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MARTIN MARIETTA

Environmental Surveillance Data Report for the Third Quarter of 1988

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EXECUTIVE SUMMARY

During the third quarter of 1988, over 2,400 samples which represent more than 9,000 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. A new section on airborne discharges of radionuclides from stacks is introduced in this report. The measurements reported there represent a more accurate characterization of source terms for dose assessments than was previously available.

Radiation doses due to long-lived airborne particulate radionuclides measured at air monitoring stations were calculated for the first half of 1988 and found to be well within the Environmental Protection Agency (EPA) standards.

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 Process Waste Treatment Plant and waste treatment ponds and therefore experiences higher levels of radiation.

Cesium-137 concentration at the Process Waste Treatment Plant was much above normal during early September due to much above normal concentrations in material fed to the plant. The situation had returned to normal by the end of September.

The cobalt-60 concentration in Melton Branch was somewhat elevated in August following a discharge from one of the High Flux Isotope Reactor (HFIR) ponds, but returned to predischarge levels in September. 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 (DCGs). Tritium concentrations at Melton Branch 1 have, in the past, occasionally exceeded the DCG for tritium. However, tritium concentrations at that site undergo seasonal fluctuations such that relatively low values tend to occur during the third quarter. Values measured this quarter were always less than 60% of the DCG for tritium and were slightly less than the values measured during the third quarter of 1987.

Even though rainfall for this quarter was above normal, the effect of the dry spell over the preceding two quarters is still evident in the flow of the Clinch River, which was only 39% of the flow for the corresponding (third) quarter of 1987.

Measurements of polychlorinated biphenyls (PCBs) in surface water and sediment during May 1988 indicated that PCB concentrations were below detection limits in the surface water samples and were also below detection limits in the sediment at most locations. Small amounts of PCBs were detected in the sediment at two locations in White Oak Creek.

There were 23 noncompliances associated with the National Pollutant Discharge Elimination System (NPDES) permit during the third quarter of 1988. This was from a total of 2,521 observations which represents a compliance ratio of greater than 99%. Two of the noncompliances were downstream pH exceedances that were not violations of a numeric limit in the ORNL permit but were violations of a Tennessee stream standard for streams classified for fish and aquatic life. Three slight temperature violations at the Coal Yard Runoff Treatment Facility during August were attributed to shallow water levels combined with above-normal daily temperatures. Two other noncompliances involved Category II runoff associated with showers after a prolonged period of little or no rain. Samples taken in such instances often contain the first-flush of several days accumulation of dust and grease from the associated drainage areas. Sometimes this can result in noncompliances. Where appropriate, corrective actions or investigations have been undertaken or are underway to address the other noncompliances.

Groundwater samples from wells at the perimeter of the Solid Waste Storage Area 6 (SWSA 6) occasionally exceeded drinking water limits for fecal coliform, tritium, and gross beta. Two samples from upgradient wells also exceeded drinking water limits for gross beta.

Milk samples from within 80 km of ORNL showed no detectable concentrations of iodine-131 this quarter. Concentrations of radioactive strontium in the milk samples were always within the lowest range (0.00 to 0.74 Bq/L) of the Federal Radiation Council guidelines.

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 Department of Energy (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, groundwater, sediments, and milk. 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. Additional sections are occasionally developed for inclusion in subsequent reports in this series. These developments occur as needs dictate and as more types of data become available. Beginning with this quarter, these reports will include the following additional sections: (1) airborne discharges from stacks; (2) radiation doses due to long-lived airborne particulate radionuclides; (3) polychlorinated biphenyls (PCBs) in the aquatic environment; and (4) groundwater. Also, the section on meteorological processes has been expanded to include precipitation data.

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.

AIRBORNE DISCHARGES

Airborne emissions are monitored at the Oak Ridge National Laboratory for the purpose of complying with the Clean Air Act (CAA) of 1970 and the Tennessee Air Quality Control Act. The gaseous emission point sources for the Laboratory consist of eight stacks. They are as follows:

Building	Description
2026	Radioactive Materials Analytical Laboratory
3020	Radioactive Processing Plant
3039	Duct 1 - 3500 and 4500 Areas Cell Ventilation Systems
	Duct 2 - Central Off-Gas and Scrubber System
	Duct 3 - Isotope Solid State Ventilation System
	Duct 4 - 3025 and 3026 Areas Cell Ventilation Systems
7025	Tritium Target Fabrication Facility
7830	Hydrofracture Facility
7911	Melton Valley Complex (High Flux Isotope Reactor, Thorium-Uranium Recycle Facility, Transuranium Processing Plant)
7512	Molten Salt Reactor Facility
6010	Electron Linear Accelerator Facility

The location of the stacks is shown in Fig. 1. Each of these point sources is provided with a variety of surveillance instrumentation including radiation alarms, near real-time monitors, and continuous sample collectors. Only data resulting from the analysis of the continuous samples are used in this report. The other equipment does not provide data of sufficient accuracy and precision to support the quantitation of emission source terms.

Data are presented for all the areas except the Electron Linear Accelerator Facility (Building 6010). Continuous sampling equipment is not presently installed at this facility. A stack monitoring improvement project is scheduled for 1989 that will provide continuous samplers at this stack.

The sampling systems generally consist of in-stack sampling probes, sample transport piping, a 47 mm particulate filter, a 47 mm diameter by 25 mm thick activated charcoal canister, a silica-gel tritium trap, flow measurement and totalizing instruments, a sampling pump, and return piping to the stack. The sampling system for the tritium target facility is configured with a tritium trap only. The sampling systems at 2026, 3020, and 7512 have not been upgraded and do not have tritium traps.

The sampling media are collected and evaluated weekly. The particulate filters are analyzed for gross alpha and gross beta activity. The silica gel samples are analyzed for tritium. The charcoal canisters are analyzed by gamma spectroscopy. Due to the prevalence of iodine isotopes in the point-source emissions, values are reported for ^{131}I and ^{133}I each week. Data for other gamma emitting isotopes are opportunistically captured. If

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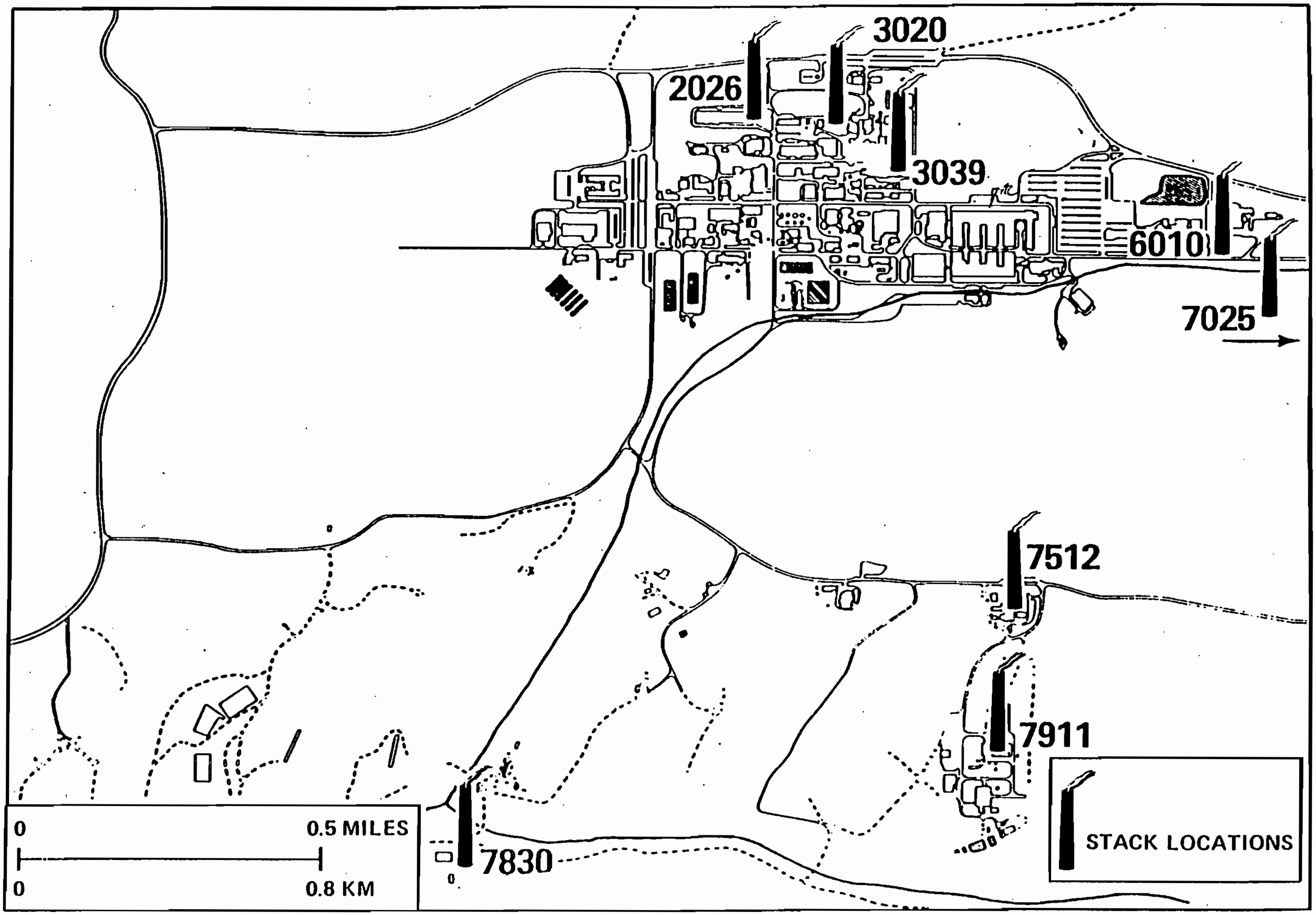

Fig. 1 Location map of major stacks
(emission points) at ORNL

an isotope is present at a concentration above the analytical instrument background, the datum is reported. Consequently, 13 data values are typically associated with gross alpha, gross beta, tritium, ^{131}I, and ^{133}I measurements. This is the number of samples for the quarter. Many of the other isotopes reported are represented by less than 13 values because they were not detected in all of the sampling events.

The current convention for data at the instrument detection limit is to treat it in the same manner as all other data. The instrument background is subtracted from the actual instrument signal and the result is reported. This practice can result in negative numbers. Results reported in this manner may be reduced with summary statistics without incurring the difficulties of performing calculations on "less than" values.

The data for ^{125}I and ^{129}I were recorded using the older convention of "less than" and the detection limit. Consequently all the values in the tables for ^{125}I and ^{129}I are actually detection limit data. This means that the isotopes may have been present, but were not distinguishable from background.

Tritium data for the Tritium Target Fabrication Facility consist of nine values collected since August 1, 1988. This is when the stack monitoring improvement project was completed and the sampling system was made operational.

Tables 1-10 present summaries of the weekly data. These data are sample results, not stack emissions. Included are the number of samples in which a particular analyte was measured, the maximum and minimum values for the quarter, and the average. Where there are two or more values, the 95% cc is also given. All data are rounded to two significant digits and reported as becquerels (Bq).

The monthly and quarterly stack emissions are summarized by stack and analyte in Tables 11-20. In each case, the weekly data were multiplied by a conversion factor which is the average ratio of the stack (or duct) flow to the sampler flow. These results were then summed for the months and the quarter. Negative sample values were treated as zeros for the purpose of computing emissions. All data are rounded to two significant digits and presented as megabecquerels (10^6 Bq).

The airborne emissions for the Laboratory consist primarily of H-3, I-131, I-133, I-135, Pb-212, Xe-133, Xe-135, and Os-191. Tritium came mostly from the Tritium Target Fabrication Facility, (91%), and the Isotope Solid State Ventilation System, (8%). The Melton Valley Complex and the Isotope Solid State Ventilation System emitted 49% and 48% of the total I-131, respectively. Ninety two percent of the Pb-212 came from four locations: the Radioactive Materials Analytical Laboratory, (57%); Melton Valley Complex, (19%); 3500 and 4500 Areas Cell Ventilation Systems, (8%); and Central Off-gas and Scrubber system, (8%). The Melton Valley Complex was the source for virtually all of the I-133 and I-135. Xenon was emitted from the Melton

Table 1. Summary of weekly sample results
Radioactive materials analytical
laboratory, Building 2026[a]

July – September 1988

Analysis	No. of Samples	Total Bq/Sample			
		Max	Min	Av	95% cc[b]
Gross alpha	13	170	6.6	85	35
Gross beta	13	160	6.5	87	34
^{60}Co	1	41	41	41	
^{137}Cs	6	48	0.45	11	20
^{125}I	1	8.0	8.0	8.0	
^{129}I	1	52	52	52	
^{131}I	13	2.0	-0.10	0.54	0.36
^{133}I	13	9.0	-0.30	1.5	1.6
^{135}I	5	2.6	-3.2	-0.38	2.8
^{191}Os	1	0.75	0.75	0.75	
^{212}Pb	12	5,800	230	1,500	950

[a]See Fig. 1.
[b]95% cc about the average of more than two samples.

Table 2. Summary of weekly sample results
Radioactive processing plant
ventilation stack, Building 3020[a]

July – September 1988

Analysis	No. of Samples	Total Bq/Sample Max	Min	Av	95% cc[b]
Gross alpha	13	0.24	-0.009	0.10	0.042
Gross beta	13	0.98	0.21	0.41	0.12
^{125}I	3	6.0	4.0	5.3	2.9
^{129}I	2	43	43	43	0
^{131}I	13	1.0	-0.9	0.09	0.32
^{133}I	13	8.0	-0.80	1.2	1.6
^{135}I	3	2.6	-1.3	0.87	4.9
^{191}Os	2	11	1.4	6.2	61
^{212}Pb	8	320	28	100	80

[a]See Fig. 1.
[b]95% cc about the average of more than two samples.

Table 3. Summary of weekly sample results 3500 and 4500 areas cell ventilation systems, Building 3039, Duct 1[a]

July – September 1988

Analysis	No. of Samples	Total Bq/Sample			
		Max	Min	Av	95% cc[b]
Gross alpha	13	40	0.005	3.7	6.7
Gross beta	13	3,200	0.54	330	530
^{60}Co	4	7.7	0.98	2.9	5.1
^{3}H	13	190	8.0	94	31
^{125}I	1	6.0	6.0	6.0	
^{131}I	13	310	-0.010	53	67
^{133}I	13	3.0	-0.10	0.75	0.61
^{135}I	8	0.40	-0.70	-0.23	0.36
^{191}Os	1	4.2	4.2	4.2	
^{212}Pb	10	110	69	91	11
^{133}Xe	4	26	2.1	15	20
^{135}Xe	2	27	4.5	16	140

[a]See Fig. 1.
[b]95% cc about the average of more than two samples.

Table 4. Summary of weekly sample results
Central off-gas and scrubber system,
Building 3039, Duct 2[a]

July - September 1988

Analysis	No. of Samples	Total Bq/Sample Max	Min	Av	95% cc[b]
Gross alpha	13	0.32	0.003	0.10	0.061
Gross beta	13	25	0.72	5.6	4.5
^{60}Co	1	1.5	1.5	1.5	
^{137}Cs	3	6.3	2.0	3.5	6.0
^{3}H	13	580	23	360	80
^{125}I	1	24	24	24	
^{131}I	13	4.3	0.10	1.7	0.83
^{133}I	13	6.6	-0.80	1.8	1.3
^{135}I	8	3.4	-1.1	0.30	1.2
^{212}Pb	10	2,800	800	1,400	370
^{75}Se	3	3.6	1.5	2.4	2.7

[a]See Fig. 1.
[b]95% cc about the average of more than two samples.

Table 5. Summary of weekly sample results Isotope solid state ventilation system, Building 3039, Duct 3[a]

July - September 1988

Analysis	No. of Samples	Total Bq/Sample			
		Max	Min	Av	95% cc[b]
Gross alpha	13	0.25	0.00	0.12	0.04
Gross beta	13	5.9	0.48	1.5	1.0
^{82}Br	9	51	2.1	19	13
^{60}Co	9	10	1.1	3.6	2.4
^{3}H	13	660,000	5,300	270,000	120,000
^{125}I	2	130	39	82	550
^{129}I	1	43	43	43	
^{131}I	13	5,400	6.9	930	930
^{133}I	13	4.0	-0.33	1.0	0.79
^{135}I	8	-0.30	-0.70	-0.15	0.30
^{191}Os	6	160	5.3	59	62
^{212}Pb	8	62	22	33	11
^{75}Se	2	240	44	140	1,200
^{133}Xe	9	420	4.9	99	110

[a]See Fig. 1.
[b]95% cc about the averge of more than two samples.

Table 6. Summary of weekly sample results 3025 and 3026 area cell ventilation system, Building 3039, Duct 4[a]

July – September 1988

Analysis	No. of Samples	Total Bq/Sample			
		Max	Min	Av	95% cc[b]
Gross alpha	13	95	0.04	11	16
Gross beta	13	12,000	32	1,500	2,000
^{3}H	13	79,000	1,200	28,000	12,000
^{125}I	2	55	8	32	300
^{129}I	1	330	330	330	
^{131}I	12	5.0	−2.1	0.37	1.0
^{133}I	11	3.0	−0.08	0.52	0.59
^{135}I	6	0.90	−0.20	0.28	0.43
^{191}Os	9	370,000	1,400	94,000	110,000
^{135}Xe	1	3.4	3.4	3.4	

[a]See Fig. 1.
[b]95% cc about the average of more than two samples.

Table 7. Summary of weekly sample results
Tritium target fabrication facility,
Building 7025[a]

July - September 1988

Analysis	No. of Samples	Total Bq/Sample Max	Min	Av	95% cc[b]
^{3}H	9	1,100,000	270,000	590,000	230,000

[a]See Fig. 1.
[b]95% cc about the average of more than two samples.

Table 8. Summary of weekly sample results Hydrofracture facility, Building 7830[a]

July - September 1988

Analysis	No. of Samples	Total Bq/Sample Max	Min	Av	95% cc[b]
Gross alpha	13	.76	-.001	0.17	.16
Gross beta	13	12	.23	2.1	1.9
^{60}Co	1	1.2	1.2	1.2	
^{125}I	5	6.0	4.0	5.0	.88
^{129}I	3	45	43	44	2.5
^{131}I	13	1.0	-1.4	0.042	.33
^{133}I	13	5.0	-0.15	1.1	1.0
^{135}I	8	.90	-1.4	-0.28	.65
^{212}Pb	8	40	22	31	4.6
^{133}Xe	2	2.0	.030	1.0	13
^{135}Xe	1	20	20	20	

[a]See Fig. 1.
[b]95% cc about the average of more than two samples.

Table 9. Summary of weekly sample results
Melton valley complex, Building 7911[a]

July – September 1988

Analysis	No. of Samples	Total Bq/Sample Max	Min	Av	95% cc[b]
Gross alpha	12	0.08	.02	0.04	0.01
Gross beta	12	2.2	.80	1.2	0.24
^{3}H	13	236	3.8	89	37
^{125}I	3	7.0	5.0	5.7	2.9
^{129}I	2	60	44	52	100
^{131}I	13	14,000	1,200	3,000	2,100
^{132}I	1	110	110	110	
^{133}I	12	13,000	960	2,700	2,100
^{135}I	12	2,300	-1.0	1,100	470
^{212}Pb	9	1,900	240	840	380
^{133}Xe	10	2,000	34	470	400
^{135}Xe	10	3,800	440	1,800	660

[a]See Fig. 1.
[b]95% cc about the average of more than two samples.

Table 10. Summary of weekly sample results
Molten salt reactor facility,
Building 7512[a]

July - September 1988

Analysis	No. of Samples	Total Bq/Sample Max	Min	Av	95% cc[b]
Gross alpha	13	.48	.078	.20	.065
Gross beta	13	.64	.20	.35	.08
^{125}I	5	7.0	5.0	6.0	.88
^{129}I	2	44	43	44	6.4
^{131}I	13	2.0	-0.70	.26	.39
^{133}I	13	5.0	-0.80	.93	1.1
^{135}I	3	1.3	-0.60	.67	2.7
^{191}Os	1	4.8	4.8	4.8	

[a]See Fig. 1.
[b]95% cc about the average of more than two samples.

Table 11. Monthly airborne emissions
Radioactive materials analytical
laboratory, Building 2026[a]

July – September 1988

Analysis	Emissions per month (10^6 Bq) July	August	September	Total (10^6Bq)
Gross alpha	5.2	5.5	0.94	12
Gross beta	4.9	5.8	1.3	12
^{60}Co	0	0.43	0	0.43
^{137}Cs	.034	0.64	0	.67
^{125}I	0	0.084	0	0.084
^{129}I	0	0.55	0	0.55
^{131}I	0.037	0.023	0.015	0.075
^{133}I	0.19	0.018	0.0032	0.21
^{135}I	0	0	0.35	0.035
^{191}Os	.0079	0	0	0.0079
^{212}Pb	26	51	120	190

[a]See Fig. 1.

Table 12. Monthly airborne emissions
Radiochemical process plant ventilation
stack, Building 3020[a]

July - September 1988

Analysis	Emissions per month (10^6 Bq) July	August	September	Total (10^6 Bq)
Gross alpha	.018	.0079	.0035	.029
Gross beta	.042	.034	.047	.12
^{125}I	0.23	0.14	0	0.36
^{129}I	0.98	0.98	0	2.0
^{131}I	.048	0.0091	.022	.078
^{133}I	0.39	.0011	0.01	.40
^{135}I	0	.089	0	.089
^{191}Os	0.28	0	0	0.28
^{212}Pb	2.5	4.1	12	19

[a]See Fig. 1.

Table 13. Monthly airborne emissions 3500 and 4500 areas cell ventilation systems, Building 3039, Duct 1[a]

July - September 1988

Analysis	Emissions per month (10^6 Bq) July	August	September	Total (10^6Bq)
Gross alpha	1.4	.019	.016	1.5
Gross beta	130	.76	1.4	140
^{60}Co	.068	.29	0	.36
^{3}H	16	32	31	79
^{125}I	.19	0	0	.19
^{131}I	.28	18	2.8	21
^{133}I	.22	0.076	.015	.31
^{135}I	0	.025	0	.025
^{191}Os	.13	0	0	.13
^{212}Pb	5.6	12	11	28
^{133}Xe	.065	1.6	.17	1.8
^{135}Xe	.84	0	0.14	.98

[a]See Fig. 1.

Table 14. Monthly airborne emissions
Central off-gas and scrubber system,
Building 3039, Duct 2[a]

July - September 1988

Analysis	Emissions per month (10^6 Bq) July	August	September	Total (10^6Bq)
Gross alpha	.00097	.0013	.00020	.0025
Gross beta	.070	.068	.0083	.15
^{60}Co	.0030	0	0	.0030
^{137}Cs	0.0040	.017	0	.021
^{3}H	4.3	8.4	6.2	19
^{125}I	0.048	0	0	0.048
^{131}I	.014	.023	.0072	.044
^{133}I	.028	.0094	.0095	.047
^{135}I	0	.0016	.0078	.0094
^{212}Pb	2.6	13	13	28
^{75}Se	.0030	.012	0	0.15

[a]See Fig. 1.

Table 15. Monthly airborne emissions
Isotope solid state ventilation system,
Building 3039, Duct 3[a]

July - September 1988

Analysis	Emissions per month (10^6 Bq) July	August	September	Total (10^6Bq)
Gross alpha	.013	.021	0.0079	.042
Gross beta	.069	.35	.095	.51
^{82}Br	1.2	1.1	2.2	4.5
^{60}Co	.46	.25	.13	.85
^{3}H	73,000	62,000	64,000	200,000
^{125}I	4.3	0	0	4.3
^{129}I	1.1	0	0	1.1
^{131}I	21	260	35	320
^{133}I	.25	.078	.031	.36
^{135}I	0	.011	.0079	.018
^{191}Os	3.7	.48	5.1	9.3
^{212}Pb	1.6	2.4	3.0	7.0
^{75}Se	1.2	0	6.3	7.5
^{133}Xe	.50	20	2.9	23

[a]See Fig. 1.

Table 16. Monthly airborne emissions 3025 and 3026 area cell ventilation systems, Building 3039, Duct 4[a]

July - September 1988

Analysis	Emissions per month (10^6 Bq) July	August	September	Total (10^6Bq)
Gross alpha	.35	.22	1.8	2.4
Gross beta	54	14	280	350
^{3}H	6,600	4,900	760	12,000
^{125}I	1.1	0	0	1.1
^{129}I	5.8	0	0	5.8
^{131}I	.10	.018	.0061	.12
^{133}I	.071	.022	.0073	.10
^{135}I	0	.010	.024	.035
^{191}Os	3,600	770	10,000	15,000
^{135}Xe	0	0	.059	0.059

[a]See Fig. 1.

Table 17. Monthly airborne emissions
Tritium target fabrication facility,
Building 7025[a]

July - September 1988

Analysis	Emissions per month (10^6 Bq) July	August	September	Total (10^6Bq)
^3H		1,300,000	910,000	2,200,000

[a]See Fig. 1.

Table 18. Monthly airborne emissions Hydrofracture facility, Building 7830[a]

July - September 1988

Analysis	Emissions per month (10^6 Bq) July	August	September	Total (10^6Bq)
Gross alpha	.00063	.000075	.000031	.00074
Gross beta	.0070	.0011	.0012	.0092
^{60}Co	.00041	0	0	.00041
^{125}I	.0065	.0021	0	.0086
^{129}I	.030	.015	0	.045
^{131}I	.00069	.000055	.00012	.00086
^{133}I	.0045	.00026	.000062	.0048
^{135}I	0	.000069	.00041	.00048
^{212}Pb	.0075	.047	.032	0.086
^{133}Xe	0	.000010	.00069	.00070
^{135}Xe	0	0	.0069	0.0069

[a]See Fig. 1.

Table 19. Monthly airborne emissions
Melton valley complex,
Building 7911[a]

July – September 1988

Analysis	Emissions per month (10^6 Bq) July	August	September	Total (10^6Bq)
Gross alpha	.00099	0.0015	.0012	.0037
Gross beta	.024	.045	.049	.12
^{3}H	7.3	20	16	44
^{125}I	.14	0	0	.14
^{129}I	.86	0	0	.86
^{131}I	91	190	45	330
^{132}I	0	0	0.91	0.91
^{133}I	55	170	45	270
^{135}I	45	40	26	110
^{212}Pb	9.6	14	39	62
^{133}Xe	3.0	26	9.4	39
^{135}Xe	25	74	47	150

[a]See Fig. 1.

Table 20. Monthly airborne emissions
Molten salt reactor facility,
Building 7512[a]

July – September 1988

Analysis	Emissions per month (10^6 Bq) July	August	September	Total (10^6 Bq)
Gross alpha	.0058	.0029	.0026	.011
Gross beta	.0074	.0061	.0066	.020
^{125}I	.10	.026	0	.13
^{129}I	.19	.19	0	.38
^{131}I	.013	.0022	.0049	.021
^{133}I	.057	.0013	.0015	.059
^{135}I	0	.0057	.0057	.011
^{191}Os	.021	0	0	.021

[a]See Fig. 1.

Valley Complex, (89%), and Isotopes Solid State Ventilation System, (11%). The 3025 and 3026 Cell Ventilation Systems released 99.9% of the Os-191.

The xenon results are from gamma spectroscopy of the activated charcoal canisters. Activated charcoal is typically 0.03 to 0.05 percent efficient at trapping xenon. Therefore, the presence of xenon should be considered significant, but caution must be exercised in using the quantitative results.

Iodine-131 may be present as a fission product and also as an artifact of the method used for testing HEPA filters. Typically, 30 mCi of I-131 is released upstream of the filter being tested. The amount of I-131 that passes the filter is quantified, and that value is used to calculate the filter efficiency.

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 Figs. 2 and 3. 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 Fig. 2).

(2) The DOE Oak Ridge reservation network (reservation PAMs) consists of stations 8, 23, 31, 33, 34, 36, and 40-46 (Fig. 2). Stations 8 and 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. All of these stations are located within a 120 km radius of ORNL outside the DOE Oak Ridge reservation (Fig. 3).

Several of the ORNL and reservation PAMs have real-time monitors for five radiation parameters (gross alpha, gross beta, iodine, gross gamma, and noble gas) and are also equipped with 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. Local data concentrators check 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.

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 three to four 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

ORNL–DWG 86-17411R2

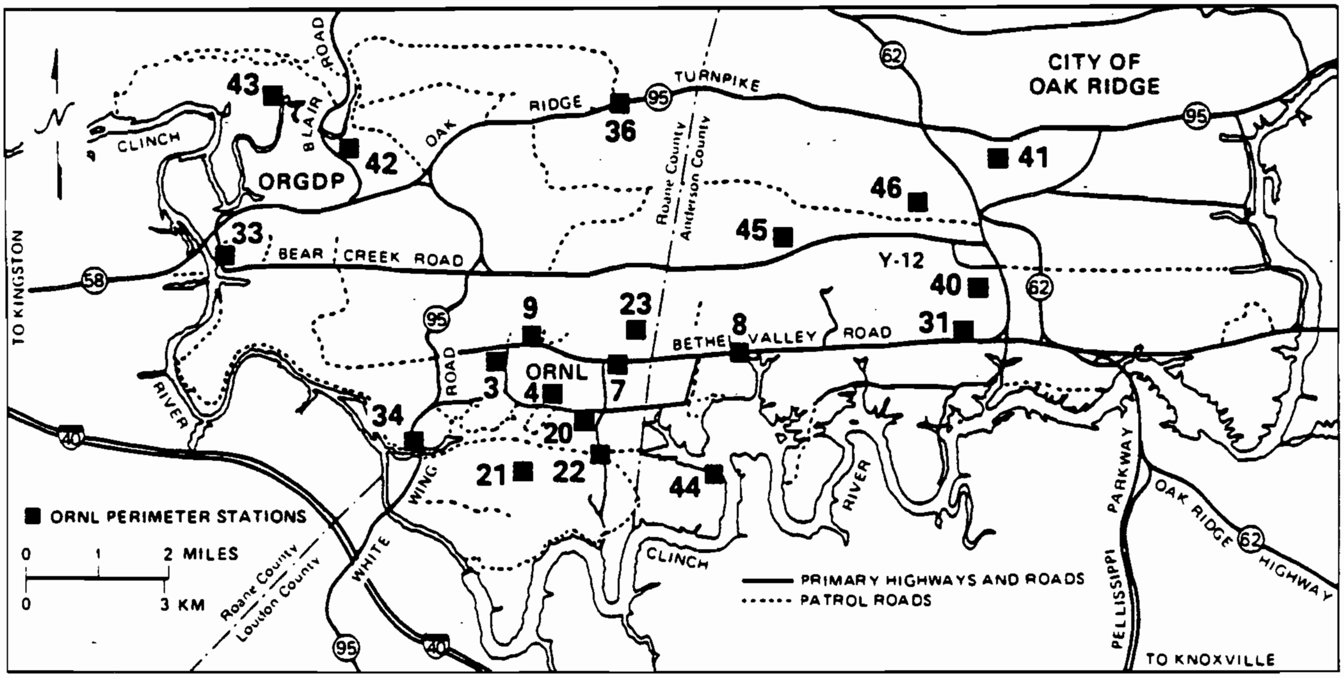

Fig. 2 Location map of ORNL perimeter and Oak Ridge Reservation air monitoring stations

ORNL-DWG 86-9187R6

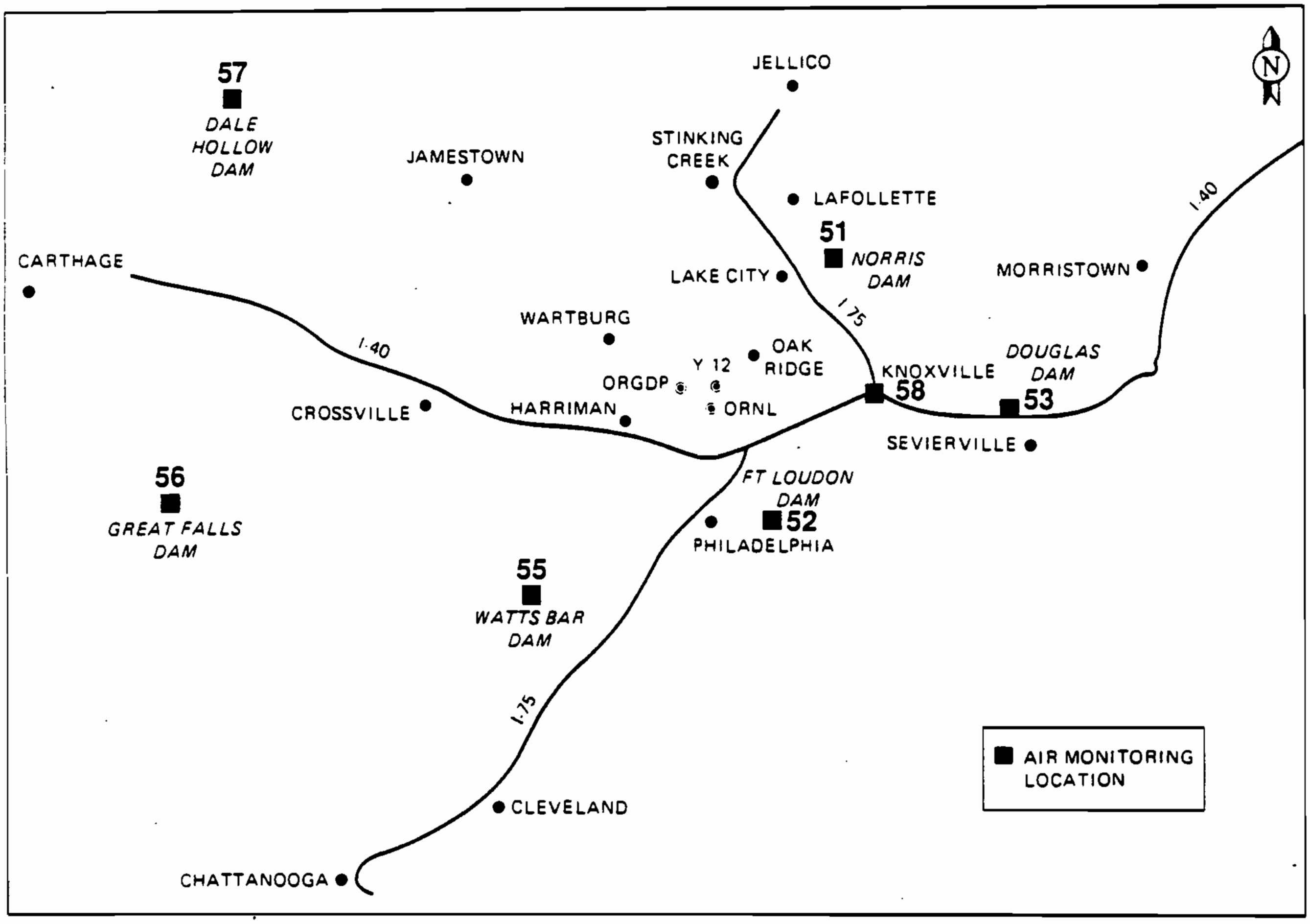

Fig. 3 Location map of the remote air monitoring stations

off, and flow rates 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 flow rates at stations 3-46 are set between 1.5 and 3.0 CFM to minimize artifacts from extremely high or low flow rates. 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 21-29. Instrument background concentrations of ^{131}I, gross alpha, and gross beta have been subtracted from the measured concentrations in Tables 21-29. Negative values represent concentrations below the instrument background level.

During July and August 1987, several changes were made in instrumentation at the monitoring stations. This resulted in more accurate detection of air-borne radionuclides because of the transition to smaller filters which did not have to be cut up before the counting process. Additional processing of the larger filters could have led to problems such as loss of particulates leading to erroneously low counts. Probably the most prominent manifestation of the transition to smaller filters (and possibly of other instrument up-grades as well) is the five-fold increase in gross beta activity reported at the remote (background) air monitoring stations. Since August 1987, reported values of gross beta activity at the remote sites have generally been between 50 and 150 x 10^{-8} Bq/L and have typically been about 100 x 10^{-8} Bq/L.

There was little or no alpha activity in July. Small amounts of alpha activity were detected at all three station networks in August and September. Values for remote stations were comparable to those from the other two station networks.

Average beta activity was essentially unchanged from the preceding quarter. Values for the ORNL stations and for reservation stations were similar to values for the remote stations.

Iodine-131 concentrations (Tables 27-29) were essentially unchanged from the previous quarter, with all values reported being less than 0.01% of the derived concentration guideline for that isotope. There was a slight but consistent tendency throughout the quarter for higher-than-average values to be recorded at stations near or to the south of the southern boundary of the ORNL complex (stations 4, 20, 21, and 22). The large negative iodine concen-tration reported in September at station 7 was due to a low flow rate.

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 30. For this quarter only, tritium values were measured at a different laboratory which experienced higher levels of background radiation. The result was that most of the tritium

Table 21. Long-lived gross alpha activity in air

July 1988

Location	No. of Samples	Concentration (10^{-8} Bq/L) Max	Min	Av	95% cc[a]
		ORNL PAM Stations[b]			
3	4	2.5	-2.0	-0.39	2.1
4	4	0.57	-4.9	-1.5	2.4
7	4	-1.9	-3.3	-2.7	0.55
9	4	2.4	-4.3	-1.4	2.8
20	4	4.2	-4.2	-0.79	3.6
21	4	2.3	-4.1	-0.83	2.7
22	3	1.1	-4.2	-1.8	3.1
Network summary	27	4.2	-4.9	-1.3	0.91
		Reservation PAM Stations[b]			
8	4	3.4	-3.2	0.015	2.9
23	3	3.7	-4.1	-0.47	4.5
31	4	4.2	-3.1	0.63	3.8
33	4	0.88	-3.8	-1.1	2.2
34	4	1.7	-1.7	0.023	1.8
36	4	-0.93	-4.7	-2.7	1.7
40	4	0.26	-4.5	-1.5	2.1
41	4	0	-3.2	-1.8	1.4
42	4	-0.23	-5.4	-2.2	2.2
43	4	0	-4.2	-2.4	1.8
44	4	1.4	-3.6	-1.0	2.3
45	4	1.2	-3.3	-0.81	2.2
46	3	1.7	-2.1	-0.63	2.3
Network summary	50	4.2	-5.4	-1.1	0.66
		RAM Stations[c]			
51	4	2.0	-0.78	0.74	1.1
52	4	-3.4	-5.3	-4.4	0.78
53	2	0.78	-0.74	0.021	1.5

Table 21. (continued)

July 1988

Location	No. of Samples	Concentration (10^{-8} Bq/L)			
		Max	Min	Av	95% cc[a]
55	4	-1.1	-3.2	-2.0	0.89
56	4	3.8	-5.0	-2.4	4.1
57	4	2.5	-4.1	-0.59	2.7
58	3	-1.4	-2.4	-2.0	0.55
Network summary	25	3.8	-5.3	-1.6	1.0
Overall summary	102	4.2	-5.4	-1.3	0.47

[a]95% cc about the average of more than two samples.
[b]See Fig. 2.
[c]See Fig. 3.

Table 22. Long-lived gross alpha activity in air

August 1988

Location	No. of Samples	Concentration (10^{-8} Bq/L) Max	Min	Av	95% cc[a]
		ORNL PAM Stations[b]			
3	5	4.4	0.44	2.6	1.3
4	5	5.0	-2.1	2.8	2.5
7	5	4.6	-2.8	1.2	2.8
9	5	5.2	-4.0	0.82	3.0
20	5	5.2	-3.8	2.7	3.3
21	5	5.2	-0.61	2.7	2.6
22	4	8.5	0.70	4.7	3.2
Network summary	34	8.5	-4.0	2.4	1.0
		Reservation PAM Stations[b]			
8	5	5.9	-1.3	3.1	2.5
23	5	8.2	-0.45	3.8	2.9
31	5	6.4	-4.1	2.8	3.8
33	5	5.3	-0.21	2.6	1.8
34	5	6.2	-2.1	3.7	3.0
36	5	6.7	-2.8	3.5	3.3
40	5	7.5	-2.2	3.8	3.3
41	3	5.1	-0.28	2.9	3.3
42	5	7.0	-3.2	2.6	3.3
43	5	5.7	-1.2	3.0	2.7
44	5	5.2	-3.6	1.9	4.0
45	5	6.9	0.23	4.8	2.4
46	4	8.8	4.9	6.6	1.6
Network summary	62	8.8	-4.1	3.4	0.81
		RAM Stations[c]			
51	5	3.9	0.14	2.4	1.3
52	4	8.3	4.6	6.4	1.6
53	5	11	-1.2	5.7	3.9

Table 22. (continued)

August 1988

Location	No. of Samples	Concentration (10^{-8} Bq/L) Max	Min	Av	95% cc[a]
55	5	8.1	-5.4	2.4	4.4
56	5	8.0	0	3.0	2.7
57	5	7.5	-1.6	4.9	3.4
58	5	13	-4.1	5.5	5.5
Network summary	34	13	-5.4	4.3	1.4
Overall summary	130	13	-5.4	3.4	0.59

[a]95% cc about the average of more than two samples.
[b]See Fig. 2.
[c]See Fig. 3.

Table 23. Long-lived gross alpha activity in air

September 1988

Location	No. of Samples	Concentration (10^{-8} Bq/L) Max	Min	Av	95% cc[a]
		ORNL PAM Stations[b]			
3	4	4.7	1.3	3.2	1.7
4	4	3.0	2.1	2.6	0.43
7	2	5.4	1.9	3.7	3.5
9	4	4.9	0.91	2.7	1.7
20	4	4.2	1.1	2.8	1.3
21	3	5.1	3.2	3.9	1.2
22	4	5.1	3.6	4.2	0.74
Network summary	25	5.4	0.91	3.3	0.52
		Reservation PAM Stations[b]			
8	4	5.4	3.1	3.8	1.1
23	4	6.4	3.7	5.1	1.1
31	4	5.2	2.4	3.3	1.3
33	4	5.5	3.3	4.7	0.98
34	4	5.4	2.6	4.3	1.3
36	3	6.4	3.1	4.3	2.1
40	4	4.3	0.95	2.4	1.4
41	4	5.6	1.9	4.1	1.5
42	4	4.8	2.5	4.0	1.0
43	4	5.9	2.6	4.5	1.5
44	4	3.7	1.3	2.5	1.0
45	4	8.1	4.7	6.6	1.6
46	4	4.2	1.2	3.2	1.4
Network summary	51	8.1	0.95	4.1	0.44
		RAM Stations[c]			
51	4	3.9	2.2	1.5	2.6
52	4	8.2	-10	2.5	8.7
53	4	6.9	-3.0	3.6	4.4

Table 23. (continued)

September 1988

Location	No. of Samples	Concentration (10^{-8} Bq/L)			
		Max	Min	Av	95% cc[a]
55	4	7.1	-5.9	1.6	5.5
56	3	3.7	-3.8	0.32	4.4
57	4	4.6	-2.2	1.3	2.8
58	4	9.2	-1.6	4.9	5.0
Network summary	27	9.2	-10	2.3	1.8
Overall summary	103	9.2	-10	3.4	0.55

[a]95% cc about the average of more than two samples.
[b]See Fig. 2.
[c]See Fig. 3.

Table 24. Long-lived gross beta activity in air

July 1988

Location	No. of Samples	Concentration (10^{-8} Bq/L) Max	Min	Av	95% cc[a]
		ORNL PAM Stations[b]			
3	4	87	58	76	13
4	4	140	98	110	18
7	4	150	68	99	38
9	4	160	54	92	45
20	4	130	82	100	23
21	4	140	92	110	22
22	3	110	89	100	11
Network summary	27	160	54	98	10
		Reservation PAM Stations[b]			
8	4	170	91	120	35
23	3	250	86	140	110
31	4	160	94	110	30
33	4	150	92	110	25
34	4	130	96	110	17
36	4	170	89	120	39
40	4	120	66	83	25
41	4	150	100	120	22
42	4	170	74	110	41
43	4	140	58	95	35
44	4	170	98	120	35
45	4	130	94	110	16
46	3	180	100	140	49
Network summary	50	250	58	110	9.9

Table 24. (continued)

July 1988

Location	No. of Samples	Concentration (10^{-8} Bq/L) Max	Min	Av	95% cc[a]
		RAM Stations[c]			
51	4	150	84	100	31
52	4	160	32	100	55
53	2	180	92	140	87
55	4	99	76	83	11
56	4	120	84	100	16
57	4	170	97	120	34
58	3	140	110	120	22
Network summary	25	180	32	110	13
Overall summary	102	250	32	110	6.5

[a]95% cc about the average of more than two samples.
[b]See Fig. 2.
[c]See Fig. 3.

Table 25. Long-lived gross beta activity in air

August 1988

Location	No. of Samples	Concentration (10^{-8} Bq/L) Max	Min	Av	95% cc[a]
		ORNL PAM Stations[b]			
3	5	140	62	110	27
4	5	140	120	130	6.9
7	5	130	81	110	16
9	5	120	57	84	22
20	5	130	120	130	8.2
21	5	150	110	130	15
22	4	180	70	130	45
Network summary	34	180	57	120	9.1
		Reservation PAM Stations[b]			
8	5	140	110	120	13
23	5	130	110	120	8.2
31	5	120	100	110	8.0
33	5	150	110	130	17
34	5	130	94	110	13
36	5	150	69	120	29
40	5	120	87	100	12
41	3	140	99	120	27
42	5	130	100	120	8.1
43	5	150	110	130	18
44	5	120	100	110	6.9
45	5	140	100	120	14
46	4	150	110	130	15
Network summary	62	150	69	120	4.2
		RAM Stations[c]			
51	5	140	92	110	15
52	4	160	120	140	19
53	5	180	130	150	19

Table 25. (continued)

August 1988

Location	No. of Samples	Concentration (10^{-8} Bq/L)			
		Max	Min	Av	95% cc[a]
55	5	110	73	93	16
56	5	130	67	100	21
57	5	160	120	140	13
58	5	160	72	130	30
Network summary	34	180	67	120	10
Overall summary	130	180	57	120	4.1

[a]95% cc about the average of more than two samples.
[b]See Fig. 2.
[c]See Fig. 3.

Table 26. Long-lived gross beta activity in air

September 1988

Location	No. of Samples	Concentration (10^{-8} Bq/L)			
		Max	Min	Av	95% cc[a]
		ORNL PAM Stations[b]			
3	4	110	100	110	5.6
4	4	120	66	97	24
7	2	95	91	93	4.4
9	4	92	68	82	10
20	4	110	100	110	3.3
21	3	120	110	110	7.8
22	4	110	93	100	6.7
Network summary	25	120	66	100	5.5
		Reservation PAM Stations[b]			
8	4	120	57	100	30
23	4	120	95	110	13
31	4	90	79	86	4.7
33	4	120	100	110	8.7
34	4	110	86	100	13
36	3	110	84	100	17
40	4	96	51	78	20
41	4	110	100	110	3.8
42	4	110	97	100	5.6
43	4	110	91	100	10
44	4	110	44	89	31
45	4	130	88	110	18
46	4	130	73	100	24
Network summary	51	130	44	99	5.0
		RAM Stations[c]			
51	4	94	65	83	13
52	4	150	110	120	15
53	4	140	100	120	17
55	4	110	54	84	29

Table 26. (continued)

September 1988

Location	No. of Samples	Concentration (10^{-8} Bq/L) Max	Min	Av	95% cc[a]
55	4	110	54	84	29
56	3	110	60	88	30
57	4	120	20	80	46
58	4	140	100	120	18
Network summary	27	150	20	100	12
Overall summary	103	150	20	100	4.1

[a]95% cc about the average of more than two samples.
[b]See Fig. 2.
[c]See Fig. 3.

Table 27. ^{131}Iodine concentrations in air

July 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	7.5	-3.6	0.35	4.9	< 0.01
4	4	5.3	0	2.8	2.4	< 0.01
7	4	4.7	0	2.6	2.1	< 0.01
9	4	5.0	0	1.9	2.4	< 0.01
20	4	13	-2.3	3.2	6.8	< 0.01
21	4	9.0	1.8	5.3	3.7	< 0.01
22	4	17	4.3	8.7	5.5	< 0.01
Network summary	28	17	-3.6	3.5	1.7	< 0.01
		Reservation PAM Stations[c]				
8	4	5.5	-4.9	1.6	4.6	< 0.01
23	4	1.9	-7.6	-2.6	3.9	< 0.01
31	4	8.3	-2.3	1.0	5.0	< 0.01
33	4	8.1	-7.0	3.3	6.9	< 0.01
34	4	10	0	4.3	4.4	< 0.01
36	4	0	-5.2	-1.8	2.4	< 0.01
40	4	1.9	0	0.90	1.0	< 0.01
41	4	22	-2.5	8.4	10	< 0.01
42	4	4.3	-3.3	-0.39	3.5	< 0.01
43	4	8.8	-5.0	0.95	5.7	< 0.01
44	4	1.7	0	0.43	0.87	< 0.01
45	4	8.9	-3.4	0.83	5.5	< 0.01
46	4	11	-2.7	2.5	5.8	< 0.01
Network summary	52	22	-7.6	1.5	1.5	< 0.01
Overall summary	80	22	-7.6	2.2	1.1	< 0.01

[a]95% cc 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 x 10^{-2} Bq/L.
[c]See Fig. 2.

Table 28. ^{131}Iodine concentrations in air

August 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	0	-5.5	-1.3	2.1	< 0.01
4	5	11	0	4.1	3.7	< 0.01
7	5	9.4	-4.2	3.0	4.5	< 0.01
9	5	4.3	-4.9	-0.51	3.8	< 0.01
20	5	5.4	-3.6	1.4	3.6	< 0.01
21	5	7.4	-2.3	2.8	3.5	< 0.01
22	4	16	0	6.4	6.8	< 0.01
Network summary	34	16	-5.5	2.1	1.6	< 0.01
		Reservation PAM Stations[c]				
8	5	3.6	-3.6	0.71	2.7	< 0.01
23	5	15	-3.8	4.6	6.4	< 0.01
31	5	13	0	7.0	4.7	< 0.01
33	5	4.1	-3.5	0.13	2.7	< 0.01
34	5	7.2	-1.9	3.1	3.4	< 0.01
36	5	12	2.0	5.6	3.4	< 0.01
40	5	5.6	1.9	3.2	1.6	< 0.01
41	5	4.5	-5.6	-0.87	4.3	< 0.01
42	5	16	-5.9	4.0	8.7	< 0.01
43	5	6.1	0	4.0	2.2	< 0.01
44	5	1.9	-3.8	-1.6	2.2	< 0.01
45	5	11	-3.9	2.5	5.7	< 0.01
46	5	6.5	-5.6	0.022	4.3	< 0.01
Network summary	65	16	-5.9	2.5	1.3	< 0.01
Overall summary	99	16	-5.9	2.4	1.0	< 0.01

[a]95% cc 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 Fig. 2.

Table 29. ^{131}Iodine concentrations in air

September 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	8.7	-3.1	1.3	5.4	< 0.01
4	4	9.4	-3.7	3.1	6.7	< 0.01
7	4	3.3	-190	-47	93	< 0.01
9	4	9.6	-3.8	1.0	5.9	< 0.01
20	4	18	1.8	8.9	7.9	< 0.01
21	4	11	-1.7	4.7	6.5	< 0.01
22	4	7.3	-1.9	2.1	4.0	< 0.01
Network summary	28	18	-190	-3.6	14	< 0.01
		Reservation PAM Stations[c]				
8	4	5.0	-1.7	2.1	2.8	< 0.01
23	4	9.7	-1.7	3.8	4.8	< 0.01
31	4	4.5	-3.0	0.33	3.5	< 0.01
33	4	5.8	-6.7	1.4	5.5	< 0.01
34	4	4.8	-4.6	1.6	4.3	< 0.01
36	4	9.8	-5.6	1.1	6.6	< 0.01
40	4	9.8	0	6.2	4.7	< 0.01
41	4	11	-2.6	3.6	5.8	< 0.01
42	4	5.2	-2.2	0.26	3.5	< 0.01
43	4	13	3.9	7.2	4.2	< 0.01
44	4	7.6	1.9	4.8	2.6	< 0.01
45	4	6.7	0	2.5	3.2	< 0.01
46	4	5.8	0	2.5	3.0	< 0.01
Network summary	52	13	-6.7	2.9	1.2	< 0.01
Overall summary	80	18	-190	0.60	4.8	< 0.01

[a]95% cc 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 x 10^{-2} Bq/L.
[c]See Fig. 2.

Table 30. Tritium activity in air

July - September 1988

Location[a]	No. of Samples	Concentration (10^{-4} Bq/L) Max	Min	Av	95% cc[b]	Percent DCG[c]
3	3	3.7	-120	-37	79	0.010
8	3	4.2	-130	-42	89	0.011
Overall summary	6	4.2	-130	-40	53	0.011

[a]See Fig. 2.
[b]95% cc 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.

values this quarter were below background, but this does not necessarily imply a decrease in tritium concentrations from those given in earlier reports.

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 for the third quarter were not available in time for publication of this report, but they will be included in the fourth quarter report.

RADIATION DOSES DUE TO LONG-LIVED AIRBORNE PARTICULATE RADIONUCLIDES

The purpose of this section is to provide some measure of potential radiation dose equivalents due to radionuclides filtered from air at locations within the ORNL perimeter, within or near the Oak Ridge reservation, and (for comparison) at the remote air monitors (Figs. 2 and 3). The dose calculations that follow are made from measurements of long-lived radioactivity in air filters presented as Tables 11-13 in both the first and second quarter reports for 1988. Dose calculations for subsequent quarters will be presented after the necessary data on radioactivity become available.

Most biological consequences of radionuclide releases to the environment involve the transfer of energy from radiation to human tissue, a process that may damage the tissue. The radiation may come from radionuclides located outside the body (in or on environmental media or objects) or from radionuclides deposited inside the body (via inhalation, ingestion, and in a few cases, absorption through the skin). Exposures to radiation from nuclides located outside the body are called external exposures. Exposures to radiation from nuclides deposited inside the body are called internal exposures. These two types of exposure differ as follows: (1) External exposures occur only when a person is near or in a radionclide-containing medium. Internal exposures continue as long as the radionuclides remain inside the person. (2) External exposures usually result in uniform irradiation of the entire body and all its components. Internal exposures usually result in nonuniform irradiation of the body. Most radionuclides, when taken into the body, deposit preferentially in specific organs or tissue and thus do not irradiate the body uniformly.

Several specialized units have been defined for characterizing exposures to ionizing radiation. Damage associated with such exposures is due primarily to the deposition of radiant energy in tissue. Therefore, the units are defined in terms of the amount of incident radiant energy absorbed by tissue and the biological consequences of the absorbed energy. Some of these units are as follows:

Absorbed Dose - A physical quantity that defines the amount of incident radiant energy absorbed per unit mass of an irradiated material. Its unit of measure is the rad. The absorbed dose depends on the type and energy of the incident radiation and on the atomic number of the absorbing material.

Dose Equivalent - A quantity that expresses the biological effectiveness of an absorbed dose in a specified human organ or tissue. Its unit of measure is the rem (or Sievert, sv; 1 sv = 100 rem). The dose equivalent is numerically equal to the absorbed dose multiplied by modifying factors that relate the absorbed dose to biological effects. In this report, as in many others, the term dose equivalent is often shortened to dose.

Effective Dose Equivalent - A measure of the overall carcinogenic and genetic risk resulting from exposures to radiations. It is a weighted sum of dose equivalents to eleven organs. The weighting factors and specific organs are described in Publications 26 and 30 of the International Commission on Radiological Protection (ICR, 1977, 1978).

Whole-Body Dose Equivalent - The dose equivalent received when the entire body is placed in a uniform radiation field. This condition can be achieved if the body is in a uniform external radiation field or if internally deposited radionuclides distribute uniformly throughout the body. For most radionuclides, the latter condition is not met.

Committed (Effective) Dose Equivalent - The total (effective) dose equivalent that will be received over a specified time period (50 years in this report) because of exposures to and intakes of radionuclides during the year of interest.

Estimation of potential dose equivalents due to airborne radionuclides at a specified air station was accomplished by calculating internal and external doses to a hypothetical, or reference, individual residing continually at the air station. In other cases, the reference individual was assumed to reside continually at a hypothetical location having airborne radionuclide concentrations representing the average situation for several air monitoring sites. Doses were calculated using a suite of computer codes developed under EPA sponsorship for use in demonstrating compliance with the National Emission Standards for Hazardous Air Pollutants. The atmospheric transport code AIRDOS-EPA was used to calculate radionuclide concentrations on the ground and in foodstuffs (meat, milk, and vegetables) resulting from the settling of contaminated particles at each location. Through the DARTAB computer code, conversion factors in the RADRISK database were applied to the calculated radionuclide concentrations to give estimates of dose contributions from inhalation of and immersion in contaminated air, from exposure to contaminated ground surfaces and from ingestion of locally grown foodstuffs (milk, meat, and vegetables). Beef, milk, and food crop production were assumed to be the maximum possible for the available ground area. It was further assumed that one third of all foodstuffs consumed were grown locally throughout the year. Because these doses are calculated from only those radionuclides measured on air filters, the contributions from tritium and noble gases are not included.

Whole-body and 50-year committed dose equivalents, due to measured quantities of airborne radioactive particulates, are presented in Table 31. Calculations are for stations 34, 36, 40, 41, 45, 46 and for the average of the remaining reservation PAMs, the average of the ORNL PAMs, and the average of the remote (or background) air monitors RAMs. Also presented are doses for the two organs, the lungs and endosteal (or surface) bone, that receive the highest doses from the measured mixes of airborne radionuclides. These results are presented for the first two quarters of 1988. Subsequent results will be presented in forthcoming quarterly reports.

At most locations, isotopes of thorium are the greatest airborne particulate contributors to the doses for lungs and endosteal bone. These isotopes are commonly found in natural soils and therefore commonly occur in airborne dust. Thorium isotopes also often provide the greatest

Table 31. Estimated dose from airborne particulate radionuclides

Station Number	Organ or Body Part	50-Year Committed Dose Equivalents (mrem) Jan-Mar	Apr-Jun	Total
34	Effective	0.21	0.35	0.56
	Lungs	1.2	2.4	3.6
	Endosteal bone	1.7	1.5	3.2
	Whole body[a]	0.000095	0.000002	0.000097
36	Effective	0.28	0.45	0.73
	Lungs	1.7	3.0	4.7
	Endosteal bone	2.0	2.0	4.0
	Whole body[a]	0.00018	0.00034	0.00052
40	Effective	0.22	0.35	0.57
	Lungs	1.2	2.4	3.6
	Endosteal bone	1.8	1.4	3.2
	Whole body[a]	0.00024	0.000037	0.00028
41	Effective	0.14	0.69	0.83
	Lungs	0.84	4.8	5.6
	Endosteal bone	0.88	2.9	3.8
	Whole body[a]	0.000076	0.000004	0.000080
45	Effective	0.33	0.55	0.88
	Lungs	2.4	3.6	6.0
	Endosteal bone	0.89	2.7	3.6
	Whole body[a]	0.000036	0.000005	0.000041
46	Effective	0.18	0.42	0.60
	Lungs	1.2	2.9	4.1
	Endosteal bone	0.72	1.7	2.4
	Whole body[a]	0.000045	0.000055	0.00010
ORNL PAMs	Effective	0.061	0.12	0.18
	Lungs	0.40	0.78	1.2
	Endosteal bone	0.31	0.59	0.90
	Whole body[a]	0.000071	0.000057	0.00013
Reservation PAMs	Effective	0.077	0.11	0.19
	Lungs	0.51	0.73	1.2
	Endosteal bone	0.35	0.51	0.86
	Whole body[a]	0.00010	0.000002	0.00010

Table 31. (continued)

Station Number	Organ or Body Part	50-Year Committed Dose Equivalents (mrem) Jan-Mar	Apr-Jun	Total
RAMs	Effective	0.068	0.075	0.14
	Lungs	0.44	0.49	0.93
	Endosteal bone	0.38	0.39	0.77
	Whole body[a]	0.000028	0.000027	0.000055

[a]Whole-body dose equivalents are due to external exposures that occur during the quarter of interest. They do not include cumulative doses from exposures to ground-deposited nuclides.

airborne particulate contributions to the effective dose. At some locations, however, uranium isotopes represent a greater contribution to the dose for lungs and occasionally to the effective dose. This especially tends to be the case at station 45, which is located near the Y-12 burial grounds. If iodine-131 is present in appreciable amounts, it will contribute the greatest dose to the thyroid.

Generally speaking, the calculated doses increased from first to second quarter. Increases in thorium isotopes were mainly responsible for the increased effective doses and also for the increased doses to the lungs and endosteal bone. Increased dust associated with dry weather and construction activities during the second quarter would be expected to produce increases in the airborne concentrations of those isotopes.

The highest committed dose from radionuclides in airborne particulates (0.88 mrem per half year at station 45) is less that 8% of the EPA whole-body standard (25 mrem/yr) from all sources. The highest committed dose from radionuclides in airborne particulates to a single organ (6 mrem, per half year, to the lungs, at station 45) is only 16% of the EPA standard (75 mrem/yr) from all sources to any single organ. In both of these cases, the calculated dose components correspond to an individual living continuously very near to the Y-12 burial grounds with one-third of the food supply provided by products grown year around at that same location.

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 PAMs, except for stations 9, 20-23, and 46 (Fig. 2). From these data, hourly averages are computed. Table 32 summarizes the valid hourly measurements for the third 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 32 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 the typical background values, which is to be expected considering the location of that particular monitor.

A decrease in the value for the PAM network summary, approximately 30% from second to third quarter, is a statistical artifact of the weighting by number of observations at each station. Specifically, station 4 (which, as explained above, consistently reports the highest values) reported about 40% fewer measurements this quarter than did any of the other stations in the PAM network. This was due to maintenance problems that have been corrected. Station average values for the quarter actually decreased at only one of the ORNL PAM stations, and the quarterly average for station 4 increased about 15% over the corresponding average for the second quarter.

The highest and lowest values of external gamma radiation at the reservation stations were both reported at station 41, where maximum values were anomalously high. The possibility of this being due to a system error in data reporting is being investigated.

Table 32. External gamma radiation measurements at ORNL and reservation perimeter air monitoring stations

July - September 1988

Location	No. of samples[a]	Concentration (nGy/h) Max	Min	Av
		ORNL PAM Stations[b]		
3	2061	120	60	70
4	1227	3724	1510	2461
7	2092	119	17	52
20	2019	150	80	87
Network summary	7399	3724	17	466
		Reservation PAM Stations[b]		
8	1692	141	62	73
31	1885	133	73	79
33	1944	129	72	81
34	1846	124	78	85
36	2126	112	70	76
40	1993	141	73	83
41	2026	249	59	98
42	2106	117	66	75
43	1952	161	65	74
44	1779	122	62	73
45	1978	115	63	71
Network summary	19301	249	59	87

[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 Fig. 2.

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 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 WOC 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 Fig. 4.

Surveillance of the water environment consists of the collection of surface water, effluent and sediment samples required under the National Pollutant Discharge Elimination System (NPDES) permit and groundwater from the SWSA 6. Samples are analyzed for radionuclides and nonradioactive chemicals.

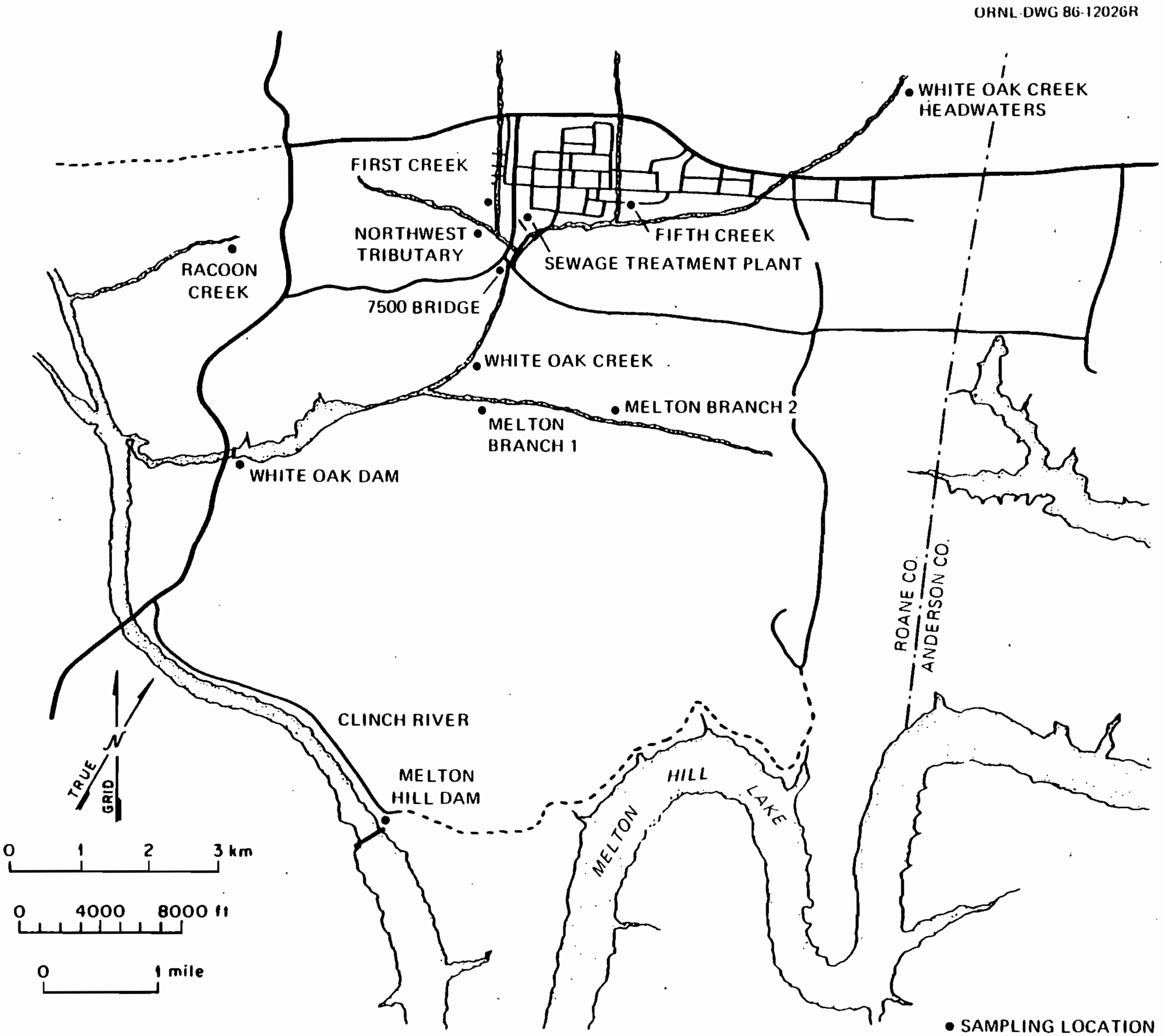

Fig. 4 Location map of ORNL streams and sampling stations

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, Melton Branch (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. Because facilities located near these creeks may discharge material to the creeks, sampling and analysis of the facility discharges are included in this section. ORNL's nonradiological sampling of these areas is 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 and groundwater 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 SWSA 5, blowdown from the recirculating cooling water system at the 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, HFIR ponds, WOC Headwaters, Melton Branch 1 (MB1), Melton Branch 2 (MB2), Melton Hill Dam, Northwest Tributary (NWT), Raccoon Creek, STP, Transuranium Processing Plant (TRU) Ponds, WOC, and WOD (Figs. 4 and 5). 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. Previously samples collected and analyzed daily at 7500 Bridge were used as an early warning of discharges of radioactivity from ORNL processes. However, this early warning capability is now provided by the real-time monitor at the WOC station, so the analysis of daily samples from the 7500 Bridge has been discontinued as of the third quarter of 1988. 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 NPDES Radiological Monitoring Plan.

Water samples are collected weekly at Kingston and ORGDP (Gallaher) water treatment plants and are analyzed quarterly for radionuclides (Fig. 6). 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

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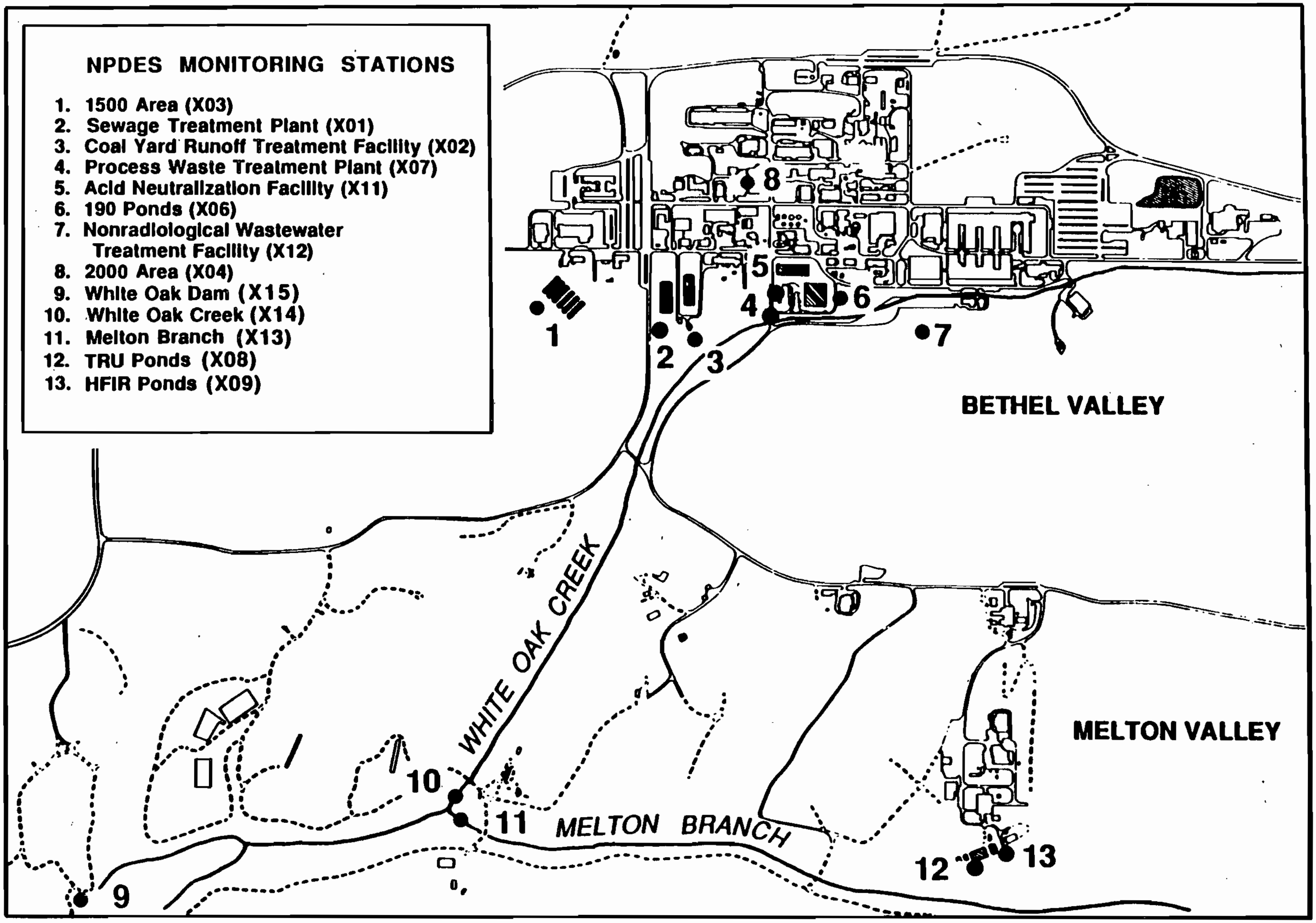

Fig. 5 Location map of NPDES monitoring points

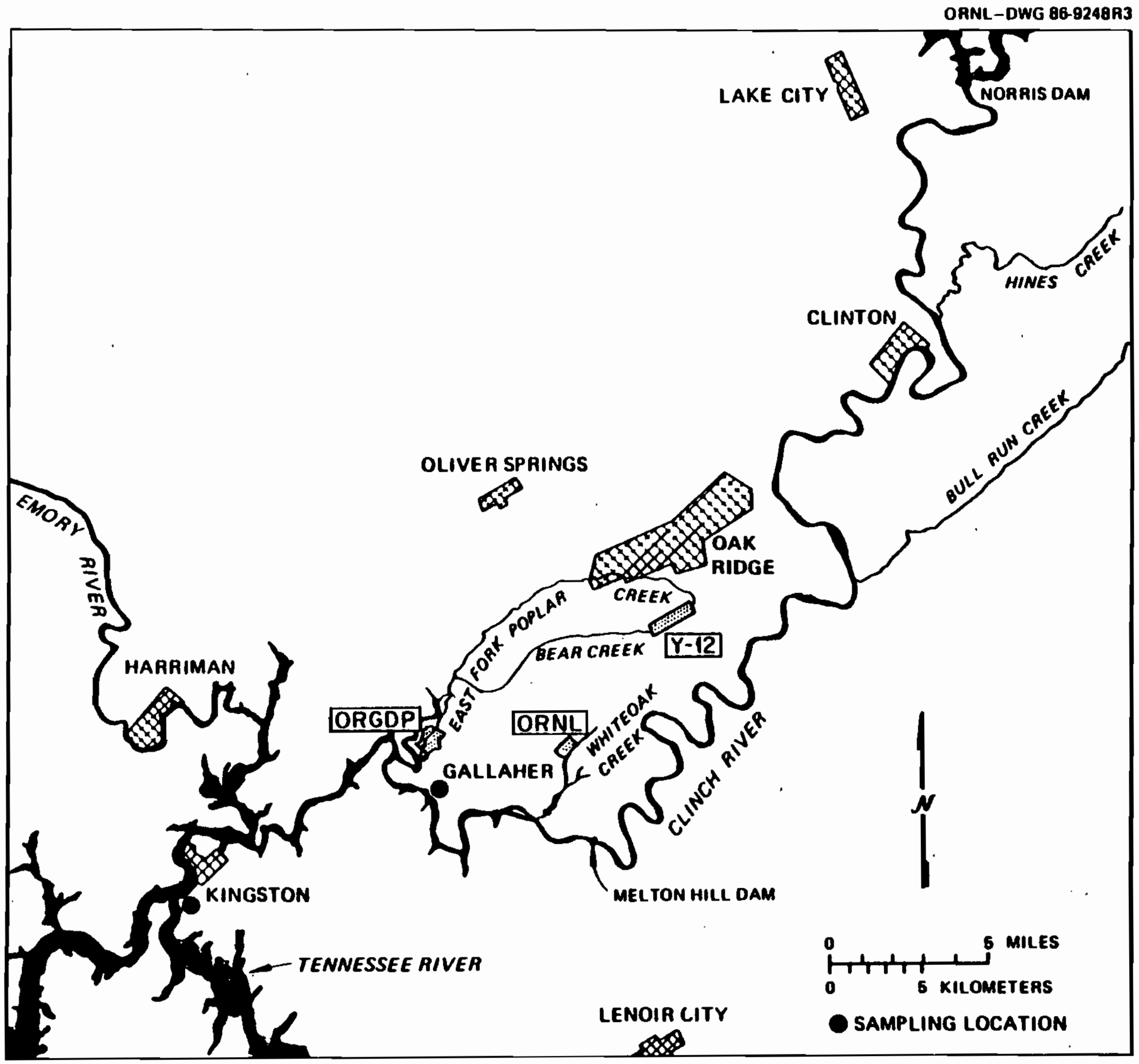

Fig. 6 Location map of Gallaher and Kingston sampling points

Dam (Fig. 6) and analyzed quarterly for radionuclides. 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.

Table 33 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 34-35. All determinations for "total Sr" are for total radioactive strontium which is the sum of ^{89}Sr and ^{90}Sr. The 95% cc about the average values have not been presented for stations with less than three samples.

September values of gross alpha and gross beta from the 1500 area were more than two orders of magnitude greater than normal, leading to unusually large maxima and averages for the quarter (Table 35). The cause of this increase is not known, but October values did drop back to 0.00 Bq/L for alpha (none detected) and 1.5 Bq/L for beta (which are more typical values).

The highest total radioactive Sr concentrations observed during this quarter were in First Creek with values ranging from 22 to 27 Bq/L (Table 35). These values are higher than the corresponding values for the previous quarter but lower than for the third quarter of 1986 or the third quarter of 1987. Strontium values at the Process Waste Treatment Plant were also elevated this quarter. Total radioactive Sr concentrations in Melton Branch 1 ranged from 8 to 11 Bq/L. These values are about 70% of the corresponding values for the previous quarter. At the Melton Hill Dam background station, total radioactive Sr ranged from 0.044 to 0.070 Bq/L. Most of the total radioactive Sr 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 Sr releases are more diffuse and are probably the result of surface and groundwater drainage rather than discharges from process facilities.

Cesium-137 concentration at the Process Waste Treatment Plant was greater than normal during early September leading to a high maximum and a high mean value for the third quarter. This was due to much above-normal concentration of cesium-137 in material fed to the plant from other locations. The situation had returned to normal by the end of September.

Concentrations of tritium are highest (36,000 to 42,000 Bq/L) at the MB1 station, probably due to releases from SWSA 5. Characterization of SWSA 5, particularly the tritium 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 36. The average ratios presented in the table were calculated weekly and averaged for the month. Even though rainfall for the quarter was above normal, the effect of the dry spell over the preceding two quarters is still evident in the flow of the Clinch River which, was 39% of the flow for the third quarter of 1987.

Table 33. 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

Table 33. (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 34. Quarterly summary of radionuclide concentrations in surface streams and tap water

July - September 1988

Radionuclide	Concentration (Bq/L)
Gallaher[a]	
^{60}Co	-0.0090
^{137}Cs	0.020
Gross alpha	0.011
Gross beta	0.27
Total Pu[b]	< 0.00011
Total Sr[c]	0.041
^{3}H	29
^{234}U	0.0053
^{235}U	0.00018
^{236}U	0.000012
^{238}U	0.0037
Kingston[a]	
^{60}Co	0.0051
^{137}Cs	-0.0013
Gross alpha	0.011
Gross beta	0.095
Total Pu[b]	< 0.00011
Total Sr[c]	0.015
^{3}H	9.1
^{234}U	0.0042
^{235}U	0.00014
^{236}U	0.000033
^{238}U	0.0027
Melton Hill Dam[a]	
^{60}Co	0.012
^{137}Cs	0.0073
Gross alpha	0.014
Gross beta	0.065
Total Pu[b]	< 0.00011
Total Sr[c]	0.0066
^{234}U	0.0013
^{235}U	0.000040
^{236}U	< 0.0000009
^{238}U	0.00083

Table 34. (continued)

Radionuclide	Concentration (Bq/L)
ORNL Tap Water	
^{60}Co	0.0050
^{137}Cs	0.0050
Gross alpha	0.016
Gross beta	0.062
Total Pu[b]	< 0.00011
Total Sr[c]	0.0020
^{234}U	0.0016
^{235}U	0.000046
^{236}U	< 0.0000007
^{238}U	0.00095

[a]See Fig. 6.
[b]Total Pu (^{239}Pu + ^{240}Pu).
[c]Total radioactive Sr (^{89}Sr + ^{90}Sr).

Table 35. Radionuclide concentrations in water around ORNL

July - September 1988

Radionuclide	No. of Samples	Concentration (Bq/L) Max	Min	Av	95% cc[a]
		1500 Area[b]			
Gross alpha	3	48	0.070	16	32
Gross beta	3	210	0.60	71	140
		190 Ponds[b]			
^{60}Co	3	0.60	-0.20	0.17	0.47
^{137}Cs	3	1.0	-0.050	0.54	0.62
Gross alpha	3	0.55	0.10	0.38	0.28
Gross beta	3	2.2	0.36	1.4	1.1
		First Creek[c]			
^{60}Co	3	1.0	-0.070	0.38	0.64
^{137}Cs	3	0.10	0.040	0.067	0.035
Total Sr[d]	3	27	22	25	2.9
		2000 Area[b]			
^{60}Co	3	0.20	-0.040	0.11	0.15
^{137}Cs	3	0.40	-0.080	0.11	0.29
Gross beta	3	3.7	0.18	1.6	2.1
Total Sr[d]	3	0.25	-0.040	0.12	0.17
		Acid Neutralization Facility[b]			
Gross alpha	3	0.35	0.0	0.13	0.22
Gross beta	3	1.5	0.64	0.93	0.57
		Process Waste Treatment Plant[b]			
^{60}Co	3	3.2	1.3	2.0	1.2
^{137}Cs	3	410	110	210	200
Gross alpha	3	1.5	0.14	0.88	0.79
Gross beta	3	130	100	110	18
Total Sr[d]	3	12	2.6	6.4	5.7

Table 35. (continued)

July - September 1988

Radionuclide	No. of Samples	Concentration (Bq/L) Max	Min	Av	95% cc[a]
		Fifth Creek[c]			
^{60}Co	3	0.16	-0.30	-0.11	0.28
^{137}Cs	3	0.10	-0.030	0.020	0.081
Total Sr[d]	3	5.0	2.0	3.2	1.8
		7500 Bridge[c]			
^{60}Co	3	0.20	0.12	0.17	0.048
^{137}Cs	3	8.8	2.1	5.2	3.9
Total Sr[d]	3	4.3	2.9	3.4	0.87
^{3}H	3	71	38	52	20
		HFIR[b]			
^{60}Co	3	230	130	170	59
^{137}Cs	3	0.40	-2.2	-0.53	1.7
Gross alpha	3	1.2	0.24	0.69	0.56
Gross beta	3	170	12	110	99
		White Oak Creek Headwaters[c]			
^{241}Am	3	0.011	0.00010	0.0055	0.0063
^{244}Cm	3	-0.0016	-0.019	-0.011	0.010
^{60}Co	3	0.90	-0.050	0.31	0.60
^{137}Cs	3	0.080	-1.0	-0.30	0.70
Gross alpha	3	0.32	0.0	0.15	0.19
^{238}Pu	3	0.0024	-0.00010	0.0013	0.0015
^{239}Pu	3	0.0079	-0.0010	0.0022	0.0057
Total Sr[d]	3	0.15	-0.060	0.013	0.14
^{3}H	3	19	-44	-7.3	38
		Melton Branch 1[c]			
^{60}Co	3	4.2	0.10	1.8	2.5
^{137}Cs	3	1.7	0.010	0.64	1.1
Total Sr[d]	3	11	7.9	9.6	1.8
^{3}H	3	42000	36000	39000	3500

Table 35. (continued)

July - September 1988

Radionuclide	No. of Samples	Concentration (Bq/L) Max	Min	Av	95% cc[a]
		Melton Branch 2[c]			
^{60}Co	3	3.3	1.5	2.6	1.1
^{137}Cs	3	0.40	< 0.13	< 0.28	0.16
Total Sr[d]	3	0.18	0.020	0.083	0.098
^{3}H	3	1100	720	920	220
		Melton Hill Dam[c]			
^{241}Am	3	0.011	0.0030	0.0060	0.0050
^{244}Cm	3	0.012	-0.0037	0.0033	0.0092
^{60}Co	3	0.010	-0.10	-0.037	0.066
^{137}Cs	3	0.18	0.10	0.13	0.050
Gross alpha	3	0.18	0.0	0.083	0.10
^{238}Pu	3	0.0028	-0.0019	0.00037	0.0027
^{239}Pu	3	0.32	-0.0062	0.11	0.21
Total Sr[d]	3	0.070	0.044	0.055	0.016
^{3}H	3	12	-57	-16	42
		Northwest Tributary[c]			
^{60}Co	3	1.4	-0.30	0.38	1.0
^{137}Cs	3	-0.010	-0.20	-0.10	0.11
Total Sr[d]	3	1.0	0.25	0.64	0.43
		Raccoon Creek[c]			
^{60}Co	3	0.22	0.070	0.16	0.094
^{137}Cs	3	0.080	-0.60	-0.17	0.43
Total Sr[d]	3	7.6	2.3	5.1	3.1
		Sewage Treatment Plant[c]			
^{60}Co	3	0.18	-0.90	-0.31	0.63
^{137}Cs	3	0.60	0.21	0.35	0.25
Gross beta	3	7.1	0.50	4.2	3.9
Total Sr[d]	3	2.8	2.5	2.6	0.20

Table 35. (continued)

July - September 1988

Radionuclide	No. of Samples	Concentration (Bq/L) Max	Min	Av	95% cc[a]
		TRU Ponds[b]			
Gross beta	3	4.5	0.39	2.4	2.4
		White Oak Creek[c]			
^{60}Co	3	1.0	0.020	0.39	0.62
^{137}Cs	3	5.9	1.5	3.4	2.6
Total Sr[d]	3	3.9	2.3	3.1	0.93
^{3}H	3	180	84	130	56
		White Oak Dam[c]			
^{241}Am	13	0.029	0.00050	0.0068	0.0042
^{244}Cm	13	0.058	-0.016	0.010	0.0092
^{60}Co	13	0.54	< 0.050	< 0.27	0.083
^{137}Cs	13	6.0	0.23	1.5	0.85
Gross beta	13	16	5.4	9.8	1.7
^{238}Pu	13	0.0050	-0.0014	0.0011	0.0011
^{239}Pu	13	0.012	-0.0043	0.0024	0.0026
Total Sr[d]	13	5.1	3.3	4.1	0.33
^{3}H	13	3200	1600	2300	320

[a]95% cc about the average of more than two samples.
[b]See Fig. 5.
[c]See Fig. 4.
[d]Total radioactive Sr (^{89}Sr + ^{90}Sr).

Table 36. Flows for Clinch River and White Oak Creek

July - September 1988

	Flow (10^9 L)		
Month	Clinch River[a]	White Oak Creek[a]	Average Ratio[b]
July	160	0.65	280
August	170	0.52	340
September	130	0.62	260

[a]See Fig. 6.
[b]Flow ratios Clinch River: White Oak Creek are calculated daily and averaged for the month.

The total hourly flows at WOC, MB, and WOD were calculated by multiplying the average 10-minute flow rate (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.

The discharges of radionuclides at WOD, WOC, 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 37-39). 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 37-39).

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 5400.3) (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 MB1 are higher, being about 25% of the DCG for strontium and about 50% of the DCG for tritium in each month of the third quarter.

Cobalt-60 concentration at MB1 was somewhat elevated in August (Table 38), although still less than 3% of the DCG of 190 Bq/L of water. This increase followed a discharge from one of the HFIR ponds. Cobalt-60 level at MB1 returned to previous levels in September (Table 39).

Table 37. Radionuclide concentrations and releases at ORNL

July 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	44	0.0053	1.2	190	0.65
^{137}Cs	44	0.00096	0.22	110	0.20
Total Sr[c]	44	0.044	10	37	27
^{3}H	44	180	42000	74000	57
			Sewage Treatment Plant[a]		
^{60}Co	26	-0.00052	-0.20	190	< 0.001
^{137}Cs	26	0.00065	0.25	110	0.23
Gross beta	26	0.013	5.0	N/A	N/A
Total Sr[c]	26	0.0065	2.5	37	6.8
			White Oak Creek[a]		
^{60}Co	480	0.00096	0.020	190	0.011
^{137}Cs	480	0.072	1.5	110	1.4
Total Sr[c]	480	0.14	3.0	37	8.1
^{3}H	480	6.7	140	74000	0.19
			White Oak Dam[a,b]		
^{241}Am	660	0.00028	0.0043	1.1	0.38
^{244}Cm	660	-0.000054	-0.00082	2.2	< 0.001
^{60}Co	660	< 0.020	< 0.30	190	0.16
^{137}Cs	660	0.050	0.77	110	0.69
Gross beta	660	0.59	9.0	N/A	N/A
^{238}Pu	660	0.000037	0.00056	1.5	0.038
^{239}Pu	660	-0.000043	-0.00066	1.1	< 0.001
Total Sr[c]	660	0.25	3.8	37	10
^{3}H	660	140	2200	74000	3.0

[a]See Fig. 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 38. Radionuclide concentrations and releases at ORNL

August 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	15	0.0064	4.2	190	2.3
^{137}Cs	15	0.000015	0.010	110	0.0090
Total Sr[c]	15	0.012	7.9	37	21
^{3}H	15	54	36000	74000	49
			Sewage Treatment Plant[a]		
^{60}Co	25	0.00046	0.18	190	0.097
^{137}Cs	25	0.00053	0.21	110	0.19
Gross beta	25	0.018	7.1	N/A	N/A
Total Sr[c]	25	0.0063	2.5	37	6.8
			White Oak Creek[a]		
^{60}Co	420	0.0058	0.14	190	0.076
^{137}Cs	420	0.12	2.8	110	2.5
Total Sr[c]	420	0.096	2.3	37	6.2
^{3}H	420	3.5	84	74000	0.11
			White Oak Dam[a,b]		
^{241}Am	520	0.00028	0.0054	1.1	0.49
^{244}Cm	520	0.00059	0.011	2.2	0.50
^{60}Co	520	0.011	0.20	190	0.11
^{137}Cs	520	0.082	1.6	110	1.4
Gross beta	520	0.52	10	N/A	N/A
^{238}Pu	520	0.000072	0.0014	1.5	0.093
^{239}Pu	520	0.00017	0.0032	1.1	0.29
Total Sr[c]	520	0.21	4.1	37	11
^{3}H	520	120	2200	74000	3.0

[a]See Fig. 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 39. Radionuclide concentrations and releases at ORNL

September 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	58	0.00058	0.10	190	0.054
^{137}Cs	58	0.0099	1.7	110	1.5
Total Sr[c]	58	0.064	11	37	30
^{3}H	58	230	40000	74000	54
		Sewage Treatment Plant[a]			
^{60}Co	24	-0.0021	-0.90	190	< 0.001
^{137}Cs	24	0.0014	0.60	110	0.54
Gross beta	24	0.0012	0.50	N/A	N/A
Total Sr[c]	24	0.0066	2.8	37	7.6
		White Oak Creek[a]			
^{60}Co	880	0.088	1.0	190	0.54
^{137}Cs	880	0.52	5.9	110	5.3
Total Sr[c]	880	0.34	3.9	37	11
^{3}H	880	16	180	74000	0.24
		White Oak Dam[a,b]			
^{241}Am	620	0.00084	0.014	1.1	1.2
^{244}Cm	620	0.0017	0.027	2.2	1.2
^{60}Co	620	0.023	0.37	190	0.20
^{137}Cs	620	0.18	3.0	110	2.7
Gross beta	620	0.68	11	N/A	N/A
^{238}Pu	620	0.00013	0.0020	1.5	0.14
^{239}Pu	620	0.00039	0.0062	1.1	0.56
Total Sr[c]	620	0.26	4.2	37	11
^{3}H	620	150	2500	74000	3.4

[a]See Fig. 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).

National Pollutant Discharge Elimination System 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 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 Fig. 5. 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 third quarter of 1988 are given for each sampling location in Tables 40 through 55. 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 56 through 58. A brief summary of the noncompliances follows.

July 1988

During the period July 1-31, 1988, ORNL experienced three NPDES noncompliances. No problems or operational upsets occurred at the Sewage Treatment Plant (STP) that would account for the July 13, 1988, fecal coliform noncompliance. ORNL personnel are currently evaluating several options for improving STP NPDES permit compliance.

A cause for the fecal coliform and oil and grease violations at VC7002 has not been found. The possibility of in-leakage from sanitary sewer pipes is being investigated.

August 1988

ORNL Category II outfalls were not monitored in August; however, a visible sheen in First Creek was traced to outfall 249. The source process was determined and procedures were revised to prevent future occurrences.

The chlorine-level noncompliances at the ORNL cooling towers were attributed to imprecise addition of chlorine. Cooling tower maintenance procedures and procedure implementation are undergoing review and improvement.

The downstream pH limit exceedance at cooling tower 4509 was not a violation of a numeric limit in the ORNL permit. However, it was a violation of a Tennessee stream standard for streams classified for "fish and aquatic life."

Table 40. NPDES discharge point X01[a]

July - September 1988

Parameter	No. of Samples	Concentration (mg/L) Max	Min	Av	95% cc[b]
Ag	3	< 0.0060	< 0.0060	< 0.0060	0
BOD[c]	39	< 5.0	< 5.0	< 5.0	0
Bromodichloromethane	3	0.0020	0.0020	0.0020	0
Cl	39	0.90	< 0.010	< 0.34	0.048
Cyanide	3	< 0.0020	< 0.0010	< 0.0017	0.00067
Cr	1	0.0060	0.0060	0.0060	
Cu	3	0.013	< 0.010	< 0.012	0.0018
DO[d]	63	8.7	6.0	7.0	0.17
Downstream pH[e]	13	8.0	6.8	NA[f]	NA[f]
Fecal coliform[g,h]	37	> 600	< 1.0	1.3	2.9
Flow[i]	64	0.32	0.12	0.21	0.011
Hg	3	< 0.00020	< 0.00020	< 0.00020	0
NH_4 (As N)	39	0.49	0.020	0.086	0.030
Oil and grease	39	12	< 2.0	< 2.8	0.67
pH[e]	13	7.8	6.8	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	5.0	< 5.0	< 5.0	0
Zn	3	0.055	0.048	0.052	0.0042

[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 41. NPDES discharge point X02[a]

July - September 1988

Parameter	No. of Samples	Concentration (mg/L) Max	Min	Av	95% cc[b]
Ag	13	< 0.0060	< 0.0060	< 0.0060	0
As	13	0.090	< 0.060	< 0.066	0.0056
Cd	13	< 0.0020	< 0.0010	< 0.0013	0.00027
Cr	13	0.0088	< 0.0050	< 0.0066	0.00078
Cu	13	0.019	< 0.010	< 0.011	0.0014
Downstream pH[c]	63	8.8	6.5	NA[d]	NA[d]
Fe	13	0.39	0.053	0.15	0.046
Flow[e]	63	0.30	0	0.0099	0.012
Mn	13	0.080	0.013	0.043	0.011
Ni	13	0.13	< 0.0060	< 0.018	0.019
Oil and grease	13	9.0	< 2.0	< 3.0	1.1
Pb	13	< 0.050	< 0.030	< 0.036	0.0053
pH	63	9.0	6.1	7.3	0.13
Se	13	0.16	< 0.050	< 0.077	0.018
SO_4	3	1900	1600	1800	180
Temperature[f]	48	33	20	27	0.88
TSS[g]	13	20	< 5.0	< 10	2.1
Zn	13	0.091	< 0.0080	< 0.026	0.012

[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 42. NPDES discharge point X03[a]

July - September 1988

		Concentration (mg/L)			
Parameter	No. of Samples	Max	Min	Av	95% cc[b]
As	6	< 0.060	< 0.060	< 0.060	0
Cd	6	0.019	< 0.0010	< 0.0042	0.0060
Cr	6	0.0061	< 0.0050	< 0.0054	0.00044
Cu	6	0.018	< 0.010	< 0.013	0.0027
Downstream pH[c]	13	8.1	7.0	NA[d]	NA[d]
Fe	6	0.12	0.041	0.077	0.026
Flow[e]	4	0.054	0.037	0.044	0.0071
Ni	6	0.0064	< 0.0060	< 0.0061	0.00013
Oil and grease	6	28	< 2.0	< 6.8	8.5
P	6	1.5	0.20	0.51	0.40
Pb	6	< 0.050	< 0.030	< 0.033	0.0067
pH	13	8.6	7.2	7.7	0.21
Temperature[f]	15	29	20	24	1.3
TOC[g]	6	17	1.8	6.1	4.9
TSS[h]	6	6.0	< 5.0	< 5.2	0.33
Zn	6	0.10	0.039	0.078	0.019

[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 43. NPDES discharge point X04[a]

July - September 1988

	Concentration (mg/L)				
Parameter	No. of Samples	Max	Min	Av	95% cc[b]
Ag	6	< 0.0060	< 0.0060	< 0.0060	0
As	6	< 0.060	< 0.060	< 0.060	0
Cd	6	< 0.0020	< 0.0010	< 0.0012	0.00033
Cr	6	< 0.0060	< 0.0050	< 0.0052	0.00033
Cu	6	0.25	< 0.010	0.052	0.079
Downstream pH[c]	13	8.3	7.6	NA[d]	NA[d]
Flow[e]	4	0.015	0.0041	0.011	0.0047
Ni	6	< 0.0060	< 0.0060	< 0.0060	0
Oil and grease	6	4.0	< 2.0	< 2.3	0.67
P	6	0.30	0.20	0.23	0.042
Pb	6	< 0.050	< 0.030	< 0.033	0.0067
pH[c]	13	8.2	7.3	NA[d]	NA[d]
Temperature[f]	15	28	19	23	1.2
TOC[g]	6	3.5	1.6	2.1	0.59
TSS[h]	6	< 5.0	< 5.0	< 5.0	0
Zn	6	0.15	0.11	0.13	0.011

[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 44. NPDES discharge point X06[a]

July - September 1988

Parameter	No. of Samples	Concentration (mg/L) Max	Min	Av	95% cc[b]
As	6	< 0.060	< 0.060	< 0.060	0
Cd	6	0.0020	< 0.0010	< 0.0014	0.00036
Cr	6	0.029	< 0.0050	< 0.015	0.0080
Cu	6	0.19	0.067	0.12	0.038
Downstream pH[c]	13	8.0	6.9	NA[d]	NA[d]
Flow[e]	3	0.20	0.17	0.18	0.014
Ni	6	0.016	< 0.0060	< 0.0078	0.0032
Oil and grease	6	3.0	< 2.0	< 2.2	0.33
Pb	6	0.11	0.038	0.065	0.023
pH[c]	13	8.0	6.6	NA[d]	NA[d]
Se	6	< 0.060	< 0.050	< 0.052	0.0033
SO_4	6	31	22	26	2.6
Temperature[f]	16	27	20	24	0.77
TOC[g]	6	4.9	2.4	3.3	0.78
TSS[h]	6	13	< 5.0	< 7.3	2.8
Zn	6	0.24	0.063	0.13	0.052

[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 45. NPDES discharge point X07[a]

July - September 1988

Parameter	No. of Samples	Concentration (mg/L) Max	Min	Av	95% cc[b]
Ag	6	< 0.0060	< 0.0060	< 0.0060	0
As	6	< 0.060	< 0.060	< 0.060	0
Cd	6	< 0.0020	< 0.0010	< 0.0012	0.00033
Cr	6	0.012	< 0.0050	< 0.0079	0.0021
Cu	6	0.17	0.034	0.081	0.040
Downstream pH[c]	13	8.1	6.6	NA[d]	NA[d]
Flow[e]	63	0.29	0.0018	0.18	0.021
Ni	6	< 0.0060	< 0.0060	< 0.0060	0
NO_3	6	6.9	< 5.0	< 5.6	0.76
O&G	6	3.0	< 2.0	< 2.3	0.42
Pb	6	< 0.050	< 0.030	< 0.033	0.0067
pH[c]	13	8.0	6.1	NA[d]	NA[d]
SO_4	6	360	180	260	51
Temperature[f]	15	30	21	25	1.3
TOC[g]	6	2.7	1.8	2.4	0.27
TSS[h]	6	< 5.0	< 5.0	< 5.0	0
TTO[i]	6	< 0.010	< 0.010	< 0.010	0
Zn	6	0.021	< 0.0080	< 0.011	0.0040

[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 46. NPDES discharge point X09[a]

July - September 1988

Parameter	No. of Samples	Concentration (mg/L)		
		Max	Min	Av
As	1	< 0.060	< 0.060	< 0.060
Cd	1	0.0017	0.0017	0.0017
Cr	1	0.014	0.014	0.014
Cu	1	0.047	0.047	0.047
Downstream pH[b]	0			
Flow[c]	1	0.0042	0.0042	0.0042
Ni	1	< 0.0060	< 0.0060	< 0.0060
NO_3	1	< 5.0	< 5.0	< 5.0
Oil and grease	1	2.0	2.0	2.0
Pb	1	< 0.030	< 0.030	< 0.030
pH[d]	1	7.4	7.4	NA[e]
SO_4	1	29	29	29
Temperature[f]	1	28	28	28
TOC[g]	1	6.0	6.0	6.0
TSS[h]	1	< 5.0	< 5.0	< 5.0
Zn	1	0.061	0.061	0.061

[a]HFIR waste basins, ORNL.
[b]Not taken.
[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.
[g]Total organic carbon.
[h]Total suspended solids.

Table 47. NPDES discharge point X11[a]

July - September 1988

Parameter	No. of Samples	Concentration (mg/L)			
		Max	Min	Av	95% cc[b]
As	6	< 0.060	< 0.060	< 0.060	0
Cd	6	< 0.0020	< 0.0010	< 0.0012	0.00033
Cr	6	0.011	< 0.0050	< 0.0082	0.0016
Cu	6	0.085	0.010	0.026	0.024
Downstream pH[c]	13	8.2	6.9	NA[d]	NA[d]
Flow[e]	3	0.031	0.029	0.030	0.0015
Ni	6	0.0069	< 0.0060	< 0.0062	0.00030
NO_3	13	12	2.7	5.6	1.4
Oil and grease	6	2.0	< 2.0	< 2.0	0
P	6	4.8	1.9	3.3	0.84
Pb	6	< 0.050	< 0.030	< 0.033	0.0067
pH[c]	13	8.0	6.2	NA[d]	NA[d]
SO_4	13	1900	370	820	300
Temperature[f]	15	32	19	23	1.4
TOC[g]	13	10	1.9	4.0	1.1
TSS[h]	6	75	7.0	30	23
Zn	6	0.50	0.21	0.33	0.093

[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 48. NPDES discharge point X13[a]

July - September 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	0.81	0.38	0.59	0.25
As	3	< 0.060	< 0.060	< 0.060	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	0.80	0.25	0.48	0.33
Cr	3	0.0069	< 0.0050	< 0.0060	0.0011
Cu	3	< 0.010	< 0.010	< 0.010	0
DO[e]	13	16	3.8	9.5	1.8
F	3	1.0	1.0	1.0	0
Fe	3	0.55	0.25	0.43	0.18
Flow[f]	63	3.2	0.14	0.43	0.13
Hg	3	< 0.00005	< 0.00005	< 0.00005	0
Mn	3	0.19	0.10	0.16	0.060
NH_4 (as N)	3	0.080	0.026	0.062	0.036
Ni	3	< 0.0060	< 0.0060	< 0.0060	0
NO_3	3	< 5.0	< 5.0	< 5.0	0
Oil & grease	13	7.0	< 2.0	< 3.2	0.88
P	3	0.40	0.20	0.30	0.12
Pb	3	< 0.0040	< 0.0040	< 0.0040	0
PCB	3	< 0.00050	< 0.00050	< 0.00050	0
pH[g]	3	8.9	8.0	NA[h]	NA[h]
Phenols	3	< 0.0010	< 0.0010	< 0.0010	0
SO_4	3	34	27	30	4.1
TDS[i]	3	220	150	190	41
Temperature[j]	12	30	19	24	1.7
TOC[k]	3	6.4	2.7	4.0	2.4
Trichloroethylene	3	< 0.0050	< 0.0050	< 0.0050	0
TSS[l]	3	62	13	35	29
Turbidity[m]	3	180	15	72	110

Table 48. (continued)

July - September 1988

		Concentration (mg/L)			
Parameter	No. of Samples	Max	Min	Av	95% cc[b]
Zn	3	0.039	0.014	0.025	0.015

[a]Melton Branch, ORNL.
[b]95% confidence coefficient about the average.
[c]Biological oxygen demand.
[d]Expressed in mS/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 49. NPDES discharge point X14[a]

July - September 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	0.37	0.31	0.35	0.040
As	3	< 0.060	< 0.060	< 0.060	0
BOD[c]	3	< 5.0	< 5.0	< 5.0	0
Cd	3	< 0.0020	< 0.0020	< 0.0020	0
Chloroform	3	0.0040	0.0030	0.0037	0.00067
Cl	12	< 0.010	< 0.010	< 0.010	0
Conductivity[d]	3	0.80	0.20	0.50	0.35
Cr	3	0.0060	< 0.0050	< 0.0056	0.00064
Cu	3	0.013	0.011	0.012	0.0012
DO[e]	13	12	5.8	8.1	0.93
F	3	1.1	1.0	1.0	0.067
Fe	3	0.21	0.16	0.18	0.031
Flow[f]	60	13	0.32	4.1	0.53
Hg	3	0.00010	0.00007	0.000087	0.000018
Mn	3	0.031	0.028	0.029	0.0023
NH_4 (as N)	3	0.080	0.044	0.061	0.021
Ni	3	< 0.0060	< 0.0060	< 0.0060	0
NO_3	3	< 5.0	< 5.0	< 5.0	0
Oil and grease	13	4.0	< 2.0	< 2.5	0.43
P	3	0.30	0.20	0.27	0.067
Pb	3	< 0.0040	< 0.0040	< 0.0040	0
PCB	3	< 0.00050	< 0.00050	< 0.00050	0
pH[g]	3	8.3	7.6	NA[h]	NA[h]
Phenols	3	0.0010	< 0.0010	< 0.0010	0
SO_4	3	52	44	48	4.7
TDS[i]	3	250	120	200	83
Temperature[j]	12	29	21	25	1.4
TOC[k]	3	4.0	2.1	2.9	1.1
Trichloroethylene	3	< 0.0050	< 0.0050	< 0.0050	0
TSS[l]	3	13	5.0	8.3	4.8
Turbidity[m]	3	140	10	54	86

Table 49. (continued)

July - September 1988

Parameter	No. of Samples	Concentration (mg/L)			
		Max	Min	Av	95% cc[b]
Zn	3	0.035	0.031	0.033	0.0027

[a]White Oak Creek, ORNL.
[b]95% confidence coefficient about the average.
[c]Biological oxygen demand.
[d]Expressed in mS/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 50. NPDES discharge point X15[a]

July - September 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	1.7	0.50	0.96	0.76
As	3	< 0.060	< 0.060	< 0.060	0
BOD[c]	3	< 5.0	< 5.0	< 5.0	0
Cd	3	< 0.0020	< 0.0020	< 0.0020	0
Chloroform	3	< 0.0050	0.0010	0.0023	0.0027
Cl	13	< 0.010	< 0.010	< 0.010	0
Conductivity[d]	3	0.70	0.35	0.48	0.22
Cr	3	0.033	0.010	0.019	0.014
Cu	3	0.020	< 0.010	< 0.016	0.0061
DO[e]	13	15	6.0	9.1	1.5
F	3	1.1	1.0	1.0	0.067
Fe	3	1.8	0.37	0.87	0.89
Flow[f]	63	19	3.1	5.2	0.58
Hg	3	0.00010	< 0.00005	< 0.000067	0.000033
Mn	3	0.19	0.044	0.096	0.089
NH_4	3	0.18	0.021	0.10	0.092
Ni	3	0.0095	< 0.0060	< 0.0072	0.0023
NO_3	3	< 5.0	< 5.0	< 5.0	0
Oil and grease	13	38	< 2.0	< 12	6.8
P	3	0.30	0.20	0.23	0.067
Pb	3	< 0.0040	< 0.0040	< 0.0040	0
PCB	3	< 0.00050	< 0.00050	< 0.00050	0
pH[g]	3	8.9	8.4	NA[h]	NA[h]
SO_4	3	69	52	59	10
TDS[i]	3	280	220	250	33
Temperature[j]	12	32	20	27	1.9
TOC[k]	3	4.2	3.5	3.8	0.41
Trichloroethylene	3	< 0.0050	< 0.0050	< 0.0050	0
TSS[l]	3	61	8.0	27	34
Turbidity[m]	3	78	12	39	40

Table 50. (continued)

July - September 1988

Parameter	No. of Samples	Concentration (mg/L)			
		Max	Min	Av	95% cc[b]
Zn	3	0.058	0.019	0.034	0.024

[a]White Oak Dam, ORNL.
[b]95% confidence coefficient about the average.
[c]Biological oxygen demand.
[d]Expressed in mS/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 51. NPDES miscellaneous source VC7002[a]

July - September 1988

Parameter	No. of Samples	Concentration (mg/L) Max	Min	Av	95% cc[b]
BOD[c]	3	6.0	< 5.0	< 5.3	0.67
Downstream pH[d]	3	7.6	7.5	NA[e]	NA[e]
Fecal coliform[f]	3	> 600	< 1.0	< 200	400
Oil and grease	3	14	4.0	7.7	6.4
pH[s] d	3	7.5	7.2	NA[e]	NA[e]
Phenols	3	0.021	0.0030	0.0090	0.012
TSS[g]	3	320	< 5.0	< 110	210

[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 52. NPDES cooling towers[a]

July - September 1988

Parameter	No. of Samples	Concentration (mg/L)			
		Max	Min	Av	95%cc[b]
Cl	23	0.50	0	0.081	0.069
Cr	24	0.20	< 0.0050	< 0.024	0.019
Cu	24	1.0	< 0.010	< 0.12	0.085
Downstream pH[c]	16	8.7	8.0	NA[d]	NA[d]
Flow[e]	25	0.19	0.00043	0.041	0.029
pH[c]	24	9.0	7.6	NA[d]	NA[d]
Temperature[f]	24	33	26	29	0.89
Zinc	24	5.1	0.047	0.85	0.57

[a]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.

Table 53. NPDES miscellaneous outfalls

July - September 1988

Parameter	Concentration (mg/L) Location EF7002[a]	SP2519[b]
Flow[c]		0.00011
Oil and grease	< 2.0	
pH[d]	7.4	7.7
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 54. NPDES discharge point category II outfalls[a]

July - September 1988

Parameter	No. of Samples	Concentration (mg/L)			
		Max	Min	Av	95%cc[b]
Downstream pH[c]	32	8.8	6.7	NA[e]	NA[e]
Flow[d]	32	0.22	0.000043	0.019	0.014
Oil and grease	32	15	< 2.0	< 3.1	1.86
pH[c]	32	8.5	6.5	NA[e]	NA[e]
Temperature[f]	32	66	19	29	4.4
TSS	32	200	5.0	18	15

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

Table 55. NPDES discharge point category III outfalls[a]

July - September 1988

Parameter	No. of Samples	Concentration (mg/L) Max	Min	Av	95%cc[b]
Flow[c]	19	0.0055	0.0000043	0.0013	0.00080
pH[d]	19	8.3	6.8	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 56. NPDES noncompliances

July 1988

Station	Parameter	Concentration (mg/L) Daily Maximum	Permit Limit (mg/L)
Sewage Treatment Plant (X01)	Fecal coliform	> 600	400[a]
Vehicle Cleaning Facility (VC7002)	Fecal coliform	> 600	200[a]
Category III Outfalls 341 & 342	Sheen on water surface; floating solids	visible sheen; visible solids	Sheen, floating solids not acceptable

[a]Colonies per 100 mL.

Table 57. NPDES noncompliances

August 1988

Station	Parameter	Concentration (mg/L) Daily Maximum	Permit Limit (mg/L)
Cooling Systems (CS 2000)	Zinc	2.94	1.0
Cooling Systems (CS 2001)	Zinc	4.05	1.0
Cooling Systems (CS 2026)	Zinc	5.14	1.0
Category II Outfall 249	Flow	"visible sheen on water"	NA[a]
Cooling Systems (CS 2539)	Residual chlorine	0.45	0.2
Cooling Systems (CS 3025E)	Residual chlorine	0.50	0.2
Cooling Systems (CS 3504)	Residual chlorine	1.0	0.2
Cooling Systems (CS 4509)	Downstream pH	8.8[b]	8.5[b]
Cooling Systems (CS 4510)	Residual chlorine	0.32	0.2
Cooling Systems (CS 3089)	Residual chlorine	0.40	0.2
Cooling Systems (CS 3525-W)	Zinc	2.86	1.0
Coal Yard Runoff (X02)	Temperature	31.6[c]	30.5[c]
Coal Yard Runoff (X02)	Temperature	30.6[c]	30.5[c]

Table 57. (continued)

August 1988

Station	Parameter	Concentration (mg/L) Daily Maximum	Permit Limit (mg/L)
Coal Yard Runoff (X02)	Temperature	32.8[c]	30.5[c]
Sewage Treatment Plant (X01)	Chlorine	0.9	0.5
Vehicle Cleaning Facility (VC7002)	Total Suspended Solids	319	40
White Oak Creek (X14)	Chlorine	Measurement not taken	NA[a]
Coal Yard Runoff (X02)	Downstream pH	8.8[b]	8.5[b]

[a]NA = not applicable.
[b]Measured in standard units. These downstream pH violations are not actually NPDES permit limit noncompliances; however, they are exceedances of Tennessee water quality criteria for White Oak Creek.
[c]Measured in degrees centigrade.

Table 58. NPDES noncompliances

September 1988

Station	Parameter	Concentration (mg/L) Daily Maximum	Permit Limit (mg/L)
Category II Outfall 248	Total suspended solids	195	50
Category II Outfall 265	Total suspended solids	164	50

The residual chlorine value at cooling tower 3504 was in exceedance of the permit limit. Cooling tower chlorination procedures and their implementation are under review and improvement by ORNL personnel.

The temperature limit violations at the Coal Yard Runoff Treatment Facility were attributed to natural conditions: shallow water levels in the X02 basins, plus hot, sunny days (daily temperature running about 2° above normal) raised the water temperature above the limit.

The chlorine exceedance at X01 was caused by a temporary peak that occurred in the effluent chlorine level on August 11, 1988, when the STP chlorinator was turned back on after having been turned off for three days. The unit had been turned off to facilitate an instream chlorine study requested by the Tennessee Department of Health and Environment (TDHE). Within a few hours after the unit was turned back on, STP personnel had regulated the effluent chlorine back to an acceptable level. No further chlorine exceedances were detected in the STP effluent.

No cause has been determined with certainty for the total suspended solids violation that was measured at VC7002 on August 1, 1988. The incident is currently under investigation by EMC personnel.

The copper and zinc limit exceedances that were measured at several cooling towers have been attributed to corrosion of metal components within the towers. Enhanced routine maintenance of ORNL cooling towers is currently being addressed by ORNL Plant and Equipment Division personnel.

The noncompliance for chlorine at WOC occurred because a measurement was not taken.

The downstream pH measurement of 8.8 at the Coal Yard Runoff Treatment Facility was an exceedance of a Tennessee Water Quality Criterion, not a NPDES numeric limit. No reason has been determined for the exceedance.

September 1988

The total suspended solids violation was measured at outfall 248 during rainfall on September 24, 1988. The exceedance was attributed to rain runoff flushing dust and other particulate matter into First Street drains that discharge through outfall 248. The rain on September 24 was the first rain of any appreciable amount since September 17.

The total suspended solids violation was measured at outfall 265 during rainfall on September 24, 1988. The exceedance was attributed to rain runoff flushing dust and other particulate matter into First Street drains that discharge through outfall 265.

Polychlorinated Biphenyls (PCBs) in the Aquatic Environment

Water and sediment samples were collected from various locations along WOC, MB, and the Clinch River (CR) to determine PCB concentrations in these areas (see Fig. 7). This was done to comply with the Clean Water Act (CWA) and is an integral part of ORNL's NPDES activities. Sediment samples were collected and analyzed in addition to water because PCBs are relatively insoluble in water and tend to accumulate in stream sediments. Water sampling is being performed quarterly and sediment sampling is being performed semiannually.

Water from the building areas containing either equipment or storage drums with PCB concentrations > 500 ppm were sampled at five locations along the Northwest Tributary (NWT) and WOC. In addition, water samples were taken on MB, White Oak Lake near WOD, and the CR. Sediment samples were taken from WOC, MB, WOD, and the CR.

There are currently no regulatory guidelines for PCB concentrations in water or stream sediment. The results from these samples will be used to help detect sources of PCB contamination and provide a history of PCB concentrations in the ORNL area.

The concentrations of PCBs in water during May 1988 were below the analytical detection limit at all sampling sites. Analyses were performed for seven arochlors of PCBs, all of which were below their detection limit. The detection limit for PCB arochlors 1016, 1221, 1232, 1242, and 1248 is 0.6 μg/L. The detection limit for PCB arochlors 1254 and 1260 is 1.2 μg/L.

Table 59 contains a summary of the sediment sample results. All samples except locations 6 and 10 had results below their detection limits. Location 6 had the highest concentrations of PCB (average of 12,000 μg/kg) and is the closest sediment sample location to ORNL. Location 10 had an average of 3,000 μg/kg concentration and is at the beginning of White Oak Lake (WOL).

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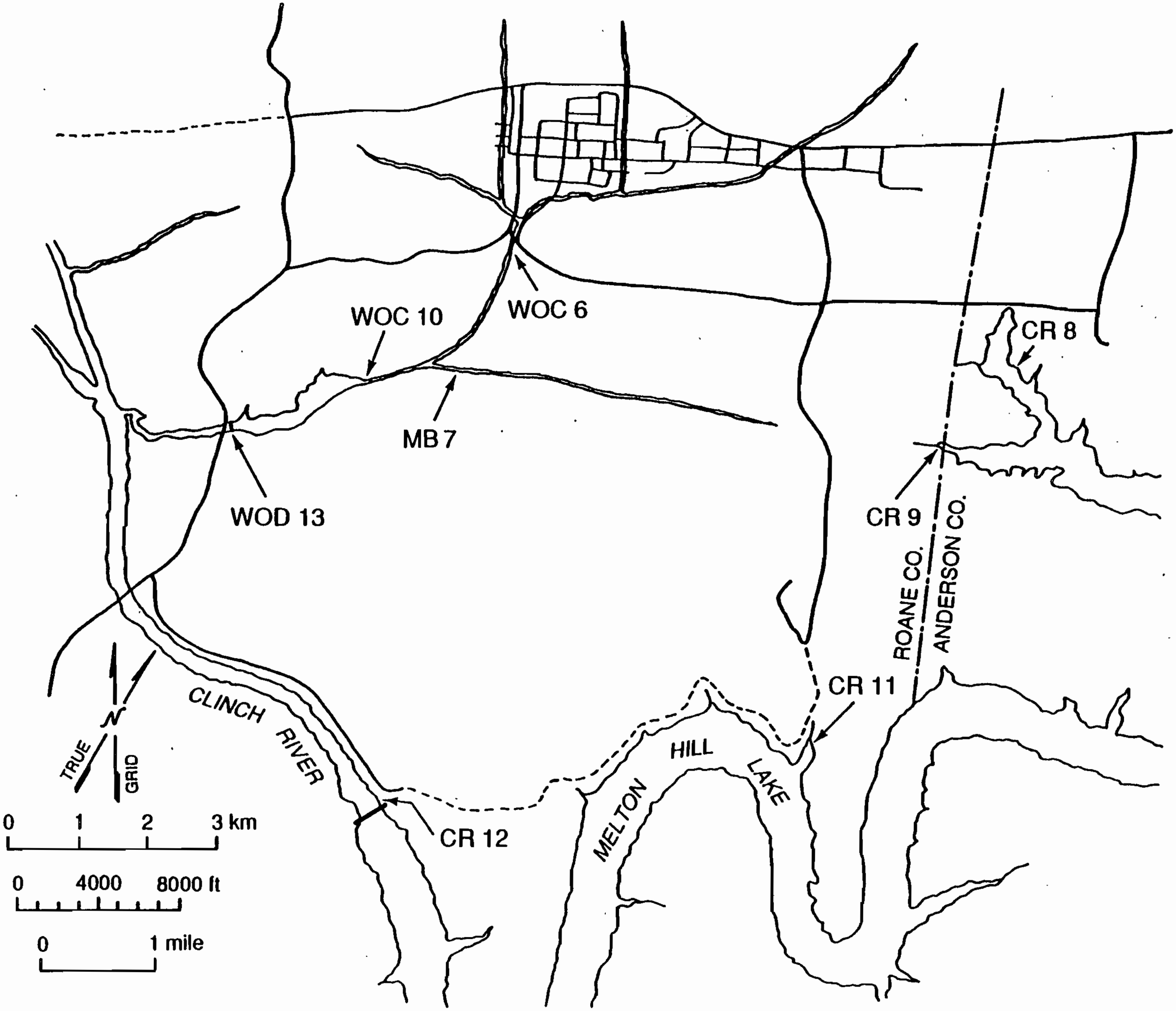

Fig. 7 Location map of PCB sampling points

Table 59. PCB concentrations in sediment[a]

May 1988

Location	Analysis	No. of Samples	Concentration (µg/kg)			
			Max	Min	Av	95%cc[b]
WOC 6	1016	2	< 910	< 530	< 720	380
	1221	2	< 910	< 530	< 520	380
	1232	2	< 910	< 530	< 720	380
	1242	2	< 910	< 530	< 720	380
	1248	2	3000	2800	2900	200
	1254	2	7800	4800	6300	3000
	1260	2	2500	2100	2300	400
MB 7	1016	2	< 170	< 160	< 170	10
	1221	2	< 170	< 160	< 170	10
	1232	2	< 170	< 160	< 170	10
	1242	2	< 170	< 160	< 170	10
	1248	2	< 170	< 160	< 170	10
	1254	2	< 350	< 330	< 340	20
	1260	2	< 350	< 330	< 340	20
CR 8	1016	2	< 130	< 120	< 130	10
	1221	2	< 130	< 120	< 130	10
	1232	2	< 130	< 120	< 130	10
	1242	2	< 130	< 120	< 130	10
	1248	2	< 130	< 120	< 130	10
	1254	2	< 270	< 230	< 250	40
	1260	2	< 270	< 230	< 250	40
CR 9	1016	2	< 220	< 170	< 200	50
	1221	2	< 220	< 170	< 200	50
	1232	2	< 220	< 170	< 200	50
	1242	2	< 220	< 170	< 200	50
	1248	2	< 220	< 170	< 200	50
	1254	2	< 440	< 350	< 400	90
	1260	2	< 440	< 350	< 400	90
WOC 10	1016	2	< 200	< 190	< 200	10
	1221	2	< 200	< 190	< 200	10
	1232	2	< 200	< 190	< 200	10
	1242	2	< 780	< 190	< 490	590
	1248	2	< 780	< 190	< 490	590
	1254	2	1800	1700	1800	100
	1260	2	1300	1100	1200	200

Table 59. (continued)

May 1988

Location	Analysis	No. of Samples	Concentration (µg/kg)			
			Max	Min	Av	95%cc[b]
CR 11	1016	2	< 120	< 120	< 120	00
	1221	2	< 120	< 120	< 120	0
	1232	2	< 120	< 120	< 120	0
	1242	2	< 120	< 120	< 120	0
	1248	2	< 120	< 120	< 120	0
	1254	2	< 240	< 240	< 240	0
	1260	2	< 240	< 240	< 240	0
CR 12	1016	2	< 110	< 110	< 110	0
	1221	2	< 110	< 110	< 110	0
	1232	2	< 110	< 110	< 110	0
	1242	2	< 110	< 110	< 110	0
	1248	2	< 110	< 110	< 110	0
	1254	2	< 220	< 220	< 220	0
	1260	2	< 220	< 220	< 220	0
WOD 13	1016	2	< 180	< 170	< 180	10
	1221	2	< 180	< 170	< 180	10
	1232	2	< 180	< 170	< 180	10
	1242	2	< 180	< 170	< 180	10
	1248	2	< 360	< 350	< 360	10
	1260	2	< 360	< 350	< 360	10

[a]See Fig. 7.
[b]95% confidence about the average of more than two samples.

Groundwater

Groundwater at the Solid Waste Storage Area (SWSA) 6 is monitored in order to comply with federal regulation 40 CFR, Part 265, and Tennessee's Hazardous Waste Management Rule 1200-1-11.05 for interim status facilities. This monitoring is also necessary to meet data needs for remediation activities. SWSA 6 was opened for limited disposal in 1969, began full-scale operations in 1973, and is still active. In the course of its operations, it has received a broad spectrum of low-level waste materials including radioactive and chemically hazardous wastes.

The wells in and around SWSA 6 are divided into the following three types: (1) upgradient wells, which are intended to provide reference information; (2) perimeter wells, which are intended to serve as downgradient boundary wells; and (3) internal site characterization wells, which provide information about conditions inside the perimeter of SWSA 6 (Fig. 8).

Data summaries for the sampling period ending during the third quarter of 1988 are presented in Table 60. Most of the samples for this period were taken during June and July. EPA guidelines require, for each well, four measurements of conductivity, pH, temperature, total organic carbon, and total organic halogens. In addition, three field measurements (of conductivity, pH, and temperature) are made to verify that a well has stabilized after purging and before sampling. Several unidentifiable organic compounds were detected and several compounds that are not on the EPA list of target compounds were tentatively identified. Each of these has a characteristic retention time (in minutes and seconds) which is also given in the first column. Unknowns with retention times within 0.5% of each other may be the same compound. Instances where primary drinking water limits were exceeded are summarized in Table 61.

Most parameters of interest were at low or undetectable levels during the sampling period. Of the perimeter wells located along the southern boundary of SWSA 6 next to White Oak lake (wells 835, 836, and 837), only well 835 with 920 Bq/L of tritium exceeded a drinking water limit (Table 61). In all the perimeter wells, the only three parameters exceeding drinking water limits were fecal coliform, gross beta, and tritium (Table 61).

High tritium levels were found in some of the internal and perimeter wells. Well 848 (internal) and well 842 (perimeter) had significant levels of tritium and gross beta. Well 848 had the highest tritium level of the tested wells. It also had the highest measured level of total strontium. The well with the highest gross beta was perimeter well 842 with 9.1 Bq/L. Cobalt-60 was also detected in this well at 13 Bq/L. All other perimeter wells contained less than 1 Bq/L of gross beta activity.

The northeast periphery of SWSA 6 is bounded by a small stream that drains radioactively contaminated pit and trench areas. Some of the contamination detected in the shallow monitoring wells may be derived from the stream and not from a groundwater contamination plume. Two shallow perimeter wells, 842 (7.2 m deep) and 843 (6 m deep), have high levels of tritium (24,000

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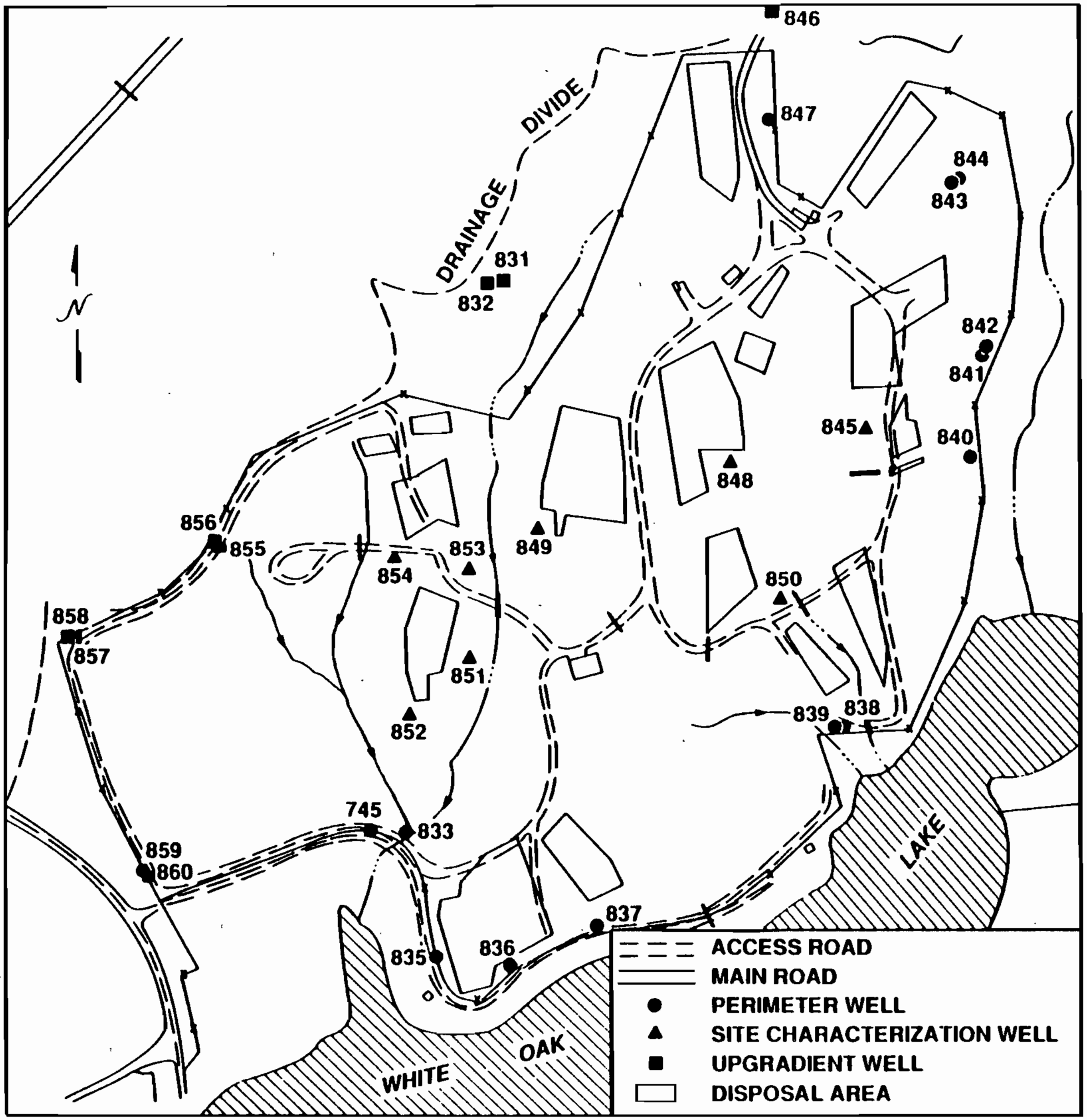

Fig. 8 Location map of SWSA 6 sampling wells

Table 60. SWSA 6 groundwater summary statistics

June - September 1988

Parameter	Number of Samples	Min	Value Qualifier[a]	Av	Max	Value Qualifier[a]	Units
			Perimeter wells[b]				
1,1,1-Trichloroethane	13	0.0050	U	0.0050	0.0050	U	mG/L
1,1-Dichloroethane	13	0.0050	U	0.0051	0.0060		mG/L
1,1-Dichloroethene	13	0.00050	J	0.0043	0.0050	U	mG/L
1,2-Dichloroethane	13	0.0050	U	0.0065	0.024		mG/L
1,2-Dichloroethene	13	0.0050	U	0.0058	0.013		mG/L
1,4-Dioxane-14.44	1	0.16	J	0.16	0.16	J	mG/L
2,4,5-T	13	0.00010	U	0.00012	0.00030		mG/L
2-Butanone	13	0.010	U	0.010	0.010	U	mG/L
Acetone	13	0.0010	JB	0.011	0.046	B	mG/L
Ag	13	0.0050	U	0.0051	0.0060		mG/L
Al	13	0.060	U	0.35	0.61		mG/L
Alkalinity	13	7.0		240	440		mG/L
B	13	0.080	U	0.080	0.080	U	mG/L
Ba	13	1.0	U	1.0	1.0	U	mG/L
Be	13	0.0011		0.0028	0.0040		mG/L
Benzene	13	0.0030	J	0.0048	0.0050	U	mG/L
Bis(2-ethylhexyl)phthalate	13	0.0020	JB	0.0079	0.016	B	mG/L
Ca	13	2.9		83	170		mG/L
Carbon tetrachloride	13	0.0050	U	0.0086	0.052		mG/L
Cd	13	0.0020	U	0.0020	0.0020	U	mG/L
Chloroform	13	0.0010	J	0.010	0.074		mG/L
Cl	13	1.1		6.4	17		mG/L
Co	13	0.0030	U	0.0030	0.0030	U	mG/L
Co-60	13	-0.11		1.1	13		Bq/L
Conductivity	91	0.010		0.23	0.60		mS/CM
Cs-137	13	-0.010		0.080	0.44		Bq/L
Cu	13	0.010	U	0.012	0.023		mG/L
Di-n-butylphthalate	13	0.00050	J	0.0057	0.011	U	mG/L
Diethylphthalate	13	0.0055	U	0.0097	0.011	U	mG/L
Dissolved Ba	13	1.0	U	1.0	1.0	U	mG/L

Table 60. (continued)

Parameter	Number of Samples	Min	Value Qualifier[a]	Av	Max	Value Qualifier[a]	Units
			Perimeter wells[b]				
Dissolved Fe	13	0.050	U	0.077	0.30		mG/L
Dissolved Hg	13	0.00010	U	0.00010	0.00010	U	mG/L
Dissolved Mn	13	0.010		0.054	0.16		mG/L
Dissolved Na	13	1.3		13	83		mG/L
Ethyl ether-12.11	1	0.22	J	0.22	0.22	J	mG/L
Ethylbenzene	13	0.0010	JB	0.0037	0.0050	U	mG/L
F	13	1.0	U	1.0	1.0	U	mG/L
Fe	13	0.090		0.51	3.2		mG/L
Fecal Coliform	17	1.0	U	30	290		NTU
Gross Alpha	13	0		0.24	0.41		Bq/L
Gross beta	13	0.12		1.1	9.1		Bq/L
Hg	13	0.00010	U	0.00010	0.00010	U	mG/L
Methylene chloride	13	0.0010	JB	0.0015	0.0030	JB	mG/L
Mg	13	0.53		13	28		mG/L
Mn	13	0.010		0.068	0.24		mG/L
Na	13	1.3		13	86		mG/L
Naphthalene	13	0.0020	J	0.0092	0.011	U	mG/L
Ni	13	0.0060	U	0.0081	0.018		mG/L
NO_3	13	0.50	U	0.71	2.5		mG/L
pH	91	5.0		6.9	7.5		STD UNITS
Phenolics, total recoverable	13	0.0010	U	0.0010	0.0010	U	mG/L
Se	13	0.0050	U	0.0050	0.0050	U	mG/L
Si	13	4.0		7.9	11		mG/L
SO_4	13	5.0	U	28	140		mG/L
Sr	13	0.011		0.38	1.1		mG/L
Temperature	91	14		15	16		DEG C
Tetrachloride	13	0.0020	J	0.0048	0.0050	U	mG/L
Ti	13	0.020	U	0.020	0.020	U	mG/L
Total organic carbon	52	0.50	U	1.1	6.7		mG/L
Toluene	13	0.0010	JB	0.0035	0.0050	U	mG/L
Total radium	13	0		0.040	0.080		Bq/L
Total Sr[c]	13	-0.10		0.075	0.19		Bq/L
Total organic halogens	65	0		0.34	5.0	U	NTU

Table 60. (continued)

Parameter	Number of Samples	Min	Value Qualifier[a]	Av	Max	Value Qualifier[a]	Units
			Perimeter wells[b]				
Trichloroethene	13	0.0050	U	0.035	0.39	E	mG/L
Trichlorofluoromethane	2	0.0050	J	0.0075	0.010	J	mG/L
Tritium	13	-14		5600	30000		Bq/L
Turbidity	13	0.050		4.0	21		NTU
Unknown hydrocarbon	1	0.0060	JB	0.0060	0.0060	JB	mG/L
Unknown hydrocarbon-30.03	2	0.021	J	0.022	0.022	J	mG/L
Unknown hydrocarbon-39.19	1	0.014	J	0.014	0.014	J	mG/L
Unknown hydrocarbon-39.21	1	0.015	J	0.015	0.015	J	mG/L
Unknown hydrocarbon-44.62	1	0.11	JB	0.11	0.11	JB	mG/L
Unknown-10.02	2	0.0050	JB	0.0055	0.0060	J	mG/L
Unknown-10.05	1	0.0030	JB	0.0030	0.0030	JB	mG/L
Unknown-11.91	1	0.0080	J	0.0080	0.0080	J	mG/L
Unknown-13.35	1	0.0060	J	0.0060	0.0060	J	mG/L
Unknown-16.53	1	0.015	J	0.015	0.015	J	mG/L
Unknown-17.56	1	0.0050	J	0.0050	0.0050	J	mG/L
Unknown-20.83	1	0.0030	J	0.0030	0.0030	J	mG/L
Unknown-22.28	1	0.0010	J	0.0010	0.0010	J	mG/L
Unknown-22.72	1	0.0030	J	0.0030	0.0030	J	mG/L
Unknown-24.57	1	0.0040	J	0.0040	0.0040	J	mG/L
Unknown-26.43	1	0.0010	J	0.0010	0.0010	J	mG/L
Unknown-26.67	3	0.0040	J	0.0053	0.0060	J	mG/L
Unknown-26.68	1	0.0020	J	0.0020	0.0020	J	mG/L
Unknown-29.29	2	0.0080	JB	0.022	0.035	JB	mG/L
Unknown-29.3	1	0.023	JB	0.023	0.023	JB	mG/L
Unknown-29.31	1	0.038	JB	0.038	0.038	JB	mG/L
Unknown-29.62	1	0.0050	JB	0.0050	0.0050	JB	mG/L
Unknown-29.63	4	0.0030	JB	0.0050	0.0070	JB	mG/L
Unknown-29.66	1	0.0020	JB	0.0020	0.0020	JB	mG/L
Unknown-30.03	1	0.0070	J	0.0070	0.0070	J	mG/L
Unknown-30.04	1	0.0040	J	0.0040	0.0040	J	mG/L
Unknown-31.68	1	0.0080	J	0.0080	0.0080	J	mG/L
Unknown-31.69	2	0.010	J	0.011	0.011	J	mG/L
Unknown-33.97	1	0.0030	J	0.0030	0.0030	J	mG/L

Table 60. (continued)

Parameter	Number of Samples	Min	Value Qualifier[a]	Av	Max	Value Qualifier[a]	Units
			Perimeter wells[b]				
Unknown-37.95	1	0.020	J	0.020	0.020	J	mG/L
Unknown-37.96	1	0.014	J	0.014	0.014	J	mG/L
Unknown-38.26	1	0.0060	JB	0.0060	0.0060	JB	mG/L
Unknown-38.3	1	0.017	JB	0.017	0.017	JB	mG/L
Unknown-39.22	1	0.0090	J	0.0090	0.0090	J	mG/L
Unknown-41.48	1	0.022	JB	0.022	0.022	JB	mG/L
Unknown-41.49	1	0.10	JB	0.10	0.10	JB	mG/L
Unknown-41.51	2	0.058	JB	0.094	0.13	JB	mG/L
Unknown-41.95	1	0.028	JB	0.028	0.028	JB	mG/L
Unknown-41.96	2	0.012	JB	0.013	0.013	JB	mG/L
Unknown-41.97	1	0.016	JB	0.016	0.016	JB	mG/L
Unknown-41.98	1	0.0060	JB	0.0060	0.0060	JB	mG/L
Unknown-42.03	1	0.024	JB	0.024	0.024	JB	mG/L
Unknown-44.6	1	0.039	JB	0.039	0.039	JB	mG/L
Unknown-44.62	1	0.19	JB	0.19	0.19	JB	mG/L
Unknown-44.65	1	0.27	JB	0.27	0.27	JB	mG/L
Unknown-7.84	3	0.010	JB	0.014	0.017	JB	mG/L
Unknown-7.86	1	0.0050	JB	0.0050	0.0050	JB	mG/L
Unknown-7.98	2	0.021	JB	0.030	0.038	JB	mG/L
Unknown-7.99	2	0.033	JB	0.058	0.082	JB	mG/L
Unknown-8.13	1	0.0040	J	0.0040	0.0040	J	mG/L
Unknown-8.21	3	0.0030	J	0.0053	0.0080	J	mG/L
Unknown-8.24	3	0.0040	J	0.0050	0.0070	J	mG/L
Unknown-8.27	1	0.015	JB	0.015	0.015	JB	mG/L
Unknown-8.33	1	0.011	JB	0.011	0.011	JB	mG/L
Unknown-8.34	3	0.0050	JB	0.0077	0.0090	JB	mG/L
Unknown-8.36	2	0.0030	JB	0.018	0.032	JB	mG/L
Unknown-8.38	2	0.076	JB	0.077	0.077	JB	mG/L
Unknown-8.67	1	0.0020	J	0.0020	0.0020	J	mG/L
Unknown-8.81	2	0.0040	JB	0.0040	0.0040	JB	mG/L
Unknown-8.85	1	0.0050	J	0.0050	0.0050	J	mG/L
V	13	0.0040	U	0.0083	0.012		mG/L
Vinyl chloride	13	0.010	U	0.010	0.010	U	mG/L

Table 60. (continued)

Parameter	Number of Samples	Min	Value Qualifier[a]	Av	Max	Value Qualifier[a]	Units
			Perimeter wells[b]				
Xylene (total)	13	0.0050	U	0.0050	0.0050	U	mG/L
Zn	13	0.0070	U	0.0080	0.013		mG/L
			Site characterization wells[b]				
1,1,1-Trichloroethane	10	0.00070	J	0.0044	0.0050	U	mG/L
1,1-Dichloroethane	10	0.0050	U	0.0062	0.013		mG/L
1,1-Dichloroethene	10	0.0050	U	0.0050	0.0050	U	mG/L
1,2-Dichloroethane	10	0.0020	J	0.0047	0.0050	U	mG/L
1,2-Dichloroethene	10	0.0040	J	0.023	0.17		mG/L
1,4-Dioxane-14.44	3	0.0050	J	0.12	0.22	J	mG/L
1,4-Dioxane-14.44	1	0.0060	J	0.0060	0.0060	J	mG/L
2,4,5-T	10	0.00010	U	0.00010	0.00010	U	mG/L
2-Butanone	10	0.010	U	0.020	0.11		mG/L
Acetone	10	0.0020	JB	0.0098	0.016	B	mG/L
Ag	10	0.0050	U	0.0050	0.0050	U	mG/L
Al	10	0.060	U	0.39	0.69		mG/L
Alkalinity	10	0.50		260	550		mG/L
B	10	0.080	U	0.092	0.20		mG/L
Ba	10	1.0	U	1.2	2.5		mG/L
Be	10	0.00030	U	0.0030	0.0045		mG/L
Benzene	10	0.0050	U	0.015	0.092		mG/L
Bis(2-ethylhexyl)phthalate	10	0.0020	JB	0.0061	0.011	U	mG/L
Benzene derivative-10.94	1	0.085	J	0.085	0.085	J	mG/L
Benzene derivative-11.12	1	0.044	J	0.044	0.044	J	mG/L
Benzene derivative-11.81	1	0.29	J	0.29	0.29	J	mG/L
Benzene derivative-12.48	1	0.048	J	0.048	0.048	J	mG/L
Benzene derivative-8.02	1	0.21	J	0.21	0.21	J	mG/L
Benzene derivative-8.38	1	0.73	J	0.73	0.73	J	mG/L
Benzene derivative-8.99	1	0.12	J	0.12	0.12	J	mG/L
Ca	10	0.20	U	97	200		mG/L
Carbon tetrachloride	10	0.0050	U	0.0050	0.0050	U	mG/L

Table 60. (continued)

Parameter	Number of Samples	Min	Value Qualifier[a]	Av	Max	Value Qualifier[a]	Units
			Site characterization wells[b]				
Cd	10	0.0020	U	0.0020	0.0020	U	mG/L
Chloroform	10	0.0010	J	0.0053	0.012		mG/L
Cl	10	1.0	U	14	36		mG/L
Co	10	0.0030	U	0.0040	0.013		mG/L
Co-60	10	-0.70		-0.021	0.20	U	Bq/L
Conductivity	56	0.050		0.35	0.91		mS/CM
Cs-137	10	-0.030		0.078	0.22		Bq/L
Cu	10	0.010	U	0.012	0.021		mG/L
Di-n-butylphthalate	10	0.0010	B	0.0045	0.011	U	mG/L
Dichlorofluoromethane-6.35	1	0.011	J	0.011	0.011	J	mG/L
Diethylphthalate	10	0.0010	J	0.0094	0.011	U	mG/L
Dissolved Ba	10	1.0	U	1.2	2.9		mG/L
Dissolved Fe	10	0.050	U	3.6	31		mG/L
Dissolved Hg	10	0.00010	U	0.00010	0.00010	U	mG/L
Dissolved Mn	10	0.010		1.4	11		mG/L
Dissolved Na	10	0.020	U	6.1	12		mG/L
Ethyl ether-12.11	1	0.29	J	0.29	0.29	J	mG/L
Ethylbenzene	10	0.0020	JB	0.026	0.22		mG/L
F	10	1.0	U	1.0	1.4		mG/L
Fe	10	0.050	U	3.9	32		mG/L
Fecal Coliform	10	1.0	U	3.4	25		COL/100 ML
Gross Alpha	10	0		0.18	0.54		Bq/L
Gross beta	10	0.040		0.79	5.9		Bq/L
Hg	10	0.00010	U	0.00010	0.00010	U	mG/L
Methylene chloride	10	0.0010	JB	0.0014	0.0030	JB	mG/L
Mg	10	0.010	U	12	31		mG/L
Mn	10	0.010		1.5	11		mG/L
Na	10	0.14		6.3	12		mG/L
Naphthalene	10	0.0010	J	0.043	0.35		mG/L
Ni	10	0.0060	U	0.0088	0.020		mG/L
NO_3	10	0.50	U	0.87	3.9		mG/L
pH	56	6.4		6.8	7.4		STD UNITS
Phenolics, total recoverable	10	0.0010	U	0.0028	0.017		mG/L

Table 60. (continued)

Parameter	Number of Samples	Min	Value Qualifier[a]	Av	Max	Value Qualifier[a]	Units
Site characterization wells[b]							
Phenol derivative-25.61	1	0.033	J	0.033	0.033	J	mG/L
Se	10	0.0050	U	0.0050	0.0050	U	mG/L
Si	10	0.20	U	7.4	12		mG/L
SO_4	10	5.0	U	12	41		mG/L
Sr	10	0.0050	U	0.18	0.41		mG/L
Temperature	56	15		16	17		DEG C
Tetrachloride	10	0.0030	J	0.0048	0.0050	U	mG/L
Tetrahydrofuran-11.12	1	0.095	J	0.095	0.095	J	mG/L
Ti	10	0.020	U	0.020	0.020	U	mG/L
Total organic carbon	40	0.50	U	2.1	6.3		mG/L
Toluene	10	0.0010	JB	0.13	1.2		mG/L
Total radium	10	0		0.014	0.040		Bq/L
Total Sr[c]	10	-0.060		0.29	1.9		Bq/L
Total organic halogens	52	0.0010	U	0.098	1.2		mG/L
Trichloroethene	10	0.0030	J	0.11	1.0	E	mG/L
Tritium	10	-26		26000	160000		Bq/L
Turbidity	10	0.020		5.3	30		NTU
Tetramethyl butyl phenol-23.	1	0.10	J	0.10	0.10	J	mG/L
Unknown-14.20	1	0.011	J	0.011	0.011	J	mG/L
Unknown-10.02	1	0.0050	JB	0.0050	0.0050	JB	mG/L
Unknown-13.36	1	0.0050	J	0.0050	0.0050	J	mG/L
Unknown-14.93	1	0.0060	J	0.0060	0.0060	J	mG/L
Unknown-24.4	1	0.025	J	0.025	0.025	J	mG/L
Unknown-24.94	1	0.024	J	0.024	0.024	J	mG/L
Unknown-25.07	1	0.061	J	0.061	0.061	J	mG/L
Unknown-25.2	1	0.094	J	0.094	0.094	J	mG/L
Unknown-25.29	1	0.070	J	0.070	0.070	J	mG/L
Unknown-25.35	1	0.032	J	0.032	0.032	J	mG/L
Unknown-25.49	1	0.036	J	0.036	0.036	J	mG/L
Unknown-25.75	1	0.061	J	0.061	0.061	J	mG/L
Unknown-25.87	1	0.027	J	0.027	0.027	J	mG/L
Unknown-29.28	1	0.011	JB	0.011	0.011	JB	mG/L
Unknown-29.29	2	0.0040	JB	0.0050	0.0060	JB	mG/L

Table 60. (continued)

Parameter	Number of Samples	Min	Value Qualifier[a]	Av	Max	Value Qualifier[a]	Units
			Site characterization wells[b]				
Unknown-29.3	3	0.012	JB	0.016	0.024	JB	mG/L
Unknown-29.63	1	0.0070	JB	0.0070	0.0070	JB	mG/L
Unknown-30.07	1	0.0050	J	0.0050	0.0050	J	mG/L
Unknown-30.24	1	0.0030	J	0.0030	0.0030	J	mG/L
Unknown-38.29	1	0.0060	JB	0.0060	0.0060	JB	mG/L
Unknown-41.48	2	0.015	JB	0.027	0.038	JB	mG/L
Unknown-41.5	2	0.022	JB	0.024	0.026	JB	mG/L
Unknown-42.02	1	0.018	JB	0.018	0.018	JB	mG/L
Unknown-44.59	1	0.078	JB	0.078	0.078	JB	mG/L
Unknown-44.6	2	0.013	JB	0.020	0.026	JB	mG/L
Unknown-44.61	2	0.038	JB	0.043	0.048	JB	mG/L
Unknown-7.83	5	0.0040	JB	0.0066	0.0090	J	mG/L
Unknown-7.84	2	0.0060	J	0.0090	0.012	JB	mG/L
Unknown-7.96	6	0.061	JB	0.064	0.066	JB	mG/L
Unknown-7.98	1	0.080	JB	0.080	0.080	JB	mG/L
Unknown-8.12	1	0.012	J	0.012	0.012	J	mG/L
Unknown-8.25	1	0.013	JB	0.013	0.013	JB	mG/L
Unknown-8.38	1	0.063	JB	0.063	0.063	JB	mG/L
Unknown-8.77	1	0.091	JB	0.091	0.091	JB	mG/L
Unknown-8.81	1	0.0060	JB	0.0060	0.0060	JB	mG/L
Unknown-8.85	1	0.010	J	0.010	0.010	J	mG/L
Unknown-8.93	1	0.010	J	0.010	0.010	J	mG/L
V	10	0.0040	U	0.0087	0.015		mG/L
Vinyl chloride	10	0.010	U	0.015	0.060		mG/L
Xylene (total)	10	0.0030	J	0.17	1.7		mG/L
Zn	10	0.0070	U	0.0081	0.018		mG/L
			Upgradient wells[b]				
1,1,1-Trichloroethane	8	0.0050	U	0.0050	0.0050	U	mG/L
1,1-Dichloroethane	8	0.0050	U	0.0050	0.0050	U	mG/L
1,1-Dichloroethene	8	0.0050	U	0.0050	0.0050	U	mG/L

Table 60. (continued)

Parameter	Number of Samples	Min	Value Qualifier[a]	Av	Max	Value Qualifier[a]	Units
			Upgradient wells[b]				
1,2-Dichloroethane	8	0.0050	U	0.0050	0.0050	U	mG/L
1,2-Dichloroethene	8	0.0050	U	0.0050	0.0050	U	mG/L
2,4,5-T	8	0.00010	U	0.00010	0.00010	U	mG/L
2-Butanone	8	0.010	U	0.013	0.032		mG/L
2-Propanol-8.82	1	0.13	J	0.13	0.13	J	mG/L
Acetone	8	0.010	U	0.70	4.7	BE	mG/L
Ag	8	0.0050	U	0.0050	0.0050	U	mG/L
Al	8	0.036	U	0.36	0.72		mG/L
Alkalinity	8	2.0		170	420		mG/L
Aliphatic acid-29.63	2	0.0040	JB	0.0055	0.0070	JB	mG/L
B	8	0.048	U	0.072	0.080	U	mG/L
Ba	8	1.0	U	1.0	1.0	U	mG/L
Be	8	0.00018	U	0.0017	0.0027		mG/L
Benzene	8	0.0050	U	0.0050	0.0050	U	mG/L
Bis(2-ethylhexyl)phthalate	8	0.0040	JB	0.0098	0.019	B	mG/L
Ca	8	0.12	U	65	160		mG/L
Carbon tetrachloride	8	0.0050	U	0.0050	0.0050	U	mG/L
Cd	8	0.0020	U	0.0023	0.0030		mG/L
Chloroform	8	0.0050	U	0.0050	0.0050	U	mG/L
Cl	8	1.0	U	2.4	7.1		mG/L
Co	8	0.0018	U	0.0027	0.0030	U	mG/L
Co-60	8	0.10	U	0.15	0.20	U	Bq/L
Conductivity	49	0.010		0.37	0.89		mS/CM
Cs-137	8	0.10	U	0.20	0.68		Bq/L
Cu	8	0.0060	U	0.0090	0.010	U	mG/L
Di-n-butylphthalate	8	0.0010	JB	0.0080	0.020	U	mG/L
Diethylphthalate	8	0.010	U	0.012	0.020	U	mG/L
Dissolved Ba	8	1.0	U	1.0	1.0	U	mG/L
Dissolved Fe	8	0.050	U	0.099	0.44		mG/L
Dissolved Hg	8	0.00010	U	0.00016	0.00040		mG/L
Dissolved Mn	8	0.010		0.025	0.050		mG/L
Dissolved Na	8	0.020	U	6.9	19		mG/L
Ethylbenzene	8	0.0020	JB	0.0020	0.0020	JB	mG/L

Table 60. (continued)

Parameter	Number of Samples	Min	Value Qualifier[a]	Av	Max	Value Qualifier[a]	Units
			Upgradient wells[b]				
F	8	1.0	U	1.0	1.0	U	mG/L
Fe	8	0.050		0.74	3.3		mG/L
Fecal Coliform	7	1.0	U	1.0	1.0	U	COL/100 ML
Gross Alpha	8	0		0.067	0.25		Bq/L
Gross beta	8	0		0.17	0.44		Bq/L
Hg	8	0.00010	U	0.00018	0.00070		mG/L
Methylene chloride	8	0.0020	JB	0.0045	0.0050	U	mG/L
Mg	8	0.010		14	45		mG/L
Mn	8	0.010		0.089	0.19		mG/L
Na	8	0.10		6.8	19		mG/L
Naphthalene	8	0.010	U	0.012	0.020	U	mG/L
Ni	8	0.0036	U	0.0064	0.012		mG/L
NO_3	8	0.50	U	0.50	0.50	U	mG/L
pH	49	5.1		7.3	8.4		STD UNITS
Phenolics, total recoverable	8	0.0010	U	0.25	1.0	U	mG/L
Se	8	0.0050		0.0050	0.0050		mG/L
Si	8	0.12	U	6.2	13		mG/L
SO_4	8	5.0	U	52	240		mG/L
Sr	8	0.0030	U	0.14	0.37		mG/L
Temperature	49	13		15	18		DEG C
Tetrachloride	8	0.0050	U	0.0050	0.0050	U	mG/L
Tetrahydrofuran-11.12	1	0.035	J	0.035	0.035	J	mG/L
Ti	8	0.012	U	0.018	0.020	U	mG/L
Total organic carbon	32	0.50		0.68	1.8		mG/L
Toluene	8	0.0030	JB	0.0046	0.0050	U	mG/L
Total radium	8	0.0017		0.031	0.057		Bq/L
Total Sr[c]	8	0.014		0.085	0.17		Bq/L
Total organic halogens	40	0		0.0012	0.0050	U	mG/L
Trichloroethene	8	0.0050	U	0.0050	0.0050	U	mG/L
Tritium	8	-8.0		15	43		Bq/L
Turbidity	8	0.025		19	140		NTU
Unknown-10.5	1	0.0030	J	0.0030	0.0030	J	mG/L
Unknown-10.52	1	0.0030	J	0.0030	0.0030	J	mG/L

Table 60. (continued)

Parameter	Number of Samples	Min	Value Qualifier[a]	Av	Max	Value Qualifier[a]	Units
			Upgradient wells[b]				
Unknown-11.91	1	0.0080	J	0.0080	0.0080	J	mG/L
Unknown-12	1	0.0030	J	0.0030	0.0030	J	mG/L
Unknown-16.47	1	0.0020	J	0.0020	0.0020	J	mG/L
Unknown-20.03	1	0.0020	J	0.0020	0.0020	J	mG/L
Unknown-22.54	1	0.0020	J	0.0020	0.0020	J	mG/L
Unknown-27.29	1	0.0030	J	0.0030	0.0030	J	mG/L
Unknown-29.63	1	0.0050	JB	0.0050	0.0050	JB	mG/L
Unknown-30.45	1	0.0040	J	0.0040	0.0040	J	mG/L
Unknown-35.3	1	0.0070	J	0.0070	0.0070	J	mG/L
Unknown-41.99	1	0.010	JB	0.010	0.010	JB	mG/L
Unknown-42	2	0.018	JB	0.020	0.021	JB	mG/L
Unknown-8.22	1	0.0060	JB	0.0060	0.0060	JB	mG/L
Unknown-8.23	7	0.0030	JB	0.0067	0.010	JB	mG/L
Unknown-8.36	5	0.016	JB	0.039	0.053	JB	mG/L
Unknown-8.37	3	0.040	JB	0.051	0.068	JB	mG/L
Unknown-9.22	1	0.0040	J	0.0040	0.0040	J	mG/L
Unknown-9.34	1	0.0030	J	0.0030	0.0030	J	mG/L
V	8	0.0024	U	0.0061	0.011		mG/L
Vinyl chloride	8	0.010	U	0.010	0.010	U	mG/L
Xylene (total)	8	0.0050	U	0.0050	0.0050	U	mG/L
Zn	8	0.0044		0.0099	0.020		mG/L

[a]Organics: U=Undetected; B=Present in blank;J=Below detection limit, but estimated E=Concentration exceeds the calibration range of the instrument.
Inorganics: U=Undetected; B=Value <Contract required detection limit >Instrument detection limit; E=Value is estimated because of the presence of interference.
[b]See Fig. 8.
[c]Total radioactive Sr (^{89}Sr + ^{90}Sr).

Table 61. SWSA 6 analyses whose values exceed the primary drinking water limits

June - September 1988

Well Identifier	Analysis	ACD Analysis Result	Primary Limit[a]	Units of Measurement
		Site Characterization Wells[b]		
852	Ba	2.5	1.0	Mg/L
852	Dissolved Ba	2.9	1.0	Mg/L
850	Fecal coliform	25	1.0	Col/100 mL
848	Gross beta	5.9	0.30	Bq/L
853	Gross beta	0.43	0.30	Bq/L
854	Gross beta	0.38	0.30	Bq/L
848	Total Sr[c]	1.9	0.30	Bq/L
850	Total Sr[c]	0.39	0.30	Bq/L
848	Tritium	160000	740	Bq/L
849	Tritium	91000	740	Bq/L
854	Tritium	6800	740	Bq/L
852	Tritium	2200	740	Bq/L
850	Tritium	1600	740	Bq/L
851	Tritium	1600	740	Bq/L
845	Tritium	980	740	Bq/L
		Perimeter Wells[b]		
839	Fecal coliform	290	1.0	Col/100 mL
839	Fecal coliform	140	1.0	Col/100 mL
838	Fecal coliform	43	1.0	Col/100 mL
838	Fecal coliform	21	1.0	Col/100 mL
842	Gross beta	9.1	0.30	Bq/L
843	Gross beta	0.99	0.30	Bq/L
847	Gross beta	0.59	0.30	Bq/L
840	Gross beta	0.53	0.30	Bq/L
838	Gross beta	0.51	0.30	Bq/L
841	Gross beta	0.51	0.30	Bq/L
844	Gross beta	0.51	0.30	Bq/L
745	Gross beta	0.49	0.30	Bq/L
839	Gross beta	0.45	0.30	Bq/L
860	Gross beta	0.38	0.30	Bq/L
843	Tritium	30000	740	Bq/L
842	Tritium	24000	740	Bq/L

Table 61. (continued)

June - September 1988

Well Identifier	Analysis	ACD Analysis Result	Primary Limit[a]	Units of Measurement
841	Tritium	10000	740	Bq/L
847	Tritium	3100	740	Bq/L
844	Tritium	2700	740	Bq/L
839	Tritium	1100	740	Bq/L
835	Tritium	920	740	Bq/L
840	Tritium	800	740	Bq/L
		Upgradient Wells[b]		
857	Gross beta	0.44	0.30	Bq/L
858	Gross beta	0.35	0.30	Bq/L

[a]Gross beta limit is derived based on a concentration of ^{90}Sr that would give a 4 mrem dose.
[b]See Fig. 8.
[c]Total radioactive Sr (^{89}Sr + ^{90}Sr).

and 30,000 Bq/L, respectively). A deeper well along that boundary, well 844 (15.8 m deep), has a tritium value about an order of magnitude lower (2,700 Bq/L) than those for the shallow wells.

Organics detected included acetone and trichloroethene (TCE). The highest acetone concentration (4.7 mg/L) was found in well 858, an upgradient well. Elevated levels of TCE were found in wells 849 and 842 in concentrations of 1.0 mg/L and 0.39 mg/L, respectively. Well 842 also exhibited low levels of other organics, including carbon tetrachloride, chloroform, and 1,2 di-chloroethane (a degradation product of TCE).

High coliform levels were detected in wells 838, 839, and 850. The high coliform levels could be an artifact of the well construction method. Well materials were not sterilized before installation. Analysis of subsequent samples (to be reported at a later date) has indicated that amounts of fecal coliform have diminished to undetectable levels. The only metal that exceeded drinking water limits was barium (both total and dissolved), detected in well 852 (an internal site characterization well).

METEOROLOGICAL PROCESSES

Meteorological processes are continuously monitored at ORNL so that current weather conditions may be taken into account, as needed, in response to emergencies that may arise. Weather records are also kept for climatological studies and for supportive information in hydrologic modeling and monitoring, facility design, scheduling of construction activities, and interpretation of nonmeteorological data (e.g., total suspended solids in surface water) that may depend on recent weather conditions.

Precipitation

Monthly precipitation totals for several sites are averaged to obtain representative monthly values for ORNL and the surrounding area. The stations included are indicated by three-character identifiers on the location map in Fig. 9. These stations provide data for climatological studies. Most of the other sites in Fig. 9 are represented by five-character identifiers with the last two digits identifying the air monitoring station at which each gauge is located. Precipitation gauges located at the air monitoring stations report real-time data for short-term studies and emergency response situations. It is expected that data from these stations will be available for quarterly and annual reporting purposes in the near future. Much of the data summarized in this report comes from the precipitation measuring network of the Environmental Sciences Division of ORNL. In addition, the Atmospheric Turbulence and Diffusion Division (ATDD) of the National Oceanic and Atmospheric Administration (NOAA) maintains a weather station in the city of Oak Ridge. Observations have been made at that station for a long enough period to provide 30-year (1951-1980) normals for comparison with amounts for the current year. Table 62 shows the total precipitation at ATDD and departure from ATDD long-term normal, along with the ORNL representative value, for each of the first nine months of 1988.

ORNL-DWG 88-1515

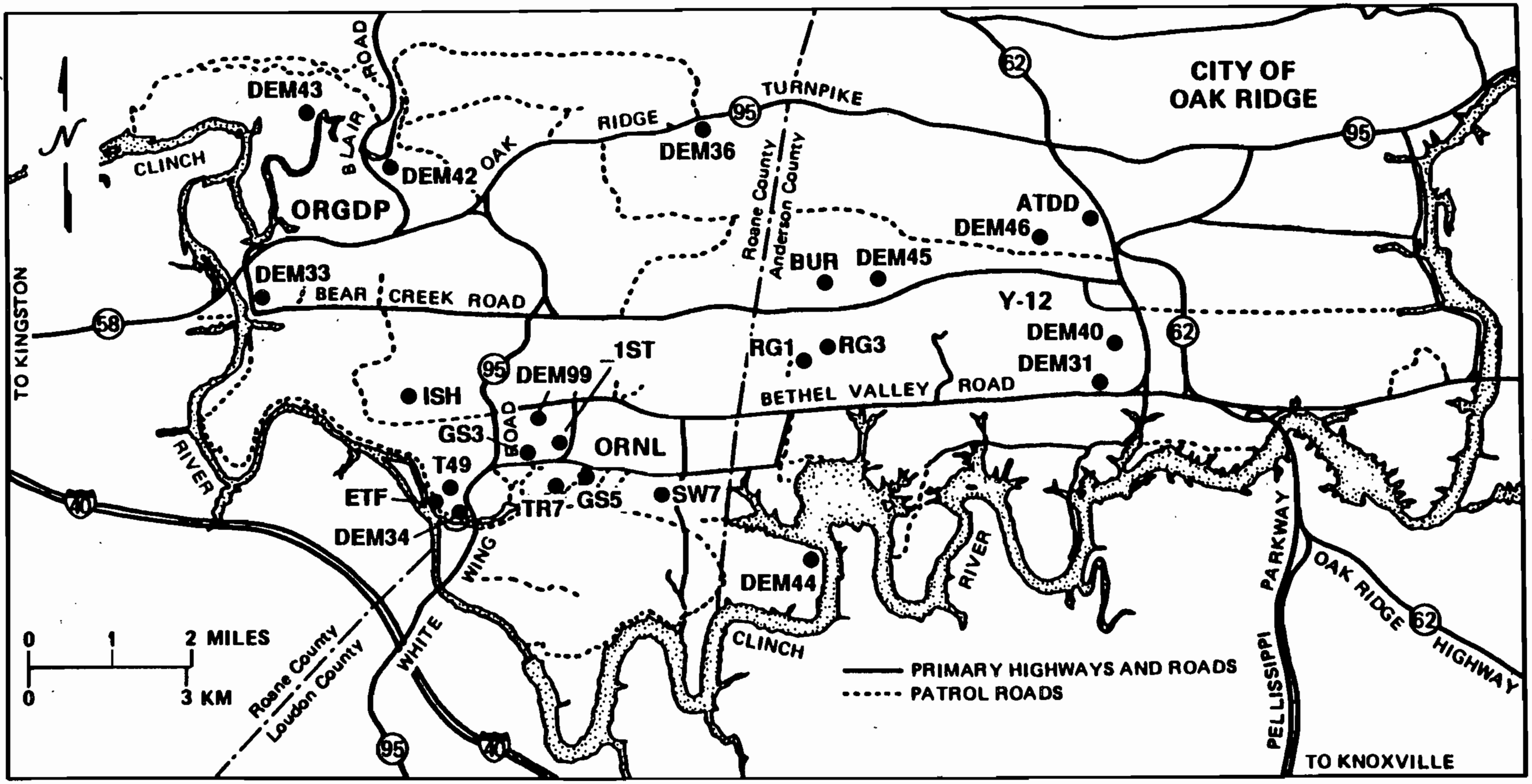

Fig. 9 Location map of precipitation gauges on or near the Oak Ridge reservation

Table 62. Precipitation for ORNL and nearby sites[a]

January - September 1988

Month	No. of Active ORNL Sites	Precipitation (mm)		
		ORNL Average[b]	ATDD	ATDD Departure from Normal
January	11	132.3	138.2	+4.8
February	11	73.0	87.1	-29.7
March	11	81.6	96.5	-61.2
April	11	77.7	86.9	-25.1
May	11	56.5	67.3	-40.1
June	11	33.1	13.5	-94.7
July	9[c]	172.9	193.0	+60.7
August	9[c]	54.9	60.7	-34.5
September	9[c]	128.9	143.0	+46.5
Total		810.9	886.2	-173.3

[a]ORNL data are stored in the ORNL Remedial Action Program database; Larry Voorhees, Coordinator, 574-7309.

[b]Average of active ORNL sites for each month; ATDD not included.

[c]Third quarter values have not yet been reported for stations GS3 and GS5 (sites operated by the U.S. Geological Survey).

Wind

The ORNL wind tower network consists of towers A and B, each with sensors mounted at 10 and 30 meters, and tower C with sensors mounted at 10, 30, and 100 meters. Locations of these towers are shown in Fig. 10. 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 24 hours. These velocities are processed into 15-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 15-minute averages into hourly averages. The 15-minute averages are retained for one day and the hourly averages, from which the wind roses in Figs. 11-17 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. This channeling effect is least evident at 100 m elevation, where the winds are more south-southwesterly. 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 m.

ORNL-DWG 86-9142R4

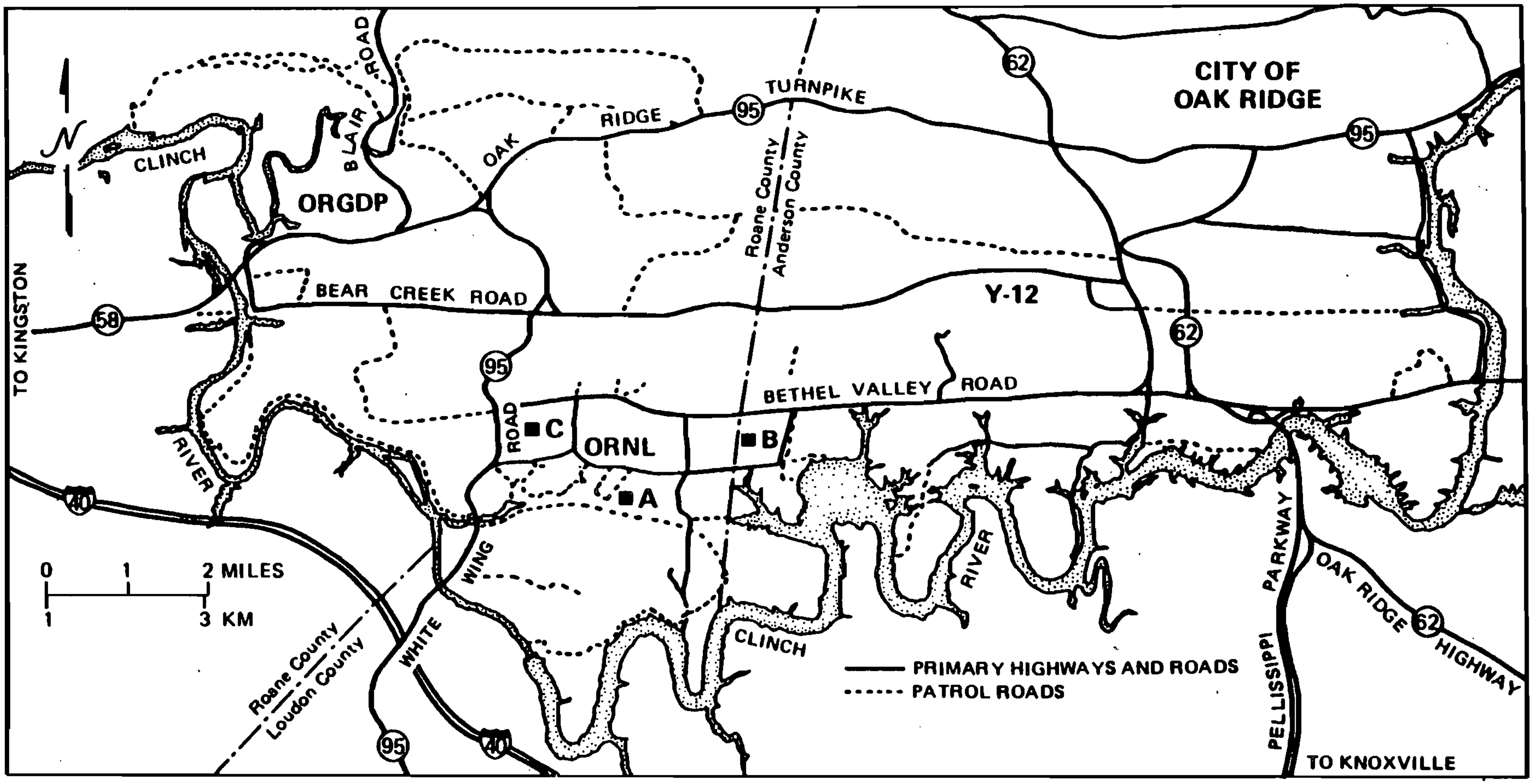

Fig. 10 Locations of meteorological towers at ORNL

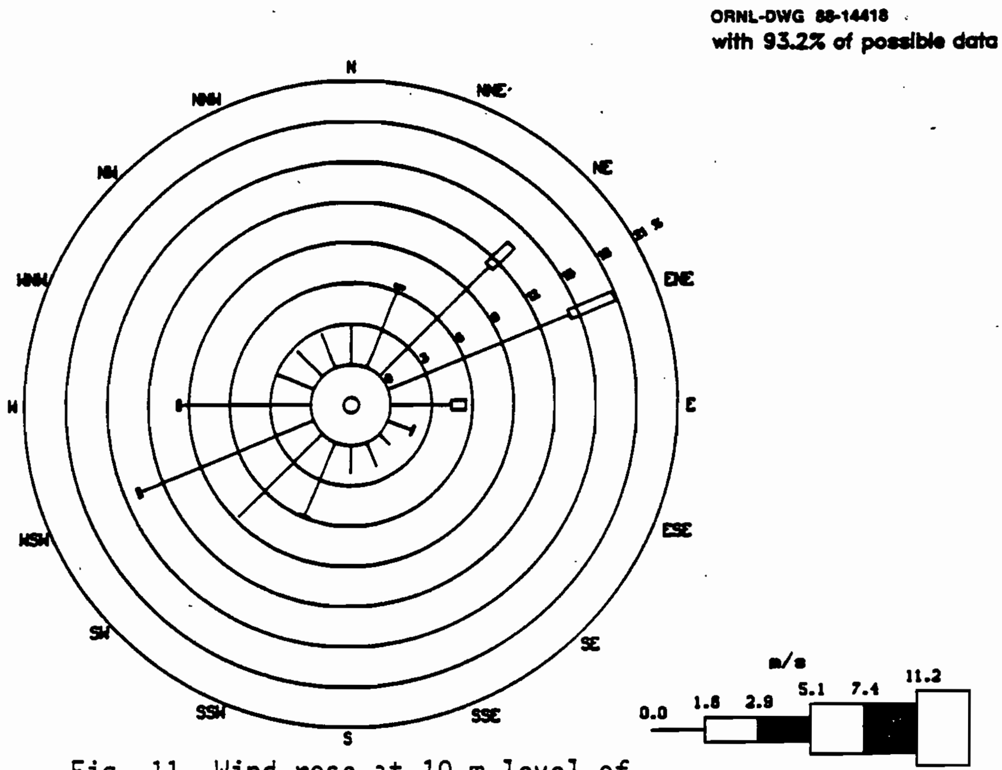

Fig. 11 Wind rose at 10-m level of meteorological tower A, July-September 1988

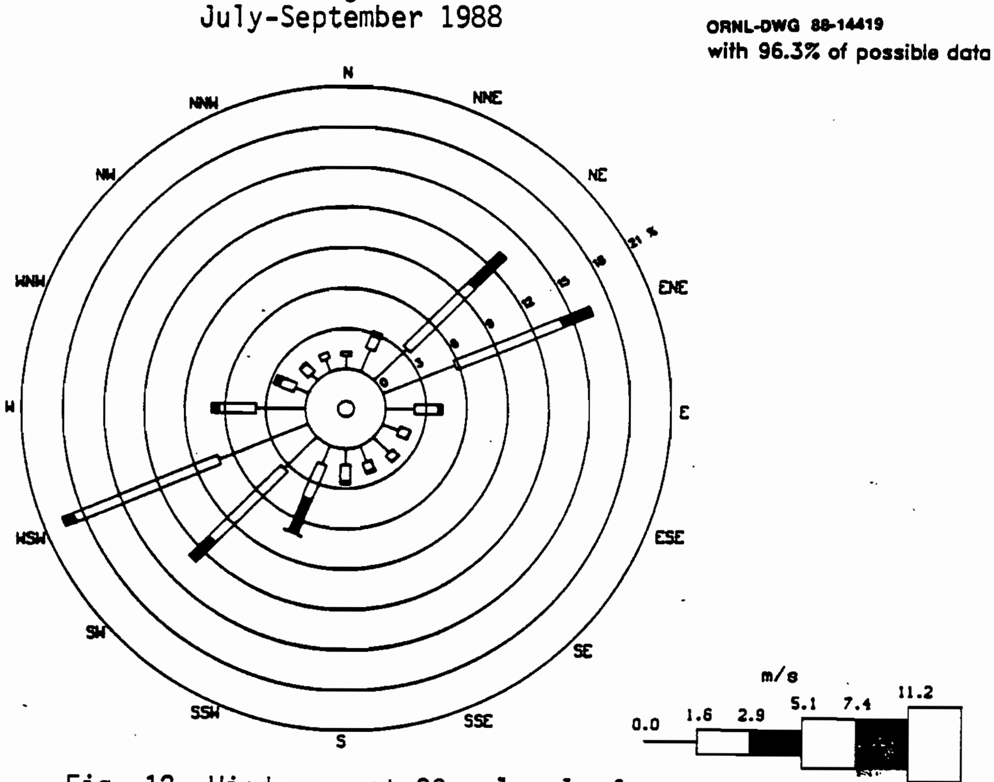

Fig. 12 Wind rose at 30-m level of meteorological tower A, July-September 1988

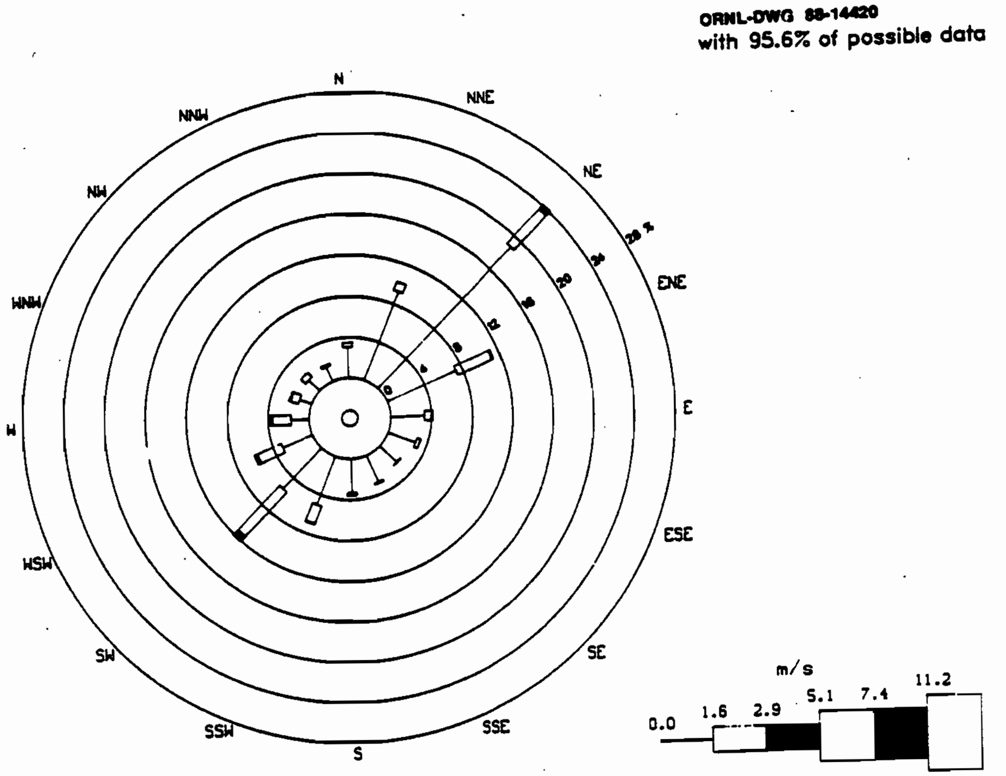

Fig. 13 Wind rose at 10-m level of meteorological tower B, July-September 1988

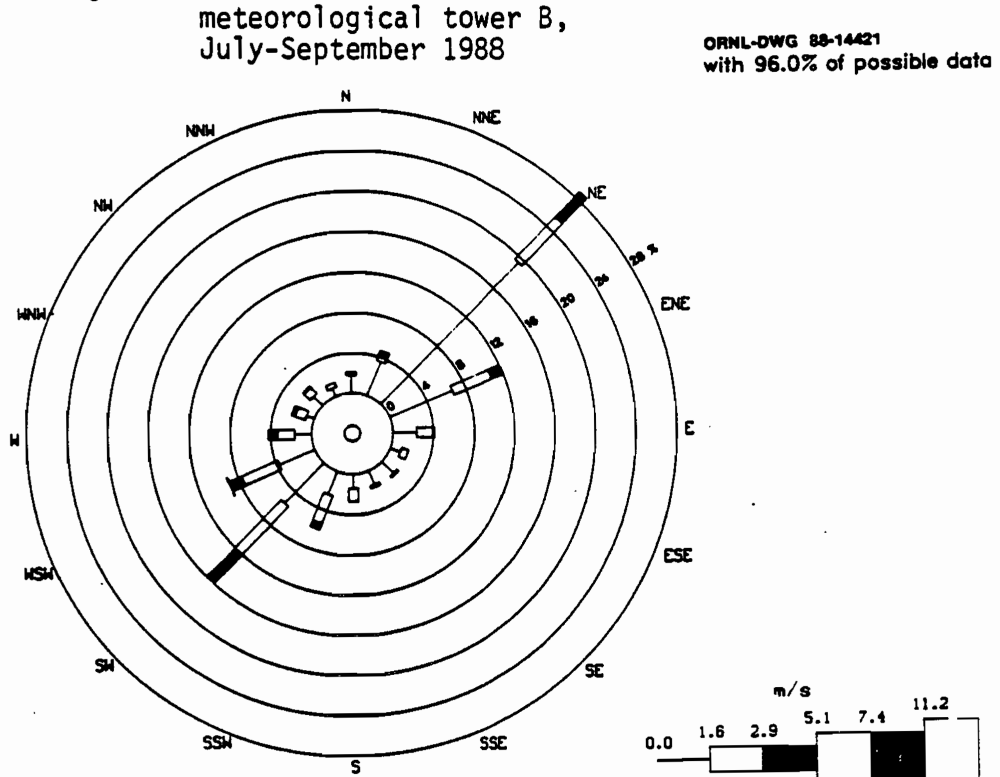

Fig. 14 Wind rose at 30-m level of meteorological tower B, July-September 1988

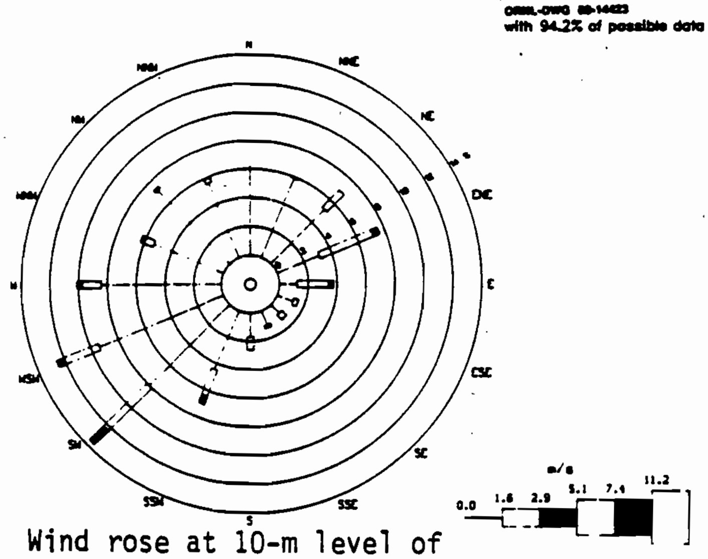

Fig. 15 Wind rose at 10-m level of meteorological tower C, July-September 1988

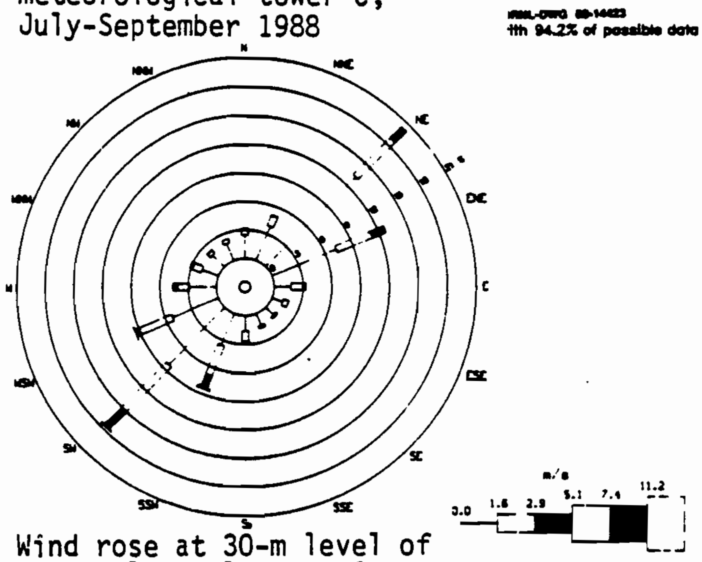

Fig. 16 Wind rose at 30-m level of meteorological tower C, July-September 1988

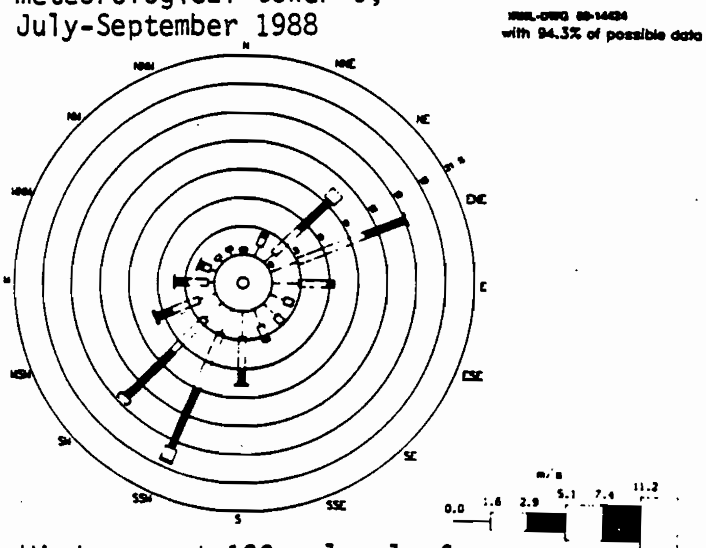

Fig. 17 Wind rose at 100-m level of meteorological tower C, July-September 1988

Milk

Raw milk from five 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 (Fig. 18). Three other stations are more remote with respect to the Oak Ridge facilities and are usually sampled semiannually (Fig. 19). 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 63 and 64) are compared with intake guidelines specified by the Federal Radiation Council (FRC). Maxima and minima for the network summaries in these tables are the greatest of the maxima and the smallest of minima, over all sites, rather than the averages of those maxima or minima.

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 < 0.08 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 occur when a sample analysis is delayed. Values reported for the quarter were always less than detection limits.

Concentrations of total radioactive Sr are shown in Table 64. The average concentration of total radioactive Sr at all stations in the immediate Oak Ridge area was 0.17 Bq/L. This concentration was not significantly different from the average for the second quarter of 1988 (0.19 Bq/L). All total radioactive Sr results are within Range I of the FRC guidelines.

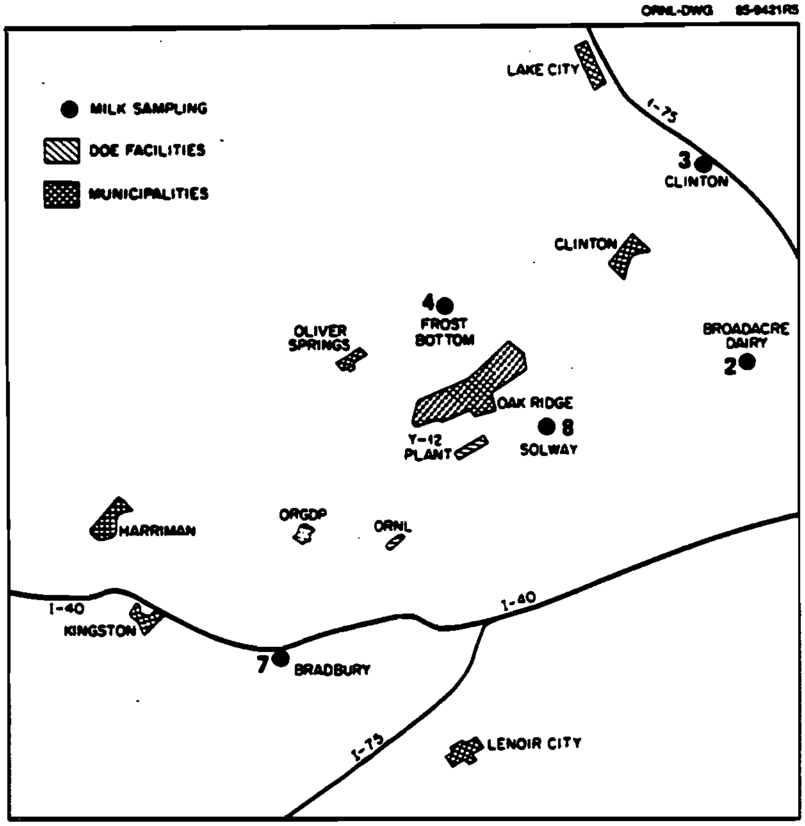

Fig. 18 Locations of milk sampling stations near the Oak Ridge facilities

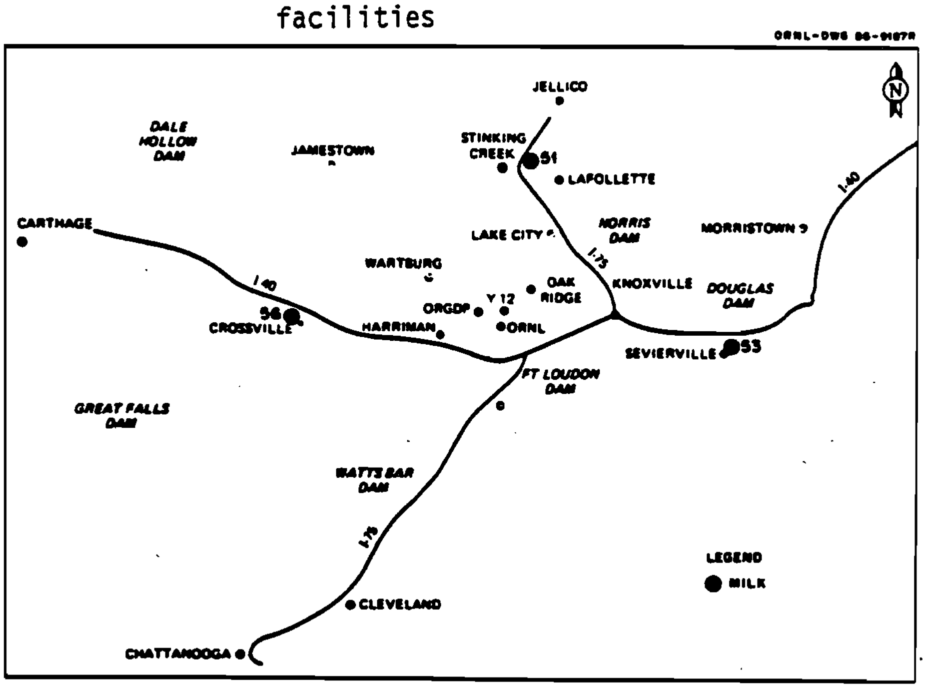

Fig. 19 Locations of milk sampling stations remote from the Oak Ridge facilities

Table 63. Concentrations of ^{131}I in milk[a]

July - September 1988

Station	No. of Samples	Concentration (Bq/L) Max	Min	Av	95%cc[b]	Percent of guideline[c]
		Immediate Environs[d]				
1	7	< 0.10	< 0.060	< 0.094	0.011	25
2	7	< 0.20	< 0.010	< 0.10	0.042	27
3	7	< 0.10	< 0.010	< 0.087	0.026	24
4	7	< 0.20	< 0.010	< 0.094	0.044	25
8	7	< 0.20	< 0.010	< 0.079	0.052	21
Network summary	35	< 0.20	< 0.010	< 0.091	0.016	25

[a]Raw milk samples; Station 2 is a dairy.
[b]95% cc about the average.
[c]Percent of applicable FRC standard assuming 1 L/d intake: Range I, 0-0.37 Bq/L; adequate surveillance required to confirm calculated intakes.
[d]See Fig. 18.

Table 64. Concentrations of total radioactive Sr in milk[a]

July - September 1988

Station	No. of Samples	Concentration (Bq/L) Max	Min	Av	95%cc[b]	Percent of guideline[c]
		Immediate Environs[d]				
1	7	0.23	0.048	0.12	0.043	16
2	7	0.23	0.083	0.14	0.041	19
3	7	0.18	0.072	0.13	0.030	17
4	7	0.44	0.11	0.23	0.094	31
8	7	0.27	0.14	0.21	0.038	29
Network summary	35	0.44	0.048	0.17	0.028	22

[a]Raw milk samples; Station 2 is a dairy.
[b]95% cc about the average.
[c]Percent of applicable FRC standard assuming 1 L/d intake: Range I, 0-0.74 Bq/L; adequate surveillance required to confirm calculated intakes.
[d]See Fig. 18.

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