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ENVIRONMENTAL SURVEILLANCE DATA REPORT FOR THE THIRD QUARTER OF 1992

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LIST OF ACRONYMS AND ABBREVIATIONS

BMP	Best management practice
CAA	Clean Air Act
CFR	Code of Federal Regulations
CWA	Clean Water Act
CYRTF	Coal Yard Runoff Treatment Facility
DCG	derived concentration guide
DOE	U.S. Department of Energy
DWL	drinking water limit
DWS	drinking water standard
EPA	Environmental Protection Agency
EC	Environmental Compliance Section of OECD
ESP	Environmental Surveillance and Protection Section of OECD
ICP	inductively coupled plasma
LLW	Low-level waste
MB	Melton Branch
MHD	Melton Hill Dam
N det	Number of detected samples
N total	Total number of samples
NESHAP	National Emission Standards for Hazardous Air Pollutants
NPDES	National Pollutant Discharge Elimination System
NRWTF	Nonradiological Wastewater Treatment Facility
NWT	Northwest Tributary
OECD	Office of Environmental Compliance and Documentation
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
PAM	Perimeter Air Monitoring
PCB	polychlorinated biphenyl
PWTP	Process Waste Treatment Plant
QA/QC	Quality assurance/Quality control
RCRA	Resource Conservation and Recovery Act
SAS	SAS Institute, Inc.
STP	Sewage Treatment Plant
SWMU	Solid Waste Management Unit
SWSA	Solid Waste Storage Area
TDEC	Tennessee Department of Environment and Conservation
Total rad Sr	Total radioactive strontium (Sr-89 + Sr-90)
WAG	Waste Area Grouping
WOC	White Oak Creek
WOD	White Oak Dam
WOL	White Oak Lake

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1.0 INTRODUCTION

The Environmental Surveillance and Protection Section within the Office of Environmental Compliance and Documentation at the Oak Ridge National Laboratory (ORNL) is responsible for the development and implementation of an environmental program to (1) ensure compliance with all federal, state, and Department of Energy (DOE) reporting requirements to quantitatively demonstrate 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.

The current environmental program is designed primarily to meet regulatory requirements and DOE directives and to provide a continuity of data on environmental media at unregulated locations. The major legislation affecting the environmental programs that assess off-site impacts of the DOE facilities includes the Clean Water Act, the Clean Air Act, the Resource Conservation and Recovery Act, and the Superfund Amendments and Reauthorization Act. In November of 1988, DOE finalized Order 5400.1, "General Environmental Protection Program," that establishes the requirements, authorities, and responsibilities for DOE operations for ensuring compliance with applicable federal, state, and local environmental protection laws and regulations. This order sets forth the requirements for both radiological and nonradiological monitoring. DOE Order 5400.5, "Radiation Protection of the Public and the Environment," specifies the guidelines for releases of radionuclides to various media. Definitive radiological monitoring requirements have been established and additional guidance on recommended procedures and activities is provided in the "Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance (the Regulatory Guide)" DOE/EH-0173T.

Environmental monitoring, as defined by the Regulatory Guide, consists of two major activities: effluent monitoring and environmental surveillance. Effluent monitoring is the collection and analysis of samples or measurements of liquid and gaseous effluents. Environmental surveillance is the collection and analysis of samples, or direct measurements of air, water, soil, foodstuff, biota, and other media from DOE sites and their environs.

Monthly or quarterly summaries are presented in this report for each medium sampled. All data are rounded to two significant digits. The summary tables generally give the number of samples collected during the period and the maximum, minimum, average, and standard error of the mean (SE) values of parameters for which determinations were made. The SE is based upon multiple samples collected throughout the period. It includes the random uncertainty over time and space associated with sampling, analysis, and the intrinsic variability of the media. The random uncertainty is a statement of precision (or imprecision), a measure of the reproducibility or scatter in a set of successive measurements, and an indication of the stability of the average value for the parameter. When differences in the magnitudes of the observations are small, the SE is small, and the precision is said to be high; when the differences are large, the SE is large, and the precision is low.

Average values have been compared where possible to applicable guidelines, criteria, or standards as a means of evaluating the impact of effluent releases or environmental concentrations. In some of the tables, radionuclide concentrations are compared with derived concentration guides (DCGs) as published in DOE Order 5400.5. These concentration guides were established for drinking water and inhaled air and are guidelines for the protection of the public. DOE Order 5400.5 defines a DCG as the concentration of a radionuclide in air or water for which, under conditions of continuous exposure by one exposure pathway (i.e., drinking water, inhaling air, submersion) for one year, a "reference man" would receive the most restrictive of (1) an effective dose equivalent of 100 mrem or (2) a dose equivalent of 5 rem to any tissue, including skin and lens of the eye. A "reference man" is a hypothetical human who is assumed to inhale 8400 m^3 of air in a year and to drink 730 L of water in a year. When there are multiple DCGs for a given isotope, the most restrictive value is used for comparisons. When the DCG is less than 0.01%, the percent is reported as "<0.01." When total radioactive strontium is measured, it is compared to the DCG for Sr-90, which is the most restrictive value.

Radioactivity measurements are reported as the net activity, or the difference between the gross activity and instrument background activity. Because of the intrinsic uncertainties associated with making radiation measurements, it is possible to subtract a background value from a sample result and get a negative number. Results that include the negative values can be evaluated statistically without incurring the difficulties associated with performing calculations on "less than" (<) values. Radiation measurements are reported in units of becquerel (Bq). A Bq is a Systeme Internationale (SI) unit equivalent to one disintegration per second.

Single measurement values and multiple value summaries are tested for their difference from zero using the standard normal distribution (z value) or the t distribution (t value) and a one-tailed test with 95% confidence level. Occasionally, the result will be declared as different from zero by the statistical test when in fact it is not. The frequency of this error is directly related to the confidence level of the test. With a specified 95% confidence level there is a 5% error rate, wrongly declaring a result greater than zero 5% of the time. This is a commonly used confidence level that represents a compromise between incorrectly declaring that a value is greater than zero and incorrectly declaring that a value is equal to zero.

The lower confidence limit for a single radioactivity measurement is computed by multiplying the counting standard deviation by 1.645 (z value for a one-tailed test at a 95% confidence level) and subtracting that from the sample result. If that difference is equal to or greater than zero, the result is said to be significantly greater than zero. Otherwise it is said to be not significantly greater than zero.

Multiple value summaries are of two types: averages and sums. An average is tested for difference from zero using the standard error of the mean and the appropriate t value with n-1 degrees of freedom. All sources of variation, counting uncertainty in the case of radionuclide measurements, laboratory preparation, sampling variance and population variation, are inherently

estimated by the calculated standard error used in this test. As a result, inference is on the whole process that generated the measurements. Sums of radioactivity measurements are tested for differences from zero using only the propagated counting uncertainties. The 95% lower bound on the sum is the calculated sum minus 1.645 times the square root of the summed counting variances. Estimates of the sampling and population variability are not available in this situation. As a result, inference is on the observed sum, not on an underlying population from which the observations were taken.

Presentations of radioactivity data throughout the report follow the convention of flagging data that are statistically significant with an * (asterisk). Data that are not significantly different from zero are presented without a flag.

Chemical (nonradionuclide) results that are below the analytical detection limit are expressed as "less than" (<) or as "undetected" (U) values. The average value is expressed with a ~ (tilde) when at least one of the results used for the average is less than the detection limit.

Results obtained in the laboratory are often reported as "less than" or "below detection." In these situations the detection limit is reported along with the "less than" designation. The sample mean and standard error of the mean are affected by these values; they become "biased"--biased high for the mean and low for the standard error of the mean. That is, the sample standard error of the mean is estimating something smaller than the true standard error.

A further consequence of the bias is an increased likelihood that a population mean will be declared greater than zero in a statistical test using the biased sample mean and standard error. A statistically significant result may be a consequence of the number of values below the detection limit. If, however, there were a number of values above the detection limit, the conclusion that the true mean is greater than zero may be valid even though the estimate of true mean is biased.

2.0 AIR

The Department of Energy (DOE) Oak Ridge facilities are subject to regulations issued by the Tennessee Department of Environment and Conservation (TDEC) Air Pollution Control Board and the Environmental Protection Agency (EPA) as well as DOE orders. Nonradioactive emission sources are regulated by TDEC, and radioactive emission sources are regulated by EPA under the National Emission Standards for Hazardous Air Pollutants (NESHAP). The authority for these regulations is derived from the Tennessee Air Quality Control Act (TAQC) and the Clean Air Act (CAA).

The TDEC air pollution control rules regulate pollution sources to protect the public health and welfare and the environment. These rules include regulations for maximum allowable ambient air concentrations of certain pollutants, open burning, pollution sources such as coal-fired boilers and processes, fugitive emission sources, performance standards for new sources, and hazardous air pollutants. State-issued permits are required for air pollution sources with the exception of certain very small emission sources that are specifically exempt from permit requirements.

The EPA regulations for radioactive emission sources limit the amount of exposure to radioactivity to the nearest or the most affected member of the public. The EPA sets the limit on exposure to radioactivity by first determining (1) a safe exposure level and (2) then adding a margin of safety. The dose, to the most affected member of the public, is determined by EPA-approved radioactive emissions dose modeling. The NESHAP regulations were reissued in December 1989. The ORR is currently not in compliance with the stack sampling criteria. A Federal Facility Compliance Agreement (FFCA) was signed in May 1992 by the DOE field office manager and is being implemented to achieve full compliance by December 1992.

DOE regulations governing airborne emissions are established in DOE orders 5400.1 and 5400.5 and DOE/ESH-0173T. Using the criteria in NESHAP regulations and DOE orders, major effluent sources are defined as emission points with the potential to discharge radionuclides in quantities that could cause an annual effective dose equivalent of 0.1 mrem/year or greater to a member of the public. Potential emissions are calculated for a source by assuming the loss of pollution control equipment while the source is otherwise operating normally.

ORNL has a comprehensive air pollution control and monitoring program to ensure that airborne discharges meet regulatory requirements and do not adversely affect ambient air quality. Air pollution controls include exhaust gas scrubbers, baghouses, and exhaust filtration systems designed to remove airborne pollution from the exhaust gases before their release to the atmosphere. Process modifications and material substitutions are also made in an effort to minimize air emissions. In addition, administrative controls play a role in regulating emissions. ORNL has developed an emissions inventory program that includes stack sampling to determine the amounts of pollutants that are not removed by the air pollution control equipment.

(Ambient air monitoring is also conducted around the facilities and at three locations within surrounding East Tennessee communities to assess the impacts of ORR operations on the ambient air quality of the region.)

2.1 AIRBORNE EMISSIONS

Laurice V. Hamilton and Joan F. Hughes

2.1.1 Program Description

The major gaseous emission point sources for ORNL consist of the following four stacks located in Bethel and Melton Valleys:

Building	Description
2026	High Radiation Level Analytical Laboratory
3020	Radiochemical Processing Plant
3039	3500 and 4500 areas cell ventilation system Central off-gas and scrubber system Isotope solid state ventilation system 3025 and 3026 areas cell ventilation system
7911	Melton Valley complex (High Flux Isotope Reactor, Radiochemical Engineering Development Center)

Fig. 1 shows the locations of the four main stacks whose emissions are routinely quantified.

Discharges from each stack are unique because of the wide variety of research activities performed at ORNL. Radiological emissions from ORNL typically consist of particulates, adsorbable gases (e.g., iodine), tritium, and nonabsorbable gases (e.g., xenon).

Gaseous effluents at ORNL originate from ventilation air from contaminated or potentially contaminated areas, vents from tanks and processes, and ventilation for reactor facilities. Many sources, mostly nonradioactive, are permitted by the TDEC Air Pollution Control Board. Most gaseous emissions are treated and filtered before discharge to the atmosphere. Typically, contaminated and potentially contaminated gaseous wastes are treated, then filtered with HEPA and/or charcoal filters before discharge to ensure that any radioactivity released is within acceptable levels.

2.1.2 Procedures and Results

Sampling systems are currently being upgraded to meet the criteria in NESHAP regulations and DOE orders. In general the present sampling systems consist of in-stack sampling probes, sample transport lines, a particulate filter, an activated charcoal canister, a silica-gel tritium trap, flow measurement and totalizing instruments, a sampling pump,

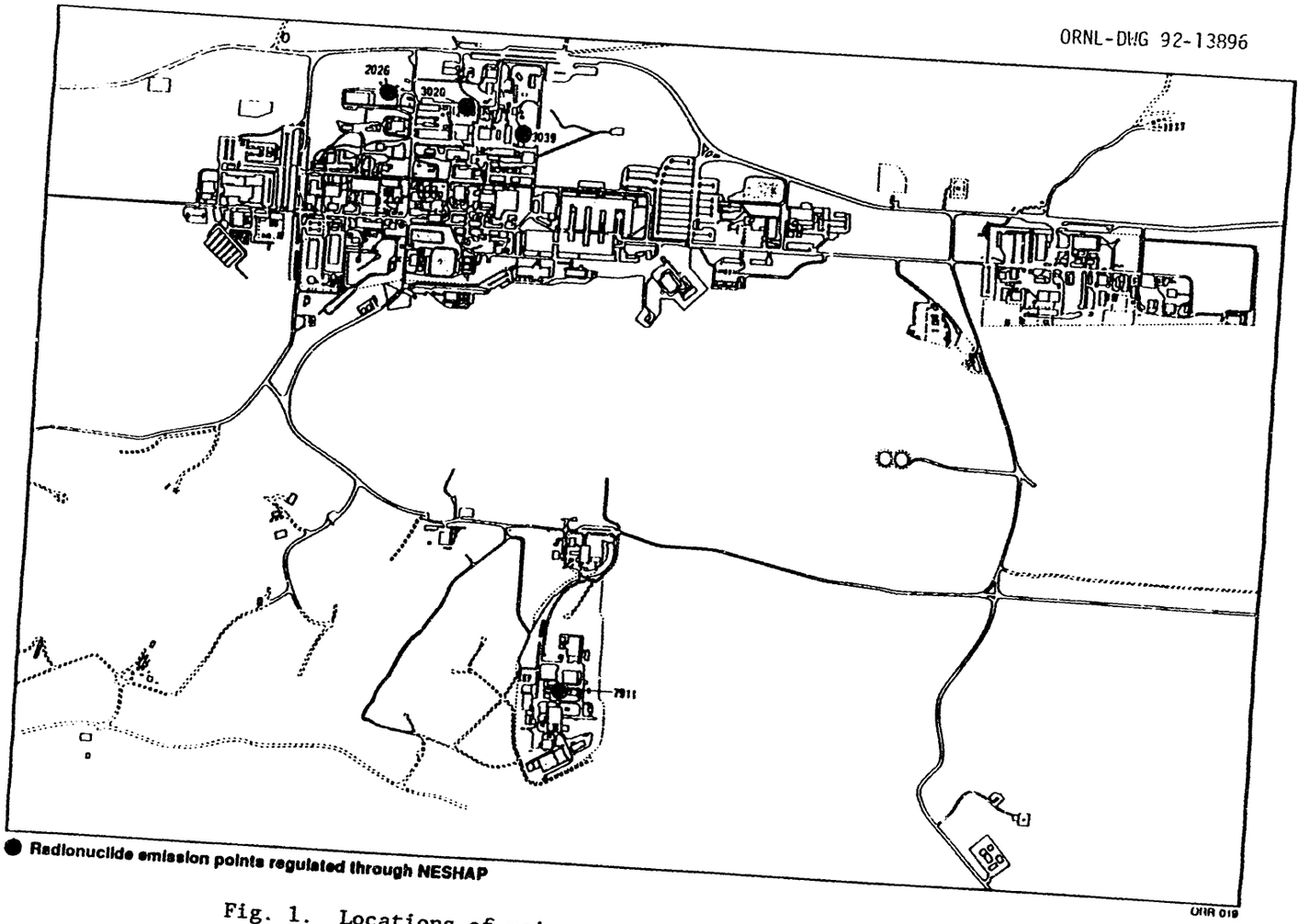

Fig. 1. Locations of major stacks (emission points) at ORNL.

and a sample return line to the stack. The present sampling systems at stacks 2026 and 3020 do not have tritium traps.

Due to major program changes, data for the third quarter will be presented in a future report.

2.2 AMBIENT AIR

Laurice V. Hamilton and Joan F. Hughes

2.2.1 Program Description

The objectives for the ambient program are (1) to sample at locations that are most likely to show impacts of airborne emissions from the operation of ORNL, (2) to maintain surveillance of airborne radionuclides at the ORR perimeter, and (3) to collect reference data from remote locations. Figs. 2-4 show the stations that are in the ORNL Ambient Air Program. The specific stations associated with each of these objectives are as follows:

Fig. 2. The ORNL Perimeter Air Monitoring (PAM) network includes stations 1, 2, 3, and 7.

Fig. 3. The DOE ORR PAM network includes stations 35, 37, 38, 39, 40, 42, 46, and 48.

Fig. 4. The Remote Air Monitoring (RAM) network consists of stations 52 and 58.

Annual composites of particulate air filters from each station are analyzed for specific radionuclides. Annual compositing of the particulate air filters for analysis of long-lived isotopes has been adopted because the data from previous years showed very low concentrations of these radionuclides. Stations 3 and 48 are equipped with tritium collection systems. Airborne radioactive particulates are sampled biweekly by pumping a continuous flow of air through a 47 mm (1.88 in.) diameter paper filter. Airborne adsorbable gases are collected biweekly (at ORNL PAM stations only) using a canister containing activated charcoal that is downstream of the particulate filter. The charcoal canister is analyzed within 24 hours after collection. The initial and final dates, time on and off, and flow rates are recorded when a sample medium is mounted or removed. The total volume of air that flowed through the sampler is obtained from a flow totalizer, with the exception of tritium. The concentration of radionuclides in air is calculated by dividing the total activity per sample by the total volume of air sampled.

Data summaries for isotopic identification of particulates on the air filters will be included in the fourth quarter report.

The sampling system is currently being upgraded. Tritium samplers will be installed at all sampling stations. In addition, hi-volume air samplers will

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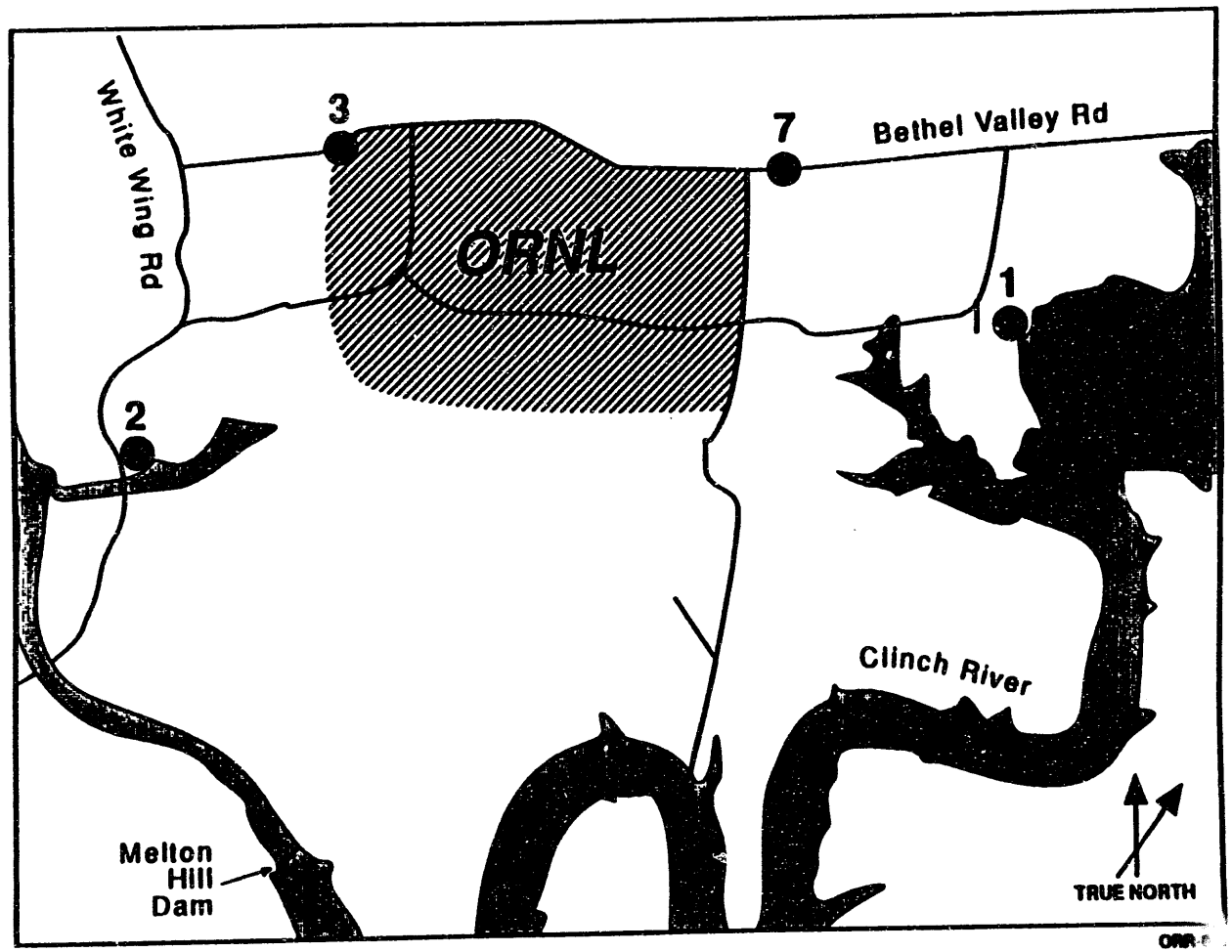

Fig. 2. ORNL perimeter monitoring locations.

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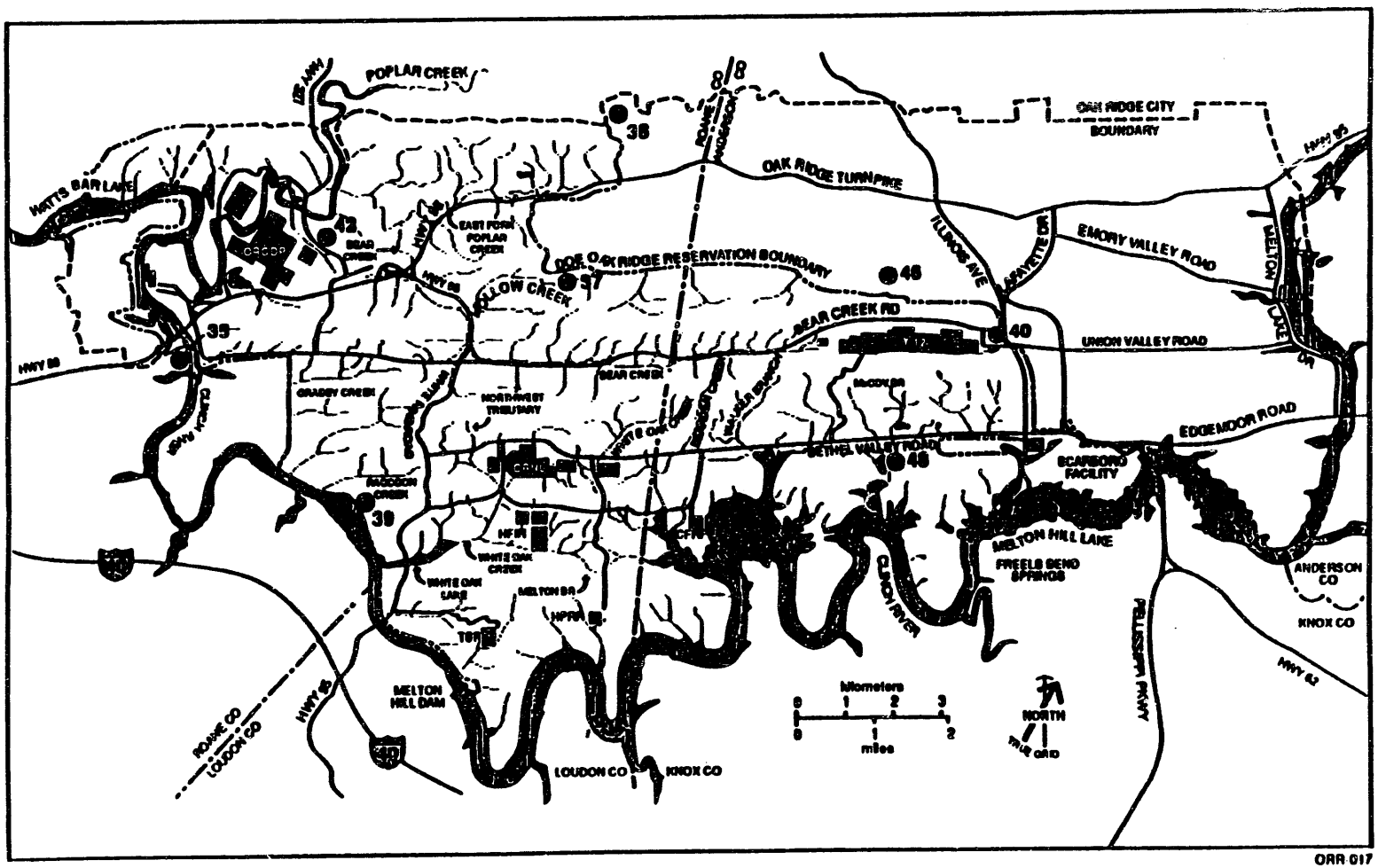

Fig. 3. ORR perimeter monitoring locations.

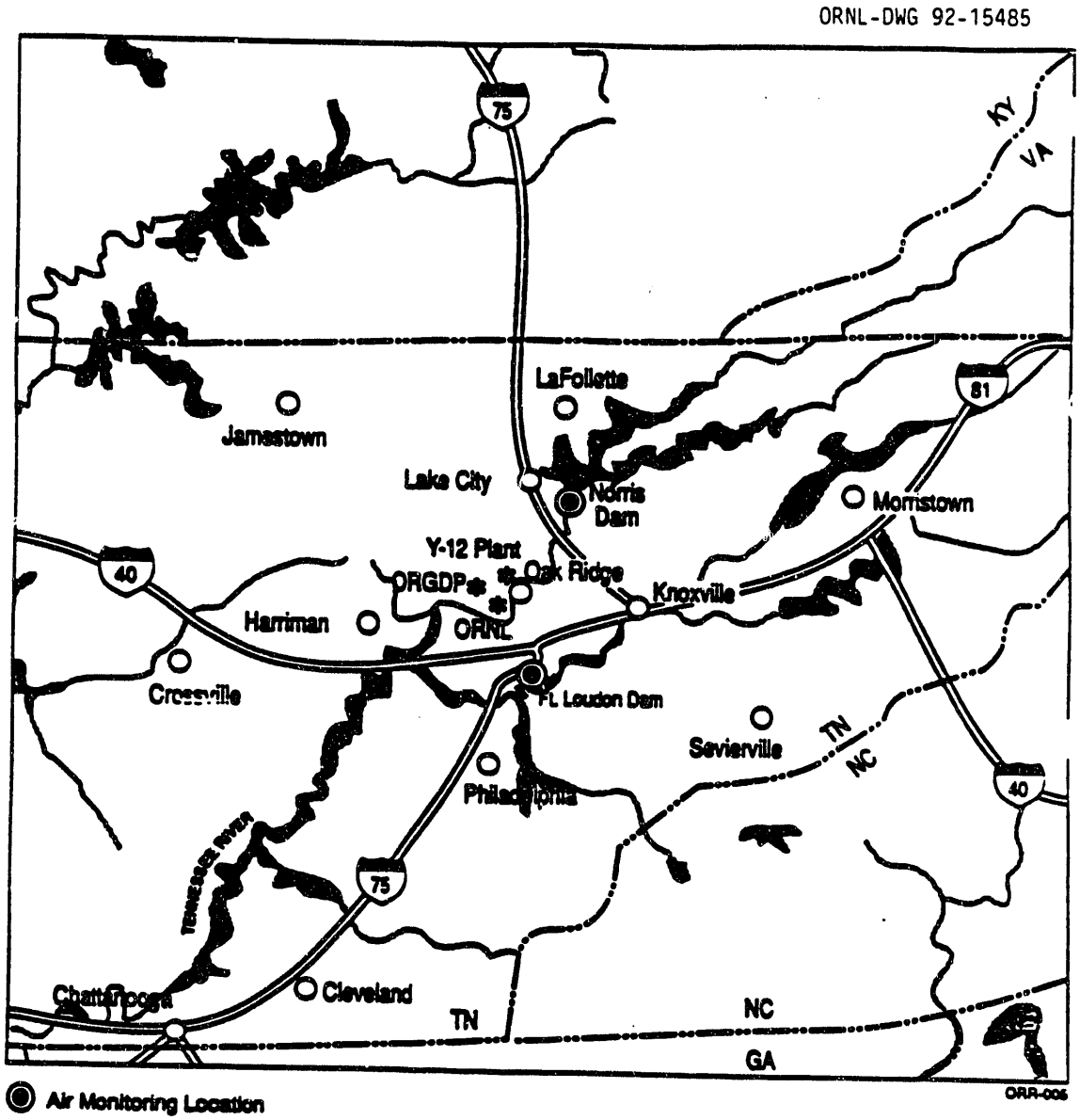

Fig. 4. ORR remote air monitoring locations.

be used at all ORR stations. These new samplers will provide a more concentrated particulate sample which will allow for better quantification of each isotope with more frequent analysis.

2.2.2 Procedures and Results

Concentrations of atmospheric adsorbable gas and atmospheric tritium for third quarter are summarized in Tables 1 and 2.

2.3 EXTERNAL GAMMA RADIATION

Laurice Hamilton and Betsy Horwedel

2.3.1 Program Description

At ORNL and the reservation perimeter air monitoring stations, external gamma radiation measurements (exposure rates) were recorded on a near real-time data acquisition system until February 1992. The locations of these PAMs are shown in Fig. 2. The readings were averaged at 10-minute intervals and stored in a database on the host computer. From these data, hourly averages were computed and also stored in a database. Readings were marked as invalid by the system if less than 75% of the data were available for the computation of the average as well as if the data are out of a predefined range. If a station had been marked off poll, which means that the host computer was not collecting data from the station, no readings were returned to the data acquisition system for inclusion in the database.

In mid February, the station locations were changed to coincide with the new ambient air locations. External gamma measurements are recorded at stations 39, 40, 42, 46, and 48, which are five of the ten ambient air stations. In addition, external gamma measurements were still collected at the DOE museum (station 41). After the relocation, the external gamma measurements were recorded weekly in the field. The readings for the quarter are entered into SAS data sets and a statistical evaluation completed. The equivalent dose rate is calculated using the average reading for each station during the quarter.

2.3.2 Procedures and Results

Typical values for cities in the United States are usually between 1.5 and 4.2 nC/kg/h (nanocoulomb per kilogram per hour) according to recent issues of EPA Environmental Radiation Data. The median value for cities in the contiguous United States for the first three quarters of 1989 was 2.4 nC/kg/h. The last value given for Knoxville (July-September 1989) was 2.4 nC/kg/h. All of the values given in Table 3 are within the above range of background values. Table 3 summarizes the weekly measurements from July-September 1992.

Table 1. Atmospheric adsorbable gas concentrations at ORNL air monitoring stations,[a] July-September 1992

Station	N det/ N total	Concentration (10^{-8} Bq/L) Max	Min	Av[b]	Standard error[c]	Percent of DCG[d]
1	0/6	9.0	-11	0.43	3.1	<0.01
2	0/6	18	8.8	1.5	3.8	<0.01
3	0/5	15	4.7	4.9	3.9	<0.01
7	0/6	12	8.4	1.6	3.5	<0.01
Overall Summary	0/23	18	-11	2.0	1.7	<0.01

[a]See Fig. 2.
[b]Average concentrations significantly greater than zero are identified by an *.
[c]Standard error of the mean.
[d]Percent of DCG = Average/DCG x 100. The DCG for I-131 is 1.5×10^{-2} Bq/L.

Table 2. Atmospheric tritium concentrations at ambient air stations, July-September 1992

Station[a]	N det/ N total	Concentration (10^{-4} Bq/L) Max	Min	Av[b]	Standard error[c]	Percent of DCG[d]
3	3/3	6.8	4.7	5.8*	0.60	0.016
48	1/3	4.0	0.78	2.5	0.94	<0.01
Overall Summary	4/6	6.8	0.78	4.2*	0.88	0.011

[a]Station locations are shown in Fig. 2.
[b]Average concentrations significantly greater than zero are identified by an *.
[c]Standard error of the mean.
[d]Percent of DCG = Average/DCG x 100. The DCG for tritium is 3.7 Bq/L.

Table 3. External gamma radiation measurements at reservation perimeter air monitoring stations,[a] July-September 1992

Station	Number of Readings	Exposure rate (nC/kg/h)[b]				Equivalent Dose (μSv/h)
		Max	Min	Av	Standard error[c]	
39	12	2.8	2.6	2.7	0.015	0.092
40	12	2.1	2.0	2.0	0.0019	0.070
41	11	1.2	1.2	1.2	0.0062	0.042
46	12	2.3	2.2	2.2	0.0049	0.076
48	9	2.2	1.8	2.0	0.062	0.069
Overall Summary	56	2.8	1.2	2.1	0.066	0.080

[a]See Fig. 2.
[b]Nanocoulomb per kilogram per hour.
[c]Standard error of the mean.

3.0 WATER

The Oak Ridge National Laboratory (ORNL) site is located in the 17 km^2 White Oak Creek (WOC) watershed, with the exception of two small effluent points in the 7600 area that discharge directly into Melton Hill Lake. A sketch of the watershed and sampling station locations is shown in Fig. 5. The major tributary to WOC is Melton Branch (MB). Upper WOC drains Bethel Valley in the vicinity of ORNL, receiving inputs from Fifth Creek, First Creek, and Northwest Tributary (NWT) prior to crossing the gap in Haw Ridge and flowing southwest to White Oak Lake (WOL). Melton Branch drains Melton Valley and joins WOC less than a mile from WOL. The final point of control for the watershed is at White Oak Dam (WOD), which is the structure that forms WOL. The lake is about two-thirds of a mile long and less than a tenth of mile wide. The receiving water for the watershed is the Clinch River embayment of Watts Bar Lake.

Water quality in these streams is affected primarily by effluent discharges, surface runoff, subsurface storm flow, and groundwater transport of contaminants from historically disposed wastes. The average flow for the watershed is 14 CFS (9 MGD), of which 1 CFS (0.67 MGD) is attributed to the major National Pollutant Discharge Elimination System (NPDES) effluent points, and 3 CFS (2 MGD) is attributed to cooling towers and blowdown. The base flow during drought is estimated at 1.75 CFS (1.14 MGD).

Surveillance of the water environment consists of the collection of surface water, effluent and sediment samples required under the NPDES Permit, and groundwater from Waste Area Groupings 1-9, 11 and 17. Of the WAGs, WAGs 2, 3, and Solid Waste Storage Area (SWSA) 6 within WAG 6 were sampled during this quarter. Samples are analyzed for radionuclides and nonradioactive chemicals.

3.1 SURFACE WATER

Melinda C. Salmons

3.1.1 Program Description

Water samples are collected for radiological analyses at off-site and on-site locations, at background or reference locations, in streams on the ORNL site, and from all process discharge point sources. A summary of locations, analyses that are conducted, and frequencies of sample collection and analysis for all radiological samples is provided in Table 4.

3.1.2 Procedure and Results

Treated water samples are collected weekly at the Kingston and Gallaher potable water treatments plants (Fig. 6) and are analyzed quarterly. Table 5 contains the concentrations measured at these stations during this quarter. At Gallaher, gross beta and total rad Sr were significantly greater than zero but at levels no greater than 14% of the Environmental Protection Agency (EPA) primary drinking water standards (40 CFR 141, as amended). Cs-137 at Gallaher was significantly greater than zero; however, drinking water standards for

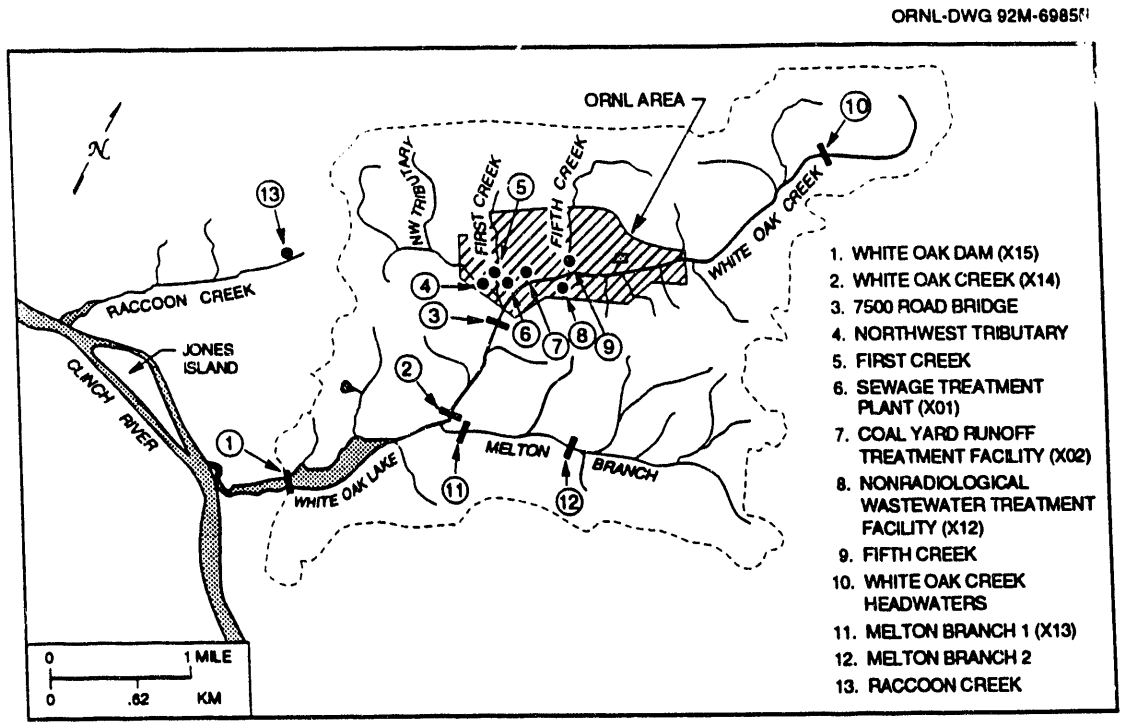

Fig. 5. ORNL surface water, NPDES, and reference sampling locations.

Table 4. Summary of collection and analysis frequencies of surface and effluent water samples for radionuclide analysis

Station	Analysis	Collection Frequency	Sample Type	Analysis Frequency
STP	Gamma scan, Gross beta, Total rad Sr	Weekly	Flow proportional composite	Monthly
7500 Road Bridge, MB1, MB2, WOC	Gamma scan, H-3, Total rad Sr	Weekly	Flow proportional composite	Monthly
First Creek, Fifth Creek, Raccoon Creek	Gamma scan, Total rad Sr	Weekly	Grab	Monthly
Gallaher	Gamma scan, Gross alpha, Gross beta, H-3, Pu-238, Pu-239, Total rad Sr, Total U	Weekly	Time proportional composite	Quarterly
Kingston	Gamma scan, Gross alpha, Gross beta, H-3, Pu-238, Pu-239, Total rad Sr, Total U	Weekly	Grab	Quarterly
MHD	Gamma scan, Gross alpha[a], Gross beta[b]	Weekly	Flow proportional composite	Monthly
NRWTF	Gamma scan, Gross alpha, Gross beta, H-3, Total rad Sr	Weekly	Flow proportional composite	Monthly
NWT	Gamma scan, Total rad Sr	Weekly	Flow proportional composite	Monthly
WOC Headwaters	Gamma scan, Gross alpha[a], Gross beta[b]	Weekly	Flow proportional composite	Monthly
WOD	Gamma scan, Gross alpha[a], Gross beta[b]	Weekly	Flow proportional composite	Weekly

Table 4. (continued)

Station	Analysis	Collection Frequency	Sample Type	Analysis Frequency
WOD	H-3, Total rad Sr	Weekly	Flow proportional composite	Monthly
Category I Outfalls	Gross beta[b],	Annually	Grab	Annually
Category II Outfalls	Gross beta[b],	Quarterly	Grab	Quarterly

[a]If gross alpha >1 Bq/L, analyze for Am-241, Cm-244, Pu-238, Pu-239, Th-228, Th-230, Th-233, U-234, U-235, and U-238.
[b]If gross beta >30 Bq/L, analyze for total rad Sr.

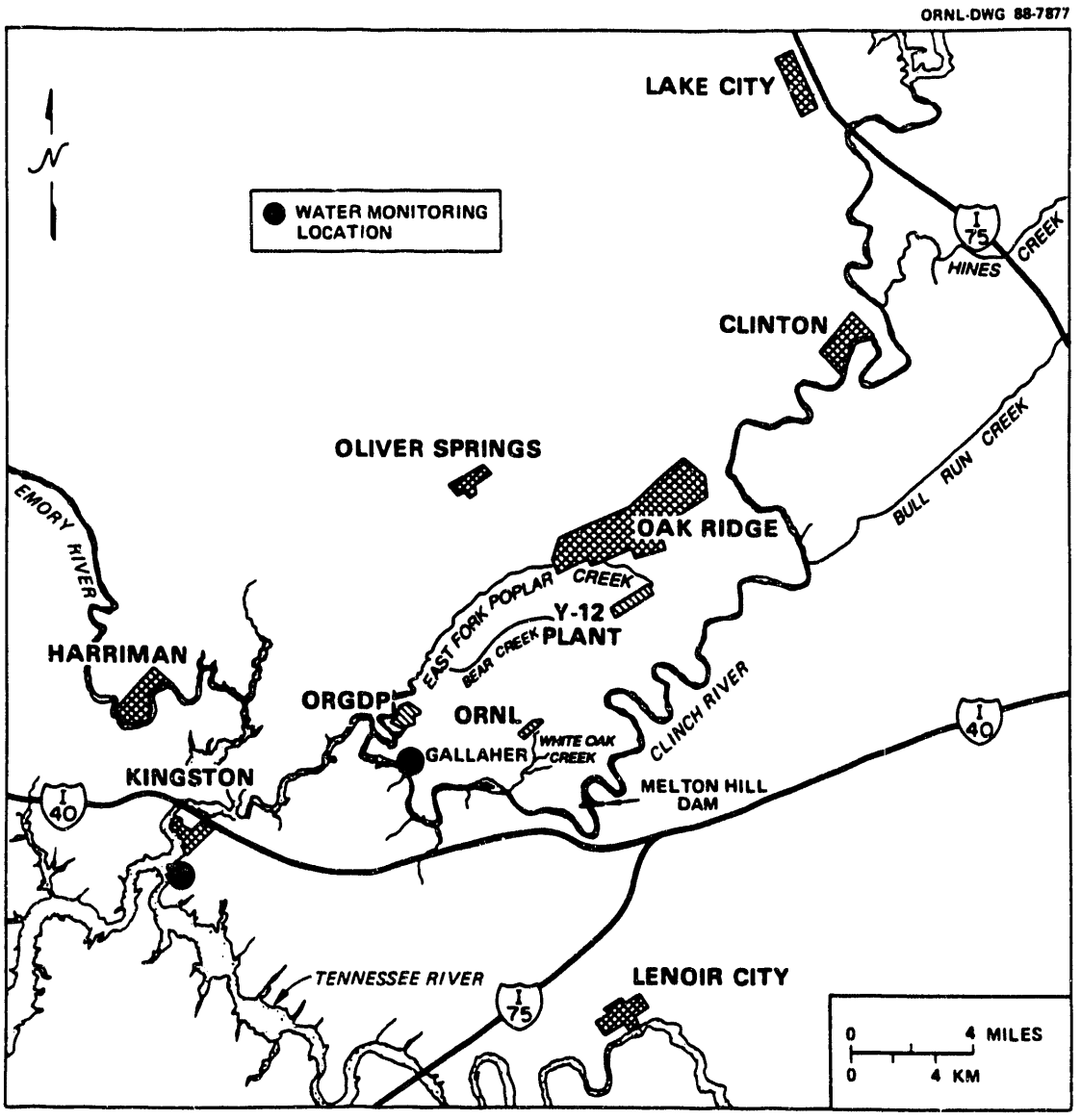

Fig. 6. Location map of Gallaher and Kingston sampling points.

Table 5. Summary of radionuclide concentrations in water off-site ORNL, July-September 1992

Radionuclide	Concentration[a] (Bq/L)	Drinking Water Standard[b] (DWS) (Bq/L)	Percent DWS[c]
	Gallaher[d]		
Co-60	0.0040	e	e
Cs-137	0.018*	e	e
Gross alpha	-0.0080	0.555	e
Gross beta	0.21*	1.85	11
Pu-238	-0.00050	e	e
Pu-239	-0.0011	e	e
Total rad Sr	0.041*	0.296	14
Total U[f] (mg/L)	0.00017	e	e
Total U[fg]	0.0042	e	e
H-3	-2.0	740	e
	Kingston[d]		
Co-60	0.0090*	e	e
Cs-137	0.019*	e	e
Gross alpha	0.016	0.555	e
Gross beta	0.11*	1.85	5.9
Pu-238	0.00030	e	e
Pu-239	-0.0020	e	e
Total rad Sr	0.012*	0.296	4.1
Total U[f] (mg/L)	0.00018	e	e
Total U[fg]	0.0044	e	e
H-3	26*	740	3.5

[a]Concentrations significantly greater than zero are identified by an *.
[b]National Primary Drinking Water Standard. From 40 CFR 141, as amended. The value for total rad Sr is based upon the Sr-90 limit. The value for gross beta is a regulatory guide for assessing compliance without further analysis.
[c]Concentration as a percentage of the DWS.
[d]See Fig. 6.
[e]Not applicable.
[f]No test for significance is possible.
[g]Activity derived from mass assuming natural abundance of U-234, U-235 and U-238.

Cs-137 have not been established. At Kingston, gross beta, total rad Sr, and tritium were significantly greater than zero but at levels no greater than 5.9% of the Environmental Protection Agency (EPA) drinking water standards. Co-60 and Cs-137 at Kingston were significantly greater than zero; however, drinking water standards for Co-60 and Cs-137 have not been established. No test of significance was possible for the total uranium measurement at each site, but the concentrations at Gallaher and Kingston are less than 0.8% of the gross alpha standard. The total uranium measurement is converted to an activity by assuming natural abundance of uranium isotopes U-234, U-235, and U-238.

Derived concentration guides (DCGs) are estimates of the rate of exposure to a given radioisotope via one exposure pathway that would result in an effective dose equivalent of 100 mrem (1 mSv) per year to "reference man," as defined by the International Commission of Radiation Protection Publication 23. These values have been published in DOE Order 5400.5 and are used here as a means of standardized comparison for effluent points with different isotope signatures. The calculation of percent of the DCG does not imply that effluent points or ambient water sampling stations at ORNL are sources of drinking water.

The sum of DCG percentages for each of the effluent points and ambient water stations is less than 100%. In the event that a sum ever exceeds 100%, an analysis of the best available technology to reduce the signature would be conducted as specified in DOE Order 5400.5.

Melton Hill Dam and WOC headwaters, two locations above ORNL discharge points, serve as references for other water sampling locations at the ORNL site. Water samples are collected from the reference sites and from six streams on-site: White Oak Creek, Melton Branch, First Creek, Fifth Creek, Northwest Tributary, and Raccoon Creek (Fig. 5). Sampling for radiological analyses is conducted at six ambient stations around ORNL and at five NPDES locations. The six ambient stations are

- 7500 Road Bridge
- First Creek
- Fifth Creek
- Melton Branch 2
- Northwest Tributary
- Raccoon Creek

The five NPDES stations are

- Sewage Treatment Plant (X01)
- Nonradiological Wastewater Treatment Facility (X12)
- Melton Branch 1 (X13)
- White Oak Creek (X14)
- White Oak Dam (X15)

Summary statistics for each radionuclide at each surface water sampling location are given in Table 6. The average concentration is expressed as a percentage of the DCG (when one exists) in the last column of this table. As shown in Table 6, only average gross beta at WOC headwaters was significantly

Table 6. Radionuclide concentrations in surface waters around ORNL,[a] July-September 1992

Radionuclide	N det/ N total	Concentration (Bq/L) Max[b]	Min[b]	Av[c]	Standard error[d]	DCG[e]	Percent DCG[f]
			Melton Hill Dam				
Co-60	0/3	0.50	-1.2	-0.40	0.4	185	g
Cs-137	0/3	0.70	-0.80	-0.067	0.43	111	g
Gross alpha	3/3	0.26*	0.062*	0.14	0.060	g	g
Gross beta	3/3	1.0*	0.25*	0.52	0.24	g	g
			White Oak Creek Headwaters				
Co-60	0/3	0.40	-0.80	-0.30	0.36	185	g
Cs-137	0/3	1.3	-0.90	0.33	0.65	111	g
Gross alpha	3/3	0.40*	0.057*	0.20	0.10	g	g
Gross beta	3/3	0.71*	0.32*	0.47*	0.12	g	g
			7500 Road Bridge				
Co-60	0/3	0.50	-0.80	-0.27	0.39	185	g
Cs-137	3/3	7.3*	4.1*	5.3*	1.0	111	4.8
Total rad Sr	3/3	3.6*	1.9*	2.7*	0.50	37	7.2
H-3	3/3	360*	160*	250*	59	74,000	0.33
			First Creek				
Co-60	1/3	1.5*	-0.30	0.33	0.58	185	g
Cs-137	1/3	2.7*	-0.50	0.77	0.98	111	g
Total rad Sr	3/3	20*	16*	18*	1.2	37	50
			Fifth Creek				
Co-60	0/3	0.20	-1.0	-0.37	0.35	185	g
Cs-137	0/3	-0.20	-0.30	-0.23	0.033	111	g
Total rad Sr	3/3	2.0*	1.4*	1.8*	0.19	37	4.8
			Melton Branch 2				
Co-60	0/3	1.0	-0.30	0.37	0.38	185	g
Cs-137	1/3	1.7*	-0.70	0.23	0.74	111	g
Total rad Sr	2/3	0.19*	0.080	0.14*	0.032	37	0.38
H-3	3/3	790*	230*	430	180	74,000	g

Table 6. (continued)

Radionuclide	N det/ N total	Concentration (Bq/L) Max[b]	Min[b]	Av[c]	Standard error[d]	DCG[e]	Percent DCG[f]
			Northwest Tributary				
Co-60	0/3	0.10	-0.40	-0.20	0.15	185	g
Cs-137	2/3	2.5*	0.70	1.6*	0.52	111	1.4
Total rad Sr	3/3	2.2*	0.89*	1.8*	0.44	37	4.8
			Raccoon Creek				
Co-60	0/3	0.40	-0.50	-0.067	0.26	185	g
Cs-137	0/3	0.60	-0.30	0.13	0.26	111	g
Total rad Sr	3/3	1.6*	1.0*	1.3*	0.17	37	3.5

[a]Locations are shown in Fig. 5.

[b]Individual concentrations significantly greater than zero are identified by an *.

[c]Average concentrations significantly greater than zero are identified by an *.

[d]Standard error of the mean.

[e]Derived concentration guide for ingestion of water. From DOE Order 5400.5.

[f]Average concentration as a percentage of the DCG, calculated only when a DCG exists and the average concentration is significantly greater than zero.

[g]Not applicable.

greater than zero. Only two ambient stations showed average radionuclide concentrations greater than 5% of the appropriate DCG with no average radionuclide concentration exceeding 50% of its DCG.

Locations that are sampled for nonradioactive chemicals under the requirements of the NPDES Permit (see Section 3.3) are also sampled for radionuclides (Fig. 5). Radiological analysis and the frequency of analysis are given in Table 4. Table 7 contains a summary of the concentrations for each of these locations during this quarter. Average radionuclide concentrations that are significantly greater than zero and greater than 5% of DCG are: total rad Sr at the Sewage Treatment Plant, Melton Branch 1, White Oak Creek, and White Oak Dam; tritium at Melton Branch 1; and Cs-137 at the Nonradiological Wastewater Treatment Facility. No radionuclide average concentration at the NPDES points exceeded 36% of its DCG.

The discharge of radioactive contaminants from ORNL is affected by the stream flows. Monthly flows in Melton Branch (as measured at station Melton Branch 1), White Oak Creek (as measured above its confluence with Melton Branch and at White Oak Dam), and the Clinch River (as measured at Melton Hill Dam) are given in Table 8. Clinch River flows are regulated by a series of Tennessee Valley Authority dams, one of which is Melton Hill Dam. The flow in Melton Branch is usually less than one-third of that in White Oak Creek. The monthly ratio of flow in White Oak Creek (measured at White Oak Dam) to flow in the Clinch River (measured at Melton Hill Dam) is reported in the last column of the table. The ratios given were calculated daily and averaged for the month. If complete mixing is assumed, this ratio gives an indication of the dilution factor that may be expected for potential contaminants entering the Clinch River from White Oak Creek. In this quarter, the ratio values ranged from 0.0033 to 0.0045.

Amounts of radioactivity in White Oak Creek at the Sewage Treatment Plant, Nonradiological Wastewater Treatment Facility, White Oak Creek, Melton Branch 1, and White Oak Dam stations are calculated from concentration and flow and reported in Tables 9-11. A single flow-proportional sample was obtained weekly at each station. From the weekly samples, a flow-weighted composite is made and analyzed monthly. The discharge for the period is calculated as the product of the flow-weighted concentration and the total flow for the sampling period. In addition, at weekly intervals, flow-proportional samples are obtained at WOD and analyzed for radionuclides other than H-3 and total rad Sr. The average concentration during the calendar month was calculated as a weighted sum of all concentrations obtained for sampling periods overlapping the calendar month. The weights were proportional to the calendar period total flow attributable to the sampling periods. This average concentration was multiplied by the calendar month total flow to arrive at the discharge.

Each average flow-weighted concentration was compared with an existing DCG. As shown in Tables 9-11, average radionuclide concentrations that are significantly greater than zero and greater than 5% of DCG are: total rad Sr at Melton Branch 1, Nonradiological Wastewater Treatment Facility, Sewage Treatment Plant, White Oak Creek, and White Oak Dam; tritium at Melton Branch 1 and White Oak Dam; and Cs-137 at Nonradiological Wastewater Treatment Facility and White Oak Creek.

Table 7. Radionuclide concentrations at ORNL NPDES locations,[a] July-September 1992

Radionuclide	N det/ N total	Concentration (Bq/L) Max[b]	Min[b]	Av[c]	Standard error[d]	DCG[e]	Percent DCG[f]
Sewage Treatment Plant (X01)							
Co-60	0/3	0.40	-1.3	-0.20	0.55	185	g
Cs-137	0/3	0.10	-0.90	-0.30	0.31	111	g
Gross beta	3/3	12*	11*	11*	0.33	g	g
Total rad Sr	3/3	6.7*	4.2*	5.6*	0.73	37	15
Nonradiological Wastewater Treatment Facility (X12)							
Co-60	0/3	1.3	-0.10	0.43	0.44	185	g
Cs-137	3/3	38*	22*	28*	4.9	111	25
Gross alpha	3/3	0.44*	0.20*	0.29*	0.074	g	g
Gross beta	3/3	24*	19*	21*	1.5	g	g
Total rad Sr	3/3	2.8*	0.68*	1.4	0.69	37	g
H-3	3/3	2,900*	230*	1,400	790	74,000	g
Melton Branch 1 (X13)							
Co-60	0/3	0.50	-0.40	0.13	0.27	185	g
Cs-137	0/3	1.5	-1.2	0.27	0.79	111	g
Total rad Sr	3/3	17*	8.6*	13*	2.5	37	36
H-3	3/3	19,000*	8,600*	16,000*	3,500	74,000	21
White Oak Creek (X14)							
Co-60	0/3	0.70	-0.40	0.033	0.34	185	g
Cs-137	3/3	7.5*	3.0*	5.2*	1.3	111	4.7
Total rad Sr	3/3	5.0*	2.4*	3.6*	0.76	37	9.6
H-3	3/3	1,200*	160*	680	300	74,000	g

Table 7. (continued)

Radionuclide	N det/ N total	Concentration (Bq/L) Max[b]	Min[b]	Av[c]	Standard error[d]	DCG[e]	Percent DCG[f]
			White Oak Dam (X15)				
Co-60	3/14	0.24*	-0.040	0.079*	0.023	185	0.042
Cs-137	14/14	2.2*	0.63*	1.3*	0.14	111	1.2
Gross alpha	13/14	0.36*	0.068*	0.19*	0.024	g	g
Gross beta	14/14	24*	9.1*	13*	1.2	g	g
Total rad Sr	3/3	9.1*	4.5*	6.3*	1.4	37	17
H-3	3/3	4,000*	2,500*	3,000*	500	74,000	4.1

[a]Locations are shown in Fig. 5.
[b]Individual concentrations significantly greater than zero are identified by an *.
[c]Average concentrations significantly greater than zero are identified by an *.
[d]Standard error of the mean.
[e]Derived concentration guide for ingestion of water. From DOE Order 5400.5.
[f]Average concentration as a percentage of the DCG, calculated only when a DCG exists and the average concentration is significantly greater than zero.
[g]Not applicable.

Table 8. Stream[a] flows, July-September 1992

Month	Flow (10^9 L)				Average Ratio[e]
	Melton Branch 1	White Oak Creek[b]	White Oak Dam[c]	Clinch River[d]	
July	0.16	0.65	0.83	280	0.0033
August	0.23	0.53	1.0	360	0.0045
September	0.068	0.33	0.43	310	0.0034

[a]See Fig. 5.
[b]White Oak Creek above its confluence with Melton Branch.
[c]White Oak Creek at White Oak Dam.
[d]Clinch River at Melton Hill Dam.
[e]Flow ratios White Oak Creek:Clinch River at White Oak Dam are calculated daily and averaged for the month.

Table 9. Radionuclide concentrations and releases at ORNL NPDES surface water stations,[a] July 1992

Radionuclide	Flow (10^6 L)	Discharge[b] (10^{10} Bq)	Concentration[c] (Bq/L)	DCG[d] (Bq/L)	Percent DCG[e]
Melton Branch 1 (06/24-07/29)					
Co-60	170	f	0.50	185	f
Cs-137	170	f	1.5	111	f
Total rad Sr	170	0.28	17*	37	46
H-3	170	320	19,000*	74,000	26
Nonradiological Wastewater Treatment Facility (06/24-07/29)					
Co-60	64	f	1.3	185	f
Cs-137	64	0.16	25*	111	23
Gross alpha	64	0.0013	0.20*	f	f
Gross beta	64	0.13	20*	f	f
Total rad Sr	64	0.018	2.8*	37	7.6
H-3	64	1.5	230*	74,000	0.31
Sewage Treatment Plant (06/25-07/30)					
Co-60	36	f	-1.3	185	f
Cs-137	36	f	-0.10	111	f
Gross beta	36	0.044	12*	f	f
Total rad Sr	36	0.024	6.7*	37	18
White Oak Creek (06/24-07/29)					
Co-60	660	f	0.70	185	f
Cs-137	660	0.49	7.5*	111	6.8
Total rad Sr	660	0.33	5.0*	37	14
H-3	660	79	1,200*	74,000	1.6
White Oak Dam (06/24-07/29)					
Total rad Sr	860	0.78	9.1*	37	25
H-3	860	340	4,000*	74,000	5.4

Table 9. (continued)

Radionuclide	Flow (10^6 L)	Discharge[b] (10^{10} Bq)	Concentration[c] (Bq/L)	DCG[d] (Bq/L)	Percent DCG[e]
		White Oak Dam[g] (07/01-08/01)			
Co-60	830	f	0.040	185	f
Cs-137	830	0.13	1.5*	111	1.4
Gross alpha	830	0.022	0.26*	f	f
Gross beta	830	1.5	18*	f	f

[a]Locations are shown in Fig. 5.

[b]Discharges are calculated from flow and concentration and are listed when concentrations are significantly greater than zero.

[c]Concentrations significantly greater than zero are identified by an *.

[d]Derived concentration guide for ingestion of water. From DOE Order 5400.5.

[e]Average concentration as a percentage of the DCG, calculated only when a DCG exists and the average concentration is significantly greater than zero.

[f]Not applicable.

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

Table 10. Radionuclide concentrations and releases at ORNL NPDES surface water stations,[a] August 1992

Radionuclide	Flow (10^6 L)	Discharge[b] (10^{10} Bq)	Concentration[c] (Bq/L)	DCG[d] (Bq/L)	Percent DCG[e]
		Melton Branch 1 (07/29-08/26)			
Co-60	230	f	0.30	185	f
Cs-137	230	f	-1.2	111	f
Total rad Sr	230	0.20	8.6*	37	23
H-3	230	200	8,600*	74,000	12
		Nonradiological Wastewater Treatment Facility (07/29-08/26)			
Co-60	48	f	0.10	185	f
Cs-137	48	0.11	22*	111	20
Gross alpha	48	0.0021	0.44*	f	f
Gross beta	48	0.091	19*	f	f
Total rad Sr	48	0.0032	0.68*	37	1.8
H-3	48	14	2,900*	74,000	3.9
		Sewage Treatment Plant (07/30-08/27)			
Co-60	28	f	0.40	185	f
Cs-137	28	f	-0.90	111	f
Gross beta	28	0.031	11*	f	f
Total rad Sr	28	0.016	5.8*	37	16
		White Oak Creek (07/29-08/26)			
Co-60	520	f	-0.40	185	f
Cs-137	520	0.26	5.0*	111	4.5
Total rad Sr	520	0.17	3.3*	37	8.9
H-3	520	35	670*	74,000	0.91
		White Oak Dam (07/29-08/26)			
Total rad Sr	1,000	0.54	5.4*	37	15
H-3	1,000	250	2,500*	74,000	3.4

Table 10. (continued)

Radionuclide	Flow (10^6 L)	Discharge[b] (10^{10} Bq)	Concentration[c] (Bq/L)	DCG[d] (Bq/L)	Percent DCG[e]
		White Oak Dam[g] *(08/01-09/01)*			
Co-60	1,000	0.012	0.12*	185	0.064
Cs-137	1,000	0.15	1.4*	111	1.3
Gross alpha	1,000	0.016	0.16*	f	f
Gross beta	1,000	1.0	9.9*	f	f

[a]Locations are shown in Fig. 5.

[b]Discharges are calculated from flow and concentration and are listed when concentrations are significantly greater than zero.

[c]Concentrations significantly greater than zero are identified by an *.

[d]Derived concentration guide for ingestion of water. From DOE Order 5400.5.

[e]Average concentration as a percentage of the DCG, calculated only when a DCG exists and the average concentration is significantly greater than zero.

[f]Not applicable.

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

Table 11. Radionuclide concentrations and releases at ORNL NPDES surface water stations,[a] September 1992

Radionuclide	Flow (10^6 L)	Discharge[b] (10^{10} Bq)	Concentration[c] (Bq/L)	DCG[d] (Bq/L)	Percent DCG[e]
Melton Branch 1 (08/26-09/30)					
Co-60	80	f	-0.40	185	f
Cs-137	80	f	0.50	111	f
Total rad Sr	80	0.11	14*	37	38
H-3	80	150	19,000*	74,000	26
Nonradiological Wastewater Treatment Facility (08/26-09/30)					
Co-60	59	f	-0.10	185	f
Cs-137	59	0.23	38*	111	34
Gross alpha	59	0.0014	0.24*	f	f
Gross beta	59	0.14	24*	f	f
Total rad Sr	59	0.0048	0.81*	37	2.2
H-3	59	6.5	1,100*	74,000	1.5
Sewage Treatment Plant (08/27-09/30)					
Co-60	35	f	0.30	185	f
Cs-137	35	f	0.10	111	f
Gross beta	35	0.038	11*	f	f
Total rad Sr	35	0.015	4.2*	37	11
White Oak Creek (08/26-09/30)					
Co-60	390	f	-0.20	185	f
Cs-137	390	0.12	3.0*	111	2.7
Total rad Sr	390	0.094	2.4*	37	6.5
H-3	390	6.3	160*	74,000	0.22
White Oak Dam (08/26-09/30)					
Total rad Sr	510	0.23	4.5*	37	12
H-3	510	130	2,500*	74,000	3.4

Table 11. (continued)

Radionuclide	Flow (10^6 L)	Discharge[b] (10^{10} Bq)	Concentration[c] (Bq/L)	DCG[d] (Bq/L)	Percent DCG[e]
		White Oak Dam[g] *(09/01-10/01)*			
Co-60	430	0.0036	0.084*	185	0.046
Cs-137	430	0.047	1.1*	111	0.98
Gross alpha	430	0.0084	0.20*	f	f
Gross beta	430	0.45	10*	f	f

[a]Locations are shown in Fig. 5.

[b]Discharges are calculated from flow and concentration and are listed when concentrations are significantly greater than zero.

[c]Concentrations significantly greater than zero are identified by an *.

[d]Derived concentration guide for ingestion of water. From DOE Order 5400.5.

[e]Average concentration as a percentage of the DCG, calculated only when a DCG exists and the average concentration is significantly greater than zero.

[f]Not applicable.

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

3.2 REFERENCE SURFACE WATERS

Melinda C. Salmons

3.2.1 Program Description

Locations that sample the natural surface waters are upstream of the various facilities on the ORR. These data can be used to assess water quality prior to the impacts of the ORR. The term "reference" is used instead of "background" because the latter typically implies an environmental medium that is pristine, or unaffected by human activities. The Clinch River is the major surface water system that is affected by the ORR. This river integrates many human activities upstream of the reservation. The net impact of the ORR can be evaluated by comparing the reference data to information from samples collected downstream of the facilities. Monthly surface water samples are collected at two sampling locations for the purpose of determining contamination levels before the influence of ORNL. One sampling location is Melton Hill Dam above ORNL's discharge point into the Clinch River (Fig. 5). The other sampling location is WOC headwaters above the point where ORNL discharges to White Oak Creek (Fig. 5).

Analyses were performed to detect classical, inorganic, and organic pollutants in the water. Classical pollutants are indicated by conductivity, temperature, turbidity, pH, total dissolved solids, total suspended solids, and oil and grease (O&G). Inorganic parameters are indicated by metal and anion analysis. The presence of organic pollutants is indicated by results from total organic carbon (TOC) analysis. If the TOC result is greater than 5 mg/L, analyses for volatile and semivolatile organic compounds will be conducted. Water samples analyzed for inorganics, O&G, and total dissolved solids were collected flow-proportionally at each location. All other samples are grab samples taken once per month.

In addition, samples are collected and analyzed for radionuclides. Results are reported in Section 3.1.

3.2.2 Results

The results for the inorganic, organic, and classical pollutants are found in Table 12. There were no high levels of organic compounds detected by the TOC analysis at either location, as indicated by the average value of 2.2 mg/L at Melton Hill Dam and by the average value of 0.95 mg/L at WOC headwaters.

Inorganic analytical results can show a wide range of detection limits. This results from a dilution that must be made to some of the water samples. When a given sample contains an element in a concentration that is higher than the inductively coupled plasma (ICP) equipment can accurately measure, this compound can cause a spectral interference with other elements. The sample must then be diluted to bring the interfering element into a range that the equipment can accurately measure. The resulting analytical values from the ICP process must be adjusted by the dilution factor. This dilution factor must also be applied to the detection limit value for each element.

Table 12. Surface water analyses at reference locations, July-September 1992

Analyte	N det/ N total	Concentration (mg/L) Max	Min	Av[a]	Standard Error[b]
		Melton Hill Dam[c]			
Anions					
Fluoride	0/3	< 0.10	< 0.10	~ 0.10	0
Nitrate (as N)	0/3	< 1.0	< 1.0	~ 1.0	0
Sulfate (as SO_4)	3/3	100	21	47	26
Field Measurements					
Conductivity (mS/cm)	3/3	1.4	0.19	0.93	0.37
Dissolved oxygen (ppm)	3/3	12	8.1	9.5*	1.1
Temperature (°C)	3/3	21	14	18*	2.1
Turbidity (NTU)	3/3	36	21	29*	4.3
pH (SU)	3/3	8.2	7.6	7.9*	0.18
Metals					
Aluminum, total	3/3	2.5	0.44	1.3	0.63
Antimony, total	0/3	< 0.050	< 0.050	~ 0.050	0
Arsenic, total	0/3	< 0.010	< 0.010	~ 0.010	0
Barium, total	3/3	0.080	0.035	0.052*	0.014
Beryllium, total	0/3	< 0.0010	< 0.0010	~ 0.0010	0
Boron, total	0/3	< 0.080	< 0.080	~ 0.080	0
Cadmium, total	0/3	< 0.0050	< 0.0050	~ 0.0050	0
Calcium, total	3/3	37	35	36*	0.67
Chromium, total	3/3	0.014	0.0062	0.010*	0.0023
Cobalt, total	0/3	< 0.0040	< 0.0040	~ 0.0040	0
Copper, total	1/3	0.026	< 0.0070	~ 0.013	0.0063
Iron, total	3/3	4.2	0.26	1.7	1.2
Lead, total	0/3	< 0.050	< 0.050	~ 0.050	0
Lithium, total	0/3	< 15	< 15	~ 15	0
Magnesium, total	3/3	9.9	9.6	9.8*	0.088
Manganese, total	3/3	2.0	0.12	0.78	0.61
Molybdenum, total	0/3	< 0.040	< 0.040	~ 0.040	0
Nickel, total	2/3	0.012	< 0.0040	~ 0.0072*	0.0024
Phosphorus, total	0/3	< 0.30	< 0.30	~ 0.30	0
Selenium, total	0/3	< 0.0050	< 0.0050	~ 0.0050	0
Silicon, total	3/3	5.8	4.0	5.1*	0.57
Silver, total	0/3	< 0.0050	< 0.0050	~ 0.0050	0
Sodium, total	0/3	< 5.0	< 5.0	~ 5.0	0
Strontium, total	3/3	0.094	0.090	0.092*	0.0012

Table 12. (continued)

Analyte	N det/ N total	Concentration (mg/L) Max	Min	Av[a]	Standard Error[b]
Metals					
Tin, total	0/3	< 0.050	< 0.050	~ 0.050	0
Titanium, total	2/3	0.035	< 0.020	~ 0.028*	0.0043
Vanadium, total	3/3	0.0066	0.0022	0.0038	0.0014
Zinc, total	2/3	0.031	< 0.0050	~ 0.015	0.0080
Zirconium, total	0/3	< 0.020	< 0.020	~ 0.020	0
Others					
Oil and grease	2/3	6.0	< 2.0	~ 3.7*	1.2
Total dissolved solids	3/3	170	160	170*	2.7
Total organic carbon	3/3	2.4	2.0	2.2*	0.12
Total suspended solids	2/3	66	< 5.0	~ 33	18
		White Oak Creek Headwaters[c]			
Anions					
Fluoride	0/3	< 0.10	< 0.10	~ 0.10	0
Nitrate (as N)	0/3	< 1.0	< 1.0	~ 1.0	0
Sulfate (as SO_4)	3/3	3.1	1.9	2.3*	0.38
Field Measurements					
Conductivity (mS/cm)	3/3	1.5	0.060	0.82	0.42
Dissolved oxygen (ppm)	3/3	11	8.5	9.6*	0.85
Temperature (°C)	3/3	18	17	17*	0.27
Turbidity (NTU)	3/3	21	19	20*	0.70
pH (SU)	3/3	7.9	7.6	7.7*	0.088
Metals					
Aluminum, total	3/3	0.96	0.14	0.43	0.27
Antimony, total	0/3	< 0.050	< 0.050	~ 0.050	0
Arsenic, total	0/3	< 0.010	< 0.010	~ 0.010	0
Barium, total	3/3	0.096	0.062	0.084*	0.011
Beryllium, total	0/3	< 0.0010	< 0.0010	~ 0.0010	0
Boron, total	0/3	< 0.080	< 0.080	~ 0.080	0
Cadmium, total	0/3	< 0.0050	< 0.0050	~ 0.0050	0
Calcium, total	3/3	31	22	28*	3.0
Chromium, total	3/3	0.015	0.0066	0.012*	0.0026
Cobalt, total	0/3	< 0.0040	< 0.0040	~ 0.0040	0
Copper, total	0/3	< 0.0070	< 0.0070	~ 0.0070	0
Iron, total	3/3	0.47	0.18	0.29*	0.090

Table 12. (continued)

Analyte	N det/ N total	Concentration (mg/L) Max	Min	Av[a]	Standard Error[b]
Metals					
Lead, total	0/3	< 0.050	< 0.050	~ 0.050	0
Lithium, total	0/3	< 15	< 15	~ 15	0
Magnesium, total	3/3	15	9.5	13*	1.8
Manganese, total	2/3	0.030	< 0.010	~ 0.017	0.0067
Molybdenum, total	0/3	< 0.040	< 0.040	~ 0.040	0
Nickel, total	1/3	0.0052	< 0.0040	~ 0.0044*	0.00040
Phosphorus, total	0/3	< 0.30	< 0.30	~ 0.30	0
Selenium, total	0/3	< 0.0050	< 0.0050	~ 0.0050	0
Silicon, total	3/3	9.8	3.8	5.9*	2.0
Silver, total	0/3	< 0.0050	< 0.0050	~ 0.0050	0
Sodium, total	0/3	< 5.0	< 5.0	~ 5.0	0
Strontium, total	3/3	0.035	0.026	0.032*	0.0028
Tin, total	0/3	< 0.050	< 0.050	~ 0.050	0
Titanium, total	0/3	< 0.020	< 0.020	~ 0.020	0
Vanadium, total	1/3	0.0021	< 0.0020	~ 0.0020*	0.000033
Zinc, total	1/3	0.011	< 0.0050	~ 0.0070*	0.0020
Zirconium, total	0/3	< 0.020	< 0.020	~ 0.020	0
Others					
Oil and grease	2/3	8.0	< 2.0	~ 4.7	1.8
Total dissolved solids	3/3	170	120	150*	16
Total organic carbon	3/3	1.0	0.90	0.95*	0.047
Total suspended solids	1/3	14	< 5.0	~ 8.0	3.0

[a]Average concentrations significantly greater than zero are identified by an *.

[b]Standard error of the mean.

[c]See Fig. 5.

3.3 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM REQUIREMENTS

Pamela Y. Goldberg and Charles K. Valentine, Jr.

3.3.1 Program Description and Results

ORNL's current NPDES permit requires that point-source outfalls be sampled prior to their discharge into receiving waters or before mixing with any other wastewater stream. There are ambient sampling points that are located in the streams as reference points or for additional information.

Quarterly summary statistics for the third quarter of 1992 are given for each sampling location in Tables 13 through 21.

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 Report and are available upon request. Noncompliances are provided in Table 22.

3.3.2 Noncompliances

3.3.2.1 July 1992

3.3.2.1.1 Inappropriate and/or Unpermitted Discharges

On July 7, 1992, contract construction personnel dewatered an excavation in the ORNL 7500 area without proper sediment-control measures in place, which resulted in muddy water being pumped into a Melton Branch tributary. Work at the construction site was halted and proper sediment controls were put in place. No further incidents were sited.

On July 22, 1992, an ORNL underground potable water pipe was damaged when a piece of heavy equipment was driven over soft ground near Building 3114, which resulted in potable (chlorinated) water flowing into the storm drain system. This drain system discharges into Fifth Creek within the ORNL Bethel Valley complex. The pipe was shut off and repaired. No impacts on aquatic species were noted.

3.3.2.1.2 Exceedences of NPDES Permit Limits

No exceedences.

3.3.2.2 August 1992

3.3.2.2.1 Inappropriate and/or Unpermitted Discharges

On August 11, 1992, a small-volume steam condensate discharge into First Creek was noted near the footbridge west of the West Portal of the ORNL main plant complex. The discharge was conveyed into First Creek via a 1-inch diameter steel drain pipe. ORNL Utilities personnel rerouted the steam condensate pipe.

Table 13. NPDES discharge point X01,[a] July-September 1992

Analyte	N det/ N total	Concentration (mg/L) Max	Min	Av[b]	Standard error[c]
Field Measurements					
Chlorine, total residual	39/39	0.43	0.050	0.17*	0.014
Dissolved oxygen (ppm)	63/63	13	6.2	9.3*	0.16
Downstream pH (SU)	13/13	8.3	7.6	d	d
Flow (Mgd)	63/63	0.39	0.19	0.27*	0.0049
pH (SU)	13/13	7.9	7.5	d	d
Temperature (°C)	76/76	28	21	25*	0.15
Metals					
Copper, total	0/3	< 0.0070	< 0.0070	~ 0.0070	0
Mercury, total	1/3	0.00021	< 0.000050	~ 0.00010	0.000053
Silver, total	0/3	< 0.0050	< 0.0050	~ 0.0050	0
Zinc, total	2/3	0.042	< 0.020	~ 0.028*	0.0069
Others					
Ammonia (as N)	39/39	0.23	0.020	0.064*	0.0072
Biochemical oxygen demand	2/39	8.0	< 5.0	~ 5.1*	0.080
Cyanide, total	0/3	< 0.0020	< 0.0020	~ 0.0020	0
Fecal Coliform (col/100 mL)[e]	12/39	44	< 1.0	~ 3.2*	1.3
Oil and grease	17/39	9.0	< 2.0	~ 2.8*	0.27
Phenolics, total recoverable	0/3	< 0.0010	< 0.0010	~ 0.0010	0
Total suspended solids	3/39	44	< 5.0	~ 6.7*	1.1
Volatile Organics					
Bromodichloromethane	0/3	U 0.0050	U 0.0050	~ 0.0050	0
Trichloroethene	0/3	U 0.0050	U 0.0050	~ 0.0050	0

[a]See Fig. 5.
[b]Average concentrations significantly greater than zero are identified by an *.
[c]Standard error of the mean.
[d]Not applicable.
[e]The geometric mean is computed rather than the average.

Table 14. NPDES discharge point X02,[a] July-September 1992

Analyte	N det/ N total	Concentration (mg/L) Max	Min	Av[b]	Standard error[c]
Anions					
Sulfate (as SO_4)	3/3	2,100	1,900	2,000*	54
Field Measurements					
Downstream pH (SU)	63/63	8.4	7.5	d	d
Flow (Mgd)	63/63	0.045	0	0.0087*	0.0014
pH (SU)	63/63	8.8	7.0	d	d
Temperature (°C)	63/63	30	18	25*	0.27
Metals					
Arsenic, total	5/10	0.16	< 0.050	~ 0.081*	0.014
Cadmium, total	0/10	< 0.0050	< 0.0050	~ 0.0050	0
Chromium, total	8/10	0.026	< 0.0040	~ 0.018*	0.0025
Copper, total	0/10	< 0.0070	< 0.0070	~ 0.0070	0
Iron, total	10/10	0.28	0.079	0.15*	0.023
Lead, total	0/10	< 0.050	< 0.050	~ 0.050	0
Manganese, total	10/10	0.19	0.021	0.077*	0.015
Nickel, total	4/10	0.016	< 0.0040	~ 0.0075*	0.0013
Selenium, total	10/10	0.20	0.099	0.15*	0.011
Silver, total	4/10	0.0070	< 0.0050	~ 0.0055*	0.00022
Zinc, total	7/10	0.023	< 0.0050	~ 0.011*	0.0022
Others					
Oil and grease	5/10	43	< 2.0	~ 6.4	4.1
Total suspended solids	7/10	19	< 5.0	~ 8.8*	1.7

[a]See Fig. 5.
[b]Average concentrations significantly greater than zero are identified by an *.
[c]Standard error of the mean.
[d]Not applicable.

Table 15. NPDES discharge point X12,[a] July-September 1992

Analyte	N det/ N total	Concentration (mg/L) Max	Min	Av[b]	Standard error[c]
Anions					
Fluoride	12/13	1.5	< 0.10	~ 1.1*	0.11
Nitrate (as N)	13/13	6.5	1.4	3.0*	0.49
Sulfate (as SO_4)	13/13	270	120	180*	11
Field Measurements					
Downstream pH (SU)	63/63	8.8	7.1	d	d
Flow (Mgd)	63/63	0.63	0.36	0.47*	0.0067
pH (SU)	[e]	8.2	7.2	d	d
Temperature (°C)	63/63	26	20	24*	0.18
Metals					
Arsenic, total	1/13	0.073	< 0.0	~ 0.052*	0.0018
Cadmium, total	0/13	< 0.0050	< 0.0050	~ 0.0050	0
Chromium, total	8/13	0.010	< 0.0040	~ 0.0062*	0.00057
Copper, total	9/13	0.056	< 0.0070	~ 0.013*	0.0037
Iron, total	0/13	< 0.050	< 0.050	~ 0.050	0
Lead, total	0/13	< 0.050	< 0.050	~ 0.050	0
Mercury, total	3/13	0.00014	0.000030	~ 0.000058*	0.0000077
Nickel, total	5/13	0.090	< 0.0040	~ 0.014*	0.0064
Phosphorus, total	7/13	0.30	< 0.20	~ 0.21*	0.0077
Selenium, total	0/13	< 0.050	< 0.050	~ 0.050	0
Silver, total	0/13	< 0.0050	< 0.0050	~ 0.0050	0
Zinc, total	13/13	0.35	0.011	0.056*	0.025
Others					
Biochemical oxygen demand	1/13	6.0	< 5.0	~ 5.1*	0.077
Cyanide, total	0/13	< 0.0020	< 0.0020	~ 0.0020	0
Oil and grease	4/13	8.0	< 2.0	~ 2.8*	0.48
Phenolics, total recoverable	0/13	< 0.0010	< 0.0010	~ 0.0010	0
Total suspended solids	0/13	< 5.0	< 5.0	~ 5.0	0
Total toxic organics	0/13	< 0.010	< 0.010	~ 0.010	0

Table 15. (continued)

Analyte	N det/ N total	Concentration (mg/L) Max	Min	Av[b]	Standard error[c]
Volatile Organics					
1,1-Dichloroethane	0/13	U 0.0050	U 0.0050	~ 0.0050	0
Benzene	0/13	U 0.0050	U 0.0050	~ 0.0050	0
Bromodichloromethane	0/13	U 0.0050	U 0.0050	~ 0.0050	0
Chlorobenzene	0/13	U 0.0050	U 0.0050	~ 0.0050	0
Chloroform	0/13	U 0.0050	U 0.0050	~ 0.0050	0
Methylene chloride	0/13	U 0.0050	U 0.0050	~ 0.0050	0
Tetrachloroethene	0/13	U 0.0050	U 0.0050	~ 0.0050	0
Trichloroethene	0/13	U 0.0050	U 0.0050	~ 0.0050	0

[a]See Fig. 5.
[b]Average concentrations significantly greater than zero are identified by an *.
[c]Standard error of the mean.
[d]Not applicable.
[e]pH monitoring is continuous.

Table 16. NPDES discharge point X13,[a] July-September 1992

Analyte	N det/ N total	Concentration (mg/L) Max	Min	Av[b]	Standard error[c]
Anions					
Fluoride	3/3	3.1	1.0	1.7	0.70
Nitrate (as N)	2/3	1.3	0.40	~ 0.90*	0.26
Sulfate (as SO_4)	3/3	300	32	140	84
Field Measurements					
Chlorine, total residual	1/13	0.080	< 0.010	~ 0.015*	0.0054
Conductivity (mS/cm)	3/3	1.5	0.27	0.83	0.36
Dissolved oxygen (ppm)	13/13	14	7.4	9.5*	0.50
Flow (Mgd)	63/63	9.8	0.060	1.0*	0.16
pH (SU)	3/3	8.3	7.1	d	d
Temperature (°C)	16/16	24	18	22*	0.40
Turbidity (NTU)	3/3	27	10	16	5.7
Metals					
Aluminum, total	3/3	1.7	0.16	0.73	0.49
Arsenic, total	0/3	< 0.050	< 0.050	~ 0.050	0
Cadmium, total	0/3	< 0.0020	< 0.0020	~ 0.0020	0
Chromium, total	3/3	0.020	0.0076	0.013*	0.0037
Copper, total	1/3	0.023	< 0.0070	~ 0.012	0.0053
Iron, total	3/3	1.5	0.40	0.79	0.36
Lead, total	0/3	< 0.040	< 0.0040	~ 0.016	0.012
Mercury, total	0/3	< 0.000050	< 0.000050	~ 0.000050	0
Manganese, total	3/3	0.19	0.10	0.15*	0.026
Nickel, total	1/3	< 0.010	< 0.0040	~ 0.0073*	0.0018
Phosphorus, total	3/3	1.1	0.30	0.59	0.24
Silver, total	0/3	< 0.0050	< 0.0050	~ 0.0050	0
Zinc, total	3/3	0.13	0.012	0.066	0.034
Others					
Ammonia (as N)	3/3	0.070	0.040	0.050*	0.010
Biochemical oxygen demand	0/3	< 5.0	< 5.0	~ 5.0	0
Oil and grease	4/13	7.0	< 2.0	~ 2.5*	0.39
Phenolics, total recoverable	0/3	< 0.0010	< 0.0010	~ 0.0010	0
Total dissolved solids	3/3	680	210	420*	140
Total organic carbon	3/3	2.9	2.7	2.8*	0.067
Total suspended solids	3/3	14	6.0	9.3*	2.4

Table 16. (continued)

Analyte	N det/ N total	Concentration (mg/L) Max	Min	Av[b]	Standard error[c]
PCBs					
PCB, total	0/3	U 0.0010	U 0.0010	~ 0.0010	0
Volatile Organics					
Chloroform	1/3	U 0.0050	J 0.0020	~ 0.0040*	0.0010
Trichloroethene	1/3	U 0.0050	J 0.0020	~ 0.0040*	0.0010

[a]See Fig. 5.
[b]Average concentrations significantly greater than zero are identified by an *.
[c]Standard error of the mean.
[d]Not applicable.

Table 17. NPDES discharge point X14,[a] July-September 1992

Analyte	N det/ N total	Concentration (mg/L) Max	Min	Av[b]	Standard error[c]
Anions					
Fluoride	3/3	1.2	1.0	1.1*	0.058
Nitrate (as N)	3/3	1.8	1.5	1.6*	0.088
Sulfate (as SO_4)	3/3	47	39	43*	2.3
Field Measurements					
Chlorine, total residual	1/13	0.060	< 0.010	~ 0.014*	0.0038
Conductivity (mS/cm)	3/3	1.8	0.090	0.72	0.54
Dissolved oxygen (ppm)	13/13	12	7.7	9.6*	0.36
Flow (Mgd)	63/63	12	2.1	3.7*	0.26
pH (SU)	3/3	8.6	7.3	d	d
Temperature (°C)	16/16	25	20	23*	0.36
Turbidity (NTU)	3/3	32	5.0	14	8.7
Metals					
Aluminum, total	3/3	0.29	0.15	0.20*	0.045
Arsenic, total	0/3	< 0.050	< 0.050	~ 0.050	0
Cadmium, total	0/3	< 0.0020	< 0.0020	~ 0.0020	0
Chromium, total	3/3	0.0093	0.0067	0.0081*	0.00076
Copper, total	0/3	< 0.0070	< 0.0070	~ 0.0070	0
Iron, total	3/3	0.50	0.097	0.23	0.13
Lead, total	0/3	< 0.020	< 0.0040	~ 0.0093	0.0053
Mercury, total	0/3	< 0.000050	< 0.000050	~ 0.000050	0
Manganese, total	3/3	0.15	0.016	0.061	0.044
Nickel, total	0/3	< 0.010	< 0.0040	~ 0.0060*	0.0020
Phosphorus, total	2/3	0.70	< 0.20	~ 0.44*	0.14
Silver, total	0/3	< 0.0050	< 0.0050	~ 0.0050	0
Zinc, total	2/3	0.043	< 0.0050	~ 0.027	0.011
Others					
Ammonia (as N)	3/3	0.050	0.040	0.043*	0.0033
Biochemical oxygen demand	1/3	5.0	< 5.0	~ 5.0*	0
Oil and grease	3/13	3.0	< 2.0	~ 2.1*	0.077
Phenolics, total recoverable	0/3	< 0.0010	< 0.0010	~ 0.0010	0
Total dissolved solids	3/3	240	220	230*	5.8
Total organic carbon	3/3	2.0	1.6	1.8*	0.12
Total suspended solids	1/3	5.0	< 5.0	~ 5.0*	0

Table 17. (continued)

Analyte	N det/ N total	Concentration (mg/L) Max	Min	Av[b]	Standard error[c]
PCBs					
PCB, total	0/3	U 0.0010	U 0.0010	~ 0.0010	0
Volatile Organics					
Chloroform	3/3	J 0.0020	J 0.0010	~ 0.0017*	0.00033
Trichloroethene	0/3	U 0.0050	U 0.0050	~ 0.0050	0

[a]See Fig. 5.
[b]Average concentrations significantly greater than zero are identified by an *.
[c]Standard error of the mean.
[d]Not applicable.

Table 18. NPDES discharge point X15,[a] July-September 1992

Analyte	N det/ N total	Concentration (mg/L) Max	Min	Av[b]	Standard error[c]
Anions					
Fluoride	3/3	1.1	0.60	0.93*	0.17
Nitrate (as N)	2/3	< 1.0	0.30	~ 0.53	0.23
Sulfate (as SO_4)	3/3	60	40	52*	6.1
Field Measurements					
Chlorine, total residual	1/13	0.080	< 0.010	~ 0.015*	0.0054
Conductivity (mS/cm)	3/3	2.0	0.12	0.88	0.57
Dissolved oxygen (ppm)	13/13	12	6.4	9.5*	0.46
Flow (Mgd)	63/63	20	2.8	5.9*	0.40
pH (SU)	3/3	8.2	7.4	d	d
Temperature (°C)	16/16	28	21	24*	0.58
Turbidity (NTU)	3/3	14	7.0	9.7*	2.2
Metals					
Aluminum, total	3/3	1.1	0.23	0.58	0.26
Silver, total	0/3	< 0.0050	< 0.0050	~ 0.0050	0
Arsenic, total	0/3	< 0.010	< 0.010	~ 0.010	0
Cadmium, total	0/3	< 0.0020	< 0.0020	~ 0.0020	0
Chromium, total	3/3	0.026	0.0093	0.017*	0.0048
Copper, total	1/3	0.0083	< 0.0070	~ 0.0074*	0.00043
Iron, total	3/3	1.2	0.37	0.71	0.25
Mercury, total	1/3	0.00025	< 0.000050	~ 0.00012	0.000067
Manganese, total	3/3	0.16	0.12	0.14*	0.012
Nickel, total	1/3	< 0.010	< 0.0040	~ 0.0065*	0.0018
Lead, total	0/3	< 0.0040	< 0.0040	~ 0.0040	0
Phosphorus, total	2/3	0.25	< 0.20	~ 0.22*	0.017
Zinc, total	2/3	0.052	< 0.0050	~ 0.025	0.014
Others					
Ammonia (as N)	3/3	0.17	0.13	0.14*	0.013
Biochemical oxygen demand	0/3	< 5.0	< 5.0	~ 5.0	0
Oil and grease	8/13	17	< 2.0	~ 4.6*	1.3
Total dissolved solids	3/3	240	220	230*	7.0
Total organic carbon	3/3	3.6	2.4	2.9*	0.36
Total suspended solids	2/3	16	< 5.0	~ 9.3	3.4

Table 18. (continued)

Analyte	N det/ N total	Concentration (mg/L) Max	Min	Av[b]	Standard error[c]
PCBs					
PCB, total	0/3	U 0.0010	U 0.0010	~ 0.0010	0
Volatile Organics					
Chloroform	0/3	U 0.0050	U 0.0050	~ 0.0050	0
Trichloroethene	0/3	U 0.0050	U 0.0050	~ 0.0050	0

[a]See Fig. 5.
[b]Average concentrations significantly greater than zero are identified by an *.
[c]Standard error of the mean.
[d]Not applicable.

Table 19. NPDES category II outfalls,[a] July-September 1992

Analyte	N det/ N total	Concentration (mg/L) Max	Min	Av[b]	Standard error[c]
Field Measurements					
Dissolved oxygen (ppm)	1/1	10	10	10	d
Downstream pH (SU)	41/41	8.1	7.2	d	d
Downstream Temperature (°C)	41/41	26	21	22*	0.16
Flow (Mgd)	40/40	0.13	0.00072	0.023*	0.0045
pH (SU)	41/41	8.3	7.0	d	d
Temperature (°C)	41/41	32	20	23*	0.37
Others					
Oil and grease	18/40	32	< 2.0	~ 5.4*	1.1
Total suspended solids	22/40	320	< 5.0	~ 28*	10
Radionuclides (Bq/L)					
Gross beta	40/40	5.0	-0.040	0.42*	0.12

[a]See Fig. 5.
[b]Average concentrations significantly greater than zero are identified by an *.
[c]Standard error of the mean.
[d]Not applicable.

Table 20. NPDES category III outfalls,[a] July-September 1992

Analyte	N det/ N total	Concentration (mg/L) Max	Min	Av[b]	Standard error[c]
Field Measurements					
Dissolved oxygen (ppm)	1/1	9.4	9.4	9.4	d
Downstream pH (SU)	1/1	7.4	7.4	d	d
Flow (Mgd)	17/17	0.15	0.00014	0.018*	0.0094
pH (SU)	18/18	8.9	7.4	d	d
Temperature (°C)	18/18	31	21	25*	0.65

[a]See Fig. 5.
[b]Average concentrations significantly greater than zero are identified by an *.
[c]Standard error of the mean.
[d]Not applicable.

Table 21. NPDES cooling towers,[a] July-September 1992

Analyte	N det/ N total	Concentration (mg/L) Max	Min	Av[b]	Standard error[c]
Field Measurements					
Chlorine, total residual	15/15	0.17	0.020	0.070*	0.011
Downstream pH (SU)	15/15	8.7	7.6	d	d
Flow (Mgd)	15/15	0.19	0.0010	0.030*	0.016
pH (SU)	15/15	9.0	7.5	d	d
Temperature (°C)	15/15	34	23	27*	0.81
Metals					
Chromium, total	14/15	0.035	< 0.0040	~ 0.016*	0.0020
Copper, total	15/15	0.25	0.013	0.095*	0.017
Zinc, total	15/15	0.37	0.024	0.15*	0.028

[a]See Fig. 5.
[b]Average concentrations significantly greater than zero are identified by an *.
[c]Standard error of the mean.
[d]Not applicable.

Table 22. NPDES permit limit noncompliances, July-September 1992

Location	Limit Violated	Date	mg/L Permit Limit	mg/L Value
STP	Total suspended solids	26AUG92	39.2[a]	42.1[a]
Category II				
Outfall 204	Oil and grease	22SEP92	15	23
	Total suspended solids	22SEP92	50	323
Outfall 206	Total suspended solids	22SEP92	50	171
Outfall 250	Oil and grease	22SEP92	15	32
	Total suspended solids	22SEP92	50	238
Outfall 268	Oil and grease	22SEP92	15	23

[a]kg/day units. Mass-load concentration exceedence.

3.3.2.2.2 Exceedences of NPDES Permit Limits

The total suspended solids (TSS) exceedence that occurred at the ORNL Sewage Treatment Plant (STP) resulted when an operator was called away on an emergency and was unable to provide continuous attention to the sand filters, which resulted in a small amount of partially treated wastewater being carried over into the effluent piping from the clarifier. The wastewater passed into the chlorine chamber where it automatically received chlorination before being discharged to the drainage ditch. The measured concentration multiplied by the total flow for that day to determine compliance with the mass-load limit resulted in a mass-load excursion. STP managerial personnel counseled STP supervisors and operators to minimize the potential for a recurrence.

3.3.2.3 September 1992

3.3.2.3.1 Inappropriate and/or Unpermitted Discharges

On September 9, 1992, a transfer hose at the 7900 area sanitary sewer lift station began leaking and allowed approximately 50 gallons of untreated domestic sewage to flow into a storm drain that discharges into Melton Branch. The leak was stopped and the hose was replaced before operations were resumed.

3.3.2.3.2 Exceedences of NPDES Permit Limits

The TSS and O&G exceedences that occurred at the Category II outfall 204 and outfall 250 were attributed to storm water runoff from the ORNL main facility complex, which may have been contributed to a nearby construction activity (Federal Facilities Agreement remedial actions). The TSS exceedence that occurred at outfall 206 was attributed to parking lot runoff near Building 3608. The O&G exceedence that occurred at outfall 268 was attributed to storm water runoff from an ORNL employee parking lot and from a public road (Bethel Valley Road).

3.4 MONITORING FOR POLYCHLORINATED BIPHENYLS

Betsy M. Horwedel

3.4.1 Program Description

Monitoring for polychlorinated biphenyls (PCBs) is conducted semiannually under Part V of the ORNL NPDES permit. Before 1992, samples of both water and sediment were collected from streams at and near ORNL and analyzed for specific aroclors (PCB groups). Based on results from analysis of water samples from earlier years, collection of water samples was dropped from the program in 1992. Before 1992, PCBs in the water samples from all sites were below analytical quantitation limits. Under the current Polychlorinated Biphenyl Monitoring Plan, only stream sediment is collected and analyzed for the aroclors.

3.4.2 Results

In July 1992, duplicate samples of sediment were collected at ten locations in streams at and around ORNL. The sampling locations are shown in Figs. 7 and 8.

ORNL-DWG 92M-13529

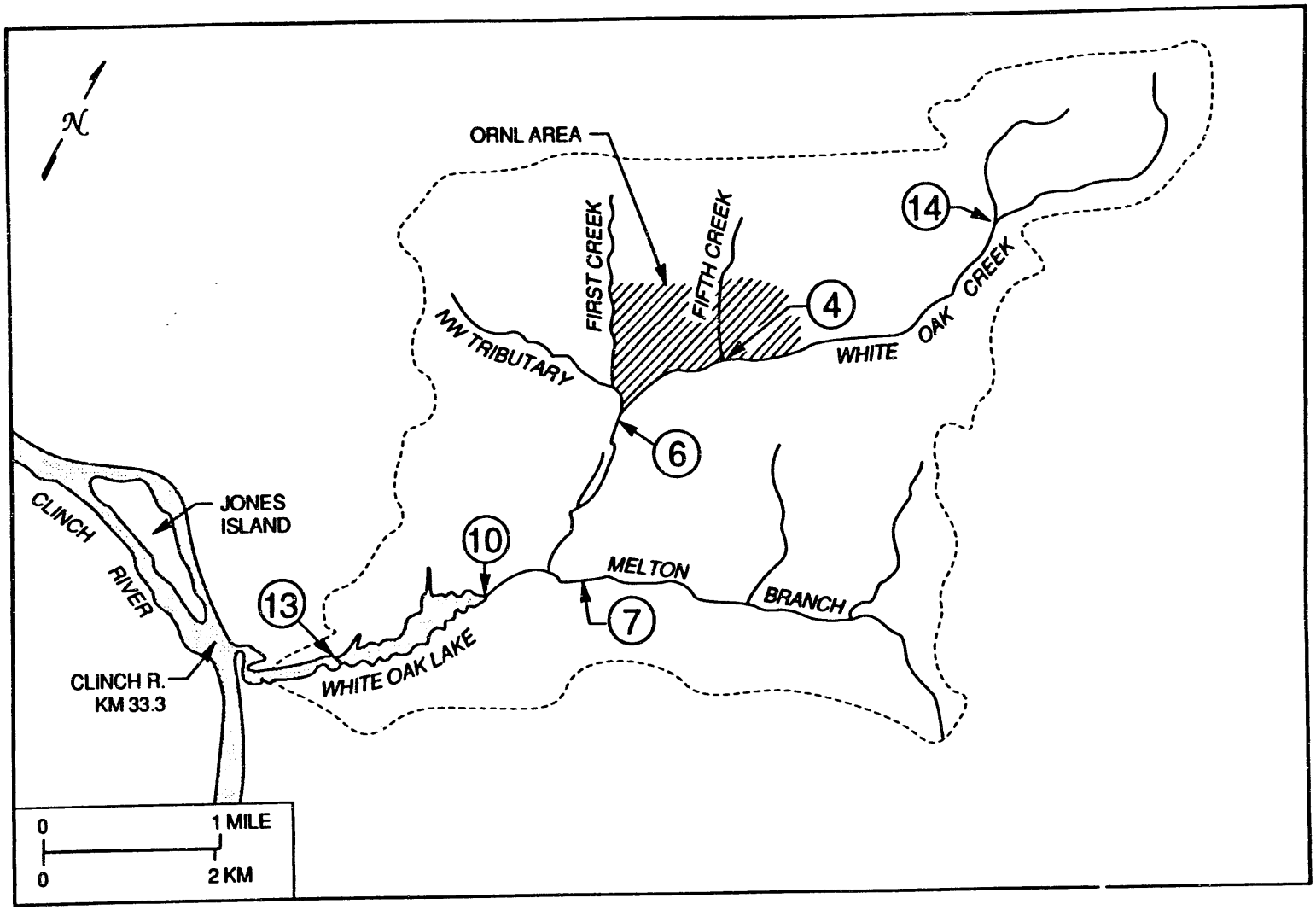

Fig. 7. Sampling locations for PCB monitoring in the ORNL environs.

ORNL-DWG 92M-13530

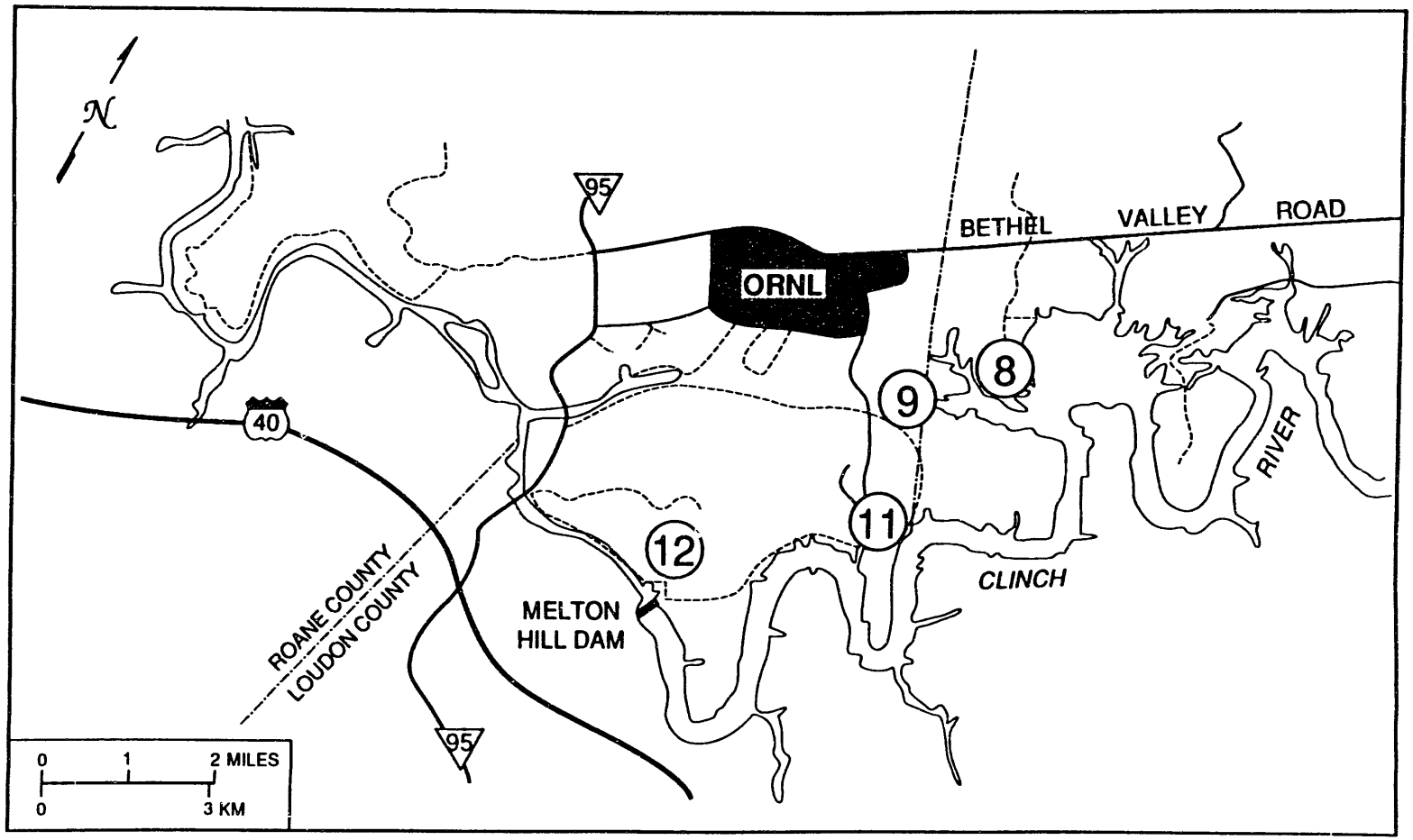

Fig. 8. Sampling locations for PCB monitoring in the greater ORNL area.

The samples from each location were analyzed in the laboratory for aroclors 1016, 1221, 1232, 1242, 1248, 1254, and 1260. Results of the analyses are presented in Table 23. By sampling site, the table lists for each aroclor the number of detected values, the total number of samples, and summary statistics for the measured concentrations. No regulatory standards have been set for PCBs in stream sediment.

Laboratory quantitation limits can vary for individual samples. Only one location had results above detection limits. On WOC, upstream from the weir at the 7500 Road Bridge, a concentration of 1400 ug/kg was reported for aroclor-1254. This location represents the area of maximum sediment deposition and collectively represents all potential releases. Results for all other samples were either below laboratory detection limits or were estimated by the laboratory.

3.5 GROUNDWATER

Regis S. Loffman

Groundwater at ORNL is monitored to comply with 3004(U) of RCRA and DOE Orders 5400.1 and 5400.5. The monitoring also provides data needed for remediation activities. Because of the large number of Solid Waste Management Unit (SWMU) sites at ORNL located close to one another and the proven hydrologic interconnections between many of these units, individual monitoring and assessment was shown to be impractical. Therefore, the concept of waste area groupings (WAGs) has been developed to evaluate potential sources of releases to the environment. A WAG is a group of multiple sites that are geographically contiguous and/or hydrologically defined areas, and each WAG contains small, distinct drainage areas within which similar contaminants may have been introduced. Fig. 9 shows the location of the WAGs.

Groundwater quality monitoring wells at ORNL are designated as up-gradient perimeter or down-gradient perimeter depending on their location relative to the general direction of groundwater flow. Up-gradient wells are located to provide groundwater samples that are not expected to be affected by possible leakage from the site. Down-gradient wells are positioned along the perimeter of the site to detect possible groundwater contaminant migration from the site.

Table 24 contains a listing of all of the analytes sought in groundwater at ORNL during third quarter 1992 and the regulatory limits associated with each. Not all parameters were quantified for each sample; however, Table 24 in conjunction with the sampling plan synopsis provided for each WAG can be used to determine the respective specific analyte lists. Groundwater and its related quality are not regulated like other environmental media (e.g., surface water by NPDES, air by CAA). Consequently, there are no mandated groundwater quality criteria. In an effort to provide a basis for evaluation of analytical results and for assessing groundwater quality at ORNL WAGs, drinking water limits and DOE DCGs have been used for comparisons. It should be emphasized that while drinking water limits are used herein it is unrealistic to assume that members of the public are going to drink groundwater from ORNL WAGs.

Table 23. PCB concentrations in sediment[a], July 1992

Analyte	N det/ N total	Concentration (μg/kg) Max[b]	Min[b]	Av	Standard error[c]
Site 04 - Confluence of Fifth Creek and White Oak Creek					
Aroclor-1016	0/2	U 80	U 80	~ 80	0
Aroclor-1221	0/2	U 80	U 80	~ 80	0
Aroclor-1232	0/2	U 80	U 80	~ 80	0
Aroclor-1242	0/2	U 80	U 80	~ 80	0
Aroclor-1248	0/2	U 80	U 80	~ 80	0
Aroclor-1254	2/2	J 73	J 60	~ 66	6.5
Aroclor-1260	2/2	200	180	190	9.9
Site 06 - Upstream of Weir at 7500 Road Bridge					
Aroclor-1016	0/2	U 80	U 80	~ 80	0
Aroclor-1221	0/2	U 80	U 80	~ 80	0
Aroclor-1232	0/2	U 80	U 80	~ 80	0
Aroclor-1242	0/2	U 80	U 80	~ 80	0
Aroclor-1248	0/2	U 80	U 80	~ 80	0
Aroclor-1254	2/2	830	790	810	18
Aroclor-1260	2/2	1,200	1,200	1,200	15
Site 07 - Upstream of Weir at Melton Branch					
Aroclor-1016	0/2	U 80	U 80	~ 80	0
Aroclor-1221	0/2	U 80	U 80	~ 80	0
Aroclor-1232	0/2	U 80	U 80	~ 80	0
Aroclor-1242	0/2	U 80	U 80	~ 80	0
Aroclor-1248	0/2	U 80	U 80	~ 80	0
Aroclor-1254	0/2	U 160	U 160	~ 160	0
Aroclor-1260	0/2	U 160	U 160	~ 160	0
Site 08 - Melton Hill Lake southeast of 7600					
Aroclor-1016	0/2	U 80	U 80	~ 80	0
Aroclor-1221	0/2	U 80	U 80	~ 80	0
Aroclor-1232	0/2	U 80	U 80	~ 80	0
Aroclor-1242	0/2	U 80	U 80	~ 80	0
Aroclor-1248	0/2	U 80	U 80	~ 80	0
Aroclor-1254	0/2	U 160	U 160	~ 160	0
Aroclor-1260	0/2	U 160	U 160	~ 160	0

Table 23. (continued)

Analyte	N det/ N total	Concentration (μg/kg) Max[b]	Min[b]	Av	Standard error[c]
Site 09 - Melton Hill Lake west of PCB Storage Areas 7652 and 7656					
Aroclor-1016	0/2	U 80	U 80	~ 80	0
Aroclor-1221	0/2	U 80	U 80	~ 80	0
Aroclor-1232	0/2	U 80	U 80	~ 80	0
Aroclor-1242	0/2	U 80	U 80	~ 80	0
Aroclor-1248	0/2	U 80	U 80	~ 80	0
Aroclor-1254	0/2	U 160	U 160	~ 160	0
Aroclor-1260	0/2	U 160	U 160	~ 160	0
Site 10 - White Oak Lake at Mouth of White Oak Creek					
Aroclor-1016	0/2	U 110	U 110	~ 110	1.5
Aroclor-1221	0/2	U 110	U 110	~ 110	1.5
Aroclor-1232	0/2	U 110	U 110	~ 110	1.5
Aroclor-1242	0/2	U 110	U 110	~ 110	1.5
Aroclor-1248	0/2	U 110	U 110	~ 110	1.5
Aroclor-1254	2/2	620	590	600	13
Aroclor-1260	2/2	600	390	500	100
Site 11 - Melton Hill Lake east of 7600 and south of 7709					
Aroclor-1016	0/2	U 80	U 80	~ 80	0
Aroclor-1221	0/2	U 80	U 80	~ 80	0
Aroclor-1232	0/2	U 80	U 80	~ 80	0
Aroclor-1242	0/2	U 80	U 80	~ 80	0
Aroclor-1248	0/2	U 80	U 80	~ 80	0
Aroclor-1254	0/2	U 160	U 160	~ 160	0
Aroclor-1260	0/2	U 160	U 160	~ 160	0
Site 12 - Watts Bar Lake south of 7700, Tower Shielding Facility					
Aroclor-1016	0/2	U 80	U 80	~ 80	0
Aroclor-1221	0/2	U 80	U 80	~ 80	0
Aroclor-1232	0/2	U 80	U 80	~ 80	0
Aroclor-1242	0/2	U 80	U 80	~ 80	0
Aroclor-1248	0/2	U 80	U 80	~ 80	0
Aroclor-1254	0/2	U 160	U 160	~ 160	0
Aroclor-1260	0/2	U 160	U 160	~ 160	0

Table 23. (continued)

Analyte	N det/ N total	Concentration (μg/kg) Max[b]	Min[b]	Av	Standard error[c]
		Site 13 - White Oak Dam			
Aroclor-1016	0/2	U 80	U 80	~ 80	0
Aroclor-1221	0/2	U 80	U 80	~ 80	0
Aroclor-1232	0/2	U 80	U 80	~ 80	0
Aroclor-1242	0/2	U 80	U 80	~ 80	0
Aroclor-1248	0/2	U 80	U 80	~ 80	0
Aroclor-1254	0/2	U 160	U 160	~ 160	0
Aroclor-1260	0/2	U 160	U 160	~ 160	0
		Site 14 - Headwaters of White Oak Creek			
Aroclor-1016	0/2	U 80	U 80	~ 80	0
Aroclor-1221	0/2	U 80	U 80	~ 80	0
Aroclor-1232	0/2	U 80	U 80	~ 80	0
Aroclor-1242	0/2	U 80	U 80	~ 80	0
Aroclor-1248	0/2	U 80	U 80	~ 80	0
Aroclor-1254	0/2	U 160	U 160	~ 160	0
Aroclor-1260	0/2	U 160	U 160	~ 160	0

[a]See Figs. 7 and 8.
[b]Prefixes containing J or U mean that the value was estimated or was not detected at that level, respectively.
[c]Standard error of the mean.

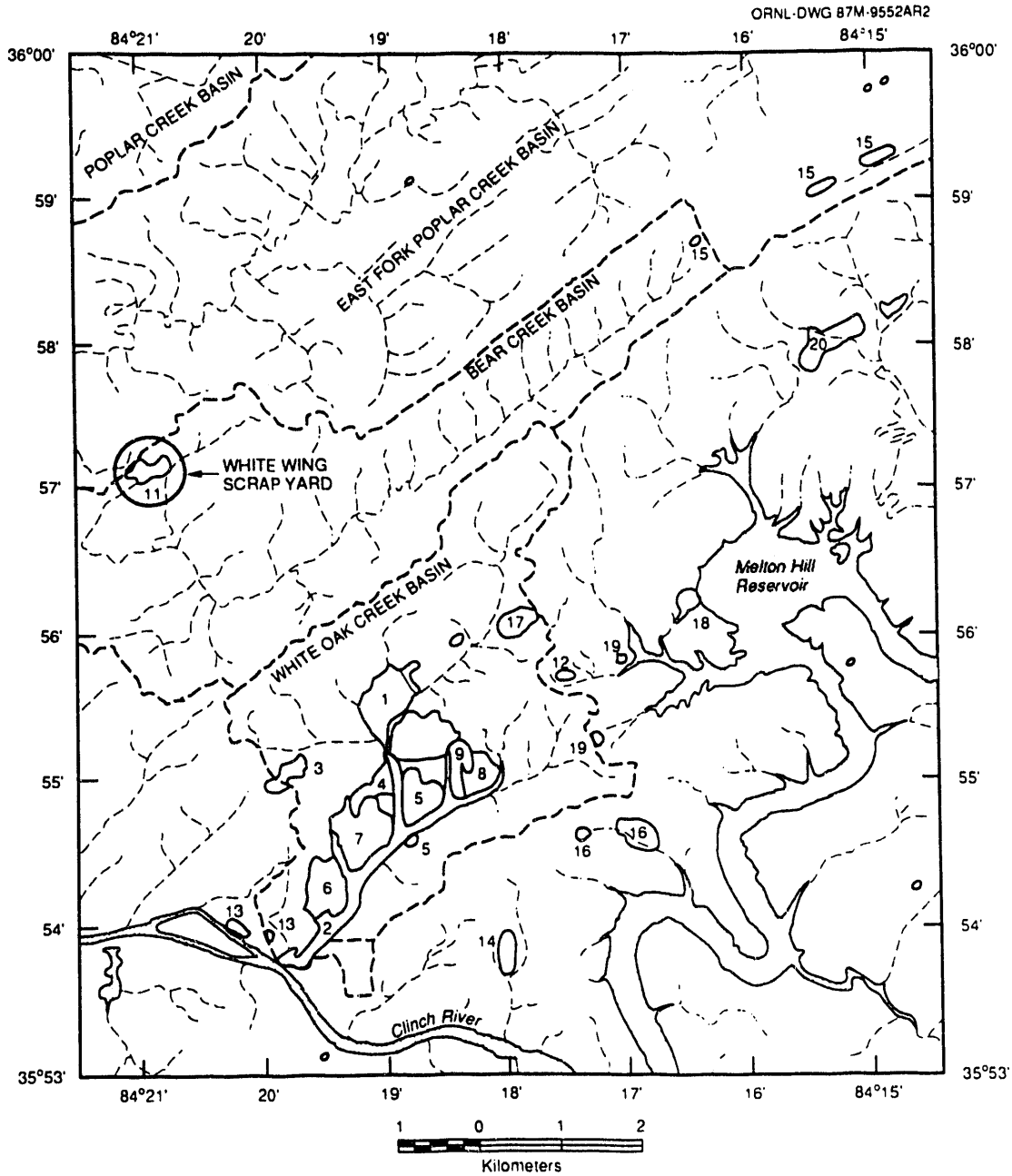

Fig. 9. ORNL WAGs.

Table 24. Analytes sought and applicable standards in groundwater at ORNL in WAGs 2, 3, and 6 during July-September 1992

Analyte	National Primary Drinking Water	National Secondary Drinking Water	Tennessee Primary Drinking Water	DOE DCG
Anions (mg/L)				
Bromide				
Chloride		250		
Fluoride	4.0	2.0		
Nitrate	10			
Phosphate				
Sulfate (as SO_4)		250		
Base/Neutral/Acid Extractable Organics[a] (µg/L)				
1,2,4-Trichlorobenzene				
1,2-Dichlorobenzene	600			
1,3-Dichlorobenzene				
1,4-Dichlorobenzene	75	5.0	75	
2,4,5-Trichlorophenol				
2,4,6-Trichlorophenol				
2,4-Dichlorophenol				
2,4-Dimethylphenol				
2,4-Dinitrophenol				
2,4-Dinitrotoluene				
2,6-Dinitrotoluene				
2-Chloronaphthalene				
2-Chlorophenol				
2-Methylnaphthalene				
2-Methylphenol				
2-Nitroaniline				
2-Nitrophenol				
3,3'-Dichlorobenzidine				
3-Nitroaniline				
4,6-Dinitro-2-methylphenol				
4-Bromophenylphenyl ether				
4-Chloro-3-methylphenol				
4-Chloroaniline				
4-Chlorophenylphenyl ether				
4-Methylphenol				
4-Nitroaniline				
4-Nitrophenol				
Acenaphthene				
Acenaphthylene				

Table 24. (continued)

Analyte	National Primary Drinking Water	National Secondary Drinking Water	Tennessee Primary Drinking Water	DOE DCG
Anthracene				
Benzo(a)anthracene				
Benzo(a)pyrene				
Benzo(b)fluoranthene				
Benzo(ghi)perylene				
Benzo(k)fluoranthene				
Benzoic acid				
Benzyl alcohol				
Benzyl butyl phthalate				
Bis(2-chloroethoxy) methane				
Bis(2-chloroethyl) ether				
Bis(2-chloroisopropyl) ether				
Bis(2-ethylhexyl) phthalate				
Chrysene				
Di-n-butylphthalate				
Di-n-octylphthalate				
Dibenzo(a,h)anthracene				
Dibenzofuran				
Diethyl phthalate				
Dimethyl phthalate				
Fluoranthene				
Fluorene				
Hexachlorobenzene				
Hexachlorobutadiene				
Hexachlorocyclopentadiene				
Hexachloroethane				
Indeno(1,2,3-cd)pyrene				
Isophorone				
N-Nitrosodi-n-propylamine				
N-Nitrosodiphenylamine				
Naphthalene				
Nitrobenzene				
Pentachlorophenol	1.0			
Phenanthrene				
Phenol				
Pyrene				
Field Measurements				
Conductivity (mS/cm)				
Dissolved oxygen (ppm)				
Redox (mV)				

Table 24. (continued)

Analyte	National Primary Drinking Water	National Secondary Drinking Water	Tennessee Primary Drinking Water	DOE DCG
Temperature (°C)			30.5	
Turbidity (JTU)	1.0			
pH (SU)	(6.5, 8.5)	(6.5, 8.5)	(6.0, 9.0)	
Metals (mg/L)				
Aluminum		0.20		
Antimony				
Arsenic	0.050		0.050	
Barium	2.0			
Beryllium				
Boron				
Cadmium	0.0050		0.010	
Calcium				
Chromium	0.10		0.050	
Cobalt				
Copper	1.3	1.0		
Iron		0.30		
Lead	0.015		0.050	
Lithium				
Magnesium				
Manganese		0.050		
Mercury	0.0020		0.0020	
Molybdenum				
Nickel				
Phosphorus				
Potassium				
Selenium	0.050		0.010	
Silicon				
Silver		0.10	0.050	
Sodium	20			
Strontium				
Thallium				
Tin				
Titanium				
Vanadium				
Zinc		5.0		
Zirconium				
Others				
Alkalinity (mg/L)				
Phenolics, total recoverable (mg/L)				

Table 24. (continued)

Analyte	National Primary Drinking Water	National Secondary Drinking Water	Tennessee Primary Drinking Water	DOE DCG
Total dissolved solids (mg/L)		500	500	
Total organic carbon (mg/L)				
Total organic halides (μg/L)				
Total suspended solids (mg/L)				
Radionuclides (Bq/L)[b]				
Co-60				7.4
Cs-137				4.44
Gross alpha	0.555			
Gross beta	1.85[c]			
H-3	740			2,960
Total rad Sr	0.296			1.48
Volatile Organics (μg/L)[a]				
1,1,1-Trichloroethane	200		200	
1,1,2,2-Tetrachloroethane				
1,1,2-Trichloroethane				
1,1-Dichloroethane				
1,1-Dichloroethene	7.0		7.0	
1,2-Dichloroethane	5.0		5.0	
1,2-Dichloroethene	70			
1,2-Dichloropropane	5.0			
2-Butanone				
2-Hexanone				
4-Methyl-2-pentanone				
Acetone				
Benzene	5.0		5.0	
Bromodichloromethane	100[d]			
Bromoform	100[d]			
Bromomethane				
Carbon disulfide				
Carbon tetrachloride	5.0		5.0	
Chlorobenzene	100			
Chloroethane	200			
Chloroform	100[d]			
Chloromethane				
Dibromochloromethane	100[d]			
Ethylbenzene	700			
Methylene chloride				
Styrene	100			
Tetrachloroethene	5.0			

Table 24. (continued)

Analyte	National Primary Drinking Water	National Secondary Drinking Water	Tennessee Primary Drinking Water	DOE DCG
Toluene	1,000			
Trichloroethene	5.0		5.0	
Vinyl acetate				
Vinyl chloride	2.0		2.0	
Xylene, total	10,000			
cis-1,3-Dichloropropene				
trans-1,3-Dichloropropene				

[a]Divide μg/L by 1000 to convert to mg/L.
[b]Divide Bq/L by 0.037 to convert to pCi/L.
[c]Regulatory guide for assessing compliance without further analysis.
[d]Limit for total trihalomethanes (bromodichloromethane + bromoform + chloroform + dibromochloromethane).

Duplicate, field blank, and trip blank samples are also collected with each WAG as part of the groundwater QA/QC program.

Two types of tables are presented which depict the monitoring parameters' values for each WAG sampled during third quarter 1992. The first table is a summary table presented by well type (i.e., down-gradient and up-gradient). The table contains the number of detected values and the total number of samples; the maximum, minimum, and average of all values; and the standard error of the mean. Various prefixes with different meanings precede the maxima and minima: "U" (analyte was undetected and the instrument was calibrated at the associated value), "<" (the analyte was not able to be quantified below the associated value), "J" (below quantification, estimated), "B" (found in the associated laboratory blank), "JB" (estimated and found in the associated laboratory blank), "E" (value exceeded instrument calibration range, estimated), and "Y" (value from reanalysis after dilution when the calibration range was exceeded).

The second table contains WAG-specific values which exceed a reference value. This reference value may be a regulatory limit or, for organic analytes which do not have regulatory limits, five times the laboratory detection limit was used as a rough rule for assessing the presence of contaminants (or ten times in the case of common organic laboratory contaminants). Tentatively identified compounds (TICs) are also presented in this table of exceedences.

All radionuclide values are corrected for background. A radionuclide value is determined to be significantly greater than zero when the value exceeds 1.645 times its estimated standard error (see Section 1.0 for discussion).

A number of the wells show vinyl chloride results of "U 10 μg/L" which appear to exceed the primary drinking water standard of 2 μg/L. However, the U designator indicates that vinyl chloride was undetected and the instrument used in the analysis was able to accurately detect vinyl chloride at 10 μg/L or above. It is unlikely that vinyl chloride was present in the sample; an estimated value (i.e., a value less than 10, accompanied by a "J" prefix) would have been returned by the laboratory if the instrument detected vinyl chloride. (A similar explanation can be applied to pentachlorophenol results.)

3.5.1 WAG 2

3.5.1.1 Program Description

The sites at Waste Area Grouping (WAG) 2 are currently remedial investigation sites regulated under RCRA 3004(u). ORNL has sampled WAG 2 since 1991 and has plans to continue sampling every year.

WAG 2 is comprised of the White Oak Creek discharge points and includes the associated floodplain and subsurface environment. It represents the major drainage system for ORNL and the surrounding facilities. WAG 2 consists of two SWMUs: one which is the area encompassed by the stream channels of White Oak Creek and Melton Branch and the other includes White Oak Lake, White Oak Dam, and the embayment. The locations of water quality wells at WAG 2 are shown in Fig. 10.

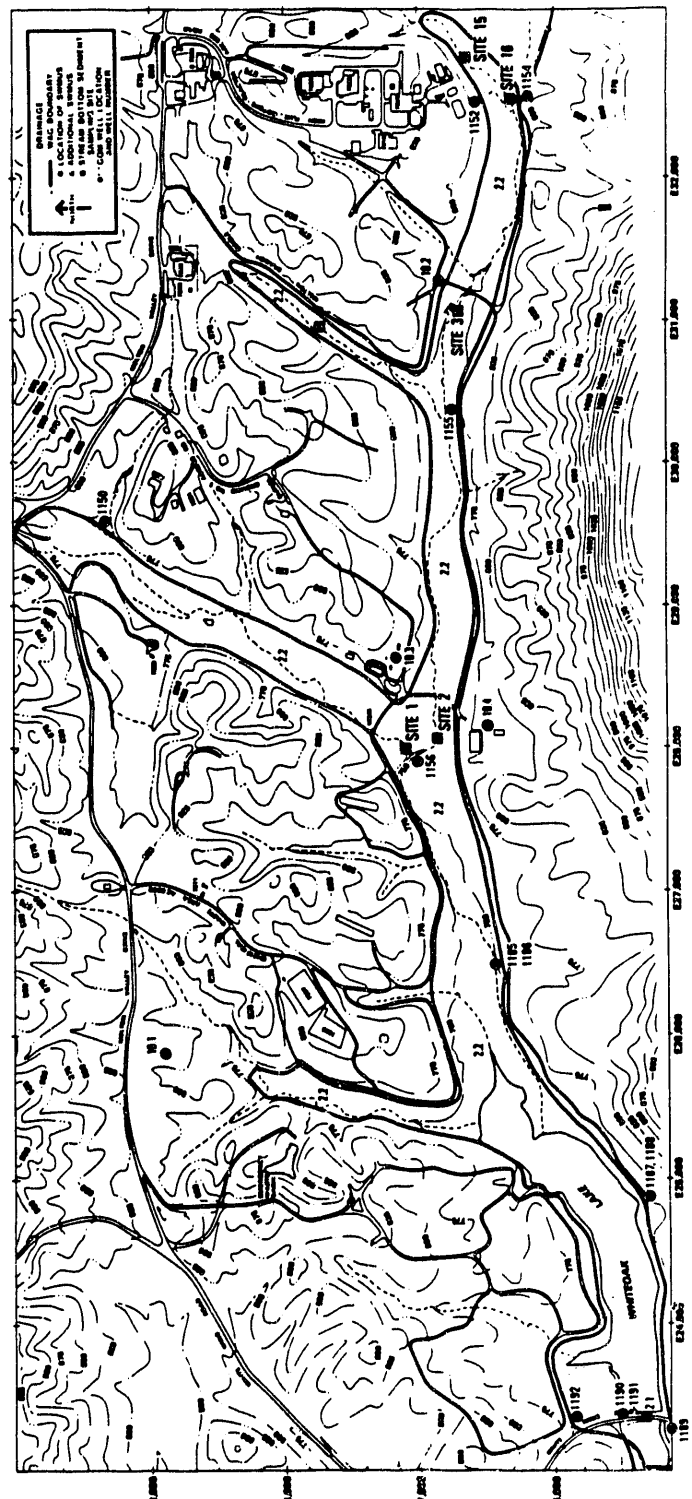

Fig. 10. Location map showing water quality wells at WAG 2.

In addition to natural drainage, White Oak Creek has received treated and untreated effluents and reactor cooling water from ORNL activities since 1943. Controlled releases include those from the Nonradiological Wastewater Treatment Facility, the STP, and a variety of process waste holdup ponds throughout the ORNL main plant area (WAG 1). It also receives groundwater discharge and surface drainage from WAGs 3, 4, 5, 6, 7, 8, 9, and 17.

Twenty wells comprise the groundwater perimeter well network at WAG 2 (wells 1150-1156, 1185-1195, 1244, and 1245); the up-gradient wells for WAG 2 are 1150-1155, 1185-1188, 1244, and 1245. Wells 1244 and 1245 were added to the WAG 2 monitoring network in the spring of 1992. During 1991 and through first quarter 1992 they were monitored as part of the SWSA 6 network. It was determined early in 1992 that these wells do not reflect groundwater conditions at SWSA 6, as recorded in "Groundwater Quality Assessment Report for the Solid Waste Storage Area 6 at the Oak Ridge National Laboratory, 1991", February 1992.

Parameters measured consisted of the Toxic Compound List for organics, metals by atomic absorption for mercury and potassium, metals by ICP/MS (antimony, arsenic, lead, mercury, selenium, silver, and thallium), metals by ICP, anions (bromide, chloride, fluoride, nitrate, phosphate, and sulfate), total organic halides, total organic carbon, total dissolved solids, total suspended solids, alkalinity, total sulfide, total cyanide, ammonia, radionuclides (tritium, total rad Sr, gamma emitting isotopes, gross alpha, and gross beta), and field parameters (pH, specific conductance, temperature, dissolved oxygen, redox, and turbidity).

3.5.1.2 Results

Perimeter wells at WAG 2 were sampled June 18-July 9, 1992. A summary of the analytical results by well type (i.e., up-gradient and down-gradient) is presented in Table 25; Table 26 presents the data which exceed some reference criteria.

Tritium was detected at wells 1244, 1191, 1152, 1156, and 1190 at values ranging from 1,200 to 33,000 Bq/L. Gross beta activity was detected at wells 1244 and 1191 at 45 and 58 Bq/L, respectively. Total rad Sr was detected in well 1191 at 32 Bq/L and a small amount was detected at well 1151. Well 1244 also had a small amount of gross alpha activity and Co-60 was observed.

Well 1190 was the only well which showed evidence of volatile organic contamination; 1,1-dichloroethene, trichloroethene, benzene, and chlorobenzne were detected at levels ranging from 44 to 50 μg/L.

3.5.2 WAG 3

3.5.2.1 Program Description

The sites at Waste Area Grouping (WAG) 3 are currently remedial investigation sites regulated under RCRA 3004(u). ORNL has sampled WAG 3 since 1991 and has plans to continue sampling every year.

Table 25. ORNL WAG 2 groundwater summary statistics from June 18-July 9, 1992

Analyte	N det/ N total	Concentration			
		Max[a]	Min[a]	Av[b]	Standard error[c]
Down-gradient Well Type					
Anions (mg/L) -- Unfiltered					
Chloride	8/8	30	1.1	11*	3.4
Fluoride	1/8	2.8	< 0.10	~ 0.44	0.34
Nitrate	1/8	1.1	< 1.0	~ 1.0*	0.013
Sulfate (as SO_4)	7/8	23	< 1.0	~ 10*	3.2
Base/Neutral/Acid Extractable Organics (µg/L) -- Unfiltered					
Diethyl phthalate	1/8	U 10	JB 3.0	~ 9.1*	0.88
Field Measurements -- Unfiltered					
Conductivity (mS/cm)	8/8	0.64	0.11	0.43*	0.059
Oxygen, dissolved (ppm)	8/8	10	5.8	7.8*	0.65
Temperature (°C)	8/8	17	13	15*	0.46
Turbidity (JTU)	8/8	2,300	310	680*	240
pH (SU)	8/8	9.4	6.5	7.4*	0.41
Metals (mg/L) -- Filtered					
Aluminum	5/8	0.39	< 0.050	~ 0.10*	0.042
Antimony	3/8	0.0093	< 0.0050	~ 0.0058*	0.00053
Arsenic	2/8	0.031	< 0.010	~ 0.013*	0.0026
Barium	8/8	0.93	0.024	0.28*	0.11
Boron	3/8	1.1	< 0.080	~ 0.22	0.12
Calcium	8/8	130	0.77	62*	18
Chromium	4/8	0.011	< 0.0040	~ 0.0062*	0.00099
Copper	1/8	0.014	< 0.0070	~ 0.0078*	0.00081
Iron	5/8	23	< 0.050	~ 5.2	3.3
Magnesium	8/8	24	0.24	9.5*	3.1
Manganese	7/8	1.1	< 0.0010	~ 0.21	0.13
Nickel	4/8	0.17	< 0.0040	~ 0.026	0.021
Potassium	8/8	2.5	0.63	1.4*	0.28
Silicon	8/8	10	3.6	7.0*	0.79
Sodium	7/8	220	< 5.0	~ 61*	28
Vanadium	1/8	0.0028	< 0.0020	~ 0.0021*	0.000095

Table 25. (continued)

Analyte	N det/ N total	Concentration			
		Max[a]	Min[a]	Av[b]	Standard error[c]
Metals (mg/L) -- Unfiltered					
Aluminum	7/8	3.7	< 0.050	~ 0.62	0.45
Arsenic	3/8	0.28	< 0.010	~ 0.053	0.034
Barium	8/8	0.92	0.033	0.32*	0.10
Boron	3/8	1.1	< 0.080	~ 0.23	0.12
Calcium	8/8	130	1.0	60*	17
Chromium	5/8	1.0	< 0.0040	~ 0.13	0.12
Cobalt	2/8	0.012	< 0.0040	~ 0.0051*	0.00099
Copper	5/8	0.013	< 0.0070	~ 0.0085*	0.00067
Iron	8/8	28	0.087	8.6*	3.9
Magnesium	8/8	23	0.25	9.4*	3.0
Manganese	8/8	1.1	0.0059	0.23	0.12
Nickel	3/8	0.20	< 0.0040	~ 0.030	0.025
Potassium	8/8	3.5	0.72	1.9*	0.31
Silicon	8/8	11	3.5	8.0*	0.91
Sodium	7/8	220	< 5.0	~ 59*	28
Vanadium	1/8	0.0051	< 0.0020	~ 0.0024*	0.00039
Zinc	3/8	0.013	< 0.0050	~ 0.0068*	0.0011
Others -- Filtered					
Alkalinity (mg/L)	8/8	460	120	300*	44
Total dissolved solids (mg/L)	8/8	520	130	350*	47
Others -- Unfiltered					
Alkalinity (mg/L)	8/8	460	120	300*	45
Ammonia (mg/L)	8/8	8.3	0.070	1.3	1.0
Total organic carbon (mg/L)	6/8	3.4	< 0.50	~ 1.1*	0.37
Total suspended solids (mg/L)	7/8	190	2.0	~ 42	23
Radionuclides (Bq/L) -- Filtered					
Cs-137	1/8	0.22*	-0.080	0.036	0.031
Gross alpha	6/8	0.34*	-0.0040	0.16*	0.041
Gross beta	7/8	51*	-0.020	6.6	6.3
H-3	5/8	11,000*	-20	2,600	1,500
Total rad Sr	2/8	30*	-0.020	3.8	3.7
Radionuclides (Bq/L) -- Unfiltered					
Co-60	3/8	0.47*	-0.16	0.11	0.066
Gross alpha	7/8	0.41*	0.060	0.21*	0.037
Gross beta	5/8	58*	-0.010	7.5	7.2

Table 25. (continued)

Analyte	N det/ N total	Concentration Max[a]	Min[a]	Av[b]	Standard error[c]
Radionuclides (Bq/L) -- Unfiltered					
H-3	5/8	11,000*	-20	2,700	1,500
Total rad Sr	5/8	32*	-0.030	4.1	4.0
Volatile Organics (µg/L) -- Unfiltered					
1,1-Dichloroethene	1/8	44	U 5.0	~ 9.9*	4.9
Benzene	1/8	49	U 5.0	~ 11*	5.5
Carbon disulfide	2/8	18	U 5.0	~ 7.6*	1.8
Chlorobenzene	1/8	50	U 5.0	~ 11	5.6
Toluene	1/8	47	U 5.0	~ 10*	5.3
Trichloroethene	1/8	48	U 5.0	~ 10*	5.4
Up-gradient Well Type					
Anions (mg/L) -- Unfiltered					
Chloride	12/12	7.4	1.6	3.6*	0.42
Fluoride	2/12	0.70	< 0.10	~ 0.17*	0.051
Nitrate	1/12	11	< 1.0	~ 1.8*	0.83
Sulfate (as SO_4)	12/12	100	9.6	35*	8.6
Base/Neutral/Acid Extractable Organics (µg/L) -- Unfiltered					
Diethyl phthalate	4/12	U 10	J 3.0	~ 8.2*	0.82
Field Measurements -- Unfiltered					
Conductivity (mS/cm)	12/12	0.54	0.11	0.37*	0.033
Oxygen, dissolved (ppm)	12/12	13	6.8	9.5*	0.56
Temperature (°C)	12/12	16	13	14*	0.22
Turbidity (JTU)	12/12	930	440	540*	42
pH (SU)	12/12	9.2	6.3	7.3*	0.21
Metals (mg/L) -- Filtered					
Aluminum	5/12	0.33	< 0.050	~ 0.076*	0.023
Antimony	2/12	0.0061	< 0.0050	~ 0.0052*	0.00011
Barium	12/12	0.63	0.035	0.18*	0.051
Boron	6/12	0.85	< 0.080	~ 0.18*	0.063
Cadmium	1/12	0.0065	< 0.0050	~ 0.0051*	0.00012
Calcium	12/12	120	1.2	60*	11
Chromium	8/12	0.016	< 0.0040	~ 0.0070*	0.0011
Cobalt	2/12	0.028	< 0.0040	~ 0.0063*	0.0020
Copper	1/12	0.0093	< 0.0070	~ 0.0072*	0.00019

Table 25. (continued)

Analyte	N det/ N total	Concentration			
		Max[a]	Min[a]	Av[b]	Standard error[c]
Metals (mg/L) -- Filtered					
Iron	6/12	1.8	< 0.050	~ 0.29*	0.14
Magnesium	12/12	27	0.34	13*	2.1
Manganese	12/12	7.8	0.0070	0.79	0.64
Nickel	5/12	0.024	< 0.0040	~ 0.0070*	0.0017
Potassium	12/12	6.0	0.55	2.7*	0.46
Silicon	12/12	9.9	3.2	7.1*	0.54
Sodium	11/12	200	< 5.0	~ 48*	16
Vanadium	1/12	0.0022	< 0.0020	~ 0.0020*	0.000014
Zinc	1/12	0.017	< 0.0050	~ 0.0060*	0.00098
Metals (mg/L) -- Unfiltered					
Aluminum	9/12	1.3	< 0.050	~ 0.27*	0.11
Barium	12/12	0.60	0.034	0.18*	0.048
Boron	6/12	0.88	< 0.080	~ 0.18*	0.065
Cadmium	1/12	0.010	< 0.0050	~ 0.0054*	0.00043
Calcium	12/12	130	1.3	58*	11
Chromium	9/12	0.014	< 0.0040	~ 0.0069*	0.00094
Cobalt	2/12	0.024	< 0.0040	~ 0.0060*	0.0017
Copper	3/12	0.0085	< 0.0070	~ 0.0072*	0.00012
Iron	10/12	3.4	< 0.050	~ 0.60*	0.27
Magnesium	12/12	26	0.50	12*	2.0
Manganese	12/12	7.4	0.0064	0.76	0.61
Mercury	1/12	0.000050	< 0.000050	~ 0.000050	0
Nickel	4/12	0.026	< 0.0040	~ 0.0067*	0.0018
Potassium	12/12	6.1	1.6	2.9*	0.40
Silicon	12/12	9.6	4.4	7.3*	0.42
Silver	1/12	0.020	< 0.0050	~ 0.0063*	0.0013
Sodium	11/12	190	< 5.0	~ 47*	15
Vanadium	1/12	0.0022	< 0.0020	~ 0.0020*	0.000013
Others -- Filtered					
Alkalinity (mg/L)	12/12	400	120	260*	26
Total dissolved solids (mg/L)	12/12	490	180	360*	30
Others -- Unfiltered					
Alkalinity (mg/L)	12/12	400	120	260*	26
Ammonia (mg/L)	12/12	0.45	0.050	0.17*	0.031
Sulfide, total (mg/L)	2/12	1.0	< 1.0	~ 1.0	0

Table 25. (continued)

Analyte	N det/ N total	Concentration			
		Max[a]	Min[a]	Av[b]	Standard error[c]
Others -- Unfiltered					
Total organic carbon (mg/L)	12/12	1.6	0.70	1.0*	0.091
Total suspended solids (mg/L)	6/12	37	2.0	~ 9.4*	3.3
Radionuclides (Bq/L) -- Filtered					
Co-60	2/12	14*	-0.23	1.2	1.2
Cs-137	1/12	0.24*	-0.27	0.013	0.038
Gross alpha	9/12	0.62*	-0.025	0.17*	0.051
Gross beta	10/12	36*	0.040	3.3	3.0
H-3	5/12	8,000*	-120	760	670
Total rad Sr	4/12	0.23*	-0.037	0.092*	0.021
Radionuclides (Bq/L) -- Unfiltered					
Co-60	1/12	16*	-0.050	1.4	1.3
Gross alpha	11/12	0.79*	0.040	0.23*	0.060
Gross beta	10/12	45*	0.010	4.1	3.7
H-3	5/12	8,300*	-110	790	690
Total rad Sr	4/12	0.31*	-0.10	0.10*	0.034
Volatile Organics (μg/L) -- Unfiltered					
Acetone	5/12	U 10	JB 1.0	~ 7.7*	1.0
Benzene	3/12	U 5.0	JB 1.0	~ 4.0*	0.52
Carbon disulfide	6/12	B 22	JB 2.0	~ 7.8*	1.9

[a]Prefixes containing J, B, E, Y, U or < mean that the value was estimated, found in the laboratory blank, exceeded the calibration range, exceeded the calibration range and was diluted and reanalyzed, was not detected at that level, or was not quantified at that level, respectively. Radionuclide values that are significantly greater than zero are identified by an *.

[b]Average concentrations significantly greater than zero are identified by an *.

[c]Standard error of the mean.

[d]Not applicable.

Table 26. ORNL WAG 2 groundwater constituents that exceed a reference value from June 18-July 9, 1992

Analyte	Concentration		Reference value	Reference source[b]
	Value[a]	Uncertainty		
Well 1150, Sampling Date 18JUN92 *Ground Elevation 770.33 ft, Water Elevation 763.97*				
Anions (mg/L) -- Unfiltered				
Sulfate (as SO_4)	24	c	1.0	D
Base/Neutral/Acid Extractable Organics (μg/L) -- Unfiltered				
Pentachlorophenol	U 50	c	1	2
Field Measurements -- Unfiltered				
pH (SU)	6.3	c	(6.5, 8.5)	2
Metals (mg/L) -- Filtered				
Aluminum	0.061	c	0.050	D
Chromium	0.0060	c	0.0040	D
Cobalt	0.0075	c	0.0040	D
Iron	1.8	c	0.3	3
Manganese	7.8	c	0.05	3
Nickel	0.0088	c	0.0040	D
Metals (mg/L) -- Unfiltered				
Aluminum	0.88	c	0.2	3
Chromium	0.0094	c	0.0040	D
Cobalt	0.0076	c	0.0040	D
Copper	0.0085	c	0.0070	D
Iron	3.4	c	0.3	3
Manganese	7.4	c	0.05	3
Nickel	0.011	c	0.0040	D
Others -- Unfiltered				
Total organic carbon (mg/L)	1.5	c	0.50	D
Volatile Organics (μg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1

Table 26. (continued)

Analyte	Concentration		Reference value	Reference source[b]
	Value[a]	Uncertainty		
Well 1151, Sampling Date 18JUN92				
Ground Elevation 807.45 ft, Water Elevation 803.35				
Anions (mg/L) -- Unfiltered				
Fluoride	0.70	c	0.10	D
Sulfate (as SO_4)	76	c	1.0	D
Base/Neutral/Acid Extractable Organics (µg/L) -- Unfiltered				
Pentachlorophenol	U 50	c	1	2
Metals (mg/L) -- Filtered				
Boron	0.18	c	0.080	D
Cadmium	0.0065	c	0.0050	D
Chromium	0.012	c	0.0040	D
Iron	0.30	c	0.050	D
Manganese	0.072	c	0.05	3
Sodium	81	c	20	2
Metals (mg/L) -- Unfiltered				
Aluminum	0.051	c	0.050	D
Boron	0.19	c	0.080	D
Cadmium	0.010	c	0.01	1
Chromium	0.0091	c	0.0040	D
Iron	0.56	c	0.3	3
Manganese	0.067	c	0.05	3
Sodium	75	c	20	2
Others -- Unfiltered				
Total organic carbon (mg/L)	0.95	c	0.50	D
Radionuclides (Bq/L) -- Unfiltered				
Total rad Sr	0.31*	0.20	0.296	2
Volatile Organics (µg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1

Table 26. (continued)

Analyte	Concentration			
	Value[a]	Uncertainty	Reference value	Reference source[b]
Well 1152, Sampling Date 19JUN92 *Ground Elevation 790.82 ft, Water Elevation 786.62*				
Anions (mg/L) -- Unfiltered				
Sulfate (as SO_4)	25	c	1.0	D
Base/Neutral/Acid Extractable Organics (μg/L) -- Unfiltered				
Pentachlorophenol	U 50	c	1	2
Metals (mg/L) -- Filtered				
Chromium	0.0062	c	0.0040	D
Iron	0.17	c	0.050	D
Manganese	0.49	c	0.05	3
Sodium	18	c	5.0	D
Metals (mg/L) -- Unfiltered				
Chromium	0.0052	c	0.0040	D
Iron	0.21	c	0.050	D
Manganese	0.37	c	0.05	3
Sodium	16	c	5.0	D
Others -- Unfiltered				
Total organic carbon (mg/L)	1.3	c	0.50	D
Radionuclides (Bq/L) -- Filtered				
H-3	8,000*	100	740	2
Radionuclides (Bq/L) -- Unfiltered				
H-3	8,300*	100	740	2
Volatile Organics (μg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Well 1153, Sampling Date 19JUN92 *Ground Elevation 800.71 ft, Water Elevation 797.40*				
Anions (mg/L) -- Unfiltered				
Sulfate (as SO_4)	56	c	1.0	D

Table 26. (continued)

Analyte	Concentration		Reference value	Reference source[b]
	Value[a]	Uncertainty		
Base/Neutral/Acid Extractable Organics (µg/L) -- Unfiltered				
Pentachlorophenol	U 50	c	1	2
Metals (mg/L) -- Filtered				
Antimony	0.0059	c	0.0050	D
Chromium	0.016	c	0.0040	D
Iron	0.34	c	0.3	3
Manganese	0.14	c	0.05	3
Sodium	12	c	5.0	D
Metals (mg/L) -- Unfiltered				
Aluminum	0.26	c	0.2	3
Chromium	0.014	c	0.0040	D
Iron	0.87	c	0.3	3
Manganese	0.14	c	0.05	3
Sodium	11	c	5.0	D
Others -- Unfiltered				
Total organic carbon (mg/L)	1.6	c	0.50	D
Total suspended solids (mg/L)	37	c	5.0	D
Volatile Organics (µg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Well 1154, Sampling Date 22JUN92				
Ground Elevation 787.93 ft, Water Elevation 782.14				
Anions (mg/L) -- Unfiltered				
Sulfate (as SO_4)	13	c	1.0	D
BNAE Organics-TICs (µg/L) -- Unfiltered				
Unknown-7.96	J 6.0	c	c	T
Base/Neutral/Acid Extractable Organics (µg/L) -- Unfiltered				
Pentachlorophenol	U 50	c	1	2
Metals (mg/L) -- Filtered				
Aluminum	0.054	c	0.050	D
Boron	0.12	c	0.080	D

Table 26. (continued)

Analyte	Concentration		Reference value	Reference source[b]
	Value[a]	Uncertainty		
Metals (mg/L) -- Filtered				
Manganese	0.47	c	0.05	3
Sodium	39	c	20	2
Metals (mg/L) -- Unfiltered				
Aluminum	0.13	c	0.050	D
Boron	0.16	c	0.080	D
Iron	0.24	c	0.050	D
Manganese	0.54	c	0.05	3
Silver	0.020	c	0.0050	D
Sodium	45	c	20	2
Others -- Unfiltered				
Total organic carbon (mg/L)	0.94	c	0.50	D
Total suspended solids (mg/L)	7.0	c	5.0	D
Volatile Organics (µg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Well 1155, Sampling Date 23JUN92				
Ground Elevation 777.11 ft, Water Elevation 766.89				
Anions (mg/L) -- Unfiltered				
Sulfate (as SO_4)	53	c	1.0	D
BNAE Organics-TICs (µg/L) -- Unfiltered				
Unknown-7.94	J 7.0	c	c	T
Base/Neutral/Acid Extractable Organics (µg/L) -- Unfiltered				
Pentachlorophenol	U 50	c	1	2
Metals (mg/L) -- Filtered				
Aluminum	0.057	c	0.050	D
Chromium	0.0067	c	0.0040	D
Copper	0.0093	c	0.0070	D
Manganese	0.044	c	0.0010	D
Sodium	29	c	20	2

Table 26. (continued)

Analyte	Concentration		Reference value	Reference source[b]
	Value[a]	Uncertainty		
Metals (mg/L) -- Unfiltered				
Aluminum	0.076	c	0.050	D
Chromium	0.0051	c	0.0040	D
Iron	0.11	c	0.050	D
Manganese	0.054	c	0.05	3
Sodium	26	c	20	2
Others -- Unfiltered				
Total organic carbon (mg/L)	0.87	c	0.50	D
Volatile Organics (µg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Well 1156, Sampling Date 23JUN92				
Ground Elevation 754.81 ft, Water Elevation 747.93				
Anions (mg/L) -- Unfiltered				
Sulfate (as SO_4)	23	c	1.0	D
BNAE Organics-TICs (µg/L) -- Unfiltered				
Unknown-7.92	J 7.0	c	c	T
Base/Neutral/Acid Extractable Organics (µg/L) -- Unfiltered				
Pentachlorophenol	U 50	c	1	2
Metals (mg/L) -- Filtered				
Aluminum	0.055	c	0.050	D
Boron	0.14	c	0.080	D
Chromium	0.0056	c	0.0040	D
Copper	0.014	c	0.0070	D
Manganese	0.13	c	0.05	3
Nickel	0.0064	c	0.0040	D
Sodium	47	c	20	2
Metals (mg/L) -- Unfiltered				
Aluminum	0.051	c	0.050	D
Boron	0.15	c	0.080	D
Chromium	0.0044	c	0.0040	D

Table 26. (continued)

Analyte	Concentration			
	Value[a]	Uncertainty	Reference value	Reference source[b]
Metals (mg/L) -- Unfiltered				
Iron	0.80	c	0.3	3
Manganese	0.16	c	0.05	3
Sodium	46	c	20	2
Others -- Unfiltered				
Total organic carbon (mg/L)	0.82	c	0.50	D
Radionuclides (Bq/L) -- Filtered				
H-3	11,000*	1,000	740	2
Radionuclides (Bq/L) -- Unfiltered				
H-3	11,000*	1,000	740	2
Volatile Organics (µg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Well 1185, Sampling Date 24JUN92				
Ground Elevation 760.08 ft, Water Elevation 748.20				
Anions (mg/L) -- Unfiltered				
Sulfate (as SO_4)	23	c	1.0	D
BNAE Organics-TICs (µg/L) -- Unfiltered				
Unknown-7.64	J 4.0	c	c	T
Base/Neutral/Acid Extractable Organics (µg/L) -- Unfiltered				
Pentachlorophenol	U 50	c	1	2
Metals (mg/L) -- Filtered				
Aluminum	0.054	c	0.050	D
Manganese	0.18	c	0.05	3
Nickel	0.0067	c	0.0040	D
Sodium	8.1	c	5.0	D
Metals (mg/L) -- Unfiltered				
Aluminum	0.31	c	0.2	3
Chromium	0.0050	c	0.0040	D
Copper	0.0074	c	0.0070	D
Iron	0.37	c	0.3	3

Table 26. (continued)

Analyte	Concentration		Reference value	Reference source[b]
	Value[a]	Uncertainty		
Metals (mg/L) -- Unfiltered				
Manganese	0.36	c	0.05	3
Nickel	0.0048	c	0.0040	D
Sodium	7.0	c	5.0	D
Others -- Unfiltered				
Total organic carbon (mg/L)	0.85	c	0.50	D
Total suspended solids (mg/L)	30	c	5.0	D
Volatile Organics (µg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Well 1186, Sampling Date 24JUN92				
Ground Elevation 759.10 ft, Water Elevation 747.83				
Anions (mg/L) -- Unfiltered				
Sulfate (as SO_4)	9.6	c	1.0	D
BNAE Organics-TICs (µg/L) -- Unfiltered				
Unknown-7.97	J 6.0	c	c	T
Base/Neutral/Acid Extractable Organics (µg/L) -- Unfiltered				
Pentachlorophenol	U 50	c	1	2
Metals (mg/L) -- Filtered				
Boron	0.19	c	0.080	D
Manganese	0.013	c	0.0010	D
Nickel	0.011	c	0.0040	D
Sodium	57	c	20	2
Vanadium	0.0022	c	0.0020	D
Metals (mg/L) -- Unfiltered				
Boron	0.19	c	0.080	D
Manganese	0.012	c	0.0010	D
Nickel	0.0071	c	0.0040	D
Sodium	52	c	20	2
Vanadium	0.0022	c	0.0020	D
Others -- Unfiltered				
Total organic carbon (mg/L)	0.70	c	0.50	D

Table 26. (continued)

Analyte	Concentration		Reference value	Reference source[b]
	Value[a]	Uncertainty		
Volatile Organics (µg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Well 1187, Sampling Date 26JUN92				
Ground Elevation 755.61 ft, Water Elevation 743.94				
Anions (mg/L) -- Unfiltered				
Sulfate (as SO_4)	11	c	1.0	D
Base/Neutral/Acid Extractable Organics (µg/L) -- Unfiltered				
Pentachlorophenol	U 50	c	1	2
Field Measurements -- Unfiltered				
pH (SU)	9.2	c	(6.5, 8.5)	2
Metals (mg/L) -- Filtered				
Aluminum	0.33	c	0.2	3
Boron	0.85	c	0.080	D
Iron	0.30	c	0.050	D
Manganese	0.0095	c	0.0010	D
Sodium	200	c	20	2
Zinc	0.017	c	0.0050	D
Metals (mg/L) -- Unfiltered				
Aluminum	1.3	c	0.2	3
Boron	0.88	c	0.080	D
Copper	0.0070	c	0.0070	D
Iron	0.93	c	0.3	3
Manganese	0.018	c	0.0010	D
Mercury	0.000050	c	0.000050	D
Sodium	190	c	20	2
Others -- Unfiltered				
Total organic carbon (mg/L)	0.93	c	0.50	D
Volatile Organics (µg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Volatile Organics-TICs (µg/L) -- Unfiltered				
Unknown-25.46	J 5.0	c	c	T

Table 26. (continued)

Analyte	Concentration		Reference value	Reference source[b]
	Value[a]	Uncertainty		
Well 1188, Sampling Date 25JUN92 *Ground Elevation 755.87 ft, Water Elevation 745.34*				
Anions (mg/L) -- Unfiltered				
Sulfate (as SO_4)	10	c	1.0	D
BNAE Organics-TICs (µg/L) -- Unfiltered				
Unknown-7.92	J 4.0	c	c	T
Base/Neutral/Acid Extractable Organics (µg/L) -- Unfiltered				
Pentachlorophenol	U 50	c	1	2
Metals (mg/L) -- Filtered				
Boron	0.18	c	0.080	D
Chromium	0.011	c	0.0040	D
Iron	0.28	c	0.050	D
Manganese	0.027	c	0.0010	D
Nickel	0.0059	c	0.0040	D
Sodium	28	c	20	2
Metals (mg/L) -- Unfiltered				
Aluminum	0.062	c	0.050	D
Boron	0.18	c	0.080	D
Chromium	0.011	c	0.0040	D
Iron	0.46	c	0.3	3
Manganese	0.028	c	0.0010	D
Sodium	27	c	20	2
Others -- Unfiltered				
Total organic carbon (mg/L)	1.5	c	0.50	D
Volatile Organics (µg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Well 1189, Sampling Date 30JUN92 *Ground Elevation 758.51 ft, Water Elevation 742.93*				
Anions (mg/L) -- Unfiltered				
Nitrate	1.1	c	1.0	D
Sulfate (as SO_4)	18	c	1.0	D

Table 26. (continued)

Analyte	Concentration		Reference value	Reference source[b]
	Value[a]	Uncertainty		
Base/Neutral/Acid Extractable Organics (µg/L) -- Unfiltered				
Pentachlorophenol	U 50	c	1	2
Metals (mg/L) -- Filtered				
Chromium	0.0097	c	0.0040	D
Manganese	0.0060	c	0.0010	D
Nickel	0.0060	c	0.0040	D
Sodium	17	c	5.0	D
Metals (mg/L) -- Unfiltered				
Aluminum	0.098	c	0.050	D
Chromium	0.018	c	0.0040	D
Copper	0.0092	c	0.0070	D
Iron	0.43	c	0.3	3
Manganese	0.011	c	0.0010	D
Sodium	17	c	5.0	D
Zinc	0.0065	c	0.0050	D
Volatile Organics (µg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Well 1190, Sampling Date 29JUN92				
Ground Elevation 755.19 ft, Water Elevation 742.27				
Anions (mg/L) -- Unfiltered				
Sulfate (as SO_4)	3.1	c	1.0	D
Base/Neutral/Acid Extractable Organics (µg/L) -- Unfiltered				
Pentachlorophenol	U 50	c	1	2
Metals (mg/L) -- Filtered				
Chromium	0.011	c	0.0040	D
Iron	0.74	c	0.3	3
Manganese	0.14	c	0.05	3
Sodium	14	c	5.0	D
Metals (mg/L) -- Unfiltered				
Chromium	0.012	c	0.0040	D
Copper	0.0087	c	0.0070	D
Iron	0.74	c	0.3	3

Table 26. (continued)

Analyte	Concentration		Reference value	Reference source[b]
	Value[a]	Uncertainty		
Metals (mg/L) -- Unfiltered				
Manganese	0.14	c	0.05	3
Sodium	14	c	5.0	D
Others -- Unfiltered				
Total organic carbon (mg/L)	1.9	c	0.50	D
Radionuclides (Bq/L) -- Filtered				
H-3	2,400*	100	740	2
Radionuclides (Bq/L) -- Unfiltered				
H-3	3,300*	100	740	2
Volatile Organics (µg/L) -- Unfiltered				
1,1-Dichloroethene	44	c	7	1
Benzene	49	c	5	1
Chlorobenzene	50	c	5.0	D
Trichloroethene	48	c	5	1
Vinyl chloride	U 10	c	2	1
Well 1191, Sampling Date 30JUN92				
Ground Elevation 755.17 ft, Water Elevation 743.36				
BNAE Organics-TICs (µg/L) -- Unfiltered				
Unknown-4.49	J 16	c	c	T
Base/Neutral/Acid Extractable Organics (µg/L) -- Unfiltered				
Pentachlorophenol	U 50	c	1	2
Metals (mg/L) -- Filtered				
Aluminum	0.060	c	0.050	D
Arsenic	0.013	c	0.010	D
Iron	23	c	0.3	3
Manganese	0.25	c	0.05	3
Nickel	0.0055	c	0.0040	D
Sodium	17	c	5.0	D

Table 26. (continued)

Analyte	Concentration		Reference value	Reference source[b]
	Value[a]	Uncertainty		
Metals (mg/L) -- Unfiltered				
Aluminum	0.10	c	0.050	D
Arsenic	0.012	c	0.010	D
Chromium	0.0059	c	0.0040	D
Cobalt	0.0046	c	0.0040	D
Copper	0.0081	c	0.0070	D
Iron	21	c	0.3	3
Manganese	0.24	c	0.05	3
Sodium	15	c	5.0	D
Others -- Unfiltered				
Total organic carbon (mg/L)	3.4	c	0.50	D
Total suspended solids (mg/L)	31	c	5.0	D
Radionuclides (Bq/L) -- Filtered				
Gross beta	51*	2.0	1.85	2
H-3	7,100*	100	740	2
Total rad Sr	30*	1.0	0.296	2
Radionuclides (Bq/L) -- Unfiltered				
Gross beta	58*	2.0	1.85	2
H-3	7,100*	100	740	2
Total rad Sr	32*	1.0	0.296	2
Volatile Organics (μg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Well 1192, Sampling Date 30JUN92				
Ground Elevation 756.48 ft, Water Elevation 744.32				
Anions (mg/L) -- Unfiltered				
Sulfate (as SO_4)	8.0	c	1.0	D
Base/Neutral/Acid Extractable Organics (μg/L) -- Unfiltered				
Pentachlorophenol	U 50	c	1	2
Metals (mg/L) -- Filtered				
Aluminum	0.051	c	0.050	D
Antimony	0.0065	c	0.0050	D
Chromium	0.0070	c	0.0040	D

Table 26. (continued)

Analyte	Concentration		Reference value	Reference source[b]
	Value[a]	Uncertainty		
Metals (mg/L) -- Filtered				
Iron	0.16	c	0.050	D
Manganese	0.017	c	0.0010	D
Nickel	0.17	c	0.0040	D
Sodium	13	c	5.0	D
Metals (mg/L) -- Unfiltered				
Aluminum	0.12	c	0.050	D
Chromium	1.0	c	0.05	1
Cobalt	0.012	c	0.0040	D
Copper	0.013	c	0.0070	D
Iron	14	c	0.3	3
Manganese	0.10	c	0.05	3
Nickel	0.20	c	0.0040	D
Sodium	13	c	5.0	D
Zinc	0.013	c	0.0050	D
Others -- Unfiltered				
Total suspended solids (mg/L)	32	c	5.0	D
Volatile Organics (μg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Well 1193, Sampling Date 06JUL92				
Ground Elevation 759.16 ft, Water Elevation 740.88				
Anions (mg/L) -- Unfiltered				
Sulfate (as SO_4)	3.0	c	1.0	D
Base/Neutral/Acid Extractable Organics (μg/L) -- Unfiltered				
Pentachlorophenol	U 50	c	1	2
Field Measurements -- Unfiltered				
pH (SU)	8.9	c	(6.5, 8.5)	2
Metals (mg/L) -- Filtered				
Aluminum	0.097	c	0.050	D
Antimony	0.0093	c	0.0050	D
Boron	0.21	c	0.080	D

Table 26. (continued)

Analyte	Concentration		Reference value	Reference source[b]
	Value[a]	Uncertainty		
Metals (mg/L) -- Filtered				
Manganese	0.0050	c	0.0010	D
Sodium	160	c	20	2
Metals (mg/L) -- Unfiltered				
Aluminum	0.11	c	0.050	D
Arsenic	0.28	c	0.05	1
Boron	0.20	c	0.080	D
Iron	0.087	c	0.050	D
Manganese	0.0059	c	0.0010	D
Sodium	140	c	20	2
Volatile Organics (µg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Well 1194, Sampling Date 07JUL92				
Ground Elevation 757.10 ft, Water Elevation 743.54				
Anions (mg/L) -- Unfiltered				
Fluoride	2.8	c	0.10	D
Sulfate (as SO_4)	21	c	1.0	D
Base/Neutral/Acid Extractable Organics (µg/L) -- Unfiltered				
Pentachlorophenol	U 50	c	1	2
Field Measurements -- Unfiltered				
pH (SU)	9.4	c	(6.5, 8.5)	2
Metals (mg/L) -- Filtered				
Aluminum	0.39	c	0.2	3
Boron	1.1	c	0.080	D
Iron	0.11	c	0.050	D
Sodium	220	c	20	2
Vanadium	0.0028	c	0.0020	D
Metals (mg/L) -- Unfiltered				
Aluminum	3.7	c	0.2	3
Boron	1.1	c	0.080	D
Copper	0.0081	c	0.0070	D
Iron	2.7	c	0.3	3

Table 26. (continued)

Analyte	Concentration		Reference value	Reference source[b]
	Value[a]	Uncertainty		
Metals (mg/L) -- Unfiltered				
Manganese	0.10	c	0.05	3
Nickel	0.0097	c	0.0040	D
Sodium	220	c	20	2
Vanadium	0.0051	c	0.0020	D
Zinc	0.011	c	0.0050	D
Others -- Filtered				
Total dissolved solids (mg/L)	520	c	500	1
Others -- Unfiltered				
Total organic carbon (mg/L)	~ 0.58	c	0.50	D
Total suspended solids (mg/L)	75	c	5.0	D
Volatile Organics (µg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Well 1195, Sampling Date 07JUL92				
Ground Elevation 756.95 ft, Water Elevation 742.86				
Anions (mg/L) -- Unfiltered				
Sulfate (as SO_4)	2.9	c	1.0	D
BNAE Organics-TICs (µg/L) -- Unfiltered				
Unknown-7.6	J 5.0	c	c	T
Base/Neutral/Acid Extractable Organics (µg/L) -- Unfiltered				
Pentachlorophenol	U 50	c	1	2
Metals (mg/L) -- Filtered				
Antimony	0.0059	c	0.0050	D
Arsenic	0.031	c	0.010	D
Iron	18	c	0.3	3
Manganese	1.1	c	0.05	3
Metals (mg/L) -- Unfiltered				
Aluminum	0.67	c	0.2	3
Arsenic	0.084	c	0.05	1
Iron	28	c	0.3	3

Table 26. (continued)

Analyte	Concentration		Reference value	Reference source[b]
	Value[a]	Uncertainty		
Metals (mg/L) -- Unfiltered				
Manganese	1.1	c	0.05	3
Nickel	0.0043	c	0.0040	D
Others -- Unfiltered				
Total organic carbon (mg/L)	~ 0.53	c	0.50	D
Total suspended solids (mg/L)	190	c	5.0	D
Volatile Organics (μg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Well 1244, Sampling Date 08JUL92				
Ground Elevation 755.49 ft, Water Elevation 753.23				
Anions (mg/L) -- Unfiltered				
Nitrate	11	c	10	2
Sulfate (as SO_4)	100	c	1.0	D
Base/Neutral/Acid Extractable Organics (μg/L) -- Unfiltered				
Pentachlorophenol	U 50	c	1	2
Metals (mg/L) -- Filtered				
Chromium	0.0061	c	0.0040	D
Cobalt	0.028	c	0.0040	D
Manganese	0.18	c	0.05	3
Nickel	0.024	c	0.0040	D
Sodium	81	c	20	2
Metals (mg/L) -- Unfiltered				
Aluminum	0.056	c	0.050	D
Chromium	0.0074	c	0.0040	D
Cobalt	0.024	c	0.0040	D
Iron	0.055	c	0.050	D
Manganese	0.14	c	0.05	3
Nickel	0.026	c	0.0040	D
Sodium	86	c	20	2
Others -- Unfiltered				
Total organic carbon (mg/L)	0.75	c	0.50	D

Table 26. (continued)

Analyte	Concentration		Reference value	Reference source[b]
	Value[a]	Uncertainty		
Radionuclides (Bq/L) -- Filtered				
Co-60	14*	1.0	7.4	4
Gross alpha	0.62*	0.27	0.555	2
Gross beta	36*	2.0	1.85	2
H-3	1,200*	100	740	2
Radionuclides (Bq/L) -- Unfiltered				
Co-60	16*	1.0	7.4	4
Gross alpha	0.79*	0.31	0.555	2
Gross beta	45*	2.0	1.85	2
H-3	1,200*	100	740	2
Volatile Organics (µg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Well 1245, Sampling Date 09JUL92				
Ground Elevation 753.03 ft, Water Elevation 753.25				
Anions (mg/L) -- Unfiltered				
Fluoride	0.30	c	0.10	D
Sulfate (as SO_4)	17	c	1.0	D
Base/Neutral/Acid Extractable Organics (µg/L) -- Unfiltered				
Pentachlorophenol	U 50	c	1	2
Metals (mg/L) -- Filtered				
Antimony	0.0061	c	0.0050	D
Boron	0.099	c	0.080	D
Chromium	0.0045	c	0.0040	D
Manganese	0.0070	c	0.0010	D
Sodium	25	c	20	2
Metals (mg/L) -- Unfiltered				
Boron	0.090	c	0.080	D
Chromium	0.0052	c	0.0040	D
Manganese	0.0064	c	0.0010	D
Sodium	22	c	20	2

Table 26. (continued)

Analyte	Concentration			
	Value[a]	Uncertainty	Reference value	Reference source[b]
Others -- Unfiltered				
Total organic carbon (mg/L)	0.78	c	0.50	D
Volatile Organics (µg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1

[a]Prefixes containing J, B, E, Y, U or < mean that the value was estimated, found in the laboratory blank, exceeded the calibration range, exceeded the calibration range and was diluted and reanalyzed, was not detected at that level, or was not quantified at that level, respectively. Radionuclide values that are significantly greater than zero are identified by an *.

[b]If a reference limit exists, the source is coded as:

1 Rules of Tennessee Department of Environment and Conservation, Division of Water Pollution Control, Chapter 1200-4-3, General Water Quality Criteria, as amended.
2 40CFR Part 141--National Primary Drinking Water Regulations, Subparts B and G, as amended.
3 40CFR Part 143--National Secondary Drinking Water Regulations, as amended.
D The value exceeds the laboratory detection limit.
T A tentatively identified compound (TIC).

[c]Not applicable.

WAG 3 is located in Bethel Valley about 0.6 mile west of the main plant area (Fig. 11). WAG 3 is composed of three individual SWMUs: SWSA 3, the Closed Scrap Metal Area (1562), and the currently operating Contractors' Landfill (1554).

SWSA 3 and the Closed Scrap Metal Area are inactive landfills known to contain radioactive solid wastes and surplus materials generated at ORNL from 1946 to 1979. Burial of solid waste ceased at this site in 1951, but it continued to be used as an above-ground scrap metal storage area until 1979. Sometime during the period of 1946-1949 radioactive solid wastes removed from SWSA 2 were buried in this site. In 1979, most of the scrap metal stored above ground at SWSA 3 was either transferred to other storage areas or buried on-site in a disposal area immediately south of SWSA 3.

Records of the composition of radioactive solid waste buried in SWSA 3 were destroyed in a fire in 1961. Sketches and drawings of the site indicate that alpha and beta-gamma wastes were segregated and buried in separate areas or trenches. Chemical wastes were probably also buried in SWSA 3 because there are no records of disposal elsewhere. Although the information is sketchy, the larger scrap metal equipment stored on the surface at this site was also probably contaminated. Because only a portion of this material is now buried in the Closed Scrap Metal Area, it is not possible to estimate the amount of contamination that exists in this SWMU.

The Contractors' Landfill was opened in 1975 and is used to dispose of various uncontaminated construction materials. No contaminated waster or asbestos is to be buried at the site. ORNL disposal procedures require that only non-RCRA, nonradioactive solid wastes are to be buried in the Contractors' Landfill.

Fifteen wells comprise the groundwater perimeter well network at WAG 3 (wells 985-988, 990-998, 1247 and 1248; the up-gradient wells for WAG 3 are wells 987, 988, and 998.

Parameters measured consisted of the Toxic Compound List for organics, metals by atomic absorption for mercury and potassium, metals by ICP/MS (antimony, arsenic, lead, mercury, selenium, silver, and thallium), metals by ICP, anions (bromide, chloride, fluoride, nitrate, phosphate, and sulfate), total organic halides, total organic carbon, total dissolved solids, total suspended solids, alkalinity, radionuclides (tritium, total rad Sr, gamma emitting isotopes, gross alpha, and gross beta), and field parameters (pH, specific conductance, temperature, dissolved oxygen, redox, and turbidity).

3.5.2.2 Results

Perimeter wells at WAG 3 were sampled August 21-September 18, 1992. Well 1247 was dry and was unable to be sampled. Well 1248 took several days to sample because the well took a long time to recover. A summary of the analytical results by well type (i.e., up-gradient and down-gradient) is presented in Table 27; Table 28 presents the data which exceed some reference criteria.

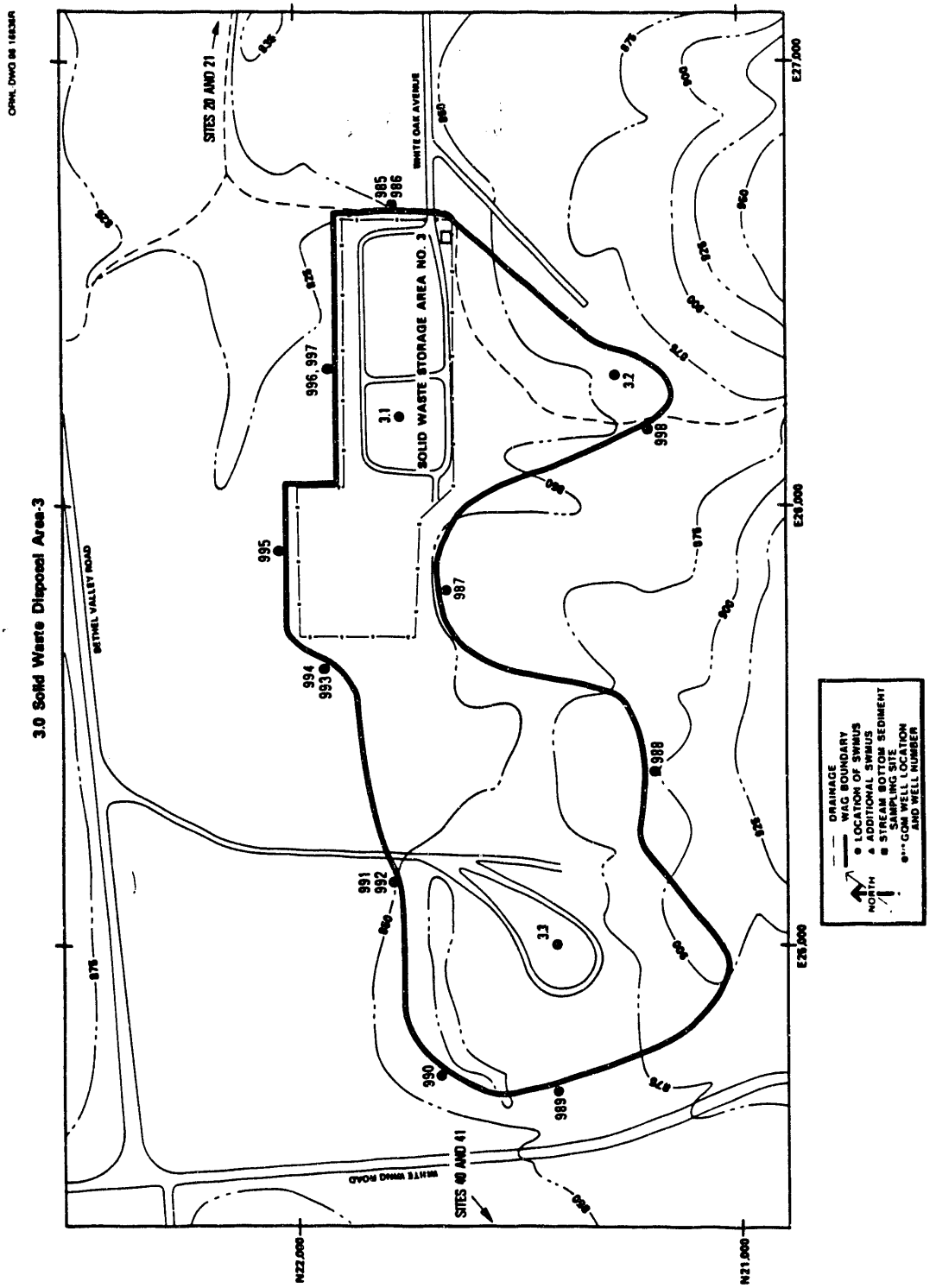

Fig. 11. Location map of WAG 3.

Table 27. ORNL WAG 3 groundwater summary statistics from August 21-September 18, 1992

Analyte	N det/ N total	Concentration			
		Max[a]	Min[a]	Av[b]	Standard error[c]
Down-gradient Well Type					
Anions (mg/L) -- Unfiltered					
Chloride	11/11	420	2.2	93*	42
Fluoride	1/11	4.1	< 0.10	~ 0.46	0.36
Nitrate	1/11	1.2	< 1.0	~ 1.0*	0.018
Sulfate (as SO_4)	11/11	120	3.2	44*	13
Base/Neutral/Acid Extractable Organics (μg/L) -- Unfiltered					
Bis(2-ethylhexyl) phthalate	1/11	U 10	B 1.0	~ 9.2*	0.82
N-Nitrosodiphenylamine	3/11	U 10	B 2.0	~ 7.8*	1.1
Field Measurements -- Unfiltered					
Conductivity (mS/cm)	11/11	1.3	0.33	0.69*	0.11
Oxygen, dissolved (ppm)	10/10	10	5.8	7.7*	0.46
Redox (mV)	10/10	630	22	480*	55
Temperature (°C)	11/11	16	14	15*	0.12
Turbidity (JTU)	10/10	46	2.1	20*	4.6
pH (SU)	11/11	11	7.0	7.8*	0.34
Metals (mg/L) -- Filtered					
Aluminum	1/11	0.75	< 0.050	~ 0.11	0.064
Antimony	2/11	0.0061	< 0.0050	~ 0.0052*	0.00013
Arsenic	2/11	0.023	< 0.010	~ 0.012*	0.0014
Barium	11/11	0.65	0.0086	0.17*	0.055
Boron	8/11	2.0	< 0.080	~ 0.50*	0.22
Calcium	11/11	160	0.85	110*	16
Chromium	2/11	0.0089	< 0.0040	~ 0.0045*	0.00045
Cobalt	1/11	0.0089	< 0.0040	~ 0.0044*	0.00045
Copper	1/11	0.016	< 0.0070	~ 0.0078*	0.00083
Iron	6/11	2.5	< 0.050	~ 0.48*	0.23
Magnesium	11/11	54	0.20	24*	5.1
Manganese	11/11	1.7	0.0021	0.29	0.17

Table 27. (continued)

Analyte	N det/ N total	Concentration			
		Max[a]	Min[a]	Av[b]	Standard error[c]
Metals (mg/L) -- Filtered					
Nickel	1/11	0.014	< 0.010	~ 0.010*	0.00034
Potassium	11/11	8.9	1.7	3.5*	0.65
Selenium	2/11	0.0068	< 0.0050	~ 0.0052*	0.00017
Silicon	11/11	39	4.7	8.8*	3.1
Sodium	11/11	250	3.2	54*	22
Vanadium	11/11	0.046	0.0021	0.0071*	0.0039
Zinc	5/11	0.021	< 0.0050	~ 0.0071*	0.0015
Metals (mg/L) -- Unfiltered					
Aluminum	3/11	2.3	< 0.050	~ 0.31	0.20
Arsenic	1/11	0.020	< 0.010	~ 0.011*	0.00091
Barium	11/11	0.64	0.015	0.17*	0.053
Boron	8/11	2.0	< 0.080	~ 0.50*	0.22
Calcium	11/11	160	1.2	110*	16
Chromium	1/11	0.011	< 0.0040	~ 0.0046*	0.00061
Cobalt	1/11	0.0049	< 0.0040	~ 0.0041*	0.000082
Copper	1/11	0.023	< 0.0070	~ 0.0084*	0.0014
Iron	9/11	3.3	< 0.050	~ 0.87*	0.35
Magnesium	11/11	54	0.58	24*	5.0
Manganese	11/11	1.7	0.0043	0.30	0.17
Nickel	1/11	0.019	< 0.010	~ 0.011*	0.00077
Potassium	11/11	9.4	1.7	3.7*	0.67
Silicon	11/11	45	4.9	9.5*	3.6
Sodium	11/11	270	3.4	57*	24
Vanadium	1/11	0.051	< 0.0020	~ 0.0064	0.0044
Zinc	5/11	0.020	< 0.0050	~ 0.0084*	0.0017
Others -- Filtered					
Alkalinity (mg/L)	11/11	520	240	350*	27
Total dissolved solids (mg/L)	11/11	700	89	450*	60
Others -- Unfiltered					
Alkalinity (mg/L)	11/11	510	240	350*	26
Phenolics, total recoverable (mg/L)	1/11	0.041	< 0.0010	~ 0.0046	0.0036

Table 27. (continued)

Analyte	N det/ N total	Concentration			
		Max[a]	Min[a]	Av[b]	Standard error[c]
Others -- Unfiltered					
Total organic carbon (mg/L)	11/11	5.9	0.63	1.6*	0.44
Total organic halides (μg/L)	3/11	110	< 5.0	~ 26*	11
Total suspended solids (mg/L)	3/11	52	< 5.0	~ 9.4*	4.3
Radionuclides (Bq/L) -- Filtered					
Cs-137	1/11	0.25*	-0.040	0.019	0.025
Gross alpha	10/11	0.63*	0.026	0.25*	0.063
Gross beta	10/11	36*	0.070	5.9	3.3
H-3	10/11	1,100*	1.0	130	97
Total rad Sr	6/11	22*	-0.011	3.3	2.0
Radionuclides (Bq/L) -- Unfiltered					
Cs-137	1/11	1.4	-0.16	0.16	0.13
Gross alpha	9/11	1.5*	-0.0060	0.35*	0.14
Gross beta	10/11	36*	0.10*	5.7	3.2
H-3	9/11	1,100*	4.0	130	97
Total rad Sr	7/11	23*	-0.049	3.4	2.1
Volatile Organics (μg/L) -- Unfiltered					
1,2-Dichloroethene	3/11	12	J 3.0	~ 5.4*	0.69
Benzene	1/11	U 5.0	J 3.0	~ 4.8*	0.18
Trichloroethene	1/11	10	U 5.0	~ 5.5*	0.45
Up-gradient Well Type					
Anions (mg/L) -- Unfiltered					
Chloride	3/3	2.3	1.9	2.1*	0.12
Nitrate	1/3	1.1	< 1.0	~ 1.0*	0.033
Sulfate (as SO_4)	3/3	18	7.9	12*	3.1
Field Measurements -- Unfiltered					
Conductivity (mS/cm)	3/3	0.44	0.18	0.32*	0.077
Oxygen, dissolved (ppm)	3/3	9.3	9.0	9.2*	0.088
Redox (mV)	3/3	630	390	490*	72
Temperature (°C)	3/3	17	14	15*	0.76
Turbidity (JTU)	3/3	53	6.3	29	13
pH (SU)	3/3	7.9	6.8	7.4*	0.32

Table 27. (continued)

Analyte	N det/ N total	Concentration			
		Max[a]	Min[a]	Av[b]	Standard error[c]
Metals (mg/L) -- Filtered					
Barium	3/3	0.047	0.018	0.030*	0.0089
Calcium	3/3	130	64	99*	18
Cobalt	1/3	0.0047	< 0.0040	~ 0.0042*	0.00023
Iron	1/3	1.2	< 0.050	~ 0.43	0.38
Magnesium	3/3	14	3.0	7.4	3.5
Metals (mg/L) -- Unfiltered					
Manganese	3/3	0.22	0.0034	0.11	0.062
Potassium	3/3	1.5	0.82	1.1*	0.23
Silicon	3/3	5.3	2.6	4.2*	0.82
Sodium	3/3	2.3	1.6	1.8*	0.24
Vanadium	2/3	0.0049	< 0.0020	~ 0.0034*	0.00084
Zinc	1/3	0.0079	< 0.0050	~ 0.0060*	0.00097
Aluminum	3/3	0.23	0.19	0.21*	0.011
Barium	3/3	0.046	0.018	0.030*	0.0083
Calcium	3/3	120	59	95*	18
Iron	3/3	1.4	0.23	0.63	0.36
Magnesium	3/3	14	2.8	7.1	3.3
Manganese	3/3	0.20	0.0048	0.10	0.057
Potassium	3/3	1.9	0.79	1.2*	0.34
Silicon	3/3	5.4	2.9	4.5*	0.82
Silver	1/3	0.0079	< 0.0050	~ 0.0060*	0.00097
Sodium	3/3	2.2	1.6	1.8*	0.21
Vanadium	1/3	0.0040	< 0.0020	~ 0.0027*	0.00067
Zinc	2/3	0.0053	< 0.0050	~ 0.0052*	0.00010
Others -- Filtered					
Alkalinity (mg/L)	3/3	360	190	280*	49
Total dissolved solids (mg/L)	3/3	400	260	330*	39
Others -- Unfiltered					
Alkalinity (mg/L)	3/3	370	190	280*	50
Total organic carbon (mg/L)	3/3	1.8	0.53	1.2*	0.37
Total organic halides (μg/L)	3/3	25	< 5.0	~ 12	6.8
Total suspended solids (mg/L)	1/3	21	< 5.0	~ 10	5.3

Table 27. (continued)

Analyte	N det/ N total	Concentration			
		Max[a]	Min[a]	Av[b]	Standard error[c]
Radionuclides (Bq/L) -- Filtered					
Gross alpha	2/3	0.13*	0.042	0.081*	0.026
Gross beta	3/3	0.29*	0.13*	0.19*	0.052
H-3	3/3	46*	24*	37*	6.7
Radionuclides (Bq/L) -- Unfiltered					
Co-60	1/3	0.12*	-0.18	-0.023	0.087
Gross alpha	3/3	0.28*	0.047*	0.13	0.077
Gross beta	2/3	0.22*	0.10	0.17*	0.037
H-3	3/3	40*	24*	34*	5.2
Volatile Organics (μg/L) -- Unfiltered					
Carbon disulfide	1/3	U 5.0	J 2.0	~ 4.0*	1.0

[a]Prefixes containing J, B, E, Y, U or < mean that the value was estimated, found in the laboratory blank, exceeded the calibration range, exceeded the calibration range and was diluted and reanalyzed, was not detected at that level, or was not quantified at that level, respectively. Radionuclide values that are significantly greater than zero are identified by an *.

[b]Average concentrations significantly greater than zero are identified by an *.

[c]Standard error of the mean.

[d]Not applicable.

Table 28. ORNL WAG 3 groundwater constituents that exceed a reference value from August 21-September 18, 1992

Analyte	Concentration		Reference value	Reference source[b]
	Value[a]	Uncertainty		
Well 985, Sampling Date 27AUG92 *Ground Elevation 829.97 ft, Water Elevation 815.11*				
Anions (mg/L) -- Unfiltered				
Chloride	300	c	250	3
Sulfate (as SO_4)	8.9	c	1.0	D
BNAE Organics-TICs (μg/L) -- Unfiltered				
Unknown-13.23	J 530	c	c	T
Unknown-17.28	J 8.0	c	c	T
Base/Neutral/Acid Extractable Organics (μg/L) -- Unfiltered				
Pentachlorophenol	U 50	c	1	2
Metals (mg/L) -- Filtered				
Boron	0.11	c	0.080	D
Iron	0.27	c	0.050	D
Manganese	0.081	c	0.05	3
Selenium	0.0058	c	0.0050	D
Sodium	80	c	20	2
Vanadium	0.0041	c	0.0020	D
Zinc	0.0051	c	0.0050	D
Metals (mg/L) -- Unfiltered				
Boron	0.093	c	0.080	D
Iron	0.37	c	0.3	3
Manganese	0.074	c	0.05	3
Sodium	76	c	20	2
Others -- Unfiltered				
Total organic carbon (mg/L)	1.3	c	0.50	D
Total organic halides (μg/L)	110	c	5.0	D
Radionuclides (Bq/L) -- Filtered				
Gross alpha	0.63*	0.18	0.555	2
Radionuclides (Bq/L) -- Unfiltered				
Gross alpha	0.84*	0.22	0.555	2

Table 28. (continued)

Analyte	Concentration		Reference value	Reference source[b]
	Value[a]	Uncertainty		
Volatile Organics (μg/L) -- Unfiltered				
Trichloroethene	10	c	5	1
Vinyl chloride	U 10	c	2	1
Volatile Organics-TICs (μg/L) -- Unfiltered				
Unknown-32.25	J 1.4	c	c	T
Well 986, Sampling Date 26AUG92				
Ground Elevation 830.56 ft, Water Elevation 811.54				
Anions (mg/L) -- Unfiltered				
Chloride	420	c	250	3
Sulfate (as SO_4)	3.2	c	1.0	D
BNAE Organics-TICs (μg/L) -- Unfiltered				
Unknown-13.21	J 300	c	c	T
Unknown-17.28	J 6.0	c	c	T
Base/Neutral/Acid Extractable Organics (μg/L) -- Unfiltered				
Pentachlorophenol	U 50	c	1	2
Metals (mg/L) -- Filtered				
Antimony	0.0060	c	0.0050	D
Arsenic	0.020	c	0.010	D
Boron	0.14	c	0.080	D
Iron	0.50	c	0.3	3
Manganese	0.038	c	0.0010	D
Sodium	110	c	20	2
Vanadium	0.0035	c	0.0020	D
Metals (mg/L) -- Unfiltered				
Boron	0.13	c	0.080	D
Iron	0.57	c	0.3	3
Manganese	0.037	c	0.0010	D
Sodium	110	c	20	2
Others -- Unfiltered				
Total organic carbon (mg/L)	1.3	c	0.50	D
Total organic halides (μg/L)	78	c	5.0	D

Table 28. (continued)

Analyte	Concentration		Reference value	Reference source[b]
	Value[a]	Uncertainty		
Volatile Organics (µg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Volatile Organics-TICs (µg/L) -- Unfiltered				
Propane,2,2'-oxybis-10.34	J 50	c	c	T
Unknown-25.47	J 5.0	c	c	T
Unknown-32.28	J 960	c	c	T
Well 987, Sampling Date 24AUG92				
Ground Elevation 857.11 ft, Water Elevation 826.27				
Anions (mg/L) -- Unfiltered				
Sulfate (as SO_4)	7.9	c	1.0	D
BNAE Organics-TICs (µg/L) -- Unfiltered				
Unknown-7.37	J 9.0	c	c	T
Base/Neutral/Acid Extractable Organics (µg/L) -- Unfiltered				
Pentachlorophenol	U 50	c	1	2
Metals (mg/L) -- Filtered				
Manganese	0.10	c	0.05	3
Vanadium	0.0032	c	0.0020	D
Zinc	0.0079	c	0.0050	D
Metals (mg/L) -- Unfiltered				
Aluminum	0.19	c	0.050	D
Iron	0.31	c	0.3	3
Manganese	0.10	c	0.05	3
Others -- Unfiltered				
Total organic carbon (mg/L)	1.8	c	0.50	D
Volatile Organics (µg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Volatile Organics-TICs (µg/L) -- Unfiltered				
Unknown-6.07	J 5.0	c	c	T

Table 28. (continued)

Analyte	Concentration		Reference value	Reference source[b]
	Value[a]	Uncertainty		
Well 988, Sampling Date 25AUG92 *Ground Elevation 910.97 ft, Water Elevation 883.38*				
Anions (mg/L) -- Unfiltered				
Nitrate	1.1	c	1.0	D
Sulfate (as SO_4)	9.8	c	1.0	D
Base/Neutral/Acid Extractable Organics (µg/L) -- Unfiltered				
Pentachlorophenol	U 50	c	1	2
Metals (mg/L) -- Filtered				
Manganese	0.0034	c	0.0010	D
Vanadium	0.0049	c	0.0020	D
Metals (mg/L) -- Unfiltered				
Aluminum	0.23	c	0.2	3
Iron	0.23	c	0.050	D
Manganese	0.0048	c	0.0010	D
Vanadium	0.0040	c	0.0020	D
Zinc	0.0053	c	0.0050	D
Others -- Unfiltered				
Total organic carbon (mg/L)	0.53	c	0.50	D
Total suspended solids (mg/L)	21	c	5.0	D
Volatile Organics (µg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Well 990, Sampling Date 09SEP92 *Ground Elevation 853.91 ft, Water Elevation 822.73*				
Anions (mg/L) -- Unfiltered				
Sulfate (as SO_4)	42	c	1.0	D
Base/Neutral/Acid Extractable Organics (µg/L) -- Unfiltered				
Pentachlorophenol	U 50	c	1	2
Metals (mg/L) -- Filtered				
Manganese	0.0064	c	0.0010	D
Vanadium	0.0031	c	0.0020	D

Table 28. (continued)

Analyte	Concentration		Reference value	Reference source[b]
	Value[a]	Uncertainty		
Metals (mg/L) -- Unfiltered				
Iron	0.16	c	0.050	D
Manganese	0.012	c	0.0010	D
Zinc	0.0085	c	0.0050	D
Others -- Unfiltered				
Total organic carbon (mg/L)	0.63	c	0.50	D
Volatile Organics (µg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Well 991, Sampling Date 08SEP92				
Ground Elevation 854.79 ft, Water Elevation 814.77				
Anions (mg/L) -- Unfiltered				
Sulfate (as SO_4)	33	c	1.0	D
Base/Neutral/Acid Extractable Organics (µg/L) -- Unfiltered				
Pentachlorophenol	U 50	c	1	2
Metals (mg/L) -- Filtered				
Boron	0.20	c	0.080	D
Manganese	0.057	c	0.05	3
Sodium	15	c	5.0	D
Vanadium	0.0021	c	0.0020	D
Zinc	0.0053	c	0.0050	D
Metals (mg/L) -- Unfiltered				
Boron	0.21	c	0.080	D
Iron	0.061	c	0.050	D
Manganese	0.058	c	0.05	3
Sodium	16	c	5.0	D
Others -- Unfiltered				
Total organic carbon (mg/L)	0.80	c	0.50	D
Volatile Organics (µg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1

Table 28. (continued)

Analyte	Concentration			
	Value[a]	Uncertainty	Reference value	Reference source[b]
Well 992, Sampling Date 04SEP92 *Ground Elevation 854.54 ft, Water Elevation 815.70*				
Anions (mg/L) -- Unfiltered				
Sulfate (as SO_4)	120	c	1.0	D
Base/Neutral/Acid Extractable Organics (µg/L) -- Unfiltered				
Pentachlorophenol	U 50	c	1	2
Metals (mg/L) -- Filtered				
Boron	2.0	c	0.080	D
Cobalt	0.0089	c	0.0040	D
Iron	1.0	c	0.3	3
Manganese	1.7	c	0.05	3
Sodium	12	c	5.0	D
Vanadium	0.0032	c	0.0020	D
Zinc	0.011	c	0.0050	D
Metals (mg/L) -- Unfiltered				
Aluminum	0.35	c	0.2	3
Boron	1.9	c	0.080	D
Cobalt	0.0049	c	0.0040	D
Iron	3.3	c	0.3	3
Manganese	1.7	c	0.05	3
Sodium	12	c	5.0	D
Zinc	0.018	c	0.0050	D
Others -- Filtered				
Total dissolved solids (mg/L)	590	c	500	1
Others -- Unfiltered				
Total organic carbon (mg/L)	2.0	c	0.50	D
Radionuclides (Bq/L) -- Filtered				
Gross beta	8.9*	0.50	1.85	2
Total rad Sr	4.5*	0.40	0.296	2
Radionuclides (Bq/L) -- Unfiltered				
Gross beta	8.2*	0.50	1.85	2
Total rad Sr	4.1*	0.40	0.296	2

Table 28. (continued)

Analyte	Concentration		Reference value	Reference source[b]
	Value[a]	Uncertainty		
Volatile Organics (µg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Well 993, Sampling Date 03SEP92				
Ground Elevation 840.39 ft, Water Elevation 812.14				
Anions (mg/L) -- Unfiltered				
Sulfate (as SO_4)	120	c	1.0	D
Base/Neutral/Acid Extractable Organics (µg/L) -- Unfiltered				
Pentachlorophenol	U 50	c	1	2
Metals (mg/L) -- Filtered				
Boron	2.0	c	0.080	D
Manganese	0.0021	c	0.0010	D
Sodium	13	c	5.0	D
Vanadium	0.0029	c	0.0020	D
Metals (mg/L) -- Unfiltered				
Boron	2.0	c	0.080	D
Manganese	0.0043	c	0.0010	D
Sodium	13	c	5.0	D
Others -- Filtered				
Total dissolved solids (mg/L)	570	c	500	1
Others -- Unfiltered				
Total organic carbon (mg/L)	1.3	c	0.50	D
Radionuclides (Bq/L) -- Filtered				
Gross beta	15*	1.0	1.85	2
Total rad Sr	7.8*	0.50	0.296	2
Radionuclides (Bq/L) -- Unfiltered				
Gross beta	12*	1.0	1.85	2
Total rad Sr	7.4*	0.50	0.296	2
Volatile Organics (µg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1

Table 28. (continued)

Analyte	Concentration		Reference value	Reference source[b]
	Value[a]	Uncertainty		
Volatile Organics-TICs (µg/L) -- Unfiltered				
4,4-Diphenyl-2,5-cyclohexadien[d]	J 57	c	c	T
Unknown-23	J 5.0	c	c	T
Well 994, Sampling Date 02SEP92				
Ground Elevation 840.41 ft, Water Elevation 815.24				
Anions (mg/L) -- Unfiltered				
Sulfate (as SO_4)	18	c	1.0	D
BNAE Organics-TICs (µg/L) -- Unfiltered				
Unknown-7.33	J 8.0	c	c	T
Base/Neutral/Acid Extractable Organics (µg/L) -- Unfiltered				
Pentachlorophenol	U 50	c	1	2
Metals (mg/L) -- Filtered				
Boron	0.13	c	0.080	D
Manganese	0.014	c	0.0010	D
Selenium	0.0068	c	0.0050	D
Sodium	9.3	c	5.0	D
Vanadium	0.0035	c	0.0020	D
Metals (mg/L) -- Unfiltered				
Boron	0.12	c	0.080	D
Manganese	0.014	c	0.0010	D
Sodium	9.1	c	5.0	D
Zinc	0.0072	c	0.0050	D
Others -- Unfiltered				
Total organic carbon (mg/L)	1.3	c	0.50	D
Radionuclides (Bq/L) -- Filtered				
Gross beta	36*	1.0	1.85	2
H-3	1,100*	100	740	2
Total rad Sr	22*	1.0	0.296	2

Table 28. (continued)

Analyte	Concentration		Reference value	Reference source[b]
	Value[a]	Uncertainty		
Radionuclides (Bq/L) -- Unfiltered				
Gross beta	36*	1.0	1.85	2
H-3	1,100*	100	740	2
Total rad Sr	23*	1.0	0.296	2
Volatile Organics (μg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Well 995, Sampling Date 01SEP92				
Ground Elevation 837.17 ft, Water Elevation 814.20				
Anions (mg/L) -- Unfiltered				
Nitrate	1.2	c	1.0	D
Sulfate (as SO_4)	34	c	1.0	D
Base/Neutral/Acid Extractable Organics (μg/L) -- Unfiltered				
Pentachlorophenol	U 50	c	1	2
Metals (mg/L) -- Filtered				
Boron	0.10	c	0.080	D
Chromium	0.0051	c	0.0040	D
Manganese	0.0035	c	0.0010	D
Sodium	22	c	20	2
Vanadium	0.0034	c	0.0020	D
Zinc	0.0056	c	0.0050	D
Metals (mg/L) -- Unfiltered				
Aluminum	0.28	c	0.2	3
Boron	0.10	c	0.080	D
Iron	0.42	c	0.3	3
Manganese	0.0083	c	0.0010	D
Sodium	23	c	20	2
Zinc	0.0081	c	0.0050	D
Others -- Unfiltered				
Total organic carbon (mg/L)	0.68	c	0.50	D
Total suspended solids (mg/L)	52	c	5.0	D
Radionuclides (Bq/L) -- Filtered				
Gross alpha	0.59*	0.18	0.555	2

Table 28. (continued)

Analyte	Concentration		Reference value	Reference source[b]
	Value[a]	Uncertainty		
Radionuclides (Bq/L) -- Unfiltered				
Gross alpha	1.5*	0.30	0.555	2
Volatile Organics (µg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Volatile Organics-TICs (µg/L) -- Unfiltered				
Sulfurdioxide-4.98	J 11	c	c	T
Unknown-32.24	J 83	c	c	T
Well 996, Sampling Date 31AUG92				
Ground Elevation 830.31 ft, Water Elevation 809.38				
Anions (mg/L) -- Unfiltered				
Sulfate (as SO_4)	12	c	1.0	D
BNAE Organics-TICs (µg/L) -- Unfiltered				
Unknown-13.29	J 580	c	c	T
Unknown-16.45	J 8.0	c	c	T
Unknown-17.3	J 24	c	c	T
Base/Neutral/Acid Extractable Organics (µg/L) -- Unfiltered				
Pentachlorophenol	U 50	c	1	2
Metals (mg/L) -- Filtered				
Iron	0.25	c	0.050	D
Manganese	0.34	c	0.05	3
Nickel	0.014	c	0.0040	D
Sodium	38	c	20	2
Vanadium	0.0030	c	0.0020	D
Metals (mg/L) -- Unfiltered				
Iron	0.28	c	0.050	D
Manganese	0.34	c	0.05	3
Nickel	0.019	c	0.0040	D
Sodium	37	c	20	2
Others -- Filtered				
Total dissolved solids (mg/L)	650	c	500	1

Table 28. (continued)

Analyte	Concentration		Reference value	Reference source[b]
	Value[a]	Uncertainty		
Others -- Unfiltered				
Total organic carbon (mg/L)	1.4	c	0.50	D
Total organic halides (μg/L)	54	c	5.0	D
Volatile Organics (μg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Volatile Organics-TICs (μg/L) -- Unfiltered				
Propane,2,2'-oxybis--10.31	J 50	c	c	T
Unknown-32.26	J 50	c	c	T
Well 997, Sampling Date 01SEP92				
Ground Elevation 830.24 ft, Water Elevation 812.56				
Anions (mg/L) -- Unfiltered				
Sulfate (as SO_4)	13	c	1.0	D
BNAE Organics-TICs (μg/L) -- Unfiltered				
Unknown-13.22	J 37	c	c	T
Base/Neutral/Acid Extractable Organics (μg/L) -- Unfiltered				
Pentachlorophenol	U 50	c	1	2
Metals (mg/L) -- Filtered				
Iron	2.5	c	0.3	3
Manganese	0.94	c	0.05	3
Sodium	49	c	20	2
Vanadium	0.0032	c	0.0020	D
Metals (mg/L) -- Unfiltered				
Iron	2.7	c	0.3	3
Manganese	0.96	c	0.05	3
Sodium	51	c	20	2
Others -- Filtered				
Total dissolved solids (mg/L)	650	c	500	1
Others -- Unfiltered				
Total organic carbon (mg/L)	5.9	c	0.50	D
Total suspended solids (mg/L)	6.0	c	5.0	D

Table 28. (continued)

Analyte	Concentration		Reference value	Reference source[b]
	Value[a]	Uncertainty		
Radionuclides (Bq/L) -- Filtered				
Gross beta	2.5*	0.30	1.85	2
Total rad Sr	1.1*	0.20	0.296	2
Radionuclides (Bq/L) -- Unfiltered				
Gross beta	2.7*	0.30	1.85	2
Total rad Sr	1.1*	0.20	0.296	2
Volatile Organics (µg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Volatile Organics-TICs (µg/L) -- Unfiltered				
Propane,2,2'-oxybis--10.3	J 50	c	c	T
Unknown-32.24	J 50	c	c	T
Well 998, Sampling Date 21AUG92				
Ground Elevation 872.17 ft, Water Elevation 866.14				
Anions (mg/L) -- Unfiltered				
Sulfate (as SO_4)	18	c	1.0	D
BNAE Organics-TICs (µg/L) -- Unfiltered				
Unknown-7.37	J 12	c	c	T
Base/Neutral/Acid Extractable Organics (µg/L) -- Unfiltered				
Pentachlorophenol	U 50	c	1	2
Metals (mg/L) -- Filtered				
Cobalt	0.0047	c	0.0040	D
Iron	1.2	c	0.3	3
Manganese	0.22	c	0.05	3
Metals (mg/L) -- Unfiltered				
Aluminum	0.21	c	0.2	3
Iron	1.4	c	0.3	3
Manganese	0.20	c	0.05	3
Silver	0.0079	c	0.0050	D
Zinc	0.0053	c	0.0050	D

Table 28. (continued)

Analyte	Concentration			
	Value[a]	Uncertainty	Reference value	Reference source[b]
Others -- Unfiltered				
Total organic carbon (mg/L)	1.4	c	0.50	D
Total organic halides (µg/L)	25	c	5.0	D
Volatile Organics (µg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Well 1248, Sampling Date 14SEP92				
Ground Elevation 860.66 ft, Water Elevation 797.87				
Anions (mg/L) -- Unfiltered				
Fluoride	4.1	c	4	2
Sulfate (as SO_4)	75	c	1.0	D
BNAE Organics-TICs (µg/L) -- Unfiltered				
Hexanoicacid,2-ethyl--12.48	J 11	c	c	T
Base/Neutral/Acid Extractable Organics (µg/L) -- Unfiltered				
Pentachlorophenol	U 50	c	1	2
Field Measurements -- Unfiltered				
pH (SU)	11	c	(6.5, 8.5)	2
Metals (mg/L) -- Filtered				
Aluminum	0.75	c	0.2	3
Antimony	0.0061	c	0.0050	D
Arsenic	0.023	c	0.010	D
Boron	0.62	c	0.080	D
Chromium	0.0089	c	0.0040	D
Copper	0.016	c	0.0070	D
Iron	0.39	c	0.3	3
Manganese	0.013	c	0.0010	D
Sodium	250	c	20	2
Vanadium	0.046	c	0.0020	D
Zinc	0.021	c	0.0050	D
Metals (mg/L) -- Unfiltered				
Aluminum	2.3	c	0.2	3
Arsenic	0.020	c	0.010	D
Boron	0.65	c	0.080	D

Table 28. (continued)

Analyte	Concentration			
	Value[a]	Uncertainty	Reference value	Reference source[b]
Metals (mg/L) -- Unfiltered				
Chromium	0.011	c	0.0040	D
Copper	0.023	c	0.0070	D
Iron	1.7	c	0.3	3
Manganese	0.026	c	0.0010	D
Sodium	270	c	20	2
Vanadium	0.051	c	0.0020	D
Zinc	0.020	c	0.0050	D
Others -- Filtered				
Total dissolved solids (mg/L)	700	c	500	1
Others -- Unfiltered				
Phenolics, total recoverable (mg/L)	0.041	c	0.0010	D
Total organic carbon (mg/L)	1.6	c	0.50	D
Radionuclides (Bq/L) -- Unfiltered				
Total rad Sr	0.80	1.2	0.296	2
Volatile Organics (μg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1

[a]Prefixes containing J, B, E, Y, U or < mean that the value was estimated, found in the laboratory blank, exceeded the calibration range, exceeded the calibration range and was diluted and reanalyzed, was not detected at that level, or was not quantified at that level, respectively. Radionuclide values that are significantly greater than zero are identified by an *.

[b]If a reference limit exists, the source is coded as:

1 Rules of Tennessee Department of Environment and Conservation, Division of Water Pollution Control, Chapter 1200-4-3, General Water Quality Criteria, as amended.

2 40CFR Part 141--National Primary Drinking Water Regulations, Subparts B and G, as amended.

3 40CFR Part 143--National Secondary Drinking Water Regulations, as amended.

D The value exceeds the laboratory detection limit.

T A tentatively identified compound (TIC).

[c]Not applicable.

[d]4,4-Diphenyl-2,5-Cyclohexadiene-1-one,-31.4.

Well 985 was the only well which had a quantifiable amount of an identifiable organic compound, trichloroethene measured at 10 μg/L. Most of the wells had some tentatively identified organic compounds. The organic analysis laboratory was consulted and determined that many of the compounds were present in both of the volatile and semivolatile fractions and were thus reported "twice."

Small amounts of radioactive contamination were detected at wells 985, 992, 993, 994, 995, and 997 with the highest levels at well 994. Tritium was detected at well 994 at 1,100 Bq/L, gross beta at 36 Bq/L, and total rad Sr at 23 Bq/L.

3.5.3 WAG 6

3.5.3.1 Program Description

Groundwater in Solid Waste Storage Area (SWSA) 6 is monitored to comply with Tennessee's Hazardous Waste Management Rule 1200-1-11-.05 (6) (a) 4. (iv). SWSA 6 is one of three SWMUs that make up WAG 6. WAG 6 is located about 1.5 km southwest of the ORNL main site. Besides SWSA 6, WAG 6 is made up of the Emergency Waste Basin and the Explosives Detonation Trench. SWSA 6 was opened for limited disposal in 1969, began full-scale operation in 1973, and it still receives radioactive wastes. In the course of its operation, SWSA 6 has received a broad spectrum of low-level waste (LLW) materials. The basin has not been used since its construction was completed in 1962. The Explosives Detonation Trench is used for explosive and shock-sensitive chemicals requiring disposal.

The wells at SWSA 6 are divided into three types: up-gradient perimeter, down-gradient perimeter, and internal site-characterization wells which provide information about conditions within the site. The SWSA 6 data reported here pertains only to the up- and down-gradient perimeter wells.

SWSA 6 is currently being monitored as part of RCRA assessment monitoring. Fig. 12 shows the groundwater monitoring well network. Eight of the wells at SWSA 6 (wells 840-844, 847, 1242, 1243) are monitored quarterly for ten volatile organic compounds, alkalinity, gross-alpha, total radioactive strontium, Co-60, Cs-137, tritium, alkalinity, and field parameters as part of this program. (Wells 1244 and 1245 used to be monitored quarterly as part of the SWSA 6 network. They were determined early in 1992 to not reflect groundwater conditions at SWSA 6. They are now monitored as part of the WAG 2 network.) The remaining 16 wells are monitored semi-annually. During third quarter 1992 all twenty-four wells were monitored. The up-gradient wells for SWSA 6 are wells 831, 832, 846, 855, 856, 857, 858.

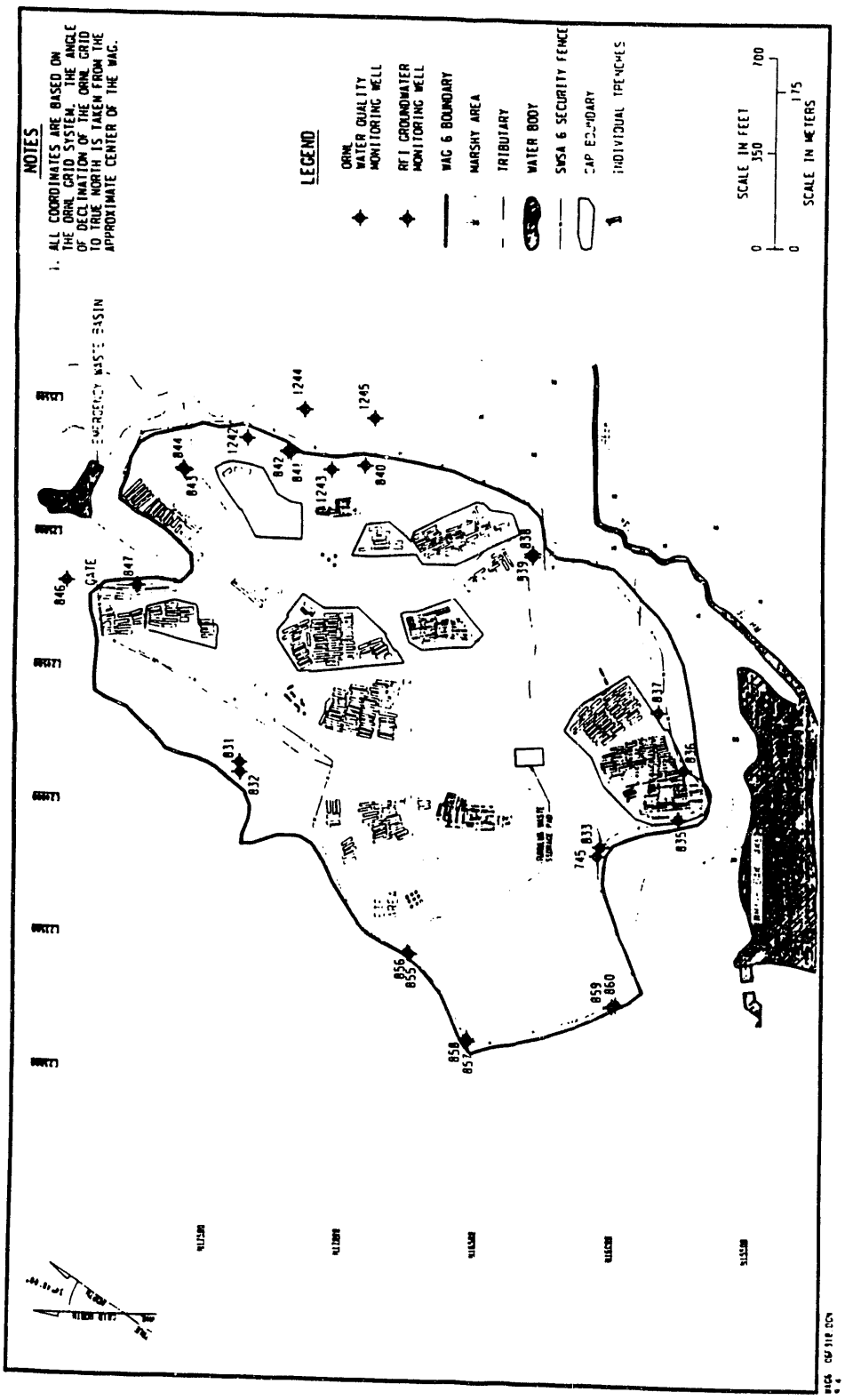

Fig. 12. Location map of WAG 6.

3.5.3.2 Results

The twenty-four perimeter assessment wells at SWSA 6 were sampled July 15-August 14, 1992. A summary of the analytical results is presented in Table 29; Table 30 presents the data which exceed some reference criteria.

Well 842 continues to exhibit the highest level of volatile organic contamination. It was the only SWSA 6 well which had significant volatile organic contaminant results for the quarter, including carbon tetrachloride, chloroform, 1,2-dichloroethane, and trichloroethene. Tritium levels were highest at wells 1243, 843, 1242, 847, 841, 842, 844, 839, and 838 with levels ranging from 940 to 58,000 Bq/L.

3.5.4 Off-Site

3.5.4.1 Program Description

Under the direction of the Energy Systems Environmental and Safety Activities (E&SA) Organization, ORNL implemented a long-term, off-site, residential drinking water quality monitoring program in 1989. The objective of the program is to document water quality from groundwater sources in areas adjacent to the ORR to help assure residents that DOE-ORO plant operations do not affect the quality of groundwater sources.

The wells were selected on the basis of their proximity to the ORR and a representative distribution of sources from the different geologic formations of the area. The wells were sampled in September 1992. The results will be reported in a future quarterly report.

Table 29. ORNL WAG 6 groundwater summary statistics from July 15-August 14, 1992

Analyte	N det/ N total	Concentration			
		Max[a]	Min[a]	Av[b]	Standard error[c]
Down-gradient Well Type					
Field Measurements -- Unfiltered					
Conductivity (mS/cm)	17/17	0.77	0.010	0.31*	0.053
Oxygen, dissolved (ppm)	17/17	9.2	5.8	7.3*	0.26
Redox (mV)	17/17	650	350	430*	22
Temperature (°C)	17/17	17	15	16*	0.18
Turbidity (JTU)	17/17	160	8.4	50*	11
pH (SU)	17/17	7.9	5.2	7.0*	0.24
Others -- Unfiltered					
Alkalinity (mg/L)	17/17	450	6.0	220*	34
Radionuclides (Bq/L) -- Filtered					
Co-60	4/17	21*	-0.030	1.3	1.2
Cs-137	1/17	0.24*	-0.070	0.024	0.017
Gross alpha	7/17	0.16*	0	0.055*	0.011
H-3	15/17	58,000*	5.0	7,000*	3,800
Total rad Sr	11/17	0.20*	-0.010	0.10*	0.014
Volatile Organics (μg/L) -- Unfiltered					
1,1,1-Trichloroethane	1/17	U 5.0	J 2.0	~ 4.8*	0.18
1,2-Dichloroethane	1/17	10	U 5.0	~ 5.3*	0.29
1,2-Dichloroethene	1/17	7.0	U 5.0	~ 5.1*	0.12
Acetone	1/17	B 38	U 10	~ 12*	1.6
Carbon disulfide	3/17	25	J 2.0	~ 6.1*	1.2
Carbon tetrachloride	1/17	39	U 5.0	~ 7.0*	2.0
Chloroform	2/17	40	J 3.0	~ 6.9*	2.1
Trichloroethene	2/17	Y 200	J 4.0	~ 16	11
Up-gradient Well Type					
Field Measurements -- Unfiltered					
Conductivity (mS/cm)	7/7	0.78	0.010	0.32*	0.12
Oxygen, dissolved (ppm)	7/7	9.2	6.2	7.8*	0.44
Redox (mV)	7/7	430	340	380*	12
Temperature (°C)	7/7	16	15	15*	0.086
Turbidity (JTU)	7/7	140	4.2	48*	22
pH (SU)	7/7	8.8	5.2	7.6*	0.46

Table 29. (continued)

Analyte	N det/ N total	Concentration			
		Max[a]	Min[a]	Av[b]	Standard error[c]
Others -- Unfiltered					
Alkalinity (mg/L)	7/7	430	7.	210*	64
Radionuclides (Bq/L) -- Filtered					
Co-60	2/7	0.29*	-0.23	0.039	0.071
Cs-137	2/7	0.96*	-0.040	0.20	0.13
Gross alpha	7/7	0.15*	0.050*	0.093*	0.014
H-3	2/7	28*	5.0	15*	3.3
Total rad Sr	2/7	0.30*	-0.052	0.11*	0.050
Volatile Organics (μg/L) -- Unfiltered					
Acetone	1/7	21	U 10	~ 12*	1.6
Benzene	1/7	U 5.0	J 1.0	~ 4.4*	0.57

[a]Prefixes containing J, B, E, Y, U or < mean that the value was estimated, found in the laboratory blank, exceeded the calibration range, exceeded the calibration range and was diluted and reanalyzed, was not detected at that level, or was not quantified at that level, respectively. Radionuclide values that are significantly greater than zero are identified by an *.

[b]Average concentrations significantly greater than zero are identified by an *.

[c]Standard error of the mean.

[d]Not applicable.

Table 30. ORNL WAG 6 groundwater constituents that exceed a reference value from July 15-August 14, 1992

Analyte	Concentration			
	Value[a]	Uncertainty	Reference value	Reference source[b]
Well 745, Sampling Date 03AUG92 *Ground Elevation 754.18 ft, Water Elevation 751.57*				
Volatile Organics (μg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Well 831, Sampling Date 15JUL92 *Ground Elevation 835.56 ft, Water Elevation 792.73*				
Volatile Organics (μg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Well 832, Sampling Date 16JUL92 *Ground Elevation 838.25 ft, Water Elevation 794.83*				
Volatile Organics (μg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Well 833, Sampling Date 31JUL92 *Ground Elevation 752.74 ft, Water Elevation 750.05*				
Volatile Organics (μg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Volatile Organics-TICs (μg/L) -- Unfiltered				
Unknown-7.67	J 14	c	c	T
Well 835, Sampling Date 28JUL92 *Ground Elevation 759.93 ft, Water Elevation 744.89*				
Field Measurements -- Unfiltered				
pH (SU)	5.4	c	(6.5, 8.5)	2

Table 30. (continued)

Analyte	Concentration			
	Value[a]	Uncertainty	Reference value	Reference source[b]
Volatile Organics (μg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Volatile Organics-TICs (μg/L) -- Unfiltered				
Unknown-16.08	J 49	c	c	T
Unknown-7.49	J 99	c	c	T
Well 836, Sampling Date 28JUL92				
Ground Elevation 763.32 ft, Water Elevation 744.50				
Field Measurements -- Unfiltered				
pH (SU)	5.6	c	(6.5, 8.5)	2
Volatile Organics (μg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Well 837, Sampling Date 27JUL92				
Ground Elevation 771.12 ft, Water Elevation 745.11				
Field Measurements -- Unfiltered				
pH (SU)	5.4	c	(6.5, 8.5)	2
Volatile Organics (μg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Well 838, Sampling Date 28JUL92				
Ground Elevation 752.29 ft, Water Elevation 748.32				
Radionuclides (Bq/L) -- Filtered				
H-3	940*	50	740	2
Volatile Organics (μg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1

Table 30. (continued)

Analyte	Concentration: Value[a]	Concentration: Uncertainty	Reference value	Reference source[b]
Well 839, Sampling Date 29JUL92 *Ground Elevation 751.56 ft, Water Elevation 747.99*				
Radionuclides (Bq/L) -- Filtered				
H-3	1,000*	100	740	2
Volatile Organics (μg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Well 840, Sampling Date 10AUG92 *Ground Elevation 766.94 ft, Water Elevation 748.00*				
Volatile Organics (μg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Volatile Organics-TICs (μg/L) -- Unfiltered				
Unknown-30.22	J 5.0	c	c	T
Well 841, Sampling Date 11AUG92 *Ground Elevation 766.04 ft, Water Elevation 754.71*				
Radionuclides (Bq/L) -- Filtered				
H-3	3,000*	100	740	2
Volatile Organics (μg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Well 842, Sampling Date 10AUG92 *Ground Elevation 767.25 ft, Water Elevation 758.35*				
Radionuclides (Bq/L) -- Filtered				
H-3	2,800*	100	740	2

Table 30. (continued)

Analyte	Concentration		Reference value	Reference source[b]
	Value[a]	Uncertainty		
Volatile Organics (µg/L) -- Unfiltered				
1,2-Dichloroethane	10	c	5	1
Carbon tetrachloride	39	c	5	1
Chloroform	40	c	5.0	D
Trichloroethene	Y 200	c	5	1
Vinyl chloride	U 10	c	2	1
Volatile Organics-TICs (µg/L) -- Unfiltered				
Methane,trichlorofluoro--6.94	J 7.0	c	c	T
Well 843, Sampling Date 12AUG92				
Ground Elevation 781.43 ft, Water Elevation 775.68				
Radionuclides (Bq/L) -- Filtered				
H-3	34,000*	1,000	740	2
Volatile Organics (µg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Volatile Organics-TICs (µg/L) -- Unfiltered				
Unknown-25.45	J 6.0	c	c	T
Unknown-30.2	J 8.0	c	c	T
Well 844, Sampling Date 12AUG92				
Ground Elevation 780.95 ft, Water Elevation 769.30				
Radionuclides (Bq/L) -- Filtered				
H-3	2,700*	100	740	2
Volatile Organics (µg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1

Table 30. (continued)

Analyte	Concentration			
	Value[a]	Uncertainty	Reference value	Reference source[b]
Well 846, Sampling Date 17JUL92 *Ground Elevation 861.03 ft, Water Elevation 815.93*				
Radionuclides (Bq/L) -- Filtered				
Total rad Sr	0.30*	0.21	0.296	2
Volatile Organics (µg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Well 847, Sampling Date 04AUG92 *Ground Elevation 839.62 ft, Water Elevation 804.33*				
Radionuclides (Bq/L) -- Filtered				
H-3	3,500*	100	740	2
Volatile Organics (µg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Well 855, Sampling Date 24JUL92 *Ground Elevation 811.28 ft, Water Elevation 793.79*				
Volatile Organics (µg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Well 856, Sampling Date 23JUL92 *Ground Elevation 810.17 ft, Water Elevation 794.48*				
Field Measurements -- Unfiltered				
pH (SU)	8.8	c	(6.5, 8.5)	2
Volatile Organics (µg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1

Table 30. (continued)

Analyte	Concentration: Value[a]	Concentration: Uncertainty	Reference value	Reference source[b]
Well 857, Sampling Date 20JUL92 *Ground Elevation 847.18 ft, Water Elevation 793.74*				
Field Measurements -- Unfiltered				
pH (SU)	5.2	c	(6.5, 8.5)	2
Volatile Organics (µg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Well 858, Sampling Date 22JUL92 *Ground Elevation 847.22 ft, Water Elevation 790.46*				
Field Measurements -- Unfiltered				
pH (SU)	8.8	c	(6.5, 8.5)	2
Volatile Organics (µg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Volatile Organics-TICs (µg/L) -- Unfiltered				
Unknown-28.34	JB 5.0	c	c	T
Well 859, Sampling Date 05AUG92 *Ground Elevation 777.91 ft, Water Elevation 759.02*				
Field Measurements -- Unfiltered				
pH (SU)	5.2	c	(6.5, 8.5)	2
Volatile Organics (µg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Well 860, Sampling Date 07AUG92 *Ground Elevation 777.14 ft, Water Elevation 757.89*				
Volatile Organics (µg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1

Table 30. (continued)

Analyte	Concentration		Reference value	Reference source[b]
	Value[a]	Uncertainty		
Well 1242, Sampling Date 13AUG92 *Ground Elevation 775.11 ft, Water Elevation 759.32*				
Radionuclides (Bq/L) -- Filtered				
H-3	12,000*	1,000	740	2
Volatile Organics (µg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1
Volatile Organics-TICs (µg/L) -- Unfiltered				
1-Hexanol,2-ethyl-28.74	J 6.0	c	c	T
Well 1243, Sampling Date 14AUG92 *Ground Elevation 778.66 ft, Water Elevation 760.27*				
Radionuclides (Bq/L) -- Filtered				
Co-60	21*	[illegible].0	7.4	4
H-3	58,000*	1,000	740	2
Volatile Organics (µg/L) -- Unfiltered				
Vinyl chloride	U 10	c	2	1

[a]Prefixes containing J, B, E, Y, U or < mean that the value was estimated, found in the laboratory blank, exceeded the calibration range, exceeded the calibration range and was diluted and reanalyzed, was not detected at that level, or was not quantified at that level, respectively. Radionuclide values that are significantly greater than zero are identified by an *.

[b]If a reference limit exists, the source is coded as:

1 Rules of Tennessee Department of Environment and Conservation, Division of Water Pollution Control, Chapter 1200-4-3, General Water Quality Criteria, as amended.
2 40CFR Part 141--National Primary Drinking Water Regulations, Subparts B and G, as amended.
3 40CFR Part 143--National Secondary Drinking Water Regulations, as amended.
D The value exceeds the laboratory detection limit.
T A tentatively identified compound (TIC).

[c]Not applicable.

4.1 MILK

Joan F. Hughes

4.1.1 Program Description

Raw milk from five locations, including one dairy, within a radius of 80 km of Oak Ridge, is monitored for I-131 and total rad Sr. Samples are collected each month from the stations located near the Oak Ridge area (Fig. 13). Samples are analyzed for I-131 by gamma spectroscopy and for total rad Sr by chemical separation and low-level beta counting. Instrument background values are subtracted from the measured values of I-131 and total rad Sr in milk samples, and net activity concentrations are summarized.

4.1.2 Procedure and Results

Concentrations of I-131 are shown in Table 31. Concentrations of total rad Sr are shown in Table 32.

The 50-y committed effective dose equivalent (EDE) was calculated for a station when the average value obtained was statistically greater than zero. The significant measured average concentrations of total rad Sr (assuming 100% Sr-90) and I-131 in milk were used to calculate the potential 50-y committed effective dose equivalents. This calculation is based on the assumption that 1 L/day of milk is ingested at these concentrations for 310 days. Doses resulting from ingestion of milk were less than 1% of DOE's guideline of 1000 μSv.

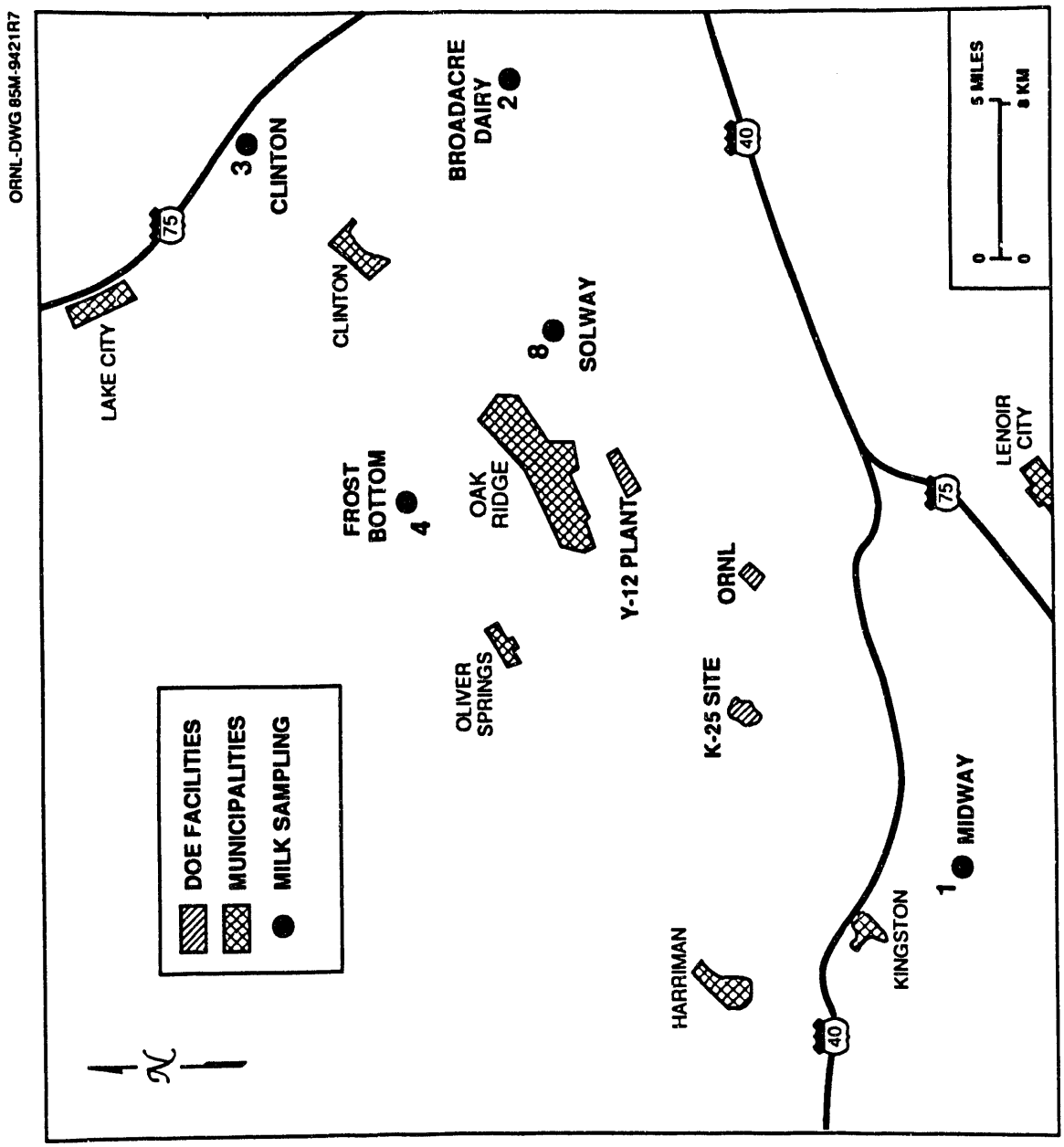

Fig. 13. Map showing milk sampling locations.

Table 31. Concentrations of I-131 in milk and calculated doses, July-September 1992

Station[a]	Number of Samples[b]	Concentration (Bq/L) Max	Min	Av[c]	Standard error[d]	EDE (μSv)[e]
1	1	0.020	0.020	0.020		
2	1	-0.010	-0.010	-0.010		
3	3	0.020	-0.020	0.005	0.012	
4	3	0.010	-0.020	-0.007	0.009	
8	2	0.040	0.010	0.025	0.015	

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

[b]At Stations 1 & 2 a single sample was collected. That value is reported as the average and no standard of error can be calculated.

[c]Average concentrations significantly greater than zero are identified by an *.

[d]Standard error of mean.

[e]Potential 50-y committed effective dose equivalents (EDE) from drinking 310 L of milk per year containing average radionuclide concentrations at each location. The EDE is estimated for stations whose average value is statistically greater than zero.

Table 32. Concentrations of total rad Sr in milk and calculated doses, July-September 1992

Station[a]	Number of Samples[b]	Concentration (Bq/L)				EDE (μSv)[e]
		Max	Min	Av[c]	Standard error[d]	
1	1	0.083	0.083	0.083		
2	1	0.063	0.063	0.063		
3	3	0.210	0.083	0.125*	0.042	1.6
4	3	0.300	0.170	0.250*	0.040	3.2
8	2	0.200	0.010	0.105	0.095	

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

[b]At Stations 1 & 2 a single sample was collected. That value is reported as the average and no standard error can be calculated.

[c]Average concentrations significantly greater than zero are identified by an *.

[d]Standard error of mean.

[e]Potential 50-y committed effective dose equivalents (EDE) from drinking 310 L of milk per year containing average radionuclide concentrations at each location. The EDE is estimated for stations whose average value is statistically greater than zero.

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