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ENVIRONMENTAL SURVEILLANCE DATA REPORT FOR THE FIRST QUARTER OF 1986

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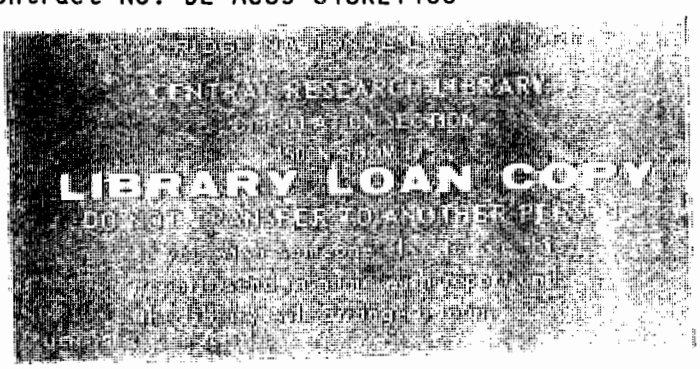

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INTRODUCTION

The Department of Environmental Management (DEM) within the Environmental and Occupational Safety Division (E&OS) at the Oak Ridge National Laboratory (ORNL) is responsible for environmental surveillance to: (1) assure compliance with all Federal, State, and local standards for the prevention, control, and abatement of environmental pollution, (2) monitor the adequacy of containment and effluent controls, and (3) assess impacts on the environment of releases from ORNL facilities.

To meet these objectives, the DEM has implemented a surveillance program that consists of both monitoring and sampling of the environment. Monitoring provides continuous data at a more gross level for rapid screening of media. Sampling followed by laboratory analyses are usually recommended for routine surveillance rather than constant monitoring. In general, monitoring systems are less sensitive and as a result have much higher detection levels than laboratory analysis. Sampling followed by laboratory analysis provides a quantitative estimate of concentrations or activities which are useful at the lower environmental levels.

The surveillance program for 1986 includes sampling and monitoring of air, water from surface streams and point sources, groundwater, fish, grass, soil, and milk for radioactive and nonradioactive materials. Surveillance points are located on-site to quantify discharges from ORNL facilities around the perimeter of ORNL, and off-site to determine public exposures and to measure background reference levels.

The purpose of this report is to provide personnel in the Laboratory and in Central Management with recent data and to identify additional available sources of information. It is intended strictly as a data report with a minimum amount of interpretation. Each quarter a report will be prepared that summarizes all environmental monitoring data from the various media. At the end of the calendar year, the data will be consolidated, analyzed, and interpreted for inclusion in an annual report which will be submitted to DOE containing information on all three Oak Ridge facilities.

Summaries of data will be presented for each month where there are multiple observations per month. For samples collected monthly, quarterly statistics will be presented. In general, the summary tables give the number of samples collected at each station or location and the maximum, minimum, and average values of substances detected. The 95% confidence coefficients (CCs) were calculated from the standard deviation of the sample average (assuming a normal frequency distribution). Where possible, average values were compared with applicable guidelines, criteria, or standards as a means of evaluating the impact of effluent releases and environmental concentrations.

During 1986, the Low-Level Counting Facility at ORNL began reporting radionuclide measurements in a manner different from that of previous years. Prior to 1986, data below the minimum detectable limit were reported as "less than (<)" the detection limit. This year, results that are negative (samples less than instrument background) are reported. If these data are compared to previous years, it will appear that average values for 1986 have decreased. Apparent decreases may be attributed to the reporting of negative values and the subsequent averaging of this data.

Nonradionuclide results that are below the analytical detection limit are expressed as less than (<) the limit. In computing average values, sample results below the limit are assigned the limit, and the resulting average value is expressed as less than the computed value.

The Four-Plant Analytical Committee is reviewing the standardization of reporting of less than detectable values. Their recommendations will be incorporated in these reports as they become policy.

AIR

Most gaseous wastes from ORNL are released to the atmosphere through stacks. Radioactivity may be present in gaseous waste streams as a solid (particulates), as an absorbable gas (iodine), or as a non-absorbable species (noble gas). Most gaseous wastes that may contain radioactivity are processed to reduce the radioactivity to acceptable levels before they are discharged. In addition to monitoring stack discharges to the atmosphere, atmospheric concentrations of materials occurring in the general environment around ORNL, the Oak Ridge Reservation, and the vicinity are monitored continuously by an air monitoring network of 23 stations. Relative locations of these stations are shown in Figures 1-2. These air monitoring stations are categorized into three groups according to their geographical locations:

(1) The ORNL perimeter air monitoring stations (ORNL PAMs) consist of numbers 3, 7, 9, 21, and 22. These stations are located off-site, but near the ORNL boundary (shown in Figure 1).

(2) The DOE Oak Ridge reservation stations (Reservation PAMS) consists of stations 8, 23, 31, 33, 34, 36, 40-45 shown in Figure 1.

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

During the latter part of 1985 and early 1986, ten of the Reservation PAMs were upgraded. Each air station has the capability to perform both sampling and continuous monitoring. At each station, there are monitors for five radiation parameters (gross alpha, gross beta, iodine, gross gamma, and noble gas), a rain gauge, and three process sensors that are used to calculate the volume of the sample collected. A central processor collects 10-minute average readings and transmits them to a VAX computer for further analysis and reporting. The central processor checks the values against alarm limits. All alarms are reported to a printer as they occur. The primary purpose of the monitoring system is to determine if radiation levels on the Reservation are above background levels. If radiation levels appear to be higher than normal, additional sampling can be initiated in order to provide quantitative measures of concentrations in the atmosphere. In addition, sampling is done at each station to quantify levels of iodine, tritium, gross alpha, and gross beta. The real-time monitoring system is the only measure of noble gas in the area.

Airborne radioactive particulates are collected weekly by pumping a continuous flow of air through a paper filter. The filter papers are collected and analyzed weekly for gross alpha and gross beta activity. To

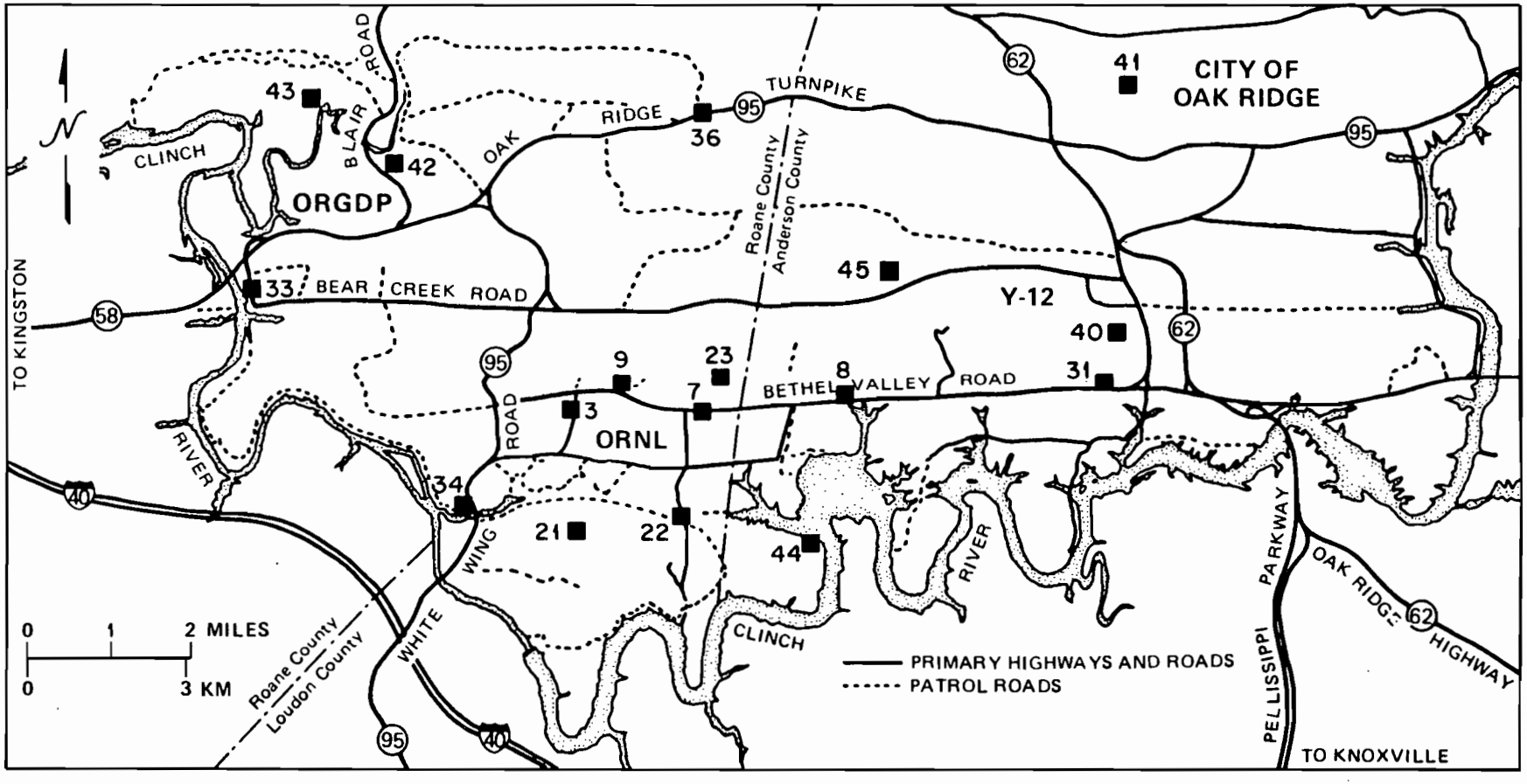

Fig. 1 Location map of the Oak Ridge Reservation air monitoring stations

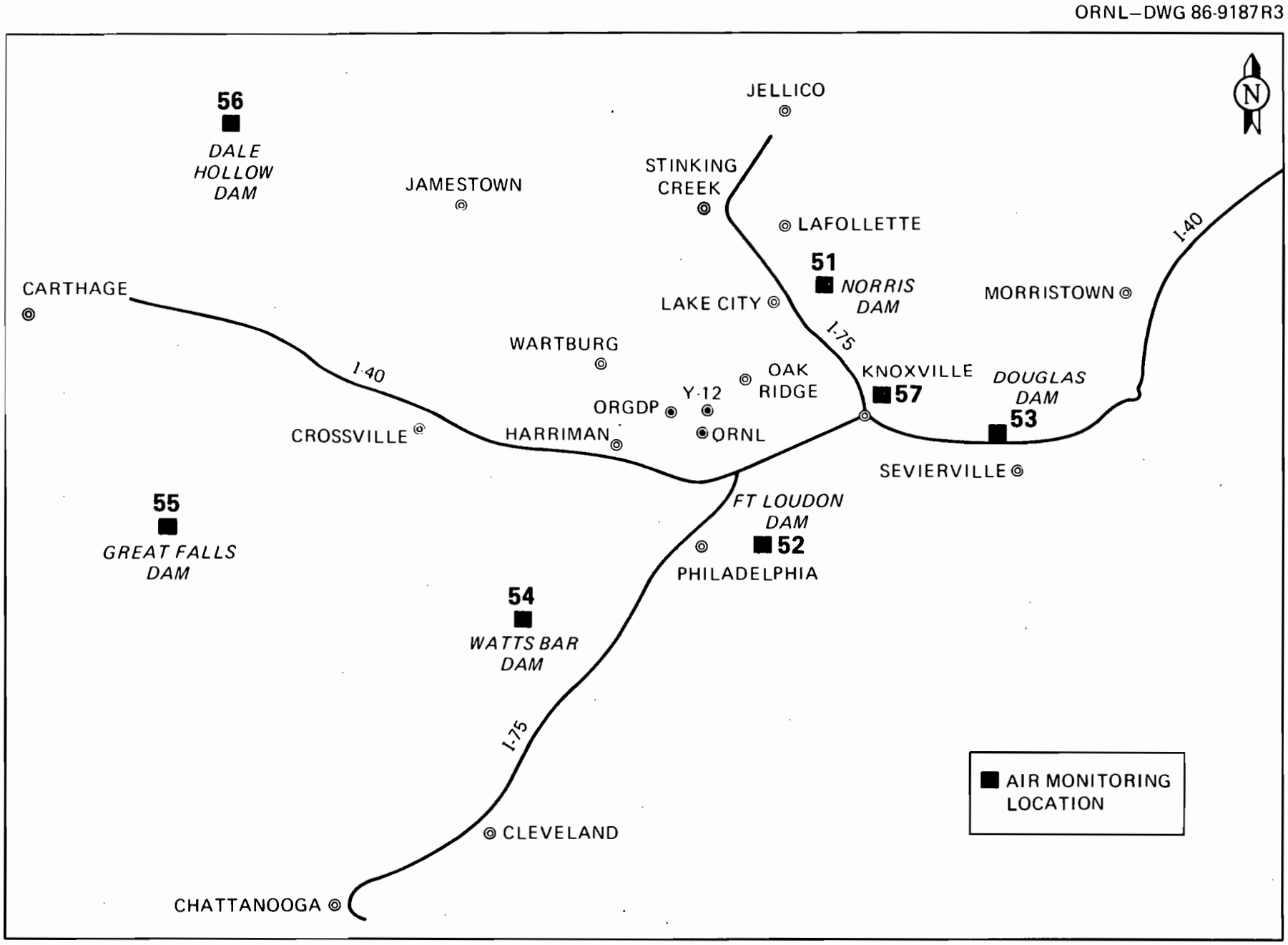

Fig. 2 Location map of the remote air monitoring stations

minimize artifacts from short-lived radionuclides, the filter papers are analyzed 3-4 days after collection. The airborne ^{131}I is collected weekly in the same fashion but using a cartridge that is packed with active charcoal, instead of using filter paper. The charcoal cartridges are analyzed within 24 hours after collection. The initial and final dates, time on and off, and flow rates are recorded when a sampler is mounted or removed. From this information, total volume of air flow through the sampler at each station is calculated. The concentration of radioactivity in air is calculated by dividing the total activity per sample by the total volume of air.

Monthly (January-March) concentrations of gross alpha, gross beta, and atmospheric ^{131}I are summarized in Tables 1-6. Background concentrations of ^{131}I have been subtracted from the measured concentrations in Table 4-6. Negative ^{131}I values represent concentrations below the background level.

Monthly samples for atmospheric tritium are collected from two ORNL PAM stations (numbers 3 and 7) and one Reservation PAM station (number 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. Quarterly summaries of atmospheric tritium concentrations are found in Table 7.

No environmental air samples are collected by ORNL for the analysis of nonradioactive materials because current operations do not require it under the Clean Air Act or state air regulations.

Table 1. Long-lived gross alpha and gross beta activities in air

January 1986

Location	Gross alpha					Gross beta				
	No. of samples	Max	Min	Av	95%cc[a]	No. of samples	Max	Min	Av	95%cc[a]
	Concentration (10^{-8} Bq/L)									
ORNL Perimeter Stations[b]										
3	5	< 91	< 76	< 81	5.6	5	< 91	< 76	< 81	5.6
7	5	< 41	< 41	< 41	0	5	< 41	< 41	< 41	0
9	5	< 110	< 91	< 100	7.2	5	< 110	< 91	< 100	7.2
Network summary	15	< 110	< 41	< 75	14	15	< 110	< 41	< 75	14
Reservation Perimeter Stations [b]										
8	5	< 35	< 35	< 35	0	5	< 35	< 35	< 35	0
23	5	< 18	< 17	< 18	0.14	5	< 18	< 17	< 18	14
31	4	36	< 36	< 36	0	4	< 36	< 36	< 36	0
33	5	36	< 17	< 32	7.7	5	< 36	< 17	< 32	7.7
34	5	36	< 16	< 32	7.8	5	180	< 16	< 89	68
36	5	< 45	< 14	< 37	12	5	< 45	< 14	< 37	12
40	4	< 60	< 36	< 45	11	4	< 60	< 36	< 45	11
41	5	< 45	< 45	< 45	0	5	< 45	< 45	< 45	0
42	4	< 36	< 36	< 36	0	4	< 36	< 36	< 36	0
43	4	< 76	< 45	< 62	16	4	< 76	< 45	< 62	16
44	4	< 36	< 36	< 36	0	4	< 36	< 36	< 36	0
45	4	< 36	< 36	< 36	0	4	36	< 36	< 36	0
Network summary	54	< 76	< 14	< 37	3.3	54	180	< 14	< 42	7.7

Table 1. (Continued)

Location	Gross alpha					Gross beta				
	Concentration (10^{-8} Bq/L)									
	No. of samples	Max	Min	Av	95%cc[a]	No. of samples	Max	Min	Av	95%cc[a]
					Remote Stations[c]					
51	3	< 14	< 14	< 14	0	3	< 14	< 14	< 14	0
52	5	< 20	< 17	< 18	0.87	5	< 20	< 17	< 18	0.87
53	4	< 19	< 18	< 19	0.36	4	< 19	< 18	< 19	0.36
55	4	< 18	< 17	< 18	0.44	4	< 18	< 17	< 18	0.44
56	4	< 18	< 17	< 18	0.17	4	< 18	< 17	< 18	0.17
57	5	< 14	< 14	< 14	0	5	22	< 14	< 16	3.2
Network summary	25	< 20	< 14	< 17	0.82	25	22	< 14	< 17	0.88
Overall summary	94	< 110	< 14	< 38	4.7	94	180	< 14	< 41	6.2

[a] 95% confidence coefficient about the mean.

[b] See Figure 1.

[c] See Figure 2.

Table 2. Long-lived gross alpha and gross beta activities in air

February 1986

Location	Gross alpha					Gross beta				
	No. of samples	Max	Min	Av	95%cc[a]	No. of samples	Max	Min	Av	95%cc[a]
	Concentration (10^{-8} Bq/L)									
ORNL Perimeter Stations[b]										
3	4	< 91	< 91	< 91	0	4	< 91	< 91	< 91	0
7	4	< 41	< 41	< 41	0	4	< 41	< 41	< 41	0
9	4	< 100	< 100	< 100	0	4	< 100	< 100	< 100	0
Network summary	12	< 100	< 41	< 78	23	12	< 100	< 41	< 78	23
Reservation Perimeter Stations[b]										
8	4	35	< 35	< 35	0	4	< 35	< 35	< 35	0
23	4	< 18	< 17	< 18	0.34	4	< 18	< 17	< 18	0.34
31	4	36	< 35	< 36	0	4	< 36	< 36	< 36	0
33	4	36	< 36	< 36	0	4	36	< 36	< 36	0
34	4	36	< 16	< 26	20	4	36	< 16	< 26	20
36	4	53	< 45	< 50	8.0	4	< 53	< 45	< 49	8.0
40	4	< 41	< 36	< 39	4.9	4	< 41	< 36	< 39	4.9
41	4	< 45	< 45	< 45	0	4	< 45	< 45	< 45	0
42	4	36	< 36	< 36	0	4	< 36	< 36	< 36	0
43	4	45	< 45	< 45	0	4	< 45	< 45	< 45	0
44	4	< 36	< 36	< 36	0	4	< 36	< 36	< 36	0
45	4	36	< 36	< 36	0	4	36	< 36	< 36	0
Network summary	48	53	< 16	< 37	3.6	48	< 53	< 16	< 37	3.6

Table 2. (Continued)

Location	Gross alpha					Gross beta				
	No. of samples	Max	Min	Av	95%cc[a]	No. of samples	Max	Min	Av	95%cc[a]
	Concentration (10^{-8} Bq/L)									
	Remote Stations[c]									
51	3	< 14	< 14	< 14	0	3	< 14	< 14	< 14	0
52	3	< 16	< 16	< 16	0	3	< 18	< 16	< 16	0
53	3	< 19	< 19	< 19	0	3	< 19	< 19	< 19	0
55	3	< 18	< 18	< 18	0	3	< 18	< 18	< 18	0
56	3	< 17	< 17	< 17	0	3	< 17	< 17	< 17	0
57	3	< 14	< 14	< 14	0	3	< 14	< 14	< 14	
Network summary	18	< 19	< 14	< 16	1.7	18	< 19	< 14	< 16	1.7
Overall summary	78	< 100	< 14	< 40	7.6	78	< 100	< 14	< 40	7.6

[a] 95% confidence coefficient about the mean.

[b] See Figure 1.

[c] See Figure 2.

Table 3. Long-lived gross alpha and gross beta activities in air

March 1986

Location	Concentration (10^{-8} Bq/L)									
	Gross alpha					Gross beta				
	No. of samples	Max	Min	Av	95%cc[a]	No. of samples	Max	Min	Av	95%cc[a]
ORNL Perimeter Stations[b]										
3	4	< 91	< 91	< 91	0	4	< 91	< 91	< 90	0
7	4	< 41	< 41	< 41	0	4	< 41	< 41	< 41	0
9	4	< 100	< 100	< 100	0	4	< 100	< 100	< 100	0
Network summary	12	< 100	< 41	< 78	16	12	< 100	< 41	< 78	18
Reservation Perimeter Stations[b]										
8	4	< 36	< 34	< 35	1.6	4	< 36	< 34	< 35	1.6
23	4	< 18	< 18	< 18	0	4	< 18	< 18	< 18	0.18
31	4	< 36	< 36	< 36	0	4	< 36	< 36	< 36	0
33	4	41	< 36	< 36	0	4	36	< 36	< 36	0
34	4	36	< 34	< 36	1.8	4	88	< 34	< 53	35
36	4	< 45	< 45	< 45	0	4	< 45	< 45	< 45	0
40	4	45	< 36	< 41	5.2	4	< 45	< 36	< 41	5.2
41	4	45	< 45	< 45	0	4	< 45	< 45	< 45	0
42	4	< 36	< 36	< 36	0	4	36	< 36	< 36	0
43	4	< 36	< 36	< 36	0	4	< 36	< 36	< 36	0
44	4	< 36	< 36	< 36	0	4	< 36	< 36	< 36	0
45	4	36	< 36	< 36	0	4	300	< 36	< 120	170
Network summary	48	45	< 18	< 36	2.3	48	300	< 18	< 46	15

Table 3. (Continued)

Concentration (10^{-8} Bq/L)

Location	Gross alpha					Gross beta				
	No. of samples	Max	Min	Av	95%cc[a]	No. of samples	Max	Min	Av	95%cc[a]
					Remote Stations[c]					
51	4	< 14	< 14	< 14	0	4	< 14	< 14	< 14	0
52	3	< 25	< 22	< 23	1.9	3	< 25	< 22	< 23	1.9
53	4	< 19	< 19	< 19	0.46	4	< 19	< 19	< 19	0.46
55	4	< 17	< 17	< 17	0.22	4	< 17	< 17	< 17	0.22
56	4	18	< 16	< 17	1.2	4	< 18	< 16	< 17	1.1
57	4	< 15	< 15	< 15	0.17	4	< 15	< 15	< 15	0.17
Network summary	23	25	< 14	< 18	1.5	23	< 25	< 14	< 18	1.5
Overall summary	83	< 100	< 14	< 37	5.5	83	300	< 14	< 42	10

[a] 95% confidence coefficient about the mean.

[b] See Figure 1.

[c] See Figure 2.

Table 4. Iodine - 131 in Air

January 1986

Location	No. of samples	Concentration (10^{-8} Bq/L) Max	Min	Av	95%cc[a]
		ORNL Perimeter Stations[b]			
3	5	18	10	13	2.7
7	5	6.4	4.8	5.7	0.78
9	5	16	-3.9	8.2	8.4
Network Summary	15	18	-3.9	8.9	3.1
		Reservation Perimeter Stations[b]			
8	5	8.1	1.4	4.3	2.6
23	5	4.8	0	1.9	1.7
31	4	13	-4.2	4.0	7.2
33	5	9.8	-5.6	2.1	4.9
34	5	6.1	-1.4	3.0	3.1
36	5	7.9	0.54	3.9	2.6
40	4	9.3	-4.2	3.4	6.1
41	5	12	-1.8	4.6	5.0
42	4	8.4	1.4	4.6	3.7
43	4	10	-6.2	2.3	9.2
44	4	14	1.4	6.3	5.4
45	4	5.6	-5.6	0.70	4.7
Network summary	54	14	-6.2	3.4	1.3
Overall summary	79	18	-6.2	4.6	1.3

[a] 95% confidence coefficient about the mean.

[b] See Figure 1.

Table 5. Iodine - 131 in air

February 1986

Location	No. of samples	Concentration (10^{-8} Bq/L) Max	Min	Av	95%cc[a]
		ORNL Perimeter Stations[b]			
3	4	11	-11	0	9.0
7	4	8.0	0	3.2	3.9
9	4	20	-3.9	8.8	1.1
Network summary	12	20	-11	4.0	4.9
		Reservation Perimeter Stations[b]			
8	4	16	0	6.5	7.8
23	4	2.8	-2.1	1.0	2.3
31	4	4.2	1.4	2.8	1.6
33	4	9.8	-4.2	3.2	7.0
34	4	5.6	0	3.2	2.3
36	4	17	-16	2.9	14
40	4	11	-5.6	2.1	6.6
41	4	8.8	0	5.3	3.8
42	4	13	0	4.2	5.9
43	4	8.8	-7	0.79	7.6
44	4	5.6	0	4.2	2.8
45	4	4.2	1.4	2.1	1.4
Network summary	48	1.8	-16	3.2	1.7
Overall summary	60	20	-16	3.3	1.7

[a] 95% confidence coefficient about the mean.

[b] See Figure 1.

Table 6. Iodine - 131 in air

March 1986

Location	No. of samples	Concentration (10^{-8} Bq/L) Max	Min	Av	95%cc[a]
		ORNL Perimeter Stations[b]			
3	4	21	3.5	7.9	11
7	4	6.4	0	4.4	3.0
9	4	27	-12	3.9	17
Network summary	12	27	-12	5.4	6.1
		Reservation Perimeter Stations[b]			
8	4	5.4	-1.4	2.0	3.2
23	4	3.5	0	1.1	1.7
31	4	8.4	-5.6	1.8	6.0
33	4	8.4	1.4	4.2	3.0
34	4	7.0	-3.9	1.1	5.3
36	4	11	-3.5	2.7	7.2
40	4	8.8	-1.6	2.2	4.6
41	4	11	3.5	6.6	3.0
42	4	4.2	-1.4	1.4	2.6
43	4	2.8	-2.8	0.35	2.4
44	4	13	-4.2	3.5	7.3
45	4	1.4	-2.8	-0.7	1.8
Network summary	48	13	-5.6	2.2	1.2
Overall summary	60	27	-12	2.8	1.6

[a] 95% confidence coefficient about the mean.

[b] See Figure 1.

Table 7. Tritium activity in air

January - March 1986

Location[b]	No. of samples	Concentration (10^{-4} Bq/L) Max	Min	Av	95%cc[a]
3	3	9.8	2.8	5.6	4.3
7	3	18	9.3	15	5.7
8	3	6.1	3.9	4.8	1.3
Overall summary	9	18	2.8	8.5	3.9

[a] 95% confidence coefficient about the mean.

[b] See Figure 1.

EXTERNAL GAMMA RADIATION

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

Currently, external gamma radiation measurements are made monthly at both the ORNL and Reservation PAMs using thermoluminescent dosimeters (TLDs) suspended 1 m above the ground. Three dosimeters are placed in each container at the ORNL stations and two are placed in containers at the Reservation stations. Measurements from each dosimeter are averaged for the month. Quarterly summaries of external gamma radiation are found in Table 8.

Table 8. External gamma radiation measurement

January - March 1986

Location	No. of samples[a]	μR/h Max	Min	Av	95%cc
		ORNL Perimeter Stations			
3	2	12	3.6	8.0	8.8
7	1	10	10	10	-
9	2	11	8.4	9.9	3.0
21	2	8.6	7.9	8.2	0.74
22	2	6.9	4.0	5.5	2.8
Network summary	9	12	3.6	8.1	2.0
		Reservation Perimeter Stations			
31	1	9.4	9.4	9.4	-
33	3	10	6.1	8.8	2.7
34	3	16	11	13	2.4
36	3	9.6	5.8	7.9	2.2
40	3	11	8.2	9.3	1.8
41	3	13	7.9	11	3.2
42	3	12	7.0	9.2	3.2
43	3	9.7	5.6	7.0	2.6
44	3	13	7.8	9.8	2.9
Network summary	25	16	5.6	9.5	1.0

[a] For each month, individual dosimeters are first averaged for each station. The number of samples indicates the number of months of data.

WATER

Most of the drainage or liquid effluent from the Oak Ridge Reservation flows into the Clinch River by ways of its principal tributary, White Oak Creek (WOC). The Clinch River flows southwest from Virginia to its mouth near Kingston, Tennessee, where it joins with the Tennessee River.

Runoff from most of ORNL, including that from the burial grounds, reaches WOC either directly or via one of its tributaries, such as White Oak Creek or Melton Branch. Concentrations of contaminants in WOC are affected by White Oak Dam (WOD) which controls the stream's flow. Flow in WOC may also be augmented by discharges from the ORNL's cooling towers and Sewage Treatment Plant. Below WOD, WOC is affected by water levels in the Clinch River which are controlled by Melton Hill Dam, shown in Figure 3.

Surveillance of the water environment consists of the collection of surface water samples and water from wells around surface impoundments. Both are analyzed for radionuclides and nonradioactive chemicals.

Surface Water

Flow and concentration data are collected from ORNL streams in order to determine discharges of contaminants from ORNL processes. Water samples are collected regularly from the following stations: First Creek, Fifth Creek, 7500 Bridge, Melton Branch 1 (MB1), Melton Branch 2, Melton Hill Dam, Northwest Tributary, Raccoon Creek, Sewage Treatment Plant (STP), White Oak Creek (WOC), White Oak Creek Head Water and White Oak Dam (WOD) (Figure 3). The Melton Hill Dam and White Oak Creek headwater sites are being sampled as background reference locations. All samples are collected weekly, but are analyzed for radionuclides at different periods. Samples from WOD are analyzed weekly while samples collected at other stations are composited first and then analyzed monthly. Samples collected from MB1, WOC, STP, and WOD are flow proportional. All other samples are collected weekly as grab samples and composited for monthly analysis.

Total flow per day is calculated by subtracting consecutive daily flow recorder readings and multiplying by a factor for conversion to liters. At three stations (MB1, WOC, and WOD) there are two weirs each. From WOC and MB1, low and high flow readings are obtained daily while low, medium, and high readings are obtained at WOD. From WOD, there are three readings: a low flow, a medium flow, and a high flow. At these three stations, the data are summed to obtain the total daily flow. Daily flows are summed for each week for WOD and for each month for all other stations.

The average flow proportional monthly concentrations are based on the total discharges divided by the total flow for the month. The discharge is the average of weekly discharges multiplied by the number of weeks in the month. Monthly discharges are given in Tables 9-11 and quarterly concentration summaries are given in Table 12.

A National Pollutant Discharge Elimination System (NPDES) permit was issued by the EPA for the ORNL facility in 1975. The permit established three sampling locations: (1) WOC, (2) MB1, and (3) STP. It listed specific concentration limits and/or monitoring requirements for a number of parameters at each location. Summary statistics for each location and parameter are presented in Tables 13-21 and the percentage of measurements in compliance for the first quarter of 1986 is given in Table 22. The percentage of measurements in compliance for all parameters at all stations, with the exception of chlorine, was 100%. The percentage for chlorine at the Sewage Treatment Plant was 74%.

During the month of March, the Tennessee Department of Health and Environment permitted ORNL to have an experimental grace period at the Sewage Treatment Plant which constituted a change in the quantity of chlorine added to the water and a decrease in the maximum concentration which could be allowed in the effluent sample. The grace period was granted so that ORNL could meet the criteria in the new NPDES permit issued on April 1, 1986. In previous years, an effort was made to achieve compliance by implementing a line item project (Improvements to Existing Sewage Treatment System), which required the replacement of the plant with an extended aeration package plant, and General Plant Projects (GPPs),

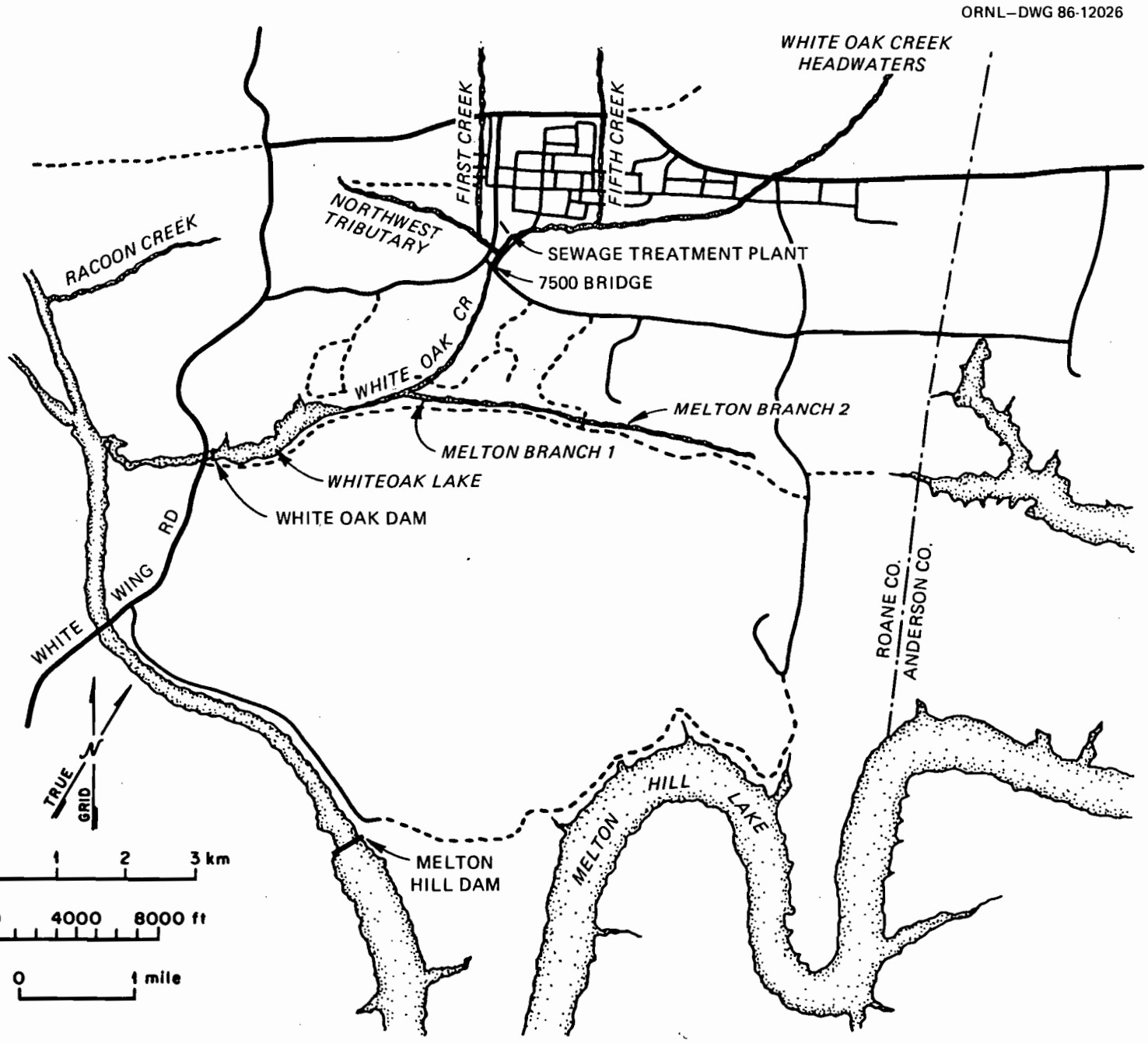

Fig. 3 Location map of ORNL streams

which required rehabilitation of the sanitary sewer system to reduce the amount of water reaching the plant. The GPPs have been completed and a new NPDES permit, which includes the addition of new discharge points and more strict limits on the releases from the current locations, has been issued. The number of noncompliances once observed has decreased since the completion of the projects.

The new NPDES permit received in April 1986 has over 183 stations designed to monitor point source outfalls at the source of effluent discharge. In addition, there are some sampling locations located in the streams designated as ambient monitoring stations.

Table 9. Radionuclides in water

January 1986

Radionuclide	Flow (10^6 Liters)	Concentration (Bq/L)	Discharge (10^4 mega Bq)
		Melton Branch 1[a]	
^{60}Co	160	58	0.92
^{137}Cs	160	0.40	0.0063
^{3}H	160	84000	1300
^{90}Sr	160	7.6	0.12
		Sewage Treatment Plant[a]	
^{60}Co	33	0.10	0.00033
^{137}Cs	33	1.1	0.0036
^{90}Sr	33	14	0.046
		White Oak Creek[a]	
^{60}Co	650	0.53	0.034
^{137}Cs	650	7.6	0.49
^{3}H	650	1300	83
^{90}Sr	650	7.2	0.46
		White Oak Dam[a,b]	
^{60}Co	830	3.4	0.28
^{137}Cs	830	5.6	0.47
Gross alpha	830	6.2	0.51
Gross beta	830	40	3.3
^{3}H	830	13000	1100
^{90}Sr	830 10.95cfs	8.3	0.69
Transuranics	830	0.034	0.0028

[a] See Figure 3. 175.79

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

Table 10. Radionuclides in water

February 1986

Radionuclide	Flow (10^6 Liters)	Concentration (Bq/L)	Discharge (10^4 mega Bq)
		Melton Branch 1[a]	
^{60}Co	340	9.1	0.31
^{137}Cs	340	0.10	0.0034
^{3}H	340	74000	2500
^{90}Sr	340	6.3	0.21
		Sewage Treatment Plant[a]	
^{60}Co	30	0.08	0.00024
^{137}Cs	30	0.30	0.00089
^{90}Sr	30	9.6	0.028
		White Oak Creek[a]	
^{60}Co	1100	0.27	0.030
^{137}Cs	1100	2.3	0.25
^{3}H	1100	2200	240
^{90}Sr	1100	6.8	0.75
		White Oak Dam[a,b]	
^{60}Co	1500	3.8	0.55
^{137}Cs	1500	3.8	0.56
Gross alpha	1500	4.4	0.65
Gross beta	1500	27	3.9
^{3}H	1500	11000	1600
^{90}Sr	1500	6.5	0.95
Transuranics	1500	0.062	0.0090

[a] See Figure 3.

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

Table 11. Radionuclides in water

March 1986

Radionuclide	Flow (10^6 Liters)	Concentration (Bq/L)	Discharge (10^4 mega Bq)
		Melton Branch 1[a]	
^{60}Co	240	11	0.26
^{137}Cs	240	0.10	0.0024
^{3}H	240	60000	1400
^{90}Sr	240	8.2	0.20
		Sewage Treatment Plant[a]	
^{60}Co	21	0.20	0.00043
^{137}Cs	21	0.28	0.00059
^{90}Sr	21	10	0.021
		White Oak Creek[a]	
^{60}Co	760	0.27	0.020
^{137}Cs	760	3.4	0.26
^{3}H	760	1600	120
^{90}Sr	760	6.4	0.48
		White Oak Dam[a,b]	
^{60}Co	1200	0.95	0.11
^{137}Cs	1200	4.7	0.57
Gross alpha	1200	4.2	0.51
Gross beta	1200	24	2.9
^{3}H	1200	13000	1500
^{90}Sr	1200	8.1	0.97
Transuranics	1200	0.098	0.012

[a] See Figure 3.

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

Table 12. Radionuclide concentrations in water

January - March 1986

Radionuclide	No. of samples	Concentration (Bq/L) Max	Min	Av	95%cc[a]
		First Creek[b]			
^{60}Co	3	0.20	0.10	0.13	0.07
^{137}Cs	3	0.20	0.09	0.13	0.07
^{90}Sr	3	17	9.2	13	4.5
		Fifth Creek[b]			
^{60}Co	3	0.20	0.10	0.13	0.07
^{137}Cs	3	0.20	0.10	0.13	0.07
^{90}Sr	3	2.0	1.4	1.6	0.37
		7500 Bridge[b]			
^{60}Co	3	0.36	0.20	0.29	0.09
^{137}Cs	3	6.3	6.1	6.2	0.11
^{152}Eu	1	7.5	7.5	7.5	-
^{154}Eu	1	2.2	2.2	2.2	-
^{155}Eu	1	0.29	0.29	0.29	-
^{156}Eu	1	0.97	0.97	0.97	-
^{3}H	3	300	180	250	71
^{90}Sr	3	5.4	4.0	4.8	0.82
		Melton Branch 1[b]			
^{60}Co	3	58	9.1	26	32
^{51}Cr	1	4.5	4.5	4.5	-
^{137}Cs	3	0.40	0.10	0.20	0.20
^{3}H	3	84000	60000	73000	14000
^{90}Sr	3	8.2	6.3	7.4	1.1
		Melton Branch 2[b]			
^{60}Co	3	67	3.2	27	40
^{51}Cr	1	8.3	8.3	8.3	-
^{137}Cs	3	0.40	0.07	0.19	0.21
^{3}H	3	3200	190	1200	2000
^{90}Sr	3	0.24	0.03	0.11	0.13
^{182}Ta	1	24	24	24	-

Table 12. (Continued)

Radionuclide	No. of samples	Concentration (Bq/L) Max	Min	Av	95%cc[a]
		Melton Hill Dam[b]			
^{60}Co	3	0.20	0.08	0.16	0.08
^{137}Cs	3	0.10	0.060	0.083	0.024
^{3}H	3	270	180	210	55
Pu	3	0.001	0.001	0.001	0.0001
^{90}Sr	3	0.16	0.046	0.090	0.071
^{228}Th	2	0.05	0.0003	0.027	0.053
^{230}Th	2	0.002	0.001	0.002	0.001
^{232}Th	3	0.007	0.0004	0.003	0.004
TransPu	3	0.001	0.001	0.001	0.0001
^{234}U	3	0.01	0.005	0.01	0.006
^{235}U	3	0.003	0.001	0.002	0.001
^{238}U	3	0.005	0.003	0.004	0.001
		Northwest Tributary[b]			
^{60}Co	3	0.10	0.10	0.10	0
^{137}Cs	3	0.10	0.080	0.093	0.013
^{90}Sr	3	2.2	1.5	1.8	0.42
		Raccoon Creek[b]			
^{60}Co	3	0.20	0.10	0.13	0.07
^{137}Cs	3	0.20	0.10	0.13	0.07
^{90}Sr	3	2.0	0.92	1.5	0.63
		Sewage Treatment Plant[b]			
^{60}Co	3	0.20	0.08	0.13	0.07
^{137}Cs	3	1.1	0.28	0.56	0.54
^{90}Sr	3	14	9.6	11	2.8
		White Oak Creek[b]			
^{60}Co	3	0.53	0.27	0.36	0.17
^{137}Cs	3	7.6	2.3	4.4	3.2
^{152}Eu	2	2.9	0.41	1.7	2.5
^{154}Eu	1	0.66	0.66	0.66	-
^{3}H	3	2200	1300	1700	530
^{90}Sr	3	7.2	6.4	6.8	0.46

Table 12. (Continued)

Radionuclide	No. of samples	Concentration (Bq/L) Max	Min	Av	95%cc[a]
		White Oak Creek Head Water[b]			
^{60}Co	3	0.20	0.10	0.17	0.07
^{137}Cs	3	0.20	0.09	0.16	0.07
^{3}H	3	180	180	180	0
Pu	3	0.001	0.001	0.001	0.0001
^{90}Sr	3	0.10	0.018	0.048	0.052
^{228}Th	2	0.052	0.001	0.026	0.051
^{230}Th	2	0.003	0.002	0.003	0.001
^{232}Th	3	0.001	0.0001	0.001	0.0006
TrPu	3	0.004	0.001	0.002	0.002
^{234}U	3	0.016	0.008	0.012	0.004
^{235}U	3	0.003	0.002	0.002	0.001
^{238}U	3	0.006	0.003	0.004	0.002

[a] 95% confidence coefficient about the mean.

[b] See Figure 3.

Table 13. National Pollutant Discharge Elimination System parameters in White Oak Creek

January 1986

Parameter	No. of samples	Concentration (mg/L) Max	Min	Av	95% cc[a]
BOD	4	< 5.0	< 5.0	< 5.0	0.0
Conductivity[b]	4	400	310	336	43
COD	4	9.0	3.0	5.5	2.6
Cr (Total)	4	< 0.01	< 0.005	< 0.009	0.0025
Dissolved oxygen	30	11	5.0	8.5	0.57
Dissolved solids	1	260	260	260	-
Oil & grease	1	2.0	2.0	2.0	-
pH[c]	30	8.6	7.5	7.8	0.076
Suspended solids	4	< 5.0	< 5.0	< 5.0	0.0
Turbidity[d]	4	15	11	13	1.7
		Quantity (10^6 liters per day)			
Flow	Continuous	27	15	19	1.1

a. 95% confidence coefficient about the average.
b. Units in µmhos.
c. Value in pH units.
d. Units in N.T.U.

Table 14. National Pollutant Discharge Elimination System parameters in White Oak Creek

February 1986

Parameter	No. of samples	Concentration (mg/L) Max	Min	Av	95% cc[a]
BOD	4	< 5.0	< 5.0	< 5.0	0.0
Conductivity[b]	4	398	200	287	85
COD	4	12	2.0	5.0	4.7
Cr (Total)	4	0.038	< 0.01	< 0.017	0.014
Dissolved oxygen	28	12	8.1	9.5	0.37
Dissolved solids	1	200	200	200	-
Oil & grease	1	3.0	3.0	3.0	-
pH[c]	28	7.9	7.0	7.6	0.081
Suspended solids	4	87	< 5.0	< 28	40
Turbidity[d]	4	45	1.0	15	21
		Quantity (10^6 liters per day)			
Flow	Continuous	250	17	38	17

a. 95% confidence coefficient about the average.
b. Units in µmhos.
c. Value in pH units.
d. Units in N.T.U.

Table 15. National Pollutant Discharge Elimination System parameters in White Oak Creek

March 1986

Parameter	No. of samples	Concentration (mg/L) Max	Min	Av	95% cc[a]
BOD	4	< 5.0	< 5.0	< 5.0	0.0
Conductivity[b]	4	400	200	333	91
COD	4	21	< 1.0	< 9.3	8.4
Cr (Total)	4	< 0.01	< 0.01	< 0.01	0.0
Dissolved oxygen	31	12	8.0	9.9	0.36
Dissolved solids	1	220	220	220	-
Oil & grease	1	< 2.0	< 2.0	< 2.0	-
pH[c]	31	8.5	7.0	7.7	0.10
Suspended solids	4	71	< 5.0	26	31
Turbidity[d]	4	240	5.0	94	111
		Quantity (10^6 liters per day)			
Flow	Continuous	83	14	26	5.7

a. 95% confidence coefficient about the average.
b. Units in µmhos.
c. Value in pH units.
d. Units in N.T.U.

Table 16. National Pollutant Discharge Elimination System parameters in Melton Branch

January 1986

Parameter	No. of samples	Concentration (mg/L) Max	Min	Av	95% cc[a]
BOD	4	< 5.0	< 5.0	< 5.0	0.0
Conductivity[b]	4	550	400	465	72
COD	4	66	< 5.0	< 23	29
Cr (Total)	4	< 0.01	< 0.005	< 0.009	0.0025
Dissolved oxygen	30	12	8.1	9.9	0.33
Dissolved solids	1	350	350	350	-
Oil and grease	1	5.0	5.0	5.0	-
pH[c]	30	8.5	7.1	7.8	0.11
Suspended solids	4	< 5.0	< 5.0	< 5.0	-
Turbidity[d]	4	63	20	31	21
		Quantity (10^6 liters per day)			
Flow	Continuous	19	15	4.9	1.3

a. 95% confidence coefficient about the average.
b. Units in μmhos.
c. Value in pH units.
d. Units in N.T.U.

Table 17. National Pollutant Discharge Elimination System parameters in Melton Branch

February 1986

Parameter	No. of samples	Concentration (mg/L) Max	Min	Av	95% cc[a]
BOD	4	< 5.0	< 5.0	< 5.0	0.0
Conductivity[b]	4	400	210	327	88
COD	4	13	1.0	5.5	5.7
Cr (Total)	4	0.012	< 0.01	< 0.011	0.001
Dissolved oxygen	28	19	9	11	0.72
Dissolved solids	1	260	260	260	-
Oil & grease	1	2.0	2.0	2.0	-
pH[c]	28	8.9	7.6	8.1	0.10
Suspended solids	4	85	< 5.0	< 30	38
Turbidity[d]	4	82	8	37	35
		Quantity (10^6 liters per day)			
Flow	Continuous	150	2.8	12	10

a. 95% confidence coefficient about the average.
b. Units in µmhos.
c. Value in pH units.
d. Units in N.T.U.

Table 18. National Pollutant Discharge Elimination System parameters in Melton Branch

March 1986

Parameter	No. of samples	Concentration (mg/L) Max	Min	Av	95% cc[a]
BOD	4	< 5.0	< 5.0	< 5.0	0.0
Conductivity	4	530	100	354	181
COD	4	19	1.0	11	7.6
Cr (Total)	4	< 0.01	< 0.01	< 0.01	0.0
Dissolved oxygen	31	12.9	6.5	11	0.44
Dissolved solids	1	290	290	290	-
Oil & grease	1	3.0	3.0	3.0	-
pH[c]	31	8.9	7.1	8.0	0.14
Suspended solids	4	44	< 5.0	< 15	20
Turbidity[d]	4	69	3.0	25	31
		Quantity (10^6 liters per day)			
Flow	Continuous	83	2.2	7.9	5.3

a. 95% confidence coefficient about the average.
b. Units in µmhos.
c. Value in pH units.
d. Units in N.T.U.

Table 19. National Pollutant Discharge Elimination System parameters in the Sewage Treatment Plant

January 1986

Parameter	No. of samples	Concentration (mg/L) Max	Min	Av	95% cc[a]
Ammonia-N (Eff)	4	2.7	< 0.2	< 0.99	1.2
BOD (Inf)	4	57	22	46	16
BOD (Eff)	4	< 5.0	< 5.0	< 5.0	0.0
CL residual (Eff)	30	2.0	1.0	1.3	0.081
pH (Eff)[b]	30	8.0	6.7	7.3	0.12
Fecal coliform (Eff)[c]	1	0.0	0.0	0.0	-
Settable solids (Eff)[d]	4	< 0.1	< 0.1	< 0.1	0.0
Suspended solids (Inf)	4	110	24	68	41
Suspended solids (Eff)	4	< 5.0	< 5.0	< 5.0	0.0
		Quantity (kg/day)			
Ammonia-N (Eff)	4	13	< 1.1	< 4.6	5.9
BOD (Eff)	4	< 26	< 18	< 22	4.2
Suspended solids (Eff)	4	< 26	< 18	< 22	4.2
Flow[e]	Continuous	1.4	0.49	0.98	0.10

a. 95% confidence coefficient about the average.
b. Value in pH units.
c. Units are colonies per 100 mL.
d. Units are mL/L.
e. Units are millions of liters per day.

Table 20. National Pollutant Discharge Elimination System parameters in the Sewage Treatment Plant

February 1986

Parameter	No. of samples	Concentration (mg/L) Max	Min	Av	95% cc[a]
Ammonia-N (Eff)	4	1.0	< 0.2	< 0.52	0.39
BOD (Inf)	4	62	39	55	11
BOD (Eff)	4	9.0	< 5.0	< 6.0	2.0
Cl residual (Eff)	28	1.9	0.9	1.2	0.083
pH (Eff)[b]	28	7.5	6.8	7.3	0.063
Fecal coliform (Eff)[c]	1	0.0	0.0	0.0	-
Settable solids (Inf)[d]	4	< 0.1	< 0.1	< 0.1	0.0
Suspended solids (Inf)	4	110	22	60	37
Suspended solids (Eff)	4	15	< 5.0	< 7.5	5.0
		Quantity (lb/day)			
Ammonia-N (Eff)	4	6.2	< 1.1	< 3.1	2.4
BOD (Eff)	4	53	< 26	< 35	13
Suspended solids (Eff)	4	92	< 26	< 44	33
Flow[e]	Continuous	1.9	0.68	1.1	0.095

a. 95% confidence coefficient about the average.
b. Value in pH units.
c. Units are colonies per 100 mL.
d. Units are mL/L.
e. Units are millions of liters per day.

Table 21. National Pollutant Discharge Elimination System parameters in the Sewage Treatment Plant

March 1986

Parameter	No. of samples	Concentration (mg/L) Max	Min	Av	95% cc[a]
Ammonia-N (Eff)	4	0.53	0.14	0.24	0.19
BOD (Inf)	4	51	33	41	7.7
BOD (Eff)	4	< 5.0	< 5.0	< 5.0	0.0
Cl residual (Eff)	31	1.9	0.15	0.53	0.17
pH (Eff)[b]	31	8.4	6.7	7.2	0.12
Fecal coliform (Eff)[c]	1	0.0	0.0	0.0	-
Settable solids (Inf)[d]	4	< 0.1	< 0.1	< 0.1	0.0
Suspended solids (Inf)	4	39	14	30	11
Suspended solids (Eff)	4	6.0	< 5.0	< 5.2	0.5
		Quantity (kg/day)			
Ammonia-N (Eff)	4	22	2.6	0.90	0.84
BOD (Eff)	4	< 20	< 14	< 18	2.6
Suspended solids (Eff)	4	24	< 14	< 19	4.2
Flow[e]	Continuous	1.3	0.45	0.79	0.076

a. 95% confidence coefficient about the average.
b. Value in pH units.
c. Units are colonies per 100 mL.
d. Units are mL/L.
e. Units are millions of liters per day.

Table 22. National Pollutant Discharge Elimination System compliance at ORNL for the first quarter, 1986

Discharge point	Effluent parameters	Effluent Limits: Daily av (mg/L)	Effluent Limits: Daily max (mg/L)	Percentage of measurements in compliance
White Oak Creek	Dissolved oxygen	5[a]		100
	Dissolved solids		2000	100
	Oil and grease	10	15	100
	Total chromium		0.05	100
	pH, units		6.0-9.0	100
Melton Branch1	Total chromium		0.05	100
	Dissolved solids		2000	100
	Oil and grease	10	15	100
	pH, units		6.0-9.0	100
Sewage Treatment Plant	Ammonia (as N)		5	100
	BOD		20	100
	Residual chlorine		0.5-2.0	74
	Fecal coliform, No./100 mL	200[b]	400[c]	100
	pH, units		0.5-2.0	100
	Suspended solids		30	100
	Settleable solids, mL/L		0.5	100

[a] Minimum
[b] Monthly average
[c] Weekly average

Groundwater

The Environmental Protection Agency (EPA) has established regulations in 40 CFR, Part 265, Subpart F, which requires the owners/operators of hazardous waste facilities to monitor the groundwater beneath those facilities. The ORNL facility has a groundwater network consisting of 22 wells located within three impoundment areas: 3524, 7900, and 3539-40 (Figures 4-5). The 3524 area consists of wells 31-001, 31-002, 31-003, 31-004, 31-013, and 31-015. The 7900 area consists of wells 32-001, 32-002, 32-003, 32-004, 32-005, 33-001, 33-002, and 33-003. The 3539-40 area consists of wells 31-005, 31-006, 31-007, 31-008, 31-009, 31-010, 31-011, and 31-012. The wells are also classified as upgradient (reference) or downgradient depending on their location relative to the waste management facility and the general direction of groundwater flow. The upgradient wells (31-001, 31-007, 31-009, 32-001, 33-001) were located so as to provide groundwater samples that would not be affected significantly by possible leakage from the facility. The downgradient wells (those not listed as upgradient) were located immediately adjacent to the waste management facility. Samples collected at these wells represent the quality of the groundwater at the point of compliance.

Water samples were collected during two periods from each well and analyzed for the parameters listed in Table 23. The data required by EPA and the State of Tennessee fall into one of three categories:

(1) Drinking water parameters (As, Ba, Cd, Cr, F, Pb, Hg, NO_3, Se, Ag, endrin, lindane, methyoxychlor, toxaphene, 2,4-D, 2,4,5-TP Silvex, Ra, gross alpha, gross beta, ^{60}CO, ^{137}CS, and fecal coliform);

(2) Water quality parameters (Cl, Fe, Mn, phenols, Na, and SO_4); or

(3) Groundwater contamination parameters (pH, specific conductance total organic carbon, and total organic halides).

In accordance with the regulations, seven measurements per well were recorded for pH, specific conductance, and temperature, while four measurements were recorded for total organic carbon and total organic halides during each period. For all other parameters, one sample per period was collected for each well. Summary concentrations for each parameter for each impoundment area are given in Tables 23-25.

The analytical values were compared to the EPA Interim Primary Drinking Water Standards. The values for several of the upgradient and downgradient wells exceeded the standards for gross alpha, Pb, fecal coliform, and NO_3. The values for gross beta at all wells exceeded that standard during at least one of the sampling periods (Table 26) The EPA Interim Primary Drinking Water Standard for gross beta is an annual dose equivalent of 4 millirem. A concentration was calculated from this dose based on ingestion of 2.2 L of water per day and a dose conversion factor of 1.438 rem per microcurie.

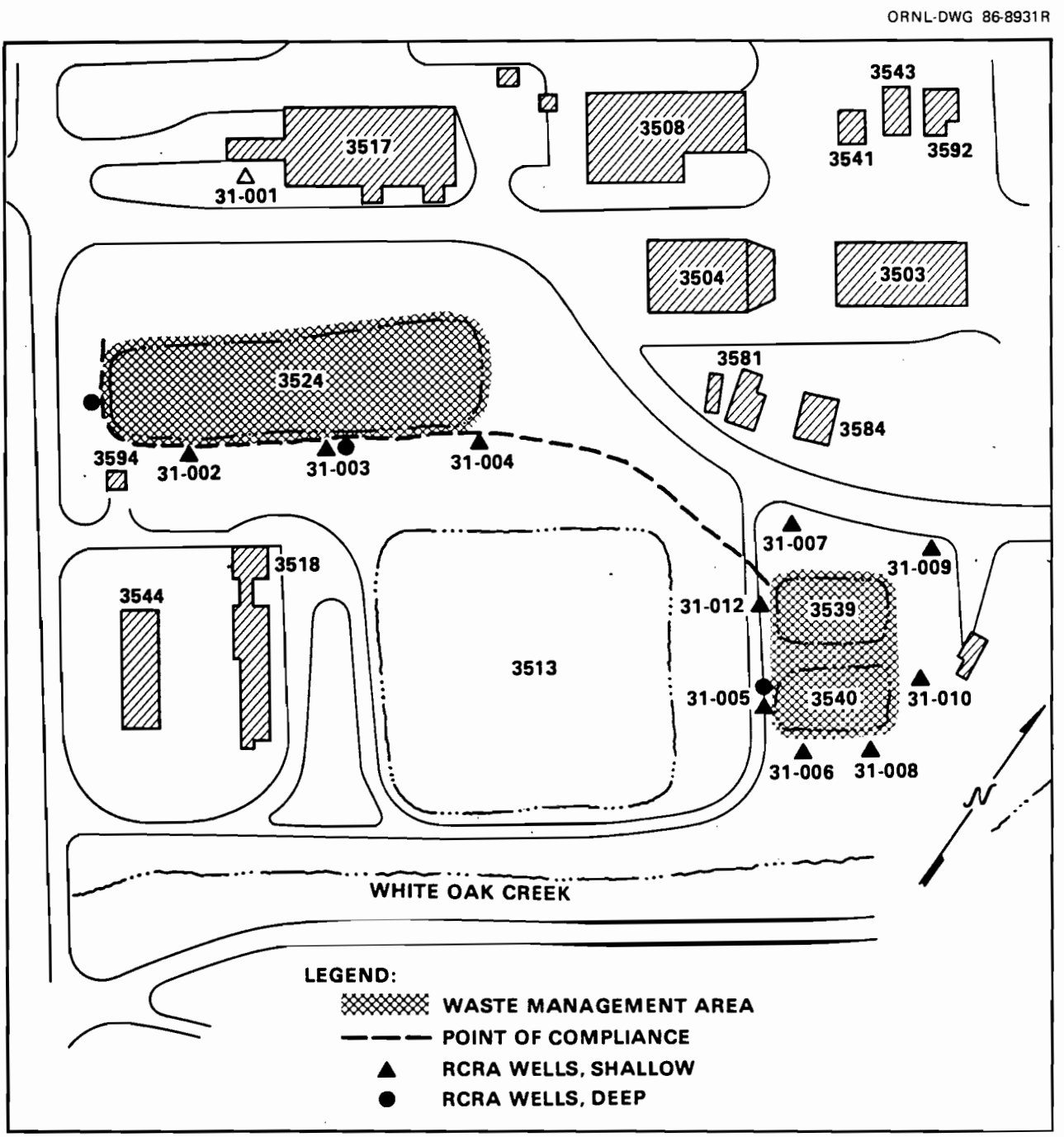

Fig. 4 Locations of sampling wells around ponds 3534, 3539, and 3540

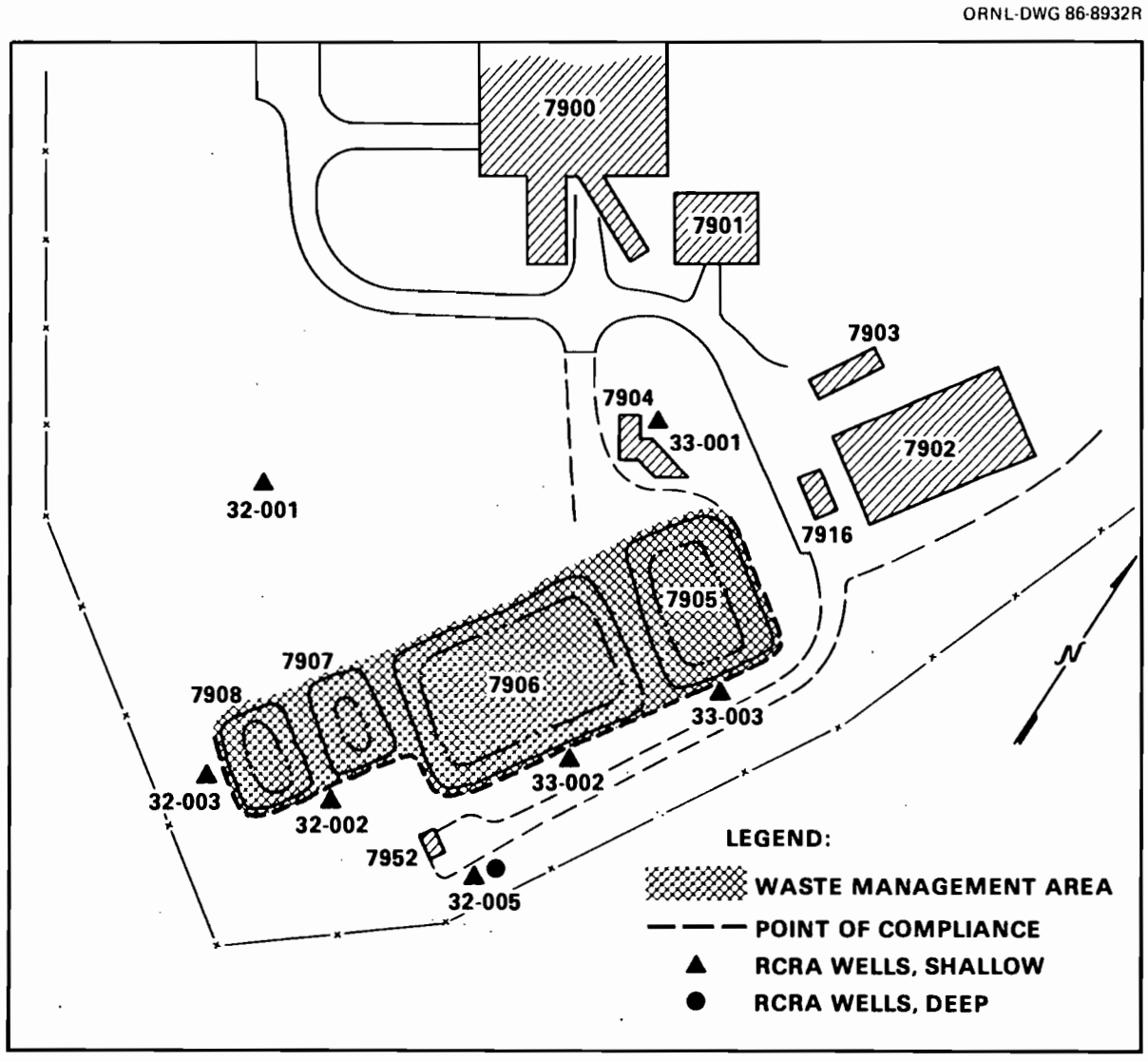

Fig. 5 Locations of sampling wells around ponds 7905, 7906, 7907, and 7908

Table 23. Concentrations of parameters in wells around 3524[a]

Parameter	No. of samples	Concentration (mg/L) Max	Min	Av	95% cc[b]
2,4,5-TP Silvex	10	< 0.01	< 0.01	< 0.01	0.0
2,4-D	10	< 0.01	< 0.01	< 0.01	0.0
Ag	10	< 0.005	< 0.005	< 0.005	0.0
As	10	< 0.01	< 0.01	< 0.01	0.0
Ba	10	< 1.0	< 1.0	< 1.0	0.0
Cd	10	< 0.002	< 0.002	< 0.002	0.0
Cl	10	11	4.7	7.0	1.3
Cr	10	< 0.02	< 0.02	< 0.02	0.0
Endrin	10	< 0.0002	< 0.0002	< 0.0002	0.0
F	10	< 1.0	< 1.0	< 1.0	0.0
Fe	10	1.5	0.08	0.46	0.3
Fecal coliform[c]	10	14	0.0	1.4	2.8
Gross alpha[d]	10	52	0.011	7.8	0.29
Gross beta[d]	10	220	0.30	52	1.4
Hg	10	< 0.0001	< 0.0001	< 0.0001	0.0
Lindane	10	< 0.002	< 0.002	< 0.002	0.0
Methoxychlor	10	< 0.01	< 0.01	< 0.01	0.0
Mn	10	4.0	0.07	1.3	1.0
Na	10	30	14	20	3.0
NO_3	10	< 5.0	< 5.0	< 5.0	0.0
Pb	10	0.05	< 0.02	< 0.02	0.01
pH[e]	70	8.2	7.2	7.5	0.05
Phenols	10	0.002	< 0.001	< 0.0013	0.0
Ra (Total)[d]	10	0.037	< 0.011	< 0.015	0.0002
Se	10	< 0.005	< 0.005	< 0.005	0.0
SO_4	10	100	19	52	21
Specific conductance[f]	70	0.49	0.03	0.23	0.02
Temperature[g]	70	22	8.8	16	0.78
Total organic carbon	40	3.8	1.1	2.4	0.22
Total organic halides	40	0.07	0.01	0.03	0.0
Toxaphene	10	< 0.005	< 0.005	< 0.005	0.0

a. See Figure 4.
b. 95% confidence coefficient about the average.
c. Units are colonies per 100 mL.
d. Units are Bq/L.
e. Value in pH units.
f. Units are in mmhos/cm.
g. Units are in °C.

Table 24. Concentrations of parameters in wells around 3539-40[a]

Parameter	No. of samples	Concentration (mg/L) Max	Min	Av	95% cc[b]
2,4,5-TP Silvex	14	< 0.01	< 0.01	< 0.01	0.0
2,4-D	14	0.06	< 0.01	< 0.014	0.0
Ag	14	< 0.005	< 0.005	< 0.005	0.0
As	14	< 0.01	< 0.01	< 0.01	0.0
Ba	14	< 1.0	< 1.0	< 1.0	0.0
Cd	14	< 0.002	< 0.002	< 0.002	0.0
Cl	14	17	5.2	8.2	1.7
Cr	14	0.032	< 0.02	< 0.021	0.0017
Endrin	14	< 0.0002	< 0.0002	< 0.0002	0.0
F	14	< 1.0	< 1.0	< 1.0	0.0
Fe	14	5.9	0.052	1.8	0.84
Fecal coliform[c]	14	0.0	0.0	0.0	0.0
Gross alpha[d]	14	0.52	0.03	0.23	0.0023
Gross beta[d]	14	2.0	0.081	0.74	0.01
Hg	14	< 0.0001	< 0.0001	< 0.0001	0.0
Lindane	14	< 0.002	< 0.002	< 0.002	0.0
Methoxychlor	14	< 0.008	< 0.008	< 0.008	0.0
Mn	14	10	0.01	4.4	2.0
Na	14	220	4.8	26	31
NO_3	14	< 5.0	< 5.0	< 5.0	0.0
Pb	14	1.2	0.02	0.10	0.17
pH[e]	98	13	6.5	7.6	0.29
Phenols	14	0.003	< 0.001	< 0.002	0.0004
Ra (Total)[d]	14	0.17	0.011	0.03	0.0007
Se	14	< 0.005	< 0.005	< 0.005	0.0
SO_4	14	250	< 5.0	< 6.5	39
Specific conductance[f]	98	1.0	0.01	0.38	0.044
Temperature[g]	98	20	13	16	0.26
Total organic carbon	56	23	1.6	5.1	1.4
Total organic halides	56	0.093	< 0.005	< 0.03	0.0063
Toxaphene	14	< 0.005	< 0.005	< 0.005	0.0

a. See Figure 4.
b. 95% confidence coefficient about the average.
c. Units are colonies per 100 mL.
d. Units are Bq/L.
e. Value in pH units.
f. Units are in mmhos/cm.
g. Units are in °C.

Table 25. Concentrations of parameters in wells around 7900[a]

Parameter	No. of samples	Concentration (mg/L) Max	Min	Av	95% cc[b]
2,4,5-TP Silvex	15	< 0.01	< 0.01	< 0.01	0.0
2,4-D	15	<0.01	< 0.01	< 0.01	0.0
Ag	15	< 0.005	< 0.005	< 0.005	0.0
As	15	< 0.01	< 0.01	< 0.01	0.0
Ba	15	< 1.0	< 1.0	< 1.0	0.0
Cd	15	< 0.002	< 0.002	< 0.002	0.0
Cl	15	52	2.5	16	6.8
Cr	15	< 0.02	< 0.02	< 0.02	0.0
Endrin	15	< 0.0002	< 0.0002	< 0.0002	0.0
F	15	< 1.0	< 1.0	< 1.0	0.0
Fe	15	0.64	0.05	0.23	0.11
Fecal coliform[c]	16	0.0	0.0	0.0	0.0
Gross alpha[d]	15	67	< 0.011	5.2	0.23
Gross beta[d]	15	100	0.11	13	0.43
Hg	15	< 0.0001	< 0.0001	< 0.0001	0.0
Lindane	15	< 0.002	< 0.002	< 0.002	0.0
Methoxychlor	15	< 0.008	< 0.008	< 0.008	0.0
Mn	15	0.72	0.04	0.17	0.10
Na	15	44	3.3	12	6.6
NO_3	15	39	< 5.0	< 13	7.0
Pb	15	< 0.02	< 0.02	< 0.02	0.0
pH[e]	105	9.0	7.0	7.8	0.084
Phenols	15	< 0.001	< 0.001	< 0.001	0.0
Ra (Total)[d]	15	0.02	0.011	< 0.015	0.0001
Se	15	< 0.005	< 0.005	< 0.005	0.0
SO_4	15	150	5.0	52	23
Specific conductance[f]	105	0.30	0.01	0.12	0.01
Temperature[g]	105	21	11	16	0.36
Total organic carbon	60	2.2	0.57	1.1	0.10
Total organic halides	60	0.05	< 0.005	< 0.012	0.0022
Toxaphene	15	< 0.005	< 0.005	< 0.005	0.0

a. See Figure 5.
b. 95% confidence coefficient about the average.
c. Units are colonies per 100 mL.
d. Units are Bq/L.
e. Value in pH units.
f. Units are in mmhos/cm.
g. Units are in °C.

Table 26. Concentrations of parameters whose values exceed standards in groundwater wells on the ORNL site

Well[a] ID	Date	Parameters				
		Gross alpha (Bq/L)	Gross beta (Bq/L)	Pb (mg/L)	Fecal coliform (colonies/ 100 ml)	NO_3 (mg/L)
Standard[b]		0.56	0.13	.05	1	10
31-001	12/26/85	0.79	2.4			
	03/19/86		1.6			
31-002	12/27/85	25	88			
	03/20/86		21			
31-003	12/27/85	51	190			
	03/19/86		220			
31-004	12/29/85				14	
	12/30/85		0.30			
	03/20/86		0.34			
31-005	12/23/85		1.4			
	03/17/86		2.0			
31-006	12/23/85		0.19			
	03/18/86		0.23			
31-007	03/17/86		1.1			
31-008	12/23/85		0.17			
	03/18/86		0.18			
31-009	03/17/86		0.32			
31-010	12/20/85		1.6			
	03/18/86		1.7			
31-011	03/18/86			0.78 (dissolved)		
	03/18/86			1.2 (Total)		
31-013	12/19/85					
	03/27/86		5.2			
31-015	03/27/86		0.44			
32-001	03/24/86		0.38			

Table 26. (Continued)

Well[a] ID	Date	Parameters				
		Gross alpha (Bq/L)	Gross beta (Bq/L)	Pb (mg/L)	Fecal coliform (colonies/ 100 ml)	NO_3 (mg/L)
32-002	03/24/86		0.22			
32-003	01/02/86		0.36			
	03/24/86		0.21			
32-004	03/26/86		0.47			
32-005	01/02/86	7.8	9.6			
	03/25/86		0.19			
33-001	12/29/85		0.15			
	03/25/86		0.37			
33-002	12/29/85		0.18			28
	03/26/86		10			31
	12/29/85	65	75			39
	03/26/86		99			39

[a]See Figure 4 & 5.

[b]EPA Interim Primary Drinking Water Standard.

METEOROLOGICAL PROCESSES

The ORNL meteorological system consists of three towers (A, B, and C) with sensors mounted at two levels (10 and 30 meters) for Towers A and B and at three levels (10, 30, and 100 meters) for Tower C. Locations of meteorological towers at ORNL are shown in Figure 6. Data from the sensors is acquired, stored, edited, and formatted by a data collection system consisting of a central processor and remote data logger. One-minute averages are processed into fifteen-minute averages which are kept for one day. The fifteen-minute averages are processed into hourly averages which are stored for at least one year.

Examination of quarterly wind roses (Figures 7-13) 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 so strongly aligned along these directions because of the channeling effect induced by the ridge and valley structure of the area. Another feature observed by 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.

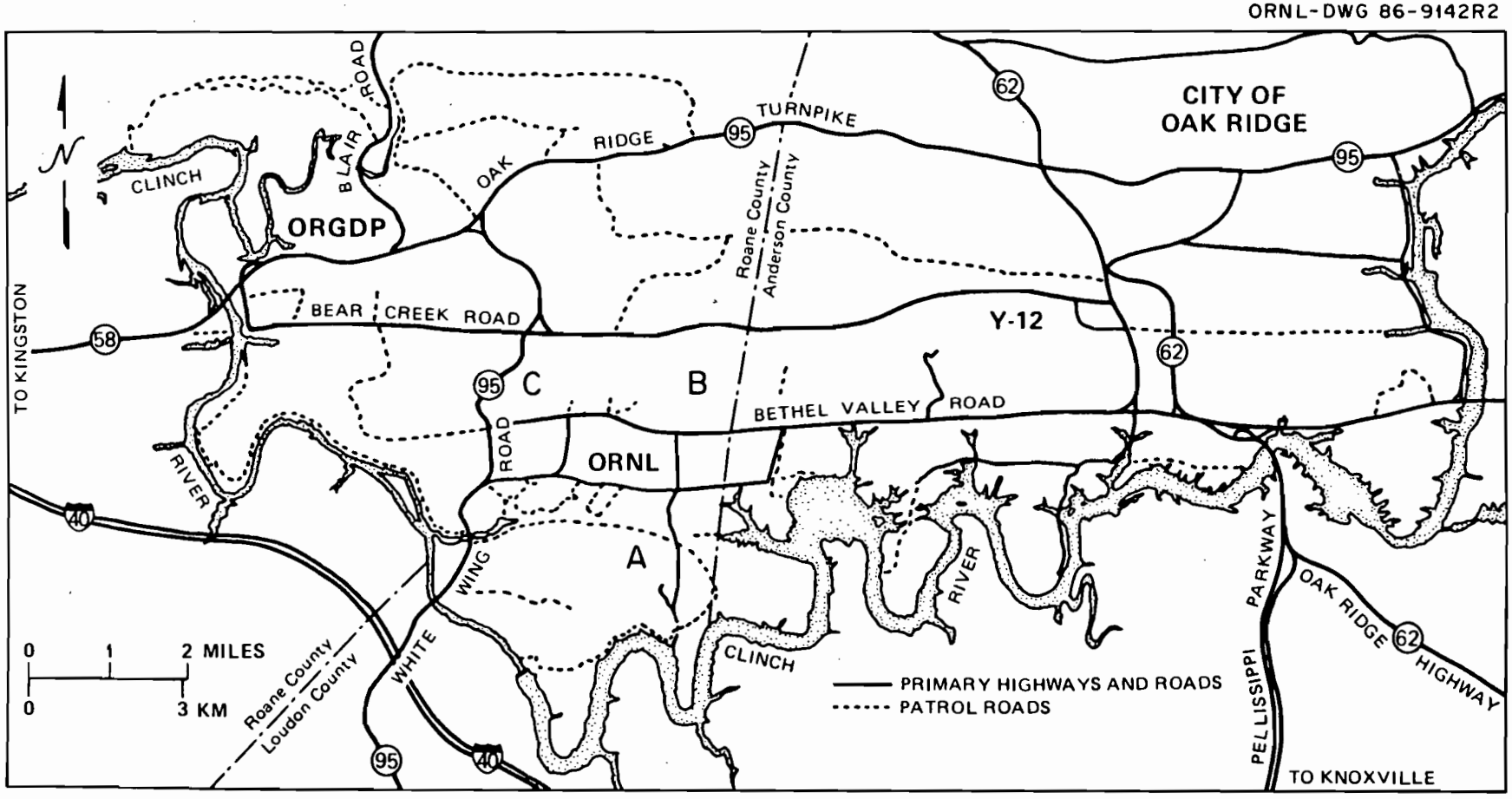

Fig. 6 Locations of meteorological towers at ORNL

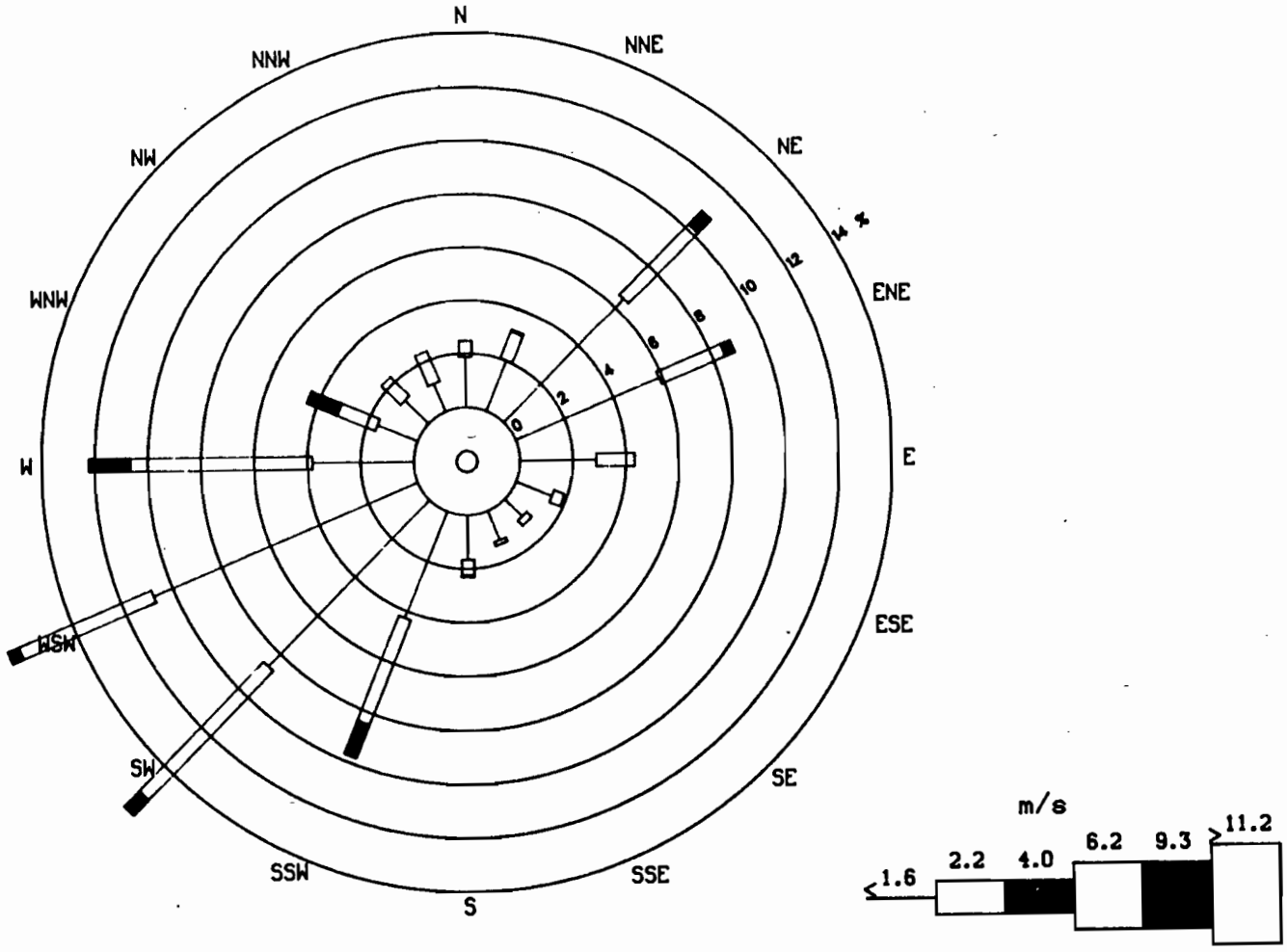

Fig. 7 Wind rose at 10-m level of meteorological tower A, January-March 1986

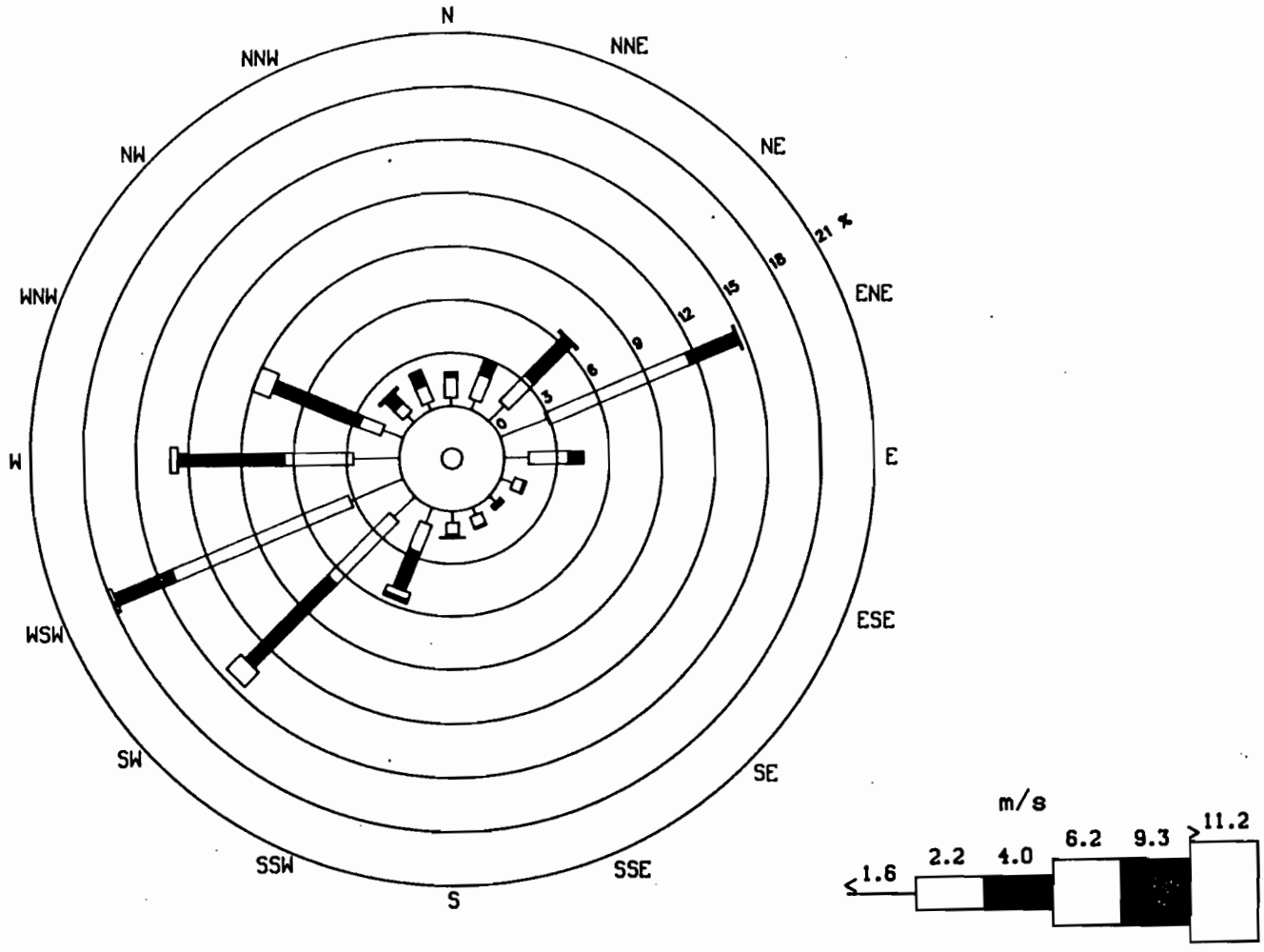

Fig. 8 Wing rose at 30-m level of meteorological tower A, January-March 1986

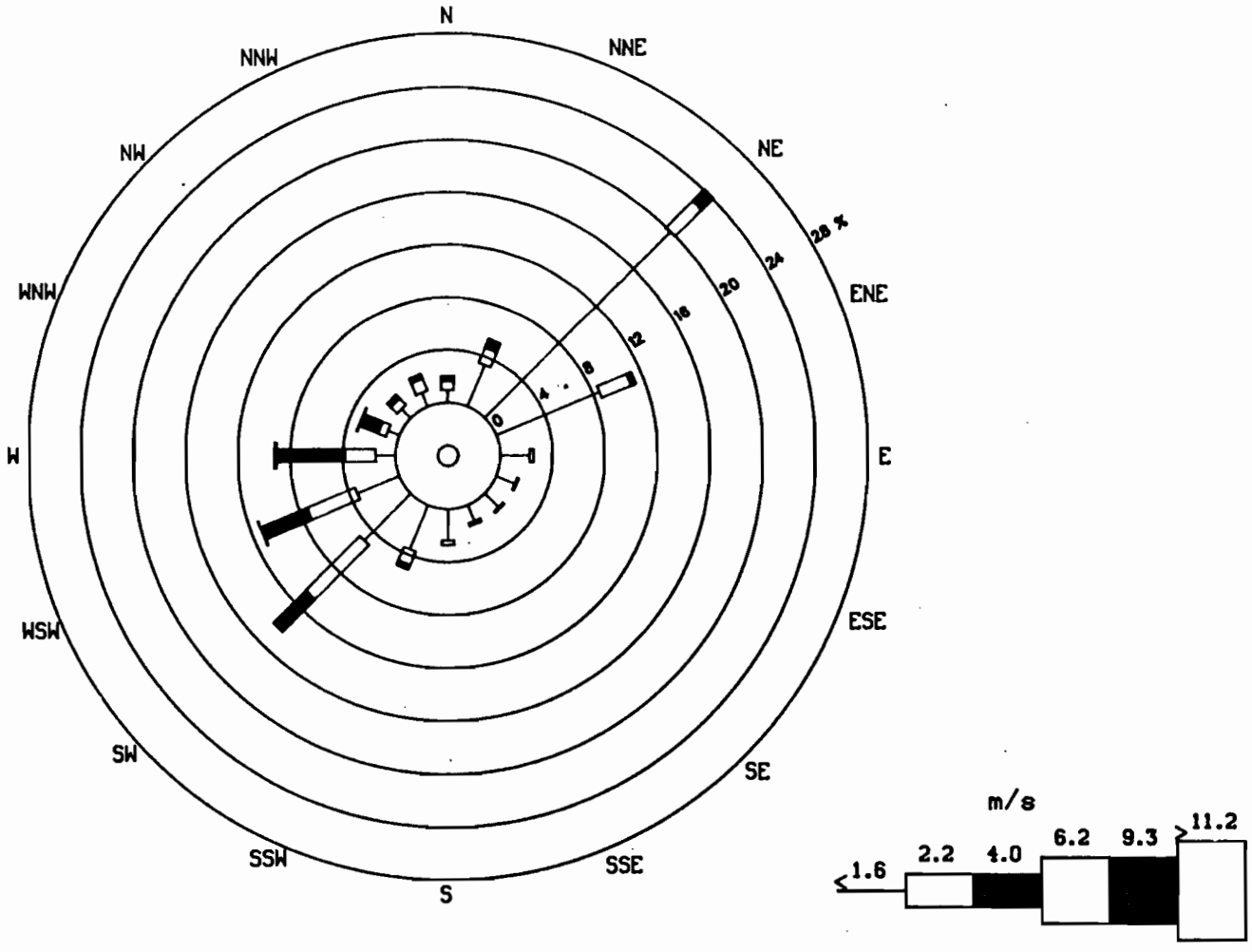

Fig. 9. Wind rose at 10-m level of meteorological tower B January-March 1986

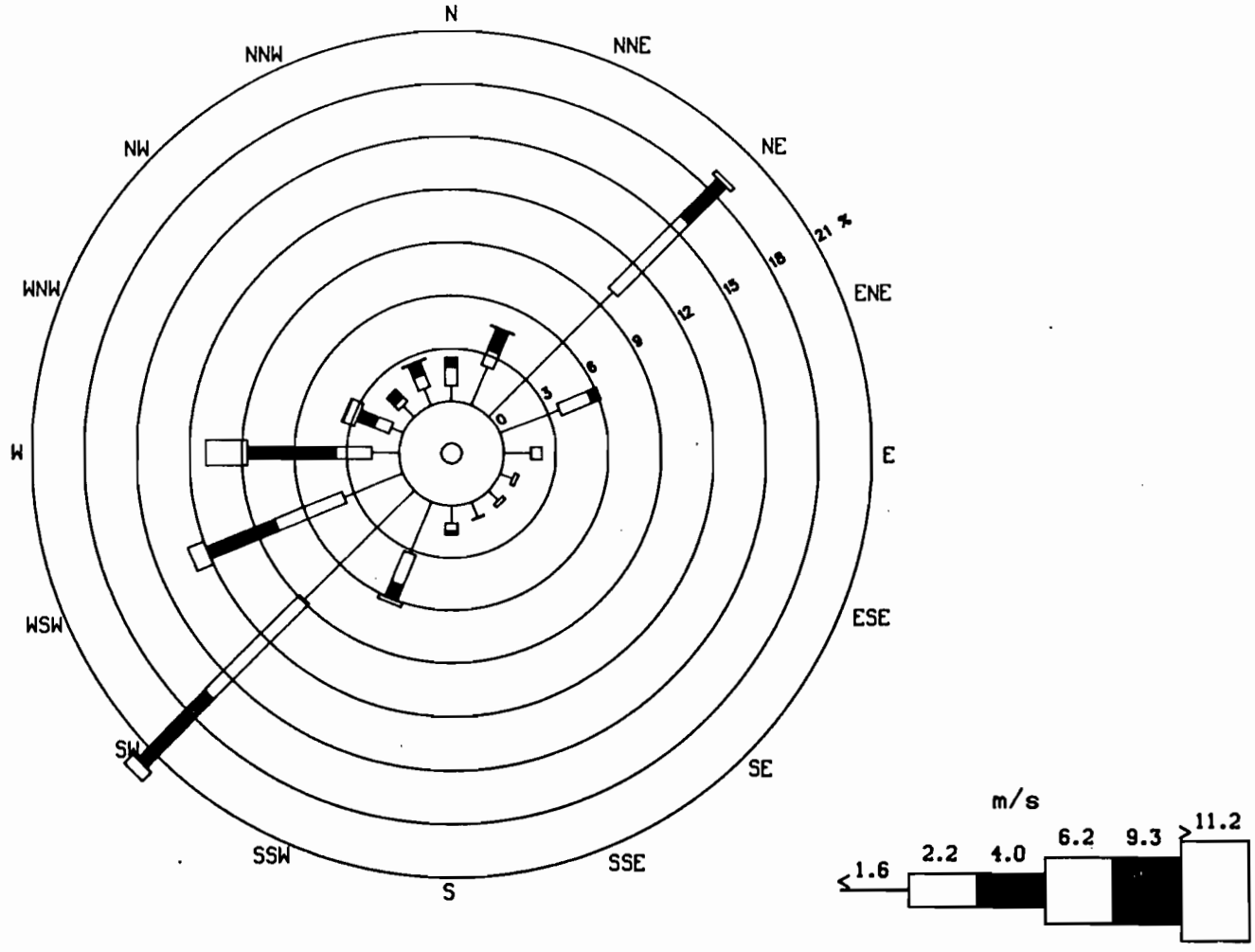

Fig. 10 Wind rose at 30-m level of meteorological tower B, January-March 1986

ORNL-DWG 86-13515

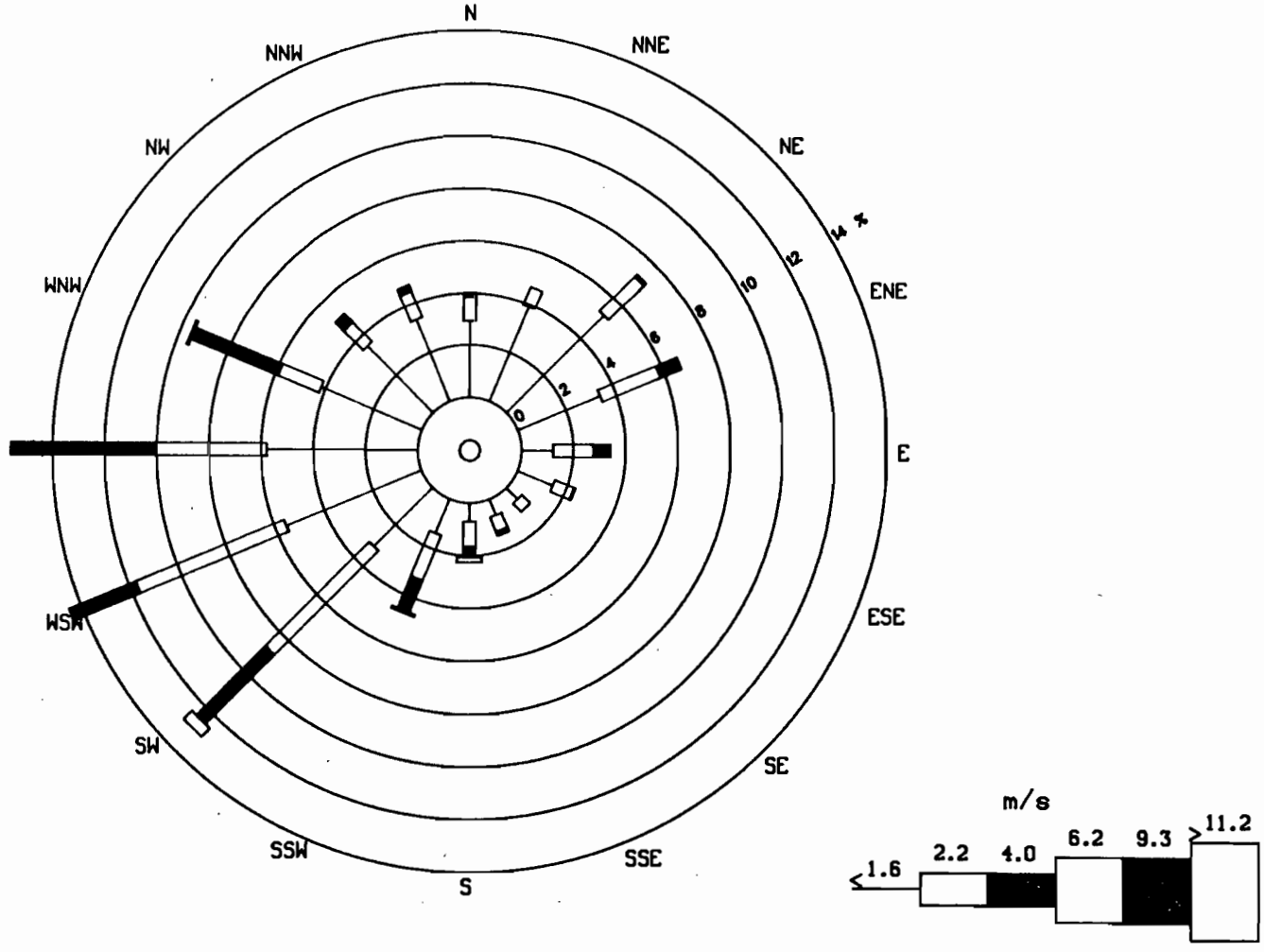

Fig. 11 Wind rose at 10-m level of meteorological tower C, January-March 1986

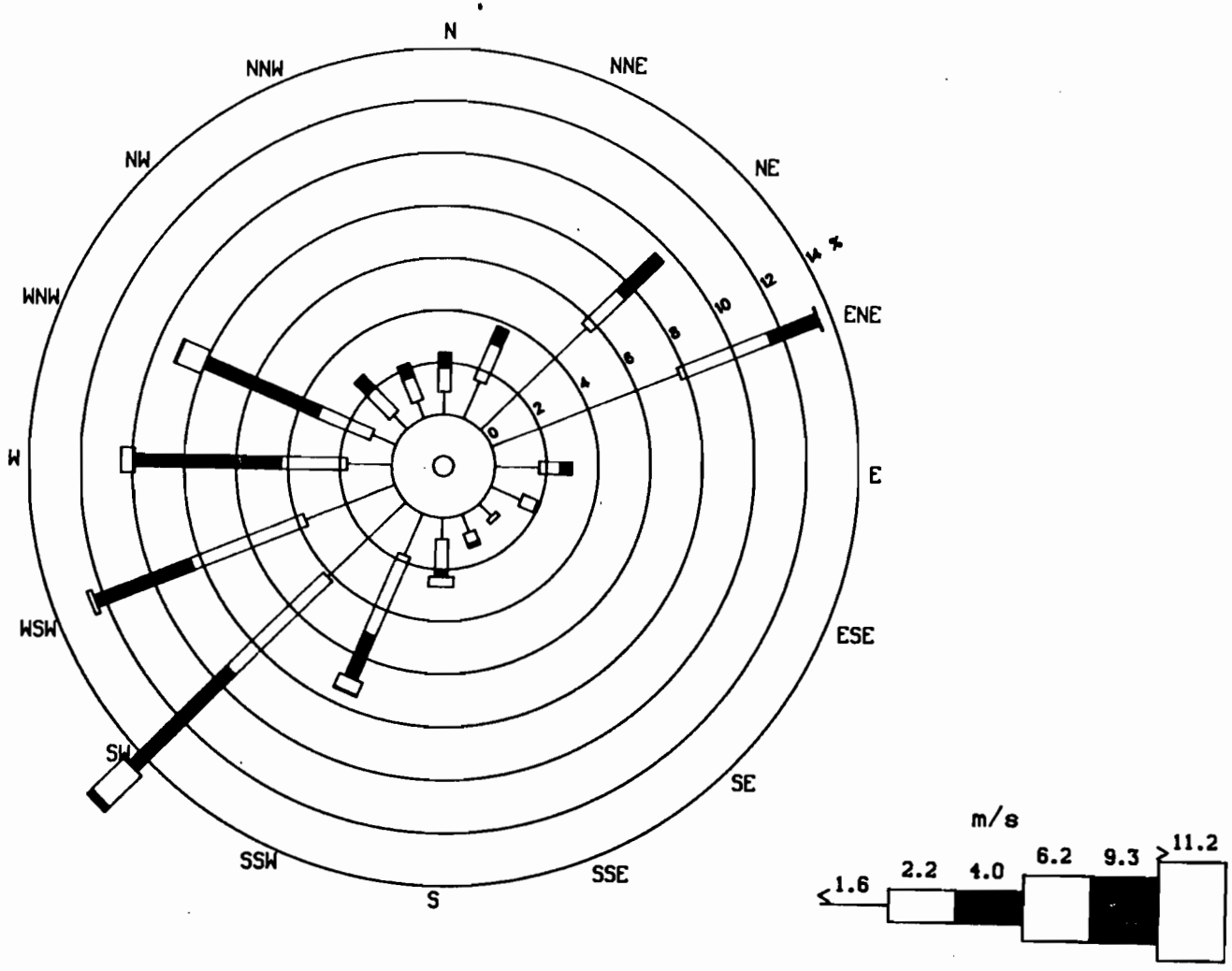

Fig. 12 Wind rose at 30-m level of meteorological tower C, January-March 1986

ORNL-DWG 86-13517

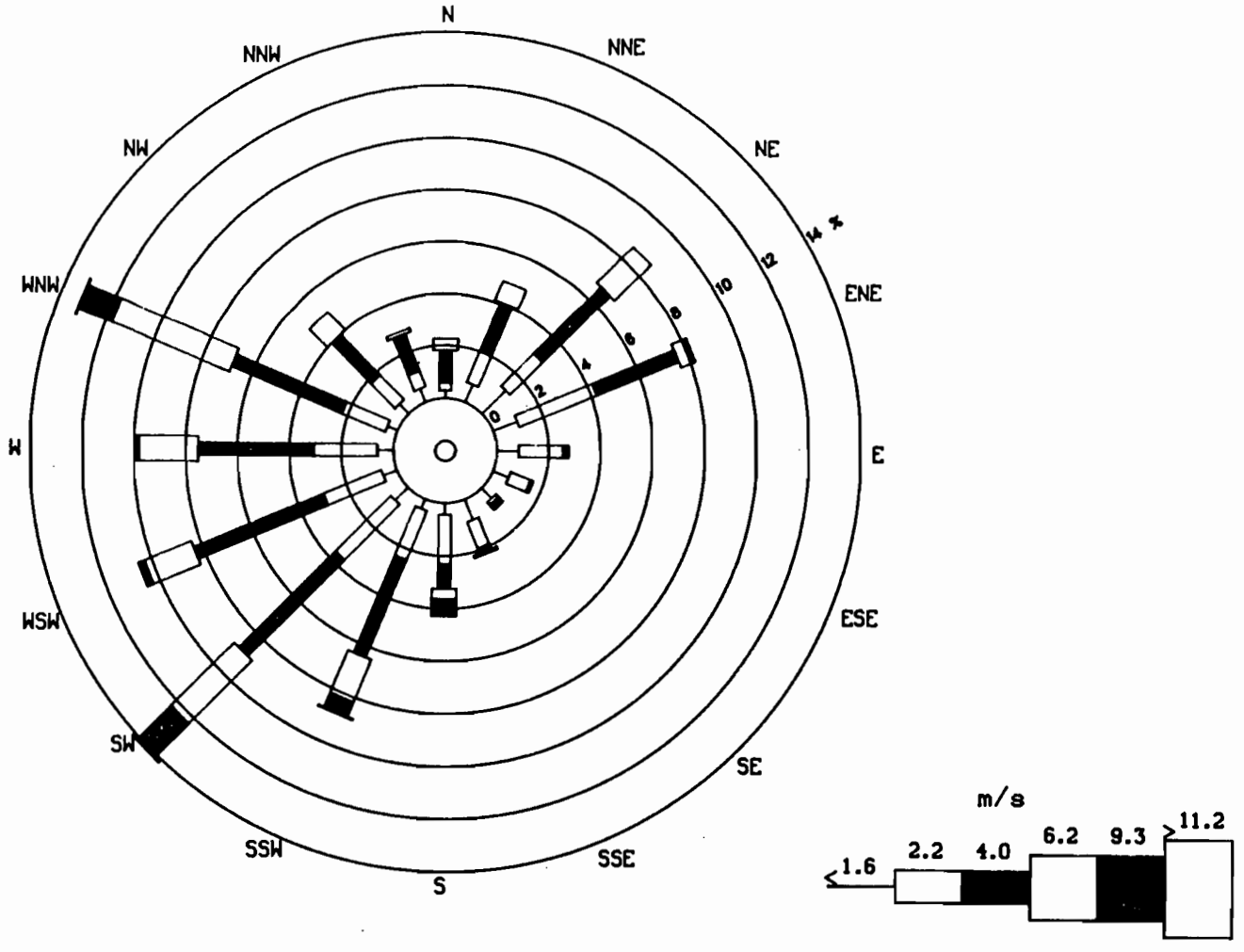

Fig. 13 Wind rose at 100-m level of meterological tower C, January-March 1986

Biological Monitoring: Milk

Raw milk is monitored for ^{131}I and ^{90}Sr by the collection and analysis of samples from eight locations and one dairy within a radius of 80 km of Oak Ridge. Samples are collected every two weeks for five stations located near the Oak Ridge area (Figure 14). Four other stations are more remote with respect to the Oak Ridge facilities and are sampled at the rate of about one station every quarter (Figure 15). Samples are analyzed by ion exchange and gamma spectrometry, and the results are compared with intake guidelines specified by the Federal Radiation Council (FRC).

All ^{131}I concentrations in milk from the immediate stations were below the accepted analytical detection limit of 0.037 Bq/L. Concentrations of ^{90}Sr are shown in Table 27. The average concentration of ^{90}Sr of all the stations in the immediate Oak Ridge area was 0.04 Bq/L, which is within Range I of the FRC guidelines, and the average concentration for each individual station was also within the Range 1 category.

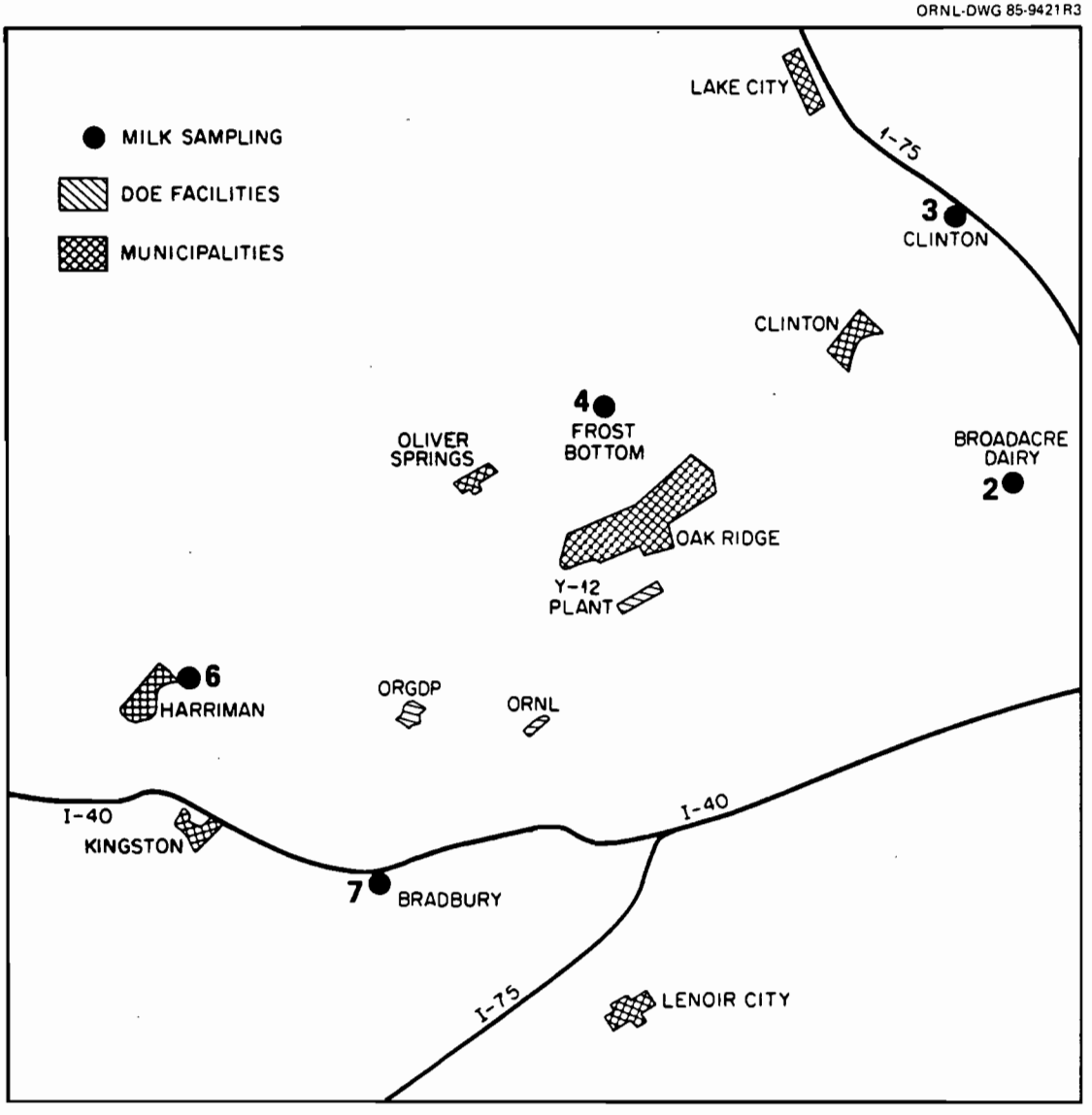

Fig. 14 Locations of milk sampling stations near the Oak Ridge facilities

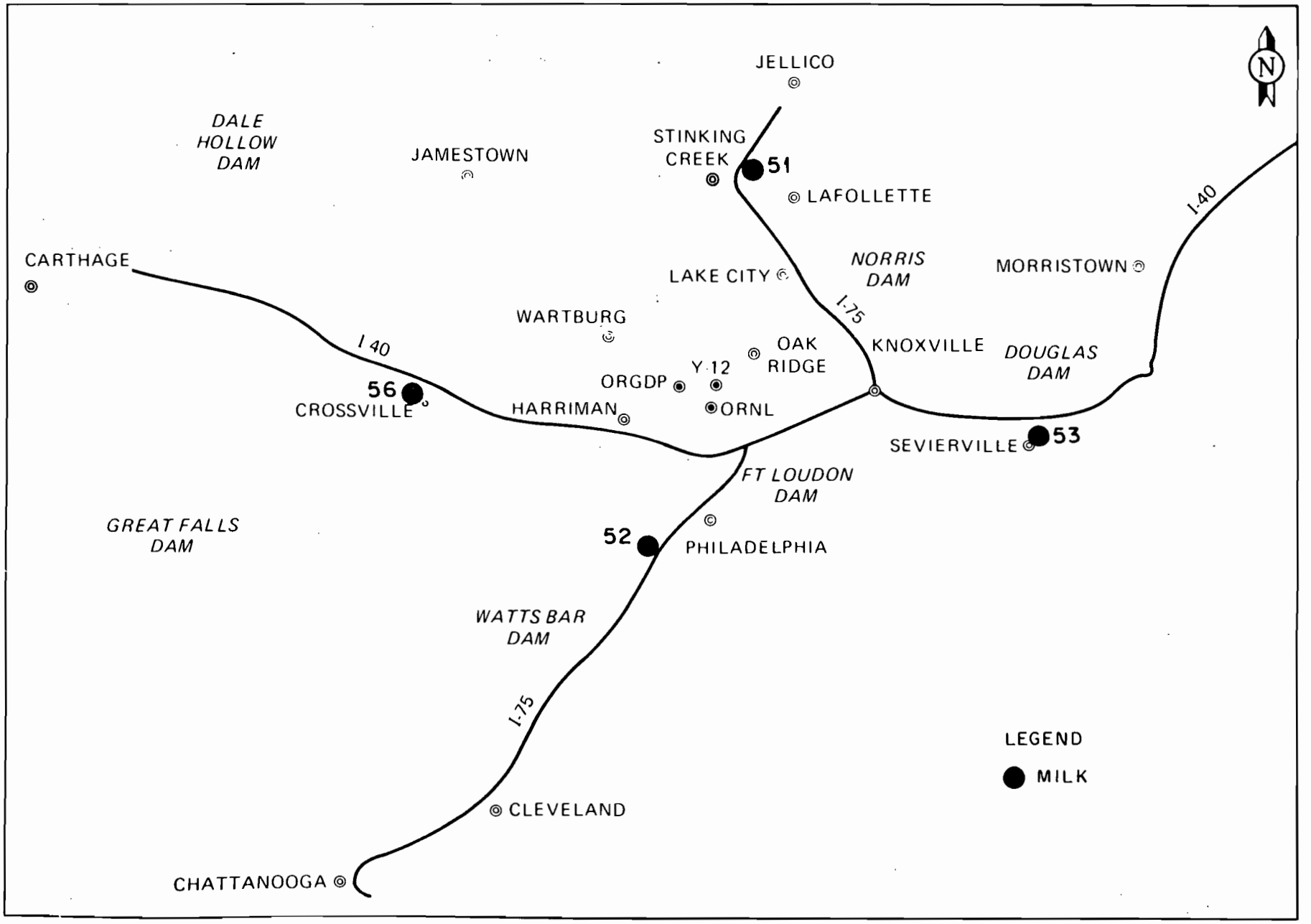

Fig. 15 Locations of milk sampling stations remote from the Oak Ridge facilities

Table 27. Concentrations of ^{90}Sr in milk[a]

January - March 1986

Station	No. of samples	Concentration (Bq/L) Max	Min	Av	95%cc[b]	Comparison with standard[c]
		Immediate Environs[d]				
2	7	0.04	0.01	0.023	0.008	Range I
3	7	0.05	0.01	0.032	0.012	Range I
4	7	0.10	0.02	0.068	0.022	Range I
6	4	0.04	0.02	0.035	0.01	Range I
7	7	0.05	0.02	0.033	0.008	Range I
Network summary	32	0.10	0.01	0.038	0.012	Range I

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

[b] 95% confidence coefficient about the average.

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

[d] See Figure 14.

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