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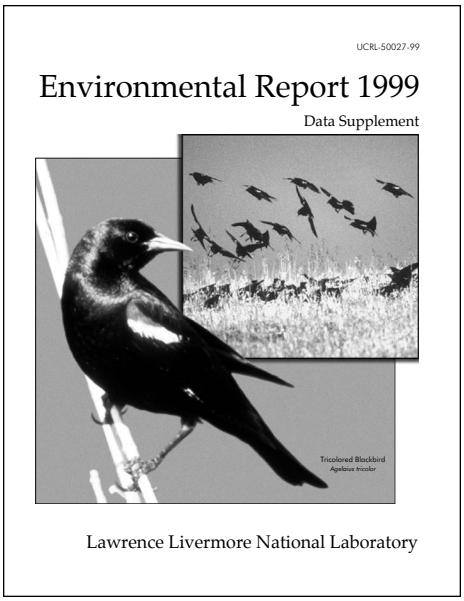
Environmental Report 1999

Data Supplement

Tricolored Blackbird
Agelaius tricolor

Lawrence Livermore National Laboratory



Cover

The Tricolored Blackbird (*Agelaius tricolor*), which has state and federal status as a species of Special Concern, is endemic only to California and is largely restricted to the San Joaquin Valley where it is estimated that populations have declined by at least 50% in the last half-century. It roosts and nests in cattail or tule marshes in dense colonies that can number in the thousands of birds. The male Tricolored has a darker red patch than the Red-winged Blackbird and a conspicuous white margin that is identifiable even in flight.

Historically, Site 300 has had a small population nesting in the Elk Ravine wetland. This colony is considered unique because Tricoloreds typically do not inhabit foothill habitat areas like those at Site 300. When Tricoloreds are actively nesting, LLNL restricts traffic levels to protect the adult birds during their egg incubation period and rearing of young (roughly late March through May). LLNL wildlife biologists collect information on the density of nesting birds, productivity at the nest sites, and the areas used by the colony for foraging. This information is important to our understanding of the natural history and wildlife management aspects of the site as well as to state and federal resource agencies that track Tricolored population trends across California.

Cover photos provided by:
- flock–Jim S. Woollett, Jr., wildlife biologist, LLNL
- single bird–David Menke, outdoor recreation planner, Lower Klamath National Wildlife Refuge, U.S. Fish and Wildlife Service

Composition
Beverly L. Chamberlain
Sherry A. Emmons

Art and Design
Lee A. Dravidzius
Brett S. Clark

For further information about this report contact: Bert Heffner, LLNL Public Affairs Department, P.O. Box 808, Livermore, CA 94550, (510) 424-4026. This report can be accessed on the Internet at http://www.llnl.gov/saer. It is also available to DOE employees and DOE contractors from: Office of Scientific and Technical Information, P.O. Box 62, Oak Ridge, TN 37831 and to the public from: National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161.

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Data Supplement

Authors

Jennifer M. Larson

Arthur H. Biermann
Robert J. Harrach
Paris E. Althouse
Nicholas A. Bertoldo
Richard G. Blake
Erich R. Brandstetter
Shari L. Brigdon
Richard A. Brown
Eric Christofferson
Karen J. Folks
Gretchen M. Gallegos
Lucinda M. Garcia
Ted A. Giesing
Allen R. Grayson
Linda C. Hall
Donald H. MacQueen
Sandra Mathews
S. Ring Peterson
Michael J. Taffet
Paula J. Tate
Robert J. Vellinger
Rebecca J. Ward
Robert A. Williams

Editors

Karen S. Rath
Nancy J. Woods
Gloria J. Cannon
Nona M. Sanford

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Preface

This Data Supplement to the Lawrence Livermore National Laboratory's (LLNL's) annual *Environmental Report 1999* was prepared for the U.S. Department of Energy. The main volume is intended to provide all information on LLNL's environmental impact and compliance activities that is of interest to most readers. The Data Supplement supports main volume summary data and is essentially a detailed data report that provides individual data points, where applicable. Some summary data are also included in the Data Supplement, and more detailed accounts are given of sample collection and analytical methods.

The two volumes are organized in a parallel fashion to aid the reader in cross-referencing between them. This supplement includes more detailed information to support the nine chapters in the main volume that cover monitoring of air, air effluent, sewerable water, surface water, ground water, soil and sediment, vegetation and foodstuff, environmental radiation, and quality assurance. The other five chapters in the main volume have no supporting information in the Data Supplement.

As in our previous annual reports, data are presented in Système International (SI) units. In particular, the primary units used for radiological results are becquerels and sieverts for activity and dose, with curies and rem used secondarily ($1\ \text{Bq} = 2.7 \times 10^{-11}\ \text{Ci}$; $1\ \text{Sv} = 100\ \text{rem}$).

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Air Effluent Monitoring

Arthur H. Biermann
Linda C. Hall

Air Effluent Sampling Methods

At the beginning of 1999, Lawrence Livermore National Laboratory used 101 continuously operating radiological sampling systems on air exhausts at eight facilities at the Livermore site (main volume, **Table 4-1**). These samplers were used to determine actual emissions from operations involving radioactive materials at the facilities and to verify the integrity of emission control systems. Some sampling systems at Buildings 251, 292, and 490 were either deactivated or removed in 1999. For a further discussion see Chapter 4 of the main volume.

Air samples for particulate emissions are extracted downstream of high-efficiency particulate air (HEPA) filters and prior to the discharge point to the atmosphere. In most cases, simple, filter-type aerosol collection systems are used. However, in some facilities (Buildings 251 and 332), continuous air monitors (CAMs) are used for sampling to check for alpha activity. In addition to collecting a sample of particles, the CAM units provide an alarm capability for the facility in the event of a release of particulates containing alpha activity. Both types of sampling systems, the simple filter type and alpha alarm monitors, are used to monitor discharge points from Building 332. In the event of a power outage, the air sampling systems in critical facilities are switched to auxiliary power and continue to operate.

The sample filters are 47-mm-diameter membrane filters and are changed weekly or biweekly, depending on the facility. After sample collection, filters are placed in glassine envelopes, and each envelope is tagged with a unique bar code label. Filter sample data—including location, equipment identification, bar code, sampling start date, sampling stop date, and flow rate—are entered into the Hazards Control Department (HCD) sample tracking and reporting (STAR) computer system. Sampling procedures are contained in the environmental section of the discipline action plan for a facility. Filters are analyzed at the HCD Radiological Measurements Laboratory (RML) for gross alpha and beta activity using gas proportional counters. Analysis is delayed for at least four days following sample termination to allow for the decay of naturally occurring radon daughters. To verify the operation of the counting system, calibration and background samples are intermixed with the sample filters for analysis. Analytical

techniques are consistent with the Environmental Protection Agency (EPA) recommended procedures. Further details about sampling and analysis are discussed in the *Environmental Monitoring Plan* (Tate et al. 1999).

Each stack of the Tritium Facility (Building 331) is monitored for tritium release by both a continuous monitoring alarm system and continuous molecular sieve samplers. The alarmed samplers, Overhoff ionization chambers, provide real-time total tritium concentration release levels (tritiated hydrogen gas and tritiated water combined). The sieve samplers, which can discriminate between tritiated water vapor and tritiated hydrogen gas, provide the values used for environmental reporting. Each sieve sampler (not alarmed) runs in parallel with an alarmed monitor and consists of two molecular sieves. The first sieve collects tritiated water vapor; the second sieve contains a palladium-coated catalyst that converts tritiated hydrogen to tritiated water and collects the tritiated water on the sieve. Sieves are changed weekly. The sieve samples are logged into the HCD STAR sample tracking system and submitted to the HCD Analytical Laboratory, where tritiated water is baked out and collected. RML analyzes the retrieved tritium for beta activity using scintillation counting techniques.

Data

Annual summaries of gross alpha, gross beta, and tritium data for samplers at each monitored facility are summarized in **Tables 4-1** through **4-8**. The tables present the ratio of the number of results that have activity concentration greater than the minimum detectable concentration (MDC) of the analysis to the total number of samples in the year, and the minimum, median, and maximum activity concentrations of the samples (in Bq/m^3). If the concentration is negative, the result is considered to be a nondetection. The MDC is defined as the smallest concentration of radioactive material that can be detected (distinguished from background) with some specified degree of confidence. Analytical results are reported as a measured concentration in Bq per volume of air. If the concentration reported is negative, the result is considered to be a nondetection. A detailed discussion of these results is provided in Chapter 14 of the main volume of this report.

Table 4-1. Summary of gross alpha and gross beta in air effluent samples from monitored emission points at Building 175, 1999.

Emission point	No. >MDC[(a)]/ total samples	Minimum (Bq/m^3)	Median (Bq/m^3)	Maximum (Bq/m^3)
Gross alpha				
1	2/48	-6.88×10^{-5}	7.46×10^{-6}	3.02×10^{-4}
2	0/48	-6.51×10^{-5}	3.81×10^{-6}	1.20×10^{-4}
3	1/48	-2.80×10^{-5}	1.03×10^{-6}	1.02×10^{-4}
4	0/49	-2.58×10^{-5}	-5.98×10^{-7}	5.74×10^{-5}
5	0/47	-6.33×10^{-5}	3.92×10^{-6}	1.43×10^{-4}
6	0/47	-6.59×10^{-5}	4.63×10^{-6}	2.59×10^{-4}
Gross beta				
1	8/48	-1.76×10^{-4}	1.01×10^{-4}	4.70×10^{-3}
2	5/48	-1.11×10^{-4}	1.05×10^{-4}	1.08×10^{-3}
3	10/48	-7.73×10^{-5}	8.38×10^{-5}	6.11×10^{-3}
4	0/49	-8.47×10^{-5}	1.46×10^{-5}	1.32×10^{-4}
5	2/47	-1.38×10^{-4}	-1.33×10^{-6}	8.47×10^{-4}
6	1/47	-1.55×10^{-4}	4.37×10^{-5}	4.11×10^{-4}

[a] MDC = Minimum detectable concentration. (See main volume, Chapter 14, Quality Assurance, for an explanation of MDC.)

Table 4-2. Summary of gross alpha and gross beta in air effluent samples from monitored emission points at Building 177, 1999.

Emission point	No. >MDC[(a)]/ total samples	Minimum (Bq/m^3)	Median (Bq/m^3)	Maximum (Bq/m^3)
Gross alpha				
1	0/50	-2.58×10^{-5}	2.54×10^{-6}	6.36×10^{-5}
Gross beta				
1	0/50	-6.96×10^{-5}	2.52×10^{-5}	2.03×10^{-4}

[a] MDC = Minimum detectable concentration. (See main volume, Chapter 14, Quality Assurance, for an explanation of MDC.)

Table 4–3. Summary of gross alpha and gross beta in air effluent samples from monitored emission points at Building 251, 1999.

Emission point[a]	No. >MDC[b,c]/ total samples	Minimum (Bq/m^3)	Median (Bq/m^3)	Maximum (Bq/m^3)
Gross Alpha				
1	0/26	-6.36×10^{-5}	4.46×10^{-5}	1.84×10^{-4}
2	0/1	1.17×10^{-4}	1.17×10^{-4}	1.17×10^{-4}
3	0/26	-6.59×10^{-5}	2.41×10^{-5}	1.39×10^{-4}
4	0/1	4.85×10^{-5}	4.85×10^{-5}	4.85×10^{-5}
5	1/26	-2.58×10^{-5}	2.69×10^{-5}	1.60×10^{-4}
6	1/25	-6.18×10^{-5}	1.00×10^{-4}	5.70×10^{-4}
7	0/26	-1.51×10^{-5}	1.34×10^{-5}	8.55×10^{-5}
8	0/2	3.70×10^{-6}	1.40×10^{-5}	2.42×10^{-5}
10	3/26	-7.84×10^{-5}	9.62×10^{-5}	4.48×10^{-4}
11	0/1	1.84×10^{-4}	1.84×10^{-4}	1.84×10^{-4}
12	0/1	8.58×10^{-7}	8.58×10^{-7}	8.58×10^{-7}
13	0/26	-6.85×10^{-5}	2.39×10^{-5}	1.63×10^{-4}
14	1/26	-4.59×10^{-5}	4.44×10^{-5}	3.52×10^{-4}
15	0/1	3.92×10^{-4}	3.92×10^{-4}	3.92×10^{-4}
16	1/26	-2.69×10^{-5}	2.28×10^{-5}	1.35×10^{-4}
17	2/26	-2.38×10^{-5}	3.14×10^{-5}	1.74×10^{-4}
18	1/26	-3.96×10^{-5}	3.69×10^{-5}	1.96×10^{-4}
19	1/26	-2.89×10^{-5}	3.65×10^{-5}	1.74×10^{-4}
20	1/26	-1.89×10^{-5}	4.51×10^{-5}	1.41×10^{-4}
21	3/26	-9.36×10^{-6}	7.49×10^{-5}	1.96×10^{-4}
22	0/1	3.77×10^{-5}	3.77×10^{-5}	3.77×10^{-5}
23	0/26	-2.51×10^{-5}	2.85×10^{-5}	1.26×10^{-4}
24	1/26	-3.24×10^{-5}	8.45×10^{-5}	2.53×10^{-4}
25	0/26	-3.58×10^{-5}	2.69×10^{-5}	1.20×10^{-4}
26	0/26	-4.88×10^{-5}	4.24×10^{-5}	1.90×10^{-4}
27	0/1	-4.22×10^{-6}	-4.22×10^{-6}	-4.22×10^{-6}
28	0/26	-5.55×10^{-5}	6.96×10^{-5}	1.90×10^{-4}
29	1/26	-3.00×10^{-5}	4.18×10^{-5}	1.41×10^{-4}
30	0/25	-4.40×10^{-5}	6.01×10^{-5}	1.76×10^{-4}
31	0/1	9.92×10^{-6}	9.92×10^{-6}	9.92×10^{-6}
32	0/1	4.81×10^{-5}	4.81×10^{-5}	4.81×10^{-5}
33	6/26	-1.25×10^{-5}	6.42×10^{-5}	2.22×10^{-4}
34	3/26	-2.09×10^{-5}	5.70×10^{-5}	1.69×10^{-4}
35	0/26	-2.87×10^{-5}	2.29×10^{-5}	9.88×10^{-5}

Table 4–3. Summary of gross alpha and gross beta in air effluent samples from monitored emission points at Building 251, 1999 (continued).

Emission point[a]	No. >MDC[b,c]/ total samples	Minimum (Bq/m^3)	Median (Bq/m^3)	Maximum (Bq/m^3)
Gross alpha				
36	0/1	3.37×10^{-5}	3.37×10^{-5}	3.37×10^{-5}
37	0/1	4.81×10^{-5}	4.81×10^{-5}	4.81×10^{-5}
38	0/1	2.52×10^{-5}	2.52×10^{-5}	2.52×10^{-5}
39	0/1	2.65×10^{-5}	2.65×10^{-5}	2.65×10^{-5}
40	0/26	-1.32×10^{-5}	2.24×10^{-5}	8.10×10^{-5}
41	0/1	5.62×10^{-5}	5.62×10^{-5}	5.62×10^{-5}
42	0/1	7.47×10^{-6}	7.47×10^{-6}	7.47×10^{-6}
43	0/26	-1.15×10^{-5}	1.26×10^{-5}	6.36×10^{-5}
44	1/26	-6.03×10^{-5}	8.10×10^{-5}	1.55×10^{-4}
45	1/26	-3.61×10^{-5}	4.13×10^{-5}	2.24×10^{-4}
46	5/26	-2.58×10^{-5}	3.10×10^{-5}	1.92×10^{-4}
47	2/26	-1.94×10^{-5}	5.40×10^{-5}	1.58×10^{-4}
48	3/26	-1.82×10^{-5}	5.18×10^{-5}	2.33×10^{-4}
49	1/26	-2.49×10^{-5}	3.85×10^{-5}	1.38×10^{-4}
Gross beta				
1	0/26	-3.54×10^{-5}	2.23×10^{-4}	4.66×10^{-4}
2	1/1	5.81×10^{-4}	5.81×10^{-4}	5.81×10^{-4}
3	4/26	-6.18×10^{-6}	1.70×10^{-4}	4.59×10^{-4}
4	1/1	4.48×10^{-4}	4.48×10^{-4}	4.48×10^{-4}
5	11/26	4.81×10^{-5}	2.21×10^{-4}	7.40×10^{-4}
6	1/25	-1.14×10^{-4}	2.75×10^{-4}	6.36×10^{-4}
7	7/26	-1.07×10^{-6}	1.07×10^{-4}	2.55×10^{-4}
8	0/2	3.96×10^{-7}	1.25×10^{-4}	2.50×10^{-4}
10	18/26	2.54×10^{-5}	7.38×10^{-4}	1.88×10^{-3}
11	0/1	1.73×10^{-3}	1.73×10^{-3}	1.73×10^{-3}
12	0/1	1.45×10^{-5}	1.45×10^{-5}	1.45×10^{-5}
13	2/26	-4.29×10^{-5}	1.96×10^{-4}	4.14×10^{-4}
14	13/26	-5.11×10^{-5}	3.74×10^{-4}	9.25×10^{-4}
15	0/1	1.43×10^{-3}	1.43×10^{-3}	1.43×10^{-3}
16	4/26	-2.09×10^{-5}	1.19×10^{-4}	3.85×10^{-4}
17	17/26	8.55×10^{-5}	3.44×10^{-4}	1.26×10^{-3}
18	2/26	-5.14×10^{-5}	1.43×10^{-4}	3.48×10^{-4}
19	3/26	-1.27×10^{-4}	1.46×10^{-4}	2.96×10^{-4}
20	2/26	3.31×10^{-5}	1.70×10^{-4}	3.16×10^{-4}

Table 4–3. Summary of gross alpha and gross beta in air effluent samples from monitored emission points at Building 251, 1999 (concluded).

Emission point[a]	No. >MDC[b,c]/ total samples	Minimum (Bq/m^3)	Median (Bq/m^3)	Maximum (Bq/m^3)
Gross beta				
21	19/26	1.08×10^{-4}	3.64×10^{-4}	8.40×10^{-4}
22	1/1	1.04×10^{-4}	1.04×10^{-4}	1.04×10^{-4}
23	5/26	-3.01×10^{-6}	1.27×10^{-4}	3.15×10^{-4}
24	1/26	1.76×10^{-5}	2.04×10^{-4}	4.11×10^{-4}
25	1/26	-4.14×10^{-5}	1.29×10^{-4}	2.87×10^{-4}
26	1/25	5.48×10^{-5}	2.62×10^{-4}	5.66×10^{-4}
27	0/1	3.92×10^{-4}	3.92×10^{-4}	3.92×10^{-4}
28	15/26	-9.29×10^{-5}	4.42×10^{-4}	1.35×10^{-3}
29	3/26	4.40×10^{-5}	1.19×10^{-4}	2.94×10^{-4}
30	12/26	7.59×10^{-5}	3.29×10^{-4}	7.62×10^{-4}
31	0/1	5.77×10^{-4}	5.77×10^{-4}	5.77×10^{-4}
32	0/1	4.81×10^{-5}	4.81×10^{-5}	4.81×10^{-5}
33	26/26	2.56×10^{-4}	6.41×10^{-4}	1.82×10^{-3}
34	14/26	1.04×10^{-4}	2.87×10^{-4}	6.96×10^{-4}
35	2/26	8.84×10^{-6}	9.60×10^{-5}	2.35×10^{-4}
36	1/1	6.14×10^{-4}	6.14×10^{-4}	6.14×10^{-4}
37	1/1	4.11×10^{-4}	4.11×10^{-4}	4.11×10^{-4}
38	0/1	4.33×10^{-5}	4.33×10^{-5}	4.33×10^{-5}
39	0/1	-1.08×10^{-6}	-1.08×10^{-6}	-1.08×10^{-6}
40	5/26	1.45×10^{-5}	8.62×10^{-5}	2.16×10^{-4}
41	0/1	1.60×10^{-4}	1.60×10^{-4}	1.60×10^{-4}
42	0/1	7.77×10^{-5}	7.77×10^{-5}	7.77×10^{-5}
43	3/26	-1.97×10^{-5}	6.59×10^{-5}	2.98×10^{-4}
44	12/26	9.25×10^{-5}	2.61×10^{-4}	7.99×10^{-4}
45	4/26	1.95×10^{-5}	1.64×10^{-4}	5.48×10^{-4}
46	25/26	1.14×10^{-4}	3.38×10^{-4}	1.34×10^{-3}
47	25/26	1.21×10^{-4}	4.00×10^{-4}	1.51×10^{-3}
48	15/26	1.29×10^{-5}	3.11×10^{-4}	1.07×10^{-3}
49	13/26	2.41×10^{-5}	1.92×10^{-4}	1.87×10^{-3}

a Results reported are from the simple, filter-type samplers (see text). The CAM samplers, located along with the simple filter samplers at stations 46–49, are in place for facility alarm purposes rather than environmental reporting, so their results are not included here.

b MDC = Minimum detectable concentration. (See main volume, Chapter 14, Quality Assurance, for an explanation of MDC.)

c The sample numbers having only one or two samples were deactivated at the beginning of 1999 (see main volume, Chapter 4).

Table 4–4. Summary of gross alpha and gross beta in air effluent samples from monitored emission point at Building 292, 1999.

Emission point	No. >MDC[a,b]/ total samples	Minimum (Bq/m^3)	Median (Bq/m^3)	Maximum (Bq/m^3)
Gross alpha				
1	1/14	-8.99×10^{-6}	1.35×10^{-6}	7.10×10^{-5}
Gross beta				
1	1/14	-2.68×10^{-5}	2.28×10^{-5}	1.07×10^{-4}

[a] MDC = Minimum detectable concentration. (See main volume, Chapter 14, Quality Assurance, for an explanation of MDC.)

[b] This sampler was removed in 1999 (see main volume, Chapter 4).

Table 4–5. Summary of tritium in air effluent samples from monitored emission points at Building 331, 1999.

Emission point[a]	No. >MDC[b]/ total samples	Minimum (Bq/m^3)	Median (Bq/m^3)	Maximum (Bq/m^3)
HT				
Stack 1	51/51	6.77	1.40×10^{1}	2.96×10^{2}
Stack 2	51/51	3.20×10^{2}	1.04×10^{3}	1.28×10^{5}
HTO				
Stack 1	51/51	2.58×10^{1}	9.51×10^{2}	2.33×10^{3}
Stack 2	51/51	1.10×10^{3}	4.00×10^{3}	1.56×10^{5}

[a] Results reported are from the molecular sieve samplers (see text). The ionization chamber samplers are in place for facility alarm purposes rather than environmental reporting, so their results are not included here.

[b] MDC = Minimum detectable concentration. (See main volume, Chapter 14, Quality Assurance, for an explanation of MDC.)

Table 4–6. Summary of gross alpha and gross beta in air effluent samples from monitored emission points at Building 332, 1999.

Emission point[a]	No. >MDC[b]/ total samples	Minimum (Bq/m^3)	Median (Bq/m^3)	Maximum (Bq/m^3)
Gross alpha				
SP-1A	0/52	-3.45×10^{-5}	4.21×10^{-6}	1.52×10^{-4}
SP-1B	0/52	-5.14×10^{-5}	1.71×10^{-6}	8.07×10^{-5}
SP-2A	0/52	-3.81×10^{-5}	6.05×10^{-6}	9.32×10^{-5}
SP-2B	0/52	-3.77×10^{-5}	4.50×10^{-6}	1.20×10^{-4}
SP-3	0/52	-5.33×10^{-5}	1.89×10^{-6}	1.14×10^{-4}
SP-4	0/52	-3.29×10^{-5}	-1.05×10^{-6}	8.84×10^{-5}
SP-5	0/52	-3.47×10^{-5}	1.49×10^{-6}	1.04×10^{-4}
SP-6A	0/52	-5.07×10^{-5}	-1.05×10^{-6}	5.85×10^{-5}
SP-6B	0/52	-3.45×10^{-5}	1.31×10^{-6}	1.11×10^{-4}
SP-7A	0/52	-3.96×10^{-5}	2.01×10^{-6}	8.44×10^{-5}
SP-7B	0/52	-4.59×10^{-5}	3.87×10^{-6}	8.66×10^{-5}
SP-8	0/52	-3.18×10^{-5}	2.34×10^{-6}	9.21×10^{-5}
SP-9	0/52	-5.07×10^{-5}	3.26×10^{-6}	8.70×10^{-5}
SP-10	0/52	-6.88×10^{-5}	2.44×10^{-7}	1.10×10^{-4}
SP-11	0/52	-3.89×10^{-5}	-1.70×10^{-5}	1.04×10^{-4}
SP-12	0/52	-1.03×10^{-4}	-2.90×10^{-6}	1.85×10^{-4}
Gross beta				
SP-1A	0/52	-1.51×10^{-4}	3.50×10^{-5}	2.88×10^{-4}
SP-1B	0/52	-9.95×10^{-5}	1.04×10^{-6}	1.60×10^{-4}
SP-2A	0/52	-8.29×10^{-5}	2.80×10^{-5}	1.79×10^{-4}
SP-2B	0/52	-1.05×10^{-4}	3.00×10^{-5}	2.27×10^{-4}
SP-3	0/52	-8.81×10^{-5}	1.38×10^{-5}	1.94×10^{-4}
SP-4	0/52	-1.33×10^{-4}	1.78×10^{-5}	2.67×10^{-4}
SP-5	0/52	-1.16×10^{-4}	1.80×10^{-5}	2.33×10^{-4}
SP-6A	2/52	-1.38×10^{-4}	1.21×10^{-5}	1.59×10^{-3}
SP-6B	0/52	-1.38×10^{-4}	1.98×10^{-5}	1.73×10^{-4}
SP-7A	0/52	-1.39×10^{-4}	4.40×10^{-6}	2.20×10^{-4}
SP-7B	0/52	-1.15×10^{-4}	1.11×10^{-5}	1.38×10^{-4}
SP-8	0/52	-1.71×10^{-4}	5.00×10^{-7}	1.50×10^{-4}
SP-9	0/52	-1.52×10^{-4}	-3.35×10^{-8}	1.30×10^{-4}
SP-10	0/52	-2.29×10^{-4}	-1.00×10^{-6}	3.01×10^{-4}
SP-11	0/52	-1.55×10^{-4}	2.11×10^{-5}	1.81×10^{-4}
SP-12	0/52	-3.25×10^{-4}	2.55×10^{-6}	3.10×10^{-4}

a Results reported are from the simple, filter-type samplers (see text). The CAM samplers are in place for facility alarm purposes rather than environmental reporting, so their results are not included here.

b MDC = Minimum detectable concentration. (See main volume, Chapter 14, Quality Assurance, for an explanation of MDC.)

Table 4–7. Summary of gross alpha and gross beta in air effluent samples from monitored emission points at Building 490, 1999.

Emission point	No. >MDC[a,b]/ total samples	Minimum (Bq/m^3)	Median (Bq/m^3)	Maximum (Bq/m^3)
Gross alpha				
1	0/15	-1.51×10^{-5}	-1.12×10^{-5}	3.16×10^{-5}
2	0/21	-1.95×10^{-4}	-9.07×10^{-6}	3.85×10^{-5}
3	0/15	-1.38×10^{-5}	3.77×10^{-6}	2.16×10^{-5}
4	0/20	-9.25×10^{-5}	1.01×10^{-6}	4.63×10^{-5}
Gross beta				
1	0/15	-5.85×10^{-5}	3.49×10^{-5}	8.58×10^{-5}
2	0/21	-2.09×10^{-5}	2.78×10^{-5}	3.03×10^{-4}
3	1/15	-6.51×10^{-5}	2.74×10^{-5}	1.81×10^{-4}
4	0/20	-3.17×10^{-4}	2.15×10^{-5}	1.37×10^{-4}

[a] MDC = Minimum detectable concentration. (See main volume, Chapter 14, Quality Assurance, for an explanation of MDC.)

[b] These sampling stations were deactivated in 1999 (see main volume, Chapter 4).

Table 4–8. Summary of gross alpha and gross beta in air effluent samples from monitored emission points at Building 491, 1999.

Emission point	No. >MDC[a]/ total samples	Minimum (Bq/m^3)	Median (Bq/m^3)	Maximum (Bq/m^3)
Gross alpha				
1	1/53	-2.70×10^{-5}	1.76×10^{-6}	8.10×10^{-5}
Gross beta				
1	3/53	-3.03×10^{-5}	3.33×10^{-5}	9.10×10^{-4}

[a] MDC = Minimum detectable concentration. (See main volume, Chapter 14, Quality Assurance, for an explanation of MDC.)

5

Air Surveillance Monitoring

Paris E. Althouse
Paula J. Tate

Air Surveillance Sampling

Lawrence Livermore National Laboratory conducts air surveillance sampling using several different networks, each one representing a general location and type of analysis. There are separate networks for sampling radiological particulates and beryllium particulates at both the Livermore site and Site 300 as well as a low-volume radiological air surveillance sampling network and a tritium sampling network in Livermore. Four different collection media are employed: glass fibers for radiological particulates, cellulose for beryllium, Millipore AW-19 for low-volume radiological particulates, and silica gel for tritium. **Table 5-1** in the main volume shows the organization of the networks; and sampling locations are shown in **Figures 5-1**, **5-2**, and **5-3** in the main volume.

Air Particulate Networks

All particulate air samplers are positioned to ensure reasonable probability that any significant concentration of particulate effluents from LLNL operations will be detected. The air sampling locations are described in the locations database. Details for accessing the database are available in the Locations Database SOP Supplement EMP-QA-DM, *Sample and Data Management*.

The air particulate networks primarily use high-volume (hi-vol) air sampling units, which collect airborne particles on filters. These hi-vols use brushless motors and provide a readout of the total elapsed time and instantaneous and total flow rates.

Mass flow totalizers in the hi-vols are checked weekly using a portable field calibration unit. If a hi-vol stops running or the measured flow rate differs more than 10% from the expected flow rate, it is recalibrated using a calibration source traceable to the National Institute for Standards and Technology (NIST). During operation, the flow rate is maintained within 10%, better than the Department of Energy (DOE) requirement of ±20%, of the nominal flow by using a mass flow controller that adjusts motor speed. All air particulate filters are changed each week at all locations.

After each particulate filter is removed from a sampler, it is identified by location, date on, date off, elapsed time, and flow rate; and it is given a sample identifier (a four-field code) that accompanies it throughout the analysis. Filters are then placed in glassine envelopes, and the sample information is recorded in a field tracking notebook. All air filters are processed at the end of each month according to their location and required analysis.

Radiological hi-vol samplers collect particulate at a continuous rate of 1 m^3/min using glass-fiber filters. The low-volume samplers collect particulate at a continuous rate of 0.03 m^3/min using Millipore AW-19 filters. Beryllium samplers collect particulate at a continuous rate of 0.43 m^3/min using Whatman-41 cellulose filters.

The details of air particulate sampling and sample change-out are described in Appendix B of the *Environmental Monitoring Plan* (Tate et al. 1999). Details of high-volume sampler flow calibration are also discussed in a procedure (ORAD EMP-AP-CA), and details of air sample analysis procedures are outlined in Hall and Edwards (1994a, b, and c).

Air Particulate Radiological Networks

The collection efficiency of particulate filters for radiological analysis should be greater than 95% (Marshall and Stevens 1980). LLNL uses glass-fiber filters that have this level of efficiency and that maintain continuous flowrates. A total volume of approximately 10 ML of air is sampled at each location each week for radiological analysis.

During 1999, two air particulate locations were moved due to nearby construction. Location COW was moved approximately 75 yards west, and location GOLF was moved approximately 60 yards east.

Data from each of the networks are grouped in categories representing the following areas: perimeter, upwind, downwind, diffuse source, and special interest locations.

The LLNL hi-vol radiological air particulate site perimeter network maintains six samplers at the perimeter (CAFE, COW, MESQ, MET, SALV, and VIS), two at diffuse source areas (B531 and CRED) shown the main volume **Figure 5-1**. The Livermore Valley network shown in the main volume **Figure 5-2**, consists of four locations in the least prevalent wind directions (CHUR, FCC, FIRE, and HOSP), considered to be upwind or background, and four samplers located in the most prevalent downwind

directions (AMON, PATT, TANK, and ZON7). An additional sampler is located in an area of special interest at the Livermore Water Reclamation Plant (LWRP) because, in 1967, there was a plutonium release to sewer that resulted in local soil contamination (see Results section in Chapter 5 of the main volume). The low-volume radiological air particulate network consists of two samplers located at HOSP and FCC.

The perimeter at Site 300 is monitored at seven locations (801E, ECP, EOBS, GOLF, NPS, WCP, and WOBS) as shown in the main volume Figure 5-3. Off-site monitoring at Site 300 occurs at two locations: PRIM (near the Site 300 boundary) and TFIR (in downtown City of Tracy).

Glass-fiber filters are collected from the field and placed in glassine bags. The glassine bags are gathered at the end of the month, and each filter is cut and separated to supply samples for the various analyses. Portions of all glass-fiber filters (except B531 and CRED) are sent in for gross alpha and gross beta analysis. These samples are sent to the analytical laboratory after a four-day delay to allow for decay of radon–thoron daughters. Gross alpha and gross beta activities are determined using a gas flow proportional counter.

The analytical laboratory uses thorium-230 and strontium-90 as calibration sources to determine alpha and beta counting efficiencies, respectively. Annual counting-efficiency measurements are made for each detector. Cross-checks using standards certified by the Environmental Protection Agency (EPA) are also completed periodically. Background and efficiency checks are completed daily, and a matrix and method blank are run with every batch of 20 samples. Records are kept of background and counting efficiency variations that occur in the counting equipment. The analytical laboratory reports the actual instrumentation values, including negative results, that arise when background measurements are higher than those for the filters.

As outlined in the *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* (U.S. Department of Energy 1991), gross alpha and gross beta air-filter results are used only as trend indicators; specific radionuclide analysis is done for plutonium, uranium, and gamma emitters, depending on the location. All analytical results are reported as a measured concentration per volume of air, or at the minimum detection concentration (MDC) when no activity is detected. In all cases, the MDC is more than adequate for demonstrating compliance with the pertinent regulatory requirements for radionuclides that are present or may be present in the air sampled. Particle size distributions are not determined because the estimated effective dose

equivalent to the maximally exposed individual is well below the 0.01 mSv (1 mrem) allowable limit (U.S. Department of Energy 1991).

For gamma scanning, one composite is created using another portion of all weekly glass-fiber filters from each Livermore perimeter location. This composite, which represents filter portions from each of the Livermore perimeter locations (CAFE, COW, MESQ, MET, SALV, and VIS) for the month, is placed into a clear bag. This monthly composite is placed into a 214-cm^3 Teflon container and counted for gamma-emitting radionuclides using a low-background Ge(Li) detector.

Still other portions of the glass-fiber filters from each Livermore site perimeter location are analyzed for the presence of plutonium-239+240, uranium-235, and uranium-238 by LLNL's Chemistry and Materials Science Environmental Services Laboratory. The filters are placed in a muffled furnace to reduce organic content and then dissolved in a mixture of nitric acid and hydrochloric and/or hydrofluoric acids. Plutonium and uranium are separated by an ion-exchange process. Each separated element is purified further by ion exchange. Then the plutonium is electroplated onto a stainless steel disk and analyzed by alpha spectrometry, and the uranium solutions are analyzed by mass spectrometry.

The remaining glass fiber portions consisting of all Livermore Valley (CHUR, FCC, FIRE, HOSP, PATT, TANK, ZON7) and Site 300 off-site locations (PRIM and TFIR) are composited by location and analyzed for plutonium-239+240 as described above.

One composite is created using portions of all Site 300 perimeter locations (801E, ECP, EOBS, GOLF, NPS, WCP, and WOBS). This composite is gamma-scanned, and its entire contents analyzed for plutonium-239+240 by alpha spectrometry and for uranium-235 and uranium-238 by mass spectrometry in the same manner as Livermore site perimeter locations.

Replicate radiological Quality Assurance (QA) samples are processed to confirm the precision of the analytical results obtained from the samplers. A duplicate QA sampler is operated for two months in parallel with the permanent sampler at a given site. In addition, a trip blank is collected during each route. The QA trip blanks and QA duplicates are processed in the same manner as the routine samples and analyzed for the same radiological parameters.

Air Particulate Beryllium

Beryllium analysis requires an easily dissolvable filter with a low trace-metal background. Whatman-41 filters provide a balance between such requirements and particulate collection efficiency (Lindeken et al. 1963).

Beryllium is monitored at all Livermore perimeter locations (CAFE, COW, MESQ, MET, SALV, and VIS) as required by the Bay Area Air Quality Management District. Although there is no requirement to monitor beryllium at Site 300, as a best management practice, it is monitored at four locations (801E, EOBS, GOLF, and TFIR).

A total volume of approximately 4.3 ML of air is sampled at each location each week for beryllium analysis. The details of air particulate sampling and sample change-out are described in Appendix B of the *Environmental Monitoring Plan* (Tate et al. 1999). Details of high-volume sampler flow calibration are also discussed in a procedure (ORAD EMP-AP-CA).

The cellulose filters from each site are halved, with one portion saved on site for archiving, and the other composited into a monthly sample (one for each location) and sent out to the analytical laboratories for analysis. The off-site analytical digests the sample, using nitric acid, hydrochloric acid, and hydrogen perioxide during various heating and cooling phases. Care is taken to prevent the sample from boiling or baking dry. The resulting solution is diluted to 50 mL with blank water and the quantity of beryllium is determined by inductively coupled plasma-mass spectrometry.

Trip blanks are collected weekly from the Site 300 and Livermore networks, and split samples are chosen from the archived portions of the routine sample filters. LLNL sends them to the analytical laboratory as blind samples to help determine the accuracy of the analytical measurement.

Air Tritium

LLNL maintains 11 continuously operating, airborne tritium samplers on the Livermore site (main volume, **Figure 5-1**), six samplers in the Livermore Valley (main volume, **Figure 5-2**), and one near Site 300 (main volume, **Figure 5-3**). Four of the Livermore site locations (B292, B331, B514, and B624) monitor diffuse source emissions. The tritium sample locations are described in the locations database. The tritium samplers, operating at a flow rate of 700 cm^3/min, use a continuous vacuum pump to capture air moisture on silica gel contained in sampling flasks. These flasks are changed every two weeks, and the

samples are identified by location, date on, date off, elapsed sampling time, and flow rate. The flow rate is the average of the initial and final flow rates, which are measured biweekly with a rotameter that is calibrated once a year. LLNL is in the process of incorporating new flow meters to each of the sampling units. These flow meters provide the instantaneous flow and the minimum, maximum and total flow during the sample period.

Each sample is given a sample identifier that accompanies it through analysis. Two additional samplers are rotated among the locations at two-month intervals to provide duplicate QA samples. Details of the actual tritium sampling and a description of tritium sampler calibration can be found in Appendix B of the *Environmental Monitoring Plan* (Tate et al. 1999).

Once the samples are taken, water is separated from the silica gel by freeze-dried vacuum distillation, and the tritium concentration in the water is determined by liquid-scintillation counting. Airborne tritium sample analysis is done by LLNL's Chemistry and Materials Science Environmental Services Laboratory. All analytical results are reported as a measured concentration per unit volume of air flow through the sampling medium. Details of the analytical procedure are described in Low-Level Tritium Analysis—Freeze Dry.

Data

Monthly summaries of gross alpha and gross beta data for the main site and Site 300 are presented in **Tables 5-1**, **5-2**, **5-3,** and **5-15**. The activities shown in the tables displaying monthly medians are concentrations calculated from samples collected weekly. **Tables 5-4** and **5-16** present monthly gamma activity on air filters for the Livermore site perimeter and Site 300. Monthly plutonium data for each sampling location are shown in **Tables 5-5, 5-6, 5-7,** and **5-17**. Monthly uranium data for the Livermore site perimeter and Site 300 are presented in **Tables 5-8** and **5-18**. The monthly low-volume gross alpha and gross beta data are presented in **Tables 5-9** and **5-10**. Biweekly tritium data for sampling locations in the Livermore Valley, Livermore site perimeter, and diffuse sources are shown in **Tables 5-11**, **5-12**, and **5-13**. **Table 5-19** shows tritium-in-air data for Site 300. **Tables 5-14** and **5-20** present monthly beryllium data for Livermore site perimeter and Site 300 sampling locations. The activities shown in the tables displaying monthly and biweekly data are measured concentrations and their associated $\pm 2\sigma$ counting errors.

The data generally reflect historic data values for these analytes at these locations. A detailed discussion of these results is provided in the main volume of this report.

Table 5-1. Monthly median activities for gross alpha and gross beta summarized from weekly data for the LLNL perimeter locations, 1999.

Month	Sampling location[a]					
	CAFE	COW	MESQ	MET	SALV	VIS
	(10^{-6} Bq/m^3)					
Gross alpha						
Jan	4.01	32.9	39.0	19.7	35.2	28.2
Feb	2.75	3.20	11.1	6.66	15.8	16.8
Mar	40.2	42.0	45.0	46.6	50.9	42.0
Apr	56.2	23.3	65.5	51.4	49.6	32.5
May	18.7	9.42	21.1	23.3	16.1	24.8
Jun	23.1	14.4	29.4	9.56	38.0	28.8
Jul	28.2	43.7	43.3	50.3	45.1	29.1
Aug	55.5	49.8	39.7	43.6	48.9	30.1
Sep	78.6	60.5	88.8	61.1	55.1	72.5
Oct	222	213	205	269	255	235
Nov	112	105	106	121	147	126
Dec	109	75.1	84.5	94.0	102	119
Annual median[b]	**48.5**	**43.7**	**53.5**	**50.7**	**50.7**	**41.2**
IQR[b,c]	**65.7**	**60.1**	**60.4**	**52.6**	**59.6**	**61.2**
Annual maximum[b]	**328**	**321**	**321**	**385**	**364**	**377**
Gross beta						
Jan	645	794	796	749	675	580
Feb	238	198	202	214	168	189
Mar	258	209	199	183	292	247
Apr	257	327	238	269	396	237
May	355	327	338	307	278	294
Jun	232	148	228	150	188	223
Jul	238	304	270	245	293	223
Aug	391	318	364	298	358	311
Sep	683	651	614	677	718	651
Oct	1340	1230	1280	1270	1510	1430
Nov	833	838	873	914	914	912
Dec	623	668	688	696	653	694
Annual median[b]	**366**	**342**	**378**	**314**	**385**	**335**
IQR[b,c]	**476**	**553**	**561**	**508**	**534**	**465**
Annual maximum[b]	**2140**	**2070**	**2220**	**2220**	**2660**	**2470**

a See **Figure 5-1**, main volume, for the description of sampling locations.

b Determined by data from the 52-week period.

c IQR = Interquartile range.

Table 5-2. Monthly median activities for gross alpha and beta summarized from weekly data for the Livermore Valley upwind locations, 1999.

Month	Sampling location[a]			
	CHUR	FCC	FIRE	HOSP
	(10^{-6} Bq/m^3)			
Gross alpha				
Jan	54.0	7.61	10.4	33.2
Feb	2.46	–11.4	12.8	31.4
Mar	47.2	47.5	24.3	41.8
Apr	56.6	27.4	54.8	27.0
May	36.7	26.7	16.3	11.7
Jun	20.5	20.7	26.3	12.5
Jul	50.0	18.1	33.3	35.7
Aug	34.1	30.7	42.0	27.4
Sep	62.9	73.6	68.1	63.1
Oct	253	277	251	211
Nov	125	132	79.6	106
Dec	117	122	74.9	91.9
Annual median[b]	**52.9**	**37.6**	**35.6**	**39.2**
IQR[b,c]	**59.5**	**62.4**	**47.2**	**59.4**
Annual maximum[b]	**309**	**414**	**299**	**385**
Gross beta				
Jan	657	679	637	646
Feb	188	256	187	174
Mar	227	234	223	260
Apr	238	267	251	307
May	310	275	224	268
Jun	228	190	187	216
Jul	260	239	238	257
Aug	382	314	292	367
Sep	718	670	646	660
Oct	1260	1390	1290	1240
Nov	890	971	788	759
Dec	775	831	635	484
Annual median[b]	**270**	**275**	**253**	**289**
IQR[b,c]	**478**	**485**	**472**	**447**
Annual maximum[b]	**2270**	**2500**	**1990**	**2110**

a See **Figure 5-1**, main volume, for the description of sampling locations.

b Determined by data from the 52-week period.

c IQR = Interquartile range.

Table 5-3. Monthly median activities for gross alpha and beta summarized from weekly data for Livermore Valley downwind and special interest locations, 1999.

Month	Sampling location[a]				
	Livermore Valley downwind				Special interest
	AMON	PATT	TANK	ZON7	LWRP
	(10^{-6} Bq/m^3)				
Gross alpha					
Jan	31.5	18.1	27.4	0.774	8.93
Feb	3.08	3.91	25.6	23.5	20.7
Mar	48.1	70.5	41.5	54.8	52.0
Apr	53.7	41.4	30.1	59.2	51.4
May	18.3	5.5	31.7	23.0	24.2
Jun	21.6	25.6	28.7	37.2	28.2
Jul	24.7	23.6	21.3	64.8	15.4
Aug	49.0	54.8	36.2	48.1	49.4
Sep	58.3	72.7	91.8	93.1	49.2
Oct	138	231	238	275	235
Nov	95.5	137	93.2	145	80.5
Dec	88.4	97.3	80.7	101	133
Annual median[b]	**41**	**45**	**46**	**59**	**53**
IQR[b,c]	**59**	**63**	**59**	**55**	**58**
Annual maximum[b]	**298**	**492**	**366**	**370**	**353**
Gross beta					
Jan	682	431	717	740	775
Feb	136	199	200	218	167
Mar	239	272	251	229	295
Apr	316	266	265	336	318
May	242	279	281	257	261
Jun	208	205	217	178	203
Jul	253	250	241	280	250
Aug	323	414	414	361	330
Sep	692	742	699	751	677
Oct	1050	1280	1140	1260	1350
Nov	699	823	821	931	905
Dec	629	612	592	836	783
Annual median[b]	**344**	**309**	**300**	**362**	**361**
IQR[b,c]	**466**	**520**	**484**	**522**	**544**
Annual maximum[b]	**1870**	**2120**	**2120**	**2680**	**2450**

a See **Figure 5-2**, main volume for sampling locations.

b Determined by data from the 52-week period.

c IQR = Interquartile range.

Table 5-4. Gamma activity in particulate air samples, Livermore site perimeter, 1999.[a]

Month	Radiological isotope						
	^{7}Be	^{137}Cs	^{40}K	^{22}Na	^{226}Ra	^{228}Ra	^{228}Th
	(10^{-3} Bq/m^3)	(10^{-6} Bq/m^3)					
Jan	2.8 ± 0.056	<0.21[b]	17 ± 19	<0.21[b]	–0.033 ± 3.5	–0.46 ± 2.0	0.038 ± 1.5
Feb	2.8 ± 0.055	<0.22[b]	26 ± 22	<0.23[b]	<–2.1[b]	–0.25 ± 2.5	–0.006 ± 1.8
Mar	3.7 ± 0.067	<0.20[b]	14 ± 19	<0.25[b]	–0.62 ± 2.1	0.20 ± 1.7	–0.83 ± 1.7
Apr	3.4 ± 0.096	<0.18[b]	25 ± 16	<0.23[b]	<–2.1[b]	0.68 ± 1.8	0.71 ± 0.83
May	3.4 ± 0.34	0.059 ± 0.85	5.1 ± 42	0.38 ± 1.3	–0.61 ± 2.1	3.7 ± 6.3	0.38 ± 1.1
Jun	2.9 ± 0.29	0.20 ± 0.75	40 ± 49	–0.12 ± 1.3	0.098 ± 1.6	1.0 ± 2.5	0.31 ± 1.1
Jul	3.8 ± 0.38	0.13 ± 0.63	–22 ± 43	0.57 ± 0.96	0.58 ± 1.4	–0.037 ± 3.3	–2.8 ± 2.2
Aug	2.7 ± 0.28	0.57 ± 0.62	11 ± 45	–0.39 ± 1.1	0.26 ± 1.1	–0.051 ± 1.2	1.5 ± 1.2
Sep	4.9 ± 0.49	0.36 ± 0.69	23 ± 48	0.39 ± 0.055	–0.20 ± 1.1	0.21 ± 3.6	1.8 ± 0.73
Oct	7.8 ± 0.77	0.51 ± 0.70	8.0 ± 45	0.33 ± 0.98	0.62 ± 1.8	3.0 ± 2.4	0.44 ± 3.3
Nov	2.9 ± 0.29	0.51 ± 0.54	–3.2 ± 45	–0.29 ± 0.93	0.96 ± 1.4	0.90 ± 2.1	–1.7 ± 0.72
Dec	3.7 ± 0.38	–0.017 ± 0.57	–32 ± 46	0.24 ± 0.14	0.012 ± 1.2	0.44 ± 2.3	0.27 ± 2.7
Median	**3.4**	**0.21**	**12**	**0.24**	**–0.011**	**0.33**	**0.29**
IQR[c]	**0.85**	**—[d]**	**20**	**—[d]**	**0.95**	**0.98**	**0.72**
Maximum	**7.8**	**0.57**	**40**	**0.57**	**0.96**	**3.7**	**1.8**
DCG[e] (Bq/m^3)	**1.5×10^{3}**	**15**	**33**	**37**	**0.037**	**0.11**	**1.5×10^{-3}**
Percent of DCG[f]	**2.3×10^{-4}**	**1.4×10^{-6}**	**3.7×10^{-5}**	**6.4×10^{-7}**	**2.6×10^{-3}[g]**	**3.0×10^{-4}**	**0.019**

Note: Radioactivities are reported as the measured concentration and either an uncertainty (±2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

a All Livermore site perimeter samples composited. See **Figure 5-1**, main volume, for sampling locations.

b Error not provided by analytical laboratory.

c IQR = Interquartile range.

d No measure of dispersion calculated; see Chapter 14, Quality Assurance.

e DCG = Derived Concentration Guide (DOE Order 5400.5). See main volume, Chapter 13, Radiation Dose Assessment.

f Percent of DCG calculated from the median concentration unless otherwise noted.

g The radium-226 percent of DCG was determined by using the maximum value because the median value was negative.

Table 5-5. Plutonium-239+240 activity in air particulate samples, Livermore site perimeter, 1999.

Month	Sampling location[a]					
	CAFE	COW	MESQ	MET	SALV	VIS
	(10^{-9} Bq/m^3)					
Jan	4.37 ± 4.29	5.55 ± 5.77	4.11 ± 4.44	5.03 ± 4.14	4.85 ± 4.74	8.25 ± 3.55
Feb	3.96 ± 9.10	1.35 ± 5.70	1.44 ± 7.03	1.57 ± 5.25	3.62 ± 6.25	6.03 ± 7.14
Mar	3.37 ± 6.55	3.21 ± 5.55	3.60 ± 7.70	1.11 ± 6.55	–2.12 ± 2.45	2.48 ± 4.88
Apr	0.077 ± 3.77	4.29 ± 4.63	4.29 ± 4.63	1.38 ± 2.58	1.47 ± 2.73	10.7 ± 6.48
May	5.99 ± 5.74	4.48 ± 5.62	5.73 ± 10.5	1.08 ± 4.59	2.93 ± 3.39	38.9 ± 13.2
Jun	25.1 ± 10.8	4.33 ± 5.03	0.807 ± 3.41	2.79 ± 4.33	0 ± 0[b]	29.3 ± 11.7
Jul	12.5 ± 6.66	7.88 ± 5.59	1.47 ± 3.15	0.888 ± 1.77	4.14 ± 4.48	15.4 ± 8.03
Aug	3.85 ± 5.03	4.81 ± 5.37	–1.66 ± 1.92	3.85 ± 4.44	5.14 ± 8.73	15.4 ± 9.73
Sep	10.4 ± 7.40	6.14 ± 6.40	5.00 ± 6.25	6.29 ± 6.99	18.0 ± 9.32	22.1 ± 10.4
Oct	13.4 ± 6.96	28.7 ± 10.4	22.0 ± 9.44	7.99 ± 6.36	15.1 ± 8.36	22.5 ± 9.21
Nov	5.03 ± 5.00	7.29 ± 6.22	4.18 ± 4.18	3.22 ± 3.7	2.83 ± 5.59	0.548 ± 4.40
Dec	6.29 ± 5.59	3.96 ± 4.96	0 ± 0[b]	2.25 ± 3.18	4.33 ± 6.55	–0.625 ± 4.37
Median	**5.51**	**4.64**	**3.85**	**2.52**	**3.88**	**13.0**
IQR[c]	**7.01**	**2.22**	**3.19**	**2.83**	**2.43**	**20.1**
Percent of DCG[d]	**7.45×10^{-4}**	**6.28×10^{-4}**	**5.21×10^{-4}**	**3.41×10^{-4}**	**5.25×10^{-4}**	**1.76×10^{-3}**

Note: Radioactivities are reported as the measured concentration and either an uncertainty (±2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

a See **Figure 5-1**, main volume, for sampling locations.

b Actual reported value provided by analytical laboratory.

c IQR = Interquartile range.

d DCG = Derived Concentration Guide of 7.4×10^{-4} Bq/m^3 for Pu-239 activity in air. Percent calculated from the median concentration

Table 5-6. Plutonium-239+240 activity in air particulate samples, Livermore Valley, 1999.[a]

Month	Livermore Valley downwind locations				Special interest
	AMON	PATT	TANK	ZON7	LWRP
	(10^{-9} Bq/m^3)				
Jan	3.13 ± 5.85	2.76 ± 5.37	1.80 ± 4.29	–1.96 ± 4.96	0.988 ± 4.18
Feb	–4.11 ± 8.21	–1.05 ± 6.07	2.29 ± 5.44	1.15 ± 4.85	5.96 ± 6.44
Mar	–2.59 ± 21.2	5.00 ± 5.37	–0.570 ± 4.00	0.810 ± 6.70	4.37 ± 5.85
Apr	9.21 ± 7.25	0.614 ± 2.59	0.138 ± 1.93	1.41 ± 3.02	3.43 ± 3.40
May	2.33 ± 4.33	1.54 ± 2.87	2.22 ± 4.11	1.99 ± 3.37	7.36 ± 5.85
Jun	4.55 ± 6.11	6.70 ± 5.99	3.45 ± 4.00	0.851 ± 3.61	5.00 ± 5.99
Jul	4.03 ± 3.92	2.56 ± 2.96	0.685 ± 2.89	3.26 ± 3.74	16.0 ± 7.73
Aug	2.04 ± 3.44	2.60 ± 3.59	2.88 ± 5.33	5.14 ± 5.55	4.59 ± 5.48
Sep	5.14 ± 5.70	12.2 ± 7.73	6.85 ± 6.11	10.5 ± 7.33	4.29 ± 6.14
Oct	16.1 ± 8.47	25.2 ± 10.58	8.66 ± 6.59	23.1 ± 9.25	21.1 ± 9.21
Nov	1.60 ± 4.77	0.651 ± 2.42	1.61 ± 4.81	2.05 ± 2.90	5.11 ± 6.11
Dec	8.95 ± 7.96	5.62 ± 5.03	1.15 ± 2.30	1.74 ± 3.23	8.29 ± 7.03
Median	**3.58**	**2.68**	**2.01**	**1.87**	**5.06**
IQR[b]	**4.16**	**4.57**	**1.99**	**2.65**	**3.24**
Percent of DCG[c]	**4.84×10^{-4}**	**3.62×10^{-4}**	**2.71×10^{-4}**	**2.52×10^{-4}**	**6.83×10^{-4}**

Table 5-6. Plutonium-239+240 activity in air particulate samples, Livermore Valley, 1999[a] (concluded).

Month	Livermore Valley upwind			
	CHUR	FCC	FIRE	HOSP
	(10^{-9} Bq/m^3)			
Jan	–1.58 ± 4.70	0.022 ± 2.66	0.040 ± 3.37	4.63 ± 5.48
Feb	1.24 ± 3.25	–2.29 ± 5.18	–0.884 ± 5.03	–1.78 ± 3.39
Mar	6.22 ± 6.48	–0.555 ± 3.89	–0.370 ± 4.66	1.14 ± 2.28
Apr	1.49 ± 3.19	–0.437 ± 3.04	1.69 ± 2.86	2.06 ± 4.4
May	0.304 ± 2.99	0.932 ± 4.00	2.66 ± 4.11	0.178 ± 2.48
Jun	1.23 ± 2.46	–3.27 ± 2.48	2.93 ± 4.55	–1.43 ± 2.02
Jul	–0.862 ± 3.38	1.83 ± 3.09	2.07 ± 3.50	0.07 ± 3.44
Aug	23.8 ± 11.0	0.184 ± 2.56	2.13 ± 4.92	–0.803 ± 1.14
Sep	6.44 ± 5.66	2.44 ± 4.11	6.59 ± 7.51	0.176 ± 2.46
Oct	21.7 ± 8.88	11.1 ± 7.14	11.1 ± 6.88	6.40 ± 5.11
Nov	4.29 ± 4.29	–1.79 ± 3.42	9.44 ± 7.40	0.855 ± 3.61
Dec	0.555 ± 4.48	3.92 ± 4.92	0.958 ± 4.11	0.349 ± 3.43
Median	**1.37**	**0.103**	**2.10**	**0.264**
IQR[b]	**5.78**	**2.85**	**3.12**	**1.52**
Percent of DCG[c]	**1.84×10^{-4}**	**1.39×10^{-5}**	**2.84×10^{-4}**	**3.56×10^{-5}**

Note: Radioactivities are reported as the measured concentration and either an uncertainty (±2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

a See **Figure 5-2**, main volume for sampling locations.

b IQR = Interquartile range.

c DCG = Derived Concentration Guide of 7.4×10^{-4} Bq/m^3 for Pu-239 activity in air. Percent calculated from the median concentration.

Table 5-7. Plutonium-239+240 activity in air particulate samples, diffuse sources, 1999.

Month	Sampling location[a]	
	B531	CRED
	(10^{-9} Bq/m^3)	
Jan	9.25 ± 6.81	5.48 ± 6.66
Feb	10.3 ± 8.21	2.04 ± 4.37
Mar	5.99 ± 5.74	4.77 ± 5.11
Apr	32.0 ± 10.9	2.79 ± 4.33
May	94.0 ± 20.8	5.77 ± 5.51
Jun	57.0 ± 16.9	8.84 ± 6.62
Jul	69.9 ± 16.2	7.25 ± 6.29
Aug	81.4 ± 19.3	8.92 ± 6.33
Sep	21.8 ± 12.1	33.5 ± 13.2
Oct	53.7 ± 14.7	25.9 ± 9.81
Nov	6.33 ± 6.03	3.96 ± 5.33
Dec	12.0 ± 8.55	6.33 ± 6.03
Median	**26.9**	**6.05**
IQR[b]	**50.2**	**4.29**
Percent of DCG[c]	**3.64×10^{-3}**	**8.18×10^{-4}**

Note: Radioactivities are reported as the measured concentration and either an uncertainty (±2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

a See **Figure 5-1**, main volume, for sampling locations.

b IQR = Interquartile range.

c DCG = Derived Concentration Guide of 7.4×10^{-4} Bq/m^3 for Pu-239 activity in air. Percent calculated from the median concentration.

Table 5-8. Uranium mass concentration in air particulate samples, Livermore site perimeter 1999.[a]

Location	Month	Uranium-235[b] (10^{-7} µg/m^3)	Uranium-238[c] (10^{-5} µg/m^3)	Uranium-235/238 (10^{-3})
CAFE	Jan	3.08 ± 0.108	4.38 ± 0.151	7.05
	Feb	1.46 ± 0.159	2.03 ± 0.191	7.18
	Mar	3.65 ± 0.107	5.11 ± 0.126	7.14
	Apr	3.38 ± 0.230	5.01 ± 0.064	6.75
	May	5.22 ± 0.373	8.04 ± 0.704	6.49
	Jun	7.08 ± 0.362	10.6 ± 0.695	6.68
	Jul	6.13 ± 0.760	9.38 ± 0.943	6.53
	Aug	4.93 ± 0.482	8.34 ± 0.761	5.91
	Sep	5.37 ± 0.776	17.9 ± 0.883	3.00
	Oct	11.3 ± 1.51	16.6 ± 2.17	6.79
	Nov	2.72 ± 1.40	4.06 ± 1.70	6.71
	Dec	2.83 ± 0.839	4.31 ± 1.02	6.55
Median		**4.29**	**6.57**	**6.70**
IQR[d]		**2.54**	**5.32**	**0.335**
Maximum		**11.3**	**17.9**	**NA[e]**
Percent of DCG[f]		**9.13×10^{-4}**	**2.19×10^{-2}**	**NA**
COW	Jan	2.51 ± 0.130	3.48 ± 0.177	7.20
	Feb	1.39 ± 0.157	2.09 ± 0.190	6.67
	Mar	1.97 ± 0.143	2.99 ± 0.206	6.61
	Apr	5.30 ± 0.438	7.48 ± 0.496	7.09
	May	5.68 ± 0.320	8.30 ± 0.671	6.84
	Jun	4.61 ± 0.413	6.79 ± 0.758	6.79
	Jul	6.05 ± 0.504	8.99 ± 0.875	6.73
	Aug	6.29 ± 0.436	10.3 ± 0.785	6.09
	Sep	7.87 ± 0.710	11.2 ± 1.14	7.03
	Oct	10.9 ± 1.51	15.7 ± 2.07	6.92
	Nov	4.17 ± 1.43	5.78 ± 1.73	7.21
	Dec	1.46 ± 1.16	1.92 ± 1.45	7.63
Median		**4.96**	**7.13**	**6.88**
IQR[d]		**3.74**	**5.96**	**0.363**
Maximum		**10.9**	**15.7**	**NA**
Percent of DCG[f]		**1.05×10^{-3}**	**2.38×10^{-2}**	**NA**

Table 5-8. Uranium mass concentration in air particulate samples, Livermore site perimeter, 1999 (continued).[a]

Location	Month	Uranium-235[b] (10^{-7} µg/m^3)	Uranium-238[c] (10^{-5} µg/m^3)	Uranium-235/238 (10^{-3})
MESQ	Jan	1.39 ± 0.12	1.97 ± 0.154	7.08
	Feb	0.69 ± 0.13	0.99 ± 0.164	7.00
	Mar	3.50 ± 0.11	4.87 ± 0.129	7.17
	Apr	4.97 ± 0.35	6.81 ± 0.352	7.29
	May	4.31 ± 0.29	6.82 ± 0.637	6.32
	Jun	4.60 ± 0.35	6.85 ± 0.551	6.72
	Jul	4.42 ± 0.34	6.68 ± 0.538	6.63
	Aug	3.45 ± 0.33	6.18 ± 0.748	5.58
	Sep	5.13 ± 0.72	7.27 ± 0.849	7.06
	Oct	8.88 ± 1.43	12.4 ± 1.84	7.14
	Nov	1.34 ± 1.38	2.32 ± 1.69	5.78
	Dec	1.70 ± 1.25	2.45 ± 1.35	6.94
Median		**3.90**	**6.43**	**6.97**
IQR[d]		**3.07**	**4.41**	**0.549**
Maximum		**8.88**	**12.4**	**NA**
Percent of DCG[f]		**8.30×10^{-4}**	**2.14×10^{-2}**	**NA**
MET	Jan	1.80 ± 0.115	2.55 ± 0.159	7.03
	Feb	1.86 ± 0.143	2.76 ± 0.169	6.73
	Mar	2.56 ± 0.098	3.64 ± 0.126	7.03
	Apr	2.88 ± 0.292	3.95 ± 0.278	7.30
	May	3.69 ± 0.285	5.74 ± 0.715	6.43
	Jun	3.61 ± 0.293	5.31 ± 0.658	6.79
	Jul	2.00 ± 0.403	3.00 ± 0.480	6.67
	Aug	2.77 ± 0.429	4.63 ± 0.923	5.98
	Sep	2.93 ± 0.867	3.96 ± 1.03	7.39
	Oct	9.32 ± 1.63	13.5 ± 1.83	6.90
	Nov	0.52 ± 1.51	0.94 ± 2.02	5.56
	Dec	1.75 ± 0.995	2.51 ± 1.11	7.00
Median		**2.66**	**3.80**	**6.85**
IQR[d]		**1.26**	**2.09**	**0.419**
Maximum		**9.32**	**13.5**	**NA**
Percent of DCG[f]		**5.67×10^{-4}**	**1.27×10^{-2}**	**NA**

Table 5-8. Uranium mass concentration in air particulate samples, Livermore site perimeter, 1999 (concluded).[a]

Location	Month	Uranium-235[b] (10^{-7} µg/m^3)	Uranium-238[c] (10^{-5} µg/m^3)	Uranium-235/238 (10^{-3})
SALV	Jan	2.00 ± 0.106	2.77 ± 0.145	7.21
	Feb	1.17 ± 0.149	1.73 ± 0.184	6.76
	Mar	0.889 ± 0.110	1.23 ± 0.131	7.20
	Apr	4.36 ± 0.340	6.12 ± 0.388	7.13
	May	3.41 ± 0.356	5.50 ± 0.609	6.20
	Jun	2.52 ± 0.343	3.94 ± 0.706	6.41
	Jul	2.19 ± 0.372	3.61 ± 0.582	6.07
	Aug	2.48 ± 0.471	4.46 ± 0.693	5.57
	Sep	3.42 ± 0.905	4.81 ± 1.00	7.11
	Oct	10.4 ± 1.39	14.8 ± 2.04	7.00
	Nov	1.45 ± 1.27	2.37 ± 1.74	6.14
	Dec	1.90 ± 0.865	2.67 ± 1.26	7.12
Median		**2.34**	**3.77**	**6.88**
IQR[d]		**1.62**	**2.39**	**0.931**
Maximum		**10.3**	**14.8**	**NA**
Percent of DCG[f]		**4.97×10^{-4}**	**1.26×10^{-2}**	**NA**
VIS	Jan	2.27 ± 0.121	3.23 ± 0.166	7.04
	Feb	1.40 ± 0.147	2.04 ± 0.180	6.83
	Mar	2.40 ± 0.105	3.40 ± 0.131	7.06
	Apr	3.33 ± 0.304	4.65 ± 0.275	7.16
	May	9.26 ± 0.302	13.7 ± 0.878	6.75
	Jun	5.81 ± 0.306	6.46 ± 0.594	8.99
	Jul	3.17 ± 0.454	4.86 ± 0.623	6.53
	Aug	4.09 ± 0.473	6.97 ± 0.756	5.87
	Sep	4.86 ± 0.910	17.1 ± 1.39	2.84
	Oct	11.4 ± 1.31	16.5 ± 1.81	6.92
	Nov	2.50 ± 1.57	3.74 ± 2.11	6.67
	Dec	1.78 ± 1.31	2.60 ± 1.38	6.86
Median		**3.25**	**4.76**	**6.85**
IQR[d]		**2.72**	**5.3**	**0.410**
Maximum		**11.4**	**17.1**	**NA**
Percent of DCG[f]		**6.92×10^{-4}**	**1.59×10^{-2}**	**NA**

Note: Radioactivities are reported as the measured concentration and either an uncertainty (±2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

a See **Figure 5-1**, main volume, for sampling locations.

b Uranium-235 activities in Bq/m^3 can be determined by dividing the weight in µg/m^3 by 12.5.

c Uranium-238 activities in Bq/m^3 can be determined by dividing the weight in µg/m^3 by 80.3.

d IQR = Interquartile range.

e NA = Not applicable.

f DCG = Derived Concentration Guide for activity in air of 0.3 µg/m^3 for ^{238}U and 0.047 µg/m^3 for ^{235}U. Percent calculated from the median concentration.

Table 5-9. Monthly median activities for gross alpha summarized from weekly data from low-volume air samplers, 1999.[a]

Month	Livermore Valley upwind	
	FCC	HOSP
	(10^{-6} Bq/m^3)	
Jan	–2.52	44.0
Feb	16.3	66.2
Mar	29.0	37.4
Apr	17.2	35.0
May	50.5	34.5
Jun	29.3	33.3
Jul	11.8	–5.88
Aug	64.8	22.8
Sep	73.1	114
Oct	285	144
Nov	89.2	126
Dec	101	50.7
Annual median[b]	**56.4**	**41.8**
IQR[b,c]	**82.9**	**73.3**
Annual maximum[b]	**466**	**271**

a See **Figure 5-2,** main volume, for sampling locations.

b Determined by data from the 52-week period.

c IQR = Interquartile range.

Table 5-10. Monthly median activities for gross beta summarized from weekly data from low-volume air samplers, 1999.[a]

Month	Livermore Valley upwind	
	FCC	HOSP
	(10^{-6} Bq/m^3)	
Jan	847	618
Feb	434	540
Mar	255	411
Apr	382	360
May	372	403
Jun	336	347
Jul	448	357
Aug	273	351
Sep	984	790
Oct	1750	1470
Nov	818	951
Dec	958	707
Annual median[b]	**440**	**503**
IQR[b,c]	**676**	**472**
Annual maximum[b]	**2410**	**2200**

a See **Figure 5-2,** main volume, for sampling locations.

b Determined by data from the 52-week period.

c IQR = Interquartile range.

Table 5-11. Tritium concentration in air, Livermore Valley, 1999.

Month	Sampling locations[a]					
	AMON	FIRE	HOSP	VET	XRDS	ZON7
	(10^{-3} Bq/m^3)					
Jan	21.8 ± 11.0	20.6 ± 12.4	21.1 ± 14.2	40.3 ± 13.5	10.8 ± 10.5	34.4 ± 12.4
	22.4 ± 17.3	17.1 ± 15.4	–1.35 ± 15.0	36.6 ± 17.3	25.9 ± 15.3	80.3 ± 18.6
Feb	115 ± 15.8	119 ± 13.8	—[b]	179 ± 17.5	87.7 ± 13.1	162 ± 14.2
	126 ± 19.8	147 ± 18.2	32.7 ± 16.9	242 ± 27.6	77.0 ± 14.1	268 ± 24.3
Mar	175 ± 22.2	93.6 ± 19.4	2.80 ± 6.25	149 ± 21.8	93.2 ± 17.8	251 ± 22.9
	108 ± 14.9	24.5 ± 10.5	5.81 ± 9.55	33.7 ± 12.2	30.9 ± 10.1	128 ± 14.8
Apr	20.0 ± 16.4	86.2 ± 20.1	–1.23 ± 13.9	29.9 ± 18.9	25.7 ± 16.0	56.6 ± 17.8
	4.14 ± 13.4	–1.72 ± 13.2	3.89 ± 14.8	5.33 ± 14.6	10.0 ± 13.2	14.8 ± 13.2
	11.5 ± 14.9	11.6 ± 15.1	10.8 ± 14.2	—[b]	5.25 ± 14.1	31.6 ± 15.0
May	—[b]	—[b]	1.78 ± 17.0	—[b]	–1.38 ± 14.9	21.1 ± 16.4
	13.1 ± 21.5	—[b]	—[b]	–6.29 ± 22.2	—[b]	39.2 ± 22.1
Jun	6.11 ± 17.6	3.42 ± 18.0	—[b]	–2.48 ± 17.1	3.02 ± 17.1	28.4 ± 18.6
	27.6 ± 29.4	2.35 ± 27.8	87.0 ± 31.7	28.2 ± 30.5	35.3 ± 27.3	79.2 ± 30.7
Jul	26.1 ± 18.5	2.32 ± 16.7	3.89 ± 17.3	4.40 ± 18.9	–0.892 ± 15.7	36.2 ± 17.5
	12.2 ± 24.9	5.14 ± 27.0	38.1 ± 26.0	–4.40 ± 24.4	–2.82 ± 22.0	40.3 ± 25.2
Aug	5.81 ± 23.1	–22.5 ± 24.2	–3.07 ± 22.8	–11.3 ± 22.4	11.5 ± 21.5	59.9 ± 25.0
	1.31 ± 17.5	–5.96 ± 17.6	–4.00 ± 10.9	–12.5 ± 15.7	0.201 ± 15.1	13.2 ± 16.8
Sep	5.70 ± 20.6	13.2 ± 22.3	2.60 ± 20.9	17.8 ± 21.9	16.7 ± 19.7	59.9 ± 22.8
	114 ± 30.9	7.10 ± 27.5	–4.81 ± 24.3	–1.08 ± 24.1	10.2 ± 23.3	40.7 ± 25.1
Oct	27.3 ± 16.9	14.1 ± 13.4	2.87 ± 15.1	0.688 ± 21.2	11.2 ± 16.8	44.8 ± 20.8
	31.7 ± 19.6	42.2 ± 23.2	25.7 ± 18.1	39.6 ± 19.1	18.0 ± 16.6	—[b]
	11.0 ± 17.8	17.1 ± 20.8	3.27 ± 16.5	32.9 ± 17.8	–3.54 ± 14.2	9.03 ± 15.8
Nov	3.48 ± 27.6	5.59 ± 25.6	–5.66 ± 20.7	26.8 ± 24.3	8.70 ± 22.6	15.5 ± 23.8
	0.807 ± 26.0	22.8 ± 27.3	3.40 ± 21.2	12.7 ± 22.8	5.74 ± 21.1	–2.77 ± 22.5
Dec	43.3 ± 24.3	12.3 ± 20.4	8.58 ± 16.4	3.77 ± 17.6	–4.66 ± 15.9	–0.463 ± 18.6
	13.1 ± 11.0	53.7 ± 14.8	–0.740 ± 10.9	8.03 ± 11.7	0.762 ± 10.8	3.31 ± 12.1
Median[c]	**20.0**	**13.7**	**3.27**	**15.3**	**10.2**	**39.2**
IQR[d]	**25.6**	**24.2**	**10.7**	**34.2**	**24.9**	**44.4**
Percent of DCG[e]	**5.4×10^{-4}**	**3.7×10^{-4}**	**8.8×10^{-5}**	**4.1×10^{-4}**	**2.8×10^{-4}**	**1.1×10^{-3}**
Dose (mSv)[f]	**4.2×10^{-6}**	**2.8×10^{-6}**	**6.8×10^{-7}**	**3.2×10^{-6}**	**2.1×10^{-6}**	**8.1×10^{-6}**

Note: Radioactivities are reported as the measured concentration and either an uncertainty (±2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

a See **Figure 5-2**, main volume, for sampling locations.

b No data. See main volume, Chapter 14, Quality Assurance.

c Livermore Valley overall median = 13.2×10^{-3} Bq/m^3.

d IQR = Interquartile range.

e DCG = Derived Concentration Guide of 3.7×10^3 Bq/m^3. Percent calculated from the median concentration.

f This dose is the effective dose equivalent.

Table 5-12. Tritium concentration in air, Livermore site perimeter, 1999.

Month	Sampling location[a]						
	CAFE	COW	MESQ	MET	POOL	SALV	VIS
	(10^{-3} Bq/m^3)						
Jan	184 ± 16.6	44.8 ± 12.0	72.2 ± 13.3	44.4 ± 12.4	429 ± 26.0	61.4 ± 13.4	50.3 ± 12.0
	131 ± 17.0	146 ± 17.9	85.5 ± 18.5	66.2 ± 14.7	250 ± 23.0	179 ± 21.2	162 ± 18.0
Feb	807 ± 28.8	300 ± 19.1	238 ± 18.6	150 ± 16.1	1240 ± 39.6	298 ± 20.0	315 ± 19.6
	507 ± 26.2	618 ± 30.4	357 ± 26.2	236 ± 20.5	1400 ± 46.3	377 ± 25.5	555 ± 27.6
Mar	426 ± 27.5	688 ± 34.3	253 ± 23.3	195 ± 21.1	944 ± 42.2	485 ± 31.1	622 ± 33.4
	107 ± 12.3	374 ± 22.4	62.2 ± 12.2	51.1 ± 11.3	385 ± 23.6	151 ± 16.8	250 ± 17.5
Apr	102 ± 18.8	103 ± 18.5	119 ± 19.5	23.9 ± 15.4	172 ± 22.2	148 ± 24.9	135 ± 18.7
	45.1 ± 14.2	24.5 ± 14.4	23.2 ± 14.5	16.8 ± 13.6	133 ± 17.7	—[b]	40.0 ± 13.3
	132 ± 18.9	47.7 ± 15.9	19.1 ± 14.9	17.9 ± 15.2	145 ± 20.8	35.4 ± 10.1	76.6 ± 16.9
May	48.5 ± 13.8	36.2 ± 15.9	—[b]	–3.77 ± 14.6	69.2 ± 13.2	8.18 ± 22.0	37.7 ± 15.5
	49.2 ± 23.0	52.5 ± 23.1	17.5 ± 21.8	8.44 ± 21.8	74.7 ± 25.8	32.7 ± 22.0	73.3 ± 21.4
Jun	–7.81 ± 17.0	34.2 ± 14.8	12.2 ± 17.9	76.2 ± 21.3	32.2 ± 20.1	15.5 ± 17.7	68.1 ± 18.0
	35.4 ± 28.7	—[b]	16.2 ± 29.0	18.9 ± 28.9	65.1 ± 33.4	26.2 ± 28.5	100 ± 26.6
Jul	76.2 ± 20.9	203 ± 43.7	8.14 ± 16.2	29.3 ± 20.0	201 ± 26.9	50.3 ± 19.3	132 ± 21.9
	34.9 ± 18.2	130 ± 33.3	17.4 ± 23.6	21.4 ± 30.0	121 ± 47.0	50.7 ± 26.2	149 ± 28.5
Aug	–11.0 ± 22.2	31.1 ± 28.0	–16.8 ± 20.5	12.6 ± 28.6	52.5 ± 44.8	1.57 ± 22.5	116 ± 26.6
	7.29 ± 20.5	52.2 ± 20.5	–4.26 ± 14.5	–20.3 ± 18.8	13.2 ± 27.9	104 ± 20.4	50.7 ± 17.6
Sep	94.7 ± 24.5	122 ± 37.4	43.3 ± 21.7	59.2 ± 26.6	82.9 ± 15.5	78.4 ± 24.2	108 ± 24.5
	45.9 ± 25.1	70.3 ± 32.1	21.7 ± 24.1	24.3 ± 31.3	108 ± 32.3	34.1 ± 24.9	94.7 ± 26.9
Oct	1890 ± 59.2	89.2 ± 22.2	83.3 ± 20.0	68.8 ± 21.2	385 ± 31.6	75.9 ± 20.4	52.5 ± 19.6
	180 ± 23.9	71.8 ± 20.0	116 ± 20.4	117 ± 24.8	374 ± 33.6	95.1 ± 20.3	89.9 ± 20.1
	131 ± 19.9	44.8 ± 17.8	150 ± 20.1	120 ± 25.5	298 ± 28.5	57.7 ± 17.0	58.5 ± 17.7
Nov	51.4 ± 21.6	31.2 ± 23.3	78.8 ± 22.7	61.4 ± 25.0	161 ± 34.8	48.5 ± 22.1	—[b]
	52.9 ± 21.3	25.6 ± 22.6	45.9 ± 20.8	33.1 ± 23.6	122 ± 27.7	18.9 ± 20.8	35.7 ± 28.0
Dec	53.7 ± 16.9	34.2 ± 17.5	46.3 ± 16.9	30.6 ± 20.3	96.9 ± 18.4	36.3 ± 18.4	29.2 ± 22.1
	47.4 ± 11.0	11.0 ± 10.7	2.23 ± 10.5	38.5 ± 14.9	98.1 ± 13.9	30.5 ± 12.2	40.3 ± 15.5
Median[c]	**65.0**	**52.5**	**45.9**	**35.8**	**139**	**50.7**	**89.9**
IQR[d]	**85.5**	**95.8**	**68.1**	**48.6**	**269**	**71.3**	**84.3**
Percent of DCG[e]	**1.8×10^{-3}**	**1.4×10^{-3}**	**1.2×10^{-3}**	**9.7×10^{-4}**	**3.8×10^{-3}**	**1.4×10^{-3}**	**2.4×10^{-3}**
Dose (mSv)[f]	**1.3×10^{-5}**	**1.1×10^{-5}**	**9.5×10^{-6}**	**7.4×10^{-6}**	**2.9×10^{-5}**	**1.1×10^{-5}**	**1.9×10^{-5}**

Note: Radioactivities are reported as the measured concentration and either an uncertainty (±2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

a See **Figure 5-1**, main volume, for sampling locations.

b No data. See main volume, Chapter 14, Quality Assurance.

c Livermore site overall median = 68.5×10^{-3} Bq/m^3.

d IQR = Interquartile range.

e DCG = Derived Concentration Guide of 3.7×10^3 Bq/m^3. Percent calculated from the median concentration.

f This dose is the effective dose equivalent.

Table 5-13. Tritium concentration in air at locations near diffuse sources, 1999.

Month	Sampling locations[a]			
	B292	B331	B514	B624
	(10^{-3} Bq/m^3)			
Jan	518 ± 25	—[b]	1,580 ± 40	4,630 ± 70
	451 ± 30	8,700 ± 100	2,350 ± 57	4,330 ± 79
Feb	522 ± 25	9,810 ± 102	1,880 ± 44	4,590 ± 71
	522 ± 31	8,880 ± 103	2,390 ± 53	5,140 ± 88
Mar	540 ± 33	11,300 ± 132	2,870 ± 63	6,220 ± 104
	290 ± 21	11,800 ± 108	1,820 ± 45	3,530 ± 68
Apr	150 ± 21	—[b]	1,040 ± 41	3,430 ± 77
	175 ± 20	9,470 ± 108	544 ± 27	3,960 ± 75
May	145 ± 20	13,800 ± 141	1,100 ± 42	4,880 ± 88
	57.4 ± 17.8	2,520 ± 63	844 ± 33	2,810 ± 59
	92.1 ± 24.8	858 ± 41	1,150 ± 47	3,490 ± 76
Jun	47.0 ± 19.5	124 ± 22	1,310 ± 48	2,390 ± 63
	68.8 ± 30.6	592 ± 42	2,540 ± 78	4,440 ± 102
Jul	156 ± 22	—[b]	2,080 ± 59	5,330 ± 96
	153 ± 28	877 ± 48	1,760 ± 62	9,070 ± 143
Aug	52.9 ± 25.3	153 ± 30	1,680 ± 66	4,260 ± 103
	71.0 ± 19.6	205 ± 25	1,620 ± 57	3,180 ± 81
Sep	325 ± 33	2,310 ± 70	2,830 ± 77	8,580 ± 134
	155 ± 31	999 ± 50	2,950 ± 83	6,030 ± 121
Oct	353 ± 31	4,550 ± 85	2,360 ± 70	9,180 ± 122
	422 ± 32	4,850 ± 90	2,010 ± 63	9,100 ± 125
	381 ± 28	—[b]	1,390 ± 49	6,880 ± 106
Nov	247 ± 31	2,530 ± 67	1,020 ± 46	5,000 ± 100
	179 ± 28	1,550 ± 53	766 ± 39	2,800 ± 64
Dec	255 ± 26	1,410 ± 45	722 ± 33	2,290 ± 53
	185 ± 18	3,380 ± 57	603 ± 25	1,270 ± 34
Median[c]	**182**	**2,530**	**1,650**	**4,520**
IQR[d]	**228**	**7,930**	**1,230**	**2,410**
Percent of DCG[e]	**4.9×10^{-3}**	**.068**	**.045**	**0.12**
Dose (mSv)[f]	**3.8×10^{-5}**	**5.2×10^{-4}**	**3.4×10^{-4}**	**9.4×10^{-4}**

Note: Radioactivities are reported as the measured concentration and either an uncertainty (±2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

a See **Figure 5-1**, main volume, for sampling locations.

b No data. See main volume, Chapter 14, Quality Assurance.

c Diffuse source overall median = 1720×10^{-3} Bq/m^3.

d IQR = Interquartile range.

e DCG = Derived Concentration Guide of 3.7×10^3 Bq/m^3. Percent calculated from the median concentration.

f This dose is the effective dose equivalent.

Table 5-14. Monthly beryllium in air particulate composites, Livermore site perimeter, 1999.

Month	Sampling location[a]					
	CAFE	COW	MESQ	MET	SALV	VIS
	(pg/m^3)					
Jan	5.95	6.39	4.15	4.43	1.78	3.59
Feb	4.50	3.75	4.00	2.24	1.96	3.52
Mar	6.52	8.37	8.86	3.51	4.55	9.69
Apr	9.10	10.6	9.07	7.39	9.69	9.51
May	11.2	13.6	13.4	9.38	7.60	21.3
Jun	15.8	9.15	13.8	8.62	7.34	11.0
Jul	18.2	28.6	16.3	9.27	13.1	33.2
Aug	13.3	15.6	12.9	8.27	9.06	13.6
Sep	16.0	23.9	16.6	14.9	14.0	14.7
Oct	23.8	37.8	36.4	23.9	25.7	24.7
Nov	9.49	8.64	0.935	5.21	3.27	7.95
Dec	10.9	11.0	7.85	7.18	7.17	8.46
Median[b]	**11.1**	**10.8**	**11.0**	**7.83**	**7.47**	**10.3**
IQR[c]	**7.40**	**9.10**	**7.50**	**4.28**	**6.31**	**8.02**
Maximum	**23.8**	**37.8**	**36.4**	**23.9**	**25.7**	**33.2**
Percent of ACL[d]	**0.111**	**0.108**	**0.110**	**0.0783**	**0.0747**	**0.103**

a See **Figure 5-1**, main volume, for sampling locations.

b Livermore site perimeter overall median is 9.33 pg/m^3.

c IQR = Interquartile range.

d The monthly Ambient Concentration Limit (ACL) is 10,000 pg/m^3 as set by the Bay Area Air Quality Management District (BAAQMD). Percent calculated from the median concentration.

Table 5-15. Monthly median activities for gross alpha and gross beta summarized from weekly data for Site 300 perimeter and off-site locations, 1999.

Month	Sampling location[a]								
	Site 300 perimeter							Off site Site 300	
	801E	ECP	EOBS	GOLF	NPS	WCP	WOBS	PRIM	TFIR
Gross alpha	(10^{-6} Bq/m^3)								
Jan	5.67	18.1	0.797	35.3	25.3	42.1	34.4	45.8	59.2
Feb	–2.83	2.03	5.42	14.1	31.3	11.0	21.6	1.53	17.5
Mar	59.9	13.8	40.9	61.4	71.2	22.9	47.9	56.6	56.2
Apr	49.6	56.6	53.3	39.6	58.8	38.9	64.8	54.4	46.3
May	38.3	20.5	33.2	44.7	34.2	32.0	38.3	26.6	14.5
Jun	29.5	39.6	19.7	58.8	56.1	19.3	33.1	32.3	42.0
Jul	36.7	64.4	53.3	70.7	63.3	24.9	65.9	62.2	39.6
Aug	34.6	63.5	63.6	64.8	81.1	79.9	13.4	75.1	76.6
Sep	128	87.0	99.0	98.2	90.1	77.7	124	92.9	78.8
Oct	260	269	187	248	184	203	243	234	196
Nov	124	138	106	120	113	133	92.5	122	68.8
Dec	93.1	106	87.7	92.1	77.3	79.7	97.9	54.4	—[b]
Annual Median[c]	**43.3**	**54.8**	**48.7**	**63.6**	**59.2**	**54.4**	**52.0**	**50.7**	**48.8**
IQR[c,d]	**79.5**	**72.4**	**65.6**	**56.9**	**53.5**	**61.1**	**65.6**	**76.1**	**60.7**
Annual Maximum[c]	**352**	**332**	**290**	**294**	**291**	**270**	**365**	**339**	**336**
Gross beta	(10^{-6} Bq/m^3)								
Jan	580	617	499	825	503	551	500	959	1306
Feb	177	396	419	376	388	422	490	482	567
Mar	217	325	275	256	264	231	229	276	280
Apr	357	346	369	303	302	335	374	312	308
May	361	370	426	339	364	383	414	426	316
Jun	363	260	283	310	377	250	301	331	311
Jul	310	301	270	307	293	326	291	308	262
Aug	548	500	488	487	389	500	184	511	418
Sep	1034	1064	840	912	1070	877	1050	914	882
Oct	1200	1370	1030	1110	1150	1090	1320	1120	1150
Nov	781	927	703	921	744	910	882	810	777
Dec	605	744	636	685	670	575	670	440	—[b]
Annual Median[c]	**424**	**381**	**403**	**361**	**413**	**433**	**364**	**426**	**392**
IQR[c,d]	**540**	**646**	**447**	**581**	**602**	**606**	**541**	**649**	**513**
Annual Maximum[c]	**2080**	**2510**	**2070**	**2300**	**2080**	**1980**	**2300**	**2010**	**1990**

a See **Figure 5-3**, main volume, for sampling locations.

b No sample collected due to lack of power at sampling location.

c Determined by data from the 52-week period.

d IQR = Interquartile range.

Table 5-16. Gamma activity in particulate air samples, Site 300, 1999.[a]

Month	Radiological isotope						
	^{7}Be	^{137}Cs	^{40}K	^{22}Na	^{226}Ra	^{228}Ra	^{228}Th
	(10^{-3} Bq/m^3)	(10^{-6} Bq/m^3)					
Jan	3.3 ± 0.066	<0.16[b]	11 ± 16	<0.19[b]	<–2.2[b]	–0.23 ± 1.8	–0.14 ± 1.2
Feb	2.8 ± 0.050	<0.17[b]	15 ± 19	<0.22[b]	<–2.1[b]	–1.2 ± 2.1	–0.48 ± 1.5
Mar	3.8 ± 0.068	<0.20[b]	0.98 ± 16	<0.48[b]	0.37 ± 2.9	–0.38 ± 1.7	–0.56 ± 1.7
Apr	3.7 ± 0.067	<0.20[b]	21 ± 15	<0.61[b]	0.28 ± 2.9	0.19 ± 1.8	0.27 ± 0.85
May[c]	5.7 ± 0.56	0.21 ± 0.56	43 ± 41	0.61 ± 0.40	0.078 ± 2.0	5.4 ± 5.7	0.54 ± 1.1
Jun	3.4 ± 0.35	–0.023 ± 0.58	–36 ± 39	0.32 ± 0.45	1.6 ± 1.1	0.19 ± 1.8	3.3 ± 1.1
Jul	4.6 ± 0.46	0.21 ± 0.28	–84 ± 35	0.57 ± 0.81	0.92 ± 1.1	–1.0 ± 2.7	–3.2 ± 2.2
Aug	3.7 ± 0.38	0.20 ± 0.72	61 ± 120	0.33 ± 0.91	–1.3 ± 1.3	1.4 ± 1.7	–1.8 ± 2.6
Sep	7.2 ± 0.72	0.35 ± 0.37	38 ± 44	–0.25 ± 0.78	–1.7 ± 1.6	1.7 ± 2.7	–0.52 ± 0.78
Oct	5.8 ± 0.58	0.18 ± 0.28	–82 ± 36	0.45 ± 1.2	1.8 ± 1.4	0.91 ± 1.3	2.5 ± 2.9
Nov	3.4 ± 0.33	–0.25 ± 0.60	25 ± 43	0.40 ± 1.2	–1.4 ± 1.3	1.2 ± 1.8	–1.2 ± 0.73
Dec	5.7 ± 0.57	0.62 ± 0.56	–4.5 ± 43	0.71 ± 0.79	0.27 ± 1.0	0.52 ± 2.1	0.47 ± 1.8
Median	**3.8**	**0.20**	**13**	**0.43**	**0.17**	**0.36**	**–0.31**
IQR[d]	**2.3**	**—[e]**	**41**	**—[e]**	**2.0**	**1.5**	**1.2**
Maximum	**7.2**	**0.62**	**61**	**0.71**	**1.8**	**5.4**	**3.3**
DCG (Bq/m^3)[f]	**1.5×10^{3}**	**15**	**33**	**37**	**0.037**	**0.11**	**1.5×10^{-3}**
Percent of DCG[g]	**2.5×10^{-4}**	**1.3×10^{-6}**	**3.8×10^{-5}**	**1.1×10^{-6}**	**4.6×10^{-4}**	**3.2×10^{-4}**	**0.22[h]**

Note: Radioactivities are reported as the measured concentration and either an uncertainty (±2s counting error) or as being less than or equal to the detection limit. If the concentration is less than the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

a All Site 300 samples composited. See Figure 5-3, main volume, for sampling locations.

b Error not provided by analytical laboratory.

c The analytical software changed in May 1999.

d IQR = Interquartile range.

e No measure of dispersion calculated; see Chapter 14, Quality Assurance.

f DCG = Derived Concentration Guide (DOE Order 5400.5). See main volume, Chapter 13, Radiation Dose Assessment.

g Percent of DCG calculated from the median concentration unless otherwise noted.

h The thorium-228 percent of DCG was determined by using the maximum value because the median value was negative.

Table 5-17. Plutonium-239+240 activity in air particulate samples, Site 300, 1999.

Month	Sampling location[a]		
	Site 300 composite	PRIM	TFIR
	(10^{-9} Bq/m^3)		
Jan	0.013 ± 1.13	–1.86 ± 3.36	–3.42 ± 4.29
Feb	0.918 ± 1.55	2.39 ± 6.48	–1.21 ± 4.33
Mar	0.154 ± 1.24	3.57 ± 7.59	–0.264 ± 2.60
Apr	2.96 ± 2.24	0.651 ± 2.76	0.714 ± 3.03
May	2.50 ± 2.13	3.54 ± 5.07	3.50 ± 4.59
Jun	6.99 ± 3.96	2.21 ± 3.74	6.77 ± 6.44
Jul	0.755 ± 1.06	1.60 ± 2.71	–0.810 ± 3.17
Aug	1.86 ± 2.07	0.221 ± 3.08	2.43 ± 3.44
Sep	8.70 ± 3.92	6.48 ± 5.70	7.62 ± 6.70
Oct	–0.164 ± 6.70	11.3 ± 7.40	12.6 ± 6.77
Nov	1.71 ± 1.97	–2.05 ± 1.83	2.52 ± 3.57
Dec	3.62 ± 3.96	–1.58 ± 4.00	—[b]
Median	**1.79**	**1.91**	**2.43**
IQR[c]	**2.52**	**3.78**	**5.67**
Percent of DCG[d]	**2.41×10^{-4}**	**2.58×10^{-4}**	**3.29×10^{-4}**

Note: Radioactivities are reported as the measured concentration and either an uncertainty (±2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

a See **Figure 5-3**, main volume, for sampling locations.

b No data. See Chapter 14, Quality Assurance.

c IQR = Interquartile range.

d DCG = Derived Concentration Guide of 7.4×10^{-4} Bq/m^3 for Pu-239 activity in air. Percent calculated from the median concentration.

Table 5-18. Uranium mass in air particulate samples for Site 300 composite and PRIM location, 1999.[a]

Location[a]	Month	Uranium-235[b] (10^{-7} µg/m^3)	Uranium-238[c] (10^{-5} µg/m^3)	Uranium 235/238 (10^{-3})
Site 300	Jan	–0.38 ± 0.23	–0.4 ± 0.3	—[d]
	Feb	0.82 ± 0.19	1.3 ± 0.3	6.46
	Mar	2.94 ± 0.11	4.7 ± 0.2	6.29
	Apr	1.59 ± 1.10	2.7 ± 1.5	5.96
	May	3.99 ± 0.41	6.0 ± 0.6	6.59
	Jun	3.61 ± 0.49	5.2 ± 0.8	6.92
	Jul	2.89 ± 0.60	4.4 ± 0.9	6.54
	Aug	6.04 ± 0.50	10.7 ± 1.3	5.62
	Sep	5.41 ± 1.28	18.6 ± 2.2	2.92
	Oct	9.06 ± 2.21	13.5 ± 2.8	2.19
	Nov	–0.03 ± 2.24	0.4 ± 3.0	—[d]
	Dec	0.01 ± 1.87	–0.01 ± 2.6	—[d]
Median		**2.9**	**4.5**	**6.3**
IQR[e]		**3.7**	**6.2**	**0.9**
Maximum		**9.1**	**18.6**	NA[f]
Percent of DCG[g]		**6.2×10^{-4}**	**1.5×10^{-2}**	NA
PRIM	Jan	1.17 ± 0.1	1.7 ± 0.1	6.98
	Feb	–0.05 ± 0.2	0.0 ± 0.2	—[d]
	Mar	14.7 ± 0.1	6.6 ± 0.1	22.1
	Apr	4.11 ± 0.4	5.7 ± 0.4	7.25
	May	4.58 ± 0.2	6.9 ± 0.5	6.65
	Jun	3.90 ± 0.3	5.7 ± 0.6	6.81
	Jul	2.96 ± 0.3	4.4 ± 0.5	6.74
	Aug	5.21 ± 0.6	8.53 ± 0.7	6.10
	Sep	5.46 ± 1.1	18.2 ± 1.3	3.00
	Oct	10.6 ± 1.8	15.1 ± 2.4	7.03
	Nov	1.29 ± 1.4	1.8 ± 1.9	7.35
	Dec	1.12 ± 0.9	1.3 ± 1.3	8.27
Median		**4.0**	**5.7**	**7.0**
IQR		**4.0**	**5.6**	**0.6**
Maximum		**14.7**	**18.2**	NA
Percent of DCG		**8.5×10^{-4}**	**1.9×10^{-2}**	NA

Note: Radioactivities are reported as the measured concentration and either an uncertainty (±2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

a See **Figure 5-3**, main volume for description of sampling locations.

b Uranium-235 activities in Bq/m^3 can be determined by dividing the weight in µg/m^3 by 12.5.

c Uranium-238 activities in Bq/m^3 can be determined by dividing the weight in µg/m^3 by 80.3.

d Ratio not determined when one of the masses is negative.

e IQR = Interquartile range.

f NA = Not applicable.

g DCG = Derived Concentration Guide of activity in air of 0.3 µg/m^3 for ^{238}U and 0.047 µg/m^3 for ^{235}U. Percent calculated from the median concentration.

Table 5-19. Tritium concentration in air, Site 300, 1999.

Month	Sampling location[a] PRIM (10^{-3} Bq/m^3)
Jan	4.63 ± 9.7
	–2.19 ± 11.4
Feb	6.11 ± 7.4
	–6.22 ± 9.8
Mar	4.66 ± 13.4
	0.370 ± 7.0
Apr	11.0 ± 13.8
	–4.18 ± 11.0
	17.5 ± 13.3
May	–8.25 ± 12.8
	27.4 ± 76.2
Jun	7.96 ± 15.2
	20.5 ± 20.9
Jul	–1.55 ± 20.1
	–6.73 ± 18.1
Aug	8.77 ± 21.2
	–13.4 ± 8.0
Sep	–6.59 ± 17.6
	11.2 ± 18.4
Oct	4.11 ± 15.7
	—[b]
	6.92 ± 22.0
Nov	–15.1 ± 20.4
	–17.4 ± 21.6
Dec	19.4 ± 16.8
	1.28 ± 5.9
Median	**4.11**
IQR[c]	**15.0**
Percent of DCG[d]	**1.1×10^{-4}**
Dose (mSv)[e]	**8.5×10^{-7}**

Note: Radioactivities are reported as the measured concentration and either an uncertainty (±2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

a See **Figure 5-3**, main volume, for sampling locations.

b No data; see main volume, Chapter 14, Quality Assurance.

c IQR = Interquartile range.

d DCG = Derived Concentration Guide of 3.7×10^3 Bq/m^3. Percent calculated from the median concentration.

e This dose is the effective dose equivalent.

Table 5-20. Beryllium in air particulate samples, Site 300 network, 1999.

Month	Sampling location[a] (pg/m^3)			
	801E	EOBS	GOLF	TFIR
Jan	0.660	1.04	2.58	3.24
Feb	2.28	2.47	2.69	4.42
Mar	12.0	4.74	4.60	7.32
Apr	13.2	5.50	7.98	11.7
May	30.9	5.55	24.8	16.1
Jun	13.1	6.54	19.0	13.4
Jul	11.5	10.1	26.4	15.3
Aug	9.21	8.15	11.4	15.4
Sep	15.4	13.2	14.4	19.5
Oct	23.4	18.2	23.1	32.3
Nov	4.09	3.04	6.17	12.0
Dec	4.54	4.15	8.97	—[b]
Median[c]	**11.8**	**5.53**	**10.2**	**13.4**
IQR[d]	**9.32**	**4.77**	**14.3**	**6.24**
Maximum	**30.9**	**18.2**	**26.4**	**32.3**
Percent of ACL[e]	**0.118**	**0.055**	**0.102**	**0.134**

a See **Figure 5-3**, main volume, for sampling locations.

b No sample collected due to lack of power at sampling location.

c Median value for all Site 300 locations is 10.1 pg/m^3.

d IQR = Interquartile range.

e The monthly Ambient Concentration Limit (ACL) is 10,000 pg/m^3 as set by the Bay Area Air Quality Management District (BAAQMD). Percent calculated from the median concentration.

6

Sewerable Water Monitoring

Jennifer M. Larson
Robert J. Vellinger
Robert A. Williams
Ted A. Giesing

Discharges of Treated Ground Water

Discharges of ground water to Lawrence Livermore National Laboratory's sanitary sewer must comply with the terms and conditions in Permit 1510G(99), issued by the Livermore Water Reclamation Plant (LWRP). Table 6-1 shows discharge dates and monitoring data for discharges of ground water. The self-monitoring program prescribed in this ground water discharge permit requires compliance with the parameters specified in **Table 6-2** in the main volume.

Flow Monitoring Methods

To monitor effluent flow, LLNL installed a flow chart recorder inside the LLNL Sewer Monitoring Station (SMS) and an ultrasonic flow sensor in the adjacent underground sewer vault (main volume **Figure 6-1**). Every day a flow totalizer reading was recorded on the flow chart recorder when the daily composite sample was acquired from the SMS. Analysts determined the daily total flows by subtracting sequentially recorded flow totalizer readings. Daily flow totals were estimated when flow totalizer readings were not available. Table 6-2a shows the daily total flows. Table 6-2b presents monthly and annual flow summary statistics for 1999.

Sewage Sampling Methods and Analytical Procedures

LLNL operated a flow-proportional, peristaltic-pump composite sampler in the SMS. This sampler created a 24-hour composite of the Livermore site sewage effluent by taking a sample every 3785 L of effluent. Every day, technologists transferred 500-mL aliquots of this 24-hour composite to polyethylene bottles and submitted them for analysis.

Two aliquots were submitted to LLNL's Hazards Control Analytical Laboratory (HCAL) for daily analyses of the gross alpha, gross beta, and tritium activity. For the gross alpha and gross beta analyses, HCAL digested a 150-mL aliquot, plated the digestate onto a planchette, and submitted the planchette to the Hazards Control Radiological Measurements Laboratory (HCRML) for a 100-min count in a gas-proportional counter. For the tritium analyses, HCAL distilled a 100-mL aliquot and submitted the distillate to HCRML. HCRML prepared 5 mL of the distillate with a scintillation cocktail and counted it for 100 min in a liquid scintillation counter. The analytical results for the gross alpha, gross beta, and tritium analyses are shown in Table 6-3.

A third daily aliquot was submitted to LLNL's Chemistry and Materials Science Environmental Services (CES). From the aliquots submitted for each month, CES created a composite sample and analyzed it, first, for ^{239}Pu, and then for ^{137}Cs. The ^{239}Pu was analyzed by adding approximately 15 L of MnO_2 to the entire volume of the monthly composite sample to precipitate the plutonium. After the composite volume was digested with concentrated HNO_3, CES used ion-exchange chromatography to separate the plutonium from the rest of the sample. The plutonium eluted from the ion-exchange column was electroplated onto a stainless steel disk, and its activity was measured by alpha spectroscopy.

Before beginning analysis for ^{137}Cs activity in the monthly composite, CES returned any nonplutonium sample material generated from the ion-exchange process to the monthly composite sample in order to prevent ^{137}Cs loss. For the ^{137}Cs analysis, CES added NH_4MoPO_4 to the monthly composite sample in order to precipitate the cesium and then counted the composite sample using gamma spectroscopy. The analytical results for the ^{239}Pu and ^{137}Cs analyses are reported in the main volume **Table 6-6**.

In 1999, LWRP also provided two types of sample—treated effluent and sludge—to LLNL for analysis. LWRP collected two 500-mL aliquots of treated effluent daily and used them to create two different composite samples: (1) a week of daily aliquots, and (2) a month of daily aliquots. LLNL technologists transferred the weekly sample (composited in a 1-gal polyethylene bottle) to HCAL for gross alpha, gross beta, and tritium analyses. Table 6-4 shows the tritium results for the LWRP weekly composite sample.

CES analyzed the monthly sample, which is composited in a 5-gal polyethylene carboy, for ^{137}Cs using gamma spectroscopy and for ^{239}Pu using alpha spectroscopy. The results of the analysis are presented in Chapter 6 of the main volume.

The other type of sample was sludge from the LWRP digesters. Each month, LWRP employees provided two 500-mL composite samples from each of the digesters. The composites consisted of aliquots taken from the circulating sludge once a week. LLNL collected the composite samples and submitted one 500-mL composite to HCAL and a second 500-mL composite to CES. HCAL analyzed the monthly composite for gross radioactivity and metals. CES composited all of the monthly samples on a quarterly basis and analyzed the quarterly composites for plutonium, cesium, and gamma-emitting radionuclides, using alpha spectroscopy for the plutonium and gamma spectroscopy for the cesium and gamma-emitting radionuclides. **Table 6-5** in the main volume shows the results for the ^{239}Pu analyses.

Throughout Chapter 6, gross alpha, gross beta, and tritium are displayed in bequerels per unit volume, and the activities shown in Tables 6-3 and 6-4 are the measured concentrations and their associated ±2σ counting errors. A ±2σ error is not shown when the measured concentration is below the limit of sensitivity (LOS). The LOS is determined individually for each sample analysis according to the following equation:

$$LOS = \frac{C}{Et}$$

where

C = Minimum significant count, above background radiation, for a length of time (t)

E = System counting efficiency

and

t = Sample counting time (t).

LLNL also operated monitoring station C196 with a flow-proportional, peristaltic pump composite sampler adjacent to the SMS. This sampler functioned as a weekly composite sampler and acquired a 60-mL sample for every 30,280 L of effluent LLNL discharged during a seven-day period. Another sampler operated once a month for 24 hours as a single-day composite sampler and collected a 65-mL sample for every 7570 L of effluent discharged.

Aliquots were acquired each week from the weekly composite sample and every month from the 24-hour composite sample. From each weekly composite (and each monthly

24-hour composite), analysts transferred one 1-L aliquot to a polyethylene bottle. This aliquot was submitted to an off-site contract laboratory for analyses of aluminum, arsenic, beryllium, cadmium, chromium, copper, iron, lead, mercury, nickel, selenium, silver, and zinc. The results for these analyses are presented in Tables 6-5 and 6-6; the EPA methods used for these analyses are identified by the method numbers 200.7, SM-3114B, 210.2, 200.7, 200.7, 200.7, 200.7, 239.2, 245.2, 249.2, 270.2, 200.7, and 200.7, respectively. In September 1999, sampling for aluminum, beryllium, selenium, and iron was reduced from weekly to twice monthly. LWRP does not require sampling for these parameters, and the change in sampling frequency reduced costs while still allowing continuity with historical records. See the main volume **Table 6-2** for constituent analyses required by the LWRP permit.

Two additional aliquots from the weekly composite were submitted each week to HCAL for analyses of gross alpha, beta, and tritium. A subset of these results contributes to the completeness of the daily analytical results for gross alpha, gross beta, and tritium; this subset is reported and footnoted in Table 6-3.

Aliquots were submitted to the contract analytical laboratory for more extensive analyses on the 24-hour composite than on the weekly composite sample. Under the heading of "Composite sample," Table 6-7 lists these results by month, parameters, and the EPA method numbers used for the analyses. (The analytical methods are EPA methods unless otherwise indicated.) It should be noted that only Table 6-6 reports the monthly metals analytical results for those metals mentioned in the previous paragraph.

Concurrent with the monthly acquisition of a 24-hour composite, a portable, peristaltic-pump sampler collected instantaneous grab samples from the sewage stream in the sewer vault adjacent to SMS. These samples were submitted to a contract analytical laboratory for additional monitoring of water quality parameters and organic compounds. The results of this monitoring are presented in Table 6-7 under the "Grab sample" heading. The table lists the parameters and the EPA method numbers used for the analyses. The last four entries show the oil and grease analysis of samples that were acquired at 4-hour intervals during the day as well as the time of collection of each oil and grease sample. Based on an April 1, 1999, letter from the LWRP, LLNL suspended its monthly oil and grease sampling in May 1999. In a subsequent letter from the LWRP, dated August 18, 1999, oil and grease sampling was reinstated, but the sampling frequency was reduced from monthly to semiannually (every six months). The letter also changed the cyanide sampling frequency from monthly to semiannually. LLNL began semiannual sampling for these parameters in July 1999.

Quality Assurance Methods

Standard quality control and quality assurance procedures were followed in the collection of LLNL samples. When each sewage field sample was collected, it was labeled with the sampling location and date of sampling. In the laboratory, each sample was assigned a number that accompanied that sample during analysis. Additionally, split samples accounted for approximately 10% of the samples submitted for analytical work in 1999.

Table 6-1. Laboratory analytical results for ground water discharges to the sanitary sewer, January 1 through December 31, 1999.

Parameter	Discharge dates					
	3/1/99	**3/23/99**	**3/26/99**	**5/6/99**	**5/26/99**	**6/14/99**
pH[a] (pH units)	6.5	7	8.2	7.5	6.5	7.5
Arsenic (mg/L)	0.0029	0.01	<0.002	<0.002	<0.002	0.0022
Cadmium (mg/L)	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Nickel (mg/L)	0.045	0.014	<0.005	<0.002	<0.005	<0.002
Total chromium (mg/L)	<0.001	<0.001	0.43	<0.001	0.005	<0.001
Copper (mg/L)	0.021	<0.010	<0.010	0.015	0.003	<0.001
Lead (mg/L)	0.0027	<0.002	<0.002	<0.005	<0.005	<0.005
Mercury (mg/L)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Silver (mg/L)	<0.0005	<0.0005	<0.0025	<0.001	<0.001	<0.001
Zinc (mg/L)	0.02	<0.02	<0.02	0.047	<0.02	<0.02
Total toxic organics[b] (mg/L)	**nd[c]**	**nd**	**0.0016**	**0.0013**	**nd**	**nd**

Parameter	Discharge dates					
	6/14/99–7/7/99	**7/7/99–9/8/99**	**8/2/99**	**8/31/99–9/29/99**	**11/13/99–11/23/99**	**12/6/99**
pH[a] (pH units)	8	8	7.5	7.5	6.5–8.0	6.5
Arsenic (mg/L)	<0.002	<0.002	<0.002	<0.002	0.0074	0.0033
Cadmium (mg/L)	<0.0005	<0.0005	0.002	<0.0005	<0.001	<0.0005
Nickel (mg/L)	<0.002	<0.002	0.0081	<0.005	<0.01	<0.0051
Total chromium (mg/L)	<0.0073	<0.001	0.008	<0.036	<0.001	0.077
Copper (mg/L)	0.172	0.0087	<0.01	<0.01	<0.001	0.0054
Lead (mg/L)	0.017	<0.005	0.073	<0.002	<0.005	<0.005
Mercury (mg/L)	<0.0002	<0.0002	0.0003	<0.0002	<0.0002	<0.0002
Silver (mg/L)	<0.001	<0.001	0.0091	<0.0005	<0.001	<0.001
Zinc (mg/L)	<0.02	0.024	0.03	<0.02	<0.05	0.023
Total toxic organics[b] (mg/L)	**nd**	**0.055**	**nd**	**nd**	**nd**	**nd**

a pH was verified prior to discharge. The pH at final discharge could have been slightly different but was always between 5 and 10.

b Total toxic organics is the sum of concentrations of compounds detected by EPA Method 601 for wastewater.

c nd = Not detected. Concentrations were not detected by EPA Method 601 for wastewater.

Table 6-2a. Daily flow totals for LLNL site sanitary sewer effluent (ML), 1999.

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.472	0.535	0.550	1.659	1.437	0.670	1.394	0.508	2.844	1.140	0.632	1.089
2	0.442	1.100	1.016	1.768	0.932	1.741	1.353	0.528	1.716	1.079	1.120	1.177
3	0.441	1.058	1.024	1.871	0.991	1.941	1.072	1.249	1.314	0.568	1.075	1.275
4	0.528	1.428	0.991	0.986	1.679	1.577	0.568	1.200	1.135	0.587	1.130	1.095
5	1.131	1.063	1.444	0.855	1.317	1.640	0.578	1.151	0.551	1.260	1.215	0.511
6	1.225	1.077	1.641	1.173	1.185	1.127	0.679	1.270	0.510	1.172	1.184	0.493
7	1.294	0.370	1.204	1.073	1.094	1.172	1.245	1.220	0.519	1.193	0.649	1.168
8	1.205	0.560	1.327	1.089	1.169	1.373	1.792	0.818	1.103	1.226	0.705	1.534
9	0.977	1.258	1.283	1.098	0.569	1.386	1.772	0.667	1.230	1.056	1.147	1.619
10	0.519	1.292	1.544	0.936	0.532	1.353	1.211	1.169	1.270	0.587	1.213	1.167
11	0.404	1.130	1.763	0.377	1.207	1.261	0.614	1.246	1.125	0.610	1.000	0.937
12	1.162	1.009	1.656	0.393	1.216	1.130	0.775	1.224	0.614	1.137	1.173	0.467
13	1.234	0.874	1.023	1.184	1.244	0.597	1.207	1.231	0.666	1.135	1.093	0.425
14	2.335	0.377	0.382	1.224	1.294	0.743	1.099	1.012	1.175	1.100	0.526	1.196
15	1.072	0.358	0.413	1.142	1.009	1.350	1.691	0.483	1.195	1.179	0.610	1.394
16	1.167	0.454	1.184	1.012	0.578	1.173	1.288	0.557	1.233	0.992	1.169	2.088
17	0.418	1.155	1.189	0.967	0.573	1.255	1.033	1.102	1.553	0.625	1.189	1.375
18	0.392	1.054	1.104	0.372	1.286	1.229	0.634	1.116	1.138	0.634	1.109	0.953
19	0.698	0.918	1.205	0.415	1.346	1.090	0.651	1.127	0.620	1.133	1.230	0.439
20	1.291	0.912	1.317	1.091	1.292	0.581	1.191	1.216	0.647	1.202	1.068	0.491
21	1.170	0.549	0.681	1.235	1.384	0.637	1.227	1.883	1.285	1.225	0.554	1.382
22	1.086	0.444	0.503	1.416	1.136	1.228	1.231	1.470	1.229	1.159	0.502	1.213
23	1.034	1.058	1.326	1.269	0.484	1.186	1.270	0.604	1.261	1.084	1.152	1.177
24	0.544	1.156	1.266	0.984	0.506	1.502	1.246	1.229	1.335	0.560	0.812	0.580
25	0.502	0.778	1.246	0.378	1.202	1.217	0.769	1.143	1.237	0.606	0.935	0.473
26	1.088	1.073	1.329	0.386	1.248	1.159	0.622	1.150	0.670	1.244	0.420	0.473
27	1.202	1.006	1.728	1.172	1.309	0.806	1.216	1.312	0.503	1.190	0.448	0.506
28	1.136	0.522	1.263	1.163	1.349	0.799	1.206	1.156	1.248	1.199	0.542	0.917
29	1.310		1.249	1.032	1.164	1.306	1.152	0.645	1.372	1.332	0.510	0.844
30	1.144		1.975	1.150	0.591	1.217	1.645	0.680	1.123	1.040	1.165	0.769
31	0.482		1.909		0.575		1.114	2.373		0.626		0.592

Note: Shaded volumes indicate an estimation of the daily flow total; actual volumes are not available. Weekend and holiday daily flow totals are shown in the boxed areas. Note that the majority of the flow volume recorded for a given day was actually discharged on the previous day.

Table 6-2b. Monthly and annual flow summary statistics for LLNL site sanitary sewer effluent (ML), 1999.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	1999
Weekend days and holidays													
Total	5.842	4.169	7.572	5.335	6.331	7.132	5.890	6.960	5.300	5.403	6.098	5.450	71.482
Minimum	0.392	0.358	0.382	0.372	0.484	0.581	0.568	0.483	0.503	0.560	0.420	0.425	0.358
Maximum	0.698	0.560	1.327	1.173	0.991	1.172	0.775	1.470	0.670	0.634	0.705	0.592	1.470
Mean	0.487	0.463	0.841	0.593	0.633	0.792	0.654	0.696	0.589	0.600	0.554	0.495	0.611
Weekdays													
Total	23.263	20.399	30.163	25.535	26.567	28.314	28.655	26.779	28.121	25.477	21.179	24.369	308.821
Minimum	0.977	0.778	0.991	0.936	1.009	1.090	1.033	1.012	1.103	0.992	0.812	0.769	0.769
Maximum	2.335	1.428	1.975	1.871	1.679	1.941	1.792	2.373	2.844	1.332	1.230	2.088	2.844
Mean	1.224	1.074	1.371	1.216	1.265	1.348	1.303	1.275	1.339	1.158	1.115	1.218	1.245
All days													
Total	29.105	24.568	37.735	30.870	32.898	35.446	34.545	33.739	33.421	30.880	27.277	29.819	380.303
Minimum	0.392	0.358	0.382	0.372	0.484	0.581	0.568	0.483	0.503	0.560	0.420	0.425	0.358
Maximum	2.335	1.428	1.975	1.871	1.679	1.941	1.792	2.373	2.844	1.332	1.230	2.088	2.844
Mean	0.939	0.877	1.217	1.029	1.061	1.182	1.114	1.088	1.114	0.996	0.909	0.962	1.042

Table 6-3. Daily monitoring results for gross alpha, gross beta, and tritium in the sanitary sewer effluent, 1999.

Date		Gross alpha (µBq/mL)		Gross beta (mBq/mL)		Tritium (mBq/mL)	
		Activity	LOS[a]	Activity	LOS	Activity	LOS
January	1	2.94	74.4	0.138 ± 0.084	0.124	9.88	11.1
	2	74.4	75.9	0.0548	0.125	14.9 ± 6.9	11.2
	3	166 ± 70	70.3	0.0326	0.124	6.03	11.4
	4	78.8 ± 52.0	74.0	0.142 ± 0.084	0.124	11.0 ± 6.3	10.7
	5	31.0	100	0.792 ± 0.119	0.133	–1.70	11.4
	6	39.2	89.9	0.525 ± 0.105	0.129	–1.70	11.8
	7	148 ± 68	99.9	0.614 ± 0.111	0.131	–6.62	12.1
	8	67.7	113	0.725 ± 0.116	0.135	–0.585	11.5
	9	111 ± 59	107	0.670 ± 0.114	0.134	5.25	11.1
	10	133 ± 70	90.3	0.199 ± 0.087	0.127	5.55	10.9
	11	182 ± 80	88.8	0.171 ± 0.085	0.127	5.92	11.2
	12	110 ± 53	95.8	0.781 ± 0.117	0.130	0.662	11.4
	13	32.6	91.4	0.611 ± 0.110	0.128	–1.60	11.5
	14	163 ± 68	84.0	0.444 ± 0.098	0.125	–8.29	12.3
	15	145 ± 69	114	0.966 ± 0.126	0.136	6.51	12.0
	16	87.0	107	0.810 ± 0.122	0.135	14.7 ± 8.2	11.9
	17	91.4 ± 55.7	84.0	0.370 ± 0.096	0.126	12.3 ± 7.0	11.5
	18	13.4	71.8	0.182 ± 0.086	0.123	13.4 ±7.0	11.2
	19	62.9	93.2	0.293 ± 0.094	0.130	15.8 ± 7.4	11.7
	20	8.51	97.3	0.692 ± 0.118	0.131	7.25	11.4
	21	123 ± 58	87	0.810 ± 0.113	0.127	1.82	11.2
	22	107 ± 57	90.7	0.703 ± 0.112	0.128	–1.24	11.8
	23	135 ± 62	85.8	0.744 ± 0.112	0.128	28.5 ± 6.5	10.8
	24	46.6	79.6	0.0755	0.127	9.81	12.0
	25	38.1	75.9	0.0799	0.126	–1.52	12.2
	26	29.4	95.8	0.644 ± 0.109	0.132	82.5 ± 9.1	11.9
	27	51.4	94.7	0.648 ± 0.110	0.132	2.93	11.7
	28	35.7	98.8	0.692 ± 0.118	0.133	–6.22	12.1
	29	158 ± 71	92.5	0.500 ± 0.105	0.128	–9.58	12.0
	30	170 ± 73	92.1	0.522 ± 0.104	0.128	8.21	11.9
	31	18.7	82.9	0.103	0.125	21.5 ± 8.2	12.5
February	1	138 ± 73	87.7	0.106	0.127	20.4 ± 7.8	11.3
	2	63.3	103	0.781 ± 0.117	0.132	7.44	11.7
	3	80.3	86.6	0.570 ± 0.108	0.126	2.35	11.8

Table 6-3. Daily monitoring results for gross alpha, gross beta, and tritium in the sanitary sewer effluent, 1999 (continued).

Date		Gross alpha (µBq/mL)		Gross beta (mBq/mL)		Tritium (mBq/mL)	
		Activity	LOS[a]	Activity	LOS	Activity	LOS
February	4	19.2	89.5	0.662 ± 0.113	0.127	–2.23	11.8
	5	45.5	94.7	0.707 ± 0.113	0.131	1.30	11.6
	6	131 ± 61	93.2	0.866 ± 0.121	0.130	5.70	11.4
	7	1.07	79.2	0.210 ± 0.090	0.126	17.3 ± 7.3	11.3
	8	73.6	85.8	0.139 ± 0.085	0.128	45.5 ± 7.7	12.0
	9	91.0	91.8	0.648 ± 0.110	0.130	12.2 ± 7.0	11.9
	10	41.8	89.5	0.599 ± 0.108	0.129	–13.9	14.1
	11	110 ± 55	91.4	0.847 ± 0.119	0.130	19.2 ± 8.2	13.5
	12	24.8	92.9	0.829 ± 0.116	0.131	14.1 ± 7.7	12.5
	13	108 ± 52	81.4	0.762 ± 0.114	0.127	5.37	12.2
	14	–27.9	72.2	0.0907	0.124	18.4 ± 8.1	12.8
	15	–15.2	72.5	0.067	0.125	–3.42	13.2
	16	34.3	75.1	0.235 ± 0.089	0.125	0.165	12.4
	17	–144	107	5.77 ± 0.25	0.140	5.48	11.8
	18	196 ± 73	94.0	1.30 ± 0.13	0.130	–0.273	12.0
	19	308 ± 105	117	1.09 ± 0.13	0.137	3.77	11.3
	20	61.4	87.3	0.944 ± 0.123	0.127	5.37	11.4
	21	151 ± 73	84.7	0.202 ± 0.087	0.127	17.6 ± 9.4	13.0
	22	36.2	81.8	0.185 ± 0.087	0.126	8.95	13.1
	23	40.0	92.9	0.744 ± 0.112	0.129	24.0 ± 7.4	11.9
	24	66.2	92.1	0.810 ± 0.113	0.128	12.5 ± 6.1	11.8
	25	111 ± 50	92.9	0.977 ± 0.127	0.128	35.2 ± 7.7	12.7
	26	146 ± 61	96.6	0.907 ± 0.118	0.130	0.102	14.8
	27	52.5	87.3	0.762 ± 0.114	0.127	14.7 ± 8.5	11.8
	28	161 ± 66	70.7	0.168 ± 0.083	0.122	5.81	11.6
March	1	27.6	71.0	0.087	0.122	16.1 ± 6.7	11.0
	2	152 ± 59	85.5	0.844 ± 0.118	0.126	10.9	11.3
	3	185 ± 63	83.6	1.05 ± 0.13	0.125	4.37	11.0
	4	73.6	104	0.955 ± 0.124	0.132	15.0 ± 7.0	12.0
	5	102 ± 54	84.0	0.503 ± 0.101	0.125	19.7 ± 8.3	12.3
	6	182 ± 82	122	0.792 ± 0.119	0.135	71.4 ± 8.6	12.0
	7	354 ± 117	114	0.455 ± 0.105	0.135	71.0 ± 8.5	12.1
	8	119 ± 67	90.7	0.217 ± 0.089	0.127	36.9 ± 8.1	12.5
	9	59.9	98.8	0.777 ± 0.117	0.130	17.8 ± 7.1	12.0

Table 6-3. Daily monitoring results for gross alpha, gross beta, and tritium in the sanitary sewer effluent, 1999 (continued).

Date		Gross alpha (µBq/mL)		Gross beta (mBq/mL)		Tritium (mBq/mL)	
		Activity	LOS[a]	Activity	LOS	Activity	LOS
March	10	93.6 ± 44.9	90.7	0.895 ± 0.116	0.128	29.0 ± 8.1	12.6
	11	136 ± 60	96.2	0.844 ± 0.118	0.130	27.9 ± 7.5	11.8
	12	84.0	95.8	0.825 ± 0.116	0.130	8.88	11.5
	13	128 ± 56	85.5	0.740 ± 0.111	0.126	4.63	11.6
	14	33.6	79.6	0.213 ± 0.087	0.124	7.44	11.7
	15	53.7	78.8	0.191 ± 0.086	0.124	2.76	11.9
	16	89.9	94.4	0.736 ± 0.110	0.129	8.14	12.0
	17	104 ± 52	94.0	0.740 ± 0.111	0.129	4.00	12.5
	18	36.0	91.0	0.596 ± 0.107	0.128	2.66	12.4
	19	82.9	92.5	0.744 ± 0.112	0.128	–0.714	12.1
	20	98.1 ± 52.0	85.8	0.555 ± 0.105	0.126	6.18	12.1
	21	5.07	79.2	0.0988	0.125	3.47	11.8
	22	56.2	73.6	0.114	0.123	10.2	11.8
	23	178 ± 71	96.2	0.747 ± 0.112	0.130	0.0633	12.3
	24	90.7 ± 46.2	82.5	0.681 ± 0.109	0.126	13.7 ± 7.3	11.8
	25	36.9	85.1	0.799 ± 0.112	0.127	10.4	12.1
	26	147 ± 66	93.6	0.625 ± 0.113	0.130	19.0 ± 7.2	11.4
	27	54.0	89.2	0.451 ± 0.099	0.128	–1.13	12.0
	28	5.03	65.1	0.0825	0.121	4.74	12.0
	29	13.7	62.9	0.0213	0.120	3.57	12.2
	30	129 ± 58	79.9	0.551 ± 0.105	0.125	4.96	12.6
	31	133 ± 61	80.3	0.422 ± 0.097	0.125	10.1	11.8
April	1	110 ± 55	83.3	0.588 ± 0.106	0.123	1.32	11.7
	2	78.4	78.8	0.500 ± 0.100	0.122	1.32	11.3
	3	66.2	76.6	0.283 ± 0.091	0.121	–0.270	11.4
	4	57.4	64.0	0.0607	0.117	13.0 ± 7.1	11.4
	5	50.0	63.6	0.0107	0.117	2.00	11.7
	6	83.6 ± 51.0	69.9	0.172 ± 0.082	0.120	–3.81	12.2
	7	74.4	96.6	0.770 ± 0.115	0.130	3.48	11.9
	8	27.9	94.7	0.947 ± 0.123	0.129	6.85	11.9
	9	165 ± 68	97.7	0.910 ± 0.118	0.130	9.77	11.1
	10	10.8	89.2	0.770 ± 0.115	0.127	–5.81	11.5
	11	31.6	72.9	0.135 ± 0.082	0.123	–10.2	12.2
	12	–16.1	78.4	0.0529	0.124	1.03	12.1

Table 6-3. Daily monitoring results for gross alpha, gross beta, and tritium in the sanitary sewer effluent, 1999 (continued).

Date		Gross alpha (µBq/mL)		Gross beta (mBq/mL)		Tritium (mBq/mL)	
		Activity	LOS[a]	Activity	LOS	Activity	LOS
April	13	47.4	108	0.888 ± 0.124	0.134	5.51	11.7
	14	113 ± 52	96.2	0.766 ± 0.115	0.130	3.63	11.8
	15	1200 ± 144	98.8	9.51 ± 0.30	0.131	–10.8	11.8
	16	105 ± 35	91.8	2.00 ± 0.16	0.128	7.99	11.4
	17	59.2	91.4	1.41 ± 0.14	0.128	–1.08	12.1
	18	72.2	78.1	0.221 ± 0.088	0.124	–2.33	12.2
	19	64.8	78.1	0.163 ± 0.085	0.124	4.55	11.7
	20	35.0	94.4	1.18 ± 0.13	0.129	8.92	11.2
	21	180 ± 65	98.4	1.03 ± 0.12	0.131	68.1 ± 8.2	11.4
	22	62.5	89.5	0.685 ± 0.110	0.127	–0.0205	11.5
	23	92.9	93.6	0.618 ± 0.111	0.129	2.33	11.7
	24	144 ± 62	94.0	0.807 ± 0.121	0.129	1.24	11.7
	25	41.4	82.9	0.217 ± 0.089	0.125	2.25	12.1
	26	59.2	78.8	0.203 ± 0.087	0.125	0.00780	12.2
	27	62.2	110	0.770 ± 0.123	0.135	–0.321	11.6
	28	107 ± 52	90.7	0.744 ± 0.112	0.128	0.0492	11.5
	29	30.2	94.7	0.910 ± 0.118	0.130	3.19	10.9
	30	28.9	96.9	0.858 ± 0.120	0.130	7.99	10.7
May	1	78.4	83.6	0.411 ± 0.099	0.126	16.6 ± 6.5	10.7
	2	105 ± 59	74.4	0.0899	0.124	10.8	11.1
	3	169 ± 71	70.7	–0.0221	0.122	16.6 ± 6.6	11.1
	4	90.3	91.4	0.455 ± 0.100	0.128	9.44	11.2
	5	40.0	107	0.707 ± 0.113	0.134	6.77	10.7
	6	85.8 ± 43.8	71.0	0.992 ± 0.129	0.137	2.93	8.58
	7	172 ± 71	105	0.873 ± 0.122	0.133	–2.45	8.77
	8	61.4(b)	99.5[b]	0.629 ± 0.113[b]	0.132[b]	5.33	8.70
	9	61.4(b)	99.5[b]	0.629 ± 0.113[b]	0.132[b]	0.540	8.73
	10	43.7	77.3	0.0855	0.124	3.29	8.77
	11	64.0	94.4	0.821 ± 0.115	0.129	1.78	8.44
	12	–1.02	91.0	0.688 ± 0.110	0.128	3.77	8.62
	13	73.6	94.4	0.692 ± 0.111	0.129	–1.06	8.73
	14	247 ± 87	96.2	0.596 ± 0.107	0.128	3.77	8.58
	15	–24.6	81.8	0.666 ± 0.107	0.123	3.81	8.55
	16	42.2	68.1	0.087	0.120	–2.12	8.92

Table 6-3. Daily monitoring results for gross alpha, gross beta, and tritium in the sanitary sewer effluent, 1999 (continued).

Date		Gross alpha (µBq/mL)		Gross beta (mBq/mL)		Tritium (mBq/mL)	
		Activity	LOS[a]	Activity	LOS	Activity	LOS
May	17	115 ± 61	71.4	0.0496	0.121	4.14	8.47
	18	261 ± 86	89.9	0.655 ± 0.111	0.126	2.56	8.55
	19	75.5	98.4	0.814 ± 0.114	0.129	2.56	8.62
	20	15.7	105	0.655 ± 0.111	0.131	–3.43	8.70
	21	69.6	116	0.851 ± 0.128	0.136	–1.99	8.77
	22	41.1	89.2	0.773 ± 0.116	0.128	5.22	8.40
	23	44.8	65.5	0.11	0.121	6.03	8.40
	24	92.5 ± 56.4	74.0	0.0973	0.124	8.25 ± 4.37	8.21
	25	116 ± 56	95.5	0.747 ± 0.112	0.130	–1.20	8.95
	26	145 ± 62	94.0	0.818 ± 0.114	0.130	132 ± 9	11.2
	27	264 ± 87	103	1.02 ± 0.12	0.133	–1.82	11.6
	28	150 ± 66	93.2	0.651 ± 0.111	0.128	–2.33	11.6
	29	70.3	91.0	0.692 ± 0.111	0.128	0.914	11.3
	30	37.0	70.3	0.191 ± 0.086	0.122	9.51	10.8
	31	62.2	76.6	0.142 ± 0.084	0.124	2.25	11.1
June	1	72.9	75.1	0.226 ± 0.088	0.123	2.67	11.3
	2	–13.5	77.3	0.666 ± 0.107	0.124	5.51	11.7
	3	160 ± 71	91.4	0.492 ± 0.103	0.128	10.8	11.4
	4	77.7	90.3	0.770 ± 0.115	0.129	4.40	11.1
	5	64.0	79.9	1.00 ± 0.12	0.125	–0.134	8.88
	6	33.9	65.1	0.0392	0.121	2.83	8.73
	7	52.2	62.9	0.0448	0.120	3.24	8.88
	8	21.9	88.8	0.718 ± 0.115	0.128	6.51	11.3
	9	109 ± 52	96.2	0.803 ± 0.120	0.131	–1.27	11.6
	10	433 ± 108	90.3	0.677 ± 0.108	0.128	–2.74	11.2
	11	75.1	95.1	0.659 ± 0.112	0.130	7.96	11.2
	12	34.6	84.7	0.629 ± 0.107	0.127	8.07	11.1
	13	37.4	74.7	0.132 ± 0.083	0.124	5.14	11.0
	14	214 ± 79	77.7	0.180 ± 0.085	0.125	–2.45	11.6
	15	106 ± 54	90.7	0.592 ± 0.107	0.128	–2.05	11.5
	16	159 ± 62	87.3	0.810 ± 0.113	0.127	0.133	11.2
	17	47.4	81.4	0.685 ± 0.110	0.124	4.18	11.0
	18	65.9	93.6	0.662 ± 0.113	0.128	1.83	11.2
	19	39.6	81.0	0.692 ± 0.111	0.124	2.15	11.0

Table 6-3. Daily monitoring results for gross alpha, gross beta, and tritium in the sanitary sewer effluent, 1999 (continued).

Date		Gross alpha (µBq/mL)		Gross beta (mBq/mL)		Tritium (mBq/mL)	
		Activity	LOS[a]	Activity	LOS	Activity	LOS
June	20	105 ± 56	69.9	0.138 ± 0.080	0.121	–5.37	11.4
	21	63.6	69.2	0.0966	0.121	0.918	11.0
	22	92.1 ± 46.1	79.9	0.596 ± 0.107	0.124	–4.48	11.5
	23	100 ± 47	83.6	0.699 ± 0.112	0.125	–2.76	11.4
	24	101 ± 46	75.9	0.622 ± 0.106	0.125	2.05	11.5
	25	243 ± 80	98.1	0.762 ± 0.114	0.132	8.47	11.2
	26	41.1	80.3	0.710 ± 0.114	0.126	0.342	11.0
	27	87.0 ± 53.0	73.6	0.128 ± 0.082	0.124	3.12	10.7
	28	31.6	78.4	0.240 ± 0.089	0.125	7.62	10.8
	29	157 ± 66	106	0.884 ± 0.124	0.134	143 ± 9	10.8
	30	103 ± 51	98.1	0.747 ± 0.112	0.131	208 ± 10	11.0
July	1	156 ± 61	80.3	0.625 ± 0.106	0.125	11.6 ± 6.6	10.5
	2	137 ± 59	84.0	0.622 ± 0.106	0.126	13.8 ± 6.7	11.2
	3	164 ± 64	90.7	0.762 ± 0.114	0.128	1.47	11.1
	4	15.7	74.4	0.168 ± 0.086	0.123	3.43	11.1
	5	19.2	71.0	–0.0301	0.122	4.07	11.0
	6	87.3 ± 48.9	68.8	0.216 ± 0.086	0.122	1.29	11.3
	7	369 ± 114	115	0.677 ± 0.115	0.135	169 ± 10	11.8
	8	–120	108	3.54 ± 0.20	0.135	2.33	11.4
	9	48.1	72.9	0.392 ± 0.098	0.124	3.07	11.0
	10	101 ± 48	81.0	0.703 ± 0.112	0.125	91.4 ± 6.1	5.44
	11	20.8	74.7	0.126 ± 0.083	0.124	2.52	5.66
	12	15.4	77.0	0.124	0.125	7.73 ± 3.48	5.44
	13	139 ± 61	94.0	0.821 ± 0.115	0.130	–0.625	11.2
	14	68.8	81.8	0.796 ± 0.111	0.126	10.2	10.7
	15	276 ± 80	87.7	1.01 ± 0.13	0.138	9.69	10.5
	16	62.2	95.1	0.729 ± 0.117	0.129	–1.38	11.1
	17	137 ± 59	86.2	0.833 ± 0.117	0.126	–0.696	5.70
	18	72.2 ± 47.6	67.3	0.132 ± 0.080	0.121	4.51	5.40
	19	75.5 ± 47.6	62.2	0.0611	0.119	4.85	5.22
	20	129 ± 58	81.0	0.622 ± 0.106	0.124	0.470	10.9
	21	248 ± 82	86.6	0.629 ± 0.107	0.126	2.63	5.37
	22	151 ± 57	80.7	0.640 ± 0.109	0.125	0.918	10.5
	23	42.2	80.7	0.640 ± 0.109	0.125	5.74	10.9

Table 6-3. Daily monitoring results for gross alpha, gross beta, and tritium in the sanitary sewer effluent, 1999 (continued).

Date		Gross alpha (µBq/mL)		Gross beta (mBq/mL)		Tritium (mBq/mL)	
		Activity	LOS[a]	Activity	LOS	Activity	LOS
July	24	135 ± 55	84.7	0.618 ± 0.105	0.126	3.44	10.8
	25	148 ± 61	65.1	0.122 ± 0.078	0.121	5.37	10.9
	26	77.7 ± 47.4	63.6	0.0862	0.120	0.951	10.9
	27	–99.2	103	5.25 ± 0.24	0.139	2.44	11.4
	28	260 ± 73	78.4	0.903 ± 0.117	0.124	–5.40	12.0
	29	64.8	102	1.21 ± 0.13	0.130	–2.59	12.6
	30	–54.0	104	1.37 ± 0.14	0.131	3.74	11.9
	31	158 ± 73	137	1.01 ± 0.13	0.139	41.1 ± 7.8	12.1
August	1	88.8 ± 53.3	83.3	0.302 ± 0.094	0.126	–1.85	11.6
	2	48.1	89.5	0.729 ± 0.109	0.127	4.92	11.4
	3	–54.8	95.5	0.766 ± 0.115	0.128	3.29	12.2
	4	157 ± 71	121	0.899 ± 0.126	0.136	20.6 ± 7.4	11.8
	5	84.4	86.2	0.559 ± 0.106	0.126	12.5 ± 6.7	11.1
	6	126 ± 63	96.2	0.751 ± 0.105	0.110	4.11	12.7
	7	–46.3	106	0.759 ± 0.106	0.113	11.7 ± 7.0	1.15
	8	2.31	65.9	0.148 ± 0.073	0.102	4.48	12.1
	9	32.8	66.2	0.313 ± 0.081	0.102	–2.27	12.5
	10	–35.3	90.3	0.525 ± 0.095	0.108	3.67	11.8
	11	68.5	102	0.648 ± 0.104	0.112	–0.966	11.3
	12	13.7	84.0	0.932 ± 0.112	0.107	12.0	12.2
	13	–24.2	83.6	0.444 ± 0.089	0.107	–4.14	13.0
	14	16.9	83.3	0.892 ± 0.107	0.107	–11.0	12.2
	15	4.85	78.1	0.437 ± 0.087	0.105	–6.92	12.0
	16	39.2	77.3	0.262 ± 0.079	0.105	–3.10	11.9
	17	–95.8	86.6	1.02 ± 0.11	0.107	4.92	13.5
	18	71.8	84.4	0.951 ± 0.114	0.107	–1.75	13.6
	19	110 ± 40	81.8	1.61 ± 0.13	0.106	4.51	13.2
	20	311 ± 65	105	4.11 ± 0.21	0.113	12.2	12.6
	21	127 ± 43	76.2	1.34 ± 0.13	0.106	0.851	8.81
	22	16.0	59.6	0.123 ± 0.069	0.0999	4.29	8.47
	23	82.9 ± 44.8	65.1	0.241 ± 0.077	0.103	2.65	8.58
	24	48.8	87.3	0.0692 ± 0.0104	0.107	1.36	11.8
	25	16.7	85.1	0.936 ± 0.112	0.107	0.858	11.3
	26	57.7	84.7	1.10 ± 0.12	0.107	–3.12	12.8

Table 6-3. Daily monitoring results for gross alpha, gross beta, and tritium in the sanitary sewer effluent, 1999 (continued).

Date		Gross alpha (µBq/mL)		Gross beta (mBq/mL)		Tritium (mBq/mL)	
		Activity	LOS[a]	Activity	LOS	Activity	LOS
August	27	4.74	90.3	0.870 ± 0.113	0.108	–7.81	13.0
	28	77.7	85.5	1.15 ± 0.12	0.107	–11.6	12.5
	29	41.1	66.6	0.228 ± 0.075	0.102	–11.5	12.4
	30	64.8	68.1	0.319 ± 0.080	0.103	–15.4	12.7
	31	104 ± 46	84.4	0.955 ± 0.115	0.107	–15.5	12.8
September	1	134 ± 54	71.4	0.611 ± 0.098	0.104	1.42	11.4
	2	118 ± 55	84.4	0.707 ± 0.099	0.107	–1.81	11.2
	3	63.6	95.5	0.947 ± 0.114	0.110	–2.22	11.5
	4	46.3	86.6	0.829 ± 0.108	0.108	5.66	11.1
	5	55.1	72.5	0.260 ± 0.078	0.105	–6.62	11.7
	6	107 ± 57	81.0	0.356 ± 0.085	0.107	–2.66	11.2
	7	103 ± 55	72.2	0.219 ± 0.077	0.105	–3.85	11.4
	8	33.4	96.6	0.907 ± 0.109	0.110	–2.84	11.2
	9	64.4	104	0.659 ± 0.105	0.112	–2.89	11.5
	10	103	113	0.707 ± 0.106	0.115	–6.73	11.2
	11	28.2	91.4	0.829 ± 0.108	0.108	1.95	10.8
	12	23.9	73.6	0.207 ± 0.077	0.105	7.14	10.7
	13	–1.13	69.2	0.191 ± 0.074	0.104	–1.19	11.0
	14	25.0	85.8	1.04 ± 0.11	0.107	–3.40	10.9
	15	69.6	89.5	0.759 ± 0.106	0.108	2.32	11.0
	16	57.7	91.0	0.803 ± 0.104	0.111	0.725	10.7
	17	96.6	108	0.873 ± 0.114	0.116	6.70	10.8
	18	268 ± 86	89.5	0.858 ± 0.112	0.110	–1.29	10.8
	19	–1.39	73.3	0.236 ± 0.080	0.107	5.00	10.6
	20	86.2 ± 50.0	68.8	0.222 ± 0.078	0.105	5.74	10.8
	21	–12.5	82.5	0.810 ± 0.105	0.109	–1.13	11.0
	22	40.0	82.5	0.810 ± 0.105	0.106	7.84	11.0
	23	–34.0	96.6	0.992 ± 0.119	0.110	0.488	10.8
	24	–3.96	102	0.799 ± 0.112	0.111	15.0 ± 6.6	11.0
	25	61.8	84.7	0.692 ± 0.104	0.107	6.22	10.5
	26	–13.0	68.1	0.198 ± 0.075	0.103	5.66	10.8
	27	62.9	67.3	0.195 ± 0.074	0.102	7.14	10.8
	28	157 ± 66	88.4	0.992 ± 0.119	0.118	131 ± 9	11.0
	29	54.4	96.9	0.892 ± 0.116	0.111	3.96	10.7

Table 6-3. Daily monitoring results for gross alpha, gross beta, and tritium in the sanitary sewer effluent, 1999 (continued).

Date	Gross alpha (µBq/mL)		Gross beta (mBq/mL)		Tritium (mBq/mL)	
	Activity	LOS[a]	Activity	LOS	Activity	LOS
September 30	–42.6	96.6	0.666 ± 0.100	0.111	3.31	11.1
October 1	–26.6	91.4	0.644 ± 0.103	0.110	–2.12	11.1
2	36.3	86.6	0.710 ± 0.100	0.109	4.29	11.0
3	24.0	66.2	0.203 ± 0.075	0.104	10.9 ± 6.3	10.7
4	–18.6	63.3	0.151 ± 0.073	0.102	8.81	10.7
5	12.4	84.4	0.777 ± 0.109	0.108	10.5	11.1
6	72.9	84.4	0.818 ± 0.106	0.105	5.18	10.7
7	–1.64	80.3	0.788 ± 0.102	0.105	–1.91	11.2
8	27.6	85.8	0.807 ± 0.105	0.106	2.22	11.0
9	–61.1	84.4	0.936 ± 0.112	0.105	14.5 ± 6.8	11.0
10	15.7	68.8	0.246 ± 0.076	0.102	14.7 ± 6.6	10.8
11	11.4	63.6	0.152 ± 0.070	0.0999	–1.45	11.0
12	43.3	92.5	0.884 ± 0.106	0.107	1.73	10.7
13	6.96	89.9	0.844 ± 0.110	0.107	3.56	10.8
14	–6.77	101	0.977 ± 0.117	0.113	–1.41	10.8
15	21.8	110	0.929 ± 0.121	0.116	4.81	10.7
16	161 ± 61	92.9	1.09 ± 0.12	0.111	929 ± 18	10.6
17	–9.73	72.2	0.147 ± 0.074	0.106	9.92	10.9
18	37.0	65.1	0.142 ± 0.071	0.104	0.947	10.8
19	8.29	88.1	0.570 ± 0.097	0.110	–1.13	10.6
20	47.4	96.2	0.877 ± 0.114	0.111	281 ± 11	10.8
21	38.5	96.6	0.644 ± 0.103	0.111	13.6 ± 5.5	10.8
22	–76.6	102	0.685 ± 0.103	0.113	17.4 ± 5.4	8.66
23	72.9	90.7	1.00 ± 0.11	0.110	2.82	8.99
24	–14.7	75.9	0.477 ± 0.091	0.107	2.42	9.14
25	8.47	74.4	0.359 ± 0.086	0.107	–1.66	9.47
26	54.0	76.6	0.503 ± 0.091	0.107	2.95	8.66
27	52.9	84.7	0.792 ± 0.103	0.109	4.22	10.9
28	33.0	74.7	0.481 ± 0.091	0.107	0.570	11.2
29	86.2	93.2	0.781 ± 0.109	0.111	3.96	10.9
30	–20.1	84.7	0.903 ± 0.108	0.109	1.18	11.2
31	42.9	87.3	0.339 ± 0.085	0.110	–0.725	11.0
November 1	–4.92	74.4	0.239 ± 0.079	0.107	3.15	10.9
2	–14.6	92.5	0.725 ± 0.102	0.111	–4.63	11.3

Table 6-3. Daily monitoring results for gross alpha, gross beta, and tritium in the sanitary sewer effluent, 1999 (continued).

Date	Gross alpha (µBq/mL)		Gross beta (mBq/mL)		Tritium (mBq/mL)	
	Activity	LOS[a]	Activity	LOS	Activity	LOS
November 3	95.1	82.9	0.947 ± 0.114	0.112	3.60	11.1
4	–5.48	95.5	0.577 ± 0.098	0.111	–0.124	11.2
5	–23.5	101	0.648 ± 0.104	0.113	4.14	10.7
6	81.8	89.9	0.840 ± 0.109	0.110	8.10	10.6
7	–1.59	76.2	0.251 ± 0.080	0.107	2.34	10.8
8	–2.59	72.5	0.155 ± 0.075	0.106	0.803	10.8
9	13.0	128	0.707 ± 0.106	0.118	6.40	10.9
10	4.70	96.2	0.762 ± 0.107	0.111	0.733	10.5
11	–0.182	80.3	0.751 ± 0.105	0.108	–2.05	10.8
12	61.1	78.4	0.622 ± 0.100	0.107	0.551	10.9
13	4.48	79.6	0.659 ± 0.099	0.108	–1.28	11.0
14	–5.59	69.2	0.209 ± 0.077	0.105	3.15	10.7
15	–12.0	64.4	0.158 ± 0.073	0.103	–6.70	10.8
16	–21.7	78.4	0.629 ± 0.101	0.107	2.27	8.73
17	3.74	82.9	0.788 ± 0.102	0.108	2.14	8.47
18	–31.5	86.6	0.862 ± 0.112	0.107	–0.947	8.47
19	7.59	85.8	0.599 ± 0.096	0.107	–2.30	11.0
20	–5.92	97.7	0.851 ± 0.111	0.110	–2.53	10.8
21	7.77	92.9	0.725 ± 0.102	0.109	0.903	10.7
22	–19.4	68.1	0.192 ± 0.075	0.103	1.05	10.7
23	7.99	91.4	0.496 ± 0.094	0.108	1.79	8.66
24	57.4	94.4	0.681 ± 0.102	0.109	3.18	8.51
25	44.8	94.0	0.814 ± 0.106	0.108	0.903	10.8
26	34.8	64.8	0.136 ± 0.069	0.101	2.22	10.3
27	4.33	66.2	0.182 ± 0.073	0.101	–2.02	10.8
28	47.0	74.0	0.178 ± 0.073	0.104	–5.66	11.1
29	7.70	65.5	0.198 ± 0.073	0.101	4.96	10.3
30	145 ± 62	110	0.847 ± 0.110	0.113	–0.744	10.9
December 1	28.3	74.7	0.962 ± 0.115	0.118	2.71	1.08
2	–7.14	113	0.973 ± 0.117	0.114	1.72	8.66
3	21.3	85.8	0.614 ± 0.098	0.106	–4.26	8.81
4	57.0	105	0.773 ± 0.108	0.111	3.02	10.6
5	26.3	77.7	0.260 ± 0.078	0.104	2.97	8.70
6	21.8	64.8	0.126 ± 0.069	0.101	–0.910	8.70

Table 6-3. Daily monitoring results for gross alpha, gross beta, and tritium in the sanitary sewer effluent, 1999 (concluded).

Date	Gross alpha (µBq/mL)		Gross beta (mBq/mL)		Tritium (mBq/mL)	
	Activity	LOS[a]	Activity	LOS	Activity	LOS
December 7	2.11	105	0.666 ± 0.100	0.111	1.77	10.6
8	17.2	93.2	0.773 ± 0.108	0.108	–2.73	8.66
9	106 ± 51	100	0.829 ± 0.108	0.110	1.38	8.70
10	–16.4	105	0.629 ± 0.101	0.111	0.422	8.84
11	42.6	102	0.995 ± 0.119	0.110	5.18	10.7
12	–7.70	87.7	0.451 ± 0.090	0.106	0.403	10.8
13	15.9	82.1	0.226 ± 0.077	0.105	7.40	10.5
14	2.21	84.4	0.625 ± 0.100	0.106	–3.36	11.2
15	62.5	71.4	0.577 ± 0.104	0.119	5.66	10.5
16	54.0	85.5	0.562 ± 0.096	0.108	0.566	11.1
17	105 ± 45	92.5	1.44 ± 0.13	0.110	1.11	10.8
18	–9.32	86.6	0.710 ± 0.100	0.108	–3.24	10.9
19	–40.0	72.9	0.149 ± 0.075	0.105	–6.92	11.1
20	12.1	72.5	0.228 ± 0.078	0.105	–1.08	10.7
21	234 ± 59	97.3	2.68 ± 0.17	0.110	–2.50	11.0
22	159 ± 60	91.8	0.929 ± 0.111	0.108	1.27	11.1
23	201 ± 60	81.4	1.35 ± 0.12	0.106	2.25	10.7
24	72.9 ± 39.4	67.0	0.422 ± 0.084	0.102	3.74	10.4
25[c]	55.5	59.2	0.225 ± 0.074	0.0988	4.48	10.5
26[c]	55.5	59.2	0.225 ± 0.074	0.0988	4.48	10.5
27	63.6 ± 40.1	63.3	0.229 ± 0.076	0.101	4.33	10.6
28	68.5	86.6	0.733 ± 0.103	0.107	5.96	10.3
29	97.3 ± 48.7	82.1	0.618 ± 0.099	0.107	2.00	10.5
30	107 ± 49	72.9	0.522 ± 0.094	0.105	–2.09	10.6
31	27.9	61.8	0.317 ± 0.079	0.101	3.24	10.5

Note: The activities shown in this table are measured concentrations and their associated 2σ counting errors. Activities do not include the 2σ counting errors when the measured concentrations are less than the limit of sensitivity (LOS). See the main volume, Chapter 14, Quality Assurance.

[a] LOS = Limit of sensitivity.

[b] This value is the monitoring result for the weekly composite sample for the sampling period of May 4-10, 1999. The daily monitoring result is not shown because of a significantly elevated LOS value. (The sample aliquot size was reduced from 150 to 10 mL to compensate for overchlorination of the daily monitoring samples; the smaller the sample volume, the greater the LOS.) The daily monitoring results for May 8,1999, were 302 and 1640 µBq/mL for gross alpha activity and LOS, respectively and –0.625 and 2.09 mBq/mL for gross beta activity and LOS, respectively. The daily monitoring results for May 9,1999, were 1320 and 1780 µBq/mL for gross alpha activity and LOS, respectively and –0.918 and 2.14 mBq/mL for gross beta activity and LOS, respectively.

[c] The daily monitoring results are not available. The results shown for this date are the monitoring results for the weekly composite sample for the sampling period of December 25 and 26, 1999.

Table 6-4. Weekly composite results for tritium (mBq/mL) for the LWRP effluent,1999.

Composite dates	Activity[a]	LOS[b]
12/28/1998–1/03/1999	8.77	10.9
1/04–1/10	1.99	12.5
1/11–1/17	3.36	11.5
1/18–1/24	16.8 ± 6.7	11.5
1/25–1/31	–8.51	12.5
2/01–2/07	3.58	12.7
2/08–2/14	2.46	12.0
2/15–2/21	10.1	11.8
2/22–2/28	2.87	11.7
3/01–3/07	–13.3	12.6
3/08–3/14	0.047	12.0
3/15–3/21	3.10	12.0
3/22–3/28	6.85	11.8
3/29–4/04	1.12	11.6
4/05–4/11	–0.525	11.2
4/12–4/18	–1.44	11.5
4/19–4/25	5.59	11.5
4/26–5/02	3.92	10.9
5/03–5/09	0.955	8.77
5/10–5/16	1.62	8.55
5/17–5/23	–0.770	8.84
5/24–5/30	–2.49	11.5
5/31–6/06	2.55	8.58
6/07–6/13	5.03	10.9
6/14–6/20	–5.33	11.6
6/21–6/27	–2.46	11.0
6/28–7/04	8.33	10.7
7/05–7/11	3.07	10.8
7/12–7/18	0.973	5.44
7/19–7/25	–6.14	11.8
7/26–8/01	–7.29	11.5
8/02–8/08	4.03	11.2
8/09–8/15	–5.11	11.8
8/16–8/22	1.14	8.66
8/23–8/29	–3.66	12.5
8/30–9/05	–2.63	11.2
9/06–9/12	–8.81	11.0
9/13–9/19	0.254	10.6
9/20–9/26	–4.18	10.9
9/27–10/03	1.31	10.9
10/04–10/10	–5.00	11.2
10/11–10/17	1.48	10.6
10/18–10/24	7.07	10.8
10/25–10/31	2.41	10.5
11/01–11/07	0.803	11.2
11/08–11/14	0.426	10.6
11/15–11/21	–1.53	8.84
11/22–11/28	4.66	11.1
11/29–12/05	1.44	10.7
12/06–12/12	–2.24	11.0
12/13–12/19	–5.99	11.0
12/20–12/26	6.07	10.8
12/27/1999–01/02/2000	1.71	10.7

a The activities shown in this table are measured concentrations and their associated 2σ counting errors. Activities do not include the 2σ counting errors when the measured concentrations are less than the limit of sensitivity (LOS). See the main volume, Chapter 14, Quality Assurance.

b LOS = Limit of sensitivity.

Table 6-5. Weekly composite results for metals in LLNL sanitary sewer effluent, 1999.

Composite dates	Parameter (mg/L)											
	Ag	Al	As	Be	Cd	Cr	Cu	Fe	Hg	Ni	Pb	Zn
12/28-1/04	<0.010	0.29	<0.0020	<0.00050	<0.0050	<0.010	0.15	1.7	0.00054	0.0053	0.014	0.21
1/04-1/11	<0.010	0.36	0.0090	<0.00050	<0.0050	0.011	0.10	1.5	0.00053	0.0066	0.0068	0.23
1/11-1/18	<0.010	<0.20	<0.0020	<0.00050	<0.0050	<0.010	0.063	0.39	<0.00020	<0.0050	<0.0020	0.091
1/18-1/25	<0.010	0.84	<0.0020	<0.00050	<0.0050	0.024	0.16	2.8	0.0012	0.033	0.032	0.36
1/25-2/01	<0.010	<0.20	<0.0020	<0.00050	<0.0050	0.011	0.046	0.70	0.00028	0.0057	0.0039	0.10
2/01-2/08	<0.010	<0.20	<0.0020	<0.00050	<0.0050	<0.010	0.037	0.60	<0.00020	<0.0050	0.0071	0.081
2/08-2/15	<0.010	1.0	<0.0020	<0.00050	<0.0050	<0.010	0.11	2.2	0.00062	0.012	0.020	0.28
2/15-2/22	<0.010	0.25	<0.0020	<0.00050	<0.0050	<0.010	0.046	0.99	0.00040	0.0061	0.0055	0.10
2/22-3/01	<0.010	0.49	<0.0020	<0.00050	<0.0050	<0.010	0.053	2.1	<0.00020	0.014	0.0075	0.36
3/01-3/08	<0.010	0.61	0.0081	<0.00050	<0.0050	0.022	0.15	2.0	0.00062	0.016	0.014	0.29
3/08-3/15	0.017	1.0	0.0025	<0.00050	<0.0050	0.031	0.20	3.2	0.00094	0.016	0.020	0.47
3/15-3/22	0.015	0.93	0.0030	<0.00050	<0.0050	0.035	0.26	4.0	0.0048	0.018	0.061	0.57
3/22-3/29	<0.010	0.40	0.0021	<0.00050	<0.0050	0.018	0.12	1.6	0.0015	0.012	0.022	0.25
3/29-4/05	<0.010	<0.20	<0.0020	<0.00050	<0.0050	<0.010	0.034	0.35	<0.00020	<0.0050	<0.0020	0.098
4/05-4/12	<0.010	0.82	0.0022	<0.00050	<0.0050	<0.010	0.15	2.5	0.0010	0.0071	0.015	0.35
4/12-4/19	0.017	1.9	0.0026	<0.00050	<0.0050	0.095	0.45	7.1	0.0013	0.027	0.060	1.1
4/19-4/26	0.011	0.91	0.0042	<0.00050	<0.0050	0.056	0.16	3.6	0.0011	0.0099	0.019	0.53
4/26-5/03	<0.010	<0.20	<0.0020	<0.00050	<0.0050	<0.010	0.073	0.72	<0.00020	<0.0050	0.0049	0.12
5/03-5/10	<0.010	0.66	0.0026	<0.00050	<0.0050	0.018	0.13	2.3	0.00051	0.0085	0.016	0.38
5/10-5/17	<0.010	0.24	0.0020	<0.00050	<0.0050	<0.010	0.083	1.1	0.00026	0.0054	0.0079	0.22
5/17-5/24	<0.010	<0.20	0.0020	<0.00050	<0.0050	<0.010	0.060	0.42	0.00066	0.0063	0.0038	0.13
5/24-5/31	<0.010	<0.20	0.0028	<0.00050	<0.0050	<0.010	0.073	0.39	<0.00020	<0.0050	0.0031	0.11
5/31-6/07	<0.010	0.62	0.0031	<0.00050	<0.0050	0.021	0.15	1.9	<0.00020	0.0080	0.012	0.40
6/07-6/14	<0.010	<0.20	<0.0020	<0.00050	<0.0050	<0.010	0.085	0.41	<0.00020	<0.0050	0.010	0.14
6/14-6/21	<0.010	<0.20	0.0021	<0.00050	<0.0050	<0.010	0.077	0.70	<0.00020	<0.0050	0.0080	0.19
6/21-6/28	0.014	1.2	0.0043	<0.00050	<0.0050	0.041	0.28	4.2	0.00080	0.014	0.045	0.64
6/30-7/07	<0.010	1.2	0.0053	<0.00050	<0.0050	0.039	0.30	3.7	0.0010	0.010	0.026	0.52
7/07-7/14	<0.010	0.20	<0.0020	<0.00050	<0.0050	<0.010	0.098	0.68	<0.00020	<0.0050	0.0070	0.15
7/14-7/21	<0.010	<0.20	0.0036	<0.00050	0.0056	<0.010	0.028	0.66	<0.00020	<0.0050	0.0040	0.032
7/21-7/28	<0.010	<0.20	<0.0020	<0.00050	<0.0050	<0.010	0.099	0.62	<0.00020	<0.0050	0.010	0.14
7/28-8/04	<0.010	<0.20	<0.0020	<0.00050	<0.0050	<0.010	0.11	0.47	<0.00020	<0.0050	0.022	0.16
8/04-8/11	<0.010	0.22	<0.0020	<0.00050	<0.0050	<0.010	0.14	0.72	<0.00020	0.0052	0.021	0.17
8/11-8/18	<0.010	<0.20	<0.0020	<0.00050	<0.0050	<0.010	0.089	0.67	<0.00020	<0.0050	0.012	0.15
8/18-8/25	<0.010	0.58	0.0028	<0.00050	<0.0050	0.023	0.19	2.0	<0.00020	<0.0050	0.014	0.30
8/25-9/01	<0.010	1.2	0.0042	<0.00050	<0.0050	0.041	0.36	3.2	0.00040	0.010	0.042	0.50

Table 6-5. Weekly composite results for metals in LLNL sanitary sewer effluent, 1999 (concluded).

Composite dates	Parameter (mg/L)											
	Ag	Al	As	Be	Cd	Cr	Cu	Fe	Hg	Ni	Pb	Zn
9/02-9/09	<0.010	<0.20	<0.0020	<0.00050	<0.0050	<0.010	0.072	0.47	<0.00020	<0.0050	0.0055	0.11
9/08-9/15	<0.010	—[a]	<0.0020	—[a]	<0.0050	0.028	0.17	—[a]	0.00063	<0.0050	0.016	0.19
9/15-9/22	0.014	—[a]	0.0040	—[a]	0.0052	0.11	0.43	—[a]	0.0014	0.013	0.031	0.80
9/22-9/29	<0.010	—[a]	0.0058	—[a]	<0.0050	0.060	0.38	—[a]	0.0013	0.018	0.071	0.70
9/29-10/06	<0.010	—[a]	0.0045	—[a]	<0.0050	0.060	0.34	—[a]	0.00050	0.011	0.041	0.57
10/06-10/13	<0.010	—[a]	0.0041	—[a]	<0.0050	0.043	0.18	—[a]	0.0010	0.010	0.018	0.40
10/13-10/20	<0.010	—[a]	0.0042	—[a]	<0.0050	0.056	0.26	—[a]	0.00046	0.013	0.036	0.59
10/20-10/27	<0.010	—[a]	0.0052	—[a]	<0.0050	0.045	0.32	—[a]	0.00051	0.012	0.031	0.67
10/27-11/03	<0.010	—[a]	<0.0020	—[a]	<0.0050	0.012	0.11	—[a]	0.00056	0.0058	0.0084	0.26
11/03-11/10	<0.010	—[a]	0.0025	—[a]	<0.0050	0.023	0.18	—[a]	0.0017	0.0052	0.0098	0.32
11/10-11/17	0.019	—[a]	0.0057	—[a]	<0.0050	0.082	0.50	—[a]	0.0012	0.015	0.040	0.94
11/17-11/24	<0.010	—[a]	0.0026	—[a]	<0.0050	0.029	0.22	—[a]	0.00036	0.0073	0.024	0.42
11/24-12/01	0.016	—[a]	0.0034	—[a]	<0.0050	<0.010	0.14	—[a]	0.00025	<0.0050	0.017	0.91
12/01-12/08	<0.010	—[a]	0.0054	—[a]	<0.0050	0.044	0.17	—[a]	0.00032	<0.0050	0.016	0.38
12/08-12/15	<0.010	—[a]	0.0055	—[a]	<0.0050	0.061	0.21	—[a]	0.00039	0.0087	0.062	0.47
12/15-12/22	<0.010	—[a]	<0.0020	—[a]	<0.0050	<0.010	0.050	—[a]	<0.00020	<0.0050	0.0059	0.14
12/22-12/29	<0.010	—[a]	0.0026	—[a]	<0.0050	0.032	0.20	—[a]	0.00064	0.0077	0.018	0.42
12/29-1/05	0.015	—[a]	<0.0020	—[a]	<0.0050	0.066	0.28	—[a]	<0.00020	0.011	0.029	0.56
Summary of weekly composite results												
Detection frequency	9/53	22/36	32/53	0/36	2/53	30/53	53/53	36/36	34/53	35/53	51/53	53/53
Minimum (mg/L)	<0.010	<0.20	<0.0020	<0.00050	<0.0050	<0.010	0.028	<0.35	<0.00020	<0.0050	<0.0020	<0.032
Maximum (mg/L)	0.019	1.9	0.0090	<0.00050	0.0056	0.11	0.50	7.1	0.0048	0.033	0.071	1.1
Median (mg/L)	<0.010	0.27	0.0025	<0.00050	<0.0050	0.018	0.15	1.3	0.00040	0.0066	0.016	0.30
IQR[b] (mg/L)	—[c]	0.63	0.0021	—[c]	—[b]	0.031	0.13	1.7	0.00060	0.0070	0.019	0.35
50% of EPL (mg/L)	0.10	—[c]	0.030	—[c]	0.070	0.31	0.50	—[c]	0.0050	0.31	0.10	1.5
Maximum/50% of EPL	0.19	—[c]	0.30	—[c]	0.080	0.35	1.0	—[c]	1.0	0.11	0.71	0.73
Median/50% of EPL	0.10	—[c]	0.083	—[c]	0.071	0.058	0.30	—[c]	0.080	0.022	0.16	0.20

a Weekly sampling for Al, Be, and Fe was suspended in September, since these are not permitted sampling requirements. Data for these parameters will continue to be collected on a monthly basis.

b IQR = Interquartile range.

c Because of the large number of nondetects, the interquartile range is omitted. See Chapter 14, Quality Assurance.

d There is no Effluent Pollutant Limit (EPL) for this parameter; therefore, no comparison value can be calculated.

Table 6-6. Monthly 24-hour composite results for metals in LLNL sanitary sewer effluent, 1999.

Sample date	Parameter (mg/L)											
	Ag	Al	As	Be	Cd	Cr	Cu	Fe	Hg	Ni	Pb	Zn
1/7/99	<0.010	<0.20	0.0057	<0.00050	<0.0050	<0.010	0.061	0.59	<0.00020	<0.0050	0.0030	0.15
2/4/99	<0.010	0.31	<0.0020	<0.00050	<0.0050	0.011	0.081	0.76	0.0022	0.0063	0.054	0.20
3/4/99	<0.010	0.23	<0.0020	<0.00050	<0.0050	<0.010	0.042	0.55	<0.00020	<0.0050	0.010	0.16
4/8/99	<0.010	1.2	<0.0020	<0.00050	<0.0050	0.012	0.067	2.0	0.00033	0.0060	0.0056	0.17
5/6/99	<0.010	0.51	<0.0020	<0.00050	<0.0050	0.015	0.12	1.6	0.00053	<0.0050	0.015	0.26
6/2/99	<0.010	0.42	0.0021	<0.00050	<0.0050	0.015	0.12	1.3	<0.00020	0.0064	0.0090	0.20
7/7/99	<0.010	0.55	0.0020	<0.00050	0.0056	0.018	0.15	1.6	0.00035	<0.0050	0.0039	0.26
8/3/99	<0.010	1.2	0.0043	<0.00050	<0.0050	0.028	0.41	2.8	<0.00020	0.012	0.10	0.43
9/2/99	<0.010	0.25	0.0023	<0.00050	<0.0050	0.013	0.11	3.2	<0.00020	<0.0050	0.0053	0.13
10/5/99	<0.010	0.69	0.0024	<0.00050	<0.0050	0.035	0.22	2.4	0.00039	0.0072	0.16	0.36
11/2/99	<0.010	0.55	<0.0020	<0.0010	<0.010	0.015	0.12	1.8	0.00023	<0.0050	0.0089	0.32
12/8/99	<0.010	0.46	0.0081	<0.00050	<0.010	0.030	0.081	1.7	0.00025	<0.010	0.0056	0.22
Summary of monthly composite results												
Detection frequency	0/12	11/12	7/12	0/12	1/12	10/12	12/12	12/12	7/12	5/12	12/12	12/12
Minimum (mg/L)	<0.010	<0.20	<0.0020	<0.00020	<0.0050	<0.010	0.042	0.55	<0.00020	<0.0050	<0.0030	0.13
Maximum (mg/L)	<0.010	1.2	0.0081	<0.0010	<0.010	0.035	0.41	3.2	0.0022	0.012	0.016	0.43
Median (mg/L)	<0.010	0.49	0.0021	<0.00050	<0.0050	0.015	0.12	1.7	0.00024	<0.0055	0.0090	0.21
IQR[a] (mg/L)	—[b]	0.29	0.00088	—[b]	—[b]	0.0088	0.050	0.94	0.00016	—[b]	0.019	0.11
EPL (mg/L)	0.2	—[c]	0.06	—[c]	0.14	0.62	1	—[c]	0.01	0.61	0.2	3.0
Maximum/EPL	0.050	—[c]	0.135	—[c]	0.071	0.056	0.41	—[c]	0.22	0.020	0.80	0.14
Median/EPL	0.050	—[c]	0.034	—[c]	0.036	0.024	0.12	—[c]	0.024	0.0090	0.045	0.070

a IQR = Interquartile range.

b Because of the large number of nondetects, the interquartile range is omitted. See Chapter 14, Quality Assurance.

c There is no Effluent Pollutant Limit (EPL) for this parameter; therefore, no comparison value can be calculated.

Table 6-7. Monthly monitoring results for physical and chemical characteristics of the LLNL sanitary sewer effluent, 1999.

24-hour composite sample parameters	EPA Method	Sample month					
		January	February	March	April	May	June
Alkalinity (mg/L)	**310.1**						
Bicarbonate alkalinity (as $CaCO_3$)		170	180	190	—[a]	180	130
Carbonate alkalinity (as $CaCO_3$)		<1	<1	<1	—[a]	<5	<5
Hydroxide alkalinity (as $CaCO_3$)		<1	<1	<1	—[a]	<5	<5
Total alkalinity (as $CaCO_3$)		170	180	190	198	180	130
Anions (mg/L)	**300.0**						
Bromide		<0.5	<0.5	0.62	<0.1	<0.1	<0.1
Chloride		31	63	43	51	44	22
Fluoride		0.095	<0.05	0.1	0.06	0.68	0.07
Nitrate (as N)		<0.5	<0.5	<0.5	<0.1	<0.1	<0.1
Nitrate (as NO_3)		<0.5	1.6	0.71	<0.4	<0.4	<0.4
Nitrite (as N)		<0.5	<0.5	<0.5	<0.02	<0.02	<0.02
Nitrite (as NO_2)		<0.5	<0.5	<0.5	<0.07	<0.07	<0.07
Orthophosphate		14	19	17	20	20	12
Sulfate		4	5.2	4.1	18	15	8.4
Nutrients (mg/L)							
Ammonia nitrogen (as N)	350.2	35	40	43	51	53	28
Total Kjeldahl nitrogen	351.3	0.61	44	2.4	53	60	40
Oxygen demand (mg/L)							
Biochemical oxygen demand	405.1	113	<75	160	106	295	137
Chemical oxygen demand	410.4	130	130	200	464	542	334
Solids (mg/L)							
Solid settling rate (mL/L/h)	160.5	60	62	25	25	50	30
Total dissolved solids (TDS)	160.1	190	270	240	378	262	120
Total suspended solids (TSS)	160.2	120	120	350	103	380	398
Volatile solids	160.4	370	350	210	260	380	218
Total metals (mg/L)							
Calcium	200.7	11	12	13	14	18	13
Magnesium	200.7	2.7	3.2	2.9	4	4.6	2.5
Potassium	200.7	14	16	17	23	20	13
Selenium	270.2	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Sodium	200.7	24	40	33	39	38	21

Table 6-7. Monthly monitoring results for physical and chemical characteristics of the LLNL sanitary sewer effluent, 1999 (continued).

24-hour composite sample parameters	EPA Method	Sample month					
		July	August	September	October	November	December
Alkalinity (mg/L)	**310.1**						
Bicarbonate alkalinity (as $CaCO_3$)		221	208	148	185	216	185
Carbonate alkalinity (as $CaCO_3$)		<5	<5	<5	<5	<5	<5
Hydroxide alkalinity (as $CaCO_3$)		<5	<5	<5	<5	<5	<5
Total alkalinity (as $CaCO_3$)		221	208	148	185	216	185
Anions (mg/L)	**300.0**						
Bromide		0.12	0.13	<0.1	<0.1	0.15	<0.1
Chloride		49	44	36	34	37	47
Fluoride		0.08	0.14	0.12	0.06	<0.05	0.14
Nitrate (as N)		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Nitrate (as NO_3)		<0.4	<0.4	<0.4	<0.4	<0.4	<0.44
Nitrite (as N)		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Nitrite (as NO_2)		<0.07	<0.07	<0.07	<0.07	<0.07	<0.07
Orthophosphate		198	18	15	15	20	13.8
Sulfate		17	44	7.4	9.3	10	11
Nutrients (mg/L)							
Ammonia nitrogen (as N)	350.2	40	38	28	42	44	31
Total Kjeldahl nitrogen	351.3	47	53	33	56	55	41
Oxygen demand (mg/L)							
Biochemical oxygen demand	405.1	221	214	98	305	96	143
Chemical oxygen demand	410.4	363	664	224	644	161	270
Solids (mg/L)							
Solid settling rate (mL/L/h)	160.5	21	19	34	27	26	23
Total dissolved solids (TDS)	160.1	510	317	190	186	202	226
Total suspended solids (TSS)	160.2	110	222	111	344	84	125
Volatile solids	160.4	190	280	55	374	120	250
Total metals (mg/L)							
Calcium	200.7	14	17	12	14	12	19
Magnesium	200.7	3.4	2.9	1.9	2.7	2.4	2.6
Potassium	200.7	99	20	15	20	19	16
Selenium	270.2	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Sodium	200.7	53	64	30	29	27	39

Table 6-7. Monthly monitoring results for physical and chemical characteristics of the LLNL sanitary sewer effluent, 1999 (continued).

24-hour composite sample parameters	EPA Method	Sample month					
		January	February	March	April	May	June
Total organic carbon (TOC) (mg/L)	**415.1**	56	94	55	64	64	38
Tributyltin (ng/L)		33	—[b]	—[b]	—[b]	—[b]	—[b]
Semivolatile organic compounds (µg/L)	**625**						
1,2,4-Trichlorobenzene[c]		<5	<50	<5	<10	<50	<10
1,2-Dichlorobenzene		<5	<50	<5	<10	<50	<10
1,2-Diphenylhydrazine[c]		—[a]	—[a]	—[a]	<10	<50	<10
1,3-Dichlorobenzene[c]		<5	<50	<5	<10	<50	<10
1,4-Dichlorobenzene[c]		<5	<50	<5	<10	<50	<10
2,4,5-Trichlorophenol		<5	<50	<5	<30	<200	<30
2,4,6-Trichlorophenol[c]		<5	<50	<5	<30	<200	<30
2,4-Dichlorophenol[c]		<5	<50	<5	<10	<50	<10
2,4-Dimethylphenol[c]		<5	<50	<5	<10	<50	<10
2,4-Dinitrophenol[c]		<25	<250	<25	<50	<300	<50
2,4-Dinitrotoluene[c]		<5	<50	<5	<10	<50	<10
2,6-Dinitrotoluene[c]		<5	<50	<5	<10	<50	<10
2-Chloronaphthalene[c]		<5	<50	<5	<10	<50	<10
2-Chlorophenol[c]		<5	<50	<5	<10	<50	<10
2-Methyl-4,6-dinitrophenol		<25	<250	<25	<50	<300	<50
2-Methylnaphthalene		<5	<50	<5	<10	<50	<10
2-Naphthylamine		—[a]	—[a]	—[a]	<100	<500	<100
2-Nitroaniline		<25	<250	<25	<10	<50	<10
2-Nitrophenol[c]		<5	<50	<5	<10	<50	<10
3,3-Dichlorobenzidine[c]		<10	<100	<10	<30	<200	<30
3-Nitroaniline		<25	<250	<25	<10	<50	<10
4-Bromophenylphenylether		<5	<50	<5	<10	<50	<10
4-Chloro-3-methylphenol		<10	<100	<10	<30	<200	<30
4-Chloroaniline		<10	<100	<10	<10	<50	<10
4-Chlorophenyl phenyl ether[c]		<5	<50	<5	<10	<50	<10
4-Nitroaniline		<25	<250	<25	<30	<200	<30
4-Nitrophenol[c]		<25	<250	<25	<30	<200	<30
Acenaphthene[c]		<5	<50	<5	<10	<50	<10
Acenaphthylene[c]		<5	<50	<5	<10	<50	<10

Table 6-7. Monthly monitoring results for physical and chemical characteristics of the LLNL sanitary sewer effluent, 1999 (continued).

24-hour composite sample parameters	EPA Method	Sample month					
		July	August	September	October	November	December
Total organic carbon (TOC) (mg/L)	**415.1**	43	51	34	31	41	42
Tributyltin (ng/L)		7	—[b]	—[b]	—[b]	—[b]	—[b]
Semivolatile organic compounds (µg/L)	**625**						
1,2,4-Trichlorobenzene[c]		<20	<10	<2	<2	<2	<2
1,2-Dichlorobenzene		<20	<10	<2	<2	<2	<2
1,2-Diphenylhydrazine[c]		<20	<10	<2	<2	<2	<2
1,3-Dichlorobenzene[c]		<20	<10	<2	<2	<2	<2
1,4-Dichlorobenzene[c]		<20	<10	<2	<2	<2	<2
2,4,5-Trichlorophenol		<30	<30	<5	<5	<5	<5
2,4,6-Trichlorophenol[c]		<30	<30	<5	<5	<5	<5
2,4-Dichlorophenol[c]		<20	<10	<2	<2	<2	<2
2,4-Dimethylphenol[c]		<20	<10	<2	<2	<2	<2
2,4-Dinitrophenol[c]		<60	<10	<10	<10	<10	<10
2,4-Dinitrotoluene[c]		<20	<10	<2	<2	<2	<2
2,6-Dinitrotoluene[c]		<20	<10	<2	<2	<2	<2
2-Chloronaphthalene[c]		<20	<10	<2	<2	<2	<2
2-Chlorophenol[c]		<20	<10	<2	<2	<2	<2
2-Methyl-4,6-dinitrophenol		<60	<50	<10	<10	<10	<10
2-Methylnaphthalene		<20	<10	<2	<2	<2	<2
2-Naphthylamine		<200	<100	<20	<20	<20	<20
2-Nitroaniline		<20	<10	<2	<2	<2	<2
2-Nitrophenol[c]		<20	<10	<2	<2	<2	<2
3,3-Dichlorobenzidine[c]		<30	<30	<5	<5	<5	<5
3-Nitroaniline		<20	<10	<2	<2	<2	<2
4-Bromophenylphenylether		<20	<10	<2	<2	<2	<2
4-Chloro-3-methylphenol		<30	<50	<5	<5	<5	<5
4-Chloroaniline		<20	<10	<2	<2	<2	<2
4-Chlorophenyl phenyl ether[c]		<20	<10	<2	<2	<2	<2
4-Nitroaniline		<30	<30	<5	<5	<5	<5
4-Nitrophenol[c]		<30	<30	<5	<5	<5	<5
Acenaphthene[c]		<20	<10	<2	<2	<2	<2
Acenaphthylene[c]		<20	<10	<2	<2	<2	<2

Table 6-7. Monthly monitoring results for physical and chemical characteristics of the LLNL sanitary sewer effluent, 1999 (continued).

24-hour composite sample parameters	EPA Method	Sample month					
		January	February	March	April	May	June
Semivolatile organic compounds (µg/L) (continued)	**625**						
Aldrin[c]		—[a]	—[a]	—[a]	<10	<50	<10
Aniline		—[a]	—[a]	—[a]	<30	<200	<30
Anthracene[c]		<5	<50	<5	<10	<50	<10
Benzidine[c]		—[a]	—[a]	—[a]	<100	<500	<100
Benzo(a)anthracene[c]		<5	<50	<5	<10	<50	<10
Benzo(a)pyrene[c]		<5	<50	<5	<10	<50	<10
Benzo(b)fluoranthene[c]		<5	<50	<5	<10	<50	<10
Benzo(g,h,i)perylene[c]		<5	<50	<5	<10	<50	<10
Benzo(k)fluoranthene[c]		<5	<50	<5	<10	<50	<10
Benzoic acid		<25	<250	<25	<50	<300	<50
Benzyl alcohol		<10	<100	<10	<5	85	22
BHC, alpha isomer[c]		—[a]	—[a]	—[a]	<5	<50	<10
BHC, beta isomer[c]		—[a]	—[a]	—[a]	<5	<50	<10
BHC, delta isomer[c]		—[a]	—[a]	—[a]	<10	<50	<10
BHC, gamma isomer (Lindane) [c]		—[a]	—[a]	—[a]	<10	<50	<10
Bis(2-chloroethoxy)methane[c]		<5	<50	<5	<10	<50	<10
Bis(2-chloroethyl)ether[c]		<5	<50	<5	<10	<50	<10
Bis(2-chloroisopropyl)ether[c]		<5	<50	<5	<10	<50	<10
Bis(2-ethylhexyl)phthalate[c]		14	<50	5.3	<30	<200	<30
Butyl benzyl phthalate[c]		<5	<50	<5	<5	55	<10
Chrysene[c]		<5	<50	<5	<10	<50	<10
Di-n-butyl phthalate[c]		<5	<50	<5	—[a]	—[a]	—[a]
Di-n-octyl phthalate[c]		<5	<50	<5	<10	<50	<10
Dibenzo(a,h)anthracene[c]		<5	<50	<5	<20	<70	<20
Dibenzofuran		<5	<50	<5	<10	<50	<10
Dibutylphthalate		—[a]	—[a]	—[a]	<10	<50	<10
Dieldrin[c]		—[a]	—[a]	—[a]	<20	<70	<20
Diethyl phthalate[c]		13	<50	<5	<10	<50	<10
Dimethyl phthalate[c]		<5	<50	<5	<10	<50	<10
Endosulfan I[c]		—[a]	—[a]	—[a]	<50	<300	<50
Endosulfan II[c]		—[a]	—[a]	—[a]	<50	<300	<50
Endosulfan sulfate[c]		—[a]	—[a]	—[a]	<20	<70	<20
Endrin[c]		—[a]	—[a]	—[a]	<10	<50	<10

Table 6-7. Monthly monitoring results for physical and chemical characteristics of the LLNL sanitary sewer effluent, 1999 (continued).

24-hour composite sample parameters	EPA Method	Sample month					
		July	August	September	October	November	December
Semivolatile organic compounds (µg/L) (continued)	**625**						
Aldrin[c]		<20	<10	<2	<2	<2	<2
Aniline		<30	<30	<5	<5	<5	<5
Anthracene[c]		<20	<10	<2	<2	<2	<2
Benzidine[c]		<200	<100	<20	<20	<20	<20
Benzo(a)anthracene[c]		<20	<10	<2	<2	<2	<2
Benzo(a)pyrene[c]		<20	<10	<2	<2	<2	<2
Benzo(b)fluoranthene[c]		<20	<10	<2	<2	<2	<2
Benzo(g,h,i)perylene[c]		<20	<10	<2	<2	<2	<2
Benzo(k)fluoranthene[c]		<20	<10	<2	<2	<2	<2
Benzoic acid		<60	<50	37	<10	31	11
Benzyl alcohol		<20	<10	4.3	<2	7.8	5.4
BHC, alpha isomer[c]		<20	<10	<2	<2	<2	<2
BHC, beta isomer[c]		<20	<10	<2	<2	<2	<2
BHC, delta isomer[c]		<20	<10	<2	<2	<2	<2
BHC, gamma isomer (Lindane) [c]		<20	<10	<2	<2	<2	<2
Bis(2-chloroethoxy)methane[c]		<20	<10	<2	<2	<2	<2
Bis(2-chloroethyl)ether[c]		<20	<30	<2	<2	<2	<2
Bis(2-chloroisopropyl)ether[c]		<20	<10	<2	<2	<2	<2
Bis(2-ethylhexyl)phthalate[c]		21	20	<5	7.5	8.9	5.8
Butyl benzyl phthalate[c]		<20	<10	<2	<2	<2	<2
Chrysene[c]		<20	<10	<2	<2	<2	<2
Di-n-butyl phthalate[c]		—[a]	—[a]	—[a]	—[a]	—[a]	—[a]
Di-n-octyl phthalate[c]		<20	<10	<2	<2	<2	<2
Dibenzo(a,h)anthracene[c]		<20	<20	<3	<3	<3	<3
Dibenzofuran		<20	<10	<2	<2	<2	<2
Dibutylphthalate		<20	<10	<2	<2	<2	<2
Dieldrin[c]		<20	<20	<3	<3	<3	<3
Diethyl phthalate[c]		14	<10	7.7	8.3	4.9	5.3
Dimethyl phthalate[c]		<20	<10	<2	<2	<2	<2
Endosulfan I[c]		<60	<50	<10	<10	<10	<10
Endosulfan II[c]		<60	<50	<10	<10	<10	<10
Endosulfan sulfate[c]		<20	<20	<3	<3	<3	<3
Endrin[c]		<20	<10	<2	<2	<2	<2

Table 6-7. Monthly monitoring results for physical and chemical characteristics of the LLNL sanitary sewer effluent, 1999 (continued).

24-hour composite sample parameters	EPA Method	Sample month					
		January	February	March	April	May	June
Semivolatile organic compounds (µg/L) (continued)	**625**						
Endrin aldehyde[c]		—[a]	—[a]	—[a]	<10	<50	<10
Fluoranthene[c]		<5	<50	<5	<10	<50	<10
Fluorene[c]		<5	<50	<5	<10	<50	<10
Heptachlor[c]		—[a]	—[a]	—[a]	<10	<50	<10
Heptachlor epoxide[c]		—[a]	—[a]	—[a]	<10	<50	<10
Hexachlorobenzene[c]		<5	<50	<5	<10	<50	<10
Hexachlorobutadiene[c]		<5	<50	<5	<10	<50	<10
Hexachlorocyclopentadiene[c]		<5	<50	<5	<10	<50	<10
Hexachloroethane[c]		<5	<50	<5	<10	<50	<10
Indeno(1,2,3-c,d)pyrene[c]		<5	<50	<5	<10	<50	<10
Isophorone[c]		<5	<50	<5	<10	<50	<10
m- and p- Cresol		<5	<50	19	—[a]	—[a]	—[a]
N-Nitrosodi-n-propylamine[c]		<5	<50	<5	<10	<50	<10
N-Nitrosodimethylamine[c]		—[a]	—[a]	—[a]	<10	<50	<10
N-Nitrosodiphenylamine[c]		<5	<50	<5	<10	<50	<10
Naphthalene		<5	<50	<5	<10	<50	<10
Nitrobenzene[c]		<5	<50	<5	<10	<50	<10
o-Cresol		<5	<50	<5	<10	<50	<10
p,p-DDD[c]		—[a]	—[a]	—[a]	<10	<50	<10
p,p-DDE[c]		—[a]	—[a]	—[a]	<20	<70	<20
p,p-DDT[c]		—[a]	—[a]	—[a]	<10	<50	<10
p-Cresol		—[a]	—[a]	—[a]	23	<50	<10
Pentachlorophenol[c]		<25	<250	<25	<50	<300	<50
Phenanthrene[c]		<5	<50	<5	<10	<50	<10
Phenol[c]		<5	<50	<5	<10	<50	<10
Pyrene[c]		<5	<50	<5	<10	<50	<10
Total cyanide (mg/L)	**335.2**	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Total oil and grease (mg/L)	**413.1**						
6:00 a.m.		2.3	4.8	3.1	2.7	—[d]	—[d]
10:00 a.m.		34	34	21	30	—[d]	—[d]
2:00 p.m.		25	37	14	23	—[d]	—[d]
6:00 p.m.		18	2.2	16	37	—[d]	—[d]

Table 6-7. Monthly monitoring results for physical and chemical characteristics of the LLNL sanitary sewer effluent, 1999 (continued).

24-hour composite sample parameters	EPA Method	Sample month					
		July	August	September	October	November	December
Semivolatile organic compounds (µg/L) (continued)	**625**						
Endrin aldehyde[c]		<20	<10	<2	<2	<2	<2
Fluoranthene[c]		<20	<10	<2	<2	<2	<2
Fluorene[c]		<20	<10	<2	<2	<2	<2
Heptachlor[c]		<20	<10	<2	<2	<2	<2
Heptachlor epoxide[c]		<20	<10	<2	<2	<2	<2
Hexachlorobenzene[c]		<20	<10	<2	<2	<2	<2
Hexachlorobutadiene[c]		<20	<10	<2	<2	<2	<2
Hexachlorocyclopentadiene[c]		<20	<10	<2	<2	<2	<2
Hexachloroethane[c]		<20	<10	<2	<2	<2	<2
Indeno(1,2,3-c,d)pyrene[c]		<20	<10	<2	<2	<2	<2
Isophorone[c]		<20	<10	<2	<2	<2	<2
m- and p- Cresol		—[a]	—[a]	—[a]	—[a]	—[a]	—[a]
N-Nitrosodi-n-propylamine[c]		<20	<10	<2	<2	<2	<2
N-Nitrosodimethylamine[c]		<20	<10	<2	<2	<2	<2
N-Nitrosodiphenylamine[c]		<20	<10	<2	<2	<2	<2
Naphthalene		<20	<10	<2	<2	<2	<2
Nitrobenzene[c]		<20	<10	<2	<2	<2	<2
o-Cresol		<20	<10	<2	<2	<2	<2
p,p-DDD[c]		<20	<10	<2	<2	<2	<2
p,p-DDE[c]		<20	<20	<3	<3	<3	<3
p,p-DDT[c]		<20	<10	<2	<2	<2	<2
p-Cresol		<20	<10	16	<2	29	<2
Pentachlorophenol[c]		<60	<50	<10	<10	<10	<10
Phenanthrene[c]		<20	<10	<2	<2	<2	<2
Phenol[c]		<20	<10	2	<2	14	<2
Pyrene[c]		<20	<10	<2	<2	<2	<2
Total cyanide (mg/L)	**335.2**	<0.02	—[b]	—[b]	—[b]	—[b]	—[b]
Total oil and grease (mg/L)	**413.1**						
6:00 a.m.		—[d]	—[d]	—[d]	—[d]	—[d]	—[d]
10:00 a.m.		—[d]	—[d]	—[d]	—[d]	—[d]	—[d]
2:00 p.m.		—[d]	—[d]	—[d]	—[d]	—[d]	—[d]
6:00 p.m.		—[d]	—[d]	—[d]	—[d]	—[d]	—[d]

Table 6-7. Monthly monitoring results for physical and chemical characteristics of the LLNL sanitary sewer effluent, 1999 (continued).

24-hour composite sample parameters	EPA Method	Sample month					
		January	February	March	April	May	June
Total recoverable phenolics (mg/L)	**420.1**	0.069	0.024	0.038	—[e]	—[e]	—[e]
Volatile organic compounds (µg/L)	**624**						
1,1,1-Trichloroethane[c]		<2	<1	<1	<0.5	<0.5	<0.5
1,1,2,2-Tetrachloroethane[c]		<2	<1	<1	<0.5	<0.5	<0.5
1,1,2-Trichloroethane[c]		<2	<1	<1	<0.5	<0.5	<0.5
1,1-Dichloroethane[c]		<2	<1	<1	<0.5	<0.5	<0.5
1,1-Dichloroethene[c]		<2	<1	<1	<0.5	<0.5	<0.5
1,2-Dichlorobenzene[c]		<2	<1	<1	<0.5	<0.5	<0.5
1,2-Dichloroethane		<2	<1	<1	<0.5	<0.5	<0.5
1,2-Dichloroethene (total)		<2	<1	<1	<1	<1	<1
1,2-Dichloropropane[c]		<2	<1	<1	<0.5	<0.5	<0.5
1,3-Dichlorobenzene		<2	<1	<1	<0.5	<0.5	<0.5
1,4-Dichlorobenzene		<2	1.2	1.4	1.9	3.6	3.1
2-Butanone		<80	<40	<40	<20	<20	<20
2-Chloroethyl vinylether[c]		<80	<40	<40	<5	<5	<5
2-Hexanone		<20	<10	<10	<20	<20	<20
4-Methyl-2-pentanone		<20	<10	<10	<20	<20	<20
Acetone		150	140	54	220	100	57
Benzene[c]		<2	<1	<1	<0.5	<0.5	<0.5
Bromodichloromethane		<2	<1	<1	<0.5	<0.5	<0.5
Bromoform		<2	<1	<1	<0.5	<0.5	<0.5
Bromomethane		<4	<2	<2	<0.5	<0.5	<0.5
Carbon disulfide		<2	<1	<1	<5	<5	<5
Carbon tetrachloride[c]		<2	<1	<1	<0.5	<0.5	<0.5
Chlorobenzene		<2	<1	<1	<0.5	<0.5	<0.5
Chloroethane[c]		<4	<2	<2	<1	<1	<1
Chloroform[c]		10	12	23	8.5	8.7	18
Chloromethane[c]		<4	<2	<2	<1	<1	<1
cis-1,2-Dichloroethene		—[a]	—[a]	—[a]	<0.5	<0.5	<0.5
cis-1,3-Dichloropropene		<2	<1	<1	<0.5	<0.5	<0.5
Dibromochloromethane		<2	<1	<1	<0.5	<0.5	<0.5
Dibromomethane		<2	<1	<1	—[a]	—[a]	—[a]

Table 6-7. Monthly monitoring results for physical and chemical characteristics of the LLNL sanitary sewer effluent, 1999 (continued).

24-hour composite sample parameters	EPA Method	Sample month					
		July	August	September	October	November	December
Total recoverable phenolics (mg/L)	**420.1**	—[e]	—[e]	—[e]	—[e]	—[e]	—[e]
Volatile organic compounds (µg/L)	**624**						
1,1,1-Trichloroethane[c]		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,2,2-Tetrachloroethane[c]		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,2-Trichloroethane[c]		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-Dichloroethane[c]		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-Dichloroethene[c]		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichlorobenzene[c]		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichloroethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichloroethene (total)		<1	<1	<1	<1	<1	<1
1,2-Dichloropropane[c]		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,3-Dichlorobenzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,4-Dichlorobenzene		1.2	1.9	<0.5	0.91	1.4	1.5
2-Butanone		<20	<20	<20	<20	<20	<20
2-Chloroethyl vinylether[c]		<5	<5	<5	<5	<5	<5
2-Hexanone		<20	<20	<20	<20	<20	<20
4-Methyl-2-pentanone		<20	<20	<20	<20	<20	<20
Acetone		72	130	360	200	110	100
Benzene[c]		1.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromodichloromethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromoform		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromomethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Carbon disulfide		<5	<5	<5	<5	<5	<5
Carbon tetrachloride[c]		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chlorobenzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chloroethane[c]		<1	<1	<1	<1	<1	<1
Chloroform[c]		19	15	11	13	16	14
Chloromethane[c]		<1	<1	<1	<1	<1	<1
cis-1,2-Dichloroethene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
cis-1,3-Dichloropropene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dibromochloromethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dibromomethane		—[a]	—[a]	<5	<0.5	<0.5	<0.5

Table 6-7. Monthly monitoring results for physical and chemical characteristics of the LLNL sanitary sewer effluent, 1999 (continued).

24-hour composite sample parameters	EPA Method	Sample month					
		January	February	March	April	May	June
Volatile organic compounds (µg/L) (continued)	**624**						
Dichlorodifluoromethane		<4	<2	<2	0.71	<0.5	<0.5
Ethanol		—[a]	—[a]	—[a]	—[a]	—[a]	—[a]
Ethylbenzene[c]		<2	<1	<1	<0.5	<0.5	<0.5
Freon 113		<2	<1	<1	<0.5	<0.5	<0.5
Methylene chloride[c]		<2	<1	<1	1.1	<1	<1
Naphthalene[c]		—[a]	—[a]	—[a]	—[a]	—[a]	—[a]
Styrene		<2	<1	<1	<0.5	<0.5	<0.5
Tetrachloroethene[c]		<2	<1	<1	<0.5	<0.5	<0.5
Toluene[c]		<2	1.6	<1	1.4	1.1	<0.5
Total xylene isomers		<4	<2	<2	<1	<1	<1
trans-1,2-Dichloroethene[c]		—[a]	—[a]	—[a]	<0.5	<0.5	<0.5
trans-1,3-Dichloropropene		<2	<1	<1	<0.5	<0.5	<0.5
Trichloroethene[c]		<1	<0.5	<0.5	<0.5	<0.5	<0.5
Trichlorofluoromethane		<2	<1	<1	<0.5	<0.5	<0.5
Vinyl acetate		<20	<10	<10	—[a]	—[a]	—[a]
Vinyl chloride[c]		<4	<2	<2	<0.5	<0.5	<0.5

a Sample missed because of a change in contract analytical services. Some parameters were not being sampled under the old contract, which ended in March.

b Sampling required by permit on a semiannual basis.

c Indicates priority pollutant parameter used in computing the total organic permit limit of 1 mg/L (1000 µg/L) issued by the Livermore Water Reclamation Plant.

Table 6-7. Monthly monitoring results for physical and chemical characteristics of the LLNL sanitary sewer effluent, 1999 (concluded).

24-hour composite sample parameters	EPA Method	Sample month					
		July	August	September	October	November	December
Volatile organic compounds (µg/L) (continued)	**624**						
Dichlorodifluoromethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ethanol		—[a]	—[a]	<1000	<1000	<1000	<1000
Ethylbenzene[c]		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Freon 113		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Methylene chloride[c]		<1	<1	<1	<1	<1	1.4
Naphthalene[c]		—[a]	—[a]	<5	<0.5	<0.5	<0.5
Styrene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Tetrachloroethene[c]		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene[c]		0.65	0.51	<0.5	0.76	0.58	<0.5
Total xylene isomers		<1	<1	<1	<1	<1	<1
trans-1,2-Dichloroethene[c]		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
trans-1,3-Dichloropropene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Trichloroethene[c]		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Trichlorofluoromethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Vinyl acetate		—[a]	—[a]	—[a]	—[a]	—[a]	—[a]
Vinyl chloride[c]		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

[d] Sampling discontinued as directed by April 1999 letter from LWRPR because of a change in the Environmental Protection Agency sampling method.

[e] Sampling discontinued because this was not a required permit parameter.

7

Surface Water Monitoring

Sandra Mathews
Erich R. Brandstetter
Karen J. Folks
Ted A. Giesing
Shari Brigdon

Introduction

Lawrence Livermore National Laboratory monitors surface water at the Livermore site, in surrounding regions of the Livermore Valley, and at Site 300 and vicinity in the nearby Altamont Hills. At the first two locales, LLNL monitors reservoirs and ponds, the LLNL swimming pool, rainfall, tap water, and storm water runoff. Water samples are analyzed for radionuclides and a wide range of nonradioactive constituents. At Site 300 and vicinity, surface water monitoring encompasses rainfall and storm water runoff. Samples of this water are analyzed for radionuclides, high explosives (HE), total organic carbon, total organic halides, total suspended solids, conductivity, and pH. Chapter 7 of the main volume includes summary data tables and a detailed discussion and analysis of the data. This supplemental chapter presents the complete dataset for 1999, from which the summaries and analyses were prepared. This data supplements material provided in the Surface Water Chapter (Chapter 7) of the main volume.

Storm Water

LLNL technologists collect storm water samples for nonradiological analysis directly into sample bottles for storm water runoff grab samples. Samples analyzed for tritium are collected in 250-mL, argon-flushed glass containers; samples for gross alpha and gross beta measurements are collected in 1000-mL polyethylene bottles. Numerical comparison criteria for Livermore site storm water are listed in Table 7-1. Results for Livermore site routine tritium, gross alpha, and gross beta are presented in Table 7-2. Results for the tritium source investigation are presented in Table 7-3. Results for plutonium in filtered and unfiltered samples are presented in Table 7-4. Results for metals detected at the Livermore site are presented in Table 7-5. Table 7-6 summarizes results for nonradioactive compounds, physical and chemical properties, and anions in Livermore site storm water. Data for nondetections in Livermore site storm water are summarized in Table 7-7. Table 7-8 shows results for tritium, gross alpha, gross beta, plutonium, and uranium in Site 300 storm water. Results for nonradioactive compounds and physical

properties for Site 300 storm water are listed in Table 7-9. Results of dioxin analyses at Site 300 sampling location NLIN are presented in Table 7-10. Analytical results from monitoring of Pit 6 post-closure runoff are in Table 7-11.

Rainfall

Rainfall is collected in stainless steel buckets mounted about 1 m above the ground. Samples are decanted into 500-mL argon-flushed amber glass with teflon lined lids and analyzed for tritium. Results are presented in Table 7-12.

Drainage Retention Basin

DRB discharge sampling locations, which monitor compliance with the Livermore site's Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Record of Decision are shown in Figure 7-2, main volume. Figure 7-9 of the main volume shows the sampling locations used to monitor how water quality compares with maintenance goals and action levels. Weekly sampling for dissolved oxygen and temperature occurs at all eight locations identified in Figure 7-9 of the main volume. Weekly turbidity measurements and monthly, quarterly, semiannual, and annual samples are collected at sample location CDBE.

Tables 7-13 and 7-14 show DRB discharge limits and water quality management levels, respectively. Table 7-15 shows the compliance monitoring data for samples collected at sample locations CDBX and WPDC from four DRB releases. Monthly, quarterly, and semiannual maintenance monitoring data for 1998 that were collected at sample location CDBE are shown in Tables 7-16, 17, and 18. Table 7-19 provides the weekly field measurements collected from sample locations CDBA, CDBC, CDBD, CDBE, CDBF, CDBJ, CDBK, and CDBL. A seasonal inventory of plants and animals observed at the Livermore site comprises Table 7-20.

Other Waters

LLNL technologists sample surface and drinking water near the Livermore site and in the Livermore Valley using a tethered pail to collect water from surface sources; other locations are sampled directly from the outfall. Samples for tritium analysis are collected in 500-mL, argon-flushed glass containers; those for other radiological analyses are collected in acidified 1000-mL polyethylene bottles. Results are presented in Table 7-21.

Table 7-1. Numerical comparison criteria for storm water constituents of concern.

Constituent	PMCL/SMCL	AWQC/Ag[a]	EPA benchmark
Physical			
Specific conductance (µmho/cm)	none/900 (CA)[b]	700 (Ag)	none
Total suspended solids (TSS) (mg/L)	none/none	none	100
Biological (mg/L)			
Biochemical oxygen demand (BOD)	none/none	none	30
Anions (mg/L)			
Bicarbonate alkalinity (as $CaCO_3$)	none/none	none	none
Bromide	none/none	none	none
Carbonate alkalinity (as $CaCO_3$)	none/none	none	none
Chloride	none/250 (EPA)[c]	250	860
Fluoride	2.0/none (CA)	1.0 (Ag)	1.8
	0.8/none (SF)[d]		
Nitrate (as N)	10/none (EPA)	none	0.68
Nitrate (as NO_3)	45/none (CA)	none	3.01
Nitrate plus nitrite (as N)	10/none (EPA)	none	0.68
Nitrate plus nitrite (as NO_3)	45/none (CA)	none	3.01
Nitrite (as N)	1.0/none (EPA)	none	0.68
Nitrite (as NO_2)	3.3/none (EPA)	none	2.2
Sulfate	none/250 (EPA)	none	none
General minerals (mg/L)			
Calcium	none/none	none	none
pH (pH units)	none/<6.5, >8.5 (EPA)	<6.5, >8.5	<6.0, >9.0
Orthophosphate	none/none	none	none
Potassium	none/none	none	none
Sodium	none/none	none	none
Surfactants	none/0.5 (CA)	0.5 (SF)	none
Total alkalinity (as $CaCO_3$)	none/none (EPA)	≥20	none
Total dissolved solids (TDS)	none/500 (EPA)	500 (SF)	none
Total hardness (as $CaCO_3$)	none/none	none	none
Total phosphorous	none/none	0.0001	2.0
Metals (mg/L)			
Aluminum	1.0/0.2 (CA)	0.75	0.75
Antimony	0.006/none (EPA)	0.088	0.636
Arsenic	0.05/none (EPA)	0.36	0.168

Table 7-1. Numerical comparison criteria for storm water constituents of concern (continued).

Constituent	PMCL/SMCL	AWQC/Ag[a]	EPA benchmark
Metals (mg/L) (continued)			
Barium	1.0/none (CA)	none	none
Beryllium	0.004/none (EPA)	0.5 (Ag)	0.13
Boron	none/none	0.7 (Ag)	none
Cadmium	0.005/none (EPA)	0.005[e]	0.0159[e]
Chromium, total	0.05/none (CA)	none	none
Chromium(VI)	none/none	0.015	none
Copper	1.3/1.0[g] (EPA)	0.026[e]	0.0636[f]
		0.2 (SF, Ag)	
Iron	none/0.3 (EPA)	none	1.0
Lead	0.015/none (EPA)	0.11[e]	0.0816[f]
Magnesium	none/none	none	0.0636
Manganese	none/0.05 (EPA)	0.2 (Ag)	1.0
Mercury	0.002/none (EPA)	0.0021	0.0024
Molybdenum	none/none	0.05 (SF, Ag)	none
Nickel	0.1/none (CA)	2.1[e]	1.417[f]
Selenium	0.05/none (EPA)	0.02	0.2385
Silver	none/0.1 (EPA)	0.0077[e]	0.0318[f]
Thallium	0.002/none (EPA)	450 (Ag)	none
Vanadium	none/none	0.1 (SF Ag)	none
Zinc	none/5 (EPA)	0.17[e]	0.117[f]
Volatile organic compounds (µg/L)			
Acetone	none/none	none	none
Benzene	1.0/none (CA)	none	10
Chloroform	80/none (EPA)	none	none
Chloromethane	none/none	none	none
Semivolatile organic compounds (µg/L)			
Benzo[*a*] pyrene	0.2/none (EPA)	none	none
Bis(2-ethylhexyl)phthalate	4/none (CA)	none	none
Butylbenzylphthalate	none/none	none	none
Herbicides (µg/L)			
2,4-D	0.07/none (EPA)	none	none
2,4,5-T	none/none	none	none
Bromacil	none/none	none	none
Diazinon	none/none	0.009	none

Table 7-1. Numerical comparison criteria for storm water constituents of concern (concluded).

Constituent	PMCL/SMCL	AWQC/Ag[(a)]	EPA benchmark
Herbicides (µg/L) (continued)			
Diuron	none/none	none	none
Glyphosate	700/none (CA)	none	none
Simazine	4/none (EPA)	10	none
Miscellaneous organics (mg/L)			
Chemical oxygen demand (mg/L)	none/none	none	120
Oil and grease	none/none	virtually free	15
Total organic carbon	none/none	none	50
Radioactive (Bq/L)			
Tritium	740/none (EPA)	740	none
Gross alpha	0.56/none (EPA)	0.56	none
Gross beta	1.85/none (EPA)	1.85	none

[a] Ag = Criteria for agricultural use.

[b] CA indicates a state PMCL or SMLL.

[c] EPA indicates a federal PMCL or SMLL.

[d] SF = San Francisco Bay Basin Plan.

[e] Hardness dependent; based on receiving water hardness of 160 mg/L.

[f] Hardness dependent benchmark at assumed 100 mg/L $CaCO_3$.

[g] 1.3 is U.S. primary maximum contaminant level (PMCL), not to be exceeded in more than 10% of samples; 1.0 is U.S./CA secondary maximum contaminant level (SMCL).

Table 7-2. Routine tritium, gross alpha, and gross beta sampling in storm water runoff at the Livermore site, 1999.

Parameter	Date	Arroyo Seco	
		Site influent	Site effluent
		ASS2	ASW
Tritium (Bq/L)	1/26	–0.903 ± 2.24	25.6 ± 3.15
	2/8	14.4 ± 2.24	38.1 ± 2.99
	4/8	–0.670 ± 2.49	–0.703 ± 2.52
	11/8	—[a]	0.189 ± 2.17
Gross alpha (Bq/L)	1/26	0.0146 ± 0.0237	0.0681 ± 0.0326
	2/8	0.0433 ± 0.0366	0.00 ± 0.0266
	4/8	0.0381 ± 0.0292	0.00618 ± 0.0135
	11/8	—[a]	0.0235 ± 0.0191
Gross beta (Bq/L)	1/26	0.0351 ± 0.0703	0.125 ± 0.0666
	2/8	0.121 ± 0.0814	0.111 ± 0.0888
	4/8	0.133 ± 0.0392	0.109 ± 0.0357
	11/8	—[a]	0.212 ± 0.0329

Parameter	Date	Arroyo Las Positas			
		Site influent			Site effluent
		ALPE	ALPO	GRNE	WPDC
Tritium (Bq/L)	1/20	0.350 ± 1.93	–0.648 ± 1.77	18.6 ± 2.53	13.1 ± 2.34
	2/8	6.77 ± 1.92	8.14 ± 1.97	43.7 ± 3.24	58.5 ± 3.53
	4/8	2.66 ± 2.58	0.278 ± 2.55	6.44 ± 2.78	11.1 ± 2.96
	11/8	4.70 ± 2.37	2.13 ± 2.28	3.51 ± 2.32	37.7 ± 3.53
Gross alpha (Bq/L)	1/20	0.107 ± 0.0518	0.0551 ± 0.0518	0.0710 ± 0.0444	0.0321 ± 0.0444
	2/8	0.160 ± 0.152	0.255 ± 0.0962	0.0477 ± 0.0337	0.044 ± 0.0407
	4/8	0.0385 ± 0.0385	0.152 ± 0.0755	0.655 ± 0.0426	0.0629 ± 0.0459
	11/8	0.0522 ± 0.0284	0.231 ± 0.0981	0.477 ± 0.159	0.0659 ± 0.0396
Gross beta (Bq/L)	1/20	0.337 ± 0.296	0.223 ± 0.148	0.183 ± 0.0703	0.208 ± 0.0777
	2/8	0.299 ± 0.285	0.279 ± 0.137	0.120 ± 0.0666	0.159 ± 0.0740
	4/8	0.228 ± 0.0555	0.374 ± 0.0722	0.136 ± 0.0400	0.224 ± 0.0510
	11/8	0.162 ± 0.0287	0.344 ± 0.0799	0.655 ± 0.114	0.237 ± 0.0444

Table 7-2. Tritium, gross alpha, and gross beta in storm water runoff at the Livermore site, 1999 (concluded).

Parameter	Date	Drainage Retention Basin		
		Site influent		Site effluent
		CDB	CDB2	CDBX
Tritium (Bq/L)	1/20	53.3 ± 3.47	—[a]	21.7 ± 2.63
	1/26	—[b]	47.4 ± 3.77	—[b]
	2/8	89.5 ± 4.33	58.5 ± 3.52	29.5 ± 2.75
	4/8	3.07 ± 2.67	52.9 ± 4.18	23.3 ± 3.37
	11/8	3.67 ± 2.33	7.03 ± 2.46	21.5 ± 3.00
Gross alpha (Bq/L)	1/20	0.121 ± 0.0518	—[a]	0.0633 ± 0.0518
	1/26	—[b]	0.0755 ± 0.0518	—[b]
	2/8	0.0210 ± 0.0270	0.149 ± 0.111	0.170 ± 0.0851
	4/8	0.0112 ± 0.0239	0.0607 ± 0.0548	0.0944 ± 0.0640
	11/8	0.0259 ± 0.0183	0.114 ± 0.0477	0.116 ± 0.0648
Gross beta (Bq/L)	1/20	0.295 ± 0.252	—[a]	0.118 ± 0.0740
	1/26	—[b]	0.0755 ± 0.0777	—[b]
	2/8	0.118 ± 0.0666	0.179 ± 0.137	0.135 ± 0.0962
	4/8	0.156 ± 0.0422	0.248 ± 0.0559	0.0470 ± 0.0799
	11/8	0.192 ± 0.0295	0.374 ± 0.0555	0.170 ± 0.0500

Note: Radioactivities are reported as the measured concentration and either an uncertainty (±2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

[a] Sample not collected because there was no flow.

[b] Locations sampled 1/20 were not sampled again on 1/26.

Table 7-3. Tritium source investigation sampling in storm water runoff (Bq/L) at the Livermore site, 1999.

Location	Date sampled			
	1/2/99	2/8/99	4/8/99	11/8/99
191E	—[a]	310 ± 8	31.9 ± 3.45	—[a]
191S	—[a]	49.2 ± 4.03	2.28 ± 2.41	—[a]
196E	13.2 ± 2.34	96.9 ± 4.37	24.2 ± 3.41	—[a]
196S	4.70 ± 2.02	5.62 ± 1.88	7.55 ± 2.83	—[a]
2582	—[a]	—[a]	15.4 ± 2.91	722 ± 37.7
298E	—[a]	—[a]	4.96 ± 2.52	12.4 ± 2.64
298S	—[a]	—[a]	237 ± 7.33	414 ± 9.32
3726	—[a]	—[a]	511 ± 10.4	1780 ± 19.1
494E	23.2 ± 2.68	43.3 ± 3.85	5.33 ± 2.72	—[a]
494S	23.3 ± 2.68	33.7 ± 3.57	18.0 ± 3.18	—[a]
591E	—[a]	18.3 ± 3.12	2.87 ± 2.43	—[a]
591S	—[a]	36.5 ± 3.66	8.03 ± 2.83	—[a]
T49E	21.7 ± 2.66	71.0 ± 4.55	5.14 ± 2.53	—[a]
T495	8.73 ± 2.19	36.5 ± 3.67	4.18 ± 2.49	—[a]
WPDS	1.18 ± 1.91	85.5 ± 4.14	25.6 ± 3.44	—[a]
WPDW	12.4 ± 2.29	16.7 ± 2.33	1.14 ± 2.35	—[a]

Note: Radioactivities are reported as the measured concentration and either an uncertainty (± 2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection.

[a] Location not sampled on the indicated date. Sample not collected at this location.

Table 7-4. Plutonium in storm water runoff, Livermore site, 1999.

Parameter	Date Sampled	Arroyo Seco effluent		
		ASW		
		Unfiltered water (Bq/L)	Filtered water (Bq/L)	Sediments (Bq/g)
Plutonium-238	1/26	$2.47 \times 10^{-6} \pm 3.44 \times 10^{-5}$	—[a]	—[a]
	2/8	$1.47 \times 10^{-6} \pm 1.02 \times 10^{-4}$	—[a]	—[a]
	4/8	—[b]	$0.00 \times 10^{0} \pm 0.00 \times 10^{0}$	$4.18 \times 10^{-4} \pm 4.11 \times 10^{-3}$
	11/8	$5.22 \times 10^{-5} \pm 1.56 \times 10^{-4}$	$4.11 \times 10^{-5} \pm 7.66 \times 10^{-5}$	$-5.81 \times 10^{-4} \pm 1.11 \times 10^{-3}$
Plutonium-239+240	1/26	$1.73 \times 10^{-5} \pm 4.55 \times 10^{-5}$	—[a]	—[a]
	2/8	$-2.06 \times 10^{-5} \pm 4.14 \times 10^{-5}$	—[a]	—[a]
	4/8	—[b]	$1.13 \times 10^{-5} \pm 4.22 \times 10^{-5}$	$9.36 \times 10^{-4} \pm 3.96 \times 10^{-3}$
	11/8	$4.03 \times 10^{-5} \pm 1.06 \times 10^{-4}$	$1.03 \times 10^{-5} \pm 3.81 \times 10^{-5}$	$3.85 \times 10^{-4} \pm 7.73 \times 10^{-4}$

Parameter	Date Sampled	Arroyo Las Positas effluent		
		WPDC		
		Unfiltered water (Bq/L)	Filtered water (Bq/L)	Sediments (Bq/g)
Plutonium-238	1/20	$5.07 \times 10^{-5} \pm 1.21 \times 10^{-4}$	—[a]	—[a]
	2/8	$-4.74 \times 10^{-5} \pm 9.81 \times 10^{-5}$	—[a]	—[a]
	4/8	—[b]	$3.27 \times 10^{-6} \pm 4.55 \times 10^{-5}$	$-1.15 \times 10^{-3} \pm 1.52 \times 10^{-3}$
	11/8	$-2.60 \times 10^{-6} \pm 1.05 \times 10^{-4}$	$4.59 \times 10^{-5} \pm 7.07 \times 10^{-5}$	$-5.70 \times 10^{-5} \pm 2.23 \times 10^{-4}$
Plutonium-239+240	1/20	$-3.04 \times 10^{-5} \pm 3.52 \times 10^{-5}$	—[a]	—[a]
	2/8	$8.36 \times 10^{-5} \pm 9.88 \times 10^{-5}$	—[a]	—[a]
	4/8	—[b]	$-5.70 \times 10^{-5} \pm 4.33 \times 10^{-5}$	$-3.27 \times 10^{-4} \pm 1.28 \times 10^{-3}$
	11/8	$9.84 \times 10^{-5} \pm 1.30 \times 10^{-4}$	$6.66 \times 10^{-5} \pm 6.66 \times 10^{-5}$	$4.22 \times 10^{-4} \pm 3.64 \times 10^{-4}$

Note: Radioactivities are reported as the measured concentration and either an uncertainty (±2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

a Sample was only analyzed on unfiltered water.

b Sample was only analyzed on filtered water and filtrate (sediments).

Table 7-5. Metals detected in storm water runoff, Livermore site, 1999.

Parameter (mg/L)	Requested analysis	Storm date	Arroyo Seco	
			Site influent ASS2	Site effluent ASW
Aluminum	GENMIN	1/20	—[a]	—[a]
	GENMINDISS		—[a]	—[a]
	NPDESDISS		—[a]	—[a]
	NPDESMETAL		—[a]	—[a]
	GENMIN	1/26	0.92	3.6
	GENMINDISS		0.13	0.21
	NPDESDISS		0.14	0.27
	NPDESMETAL		0.88	3.3
	GENMIN	2/8	2.9	2.5
	GENMINDISS		0.17	0.15
	NPDESDISS		0.15	0.13
	NPDESMETAL		3	2.9
	GENMIN	4/8	2.8	1.7
	GENMINDISS		0.13	0.13
	NPDESDISS		0.2	0.17
	NPDESMETAL		2.8	1.6
	GENMIN	11/8	—[a]	2
	NPDESMETAL		—[a]	2.2
Arsenic	NPDESDISS	1/20	—[a]	—[a]
	NPDESMETAL		—[a]	—[a]
	NPDESDISS	1/26	<0.002	<0.002
	NPDESMETAL		<0.004	<0.004
	NPDESDISS	2/8	<0.002	<0.002
	NPDESMETAL		<0.002	<0.002
	NPDESDISS	4/8	<0.002	<0.002
	NPDESMETAL		<0.002	<0.002
	NPDESMETAL	11/8	—[a]	<0.002
Barium	NPDESDISS	1/20	—[a]	—[a]
	NPDESMETAL		—[a]	—[a]
	NPDESDISS	1/26	0.032	0.058
	NPDESMETAL		<0.025	0.049
	NPDESDISS	2/8	0.05	0.048
	NPDESMETAL		0.056	0.062
	NPDESDISS	4/8	0.056	0.044
	NPDESMETAL		0.044	0.03
	NPDESMETAL	11/8	—[a]	0.044

Table 7-5. Metals detected in storm water runoff, Livermore site, 1999 (continued).

Parameter (mg/L)	Requested analysis	Storm date	Arroyo Seco	
			Site influent ASS2	Site effluent ASW
Beryllium	NPDESDISS	1/20	—[a]	—[a]
	NPDESMETAL		—[a]	—[a]
	NPDESDISS	1/26	<0.0002	<0.0002
	NPDESMETAL		<0.0002	<0.0002
	NPDESDISS	2/8	<0.0002	<0.0002
	NPDESMETAL		<0.0002	<0.0002
	NPDESDISS	4/8	<0.0002	<0.0002
	NPDESMETAL		<0.0002	<0.0002
	NPDESMETAL	11/8	—[a]	<0.0002
Boron	NPDESDISS	1/20	—[a]	—[a]
	NPDESMETAL		—[a]	—[a]
	NPDESDISS	1/26	<0.05	<0.05
	NPDESMETAL		<0.05	<0.05
	NPDESDISS	2/8	0.41	0.36
	NPDESMETAL		0.4	0.34
	NPDESDISS	4/8	0.065	<0.05
	NPDESMETAL		0.065	<0.05
	NPDESMETAL	11/8	—[a]	0.067
Cadmium	NPDESDISS	1/20	—[a]	—[a]
	NPDESMETAL		—[a]	—[a]
	NPDESDISS	1/26	<0.0005	<0.0005
	NPDESMETAL		<0.0005	<0.0005
	NPDESDISS	2/8	<0.0005	<0.0005
	NPDESMETAL		<0.0005	<0.0005
	NPDESDISS	4/8	<0.0005	<0.0005
	NPDESMETAL		<0.0005	<0.0005
	NPDESMETAL	11/8	—[a]	<0.0005
Chromium	NPDESDISS	1/20	—[a]	—[a]
	NPDESMETAL		—[a]	—[a]
	NPDESDISS	1/26	<0.001	<0.001
	NPDESMETAL		0.0021	0.008
	NPDESDISS	2/8	<0.001	<0.001
	NPDESMETAL		0.0076	0.0061
	NPDESDISS	4/8	<0.001	<0.001
	NPDESMETAL		0.0067	0.0039
	NPDESMETAL	11/8	—[a]	0.005

Table 7-5. Metals detected in storm water runoff, Livermore site, 1999 (continued).

Parameter (mg/L)	Requested analysis	Storm date	Arroyo Seco	
			Site influent ASS2	Site effluent ASW
Copper	GENMIN	1/20	—[a]	—[a]
	GENMINDISS		—[a]	—[a]
	NPDESDISS		—[a]	—[a]
	NPDESMETAL		—[a]	—[a]
	GENMIN	1/26	<0.01	0.012
	GENMINDISS		<0.01	<0.01
	NPDESDISS		0.0037	0.0051
	NPDESMETAL		0.0055	0.012
	GENMIN	2/8	0.014	0.023
	GENMINDISS		<0.01	<0.01
	NPDESDISS		<0.001	<0.001
	NPDESMETAL		0.008	0.0096
	GENMIN	4/8	0.017	0.017
	GENMINDISS		<0.01	<0.01
	NPDESDISS		0.0066	0.0077
	NPDESMETAL		0.011	0.0097
	GENMIN	11/8	—[a]	0.023
	NPDESMETAL		—[a]	0.018
Chromium(VI)	NPDESDISS	1/20	—[a]	—[a]
	NPDESDISS	1/26	0.002	0.0043
	NPDESDISS	2/8	<0.002	<0.002
	NPDESDISS	4/8	<0.002	<0.002
	NPDESMETAL	11/8	—[a]	<0.002
Iron	GENMIN	1/20	—[a]	—[a]
	GENMINDISS		—[a]	—[a]
	NPDESDISS		—[a]	—[a]
	NPDESMETAL		—[a]	—[a]
	GENMIN	1/26	0.97	3.8
	GENMINDISS		0.12	0.19
	NPDESDISS		0.12	0.23
	NPDESMETAL		0.95	3.7
	GENMIN	2/8	3.4	3
	GENMINDISS		0.16	0.13
	NPDESDISS		0.16	0.15
	NPDESMETAL		3.3	3

Table 7-5. Metals detected in storm water runoff, Livermore site, 1999 (continued).

Parameter (mg/L)	Requested analysis	Storm date	Arroyo Seco	
			Site influent ASS2	Site effluent ASW
Iron (continued)	GENMIN	4/8	3.1	2
	GENMINDISS		0.14	0.14
	NPDESDISS		0.18	0.15
	NPDESMETAL		3	1.8
	GENMIN	11/8	—[a]	1.9
	NPDESMETAL		—[a]	2.2
Lead	NPDESDISS	1/20	—[a]	—[a]
	NPDESMETAL		—[a]	—[a]
	NPDESDISS	1/26	<0.005	<0.005
	NPDESMETAL		<0.005	0.0061
	NPDESDISS	2/8	<0.005	<0.005
	NPDESMETAL		<0.005	<0.005
	NPDESDISS	4/8	<0.005	<0.005
	NPDESMETAL		<0.005	<0.005
	NPDESMETAL	11/8	—[a]	<0.005
Magnesium	GENMIN	1/20	—[a]	—[a]
	GENMINDISS		—[a]	—[a]
	GENMIN	1/26	0.83	2.2
	GENMINDISS		0.58	1.1
	GENMIN	2/8	11	9.6
	GENMINDISS		11	9.6
	GENMIN	4/8	2.3	1.7
	GENMINDISS		1.4	1.1
	GENMIN	11/8	—[a]	2.7
Manganese	GENMIN	1/20	—[a]	—[a]
	GENMINDISS		—[a]	—[a]
	NPDESDISS		—[a]	—[a]
	NPDESMETAL		—[a]	—[a]
	GENMIN	1/26	0.021	0.074
	GENMINDISS		<0.01	<0.01
	NPDESDISS		<0.01	<0.01
	NPDESMETAL		0.02	0.073
	GENMIN	2/8	0.067	0.065
	GENMINDISS		<0.01	<0.01
	NPDESDISS		<0.01	<0.01

Table 7-5. Metals detected in storm water runoff, Livermore site, 1999 (continued).

Parameter (mg/L)	Requested analysis	Storm date	Arroyo Seco	
			Site influent ASS2	Site effluent ASW
Manganese (continued)	NPDESMETAL		0.064	0.06
	GENMIN	4/8	0.059	0.039
	GENMINDISS		<0.01	<0.01
	NPDESDISS		0.01	<0.01
	NPDESMETAL		0.06	0.037
	GENMIN	11/8	—[a]	0.064
	NPDESMETAL		—[a]	0.071
Mercury	NPDESDISS	1/20	—[a]	—[a]
	NPDESMETAL		—[a]	—[a]
	NPDESDISS	1/26	<0.0002	<0.0002
	NPDESMETAL		<0.0002	<0.0002
	NPDESDISS	2/8	<0.0002	<0.0002
	NPDESMETAL		<0.0002	<0.0002
	NPDESDISS	4/8	<0.0002	<0.0002
	NPDESMETAL		<0.0002	<0.0002
	NPDESMETAL	11/8	—[a]	<0.0002
Molybdenum	NPDESDISS	1/20	—[a]	—[a]
	NPDESMETAL		—[a]	—[a]
	NPDESDISS	1/26	<0.025	<0.025
	NPDESMETAL		<0.025	<0.025
	NPDESDISS	2/8	<0.025	<0.025
	NPDESMETAL		<0.025	<0.025
	NPDESDISS	4/8	<0.025	<0.025
	NPDESMETAL		<0.025	<0.025
	NPDESMETAL	11/8	—[a]	0.066
Nickel	GENMIN	1/20	—[a]	—[a]
	GENMINDISS		—[a]	—[a]
	NPDESDISS		—[a]	—[a]
	NPDESMETAL		—[a]	—[a]
	GENMIN	1/26	<0.05	<0.05
	GENMINDISS		<0.05	<0.05
	NPDESDISS		<0.002	<0.002
	NPDESMETAL		0.0028	0.0084
	GENMIN	2/8	<0.05	<0.05
	GENMINDISS		<0.05	<0.05

Table 7-5. Metals detected in storm water runoff, Livermore site, 1999 (continued).

Parameter (mg/L)	Requested analysis	Storm date	Arroyo Seco	
			Site influent ASS2	Site effluent ASW
Nickel (continued)	NPDESDISS		<0.002	<0.002
	NPDESMETAL		0.0098	0.0081
	GENMIN	4/8	<0.05	<0.05
	GENMINDISS		<0.05	<0.05
	NPDESDISS		0.002	<0.002
	NPDESMETAL		0.0083	0.0049
	GENMIN	11/8	—[a]	<0.05
	NPDESMETAL		—[a]	0.0088
Vanadium	NPDESDISS	1/20	—[a]	—[a]
	NPDESMETAL		—[a]	—[a]
	NPDESDISS	1/26	<0.01	<0.01
	NPDESMETAL		<0.01	<0.01
	NPDESDISS	2/8	<0.01	<0.01
	NPDESMETAL		<0.01	<0.01
	NPDESDISS	4/8	<0.01	<0.01
	NPDESMETAL		<0.01	<0.01
	NPDESMETAL	11/8	—[a]	<0.01
Zinc	GENMIN	1/20	—[a]	—[a]
	GENMINDISS		—[a]	—[a]
	NPDESDISS		—[a]	—[a]
	NPDESMETAL		—[a]	—[a]
	GENMIN	1/26	0.081	0.098
	GENMINDISS		0.062	0.048
	NPDESDISS		0.062	0.05
	NPDESMETAL		0.078	0.097
	GENMIN	2/8	0.077	0.085
	GENMINDISS		0.029	0.042
	NPDESDISS		0.03	0.04
	NPDESMETAL		0.074	0.08
	GENMIN	4/8	0.097	0.084
	GENMINDISS		0.056	0.056
	NPDESDISS		0.058	0.062
	NPDESMETAL		0.096	0.085
	GENMIN	11/8	—[a]	0.27
	NPDESMETAL		—[a]	0.27

Table 7-5. Metals detected in storm water runoff, Livermore site, 1999 (continued).

Parameter (mg/L)	Requested analysis	Storm date	Arroyo Las Positas			
			Site influent			Site effluent
			ALPE	ALPO	GRNE	WPDC
Aluminum	GENMIN	1/20	0.55	5.4	25	1.4
	GENMINDISS		<0.05	<0.05	0.18	<0.05
	NPDESDISS		<0.05	<0.05	0.15	<0.05
	NPDESMETAL		0.55	5.6	27	1.4
	GENMIN	1/26	—(b)	—(b)	—(b)	—(b)
	GENMINDISS		—(b)	—(b)	—(b)	—(b)
	NPDESDISS		—(b)	—(b)	—(b)	—(b)
	NPDESMETAL		—(b)	—(b)	—(b)	—(b)
	GENMIN	2/8	6.7	12	4.8	4.1
	GENMINDISS		0.28	<0.05	0.17	0.21
	NPDESDISS		0.28	<0.05	0.14	0.28
	NPDESMETAL		6.9	12	6.2	3.9
	GENMIN	4/8	3.1	9.9	3.6	4.2
	GENMINDISS		0.14	0.11	0.14	0.19
	NPDESDISS		0.096	0.084	0.12	0.18
	NPDESMETAL		3.2	9.3	4.8	3.7
	GENMIN	11/8	2.6	6.4	31	4.6
	NPDESMETAL		2.3	5.9	28	4.5
Arsenic	NPDESDISS	1/20	0.0067	0.011	0.0026	0.0063
	NPDESMETAL		0.0044	0.0098	0.0058	0.0047
	NPDESDISS	1/26	—(b)	—(b)	—(b)	—(b)
	NPDESMETAL		—(b)	—(b)	—(b)	—(b)
	NPDESDISS	2/8	0.0028	0.0063	<0.002	<0.002
	NPDESMETAL		0.004	0.0094	<0.002	<0.002
	NPDESDISS	4/8	<0.002	<0.002	<0.002	<0.002
	NPDESMETAL		<0.002	0.0029	<0.002	<0.002
	NPDESMETAL	11/8	<0.002	0.0052	0.0058	0.0026
Barium	NPDESDISS	1/20	0.077	0.11	0.093	0.11
	NPDESMETAL		0.082	0.17	0.39	0.12
	NPDESDISS	1/26	—(b)	—(b)	—(b)	—(b)
	NPDESMETAL		—(b)	—(b)	—(b)	—(b)
	NPDESDISS	2/8	0.071	0.086	0.064	0.059
	NPDESMETAL		0.11	0.21	0.11	0.076
	NPDESDISS	4/8	0.057	0.13	0.07	0.09
	NPDESMETAL		0.078	0.16	0.098	0.072
	NPDESMETAL	11/8	0.047	0.16	0.4	0.096

Table 7-5. Metals detected in storm water runoff, Livermore site, 1999 (continued).

Parameter (mg/L)	Requested analysis	Storm date	Arroyo Las Positas			
			Site influent			Site effluent
			ALPE	ALPO	GRNE	WPDC
Beryllium	NPDESDISS	1/20	<0.0002	<0.0002	<0.0002	<0.0002
	NPDESMETAL		<0.0002	<0.0002	0.00074	<0.0002
	NPDESDISS	1/26	—(b)	—(b)	—(b)	—(b)
	NPDESMETAL		—(b)	—(b)	—(b)	—(b)
	NPDESDISS	2/8	<0.0002	<0.0002	<0.0002	<0.0002
	NPDESMETAL		<0.0002	0.00033	<0.0002	<0.0002
	NPDESDISS	4/8	<0.0002	<0.0002	<0.0002	<0.0002
	NPDESMETAL		<0.0002	0.0002	<0.0002	<0.0002
	NPDESMETAL	11/8	<0.0002	<0.0002	0.0008	<0.0002
Boron	NPDESDISS	1/20	21	5.3	0.29	2
	NPDESMETAL		20	5	0.28	2
	NPDESDISS	1/26	—(b)	—(b)	—(b)	—(b)
	NPDESMETAL		—(b)	—(b)	—(b)	—(b)
	NPDESDISS	2/8	12	4.6	0.23	0.63
	NPDESMETAL		12	4.4	0.24	0.6
	NPDESDISS	4/8	2.8	0.18	0.2	0.21
	NPDESMETAL		2.8	0.17	0.18	0.22
	NPDESMETAL	11/8	0.3	2.5	0.24	0.27
Cadmium	NPDESDISS	1/20	<0.0005	<0.0005	<0.0005	<0.0005
	NPDESMETAL		<0.0005	<0.0005	<0.0005	<0.0005
	NPDESDISS	1/26	—(b)	—(b)	—(b)	—(b)
	NPDESMETAL		—(b)	—(b)	—(b)	—(b)
	NPDESDISS	2/8	<0.0005	<0.0005	<0.0005	<0.0005
	NPDESMETAL		<0.0005	<0.0005	<0.0005	<0.0005
	NPDESDISS	4/8	<0.0005	<0.0005	<0.0005	<0.0005
	NPDESMETAL		<0.0005	<0.0005	<0.0005	<0.0005
	NPDESMETAL	11/8	<0.0005	<0.0005	<0.0005	<0.0005
Chromium	NPDESDISS	1/20	<0.001	<0.001	0.0016	0.0022
	NPDESMETAL		0.0017	0.0095	0.041	0.0056
	NPDESDISS	1/26	—(b)	—(b)	—(b)	—(b)
	NPDESMETAL		—(b)	—(b)	—(b)	—(b)
	NPDESDISS	2/8	<0.001	<0.001	<0.001	0.0023
	NPDESMETAL		0.011	0.018	0.011	0.012
	NPDESDISS	4/8	<0.001	<0.001	<0.001	0.0022
	NPDESMETAL		0.007	0.017	0.0066	0.0087
	NPDESMETAL	11/8	0.0057	0.011	0.055	0.013

Table 7-5. Metals detected in storm water runoff, Livermore site, 1999 (continued).

Parameter (mg/L)	Requested analysis	Storm date	Arroyo Las Positas			
			Site influent			Site effluent
			ALPE	ALPO	GRNE	WPDC
Copper	GENMIN	1/20	0.026	0.026	0.033	0.011
	GENMINDISS		<0.01	<0.01	<0.01	<0.01
	NPDESDISS		0.0063	0.005	0.0033	0.0037
	NPDESMETAL		0.0056	0.011	0.019	0.005
	GENMIN	1/26	—(b)	—(b)	—(b)	—(b)
	GENMINDISS		—(b)	—(b)	—(b)	—(b)
	NPDESDISS		—(b)	—(b)	—(b)	—(b)
	NPDESMETAL		—(b)	—(b)	—(b)	—(b)
	GENMIN	2/8	0.015	0.025	<0.01	0.022
	GENMINDISS		0.016	0.015	<0.01	<0.01
	NPDESDISS		<0.001	<0.001	<0.001	<0.001
	NPDESMETAL		0.016	0.026	0.0056	0.0098
	GENMIN	4/8	0.016	0.02	0.01	0.017
	GENMINDISS		<0.01	<0.01	<0.01	<0.01
	NPDESDISS		0.008	0.0029	0.0023	0.0054
	NPDESMETAL		0.0092	0.012	0.0058	0.009
	GENMIN	11/8	0.019	0.017	0.039	0.015
	NPDESMETAL		0.011	0.017	0.028	0.014
Chromium(VI)	NPDESDISS	1/20	<0.01	<0.002	0.0027	0.0027
	NPDESDISS	1/26	—(b)	—(b)	—(b)	—(b)
	NPDESDISS	2/8	0.002	<0.002	0.002	0.004
	NPDESDISS	4/8	<0.002	<0.002	<0.002	<0.002
	NPDESMETAL	11/8	<0.002	<0.002	<0.002	<0.002
Iron	GENMIN	1/20	0.61	5.2	25	1.4
	GENMINDISS		0.11	<0.05	0.17	0.065
	NPDESDISS		0.11	<0.05	0.15	0.066
	NPDESMETAL		0.59	5.2	26	1.4
	GENMIN	1/26	—(b)	—(b)	—(b)	—(b)
	GENMINDISS		—(b)	—(b)	—(b)	—(b)
	NPDESDISS		—(b)	—(b)	—(b)	—(b)
	NPDESMETAL		—(b)	—(b)	—(b)	—(b)
	GENMIN	2/8	5.4	11	4.7	4
	GENMINDISS		0.25	<0.05	0.16	0.18
	NPDESDISS		0.27	<0.05	0.14	0.25
	NPDESMETAL		5.6	11	5.2	3.9

Table 7-5. Metals detected in storm water runoff, Livermore site, 1999 (continued).

Parameter (mg/L)	Requested analysis	Storm date	Arroyo Las Positas			
			Site influent			Site effluent
			ALPE	ALPO	GRNE	WPDC
Iron (continued)	GENMIN	4/8	3	12	3.7	4.8
	GENMINDISS		0.21	0.12	0.14	0.17
	NPDESDISS		0.1	0.095	0.11	0.16
	NPDESMETAL		2.8	9.9	4.6	4.1
	GENMIN	11/8	2.4	5.9	28	4.5
	NPDESMETAL		2.4	5.3	25	4.6
Lead	NPDESDISS	1/20	<0.005	<0.005	<0.005	<0.005
	NPDESMETAL		<0.005	<0.005	0.0093	<0.005
	NPDESDISS	1/26	—(b)	—(b)	—(b)	—(b)
	NPDESMETAL		—(b)	—(b)	—(b)	—(b)
	NPDESDISS	2/8	<0.005	<0.005	<0.005	<0.005
	NPDESMETAL		<0.005	0.0066	<0.005	<0.005
	NPDESDISS	4/8	<0.005	<0.005	<0.005	<0.005
	NPDESMETAL		<0.005	<0.005	<0.005	<0.005
	NPDESMETAL	11/8	<0.005	0.0066	0.0077	<0.005
Magnesium	GENMIN	1/20	55	29	12	18
	GENMINDISS		57	28	5.6	18
	GENMIN	1/26	—(b)	—(b)	—(b)	—(b)
	GENMINDISS		—(b)	—(b)	—(b)	—(b)
	GENMIN	2/8	33	30	5.3	8.2
	GENMINDISS		34	28	4.2	7.2
	GENMIN	4/8	11	7.3	4.6	5.6
	GENMINDISS		10	4	3.8	4.2
	GENMIN	11/8	2.9	21	13	6.8
Manganese	GENMIN	1/20	0.054	0.15	0.39	0.028
	GENMINDISS		0.027	<0.01	<0.01	<0.01
	NPDESDISS		0.027	<0.01	<0.01	<0.01
	NPDESMETAL		0.054	0.15	0.4	0.028
	GENMIN	1/26	—(b)	—(b)	—(b)	—(b)
	GENMINDISS		—(b)	—(b)	—(b)	—(b)
	NPDESDISS		—(b)	—(b)	—(b)	—(b)
	NPDESMETAL		—(b)	—(b)	—(b)	—(b)
	GENMIN	2/8	0.1	0.3	0.071	0.07
	GENMINDISS		0.012	<0.01	<0.01	<0.01
	NPDESDISS		0.018	<0.01	<0.01	<0.01

Table 7-5. Metals detected in storm water runoff, Livermore site, 1999 (continued).

Parameter (mg/L)	Requested analysis	Storm date	Arroyo Las Positas			
			Site influent			Site effluent
			ALPE	ALPO	GRNE	WPDC
Manganese (continued)	NPDESMETAL		0.1	0.29	0.076	0.065
	GENMIN	4/8	0.063	0.21	0.062	0.1
	GENMINDISS		0.043	<0.01	0.01	<0.01
	NPDESDISS		0.013	<0.01	<0.01	<0.01
	NPDESMETAL		0.058	0.18	0.078	0.078
	GENMIN	11/8	0.12	0.26	0.41	0.11
	NPDESMETAL		0.12	0.25	0.36	0.11
Mercury	NPDESDISS	1/20	<0.0002	<0.0002	<0.0002	<0.0002
	NPDESMETAL		<0.0002	<0.0002	<0.0002	<0.0002
	NPDESDISS	1/26	—(b)	—(b)	—(b)	—(b)
	NPDESMETAL		—(b)	—(b)	—(b)	—(b)
	NPDESDISS	2/8	<0.0002	<0.0002	<0.0002	<0.0002
	NPDESMETAL		<0.0002	<0.0002	<0.0002	<0.0002
	NPDESDISS	4/8	<0.0002	<0.0002	<0.0002	<0.0002
	NPDESMETAL		<0.0002	<0.0002	<0.0002	<0.0002
	NPDESMETAL	11/8	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	NPDESDISS	1/20	<0.025	<0.025	<0.025	<0.025
	NPDESMETAL		<0.025	<0.025	<0.025	<0.025
	NPDESDISS	1/26	—(b)	—(b)	—(b)	—(b)
	NPDESMETAL		—(b)	—(b)	—(b)	—(b)
	NPDESDISS	2/8	<0.025	<0.025	<0.025	<0.025
	NPDESMETAL		<0.025	<0.025	<0.025	<0.025
	NPDESDISS	4/8	<0.025	<0.025	<0.025	<0.025
	NPDESMETAL		<0.025	<0.025	<0.025	<0.025
	NPDESMETAL	11/8	<0.025	<0.025	<0.025	<0.025
Nickel	GENMIN	1/20	<0.05	<0.05	<0.05	<0.05
	GENMINDISS		<0.05	<0.05	<0.05	<0.05
	NPDESDISS		0.0087	0.0039	0.0029	0.0033
	NPDESMETAL		0.01	0.011	0.039	0.006
	GENMIN	1/26	—(b)	—(b)	—(b)	—(b)
	GENMINDISS		—(b)	—(b)	—(b)	—(b)
	NPDESDISS		—(b)	—(b)	—(b)	—(b)
	NPDESMETAL		—(b)	—(b)	—(b)	—(b)
	GENMIN	2/8	<0.05	<0.05	<0.05	<0.05

Table 7-5. Metals detected in storm water runoff, Livermore site, 1999 (continued).

Parameter (mg/L)	Requested analysis	Storm date	Arroyo Las Positas			
			Site influent			Site effluent
			ALPE	ALPO	GRNE	WPDC
Nickel (continued)	GENMINDISS		<0.05	<0.05	<0.05	<0.05
	NPDESDISS		0.0062	0.0032	0.0024	0.0026
	NPDESMETAL		0.016	0.017	0.0083	0.0071
	GENMIN	4/8	<0.05	<0.05	<0.05	<0.05
	GENMINDISS		<0.05	<0.05	<0.05	<0.05
	NPDESDISS		0.0041	<0.002	<0.002	<0.002
	NPDESMETAL		0.01	0.019	0.0078	0.0087
	GENMIN	11/8	<0.05	<0.05	0.05	<0.05
	NPDESMETAL		0.01	0.014	0.038	0.014
Vanadium	NPDESDISS	1/20	0.01	0.015	<0.01	<0.01
	NPDESMETAL		0.01	0.023	0.058	<0.01
	NPDESDISS	1/26	—(b)	—(b)	—(b)	—(b)
	NPDESMETAL		—(b)	—(b)	—(b)	—(b)
	NPDESDISS	2/8	<0.01	0.013	<0.01	<0.01
	NPDESMETAL		0.016	0.035	0.013	0.012
	NPDESDISS	4/8	<0.01	<0.01	<0.01	<0.01
	NPDESMETAL		<0.01	0.02	0.012	0.011
	NPDESMETAL	11/8	<0.01	0.018	0.058	0.014
Zinc	GENMIN	1/20	<0.01	0.031	0.17	0.084
	GENMINDISS		0.012	<0.01	0.014	0.055
	NPDESDISS		<0.02	<0.02	<0.02	0.058
	NPDESMETAL		<0.02	0.034	0.17	0.087
	GENMIN	1/26	—(b)	—(b)	—(b)	—(b)
	GENMINDISS		—(b)	—(b)	—(b)	—(b)
	NPDESDISS		—(b)	—(b)	—(b)	—(b)
	NPDESMETAL		—(b)	—(b)	—(b)	—(b)
	GENMIN	2/8	0.021	0.047	0.083	0.086
	GENMINDISS		0.016	<0.01	0.028	0.018
	NPDESDISS		<0.02	<0.02	0.037	0.022
	NPDESMETAL		0.023	0.048	0.084	0.071
	GENMIN	4/8	0.033	0.096	0.07	0.13
	GENMINDISS		0.076	0.021	0.044	0.043
	NPDESDISS		0.022	0.02	0.034	0.046
	NPDESMETAL		0.03	0.088	0.079	0.097
	GENMIN	11/8	0.13	0.13	0.29	0.28
	NPDESMETAL		0.16	0.17	0.24	0.29

Table 7-5. Metals detected in storm water runoff, Livermore site, 1999 (continued).

Parameter (mg/L)	Requested analysis	Storm date	Drainage retention basin		
			DRB influent		DRB effluent
			CDB	CDB2	CDBX
Aluminum	GENMIN	1/20	3.1	—[a]	2.2
	GENMINDISS		0.11	—[a]	<0.05
	NPDESDISS		0.12	—[a]	<0.05
	NPDESMETAL		2.8	—[a]	1.8
	GENMIN	1/26	—[b]	4.8	—[b]
	GENMINDISS		—[b]	0.22	—[b]
	NPDESDISS		—[b]	0.26	—[b]
	NPDESMETAL		—[b]	4.5	—[b]
	GENMIN	2/8	6	3.6	17
	GENMINDISS		0.55	0.11	<0.05
	NPDESDISS		0.52	0.19	<0.05
	NPDESMETAL		6	3.4	11
	GENMIN	4/8	3.4	7.4	0.34
	GENMINDISS		0.23	0.19	<0.05
	NPDESDISS		0.24	0.31	<0.05
	NPDESMETAL		3.3	6.7	0.27
	GENMIN	11/8	1.5	7.5	1.5
	NPDESMETAL		1.4	8.1	1.5
Arsenic	NPDESDISS	1/20	0.0053	—[a]	0.0034
	NPDESMETAL		0.004	—[a]	0.0028
	NPDESDISS	1/26	—[b]	<0.002	—[b]
	NPDESMETAL		—[b]	<0.004	—[b]
	NPDESDISS	2/8	<0.002	0.0023	<0.002
	NPDESMETAL		0.0022	0.0039	0.0029
	NPDESDISS	4/8	<0.002	0.0027	<0.002
	NPDESMETAL		0.0022	0.0041	<0.002
	NPDESMETAL	11/8	<0.002	0.011	0.0043
Barium	NPDESDISS	1/20	0.11	—[a]	0.098
	NPDESMETAL		0.14	—[a]	0.12
	NPDESDISS	1/26	—[b]	0.057	—[b]
	NPDESMETAL		—[b]	0.088	—[b]
	NPDESDISS	2/8	0.14	0.089	0.11
	NPDESMETAL		0.12	0.12	0.23
	NPDESDISS	4/8	0.1	0.086	0.095
	NPDESMETAL		0.085	0.1	0.098
	NPDESMETAL	11/8	0.042	0.11	0.13

Table 7-5. Metals detected in storm water runoff, Livermore site, 1999 (continued).

Parameter (mg/L)	Requested analysis	Storm date	Drainage retention basin		
			DRB influent		DRB effluent
			CDB	CDB2	CDBX
Beryllium	NPDESDISS	1/20	<0.0002	—[a]	<0.0002
	NPDESMETAL		<0.0002	—[a]	<0.0002
	NPDESDISS	1/26	—[b]	<0.0002	—[b]
	NPDESMETAL		—[b]	<0.0002	—[b]
	NPDESDISS	2/8	<0.0002	<0.0002	<0.0002
	NPDESMETAL		<0.0002	<0.0002	0.00028
	NPDESDISS	4/8	<0.0002	<0.0002	<0.0002
	NPDESMETAL		<0.0002	<0.0002	<0.0002
	NPDESMETAL	11/8	<0.0002	0.00021	<0.0002
Boron	NPDESDISS	1/20	10	—[a]	1.8
	NPDESMETAL		10	—[a]	1.8
	NPDESDISS	1/26	—[b]	2.6	—[b]
	NPDESMETAL		—[b]	2.8	—[b]
	NPDESDISS	2/8	0.086	7.6	1.8
	NPDESMETAL		0.1	10	1.7
	NPDESDISS	4/8	0.071	0.81	1.9
	NPDESMETAL		0.079	0.8	1.9
	NPDESMETAL	11/8	0.082	0.21	1.6
Cadmium	NPDESDISS	1/20	<0.0005	—[a]	<0.0005
	NPDESMETAL		<0.0005	—[a]	<0.0005
	NPDESDISS	1/26	—[b]	<0.0005	—[b]
	NPDESMETAL		—[b]	<0.0005	—[b]
	NPDESDISS	2/8	<0.0005	<0.0005	<0.0005
	NPDESMETAL		<0.0005	<0.0005	<0.0005
	NPDESDISS	4/8	<0.0005	<0.0005	<0.0005
	NPDESMETAL		<0.0005	<0.0005	<0.0005
	NPDESMETAL	11/8	<0.0005	0.00065	<0.0005
Chromium	NPDESDISS	1/20	0.001	—[a]	0.0044
	NPDESMETAL		0.006	—[a]	0.01
	NPDESDISS	1/26	—[b]	0.0012	—[b]
	NPDESMETAL		—[b]	0.012	—[b]
	NPDESDISS	2/8	<0.001	<0.001	0.0048
	NPDESMETAL		0.016	0.0084	0.03
	NPDESDISS	4/8	0.0018	0.001	0.0078
	NPDESMETAL		0.0078	0.016	0.0085
	NPDESMETAL	11/8	0.004	0.023	0.0068

Table 7-5. Metals detected in storm water runoff, Livermore site, 1999 (continued).

Parameter (mg/L)	Requested analysis	Storm date	Drainage retention basin		
			DRB influent		DRB effluent
			CDB	CDB2	CDBX
Copper	GENMIN	1/20	0.02	—[a]	0.014
	GENMINDISS		<0.01	—[a]	<0.01
	NPDESDISS		0.0063	—[a]	0.0026
	NPDESMETAL		0.0078	—[a]	0.0042
	GENMIN	1/26	—[b]	<0.01	—[b]
	GENMINDISS		—[b]	<0.01	—[b]
	NPDESDISS		—[b]	0.0051	—[b]
	NPDESMETAL		—[b]	0.011	—[b]
	GENMIN	2/8	0.012	0.019	0.038
	GENMINDISS		<0.01	0.01	0.01
	NPDESDISS		<0.001	<0.001	<0.001
	NPDESMETAL		0.0094	0.012	0.019
	GENMIN	4/8	0.02	0.019	0.013
	GENMINDISS		<0.01	<0.01	0.015
	NPDESDISS		0.0052	0.0066	0.0079
	NPDESMETAL		0.0085	0.016	0.0027
	GENMIN	11/8	0.022	0.035	0.016
	NPDESMETAL		0.0096	0.027	0.0066
Chromium(VI)	NPDESDISS	1/20	<0.02	—[a]	0.005
	NPDESDISS	1/26	—[b]	0.006	—[b]
	NPDESDISS	2/8	<0.002	<0.002	0.0053
	NPDESDISS	4/8	<0.002	<0.002	0.007
	NPDESMETAL	11/8	<0.002	<0.002	<0.002
Iron	GENMIN	1/20	2.8	—[a]	2
	GENMINDISS		0.17	—[a]	<0.05
	NPDESDISS		0.17	—[a]	<0.05
	NPDESMETAL		2.7	—[a]	1.9
	GENMIN	1/26	—[b]	4.8	—[b]
	GENMINDISS		—[b]	0.21	—[b]
	NPDESDISS		—[b]	0.23	—[b]
	NPDESMETAL		—[b]	4.7	—[b]
	GENMIN	2/8	6.6	3.6	20
	GENMINDISS		0.42	0.16	<0.05
	NPDESDISS		0.42	0.21	<0.05
	NPDESMETAL		6.3	3.4	12
	GENMIN	4/8	3.9	7.9	0.4

Table 7-5. Metals detected in storm water runoff, Livermore site, 1999 (continued).

Parameter (mg/L)	Requested analysis	Storm date	Drainage retention basin		
			DRB influent		DRB effluent
			CDB	CDB2	CDBX
Iron (continued)	GENMINDISS		0.19	0.17	<0.05
	NPDESDISS		0.18	0.26	<0.05
	NPDESMETAL		3.6	7.6	0.33
	GENMIN	11/8	1.7	8.3	1.5
	NPDESMETAL		1.7	8.7	1.4
Lead	NPDESDISS	1/20	<0.005	—[a]	<0.005
	NPDESMETAL		<0.005	—[a]	<0.005
	NPDESDISS	1/26	—[b]	<0.005	—[b]
	NPDESMETAL		—[b]	0.0091	—[b]
	NPDESDISS	2/8	<0.005	<0.005	<0.005
	NPDESMETAL		<0.005	<0.005	0.0079
	NPDESDISS	4/8	<0.005	<0.005	<0.005
	NPDESMETAL		<0.005	0.0067	<0.005
	NPDESMETAL	11/8	0.0052	0.0086	<0.005
Magnesium	GENMIN	1/20	29	—[a]	23
	GENMINDISS		29	—[a]	23
	GENMIN	1/26	—[b]	10	—[b]
	GENMINDISS		—[b]	9.1	—[b]
	GENMIN	2/8	6.7	28	30
	GENMINDISS		4.7	28	25
	GENMIN	4/8	5	5.6	30
	GENMINDISS		3.9	3.5	31
	GENMIN	11/8	2.6	5	30
Manganese	GENMIN	1/20	0.073	—[a]	0.048
	GENMINDISS		0.013	—[a]	<0.01
	NPDESDISS		0.014	—[a]	<0.01
	NPDESMETAL		0.072	—[a]	0.046
	GENMIN	1/26	—[b]	0.083	—[b]
	GENMINDISS		—[b]	<0.01	—[b]
	NPDESDISS		—[b]	0.01	—[b]
	NPDESMETAL		—[b]	0.082	—[b]
	GENMIN	2/8	0.14	0.089	0.68
	GENMINDISS		<0.01	0.012	<0.01
	NPDESDISS		<0.01	<0.01	<0.01
	NPDESMETAL		0.13	0.083	0.48
	GENMIN	4/8	0.085	0.14	0.034

Table 7-5. Metals detected in storm water runoff, Livermore site, 1999 (continued).

Parameter (mg/L)	Requested analysis	Storm date	Drainage retention basin		
			DRB influent		DRB effluent
			CDB	CDB2	CDBX
Manganese	GENMINDISS		0.018	<0.01	<0.01
(continued)	NPDESDISS		0.018	<0.01	<0.01
	NPDESMETAL		0.079	0.14	0.029
	GENMIN	11/8	0.073	0.24	0.049
	NPDESMETAL		0.068	0.25	0.049
Mercury	NPDESDISS	1/20	<0.0002	—[a]	<0.0002
	NPDESMETAL		<0.0002	—[a]	<0.0002
	NPDESDISS	1/26	—[b]	<0.0002	—[b]
	NPDESMETAL		—[b]	<0.0002	—[b]
	NPDESDISS	2/8	<0.0002	<0.0002	<0.0002
	NPDESMETAL		<0.0002	<0.0002	0.00043
	NPDESDISS	4/8	<0.0002	<0.0002	<0.0002
	NPDESMETAL		<0.0002	<0.0002	<0.0002
	NPDESMETAL	11/8	<0.0002	<0.0002	<0.0002
Molybdenum	NPDESDISS	1/20	<0.025	—[a]	<0.025
	NPDESMETAL		<0.025	—[a]	<0.025
	NPDESDISS	1/26	—[b]	<0.025	—[b]
	NPDESMETAL		—[b]	<0.025	—[b]
	NPDESDISS	2/8	<0.025	<0.025	<0.025
	NPDESMETAL		<0.025	<0.025	<0.025
	NPDESDISS	4/8	<0.025	<0.025	<0.025
	NPDESMETAL		<0.025	<0.025	<0.025
	NPDESMETAL	11/8	<0.025	<0.025	<0.025
Nickel	GENMIN	1/20	0.05	—[a]	<0.05
	GENMINDISS		<0.05	—[a]	<0.05
	NPDESDISS		0.0068	—[a]	<0.002
	NPDESMETAL		0.013	—[a]	0.0065
	GENMIN	1/26	—[b]	<0.05	—[b]
	GENMINDISS		—[b]	<0.05	—[b]
	NPDESDISS		—[b]	0.0036	—[b]
	NPDESMETAL		—[b]	0.014	—[b]
	GENMIN	2/8	<0.05	<0.05	0.051
	GENMINDISS		<0.05	<0.05	<0.05
	NPDESDISS		0.0024	0.0057	<0.002
	NPDESMETAL		0.016	0.012	0.028
	GENMIN	4/8	<0.05	<0.05	<0.05

Table 7-5. Metals detected in storm water runoff, Livermore site, 1999 (continued).

Parameter (mg/L)	Requested analysis	Storm date	Drainage retention basin		
			DRB influent		DRB effluent
			CDB	CDB2	CDBX
Nickel (continued)	GENMINDISS		<0.05	<0.05	<0.05
	NPDESDISS		<0.002	0.0025	<0.002
	NPDESMETAL		0.011	0.02	0.0023
	GENMIN	11/8	<0.05	<0.05	<0.05
	NPDESMETAL		0.0083	0.026	0.0065
Vanadium	NPDESDISS	1/20	<0.01	—[a]	<0.01
	NPDESMETAL		0.011	—[a]	<0.01
	NPDESDISS	1/26	—[b]	<0.01	—[b]
	NPDESMETAL		—[b]	<0.01	—[b]
	NPDESDISS	2/8	<0.01	<0.01	<0.01
	NPDESMETAL		0.014	0.012	0.028
	NPDESDISS	4/8	<0.01	<0.01	<0.01
	NPDESMETAL		<0.01	0.016	<0.01
	NPDESMETAL	11/8	<0.01	0.021	0.012
Zinc	GENMIN	1/20	0.045	—[a]	0.026
	GENMINDISS		0.031	—[a]	<0.01
	NPDESDISS		0.03	—[a]	<0.02
	NPDESMETAL		0.046	—[a]	0.026
	GENMIN	1/26	—[b]	0.13	—[b]
	GENMINDISS		—[b]	0.048	—[b]
	NPDESDISS		—[b]	0.046	—[b]
	NPDESMETAL		—[b]	0.12	—[b]
	GENMIN	2/8	0.16	0.064	0.27
	GENMINDISS		0.064	0.034	<0.01
	NPDESDISS		0.07	0.033	<0.02
	NPDESMETAL		0.15	0.05	0.2
	GENMIN	4/8	0.12	0.096	0.018
	GENMINDISS		0.052	0.032	<0.01
	NPDESDISS		0.054	0.033	<0.02
	NPDESMETAL		0.11	0.099	<0.02
	GENMIN	11/8	0.23	0.21	0.07
	NPDESMETAL		0.24	0.22	0.11

[a] Sample not collected because there was no flow.

[b] Locations sampled on 1/20 were not sampled again on 1/26.

Table 7-6. Nonradioactive constituents (other than metals) detected in storm water runoff, Livermore site, 1999.

Parameter	Storm Date	Arroyo Seco		Arroyo Las Positas				Drainage Retention Basin		
		Site influent	Site effluent	Site influent			Site effluent	Site influent		Site effluent
		ASS2	ASW	ALPE	ALPO	GRNE	WPDC	CDB	CDB2	CDBX
Physical (mg/L)										
Chemical oxygen demand	1/20	—[a]	—[a]	169	61	<20	30	108	—[a]	24
	1/26	<4	33	—[b]	—[b]	—[b]	—[b]	—[b]	46	—[b]
	2/8	27	33	104	64	<20	79	54	116	71
	4/8	33	50	85	43	28	40	50	84	43
	11/8	—[a]	64	79	56	53	64	61	126	37
Total suspended solids (TSS)	1/20	—[a]	—[a]	7.8	91	206	40	44	—[a]	55
	1/26	21	56	—[b]	—[b]	—[b]	—[b]	—[b]	66	—[b]
	2/8	47	53	95	240	66	52	87	62	169
	4/8	34	16	64	219	35	84	48	72	57
	11/8	—[a]	38	29	139	213	94	24	144	28
Anions (mg/L)										
Bromide	1/20	—[a]	—[a]	0.38	0.61	0.07	0.31	0.32	—[a]	0.41
	1/26	<0.1	<0.1	—[b]	—[b]	—[b]	—[b]	—[b]	0.28	—[b]
	2/8	<0.1	<0.1	0.62	0.9	<0.05	0.1	<0.05	0.46	0.42
	4/8	<0.1	0.16	0.19	0.22	0.11	<0.1	<0.1	<0.1	0.5
	11/8	—[a]	<0.1	<0.1	0.96	0.14	<0.1	<0.1	<0.1	0.51
Chloride	1/20	—[a]	—[a]	550	251	7.2	114	279	—[a]	130
	1/26	2.7	2.6	—[b]	—[b]	—[b]	—[b]	—[b]	85	—[b]
	2/8	26	23	310	223	5.2	30	11	304	138
	4/8	1.5	1.3	89	12	5.2	12	8.3	15	76
	11/8	—[a]	2.7	4.2	180	13	19	4.9	6.5	146
Fluoride	1/20	—[a]	—[a]	1.2	0.92	0.38	0.38	0.57	—[a]	0.38
	1/26	<0.05	<0.05	—[b]	—[b]	—[b]	—[b]	—[b]	0.26	—[b]
	2/8	0.12	0.1	0.97	0.88	0.17	0.17	0.09	0.92	0.38
	4/8	<0.05	<0.05	0.29	0.1	0.11	0.07	0.07	0.12	0.4
	11/8	—[a]	0.06	0.08	0.66	0.27	0.11	0.06	0.07	0.35
Nitrate (as N)	1/20	—[a]	—[a]	0.2	2.6	6.8	2.2	0.63	—[a]	2.2
	1/26	0.14	0.26	—[b]	—[b]	—[b]	—[b]	—[b]	0.38	—[b]
	2/8	0.56	0.62	0.27	2.6	3.8	1.1	0.94	0.24	2.6
	4/8	0.7	0.51	0.45	5.2	3.9	0.91	0.76	0.6	2.6
	11/8	—[a]	1.1	0.75	1.7	6.2	1	0.69	1.1	2

Table 7-6. Nonradioactive constituents (other than metals) detected in storm water runoff, Livermore site, 1999 (continued).

Parameter	Storm Date	Arroyo Seco		Arroyo Las Positas				Drainage Retention Basin		
		Site influent	Site effluent	Site influent			Site effluent	Site influent		Site effluent
		ASS2	ASW	ALPE	ALPO	GRNE	WPDC	CDB	CDB2	CDBX
Anions (mg/L) (continued)										
Nitrate (as NO_3)	1/20	—[a]	—[a]	0.89	12	30	9.7	2.8	—[a]	9.7
	1/26	0.62	1.1	—[b]	—[b]	—[b]	—[b]	—[b]	1.7	—[b]
	2/8	2.5	2.7	1.2	11	17	4.9	4.1	1.1	11
	4/8	3.1	2.3	2	23	17	4.1	3.4	2.7	11
	11/8	—[a]	4.9	3.3	7.7	27	4.6	3.1	4.8	9
Nitrite (as N)	1/20	—[a]	—[a]	<0.02	0.06	0.03	0.02	0.03	—[a]	<0.02
	1/26	<0.02	<0.02	—[b]	—[b]	—[b]	—[b]	—[b]	<0.02	—[b]
	2/8	<0.02	0.02	<0.02	0.03	<0.02	<0.02	<0.02	<0.02	<0.02
	4/8	<0.02	<0.02	0.03	0.02	0.02	0.03	<0.02	0.02	<0.02
	11/8	—[a]	0.05	0.07	0.08	0.06	0.02	<0.02	0.03	0.02
Nitrite (as NO_2)	1/20	—[a]	—[a]	<0.07	0.18	0.1	0.07	0.1	—[a]	<0.07
	1/26	<0.07	<0.07	—[b]	—[b]	—[b]	—[b]	—[b]	<0.07	—[b]
	2/8	<0.07	0.07	<0.07	0.11	<0.07	<0.07	<0.07	<0.07	<0.07
	4/8	<0.07	<0.07	0.09	0.07	0.07	0.11	<0.07	0.07	<0.07
	11/8	—[a]	0.15	0.24	0.28	0.2	0.07	<0.07	0.11	0.07
Orthophosphate	1/20	—[a]	—[a]	4.6	1.1	0.33	0.35	2.5	—[a]	0.15
	1/26	0.21	0.33	—[b]	—[b]	—[b]	—[b]	—[b]	0.64	—[b]
	2/8	0.43	0.47	3.1	0.92	0.44	0.39	0.18	2.9	0.14
	4/8	0.94	0.49	0.81	0.39	0.33	0.2	0.4	0.35	0.11
	11/8	—[a]	0.75	0.64	0.39	0.7	0.42	1	1.2	0.3
Sulfate	1/20	—[a]	—[a]	692	232	10	104	358	—[a]	61
	1/26	1.7	1.7	—[b]	—[b]	—[b]	—[b]	—[b]	78	—[b]
	2/8	40	37	349	212	6.6	22	3.8	323	62
	4/8	3	1.8	69	8.3	3.2	6.2	2.6	9.6	26
	11/8	—[a]	2.9	7.8	187	8.1	11	2.1	6.1	51
General minerals (mg/L)										
Bicarbonate alkalinity (as $CaCO_3$)	1/20	—[a]	—[a]	342	190	59	129	190	—[a]	139
	1/26	16	19	—[b]	—[b]	—[b]	—[b]	—[b]	80	—[b]
	2/8	57	56	281	197	55	66	43	257	173
	4/8	14	14	93	25	34	43	32	37	153
	11/8	—[a]	36	43	146	43	72	25	42	177

Table 7-6. Nonradioactive constituents (other than metals) detected in storm water runoff, Livermore site, 1999 (continued).

Parameter	Storm Date	Arroyo Seco		Arroyo Las Positas				Drainage Retention Basin		
		Site influent	Site effluent	Site influent			Site effluent	Site influent		Site effluent
		ASS2	ASW	ALPE	ALPO	GRNE	WPDC	CDB	CDB2	CDBX
General minerals (mg/L) (continued)										
Carbonate alkalinity (as $CaCO_3$)	1/20	—[a]	—[a]	<5	<5	<5	<5	<5	—[a]	25
	1/26	<1	<1	—[b]	—[b]	—[b]	—[b]	—[b]	<5	—[b]
	2/8	<5	<5	<5	<5	<5	<5	<5	<5	<5
	4/8	<5	<5	<5	<5	<5	<5	<5	<5	38
	11/8	—[a]	<5	<5	<5	<5	<5	<5	<5	<5
Herbicides (µg/L)										
Atrazine	1/20	—[a]	—[a]	<0.2	<0.2	0.26	<0.2	<0.2	—[a]	<0.2
	1/26	<0.2	<0.2	—[b]	—[b]	—[b]	—[b]	—[b]	<0.2	—[b]
	2/8	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Bromacil	1/20	—[a]	—[a]	<0.5	<0.5	<0.5	<0.5	<0.5	—[a]	<0.5
	1/26	<0.5	<0.5	—[b]	—[b]	—[b]	—[b]	—[b]	<0.5	—[b]
	2/8	2.7	2.2	<0.5	35	<0.5	270	20	5	6
	4/8	<0.5	<0.5	4.2	400	330	3.6	2.5	5.5	4.4
	11/8	—[a]	<0.5	1.9	<5	16	2.2	<5	<5	<5
Glyphosate	1/20	—[a]	—[a]	<9	10	<9	<9	<9	—[a]	<9
	1/26	<9	<9	—[b]	—[b]	—[b]	—[b]	—[b]	16	—[b]
	2/8	<9	<9	<9	<9	<9	<9	<9	<9	<9
	4/8	12	14	51	16	<20	<9	24	16	<9
	11/8	—[a]	57	94	95	100	99	11	100	100
Diuron	1/20	—[a]	—[a]	<1	190	11	63	6.9	—[a]	5.2
	1/26	<1	1.6	—[b]	—[b]	—[b]	—[b]	—[b]	7.5	—[b]
	2/8	<1	<1	<1	34	100	6.3	5.5	2.3	2.1
	4/8	<1	<1	<2	11	12	<1	<1	1.6	<1
	11/8	—[a]	<2	<2	<2	2.8	<1	<1	<2	<2
Simazine	1/20	—[a]	—[a]	<0.2	<0.2	0.97	<0.2	<0.2	—[a]	<0.2
	1/26	<0.2	<0.2	—[b]	—[b]	—[b]	—[b]	—[b]	<0.2	—[b]
	2/8	0.39	0.2	<0.2	0.39	1.3	<0.2	<0.2	<0.2	<0.2
	4/8	0.21	<0.2	<0.2	0.77	1.1	<0.2	<0.2	<0.2	<0.2
	11/8	—[a]	<0.2	<0.3	<2	0.34	<0.3	<2	<2	<2

Table 7-6. Nonradioactive constituents (other than metals) detected in storm water runoff, Livermore site, 1999 (concluded).

Parameter	Storm Date	Arroyo Seco		Arroyo Las Positas				Drainage Retention Basin		
		Site influent	Site effluent	Site influent			Site effluent	Site influent		Site effluent
		ASS2	ASW	ALPE	ALPO	GRNE	WPDC	CDB	CDB2	CDBX
Semivolatile organic compounds (µg/L)										
Anthracene	11/8	—[a]	0.11	<0.2	<1	<0.1	<0.1	<1	<1	<1
Benzo(*a*)pyrene	11/8	—[a]	<0.1	<0.2	<1	0.23	0.24	<1	<1	<1
Benzo(*b*)fluoranthene	11/8	—[a]	<0.3	<0.5	<3	<0.4	0.44	<3	<3	<3
Butylbenzylphthalate	11/8	—[a]	<1	4.2	<10	3.1	<1	<10	<10	<10
Di (2-ethylhexyl) adipate	11/8	—[a]	<1	2.7	<10	1.9	<1	<10	<10	<10
Diazinon	4/8	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	11/8	—[a]	0.26	<0.3	<2	4.8	<0.3	<2	<2	<2
Dibutylphthalate	11/8	—[a]	<1	<0.2	<10	<1	<1	<10	<10	<10
Diethylhexylphthalate	11/8	—[a]	<3	9.6	<30	5.6	5.4	<30	<30	<30
Polychlorinated biphenyls (µg/L)										
PCB 1260	1/20	—[b]	—[b]	—[b]	—[b]	—[b]	<0.2	—[b]	—[a]	<0.2
	1/26	—[b]	—[b]	—[b]	—[b]	—[b]	—[b]	—[b]	<0.3	—[b]
	2/8	—[b]	—[b]	—[b]	—[b]	—[b]	<0.2	0.24	<0.2	<0.2
Total PCBs	1/20	—[b]	—[b]	—[b]	—[b]	—[b]	<0.2	—[b]	—[b]	<0.2
	1/26	—[b]	—[b]	—[b]	—[b]	—[b]	—[b]	—[b]	<0.3	—[b]
	2/8	—[b]	—[b]	—[b]	—[b]	—[b]	<0.2	0.24	<0.2	<0.2
Miscellaneous organics (mg/L)										
Oil and grease	1/20	—[a]	—[a]	1.1	<1	<1	<1	1.1	—[a]	1.1
	1/26	<1	2.2	—[b]	—[b]	—[b]	—[b]	—[b]	3.4	—[b]
	2/8	2.7	<1	1.2	1.1	<1	<1	2.1	1.6	<1
	4/8	2.1	<1	2.4	2.2	1.1	<1	<1	1.6	<1
	11/8	—[a]	1.4	110	1.9	1.9	<1	<1	1.2	1.9
Total organic carbon (TOC)	1/20	—[a]	—[a]	60	14	4.7	8.5	34	—[a]	5.2
	1/26	4.6	6.4	—[b]	—[b]	—[b]	—[b]	—[b]	12	—[b]
	2/8	6	6.1	28	9.1	4.1	4.5	10	20	4.4
	4/8	6.2	6.7	20	3.5	4	6.2	8.4	12	3.5
	11/8	—[a]	20	24	11	13	17	22	31	8.8

[a] Sample not collected because there was no flow.

[b] Not sampled (because, in most cases, locations sampled on 1/20 were not sampled again on 1/26).

Table 7-7. Number of nondetects in storm water runoff, Livermore site, 1999.

Parameter	Number of nondetects (total analyses)	Number of samples taken	Highest reported detection limit
Anions (mg/L)			
Bromide	15	34	<0.1
Fluoride	12	96	<0.05
Nitrate (as N)	1	96	<0.1
Nitrate (as NO_3)	1	96	<0.4
Nitrite (as N)	37	96	<0.02
Nitrite (as NO_2)	17	35	<0.07
Sulfate	2	97	<1
Wet Chemistry			
Carbonate alkalinity (as $CaCO_3$)	78	88	<5
Chemical oxygen demand	3	34	<20
Hydroxide alkalinity (as $CaCO_3$)	61	61	<5
TOX	11	11	<20
Herbicides (µg/L)			
Atrazine	33	34	<2
Bromacil	18	34	<5
Butachlor	26	26	<0.3
Diazinon	32	34	<2
Dimethoate	34	34	<20
Diuron	18	34	<2
Glyphosate	18	34	<20
Metolachlor	34	34	<5
Metribuzin	34	34	<5
Molinate	34	34	<5
Prometryn	35	35	<5
Propachlor	27	27	<0.5
Simazine	26	35	<2
Thiobencarb	35	35	<5
Volatile organic compounds (µg/L)			
1,1,1-Trichloroethane	9	9	<0.5
1,1,2,2-Tetrachloroethane	9	9	<0.5
1,1,2-Trichloroethane	9	9	<0.5
1,1-Dichloroethane	9	9	<0.5
1,2-Dichlorobenzene	11	11	<3
1,2-Dichloroethane	9	9	<0.5

Table 7-7. Number of nondetects in storm water runoff, Livermore site, 1999 (continued).

Parameter	Number of nondetects (total analyses)	Number of samples taken	Highest reported detection limit
Volatile organic compounds (µg/L) (continued)			
1,2-Dichloroethene (total)	9	9	<1
1,2-Dichloropropane	9	9	<0.5
1,3-Dichlorobenzene	11	11	<3
1,4-Dichlorobenzene	11	11	<3
2-Butanone	2	2	<20
2-Chloroethylvinylether	2	2	<5
2-Hexanone	2	2	<20
4-Methyl-2-pentanone	2	2	<20
Acenaphthylene	10	10	<3
Acetone	2	2	<20
Alachlor	8	8	<2
Aldrin	13	13	<5
Anthracene	9	10	<3
Atraton	8	8	<5
Benzene	2	2	<0.5
Benzo(a)anthracene	10	10	<3
Benzo(a)pyrene	6	8	<1
Benzo(b)fluoranthene	7	8	<3
Benzo(g,h,i)perylene	10	10	<3
Benzo(k)fluoranthene	10	10	<3
Bromodichloromethane	9	9	<0.5
Bromoform	9	9	<0.5
Bromomethane	9	9	<0.5
Butylbenzylphthalate	8	10	<10
Carbon disulfide	2	2	<5
Carbon tetrachloride	9	9	<0.5
Chlordane	11	11	<20
Chlorobenzene	9	9	<0.5
Chloroethane	9	9	<1
Chloroform	9	9	<0.5
Chloromethane	9	9	<1
Chrysene	10	10	<3

Table 7-7. Number of nondetects in storm water runoff, Livermore site, 1999 (continued).

Parameter	Number of nondetects (total analyses)	Number of samples taken	Highest reported detection limit
Volatile organic compounds (µg/L) (continued)			
cis-1,2-Dichloroethene	9	9	<0.5
cis-1,3-Dichloropropene	9	9	<0.5
Di(2-ethylhexyl) adipate	6	8	<10
Dibenzo(a,h)anthracene	10	10	<4
Dibromochloromethane	9	9	<0.5
Dibromomethane	1	1	<0.5
Dibutylphthalate	10	10	<10
Dichlorodifluoromethane	9	9	<0.5
Diethylhexylphthalate	5	8	<30
Diethylphthalate	10	10	<30
Dimethylphthalate	10	10	<10
Endrin	13	13	<3
Ethanol	1	1	<1000
Ethylbenzene	2	2	<0.5
Fluorene	10	10	<3
Freon 113	8	9	<0.5
Heptachlor	13	13	<3
Heptachlor epoxide	13	13	<3
Hexachlorobenzene	10	10	<5
Hexachlorocyclopentadiene	10	10	<10
Indeno(1,2,3-c,d)pyrene	10	10	<3
Methoxychlor	11	11	<5
Methylene chloride	8	9	<1
Naphthalene	3	3	<3
Pentachlorophenol	10	10	<20
Phenanthrene	10	10	<3
Prometon	8	8	<5
Pyrene	10	10	<3
Secbumeton	8	8	<5
Styrene	2	2	<0.5
Terbutryn	8	8	<5
Tetrachloroethene	9	9	<0.5

Table 7-7. Number of nondetects in storm water runoff, Livermore site, 1999 (continued).

Parameter	Number of nondetects (total analyses)	Number of samples taken	Highest reported detection limit
Volatile organic compounds (µg/L) (continued)			
Toluene	2	2	<0.5
Total Trihalomethanes	7	7	<2
Total xylene isomers	2	2	<1
trans-1,2-Dichloroethene	9	9	<0.5
trans-1,3-Dichloropropene	10	10	<0.5
Trichloroethene	9	9	<0.5
Trichlorofluoromethane	10	10	<0.5
Vinyl chloride	9	9	<0.5
Pesticides (µg/L)			
Dieldrin	5	5	<4
Endosulfan I	5	5	<20
Endosulfan II	5	5	<20
Endosulfan sulfate	5	5	<4
Endrin aldehyde	5	5	<3
p,p'-DDD	5	5	<3
p,p'-DDE	5	5	<4
p,p'-DDT	5	5	<3
PCB 1016	17	17	<0.3
PCB 1221	17	17	<0.3
PCB 1232	17	17	<0.3
PCB 1242	17	17	<0.3
PCB 1248	17	17	<0.3
PCB 1260	16	17	<0.2
Total PCBs	9	10	<0.3
Toxaphene	3	3	<0.3
Semivolatile organic compounds (µg/L)			
1,2,3,7,8-PeCDD	1	1	<3.2
1,2,4-Trichlorobenzene	2	2	<3
1,2-Diphenylhydrazine	2	2	<3
2,3,7,8-TCDD	1	1	<1.6
2,4,5-Trichlorophenol	2	2	<7
2,4,6-Trichlorophenol	2	2	<7

Table 7-7. Number of nondetects in storm water runoff, Livermore site, 1999 (continued).

Parameter	Number of nondetects (total analyses)	Number of samples taken	Highest reported detection limit
Semiolatile organic compounds (µg/L) (continued)			
2,4-Dichlorophenol	2	2	<3
2,4-Dimethylphenol	2	2	<3
2,4-Dinitrophenol	2	2	<20
2,4-Dinitrotoluene	2	2	<3
2,6-Dinitrotoluene	2	2	<3
2-Chloronaphthalene	2	2	<3
2-Chlorophenol	2	2	<3
2-Methyl-4,6-dinitrophenol	2	2	<20
2-Methylnaphthalene	2	2	<3
2-Naphthylamine	2	2	<30
2-Nitroaniline	2	2	<3
2-Nitrophenol	2	2	<3
3,3-Dichlorobenzidine	2	2	<7
3-Nitroaniline	2	2	<3
4-Bromophenylphenylether	2	2	<3
4-Chloro-3-methylphenol	2	2	<7
4-Chloroaniline	2	2	<3
4-Chlorophenylphenylether	2	2	<3
4-Nitroaniline	2	2	<7
4-Nitrophenol	2	2	<7
Acenaphthene	2	2	<3
Aniline	2	2	<7
Benzidine	2	2	<30
Benzo(a)pyrene	2	2	<3
Benzo(b)fluoranthene	2	2	<3
Benzoic Acid	2	2	<20
Benzyl Alcohol	2	2	<3
Bis(2-chloroethoxy)methane	2	2	<3
Bis(2-chloroethyl)ether	2	2	<3
Bis(2-chloroisopropyl)ether	2	2	<3
Bis(2-ethylhexyl)phthalate	2	2	<7
Di-n-octylphthalate	2	2	<3
Dibenzofuran	2	2	<3
Fluoranthene	2	2	<3
Hexachlorobutadiene	2	2	<3
Hexachloroethane	2	2	<3

Table 7-7. Number of nondetects in storm water runoff, Livermore site, 1999 (concluded).

Parameter	Number of nondetects (total analyses)	Number of samples taken	Highest reported detection limit
Semiolatile organic compounds (µg/L) (continued)			
Isophorone	2	2	<3
N-Nitrosodi-n-propylamine	2	2	<3
N-Nitrosodimethylamine	2	2	<3
N-Nitrosodiphenylamine	2	2	<3
Nitrobenzene	2	2	<3
o-Cresol	2	2	<3
Oil and Grease	14	35	<1
p-Cresol	2	2	<3
Pentachlorinated dibenzo-p-dioxins	1	1	<3.2
Phenol	2	2	<3
Tetrachlorinated dibenzo-p-dioxins	1	1	<1.6
Metals (mg/L)			
Aluminum	14	126	<0.05
Antimony	63	63	<0.004
Arsenic	33	63	<0.002
Barium	1	63	<0.025
Beryllium	58	65	<0.0002
Boron	6	63	<0.05
Cadmium	62	63	<0.0005
Chromium	16	63	<0.001
Cobalt	63	63	<0.05
Copper	35	125	<0.01
Chromium(VI)	24	36	<0.02
Iron	10	125	<0.05
Lead	10	63	<0.005
Manganese	41	125	<0.01
Mercury	64	65	<0.0002
Molybdenum	62	63	<0.025
Nickel	70	125	<0.05
Potassium	1	64	<1
Selenium	64	64	<0.002
Silver	64	64	<0.001
Surfactants	29	62	<0.1
Thallium	64	64	<0.001
Vanadium	40	64	<0.01
Zinc	18	126	<0.02

Table 7-8. Radioactivity in storm water runoff, Site 300, 1999.

Parameter (Bq/L)	Sampling Date	Upstream location CARW	Effluent locations N883	Effluent locations NLIN
Gross alpha	2/9	$3.89 \times 10^{-1} \pm 2.15 \times 10^{-1}$	$1.36 \times 10^{-2} \pm 2.22 \times 10^{-2}$	$2.34 \times 10^{-1} \pm 5.55 \times 10^{-2}$
	4/8	3.67 ± 1.12	$2.46 \times 10^{-2} \pm 2.36 \times 10^{-2}$	—[a]
Gross beta	2/9	$6.25 \times 10^{-1} \pm 3.48 \times 10^{-1}$	$4.63 \times 10^{-2} \pm 7.77 \times 10^{-2}$	$4.77 \times 10^{-1} \pm 8.88 \times 10^{-2}$
	4/8	$5.11 \pm 8.18 \times 10^{-1}$	$1.52 \times 10^{-1} \pm 4.14 \times 10^{-2}$	—[a]
Tritium	2/9	-4.51 ± 1.56	-5.07 ± 1.51	-3.15 ± 1.64
	4/8	$-7.70 \times 10^{-1} \pm 2.47 \times 10$	$5.48 \times 10^{-1} \pm 2.55$	—[a]
Uranium 234+233	2/9	$3.26 \times 10^{-1} \pm 4.07 \times 10^{-2}$	$6.66 \times 10^{-4} \pm 9.62 \times 10^{-4}$	$6.33 \times 10^{-2} \pm 1.07 \times 10^{-2}$
	4/8	$1.75 \times 10^{-1} \pm 3.02 \times 10^{-2}$	$9.14 \times 10^{-4} \pm 1.20 \times 10^{-3}$	—[a]
Uranium-235+236	2/9	$1.81 \times 10^{-2} \pm 4.81 \times 10^{-3}$	$1.18 \times 10^{-3} \pm 9.99 \times 10^{-4}$	$2.96 \times 10^{-3} \pm 2.26 \times 10^{-3}$
	4/8	$1.22 \times 10^{-2} \pm 4.00 \times 10^{-3}$	$3.16 \times 10^{-4} \pm 8.66 \times 10^{-4}$	—[a]
Uranium-238	2/9	$3.11 \times 10^{-1} \pm 4.07 \times 10^{-2}$	$2.22 \times 10^{-3} \pm 1.30 \times 10^{-3}$	$9.77 \times 10^{-2} \pm 1.48 \times 10^{-2}$
	4/8	$1.71 \times 10^{-1} \pm 2.95 \times 10^{-2}$	$1.51 \times 10^{-3} \pm 1.34 \times 10^{-3}$	—[a]

Parameter (Bq/L)	Sampling Date	Effluent locations NPT6	Effluent locations NPT7	Downstream location GEOCRK
Gross alpha	2/9	$1.55 \times 10^{-1} \pm 4.44 \times 10^{-2}$	$8.10 \times 10^{-2} \pm 4.44 \times 10^{-2}$	$3.70 \times 10^{-1} \pm 2.04 \times 10^{-1}$
	4/8	$1.45 \times 10^{-1} \pm 8.92 \times 10^{-2}$	$1.30 \times 10^{-1} \pm 6.07 \times 10^{-2}$	$4.85 \times 10^{-2} \pm 6.03 \times 10^{-2}$
Gross beta	2/9	$4.74 \times 10^{-1} \pm 8.14 \times 10^{-2}$	$1.02 \times 10^{-1} \pm 8.51 \times 10^{-2}$	$3.52 \times 10^{-1} \pm 2.59 \times 10^{-1}$
	4/8	$3.59 \times 10^{-1} \pm 6.70 \times 10^{-2}$	$2.87 \times 10^{-1} \pm 5.74 \times 10^{-2}$	$3.62 \times 10^{-1} \pm 1.11 \times 10^{-1}$
Tritium	2/9	-5.55 ± 1.49	-4.63 ± 1.56	-3.92 ± 1.60
	4/8	1.58 ± 2.56	$-2.86 \times 10^{-1} \pm 2.48$	$6.73 \times 10^{-1} \pm 2.53$
Uranium 234+233	2/9	$1.81 \times 10^{-2} \pm 4.44 \times 10^{-3}$	$3.07 \times 10^{-2} \pm 7.03 \times 10^{-3}$	$8.21 \times 10^{-2} \pm 1.37 \times 10^{-2}$
	4/8	$1.64 \times 10^{-2} \pm 4.55 \times 10^{-3}$	$2.85 \times 10^{-3} \pm 1.44 \times 10^{-3}$	$7.29 \times 10^{-2} \pm 1.30 \times 10^{-2}$
Uranium-235+236	2/9	$1.11 \times 10^{-3} \pm 1.18 \times 10^{-3}$	$3.37 \times 10^{-3} \pm 2.44 \times 10^{-3}$	$4.77 \times 10^{-3} \pm 2.63 \times 10^{-3}$
	4/8	$9.36 \times 10^{-4} \pm 1.02 \times 10^{-3}$	$4.96 \times 10^{-4} \pm 6.36 \times 10^{-4}$	$3.38 \times 10^{-3} \pm 1.57 \times 10^{-3}$
Uranium-238	2/9	$1.74 \times 10^{-2} \pm 4.44 \times 10^{-3}$	$1.89 \times 10^{-2} \pm 5.18 \times 10^{-3}$	$6.99 \times 10^{-2} \pm 1.26 \times 10^{-2}$
	4/8	$1.64 \times 10^{-2} \pm 4.51 \times 10^{-3}$	$2.97 \times 10^{-3} \pm 1.44 \times 10^{-3}$	$6.03 \times 10^{-2} \pm 1.11 \times 10^{-2}$

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection.

[a] Sample not collected because there was no flow.

Table 7-9. Nonradioactive constituents in storm water runoff, Site 300, 1999.

Parameter	Sampling	Upstream location	Effluent location				Downstream location
	Date	CARW	N883	NLIN	NPT6	NPT7	GEOCRK
General minerals							
pH (pH units)	2/9	7.88	6.04	7.55	7.19	8.03	8.28
	4/8	7.66	6.1	—[a]	7.19	8.38	8.3
Specific conductance	2/9	1,120	15	319	69	172	1,670
(µmho/cm)	4/8	1,280	35	—[a]	200	93	1,610
Total suspended solids	2/9	25,000	350	2,220	512	64	362
(TSS) (mg/L)	4/8	1,230	58	—[a]	2,190	371	118
Miscellaneous organics							
Total organic carbon (TOC)	2/9	11	3.4	11	6.7	7.3	13
(mg/L)	4/8	7.5	13	—[a]	13	1.9	5.7
Total organic halides (TOX)	2/9	<20	<20	<20	<20	<20	<20
(µg/L)	4/8	<20	<20	—[a]	<20	<20	<20
Polychlorinated biphenyls (µg/L)							
PCB 1016	2/9	—[b]	—[b]	<0.2	—[b]	—[b]	—[b]
PCB 1221	2/9	—[b]	—[b]	<0.2	—[b]	—[b]	—[b]
PCB 1232	2/9	—[b]	—[b]	<0.2	—[b]	—[b]	—[b]
PCB 1242	2/9	—[b]	—[b]	<0.2	—[b]	—[b]	—[b]
PCB 1248	2/9	—[b]	—[b]	<0.2	—[b]	—[b]	—[b]
PCB 1254	2/9	—[b]	—[b]	<0.2	—[b]	—[b]	—[b]
PCB 1260	2/9	—[b]	—[b]	<0.2	—[b]	—[b]	—[b]
Total PCBs	2/9	—[b]	—[b]	<0.2	—[b]	—[b]	—[b]

a Not analyzed because there was no flow at this location.

b PCB analysis not conducted at this location.

Table 7-10. Dioxins in storm water runoff, Site 300, 1999.

Constituents (pg/L)	Sampled 2/9/99
Aldrin	<0.005
BHC, alpha isomer	<0.005
BHC, beta isomer	<0.005
BHC, delta isomer	<0.005
BHC, gamma isomer (Lindane)	<0.005
Chlordane	<0.2
Dieldrin	<0.005
Endosulfan I	<0.005
Endosulfan II	<0.005
Endosulfan sulfate	<0.005
Endrin	<0.005
Endrin aldehyde	<0.01
Heptachlor	<0.005
Heptachlor epoxide	<0.005
Methoxychlor	<0.005
p,p'-DDD	<0.005
p,p'-DDE	<0.005
p,p'-DDT	<0.005
Toxaphene	<0.2
1,2,3,4,6,7,8-HpCDD	280
1,2,3,4,6,7,8-HpCDF	59
1,2,3,4,6,7,8-OCDD	2800
1,2,3,4,6,7,8-OCDF	250
1,2,3,4,7,8,9-HpCDF	6.2
1,2,3,4,7,8-HxCDD	7
1,2,3,4,7,8-HxCDF	8.2
1,2,3,6,7,8-HxCDD	17
1,2,3,6,7,8-HxCDF	4.4
1,2,3,7,8,9-HxCDD	13
1,2,3,7,8,9-HxCDF	6.8
1,2,3,7,8-PeCDD	<3.2
1,2,3,7,8-PeCDF	4.4
2,3,4,6,7,8-HxCDF	7.6
2,3,4,7,8-PeCDF	8.7

Table 7-10. Dioxins in storm water runoff, Site 300, 1999 (concluded).

Constituents (pg/L)	Sampled 2/9/99
2,3,7,8-TCDD	<1.6
2,3,7,8-TCDF	15
Heptachlorinated dibenzo-furans	200
Heptachlorinated dibenzo-p-dioxins	450
Hexachlorinated dibenzo-furans	81
Hexachlorinated dibenzo-p-dioxins	91
Pentachlorinated dibenzo-furans	65
Pentachlorinated dibenzo-p-dioxins	<3.2
Tetrachlorinated dibenzo-furans	91
Tetrachlorinated dibenzo-p-dioxins	<1.6

Table 7-11. Pit 6 post-closure storm water monitoring, Site 300, 1999.

Parameters	Sampled 2/9/99	Sampled 4/8/99
Inorganics (mg/L)		
Beryllium	0.0011	<0.0002
Mercury	<0.0002	<0.0002
Potassium	—[a]	11
Total dissolved solids (TDS)	177	185
Volatile organic compounds (µg/L)		
1,1,1-Trichloroethane	<0.5	<0.5
1,1,2,2-Tetrachloroethane	<0.5	<0.5
1,1,2-Trichloroethane	<0.5	<0.5
1,1-Dichloroethane	<0.5	<0.5
1,1-Dichloroethene	<0.5	<0.5
1,2-Dichlorobenzene	<0.5	<0.5
1,2-Dichloroethane	<0.5	<0.5
1,2-Dichloroethene (total)	<1	<1
1,2-Dichloropropane	<0.5	<0.5
1,3-Dichlorobenzene	<0.5	<0.5
1,4-Dichlorobenzene	<0.5	<0.5
2-Butanone	<20	<20
2-Chloroethylvinylether	<5	<5
2-Hexanone	<20	<20
4-Methyl-2-pentanone	<20	<20
Acetone	<20	<20
Benzene	<0.5	<0.5
Bromodichloromethane	<0.5	<0.5
Bromoform	<0.5	<0.5
Bromomethane	<0.5	<0.5
Carbon disulfide	<5	<5
Carbon tetrachloride	<0.5	<0.5
Chlorobenzene	<0.5	<0.5
Chloroethane	<1	<1
Chloroform	<0.5	<0.5
Chloromethane	<1	<1
cis-1,2-Dichloroethene	<0.5	<0.5
cis-1,3-Dichloropropene	<0.5	<0.5
Dibromochloromethane	<0.5	<0.5
Dibromomethane	<0.5	<0.5
Dichlorodifluoromethane	<0.5	<0.5

Table 7-11. Pit 6 post-closure storm water monitoring, Site 300, 1999 (continued).

Parameters	Sampled 2/9/99	Sampled 4/8/99
Volatile organic compounds (µg/L) (continued)		
Ethanol	<1000	<1000
Ethylbenzene	<0.5	<0.5
Freon 113	0.63	<0.5
Methylene chloride	<1	1.8
Naphthalene	<0.5	<0.5
Styrene	<0.5	<0.5
Tetrachloroethene	<0.5	<0.5
Toluene	<0.5	<0.5
Total xylene isomers	<1	<1
trans-1,2-Dichloroethene	<0.5	<0.5
trans-1,3-Dichloropropene	<0.5	<0.5
Trichloroethene	<0.5	<0.5
Trichlorofluoromethane	<0.5	<0.5
Vinyl chloride	<0.5	<0.5
Semivolatile organic compounds (µg/L)		
1,2,4-Trichlorobenzene	<3	<3
1,2-Dichlorobenzene	<3	<3
1,2-Diphenylhydrazine	<3	<3
1,3-Dichlorobenzene	<3	<3
1,4-Dichlorobenzene	<3	<3
2,4,5-Trichlorophenol	<6	<7
2,4,6-Trichlorophenol	<6	<7
2,4-Dichlorophenol	<3	<3
2,4-Dimethylphenol	<3	<3
2,4-Dinitrophenol	<20	<20
2,4-Dinitrotoluene	<3	<3
2,6-Dinitrotoluene	<3	<3
2-Chloronaphthalene	<3	<3
2-Chlorophenol	<3	<3
2-Methyl-4,6-dinitrophenol	<20	<20
2-Methylnaphthalene	<3	<3
2-Naphthylamine	<30	<30
2-Nitroaniline	<3	<3
2-Nitrophenol	<3	<3
3,3-Dichlorobenzidine	<6	<7
3-Nitroaniline	<3	<3

Table 7-11. Pit 6 post-closure storm water monitoring, Site 300, 1999 (continued).

Parameters	Sampled 2/9/99	Sampled 4/8/99
Semivolatile organic compounds (µg/L) (continued)		
4-Bromophenylphenylether	<3	<3
4-Chloro-3-methylphenol	<6	<7
4-Chloroaniline	<3	<3
4-Chlorophenylphenylether	<3	<3
4-Nitroaniline	<6	<7
4-Nitrophenol	<6	<7
Acenaphthene	<3	<3
Acenaphthylene	<3	<3
Aldrin	<3	<3
Aniline	<6	<7
Anthracene	<3	<3
Benzidine	<30	<30
Benzo(a)anthracene	<3	<3
Benzo(a)pyrene	<3	<3
Benzo(b)fluoranthene	<3	<3
Benzo(g,h,i)perylene	<3	<3
Benzo(k)fluoranthene	<3	<3
Benzoic Acid	<20	<20
Benzyl Alcohol	<3	<3
BHC, alpha isomer	<3	<3
BHC, beta isomer	<3	<3
BHC, delta isomer	<3	<3
BHC, gamma isomer (Lindane)	<3	<3
Bis(2-chloroethoxy)methane	<3	<3
Bis(2-chloroethyl)ether	<3	<3
Bis(2-chloroisopropyl)ether	<3	<3
Bis(2-ethylhexyl)phthalate	<6	<7
Butylbenzylphthalate	<3	<3
Chrysene	<3	<3
Di-n-octylphthalate	<3	<3
Dibenzo(a,h)anthracene	<4	<4
Dibenzofuran	<3	<3
Dibutylphthalate	<3	<3
Dieldrin	<4	<4
Diethylphthalate	<3	<3
Dimethylphthalate	<3	<3

Table 7-11. Pit 6 post-closure storm water monitoring, Site 300, 1999 (continued).

Parameters	Sampled 2/9/99	Sampled 4/8/99
Semivolatile organic compounds (µg/L) (continued)		
Endosulfan I	<20	<20
Endosulfan II	<20	<20
Endosulfan sulfate	<4	<4
Endrin	<3	<3
Endrin aldehyde	<3	<3
Fluoranthene	<3	<3
Fluorene	<3	<3
Heptachlor	<3	<3
Heptachlor epoxide	<3	<3
Hexachlorobenzene	<3	<3
Hexachlorobutadiene	<3	<3
Hexachlorocyclopentadiene	<3	<3
Hexachloroethane	<3	<3
Indeno(1,2,3-c,d)pyrene	<3	<3
Isophorone	<3	<3
N-Nitrosodi-n-propylamine	<3	<3
N-Nitrosodimethylamine	<3	<3
N-Nitrosodiphenylamine	<3	<3
Naphthalene	<3	<3
Nitrobenzene	<3	<3
o-Cresol	<3	<3
p,p'-DDD	<3	<3
p,p'-DDE	<4	<4
p,p'-DDT	<3	<3
p-Cresol	<3	<3
Pentachlorophenol	<20	<20
Phenanthrene	<3	<3
Phenol	<3	<3
Pyrene	<3	<3
Pesticides (µg/L)		
Aldrin	<0.006	<0.006
BHC, alpha isomer	<0.006	<0.006
BHC, beta isomer	<0.006	<0.006
BHC, delta isomer	<0.006	<0.006
BHC, gamma isomer (Lindane)	<0.006	<0.006
Chlordane	<0.3	<0.3

Table 7-11. Pit 6 post-closure storm water monitoring, Site 300, 1999 (concluded).

Parameters	Sampled 2/9/99	Sampled 4/8/99
Pesticides (µg/L) (continued)		
Dieldrin	<0.006	<0.006
Endosulfan I	<0.006	<0.006
Endosulfan II	<0.006	<0.006
Endosulfan sulfate	<0.006	<0.006
Endrin	<0.006	<0.006
Endrin aldehyde	<0.02	<0.02
Heptachlor	<0.006	<0.006
Heptachlor epoxide	<0.006	<0.006
Methoxychlor	<0.006	<0.006
p,p'-DDD	<0.006	<0.006
p,p'-DDE	<0.006	<0.006
p,p'-DDT	<0.006	<0.006
PCB 1016	<0.3	<0.3
PCB 1221	<0.3	<0.3
PCB 1232	<0.3	<0.3
PCB 1242	<0.3	<0.3
PCB 1248	<0.3	<0.3
PCB 1254	<0.3	<0.3
PCB 1260	<0.3	<0.3
Total PCBs	<0.3	<0.3
Toxaphene	<0.006	<0.3

[a] Analyses not requested. See the main volume, **Table 14-4**.

Table 7-12. Tritium in rain (Bq/L), Livermore site and Livermore Valley, 1999.

Location	Sampling dates			
	1/21/99	2/10/99	3/23/99	4/9/99
Livermore site				
B343	220 ± 7	466 ± 10	540 ± 11	154 ± 6
B291	1.88 ± 2.40	18.4 ± 2.7	25.6 ± 3.0	2.66 ± 2.76
CDB	88.1 ± 4.7	303 ± 10	228 ± 7	20.0 ± 3.4
VIS	13.3 ± 2.8	72.2 ± 4.3	55.9 ± 4.0	5.11 ± 2.85
COW	8.51 ± 2.84	65.1 ± 4.2	48.5 ± 3.8	3.12 ± 2.77
SALV	8.92 ± 2.68	18.7 ± 2.7	19.4 ± 2.8	0.66 ± 2.68
MET	–5.11 ± 2.34	4.74 ± 2.16	8.73 ± 2.34	0.43 ± 2.68
Livermore Valley				
ESAN	–2.19 ± 2.26	9.55 ± 2.36	11.3 ± 2.5	–0.15 ± 2.67
ZON7	5.07 ± 2.53	60.7 ± 7.8	19.4 ± 2.8	2.49 ± 2.77
AQUE	—[a]	—[a]	16.7 ± 2.7	0.67 ± 2.70
SLST	–5.66 ± 2.09	2.56 ± 2.05	2.91 ± 2.04	0.01 ± 2.66
GTES	–5.29 ± 2.16	6.29 ± 2.25	6.55 ± 2.24	0.54 ± 2.69
VINE	–7.33 ± 2.00	0.95 ± 1.96	6.07 ± 2.23	–1.59 ± 2.60
BVA	–4.92 ± 2.12	8.84 ± 2.34	7.40 ± 2.28	–0.84 ± 2.64
VET	–6.99 ± 2.01	10.9 ± 2.4	8.18 ± 2.34	–1.91 ± 2.59

Note: Radioactivities are reported as the measured concentration and either an uncertainty (±2σ counting error) or as being less than the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection.

[a] Sample not collected at this location.

Table 7-13. Drainage Retention Basin discharge limits for CDBX, identified in CERCLA Record of Decision as amended, and sampling frequencies for CDBX and WPDC.

Parameter	CDBX	WPDC	Effluent discharge limits	
			Dry season Apr 1–Nov 30	Wet season Dec 1–Mar 31
Physical				
Specific conductance (µmho/cm)	A	A	Not applicable	Not applicable
pH (units)	A & B	A & B	6.5–8.5	6.5–8.5
Total suspended solids (mg/L)	A & B	A & B	Not applicable	Not applicable
Total dissolved solids (mg/L)	A	A	Not applicable	Not applicable
Toxicity				
Aquatic survival bioassay (96 hours)	A & B	A	Median of 90% survival and a 90 percentile value of not less than 70% survival for 96-hour bioassay.	Median of 90% survival and a 90 percentile value of not less than 70% survival for 96-hour bioassay.
Fish	A	A	Not applicable	Not applicable
Flea	A	A	Not applicable	Not applicable
Algae	A	A	Not applicable	Not applicable
General minerals (mg/L)				
Total alkalinity	A	–	Not applicable	Not applicable
Nitrate (as N)	A	–	Not applicable	Not applicable
Nitrite (as N)	A	–	Not applicable	Not applicable
Metals (µg/L)				
Antimony	A & B	A & B	6	Not applicable[a]
Arsenic	A & B	A & B	50	10
Beryllium	A & B	A & B	4	Not applicable[a]
Boron	A & B	A & B	Not applicable[b]	Not applicable[a]
Cadmium	A & B	A & B	5	2.2
Chromium (total)	A & B	A & B	50	Not applicable[a]
Chromium(VI)	A & B	A & B	Not applicable[b]	22
Copper	A & B	A & B	1300	23.6
Iron	A & B	A & B	Not applicable[b]	Not applicable[a]
Lead	A & B	A & B	15	6.4
Manganese	A & B	A & B	Not applicable[b]	Not applicable[a]
Mercury	A & B	A & B	2	2
Nickel	A & B	A & B	100	320
Selenium	A & B	A & B	50	10
Silver	A & B	A & B	100	8.2
Thallium	A & B	A & B	2	Not applicable[a]
Zinc	A & B	A & B	Not applicable[b]	220

Table 7-13. Drainage Retention Basin discharge limits for CDBX, identified in CERCLA ROD as amended, and sampling frequencies for CDBX and WPDC (concluded).

Parameter	CDBX	WPDC	Effluent discharge limits	
			Dry season Apr 1–Nov 30	Wet season Dec 1–Mar 31
Organics (µg/L)				
Herbicides (EPA 507, 547, 632)	A	—	Not applicable	Not applicable
Volatile organic compounds (EPA Method 601 only)				
Tetrachloroethene	—	—	4	4
Vinyl chloride	A	—	2	2
Chemical oxygen demand	A	—	Not applicable	Not applicable
Total organic carbon	A	—	Not applicable	Not applicable
Radioactivity (Bq/L)				
Alpha	A	—	0.56	0.56
Beta	A	—	1.85	1.85
Tritium	A	—	740	740

[a] No limit is established for aquatic life protection; however, aquatic life is protected by bioassay analysis.

[b] No MCL is established for this metal.

A = Monitoring occurs at the first DRB discharge of the wet season and at one or more additional discharges associated with storm water runoff monitoring. Toxicity testing is required only on the first release.

B = Monitoring occurs at each dry season release. For purposes of discharge sampling, the dry season is defined to occur from June 1 through September 30.

Table 7-14. Routine water quality management action levels and monitoring plan for the Drainage Retention Basin.

Constituent	Location	Sampling Frequency	Management action levels	
			Dry season Apr 1–Nov 30	Wet season Dec 1–Mar 31
Physical				
Dissolved oxygen (mg/L)	CDBA, CDBC, CDBD, CDBE, CDBF, CDFJ, CDBK, CDBL	Weekly	<80% saturation and <5 mg/L	<80% saturation and <5 mg/L
Temperature (°C)	CDBA, CDBC, CDBD, CDBE, CDBF, CDFJ, CDBK, CDBL	Weekly	<15.6 and >26.7	<15.6 and >26.7
Total alkalinity (as $CaCO_3$) (mg/L)	CDBE	Monthly	<50	<50
Chlorophyll-a (mg/L)	CDBE	Monthly	>10	>10
pH (pH units)	CDBE	Monthly	<6.0 and >9.0	<6.0 and >9.0
Total dissolved solids (mg/L)	CDBE	Monthly	>360	>360
Total suspended solids (mg/L)	CDBE	Monthly	Not applicable	Not applicable
Turbidity (m)	CDBE	Weekly	<0.91	<0.914
Chemical oxygen demand (mg/L)	CDBE	Quarterly	>20	>20
Oil and grease (mg/L)	CDBE	Quarterly	>15	>15
Specific Conductance (µmho/cm)	CDBE	Monthly	>900	>900
Nutrients (mg/L)				
Nitrate (as N)	CDBE	Monthly	>0.2	>0.2
Nitrite (as N)	CDBE	Monthly	>0.2	>0.2
Ammonia nitrogen	CDBE	Monthly	>0.1	>0.1
Phosphate (as P)	CDBE	Monthly	>0.02	>0.02
Microbiological (MPN[(a)]/100 mL)				
Total coliform	CDBE	Quarterly	>5000	>5000
Fecal coliform	CDBE	Quarterly	>400	>400
Metals (µg/L)				
Antimony	CDBE	Monthly	>6	Not applicable
Arsenic	CDBE	Monthly	>50	>10
Beryllium	CDBE	Monthly	>4	Not applicable
Boron	CDBE	Monthly	Not applicable	Not applicable
Cadmium	CDBE	Monthly	>5	>2.2
Chromium, total	CDBE	Monthly	>50	Not applicable
Chromium(VI)	CDBE	Monthly	Not applicable	>22
Copper	CDBE	Monthly	>1300	>23.6
Iron	CDBE	Monthly	Not applicable	Not applicable

Table 7-14. Routine water quality management action levels and monitoring plan for the Drainage Retention Basin (concluded).

Constituent	Location	Sampling Frequency	Management action levels	
			Dry season Apr 1–Nov 30	Wet season Dec 1–Mar 31
Metals (µg/L) (continued)				
Lead	CDBE	Monthly	>15	>6.4
Manganese	CDBE	Monthly	Not applicable	Not applicable
Mercury	CDBE	Monthly	>2	>2
Nickel	CDBE	Monthly	>100	>320
Selenium	CDBE	Monthly	>50	>10
Silver	CDBE	Monthly	>100	>8.2
Thallium	CDBE	Monthly	>2	Not applicable
Zinc	CDBE	Monthly	Not applicable	>220
Organics (µg/L)				
Total volatile organic compounds (EPA Method 601 only)	CDBE	Semiannually	>5	>5
Tetrachloroethene	CDBE	Semiannually	>4	>4
Vinyl chloride	CDBE	Semiannually	>2	>2
Herbicides	CDBE	Quarterly	Not applicable	Not applicable
Radiological (Bq/L)				
Gross alpha	CDBE	Semiannually	>0.555	>0.555
Gross beta	CDBE	Semiannually	>1.85	>1.85
Tritium	CDBE	Semiannually	>740	>740
Toxicity (% survival/96-hour)				
Aquatic bioassay, fathead minnow	CDBE	Annually	90% survival median, 90 percentile value of not less than 70% survival	90% survival median, 90 percentile value of not less than 70% survival
Chronic bioassay, fathead minnow	CDBE	Annually	Not applicable	Not applicable
Chronic bioassay, water flea	CDBE	Annually	Not applicable	Not applicable
Chronic bioassay, algae	CDBE	Annually	Not applicable	Not applicable

[a] Most probable number.

Table 7-15. Compliance monitoring data for releases from the Drainage Retention Basin, 1999.

Parameter	CDBX sampling dates							
	1/20/99	2/8/99	4/8/99	6/28/99	8/19/99	10/4/99	10/8/99	11/8/99
Biological								
Aquatic bioassay								
Pimephales promelas survival (percent survival)	na[a]	na	na	90	100	na	100	na
Pimephales promelas growth (toxic units)	na	na	na	na	na	na	<1	na
Pimephales promelas growth IC-25[b]	na	na	na	na	na	na	>100	na
Pimephales promelas growth IC-50[c]	na	na	na	na	na	na	>100	na
Pimephales promelas growth LOEC[d]	na	na	na	na	na	na	>100	na
Pimephales promelas growth NOEC[e]	na	na	na	na	na	na	>100	na
Pimephales promelas survival toxic units	na	na	na	na	na	na	<1	na
Pimephales promelas survival LC-50[f]	na	na	na	na	na	na	>100	na
Pimephales promelas survival LOEC	na	na	na	na	na	na	>100	na
Pimephales promelas survival NOEC	na	na	na	na	na	na	>100	na
Ceriodaphnia dubia growth (toxic unit)	na	na	na	na	na	na	<1	na
Ceriodaphnia dubia growth IC-25	na	na	na	na	na	na	>100	na
Ceriodaphnia dubia growth IC-50	na	na	na	na	na	na	>100	na
Ceriodaphnia dubia growth LOEC	na	na	na	na	na	na	>100	na
Ceriodaphnia dubia growth NOEC	na	na	na	na	na	na	>100	na
Ceriodaphnia dubia survival (toxic units)	na	na	na	na	na	na	<1	na
Ceriodaphnia dubia survival LC-50	na	na	na	na	na	na	>100	na
Ceriodaphnia dubia survival LOEC	na	na	na	na	na	na	>100	na
Ceriodaphnia dubia survival NOEC	na	na	na	na	na	na	>100	na
Selanastrum capriocomutum growth (toxic units)	na	na	na	na	na	na	>1	na
Selanastrum capriocomutum growth IC-25	na	na	na	na	na	na	56.6	na
Selanastrum capriocomutum growth IC-50	na	na	na	na	na	na	>100	na
Selanastrum capriocomutum growth LOEC	na	na	na	na	na	na	100	na
Selanastrum capriocomutum growth NOEC	na	na	na	na	na	na	<100	na

Table 7-15. Compliance monitoring data for releases from the Drainage Retention Basin, 1999 (continued).

Parameter	WPDC sampling dates							
	1/20/99	2/8/99	4/8/99	6/28/99	8/19/99	10/4/99	10/8/99	11/8/99
Biological (continued)								
Aquatic bioassay (continued)								
Pimephales promelas survival (percent survival)	100	na	na	90	100	na	90	na
Pimephales promelas growth (toxic units)	<1	na	na	na	na	na	na	na
Pimephales promelas growth IC-25[b]	>100	na	na	na	na	na	na	na
Pimephales promelas growth IC-50[c]	>100	na	na	na	na	na	na	na
Pimephales promelas growth LOEC[d]	>100	na	na	na	na	na	na	na
Pimephales promelas growth NOEC[e]	>100	na	na	na	na	na	na	na
Pimephales promelas survival (toxic units)	<1	na	na	na	na	na	na	na
Pimephales promelas survival LC-50[f]	>100	na	na	na	na	na	na	na
Pimephales promelas survival LOEC	>100	na	na	na	na	na	na	na
Pimephales promelas survival NOEC	>100	na	na	na	na	na	na	na
Ceriodaphnia dubia growth (toxic unit)	na	na	na	na	na	na	na	na
Ceriodaphnia dubia growth IC-25	na	na	na	na	na	na	na	na
Ceriodaphnia dubia growth IC-50	na	na	na	na	na	na	na	na
Ceriodaphnia dubia growth LOEC	na	na	na	na	na	na	na	na
Ceriodaphnia dubia growth NOEC	na	na	na	na	na	na	na	na
Ceriodaphnia dubia survival (toxic units)	na	na	na	na	na	na	na	na
Ceriodaphnia dubia survival LC-50	na	na	na	na	na	na	na	na
Ceriodaphnia dubia survival LOEC	na	na	na	na	na	na	na	na
Ceriodaphnia dubia survival NOEC	na	na	na	na	na	na	na	na
Selanastrum capriocomutum growth (toxic units)	na	na	na	na	na	na	na	na
Selanastrum capriocomutum growth IC-25	na	na	na	na	na	na	na	na
Selanastrum capriocomutum growth IC-50	na	na	na	na	na	na	na	na
Selanastrum capriocomutum growth LOEC	na	na	na	na	na	na	na	na
Selanastrum capriocomutum growth NOEC	na	na	na	na	na	na	na	na

Table 7-15. Compliance monitoring data for releases from the Drainage Retention Basin, 1999 (continued).

Parameter	CDBX sampling dates							
	1/20/99	2/8/99	4/8/99	6/28/99	8/19/99	10/4/99	10/8/99	11/8/99
Anions (mg/L)								
Bicarbonate alkalinity (as $CaCO_3$)	139	173	153	na	na	na	na	na
Bromide	0.41	0.42	0.5	na	na	na	na	0.51
Carbonate alkalinity (as $CaCO_3$)	25	<5	38	na	na	na	na	na
Chloride	130	138	76	na	na	na	na	146
Fluoride	0.38	0.38	0.4	na	na	na	na	0.35
Nitrate (as N)	2.2	2.6	2.6	na	na	na	na	2
Nitrate (as NO_3)	9.7	11	11	na	na	na	na	9
Nitrite (as N)	<0.02	<0.02	<0.02	na	na	na	na	0.02
Nitrite (as NO_2)	<0.07	<0.07	<0.07	na	na	na	na	0.07
Orthophosphate	0.15	0.14	0.11	na	na	na	na	na
Sulfate	61	62	26	na	na	na	na	51
Dissolved general minerals (mg/L)								
Aluminum	<0.05	<0.05	<0.05	na	na	na	na	na
Bicarbonate alkalinity (as $CaCO_3$)	141	166	151	na	na	na	na	na
Calcium	46	51	62	na	na	na	na	na
Carbonate alkalinity (as $CaCO_3$)	20	10	45	na	na	na	na	na
Chloride	128	138	157	na	na	na	na	na
Copper	<0.01	0.01	0.015	na	na	na	na	na
Fluoride	0.36	0.38	0.4	na	na	na	na	na
Hydroxide alkalinity (as $CaCO_3$)	<5	<5	<5	na	na	na	na	na
Iron	<0.05	<0.05	<0.05	na	na	na	na	na
Magnesium	23	25	31	na	na	na	na	na
Manganese	<0.01	<0.01	<0.01	na	na	na	na	na
Nickel	<0.05	<0.05	<0.05	na	na	na	na	na
Nitrate (as N)	2.2	2.6	3.3	na	na	na	na	na
Nitrate (as NO_3)	9.5	11	15	na	na	na	na	na
Nitrite (as N)	<0.02	0.03	<0.02	na	na	na	na	na
Orthophosphate	0.16	0.14	0.11	na	na	na	na	na
pH (pH units)	8.74	8.39	8.7	na	na	na	na	na
Potassium	2	2.1	2	na	na	na	na	na
Sodium	97	98	109	na	na	na	na	na
Specific conductance	832	900	1050	na	na	na	na	na
Sulfate	60	61	57	na	na	na	na	na
Surfactants	<0.1	<0.05	0.06	na	na	na	na	na

Table 7-15. Compliance monitoring data for releases from the Drainage Retention Basin, 1999 (continued).

Parameter	WPDC sampling dates							
	1/20/99	2/8/99	4/8/99	6/28/99	8/19/99	10/4/99	10/8/99	11/8/99
Anions (mg/L)								
Bicarbonate alkalinity (as $CaCO_3$)	129	66	43	na	na	na	na	na
Bromide	0.31	0.1	<0.1	na	na	na	na	<0.1
Carbonate alkalinity (as $CaCO_3$)	<5	<5	<5	na	na	na	na	na
Chloride	114	30	12	na	na	na	na	19
Fluoride	0.38	0.17	0.07	na	na	na	na	0.11
Nitrate (as N)	2.2	1.1	0.91	na	na	na	na	1
Nitrate (as NO3)	9.7	4.9	4.1	na	na	na	na	4.6
Nitrite (as N)	0.02	<0.02	0.03	na	na	na	na	0.02
Nitrite (as NO_2)	0.07	<0.07	0.11	na	na	na	na	0.07
Orthophosphate	0.35	0.39	0.2	na	na	na	na	na
Sulfate	104	22	6.2	na	na	na	na	11
Dissolved general minerals (mg/L)								
Aluminum	<0.05	0.21	0.19	na	na	na	na	na
Bicarbonate alkalinity (as $CaCO_3$)	134	73	42	na	na	na	na	na
Calcium	46	20	13	na	na	na	na	na
Carbonate alkalinity (as $CaCO_3$)	<5	<5	<5	na	na	na	na	na
Chloride	117	29	6.1	na	na	na	na	na
Copper	<0.01	<0.01	<0.01	na	na	na	na	na
Fluoride	0.38	0.17	0.08	na	na	na	na	na
Hydroxide alkalinity (as $CaCO_3$)	<5	<5	<5	na	na	na	na	na
Iron	0.065	0.18	0.17	na	na	na	na	na
Magnesium	18	7.2	4.2	na	na	na	na	na
Manganese	<0.01	<0.01	<0.01	na	na	na	na	na
Nickel	<0.05	<0.05	<0.05	na	na	na	na	na
Nitrate (as N)	2.2	1.3	1.4	na	na	na	na	na
Nitrate (as NO_3)	9.7	5.7	6.1	na	na	na	na	na
Nitrite (as N)	0.02	<0.02	0.02	na	na	na	na	na
Orthophosphate	0.48	0.33	0.2	na	na	na	na	na
pH (pH units)	8.07	8.17	7.34	na	na	na	na	na
Potassium	4.6	1.7	1.4	na	na	na	na	na
Sodium	96	32	14	na	na	na	na	na
Specific conductance	835	307	170	na	na	na	na	na
Sulfate	89	21	3.6	na	na	na	na	na
Surfactants	<0.1	<0.05	0.06	na	na	na	na	na

Table 7-15. Compliance monitoring data for releases from the Drainage Retention Basin, 1999 (continued).

Parameter	CDBX sampling dates							
	1/20/99	2/8/99	4/8/99	6/28/99	8/19/99	10/4/99	10/8/99	11/8/99
Dissolved general minerals (mg/L) (continued)								
Total alkalinity (as $CaCO_3$)	161	176	196	na	na	na	na	na
Total dissolved solids (TDS)	473	537	603	na	na	na	na	na
Total hardness (as $CaCO_3$)	210	230	282	na	na	na	na	na
Total phosphorus (as P)	0.16	0.64	0.12	na	na	na	na	na
Zinc	<0.01	<0.01	<0.01	na	na	na	na	na
Total general minerals (mg/L)								
Aluminum	2.2	17	0.34	na	na	0.78	na	1.5
Bicarbonate alkalinity (as $CaCO_3$)	135	173	152	na	na	179	na	177
Calcium	46	58	61	na	na	54	na	50
Carbonate alkalinity (as $CaCO_3$)	25	5	38	na	na	45	na	<5
Chloride	129	138	176	na	na	241	na	157
Copper	0.014	0.038	0.013	na	na	<0.01	na	0.016
Fluoride	0.36	0.4	0.41	na	na	0.52	na	0.35
Hydroxide alkalinity (as $CaCO_3$)	<5	<5	<5	na	na	<5	na	<5
Iron	2	20	0.4	na	na	0.65	na	1.5
Magnesium	23	30	30	na	na	39	na	30
Manganese	0.048	0.68	0.034	na	na	0.028	na	0.049
Nickel	<0.05	0.051	<0.05	na	na	<0.05	na	<0.05
Nitrate (as N)	2.2	2.6	3.3	na	na	1.2	na	2.2
Nitrate (as NO_3)	9.7	12	15	na	na	5.4	na	9.8
Nitrite (as N)	0.02	0.02	0.02	na	na	0.02	na	0.02
Orthophosphate	0.16	0.14	0.11	na	na	0.18	na	0.3
pH (pH units)	8.77	8.17	8.75	8.82	8.35	8.45	na	8.52
Potassium	2.5	4.4	2	na	na	2.6	na	2.7
Sodium	93	89	112	na	na	141	na	98
Specific conductance	835	901	1060	na	na	1210	na	963
Sulfate	60	61	69	na	na	82	na	57
Surfactants	<0.1	<0.05	0.06	na	na	0.07	na	0.06
Total alkalinity (as $CaCO_3$)	160	173	190	na	na	224	na	177
Total dissolved solids (TDS)	467	513	637	na	na	720	na	546
Total hardness (as $CaCO_3$)	210	268	276	na	na	295	na	248
Total phosphorus (as P)	0.17	0.61	0.1	na	na	0.12	na	0.19
Total suspended solids (TSS)	55	169	57	33	18	8	na	28
Zinc	0.026	0.27	0.018	<0.02	<0.02	<0.05	na	0.07

Table 7-15. Compliance monitoring data for releases from the Drainage Retention Basin, 1999 (continued).

Parameter	WPDC sampling dates							
	1/20/99	2/8/99	4/8/99	6/28/99	8/19/99	10/4/99	10/8/99	11/8/99
Dissolved general minerals (mg/L)								
Total alkalinity (as $CaCO_3$)	134	73	42	na	na	na	na	na
Total dissolved solids (TDS)	483	234	131	na	na	na	na	na
Total hardness (as $CaCO_3$)	189	80	50	na	na	na	na	na
Total phosphorus (as P)	0.24	0.18	0.25	na	na	na	na	na
Zinc	0.055	0.018	0.043	na	na	na	na	na
Total general minerals (mg/L)								
Aluminum	1.4	4.1	4.2	na	na	0.33	na	4.6
Bicarbonate alkalinity (as $CaCO_3$)	138	74	34	na	na	210	na	72
Calcium	48	20	17	na	na	54	na	18
Carbonate alkalinity (as $CaCO_3$)	<5	<5	<5	na	na	30	na	<5
Chloride	117	29	9.4	na	na	127	na	22
Copper	0.011	0.022	0.017	na	na	<0.01	na	0.015
Fluoride	0.37	0.17	0.08	na	na	0.53	na	0.12
Hydroxide alkalinity (as $CaCO_3$)	<5	<5	<5	na	na	<5	na	<5
Iron	1.4	4	4.8	na	na	0.37	na	4.5
Magnesium	18	8.2	5.6	na	na	25	na	6.8
Manganese	0.028	0.07	0.1	na	na	0.019	na	0.11
Nickel	<0.05	<0.05	<0.05	na	na	<0.05	na	<0.05
Nitrate (as N)	2.2	1.3	1.4	na	na	2.3	na	1.1
Nitrate (as NO_3)	9.7	5.7	6	na	na	10	na	4.9
Nitrite (as N)	0.02	0.02	0.03	na	na	0.02	na	0.02
Orthophosphate	0.48	0.32	0.23	na	na	0.19	na	0.42
pH (pH units)	8.06	7.88	7.39	8.9	8.72	8.4	na	7.7
Potassium	4.9	3.1	2.4	na	na	7	na	3.7
Sodium	94	32	14	na	na	122	na	18
Specific conductance	827	312	175	na	na	946	na	250
Sulfate	89	21	5.2	na	na	68	na	12
Surfactants	<0.1	<0.05	0.06	na	na	0.05	na	0.08
Total alkalinity (as $CaCO_3$)	138	74	34	na	na	240	na	72
Total dissolved solids (TDS)	497	220	129	na	na	583	na	182
Total hardness (as $CaCO_3$)	194	84	66	na	na	238	na	73
Total phosphorus (as P)	0.23	0.19	0.18	na	na	0.18	na	0.29
Total suspended solids (TSS)	40	52	84	26	85	21	na	94
Zinc	0.084	0.086	0.13	na	na	<0.05	na	0.28

Table 7-15. Compliance monitoring data for releases from the Drainage Retention Basin, 1999 (continued).

Parameter	CDBX sampling dates							
	1/20/99	2/8/99	4/8/99	6/28/99	8/19/99	10/4/99	10/8/99	11/8/99
Dissolved metals (mg/L)								
Aluminum	<0.05	<0.05	<0.05	na	na	na	na	na
Antimony	<0.004	<0.004	<0.004	na	na	na	na	na
Arsenic	0.0034	<0.002	<0.002	na	na	na	na	na
Barium	0.098	0.11	0.095	na	na	na	na	na
Beryllium	<0.0002	<0.0002	<0.0002	na	na	na	na	na
Boron	1.8	1.8	1.9	na	na	na	na	na
Cadmium	<0.0005	<0.0005	<0.0005	na	na	na	na	na
Chromium	0.0044	0.0048	0.0078	na	na	na	na	na
Cobalt	<0.05	<0.05	<0.05	na	na	na	na	na
Copper	0.0026	<0.001	0.0079	na	na	na	na	na
Chromium(VI)	0.005	0.0053	0.007	na	na	na	na	na
Iron	<0.05	<0.05	<0.05	na	na	na	na	na
Lead	<0.005	<0.005	<0.005	na	na	na	na	na
Manganese	<0.01	<0.01	<0.01	na	na	na	na	na
Mercury	<0.0002	<0.0002	<0.0002	na	na	na	na	na
Molybdenum	<0.025	<0.025	<0.025	na	na	na	na	na
Nickel	<0.002	<0.002	<0.002	na	na	na	na	na
Selenium	<0.002	<0.002	<0.002	na	na	na	na	na
Silver	<0.001	<0.001	<0.001	na	na	na	na	na
Thallium	<0.001	<0.001	<0.001	na	na	na	na	na
Vanadium	<0.01	<0.01	<0.01	na	na	na	na	na
Zinc	<0.02	<0.02	<0.02	na	na	na	na	na
Total metals (mg/L)								
Aluminum	1.8	11	0.27	1.6	1.6	0.74	na	1.5
Antimony	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	na	<0.004
Arsenic	0.0028	0.0029	<0.002	0.0042	0.004	0.0023	na	0.0043
Barium	0.12	0.23	0.098	0.14	0.15	0.18	na	0.13
Beryllium	<0.0002	0.00028	<0.0002	<0.0002	<0.0002	<0.0002	na	<0.0002
Boron	1.8	1.7	1.9	2.2	2.2	2.3	na	1.6
Cadmium	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	na	<0.0005
Chromium	0.01	0.03	0.0085	0.0085	0.0056	0.0024	na	0.0068
Cobalt	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	na	<0.05
Copper	0.0042	0.019	0.0027	0.007	0.0042	0.0017	na	0.0066
Chromium(VI)	na	na	na	0.014	0.0046	0.0031	na	<0.002
Iron	1.9	12	0.33	1.6	1.5	0.62	na	1.4

Table 7-15. Compliance monitoring data for releases from the Drainage Retention Basin, 1999 (continued).

Parameter	WPDC sampling dates							
	1/20/99	2/8/99	4/8/99	6/28/99	8/19/99	10/4/99	10/8/99	11/8/99
Dissolved metals (mg/L)								
Aluminum	<0.05	0.28	0.18	na	na	na	na	na
Antimony	<0.004	<0.004	<0.004	na	na	na	na	na
Arsenic	0.0063	<0.002	<0.002	na	na	na	na	na
Barium	0.11	0.059	0.09	na	na	na	na	na
Beryllium	<0.0002	<0.0002	<0.0002	na	na	na	na	na
Boron	2	0.63	0.21	na	na	na	na	na
Cadmium	<0.0005	<0.0005	<0.0005	na	na	na	na	na
Chromium	0.0022	0.0023	0.0022	na	na	na	na	na
Cobalt	<0.05	<0.05	<0.05	na	na	na	na	na
Copper	0.0037	<0.001	0.0054	na	na	na	na	na
Chromium(VI)	0.0027	0.004	<0.002	na	na	na	na	na
Iron	0.066	0.25	0.16	na	na	na	na	na
Lead	<0.005	<0.005	<0.005	na	na	na	na	na
Manganese	<0.01	<0.01	<0.01	na	na	na	na	na
Mercury	<0.0002	<0.0002	<0.0002	na	na	na	na	na
Molybdenum	<0.025	<0.025	<0.025	na	na	na	na	na
Nickel	0.0033	0.0026	<0.002	na	na	na	na	na
Selenium	<0.002	<0.002	<0.002	na	na	na	na	na
Silver	<0.001	<0.001	<0.001	na	na	na	na	na
Thallium	<0.001	<0.001	<0.001	na	na	na	na	na
Vanadium	<0.01	<0.01	<0.01	na	na	na	na	na
Zinc	0.058	0.022	0.046	na	na	na	na	na
Total metals (mg/L)								
Aluminum	1.4	3.9	3.7	0.2	0.2	0.34	na	4.5
Antimony	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	na	<0.004
Arsenic	0.0047	<0.002	<0.002	0.0022	0.0028	<0.002	na	0.0026
Barium	0.12	0.076	0.072	0.098	0.15	0.11	na	0.096
Beryllium	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	na	<0.0002
Boron	2	0.6	0.22	1.6	1.7	1.6	na	0.27
Cadmium	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	na	<0.0005
Chromium	0.0056	0.012	0.0087	0.013	0.018	0.0099	na	0.013
Cobalt	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	na	<0.05
Copper	0.005	0.0098	0.009	<0.005	0.0024	0.0036	na	0.014
Chromium(VI)	na	na	na	0.014	0.014	0.013	na	<0.002
Iron	1.4	3.9	4.1	0.24	0.31	0.38	na	4.6

Table 7-15. Compliance monitoring data for releases from the Drainage Retention Basin, 1999 (continued).

Parameter	CDBX sampling dates							
	1/20/99	2/8/99	4/8/99	6/28/99	8/19/99	10/4/99	10/8/99	11/8/99
Total metals (mg/L) (continued)								
Lead	<0.005	0.0079	<0.005	<0.005	<0.005	<0.005	na	<0.005
Manganese	0.046	0.48	0.029	0.11	0.11	0.028	na	0.049
Mercury	<0.0002	0.00043	<0.0002	<0.0002	<0.0002	<0.0002	na	<0.0002
Molybdenum	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	na	<0.025
Nickel	0.0065	0.028	0.0023	0.0054	0.0043	0.0024	na	0.0065
Selenium	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	na	<0.002
Silver	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	na	<0.001
Thallium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	na	<0.001
Vanadium	<0.01	0.028	<0.01	0.013	0.011	<0.01	na	0.012
Zinc	0.026	0.2	<0.02	<0.02	<0.02	<0.02	na	0.11
Volatile organic compounds (µg/L)								
1,1,1-Trichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5
1,1,2,2-Tetrachloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5
1,1,2-Trichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5
1,1-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5
1,1-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5
1,2-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5
1,2-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5
1,2-Dichloroethene (total)	<1	<1	<1	<1	<1	<1	na	<1
1,2-Dichloropropane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5
1,3-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5
1,4-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5
Bromodichloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5
Bromoform	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5
Bromomethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5
Carbon tetrachloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5
Chlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5
Chloroethane	<1	<1	<1	<1	<1	<1	na	<1
Chloroform	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5
Chloromethane	<1	<1	<1	<1	<1	<1	na	<1
cis-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5
cis-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5
Dibromochloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5
Dichlorodifluoromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5

Table 7-15. Compliance monitoring data for releases from the Drainage Retention Basin, 1999 (continued).

Parameter	WPDC sampling dates							
	1/20/99	2/8/99	4/8/99	6/28/99	8/19/99	10/4/99	10/8/99	11/8/99
Total metals (mg/L) (continued)								
Lead	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	na	<0.005
Manganese	0.028	0.065	0.078	<0.01	0.034	0.022	na	0.11
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	na	<0.0002
Molybdenum	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	na	<0.025
Nickel	0.006	0.0071	0.0087	<0.002	<0.002	0.0021	na	0.014
Selenium	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	na	<0.002
Silver	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	na	<0.001
Thallium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	na	<0.001
Vanadium	<0.01	0.012	0.011	<0.01	0.013	<0.01	na	0.014
Zinc	0.087	0.071	0.097	<0.02	0.022	0.024	na	0.29
Volatile organic compounds (µg/L)								
1,1,1-Trichloroethane	na	na	<0.5	<0.5	<0.5	na	na	na
1,1,2,2-Tetrachloroethane	na	na	<0.5	<0.5	<0.5	na	na	na
1,1,2-Trichloroethane	na	na	<0.5	<0.5	<0.5	na	na	na
1,1-Dichloroethane	na	na	<0.5	<0.5	<0.5	na	na	na
1,1-Dichloroethene	na	na	<0.5	<0.5	<0.5	na	na	na
1,2-Dichlorobenzene	na	na	<0.5	<0.5	<0.5	na	na	na
1,2-Dichloroethane	na	na	<0.5	<0.5	<0.5	na	na	na
1,2-Dichloroethene (total)	na	na	<1	<1	<1	na	na	na
1,2-Dichloropropane	na	na	<0.5	<0.5	<0.5	na	na	na
1,3-Dichlorobenzene	na	na	<0.5	<0.5	<0.5	na	na	na
1,4-Dichlorobenzene	na	na	<0.5	<0.5	<0.5	na	na	na
Bromodichloromethane	na	na	<0.5	<0.5	<0.5	na	na	na
Bromoform	na	na	<0.5	<0.5	<0.5	na	na	na
Bromomethane	na	na	<0.5	<0.5	<0.5	na	na	na
Carbon tetrachloride	na	na	<0.5	<0.5	<0.5	na	na	na
Chlorobenzene	na	na	<0.5	<0.5	<0.5	na	na	na
Chloroethane	na	na	<1	<1	<1	na	na	na
Chloroform	na	na	<0.5	<0.5	<0.5	na	na	na
Chloromethane	na	na	<1	<1	<1	na	na	na
cis-1,2-Dichloroethene	na	na	<0.5	<0.5	<0.5	na	na	na
cis-1,3-Dichloropropene	na	na	<0.5	<0.5	<0.5	na	na	na
Dibromochloromethane	na	na	<0.5	<0.5	<0.5	na	na	na
Dichlorodifluoromethane	na	na	<0.5	<0.5	<0.5	na	na	na

Table 7-15. Compliance monitoring data for releases from the Drainage Retention Basin, 1999 (continued).

Parameter	CDBX sampling dates							
	1/20/99	2/8/99	4/8/99	6/28/99	8/19/99	10/4/99	10/8/99	11/8/99
Volatile organic compounds (µg/L) (continued)								
Freon 113	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5
Methylene chloride	<1	<1	<1	<1	<1	<1	na	<1
Tetrachloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5
Total trihalomethanes	<2	<2	<2	<2	<2	<2	na	<2
trans-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5
trans-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5
Trichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5
Trichlorofluoromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5
Vinyl chloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5
Polychlorinated biphenyls (µg/L)								
PCB 1016	<0.2	<0.2	<0.2	na	na	na	na	<0.3
PCB 1221	<0.2	<0.2	<0.2	na	na	na	na	<0.3
PCB 1232	<0.2	<0.2	<0.2	na	na	na	na	<0.3
PCB 1242	<0.2	<0.2	<0.2	na	na	na	na	<0.3
PCB 1248	<0.2	<0.2	<0.2	na	na	na	na	<0.3
PCB 1254	<0.2	<0.2	<0.2	na	na	na	na	<0.3
PCB 1260	<0.2	<0.2	<0.2	na	na	na	na	<0.3
Total PCBs	<0.2	<0.2	<0.2	na	na	na	na	<0.3
Herbicides (µg/L)								
Acennaphthylene	na	na	na	na	na	<0.1	na	<1
Alachlor	na	na	na	na	na	<0.2	na	<2
Aldrin	na	na	na	na	na	<0.5	na	<5
Anthracene	na	na	na	na	na	<0.1	na	<1
Atraton	na	na	na	na	na	<0.5	na	<5
Atrazine	<0.2	<0.2	<0.2	na	na	<0.2	na	<2
Benzo(a)anthracene	na	na	na	na	na	<0.3	na	<3
Benzo(a)pyrene	na	na	na	na	na	<0.1	na	<1
Benzo(b)fluoranthene	na	na	na	na	na	<0.3	na	<3
Benzo(g,h,i)perylene	na	na	na	na	na	<0.3	na	<3
Benzo(k)fluoranthene	na	na	na	na	na	<0.3	na	<3
BHC, delta isomer	na	na	na	na	na	<0.2	na	<2
BHC, gamma isomer (Lindane)	na	na	na	na	na	<0.1	na	<1
Bromacil	<0.5	6	4.4	na	na	<0.5	na	<5

Table 7-15. Compliance monitoring data for releases from the Drainage Retention Basin, 1999 (continued).

Parameter	WPDC sampling dates							
	1/20/99	2/8/99	4/8/99	6/28/99	8/19/99	10/4/99	10/8/99	11/8/99
Volatile organic compounds (µg/L) (continued)								
Freon 113	na	na	<0.5	<0.5	<0.5	na	na	na
Methylene chloride	na	na	<1	<1	<1	na	na	na
Tetrachloroethene	na	na	<0.5	<0.5	<0.5	na	na	na
Total trihalomethanes	na	na	<2	<2	<2	na	na	na
trans-1,2-Dichloroethene	na	na	<0.5	<0.5	<0.5	na	na	na
trans-1,3-Dichloropropene	na	na	<0.5	<0.5	<0.5	na	na	na
Trichloroethene	na	na	<0.5	<0.5	<0.5	na	na	na
Trichlorofluoromethane	na	na	<0.5	<0.5	<0.5	na	na	na
Vinyl chloride	na	na	<0.5	<0.5	<0.5	na	na	na
Polychlorinated biphenyls (µg/L)								
PCB 1016	<0.2	<0.2	<0.2	na	na	na	na	<0.2
PCB 1221	<0.2	<0.2	<0.2	na	na	na	na	<0.2
PCB 1232	<0.2	<0.2	<0.2	na	na	na	na	<0.2
PCB 1242	<0.2	<0.2	<0.2	na	na	na	na	<0.2
PCB 1248	<0.2	<0.2	<0.2	na	na	na	na	<0.2
PCB 1254	<0.2	<0.2	<0.2	na	na	na	na	<0.2
PCB 1260	<0.2	<0.2	<0.2	na	na	na	na	<0.2
Total PCBs	<0.2	<0.2	<0.2	na	na	na	na	<0.2
Herbicides (µg/L)								
Acennaphthylene	na	na	na	na	na	na	na	<0.1
Alachlor	na	na	na	na	na	na	na	<0.3
Aldrin	na	na	na	na	na	na	na	<0.7
Anthracene	na	na	na	na	na	na	na	<0.1
Atraton	na	na	na	na	na	na	na	<0.7
Atrazine	<0.2	<0.2	<0.2	na	na	na	na	<0.3
Benzo(a)anthracene	na	na	na	na	na	na	na	<0.4
Benzo(a)pyrene	na	na	na	na	na	na	na	0.24
Benzo(b)fluoranthene	na	na	na	na	na	na	na	0.44
Benzo(g,h,i)perylene	na	na	na	na	na	na	na	<0.4
Benzo(k)fluoranthene	na	na	na	na	na	na	na	<0.4
BHC, delta isomer	na	na	na	na	na	na	na	<0.3
BHC, gamma isomer (Lindane)	na	na	na	na	na	na	na	<0.1
Bromacil	<0.5	270	3.6	na	na	na	na	2.2

Table 7-15. Compliance monitoring data for releases from the Drainage Retention Basin, 1999 (continued).

Parameter	CDBX sampling dates							
	1/20/99	2/8/99	4/8/99	6/28/99	8/19/99	10/4/99	10/8/99	11/8/99
Volatile organic compounds (µg/L) (continued)								
Butachlor	<0.3	<0.3	<0.3	na	na	<0.3	na	na
Butylbenzylphthalate	na	na	na	na	na	<1	na	<10
Chlordane	na	na	na	na	na	<2	na	<20
Chrysene	na	na	na	na	na	<0.3	na	<3
Di (2-ethylhexyl) adipate	na	na	na	na	na	<1	na	<10
Diazinon	<0.2	<0.2	<0.2	na	na	<0.2	na	<2
Dibenzo(*a,h*)anthracene	na	na	na	na	na	<0.3	na	<3
Dibutylphthalate	na	na	na	na	na	<1	na	<10
Diethylhexylphthalate	na	na	na	na	na	<3	na	<30
Diethylphthalate	na	na	na	na	na	<3	na	<30
Dimethoate	<2	<2	<2	na	na	<2	na	<20
Dimethylphthalate	na	na	na	na	na	<1	na	<10
Diuron	5.2	2.1	<1	na	na	<1	na	<2
Endrin	na	na	na	na	na	<0.2	na	<2
Fluorene	na	na	na	na	na	<0.1	na	<1
Glyphosate	<9	<9	<9	na	na	<9	na	100
Heptachlor	na	na	na	na	na	<0.1	na	<1
Heptachlor epoxide	na	na	na	na	na	<0.1	na	<1
Hexachlorobenzene	na	na	na	na	na	<0.5	na	<5
Hexachlorocyclopentadiene	na	na	na	na	na	<1	na	<10
Indeno(1,2,3-*c,d*)pyrene	na	na	na	na	na	<0.3	na	<3
Methoxychlor	na	na	na	na	na	<0.5	na	<5
Metolachlor	<0.5	<0.5	<0.5	na	na	<0.5	na	<5
Metribuzin	<0.5	<0.5	<0.5	na	na	<0.5	na	<5
Molinate	<0.5	<0.5	<0.5	na	na	<0.5	na	<5
Pentachlorophenol	na	na	na	na	na	<1	na	<10
Phenanthrene	na	na	na	na	na	<0.1	na	<1
Prometon	na	na	na	na	na	<0.5	na	<5
Prometryn	<0.5	<0.5	<0.5	na	na	<0.5	na	<5
Propachlor	<0.5	<0.5	<0.5	na	na	<0.5	na	na
Pyrene	na	na	na	na	na	<0.1	na	<1
Secbumeton	na	na	na	na	na	<0.5	na	<5
Simazine	<0.2	<0.2	<0.2	na	na	<0.2	na	<2

Table 7-15. Compliance monitoring data for releases from the Drainage Retention Basin, 1999 (continued).

Parameter	WPDC sampling dates							
	1/20/99	2/8/99	4/8/99	6/28/99	8/19/99	10/4/99	10/8/99	11/8/99
Volatile organic compounds (µg/L) (continued)								
Butachlor	<0.3	<0.3	<0.3	na	na	na	na	na
Butylbenzylphthalate	na	na	na	na	na	na	na	<1
Chlordane	na	na	na	na	na	na	na	<3
Chrysene	na	na	na	na	na	na	na	<0.4
Di (2-ethylhexyl) adipate	na	na	na	na	na	na	na	<1
Diazinon	na	na	<0.2	na	na	na	na	<0.3
Dibenzo(*a,h*)anthracene	na	na	na	na	na	na	na	<0.4
Dibutylphthalate	na	na	na	na	na	na	na	<1
Diethylhexylphthalate	na	na	na	na	na	na	na	5.4
Diethylphthalate	na	na	na	na	na	na	na	<4
Dimethoate	na	na	<2	na	na	na	na	<3
Dimethylphthalate	na	na	na	na	na	na	na	<1
Diuron	63	6.3	<1	na	na	na	na	<1
Endrin	na	na	na	na	na	na	na	<0.3
Fluorene	na	na	na	na	na	na	na	<0.1
Glyphosate	<9	<9	<9	na	na	na	na	99
Heptachlor	na	na	na	na	na	na	na	<0.1
Heptachlor epoxide	na	na	na	na	na	na	na	<0.1
Hexachlorobenzene	na	na	na	na	na	na	na	<0.7
Hexachlorocyclopentadiene	na	na	na	na	na	na	na	<1
Indeno(1,2,3-*c,d*)pyrene	na	na	na	na	na	na	na	<0.4
Methoxychlor	na	na	na	na	na	na	na	<0.7
Metolachlor	<0.5	<0.5	<0.5	na	na	na	na	<0.7
Metribuzin	<0.5	<0.5	<0.5	na	na	na	na	<0.7
Molinate	<0.5	<0.5	<0.5	na	na	na	na	<0.7
Pentachlorophenol	na	na	na	na	na	na	na	<1
Phenanthrene	na	na	na	na	na	na	na	<0.1
Prometon	na	na	na	na	na	na	na	<0.7
Prometryn	<0.5	<0.5	<0.5	na	na	na	na	<0.7
Propachlor	<0.5	<0.5	<0.5	na	na	na	na	na
Pyrene	na	na	na	na	na	na	na	<0.1
Secbumeton	na	na	na	na	na	na	na	<0.7
Simazine	<0.2	<0.2	<0.2	na	na	na	na	<0.3

Table 7-15. Compliance monitoring data for releases from the Drainage Retention Basin, 1999 (continued).

Parameter	CDBX sampling dates							
	1/20/99	2/8/99	4/8/99	6/28/99	8/19/99	10/4/99	10/8/99	11/8/99
Volatile organic compounds (µg/L) (continued)								
Terbutryn	na	na	na	na	na	<0.5	na	<5
Thiobencarb	<0.5	<0.5	<0.5	na	na	<0.5	na	<5
Miscellaneous organics (mg/L)								
Chemical oxygen demand	24	71	43	na	na	<20	na	37
Oil and grease	1.1	<1	<1	na	na	na	na	1.9
Total organic carbon (TOC)	5.2	4.4	3.5	na	na	3.7	na	8.8

Parameter	Sampling dates							
	1/20/99	2/8/99	4/8/99	6/28/99	8/19/99	10/4/99	10/8/99	11/8/99
Radioactivity (Bq/L)								
Gross alpha	0.063 ± 0.052	0.17 ± 0.085	0.094 ± 0.064	na	na	0.096 ± 0.044	na	0.116 ± 0.065
Gross beta	0.118 ± 0.074	0.135 ± 0.096	0.047 ± 0.08	na	na	0.085 ± 0.044	na	0.17 ± 0.05
Tritium	21.7 ± 2.6	29.6 ± 2.7	23.3 ± 3.4	na	na	31.4	na	21.6 ± 3.0

Note: Radioactivities are reported as the measured concentration and either an uncertainty (±2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

[a] na = Not analyzed because the analysis was not required.

[b] IC_{25} = 25% inhibition concentration; concentration at which 25% of the organisms show inhibition responses.

Table 7-15. Compliance monitoring data for releases from the Drainage Retention Basin, 1999 (concluded).

Parameter	WPDC sampling dates							
	1/20/99	2/8/99	4/8/99	6/28/99	8/19/99	10/4/99	10/8/99	11/8/99
Volatile organic compounds (µg/L) (continued)								
Terbutryn	na	na	na	na	na	na	na	<0.7
Thiobencarb	<0.5	<0.5	<0.5	na	na	na	na	<0.7
Miscellaneous organics (mg/L)								
Chemical oxygen demand	30	79	40	na	na	na	na	64
Oil and grease	<1	<1	<1	na	na	na	na	<1
Total organic carbon (TOC)	8.5	4.5	6.2	na	na	na	na	17

Parameter	Sampling dates							
	1/20/99	2/8/99	4/8/99	6/28/99	8/19/99	10/4/99	10/8/99	11/8/99
Radioactivity (Bq/L)								
Gross alpha	0.032 ± 0.044	0.044 ± 0.041	0.063 ± 0.046	na	na	na	na	0.066 ± 0.04
Gross beta	0.208 ± 0.078	0.16 ± 0.074	0.224 ± 0.051	na	na	na	na	0.237 ± 0.044
Tritium	13.1 ± 2.3	70.7 ± 5.6	11.2 ± 3.0	na	na	na	na	37.8 ± 3.5

[c] IC_{50} = 50% inhibition concentration: concentration at which 50% of the organisms show inhibition responses.

[d] LOEC = Lowest observed effect concentration.

[e] NOEC = No observed effect concentration.

[f] LC_{50} = 50% lethal concentration; concentration at which 50% of the organisms die.

Table 7-16. Monthly analyses of water samples collected from the Drainage Retention Basin location CDBE, 1999.

Parameter	Sampling dates					
	1/13/99	2/4/99	3/11/99	4/26/99	5/4/99	6/14/99
Nutrients (mg/L)						
Ammonia nitrogen (as N)	0.03	0.02	0.06	0.07	0.22	0.07
Nitrate (as N)	1.7	1.2	0.54	<0.1	0.33	0.77
Nitrate (as NO_3)	7.7	5.4	2.4	<0.4	1.4	3.4
Nitrite (as N)	0.03	0.02	0.02	<0.02	<0.02	<0.02
Nitrite (as NO_2)	0.09	0.07	0.07	<0.07	<0.07	<0.07
Total Kjeldahl nitrogen	1.0	0.94	1.2	1.0	1.2	1.3
General minerals (mg/L)						
Aluminum	0.15	0.61	0.6	0.3	1.4	1.5
Bicarbonate alkalinity (as $CaCO_3$)	147	137	116	152	125	176
Calcium	53	42	32	37	40	53
Carbonate alkalinity (as $CaCO_3$)	62	22	30	<5	33	28
Chloride	134	111	89	108	116	160
Copper	<0.01	<0.01	<0.01	<0.01	0.026	0.033
Fluoride	0.44	0.32	0.32	0.40	0.36	0.49
Hydroxide alkalinity (as $CaCO_3$)	<5	<5	<5	<5	<5	<5
Iron	0.16	0.6	0.6	0.29	1.4	1.6
Magnesium	26	21	16	22	24	31
Manganese	0.016	0.025	0.059	0.039	0.23	0.12
Nickel	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nitrate (as N)	1.7	1.2	0.57	<0.1	0.33	0.77
Nitrate (as NO_3)	7.6	5.4	2.5	<0.4	1.4	3.4
Nitrite (as N)	0.03	0.02	0.02	<0.02	<0.02	<0.02
Orthophosphate	<0.05	0.12	0.25	<0.05	0.32	<0.05
pH (pH units)	9.1	8.7	9.2	9.1	9.1	9.1
Potassium	2.0	1.9	2.2	2.1	2.2	2.4
Sodium	94	76	70	80	86	115
Specific conductance (µmho/cm)	910	736	648	710	773	1000
Sulfate	48	51	48	45	45	56
Surfactants	<0.05	<0.1	0.09	<0.05	<0.05	<0.05
Total alkalinity (as $CaCO_3$)	209	159	146	152	158	204
Total dissolved solids (TDS)	510	457	372	414	435	600
Total hardness (as $CaCO_3$)	239	191	146	183	199	260
Total phosphorus (as P)	0.08	0.12	0.17	0.1	0.21	0.21
Total solids	na	na	398	458	390	623

Table 7-16. Monthly analyses of water samples collected from the Drainage Retention Basin location CDBE, 1999 (continued).

Parameter	Sampling dates					
	1/13/99	2/4/99	3/11/99	4/26/99	5/4/99	6/14/99
General minerals (mg/L) (continued)						
Total suspended solids (TSS)	14	16	7.6	15	14	59
Volatile solids	na	15	4.8	114	90	217
Volatile suspended solids	na	87	76	10	4.5	20
Zinc	<0.01	0.016	0.012	<0.01	0.028	0.019
Total metals (mg/L)						
Aluminum	0.13	0.56	0.6	0.29	0.74	1.3
Antimony	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Arsenic	0.0026	<0.002	0.0021	0.0031	0.0037	0.0044
Barium	0.13	0.12	0.093	0.093	0.1	0.15
Beryllium	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Boron	1.4	1.5	1.5	1.5	1.5	1.8
Cadmium	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Chromium	0.0058	0.005	0.0049	0.0036	0.0055	0.0062
Chromium(VI)	0.0062	0.0071	0.0056	0.0048	<0.002	0.0073
Cobalt	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Copper	0.0018	0.0068	0.004	0.0047	0.0063	0.0068
Iron	0.16	0.55	0.59	0.28	0.79	1.6
Lead	<0.005	0.0093	<0.005	<0.005	<0.005	<0.005
Manganese	0.016	0.023	0.059	0.038	0.16	0.11
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Nickel	0.0033	0.0031	0.0038	0.0028	0.0045	0.007
Selenium	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Silver	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	<0.01	<0.01	<0.01	<0.01	<0.01	0.013
Zinc	<0.02	<0.02	<0.02	<0.02	0.029	<0.02
Miscellaneous organics (µg/L)						
Chlorophyll-a	54.5	28	36.7	16	5.0	73.7

Table 7-16. Monthly analyses of water samples collected from the Drainage Retention Basin location CDBE, 1999 (continued).

Parameter	Sampling dates					
	7/29/99	8/19/99	9/9/99	10/4/99	11/4/99	12/2/99
Nutrients (mg/L)						
Ammonia nitrogen (as N)	<0.02	0.04	0.14	0.09	0.04	0.10
Nitrate (as N)	1.20	0.59	0.46	1.1	2.0	1.9
Nitrate (as NO_3)	5.2	2.6	2.1	4.9	8.9	8.6
Nitrite (as N)	0.03	<0.02	0.04	0.02	0.03	0.03
Nitrite (as NO_2)	0.09	<0.07	0.15	<0.50	<0.50	<0.50
Total Kjeldahl nitrogen	0.96	0.96	0.95	0.57	0.68	0.71
General minerals (mg/L)						
Aluminum	1.7	2.0	2.0	0.56	0.95	0.64
Bicarbonate alkalinity (as $CaCO_3$)	211	191	206	226	204	182
Calcium	58	45	51	52	59	47
Carbonate alkalinity (as $CaCO_3$)	18	28	17	<5	22	35
Chloride	202	212	223	215	208	186
Copper	0.019	0.023	<0.01	<0.01	<0.01	<0.01
Fluoride	0.49	0.51	0.54	0.56	0.52	0.43
Hydroxide alkalinity (as $CaCO_3$)	<5	<5	<5	<5	<5	<5
Iron	1.7	1.8	1.9	0.49	0.91	0.62
Magnesium	36	37	41	38	39	29
Manganese	0.081	0.11	0.095	0.018	0.034	0.025
Nickel	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nitrate (as N)	1.2	0.59	0.49	1.2	2.0	1.9
Nitrate (as NO_3)	5.1	2.6	2.2	5.2	8.9	8.6
Nitrite (as N)	0.02	0.02	0.04	0.02	0.03	0.03
Orthophosphate	0.32	0.06	0.18	0.22	0.16	0.13
pH (pH units)	8.6	8.4	8.3	8.3	8.6	8.7
Potassium	2.7	2.9	3.0	2.5	2.5	1.9
Sodium	128	132	142	132	132	100
Specific conductance (µmho/cm)	1180	1160	1200	1210	1210	1100
Sulfate	69	71	77	74	74	65
Surfactants	<0.1	0.05	<0.05	<0.05	<0.05	<0.05
Total alkalinity (as $CaCO_3$)	229	219	223	226	226	217
Total dissolved solids (TDS)	745	680	695	700	735	653
Total hardness (as $CaCO_3$)	293	265	296	286	308	237
Total phosphorus (as P)	0.21	0.12	0.14	0.14	0.13	0.1
Total solids	760	720	735	760	765	670

Table 7-16. Monthly analyses of water samples collected from the Drainage Retention Basin location CDBE, 1999 (continued).

Parameter	Sampling dates					
	7/29/99	8/19/99	9/9/99	10/4/99	11/4/99	12/2/99
General minerals (mg/L) (continued)						
Total suspended solids (TSS)	30	35	21	17	13	9.2
Volatile solids	190	195	180	190	165	133
Volatile suspended solids	6.5	7.3	4	6	3.4	2
Zinc	0.045	0.03	0.021	<0.05	0.082	0.03
Total metals (mg/L)						
Aluminum	1.8	na	2.2	1.0	1.0	0.49
Antimony	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Arsenic	0.006	0.0029	0.0035	0.0022	0.0023	0.003
Barium	0.18	0.15	0.19	0.16	0.18	0.14
Beryllium	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Boron	2.1	2.1	2.3	2.0	2.0	1.5
Cadmium	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Chromium	0.0084	0.0077	0.0048	0.0028	0.0051	0.0057
Chromium(VI)	0.002	0.006	0.002	0.0031	0.0046	0.006
Cobalt	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Copper	0.014	0.01	0.006	0.0024	0.0039	0.003
Iron	1.8	1.8	2.0	0.88	0.88	0.47
Lead	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Manganese	0.083	na	0.095	0.038	0.033	0.022
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	0.0005	<0.0002
Molybdenum	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Nickel	0.0065	0.0057	0.007	0.0032	0.003	0.0029
Selenium	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Silver	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	0.014	0.012	0.01	<0.01	0.01	<0.01
Zinc	0.13	0.024	<0.02	<0.02	0.082	0.046
Miscellaneous organics (µg/L)						
Chlorophyll-a	84.6	35.4	10.4	3.36	13	2.35

Table 7-16. Monthly analyses of water samples collected from the Drainage Retention Basin location CDBE, 1999 (continued).

Parameter	Number of samples	Minimum	Maximum	Median	Interquartile range
Nutrients (mg/L)					
Ammonia nitrogen (as N)	12	<0.02	0.22	0.07	0.06
Nitrate (as N)	12	<0.1	2.0	0.94	0.81
Nitrate (as NO_3)	12	<0.4	8.9	4.2	3.7
Nitrite (as N)	12	<0.02	0.04	0.02	0.01
Nitrite (as NO_2)	12	<0.07	<0.5	0.08	0.17
Total Kjeldahl nitrogen	12	0.57	1.30	0.96	0.17
General minerals (mg/L)					
Aluminum	12	0.15	2.0	0.8	0.96
Bicarbonate alkalinity (as $CaCO_3$)	12	116	226	179	60
Calcium	12	32	59	49	12
Carbonate alkalinity (as $CaCO_3$)	12	<5	62	25	13
Chloride	12	89	223	173	94
Copper	12	<0.01	0.033	0.01	0.01
Fluoride	12	0.32	0.56	0.47	0.12
Hydroxide alkalinity (as $CaCO_3$)	12	<5	<5	<5	0
Iron	12	0.16	1.90	0.77	1.05
Magnesium	12	16	41	30	14
Manganese	12	0.016	0.23	0.049	0.074
Nickel	12	<0.05	<0.05	<0.05	0.00
Nitrate (as N)	12	<0.1	2.0	0.99	0.78
Nitrate (as NO_3)	12	<0.4	8.9	4.3	3.5
Nitrite (as N)	12	<0.02	0.04	0.02	0.01
Orthophosphate	12	<0.05	0.32	0.15	0.17
pH (pH units)	12	8.2	9.2	8.7	0.5
Potassium	12	1.9	3.0	2.3	0.5
Sodium	12	70	142	108	48
Specific conductance (µmho/cm)	12	648	1210	1050	421
Sulfate	12	45	77	61	24
Surfactants	12	<0.05	0.10	0.05	0.01
Total alkalinity (as $CaCO_3$)	12	146	229	213	65
Total dissolved solids (TDS)	12	372	745	627	245
Total hardness (as $CaCO_3$)	12	146	308	250	91
Total phosphorus (as P)	12	0.08	0.21	0.14	0.07
Total solids	10	390	765	695	255

Table 7-16. Monthly analyses of water samples collected from the Drainage Retention Basin location CDBE, 1999 (concluded).

Parameter	Number of samples	Minimum	Maximum	Median	Interquartile range
General minerals (mg/L) (continued)					
Total suspended solids (TSS)	12	7.6	59.0	15.5	9.5
Volatile solids	11	5	217	165	88
Volatile suspended solids	11	2.0	87	6.5	10.8
Zinc	12	<0.01	0.082	0.025	0.019
Total metals (mg/L)					
Aluminum	12	0.13	2.20	0.87	0.86
Antimony	12	<0.004	<0.004	<0.004	–0.004
Arsenic	12	0.002	0.006	0.003	0.001
Barium	12	0.093	0.19	0.15	0.05
Beryllium	12	<0.0002	<0.0002	<0.0002	0.000
Boron	12	1.4	2.3	1.7	0.5
Cadmium	12	<0.0005	<0.0005	<0.0005	0
Chromium	12	0.0028	0.0084	0.0053	0.001
Chromium(VI)	12	<0.002	0.007	0.005	0.003
Cobalt	12	<0.05	<0.05	<0.05	0
Copper	12	0.0018	0.0140	0.0054	0.0031
Iron	12	0.160	2.000	0.835	1.12
Lead	12	<0.005	0.009	<0.005	0
Manganese	12	0.016	0.16	0.049	0.056
Mercury	12	<0.0002	0.0005	<0.0002	0
Molybdenum	12	<0.025	<0.025	<0.025	0
Nickel	12	0.0028	0.0070	0.0036	0.0028
Selenium	12	<0.002	<0.002	<0.002	0
Silver	12	<0.001	<0.001	<0.001	0
Thallium	12	<0.001	<0.001	<0.001	0
Vanadium	12	<0.01	0.014	<0.01	0.001
Zinc	12	<0.02	0.130	<0.02	0.013
Miscellaneous organics (µg/L)					
Chlorophyll-a	12	2.35	84.6	22	32.1

[a] na = Sample not analyzed for this constituent.

Table 7-17. Quarterly analyses of water samples collected from the Drainage Retention Basin location CDBE, 1999.

Parameter	Sampling dates			
	1/13/99	4/26/99	8/19/99	10/4/99
Biological				
Fecal coliform MPN/100ml	<2	<2	<2	49
Total coliform MPN/100ml	8	50	240	240
Herbicides (µg/L)[a]				
Acenaphthylene	—[a]	<0.1	<0.1	<0.1
Alachlor	—[a]	<0.2	<0.2	<0.2
Aldrin	—[a]	<0.5	<0.5	<0.5
Anthracene	—[a]	<0.1	<0.1	<0.1
Atraton	—[a]	<0.5	<0.5	<0.5
Atrazine	<0.2	<0.2	<0.2	<0.2
Benzo(*a*)anthracene	—[a]	<0.3	<0.3	<0.3
Benzo(*a*)pyrene	—[a]	0.14	<0.1	0.12
Benzo(*b*)fluoranthene	—[a]	<0.3	<0.3	<0.3
Benzo(*g,h,i*)perylene	—[a]	<0.3	<0.3	<0.3
Benzo(*k*)fluoranthene	—[a]	<0.3	<0.3	<0.3
BHC, delta isomer	—[a]	<0.2	<0.2	<0.2
BHC, gamma isomer (Lindane)	—[a]	<0.1	<0.1	<0.1
Bromacil	<0.5	1.8	<0.5	<0.5
Butachlor	<0.3	<0.3	<0.3	<0.3
Butylbenzylphthalate	—[a]	<1	<1	<1
Chlordane	—[a]	<2	<2	<2
Chrysene	—[a]	<0.3	<0.3	<0.3
Di(2-ethylhexyl)adipate	—[a]	<1	<1	<1
Diazinon	<0.2	<0.2	<0.2	<0.2
Dibenzo(*a,h*)anthracene	—[a]	<0.3	<0.3	<0.3
Dibutylphthalate	—[a]	<1	<1	<1
Diethylhexylphthalate	—[a]	<3	<3	<3
Diethylphthalate	—[a]	<3	<3	<3
Dimethoate	<2	<2	<2	<2
Dimethylphthalate	—[a]	<1	<1	<1
Diuron	<1	1.8	0.3	<1
Endrin	—[a]	<0.2	<0.2	<0.2
Fluorene	—[a]	<0.1	<0.1	<0.1
Glyphosate	<9	<9	<9	<9
Heptachlor	—[a]	<0.1	<0.1	<0.1

Table 7-17. Quarterly analyses of water samples collected from the Drainage Retention Basin location CDBE, 1999 (concluded).

Parameter	Sampling dates			
	1/13/99	4/26/99	8/19/99	10/4/99
Herbicides (µg/L) (continued)				
Heptachlor epoxide	—[a]	<0.1	<0.1	<0.1
Hexachlorobenzene	—[a]	<0.5	<0.5	<0.5
Hexachlorocyclopentadiene	—[a]	<1	<1	<1
Indeno(1,2,3-*c,d*)pyrene	—[a]	<0.3	<0.3	<0.3
Methoxychlor	<0.5	<0.5	<0.5	<0.5
Metolachlor	<0.5	<0.5	<0.5	<0.5
Metribuzin	—[a]	<0.5	<0.5	<0.5
Molinate	<0.5	<0.5	<0.5	<0.5
Pentachlorophenol	—[a]	<1	<1	<1
Phenanthrene	—[a]	<0.1	<0.1	<0.1
Prometon	—[a]	<0.5	<0.5	<0.5
Prometryn	<0.5	<0.5	<0.5	<0.5
Propachlor	<0.5	<0.5	<0.5	<0.5
Pyrene	—[a]	<0.1	<0.1	<0.1
Secbumeton	—[a]	<0.5	<0.5	<0.5
Simazine	<0.2	<0.2	<0.2	<0.2
Terbutryn	—[a]	<0.5	<0.5	<0.5
Thiobencarb	<0.5	<0.5	<0.5	<0.5
Toxaphene	—[a]	<5	—[a]	—[a]
Miscellaneous organics (mg/L)				
Chemical oxygen demand	<20	46	27	<20
Oil and grease	1.4	<1	—[b]	—[b]

[a] Herbicide analyses are mainly directed at bromacil, diazinon, diuron, and glyphosate. Other analyses may be reported by the analytical laboratory.

[b] No sample collected.

Table 7-18. Semiannual/annual analyses of water samples collected from the Drainage Retention Basin location CDBE, 1999.

Parameter	Sampling dates	
	4/26/99	10/4/99
Biological		
Aqueous bioassay		
Pimephales promelas acute survival (percent)	na[a]	95
Pimephales promelas growth (toxic units)	na	<1
Pimephales promelas growth, IC-25[b]	na	>100
Pimephales promelas growth, IC-50[c]	na	>100
Pimephales promelas growth, LOEC[d]	na	>100
Pimephales promelas growth, NOEC[e]	na	>100
Pimephales promelas chronic survival (toxic units)	na	<1
Pimephales promelas chronic survival, LC-50[f]	na	>100
Pimephales promelas chronic survival, LOEC	na	>100
Pimephales promelas chronic survival, NOEC	na	>100
Ceriodaphnia dubia growth (toxic units)	na	>1
Ceriodaphnia dubia growth, IC-25	na	>100
Ceriodaphnia dubia growth, IC-50	na	>100
Ceriodaphnia dubia growth, LOEC	na	100
Ceriodaphnia dubia growth, NOEC	na	<100
Ceriodaphnia dubia chronic survival (toxic units)	na	<1
Ceriodaphnia dubia chronic survival, LC-50	na	>100
Ceriodaphnia dubia chronic survival, LOEC	na	>100
Ceriodaphnia dubia chronic survival, NOEC	na	>100
Selanastrum capriocornutum growth (toxic units)	na	>1
Selanastrum capriocornutum growth, IC-25	na	>100
Selanastrum capriocornutum growth, IC-50	na	>100
Selanastrum capriocornutum growth, LOEC	na	100
Selanastrum capriocornutum growth, NOEC	na	<100
Volatile organic compounds (µg/L)		
1,1,1-Trichloroethane	<0.5	<0.5
1,1,2,2-Tetrachloroethane	<0.5	<0.5
1,1,2-Trichloroethane	<0.5	<0.5
1,1-Dichloroethane	<0.5	<0.5
1,1-Dichloroethene	<0.5	<0.5
1,2-Dichlorobenzene	<0.5	<0.5
1,2-Dichloroethane	<0.5	<0.5
1,2-Dichloroethene (total)	<1	<1
1,2-Dichloropropane	<0.5	<0.5

Table 7-18. Semiannual/annual analyses of water samples collected from the Drainage Retention Basin location CDBE, 1999 (concluded).

Parameter	Sampling dates	
	4/26/99	10/4/99
Volatile organic compounds (µg/L) (continued)		
1,3-Dichlorobenzene	<0.5	<0.5
1,4-Dichlorobenzene	<0.5	<0.5
Bromodichloromethane	<0.5	<0.5
Bromoform	<0.5	<0.5
Bromomethane	<0.5	<0.5
Carbon tetrachloride	<0.5	<0.5
Chlorobenzene	<0.5	<0.5
Chloroethane	<1	<1
Chloroform	<0.5	<0.5
Chloromethane	<1	<1
cis-1,2-Dichloroethene	<0.5	<0.5
cis-1,3-Dichloropropene	<0.5	<0.5
Dibromochloromethane	<0.5	<0.5
Dichlorodifluoromethane	<0.5	<0.5
Freon 113	<0.5	<0.5
Methylene chloride	<1	<1
Tetrachloroethene	<0.5	<0.5
Total Trihalomethanes	<2	<2
trans-1,2-Dichloroethene	<0.5	<0.5
trans-1,3-Dichloropropene	<0.5	<0.5
Trichloroethene	<0.5	<0.5
Trichlorofluoromethane	<0.5	<0.5
Vinyl chloride	<0.5	<0.5
Miscellaneous organics		
Total organic carbon (TOC) (mg/L)	6.4	3.8
Radioactive (Bq/L)		
Gross alpha	0.072 ± 0.037	0.138 ± 0.056
Gross beta	0.08 ± 0.036	0.1 ± 0.044
Tritium	43.7 ± 3.8	31.4 ± 3.4

Note: Radioactivities are reported as the measured concentration and either an uncertainty (±2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

[a] na = Not analyzed.

[b] IC 25 = 25% Inhibition concentration; concentration at which 25% of the organisms show inhibition responses.

[c] IC 50 = 50% Inhibition concentration; concentration at which 50% of the organisms show inhibition responses.

[d] LOEC = Lowest observed effect concentration.

[e] NOEC = No observed effect concentration.

[f] LC 50 = 50% Lethal concentration; concentration at which 50% of the organisms die.

Table 7-19. Field data collected from the Drainage Retention Basin at eight locations, 1999.

Date	CDBA		CDBC		CDBD		CDBE		
	Dissolved oxygen (mg/L)	Temper-ature (°C)	Dissolved oxygen (mg/L)	Temper-ature (°C)	Dissolved oxygen (mg/L)	Temper-ature (°C)	Dissolved oxygen (mg/L)	Temper-ature (°C)	Turbidity (m)
1/7/99	13.7	7.3	17.8	8.2	17.7	7.8	12.9	7.8	0.76
1/13/99	16.7	11.3	17.5	10.1	17.1	8.8	13.3	8.6	0.61
1/22/99	10.1	14.2	12.2	11.9	13.8	10.7	10	10.1	0.38
1/29/99	8.47	13.3	11.3	10.1	13.6	8.4	8.38	8.4	0.53
2/4/99	13.3	13.4	16.2	11	13.6	10.8	10.2	10.9	0.46
2/12/99	11.2	10.2	10.3	9.3	9.54	9.6	9.56	9.5	0.33
2/19/99	9.35	13.1	11.1	12.7	11.4	11.5	7.63	10.6	0.48
2/26/99	7.29	14.9	8.56	10.5	8.67	10.6	8.23	10.6	0.46
3/5/99	12.9	13.4	15.9	10.5	13.1	11.6	10.3	10.7	0.43
3/11/99	12.7	15.8	15.0	14.7	14.8	13.6	11.5	13.8	0.41
3/19/99	12.4	12.6	12.0	12.6	11.4	12.3	9.04	12.1	0.48
3/26/99	12.6	18.9	10.0	15.1	8.38	13.8	7.28	13.6	1.19
4/2/99	10.7	13.9	13.9	14	13.9	13.5	10.5	13.4	0.71
4/9/99	10.0	14	12.7	10.4	11.4	10.9	8.11	10.9	0.75
4/16/99	10.8	21.6	11.5	22	13.3	18.3	4.96	14.3	0.91
4/21/99	16	17.8	14.8	16.9	14.6	15.5	12.6	13.4	0.69
4/26/99	11.2	21.8	11.6	18.1	11.3	17.5	8.92	16.4	0.56
5/4/99	9.66	19.4	8.42	15.6	7.26	15.1	6.52	14.8	0.48
5/13/99	11.3	22.2	6.82	18.9	6.48	18.5	6.18	18.4	0.76
5/21/99	12.3	22.8	8.05	20.1	8.1	20.2	7.72	7.62	0.64
5/27/99	9.6	24.6	6.9	22.4	6.5	21.8	5.9	21.6	0.56
6/4/99	10.3	21.3	8.34	20.4	8.35	18.9	7.02	19	0.56
6/11/99	6.95	21	5.88	22.2	6.55	20.6	6.05	20.4	0.46
6/15/99	12.7	22.9	9.66	22.1	8.95	21.8	7.5	21.7	0.38
6/24/99	3.63	23.6	5.37	24.4	5.52	24.3	5.02	24.1	0.41
7/2/99	12.7	24.5	12.2	24.4	9.78	25.1	4.85	25.1	0.20
7/8/99	8.56	22.1	7.07	24.3	6.55	23.3	6.24	23.1	0.23
7/15/99	10.2	23.3	9.81	24.3	7.88	25.6	7	25.5	0.28
7/22/99	9.01	20.5	7.98	22.2	8.01	22.3	5.82	22.1	0.27
7/29/99	12.3	28.9	14.5	24.9	11.1	22.6	10.4	22.6	0.33
8/6/99	7.67	21.2	11.5	22	9.27	20.8	8.95	20.8	0.38
8/12/99	10.1	23.3	10.1	22.7	10.2	20.7	6.25	20.7	0.41
8/19/99	8.96	24.6	9.72	23.1	7.27	21.6	4.78	21.5	0.36
8/27/99	6.27	24	5.21	23.9	4.23	23.7	3.25	23.6	0.38
9/3/99	9.75	22.4	9.06	22.2	7.06	21.8	3.78	21.7	0.51

Table 7-19. Field data collected from the Drainage Retention Basin at eight locations, 1999 (continued).

Date	CDBF		CDBJ		CDBK		CDBL	
	Dissolved oxygen (mg/L)	Temper-ature (°C)	Dissolved oxygen (mg/L)	Temper-ature (°C)	Dissolved oxygen (mg/L)	Temper-ature (°C)	Dissolved oxygen (mg/L)	Temper-ature (°C)
1/7/99	12.4	7.7	18.0	8	12.9	8	12.9	8.5
1/13/99	12.3	9.1	17.5	8.8	12.1	8.5	10.1	8.8
1/22/99	12.2	10.3	13.4	11.5	9.37	9.7	10.9	9.6
1/29/99	7.52	8.4	18.6	8.5	6.85	8.5	9.25	9
2/4/99	7.49	12.4	11.8	9.6	8.71	8.5	9.42	10.7
2/12/99	9.25	9.4	9.36	9.6	10.3	9.3	9.05	9.5
2/19/99	4.98	10.3	9.56	11.5	6.97	10.7	3.57	11
2/26/99	8.64	10.5	7.99	10.8	7.12	10.6	5.81	10.6
3/5/99	3.9	10.6	13.4	11.5	10.2	11	3.95	10.8
3/11/99	7.5	12.2	14.8	11.6	9	11.5	6.28	12.8
3/19/99	5.52	11.9	11.5	12.1	7.93	11.8	6.72	11.6
3/26/99	5.35	14	9.71	15.2	8.34	14.9	4.45	13.6
4/2/99	9.15	13.2	13.5	12.9	7.94	12.8	6.39	12.2
4/9/99	8.57	10.8	11.6	11	8.23	11.1	8.35	11.1
4/16/99	3.43	14.9	10.9	16.8	3.41	15.5	3.67	16.3
4/21/99	3.25	13.4	15.4	16.3	13.9	15.9	3.27	15.6
4/26/99	3.54	17.3	11.0	17.4	8.98	15.6	3.36	15.6
5/4/99	6.26	15.1	7.44	15.5	6.95	15.2	6.38	15.3
5/13/99	6.04	18.7	7.26	19.3	6.9	18.8	6.57	18.8
5/21/99	8.01	19.4	8.88	20.1	7.86	19.6	7.31	20.3
5/27/99	5.85	21.7	6.48	22.3	5.8	22	5.61	22.3
6/4/99	6.81	19.1	8.15	19.8	6.9	19.9	6.55	21.3
6/11/99	5.99	20.4	6.84	21.4	5.92	21.4	5.23	21.4
6/15/99	6.65	20.8	9.49	22.6	8.97	22.4	8.85	22.4
6/24/99	4.96	24.1	6.35	24.4	6.16	24.2	6.05	24.1
7/2/99	4.53	25.2	7.03	25.4	5.42	24.9	4.5	24.8
7/8/99	6	22.8	6.91	23.1	6.06	23.1	5.83	22.8
7/15/99	7.11	25.2	8.41	25.5	7.7	25.1	7.5	24.8
7/22/99	5.69	22.3	7.69	22.2	6.29	22.1	5.8	20.8
7/29/99	10.2	23.3	12.3	22.9	11.0	22.5	10.4	22.6
8/6/99	8.15	20.9	10.9	21.1	9.53	21	7.99	21.1
8/12/99	5.35	20.8	10.1	21.1	7.07	21	5.9	21.1
8/19/99	3.94	21.6	11.4	21.8	5.16	21.3	4.45	21.6
8/27/99	3.12	23.7	4.41	23.6	3.38	23.5	3.35	23.5
9/3/99	3.32	21.8	7.94	21.8	4.06	21.8	3.67	21.9

Table 7-19. Field data collected from the Drainage Retention Basin at eight locations, 1999 (continued).

Date	CDBA		CDBC		CDBD		CDBE		
	Dissolved oxygen (ppm)	Temper-ature (°C)	Dissolved Oxygen (ppm)	Temper-ature (°C)	Dissolved Oxygen (ppm)	Temper-ature (°C)	Dissolved Oxygen (ppm)	Temper-ature (°C)	Turbidity (m)
9/9/99	11.1	21.4	7.38	22.8	8.7	22.1	4.55	22.2	0.41
9/17/99	7.8	17.7	5.47	19.4	4.86	21	4.4	20.9	0.46
9/30/99	9.01	22.8	8.14	22.1	7.2	20.9	5.28	20.8	0.64
10/4/99	8.35	25	7.53	20.4	5.42	20.1	3.92	20	0.64
10/15/99	7.78	22.4	6.8	18.8	6.38	19.3	4.3	19.3	0.61
10/22/99	11.6	17.2	7.55	17.1	9.12	16.7	5.66	16.5	0.53
10/30/99	10.6	15.3	7.59	14.6	9.62	16	5.77	15.9	0.48
11/4/99	15.4	18.3	10.4	18.1	8.54	16.1	6.94	15.9	0.61
11/11/99	10.7	16.2	8.47	16.1	7.78	15.2	4.27	15	0.48
11/19/99	11.5	11.6	9.92	12.7	8.79	12.8	6.86	12.8	0.56
11/24/99	12.7	10.5	12.2	11.2	12.3	10.9	8.75	10.7	0.38
12/2/99	9.69	11.2	8.7	11.7	9.22	11.1	5.96	11.2	0.48
12/3/99	9.52	9.6	8.03	9.3	7.84	10.3	5.3	10.3	0.51
12/10/99	8.15	7.7	9.45	9.3	9.6	7.97	7.75	9.6	0.48
12/17/99	9.44	10	8.22	10.9	8.17	8.9	7.66	8.9	0.53
12/21/99	9.3	10.8	9	10	10.3	9.8	8.14	9.7	0.43
12/28/99	10.9	8.4	10.3	9.3	10.07	8.1	8.87	8.7	0.28
Data Summary									
Number of samples	52	52	52	52	52	52	52	52	52
Minimum	3.63	7.3	5.2	8.2	4.2	7.8	3.3	7.6	0.20
Maximum	16.7	28.9	17.8	24.9	17.7	25.6	13.3	25.5	1.19
Median	10.2	17.8	9.7	17.0	9.0	16.1	7.0	14.9	0.48
75th percentile	12.3	22.4	11.7	22.1	11.4	20.9	8.88	20.8	0.57
25th percentile	9.0	13.3	8.0	11.0	7.7	10.9	5.57	10.7	0.40
Interquartile range	3.3	9.2	3.7	11.0	3.7	10.0	3.3	10.2	0.17

Table 7-19. Field data collected from the Drainage Retention Basin at eight locations, 1999 (concluded).

Date	CDBF		CDBJ		CDBK		CDBL	
	Dissolved oxygen (ppm)	Temper-ature (°C)	Dissolved oxygen (ppm)	Temper-ature (°C)	Dissolved oxygen (ppm)	Temper-ature (°C)	Dissolved oxygen (ppm)	Temper-ature (°C)
9/9/99	4.18	22.3	8.57	22.5	4.97	22.5	4.43	22.6
9/17/99	4.19	21	4.71	21.1	4.33	21.1	4.01	21.1
9/30/99	4.21	20.9	7.48	20.7	5.09	20.7	4.33	20.6
10/4/99	3.25	20.1	8.4	20.3	4.86	20.3	4.4	20.5
10/15/99	3.79	19.4	6.65	19.3	4.9	19.2	4.14	19.7
10/22/99	5.12	16.5	8.01	16.4	6.26	16.4	5.66	16.3
10/30/99	5.56	15	7.32	16.1	5.2	16	4.74	15.8
11/4/99	5.7	16.1	9.84	16.1	7.23	15.8	4.76	15.9
11/11/99	3.22	15.1	8.14	14.6	4.26	14.6	3.78	14.6
11/19/99	3.95	12.9	7.36	12.7	4.53	12.6	3.4	12.6
11/24/99	6.59	10.6	9.75	11	9.43	11	8.47	11.1
12/2/99	4.67	11.5	8.39	11	5.5	11.1	4.88	11.3
12/3/99	4.26	10	7.56	10.4	4.93	10.3	4.2	10.2
12/10/99	7.67	9.6	8.82	9.8	9.2	9.7	8.4	9.6
12/17/99	7.57	9.2	8.52	8.9	7.94	9	7.4	9.3
12/21/99	8.13	9.9	8.07	9.8	7.69	9.9	7.32	10
12/28/99	8.75	8	4.18	9.2	4.06	9.3	4.44	8.2
Data Summary								
Number of samples	52	52	52	52	52	52	52	52
Minimum	3.1	7.7	4.18	8	3.38	8	3.27	8.2
Maximum	12.4	25.2	18.6	25.5	13.9	25.1	12.9	24.8
Median	5.8	15.1	8.5	16.2	7.0	15.7	5.8	15.7
75th percentile	7.6	20.9	11.1	21.2	8.78	21.2	7.45	21.2
25th percentile	4.21	10.6	7.47	11	5.18	10.9	4.38	11.0
Interquartile range	3.4	10.3	3.6	10.2	3.6	10.2	3.0	10.2

Table 7-20. Seasonal inventory of plants and animals, Livermore site, 1999.

Common Name	Scientific Name	Location					
		DRB		Arroyo Las Positas		Tributaries (CDB and CDB2)	
		Spring[a]	Fall[b]	Spring	Fall	Spring	Fall
Birds							
American crow	*Corvus bachyrhynchos*	P[c]	P	P	P	P	P
American kestrel	*Falco sparverius*	P	P	NO[d]	P	NO	NO
American robin	*Turdus migratorius*	P	P	P	P	NO	NO
Anna's hummingbird	*Calypte anna*	P	P	P	P	P	P
Black phoebe	*Sayornis saya*	NO	NO	P	P	NO	NO
Black-chinned hummingbird	*Archilochus alexandri*	P	NO	NO	NO	NO	NO
Black-necked stilt	*Himantopus mexicanus*	P	NO	NO	NO	NO	NO
Brewer's blackbird	*Euphagus cyanocephalus*	P	P	P	P	P	P
Bufflehead	*Bucephala*	P	P	NO	NO	NO	NO
Bushtit	*Psaltriparus minimus*	NO	NO	NO	NO	P	P
Canada goose	*Branta canadensis*	P	P	NO	NO	NO	NO
Cedar waxwing	*Bombycilla garrulus*	P	NO	NO	NO	P	NO
Chestnut-backed chickadee	*Parus rufescens*	P	NO	P	NO	NO	NO
Cliff swallow	*Hirundo pyrrhonota*	P	NO	NO	NO	NO	NO
Common raven	*Corvus corax*	NO	NO	P	P	NO	NO
Double-crested cormorant	*Phalacrocorax auritus*	P	P	NO	NO	NO	NO
European starling	*Sturnus vulgaris*	P	P	P	P	P	P
Great egret	*Casmerodius albus*	P	P	P	P	NO	NO
Greater scaup	*Aythya marila*	P	NO	NO	NO	NO	NO
Greater-yellow legs	*Tringa melanoleuca*	P	P	NO	NO	NO	NO
House finch	*Carpodacus mexicanus*	P	P	P	P	P	P
Killdeer	*Haradrius vociferus*	P	P	NO	NO	NO	NO
Loggerhead shrike	*Lanius ludovicianus*	NO	NO	P	NO	NO	NO
Mallard	*Anas platyrhynchos*	P	P	NO	NO	P	P
Mourning dove	*Zenaida macroura*	P	P	P	P	P	P
Pied-billed grebe	*Podilymbus podiceps*	P	P	NO	NO	NO	NO
Red-shafted flicker	*Colaptes auratus*	P	P	P	P	NO	NO
Red-shouldered hawk	*Buteo lineatus*	NO	NO	P	P	NO	NO

Table 7-20. Seasonal inventory of plants and animals, Livermore site, 1999 (continued).

Common Name	Scientific Name	Location					
		DRB		Arroyo Las Positas		Tributaries (CDB and CDB2)	
		Spring[a]	Fall[b]	Spring	Fall	Spring	Fall
Red-tailed hawk	*Buteo jamaicensis*	NO	NO	P	P	P	P
Red-winged blackbird	*Agelaius phoeniceus*	P	P	P	P	P	P
Rock dove	*Columba livia*	P	P	P	P	P	P
Ruby-crowned kinglet	*Regulus caledula*	P	P	NO	NO	NO	NO
Scrub jay	*Aphelocoma coerulescens*	P	P	P	P	P	P
Snowy egret	*Egretta thula*	NO	NO	P	P	NO	NO
Song sparrow	*Zmelospiza melodia*	P	P	P	P	P	P
Turkey vulture	*Cathartes aura*	NO	NO	P	P	NO	NO
Western gull	*Larus occidentalis*	P	P	NO	NO	NO	NO
Western meadowlark	*Sturnella neglecta*	NO	NO	P	P	NO	NO
White-breasted nuthatch	*Sitta carolinensis*	NO	NO	NO	NO	P	NO
White-crowned sparrow	*Zonotrichia leucophrys*	P	P	P	P	P	P
White-tailed kite	*Elanus leucurus*	NO	NO	P	P	NO	NO
Yellow-rumped warbler	*Dendroica coronata*	P	P	P	P	P	P
Amphibians and reptiles							
Bullfrog	*Rana catesbeiana*	P	P	NO	NO	P	P
Pacific tree frog	*Hyla regilla*	P	P	P	P	P	P
Red-legged frog	*Rana aurora draytonii*	NO	NO	P	P	P	P
Western fence lizard	*Sceloporus occidentailis*	P	P	NO	NO	P	P
Western pond turtle	*Clemmys marmorata*	NO	P	NO	NO	NO	NO
Western toad	*Bufo borieus*	P	P	P	P	P	P
Fish							
Catfish	*Ictalurus sp.*	P	P	NO	NO	NO	NO
Mosquito fish	*Gambusia affinis*	P	P	P	P	P	P
Prickly sculpin	*Cottus asper*	NO	NO	P	P	P	P

Table 7-20. Seasonal inventory of plants and animals, Livermore site, 1999 (concluded).

Common Name	Scientific Name	Spring[a]	Fall[b]
Mammals			
California ground squirrel	*Spermophilus beecheyi*	P	P
California meadow vole	*Microtus californicus*	P	P
Feral house cat	*Felis domesticus*	P	P
Gray fox	*Urocyon cinereoargenteus*	P	P
House mouse	*Mus musculus*	P	P
Red fox	*Vulps vulpes*	P	P
Vegetation			
American water-plantain	*Alisma plantago-aquatica*	P	P
Bullrush	*Scripus spp.*	P	P
Cattail	*Typha latifolia*	P	P
Cocklebur	*Xanthium spinosum*	P	P
Coontail	*Ceratophyllum demersum*	P	P
Curly dock	*Rumex crispus*	P	P
Harding grass	*Phalaris aquatica*	P	P
Leafy pondweed	*Potamogeton foliosus*	P	P
Nutsedge	*Carex spp.*	P	P
Spearscale	*Atriplex triangularis*	P	P
Water velvet	*Azolla mexicana*	P	P
Watercress	*Rorippa nasturium-aquaticum*	P	P
Waterpepper	*Polygonum hydropiperoides*	P	P
Willow	*Salix spp.*	P	P

a Spring survey dates are as follows: amphibians 2/22/99, 3/5/99, 3/10/99, and 3/16/99; birds 2/21/99, 2/25/99, 3/10/99, and 3/16/99; fish 3/1/99; mammals 3/13/99; and vegetation 3/99.

b Fall survey dates are as follows: amphibians 3/27/99, 10/21/99, 11/5/99, and 11/18/99; birds 10/21/99, 10/28/99, 1/11/99, and 11/18/99; fish 11/11/99; mammals 10/29/99; and vegetation 9/99.

c P = present.

d NO = Not observed.

Table 7-21. Radioactivity in surface and drinking water (Bq/L) in the Livermore Valley, 1999.

Locations	Date	Tritium	Gross alpha	Gross beta
Drinking waters				
BELL	1/14	–5.74 ± 2.14	0.0132 ± 0.0481	1.03 ± 0.178
	7/16	–1.48 ± 1.38	0.0191 ± 0.0206	0.0718 ± 0.0168
GAS	1/14	–5.25 ± 2.15	0.168 ± 0.0703	0.389 ± 0.155
	7/15	–1.64 ± 1.41	0.0159 ± 0.0236	0.0611 ± 0.0312
PALM	1/14	–5.96 ± 2.15	0.0762 ± 0.0629	0.192 ± 0.141
	7/16	–1.21 ± 1.4	—[a]	—[a]
	7/30	—[a]	0.0114 ± 0.0264	0.0929 ± 0.0418
ORCH	1/14	–4.96 ± 2.18	0.0463 ± 0.0629	0.132 ± 0.126
	7/15	0.356 ± 1.48	0.0366 ± 0.0411	0.381 ± 0.091
TAP	1/14	–5 ± 2.16	0.0403 ± 0.0444	< 2.9
	7/15	—[a]	0.00622 ± 0.0105	0.0353 ± 0.0118
	7/16	–0.377 ± 1.44	—[a]	—[a]
Surface waters				
CAL	1/14	–4.59 ± 2.26	0.057 ± 0.0481	0.071 ± 0.133
	7/15	–0.574 ± 1.42	–0.00181 ± 0.0114	0.074 ± 0.0175
DEL	1/14	–5.22 ± 2.18	0.109 ± 0.0518	0.396 ± 0.137
	7/15	–0.71 ± 1.46	0.0293 ± 0.0273	0.14 ± 0.0335
DUCK	1/14	–4.63 ± 2.19	<5.3	0.651 ± 0.252
	7/15	0.87 ± 1.5	0.232 ± 0.188	0.326 ± 0.188
ALAG	1/14	–4.14 ± 2.22	0.0847 ± 0.0666	0.136 ± 0.141
	7/15	–1.04 ± 1.41	0.0237 ± 0.0256	0.091 ± 0.0275
SHAD	1/14	–4.55 ± 2.19	0.196 ± 0.0925	0.193 ± 0.13
	7/15	1.18 ± 1.56	0.0459 ± 0.0429	0.181 ± 0.0481
ZON7	1/14	–5.74 ± 2.14	0.374 ± 0.0999	0.555 ± 0.163
	7/16	–0.518 ± 1.43	0.0208 ± 0.0194	0.0592 ± 0.016
On-site pool				
POOL	1/14	0.0807 ± 2.4	0.102 ± 0.118	0.201 ± 0.137
	4/2	10.1 ± 1.91	—[b]	—[b]
	7/16	4.66 ± 1.72	0.0574 ± 0.0821	0.225 ± 0.105
	10/12	5.29 ± 2.35	—[b]	—[b]

Note: Radioactivities are reported as the measured concentration and either an uncertainty (±2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

[a] Third-quarter—samples for all analytes were not collected on the same day (procedures do not require same-day sample collection).

[b] Sampled semiannually—Pool samples are collected quarterly for tritium, semiannually for gross alpha and gross beta radiation.

8

There are no supplemental data in this chapter. Please see the main volume for details about Ground Water Investigation and Remediation.

9

Ground Water Monitoring

Eric Christofferson
Richard A. Brown
Sandra Mathews
Rebecca Ward

Methods

Representative samples of ground water from monitoring wells were obtained by following the written protocols contained in *the LLNL Environmental Restoration Project Standard Operating Procedures* (Dibley and Depue 1999), which are updated annually. The protocols cover sampling techniques and specific information for the analytes that are routinely searched for in ground water. Different sampling techniques were applied to different wells depending on whether they were fitted with submersible pumps, had to be bailed, or contained Barcad devices, where we used nitrogen gas under pressure to extract water samples.

Typically, sampling technologists purged wells of standing water and waited for the wells to recover before they collected water samples. They wore disposable vinyl gloves to prevent accidental contamination during sampling and cleaned pH and depth-to-water probes with deionized water after each use. For quality assurance purposes, they obtained field blank samples and equipment blank samples to test the cleanliness of the sampling methods. They used clean sample containers and, where required, they used ultrapure chemicals (mostly acids) to preserve the samples.

Off-site laboratories performed most of the water analyses during 1999, under contract with LLNL. LLNL personnel primarily measured tritium activity in an on-site laboratory dedicated to that purpose. (Note that the ground water radioactivity data for 1999 include some small negative values [in Bq/L]. These can occur when the independently determined correction for background radioactivity is subtracted from measurements of ground waters that contain little or no radioactive material.)

At Site 300, wastewater samples were collected in accordance with written protocols outlined in Operations and Regulatory Affairs Division, Water Guidance and Monitoring Group procedure EMP-W-S (Rev. 4), *Water Sampling*. The procedure details several sample collection methodologies appropriate for wastewater sampling, and the field technologist selected the exact methodology for sampling the process discharge.

As with ground water sampling, standard sample handling and hygiene procedures were employed to prevent cross-contamination (e.g., wearing disposable gloves, decontaminating sampling equipment, and maintaining samples at 4 ± 2° Celsius). Replicates, field blanks, and trip blanks were collected for quality assurance/quality control purposes. Most analyses were performed off site by contract analytical laboratories except when the on-site laboratory offered better capabilities and/or detection limits.

Technologists sampled wastewater from the chemistry area and sampled retention tanks associated with Buildings 825, 826, and 827 using Hazardous Waste Management Procedure 411. Wastewater was held in retention tanks until analytical results were reviewed for compliance with Waste Discharge Requirements No. 96-248.

Livermore Site

Table 9-1 lists the ground water constituents monitored at the Livermore site and at Site 300, the EPA-approved methods used to measure them, and the detection limits (reporting limits) employed.

Tables 9-2 to **9-11** report routine surveillance monitoring for wells along the Livermore site perimeter; wells W-008, W-017, and W-221 are upgradient and the remaining seven wells are downgradient from the site. **Tables 9-12** and **9-13** contain analytical data obtained from monitoring wells downgradient from the Taxi Strip Area, and **Tables 9-14** through **9-18** contain analytical data obtained from monitoring wells downgradient from the East Traffic Circle Area. **Table 9-19** contains data from W-593, downgradient from the Decontamination and Waste Treatment Facility. **Tables 9-20** through **9-22** contain data from wells downgradient from the Hazardous Waste Management facilities near Buildings 514 and 612. **Tables 9-23** through **9-25** list results of metals analyses from wells downgradient from where metal wastes are managed. **Table 9-26** contains data from monitoring well W-305 just upgradient from Superblock, containing the Plutonium and Tritium facilities. Data from SIP-331-001, just downgradient from the Plutonium Facility is contained in **Table 9-27**; data from well W-148, downgradient from both the Plutonium and Tritium Facilities, is contained in **Table 9-28**.

Tritium activities in ground water at 18 monitoring wells in the Livermore Valley are listed in **Table 9-29**.

Site 300

Tables 9-30 through **9-43** contain chemical data for Site 300 surveillance monitoring wells (Elk ravine drainage area, including closed landfill pits 2, 8, and 9, and Corral Hollow creek drainage area, including closed high-explosives burn pit, standby water supply, active water supply, and off-site wells).

Additional chemical data for Site 300 ground water that was obtained during 1999 from compliance monitoring of closed landfill pits 1, 6, and 7, active surface water impoundments, and sewage ponds can be found in published compliance monitoring reports (Brown et al. 2000; Christofferson and MacQueen 2000; and Christofferson and Taffet 2000).

Table 9-1a. Analytical methods and reporting limits for inorganic constituents of concern in ground water.[(a)]

Constituents of concern	Analytical method	Reporting limit
Metals and minerals (mg/L)		
All alkalinities	EPA 310.1	1
Aluminum	EPA 200.7	0.02
Ammonia nitrogen (as N)	EPA 350.3	0.03
Antimony	EPA 204.2	0.005
Arsenic	EPA 206.2	0.002
Barium	EPA 200.7	0.025
Beryllium	EPA 210.2	0.0005
Cadmium	EPA 213.2	0.0005
Calcium	EPA 200.7	0.5
Chloride	EPA 325.3 or 300.0	1
Chromium	EPA 218.2	0.001
Cobalt	EPA 200.7	0.025
Copper	EPA 200.7	0.01
Fluoride	EPA 340.2	0.1
Hardness, total (as $CaCO_3$)	SM 2320B	1
Iron	EPA 200.7	0.1
Lead	EPA 239.2	0.002
Magnesium	EPA 200.7	0.5
Manganese	EPA 200.7	0.03
Mercury	EPA 245.2	0.0002
Molybdenum	EPA 200.7	0.025
Nickel	EPA 249.2	0.005
Nitrate (as NO_3)	EPA 353.2	0.1
Perchlorate	EPA 300.0-IC	0.004
Potassium	EPA 200.7	1
Selenium	EPA 270.2	0.002
Silver	EPA 272.2	0.001
Sodium	EPA 200.7	1
Sulfate	EPA 300.0	1
Surfactants	EPA 425.1	0.5
Thallium	EPA 279.2	0.001
Total dissolved solids	EPA 160.1	1
Total Kjeldahl nitrogen	EPA 351.4	0.2
Total suspended solids	EPA 160.2	1

Table 9-1a. Analytical methods and reporting limits for inorganic constituents of concern in ground water (concluded).[a]

Constituents of concern	Analytical method	Reporting limit
Metals and minerals (mg/L) (continued)		
Vanadium	EPA 200.7	0.025
Zinc	EPA 200.7	0.02
Phenolics (mg/L)		
Phenolics	EPA 420.1	0.005
General indicator parameters		
pH (pH units)	EPA 150.1	none
Specific conductance (µmho/cm)	EPA 120.1	1
Total organic carbon (mg/L)	EPA 415.1	0.5
Total organic halides (mg/L)	EPA 9020	0.01
Explosive compounds (µg/L)		
HMX[b]	HPLC	5
RDX[c]	HPLC	5
TNT[d]	HPLC	5
Radioactivity (Bq/L)		
Gross alpha	EPA 900	0.1
Gross beta	EPA 900	0.1
Radioisotopes (Bq/L)		
Americium-241	U-NAS-NS-3050	0.0037
Plutonium-238	U-NAS-NS-3050	0.0037
Plutonium-239+240	U-NAS-NS-3050	0.0037
Radon-222	EPA 913	0.4
Radium-226	EPA 903	0.0037
Radium-228	EPA 904	0.037
Strontium-90	SM 7500	0.1–0.15
Thorium-228	U-NAS-NS-3050	0.009
Thorium-230	U-NAS-NS-3050	0.006
Thorium-232	U-NAS-NS-3050	0.006
Tritium	LLNL-RAS-011	2
Uranium-234	U-NAS-NS-3050	0.0037
Uranium-235	U-NAS-NS-3050	0.0037
Uranium-238	U-NAS-NS-3050	0.0037

a The significant figures displayed in this table vary by constituents of concern. These variations reflect regulatory agency permit stipulations, or the applicable analytical laboratory contract under which the work was performed, or both.

b HMX is octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine.

c RDX is hexahydro-1,3,5-trinitro-1,3,5-triazine.

d TNT is 2,4,6-trinitrotoluene.

Table 9-1b. Analytical methods and reporting limits for organic constituents of concern in ground water.[a]

Constituents of concern	Reporting limit (µg/L)
EPA Method 502.2	
1,1,1,2-Tetrachloroethane	0.2
1,1,1-Trichloroethane	0.2
1,1,2,2-Tetrachloroethane	0.2
1,1,2-Trichloroethane	0.2
1,1-Dichloroethane	0.2
1,1-Dichloroethene	0.2
1,1-Dichloropropene	0.2
1,2,3-Trichlorobenzene	0.2
1,2,3-Trichloropropane	0.2
1,2,4-Trichlorobenzene	0.2
1,2,4-Trimethylbenzene	0.2
1,2-Dichlorobenzene	0.2
1,2-Dichloroethane	0.2
1,2-Dichloropropane	0.2
1,3,5-Trimethylbenzene	0.2
1,3-Dichlorobenzene	0.2
1,3-Dichloropropane	0.2
1,4-Dichlorobenzene	0.2
2,2-Dichloropropane	0.2
2-Chlorotoluene	0.2
4-Chlorotoluene	0.2
Benzene	0.2
Bromobenzene	0.2
Bromochloromethane	0.2
Bromodichloromethane	0.2
Bromoform	0.2
Bromomethane	0.2
Carbon tetrachloride	0.2
Chlorobenzene	0.2
Chloroethane	0.2
Chloroform	0.2
Chloromethane	0.2
cis-1,2-Dichloroethene	0.2
cis-1,3-Dichloropropene	0.5
Dibromochloromethane	0.2
Dibromomethane	0.2
Dichlorodifluoromethane	0.2
Ethylbenzene	0.2
Freon 113	0.2
Hexachlorobutadiene	0.2
Isopropylbenzene	0.2
m- and *p*-Xylene isomers	0.2
Methylene chloride	0.2
n-Butylbenzene	0.2
n-Propylbenzene	0.2
Naphthalene	0.2
o-Xylene	0.2
Isopropyl toluene	0.2
sec-Butylbenzene	0.2
Styrene	0.2
tert-Butylbenzene	0.2
Tetrachloroethene	0.2
Toluene	0.2
trans-1,2-Dichloroethene	0.2
trans-1,3-Dichloropropene	0.2
Trichloroethene	0.2
Trichlorofluoromethane	0.2
Vinyl chloride	0.2
EPA Method 525.2	
Atrazine	0.2
Bromacil	0.5

Table 9-1b. Analytical methods and reporting limits for organic constituents of concern in ground water (continued).[a]

Constituents of concern	Reporting limit (µg/L)
EPA Method 525.2	
Butachlor	0.3
Diazinon	0.2
Dimethoate	2
Metolachlor	0.5
Metribuzin	0.5
Molinate	0.5
Prometryn	0.5
Propachlor	0.5
Simazine	0.2
Thiobencarb	0.5
EPA Method 524.2	
1,1,1,2-Tetrachloroethane	1
1,1,1-Trichloroethane	1
1,1,2,2-Tetrachloroethane	1
1,1,2-Trichloroethane	1
1,1-Dichloroethane	1
1,1-Dichloroethene	1
1,1-Dichloropropene	1
1,2,3-Trichlorobenzene	1
1,2,3-Trichloropropane	1
1,2,4-Trichlorobenzene	1
1,2,4-Trimethylbenzene	1
1,2-Dibromo-3-chloropropane	2
1,2-Dichlorobenzene	1
1,2-Dichloroethane	1
1,2-Dichloropropane	1
1,3,5-Trimethylbenzene	1
1,3-Dichlorobenzene	1
1,3-Dichloropropane	1
1,4-Dichlorobenzene	1
2-Chlorotoluene	1
4-Chlorotoluene	1
Benzene	1
Bromobenzene	1
Bromodichloromethane	1
Bromoform	1
Bromomethane	2
Carbon tetrachloride	1
Chlorobenzene	1
Chloroethane	2
Chloroform	1
Chloromethane	2
cis-1,2-Dichloroethene	1
cis-1,3-Dichloropropene	1
Dibromochloromethane	1
Dibromomethane	1
Dichlorodifluoromethane	2
Ethylbenzene	1
Ethylene dibromide	1
Freon 113	1
Hexachlorobutadiene	1
Isopropylbenzene	1
m- and *p*-Xylene isomers	1
Methylene chloride	1
n-Butylbenzene	1
n-Propylbenzene	1
Naphthalene	1
o-Xylene	1
Isopropyl toluene	1
sec-Butylbenzene	1
Styrene	1

Table 9-1b. Analytical methods and reporting limits for organic constituents of concern in ground water (continued).[a]

Constituents of concern	Reporting limit (µg/L)
EPA Method 524.2 (cont'd)	
tert-Butylbenzene	1
Tetrachloroethene	1
Toluene	1
trans-1,2-Dichloroethene	1
trans-1,3-Dichloropropene	1
Trichloroethene	0.5
Trichlorofluoromethane	1
Vinyl chloride	2
EPA Method 547	
Glyphosate	9
EPA Method 601	
1,1,1-Trichloroethane	0.5
1,1,2,2-Tetrachloroethane	0.5
1,1,2-Trichloroethane	0.5
1,1-Dichloroethane	0.5
1,1-Dichloroethene	0.5
1,2-Dichlorobenzene	0.5
1,2-Dichloroethane	0.5
1,2-Dichloroethene (total)	0.5
1,2-Dichloropropane	0.5
1,3-Dichlorobenzene	0.5
1,4-Dichlorobenzene	0.5
2-Chloroethylvinylether	0.5
Bromodichloromethane	0.5
Bromoform	0.5
Bromomethane	0.5
Carbon tetrachloride	0.5
Chlorobenzene	0.5
Chloroethane	0.5
Chloroform	0.5
Chloromethane	0.5
cis-1,3-Dichloropropene	0.5
Dibromochloromethane	0.5
Dichlorodifluoromethane	0.5
Freon 113	0.5
Methylene chloride	0.5
Tetrachloroethene	0.5
trans-1,3-Dichloropropene	0.5
Trichloroethene	0.5
Trichlorofluoromethane	0.5
Vinyl chloride	0.5
1,2-Dichlorobenzene	0.5
EPA Method 602	
1,3-Dichlorobenzene	0.3
1,4-Dichlorobenzene	0.3
Benzene	0.4
Chlorobenzene	0.3
Ethylbenzene	0.3
m- and *p*-Xylene isomers	0.4
o-Xylene	0.4
Toluene	0.3
Total xylene isomers	0.4
EPA Method 608	
Aldrin	0.05
BHC, alpha isomer	0.05
BHC, beta isomer	0.05
BHC, delta isomer	0.05
BHC, gamma isomer (Lindane)	0.05
Chlordane	0.5
Dieldrin	0.1
Endosulfan I	0.05
Endosulfan II	0.1
Endosulfan sulfate	0.1

Table 9-1b. Analytical methods and reporting limits for organic constituents of concern in ground water (continued).[a]

Constituents of concern	Reporting limit (µg/L)
EPA Method 608 (cont'd)	
Endrin	0.1
Endrin aldehyde	0.1
Heptachlor	0.05
Heptachlor epoxide	0.05
Methoxychlor	0.5
4,4'-DDD	0.1
4,4'-DDE	0.1
4,4'-DDT	0.1
PCBs	0.5
Toxaphene	1
EPA Method 615	
2,4,5-T	0.5
2,4,5-TP (Silvex)	0.2
2,4-D	1
2,4-Dichlorophenoxy acetic acid	2
Dalapon	2
Dicamba	1
Dichloroprop	2
Dinoseb	1
MCPA	250
MCPP	250
EPA Method 624	
1,1,1-Trichloroethane	0.5
1,1,2,2-Tetrachloroethane	0.5
1,1,2-Trichloroethane	0.5
1,1-Dichloroethane	0.5
1,1-Dichloroethene	0.5
1,2-Dichlorobenzene	0.5
1,2-Dichloroethane	0.5
1,2-Dichloroethene (total)	0.5

Constituents of concern	Reporting limit (µg/L)
1,2-Dichloropropane	0.5
1,3-Dichlorobenzene	0.5
1,4-Dichlorobenzene	0.5
2-Butanone	20
2-Chloroethylvinylether	5
2-Hexanone	20
4-Methyl-2-pentanone	20
Acetone	10
Benzene	0.5
Bromodichloromethane	0.5
Bromoform	0.5
Bromomethane	0.5
Carbon disulfide	5
Carbon tetrachloride	0.5
Chlorobenzene	0.5
Chloroethane	1
Chloroform	0.5
Chloromethane	1
cis-1,3-Dichloropropene	0.5
Dibromochloromethane	1
Dibromomethane	1
Dichlorodifluoromethane	0.5
Ethylbenzene	0.5
Freon 113	0.5
Methylene chloride	1.0
Styrene	0.5
Tetrachloroethene	0.5
Toluene	0.5
Total xylene isomers	1
trans-1,3-Dichloropropene	0.5
Trichloroethene	0.5

Table 9-1b. Analytical methods and reporting limits for organic constituents of concern in ground water (continued).[a]

Constituents of concern	Reporting limit (µg/L)
EPA Method 624 (cont'd)	
Trichlorofluoromethane	0.5
Vinyl chloride	0.5
EPA Method 625[b]	
1,2,4-Trichlorobenzene	5
1,2-Dichlorobenzene	5
1,3-Dichlorobenzene	5
1,4-Dichlorobenzene	5
2,4,5-Trichlorophenol	5
2,4,6-Trichlorophenol	5
2,4-Dichlorophenol	5
2,4-Dimethylphenol	5
2,4-Dinitrophenol	25
2,4-Dinitrotoluene	5
2,6-Dinitrotoluene	5
2-Chloronaphthalene	5
2-Chlorophenol	5
2-Methylphenol	5
2-Methyl-4,6-dinitrophenol	25
2-Methylnaphthalene	5
2-Nitroaniline	25
2-Nitrophenol	5
3,3'-Dichlorobenzidine	10
3-Nitroaniline	25
4-Bromophenylphenylether	5
4-Chloro-3-methylphenol	10
4-Chloroaniline	10
4-Chlorophenylphenylether	5
4-Nitroaniline	25
4-Nitrophenol	25

Constituents of concern	Reporting limit (µg/L)
Acenaphthene	5
Acenaphthylene	5
Anthracene	5
Benzo[*a*]anthracene	5
Benzo[*a*]pyrene	5
Benzo[*b*]fluoranthene	5
Benzo[*g,h,i*]perylene	5
Benzo[*k*]fluoranthene	5
Benzoic acid	25
Benzyl alcohol	10
Bis(2-chloroethoxy)methane	5
Bis(2-chloroisopropyl)ether	5
Bis(2-ethylhexyl)phthalate	5
Butylbenzylphthalate	5
Chrysene	5
Di-*n*-butylphthalate	5
Di-*n*-octylphthalate	5
Dibenzo[*a,h*]anthracene	5
Dibenzofuran	5
Diethylphthalate	5
Dimethylphthalate	5
Fluoranthene	5
Fluorene	5
Hexachlorobenzene	5
Hexachlorobutadiene	5
Hexachlorocyclopentadiene	5
Hexachloroethane	5
Indeno[*1,2,3-c,d*]pyrene	5
Isophorone	5
m- and *p*-Cresol	5

Table 9-1b. Analytical methods and reporting limits for organic constituents of concern in ground water (concluded).[a]

Constituents of concern	Reporting limit (µg/L)
EPA Method 625 (cont'd)	
N-Nitroso-di-*n*-propylamine	5
N-Nitrosodiphenylamine	5
Naphthalene	5
Nitrobenzene	5
Pentachlorophenol	25
Phenanthrene	5
Phenol	5
Pyrene	5
EPA Method 632	
Diuron	0.1
EPA Method 8080	
Polychlorinated biphenyls	0.2

a The significant figures displayed in this table vary by constituents of concern. These variations reflect regulatory agency permit stipulations, or the applicable analytical laboratory contract under which the work was performed, or both.

b Analytical reporting limits for analytes in EPA Method 625 varied by laboratory used.

Table 9-1c. Radioisotopes and reporting limits for gamma spectroscopic analysis of constituents of concern in ground water.[a]

Constituents of concern	Reporting limit (Bq/L)
Actinium-228	0.52
Americum-241	0.28
Beryllium-7	0.9
Bismuth-214	0.56
Cesium-137	0.56
Cobalt-57	1.0
Cobalt-60	0.9
Europium-152	0.96
Potassium-40	1.66
Lead-212	0.9
Lead-214	0.9
Thorium-234	0.23
Thallium-208	0.15
Uranium-235	0.89
Zirconium-95	0.9

a The significant figures displayed in this table vary by constituents of concern. These variations reflect the applicable analytical laboratory contract under which the work was performed.

Table 9-2. Livermore site surveillance well W-008.

Constituents of concern	Sampling dates			
	2/3/99	6/9/99	7/21/99	10/18/99
Inorganic (µg/L)				
pH (pH units)	7.7	na[(a)]	na	7.2
Field pH (pH units)	7.3	7.4	7.32	7.4
Specific conductance (µmho/cm)	2500	na	na	2400
Field specific conductance (µmho/cm)	1000	540	2600	2600
Total dissolved solids (TDS)	1500	na	na	1600
Water temperature (°C)	20	20	20	20
Aluminum	<50	<100	<100	<100
Antimony	<4	<5	<5	<5
Arsenic	<2	<2	2	2
Barium	<25	<25	<25	<25
Beryllium	<0.2	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5	<0.5
Chromium	6.8	5	5	3
Cobalt	<50	<50	<50	<50
Copper	<1	<2	<2	<1
Chromium(VI)	9.5	5	8	10
Iron	<50	<100	<100	<100
Lead	<5	<5	<5	<5
Manganese	<10	<30	<30	<30
Mercury	<0.2	<0.2	<0.2	<0.2
Molybdenum	<25	<25	<25	<25
Nickel	<2	<5	<5	<5
Selenium	<2	<2	<2	<2
Silver	<1	<1	<1	<1
Thallium	<1	<2	<2	<2
Vanadium	16	<20	<20	<20
Zinc	<10	<20	<20	<20
General minerals (mg/L)				
Bicarbonate alkalinity (as $CaCO_3$)[(b)]	230	na	na	220
Boron	9.4	9.1	9	8.3
Calcium	100	na	na	98
Chloride	510	na	na	560
Fluoride	1.3	na	na	1.28
Magnesium	54	na	na	49
Nitrate	19	na	na	<0.5
Orthophosphate	0.06	na	na	<0.02
Potassium	2	na	na	2

Table 9-2. Livermore site surveillance well W-008 (concluded).

Constituents of concern	Sampling dates			
	2/3/99	6/9/99	7/21/99	10/18/99
General minerals (mg/L) (continued)				
Sodium	370	na	na	320
Sulfate	340	na	na	330
Surfactants	<0.05	na	na	<0.5
Total hardness (as $CaCO_3$)	470	na	na	450
Total phosphorus	0.05	na	na	na
Organic (µg/L)				
EPA Method 625	na	na	na	nd[c]
Radioactive (Bq/L)				
Gross alpha	0.38 ± 0.10	0.13 ± 0.13	0.27 ± 0.15	0.17 ± 0.052
Gross beta	0.20 ± 0.10	0.085 ± 0.088	0.20 ± 0.12	0.082 ± 0.053
Americium-241	0.0005 ± 0.001	0.0004 ± 0.001	0.001 ± 0.0004	na
Plutonium-238	–0.00002 ± 0.00002	na	<0.19	0.0004 ± 0.001
Plutonium-239+240	0.00002 ± 0.00006	na	0.0002 ± 0.0002	0.0001 ± 0.001
Radium-226	0.020 ± 0.013	0.001 ± 0.001	0.003 ± 0.001	na
Radium-228	0.011 ± 0.011	0.036 ± 0.013	0.009 ± 0.010	na
Thorium-228	0.003 ± 0.003	0.0002 ± 0.001	0.001 ± 0.002	na
Thorium-230	0.003 ± 0.002	–0.0001 ± 0.0001	0.001 ± 0.002	na
Thorium-232	0.00001 ± 0.001	<0.006	–0.0001 ± 0.0001	na
Tritium	–2.8 ± 2.0	0.18 ± 2.7	–1.3 ± 1.4	0.74 ± 2.3
Uranium (total)	0.21 ± 0.02	0.20 ± 0.02	0.20 ± 0.02	0.19 ± 0.02

Note: Radioactivities are reported as the measured concentration and either an uncertainty (±2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

[a] na = Not analyzed (analysis not required).

[b] Bicarbonate alkalinity = total alkalinity.

[c] nd = None detected above reporting limits. See Table 9-1 for analytical methods and their constituents.

Table 9-3. Livermore site surveillance well W-221.

Constituents of concern	Sampling dates			
	2/3/99	6/14/99	7/22/99	10/18/99
Inorganic (µg/L)				
pH (pH units)	7.5	na[a]	na	7.1
Field pH (pH units)	7.0	7.3	7.2	7.3
Specific conductance (µmho/cm)	1600	na	na	1600
Field specific conductance (µmho/cm)	1700	1700	1700	1600
Total dissolved solids (TDS) (mg/L)	1000	na	na	1000
Water temperature (°C)	20	21	20	21
Aluminum	<50	<100	300	<100
Antimony	<4	<5	<5	<5
Arsenic	<2	<2	<2	<2
Barium	110	120	110	110
Beryllium	<0.2	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5	<0.5
Chromium	5.2	3	3	2
Cobalt	<50	<50	<50	<50
Chromium(VI)	4.6	4	5	4
Lead	<5	<5	<5	<5
Mercury	<0.2	<0.2	<0.2	<0.2
Nickel	24	21	14	18
Selenium	<2	<2	<2	<2
Silver	<1	<1	<1	<1
Thallium	<1	<2	<2	<2
Vanadium	<10	<20	<20	<20
Zinc	<10	<20	30	<20
General minerals (mg/L)				
Bicarbonate alkalinity (as $CaCO_3$)[b]	330	na	na	310
Boron	2.5	2.5	2.4	2.3
Calcium	120	na	na	130
Chloride	290	na	na	280
Fluoride	0.65	na	na	0.7
Magnesium	45	na	na	43
Nitrate	31	na	na	<0.5
Orthophosphate	<0.05	na	na	<0.02
Potassium	1.9	na	na	1
Sodium	150	na	na	140
Sulfate	88	na	na	77
Surfactants	0.12	na	na	<0.5
Total hardness (as $CaCO_3$)	490	na	na	500
Total phosphorus	<0.05	na	na	na

Table 9-3. Livermore site surveillance well W-221 (continued).

Constituents of concern	Sampling dates			
	2/3/99	6/14/99	7/22/99	10/18/99
Organic (µg/L)				
EPA Method 625	na	na	na	nd[c]
Radioactive (Bq/L)				
Gross alpha	0.31 ± 0.06	0.23 ± 0.11	0.21 ± 0.11	0.33 ± 0.07
Gross beta	0.15 ± 0.05	0.23 ± 0.09	0.21 ± 0.10	0.36 ± 0.06
Americium-241	0.001 ± 0.001	0.0005 ± 0.001	0.0003 ± 0.0003	na
Plutonium-238	0.0001 ± 0.00009	na	–0.00004 ± 0.0001	0.002 ± 0.002
Plutonium-239+240	–0.000004 ± 0.00004	na	–0.0001 ± 0.0001	-0.0004 ± 0.001
Radium-226	0.033 ± 0.016	0.001 ± 0.001	0.001 ± 0.001	na
Radium-228	0.012 ± 0.020	0.010 ± 0.008	0.017 ± 0.011	na
Thorium-228	0.003 ± 0.002	0.001 ± 0.001	–0.0003 ± 0.0011	na
Thorium-230	0.001 ± 0.001	<0.006 ± 0.001	–0.00004 ± 0.0001	na
Thorium-232	–0.0002 ± 0.0003	<0.006 ± 0.001	<0.006 ± 0.001	na
Tritium	–1.3 ± 2.0	4.4 ± 2.7	1.4 ± 1.6	1.7 ± 2.3
Uranium (total)	0.30 ± 0.03	0.28 ± 0.03	0.26 ± 0.03	0.27 ± 0.02

Note: Radioactivities are reported as the measured concentration and either an uncertainty (±2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

[a] na = Not analyzed (analysis not required).

[b] Bicarbonate alkalinity = total alkalinity.

[c] nd = None detected by above method reporting limits. See Table 9-1 for analytical methods and their constituents.

Table 9-4. Livermore site surveillance well W-017.

Constituents of concern	Sampling date 7/26/99
Inorganic (µg/L)	
Aluminum	<100
Antimony	<5
Arsenic	3
Barium	230
Beryllium	<0.5
Boron	600
Cadmium	<0.5
Chromium	9
Cobalt	<50
Copper	<2
Chromium(VI)	11
Iron	<100
Lead	<5
Manganese	<30
Mercury	<0.2
Molybdenum	<25
Nickel	<5
Selenium	<2
Silver	<1
Thallium	<2
Vanadium	<20
Zinc	<20
Radioactive (Bq/L)	
Gross alpha	0.24 ± 0.08
Gross beta	0.12 ± 0.05
Americium 241	0.0001 ± 0.0002
Plutonium 238	–0.00002 ± 0.0002
Plutonium 239+240	0.00008 ± 0.0002
Radium 226	0.029 ± 0.007
Radium 228	0.011 ± 0.010
Thorium 228	–0.000001 ± 0.001
Thorium 230	0.0002 ± 0.0005
Thorium 232	<0.006
Tritium	–1.8 ± 1.4
Uranium (total)	0.19 ± 0.01

Note: Radioactivities are reported as the measured concentration and either an uncertainty (±2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

Table 9-5. Livermore off-site surveillance well 14B1.

Constituents of concern	Sampling dates			
	2/3/99	6/14/99	7/20/99	10/19/99
Inorganic (µg/L)				
pH (pH units)	7.7	na[a]	na	na
Specific conductance (µmho/cm)	820	na	na	na
Total dissolved solids (TDS) (mg/L)	520	na	na	na
Aluminum	<50	na	na	na
Antimony	<4	na	na	na
Arsenic	<2	na	na	na
Barium	110	na	na	na
Beryllium	<0.2	na	na	na
Cadmium	<0.5	na	na	na
Chromium	12	na	na	na
Cobalt	<50	na	na	na
Copper	<1	na	na	na
Chromium(VI)	8.9	na	na	na
Iron	68	na	na	20
Lead	<5	na	na	na
Manganese	<10	na	na	na
Mercury	<0.2	na	na	na
Molybdenum	<25	na	na	na
Nickel	<2	na	na	na
Selenium	<2	na	na	na
Silver	<1	na	na	na
Thallium	<1	na	na	na
Vanadium	<10	na	na	na
Zinc	36	na	na	na
General minerals (mg/L)				
Bicarbonate alkalinity (as $CaCO_3$)[b]	240	na	na	na
Boron	0.78	na	na	na
Calcium	58	na	na	na
Chloride	82	na	na	na
Fluoride	0.25	na	na	na
Magnesium	33	na	na	na
Nitrate	30	na	na	na
Orthophosphate	0.24	na	na	na
Potassium	2	na	na	na
Sodium	69	na	na	na
Sulfate	48	na	na	na
Surfactants	0.11	na	na	na

Table 9-5. Livermore off-site surveillance well 14B1 (concluded).

Constituents of concern	Sampling dates			
	2/3/99	6/14/99	7/20/99	10/19/99
General minerals (mg/L) (continued)				
Total hardness (as $CaCO_3$)	280	na	na	na
Total phosphorus	0.06	na	na	na
Organic (µg/L)				
EPA Method 507	nd[c]	nd	nd	na
EPA Method 547	nd	nd	na	na
EPA Method 632	nd	nd	na	na
EPA Method 625	na	nd	na	na
Radioactive (Bq/L)				
Gross alpha	0.12 ± 0.03	0.075 ± 0.038	0.091 ± 0.052	0.12 ± 0.04
Gross beta	0.15 ± 0.03	0.087 ± 0.041	0.091 ± 0.058	0.12 ± 0.04
Plutonium-238	0.00002 ± 0.00004	na	na	na
Plutonium-239+240	0.00002 ± 0.00004	na	na	na
Radium-226	0.013 ± 0.011	0.001 ± 0.001	na	na
Radium-228	0.012 ± 0.019	0.021 ± 0.010	na	na
Thorium-228	0.004 ± 0.003	na	na	na
Thorium-230	0.0005 ± 0.001	na	na	na
Thorium-232	0.00001 ± 0.001	na	na	na
Tritium	–1.3 ± 2.0	3.3 ± 2.7	2.8 ± 1.6	na
Uranium (total)	0.087 ± 0.013	0.068 ± 0.010	na	na

Note: Radioactivities are reported as the measured concentration and either an uncertainty (±2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

[a] na = Not analyzed (analysis not required).

[b] Bicarbonate alkalinity = total alkalinity.

[c] nd = None detected above reporting limits. See Table 9-1 for analytical methods and their constituents.

Table 9-6. Livermore off-site surveillance well W-121.

Constituents of concern	Sampling dates			
	1/27/99	6/10/99	7/20/99	10/20/99
Inorganic (µg/L)				
pH (pH units)	8.0	na[a]	na	na
Field pH (pH units)	7.8	8.1	7.9	8.1
Specific conductance (µmho/cm)	720	na	na	na
Field specific conductance (µmho/cm)	740	730	730	730
Total dissolved solids (TDS) (mg/L)	440	na	na	na
Water temperature (°C)	19	21	20.1	19.7
Aluminum	<50	na	na	na
Antimony	<4	na	na	na
Arsenic	<2	na	na	na
Barium	66	na	na	na
Beryllium	<0.2	na	na	na
Cadmium	<0.5	na	na	na
Chromium	12	na	na	na
Cobalt	<50	na	na	na
Copper	<1	na	na	na
Chromium(VI)	12	13	na	9
Iron	<50	na	na	na
Lead	<5	na	na	na
Manganese	<10	na	na	na
Mercury	<0.2	na	na	na
Molybdenum	<25	na	na	na
Nickel	<2	na	na	na
Selenium	<2	na	na	na
Silver	<1	na	na	na
Thallium	<1	na	na	na
Vanadium	<10	na	na	na
Zinc	<10	na	na	na
General minerals (mg/L)				
Bicarbonate alkalinity (as $CaCO_3$)[b]	190	na	na	na
Boron	0.9	na	na	na
Calcium	37	na	na	na
Chloride	76	na	na	na
Fluoride	0.34	na	na	na
Magnesium	30	na	na	na
Nitrate	27[c]	na	na	na

Table 9-6. Livermore off-site surveillance well W-121 (concluded).

Constituents of concern	Sampling dates			
	1/27/99	6/10/99	7/20/99	10/20/99
General minerals (mg/L) (continued)				
Orthophosphate	0.24	na	na	na
Potassium	1.6	na	na	na
Sodium	69	na	na	na
Sulfate	12	na	na	na
Surfactants	<0.05	na	na	na
Total hardness (as $CaCO_3$)	220	na	na	na
Total phosphorus	0.07	na	na	na
Organic (µg/L)				
EPA Method 507	nd[d]	nd	nd	na
EPA Method 547	nd	nd	na	na
EPA Method 625	na	nd	na	na
EPA Method 632	nd	nd	na	na
Radioactive (Bq/L)				
Gross alpha	0.20 ± 0.05	0.011 ± 0.034	0.015 ± 0.025	0.030 ± 0.029
Gross beta	0.068 ± 0.032	0.083 ± 0.040	0.10 ± 0.047	0.061 ± 0.034
Radium 226	0.018 ± 0.008	0.001 ± 0.001	na	na
Radium 228	0.007 ± 0.022	0.015 ± 0.011	na	na
Tritium	na	–1.1 ± 2.5	–0.53 ± 1.5	na
Thorium 228	0.003 ± 0.002	na	na	na
Thorium 230	0.0002 ± 0.001	na	na	na
Thorium 232	0.0002 ± 0.0004	na	na	na
Uranium (total)	0.032 ± 0.008	0.002 ± 0.005	na	na

Note: Radioactivities are reported as the measured concentration and either an uncertainty (±2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

[a] na = Not analyzed (analysis not required).

[b] Bicarbonate alkalinity = total alkalinity.

[c] Samples were analyzed in five days, outside the holding time of two days.

[d] nd = None detected above reporting limits. See Table 9-1 for analytical methods and their constituents.

Table 9-7. Livermore off-site surveillance well W-151.

Constituents of concern	Sampling dates			
	1/27/99	6/10/99	7/20/99	10/20/99
Inorganic (µg/L)				
pH (pH units)	7.9	na[a]	na	na
Field pH (pH units)	7.4	7.7	7.5	7.8
Specific conductance (µmho/cm)	850	na	na	na
Field specific conductance (µmho/cm)	860	870	870	870
Total dissolved solids (TDS) (mg/L)	530	na	na	na
Water temperature (°C)	18	20	19	19
Aluminum	<50	na	na	na
Antimony	<4	na	na	na
Arsenic	<2	na	na	na
Barium	87	na	na	na
Beryllium	<0.2	na	na	na
Cadmium	<0.5	na	na	na
Chromium	16	na	na	na
Cobalt	<50	na	na	na
Copper	1	na	na	na
Chromium(VI)	18	22	na	19
Iron	<50	na	na	na
Lead	<5	na	na	na
Manganese	<10	na	na	na
Mercury	<0.2	na	na	na
Molybdenum	<25	na	na	na
Nickel	<2	na	na	na
Selenium	<2	na	na	na
Silver	<1	na	na	na
Thallium	<1	na	na	na
Vanadium	<10	na	na	na
Zinc	<10	na	na	na
General minerals (mg/L)				
Bicarbonate alkalinity (as $CaCO_3$)[b]	240	na	na	na
Boron	0.77	na	na	na
Calcium	52	na	na	na
Chloride	87	na	na	na
Fluoride	0.3	na	na	na
Magnesium	38	na	na	na
Nitrate	31[c]	na	na	na
Orthophosphate	0.25	na	na	na

Table 9-7. Livermore off-site surveillance well W-151 (concluded).

Constituents of concern	Sampling dates			
	1/27/99	6/10/99	7/20/99	10/20/99
General minerals (mg/L) (continued)				
Potassium	1.8	na	na	na
Sodium	70	na	na	na
Sulfate	44	na	na	na
Surfactants	<0.05	na	na	na
Total hardness (as $CaCO_3$)	290	na	na	na
Total phosphorus	0.07	na	na	na
Organic (µg/L)				
EPA Method 507	nd[d]	nd	nd	na
EPA Method 547	nd	nd	na	na
EPA Method 625	na	nd	na	na
EPA Method 632	nd	nd	na	na
Radioactive (Bq/L)				
Gross alpha	0.066 ± 0.035	0.062 ± 0.049	0.11 ± 0.06	0.047 ± 0.035
Gross beta	0.19 ± 0.04	0.15 ± 0.05	0.084 ± 0.056	0.073 ± 0.036
Plutonium-238	–0.0001 ± 0.0001	na	na	na
Plutonium-239+240	–0.00004 ± 0.0001	na	na	na
Radium-226	0.023 ± 0.007	0.001 ± 0.001	na	na
Radium-228	–0.011 ± 0.017	0.027 ± 0.011	na	na
Thorium-228	0.004 ± 0.003	na	na	na
Thorium-230	0.001 ± 0.002	na	na	na
Thorium-232	–0.0002 ± 0.001	na	na	na
Tritium	–4.4 ± 2.1	0.88 ± 2.6	–0.32 ± 1.5	na
Uranium (total)	0.060 ± 0.012	0.048 ± 0.007	na	na

Note: Radioactivities are reported as the measured concentration and either an uncertainty (±2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

[a] na = Not analyzed (analysis not required).

[b] Bicarbonate alkalinity = total alkalinity.

[c] Samples were analyzed in five days, outside the holding time of two days.

[d] nd = None detected above reporting limits. See Table 9-1 for analytical methods and their constituents.

Table 9-8. Livermore off-site surveillance well W-571.

Constituents of concern	Sampling dates			
	1/27/99	6/10/99	7/26/99	10/20/99
Inorganic (µg/L)				
pH (units)	7.6	na[a]	na	na
Field pH (units)	7.3	7.5	na	7.6
Specific conductance (µmho/cm)	830	na	na	na
Field specific conductance (µmho/cm)	860	840	na	850
Total dissolved solids (TDS, mg/L)	510	na	na	na
Field temperature (°C)	18	19	na	19
Aluminum	<50	na	na	na
Antimony	<4	na	na	na
Arsenic	<2	na	na	na
Barium	96	na	na	na
Beryllium	<0.2	na	na	na
Cadmium	<0.5	na	na	na
Chromium	20	na	na	na
Cobalt	<50	na	na	na
Copper	1	na	na	na
Chromium(VI)	20	24	na	21
Iron	<50	na	na	na
Lead	<5	na	na	na
Manganese	<10	na	na	na
Mercury	<0.2	na	na	na
Molybdenum	<25	na	na	na
Nickel	2.6	na	na	na
Selenium	2	na	na	na
Silver	<1	na	na	na
Thallium	<1	na	na	na
Vanadium	<10	na	na	na
Zinc	<10	na	na	na
General minerals (mg/L)				
Bicarbonate alkalinity (as $CaCO_3$)[b]	250	na	na	na
Boron	0.67	na	na	na
Calcium	64	na	na	na
Chloride	87	na	na	na
Fluoride	0.34	na	na	na
Magnesium	25	na	na	na

Table 9-8. Livermore off-site surveillance well W-571 (concluded).

Constituents of concern	Sampling dates			
	1/27/99	6/10/99	7/26/99	10/20/99
General minerals (mg/L) (continued)				
Nitrate	31[c]	na	na	na
Orthophosphate	0.21	na	na	na
Potassium	2	na	na	na
Sodium	73	na	na	na
Sulfate	35	na	na	na
Surfactants	<0.05	na	na	na
Total hardness (as $CaCO_3$)	260	na	na	na
Total phosphorus	0.06	na	na	na
Radioactive (Bq/L)				
Gross alpha	0.11 ± 0.04	0.061 ± 0.059	0.12 ± 0.05	0.058 ± 0.031
Gross beta	0.22 ± 0.04	0.12 ± 0.05	0.14 ± 0.05	0.15 ± 0.04
Americium-241	0.002 ± 0.002	na	na	na
Plutonium-238	0.000002 ± 0.0001	na	na	na
Plutonium-239+240	0.00003 ± 0.0001	na	na	na
Radium-226	0.007 ± 0.006	0.002 ± 0.001	na	na
Radium-228	0.016 ± 0.022	0.032 ± 0.012	na	na
Thorium-228	–0.003 ± 0.003	na	na	na
Thorium-230	–0.0003 ± 0.001	na	na	na
Thorium-232	0.0005 ± 0.001	na	na	na
Tritium	–1.8 ± 2.2	4.5 ± 2.8	2.2 ± 1.6	na
Uranium (total)	0.10 ± 0.02	0.098 ± 0.013	na	na

Note: Radioactivities are reported as the measured concentration and either an uncertainty (±2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

[a] na = Not analyzed (analysis not required).

[b] Bicarbonate alkalinity = total alkalinity.

[c] Samples were analyzed in five days, outside the holding time of two days.

Table 9-9. Livermore site surveillance well W-1012.

Constituents of concern	Sampling dates			
	2/11/99	6/8/99	7/20/99	10/19/99
Inorganic (µg/L)				
pH (pH units)	7.8	na[a]	na	na
Field pH (pH units)	na	7.5	7.3	7.3
Specific conductance (µmho/cm)	1100	na	na	na
Field specific conductance (µmho/cm)	na	970	1100	1100
Total dissolved solids (TDS, mg/L)	650	na	na	na
Water temperature (°C)	na	19.2	20	19
Aluminum	<50	na	na	na
Antimony	<4	na	na	na
Arsenic	<2	na	na	na
Barium	140	na	na	na
Beryllium	<0.2	na	na	na
Cadmium	<0.5	na	na	na
Chromium	20	na	na	na
Cobalt	22	na	na	na
Copper	<1	na	na	na
Chromium(VI)	18	15	21	24
Iron	<50	na	na	na
Lead	<5	na	na	na
Manganese	<10	na	na	na
Mercury	<0.2	na	na	na
Molybdenum	<25	na	na	na
Nickel	2.6	na	na	na
Selenium	3.5	na	na	na
Silver	<2	na	na	na
Thallium	<1	na	na	na
Vanadium	<10	na	na	na
Zinc	<10	na	na	na
General minerals (mg/L)				
Bicarbonate alkalinity (as $CaCO_3$)[b]	270	na	na	na
Boron	0.69	na	na	na
Calcium	89	na	na	na
Chloride	130	na	na	na
Fluoride	0.20	na	na	na
Magnesium	34	na	na	na
Nitrate	79	na	na	na
Orthophosphate	0.15	na	na	na

Table 9-9. Livermore site surveillance well W-1012 (concluded).

Constituents of concern	Sampling dates			
	2/11/99	6/8/99	7/20/99	10/19/99
General minerals (mg/L) (continued)				
Potassium	2.8	na	na	na
Sodium	79	na	na	na
Sulfate	28	na	na	na
Surfactants	<0.05	na	na	na
Total hardness (as $CaCO_3$)	360	na	na	na
Total phosphorus	0.05	na	na	na
Organic (µg/L)				
EPA Method 507	nd[c]	nd	nd	na
EPA Method 547	nd	nd	na	na
EPA Method 632	nd	nd	na	na
EPA Method 625	na	nd	na	na
Radioactive (Bq/L)				
Gross alpha	0.23 ± 0.05	0.087 ± 0.058	0.11 ± 0.07	0.165 ± 0.045
Gross beta	0.14 ± 0.03	0.14 ± 0.06	0.14 ± 0.06	0.175 ± 0.053
Plutonium-238	–0.00002 ± 0.0001	na	na	na
Plutonium-239+240	0.00002 ± 0.0001	na	na	na
Radium-226	0.011 ± 0.010	0.001 ± 0.001	na	na
Radium-228	0.039 ± 0.021	0.028 ± 0.012	na	na
Thorium-228	0.006 ± 0.002	na	na	na
Thorium-230	0.002 ± 0.001	na	na	na
Thorium-232	–0.0001 ± 0.0003	na	na	na
Tritium	0.27 ± 2.5	–1.1 ± 2.7	–0.32 ± 1.5	na
Uranium (total)	0.14 ± 0.02	0.12 ± 0.02	na	na

Note: Radioactivities are reported as the measured concentration and either an uncertainty (± 2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

[a] na = Not analyzed (analysis not required).

[b] Bicarbonate alkalinity = total alkalinity.

[c] nd = None detected above reporting limits. See Table 9-1 for analytical methods and their constituents.

Table 9-10. Livermore site surveillance well W-556.

Constituents of concern	Sampling dates			
	1/13/99	6/8/99	7/21/99	10/19/99
Inorganic (µg/L)				
pH (pH units)	7.7	na[a]	na	na
Field pH (pH units)	7.4	7.6	7.5	7.5
Specific conductance (µmho/cm)	720	850	970	980
Field specific conductance (µmho/cm)	960	na	na	na
Total dissolved solids (TDS, mg/L)	560	na	na	na
Field temperature (°C)	18	19	19	18
Aluminum	<50	na	na	na
Antimony	<4	na	na	na
Arsenic	<2	na	na	na
Barium	81	na	na	na
Beryllium	<0.2	na	na	na
Cadmium	<0.5	na	na	na
Chromium	29	na	na	na
Cobalt	<50	na	na	na
Copper	<1	na	na	na
Chromium(VI)	32	na	na	27
Iron	<50	na	na	na
Lead	<5	na	na	na
Manganese	<10	na	na	na
Mercury	<0.2	na	na	na
Molybdenum	<25	na	na	na
Nickel	<2	na	na	na
Selenium	5.4	na	na	na
Silver	<1	na	na	na
Thallium	<1	na	na	na
Vanadium	<10	na	na	na
Zinc	<10	na	na	na
General minerals (mg/L)				
Bicarbonate alkalinity (as $CaCO_3$)[b]	230	na	na	na
Boron	1100	na	na	na
Calcium	58	na	na	na
Chloride	130	na	na	na
Fluoride	0.3	na	na	na
Magnesium	22	na	na	na
Nitrate	29	na	na	na
Orthophosphate	0.17	na	na	na

Table 9-10. Livermore site surveillance well W-556 (concluded).

Constituents of concern	Sampling dates			
	1/13/99	6/8/99	7/21/99	10/19/99
General minerals (mg/L) (continued)				
Potassium	1.6	na	na	na
Sodium	100	na	na	na
Sulfate	38	na	na	na
Surfactants	<0.05	na	na	na
Total hardness (as $CaCO_3$)	240	na	na	na
Total phosphorus	0.05	na	na	na
Organic constituents (µg/L)				
EPA Method 507	na	nd[c]	nd	na
EPA Method 525	no[d]	na	na	na
Di(2-ethylhexyl)adipate	3.9	na	na	na
EPA Method 547	nd	nd	na	na
EPA Method 625	na	nd	na	na
EPA Method 632	nd	nd	na	na
Radioactive (Bq/L)				
Gross alpha	0.098 ± 0.037	0.15 ± 0.07	0.029 ± 0.043	0.16 ± 0.05
Gross beta	0.19 ± 0.04	0.11 ± 0.05	0.15 ± 0.06	0.067 ± 0.048
Plutonium-238	–0.0001 ± 0.0001	na	na	na
Plutonium-239+240	–0.0001 ± 0.0001	na	na	na
Radium-226	0.018 ± 0.007	0.004 ± 0.001	na	na
Radium-228	0.027 ± 0.016	0.039 ± 0.015	na	na
Thorium-228	–0.001 ± 0.002	na	na	na
Thorium-230	0.002 ± 0.001	na	na	na
Thorium-232	–0.0002 ± 0.001	na	na	na
Tritium	–3.4 ± 2.7	2.0 ± 2.8	0.095 ± 1.5	na
Uranium (total)	0.089 ± 0.009	0.092 ± 0.013	na	na

Note: Radioactivities are reported as the measured concentration and either an uncertainty (± 2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

[a] na = Not analyzed (analysis not required).

[b] Bicarbonate alkalinity = total alkalinity.

[c] nd = None detected above reporting limits (exceptions are listed). See Table 9-1 for analytical methods and their constituents.

[d] no = No analytes other than di(2-ethylhexvl)adipate were detected by this method.

Table 9-11. Livermore site surveillance well W-373.

Constituents of concern	Sampling dates			
	1/13/99	6/8/99	7/21/99	10/19/99
Inorganic (µg/L)				
pH (units)	7.8	na[a]	na	na
Field pH (units)	7.4	7.7	7.5	7.5
Specific conductance (µmho/cm)	930	na	na	na
Field specific conductance (µmho/cm)	800	810	930	930
Total dissolved solids (TDS, mg/L)	560	na	na	na
Field temperature (°C)	18	18	19	18
Aluminum	<50	na	na	na
Antimony	<4	na	na	na
Arsenic	<2	na	na	na
Barium	48	na	na	na
Beryllium	<0.2	na	na	na
Cadmium	<0.5	na	na	na
Chromium	65	na	na	na
Cobalt	<50	na	na	na
Copper	<1	na	na	na
Chromium(VI)	76	54	na	65
Iron	<50	na	na	na
Lead	<5	na	na	na
Manganese	<10	na	na	na
Mercury	<0.2	na	na	na
Molybdenum	<25	na	na	na
Nickel	<2	na	na	na
Selenium	<2	na	na	na
Silver	<1	na	na	na
Thallium	<1	na	na	na
Vanadium	<10	na	na	na
Zinc	<10	na	na	na
General minerals (mg/L)				
Bicarbonate alkalinity (as $CaCO_3$)[b]	210	na	na	na
Boron	1800	na	na	na
Calcium	50	na	na	na
Chloride	120	na	na	na
Fluoride	0.49	na	na	na
Magnesium	19	na	na	na
Nitrate	12	na	na	na
Orthophosphate	0.12	na	na	na

Table 9-11. Livermore site surveillance well W-373 (concluded).

Constituents of concern	Sampling dates			
	1/13/99	6/8/99	7/21/99	10/19/99
General minerals (mg/L) (continued)				
Potassium	1.4	na	na	na
Sodium	110	na	na	na
Sulfate	65	na	na	na
Surfactants	<0.05	na	na	na
Total hardness (as $CaCO_3$)	200	na	na	na
Total phosphorus	<0.05	na	na	na
Organic (µg/L)				
EPA Method 507	na	nd[c]	nd	na
EPA Method 525	no[d]	na	na	na
Di(2-ethylhexyl)adipate	5.2	na	na	na
EPA Method 547	nd	nd	na	na
EPA Method 625	na	nd	na	na
EPA Method 632	nd	nd	na	na
Radioactive (Bq/L)				
Gross alpha	0.093 ± 0.036	0.065 ± 0.063	0.066 ± 0.045	0.26 ± 0.07
Gross beta	0.076 ± 0.032	0.048 ± 0.046	0.13 ± 0.05	0.076 ± 0.060
Plutonium 238	0.00002 ± 0.00006	na	na	na
Plutonium 239+240	0.000003 ± 0.00005	na	na	na
Radium 226	0.032 ± 0.010	0.001 ± 0.001	na	na
Radium 228	0.013 ± 0.017	0.014 ± 0.013	na	na
Thorium 228	–0.001 ± 0.002	na	na	na
Thorium 230	0.002 ± 0.001	na	na	na
Thorium 232	–0.0003 ± 0.001	na	na	na
Tritium	7.6 ± 3.1	10 ± 3.1	9.7 ± 1.9	na
Uranium (total)	0.092 ± 0.009	0.081 ± 0.011	na	na

Note: Radioactivities are reported as the measured concentration and either an uncertainty (±2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

[a] na = Not analyzed (analysis not required).

[b] Bicarbonate alkalinity = total alkalinity.

[c] nd = None detected above reporting limits (exceptions are listed). See Table 9-1 for analytical methods and their constituents.

[d] no = No analytes other than di(2-ethylhexvl)adipate were detected by this method.

Table 9-12. Livermore site surveillance well W-204.

Constituents of concern	Sampling dates			
	2/4/99	6/15/99	7/26/99	11/3/99
Inorganic (µg/L)				
pH (pH units)	8.0	na[a]	na	na
Field pH (pH units)	7.7	8.1	na	7.6
Specific conductance (µmho/cm)	400	na	na	na
Field specific conductance (µmho/cm)	420	410	na	430
Total dissolved solids (TDS) (mg/L)	250	na	na	na
Water temperature (°C)	20	21	na	20
Aluminum	<50	100	na	100
Antimony	<4	5	na	5
Arsenic	<2	2	na	3
Barium	170	190	na	180
Beryllium	<0.2	0.5	na	0.5
Cadmium	<0.5	0.5	na	0.5
Chromium	17	12	na	12
Cobalt	<50	<50	na	<50
Copper	<1	2	na	2
Chromium(VI)	18	21	na	14
Iron	<50	<100	na	<100
Lead	<5	<5	na	<5
Manganese	<10	30	na	30
Mercury	<0.2	<0.2	na	<0.2
Molybdenum	<25	<25	na	<25
Nickel	<2	<5	na	<5
Selenium	<2	<2	na	<2
Silver	<1	<1	na	<1
Thallium	<1	<2	na	<2
Vanadium	12	<20	na	<20
Zinc	<10	<20	na	<20
General minerals (mg/L)				
Bicarbonate alkalinity (as $CaCO_3$)[b]	130	na	na	na
Boron	0.14	0.18	na	0.1
Calcium	33	na	na	na
Chloride	39	na	na	na
Fluoride	0.22	na	na	na

Table 9-12. Livermore site surveillance well W-204 (concluded).

Constituents of concern	Sampling dates			
	2/4/99	6/15/99	7/26/99	11/3/99
General minerals (mg/L) (continued)				
Magnesium	8.4	na	na	na
Nitrate	6.1[c]	na	na	na
Orthophosphate	0.1	na	na	na
Potassium	1.6	na	na	na
Sodium	37	na	na	na
Sulfate	9.3	na	na	na
Surfactants	<0.05	na	na	na
Total hardness (as $CaCO_3$)	120	na	na	na
Total phosphorus	0.06	na	na	na
Organic (µg/L)				
EPA Method 8082 (for PCBs)	na	na	nd[d]	na
Radioactive (Bq/L)				
Gross alpha	0.083 ± 0.022	0.023 ± 0.027	na	0.040 ± 0.020
Gross beta	0.086 ± 0.025	0.056 ± 0.029	na	0.076 ± 0.025
Americium 241	0.0001 ± 0.0004	0.0001 ± 0.000	na	0.001 ± 0.001
Plutonium 238	–0.00001 ± 0.0001	na	na	na
Plutonium 239+240	0.0001 ± 0.0001	na	na	na
Radium 226	0.014 ± 0.012	0.003 ± 0.001	na	0.083 ± 0.032
Radium 228	0.016 ± 0.014	0.005 ± 0.008	na	–0.065 ± 0.026
Thorium 228	0.001 ± 0.002	0.001 ± 0.001	na	–0.005 ± 0.006
Thorium 230	0.001 ± 0.001	–0.0001 ± 0.0001	na	0.0004 ± 0.004
Thorium 232	0.0002 ± 0.001	<0.006	na	0.002 ± 0.003
Tritium	–2.4 ± 2.0	1.0 ± 2.6	na	–0.7 ± 2.2
Uranium 238	0.044 ± 0.008	0.044± 0.007	na	0.037 ± 0.006

Note: Radioactivities are reported as the measured concentration and either an uncertainty (± 2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

[a] na = Not analyzed (analysis not required).

[b] Bicarbonate alkalinity = total alkalinity.

[c] Samples were analyzed in 13 days, outside the holding time of two days.

[d] nd = None detected above reporting limits. See Table 9-1 for analytical methods and their constituents.

Table 9-13. Livermore site surveillance well W-363.

Constituents of concern	Sampling dates			
	2/4/99	6/15/99	7/26/99	11/3 and 11/4/99
Inorganic (µg/L)				
pH (units)	7.4	na[a]	na	na
Field pH (units)	7.1	7.4	na	7.6
Specific conductance (µmho/cm)	470	na	na	na
Field specific conductance (µmho/cm)	490	470	na	490
Total dissolved solids (TDS, mg/L)	270	na	na	na
Field temperature (°C)	20	21	na	20
Aluminum	<50	<100	na	<100
Antimony	<4	<5	na	<5
Arsenic	<2	<2	na	<2
Barium	220	220	na	220
Beryllium	<0.2	<0.5	na	<0.5
Cadmium	<0.5	<0.5	na	<0.5
Chromium	12	10	na	14
Cobalt	<50	<50	na	<50
Copper	<1	<2	na	2
Chromium(VI)	9.1	17	na	<2
Iron	<50	<100	na	<100
Lead	<5	<5	na	<5
Manganese	<10	<30	na	<30
Mercury	<0.2	<0.2	na	<0.2
Molybdenum	<25	<25	na	<25
Nickel	<2	<5	na	12
Selenium	<2	<2	na	<2
Silver	<1	<1	na	<1
Thallium	<1	<2	na	<2
Vanadium	10	<20	na	<20
Zinc	<10	<20	na	<20
General minerals (mg/L)				
Bicarbonate alkalinity (as $CaCO_3$)[b]	150	na	na	na
Boron	0.18	0.19	na	0.1
Calcium	41	na	na	na
Chloride	40	na	na	na
Fluoride	0.24	na	na	na

Table 9-13. Livermore site surveillance well W-363 (concluded).

Constituents of concern	Sampling dates			
	2/4/99	6/15/99	7/26/99	11/3 and 11/4/99
General minerals (mg/L) (continued)				
Magnesium	14	na	na	na
Nitrate	14[c]	na	na	na
Orthophosphate	0.12	na	na	na
Potassium	1.5	na	na	na
Sodium	35	na	na	na
Sulfate	9.1	na	na	na
Surfactants	<0.05	na	na	na
Total hardness (as $CaCO_3$)	160	na	na	na
Total phosphorus	0.05	na	na	na
Organic (µg/L)				
EPA Method 8082 (for PCBs)	na	na	nd[d]	na
Radioactive (Bq/L)				
Gross alpha	0.076 ± 0.031	0.035 ± 0.034	na	0.042 ± 0.020
Gross beta	0.076 ± 0.032	0.082 ± 0.032	na	0.061 ± 0.023
Americium 241	0.001 ± 0.001	0.0004 ± 0.001	na	0.0002 ± 0.0004
Plutonium 238	0.0000 ± 0.0002	na	na	<0.037
Plutonium 239+240	–0.00004 ± 0.0001	na	na	<0.037
Radium 226	0.013 ± 0.012	0.003 ± 0.001	na	0.058 ± 0.030
Radium 228	0.014 ± 0.019	0.026 ± 0.011	na	–0.057 ± 0.025
Thorium 228	0.002 ± 0.002	–0.0003 ± 0.001	na	0.002 ± 0.008
Thorium 230	0.002 ± 0.001	<0.006	na	0.005 ± 0.006
Thorium 232	–0.0005 ± 0.0005	–0.00004 ± 0.0001	na	0.003 ± 0.005
Tritium	140 ± 6	100 ± 5.1	na	140 ± 6
Uranium (total)	0.018 ± 0.005	0.035 ± 0.006	na	0.044 ± 0.007

Note: Radioactivities are reported as the measured concentration and either an uncertainty (± 2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

a na = Not analyzed (analysis not required).

b Bicarbonate alkalinity = total alkalinity.

c Samples were analyzed in 13 days, outside the holding time of two days.

d nd = None detected above reporting limits. See Table 9-1 for analytical methods and their constituents.

Table 9-14. Livermore site surveillance well W-1308.

Constituents of concern	Sampling dates		
	1/2/99 and 1/19/99	4/15/99 and 6/7/99	7/15/99 and 7/19/99
Inorganic (µg/L)			
pH (pH units)	7.5	na[(a)]	na
Specific conductance (µmho/cm)	910	na	na
Total dissolved solids (TDS) (mg/L)	520	na	na
Aluminum	<50	<100	na
Antimony	<4	<5	na
Arsenic	<2	<2	na
Barium	340	410	na
Beryllium	<0.2	<0.5	na
Cadmium	<0.5	<0.5	na
Chromium	17	13	na
Cobalt	<50	<50	na
Copper	<1	<2	na
Chromium(VI)	21	19	na
Iron	<50	<100	na
Lead	<5	<5	na
Manganese	<10	<30	na
Mercury	<0.2	<0.2	na
Molybdenum	<25	<25	na
Nickel	<2	<5	na
Selenium	<2	<2	na
Silver	<1	<1	na
Thallium	<2	<2	na
Vanadium	<10	<20	na
Zinc	<10	<20	na
General minerals (mg/L)			
Bicarbonate alkalinity (as $CaCO_3$)[(b)]	330	na	na
Boron	0.54	0.59	na
Calcium	70	na	na
Chloride	72	na	na
Fluoride	0.48	na	na
Magnesium	27	na	na
Nitrate	29	na	na
Orthophosphate	0.08	na	na

Table 9-14. Livermore site surveillance well W-1308 (concluded).

Constituents of concern	Sampling date		
	1/2/99 and 1/19/99	4/15/99 and 6/7/99	7/15/99 and 7/19/99
General minerals (mg/L) (continued)			
Potassium	1.9	na	na
Sodium	85	na	na
Sulfate	21	na	na
Surfactants	<0.05	na	na
Total hardness (as $CaCO_3$)	290	na	na
Total phosphorus	<0.05	na	na
Organic (µg/L)			
EPA Method 8082 (for PCBs)	na	na	nd[c]
Radioactive (Bq/L)			
Gross alpha	0.15 ± 0.03	0.22 ± 0.09	na
Gross beta	0.10 ± 0.03	0.17 ± 0.06	na
Americium-241	–0.0004 ± 0.0005	0.0004 ± 0.001	na
Plutonium-238	0.00003 ± 0.0001	na	na
Plutonium-239+240	0.0001 ± 0.0001	na	na
Radium-226	0.018 ± 0.012	0.001 ± 0.001	na
Radium-228	–0.019 ± 0.020	0.023 ± 0.011	na
Thorium-228	0.003 ± 0.003	–0.001 ± 0.001	na
Thorium-230	0.003 ± 0.003	<0.006	na
Thorium-232	0.002 ± 0.002	<0.006	na
Tritium	19 ± 3.5	23 ± 3.4	na
Uranium (total)	0.22 ± 0.02	0.16 ± 0.02	na

Note: Radioactivities are reported as the measured concentration and either an uncertainty (± 2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

[a] na = Not analyzed (analysis not required).

[b] Bicarbonate alkalinity = total alkalinity.

[c] nd = None detected above reporting limits. See Table 9-1 for analytical methods and their constituents.

Table 9-15. Livermore site surveillance well W-1303.

Constituents of concern	Sampling dates		
	1/21/99 and 1/26/99	4/14/99 and 6/7/99	7/19/99
Inorganic (µg/L)			
pH (pH units)	7.5	na[a]	na
Specific conductance (µmho/cm)	1300	na	na
Total dissolved solids (TDS) (mg/L)	760	na	na
Aluminum	<50	<100	na
Antimony	<4	<5	na
Arsenic	<2	<2	na
Barium	740	750	na
Beryllium	<0.2	<0.5	na
Cadmium	<0.5	<0.5	na
Chromium	6.1	4	na
Cobalt	<50	<50	na
Copper	<1	<2	na
Chromium(VI)	<2	10	na
Iron	76	<100	na
Lead	<5	<5	na
Manganese	<10	<30	na
Mercury	<0.2	<0.2	na
Molybdenum	<25	<25	na
Nickel	<50	<5	na
Selenium	<2	<2	na
Silver	<1	<1	na
Thallium	<1	<2	na
Vanadium	<10	<20	na
Zinc	<10	<20	na
General minerals (mg/L)			
Bicarbonate alkalinity (as $CaCO_3$)[b]	500	na	na
Boron	0.48	na	na
Calcium	120	na	na
Chloride	110	na	na
Fluoride	0.45	na	na
Magnesium	43	na	na
Nitrate	31	na	na

Table 9-15. Livermore site surveillance well W-1303 (concluded).

Constituents of concern	Sampling dates		
	1/21/99 and 1/26/99	4/14/99 and 6/7/99	7/19/99
General minerals (mg/L) (continued)			
Orthophosphate	0.05	na	na
Potassium	2	na	na
Sodium	80	na	na
Sulfate	21	na	na
Surfactants	<0.05	na	na
Total hardness (as $CaCO_3$)	480	na	na
Total phosphorus	<0.05	na	na
Organic (µg/L)			
EPA Method 8082 (for PCBs)	na	na	nd[c]
Radioactive (Bq/L)			
Gross alpha	0.39 ± 0.07	0.35 ± 0.13	na
Gross beta	0.14 ± 0.05	0.20 ± 0.06	na
Americium-241	0.002 ± 0.003	<0.0004	na
Plutonium-238	0.0001 ± 0.0001	na	na
Plutonium-239+240	0.0002 ± 0.0001	na	na
Radium-226	0.006 ± 0.006	0.008 ± 0.002	na
Radium-228	0.025 ± 0.016	0.036 ± 0.013	na
Thorium-228	0.0002 ± 0.003	<0.009	na
Thorium-230	0.001 ± 0.001	<0.006	na
Thorium-232	–0.0003 ± 0.0004	<0.006	na
Tritium	43 ± 3.6	47 ± 4.1	na
Uranium (total)	0.30 ± 0.04	0.32 ± 0.04	na

Note: Radioactivities are reported as the measured concentration and either an uncertainty (± 2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

[a] na = Not analyzed (analysis not required).

[b] Bicarbonate alkalinity = total alkalinity.

[c] nd = None detected above reporting limits. See Table 9-1 for analytical methods and their constituents.

Table 9-16. Livermore site surveillance well W-119.

Constituents of concern	Sampling dates		
	2/4/99	6/14/99	7/22/99
Inorganic (µg/L)			
pH (pH units)	7.4	na[(a)]	na
Field pH (pH units)	na	7.4	7.3
Specific conductance (µmho/cm)	900	na	na
Field specific conductance (µmho/cm)	na	830	830
Total dissolved solids (TDS) (mg/L)	530	na	na
Water temperature (°C)	na	19	19
Aluminum	<50	<100	200
Antimony	<4	<5	<5
Arsenic	<2	<2	<2
Barium	390	370	350
Beryllium	<0.2	<0.5	<0.5
Cadmium	<0.5	<0.5	1.1
Chromium	5.4	2	4
Cobalt	<50	<50	<50
Copper	<1	<2	<2
Chromium(VI)	5	3	4
Iron	<50	<100	<100
Lead	<5	<5	<5
Manganese	<10	<30	<30
Mercury	<0.2	<0.2	<0.2
Molybdenum	<25	<25	<25
Nickel	<2	<5	<5
Selenium	<2	<2	<2
Silver	<1	<1	<1
Thallium	<1	<2	<2
Vanadium	<10	<20	<20
Zinc	<10	<20	30
General minerals (mg/L)			
Bicarbonate alkalinity (as $CaCO_3$)[(b)]	290	na	na
Boron	0.46	0.51	0.48
Calcium	81	na	na
Chloride	95	na	na
Fluoride	0.32	na	na

Table 9-16. Livermore site surveillance well W-119 (concluded).

Constituents of concern	Sampling dates		
	2/4/99	6/14/99	7/22/99
General minerals (mg/L) (continued)			
Magnesium	29	na	na
Nitrate	35[c]	na	na
Orthophosphate	0.09	na	na
Potassium	1.5	na	na
Sodium	69	na	na
Sulfate	25	na	na
Surfactants	<0.05	na	na
Total hardness (as $CaCO_3$)	320	na	na
Total phosphorus	<0.05	na	na
Radioactive (Bq/L)			
Gross alpha	0.23 ± 0.05	0.11 ± 0.05	0.076 ± 0.055
Gross beta	0.098 ± 0.031	0.11 ± 0.05	0.081 ± 0.051
Americium-241	0.001 ± 0.001	0.001 ± 0.001	0.0001 ± 0.0003
Plutonium-238	<0.0002	na	–0.00004 ± 0.0001
Plutonium-239+240	–0.00001 ± 0.0001	na	–0.0000 ± 0.0001
Radium-226	0.027 ± 0.014	0.006 ± 0.002	0.004 ± 0.001
Radium-228	0.017 ± 0.016	0.017 ± 0.010	0.009 ± 0.009
Thorium-228	0.002 ± 0.002	0.001 ± 0.002	0.001 ± 0.002
Thorium-230	0.001 ± 0.001	0.001 ± 0.001	–0.00003 ± 0.0001
Thorium-232	0.0005 ± 0.001	0.0003 ± 0.001	<0.006
Tritium	19 ± 2.8	25 ± 3.4	24 ± 2.5
Uranium (total)	0.15 ± 0.02	0.12 ± 0.02	0.13 ± 6.00

Note: Radioactivities are reported as the measured concentration and either an uncertainty (± 2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

[a] na = Not analyzed (analysis not required).

[b] Bicarbonate alkalinity = total alkalinity.

[c] Samples were analyzed in 13 days, outside the holding time of two days.

Table 9-17. Livermore site surveillance well W-1306.

Constituents of concern	Sampling dates		
	1/21/99 and 1/26/99	4/14/99 and 6/7/99	7/14/99 and 7/19/99
Inorganic (µg/L)			
pH (pH units)	7.8	na[(a)]	na
Specific conductance (µmho/cm)	1300	na	na
Total dissolved solids (TDS) (mg/L)	770	na	na
Aluminum	<50	<100	na
Antimony	<4	<5	na
Arsenic	<2	2	na
Barium	480	490	na
Beryllium	<0.2	<0.5	na
Cadmium	<0.5	<0.5	na
Chromium	6.4	4	na
Cobalt	<50	<50	na
Copper	1.1	<2	na
Chromium(VI)	3.2	8	na
Iron	<50	<100	na
Lead	<5	<5	na
Manganese	<10	<30	na
Mercury	<0.2	<0.2	na
Molybdenum	<25	<25	na
Nickel	4	<5	na
Selenium	<2	<2	na
Silver	<1	<1	na
Thallium	<1	<2	na
Vanadium	<10	<20	na
Zinc	<10	<20	na
General minerals (mg/L)			
Bicarbonate alkalinity (as $CaCO_3$)[(b)]	370	na	na
Boron	0.45	0.4	na
Calcium	110	na	na
Chloride	160	na	na
Fluoride	0.48	na	na
Magnesium	41	na	na
Nitrate	41	na	na
Orthophosphate	0.09	na	na

Table 9-17. Livermore site surveillance well W-1306 (concluded).

Constituents of concern	Sampling dates		
	1/21/99 and 1/26/99	4/14/99 and 6/7/99	7/14/99 and 7/19/99
General minerals (mg/L) (continued)			
Potassium	2	na	na
Sodium	91	na	na
Sulfate	43	na	na
Surfactants	<0.05	na	na
Total hardness (as $CaCO_3$)	450	na	na
Total phosphorus	<0.05	na	na
Organic (µg/L)			
EPA Method 8082 (for PCBs)	na	na	nd[c]
Radioactivity (Bq/L)			
Gross alpha	0.31 ± 0.06	0.32 ± 0.12	na
Gross beta	0.13 ± 0.05	0.20 ± 0.07	na
Americium-241	<0.004	<0.004	na
Plutonium-238	–0.0001 ± 0.0001	na	na
Plutonium-239+240	0.00002 ± 0.0001	na	na
Radium-226	0.013 ± 0.007	0.006 ± 0.002	na
Radium-228	0.020 ± 0.018	0.045 ± 0.014	na
Thorium-228	0.003 ± 0.002	–0.0003 ± 0.001	na
Thorium-230	0.0002 ± 0.001	–0.0001 ± 0.0001	na
Thorium-232	<0.006	<0.006	na
Tritium	7.4 ± 2.6	13 ± 3.2	na
Uranium (total)	0.34 ± 0.03	0.33 ± 0.04	na

Note: Radioactivities are reported as the measured concentration and either an uncertainty (± 2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

[a] na = Not analyzed (analysis not required).

[b] Bicarbonate alkalinity = total alkalinity.

[c] nd = None detected above reporting limits. See Table 9-1 for analytical methods and their constituents.

Table 9-18. Livermore site surveillance well W-906.

Constituents of concern	Sampling dates			
	1/13/99 and 1/19/99	4/14/99 and 6/9/99	7/14/99 and 7/19/99	10/12/99 and 10/18/99
Inorganic (µg/L)				
pH (units)	7.6	na[a]	na	na
Specific conductance (µmho/cm)	1800	na	na	na
Total dissolved solids (TDS, mg/L)	1100	na	na	na
Aluminum	<50	<100	na	na
Antimony	<4	<5	na	na
Arsenic	<2	<2	na	na
Barium	350	380	na	na
Beryllium	<0.2	<0.5	na	na
Cadmium	0.59	<0.5	na	na
Chromium	12	5	na	na
Cobalt	<50	<50	na	na
Copper	160	<2	10	na
Chromium(VI)	8.3	2	na	na
Iron	130	<100	na	na
Lead	73	<5	<5	na
Manganese	<10	<30	na	na
Mercury	<0.2	<0.2	na	na
Molybdenum	<25	<25	na	na
Nickel	6.9	<5	na	na
Selenium	<2	<2	na	na
Silver	<1	<1	na	na
Thallium	<2	<2	na	na
Vanadium	<10	<20	na	na
Zinc	3400	<20	110	na
General minerals (mg/L)				
Bicarbonate alkalinity (as $CaCO_3$)[b]	330	na	na	na
Boron	0.9	0.88	na	na
Calcium	140	na	na	na
Chloride	330	na	na	na
Fluoride	0.49	na	na	na
Magnesium	60	na	na	na
Nitrate	35	na	na	na
Orthophosphate	0.09	na	na	na
Potassium	1.9	na	na	na
Sodium	120	na	na	na

Table 9-18. Livermore site surveillance well W-906 (concluded).

Constituents of concern	Sampling dates			
	1/13/99 and 1/19/99	4/14/99 and 6/9/99	7/14/99 and 7/19/99	10/12/99 and 10/18/99
General minerals (mg/L) (continued)				
Sulfate	53	na	na	na
Surfactants	<0.05	na	na	na
Total hardness (as $CaCO_3$)	600	na	na	na
Total phosphorus	<0.05	na	na	na
Organic constituents (µg/L)				
EPA Method 8082 (for PCBs)	na	na	na	nd[c]
Radioactive (Bq/L)				
Gross alpha	0.30 ± 0.06	0.36 ± 0.13	na	na
Gross beta	0.095 ± 0.047	0.13 ± 0.07	na	na
Americium-241	0.013 ± 0.010	<0.004	na	0.0004 ± 0.001
Plutonium-238	0.0001 ± 0.0002	na	na	na
Plutonium-239+240	–0.00002 ± 0.0001	na	na	na
Radium-226	0.016 ± 0.012	0.005 ± 0.002	na	na
Radium-228	–0.003 ± 0.018	0.023 ± 0.011	na	na
Thorium-228	–0.001 ± 0.002	0.0003 ± 0.000	na	na
Thorium-230	0.001 ± 0.001	0.0002 ± 0.0004	na	na
Thorium-232	0.001 ± 0.001	0.0002 ± 0.0004	na	na
Tritium	–2.5 ± 2.8	3.4 ± 2.8	na	na
Uranium (total)	0.31 ± 0.03	0.31 ± 0.04	na	na

Note: Radioactivities are reported as the measured concentration and either an uncertainty (± 2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

[a] na = Not analyzed (analysis not required).

[b] Bicarbonate alkalinity = total alkalinity.

[c] nd = None detected above reporting limits. See Table 9-1 for analytical methods and their constituents.

Table 9-19. Livermore site surveillance well W-593.

Constituents of concern	Sampling dates	
	1/12/99	6/9/99
Inorganic (µg/L)		
pH (units)	7.9	na[(a)]
Field pH (units)	na	7.4
Specific conductance (µmho/cm)	2300	na
Field specific conductance (µmho/cm)	na	490
Total dissolved solids (TDS, mg/L)	na	20
Field temperature (°C)	1400	na
Aluminum	<50	<100
Antimony	<4	<5
Arsenic	3	2
Barium	<25	<25
Beryllium	<0.2	<0.5
Cadmium	<0.5	<0.5
Chromium	6.2	6
Cobalt	<50	<50
Copper	1.6	<2
Chromium(VI)	11	5
Iron	<50	<100
Lead	<5	<5
Manganese	<10	<30
Mercury	<0.2	<0.2
Molybdenum	<25	<25
Nickel	14	9
Selenium	<2	<2
Silver	<1	<1
Thallium	<1	<2
Vanadium	16	<20
Zinc	28	<20
General minerals (mg/L)		
Bicarbonate alkalinity (as $CaCO_3$)[(b)]	260	na
Boron	8.5	8.1
Calcium	88	na
Chloride	460	na
Fluoride	1.2	na

Table 9-19. Livermore site surveillance well W-593 (concluded).

Constituents of concern	Sampling dates	
	1/12/99	6/9/99
General minerals (mg/L) (continued)		
Magnesium	49	na
Nitrate	21	na
Orthophosphate	0.05	na
Potassium	1.7	na
Sodium	300	na
Sulfate	210	na
Surfactants	<0.05	na
Total hardness (as $CaCO_3$)	420	na
Total phosphorus	<0.05	na
Radioactive (Bq/L)		
Gross alpha	0.41 ± 0.12	0.13 ± 0.12
Gross beta	0.16 ± 0.10	0.20 ± 0.10
Americium-241	0.0003 ± 0.001	–0.0002 ± 0.0003
Plutonium-238	0.000005 ± 0.0001	na
Plutonium-239+240	0.0001 ± 0.0001	na
Radium-226	0.016 ± 0.008	0.001 ± 0.001
Radium-228	–0.005 ± 0.018	0.019 ± 0.010
Thorium-228	–0.0004 ± 0.001	–0.0002 ± 0.001
Thorium-230	0.003 ± 0.001	<0.006 ± 0.001
Thorium-232	<0.006	0.0002 ± 0.0004
Tritium	–2.7 ± 2.7	–0.46 ± 2.7
Uranium(total)	0.21 ± 0.02	0.23 ± 0.03

Note: Radioactivities are reported as the measured concentration and either an uncertainty (± 2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

[a] na = Not analyzed (analysis not required).

[b] Bicarbonate alkalinity = total alkalinity.

Table 9-20. Livermore site surveillance well W-270.

Constituents of concern	Sampling date 7/27/99
Inorganic (µg/L)	
Field temperature (°C)	21
Field specific conductance (µmho/cm)	780
Field pH (pH units)	7.5
Aluminum	<100
Antimony	<5
Arsenic	2
Barium	97
Beryllium	<0.5
Boron	200
Cadmium	<0.5
Chromium	15
Cobalt	<50
Copper	<2
Chromium(VI)	4
Iron	<100
Lead	<5
Manganese	<30
Mercury	<0.2
Molybdenum	<25
Nickel	<5
Selenium	6
Silver	<1
Thallium	<2
Vanadium	<20
Zinc	<20
Radioactive (Bq/L)	
Gross alpha	0.14 ± 0.06
Gross beta	0.12 ± 0.04
Americium-241	0.0006 ± 0.0004
Plutonium-238	–0.00002 ± 0.0002
Plutonium-239+240	0.0001 ± 0.0002

Table 9-20. Livermore site surveillance well W-270 (concluded).

Constituents of concern	Sampling date 7/27/99
Radioactive (Bq/L) (continued)	
Radium-226	0.004 ± 0.002
Radium-228	0.014 ± 0.010
Thorium-228	0.001 ± 0.001
Thorium-230	0.0003 ± 0.0005
Thorium-232	<0.006
Tritium	0.03 ± 1.5
Uranium (total)	0.13 ± 0.02

Note: Radioactivities are reported as the measured concentration and either an uncertainty (± 2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

Table 9-21. Livermore site surveillance well W-359.

Constituents of concern	Sampling dates	
	2/1/99	10/26/99
Inorganic (µg/L)		
pH (units)	na[(a)]	7.2
Field pH (units)	na	7.6
Field specific conductance (µmho/cm)	na	590
Specific conductance (µmho/cm)	na	560
Total dissolved solids (TDS, mg/L)	na	760
Field temperature (°C)	na	20
Aluminum	<200	100
Antimony	<5	<5
Arsenic	<2	<2
Barium	160	140
Beryllium	<0.5	<0.5
Cadmium	<0.5	<0.5
Chromium	9.7	5
Cobalt	<50	<50
Copper	16	<2
Chromium(VI)	8.7	7
Iron	<100	<100
Lead	<2	<5
Manganese	<30	<30
Mercury	<0.2	<0.2
Molybdenum	<50	<25
Nickel	7.9	<5
Selenium	<2	<2
Silver	<0.5	<1
Thallium	<1	<2
Vanadium	<50	<20
Zinc	<20	<20
General minerals (mg/L)		
Bicarbonate alkalinity (as $CaCO_3$)[(b)]	na	150
Boron	0.38	0.3
Calcium	na	41
Chloride	na	69
Fluoride	na	0.32

Table 9-21. Livermore site surveillance well W-359 (concluded).

Constituents of concern	Sampling dates	
	2/1/99	10/26/99
General minerals (mg/L) (continued)		
Magnesium	na	17
Nitrate	na	50[c]
Orthophosphate	na	0.04
Potassium	na	2
Sodium	na	49
Sulfate	na	15
Surfactants	na	<0.5
Total hardness (as $CaCO_3$)	na	170
Total phosphorus	na	<0.05
Organic (µg/L)		
EPA Method 625	na	nd[d]
Radioactive (Bq/L)		
Gross alpha	na	0.053 ± 0.022
Gross beta	na	0.075 ± 0.026
Plutonium 238		0.012 ± 0.004
	na	0.000002[e] ± 0.00008
Plutonium 239+240	na	0.00003 ± 0.00073
	na	0.00003[e] ± 0.00003
Tritium	4.9[f] ± 2.7	6.8 ± 2.6
Uranium 238	na	0.037 ± 0.005

Note: Radioactivities are reported as the measured concentration and either an uncertainty (± 2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

[a] na = Not analyzed (analysis not required).

[b] Bicarbonate alkalinity = total alkalinity.

[c] Concentration is supect; it is much greater than nitrate concentrations previously measured in ground water samples collected from this well.

[d] nd = None detected above reporting limits. See Table 9-1 for analytical methods and their constituents.

[e] Retest sample collected on 12/1/99 and analyzed by LLNL on-site laboratory. (Original sample collected on 10/26/99 was analyzed by off-site laboratory.)

[f] Concentration is approximate.

Table 9-22. Livermore site surveillance well GSW-011.

Constituents of concern	Sampling date 7/27/99
Inorganic (µg/L)	
Field temperature (°C)	21
Field specific conductance (µmho/cm)	960
Field pH (pH units)	7.3
Aluminum	<100
Antimony	<5
Arsenic	<2
Barium	370
Beryllium	<0.5
Boron	1100
Cadmium	<0.5
Chromium	<1
Cobalt	<50
Copper	<2
Chromium(VI)	<2
Iron	<100
Lead	<5
Manganese	690
Mercury	<0.2
Molybdenum	<25
Nickel	24
Selenium	<2
Silver	<1
Thallium	<2
Vanadium	<20
Zinc	<20
Radioactive (Bq/L)	
Gross alpha	0.25 ± 0.09
Gross beta	0.13 ± 0.05
Americium-241	0.0002 ± 0.0002
Plutonium-238	–0.0001 ± 0.0002
Plutonium-239+240	0.0001 ± 0.0002

Table 9-22. Livermore site surveillance well GSW-011 (concluded).

Constituents of concern	Sampling date 7/27/99
Radioactive (Bq/L) (continued)	
Radium-226	0.004 ± 0.001
Radium-228	0.008 ± 0.009
Thorium-228	0.001 ± 0.001
Thorium-230	0.001 ± 0.001
Thorium-232	–0.00004 ± 0.0001
Tritium	3.8 ± 1.7
Uranium (total)	0.24 ± 0.03

Note: Radioactivities are reported as the measured concentration and either an uncertainty (± 2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

Table 9-23. Livermore site surveillance well W-307.

Constituents of concern	Sampling dates	
	2/11/99	10/27/99
Inorganic (µg/L)		
Aluminum	<50	na[(a)]
Antimony	<4	na
Arsenic	<2	na
Barium	300	na
Beryllium	<0.2	na
Boron	690	na
Cadmium	<0.5	na
Chromium	13	na
Chromium(VI)	12	13
Cobalt	<50	na
Copper	<1	na
Iron	<50	na
Lead	<5	na
Manganese	<10	na
Mercury	<0.2	na
Molybdenum	<25	na
Nickel	<2	na
Selenium	<2	na
Silver	<2	na
Thallium	<1	na
Vanadium	<10	na
Zinc	<20	na

Note: Radioactivities are reported as the measured concentration and either an uncertainty (± 2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

[a] na = Not analyzed (analysis not required).

Table 9-24. Livermore site surveillance well W-226.

Constituents of concern	Sampling dates	
	2/11/99	7/29/99
Inorganic (µg/L)		
Aluminum	<50	na[(a)]
Antimony	<4	na
Arsenic	<2	na
Barium	180	na
Beryllium	<0.2	na
Boron	470	na
Cadmium	<0.5	na
Chromium	71	19
Chromium(VI)	27	24
Cobalt	<50	na
Copper	3.2	na
Iron	<50	na
Lead	<5	na
Manganese	<10	na
Mercury	<0.2	na
Molybdenum	<25	na
Nickel	<2	na
Selenium	<2	na
Silver	<2	na
Thallium	<1	na
Vanadium	13	na
Zinc	<20	na

Note: Radioactivities are reported as the measured concentration and either an uncertainty (± 2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

[a] na = Not analyzed (analysis not required).

Table 9-25. Livermore site surveillance well W-306.

Constituents of concern	Sampling dates		
	2/11/99	7/29/99	7/29/99
Inorganic (µg/L)			
Aluminum	<50	na[(a)]	na
Antimony	<4	na	na
Arsenic	<2	na	na
Barium	92	na	na
Beryllium	<0.2	na	na
Boron	1200	na	na
Cadmium	<0.5	na	na
Chromium	37	na	na
Chromium(VI)	25	33	13
Cobalt	<50	50	na
Copper	<1	na	na
Iron	<50	na	na
Lead	<5	na	na
Manganese	<10	na	na
Mercury	<0.2	na	na
Molybdenum	<25	na	na
Nickel	<2	na	na
Selenium	<2	na	na
Silver	<2	na	na
Thallium	<1	na	na
Vanadium	<10	na	na
Zinc	<20	na	na

Note: Radioactivities are reported as the measured concentration and either an uncertainty (± 2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

[a] na = Not analyzed (analysis not required).

Table 9-26. Livermore site surveillance well W-305.

Constituents of concern	Sampling date 11/3/99
Inorganic (µg/L)	
pH (units)	7.2
Field pH (pH units)	7.6
Specific conductance (µmho/cm)	660
Field specific conductance (µmho/cm)	690
Total dissolved solids (TDS, mg/L)	400
Field temperature (°C)	20
Aluminum	<100
Antimony	<5
Arsenic	<2
Barium	310
Beryllium	<0.5
Cadmium	<0.5
Chromium	11
Cobalt	<50
Copper	<2
Chromium	10
Iron	<100
Lead	<5
Manganese	<30
Mercury	<0.2
Molybdenum	<25
Nickel	<5
Selenium	<2
Silver	<1
Thallium	<2
Vanadium	<20
Zinc	<20
General minerals (mg/L)	
Bicarbonate alkalinity (as $CaCO_3$)[(a)]	280
Boron	0.3
Calcium	64
Chloride	37
Fluoride	0.26

Table 9-26. Livermore site surveillance well W-305 (concluded).

Constituents of concern	Sampling date 11/3/99
General minerals (mg/L) (continued)	
Magnesium	20
Nitrate	<0.5
Orthophosphate	0.02
Potassium	2
Sodium	50
Sulfate	11
Surfactants	<0.5
Total hardness (as $CaCO_3$)	240
Total phosphorus	0.05
Organic constituents (µg/L)	
EPA Method 625	nd[(b)]
Radioactive (Bq/L)	
Gross alpha	0.17 ± 0.03
Gross beta	0.064 ± 0.025
Plutonium-238	–0.001 ± 0.001
Plutonium-239+240	<0.037
Tritium	4.7 ± 2.5
Uranium (total)	0.13 ± 0.01

Note: Radioactivities are reported as the measured concentration and either an uncertainty (± 2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

[a] Bicarbonate alkalinity = total alkalinity.

[b] nd = None detected above reporting limits. See Table 9-1 for analytical methods and their constituents.

Table 9-27. Livermore site surveillance well SIP-331-001.

Constituents of concern	Sampling dates	
	6/23/99	10/21/99
Inorganic (µg/L)		
pH (pH units)	na[(a)]	7
Field pH (pH units)	na	7.3
Specific conductance (µmho/cm)	na	780
Field specific conductance (µmho/cm)	na	880
Total dissolved solids (TDS) (mg/L)	na	570
Water temperature (°C)	na	24
Aluminum	970	1600
Antimony	15	<5
Arsenic	7.4	9
Barium	140	440
Beryllium	<0.2	<0.5
Cadmium	<0.5	<0.5
Chromium	4.2	1
Cobalt	<50	<50
Copper	8	<2
Chromium(VI)	<2	<2
Iron	2600	1600
Lead	<5	<5
Manganese	880	1500
Mercury	<0.2	<0.2
Molybdenum	<25	<25
Nickel	3	6
Selenium	<2	<2
Silver	<1	<1
Thallium	<1	<2
Vanadium	<10	<20
Zinc	53	<20
General minerals (mg/L)		
Bicarbonate alkalinity (as $CaCO_3$)[(b)]	na	460
Boron	0.31	0.5
Calcium	na	68
Chloride	na	65
Fluoride	na	0.6

Table 9-27. Livermore site surveillance well SIP-331-001 (concluded).

Constituents of concern	Sampling dates	
	6/23/99	10/21/99
General minerals (mg/L) (continued)		
Magnesium	na	27
Nitrate	na	<0.5
Orthophosphate	na	0.03
Potassium	na	3
Sodium	na	69
Sulfate	na	8
Surfactants	na	<0.5
Total hardness (as $CaCO_3$)	na	280
Total phosphorus	na	13
Organic (µg/L)		
EPA Method 625	na	nd[c]
Bis(2-ethylhexyl)phthalate	na	29
Phenol	na	10
Radioactive (Bq/L)		
Gross alpha	na	0.092 ± 0.038
Gross beta	na	0.19 ± 0.04
Plutonium-238	na	0.001 ± 0.003
Plutonium-239+240	na	0.004 ± 0.002
Tritium	11 ± 2.5	18 ± 3.0
Uranium (total)	na	0.061 ± 0.010

Note: Radioactivities are reported as the measured concentration and either an uncertainty (± 2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

[a] na = Not analyzed (analysis not required).

[b] Bicarbonate alkalinity = total alkalinity.

[c] nd = None detected above reporting limits. See Table 9-1 for analytical methods and their constituents.

Table 9-28. Livermore site surveillance well W-148.

Constituents of concern	Sampling dates	
	5/27/99	10/21/99
Inorganic (µg/L)		
pH (pH units)	na[(a)]	7.4
Field pH (units)	na	7.8
Specific conductance (µmho/cm)	na	460
Field specific conductance (µmho/cm)	na	480
Total dissolved solids (TDS, mg/L)	na	310
Field temperature (°C)	na	19
Aluminum	1400	<100
Antimony	<4	<5
Arsenic	3.5	<2
Barium	300	230
Beryllium	<0.2	<0.5
Cadmium	<0.5	<0.5
Chromium	4.1	<1
Cobalt	<50	<50
Copper	3.4	<2
Chromium(VI)	<2	<2
Iron	1300	<100
Lead	<5	<5
Manganese	180	240
Mercury	<0.2	<0.2
Molybdenum	<25	<25
Nickel	6.5	<5
Selenium	<2	<2
Silver	<1	<1
Thallium	<1	<2
Vanadium	18	<20
Zinc	35	<20
General minerals (mg/L)		
Bicarbonate alkalinity (as $CaCO_3$)[(b)]	na	180
Boron	0.19	<0.1
Calcium	na	54
Chloride	na	20

Table 9-28. Livermore site surveillance well W-148 (concluded).

Constituents of concern	Sampling dates	
	5/27/99	10/21/99
General minerals (mg/L) (continued)		
Fluoride	na	0.1
Magnesium	na	16
Nitrate	na	24
Orthophosphate	na	0.06
Potassium	na	2
Sodium	na	21
Sulfate	na	9
Surfactants	na	<0.5
Total hardness (as $CaCO_3$)	na	200
Total phosphorus	na	<0.05
Organic (µg/L)		
EPD Method 625	na	nd[c]
Radioactive (Bq/L)		
Gross alpha	na	0.15 ± 0.05
Gross beta	na	0.11 ± 0.04
Plutonium-238	na	0.006[d] ± 0.002
Plutonium-239+240	na	0.0002[e] ± 0.0004
Tritium	59 ± 6.7	46 ± 3.8
Uranium (total)	na	0.10 ± 0.01

Note: Radioactivities are reported as the measured concentration and either an uncertainty (± 2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

[a] na = Not analyzed (analysis not required).

[b] Bicarbonate alkalinity = total alkalinity.

[c] nd = None detected above reporting limits. See Table 9-1 for analytical methods and their constituents.

[d] Reanalysis result from off-site laboratory was 0.012 ± 0.012 for Pu-238.

[e] Reanalysis result from off-site laboratory was –0.0011 ± 0.0012 Pu-239+240.

Table 9-29. Tritium activity in Livermore Valley wells, 1999.

Location	Sampling date	Tritium activity (Bq/L)
11B1	8/31	8.5 ± 2.4
12A2	8/31	1.9 ± 2.1
12D2	8/31	8.1 ± 2.4
12G1	8/31	2.4 ± 2.1
16L5	9/17	0.8 ± 2.2
16L7	9/17	1.4 ± 2.2
17D2	No sample	na[(a)]
18A1	6/24	0.4 ± 2.2
1H3	8/31	0.2 ± 2.1
1P2	8/31	2.9 ± 2.2
1R2	8/31	1.3 ± 2.1
2R1	8/31	2.4 ± 2.2
004	9/17	0.2 ± 2.1
9M2	6/24	–0.01 ± 2.2
9M3	6/24	0.43 ± 2.2
16B1	No sample	na
7C2	8/31	0.9 ± 2.1
7P3	6/24	0.5 ± 2.1
8P1	6/24	0.3 ± 2.2
9Q1	6/24	1.6 ± 2.2

[a] na = Not analyzed (analysis not required).

Table 9-30. Site 300, Elk Ravine surveillance wells.

Constituents of concern	Well					
	K7-07[a]	NC7-61		NC7-69[b]	K2-04D	
	Sampling dates					
	5/26/99	6/1/99	11/9/99	11/10/99	5/26/99	11/8/99
Inorganic (µg/L)						
Antimony	<5	<5	<5	<5	<5	<5
Arsenic	18	18	19	<2	12	12
Barium	81	97	94	28	39	39
Beryllium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	<1	<1	<1	<1	2	<1
Cobalt	<25	<25	<25	<25	<25	<25
Copper	<10	<10	<10	<10	<10	<10
Lead	<2	<2	<2	<2	2	<2
Mercury	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Molybdenum	<25	<25	<25	<25	<25	<25
Nickel	<5	<5	<5	<5	<5	<5
Potassium (mg/L)	1.1	4.4	3.3	4.4	2.8	3
Selenium	<2	<2	<2	<2	2	<2
Silver	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Thallium	<2	<2	<2	<2	<2	<2
Vanadium	33	96	93	<25	54	54
Zinc	<20	<20	<20	<20	<20	<20
Organic (µg/L)						
EPA Method 601 (volatile)	nd[c]	nd	nd	nd	nd	nd
Explosives (µg/L)						
HMX	<1	5	4	<1	<1	<1
RDX	<1	7	6	<1	<1	<1
Radioactive (Bq/L)						
Gross alpha	0.16 ± 0.04	0.07 ± 0.03	0.11 ± 0.04	0.13 ± 0.04	0.04 ± 0.02	0.06 ± 0.03
Gross beta	0.17 ± 0.04	0.14 ± 0.04	0.16 ± 0.04	0.41 ± 0.07	0.13 ± 0.03	0.14 ± 0.03
Tritium	260 ± 7.7	3900 ± 28	3600 ± 27	0.26 ± 2.1	140 ± 5.7	150 ± 5.9
Uranium (total)	0.38 ± 0.03	0.14 ± 0.01	0.08 ± 0.01	0.002 ± 0.001	0.10 ± 0.01	0.07 ± 0.01

Table 9-30. Site 300, Elk Ravine surveillance wells (continued).

Constituents of concern	Well					
	K2-04S		K2-01C		NC2-12D	
	Sampling dates					
	6/2/99	11/9/99	5/26/99	11/8/99	5/24/99	11/10/99
Inorganic (µg/L)						
Antimony	<5	<5	<5	<5	<5	<5
Arsenic	15	18	8	7	12	10
Barium	53	70	380	39	<25	<25
Beryllium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	<1	<1	1	<1	1	<1
Cobalt	<25	<25	<25	<25	<25	<25
Copper	<10	<10	<10	40	<10	<10
Lead	<2	<2	<2	<2	<2	<2
Mercury	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Molybdenum	<25	<25	<25	<25	<25	<25
Nickel	<5	<5	5	<5	<5	<5
Potassium (mg/L)	2.7	2.7	3.5	3.4	3.4	3.7
Selenium	3	2	<2	<2	2	3
Silver	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Thallium	<2	<2	<2	<2	<2	<2
Vanadium	67	71	50	48	48	48
Zinc	<20	20	<20	200	<20	<20
Organic (µg/L)						
EPA Method 601 (volatile)	nd	nd	nd	nd	nd	nd
Explosives (µg/L)						
HMX	<1	<1	<1	<1	<1	<1
RDX	<1	<1	<1	<1	<1	<1
Radioactive (Bq/L)						
Gross alpha	<0.07 ± 0.03	0.06 ± 0.03	0.10 ± 0.04	0.11 ± 0.04	0.08 ± 0.03	0.03 ± 0.02
Gross beta	<0.11 ± 0.04	0.11 ± 0.04	0.18 ± 0.04	0.18 ± 0.04	0.15 ± 0.04	0.07 ± 0.03
Tritium	490 ± 10	700 ± 12	680 ± 12	710 ± 12	310 ± 7.2	350 ± 8.6
Uranium (total)	0.11 ± 0.01	0.10 ± 0.01	0.21 ± 0.02	0.16 ± 0.01	0.13 ± 0.01	0.09 ± .01

Table 9-30. Site 300, Elk Ravine surveillance wells (concluded).

Constituents of concern	Well					
	NC2-11D		812CRK (SPRING6)		NC2-07	
	Sampling dates					
	5/25/99	11/10/99	5/24/99	11/9/99	6/3/99	11/15/99
Inorganic (µg/L)						
Antimony	<5	<5	<5	<5	<5	<5
Arsenic	12	11	24	30	34	34
Barium	<25	<25	78	56	34	35
Beryllium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	<1	<1	1	<1	<1	<1
Cobalt	<25	<25	<25	<25	<25	<25
Copper	<10	<10	<10	<10	<10	<10
Lead	<2	<2	<2	<2	<2	<2
Mercury	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Molybdenum	<25	<25	<25	<25	<25	<25
Nickel	<5	<5	<5	<5	<5	<5
Potassium (mg/L)	4.5	4.1	6.7	4.8	4	4.6
Selenium	<2	2	2	4	3	2
Silver	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Thallium	<2	<2	<2	<2	<2	<2
Vanadium	52	51	40	67	48	49
Zinc	<20	<20	<20	<20	<20	<20
Organic (µg/L)						
EPA Method 601 (volatile)	nd	nd	nd	nd	nd	nd
Explosives (µg/L)						
HMX	<1	<1	<1	<1	<1	<1
RDX	<1	<1	<1	<1	<1	<1
Radioactive (Bq/L)						
Gross alpha	0.07 ± 0.03	0.07 ± 0.03	0.10 ± 0.04	0.10 ± 0.04	0.14 ± 0.05	0.15 ± 0.05
Gross beta	0.20 ± 0.04	0.14 ± 0.03	0.25 ± 0.05	0.25 ± 0.06	0.23 ± 0.05	0.24 ± 0.06
Tritium	120 ± 5.5	140 ± 5.6	0.65 ± 1.40	0.93 ± 2.1	–1.2 ± 2.1	0.27 ± 2.1
Uranium (total)	0.20 ± 0.02	0.15 ± 0.01	0.21 ± 0.02	0.15 ± 0.01	0.28 ± 0.02	0.22 ± 0.02

Note: Radioactivities are reported as the measured concentration and either an uncertainty (±2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

[a] Well was dry during fourth quarter.

[b] Well was dry during fourth quarter.

[c] nd = None detected above reporting limits. See Table 9-1 for analytical methods and their constituents..

Table 9-31. Site 300, Pit 2 surveillance wells.[a]

Constituents of concern	Barcad			
	K1-02A		K2-01A	
	Sampling dates			
	5/21/99	11/2/99	5/21/99	11/2/99
Inorganic (µg/L)				
Antimony	<5	<5	<5	<5
Arsenic	14	14	<2	<2
Barium	40	43	25	27
Beryllium	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5	<0.5
Chromium	<1	<1	<1	<1
Cobalt	<25	<25	<25	<25
Copper	<10	<10	<10	<10
Lead	<2	<2	<2	<2
Mercury	<0.2	<0.2	<0.2	<0.2
Molybdenum	<25	<25	<25	<25
Nickel	<5	<5	<5	<5
Potassium (mg/L)	3	3.3	3.7	3.8
Selenium	<2	<2	<2	<2
Silver	<0.5	<0.5	<0.5	<0.5
Thallium	<2	<2	<2	<2
Vanadium	<25	<25	<25	<25
Zinc	<20	<20	<20	<20
Explosive (µg/L)				
HMX	<1	<1	<1	<1
RDX	<1	<1	<1	<1
Radioactive (Bq/L)				
Gross alpha	0.064 ± 0.027	0.022 ± 0.016	0.007 ± 0.022	0.003 ± 0.016
Gross beta	0.13 ± 0.04	0.077 ± 0.028	0.14 ± 0.04	0.11 ± 0.03
Tritium	0.66 ± 1.5	–0.53 ± 2.2	–0.39 ± 1.3	–2.4 ± 2.1
Uranium (total)	0.092 ± 0.009	0.033 ± 0.004	0.004 ± 0.001	0.007 ± 0.001

Table 9-31. Site 300, Pit 2 surveillance wells (concluded).

Constituents of concern	Barcad			
	K2-02A		K2-02B	
	Sampling dates			
	6/22/99	12/16/99	6/2/99	12/16/99
Inorganic (µg/L)				
Antimony	<5	<5	<5	<5
Arsenic	42	33	<2	<2
Barium	27	27	28	27
Beryllium	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5	<0.5
Chromium	<1	<1	<1	<1
Cobalt	<25	<25	<25	<25
Copper	<10	<10	<10	<10
Lead	<2	<2	<2	<2
Mercury	<0.2	0.3	<0.2	<0.2
Molybdenum	<25	<25	<25	<25
Nickel	<5	<5	<5	<5
Potassium (mg/L)	4	3.8	3.5	3.7
Selenium	<2	<2	<2	<2
Silver	<0.5	<0.5	<0.5	<0.5
Thallium	<2	<2	<2	<2
Vanadium	<25	<25	<25	<25
Zinc	<20	<20	<20	<20
Explosive (µg/L)				
HMX	<1	<1	<1	<1
RDX	<1	<1	<1	<1
Radioactive (Bq/L)				
Gross alpha	0.13 ± 0.03	0.037 ± 0.019	0.022 ± 0.019	–0.002 ± 0.013
Gross beta	0.15 ± 0.03	0.088 ± 0.031	0.13 ± 0.03	0.083 ± 0.028
Tritium	–0.61 ± 1.4	–1.9 ± 2.2	–0.57 ± 1.4	–1.2 ± 2.2
Uranium (total)	0.12 ± 0.007	0.081 ± 0.009	0.001 ± 0.001	0.001 ± 0.001

Note: Radioactivities are reported as the measured concentration and either an uncertainty (±2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

[a] Other barcads were inoperative during 1999.

Table 9-32. Site 300, Pit 8 surveillance wells.[a]

Constituents of concern	Wells			
	K8-01		K8-02B	
	Sampling dates			
	6/4/99	11/4/99	6/4/99	11/4/99
Inorganic (µg/L)				
Antimony	<5	<5	<5	<5
Arsenic	19	18	25	25
Barium	<25	<25	<25	<25
Beryllium	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5	<0.5
Chromium	13	17	<1	1
Cobalt	<25	<25	<25	<25
Copper	<10	<10	<10	<10
Lead	<2	<2	<2	<2
Mercury	<0.2	<0.2	<0.2	<0.2
Molybdenum	<25	<25	<25	<25
Nickel	<5	<5	<5	<5
Selenium	4	4	7	6
Silver	1	<0.5	<0.5	<0.5
Thallium	<2	<2	<2	<2
Vanadium	75	74	70	71
Zinc	<20	<20	<20	<20
Potassium (mg/L)	4.6	3.9	4.2	4.5
Organics (µg/L)				
EPA Method 601	nd[b]	nd	nd	nd
1,2-dichloroethane	2.3	1.6	<0.5	<0.5
Trichloreoethene	3.9	3.7	1.4	1.6
EPA Method 608	na[c]	nd	na	nd
Explosive (µg/L)				
HMX	<1	na	<1	<1
RDX	<1	na	<1	<1
Radioactivity (Bq/L)				
Gross alpha	0.19 ± 0.06	0.21 ± 0.06	0.25 ± 0.06	0.26 ± 0.07
Gross beta	0.28 ± 0.05	0.22 ± 0.04	0.27 ± 0.05	0.29 ± 0.06
Tritium	1.39 ± 1.6	3.3 ± 2.1	–1.48 ± 1.5	–0.28 ± 2.1
Uranium (total)	0.32 ± 0.03	0.24 ± 0.02	0.41 ± 0.03	0.29 ± 0.02

a Well K8-03B was inaccessible during 1999 because of construction activities there.

b nd = None detected above reporting limits. See Table 9-1 for analytical methods and their constituents.

c na = Not analyzed (analysis not required).

Table 9-33. Site 300, Pit 9 surveillance wells.

Constituents of concern	Well			
	K9-01	K9-02	K9-03	K9-04
	Sampling dates			
	9/28/99	9/27/99	9/27/99	9/28/99
Inorganic (µg/L)				
Antimony	<5	<5	<5	<5
Arsenic	4	35	13	<2
Barium	<25	<25	<25	<25
Beryllium	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5	<0.5
Chromium	<1	<1	<1	1
Cobalt	<25	<25	<25	<25
Copper	<10	<10	<10	<10
Lead	<2	<2	<2	<2
Mercury	<0.2	<0.2	<0.2	<0.2
Molybdenum	26	53	29	32
Nickel	<5	<5	<5	<5
Potassium (mg/L)	7.6	8	8.4	10
Selenium	<2	<2	<2	<2
Silver	<0.5	<0.5	<0.5	<0.5
Thallium	<2	<2	<2	<2
Vanadium	<25	<25	<25	<25
Zinc	<20	<20	<20	20
Organic				
EPA Method 601 (volatile)	nd[(a)]	nd	nd	nd
EPA Method 625 (volatile)	nd	nd	nd	nd
Explosive (µg/L)				
HMX	<1	<1	<1	<1
RDX	<1	<1	<1	<1
Radioactive (Bq/L)				
Gross alpha	–0.040 ± 0.070	0.002 ± 0.052	–0.050 ± 0.048	0.029 ± 0.044
Gross beta	0.29 ± 0.06	0.27 ± 0.07	0.28 ± 0.06	0.24 ± 0.06
Tritium	–1.6 ± 2.6	–0.64 ± 2.6	–1. 8 ± 2.6	–2.0 ± 2.6
Uranium (total)	0.003 ± 0.001	0.013 ± 0.002	0.013 ± 0.003	0.017 ± 0.003

Note: Radioactivities are reported as the measured concentration and either an uncertainty (±2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

[a] nd = None detected above reporting limits. See Table 9-1 for analytical methods and their constituents.

Table 9-34. 1999 analytical results for Site 300 Building 829 area deep monitoring wells.[a]

Constituents of concern	Sampling dates for W-827-05			
	3/11/99	6/14/99	9/2/99	11/22–23/99
Inorganic (µg/L)				
pH (pH units)	na[b]	na	na	na
Field pH	7.5	7.2	7.0	8.2
Specific conductance (µmho/cm)	na	na	na	na
Field specific conductance (µmho/cm)	1800	1900	1800	1100
Total dissolved solids (TDS)	na	na	na	na
Field temperature (°C)	22	23	23	21
Aluminum	na	na	na	na
Antimony	<5	<5	<5	<5
Arsenic	<2	<2	<4	<2
Barium	<25	<25	<25	<25
Beryllium	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5	<0.5
Chromium	1.4	1.5	1.4	<1
Cobalt	<25	<25	<25	<25
Copper	<10	<10	<10	<10
Iron	<50	58	<50	<50
Lead	<2	<2	<2	<2
Manganese	250	230	240	200
Mercury	<0.2	<0.2	<0.2	<0.2
Molybdenum	<25	<25	<25	<25
Nickel	<5	<5	<5	<5
Selenium	<2	<2	<4	<2
Silver	<0.5	<1	<0.5	<0.5
Thallium	<1	<1	<1	<1
Vanadium	<25	<25	<25	<25
Zinc	<50	na	<20	<20
General Minerals (mg/L)				
Bicarbonate alkalinity (as $CaCO_3$)[c]	na	na	na	na
Bromide	0.57	0.78	0.82	0.7
Calcium	na	na	na	na

Table 9-34. 1999 analytical results for Site 300 Building 829 area deep monitoring wells (continued).

Constituents of concern	Sampling dates for W-827-05			
	3/11/99	6/14/99	9/2/99	11/22–23/99
General minerals (mg/L) (continued)				
Chloride	180	170	170	170
Fluoride	0.22	0.2	0.21	0.2
Magnesium	na	na	na	na
Nitrate	<0.4	<0.4	<0.4	<0.4
Orthophosphate	0.1	<0.05	0.09	0.09
Potassium	na	na	na	23
Sodium	260	250	260	250
Sulfate	630	610	620	590
Surfactants	na	na	na	na
Perchlorate	na	<4	na	<4
Total hardness (as $CaCO_3$)	na	na	na	na
Total phosphorus	na	na	na	na
Organic (µg/L)				
EPA Method 624	nd[d]	nd	nd	nd
EPA Method 625	nd	nd	nd	nd
EPA Method 608	nd	nd	nd	nd
Total organic halides (TOX, µg/L)	<20	<20	<20	55
Total organic carbon (TOC, mg/L)	1.5	1.7	<1	<1
Fecal coliform (MPN[e]/100 mL)	<1.1	na	<2	<2
Total coliform (MPN/100 mL)	<1.1	<2	<2	<2
Explosive compounds (µg/L)				
HMX	<1	<5	<5	<5
RDX	<0.8	<5	<5	<5
TNT	na	<5	<5	<5
1,3,5-trinitrobenzene	<0.3	na	na	na
Radioactive (Bq/L)				
Gross alpha	0.043 ± 0.033	–0.001 ± 0.025	–0.011 ± 0.017	–0.025 ± 0.048
Gross beta	0.310 ± 0.042	0.28 ± 0.06	0.22 ± 0.05	0.81 ± 0.13
Radium 226	0.009 ± 0.004	0.002 ± 0.003	0.002 ± 0.003	0.003 ± 0.004
Radium 228	0.009 ± 0.010	na	na	na
Tritium	0.37 ± 1.9	1.2 ± 2.6	–0.36 ± 2.04	–0.3 ± 2.1
Uranium (total)	0.004 ± 0.001	0.003 ± 0.001	0.005 ± 0.001	0.003 ± 0.001

Table 9-34. 1999 analytical results for Site 300 Building 829 area deep monitoring wells (continued).

Constituents of concern	Sampling dates for W-829-15			
	3/17–23/99	6/10/99	9/1/99	11/29/99
Inorganic (µg/L)				
pH (pH units)	na	9.9	10	na
Field pH	9.8	9.9	9.7	9.9
Specific conductance (µmho/cm)	na	1300	1300	na
Field specific conductance (µmho/cm)	1500	1100	1200	1300
Total dissolved solids (TDS)	na	850	850	na
Field temperature (°C)	23	20	22	21
Aluminum	na	57	<50	na
Antimony	<10	<5	<5	<5
Arsenic	13	13	11	12
Barium	<25	<25	<25	<25
Beryllium	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5	<0.5
Chromium	<1	1.4	<1	<1
Cobalt	<25	<25	<25	<25
Copper	<10	<10	<10	<10
Iron	<50	<50	<50	<50
Lead	<2	<2	<2	<5
Manganese	<10	<10	<10	<10
Mercury	<0.2	<0.2	<0.2	<0.2
Molybdenum	<25	<25	<25	<25
Nickel	<5	<5	<5	<5
Selenium	<2	<2	<4	<2
Silver	<0.5	<0.5	<0.5	<0.5
Thallium	<1	<1	<1	<1
Vanadium	<25	<25	<25	<25
Zinc	na	<10	<10	<20
General minerals (mg/L)				
Bicarbonate alkalinity (as $CaCO_3$)[c]	na	300	260	na
Bromide	0.33	0.4	0.34	0.35
Calcium	na	3.1	4.3	na

Table 9-34. 1999 analytical results for Site 300 Building 829 area deep monitoring wells (continued).

Constituents of concern	Sampling dates for W-829-15			
	3/17–23/99	6/10/99	9/1/99	11/29/99
General minerals (mg/L) (continued)				
Chloride	90	87	90	86
Fluoride	0.32	0.28	0.28	0.22
Magnesium	na	<0.5	<0.5	na
Nitrate	<0.4	<0.4	<0.4	0.9
Orthophosphate	0.19	0.17	0.15	0.14
Potassium	na	73	72	72
Sodium	280	240	230	220
Sulfate	180	180	190	190
Surfactants	na	<0.05	<0.05	na
Perchlorate	na	<4	<4	<4
Total hardness (as $CaCO_3$)	na	8.1	11	na
Total phosphorus	na	0.06	0.16	na
Organic (µg/L)				
EPA Method 624	nd	nd	nd	nd
EPA Method 625	nd	nd	nd	nd
EPA Method 608	nd	nd	nd	nd
Total organic halides (TOX, µg/L)	<20	<20	<20	<20
Total organic carbon (TOC, mg/L)	1.7	1.6	1.4	1.2
Fecal coliform (MPN/100 mL)	<1.1	na	<2	na
Total coliform (MPN/100 mL)	<1.1	<2	<2	<2
Explosive compounds (µg/L)				
HMX	<1	<5	<5	<5
RDX	<0.8	na	na	<5
TNT	<0.1	<5	<5	na
Radioactive (Bq/L)				
Gross alpha	0.040 ± 0.043	–0.011 ± 0.019	–0.028 ± 0.041	0.020 ± 0.052
Gross beta	2.0 ± 0.2	0.54 ± 0.09	1.0 ± 0.2	2.4 ± 0.37
Radium 226	0.001 ± 0.003	0.003 ± 0.002	–0.001 ± 0.004	–0.005 ± 0.004
Radium 228	–0.006 ± 0.014	na	na	na
Tritium	–1.5 ± 1.3	–0.24 ± 2.5	–0.39 ± 2.0	–0.67 ± 2.0
Uranium (total)	0.005 ± 0.001	0.003 ± 0.002	0.004 ± 0.002	<0.007 ± 0.001

Table 9-34. 1999 analytical results for Site 300 Building 829 area deep monitoring wells (continued).

Constituents of concern	Sampling dates for W-829-22			
	3/24/99	6/17/99	9/2/99	11/22/99
Inorganic (µg/L)				
pH (pH units)	na	8.5	8.4	na
Field pH (pH units)	8.5	8.8	7.9	8.5
Specific conductance (µmho/cm)	na	970	940	na
Field specific conductance (µmho/cm)	1000	1200	900	1000
Total dissolved solids (TDS)	na	620	650	na
Field temperature (°C)	22	24	23	21
Aluminum	na	<50	<50	na
Antimony	<5	<5	<5	<5
Arsenic	2.9	<2	<4	<2
Barium	<25	<25	<25	<25
Beryllium	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5	<0.5
Chromium	1.2	<1	<1	<1
Cobalt	<25	<25	<25	<25
Copper	<10	<10	<10	<10
Iron	<50	<50	<50	<50
Lead	<2	<2	<2	<2
Manganese	<10	<10	<10	<10
Mercury	<0.2	<0.2	<0.2	<0.2
Molybdenum	<25	<25	<25	<25
Nickel	<5	<5	<5	<5
Selenium	<2	<2	<2	<2
Silver	<0.5	<1	<0.5	<0.5
Thallium	<1	<1	<1	<1
Vanadium	<25	<25	<25	<25
Zinc	na	<10	<10	<20
General minerals (mg/L)				
Bicarbonate alkalinity (as $CaCO_3$)	na	220	220	na
Carbonate alkalinity (as $CaCO_3$)	na	10	<5	na
Total alkalinity (as $CaCO_3$)	na	230	220	na
Bromide	0.32	0.38	0.38	0.46
Calcium	na	6.2	6.5	na
Chloride	95	89	90	87

Table 9-34. 1999 analytical results for Site 300 Building 829 area deep monitoring wells (concluded).

Constituents of concern	Sampling dates for W-829-22			
	3/24/99	6/17/99	9/2/99	11/22/99
General minerals (µg/L) (continued)				
Fluoride	0.38	0.38	0.4	0.36
Magnesium	na	0.9	0.93	na
Nitrate	<0.4	<0.4	<0.4	<0.4
Orthophosphate	0.21	0.16	0.16	0.14
Potassium	na	9	8.6	8.3
Sodium	180	210	210	190
Sulfate	130	120	120	120
Surfactants	na	<0.05	<0.05	na
Perchlorate	na	<4	<4	<4
Total hardness (as $CaCO_3$)	na	19	20	na
Total phosphorus	na	0.07	0.06	na
Organic (µg/L)				
EPA Method 624	nd	nd	nd	nd
EPA Method 625	nd	nd	nd	nd
EPA Method 608	nd	nd	nd	nd
Total organic halides (TOX, µg/L)	<20	45	<20	<20
Total organic carbon (TOC, mg/L)	1.1	1.4	1.5	1.2
Fecal coliform (MPN/100 mL)	<1.1	<2	<2	<2
Total coliform (MPN/100 mL)	23	44	<2	8
Explosive compounds (µg/L)				
HMX	<1	<5	<5	<5
RDX	<0.8	<5	<5	<5
TNT	<1.2	<5	<5	<5
1,3,5-Trinitrobenzene	na	na	na	na
Radioactive (Bq/L)				
Gross alpha	0.027 ± 0.027	0.010 ± 0.031	–0.008 ± 0.035	–0.006 ± 0.028
Gross beta	0.39 ± 0.05	0.29 ± 0.06	0.26 ± 0.05	0.30 ± 0.06
Radium 226	0.006 ± 0.005	0.002 ± 0.004	0.003 ± 0.004	0.005 ± 0.004
Radium 228	0.001 ± 0.016	na	na	na
Tritium	–1.6 ± 1.3	–0.59 ± 2.7	0.04 ± 2.1	0.07 ± 2.1
Uranium (total)	0.005 ± 0.002	<0.007 ± 0.001	<0.006 ± 0.002	0.004 ± 0.002

[a] W-827-04 dry all year. No samples obtained.
[b] na = Not analyzed (analysis not required).
[c] Bicarbonate alkalinity = total alkalinity.
[d] nd = None detected above reporting limits (exceptions are listed). See Table 9-1 for analytical methods and their constituents.
[e] MPN = Most probable number

Table 9-35. 1999 analytical results for Site 300 Building 829 area shallow monitoring wells.

Constituents of concern	Well						
	W-829-06				W-829-08[a]		
	Sampling dates						
	3/9/99	6/11/99	8/26/99	12/1/99	3/15/99	8/26/99	12/2/99
Inorganic (µg/L)							
Field pH (units)	7.9	7.6	7.4	7.4	7.6	7.5	7.8
Field specific conductance (µmho/cm)	2800	2800	2700	1000	2900	2800	1100
Field temperature (°C)	15	21	23	19	19	21	17
Antimony	na[b]	na	na	<5	na	na	<5
Arsenic	na	na	na	3	na	na	<2
Barium	na	na	na	74	na	na	29
Beryllium	na	na	na	<0.5	na	na	<0.5
Cadmium	na	na	na	<0.5	na	na	<1
Chromium	na	na	na	2	na	na	2
Cobalt	na	na	na	<50	na	na	<50
Copper	na	na	na	<10	na	na	34
Iron	na	na	na	270	na	na	<50
Lead	na	na	na	<5	na	na	<5
Manganese	na	na	na	74	na	na	<10
Mercury	na	na	na	<0.2	na	na	<0.2
Molybdenum	na	na	na	<25	na	na	<25
Nickel	na	na	na	<5	na	na	10
Perchlorate (µg/L)[c]	18	21	na	24	12	na	14
Potassium	na	na	na	25	na	na	27
Selenium	na	na	na	410	na	na	520
Silver	na	na	na	<1	na	na	<1
Thallium	na	na	na	<1	na	na	<1
Vanadium	na	na	na	<25	na	na	<25
Zinc	na	na	na	32	na	na	260
General minerals (mg/L)							
Bromide	na	na	na	1.7	na	na	2
Chloride	na	na	na	410	na	na	500
Fluoride	na	na	na	0.52	na	na	0.52
Nitrate	na	na	na	230	na	na	230
Orthophosphate	na	na	na	0.24	na	na	0.16
Sodium	na	na	na	520	na	na	540
Sulfate	na	na	na	320	na	na	300

Table 9-35. 1999 analytical results for Site 300 Building 829 area shallow monitoring wells (concluded).

Constituents of concern	Well						
	W-829-06				W-829-08[a]		
	Sampling dates						
	3/9/99	6/11/99	8/26/99	12/1/99	3/15/99	8/26/99	12/2/99
General minerals (mg/L)							
Organic (µg/L)							
EPA Method 624	nd[d]	nd	nd	nd	nd	nd	nd
1,2-Dichloroethene (total)	<3	2.6	<3	2.9	<1	<1	<1
cis-1,2-Dichloroethene	2.5	2.6	2.4	2.9	<0.5	<0.5	<0.5
Trichloroethene	260	310	280	280	28	31	29
EPA Method 625	na	na	na	nd	na	na	nd
EPA Method 608	na	na	na	nd	na	na	nd
Total organic halides (TOX, µg/L)	na	na	na	192	na	na	<20
Fecal coliform (MPN[e]/100 mL)	na	na	na	na	na	na	<2
Total coliform (MPN/100 mL)	na	na	na	<2	na	na	<2
Total organic carbon (TOC, mg/L)	na	na	na	1.8	na	na	1.9
Explosive compounds (µg/L)							
HMX	<1	<5	<5	<5	<1	<5	<5
RDX	<0.8	<5	<5	<5	<0.8	<5	<5
TNT	na	na	na	<5	na	na	<5
Radioactivity (Bq/L)							
Gross alpha	na	na	na	1.7 ± 0.41	na	na	1.2 ± 0.33
Gross beta	na	na	na	1.0 ± 0.25	na	na	1.3 ± 0.26
Radium-226	na	na	na	0.011 ± 0.004	na	na	0.002 ± 0.003
Tritium	na	na	na	–0.63 ± 2.0	na	na	0.70 ± 2.1
Uranium (total)	na	na	na	0.43 ± 0.03	na	na	1.1 ± 0.08

a Second quarter sampling not done because pump down.

b na = Not analyzed (analysis not required).

c Perchlorate sampled on 3/5/99 for first quarter.

d nd = None detected above reporting limits (exceptions are listed). See Table 9-1 for analytical methods and their constituents.

e MPN = Most probable number

Table 9-36. Site 300 potable standby supply well 18.

Constituents of concern	Sampling dates			
	1/13/99	4/14/99[a]	9/15/99	11/10/99
Organic (µg/L)				
EPA Method 502.2 (volatile)	nd[b]	nd	—[c]	—[c]
EPA Method 601 (volatile)	nd	nd	nd	nd
Trichloroethene (TCE)	<0.5	0.63	0.54	<0.5
EPA Method 624 (volatile)	nd	na[d]	na	na
Radioactive (Bq/L)				
Gross alpha	–0.024 ± 0.034	–0.014 ± 0.026	—[c]	–0.0004 ± 0.041
Gross beta	0.064 ± 0.056	0.23 ± 0.03	—[c]	0.23 ± 0.06
Tritium	–3.9 ± 2.6	–0.53 ± 1.7	—[c]	0.008 ± 2.1

Note: Radioactivities are reported as the measured concentration and either an uncertainty (±2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

[a] There was one analysis for perchlorate, resulting in a nondetection of <4 µg/L.

[b] nd = None detected above reporting limits (exceptions are listed). See Table 9-1 for analytical methods and their constituents.

[c] Construction prohibited sampling.

[d] na = Not analyzed (analysis not required).

Table 9-37. Site 300 potable supply well 20.

Constituents of concern	Sampling dates			
	1/28/99	4/30/99	7/29/99	12/28/99
Inorganic (µg/L)				
Antimony	<5	<5	<5	<5
Arsenic	<2	<2	<2	<2
Barium	<25	<25	<25	<25
Beryllium	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5	<0.5
Chromium	<1	<1	<1	<1
Cobalt	<25	<25	<25	<25
Copper	<10	<10	<10	<10
Lead	2.1	<4	<2	<2
Mercury	<0.2	<0.2	<0.2	<0.2
Molybdenum	<25	<25	<25	<25
Nickel	<5	<5	<5	<5
Nitrate (mg/L)	na[(a)]	<0.4	<0.4	<0.4
Perchlorate	<4	na	na	na
Potassium (mg/L)	8	8.4	7.6	8.1
Selenium	<2	<2	<4	<2
Silver	<0.5	<0.5	<2	<1
Thallium	<1	<1	<1	<1
Vanadium	<25	<25	<25	<25
Zinc	<20	na	na	<20
Organic (µg/L)				
EPA Method 502.2 (volatile)	nd[(b)]	nd	nd	nd
Explosive (µg/L)				
HMX	<5	<5	<5	<5
RDX	<5	<5	<5	<5
Radioactive (Bq/L)				
Gross alpha	–0.031 ± 0.043	–0.003 ± 0.031	–0.012 ± 0.030	0.004 ± 0.034
Gross beta	0.28 ± 0.06	0.23 ± 0.04	0.22 ± 0.05	0.24 ± 0.06
Tritium	–6.0 ± 2.0	–0.18 ± 1.8	–0.72 ± 1.5	0.7 ± 2.1

Note: Radioactivities are reported as the measured concentration and either an uncertainty (±2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

a na = Not analyzed (analysis not required).

b nd = None detected above reporting limits (exceptions are listed). See Table 9-1 for analytical methods and their constituents.

Table 9-38. Site 300 off-site well CARNRW1.

Constituents of concern	Sampling dates			
	1/21/99	4/29/99	7/29/99	10/14/99
Organic (µg/L)				
EPA Method 601 (volatile)	nd[a]	nd	nd	nd

[a] nd = None detected above reporting limits. See Table 9-1 for analytical methods and their constituents.

Table 9-39. Site 300 off-site well CDF1.

Constituents of concern	Sampling date			
	1/20/99	4/28/99	7/30/99	10/14/99
Inorganic (µg/L)				
Antimony	<5	__[a]	<5	<5
Arsenic	5	__[a]	4.7	6.5
Barium	28	__[a]	38	30
Beryllium	<0.5	__[a]	<0.5	<0.5
Cadmium	<0.5	__[a]	<0.5	<0.5
Chromium	<1	__[a]	<1	<1
Cobalt	<25	__[a]	<25	<25
Copper	<10	__[a]	<10	<10
Lead	6	__[a]	2.4	<4
Mercury	<0.2	__[a]	<0.2	<0.2
Molybdenum	<25	__[a]	<25	<25
Nickel	<5	__[a]	<5	<5
Nitrate (mg/L)	0.6	2.0	3.0	0.5
Potassium (mg/L)	8	8	7.6	8.9
Selenium	<2	__[a]	<2	<2
Silver	<0.5	__[a]	<0.5	<2
Thallium	<1	__[a]	<1	<1
Vanadium	<25	__[a]	<25	<25
Zinc	38	__[a]	na[b]	<20
Organic (µg/L)				
EPA Method 524.2 (volatile)	nd[c]	nd	nd	nd
EPA Method 608 (pesticides and PCBs)	__[d]	__[d]	nd	nd
EPA Method 615 (herbicides)	__[d]	__[d]	nd	nd
EPA Method 625 (semivolatile)	__[d]	__[d]	nd	nd
Explosive (µg/L)				
HMX	<5	<5	<5	<5
RDX	<5	<5	<5	<5
Radioactive (Bq/L)				
Gross alpha	0.041 ± 0.041	0.029 ± 0.037	0.092 ± 0.052	0.036 ± 0.044
Gross beta	0.34 ± 0.06	0.26 ± 0.06	0.25 ± 0.05	0.29 ± 0.06
Tritium	–7.1 ± 2.2	0.24 ± 1.8	–1.2 ± 1.4	–1.1 ± 2.6
Uranium (total)	__[d]	__[d]	0.064 ± 0.007	0.016 ± 0.003

Note: Radioactivities are reported as the measured concentration and either an uncertainty (±2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

[a] Analysis not requested (sampling error).

[b] na = Not analyzed (analysis not required).

[c] nd = None detected above reporting limits. See Table 9-1 for analytical methods and their constituents.

[d] Analysis not planned.

Table 9-40. Off-site surveillance well CON1.

Constituents of concern	Sampling dates			
	1/20/99	4/29/99	7/30/99	10/15/99
Inorganic (µg/L)				
Antimony	<5	<5	<5	<5
Arsenic	<2	2.6	<2	2.6
Barium	<25	<25	<25	<25
Beryllium	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5	<0.5
Chromium	4.3	<1	<1	<1
Cobalt	<25	<25	<25	<25
Copper	<10	<10	<10	<10
Lead	<2	<4	<2	<5
Mercury	<0.2	<0.2	<0.2	<0.2
Molybdenum	<25	<25	<25	<25
Nickel	18	<5	<5	<5
Selenium	<2	<2	<2	<2
Silver	<0.5	<0.5	<0.5	<0.5
Thallium	<1	<1	<1	<1
Vanadium	<25	<25	<25	<25
Zinc	<20	—[a]	—[a]	<20
Potassium (mg/L)	8.1	9.2	8.9	8.9
Nitrate (mg/L)	<0.5	<0.9	<0.9	<0.9
Organic (µg/L)				
EPA Method 524.2 (volatile)	nd[b]	nd	nd	nd
EPA Method 608 (pesticides and PCBs)	—[c]	—[c]	nd	—[c]
EPA Method 615 (herbicides)	—[c]	—[c]	nd	—[c]
EPA Method 625 (semivolatile)	—[c]	—[c]	nd	—[c]
Energetic (µg/L)				
HMX	<5	<5	<5	<5
RDX	<5	<5	<5	<5
Radioactive (Bq/L)				
Gross alpha	0.056 ± 0.061	0.001 ± 0.015	–0.018 ± 0.030	–0.001 ± 0.028
Gross beta	0.32 ± 0.07	0.004 ± 0.027	0.15 ± 0.04	0.13 ± 0.05
Tritium	–8.1 ± 2.1	–0.54 ± 1.8	–2.3 ± 1.4	–0.4 ± 2.6
Uranium (total)	—[c]	—[c]	0.002 ± 0.001	—[c]

Note: Radioactivities are reported as the measured concentration and either an uncertainty (±2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

[a] Analysis not requested (sampling error).

[b] nd = None detected above reporting limits. See Table 9-1 for analytical methods and their constituents.

[c] Analysis not planned.

Table 9-41. Site 300, off-site surveillance well GALLO1.

Constituents of concern	Sampling date			
	1/21/99	4/30/99	7/29/99	10/14/99
Inorganic (µg/L)				
Antimony	<5	<5	<5	<5
Arsenic	2.7	5.4	3.5	5.4
Barium	<25	<25	<25	<25
Beryllium	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5	<0.5
Chromium	<1	<1	<1	<1
Cobalt	<25	<25	<25	<25
Copper	<10	<10	<10	<10
Lead	2.7	<4	<2	<4
Mercury	<0.2	<0.2	<0.2	<0.2
Molybdenum	42	44	37	45
Nickel	<5	<5	<5	<5
Selenium	<2	<2	<4	<2
Silver	<0.5	<0.5	<2	<2
Thallium	<1	<1	<1	<1
Vanadium	<25	<25	<25	<25
Zinc	<20	—[a]	—[a]	<20
Potassium (mg/L)	3.6	3.9	3.8	3.9
Nitrate (mg/L)	2.9	<0.4	<0.4	<0.4
Organic (µg/L)				
EPA Method 524.2 (volatile)	nd[b]	nd	nd	nd
Trichloroethene	0.57	0.74	0.58	0.52
EPA Method 608 (pesticides and PCBs)	—[c]	—[c]	nd	—[c]
EPA Method 615 (herbicides)	—[c]	—[c]	nd	—[c]
EPA Method 625 (semivolatile)	—[c]	—[c]	nd	—[c]
Explosive (µg/L)				
HMX	<5	<5	<5	<5
RDX	<5	<5	<5	<5
Radioactive (Bq/L)				
Gross alpha	0.034 ± 0.040	0.006 ± 0.026	–0.043 ± 0.031	0.005 ± 0.036
Gross beta	0.17 ± 0.05	0.094 ± 0.034	0.074 ± 0.030	0.078 ± 0.048
Tritium	–7.0 ± 2.1	–0.74 ± 1.8	–2.8 ± 1.3	–0.58 ± 2.6
Uranium (total)	—[c]	—[c]	0.006 ± 0.001	—[c]

Note: Radioactivities are reported as the measured concentration and either an uncertainty (±2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

[a] Analysis not requested (sampling error).

[b] nd = None detected above reporting limits (exceptions are listed). See Table 9-1 for analytical methods and their constituents.

[c] Analysis not planned.

Table 9-42. Site 300 off-site surveillance well CARNRW2.

Constituents of concern	Sampling date			
	1/21/99	4/29/99	7/29/99	10/14/99
Inorganic (µg/L)				
Antimony	<5	<5	<5	<5
Arsenic	2.6	3.7	3	4.5
Barium	<25	<25	<25	<25
Beryllium	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5	<0.5
Chromium	<1	<1	<1	<1
Cobalt	<25	<25	<25	<25
Copper	<10	<10	<10	<10
Lead	2.8	<4	<2	<4
Mercury	<0.2	<0.2	<0.2	<0.2
Molybdenum	<25	<25	<25	31
Nickel	<5	<5	<5	<5
Nitrate (mg/L)	1.9	—[a]	<0.4	<0.4
Perchlorate	na[b]	<4	na	na
Potassium (mg/L)	8.5	9	8.1	8.9
Selenium	<2	<2	<4	<2
Silver	<0.5	<0.5	<2	<2
Thallium	<1	<1	<1	<1
Vanadium	<25	<25	<25	<25
Zinc	26	—[c]	—[c]	<20
Organic (µg/L)				
EPA Method 524.2 (volatile)	nd[d]	nd	nd	nd
EPA Method 608 (pesticides and PCBs)	—[e]	—[e]	nd	—[e]
EPA Method 615 (herbicides)	—[e]	—[e]	nd	—[e]
EPA Method 625 (semivolatile)	—[e]	—[e]	nd	—[e]
Explosive (µg/L)				
HMX	<5	<5	<5	<5
RDX	<5	<5	<5	<5
Radioactive (Bq/L)				
Gross alpha	0.019 ± 0.033	–0.020 ± 0.037	–0.022 ± 0.036	–0.025 ± 0.033
Gross beta	0.37 ± 0.05	0.29 ± 0.03	0.27 ± 0.06	0.26 ± 0.06
Tritium	–6.6 ± 2.2	–0.44 ± 1.8	–0.87 ± 1.4	—[a]
Uranium (total)	—[e]	—[e]	<0.008 ± 0.001	—[e]

Note: Radioactivities are reported as the measured concentration and either an uncertainty (±2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

[a] Analysis not requested (sampling error).

[b] na = Not analyzed (analysis not required).

[c] Analysis not reported (analytical error)

[d] nd = None detected above reporting limits. See Table 9-1 for analytical methods and their constituents.

[e] Analysis not planned

Table 9-43. Site 300 off-site surveillance well CON2.

Constituents of concern	Sampling dates			
	1/20/99	4/29/99	7/29/99	10/15/99
Organic (µg/L)				
EPA Method 601 (volatile)	nd[a]	nd	nd	nd

[a] nd = None detected above reporting limits. See Table 9-1 for analytical methods and their constituents.

Table 9-44. Annually monitored off-site surveillance wells.

Constituents of concern	Well					
	MUL1	MUL2	STONEHAM1	VIE1	VIE2	W-35A-04
	Sampling dates					
	9/8/99	9/8/99	9/8/99	9/10/99	9/8/99	8/6/99
Inorganic (µg/L)						
Antimony	<5	<5	<5	<5	<5	<5
Arsenic	4	<2	<2	12	<2	2.4
Barium	30	<25	61	54	38	57
Beryllium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	<1	<1	<1	<1	<1	1.7
Cobalt	<25	<25	<25	<25	<25	<25
Copper	<10	<10	<10	<10	20	<10
Lead	<2	<2	<2	<2	3	<2
Mercury	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Molybdenum	<25	<25	<25	<25	<25	<25
Nickel	<5	8	<5	<5	<5	<5
Potassium (mg/L)	5.1	7.7	6.9	11	2	5.6
Selenium	<2	3	<2	5	<2	2
Silver	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Thallium	<2	<2	<2	<2	<2	<1
Vanadium	<25	<25	<25	32	<25	<25
Zinc	40	20	90	40	40	0
Organic (µg/L)						
EPA Method 502.2	nd[a]	nd	nd	nd	nd	nd
EPA Method 608	nd	nd	nd	nd	nd	nd
EPA Method 615	nd	nd	nd	na[b]	nd	nd
EPA Method 625	nd	nd	nd	nd	nd	nd
Explosive (µg/L)						
HMX	<1	<1	<1	<1	<1	na
RDX	<1	<1	<1	<1	<1	na
Radioactive (Bq/L)						
Gross alpha	0.080 ± 0.034	–0.006 ± 0.023	0.051 ± 0.048	0.051 ± 0.037	0.096 ± 0.052	0.032 ± 0.037
Gross beta	0.21 ± 0.04	0.11 ± 0.03	0.10 ± 0.03	0.41 ± 0.07	0.095 ± 0.034	0.056 ± 0.048
Tritium	–0.78 ± 2.0	1.0 ± 2.1	–0.01 ± 2.0	–0.58 ± 2.0	–0.84 ± 2.0	1.1 ± 2.1
Uranium (total)	0.13 ± 0.01	0.035 ± 0.004	0.22 ± 0.02	0.11 ± 0.01	0.093 ± 0.008	0.14 ± 0.01

Note: Radioactivities are reported as the measured concentration and either an uncertainty (±2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

[a] nd = None detected above reporting limits. See Table 9-1 for analytical methods and their constituents..

[b] na = Not analyzed (sampling error).

10

Soil and Sediment Monitoring

Gretchen M. Gallegos
Erich R. Brandstetter

Surface Soil Methods

Prior to 1988, surface soil samples were collected at sites selected at random from Livermore Valley locations previously sampled for a 1971–1972 study. That earlier study was conducted to determine background concentrations of radionuclides in area soils. In 1988, Livermore Valley surface soil sampling locations were chosen to coincide with air sampling locations, to cover areas with contaminants from past incidents, or to sample other areas of special concern (see **Figure 10-1**, in the main volume). In 1991, five additional soil sampling locations associated with air sampling locations were established. The 1999 Livermore Valley surface soil samples were collected from generally the same locations as those in 1991 to 1998. The 1999 Site 300 soil samples were collected from the same 14 locations as those sampled between 1990 and 1998. In 1998, the soil sampling program added the PRIM location at Site 300 to complement air monitoring at that location. The PRIM site is downwind of Site 300 and off site but sufficiently close to the Site 300 boundary to potentially be affected by Site 300 operations. Analysis for plutonium in Site 300 soils was discontinued in 1997 because plutonium has not been used at the site, and sample results have continuously been at background levels since sampling began in 1972. The use of established sampling locations is preferred, when possible, from year to year because it allows us to determine more meaningful trends in data.

Sampling locations at areas with known or suspected contaminants were monitored to delimit the extent of the contaminants and to track the contaminants from year to year. For example, six surface soil sampling locations are located near the Livermore Water Reclamation Plant (LWRP) to monitor soils that contain slightly elevated plutonium levels originating from resuspension of sludge that contained plutonium contamination from accidental releases to the sewer, from 1967 and earlier years.

Surface soil sampling is conducted according to written, standardized procedures contained in the *Environmental Monitoring Plan* (Tate et al. 1999). Samples are collected from undisturbed areas near the permanent sampling location marker. These areas generally are level, free of rocks, and unsheltered by trees or buildings. The sampling technicians choose two 1-m squares from which to collect the sample and record how far away and in what direction from the permanent marker the sample is collected. Each

sample is a composite consisting of 10 subsamples that are collected with an 8.25-cm-diameter stainless steel core sampler at the corners and the center of each square. All subsamples are collected from the top 5 cm of soil because surface deposition from the air is the primary pathway for potential contamination.

Quality assurance (QA) duplicate samples are submitted with each batch of soil samples. At locations chosen for duplicate sampling, two identical samples are obtained by collecting adjacent cores from the corners and center of the sampling squares. Separate composites of 10 cores each are made, and the duplicate samples are identified with unique sample identifier codes.

Surface soil samples are dried, ground, sieved, and homogenized. Samples are analyzed by LLNL's Chemistry and Materials Science Environmental Services (CES) laboratory. The plutonium content of a 100-g sample aliquot is determined by alpha spectroscopy (Hall and Edwards 1994c). Other sample aliquots (300 g) are analyzed for more than 150 radionuclides by gamma spectroscopy, using a high-purity germanium (HPGe) detector (Hall and Edwards 1994a, b, and c). Only those nuclides measured above detection limits or of particular interest are reported. The 10-g subsamples of samples from Site 300 are sent to a contract analytical laboratory and are analyzed by graphite-furnace atomic absorption spectroscopy for beryllium. Chain-of-custody procedures are followed throughout the sampling, delivery, and analytical processes.

Surface Sediment Methods

Surface samples of a sediment are collected from arroyos and storm water drainages at and around the Livermore site after the cessation of spring runoff. For 1999, samples were analyzed for radionuclides.

Sediment was sampled from seven Livermore site drainages. Location ALPO was covered in water throughout the sampling period and was not sampled (see **Figure 10-3**, in the main volume). The sediment sampling locations coincide with storm water runoff sampling locations so that the sampling results from these two media can be compared.

All surface sediment locations are marked by a permanent location marker, which serves as a reference point for each sampling location. Ten subsamples, 5-cm deep, are collected at 1-m intervals along a transect of the arroyo or drainage channel. At one of the subsample locations, a 15-cm-deep sample is acquired for tritium analysis. The sample collection technicians record how far away and in what direction from the

permanent marker the samples are actually collected. As with soil samples, QA samples are submitted with each batch of sediment samples.

Samples are analyzed by LLNL's CES laboratory. For samples collected for tritium analyses, CES uses freeze-drying techniques to recover water from the samples and determines the tritium content of the water by liquid-scintillation counting. The plutonium content of a sample aliquot is determined by alpha spectroscopy. Other sample aliquots are analyzed for radionuclides using gamma spectroscopy as described above for surface soil samples. The radioanalytical methods employed by the CES laboratory enable detection of concentrations at levels far more sensitive than regulatory limits. Chain-of-custody procedures are followed throughout the sampling, delivery, and analytical processes.

Vadose Zone Soil Methods

Vadose zone soil samples are collected at the same locations as the surface sediments. One of the 10 surface subsample locations is selected for collection of the deeper vadose zone samples. A hand auger is used to collect a 30- to 45-cm-deep sample, which is submitted for analysis for total and soluble metals by EPA Methods 200.7, 245.2, 7471A and 6010B. Using an electric drive, a sample is collected at 45–65 cm deep for analysis for organic compounds by EPA Method 8240. Chain-of-custody procedures are followed throughout the sampling, delivery, and analytical processes.

Data

Table 10-1 presents the analytical data for radionuclides for surface soil and sediment samples collected in 1999 in the Livermore Valley and Livermore site. Table 10-2 presents the data, which include radionuclides and beryllium, for samples collected at Site 300. The data generally reflect historic data values for these analytes at these locations. A detailed discussion of these results is provided in the main volume of this report. Tables 10-3 through 10-5 list background levels for total and soluble metals in soils and sediments and de minimis concentrations for soluble metals and organics. Table 10-6 presents analytical values for semi-volatile organic compounds measured by EPA Method 8240 in Livermore site sediments. Tables 10-7 and 10-8 give results for total and dissolved metals, respectively.

Table 10-1. Radionuclides in soils and sediments in the Livermore Valley, 1999.

Location identifier	Plutonium-238 (µBq/dry g)	Plutonium-239+240 (µBq/dry g)	Americium-241 (mBq/dry g)	Cesium-137 (mBq/dry g)
Livermore Valley soils				
L-AMON-SO	2.7 ± 1.4	72.5 ± 7.7	—[d]	2.9 ± 0.3
L-CHUR-SO	4.4 ± 1.8	73.6 ± 7.8	—[d]	6.1 ± 0.5
L-COW-SO	2.1 ± 1.4	23.1 ± 4.4	—[d]	<0.13
L-FCC-SO	2.6 ± 1.6	79.6 ± 9.0	—[d]	2.3 ± 0.3
L-HOSP-SO	1.4 ± 1.1	42.6 ± 6.0	—[d]	1.5 ± 0.4
L-MESQ-SO	1.2 ± 1.1	28.3 ± 4.9	—[d]	0.69 ± 0.20
L-MET-SO	1.2 ± 1.1	52.5 ± 6.7	—[d]	1.6 ± 0.3
L-NEP-SO	3.2 ± 1.7	64.4 ± 7.6	—[d]	2.0 ± 0.4
L-PATT-SO	0.64 ± 0.84	18.9 ± 4.0	—[d]	0.64 ± 0.20
L-SALV-SO	4.4 ± 1.9	93.2 ± 9.0	—[d]	1.0 ± 0.2
L-TANK-SO	6.6 ± 2.5	125 ± 11	—[d]	4.2 ± 0.4
L-VIS-SO	22.8 ± 4.4	507 ± 28	—[d]	1.0 ± 0.2
L-ZON7-SO	6.1 ± 2.3	156 ± 13	—[d]	3.3 ± 0.4
Median	**2.7**	**72.5**	—[f]	**1.6**
Interquartile range	**3.0**	**51**	—[f]	**1.9**
Maximum	**22.8**	**507**	—[f]	**6.1**
LWRP soils				
L-WRP1-SO	354 ± 22	6960 ± 290	2.5 ± 2.1	4.0 ± 0.3
L-WRP2-SO	196 ± 14	3550 ± 150	2.9 ± 2.1	2.4 ± 0.3
L-WRP3-SO	27.6 ± 4.7	544 ± 29	<1.0	0.50 ± 0.32
L-WRP4-SO	124 ± 10	2170 ± 90	<0.7	1.0 ± 0.2
L-WRP5-SO	91.4 ± 91	2120 ± 90	<0.7	1.2 ± 0.3
L-WRP6-SO	33.8 ± 5.3	588 ± 32	<1.2	0.46 ± 0.17
Median	**108**	**2150**	**<1.1**	**1.1**
Interquartile range	**130**	**2230**	—[g]	**1.4**
Maximum	**354**	**6960**	**2.9**	**4.0**
Livermore site sediments				
L-ALPE-SD	6.2 ± 2.2	173 ± 13	—[d]	0.72 ± 0.26
L-ASS2-SD	–0.12 ± 0.48	7.0 ± 2.3	—[d]	0.24 ± 0.19
L-ASW-SD	0.75 ± 0.83	7.2 ± 2.4	—[d]	<0.10
L-CDB-SD	42.2 ± 5.8	607 ± 32	—[d]	0.53 ± 0.28
L-ESB-SD	211 ± 15	2180 ± 90	—[d]	0.46 ± 0.19
L-GRNE-SD	5.0 ± 2.1	84 ± 9	—[d]	1.3 ± 0.2
L-WPDC-SD	0.44 ± 0.82	7.4 ± 2.4	—[d]	<0.12
Median	**5.0**	**84**	—[f]	**0.46**
Interquartile range	**23.6**	**382**	—[f]	**0.44**
Maximum	**211**	**2180**	—[f]	**1.3**

Note: Radioactivities are reported as the measured concentration and either an uncertainty (±2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

[a] Thorium-232 activities in Bq/dry g can be determined by dividing the weight in µg/dry g by 247.3, and pCi/dry g can be determined by dividing by 9.15.

[b] Uranium-235 activities in Bq/dry g were determined by dividing the weight in µg/dry g by 12.5, and in pCi/dry g by dividing by 0.463.

Potassium-40 (Bq/dry g)	Tritium (Bq/L)	Thorium-232[a] (µg/dry g)	Uranium-235[b] (µg/dry g)	Uranium-238[c] (µg/dry g)	Uranium-235/238
Livermore Valley soils					
0.581 ± 0.013	—[e]	9.2 ± 0.2	0.022 ± 0.009	1.8 ± 1.3	0.012 ± 0.010
0.485 ± 0.014	—[e]	8.0 ± 0.2	0.024 ± 0.012	2.5 ± 1.7	0.009 ± 0.008
0.466 ± 0.013	—[e]	7.5 ± 0.2	0.015 ± 0.008	1.3 ± 0.9	0.012 ± 0.010
0.385 ± 0.012	—[e]	6.1 ± 0.2	0.017 ± 0.009	1.2 ± 1.1	0.013 ± 0.014
0.418 ± 0.013	—[e]	5.4 ± 0.2	0.015 ± 0.012	1.2 ± 1.0	0.013 ± 0.015
0.474 ± 0.014	—[e]	7.9 ± 0.2	0.023 ± 0.011	2.2 ± 1.7	0.011 ± 0.010
0.544 ± 0.017	—[e]	7.7 ± 0.2	0.019 ± 0.011	1.7 ± 1.2	0.011 ± 0.010
0.477 ± 0.014	—[e]	7.2 ± 0.2	0.020 ± 0.011	2.0 ± 1.2	0.010 ± 0.008
0.518 ± 0.011	—[e]	7.4 ± 0.2	0.017 ± 0.011	1.5 ± 0.8	0.011 ± 0.009
0.422 ± 0.012	—[e]	8.6 ± 0.2	0.024 ± 0.010	2.5 ± 0.9	0.010 ± 0.005
0.295 ± 0.011	—[e]	6.7 ± 0.2	0.020 ± 0.013	1.5 ± 1.2	0.013 ± 0.014
0.403 ± 0.010	—[e]	6.8 ± 0.2	0.016 ± 0.008	1.6 ± 0.8	0.010 ± 0.007
0.418 ± 0.011	—[e]	7.7 ± 0.2	0.020 ± 0.008	1.6 ± 1.2	0.012 ± 0.010
0.466	—[f]	**7.5**	**0.020**	**1.6**	—[f]
0.067	—[f]	**1.2**	**0.005**	**0.5**	—[f]
0.581	—[f]	**9.2**	**0.024**	**2.5**	—[f]
LWRP soils					
0.407 ± 0.011	—[e]	7.8 ± 0.2	0.020 ± 0.011	1.9 ± 1.0	0.011 ± 0.008
0.323 ± 0.012	—[e]	7.1 ± 0.2	0.019 ± 0.009	2.2 ± 1.0	0.009 ± 0.006
0.345 ± 0.013	—[e]	7.7 ± 0.2	0.018 ± 0.010	2.1 ± 1.3	0.009 ± 0.007
0.337 ± 0.013	—[e]	7.3 ± 0.2	0.018 ± 0.009	1.6 ± 1.0	0.011 ± 0.009
0.374 ± 0.013	—[e]	7.0 ± 0.2	0.020 ± 0.005	2.0 ± 1.4	0.010 ± 0.007
0.381 ± 0.012	—[e]	6.1 ± 0.2	0.017 ± 0.008	2.0 ± 1.5	0.008 ± 0.007
0.359	—[f]	**7.2**	**0.018**	**2.0**	—[f]
0.040	—[f]	**0.6**	**0.002**	**0.2**	—[f]
0.407	—[f]	**7.8**	**0.020**	**2.2**	—[f]
Livermore site sediments					
0.361 ± 0.012	20.9 ± 3.0	5.9 ± 0.2	0.017 ± 0.009	1.9 ± 1.1	0.009 ± 0.007
0.529 ± 0.014	<0.5 ± 2.2	3.9 ± 0.1	0.011 ± 0.008	<0.6	0.019 ± 0.014
0.466 ± 0.014	<1.4 ± 2.3	3.9 ± 0.2	0.014 ± 0.013	1.2 ± 0.9	0.012 ± 0.014
0.440 ± 0.016	75.1 ± 4.4	7.5 ± 0.3	0.024 ± 0.007	2.0 ± 0.8	0.012 ± 0.006
0.407 ± 0.009	68.1 ± 4.3	6.2 ± 0.1	0.015 ± 0.009	2.7 ± 1.3	0.006 ± 0.004
0.466 ± 0.010	<2.7 ± 2.3	5.8 ± 0.2	0.016 ± 0.010	1.2 ± 0.8	0.013 ± 0.012
0.485 ± 0.014	4.5 ± 2.5	8.6 ± 0.2	0.024 ± 0.014	2.0 ± 1.4	0.012 ± 0.011
0.466	**4.5**	**5.9**	**0.016**	**1.9**	—[f]
0.052	—[g]	**2.0**	**0.006**	**0.8**	—[f]
0.529	**75.1**	**8.6**	**0.024**	**2.7**	—[f]

c Uranium-238 activities in Bq/dry g were determined by dividing the weight in µg/dry g by 80.3, and in pCi/dry g by dividing by 2.97.

d Americium-241was detected only in LWRP samples.

e Only sediment samples are analyzed for tritium.

f Not calculated.

g Interquartile range not calculated because of high incidence of reported values below detection limits.

Table 10-2. Radionuclides and beryllium in soils at Site 300, 1999.

Location identifier	Cesium-137 (mBq/dry g)	Potassium-40 (Bq/dry g)	Thorium-232[a] (µg/dry g)	Uranium-235[b] (µg/dry g)	Uranium-238[c] (µg/dry g)	Beryllium (mg/kg)	Uranium 235/238
3-801E-SO	1.4 ± 0.3	0.396 ± 0.012	9.6 ± 0.2	0.021 ± 0.010	1.5 ± 1.2	0.62	0.014 ± 0.012
3-801N-SO	2.4 ± 0.4	0.440 ± 0.013	12.4 ± 0.3	0.037 ± 0.014	6.9 ± 3.0	1.0	0.005 ± 0.003
3-801W-SO	3.6 ± 0.4	0.474 ± 0.015	10.1 ± 0.3	0.028 ± 0.013	4.8 ± 1.7	0.64	0.006 ± 0.003
3-812N-SO	1.1 ± 0.3	0.392 ± 0.015	12.6 ± 0.4	0.148 ± 0.008	71.3 ± 2.8	2.5	0.002 ± 0.0001
3-834W-SO	3.2 ± 0.4	0.444 ± 0.017	11.6 ± 0.3	0.016 ± 0.013	1.1 ± 0.9	0.9	0.014 ± 0.016
3-851N-SO	1.8 ± 0.3	0.433 ± 0.016	14.2 ± 0.4	0.033 ± 0.019	2.9 ± 1.6	0.8	0.011 ± 0.009
3-856N-SO	3.2 ± 0.3	0.377 ± 0.013	10.6 ± 0.3	0.023 ± 0.012	2.0 ± 1.2	0.8	0.012 ± 0.009
3-858S-SO	5.4 ± 0.3	0.440 ± 0.018	9.5 ± 0.3	0.029 ± 0.014	2.8 ± 1.8	0.56	0.010 ± 0.008
3-DSW-SO	5.1 ± 0.5	0.414 ± 0.013	9.3 ± 0.3	0.033 ± 0.011	3.5 ± 1.5	0.6	0.009 ± 0.005
3-EOBS-SO	1.4 ± 0.3	0.500 ± 0.013	10.2 ± 0.2	0.025 ± 0.011	1.3 ± 1.2	0.8	0.019 ± 0.019
3-EVAP-SO	2.3 ± 0.4	0.377 ± 0.009	12.3 ± 0.2	0.035 ± 0.013	4.0 ± 1.1	0.8	0.009 ± 0.004
3-GOLF-SO	5.6 ± 0.4	0.492 ± 0.013	8.9 ± 0.2	0.019 ± 0.008	1.4 ± 1.0	0.55	0.014 ± 0.012
3-NPS-SO	4.5 ± 0.5	0.574 ± 0.017	8.5 ± 0.2	0.020 ± 0.011	2.3 ± 1.5	0.54	0.009 ± 0.008
3-PRIM-SO	1.0 ± 0.3	0.525 ± 0.014	10.8 ± 0.2	0.025 ± 0.011	2.2 ± 1.3	0.56	0.011 ± 0.008
3-WOBS -SO	4.0 ± 0.3	0.396 ± 0.013	8.0 ± 0.2	0.017 ± 0.010	1.9 ± 1.5	0.63	0.009 ± 0.009
Median	**3.2**	**0.440**	**10.2**	**0.025**	**2.3**	**0.6**	—[d]
Interquartile range	**2.6**	**0.087**	**2.5**	**0.012**	**2.1**	**0.2**	—[d]
Maximum	**5.6**	**0.574**	**14.2**	**0.148**	**71.3**	**2.5**	—[d]

Note: Radioactivities are reported as the measured concentration and either an uncertainty (±2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

[a] Thorium-232 activities in Bq/dry g can be determined by dividing the weight in µg/dry g by 247.3, and pCi/dry g can be determined by dividing by 9.15.

[b] Uranium-235 activities in Bq/dry g can be determined by dividing the weight in µg/dry g by 12.5, and pCi/dry g can be determined by dividing by 0.463.

[c] Uranium-238 activities in Bq/dry g can be determined by dividing the weight in µg/dry g by 80.3, and pCi/dry g can be determined by dividing by 2.97.

[d] Not calculated.

Table 10-3. Background screening concentration values for metals in soils at the Livermore site.

Metal	Background screening value Total (mg/kg)
Antimony	1.12
Arsenic	8.51
Barium	308
Beryllium	0.62
Cadmium	1.59
Chromium	72.4
Chromium(VI)	Any detection
Cobalt	14.6
Copper	62.5
Lead	43.7
Mercury	0.14
Molybdenum	Any detection
Nickel	82.8
Selenium	Any detection
Silver	Any detection
Thallium	Any detection
Vanadium	65.2
Zinc	75.3

Metal	Background screening value Soluble (mg/L)
Antimony	Any detection
Arsenic	0.237
Barium	16.7
Beryllium	Any detection
Boron	To be determined
Cadmium	Any detection
Chromium	0.727
Cobalt	0.985
Copper	2.6
Iron	To be determined
Lead	0.987
Manganese	To be determined
Mercury	0.0063
Molybdenum	Any detection
Nickel	1.68
Selenium	Any detection
Silver	Any detection
Thallium	Any detection
Vanadium	1.22
Zinc	4.52

Note: Background values were developed for all soils and sediments at the Livermore site but are used here as a basis for comparison for analytical results for vadose zone soils.

Table 10-4. De minimis concentration levels for soluble metals found in Livermore site soils.

Constituents	Water quality objective (mg/L)	Reference	Attenuation factor	De minimis level (mg/L)
Metals				
Antimony	0.006	Cal Primary MCL[a]	100	0.06
Arsenic	0.050	Cal Primary MCL	100	0.5
Barium	1.0	Cal Primary MCL	100	10
Beryllium	0.004	Cal Primary MCL	100	0.04
Cadmium	0.005	Cal Primary MCL	100	0.05
Chromium	0.05	Cal Primary MCL	100	0.5
Cobalt	5	RWQCB Basin Plan	100	50
Copper	1	RWQCB Basin Plan	1000	100[b]
Lead	0.015	EPA	1000	1.5
Mercury	0.002	Cal Primary MCL	100	0.02
Molybdenum	0.05	RWQCB Basin Plan	100	0.5
Nickel	0.1	Cal Primary MCL	100	1
Selenium	0.05	Cal Primary MCL	100	0.5
Silver	0.1	Cal Secondary MCL	100	1
Thallium	0.002	Cal Primary MCL	100	0.02
Vanadium	1	RWQCB Basin Plan	100	10
Zinc	5	Cal Secondary MCL	1000	500[b]

Note: De minimis values were developed for all soils and sediments at the Livermore site but are used here as a basis for comparison for analytical results for vadose zone soils.

a MCL = maximum contaminant level in drinking water.

b Although the de minimis leavels are 100 mg/L for copper and 500 mg/L for zinc, the hazardous waste limit is 25 mg/L for copper and 250 mg/L for zinc. Consequently, soils with soluble concentrations at or above the hazardous waste limit are disposed of as a hazardous waste and not reused on site.

Table 10-5. De minimis concentration levels for organic and radioactive constituents of concern found in Livermore site soils and sediments.

Constituents	Water quality objective	Reference	Attenuation factor	De minimis level
Organics (µg/L)				
1,2-Dichlorobenzene	600	EPA Primary MCL[a]	100	3000
1,3-Dichlorobenzene	130	CA DHS Action Level	100	650
1-4-Dichlorobenzene	5	Cal Primary MCL	100	25
1,1-Dichloroethane	5	Cal Primary MCL	100	25
1-2-Dichloroethane	0.5	Cal Primary MCL	100	2.5
1,1-Dichloroethene	6	Cal Primary MCL	100	30
1,2-Dichloroethene	6	Cal Primary MCL	100	30
cis-1,2-Dichloroethene	6	Cal Primary MCL	100	30
trans-1,2-Dichloroethene	10	Cal Primary MCL	100	50
1,1,1-Trichloroethane	200	Cal Primary MCL	100	1000
1,1,2-Trichloroethane	5	Cal Primary MCL	100	25
Benzene	1	Cal Primary MCL	100	5
Carbon tetrachloride	0.5	Cal Primary MCL	100	2.5
Chloroform	100	EPA Primary MCL	100	500
Diesel oil/kerosene	100	SNARL[b]	100	500
Ethyl benzene	700	Cal Primary MCL	100	3500
Freon 11 (trichlorofluoromethane)	150	Cal Primary MCL	100	750
Freon 12 (dichlorodifluoromethane)	1000	CA DHS Action Level	100	5000
Freon 113 (1,1,2-trichloro-1,2,2-trifluoroethane)	1200	Cal Primary MCL	100	6000
Gasoline	5	Other[c]	100	25
Methylene chloride	5	Cal Primary MCL	100	25
Methyl tertiary-butyl ether (MTBE)	35	CA DHS Action Level	100	175
Oil and grease	25,000	Other	100	125,000
Tetrachloroethene (PCE)	5	Cal Primary MCL	100	25
Toluene	150	Cal Primary MCL	100	750
Trichloroethene (TCE)	5	Cal Primary MCL	100	25
Xylene(s)	1750	Cal Primary MCL	100	8750
PCB (total)	0.5	Cal Primary MCL	100	2.5
Vinyl chloride	0.5	Cal Primary MCL	100	2.5

Table 10-5. De minimis concentration levels for organic and radioactive constituents of concern found in Livermore site soils and sediments (concluded).

Constituents	Water quality objective	Reference	Attenuation factor	De minimis level
Radioactivity (Bq/L)				
Gross alpha	0.56	Cal Primary MCL	100	5.6
Gross beta	1.9	Cal Primary MCL	100	19
Tritium	740	Cal Primary MCL	100	7400

Note: De minimis values were developed for all soils and sediments at the Livermore site but are used here as a basis for comparison for analytical results for vadose zone soils.

[a] MCL = Maximum contaminant level.

[b] SNARL = Suggested No Adverse Response Level.

[c] Other = Taste and odor threshold for gasoline, and the California Ocean Plan Water Quality Objectives for oil and grease.

Table 10-6. Semi-volatile organic compounds measured by EPA Method 8240 in Livermore site vadose zone soil, 1999.

Organic compounds (µg/L)	ASS2	ASW	ALPE	GRNE	WPDC	CDB	ESB
1,1-Dichloroethene	<10	<10	<10	<10	<10	<10	<10
1,2-Dichloroethane	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5
1-4-Dichlorobenzene	<10	<10	<10	<10	<10	<10	<10
2-Butanone	<10	<10	<10	<10	<10	<10	<10
Benzene	<5	<5	<5	<5	<5	<5	<5
Carbon tetrachloride	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5
Chlorobenzene	<10	<10	<10	<10	<10	<10	<10
Chloroform	<10	<10	<10	<10	<10	<10	<10
Trichloroethene	<10	<10	<10	<10	<10	<10	<10
Vinyl chloride	<10	<10	<10	<10	<10	<10	<10

Table 10-7. Total metals in Livemore site vadose zone soil, 1999.

Total metals (mg/kg)	Arroyo Seco		Arroyo Las Positas			Drainage Retention Basin	
	Influent	Effluent	Influent		Effluent	Influent	
	ASS2	ASW	ALPE	GRNE	WPDC	CDB	ESB
Antimony	<1	<1	<1	<1	<1	<1	<1
Arsenic	3.3	3.5	3.8	2.7	5.8	4.8	3.5
Barium	53	100	520	140	220	150	130
Beryllium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.1	<0.1	0.1	0.1	0.4	<0.1	0.2
Chromium	22	22	21	11	35	27	24
Cobalt	6	7	9	6	11	8	10
Copper	11	14	13	7	25	17	13
Lead	<10	<10	<10	10	<10	<10	<10
Mercury	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Molybdenum	<5	<5	<5	<5	<5	<5	<5
Nickel	30	30	30	10	40	30	40
Potassium	800	800	900	600	1800	1800	800
Selenium	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5
Silver	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5
Thallium	<1	<1	<1	<1	<1	<1	<1
Vanadium	18	19	32	18	37	34	25
Zinc	47	41	25	20	47	37	45

Table 10-8. Soluble metals in Livermore site vadose zone soil, 1999.

Soluable metals (mg/L)	Arroyo Seco		Arroyo Las Positas			Drainage Retention Basin	
	Influent	Effluent	Influent		Effluent	Influent	
	ASS2	ASW	ALPE	GRNE	WPDC	CDB	ESB
Antimony	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06
Arsenic	0.07	0.08	<0.05	0.1	<0.05	<0.05	0.06
Barium	3.3	4.2	6.3	5.6	7.6	5.7	6.2
Beryllium	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Cadmium	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Chromium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cobalt	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Copper	<0.5	0.6	<0.5	<0.5	<0.5	<0.5	<0.5
Lead	<0.5	<0.5	<0.5	0.5	<0.5	<0.5	<0.5
Mercury	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Molybdenum	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Nickel	<0.5	<0.5	0.6	<0.5	0.5	<0.5	0.6
Potassium	17	16	7	13	9	13	13
Selenium	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Silver	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Thallium	<0.03	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Vanadium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Zinc	1	0.7	<0.5	<0.5	<0.5	<0.5	0.9

11

Vegetation and Foodstuff Monitoring

S. Ring Peterson

Introduction

This chapter discusses the sampling methods Lawrence Livermore National Laboratory uses to monitor vegetation and wine, including a description of how sampling locations are selected, what types and amounts of samples are collected, and the process for handling the samples. Of the radionuclides released to the environment from LLNL activities, tritium is the only one that can be measured in vegetation and foodstuff and, therefore, is the only radionuclide monitored.

Vegetation Sampling Methods

The vegetation sampling locations that Lawrence Livermore National Laboratory chose were areas with ample living vegetation during most of the year. Sampling locations were distant from buildings or other obstructions that could have caused unusual patterns of airflow or precipitation. Irrigated or shaded areas were also avoided. Practical considerations, such as access during inclement weather and personnel safety during vehicle operation or sample collection, also affected selection of sampling locations.

Sampling locations for 1999 were the same as in 1998 and are listed in **Table 11-1**. The routine vegetation sampling locations are designated with permanent location markers. Consistent use of the same general sampling locations allows LLNL to determine more meaningful trends in data and to monitor areas of concern more closely. For example, every year at Site 300, LLNL examines vegetation from areas where tritium is known to be present in the subsurface soil.

Vegetation sampling is conducted according to written, standardized procedures contained in the *Environmental Monitoring Plan* (Tate et al. 1999). In 1999, vegetation samples consisted of annual grasses and weeds. LLNL collected approximately 340 to 450 g of vegetation with relatively high water content for each analysis. Standard chain-of-custody procedures were followed.

Samples were delivered on the day of collection to LLNL's Chemistry and Materials Science Environmental Services laboratory and were kept frozen prior to processing. Water from the vegetation was collected using freeze-drying techniques (lyophilization), and the tritium content of the water was determined by liquid-scintillation counting.

Approximately 10% of the sites was sampled in duplicate to comply with quality assurance protocols. Duplicate samples were preserved, stored, processed, and analyzed with methods identical to those employed for all other samples.

Wine Sampling Methods

California is divided into nine wine-growing regions (including Livermore), and Europe is divided into 13 (Tate et al. 1999). LLNL purchased 12 wines from the Livermore Valley, one wine from each of six California wine growing regions (excluding Livermore), and one wine from each of four European wine growing regions and submitted them for tritium analyses (see **Table 11-2**). The selection of wines from a particular wine-growing region was random. An equal mix of red and white wines was selected from the Livermore Valley, other California wine-growing areas, and Europe. Any estate wine from a designated area was considered representative of that area. Samples were purchased in 750-mL or 1-L bottles. Approximately 10% of the total complement of wines was sampled in duplicate to comply with quality assurance protocols. Because of the importance of the wine-sampling network, LLNL either samples or archives as many of the available Livermore Valley wines as possible.

Wine sampling is conducted according to written, standardized procedures contained in the *Environmental Monitoring Plan* (Tate et al. 1999). The wine samples were submitted unopened to the laboratory for analysis to prevent potential airborne tritium contamination. Chain-of-custody procedures were followed when delivering the samples and throughout the analytical process. LLNL analyzed wines for tritium using ^{3}He mass spectrometry in the Isotope Sciences Division Noble Gas Mass Spectrometry Laboratory (Surano et al. 1991). Using this highly sensitive method, the minimum detectable tritium concentration is about 0.056 Bq/L (1.5 pCi/L). Conventional scintillation detection systems typically have detection limits between 3.7 and 19 Bq/L (100–500 pCi/L) depending on sample size and counting times. With great care, a scintillation detection system's sensitivity can reach about 1 Bq/L (27 pCi/L); however, this detection level is still not sensitive enough to detect small differences in wine samples.

Table 11-1. Concentrations of tritium in plant water (Bq/L), 1999.

	First quarter	Second quarter	Third quarter	Fourth quarter	Median	Inter-quartile range	Dose (μSv/y)[a]	
							Median	Maximum
Sampling locations near Livermore site								
AQUE	7.0 ± 2.0	5.9 ± 1.8	9.7 ± 2.9	6.1 ± 2.6	6.6	1.6	0.032	0.047
VIS	100 ± 4.4	19 ± 2.3	16 ± 3.1	6.7 ± 2.7	18	26	0.085	0.48
NPER	18 ± 2.3	7.5 ± 1.9	9.1 ± 2.9	6.6 ± 2.6	8.3	4.1	0.040	0.087
MET	3.4 ± 1.7	1.8 ± 1.6	4.7 ± 2.8	19 ± 3.1	4.1	5.3	0.020	0.092
MESQ	6.9 ± 1.9	1.6 ± 1.6	0.37 ± 2.6	8.2 ± 2.7	4.3	5.9	0.021	0.040
GARD	5.9 ± 1.8	2.5 ± 2.6	0.60 ± 2.6	2.2 ± 2.5	2.4	1.6	0.011	0.029
PIN1	110 ± 4.6	26 ± 2.6	180 ± 6.5	280 ± 7.8	150	120	—[b]	—[b]
PIN2	89 ± 4.1	15 ± 2.2	14 ± 3.1	11 ± 2.8	15	20	—[b]	—[b]
Sampling locations at an intermediate distance from Livermore site								
PATT	–0.75 ± 1.5	1.4 ± 1.6	4.9 ± 2.8	0.93 ± 2.4	1.2	1.8	0.0056	0.024
ZON7	21 ± 2.5	6.7 ± 1.8	5.4 ± 2.8	2.5 ± 2.5	6.1	5.6	0.029	0.010
I580	100 ± 4.4	0.83 ± 1.5	1.3 ± 2.6	0.076 ± 2.4	1.1	25	0.0052	0.49
TESW	0.52 ± 1.6	1.4 ± 1.6	0.70 ± 2.6	3.0 ± 2.7	1.1	1.1	0.0051	0.015
Sampling locations far from Livermore site								
FCC	0.68 ± 1.6	–1.8 ± 1.4	–0.79 ± 2.6	–2.0 ± 2.3	–1.3	1.4	—[c]	0.0033
CAL	–2.8 ± 1.4	0.34 ± 1.5	0.065 ± 2.6	–0.54 ± 2.4	–0.24	1.2	—[c]	0.0016
PARK	–1.8 ± 1.4	–0.070 ± 1.5	–0.64 ± 2.6	–3.2 ± 2.2	–1.2	1.7	—[c]	—[c]
Sampling locations at Site 300								
CARN	1.7 ± 1.5	–1.0 ± 1.4	1.1 ± 2.6	–1.3 ± 2.7	0.050	2.3	0.00024	0.0082
GOLF	4.0 ± 1.6	–1.1 ± 1.4	–0.68 ± 2.6	–0.88 ± 2.7	–0.78	1.4	—[c]	0.019
GEO	1.7 ± 1.5	–0.0055 ± 1.4	0.51 ± 2.6	–0.025 ± 2.7	0.25	0.82	0.0012	0.0082
DSW	3.1 ± 1.6	1.1 ± 1.6	2.1 ± 2.7	1.1 ± 2.8	1.6	1.3	0.0078	0.015
801E	–0.45 ± 1.4	–1.5 ± 1.4	0.38 ± 2.6	–0.52 ± 2.7	–0.49	0.52	—[c]	0.0018
EVAP	2.9 ± 1.6	–0.90 ± 1.4	330 ± 8.6	480 ± 10	170	370	0.810	2.3
PRIM	2.0 ± 1.5	0.17 ± 1.5	0.51 ± 2.6	–1.4 ± 2.7	1.6	1.3	0.0078	0.0097

Note: Radioactivities are reported as the measured concentration and either an uncertainty (±2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

[a] Ingestion dose is based on conservative assumptions that an adult's diet is exclusively vegetables with this tritium concentration, and that meat and milk are derived from livestock fed on grasses with the same concentration of tritium. See Appendix A, Methods of Dose Calculations.

[b] Doses were not calculated because pine trees are not ingested by human beings; an ingestion dose to the maximally exposed individual was calculated with CAP88 using evapotranspiration from PIN1 as a diffuse source of tritium. The median dose was 8.0×10^{-6} μSv/y, and the maximum dose was 1.5×10^{-5} μSv/y.

[c] Doses resulting from negative median concentrations are not calculated.

Table 11-2. Tritium in retail wine (Bq/L), 1999.[a]

Sample	Area of production		
	Livermore Valley	California	Europe
1	0.94 ± 0.21	0.30 ± 0.19	0.72 ± 0.20
2	1.0 ± 0.21	0.39 ± 0.19	1.4 ± 0.23
3	1.3 ± 0.23	0.39 ± 0.19	1.5 ± 0.24
4	1.5 ± 0.24	0.47 ± 0.19	1.6 ± 0.25
5	1.5 ± 0.24	0.56 ± 0.19	
6	1.7 ± 0.25	0.57 ± 0.19	
7	1.7 ± 0.25		
8	1.9 ± 0.26		
9	2.1 ± 0.28		
10	2.2 ± 0.29		
11	4.9 ± 0.52		
12	8.3 ± 0.85		
Median	**1.7**	**0.43**	**1.5**
Interquartile range	**0.68**	**0.15**	**0.30**
Mean	**2.4**	**0.45**	**1.3**
Standard deviation	**2.1**	**0.11**	**0.40**
nSv/y[b] from median concentration	**1.5**	**0.38**	**1.3**
nSv/y[b] from mean concentration	**2.2**	**0.40**	**1.2**
nSv/y[b] from maximum concentration	**7.4**	**0.51**	**1.4**

Note: Radioactivities are reported as the measured concentration and either an uncertainty (±2σ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

[a] A variety of vintages was purchased and analyzed during 1999. The tritium concentrations reported are those at the time the bottle was opened.

[b] This dose is calculated based on consumption of 52 L wine per year (see Appendix A).

12

Environmental Radiation Monitoring

Nicholas A. Bertoldo

Methods of Gamma Radiation Monitoring

The environmental gamma-radiation dose from terrestrial and cosmic sources is monitored at 14 locations on the laboratory site perimeter, twenty-three locations in the Livermore Valley, eight locations on the Site 300 perimeter, five sites in the vicinity of Site 300, and at two locations in the City of Tracy. Thermoluminescent dosimeters (TLDs) are deployed to the field on a quarterly basis following laboratory preparation. Each TLD is labeled with a Lawrence Livermore National Laboratory dosimeter identification number and placed into a mylar foil sample pouch for protection.

Each sample pouch is then numbered by its field location and mounted on preexisting structures (such as fences) at approximately 1 m above ground to comply with *Environmental Regulatory Guide for Radiological Effluent Monioring and Environmental Surveillance* (U.S. Department of Energy 1991). Duplicate trip blanks, transit control TLDs, and calibration control TLDs are also prepared. Upon their removal from the site locations at the end of each quarter, the exposed TLDs are taken to the LLNL Hazards Control dosimetry laboratory for processing. A chain-of-custody form accompanies the field deployment and the collection of the TLDs. Details of the TLD calculations and reporting of external gamma-radiation dose are described in an Operations and Regulatory Affairs Division procedure.

LLNL uses the Panasonic Model UD-814AS1 TLD, which contains three thallium-activated calcium sulfate crystals ($CaSO_4$) and one lithium borate crystal ($Li_2B_4O_7$). The gamma-ray energy imparted to the TLD's crystal elements excite the electrons in the valence band to a higher energy state, creating a vacancy in the valence band known as a "hole." These electron holes are trapped in impurity sites within the crystal. When the TLDs are heated in the analytical laboratory, the thermal energy of the process raises the electron trap to the conduction band or the hole trap to the valence band, causing thermoluminescence. This light intensity is proportional to the original gamma-ray energy imparted to the TLD crystal elements (that is, the TLD absorbed dose) and is measured by the photomultiplier tube output signal. After the TLD is measured, it is reheated and remeasured. A near-zero reading indicates that all the stored energy has been released. This process, called annealing, also verifies that the TLD is again ready

for field deployment. When a TLD is found open on the ground, damaged, or lost, the associated annual dose reported is calculated from the average of the available mean quarterly dose values for that given location.

Gamma-radiation exposure is measured in roentgens (R), which are defined as the electronic charge required to ionize a given volume of air (2.54×10^{-4} coulombs/kg air). The equivalent absorbed dose is 8.7×10^{-3} Gy (0.87 rad) in air. The tissue equivalent absorbed dose is 9.6×10^{-3} Gy (0.96 rad). The measured exposure is converted to dose equivalent by calibrating the dosimeters against sources that deliver a known absorbed dose and then applying the gamma-radiation quality factor of 1. The resultant dose-equivalent is reported for environmental dose in submultiple factors of 1×10^{-3} sieverts or millisieverts (mSv) and compared to Department of Energy (DOE) Order 5400.5 radiation protection standards. Site boundary doses are compared to environmental background measurements to assess the contribution or impact, if any, from LLNL operations.

To ensure accuracy in TLD measurements, some TLDs are irradiated each quarter to specific exposures for calibration purposes, and others are irradiated to specific exposures to serve as quality-control accuracy checks. Duplicate TLDs are located in the field at several locations each quarter to assess TLD measurement precision. When the field deployment time is either less than or exceeds 90 days, the data is normalized to a standard, 90-day quarter or 360 days per year for the purpose of comparison. LLNL participates in the National Intercomparison Laboratory Study for external gamma radiation measurements, and LLNL processing complies with the DOE Environmental Measurement Laboratory standards.

Tables

Data tables for the 1999 gamma-radiation monitoring network are presented below. Table 12-1 presents the Livermore site perimeter data, Table 12-2 presents the Livermore Valley data, Table 12-3 presents the Site 300 perimeter data, and Table 12-4 presents Tracy and other Site 300 off-site data. Summary data are discussed in detail in Chapter 12 of the main volume of this report.

Table 12-1. Calculated dose from TLD environmental radiation measurements, Livermore site perimeter, 1999.

Location[a]	Quarterly dose (mSv)[b]				Annual Dose[c] (mSv)
	Jan–Mar	Apr–Jun	Jul–Sep	Oct–Dec	
L-001-TD	0.159 ± 0.010	0.148 ± 0.001	0.149 ± 0.011	0.156 ± 0.004	0.612 ± 0.015
L-004-TD	0.154 ± 0.006	0.149 ± 0.005	0.153 ± 0.001	0.152 ± 0.006	0.608 ± 0.010
L-005-TD	0.159 ± 0.005	0.159 ± 0.006	0.156 ± 0.007	0.157 ± 0.005	0.631 ± 0.012
L-006-TD	0.156 ± 0.010	0.160 ± 0.011	0.158 ± 0.007	0.156 ± 0.008	0.630 ± 0.018
L-011-TD	0.117 ± 0.004	0.120 ± 0.011	0.119 ± 0.014	0.119 ± 0.005	0.475 ± 0.019
L-014-TD	0.136 ± 0.018	0.140 ± 0.004	—[d]	0.139 ± 0.005	0.553 ± 0.025
L-016-TD	0.135 ± 0.009	0.141 ± 0.006	0.14 ± 0.012	0.140 ± 0.010	0.556 ± 0.019
L-042-TD	0.137 ± 0.008	0.152 ± 0.004	0.142 ± 0.004	0.155 ± 0.005	0.586 ± 0.011
L-043-TD	0.150 ± 0.019	0.149 ± 0.005	0.154 ± 0.002	0.164 ± 0.010	0.617 ± 0.022
L-047-TD	0.134 ± 0.009	0.129 ± 0.009	0.126 ± 0.005	0.131 ± 0.007	0.520 ± 0.015
L-052-TD	0.137 ± 0.003	0.141 ± 0.008	0.134 ± 0.008	0.154 ± 0.009	0.566 ± 0.015
L-056-TD	0.139 ± 0.005	0.140 ± 0.008	0.147 ± 0.012	0.141 ± 0.004	0.567 ± 0.016
L-068-TD	0.145 ± 0.008	0.144 ± 0.007	0.15 ± 0.008	0.144 ± 0.000	0.583 ± 0.013
L-069-TD	0.136 ± 0.004	0.138 ± 0.009	0.139 ± 0.011	0.135 ± 0.012	0.548 ± 0.019
Mean[e]	**0.142 ± 0.006**	**0.144 ± 0.006**	**0.144 ± 0.007**	**0.146 ± 0.006**	**0.577 ± 0.025**

Note: Measurement represents the TLD absorbed dose in mR converted to mSv.

a See **Figure 12-1** in the main volume for locations.

b Measurement uncertainty is reported as ±2σ of the data.

c Uncertainty is reported as twice the propagated error of the quarterly means.

d Data are not available due to a missing or damaged TLD.

e Uncertainty associated with the quarterly means is reported as two standard errors of the location data.

Table 12-2. Calculated dose from TLD environmental radiation measurements, Livermore Valley, 1999.

Location[a]	Quarterly dose (mSv)[b]				Annual dose[c] (mSv)
	Jan–Mar	Apr–Jun	Jul–Sep	Oct–Dec	
V-018-TD	0.119 ± 0.013	0.114 ± 0.011	0.117 ± 0.003	0.121 ± 0.009	0.471 ± 0.019
V-019-TD	0.132 ± 0.008	0.133 ± 0.010	0.130 ± 0.006	0.131 ± 0.005	0.526 ± 0.015
V-022-TD	0.151 ± 0.011	0.161 ± 0.011	0.159 ± 0.002	0.151 ± 0.002	0.622 ± 0.016
V-024-TD	0.147 ± 0.007	0.153 ± 0.006	0.145 ± 0.011	0.148 ± 0.008	0.593 ± 0.016
V-027-TD	0.137 ± 0.004	0.138 ± 0.009	0.136 ± 0.011	0.131 ± 0.010	0.542 ± 0.018
V-028-TD	0.160 ± 0.014	0.168 ± 0.011	0.159 ± 0.004	0.171 ± 0.006	0.658 ± 0.019
V-030-TD	0.134 ± 0.010	0.142 ± 0.003	0.146 ± 0.007	0.149 ± 0.009	0.571 ± 0.015
V-032-TD	0.139 ± 0.005	0.143 ± 0.007	0.142 ± 0.003	0.145 ± 0.003	0.569 ± 0.010
V-033-TD	0.145 ± 0.009	0.149 ± 0.006	0.152 ± 0.006	0.152 ± 0.016	0.598 ± 0.020
V-035-TD	0.149 ± 0.016	0.150 ± 0.007	0.159 ± 0.006	0.150 ± 0.011	0.608 ± 0.021
V-037-TD	0.145 ± 0.011	0.144 ± 0.009	—[d]	—[d]	0.578 ±0.028
V-045-TD	0.131 ± 0.006	0.142 ± 0.004	0.145 ± 0.008	0.138 ± 0.004	0.556 ± 0.011
V-057-TD	0.148 ± 0.002	0.153 ± 0.007	0.162 ± 0.013	0.159 ± 0.010	0.622 ± 0.018
V-060-TD	0.143 ± 0.005	0.152 ± 0.008	0.147 ± 0.007	0.148 ± 0.009	0.590 ± 0.015
V-061-TD	0.137 ± 0.009	—[d]	0.127± 0.004	0.127 ± 0.007	0.521 ± 0.016
V-066-TD	0.150 ± 0.008	0.149 ± 0.008	0.152 ± 0.006	0.150 ± 0.007	0.601 ± 0.015
V-070-TD	0.142 ± 0.007	0.143 ± 0.002	—[d]	0.143 ± 0.006	0.571 ± 0.013
V-072-TD	0.170 ± 0.014	0.166 ± 0.004	0.170 ± 0.013	0.172 ± 0.007	0.678 ± 0.021
V-073-TD	—[d]	0.151 ± 0.004	0.156 ± 0.008	0.144 ± 0.008	0.601 ± 0.016
V-074-TD	0.135 ± 0.009	0.151 ± 0.004	0.156 ± 0.008	0.144 ± 0.008	0.586 ± 0.015
V-075-TD	0.117 ± 0.005	0.130 ± 0.012	0.131 ± 0.009	0.136 ± 0.009	0.514 ± 0.018
V-076-TD	0.124 ± 0.005	0.113 ± 0.008	0.112 ± 0.004	0.117 ± 0.004	0.466 ± 0.011
V-077-TD	0.133 ± 0.009	0.119 ± 0.015	0.120 ± 0.003	0.123 ± 0.005	0.495 ± 0.018
Mean[e]	**0.140 ± 0.005**	**0.143 ± 0.006**	**0.143 ± 0.007**	**0.143 ± 0.006**	**0.571 ± 0.022**

Note: Measurement represents the TLD absorbed dose in mR converted to mSv.

a See **Figure 12-2** in the main volume for locations.

b Measurement uncertainty is reported as ±2σ of the data.

c Uncertainty is reported as twice the propagated error of the quarterly mean.

d Data are not available due to a missing or damaged TLD.

e Uncertainty associated with the quarterly mean is reported as two standard errors of the location data.

Table 12-3. Calculated dose from TLD environmental radiation measurements, Site 300 perimeter, 1999.

Location[a]	Quarterly dose (mSv)[b]				Annual dose[c] (mSv)
	Jan–Mar	Apr–Jun	Jul–Sep	Oct–Dec	
3-078-TD	0.148 ± 0.001	0.148 ± 0.007	0.151 ± 0.004	0.154 ± 0.011	0.601 ± 0.014
3-081-TD	0.197 ± 0.036	0.189 ± 0.014	0.234 ± 0.019	0.190 ± 0.009	0.810 ± 0.044
3-082-TD	0.161 ± 0.012	0.174 ± 0.008	0.169 ± 0.010	0.173 ± 0.005	0.677 ± 0.018
3-085-TD	0.163 ± 0.012	0.168 ± 0.008	0.175 ± 0.004	0.173 ± 0.009	0.679 ± 0.017
3-086-TD	0.169 ± 0.012	0.179 ± 0.012	0.174 ± 0.011	0.170 ± 0.012	0.692 ± 0.024
3-088-TD	0.174 ± 0.012	0.165 ± 0.012	0.169 ± 0.002	0.170 ± 0.009	0.678 ± 0.019
3-089-TD	0.186 ± 0.012	0.187 ± 0.017	0.180 ± 0.012	0.184 ± 0.007	0.737 ± 0.025
3-091-TD	0.168 ± 0.007	0.176 ± 0.004	0.188 ± 0.001	0.181 ± 0.003	0.713 ± 0.009
3-121-TD	0.182 ± 0.008	0.189 ± 0.009	0.192 ± 0.023	0.208 ± 0.013	0.771 ± 0.029
Mean[d]	**0.172 ± 0.009**	**0.175 ± 0.008**	**0.181 ± 0.015**	**0.178 ± 0.010**	**0.706 ± 0.040**

Note: Measurement represents the TLD absorbed dose in mR converted to mSv.

[a] See **Figure 12-3** in the main volume for locations.

[b] Measurement uncertainty is reported as ±2σ of the data.

[c] Uncertainty is reported as twice the propagated error of the quarterly means.

[d] Uncertainty associated with the quarterly means is reported as two standard errors of the location data.

Table 12-4. Calculated dose from TLD environmental radiation measurements, Tracy and other off-site locations in the vicinity of Site 300, 1999.

Location[a]	Quarterly dose (mSv)[b]				Annual dose[c] (mSv)
	Jan–Mar	Apr–Jun	Jul–Sep	Oct–Dec	
3-092-TD	0.153 ± 0.008	0.157 ± 0.014	0.154 ± 0.000	0.161 ± 0.004	0.625 ± 0.017
3-093-TD	0.143 ± 0.008	0.132 ± 0.002	0.140 ± 0.005	0.143 ± 0.007	0.558 ± 0.012
Mean[d]	**0.148 ± 0.010**	**0.144 ± 0.024**	**0.147 ± 0.013**	**0.152 ± 0.017**	**0.591 ± 0.066**
3-090-TD	0.177 ± 0.003	0.181 ± 0.009	0.189 ± 0.006	0.181 ± 0.011	0.728 ± 0.016
3-094-TD	0.214 ± 0.028	0.230 ± 0.005	0.203 ± 0.002	0.202 ± 0.010	0.849 ± 0.030
3-096-TD	0.202 ± 0.011	0.198 ± 0.012	0.238 ± 0.016	0.231 ± 0.008	0.869 ± 0.024
3-099-TD	0.157 ± 0.008	0.161 ± 0.003	0.174 ± 0.014	0.144 ± 0.002	0.636 ± 0.017
3-120-TD	—[e]	0.177 ± 0.014	—[f]	—[f]	—[g]
Mean	**0.187 ± 0.025**	**0.189 ± 0.023**	**0.201 ± 0.027**	**0.189 ± 0.036**	**0.770 ± 0.109**

Note: Measurement represents the TLD absorbed dose in mR converted to mSv.

[a] See **Figure 12-2** in the main volume for locations.

[b] Measurement uncertainty is reported as ±2σ of the data.

[c] Uncertainty is reported as twice the propagated error of the quarterly mean.

[d] Uncertainty associated with the quarterly mean is reported as two standard errors of the location data.

[e] Data are not available due to a missing or damaged TLD.

[f] Location removed.

[g] Not applicable.

13

There are no supplemental data in this chapter. Please see the main volume for details about Radiological Dose Assessment.

14

Quality Assurance

Lucinda M. Garcia

Participation in Laboratory Intercomparison Studies

Two laboratories at Lawrence Livermore National Laboratory participated in the annual Environmental Monitoring Laboratory (EML) intercomparison studies program sponsored by the U.S. Department of Energy (DOE). The two LLNL laboratories are the Chemistry and Materials Science Environmental Services (CES) Environmental Monitoring Radiation Laboratory (EMRL) and the Hazards Control Department's Analytical Laboratory (HCAL).

The results of CES EMRL's participation in the EML studies are presented in **Table 14-1**. According to the results, 55 of 58 analyses fell within established acceptance control limits.

The CES result for plutonium-238 in vegetation for the Semi-Annual Report for the Department of Energy's Office of Environmental Management Quality Assurance Program (QAP-51) (Greenlaw 1999) study fell below the lower acceptance control limit. CES attributed this unacceptable result to poor counting statistics for plutonium-238, which was present at a relatively low activity. The count time for this sample was shortened (16 hours as opposed to 72 hours typically used for standard samples) to prevent detector and counting chamber contamination by long-lived decay daughter recoil nuclides from plutonium-239, which was present at an activity ten times higher than that of plutonium-238. If the standard deviation of the CES reported activity is taken into account, the CES result is not statistically different from the EML value.

CES results for cobalt-60 and cesium-137 in water for the QAP-51 study fell above the upper acceptance control limits. CES attributed these unacceptable results to inattention to detail. Specifically, the efficiency calibration standards for the gamma spectrometer unit were not prepared correctly, leading to an erroneous estimation of the minimum detectable concentration (MDC) and unacceptable results. When CES analysts discovered this problem, they recounted all affected client samples and reissued corrected analytical reports. In the future, CES will count a second source standard that is independent of the standard used for calibration after they have performed efficiency calibration of the gamma spectrometer units.

The results of HCAL's participation in the 1999 EML studies (see **Table 14-2**) indicate that ten of ten sample results fell within the 3σ acceptance control limits.

CES EMRL participated in two DOE Mixed Analyte Performance Evaluation Program (MAPEP) studies in 1999. The results of these study are presented in **Tables 14-3** and **14-4**. Sixteen of 16 analytes reported by CES in the first study, and 23 of 23 analytes reported by CES in the second study fell within acceptable limits.

Although contract laboratories are also required to participate in laboratory inter-comparison programs, permission to publish their results for comparison purposes was not granted for 1999.

Table 14-1. LLNL's CES EMRL results from the DOE EML Quality Assurance Program, 1999.

Analyte	EML study	CES value	EML value	CES/EML	Control limits (3σ)[a]	Warning limits (2σ)	Performance[b]
Air filter (Bq/filter)							
Am-241	QAP-50	0.145	0.134	1.09	0.73–2.58	0.88–1.46	Acceptable
	QAP-51	0.124	0.127	0.976	0.73–2.58	0.88–1.46	Acceptable
Co-57	QAP-50	3.24	3.01	1.08	0.65–1.39	0.72–1.13	Acceptable
	QAP-51	8.56	7.73	1.11	0.65–1.39	0.72–1.13	Acceptable
Co-60	QAP-50	5.24	4.96	1.06	0.75–1.32	0.83–1.10	Acceptable
	QAP-51	6.83	6.35	1.08	0.75–1.32	0.83–1.10	Acceptable
Cs-137	QAP-50	6.59	6.05	1.09	0.73–1.37	0.82–1.14	Acceptable
	QAP-51	7.36	6.43	1.15	0.73–1.37	0.82–1.14	Warning
Mn-54	QAP-51	8.70	7.91	1.10	0.76–1.42	0.84–1.18	Acceptable
Pu-238	QAP-50	0.274	0.272	1.01	0.74–1.40	0.89–1.15	Acceptable
	QAP-51	0.108	0.097	1.12	0.74–1.40	0.89–1.15	Acceptable
Pu-239	QAP-50	0.128	0.124	1.03	0.76–1.44	0.90–1.19	Acceptable
	QAP-51	0.129	0.136	0.949	0.76–1.44	0.90–1.19	Acceptable
Sb-125	QAP-50	4.19	3.59	1.17	0.61–1.43	0.83–1.19	Acceptable
U (Bq)	QAP-51	0.127	0.133	0.955	0.80–3.35	0.90–1.53	Acceptable
U-234	QAP-50	0.073	0.060	1.21	0.83–1.92	0.90–1.40	Acceptable
U-238	QAP-50	0.064	0.061	1.05	0.84–2.61	0.90–1.31	Acceptable
Soil (Bq/kg)							
Ac-228	QAP-50	49.9	47.2	1.06	0.79–1.75	0.87–1.31	Acceptable
Am-241	QAP-50	7.23	4.89	1.48	0.63–2.31	0.79–1.48	Acceptable
Bi-214	QAP-50	77.6	69.9	1.11	0.75–1.42	0.83–1.18	Acceptable
U (Bq)	QAP-51	383	401	0.955	0.42–1.39	0.61–1.16	Acceptable
Cs-137	QAP-50	759	660	1.15	0.83–1.32	0.90–1.21	Acceptable
	QAP-51	187	204	0.917	0.83–1.32	0.90–1.21	Acceptable
K-40	QAP-50	374	363	1.03	0.78–1.53	0.90–1.25	Acceptable
	QAP-51	715	780	0.917	0.78–1.53	0.90–1.25	Acceptable
Pb-212	QAP-50	50.7	47.9	1.06	0.74–1.33	0.91–1.21	Acceptable
Pb-214	QAP-50	87.1	71.0	1.23	0.65–1.45	0.89–1.25	Acceptable
Pu-238	QAP-51	0.193	0.320	0.603	0.52–2.84	0.74–1.37	Warning
Pu-239	QAP-50	8.09	8.11	0.997	0.69–1.74	0.89–1.24	Acceptable
	QAP-51	2.90	3.20	0.906	0.69–1.74	0.89–1.24	Acceptable
Th-234	QAP-50	146	138	1.06	0.59–1.85	.082–1.48	Acceptable
U (µg)	QAP-50	11.8	11.8	1.00	0.46–1.22	0.67–1.10	Acceptable

Table 14-1. LLNL's CES EMRL results from the DOE EML Quality Assurance Program, 1999 (concluded).

Analyte	EML study	CES value	EML value	CES/EML	Control limits (3σ)[a]	Warning limits (2σ)	Performance[b]
Vegetation (Bq/kg)							
Am-241	QAP-50	3.2	3.52	0.909	0.68–2.70	0.89–1.60	Acceptable
	QAP-51	4.24	2.88	1.47	0.68–2.70	0.89–1.60	Acceptable
Cm-244	QAP-51	2.34	1.61	1.45	0.47–1.74	0.81–1.35	Warning
Co-60	QAP-50	21.5	21.5	1.00	0.69–1.46	0.86–1.24	Acceptable
	QAP-51	15.6	17.6	0.886	0.69–1.46	0.86–1.24	Acceptable
Cs-137	QAP-50	500	467	1.07	0.80–1.40	0.90–1.25	Acceptable
	QAP-51	378	440	0.859	0.80–1.40	0.90–1.25	Warning
K-40	QAP-50	643	657	0.979	0.79–1.42	0.90–1.24	Acceptable
	QAP-51	439	513	0.856	0.79–1.42	0.90–1.24	Warning
Pu-238	QAP-51	0.313	0.500	0.626	0.66–7.94	0.81–2.89	Not acceptable
Pu-239	QAP-50	5.01	5.20	0.963	0.68–1.59	0.86–1.23	Acceptable
	QAP-51	4.66	4.30	1.08	0.68–1.59	0.86–1.23	Acceptable
Water (Bq/L)							
Am-241	QAP-50	1.21	1.15	1.06	0.75–1.49	0.90–1.24	Acceptable
Co-60	QAP-50	54.4	51.1	1.065	0.80–1.20	0.90–1.14	Acceptable
	QAP-51	109	52.4	2.08	0.80–1.20	0.90–1.14	Not acceptable
Cs-137	QAP-50	39.4	39.4	1.00	0.80–1.26	0.90–1.18	Acceptable
	QAP-51	163	76.0	2.15	0.80–1.26	0.90–1.18	Not acceptable
H-3	QAP-50	141	121	1.17	0.71–1.79	0.82–1.22	Acceptable
	QAP-51	98.4	80.70	1.22	0.71–1.79	0.82–1.22	Acceptable
Pu-238	QAP-50	0.815	0.772	1.06	0.78–1.25	0.90–1.11	Acceptable
	QAP-51	0.800	0.790	1.01	0.78–1.25	0.90–1.11	Acceptable
Pu-239	QAP-50	0.954	1.01	0.945	0.80–1.39	0.90–1.15	Acceptable
	QAP-51	0.934	0.870	1.07	0.80–1.39	0.90–1.15	Acceptable
U (Bq)	QAP-51	0.756	0.760	0.995	0.67–1.42	0.90–1.26	Acceptable
U-234	QAP-50	0.256	0.269	0.953	0.80–1.40	0.90–1.22	Acceptable
U-238	QAP-50	0.277	0.262	1.06	0.80–1.26	0.90–1.17	Acceptable

a Control limits are established from historical QAP data and reported as the ratio of reported value to EML value. Limits were not applied where historical data were insufficient.

b Data are considered acceptable when they fall within the 2σ warning limits. Data should be checked for error when they are between the 2σ warning limits and the 3σ control limits. Data are considered unacceptable when they are outside the 3σ control limits.

Table 14-2. LLNL's HCAL results from the DOE EML Quality Assurance Program, 1999.

Analyte	EML study	CES value	EML value	CES/EML	Control limits (3σ)	Warning limits (2 σ)	Performance[a]
Air filter (Bq/filter)							
Gross alpha	QAP-50	1.38	1.61	0.854	0.50–1.55	0.81–1.32	Acceptable
Gross alpha	QAP-51	2.44	2.77	0.881	0.50–1.55	0.81–1.32	Acceptable
Gross beta	QAP-50	1.20	1.56	0.771	0.72–1.67	0.89–1.39	Warning
Gross beta	QAP-51	2.26	2.66	0.850	0.72–1.67	0.89–1.39	Warning
Water (Bq/L)							
Gross alpha	QAP-50	1100	1090	1.00	0.61–1.32	0.83–1.17	Acceptable
Gross alpha	QAP-51	1500	1580	0.946	0.61–1.32	0.83–1.17	Acceptable
Gross beta	QAP-50	1190	1100	1.08	0.55–1.54	0.71–1.32	Acceptable
Gross beta	QAP-51	951	740	1.29	0.55–1.54	0.71–1.32	Acceptable
Tritium	QAP-50	111	121	0.917	0.71–1.79	0.82–1.22	Acceptable
Tritium	QAP-51	82.3	80.7	1.02	0.71–1.79	0.82–1.22	Acceptable

[a] Data are considered acceptable when they fall within the 2σ warning limits. Data should be checked for error when they are between the 2σ warning limits and the 3σ control limits. Data are considered unacceptable when they are outside the 3σ control limits.

Table 14-3. LLNL CES EMRL performance in the MAPEP-98-W6 Intercomparison Program for Water.

Analyte	CES value	Units	Reference value	Bias (%)	Acceptance range	Performance[(a)]
Antimony	0.543	mg/L	0.50	9.48	0.35–0.64	Acceptable
Barium	80.8	mg/L	79.4	1.76	55.6–103	Acceptable
Beryllium	2.04	mg/L	1.99	2.51	1.39–2.59	Acceptable
Chromium	0.5	mg/L	0.50	0.81	0.35–0.65	Acceptable
Copper	0.976	mg/L	0.99	–1.71	0.69–1.29	Acceptable
Lead	2.99	mg/L	2.98	0.34	2.09–3.87	Acceptable
Thallium	0.509	mg/L	0.50	2.62	0.35–0.65	Acceptable
Zinc	0.761	mg/L	0.75	1.33	0.53–0.98	Acceptable
Cesium-137	621	Bq/L	637	–2.51	446–828	Acceptable
Cobalt-57	343	Bq/L	358	–4.19	251–465	Acceptable
Manganese-54	222	Bq/L	229	–3.06	160–298	Acceptable
Plutonium-238	1.42	Bq/L	1.45	–2.07	1.02–1.89	Acceptable
Plutonium-239+240	3.68	Bq/L	4.04	–8.91	2.83–5.25	Acceptable
Uranium-234+233	2.62	Bq/L	2.67	–1.87	1.87–3.47	Acceptable
Uranium-238	20	Bq/L	21.2	–5.66	14.8–27.6	Acceptable
Zinc-65	1480	Bq/L	1560	–5.13	1090–2030	Acceptable

[a] Acceptable results have | bias | ≤20%. Results with warning have 20% <| bias | ≤30%.

Table 14-4. LLNL CES EMRL performance in the MAPEP-99-S6 Intercomparison Program for Soil.

Analyte	CES value	Units	Reference value	Bias (%)	Acceptance range	Performance[a]
Arsenic	27	mg/kg	26.7	1.12	18.7–34.7	Acceptable
Barium	390	mg/kg	400	–2.52	280–520	Acceptable
Beryllium	48	mg/kg	48.0	–0.06	33.6–62.4	Acceptable
Cadmium	14	mg/kg	14.4	–2.85	10.1–18.7	Acceptable
Chromium	79	mg/kg	79.0	0.00	55.3–103	Acceptable
Lead	78	mg/kg	77.8	0.22	54.5–101	Acceptable
Nickel	44	mg/kg	49.6	–11.3	34.7–64.5	Acceptable
Selenium	8.7	mg/kg	9.61	–9.47	6.73–12.5	Acceptable
Thallium	79	mg/kg	96.1	–17.8	67.2–125	Acceptable
Vanadium	200	mg/kg	194	2.88	136–253	Acceptable
Zinc	85	mg/kg	102	–16.3	71.1–132	Acceptable
Americium-241	6.79	Bq/kg	6.55	3.66	4.59–8.52	Acceptable
Cesium-134	693	Bq/kg	752	–7.85	526–978	Acceptable
Cesium-137	312	Bq/kg	331	–5.74	232–430	Acceptable
Cobalt-57	354	Bq/kg	360	–1.67	252–468	Acceptable
Cobalt-60	134	Bq/kg	131	2.29	91.7–170	Acceptable
Manganese-54	349	Bq/kg	345	1.16	242–449	Acceptable
Plutonium-238	27.2	Bq/kg	27.5	–1.09	19.3–35.8	Acceptable
Plutonium-239+240	46.8	Bq/kg	48.1	–2.70	33.7–62.5	Acceptable
Potassium-40	636	Bq/kg	652	–2.45	456–848	Acceptable
Uranium-234+233	139	Bq/kg	157	–11.45	110–204	Acceptable
Uranium-238	31.5	Bq/kg	40.7	–22.6	28.5–52.9	Warning
Zinc-65	2880	Bq/kg	2840	1.41	1990–3690	Acceptable

[a] Acceptable results have | bias | ≤20%. Results acceptable with warning have | bias | >20% less but ≤30%.

Environmental Protection Department • Lawrence Livermore National Laboratory
University of California • P.O. Box 808 • Livermore, California 94551