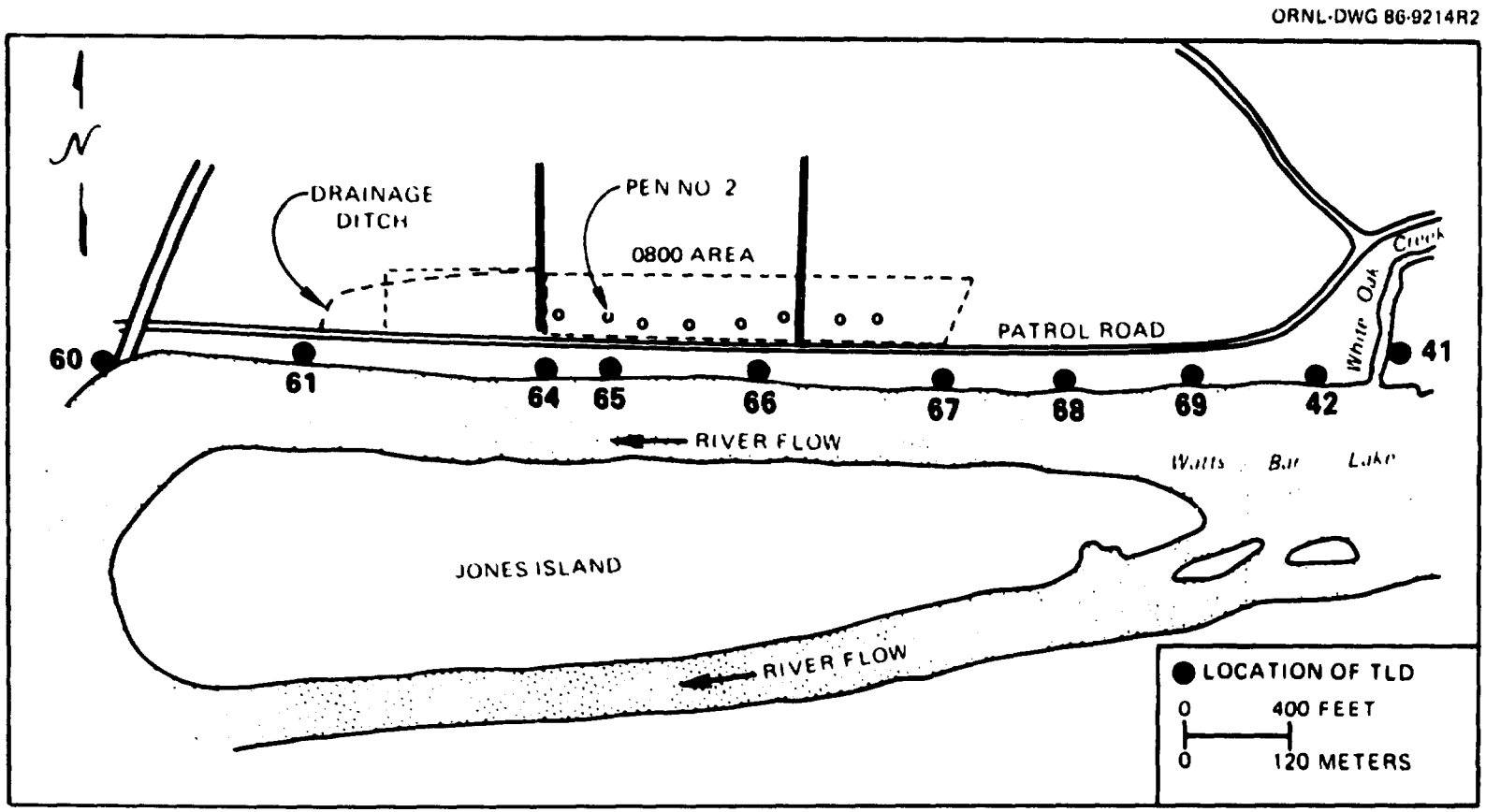

Fig. 3 Location map of TLDs along the Clinch River

Table 13. External gamma radiation measurements at ORNL and reservation perimeter air monitoring stations

July - September 1987

Location	No. of samples[a]	Concentration (nGy/h) Max	Min	Av	95%cc[b]
		ORNL PAM Stations[c]			
3	3	57	30	39	18
7	3	40	13	27	15
9	3	67	20	38	29
21	3	40	23	33	10
22	3	60	43	49	11
Network summary	15	67	13	37	7.9
		Reservation PAM Stations			
8	3	40	6.7	22	19
23	3	30	13	21	9.7
Network summary	6	40	6.7	22	9.7

[a] Individual dosimeters are averaged for each location. The number of samples indicates the number of months of data.

[b] 95% confidence coefficient about the average.

[c] See Figure 1.

Table 14. External gamma radiation measurements along the Clinch River

July - September 1987

Location[a]	No. of samples[b]	Concentration (nGy/h)
41	1	120
42	1	93
60	1	77
61	1	120
64	1	180
65	1	200
66	1	220
67	1	130
68	1	80
69	1	73
Quarterly average	10	130

[a] See Figure 3.

[b] Individual dosimeters are averaged for each station. The number of samples indicates the number of quarters of data.

WATER

The majority of the drainage or liquid effluent from ORNL flows into the Clinch River by way of White Oak Creek (WOC). The Clinch River flows southwest from Virginia to its mouth near Kingston, Tennessee, where it joins with the Tennessee River.

Runoff from the majority of the sites at ORNL, including that from the burial grounds, reaches WOC either directly or via one of its tributaries, such as Melton Branch (MB). Concentrations of contaminants in WOC are affected by White Oak Dam (WOD) which controls the stream's flow. Flow in WOC may also be augmented by discharges from the ORNL cooling towers and Sewage Treatment Plant. Below WOD, WOC is affected by water levels in the Clinch River which are controlled by Melton Hill Dam, shown in Figure 4.

Surveillance of the water environment consists of the collection of surface water samples and effluent samples required under the National Pollutant Discharge Elimination System (NPDES) permit. Samples are analyzed for radionuclides and nonradioactive chemicals.

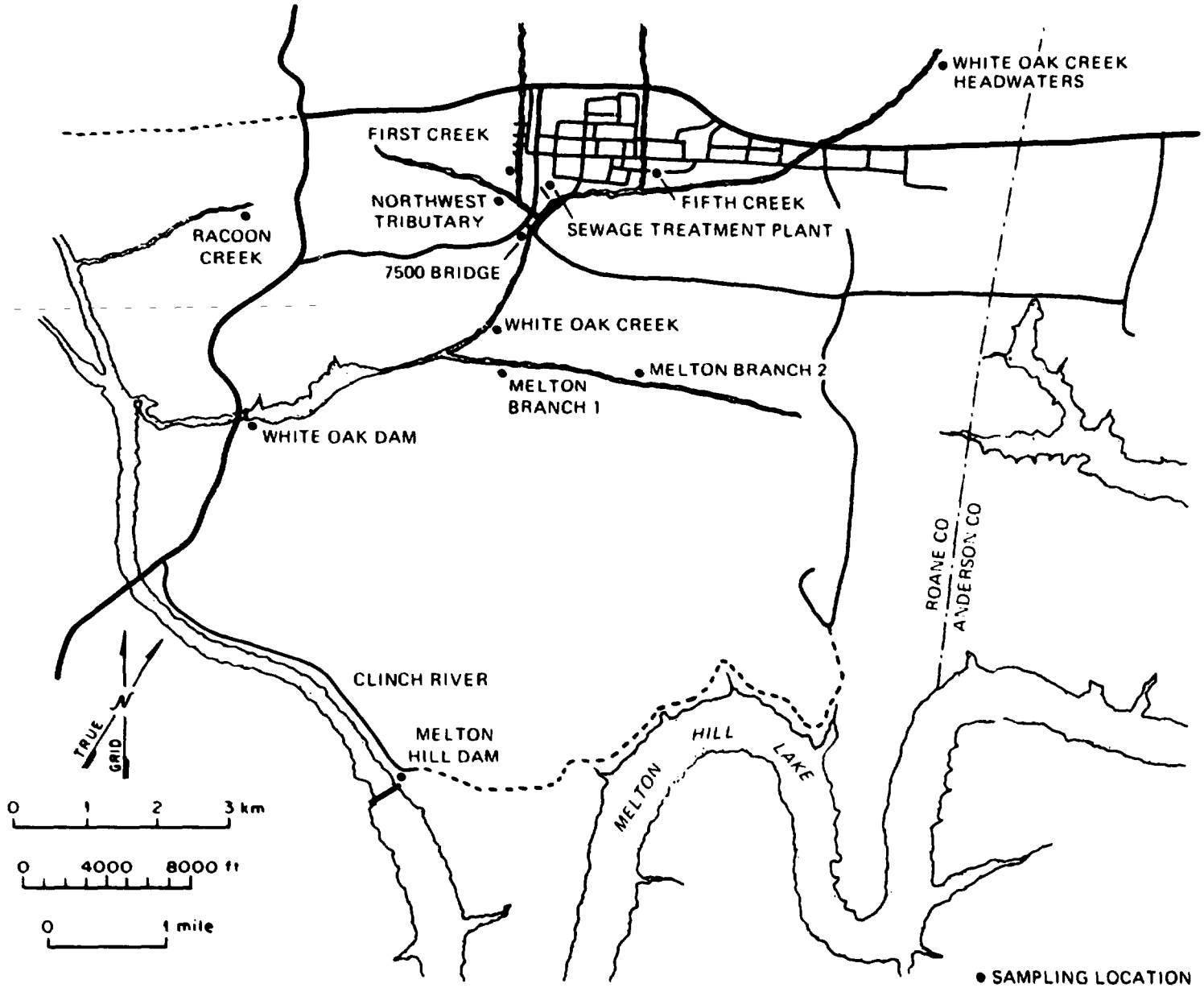

Fig. 4 Location map of ORNL streams and sampling stations

Surface Water

White Oak Creek drains an area of 17 km^2 in Bethel and Melton Valleys and is the largest stream flowing through ORNL. Run-off from sites at ORNL reaches WOC either directly or via one of its tributaries. After entering Melton Valley, WOC is joined by its major tributary, MB, at WOC kilometer 2.49. White Oak Dam, located one kilometer above the mouth of WOC, forms White Oak Lake and serves as a point for monitoring flow and discharges of contaminants from the ORNL site. Major discharges to WOC include: (1) treated domestic (sanitary) waste from the Sewage Treatment Plant (STP); (2) cooling tower blowdown; (3) cooling water from various sources; (4) surface drainage from the main Laboratory area, including drainage from Solid Waste Storage Areas 3, 4, and 6; (5) discharges from the low-level radioactive waste collection (190 ponds) and process waste treatment plant (3544); and (6) discharges from process building areas. Major discharges to MB include discharges from Solid Waste Storage Area 5, blowdown from the recirculating cooling water system at the High Flux Isotope Reactor, and discharges from the 7900 waste pond system.

To determine discharges of radionuclides from ORNL processes, flow and concentration data from ORNL streams are recorded. Water samples are collected regularly from the following stations: 1500 Area, 190 Ponds, First Creek, 2000 Area, Acid Neutralization Facility (3518), Process Waste Treatment Plant (3544), Fifth Creek, 7500 Bridge, Melton Branch 1 (MB1), Melton Branch 2 (MB2), Melton Hill Dam, Northwest Tributary (NWT), ORR Resin Regeneration Facility (ORR), Raccoon Creek, STP, TRU Ponds, WOC, White Oak Creek Headwaters, and WOD (Figures 4 and 5). Radiological monitoring at stations in the 1500 Area, 190 Ponds, 3518, 3544, and TRU Ponds was initiated in February to comply with the requirements of the National Pollutant Discharge Elimination System (NPDES) Radiological Monitoring Plan.

In addition, process water samples are collected from the sanitary waste treatment plants at the Oak Ridge Gaseous Diffusion Plant (ORGDP - Gallaher) and Kingston (Figure 6). ORNL tap water is also sampled. Samples collected from Melton Hill Dam, WOC Headwaters, and ORNL tap are considered as background or reference samples. Table 15 summarizes the sampling and analysis frequencies, the parameters analyzed, and the type of sample collected at each of these stations. Summaries of radionuclide concentrations are presented in Tables 16-19. All determinations for "total Sr" are for total radioactive strontium which is the sum of ^{89}Sr and ^{90}Sr. The 95% confidence coefficients about the averages have not been presented for stations with less than three samples. Results of these determinations for the second and third quarters have been included in this report (Tables 16-17).

Cobalt-60 and ^{3}H maximum concentrations at MB2 were high relative to the first quarter results (Table 18). This was due to concentrations measured during the month of August. These values are the highest since January 1987. The sources of ^{60}Co and ^{3}H are under investigation but have not yet been identified. The maximum cesium-137 concentration in the 190 ponds was also high during this period due to the concentration measured during September. The Operations Division is investigating possible sources of the ^{137}Cs.

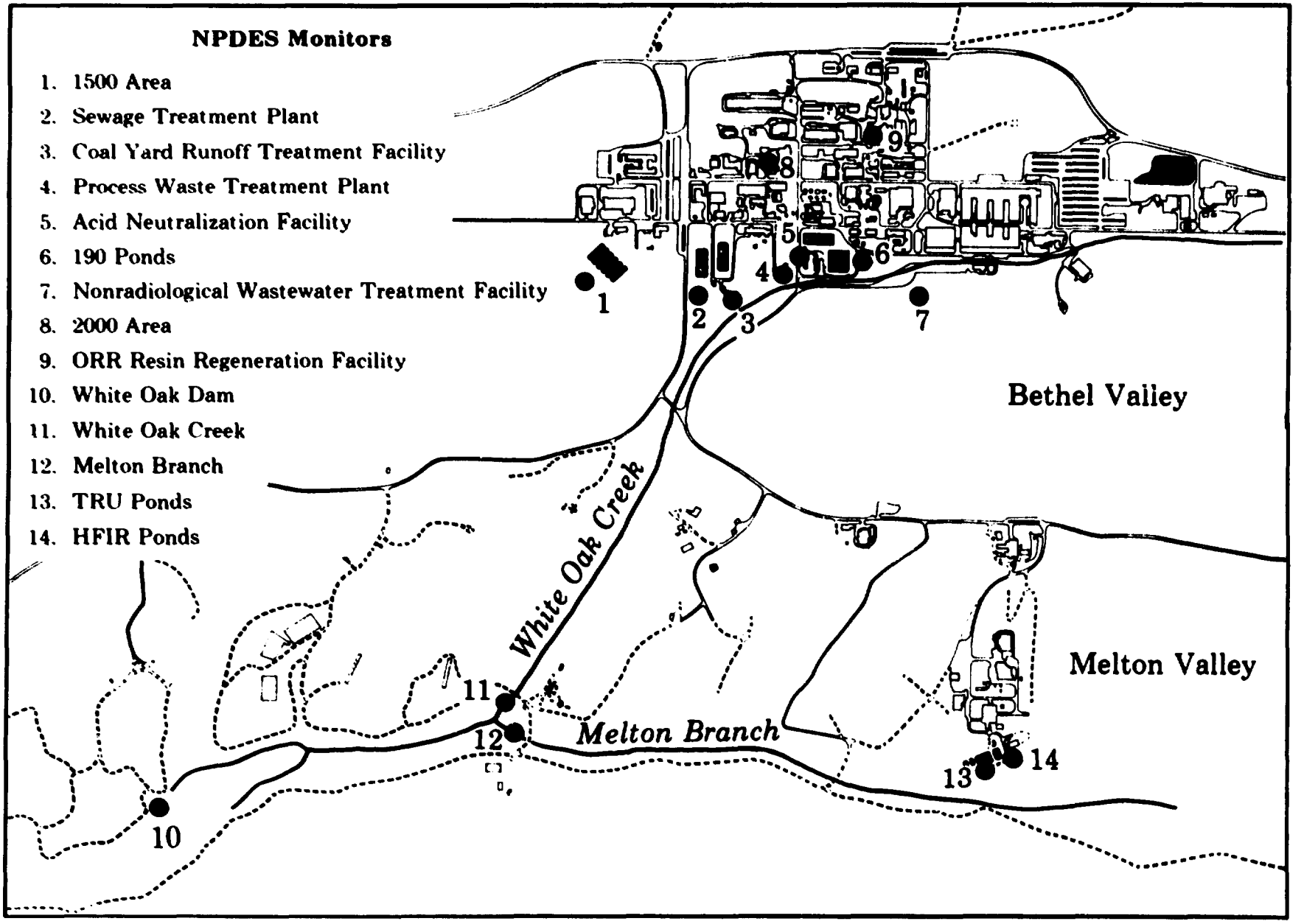

Figure 5 Location map of NPDES monitoring points

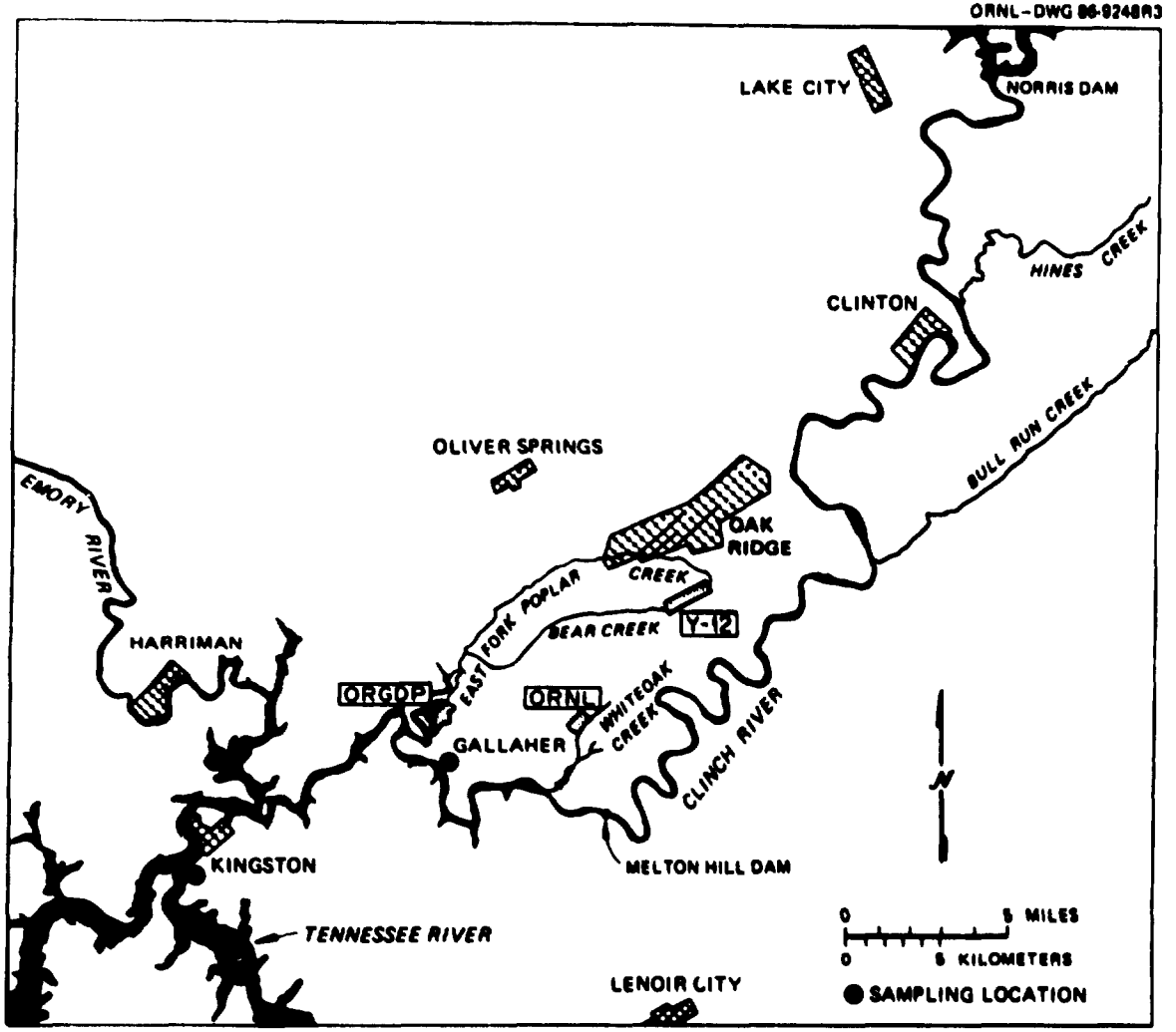

Fig. 6 Location map of Gallaher and Kingston sampling points

Table 15. Summary of collection and analysis frequencies of surface and tap water samples

Station	Parameter	Collection frequency	Type	Analysis frequency
190 Ponds	Gamma scan, gross alpha, gross beta	Weekly	Flow Proportional	Monthly
1500 Area, 3518	Gross alpha, gross beta	Weekly	Flow Proportional	Monthly
2000 Area, STP	Gamma scan, gross beta, Total Sr^a	Weekly	Flow Proportional	Monthly
3544	Gross alpha, gross beta, gamma scan, Total Sr^a	Weekly	Flow Proportional	Monthly
7500 Bridge	Gamma scan, Total Sr^a	Daily	Time Proportional	Daily
7500 Bridge, MB1, WOC, MB2	Gamma scan, Total Sr^a, ^3H	Weekly	Flow Proportional	Monthly
First Creek, Fifth Creek, NWT, Raccoon Creek	Gamma scan, Total Sr^a	Weekly	Grab	Monthly
Gallaher, Kingston	^3H, ^{60}Co, ^{137}Cs, gamma scan, gross alpha, gross beta, Pu, Total Sr^a, U	Weekly	Grab	Quarterly
HFIR Ponds	Gamma scan, gross alpha, gross beta	After Discharge	Flow Proportional	Monthly
Melton Hill Dam	^{241}Am, ^{244}Cm, ^{60}Co, ^{137}Cs, gross alpha, Pu, Th, U, Total Sr^a, ^3H,	Weekly	Flow Proportional	Monthly
NWT	Gamma scan, Total Sr^a	Weekly	Flow Proportional	Monthly
ORNL Tap	^{60}Co, ^{137}Cs, gross alpha, gross beta, Pu, Total Sr^a, U	Daily	Grab	Quarterly
ORR	^{60}Co, ^{137}Cs, gross alpha, gross beta	After Discharge	Flow Proportional	Monthly
WOC Headwaters	^{241}Am, ^{244}Cm, ^{60}Co, ^{137}Cs, gross alpha, Total Sr^a, ^3H, Pu, Th, U	Weekly	Grab	Monthly

Table 15. (continued)

Station	Parameter	Collection frequency	Type	Analysis frequency
WOD	^{241}Am, ^{244}Cm, ^{60}Co, ^{137}Cs, gross beta, Pu, Total Sr[a], ^{3}H	Weekly	Flow Proportional	Weekly
TRU Ponds	Gross beta	After Discharge	Flow Proportional	Monthly

[a] Total radioactive Sr (^{89}Sr + ^{90}Sr).

Table 16. Quarterly concentrations of radionuclides in surface streams and tap water

April - June 1987

Radionuclide	Concentration (Bq/L)
Gallaher[a]	
^{60}Co	< 0.01
^{137}Cs	< 0.01
Gross alpha	0.11
Gross beta	0.26
^{3}H	91
Pu[b]	< 0.0001
Total Sr[c]	0.044
^{234}U	0.0036
^{235}U	0.00010
^{236}U	0.000013
^{238}U	0.0021
Kingston[a]	
^{60}Co	< 0.01
^{137}Cs	< 0.01
Gross alpha	0.036
Gross beta	0.14
^{3}H	6.6
Pu[b]	< 0.0001
Total Sr[c]	0.019
^{234}U	0.0038
^{235}U	0.00012
^{236}U	< 0.000022
^{238}U	0.0023
ORNL Tap Water	
^{60}Co	< 0.01
^{137}Cs	< 0.01
Gross alpha	0.044
Gross beta	0.14
Pu[b]	< 0.0001
Total Sr[c]	0.024
^{234}U	0.00058
^{235}U	0.000017
^{236}U	< 0.0000007
^{238}U	0.00036

[a] See Figure 6.

[b] Total Pu (^{239}Pu + ^{240}Pu).

[c] Total radioactive Sr (^{89}Sr + ^{90}Sr).

Table 17. Quarterly concentrations of radionuclides in surface streams and tap water

July - September 1987

Radionuclide	Concentration (Bq/L)
Gallaher[a]	
^{60}Co	< 0.08
^{137}Cs	< 0.05
Gross alpha	0.11
Gross beta	0.17
^{3}H	30
Pu[b]	< 0.0001
Total Sr[c]	0.15
^{234}U	0.0024
^{235}U	0.00010
^{236}U	0.0000012
^{238}U	0.0016
Kingston[a]	
^{60}Co	< 0.06
^{137}Cs	< 0.05
Gross alpha	0.050
Gross beta	0.080
^{3}H	8.0
Pu[b]	< 0.0001
Total Sr[c]	0.16
^{234}U	0.0023
^{235}U	0.000068
^{236}U	0.0000073
^{238}U	0.0013
ORNL Tap Water	
^{60}Co	< 0.06
^{137}Cs	< 0.05
Gross alpha	0.050
Gross beta	0.11
Pu[b]	< 0.0001
Total Sr[c]	0.19
^{234}U	0.0032
^{235}U	0.000093
^{236}U	0.0000015
^{238}U	0.0019

[a] See Figure 6.

Table 18. Radionuclide concentrations in water

July - September 1987

Radionuclides	No. of Samples	Concentration (Bq/L) Max	Min	Av	95% cc[a]
		1500 Area[b]			
Gross alpha	3	1.2	- 0.20	0.66	0.87
Gross beta	3	3.2	1.2	2.5	1.3
		190 Ponds[b]			
^{60}Co	3	3.6	< 0.2	< 1.3	2.2
^{137}Cs	3	64	0.98	22	41
Gross alpha	3	1.7	0.30	1.0	0.81
Gross beta	3	5.2	4.1	4.6	0.63
		2000 Area[b]			
^{60}Co	3	< 0.2	< 0.1	< 0.2	0.066
^{137}Cs	3	< 0.2	< 0.1	< 0.2	0.066
Gross beta	3	2.7	- 0.60	0.96	1.9
Total Sr[d]	3	0.56	0.090	0.33	0.27
		3518[b]			
Gross alpha	3	1.2	- 0.80	0.23	1.1
Gross beta	3	2.1	0.40	1.4	1.0
		3544[b]			
^{60}Co	3	5.3	< 0.2	< 2.7	2.9
^{134}Cs	1			0.37	
^{137}Cs	3	86	0.96	48	50
^{152}Eu	1			2.2	
^{154}Eu	1			1.1	
Gross alpha	3	8.6	4.5	5.9	2.6
Gross beta	3	82	35	63	28
^{106}Ru	1			5.1	
Total Sr[d]	3	1.5	1.2	1.3	0.17

Table 18. (continued)

July - September 1987

Radionuclides	No. of Samples	Concentration (Bq/L) Max	Min	Av	95% cc[a]
		First Creek[c]			
^{60}Co	3	< 0.2	< 0.1	< 0.2	0.066
^{137}Cs	3	< 0.2	< 0.1	< 0.1	0.066
Total Sr[d]	3	30	25	27	2.9
		Fifth Creek[c]			
^{60}Co	3	< 0.2	< 0.1	< 0.2	0.066
^{137}Cs	3	< 0.3	< 0.01	< 0.2	0.11
Total Sr[d]	3	1.7	0.73	1.2	0.56
		7500 Bridge			
^{60}Co	3	0.21	< 0.2	< 0.2	0.0066
^{137}Cs	3	2.8	1.4	2.0	0.81
Total Sr[d]	3	2.8	2.3	2.6	0.30
^{3}H	3	260	200	230	34
		HFIR			
^{60}Co	1			590	
^{137}Cs	1			1.3	
Gross alpha	1			22	
Gross beta	1			450	
		Melton Branch 1[c]			
^{60}Co	3	2.9	0.94	2.1	1.1
^{137}Cs	3	< 0.4	< 0.2	< 0.3	0.11
Total Sr[d]	3	7.5	4.8	6.0	1.5
^{3}H	3	48000	38000	44000	5900
		Northwest Tributary[c]			
^{60}Co	3	< 0.2	< 0.2	< 0.2	0
^{137}Cs	3	< 0.2	< 0.1	< 0.2	0.066
Total Sr[d]	3	0.41	0.26	0.35	0.096

Table 18. (continued)

July - September 1987

Radionuclides	No. of Samples	Concentration (Bq/L) Max	Min	Av	95% cc[a]
		Melton Branch 2[c]			
^{60}Co	3	38	0.47	13	24
^{137}Cs	3	< 0.3	< 0.1	< 0.2	0.11
^{152}Eu	1			6.7	
^{154}Eu	1			11	
^{155}Eu	1			6.2	
Total Sr	3	1.3	0.08	0.55	0.8
^{3}H	3	28000	790	9900	18000
		Melton Hill Dam[c]			
^{241}Am	3	0.0045	0.0010	0.0027	0.0020
^{244}Cm	3	< 0.002	- 0.0030	- 0.0012	0.0034
^{60}Co	3	< 0.2	< 0.1	< 0.2	0.066
^{137}Cs	3	< 0.2	< 0.1	< 0.2	0.066
Gross alpha	3	1.0	0.20	0.60	0.46
^{238}Pu	3	< 0.002	- 0.00060	0.00036	0.0018
^{239}Pu	3	< 0.004	- 0.0010	0.00066	0.0028
Total Sr[d]	3	1.3	0.10	0.56	0.74
^{3}H	3	26	- 5.0	14	19
		Raccoon Creek[c]			
^{60}Co	3	< 0.2	< 0.2	< 0.2	0
^{137}Cs	3	< 0.2	< 0.2	< 0.2	0
Total Sr[d]	3	7.4	4.2	5.6	1.8
		Sewage Treatment Plant[c]			
^{60}Co	3	< 0.3	< 0.1	< 0.2	0.13
^{137}Cs	3	< 0.2	0.2	< 0.27	0.085
Gross beta	3	9.8	8.1	9.1	1.0
Total Sr[d]	3	5.0	4.2	4.6	0.46
		TRU Ponds[b]			
Gross beta	1			2.1	

Table 18. (continued)

July - September 1987

Radionuclides	No. of Samples	Concentration (Bq/L) Max	Min	Av	95% cc[a]
White Oak Creek[c]					
^{60}Co	3	< 0.3	< 0.2	< 0.3	0.066
^{137}Cs	3	7.1	2.0	3.7	3.3
Total Sr[d]	3	3.3	2.5	2.8	0.50
^{3}H	3	410	280	350	75
White Oak Creek Headwaters[c]					
^{241}Am	3	0.011	0.0024	0.0058	0.0053
^{244}Cm	3	0.0020	- 0.0011	0.00050	0.0018
^{60}Co	3	< 0.2	< 0.1	< 0.2	0.066
^{137}Cs	3	< 0.2	< 0.1	< 0.2	0.066
Gross alpha	3	2.4	1.0	1.6	0.85
^{238}Pu	3	0.0016	- 0.0013	0	0.0017
^{239}Pu	3	0.00040	- 0.0042	- 0.0014	0.0028
Total Sr[d]	3	0.59	0.33	0.42	0.17
^{3}H	3	21	8.0	14	7.7
White Oak Dam[c]					
^{241}Am	13	0.012	- 0.021	< 0.003	0.0043
^{244}Cm	13	0.016	- 0.0030	0.0045	0.0071
^{60}Co	13	0.67	< 0.2	< 0.3	0.077
^{137}Cs	13	5.6	0.56	1.6	0.80
Gross beta	13	16	6.8	10	1.7
^{238}Pu	13	0.010	-0.000096	0.0019	0.0014
^{239}Pu	13	0.0068	-0.0070	0.00095	0.0017
Total Sr[d]	13	15	0.28	4.5	1.8
^{3}H	13	5800	1700	3400	810

[a] 95% confidence coefficient about the average of more than two samples.

[b] See Figure 5.

[c] See Figure 4.

[d] Total radioactive Sr (^{89}Sr + ^{90}Sr).

Table 19. Radionuclide concentrations in water at 7500 Bridge[a]

July - September 1987

Radionuclide	No. of Samples	Concentration (Bq/L) Max	Min	Av	95% cc[b]
		July			
^{60}Co	21	0.6	< 0.2	< 0.3	0.045
^{137}Cs	21	28	1.2	9.6	3.0
Total Sr[c]	21	4.9	2.3	3.0	0.26
		August			
^{60}Co	21	0.50	< 0.2	< 0.3	0.034
^{137}Cs	21	20	1.8	5.5	1.7
Total Sr[c]	21	10	2.2	3.4	0.84
		September			
^{60}Co	21	0.99	< 0.2	< 0.4	0.079
^{137}Cs	21	61	0.64	12	6.8
Total Sr[c]	21	4.4	1.6	2.6	0.27

[a] See Figure 4.

[b] 95% confidence coefficient about the average of more than two samples.

[c] Total radioactive Sr (^{89}Sr + ^{90}Sr).

Flows in the Clinch River (as measured at Melton Hill Dam) and in WOC (as measured at WOD) and the ratios of these flows, are presented in Table 20. The average ratios presented in the table were calculated weekly and averaged for the month. The average ratios for July and August are higher than the ratios observed during the first and second quarters. The flow values for Clinch River were approximately three orders of magnitude higher than those calculated for White Oak Creek.

The total hourly flows at WOC, MB, and WOD were calculated by multiplying the average 10-minute flowrate (gallons per minute) transmitted via the real-time monitoring system by the number of minutes per hour. Low and high readings are recorded at WOC and MB while low, medium, and high flow readings are recorded at WOD.

Total flows per day at the STP are calculated by subtracting consecutive daily flow recorder readings and multiplying by a factor for conversion to million liters. The weekly total flows are determined by averaging the total flows for the week and multiplying by the number of days in the week.

The discharges of radionuclides at WOD, MB1, and the STP are calculated by multiplying the concentration by the flow (Tables 21-23). At WOC, MB1, and the STP, a single flow proportional sample is analyzed monthly to estimate radionuclide concentrations. At WOD, weekly flow proportional samples are analyzed. At WOD, weekly radionuclide discharges are calculated by multiplying the weekly composite sample concentration by the total weekly flow. Monthly discharges of radionuclides at WOD are then calculated by averaging the weekly discharges and multiplying by the number of weeks per month (Tables 21-23). A flow weighted concentration at WOD for the month is calculated by dividing the total radionuclide discharge for the month by the total monthly flow (Tables 21-23).

Tritium and total radioactive Sr are the radionuclides of greatest concern in terms of radiation dose to the public from drinking water. The discharge of total radioactive Sr at MB1 during this quarter are lower than those measured during the first and and second quarters and are lower than the average calculated for 1987. The average value of total radioactive Sr at WOD is slightly lower than those measured during first and second quarters. The total radioactive Sr discharged over WOD during this quarter was lower than the first and second quarters of 1987. The decreases in the discharge of total radioactive Sr at MB1 were caused by decreases in the flow and concentration. The decreases at WOD were caused by decreases in the flow at WOD. The ^{3}H discharged over WOD during August and September could be accounted for by the discharge of ^{3}H over the MB1 weir (Tables 21-23). The ^{3}H values measured at MB1 are thought to be due primarily to releases from SWSA 5. Tritium values measured at MB1 weir, which is below the areas where SWSA 5 discharges to Melton Branch, are generally more than an order of magnitude higher than values measured at the MB2 weir above the SWSA 5 area (Table 18). The ^{3}H discharged at MB1 in July was higher than at WOD. A review of previously reported data indicates that during several months of 1986, the first quarter of 1987, and June 1987, the calculated discharge of ^{3}H over MB1 weir was higher than at WOD. We believe that this is due to a problem in compositing the samples from the low and high flow weirs.

Table 20. Flow for Clinch River and White Oak Creek

July - August 1987

Month	Flow (10^9 Liters)		Average Ratio[b]
	Clinch River[a]	White Oak Creek[a]	
July	520	0.56	1000
August	420	0.41	1100
September	230	0.43	550

[a] See Figure 4.

[b] Ratio of Clinch River to White Oak Creek flow is calculated weekly and averaged for the month.

Table 21. Discharges of radionuclides in water

July 1987

Radionuclide	Flow (10^6 Liters)	Concentration (Bq/L)	Discharge (10^4 mega Bq)
		Melton Branch 1[a]	
^{60}Co	89	0.94	0.0084
^{137}Cs	89	< 0.2	< 0.002
Total Sr[c]	89	7.5	0.067
^{3}H	89	45000	400
		Sewage Treatment Plant[a]	
^{60}Co	20	< 0.1	< 0.0002
^{137}Cs	20	0.33	0.00070
Gross beta	20	9.6	0.020
Total Sr[c]	20	4.2	0.0086
		White Oak Creek[a]	
^{60}Co	470	< 0.2	< 0.01
^{137}Cs	470	2.0	0.095
Total Sr[c]	470	2.5	0.12
^{3}H	470	350	17
		White Oak Dam [a,b]	
^{241}Am	560	0.0079	0.00040
^{244}Cm	560	0.011	0.00060
^{60}Co	560	0.33	0.018
^{137}Cs	560	2.0	0.11
Gross beta	560	12	0.70
^{238}Pu	560	< 0.0027	< 0.0002
^{239}Pu	560	0.00086	0.000048
Total Sr[c]	560	6.2	0.35
^{3}H	560	4500	250

[a] See Figure 4.

[b] Concentration is a flow weighted average of the weekly samples. Discharge is the total for the month.

[c] Total radioactive Sr (^{89}Sr + ^{90}Sr).

Table 22. Discharges of radionuclides in water

August 1987

Radionuclide	Flow (10^6 Liters)	Concentration (Bq/L)	Discharge (10^4 mega Bq)
		Melton Branch 1[a]	
^{60}Co	19	2.9	0.0056
^{137}Cs	19	< 0.4	< 0.0008
Total Sr[c]	19	4.8	0.0093
^{3}H	19	38000	73
		Sewage Treatment Plant[a]	
^{60}Co	22	< 0.1	< 0.0002
^{137}Cs	22	0.19	0.00042
Gross beta	22	9.8	0.022
Total Sr[c]	22	5.0	0.011
		White Oak Creek[a]	
^{60}Co	370	< 0.3	< 0.01
^{137}Cs	370	2.1	0.078
Total Sr[c]	370	3.3	0.12
^{3}H	370	410	15
		White Oak Dam[a,b]	
^{241}Am	410	- 1.0	< 0.0001
^{244}Cm	410	0.0023	0.00010
^{60}Co	410	< 0.4	< 0.02
^{137}Cs	410	1.8	0.072
Gross beta	410	9.9	0.41
^{238}Pu	410	< 0.001	< 0.0001
^{239}Pu	410	0.0027	0.00010
Total Sr[c]	410	4.0	0.16
^{3}H	410	3000	120

[a] See Figure 4.

[b] Concentration is a flow weighted average of the weekly samples. Discharge is the total for the month.

[c] Total radioactive Sr (^{89}Sr + ^{90}Sr).

Table 23. Discharges of radionuclides in water

September 1987

Radionuclide	Flow (10^6 Liters)	Concentration (Bq/L)	Discharge (10^4 mega Bq)
		Melton Branch 1[a]	
^{60}Co	24	2.5	0.0059
^{137}Cs	24	< 0.3	< 0.0007
Total Sr[c]	24	5.9	0.014
^{3}H	24	48000	110
		Sewage Treatment Plant[a]	
^{60}Co	30	< 0.3	< 0.0009
^{137}Cs	30	< 0.3	< 0.0009
Gross beta	30	8.1	0.025
Total Sr[c]	30	4.7	0.014
		White Oak Creek[a]	
^{60}Co	400	< 0.3	< 0.01
^{137}Cs	400	7.1	0.29
Total Sr[c]	400	2.6	0.10
^{3}H	400	280	11
		White Oak Dam[a,b]	
^{241}Am	430	0.0032	0.00014
^{244}Cm	430	0.0018	0.00010
^{60}Co	430	< 0.3	< 0.01
^{137}Cs	430	1.2	0.053
Gross beta	430	10	0.44
^{238}Pu	430	0.0012	0.000051
^{239}Pu	430	- 0.00070	- 0.000030
Total Sr[c]	430	2.7	0.12
^{3}H	430	2500	110

[a] See Figure 4.

[b] Concentration is a flow weighted average of the weekly samples. Discharge is the total for the month.

[c] Total radioactive Sr (^{89}Sr + ^{90}Sr).

Strontium discharges from ORNL, unlike ^{3}H which comes primarily from SWSA 5, are much more diffuse, They are primarily the result of discharges from the plant area, burial grounds, and floodplains with lesser amounts also being contributed by process discharges. Most of the strontium discharged from ORNL can be attributed to discharges into WOC occurring above the WOC monitoring stations.

Characterization of SWSA 5, particularly the ^{3}H releases in SWSA 5, will be one of the highest priorities of the Remedial Investigation Feasibility Study (RI/FS) subcontract. This characterization, which began in August 1987, is necessary in order to comply with Resource Conservation and Recovery Act (RCRA) requirements and to determine the measures which will most effectively reduce the flow of ^{3}H and/or other contaminants from SWSA 5.

National Pollutant Discharge Elimination System (NPDES) Requirements

ORNL's current NPDES permit requires that 10 point source outfalls be sampled prior to their discharge into receiving waters, or before mixing with any other wastewater stream. One of these points, the Nonradiological Wastewater Treatment Plant, will not be in operation until March of 1990. In addition, there are three sampling locations that are located in the streams as reference points or for additional information and one (ORR Resin Regeneration Facility) that was taken out of operation in December 1986. These fourteen sampling locations are shown in Figure 5. There are about 170 additional locations that include storm drains, parking lot and roof drains, cooling tower drains, storage area drains, condensate drains, untreated process drains, and miscellaneous facilities that are sampled less frequently than the point source outfalls or surface streams.

Quarterly summary statistics for the third quarter of 1987 are given for each sampling location in Tables 24 through 39. Monitoring of the ORR Resin Regeneration Facility is no longer required because the permitted operation has been discontinued.

Data collected for the NPDES permit are also summarized monthly for reporting to DOE and the State of Tennessee. These summaries are submitted to DOE in the monthly Discharge Monitoring Reports and are available upon request. Noncompliances, parameters whose values exceed the specified permit limits, are provided in Table 40. A brief summary of the non-compliances follows.

During the third quarter, the Paint Facility (7007) had two noncompliances of total suspended solids. The effluent from this facility is discharged to a parking lot drain that routes runoff to a storm drain discharge pipe. This pipe carries the combined runoff from much of the 7000 area to White Oak Creek some 400 meters away. It is believed that this discharge is due not only to the Paint Facility, but also to the other area sources discharging to the same drain. This will be addressed in future sampling as the samples will be taken at the point of discharge and only when there is a discharge.

There are no known causes for the total suspended solids or fecal coliform violations that occurred in July at the Sewage Treatment Plant (STP). The fecal coliform violation that occurred in September at the STP was attributed to inadequate sensitivity in the existing chlorination system at that facility. An engineering review of the STP chlorination system is expected to result in permanent solution to chlorine/fecal coliform problems at that facility.

There is no explanation for the pH violation at the steam plant (SP2519) in August. The effluent from this facility is currently monitored quarterly. A more detailed monitoring plan is being developed in order to relate the effluent pH to the operations being conducted at that facility at a given time.

Table 24. NPDES Discharge Point X01[a]

July - September 1987

Parameter	No. of Samples	Concentration (mg/L) Max	Min	Av	95% cc[b]
Ag	3	< 0.030	< 0.030	< 0.030	0
BOD[c]	39	< 5.0	< 5.0	< 5.0	0
Bromodichloromethane	3	< 0.0050	< 0.0050	< 0.0050	0
Chloroform	3	0.0080	< 0.0050	< 0.0060	0.0020
Cl	39	0.45	0.12	0.28	0.032
CN	3	0.014	< 0.0020	< 0.0060	0.0080
Cu	3	0.015	< 0.012	< 0.013	0.0018
DO[d]	62	8.4	3.2	6.9	0.24
Downstream pH[e]	13	8.5	7.1	NA[f]	NA[f]
Fecal coliform[g,h]	39	> 600	< 1.0	< 3.0	1.9
Flow[i]	62	0.43	0.074	0.21	0.021
Hg	3	< 0.00020	< 0.00020	< 0.00020	0
NH_4-N	39	0.47	0.030	0.11	0.030
Oil and grease	39	10	< 2.0	< 2.6	0.47
pH[e]	13	8.0	7.0	NA[f]	NA[f]
Phenols	3	0.0030	< 0.0010	< 0.0017	0.0013
Trichloroethylene	3	< 0.0050	< 0.0050	< 0.0050	0
TSS[j]	39	710	< 2.0	< 23	36
Zn	3	0.067	0.053	0.060	0.0081

[a] Sewage Treatment Plant, ORNL.
[b] 95% confidence coefficient about the average.
[c] Biological oxygen demand.
[d] Dissolved oxygen.
[e] Expressed in standard units; average not applicable.
[f] NA = not applicable.
[g] Expressed in colonies per 100 mL.
[h] Geometric mean.
[i] Measured in millions of gallons per day.
[j] Total suspended solids.

Table 25. NPDES Discharge Point XO2[a]

July - September 1987

Parameter	No. of Samples	Concentration (mg/L) Max	Min	Av	95% cc[b]
Ag	10	< 0.030	< 0.030	< 0.030	0
As	10	0.068	< 0.060	< 0.061	0.0016
Cd	10	< 0.0030	< 0.0030	< 0.0030	0
Cr	10	< 0.024	< 0.024	< 0.024	0
Cu	10	< 0.012	< 0.012	< 0.012	0
Downstream pH[c]	62	8.9	7.0	NA[d]	NA[d]
Fe	10	0.44	< 0.018	< 0.11	0.081
Flow[e]	62	0.0016	0	0.000070	0.000064
Mn	10	0.070	0.0035	0.025	0.014
Ni	10	< 0.036	< 0.036	< 0.036	0
Oil and grease	10	6.0	< 2.0	< 2.7	0.79
Pb	10	< 0.12	< 0.12	< 0.12	0
pH[c]	62	9.0	6.3	NA[d]	NA[d]
Se	10	0.17	< 0.12	< 0.13	0.012
SO_4	2	2200	1800	2000	400
Temperature[f]	13	24	15	23	1.5
TSS[g]	10	13	< 5.0	< 6.6	1.7
Zn	10	0.031	< 0.012	< 0.015	0.0040

[a] Coal Yard Runoff Facility, ORNL.
[b] 95% confidence coefficient about the average.
[c] Expressed in standard units; average not applicable.
[d] NA = not applicable.
[e] Measured in millions of gallons per day.
[f] Measured in degrees centigrade.
[g] Total suspended solids.

Table 26. NPDES Discharge Point X03[a]

July - September 1987

Parameter	No. of Samples	Concentration (mg/L) Max	Min	Av	95% cc[b]
As	6	< 0.060	< 0.060	< 0.060	0
Cd	6	0.0044	< 0.0030	< 0.0032	0.00047
Cr	6	< 0.024	< 0.024	< 0.024	0
Cu	6	0.018	< 0.012	< 0.013	0.0020
Downstream pH[c]	13	7.9	6.9	NA[d]	NA[d]
Fe	6	0.14	0.039	0.070	0.030
Flow[e]	4	0.040	0.017	0.025	0.014
Ni	6	< 0.036	< 0.036	< 0.036	0
Oil and grease	6	4.0	< 2.0	< 2.5	0.68
P	6	0.90	0.30	0.44	0.19
Pb	6	< 0.12	< 0.12	< 0.12	0
pH[c]	13	7.7	7.0	NA[d]	NA[d]
Temperature[f]	6	25	12	20	5.0
TOC[g]	6	5.6	1.7	3.3	1.3
TSS[h]	6	< 5.0	< 5.0	< 5.0	0
Zn	6	0.11	0.056	0.089	0.016

[a] 1500 area, ORNL.
[b] 95% confidence coefficient about the average.
[c] Expressed in standard units; average not applicable.
[d] NA = not applicable.
[e] Measured in millions of gallons per day.
[f] Measured in degrees centigrade.
[g] Total organic carbon.
[h] Total suspended solids.

Table 27. NPDES Discharge Point XO4[a]

July - September 1987

Parameter	No. of Samples	Concentration (mg/L) Max	Min	Av	95% cc[b]
Ag	6	< 0.030	< 0.030	< 0.030	0
As	6	< 0.060	< 0.060	< 0.060	0
Cd	6	< 0.0030	< 0.0030	< 0.0030	0
Cr	6	< 0.024	< 0.024	< 0.024	0
Cu	6	0.069	< 0.012	< 0.022	0.019
Downstream pH[c]	13	7.8	7.0	NA[d]	NA[d]
Flow[e]	4	0.023	0.010	0.015	0.0083
Ni	6	0.13	< 0.036	< 0.052	0.031
Oil and grease	6	4.0	< 2.0	< 2.5	0.68
P	6	0.40	0.30	0.32	0.033
Pb	6	< 0.12	< 0.12	< 0.12	0
pH[c]	13	7.8	7.0	NA[d]	NA[d]
Temperature[f]	6	25	11	19	4.8
TOC[g]	6	1.9	1.3	1.6	0.17
TSS[h]	6	< 5.0	< 5.0	< 5.0	0
Zn	6	0.44	0.074	0.16	0.11

[a] 2000 area, ORNL.
[b] 95% confidence coefficient about the average.
[c] Expressed in standard units; average not applicable.
[d] NA = not applicable.
[e] Measured in millions of gallons per day.
[f] Measured in degrees centigrade.
[g] Total organic carbon.
[h] Total suspended solids.

Table 28. NPDES Discharge Point X06[a]

July - September 1987

Parameter	No. of Samples	Concentration (mg/L) Max	Min	Av	95% cc[b]
As	6	< 0.060	< 0.060	< 0.060	0
Cd	6	< 0.0030	< 0.0030	< 0.0030	0
Cr	6	0.12	< 0.024	< 0.040	0.032
Cu	6	0.18	0.049	0.11	0.035
Downstream pH[c]	13	7.5	7.0	NA[d]	NA[d]
Flow[e]	3	0.14	0.012	0.098	0.085
Ni	6	< 0.036	< 0.036	< 0.036	0
Oil and grease	6	24	< 2.0	< 11	8.5
Pb	6	0.12	< 0.12	< 0.12	0
pH[c]	13	7.6	7.0	NA[d]	NA[d]
Se	6	< 0.12	< 0.12	< 0.12	0
SO_4	6	28	21	23	2.3
Temperature[f]	6	25	11	18	5.6
TOC[g]	6	8.7	2.5	4.6	1.9
TSS[h]	6	10	< 5.0	< 6.8	1.8
Zn	6	0.14	0.051	0.086	0.025

[a] 3539/3540 ponds, ORNL.
[b] 95% confidence coefficient about the average.
[c] Expressed in standard units; average not applicable.
[d] NA = not applicable.
[e] Measured in millions of gallons per day.
[f] Measured in degrees centigrade.
[g] Total organic carbon.
[h] Total suspended solids.

Table 29. NPDES Discharge Point X07[a]

July - September 1987

Parameter	No. of Samples	Concentration (mg/L) Max	Min	Av	95% cc[b]
Ag	6	< 0.030	< 0.030	< 0.030	0
As	6	< 0.060	< 0.060	< 0.060	0
Cd	6	< 0.0030	< 0.0030	< 0.0030	0
Cr	6	< 0.024	< 0.024	< 0.024	0
Cu	6	0.056	0.021	0.033	0.011
Downstream pH[c]	13	7.6	7.0	NA[d]	NA[d]
Flow[e]	62	0.14	0.0025	0.015	0.0080
Ni	6	< 0.036	< 0.036	< 0.036	0
NO_3	6	17	< 5.0	< 8.9	4.8
Oil and grease	6	8.0	< 2.0	< 4.5	2.3
Pb	6	< 0.12	< 0.12	< 0.12	0
pH[c]	13	7.7	6.9	NA[d]	NA[d]
SO_4	6	300	110	240	57
Temperature[f]	6	25	16	21	2.9
TOC[g]	6	2.8	1.5	2.1	0.37
TSS[h]	6	10	< 5.0	< 6.0	1.6
TTO[i]	6	0.044	0	0.0092	0.014
Zn	6	0.012	< 0.012	< 0.012	0

[a] Process Waste Treatment Plant (3544), ORNL.
[b] 95% confidence coefficient about the average.
[c] Expressed in standard units; average not applicable.
[d] NA = not applicable.
[e] Measured in millions of gallons per day.
[f] Measured in degrees centigrade.
[g] Total organic carbon.
[h] Total suspended solids.
[i] Total toxic organics.

Table 30. NPDES Discharge Point X08[a]

July - September 1987

Parameter	No. of Samples	Concentration (mg/L) Max	Min	Av	95% cc[b]
As	1	< 0.060	< 0.060	< 0.060	
Cd	1	< 0.0030	< 0.0030	< 0.0030	
Cr	1	< 0.024	< 0.024	< 0.024	
Cu	1	0.016	0.016	0.016	
Downstream pH[c]	1	7.8	7.8	NA[d]	NA[d]
Flow[e]	1	0.00097	0.00097	0.00097	
Ni	1	< 0.036	< 0.036	< 0.036	
NO_3	1	< 5.0	< 5.0	< 5.0	
Oil and grease	1	4.0	4.0	4.0	
Pb	1	< 0.12	< 0.12	< 0.12	
pH[c]	1	7.5	7.5	NA[d]	NA[d]
SO_4	1	56	56	56	
Temperature[f]	1	24	24	24	
TOC[g]	1	5.1	5.1	5.1	
TSS[h]	1	7.0	7.0	7.0	
Zn	1	0.039	0.039	0.039	

[a] TRU waste basins, ORNL.
[b] 95% confidence coefficient about the average.
[c] Expressed in standard units; average not applicable.
[d] NA = not applicable.
[e] Measured in millions of gallons per day.
[f] Measured in degrees centigrade.
[g] Total organic carbon.
[h] Total suspended solids.

Table 31. NPDES Discharge Point X09[a]

July - September 1987

Parameter	No. of Samples	Concentration (mg/L) Max	Min	Av	95% cc[b]
As	2	< 0.060	< 0.060	< 0.060	0
Cd	2	0.0033	< 0.0030	< 0.0032	0.00030
Cr	2	0.046	< 0.024	< 0.035	0.022
Cu	2	0.11	0.083	0.096	0.027
Downstream pH[c]	2	7.8	6.9	NA[d]	NA[d]
Flow[e]	2	0.0042	0.000096	0.0021	0.0041
Ni	2	< 0.036	< 0.036	< 0.036	0
NO_3	2	23	< 5.0	< 14	18
Oil and grease	2	3.0	3.0	3.0	0
Pb	2	< 0.12	< 0.12	< 0.12	0
pH[c]	2	7.8	7.1	NA[d]	NA[d]
SO_4	2	420	110	260	310
Temperature[f]	2	25	4.9	15	20
TOC[g]	2	6.6	4.5	5.6	2.1
TSS[h]	2	22	9.0	16	13
Zn	2	0.26	0.14	0.20	0.12

[a] HFIR waste basins, ORNL.
[b] 95% confidence coefficient about the average.
[c] Expressed in standard units; average not applicable.
[d] NA = not applicable.
[e] Measured in millions of gallons per day.
[f] Measured in degrees centigrade.
[g] Total organic carbon.
[h] Total suspended solids.

Table 32. NPDES Discharge Point X11[a]

July - September 1987

Parameter	No. of Samples	Concentration (mg/L) Max	Min	Av	95% cc[b]
As	6	0.070	< 0.060	< 0.062	0.0033
Cd	6	< 0.0030	< 0.0030	< 0.0030	0
Cr	6	0.048	< 0.024	< 0.033	0.0081
Cu	6	0.43	< 0.012	< 0.14	0.13
Downstream pH[c]	13	7.5	7.0	NA[d]	NA[d]
Flow[e]	3	0.13	0.010	0.051	0.079
Ni	6	0.054	< 0.036	< 0.039	0.0060
NO_3	13	< 5.0	< 5.0	< 5.0	0
Oil and grease	6	5.0	< 2.0	< 2.7	0.99
P	6	2.1	0.60	0.98	0.45
Pb	6	< 0.12	< 0.12	< 0.12	0
pH[c]	13	7.6	7.0	NA[d]	NA[d]
SO_4	13	4000	1300	2300	390
Temperature[f]	6	25	11	18	5.3
TOC[g]	13	6.7	1.7	3.3	0.75
TSS[h]	6	160	< 5.0	< 34	49
Zn	6	1.2	0.39	0.79	0.30

[a] 3518 Acid Neutralization Facility, ORNL.
[b] 95% confidence coefficient about the average.
[c] Expressed in standard units; average not applicable.
[d] NA = not applicable.
[e] Measured in millions of gallons per day.
[f] Measured in degrees centigrade.
[g] Total organic carbon.
[h] Total suspended solids.

Table 33. NPDES Discharge Point X13[a]

July - September 1987

Parameter	No. of Samples	Concentration (mg/L) Max	Min	Av	95% cc[b]
Ag	3	< 0.0050	< 0.0050	< 0.0050	0
Al	3	0.57	0.33	0.47	0.14
As	3	< 0.060	< 0.060	< 0.060	0
BOD[c]	3	7.0	< 5.0	< 5.7	1.3
Bromodichloromethane	3	< 0.0050	< 0.0050	< 0.0050	0
Cd	3	< 0.0020	< 0.0020	< 0.0020	0
Chloroform	3	< 0.0050	< 0.0050	< 0.0050	0
Cl	13	< 0.010	< 0.010	< 0.010	0
Conductivity[d]	3	390	330	360	35
Cr	3	< 0.024	< 0.024	< 0.024	0
Cu	3	0.017	< 0.012	< 0.015	0.0029
DO[e]	13	8.1	4.0	6.7	0.67
F	3	1.1	1.0	1.0	0.067
Fe	3	0.64	0.36	0.50	0.16
Flow[f]	62	0.91	0.14	0.29	0.040
Hg	3	< 0.000050	< 0.00050	< 0.000050	0
Mn	3	0.20	0.15	0.17	0.033
NH_4-N	3	0.10	0.082	0.091	0.010
Ni	3	< 0.036	< 0.036	< 0.036	0
NO_3	3	< 5.0	< 5.0	< 5.0	0
Oil and grease	13	15	< 2.0	< 3.2	2.0
P	3	1.7	0.90	1.3	0.47
Pb	3	< 0.0040	< 0.0040	< 0.0040	0
PCB	3	< 0.00050	< 0.00050	< 0.00050	0
pH[g]	3	7.8	7.4	NA[h]	NA[h]
Phenols	3	0.0010	< 0.0010	< 0.0010	0
SO_4	3	28	26	27	1.3
TDS[i]	3	2100	230	850	1200
Temperature[j]	3	24	21	22	1.7
TOC[k]	3	3.0	2.4	2.6	0.37
Trichloroethylene	3	< 0.0050	< 0.0050	< 0.0050	0
TSS[l]	3	13	7.0	9.7	3.5
Turbidity[m]	3	30	20	23	6.7

Table 33. (Continued)

July - September 1987

Parameter	No. of Samples	Concentration (mg/L) Max	Min	Av	95% cc[b]
Zn	3	0.099	0.034	0.062	0.039

[a] Melton Branch, ORNL.
[b] 95% confidence coefficient about the average.
[c] Biological oxygen demand.
[d] Express in μmhos/cm.
[e] Dissolved oxygen.
[f] Measured in millions of gallons per day.
[g] Expressed in standard units; average not applicable.
[h] NA = not applicable.
[i] Total dissolved solids.
[j] Measured in degrees centigrade.
[k] Total organic carbon.
[l] Total suspended solids.
[m] Measured in Jackson turbidity units.

Table 34. NPDES Discharge Point X14[a]

July - September 1987

Parameter	No. of Samples	Concentration (mg/L) Max	Min	Av	95% cc[b]
Ag	3	< 0.0050	< 0.0050	< 0.0050	0
Al	3	0.92	< 0.12	< 0.40	0.52
As	3	< 0.060	< 0.060	< 0.060	0
BOD[c]	3	< 5.0	< 5.0	< 5.0	0
Bromodichloromethane	3	< 0.0050	< 0.0050	< 0.0050	0
Cd	3	< 0.0020	< 0.0020	< 0.0020	0
Chloroform	3	< 0.0050	< 0.0050	< 0.0050	0
Cl	13	< 0.010	< 0.010	< 0.010	0
Conductivity[d]	3	350	310	330	24
Cr	3	< 0.024	< 0.024	< 0.024	0
Cu	3	0.014	< 0.012	< 0.013	0.0013
DO[e]	13	8.1	5.9	7.2	0.38
F	3	1.1	1.0	1.0	0.067
Fe	3	0.87	0.089	0.35	0.52
Flow[f]	62	6.8	3.0	4.0	0.19
Hg	3	0.00010	< 0.00005	< 0.000076	0.000029
Mn	3	0.12	0.028	0.059	0.061
NH_4-N	3	0.10	0.070	0.087	0.018
Ni	3	< 0.036	< 0.036	< 0.036	0
NO_3	3	< 5.0	< 5.0	< 5.0	0
Oil and grease	13	5.0	< 2.0	< 2.4	0.53
P	13	0.42	0.20	0.34	0.14
Pb	3	0.012	< 0.0040	< 0.0067	0.0053
PCB	3	< 0.00050	< 0.00050	< 0.00050	0
pH[g]	3	7.8	7.5	NA[h]	NA[h]
Phenols	3	0.0030	< 0.0010	< 0.0017	0.0013
SO_4	3	48	36	44	7.7
TDS[i]	3	540	300	390	160
Temperature[j]	3	29	21	25	4.7
TOC[k]	3	2.0	1.7	1.8	0.18
Trichloroethylene	3	< 0.0050	< 0.0050	< 0.0050	0
TSS[l]	3	7.0	< 5.0	< 5.7	1.3
Turbidity[m]	3	120	50	87	41

Table 34. (continued)

July - September 1987

Parameter	No. of Samples	Concentration (mg/L) Max	Min	Av	95% cc[b]
Zn	3	0.072	0.022	0.044	0.029

[a] White Oak Creek, ORNL.
[b] 95% confidence coefficient about the average.
[c] Biological oxygen demand.
[d] Express in μmhos/cm.
[e] Dissolved oxygen.
[f] Measured in millions of gallons per day.
[g] Expressed in standard units; average not applicable.
[h] NA = not applicable.
[i] Total dissolved solids.
[j] Measured in degrees centigrade.
[k] Total organic carbon.
[l] Total suspended solids.
[m] Measured in Jackson turbidity units.

Table 35. NPDES Discharge Point X15[a]

July - September 1987

Parameter	No. of Samples	Concentration (mg/L) Max	Min	Av	95% cc[b]
Ag	3	< 0.0050	< 0.0020	< 0.0040	0.0020
Al	3	4.7	0.35	2.1	2.7
As	3	< 0.060	< 0.060	< 0.060	0
COD[c]	3	9.0	5.0	7.0	2.3
Bromodichloromethane	3	< 0.0050	< 0.0050	< 0.0050	0
Cd	3	< 0.0050	< 0.0020	< 0.0033	0.0018
Chloroform	3	< 0.0050	< 0.0050	< 0.0050	0
Cl	13	< 0.010	< 0.010	< 0.010	0
Conductivity[d]	3	400	300	340	59
Cr	3	0.093	< 0.024	< 0.050	0.044
Cu	3	0.030	< 0.012	< 0.018	0.012
DO[e]	13	9.0	1.1	5.4	1.3
F	3	1.1	1.0	1.0	0.067
Fe	3	4.3	0.34	2.0	2.4
Flow[f]	62	9.1	3.1	4.4	0.28
Hg	3	0.00010	< 0.000050	< 0.000066	0.000033
Mn	3	0.26	0.051	0.15	0.12
NH_4-N	3	0.30	0.090	0.17	0.13
Ni	3	< 0.036	0.036	< 0.036	0
NO_3	3	< 5.0	< 5.0	< 5.0	0
Oil and grease	13	15	< 2.0	< 4.5	2.1
P	3	0.43	0.20	0.31	0.13
Pb	3	0.019	< 0.0040	< 0.0090	0.010
PCB	3	< 0.00050	< 0.00050	< 0.00050	0
pH[g]	3	8.5	7.1	NA[h]	NA[h]
Phenols	1	< 0.0010	< 0.0010	< 0.0010	
SO_4	3	45	36	41	5.3
TDS[i]	3	370	260	330	65
Temperature[j]	3	28	24	26	2.5
TOC[k]	3	3.3	3.2	3.2	0.067
Trichloroethylene	3	< 0.0050	< 0.0050	< 0.0050	0
TSS[l]	3	94	16	53	45
Turbidity[m]	3	160	68	100	53

Table 35. (continued)

July - September 1987

Parameter	No. of Samples	Concentration (mg/L) Max	Min	Av	95% cc[b]
Zn	3	0.10	0.015	0.049	0.052

[a] White Oak Dam, ORNL.
[b] 95% confidence coefficient about the average.
[c] Biological oxygen demand.
[d] Express in μmhos/cm.
[e] Dissolved oxygen.
[f] Measured in millions of gallons per day.
[g] Expressed in standard units; average not applicable.
[h] NA = not applicable.
[i] Total dissolved solids.
[j] Measured in degrees centigrade.
[k] Total organic carbon.
[l] Total suspended solids.
[m] Measured in Jackson turbidity units.

Table 36. NPDES miscellaneous source PF7007[a]

July - September 1987

Parameter	No. of Samples	Concentration (mg/L) Max	Min	Av	95% cc[b]
Downstream pH[c]	2	8.4	8.2	NA[d]	NA[d]
Oil and grease	2	6.0	< 2.0	< 4.0	4.0
pH[c]	2	8.8	8.5	NA[d]	NA[d]
Phenols	3	0.012	< 0.0010	< 0.0053	0.0068
TSS[e]	2	69	46	58	23

[a] Painting and Corrosion Control Facility, Building 7007.

[b] 95% confidence coefficient about the average.

[c] Expressed in standard units; average not applicable.

[d] NA = not applicable.

[e] Total suspended solids.

Table 37. NPDES miscellaneous source VC7002[a]

July - September 1987

Parameter	No. of Samples	Concentration (mg/L) Max	Min	Av	95% cc[b]
BOD[c]	2	< 5.0	< 5.0	< 5.0	0
Downstream pH[d]	3	8.4	0	NA[e]	NA[e]
Fecal coliform[f]	2	10	< 2.0	6.0	8.0
Oil and grease	2	3.0	2.0	2.5	1.0
pH[d]	3	8.7	7.7	NA[e]	NA[e]
Phenols	2	0.0030	< 0.0010	< 0.0020	0.0020
TSS[g]	2	< 5.0	< 5.0	< 5.0	0

[a] Vehicle and Equipment Cleaning Facility, Building 7002.

[b] 95% confidence coefficient about the average.

[c] Biological oxygen demand.

[d] Expressed in standard units; average not applicable.

[e] NA = not applicable.

[f] Expressed in colonies per 100 mL.

[g] Total suspended solids.

Table 38. NPDES cooling towers

July - September 1987

Parameter	Concentration (mg/L) Cooling Towers 4509	7902
Cr	< 0.024	< 0.024
Cu	0.042	0.086
Temperature[a]	29	23
Zn	0.077	0.46

[a] Measured in degrees centigrade.

Table 39. NPDES miscellaneous outfalls

July - September 1987

Parameter	Concentration (mg/L) Location EF7002[a]	SP2519[b]
Cr	7.0	10
Oil and grease	< 2.0	
Temperature[c]		24

[a] Vehicle and Equipment Maintenance Facility, Building 7002.

[b] Central Steam Plant, Building 2519.

[c] Measured in degrees centigrade.

Table 40. Parameters whose values exceed NPDES compliance limits

July - September 1987

Station	Parameter	Concentration (mg/L) Daily maximum	Permit Limit (mg/L)
		July 1987	
Paint Facility (PF7007)	Total Suspended Solids	69	40
Sewage Treatment Plant	Total Suspended Solids	711	45
Sewage Treatment Plant	Total Suspended Solids	333[d]	39[d]
Sewage Treatment Plant	Total Suspended Solids	59[b]	30[b]
Sewage Treatment Plant	Total Suspended Solids	28[b,d]	26[b,d]
Sewage Treatment Plant	Fecal Coliform	600[a]	400[a]
		August 1987	
Paint Facility (PF7007)	Total Suspended Solids	46	40
Miscellaneous (SP2519)	pH	10.1[c]	9.0[c]
		September 1987	
Sewage Treatment Plant	Fecal Coliform	600[a]	400[a]

[a] Colonies per 100 mL.
[b] Monthly average.
[c] Standard units.
[d] Kilograms per day.

The ORNL meteorological system consists of three towers (A, B, and C) with sensors mounted at two levels (10 and 30 meters) for Towers A and B and three levels (10, 30, and 100 meters) for Tower C. Locations of meteorological towers at ORNL are shown in Figure 7. Data from the sensors are acquired, stored, edited, and formatted by a data collection system consisting of a central processor and remote data logger. One-minute vector averages of wind velocity are calculated in the conventional way and retained for twenty-four hours. These velocities are processed into fifteen minute averages using a procedure that avoids the unrealistically low windspeed values obtained when appreciable winds of nearly opposite direction are vector averaged in the conventional way. This alternative averaging procedure involves calculating the mean (scalar) windspeed and multiplying it by a unit vector having the same direction as the conventionally calculated vector sum of the individual velocities. A similar calculation is used to convert the fifteen-minute averages into hourly averages. The fifteen-minute averages are retained for one day and the hourly averages, from which the wind roses in Figures 8-14 are obtained, are stored for at least one year and eventually archived.

Examination of quarterly wind roses reveals that the prevailing winds are almost equally split into two directions that are 180° apart: one prevailing direction is from the SW to WSW sector and the other prevailing direction is from the NE to ENE sector. The winds are strongly aligned along these directions because of the channeling effect induced by the ridge and valley structure of the area. Another feature observed from the wind roses is that the wind speeds increase with height (tower level) at each of the towers. On the average, the wind speeds can be expected to increase steadily from ground level to 100 meters.

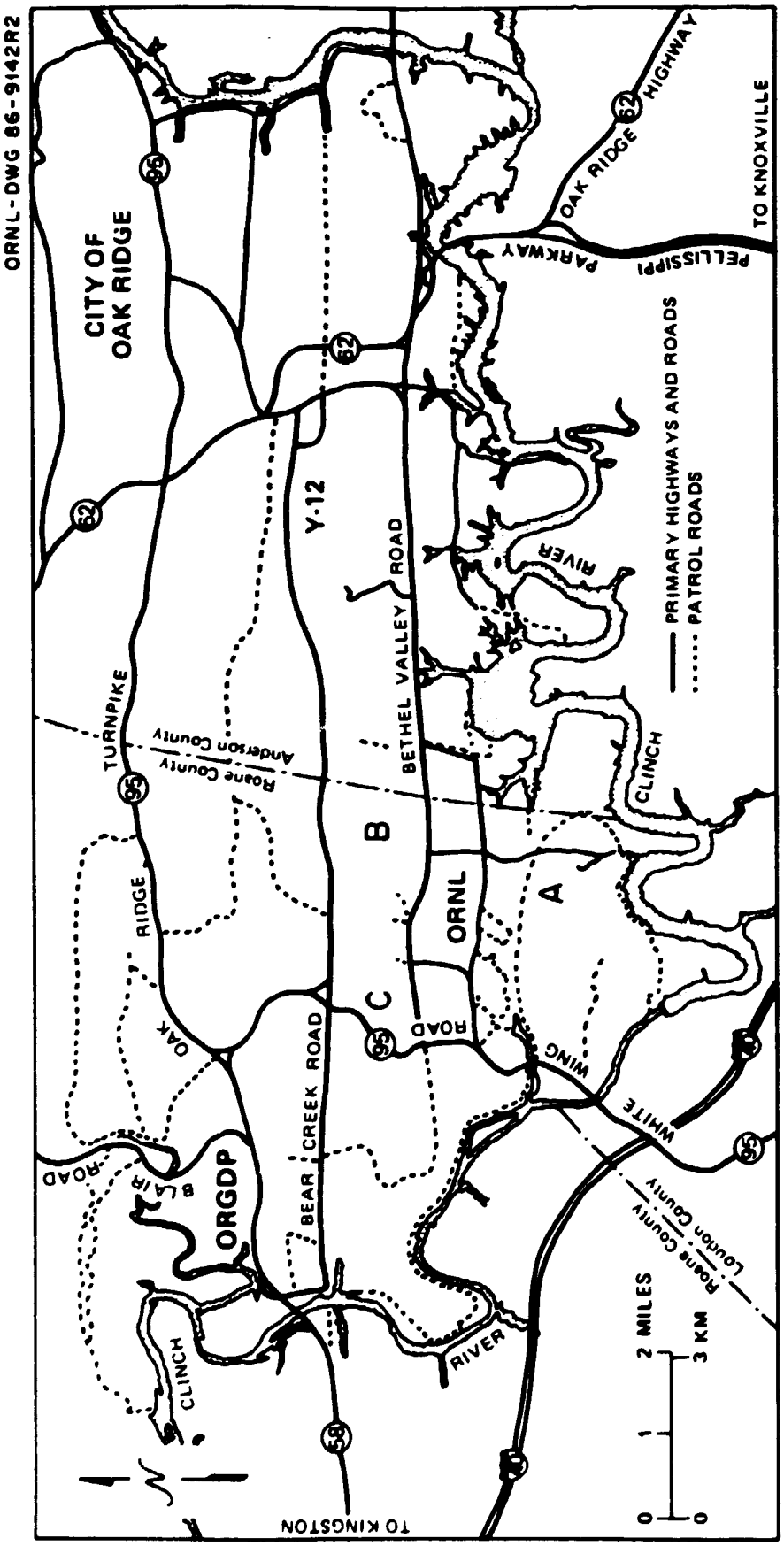

Fig. 7 Locations of meteorological towers at ORNL

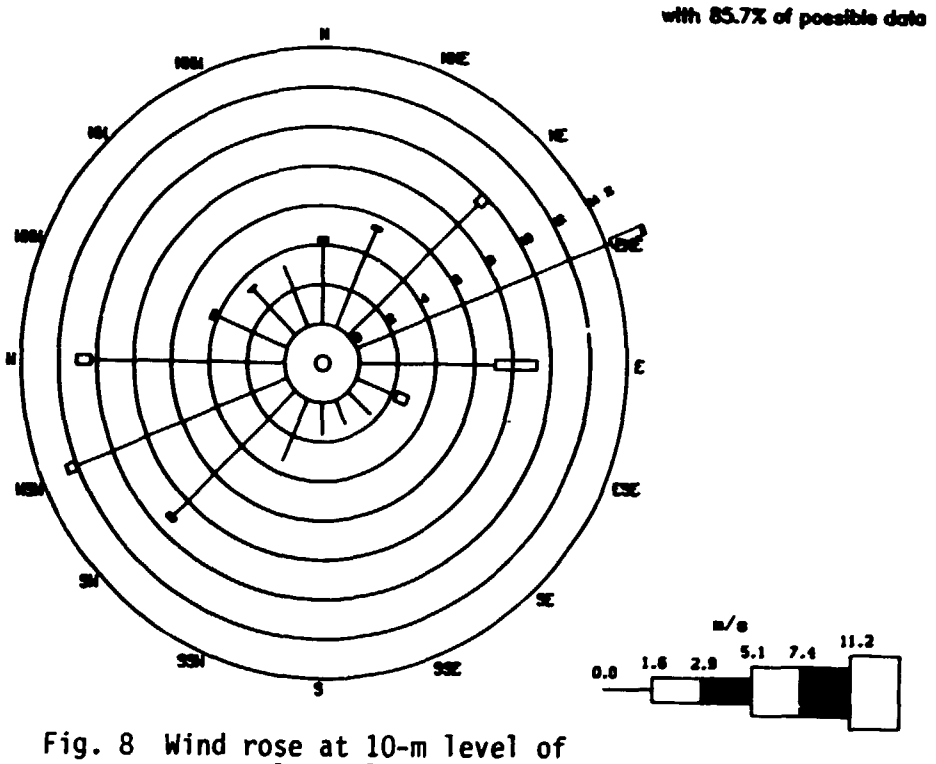

Fig. 8 Wind rose at 10-m level of meteorological tower A, July-September 1987

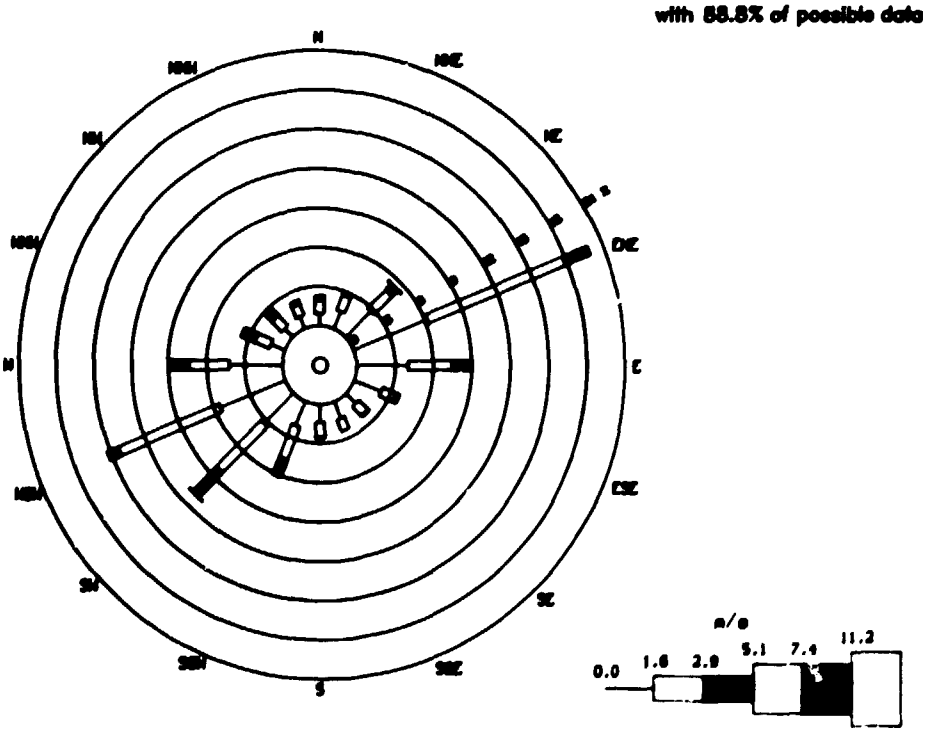

Fig. 9 Wind rose at 30-m level of meteorological tower A, July-September 1987

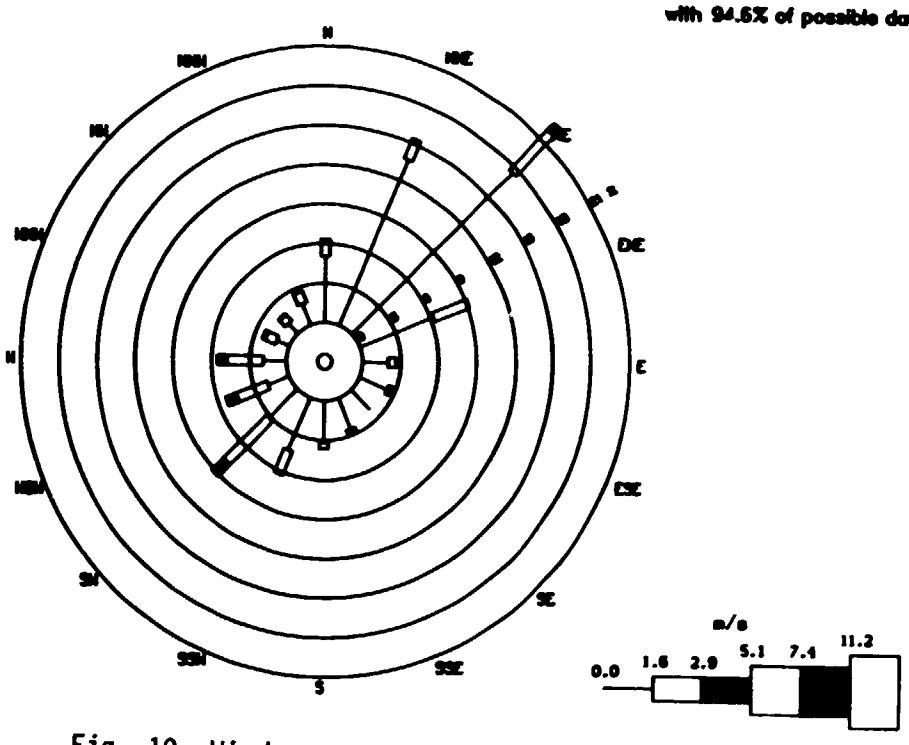

Fig. 10 Wind rose at 10-m level of meteorological tower B, July-September 1987

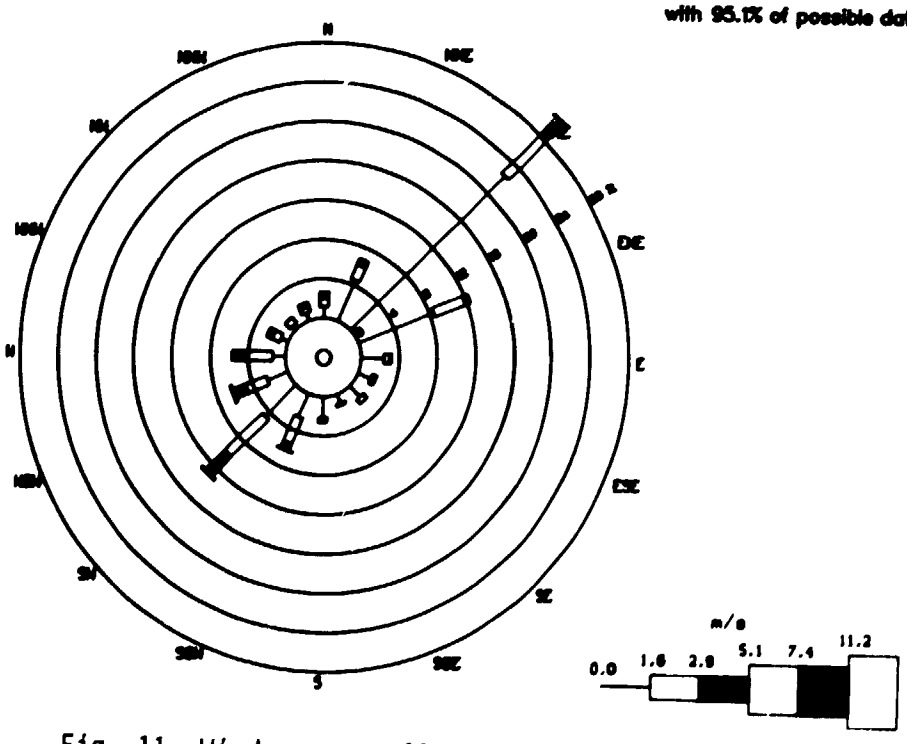

Fig. 11 Wind rose at 30-m level of meteorological tower B, July-September 1987

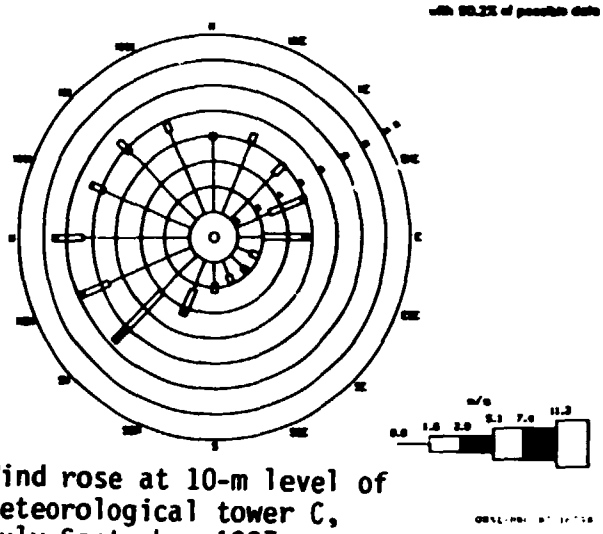

Fig. 12 Wind rose at 10-m level of meteorological tower C, July-September 1987

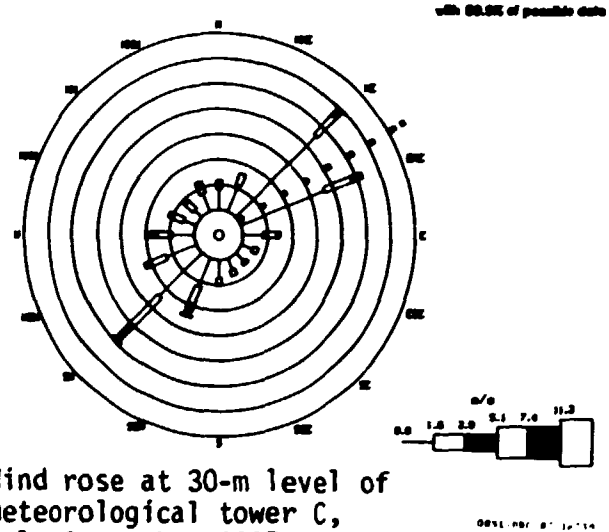

Fig. 13 Wind rose at 30-m level of meteorological tower C, July-September 1987

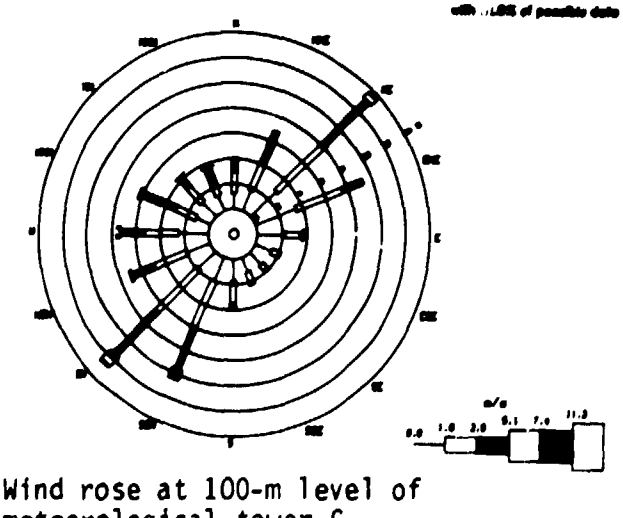

Fig. 14 Wind rose at 100-m level of meteorological tower C, July-September 1987

Milk

Raw milk from five stations and one dairy within a radius of 80 km of Oak Ridge is monitored for ^{131}I and total radioactive Sr. Samples are collected every two weeks from the stations located near the Oak Ridge area (Fig. 15). Three other stations are more remote with respect to the Oak Ridge facilities and are usually sampled semiannually (Fig. 16). None of the remote stations were sampled during this period. At station 6, the cow was sold which resulted in no samples being collected. At station 7, the cow had a calf, so no milk samples were collected. Samples were analyzed for ^{131}I by gamma spectroscopy and for total radioactive Sr by chemical separation and low-level beta counting. The results (Tables 41 and 42) are compared with intake guidelines specified by the Federal Radiation Council (FRC).

Concentrations of ^{131}I are shown in Table 41. The average concentration of ^{131}I for all stations in the immediate Oak Ridge area was less than 0.08 Bq/L, which is within Range I of the FRC guidelines. This quarter was the third in which all ^{131}I analyses were by gamma spectroscopy as opposed to the previous method of ion exchange and low-level beta counting. This change has resulted in a greater than two-fold increase in the lower limit of detection for ^{131}I and is responsible for the increase in the average value for this quarter over 1986 values.

Concentrations of total radioactive Sr are shown in Table 42. The average concentration of total radioactive Sr at all stations in the immediate Oak Ridge area was 0.22 Bq/L. This concentration is not significantly different than the average for the second quarter of 1987 (0.26 Bq/L). All total radioactive Sr results are within Range I of the FRC guidelines.

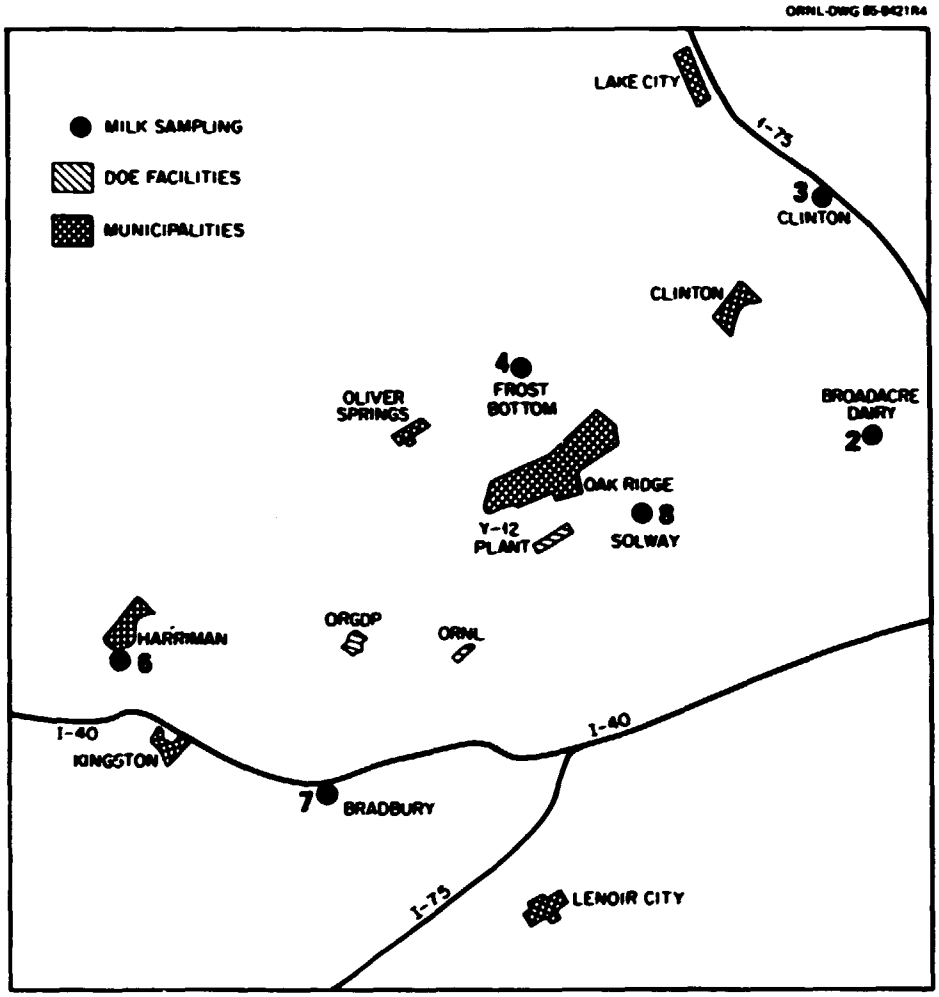

Fig. 15 Locations of milk sampling stations near the Oak Ridge facilities

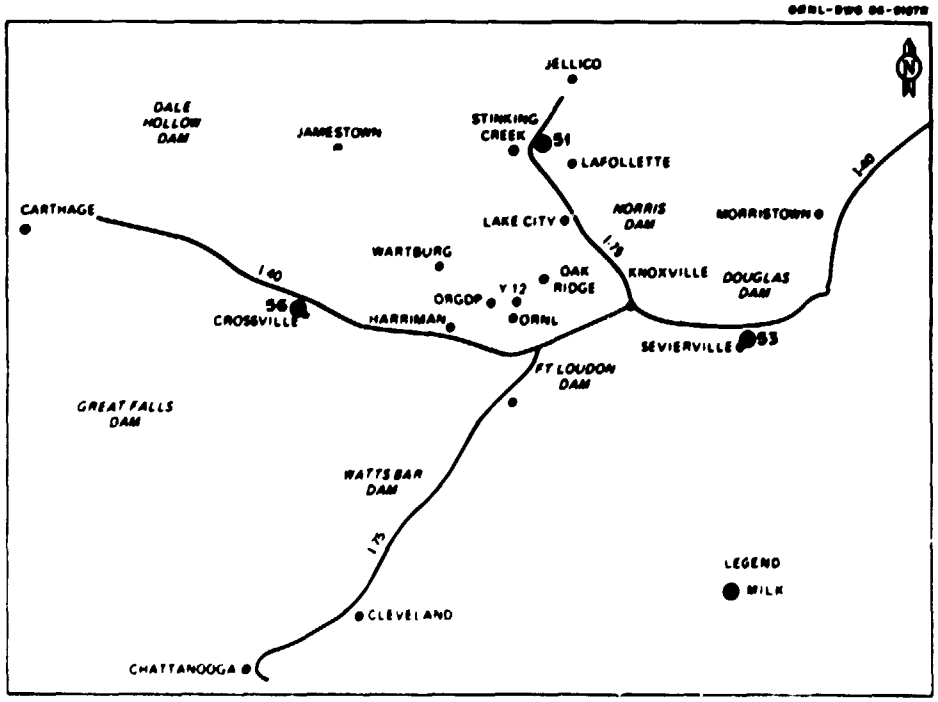

Fig. 16 Locations of milk sampling stations remote from the Oak Ridge facilities

Table 41. Concentrations of ^{131}I in milk[a]

July - September 1987

Station	No. of samples	Concentration (Bq/L) Max	Min	Av	95%cc[b]	Comparison with standard[c]
		Immediate Environs[d]				
2	7	< 0.08	< 0.08	< 0.08	0	Range I
3	4	< 0.08	< 0.08	< 0.08	0	Range I
4	7	< 0.08	< 0.08	< 0.08	0	Range I
8	2	< 0.08	< 0.08	< 0.08	0	Range I
Network summary	20	< 0.08	< 0.08	< 0.08	0	Range I

[a] Raw milk samples; Station 2 is a dairy.

[b] 95% confidence coefficient about the average.

[c] Applicable FRC standard assuming 1 L/d intake: Range I, 0 - 0.37 Bq/L, adequate surveillance required to confirm calculated intakes; Range II, 0.37 - 3.7 Bq/L, active surveillance required; and Range III, > 3.7 Bq/L, positive control required.

[d] See Figure 15.

Table 42. Concentrations of total radioactive Sr in milk[a]

July - September 1987

Station	No. of samples	Concentration (Bq/L) Max	Min	Av	95%cc[b]	Comparison with standard[c]
		Immediate Environs[d]				
2	7	0.24	0.12	0.17	0.038	Range I
3	4	0.37	0.11	0.21	0.12	Range I
4	7	0.30	0.06	0.21	0.067	Range I
8	2	0.49	0.33	0.41	0.16	Range I
Network summary	20	0.49	0.06	0.22	0.046	Range I

[a] Raw milk samples, Station 2 is a dairy.

[b] 95% confidence coefficient about the average.

[c] Applicable FRC standard assuming 1 L/d intake: Range I, 0 - 0.74 Bq/L, adequate surveillance required to confirm calculated intakes; Range II, 0.74 - 7.4 Bq/L, active surveillance required; and Range III, > 7.4 Bq/L, positive control required.

[d] See Figure 15.

Fish

Bluegill from three Clinch River locations were collected during this quarter for tissue analyses of radionuclides, mercury, and PCBs (Fig. 17). (Note: Sampling is done semiannually). Sampling locations include the following river kilometers (CRK): (1) 40.0 which is above Melton Hill Dam and serves as a background location. It is above all of the Oak Ridge DOE facilities' outfalls; (2) 33.3, which is ORNL's discharge point from White Oak Creek to the Clinch River; and (3) 8.0, which is downstream from both ORNL and ORGDP.

The primary radionuclides of concern at ORNL due to fish consumption are total radioactive Sr and ^{137}Cs. These two result in the highest dose to man from ingestion of fish. Radionuclide concentrations were determined on at least one composite of 6-10 fish per sampling period. Mercury and PCB concentrations were measured in six individual fish from each sampling location. Scales, head, and entrails are removed from each fish before samples are obtained. Composite samples were ashed and analyzed by gamma spectroscopy and radiochemical techniques for the radionuclides that contribute most of the potential radionuclide dose to humans.

Average mercury concentrations in fish from each of the three locations were not significantly different from the second quarter of 1987 (Table 43). The average concentration of mercury in fish from each location was less than 20% of the FDA's action level of 1.0 µg/g wet weight.

The concentrations of PCBs in fish during the third quarter of 1987 were not significantly different from those measured during the second quarter of 1987 (Table 44). All concentrations of PCBs (individual types and the sum) were less than 5% of the FDA's tolerance level of 2µg/g wet weight for fish.

Summary statistics of concentrations of radionuclides found in bluegill during the quarter are given in Table 45. For the background location (CRK 40.0), and the location downstream from ORNL and ORGDP (CRK 8.0), the average concentrations of all radionuclides, except total radioactive Sr are similar to past years. Total radioactive Sr in fish collected at CRK 33.3 (ORNL's discharge point) was significantly lower this quarter than the second quarter. No ^{60}Co was detected in any of the fish samples. Cesium-137 concentrations in fish at each of the locations were similar to those measured during the second quarter of 1987. There were no significant differences in total radioactive strontium measured at any of the locations sampled.

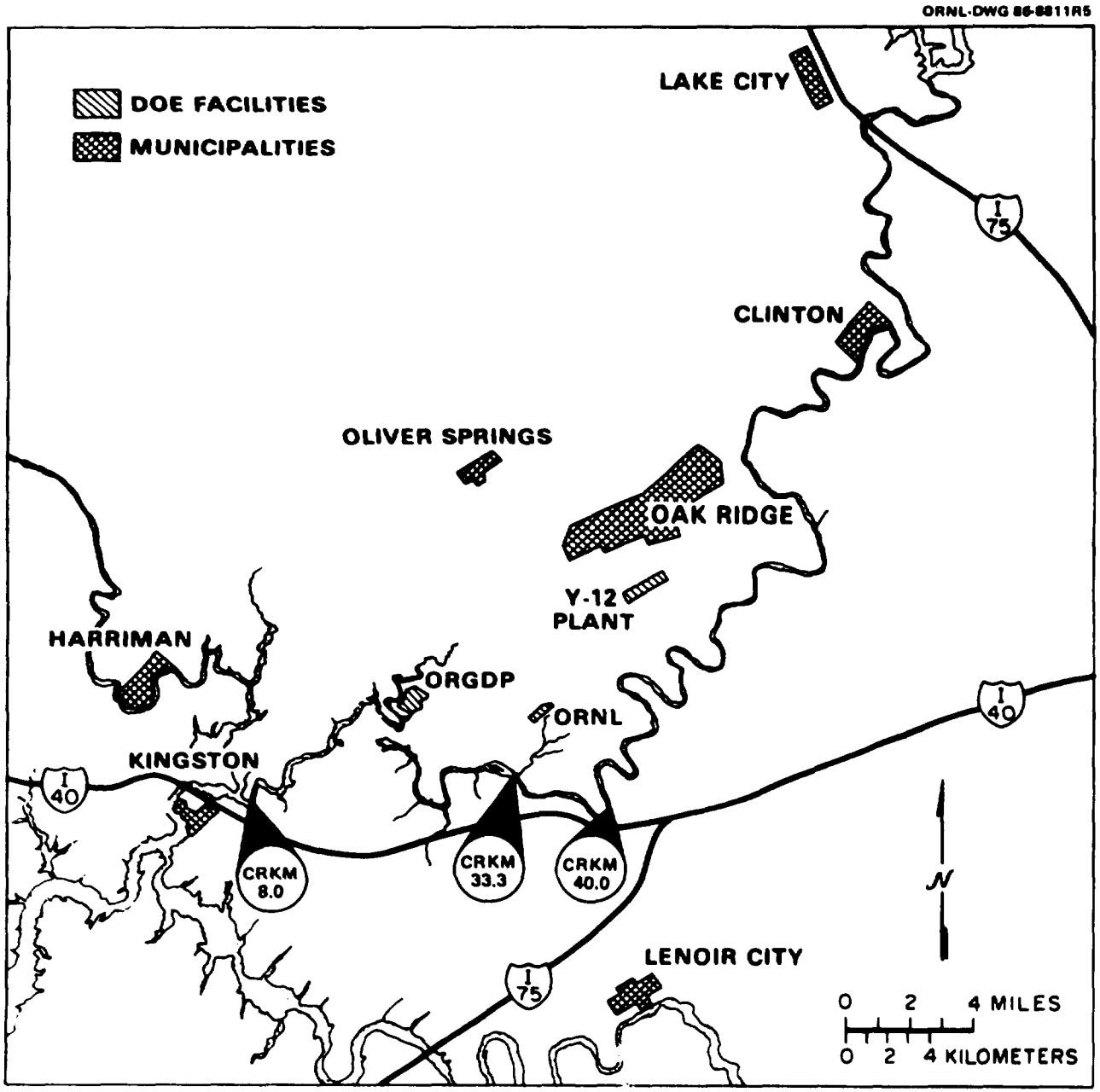

Fig. 17 Location of fish sampling points

Table 43. Mercury concentrations in Clinch River bluegill

July - September 1987

Location[a]	No. of Fish Sampled	Concentration (µg/g wet wt) Max	Min	Av	95%cc[b]	Percentage of Action Level[c]
CRK 8.0	6	0.14	0.050	0.085	0.028	8.5
CRK 33.3	6	0.22	0.030	0.092	0.065	9.2
CRK 40.0	6	0.040	0.030	0.035	0.0045	3.5

[a] See Figure 17.

[b] 95% confidence coefficient about the average.

[c] Percentage of Food and Drug Administration action level of mercury in fish (1.0 µg/g) for the average concentration.

Table 44. PCB concentrations in Clinch River bluegill

July - September 1987

Location[a]	PCB Type	No. of Fish Sampled	Concentration (µg/g wet wt) Max	Min	Av	95%cc[b]	Percentage of Tolerance[c]
CRK 8.0	1254	6	0.02	0.01	0.01	0.004	0.5
	1260	6	0.09	< 0.01	< 0.02	0.026	1.0
CRK 33.3	1254	6	0.02	0.01	0.01	0.004	0.5
	1260	6	0.02	< 0.01	< 0.01	0.004	0.5
CRK 40.0	1254	6	0.03	0.01	0.02	0.008	1.0
	1260	6	0.02	0.01	0.01	0.003	0.5

[a] See Figure 17.

[b] 95% confidence coefficient about the average.

[c] Percentage of Food and Drug Administration tolerance for PCBs in fish (2 µg/g wet wt) for the average.

Table 45. Radionuclide concentrations in Clinch River bluegill

July - September 1987

Location[a]	Radionuclide	No. of Samples[b]	Concentration (Bq/kg wet wt) Max	Min	Av	95%cc[c]
CRK 8.0	^{60}Co	3	< 0.13	< 0.11	< 0.12	0.015
	^{137}Cs	3	2.02	1.5	1.7	0.29
	Total Sr[d]	3	0.55	0.064	0.26	0.29
CRK 33.3	^{60}Co	3	< 0.16	< 0.035	< 0.11	0.077
	^{137}Cs	3	10.8	3.7	6.4	4.4
	Total Sr[d]	3	0.58	0.17	0.34	0.24
CRK 40.0	^{60}Co	3	< 0.12	< 0.11	< 0.12	0.0069
	^{137}Cs	3	0.30	0.063	0.16	0.15
	Total Sr[d]	3	0.12	0.023	0.073	0.058

[a] See Figure 17.

[b] A sample is a composite of 6-10 fish.

[c] 95% confidence coefficient about the average.

[d] Total radioactive Sr (^{89}Sr and ^{90}Sr).

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