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MARTIN MARIETTA

Environmental Surveillance Data Report for the Second Quarter of 1988

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K. L. Daniels
B. M. Horwedel
I. L. McCollough
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EXECUTIVE SUMMARY

During the second quarter of 1988, over 1,600 samples which represent more than 5,000 analyses and measurements were collected by the Environmental Monitoring and Compliance (EMC) Section. A network of real-time monitoring stations which telemeter 10-minute averaged readings of radiation levels, total precipitation, flows, water quality parameters, and air quality parameters around ORNL also reported data. In addition, three meteorological towers sent weather data at various heights to a host computer every 15-minutes.

Increases in thorium and uranium isotopes were reported in several of the composited air filters from individual stations during the second quarter. Construction activities, in particular dirt movement, near these sites combined with an unusually dry summer appear to be responsible for most of these increases. There was also an increase in strontium at the sites near the Y-12 plant where the construction activities mainly involve the replacement of New Hope Pond. Elevated levels of these isotopes at individual stations may be expected to continue into the third quarter of 1988 as construction activities continue to cause elevated levels of dust in the air around particular monitoring sites.

Real-time measurements of external gamma radiation are now being reported from fifteen stations, including some recently activated or upgraded stations. Measurements this quarter indicate that external gamma radiation around ORNL is close to background, except at station 4 which is located between the Waste Treatment Plant and waste treatment ponds and therefore experiences higher levels of radiation.

The cobalt-60 concentration in Melton Branch was somewhat elevated in May following a discharge from one of the HFIR ponds, but returned to pre-discharge levels in June. The HFIR ponds appear to be the source of most of the cobalt-60 that does occur in Melton Branch.

Flow-weighted concentrations of radionuclides in surface water were found to be generally much lower than the DOE derived concentration guidelines except for tritium in Melton Branch. Tritium concentrations measured at Melton Branch Site 1 were 120% of the guideline for April and 140% for May. These tritium concentrations are similar to those at Melton Branch 1 for the first quarter of 1988.

Although short-period flows of the Clinch River can be regulated, the total flow for the second quarter of 1988 was 49% of the flow for the second quarter of 1987, reflecting the continued dry spell.

There were 31 noncompliances associated with the NPDES permits during the second quarter of 1988. This was from a total of 2,354 observations which represents a compliance ratio of greater than 98.5%. Thirteen of the noncompliances involved Category II runoff associated with showers after a

prolonged period of little or no shower activity. In this case, over 1 cm of precipitation occurred over a two-hour period on April 6, when precipitation approaching that intensity had not occurred since March 12. The samples taken on April 6 would therefore be expected to contain the first-flush of several days accumulation of dust, particulates, and oil and grease from the areas drained by these outfalls. Three temperature related noncompliances were also attributable to hot and dry conditions during the quarter. Five other noncompliances involving iron were associated with minor equipment failures at the monitoring stations, in which cases no actual discharge of noncompliant effluent is known to have occurred. The faulty equipment was repaired on May 10. Where appropriate, corrective actions or investigations have been undertaken or are underway to address the other noncompliances.

INTRODUCTION

The Environmental Monitoring and Compliance (EMC) Section within the Environmental and Health Protection Division (EHP) 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 Section 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 1988 includes sampling and monitoring of air, water from surface streams and point sources, fish, milk, soil, and vegetation (grass) for radioactive and nonradioactive materials. This report includes data for air, surface water, milk, and fish. 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.

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 at least one of the samples for the period is 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 the monitoring of stack effluents, atmospheric concentrations of materials are monitored continuously at 27 stations around ORNL, the Oak Ridge Reservation, and the surrounding vicinity. 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, 4, 7, 9, 20, 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 was installed at station 22 and this station began operating in March 1987. Sampling equipment has now been installed at Station 21 and this station began operating in March 1988. Installation of proper filtering equipment at PAMs 4 and 20 in late May allowed the monitoring of June data at those stations and brought the total number of PAMs up to 7.

(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 55-58. Station 58 (Knoxville) was added in late April. All of 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.

ORNL–DWG 86-17411R2

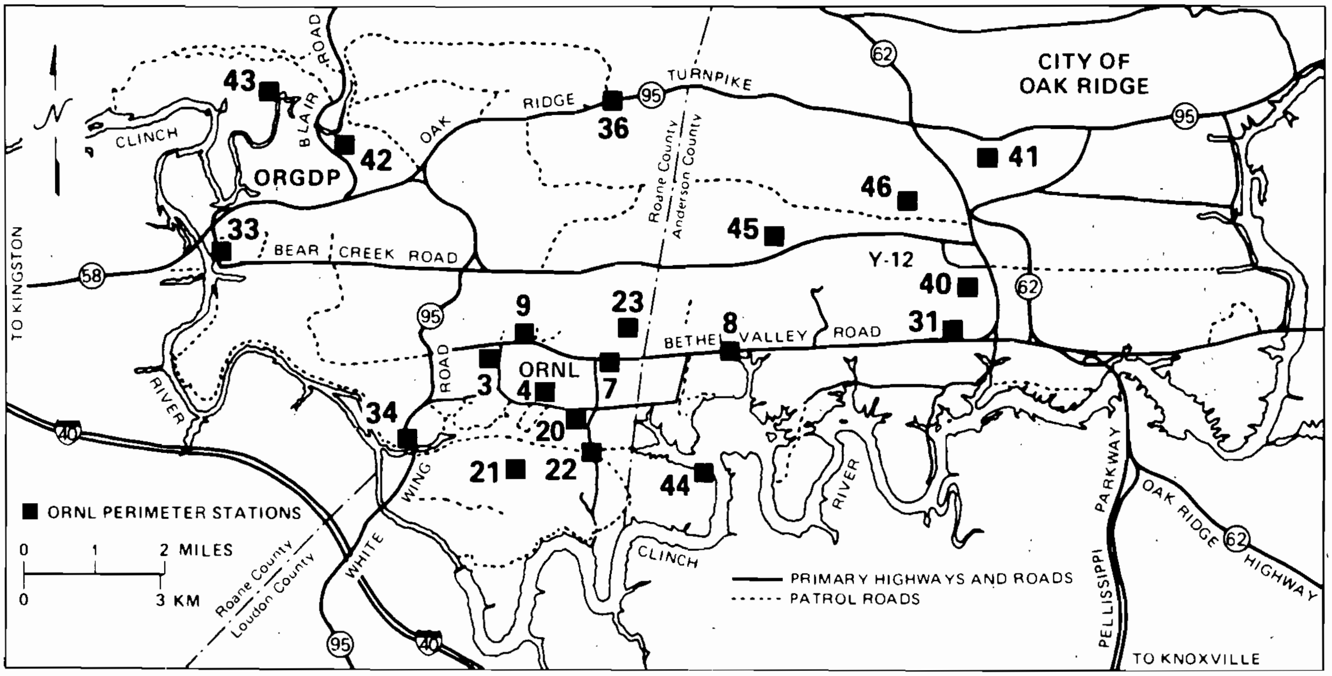

Fig. 1. Location map of the ORNL perimeter and Oak Ridge Reservation air monitoring stations.

ORNL-DWG 86-9187R6

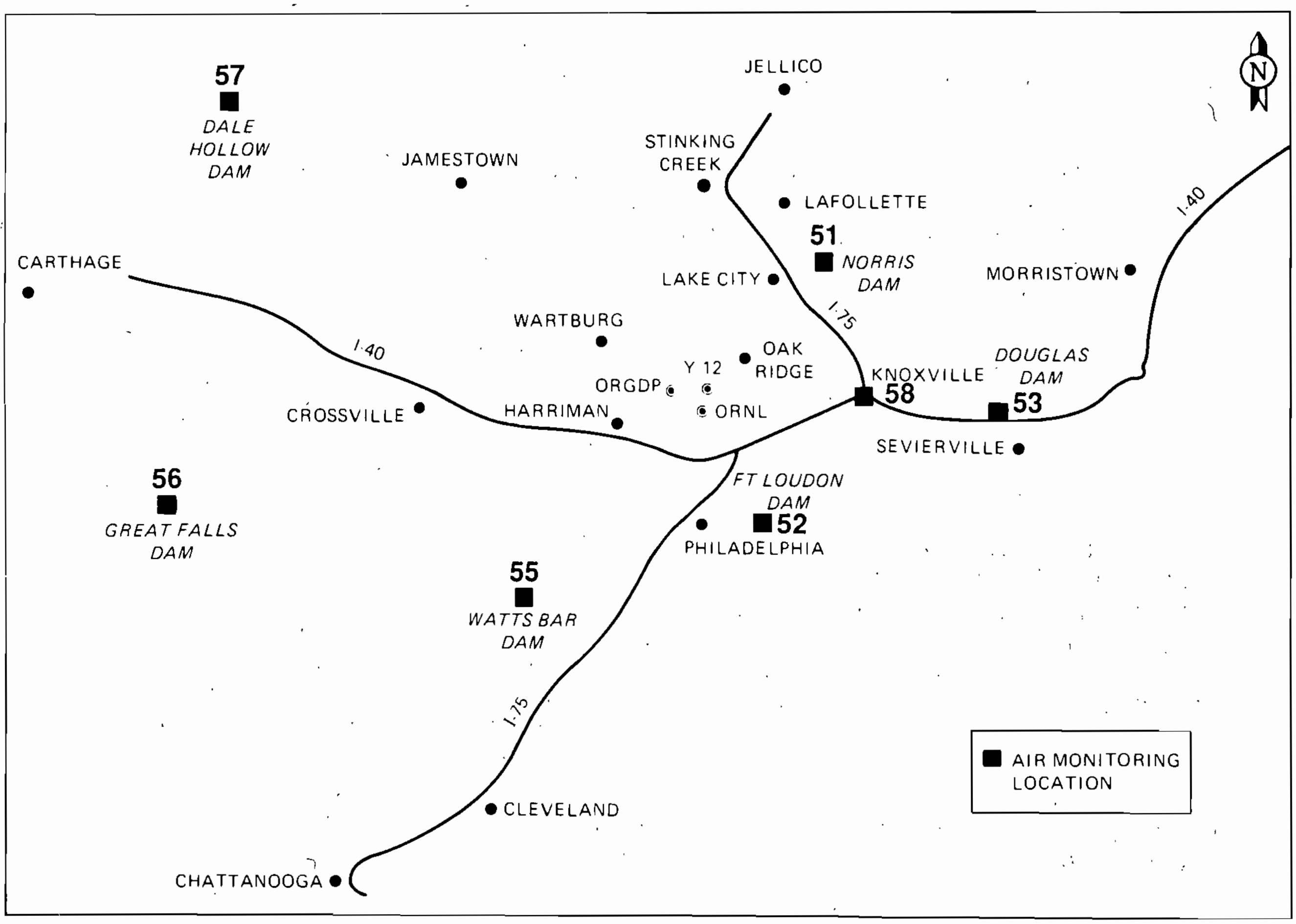

Fig. 2. Location map of the remote air monitoring stations

Airborne radioactive particulates are collected 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 3-46 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 (April-June) 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. These improvements have led to lower minimum values for gross alpha and gross beta, and also to lower values of gross alpha generally Tables (1-6).

There appears to be little or no alpha activity at any of the stations during this quarter.

The average beta activity at the three networks were within the normal background range for East Tennessee.

The charcoal samples collected weekly at the air monitoring stations showed no appreciable differences in iodine concentrations from the first quarter of 1988 (Tables 7-9).

Monthly samples for atmospheric tritium are routinely collected from ORNL PAM station 3 and Reservation PAM station 8. 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 summary of the atmospheric tritium concentrations is presented in Table 10. Tritium concentrations in air showed no significant differences from the past three years' values.

Air filters are composited quarterly from ORNL PAMs (stations 3, 7, 9, 21, 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. The results are in Tables 11 through 13. No ^{60}Co was detected on any of the quarterly air filters.

Table 1. Long-lived gross alpha activity in air

April 1988

Location	No. of Samples	Concentration (10^{-8} Bq/L) Max	Min	Av	95% cc[a]
		ORNL PAM Stations[b]			
3	4	5.2	-5.2	-1.8	4.7
9	4	3.1	-5.2	-2.7	3.9
21	4	6.3	-5.3	-1.5	5.3
22	4	1.9	-6.6	-3.9	4.0
Network summary	16	6.3	-6.6	-2.5	2.1
		Reservation PAM Stations[b]			
8	4	1.6	-4.7	-2.5	2.9
23	4	5.9	-5.6	-1.9	5.2
31	4	4.1	-4.9	-2.5	4.4
33	1	6.0	6.0	6.0	
34	4	6.5	-6.1	-0.95	5.3
36	3	3.0	-6.9	-2.8	5.9
40	4	4.8	-4.3	-1.7	4.3
42	4	3.9	-6.8	-2.9	4.7
43	1	0.79	0.79	0.79	
44	4	3.1	-5.2	-2.3	3.9
45	4	13	-6.8	-0.33	9.2
46	4	6.5	-5.8	-1.7	5.6
Network summary	41	13	-6.9	-1.7	1.5
		RAM Stations[c]			
51	4	0.63	-1.6	-0.65	0.95
52	4	-1.2	-5.3	-3.4	1.7
53	4	0	-6.2	-3.4	2.8
55	4	-1.3	-4.5	-2.7	1.5

Table 1. (continued)

April 1988

Location	No. of Samples	Concentration (10^{-8} Bq/L) Max	Min	Av	95% cc[a]
56	4	-4.1	-4.7	-4.4	0.26
57	4	-1.8	-2.9	-2.2	0.54
Network summary	24	0.63	-6.2	-2.8	0.74
Overall summary	81	13	-6.9	-2.2	0.88

[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

May 1988

Location	No. of Samples	Concentration (10^{-8} Bq/L) Max	Min	Av	95% cc[a]
		ORNL PAM Stations[b]			
3	5	-3.1	-5.2	-4.2	0.75
7	2	-1.2	-5.8	-3.5	4.6
9	5	-1.1	-4.1	-2.9	1.0
21	5	-0.44	-5.1	-2.7	1.7
22	4	-3.1	-7.1	-4.8	1.7
Network summary	21	-0.44	-7.1	-3.6	0.73
		Reservation PAM Stations[b]			
8	5	-1.6	-5.2	-4.1	1.3
23	4	0.42	-5.9	-2.8	2.6
31	5	-2.3	-4.8	-3.7	0.92
33	4	-3.5	-4.0	-3.8	0.50
34	4	-2.9	-3.7	-3.3	0.78
36	5	0	-4.7	-3.3	1.8
40	5	-2.9	-6.3	-4.3	1.3
41	5	-0.50	-6.2	-3.3	3.1
42	5	-2.6	-7.2	-5.2	1.5
43	4	-2.2	-7.5	-5.2	3.2
44	5	-1.4	-5.8	-3.9	1.8
45	5	3.8	-1.8	1.0	5.6
46	5	-0.99	-6.4	-4.3	2.0
Network summary	61	3.8	-7.5	-3.8	0.60
		RAM Stations[c]			
51	5	-0.62	-1.8	-1.1	0.41
52	5	-1.8	-6.1	-4.3	1.6
53	4	-1.7	-4.0	-2.8	1.3
55	5	-2.3	-5.5	-4.0	1.1

Table 2. (continued)

May 1988

Location	No. of Samples	Concentration (10^{-8} Bq/L)			
		Max	Min	Av	95% cc[a]
56	4	-1.6	-5.3	-3.7	1.8
57	4	-0.56	-2.1	-1.5	0.68
58	3	-1.4	-3.6	-2.7	1.3
Network summary	30	-0.56	-6.1	-2.9	0.62
Overall summary	112	3.8	-7.5	-3.5	0.39

[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

June 1988

Location	No. of Samples	Concentration (10^{-8} Bq/L) Max	Min	Av	95% cc[a]
		ORNL PAM Stations[b]			
3	4	0.49	-5.4	-2.6	2.5
4	3	-2.5	-4.1	-3.6	1.0
7	4	-1.9	-8.2	-4.9	3.7
9	4	-3.6	-4.7	-4.0	0.50
20	3	-1.1	-4.1	-2.3	1.9
21	4	0	-5.0	-3.0	2.3
22	4	0	-6.2	-3.3	3.2
Network summary	26	0.49	-8.2	-3.4	0.85
		Reservation PAM Stations[b]			
8	4	-1.6	-6.6	-3.4	2.3
23	4	-1.1	-3.9	-2.2	1.8
31	4	-2.6	-4.9	-3.5	0.99
33	4	0	-4.4	-2.3	1.9
34	4	-1.5	-5.2	-3.0	1.6
36	4	-1.1	-4.9	-3.1	1.6
40	4	2.0	-3.6	-1.4	2.4
41	4	-1.2	-6.3	-4.2	2.1
42	4	-1.0	-4.8	-3.0	1.5
43	4	-1.0	-4.8	-3.3	1.8
44	4	-1.6	-4.9	-3.5	1.4
45	4	0.55	-3.1	-1.3	1.6
46	4	-3.3	-5.6	-4.3	0.98
Network summary	52	2.0	-6.6	-3.0	0.49
		RAM Stations[c]			
51	4	3.1	-2.1	0.63	2.2
52	4	2.7	-6.4	-2.2	4.1
53	3	6.9	0	3.5	6.9

Table 3. (continued)

June 1988

Location	No. of Samples	Concentration (10^{-8} Bq/L) Max	Min	Av	95% cc[a]
55	4	-1.1	-5.1	-2.8	1.7
56	3	0.22	-7.5	-3.7	4.5
57	4	2.7	-1.1	0.41	1.6
58	4	-1.2	-5.0	-2.3	1.8
Network summary	26	6.9	-7.5	-1.2	1.3
Overall summary	104	6.9	-8.2	-2.6	0.48

[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

April 1988

Location	No. of Samples	Concentration (10^{-8} Bq/L) Max	Min	Av	95% cc[a]
		ORNL PAM Stations[b]			
3	4	67	57	62	4.2
9	4	73	62	69	5.0
21	4	100	86	95	7.1
22	4	100	33	68	31
Network summary	16	100	33	74	9.9
		Reservation PAM Stations[b]			
8	4	73	41	60	14
23	4	110	25	74	38
31	4	100	40	80	28
33	1	95	95	95	
34	4	110	91	100	9.0
36	3	99	59	79	23
40	4	79	61	71	7.3
42	4	75	65	71	4.4
43	1	55	55	55	
44	4	99	57	69	20
45	4	100	41	80	27
46	4	110	55	81	26
Network summary	41	110	25	76	6.9
		RAM Stations[c]			
51	4	99	91	94	3.4
52	4	100	88	97	5.9
53	4	110	82	100	13
55	4	92	35	65	24

Table 4. (continued)

April 1988

Location	No. of Samples	Concentration (10^{-8} Bq/L)			
		Max	Min	Av	95% cc[a]
56	4	97	76	88	10
57	4	110	91	98	7.8
Network summary	24	110	35	90	6.8
Overall summary	81	110	25	80	4.7

[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

May 1988

Location	No. of Samples	Concentration (10^{-8} Bq/L) Max	Min	Av	95% cc[a]
		ORNL PAM Stations[b]			
3	5	83	67	77	6.0
7	2	93	81	87	11
9	5	92	67	79	8.5
21	5	290	100	150	72
22	4	120	97	110	9.0
Network summary	21	290	67	100	21
		Reservation PAM Stations[b]			
8	5	83	67	76	6.3
23	4	140	86	110	23
31	5	110	90	100	6.6
33	4	100	93	97	7.3
34	4	110	84	95	22
36	5	110	76	98	11
40	5	98	39	74	20
41	5	120	98	110	8.2
42	5	100	77	89	9.4
43	4	130	83	100	33
44	5	110	97	100	7.3
45	5	130	98	110	31
46	5	140	110	120	9.5
Network summary	61	140	39	98	5.3
		RAM Stations[c]			
51	5	100	86	92	5.3
52	5	100	79	95	8.5
53	4	120	97	110	15
55	5	100	55	78	19

Table 5. (continued)

May 1988

Location	No. of Samples	Concentration (10^{-8} Bq/L) Max	Min	Av	95% cc[a]
56	4	130	95	110	16
57	4	120	100	110	9.4
58	3	120	78	95	21
Network summary	30	130	55	98	6.4
Overall summary	112	290	39	99	5.3

[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

June 1988

Location	No. of Samples	Concentration (10^{-8} Bq/L) Max	Min	Av	95% cc[a]
		ORNL PAM Stations[b]			
3	4	150	110	120	16
4	3	160	120	140	26
7	4	130	100	120	18
9	4	93	78	87	7.7
20	3	160	98	130	38
21	4	150	110	140	17
22	4	150	120	140	13
Network summary	26	160	78	120	9.6
		Reservation PAM Stations[b]			
8	4	160	100	130	24
23	4	150	120	140	22
31	4	140	100	130	17
33	4	160	120	130	20
34	4	150	100	120	19
36	4	160	69	120	41
40	4	120	76	100	19
41	4	140	120	130	7.4
42	4	140	120	130	12
43	4	140	78	120	27
44	4	150	110	130	20
45	4	140	79	120	30
46	4	140	23	60	56
Network summary	52	160	23	120	8.7
		RAM Stations[c]			
51	4	160	110	140	22
52	4	160	77	120	35
53	3	230	160	190	68

Table 6. (continued)

June 1988

Location	No. of Samples	Concentration (10^{-8} Bq/L) Max	Min	Av	95% cc[a]
55	4	150	72	120	36
56	3	150	86	110	37
57	4	180	81	130	40
58	4	200	17	120	76
Network summary	26	230	17	130	18
Overall summary	104	230	17	120	6.6

[a]95% confidence coefficient about the average of more than two samples.
[b]See Figure 1.
[c]See Figure 2.

Table 7. ^{131}I concentrations in air

April 1988

Location	No. of Samples	Concentration (10^{-8} Bq/L) Max	Min	Av	95% cc[a]	Percent DCG[b]
		ORNL PAM Stations[c]				
3	4	2.0	-2.0	0.49	1.9	< 0.01
9	4	7.7	-2.0	3.8	4.2	< 0.01
21	4	0	-4.6	-1.8	2.2	< 0.01
22	4	12	-5.7	0.93	8.1	< 0.01
Network summary	16	12	-5.7	0.86	2.4	< 0.01
		Reservation PAM Stations[c]				
8	4	5.7	0	2.9	2.5	< 0.01
23	4	8.8	-5.1	-0.35	6.2	< 0.01
31	4	6.0	-5.5	-0.31	5.3	< 0.01
33	1	0	0	0		< 0.01
34	4	9.6	-2.9	2.4	5.4	< 0.01
36	3	5.6	-2.8	0.21	5.4	< 0.01
40	4	13	-5.3	3.2	7.4	< 0.01
42	4	7.6	-4.9	1.2	5.9	< 0.01
43	1	-3.0	-3.0	-3.0		< 0.01
44	4	5.7	-3.8	0.98	4.0	< 0.01
45	4	2.7	-7.8	-1.8	5.3	< 0.01
46	4	7.6	0	5.0	3.5	< 0.01
Network summary	41	13	-7.8	1.2	1.5	< 0.01
Overall summary	57	13	-7.8	1.1	1.3	< 0.01

[a]95% confidence coefficient about the average of more than two samples.
[b]Percent DCG = maximum value x 100/derived concentration guide (DCG). The DCG for ^{131}I is 1.5×10^{-2} Bq/L.
[c]See Figure 1.

Table 8. ^{131}I concentrations in air

May 1988

Location	No. of Samples	Concentration (10^{-8} Bq/L) Max	Min	Av	95% cc[a]	Percent DCG[b]
		ORNL PAM Stations[c]				
3	5	7.7	-13	-3.5	6.8	< 0.01
7	2	-4.5	-7.0	-5.8	2.5	< 0.01
9	5	15	-8.3	-0.52	8.2	< 0.01
21	5	8.8	-13	-4.9	8.0	< 0.01
22	4	2.2	-18	-7.4	10	< 0.01
Network summary	21	15	-18	-4.1	3.5	< 0.01
		Reservation PAM Stations[c]				
8	5	3.7	-7.4	-1.2	4.1	< 0.01
23	4	6.8	-9.4	-3.4	7.5	< 0.01
31	5	3.5	-11	-2.2	5.0	< 0.01
33	4	4.9	-24	-8.4	12	< 0.01
34	4	-1.7	-9.2	-6.6	3.4	< 0.01
36	5	44	-14	10	19	< 0.01
40	5	7.8	-9.0	0.039	5.5	< 0.01
41	5	6.1	-20	4.1	8.8	< 0.01
42	5	6.9	-6.5	-2.3	4.8	< 0.01
43	4	-1.8	-17	-7.5	6.4	< 0.01
44	5	-2.0	-14	-5.5	4.5	< 0.01
45	5	-1.8	-16	-8.4	4.8	< 0.01
46	5	17	-8.6	-0.38	9.4	< 0.01
Network summary	61	44	-24	-2.9	2.4	< 0.01
Overall summary	82	44	-24	-3.2	2.0	< 0.01

[a]95% confidence coefficient about the average of more than two samples.
[b]Percent DCG = maximum value x 100/derived concentration guide (DCG). The DCG for ^{131}I is 1.5×10^{-2} Bq/L.
[c]See Figure 1.

Table 9. ^{131}I concentrations in air

June 1988

Location	No. of Samples	Concentration (10^{-8} Bq/L) Max	Min	Av	95% cc[a]	Percent DCG[b]
		ORNL PAM Stations[c]				
3	4	1.9	-1.9	-0.0036	1.5	< 0.01
4	3	0	-1.9	-1.3	1.3	< 0.01
7	4	3.5	-14	3.4	7.4	< 0.01
9	4	7.7	-5.7	2.0	5.7	< 0.01
20	3	14	-3.9	3.2	11	< 0.01
21	4	12	-4.0	5.2	6.6	< 0.01
22	4	20	4.5	10	7.2	< 0.01
Network summary	26	20	-14	2.4	2.7	< 0.01
		Reservation PAM Stations[c]				
8	4	0	-6.0	-2.1	2.8	< 0.01
23	4	12	-3.5	6.8	7.0	< 0.01
31	4	5.7	-2.3	1.7	4.5	< 0.01
33	4	-1.8	-5.3	-3.7	1.4	< 0.01
34	4	7.3	-3.5	0.94	4.6	< 0.01
36	4	20	0	9.3	8.4	< 0.01
40	4	2.3	-3.7	-0.83	2.6	< 0.01
41	4	6.8	0	2.9	2.9	< 0.01
42	4	5.8	-5.9	1.6	5.2	< 0.01
43	4	4.4	2.0	3.5	1.0	< 0.01
44	4	9.0	-2.0	2.9	4.5	< 0.01
45	4	3.8	-6.9	-1.3	5.0	< 0.01
46	4	2.5	-4.0	-0.91	2.8	< 0.01
Network summary	52	20	-6.9	1.6	1.5	< 0.01
Overall summary	78	20	-14	1.9	1.3	< 0.01

[a]95% confidence coefficient about the average of more than two samples.
[b]Percent DCG = maximum value x 100/derived concentration guide (DCG). The DCG for ^{131}I is 1.5×10^{-2} Bq/L.
[c]See Figure 1.

Table 10. Tritium activity in air

April - June 1988

Location[a]	No. of Samples	Concentration (10^{-4} Bq/L) Max	Min	Av	95% cc[b]	Percent DCG[c]
3	3	3.7	3.1	3.5	0.36	0.010
8	3	3.4	2.0	2.5	0.90	0.0091
Overall summary	6	3.7	2.0	3.0	0.63	0.010

[a]See Figure 1.
[b]95% confidence coefficient about the average of more than two samples.
[c]Percent DCG = maximum x 100/derived concentration guide (DCG). The DCG for tritium is 3.7 Bq/L. This assumes that 50% of the tritium is absorbed through the skin.

Table 11. Long-lived radioactivity in composited air filters from individual stations

April - June 1988

	Concentration (10^{-10} Bq/L)					
	Location[a]					
Analysis	Station 34	Percent DCG[b]	Station 36	Percent DCG[b]	Station 40	Percent DCG[b]
^{60}Co	< 110	< 0.01	< 130	< 0.01	< 120	< 0.01
^{137}Cs	< 110	< 0.01	< 120	< 0.01	< 120	< 0.01
^{238}Pu	0.31	< 0.01	1.2	< 0.01	0.94	< 0.01
^{239}Pu	-1.8	< 0.01	-1.3	< 0.01	0.12	< 0.01
^{228}Th	180	1.2	190	1.3	140	0.93
^{230}Th	68	0.36	83	0.44	52	0.27
^{232}Th	8.8	0.24	13	0.35	9.4	0.25
Total Sr[c]	120	< 0.01	-13	< 0.01	120	< 0.01
^{234}U	130	0.39	130	0.39	210	0.64
^{235}U	2.8	< 0.01	2.1	< 0.01	3.9	0.011
^{238}U	15	0.041	18	0.049	30	0.081

[a]See Figures 1 and 2.
[b]Percent DCG = value x 100/derived concentration guide (DCG). The DCG for ^{60}Co is 3.0×10^{-3} Bq/L; ^{137}Cs is 1.5×10^{-2} Bq/L; ^{238}Pu is 1.5×10^{-6} Bq/L; ^{239}Pu is 1.5×10^{-6} Bq/L; ^{228}Th is 1.5×10^{-6} Bq/L; ^{230}Th is 1.9×10^{-6} Bq/L; ^{232}Th is 3.7×10^{-7} Bq/L; Total Sr is 3.3×10^{-4} Bq/L; ^{234}U is 3.3×10^{-6} Bq/L; ^{235}U is 3.7×10^{-6} Bq/L; and ^{238}U is 3.7×10^{-6} Bq/L.
[c]Total radioactive Sr = (^{89}Sr + ^{90}Sr).

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

April - June 1988

	Concentration (10^{-10} Bq/L)					
	Location[a]					
Analysis	Station 41	Percent DCG[b]	Station 45	Percent DCG[b]	Station 46	Percent DCG[b]
^{60}Co	< 140	< 0.01	< 98	< 0.01	< 77	< 0.01
^{137}Cs	< 140	< 0.01	< 81	< 0.01	< 77	< 0.01
^{238}Pu	3.2	0.021	4.9	0.033	1.4	< 0.01
^{239}Pu	-0.23	< 0.01	-14	< 0.01	0.49	< 0.01
^{228}Th	320	2.1	230	1.5	180	1.2
^{230}Th	120	0.63	140	0.74	74	0.39
^{232}Th	27	0.73	14	0.38	4.9	0.13
Total Sr[c]	110	< 0.01	240	< 0.01	-38	< 0.01
^{234}U	320	0.97	370	1.1	190	0.58
^{235}U	5.2	0.014	15	0.041	8.6	0.023
^{238}U	43	0.12	59	0.16	18	0.049

[a]See Figures 1 and 2.
[b]Percent DCG = value x 100/derived concentration guide (DCG). The DCG for ^{60}Co is 3.0×10^{-3} Bq/L; ^{137}Cs is 1.5×10^{-2} Bq/L; ^{238}Pu is 1.5×10^{-6} Bq/L; ^{239}Pu is 1.5×10^{-6} Bq/L; ^{228}Th is 1.5×10^{-6} Bq/L; ^{230}Th is 1.9×10^{-6} Bq/L; ^{232}Th is 3.7×10^{-7} Bq/L; Total Sr is 3.3×10^{-4} Bq/L; ^{234}U is 3.3×10^{-6} Bq/L; ^{235}U is 3.7×10^{-6} Bq/L; and ^{238}U is 3.7×10^{-6} Bq/L.
[c]Total radioactive Sr = (^{89}Sr + ^{90}Sr).

Table 13. Long-lived radioactivity in composited air filters from air monitoring networks

April - June 1988

	Concentration (10^{-10} Bq/L)					
	Location[a]					
Analysis	ORNL PAMs	Percent DCG[b]	Reservation PAMs	Percent DCG[b]	RAMs	Percent DCG[b]
^{60}Co	< 26	< 0.01	< 37	< 0.01	< 15	< 0.01
^{137}Cs	53	< 0.01	< 37	< 0.01	25	< 0.01
^{238}Pu	0.58	< 0.01	0.074	< 0.01	0.10	< 0.01
^{239}Pu	0.42	< 0.01	-0.056	< 0.01	-0.099	< 0.01
^{228}Th	42	0.28	33	0.22	27	0.18
^{230}Th	20	0.11	17	0.089	11	0.058
^{232}Th	8.7	0.24	9.7	0.26	10	0.27
Total Sr[c]	42	< 0.01	35	< 0.01	25	< 0.01
^{234}U	42	0.13	74	0.22	15	0.045
^{235}U	2.4	< 0.01	4.1	0.011	0.61	< 0.01
^{238}U	11	0.030	18	0.049	7.6	0.021

[a]See Figures 1 and 2.
[b]Percent DCG = value x 100/derived concentration guide (DCG). The DCG for ^{60}Co is 3.0×10^{-3} Bq/L; ^{137}Cs is 1.5×10^{-2} Bq/L; ^{238}Pu is 1.5×10^{-6} Bq/L; ^{239}Pu is 1.5×10^{-6} Bq/L; ^{228}Th is 1.5×10^{-6} Bq/L; ^{230}Th is 1.9×10^{-6} Bq/L; ^{232}Th is 3.7×10^{-7} Bq/L; Total Sr ix 3.3×10^{-4} Bq/L; ^{234}U is 3.3×10^{-6} Bq/L; ^{235}U is 3.7×10^{-6} Bq/L; and ^{238}U is 3.7×10^{-6} Bq/L.
[c]Total radioactive Sr = (^{89}Sr + ^{90}Sr).

Increases in thorium and uranium isotopes were reported in several of the composited air filters from individual stations during the second quarter. Construction activities, in particular dirt movement, near these sites combined with an unusually dry summer appear to be responsible for most of the increases. There was also an increase in strontium at the sites near the Y-12 plant, where the construction activities mainly involve the replacement of New Hope Pond. Elevated levels of these isotopes at individual stations may be expected to continue into the third quarter of 1988 as construction activities combined with dry weather continue to cause elevated concentrations of dust in the air around particular monitoring sites.

There were also various other anomalous isotope concentrations which were closer to or within the range of spatial and temporal variability that normally exists. However, all values are recorded for continued observation and, when necessary, for further investigation.

All concentrations of airborne isotopes were less than three percent of their respective derived concentration guides given in DOE Draft Order 5400.XX. A derived concentration guide (DCG) for airborne radionuclides is defined as the concentration which, under continuous exposure by submersion or inhalation of air, a "reference man" would receive the most restrictive of 1 mSv; or a dose equivalent of 50 mSv to any tissue including skin and lens of the eye (DOE Draft Order 5400.XX) (one milliSievert, mSv, equals 100 mrem).

EXTERNAL GAMMA RADIATION

External gamma radiation measurements are made to determine if routine radioactive effluents from ORNL are increasing external gamma radiation levels significantly above normal background.

Average gamma radiation measurements are recorded at 10-minute intervals at ORNL and perimeter air monitoring stations (PAMs), except for stations 9, 20-23, and 46 (Figure 1). From these data, hourly averages are computed. Table 14 summarizes the valid hourly measurements for the second quarter of 1988. Typical values for cities in the United States are usually between 50 and 200 nGy/h according to the recent issues of EPA Environmental Radiation Data. The most recent value for Knoxville, published in these EPA quarterly reports (EPA 1987), was 177 nGy/h for the second quarter of 1987. All of the values given in Table 14 are close to the range of background values as given above, except for PAM 4 which is located very close to the Process Waste Treatment Plant and treatment ponds. Values for station 4 are more than ten times that of the typical background value, which is to be expected considering the location of that particular monitor.

Table 14. External gamma radiation measurements at ORNL and reservation perimeter air monitoring stations

April - June 1988

Location	No. of samples[a]	Concentration (nGy/h) Max	Min	Av
		ORNL PAM Stations[b]		
3	1693	99	61	67
4	2162	3454	1521	2133
7	1768	152	54	80
20	2163	117	81	86
Network summary	7786	3454	54	649
		Reservation PAM Stations[b]		
8	2174	3470	60	81
31	2174	120	75	79
33	2121	109	73	80
34	1942	151	80	91
36	1962	661	69	75
40	991	124	72	78
41	2063	74	58	62
42	2157	111	65	71
43	2177	102	60	68
44	2012	97	60	70
45	1725	103	63	69
Network summary	21498	3470	58	74

[a]Real-time readings were collected at all stations at 10-minute intervals. The number of samples indicate the total number of valid hourly averages during the quarter.
[b]See Figure 1.

WATER

The ORNL site is drained by two main streams, White Oak Creek (WOC) and Melton Branch. With the exception of two small discharges from the 7600 area which discharge to Melton Hill Lake, all ORNL effluents discharge to these two streams or their tributaries. White Oak Creek flows through Bethel Valley where Fifth Creek, First Creek, and the Northwest Tributary enter it. White Oak Creek continues through a gap in Chestnut Ridge into Melton Valley where it is joined by Melton Branch, which drains Melton Valley. White Oak Creek empties into White Oak Lake, which is controlled by White Oak Dam (WOD), and is the last monitoring/sampling point before effluents leave the ORNL site. 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. Process effluents discharged to these streams are handled in a number of ways which include: treatment (PWTP, Coal Yard Runoff), holding basins (190 ponds, HFIR/TRU ponds), and direct discharge to the stream. Sanitary effluent is discharged to White Oak Creek after treatment at the 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 3.

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.

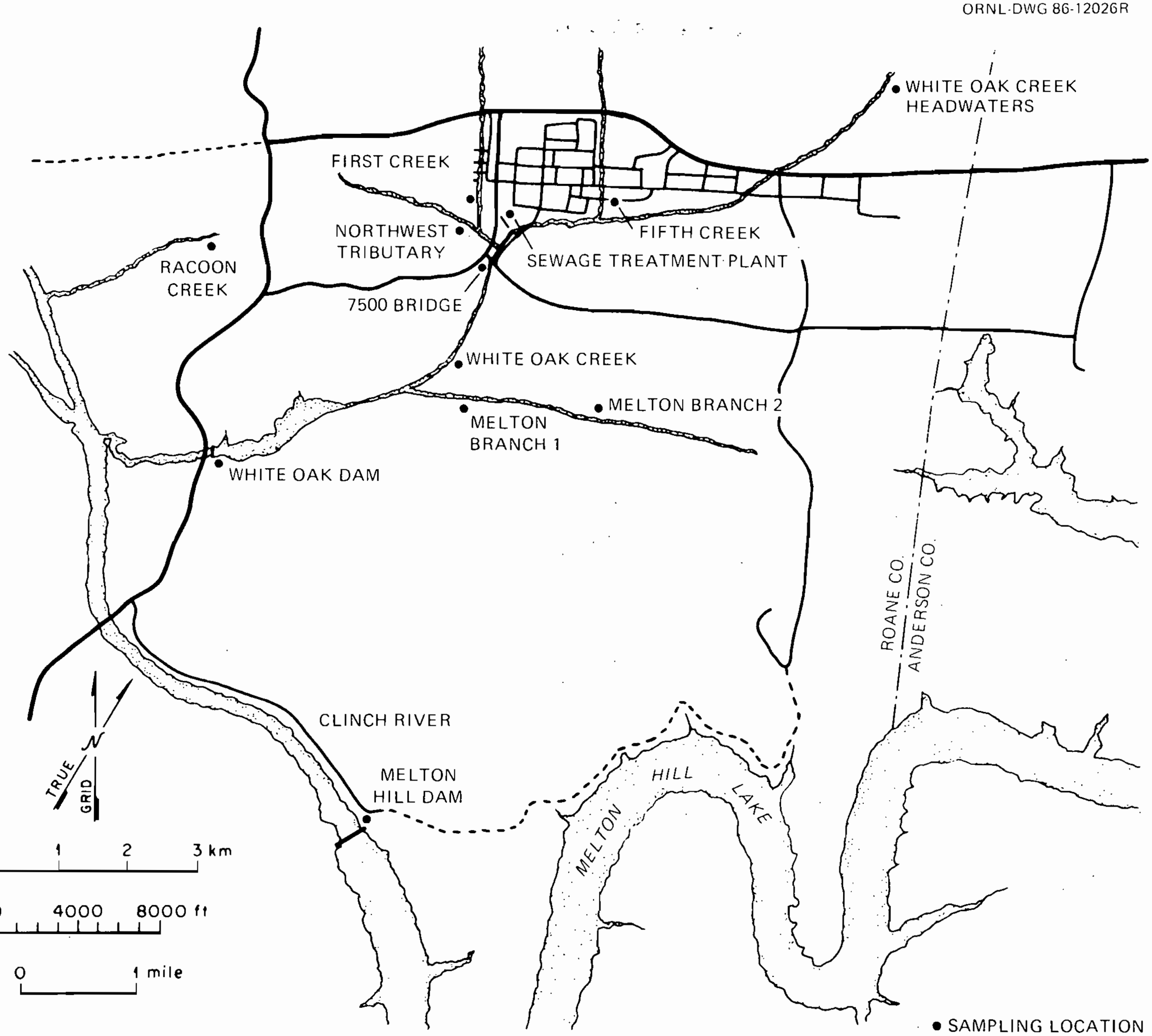

Fig. 3 Location map of ORNL streams and sampling stations

<u>Surface Water</u>

White Oak Creek (WOC) 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, Melton Branch (MB), at WOC kilometer 2.49. White Oak Dam (WOD), 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. Because facilities located near these creeks may discharge material to the creeks, sampling and analysis of the processes and their discharges are included in this section. ORNL's nonradiological sampling of these areas are those specified in the NPDES permit (see following section). This section is limited to a discussion of the radiological sampling that is performed by ORNL. 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 process 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 (HFIR), and discharges from the 7900 waste pond system.

To determine discharges of radionuclides from ORNL processes, flow and concentration data from ORNL streams were recorded. Water samples were 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, High Flux Isotope Reactor (HFIR), White Oak Creek Headwaters, Melton Branch 1 (MB1), Melton Branch 2 (MB2), Melton Hill Dam, Northwest Tributary (NWT), Raccoon Creek, STP, TRU Ponds, WOC, and WOD (Figures 3 and 4). Real-time monitoring was performed at MB, WOC, and WOD. The parameters monitored include pH, dissolved oxygen, turbidity, conductivity, temperature, flow, beta and gamma activity (in cpm), and a gamma spectrum at WOD. The samples collected and analyzed daily at 7500 Bridge were used as an early warning of discharges of radioactivity from ORNL processes. Radiological monitoring at stations in the 1500 area, 190 Ponds, 3518, and 3544 was initiated in February 1987 to comply with the requirements of the National Pollutant Discharge Elimination System (NPDES) Radiological Monitoring Plan.

Water samples are picked up weekly at Kingston and ORGDP (Gallaher) water treatment plants and are analyzed quarterly for radionuclides (Figure 5). For comparison, samples are collected daily from the ORNL potable water system (tap water) in Building 4500S and analyzed quarterly for radionuclides. In addition, flow proportional samples are collected weekly from Melton Hill Dam and analyzed quarterly for radionuclides (Figure 5). This sampling location, on the Clinch River, is above ORNL's discharge point to the Clinch River and serves as a local background or reference station for ORNL.

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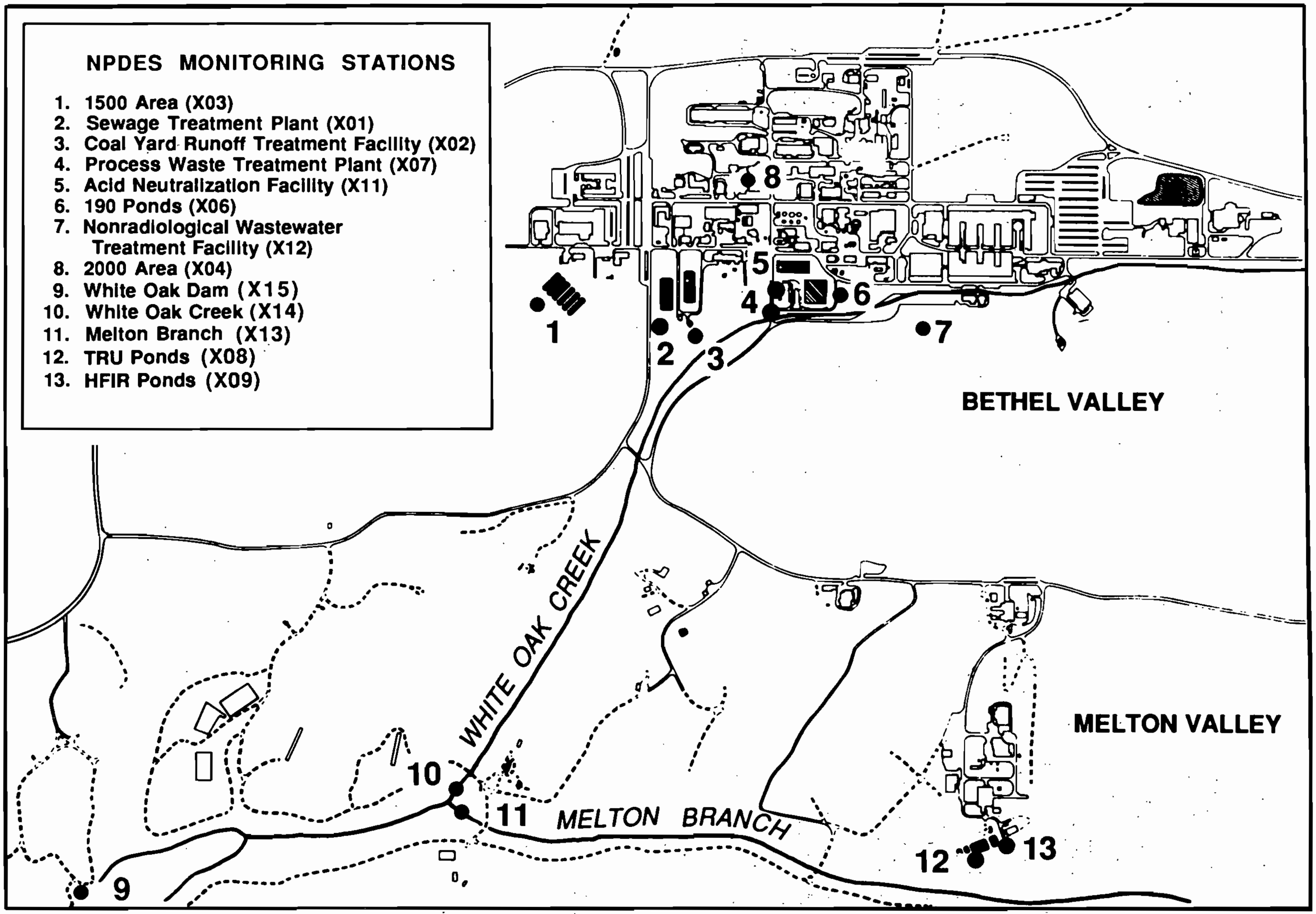

Fig. 4 Location map of NPDES monitoring points

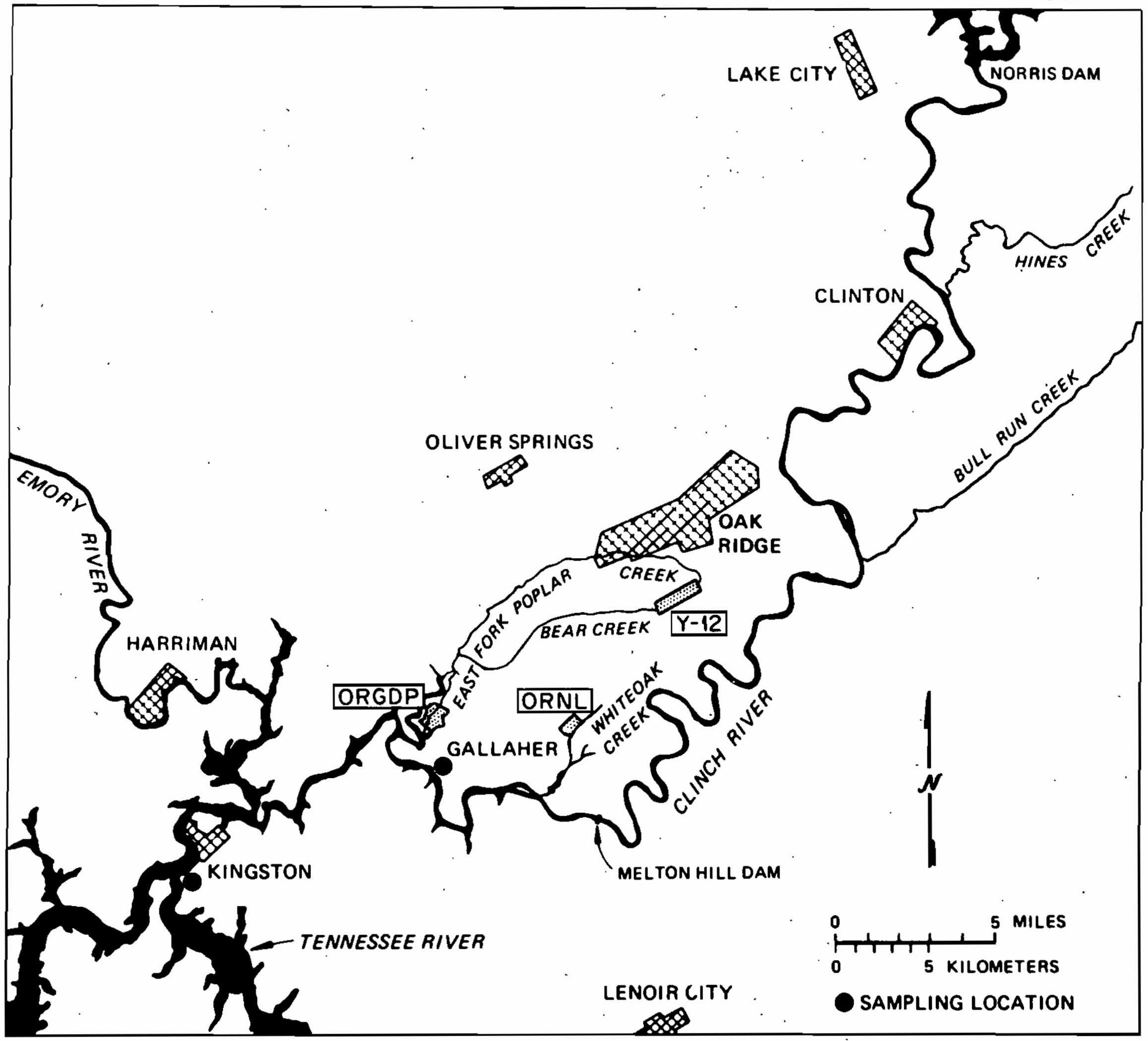

Fig. 5 Location map of Gallaher and Kingston sampling points

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 16-18. 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 average values have not been presented for stations with less than three samples.

No ^{60}Co or ^{137}Cs was detected at any of the stations downstream from ORNL (Gallaher and Kingston) or in the ORNL tap water samples (Table 16). Concentrations of other radionuclides at the downstream locations were similar to the first quarter of 1988.

The highest total radioactive Sr concentrations observed during this quarter were in First Creek with values ranging from 18 to 26 Bq/L (Table 17). Total radioactive Sr concentrations in Melton Branch 1 ranged from 12 to 15 Bq/L. These values range from 32% to 70% of the derived concentration guideline for strontium (37 Bq per liter of water). At the Melton Hill Dam background station, total radioactive Sr ranged from 0.037 to 0.11 Bq/L. Most of the total radioactive strontium appears to be coming from the main ORNL plant area (4500 complexes), the 2000 area, and a smaller portion from the 3000 area. Unlike the ^{60}Co and ^{137}Cs discharges, which are primarily process related, the total radioactive strontium releases are more diffuse and are probably the result of surface runoff rather than discharges from process facilities.

Concentrations of tritium are highest (68,000 to 100,000 Bq/L) at the Melton Branch 1 station, which is believed to be due to releases from SWSA 5. Characterization of SWSA 5, particularly the ^{3}H releases, is one of the highest priorities of the Remedial Investigation Feasibility Study (RI/FS) subcontract.

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 19. The average ratios presented in the table were calculated weekly and averaged for the month. The effect of a prolonged shortage of precipitation is evident in the flow of the Clinch River. Total flow for the quarter was appreciably less than for the second quarter of 1987.

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 flows are determined by averaging the total flows for the week and multiplying by the number of days in the week.

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], ^{3}H	Weekly	Flow Proportional	Monthly
First Creek, Fifth Creek, Raccoon Creek	Gamma scan, Total Sr[a]	Weekly	Grab	Monthly
Gallaher, Kingston	^{3}H, ^{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], ^{3}H,	Weekly	Flow Proportional	Quarterly
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

Table 15. (continued)

Station	Parameter	Collection frequency	Type	Analysis frequency
WOC Headwaters	^{241}Am, ^{244}Cm, ^{60}Co, ^{137}Cs, gross alpha, Total Sr[a], ^{3}H, Pu, Th, U	Weekly	Grab	Monthly
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 summary of radionuclide concentrations in surface streams and tap water

April - June

Radionuclide	Concentration (Bq/L)
Gallaher[a]	
^{60}Co	< 0.030
^{137}Cs	< 0.040
Gross alpha	0.00030
Gross beta	0.17
Total Pu[b]	< 0.00011
Total Sr[c]	0.17
^{3}H	66
^{234}U	0.0044
^{235}U	0.00014
^{236}U	< 0.0000055
^{238}U	0.0029
Kingston[a]	
^{60}Co	< 0.010
^{137}Cs	< 0.0090
Gross alpha	0.011
Gross beta	0.080
Total Pu[b]	< 0.00011
Total Sr[c]	0.024
^{3}H	8.9
^{234}U	0.0072
^{235}U	0.00024
^{236}U	0.00012
^{238}U	0.0044
Melton Hill Dam[a]	
^{60}Co	< 0.020
^{137}Cs	< 0.020
Gross alpha	0.060
Gross beta	0.16
Total Pu[b]	< 0.00011
Total Sr[c]	0.013
^{234}U	0.0059
^{235}U	0.00016
^{236}U	< 0.0000064
^{238}U	0.0033

Table 16. (continued)

April - June

Radionuclide	Concentration (Bq/L)
^{60}Co	< 0.010
^{137}Cs	< 0.010
Gross alpha	0.017
Gross beta	0.097
Total Pu[b]	< 0.00011
Total Sr[c]	0.0010
^{234}U	0.0047
^{235}U	0.00014
^{236}U	< 0.0000055
^{238}U	0.0029

[a]See Figure 5.
[b]Total Pu (^{239}Pu + ^{240}Pu).
[c]Total radioactive Sr (^{89}Sr + ^{90}Sr).

Table 17. Radionuclide concentrations in water around ORNL

April - June

Radionuclide	No. of Samples	Concentration (Bq/L) Max	Min	Av	95% cc
		1500 Area[b]			
Gross alpha	3	0.83	0.0	0.28	0.55
Gross beta	3	0.41	0.0	0.18	0.24
		190 Ponds[b]			
^{60}Co	3	< 0.40	< 0.10	< 0.23	0.18
^{137}Cs	3	0.92	0.40	0.64	0.30
Gross alpha	3	1.5	0.62	1.0	0.51
Gross beta	3	1.7	1.3	1.5	0.24
		First Creek[c]			
^{60}Co	3	< 0.30	< 0.20	< 0.27	0.067
^{137}Cs	3	< 0.20	< 0.10	< 0.17	0.067
Total Sr[d]	3	26	12	18	8.5
		2000 Area[b]			
^{60}Co	3	< 0.40	< 0.30	< 0.33	0.067
^{137}Cs	3	< 0.30	< 0.20	< 0.27	0.067
Gross beta	3	0.84	0.039	0.34	0.50
Total Sr[d]	3	0.25	0.060	0.14	0.12
		Acid Neutralization Facility[b]			
Gross alpha	3	0.40	0.0	0.13	0.27
Gross beta	3	2.2	1.2	1.7	0.58
		Process Waste Treatment Plant[b]			
^{60}Co	3	4.2	1.8	2.8	1.4
^{137}Cs	3	110	63	92	30
Gross alpha	3	4.2	0.56	2.2	2.1
Gross beta	3	120	72	90	30
Total Sr[d]	3	0.42	0.11	0.26	0.18

Table 17. (continued)

April - June

Radionuclide	No. of Samples	Concentration (Bq/L) Max	Min	Av	95% cc
		Fifth Creek[c]			
^{60}Co	3	< 0.30	< 0.20	< 0.27	0.067
^{137}Cs	3	< 0.30	< 0.20	< 0.27	0.067
Total Sr[d]	3	5.9	1.3	2.9	3.0
		7500 Bridge[c]			
^{60}Co	3	< 0.40	< 0.20	< 0.27	0.13
^{137}Cs	3	2.3	1.8	2.0	0.29
Total Sr[d]	3	2.2	2.2	2.2	0.0
^{3}H	3	100	42	64	36
		HFIR[b]			
^{60}Co	2	230	180	210	50
^{137}Cs	2	< 1.0	< 1.0	< 1.0	0.0
^{155}Eu	1	4.3	4.3	4.3	N/A
Gross alpha	2	0.42	0.24	0.33	0.18
Gross beta	2	200	130	170	70
^{54}Mn	1	1.4	1.4	1.4	N/A
		White Oak Creek Headwaters[c]			
^{241}Am	3	0.0070	-0.00040	0.0029	0.0043
^{244}Cm	3	0.014	-0.0010	0.0041	0.0099
^{60}Co	3	< 0.30	< 0.10	< 0.20	0.12
^{137}Cs	3	< 0.30	< 0.10	< 0.20	0.12
Gross alpha	3	0.31	0.0	0.15	0.18
^{238}Pu	3	0.0032	-0.00030	0.0012	0.0021
^{239}Pu	3	0.0021	-0.0030	-0.00040	0.0029
Total Sr[d]	3	0.36	-0.010	0.13	0.23
^{3}H	3	36	-3.0	14	23

Table 17. (continued)

April - June

Radionuclide	No. of Samples	Concentration (Bq/L) Max	Min	Av	95% cc
		Melton Branch 1[c]			
^{60}Co	3	6.7	0.75	2.8	4.0
^{137}Cs	3	< 0.30	< 0.20	< 0.23	0.067
Total Sr[d]	3	15	9.7	12	3.1
^{3}H	3	100000	68000	86000	19000
		Melton Branch 2[c]			
^{60}Co	3	1.3	< 0.10	< 0.66	0.70
^{137}Cs	3	< 0.30	< 0.20	< 0.23	0.067
Total Sr[d]	3	0.28	-0.030	0.12	0.18
^{3}H	3	1500	300	780	730
		Melton Hill Dam[c]			
^{241}Am	3	0.0052	0.00017	0.0025	0.0029
^{244}Cm	3	0.0033	-0.0023	0.00047	0.0032
^{60}Co	3	< 0.40	< 0.30	< 0.33	0.067
^{137}Cs	3	< 0.30	< 0.20	< 0.23	0.067
Gross alpha	3	0.0	0.0	0.0	0.0
^{238}Pu	3	0.00030	-0.026	-0.0088	0.017
^{239}Pu	3	0.0034	-0.0027	-0.00057	0.0040
Total Sr[d]	3	0.11	-0.040	0.037	0.087
^{3}H	3	10	-9.0	1.1	11
		Northwest Tributary[c]			
^{60}Co	3	< 0.30	< 0.10	< 0.20	0.12
^{137}Cs	3	< 0.20	< 0.10	< 0.17	0.067
Total Sr[d]	3	2.2	0.026	1.0	1.3

Table 17. (continued)

April - June

Radionuclide	No. of Samples	Concentration (Bq/L) Max	Min	Av	95% cc
		Raccoon Creek[c]			
^{60}Co	3	< 0.30	< 0.10	< 0.20	0.12
^{137}Cs	3	< 0.20	< 0.10	< 0.17	0.067
Total Sr[d]	3	6.1	1.1	3.7	2.9
		Sewage Treatment Plant[c]			
^{60}Co	3	< 0.30	< 0.30	< 0.30	0.0
^{137}Cs	3	< 0.30	< 0.20	< 0.23	0.067
Gross beta	3	8.5	4.5	6.2	2.4
Total Sr[d]	3	4.0	1.7	2.6	1.4
		TRU Ponds[b]			
Gross beta	3	3.1	0.21	1.5	1.7
		White Oak Creek[c]			
^{60}Co	3	< 0.30	< 0.10	< 0.23	0.13
^{137}Cs	3	2.4	1.5	1.9	0.55
Total Sr[d]	3	4.7	2.5	3.7	1.3
^{3}H	3	1600	75	680	930
		White Oak Dam[c]			
^{241}Am	13	0.13	0.0034	0.018	0.019
^{244}Cm	13	0.15	-0.0010	0.022	0.022
^{60}Co	13	0.54	< 0.20	< 0.35	0.063
^{137}Cs	13	3.2	0.50	1.3	0.46
Gross beta	13	41	4.1	12	5.0
^{238}Pu	13	0.0076	-0.077	-0.0041	0.012
^{239}Pu	13	0.0087	-0.0053	0.0015	0.0022

Table 17. (continued)

April - June

Radionuclide	No. of Samples	Concentration (Bq/L) Max	Min	Av	95% cc
Total Sr[d]	13	5.5	3.0	4.3	0.45
^{3}H	13	15000	2100	8500	2700

[a]95% confidence coefficient about the average of more than two samples.
[b]See Figure 4.
[c]See Figure 3.
[d]Total radioactive Sr (^{89}Sr + ^{90}Sr).

Table 18. Radionuclide concentrations in water at 7500 Bridge[a]

April - June

Radionuclide	No. of Samples	Concentration (Bq/L) Max	Min	Av	95%cc[b]
		April			
^{60}Co	20	< 0.60	< 0.20	< 0.35	0.051
^{137}Cs	20	6.1	1.3	2.4	0.51
Total Sr[c]	20	3.0	1.4	2.2	0.20
		May			
^{60}Co	21	< 0.70	< 0.30	< 0.39	0.053
^{137}Cs	21	4.5	1.0	2.3	0.39
Total Sr[c]	21	7.5	1.7	2.5	0.53
		June			
^{60}Co	21	< 0.80	< 0.10	< 0.36	0.074
^{137}Cs	21	4.7	1.2	2.5	0.32
Total Sr[c]	21	2.7	1.1	1.9	0.18

[a]See Figure 3.
[b]95% confidence coefficient about the average of more than two samples.
[c]Total radioactive Sr (^{89}Sr + ^{90}Sr).

Table 19. Clinch River and White Oak Creek flow summaries

April - June

	Flow (10^9 L)		
Month	Clinch River[a]	White Oak Creek[a]	Average Ratio[b]
April	52	0.7	76
May	63	0.51	130
June	320	0.43	730

[a]See Figure 3.
[b]Flow ratios Clinch River: White Oak Creek are calculated daily and averaged for the month.

The discharges of radionuclides at WOD, MB1, and the STP are calculated by multiplying the concentration by the flow. 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 20-22). 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 20-22).

Each average flow-weighted concentration is compared to a corresponding derived concentration guide (DCG). A DCG, for water, is the concentration of a particular radionuclide for which a "reference man" under continuous exposure (ingestion) for one year would receive the most restrictive of (1) an effective dose equivalent of 1 mSv or (2) a dose equivalent of 50 mSv to any particular tissue (DOE draft order 5400.XX) (one milliSievert, mSv, equals 100 mrem). In almost all cases the actual values are a small percentage of the corresponding DCGs. However, the percentages for strontium and tritium at Melton Branch 1 are higher. Tritium concentrations at Melton Branch 1 are typically near the corresponding DCG, and were 120% and 140% of the DCG in April and May, respectively.

Cobalt-60 concentrations a Melton Branch 1 were somewhat elevated in May (Table 21), although still less than 5% of the DOE derived concentration guide (DCG) of 190 Bq/L of water. These increases followed a discharge from one of the HFIR ponds. Cobalt-60 levels at Melton Branch 1 returned to their previous levels in June (Table 22).

Table 20. Radionuclide concentrations and releases at ORNL

April 1988

Radionuclide	Flow (10^6 L)	Discharge (10^4 Mega Bq)	Concentration (Bq/L)	Derived Concentration Guide (DCG) (Bq/L)	Percent of DCG
			Melton Branch 1[a]		
^{60}Co	99	0.0074	0.75	190	0.41
^{137}Cs	99	< 0.0020	< 0.20	110	0.18
Total Sr[c]	99	0.12	12	37	32
^{3}H	99	890	90000	74000	120
			Sewage Treatment Plant[a]		
^{60}Co	21	< 0.00064	< 0.30	190	0.16
^{137}Cs	21	< 0.00064	< 0.30	110	0.27
Gross beta	21	0.018	8.5	N/A	N/A
Total Sr[c]	21	0.0085	4.0	37	11
			White Oak Creek[a]		
^{60}Co	590	< 0.0059	< 0.10	190	0.054
^{137}Cs	590	0.10	1.7	110	1.5
Total Sr[c]	590	0.28	4.7	37	13
^{3}H	590	95	1600	74000	2.2
			White Oak Dam[a,b]		
^{241}Am	700	0.00059	0.0085	1.1	0.77
^{244}Cm	700	0.0023	0.033	2.2	1.5
^{60}Co	700	< 0.026	< 0.37	190	0.20
^{137}Cs	700	0.064	0.92	110	0.83
Gross beta	700	0.91	13	N/A	N/A
^{238}Pu	700	-0.0011	-0.015	1.5	< 0.001
^{239}Pu	700	0.000069	0.00099	1.1	0.090
Total Sr[c]	700	0.36	5.1	37	14
^{3}H	700	960	14000	74000	19

[a]See Figure 3.
[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 21. Radionuclide concentrations and releases at ORNL

May 1988

Radionuclide	Flow (10^6 L)	Discharge (10^4 Mega Bq)	Concentration (Bq/L)	Derived Concentration Guide (DCG) (Bq/L)	Percent of DCG
			Melton Branch 1[a]		
^{60}Co	27	0.018	6.7	190	3.6
^{137}Cs	27	< 0.00082	< 0.30	110	0.27
Total Sr[c]	27	0.041	15	37	41
^{3}H	27	270	100000	74000	140
			Sewage Treatment Plant[a]		
^{60}Co	21	< 0.00062	< 0.30	190	0.16
^{137}Cs	21	< 0.00041	< 0.20	110	0.18
Gross beta	21	0.012	5.7	N/A	N/A
Total Sr[c]	21	0.0046	2.2	37	5.9
			White Oak Creek[a]		
^{60}Co	520	< 0.015	< 0.30	190	0.16
^{137}Cs	520	0.12	2.4	110	2.2
Total Sr[c]	520	0.20	3.9	37	11
^{3}H	520	19	370	74000	0.50
			White Oak Dam[a,b]		
^{241}Am	510	0.00045	0.0089	1.1	0.80
^{244}Cm	510	0.00071	0.014	2.2	0.62
^{60}Co	510	< 0.019	< 0.38	190	0.20
^{137}Cs	510	0.076	1.5	110	1.3
Gross beta	510	0.49	9.5	N/A	N/A
^{238}Pu	510	0.00010	0.0020	1.5	0.13
^{239}Pu	510	0.00010	0.0020	1.1	0.18
Total Sr[c]	510	0.22	4.2	37	11
^{3}H	510	380	7500	74000	10

[a]See Figure 3.
[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. Radionuclide concentrations and releases at ORNL

June 1988

Radionuclide	Flow (10^6 L)	Discharge (10^4 Mega Bq)	Concentration (Bq/L)	Derived Concentration Guide (DCG) (Bq/L)	Percent of DCG
		Melton Branch 1[a]			
^{60}Co	12	0.00099	0.80	190	0.43
^{137}Cs	12	< 0.00025	< 0.20	110	0.18
Total Sr[c]	12	0.012	9.7	37	26
^{3}H	12	84	68000	74000	92
		Sewage Treatment Plant[a]			
^{60}Co	23	< 0.00068	< 0.30	190	0.16
^{137}Cs	23	< 0.00045	< 0.20	110	0.18
Gross beta	23	0.010	4.5	N/A	N/A
Total Sr[c]	23	0.0039	1.7	37	4.6
		White Oak Creek[a]			
^{60}Co	390	< 0.012	< 0.30	190	0.16
^{137}Cs	390	0.059	1.5	110	1.4
Total Sr[c]	390	0.098	2.5	37	6.8
^{3}H	390	2.9	75	74000	0.10
		White Oak Dam[a,b]			
^{241}Am	430	0.0015	0.035	1.1	3.1
^{244}Cm	430	0.00021	0.0050	2.2	0.22
^{60}Co	430	< 0.013	< 0.30	190	0.16
^{137}Cs	430	0.044	1.0	110	0.92
Gross beta	430	0.39	9.0	N/A	N/A
^{238}Pu	430	0.000072	0.0017	1.5	0.11
^{239}Pu	430	0.000031	0.00071	1.1	0.064
Total Sr[c]	430	0.15	3.5	37	9.4
^{3}H	430	120	2800	74000	3.8

[a]See Figure 3.
[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).

National Pollutant Discharge Elimination System (NPDES) Requirements

ORNL's current NPDES permit requires that ten 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 thirteen sampling locations are shown in Figure 4. There are approximately 150 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 second quarter of 1988 are given for each sampling location in Tables 23 through 38. 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 are provided in Tables 39 through 41. A brief summary of the noncompliances follows.

April 1988

The Category II total suspended solids and oil and grease noncompliances that were recorded during the rainfall on April 6, 1988, were attributed to the fact that many Category II outfalls only flow during rain events. Because approximately 0.5 inches of precipitation had occurred during the two weeks prior to the sampling date, the samples would be expected to contain the first-flush of dust, oil, and other matter that has accumulated in the areas drained by the outfalls during that time period.

The effluent iron limit exceedences that were recorded at X02 were due to a minor equipment failure at the X02 NPDES monitoring station. The equipment was repaired on May 10, 1988. No actual discharge of noncompliant effluent is known to have occurred.

Effluent temperature readings were taken incorrectly at X02 on April 5 and April 12, 1988. The resulting data were determined to be invalid for compliance reporting purposes.

May 1988

The May 31, 1988, biological oxygen demand (BOD) exceedence at X01 was based on a monthly average calculation that is required by the NPDES permit. No BOD daily limit exceedence actually occurred in May.

Table 23. NPDES Discharge Point X01[a]

April – June 1988

Parameter	No. of Samples	Concentration (mg/L) Max	Min	Av	95% cc[b]
Ag	3	0.0059	< 0.0036	0.0045	0.0014
BOD[c]	39	< 5.0	< 5.0	< 5.0	0
Bromodichloromethane	3	< 0.0050	< 0.0020	< 0.0040	0.0020
Cl	39	0.50	0.010	0.28	0.049
Cyanide	3	0.0030	< 0.0020	0.0023	0.00067
Cu	3	0.020	0.012	0.015	0.0048
DO[d]	63	11	6.0	7.7	0.25
Downstream pH[e]	13	8.3	7.5	NA[f]	NA[f]
Fecal coliform[g,h]	38	> 600	< 1.0	17	32
Flow[i]	63	0.27	0.15	0.20	0.0074
Hg	3	0.00020	< 0.00020	0.00020	0
NH_4 (As N)	39	0.52	0.020	0.067	0.027
Oil and grease	39	3.0	< 2.0	2.1	0.11
pH[e]	13	7.9	6.2	NA[f]	NA[f]
Phenols	3	0.0010	< 0.0010	0.0010	0
Trichloroethylene	3	< 0.0050	< 0.0050	< 0.0050	0
TSS[j]	39	6.0	< 2.0	5.0	0.17
Zn	3	0.070	0.059	0.065	0.0066

[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 24. NPDES Discharge Point X02[a]

April - June 1988

Parameter	No. of Samples	Concentration (mg/L) Max	Min	Av	95% cc[b]
Ag	13	0.0039	0.00089	0.0034	0.00042
As	13	0.20	< 0.0060	0.048	0.026
Cd	13	0.038	0.00050	0.0043	0.0056
Cr	13	0.023	0.0036	0.0079	0.0027
Cu	13	0.31	< 0.0060	0.033	0.046
Downstream pH[c]	63	8.7	6.7	NA[d]	NA[d]
Fe	13	47	0.018	4.2	7.2
Flow[e]	63	0.034	0	0.0015	0.0013
Mn	13	0.033	0.0083	0.052	0.048
Ni	13	0.14	0.0026	0.017	0.021
Oil and grease	13	2.0	< 2.0	2.0	0
Pb	13	0.058	< 0.0050	0.031	0.0062
pH[c]	63	8.8	6.1	NA[d]	NA[d]
Se	13	0.050	0.0061	0.035	0.0054
SO_4	3	1300	900	1100	240
Temperature[f]	11	31	17	24	2.9
TSS[g]	13	180	< 5.0	21	26
Zn	13	0.69	< 0.0018	0.074	0.10

[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 25. NPDES Discharge Point X03[a]

April - June 1988

Parameter	No. of Samples	Concentration (mg/L) Max	Min	Av	95% cc[b]
As	6	< 0.036	< 0.036	< 0.036	0
Cd	6	0.0012	< 0.0012	0.0012	0
Cr	6	0.0084	< 0.0036	0.0060	0.0015
Cu	6	0.023	0.010	0.017	0.0042
Downstream pH[c]	13	8.7	7.8	NA[d]	NA[d]
Fe	6	0.34	0.073	0.16	0.082
Flow[e]	3	0.065	0.044	0.053	0.012
Ni	6	0.0048	< 0.0036	0.0039	0.00041
Oil and grease	6	10	< 2.0	4.2	2.7
P	6	1.1	0.20	0.56	0.26
Pb	6	< 0.030	< 0.030	< 0.030	0
pH[c]	13	8.1	7.4	NA[d]	NA[d]
Temperature[f]	6	27	19	23	2.5
TOC[g]	6	8.9	2.3	4.7	2.1
TSS[h]	6	8.0	< 5.0	5.7	0.99
Zn	6	0.12	0.072	0.096	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 26. NPDES Discharge Point X04[a]

April - June 1988

Parameter	No. of Samples	Concentration (mg/L) Max	Min	Av	95% cc[b]
Ag	6	< 0.0036	< 0.0036	< 0.0036	0
As	6	< 0.036	< 0.036	< 0.036	0
Cd	6	< 0.0012	< 0.0012	< 0.0012	0
Cr	6	0.0079	< 0.0036	0.0050	0.0014
Cu	6	0.012	0.0066	0.010	0.0018
Downstream pH[c]	13	8.4	6.3	NA[d]	NA[d]
Flow[e]	3	0.037	0.0088	0.024	0.017
Ni	6	< 0.0036	< 0.0036	< 0.0036	0
Oil and grease	6	2.0	< 2.0	2.0	0
P	6	0.84	0.19	0.39	0.20
Pb	6	0.076	< 0.030	0.038	0.015
pH[c]	13	8.3	6.3	NA[d]	NA[d]
Temperature[f]	6	26	16	20	3.2
TOC[g]	6	4.2	2.0	2.7	0.69
TSS[h]	6	< 5.0	< 5.0	< 5.0	0
Zn	6	0.13	0.072	0.10	0.016

[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 27. NPDES Discharge Point X06[a]

April - June 1988

Parameter	No. of Samples	Concentration (mg/L) Max	Min	Av	95% cc[b]
As	6	< 0.036	< 0.036	< 0.036	0
Cd	6	0.0022	< 0.0012	0.0016	0.00040
Cr	6	0.030	0.0058	0.013	0.0070
Cu	6	0.15	0.032	0.11	0.038
Downstream pH[c]	13	8.0	6.7	NA[d]	NA[d]
Flow[e]	3	0.15	0.15	0.15	0.0056
Ni	6	0.011	< 0.0036	0.0062	0.0024
Oil and grease	6	12	< 2.0	3.8	3.3
Pb	6	0.057	< 0.030	0.038	0.010
pH[c]	13	7.8	6.8	NA[d]	NA[d]
Se	6	< 0.036	< 0.036	< 0.036	0
SO_4	6	32	27	29	1.5
Temperature[f]	6	27	14	20	3.6
TOC[g]	6	6.3	3.0	4.2	0.96
TSS[h]	6	5.0	3.0	4.7	0.67
Zn	6	0.14	0.066	0.10	0.021

[a]3539/40 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 28. NPDES Discharge Point X07[a]

April – June 1988

Parameter	No. of Samples	Concentration (mg/L) Max	Min	Av	95% cc[b]
Ag	6	< 0.0036	< 0.0036	< 0.0036	0
As	6	< 0.036	< 0.036	< 0.036	0
Cd	6	< 0.0012	< 0.0012	< 0.0012	0
Cr	6	0.0074	< 0.0036	0.0050	0.0012
Cu	6	0.27	0.0085	0.096	0.084
Downstream pH[c]	13	8.5	6.2	NA[d]	NA[d]
Flow[e]	63	0.26	0	0.069	0.023
Ni	6	< 0.0036	< 0.0036	< 0.0036	0
NO_3	6	5.6	< 5.0	5.1	0.20
Oil and grease	6	6.0	< 2.0	2.7	1.3
Pb	6	< 0.030	< 0.030	< 0.030	0
pH[c]	13	8.1	6.3	NA[d]	NA[d]
SO_4	6	370	210	250	50
Temperature[f]	6	28	17	21	3.7
TOC[g]	6	5.2	< 0.30	2.8	1.3
TSS[h]	6	10	< 5.0	6.2	1.7
TTO[i]	5	15	0	3.1	6.0
Zn	6	0.049	< 0.0027	0.014	0.015

[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 29. NPDES Discharge Point X08[a]

April - June 1988

Parameter	No. of Samples	Concentration (mg/L) Max	Min	Av
As	1	< 0.036	< 0.036	< 0.036
Cd	1	< 0.0012	< 0.0012	< 0.0012
Cr	1	0.030	0.030	0.030
Cu	1	0.061	0.061	0.061
Downstream pH[b]	1	7.8	7.8	NA[c]
Flow[d]	1	0.0042	0.0042	0.0042
Ni	1	0.0069	0.0069	0.0069
NO_3	1	< 5.0	< 5.0	< 5.0
Oil and grease	1	7.0	7.0	7.0
Pb	1	< 0.030	< 0.030	< 0.030
pH[c]	1	8.4	8.4	NA[c]
SO_4	1	49	49	49
Temperature[e,f]	1	22	22	22
TOC[g]	1	5.7	5.7	5.7
TSS[h]	1	12	12	12
Zn	1	0.067	0.067	0.067

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

Table 30. NPDES Discharge Point X11[a]

April - June 1988

Parameter	No. of Samples	Concentration (mg/L) Max	Min	Av	95% cc[b]
As	6	< 0.036	< 0.036	< 0.036	0
Cd	6	0.0015	< 0.0012	0.0013	0.00010
Cr	6	0.013	< 0.0036	0.0082	0.0035
Cu	6	0.014	< 0.0060	0.011	0.0026
Downstream pH[c]	13	8.4	6.9	NA[d]	NA[d]
Flow[e]	3	0.035	0.026	0.030	0.0050
Ni	6	0.015	< 0.0036	0.0072	0.0039
NO_3	13	< 50	< 5.0	< 8.5	6.9
Oil and grease	6	3.0	< 2.0	2.2	0.33
P	6	4.1	1.9	2.8	0.75
Pb	6	< 0.030	< 0.030	< 0.030	0
pH[c]	13	7.7	6.5	NA[d]	NA[d]
SO_4	13	2000	380	1300	290
Temperature[f]	6	25	17	20	2.5
TOC[g]	13	10	3.4	5.3	1.1
TSS[h]	6	35	< 5.0	20	10
Zn	6	0.67	0.17	0.44	0.17

[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 31. NPDES Discharge Point X13[a]

April - June 1988

Parameter	No. of Samples	Concentration (mg/L) Max	Min	Av	95% cc[b]
Ag	3	0.0050	0.0050	0.0050	0
Al	3	1.3	0.25	0.64	0.66
As	3	0.036	0.036	0.036	0
BOD[c]	3	5.0	5.0	5.0	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	400	250	340	94
Cr	3	0.0086	0.0048	0.0072	0.0024
Cu	3	0.0065	< 0.0060	0.0063	0.00031
DO[e]	13	12	5.2	8.4	1.2
F	3	1.0	1.0	1.0	0
Fe	3	1.1	0.14	0.48	0.62
Flow[f]	63	3.1	0.090	0.51	0.15
Hg	3	< 0.00005	< 0.00005	< 0.00005	0
Mn	3	0.14	0.099	0.12	0.025
NH_4 (as N)	3	0.069	0.041	0.057	0.017
Ni	3	0.0081	< 0.0036	0.0052	0.0029
NO_3	3	< 5.0	< 5.0	< 5.0	0
Oil and grease	13	9.0	< 2.0	2.9	1.1
P	3	1.0	0.20	0.50	0.50
Pb	3	< 0.0040	< 0.0040	< 0.0040	0
PCB	3	< 0.00050	< 0.00050	< 0.00050	0
pH[g]	3	8.8	8.1	NA[h]	NA[h]
Phenols	3	0.0010	< 0.0010	0.0010	0
SO_4	3	31	25	28	3.5
TDS[i]	3	290	190	230	62
Temperature[j]	3	22	10	17	7.4
TOC[k]	3	2.7	2.0	2.3	0.41
Trichloroethylene	3	< 0.0050	< 0.0050	< 0.0050	0
TSS[l]	3	9.0	< 5.0	6.3	2.7
Turbidity[m]	3	30	0	13	18

Table 31. (continued)

April – June 1988

Parameter	No. of Samples	Concentration (mg/L) Max	Min	Av	95% cc[b]
Zn	3	0.022	0.0042	0.014	0.010

[a]Melton Branch, ORNL.
[b]95% confidence coefficient about the average.
[c]Biological oxygen demand.
[d]Expressed 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 32. NPDES Discharge Point X14[a]

April - June 1988

Parameter	No. of Samples	Concentration (mg/L)			
		Max	Min	Av	95% cc[b]
Ag	3	< 0.005	< 0.003	< 0.0043	0.0013
Al	3	0.39	0.24	0.33	0.092
As	3	< 0.036	< 0.036	< 0.036	0
BOD[c]	3	< 5.0	< 5.0	< 5.0	0
Cd	3	< 0.002	0.001	< 0.0017	0.00067
Chloroform	3	0.0070	< 0.0040	0.0053	0.0018
Cl	13	0.010	0.010	0.010	0
Conductivity[d]	3	480	300	360	120
Cr	3	0.0079	0.0038	0.0065	0.0027
Cu	3	0.010	< 0.0060	0.0077	0.0024
DO[e]	13	12	6.5	8.8	0.71
F	3	1.1	1.0	1.0	0.067
Fe	3	0.44	0.089	0.22	0.22
Flow[f]	63	7.6	2.5	4.4	0.25
Hg	3	0.00007	0.00005	0.000057	0.000013
Mn	3	0.030	0.025	0.028	0.0029
NH_4 (as N)	3	0.092	0.043	0.072	0.029
Ni	3	0.0047	< 0.0036	0.0040	0.00073
NO_3	3	< 5.0	< 5.0	< 5.0	0
Oil and grease	13	7.0	< 2.0	2.5	0.77
P	3	1.7	0.10	0.73	0.98
Pb	3	< 0.03	0.004	< 0.013	0.017
PCB	3	< 0.00050	< 0.00050	< 0.00050	0
pH[g]	3	9.0	8.1	NA[h]	NA[h]
Phenols	3	0.0010	< 0.0010	0.0010	0
SO_4	3	110	38	66	45
TDS[i]	3	320	200	240	78
Temperature[j]	3	22	16	20	3.8
TOC[k]	3	2.5	2.1	2.3	0.24
Trichloroethylene	3	0.0050	0.0050	0.0050	0
TSS[l]	3	8.0	< 5.0	6.0	2.0
Turbidity[m]	3	36	0	15	22

Table 32. (continued)

April - June 1988

Parameter	No. of Samples	Concentration (mg/L)			
		Max	Min	Av	95% cc[b]
Zn	3	0.035	0.024	0.029	0.0064

[a]White Oak Creek, ORNL.
[b]95% confidence coefficient about the average.
[c]Biological oxygen demand.
[d]Expressed 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 33. NPDES Discharge Point X15[a]

April - June 1988

Parameter	No. of Samples	Concentration (mg/L) Max	Min	Av	95% cc[b]
Ag	3	0.0050	0.0050	0.0050	0
Al	3	1.9	0.32	1.0	0.94
As	3	< 0.036	< 0.036	< 0.036	0
BOD[c]	3	< 5.0	< 5.0	< 5.0	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	380	300	340	47
Cr	3	0.020	0.012	0.016	0.0047
Cu	3	0.010	< 0.0060	0.0075	0.0025
DO[e]	13	14	4.0	9.5	1.7
F	3	1.0	1.0	1.0	0
Fe	3	1.9	0.29	0.92	1.0
Flow[f]	63	11	2.6	5.0	0.39
Hg	3	0.00006	< 0.00005	0.000053	0.0000067
Mn	3	0.14	0.066	0.096	0.045
NH_4 (as N)	3	0.10	0.029	0.070	0.042
Ni	3	0.0058	< 0.0036	0.0046	0.0013
NO_3	3	< 5.0	< 5.0	< 5.0	0
Oil and grease	13	9.0	< 2.0	3.1	1.1
P	3	1.1	0.20	0.53	0.57
Pb	3	0.0040	< 0.0040	0.0040	0
PCB	3	< 0.00050	< 0.00050	< 0.00050	0
pH[g]	3	9.2	8.0	NA[h]	NA[h]
SO_4	3	57	35	46	13
TDS[i]	3	230	140	180	55
Temperature[j]	3	27	16	21	6.8
TOC[k]	3	4.2	3.1	3.6	0.64
Trichloroethylene	3	< 0.0050	< 0.0050	< 0.0050	0
TSS[l]	3	45	17	27	18
Turbidity[m]	3	35	20	30	10

Table 33. (continued)

April - June 1988

Parameter	No. of Samples	Concentration (mg/L)			
		Max	Min	Av	95% cc[b]
Zn	3	0.038	0.016	0.025	0.013

[a]White Oak Dam, ORNL.
[b]95% confidence coefficient about the average.
[c]Biological oxygen demand.
[d]Expressed 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 miscellaneous source VC7002[a]

April - June 1988

Parameter	No. of Samples	Concentration (mg/L) Max	Min	Av	95% cc[b]
BOD[c]	3	< 5.0	< 5.0	< 5.0	0
Downstream pH[d]	3	8.0	7.0	NA[e]	NA[e]
Fecal coliform[f]	3	35	1.0	14	21
Oil and grease	3	2.0	< 2.0	2.0	0
pH[d]	3	7.7	6.7	NA[e]	NA[e]
Phenols	3	0.0060	< 0.0010	0.0027	0.0033
TSS[g]	3	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 35. NPDES cooling towers[a]

April - June 1988

Parameter	No. of Samples	Concentration (mg/L) Max	Min	Av	95% cc[b]
Cl	21	0	0	0	0
Cr	22	0.23	0.0049	0.030	0.021
Cu	22	1.1	0.0060	0.17	0.10
Flow[c]	27	0.25	0.00043	0.025	0.024
Temperature[d]	37	37	17	25	1.4
Zn	21	160	0.089	14	18

[a]Cooling towers, ORNL.
[b]95% confidence coefficient about the average.
[c]Measured in millions of gallons per day.
[d]Measured in degrees centigrade.

Table 36. NPDES miscellaneous outfalls

April - June 1988

Parameter	Concentration (mg/L)	
	Location	
	EF7002[a]	SP2579[b]
Flow[c]		0.000091
Oil and grease	8.0	
pH[d]	8.5	8.6
Temperature[e]		31

[a]Vehicle and Equipment Maintenance Facility, Building 7002.
[b]Central Steam Plant, Building 2519.
[c]Measured in millions of gallons per day.
[d]Expressed in standard units.
[e]Measured in degrees centigrade.

Table 37. NPDES discharge point: category II outfalls[a]

April – June 1988

Parameter	No. of Samples	Concentration (mg/L) Max	Min	Av	95% cc[b]
Flow[c]	40	0.26	0.00086	0.056	0.025
Oil and grease	40	4500	< 2.0	210	290
pH[d]	40	7.9	6.3	NA[e]	NA[e]
Temperature[f]	40	29	13	18	1.1
TSS	40	630	< 5.0	67	44

[a]ORNL.
[b]95% confidence coefficient about the average.
[c]Measured in millions of gallons per day.
[d]Expressed in standard units; average not applicable.
[e]NA = not applicable.
[f]Measured in degrees centigrade.

Table 38. NPDES discharge point: category III outfalls[a]

April - June 1988

Parameter	No. of Samples	Concentration (mg/L) Max	Min	Av	95% cc[b]
Flow[c]	25	0.22	0.000075	0.024	0.020
pH[d]	25	8.4	7.4	NA[e]	NA[e]

[a]ORNL.
[b]95% confidence coefficient about the average.
[c]Measured in millions of gallons per day.
[d]Standard units; average not applicable.
[e]NA = not applicable.

Table 39. NPDES noncompliances

April 1988

Station	Parameter	Concentration (mg/L) Daily Maximum	Permit Limit (mg/L)
Category II Outfall 202	Total suspended solids	599	50.0
Category II Outfall 204	Total suspended solids	137	50.0
Category II Outfall 216	Total suspended solids	165	50.0
Category II Outfall 217	Total suspended solids	65	50.0
Category II Outfall 224	Total suspended solids	67	50.0
Category II Outfall 230	Total suspended solids	106	50.0
Category II Outfall 233	Total suspended solids	51	50.0
Category II Outfall 242	Oil and grease	4497	15.0
Category II Outfall 245	Oil and grease	3638	15.0
Category II Outfall 267	Total suspended solids	60	50.0
Category II Outfall 268	Total suspended solids	632	50.0
Category II Outfall 283	Total suspended solids	256	50.0

Table 39. (continued)

April 1988

Station	Parameter	Concentration (mg/L) Daily Maximum	Permit Limit (mg/L)
Category II Outfall 291	Total suspended solids	130	50.0
Coal Yard Runoff Facility (X02)	Iron	2.2	1.0
	Iron	4.1	1.0
	Iron	1.8[a]	1.0
Coal Yard Runoff Facility (X02)	Temperature	No Data[b]	30.5[c]

[a]Daily average.
[b]Procedural noncompliance, 4/5/88 and 4/12/88.
[c]Degrees centigrade.

Table 40. NPDES noncompliances

May 1988

Station	Parameter	Concentration (mg/L) Daily Maximum	Permit Limit (mg/L)
Sewage Treatment Plant (X01)	Biological oxygen demand	9.4[a,b]	8.7[a,b]
Coal Yard Runoff Facility (X02)	Iron	47.0	1.0
Coal Yard Runoff Facility (X02)	Iron	11.8	1.0
Coal Yard Runoff Facility (X02)	Total suspended solids	178	50
Coal Yard Runoff Facility (X02)	Temperature	30.5[c]	33.1[c]
Cooling Systems (CS 2026)	Zinc	1.2	1.0
Cooling Systems (CS 2026)	Copper	1.1	1.0

[a]Loading (Kg/d).
[b]Monthly average.
[c]Degrees centigrade.

Table 41. NPDES noncompliances

June 1988

Station	Parameter	Concentration (mg/L) Daily Maximum	Permit Limit (mg/L)
Sewage Treatment Plant (X01)	Fecal coliform	> 600	400[a]
Sewage Treatment Plant (X01)	Fecal coliform	No Data[b]	400[a]
Coal Yard Runoff Facility	Temperature	31.2[c]	30.5[c]
Cooling Systems (CS 2000)	Zinc	155	1.0
Cooling Systems (CS 2001)	Zinc	1.9	1.0
Cooling Systems (CS 3025E)	Zinc	117	1.0
Cooling Systems (CS 3525W)	Zinc	3.4	1.0

[a]Colonies per 100 mL.
[b]Procedural noncompliance, 6/15/88.
[c]Degrees centigrade.

The effluent iron limit exceedences at X02 experienced in April continued until the equipment was repaired on May 10, 1988. No actual discharge of noncompliant effluent is known to have occurred.

The temperature exceedence at X02 on May 31, 1988, was attributed to natural conditions. Low rainfall, plus a series of hot, sunny days caused the temperature in the X02 basin to slightly exceed the NPDES discharge limit for that facility.

The zinc and copper noncompliances that were recorded at the CS 2026 cooling tower were attributed to maintenance scheduling problems that may have resulted in inadequate maintenance of the tower. Maintenance scheduling has now been computerized and cooling tower water quality is expected to show improvement as a result.

June 1988

The fecal coliform noncompliance that was measured at X01 on June 1 was attributed to a depletion of the normal bacterial population that is required for proper operation of the extended aeration sewage plant, possibly due to an accidental or inadvertent improper discharge of waste material to a sanitary drain during the Memorial Day holiday weekend.

The required three fecal coliform samples were collected at X01 during the week of June 13-17; however, the time interval between two of the samples was inadequate. The June 15 sample was therefore considered a procedural noncompliance.

The temperature exceedence at X02 on June 7 was attributed to natural conditions. Low rainfall, plus a series of hot, sunny days caused the temperature in the X02 basin to slightly exceed the NPDES discharge limit for that facility.

The zinc and temperature noncompliances at the indicated cooling systems (cooling towers) were attributed to inadequate cooling tower maintenance. An enhanced, computer scheduled inspection and maintenance program is being implemented for ORNL cooling towers. This program is expected to improve the environmental acceptability of the towers in the future.

METEOROLOGICAL PROCESSES

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 6. 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 a unit vector to represent the direction of each one-minute wind velocity, finding the vector average of those unit vectors, scaling that average to a unit vector, and multiplying the result by the mean (scalar) windspeed. 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 7-13 are obtained, are stored for at least one year and eventually archived.

Examination of quarterly wind roses reveal that the prevailing winds are 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.

ORNL-DWG 86-9142R4

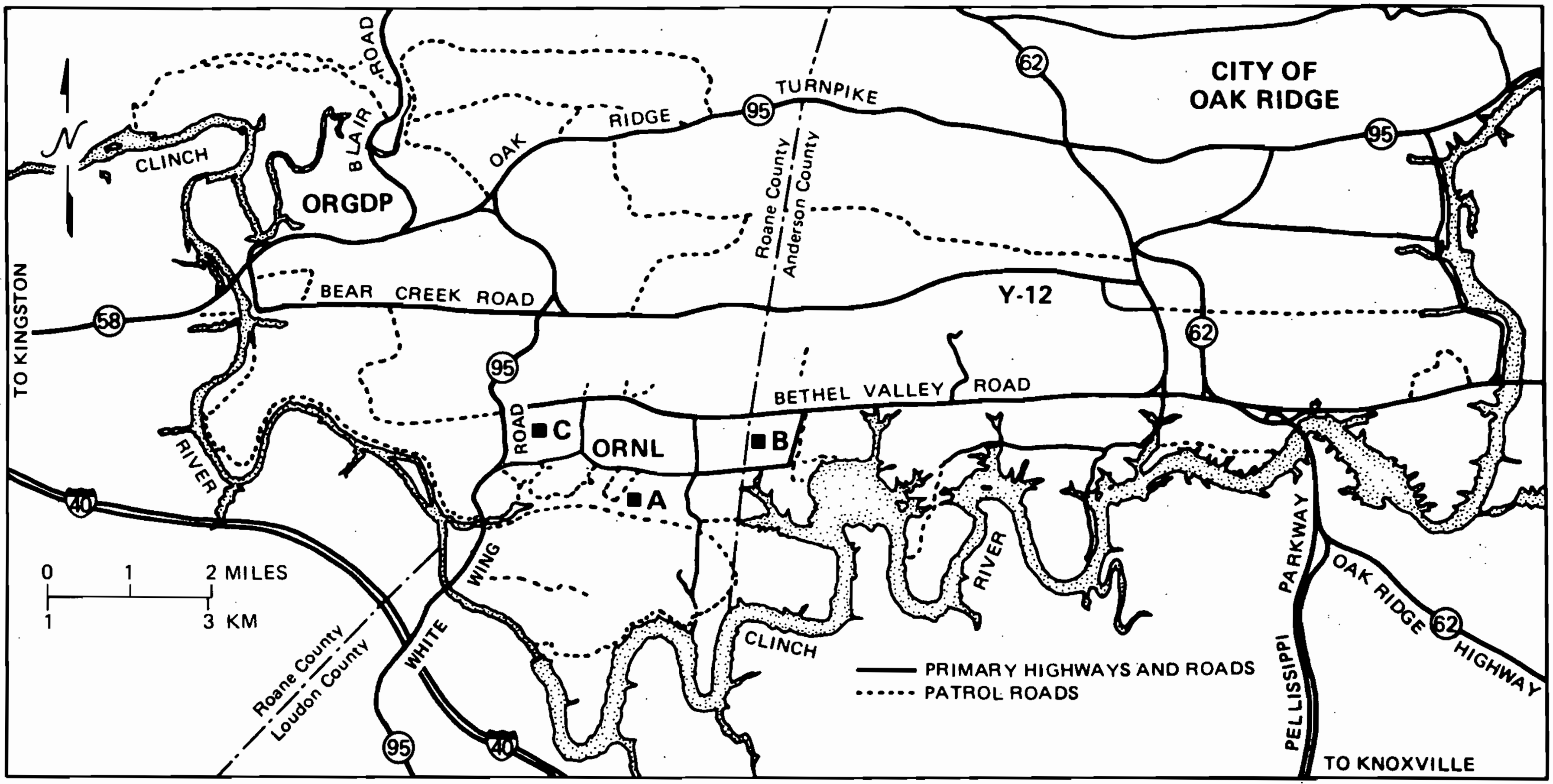

Fig. 6 Locations of meteorological towers at ORNL

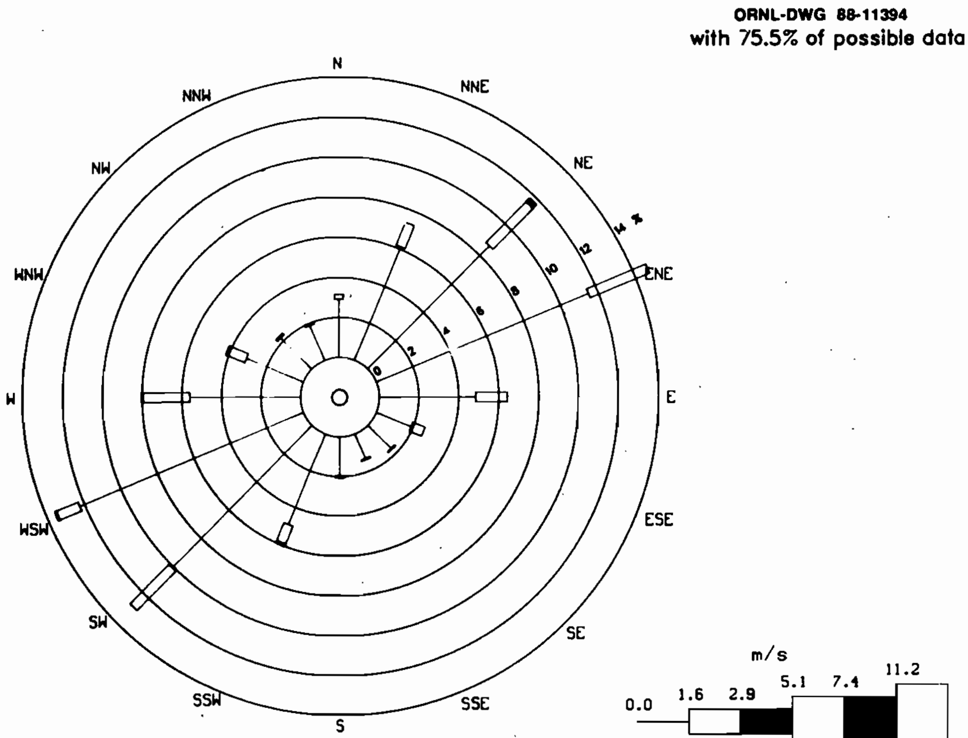

Fig. 7 Wind rose at 10-m level of meteorological tower A, April-June 1988

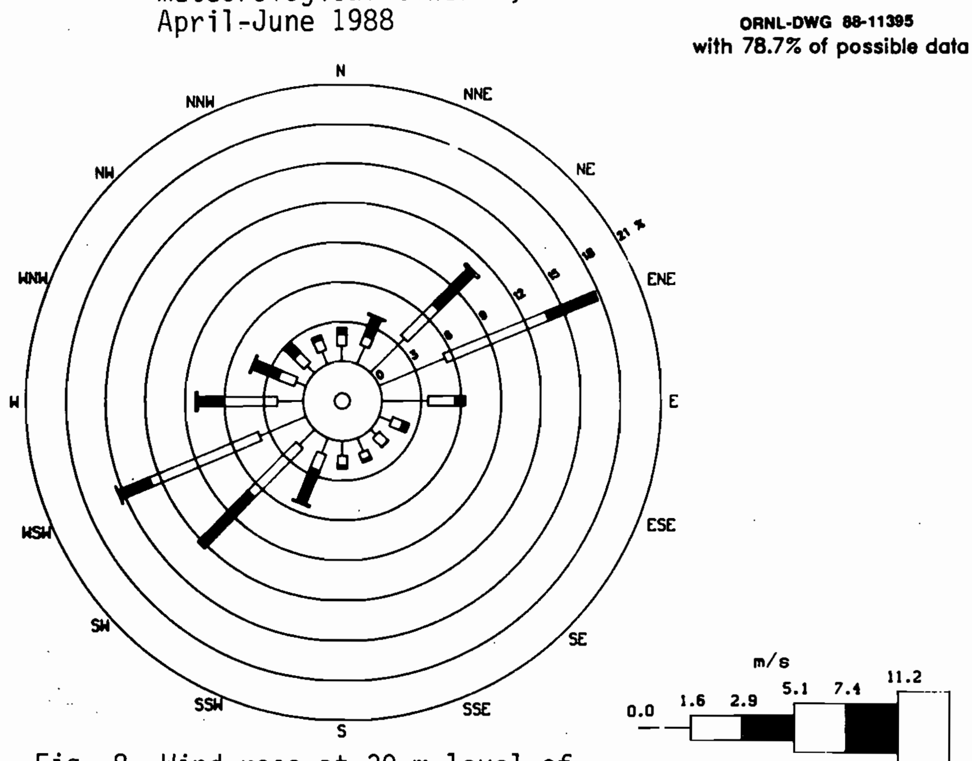

Fig. 8 Wind rose at 30-m level of meteorological tower A, April-June 1988

ORNL-DWG 88-11396
with 80.6% of possible data

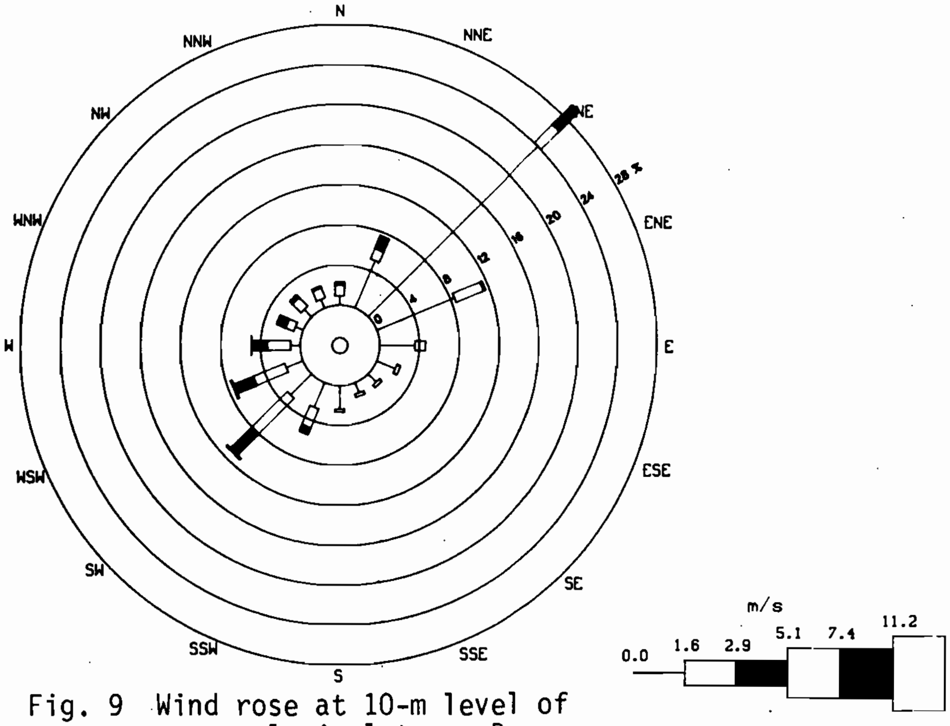

Fig. 9 Wind rose at 10-m level of meteorological tower B, April-June 1988

ORNL-DWG 88-11397
with 81.6% of possible data

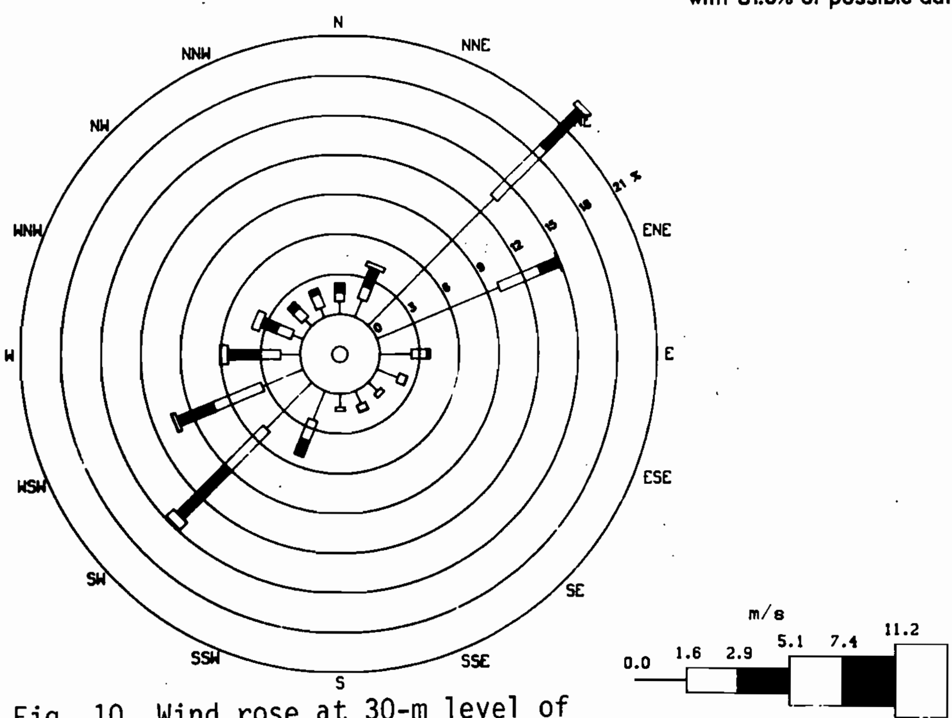

Fig. 10 Wind rose at 30-m level of meteorological tower B, April-June 1988

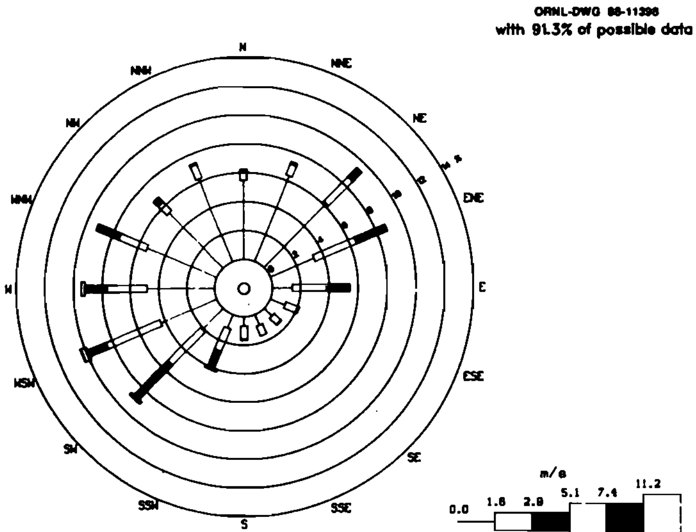

Fig. 11 Wind rose at 10-m level of meteorological tower C, April-June 1988

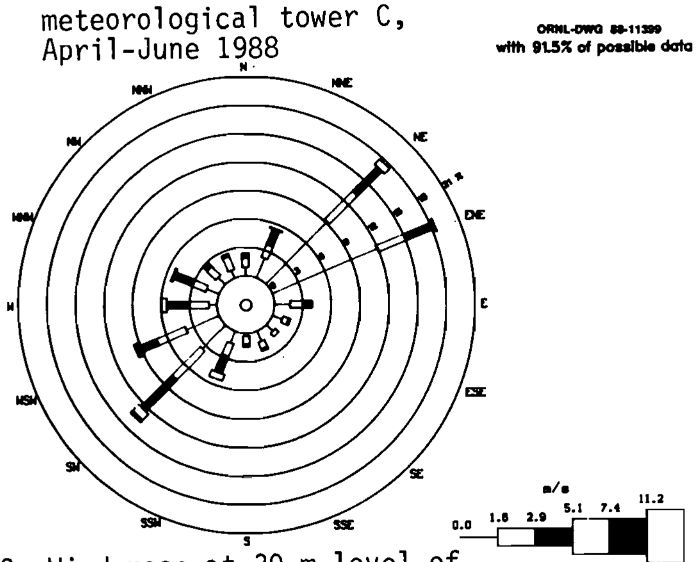

Fig. 12 Wind rose at 30-m level of meteorological tower C, April-June 1988

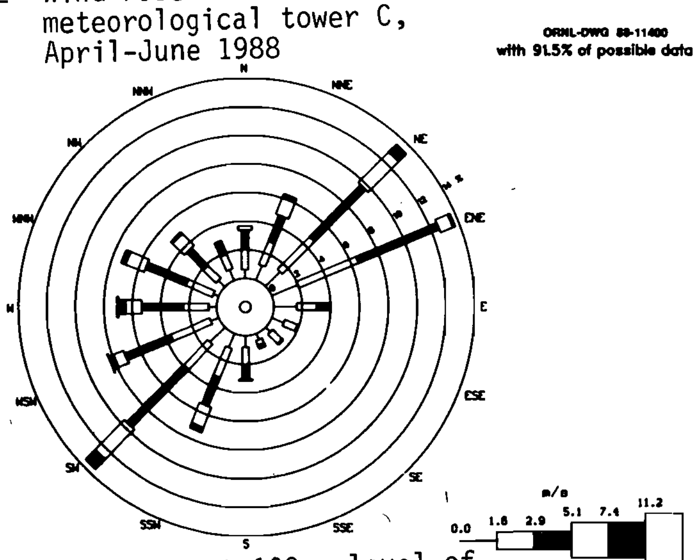

Fig. 13 Wind rose at 100-m level of meteorological tower C, April-June 1988

Milk

Raw milk from four locations including 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 (Figure 15). Three other stations are more remote with respect to the Oak Ridge facilities and are usually sampled semiannually (Figure 15). None of the remote stations were sampled during this period. 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 42 and 43) are compared with intake guidelines specified by the Federal Radiation Council.

During the last quarter of 1987, the software program on the Nuclear Data Analyzer for computing the lower limits of detection for the analysis of ^{131}I in milk was updated. The old system used a value of < .08 Bq/L for the detection limit while the new one uses < 0.1 Bq/L. This assumes that the milk samples are brought into the laboratory in the afternoon and are counted the same night. Because ^{131}I has such a short half-life (8.04 d), it quickly decays and the precision of the result decreases. Therefore, detection limits of 0.2 or greater may be observed in the data for this quarter.

Concentrations of total radioactive Sr are shown in Table 43. The average concentration of total radioactive Sr at all stations in the immediate Oak Ridge area was 0.19 Bq/L. This concentration was not significantly different from the average for the first quarter of 1988 (0.12 Bq/L). All total radioactive Sr results are within Range I of the FRC guidelines.

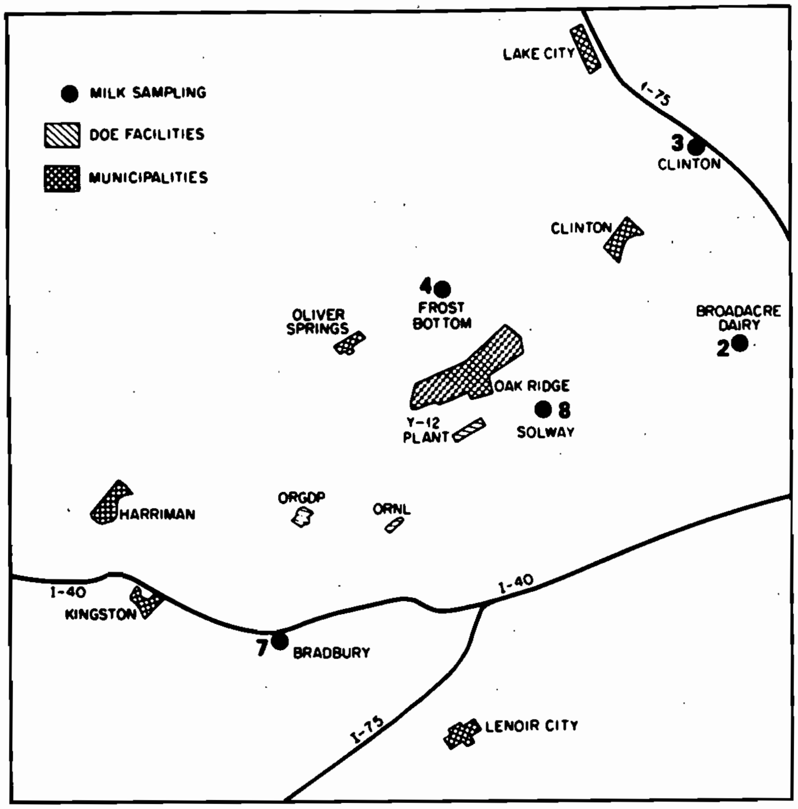

Fig. 14 Locations of milk sampling stations near the Oak Ridge facilities

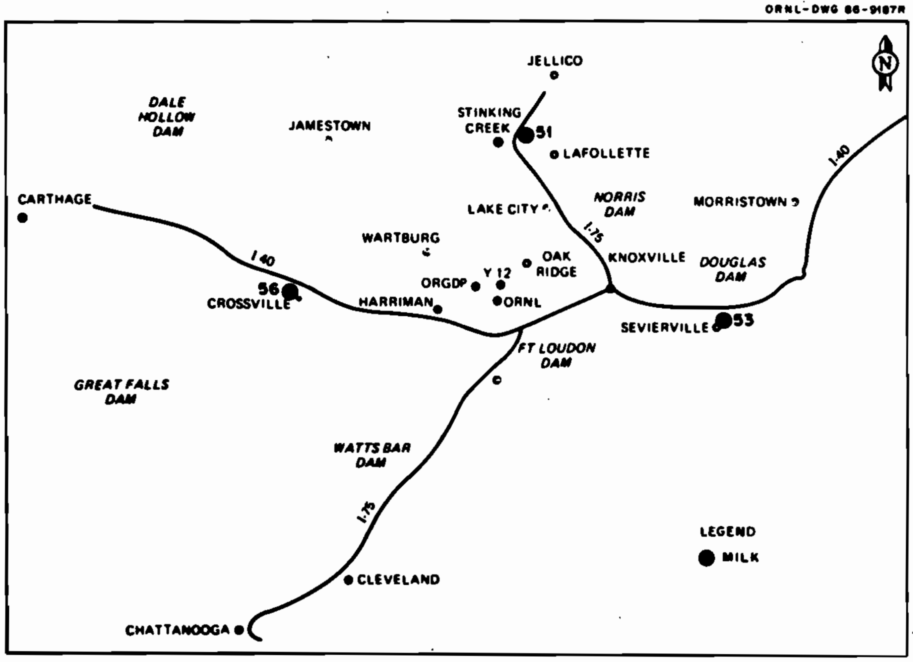

Fig. 15 Locations of milk sampling stations remote from the Oak Ridge facilities

Table 42. Concentrations of ^{131}I in milk[a]

April - June 1988

Station	No. of Samples	Concentration (Bq/L) Max	Min	Av	95%cc[b]	Percent of guideline[c]
		Immediate Environs[d]				
2	6	< 0.2	< 0.1	< 0.13	0.042	36
3	3	< 0.1	< 0.1	< 0.1	0.0	27
4	6	< 0.3	< 0.1	< 0.13	0.067	36
8	6	< 0.2	< 0.1	< 0.12	0.033	32
Network summary	21	< 0.3	< 0.1	< 0.12	0.024	33

[a]Raw milk samples; Station 2 is a dairy.
[b]95% confidence coefficient about the average.
[c]Percent of applicable FRC standard assuming 1 L/d intake.
[d]See Figure 14.

Table 43. Concentrations of total radioactive Sr in milk[a]

April - June 1988

Station	No. of Samples	Concentration (Bq/L) Max	Min	Av	95%cc[b]	Percent of guideline[c]
		Immediate Environs[d]				
2	6	0.37	0.09	0.16	0.085	22
3	3	0.18	0.11	0.13	0.047	18
4	6	0.25	0.12	0.18	0.035	24
8	6	0.34	0.08	0.24	0.073	33
Network summary	21	0.37	0.08	0.19	0.036	25

[a]Raw milk samples; Station 2 is a dairy.
[b]95% confidence coefficient about the average.
[c]Percent of applicable FRC standard assuming 1 L/d intake.
[d]See Figure 14.

Fish

Bluegill from three Clinch River locations were collected during this quarter for tissue analyses of radionuclides, mercury, and PCBs (Figure 16). (NOTE: Sampling is done semiannually. The last sampling was reported in the third quarter of 1987.) Sampling locations include the following Clinch 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 are determined on at least one composite of 6-10 fish per sampling period. Mercury and PCB concentrations are 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 appreciably different from the third quarter of 1987 (Table 44). The average concentration of mercury in fish from each location was less than 20% of FDA's action level of 1.0 μg/g wet weight.

The concentrations of PCBs in fish during the second quarter of 1988 were slightly higher than those measured during the third quarter of 1987, except for PCB-1254 at CRK 40.0 (Table 45). All concentrations of PCBs (individual types and the sum) were less than 5% of the FDA's tolerance level of 2 μg/g wet weight for fish.

Summary statistics of radionuclides found in bluegill during the quarter are given in Table 46. Concentrations of cobalt-60 are about the same at all locations. Concentrations of cesium-137 are higher at the downstream locations than at the background (CRK 40.0) station. However, the cesium-137 value at CRK 8.0 is practically unchanged from that for the third quarter of 1987, and the cesium-137 value for CRK 33.3 is about half that for the third quarter of 1987. Total radioactive strontium is highest at CRK 33.3, but the concentration value is only slightly higher than the value of 0.34 Bq/kg given for the third quarter of 1987.

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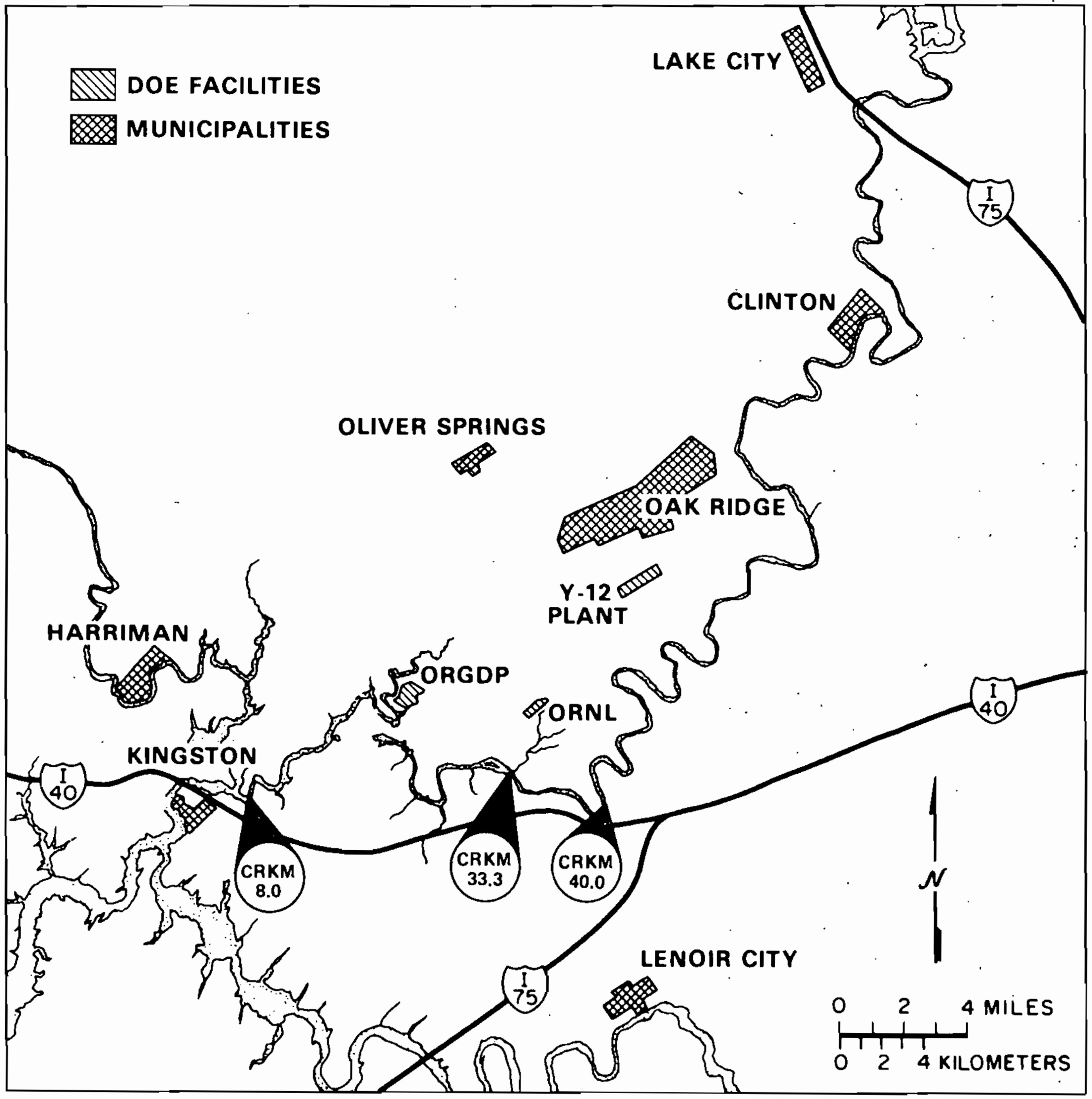

Fig. 16 Location of fish sampling points

Table 44. Mercury concentrations in Clinch River bluegill

April - June 1988

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	0.21	0.07	0.115	0.044	11.5
CRK 33.3	6	0.12	0.04	0.075	0.030	7.5
CRK 40.0	6	0.04	0.02	0.025	0.0063	2.5

[a]See Figure 16.
[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 45. PCB concentrations in Clinch River bluegill

April - June 1988

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	0.04	0.02	0.03	0.008	1.5
	1260	6	0.09	0.01	0.05	0.022	2.5
CRK 33.3	1254	6	0.05	0.01	0.02	0.014	1.0
	1260	6	0.07	0.01	0.03	0.018	1.5
CRK 40.0	1254	6	< 0.01	0.01	0.01	0.0	0.5
	1260	6	0.05	0.02	0.03	0.010	1.5

[a]See Figure 16.
[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 46. Radionuclide concentrations in Clinch River bluegill

April - June 1988

Location[a]	Radionuclide	No. of Samples[b]	Concentration (Bq/kg wet wt) Max	Min	Av	95%cc[c]
CRK 8.0	^{60}Co	3	< 0.12	< 0.12	< 0.12	0.006
	^{137}Cs	3	1.96	1.6	1.8	0.21
	Total Sr[d]	3	0.21	0.046	0.12	0.09
CRK 33.3	^{60}Co	3	< 0.10	< 0.081	< 0.089	0.013
	^{137}Cs	3	5.3	1.7	3.3	2.11
	Total Sr[d]	3	0.54	0.32	0.39	0.14
CRK 40.0	^{60}Co	3	< 0.12	< 0.08	< 0.109	0.02
	^{137}Cs	3	0.18	0.10	0.16	0.05
	Total Sr[d]	3	0.06	-0.53	-0.18	0.36

[a]See Figure 16.
[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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Environmental Protection Agency (EPA), 1987. Environmental Radiation Data, Report 50, (April 1987 - June 1987). Eastern Environmental Radiation Facility, Montgomery, Alabama, pp 33.

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