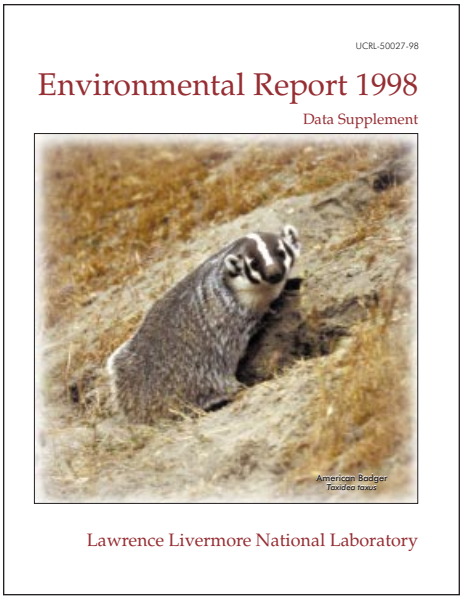
UCRL-50027-98

Environmental Report 1998

Data Supplement


American Badger
Taxidea taxus

Lawrence Livermore National Laboratory



Cover

The American badger (*Taxidea taxus*), a relatively rare animal in California, receives protection at Site 300 as one of three keystone species. American badgers are nocturnal fossorial creatures with long, well-developed claws to dig dens and pursue ground-dwelling prey such as ground squirrels. Dens may be 5 to 30 ft long and contain an enlarged chamber of 2 to 3 ft for birthing. The badgers at Site 300 are significant creators of microhabitat that can be used by other special-status wildlife including western burrowing owls, California red-legged frogs, and San Joaquin whipsnakes. At LLNL, field reconnaissance surveys are conducted before ground is disturbed to determine if animals are present. If occupied dens are discovered during field evaluations, certain restrictions may be implemented to protect the badger during project development.

Jim S. Woollett, Jr., LLNL's wildlife biologist, provided the cover photo.

Composition
Beverly L. Chamberlain
Sherry A. Emmons

Art and Design
Lee A. Dravidzius
Brett S. Clark

Proofreader
Jill S. Sprinkle
Ellen S. Bradley

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.

Work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under contract W-7405-Eng-48.

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Data Supplement

Authors

Jennifer M. Larson

Robert J. Harrach
Paris E. Althouse
Nicholas A. Bertoldo
Arthur H. Biermann
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

Editors

Howard L. Lentzner
Karen S. Rath
Geoff S. Siemering

September 1, 1999 **Lawrence Livermore National Laboratory**

UCRL-50027-98
Distribution Category UC-702

Preface

This Data Supplement to the Lawrence Livermore National Laboratory's (LLNL's) annual *Environmental Report* 1998 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. Not all of the data in the Data Supplement tables have been reduced to the proper number of significant figures; however, summary data in both volumes are expressed using the proper number of significant figures.

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 ($1\ \text{Bq} = 2.7 \times 10^{-11}\ \text{Ci}$; $1\ \text{Sv} = 100\ \text{rem}$).

Table of Contents

Indicates no supplemental data in this volume. Please see the main volume for detailed information on this subject.

Table of Contents

Indicates no supplemental data in this volume. Please see the main volume for detailed information on this subject.

List of Tables

List of Tables

List of Tables

List of Tables

List of Tables

1

There are no supplemental data in this chapter. Please see the main volume for details about Site Overview.

2

There are no supplemental data in this chapter.
Please see the main volume for details
Compliance Summary.

3

There are no supplemental data in this chapter. Please see the main volume for details about Environmental Program Information.

4

Air Effluent Monitoring

Arthur H. Biermann
Linda C. Hall
Paula J. Tate

Air Effluent Sampling Methods

At the beginning of 1998, LLNL 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.

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 would be 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 from 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. 1995).

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 ion 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 (unalarmed) runs in parallel with an alarmed monitor and consists of two molecular sieves. The first sieve collects tritiated water vapor; then a palladium-coated catalyst converts tritiated hydrogen to tritiated water and collects the tritiated water on a second sieve. Sieves are exchanged 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/mL). 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, 1998.

Sampler no.	No. >MDC[(a)]/ Total samples	Minimum (Bq/mL)	Median (Bq/mL)	Maximum (Bq/mL)
Gross alpha				
1	0/52	-2.23×10^{-11}	4.80×10^{-12}	7.44×10^{-11}
2	1/52	-3.12×10^{-11}	5.86×10^{-12}	8.07×10^{-11}
3	1/52	-2.68×10^{-11}	1.46×10^{-11}	1.27×10^{-10}
4	0/52	-2.97×10^{-11}	-1.76×10^{-13}	5.25×10^{-11}
5	0/52	-4.00×10^{-11}	1.93×10^{-12}	1.45×10^{-10}
6	0/52	-2.55×10^{-11}	-6.42×10^{-13}	4.33×10^{-11}
Gross beta				
1	7/52	-7.18×10^{-11}	8.47×10^{-11}	5.59×10^{-10}
2	5/52	-5.66×10^{-11}	6.38×10^{-11}	2.66×10^{-10}
3	11/52	-4.85×10^{-11}	7.51×10^{-11}	2.33×10^{-10}
4	0/52	-5.96×10^{-11}	1.42×10^{-11}	1.31×10^{-10}
5	0/52	-7.18×10^{-11}	1.13×10^{-11}	1.61×10^{-10}
6	0/52	-8.14×10^{-11}	2.56×10^{-11}	1.44×10^{-10}

[a] 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, 1998.

Sampler no.	No. >MDC[(a)]/ Total samples	Minimum (Bq/mL)	Median (Bq/mL)	Maximum (Bq/mL)
Gross alpha				
1	0/23	-3.11×10^{-11}	-4.48×10^{-13}	8.25×10^{-11}
Gross beta				
1	1/23	-1.01×10^{-10}	7.55×10^{-11}	3.74×10^{-10}

[a] 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, 1998.

Sampler no.	No. >MDC[(a)]/ Total samples	Minimum (Bq/mL)	Median (Bq/mL)	Maximum (Bq/mL)
Gross alpha				
1	0/26	-7.96×10^{-11}	5.05×10^{-11}	2.40×10^{-10}
2	0/26	-2.86×10^{-11}	4.22×10^{-11}	1.22×10^{-10}
3	0/26	-2.64×10^{-11}	2.52×10^{-11}	1.09×10^{-10}
4	3/26	-2.31×10^{-11}	6.35×10^{-11}	1.44×10^{-10}
5	1/26	-1.93×10^{-10}	4.33×10^{-11}	6.96×10^{-10}
6	1/26	-5.96×10^{-11}	9.05×10^{-11}	3.89×10^{-10}
7	0/26	-7.59×10^{-11}	3.89×10^{-11}	1.92×10^{-10}
8	0/26	-2.04×10^{-10}	2.60×10^{-10}	8.40×10^{-10}
10	1/26	-7.55×10^{-11}	1.30×10^{-10}	3.96×10^{-10}
11	0/26	-3.04×10^{-10}	2.50×10^{-10}	7.25×10^{-10}
12	1/26	-1.52×10^{-11}	1.68×10^{-11}	6.73×10^{-11}
13	0/26	-4.44×10^{-11}	3.36×10^{-11}	1.36×10^{-10}
14	4/26	-4.77×10^{-11}	6.77×10^{-11}	2.64×10^{-10}
15	1/26	-2.61×10^{-10}	2.02×10^{-10}	1.12×10^{-9}
16	0/26	-5.99×10^{-11}	4.13×10^{-11}	2.03×10^{-10}
17	0/26	-1.27×10^{-11}	3.03×10^{-11}	1.70×10^{-10}
18	1/26	-3.92×10^{-11}	1.42×10^{-11}	6.85×10^{-11}
19	0/26	-2.72×10^{-10}	1.75×10^{-10}	1.35×10^{-9}
20	0/26	-2.65×10^{-11}	1.13×10^{-11}	7.18×10^{-11}
21	0/26	-5.62×10^{-11}	8.79×10^{-11}	2.93×10^{-10}
22	0/26	-2.05×10^{-11}	2.12×10^{-11}	4.96×10^{-11}
23	0/26	-2.72×10^{-10}	2.29×10^{-10}	6.55×10^{-10}
24	0/26	-5.33×10^{-11}	3.65×10^{-11}	1.55×10^{-10}
25	0/26	-3.50×10^{-11}	2.54×10^{-11}	1.48×10^{-10}
26	0/26	-5.92×10^{-11}	3.39×10^{-11}	1.41×10^{-10}
27	0/26	-5.40×10^{-11}	4.72×10^{-11}	1.68×10^{-10}
28	0/26	-3.33×10^{-11}	4.81×10^{-11}	2.24×10^{-10}
29	0/26	-4.11×10^{-11}	4.29×10^{-11}	1.82×10^{-10}
30	1/26	-3.96×10^{-11}	3.35×10^{-11}	2.50×10^{-10}
31	0/26	-3.02×10^{-10}	4.29×10^{-10}	1.01×10^{-9}
32	5/26	-3.06×10^{-11}	5.46×10^{-11}	2.06×10^{-10}
33	13/26	-1.12×10^{-11}	8.44×10^{-11}	1.93×10^{-10}
34	1/26	-2.98×10^{-11}	3.56×10^{-11}	1.30×10^{-10}
35	0/26	-4.29×10^{-11}	4.90×10^{-12}	9.55×10^{-11}

Table 4–3. Summary of gross alpha and gross beta in air effluent samples from monitored emission points at Building 251, 1998 (continued).

Sampler no.	No. >MDC[(a)]/ Total samples	Minimum (Bq/mL)	Median (Bq/mL)	Maximum (Bq/mL)
Gross alpha				
36	15/26	3.08×10^{-11}	1.15×10^{-10}	4.37×10^{-10}
37	0/26	-1.48×10^{-11}	7.64×10^{-11}	1.82×10^{-10}
38	1/26	-1.96×10^{-11}	1.26×10^{-11}	8.92×10^{-11}
39	2/26	-1.39×10^{-11}	1.46×10^{-11}	6.62×10^{-11}
40	1/26	-1.75×10^{-11}	8.44×10^{-12}	8.33×10^{-11}
41	1/26	-2.54×10^{-11}	3.01×10^{-11}	2.83×10^{-10}
42	0/26	-1.13×10^{-11}	8.64×10^{-12}	5.00×10^{-11}
43	0/26	-1.89×10^{-11}	4.71×10^{-12}	3.46×10^{-11}
44	0/26	-2.24×10^{-11}	4.55×10^{-11}	1.36×10^{-10}
45	0/26	-3.07×10^{-11}	3.20×10^{-11}	1.57×10^{-10}
46	0/26	-2.74×10^{-12}	3.84×10^{-11}	8.84×10^{-11}
47	3/26	-2.33×10^{-11}	6.25×10^{-11}	1.35×10^{-10}
48	2/26	-2.19×10^{-11}	2.65×10^{-11}	2.12×10^{-10}
49	3/26	-2.07×10^{-11}	3.30×10^{-11}	1.89×10^{-10}
Gross beta				
1	2/26	-9.81×10^{-12}	2.88×10^{-10}	5.74×10^{-10}
2	22/26	1.30×10^{-10}	4.61×10^{-10}	1.24×10^{-9}
3	2/26	-8.36×10^{-11}	1.71×10^{-10}	3.05×10^{-10}
4	21/26	1.35×10^{-10}	4.42×10^{-10}	1.43×10^{-9}
5	7/26	-2.23×10^{-11}	7.71×10^{-10}	4.18×10^{-9}
6	6/26	4.33×10^{-11}	4.00×10^{-10}	9.44×10^{-10}
7	12/26	4.48×10^{-11}	2.70×10^{-10}	6.18×10^{-10}
8	4/26	-2.02×10^{-10}	1.52×10^{-9}	3.58×10^{-9}
10	17/26	3.04×10^{-10}	7.94×10^{-10}	1.70×10^{-9}
11	3/26	-1.76×10^{-10}	9.73×10^{-10}	4.37×10^{-9}
12	2/26	9.55×10^{-13}	5.72×10^{-11}	1.32×10^{-10}
13	3/26	-3.11×10^{-11}	1.11×10^{-10}	4.70×10^{-10}
14	10/26	7.10×10^{-11}	2.95×10^{-10}	6.48×10^{-10}
15	1/26	-1.98×10^{-10}	1.19×10^{-9}	3.11×10^{-9}
16	3/26	8.44×10^{-11}	2.56×10^{-10}	6.36×10^{-10}
17	8/26	3.89×10^{-11}	1.87×10^{-10}	5.48×10^{-10}
18	3/26	9.14×10^{-12}	9.86×10^{-11}	2.34×10^{-10}
19	3/26	-5.07×10^{-11}	9.29×10^{-10}	2.80×10^{-9}
20	7/26	8.07×10^{-12}	8.01×10^{-11}	1.62×10^{-10}

Table 4–3. Summary of gross alpha and gross beta in air effluent samples from monitored emission points at Building 251, 1998 (concluded).

Sampler no.	No. >MDC[(a)]/ Total samples	Minimum (Bq/mL)	Median (Bq/mL)	Maximum (Bq/mL)
Gross beta				
21	16/26	2.45×10^{-10}	7.05×10^{-10}	2.01×10^{-9}
22	8/26	-7.81×10^{-13}	8.10×10^{-11}	1.90×10^{-10}
23	1/26	-1.75×10^{-10}	9.12×10^{-10}	2.18×10^{-9}
24	2/26	2.85×10^{-11}	1.39×10^{-10}	4.88×10^{-10}
25	4/26	-6.96×10^{-11}	1.21×10^{-10}	3.81×10^{-10}
26	6/26	-6.59×10^{-11}	2.08×10^{-10}	6.99×10^{-10}
27	5/26	-1.16×10^{-10}	3.90×10^{-10}	6.88×10^{-10}
28	9/26	2.80×10^{-11}	2.72×10^{-10}	1.44×10^{-9}
29	6/26	2.04×10^{-11}	1.75×10^{-10}	5.48×10^{-10}
30	6/26	8.70×10^{-11}	2.10×10^{-10}	6.77×10^{-10}
31	2/26	-4.81×10^{-10}	1.24×10^{-9}	2.31×10^{-9}
32	1/26	-2.34×10^{-11}	1.29×10^{-10}	3.44×10^{-10}
33	24/26	8.51×10^{-11}	3.52×10^{-10}	1.55×10^{-9}
34	15/26	8.25×10^{-11}	2.44×10^{-10}	7.51×10^{-10}
35	1/26	-3.46×10^{-12}	1.15×10^{-10}	2.96×10^{-10}
36	26/26	3.74×10^{-10}	9.81×10^{-10}	2.36×10^{-9}
37	17/26	9.58×10^{-11}	3.90×10^{-10}	8.62×10^{-10}
38	7/26	-1.24×10^{-11}	1.08×10^{-10}	3.89×10^{-10}
39	10/26	5.96×10^{-12}	8.08×10^{-11}	2.37×10^{-10}
40	7/26	9.99×10^{-12}	1.04×10^{-10}	1.87×10^{-10}
41	3/26	-2.18×10^{-11}	1.62×10^{-10}	4.03×10^{-10}
42	1/26	-8.81×10^{-12}	5.24×10^{-11}	1.15×10^{-10}
43	0/26	-1.89×10^{-11}	5.88×10^{-11}	1.09×10^{-10}
44	9/26	-4.14×10^{-11}	2.30×10^{-10}	8.70×10^{-10}
45	2/26	4.63×10^{-11}	2.10×10^{-10}	6.40×10^{-10}
46	19/26	4.85×10^{-11}	2.82×10^{-10}	7.62×10^{-10}
47	25/26	1.25×10^{-10}	4.42×10^{-10}	1.62×10^{-9}
48	13/26	-1.47×10^{-11}	1.80×10^{-10}	1.47×10^{-9}
49	14/26	-3.11×10^{-11}	1.99×10^{-10}	8.73×10^{-10}

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

Table 4-4. Summary of gross alpha and gross beta in air effluent samples from monitored emission points at Building 292, 1998.

Sampler no.	No. >MDC[(a)]/ Total samples	Minimum (Bq/mL)	Median (Bq/mL)	Maximum (Bq/mL)
Gross alpha				
PAM 1	1/12	-9.88×10^{-12}	4.11×10^{-13}	2.51×10^{-11}
Gross beta				
PAM 1	1/12	-4.07×10^{-11}	2.06×10^{-11}	2.10×10^{-10}

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

Table 4-5. Summary of tritium in air effluent samples from monitored emission points at Building 331, 1998.

Sampler no.	No. >MDC[(a)]/ Total samples	Minimum (Bq/mL)	Median (Bq/mL)	Maximum (Bq/mL)
HT				
Stack 1	53/53	1.89×10^{-5}	6.33×10^{-5}	8.10×10^{-4}
Stack 2	53/53	2.01×10^{-4}	1.52×10^{-3}	3.51×10^{-2}
HTO				
Stack 1	53/53	2.16×10^{-4}	1.36×10^{-3}	1.74×10^{-2}
Stack 2	53/53	3.16×10^{-4}	7.18×10^{-3}	1.98×10^{-2}

[a] 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, 1998.

Sampler no.	No. >MDC[(a)]/ Total samples	Minimum (Bq/mL)	Median (Bq/mL)	Maximum (Bq/mL)
Gross alpha				
SP-1A	0/52	-3.19×10^{-11}	1.48×10^{-11}	1.08×10^{-10}
SP-1B	0/52	-4.96×10^{-11}	2.40×10^{-12}	9.32×10^{-11}
SP-2A	0/52	-5.11×10^{-11}	-5.62×10^{-12}	6.03×10^{-11}
SP-2B	0/51	-3.09×10^{-11}	3.26×10^{-12}	8.70×10^{-11}
SP-3	0/52	-5.14×10^{-11}	1.10×10^{-12}	1.07×10^{-10}
SP-4	0/52	-5.51×10^{-11}	1.03×10^{-12}	1.09×10^{-10}
SP-5	0/52	-4.92×10^{-11}	1.91×10^{-12}	6.25×10^{-11}
SP-6A	0/52	-5.11×10^{-11}	-3.52×10^{-12}	4.18×10^{-11}
SP-6B	0/52	-2.57×10^{-11}	1.06×10^{-11}	5.48×10^{-11}
SP-7A	0/52	-5.25×10^{-11}	1.20×10^{-12}	9.18×10^{-11}
SP-7B	0/52	-3.33×10^{-11}	-4.81×10^{-12}	1.19×10^{-10}
SP-8	0/52	-4.63×10^{-11}	$5.05 \times 10–13$	6.11×10^{-11}
SP-9	0/52	-4.37×10^{-11}	-7.12×10^{-12}	9.03×10^{-11}
SP-10	0/52	-9.47×10^{-11}	4.24×10^{-12}	1.81×10^{-10}
SP-11	0/52	-5.55×10^{-11}	2.51×10^{-12}	1.34×10^{-10}
SP-12	0/52	-7.84×10^{-11}	-1.15×10^{-11}	2.15×10^{-10}
Gross beta				
SP-1A	1/52	-1.02×10^{-10}	9.56×10^{-12}	2.43×10^{-10}
SP-1B	1/52	-1.02×10^{-10}	2.23×10^{-11}	2.81×10^{-10}
SP-2A	2/52	-1.02×10^{-10}	4.38×10^{-11}	3.22×10^{-10}
SP-2B	1/51	-1.23×10^{-10}	3.56×10^{-11}	3.36×10^{-10}
SP-3	1/52	-1.05×10^{-10}	2.39×10^{-11}	5.51×10^{-10}
SP-4	0/52	-1.09×10^{-10}	4.29×10^{-11}	2.02×10^{-10}
SP-5	0/52	-9.36×10^{-11}	1.66×10^{-11}	2.36×10^{-10}
SP-6A	0/52	-1.21×10^{-10}	2.29×10^{-11}	1.42×10^{-10}
SP-6B	0/52	-1.86×10^{-10}	1.98×10^{-11}	2.49×10^{-10}
SP-7A	0/52	-1.11×10^{-10}	1.20×10^{-11}	2.55×10^{-10}
SP-7B	1/52	-1.16×10^{-10}	4.10×10^{-12}	3.46×10^{-10}
SP-8	0/52	-1.21×10^{-10}	2.23×10^{-11}	1.62×10^{-10}
SP-9	1/52	-1.19×10^{-10}	4.05×10^{-11}	3.45×10^{-10}
SP-10	0/52	-2.07×10^{-10}	2.25×10^{-11}	4.18×10^{-10}
SP-11	0/52	-1.11×10^{-10}	2.15×10^{-11}	1.35×10^{-10}
SP-12	0/52	-2.02×10^{-10}	1.83×10^{-11}	2.81×10^{-10}

[a] 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, 1998.

Sampler no.	No. >MDC[(a)]/ Total samples	Minimum (Bq/mL)	Median (Bq/mL)	Maximum (Bq/mL)
Gross alpha				
1	0/24	-1.56×10^{-11}	-2.52×10^{-13}	4.37×10^{-11}
2	0/28	-1.65×10^{-11}	-1.17×10^{-11}	5.85×10^{-11}
3	0/24	-2.96×10^{-11}	-1.13×10^{-13}	3.85×10^{-11}
4	0/28	-3.19×10^{-11}	5.85×10^{-12}	3.28×10^{-11}
Gross beta				
1	1/24	-1.07×10^{-10}	2.15×10^{-11}	1.85×10^{-10}
2	0/28	-4.44×10^{-11}	1.41×10^{-11}	9.81×10^{-11}
3	3/24	-5.48×10^{-11}	2.17×10^{-11}	1.91×10^{-10}
4	0/28	-1.07×10^{-10}	-1.88×10^{-12}	6.92×10^{-11}

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

Table 4-8. Summary of gross alpha and gross beta in air effluent samples from monitored emission points at Building 491, 1998.

Sampler no.	No. >MDC[(a)]/ Total samples	Minimum (Bq/mL)	Median (Bq/mL)	Maximum (Bq/mL)
Gross alpha				
1	0/52	-1.96×10^{-11}	-8.64×10^{-13}	5.48×10^{-11}
Gross beta				
1	1/52	-3.54×10^{-11}	2.82×10^{-11}	1.94×10^{-10}

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

5

Surveillance Air Monitoring

Paris E. Althouse
Paula J. Tate

Air Surveillance Sampling

LLNL 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, a low-volume radiological 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 geographical details of the particulate sampling locations are outlined in a procedure in Appendix B of the *Environmental Monitoring Plan* (Tate et al. 1995).

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 flowrates.

Mass flow totalizers are checked weekly using a portable field unit. If a hi-vol fails or the measured flow rate differs more than 10% from the expected flow rate, it is bench tested 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 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. 1995). 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 higher continuous flowrates. A total volume of approximately 10 ML of air is sampled at each location each week for radiological analysis.

LLNL has made several recent changes to the radiological air particulate network. In 1997, the downwind location at ALTA was removed at the request of the landowner. A replacement location was selected and identified as AMON; however, because of weather conditions, contract negotiations, and permit conflicts, sample collection at this location did not begin until March of 1998.

In February 1998, the radiological analysis from PRIM location, which serves as the site-wide maximally exposed individual for National Emission Standards for Hazardous Air Pollution (NESHAPs) reporting purposes was expanded to provide airborne off-site uranium impacts from Site 300 activities.

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), and one at an area of special interest (LWRP). The Livermore Valley network consists of four locations in the least prevalent wind directions (FCC, FIRE, HOSP, and CHUR), considered to be upwind or background, and four samplers located in the most prevalent downwind directions (PATT, ZON7, TANK, and AMON). 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). Off-site monitoring at Site 300 occurs at two locations: PRIM (near the Site 300 boundary) and TFIR (in downtown 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 ^{241}Am and ^{137}Cs as calibration sources to determine alpha and beta counting efficiencies, respectively. Cross-checks using ^{230}Th and ^{90}Sr are also completed periodically. These standards are certified by the Environmental Protection Agency (EPA). Counting-efficiency measurements are made for each set of counted filters. A background count is taken at the beginning of each run and between each 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. 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, six separate composites are created using another portion of all weekly glass fiber filters from each Livermore perimeter location. These composited filters are placed into clear bags representing each of the Livermore perimeter locations (SALV, MESQ, CAFE, MET, VIS, and COW) for the month. Each 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 $^{239+240}Pu$, ^{235}U, and ^{238}U 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 (ALTA, PATT, TANK, ZON7, FCC, FIRE, HOSP, RRCH, CHUR) and Site 300 off-site (PRIM and TFIR) locations are composited by location and analyzed for $^{239+240}Pu$ 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 $^{239+240}Pu$ by alpha spectrometry and for ^{235}U and ^{238}U 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 (SALV, MESQ, CAFE, VIS, MET, and COW) as required by the Bay Area Air Quality Management District. Although there is no requirement to monitor beryllium at Site 300, 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. 1995). 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 labs for analysis. The off-site analytical laboratory adds 40 mL of 10% nitric acid to each composite and digests the mixture for 30 minutes. The nitric acid supernatant is decanted into a separate beaker, where more nitric acid is added. This step is repeated two more times, and the resulting solution is evaporated to less than 20 mL (care is taken to prevent the samples from boiling or baking dry). The samples are diluted to 20 mL with deionized water. The quantity of beryllium is determined by graphite furnace atomic absorption spectroscopy.

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), five 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 (B331, B292, B514, and B624) monitor diffuse source emissions. The tritium sample locations are detailed in Appendix B of the *Environmental Monitoring Plan* (Tate et al. 1995). 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. 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. 1995).

Once the samples are taken, the 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 Hall and Edwards (1994a, b, and c).

Data

Monthly summaries of gross alpha and gross beta data 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**. 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 monthly low-volume gross alpha and gross beta data for locations HOSP and FCC are presented in **Tables 5-9** and **5-10**. 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, 1998.

Month	Sampling location[a]					
	SALV	MESQ	CAFE	MET	VIS	COW
	(10^{-6} Bq/m^3)					
Gross alpha						
Jan	7.5	33.4	36.6	–1.1	15.9	7.6
Feb	7.8	–17.4	4.8	–10.4	1.4	–9.2
Mar	0.5	1.7	18.1	–8.5	–18.3	–15.5
Apr	–1.8	–4.4	–9.2	2.5	2.8	–14.9
May	12.3	7.4	–21.2	–16.8	6.3	–14.6
Jun	15.7	47.7	46.6	18.7	32.3	17.3
Jul	27.9	56.8	16.5	37.9	11.0	32.7
Aug	28.0	51.1	13.1	8.7	40.6	32.0
Sep	32.4	1.6	9.6	35.1	15.8	15.3
Oct	–40.2	–5.8	–8.7	7.1	15.7	–9.1
Nov	–5.7	4.4	12.1	13.3	14.6	25.7
Dec	20.5	11.0	18.9	32.2	37.7	36.1
Annual median[b]	**10.9**	**11.7**	**15.8**	**7.2**	**11.1**	**15.3**
IQR[b,c]	**42.1**	**52.2**	**35.0**	**42.8**	**38.3**	**39.5**
Annual maximum[b]	**141**	**78.2**	**110**	**97.3**	**72.0**	**97.6**
Gross beta						
Jan	253	240	236	310	309	216
Feb	115	111	127	175	129	126
Mar	346	194	302	286	283	268
Apr	284	320	320	220	251	262
May	177	149	183	172	174	157
Jun	163	127	213	148	262	223
Jul	366	365	400	335	403	431
Aug	613	595	620	534	736	586
Sep	529	555	527	488	529	404
Oct	397	505	441	430	628	500
Nov	300	289	315	282	351	282
Dec	664	604	683	639	602	574
Annual median[b]	**324**	**302**	**325**	**324**	**377**	**314**
IQR[b,c]	**361**	**332**	**323**	**329**	**391**	**300**
Annual maximum[b]	**1516**	**1344**	**1497**	**1393**	**1376**	**1419**

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, 1998.

Month	Sampling location[a]			
	CHUR	FCC	FIRE	HOSP
	(10^{-6} Bq/m^3)			
Gross alpha				
Jan	30.8	26.2	33.1	31.9
Feb	–2.8	7.2	7.8	–1.4
Mar	–30.2	4.1	8.3	10.2
Apr	0.9	–9.9	–7.5	9.0
May	6.5	–11.0	–2.9	13.6
Jun	20.8	33.9	13.5	29.5
Jul	27.4	29.3	21.2	17.3
Aug	21.0	12.5	13.3	35.3
Sep	–4.3	28.5	10.6	3.9
Oct	20.3	–1.1	–8.3	3.3
Nov	0.5	19.2	16.6	14.1
Dec	11.2	12.3	8.5	12.6
Annual median[b]	**9.8**	**9.6**	**10.0**	**13.7**
IQR[b,c]	**39.0**	**34.9**	**31.9**	**25.8**
Annual maximum[b]	**61.9**	**78.0**	**66.5**	**80.2**
Gross beta				
Jan	369	271	294	208
Feb	133	85.2	96.2	147
Mar	336	215	251	316
Apr	269	202	200	229
May	167	112	134	107
Jun	184	129	185	178
Jul	451	375	366	350
Aug	660	624	685	645
Sep	542	499	429	517
Oct	400	484	411	500
Nov	238	350	216	195
Dec	667	676	573	520
Annual median[b]	**349**	**276**	**298**	**290**
IQR[b,c]	**358**	**384**	**304**	**343**
Annual maximum[b]	**1580**	**1622**	**1186**	**1091**

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, 1998.

Month	Sampling location[a]				
	Livermore Valley downwind				Special interest
	PATT	ZON7	TANK	AMON	LWRP
	(10^{-6} Bq/m^3)				
Gross alpha					
Jan	29.5	16.4	–8.5		29.8
Feb	–4.3	–18.9	–4.0	—[b]	–14.2
Mar	11.1	20.0	21.2	–5.6	–6.9
Apr	–3.1	–5.0	–10.7	–7.0	–1.2
May	–3.9	–12.2	–18.9	3.9	20.6
Jun	–5.7	18.8	13.6	19.7	49.5
Jul	15.1	33.4	1.5	1.4	12.8
Aug	44.5	42.0	11.3	5.6	26.2
Sep	19.1	28.6	20.8	–4.8	24.7
Oct	0.8	0.8	5.5	1.0	6.1
Nov	9.7	6.9	13.9	18.6	4.9
Dec	–12.9	11.1	19.3	36.9	2.3
Annual median[c]	**3.8**	**14.1**	**6.6**	**3.5**	**9.31**
IQR[c,d]	**31.4**	**41.9**	**39.5**	**31.7**	**36.0**
Annual maximum[c]	**11**	**113**	**62.4**	**119**	**124**
Gross beta					
Jan	174	251	232		300
Feb	95	165	142	—[b]	126
Mar	299	335	231	244	280
Apr	287	298	232	210	278
May	141	191	169	175	147
Jun	192	192	167	207	223
Jul	464	423	409	454	348
Aug	682	668	580	656	597
Sep	551	616	463	535	603
Oct	441	546	457	394	657
Nov	305	379	254	242	367
Dec	594	697	639	538	752
Annual median[c]	**319**	**391**	**305**	**369**	**310**
IQR[c,d]	**316**	**406**	**350**	**360**	**382**
Annual maximum[c]	**1145**	**1392**	**1438**	**1309**	**1750**

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

b Sampling site added March 10, 1998.

c Determined by data from the 52-week period.

d IQR = Interquartile range.

Table 5-4. Gamma activity in particulate air samples, Livermore site perimeter, 1998.[a]

Month	^{7}Be	^{40}K	^{137}Cs	^{22}Na	^{226}Ra	^{228}Ra	^{228}Th
	(10^{-3} Bq/m^3)	(10^{-6} Bq/m^3)					
Jan	2.3 ± 0.05	22.1 ± 23.0	<0.3	<0.3	–3.2 ± 2.4	1.8 ± 3.5	0.7 ± 3.3
Feb	2.4 ± 0.05	–19.4 ± 21.5	<0.3	<0.3	–3.3 ± 2.4	0.8 ± 2.2	0.3 ± 2.0
Mar	3.8 ± 0.07	13.4 ± 32.4	<0.2	<0.3	–0.1 ± 4.2	1.2 ± 1.9	1.3 ± 1.7
Apr	3.7 ± 0.09	50.7 ± 19.9	<0.2	<0.3	0.2 ± 5.2	1.1 ± 2.1	1.9 ± 1.8
May	2.3 ± 0.07	4.0 ± 18.9	<0.2	<0.2	0.6 ± 3.9	0.8 ± 1.8	1.0 ± 1.5
Jun	2.4 ± 0.06	28.1 ± 19.5	<0.2	<0.3	1.0 ± 2.4	0.8 ± 2.4	1.8 ± 2.2
Jul	3.3 ± 0.06	36.0 ± 18.8	<0.2	<0.2	1.2 ± 2.4	0.5 ± 3.0	1.4 ± 2.8
Aug	4.4 ± 0.08	16.8 ± 18.9	<0.2	<0.3	–3.5 ± 2.3	1.3 ± 1.8	1.4 ± 1.6
Sep	3.7 ± 0.08	6.2 ± 20.5	<0.2	<0.2	0.3 ± 4.3	0.2 ± 1.8	0.4 ± 1.6
Oct	3.8 ± 0.08	15.1 ± 17.8	<0.2	<0.2	0.4 ± 2.4	–0.6 ± 1.6	0.5 ± 1.3
Nov	2.2 ± 0.04	–11.9 ± 18.9	<0.2	<0.2	–3.5 ± 2.3	–0.7 ± 2.0	–0.9 ± 1.7
Dec	3.6 ± 0.07	5.8 ± 20.6	<0.2	<0.2	–1.0 ± 3.8	–0.1 ± 1.8	–1.0 ± 1.6
Median	3.44	14.3	<0.2	<0.3	0.03	0.8	0.9
IQR[b]	1.37	18.3	—[c]	—[c]	3.7	1.0	1.0
Maximum	4.37	50.7	<0.3	<0.3	1.25	1.8	1.9
DCG[d] (Bq/m^3)	**1.5×10^{3}**	**3.0×10^{1}**	**1.5×10^{1}**	**3.7×10^{1}**	**3.7×10^{-2}**	**1.1×10^{-1}**	**1.5×10^{-3}**
Median fraction of DCG	**2.3×10^{-6}**	**4.3×10^{-7}**	**$<5.9 \times 10^{-9}$**	**$<6.88 \times 10^{-9}$**	**3.11×10^{-5}**	**6.94×10^{-6}**	**5.85×10^{-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 All Livermore site perimeter samples composited. See **Figure 5-1**, main volume, for sampling locations.

b IQR = Interquartile range.

c No IQR calculated; see Chapter 14, Quality Assurance.

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

Table 5-5. Plutonium-239+240 activity in air particulate samples, Livermore site perimeter, 1998.

Month	Sampling location[a]					
	CAFE	COW	MESQ	MET	SALV	VIS
	(10^{-9} Bq/m^3)					
Jan	–2.1 ± 6.0	5.1 ± 5.6	2.4 ± 4.7	1.5 ± 4.6	1.9 ± 7.7	9.0 ± 6.3
Feb	7.1 ± 7.3	–0.7 ± 4.6	0.3 ± 3.4	1.7 ± 4.3	5.5 ± 6.3	8.3 ± 7.4
Mar	5.7 ± 6.6	3.7 ± 7.3	2.9 ± 5.5	2.7 ± 4.6	2.0 ± 7.4	–3.5 ± 5.4
Apr	6.0 ± 8.5	–1.9 ± 9.8	9.0 ± 8.0	7.6 ± 7.5	8.7 ± 8.8	5.0 ± 11.8
May	5.1 ± 5.4	6.0 ± 5.2	4.4 ± 5.4	1.2 ± 5.0	5.6 ± 5.1	9.9 ± 7.3
Jun	8.3 ± 8.8	–1.0 ± 5.1	0.3 ± 5.2	–0.2 ± 6.3	–1.0 ± 5.1	44.0 ± 14.7
Jul	3.2 ± 5.6	3.1 ± 5.4	–1.7 ± 3.3	–1.8 ± 3.4	2.8 ± 4.9	14.4 ± 13.3
Aug	6.4 ± 11.9	0.1 ± 5.8	0.8 ± 5.7	2.1 ± 6.5	5.7 ± 7.6	8.1 ± 8.5
Sep	6.1 ± 7.7	1.7 ± 7.1	4.7 ± 8.5	–1.8 ± 4.9	4.0 ± 8.2	14.7 ± 11.9
Oct	15.7 ± 9.3	4.3 ± 6.7	4.6 ± 7.6	5.1 ± 5.5	7.8 ± 8.1	15.8 ± 9.0
Nov	0.1 ± 6.7	10.5 ± 9.0	2.2 ± 6.1	1.2 ± 4.2	4.8 ± 6.6	8.2 ± 7.7
Dec	4.1 ± 5.8	1.4 ± 6.0	–2.5 ± 4.5	–0.2 ± 5.6	–0.6 ± 4.0	3.8 ± 5.5
Median	**5.9**	**2.4**	**2.3**	**1.4**	**4.4**	**8.6**
IQR[b]	**2.7**	**4.6**	**4.2**	**2.5**	**3.7**	**7.2**
Fraction of DCG[c]	**8.0×10^{-6}**	**3.2×10^{-6}**	**3.1×10^{-6}**	**1.9×10^{-6}**	**5.9×10^{-6}**	**1.2×10^{-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 5-1**, 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.

Table 5-6. Plutonium-239+240 activity in air particulate samples, Livermore Valley, 1998.[a]

Month	Livermore Valley downwind				Special interest
	AMON	PATT	TANK	ZON7	LWRP
	(10^{-9} Bq/m^3)				
Jan		0.2 ± 5.8	5.8 ± 4.0	8.4 ± 16.5	–4.8 ± 3.2
Feb	—[b]	0.6 ± 4.5	2.7 ± 4.6	0.4 ± 4.3	–1.7 ± 3.2
Mar	18.6 ± 10.5	0.1 ± 3.3	—[c]	–3.0 ± 4.5	0.7 ± 5.7
Apr	2.7 ± 21.8	2.7 ± 8.1	–0.7 ± 6.1	5.8 ± 7.3	3.5 ± 8.5
May	4.2 ± 4.8	2.5 ± 6.0	1.2 ± 5.7	5.3 ± 7.5	11.5 ± 6.8
Jun	–1.0 ± 5.2	–2.3 ± 4.4	–1.1 ± 5.5	8.5 ± 10.2	17.9 ± 12.1
Jul	18.1 ± 11.2	1.7 ± 6.7	–0.7 ± 3.8	0.2 ± 4.4	25.2 ± 11.2
Aug	–1.4 ± 3.4	–0.4 ± 5.7	–0.4 ± 5.6	5.6 ± 7.0	13.4 ± 9.3
Sep	4.3 ± 7.8	1.7 ± 6.8	2.3 ± 6.8	7.0 ± 9.2	8.2 ± 7.7
Oct	–0.3 ± 7.5	6.0 ± 8.2	3.4 ± 5.9	1.9 ± 5.8	5.4 ± 6.9
Nov	1.0 ± 4.0	3.9 ± 6.1	–3.0 ± 2.7	10.7 ± 9.8	–1.6 ± 5.9
Dec	–0.1 ± 4.0	–0.1 ± 4.0	2.7 ± 5.0	3.7 ± 6.1	1.8 ± 5.4
Median	**1.8**	**1.1**	**1.2**	**5.4**	**4.5**
IQR[d]	**4.5**	**2.5**	**3.5**	**5.8**	**11.9**
Fraction of DCG[e]	**2.5×10^{-6}**	**1.6×10^{-6}**	**1.7×10^{-6}**	**7.4×10^{-6}**	**6.0×10^{-6}**

Table 5-6. Plutonium-239+240 activity in air particulate samples, Livermore Valley, 1998 (concluded).[a]

Month	Livermore Valley upwind			
	FCC	FIRE	HOSP	CHUR
	(10^{-9} Bq/m^3)			
Jan	2.3 ± 4.8	–0.9 ± 7.2	–0.3 ± 2.7	–0.4 ± 3.0
Feb	1.6 ± 4.7	–2.5 ± 3.8	2.9 ± 5.5	–1.1 ± 1.6
Mar	0.9 ± 2.7	4.5 ± 9.7	–3.0 ± 4.6	2.1 ± 3.4
Apr	5.9 ± 6.4	7.7 ± 9.8	3.6 ± 5.6	3.7 ± 7.4
May	–0.2 ± 6.2	5.9 ± 6.3	10.8 ± 8.7	4.3 ± 7.5
Jun	–0.9 ± 4.8	–1.6 ± 6.5	4.2 ± 7.3	0.3 ± 5.7
Jul	2.1 ± 6.9	3.0 ± 5.2	2.3 ± 3.7	–3.7 ± 3.7
Aug	1.2 ± 5.0	2.0 ± 3.7	3.6 ± 11.1	1.5 ± 6.3
Sep	7.0 ± 8.0	2.6 ± 7.8	5.8 ± 7.8	2.6 ± 6.1
Oct	3.6 ± 5.9	4.3 ± 6.1	3.8 ± 6.3	4.4 ± 6.3
Nov	–1.3 ± 5.0	10.4 ± 8.9	–2.1 ± 3.9	0.4 ± 4.0
Dec	1.7 ± 4.8	2.1 ± 6.5	0.1 ± 5.3	2.0 ± 4.3
Median	**1.62**	**2.81**	**3.28**	**1.77**
IQR[d]	**1.96**	**3.57**	**3.86**	**2.75**
Fraction of DCG[e]	**2.19×10^{-6}**	**3.79×10^{-6}**	**4.44×10^{-6}**	**2.40×10^{-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 Sampling site added March 10, 1998.

c Sample lost during analytical process.

d IQR = Interquartile range.

e DCG = Derived Concentration Guide of 7.4×10^{-4} Bq/m^3 for Pu-239 activity in air.

Table 5-7. Plutonium-239+240 activity in air particulate samples, diffuse sources, 1998.

Month	Sampling location[a]	
	B531	CRED
	(10^{-9} Bq/m^3)	
Jan	3.5 ± 7.0	–0.6 ± 5.3
Feb	–0.8 ± 5.1	0.6 ± 4.8
Mar	8.5 ± 6.8	0.6 ± 5.0
Apr	14.8 ± 11.3	1.1 ± 8.8
May	8.0 ± 7.0	3.9 ± 5.5
Jun	47.4 ± 16.3	2.9 ± 4.7
Jul	114 ± 25.2	–1.1 ± 3.3
Aug	79.6 ± 22.4	–0.6 ± 4.4
Sep	99.9 ± 24.8	4.3 ± 6.1
Oct	52.9 ± 16.6	9.9 ± 9.4
Nov	16.2 ± 10.6	1.3 ± 5.8
Dec	9.4 ± 8.5	3.5 ± 5.0
Median	**15.5**	**1.2**
IQR[b]	**51.2**	**3.3**
Fraction of DCG[c]	**2.1×10^{-5}**	**1.6×10^{-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 5-1**, 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.

Table 5-8. Uranium mass concentration in air particulate samples, Livermore site perimeter 1998.[a]

Location	Month	Uranium-238[b] (10^{-5} μg/m^3)	Uranium-235[c] (10^{-7} μg/m^3)	Uranium-235/238 (10^{-3})
SALV	**Jan**	–0.3 ± 1.0	–1.6 ± 0.8	—[d]
	Feb	0.2 ± 1.1	–1.4 ± 0.9	—[d]
	Mar	1.9 ± 0.6	0.5 ± 0.3	2.44
	Apr	2.5 ± 0.6	1.1 ± 0.3	4.48
	May	0.3 ± 0.6	–0.5 ± 0.3	—[d]
	Jun	2.5 ± 0.6	0.9 ± 0.3	3.79
	Jul	5.4 ± 0.6	3.0 ± 0.3	5.61
	Aug	4.7 ± 0.9	2.7 ± 0.5	5.73
	Sep	11.5 ± 0.6	8.1 ± 0.4	7.04
	Oct	6.0 ± 0.7	4.5 ± 0.5	7.49
	Nov	–0.9 ± 0.2	–0.8 ± 0.2	—[d]
	Dec	1.6 ± 0.2	1.0 ± 0.2	6.64
Median		**2.2**	**1.0**	**5.67**
IQR[e]		**4.5**	**3.3**	**2.43**
Maximum		**11.5**	**8.1**	**NA[f]**
Fraction of DCG[g]		**7.4×10^{-5}**	**2.1×10^{-6}**	**NA**
MESQ	**Jan**	–2.3 ± 1.0	–3.1 ± 0.6	—[d]
	Feb	1.9 ± 2.3	–0.2 ± 1.6	—[d]
	Mar	2.6 ± 0.6	1.1 ± 0.3	4.07
	Apr	4.8 ± 0.6	2.7 ± 0.3	5.62
	May	1.9 ± 0.6	0.7 ± 0.3	3.46
	Jun	6.2 ± 0.6	3.6 ± 0.3	5.89
	Jul	8.0 ± 0.6	5.2 ± 0.3	6.52
	Aug	8.9 ± 0.9	5.5 ± 0.6	6.11
	Sep	15.8 ± 0.7	11.6 ± 0.5	7.33
	Oct	4.8 ± 0.6	3.4 ± 0.4	7.18
	Nov	0.7 ± 0.2	0.5 ± 0.2	6.51
	Dec	2.6 ± 0.3	1.7 ± 0.2	6.65
Median		**3.7**	**2.2**	**6.31**
IQR		**4.7**	**3.4**	**0.93**
Maximum		**15.8**	**11.6**	**NA**
Fraction of DCG		**1.2×10^{-4}**	**4.7×10^{-6}**	**NA**

Table 5-8. Uranium mass concentration in air particulate samples, Livermore site perimeter, 1998 (continued).[a]

Location	Month	Uranium-238[b] (10^{-5} μg/m^3)	Uranium-235[c] (10^{-7} μg/m^3)	Uranium-235/238 (10^{-3})
CAFE	**Jan**	1.5 ± 1.2	–0.4 ± 0.8	—[d]
	Feb	2.4 ± 2.4	–0.6 ± 1.8	—[d]
	Mar	2.5 ± 0.6	1.0 ± 0.3	4.07
	Apr	5.7 ± 0.6	3.4 ± 0.3	5.99
	May	1.8 ± 0.6	0.5 ± 0.3	2.82
	Jun	3.0 ± 1.1	1.0 ± 0.3	3.42
	Jul	5.0 ± 0.6	3.1 ± 0.3	6.11
	Aug	7.2 ± 0.8	4.3 ± 0.5	5.94
	Sep	13.8 ± 0.6	10.0 ± 0.4	7.26
	Oct	7.2 ± 0.5	5.1 ± 0.4	7.07
	Nov	1.9 ± 0.3	1.2 ± 0.3	6.69
	Dec	3.7 ± 0.3	2.5 ± 0.2	6.83
Median		**3.4**	**1.9**	**6.05**
IQR[e]		**3.8**	**2.8**	**2.25**
Maximum		**13.8**	**10.0**	**NA**
Fraction of DCG[g]		**1.1×10^{-4}**	**4.0×10^{-6}**	**NA**
MET	**Jan**	2.1 ± 1.3	–0.2 ± 0.9	—[d]
	Feb	0.6 ± 1.7	–1.3 ± 1.3	—[d]
	Mar	7.6 ± 0.5	4.9 ± 0.3	6.51
	Apr	3.6 ± 0.6	1.9 ± 0.3	5.24
	May	0.6 ± 0.6	–0.2 ± 0.3	—[d]
	Jun	1.8 ± 0.6	0.5 ± 0.3	3.06
	Jul	3.4 ± 0.6	1.9 ± 0.3	5.49
	Aug	6.9 ± 0.9	4.2 ± 0.6	6.00
	Sep	13.9 ± 0.5	9.9 ± 0.4	7.16
	Oct	6.3 ± 0.6	4.3 ± 0.4	6.86
	Nov	0.7 ± 0.2	0.4 ± 0.2	6.25
	Dec	1.3 ± 0.2	0.8 ± 0.2	6.31
Median		**2.8**	**1.3**	**6.25**
IQR		**5.3**	**3.9**	**1.02**
Maximum		**13.9**	**9.9**	**NA**
Fraction of DCG		**9.2×10^{-5}**	**2.8×10^{-6}**	**NA**

Table 5-8. Uranium mass concentration in air particulate samples, Livermore site perimeter, 1998 (concluded).[a]

Location	Month	Uranium-238[b] (10^{-5} μg/m^3)	Uranium-235[c] (10^{-7} μg/m^3)	Uranium-235/238 (10^{-3})
VIS	**Jan**	0.03 ± 1.1	–1.7 ± 1.0	—[d]
	Feb	0.6 ± 1.6	–1.4 ± 1.0	—[d]
	Mar	2.7 ± 0.6	1.1 ± 0.3	4.19
	Apr	4.3 ± 0.6	2.3 ± 0.3	5.45
	May	1.5 ± 0.6	0.3 ± 0.3	1.93
	Jun	11.1 ± 0.6	7.2 ± 0.3	6.46
	Jul	7.2 ± 0.6	4.4 ± 0.3	6.04
	Aug	5.5 ± 0.9	3.0 ± 0.6	5.48
	Sep	19.7 ± 0.6	13.9 ± 0.6	7.07
	Oct	10.9 ± 0.6	7.9 ± 0.6	7.26
	Nov	1.9 ± 0.2	1.2 ± 0.2	6.51
	Dec	2.8 ± 0.3	2.0 ± 0.2	7.02
Median		**3.6**	**2.2**	**6.25**
IQR[e]		**6.3**	**4.2**	**1.43**
Maximum		**19.7**	**13.9**	**NA**
Fraction of DCG[g]		**1.2×10^{-4}**	**4.6×10^{-6}**	**NA**
COW	**Jan**	–0.2 ± 1.1	–2.0 ± 0.7	—[d]
	Feb	2.9 ± 1.6	–0.3 ± 1.3	—[d]
	Mar	2.6 ± 0.6	1.0 ± 0.3	3.65
	Apr	4.8 ± 0.6	2.6 ± 0.3	5.42
	May	0.9 ± 0.6	–0.2 ± 0.3	—[d]
	Jun	2.7 ± 0.6	1.1 ± 0.3	4.06
	Jul	5.8 ± 0.6	3.4 ± 0.3	5.77
	Aug	6.4 ± 0.9	3.9 ± 0.6	6.12
	Sep	14.0 ± 0.6	10.1 ± 0.4	7.18
	Oct	7.5 ± 0.6	5.1 ± 0.5	6.83
	Nov	0.8 ± 0.2	0.5 ± 0.2	6.70
	Dec	2.5 ± 0.3	1.8 ± 0.2	7.01
Median		**2.8**	**1.4**	**6.12**
IQR		**3.9**	**3.1**	**1.41**
Maximum		**14.0**	**10.1**	**NA**
Fraction of DCG		**9.3×10^{-5}**	**3.1×10^{-6}**	**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-238 activities in Bq/m^3 can be determined by dividing the weight in μg/ m^3 by 80.3, and pCi/m^3 can be determined by dividing by 2.97.

c Uranium-235 activities in Bq/m^3 can be determined by dividing the weight in μg/ m^3 by 12.5, and pCi/m^3 can be determined by dividing by 0.463.

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

e IQR = Interquartile range.

f NA = Not applicable.

g 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.

Table 5-9. Monthly median activities for gross alpha summarized from weekly data from low-volume air samplers, 1998.[a]

Month	Livermore Valley upwind	
	HOSP	FCC
	(10^{-12} Bq/mL)	
Jan	35.6	110
Feb	39.3	31.9
Mar	52.5	13.2
Apr	46.8	76.8
May	40.6	16.1
Jun	9.2	13.5
Jul	85.7	105
Aug	31.2	99.3
Sep	56.2	23.5
Oct	63.6	26.8
Nov	67.7	55.3
Dec	53.3	56.6
Annual median[b]	**54.2**	**54.0**
IQR[c]	**61.8**	**97.3**
Annual maximum[b]	**245**	**173**

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, 1998.[a]

Month	Livermore Valley upwind	
	HOSP	FCC
	(10^{-12} Bq/mL)	
Jan	459	455
Feb	161	160
Mar	477	414
Apr	520	351
May	262	317
Jun	253	300
Jul	559	442
Aug	853	709
Sep	755	925
Oct	766	768
Nov	646	631
Dec	688	910
Annual median[b]	**505**	**459**
IQR[c]	**474**	**489**
Annual maximum[b]	**1450**	**2130**

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 concentrations in air, Livermore Valley, 1998.

Month	Sampling locations[a]					
	ZON7	AMON	FIRE	XRDS	VET	HOSP
	(10^{-3} Bq/m^3)					
Jan	24.1 ± 6.6		26.5 ± 10.1	27.2 ± 6.0	46.3 ± 7.4	15.5 ± 7.0
	72.5 ± 15.7		31.1 ± 11.2	1.1 ± 11.2	45.9 ± 14.5	10.1 ± 12.5
Feb	36.3 ± 9.6		15.5 ± 15.1	14.7 ± 10.4	33.6 ± 11.5	1.1 ± 14.4
	16.9 ± 15.0		10.3 ± 9.4	–4.6 ± 13.9	13.9 ± 9.8	15.0 ± 13.0
Mar	36.1 ± 11.4	—[b]	4.5 ± 9.0	0.3 ± 7.7	1.3 ± 8.9	–1.4 ± 10.0
	6.1 ± 9.2	16.0 ± 11.2	4.7 ± 9.3	0.6 ± 9.3	8.5 ± 9.8	–0.2 ± 11.4
Apr	25.6 ± 10.8	4.8 ± 10.4	15.9 ± 10.7	18.9 ± 11.0	16.9 ± 11.9	18.0 ± 12.5
	22.3 ± 9.8	12.7 ± 9.2	6.8 ± 7.8	–2.0 ± 6.7	0.3 ± 9.1	–3.3 ± 10.1
	27.3 ± 8.9	14.4 ± 9.0	13.9 ± 8.5	10.1 ± 8.0	28.4 ± 10.0	13.9 ± 10.0
May	17.0 ± 11.8	2.6 ± 10.7	0.6 ± 9.8	–0.5 ± 10.4	3.2 ± 11.8	2.8 ± 13.1
	20.1 ± 9.9	20.7 ± 9.5	0.2 ± 9.8	3.6 ± 13.3	9.2 ± 10.3	—[c]
Jun	23.5 ± 12.1	4.0 ± 11.1	7.0 ± 10.5	11.1 ± 11.0	28.8 ± 11.7	1.8 ± 12.0
	11.7 ± 10.8	6.7 ± 10.7	9.4 ± 10.7	4.6 ± 9.9	6.0 ± 11.7	–0.6 ± 12.2
Jul	43.7 ± 10.6	11.1 ± 9.7	0.4 ± 8.9	12.5 ± 9.1	7.0 ± 10.1	6.2 ± 10.5
	18.8 ± 9.9	8.3 ± 9.6	2.6 ± 9.1	1.5 ± 9.3	0.3 ± 12.1	–6.8 ± 9.6
Aug	38.9 ± 10.4	38.1 ± 10.8	8.5 ± 8.7	8.2 ± 9.4	14.1 ± 10.9	–1.2 ± 9.9
	–6.5 ± 11.4	34.4 ± 13.4	0.6 ± 12.5	15.0 ± 12.2	–46.3 ± 13.4	–0.1 ± 13.7
Sep	20.5 ± 14.4	–9.3 ± 13.2	4.5 ± 14.1	–2.5 ± 13.3	–22.3 ± 18.8	–36.6 ± 13.9
	44.4 ± 22.2	30.0 ± 21.5	22.1 ± 21.8	0.5 ± 20.4	4.8 ± 23.3	–2.8 ± 21.5
Oct	25.4 ± 22.5	–4.4 ± 21.9	–25.6 ± 21.9	–7.5 ± 21.1	–12.0 ± 24.7	–7.5 ± 24.2
	7.3 ± 12.6	58.1 ± 15.4	3.0 ± 13.7	14.0 ± 12.8	16.6 ± 14.7	17.3 ± 14.9
	25.3 ± 11.1	22.5 ± 11.1	30.1 ± 12.2	7.0 ± 9.4	27.2 ± 12.8	–13.1 ± 10.7
Nov	37.0 ± 12.2	26.1 ± 11.9	22.8 ± 13.1	12.5 ± 11.2	38.5 ± 14.6	9.6 ± 12.9
	25.0 ± 21.9	22.2 ± 21.3	12.7 ± 22.5	22.6 ± 21.3	30.8 ± 23.1	–9.8 ± 23.5
Dec	68.5 ± 21.1	57.0 ± 22.3	34.0 ± 22.3	29.4 ± 17.6	26.2 ± 25.3	45.5 ± 21.1
	6.9 ± 8.0	21.6 ± 8.7	29.7 ± 10.1	13.6 ± 13.6	21.6 ± 10.0	3.3 ± 10.1
Median[d]	**24.5**	**16.0**	**8.92**	**7.59**	**14.0**	**1.76**
IQR[e]	**18.8**	**19.4**	**17.1**	**13.4**	**24.5**	**16.7**
Fraction of DCG[f]	**6.6×10^{-6}**	**4.3×10^{-6}**	**2.4×10^{-6}**	**2.1×10^{-6}**	**3.8×10^{-6}**	**4.8×10^{-7}**
Dose (mSv)[g]	**5.4×10^{-6}**	**3.5×10^{-6}**	**1.9×10^{-6}**	**1.7×10^{-6}**	**3.0×10^{-6}**	**3.8×10^{-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 5-2**, main volume, for sampling locations.

b Sampling site added in March.

c No data. See Chapter 14, Quality Assurance.

d Livermore Valley overall median = 12.5×10^{-3} Bq/m^3.

e IQR = Interquartile range.

f DCG = Derived Concentration Guide of 3.7×10^3 Bq/m^3.

g This dose is the effective dose equivalent.

Table 5-12. Tritium concentration in air, Livermore site perimeter, 1998.

Month	Sampling location[a]						
	SALV	MESQ	CAFE	MET	VIS	COW	POOL
	(10^{-3} Bq/m^3)						
Jan	65.9 ± 8.0	60.3 ± 8.4	—[b]	36.6 ± 7.4	51.1 ± 5.4	42.2 ± 6.0	144 ± 7.5
	67.3 ± 14.1	50.7 ± 13.9	109.2 ± 15.1	32.0 ± 13.7	95.8 ± 13.1	79.9 ± 12.3	273 ± 19.9
Feb	94.0 ± 16.5	59.2 ± 14.2	117.3 ± 14.2	44.8 ± 11.5	99.5 ± 18.2	84.0 ± 14.1	223 ± 21.9
	55.5 ± 13.2	53.3 ± 13.2	90.3 ± 13.7	37.7 ± 12.4	61.1 ± 13.1	40.3 ± 13.2	117 ± 14.2
Mar	26.0 ± 10.5	19.9 ± 10.0	38.1 ± 9.3	34.8 ± 9.8	95.5 ± 13.9	76.6 ± 10.9	82 ± 12.4
	23.5 ± 13.3	20.5 ± 10.4	41.1 ± 10.1	31.5 ± 10.6	—[b]	22.2 ± 10.8	125 ± 14.6
Apr	34.0 ± 13.2	20.2 ± 11.5	64.0 ± 11.5	14.2 ± 10.3	76.2 ± 14.0	53.7 ± 12.1	127 ± 15.3
	26.0 ± 10.7	13.3 ± 9.8	26.3 ± 7.6	13.7 ± 13.5	—[b]	40.0 ± 9.4	60 ± 11.1
	53.3 ± 12.0	21.7 ± 8.9	179.1 ± 15.9	26.3 ± 9.0	64.4 ± 11.1	37.4 ± 9.4	346 ± 20.4
May	19.4 ± 13.8	16.7 ± 12.5	31.6 ± 10.7	13.7 ± 11.6	44.4 ± 11.6	76.2 ± 13.9	89 ± 14.8
	—[b]	2.8 ± 9.4	36.3 ± 10.8	–1.7 ± 9.5	58.5 ± 13.8	85.8 ± 12.8	56 ± 12.8
Jun	—[b]	–9.3 ± 14.9	17.4 ± 15.7	8.0 ± 11.1	—[b]	50.7 ± 12.9	54 ± 13.9
	65.1 ± 14.3	16.1 ± 12.4	78.4 ± 12.5	20.6 ± 10.9	65.1 ± 12.6	40.3 ± 10.8	—[b]
Jul	29.2 ± 10.7	9.8 ± 9.4	29.7 ± 9.9	11.4 ± 10.2	109.5 ± 12.5	38.5 ± 10.2	82 ± 14.3
	57.7 ± 14.1	15.2 ± 6.9	48.1 ± 11.4	14.7 ± 9.9	92.9 ± 12.4	37.0 ± 10.4	141 ± 17.5
Aug	58.5 ± 11.6	16.0 ± 10.1	111.4 ± 14.1	21.5 ± 11.8	107.3 ± 11.3	43.3 ± 11.0	411 ± 24.2
	25.7 ± 13.5	17.2 ± 13.0	70.7 ± 14.0	–7.1 ± 12.0	138.4 ± 15.5	98.4 ± 14.8	121 ± 17.9
Sep	117.3 ± 16.4	8.4 ± 15.7	133.2 ± 20.9	–10.0 ± 13.8	67.0 ± 15.0	26.4 ± 14.9	180 ± 27.0
	—[b]	47.0 ± 23.3	436.6 ± 37.4	50.7 ± 22.2	146.9 ± 26.8	91.4 ± 22.6	648 ± 51.4
Oct	45.5 ± 24.2	10.3 ± 23.2	58.8 ± 23.0	13.9 ± 22.2	112.5 ± 24.1	80.3 ± 25.6	208 ± 36.3
	65.9 ± 16.0	67.7 ± 15.4	106.9 ± 16.8	48.8 ± 14.9	109.9 ± 17.9	117.7 ± 17.5	315 ± 28.1
	88.4 ± 13.9	108.4 ± 15.2	264.6 ± 19.3	50.0 ± 12.7	86.2 ± 13.0	—[b]	581 ± 31.8
Nov	83.3 ± 14.0	67.3 ± 13.8	173.2 ± 17.8	47.7 ± 12.7	97.7 ± 16.5	82.5 ± 14.7	239 ± 22.7
	—[b]	55.9 ± 22.9	146.5 ± 26.0	57.4 ± 24.2	58.5 ± 20.9	33.8 ± 21.8	267 ± 33.5
Dec	54.8 ± 21.6	74.7 ± 20.1	97.3 ± 20.5	–2.7 ± 19.5	91.4 ± 21.2	124.0 ± 26.5	204 ± 27.7
	32.5 ± 10.0	53.7 ± 10.1	173.9 ± 13.9	44.0 ± 9.9	28.3 ± 8.6	27.0 ± 9.0	451 ± 23.2
Median[c]	**55.1**	**20.4**	**90.3**	**23.9**	**91.4**	**50.7**	**180**
IQR[d]	**35.8**	**39.9**	**92.1**	**28.8**	**40.7**	**44.0**	**155**
Fraction of DCG[e]	**1.5×10^{-5}**	**5.5×10^{-6}**	**2.4×10^{-5}**	**6.5×10^{-6}**	**2.5×10^{-5}**	**1.4×10^{-5}**	**4.9×10^{-5}**
Dose (mSv)[f]	**1.2×10^{-5}**	**4.4×10^{-6}**	**2.0×10^{-5}**	**5.2×10^{-6}**	**2.0×10^{-5}**	**1.1×10^{-5}**	**3.9×10^{-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 Chapter 14, Quality Assurance.

c Livermore site overall median = 58.1×10^{-3} Bq/m^3.

d IQR = Interquartile range.

e DCG = Derived Concentration Guide of 3.7×10^3 Bq/m^3.

f This dose is the effective dose equivalent.

Table 5-13. Tritium concentrations in air at locations near diffuse sources, 1998.

Month	Sampling locations[a]			
	B292	B331	B514	B624
	(10^{-3} Bq/m^3)			
Jan	117 ± 10	3,363 ± 54	—[b]	3,959 ± 44
	97 ± 16	10,989 ± 110	3,138 ± 53	4,107 ± 66
Feb	146 ± 19	—[b]	2,631 ± 47	5,291 ± 74
	105 ± 13	1,987 ± 42	2,183 ± 39	5,143 ± 62
Mar	111 ± 13	2,216 ± 56	3,082 ± 46	4,033 ± 53
	73 ± 13	3,204 ± 54	2,357 ± 43	5,402 ± 65
Apr	60 ± 12	12,284 ± 111	2,261 ± 40	4,773 ± 67
	32 ± 10	12,802 ± 102	2,054 ± 35	3,193 ± 48
May	63 ± 10	10,175 ± 92	2,501 ± 45	5,439 ± 65
	37 ± 12	11,877 ± 119	2,305 ± 44	3,848 ± 58
	24 ± 10	20,128 ± 141	2,779 ± 47	2,971 ± 51
Jun	19 ± 11	6,401 ± 83	7,622 ± 84	4,958 ± 70
	50 ± 12	11,359 ± 102	—[b]	—[b]
Jul	25 ± 10	41,810 ± 209	8,214 ± 82	7,696 ± 85
	—[b]	36,038 ± 180	10,138 ± 91	10,471 ± 94
Aug	91 ± 14	35,594 ± 142	7,733 ± 77	10,434 ± 94
	8 ± 13	—[b]	8,140 ± 81	10,323 ± 93
Sep	91 ± 20	36,889 ± 212	6,142 ± 94	10,434 ± 117
	207 ± 31	62,160 ± 360	6,364 ± 116	6,364 ± 114
Oct	58 ± 24	41,440 ± 259	3,774 ± 105	4,292 ± 96
	157 ± 20	35,520 ± 224	3,319 ± 65	3,848 ± 72
	136 ± 16	39,960 ± 272	2,560 ± 56	4,995 ± 77
Nov	141 ± 17	15,947 ± 154	1,976 ± 50	3,315 ± 68
	111 ± 24	20,683 ± 211	2,446 ± 65	4,107 ± 88
Dec	66 ± 18	35,594 ± 272	2,461 ± 67	3,811 ± 85
	99 ± 12	17,279 ± 139	1,432 ± 35	4,033 ± 60
Median[c]	**91**	**16,613**	**2,705**	**4,773**
IQR[d]	**62**	**24,920**	**3,854**	**1,480**
Fraction of DCG[e]	**2.5×10^{-5}**	**4.5×10^{-3}**	**7.3×10^{-4}**	**1.3×10^{-3}**
Dose (mSv)[f]	**2.0×10^{-5}**	**3.6×10^{-3}**	**5.9×10^{-4}**	**1.0×10^{-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 No data. See Chapter 14, Quality Assurance.

c Diffuse source overall median = 3793×10^{-3} Bq/m^3.

d IQR = Interquartile range.

e DCG = Derived Concentration Guide of 3.7×10^3 Bq/m^3

f This dose is the effective dose equivalent.

Table 5-14. Monthly beryllium in air particulate composites, Livermore site perimeter, 1998.

Month	Sampling location[a]					
	SALV	MESQ	CAFE	VIS	MET	COW
	(pg/m^3)					
Jan	0.97	2.01	2.97	1.59	1.98	2.14
Feb	0.00[b]	1.82	2.44	0.25	0.27	0.45
Mar	2.20	5.03	6.13	3.90	3.48	4.98
Apr	5.55	8.59	10.4	4.83	5.71	7.28
May	4.25	8.53	8.37	4.69	5.84	7.43
Jun	4.29	11.6	6.42	9.98	4.24	5.36
Jul	6.70	20.4	12.1	7.16	9.14	8.70
Aug	9.37	8.69	10.6	11.0	11.3	13.3
Sep	8.71	8.89	10.4	9.13	13.1	12.8
Oct	8.33	11.4	12.2	15.2	9.26	14.1
Nov	1.34	2.47	2.60	1.03	2.06	3.18
Dec	1.63	1.50	0.63	0.92	2.40	1.62
Median[c]	**4.27**	**8.56**	**7.40**	**4.76**	**4.98**	**6.32**
IQR[d]	**5.55**	**7.16**	**7.56**	**7.89**	**6.86**	**6.81**
Maximum	**9.37**	**20.4**	**12.2**	**15.2**	**13.1**	**14.1**
Fraction of ACL[e]	$\mathbf{4.27 \times 10^{-4}}$	$\mathbf{8.56 \times 10^{-4}}$	$\mathbf{7.40 \times 10^{-4}}$	$\mathbf{4.76 \times 10^{-4}}$	$\mathbf{4.98 \times 10^{-4}}$	$\mathbf{6.32 \times 10^{-4}}$

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

b Actual reported value.

c Livermore site perimeter overall median is 5.63 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). Fractions are determined using the annual median value.

Table 5-15. Gross alpha and gross beta activities summarized from weekly data for Site 300 perimeter and associated off-site locations, 1998.

Month	Sampling location[a]								
	Site 300 perimeter							Site 300 offsite	
	801E	ECP	EOBS	GOLF	NPS	WCP	WOBS	TFIR	PRIM
Gross alpha	(μBq/m^3)								
Jan	44.1	11.4	10.8	36.7	48.5	18.6	44.5	46.7	44.2
Feb	12.6	–7.5	–16.5	4.7	5.5	7.9	–5.9	–17.9	–4.0
Mar	14.4	–4.0	12.3	–2.4	10.3	–1.5	6.5	16.4	2.6
Apr	16.1	–13.2	7.0	–5.3	17.9	5.0	44.1	6.0	–4.7
May	–23.6	–21.3	–17.2	–0.9	7.2	0.8	2.1	–3.9	7.0
Jun	14.0	34.4	3.3	–4.5	23.7	8.0	22.3	25.9	25.3
Jul	12.2	15.6	68.2	23.7	37.9	30.3	24.8	15.0	17.0
Aug	34.0	34.5	72.2	65.9	55.2	54.4	13.0	–4.5	71.5
Sept	18.5	33.7	21.9	19.3	22.7	29.1	–21.3	11.1	3.7
Oct	–32.6	–4.3	19.0	15.4	6.8	–4.4	–13.3	1.4	5.9
Nov	14.2	11.6	–0.9	8.6	30.4	–14.3	7.2	14.2	9.9
Dec	14.6	29.4	25.1	30.4	40.4	42.5	–6.2	–7.8	41.4
Median[b]	**12.8**	**3.3**	**16.2**	**12.6**	**18.7**	**12.1**	**10.3**	**6.4**	**11.2**
IQR[b,c]	**41.4**	**47.9**	**47.1**	**45.3**	**30.0**	**35.5**	**55.2**	**30.3**	**42.8**
Maximum[b]	**154**	**85.5**	**108**	**94.5**	**77.8**	**78.9**	**104**	**110**	**83.4**
Gross beta									
Jan	207	251	268	316	213	234	169	522	438
Feb	159	158	107	107	111	89	144	151	193
Mar	391	265	293	300	280	227	328	305	329
Apr	345	355	276	363	468	342	331	375	470
May	192	158	134	130	162	158	130	175	207
Jun	223	195	228	213	199	241	201	192	235
Jul	664	511	505	424	530	463	527	463	557
Aug	721	588	605	670	662	626	704	697	638
Sep	687	727	540	551	671	523	526	578	647
Oct	701	669	501	450	571	453	521	586	553
Nov	382	339	241	352	268	369	284	425	303
Dec	720	656	659	711	716	668	689	931	740
Median	**425**	**416**	**349**	**360**	**341**	**314**	**331**	**402**	**391**
IQR[b]	**474**	**379**	**406**	**330**	**403**	**383**	**421**	**417**	**373**
Maximum	**1675**	**1684**	**1515**	**1553**	**1606**	**1417**	**1487**	**2359**	**1174**

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

b Determined by data from the 52-week period.

c IQR = Interquartile range.

Table 5-16. Gamma activity in particulate air samples, Site 300, 1998.[a]

Month	^{7}Be	^{40}K	^{137}Cs	^{22}Na	^{226}Ra	^{228}Ra	^{228}Th
	(10^{-3} Bq/m^3)	(10^{-6} Bq/m^3)					
Jan	1.6 ± 0.03	–51.2 ± 22.0	<0.2	<0.3	–4.5 ± 3.0	–0.6 ± 2.6	–1.0 ± 1.0
Feb	2.4 ± 0.08	37.2 ± 20.5	<0.2	<0.3	–2.3 ± 1.8	1.2 ± 2.1	2.0 ± 1.1
Mar	3.6 ± 0.10	53.3 ± 26.3	<0.2	<0.2	0.8 ± 3.3	1.1 ± 1.5	1.9 ± 0.8
Apr	4.5 ± 0.10	50.1 ± 16.0	0.5 ± 0.4	0.8 ± 0.5	1.5 ± 3.8	1.9 ± 1.7	2.5 ± 0.8
May	2.6 ± 0.05	–41.2 ± 21.5	<0.2	<0.2	–0.9 ± 4.9	–0.4 ± 1.8	–1.0 ± 1.0
Jun	3.0 ± 0.05	45.6 ± 17.0	<0.2	<0.2	0.8 ± 3.5	0.9 ± 1.5	1.7 ± 0.9
Jul	6.5 ± 0.12	26.6 ± 21.7	<0.2	0.9 ± 0.7	1.5 ± 7.4	0.8 ± 2.2	1.5 ± 1.2
Aug	6.4 ± 0.11	–6.2 ± 18.1	<0.2	0.8 ± 0.6	–3.6 ± 2.4	0.2 ± 1.8	–0.2 ± 1.0
Sep	4.8 ± 0.09	52.1 ± 16.3	<0.2	<0.2	1.1 ± 2.0	1.0 ± 1.6	1.4 ± 0.9
Oct	5.6 ± 0.11	24.4 ± 21.3	<0.2	<0.3	1.6 ± 4.7	0.4 ± 2.0	0.7 ± 1.1
Nov	2.8 ± 0.07	–14.0 ± 17.7	<0.2	<0.2	–1.1 ± 3.8	–1.5 ± 1.6	–1.1 ± 0.9
Dec	3.3 ± 0.06	2.9 ± 19.1	<0.2	<0.2	–3.7 ± 2.5	–0.6 ± 1.8	–0.6 ± 1.0
Median	**3.4**	**25.5**	**<0.21**	**<0.3**	**–0.04**	**0.6**	**1.0**
IQR[b]	**2.2**	**54.9**	**—[c]**	**—[c]**	**3.8**	**1.5**	**2.4**
Maximum	**6.5**	**53.3**	**0.5**	**0.9**	**1.6**	**1.9**	**2.5**
DCG (Bq/m^3)[d]	**1.5×10^{3}**	**3.3×10^{1}**	**1.5×10^{1}**	**3.7×10^{1}**	**3.7×10^{-2}**	**1.1×10^{-1}**	**1.5×10^{-3}**
Median fraction of DCG	**1.5×10^{-6}**	**7.7×10^{-7}**	**$<1.4 \times 10^{-8}$**	**$<6.8 \times 10^{-9}$**	**4.3×10^{-5}[e]**	**5.8×10^{-6}**	**6.9×10^{-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 All Livermore site perimeter samples composited. See **Figure 5-1**, main volume, for sampling locations.

b IQR = Interquartile range.

c No IQR calculated; see Chapter 14, Quality Assurance.

d DCG = Derived Concentration Guide (DOE 5400.5). See Chapter 13, Radiation Dose Assessment.

e The radium-226 median fraction of DCG was determined by using the maximum value since the median value was negative.

Table 5-17. Plutonium-239+240 activity in air particulate samples, Site 300, 1998.

Month	Sampling location[a]		
	Site 300 composite	PRIM	TFIR
	(10^{-9} Bq/m^3)		
Jan	1.5 ± 1.5	6.2 ± 7.8	–4.9 ± 3.7
Feb	1.7 ± 2.2	3.9 ± 7.1	–0.9 ± 6.1
Mar	2.2 ± 1.7	2.3 ± 5.0	0.9 ± 3.8
Apr	16.1 ± 6.7	10.8 ± 8.8	10.6 ± 9.2
May	0.7 ± 1.8	2.2 ± 5.3	4.0 ± 6.7
Jun	0.5 ± 1.9	1.0 ± 6.9	0.8 ± 4.6
Jul	2.9 ± 3.5	1.7 ± 5.5	–1.9 ± 3.6
Aug	1.1 ± 2.3	0.6 ± 5.1	5.1 ± 8.1
Sep	1.0 ± 2.1	8.4 ± 7.9	8.3 ± 8.7
Oct	5.1 ± 3.4	1.0 ± 4.5	2.8 ± 5.1
Nov	0.6 ± 2.9	–1.3 ± 4.8	0.5 ± 5.1
Dec	1.6 ± 3.9	2.1 ± 6.0	–1.4 ± 1.6
Median	**1.6**	**2.2**	**0.9**
IQR[b]	**1.4**	**3.4**	**5.2**
Fraction of DCG[c]	**2.1×10^{-6}**	**2.9×10^{-6}**	**1.2×10^{-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 5-3**, 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.

Table 5-18. Uranium mass in air particulate samples for Site 300 composite and PRIM location, 1998.

Location[a]	Month	Uranium-238[b] (10^{-5} μg/m^3)	Uranium-235[c] (10^{-7} μg/m^3)	Uranium 235/238 (10^{-3})
Site 300	Jan	–1.9 ± 1.8	–2.7 ± 1.3	—[d]
	Feb	2.0 ± 5.1	–0.2 ± 3.6	—[d]
	Mar	58.1 ± 32.7	14.6 ± 14.7	2.51
	Apr	4.4 ± 0.4	2.3 ± 0.3	5.19
	May	–0.6 ± 0.8	–1.3 ± 0.4	—[d]
	Jun	1.9 ± 0.4	0.7 ± 0.3	3.50
	Jul	12.2 ± 1.6	7.8 ± 1.1	6.41
	Aug	6.9 ± 5.3	2.3 ± 3.6	3.37
	Sep	13.6 ± 4.4	9.6 ± 3.1	7.04
	Oct	9.9 ± 4.5	6.9 ± 2.9	7.01
	Nov	–0.5 ± 0.4	–0.5 ± 0.3	—[d]
	Dec	–0.2 ± 0.3	–0.3 ± 0.2	—[d]
Median		**3.2**	**1.5**	**5.19**
IQR[f]		**10.7**	**7.5**	**3.27**
Maximum		**58.1**	**14.6**	**NA**
Fraction of DCG[g]		**1.06×10^{-4}**	**3.15×10^{-6}**	**NA**
PRIM	Jan	—[e]	—[e]	—[e]
	Feb	0.9 ± 1.7	–1.3 ± 1.4	—[d]
	Mar	6.0 ± 0.6	0.7 ± 0.3	1.12
	Apr	3.4 ± 0.6	1.6 ± 0.3	4.78
	May	0.6 ± 0.6	–0.4 ± 0.3	—[d]
	Jun	4.0 ± 0.6	2.0 ± 0.3	5.11
	Jul	4.8 ± 0.6	2.8 ± 0.3	5.76
	Aug	6.7 ± 0.8	4.3 ± 0.6	6.45
	Sep	16.5 ± 0.7	11.8 ± 0.6	7.16
	Oct	10.9 ± 0.7	7.8 ± 0.5	7.19
	Nov	0.2 ± 0.2	–0.04 ± 0.2	—[d]
	Dec	–0.38 ± 0.3	–0.4 ± 0.2	—[d]
Median		**4.0**	**1.6**	**5.76**
IQR		**5.6**	**3.8**	**1.86**
Maximum		**16.5**	**11.8**	**NA[h]**
Fraction of DCG		**1.32×10^{-4}**	**3.47×10^{-16}**	**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-238 activities in Bq/m^3 can be determined by dividing the weight in μg/ m^3 by 80.3, and in pCi/m^3 can be determined by dividing by 2.97.

c Uranium-235 activities in Bq/m^3 can be determined by dividing the weight in μg/ m^3 by 12.5, and in pCi/m^3 can be determined by dividing by 0.463.

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

e Sampling site added.

f IQR = Interquartile range.

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.

h NA = Not applicable.

Table 5-19. Tritium concentration in air, Site 300, 1998.

Month	Sampling location[a] PRIM (10^{-3} Bq/m^3)
Jan	12.1 ± 6.2
	–5.6 ± 9.3
Feb	13.4 ± 12.5
	–0.3 ± 11.3
Mar	__[b]
	__[b]
Apr	4.4 ± 9.8
	2.9 ± 7.4
	5.3 ± 6.7
May	–10.1 ± 12.2
	5.1 ± 8.6
Jun	1.5 ± 10.0
	3.4 ± 9.9
Jul	11.6 ± 8.1
	–0.4 ± 8.2
Aug	–1.1 ± 8.0
	–19.8 ± 8.5
Sep	–15.2 ± 11.9
	2.0 ± 19.6
Oct	–12.9 ± 18.9
	9.4 ± 11.7
	–0.04 ± 9.2
Nov	0.1 ± 9.6
	13.5 ± 19.5
Dec	41.1 ± 17.9
	4.6 ± 7.5
Median	**2.4**
IQR[c]	**6.9**
Fraction of DCG[d]	**6.6×10^{-7}**
Dose (mSv)[e]	**5.3×10^{-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 Chapter 14, Quality Assurance.

c IQR = Interquartile range.

d DCG = Derived Concentration Guide of 3.7×10^3 Bq/m^3.

e This dose is the effective dose equivalent.

Table 5-20. Beryllium in air particulate samples, Site 300 network, 1998.

Month	Sampling location[a]			
	EOBS	GOLF	TFIR	801E
	(pg/m^3)			
Jan	0.38	0.76	1.62	0.38
Feb	0.00[b]	0.00[b]	1.15	0.00[b]
Mar	20.8	3.88	6.90	36.6
Apr	7.86	5.78	10.6	7.09
May	3.32	3.60	6.92	3.04
Jun	3.88	4.84	6.68	12.3
Jul	6.28	7.23	14.4	9.16
Aug	10.5	13.3	12.6	11.5
Sep	12.3	13.3	12.5	10.2
Oct	8.29	9.28	18.1	10.4
Nov	0.92	1.29	3.54	0.18
Dec	2.27	3.40	5.85	4.16
Median[c]	**5.08**	**4.36**	**6.91**	**8.12**
IQR[d]	**6.90**	**4.87**	**7.23**	**8.29**
Maximum	**20.8**	**13.3**	**18.1**	**36.6**
Fraction of ACL[e]	**5.08×10^{-4}**	**4.36×10^{-4}**	**6.91×10^{-4}**	**8.12×10^{-4}**

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

b Actual reported value.

c Median value for all Site 300 locations is 6.48 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). Fractions are determined by using the annual median values.

6

Sewerable Water

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

Methods and Data

LLNL operated a flow-proportional peristaltic pump composite sampler in the Sewer Monitoring Station (SMS) (main volume, Figure 6-1), that created a 24-hour composite of Livermore site sewage effluent by taking a sample for every 3765 L of effluent. Each day, 500-mL aliquots of this 24-hour composite were transferred to polyethylene bottles. Aliquots were submitted for analysis as follows:

First, 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 200-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 the HCRML. The HCRML prepared the distillate 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 6-1**.

Finally, an aliquot was submitted to LLNL's Chemistry and Materials Science Environmental Services (CES). Each month, CES created a composite sample from the aliquots submitted for that month and analyzed it first for ^{239}Pu and then for ^{137}Cs. CES began the ^{239}Pu analysis by adding MnO_2 to the entire volume of the monthly composite sample, approximately 15 L, to precipitate the plutonium. After digestion of the composite volume with concentrated HNO_3, ion-exchange chromatography was used to separate out 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 measured by alpha spectroscopy. It should be noted that CES, prior to beginning analysis for ^{137}Cs activity in the monthly composite, returned any non-plutonium sample material generated from the ion-exchange process to the monthly composite sample, preventing ^{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.

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 30-mL sample for every 30,280 L of effluent discharged during a seven-day period. Another sampler operated once a month as a single-day composite sampler, running for 24 hours, collecting a 150-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), one 1-L aliquot was transferred to a polyethylene bottle. This aliquot was submitted to an off-site contract laboratory for aluminum, arsenic, beryllium, cadmium, chromium, copper, iron, lead, mercury, nickel, silver, and zinc analyses. The results for these analyses are presented in **Tables 6-2** and **6-3**; the EPA Methods used for these analyses are identified by the method numbers 200.7, 206.2, 210.2, 200.7, 200.7, 200.7, 200.7, 239.2, 245.2, 249.2, 200.7, and 200.7, respectively. Two additional aliquots were submitted each week from the weekly composite. These two aliquots are analyzed by HCAL for gross alpha, beta, and tritium activities. A subset of these results contribute to the completeness of the daily analytical results for gross alpha, gross beta, and tritium; this subset is reported and footnoted in **Table 6-1**.

Aliquots were submitted to the contract analytical laboratory for a far more extensive set of analyses on the 24-hour composite than the weekly composite sample. Under the heading of "Composite sample," **Table 6-4** 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 6-3** 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 are submitted to a contract analytical laboratory for additional monitoring of water quality parameters and organic compounds. The results of this monitoring are found in **Table 6-4** under the "Grab sample" heading. The table lists the parameters and the EPA method numbers used for the analyses. The last four entries are for oil and grease analysis of samples that were acquired at 4-hour intervals during the day, showing the time of collection of each oil and grease sample.

A flow chart recorder is located inside the SMS, and an ultrasonic flow sensor is installed in the adjacent underground sewer vault. A flow totalizer reading from the flow chart recorder was entered into a daily sampling log every day when the daily

composite sample was acquired from the SMS. The daily total flows are determined by subtracting sequentially recorded flow totalizer readings. For days that flow totalizer readings are not available, daily flow totals are estimated. **Tables 6-5a** and **b** present the daily total flows and monthly annual flow summary statistics for 1998.

Discharges of ground water to the sanitary sewer must comply with the terms and conditions in Permit 1510G(98), issued by the Livermore Water Reclamation Plant (LWRP). The self-monitoring program prescribed in ground water discharge permit requires compliance with the parameters specified in Table 6-2 in the main volume. **Table 6-6** shows discharge dates and monitoring data for discharges of ground water.

Two 500-mL aliquots of treated effluent from LWRP were collected daily by LWRP employees. These daily 500-mL aliquots were used to create two different composite samples. The first of the samples contained a week of daily aliquots. This weekly sample, composited in a 1-gal polyethylene bottle, was collected each week by LLNL and submitted to HCAL for gross alpha, gross beta, and tritium analyses. **Table 6-7** shows the tritium results for the LWRP weekly composite sample. The other composite sample contained a month of daily aliquots. This monthly sample, composited in a 5-gallon polyethylene carboy, was collected each month by LLNL. CES analyzes the monthly composite for ^{137}Cs using gamma spectroscopy and for ^{239}Pu using alpha spectroscopy. These results are presented in the main volume, Chapter 6.

Two 500-mL composite samples from each of the LWRP digesters were acquired monthly by LWRP employees. The composites consisted of aliquots taken from the circulating sludge once a week. Every month LLNL collected the composite samples and submitted one 500-mL composite to HCAL and one to CES. HCAL analyzes the monthly composite for gross radioactivity and metals. CES composites 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, beta, and tritium are displayed in mBq/mL. The activities shown in the daily effluent monitoring and weekly composite tritium tables are the measured concentrations and their associated $\pm 2\sigma$ counting errors. A $\pm 2\sigma$ 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)

Standard quality control and quality assurance procedures were followed. 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 1998.

Table 6-1. Daily monitoring results for gross alpha, gross beta, and tritium in the sanitary sewer effluent, 1998.

Date		Gross alpha (μBq/mL)		Gross beta (mBq/mL)		Tritium (mBq/mL)	
		Activity	LOS[a]	Activity	LOS	Activity	LOS
January	1	9.55	81.4	0.703 ± 0.084	0.0899	–4.51	11.7
	2	–24.6	89.9	0.588 ± 0.082	0.0914	–0.596	11.6
	3	8.25	85.5	0.481 ± 0.077	0.0907	–2.69	10.9
	4	17.6	78.1	0.407 ± 0.077	0.0895	3.06	11.2
	5	–14.0	80.3	0.348 ± 0.073	0.0899	–1.62	11.4
	6	–1.15	94.0	0.792 ± 0.095	0.0921	5.66	10.8
	7	–2.46	84.4	0.529 ± 0.079	0.0907	1.79	10.9
	8	103 ± 60	88.8	1.38 ± 0.11	0.0925	4.48	11.1
	9	98.8 ± 59.3	92.1	1.60 ± 0.12	0.0929	1.60	11.0
	10	29.4	99.5	1.75 ± 0.12	0.0947	2.29	11.1
	11	–3.26	81.0	1.14 ± 0.10	0.0910	1.09	11.4
	12	5.55	94.4	1.31 ± 0.11	0.0936	4.14	11.1
	13	15.7	94.0	1.37 ± 0.11	0.0932	4.59	10.9
	14	83.6	94.4	1.27 ± 0.11	0.0932	–1.02	11.5
	15	75.1	89.2	0.688 ± 0.089	0.0895	4.77	11.2
	16	32.9	90.7	0.866 ± 0.095	0.0899	8.88	10.9
	17	40.7	101	1.09 ± 0.10	0.0921	4.59	11.1
	18	22.7	98.1	0.614 ± 0.086	0.0914	5.11	11.1
	19	–31.1	79.2	0.688 ± 0.083	0.0881	56.6 ± 7.9	11.1
	20	41.1	77.7	0.729 ± 0.087	0.0877	4.51	11.2
	21	61.4	91.0	0.821 ± 0.090	0.0899	4.07	11.2
	22	28.9	86.2	0.781 ± 0.086	0.0892	–2.80	11.0
	23	24.8	84.7	0.884 ± 0.097	0.0888	–0.170	11.1
	24	71.0	94.0	0.914 ± 0.091	0.0907	0.0925	11.1
	25	6.55	79.6	0.236 ± 0.066	0.0881	4.96	10.9
	26	24.3	81.0	0.279 ± 0.070	0.0884	7.81	10.6
	27	31.2	91.4	0.622 ± 0.087	0.0899	–0.858	10.7
	28	7.59	95.8	0.851 ± 0.094	0.0910	0.759	11.1
	29	–7.96	100	0.747 ± 0.090	0.0914	4.26	10.7
	30	–0.0176	96.6	0.703 ± 0.091	0.0907	12.1 ± 6.8	11.0
	31	47.4	87.7	0.551 ± 0.083	0.0888	1.42	10.7
February	1	15.2	84.0	0.334 ± 0.070	0.0884	4.11	10.8
	2	75.9	88.4	0.271 ± 0.068	0.0888	8.18	11.0
	3	25.4	79.9	0.294 ± 0.068	0.0877	3.12	11.1

Table 6-1. Daily monitoring results for gross alpha, gross beta, and tritium in the sanitary sewer effluent, 1998 (continued).

Date		Gross alpha (μBq/mL)		Gross beta (mBq/mL)		Tritium (mBq/mL)	
		Activity	LOS[a]	Activity	LOS	Activity	LOS
February	4	169 ± 68	85.1	0.470 ± 0.075	0.0884	0.0851	11.1
	5	14.6	120	0.844 ± 0.093	0.0958	10.3	10.6
	6	6.88	88.4	0.759 ± 0.091	0.0892	6.77	10.9
	7	57.4	88.1	0.685 ± 0.089	0.0888	15.5 ± 6.8	11.0
	8	–29.3	89.2	0.357 ± 0.071	0.0892	2.55	11.0
	9	31.9	90.3	0.492 ± 0.079	0.0892	2.30	11.0
	10	–19.9	88.8	0.773 ± 0.093	0.0892	–5.85	11.5
	11	69.6	88.1	0.740 ± 0.089	0.0888	–5.70	11.5
	12	–42.9	111	0.899 ± 0.099	0.0944	–2.12	11.2
	13	–12.5	95.8	0.825 ± 0.091	0.0903	–5.70	11.2
	14	17.1	85.8	0.648 ± 0.084	0.0884	–3.23	11.4
	15	117 ± 59	83.3	0.392 ± 0.074	0.0881	0.333	11.2
	16	7.84	81.8	0.426 ± 0.077	0.0881	–1.38	11.0
	17	4.22	70.3	0.381 ± 0.072	0.0858	–4.44	11.1
	18	136 ± 60	91.4	0.796 ± 0.088	0.0895	–0.511	11.3
	19	16.8	89.9	0.929 ± 0.093	0.0892	2.29	11.2
	20	66.6	88.1	0.648 ± 0.084	0.0888	0.847	11.2
	21	15.8	85.8	0.618 ± 0.080	0.0884	10.2	11.4
	22	59.6	87.7	0.466 ± 0.079	0.0888	1.09	11.4
	23	–3.39	69.9	0.287 ± 0.066	0.0855	–1.59	11.4
	24	–9.47	74.7	0.429 ± 0.073	0.0866	1.27	11.2
	25	43.7	87.0	0.514 ± 0.077	0.0888	2.72	11.2
	26	1.94	83.6	0.418 ± 0.075	0.0884	5.70	11.5
	27	231 ± 83	99.5	0.655 ± 0.085	0.0914	807 ± 18	11.1
	28	124 ± 62	97.3	0.751 ± 0.090	0.0910	3.23	11.4
March	1	31.1	81.4	0.284 ± 0.068	0.0881	9.44	11.0
	2	23.6	78.1	0.214 ± 0.066	0.0877	4.92	11.3
	3	104 ± 55	89.5	0.718 ± 0.086	0.0895	3.06	11.1
	4	28.9	87.0	0.614 ± 0.086	0.0888	–0.429	11.1
	5	31.6	107	1.35 ± 0.11	0.0936	5.11	11.1
	6	–51.4	96.6	1.33 ± 0.11	0.0914	5.59	11.1
	7	–45.1	102	1.11 ± 0.10	0.0925	134 ± 9	11.2
	8	–8.29	84.0	0.803 ± 0.088	0.0892	7.44	11.2
	9	0.847	77.0	0.710 ± 0.085	0.0881	6.44	11.2

Table 6-1. Daily monitoring results for gross alpha, gross beta, and tritium in the sanitary sewer effluent, 1998 (continued).

Date		Gross alpha (μBq/mL)		Gross beta (mBq/mL)		Tritium (mBq/mL)	
		Activity	LOS[a]	Activity	LOS	Activity	LOS
March	10	41.4	94.4	1.27 ± 0.11	0.0910	–0.677	11.4
	11	26.8	86.6	0.995 ± 0.098	0.0895	–3.33	11.4
	12	94.4 ± 46.3	68.5	0.514 ± 0.077	0.0833	1.86	10.8
	13	42.2	66.6	0.414 ± 0.070	0.0829	0.414	11.0
	14	0.0977	70.7	0.444 ± 0.075	0.0836	5.77	10.7
	15	34.2	69.6	0.337 ± 0.067	0.0833	–0.0903	11.2
	16	–5.33	61.8	0.196 ± 0.061	0.0818	4.00	11.1
	17	12.0	65.5	0.466 ± 0.075	0.0825	507 ± 14	11.0
	18	97.7 ± 45.9	71.0	0.614 ± 0.080	0.0836	–5.74	11.5
	19	8.81	69.2	0.544 ± 0.076	0.0833	–3.23	11.5
	20	20.6	74.4	0.714 ± 0.086	0.0844	2.39	11.2
	21	22.6	74.7	0.681 ± 0.082	0.0847	8.47	11.4
	22	51.4	66.2	0.234 ± 0.063	0.0829	0.0821	11.4
	23	33.8	67.3	0.237 ± 0.064	0.0829	7.92	11.4
	24	–6.62	70.3	0.655 ± 0.085	0.0836	13.0 ± 6.8	11.0
	25	75.1 ± 29.3	61.1	0.799 ± 0.096	0.0936	1.78	11.1
	26	22.0	67.0	0.692 ± 0.09	0.0955	2.01	11.1
	27	49.2	64.8	0.574 ± 0.086	0.0947	–2.92	11.5
	28	198 ± 57	62.2	0.733 ± 0.088	0.094	0.640	11.5
	29	9.18	50.7	0.210 ± 0.067	0.0910	4.96	10.7
	30	15.6	53.3	0.283 ± 0.071	0.0918	1.18	10.9
	31	156 ± 51	61.4	0.548 ± 0.082	0.0936	0.00	11.2
April	1	–5.99	104	0.995 ± 0.119	0.115	–3.06	11.4
	2	74.4	112	0.784 ± 0.110	0.117	1.19	10.9
	3	27.0	108	0.784 ± 0.110	0.116	0.00	11.2
	4	179 ± 81	132	1.41 ± 0.14	0.122	28.4 ± 7.1	10.9
	5	70.3	117	0.781 ± 0.109	0.119	4.18	11.2
	6	72.9	96.2	0.422 ± 0.093	0.113	–1.45	11.4
	7	100	137	1.12 ± 0.12	0.122	2.46	11.2
	8	57.0	108	0.925 ± 0.111	0.116	1.19	11.1
	9	–0.346	108	0.881 ± 0.115	0.116	5.62	10.6
	10	69.2	112	0.892 ± 0.116	0.118	–0.0851	11.1
	11	56.2	119	0.918 ± 0.119	0.120	–2.21	10.8
	12	–1.20	92.1	0.200 ± 0.080	0.112	3.15	10.9

Table 6-1. Daily monitoring results for gross alpha, gross beta, and tritium in the sanitary sewer effluent, 1998 (continued).

Date		Gross alpha (μBq/mL)		Gross beta (mBq/mL)		Tritium (mBq/mL)	
		Activity	LOS[a]	Activity	LOS	Activity	LOS
April	13	98.8 ± 65.2	93.2	0.267 ± 0.083	0.112	–1.19	10.8
	14	–10.2	101	0.426 ± 0.094	0.114	–1.96	10.8
	15	209 ± 86	105	0.862 ± 0.112	0.115	0.255	10.8
	16	104	109	1.08 ± 0.13	0.134	2.46	10.7
	17	164 ± 64	84.7	1.08 ± 0.13	0.137	7.99	10.7
	18	59.2	88.4	1.47 ± 0.15	0.137	–1.53	11.1
	19	–64.0	88.4	0.736 ± 0.110	0.127	6.36	10.7
	20	21.7	86.2	0.574 ± 0.109	0.127	0.681	11.1
	21	26.3	121	0.951 ± 0.124	0.134	7.66	10.8
	22	–65.9	118	1.23 ± 0.14	0.134	–1.45	11.2
	23	40.3	107	1.11 ± 0.13	0.133	1.62	11.0
	24	–92.9	119	1.17 ± 0.14	0.134	33.1 ± 7.0	10.8
	25	–35.6	121	1.33 ± 0.15	0.134	3.49	10.6
	26	19.4	100	0.374 ± 0.101	0.131	1.19	11.0
	27	–2.47	117	0.599 ± 0.114	0.134	–1.61	11.1
	28	88.8	98.4	1.05 ± 0.13	0.130	6.73	10.5
	29	103 ± 41	92.9	1.00 ± 0.12	0.128	1.02	11.1
	30	50.3	91.0	0.888 ± 0.115	0.127	–4.40	11.5
May	1	136 ± 56	117	0.951 ± 0.124	0.134	126 ± 9	11.2
	2	–58.1	114	1.04 ± 0.12	0.134	4.77	11.3
	3	97.7 ± 52.8	87.0	0.279 ± 0.092	0.126	0.511	11.3
	4	36.6	81.4	0.299 ± 0.093	0.124	4.40	11.1
	5	65.9	93.6	0.788 ± 0.118	0.128	–1.19	11.1
	6	98.4	103	1.10 ± 0.13	0.132	8.14	10.8
	7	–37.0	118	1.22 ± 0.13	0.134	0.470	11.1
	8	–12.3	88.1	3.20 ± 0.20	0.141	0.766	10.8
	9	31.2	85.5	0.829 ± 0.116	0.125	–3.39	11.1
	10	35.0	82.1	0.248 ± 0.089	0.124	3.74	10.4
	11	73.6	78.1	0.324 ± 0.091	0.122	1.70	10.7
	12	9.32	100	0.892 ± 0.125	0.130	78.8 ± 8.7	11.1
	13	104	105	0.936 ± 0.122	0.132	161 ± 9	10.5
	14	89.5	104	0.973 ± 0.126	0.133	0.936	10.4
	15	74.4	95.8	1.09 ± 0.13	0.130	418 ± 13	10.9
	16	98.8	106	0.921 ± 0.129	0.134	3.64	10.8

Table 6-1. Daily monitoring results for gross alpha, gross beta, and tritium in the sanitary sewer effluent, 1998 (continued).

Date		Gross alpha (μBq/mL)		Gross beta (mBq/mL)		Tritium (mBq/mL)	
		Activity	LOS[a]	Activity	LOS	Activity	LOS
May	17	6.62	85.1	0.307 ± 0.095	0.126	8.92	10.5
	18	21.1	81.0	0.285 ± 0.091	0.125	5.03	10.9
	19	78.8	104	1.39 ± 0.14	0.133	–0.603	9.07
	20	131 ± 48	115	1.42 ± 0.14	0.135	–5.22	9.40
	21	120 ± 46	102	1.27 ± 0.14	0.131	1.81	8.95
	22	68.5	101	1.21 ± 0.13	0.131	–1.68	9.18
	23	33.1	108	1.08 ± 0.13	0.133	6.62	11.5
	24	28.2	89.5	0.485 ± 0.102	0.126	4.77	11.3
	25	114 ± 57	94.0	0.466 ± 0.103	0.128	4.07	11.1
	26	–15.4	114	0.411 ± 0.136	0.184	–2.63	11.3
	27	–195	120	6.51 ± 0.27	0.141	2.04	11.1
	28	121 ± 56	92.1	1.23 ± 0.14	0.138	150 ± 10	11.2
	29	–50.7	96.9	1.27 ± 0.14	0.129	–2.72	11.0
	30	96.2 ± 46.2	76.2	1.16 ± 0.14	0.135	–3.66	11.3
	31	29.3	81.0	0.377 ± 0.094	0.124	0.681	11.2
June	1	47.4	75.9	0.299 ± 0.090	0.122	1.28	10.9
	2	239 ± 72	94.7	1.23 ± 0.14	0.128	1.87	11.0
	3	50.3	95.8	1.43 ± 0.14	0.129	130 ± 8	8.88
	4	164 ± 51	97.3	1.28 ± 0.14	0.131	3.57	11.1
	5	120 ± 53	112	1.39 ± 0.15	0.143	3.74	10.5
	6	136 ± 46	84.7	0.955 ± 0.124	0.127	7.59	11.3
	7	127 ± 60	82.5	0.252 ± 0.091	0.126	1.79	11.4
	8	51.1	77.7	0.259 ± 0.091	0.124	–4.51	11.5
	9	172 ± 55	86.6	0.962 ± 0.125	0.127	0.250	11.5
	10	104 ± 42	94.0	0.847 ± 0.119	0.130	0.340	11.2
	11	183 ± 64	118	0.958 ± 0.125	0.136	241 ± 11	11.2
	12	2.4	108	0.918 ± 0.129	0.135	11.3 ± 6.8	11.0
	13	37.7	101	0.977 ± 0.127	0.132	0.340	11.4
	14	35.6	85.1	0.354 ± 0.096	0.127	2.30	11.3
	15	119 ± 61	84.7	0.195 ± 0.088	0.127	0.932	11.7
	16	162 ± 60	95.8	0.944 ± 0.123	0.131	10.2	10.4
	17	101	110	0.833 ± 0.125	0.135	–1.11	11.2
	18	–22.2	112	1.28 ± 0.14	0.136	8.51	10.9
	19	112 ± 49	105	0.895 ± 0.125	0.134	6.81	11.1

Table 6-1. Daily monitoring results for gross alpha, gross beta, and tritium in the sanitary sewer effluent, 1998 (continued).

Date		Gross alpha (μBq/mL)		Gross beta (mBq/mL)		Tritium (mBq/mL)	
		Activity	LOS[a]	Activity	LOS	Activity	LOS
June	20	107	107	0.829 ± 0.124	0.135	–3.06	11.3
	21	90.7 ± 52.6	83.6	0.254 ± 0.091	0.126	2.89	11.1
	22	41.4	80.3	0.0870	0.125	0.255	11.4
	23	212 ± 74	107	0.925 ± 0.130	0.135	3.06	11.2
	24	66.2	104	0.873 ± 0.122	0.134	60.3 ± 7.8	11.0
	25	102	121	3.01 ± 0.19	0.137	4.59	11.1
	26	78.4	106	0.792 ± 0.119	0.135	2.56	10.8
	27	53.7	99.9	0.810 ± 0.122	0.132	7.47	10.9
	28	38.5	84.4	0.308 ± 0.095	0.127	–0.426	11.2
	29	33.3	93.2	0.270 ± 0.095	0.130	10.2	11.0
	30	136 ± 57	77.0	0.792 ± 0.127	0.141	0.173	11.4
July	1	75.9 ± 38.7	73.6	0.995 ± 0.129	0.140	1.53	11.0
	2	134 ± 50	98.1	1.42 ± 0.14	0.131	–1.62	11.4
	3	109 ± 55	98.1	0.677 ± 0.115	0.131	1.19	11
	4	12.3	91.8	0.171 ± 0.089	0.129	2.80	10.9
	5	26.3	81.0	0.138 ± 0.084	0.125	–1.20	11.1
	6	58.5	79.6	0.128 ± 0.083	0.125	0.418	11.0
	7	16.1	86.2	0.703 ± 0.112	0.127	3.81	10.6
	8	164 ± 72	115	0.947 ± 0.133	0.140	7.62	11.0
	9	6.22	91.0	1.61 ± 0.14	0.129	5.29	10.8
	10	114	119	0.992 ± 0.129	0.136	1.57	11.7
	11	67.3	101	0.903 ± 0.126	0.133	1.44	11.5
	12	14.7	81.0	0.308 ± 0.092	0.125	–2.49	11.2
	13	68.8	79.6	0.234 ± 0.089	0.125	–4.40	11.8
	14	132 ± 51	94.7	0.781 ± 0.117	0.130	0.592	11.1
	15	160 ± 53	93.2	1.01 ± 0.12	0.130	5.92	11.2
	16	203 ± 71	92.9	0.733 ± 0.117	0.129	–0.369	11.6
	17	165 ± 64	109	0.862 ± 0.121	0.135	2.94	11.4
	18	89.5 ± 42.1	81.4	0.636 ± 0.108	0.125	1.57	11.3
	19	27.5	81.0	0.0980	0.125	11.0 ± 6.3	10.6
	20	63.6	74.7	0.128 ± 0.082	0.124	5.07	10.9
	21	199 ± 70	90.7	0.725 ± 0.116	0.128	5.25	10.8
	22	78.4	84.0	0.588 ± 0.106	0.126	4.66	10.8
	23	163 ± 62	88.1	0.677 ± 0.108	0.127	2.66	11.4

Table 6-1. Daily monitoring results for gross alpha, gross beta, and tritium in the sanitary sewer effluent, 1998 (continued).

Date		Gross alpha (μBq/mL)		Gross beta (mBq/mL)		Tritium (mBq/mL)	
		Activity	LOS[a]	Activity	LOS	Activity	LOS
July	24	238 ± 74	90.3	1.01 ± 0.13	0.139	7.96	8.84
	25	66.2	85.8	0.751 ± 0.113	0.128	0.747	11.1
	26	63.6	75.9	0.289 ± 0.092	0.125	8.55	10.7
	27	35.3	71.8	0.260 ± 0.091	0.124	6.22	10.6
	28	128 ± 46	91.4	0.947 ± 0.123	0.129	–1.10	8.95
	29	114 ± 42	90.7	0.936 ± 0.122	0.129	–6.62	11.8
	30	43.7	87.0	0.722 ± 0.116	0.128	30.1 ± 7.2	11.4
	31	238 ± 71	91.0	0.888 ± 0.124	0.129	–2.69	11.7
August	1	1.39	80.7	0.673 ± 0.108	0.126	4.14	11.6
	2	74.7	76.6	0.210 ± 0.088	0.125	1.80	11.6
	3	109 ± 59	78.8	0.120	0.125	5.51	11.8
	4	120 ± 52	118	0.796 ± 0.119	0.137	167 ± 10	11.8
	5	22.1	88.4	0.829 ± 0.116	0.128	–2.60	11.7
	6	–3.31	81.4	0.648 ± 0.110	0.125	–0.907	11.5
	7	77.3	83.6	0.699 ± 0.112	0.126	3.17	11.1
	8	64.4	87.3	0.729 ± 0.109	0.127	4.81	11.0
	9	71.4	81.4	0.243 ± 0.090	0.125	0.166	11.4
	10	80.7 ± 56.5	76.6	0.0450	0.124	–1.40	11.7
	11	45.1	88.4	0.599 ± 0.108	0.127	5.92	11.3
	12	–33.1	84.0	0.681 ± 0.109	0.126	–2.33	11.4
	13	77.7	84.7	0.833 ± 0.117	0.126	–3.59	11.2
	14	80.7	88.8	0.722 ± 0.116	0.128	–0.329	11.2
	15	128 ± 54	91.4	0.773 ± 0.116	0.128	11.4 ± 7.0	11.0
	16	61.4	84.7	0.299 ± 0.093	0.126	7.62	11.0
	17	102 ± 57	82.1	0.206 ± 0.089	0.125	–0.588	11.0
	18	178 ± 66	90.7	0.703 ± 0.112	0.128	2.99	10.9
	19	35.2	78.8	0.696 ± 0.111	0.125	2.66	11.1
	20	88.8 ± 39.1	81.4	0.622 ± 0.106	0.126	15.2 ± 6.7	10.7
	21	150 ± 53	87.3	0.770 ± 0.116	0.128	–3.51	11.6
	22	94.4 ± 43.4	93.6	0.596 ± 0.107	0.130	4.03	11.2
	23	96.9 ± 54.3	95.8	0.283 ± 0.096	0.131	–3.60	11.4
	24	78.8 ± 49.6	75.9	0.120	0.125	–0.503	11.4
	25	25.6	85.5	0.714 ± 0.114	0.127	3.02	11.1
	26	10.6	82.9	0.718 ± 0.115	0.127	1.49	11.8

Table 6-1. Daily monitoring results for gross alpha, gross beta, and tritium in the sanitary sewer effluent, 1998 (continued).

Date		Gross alpha (μBq/mL)		Gross beta (mBq/mL)		Tritium (mBq/mL)	
		Activity	LOS[a]	Activity	LOS	Activity	LOS
August	27	34.8	83.3	0.559 ± 0.106	0.126	–0.234	11.1
	28	38.9	84.7	0.821 ± 0.115	0.127	–2.77	11.5
	29	183 ± 62	88.4	0.718 ± 0.115	0.128	7.81	10.9
	30	37.7	86.6	0.359 ± 0.097	0.127	0.418	11.2
	31	76.6	97.7	0.350 ± 0.098	0.131	3.27	11.1
September	1	27.8	94.4	0.944 ± 0.123	0.130	8.40	11.1
	2	75.5	91.4	0.755 ± 0.113	0.129	0.503	11.2
	3	71.0	92.5	0.792 ± 0.119	0.129	2.18	11.4
	4	59.2	85.5	0.825 ± 0.116	0.127	4.77	11.1
	5	238 ± 76	96.6	0.788 ± 0.118	0.131	16.7 ± 6.7	11.2
	6	225 ± 79	99.9	0.529 ± 0.106	0.132	13.5 ± 7.0	11.7
	7	75.1	76.2	0.216 ± 0.089	0.124	16.5 ± 6.9	11.2
	8	90.7 ± 50.8	76.6	0.191 ± 0.086	0.125	13.5 ± 6.9	11.4
	9	122 ± 49	89.5	0.714 ± 0.114	0.128	5.22	11.5
	10	124 ± 50	106	1.00 ± 0.13	0.135	–2.58	11.6
	11	138 ± 54	84.7	0.918 ± 0.129	0.141	11.2	11.4
	12	162 ± 63	105	0.788 ± 0.118	0.134	2.91	11.2
	13	121 ± 65	90.3	0.175 ± 0.088	0.128	0.496	11.4
	14	74.0	85.8	0.172 ± 0.088	0.127	8.07	11.5
	15	52.9	96.9	0.799 ± 0.120	0.131	6.33	10.8
	16	193 ± 69	95.8	0.677 ± 0.108	0.129	–0.703	11.5
	17	84.7	85.8	0.707 ± 0.113	0.125	0.836	11.2
	18	113 ± 44	94.0	1.01 ± 0.12	0.128	4.44	11.2
	19	67.3	86.2	0.740 ± 0.111	0.125	4.14	11.3
	20	30.8	90.3	0.301 ± 0.093	0.127	–1.49	11.4
	21	107 ± 60	86.6	0.178 ± 0.085	0.125	7.66	11.1
	22	198 ± 67	86.6	1.20 ± 0.13	0.137	–0.258	11.4
	23	58.5	105	0.796 ± 0.119	0.134	–6.55	11.6
	24	347 ± 100	111	1.15 ± 0.14	0.147	12.1 ± 7.6	11.7
	25	292 ± 85	82.1	0.766 ± 0.123	0.138	42.9 ± 7.3	11.1
	26	170 ± 65	79.9	0.762 ± 0.122	0.137	19.6 ± 7.1	11.2
	27	884	1490	–0.760	2.08	7.62	11.1
	28	176 ± 88	117	0.234 ± 0.096	0.135	14.6 ± 7.2	11.5
	29	157 ± 61	90.3	0.585 ± 0.105	0.128	23.7 ± 7.3	11.3

Table 6-1. Daily monitoring results for gross alpha, gross beta, and tritium in the sanitary sewer effluent, 1998 (continued).

Date		Gross alpha (μBq/mL)		Gross beta (mBq/mL)		Tritium (mBq/mL)	
		Activity	LOS[a]	Activity	LOS	Activity	LOS
September	30	99.9 ± 47.0	86.2	0.544 ± 0.103	0.127	1.71	11.8
October	1	92.1	95.8	0.744 ± 0.119	0.131	4.11	11.3
	2	174 ± 63	87.3	0.844 ± 0.118	0.127	4.81	11.0
	3	119 ± 54	95.1	0.751 ± 0.113	0.130	–11.6	12.3
	4	51.1	73.6	0.146 ± 0.083	0.123	–2.58	11.2
	5	82.5	82.9	0.290 ± 0.093	0.125	2.09	11.2
	6	29.0	90.3	0.788 ± 0.118	0.128	–3.26	11.4
	7	128 ± 59	121	0.881 ± 0.123	0.135	6.22	11.1
	8	94.0 ± 44.2	77.0	0.936 ± 0.131	0.137	0.836	11.4
	9	125 ± 55	93.6	0.740 ± 0.111	0.129	4.51	11.0
	10	31.8	101	0.821 ± 0.123	0.132	1.76	11.1
	11	91.8 ± 49.6	77.7	0.325 ± 0.094	0.124	–4.74	11.2
	12	63.3	79.6	0.189 ± 0.087	0.124	4.85	11.2
	13	–11.2	102	5.03 ± 0.24	0.137	3.58	11.3
	14	72.9	92.1	0.729 ± 0.117	0.128	–2.41	11.4
	15	115 ± 55	104	0.685 ± 0.116	0.133	4.29	10.7
	16	–4.85	103	0.899 ± 0.126	0.134	–7.25	11.4
	17	84.4	99.2	0.633 ± 0.114	0.132	2.66	11.0
	18	39.2	75.9	0.110	0.124	0.570	10.8
	19	72.9 ± 51.0	72.2	0.0930	0.124	–1.51	11.1
	20	193 ± 77	104	0.666 ± 0.113	0.134	2.29	10.9
	21	192 ± 83	121	0.722 ± 0.116	0.137	7.73	10.5
	22	31.0	92.5	0.733 ± 0.117	0.129	1.25	11.3
	23	144 ± 53	87.3	0.981 ± 0.118	0.127	–2.66	11.4
	24	122 ± 50	85.5	0.829 ± 0.116	0.126	0.847	11.0
	25	79.6 ± 46.2	77.0	0.314 ± 0.091	0.124	25.0 ± 7.3	11.1
	26	124 ± 58	69.9	0.167 ± 0.082	0.122	4.85	11.3
	27	71.8	90.3	0.777 ± 0.117	0.128	6.11	10.8
	28	28.9	105	0.781 ± 0.117	0.133	5.22	11.0
	29	151 ± 69	121	0.918 ± 0.129	0.135	633 ± 16	11.2
	30	138 ± 62	99.5	0.829 ± 0.116	0.131	–1.93	11.3
	31	128 ± 55	90.3	0.940 ± 0.122	0.127	–2.50	11.1
November	1	207 ± 87	102	0.396 ± 0.099	0.132	15.7 ± 6.8	10.6
	2	300 ± 96	95.1	0.659 ± 0.119	0.139	11.2 ± 6.7	10.8

Table 6-1. Daily monitoring results for gross alpha, gross beta, and tritium in the sanitary sewer effluent, 1998 (continued).

Date		Gross alpha (μBq/mL)		Gross beta (mBq/mL)		Tritium (mBq/mL)	
		Activity	LOS[a]	Activity	LOS	Activity	LOS
November	3	214 ± 81	110	0.918 ± 0.129	0.134	9.73	10.7
	4	49.6	94.7	0.714 ± 0.114	0.128	4.33	11.2
	5	145 ± 67	97.7	0.740 ± 0.118	0.131	4.74	10.7
	6	109 ± 58	94.0	0.648 ± 0.110	0.130	8.70	10.8
	7	131 ± 62	86.2	0.570 ± 0.108	0.127	1.85	11.0
	8	88.4 ± 53.9	81.0	0.318 ± 0.092	0.125	–0.249	11.2
	9	42.6	75.1	0.180 ± 0.086	0.124	–2.66	11.3
	10	57.4	91.0	0.710 ± 0.114	0.129	–0.677	10.9
	11	134 ± 62	89.9	0.725 ± 0.116	0.128	1.38	11.5
	12	244 ± 83	90.7	0.740 ± 0.111	0.127	4.74	11.3
	13	138 ± 59	91.8	0.925 ± 0.120	0.127	–3.92	11.5
	14	93.6	99.5	0.766 ± 0.115	0.130	9.40	11.2
	15	213 ± 77	76.6	0.256 ± 0.087	0.122	2.42	10.9
	16	175 ± 72	74.4	0.110	0.122	2.79	11.5
	17	142 ± 64	94.7	0.759 ± 0.114	0.128	7.88	11.2
	18	111 ± 56	94.7	0.751 ± 0.113	0.130	–5.44	12.0
	19	77.3	94.7	0.799 ± 0.120	0.130	–3.56	11.2
	20	57.7	71.4	0.792 ± 0.119	0.136	–0.766	10.7
	21	28.3	96.2	0.762 ± 0.114	0.129	–31.5	13.9
	22	24.1	80.7	0.176 ± 0.086	0.124	1.32	11.8
	23	49.6	81.4	0.182 ± 0.086	0.124	12.5 ± 7.3	12.0
	24	184 ± 72	112	1.13 ± 0.14	0.134	566 ± 15	11.1
	25	4.07	101	0.847 ± 0.119	0.131	7.73	10.7
	26	112 ± 57	94.7	0.788 ± 0.118	0.129	1.98	11.7
	27	104 ± 63	80.3	0.0610	0.124	4.03	11.7
	28	12.0	79.6	0.120	0.124	–0.733	11.8
	29[b]	334 ± 110	112	1.35 ± 0.19	0.207	147 ± 10	11.5
	30	56.2	81.0	0.139 ± 0.083	0.124	–0.0570	12.0
December	1	320 ± 110	121	0.884 ± 0.124	0.135	37.4 ± 7.9	11.5
	2	196 ± 74	89.5	0.784 ± 0.118	0.128	15.8 ± 7.3	11.4
	3	51.1	84.4	0.788 ± 0.118	0.127	7.07	12.1
	4	41.8	94.4	0.703 ± 0.112	0.130	3.68	12.2
	5	71.0	87.7	0.622 ± 0.106	0.128	8.62	11.5
	6	40.7	77.7	0.149 ± 0.085	0.125	4.48	11.7

Table 6-1. Daily monitoring results for gross alpha, gross beta, and tritium in the sanitary sewer effluent, 1998 (concluded).

Date		Gross alpha (μBq/mL)		Gross beta (mBq/mL)		Tritium (mBq/mL)	
		Activity	LOS[a]	Activity	LOS	Activity	LOS
December	7	74.0	76.6	0.0850	0.125	5.00	12.0
	8	30.4	82.5	0.673 ± 0.108	0.126	29.4 ± 7.6	11.5
	9	158 ± 70	90.3	0.640 ± 0.109	0.129	–0.0788	11.0
	10	152 ± 64	96.6	0.714 ± 0.114	0.130	3.11	11.8
	11	183 ± 44	109	5.33 ± 0.25	0.142	0.309	11.8
	12	108 ± 54	93.6	0.596 ± 0.107	0.129	–0.666	11.0
	13	177 ± 76	86.6	0.219 ± 0.088	0.126	4.26	11.2
	14	47.0	76.2	0.0800	0.123	2.85	11.0
	15	19.8	117	0.799 ± 0.120	0.135	2.02	11.7
	16	149 ± 61	69.2	0.899 ± 0.126	0.137	503 ± 15	11.7
	17	104 ± 50	96.9	0.744 ± 0.112	0.130	–2.12	11.4
	18	101 ± 51	92.1	0.710 ± 0.114	0.129	8.18	11.4
	19	47.7	89.2	0.703 ± 0.112	0.128	–1.60	11.4
	20	87.3 ± 50.6	72.9	0.213 ± 0.087	0.123	1.22	11.5
	21	111 ± 57	72.5	0.190 ± 0.086	0.123	–3.68	11.7
	22	124 ± 57	89.9	0.662 ± 0.113	0.128	3.32	11.0
	23	214 ± 77	101	0.899 ± 0.126	0.132	577 ± 15	11.4
	24	101	108	0.736 ± 0.118	0.135	333 ± 12	11.7
	25	33.2	76.6	0.110	0.124	–0.359	11.7
	26	71.4 ± 55.7	69.6	–0.0710	0.122	5.77	11.6
	27	84.0 ± 52.9	68.8	0.0460	0.122	–4.14	12.1
	28	45.9	68.8	0.0410	0.122	4.26	11.5
	29	51.8	84.4	0.470 ± 0.103	0.126	8.33	11.5
	30	92.9 ± 52.0	78.4	0.377 ± 0.094	0.125	3.18	11.8
	31	67.0	90.7	0.540 ± 0.108	0.129	3.64	10.9

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] 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 November 24–30, 1998.

Table 6-2. Weekly composite results for metals in LLNL sanitary sewer effluent, 1998.

Composite dates	Parameter (mg/L)											
	Ag	Al	As	Be	Cd	Cr	Cu	Fe	Hg	Ni	Pb	Zn
12/29-1/5	<0.010	0.34	0.0051	<0.00050	<0.0050	0.013	0.076	1.7	<0.00020	0.0084	0.022	0.23
1/5-1/12	<0.010	0.65	<0.0020	<0.00050	<0.0050	<0.010	0.10	1.4	0.00033	0.0068	0.013	0.33
1/12-1/19	<0.010	0.67	0.0067	<0.00050	<0.0050	0.021	0.10	1.4	0.00063	0.0083	0.018	0.22
1/19-1/26	<0.010	0.53	0.0027	<0.00050	<0.0050	<0.010	0.10	1.4	0.0010	0.0063	0.014	0.28
1/26-2/2	<0.010	0.64	0.0027	<0.00050	<0.0050	<0.010	0.11	1.6	0.00037	0.010	0.020	0.44
2/2-2/9	<0.010	1.2	0.0032	<0.00050	<0.0050	0.016	0.20	2.6	0.00038	0.0098	0.038	0.69
2/9-2/16	0.015	1.4	0.014	<0.00050	0.029	0.029	0.21	3.4	0.00080	0.017	0.047	0.84
2/16-2/23	0.011	1.9	0.0048	<0.00050	<0.0050	0.046	0.27	4.4	0.00081	0.015	0.068	1.8
2/23-3/2	<0.010	<0.20	0.0022	<0.00050	<0.0050	<0.010	<0.010	<0.10	0.00054	0.0064	0.0085	<0.020
3/2-3/9	<0.010	0.91	0.0042	<0.00050	<0.0050	0.024	0.13	2.5	0.00057	0.012	0.028	0.53
3/9-3/16	<0.010	1.0	0.0045	<0.00050	<0.0050	0.043	0.20	2.6	0.00094	0.014	0.024	0.40
3/16-3/23	<0.010	0.61	0.0029	<0.00050	<0.0050	0.027	0.14	2.1	0.00036	0.011	0.023	0.41
3/23-3/30	0.014	0.95	0.0034	<0.00050	<0.0050	0.042	0.26	3.4	<0.00020	0.0099	0.031	0.56
3/30-4/6	<0.010	0.21	<0.0020	<0.00050	<0.0050	<0.010	0.060	0.65	0.00053	<0.0050	0.0024	0.17
4/6-4/13	<0.010	0.57	0.0028	<0.00050	<0.0050	0.020	0.10	1.6	0.00042	0.0056	0.010	0.30
4/13-4/20	<0.010	<0.20	<0.0020	<0.00050	<0.0050	<0.010	0.047	0.85	<0.00020	<0.0050	0.0031	0.25
4/20-4/27	<0.010	<0.20	<0.0020	<0.00050	<0.0050	<0.010	0.054	0.79	<0.00020	<0.0050	0.0079	0.15
4/27-5/4	<0.010	0.27	<0.0020	<0.00050	<0.0050	<0.010	0.080	0.95	<0.00020	<0.0050	0.0025	0.17
5/4-5/11	<0.010	0.42	<0.0020	<0.00050	<0.0050	0.034	0.10	1.6	0.0082	0.013	0.030	0.23
5/11-5/18	<0.010	<0.20	<0.0020	<0.00050	<0.0050	<0.010	0.046	0.55	0.00033	0.0051	0.0048	0.15
5/18-5/25	0.012	0.41	<0.0020	<0.00050	<0.0050	0.014	0.097	1.5	0.0022	<0.0050	0.012	0.26
5/25-6/1	<0.010	0.25	<0.0020	<0.00050	<0.0050	<0.010	0.052	0.58	<0.00020	<0.0050	<0.0020	0.20
6/1-6/8	<0.010	<0.20	0.0028	<0.00050	0.0079	<0.010	0.064	0.45	0.00029	<0.0050	<0.0020	0.11
6/8-6/15	<0.010	<0.20	<0.0020	<0.00050	<0.0050	<0.010	0.069	0.67	<0.00020	0.0095	0.014	0.19
6/15-6/22	<0.010	0.42	<0.0020	<0.00050	<0.0050	0.029	0.12	1.5	0.00053	0.0065	<0.0020	0.21
6/22-6/29	<0.010	0.23	<0.0020	<0.00050	<0.0050	0.012	0.088	0.74	<0.00020	0.0056	<0.0020	0.19
6/29-7/6	<0.010	0.33	<0.0020	<0.00050	<0.0050	<0.010	0.027	1.4	<0.00020	<0.0050	0.011	0.37
7/6-7/13	<0.010	0.24	<0.0020	<0.00050	<0.0050	<0.010	0.034	0.81	<0.00020	<0.0050	0.011	0.20
7/13-7/20	0.010	0.60	0.0041	<0.00050	<0.0050	0.019	0.18	1.9	0.00033	0.010	0.029	0.49
7/20-7/27	<0.010	<0.20	0.0032	<0.00050	<0.0050	<0.010	0.073	0.36	<0.00020	0.011	0.0041	0.098
7/27-8/3	<0.010	<0.20	<0.0020	<0.00050	<0.0050	<0.010	0.082	0.73	<0.00020	<0.0050	0.010	0.16
8/3-8/10	<0.010	0.25	<0.0020	<0.00050	<0.0050	<0.010	0.064	1.3	<0.00020	<0.0050	0.0047	0.10
8/10-8/17	<0.010	0.33	<0.0020	<0.00050	<0.0050	<0.010	0.11	2.8	0.00027	0.0074	0.022	0.23
8/17-8/24	<0.010	0.26	<0.0020	<0.00050	<0.0050	<0.010	0.073	0.77	<0.00020	<0.0050	0.0062	0.14
8/24-8/31	<0.010	<0.20	<0.0020	<0.00050	<0.0050	<0.010	0.061	0.59	0.00092	0.0087	0.0047	0.12

Table 6-2. Weekly composite results for metals in LLNL sanitary sewer effluent, 1998 (concluded).

Composite dates	Parameter (mg/L)											
	Ag	Al	As	Be	Cd	Cr	Cu	Fe	Hg	Ni	Pb	Zn
9/1-9/8	<0.010	0.51	<0.0020	<0.00050	<0.0050	0.013	0.17	1.4	0.00027	<0.0050	0.0088	0.34
9/7-9/14	<0.010	0.40	<0.0020	<0.00050	<0.0050	<0.010	0.19	1.4	0.00029	<0.0050	0.024	0.21
9/14-9/21	<0.010	<0.20	<0.0020	<0.00050	<0.0050	<0.010	0.064	0.48	<0.00020	<0.0050	0.0090	0.13
9/21-9/28	<0.010	<0.20	0.0030	<0.00050	<0.0050	<0.010	0.080	0.34	<0.00020	<0.0050	0.079	0.11
9/28-10/5	<0.010	0.33	<0.0020	<0.00050	<0.0050	<0.010	0.10	0.79	<0.00020	0.0051	0.021	0.20
10/5-10/12	<0.010	<0.20	<0.0020	<0.00050	<0.0050	<0.010	0.050	0.58	<0.00020	<0.0050	0.017	0.13
10/12-10/19	0.017	0.66	<0.0020	<0.00050	<0.0050	0.017	0.17	2.1	<0.00020	0.011	0.011	0.28
10/19-10/26	0.030	1.6	0.0025	<0.00050	<0.0050	0.051	0.29	4.5	0.0015	0.019	0.045	0.66
10/26-11/2	<0.010	0.68	0.0051	<0.00050	<0.0050	0.048	0.13	1.9	<0.00020	0.031	0.011	0.32
11/2-11/9	<0.010	<0.20	<0.0020	<0.00050	<0.0050	<0.010	0.037	0.38	<0.00020	<0.0050	0.011	0.096
11/9-11/16	<0.010	0.52	<0.0020	<0.00050	<0.0050	<0.010	0.073	0.86	<0.00020	<0.0050	0.0043	0.17
11/16-11/23	0.069	0.70	0.0036	<0.00050	<0.0050	0.035	0.16	2.3	0.00023	0.0095	0.021	0.35
11/23-11/30	<0.010	0.27	<0.0020	<0.00050	<0.0050	<0.010	0.058	1.2	0.0017	0.0066	0.029	0.12
11/30-12/7	<0.010	0.92	<0.0020	<0.00050	<0.0050	0.012	0.11	2.3	0.00029	0.019	0.026	0.24
12/7-12/14	<0.010	0.31	<0.0020	<0.00050	<0.0050	<0.010	0.067	0.77	<0.00020	0.0091	0.018	0.15
12/14-12/21	<0.010	0.60	<0.0020	<0.00050	<0.0050	0.020	0.073	1.9	<0.00020	0.018	0.021	0.39
12/21-12/28	<0.010	0.38	<0.0020	<0.00050	<0.0050	0.019	0.18	1.4	0.0090	0.018	0.027	0.29
12/28-1/4	<0.010	0.29	<0.0020	<0.00050	<0.0050	<0.010	0.15	1.7	0.00054	0.0053	0.014	0.21
Summary of 24-hour composite results												
Detection frequency	8/53	40/53	20/53	0/53	2/53	23/53	52/53	52/53	29/53	24/53	49/53	52/53
Minimum (mg/L)	<0.010	<0.20	<0.0020	<0.00050	<0.0050	<0.010	<0.010	<0.10	<0.00020	<0.0050	<0.0020	<0.020
Maximum (mg/L)	0.069	1.9	0.014	<0.00050	0.029	0.051	0.29	4.5	0.0090	0.031	0.079	1.8
Median (mg/L)	<0.010	0.34	<0.0020	<0.00050	<0.0050	<0.010	0.097	1.4	0.00027	<0.0065	0.014	0.22
IQR[a] (mg/L)	—[b]	0.43	—[b]	—[b]	—[b]	—[b]	0.076	1.2	0.00034	—[b]	0.016	0.19
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	0.69	—[c]	0.47	—[b]	0.41	0.16	0.58	—[c]	1.8	0.10	0.79	1.2
Median/50% of EPL	0.10	—[c]	0.067	—[b]	0.071	0.032	0.19	—[c]	0.054	0.021	0.14	0.15

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 6-3. Monthly 24-hour composite results for metals in LLNL sanitary sewer effluent, 1998.

Sample date	Parameter (mg/L)											
	Ag	Al	As	Be	Cd	Cr	Cu	Fe	Hg	Ni	Pb	Zn
1/7	<0.010	0.73	<0.0020	<0.00050	<0.0050	<0.010	0.097	1.4	0.00037	0.0073	0.015	0.27
2/5	0.012	0.78	<0.0020	<0.00050	<0.0050	0.029	0.10	1.8	0.00090	0.0090	0.020	0.51
3/4	<0.010	0.23	<0.0020	<0.00050	<0.0050	<0.010	0.041	0.54	0.00022	<0.0050	0.0056	0.12
4/2	0.011	0.46	<0.0040	<0.0010	<0.0050	0.025	0.068	0.75	0.00024	<0.010	0.0076	0.20
5/7	<0.010	0.62	<0.0020	<0.00050	<0.0050	0.024	0.11	1.5	0.00040	<0.0050	0.038	0.22
6/4	<0.010	0.50	<0.0020	<0.00050	<0.0050	0.012	0.063	1.9	<0.00020	<0.0050	<0.0020	0.42
7/7	<0.010	<0.20	<0.0020	<0.00050	0.0056	<0.010	0.035	0.57	<0.00020	0.010	0.0057	0.11
8/6	<0.010	<0.20	<0.0020	<0.00050	<0.0050	<0.010	0.056	0.41	0.00043	<0.0050	0.010	0.057
9/3	<0.010	<0.20	<0.0020	<0.00050	<0.0050	<0.010	0.076	0.44	<0.00020	0.0076	0.010	0.12
10/8	<0.010	0.23	<0.0020	<0.00050	<0.0050	<0.010	0.064	0.38	<0.00020	<0.0050	0.0056	0.21
11/4	<0.010	<0.20	<0.0020	<0.00050	<0.0050	<0.010	0.062	0.63	0.00036	0.016	0.013	0.11
12/3	<0.010	2.2	<0.0020	<0.00050	<0.0050	0.011	0.091	3.6	0.00066	0.011	0.013	0.17
Summary of 24-hour composite results												
Detection frequency	3/12	8/12	0/12	0/12	1/12	6/12	12/12	12/12	8/12	6/12	11/12	12/12
Minimum (mg/L)	<0.010	<0.2	<0.0020	<0.00050	<0.0050	<0.010	0.035	0.38	<0.00020	<0.0050	<0.0020	0.057
Maximum (mg/L)	0.012	2.2	0.0040	0.0010	0.0056	0.029	0.11	3.6	0.00090	0.016	0.038	0.51
Median (mg/L)	<0.010	0.35	<0.0020	<0.00050	<0.0050	<0.010	0.066	0.69	0.00030	<0.0075	0.010	0.19
IQR[a] (mg/L)	—[b]	0.45	—[b]	—[b]	—[b]	—[b]	0.032	1.1	0.00021	—[b]	0.008	0.12
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	0.060	—[c]	0.067	—[c]	0.040	0.047	0.11	—[c]	0.090	0.026	0.19	0.17
Median/EPL	0.050	—[c]	0.033	—[c]	0.036	0.016	0.066	—[c]	0.030	0.012	0.050	0.062

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 6-4. Monthly monitoring results for physical and chemical characteristics of the LLNL sanitary sewer effluent, 1998.

Parameter	Sample month					
	January	February	March	April	May	June
Grab sample						
Alkalinity (mg/L) – 310.1						
Bicarbonate alkalinity (as $CaCO_3$)	210	180	210	190	200	200
Carbonate alkalinity (as $CaCO_3$)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Hydroxide alkalinity (as $CaCO_3$)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Total alkalinity (as $CaCO_3$)	210	180	210	190	200	200
Anions (mg/L) – 300.0						
Bromide	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Chloride	44	63	42	45	37	56
Fluoride	0.12	0.42	0.085	0.12	0.076	0.11
Nitrate (as N)	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Nitrate (as NO_3)	0.79	1.7	<0.50	<0.50	<0.50	<0.50
Nitrite (as N)	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Nitrite (as NO_2)	<0.50	<0.50	<0.50	<0.50	>0.50	>0.50
Orthophosphate	13	14	19	17	17	23
Sulfate	15	14	16	21	13	17
Nutrients (mg/L)						
Ammonia nitrogen (as N) – 350.2	57	49	53	48	47	76
Total Kjeldahl nitrogen – 351.3	60	54	65	42	46	46
Oxygen demand (mg/L)						
Biochemical oxygen demand – 405.1	250	370	310	270	160	160
Chemical oxygen demand – 410.4	370	380	220	680	320	150
Solids (mg/L)						
Solid settling rate (mL/L/h) – 160.5	60	62	25	25	50	<0.50
Total dissolved solids (TDS) – 160.1	270	220	250	220	720	260
Total suspended solids (TSS) – 160.2	400	360	210	280	400	91
Volatile solids – 160.4	370	350	210	260	380	89
Total metals (mg/L)						
Calcium – 200.7	14	16	11	13	16	21
Magnesium – 200.7	3.5	3.4	2.6	3.0	3.5	3.9
Potassium – 200.7	18	20	14	18	18	18
Selenium – 270.2	<0.0020	<0.0020	<0.0020	<0.0040	<0.0020	<0.0020
Sodium – 200.7	36	47	26	35	30	32

Table 6-4. Monthly monitoring results for physical and chemical characteristics of the LLNL sanitary sewer effluent, 1998 (continued).

Parameter	Sample month					
	July	August	September	October	November	December
Grab sample						
Alkalinity (mg/L) – 310.1						
Bicarbonate alkalinity (as $CaCO_3$)	180	180	230	220	190	240
Carbonate alkalinity (as $CaCO_3$)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Hydroxide alkalinity (as $CaCO_3$)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Total alkalinity (as $CaCO_3$)	180	180	230	220	190	240
Anions (mg/L) – 300.0						
Bromide	<0.50	<0.50	<0.50	(a)	<0.50	<0.50
Chloride	33	35	55	(a)	57	50
Fluoride	0.059	0.10	0.075	<0.050	0.13	0.089
Nitrate (as N)	<0.50	<1.0	<0.50	<0.50	<0.50	<0.50
Nitrate (as NO_3)	<0.50	1.0	<0.50	<0.50	0.56	<0.50
Nitrite (as N)	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Nitrite (as NO_2)	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Orthophosphate	5.5	1.3	23	5.6	3.6	19
Sulfate	14	13	13	(a)	20	16
Nutrients (mg/L)						
Ammonia nitrogen (as N) – 350.2	35	43	45	50	36	66
Total Kjeldahl nitrogen – 351.3	42	47	60	49	26	29
Oxygen demand (mg/L)						
Biochemical oxygen demand – 405.1	220	610	270	100	150	120
Chemical oxygen demand – 410.4	360	240	500	220	260	140
Solids (mg/L)						
Solid settling rate (mL/L/h) – 160.5	21	19	34	<0.50	26	23
Total dissolved solids (TDS) – 160.1	130	210	260	280	160	250
Total suspended solids (TSS) – 160.2	190	290	54	53	150	320
Volatile solids – 160.4	190	280	55	190	120	250
Total metals (mg/L)						
Calcium – 200.7	11	9.7	10	11	15	11
Magnesium – 200.7	2.3	2.2	2.1	2.4	2.5	3.0
Potassium – 200.7	16	14	18	21	16	21
Selenium – 270.2	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Sodium – 200.7	23	23	34	42	41	36

Table 6-4. Monthly monitoring results for physical and chemical characteristics of the LLNL sanitary sewer effluent, 1998 (continued).

Parameter	Sample month					
	January	February	March	April	May	June
Grab sample						
Total organic carbon (mg/L) – 415.1						
Total organic carbon (TOC)	73	70	46	51	55	66
Tributyltin (ng/L)						
Tributyltin	160	31	26	46	15	23
Polychlorinated biphenyls (μg/L) -608[b]						
PCB 1016	<0.50	<0.50	<0.50	<0.50	<0.50	
PCB 1221	<0.50	<0.50	<>0.50	<0.50	<0.50	
PCB 1232	<0.50	<0.50	<0.50	<0.50	<0.50	
PCB 1242	<0.50	<0.50	<0.50	<0.50	<0.50	
PCB 1248	<0.50	<0.50	<0.50	<0.50	<0.50	
PCB 1254	<0.50	<0.50	<0.50	<0.50	<0.50	
PCB 1260	<0.50	<0.50	<0.50	<0.50	<0.50	
Organochlorine Pesticides (μg/L) – 608[b]						
Aldrin	<0.050	<0.050	<0.050	<0.050	<0.050	
BHC, alpha isomer	<0.050	<0.050	<0.050	<0.050	<0.050	
BHC, beta isomer	<0.050	<0.050	<0.050	<0.050	<0.050	
BHC, delta isomer	<0.050	<0.050	<0.050	<0.050	<0.050	
BHC, gamma isomer (Lindane)	<0.050	<0.050	<0.050	<0.050	<0.050	
Chlordane	<0.50	<0.50	<0.50	<0.50	<0.50	
Dieldrin	<0.10	<0.10	<0.10	<0.10	<0.10	
Endosulfan I	<0.050	<0.050	<0.050	<0.050	<0.050	
Endosulfan II	<0.10	<0.10	<0.10	<0.10	<0.10	
Endosulfan sulfate	<0.10	<0.10	<0.10	<0.10	<0.10	
Endrin	<0.10	<0.10	<0.10	<0.10	<0.10	
Endrin aldehyde	<0.10	<0.10	<0.10	<0.10	<0.10	
Heptachlor	<0.050	<0.050	<0.050	<0.050	<0.050	
Heptachlor epoxide	<0.050	<0.050	<0.050	<0.050	<0.050	
Methoxychlor	<0.50	<0.50	<0.50	<0.50	<0.50	
p,p'-DDD	<0.10	<0.10	<0.10	<0.10	<0.10	
p,p'-DDE	<0.10	<0.10	<0.10	<0.10	<0.10	
p,p'-DDT	<0.10	<0.10	<0.10	<0.10	<0.10	
Toxaphene	<1.0	<1.0	<1.0	<1.0	<1.0	

Table 6-4. Monthly monitoring results for physical and chemical characteristics of the LLNL sanitary sewer effluent, 1998 (continued).

Parameter	Sample month					
	July	August	September	October	November	December
Grab sample						
Total organic carbon (mg/L) – 415.1						
Total organic carbon (TOC)	66	52	110	73	66	49
Tributyltin (ng/L)						
Tributyltin	72	29	77	24	52	25
Polychlorinated biphenyls (μg/L) -608[b]						
PCB 1016						
PCB 1221						
PCB 1232						
PCB 1242						
PCB 1248						
PCB 1254						
PCB 1260						
Organochlorine Pesticides (μg/L) – 608[b]						
Aldrin						
BHC, alpha isomer						
BHC, beta isomer						
BHC, delta isomer						
BHC, gamma isomer (Lindane)						
Chlordane						
Dieldrin						
Endosulfan I						
Endosulfan II						
Endosulfan sulfate						
Endrin						
Endrin aldehyde						
Heptachlor						
Heptachlor epoxide						
Methoxychlor						
p,p'-DDD						
p,p'-DDE						
p,p'-DDT						
Toxaphene						

Table 6-4. Monthly monitoring results for physical and chemical characteristics of the LLNL sanitary sewer effluent, 1998 (continued).

Parameter	Sample month					
	January	February	March	April	May	June
Grab sample						
Semivolatile organic compounds (μg/L) – 625						
1,2,4-Trichlorobenzene	<5.0	<10	<10	<5.0	<50	<5.0
1,2-Dichlorobenzene	<5.0	<10	<10	<5.0	<50	<5.0
1,3-Dichlorobenzene	<5.0	<10	<10	<5.0	<50	<5.0
1,4-Dichlorobenzene	<5.0	<10	<10	<5.0	<50	<5.0
2,4,5-Trichlorophenol	<5.0	<10	<10	<5.0	<50	<5.0
2,4,6-Trichlorophenol	<5.0	<10	<10	<5.0	<50	<5.0
2,4-Dichlorophenol	<5.0	<10	<10	<5.0	<50	<5.0
2,4-Dimethylphenol	<5.0	<10	<10	<5.0	<50	<5.0
2,4-Dinitrophenol	<25	<50	<50	<25	<250	<25
2,4-Dinitrotoluene	<5.0	<10	<10	<5.0	<50	<5.0
2,6-Dinitrotoluene	<5.0	<10	<10	<5.0	<50	<5.0
2-Chloronaphthalene	<5.0	<10	<10	<5.0	<50	<5.0
2-Chlorophenol	<5.0	<10	<10	<5.0	<50	<5.0
2-Methyl-4,6-dinitrophenol	<25	<50	<50	<25	<250	<25
2-Methylnaphthalene	<5.0	<10	<10	<5.0	<50	<5.0
2-Nitroaniline	<25	<50	<50	<25	<250	<25
2-Nitrophenol	<5.0	<10	<10	<5.0	<50	<5.0
3,3-Dichlorobenzidine	<10	<20	<20	<10	<100	<10
3-Nitroaniline	<25	<50	<50	<25	<250	<25
4-Bromophenylphenylether	<5.0	<10	<10	<5.0	<50	<5.0
4-Chloro-3-methylphenol	<10	<20	<20	<10	<100	<10
4-Chloroaniline	<10	<20	<20	<10	<100	<10
4-Chlorophenylphenylether	<5.0	<10	<10	<5.0	<50	<5.0
4-Nitroaniline	<25	<50	<50	<25	<250	<25
4-Nitrophenol	<25	<50	<50	<25	<250	<25
Acenaphthene	<5.0	<10	<10	<5.0	<50	<5.0
Acenaphthylene	<5.0	<10	<10	<5.0	<50	<5.0
Anthracene	<5.0	<10	<10	<5.0	<50	<5.0
Benzo(a)anthracene	<5.0	<10	<10	<5.0	<50	<5.0
Benzo(a)pyrene	<5.0	<10	<10	<50	<50	<5.0
Benzo(b)fluoranthene	<5.0	<10	<10	<50	<50	<5.0

Table 6-4. Monthly monitoring results for physical and chemical characteristics of the LLNL sanitary sewer effluent, 1998 (continued).

Parameter	Sample month					
	July	August	September	October	November	December
Grab sample						
Semivolatile organic compounds (μg/L) – 625						
1,2,4-Trichlorobenzene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,2-Dichlorobenzene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,3-Dichlorobenzene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,4-Dichlorobenzene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
2,4,5-Trichlorophenol	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
2,4,6-Trichlorophenol	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
2,4-Dichlorophenol	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
2,4-Dimethylphenol	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
2,4-Dinitrophenol	<25	<25	<25	<25	<25	<25
2,4-Dinitrotoluene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
2,6-Dinitrotoluene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
2-Chloronaphthalene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
2-Chlorophenol	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
2-Methyl-4,6-dinitrophenol	<25	<25	<25	<25	<25	<25
2-Methylnaphthalene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
2-Nitroaniline	<25	<25	<25	<25	<25	<25
2-Nitrophenol	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
3,3-Dichlorobenzidine	<10	<10	<10	<10	<10	<10
3-Nitroaniline	<25	<25	<25	<25	<25	<25
4-Bromophenylphenylether	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
4-Chloro-3-methylphenol	<10	<10	<10	<10	<10	<10
4-Chloroaniline	<10	<10	<10	<10	<10	<10
4-Chlorophenylphenylether	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
4-Nitroaniline	<25	<25	<25	<25	<25	<25
4-Nitrophenol	<25	<25	<25	<25	<25	<25
Acenaphthene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Acenaphthylene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Anthracene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Benzo(a)anthracene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Benzo(a)pyrene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Benzo(b)fluoranthene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0

Table 6-4. Monthly monitoring results for physical and chemical characteristics of the LLNL sanitary sewer effluent, 1998 (continued).

Parameter	Sample month					
	January	February	March	April	May	June
Grab sample						
Semivolatile organic compounds (μg/L) – 625 (continued)						
Benzo(g,h,i)perylene	<5.0	<10	<10	<50	<50	<5.0
Benzo(k)fluoranthene	<5.0	<10	<10	<50	<50	<5.0
Benzoic Acid	<25	<50	<50	<25	<250	<25
Benzyl Alcohol	<10	<20	22	<10	100	<26
Bis(2-chloroethoxy)methane	<5.0	<10	<10	<5.0	<50	<5.0
Bis(2-chloroethyl)ether	<5.0	<10	<10	<5.0	<50	<5.0
Bis(2-chloroisopropyl)ether	<5.0	<10	<10	<5.0	<50	<5.0
Bis(2-ethylhexyl)phthalate	<5.0	<10	<10	15	<50	20
Butylbenzylphthalate	<5.0	<10	<10	<5.0	<50	<5.0
Chrysene	<5.0	<10	<10	<5.0	<50	<5.0
Di-*n*-butylphthalate	<5.0	<10	<10	120	<50	<5.0
Di-*n*-octylphthalate	<5.0	<10	<10	<50	<50	<5.0
Dibenzo(a,h)anthracene	<5.0	<10	<10	<50	<50	<5.0
Dibenzofuran	<5.0	<10	<10	<5.0	<50	<5.0
Diethylphthalate	8.3	11	13	10	<50	7.0
Dimethylphthalate	<5.0	<10	<10	<5.0	<50	<5.0
Fluoranthene	<5.0	<10	<10	<5.0	<50	<5.0
Fluorene	<5.0	<10	<10	<5.0	<50	<5.0
Hexachlorobenzene	<5.0	<10	<10	<5.0	<50	<5.0
Hexachlorobutadiene	<5.0	<10	<10	<5.0	<50	<5.0
Hexachlorocyclopentadiene	<5.0	<10	<10	<5.0	<50	<5.0
Hexachloroethane	<5.0	<10	<10	<5.0	<50	<5.0
Indeno(1,2,3-c,d)pyrene	<5.0	<10	<10	<50	<50	<5.0
Isophorone	<5.0	<10	<10	<5.0	<50	<5.0
m- and *p*- Cresol	<5.0	<10	14	<5.0	<50	8.0
N-Nitrosodi-n-propylamine	<5.0	<10	<10	<5.0	<50	<5.0
N-Nitrosodiphenylamine	<5.0	<10	<10	<5.0	<50	<5.0
Naphthalene	<5.0	<10	<10	<5.0	<50	<5.0
Nitrobenzene	<5.0	<10	<10	<5.0	<50	<5.0
o-Cresol	<5.0	<10	<10	<5.0	<50	<5.0
Pentachlorophenol	<25	<50	<50	<25	<250	<25

Table 6-4. Monthly monitoring results for physical and chemical characteristics of the LLNL sanitary sewer effluent, 1998 (continued).

Parameter	Sample month					
	July	August	September	October	November	December
Grab sample						
Semivolatile organic compounds (μg/L) – 625 (continued)						
Benzo(g,h,i)perylene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Benzo(k)fluoranthene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Benzoic Acid	<25	<25	<25	<25	<25	<25
Benzyl Alcohol	<10	<10	<10	<10	<10	<10
Bis(2-chloroethoxy)methane	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Bis(2-chloroethyl)ether	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Bis(2-chloroisopropyl)ether	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Bis(2-ethylhexyl)phthalate	<5.0	7.6	7.4	6.8	9.3	<5.0
Butylbenzylphthalate	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Chrysene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Di-*n*-butylphthalate	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Di-*n*-octylphthalate	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Dibenzo(a,h)anthracene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Dibenzofuran	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Diethylphthalate	12	13	<5.0	<5.0	6.8	<5.0
Dimethylphthalate	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Fluoranthene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Fluorene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Hexachlorobenzene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Hexachlorobutadiene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Hexachlorocyclopentadiene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Hexachloroethane	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Indeno(1,2,3-c,d)pyrene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Isophorone	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
m- and *p*- Cresol	<5.0	<5.0	<5.0	<5.0	18	<5.0
N-Nitrosodi-n-propylamine	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
N-Nitrosodiphenylamine	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Naphthalene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Nitrobenzene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
o-Cresol	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Pentachlorophenol	<25	<25	<25	<25	<25	<25

Table 6-4. Monthly monitoring results for physical and chemical characteristics of the LLNL sanitary sewer effluent, 1998 (continued).

Parameter	Sample month					
	January	February	March	April	May	June
Grab sample						
Semivolatile organic compounds (μg/L) – 625 (continued)						
Phenanthrene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Phenol	<5.0	<10	<10	<5.0	<50	<5.0
Pyrene	<5.0	<10	<10	<5.0	<50	<5.0
Total cyanide (mg/L) – 335.2						
Cyanide	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Total oil and grease (mg/L) – 413.1						
6 A.M.	2.5	4.0	4.4	2.2	3.6	3.0
10 A.M.	35	22	36	34	46	37
2 P.M.	32	32	27	38	31	30
6 P.M.	16	14	16	17	18	15
Total recoverable phenolics (mg/L) – 420.1						
Phenolics	0.033	0.032	0.049	0.077	0.021	0.12
Volatile organic compounds (μg/L) – 624						
1,1,1-Trichloroethane	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,2,2-Tetrachloroethane	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,2-Trichloroethane	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethane	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethene	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloroethane	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloroethene (total)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloropropane	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2-Butanone	<40	<40	<40	<40	<40	<40
2-Chloroethylvinylether	<40	<40	<40	<40	<40	<40
2-Hexanone	<10	<10	<10	<10	<10	<10
4-Methyl-2-pentanone	<10	<10	<10	<10	<10	<10
Acetone	180	290	130	140	91	150
Benzene	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bromodichloromethane	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Table 6-4. Monthly monitoring results for physical and chemical characteristics of the LLNL sanitary sewer effluent, 1998 (continued).

Parameter	Sample month					
	July	August	September	October	November	December
Grab sample						
Semivolatile organic compounds (μg/L) – 625 (continued)						
Phenanthrene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Phenol	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Pyrene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Total cyanide (mg/L) – 335.2						
Cyanide	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Total oil and grease (mg/L) – 413.1						
6 A.M.	4.3	1.9	2.9	3.4	1.0	4.3
10 A.M.	27	35	34	45	28	41
2 P.M.	31	35	29	20	32	41
6 P.M.	14	11	14	13	14	17
Total recoverable phenolics (mg/L) – 420.1						
Phenolics	0.049	0.076	0.024	0.019	0.042	0.026
Volatile organic compounds (μg/L) – 624						
1,1,1-Trichloroethane	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,2,2-Tetrachloroethane	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,2-Trichloroethane	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethane	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethene	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloroethane	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloroethene (total)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloropropane	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	4.3	2.7	<1.0	1.8	1.8	<1.0
2-Butanone	<40	<40	<40	<40	<40	<40
2-Chloroethylvinylether	<40	<40	<40	<40	<40	<40
2-Hexanone	<10	<10	<10	<10	<10	<10
4-Methyl-2-pentanone	<10	<10	<10	<10	<10	<10
Acetone	270	200	110	160	180	180
Benzene	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bromodichloromethane	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Table 6-4. Monthly monitoring results for physical and chemical characteristics of the LLNL sanitary sewer effluent, 1998 (continued).

Parameter	Sample month					
	January	February	March	April	May	June
Grab sample						
Volatile organic compounds (μg/L) – 624 (continued)						
Bromoform	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bromomethane	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Carbon disulfide	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Carbon tetrachloride	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chlorobenzene	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chloroethane	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Chloroform	8.0	9.5	8.3	9.0	13	21
Chloromethane	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
cis-1,3-Dichloropropene	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dibromochloromethane	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dibromomethane	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dichlorodifluoromethane	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Ethylbenzene	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Freon 113	<1.0	<1.0	5.7	<1.0	7.0	<1.0
Methylene chloride	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Styrene	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Tetrachloroethene	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Toluene	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Total xylene isomers	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
trans-1,3-Dichloropropene	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Trichloroethene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Trichlorofluoromethane	<1.0	<1.0	1.4	<1.0	1.1	<1.0
Vinyl acetate	<10	<10	<10	<10	<10	<10
Vinyl chloride	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0

Table 6-4. Monthly monitoring results for physical and chemical characteristics of the LLNL sanitary sewer effluent, 1998 (concluded).

Parameter	Sample month					
	July	August	September	October	November	December
Grab sample						
Volatile organic compounds (μg/L) – 624 (continued)						
Bromoform	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bromomethane	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Carbon disulfide	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Carbon tetrachloride	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chlorobenzene	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chloroethane	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Chloroform	19	9.6	11	12	8.1	7.5
Chloromethane	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
cis-1,3-Dichloropropene	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dibromochloromethane	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dibromomethane	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dichlorodifluoromethane	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Ethylbenzene	<1.0	<1.0	<1.0	<1.0	13	<1.0
Freon 113	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Methylene chloride	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Styrene	<1.0	<1.0	<1.0	<1.0	67	<1.0
Tetrachloroethene	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Toluene	1.3	<1.0	<1.0	<1.0	<1.0	<1.0
Total xylene isomers	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
trans-1,3-Dichloropropene	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Trichloroethene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Trichlorofluoromethane	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Vinyl acetate	<10	<10	<10	<10	<10	<10
Vinyl chloride	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0

[a] Due to a problem with the contract analytical laboratory, this parameter was not analyzed.

[b] The Livermore Water Reclamation Plant (LWRP) issued a permit amendment on April 10, 1998, removing the EPA Method 608 (PCBs and organochlorine pesticides) sampling and reporting requirement.

Table 6-5a. Daily flow totals for LLNL site sanitary sewer effluent in megaliters (ML), 1998.

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1.069	0.318	0.409	1.133	0.927	0.391	1.020	1.074	0.959	1.256	0.517	1.310
2	0.566	0.340	0.370	0.903	1.172	1.039	1.151	0.738	1.032	1.100	0.594	1.136
3	0.338	1.991	1.095	1.230	0.651	0.922	0.989	0.568	1.163	1.047	1.174	1.151
4	0.497	1.385	1.106	1.145	0.699	1.080	0.399	1.359	1.245	0.505	1.208	1.343
5	0.244	1.025	1.068	0.455	1.293	0.971	0.405	1.174	1.095	0.424	1.569	1.190
6	1.136	1.191	0.954	0.343	1.185	1.020	0.446	1.222	0.619	1.172	1.438	0.718
7	0.997	1.097	0.920	1.123	1.324	0.468	1.367	1.270	0.475	1.021	1.246	0.676
8	1.082	0.486	0.476	0.917	1.615	0.467	0.997	1.471	0.496	1.212	0.528	1.349
9	0.875	0.389	0.266	1.056	1.309	1.415	1.245	0.632	1.158	1.454	0.468	1.216
10	0.860	1.039	1.107	1.042	0.321	1.240	1.317	0.613	1.204	1.520	1.149	1.148
11	0.404	1.137	1.044	0.920	0.483	1.388	1.103	1.317	1.172	0.623	1.062	1.179
12	0.355	0.891	1.032	0.425	1.173	1.149	0.418	1.043	1.176	0.836	1.050	1.051
13	1.192	1.060	1.164	0.425	1.241	1.043	0.439	1.216	0.588	1.529	1.062	0.483
14	1.011	1.086	1.023	0.479	1.149	0.494	1.294	1.168	0.469	1.272	1.000	0.450
15	1.227	0.496	0.362	1.067	1.123	0.449	1.272	1.125	1.201	1.219	0.389	1.157
16	1.139	0.418	0.331	1.094	1.127	1.165	1.207	0.559	1.297	1.033	0.494	1.246
17	1.016	0.631	1.269	1.100	0.415	1.393	1.264	0.474	1.201	1.091	1.252	1.250
18	0.436	1.038	1.026	0.963	0.418	1.197	1.465	1.156	1.193	0.608	1.097	1.219
19	0.506	1.164	0.851	0.380	1.123	1.138	0.823	1.192	1.170	0.596	1.078	1.065
20	0.445	1.097	0.990	0.400	1.129	1.110	0.823	1.240	0.562	1.252	1.183	0.444
21	1.143	1.157	1.033	1.157	1.053	0.399	1.338	1.202	0.454	1.233	1.099	0.444
22	0.968	0.710	0.287	1.002	1.137	0.566	1.387	1.314	1.230	1.274	0.418	1.118
23	0.975	0.333	0.294	1.021	0.911	1.201	1.345	0.505	1.034	1.048	0.447	1.183
24	1.009	1.591	1.229	1.082	0.385	1.117	1.890	0.496	1.463	0.911	1.248	1.015
25	0.333	1.551	1.032	0.967	0.335	1.274	1.238	1.194	1.790	0.617	1.081	0.550
26	0.295	1.039	0.920	0.467	0.443	1.101	0.571	1.113	1.632	0.520	0.900	0.622
27	1.183	0.964	1.110	0.377	1.296	1.116	0.612	1.375	1.188	1.273	0.370	0.742
28	1.133	1.044	0.858	1.018	1.155	0.364	1.245	1.119	1.183	0.977	0.484	0.747
29	1.044		0.358	1.098	1.143	0.359	1.193	1.145	1.737	1.255	0.414[a]	1.021
30	1.160		0.307	1.403	1.034	1.101	1.238	0.731	1.576	1.417	0.414	0.952
31	1.045		1.064		0.398		1.219	0.559		1.077		0.835

a 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 6-5b. Monthly and annual flow summary statistics for LLNL site sanitary sewer effluent in megaliters (ML), 1998.

Days	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	1998
Weekend days and holidays													
Total	4.421	4.120	3.460	3.751	4.548	3.957	4.935	5.875	6.035	4.729	5.535	5.877	57.243
Minimum	0.244	0.318	0.266	0.343	0.321	0.359	0.399	0.474	0.454	0.424	0.370	0.444	0.244
Maximum	0.566	0.710	0.476	0.479	0.699	0.566	0.823	0.738	1.188	0.836	0.594	0.747	1.188
Mean	0.402	0.458	0.346	0.417	0.455	0.440	0.548	0.588	0.671	0.591	0.461	0.588	0.493
Weekdays													
Total	21.264	22.548	21.894	22.442	24.618	24.181	27.784	25.490	26.728	27.642	20.895	24.134	289.621
Minimum	0.860	0.891	0.851	0.903	0.911	0.922	0.989	1.043	0.959	0.911	0.900	0.835	0.835
Maximum	1.227	1.991	1.269	1.403	1.615	1.415	1.890	1.471	1.790	1.529	1.569	1.349	1.991
Mean	1.063	1.187	1.043	1.069	1.172	1.151	1.263	1.214	1.273	1.202	1.161	1.149	1.163
All days													
Total	25.685	26.667	25.354	26.193	29.167	28.138	32.719	31.365	32.763	32.371	26.431	30.011	346.864
Minimum	0.244	0.318	0.266	0.343	0.321	0.359	0.399	0.474	0.454	0.424	0.370	0.444	0.244
Maximum	1.227	1.991	1.269	1.403	1.615	1.415	1.890	1.471	1.790	1.529	1.569	1.349	1.991
Mean	0.829	0.952	0.818	0.873	0.941	0.938	1.055	1.012	1.092	1.044	0.881	0.968	0.950

Table 6-6. Laboratory analytical results for ground water discharges to the sanitary sewer, January 1 through December 31, 1998.

Parameter	Discharge dates										
	3/12/98	3/16/98 to 3/19/98[a]	4/7/98 and 4/9/98[b]	4/15/98	6/30/98 to 7/23/98[b]	9/2/98	9/10/98[b]	9/18/98	12/14/98	12/16/98[c]	
pH[d] (pH units)	8.3	7	8.0	7.7	8.0	8.5	8.0	7.0	6.0	6.5	7.0
Arsenic (mg/L)	NA[e]	0.0070	0.040	NA	0.040	0.0022	0.040	<0.0020	<0.0020	<0.0020	<0.0020
Cadmium (mg/L)	NA	0.00096	<0.00050	NA	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Nickel (mg/L)	NA	0.0091	0.065	NA	0.065	0.020	0.065	<0.0050	<0.0050	0.013	0.021
Total chromium (mg/L)	NA	0.0093	0.0015	0.070	0.0015	0.076	0.0015	0.0023	0.0050	<0.0010	0.0061
Copper (mg/L)	NA	<0.010	<0.010	NA	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Lead (mg/L)	NA	<0.0020	0.0029	NA	0.0029	<0.0020	0.0029	0.024	0.0049	0.0044	0.0032
Mercury (mg/L)	NA	<0.00020	<0.00020	NA	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	0.00034	0.00025
Silver (mg/L)	NA	<0.00050	<0.00050	NA	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (mg/L)	NA	<0.020	<0.020	NA	<0.020	0.053	<0.020	<0.020	<0.020	<0.020	<0.020
TTO[f] (mg/L)	0.368	0.0585	0.0591	NA	0.0591	nd[g]	0.0591	nd	0.00394	nd	nd

a The data tabulated for this Nitrate Removal System Experiment are from the treated ground water sample (effluent). Other analytical data, e.g., historical well data and other effluent samples, are also available. The additional data also show compliance with permit conditions.

b The data tabulated for this Nitrate Removal System Experiment are from the untreated ground water sample (the worst-case scenario). Other analytical data, e.g., historical well data and effluent samples, are also available. The additional data also show compliance with permit conditions.

c There were two separate discharges on this date.

d pH was verified prior to discharge. The pH at final discharge may be slightly different, but was always between 5 and 10.

e NA = Not applicable. Although these activities were related to Ground Water Treatment Facility operation, ground water was not discharged. Instead, city water was used for this activity. Laboratory analyses were conducted for constituents of concern to verify compliance with permit conditions.

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

g nd = Not detected. Concentrations were not detected by EPA Method 601 for wastewater. The reporting limit for each of the analytes was 0.00050 mg/L.

Table 6-7. Weekly composite results for tritium (in mBq/mL) for the LWRP effluent, 1998.

Composite dates	Activity[a]	LOS[b]
12/29/97–1/04/1998	–4.14	11.3
1/05–1/11	3.74	11.3
1/12–1/18	–6.11	11.3
1/19–1/25	–4.48	10.8
1/26–2/01	–4.59	11.3
2/02–2/08	–1.26	11.0
2/09–2/15	–5.25	11.3
2/16–2/22	–5.55	11.4
2/23–3/01	2.04	11.1
3/02–3/08	1.61	11.1
3/09–3/15	1.96	11.0
3/16–3/22	0.514	11.4
3/23–3/29	10.2	10.4
3/30–4/05	–2.63	11.3
4/06–4/12	0.340	11.0
4/13–4/19	0.00	10.8
4/20–4/26	–1.88	11.2
4/27–5/03	4.07	10.5
5/04–5/10	–1.46	11.0
5/11–5/17	9.32	11.0
5/18–5/24	4.07	10.9
5/25–5/31	–0.146	11.0
6/01–6/07	2.47	11.2
6/08–6/14	5.88	11.1
6/15–6/21	6.36	10.8
6/22–6/28	–0.936	11.0
6/29–7/05	–6.55	11.3
7/06–7/12	2.93	11.4
7/13–7/19	–1.68	11.0
7/20–7/26	1.66	8.77
7/27–8/02	–11.4	12.3
8/03–8/09	–5.22	11.1
8/10–8/16	–2.57	11.2
8/17–8/23	–1.24	12.5
8/24–8/30	–6.51	11.5
8/31–9/06	3.74	11.0
9/07–9/13	2.26	11.0
9/14–9/20	–1.25	11.1
9/21–9/27	2.58	11.2
9/28–10/04	2.43	10.8
10/05–10/11	–1.68	11.3
10/12–10/18	12.5 ± 5.0	10.7
10/19–10/25	–2.02	11.3
10/26–11/01	3.18	11.4
11/02–11/08	–2.09	11.1
11/09–11/15	2.16	11.5
11/16–11/22	4.18	11.5
11/23–11/29	12.0 ± 7.1	11.2
11/30–12/06	13.3 ± 6.9	11.4
12/07–12/13	–6.36	11.7
12/14–12/20	–1.22	11.5
12/21–12/27	7.25	11.1
12/28/98–1/03/1999	8.77	10.9

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.

7

Surface Water

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

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 1998, including a summary of analyses requested in storm water samples and a summary of constituents for which analyses were conducted but which were never detected. This chapter also provides detailed data on monitoring of the Drainage Retention Basin (DRB) at the Livermore site and the cooling towers at Site 300. This data supplements material provided in the Surface Water Chapter (Chapter 7) of the main volume.

Storm Water

LLNL technicians 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 tritium, gross alpha, and gross beta are presented in **Table 7-2**. Results for plutonium in filtered and unfiltered samples are presented in **Table 7-3**. Results for metals detected at the Livermore site are presented in **Table 7-4**. **Table 7-5** summarizes results for nonradioactive compounds, physical and chemical properties, and anions in Livermore site storm water. **Table 7-6** 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 7-7**. Analytical results from monitoring of Pit 6 post-closure runoff are in **Table 7-8**. Nondetects for Livermore site storm water are summarized in **Table 7-20**.

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 7-9**.

Drainage Retention Basin

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 7-10 and **7-11** show DRB discharge limits and water quality management levels, respectively. **Table 7-12** 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 7-13**, **14**, and **15**. **Table 7-16** provides the weekly field measurements collected from sample locations CDBA, CDBC, CDBD, CDBE, CDBF, CDBJ, CDBK, and CDBL. A seasonal inventory of birds and fish observed at the Livermore site comprises **Table 7-17**. The seasonal inventory of microorganisms in the DRB is in **Table 7-18**.

Other Waters

LLNL technicians 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 7-19**.

Table 7-1. Numerical comparison criteria for storm water constituents of concern at the Livermore site.

Constituent	PMCL/SMCL	AWQC/Ag[(a)]	EPA benchmark
Physical			
Specific conductance (μmho/cm)	none/900 (CA)	700 (Ag[(a)])	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)	250	860
Fluoride	1.4/none (CA)	1.0 (Ag[(a)])	1.8
	0.8/none (SF[(b)])		
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 at the Livermore site (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[a])	0.13
Boron	none/none	0.7 (Ag)	none
Cadmium	0.005/none (EPA)	0.005[c]	0.0159[c]
Chromium, total	0.05/none (CA)	none	none
Chromium(VI)	none/none	0.015	none
Copper	1.3/1.0 (EPA[e])	0.026[c] 0.2 (SF[b] Ag)	0.0636[d]
Iron	none/0.3 (EPA)	none	1.0
Lead	0.015/none (EPA)	0.11[c]	0.0816[d]
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[c]	1.417[d]
Selenium	0.05/none (EPA)	0.02	0.2385
Silver	none/0.1 (EPA)	0.0077[c]	0.0318[d]
Thallium	0.002/none (EPA)	450 (Ag)	none
Vanadium	none/none	0.1 (SF Ag)	none
Zinc	none/5 (EPA)	0.17[c]	0.117[d]
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

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

Constituent	PMCL/SMCL	AWQC/Ag[a]	EPA benchmark
Herbicides (μg/L) (continued)			
Diazinon	none/none	0.009	none
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] SF = San Francisco Bay Basin Plan.

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

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

[e] 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. Tritium, gross alpha, and gross beta in storm water runoff at the Livermore site, 1998.

Parameter	Date	Arroyo Seco	
		Site influent	Site effluent
		ASS2	ASW
Tritium (Bq/L)	2/12	1.79 ± 1.25	1.83 ± 1.25
	3/31	2.27 ± 1.27	1.32 ± 1.32
	11/30	0.21 ± 0.19	0.94 ± 1.84
Gross alpha (Bq/L)	2/12	0.12 ± 0.044	0.040 ± 0.052
	3/31	0.12 ± 0.067	0.074 ± 0.030
	11/30	0.045 ± 0.031	0.067 ± 0.030
Gross beta (Bq/L)	2/12	0.017 ± 0.010	0.15 ± 0.12
	3/31	0.018 ± 0.014	0.088 ± 0.11
	11/30	0.11 ± 0.067	0.080 ± 0.063

Parameter	Date	Arroyo Las Positas			
		Site influent			Site effluent
		ALPE	ALPO	GRNE	WPDC
	1/29	—[a]	—[a]	—[a]	12.3 ± 1.38
Tritium (Bq/L)	2/12	2.40 ± 1.76	2.32 ± 1.27	1.88 ± 1.25	6.66 ± 1.43
	3/31	2.95 ± 1.42	1.20 ± 1.20	2.40 ± 1.28	7.70 ± 1.57
	11/30	3.47 ± 1.98	0.55 ± 1.82	1.97 ± 1.38	1.14 ± 1.32
Gross alpha (Bq/L)	2/12	0.008 ± 0.035	0.38 ± 0.17	0.023 ± 0.028	0.020 ± 0.025
	3/31	0.069 ± 0.044	0.21 ± 0.048	0.024 ± 0.028	0.007 ± 0.020
	11/30	0.16 ± 0.074	0.19 ± 0.085	0.055 ± 0.036	0.023 ± 0.030
Gross beta (Bq/L)	2/12	0.080 ± 0.074	0.32 ± 0.29	0.036 ± 0.081	0.004 ± 0.078
	3/31	0.10 ± 0.41	0.17 ± 0.37	0.004 ± 0.078	0.047 ± 0.081
	11/30	0.061 ± 0.078	0.12 ± 0.093	0.091 ± 0.081	0.12 ± 0.085

Parameter	Date	Arroyo Las Positas			
		On site			
		196E	196S	WPDS	WPDW
Tritium (Bq/L)	11/30	0.90 ± 1.82	31.4 ± 3.13	31.0 ± 3.09	2.02 ± 1.92
Gross alpha (Bq/L)		—[b]	—[b]	—[b]	—[b]
Gross beta (Bq/L)		—[b]	—[b]	—[b]	—[b]

Table 7-2. Tritium, gross alpha, and gross beta in storm water runoff at the Livermore site, 1998 (concluded).

Parameter	Date	Drainage Retention Basin		
		Site influent		Site effluent
		CDB	CDB2	CDBX
Tritium (Bq/L)	2/12	6.40 ± 1.42	4.07 ± 1.34	4.74 ± 1.37
	3/31	11.1 ± 1.58	9.36 ± 1.62	—[c]
	11/30	5.59 ± 2.08	21.94 ± 2.77	18.50 ± 2.19
Gross alpha (Bq/L)	2/12	0.027 ± 0.024	0.022 ± 0.036	0.023 ± 0.030
	3/31	0.029 ± 0.035	0.073 ± 0.13	—[c]
	11/30	0.031 ± 0.029	0.048 ± 0.037	0.15 ± 0.074
Gross beta (Bq/L)	2/12	0.16 ± 0.074	0.041 ± 0.081	0.11 ± 0.089
	3/31	0.090 ± 0.085	0.056 ± 0.28	—[c]
	11/30	0.12 ± 0.070	0.13 ± 0.067	0.15 ± 0.074

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] Not analyzed; location WPDC tritium was the only analysis conducted on 1/29.

[b] Not analyzed; this location used for tritium only.

[c] NA = Not analyzed; no flow at CDBX on 3/31.

Table 7-3 Plutonium in Livermore site runoff, 1998.

Parameter	Date	Arroyo Seco effluent		
		ASW		
		Unfiltered water (Bq/L)	Filtered water (Bq/L)	Sediments (Bq/g)
Plutonium-238	2/12	$2.6 \times 10^{-4} \pm 1.91 \times 10^{-3}$	—[a]	$-6.77 \times 10^{-4} \pm 4.49 \times 10^{-3}$
	3/31	—[b]	$2.42 \times 10^{-5} \pm 5.22 \times 10^{-5}$	$1.09 \times 10^{-3} \pm 3.26 \times 10^{-3}$
	5/4	$3.17 \times 10^{-4} \pm 2.15 \times 10^{-3}$	$1.60 \times 10^{-5} \pm 2.73 \times 10^{-5}$	$-3.67 \times 10^{-5} \pm 3.41 \times 10^{-5}$
	11/30	—[b]	$<1.11 \times 10^{-3}$	$<3.70 \times 10^{-3}$
Plutonium-239+240	2/12	$<3.33 \times 10^{-3}$	—[a]	$-2.03 \times 10^{-3} \pm 3.59 \times 10^{-3}$
	3/31	—[b]	$-4.37 \times 10^{-5} \pm 4.81 \times 10^{-5}$	$1.58 \times 10^{-3} \pm 3.41 \times 10^{-3}$
	5/4	$1.16 \times 10^{-4} \pm 2.05 \times 10^{-4}$	$1.98 \times 10^{-5} \pm 2.83 \times 10^{-5}$	$1.44 \times 10^{-4} \pm 6.36 \times 10^{-5}$
	11/30	—[b]	$<1.11 \times 10^{-3}$	$<3.70 \times 10^{-3}$

Parameter	Date	Arroyo Las Positas effluent		
		WPDC		
		Unfiltered water (Bq/L)	Filtered water (Bq/L)	Sediments (Bq/g)
Plutonium-238	3/31	—[b]	$-4.85 \times 10^{-5} \pm 6.22 \times 10^{-5}$	$5.44 \times 10^{-5} \pm 4.03 \times 10^{-4}$
	5/4	$1.19 \times 10^{-4} \pm 1.20 \times 10^{-4}$	$-4.44 \times 10^{-6} \pm 5.22 \times 10^{-5}$	$1.86 \times 10^{-4} \pm 4.96 \times 10^{-4}$
	11/30	—[b]	$<1.11 \times 10^{-3}$	$1.44 \times 10^{-2} \pm 1.41 \times 10^{-2}$
Plutonium-239+240	3/31	—[b]	$-3.81 \times 10^{-5} \pm 5.66 \times 10^{-5}$	$-7.25 \times 10^{-5} \pm 5.07 \times 10^{-5}$
	5/4	$7.25 \times 10^{-5} \pm 1.01 \times 10^{-4}$	$8.88 \times 10^{-6} \pm 2.70 \times 10^{-5}$	$2.62 \times 10^{-4} \pm 2.39 \times 10^{-4}$
	11/30	—[b]	$<1.11 \times 10^{-3}$	$-7.03 \times 10^{-3} \pm 1.41 \times 10^{-2}$

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than 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] Initially, analysis was conducted on unfiltered water, then remaining water was filtered for sediment analysis. No filtered water analysis conducted on 2/12.

[b] In order to collect sufficient sediment, the entire sample was filtered, therefore water analysis conducted on filtered water only on 3/31 and 11/30.

Table 7-4. Metals detected in storm water runoff at the Livemore site in 1998.

Parameter (mg/L)	Requested Analysis	Storm Date	Arroyo Seco			
			Site influent		Site effluent	
			ASS2		ASW	
			Dissolved	Total	Dissolved	Total
Aluminum	GENMIN	2/12	<0.05	43	<0.05	6.8
	NPDESMETAL		0.057	<0.05	<0.05	<0.05
	GENMIN	3/31	<0.05	0.69	<0.05	0.55
	NPDESMETAL		<0.05	0.98	<0.05	0.75
	GENMIN	11/30	0.28	2.5	0.19	3.7
	NPDESMETAL		0.27	2.9	0.21	4.0
Antimony	NPDESMETAL	2/12	<0.004	<0.004	<0.004	<0.004
	NPDESMETAL	3/31	<0.004	0.0062	<0.004	<0.004
	NPDESMETAL	11/30	<0.004	<0.004	<0.004	<0.004
Arsenic	NPDESMETAL	2/12	<0.002	0.013	<0.002	0.0027
	NPDESMETAL	3/31	<0.002	<0.002	<0.002	<0.002
	NPDESMETAL	11/30	<0.002	0.0022	<0.002	0.0026
Barium	NPDESMETAL	2/12	0.14	0.11	0.1	0.092
	NPDESMETAL	3/31	0.11	0.09	0.12	0.08
	NPDESMETAL	11/30	0.05	0.047	0.053	0.06
Beryllium	NPDESMETAL	2/12	<0.0002	0.0019	<0.0002	0.00049
	NPDESMETAL	3/31	<0.0002	<0.0002	<0.0002	<0.0002
	NPDESMETAL	11/30	<0.0002	<0.0002	<0.0002	<0.0002
Boron	NPDESMETAL	2/12	0.92	0.75	0.91	0.84
	NPDESMETAL	3/31	1.2	1.0	0.99	0.89
	NPDESMETAL	11/30	0.058	0.065	<0.05	0.05
Cadmium	NPDESMETAL	2/12	<0.0005	0.00054	<0.0005	<0.0005
	NPDESMETAL	3/31	<0.0005	<0.0005	<0.0005	<0.0005
	NPDESMETAL	11/30	<0.0005	<0.0005	<0.0005	<0.0005
Chromium	NPDESMETAL	2/12	<0.005	0.098	0.001	0.01
	NPDESMETAL	3/31	<0.001	0.0037	<0.001	0.0037
	NPDESMETAL	11/30	0.0012	0.008	0.001	0.011

Table 7-4. Metals detected in storm water runoff at the Livemore site in 1998 (continued).

Parameter (mg/L)	Requested Analysis	Storm Date	Arroyo Seco			
			Site influent		Site effluent	
			ASS2		ASW	
			Dissolved	Total	Dissolved	Total
Copper	GENMIN	2/12	<0.01	0.057	<0.01	<0.01
	NPDESMETAL		0.0044	0.088	0.0066	0.026
	GENMIN	3/31	<0.01	<0.01	<0.01	<0.01
	NPDESMETAL		0.0057	0.017	0.0091	0.0084
	GENMIN	11/30	<0.01	<0.01	<0.01	0.016
	NPDESMETAL		0.0048	0.0091	0.0062	0.013
Chromium(VI)	NPDESMETAL	2/12	<0.002	—[a]	0.004	—[a]
	NPDESMETAL	3/31	<0.002	—[a]	<0.002	—[a]
	NPDESMETAL	11/30	<0.002	—[a]	<0.002	—[a]
Iron	GENMIN	2/12	0.06	61	<0.05	8.1
	NPDESMETAL		0.067	0.058	<0.05	<0.05
	GENMIN	3/31	<0.05	0.97	<0.05	0.71
	NPDESMETAL		<0.05	1.3	<0.05	0.95
	GENMIN	11/30	0.25	3	0.2	4.4
	NPDESMETAL		0.23	3.5	0.19	5.1
Lead	NPDESMETAL	2/12	<0.005	0.027	<0.005	0.0052
	NPDESMETAL	3/31	<0.005	0.061	<0.005	<0.005
	NPDESMETAL	11/30	<0.005	<0.005	<0.005	0.006
Magnesium	GENMIN	2/12	25	35	23	25
	GENMIN	3/31	33	34	27	25
	GENMIN	11/30	1.6	2.1	1.1	2.4
Manganese	GENMIN	2/12	<0.01	1.2	<0.01	0.22
	NPDESMETAL		<0.01	<0.01	<0.01	<0.01
	GENMIN	3/31	0.012	0.044	<0.01	0.031
	NPDESMETAL		0.01	0.05	<0.01	0.03
	GENMIN	11/30	<0.01	0.068	<0.01	0.088
	NPDESMETAL		<0.01	0.074	<0.01	0.097

Table 7-4. Metals detected in storm water runoff at the Livemore site in 1998 (continued).

Parameter (mg/L)	Requested Analysis	Storm Date	Arroyo Seco			
			Site influent		Site effluent	
			ASS2		ASW	
			Dissolved	Total	Dissolved	Total
Nickel	GENMIN	2/12	<0.05	0.12	<0.05	<0.05
	NPDESMETAL		0.0038	0.12	0.0039	0.021
	GENMIN	3/31	<0.05	<0.05	<0.05	<0.05
	NPDESMETAL		0.0028	0.0052	0.0024	0.0071
	GENMIN	11/30	<0.05	<0.05	<0.05	<0.05
	NPDESMETAL		0.0029	0.01	0.0022	0.012
Selenium	NPDESMETAL	2/12	<0.004	<0.004	<0.004	<0.004
	NPDESMETAL	3/31	<0.002	<0.002	<0.002	<0.002
	NPDESMETAL	11/30	<0.002	<0.002	<0.002	<0.002
Silver	NPDESMETAL	2/12	<0.002	<0.001	<0.002	<0.001
	NPDESMETAL	3/31	<0.001	<0.001	<0.001	<0.001
	NPDESMETAL	11/30	<0.001	<0.001	<0.001	<0.001
Vanadium	NPDESMETAL	2/12	<0.01	<0.01	<0.01	<0.01
	NPDESMETAL	3/31	<0.01	<0.01	<0.01	<0.01
	NPDESMETAL	11/30	<0.01	<0.01	<0.01	<0.01
Zinc	GENMIN	2/12	<0.01	0.19	<0.01	0.069
	NPDESMETAL		<0.02	<0.02	<0.02	0.032
	GENMIN	3/31	<0.01	0.042	0.011	0.061
	NPDESMETAL		<0.02	0.04	<0.02	0.07
	GENMIN	11/30	0.066	0.096	0.058	0.1
	NPDESMETAL		0.055	0.1	0.054	0.12

Table 7-4. Metals detected in storm water runoff at the Livemore site in 1998 (continued).

Parameter (mg/L)	Requested Analysis	Storm Date	Arroyo Las Positas							
			Site influent						Site effluent	
			ALPE		ALPO		GRNE		WPDC	
			Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total
Aluminum	GENMIN	2/12	<0.05	2.1	<0.05	13	<0.05	27	<0.05	7.0
	NPDESMETAL		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	GENMIN	3/31	<0.05	5.6	<0.05	2.0	<0.05	2.4	<0.05	1.8
	NPDESMETAL		<0.05	7.3	<0.05	2.9	<0.05	2.8	0.06	2.7
	GENMIN	11/30	<0.05	5.6	<0.05	1.7	0.15	7.5	0.1	2.8
	NPDESMETAL		0.16	5.7	<0.05	2.5	0.14	9.7	0.14	2.9
Antimony	NPDESMETAL	2/12	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
	NPDESMETAL	3/31	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
	NPDESMETAL	11/30	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Arsenic	NPDESMETAL	2/12	<0.002	0.0028	0.0056	0.0073	<0.002	0.0021	<0.002	0.0023
	NPDESMETAL	3/31	0.003	0.0048	0.0061	0.0062	<0.002	<0.002	<0.002	0.0022
	NPDESMETAL	11/30	0.002	0.0032	0.0041	0.0045	<0.002	0.0035	<0.002	0.0021
Barium	NPDESMETAL	2/12	0.13	0.13	0.16	0.12	0.18	0.17	0.13	0.12
	NPDESMETAL	3/31	0.09	0.15	0.11	0.15	0.18	0.088	0.14	0.06
	NPDESMETAL	11/30	0.076	0.12	0.092	0.12	0.052	0.14	0.05	0.06
Beryllium	NPDESMETAL	2/12	<0.0002	0.00064	<0.0002	0.0004	<0.0002	0.00037	<0.0002	0.00022
	NPDESMETAL	3/31	<0.0002	0.00024	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
	NPDESMETAL	11/30	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.00027	<0.0002	<0.0002
Boron	NPDESMETAL	2/12	2.1	2.0	4.7	3.4	0.27	0.26	0.19	0.20
	NPDESMETAL	3/31	12	11	6.2	5.9	0.26	0.20	0.52	0.44
	NPDESMETAL	11/30	4.0	4.0	4.0	4.1	0.14	0.15	0.15	0.19
Cadmium	NPDESMETAL	2/12	<0.0005	<0.0005	<0.0005	0.00098	<0.0005	<0.0005	<0.0005	<0.0005
	NPDESMETAL	3/31	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
	NPDESMETAL	11/30	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Chromium	NPDESMETAL	2/12	<0.001	0.014	<0.001	0.018	<0.001	0.011	0.0013	0.015
	NPDESMETAL	3/31	<0.001	0.02	<0.001	0.0049	<0.001	0.0061	0.0017	0.007
	NPDESMETAL	11/30	<0.001	0.012	<0.001	0.0039	<0.001	0.018	0.0033	0.0092

Table 7-4. Metals detected in storm water runoff at the Livemore site in 1998 (continued).

Parameter (mg/L)	Requested Analysis	Storm Date	Arroyo Las Positas							
			Site influent						Site effluent	
			ALPE		ALPO		GRNE		WPDC	
			Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total
Copper	GENMIN	2/12	<0.01	<0.01	<0.01	0.018	<0.01	0.019	<0.01	0.011
	NPDESMETAL		0.0041	0.021	0.0074	0.038	0.0027	0.016	0.0026	0.018
	GENMIN	3/31	<0.01	0.012	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	NPDESMETAL		0.015	0.016	0.011	0.0096	0.0047	0.0064	0.0076	0.014
	GENMIN	11/30	<0.01	0.012	<0.01	<0.01	<0.01	0.012	<0.01	<0.01
	NPDESMETAL		0.0046	0.0093	0.004	0.0069	0.0019	0.0097	0.0032	0.0076
Chromium(VI)	NPDESMETAL	2/12	0.006	—[a]	0.004	—[a]	0.002	—[a]	0.008	—[a]
	NPDESMETAL	3/31	0.002	—[a]	<0.002	—[a]	<0.002	—[a]	<0.002	—[a]
	NPDESMETAL	11/30	<0.002	—[a]	<0.002	—[a]	<0.002	—[a]	0.004	—[a]
Iron	GENMIN	2/12	0.078	1.9	<0.05	13	<0.05	29	<0.05	7.8
	NPDESMETAL		0.078	0.08	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	GENMIN	3/31	<0.05	6.5	<0.05	2.1	<0.05	2.6	<0.05	2.2
	NPDESMETAL		<0.05	7.3	<0.05	2.6	<0.05	2.9	<0.05	3.3
	GENMIN	11/30	0.098	5.1	<0.05	1.6	0.12	8.0	0.1	3.0
	NPDESMETAL		0.14		<0.05	2.2	0.13	9.7	0.13	3.4
Lead	NPDESMETAL	2/12	<0.005	0.0076	<0.005	0.0082	<0.005	<0.005	<0.005	0.035
	NPDESMETAL	3/31	<0.005	0.0071	<0.005	<0.005	<0.005	0.0053	<0.005	<0.005
	NPDESMETAL	11/30	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Magnesium	GENMIN	2/12	10	8.7	35	37	5.3	13	2.5	4.6
	GENMIN	3/31	37	40	49	44	4.9	5.1	5.0	5.6
	GENMIN	11/30	13	14	32	31	2.6	4.8	4.0	4.9
Manganese	GENMIN	2/12	<0.01	0.23	<0.01	0.33	<0.01	0.53	<0.01	0.17
	NPDESMETAL		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	GENMIN	3/31	<0.01	0.18	<0.01	0.1	<0.01	0.05	<0.01	0.055
	NPDESMETAL		<0.01	0.2	<0.01	0.12	<0.01	0.05	<0.01	0.07
	GENMIN	11/30	<0.01	0.1	<0.01	0.034	<0.01	0.15	<0.01	0.061
	NPDESMETAL		<0.01	0.1	<0.01	0.047	<0.01	0.16	<0.01	0.066

Table 7-4. Metals detected in storm water runoff at the Livemore site in 1998 (continued).

Parameter (mg/L)	Requested Analysis	Storm Date	Arroyo Las Positas							
			Site influent						Site effluent	
			ALPE		ALPO		GRNE		WPDC	
			Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total
Nickel	GENMIN	2/12	<0.05	<0.05	<0.05	<0.05	<0.05	0.052	<0.05	<0.05
	NPDESMETAL		0.0064	0.028	0.0043	0.023	0.003	0.023	<0.002	0.018
	GENMIN	3/31	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	NPDESMETAL		0.0063	0.024	0.0033	0.0054	<0.002	0.0048	0.0029	0.0075
	GENMIN	11/30	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	NPDESMETAL		0.0052	0.016	0.0023	0.0054	<0.002	0.02	<0.002	0.0083
Selenium	NPDESMETAL	2/12	<0.004	<0.004	0.0043	<0.004	<0.004	<0.004	<0.004	<0.004
	NPDESMETAL	3/31	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
	NPDESMETAL	11/30	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Silver	NPDESMETAL	2/12	<0.002	<0.001	<0.002	<0.001	<0.002	0.0012	<0.002	<0.001
	NPDESMETAL	3/31	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	NPDESMETAL	11/30	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	NPDESMETAL	2/12	<0.01	<0.01	0.014	0.011	<0.01	<0.01	<0.01	<0.01
	NPDESMETAL	3/31	<0.01	0.02	0.01	0.02	<0.01	<0.01	<0.01	<0.01
	NPDESMETAL	11/30	<0.01	0.014	<0.01	0.04	<0.01	0.022	<0.01	<0.01
Zinc	GENMIN	2/12	0.015	0.034	<0.01	0.061	0.027	0.14	0.023	0.15
	NPDESMETAL		0.03	0.03	<0.02	<0.02	<0.02	0.02	0.026	0.028
	GENMIN	3/31	<0.01	0.062	<0.01	0.02	0.024	0.12	0.041	0.11
	NPDESMETAL		<0.02	0.06	<0.02	0.02	0.04	0.13	0.05	<0.02
	GENMIN	11/30	0.015	0.04	<0.01	0.02	0.018	0.085	0.028	0.092
	NPDESMETAL		<0.02	0.029	<0.02	0.025	<0.02	0.098	0.027	0.093

Table 7-4. Metals detected in storm water runoff at the Livemore site in 1998 (continued).

Parameter (mg/L)	Requested Analysis	Storm Date	Drainage Retention Basin					
			DRB influent				DRB effluent	
			CDB		CDB2		CDBX	
			Dissolved	Total	Dissolved	Total	Dissolved	Total
Aluminum	GENMIN	2/12	<0.05	4.3	<0.05	8.1	0.06	5.9
	NPDESMETAL		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	GENMIN	3/31	<0.05	2.1	<0.05	0.87	—(b)	—(b)
	NPDESMETAL		<0.05	1.9	<0.05	1.1	—(b)	—(b)
	GENMIN	11/30	0.28	2.8	0.29	6.2	<0.05	2.1
	NPDESMETAL		0.26	3.0	0.30	6.1	<0.05	2.4
Antimony	NPDESMETAL	2/12	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
	NPDESMETAL	3/31	<0.004	<0.004	<0.004	<0.004	—(b)	—(b)
	NPDESMETAL	11/30	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Arsenic	NPDESMETAL	2/12	<0.002	<0.002	0.0033	0.0048	<0.002	0.0027
	NPDESMETAL	3/31	<0.002	<0.002	0.0046	0.0051	—(b)	—(b)
	NPDESMETAL	11/30	0.0025	0.0029	0.0038	0.0051	0.0038	0.0045
Barium	NPDESMETAL	2/12	0.074	0.067	0.12	0.1	0.12	0.11
	NPDESMETAL	3/31	0.19	0.16	0.15	0.15	—(b)	—(b)
	NPDESMETAL	11/30	0.67	0.066	0.064	0.1	0.13	0.15
Beryllium	NPDESMETAL	2/12	<0.0002	<0.0002	<0.0002	0.00034	<0.0002	0.00052
	NPDESMETAL	3/31	<0.0002	<0.0002	<0.0002	<0.0002	—(b)	—(b)
	NPDESMETAL	11/30	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Boron	NPDESMETAL	2/12	<0.05	<0.05	1.8	1.7	0.77	0.74
	NPDESMETAL	3/31	0.18	0.16	10	8.8	—(b)	—(b)
	NPDESMETAL	11/30	0.062	0.084	0.54	0.55	1.3	1.4
Cadmium	NPDESMETAL	2/12	<0.0005	0.00052	<0.0005	<0.0005	<0.0005	<0.0005
	NPDESMETAL	3/31	<0.0005	0.0005	<0.0005	<0.0005	—(b)	—(b)
	NPDESMETAL	11/30	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Chromium	NPDESMETAL	2/12	<0.001	0.0079	<0.001	0.016	<0.001	0.011
	NPDESMETAL	3/31	0.0039	0.011	0.0012	0.0035	—(b)	—(b)
	NPDESMETAL	11/30	0.0016	0.0078	0.0018	0.015	0.0031	0.0088

Table 7-4. Metals detected in storm water runoff at the Livemore site in 1998 (continued).

Parameter (mg/L)	Requested Analysis	Storm Date	Drainage Retention Basin					
			DRB influent				DRB effluent	
			CDB		CDB2		CDBX	
			Dissolved	Total	Dissolved	Total	Dissolved	Total
Copper	GENMIN	2/12	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	NPDESMETAL		0.0022	0.018	0.0036	0.019	0.0041	0.0084
	GENMIN	3/31	<0.01	<0.01	<0.01	0.013	—[b]	—[b]
	NPDESMETAL		0.0048	0.023	0.013	0.036	—[b]	—[b]
	GENMIN	11/30	<0.01	<0.01	<0.01	0.014	<0.01	<0.01
	NPDESMETAL		0.0046	0.0082	0.0057	0.015	0.0032	0.0073
Chromium(VI)	NPDESMETAL	2/12	0.006	—[a]	0.005	—[a]	0.007	—[a]
	NPDESMETAL	3/31	0.004	—[a]	<0.002	—[a]	—[b]	—[b]
	NPDESMETAL	11/30	0.002	—[a]	<0.002	—[a]	0.003	—[a]
Iron	GENMIN	2/12	0.056	4.3	<0.05	8.5	0.10	5.4
	NPDESMETAL		<0.05	0.05	<0.05	<0.05	0.075	0.069
	GENMIN	3/31	<0.05	2.4	<0.05	1.0	—[b]	—[b]
	NPDESMETAL		<0.05	2.3	<0.05	1.0	—[b]	—[b]
	GENMIN	11/30	0.24	2.9	0.25	6.3	<0.05	2.1
	NPDESMETAL		0.22	3.2	0.26	6.3	<0.05	2.4
Lead	NPDESMETAL	2/12	<0.005	0.0084	<0.005	0.0079	<0.005	<0.005
	NPDESMETAL	3/31	<0.005	0.006	<0.005	<0.005	—[b]	—[b]
	NPDESMETAL	11/30	<0.005	<0.005	<0.005	0.0062	<0.005	<0.005
Magnesium	GENMIN	2/12	0.53	1.6	8.5	10	5.6	6.7
	GENMIN	3/31	11	11	30	31	—[b]	—[b]
	GENMIN	11/30	2.8	3.5	3.7	5.3	21	21
Manganese	GENMIN	2/12	<0.01	0.087	<0.01	0.18	<0.01	0.087
	NPDESMETAL		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	GENMIN	3/31	<0.01	0.052	<0.01	0.081	—[b]	—[b]
	NPDESMETAL		<0.01	0.05	<0.01	0.08	—[b]	—[b]
	GENMIN	11/30	<0.01	0.064	<0.01	0.11	<0.01	0.052
	NPDESMETAL		<0.01	0.069	<0.01	0.11	<0.01	0.057

Table 7-4. Metals detected in storm water runoff at the Livemore site in 1998 (concluded).

Parameter (mg/L)	Requested Analysis	Storm Date	Drainage Retention Basin					
			DRB influent				DRB effluent	
			CDB		CDB2		CDBX	
			Dissolved	Total	Dissolved	Total	Dissolved	Total
Nickel	GENMIN	2/12	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	NPDESMETAL		<0.002	0.014	0.0034	0.027	0.0044	0.019
	GENMIN	3/31	<0.05	<0.05	<0.05	<0.05	—[b]	—[b]
	NPDESMETAL		0.002	0.0064	0.0081	0.02	—[b]	—[b]
	GENMIN	11/30	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	NPDESMETAL		0.0025	0.0089	0.0037	0.016	0.0024	0.0082
Selenium	NPDESMETAL	2/12	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
	NPDESMETAL	3/31	<0.002	<0.002	<0.002	<0.002	—[b]	—[b]
	NPDESMETAL	11/30	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Silver	NPDESMETAL	2/12	<0.002	<0.001	<0.002	<0.001	<0.002	<0.001
	NPDESMETAL	3/31	<0.001	<0.001	<0.001	<0.001	—[b]	—[b]
	NPDESMETAL	11/30	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	NPDESMETAL	2/12	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	NPDESMETAL	3/31	<0.01	<0.01	<0.01	<0.01	—[b]	—[b]
	NPDESMETAL	11/30	<0.01	<0.01	<0.01	0.013	<0.01	0.012
Zinc	GENMIN	2/12	0.024	0.11	0.025	0.068	0.017	0.039
	NPDESMETAL		0.039	0.035	0.03	0.028	0.024	0.024
	GENMIN	3/31	0.021	0.12	0.013	0.03	—[b]	—[b]
	NPDESMETAL		0.03	0.12	<0.02	0.03	—[b]	—[b]
	GENMIN	11/30	0.088	0.13	0.049	0.11	0.012	0.034
	NPDESMETAL		0.087	0.17	0.046	0.11	<0.02	0.038

[a] Chromium(VI) analyzed as dissolved only.

[b] CDBX samples not collected on 3/31 because there was no flow at this location.

Table 7-5. Nonradioactive compounds detected in storm water runoff, Livermore site.

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	2/12	115	39	59	84	50	38	35	54	39
	3/31	35	24	124	35	27	62	22	73	—[a]
	11/30	64	37	64	47	32	52	32	52	28
Anions (mg/L)										
Bicarbonate alkalinity (as $CaCO_3$)	2/12	153	153	96	262	93	26	8.5	76	67
	3/31	151	139	318	281	43	20	99	267	—[a]
	11/30	18	18	90	228	22	49	24	34	165
Bromide	2/12	0.19	0.18	0.16	0.94	<0.05	<0.05	<0.05	0.12	0.06
	3/31	0.25	0.15	0.88	1.2	0.08	<0.05	0.13	0.92	—[a]
	11/30	<0.05	<0.05	0.31	1.1	0.09	<0.05	<0.05	0.08	0.31
Carbonate alkalinity (as $CaCO_3$)	2/12	<1	<1	<1	<1	<1	<1	<1	<1	<1
	3/31	<5	<5	38	30	<5	<5	<5	18	—[a]
	11/30	<5	<5	<5	<5	<5	<5	<5	<5	<5
Chloride	2/12	61	57	61	250	2.1	8.6	<0.5	49	20
	3/31	92	91	388	333	13	3.2	31	302	—[a]
	11/30	1.4	6.9	125	213	5.2	6.3	5.8	16	93
Fluoride	2/12	0.26	0.25	0.18	0.95	0.13	0.07	<0.05	0.14	0.14
	3/31	0.2	0.18	1.2	1.4	0.11	<0.05	0.18	1.2	—[a]
	11/30	<0.05	<0.05	0.3	1	0.12	0.07	0.05	0.08	0.32
Nitrate (as N)	2/12	2.8	2.8	<0.1	3.4	0.71	0.34	0.1	0.17	0.44
	3/31	1.6	1.5	0.16	2.9	4.9	0.51	1.8	<0.1	—[a]
	11/30	0.32	0.32	0.49	2.2	3.3	0.89	0.64	0.55	1.7
Nitrate (as NO_3)	2/12	12	12	<0.4	15	3.1	1.5	0.44	0.75	1.9
	3/31	7.2	6.7	0.69	13	22	2.2	8	<0.4	—[a]
	11/30	1.4	1.4	2.2	9.5	14	4	2.8	2.4	7.5
Nitrite (as N)	2/12	0.02	0.02	0.04	0.06	0.04	0.04	0.03	0.02	0.06
	3/31	0.03	0.03	<0.02	0.04	<0.02	0.03	0.02	<0.02	—[a]
	11/30	<0.02	<0.02	0.02	0.02	0.02	<0.02	<0.02	<0.02	<0.02
Nitrite (as NO_2)	2/12	0.07	0.07	0.13	0.2	0.13	0.13	0.1	0.07	0.2
	3/31	0.1	0.1	<0.07	0.13	<0.07	0.11	0.07	<0.07	—[a]
	11/30	<0.07	<0.07	0.07	0.07	0.07	<0.07	<0.07	<0.07	<0.07

Table 7-5. Nonradioactive compounds detected in storm water runoff, Livermore site (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)										
Orthophosphate	2/12	0.6	0.46	0.62	1.2	0.34	0.16	0.12	<0.05	1.8
	3/31	0.3	0.25	0.95	0.33	0.26	0.4	0.27	0.51	—[a]
	11/30	0.43	0.35	0.88	0.25	0.45	0.4	0.12	0.33	0.41
Sulfate	2/12	136	120	63	304	3.3	9.3	<1	51	21
	3/31	162	138	317	355	10	3.7	9.1	237	—[a]
	11/30	1.5	1.4	98	190	5.7	3.7	2.3	13	39
General minerals (mg/L)										
Bicarbonate alkalinity (as $CaCO_3$)	2/12	161	156	98	262	92	26	7.1	80	66
	3/31	155	143	308	281	38	44	99	285	—[a]
	11/30	15	19	20	226	24	84	24	34	172
	11/30	19	16	93	226	21	50	25	34	166
Calcium	2/12	52	48	24	114	18	8.8	1.8	22	16
	2/12	56	49	20	117	27	9.7	2.1	22	16
	3/31	57	49	72	142	17	14	26	62	—[a]
	11/30	58	44	75	124	15	14	25	62	—[a]
	11/30	4.7	3.9	23	69	8.9	11	6.8	9	46
	11/30	4.2	4.6	23	67	10	12	7	9.4	43
Carbonate alkalinity (as $CaCO_3$)	2/12	<1	<1	<1	<1	<1	<1	<1	<1	<1
	3/31	<5	<5	30	27	<5	<5	<5	16	—[a]
	11/30	<5	<5	<5	<5	<5	<5	<5	<5	7.2
	11/30	<5	<5	<5	<5	<5	<5	<5	<5	5.7
Chloride	2/12	63	62	63	248	2.1	8.4	0.75	60	21
	3/31	93	90	365	331	13	22	30	303	—[a]
	11/30	1.2	7.6	7.5	221	5.2	12	5	17	95
	11/30	1.2	6.8	132	222	5.6	6.7	5.7	16	98
Fluoride	2/12	0.26	0.24	0.19	0.97	0.12	0.07	<0.05	0.14	0.12
	3/31	0.21	0.18	1.2	1.4	0.11	0.12	0.18	1	—[a]
	11/30	<0.05	<0.05	<0.05	1	0.11	0.07	<0.05	0.08	0.32
	11/30	<0.05	<0.05	0.32	1	0.12	0.07	<0.05	0.08	0.34

Table 7-5. Nonradioactive compounds detected in storm water runoff, Livermore site (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)										
Nitrate (as N)	2/12	2.8	2.8	<0.1	3.3	0.72	0.34	0.11	0.17	0.45
	3/31	1.7	1.5	0.16	2.9	4.9	0.74	1.8	<0.1	—[a]
	11/30	0.35	0.32	0.55	2.2	3.4	0.98	0.66	0.55	1.8
	11/30	0.35	0.32	0.55	2.2	3.2	0.95	0.64	0.52	1.8
Nitrate (as NO_3)	2/12	12	12	<0.4	15	3.2	1.5	0.49	0.75	2
	3/31	7.4	6.7	0.69	13	22	3.3	7.9	<0.4	—[a]
	11/30	1.5	1.4	2.4	9.8	15	4.3	2.9	2.4	7.8
	11/30	1.5	1.4	2.4	9.5	14	4.2	2.8	2.3	7.8
Nitrite (as N)	2/12	0.02	<0.02	0.04	0.06	0.03	0.04	0.02	0.02	0.05
	3/31	0.03	0.03	<0.02	0.05	0.03	<0.02	0.03	<0.02	—[a]
	11/30	<0.02	<0.02	<0.02	0.02	0.02	<0.02	<0.02	<0.02	<0.02
	11/30	<0.02	<0.02	<0.02	<0.02	0.02	<0.02	<0.02	<0.02	<0.02
Orthophosphate	2/12	0.7	0.41	0.68	1.1	0.37	<0.05	0.07	0.15	1.8
	3/31	0.28	0.25	0.85	0.32	0.24	0.32	0.28	0.53	—[a]
	11/30	0.44	0.38	0.36	0.25	0.45	0.36	0.15	0.33	0.43
	11/30	0.43	0.36	0.89	0.25	0.45	0.4	0.12	0.32	0.42
pH (pH units)	2/12	8.08	8.16	7.7	8.13	7.86	7.65	6.53	7.84	5.57
	3/31	8.32	8.26	7.55	8.27	7.5	7.47	7.92	8.57	—[a]
	11/30	6.83	6.81	6.78	8.1	7.61	7.79	7.01	7.24	8.26
	11/30	6.71	6.79	7.9	8.11	7.63	7.61	7.1	7.21	8.31
Potassium	2/12	4.7	3.6	3.6	6	1.3	<1	<1	2.8	3.2
	2/12	12	5.4	3.5	7.8	4.6	2.6	1.5	4.6	4.5
	3/31	3.3	3.1	2.4	3.2	<1	1.2	1.2	3.6	—[a]
	3/31	3.4	2.9	3.1	2.8	1.4	1.7	1.5	3.5	—[a]
	11/30	2.1	1.9	3.6	2.4	<1	1.8	1.7	2.4	2.6
	11/30	2.7	2.9	4.2	2.6	2.3	2.4	2.4	3.3	2.8
Sodium	2/12	68	60	67	189	16	10	1.5	64	25
	2/12	53	61	51	187	16	9.2	0.93	61	24
	3/31	88	86	366	275	15	24	27	307	—[a]
	3/31	86	75	369	237	12	21	24	306	—[a]
	11/30	3.4	8.3	136	206	9.8	12	5.2	21	80
	11/30	2.2	8.4	137	207	9.4	13	5.5	20	76

Table 7-5. Nonradioactive compounds detected in storm water runoff, Livermore site (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)										
Specific conductance (μmho/cm)	2/12	795	735	537	1830	203	113	22	492	272
	3/31	930	855	2300	2230	204	230	340	1940	—[a]
	11/30	47	75	76	1520	115	240	80	178	765
	11/30	48	71	866	1530	116	150	88	178	761
Sulfate	2/12	138	121	64	302	3.5	9.3	1.1	64	23
	3/31	163	136	297	352	9.98	18	8.9	239	—[a]
	11/30	1.7	1.5	1.5	199	5.8	6.5	2	13	39
	11/30	1.7	1.4	104	201	6.2	4	2.3	13	41
Surfactants	2/12	<0.05	<0.05	0.05	0.07	<0.05	<0.05	<0.05	0.07	0.06
	3/31	0.07	0.08	0.2	<0.05	<0.05	0.13	0.08	0.14	—[a]
	11/30	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	11/30	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total alkalinity (as $CaCO_3$)	2/12	161	156	98	262	92	26	7.1	80	66
	3/31	155	143	338	308	38	44	99	301	—[a]
	11/30	15	19	20	226	24	84	24	34	179
	11/30	19	16	93	226	21	50	25	34	172
Total dissolved solids (TDS)	2/12	508	460	380	1200	134	91	28	286	203
	3/31	563	517	1450	1460	125	143	194	1220	—[a]
	11/30	46	52	61	890	101	137	92	111	407
	11/30	50	56	517	937	100	95	60	134	447
Total hardness (as CaCO3)	2/12	233	215	101	429	67	32	6.7	90	63
	3/31	278	233	332	556	63	56	110	278	—[a]
	11/30	18	14	111	304	33	44	29	38	201
	11/30	19	21	115	295	45	50	32	45	194
Total phosphorus (as P)	2/12	2.1	0.45	0.68	0.86	0.35	0.24	0.13	0.37	0.68
	3/31	0.15	0.13	0.49	0.21	0.13	0.2	0.15	0.27	—[a]
	11/30	0.26	0.29	0.44	0.16	0.26	0.24	0.12	0.26	0.23
	11/30	0.24	0.23	0.42	0.14	0.27	0.21	0.12	0.24	0.21
Total suspended solids (TSS)	2/12	454	90	370	280	748	158	154	160	67
	3/31	27	19	179	62	69	54	31	21	—[a]
	11/30	38	81	93	42	131	54	43	91	37

Table 7-5. Nonradioactive compounds detected in storm water runoff, Livermore site (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
Herbicides (μg/L)										
Bromacil	2/12	<1	<1	<1	3.5	2.8	<1	<1	1	1.8
	3/31	<0.5	<0.5	<0.5	3.8	46	4.5	2.1	1.7	—[a]
	11/30	1.4	0.79	17	15	820	4.5	2.5	8.4	2.5
Simazine	2/12	<0.4	1	<0.4	0.5	<0.4	<0.4	<0.4	<0.4	<0.4
	3/31	1	0.45	<0.2	<0.2	2.6	<0.2	<0.2	<0.2	—[a]
	11/30	0.64	<0.2	<0.4	<0.2	1.2	<0.2	<0.2	<0.2	<0.2
Glyphosate	2/12	<9	40	—[b]	<9	<9	26	<9	<9	<9
	3/31	19	19	14	<9	<9	20	<9	12	—[a]
	11/30	<9	<9	<9	<9	24	<9	<9	<9	<9
Diuron	2/12	<1	<1	<1	1.1	<1	<1	<1	<1	<1
	3/31	<1	<1	<1	<1	2.9	4.5	<1	1.3	—[a]
	11/30	<1	<1	53	18	150	2.8	<1	18	3.5
Miscellaneous organics (mg/L)										
Oil and grease	2/12	<1	<1	<1	<1	<1	<1	<1	<1	<1
	3/31	1	2.4	3	<1	<1	1.9	<1	<1	—[a]
	11/30	<1	<1	<1	1.1	3.4	4.5	<1	<1	3.4
Total organic carbon (TOC)	2/12	9.5	12	14	14	6.1	3.4	2.9	9.6	12
	3/31	7.1	6.8	20	8.7	5.1	8.7	5.5	24	—[a]
	11/30	7.8	8	15	6.8	3.5	5.5	9	10	5.8

[a] CDBX samples not collected on 3/31 because there was no flow at this location.

[b] Not analyzed because holding time exceeded.

Table 7-6. Radioactivity in storm water runoff at Site 300, 1998.

Parameter	Date	Upstream location	Effluent locations	
		CARW	N883	NLIN
Gross alpha (Bq/L)	1/12	na[(a)]	$1.9 \times 10^{-2} \pm 2.2 \times 10^{-2}$	na
	2/2	$5.7 \times 10^{-2} \pm 5.6 \times 10^{-2}$	$8.1 \times 10^{-3} \pm 1.9 \times 10^{-2}$	$7.4 \times 10^{-2} \pm 3.4 \times 10^{-2}$
	5/5	$7.5 \times 10^{-2} \pm 6.3 \times 10^{-2}$	$1.5 \times 10^{-2} \pm 2.2 \times 10^{-2}$	na
	11/30	na	$2.0 \times 10^{-2} \pm 2.8 \times 10^{-2}$	na
Gross beta (Bq/L)	1/12	na	$5.8 \times 10^{-2} \pm 7.8 \times 10^{-2}$	na
	2/2	$1.1 \times 10^{-1} \pm 1.1 \times 10^{-1}$	$1.6 \times 10^{-2} \pm 7.4 \times 10^{-2}$	$2.6 \times 10^{-1} \pm 8.1 \times 10^{-2}$
	5/5	$2.1 \times 10^{-1} \pm 1.5 \times 10^{-1}$	$5.3 \times 10^{-2} \pm 7.4 \times 10^{-2}$	na
	11/30	na	$6.6 \times 10^{-2} \pm 7.4 \times 10^{-2}$	na
Tritium (Bq/L)	1/12	na	<1.30	na
	2/2	<1.22	<1.15	<1.17
	5/5	<1.26	<1.23	na
	11/30	na	$-5.99 \times 10^{-1} \pm 1.21$	na
Plutonium-238	11/30	na	$<4 \times 10^{-3}$	na
Plutonium-239	11/30	na	$4. \times 10^{-4} \pm 1. \times 10^{-3}$	na
Uranium-233+234	1/12	na	$2.2 \times 10^{-3} \pm 3.7 \times 10^{-3}$	na
	2/2	$3.5 \times 10^{-2} \pm 7.8 \times 10^{-3}$	$1.5 \times 10^{-3} \pm 1.5 \times 10^{-3}$	$3.4 \times 10^{-2} \pm 7.4 \times 10^{-3}$
	5/5	$7.9 \times 10^{-2} \pm 1.1 \times 10^{-2}$	$5.5 \times 10^{-3} \pm 7.0 \times 10^{-3}$	na
Uranium-235+236	1/12	na	$3.7 \times 10^{-4} \pm 1.5 \times 10^{-3}$	na
	2/2	$1.9 \times 10^{-3} \pm 2.6 \times 10^{-3}$	$-3.7 \times 10^{-4} \pm 1.1 \times 10^{-3}$	$3.3 \times 10^{-3} \pm 2.6 \times 10^{-3}$
	5/5	$1.8 \times 10^{-3} \pm 2.7 \times 10^{-3}$	$-8.4 \times 10^{-4} \pm 6.5 \times 10^{-3}$	na
Uranium-238	1/12	na	$3.7 \times 10^{-4} \pm 1.9 \times 10^{-3}$	na
	2/2	$2.1 \times 10^{-2} \pm 6.3 \times 10^{-3}$	$1.5 \times 10^{-3} \pm 1.1 \times 10^{-3}$	$4.3 \times 10^{-2} \pm 8.1 \times 10^{-3}$
	5/5	$6.7 \times 10^{-2} \pm 9.7 \times 10^{-3}$	$3.4 \times 10^{-3} \pm 7.8 \times 10^{-3}$	na

Table 7-6. Radioactivity in storm water runoff at Site 300, 1998 (concluded).

Parameter	Date	Effluent locations		Downstream location
		NPT6	NPT7	GEOCRK
Gross alpha (Bq/L)	1/12	$5.0 \times 10^{-2} \pm 3.3 \times 10^{-2}$	$1.9 \times 10^{-3} \pm 2.0 \times 10^{-2}$	na
	2/2	$4.4 \times 10^{-2} \pm 3.4 \times 10^{-2}$	$2.8 \times 10^{-2} \pm 2.6 \times 10^{-2}$	$5.4 \times 10^{-2} \pm 6.3 \times 10^{-2}$
	5/5	$3.0 \times 10^{-2} \pm 2.7 \times 10^{-2}$	$7.0 \times 10^{-2} \pm 4.4 \times 10^{-2}$	$1.4 \times 10^{-1} \pm 7.8 \times 10^{-2}$
	11/30	na	$1.5 \times 10^{-2} \pm 2.4 \times 10^{-2}$	na
Gross beta (Bq/L)	1/12	$7.4 \times 10^{-2} \pm 8.1 \times 10^{-2}$	$5.1 \times 10^{-2} \pm 7.8 \times 10^{-2}$	na
	2/2	$1.7 \times 10^{-1} \pm 7.8 \times 10^{-2}$	$1.0 \times 10^{-1} \pm 8.5 \times 10^{-2}$	$1.1 \times 10^{-1} \pm 1.4 \times 10^{-1}$
	5/5	$1.8 \times 10^{-1} \pm 7.4 \times 10^{-2}$	$1.3 \times 10^{-1} \pm 6.7 \times 10^{-2}$	$2.8 \times 10^{-1} \pm 1.4 \times 10^{-1}$
	11/30	na	$8.1 \times 10^{-2} \pm 6.7 \times 10^{-2}$	na
Tritium (Bq/L)	1/12	<1.31	<1.31	na
	2/2	<1.21	<1.17	<1.22
	5/5	<1.23	<1.75	<1.25
	11/30	na	$3.69 \times 10^{-2} \pm 1.26$	na
Plutonium-238	11/30	na	$<1. \times 10^{-3}$	na
Plutonium-239	11/30	na	$<1. \times 10^{-3}$	na
Uranium-233+234	1/12	$2.0 \times 10^{-2} \pm 5.9 \times 10^{-3}$	$4.8 \times 10^{-3} \pm 2.6 \times 10^{-3}$	na
	2/2	$3.0 \times 10^{-3} \pm 1.9 \times 10^{-3}$	$5.6 \times 10^{-3} \pm 2.2 \times 10^{-3}$	$4.2 \times 10^{-2} \pm 9.3 \times 10^{-3}$
	5/5	$2.9 \times 10^{-2} \pm 6.0 \times 10^{-3}$	$6.2 \times 10^{-2} \pm 8.6 \times 10^{-3}$	$7.0 \times 10^{-2} \pm 9.6 \times 10^{-3}$
Uranium-235+236	1/12	$<5.2 \times 10^{-3}$	$-3.7 \times 10^{-4} \pm 1.5 \times 10^{-3}$	na
	2/2	$3.7 \times 10^{-4} \pm 7.4 \times 10^{-4}$	$-3.7 \times 10^{-4} \pm 1.5 \times 10^{-3}$	$7.4 \times 10^{-4} \pm 2.2 \times 10^{-3}$
	5/5	$1.3 \times 10^{-3} \pm 1.6 \times 10^{-3}$	$3.4 \times 10^{-3} \pm 2.1 \times 10^{-3}$	$3.0 \times 10^{-3} \pm 2.4 \times 10^{-3}$
Uranium-238	1/12	$2.3 \times 10^{-2} \pm 5.9 \times 10^{-3}$	$3.3 \times 10^{-3} \pm 2.2 \times 10^{-3}$	na
	2/2	$3.7 \times 10^{-3} \pm 1.8 \times 10^{-3}$	$4.4 \times 10^{-3} \pm 1.9 \times 10^{-3}$	$3.5 \times 10^{-2} \pm 7.8 \times 10^{-3}$
	5/5	$3.3 \times 10^{-2} \pm 6.3 \times 10^{-3}$	$4.9 \times 10^{-2} \pm 7.4 \times 10^{-3}$	$5.5 \times 10^{-2} \pm 8.4 \times 10^{-3}$

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ 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.

Table 7-7. Nonradioactive constituents in Site 300 runoff.

Parameter	Date	Upstream location	Effluent location				Downstream location
		CARW	N883	NLIN	NPT6	NPT7	GEOCRK
General Minerals							
pH (pH units)	1/12	—[a]	7.00	—[a]	7.58	7.85	—[a]
	2/2	8.26	5.98	7.92	7.51	8.09	8.26
	5/5	8.47	7.5	—[a]	6.94	8.49	8.49
	11/30	—[a]	6.42	—[a]	—[a]	9.38	—[a]
Specific conductance	1/12	—[a]	21	—[a]	66	58	—[a]
(µmho/cm)	2/2	819	12	374	96	103	1140
	5/5	1098	94	—[a]	103	368	1120
	11/30	—[a]	30	—[a]	—[a]	106	—[a]
Total suspended solids (TSS)	1/12	—[a]	71	—[a]	6480	149	—[a]
(mg/L)	2/2	676	13	940	485	60	57
	5/5	1760	72	—[a]	586	6.7	796
	11/30	—[a]	47	—[a]	—[a]	11	—[a]
Miscellaneous organics							
Total organic carbon (TOC)	1/12	—[a]	3.0	—[a]	4.1	2.1	—[a]
(mg/L)	2/2	7.8	6.3	5.5	3.3	1.5	8.3
	5/5	6.1	16	—[a]	11	5.7	4.1
	11/30	—[a]	17	—[a]	—[a]	2.9	—[a]
Total organic halides (µg/L)	1/12	—[a]	<20	—[a]	<20	<20	—[a]
	2/2	<20	<20	27	<20	<20	<20
	5/5	<20	<20	—[a]	<20	<20	<20
	11/30	—[a]	<20	—[a]	—[a]	<20	—[a]
Pesticides (µg/L)							
PCB 1016	2/2	—[b]	—[b]	<0.2	—[c]	—[b]	—[b]
	5/6	—[b]	—[b]	—[a]	<0.2	—[b]	—[b]
PCB 1221	2/2	—[b]	—[b]	<0.2	—[c]	—[b]	—[b]
	5/6	—[b]	—[b]	—[a]	<0.2	—[b]	—[b]
PCB 1232	2/2	—[b]	—[b]	<0.2	—[c]	—[b]	—[b]
	5/6	—[b]	—[b]	—[a]	<0.2	—[b]	—[b]
PCB 1242	2/2	—[b]	—[b]	<0.2	—[c]	—[b]	—[b]
	5/6	—[b]	—[b]	—[a]	<0.2	—[b]	—[b]
PCB 1248	2/2	—[b]	—[b]	<0.2	—[c]	—[b]	—[b]
	5/6	—[b]	—[b]	—[a]	<0.2	—[b]	—[b]
PCB 1254	2/2	—[b]	—[b]	<0.2	—[c]	—[b]	—[b]
	5/6	—[b]	—[b]	—[a]	<0.2	—[b]	—[b]
PCB 1260	2/2	—[b]	—[b]	<0.2	—[c]	—[b]	—[b]
	5/6	—[b]	—[b]	—[a]	<0.2	—[b]	—[b]
Total PCBs	2/2	—[b]	—[b]	<0.2	—[c]	—[b]	—[b]
	5/6	—[b]	—[b]	—[a]	<0.2	—[b]	—[b]

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

[b] PCB analysis not conducted at this location.

[c] Not analyzed because PCB analysis at this location started on 5/6/98.

Table 7-8. Pit 6 post-closure runoff monitoring (all samples collected on 5/6/98).

Constituents	NPT6
Inorganics (mg/L)	
Beryllium	0.00095
Mercury	<0.0002
Potassium	12
Total dissolved solids	77
Volatile organic compounds (μg/L)	
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)	<1
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-1,2-Dichloroethene	<0.5
cis-1,3-Dichloropropene	<0.5

Table 7-8. Pit 6 post-closure runoff monitoring (all samples collected on 5/6/98) (continued).

Constituents	NPT6
Volatile organic compounds (μg/L) (continued)	
Dibromochloromethane	<0.5
Dibromomethane	<0.5
Dichlorodifluoromethane	<0.5
Ethanol	<1000
Ethylbenzene	<0.5
Freon 113	<0.5
Methylene chloride	<1
Naphthalene	<0.5
Styrene	<0.5
Tetrachloroethene	<0.5
Toluene	<0.5
Total xylene isomers	<1
trans-1,2-Dichloroethene	<0.5
trans-1,3-Dichloropropene	<0.5
Trichloroethene	<0.5
Trichlorofluoromethane	<0.5
Vinyl chloride	<0.5
Semivolatile organic compounds (μg/L)	
1,2,4-Trichlorobenzene	<2
1,2-Dichlorobenzene	<2
1,2-Diphenylhydrazine	<2
1,3-Dichlorobenzene	<2
1,4-Dichlorobenzene	<2
2,4,5-Trichlorophenol	<5
2,4,6-Trichlorophenol	<5
2,4-Dichlorophenol	<2
2,4-Dimethylphenol	<2
2,4-Dinitrophenol	<10
2,4-Dinitrotoluene	<2
2,6-Dinitrotoluene	<2
2-Chloronaphthalene	<2
2-Chlorophenol	<2
2-Methyl-4,6-dinitrophenol	<10

Table 7-8. Pit 6 post-closure runoff monitoring (all samples collected on 5/6/98) (continued).

Constituents	NPT6
Semivolatile organic compounds (μg/L) (continued)	
2-Methylnaphthalene	<2
2-Naphthylamine	<20
2-Nitroaniline	<2
2-Nitrophenol	<2
3,3-Dichlorobenzidine	<5
3-Nitroaniline	<2
4-Bromophenylphenylether	<2
4-Chloro-3-methylphenol	<5
4-Chloroaniline	<2
4-Chlorophenylphenylether	<2
4-Nitroaniline	<5
4-Nitrophenol	<5
Acenaphthene	<2
Acenaphthylene	<2
Aldrin	<2
Aniline	<5
Anthracene	<2
Benzidine	<20
Benzo(*a*)anthracene	<2
Benzo(a)pyrene	<2
Benzo(*b*)fluoranthene	<2
Benzo(*g,h,i*)perylene	<2
Benzo(*k*)fluoranthene	<2
Benzoic Acid	<10
Benzyl Alcohol	<2
BHC, alpha isomer	<2
BHC, beta isomer	<2
BHC, delta isomer	<2
BHC, gamma isomer (Lindane)	<2
Bis(2-chloroethoxy)methane	<2
Bis(2-chloroethyl)ether	<2
Bis(2-chloroisopropyl)ether	<2
Bis(2-ethylhexyl)phthalate	<5

Table 7-8. Pit 6 post-closure runoff monitoring (all samples collected on 5/6/98) (continued).

Constituents	NPT6
Semivolatile organic compounds (μg/L) (continued)	
Butylbenzylphthalate	<2
Chrysene	<2
Di-n-octylphthalate	<2
Dibenzo(a,h)anthracene	<3
Dibenzofuran	<2
Dibutylphthalate	<2
Dieldrin	<3
Diethylphthalate	<2
Dimethylphthalate	<2
Endosulfan I	<10
Endosulfan II	<10
Endosulfan sulfate	<3
Endrin	<2
Endrin aldehyde	<2
Fluoranthene	<2
Fluorene	<2
Heptachlor	<2
Heptachlor epoxide	<2
Hexachlorobenzene	<2
Hexachlorobutadiene	<2
Hexachlorocyclopentadiene	<2
Hexachloroethane	<2
Indeno(1,2,3-c,d)pyrene	<2
Isophorone	<2
N-Nitrosodi-n-propylamine	<2
N-Nitrosodimethylamine	<2
N-Nitrosodiphenylamine	<2
Naphthalene	<2
Nitrobenzene	<2
o-Cresol	<2
p,p'-DDD	<2
p,p'-DDE	<3
p,p'-DDT	<2

Table 7-8. Pit 6 post-closure runoff monitoring (all samples collected on 5/6/98) (concluded).

Constituents	NPT6
Semivolatile organic compounds (μg/L) (continued)	
p-Cresol	<2
Pentachlorophenol	<10
Phenanthrene	<2
Phenol	<2
Pyrene	<2
Pesticides	
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

Table 7-9. Tritium in rain (Bq/L), Livermore site and Livermore Valley.

Location	2/12/98	12/1/98
Livermore site		
B343	72.9 ± 3.06	169 ± 6.14
B291	6.85 ± 1.41	5.70 ± 2.10
CDB	17.2 ± 1.78	16.4 ± 2.58
VIS	5.25 ± 1.35	5.48 ± 2.09
COW	5.44 ± 1.35	6.40 ± 1.62
SALV	3.67 ± 1.28	2.05 ± 1.92
MET	4.92 ± 1.33	<1.60
Livermore Valley		
ESAN	4.63 ± 1.33	2.22 ± 1.92
ZON7	2.98 ± 1.24	<1.61
AQUE	1.46 ± 1.18	—[a]
SLST	2.49 ± 1.22	<2.30
GTES	1.90 ± 1.52	<2.27
VINE	<1.50	<2.38
BVA	2.21 ± 1.22	<2.28
VET	2.51 ± 1.23	<2.29

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 7-10. Drainage Retention Basin discharge limits for CDBX, as identified in CERCLA ROD 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 7-10. Drainage Retention Basin discharge limits for CDBX, as 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 7-11. Routine water quality management action levels and monitoring plan for the Drainage Retention Basin.

Constituent	Location	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)]/0.1L)				
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 7-11. Routine water quality management action levels and monitoring plan for the Drainage Retention Basin (concluded).

Constituent	Location	Frequency	Management action levels	
			Dry season Apr 1–Nov 30	Wet season Dec 1–Mar 31
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 7-12. Compliance monitoring data for the four releases from the Drainage Retention Basin sampled in 1998.

Parameter	CDBX				WPDC			
	2/12	8/12	11/2–11/6	11/30	2/12	8/12	11/2–11/6	11/30
Biological								
Aqueous bioassay								
Pimephales promelas survival (percent survival)	100	100	100	na	100	100	100	na
Pimephales promelas growth (toxic units)	na	na	<1	na	na	na	na	na
Pimephales promelas growth, IC-25[b]	na	na	>100	na	na	na	na	na
Pimephales promelas growth, IC-50[c]	na	na	>100	na	na	na	na	na
Pimephales promelas growth, LOEC[d]	na	na	>100	na	na	na	na	na
Pimephales promelas growth, NOEC[e]	na	na	>100	na	na	na	na	na
Pimephales promelas survival, LC-50[f]	na	na	>100	na	na	na	na	na
Pimephales promelas survival, LOEC	na	na	>100	na	na	na	na	na
Pimephales promelas survival, NOEC	na	na	>100	na	na	na	na	na
Pimephales promelas survival (toxic units)	na	na	<1	na	na	na	na	na
Ceriodaphnia dubia survival, LC-50	na	na	>100	na	na	na	na	na
Ceriodaphnia dubia survival, LOEC	na	na	>100	na	na	na	na	na
Ceriodaphnia dubia survival, NOEC	na	na	>100	na	na	na	na	na
Ceriodaphnia dubia survival (toxic units)	na	na	<1	na	na	na	na	na
Ceriodaphnia dubia reproduction, IC-25	na	na	>100	na	na	na	na	na
Ceriodaphnia dubia reproduction, IC-50	na	na	>100	na	na	na	na	na
Ceriodaphnia dubia reproduction, LOEC	na	na	>100	na	na	na	na	na
Ceriodaphnia dubia reproduction, NOEC	na	na	>100	na	na	na	na	na
Ceriodaphnia dubia reproduction, toxic unit	na	na	<1	na	na	na	na	na
Selanastrum capriocornutum growth, IC-25	na	na	>100	na	na	na	na	na
Selanastrum capriocornutum growth, IC-50	na	na	>100	na	na	na	na	na
Selanastrum capriocornutum growth, LOEC	na	na	>100	na	na	na	na	na
Selanastrum capriocornutum growth, NOEC	na	na	>100	na	na	na	na	na
Selanastrum capriocornutum growth (toxic units)	na	na	<1	na	na	na	na	na

Table 7-12. Compliance monitoring data for the four releases from the Drainage Retention Basin sampled in 1998 (continued).

Parameter	CDBX				WPDC			
	2/12	8/12	11/2–11/6	11/30	2/12	8/12	11/2–11/6	11/30
Anions (mg/L)								
Bicarbonate alkalinity (as $CaCO_3$)	67	na	na	165	26	na	na	49
Bromide	0.06	na	na	0.31	<0.05	na	na	<0.05
Carbonate alkalinity (as $CaCO_3$)	<1	na	na	<5	<1	na	na	<5
Chloride	20	na	na	93	8.6	na	na	6.3
Fluoride	0.14	na	na	0.32	0.07	na	na	0.07
Nitrate (as N)	0.44	na	na	1.7	0.34	na	na	0.89
Nitrate (as NO_3)	1.9	na	na	7.5	1.5	na	na	4
Nitrite (as N)	0.06	na	na	<0.02	0.04	na	na	<0.02
Nitrite (as NO_2)	0.2	na	na	<0.07	0.13	na	na	<0.07
Orthophosphate	1.8	na	na	0.41	0.16	na	na	0.4
Sulfate	21	na	na	39	9.3	na	na	3.7
Dissolved general minerals (mg/L)								
Aluminum	0.06	na	na	<0.05	<0.05	na	na	0.1
Bicarbonate alkalinity (as $CaCO_3$)	66	na	na	172	26	na	na	84
Calcium	16	na	na	46	8.8	na	na	11
Carbonate alkalinity (as $CaCO_3$)	<1	na	na	7.2	<1	na	na	<5
Chloride	21	na	na	95	8.4	na	na	12
Copper	<0.01	na	na	<0.01	<0.01	na	na	<0.01
Fluoride	0.12	na	na	0.32	0.07	na	na	0.07
Chromium(VI) (µg/L)	na	na	2	na	na	na	2	na
Hydroxide alkalinity (as $CaCO_3$)	<1	na	na	<5	<1	na	na	<5
Iron	0.1	na	na	<0.05	<0.05	na	na	0.1
Magnesium	5.6	na	na	21	2.5	na	na	4
Manganese	<0.01	na	na	<0.01	<0.01	na	na	<0.01
Nickel	<0.05	na	na	<0.05	<0.05	na	na	<0.05
Nitrate (as N)	0.45	na	na	1.8	0.34	na	na	0.98
Nitrate (as NO_3)	2	na	na	7.8	1.5	na	na	4.3
Nitrite (as N)	0.05	na	na	<0.02	0.04	na	na	<0.02
Orthophosphate	1.8	na	na	0.43	<0.05	na	na	0.36
pH (pH units)	5.57	8.61	na	8.26	7.65	8.66	na	7.79
Potassium	3.2	na	na	2.6	<1	na	na	1.8
Sodium	25	na	na	80	10	na	na	12
Specific conductance (µmho/cm)	272	na	na	765	113	na	na	240
Sulfate	23	na	na	39	9.3	na	na	6.5
Surfactants	0.06	na	na	<0.1	<0.05	na	na	<0.1
Total alkalinity (as $CaCO_3$)	66	na	na	179	26	na	na	84
Total dissolved solids (TDS)	203	na	na	407	91	na	na	137
Total hardness (as $CaCO_3$)	63	na	na	201	32	na	na	44
Total phosphorus (as P)	0.68	na	na	0.23	0.24	na	na	0.24
Zinc	0.02	na	na	0.012	0.02	na	na	0.03

Table 7-12. Compliance monitoring data for the four releases from the Drainage Retention Basin sampled in 1998 (continued).

Parameter	CDBX				WPDC			
	2/12	8/12	11/2–11/6	11/30	2/12	8/12	11/2–11/6	11/30
Total general minerals (mg/L)								
Aluminum	5.9	na	1.6	2.1	7	na	0.31	2.8
Bicarbonate alkalinity (as $CaCO_3$)	na	na	175	166	na	na	191	50
Calcium	16	na	45	43	9.7	na	48	12
Carbonate alkalinity (as $CaCO_3$)	na	na	18	5.7	na	na	18	<5
Chloride	na	na	84	98	na	na	97	6.7
Copper	<0.01	na	<0.01	<0.01	0.01	na	<0.01	<0.01
Fluoride	na	na	0.46	0.34	na	na	0.47	0.07
Hydroxide alkalinity (as $CaCO_3$)	na	na	<5	<5	na	na	<5	<5
Iron	5.4	na	1.4	2.1	7.8	na	0.37	3
Magnesium	6.7	na	20	21	4.6	na	21	4.9
Manganese	0.09	na	0.05	0.052	0.17	na	0.01	0.06
Nickel	<0.05	na	<0.05	<0.05	<0.05	na	<0.05	<0.05
Nitrate (as N)	na	na	0.91	1.8	na	na	0.91	0.95
Nitrate (as NO_3)	na	na	4	7.8	na	na	4	4.2
Nitrite (as N)	na	na	0.03	<0.02	na	na	0.03	<0.02
Orthophosphate	na	na	0.75	0.42	na	na	0.75	0.4
pH (pH units)	na	na	8.45	8.31	na	na	8.31	7.61
Potassium	4.5	na	2.7	2.8	2.6	na	2.5	2.4
Sodium	24	na	68	76	9.2	na	76	13
Specific conductance (μmho/cm)	na	na	715	761	na	na	790	150
Sulfate	na	na	29	41	na	na	35	4
Surfactants	na	na	<0.05	<0.1	na	na	<0.05	<0.1
Total alkalinity (as $CaCO_3$)	na	na	193	172	na	na	209	50
Total dissolved solids (TDS)	na	na	407	447	na	na	453	95
Total hardness (as $CaCO_3$)	na	na	195	194	na	na	206	50
Total phosphorus (as P)	na	na	0.28	0.21	na	na	0.27	0.21
Total suspended solids (TSS)	67	37	27	37	158	na	6	54
Dissolved metals (mg/L)								
Aluminum	<0.05	na	na	<0.05	<0.05	na	na	0.14
Antimony	<0.004	na	na	<0.004	<0	na	na	<0.004
Arsenic	<0.002	na	na	0.0038	<0.002	na	na	<0.002
Barium	0.12	na	na	0.13	0.13	na	na	0.05
Beryllium	<0.002	na	na	<0.0002	<0.002	na	na	<0.002
Boron	0.77	na	na	1.3	0.19	na	na	0.15
Cadmium	<0.005	na	na	<0.0005	<0.0005	na	na	<0.0005
Chromium	<0.001	na	na	0.0031	0.0013	na	na	0.0033
Cobalt	<0.05	na	na	<0.05	<0.05	na	na	<0.05
Copper	0.0041	na	na	0.0032	0.0026	na	na	0.0032

Table 7-12. Compliance monitoring data for the four releases from the Drainage Retention Basin sampled in 1998 (continued).

Parameter	CDBX				WPDC			
	2/12	8/12	11/2–11/6	11/30	2/12	8/12	11/2–11/6	11/30
Dissolved metals (mg/L) (continued)								
Chromium(VI)	0.007	<0.002	na	0.003	0.008	0.0059	na	0.004
Iron	0.758	na	na	<0.05	<0.05	na	na	0.13
Lead	<0.005	na	na	<0.005	<0.005	na	na	<0.005
Manganese	<0.01	na	na	<0.01	<0.01	na	na	<0.01
Mercury	<0.002	na	na	<0.0002	<0.0002	na	na	<0.0002
Molybdenum	<0.025	na	na	<0.025	<0.025	na	na	<0.025
Nickel	0.0044	na	na	0.0024	<0.002	na	na	<0.002
Selenium	<0.004	na	na	<0.002	<0.004	na	na	<0.002
Silver	<0.002	na	na	<0.001	<0.002	na	na	<0.001
Thallium	<0.002	na	na	<0.001	<0.002	na	na	<0.001
Vanadium	<0.01	na	na	<0.01	<0.01	na	na	<0.01
Zinc	0.024	na	na	<0.02	0.026	na	na	0.027
Total metals (mg/L)								
Aluminum	<0.05	1.6	1.3	2.4	<0.05	<0.05	0.32	2.9
Antimony	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Arsenic	0.0027	0.0069	0.0051	0.0045	0.0023	0.0041	0.0042	0.0021
Barium	0.11	0.13	0.16	0.15	0.12	0.09	0.12	0.06
Beryllium	0.005	<0	<0.0002	<0.0002	0	<0	<0	<0.0002
Boron	0.74	1	0.97	1.4	0.2	1.6	1.1	0.19
Cadmium	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Chromium	0.011	0.0072	0.0064	0.0088	0.015	0.011	0.0056	0.0092
Cobalt	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Copper	0.0084	0.0037	0.005	0.0073	0.018	0.0014	0.0029	0.0076
Iron	0.07	1.7	1.4	2.4	<0.05	0.058	0.38	3.4
Lead	<0.005	<0.0005	<0.005	<0.005	0.035	<0.005	<0.005	<0.005
Manganese	<0.01	0.11	0.051	0.057	<0.01	<0.01	0.014	0.066
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.03	<0.03	<0.0025	<0.025	<0.025	<0.025	<0.025	<0.025
Nickel	0.02	0.0082	0.0061	0.0082	0.018	<0.002	<0.002	0.0083
Selenium	<0.004	<0.002	<0.002	<0.002	<0.004	<0.002	<0.002	<0.002
Silver	<0.001	<0.001	<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	<0.001	<0.001
Vanadium	<0.01	0.011	0.011	0.012	<0.01	<0.01	0.01	<0.01
Zinc	0.024	<0.02	<0.02	0.038	0.028	<0.02	<0.02	0.093
Volatile organic compounds (μg/L)								
1,1,1-Trichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na
1,1,2,2-Tetrachloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na
1,1,2-Trichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na

Table 7-12. Compliance monitoring data for the four releases from the Drainage Retention Basin sampled in 1998 (continued).

Parameter	CDBX				WPDC			
	2/12	8/12	11/2–11/6	11/30	2/12	8/12	11/2–11/6	11/30
1,1-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na
1,1-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na
1,2-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na
1,2-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na
1,2-Dichloroethene (total)	na	<1	<1	<1	na	<1	na	na
1,2-Dichloropropane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na
1,3-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na
1,4-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na
2-Chloroethylvinylether	<0.5	na	na	na	<0.5	na	na	na
Bromodichloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na
Bromoform	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na
Bromomethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na
Carbon tetrachloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na
Chlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na
Chloroethane	<0.5	<1	<1	<1	<0.5	<1	na	na
Chloroform	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na
Chloromethane	<0.5	<1	<1	<1	<0.5	<1	na	na
cis-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na
cis-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na
Dibromochloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na
Dichlorodifluoromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na
Freon 113	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na
Methylene chloride	<0.5	<1	<1	<1	<0.5	<1	na	na
Tetrachloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na
Total trihalomethanes	na	<2	<2	<2	na	<2	na	na
trans-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na
trans-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na
Trichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na
Trichlorofluoromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na
Vinyl chloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na
Herbicides (μg/L)								
Atrazine	<0.4	na	<0.2	<0.2	<0.4	na	na	<0.2
Barban	na	na	<5	na	na	na	na	na
Bromacil	1.8	na	<0.5	2.5	<1	na	na	4.5
Butachlor	<0.6	na	<0.3	<0.3	<0.6	na	na	<0.3
Carbaryl	na	na	<5	na	na	na	na	na
Carbofuran	na	na	<10	na	na	na	na	na

Table 7-12. Compliance monitoring data for the four releases from the Drainage Retention Basin sampled in 1998 (concluded).

Parameter	CDBX				WPDC			
	2/12	8/12	11/4	11/30	2/12	8/12	11/4	11/30
Herbicides (μg/L) (continued)								
Chloropropham	na	na	<1	na	na	na	na	na
Diazinon	<0.4	na	<0.2	<0.2	<0.4	na	na	<0.2
Dimethoate	<4	na	<2	<2	<4	na	na	<2
Diuron	<1	na	<1	3.5	<1	na	na	2.8
Fenuron	na	na	<1	na	na	na	na	na
Fluometuron	na	na	<5	na	na	na	na	na
Glyphosate	<9	na	<9	<9	26	na	na	<9
Linuron	na	na	<0.5	na	na	na	na	na
Methomyl	na	na	<10	na	na	na	na	na
Metolachlor	<1	na	<0.5	<0.5	<1	na	na	<0.5
Metribuzin	<1	na	<0.5	<0.5	<1	na	na	<0.5
Molinate	<1	na	<0.5	<0.5	<1	na	na	<0.5
Monuron	na	na	<1	na	na	na	na	na
Neburon	na	na	<1	na	na	na	na	na
Oxamyl	na	na	<5	na	na	na	na	na
Prometryn	<1	na	<0.5	<0.5	<1	na	na	<0.5
Propachlor	<1	na	<0.5	<0.5	<1	na	na	<0.5
Propham	na	na	<3	na	na	na	na	na
Propoxur	na	na	<10	na	na	na	na	na
Siduron	na	na	<1	na	na	na	na	na
Simazine	<0.4	na	<0.2	<0.2	<0.4	na	na	<0.2
Thiobencarb	<1	na	<0.5	<0.5	<1	na	na	<0.5
Miscellaneous organics (mg/L)								
Chemical oxygen demand	39	na	<20	28	38	na	na	52
Oil and grease	<1	na	na	3.4	<1	na	na	4.5
Total organic carbon (TOC)	12	na	4.6	5.8	3.4	na	na	5.5
Radioactive (Bq/L)								
Gross alpha	0.023 ± 0.03	na	0.15 ± 0.09	0.15 ± 0.07	0.02 ± 0.02	na	na	0.023 ± 0.03
Gross beta	0.11 ± 0.09	na	0.002 ± 0.08	0.15 ± 0.07	0.004 ± 0.08	na	na	0.13 ± 0.08
Tritium	4.7 ± 1.3	na	23.5 ± 2.4	18.5 ± 2.2	6.7 ± 1.4	na	na	1.1 ± 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] na = Not analyzed because the analysis was not required.

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

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

[d] IC 25 = 50% Inhibition concentration; concentration at which 50% of the organisms show inhibition responses.

[e] NOEC = No observed effect concentration.

[f] LOEC = Lowest observed effect concentration.

Table 7-13. Monthly analyses of water samples collected from the Drainage Retention Basin from sample location CDBE

Parameter	1/14	2/12	3/4	4/15	5/7	6/4
Nutrients (mg/L)						
Ammonia nitrogen (as N)	0.08	0.12	0.16	0.09	0.15	0.02
Nitrate (as N)	0.79	0.50	0.43	0.10	0.21	<0.1
Nitrate (as NO_3)	2.2	2.2	1.9	0.44	0.94	<0.4
Nitrate plus nitrite (as N)	na[(a)]	na	na	na	na	na
Nitrate plus nitrite (as NO_3)	na	na	na	na	na	na
Nitrite (as N)	0.02	0.05	0.04	<0.02	<0.02	<0.02
Nitrite (as NO_2)	0.07	0.16	0.13	<0.07	<0.07	<0.07
Total Kjeldahl nitrogen	0.88	1.2	1.0	0.80	0.85	3.9
General minerals (mg/L)						
Aluminum	2.5	6.8	3.0	1.0	0.72	0.25
Bicarbonate alkalinity (as $CaCO_3$)	103	71	75	93	106	68
Calcium	25	18	15	22	26	30
Carbonate alkalinity (as $CaCO_3$)	<1	<1	<1	13	7.7	57
Chloride	80	23	24	40	43	56
Copper	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fluoride	0.21	0.15	0.15	0.18	0.22	0.27
Hydroxide alkalinity (as $CaCO_3$)	<1	<1	<1	<5	<5	<5
Iron	3.1	5.7	2.6	1.0	0.74	0.32
Magnesium	12	7.4	5.6	8.8	10	13
Manganese	0.073	0.091	0.046	0.06	0.094	0.15
Nickel	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nitrate (as N)	0.79	0.50	0.36	0.10	0.21	<0.1
Nitrate (as NO_3)	2.2	2.2	1.6	0.44	0.94	<0.4
Nitrite (as N)	0.03	0.05	0.04	<0.02	<0.02	<0.02
Orthophosphate	1.60	1.50	1.60	0.08	0.81	0.51
pH (pH units)	7.8	7.5	7.6	9.0	8.8	9.4
Potassium	3.2	4.9	2.8	2.5	2.6	2.4
Sodium	67	30	24	37	46	50
Specific conductance (μmho/cm)	570	293	323	400	423	474
Sulfate	49	24	26	28	26	29
Surfactants	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Total alkalinity (as $CaCO_3$)	103	71	75	106	100	125
Total dissolved solids (TDS)	366	211	196	251	260	298
Total hardness (as $CaCO_3$)	112	75	61	91	106	128
Total phosphorus (as P)	0.28	0.67	1.3	0.85	0.34	0.25
Total phosphorus (as PO_4)	na	na	na	na	na	na

Table 7-13. Monthly analyses of water samples collected from the Drainage Retention Basin from sample location CDBE (continued).

Parameter	1/14	2/12	3/4	4/15	5/7	6/4
General minerals (mg/L)						
Total suspended solids (TSS)	41	na	31	14	na	na
Zinc	0.034	0.059	0.017	0.020	0.032	<0.010
Total metals (mg/L)						
Aluminum	2.2	6.2	3.5	0.67	0.81	0.31
Antimony	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Arsenic	0.0026	<0.0020	0.0028	0.0022	0.0026	0.0036
Barium	0.11	0.13	0.11	0.082	0.084	0.076
Beryllium	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Boron	1.6	0.85	0.79	0.94	0.99	1.0
Cadmium	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Chromium	0.0096	0.011	0.0077	0.0046	0.0039	0.0027
Chromium(VI)	na	0.008	0.039	0.012	0.003	0.003
Cobalt	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Copper	0.0099	0.014	0.0056	0.0046	0.0051	0.0034
Iron	2.7	5.8	3.1	0.83	0.87	0.34
Lead	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Manganese	0.071	0.099	0.054	0.062	0.085	0.15
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	0.0094	0.019	0.011	0.007	0.0088	0.0023
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	0.016	0.010	<0.01	<0.01	<0.01
Zinc	0.033	0.056	<0.02	<0.02	<0.02	<0.02
Miscellaneous organics (μg/L)						
Chlorophyll-a	<5	<5	5.95	<5	21.6	40.3

Table 7-13. Monthly analyses of water samples collected from the Drainage Retention Basin from sample location CDBE (continued).

Parameter	7/8	8/12	9/9	10/7	11/5	12/10
Nutrients (mg/L)						
Ammonia nitrogen (as N)	0.26	0.20	0.06	<0.02	<0.02	0.19
Nitrate (as N)	<0.1	0.40	na	1.10	0.82	1.90
Nitrate (as NO3)	<0.4	1.8	na	4.7	3.6	8.4
Nitrate plus nitrite (as N)	na	na	0.7	na	na	na
Nitrate plus nitrite (as NO_3)	na	na	3.1	na	na	na
Nitrite (as N)	<0.02	0.06	na	0.07	<0.02	<0.5
Nitrite (as NO_2)	<0.07	0.19	na	0.23	<0.07	<0.5
Total Kjeldahl nitrogen	1.3	1.1	0.85	0.84	0.72	0.92
General minerals (mg/L)						
Aluminum	0.84	2.0	1.4	1.7	1.4	0.48
Bicarbonate alkalinity (as $CaCO_3$)	145	160	166	161	na	170
Calcium	35	40	44	43	na	51
Carbonate alkalinity (as $CaCO_3$)	11	17	25	52	na	<1
Chloride	63	75	79	88	na	110
Copper	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05
Fluoride	0.32	0.37	0.37	0.52	na	0.40
Hydroxide alkalinity (as $CaCO_3$)	<5	<5	<5	<5	na	<1
Iron	0.91	2.4	1.4	1.6	1.3	0.32
Magnesium	15	18	20	20	na	23
Manganese	0.29	0.14	0.062	0.054	0.049	<0.03
Nickel	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1
Nitrate (as N)	<0.1	0.40	0.70	1	na	1.9
Nitrate (as NO3)	<0.4	1.8	3.1	4.5	na	8.4
Nitrite (as N)	<0.02	0.1	0.04	0.07	na	<0.5
Orthophosphate	0.92	0.90	0.79	0.83	na	0.08
pH (pH units)	8.7	8.3	8.6	8.4	na	8.4
Potassium	2.7	3.2	3.1	2.9	na	2.5
Sodium	58	65	68	65	na	86
Specific conductance (μmho/cm)	550	610	670	710	na	690
Sulfate	27	27	28	30	na	47
Surfactants	<0.05	<0.05	<0.05	<0.05	na	<0.50
Total Alkalinity (as $CaCO_3$)	156	177	191	213	na	170
Total dissolved solids (TDS)	342	394	402	440	na	440
Total hardness (as $CaCO_3$)	149	na	192	190	na	220
Total phosphorus (as P)	0.37	0.38	0.35	0.33	na	na
Total phosphorus (as PO_4)	na	na	na	na	na	0.66

Table 7-13. Monthly analyses of water samples collected from the Drainage Retention Basin from sample location CDBE (continued).

Parameter	7/8	8/12	9/9	10/7	11/5	12/10
General minerals (mg/L)						
Total suspended solids (TSS)	10	39	22	24	na	16
Zinc	0.021	0.046	0.016	0.015	0.014	<0.05
Total metals (mg/L)						
Aluminum	0.83	2.2	1.3	1.7	1.6	0.27
Antimony	<0.004	<0.004	<0.004	<0.004	<0.004	<0.005
Arsenic	0.0041	0.0051	0.0047	0.0062	0.0051	0.0043
Barium	0.10	0.13	0.15	0.152	0.16	0.13
Beryllium	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0005
Boron	1.1	1.1	1.1	0.96	1.0	1.1
Cadmium	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Chromium	0.0054	0.012	0.0046	0.0052	0.0047	0.0045
Chromium(VI)	0.003	<0.002	0.002	0.008	0.009	<0.002
Cobalt	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Copper	0.0048	0.0084	0.0093	0.0037	0.0045	<0.01
Iron	0.91	2.3	1.3	1.6	1.4	0.33
Lead	<0.005	<0.005	<0.005	<0.005	<0.005	0.0037
Manganese	0.29	0.14	0.062	0.054	0.053	<0.03
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.025	<0.025	<0.025	<0.025	<0.025	<0.05
Nickel	0.0051	0.0091	0.0054	0.0073	0.0051	0.0062
Selenium	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Silver	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0005
Thallium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	<0.01	0.012	0.010	0.015	0.014	<0.05
Zinc	<0.02	0.032	<0.02	<0.02	<0.02	<0.02
Miscellaneous organics (μg/L)						
Chlorophyll-a	8.7	3.8	<5	6.09	5.07	29

Table 7-13. Monthly analyses of water samples collected from the Drainage Retention Basin from sample location CDBE (continued).

Parameter	Number of samples	Minimum	Maximum	Median	Interquartile range
Nutrients (mg/L)					
Ammonia nitrogen (as N)	12	<0.02	0.26	0.11	0.12
Nitrate (as N)	11	<0.1	1.9	0.43	0.65
Nitrate (as NO_3)	11	<0.4	8.4	1.9	2.2
Nitrate plus nitrite (as N)	1	0.7	0.7	0.7	0
Nitrate plus nitrite (as NO_3)	1	3.1	3.1	3.1	0
Nitrite (as N)	11	<0.02	<0.5	<0.02	0.04
Nitrite (as NO_2)	11	<0.07	<0.5	0.07	0.11
Total Kjeldahl nitrogen	12	0.72	3.9	0.9	0.28
General Minerals (mg/L)					
Aluminum	12	0.25	6.8	1.4	1.3
Bicarbonate alkalinity (as $CaCO_3$)	11	68	170	106	77
Calcium	11	15	51	30	18
Carbonate alkalinity (as $CaCO_3$)	11	<1	57	11	20
Chloride	11	23	110	63	38
Copper	12	<0.01	<0.05	<0.01	0
Fluoride	11	0.15	0.52	0.27	0.18
Hydroxide alkalinity (as $CaCO_3$)	11	<1	<5	<5	4
Iron	12	0.32	5.7	1.4	1.6
Magnesium	11	5.6	23	13	9.6
Manganese	12	0.03	0.29	0.068	0.053
Nickel	12	<0.05	<0.1	<0.05	0
Nitrate (as N)	11	<1	1.9	0.4	0.6
Nitrate (as NO_3)	11	<0.4	8.4	1.8	2.0
Nitrite (as N)	11	<0.02	<0.5	0.04	0.04
Orthophosphate	11	0.08	1.60	0.83	0.56
pH (pH units)	11	7.5	9.4	8.4	0.7
Potassium	11	2.4	4.9	2.8	0.6
Sodium	11	24	86	58	25
Specific conductance (μmho/cm)	11	293	710	550	229
Sulfate	11	24	49	28	3
Surfactants	11	<0.05	<0.5	<0.05	0.00
Total alkalinity (as $CaCO_3$)	11	71	213	125	72
Total dissolved solids (TDS)	11	196	440	342	143
Total hardness (as $CaCO_3$)	10	61	220	120	85
Total phosphorus (as P)	10	0.25	1.30	0.36	0.27
Total phosphorus (as PO4)	1	0.66	0.66	0.66	0.00

Table 7-13. Monthly analyses of water samples collected from the Drainage Retention Basin from sample location CDBE (concluded).

Parameter	Number of samples	Minimum	Maximum	Median	Interquartile range
General Minerals (mg/L) (continued)					
Total suspended solids (TSS)	8	10	41	23	18
Zinc	12	<0.01	0.059	0.021	0.021
Total metals (mg/L)					
Aluminum	12	0.27	6.2	1.5	1.4
Antimony	12	<0.004	<0.005	<0.004	0
Arsenic	12	0.002	0.0062	0.0039	0.002
Barium	12	0.076	0.16	0.12	0.039
Beryllium	12	<0.0002	<0.0005	<0.0002	0
Boron	12	0.79	1.6	1	0.15
Cadmium	12	<0.0005	<0.0005	<0.0005	0
Chromium	12	0.0027	0.012	0.005	0.004
Chromium(VI)	11	<0.002	0.039	0.003	0.006
Cobalt	12	<0.05	<0.05	<0.05	0
Copper	12	0.0034	0.014	0.0054	0.005
Iron	12	0.33	5.8	1.4	1.5
Lead	12	0.0037	<0.005	<0.005	0
Manganese	12	<0.03	0.29	0.067	0.055
Mercury	12	<0.0002	<0.0002	<0.0002	0
Molybdenum	12	<0.025	<0.05	<0.025	0
Nickel	12	0.0023	0.019	0.0072	0.004
Selenium	12	<0.002	<0.002	<0.002	0
Silver	12	<0.0005	<0.001	<0.001	0
Thallium	12	<0.001	<0.001	<0.001	0
Vanadium	12	<0.01	<0.05	0.01	0.004
Zinc	12	<0.02	0.056	<0.02	0.003
Miscellaneous Organics (ug/L)					
Chlorophyll-a	12	3.8	40.3	5.5	6.9

[a] na = Sample not analyzed either because the sample was preserved incorrectly for the analysis or the analytical laboratory ran an alternate method to the routine method.

Table 7-14. Quarterly analyses of water samples collected from the Drainage Retention Basin from sample location CDBE.

Parameter	1/14	2/12[a]	2/24[b]	3/4	4/15	8/12	10/7
Biological							
Fecal coliform MPN/100ml	>1600	na[(c)]	900	na	50	<2	11
Total coliform MPN/100ml	>1600	na	>1600	na	130	<240	130
Herbicides (μg/L)[(d)]							
Acenaphthylene	na	na	na	na	na	<0.1	na
Alachlor	na	na	na	na	na	<0.2	na
Aldrin	na	na	na	na	na	<0.5	na
Anthracene	na	na	na	na	na	<0.1	na
Atraton	na	na	na	na	na	<0.5	na
Atrazine	<0.2	na	na	na	<0.2	<0.2	<0.2
Benzo(*a*)anthracene	na	na	na	na	na	<0.3	na
Benzo(*a*)pyrene	na	na	na	na	na	<0.1	na
Benzo(*b*)fluoranthene	na	na	na	na	na	<0.3	na
Benzo(*g,h,i*)perylene	na	na	na	na	na	<0.3	na
Benzo(*k*)fluoranthene	na	na	na	na	na	<0.3	na
BHC, delta isomer	na	na	na	na	na	<0.2	na
BHC, gamma isomer (Lindane)	na	na	na	na	na	<0.1	na
Bromacil	16	na	na	na	1.4	<0.5	<0.5
Butachlor	<0.3	na	na	na	<0.3	<0.3	<0.3
Butylbenzylphthalate	na	na	na	na	na	<1	na
Chlordane	na	na	na	na	na	<2	na
Chrysene	na	na	na	na	na	<0.3	na
Di (2-ethylhexyl) adipate	na	na	na	na	na	<1	na
Diazinon	<0.2	na	na	na	<0.2	<0.2	<0.2
Dibenzo(*a,h*)anthracene	na	na	na	na	na	<0.3	na
Dibutylphthalate	na	na	na	na	na	<1	na
Diethylhexylphthalate	na	na	na	na	na	<3	na
Diethylphthalate	na	na	na	na	na	<3	na
Dimethoate	<2	na	na	na	<2	<2	<2
Dimethylphthalate	na	na	na	na	na	<1	na
Diuron	25	<1	na	<1	<1	<1	<1
Endrin	na	na	na	na	na	<0.2	na
Fluorene	na	na	na	na	na	<0.1	na
Glyphosate	<9	na	na	na	<9	<9	<9
Heptachlor	na	na	na	na	na	<0.1	na
Heptachlor epoxide	na	na	na	na	na	<0.1	na
Hexachlorobenzene	na	na	na	na	na	<0.5	na
Hexachlorocyclopentadiene	na	na	na	na	na	<1	na

Table 7-14. Quarterly analyses of water samples collected from the Drainage Retention Basin from sample location CDBE (concluded).

Parameter	1/14	2/12[a]	2/24[b]	3/4	4/15	8/12	10/7
Herbicides (μg/L) (continued)							
Indeno(1,2,3-*c,d*)pyrene	na	na	na	na	na	<0.3	na
Methoxychlor	na	na	na	na	na	<0.5	na
Metolachlor	<0.5	na	na	na	<0.5	<0.5	<0.5
Metribuzin	<0.5	na	na	na	<0.5	<0.5	<0.5
Molinate	<0.5	na	na	na	<0.5	<0.5	<0.5
Pentachlorophenol	na	na	na	na	na	<1	na
Phenanthrene	na	na	na	na	na	<0.1	na
Prometon	na	na	na	na	na	<0.5	na
Prometryn	<0.5	na	na	na	<0.5	<0.5	<0.5
Propachlor	<0.5	na	na	na	<0.5	<0.5	<0.5
Pyrene	na	na	na	na	na	<0.1	na
Secbumeton	na	na	na	na	na	<0.5	na
Simazine	<0.2	na	na	na	<0.2	<0.2	<0.2
Terbutryn	na	na	na	na	na	<0.5	na
Thiobencarb	<0.5	na	na	na	<0.5	<0.5	<0.5
Toxaphene	na	na	na	na	na	<5	na
Miscellaneous Organics (mg/L)	na	na	na	na	na	na	na
Chemical oxygen demand	32	na	na	na	na	na	na
Chemical oxygen demand	na	na	na	na	27	22	27
Oil and grease	<1	na	na	na	<1	<1	<1

[a] Repeat sample for coliform, other analyses not run.

[b] Repeat sample for diuron, other analyses not run.

[c] na= Not analyzed.

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

Table 7-15. Semiannual/annual analyses of water samples collected from the Drainage Retention Basin from sample location CDBE.

Parameter	Sampling date				
	2/24[a]	4/15	6/4	10/7	11/5
Biological					
Aqueous Bioassay					
Pimephales promelas survival (percent survival)	na[b]	sa[c]	sa	80	sa
Pimephales promelas growth (toxic units)	na	sa	sa	2	sa
Pimephales promelas growth, IC-25[d]	na	sa	sa	69	sa
Pimephales promelas growth, IC-50[e]	na	sa	sa	98	sa
Pimephales promelas growth, LOEC[f]	na	sa	sa	100	sa
Pimephales promelas growth, NOEC[g]	na	sa	sa	50	sa
Pimephales promelas survival, LC-50[h]	na	sa	sa	>100	sa
Pimephales promelas survival, LOEC	na	sa	sa	100	sa
Pimephales promelas survival, NOEC	na	sa	sa	50	sa
Pimephales promelas survival (toxic units)	na	sa	sa	2	sa
Ceriodaphnia dubia survival, LC-50	na	sa	sa	>100	sa
Ceriodaphnia dubia survival, LOEC	na	sa	sa	>100	sa
Ceriodaphnia dubia survival, NOEC	na	sa	sa	>100	sa
Ceriodaphnia dubia survival (toxic units)	na	sa	sa	<1	sa
Ceriodaphnia dubia reproduction, IC-25	na	sa	sa	81	sa
Ceriodaphnia dubia reproduction, IC-50	na	sa	sa	>100	sa
Ceriodaphnia dubia reproduction, LOEC	na	sa	sa	100	sa
Ceriodaphnia dubia reproduction, NOEC	na	sa	sa	50	sa
Ceriodaphnia dubia reproduction, toxic unit	na	sa	sa	2	sa
Selanastrum capriocornutum growth, IC-25	na	sa	sa	>100	sa
Selanastrum capriocornutum growth, IC-50	na	sa	sa	>100	sa
Selanastrum capriocornutum growth, LOEC	na	sa	sa	>100	sa
Selanastrum capriocornutum growth, NOEC	na	sa	sa	>100	sa
Selanastrum capriocornutum growth (toxic units)	na	sa	sa	<1	sa
Volatile organic compounds (µg/L)					
1,1,1-Trichloroethane	na	na	<0.5	<0.5	<0.5
1,1,2,2-Tetrachloroethane	na	na	<0.5	<0.5	<0.5
1,1,2-Trichloroethane	na	na	<0.5	<0.5	<0.5
1,1-Dichloroethane	na	na	<0.5	<0.5	<0.5
1,1-Dichloroethene	na	na	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	na	na	<0.5	<0.5	<0.5
1,2-Dichloroethane	na	na	<0.5	<0.5	<0.5
1,2-Dichloroethene (total)	na	na	<1	<1	<1
1,2-Dichloropropane	na	na	<0.5	<0.5	<0.5

Table 7-15. Semiannual/annual analyses of water samples collected from the Drainage Retention Basin from sample location CDBE (continued).

Parameter	Sampling date				
	2/24[a]	4/15	6/4	10/7	11/5
Volatile organic compounds (μg/L) (continued)					
1,3-Dichlorobenzene	na[b]	na	<0.5	<0.5	<0.5
1,4-Dichlorobenzene	na	na	<0.5	<0.5	<0.5
Bromodichloromethane	na	na	<0.5	<0.5	<0.5
Bromoform	na	na	<0.5	<0.5	<0.5
Bromomethane	na	na	<0.5	<0.5	<0.5
Carbon tetrachloride	na	na	<0.5	<0.5	<0.5
Chlorobenzene	na	na	<0.5	<0.5	<0.5
Chloroethane	na	na	<1	<1	<1
Chloroform	na	na	<0.5	<0.5	<0.5
Chloromethane	na	na	<1	<1	<1
cis-1,2-Dichloroethene	na	na	<0.5	<0.5	<0.5
cis-1,3-Dichloropropene	na	na	<0.5	<0.5	<0.5
Dibromochloromethane	na	na	<0.5	<0.5	<0.5
Dichlorodifluoromethane	na	na	<0.5	<0.5	<0.5
Freon 113	na	na	<0.5	<0.5	<0.5
Methylene chloride	na	na	<1	<1	<1
Tetrachloroethene	na	na	<0.5	<0.5	<0.5
Total Trihalomethanes	na	na	<2	<2	<2
trans-1,2-Dichloroethene	na	na	<0.5	<0.5	<0.5
trans-1,3-Dichloropropene	na	na	<0.5	<0.5	<0.5
Trichloroethene	na	na	<0.5	<0.5	<0.5
Trichlorofluoromethane	na	na	<0.5	<0.5	<0.5
Vinyl chloride	na	na	<0.5	<0.5	<0.5
Miscellaneous organics					
Total organic carbon (TOC) (mg/L)	na	7.9		4	5
Radioactive (Bq/L)					
Gross alpha	0.017 ± 0.036	003 ± 0.036	na	0.052 ± 0.059	0.1 ± 0.063
Gross beta	0.16 ± 0.14	0.078 ± 0.085	0.12 ± 0.078	na	0.034 ± 0.067
Tritium	na	9.15 ± 1.45	na	24.3 ± 2.4	23.3 ± 2.4

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] Make-up value for lost October 97 analysis, no other parameters were analyzed.

[b] na = Not analyzed.

[c] sa = Annual sample.

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

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

[f] LOEC = Lowest observed effect concentration.

[g] NOEC = No observed effect concentration.

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

Table 7-16. Field data collected from the Drainage Retention Basin at eight locations.

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)
1/14	3.9	8.9	7.2	9.6	7.6	9.1	7.7	8.5	0.18
1/23	6.7	13.7	7.2	11.3	6.6	10.9	6.3	10.2	na
1/30	6.4	12.4	7.6	12.5	6.9	12.6	6.8	12.6	na
2/4	7.4	14.0	7.7	10.8	7.9	10.6	8.2	10.6	na
2/12	6.7	12.2	7.9	10.8	7.5	10.3	7.4	10.2	na
2/20	7.7	12.5	7.1	10.7	7.2	10.1	7.1	9.7	0.15
2/26	7.4	14.5	7.5	11.9	7.4	11.6	7.1	10.9	na
3/4	7.0	13.8	7.8	13.4	7.3	13.0	6.8	11.6	0.23
3/13	8.4	20.9	9.2	15.2	10.3	14.3	9.9	13.7	na
3/20	14.5	17.8	12.3	16.4	12.2	15.2	4.1	13.2	na
4/10	13.0	19.2	12.6	17.9	12.3	15.4	9.5	13.9	0.50
4/15	8.0	19.3	8.2	16.3	7.6	13.9	6.1	13.9	0.66
4/22	12.7	20.6	13.4	21.2	10.4	18.1	5.1	16.7	0.66
4/27	10.6	20.5	14.3	21.2	13.1	18.7	10.5	18.1	0.55
5/7	6.2	18.5	6.2	18.3	6.0	18.4	5.9	18.4	0.71
5/15	9.9	20.0	8.9	17.1	8.5	16.4	7.0	16.1	0.86
5/20	11.8	16.7	10.1	17.8	10.1	17.5	8.6	17.2	0.76
5/29	15.2	16.2	13.3	17.3	13.0	17.2	12.3	17.2	0.58
6/4	9.5	22.0	9.2	19.8	9.2	19.4	8.6	19.3	0.94
6/11	8.6	19.3	8.2	19.4	8.1	19.4	7.3	19.4	0.89
6/19	7.6	23.7	7.0	23.9	7.2	23.0	6.6	22.2	0.69
6/25	7.7	24.3	7.2	25.7	7.2	22.7	6.4	22.5	0.55
7/8	6.2	29.4	5.5	25.7	5.3	24.9	4.4	24.6	0.74
7/17	9.9	27.0	7.4	30.2	6.4	26.0	4.8	25.9	0.51
7/24	7.6	32.2	5.3	26.3	5.3	26.9	3.7	26.0	0.51
7/31	6.1	28.8	5.2	29.3	5.5	24.2	3.9	24.2	0.38
8/6	8.1	28.5	6.7	25.5	6.7	26.9	4.8	26.9	0.41
8/13	5.2	26.7	4.7	27.4	4.3	26.5	3.6	26.3	0.25
8/21	6.5	24.5	7.1	20.3	6.4	23.0	4.9	22.9	0.23
8/28	6.5	24.1	7.0	22.3	6.5	23.5	4.8	23.0	0.25
9/3	6.3	23.9	7.2	22.5	6.4	24.0	4.6	23.0	0.20
9/9	10.0	22.6	8.8	22.2	8.7	24.2	7.0	23.3	0.40
9/17	6.0	24.2	5.8	25.0	5.9	24.6	4.9	23.2	0.18
9/25	8.4	21.6	6.4	21.3	7.0	21.0	6.2	20.8	0.34

Table 7-16. Field data collected from the Drainage Retention Basin at eight locations (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)
1/14	6.5	8.4	7.4	8.9	9.6	8.5	8.4	8.5
1/23	6.4	10.3	6.5	10.9	6.3	10.4	6.3	10.7
1/30	6.5	12.4	6.5	12.4	6.3	12.3	5.3	12.1
2/4	7.3	10.7	7.7	11.1	8.0	11.2	7.4	11.4
2/12	7.0	10.2	7.9	10.4	7.8	10.4	6.3	10.7
2/20	7.2	9.7	7.4	10.7	7.4	10.0	6.6	10.1
2/26	6.2	10.9	7.4	12.0	7.3	11.9	6.7	11.6
3/4	6.8	11.0	7.0	13.1	6.7	12.1	5.7	11.7
3/13	8.6	13.7	9.7	13.5	8.4	12.4	8.1	13.4
3/20	1.0	13.8	13.2	15.4	4.1	12.6	1.0	12.6
4/10	4.8	13.7	13.6	14.9	9.0	13.2	1.2	13.1
4/15	0.1	13.0	7.9	14.9	7.0	13.8	0.2	14.2
4/22	4.0	17.2	10.3	18.4	5.6	16.5	4.0	16.7
4/27	9.0	18.6	10.3	18.5	9.0	18.1	9.0	18.3
5/7	5.8	18.3	6.1	17.8	5.7	18.0	5.0	18.4
5/15	6.8	16.2	8.7	16.8	7.8	16.5	7.3	16.5
5/20	9.3	17.1	10.6	17.6	9.0	17.6	3.9	17.6
5/29	11.7	17.1	13.7	17.2	12.6	17.2	10.6	17.1
6/4	8.7	19.3	9.5	19.3	8.7	19.2	8.4	19.5
6/11	6.8	19.4	8.3	19.5	8.0	19.5	6.6	19.4
6/19	6.5	22.0	7.1	22.8	6.8	23.0	6.5	22.9
6/25	6.6	22.6	6.9	23.0	6.6	23.0	6.2	23.8
7/8	4.1	24.6	5.7	25.3	4.1	25.0	4.0	25.1
7/17	4.8	25.9	8.7	26.2	4.8	25.8	4.6	25.8
7/24	3.6	26.0	5.2	26.5	3.7	26.9	3.6	26.7
7/31	3.7	24.6	5.9	25.3	3.9	24.5	3.8	25.3
8/6	4.5	26.9	6.0	26.7	4.8	26.7	3.7	27.1
8/13	3.2	26.4	5.1	26.6	3.3	26.2	3.4	26.2
8/21	5.5	22.9	6.2	23.2	4.9	23.2	4.3	23.7
8/28	4.7	22.7	6.1	22.8	4.8	23.4	4.6	22.8
9/3	4.5	22.7	6.2	23.5	4.8	23.0	4.6	22.2
9/9	7.8	23.0	10.0	24.2	7.7	24.1	7.5	23.3
9/17	4.8	22.9	5.5	23.7	4.8	23.8	4.6	22.9
9/25	4.9	20.4	6.7	21.3	5.8	21.2	6.0	21.1

Table 7-16. Field data collected from the Drainage Retention Basin at eight locations (continued).

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)
10/2	8.7	19.5	8.0	18.5	8.2	19.1	6.1	19.1	na
10/7	8.2	25.0	7.8	19.2	9.0	20.0	8.6	20.8	0.38
10/13	8.0	17.4	7.5	17.9	7.7	17.8	7.5	17.7	0.51
10/16	na	na	na	na	16.2	na	16.2	na	na
10/22	10.9	17.2	9.0	18.7	8.7	17.0	8.3	17.0	0.38
10/30	10.4	13.8	8.6	14.8	8.2	16.2	8.0	16.2	0.51
11/5	9.6	16.2	11.1	15.6	9.1	15.7	9.0	15.6	0.41
11/10	9.5	14.6	9.7	11.5	9.3	13.7	8.8	13.7	0.30
11/11	8.9	17.4	8.1	13.5	9.8	13.2	7.1	13.2	0.43
11/25	8.5	16.7	10.7	12.9	10.6	13.0	6.5	13.1	0.61
12/3	10.2	12.8	9.2	11.1	11.1	12.8	7.9	12.8	0.61
12/10	9.4	11.0	10.7	9.7	11.5	9.8	9.5	9.8	0.64
12/16	9.8	11.0	11.0	10.5	12.7	9.8	9.9	9.8	0.76
12/23	11.7	9.5	12.7	7.2	14.8	6.9	13.6	6.8	0.79
12/29	13.4	8.8	14.0	6.6	13.0	6.6	12.9	6.7	0.69
Data Summary									
Number of samples	48	48	48	48	49	48	49	48	40
Minimum	3.9	8.8	4.7	6.6	4.3	6.6	3.6	6.7	0.15
Maximum	15.2	32.2	14.3	30.2	16.2	26.9	16.2	26.9	0.94
Median	8.4	18.9	7.9	17.9	8.1	17.1	7.1	16.9	0.51
Interquartile range	3.0	9.8	2.7	9.2	3.4	9.8	2.7	9.5	0.30

Table 7-16. Field data collected from the Drainage Retention Basin at eight locations (concluded).

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)
10/2	5.8	20.6	8.1	19.2	5.9	19.1	5.9	18.9
10/7	5.2	19.1	8.5	19.2	7.0	18.8	5.2	20.7
10/13	7.0	17.6	8.2	17.6	8.1	17.8	6.8	17
10/16	16.2	na[a]	na	na	na	na	na	na
10/22	7.9	17.1	8.9	17	8.9	17	8.3	17
10/30	3.3	16.2	8.9	16.1	8.3	15.8	7.7	15.8
11/5	9.4	15.6	10.1	16.9	10.9	17.2	10.6	17.5
11/10	8.0	13.6	9.1	13.8	8.8	13.9	8.0	13.8
11/11	8.4	13.1	9.8	13.4	5.9	13.3	8.0	13.4
11/25	8.6	13	11.6	13.3	6.5	13.1	6.0	13.1
12/3	8.0	12.7	11.0	12.9	8.5	12.9	8.3	12.8
12/10	9.3	9.8	9.8	9.6	9.1	9.6	8.2	9.6
12/16	8.7	9.8	12.0	10	9.9	9.9	10.3	10.3
12/23	10.2	6.8	13.4	7.2	11.5	7.1	11.9	7.1
12/29	11.3	6.7	12.8	6.7	12.5	6.7	11.5	7.2
Data Summary								
Number of samples	49	48	48	48	48	48	48	48
Minimum	0.08	6.7	5.12	6.7	3.32	6.7	0.2	7.1
Maximum	16.2	26.9	13.72	26.7	12.62	26.9	11.85	27.1
Median	6.6	17.1	8.225	17.1	7.16	17.1	6.3	17
Interquartile range	3.55	9.525	3.335	9.75	3.015	10.625	3.455	9.875

[a] na = Not analyzed

Table 7-17. Seasonal inventory of plants and animals at the Livermore site.

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 brachyr.*	P[c]	P	P	P	P	P
American goldfinch	*Spinus tristis*	NO[d]	NO	NO	NO	P	NO
American kestrel	*Falco sparverius*	P	P	P	P	P	P
Anna's hummingbird	*Calypte anna*	P	P	P	P	P	P
B-C night heron	*Nycticorax nycticorax*	NO	P	NO	NO	NO	NO
Barn owl	*Tyto alba*	NO	NO	NO	P	NO	NO
Black-capped chickadee	*Parus atricapillus*	NO	NO	NO	NO	NO	P
Black-necked stilt	*Himantopus m.*	P	NO	NO	NO	NO	NO
Brewer's blackbird	*Euphagus cyanocephalus*	P	NO	P	NO	NO	NO
Bufflehead	*Bucephala albeola*	P	P	NO	NO	NO	NO
California quail	*Callipepla californica*	P	NO	NO	NO	P	NO
Canada goose	*Branta canadensis*	P	NO	NO	NO	NO	NO
Cliff swallow	*Hirundo pyrrhonota*	P	NO	NO	NO	NO	NO
Common bushtit	*Psaltriparus minimus*	NO	P	NO	P	NO	P
Common egret	*Casmerodius albus*	P	P	P	NO	P	NO
Common snipe	*Capella gallinago*	P	NO	NO	NO	P	NO
Double-crested cormorant	*Phalacrocorax auritus*	P	P	NO	NO	NO	NO
Ferruginous hawk	*Buteo regalis*	NO	NO	NO	NO	NO	NO
Great blue heron	*Ardea herodias*	NO	P	NO	P	NO	P
Horned grebe	*Podiceps auritus*	NO	P	NO	NO	NO	NO
Killdeer	*Charadrius vociferus*	P	P	P	P	P	P
Lazuli bunting	*Passerina amoena*	NO	NO	P	NO	NO	NO
Lesser yellowlegs	*Totanus flavipes*	P	NO	NO	NO	P	NO
Loggerhead shrike	*Lanius ludovicianus*	NO	NO	P	P	P	NO
Magnolia warbler	*Dendroica magnolia*	NO	NO	NO	NO	P	NO
Mallard	*Anas platyrhynchos*	P	NO	P	NO	P	NO
Mourning dove	*Zenaida macroura*	P	NO	P	P	P	NO
Oregon junco	*Junco oreganus*	NO	NO	NO	NO	NO	P

Table 7-17. Seasonal inventory of plants and animals at the Livermore site (continued).

Common Name	Scientific Name	Location					
		DRB		Arroyo Las Positas		Tributaries (CDB and CDB2)	
		Spring[a]	Fall[b]	Spring	Fall	Spring	Fall
Pied-billed grebe	*Podilymbus podiceps*	P	P	NO	NO	NO	NO
Pine siskin	*Spinus pinus*	NO	P	NO	P	NO	P
Red-shouldered hawk	*Buteo lineatus*	NO	NO	P	NO	NO	NO
Red-tailed hawk	*Buteo jamaicensis*	NO	NO	P	P	P	P
Ring-necked duck	*Aythya collaris*	P	NO	NO	NO	NO	NO
Robin	*Turdus migratorius*	NO	NO	NO	NO	P	NO
Rock dove	*Columba livia*	P	P	P	P	P	P
Say's phoebe	*Sayornis saya*	NO	NO	NO	NO	NO	P
Snowy egret	*Leucophoyx thula*	P	NO	NO	NO	NO	NO
Turkey vulture	*Cathartes aura*	NO	NO	NO	P	NO	NO
Western meadowlark	*Sturnella neglecta*	NO	NO	NO	NO	P	NO
White-tailed kite	*Elanus leucurus*	NO	NO	P	P	P	P
Fish							
Mosquitofish	*Gambusia sp.*	P	P	NO	NO	NO	NO
Catfish	*Ictalurus sp.*	NO	P	NO	NO	NO	NO
Amphibians							
Pacific tree frog	*Hyla r.*	P	P	P	P	P	P
Western toad	*Bufo b.*	P	NO	P	NO	NO	NO
California red legged frog	*Rana a.d.*	NO	P	P	P	NO	P
Bullfrog	*Rana C.*	NO	P	NO	NO	NO	P
Vegetation							
Cattail	*Typha sp.*	P	P	NS[e]	NS	P	P
Bulrush	*Scirpus sp.*	NO	NO	NS	NS	P	P
Sedge	*Cyperus sp.*	P	NO	NS	NS	P	P

Table 7-17. Seasonal inventory of plants and animals at the Livermore site (concluded).

Common Name	Scientific Name	Spring[(a)]	Fall[(b)]
Mamals			
Red fox	*Vulpes vulpes*	P	NO
Deer mouse	*Peromyscus maniculatis*	P	NO
Stripped skunk	*Mephitis mephitis*	P	P
Feral house cat	*Felis domesticus*	P	P
Gray fox	*Urocyon cinereoargenteus*	NO	P
Meadow vole	*Microtus californicus*	NO	P
B-T Jackrabbit	*Lepus californicus*	NO	P

a Spring surveys for all species but fish were conducted in February and March. For fish species, a single survey was conducted in March.

b Fall surveys for all species but fish were conducted in October and November. For fish species, a single survey was conducted in November.

c P = present.

d NO = Not observed.

e NS = Not surveyed.

Table 7-18. Seasonal inventory of microorganisms present in the Drainage Retention Basin.

Type and Name	Phylum	Concentration (organisms/m^3)					
		Surface midsection sample			Surface shelf sample		
		1/14	5/7	10/13	1/14	5/7	10/13
Zooplankton							
Alona sp.	Arthropoda	nd[(a)]	nd	nd	nd	nd	nd
Bosmina sp.	Arthropoda	106	636	636	nd	nd	706
Diaptomus sp.	Arthropoda	177	nd	nd	212	2119	706
Cyclops sp.	Arthropoda	459	2543	nd	318	nd	nd
Daphnia sp.	Arthropoda	459	13278	13278	530	12643	5650
Branchinecta sp.	Arthropoda	nd	nd	nd	nd	nd	nd
Leptofora sp.	Arthropoda	742	nd	636	1024	nd	nd
Cypridopsis sp.	Arthropoda	106	636	636	106	106	nd
Gammarus sp.	Arthropoda	nd	nd	nd	nd	nd	nd
Mysis sp.	Arthropoda	nd	636	1271	nd	nd	nd
Polyphemus sp.	Arthropoda	nd	12996	nd	nd	70276	nd
Enchelys sp.	Protozoa	nd	636	nd	nd	706	nd
Eudorina sp.	Protozoa	nd	nd	nd	nd	nd	nd
Euglena sp.	Protozoa	nd	nd	nd	nd	706	nd
Trachelomonas sp.	Protozoa	nd	nd	nd	nd	706	nd
Eudorina sp.	Protozoa	nd	nd	nd	nd	nd	nd
Vorticella sp.	Protozoa	nd	636	nd	nd	706	nd
Paramoecium sp.	Protozoa	nd	nd	nd	nd	706	nd
Volvox sp.	Protozoa	nd	nd	nd	106	nd	nd
Keratella sp.	Rotatoria	nd	636	nd	nd	nd	nd
Monostyla sp.	Rotatoria	nd	1271	nd	nd	nd	nd
Algae							
Anacystis sp.	Chlorophyta	nd	636	nd	nd	nd	nd
Aphanizomenon sp.	Chlorophyta	nd	nd	TNTC[(b)]	nd	nd	TNTC
Aphanocapsa sp.	Chlorophyta	nd	nd	nd	nd	nd	nd
Bumillera klebs	Chlorophyta	nd	1	nd	nd	nd	nd
Ceratium hirundinella	Chlorophyta	nd	nd	6357	nd	nd	4944
Chlorella sp.	Chlorophyta	nd	565	15892	530	1413	17657
Coelastrum sp.	Chlorophyta	nd	nd	nd	nd	nd	nd
Coelosphaerium naegelianum	Chlorophyta	nd	3814	21613	nd	2013	8476
Crucigenia sp.	Chlorophyta	nd	1271	nd	nd	nd	nd
Eudorina sp.	Chlorophyta	nd	nd	nd	nd	nd	nd
Marssoniella elegans	Chlorophyta	nd	nd	nd	nd	nd	nd
Microcystis sp.	Chlorophyta	nd	88993	nd	nd	nd	nd

Table 7-18. Seasonal inventory of microorganisms present in the Drainage Retention Basin (concluded).

Type and Name	Phylum	Concentration (organisms/m^3)					
		Surface midsection sample			Surface shelf sample		
		1/14	5/7	10/13	1/14	5/7	10/13
Algae (continued)							
Ochromonas sp.	Chlorophyta	nd	nd	nd	nd	706	706
Oocystis sp.	Chlorophyta	nd	636	nd	nd	nd	nd
Pascherina	Chlorophyta	nd	636	nd	nd	nd	nd
Peiastrum sp.	Chlorophyta	nd	1271	9535	nd	80517	tntc
Pediastrum simplex	Chlorophyta	nd	nd	nd	nd	nd	nd
Polyedriopsis spinolose	Chlorophyta	nd	nd	nd	nd	nd	nd
Selenastrum sp.	Chlorophyta	nd	nd	nd	nd	706	nd
Spirogyra sp.	Chlorophyta	nd	nd	636	nd	nd	706
Synedra sp.	Chlorophyta	nd	nd	nd	nd	nd	nd
Synura sp.	Chlorophyta	nd	nd	nd	nd	nd	nd
Tribonema sp.	Chlorophyta	nd	nd	nd	nd	nd	nd
General microganism counts							
Total direct microorganism (cells/mL)		$6.7 \times 10^5 \pm 4.9 \times 10^4$	$5.45 \times 10^5 \pm 0$	$4.81 \times 10^5 \pm 8.49 \times 10^3$	$6.0 \times 10^5 \pm 4.1 \times 10^4$	$5.45 \times 10^5 \pm 1.6 \times 10^4$	$4.47 \times 10^5 \pm 7.78 \times 10^3$
Heterotrophic bacteria (cells/mL)		$2.3 \times 10^5 \pm 2.3 \times 10^4$	$4.6 \times 10^5 \pm 4.9 \times 10^3$	$1.2 \times 10^5 \pm 6.3 \times 10^3$	$3.4 \times 10^5 \pm 2.4 \times 10^4$	$1.0 \times 10^5 \pm 8.7 \times 10^3$	$9.0 \times 10^3 \pm 1.6 \times 10^3$
Sulfate-reducing bacteria (cfu/mL)[c]		>104	>500	>104	>104	>500	>104
		>104	>500	>104	>104	>500	>104
Blue-green algae		nd	present	present	nd	present	present
		nd	present	present	nd	nd	present

[a] nd = Not detected.

[b] tntc = To numerous to count.

[c] cfu/mL = Colony forming units per mL.

Table 7-19. Radioactivity (in Bq/L) in surface and drinking water in the Livermore Valley, 1998.

Locations	Date	Tritium	Gross alpha	Gross beta
Drinking waters				
BELL	2/24	<0.92	0.010 ± 0.037	0.15 ± 0.14
	7/13	<1.22	0.014 ± 0.035	–0.010 ± 0.12
GAS	2/24	<1.07	0.013 ± 0.041	0.038 ± 0.13
	7/13	<1.22	–0.007 ± 0.037	0.078 ± 0.13
PALM	2/24	<1.11	0 ± 0.044	0.077 ± 0.14
	7/13	<1.20	0.007 ± 0.044	0.13 ± 0.13
ORCH	2/24	<0.91	0.12 ± 0.074	0.13 ± 0.14
	7/13	<1.21	0.061 ± 0.063	0.27 ± 0.14
TAP	2/24	1.24 ± 1.12	0.025 ± 0.033	0.008 ± 0.12
	7/13	<1.19	0.005 ± 0.028	0.035 ± 0.12
Surface waters				
CAL	2/24	2.07 ± 2.09	0.012 ± 0.036	0.011 ± 0.074
	7/13	<1.20	0.069 ± 0.044	–0.047 ± 0.13
DEL	2/24	<1.09	0.042 ± 0.041	0.13 ± 0.13
	7/13	<1.24	0.025 ± 0.041	0.15 ± 0.14
DUCK	2/24	1.78 ± 1.14	0.010 ± 0.074	0.11 ± 0.14
	7/13	<1.29	0.11 ± 0.081	0.20 ± 0.13
ALAG	2/24	<1.10	0.066 ± 0.048	0.074 ± 0.13
	7/13	<1.19	0.056 ± 0.059	–0.014 ± 0.14
SHAD	2/24	1.46 ± 1.12	0.019 ± 0.052	0.14 ± 0.14
	7/13	<1.24	0.19 ± 0.074	0.22 ± 0.15
ZON7	2/24	<1.53	0.11 ± 0.059	0.16 ± 0.14
	7/13	<1.18	0.041 ± 0.037	0.029 ± 0.12
On-site pool				
POOL	2/24	7.22 ± 1.21	0.024 ± 0.074	0.31 ± 0.15
	4/7	7.81 ± 1.42	na[(a)]	na
	7/13	3.62 ± 1.34	0.039 ± 0.067	0.039 ± 0.14
	10/9	3.28 ± 2.06	na	na

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ 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 (POOL tritium analyzed quarterly, gross alpha/beta analyzed semi-annually).

Table 7-20. Summary of nondetects in storm water runoff for Livermore site nonradioactive parameters.

Parameter	Number of samples	Reporting limit
General minerals (mg/L)		
Hydroxide alkalinity (as $CaCO_3$)	35	<5
Metals (mg/L)		
Cobalt	52	<0.05
Mercury	52	<0.0002
Molybdenum	52	<0.025
Thallium	52	<0.004
Volatile organic compounds (μg/L)		
1,1,1-Trichloroethane	1	<0.5
1,1,2,2-Tetrachloroethane	1	<0.5
1,1,2-Trichloroethane	1	<0.5
1,1-Dichloroethane	1	<0.5
1,1-Dichloroethene	1	<0.5
1,2-Dichlorobenzene	1	<0.5
1,2-Dichloroethane	1	<0.5
1,2-Dichloroethene (total)	1	<1
1,2-Dichloropropane	1	<0.5
1,3-Dichlorobenzene	1	<0.5
1,4-Dichlorobenzene	1	<0.5
Bromodichloromethane	1	<0.5
Bromoform	1	<0.5
Bromomethane	1	<0.5
Carbon tetrachloride	1	<0.5
Chlorobenzene	1	<0.5
Chloroethane	1	<1
Chloroform	1	<0.5
Chloromethane	1	<1
cis-1,2-Dichloroethene	1	<0.5
cis-1,3-Dichloropropene	1	<0.5
Dibromochloromethane	1	<0.5
Dichlorodifluoromethane	1	<0.5
Freon 113	1	<0.5
Methylene chloride	1	<1

Table 7-20. Summary of nondetects in storm water runoff for Livermore site nonradioactive parameters (concluded).

Parameter	Number of samples	Reporting limit
Volatile organic compounds (μg/L) (continued)		
Tetrachloroethene	1	<0.5
Total Trihalomethanes	1	<2
trans-1,2-Dichloroethene	1	<0.5
trans-1,3-Dichloropropene	1	<0.5
Trichloroethene	1	<0.5
Trichlorofluoromethane	1	<0.5
Vinyl chloride	1	<0.5
Herbicides (μg/L)		
Atrazine	26	<0.4
Butachlor	26	<0.6
Diazinon	26	<0.4
Dimethoate	26	<4
Metolachlor	26	<1
Metribuzin	26	<1
Molinate	26	<1
Prometryn	26	<1
Propachlor	26	<1
Thiobencarb	26	<1

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 1998), which is 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 pressurized nitrogen gas 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 under contract with LLNL. LLNL personnel primarily measured tritium activity on site in a laboratory dedicated to that purpose.

The ground water radioactivity data include some small negative values (in Bq/L). They can occur when a 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 (ORAD), Water Guidance and Monitoring Group (WGMG) procedure EMP-W-S (Rev. 4*): Water Sampling*. The procedure details several sample collection methodologies appropriate for wastewater sampling. 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 equipment between use, 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. Most of the analyses were performed by the on-site analytical laboratory; however, some analyses shifted to off-site contract laboratories late in the year.

Livermore Site

Tables 9-1 to **9-9** report routine surveillance monitoring for wells along the Livermore site perimeter. **Tables 9-10** through **9-11** contain analytical data obtained from monitoring wells downgradient from the Taxi Strip Area, and **Tables 9-12** to **9-16** contain analytical data obtained from monitoring wells downgradient from the East Traffic Circle Area. **Table 9-17** contains data from W-593, downgradient from the Mixed-Waste Storage Area. **Table 9-18** lists metals analysis from wells downgradient from where metal wastes are managed. In **Tables 9-1** to **9-17**, where blank spaces are present, it can be assumed that those analyses were not performed on those specific samples.

Table 9-19 is a complete list of analytical methods and reporting limits for the Livermore site and Site 300 monitoring. Tritium activities in 20 ground water monitoring wells in the Livermore Valley are listed in **Table 9-20**. Concentrations of organic compounds, total metals, and soluble metals in Livermore site sediments, July 29–31, are in **Tables 9-82** through **9-84**, respectively.

Site 300

Data from Site 300 monitoring wells (Pits 6, 2, 8, and 9; Elk Ravine; standby supply; water supply; and off-site) are included in **Tables 9-21** through **9-30**. Analytical results

for constituents of concern in ground water beneath the surface impoundments are reported in **Tables 9-31** to **9-38**.

Analytical results of discharges to the surface impoundments are tabulated in **Tables 9-39** through **9-43**.

Analytical data for the percolation pits is in **Table 9-44**, water supply data is in **Tables 9-45** and **9-46**, and the sewage pond ground water monitoring network is in **Tables 9-47** and **9-48**. Analytical results for the off-site surveillance wells are found in **Tables 9-49** to **9-55**.

Table 9-1. Constituent concentrations in ground water from Livermore site upgradient well W-008.

	1st Quarter[a]	2nd Quarter[b]	3rd Quarter[c]	4th Quarter[d]
Physical				
pH (pH units)	8.16	na[e]	7.64	na
Field pH (pH units)	7.52	7.33	7.25	7.31
Specific conductance (µmho/cm)	2550	na	2610	na
Water temperature (°C)	19	20.6	19.7	19.5
General minerals (mg/L)				
Bicarbonate alkalinity (as $CaCO_3$)	238	na	229	na
Carbonate alkalinity (as $CaCO_3$)	<1	na	<5	na
Hydroxide alkalinity (as $CaCO_3$)	<1	na	<5	na
Total alkalinity (as $CaCO_3$)	238	na	229	na
Boron	9.1	na	9.0	na
Calcium	93	na	na	na
Chloride	488	na	526	na
Fluoride	1.3	na	1.3	na
Magnesium	48	na	na	na
Nitrate (as N)	4.2	na	4.5	na
Nitrite (as N)	<0.02	na	<0.02	na
Nitrate (as NO_3)	19	na	20	na
Orthophosphate	0.05	na	0.08	na
Potassium	1.9	na	na	na
Sodium	346	na	na	na
Sulfate	326	na	325	na
Surfactants	<0.05	na	<0.05	na
Total dissolved solids (TDS)	1600	na	1630	na
Total hardness (as $CaCO_3$)	430	na	na	na
Total phosphorus (as P)	0.06	na	<0.05	na
Metals (µg/L)				
Aluminum	<50	na	<50	na
Antimony	<4	na	<4	na
Arsenic	2.2	na	2.3	na
Barium	<25	na	<25	na
Beryllium	<0.2	na	<0.2	na
Cadmium	<0.5	na	<0.5	na
Chromium	6	na	6.2	na
Cobalt	<50	na	<50	na
Copper	<10	na	<1	na

Table 9-1. Constituent concentrations in ground water from Livermore site upgradient well W-008 (continued).

Parameter	1st Quarter[a]	2nd Quarter[b]	3rd Quarter[c]	4th Quarter[d]
Metals (μg/L) (continued)				
Chromium(VI)	6	na	8.4	na
Iron	310	na	<50	na
Lead	<5	na	<5	na
Manganese	<10	na	<10	na
Mercury	<0.2	na	<0.2	na
Molybdenum	<25	na	<25	na
Nickel	<50	na	<2	na
Selenium	<2	na	<2	na
Silver	<1	na	<1	na
Thallium	<1	na	<1	na
Vanadium	16	na	17	na
Zinc	11	na	<20	na
Radioactivity (Bq/L)				
Gross-alpha	0.148 ± 0.037	0.154 ± 0.074	0.0144 ± 0.0354	0.037 ± 0.015
Gross-beta	0.111 ± 0.296	0.134 ± 0.066	0.0220 ± 0.0272	0.029 ± 0.016
Radium-226	0.003 ± 0.009	0.008 ± 0.007	0.0098 ± 0.0077	0.024 ± 0.010
Radium-228	0.035 ± 0.028	0.054 ± 0.016	0.0221 ± 0.0147	0.033 ± 0.026
Radon-222	21.1 ± 1.11			
Strontium-90	<0.0925 ± 0.037			
Tritium	<0.981	na	0.328 ± 1.750	–1.29 ± 2.40
Uranium-233+234	0.107 ± 0.0118	0.202 ± 0.0267	0.118 ± 0.016	0.107 ± 0.0137
Uranium-235+236	0.00444 ± 0.00259	0.0106 ± 0.00411	0.00566 ± 0.00259	0.0112 ± 0.00316
Uranium-238	0.0858 ± 0.0104	0.179 ± 0.0242	0.0818 ± 0.0125	0.0685 ± 0.00981
Radioisotopes by gamma spectroscopy (Bq/L)[f]				
Bismuth-214	na	1.53 ± 0.400	na	na
Lead-214	na	1.22 ± 0.309	na	na
Radioisotopes by alpha spectroscopy (mBq/L)				
Americium-241	<6.67		0.176 ± 0.233	0.143 ± 0.507
Plutonium-238	na	0.313 ± 0.629	0.0614 ± 0.201	–0.151 ± 0.302
Plutonium-239+240	na	0.622 ± 11.2	0.145 ± 0.238	0.295 ± 0.944
Thorium-228	na	2.28 ± 4.22	0.677 ± 0.463	0.488 ± 1.42
Thorium-230	na	1.99 ± 2.79	0.648 ± 0.407	2.310 ± 1.70
Thorium-232	na	0.851 ± 2.23	–0.0596 ± 0.0844	0.488 ± 0.692

Table 9-1. Constituent concentrations in ground water from Livermore site upgradient well W-008 (concluded).

	1st Quarter[a]	2nd Quarter[b]	3rd Quarter[c]	4th Quarter[d]
Organic constituents (μg/L)				
EPA 525.2	nd[g]	na	na	na
EPA 632	nd	na	na	na
EPA 547	nd	na	na	na
EPA 8080 (for PCBs)	nd	na	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 First quarter samples collected on 2/17/98.

b Second quarter samples collected on 6/15/98.

c Third quarter samples collected on 8/26/98.

d Fourth quarter samples collected on 10/26/98.

e na = Not analyzed.

f No other radioisotopes were detected above the analytical reporting limit by gamma spectroscopy.

g nd = Not detected by this method.

Table 9-2. Constituent concentrations in ground water from Livermore site upgradient well W-221.

	1st Quarter[a]	2nd Quarter[b]	3rd Quarter[c]	4th Quarter[d]
Physical				
pH (pH units)	7.61	na[e]	7.34	na
Field pH (pH units)	7.21	7.01	7.14	7.18
Specific conductance (µmho/cm)	1690	na	1730	na
Water temperature (°C)	19.1	21.1	20.6	20.1
General minerals (mg/L)				
Bicarbonate alkalinity (as $CaCO_3$)	356	na	340	na
Carbonate alkalinity (as $CaCO_3$)	<1	na	<5	na
Hydroxide alkalinity (as $CaCO_3$)	<1	na	<5	na
Total alkalinity (as $CaCO_3$)	356	na	340	na
Boron	2.6	na	2.3	na
Calcium	116	na	134	na
Chloride	284	na	295	na
Fluoride	0.71	na	0.66	na
Magnesium	42	na	49	na
Nitrate (as N)	6.1	na	7.6	na
Nitrite (as N)	<0.02	na	<0.02	na
Nitrate (as NO_3)	27	na	33	na
Orthophosphate	<0.05	na	<0.05	na
Potassium	1.8	na	1.9	na
Sodium	134	na	159	na
Sulfate	84	na	84	na
Surfactants	<0.05	na	<0.05	na
Total dissolved solids (TDS)	980	na	1030	na
Total hardness (as $CaCO_3$)	463	na	536	na
Total phosphorus (as P)	<0.05	na	<0.05	na
Metals (µg/L)				
Aluminum	<50	na	<50	na
Antimony	<4	na	<4	na
Arsenic	<2	na	<2	na
Barium	120	na	110	na
Beryllium	<0.2	na	<0.2	na
Cadmium	<0.5	na	<0.5	na
Chromium	3.8	na	3.5	na
Cobalt	<50	na	<50	na

Table 9-2. Constituent concentrations in ground water from Livermore site upgradient well W-221 (continued).

	1st Quarter[a]	2nd Quarter[b]	3rd Quarter[c]	4th Quarter[d]
Metals (μg/L) (continued)				
Copper	3.4	na	2.3	na
Chromium(VI)	4	na	4.1	na
Iron	<50	na	180	na
Lead	<5	na	<5	na
Manganese	<10	na	<10	na
Mercury	<0.2	na	<0.2	na
Molybdenum	<25	na	<25	na
Nickel	<50	na	<50	na
Selenium	<2	na	<2	na
Silver	<1	na	<1	na
Thallium	<1	na	<1	na
Vanadium	10	na	10	na
Zinc	<20	na	<20	na
Radioactivity (Bq/L)				
Gross-alpha	0.185 ± 0.111	0.357 ± 0.087	0.349 ± 0.094	0.224 ± 0.074
Gross-beta	0.037 ± 0.296	0.141 ± 0.064	0.154 ± 0.058	0.175 ± 0.064
Radium-226	<0.00925	0.00766 ± 0.00744	0.0188 ± 0.0084	0.0292 ± 0.0101
Radium-228	0.00481 ± 0.02072	0.0733 ± 0.0118	–0.0225 ± 0.0278	0.0269 ± 0.0235
Radon-222	<9.25	na	na	na
Strontium-90	<0.0925	na	na	na
Tritium	2.30 ± 1.14	na	2.91 ± 2.09	5.66 ± 2.69
Uranium-233+234	0.178 ± 0.015	0.178 ± 0.025	0.170 ± 0.025	0.172 ± 0.022
Uranium-235+236	0.0070 ± 0.0030	0.0157 ± 0.0051	0.00581 ± 0.00344	0.030 ± 0.007
Uranium-238	0.124 ± 0.012	0.124 ± 0.0187	0.118 ± 0.019	0.125 ± 0.017
Radioisotopes by gamma spectroscopy (Bq/L)[f]				
Bismuth-214	na	1.0323 ± 0.24605	na	na
Lead-214	na	1.295 ± 0.34817	na	na
Uranium-235	na	0.4255 ± 0.407	na	na

Table 9-2. Constituent concentrations in ground water from Livermore site upgradient well W-221 (concluded).

	1st Quarter[a]	2nd Quarter[b]	3rd Quarter[c]	4th Quarter[d]
Radioisotopes by alpha spectroscopy (mBq/L)				
Americium-241	3.33 ± 3.33	na	0.323 ± 0.306	1.62 ± 2.03
Plutonium-238	na	3 ± 2.49	$-4.59 \times 10^{-3} \pm 0.146$	0.231 ± 0.463
Plutonium-239+240	na	0.33411 ± 0.67	0.154 ± 0.271	$-2.31 \times 10^{-3} \pm 0.566$
Thorium-228	na	7.33 ± 4.96	0.463 ± 0.463	0.105 ± 1.56
Thorium-230	na	1.16 ± 2.32	0.451 ± 0.314	2.83 ± 1.78
Thorium-232	na	0.577 ± 1.16	0.142 ± 0.245	$-2.36 \times 10^{-3} \pm 0.581$
Organic constituents (μg/L)				
EPA Method 525.2	nd[g]	na	na	na
EPA Method 547	nd	na	na	na
EPA Method 632	nd	na	na	na
EPA Method 8080 (for PCBs)	nd	na	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 First quarter samples collected on 2/23/98 and 2/24/98.

b Second quarter samples collected on 6/16/98.

c Third quarter samples collected on 8/3198.

d Fourth quarter samples collected on 10/27/98.

e na = Not analyzed.

f No other radioisotopes were detected above the analytical reporting limit by gamma spectroscopy.

g nd = Not detected by this method.

Table 9-3. Constituent concentrations in ground water from Livermore site downgradient well 14B1 (near TFA).

	2nd Quarter[a]	3rd Quarter[b]	4th Quarter[c]
Physical			
pH (pH units)	na[d]	7.68	na
Field pH (pH units)	na	na	na
Specific conductance (μmho/cm)	na	836	na
Water temperature (°C)	na	na	na
General minerals (mg/L)			
Bicarbonate alkalinity (as $CaCO_3$)	na	292	na
Carbonate alkalinity (as $CaCO_3$)	na	<5	na
Hydroxide alkalinity (as $CaCO_3$)	na	<5	na
Total alkalinity (as $CaCO_3$)	na	239	na
Boron	na	0.73	na
Calcium	na	57	na
Chloride	na	80	na
Fluoride	na	0.26	na
Magnesium	na	32	na
Nitrate (as N)	na	7.2	na
Nitrite (as N)	na	<0.02	na
Nitrate (as NO_3)	na	32	na
Orthophosphate	na	0.22	na
Potassium	na	2	na
Sodium	na	65	na
Sulfate	na	47	na
Surfactants	na	<0.05	na
Total dissolved solids (TDS)	na	530	na
Total hardness (as $CaCO_3$)	na	274	na
Total phosphorus (as P)	na	0.08	na
Metals (μg/L)			
Aluminum	na	<50	na
	na	<50	na
Antimony	na	<4	na
Arsenic	na	<2	na
Barium	na	110	na
Beryllium	na	<0.2	na
Cadmium	na	<0.5	na
Chromium	na	11	na
Cobalt	na	<50	na

Table 9-3. Constituent concentrations in ground water from Livermore site downgradient well 14B1 (near TFA) (continued).

	2nd Quarter[a]	3rd Quarter[b]	4th Quarter[c]
Metals (μg/L) (continued)			
Copper	na	1.6	na
Chromium(VI)	na	10	na
Iron	na	<50	na
Lead	na	<5	na
Manganese	na	<10	na
Mercury	na	<0.2	na
Molybdenum	na	<25	na
Nickel	na	<2	na
Selenium	na	<2	na
Silver	na	<1	na
Thallium	na	<1	na
Vanadium	na	<10	na
Zinc	na	25	na
Radioactivity (Bq/L)			
Gross-alpha	0.0929 ± 0.0411	0.0555 ± 0.0297	0.0685 ± 0.0257
Gross-beta	0.0744 ± 0.0342	0.103 ± 0.0299	0.0803 ± 0.0265
Radium-226	0.0144 ± 0.0089	0.0147 ± 0.00817	na
Radium-228	0.0437 ± 0.0160	0.0275 ± 0.0167	na
Tritium	2.82 ± 1.32	2.03 ± 2.04	3.81 ± 2.62
Uranium-233+234	0.0422 ± 0.0090	na	na
Uranium-235+236	0.00219 ± 0.00181	na	na
Uranium-238	0.0348 ± 0.0080	na	na
Radioisotopes by gamma spectroscopy (Bq/L)[e]			
Bismuth-214	1.45 ± 0.43	na	na
Lead-214	1.49 ± 0.45	na	na
Radioisotopes by alpha spectroscopy (mBq/L)			
Plutonium-238	<3.70	–0.205 ± 0.242	0.659 ± 0.940
Plutonium-239+240	<3.70	<0.0814	0.492 ± 0.992
Thorium-228	<9.25	na	na
Thorium-230	<5.55	na	na
Thorium-232	<5.55	na	na

Table 9-3. Constituent concentrations in ground water from Livermore site downgradient well 14B1 (near TFA) (concluded).

	2nd Quarter[a]	3rd Quarter[b]	4th Quarter[c]
Organic constituents (μg/L)			
EPA 525.2	nd[f]	nd	nd
EPA 632	nd	nd	nd
EPA 547	nd	nd	nd
EPA 8080 (for PCBs)	nd	nd	nd

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 Second quarter samples collected on 6/15/98.

b Third quarter samples collected on 8/27/98.

c Fourth quarter samples collected on 10/27/98.

d na = Not analyzed.

e No other radioisotopes were detected above the analytical reporting limit by gamma spectroscopy.

f nd = Not detected by this method.

Table 9-4. Constituent concentrations in ground water from Livermore site upgradient well W-1012 (near TFB).

	1st Quarter[a]	2nd Quarter[b]	3rd Quarter[c]	4th Quarter[d]
Physical				
pH (pH units)	na[e]	na	7.38	na
Field pH (pH units)	7.34	7.13	7.19	7.24
Specific conductance (µmho/cm)	na	na	1070	na
Water temperature (°C)	19.2	19.7	19.2	18.9
General minerals (mg/L)				
Bicarbonate alkalinity (as $CaCO_3$)	na	na	274	na
Carbonate alkalinity (as $CaCO_3$)	na	na	<5	na
Hydroxide alkalinity (as $CaCO_3$)	na	na	<5	na
Total alkalinity (as $CaCO_3$)	na	na	274	na
Boron	na	na	0.67	na
Calcium	na	na	95	na
Chloride	na	na	125	na
Fluoride	na	na	0.26	na
Magnesium	na	na	36	na
Nitrate (as N)	na	na	18	na
Nitrite (as N)	na	na	<0.02	na
Nitrate (as NO_3)	71	na	78	na
Orthophosphate	na	na	0.16	na
Potassium	na	na	2.8	na
Sodium	na	na	81	na
Sulfate	na	na	27	na
Surfactants	na	na	<0.05	na
Total dissolved solids (TDS)	na	na	627	na
Total hardness (as $CaCO_3$)	na	na	385	na
Total phosphorus (as P)	na	na	0.05	na
Metals (µg/L)				
Aluminum	na	na	<50	na
Antimony	na	na	<4	na
Arsenic	na	na	<2	na
Barium	na	na	130	na
Beryllium	na	na	<0.2	na
Cadmium	na	na	<0.5	na
Chromium	na	na	18	na
Cobalt	na	na	<50	na

Table 9-4. Constituent concentrations in ground water from Livermore site upgradient well W-1012 (near TFB) (continued).

	1st Quarter[a]	2nd Quarter[b]	3rd Quarter[c]	4th Quarter[d]
Copper	na	na	<1	na
Chromium(VI)	na	na	17	na
Iron	na	na	<50	na
Lead	na	na	<5	na
Manganese	na	na	<10	na
Mercury	na	na	<0.2	na
Molybdenum	na	na	<25	na
Nickel	na	na	3.4	na
Selenium	na	na	<2	na
Silver	na	na	<1	na
Thallium	na	na	<1	na
Vanadium	na	na	<10	na
Zinc	na	na	<20	na
Radioactivity (Bq/L)				
Gross-alpha	na	0.150 ± 0.053	0.108 ± 0.056	0.0559 ± 0.0279
Gross-beta	na	0.104 ± 0.0407	0.106 ± 0.046	0.119 ± 0.027
Radium-226	na	0.0235 ± 0.0102	0.0075 ± 0.0053	na
Radium-228	na	0.0466 ± 0.0108	0.0175 ± 0.0153	na
Strontium-90	<0.0925	na	na	<0.0925
Tritium	na	<1.21	0.34 ± 1.93	0.15 ± 1.89
Uranium-233+234	na	0.0559 ± 0.0097	0.0666 ± 0.0107	na
Uranium-235+236	na	0.00381 ± 0.00216	0.00114 ± 0.00181	na
Uranium-238	na	0.0323 ± 0.0068	0.0463 ± 0.0085	na
Radioisotopes by gamma spectroscopy (Bq/L)[f]				
Bismuth-214	na	0.518 ± 0.2368	na	na
Lead-214	na	0.4921 ± 0.20276	na	na
Radioisotopes by alpha spectroscopy (mBq/L)				
Plutonium-238	na	<3.70	0.0666 ± 0.216	<3.70
Plutonium-239+240	na	0.577 ± 1.09	–0.005 ± 0.162	0.548 ± 0.777
Thorium-228	na	2.48 ± 4.48	na	na
Thorium-230	na	1.22 ± 1.52	na	na
Thorium-232	na	0.614 ± 0.873	na	na

Table 9-4. Constituent concentrations in ground water from Livermore site upgradient well W-1012 (near TFB) (continued).

	1st Quarter[a]	2nd Quarter[b]	3rd Quarter[c]	4th Quarter[d]
Organic constituents (μg/L)				
EPA 525.2	na	nd[g]	nd	nd
EPA547	na	nd	nd	nd
EPA632	na	nd	nd	nd

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 First quarter samples collected on 3/4/98.

b Second quarter samples collected on 6/16/98.

c Third quarter samples collected on 8/31/98.

d Fourth quarter samples collected on 10/21/98.

e na = Not analyzed.

f No other radioisotopes were detected above the analytical reporting limit by gamma spectroscopy.

g nd = Not detected by this method.

Table 9-5. Constituent concentrations in ground water from Livermore site upgradient well W-121 (near TFA).

	1st Quarter[a]	2nd Quarter[b]	3rd Quarter[c]	4th Quarter[d]
Physical				
pH (pH units)	na[e]	na	8.02	na
Field pH (pH units)	na	7.84	7.95	7.78
Specific conductance (µmho/cm)	na	na	740	na
Water temperature (°C)	na	19.7	19.9	19.6
General minerals (mg/L)				
Bicarbonate alkalinity (as $CaCO_3$)	na	na	193	na
Carbonate alkalinity (as $CaCO_3$)	na	na	<5	na
Hydroxide alkalinity (as $CaCO_3$)	na	na	<5	na
Total alkalinity (as $CaCO_3$)	na	na	193	na
Boron	na	na	0.89	na
Calcium	na	na	37	na
Chloride	na	na	78	na
Fluoride	na	na	0.32	na
Magnesium	na	na	29	na
Nitrate (as N)	na	na	7.6	na
Nitrite (as N)	na	na	<0.02	na
Nitrate (as NO_3)	na	na	33	na
Orthophosphate	na	na	0.22	na
Potassium	na	na	1.5	na
Sodium	na	na	65	na
Sulfate	na	na	39	na
Surfactants	na	na	<0.05	na
Total dissolved solids (TDS)	na	na	440	na
Total hardness (as $CaCO_3$)	na	na	212	na
Total phosphorus (as P)	na	na	0.09	na
Metals (µg/L)				
Aluminum	na	na	<50	na
Antimony	na	na	<4	na
Arsenic	na	na	<2	na
Barium	na	na	65	na
Beryllium	na	na	<0.2	na
Cadmium	na	na	<0.5	na
Chromium	na	na	11	na
Cobalt	na	na	<50	na
Copper	na	na	<10	na

Table 9-5. Constituent concentrations in ground water from Livermore site upgradient well W-121 (near TFA) (continued).

	1st Quarter[a]	2nd Quarter[b]	3rd Quarter[c]	4th Quarter[d]
Metals (μg/L) (continued)				
Chromium(VI)	na	na	10	na
Iron	na	na	<50	na
Lead	na	na	<5	na
Manganese	na	na	<10	na
Mercury	na	na	<0.2	na
Molybdenum	na	na	<25	na
Nickel	na	na	<50	na
Selenium	na	na	<2	na
Silver	na	na	<1	na
Thallium	na	na	<1	na
Vanadium	na	na	<10	na
Zinc	na	na	<20	na
Radioactivity (Bq/L)				
Gross-alpha	na	0.0162 ± 0.0135	na	0.00047 ± 0.01706
Gross-beta	na	0.0414 ± 0.0193	na	0.0292 ± 0.0186
Radium-226	na	0.00829 ± 0.00736	na	0.0144 ± 0.0086
Radium-228	na	0.0474 ± 0.0145	na	0.0507 ± 0.0234
Tritium	na	<1.1433	0.175 ± 1.943	–0.951 ± 2.427
Uranium-233+234	na	0.0165 ± 0.0088	na	na
Uranium-235+236	na	0.00078 ± 0.00113	na	na
Uranium-238	na	0.0119 ± 0.00411	na	na
Radioisotopes by gamma spectroscopy (Bq/L)[f]				
Lead-214	na	1.032 ± 0.385	na	na
Potassium-40	na	0.770 ± 0.770	na	na
Thorium-234	na	4.92 ± 4.0	na	na
Radioisotopes by alpha spectroscopy (mBq/L)				
Plutonium-238	na	<3.7	<3.7	na
Plutonium-239+240	na	<3.7	<3.7	na
Thorium-228	na	<9.25	na	na
Thorium-230	na	1.26 ± 1.28	na	na
Thorium-232	na	<5.55	na	na

Table 9-5. Constituent concentrations in Livermore site upgradient well W-121 (near TFA) (concluded).

	1st Quarter[a]	2nd Quarter[b]	3rd Quarter[c]	4th Quarter[d]
Organic constituents (μg/L)				
EPA 525.2	na	nd[g]	nd	nd
EPA547	na	nd	nd	nd
EPA632	na	nd	nd	nd

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 First quarter samples collected on 1/21/98.

b Second quarter samples collected on 6/16/98.

c Third quarter samples collected on 8/27/98.

d Fourth quarter samples collected on 10/26/98.

e na = Not analyzed.

f No other radioisotopes were detected above the analytical reporting limit by gamma spectroscopy.

g nd = Not detected by this method.

Table 9-6. Constituent concentrations in ground water from Livermore site upgradient well W-151 (near TFA).

	1st Quarter[a]	2nd Quarter[b]	3rd Quarter[c]	4th Quarter[d]
Physical				
pH (pH units)	na[e]	na	7.77	na
Field pH (pH units)	na	7.46	7.38	7.55
Specific conductance (µmho/cm)	na	na	866	na
Water temperature (°C)	na	20.1	19.1	18.8
General minerals (mg/L)				
Bicarbonate alkalinity (as $CaCO_3$)	na	na	248	na
Carbonate alkalinity (as $CaCO_3$)	na	na	<5	na
Hydroxide alkalinity (as $CaCO_3$)	na	na	<5	na
Total alkalinity (as $CaCO_3$)	na	na	248	na
Boron	na	na	0.78	na
Calcium	na	na	53	na
Chloride	na	na	86	na
Fluoride	na	na	0.28	na
Magnesium	na	na	38	na
Nitrate (as N)	na	na	8.9	na
Nitrite (as N)	na	na	<0.02	na
Nitrate (as NO_3)	na	na	39	na
Orthophosphate	na	na	0.24	na
Potassium	na	na	1.8	na
Sodium	na	na	68	na
Sulfate	na	na	42	na
Surfactants	na	na	<0.05	na
Total dissolved solids (TDS)	na	na	526	na
Total hardness (as $CaCO_3$)	na	na	289	na
Total phosphorus (as P)	na	na	0.08	na
Metals (µg/L)				
Aluminum	na	na	<50	na
Antimony	na	na	<4	na
Arsenic	na	na	<2	na
Barium	na	na	<25	na
Beryllium	na	na	0.7	na
Cadmium	na	na	<0.5	na
Chromium	na	na	16	na
Cobalt	na	na	<50	na
Copper	na	na	<10	na

Table 9-6. Constituent concentrations in ground water from Livermore site upgradient well W-151 (near TFA) (continued).

	1st Quarter[a]	2nd Quarter[b]	3rd Quarter[c]	4th Quarter[d]
Metals (μg/L) (continued)				
Chromium(VI)	na	na	16	na
Iron	na	na	50	na
Lead	na	na	<5	na
Manganese	na	na	<10	na
Mercury	na	na	<0.2	na
Molybdenum	na	na	<25	na
Nickel	na	na	<50	na
Selenium	na	na	<2	na
Silver	na	na	<1	na
Thallium	na	na	<1	na
Vanadium	na	na	<10	na
Zinc	na	na	<20	na
Radioactivity (Bq/L)				
Gross-alpha	na	0.0699 ± 0.0319	0.0718 ± 0.0292	0.0907 ± 0.0440
Gross-beta	na	0.0688 ± 0.0344	0.0722 ± 0.0287	0.0799 ± 0.0343
Radium-226	na	0.0138 ± 0.0085	0.0268 ± 0.0103	na
Radium-228	na	0.0396 ± 0.0107	0.0253 ± 0.0213	na
Tritium	na	<1.22	1.11 ± 1.98	3.77 ± 2.60
Uranium-233+234	na	0.032 ± 0.008	0.0326 ± 0.0068	na
Uranium-235+236	na	0.00319 ± 0.00232	0.00232 ± 0.00108	na
Uranium-238	na	0.0184 ± 0.0054	0.0212 ± 0.0052	na
Radioisotopes by gamma spectroscopy (Bq/L)[f]				
Actinium-228	na	0.275 ± 0.269	na	na
Bismuth-214	na	1.37 ± 0.37	na	na
Lead-214	na	1.32 ± 0.38	na	na
Thallium-208	na	0.115 ± 0.081	na	na
Radioisotopes by alpha spectroscopy (mBq/L)				
Plutonium-238	na	2.84 ± 2.75	–0.0273 ± 0.164	<3.7
Plutonium-239+240	na	0.947 ± 1.38	0.0273 ± 0.0544	0.290 ± 0.581
Thorium-228	na	3.96 ± 4.81	na	na
Thorium-230	na	2.93 ± 2.23	na	na
Thorium-232	na	<5.55	na	na

Table 9-6. Constituent concentrations in Livermore site upgradient well W-151 (near TFA) (concluded).

	1st Quarter[a]	2nd Quarter[b]	3rd Quarter[c]	4th Quarter[d]
Organic constituents (μg/L)				
Bromacil/EPA 525.2	na	3.6[g]	nd	nd
EPA547	na	nd[h]	nd	nd
EPA632	na	nd	nd	nd

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 First quarter samples collected on 1/21/98.

b Second quarter samples collected on 6/16/98.

c Third quarter samples collected on 8/27/98.

d Fourth quarter samples collected on 10/27/98.

e na = Not analyzed.

f No other radioisotopes were detected above the analytical reporting limit by gamma spectroscopy.

g No other analytes were detected by this method.

h nd = Not detected by this method.

Table 9-7. Constituent concentrations in ground water from Livermore site downgradient well W-373 (near TFC).

Parameter	1st Quarter[a]	2nd Quarter[b]	3rd Quarter[c]	4th Quarter[d]
Physical				
pH (pH units)	na[e]	na	7.98	na
Field pH (pH units)	7.53	7.5	7.33	na
Specific conductance (μmho/cm)	na	na	932	na
Water temperature (°C)	19.4	19.2	19	18.4
General minerals (mg/L)				
Bicarbonate alkalinity (as $CaCO_3$)	na	na	202	na
Carbonate alkalinity (as $CaCO_3$)	na	na	<5	na
Hydroxide alkalinity (as $CaCO_3$)	na	na	<5	na
Total alkalinity (as $CaCO_3$)	na	na	202	na
Boron	na	na	1.9	na
Calcium	na	na	49	na
Chloride	na	na	123	na
Fluoride	na	na	0.47	na
Magnesium	na	na	19	na
Nitrate (as N)	na	na	3	na
Nitrite (as N)	na	na	<0.02	na
Nitrate (as NO_3)	na	na	13	na
Orthophosphate	na	na	0.12	na
Potassium	na	na	1.5	na
Sodium	na	na	105	na
Sulfate	na	na	69	na
Surfactants	na	na	<0.05	na
Total dissolved solids (TDS)	na	na	550	na
Total hardness (as $CaCO_3$)	na	na	201	na
Total phosphorus (as P)	na	na	0.05	na
Metals (μg/L)				
Aluminum	na	na	<50	na
Antimony	na	na	<4	na
Arsenic	na	na	<2	na
Barium	na	na	51	na
Beryllium	na	na	<0.2	na
Cadmium	na	na	<0.5	na
Chromium	na	na	75	na
Cobalt	na	na	<50	na

Table 9-7. Constituent concentrations in ground water from Livermore site downgradient well W-373 (near TFC) (continued).

Parameter	1st Quarter[a]	2nd Quarter[b]	3rd Quarter[c]	4th Quarter[d]
Metals (μg/L) (continued)				
Copper	na	na	1.9	na
Chromium(VI)	76	na	75	na
Iron	na	na	<50	na
Lead	na	na	<5	na
Manganese	na	na	<10	na
Mercury	na	na	<0.2	na
Molybdenum	na	na	<25	na
Nickel	na	na	<2	na
Selenium	na	na	<2	na
Silver	na	na	<1	na
Thallium	na	na	<1	na
Vanadium	na	na	<10	na
Zinc	na	na	<20	na
Radioactivity (Bq/L)				
Gross alpha	na	0.108 ± 0.038	na	0.106 ± 0.040
Gross beta	na	0.092 ± 0.032	na	0.114 ± 0.051
Radium-226	na	0.018 ± 0.007	na	na
Radium-228	na	0.062 ± 0.017	na	na
Strontium-90	<0.0925	na	<0.0925	na
Tritium	na	11.1 ± 1.62	10.2 ± 2.21	10.5 ± 2.39
Uranium-233+234	na	0.0525 ± 0.0100	na	na
Uranium-235+236	na	0.0028 ± 0.0021	na	na
Uranium-238	na	0.0329 ± 0.0075	na	na
Radioisotopes by gamma spectroscopy (Bq/L)[f]				
Bismuth-214	na	2.07 ± 0.537	na	na
Lead-214	na	2.23 ± 0.455	na	na
Radioisotopes by alpha spectroscopy (mBq/L)				
Plutonium-238	na	2.32 ± 1.39	0.01 ± 0.24	1.68 ± 1.53
Plutonium-239+240	na	<3.7	0.110 ± 0.221	0.84 ± 1.22
Thorium-228	na	2.67 ± 5.03	na	na
Thorium-230	na	<5.55	na	na
Thorium-232	na	<5.55 na	na	na

Table 9-7. Constituent concentrations in ground water from Livermore site downgradient well W-373 (near TFC) (concluded).

Parameter	1st Quarter[a]	2nd Quarter[b]	3rd Quarter[c]	4th Quarter[d]
Organic constituents (μg/L)				
EPA 525.2	nd[g]	nd	nd	nd
EPA 632	nd	nd	nd	nd
EPA 547	nd	nd	nd	nd

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] First quarter samples collected on 3/4/98.

[b] Second quarter samples collected on 6/17/98.

[c] Third quarter samples collected on 8/25/98.

[d] Fourth quarter samples collected on 10/21/98.

[e] na = Not analyzed.

[f] No other radioisotopes were detected above the analytical reporting limit by gamma spectroscopy.

[g] nd = Not detected by this method.

Table 9-8. Constituent concentrations in ground water from Livermore site downgradient well W-556 (near TFC).

Parameter	2nd Quarter[a]	3rd Quarter[b]	4th Quarter[c]
Physical			
pH (pH units)	na[d]	7.8	na
Field pH (pH units)	7.49	7.46	7.33
Specific conductance (μmho/cm)	na	965	na
Water temperature (°C)	18.7	19	18.5
General minerals (mg/L)			
Bicarbonate alkalinity (as $CaCO_3$)	na	229	na
Carbonate alkalinity (as $CaCO_3$)	na	<5	na
Hydroxide alkalinity (as $CaCO_3$)	na	<5	na
Total alkalinity (as $CaCO_3$)	na	229	na
Boron	na	1.2	na
Calcium	na	56	na
Chloride	na	131	na
Fluoride	na	0.28	na
Magnesium	na	21	na
Nitrate (as N)	na	7.1	na
Nitrite (as N)	na	<0.02	na
Nitrate (as NO_3)	na	31	na
Orthophosphate	na	0.17	na
Potassium	na	1.7	na
Sodium	na	98	na
Sulfate	na	40	na
Surfactants	na	<0.05	na
Total dissolved solids (TDS)	na	567	na
Total hardness (as $CaCO_3$)	na	226	na
Total phosphorus (as P)	na	0.06	na
Metals (μg/L)			
Aluminum	na	<50	na
Antimony	na	<4	na
Arsenic	na	<2	na
Barium	na	85	na
Beryllium	na	<0.2	na
Cadmium	na	<0.5	na
Chromium	na	30	na
Cobalt	na	<50	na
Copper	na	<1	na

Table 9-8. Constituent concentrations in ground water from Livermore site downgradient well W-556 (near TFC) (continued).

Parameter	2nd Quarter[a]	3rd Quarter[b]	4th Quarter[c]
Metals (μg/L) (continued)			
Chromium(VI)	na	29	na
Iron	na	<50	na
Lead	na	<5	na
Manganese	na	<10	na
Mercury	na	<0.2	na
Molybdenum	na	<25	na
Nickel	na	<50	na
Selenium	na	4.8	na
Silver	na	<1	na
Thallium	na	<1	na
Vanadium	na	<10	na
Zinc	na	<20	na
Radioactivity (Bq/L)			
Gross-alpha	0.0688 ± 0.0342	0.0562 ± 0.0300	0.0718 ± 0.0385
Gross-beta	0.0744 ± 0.0296	0.0707 ± 0.0294	0.0814 ± 0.0481
Radium-226	0.0145 ± 0.0085	0.00814 ± 0.00562	na
Radium-228	0.0685 ± 0.0185	0.0285 ± 0.0172	na
Tritium	<1.25	1.08 ± 1.79	0.71 ± 1.93
Uranium-233+234	0.0455 ± 0.0091	0.0500 ± 0.0094	na
Uranium-235+236	0.00369 ± 0.00226	0.00111 ± 0.00153	na
Uranium-238	0.0361 ± 0.0078	0.0309 ± 0.0070	na
Radioisotopes by gamma spectroscopy (Bq/L)[e]			
Bismuth-214	0.747 ± 0.260	na	na
Lead-214	0.570 ± 0.238	na	na
Radioisotopes by alpha spectroscopy (mBq/L)			
Plutonium-238	0.747 ± 0.677	–0.022 ± 0.111	0.551 ± 0.781
Plutonium-239+240	0.299 ± 0.426	–0.061 ± 0.124	<3.7
Thorium-228	1.41 ± 3.89	na	na
Thorium-230	1.74 ± 1.87	na	na
Thorium-232	1.39 ± 1.73	na	na

Table 9-8. Constituent concentrations in ground water from Livermore site downgradient well W-556 (near TFC) (concluded).

	2nd Quarter[a]	3rd Quarter[b]	4th Quarter[c]
Organic constituents (μg/L)			
EPA Method 525.2	nd[f]	nd	nd
EPA Method 547	nd	nd	nd
EPA Method 632	nd	nd	nd

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] Second quarter samples collected on 6/17/98.

[b] Third quarter samples collected on 8/25/98.

[c] Fourth quarter samples collected on10/21/98.

[d] na = Not analyzed.

[e] No other radioisotopes were detected above the analytical reporting limit by gamma spectroscopy.

[f] nd = Not detected by this method.

Table 9-9. Constituent concentrations in ground water from Livermore site downgradient well W-571 (near TFB).

Parameter	2nd Quarter[a]	3rd Quarter[b]	4th Quarter[c]
Physical			
pH (pH units)	na[d]	7.73	na
Field pH (pH units)	7.36	7.44	7.31
Specific conductance (μmho/cm)	na	850	na
Water temperature (°C)	19.2	19.2	18.6
General minerals (mg/L)			
Bicarbonate alkalinity (as $CaCO_3$)	na	243	na
Carbonate alkalinity (as $CaCO_3$)	na	<5	na
Hydroxide alkalinity (as $CaCO_3$)	na	<5	na
Total alkalinity (as $CaCO_3$)	na	243	na
Boron	na	0.7	na
Calcium	na	na	na
Chloride	na	84	na
Fluoride	na	0.32	na
Magnesium	na	na	na
Nitrate (as N)	na	8.3	na
Nitrite (as N)	na	<0.02	na
Nitrate (as NO_3)	na	37	na
Orthophosphate	na	0.2	na
Potassium	na	na	na
Sodium	na	na	na
Sulfate	na	32	na
Surfactants	na	<0.1	na
Total dissolved solids (TDS)	na	530	na
Total hardness (as $CaCO_3$)	na	na	na
Total phosphorus (as P)	na	0.07	na
Metals (μg/L)			
Aluminum	na	<50	na
Antimony	na	<4	na
Arsenic	na	<2	na
Barium	na	100	na
Beryllium	na	<0.2	na
Cadmium	na	<0.5	na
Chromium	na	21	na
Cobalt	na	<50	na

Table 9-9. Constituent concentrations in ground water from Livermore site downgradient well W-571 (near TFB) (continued).

Parameter	2nd Quarter[a]	3rd Quarter[b]	4th Quarter[c]
Metals (μg/L) (continued)			
Copper	na	2.8	na
Chromium(VI)	na	20	na
Iron	na	<50	na
Lead	na	5.3	na
Manganese	na	<10	na
Mercury	na	<0.2	na
Molybdenum	na	<25	na
Nickel	na	2.7	na
Selenium	na	2.1	na
Silver	na	<1	na
Thallium	na	<1	na
Vanadium	na	<10	na
Zinc	na	<10	na
Radioactivity (Bq/L)			
Gross-alpha	0.0814 ± 0.0271	0.101 ± 0.031	0.138 ± 0.043
Gross-beta	0.0588 ± 0.0261	0.0910 ± 0.0274	0.0903 ± 0.0566
Radium-226	0.0201 ± 0.0100	0.00918 ± 0.00862	0.0218 ± 0.0104
Radium-228	0.0411 ± 0.0114	0.0362 ± 0.0213	0.0377 ± 0.0212
Tritium	<1.25	1.23 ± 1.79	0.71 ± 2.49
Uranium-233+234	0.0592 ± 0.0112	0.0607 ± 0.0099	na
Uranium-235+236	0.00152 ± 0.00153	<0.0037	na
Uranium-238	0.0418 ± 0.0091	0.0352 ± 0.0071	na
Radioisotopes by gamma spectroscopy (Bq/L)[e]			
Bismuth-214	1.2765 ± 0.34817	na	na
Lead-214	1.1026 ± 0.30932	na	na
Radioisotopes by alpha spectroscopy (mBq/L)			
Plutonium-238	<3.7	0.138 ± 0.248	na
Plutonium-239+240	0.655 ± 0.932	–0.095 ± 0.11	na
Thorium-228	4.44 ± 5.51	na	na
Thorium-230	0.400 ± 1.791	na	na
Thorium-232	0.400 ± 1.388	na	na

Table 9-9. Constituent concentrations in ground water from Livermore site downgradient well W-571 (near TFB) (concluded).

Parameter	2nd Quarter[a]	3rd Quarter[b]	4th Quarter[c]
Organic constituents (μg/L)			
EPA Method 525.2	nd[f]	nd	nd
EPA Method 547	nd	nd	nd
EPA Method 632	nd	nd	nd

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 Second quarter samples collected on 6/16/98.

b Third quarter samples collected on 8/26/98.

c Fourth quarter samples collected on10/26/98.

d na = Not analyzed.

e No other radioisotopes were detected above the analytical reporting limit by gamma spectroscopy.

f nd = Not detected by this method.

Table 9-10. Constituent concentrations in ground water from Livermore site well W-204, downgradient from the Taxi Strip Area.

Parameter	1st Quarter[a]	2nd Quarter[b]	3rd Quarter[c]	4th Quarter[d]
Physical				
pH (pH units)	7.83	na[e]	8.18	na
Field pH (pH units)	7.91	7.76	7.42	8.69
Specific conductance (μmho/cm)	446	na	423	na
Water temperature (°C)	20.2	21	20.6	20.2
General minerals (mg/L)				
Bicarbonate alkalinity (as $CaCO_3$)	136	na	132	na
Carbonate alkalinity (as $CaCO_3$)	<1	na	<5	na
Hydroxide alkalinity (as $CaCO_3$)	<1	na	<5	na
Total alkalinity (as $CaCO_3$)	136	na	132	na
Boron	0.15	na	0.16	na
Calcium	30	na	33	na
Chloride	46	na	42	na
Fluoride	0.24	na	0.25	na
Magnesium	7.9	na	8.4	na
Nitrate (as N)	2.3	na	2.10	na
Nitrite (as N)	<0.02	na	<0.020	na
Nitrate (as NO_3 [a])	10	na	9.3	na
Orthophosphate	0.11	na	0.08	na
Potassium	1.5	na	1.6	na
Sodium	34	na	40	na
Sulfate	7.2	na	8.9	na
Surfactants	<0.05	na	<0.05	na
Total dissolved solids (TDS)	275	na	250	na
Total hardness (as $CaCO_3$)	107	na	117	na
Total phosphorus (as P)	0.05	na	<0.05	na
Metals (μg/L)				
Aluminum	<50	na	<50	na
Antimony	<4	na	<4	na
Arsenic	2.7	na	<2	na
Barium	160	na	170	na
Beryllium	<0.2	na	<0.2	na
Cadmium	<0.5	na	<0.5	na
Chromium	15	na	16	na
Cobalt	<50	na	<50	na
Copper	<1	na	3	na

Table 9-10. Constituent concentrations in ground water from Livermore site well W-204, downgradient from the Taxi Strip Area (continued).

Parameter	1st Quarter[a]	2nd Quarter[b]	3rd Quarter[c]	4th Quarter[d]
Metals (μg/L) (continued)				
Chromium(VI)	13	na	15	na
Iron	<50	na	<50	na
Lead	<5	na	<5	na
Manganese	<10	na	<10	na
Mercury	<0.2	na	<0.2	na
Molybdenum	<25	na	<25	na
Nickel	<50	na	<50	na
Selenium	<2	na	<2	na
Silver	<1	na	<1	na
Thallium	<1	na	<1	na
Vanadium	<10	na	<10	na
Zinc	<20	na	<20	na
Radioactivity (Bq/L)				
Gross alpha	0.0266 ± 0.0144	0.548 ± 0.066	0.047 ± 0.021	0.0244 ± 0.0172
Gross beta	0.0533 ± 0.0192	5.03 ± 0.12	0.051 ± 0.029	0.0618 ± 0.0180
Radium-226	0.00925 ± 0.00481	0.0107 ± 0.0064	0.018 ± 0.01	0.0261 ± 0.0097
Radium-228	0.0403 ± 0.0181	0.0722 ± 0.0201	0.016 ± 0.017	0.0392 ± 0.0256
Strontium-89	21.5 ± 12.6	na	na	na
Strontium-90	<15.9	na	na	na
Uranium-233+234	0.0331 ± 0.0163	0.0236 ± 0.0065	na	0.0226 ± 0.0049
Uranium-235+236	0.00333± 0.00592	0.00225 ± 0.00185	na	0.00227 ± 0.00139
Uranium-238	0.0337 ± 0.0167	0.0178 ± 0.0055	na	0.0164 ± 0.0040
Tritium	<1.02	2.10 ± 3.13	1.08 ± 1.97	2.42 ± 2.57
Radioisotopes by gamma spectroscopy (Bq/L)[f]				
Actinium-228	na	0.268 ± 0.243	na	na
Bismuth-214	na	2.95 ± 0.50	na	na
Lead-214	na	2.83 ± 0.48	na	na
Uranium-235	na	0.548 ± 0.437	na	na

Table 9-10. Constituent concentrations in ground water from Livermore site well W-204, downgradient from the Taxi Strip Area (concluded).

Parameter	1st Quarter[a]	2nd Quarter[b]	3rd Quarter[c]	4th Quarter[d]
Radioisotopes by alpha spectroscopy (mBq/L)				
Americium-241	14.1 ± 13.0	na	0.152 ± 0.295	–0.00725 ± 0.03511
Plutonium-238	na	0.847 ± 0.903	0.0511 ± 0.1447	<3.70
Plutonium-239+240	na	0.677 ± 0.833	0.179 ± 0.185	0.128 ± 0.581
Thorium-228	na	<9.25	0.340 ± 0.279	–0.147 ± 1.680
Thorium-230	na	0.722 ± 1.277	0.352 ± 0.313	1.74 ± 1.47
Thorium-232	na	<5.55	0.121 ± 0.192	0.622 ± 0.903
Organic constituents (µg/L)				
EPA 525.2	na	na	na	na
EPA 632	na	na	na	na
EPA 547	na	na	na	na
EPA 8080 (for PCBs)	nd[g]	na	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 First quarter samples collected on 3/16/98.

b Second quarter samples collected on 6/18/98.

c Third quarter samples collected on 8/27/98.

d Fourth quarter samples collected on 10/28/98.

e na = Not analyzed.

f No other radioisotopes were detected above the analytical reporting limit by gamma spectroscopy.

g nd = Not detected by this method.

Table 9-11. Constituent concentrations in ground water from Livermore site well W-363, downgradient from the Taxi Strip Area.

Parameter	1st Quarter[a]	2nd Quarter[b]	3rd Quarter[c]	4th Quarter[d]
Physical				
pH (pH units)	7.4	na[e]	7.63	na
Field pH (pH units)	7.49	7.36	7.24	7.29
Specific conductance (μmho/cm)	477	na	487	na
Water temperature (°C)	19.8	22.8	20.6	19.6
General minerals (mg/L)				
Bicarbonate alkalinity (as $CaCO_3$)	135	na	155	na
Carbonate alkalinity (as $CaCO_3$)	<1	na	<5	na
Hydroxide alkalinity (as $CaCO_3$)	<1	na	<5	na
Total alkalinity (as $CaCO_3$)	135	na	155	na
Boron	0.18	na	0.24	na
Calcium	38	na	38	na
Chloride	44	na	44	na
Fluoride	0.26	na	0.27	na
Magnesium	12	na	13	na
Nitrate (as N)	2.7	na	3.4	na
Nitrite (as N)	<0.02	na	<0.02	na
Nitrate (as NO_3)	12	na	15	na
Orthophosphate	<0.05	na	0.1	na
Potassium	1.6	na	1.7	na
Sodium	33	na	37	na
Sulfate	2.4	na	7.9	na
Surfactants	<0.05	na	<0.05	na
Total dissolved solids (TDS)	201	na	282	na
Total hardness (as $CaCO_3$)	144	na	148	na
Total phosphorus (as P)	<0.05	na	0.06	na
Metals (μg/L)				
Aluminum	<50	na	<50	na
Antimony	<4	na	<4	na
Arsenic	2	na	4.4	na
Barium	260	na	250	na
Beryllium	<0.2	na	<0.2	na
Cadmium	<0.5	na	<0.5	na
Chromium	7.8	na	13	na
Chromium(VI)	4	na	13	na

Table 9-11. Constituent concentrations in ground water from Livermore site well W-363, downgradient from the Taxi Strip Area (continued).

Parameter	1st Quarter[a]	2nd Quarter[b]	3rd Quarter[c]	4th Quarter[d]
Metals (μg/L) (continued)				
Cobalt	<50	na	<50	na
Copper	2.3	na	<1	na
Iron	<50	na	<50	na
Lead	<5	na	<5	na
Manganese	<10	na	<10	na
Mercury	<0.2	na	<0.2	na
Molybdenum	<25	na	<25	na
Nickel	<2	na	<2	na
Selenium	<2	na	<2	na
Silver	<1	na	<1	na
Thallium	<1	na	<1	na
Vanadium	10	na	10	na
Zinc	<20	na	<20	na
Radioactivity (Bq/L)				
Gross alpha	0.0148 ± 0.0126	0.0044 ± 0.0154	0.051 ± 0.025	0.0006 ± 0.0119
Gross beta	0.0459 ± 0.0185	0.0574 ± 0.0264	0.058 ± 0.024	0.0614 ± 0.0229
Radium-226	0.0030 ± 0.0052	0.0152 ± 0.0066	0.007 ± 0.006	0.0188 ± 0.0075
Radium-228	0.0226 ± 0.0174	0.0969 ± 0.0210	0.017 ± 0.019	0.0422 ± 0.0165
Strontium-89	–0.0163 ± 0.0104	na	na	na
Strontium-90	0.0292 ± 0.0118	na	na	na
Tritium	192 ± 4	187 ± 19	139 ± 6	123 ± 6
	na	na	na	114 ± 12
Uranium-233+234	0.107 ± 0.01	0.00348 ± 0.00223	0.022 ± 0.006	0.00295 ± 0.00183
Uranium-235+236	0.0037 ± 0.0059	0.0007 ± 0.0013	0.001 ± 0.001	0.000352 ± 0.000921
Uranium-238	0.0074 ± 0.0078	0.0050 ± 0.0029	0.015 ± 0.005	0.00142 ± 0.00130
Radioisotopes by gamma spectroscopy (Bq/L)[f]				
Bismuth-214	na	0.377 ± 0.266	na	na
Lead-214	na	0.463 ± 0.310	na	na
Uranium-235	na	0.481 ± 0.418	na	na

Table 9-11. Constituent concentrations in ground water from Livermore site well W-363, downgradient from the Taxi Strip Area (concluded).

Parameter	1st Quarter[a]	2nd Quarter[b]	3rd Quarter[c]	4th Quarter[d]
Radioisotopes by alpha spectroscopy (mBq/L)				
Americium-241	788 ± 3152	na	0.336 ± 0.307	–0.288 ± 35.409
Plutonium-238	na	2.77 ± 1.53	–0.255 ± 0.274	1.09 ± 1.22
Plutonium-239+240	na	1.63 ± 1.05	0.111 ± 0.198	0.195 ± 0.796
Thorium-228	na	<9.25	0.289 ± 0.403	0.351 ± 1.391
Thorium-230	na	1.09 ± 2.42	0.285 ± 0.281	0.944 ± 0.951
Thorium-232	na	1.09 ± 3.00	–0.0385 ± 0.0444	0.236 ± 0.474
Organic constituents (µg/L)				
EPA 525.2	na	na	na	na
EPA 632	na	na	na	na
EPA 547	na	na	na	na
EPA 8080 (for PCBs)	nd[g]	na	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 First quarter samples collected on 3/16/98.

b Second quarter samples collected on 6/18/98.

c Third quarter samples collected on 8/25/98.

d Fourth quarter samples collected on 10/28/98.

e na = Not analyzed.

f No other radioisotopes were detected above the analytical reporting limit by gamma spectroscopy.

g nd = Not detected by this method.

Table 9-12. Constituent concentrations in ground water from Livermore site well W-119, downgradient from the East Traffic Circle Area.

Parameter	1st Quarter[a]	2nd Quarter[b]	3rd Quarter[c]	4th Quarter[d]
Physical				
pH (pH units)	8.21	na (e)	7.56	na
Field pH (pH units)	7.13	6.94	6.99	6.9
Specific conductance (μmho/cm)	1050	na	1150	na
Water temperature (°C)	17.9	20.3	19.3	18.5
General minerals (mg/L)				
Bicarbonate alkalinity (as CaCO3)	476	na	418	na
Carbonate alkalinity (as $CaCO_3$)	<1	na	<5	na
Hydroxide alkalinity (as $CaCO_3$)	<1	na	<5	na
Total alkalinity (as $CaCO_3$)	476	na	418	na
Boron	0.47	na	0.53	na
Calcium	103	na	99	na
Chloride	83	na	99	na
Fluoride	0.33	na	0.32	na
Magnesium	37	na	35	na
Nitrate (as N)	9.7	na	10	na
Nitrite (as N)	<0.02	na	<0.02	na
Nitrate (as NO_3)	43	na	46	na
Orthophosphate	0.11	na	0.09	na
Potassium	1.8	na	2	na
Sodium	85	na	81	na
Sulfate	18	na	24	na
Surfactants	<0.05	na	<0.05	na
Total dissolved solids (TDS)	680	na	705	na
Total hardness (as $CaCO_3$)	410	na	391	na
Total phosphorus (as P)	<0.05	na	<0.05	na
Metals (μg/L)				
Aluminum	<50	na	<50	na
Antimony	<4	na	<4	na
Arsenic	<2	na	3.8	na
Barium	610	na	590	na
Beryllium	<0.2	na	<0.2	na
Cadmium	<0.5	na	<0.5	na
Chromium	7.2	na	7.1	na
Chromium(VI)	6	na	7.3	na
Cobalt	<50	na	<50	na

Table 9-12. Constituent concentrations in ground water from Livermore site well W-119, downgradient from the East Traffic Circle Area (continued).

Parameter	1st Quarter[a]	2nd Quarter[b]	3rd Quarter[c]	4th Quarter[d]
Metals (μg/L) (continued)				
Copper	<10	na	1.8	na
Iron	<50	na	<50	na
Lead	<5	na	<5	na
Manganese	<10	na	<10	na
Mercury	<0.2	na	<0.2	na
Molybdenum	<25	na	<25	na
Nickel	<2	na	<50	na
Selenium	<4	na	<2	na
Silver	<1	na	<1	na
Thallium	<1	na	<1	na
Vanadium	<10	na	<10	na
Zinc	28	na	<20	na
Radioactivity (Bq/L)				
Gross alpha	0.259 ± 0.074	0.333 ± 0.118	0.174 ± 0.043	0.252 ± 0.087
Gross beta	0.111 ± 0.148	0.185 ± 0.095	0.152 ± 0.031	0.361 ± 0.090
Radium-226	0.0037 ± 0.0370	0.00833 ± 0.00729	0.012 ± 0.008	0.0226 ± 0.0093
Radium-228	0.0229 ± 0.0263	0.110 ± 0.022	0.012 ± 0.018	0.0297 ± 0.0203
Strontium-90	<0.0925	na	na	na
Tritium	24.6 ± 1.9	na	18.2 ± 2.5	22.6 ± 3.3
Uranium-233+234	0.166 ± 0.014	0.150 ± 0.021	0.150 ± 0.021	0.138 ± 0.018
Uranium-235+236	0.00777 ± 0.00259	0.00788 ± 0.00355	0.007 ± 0.003	0.00310 ± 0.00193
Uranium-238	0.133 ± 0.012	0.112 ± 0.017	0.117 ± 0.017	0.0995 ± 0.0142
Radioisotopes by gamma spectroscopy (Bq/L)[f]				
Bismuth-214	na	1.80 ± 0.46	na	na
Lead-214	na	1.85 ± 0.38	na	na

Table 9-12. Constituent concentrations in ground water from Livermore site well W-119, downgradient from the East Traffic Circle Area (concluded).

Parameter	1st Quarter[a]	2nd Quarter[b]	3rd Quarter[c]	4th Quarter[d]
Radioisotopes by alpha spectroscopy (mBq/L)				
Americium-241	0.222 ± 0.296	na	0.235 ± 0.271	2.02 ± 2.06
Plutonium-238	na	3.62 ± 1.61	0.165 ± 0.229	–0.056 ± 0.936
Plutonium-239+240	na	<3.7	0.112 ± 0.122	–0.455 ± 0.666
Thorium-228	na	3.37 ± 3.89	0.551 ± 0.636	1.36 ± 2.07
Thorium-230	na	1.79 ± 1.87	0.385 ± 0.511	1.34 ± 1.38
Thorium-232	na	2.05 ± 2.08	0.055 ± 0.232	0.13 ± 0.60
Organic constituents (µg/L)				
EPA 525.2	na	na	na	na
EPA 632	na	na	na	na
EPA 547	na	na	na	na
EPA 8080 (for PCBs)	nd[g]	na	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 First quarter samples collected on 2/26/98.

b Second quarter samples collected on 6/17/98.

c Third quarter samples collected on 8/25/98.

d Fourth quarter samples collected on 10/28/98.

e na = Not analyzed.

f No other radioisotopes were detected above the analytical reporting limit by gamma spectroscopy.

g nd = Not detected by this method.

Table 9-13. Constituent concentrations in ground water from Livermore site well W-1303, downgradient from the East Traffic Circle Area.

Parameter	1st Quarter[a]	2nd Quarter[b]	3rd Quarter[c]	4th Quarter[d]
Physical				
pH (pH units)	7.24	na[e]	7.44	na
Field pH (pH units)[f]	na	na	na	na
Specific conductance (μmho/cm)	1240	na	1390	na
Water temperature (°C)[f]	na	na	na	na
General minerals (mg/L)				
Bicarbonate alkalinity (as $CaCO_3$)	487	na	518	na
Carbonate alkalinity (as $CaCO_3$)	<1	na	<5	na
Hydroxide alkalinity (as $CaCO_3$)	<1	na	<5	na
Total alkalinity (as $CaCO_3$)	487	na	518	na
Boron	610	na	600	na
Calcium	114	na	na	na
Chloride	107	na	119	na
Fluoride	0.38	na	0.34	na
Magnesium	39	na	na	na
Nitrate (as N)	5.5	na	6.1	na
Nitrite (as N)	<0.02	na	<0.02	na
Nitrate (as NO_3)	24	na	27	na
Orthophosphate	<0.05	na	<0.05	na
Potassium	2.1	na		na
Sodium	82	na		na
Sulfate	20	na	21	na
Surfactants	<0.05	na	<0.05	na
Total dissolved solids (TDS)	735	na	795	na
Total hardness (as $CaCO_3$)	445	na		na
Total phosphorus (as P)	<0.05	na	<0.05	na
Metals (μg/L)		na		na
Aluminum	<50	na	<50	na
Antimony	<4	na	<4	na
Arsenic	<2	na	<2	na
Barium	670	na	960	na
Beryllium	<0.2	na	<0.2	na
Cadmium	<0.5	na	<0.5	na
Chromium	<1	na	<1	na
Cobalt	<50	na	<50	na

Table 9-13. Constituent concentrations in ground water from Livermore site well W-1303, downgradient from the East Traffic Circle Area (continued).

Parameter	1st Quarter[a]	2nd Quarter[b]	3rd Quarter[c]	4th Quarter[d]
Metals (μg/L) (continued)				
Copper	<10	na	1.7	na
Chromium(VI)	<2	na	<2	na
Iron	<50	na		na
Lead	<5	na	<5	na
Manganese	<10	na	na	na
Mercury	<0.2	na	<0.2	na
Molybdenum	<25	na	<25	na
Nickel	<2	na	na	na
Selenium	<4	na	<2	na
Silver	<1	na	<1	na
Thallium	<1	na	<1	na
Vanadium	<10	na	<10	na
Zinc	<20	na	<20	na
Radioactivity (Bq/L)				
Gross alpha	0.148 ± 0.111	0.444 ± 0.090	0.196 ± 0.051	0.370 ± 0.073
Gross beta	0.0296 ± 0.296	0.205 ± 0.077	0.164 ± 0.032	0.144 ± 0.056
Radium-226	<0.00925	na	na	na
Radium-226	na	0.0229 ± 0.0093	0.035 ± 0.011	0.0305 ± 0.0099
Radium-228	<0.0614	0.0696 ± 0.0211	0.029 ± 0.016	0.0190 ± 0.0180
Strontium-90	<0.0925 ± 0.03	na	na	na
Uranium-233+234	0.160 ± 0.014	0.177 ± 0.026	0.165 ± 0.022	0.188 ± 0.024
Uranium-235+236	0.00444 ± 0.00222	0.0105 ± 0.0045	0.005 ± 0.003	0.00688 ± 0.00313
Uranium-238	0.115 ± 0.011	0.123 ± 0.020	0.128 ± 0.018	0.134 ± 0.019
Tritium	63.6 ± 2.7	na	54.8 ± 3.6	60.7 ± 4.0
Radioisotopes by gamma spectroscopy (Bq/L)[g]				
Actinium-228	na	0.304 ± 0.213	na	na
Bismuth-214	na	1.64 ± 0.35	na	na
Lead-214	na	1.21 ± 0.33	na	na
Thallium-208	na	0.0685 ± 0.0622	na	na

Table 9-13. Constituent concentrations in ground water from Livermore site well W-1303, downgradient from the East Traffic Circle Area (concluded).

Parameter	1st Quarter[a]	2nd Quarter[b]	3rd Quarter[c]	4th Quarter[d]
Radioisotopes by alpha spectroscopy (mBq/L)				
Americium-241	<5.55	na	0.161 ± 0.302	1.088 ± 1.606
Plutonium-238	na	3.16 ± 1.43	–0.0681 ± 0.0004	–0.692 ± 1.35
Plutonium-239+240	na	0.411 ± 0.477	0.111 ± 0.200	0.333 ± 0.870
Thorium-228	na	<9.25	0.681 ± 1.055	–1.60 ± 1.62
Thorium-230	na	4.03 ± 2.75	0.463 ± 0.418	7.29 ± 5.07
Thorium-232	na	2.19 ± 2.57	0.113 ± 0.277	–0.389 ± 0.777
Organic constituents (μg/L)				
EPA 525.2	na	na	na	na
EPA 632	na	na	na	na
EPA 547	na	na	na	na
EPA 8080 (for PCBs)	nd[h]	na	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 First quarter samples collected on 1/26 and 3/2/98.

b Second quarter samples collected on 4/23 and 6/17/98.

c Third quarter samples collected on 7/22 and 8/24/98.

d Fourth quarter samples collected on 10/8 and 10/22/98.

e na = Not analyzed.

f Field pH and water temperature were not recorded on these samples

g No other radioisotopes were detected above the analytical reporting limit by gamma spectroscopy.

h nd = Not detected by this method.

Table 9-14. Constituent concentrations in ground water from Livermore site well W-1306, downgradient from the East Traffic Circle Area.

Parameter	1st Quarter[a]	2nd Quarter[b]	3rd Quarter[c]	4th Quarter[d]
Physical				
pH (pH units)	7.89	na[e]	7.67	na
Field pH (pH units)[f]	na	na	na	na
Specific conductance (μmho/cm)	1130	na	1300	na
Water temperature (°C)[f]	na	na	na	na
General minerals (mg/L)				
Bicarbonate alkalinity (as $CaCO_3$)	380	na	400	na
Carbonate alkalinity (as $CaCO_3$)	<1	na	<5	na
Hydroxide alkalinity (as $CaCO_3$)	<1	na	<5	na
Total alkalinity (as $CaCO_3$)	380	na	400	na
Boron	0.36	na	0.43	na
Calcium	95	na	na	na
Chloride	99	na	118	na
Fluoride	0.5	na	0.4	na
Magnesium	34	na	na	na
Nitrate (as N)	12	na	12	na
Nitrite (as N)	<0.02	na	<0.02	na
Nitrate (as NO3)	53	na	54	na
Orthophosphate	0.11	na	0.11	na
Potassium	1.8	na	na	na
Sodium	77	na	na	na
Sulfate	46	na	44	na
Surfactants	<0.05	na	<0.05	na
Total dissolved solids (TDS) (mg/L)	690	na	760	na
Total hardness (as CaCO3)	377	na	na	na
Total phosphorus (as P)	<0.05	na	0.05	na
Metals (μg/L)				
Aluminum	<50	na	<50	na
Antimony	<4	na	<4	na
Arsenic	<2	na	<2	na
Barium	470	na	480	na
Beryllium	<0.2	na	<0.2	na
Cadmium	<0.5	na	<0.5	na
Chromium	6.8	na	6.8	na
Cobalt	<50	na	<50	na

Table 9-14. Constituent concentrations in ground water from Livermore site well W-1306, downgradient from the East Traffic Circle Area (continued).

Parameter	1st Quarter[a]	2nd Quarter[b]	3rd Quarter[c]	4th Quarter[d]
Metals (μg/L) (continued)				
Copper	<10	na	na	na
Chromium(VI)	6	na	6.4	na
Iron	<50	na	<50	na
Lead	<5	na	<5	na
Manganese	<10	na	<10	na
Mercury	<0.2	na	<0.2	na
Molybdenum	<25	na	<25	na
Nickel	<2	na	<2	na
Selenium	<4	na	<2	na
Silver	<1	na	<1	na
Thallium	<1	na	<1	na
Vanadium	<10	na	<10	na
Zinc	<20	na	<20	na
Radioactivity (Bq/L)				
Gross alpha	0.185 ± 0.074	0.300 ± 0.057	0.244 ± 0.049	0.353 ± 0.067
Gross beta	0.185 ± 0.148	0.104 ± 0.039	0.161 ± 0.029	0.266 ± 0.054
Radium-226	0.0074 ± 0.0370	0.0359 ± 0.0126	0.020 ± 0.009	0.0201 ± 0.0075
Radium-228	0.0344 ± 0.0233	0.0599 ± 0.0225	0.022 ± 0.019	0.0507 ± 0.0222
Strontium-90	<0.0925 ± 0.037	na	na	na
Tritium	15.8 ± 1.6	na	14.1 ± 2.3	14.6 ± 2.6
Uranium-233+234	0.154 ± 0.013	0.169 ± 0.024	0.166 ± 0.023	0.169 ± 0.023
Uranium-235+236	0.00481 ± 0.00222	0.00796 ± 0.00389	0.007 ± 0.003	0.00662 ± 0.00313
Uranium-238	0.113 ± 0.0104	0.135 ± 0.021	0.138 ± 0.020	0.146 ± 0.021
Radioisotopes by gamma spectroscopy (Bq/L)[g]				
Bismuth-214	na	1.74 ± 0.37	na	na
Lead-214	na	1.52 ± 0.41	na	na
Thorium-234	na	5.77 ± 4.77	na	na

Table 9-14. Constituent concentrations in ground water from Livermore site well W-1306, downgradient from the East Traffic Circle Area (concluded).

Parameter	1st Quarter[a]	2nd Quarter[b]	3rd Quarter[c]	4th Quarter[d]
Radioisotopes by alpha spectroscopy (mBq/L)				
Americium-241	<5.18	na	0.185 ± 0.251	0.190 ± 0.592
Plutonium-238	na	<3.70	0.035 ± 0.362	0.662 ± 1.724
Plutonium-239+240	na	2.84 ± 2.39	0.227 ± 0.290	–0.170 ± 0.341
Thorium-228	na	2.38 ± 7.47	0.888 ± 0.877	1.10 ± 1.76
Thorium-230	na	2.35 ± 1.97	0.662 ± 0.592	1.74 ± 1.47
Thorium-232	na	0.00 ± 1.56	–0.0755 ± 0.0873	–0.135 ± 0.272
Organic constituents				
EPA 525.2	na	na	na	na
EPA 632	na	na	na	na
EPA 547	na	na	na	na
EPA 8080 (for PCBs)	nd[h]	na	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 First quarter samples collected on 1/26 and 3/2/98.

b Second quarter samples collected on 4/23 and 6/17/98.

c Third quarter samples collected on 7/22 and 8/24/98.

d Fourth quarter samples collected on 10/8 and 10/22/98.

e na = Not analyzed.

f Field pH and water temperature were not recorded on these samples.

g No other radioisotopes were detected above the analytical reporting limit by gamma spectroscopy.

h nd = Not detected by this method.

Table 9-15. Constituent concentrations in ground water from Livermore site well W-1308, downgradient from the East Traffic Circle Area.

Parameter	1st Quarter[a]	2nd Quarter[b]	3rd Quarter[c]	4th Quarter[d]
Physical				
pH (pH units)	na[e]	na	7.62	na
Field pH (pH units)[f]	na	na	na	na
Specific conductance (μmho/cm)	na	na	962	na
Water temperature (°C)[f]	na	na	na	na
General minerals (mg/L)				
Bicarbonate alkalinity (as $CaCO_3$)	na	na	342	na
Carbonate alkalinity (as $CaCO_3$)	na	na	<5	na
Hydroxide alkalinity (as $CaCO_3$)	na	na	<5	na
Total alkalinity (as $CaCO_3$)	na	na	342	na
Boron	na	na	0.61	na
Calcium	na	na	na	na
Chloride	na	na	68	na
Fluoride	na	na	0.45	na
Magnesium	na	na		na
Nitrate (as N)	na	na	6.2	na
Nitrite (as N)	na	na	<0.02	na
Nitrate (as NO3)	na	na	28	na
Orthophosphate	na	na	0.09	na
Potassium	na	na	na	na
Sodium	na	na	na	na
Sulfate	na	na	19	na
Surfactants	na	na	<0.05	na
Total dissolved solids (TDS)	na	na	550	na
Total hardness (as $CaCO_3$)	na	na	na	na
Total phosphorus (as P)	na	na	<0.05	na
Metals (μg/L)				
Aluminum	na	na	<50	na
Antimony	na	na	<4	na
Arsenic	na	na	<2	na
Barium	na	na	350	na
Beryllium	na	na	<0.2	na
Cadmium	na	na	<0.5	na
Chromium	na	na	18	na
Cobalt	na	na	<50	na

Table 9-15. Constituent concentrations in ground water from Livermore site well W-1308, downgradient from the East Traffic Circle Area (continued).

Parameter	1st Quarter[a]	2nd Quarter[b]	3rd Quarter[c]	4th Quarter[d]
Metals (μg/L) (continued)				
Copper	na	na	1.2	na
Chromium(VI)	na	na	17.7	na
Iron	na	na	<50	na
Lead	na	na	<5	na
Manganese	na	na	<10	na
Mercury	na	na	<0.2	na
Molybdenum	na	na	<25	na
Nickel	na	na	<2	na
Selenium	na	na	<2	na
Silver	na	na	<1	na
Thallium	na	na	<1	na
Vanadium	na	na	<10	na
Zinc	na	na	<20	na
Radioactivity (Bq/L)				
Gross alpha	na	0.137 ± 0.035	0.129 ± 0.038	0.177 ± 0.050
Gross beta	na	0.103 ± 0.028	0.108 ± 0.028	0.0973 ± 0.0522
Radium-226	na	0.0213 ± 0.0100	0.012 ± 0.007	0.0167 ± 0.0078
Radium-228	na	0.0559 ± 0.0155	0.011 ± 0.014	0.0106 ± 0.0233
Tritium	na	na	22.9 ± 2.7	22.4 ± 2.9
Uranium-233+234	na	0.0992 ± 0.0168	0.081 ± 0.012	0.0803 ± 0.0122
Uranium-235+236	na	0.00433 ± 0.00276	0.001 ± 0.001	0.0027 ± 0.0018
Uranium-238	na	0.0555 ± 0.0114	0.057 ± 0.010	0.0696 ± 0.0110
Radioisotopes by gamma spectroscopy (Bq/L)[g]				
Americium-241	na	0.0873 ± 0.0807	na	na
Cobalt-60	na	0.0940 ± 0.0551	na	na
Lead-214	na	0.298 ± 0.193	na	na
Radioisotopes by alpha spectroscopy (mBq/L)				
Americium-241	na	na	0.231 ± 0.259	0.744 ± 1.232
Plutonium-238	na	<3.7	0.124 ± 0.223	0.555 ± 1.447
Plutonium-239+240	na	0.332 ± 0.666	0.248 ± 0.316	0.139 ± 0.633
Thorium-228	na	<9.25	0.496 ± 0.640	0.588 ± 1.462
Thorium-230	na	1.31 ± 1.86	0.241 ± 0.279	2.21 ± 1.52
Thorium-232	na	$1.17 \times 10^{-6} \pm 1.60$	0.0346 ± 0.1450	0.115 ± 0.522

Table 9-15. Constituent concentrations in ground water from Livermore site well W-1308, downgradient from the East Traffic Circle Area (concluded).

Parameter	1st Quarter[a]	2nd Quarter[b]	3rd Quarter[c]	4th Quarter[d]
Organic constituents				
EPA 525.2	na	na	na	na
EPA 632	na	na	na	na
EPA 547	na	na	na	na
EPA 8080 (for PCBs)	nd[h]	na	na	na

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ 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] First quarter samples collected on 1/22 and 2/3/98.

[b] Second quarter samples collected on 4/15 and 6/15/98.

[c] Third quarter samples collected on 8/24/98.

[d] Fourth quarter samples collected on 10/13, 10/22, and 12/15/98.

[e] na = Not analyzed.

[f] Field pH and water temperature were not recorded on these samples.

[g] No other radioisotopes were detected above the analytical reporting limit by gamma spectroscopy.

[h] nd = Not detected by this method.

Table 9-16. Constituent concentrations in ground water from Livermore site well W-906, downgradient from the East Traffic Circle Area.

Parameter	1st Quarter[a]	2nd Quarter[b]	3rd Quarter[c]	4th Quarter[d]
Physical				
pH (pH units)[f]	8.27	na[e]	7.6	na
Field pH (pH units)[f]	na	na	na	na
Specific conductance (μmho/cm)	1620.	na	1860.	na
Field Temperature (°C)	na	na	na	na
General minerals (mg/L)				
Bicarbonate alkalinity (as $CaCO_3$)	353.	na	353.	na
Carbonate alkalinity (as $CaCO_3$)	<1.	na	<5.	na
Hydroxide alkalinity (as $CaCO_3$)	<1.	na	<5.	na
Total alkalinity (as $CaCO_3$)	353.	na	353.	na
Boron	0.85	na	0.90	na
Calcium	125.	na	na	na
Chloride	304.	na	333.	na
Fluoride	0.53	na	0.48	na
Magnesium	49	na	na	na
Nitrate (as N)	7.	na	7.8	na
Nitrite (as N)	<0.02	na	<0.02	na
Nitrate (as NO_3)	31.	na	35.	na
Orthophosphate	0.13	na	0.1	na
Potassium	1.7	na	na	na
Sodium	109.	na	na	na
Sulfate	44.	na	48.	na
Surfactants	<0.05	na	<0.05	na
Total dissolved solids (TDS)	930.	na	1060.	na
Total hardness (as $CaCO_3$)	514.	na	na	na
Total phosphorus (as P)	<0.05	na	0.05	na
Metals (μg/L)				
Aluminum	<50	na	<50	na
Antimony	<4	na	<4	na
Arsenic	<2	na	<2	na
Barium	330	na	350	na
Beryllium	<0.2	na	<0.2	na
Cadmium	<0.5	na	<0.5	na
Chromium	7.4	na	7	na
Cobalt	<50	na	<50	na

Table 9-16. Constituent concentrations in ground water from Livermore site well W-906, downgradient from the East Traffic Circle Area (continued).

Parameter	1st Quarter[a]	2nd Quarter[b]	3rd Quarter[c]	4th Quarter[d]
Metals (μg/L) (continued)				
Copper	13	na	13	na
Chromium(VI)	5	na	5.6	na
Iron	<50	na	<50	na
Lead	<5	na	7.8	na
Manganese	<10	na	<10	na
Mercury	<0.2	na	<0.2	na
Molybdenum	<25	na	<25	na
Nickel	<2	na	na	na
Selenium	<4	na	<2	na
Silver	<1	na	<1	na
Thallium	<1	na	<1	na
Vanadium	<10	na	<10	na
Zinc	<20	na	na	na
Radioactivity (Bq/L)				
Gross alpha	0.333 ± 0.148	0.343 ± 0.075	0.123 ± 0.039	0.332 ± 0.062
Gross beta	0.148 ± 0.296	0.138 ± 0.053	0.178 ± 0.032	0.191 ± 0.051
Radium-226	0.0037 ± 0.0370	0.0135 ± 0.0087	0.01 ± 0.008	0.0175 ± 0.0070
Radium-228	<0.0636	0.0662 ± 0.0159	0.03 ± 0.08	0.0485 ± 0.0212
Strontium-90	<0.0925	na	na	na
Tritium	4.92 ± 1.25	na	4.29 ± 1.87	3.74 ± 2.09
Uranium-233+234	0.708 ± 0.044	0.176 ± 0.025	0.186 ± 0.026	0.199 ± 0.028
Uranium-235+236	0.0314 ± 0.0059	0.00718 ± 0.00356	0.004 ± 0.003	0.00914 ± 0.00396
Uranium-238	0.605 ± 0.038	0.142 ± 0.021	0.136 ± 0.02	0.138 ± 0.021
Radioisotopes by gamma spectroscopy (Bq/L)[g]				
Bismuth-214	na	1.59 ± 0.35	na	na
Lead 212	na	0.222 ± 0.176	na	na
Lead-214	na	1.62 ± 0.39	na	na
Thorium 234	na	2.31 ± 1.48	na	na

Table 9-16. Constituent concentrations in ground water from Livermore site well W-906, downgradient from the East Traffic Circle Area (concluded).

Parameter	1st Quarter[a]	2nd Quarter[b]	3rd Quarter[c]	4th Quarter[d]
Radioisotopes by alpha spectroscopy (mBq/L)				
Americium-241	1.85 ± 5.55	na	0.115 ± 0.183	0.870 ± 1.288
Plutonium-238	na	<3.70	–0.0381 ± 0.1902	<3.70
Plutonium-239+240	na	1.75 ± 2.08	0.0951 ± 0.2298	–0.121 ± 0.242
Thorium-228	na	4.11 ± 4.22	0.396 ± 0.666	–0.500 ± 1.291
Thorium-230	na	0.312 ± 1.399	0.191 ± 0.329	1.52 ± 1.41
Thorium-232	na	0.625 ± 0.892	–0.003 ± 0.198	–0.242 ± 0.884
Organic Constituents (μg/L)				
EPA Method 525.2	na	na	na	na
EPA 547	na	na	na	na
EPA 632	na	na	na	na
EPA 8080 (for PCBs)	nd[h]	na	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 First quarter samples collected on 1/22 and 2/3/98.

b Second quarter samples collected on 4/15 and 6/15/98.

c Third quarter samples collected on 8/24/98.

d Fourth quarter samples collected on 10/13, 10/22, and 12/15/98.

e na = Not analyzed.

f Field pH and water temperature were not recorded on these samples.

g No other radioisotopes were detected above the analytical reporting limit by gamma spectroscopy.

h nd = Not detected by this method.

Table 9-17. Constituent concentrations in ground water from Livermore site well W-593, downgradient from the Mixed-Waste Storage Area.

Parameter	2nd Quarter	3rd Quarter	4th Quarter
Physical			
pH (pH units)	na[d]	7.6	na
Field pH (pH units)	7.25	7.24	7.32
Specific conductance (μmho/cm)	na	2330	na
Field temperature (°C)	20.2	19.9	19.8
General minerals (mg/L)			
Bicarbonate alkalinity (as $CaCO_3$)	na	262	na
Carbonate alkalinity (as $CaCO_3$)	na	<5	na
Hydroxide alkalinity (as $CaCO_3$)	na	<5	na
Total alkalinity (as $CaCO_3$)	na	262	na
Boron	na	7.6	na
Calcium	na	93	na
Chloride	na	453	na
Fluoride	na	1.3	na
Magnesium	na	52	na
Nitrate (as N)	na	5	na
Nitrite (as N)	na	<0.02	na
Nitrate (as NO_3)	na	22	na
Orthopphosphate	na	0.05	na
Potassium	na	1.9	na
Sodium	na	347	na
Sulfate	na	218	na
Surfactants	na	<0.05	na
Total dissolved solids (TDS)	na	1450	na
Total hardness (as $CaCO_3$)	na	446	na
Total phosphorus (as P)	na	<0.05	na
Metals (μg/L)			
Aluminum	na	<50	na
Antimony	na	<4	na
Arsenic	na	<2	na
Barium	na	<25	na
Beryllium	na	<0.2	na
Cadmium	na	<0.5	na
Chromium	na	6.3	na
Cobalt	na	<50	na

Table 9-17. Constituent concentrations in ground water from Livermore site well W-593, downgradient from the Mixed-Waste Storage Area (continued).

Parameter	2nd Quarter	3rd Quarter	4th Quarter
Metals (μg/L) (concluded)			
Copper	na	<10	na
Chromium (VI)	na	10	na
Iron	na	<50	na
Lead	na	<5	na
Manganese	na	<10	na
Mercury	na	<0.2	na
Molybdenum	na	<25	na
Nickel	na	7.3	na
Selenium	na	<2	na
Silver	na	<1	na
Thallium	na	<1	na
Vanadium	na	16	na
Zinc	na	<20	na
Radioactivity (Bq/L)			
Gross alpha	0.321 ± 0.095	0.286 ± 0.1	0.208 ± 0.150
Gross beta	0.145 ± 0.087	0.135 ± 0.1	0.149 ± 0.193
Radium-226	0.00840 ± 0.00736	0.005 ± 0.004	0.0149 ± 0.0077
Radium-228	0.0525 ± 0.0208	0.008 ± 0.015	0.0271 ± 0.0195
Tritium	<1.24	1.06 ± 1.98	0.269 ± 1.920
Uranium-233+234	0.132 ± 0.019	0.129 ± 0.021	0.128 ± 0.017
Uranium-235+236	0.0129 ± 0.0043	0.006 ± 0.003	0.00984 ± 0.00343
Uranium-238	0.0814 ± 0.0133	0.112 ± 0.019	0.0903 ± 0.0134
Radioisotopes by gamma spectroscopy (Bq/L)[e]			
Bismuth-214	0.888 ± 0.307	na	na
Lead-212	0.189 ± 0.122	na	na
Lead-214	0.792 ± 0.275	na	na
Potassium-40	1.08 ± 0.65	na	na

Table 9-17. Constituent concentrations in ground water from Livermore site well W-593, downgradient from the Mixed-Waste Storage Area (concluded).

Parameter	2nd Quarter	3rd Quarter	4th Quarter
Radioisotopes by alpha spectroscopy (mBq/L)			
Americium-241	na	0.325 ± 0.337	–0.285 ± 40.364
Plutonium-238	<3.70	–0.024 ± 0.163	1.069 ± 1.25
Plutonium-239+240	0.206 ± 1.09	–0.005 ± 0.158	0.356 ± 0.714
Thorium-228	<9.25	–0.341 ± 0.984	1.191 ± 1.61
Thorium-230	4.03 ± 2.80	0.317 ± 0.596	2.794 ± 1.76
Thorium-232	<5.55	–0.248 ± 0.592	0.233 ± 0.466
Organic constituents (µg/L)			
Atrazine/EPA Method 525.2	0.35[f]	na	na
EPA 547	nd[g]	na	na
EPA 632	nd	na	na
EPA 8080 (for PCBs)	na	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] Second quarter samples collected on 6/17/98.

[b] Third quarter samples collected on 8/31/98.

[c] Fourth quarter samples collected on 10/22/98.

[d] na = Not analyzed.

[e] No other radioisotopes were detected above the analytical reporting limit by gamma spectroscopy.

[f] Atrazine was detected at a concentration of of 0.35 µg/L in the second quarter sample. No other analytes were detected by this method.

[g] nd = Not detected by this method.

Table 9-18. Third quarter metal concentrations in ground water from within the Livermore site.[a]

Metals (μg/L)	Well W-307 Downgradient from Building 322	Well W-226 Downgradient from the Building 253 catch basin	Well W-306 Downgradient from the Building 253 catch basin
Aluminum	<50	<50	<50
Antimony	<4	<4	<4
Arsenic	<2	<2	<2
Barium	300	160	98
Beryllium	1.7	<0.2	<0.2
Boron	750	640	1300
Cadmium	<0.5	<0.5	<0.5
Chromium	12	25	38
Cobalt	<50	<50	<50
Copper	6.8	14	30
Chromium(VI)	11	27	47
Iron	<50	<50	<50
Lead	<5	<5	<5
Manganese	<10	<10	<10
Mercury	<0.2	<0.2	<0.2
Molybdenum	<25	<25	<25
Nickel	<2	<2	<2
Selenium	<2	<2	<2
Silver	<1	<1	<1
Thallium	<1	<1	<1
Vanadium	<10	<10	<10
Zinc	<20	<20	<20

[a] Third quarter samples collected on 8/31/98.

Table 9-19a. 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	0.0005
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 9-19a. 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	0.5–0.7
Plutonium-238 (mBq/L)	U-NAS-NS-3050	0.7– 3.7
Plutonium-239+240 (mBq/L)	U-NAS-NS-3050	0.7 –3.7
Radon-222	EPA 913	0.4
Radium-226	EPA 903	0.1
Radium-228	EPA 904	0.1
Strontium-90	SM 7500	0.1–0.15
Thorium-228	U-NAS-NS-3050	0.1
Thorium-230	U-NAS-NS-3050	0.1
Thorium-232	U-NAS-NS-3050	0.1
Tritium	LLNL-RAS-011	2
Uranium-234	U-NAS-NS-3050	0.1
Uranium-235	U-NAS-NS-3050	0.1
Uranium-238	U-NAS-NS-3050	0.1

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 9-19b. 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 9-19b. 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

Constituents of concern	Reporting limit (µg/L)
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 9-19b. 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 9-19b. 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	0.5
Styrene	0.5
Tetrachloroethene	0.5
Toluene	0.5
Total xylene isomers	1
trans-1,3-Dichloropropene	0.5
Trichloroethene	0.5

Table 9-19b. 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 9-19b. 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. Lower reporting limits were used and reported for specific analytes in Tables 9-31 through 9-43.

Table 9-19c. 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 9-20. Tritium activity in Livermore Valley wells, 1998.

Location	Sampling date	Tritium activity (Bq/L)
11B1	6/9	8.47 ± 2.96
12A2	6/11	0.75 ± 2.61
12D2	6/11	9.03 ± 2.30
12G1	6/10	1.57 ± 2.67
16L5	9/9	–0.38 ± 1.86
16L7	9/9	0.18 ± 1.84
17D2	9/15	–0.04 ± 1.81
18A1	9/15	–0.37 ± 1.82
1H3	6/9	–0.52 ± 2.58
1P2	6/10	2.88 ± 2.72
1R2	6/10	0.91 ± 2.63
2R1	6/9	3.32 ± 2.75
004	9/9	–0.30 ± 1.82
9M2	9/16	1.34 ± 2.05
9M3	9/16	–0.95 ± 1.78
16B1	6/9	–0.05 ± 2.6
7C2	6/9	0.75 ± 2.64
7P3	6/9	–1.06 ± 2.55
8P1	6/9	–1.53 ± 2.53
9Q1	6/9	–1.08 ± 2.56

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. WDR 93-100 constituents of concern in Site 300 Pit 7 monitoring wells.

Constituents of concern	Monitoring well	Statistical limit	Quarterly sample dates			
			14–27 Jan	20–30 Apr	21–31 Jul	19–26 Oct
Arsenic (µg/L)	K7-06	—[a]	14.0	14	13	12
	K7-01	14	7.6	7.2	7.1	7.7
	K7-03	3.2	<2	2.8	<2	<2
	K7-09	2.0	<2	<2	<2	<2
	K7-10	4.2	<2	<2	<2	2.6
	NC7-25	8.6	18.0	4.4	<2	5.0
	NC7-26	3.6	2.1	2.1	<2	<2
	NC7-47	17	9.8	11	4.3	9.0
	NC7-48	19	6.2	6.6	<2	5.7
Barium (µg/L)	K7-06	—[a]	74	71	83	71
	K7-01	230	160	190	200	180
	K7-03	85	60	60	52	62
	K7-09	25	<25	<25	<25	<25
	K7-10	120	66	180	58	33
	NC7-25	140	75	75	130	85
	NC7-26	39	28	25	<25	26
	NC7-47	63	52	59	53	58
	NC7-48	400	130	150	66	110
Beryllium (µg/L)	K7-06	—[a]	<0.5	<0.5	<0.5	<0.5
	K7-01	0.5	<0.5	<0.5	<0.5	<0.5
	K7-03	0.5	<0.5	<0.5	<0.5	<0.5
	K7-09	0.5	<0.5	<0.5	<0.5	<0.5
	K7-10	0.5	<0.5	<0.5	<0.5	<0.5
	NC7-25	0.5	<0.5	<0.5	<0.5	<0.5
	NC7-26	0.5	<0.5	<0.5	<0.5	<0.5
	NC7-47	0.5	<0.5	<0.5	<0.5	<0.5
	NC7-48	0.5	<0.5	<0.5	<0.5	<0.5
Cadmium (µg/L)	K7-06	—[a]	<0.5	<0.5	<0.5	<0.5
	K7-01	0.5	<0.5	<0.5	<0.5	<0.5
	K7-03	0.5	<0.5	<0.5	<0.5	<0.5
	K7-09	0.5	<0.5	<0.5	<0.5	<0.5
	K7-10	1.6	<0.5	<0.5	<0.5	<0.5
	NC7-25	0.6	<0.5	<0.5	<0.5	<0.5
	NC7-26	0.5	<0.5	<0.5	<0.5	<0.5
	NC7-47	0.5	<0.5	<0.5	<0.5	<0.5
	NC7-48	1.2	<0.5	<0.5	<0.5	<0.5

Table 9-21. WDR 93-100 constituents of concern in Site 300 Pit 7 monitoring wells (continued).

Constituents of concern	Monitoring well	Statistical limit	Quarterly sample dates			
			14–27 Jan	20–30 Apr	21–31 Jul	19–26 Oct
Cobalt (µg/L)	K7-06	—[a]	<25	<25	<25	<25
	K7-01	25	<25	<25	<25	<25
	K7-03	25	<25	<25	<25	<25
	K7-09	25	<25	<25	<25	<25
	K7-10	25	<25	<25	<25	<25
	NC7-25	25	<25	<25	<25	<25
	NC7-26	25	<25	<25	<25	<25
	NC7-47	25	<25	<25	<25	<25
	NC7-48	25	<25	<25	<25	<25
Copper (µg/L)	K7-06	—[a]	<10	<10	<10	10
	K7-01	40	28	10	14	26
	K7-03	140	71	55	43	71
	K7-09	10	<10	<10	<10	<10[b]
	K7-10	10	<10	<10	51	<10
	NC7-25	10	<10[b]	<10	<10	<10
	NC7-26	10	<10	<10	<10	<10
	NC7-47	10	<10	<10	<10	<10
	NC7-48	10	<10	<10	<10	<10
Lead (µg/L)	K7-06	—[a]	<2	<2	<2	<2
	K7-01	6.0	<2	<2	<2	2.7[b]
	K7-03	6.1	<2	<2	<2	<2
	K7-09	5.9	<2	<2	<2	<2
	K7-10	2.0	<2	<2	<2	<2
	NC7-25	2.0	<2	<2	<2	<2
	NC7-26	5.1	<2	<2	<2	<2
	NC7-47	7.6	<2	<2	<2	<2
	NC7-48	2.0	<2	<2	<2	<2
Nickel (µg/L)	K7-06	—[a]	6	<5	<5	<5
	K7-01	25	11	<5	<5	<5
	K7-03	26	9.0[b]	7.8	9.2	11
	K7-09	29	<5[b]	<5	<5	6
	K7-10	13	13	<5	<5	<5
	NC7-25	13	12	<5	<5	<5
	NC7-26	5	<5[b]	<5	<5	<5
	NC7-47	14	<5	<5	<5	<5
	NC7-48	48	8	<5	<5	<5

Table 9-21. WDR 93-100 constituents of concern in Site 300 Pit 7 monitoring wells (continued).

Constituents of concern	Monitoring well	Statistical limit	Quarterly sample dates			
			14–27 Jan	20–30 Apr	21–31 Jul	19–26 Oct
Vanadium (µg/L)	K7-06	—[a]	35	35	39	34
	K7-01	25	<25	<25	<25	<25
	K7-03	25	<25	<25	<25	<25
	K7-09	25	<25	<25	<25	<25
	K7-10	25	<25	<25	<25	<25
	NC7-25	25	<25	17	<25	<25
	NC7-26	25	<25	<25	<25	<25
	NC7-47	79	65	70	69	66
	NC7-48	110	<25	22	<25	<25
Zinc (µg/L)	K7-06	—[a]	<20	<20	<20	<20
	K7-01	52	29	<20	29	<20
	K7-03	72	49	60	51	63
	K7-09	20	<20	<20	<20	<20
	K7-10	20	<20	<20	<20[b]	<20
	NC7-25	36	<20	<20	<20	21
	NC7-26	20	<20	<20	<20	<20
	NC7-47	50	<20	<20	<20	36
	NC7-48	44	<20	<20	<20	<20
HMX (µg/L)	K7-06	—[a]	<5	<5	<5	<5
	K7-01	5	<5	<5	<5	<5
	K7-03	5	<5	<5	<5	<5
	K7-09	5	<5	<5	<5	<5
	K7-10	5	<5	<5	<5	<5
	NC7-25	5	<5	<5	<5	<5
	NC7-26	5	<5	<5	<5	<5
	NC7-47	5	<5	<5	<5	<5
	NC7-48	5	<5	<5	<5	<5
RDX (µg/L)	K7-06	—[a]	<5	<5	<5	<5
	K7-01	5	<5	<5	<5	<5
	K7-03	5	<5	<5	<5	<5
	K7-09	5	<5	<5	<5	<5
	K7-10	5	<5	<5	<5	<5
	NC7-25	5	<5	<5	<5	<5
	NC7-26	5	<5	<5	<5	<5
	NC7-47	5	<5	<5	<5	<5
	NC7-48	5	<5	<5	<5	<5

Table 9-21. WDR 93-100 constituents of concern in Site 300 Pit 7 monitoring wells (continued).

Constituent of concern	Monitoring well	Statistical limit	Quarterly sample dates			
			14–27 Jan	20–30 Apr	21–31 Jul	19–26 Oct
Radium 226 (Bq/L)	K7-06	—[a]	0.004	0.008	0.009	0.010
	K7-01	0.080	0.030	0.027	0.031	0.021
	K7-03	0.030	0.004	0.003	0.005	0.007
	K7-09	0.023	0.000	0.007	0.004	0.006
	K7-10	0.032	0.011	0.023	0.010	0.008
	NC7-25	0.054	0.015	0.023	0.016	0.033
	NC7-26	0.034	0.000	0.011	0.012	0.016
	NC7-47	0.022	0.000	0.003	0.000	0.007
	NC7-48	0.040	0.000	0.015	0.014	0.016
Thorium 228 (Bq/L)	K7-06	—[a]	0.003	–0.001	0.003	0.005
	K7-01	0.024	0.001	0.001	0.003	–0.005
	K7-03	0.024	0.004	0.007	0.006	0.001
	K7-09	0.024	0.005	0.001	0.003	0.000
	K7-10	0.024	0.003	–0.003	0.003	0.003
	NC7-25	0.024	0.004	0.002	0.007	0.008
	NC7-26	0.024	0.005	–0.002	0.003	0.000
	NC7-47	0.024	0.003	–0.002	0.006	–0.002
	NC7-48	0.024	0.004	0.000	0.005	0.003
Thorium 232 (Bq/L)	K7-06	—[a]	0.003	0.001	–0.005	0.013
	K7-01	0.014	0.002	0.000	0.004	0.003
	K7-03	0.014	0.002	0.001	0.001	0.002
	K7-09	0.014	0.000	0.001	0.001	0.002
	K7-10	0.014	0.000	0.002	0.003	0.000
	NC7-25	0.014	0.001	0.001	0.006	0.001
	NC7-26	0.014	0.002	0.000	0.000	0.005
	NC7-47	0.014	0.001	–0.001	0.002	0.003
	NC7-48	0.014	0.000	–0.002	–0.004	0.003
Uranium (total, Bq/L)	K7-06	—[a]	0.052	0.037	0.042	0.048
	K7-01	0.636	0.518	0.613	0.608	0.613[c]
	K7-03	0.224	0.124	0.138	0.131	0.119
	K7-09	0.035	0.119	0.021	0.010	0.012
	K7-10	0.083	0.004	0.045	0.102	0.031
	NC7-25	1.262	1.179	0.823	1.285	1.240
	NC7-26	0.034	0.010	0.182	0.033	0.028
	NC7-47	0.178	0.075	0.063	0.067[b]	0.123[b]
	NC7-48	2.327	1.056	2.045	2.587	0.895

Table 9-21. WDR 93-100 constituents of concern in Site 300 Pit 7 monitoring wells (concluded).

Constituents of concern	Monitoring well	Statistical limit	Quarterly sample dates			
			14–27 Jan	20–30 Apr	21–31 Jul	19–26 Oct
Tritium (Bq/L)	K7-06	—[a]	0.2	0.1	–0.2	–0.6
	K7-01	—[d]	1,620	2,250	2,300	2,460
	K7-03	—[d]	5,140	5,200	5,300	5,620
	K7-09	4.7	0.3	0.6	0.5	-0.6
	K7-10	4.7	–0.1	1.2	–1.2	0.3
	NC7-25	—[d]	19,900	20,200	21,600	24,500
	NC7-26	—[d]	148	129	400	257
	NC7-47	4.7	1.9	0.5	–1.0	–1.2
	NC7-48	16.4	3.0	6.7	11.0	7.1

[a] Upgradient well. No statistical limit.

[b] Mean of two retest results.

[c] Mean of laboratory duplicates.

[d] Exempt well (insensitive to further detection of tritium releases).

Table 9-22. Additional RCRA Post-Closure Monitoring Plan parameters and constituents of concern for Site 300 Pit 7 monitoring wells.

Constituents of concern	Monitoring well	Quarterly sample dates			
		14–27 Jan	20–30 Apr	21–31 Jul	19–26 Oct
Ground water elevation (ft)	K7-06[a]	1390.4	1391.6	1390.9	1390.3
	K7-01	1298.0	1300.4	1301.2	1300.6
	K7-03	1315.5	1322.4	1320.5	1317.7
	K7-09	1300.5	1304.0	1303.2	1303.5
	K7-10	1312.1	1311.6	1311.2	1310.7
	NC7-25	1301.2	1302.5	1302.3	1301.7
	NC7-26	1258.9	1261.1	1260.7	1260.1
	NC7-47	1205.7	1205.8	1206.2	1206.3
	NC7-48	1349.4	1352.6	1350.1	1349.0
VOCs (EPA Method 601)	nd[b]	nd	nd	nd	nd
TCE (µg/L)	K7-01	2.2	1.4	1.7	1.6
TCE (µg/L)	K7-03	3.3	1.5	0.68	0.78
1,1-DCE (µg/L)	K7-03	0.76	<0.5	<0.5	<0.5
Freon 11 (µg/L)	NC7-48	0.77	1.0	1.2	0.92
Gross alpha (Bq/L)	K7-06[a]	0.037	0.155	0.077	0.026
	K7-01	0.592	0.629	0.407	0.329
	K7-03	0.074	0.190	0.174	0.084
	K7-09	0.037	0.072	0.050	0.346
	K7-10	0.030	0.677	0.117	0.171
	NC7-25	0.888	0.907	1.092	1.169
	NC7-26	0.019	0.699	0.021	0.278
	NC7-47	0.074	0.066	0.156	0.082
	NC7-48	0.666	1.783	0.622	0.396
Gross beta (Bq/L)	K7-06[a]	0.148	0.174	0.297	0.098
	K7-01	0.444	0.444	0.209	0.289
	K7-03	0.148	0.235	0.173	0.220
	K7-09	0.444	2.601	1.728	0.729
	K7-10	0.259	0.992	0.273	0.155
	NC7-25	0.222	0.710	0.392	0.311
	NC7-26	0.074	1.339	0.137	0.107
	NC7-47	0.074	0.090	0.426	0.099
	NC7-48	0.370	1.106	0.455	0.389

[a] Upgradient well.

[b] VOCs were not detected above reporting limits for monitoring wells not listed.

Table 9-23. Site 300, Elk Ravine.

Constituents of concern	Well					
	K7-07		NC7-61		NC7-69	
	6/2/98	11/30/98	6/2/98	12/2/98	6/2/98	12/3/98
Inorganic (μg/L)						
Antimony	<5	<5	<5	<5	<5	<5
Arsenic	13	15	16	17	<2	<2
Barium	96	94	130	100	27	29
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	3.5	<1	3.7	1.5	1.1	<1
Cobalt	<25	<25	<25	<25	<25	<25
Copper	<10	<10	<10	<10	<10	<10
Lead	<2	<2	<2	<2	<2	2.4
Mercury	<0.2	<0.2	<0.2	0.3	<0.2	<0.2
Molybdenum	<25	<25	<25	<25	<25	<25
Nickel	<5	<5	<5	<5	<5	<5
Selenium	<2	<2	<2	<2	<2	<2
Silver	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Thallium	<1	<1	<1	<1	<1	<1
Vanadium	30	31	91	92	<25	<25
Zinc	<20	<20	<20	<20	<20	<20
Potassium (mg/L)	1.2	1.4	4	4.1	4.3	4.4
Nitrate (mg/L)	37	34	97	66	<0.4	<0.4
Organic (μg/L)						
Volatile (EPA 601)	nd[c]	nd	nd	nd	nd	nd
Explosives (μg/L)						
HMX	<5	<5	<5	<5	<5	<5
RDX	<5	<5	6	<5	<5	<5
Radioactive (Bq/L)						
Gross alpha	0.25 ± 0.07	0.18 ± 0.03	0.12 ± 0.06	0.088 ± 0.026	0.073 ± 0.057	0.041 ± 0.023
Gross beta	0.13 ± 0.04	0.022 ± 0.021	0.13 ± 0.04	0.050 ± 0.022	0.16 ± 0.05	0.15 ± 0.03
Tritium	82 ± 3	580 ± 10	4400 ± 20	4480 ± 30	–0.4 ± 1.1	–0.7 ± 1.8
Uranium (total)	—[d]	0.52 ± 0.08	0.22 ± 0.05	0.30 ± 0.05	0.021 ± 0.013	0.0027 ± 0.0024

Table 9-23. Site 300, Elk Ravine (continued).

Constituents of concern	Well					
	K2-04D		K2-04S		NC2-12D	
	6/22/98	12/7/98	6/22/98	11/30/98	6/22/98	12/3/98
Inorganic (μg/L)						
Antimony	<5	<5	<5	<5	<5	<5
Arsenic	10	14	13	15	10	12
Barium	38	40	65	53	<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	2.2	<1	1.8	<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	0.73
Molybdenum	<25	<25	<25	<25	<25	<25
Nickel	<5	<5	<5	<5	<5	<5
Selenium	<2	<2	2.7	<2	2.7	<2
Silver	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Thallium	<1	<1	<1	<1	<1	<1
Vanadium	53	53	59	67	44	44
Zinc	25	29	<20	<20	<20	<20
Potassium (mg/L)	2.7	2.8	3.1	3	3.3	3.4
Nitrate (mg/L)	35	37	58	51	27	25
Organic (μg/L)						
Volatile (EPA 601)	nd	nd	nd	nd	nd	nd
Trichloroethene (TCE)	<0.5	<0.5	1.2	<0.5	<0.5	<0.5
Explosives (μg/L)						
HMX	<5	<5	<5	<5	<5	<5
RDX	<5	<5	<5	<5	<5	<5
Radioactive (Bq/L)						
Gross alpha	0.051 ± 0.041	0.069 ± 0.026	0.12 ± 0.06	0.062 ± 0.022	0.08 ± 0.05	0.14 ± 0.03
Gross beta	0.28 ± 0.06	0.14 ± 0.02	0.14 ± 0.05	0.093 ± 0.020	0.33 ± 0.06	0.15 ± 0.03
Tritium	145 ± 4	141 ± 6	620 ± 10	310 ± 10	295 ± 6	316 ± 8
Uranium (total)	0.094 ± 0.023	0.094 ± 0.015	0.46 ± 0.08	0.31 ± 0.05	0.15 ± 0.03	0.13 ± 0.02

Table 9-23. Site 300, Elk Ravine (concluded).

Constituents of concern	Well					
	812CRK (SPRING6)		NC2-07		NC2-11D	K2-01C
	6/22/98	12/7/98	6/23/98	12/9/98	12/7/98[a]	12/14/98[b]
Inorganic (μg/L)						
Antimony	<5	<5	<5	<5	<5	<5
Arsenic	25	27	35	37	14	7.7
Barium	46	51	31	34	<25	37
Beryllium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5	<0.5	0.54	<0.5
Chromium	2.2	<1	1.4	<1	45	1.9
Cobalt	<25	<25	<25	<25	<25	<25
Copper	<10	<10	<10	<10	<10	<10
Lead	<2	<2	<2	<2	180	3.1
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	12	<5
Selenium	<2	<2	3	<2	<2	<2
Silver	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Thallium	<1	<1	<1	<1	<1	<1
Vanadium	54	52	45	45	50	45
Zinc	<20	20	<20	22	20	20
Potassium (mg/L)	5.3	4.5	4.3	4.7	3.8	3.3
Nitrate (mg/L)	43	25	25	23	31	48
Organic (μg/L)						
Volatile (EPA 601)	nd	nd	nd	nd	nd	nd
Trichloroethene (TCE)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Explosives (μg/L)						
HMX	<5	<5	<5	<5	<5	<5
RDX	<5	<5	<5	<5	<5	<5
Radioactive (Bq/L)						
Gross alpha	0.12 ± 0.06	0.16 ± 0.04	0.38 ± 0.10	0.29 ± 0.05	0.12 ± 0.03	0.20 ± 0.04
Gross beta	0.26 ± 0.06	0.17 ± 0.03	1.5 ± 0.2	0.27 ± 0.04	0.16 ± 0.03	0.13 ± 0.02
Tritium[a]						555 ± 8
Tritium	–0.4 ± 1.1	0.4 ± 1.8	–0.3 ± 1.1	0.4 ± 1.8	111 ± 5	585 ± 11
Uranium (total)	0.23 ± 0.05	0.23 ± 0.04	0.26 ± 0.07	0.24 ± 0.03	0.19 ± 0.03	0.22 ± 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 Sampled only once in 1998. Well pump inoperable during second quarter.

b Grab sample taken 6/22/98 for tritium only. Well pump inoperable during second quarter.

c nd = Not detected above reporting limits, except as listed. See **Tables 9-19a** and **19b** for analytical methods for constituents and their reporting limits.

d Analysis not requested (sampling error).

Table 9-24. Site 300, Pit 2.

Constituents of concern	Barcad				
	K1-02A		K2-01A		K2-01B[a]
	6/24/98	12/16/98	6/25/98	12/17/98	6/25/98
Inorganic (μg/L)					
Antimony	<5	<5	<5	<5	<5
Arsenic	12	14	<2	<2	20
Barium	37	39	<25	<25	<25
Beryllium	<0.5	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	<1	<1	7.6	<1	1.2
Cobalt	<25	<25	<25	<25	<25
Copper	<10	<10	<10	<10	<10
Lead	<2	<2	2.4	<2	<2
Mercury	<0.2	<0.2	<0.2	0.21	<0.2
Molybdenum	<25	<25	<25	<25	<25
Nickel	<5	<5	<5	<5	<5
Selenium	<2	<2	<2	<2	<2
Silver	<0.5	<0.5	<0.5	<0.5	<0.5
Thallium	<1	<1	<1	<1	<1
Vanadium	<25	<25	<25	<25	<25
Zinc	<20	<20	<20	<20	<20
Potassium (mg/L)	3.3	3.2	3.7	3.9	<1
Nitrate (mg/L)	<0.4	<0.4	<0.4	<0.4	<0.4
Explosive (μg/L)					
HMX	<5	<5	<5	<5	<5
RDX	<5	<5	<5	<5	<5
Radioactive (Bq/L)					
Gross alpha	0.11 ± 0.06	0.12 ± 0.03	0.048 ± 0.050	0.067 ± 0.024	0.30 ± 0.11
Gross beta	0.39 ± 0.07	0.14 ± 0.02	0.13 ± 0.04	0.16 ± 0.03	0.20 ± 0.05
Tritium	0.3 ± 1.2	1.5 ± 1.9	–0.1 ± 1.2	1.9 ± 1.8	9.4 ± 1.5
Uranium (total)	0.081 ± 0.024	0.091 ± 0.014	0.023 ± 0.017	0.0064 ± 0.0025	0.096 ± 0.029

Table 9-24. Site 300, Pit 2 (concluded).

Constituents of concern	Barcad			
	K2-02A		K2-02B	
	6/22/98	12/16/98	6/2/98	12/16/98
Inorganic (μg/L)				
Antimony	<5	<5	<5	<5
Arsenic	34	37	<2	<2
Barium	<25	26	26	28
Beryllium	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5	<0.5
Chromium	1.6	<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
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	<20	<20	<20
Potassium (mg/L)	4.1	4.3	4	3.8
Nitrate (mg/L)	<0.4	<0.4	<0.4	<0.4
Explosive (μg/L)				
HMX	<5	<5	<5	<5
RDX	<5	<5	<5	<5
Radioactive (Bq/L)				
Gross alpha	0.14 ± 0.06	0.11 ± 0.03	–0.011 ± 0.040	0.030 ± 0.027
Gross beta	0.22 ± 0.05	0.14 ± 0.02	0.11 ± 0.05	0.14 ± 0.03
Tritium	–0.5 ± 1.2	1.6 ± 1.8	0.4 ± 1.2	–0.6 ± 1.7
Uranium (total)	0.14 ± 0.034	0.15 ± 0.03	0.017 ± 0.010	0.0023 ± 0.0021

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] Barcad became inoperative and was only sampled once during 1998.

Table 9-25. WDR 93-100 constituents of concern in ground water at Site 300 Pit 1 monitoring wells.

Constituents of concern	Monitoring well	Statistical limit	Quarterly sample dates			
			8–12 Jan	9–15 Apr	14–16 Jul	13–15 Oct
Arsenic (µg/L)	K1-01C	— [a]	11	12	10	10
	K1-07	— [a]	12	14	11	13
	K1-02B	20	10	14	10	11
	K1-03	19	12	13	11	11
	K1-04	19	11	11	9	10
	K1-05	24	11	14	11	12
	K1-08	21	12	13	12	12
	K1-09	19	12	13	11	13
Barium (µg/L)	K1-01C	— [a]	<25	<25	<25	<25
	K1-07	— [a]	<25	<25	25	<25
	K1-02B	25	<25	<25	<25	25
	K1-03	25	<25	<25	<25	<25
	K1-04	32	<25	<25	27	25
	K1-05	41	31	32	36	36
	K1-08	51	36	42	43	41
	K1-09	46	40	39	44	43
Beryllium (µg/L)	K1-01C	— [a]	<0.5	<0.5	<0.5	<0.5
	K1-07	— [a]	<0.5	<0.5	<0.5	<0.5
	K1-02B	0.5	<0.5	<0.5	<0.5	<0.5
	K1-03	0.5	<0.5	<0.5	<0.5	<0.5
	K1-04	0.5	<0.5	<0.5	<0.5	<0.5
	K1-05	0.5	<0.5	<0.5	<0.5	<0.5
	K1-08	0.5	<0.5	<0.5	<0.5	<0.5
	K1-09	0.5	<0.5	<0.5	<0.5	<0.5
Cadmium (µg/L)	K1-01C	— [a]	<0.5	<0.5	<0.5	<0.5
	K1-07	— [a]	<0.5	<0.5	<0.5	<0.5
	K1-02B	0.5	<0.5	<0.5	<0.5	<0.5
	K1-03	0.5	<0.5	<0.5	<0.5	<0.5
	K1-04	0.5	<0.5	<0.5	<0.5	<0.5
	K1-05	0.5	<0.5	<0.5	<0.5	<0.5
	K1-08	0.5	<0.5	<0.5	<0.5	<0.5
	K1-09	0.5	<0.5	<0.5	<0.5	<0.5
Cobalt (µg/L)	K1-01C	— [a]	<25	<25	<25	<25
	K1-07	— [a]	<25	<25	<25	<25
	K1-02B	25	<25	<25	<25	<25
	K1-03	25	<25	<25	<25	<25
	K1-04	25	<25	<25	<25	<25
	K1-05	25	<25	<25	<25	<25
	K1-08	25	<25	<25	<25	<25
	K1-09	25	<25	<25	<25	<25

Table 9-25. WDR 93-100 constituents of concern in ground water at Site 300 Pit 1 monitoring wells (continued).

Constituents of concern	Monitoring well	Statistical limit	Quarterly sample dates			
			8–12 Jan	9–15 Apr	14–16 Jul	13–15 Oct
Copper (µg/L)	K1-01C	— [a]	32	22	12	20
	K1-07	— [a]	<10	<10	<10	<10
	K1-02B	34	<10	11	12	17
	K1-03	34	<10	<10	<10	<10
	K1-04	34	<10	<10	<10	<10
	K1-05	34	<10	<10	<10	17
	K1-08	34	<10	<10	<10	<10
	K1-09	34	<10	<10	<10	<10
Lead (µg/L)	K1-01C	— [a]	<2	<2	<2	<2
	K1-07	— [a]	<2	<2	<2	<2
	K1-02B	2	<2	<2	<2	<2 [b]
	K1-03	2	<2	<2	<2	<2
	K1-04	2	<2	<2	<2	<2 [b]
	K1-05	2	<2	<2	<2	<2 [b]
	K1-08	2	<2	<2	<2	<2 [b]
	K1-09	2	<2	<2	<2	<2
Nickel (µg/L)	K1-01C	— [a]	12	7	<5	<5
	K1-07	— [a]	<5	<5	<5	<5
	K1-02B	12	6	7	<5	<5
	K1-03	12	5	<5	<5	<5
	K1-04	12	<5	<5	<5	<5
	K1-05	12	<5	<5	<5	<5
	K1-08	12	6	5	<5	<5
	K1-09	12	5.3	<5	<5	<5
Vanadium (µg/L)	K1-01C	— [a]	62	69	75	73
	K1-07	— [a]	70	70	78	79
	K1-02B	78	48	48	55	52
	K1-03	72	51	48	55	51
	K1-04	48	34	35	39	42
	K1-05	97	65	63	71	73
	K1-08	100	62	65	72	69
	K1-09	92	60	55	61	63
Zinc (µg/L)	K1-01C	— [a]	36	27	24	27
	K1-07	— [a]	<20	<20	20	<20
	K1-02B	94	22	26	38	34
	K1-03	94	<20	26	24	34
	K1-04	94	<20	<20	<20	<20
	K1-05	94	<20	<20	20	<20
	K1-08	94	<20	<20	<20	<20
	K1-09	94	<20	<20	<20	<20

Table 9-25. WDR 93-100 constituents of concern in ground water at Site 300 Pit 1 monitoring wells (continued).

Constituents of concern	Monitoring well	Statistical limit	Quarterly sample dates			
			8–12 Jan	9–15 Apr	14–16 Jul	13–15 Oct
Radium 226 (Bq/L)	K1-01C	— [a]	<0.02	0.006	0.007	0.001
	K1-07	— [a]	<0.02	0.000	0.001	0.003
	K1-02B	0.044	<0.02	0.011	0.010	0.002
	K1-03	0.044	<0.02	0.007	0.009	0.003
	K1-04	0.044	<0.02	0.008	0.003	0.004
	K1-05	0.044	<0.02	0.000	0.006	0.000
	K1-08	0.044	<0.02	0.000	0.005	0.004
	K1-09	0.044	0.014	0.014	0.001	0.002
Tritium (Bq/L)	K1-01C	— [a]	6.8	9.8	8.8	8.5
	K1-07	— [a]	1.01	0.66	<1.3	–0.07
	K1-02B	— [c]	203	190	197	244
	K1-03	23.4	20.3	21.6	20.6	26.9 [b]
	K1-04	3.70	-0.34	0.05	<1.4	1.78
	K1-05	3.70	-0.06	0.48	<1.3	1.10
	K1-08	3.70	0.10	0.78	<1.5	0.77
	K1-09	4.44	0.14	0.62	<1.3	-0.43
Uranium (total, Bq/L)	K1-01C	— [a]	0.119	0.157	0.111	0.113
	K1-07	— [a]	0.068	0.068	0.064	0.065
	K1-02B	0.192	0.098	0.139	0.086	0.128
	K1-03	0.145	0.049	0.091	0.045	0.040
	K1-04	0.124	0.053	0.064	0.052	0.063
	K1-05	0.109	0.077	0.077	0.079	0.093
	K1-08	0.120	0.081	0.081	0.097	0.072
	K1-09	0.109	0.082	0.082	0.093	0.098
Thorium 228 (Bq/L)	K1-01C	— [a]	0.003	-0.002	–0.003	0.000
	K1-07	— [a]	0.004	0.004	0.000	0.001
	K1-02B	0.023	0.003	0.001	0.000	0.002
	K1-03	0.023	0.003	0.003	–0.001	0.001
	K1-04	0.023	0.005	0.002	0.001	0.000
	K1-05	0.023	0.001	0.001	–0.001	-0.002
	K1-08	0.023	0.003	0.003	0.003	0.003
	K1-09	0.023	0.001	0.001	0.001	0.002
Thorium 232 (Bq/L)	K1-01C	— [a]	0.002	0.003	0.004	0.001
	K1-07	— [a]	0.003	0.003	0.001	0.003
	K1-02B	0.009	0.005	0.002	0.003 [d]	0.002
	K1-03	0.009	0.000	0.002	0.002	0.001
	K1-04	0.009	0.002	0.000	0.000	0.000
	K1-05	0.009	0.001	0.001	0.001	0.008
	K1-08	0.009	0.000	0.000	0.006 [d]	0.001
	K1-09	0.009	0.000	0.000	0.002	0.003

Table 9-25. WDR 93-100 constituents of concern in ground water at Site 300 Pit 1 monitoring wells (concluded).

Constituents of concern	Monitoring well	Statistical limit	Quarterly sample dates			
			8–12 Jan	9–15 Apr	14–16 Jul	13–15 Oct
HMX (µg/L)	K1-01C	— [a]	<5	<5	<5	<5
	K1-07	— [a]	<5	<5	<5	<5
	K1-02B	5	<5	<5	<5	<5
	K1-03	5	<5	<5	<5	<5
	K1-04	5	<5	<5	<5	<5
	K1-05	5	<5	<5	<5	<5
	K1-08	5	<5	<5	<5	<5
	K1-09	5	<5	<5	<5	<5
RDX (µg/L)	K1-01C	— [a]	<5	<5	<5	<5
	K1-07	— [a]	<5	<5	<5	<5
	K1-02B	5	<5	<5	<5	<5
	K1-03	5	<5	<5	<5	<5
	K1-04	5	<5	<5	<5	<5
	K1-05	5	<5	<5	<5	<5
	K1-08	5	<5	<5	<5	<5
	K1-09	5	<5	<5	<5	<5

[a] Upgradient well. No statistical limit.

[b] Mean of two retest results.

[c] Exempt well (insensitive to further detection of tritium releases).

[d] Mean of laboratory duplicates.

Table 9-26. Analytical results for RCRA Post-Closure Monitoring Plan parameters and constituents of concern for Site 300 Pit 1 monitoring wells in 1998.

Constituents of concern	Q[a]	Monitoring well							
		K1-01C[b]	K1-07[b]	K1-02B	K1-03	K1-04	K1-05	K1-08	K1-09
pH (pH units)	1	7.3	7.3	7.3	7.4	7.5	7.3	7.3	7.5
	2	7.5	7.5	7.4	7.4	7.5	7.5	7.5	7.6
	3	7.7	7.7	7.6	7.6	7.7	7.6	7.7	7.7
	4	7.6	7.7	7.4	7.4	7.4	7.5	7.4	7.6
Specific conductance (μmho/cm)	1	500	500	700	500	500	600	600	700
	2	600	600	700	600	600	700	700	700
	3	600	600	800	700	600	700	700	700
	4	600	600	700	600	600	700	700	700
Water table elevation (m)	1	299.7	297.2	298.5	297.9	296.3	293.8	297.0	296.0
	3	301.3	298.5	299.9	299.3	297.5	294.8	298.3	297.3
Water temperature (^{o}C)	1	20.5	20.5	19.1	20.5	18.3	21.0	20.8	20.9
	2	20.6	18.7	20.0	19.8	20.2	19.2	19.0	19.9
	3	22.9	22.8	21.6	21.2	22.1	22.2	23.6	21.8
	4	22.0	21.1	21.0	21.0	21.4	22.0	21.3	21.2
Chromium (μg/L)	2	8.8	13.0	7.8	7.2	7.5	15.0	10.0	15.0
	4	1.4	<1.0	1.7	1.3	1.5	<1.0	1.3	1.1
Iron mg/L)	2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Manganese (mg/L)	2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Mercury (μg/L)	2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	4	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Nitrate (as NO_3) (mg/L)	1	37	33	31	29	23	35	36	36
	2	37	32	29	29	22	35	36	36
	3	37	33	31	30	24	35	37	37
	4	37	34	33	31	28	37	37	37
Selenium (μg/L)	2	4.5	2.9	4.5	3.2	3.6	<2.0	<2.0	2.4
	4	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Silver (μg/L)	2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	4	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Sodium (mg/L)	2	31	36	37	31	34	38	41	40
	4	32	37	39	33	36	41	43	42

Table 9-26. Analytical results for RCRA Post-Closure Monitoring Plan parameters and constituents of concern for Site 300 Pit 1 monitoring wells in 1998 (concluded).

Constituents of concern	Q[a]	Monitoring well							
		K1-01C[b]	K1-07[b]	K1-02B	K1-03	K1-04	K1-05	K1-08	K1-09
Gross alpha (Bq/L)	1	0.074	0.074	0.111	0.074	0.074	0.037	0.444	0.242
	2	0.305	0.131	0.308	0.182	0.185	0.087	0.097	0.153
	3	0.085	0.096	0.097	0.016	0.041	0.135	0.098	0.097
	4	0.085	0.042	0.075	0.033	0.038	0.059	0.106	0.058
Gross beta (Bq/L)	1	0.074	0.111	0.111	0.037	0.111	0.148	0.148	0.233
	2	0.268	0.218	0.330	0.232	0.252	0.209	0.197	0.199
	3	0.084	0.200	0.060	0.168	–0.124	0.211	0.278	–0.078
	4	0.140	0.075	0.034	0.073	0.078	0.095	0.297	0.149
Organic compounds									
Volatile (EPA 601)	4	nd[c]	nd	nd	nd	nd	nd	nd	nd
Freon 113 (µg/L)		nd	nd	nd	nd	nd	40	65	140
Semivolatile (EPA 625)	4	nd	nd	nd	nd	nd	nd	nd	nd
Benzoic acid		nd	nd	nd	nd	nd	nd	30	nd
Pesticide and PCB (EPA 608)	4	nd	nd	nd	nd	nd	nd	nd	nd
Total organic carbon (TOC) (EPA 415.1) (mg/L)	4	9.2	8.2	9	8.9	8.4	7.8	13	8.9
Total organic halides (TOX) (EPA 9020) (µg/L)	4	20	<10	10	<10	<10	20	20	50

a Sample date (quarter-year division). 1 = 1/8/98–1/12/98; 2 = 4/9/98–4/15/98; 3 = 7/14/98–7/16/98; 4 = 10/13/98–10/15/98.

b Upgradient well.

c Not detected above reporting limits, except as listed.

Table 9-27. Site 300, Pit 8 wells.[a]

Constituents of concern	Wells	
	K8-01	K8-02B
	Sampled	
	6/30/98	6/30/98
Elements (μg/L)		
Antimony	<5	<5
Arsenic	16	22
Barium	<25	<25
Beryllium	<0.5	<0.5
Cadmium	<0.5	<0.5
Chromium	17	<1
Cobalt	<25	<25
Copper	<10	<10
Lead	<2	<2
Mercury	<0.2	<0.2
Molybdenum	<25	<25
Nickel	<5	<5
Selenium	<2	3.2
Silver	<0.5	<0.5
Thallium	<1	<1
Vanadium	65	62
Zinc	<20	<20
Potassium (mg/L)	4	4.2
Nitrate (as NO_3)	47	35
Explosive (μg/L)		
HMX	<5	<5
RDX	<5	<5
Radioactivity (Bq/L)		
Gross alpha	0.12 ± 0.05	—[b]
Gross beta	0.15 ± 0.05	—[b]
Tritium	4.0 ± 3.1	2.0 ± 3.0
Uranium (total)	—[b]	—[b]

a Well K8-03B was inaccessible during 1998 due to construction activities there.

b Analysis not requested (sampling error).

Table 9-28. Site 300, Pit 9 wells.

Constituents of concern	Well			
	K9-01	K9-02	K9-03	K9-04
	Sampled			
	8/27/98	8/31/98	8/31/98	8/31/98
Element (μg/L)				
Antimony	<5	<5	<5	<5
Arsenic	4.1	24	9.2	<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	1.3	2.2	1.9	1.5
Cobalt	<25	<25	<25	<25
Copper	<10	<10	<10	<10
Lead	2.6	<2	<2	<2
Mercury	<0.2	<0.2	<0.2	<0.2
Molybdenum	31	57	30	30
Nickel	<5	<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	<20	<20	<20
Inorganic (mg/L)				
Nitrate	<0.5	<0.5	<0.5	<0.5
Organic				
Volatile (EPA Method 601)	nd[a]	nd	nd	nd
Explosive (μg/L)				
HMX	<5	<5	<5	<5
RDX	<5	<5	<5	<5
Radioactive (Bq/L)				
Gross alpha	0.09 ± 0.04	0.16 ± 0.06	0.046 ± 0.044	0.20 ± 0.06
Gross beta	0.18 ± 0.04	0.41 ± 0.06	0.41 ± 0.06	0.53 ± 0.07
Tritium	–1.10 ± 1.2	–0.1 ± 1.2	–0.5 ± 1.2	–0.8 ± 1.2
Uranium (total)	0.013 ± 0.004	0.033 ± 0.010	0.032 ± 0.009	0.023 ± 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] nd = Not detected above reporting limits, except as listed. See **Tables 9-19a** and **9-19b** for method constituents and their reporting limits.

Table 9-29. Post-closure monitoring plan constituents of concern in Pit 6 detection monitoring wells for 1998.[a]

Constituents of concern	Well ID	Statistical limit[b]	Analytical results by quarter		
			Second	Third	Fourth
Inorganic (μg/L)					
Beryllium	K6-03	—[b]	<0.2	<0.2	<0.2
	K6-04	—[b]	<0.2	<0.2	<0.2
	K6-32	—[b]	—[c]	<0.2	<0.2
	BC6-12	RL[d]	<0.2	<0.4	<0.2
	EP6-06	RL	<0.2	<0.4	<0.2
	EP6-08	RL	<0.2	<0.4	<0.2
	EP6-09	RL	<0.2	<0.2	<0.2
	K6-01S	TBD[e]	<0.2	<0.2	<0.2
	K6-19	RL	<0.2	<0.2	<0.2
Mercury	K6-03	—[b]	<0.2	<0.2	<0.2
	K6-04	—[b]	<0.2	<0.2	<0.2
	K6-32	—[b]	—[c]	<0.2	<0.2
	BC6-12	RL	<0.2	<0.2	<0.2
	EP6-06	RL	<0.2	<0.2	<0.2
	EP6-08	RL	<0.2	<0.2	<0.2
	EP6-09	RL	<0.2	<0.2	<0.2
	K6-01S	TBD	<0.2	<0.2	<0.2
	K6-19	RL	<0.2	<0.2	<0.2
Volatile organic (μg/L, EPA Method 624)					
Benzene	K6-03	—[b]	<0.5	<0.5	<0.5
	K6-04	—[b]	<0.5	<0.5	<0.5
	K6-32	—[b]	—[c]	<0.5	<0.5
	BC6-12	TBD	<0.5	<0.5	<0.5
	EP6-06	TBD	<0.5	<0.5	<0.5
	EP6-08	TBD	<0.5	<0.5	<0.5
	EP6-09	TBD	<0.5	<0.5	<0.5
	K6-01S	TBD	<0.5	<0.5	<0.5
	K6-19	TBD	<0.5	<0.5	<0.5
Chloroform	K6-03	—[b]	<0.5	<0.5	<0.5
	K6-04	—[b]	<0.5	<0.5	<0.5
	K6-32	—[b]	—[c]	<0.5	<0.5
	BC6-12	RL	<0.5	<0.5	<0.5
	EP6-06	RL	<0.5	<0.5	<0.5
	EP6-08	0.97	<0.5	<0.5	<0.5

Table 9-29. Post-closure monitoring plan constituents of concern in Pit 6 detection monitoring wells for 1998 (continued).[a]

Constituents of concern	Well ID	Statistical limit[b]	Analytical results by quarter		
			Second	Third	Fourth
Volatile organic (µg/L, EPA Method 624) (continued)					
Chloroform	EP6-09	RL	<0.5	<0.5	<0.5
	K6-01S	RL	<0.5	<0.5	<0.5
	K6-19	1.48	<0.5	<0.5	<0.5
1,2-dichloroethane	K6-03	—[b]	<0.5	<0.5	<0.5
	K6-04	—[b]	<0.5	<0.5	<0.5
	K6-32	—[b]	—[c]	<0.5	<0.5
	BC6-12	RL	<0.5	<0.5	<0.5
	EP6-06	RL	<0.5	<0.5	<0.5
	EP6-08	RL	<0.5	<0.5	<0.5
	EP6-09	RL	<0.5	0.68	0.52
	K6-01S	RL	<0.5	<0.5	<0.5
	K6-19	RL	<0.5	<0.5	<0.5
Cis-1,2-dichloroethene	K6-03	—[b]	<0.5	<0.5	<0.5
	K6-04	—[b]	<0.5	<0.5	<0.5
	K6-32	—[b]	—[c]	<0.5	<0.5
	BC6-12	RL	<0.5	<0.5	<0.5
	EP6-06	RL	<0.5	<0.5	<0.5
	EP6-08	RL	<0.5	<0.5	<0.5
	EP6-09	RL	<0.5	<0.5	<0.5
	K6-01S	6.98	4.4	4.1	2.6
	K6-19	RL	<0.5	<0.5	<0.5
Ethyl benzene	K6-03	—[b]	<0.5	<0.5	<0.5
	K6-04	—[b]	<0.5	<0.5	<0.5
	K6-32	—[b]	—[c]	<0.5	<0.5
	BC6-12	TBD	<0.5	<0.5	<0.5
	EP6-06	TBD	<0.5	<0.5	<0.5
	EP6-08	TBD	<0.5	<0.5	<0.5
	EP6-09	TBD	<0.5	<0.5	<0.5
	K6-01S	TBD	<0.5	<0.5	<0.5
	K6-19	TBD	<0.5	<0.5	<0.5
Methylene chloride	K6-03	—[b]	<1.0	<1.0	<1.0
	K6-04	—[b]	<1.0	<1.0	<1.0
	K6-32	—[b]	—[c]	<1.0	<1.0
	BC6-12	RL	<1.0	<1.0	<1.0

Table 9-29. Post-closure monitoring plan constituents of concern in Pit 6 detection monitoring wells for 1998 (continued).[a]

Constituents of concern	Well ID	Statistical limit[b]	Analytical results by quarter		
			Second	Third	Fourth
Volatile organic (µg/L, EPA Method 624) (continued)					
Methylene chloride	EP6-06	RL	<1.0	<1.0	<1.0
	EP6-08	RL	<1.0	<1.0	<1.0
	EP6-09	RL	<1.0	1.2	<1.0
	K6-01S	RL	<1.0	<1.0	<1.0
	K6-19	RL	<1.0	<1.0	<1.0
Tetrachloroethene (PCE)	K6-03	—[b]	<0.5	<0.5	<0.5
	K6-04	—[b]	<0.5	<0.5	<0.5
	K6-32	—[b]	—[c]	<0.5	<0.5
	BC6-12	RL	<0.5	<0.5	<0.5
	EP6-06	RL	<0.5	<0.5	<0.5
	EP6-08	1.57	0.7	0.93	0.88
	EP6-09	RL	<0.5	<0.5	<0.5
	K6-01S	RL	<0.5	<0.5	<0.5
	K6-19	RL	<0.5	<0.5	<0.5
Toluene	K6-03	—[b]	<0.5	<0.5	<0.5
	K6-04	—[b]	<0.5	<1.0	<1.0
	K6-32	—[b]	—[c]	<1.0	<1.0
	BC6-12	TBD	<0.5	<0.5	<0.5
	EP6-06	TBD	<0.5	<0.5	<0.5
	EP6-08	TBD	<0.5	<0.5	<0.5
	EP6-09	TBD	<0.5	<0.5	<0.5
	K6-01S	TBD	<0.5	<0.5	<0.5
	K6-19	TBD	<0.5	<0.5	<0.5
1,1,1-trichloroethane	K6-03	—[b]	<0.5	<0.5	<0.5
	K6-04	—[b]	<0.5	<0.5	<0.5
	K6-32	—[b]	—[c]	<0.5	<0.5
	BC6-12	RL	<0.5	<0.5	<0.5
	EP6-06	RL	<0.5	<0.5	<0.5
	EP6-08	RL	<0.5	<0.5	<0.5
	EP6-09	RL	<0.5	<0.5	<0.5
	K6-01S	RL	<0.5	<0.5	<0.5
	K6-19	RL	<0.5	<0.5	<0.5

Table 9-29. Post-closure monitoring plan constituents of concern in Pit 6 detection monitoring wells for 1998 (continued).[a]

Constituents of concern	Well ID	Statistical limit[b]	Analytical results by quarter		
			Second	Third	Fourth
Volatile organic (µg/L, EPA Method 624) (continued)					
Trichloroethene (TCE)	K6-03	—[b]	<0.5	<0.5	<0.5
	K6-04	—[b]	<0.5	<0.5	<0.5
	K6-32	—[b]	—[c]	<0.5	<0.5
	BC6-12	1.08	<0.5	<0.5	<0.5
	EP6-06	RL	<0.5	<0.5	<0.5
	EP6-08	RL	<0.5	<0.5	<0.5
	EP6-09	17.4	14	15	6.1
	K6-01S	1.52	1.0	0.9	<0.5
	K6-19	12.6	5.7	6.1	6.4
Xylenes (total)	K6-03	—[b]	<1.0	<1.0	<1.0
	K6-04	—[b]	<1.0	<1.0	<1.0
	K6-32	—[b]	—[c]	<1.0	<1.0
	BC6-12	TBD	<1.0	<1.0	<1.0
	EP6-06	TBD	<1.0	<1.0	<1.0
	EP6-08	TBD	<1.0	<1.0	<1.0
	EP6-09	TBD	<1.0	<1.0	<1.0
	K6-01S	TBD	<1.0	<1.0	<1.0
	K6-19	TBD	<1.0	<1.0	<1.0
Semivolatile organic (µg/L, EPA Method 625)[f]	all	none	nd [g]	nd	nd
bis(2-ethylhexyl)phthalate	K6-04		5.4	<5.0	<5.0
bis(2-ethylhexyl)phthalate	EP6-06		41	<5.0	<5.0
bis(2-ethylhexyl)phthalate	EP6-08		19	7.8	<5.0
Pesticides and PCBs (µg/L, EPA Method 608)[f]	all	none	nd [g]	nd	nd
Radioactive (Bq/L)[h]					
Tritium	K6-03	—[b]	<1.2	<1.6	<2.4
	K6-04	—[b]	<1.1	<1.2	<2.4
	K6-32	—[b]	—[c]	<1.6	<2.4
	BC6-12	TBD	35.7	36.6	31.3
	EP6-06	TBD	<1.1	<1.3	<2.4
	EP6-08	RL	<1.1	6.4	<2.4
	EP6-09	RL	<1.1	<1.2	<2.4
	K6-01S	TBD	<1.2	<1.6	<2.4
	K6-19	RL	21.6	30.4	91.0

Table 9-29. Post-closure monitoring plan constituents of concern in Pit 6 detection monitoring wells for 1998 (concluded).[a]

Constituents of concern	Well ID	Statistical limit[b]	Analytical results by quarter		
			Second	Third	Fourth
Radioactive (Bq/L)[h] (continued)					
Uranium (total)	K6-03	—[b]	0.041	0.035	0.053
	K6-04	—[b]	0.083	0.077	0.071
	K6-32	—[b]	—[c]	0.238	0.282
Uranium (total)	BC6-12	0.024	0.042	0.017	0.017
	EP6-06	TBD	0.060	0.060	0.105
	EP6-08	0.056	0.057	0.034	0.042
	EP6-09	0.136	0.085	0.081	0.104
	K6-01S	TBD	0.031	0.022	0.530
	K6-19	0.268	0.029	0.062	0.054
Gross alpha	K6-03	—[b]	0.091	0.070	0.053
	K6-04	—[b]	0.095	0.098	0.120
	K6-32	—[b]	—[c]	0.466	0.155
	BC6-12	RL	0.066	<0.071	<0.069
	EP6-06	0.285	0.031	0.031	0.026
	EP6-08	0.147	0.139	0.037	0.063
	EP6-09	0.179	0.031	0.105	0.152
	K6-01S	TBD	–0.002	0.311	0.082
	K6-19	0.340	0.021	0.048	0.011
Gross beta	K6-03	—[b]	0.562	0.228	0.218
	K6-04	—[b]	0.622	0.234	0.121
	K6-32	—[b]	—[c]	0.477	0.209
	BC6-12	0.788	0.312	0.275	0.161
	EP6-06	0.788	0.166	0.166	0.274
	EP6-08	0.788	0.666	0.241	0.275
	EP6-09	0.788	0.268	0.196	0.307
	K6-01S	TBD	0.292	1.425	0.117
	K6-19	0.788	0.278	0.185	0.204

Note: Statistical limits are calculated by LLNL according to methods specified in CCR Title 23, Chapter 15.

a Post-closure monitoring of Pit 6 began second quarter 1998. No first quarter results.

b Statistical limit of concentration. Background wells (hydrologically upgradient, or cross-gradient) do not have SLs.

c Upgradient well K6-32 inaccessible during second quarter.

d Statistical limit = laboratory reporting limit (RL). Analytical results below the RL are shown as less-than (<) the calculated RL.

e SL is to be determined (TBD).

f See **Table 9-1** for constituents measured by the indicated EPA method. Only constituents detected are shown.

g nd = Not detected, except as listed.

h Radioactivity SLs and quarterly results are rounded to 3 decimal places for compliance comparison. Uncertainties are not used when comparing radioactivity measurements with permitted limits (statistical limits).

Table 9-30. Post-closure monitoring plan general parameters in Pit 6 detection monitoring wells for 1998.[a]

Detection well	Date sampled	Ground water elevation (m)	Temperature (°C)	pH (pH units)	Specific conductance (mmho/cm)	Total dissolved solids. (mg/L)
Second Quarter						
K6-03 [b]	5/7/98	203.7	21.7	7.81	1.1	685
K6-04 [b]	5/7/98	203.9	21.3	7.75	1.0	602
BC6-12	5/26/98	203.4	20.0	7.98	1.0	723
EP6-06	5/18/98	200.5	19.8	7.65	1.5	905
EP6-08	5/6/98	203.9	19.2	7.77	1.1	665
EP6-09	5/13/98	203.1	20.6	7.97	1.2	775
K6-01S	5/18/98	203.1	20.9	7.39	2.6	1920
K6-19	5/20/98	202.9	21.7	8.05	1.2	770
Third quarter						
K6-03 [b]	9/2/98	203.0	22.8	7.82	1.3	713
K6-04 [b]	7/9/98	203.3	21.5	7.73	1.0	603
K6-32 [b]	9/2/98	203.4	22.5	8.04	1.1	703
BC6-12	7/13/98	202.8	22.5	7.85	1.1	707
EP6-06	7/13/98	200.8	23.8	7.68	1.6	930
EP6-08	7/13/98	202.8	23.1	7.71	1.1	687
EP6-09	7/9/98	203.1	21.4	7.83	1.2	767
K6-01S	9/1/98	203.0	22.8	7.43	2.6	2150
K6-19	9/2/98	202.8	26.5	8.05	1.2	775
Fourth quarter						
K6-03 [b]	11/3/98	203.4	21.3	8.22	1.0	690
K6-04 [b]	11/2/98	203.5	21.0	8.14	1.0	600
K6-32 [b]	11/11/98	203.7	20.0	8.40	1.0	680
BC6-12	11/3/98	203.3	19.8	8.24	1.0	683
EP6-06	11/11/98	202.5	17.2	8.09	1.5	935
EP6-08	11/3/98	203.2	24.0	8.04	1.1	677
EP6-09	11/2/98	201.5	19.4	8.20	1.1	770
K6-01S	11/2/98	201.5	20.7	7.88	2.6	2060
K6-19	11/11/98	202.8	17.8	8.20	1.1	850

a Post-closure monitoring of Pit 6 began second quarter 1998. No first quarter results.

b Background well (hydrologically upgradient or cross-gradient).

Table 9-31. First quarter analytical results for WDR 96-248 constituents of concern in Site 300 ground water beneath surface impoundments.[a]

Parameter	Reporting limit	Location				Statistical limit[b]
		W-817-01	W-817-02	W-817-03	W-817-04	
General						
pH (pH units)	0.1	8.35	7.80	7.97	7.93	None
Halocarbons (µg/L)						
1,1,1-Trichloroethane	0.5	<0.5	<0.5	<0.5	<0.5	1
Bromoform	0.5	<0.5	<0.5	<0.5	<0.5	1
1,2-Dichloroethane (1,2-DCA)	0.5	<0.5	<0.5	<0.5	<0.5	1
Freon 113	0.5	1.7	<0.5	<0.5	0.11est[c]	1
Methylene chloride	1	1.2	0.33 est	0.26 est	0.39 est	1
Tetrachloroethene (PCE)	0.5	<0.5	<0.5	<0.5	<0.5	1
Chlorobenzene	0.5	<0.5	<0.5	<0.5	<0.5	1
Hydrocarbons (µg/L)						
Toluene	0.5	<0.5	<0.5	<0.5	<0.5	1
Naphthalene	2	<2	<2	<2	<2	5
Photographic chemicals (µg/L)						
o-Cresol	2	<2	<2	<2	<2	5
p-Cresol	2	<2	<2	<2	<2	5
Volatile/semivolatile compounds (µg/L)						
Acetone	10	<10	<10	<10	<10	40
2-Butanone (MEK)	20	<20	<20	<20	<20	40
Dimethyl sulfoxide (DMSO)[d]	10	<10.	<10.	<10.	<10.	10
Additives to energetic compounds (µg/L)						
Bis(2-ethylhexyl) phthalate	5	<5	<5	<5	<5	5
Unreactive polymers (µg/L)						
Styrene	0.5	<0.5	<0.5	<0.5	<0.5	1
Vinyl chloride	0.5	<0.5	<0.5	<0.5	<0.5	1
Metals (mg/L)						
Aluminum	0.05	<0.05	<0.05	<0.05	<0.05	0.2
	0.05	<0.05	<0.05	<0.05	<0.05	0.2
Arsenic	0.002	0.043	0.044	0.051	0.052	ANOVA[e]
Sampled on 1/13–1/14/98	0.002	0.045	0.050	0.049	0.053	ANOVA
Sampled on 1/20/98	0.002	0.050	0.050	0.050	0.054	ANOVA
Sampled on 1/26/98	0.004	0.041	0.048	0.046	0.054	ANOVA
Barium	0.025	0.0084 est	0.0054 est	0.0031 est	0.0023 est	0.05
Cadmium	0.0005	<0.0005	0.0001 est	<0.0005	<0.0005	0.0042
Chromium	0.001	0.0017	0.0015	0.0027	0.0050	0.0098
Cobalt	0.05	<0.05	<0.05	<0.05	<0.05	0.05

Table 9-31. First quarter analytical results for WDR 96-248 constituents of concern in Site 300 ground water beneath surface impoundments (continued).[a]

Parameter	Reporting limit	Location				Statistical limit[b]
		W-817-01	W-817-02	W-817-03	W-817-04	
Metals (mg/L) (continued)						
Copper	0.01	0.008 est	<0.01	<0.01	<0.01	0.099
	0.001	0.0067	0.0029	0.00091 est	0.0012	0.099
Lead	0.005	0.001 est	<0.005	<0.005	<0.005	0.0067
Manganese	0.01	<0.01	<0.01	<0.01	<0.01	0.042
	0.01	<0.01	<0.01	<0.01	<0.01	0.042
Molybdenum	0.025	0.020 est	0.029	0.024 est	0.025	0.093
Nickel	0.05	<0.05	<0.05	0.013 est	0.095	0.044
	0.002	0.0029	0.0015 est	0.0098	0.077	0.044
	0.002				0.019	0.044
	0.002				0.025	0.044
Potassium	0.2	11				NA
	0.2		14			16.2
	0.2			11		14.1
	0.2				11	13.1
Silver	0.001	<0.001	<0.001	<0.001	<0.001	0.0083
Zinc	0.01	0.017	0.18	0.056	0.013	0.076
	0.02	0.0099 est	0.17	0.0021 est	0.0016 est	0.076
Salts (mg/L)						
Ammonia nitrogen (as N)	0.02	0.02	<0.02	<0.02	<0.02	0.02
Bicarbonate alkalinity (as $CaCO_3$)	1	220	240	260	260	277
Bromide	0.05	0.42				NA[f]
	0.1		1.1			1.46
	0.1			0.75		1.18
	0.1				0.91	1.49
Chloride	0.5	163				NA
	1		306			356
				214		271
					224	283
Nitrate (as NO_3)	2.2	81				NA
			93			107
				93		107
					89	107
Orthophosphate	0.05	0.12	0.09	0.07	0.10	0.19
Perchlorate	0.004	0.050	0.032	0.032	0.029	TBD[g]
Sampled on 3/10/98	0.004	0.045	0.018	0.030	0.024	TBD

Table 9-31. First quarter analytical results for WDR 96-248 constituents of concern in Site 300 ground water beneath surface impoundments (concluded).[a]

Parameter	Reporting limit	Location				Statistical limit[b]
		W-817-01	W-817-02	W-817-03	W-817-04	
Salts (mg/L) (continued)						
Sulfate	1	128				NA
	2		398			442
	2			188		233
	2				214	275
Explosives (µg/L)						
HMX	1.4	15	<1.4	<1.4	<1.4	5
RDX	0.8	55	<0.8	7	2.9	9.1
TNT	0.9	<0.9	<0.9	<0.9	<0.9	5
TATB	20	<20	<20	<20	<20	20
Pentaerythritol tetranitrate (PETN)	5	<5.	<5.	<5.	<5.	1.3

a Date(s) sampled: 1/5–2/4/98.

b Statistical limit as listed in MRP 96-248.

c Sample values followed by an “est” have estimated values between the method detection limit and the reporting limit for that compound.

d Value reported as a tentatively identified compound.

e ANOVA = Analysis of variance statistical method.

f NA = Not applicable

g TBD = Statistical limits are to be determined by the end of 1999 for the perchlorate ion.

Table 9-32. First quarter analytical results for constituents of concern not listed in WDR 96-248 and occurring in Site 300 ground water beneath surface impoundments.[a]

Parameter	Reporting limit	Location			
		W-817-01	W-817-02	W-817-03	W-817-04
General					
Ground water elevation (m above MSL)	NA[b]	194.6	180.46	175.93	186.37
	NA	194.63			
	NA	194.64	180.46	175.87	186.37
	NA	194.65	180.53	175.96	186.4
	NA	194.68	180.51	175.96	186.45
	NA	194.63	180.6	175.98	186.35
Field pH (pH units)	NA	7.8	7.59	7.76	7.65
	NA	7.77	7.43	7.67	7.76
	NA	7.71	7.46	7.71	7.6
	NA	8.48	8.39	8.71	8.9
	NA	8.07	8.03	8.28	8.25
Specific conductance (µmho/cm)	1	1410	2340	1720	1800
Field specific conductance (µmho/cm)	NA	1500	2500	1800	1800
	NA	1500	2300	1800	1700
	NA	1400	2400	1700	1900
	NA	1500	2500	1800	2000
	NA	1500	2400	1500	1700
Total dissolved solids (mg/L)	10	965	1500	1100	1140
Water temperature (°C)	NA	23	19.5	18.2	19
	NA	20.9	21.1	19.7	18.4
	NA	22.9	20	18.3	21.4
	NA	23.9	21.2	19.9	21
	NA	21.7	20	19.5	20.5
Nitrite (as N) (mg/L)	0.02	<0.02	<0.02	<0.02	<0.02
Nitrate (as N) (mg/L)	0.5	18	21	21	20
Total phosphorus (as P) (mg/L)	0.05	0.06	0.05	<0.05	<0.05
Metals and minerals (mg/L)					
Carbonate alkalinity (as $CaCO_3$)	1	33	<1	<1	<1
Hydroxide alkalinity (as $CaCO_3$)	1	<1	<1	<1	<1
Total alkalinity (as $CaCO_3$)	1	253	240	260	260
Calcium	1	17	37	21	20
Fluoride	0.05	1.2	0.86	1.2	1.3
Total hardness (as $CaCO_3$)	1	74	170	98	91
Iron	0.05	0.035 est[c]	0.12	0.014 est	0.035 est

Table 9-32. First quarter analytical results for constituents of concern not listed in WDR 96-248 and occurring in Site 300 ground water beneath surface impoundments (concluded).[a]

Parameter	Reporting limit	Location			
		W-817-01	W-817-02	W-817-03	W-817-04
Metals and minerals (mg/L) (continued)					
Magnesium	0.1	7.7	20	11	9.9
Sodium	1	283	416	338	364
Surfactants	0.05	<0.05	<0.05	<0.05	<0.05
Volatile/semivolatile organic compounds (μg/L)[d]					
Trichloroethane (TCE)	0.5	0.18 est	0.43 est	14	11
Chloroform	0.5	<0.5	<0.5	0.25 est	0.25 est
1,1-Dichloroethene	0.5	<0.5	<0.5	0.13 est	<0.5
Explosives (μg/L)					
1,3,5-Trinitrobenzene	0.85	<0.85	<0.85	<0.85	<0.85
1,3-Dinitrobenzene	0.9	<0.9	<0.9	<0.9	<0.9
2,4-Dinitrotoluene	1.2	<1.2	<1.2	<1.2	<1.2
2,6-Dinitrotoluene	2.1	<2.1	<2.1	<2.1	<2.1
2-Amino-4,6-dinitrotoluene	0.9	<0.9	<0.9	<0.9	<0.9
4-Amino-2,6-dinitrotoluene	1.6	11	<1.6	<1.6	<1.6
2-Nitrotoluene	2	<2	<2	<2	<2
3-Nitrotoluene	2	<2	<2	<2	<2
4-Nitrotoluene	2	<2	<2	<2	<2
Nitrobenzene	1.5	<1.5	<1.5	<1.5	<1.5
Tetryl	1.2	<1.2	<1.2	<1.2	<1.2

a Date(s) sampled: 1/5–2/4/98

b NA = Not applicable.

c Sample values followed by an “est” have values between the method detection limit and the reporting limit for that compound.

d No other compounds were detected via EPA Method 624 for VOCs and no compounds were detected by EPA Method 625 for semi-volatiles.

Table 9-33. Second quarter analytical results for WDR 96-248 constituents of concern in Site 300 ground water beneath surface impoundments.[a]

Parameter	Reporting limit	Location				Statistical limit[b]
		W-817-01	W-817-02	W-817-03	W-817-04	
General						
pH (pH units)	0.1	7.20	7.94	8.21	8.14	None
Halocarbons (µg/L)						
1,1,1-Trichloroethane	0.5	<0.5	<0.5	<0.5	<0.5	1
Bromoform	0.5	<0.5	<0.5	<0.5	<0.5	1
1,2-Dichloroethane (1,2-DCA)	0.5	<0.5	<0.5	<0.5	<0.5	1
Freon 113	0.5	<0.5	<0.5	<0.5	0.24 est[c]	1
Methylene chloride	1	0.36 est	0.28 est	0.38 est	0.54 est	1
Tetrachloroethene (PCE)	0.5	0.17 est	<0.5	<0.5	0.1 est	1
Chlorobenzene	0.5	<0.5	<0.5	<0.5	<0.5	1
Hydrocarbons (µg/L)						
Toluene	0.5	<0.5	0.12 est	<0.5	<0.5	1
Naphthalene	2	<2	<2	<2	<2	5
Photographic chemicals (µg/L)						
o-Cresol	2	<2	<2	<2	<2	5
p-Cresol	2	<2	<2	<2	<2	5
Volatile/semivolatile compounds (µg/L)						
Acetone	10	<10	<10	<10	<10	10
2-Butanone (MEK)	20	<20	<20	<20	<20	20
Dimethyl sulfoxide (DMSO)[d]	10	<10	<10	<10	<10	10
Additives to energetic compounds (µg/L)						
Bis(2-ethylhexyl)phthalate	5	<5	<5	<5	<5	5
Unreactive polymers (µg/L)						
Styrene	0.5	<0.5	<0.5	<0.5	<0.5	1
Vinyl chloride	0.5	<0.5	<0.5	<0.5	<0.5	1
Metals (mg/L)						
Aluminum	0.05	<0.05	0.025 est	0.023 est	0.018 est	0.2
	0.05	<0.05	<0.05	<0.05	<0.05	0.2
Arsenic	0.002	0.059				NA[e]
	0.002		0.054			0.073
	0.002			0.058		0.072
	0.002				0.071	0.077
Barium	0.025	0.0089 est	0.0069 est	0.0034 est	0.003 est	0.025

Table 9-33. Second quarter analytical results for WDR 96-248 constituents of concern in Site 300 ground water beneath surface impoundments (continued).[a]

Parameter	Reporting limit	Location				Statistical limit[b]
		W-817-01	W-817-02	W-817-03	W-817-04	
Cadmium	0.0005	<0.0005				NA
	0.0005		0.00014 est			0.0016
	0.0005			<0.0005		0.001
	0.0005				0.000073 est	0.001
Chromium	0.001	0.0021				NA
	0.001		<0.001			0.003
	0.001			0.0022		0.0042
	0.001				0.0038	0.0098
Cobalt	0.05	<0.05	<0.05	<0.05	<0.05	0.05
Copper	0.01	<0.01	<0.01	<0.01	<0.01	0.02
	0.001	0.0078	0.0044	0.0023	0.015	0.02
Lead	0.005	0.00046 est	<0.005	<0.005	0.00037 est	0.0099
Manganese	0.01	0.0011 est	0.0047est	0.0012 est	<0.01	0.01
	0.01	0.0013 est	0.005 est	<0.01	<0.01	0.01
Molybdenum	0.025	0.022 est				NA
	0.025		0.034			0.073
	0.025			0.032		0.060
	0.025				0.036	0.054
Nickel	0.05	<0.05	<0.05	<0.05	0.0231 est	0.044
	0.002	0.0016 est	0.0041	<0.002	0.024	0.044
Potassium	1	11				NA
	1		14			18.6
	1			12		14.6
	1				11	13.7
Silver	0.001	<0.001	<0.001	<0.001	<0.001	0.001
Zinc	0.01	0.007 est				NA
	0.02	0.0086 est				NA
			0.15			0.24
			0.16			0.24
				<0.01		0.0099
				<0.02		0.0099
					<0.01	0.055
					0.0096 est	0.055
Salts (mg/L)						
Ammonia nitrogen (as N)	0.02	0.015 est	<0.02	<0.02	<0.02	0.02

Table 9-33. Second quarter analytical results for WDR 96-248 constituents of concern in Site 300 ground water beneath surface impoundments (concluded).[a]

Parameter	Reporting limit	Location				Statistical limit[b]
		W-817-01	W-817-02	W-817-03	W-817-04	
Bicarbonate alkalinity (as $CaCO_3$)	5	251	242	252	260	277
Bromide	0.1	0.51				NA
			0.99			1.46
				0.67		1.18
					0.72	1.49
Chloride	0.5	180				NA
	2		311			388
				222		302
					240	296
Nitrate (as NO_3)	4.4	8.6	85	85	94	110
Orthophosphate	0.05	0.1	0.08	0.07	0.07	0.19
Perchlorate	0.004	0.012	0.011	0.022	0.011	TBD[f]
Sulfate	1	143				NA
	2		389			512
				187		233
					220	284
Explosives (µg/L)						
HMX	1.9 - 2.5	17.5	<1.9	<2.4	<2.5	1.0
RDX	1.1	58.3				NA
	1.1		<1.1			0.85
	1.1			7.44		9.3
	1.1				3.43	9.68
TNT	1.2	<1.2	<1.2	<1.2	<1.2	0.26
TATB	20	<20	<20	<20	<20	20
Tetryl	1.6	<1.6	<1.6	<2.0	<2.1	1.0
4-Amino-2,6-dinitrotoluene	2.2	<2.2				NA
	2.1		<2.1			0.26
	2.7			<2.7		1.22
	2.8				<2.8	1.08
Pentaerythritol tetranitrate (PETN)	5	<5	<5	<5	<5	1.0

a Date(s) sampled: 4/6–4/7/98.

b Statistical limit as listed in MRP 96-248.

c Results followed by an “est” have values between the method detection limit and the reporting limit for that compound.

d Value reported as a tentatively identified compound.

e NA = Not applicable.

f TBD = To be determined. Statistical limits are to be developed by the end of 1999 for the perchlorate ion.

Table 9-34. Second quarter analytical results for constituents of concern not listed in WDR 96-248 and occurring in Site 300 ground water beneath surface impoundments.[a]

Parameter	Reporting limit	Location			
		W-817-01	W-817-02	W-817-03	W-817-04
General					
Ground water elevation (m above MSL)	NA[b]	194.74	181.02	176.80	186.52
	NA	194.75	181.11	176.83	186.52
	NA	194.77	181.18	176.85	186.53
	NA	194.82	181.27	176.89	186.60
Field pH (pH units)	NA	7.96	7.83	7.93	7.9
	NA	7.97	7.69	7.95	7.79
	NA	7.94	7.58	7.85	7.79
	NA	8.11	7.83	8.08	8.02
Specific conductance (µmho/cm)	1	1430	2370	1780	1780
Field specific conductance (µmho/cm)	NA	1500	2300	1700	1700
	NA	1400	2300	1700	1800
	NA	1400	2200	1700	1800
	NA	1500	2200	1800	1800
Total dissolved solids (mg/L)	10	930	1550	1100	1130
Water temperature (°C)	NA	22.3	19	17.9	21.7
	NA	22.1	19	18.7	20.4
	NA	22.7	19.2	19.5	19.4
	NA	22.6	21.9	20	22.1
Nitrite (as N) (mg/L)	0.02	0.01 est[c]	<0.02	<0.02	<0.02
Nitrate (as N) (mg/L)	1	19	19	19	21
Total phosphorus (as PO_4) (mg/L)	0.05	<0.05	0.046 est	0.03 est	<0.05
Metals and minerals (mg/L)					
Carbonate alkalinity (as $CaCO_3$)	5	<5	<5	<5	<5
Hydroxide alkalinity (as $CaCO_3$)	5	<5	<5	<5	<5
Total alkalinity (as $CaCO_3$)	5	251	242	252	260
Calcium	0.5	17	40	22	19
Fluoride	0.05	0.96	0.87	1.2	1.2
Total hardness (as $CaCO_3$)	5	74	186	100	86
Iron	0.05	0.039 est	0.31	0.058	0.0148 est
Magnesium	0.5	7.7	21	11	9.4
Sodium	1	271	423	331	335
Surfactants	0.05	<0.05	<0.05	<0.05	<0.05

Table 9-34. Second quarter analytical results for constituents of concern not listed in WDR 96-248 and occurring in Site 300 ground water beneath surface impoundments (concluded).[a]

Parameter	Reporting limit	Location			
		W-817-01	W-817-02	W-817-03	W-817-04
Volatile/semivolatile organic compounds (μg/L)[d]					
1,1-Dichloroethene	0.5	0.47 est	<0.5	0.17 est	0.24 est
Benzene	0.5	<0.5	0.21 est	<0.5	<0.5
Carbon disulfide	5	<5	<5	<5	1.6 est
Chloroform	0.5	<0.5	<0.5	0.35 est	0.46 est
Trichloroethene (TCE)	0.5	0.27 est	0.53	16	12
Explosives (μg/L)					
1,3,5-Trinitrobenzene	1.1 – 1.5	<1.2	<1.1	<1.4	<1.5
1,3-Dinitrobenzene	1.2 – 4.5	<1.2	<1.2	<4.5	<1.6
2,4-Dinitrotoluene	1.6 – 2.1	<1.6	<1.6	<2	<2.1
2,6-Dinitrotoluene	2.8 – 3.7	<2.9	<2.8	<3.6	<3.7
2-Amino-4,6-dinitrotoluene	1.2 – 1.6	<1.2	<1.2	<1.5	<1.6
2-Nitrotoluene	2.7 – 3.6	<2.7	<2.7	<3.4	<3.6
3-Nitrotoluene	2.7 – 3.6	<2.7	<2.7	<3.4	<3.6
4-Nitrotoluene	2.7 – 3.6	<2.7	<2.7	<3.4	<3.6
Nitrobenzene	2 – 2.7	<2	<2	<2.5	<2.7

a Dates sampled: 4/6–5/1/98.

b NA = Not applicable.

c Results followed by an “est” have values between the method detection limit and the reporting limit for that compound.

d No other compounds were detected via EPA Method 624 for VOCs and no compounds were detected by EPA Method 625 for semi-volatiles.

Table 9-35. Third quarter analytical results for WDR 96-248 constituents of concern in Site 300 ground water beneath surface impoundments.[a]

Parameter	Reporting limit	Location				Statistical limit[b]
		W-817-01	W-817-02	W-817-03	W-817-04	
General						
pH (pH units)	0.1	7.86	7.63	8.18	7.93	None
Halocarbons (µg/L)						
1,1,1-Trichloroethane	0.5	<0.5	<0.5	<0.5	<0.5	1
Bromoform	0.5	<0.5	<0.5	<0.5	<0.5	1
1,2-Dichloroethane (1,2-DCA)	0.5	<0.5	<0.5	<0.5	<0.5	1
Freon 113	0.5	0.30 est[c]	0.18 est	<0.5	0.14 est	1
Methylene chloride	1	0.37 est	0.35 est	<1.0	0.34 est	1
Tetrachloroethene (PCE)	0.5	0.12 est	<0.5	<0.5	<0.5	1
Chlorobenzene	0.5	<0.5	<0.5	<0.5	<0.5	1
Hydrocarbons (µg/L)						
Toluene	0.5	<0.5	<0.5	<0.5	<0.5	1
Naphthalene	2	<2.0	<2.0	<2.0	<2.0	5
Photographic chemicals (µg/L)						
o-Cresol	2	<2	<2	<2	<2	5
p-Cresol	2	<2	<2	<2	<2	5
Volatile/semivolatile compounds (µg/L)						
Acetone	10	<10	<10	<10	<10	10
2-Butanone (MEK)	20	<20	<20	<20	<20	20
Dimethyl sulfoxide (DMSO)[d]	10	<10	<10	<10	<10	10
Additives to energetic compounds (µg/L)						
Bis(2-ethylhexyl)phthalate	5	<5	0.96 est	<5	<5	5
Unreactive polymers (µg/L)						
Styrene	0.5	<0.5	<0.5	<0.5	<0.5	1
Vinyl chloride	0.5	<0.5	<0.5	<0.5	<0.5	1
Metals (mg/L)						
Aluminum	0.05	<0.05	<0.05	<0.05	0.02 est	0.2
	0.05	0.02 est	<0.05	<0.05	<0.05	0.2
Arsenic	0.002	0.043				NA[e]
	0.002		0.048			0.073
	0.002			0.044		0.072
	0.002				0.055	0.077
Barium	0.025	0.0135 est	0.010 est	0.0079 est	0.006 est	0.025

Table 9-35. Third quarter analytical results for WDR 96-248 constituents of concern in Site 300 ground water beneath surface impoundments (continued).[a]

Parameter	Reporting limit	Location				Statistical limit[b]
		W-817-01	W-817-02	W-817-03	W-817-04	
Metals (mg/L) (continued)						
Cadmium	0.0005	<0.0005				NA
	0.0005		0.00014 est			0.0016
	0.0005			0.000076 est		0.001
	0.0005				<0.0005	0.001
Chromium	0.001	0.0013				NA
	0.001		0.00099 est			0.003
	0.001			0.0011		0.0042
	0.001				0.0052	0.0098
Cobalt	0.05	<0.05	<0.05	<0.05	<0.05	0.05
Copper	0.01	<0.01	0.0066 est	<0.01	0.0051 est	0.02
	0.001	0.004	0.0031	0.00035 est	0.00068 est	0.02
Lead	0.005	<0.005	<0.005	<0.005	<0.005	0.0099
Manganese	0.01	<0.01	0.0009 est	0.0013 est	0.0031 est	0.01
	0.01	0.0010 est	0.0008 est	<0.01	0.0032 est	0.01
Molybdenum	0.025	0.026				NA
	0.025		0.044			0.073
	0.025			0.033		0.060
	0.025				0.038	0.054
Nickel	0.05	<0.05	0.0095 est	<0.05	0.0213 est	0.044
	0.002	0.0011 est	0.012	0.0017 est	0.023	0.044
Potassium	0.2	11				NA
	0.2		16			18.6
	1			11		14.6
	0.2				11	13.7
Silver	0.001	<0.001	<0.001	<0.001	<0.001	0.001
Zinc	0.02	<0.02				NA
	0.02	<0.02				NA
Sampled on 7/6/98	0.02		0.29[f]			0.24
Sampled on 7/6/98	0.02		0.28[f]			0.24
Sampled on 8/28/98	0.02		0.16[g]			0.24
Sampled on 9/8/98	0.02		0.133 [g]			0.24
Sampled on 7/14/98	0.01			0.019[f]		0.0099
Sampled on 7/14/98	0.02			0.027[f]		0.0099

Table 9-35. Third quarter analytical results for WDR 96-248 constituents of concern in Site 300 ground water beneath surface impoundments (continued).[a]

Parameter	Reporting limit	Location				Statistical limit[b]
		W-817-01	W-817-02	W-817-03	W-817-04	
Metals (mg/L) (continued)						
Zinc Sampled on 8/28/98	0.01			<0.01[g]		0.0099
Sampled on 9/8/98	0.01			<0.01[g]		0.0099
	0.01				<0.01	0.055
	0.02				<0.02	0.055
Salts (mg/L)						
Ammonia nitrogen (as N)	0.02	<0.02	0.01 est	0.01 est	<0.02	0.02
Bicarbonate alkalinity (as $CaCO_3$)	5	248	239	254	259	277
Bromide	0.05	0.51				NA
	0.1		1			1.46
	0.1			0.67		1.18
	0.1				0.77	1.49
Chloride	0.5	169				NA
	1		320			388
	1			229		302
	0.5				223	296
Nitrate (as NO_3)	0.4 - 8.9	91	94	96	97	110
Orthophosphate	0.05	0.1	0.08	0.08	0.07	0.19
Percholate	0.004	0.0371	0.0126	0.005	0.0231	TBD[h]
Sampled on 8/25 and 8/26/98	0.004	0.030	<0.004	0.014	0.011	TBD
Sulfate	1	139				NA
	2		441			512
	2			195		233
	1				208	284
Explosives (µg/L)						
HMX	1.00	17.0	<1.00	<1.00	<1.00	1.0
RDX	2.08	48.6				NA
	0.85		0.122 est			0.85
	5.0			8.10		9.3
	0.85				2.71	9.68
TNT	0.11	<0.11	<0.11	<0.11	<0.11	0.26
TATB	20	<20	<20	<20	<20	20
Pentaerythritol tetranitrate (PETN)	1.00	0.134 est	0.121 est	<1.00	0.141 est	1.0
Tetryl	1.00	<1.00	<1.00	<1.00	<1.00	1.0

Table 9-35. Third quarter analytical results for WDR 96-248 constituents of concern in Site 300 ground water beneath surface impoundments (concluded).[a]

Parameter	Reporting limit	Location				Statistical limit[b]
		W-817-01	W-817-02	W-817-03	W-817-04	
Explosives (μg/L) (continued)						
4-Amino-2,6-dinitrotoluene	2.08	7.17				NA
	0.26		<0.26			0.26
	0.26			<0.26		1.22
	0.26				0.264	1.08

a Date(s) sampled: 7/6 –7/14/98, resamples separately noted in table.

b Statistical limit as listed in MRP 96-248.

c Results followed by an “est” have values between the method detection limit and the reporting limit for that compound.

d Value reported as a tentatively identified compound.

e NA = Not applicable.

f Analytical results from the ground water samples initially collected from wells W-817-02 and W-817-03 and analyzed for zinc indicated exceedances of the respective statistical limits (SLs) for zinc in these wells. These samples were essentially duplicate samples.

g Analytical results from the two discrete retest ground water samples collected from wells W-817-02 and W-817-03 and analyzed for zinc refuted the exceedances of the respective SLs for zinc in these wells.

h TBD = To be determined. Statistical limits are to be developed by the end of 1999 for the perchlorate ion.

Table 9-36. Third quarter analytical results for constituents of concern not listed in WDR 96-248 and occurring in Site 300 ground water beneath surface impoundments.[a]

Parameter	Reporting limit	Location			
		W-817-01	W-817-02	W-817-03	W-817-04
General					
Ground water elevation (m above MSL)	NA[b]	194.8	181.5	177	186.8
Field pH (pH units)	NA	8.05	7.69	8.12	7.99
Specific conductance (µmho/cm)	1	1430	2390	1740	1760
Field specific conductance (µmho/cm)	1	1500	2000	1800	1800
Total dissolved solids (mg/L)	10	940	1570	1130	1140
Water temperature (°C)		25.3	23.1	21	25.1
Nitrite (as N) (mg/L)	0.02	0.01 est[c]	<0.02	<0.02	<0.02
Nitrate (as N) (mg/L)	0.1–2	21	21	22	22
Total phosphorus (as PO_4) (mg/L)	0.05	0.04 est	0.04 est	<0.05	<0.05
Metals and minerals (mg/L)					
Carbonate alkalinity (as $CaCO_3$)	5	<5	<5	<5	<5
Hydroxide alkalinity (as $CaCO_3$)	5	<5	<5	<5	<5
Total alkalinity (as $CaCO_3$)	5	248	239	254	259
Calcium	0.05–1	18	44	22	19
Fluoride	0.05	1.1	1.9	1.3	1.4
Total hardness (as $CaCO_3$)	5	80	209	100	86
Iron	0.05	<0.05	0.0311 est	<0.05	<0.05
Magnesium	0.05–1	8.5	24	11	9.4
Sodium	0.5–1	304	490	356	360
Surfactants	0.05	<0.05	<0.05	<0.05	<0.05
Volatile organic compounds (µg/L)[d]					
1,1-Dichloroethane	0.5	<0.5	<0.5	0.13 est	<0.5
Chloroform	0.5	<0.5	<0.5	0.31 est	0.33 est
Trichloroethene	0.5	0.20 est	0.67	16	12
Semivolatile organic compounds (µg/L))[d]					
Diethylphthalate	2	<2	2.6	<2	<2
Hexachloroethane	2	<2	0.41 est	<2	<2

Table 9-36. Third quarter analytical results for constituents of concern not listed in WDR 96-248 and occurring in Site 300 ground water beneath surface impoundments (concluded).[a]

Parameter	Reporting limit	Location			
		W-817-01	W-817-02	W-817-03	W-817-04
Explosives (μg/L)					
1,3,5-Trinitrobenzene	0.26	<0.26	<0.26	<0.26	<0.26
1,3-Dinitrobenzene	0.11	<0.11	<0.11	<0.11	<0.11
2,4-Dinitrotoluene	0.26	<0.26	<0.26	<0.26	<0.26
2,6-Dinitrotoluene	0.26	<0.26	<0.26	<0.26	<0.26
2-Amino-4,6-dinitrotoluene	0.26	<0.26	<0.26	<0.26	<0.26
2-Nitrotoluene	0.26	<0.26	<0.26	<0.26	<0.26
3-Nitrotoluene	0.26	<0.26	<0.26	<0.26	<0.26
4-Nitrotoluene	0.26	<0.26	<0.26	<0.26	<0.26
Nitrobenzene	0.85	<0.85	<0.85	<0.85	<0.85

a Dates sampled: 7/6–7/14/98.

b NA = Not applicable.

c Results followed by an “est” have values between the method detection limit and the reporting limit for that compound.

d No other compounds were detected via EPA Method 624 for VOCs and no compounds above their reporting limit were detected by EPA Method 625 for semivolatiles.

Table 9-37. Fourth quarter analytical results for WDR 96-248 constituents of concern in Site 300 ground water beneath surface impoundments.[a]

Parameter	Reporting limits	Location				Statistical limits[b]
		W-817-01	W-817-02	W-817-03	W-817-04	
General						
pH (pH units)	0.1	8.14	7.90	8.07	8.03	None
Halocarbons (µg/L)						
1,1,1-Trichloroethane	0.5	<0.5	<0.5	<0.5	<0.5	1
Bromoform	0.5	<0.5	<0.5	<0.5	<0.5	1
1,2-Dichloroethane (1,2-DCA)	0.5	<0.5	<0.5	<0.5	<0.5	1
Freon 113	0.5	<0.5	<0.5	<0.5	<0.5	1
Methylene chloride	1	<1	<1	<1	<1	1
Tetrachloroethene (PCE)	0.5	<0.5	<0.5	<0.5	<0.5	1
Chlorobenzene	0.5	<0.5	<0.5	<0.5	<0.5	1
Hydrocarbons (µg/L)						
Toluene	0.5	<0.5	<0.5	<0.5	<0.5	1
Naphthalene	2	<2	<2	<2	<2	5
Photographic chemicals (µg/L)						
o-Cresol	2	<2	<2	<2	<2	5
p-Cresol	2	<2	<2	<2	<2	5
Volatile/semivolatile compounds (µg/L)						
Acetone	10	<10	<10	<10	<10	10
2-Butanone (MEK)	20	<20	<20	<20	<20	20
Dimethyl sulfoxide (DMSO)[c]	10	<10	<10	<10	<10	10
Additives to explosives (µg/L)						
Bis(2-ethylhexyl)phthalate	5	1.1 est[d]	1.5 est	<5	<5	5
Unreactive polymers (µg/L)						
Styrene	0.5	<0.5	<0.5	<0.5	<0.5	1
Vinyl chloride	0.5	<0.5	<0.5	<0.5	<0.5	1
Metals (mg/L)						
Aluminum	0.05	<0.05	<0.05	<0.05	<0.05	0.2
Arsenic	0.002	0.047				NA[e]
	0.002		0.050			0.073
	0.002			0.048		0.072
	0.01				0.056	0.077
Barium	0.025	0.012 est	0.011 est	0.0084 est	0.0067 est	0.025
Cadmium	0.0005	<0.0005				NA
	0.0005		0.00019 est			0.0016
	0.0005			0.00034 est		0.001
	0.0005				<0.0005	0.001

Table 9-37. Fourth quarter analytical results for WDR 96-248 constituents of concern in Site 300 ground water beneath surface impoundments (continued).[a]

Parameter	Reporting limits	Location				Statistical limits[b]
		W-817-01	W-817-02	W-817-03	W-817-04	
Metals (mg/L) (continued)						
Chromium	0.001	0.0012				NA
	0.001		0.00093 est			0.003
Sampled on 10/7/98	0.001			0.0055[f]		0.0042
Sampled on 12/1/98	0.001			0.0029[g]		0.0042
Sampled on 12/9/98	0.001			0.0037[g]		0.0042
	0.001				0.0045	0.0098
Cobalt	0.05	<0.05	<0.05	<0.05	<0.05	0.05
Copper	0.001	0.0034	0.0023	0.00079 est	0.00041 est	0.02
Lead	0.005	<0.005	0.00046 est	<0.005	<0.005	0.0099
Manganese	0.01	<0.01	0.0024 est	<0.01	0.0017 est	0.01
Molybdenum	0.025	0.022 est				NA
	0.025		0.041			0.073
	0.025			0.035		0.060
	0.025				0.03	0.054
Nickel	0.002	0.0014 est	0.019	0.0058	0.02	0.044
Potassium	1	11				NA
	1		15			18.6
	1			11		14.6
	0.2				11	13.7
Silver	0.001	<0.001	<0.001	<0.001	<0.001	0.001
Zinc	0.02	<0.02				NA
	0.02		0.18			0.24
	0.02			<0.02		0.0099
	0.02				<0.02	0.055
Salts (mg/L)						
Ammonia nitrogen (as N)	0.02	<0.02	<0.02	<0.02	<0.02	0.02
Bicarbonate alkalinity (as $CaCO_3$)	5	253	237	256	265	277
Bromide	0.05	0.53				NA
	0.1		1.1			1.46
	0.1			0.72		1.18
	0.1				0.8	1.49

Table 9-37. Fourth quarter analytical results for WDR 96-248 constituents of concern in Site 300 ground water beneath surface impoundments (concluded).[a]

Parameter	Reporting limits	Location				Statistical limits[b]
		W-817-01	W-817-02	W-817-03	W-817-04	
Salts (mg/L) (continued)						
Chloride	0.5	167				NA
	1		325			388
	1			240		302
	1				216	296
Nitrate (as NO_3)	0.4–0.89	87	95	95	87	110
Orthophosphate	0.05	0.11	0.08	0.07	0.11	0.19
Perchlorate	0.004	0.0379	0.0157	0.0263	0.0239	TBD[f]
Sulfate	1	132				NA
	2		445			512
	2			203		233
	2				186	284
Explosives (µg/L)						
HMX	1.00	15.0	<1.00	<1.00	<1.00	1.0
RDX	1.04	44.2				NA
	0.85		<0.850			0.85
				5.68		9.3
					5.28	9.68
TNT	0.11	<0.11	<0.11	<0.11	0.17	0.26
TATB	20	<20	<20	<20	<20	20
4-Amino-2,6-dinitrotoluene	0.26	7.25				NA
	0.26		<0.26			0.26
	0.26			0.640		1.22
	0.26				0.556	1.08
Tetryl	1.00	<1.00	<1.00	<1.00	<1.00	1.0
Pentaerythritol tetranitrate (PETN)	1.00	<1.00	<1.00	<1.00	<1.00	1.0

a Date(s) sampled: 10/7–10/23/98, resamples separately noted in table.

b Statistical limit as listed in MRP 96-248.

c Value reported as a tentatively identified compound.

d Results followed by an “est” have values between the method detection limit and the reporting limit for that compound.

e NA = Not applicable.

f TBD = Statistical limits are to be developed by the end of 1999 for the perchlorate ion.

Table 9-38. Fourth quarter analytical results for constituents of concern not listed in WDR 96-248 and occurring in Site 300 ground water beneath surface impoundments.[a]

Parameter	Reporting limit	Location			
		W-817-01	W-817-02	W-817-03	W-817-04
General					
Ground water elevation (m above MSL)	NA[b]	194.94	181.47	176.86	187.02
Field pH (pH units)	NA	8.00	7.76	7.90	8.07
Field specific conductance (μmho/cm)	NA	1500	2350	1750	1800
Water temperature (Celsius)	NA	24.1	21.5	20.1	22.7
Volatile/semivolatile organic compounds (μg/L)[c]					
Trichloroethene (TCE)	0.5	<0.5	0.63	15	12
Explosives (μg/L)					
1,3,5-Trinitrobenzene	0.26	<0.26	<0.26	<0.26	<0.26
1,3-Dinitrobenzene	0.11	<0.11	<0.11	<0.11	<0.11
2,4-Dinitrotoluene	0.26	<0.26	<0.26	<0.26	<0.26
2,6-Dinitrotoluene	0.26	0.415	<0.26	<0.26	<0.26
2-Amino-4,6-dinitrotoluene	0.26	<0.26	0.262	<0.26	0.191 est[d]
2-Nitrotoluene	0.26	<0.26	<0.26	<0.26	<0.26
3-Nitrotoluene	0.26	<0.26	<0.26	<0.26	<0.26
4-Nitrotoluene	0.26	<0.26	<0.26	<0.26	<0.26
Nitrobenzene	0.85	<0.85	<0.85	<0.85	<0.85

a Dates sampled: 10/7–10/23/98.

b NA = Not applicable

c No other compounds were detected via EPA Method 624 for VOCs and no compounds were detected by EPA Method 625 for semi-volatiles.

d Results followed by an “est” have values between the method detection limit and the reporting limit for that compound.

Table 9-39. Analysis of photographic process rinsewater effluent from Site 300 Building 801.

Parameter	WDR effluent limits[a]	Sampling Date 2/10/98		Sampling Date 5/14/98		Sampling Date 10/12/98	
		Reporting limit	Result	Reporting limit	Result	Reporting limit	Result
Constituents of concern required by WDR 96-248							
Physical							
pH (units)	2<pH≤12.5	NAFL[b]	6.84	NAFL	7.33	NAFL	8.06
Metals (mg/L)							
Antimony	15[c]	0.005	<0.005	0.005	0.00076 est	0.005	<0.005
Arsenic	5	0.004	<0.004	0.002	<0.002	0.002	<0.002
Barium	100	0.025	0.015 est[d]	0.025	0.010 est	0.025	0.006 est
Beryllium	0.75[c]	0.0002	<0.0002	0.0002	<0.0002	0.0002	<0.0002
Cadmium	1	0.0005	0.005	0.0005	0.0041	0.001	0.0035
Chromium	5	0.001	0.0029	0.001	0.0014	0.001	0.0014
Cobalt	80	0.05	<0.05	0.05	<0.05	0.05	<0.05
Copper	25	0.005	0.117	0.005	0.061	0.010	0.067
Lead	5	0.005	0.015	0.005	0.0083	0.005	0.014
Manganese	NL[e]	0.01	0.068	0.01	0.043	0.01	0.022
Molybdenum	350	0.025	0.022 est	0.025	0.018 est	0.025	0.022 est
Nickel	20	0.002	0.012	0.002	0.0063	0.002	0.0053
Potassium	NL	1	18	0.1	14	1	29
Silver	5	0.1	<0.1	0.001	0.031	0.005	0.086
Thallium	7[c]	0.001	<0.001	0.001	0.00030 est	0.001	<0.001
Vanadium	24[c]	0.01	0.007 est	0.01	0.0033 est	0.01	<0.01
Zinc	250	0.02	6.9	0.02	4.4	0.02	2.5

Table 9-39. Analysis of photographic process rinsewater effluent from Site 300 Building 801 (concluded).

Parameter	WDR effluent limits[a]	Sampling Date 2/10/98		Sampling Date 5/14/98		Sampling Date 10/12/98	
		Reporting limit	Result	Reporting limit	Result	Reporting limit	Result
Surveillance monitoring constituents							
Semivolatile organic compounds (μg/L)[f]							
Bis(2-ethylhexl)phathalate	1,000,000	5	5.5	5	1.4 est[c]	5	0.93 est[c]
Butylbenzylphthalate	1,000,000					2	<2
Diethyl phthalate	1,000,000	2	<2	2	<2	2	<2
o-Cresol	50,000	2	<2	2	<2	2	<2
p-Cresol	50,000	2	<2	2	<2	2	<2
Di-*n*-octylphalate	1,000,000	2	<2	2	<2	2	<2
Naphthalene	200,000	2	<2	2	<2	2	<2
Dibutylphthalate	1,000,000					2	<2
Phenol	1,000,000					5	1.4 est

a These discharge limits are found in the Monitoring and Reporting Program No. 96-248, adopted on September 20, 1996, or in Appendix C of the Amended Report of Waste Discharge (Fisher, 1995).

b NAFL = Not available from laboratory.

c California soluble threshold limit concentration (STLC), i.e., hazardous waste limit, not noted in WDR 96-248.

d Results followed by an “est” have estimated values between the method detection limit (MDL) and the reporting limit for that compound.

e NL = No limit.

f No other semivolatile organic compounds were detected using EPA Method 625.

Table 9-40. Analysis of photographic process rinsewater effluent from Site 300 Building 823.

Parameter	WDR effluent limits[a]	Sampling Date 12/18/97		Sampling Date 3/12/98	
		Reporting limit	Result	Reporting limit	Result
Constituents of concern required by WDR 96-248					
Physical					
pH (units)	2<pH≤12.5	NAFL[b]	7.7	NAFL	7.6
Metals (mg/L)					
Antimony	15[c]	0.005	<0.005	0.005	<0.005
Arsenic	5	0.004	<0.004	0.002	<0.002
Barium	100	0.025	0.013 est[d]	0.025	0.0062 est
Beryllium	0.75[c]	0.0002	<0.0002	0.0002	<0.0002
Cadmium	1	0.0005	0.001	0.0005	0.00025 est
Chromium	5	0.001	0.0016	0.001	0.0006 est
Cobalt	80	0.05	<0.05	0.05	<0.05
Copper	25	0.005	0.03	0.001	0.021
Lead	5	0.005	0.0038 est	0.005	0.002 est
Manganese	NL[e]	0.01	0.012	0.01	0.0052 est
Molybdenum	350	0.025	0.022 est	0.025	0.026
Nickel	20	0.002	0.0	0.002	0.0014 est
Potassium	NL	1	8	1.0	7.6
Silver	5	0.002	0.033	0.001	0.029
Thallium	7[c]	0.002	<0.002	0.001	<0.001
Vanadium	24[c]	0.01	<0.01	0.01	<0.01
Zinc	250	0.02	1.4	0.02	0.03
Surveillance monitoring constituents					
Semivolatile organic compounds (μg/L)[g]					
Bis(2-ethylhexl)phathalate	1,000,000	5	76	5	1.1 est
Butylbenzylphthalate	1,000,000	2	5		
Diethyl phthalate	1,000,000	2	2.1	2	<2
o-Cresol	50,000	2	<2	2	<2
p-Cresol	50,000	2	<2	2	<2
Di-*n*-octylphalate	1,000,000	2	<2	2	<2
Naphthalene	200,000	2	<2	2	<2
Dibutylphthalate	1,000,000	10	510		
Phenol	1,000,000	2	<2		

a These discharge limits are found in the Monitoring and Reporting Program No. 96-248, adopted on September 20, 1996, or in Appendix C of the Amended Report of Waste Discharge (Fisher, 1995).

b NAFL = Not available from laboratory.

c California soluble threshold limit concentration (STLC), i.e., hazardous waste limit, not noted in WDR 96-248.

Sampling Date 6/29/98		Sampling Date 9/9/98		Sampling Date 12/7/98	
Reporting limit	Result	Reporting limit	Result	Reporting limit	Result
NAFL	8.01	NAFL	7.7	NAFL	7.6
0.005	<0.005	0.005	<0.005	0.005	<0.005
0.002	<0.002	0.002	<0.002	0.002	0.0024
0.025	0.011 est	0.025	0.015 est[d]	0.025	<0.025
0.0002	<0.0002	0.0002	<0.0026	0.0002	<0.0002
0.0005	0.00053	0.0005	0.00045 est	0.0005	<0.0005
0.001	0.0004	0.001	0.00048 est	0.001	<0.001
0.05	<0.05	0.05	<0.05	0.05	<0.05
0.003	0.029	0.001	0.015	0.001	0.028
0.005	0.006	0.005	0.0031 est	0.005	<0.005
0.01	0.0065 est	0.01	0.0058 est	0.01	<0.01
0.025	0.0198 est	0.025	0.023 est	0.025	<0.025
0.002	0.0036	0.002	0.0024	0.002	<0.002
0.1	8.8	1	9.6	1	22
0.003	0.026	0.001	0.17[f]	0.01	0.342
0.001	<0.001	0.001	<0.001	0.001	<0.001
0.01	<0.01	0.01	<0.01	0.01	<0.01
0.02	0.035	0.02	0.017 est	0.02	0.039
5	1.7 est	5	<5	5	<5
		2	1.3 est	2	<2
2	1.0 est	2	<2	2	<2
2	<2	2	<2	2	<2
2	<2	2	<2	2	<2
2	<2	2	<2	2	<2
2	<2				

d Results followed by an “est” have estimated values between the method detection limit (MDL) and the reporting limit for that compound.

e NL = No limit.

f Estimated value because of matrix interference. The result from EPA Method 200.7 is 0.25 mg/L.

g No other semivolatile organic compounds were detected using EPA Method 625.

Table 9-41. Analysis of photographic process rinsewater effluent from Site 300 Building 851.

Parameter	WDR effluent limits[a]	Sampling Date 2/19/98		Sampling Date 2/20/98	
		Reporting limit	Result	Reporting limit	Result
Constituents of concern required by WDR 96-248					
Physical					
pH (units)	2<pH≤12.5	NAFL[b]	7.27	NAFL	7.24
Metals (mg/L)					
Antimony	15[c]	0.005	<0.005	0.005	<0.005
Arsenic	5	0.002	<0.002	0.002	<0.002
Barium	100	0.025	0.008 est[d]	0.025	0.0064 est
Beryllium	0.75[c]	0.0002	<0.0002	0.0002	<0.0002
Cadmium	1	0.0005	0.00051	0.0005	0.0004 est
Chromium	5	0.005	0.049	0.005	0.043
Cobalt	80	0.05	<0.05	0.05	<0.05
Copper	25	0.01	0.27	0.01	0.26
Lead	5	0.005	0.009	0.005	0.0074
Manganese	NL[e]	0.01	0.14	0.01	0.12
Molybdenum	350	0.025	0.02 est	0.025	0.019 est
Nickel	20	0.002	0.035	0.002	0.031
Potassium	NL	1	36	1	31
Silver	5	0.001	0.0035	0.002	0.01
Thallium	7[c]	0.001	<0.001	0.001	<0.001
Vanadium	24[c]	0.01	<0.01	0.01	<0.01
Zinc	250	0.02	0.14	0.02	0.11
Surveillance monitoring constituents					
Semivolatile organic compounds (μg/L)[f]					
Bis(2-ethylhexl)phathalate	1,000,000	5	<5	5	4.1 est
o-Cresol	50,000	2	<2	2	<2
p-Cresol	50,000	2	<2	2	<2
Di-*n*-octylphalate	1,000,000	2	<2	2	<2
Naphthalene	200,000	2	<2	2	<2
2-Nitrophenol					
Dimethyl phthalate					

a These discharge limits are found in the Monitoring and Reporting Program No. 96-248, adopted on September 20, 1996, or in Appendix C of the Amended Report of Waste Discharge (Fisher, 1995).

b NAFL = Not available from laboratory.

c California soluble threshold limit concentration (STLC), i.e., hazardous waste limit, not noted in WDR 96-248.

Sampling Date 7/8/98		Sampling Date 8/24/98		Sampling Date 9/21/98		Sampling Date 11/19/98	
Reporting limit	Result	Reporting limit	Result	Reporting limit	Result	Reporting limit	Result
NAFL	7.64	NAFL	7.55	NAFL	7.55	NAFL	8.11
0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005
0.002	<0.002	0.002	<0.002	0.002	0.0014 est[d]	0.002	0.00069 est
0.025	<0.025	0.025	0.0079	0.025	0.023 est	0.025	<0.025
0.0002	<0.0002	0.0002	0.000077 est	0.0002	0.00010 est	0.0002	<0.0002
0.0005	0.00033 est	0.0005	0.00032 est	0.0005	0.00025 est	0.0005	0.00012 est
0.001	0.078	0.001	0.051 est	0.001	0.044	0.001	0.038
0.05	<0.05	0.05	<0.05	0.05	< 0.05	0.05	<0.05
0.001	0.073	0.001	0.066	0.001	0.057	0.001	0.16
0.005	0.0054	0.005	0.0048 est	0.005	0.0087	0.005	0.007
0.01	0.078	0.01	0.043	0.01	0.10	0.01	0.033
0.025	<0.025	0.025	0.029	0.025	0.022 est	0.025	0.025
0.002	0.016	0.002	0.027	0.002	0.012	0.002	0.0087
1	28	1	20	1	9	1	8.4
0.001	0.011	0.001	0.15	0.001	0.34	0.01	0.45
0.001	<0.001	0.001	<0.001	0.001	0.00035 est	0.001	<0.001
0.01	<0.01	0.01	<0.01	0.01	0.0055 est	0.01	<0.01
0.02	0.084	0.02	0.092	0.02	0.094	0.02	0.05
5	1.3 est	5	28	5	<5		
2	<2	2	<2	2	3.4		
2	<2	2	<2	2	<2		
2	<2	2	<2	2	<2		
2	<2	2	<2	2	<2		
		2	<2	2	<2		
		2	0.67 est	2	<2		
		2	<2	2	0.51 est		

d Results followed by an “est” have estimated values between the method detection limit (MDL) and the reporting limit for that compound.

e NL = No limit.

f No other semivolatile organic compounds were detected using EPA Method 625.

Table 9-42. Analysis of chemistry process wastewater for constituents of concern required by WDR 96-248.

Parameter	WDR[a] effluent limits	Building 825 Sampled 6/3/98		Building 827C Sampled 4/21/98		Building 827E Sampled 6/3/98		Building 827E Sampled 8/24/98	
		Reporting limit	Result	Reporting limit	Result	Reporting limit	Result	Reporting limit	Result
Explosives (μg/L)									
HMX	NL[b]	20	140	20	310	20	1500	5	36
RDX	NL	20	<20	20	<20	200	<200	5	36
TATB	NL	20	<20	20	<20[c]	20	<20	20	<20
Volatile organic compounds (μg/L)[d]									
1,1,1-Trichloroethane	1,000,000	0.5	0.19 est[e]	0.5	<0.5	0.5	<0.5	0.5	<0.5
1,1,2,2-Tetrachloroethane	1,000,000	0.5	0.21 est	0.5	<0.5	0.5	<0.5	0.5	<0.5
1,2-Dichloroethane	500	0.5	<0.5	0.5	<0.5	0.5	<0.5	0.5	<0.5
2-Butanone	200,000	20	<20	20	<20	20	<20	20	<20
Acetone	1,000,000	10	<10	10	<10	10	<10	10	<10
Bromoform	100,000	0.5	<0.5	0.5	0.81	0.5	<0.5	0.5	<0.5
Carbon tetrachloride	100,000	0.5	1.6	0.5	<0.5	0.5	<0.5	0.5	<0.5
Chlorobenzene	100,000	0.5	<0.5	0.5	<0.5	0.5	<0.5	0.5	<0.5
Chloroform	100,000	0.5	3.2	0.5	<0.5	0.5	4	0.5	0.63
Dichlorodifluoromethane	1,000,000					0.5	<0.5	0.5	0.20 est
Dimethyl sulfoxide (DMSO)[f]	1,000	NA[g]	NA	10	<10	10	<20	10	<10
Ethanol	1,000,000	1000	<1000	1000	<1000	1000	<1000	1000	<1000
Freon 113	1,000,000	0.5	<0.5	0.5	0.27	0.5	<0.5	0.5	<0.5
Methylene chloride	1,000,000	1	0.5 est	1	0.33	1	0.54	1	0.55 est[h]
Naphthalene	1,000,000	0.5	<0.5	0.5	<0.5	0.5	<0.5	0.5	<0.5
Styrene	1,000,000	0.5	<0.5	0.5	<0.5	0.5	<0.5	0.5	<0.5
Tetrachloroethene	700	0.5	0.62	0.5	<0.5	0.5	<0.5	0.5	<0.5
Toluene	200,000	0.5	0.84	0.5	1.2	0.5	0.58	0.5	0.95
Total xylene isomers	1,000,000	1	0.59 est	1	<1	1	<1	1	<1
Vinyl chloride	200	0.5	<0.5	0.5	<0.5	0.5	<0.5	0.5	<0.5
Physical									
pH	2<pH≤12.5	pH units	7.8	pH units	8.7	pH units	10.1	pH units	8.20
Metals (mg/L)									
Antimony	15[i]	0.02	0.02	0.02	< 0.02	0.02	0.02	0.02	< 0.02
Arsenic	5	0.05	0.06	0.05	< 0.05	0.05	< 0.05	0.08	< 0.08
Barium	100	0.002	0.086	0.002	0.62	0.002	0.21	0.002	0.14
Beryllium	0.75[i]	0.001	0.001	0.001	0.002	0.001	0.001	0.001	<0.001

Table 9-42. Analysis of chemistry process wastewater for constituents of concern required by WDR 96-248 (concluded).

Parameter	WDR[a] effluent limits	Building 825 sampled 6/3/98		Building 827C sampled 4/21/98		Building 827E sampled 6/3/98		Building 827E sampled 8/24/98	
		Reporting limit	Result	Reporting limit	Result	Reporting limit	Result	Reporting limit	Result
Metals (mg/L) (continued)									
Cadmium	1	0.002	0.002	0.002	< 0.002	0.002	0.002	0.002	0.003
Chromium	5	0.005	0.02	0.005	0.12	0.005	0.02	0.005	0.008
Cobalt	80	0.005	< 0.005	0.005	0.03	0.005	0.007	0.005	<0.005
Copper	25	0.01	0.02	0.01	0.16	0.01	0.07	0.01	0.05
Lead	5	0.02	< 0.02	0.02	0.07	0.02	0.03	0.02	<0.02
Manganese	NL	0.002	0.11	0.002	0.91	0.002	0.37	0.002	0.035
Mercury	NL	0.0004	< 0.0004	0.0009	0.002	0.0004	< 0.0004	0.0004	<0.0004
Molybdenum	350	0.005	< 0.005	0.005	0.01	0.005	< 0.005	0.005	0.01
Nickel	20	0.01	0.01	0.01	0.11	0.01	0.03	0.01	0.02
Potassium	NL	0.2	4.5	0.2	18	0.2	6.6	0.2	5.7
Selenium	1[i]	0.02	< 0.02	0.02	< 0.02	0.02	0.02	0.02	<0.02
Silver	5	0.01	< 0.01	0.01	< 0.01	0.01	< 0.01	0.01	<0.01
Strontium	NL	0.001	0.16	0.001	0.41	0.001	0.17	0.001	0.051
Thallium	7[i]	0.04	< 0.04	0.04	< 0.04	0.04	< 0.04	0.04	<0.04
Vanadium	24[i]	0.005	0.03	0.005	0.18	0.005	0.05	0.005	<0.005
Zinc	250	0.01	0.07	0.01	2.2	0.01	0.18	0.01	0.09

a These discharge limits are found in the Monitoring and Reporting Program No. 96-248, adopted on September 20, 1996, or in Appendix C of the *Amended Report of Waste Discharge* (Fisher, 1995).

b NL = No limit.

c Analyzed using a non-certified method.

d No other VOCs were detected using EPA Method 624.

e Results followed by an "est" have estimated values between the method detection limit (MDL) and the reporting limit for that compound.

f Tentatively identified using EPA Method 625 for semivolatile organic compounds.

g NA = Not available from Laboratory for 6/3/98 (825) sample

h Result is suspect. Methylene chloride was detected in the associated method blank at a trace concentration (between MDL & PQL) of 0.51 µg/L and has been identified as a common laboratory contaminant.

i California soluble threshold limit concentration (STLC), i.e., hazardous waste limit not noted in WDR 96-248.

Table 9-43. Analysis of explosive process area wastewater monitoring, constituents of concern.

Parameter	WDR Effluent limit[a]	Location and date					
		Building 806/807 3/18/98		Building 809 11/10/98		Building 817 6/16/98	
		Reporting limit	Result	Reporting limit	Result	Reporting limit	Result
Explosives (μg/L)							
PETN	NL[b]	5	<5	1.9	< 1.9	NR	NR
RDX	NL	1.4	<1.4	0.39	36	0.75	<0.75
HMX	NL	1.9	596	39	3100	0.92	33
TATB	NL	20	<20	20	< 20	20	<20
TNT	NL	1.5	<1.5	0.39	< 0.39	0.75	<0.75
Metals (mg/L)							
Aluminum	NA[c]	0.05	0.03 est[d]	0.05	9.5	0.05	1.4
Arsenic	5	0.002	<0.002	0.002	0.0014 est	0.002	0.0012 est
Barium	100	0.025	0.0069 est	0.025	0.15	0.025	0.03
Cadmium	1	0.0005	0.00084	0.001	0.0049	0.0005	0.00054
Chromium	5	0.001	0.0011	0.001	0.014	0.001	0.0017
Cobalt	80	0.050	0.05	0.050	< 0.05	0.05	<0.05
Copper	25	0.001	0.034	0.002	0.023	0.001	0.011
Lead	5	0.005	0.0016 est	0.005	0.0097	0.005	0.0032 est
Manganese	NA	0.010	0.0016 est	0.010	0.20	0.01	0.03
Molybdenum	350	0.050	<0.05	0.025	< 0.025	0.025	0.02 est
Nickel	20	0.010	0.0014 est	0.002	0.014	0.002	0.0017 est
Silver	5	0.001	<0.001	0.001	0.003	0.001	<0.001
Zinc	250	0.050	0.083	0.02	0.21	0.02	0.03
Volatile organic compounds (μg/L)[e]							
1,2-Dichloroethane	500	0.5	<0.5	0.5	< 0.5	0.5	<0.5
2-Butanone	200,000	20	<20	20	< 20	20	<20
Acetone	1,000,000	10	<10	20	52	10	<10
Bromoform	100,000	0.5	<0.5	0.5	< 0.5	0.5	<0.5
Chlorobenzene	100,000	0.5	<0.5	0.5	< 0.5	0.5	<0.5
Freon 113	100,000	0.5	<0.5	0.5	< 0.5	0.5	<0.5
Methylene chloride	100,000	1	0.41 est	1	< 1	1	0.36 est
Naphthalene	200,000	0.5	<0.5	0.5	< 0.5	0.5	<0.5
Styrene	1,000,000	0.5	<0.5	0.5	< 0.5	0.5	<0.5
Tetrachloroethene	700	0.5	0.5	0.5	< 0.5	0.5	<0.5
Toluene	200,000	0.5	2.9	0.5	< 0.5	0.5	<0.5
Vinyl chloride	200	0.5	0.5	0.5	< 0.5	0.5	<0.5

Table 9-43. Analysis of explosive process area wastewater monitoring, constituents of concern (concluded).

Parameter	WDR Effluent limit[a]	Location and date					
		Building 806/807 3/18/98		Building 809 11/10/98		Building 817 6/16/98	
		Reporting limit	Result	Reporting limit	Result	Reporting limit	Result
Semivolatile organic compounds (μg/L)[e]							
Benzyl alcohol	1,000,000			2	0.64 est		
Bis(2-ethylhexyl)phthalate	1,000,000	5	2.6 est	5	0.98 est	5	<5
Di-*n*-octylphthalate	1,000,000	2	<2	2	< 2	2	<2
Diethylphthalate	1,000,000	2	0.62 est	2	0.70 est	2	3.5
Naphthalene	200,000	2	<2	2	< 2	2	<2
n-Nitrosodiphenylamine	1,000,000			2	67		
o-Cresol	50,000	2	<2	2	< 2	2	<2
p-Cresol	50,000	2	<2	2	< 2	2	<2
Phenol	1,000,000			2	1.2 est		

a These discharge limits are found either in the Monitoring and Reporting Program No. 96-248, adopted on September 20, 1996, or in Appendix C of the Amended Report of Waste Discharge (1995).

b NL = No Limit

c NA = Not applicable.

d Results followed by an “est” have estimated values between the method detection limit (MDL) and the reporting limit for that compound.

e No other volatile or semivolatile organic compounds were detected via EPA Methods 624 and 625.

Table 9-44. Percolation pits Second Quarter 1998 overflow results.

Analyte	Reporting limit (mg/L)	Results (mg/L)
Aluminum	0.20	< 0.20
Antimony	0.0050	< 0.0050
Arsenic	0.0020	< 0.0020
Barium	0.025	< 0.025
Beryllium	0.00050	< 0.00050
Boron	0.10	1.2
Cadmium	0.00050	< 0.00050
Chromium (total)	0.0010	0.0018
Chromium (VI)	0.0020	0.0059[a]
Cobalt	0.050	< 0.050
Copper	0.010	0.049
Iron	0.10	0.50
Lead	0.0020	0.0046
Manganese	0.030	< 0.030
Mercury	0.00020	< 0.00020
Molybdenum	0.050	< 0.050
Nickel	0.0050	< 0.0050
Selenium	0.0020	< 0.0020
Silver	0.00050	< 0.00050
Thallium	0.0010	< 0.0010
Vanadium	0.050	< 0.050
Zinc	0.020	0.072

[a] The chromium(VI) value is suspect because the sample was held too long before analysis, and the value for chromium(VI) was greater than the value for total chromium.

Table 9-45. Site 300 potable standby supply well 18.

Constituents of Concern	Sampled			
	1st Quarter[a]	2nd Quarter[b]	3rd Quarter[c]	4th Quarter[d]
Inorganic (μg/L)				
Arsenic	—[e]	<2	<2	—[e]
Zinc	—[e]	30	57	—[e]
Organic (μg/L)				
Volatile (EPA 502.2)	nd[f]	nd	nd	nd
Trichloroethene (TCE)	0.32	0.29	<0.2	0.25
Volatile (EPA 601)	nd	nd	nd	nd
Trichloroethene (TCE)	<0.5	<0.5	0.6	<0.5
Volatile (EPA 624)	—[e]	—[e]	nd	—[e]
Radioactive (Bq/L)				
Gross alpha	0.03 ± 0.11	0.24 ± 0.08	0.027 ± 0.054	0.011 ± 0.014
Gross beta	0.07 ± 0.30	0.27 ± 0.06	0.24 ± 0.07	0.033 ± 0.020
Tritium	0.2 ± 1.3	–1.3 ± 1.0	–1.0 ± 1.3	–0.9 ± 1.8

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 First quarter samples collected on 1/14, 2/11, and 3/12/98.

b Second quarter samples collected on 4/16, 5/13, and 6/10/98.

c Third quarter samples collected on 7/15, 8/12, and 9/16/98.

d Fourth quarter samples collected on 10/14, 11/11, and 12/9/98.

e Analysis not planned.

f nd = Not detected above reporting limits, except as listed. See **Table 9-19b** for method constituents and their reporting limits.

Table 9-46. Site 300 potable supply well 20.

Constituents of concern	Sampled			
	1/23/98	4/29/98	7/30/98	10/23/98
Inorganic (μg/L)				
Antimony	<5	<5	<5	<5
Arsenic	<2	<2	<2	<2
Barium	<25	<25	62	<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	11
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	<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	<20	<20	<20
Potassium (mg/L)	—[a]	7.8	3.5	7.7
Nitrate (mg/L)	—[a]	<0.4	—[a]	<0.4
Organic (μg/L)				
Volatile (EPA 502.2)	nd[b]	nd	nd	nd
Explosive (μg/L)				
HMX	<5	<5	<5	<5
RDX	<5	<5	<5	<5
Radioactive (Bq/L)				
Gross alpha	0.037 ± 0.074	–0.061 ± 0.048	0.060 ± 0.030	0.016 ± 0.024
Gross beta	0.296 ± 0.148	0.26 ± 0.07	0.25 ± 0.04	0.096 ± 0.024
Tritium	0.1 ± 1.3	0.3 ± 1.1	–1.1 ± 1.2	–0.2 ± 1.9

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 planned.

[b] nd = Not detected above reporting limits, except as listed. See **Table 9-19a** and **9-19b** for method constituents and their reporting limits.

Table 9-47. First quarter analytical results for WDR 96-248 constituents of concern in ground water beneath Site 300 sewage ponds.[a]

	Upgradient locations			Crossgradient locations
	W-7E	**W-7ES**	**W-7PS**	**W-35A-04**
Biological Parameters[b]				
Total Coliform (MPN/100 mL)	<1.1	2.2	<1.1	12
Fecal Coliform (MPN/100 mL)[c]	<1.1	<1.1	<1.1	<1.1
Minerals (mg/L)				
Nitrate (as NO_3)	<0.4	11	17	13
General Parameters				
pH (pH units)	8.39	7.86	7.57	7.80
Specific conductance (μmho/cm)	1530	1250	1250	1400

	Downgradient locations				
	W-25N-20	W-26R-01	W-26R-05	W-26R-11	W-7DS
Biological Parameters[b]					
Total Coliform (MPN/100 mL)	<1.1	<1.1	23	<1.1	<1.1
Fecal Coliform (MPN/100 mL)[c]	<1.1	<1.1	<1.1	<1.1	<1.1
Minerals (mg/L)					
Nitrate (as NO_3)	8.4	44	8.4	12	8
General Parameters					
pH (pH units)	7.80	7.76	7.98	7.69	7.71
Specific conductance (μmho/cm)	1380	1500	1180	1330	1370

a Samples collected from 1/22–2/5/98.

b Coliform bacteria measurements are in terms of “most probable number” (MPN) of organisms/100 mL of sample.

c The WDR limit for fecal coliform is 2.2 MPN/100 L.

Table 9-48. Third quarter analytical results for WDR 96-248 constituents of concern in ground water beneath Site 300 sewage ponds.[a]

	Upgradient locations			Crossgradient location
	W-7E	**W-7ES**	**W-7PS**	**W-35A-04[d]**
Biological Parameters[b]				
Total Coliform (MPN/100 mL)	<1.1	<1.1	<1.1	<1.1/<1.1
Fecal Coliform (MPN/100 mL)[c]	<1.1	<1.1	<1.1	<1.1/<1.1
Minerals (mg/L)				
Nitrate (as NO_3)	<0.4	8.9	17	8.9/8.8
General Parameters				
pH (pH units)	8.49	7.60	7.68	7.77/7.71
Specific conductance (μmho/cm)	1420	1260	1390	1290/1290

	Downgradient locations				
	W-25N-20	**W-26R-01**	**W-26R-05**	**W-26R-11**	**W-7DS**
Biological Parameters[b]					
Total Coliform (MPN/100 mL)	<1.1	<1.1	16.1	<2	<2
Fecal Coliform (MPN/100 mL) [c]	<1.1	<1.1	<1.1	<2	<2
Minerals (mg/L)					
Nitrate (as NO_3)	9.3	40	53	14	8.9
General Parameters					
pH (pH units)	7.58	7.66	7.81	7.51	7.56
Specific conductance (μmho/cm)	1300	1430	1320	1350	1300

a Samples collected from 8/5/–8/21/98.

b Coliform bacteria measurements are in terms of “most probable number” (MPN) of organisms/100 mL of sample.

c The WDR limit for fecal coliform is 2.2 MPN/100 L.

d Sample and duplicate (collocated) sample results are reported for ground water from this location.

Table 9-49. Off-site well CARNRW1.

Constituents of concern	Sampled			
	1/23/98	**4/27/98**	**7/28/98**	**10/22/98**
Organic (μg/L)				
Volatile (EPA 502.2)	nd[a]	nd	nd	nd

a nd = Not detected above reporting limits, except as listed. See **Table 9-19b** for method constituents and their reporting limits.

Table 9-50. Off-site well CDF1.

Constituents of concern	Sampled			
	1/26/98	4/27/98	7/23/98	10/21/98
Inorganic (μg/L)				
Antimony	<5	<5	<5	—[a]
Arsenic	4.3	4.1	3.4	4.5
Barium	26	29	32	29
Beryllium	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5	<0.5
Chromium	<1	1.1	<1	—[a]
Cobalt	<25	<25	<25	<25
Copper	<10	<10	<10	<10
Lead	<2	<2	<2	<2
Mercury	<0.2	<0.2	<0.2	—[a]
Molybdenum	<25	<25	<25	—[a]
Nickel	5.1	<5	<5	<5
Selenium	<2	<2	<2	—[a]
Silver	<0.5	<0.5	<0.5	—[a]
Thallium	<1	<1	<1	—[a]
Vanadium	<25	<25	<25	<25
Zinc	<20	35	34	<20
Potassium (mg/L)	—[b]	7.3	6.9	7.5
Nitrate (mg/L)	—[b]	2.9	3	<0.4
Organic (μg/L)				
Volatile (EPA 502.2)	nd[c]	nd	nd	nd
Pesticides and PCBs (EPA 608)	—[b]	—[b]	nd	—[b]
Herbicides (EPA 615)	—[b]	—[b]	nd	—[b]
Semivolatile (EPA 625)	—[b]	—[b]	nd	—[b]
Explosive (μg/L)				
HMX	<5	<5	<5	<5
RDX	<5	<5	<5	<5
Radioactive (Bq/L)				
Gross alpha	<0.13	0.031 ± 0.081	0.052 ± 0.048	0.077 ± 0.034
Gross beta	0.19 ± 0.15	0.45 ± 0.17	0.24 ± 0.05	0.24 ± 0.03
Tritium	0.5 ± 1.3	0.5 ± 1.2	0.8 ± 1.3	–0.4 ± 2.6
Uranium (total)	—[b]	—[b]	0.034 ± 0.014	—[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] Analysis not requested (sampling error).

[b] Analysis not planned.

[c] nd = not detected above reporting limits, except as listed. See **Table 9-19 a** and **9-19b** for method constituents and their reporting limits.

Table 9-51. Off-site well CON1.

Constituents of concern	Sampled			
	1/26/98	4/27/98	7/23/98	10/21/98
Inorganic (μg/L)				
Antimony	<5	<5	<5	—[a]
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	—[a]
Cobalt	<25	<25	<25	<25
Copper	<10	<10	<10	<10
Lead	<2	<2	<2	3.9
Mercury	<0.2	<0.2	<0.2	—[a]
Molybdenum	<25	<25	<25	—[a]
Nickel	<5	<5	<5	<5
Selenium	<2	<2	<2	—[a]
Silver	<0.5	<0.5	<0.5	—[a]
Thallium	<1	<1	<1	—[a]
Vanadium	<25	<25	<25	<25
Zinc	<20	<20	<20	<20
Potassium (mg/L)	—[b]	8.8	8.9	8.3
Nitrate (mg/L)	—[b]	<0.89	<0.89	<0.89
Organic (μg/L)				
Volatile (EPA 502.2)	nd[c]	nd	nd	nd
Methylene chloride	<0.2	0.21	<0.2	<0.2
Pesticides and PCBs (EPA 608)	—[b]	—[b]	nd[d]	—[b]
Herbicides (EPA 615)	—[b]	—[b]	nd[d]	—[b]
Semivolatile (EPA 625)	—[b]	—[b]	nd[d]	—[b]
Energetic (μg/L)				
HMX	<5	<5	<5	<5
RDX	<5	<5	<5	<5
Radioactive[e] (Bq/L)				
Gross alpha	0.011 ± 0.037	-0.020 ± 0.087	0.053 ± 0.044	0.11 ± 0.05
Gross beta	0.26 ± 0.30	0.03 ± 0.16	0.36 ± 0.05	0.28 ± 0.05
Tritium	0.2 ± 1.3	–0.3 ± 1.1	0.4 ± 1.3	–1.4 ± 2.5

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 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 Analysis not planned.

c nd = Not detected above reporting limits, except as listed. See **Table 9-19a** and **9-19b** for method constituents and their reporting limits.

d Sample collected on 8/13/98.

Table 9-52. Off-site well GALLO1.

Constituents of concern	Sampled		
	1/23/98	7/29/98[a]	10/22/98
Inorganic (μg/L)			
Antimony	<5	<5	<5
Arsenic	4.2	3.4	2.2
Barium	<25	<25	<25
Beryllium	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5
Chromium	<1	<1	<1
Cobalt	<25	<25	<25
Copper	<10	<10	<10
Lead	2.5	<2	<2
Mercury	<0.2	<0.2	<0.2
Molybdenum	41	<25	43
Nickel	<5	<5	<5
Selenium	<2	<2	<2
Silver	<0.5	<0.5	<0.5
Thallium	<1	<1	<1
Vanadium	<25	<25	<25
Zinc	<20	<20	<20
Potassium (mg/L)	—[b]	6.3	3.8
Nitrate (mg/L)	1.4[c]	<0.4	<0.4
Organic (μg/L)			
Volatile (EPA 502.2)	nd[d]	nd	nd
Methylene chloride	<0.2	<0.2	0.31
Pesticides and PCBs (EPA 608)	—[b]	nd	—[b]
Herbicides (EPA 615)	—[b]	nd	—[b]
Semivolatile (EPA 625)	—[b]	nd	—[b]
Explosive (μg/L)			
HMX	<5	<5	<5
RDX	<5	<5	<5
Radioactive (Bq/L)			
Gross alpha	0.20 ± 0.07	0.23 ± 0.05	0.11 ± 0.03
Gross beta	0.07 ± 0.30	0.19 ± 0.04	0.10 ± 0.02
Tritium	–0.8 ± 1.2	–1.1 ± 1.2	0.4 ± 2.0
Uranium (total)	—[b]	0.061 ± 0.018	—[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] Well unavailable for sampling during second quarter 1998.

[b] Analysis not planned.

[c] Sample collected on 2/25/98.

[d] nd = Not detected above reporting limits, except as listed. See **Table 9-19a** and **9-19b** for method constituents and their reporting limits.

Table 9-53. Off-site well CARNRW2.

Constituents of concern	Sampled			
	1/23/98	4/27/98	7/28/98	10/22/98
Inorganic (μg/L)				
Antimony	<5	<5	<5	<5
Arsenic	3.4	2.8	3.2	<2
Barium	<25	<25	35	<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	<25	<25	<25	<25
Nickel	<5	<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	<20	<20	<20
Potassium (mg/L)	—[a]	9	6.6	8.5
Nitrate (mg/L)	—[a]	<0.4	<0.4	<0.4
Organic (μg/L)				
Volatile (EPA 502.2)	nd[b]	nd	nd	nd
Methylene chloride	<0.2	0.66	<0.2	<0.2
Pesticides and PCBs (EPA 608)	—[a]	—[a]	nd	—[a]
Herbicides (EPA 615)	—[a]	—[a]	nd	—[a]
Semivolatile (EPA 625)	—[a]	—[a]	nd	—[a]
Explosive (μg/L)				
HMX	<5	<5	<5	<5
RDX	<5	<5	<5	<5
Radioactive (Bq/L)				
Gross alpha	<0.13	–0.007 ± 0.063	0.054 ± 0.033	0.081 ± 0.031
Gross beta	0.33 ± 0.15	0.31 ± 0.17	0.41 ± 0.06	0.23 ± 0.03
Tritium	1.0 ± 1.3	0.4 ± 1.2	–0.4 ± 1.2	0.80 ± 2.01
Uranium (total)	—[a]	—[a]	0.011 ± 0.014	—[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. See the main volume, Chapter 14, Quality Assurance.

[a] Analysis not planned.

[b] nd = Not detected above reporting limits, except as listed. See **Table 9-19a** and **9-19b** for method constituents and their reporting limits.

Table 9-54. Off-site well CON2.

Constituents of concern	Sampled			
	1/26/98	4/27/98	7/23/98	10/21/98
Organic (μg/L)				
Volatile (EPA 601)	nd[a]	nd	nd	nd

[a] nd = Not detected above reporting limits, except as listed. See **Table 9-19a** and **9-19b** for method constituents and their reporting limits.

Table 9-55. Annually monitored off-site surveillance wells.

Constituents of concern	Well					
	MUL1	MUL2	VIE1	VIE2	STONEHAM1	W-35A-04
	Sampled					
	9/16/98	9/16/98	9/10/98	9/9/98	9/9/98	8/4/98
Inorganic (μg/L)						
Antimony	<5	<5	<5	<5	<5	<5
Arsenic	4.1	<2	12	<2	<2	3
Barium	27	<25	52	36	41	41
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	2.9	2.6	2.7	<2	<2	3.2
Cobalt	<25	<25	<25	<25	<25	<25
Copper	<10	<10	11	<10	<10	<10
Lead	<2	2.1	<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
Selenium	<2	2.8	3.9	<2	<2	<2
Silver	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Thallium	<1	<1	<1	<1	<1	<1
Vanadium	<25	<25	<25	<25	<25	<25
Zinc	59	<20	<20	210	38	<20
Nitrate (mg/L)	4.9	11	71	71	6.1	8.9
Organic (μg/L)						
Volatile (EPA 502.2)	nd[a]	nd	nd	nd	nd	nd
Pesticides and PCBs (EPA 608)	nd	nd	nd	—[b]	nd	nd
Herbicides (EPA 615)	nd	nd	nd	nd	nd	nd
Semivolatile (EPA 625)	nd	nd	nd	nd	nd	nd
Explosives (μg/L)						
HMX	<5	<5	<5	<5	<5	<5
RDX	<5	<5	<5	<5	<5	<5
Radioactive (Bq/L)						
Gross alpha	—[b]	—[b]	0.084 ± 0.067	0.000 ± 0.070	0.014 ± 0.082	0.14 ± 0.04
Gross beta	—[b]	—[b]	0.064 ± 0.064	0.053 ± 0.047	0.25 ± 0.07	0.17 ± 0.04
Tritium	–0.3 ± 2.5	–0.2 ± 2.4	–0.3 ± 2.4	1.1 ± 2.5	–0.6 ± 2.5	1.2 ± 1.1
Uranium (total)	0.15 ± 0.02	0.050 ± 0.009	0.14 ± 0.02	0.19 ± 0.03	0.20 ± 0.03	0.21 ± 0.05

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 = Not detected above reporting limits, except as listed. See **Table 9-19a** and **9-19b** for method constituents and their reporting limits.

[b] Requested analysis not completed.

10

Soil and Sediment Monitoring

Gretchen M. Gallegos
Erich R. Brandstetter

Surface Soil Methods

Prior to 1988, 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 surveillance 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. In 1991, five additional soil sampling locations associated with air sampling locations were established. The 1998 Livermore site soil samples were collected from generally the same locations as those in 1991 to 1997. A few changes were made to the sampling locations because of accessibility and other considerations in 1997, but no changes were made to Livermore Valley soil sampling in 1998. The 1998 Site 300 soil samples were collected from the same 14 locations as sampled between 1990 and 1997. However, 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 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 more meaningful trending of 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 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.

Soil sampling is conducted according to written, standardized procedures contained in the *Environmental Monitoring Plan* (Tate et al. 1995). Samples are collected from undisturbed areas near the permanent sampling location marker. These areas generally are level, free of rocks, and are unsheltered by trees or buildings. The sampling technician chooses two 1-m squares from which to collect the sample and records 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) samples are submitted with each batch of soil samples. Two identical samples are collected and, at locations chosen for duplicate sampling, adjacent cores are collected 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.

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). 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

Samples of the sediment deposition are collected from arroyos and storm water drainages at and around the Livermore site after the cessation of spring runoff. For 1998, samples were analyzed for radionuclides and nonradiological materials.

Sediment was sampled from seven Livermore site drainages. Location ALPO was covered in water throughout the sampling period and was not sampled. The sediment sampling locations coincide with storm water runoff sampling locations so that the sampling results from these two media can be compared.

A culvert, bridge, or other permanent marker 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 more than 150 radionuclides using gamma spectroscopy as described above for 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 30–45 cm deep sample, which is submitted for analysis for total and soluble metals by the California Wet Extraction Test. 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 soil and sediment samples collected in 1998 in the Livermore Valley. **Table 10-2** presents the data, which includes 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 leachable organics 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, 1998.

Location identifier	Plutonium-238 (μBq/g)	Plutonium-239/240 (μBq/g)	Americium-241 (mBq/g)	Cesium-137 (mBq/g)
Livermore Valley soils				
L-AMON-SO	2.2±3.1	38.5±10.6	(a)	1.3±0.3
L-CHUR-SO	3.0±3.3	152±25	(a)	4.9±0.4
L-COW-SO	4.3±2.2	25.8±5.6	(a)	0.5±0.2
L-FCC-SO	3.3±2.2	50.3±8.4	(a)	1.5±0.2
L-HOSP-SO	1.9±2.5	52.5±8.5	(a)	2.1±0.3
L-MESQ-SO	2.4±1.9	29.5±6.0	(a)	1.1±0.3
L-MET-SO	1.8±1.7	48.5±7.8	(a)	1.5±0.3
L-NEP-SO	2.5±2.2	89.2±13.2	(a)	3.1±0.4
L-PATT-SO	0.5±0.9	19.5±4.6	(a)	0.7±0.3
L-SALV-SO	10.9±4.5	216±25	(a)	1.5±0.2
L-TANK-SO	1.1±1.2	12.4±3.7	(a)	0.33±0.28
L-VIS-SO	49.6±8.0	744±61	(a)	3.8±0.2
L-ZON7-SO	13.5±3.7	173±18	(a)	3.7±0.3
Median	**2.5**	**50.3**		**1.5**
Interquartile range	**2.4**	**122**		**2.1**
Maximum	**49.6**	**744**		**4.9**
LWRP soils				
L-WRP1-SO	381 ± 34	6070 ± 450	<2.9	4.7 ± 0.4
L-WRP2-SO	190 ± 20	4260 ± 320	2.4 ± 2.0	2.5 ± 0.3
L-WRP3-SO	19 ± 5	294 ± 30	<3.7	0.5 ± 0.2
L-WRP4-SO	15 ± 4	279 ± 27	<4.7	0.4 ± 0.2
L-WRP5-SO	57 ± 8	1190 ± 90	<2.2	0.7 ± 0.3
L-WRP6-SO	63 ± 11	958 ± 85	<0.7	0.7 ± 0.2
Median	**60**	**1070**	**<2.6**	**0.7**
Interquartile range	**130**	**3030**	(f)	**1.5**
Maximum	**381**	**6070**	(g)	**4.7**
Livermore site sediments				
L-ALPE-SD	1.9 ± 2.6	25 ± 6	(a)	0.4 ± 0.2
L-ASS2-SD	3.7 ± 3.8	5.2 ± 3.9	(a)	0.3 ± 0.2
L-ASW-SD	2.4 ± 2.7	8.1 ± 4.5	(a)	0.2 ± 0.2
L-CDB-SD	26.8 ± 6.4	403 ± 39	(a)	0.4 ± 0.3
L-ESB-SD	193 ± 26	1740 ± 160	(a)	0.7 ± 0.2
L-GRNE-SD	7.1 ± 6.5	70 ± 15	(a)	0.9 ± 0.3
L-WPDC-SD	–1.4 ± 3.0	5.1 ± 3.4	(a)	<0.1
Median	**3.7**	**25**		**0.4**
Interquartile range	**14.8**	**230**		**0.3**
Maximum	**193**	**1740**		**0.9**

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] Americium-241 only detected in LWRP samples.

[b] Only sediment samples are analyzed for tritium.

Potassium-40 (Bq/g)	Tritium (Bq/L)	Thorium-232[c] (μg/g)	Uranium-235[d] (μg/g)	Uranium-238[e] (μg/g)	Uranium 235/238
Livermore Valley soils					
0.566±0.017	(b)	9.2 ± 0.2	0.025 ± 0.010	2.2 ± 1.8	0.011 ± 0.010
0.522±0.017	(b)	8.3 ± 0.2	0.020 ± 0.012	1.9 ± 1.2	0.010 ± 0.009
0.522±0.018	(b)	6.2 ± 0.3	0.023 ± 0.013	2.0 ± 1.3	0.011 ± 0.010
0.369±0.015	(b)	5.9 ± 0.2	0.020 ± 0.008	2.1 ± 1.4	0.010 ± 0.007
0.381±0.011	(b)	5.3 ± 0.2	0.017 ± 0.013	1.3 ± 1.1	0.013 ± 0.014
0.511±0.015	(b)	8.1 ± 0.2	0.022 ± 0.011	1.7 ± 1.4	0.013 ± 0.012
0.540±0.025	(b)	7.4 ± 0.2	0.023 ± 0.014	1.9 ± 1.3	0.012 ± 0.011
0.481±0.013	(b)	6.1 ± 0.3	0.014 ± 0.008	1.2 ± 0.9	0.011 ± 0.011
0.492±0.013	(b)	7.8 ± 0.2	0.022 ± 0.009	2.2 ± 0.8	0.010 ± 0.005
0.403±0.014	(b)	7.2 ± 0.3	0.022 ± 0.013	2.9 ± 1.7	0.008 ± 0.006
0.411±0.019	(b)	7.9 ± 0.2	0.024 ± 0.015	1.9 ± 1.5	0.013 ± 0.013
0.389±0.016	(b)	6.7 ± 0.2	0.022 ± 0.011	3.3 ± 2.1	0.007 ± 0.005
0.448±0.017	(b)	8.2 ± 0.3	0.024 ± 0.011	2.9 ± 2.0	0.008 ± 0.007
0.481		**7.4**	**0.022**	**2.0**	
0.118		**1.9**	**0.003**	**0.4**	
0.566		**9.2**	**0.025**	**3.3**	
LWPP soils					
0.433 ± 0.012	(b)	7.6 ± 0.2	0.023 ± 0.014	2.2 ± 1.4	0.010 ± 0.009
0.365 ± 0.012	(b)	7.0 ± 0.2	0.019 ± 0.009	2.3 ± 1.4	0.008 ± 0.006
0.448 ± 0.016	(b)	7.9 ± 0.2	0.019 ± 0.010	3.4 ± 2.4	0.006 ± 0.005
0.374 ± 0.022	(b)	7.1 ± 0.2	0.020 ± 0.011	<1.0	0.019 ± 0.011
0.418 ± 0.012	(b)	7.0 ± 0.2	0.017 ± 0.009	2.5 ± 1.4	0.007± 0.005
0.374 ± 0.015	(b)	6.2 ± 0.2	0.019 ± 0.010	1.7 ± 1.4	0.011 ± 0.011
0.396		**7.1**	**0.019**	**2.3**	
0.056		**0.5**	**0.0004**	**0.6**	
0.448		**7.9**	**0.023**	**3.4**	
Livermore site sediments					
0.411 ± 0.012	6.5 ± 3.4	4.7 ± 0.1	0.014 ± 0.009	1.6 ± 1.0	0.009 ± 0.008
0.603 ± 0.016	3.1 ± 1.5	4.1 ± 0.1	0.013 ± 0.011	1.7 ± 1.7	0.008 ± 0.010
0.455 ± 0.013	6.8 ± 4.9	3.2 ± 0.2	0.011 ± 0.008	0.8 ± 0.4	0.014 ± 0.011
0.481 ± 0.013	15.7 ± 1.8	6.9 ± 0.2	0.215 ± 0.011	2.1 ± 1.3	0.104 ± 0.093
0.433 ± 0.012	9.5 ± 1.6	6.2 ± 0.2	0.019 ± 0.001	2.3 ± 1.9	0.009 ± 0.009
0.474 ± 0.012	1.6 ± 1.3	4.6 ± 0.1	0.012 ± 0.008	1.1 ± 0.6	0.011 ± 0.009
0.485 ± 0.015	1.3 ± 1.3	7.4 ± 0.3	0.026 ± 0.018	1.8 ± 1.5	0.015 ± 0.016
0.474	**6.5**	**4.7**	**0.014**	**1.7**	
0.039	**5.8**	**2.1**	**0.010**	**0.6**	
0.603	**15.7**	**7.4**	**0.215**	**2.3**	

c 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.

d 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.

e 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.

f Interquartile range not calculated because of high incidence of reported values below detection limits.

g Maximum value not presented because the only detection is within the range of values reported as below detection limits.

Table 10-2. Radionuclides and beryllium in soils at Site 300, 1998.

Location identifier	Cesium-137 (mBq/g)	Potassium-40 (Bq/ g)	Thorium-232[a] (μg/g)	Uranium-235[b] (μg/g)	Uranium-238[c] (μg/g)	Beryllium (mg/kg)	Uranium 235/238
3-801E-SO	0.4 ± 0.3	0.418 ± 0.014	9.1 ± 0.2	0.022 ± 0.006	<1.2	0.85	0.018 ± 0.019
3-801N-SO	2.1 ± 0.3	0.496 ± 0.015	10.7 ± 0.4	0.049 ± 0.017	14.9 ± 2.7	1.3	0.003 ± 0.001
3-801W-SO	2.1 ± 0.4	0.537 ± 0.016	9.8 ± 0.3	0.034 ± 0.015	6.3 ± 2.2	0.85	0.005 ± 0.003
3-812N-SO	<0.1	0.433 ± 0.014	13.4 ± 0.3	0.027 ± 0.016	3.3 ± 2.6	2.2	0.008 ± 0.005
3-834W-SO	2.8 ± 0.3	0.451 ± 0.016	10.6 ± 0.3	0.029 ± 0.018	2.4 ± 1.9	1.9	0.012 ± 0.012
3-851N-SO	4.1 ± 0.4	0.500 ± 0.017	11.4 ± 0.3	0.044 ± 0.018	9.8 ± 2.3	0.97	0.004 ± 0.002
3-856N-SO	1.4 ± 0.3	0.381 ± 0.013	9.5 ± 0.3	0.023 ± 0.012	2.6 ± 1.8	0.88	0.009 ± 0.008
3-858S-SO	0.7 ± 0.4	0.544 ± 0.016	11.5 ± 0.3	0.031 ± 0.015	3.3 ± 1.5	0.86	0.009 ± 0.006
3-DSW-SO	5.2 ± 0.4	0.437 ± 0.014	8.0 ± 0.4	0.035 ± 0.016	4.8 ± 2.3	0.68	0.007 ± 0.005
3-EOBS-SO	0.6 ± 0.3	0.488 ± 0.014	9.7 ± 0.2	0.025 ± 0.013	1.7 ± 1.6	0.97	0.015 ± 0.016
3-EVAP-SO	0.7 ± 0.3	0.407 ± 0.015	8.8 ± 0.2	0.024 ± 0.010	5.5 ± 1.8	0.58	0.004 ± 0.002
3-GOLF-SO	5.1 ± 0.4	0.492 ± 0.028	8.2 ± 0.3	0.024 ± 0.007	2.4 ± 2.3	0.68	0.010 ± 0.010
3-NPS-SO	3.7 ± 2.3	0.577 ± 0.020	7.2 ± 0.3	0.028 ± 0.015	2.4 ± 1.4	0.49	0.012 ± 0.010
3-PRIM-SO	0.8 ± 0.2	0.492 ± 0.020	10.4 ± 0.3	0.031 ± 0.013	3.0 ± 1.8	1.6	0.010 ± 0.007
3- WOBS -SO	4.8 ± 3.1	0.444 ± 0.012	7.4 ± 0.2	0.018 ± 0.013	2.6 ± 1.7	0.7	0.007 ± 0.007
Median	**2.1**	**0.488**	**9.7**	**0.028**	**3.0**	**0.9**	
Interquartile range	**3.2**	**0.063**	**2.2**	**0.008**	**2.8**	**0.4**	
Maximum	**5.2**	**0.577**	**13.4**	**0.049**	**14.9**	**2.2**	

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.

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

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	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[a]
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[a]

a Hazardous waste limit is 25 mg/L for copper and 250 mg/L for zinc. Soils with soluble concentrations at or above these values would be 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.

Constituents	Water quality objective	Reference	Attenuation factor	De minimis level
Organics (μg/L)				
1,2-Dichlorobenzene	600	EPA Primary MCL	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[(a)]	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[(b)]	100	25
Methylene chloride	5	Cal Primary MCL	100	25
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
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

[a] SNARL = Suggested No Adverse Response Level.

[b] Other = Taste and odor threshold for gasoline, and the California Ocean Plan Water Quality Objectives for Oil and Grease.

Table 10-6. Leachable organic compounds in Livermore site sediments, July 20–23, 1998.

Organic compounds (μg/L)	ASS2	ASW	ALPE	GRNE	WPDC	CDB	ESB
1,1-Dichloroethene	<50	<50	<50	<50	<50	<50	<50
1,2-Dichloroethane	<50	<50	<50	<50	<50	<50	<50
2-Butanone	<200	<200	<200	<200	<200	<200	<200
Carbon tetrachloride	<50	<50	<50	<50	<50	<50	<50
Chlorobenzene	<50	<50	<50	<50	<50	<50	<50
Chloroform	<50	<50	<50	<50	<50	<50	<50
Tetrachloroethene	<50	<50	<50	<50	<50	<50	<50
Trichloroethene	<50	<50	<50	<50	<50	<50	<50
Vinyl chloride	<100	<100	<100	<100	<100	<100	<100

Table 10-7. Total metals in Livemore site sediments, July 20–23, 1998.

Total metals (mg/kg)	Arroyo Seco		Arroyo Las Positas			Drainage Retention Basin	
	Influent	Effluent	Influent		Effluent	Influent	Effluent
	ASS2	ASW	ALPE	GRNE	WPDC	CDB	ESB
Antimony	<6.2	<6.2	<6.5	<6.8	<7.3	<6.6	<6.8
Arsenic	4.6	2.9	4.3	5.2	7.5	5.5	4.3
Barium	94.2	91.4	211	240	333	206	210
Beryllium	<0.52	<0.51	0.67	0.83	1.2	0.78	0.66
Cadmium	<0.52	<0.51	<0.54	<0.56	<0.61	<0.55	4.2
Chromium	23.6	20.8	39.3	32.5	59.3	40.3	44.4
Cobalt	6.9	5.5	11.1	11.1	14.8	11.1	10.9
Copper	13.9	10.4	18.2	13.1	32.3	19.3	38.3
Lead	6.4	4.3	9.9	7	11.3	7.7	14.9
Mercury	<0.1	<0.1	<0.11	<0.11	<0.12	<0.11	0.18
Molybdenum	<4.2	<4.1	<4.3	<4.5	<4.9	<4.4	<4.5
Nickel	29.3	27.2	48.7	31	65.2	46.9	46.9
Potassium	1220	939	1640	2050	3680	3080	1910
Selenium	<0.52	<0.51	<0.54	<0.56	<0.61	<0.55	<0.56
Silver	<1	<1	<1.1	<1.1	<1.2	<1.1	<1.1
Thallium	1.6	1.1	1.3	1.4	2	1.9	1.5
Vanadium	24.7	17.5	40.1	47.7	58	44.2	34.7
Zinc	44.4	33.4	47.3	43.1	66.4	48.5	68.6

Table 10-8. Soluble metals in Livermore site sediments, July 20–23, 1998.

Soluable metals (µg/L)	Arroyo Seco		Arroyo Las Positas			Drainage Retention Basin	
	Influent	Effluent	Influent		Effluent	Influent	Effluent
	ASS2	ASW	ALPE	GRNE	WPDC	CDB	ESB
Antimony	<240	<240	<120	<240	<240	<240	<240
Arsenic	<40	<40	54.2	66.4	40.4	<40	73.5
Barium	8050	11,800	12,900	15,300	15,100	14,200	12,100
Beryllium	<20	<20	<20	<20	<20	<20	<20
Cadmium	<20	<20	<20	<20	<20	<20	<20
Chromium	57	424	254	203	157	150	241
Cobalt	<200	324	529	524	598	685	450
Copper	<100	340	281	331	175	242	323
Lead	73.5	252	215	462	123	133	192
Mercury	<2	<2	<2	<2	<2	<2	<2
Molybdenum	<160	<160	<160	<160	<160	<160	<160
Nickel	218	865	1140	809	992	1140	997
Potassium	<20,000	30,300	21,000	<20,000	<20,000	<20,000	<20,000
Selenium	43.4	57.6	28.7	28.7	33.9	51.5	29.3
Silver	<40	<40	<40	<40	<40	<40	<40
Thallium	<40	<40	<40	<40	<40	<40	<40
Vanadium	<200	472	624	914	522	561	646
Zinc	759	22900	4880	218	497	544	5240

11

Vegetation and Foodstuff Monitoring

S. Ring Peterson

Vegetation Sampling Methods

When obtaining vegetation samples, LLNL avoids frequently tilled or disturbed areas and locations near buildings or other obstructions. Areas with unusual wind, precipitation, or irrigation influences also are avoided. Practical considerations also temper the location selections. These include access during inclement weather, personnel safety in vehicle operation, vehicle parking, or sample collection requirements.

Sampling locations for 1998 were the same as in 1997 and are listed in **Table 11-1**. Sampling at PIN1 and PIN2 was quarterly in 1998 rather than monthly, as in 1997.

The selected areas are unshaded and exhibit native vegetation for much of the year. The routine vegetation sampling locations are designated with permanent location markers. Consistent use of the same general sampling locations allows for more meaningful trending of data and closer monitoring of areas of concern. For example, every year at Site 300, LLNL examines vegetation from areas where tritium is known to be present in the subsurface soil.

In 1998, vegetation samples usually consisted of annual grasses and weeds although cabbage leaves were sampled at GARD for the third quarter. LLNL gathered samples with relatively high water content and collected approximately 0.5 to 1 kg of vegetation for analysis. Standard chain-of-custody procedures were followed (Tate et al. 1995).

Samples are delivered on the day of collection to LLNL's Chemistry and Materials Science Environmental Services laboratory and are kept frozen prior to processing. Water from the vegetation is collected using freeze-drying techniques (lyophilization), and the tritium content of the water is determined by liquid-scintillation counting.

Approximately 10% of the sites are sampled in duplicate to comply with quality assurance protocols. Duplicate samples are 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 thirteen (Tate et al. 1995). Twelve 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 were purchased and submitted for tritium analyses (see **Table 11-2**). The selection of wines from a wine growing region was random. An equal mix of red and white wines was selected from the Livermore Valley, California, and Europe. Any estate wine from a designated area was considered representative of that area. The most recent vintages available were collected, and the 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 sampled and analyzed as many of the available Livermore Valley wines as possible.

The wine samples were submitted for analysis unopened to prevent potential airborne tritium contamination. Chain-of-custody procedures were followed when delivering samples and throughout the analytical process. Wines were analyzed for tritium using ^{3}He mass spectrometry in the LLNL 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), which is still not sensitive enough to detect small differences in wine samples.

Table 11-1. Tritium in vegetation (in Bq/L), 1998.

	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	Median	Inter-quartile range	Dose (μSv/y)[a]	
							Median	Maximum
Sampling locations near Livermore site								
AQUE	2.7 ± 1.2	8.5 ± 1.5	6.8 ± 1.8	7.0 ± 1.9	6.9	1.6	0.034	0.041
VIS	4.7 ± 1.7	6.8 ± 1.5	6.8 ± 1.8	6.1 ± 1.8	6.5	0.98	0.031	0.033
NPER	4.1 ± 1.3	3.5 ± 1.3	5.3 ± 1.8	—[b]	4.1	0.91	0.020	0.026
MET	4.4 ± 1.3	2.6 ± 1.3	1.4 ± 1.6	0.68 ± 1.5	2.0	1.8	0.0096	0.021
MESQ	5.6 ± 1.3	3.2 ± 1.3	–2.0 ± 1.5	8.1 ± 1.9	4.4	4.3	0.0021	0.039
GARD	3.4 ± 1.2	2.5 ± 1.3	–1.8 ± 1.5	22 ± 2.4	3.0	6.5	0.0014	0.10
PIN1	25 ± 1.9	50 ± 2.5	16 ± 2.0	110 ± 4.5	37	41	—[c]	—[c]
PIN2	8.7 ± 2.0	7.8 ± 1.5	12 ± 1.9	11 ± 2.0	10	3.0	—[c]	—[c]
Sampling locations at an intermediate distance from Livermore site								
PATT	0.22 ± 1.1	1.2 ± 1.3	–0.96 ± 1.5	–0.89 ± 1.5	–0.34	1.4	—[d]	0.0060
ZON7	0.80 ± 1.6	3.3 ± 1.3	5.6 ± 1.8	6.0 ± 1.8	4.4	3.0	0.022	0.029
I580	0.71 ± 1.1	2.5 ± 1.3	–0.62 ± 1.6	4.3 ± 1.7	1.6	2.6	—[d]	0.021
TESW	0.37 ± 1.1	4.1 ± 1.4	0.096 ± 1.6	2.1 ± 1.6	1.3	2.3	0.0061	0.020
Sampling locations far from Livermore site								
FCC	–0.44 ± 1.1	3.6 ± 1.4	–0.47 ± 1.6	–0.85 ± 1.4	–0.46	1.1	—[d]	0.017
CAL	0.50 ± 1.1	2.7 ± 1.3	–1.7 ± 1.5	–0.75 ± 1.5	–0.12	2.0	—[d]	0.013
PARK	0.12 ± 1.1	2.4 ± 1.3	–0.14 ± 1.6	–1.5 ± 1.4	–0.012	1.2	—[d]	0.012
Sampling locations at Site 300								
CARN	–0.14 ± 1.2	0.59 ± 1.2	–1.6 ± 1.5	–0.016 ± 2.6	–0.080	0.65	—[d]	0.0028
GOLF	–0.29 ± 1.2	0.22 ± 1.2	–0.94 ± 1.5	–1.1 ± 1.4	–0.61	0.82	—[d]	0.0010
GEO	–1.3 ± 1.2	0.80 ± 1.2	–0.26 ± 1.6	–0.39 ± 1.4	–0.33	0.61	—[d]	0.0039
DSW	1.5 ± 1.1	120 ± 4.0	3300 ± 20	650 ± 11	390	1200	1.9	16
801E	0.0 ± 1.1	0.060 ± 1.2	–0.56 ± 1.6	–0.16 ± 1.4	–0.082	0.28	—[d]	0.00029
EVAP	0.74 ± 1.1	1.0 ± 1.3	8.5 ± 1.8	510 ± 9.5	4.7	130	0.023	2.5
PRIM	–0.37 ± 1.1	–0.61 ± 1.2	–0.71 ± 1.5	0.27 ± 1.4	–0.49	0.42	—[d]	0.0013

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] 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] No sample was collected.

[c] Doses not calculated because pine trees are not ingested by human beings; a dose to the maximally exposed individual was calculated with CAP88 using evapotranspiration from PIN1 as a diffuse source of tritium. The median dose was 1.9×10^{-6} μSv/y, and the maximum dose was 5.3×10^{-6} μSv/y.

[d] Doses resulting from negative median concentrations are not calculated.

Table 11-2. Tritium in retail wine (in Bq/L), 1998.[a]

Sample	Area of production		
	Livermore Valley	**California**	**Europe**
1	1.3 ± 0.22	0.34 ± 0.19	1.1 ± 0.22
2	1.4 ± 0.23	0.35 ± 0.19	1.5 ± 0.24
3	1.5 ± 0.24	0.38 ± 0.19	1.6 ± 0.25
4	1.6 ± 0.25	0.42 ± 0.19	1.7 ± 0.25
5	1.8 ± 0.26	0.46 ± 0.19	
6	2.3 ± 0.30	0.58 ± 0.19	
7	3.2 ± 0.37		
8	3.3 ± 0.38		
9	3.4 ± 0.39		
10	4.8 ± 0.51		
11	5.6 ± 0.59		
12	8.2 ± 0.84		
Median	**2.8**	**0.40**	**1.6**
Interquartile range	**2.2**	**0.10**	**0.24**
Mean	**3.2**	**0.42**	**1.5**
Standard deviation	**2.1**	**0.09**	**0.27**

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 were purchased and analyzed during 1998. The tritium concentrations reported are those at the time the bottle was opened.

12

Environmental Radiation Monitoring

Nicholas A. Bertoldo

Methods of Gamma Radiation Monitoring

The environmental gamma radiation dose from terrestrial and cosmic sources are monitored at Livermore site perimeter (14 sites), Livermore Valley (23 sites), Site 300 perimeter (9 locations), in the vicinity of Site 300 (5 locations), and in Tracy (2 sites). Thermoluminescent dosimeters (TLDs) are deployed to the field on a quarterly basis following laboratory preparation. Each TLD is labeled with an LLNL 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 DOE/EH-0173T. Duplicate trip blanks, transit control TLDs, and calibration control TLDs are also prepared. Upon removal from the site locations at the end of each quarter, the exposed TLDs are taken to the Hazards Control dosimetry laboratory for processing. A chain-of-custody form accompanies the field deployment and collection of the TLDs. Details of the TLD calculations and reporting of external gamma radiation dose are described in procedure ORAD EMP-TLD-CALC.

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. 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 (TLD absorbed dose), and is measured by photomultiplier tube output signal. After the TLD is measured, it is re-heated and re-measured. 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.

Gamma radiation exposure is measured in roentgens (R), which is 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 sub-multiple factors of 1×10^{-3} sieverts or millisieverts (mSv) and are compared to 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 day year for the purpose of comparison. LLNL participates in the National Inter-comparison Laboratory Study for external gamma radiation measurements, and our processing complies with the DOE Environmental Measurement Laboratory standards.

Tables

Data tables for the 1998 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, 1998.

Location[a]	Quarterly dose (mSv)[b]				Annual Dose[c] (mSv)
	Jan–Mar	Apr–Jun	Jul–Sep	Oct–Dec	
1	0.148 ± 0.075	0.152 ± 0.048	0.152 ± 0.060	0.168 ± 0.062	0.620 ± 0.124
4	0.149 ± 0.035	0.158 ± 0.034	0.161 ± 0.010	0.175 ± 0.098	0.643 ± 0.110
5	0.148 ± 0.019	0.164 ± 0.076	0.164 ± 0.026	0.174 ± 0.088	0.650 ± 0.021
6	0.156 ± 0.043	0.167 ± 0.076	0.162 ± 0.042	0.174 ± 0.050	0.659 ± 0.109
11	0.122 ± 0.022	0.123 ± 0.084	0.116 ± 0.062	0.136 ± 0.070	0.497 ± 0.128
14	0.138 ± 0.031	0.149 ± 0.048	0.137 ± 0.062	0.150 ± 0.142	0.574 ± 0.165
16	0.143 ± 0.036	0.141 ± 0.088	0.143 ± 0.074	0.156 ± 0.116	0.583 ± 0.167
42	0.143 ± 0.020	0.151 ± 0.042	0.153 ± 0.092	0.164 ± 0.046	0.611 ± 0.113
43	0.136 ± 0.009	0.157 ± 0.114	—[d]	0.172 ± 0.070	0.620 ± 0.179
47	0.131 ± 0.028	0.135 ± 0.094	0.133 ± 0.100	0.147 ± 0.044	0.546 ± 0.147
52	0.135 ± 0.013	0.136 ± 0.088	0.142 ± 0.036	0.158 ± 0.046	0.571 ± 0.106
56	0.143 ± 0.018	0.148 ± 0.048	0.147 ± 0.022	0.156 ± 0.040	0.594 ± 0.069
68	0.151 ± 0.026	0.149 ± 0.084	0.157 ± 0.056	0.165 ± 0.014	0.622 ± 0.105
69	0.134 ± 0.012	0.144 ± 0.074	0.143 ± 0.070	0.148 ± 0.070	0.569 ± 0.124
Mean[e]	**0.141 ± 0.005**	**0.148 ± 0.006**	**0.147 ± 0.007**	**0.160 ± 0.006**	**0.597 ± 0.024**

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 See **Figure 12-1** main volume for locations.

b Measurement uncertainty is reported as two standard deviations of the data.

c The annual dose reported per location is four times the average of the available quarterly data with the uncertainty reported as twice the propogated uncertainty of the available quarterly doses.

d Data not available due to a missing or damaged TLD.

e Uncertainty associated with the quarterly means is reported as two standard errors.

Table 12-2. Calculated dose from TLD environmental radiation measurements, Livermore Valley, 1998.

Location[a]	Quarterly dose (mSv) [b]				Annual Dose[c] (mSv)
	Jan–Mar	Apr–Jun	Jul–Sep	Oct–Dec	
18	0.112 ± 0.022	0.116 ± 0.066	0.116 ± 0.008	0.126 ± 0.068	0.470 ± 0.098
19	—[d]	—[d]	—[d]	—[d]	—[d]
22[f]	0.152 ± 0.033	0.157 ± 0.086	—[d]	0.151 ± 0.064	0.613 ± 0.149
24	0.147 ± 0.043	0.151 ± 0.062	0.156 ± 0.042	0.178 ± 0.102	0.632 ± 0.134
27	0.133 ± 0.032	0.140 ± 0.082	0.141 ± 0.038	0.155 ± 0.050	0.569 ± 0.108
28	0.162 ± 0.014	0.172 ± 0.060	0.170 ± 0.082	0.183 ± 0.060	0.687 ± 0.119
30	—[d]	0.151 ± 0.042	—[d]	0.158 ± 0.112	0.618 ± 0.239
32	—[d]	0.143 ± 0.006	0.150 ± 0.082	0.160 ± 0.016	0.604 ± 0.112
33	0.176 ± 0.066	0.155 ± 0.058	0.160 ± 0.036	0.180 ± 0.092	0.671 ± 0.132
35	—[d]	0.154 ± 0.012	0.155 ± 0.062	0.177 ± 0.076	0.648 ± 0.132
37	—[d]	—[d]	—[d]	—[d]	—[d]
45	0.129 ± 0.025	0.144 ± 0.076	0.148 ± 0.086	0.151 ± 0.098	0.572 ± 0.153
57	0.153 ± 0.033	0.163 ± 0.054	0.157 ± 0.114	0.170 ± 0.012	0.643 ± 0.131
60	0.144 ± 0.029	0.153 ± 0.068	0.149 ± 0.126	0.160 ± 0.008	0.606 ± 0.146
61	0.136 ± 0.077	0.137 ± 0.036	0.132 ± 0.054	0.155 ± 0.050	0.560 ± 0.113
66	0.146 ± 0.022	0.157 ± 0.046	0.154 ± 0.038	0.180 ± 0.058	0.637 ± 0.086
70[f]	0.144 ± 0.024	—[d]	—[d]	0.148 ± 0.082	0.584 ± 0.171
72	0.166 ± 0.031	0.170 ± 0.104	—[d]	0.183 ± 0.112	0.692 ± 0.208
73	0.135 ± 0.033	0.143 ± 0.104	0.140 ± 0.048	—[d]	0.557 ± 0.159
74	0.132 ± 0.033	0.138 ± 0.072	0.132 ± 0.062	0.140 ± 0.092	0.542 ± 0.136
75	0.113 ± 0.012	0.119 ± 0.042	0.117 ± 0.036	0.133 ± 0.130	0.482 ± 0.142
76	—[d]	—[d]	—[d]	—[d]	—[d]
77[f]	0.134 ± 0.007	0.137 ± 0.098	—[d]	0.137 ± 0.090	0.544 ± 0.178
Mean[e]	**0.142 ± 0.008**	**0.147 ± 0.007**	**0.145 ± 0.008**	**0.159 ± 0.008**	**0.597 ± 0.027**

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 See **Figure 12-2** main volume for locations.

b Measurement uncertainty is reported as two standard deviations of the data.

c The annual dose reported per location is four times the average of the available quarterly data with the uncertainty reported as twice the propogated uncertainty of the available quarterly doses.

d Data not available due to a missing or damaged TLD.

e Uncertainty associated with the quarterly means is reported as two standard errors.

f TLDs at locations 22, 70 and 77 were deployed in the field for both the third and fourth quarters. Data reported in the fourth quarter is corrected for one 90-day standard quarter exposure.

Table 12-3. Calculated dose from TLD environmental radiation measurements, Site 300 perimeter, 1998.

Location[a]	Quarterly dose (mSv)[b]				Annual Dose[c] (mSv)
	Jan–Mar	Apr–Jun	Jul–Sep	Oct–Dec	
78	0.148 ± 0.008	0.144 ± 0.032	0.141 ± 0.078	0.160 ± 0.118	0.593 ± 0.145
81	0.196 ± 0.026	0.197± 0.102	0.198 ± 0.040	0.218 ± 0.034	0.809 ± 0.118
82	—[d]	—[d]	0.172 ± 0.088	—[d]	0.688 ± 0.352
85	0.167 ± 0.062	0.164 ± 0.068	0.167 ± 0.040	0.197 ± 0.076	0.695 ± 0.126
86	0.171 ± 0.041	0.175 ± 0.042	0.174 ± 0.052	0.186 ± 0.038	0.706 ± 0.087
88	0.179 ± 0.027	0.167 ± 0.084	0.175 ± 0.050	0.193 ± 0.048	0.714 ± 0.112
89	0.189 ± 0.010	0.191 ± 0.068	0.187 ± 0.048	—[d]	0.756 ± 0.112
91	0.176 ± 0.037	0.178 ± 0.042	0.180 ± 0.050	0.196 ± 0.072	0.730 ± 0.104
121	0.192 ± 0.073	0.194 ± 0.038	0.197 ± 0.132	0.185 ± 0.094	0.768 ± 0.182
Mean[e]	**0.177 ± 0.011**	**0.176 ± 0.013**	**0.177 ± 0.012**	**0.191 ± 0.013**	**0.718 ± 0.041**

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ 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 See **Figure 12-3** main volume for locations.

b Measurement uncertainty is reported as two standard deviations of the data.

c The annual dose reported per location is four times the average of the available quarterly data with the uncertainty reported as twice the propogated uncertainty of the available quarterly doses.

d Data not available due to a missing or damaged TLD.

e Uncertainty associated with the quarterly means is reported as two standard errors.

Table 12-4. Calculated dose from TLD environmental radiation measurements, Tracy and other off-site locations in the vicinity of Site 300, 1998.

Location[a]	Quarterly dose (mSv)[b]				Annual Dose[c] (mSv)
	Jan–Mar	Apr–Jun	Jul–Sep	Oct–Dec	
Tracy					
92	0.171 ± 0.033	0.162 ± 0.078	0.165 ± 0.060	0.178 ± 0.032	0.676 ± 0.108
93	0.148 ± 0.007	0.142 ± 0.028	0.141 ± 0.026	0.172 ± 0.060	0.603 ± 0.072
Mean	**0.160 ± 0.023**	**0.152 ± 0.020**	**0.153 ± 0.024**	**0.175 ± 0.006**	**0.640 ± 0.073**
Other off-site					
90	0.178 ± 0.014	0.170 ± 0.046	0.181 ± 0.042	0.210 ± 0.154	0.743 ± 0.167
94	—[d]	0.229 ± 0.102	0.231 ± 0.054	0.259 ± 0.016	0.965 ± 0.155
96	0.188 ± 0.008	0.194 ± 0.100	0.198 ± 0.060	0.218 ± 0.058	0.804 ± 0.130
99	—[d]	0.161 ± 0.054	—[d]	0.175 ± 0.130	0.674 ± 0.282
120	0.160 ± 0.013	—[d]	0.169 ± 0.026	0.185 ± 0.046	0.687 ± 0.073
Mean[e]	**0.175 ± 0.016**	**0.189 ± 0.030**	**0.195 ± 0.027**	**0.209 ± 0.029**	**0.775 ± 0.106**

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 See **Figure 12-3** main volume for locations.

b Measurement uncertainty is reported as two standard deviations of the data.

c The annual dose reported per location is four times the average of the available quarterly data with the uncertainty reported as twice the propogated uncertainty of the available quarterly doses.

d Data not available due to a missing or damaged TLD.

e Uncertainty associated with the quarterly means is reported as two standard errors.

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
Donald H. MacQueen

Participation in Laboratory Intercomparison Studies

The LLNL Chemistry and Materials Science Environmental Services (CES) Environmental Monitoring Radiation Laboratory (EMRL) and the Hazards Control Department's Analytical Laboratory (HCAL) participated in both the annual Environmental Protection Agency's (EPA) Environmental Monitoring Systems Laboratory (EMSL) intercomparison studies program and the annual DOE Environmental Monitoring Laboratory (EML) intercomparison studies program.

The results of CES EMRL's participation in the EMSL studies are presented in **Table 14-1**. A review of these data indicates that 29 of 31 analyses fell within established acceptance control limits.

One value for gross beta was slightly above the acceptance limits due to an inadequate calibration curve. The CES calibration curve was based on single beta energy (514 keV) Cesium-137, and the majority of the composition of the EMSL performance evaluation sample was in an energy range from 318 to 2280 keV, with the majority of the beta emitters on the high-energy side. In the future, CES will prepare a second calibration curve for gross beta to provide a two-energy calibration source that can be used to average results over a wide range of gross beta energies.

The second unacceptable result was a low value for natural uranium that was caused by using a pipette that was out of calibration to deliver the tracer standard. To prevent this kind of a problem from happening again, CES now regularly calibrates pipettes used to deliver tracer standards when the amount of tracer used is critical to the results obtained.

The results of HCAL's participation in 1998 EMSL studies (see **Table 14-2**) indicate that 13 of 14 sample results fell within the 3-σ acceptance control limits. LLNL is currently investigating the reason for the high gross beta value.

The results of the CES EMRL's participation in the EML studies (see **Table 14-3**) indicate that 66 of 73 results were within the established acceptance control limits. The unacceptable values for Cesium-137 on air filters and Uranium-238 in soil in the EML

QAP-48 study were due to human error when converting a value from scientific to standard notation.

The unacceptable values for Uranium-234 and Uranium-238 on air filters for the same study were also caused by human error: the sample and the blank were inadvertently switched during analysis. CES has implemented stricter controls on data verification and validation as a result of these errors.

In the EML QAP-49 study, CES EMRL's unacceptable results for Potassium-40 and Cesium-137 were caused by an error in the data entry of gamma-counting parameters. To prevent such failures from occurring again, CES has implemented a second level review of data entry. CES also had an unacceptable result for Curium-244 in vegetation in the EML QAP-49 study. This was caused by an inadequate plating technique. Plating procedures have been modified to ensure adequate plating of Curium.

HCAL's EML results are presented in **Table 14-4**. Review of these results show that 10 of 10 results were within the established acceptance control limits.

CES EMRL participated in a DOE Mixed Analyte Performance Evaluation Program (MAPEP) study in 1998. The results of this study are presented in **Table 14-5**. Eleven of 11 analytes reported by CES fell within acceptable limits.

HCAL also participated in four EPA Water Pollution and Water Supply intercomparison studies for metals during 1998 (see **Table 14–6**). HCAL measures aluminum, arsenic, beryllium, cadmium, chromium, copper, iron, lead, mercury, nickel, silver, and zinc in sewage effluent for the LLNL environmental monitoring program. Review of these results shows that 24 of 24 samples fell within established acceptance control limits for those metals.

Although contract laboratories are also required to participate in laboratory intercomparison programs, permission to publish their results for comparison purposes was not granted for 1998.

Table 14-1. LLNL CES EMRL performance in the EPA EMSL Intercomparison Program for Water, 1998.

Analyte	Study date	CES value (pCi/L)	Known value (pCi/L)	Control limits (3σ)	Warning limits (2σ)	Performance[a]
Gross alpha	1/30/98	17.9	30.5	17.3–43.7	21.7–39.3	Warning
	4/21/98	70.1	54.4	30.8–78.0	38.7–70.1	Warning
	7/24/98	7.87	7.2	0.0–15.9	1.4–13.0	Acceptable
	10/20/98	34.8	30.1	17.1–43.1	21.4–38.8	Acceptable
	11/13/98	37.5	47.2	33.5–60.9	26.7–67.7	Acceptable
Gross beta	1/30/98	8.67	3.9	0.0–12.6	0.0–9.7	Acceptable
	4/21/98	120	94.7	77.4–112	83.1–106	Not acceptable
	7/24/98	16.4	12.8	4.1–21.5	7.0–18.6	Acceptable
	10/20/98	82.9	94.0	76.7–111	82.4–106	Acceptable
	11/13/98	9.57	3.5	0.0–9.3	0.0–12.2	Warning
U-natural	2/13/98	20.1	32.0	26.8–37.2	28.5–35.5	Not acceptable
	4/21/98	4.97	5.0	0.0–10.2	1.5–8.5	Acceptable
	6/12/98	2.83	3.0	0.0–8.2	0.0–6.5	Acceptable
	9/18/98	8.54	9.1	3.9–14.3	5.6–12.6	Acceptable
Ra-226	2/13/98	13.7	16.0	11.8–20.2	13.2–18.8	Acceptable
Ra-228	2/13/98	26.6	33.3	18.9 –47.7	23.7–42.9	Acceptable
Tritium	3/13/98	2,090	2,160	1,550–2,760	1,750–2,560	Acceptable
	8/7/98	17,500	18,000	14,900–21,000	15,900–20,100	Acceptable
Co-60	6/5/98	12.3	12.0	3.3–20.7	6.2–17.8	Acceptable
	10/20/98	19.0	21.0	12.3–29.7	15.2–26.8	Acceptable
	11/6/98	33.7	38.0	29.3–46.7	32.2–43.8	Acceptable
Zn-65	6/5/98	108	104	86.7–121	92.4–116	Acceptable
	11/6/98	126	131	108.4–154	116–146	Acceptable
Cs-134	6/5/98	25.7	31.0	22.3 –39.7	25.2–36.8	Acceptable
	10/20/98	Not detected	6.0	0.0–14.7	0.2–11.8	Warning
	11/6/98	98.7	105.0	96.3–114	99.2–111	Warning
Cs-137	6/5/98	37.0	35.0	26.3–43.7	29.2–40.8	Acceptable
	10/20/98	54.0	50.0	41.3–58.7	44.2–55.8	Acceptable
	11/6/98	114	111	101–121	104–118	Acceptable
Ba-133	6/5/98	34.3	40.0	31.3–48.7	34.2–45.8	Acceptable
	11/6/98	55.0	56.0	45.6–66.4	49.1–62.9	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 14-2. LLNL HCAL performance in the EPA EMSL Intercomparison Program for Water, 1998.

Analyte	Study date	HC value (pCi/L)	Known value (pCi/L)	Control limits (3 σ)	Warning limits (2 σ)	Performance[a]
Gross alpha	1/30/98	28.8	30.5	17.3–43.7	21.7–39.3	Acceptable
	4/21/98	63.7	54.4	30.8–78.0	38.7–70.1	Acceptable
	7/24/98	8.20	7.2	0.0–15.9	1.4–13.0	Acceptable
	10/20/98	29.8	30.1	17.1–43.1	21.4–38.8	Acceptable
	11/13/98	38.9	47.2	33.5–60.9	26.7–67.7	Acceptable
Gross beta	1/30/98	22.2	3.9	0.0–12.6	0.0–9.7	Not acceptable
	4/21/98	107	94.7	77.4–112.0	83.1–106.3	Warning
	7/24/98	11.8	12.8	4.1–21.5	7.0–18.6	Acceptable
	10/20/98	104	94.0	76.7–111.3	82.4–105.6	Acceptable
	11/13/98	3.97	3.5	0.0–9.3	0.0–12.2	Acceptable
Tritium (RML)[b]	3/13/98	2,120	2,160	1,550–2,760	1,750–2,560	Acceptable
Tritium (HCAL)[c]	3/13/98	2,020	2,160	1,550–2,760	1,750–2,560	Acceptable
Tritium (RML)	8/7/98	17,700	18,000	14,900–21,100	15,900–20,100	Acceptable
Tritium (HCAL)	8/7/98	17,800	18,000	14,900–21,100	15,900–20,100	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.

b RML = Radiological Measurements Laboratory.

c HCAL = Hazards Control Departments Analytical Laboratory.

Table 14-3. LLNL's CES EMRL results from the DOE EML Quality Assurance Program, 1998.

Analyte	EML Study	Matrix (units)	CES value	EML value	CES/ EML	Control limits (3 σ)	Warning limits (2 σ)	Performance[a]
Gross alpha	QAP-48	Air Filter (Bq/filter)	1.31	1.40	0.936	0.49–1.56	0.84–1.35	Acceptable
	QAP-49		1.52	1.65	0.921	0.50–1.55	0.81–1.32	Acceptable
Gross beta	QAP-48		2.50	1.96	1.28	0.71–1.71	0.88–1.41	Acceptable
	QAP-49		2.33	2.16	1.08	0.72–1.67	0.89–1.39	Acceptable
Mn-54	QAP-48		5.78	5.44	1.06	0.76–1.37	0.84–1.15	Acceptable
	QAP-49		5.16	4.92	1.059	0.76–1.42	0.84–1.18	Acceptable
Co-57	QAP-48		11.6	11.1	1.04	0.65–1.34	0.71–1.10	Acceptable
Co-60	QAP-48		9.10	9.09	1.00	0.75–1.30	0.82–1.10	Acceptable
	QAP-49		9.01	9.16	0.984	0.75–1.32	0.83–1.10	Acceptable
Sb-125	QAP-48		14.6	12.2	1.20	0.61–1.41	0.83–1.18	Warning
	QAP-49		9.67	8.89	1.09	0.61–1.43	0.83–1.19	Acceptable
Cs-134	QAP-48		20.8	19.7	1.05	0.74–1.23	0.82–1.12	Acceptable
Cs-137	QAP-48		1.20	11.9	0.101	0.73–1.33	0.82–1.13	Not acceptable
	QAP-49		22.4	22.5	0.997	0.73–1.37	0.82–1.14	Acceptable
Ce-144	QAP-48		8.06	8.21	0.982	0.60–1.30	0.66–1.10	Acceptable
Pu-238	QAP-48		0.069	0.070	0.993	0.72–1.39	0.88–1.14	Acceptable
	QAP-49		0.479	0.46	1.04	0.74–1.40	0.89–1.15	Acceptable
Pu-239	QAP-48		0.0654	0.062	1.05	0.72–1.42	0.90–1.18	Acceptable
	QAP-49		0.463	0.420	1.10	0.76–1.44	0.90–1.19	Acceptable
U-234	QAP-48		0.009	0.031	0.284	0.80–2.02	0.90–1.39	Not acceptable
	QAP-49		0.251	0.260	0.965	0.83–1.92	0.90–1.40	Acceptable
U-238	QAP-48		0.009	0.030	0.305	0.80–2.55	0.90–1.32	Not acceptable
	QAP-49		0.252	0.260	0.969	0.84–2.61	0.90–1.31	Acceptable
Am-241	QAP-48		0.076	0.069	1.11	0.71–2.12	0.87–1.39	Acceptable
	QAP-49		0.567	0.510	1.11	0.73–2.58	0.88–1.46	Acceptable
K-40	QAP-48	Soil (Bq/kg)	327	314	1.04	0.76–1.54	0.90–1.25	Acceptable
	QAP-49		242	314	0.771	0.78–1.53	0.90–1.25	Not acceptable
Cs-137	QAP-48		374	330	1.14	0.80–1.32	0.90–1.21	Acceptable
	QAP-49		716	954	0.751	0.83–1.32	0.90–1.21	Not acceptable
Pu-239	QAP-48		5.42	5.30	1.02	0.69–1.67	0.88–1.22	Acceptable
	QAP-49		13.2	13.1	1.01	0.69–1.74	0.89–1.24	Acceptable
Ra-226	QAP-49		26.3	29.0	0.907	—[b]	—[b]	Acceptable
Th-228	QAP-49		39.9	52.7	0.757	—[b]	—[b]	Acceptable

Table 14-3. LLNL's CES EMRL results from the DOE EML Quality Assurance Program, 1998 (continued).

Analyte	EML study	Matrix (units)	CES value	EML value	CES/ EML	Control limits (3 σ)	Warning limits (2 σ)	Performance[a]
U-234	QAP-48		25.1	31.1	0.806	0.46–1.30	0.70–1.11	Acceptable
	QAP-49		98.9	113	0.875	0.47–1.30	0.70–1.11	Acceptable
U-238	QAP-48		2.52	31.9	0.079	0.43–1.39	0.68–1.10	Not acceptable
	QAP-49		105	120	0.875	0.44–1.42	0.69–1.10	Acceptable
Am-241	QAP-48		3.87	2.68	1.45	0.57–2.26	0.77–1.46	Acceptable
	QAP-49		7.62	7.47	1.02	0.63–2.31	0.79–1.48	Acceptable
K-40	QAP-48	Vegetation (Bq/kg)	718	708	1.02	0.76–1.31	0.90–1.24	Acceptable
	QAP-49		519	460	1.13	0.79–1.42	0.90–1.24	Acceptable
Cm-244	QAP-48		2.17	2.17	0.998	0.46–1.65	0.81–1.36	Acceptable
	QAP-49		3.58	1.76	2.03	0.44–1.62	0.81–1.30	Not Acceptable
Co-60	QAP-48		12.2	10.6	1.15	0.65–1.46	0.84–1.23	Acceptable
	QAP-49		22.3	20.0	1.12	0.69–1.46	0.86–1.24	Acceptable
Cs-137	QAP-48		203	182	1.12	0.80–1.39	0.90–1.25	Acceptable
	QAP-49		454	390	1.16	0.80–1.40	0.90–1.25	Acceptable
Pu-239	QAP-48		1.87	1.77	1.06	0.59–1.72	0.85–1.24	Acceptable
	QAP-49		3.42	3.72	0.919	0.68–1.59	0.86–1.23	Acceptable
Am-241	QAP-48		1.29	1.11	1.17	0.71–2.70	0.89–1.60	Acceptable
	QAP-49		2.81	2.33	1.21	0.68–2.70	0.89–1.60	Acceptable
Gross alpha	QAP-48	Water (Bq/L)	1560	1420	1.10	0.52–1.31	0.82–1.16	Acceptable
	QAP-49		819	1080	0.758	0.61–1.32	0.83–1.17	Warning
Gross beta	QAP-48		2680	2200	1.22	0.53–1.60	0.67–1.35	Acceptable
	QAP-49		1330	1420	0.937	0.55–1.54	0.71–1.32	Acceptable
Tritium	QAP-48		231	218	1.06	0.69–1.80	0.81–1.20	Acceptable
	QAP-49		91.5	76.2	1.20	0.71–1.79	0.82–1.22	Acceptable
Mn-54	QAP-48		62.1	57.0	1.09	0.80–1.24	0.90–1.17	Acceptable
	QAP-49		33.6	32.4	1.04	0.80–1.25	0.90–1.17	Acceptable
Co-60	QAP-48		13.0	13.6	0.956	0.80–1.20	0.90–1.13	Acceptable
	QAP-49		49.1	49.4	0.994	0.80–1.20	0.90–1.14	Acceptable
Cs-137	QAP-48		49.7	46.0	1.08	0.80–1.25	0.90–1.18	Acceptable
	QAP-49		49.4	50.0	0.988	0.80–1.26	0.90–1.18	Acceptable
Pu-238	QAP-48		2.59	2.53	1.03	0.76–1.25	0.90–1.11	Acceptable
	QAP-49		1.24	1.10	1.13	0.78–1.25	0.90–1.11	Warning
Pu-239	QAP-48		1.80	1.65	1.09	0.80–1.36	0.90–1.15	Acceptable
	QAP-49		1.53	1.41	1.09	0.80–1.39	0.90–1.15	Acceptable

Table 14-3. LLNL's CES EMRL results from the DOE EML Quality Assurance Program, 1998 (concluded).

Analyte	EML study	Matrix (units)	CES value	EML value	CES/ EML	Control limits (3 σ)	Warning limits (2 σ)	Performance[a]
U-234	QAP-48		0.428	0.396	1.08	0.80–1.42	0.90–1.22	Acceptable
	QAP-49		0.503	0.510	0.986	0.80–1.40	0.90–1.22	Acceptable
U-238	QAP-48		0.396	0.396	0.999	0.80–1.29	0.90–1.17	Acceptable
	QAP-49		0.519	0.520	0.998	0.80–1.26	0.90–1.17	Acceptable
Am-241	QAP-48		1.27	1.23	1.04	0.72–1.52	0.90–1.23	Acceptable
	QAP-49		1.35	1.25	1.08	0.75–1.49	0.90–1.24	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.

b 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.

Table 14-4. LLNL's HCAL results from the DOE EML Quality Assurance Program, 1998.

Analyte	EML study	Matrix (units)	HC value	EML Value	HC/ EML	Control limits (3 σ)	Warning limits (2 σ)	Performance[a]
Gross alpha	QAP-48	Air Filter (Bq/filter)	0.989	1.40	0.706	0.49–1.56	0.84–1.35	Warning
	QAP-49		1.50	1.65	0.907	0.50–1.55	0.81–1.32	Acceptable
Gross beta	QAP-48		1.71	1.96	0.872	0.71–1.71	0.88–1.41	Warning
	QAP-49		1.60	2.16	0.742	0.72–1.67	0.89–1.39	Warning
Gross alpha	QAP-48	Water (Bq/L)	1520	1420	1.07	0.52–1.31	0.82–1.16	Acceptable
	QAP–49		1010	1080	0.937	0.61–1.32	0.83–1.17	Acceptable
Gross beta	QAP–48		2420	2200	1.10	0.53–1.60	0.67–1.35	Acceptable
	QAP–49		1350	1420	0.949	0.55–1.54	0.71–1.32	Acceptable
Tritium	QAP–48		223	218	1.02	0.69–1.80	0.81–1.20	Acceptable
	QAP–49		78.1	76.2	1.03	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 14-5. LLNL CES EMRL performance in the MAPEP-98-S5 Intercomparison Program for Soil, 1998.[a]

Analyte	CES value (Bq/kg)	Grand mean (Bq/kg)	Standard deviation (Bq/kg)	Reference value (Bq/kg)	Acceptance range (Bq/kg)	Performance[b]
Americium-241	30	30.0	3.01	32.4	22.7 – 42.1	Acceptable
Cesium-137	568	570	49.7	552.0	386 – 717	Acceptable
Cobalt-57	1230	1170	148	1190	833 –1550	Acceptable
Cobalt-60	1030	1120	99.1	1110	777 – 1440	Acceptable
Manganese-54	1080	1130	119	1090	763.0 – 1420	Acceptable
Plutonium-238	50	51.0	4.32	50.6	35.4 – 65.8	Acceptable
Plutonium-239	0.09	—[c]	—[c]	0.00	0.00 – 0.00	Acceptable
Potassium-40	579	655	73.2	652	456 – 848	Acceptable
Uranium-234/233	38.0	45.9	6.0	51.4	36.0 – 66.8	Warning
Uranium-238	108	113	9.21	120	84.0 – 156	Acceptable
Zinc-65	2840	2960	279	2780	1950 – 3610	Acceptable

a The MAPEP water sample for 1998 (MAPEP 98-W6) was not distributed for analysis until January 1999. The results for that sample will be reported in the *Environmental Report 1999*.

b Acceptable results have bias ≤70% or |z-score| ≤3.0. Results with warning have 20% <bias ≤30% or 3.0 ≤ |z-score| ≤4.0.

c False positive test.

Table 14-6. Hazards Control Department Analytical Laboratory results from EPA Water Pollution and Water Supply Studies.[a]

Analysis	Study	Sample	LLNL value[a] (µg/L)	True value[a] (µg/L)	Acceptable limits[b] (µg/L)	Warning limits[b] (µg/L)	Performance
Aluminum	WP-039	01	468	489	420–562	437–544	Acceptable
	WP-040	01	2980	3105	2740–3440	2830–335	Acceptable
Arsenic	WP-039	01	758	864	739–1010	772–972	Warning
	WP-040	01	148	160	128–190	136–183	Acceptable
Beryllium	WP-039	02	178	191	170–214	176–208	Acceptable
	WP-040	02	35.6	36.9	33.1–42.2	34.2–41	Acceptable
Cadmium	WP-039	01	33.5	33.9	28.7–39.1	30.0–37.8	Acceptable
	WP-040	01	171	170	147–193	152–187	Acceptable
Chromium	WP-039	01	207	216	189–244	196–237	Acceptable
	WP-040	01	610	650	579–726	598–708	Acceptable
Copper	WP-039	01	73.0	74.3	68.2–84.3	70.2–82.3	Acceptable
	WP-040	01	700	700	654–781	670–765	Acceptable
Iron	WP-039	01	185	191	165–218	171–211	Acceptable
	WP-040	01	845	834	744–936	768–912	Acceptable
Lead	WP-039	01	1880	1900	1690–2110	1740–2060	Acceptable
	WP-040	01	85	70.6	61.7–83.3	64.4–80.6	Acceptable
	WS-040	—	76	71	49.7–92.3	—	Acceptable
Mercury	WP-039	01	0.520	0.563	0.307–0.782	0.366–0.722	Acceptable
	WP-040	01	1.13	1.15	0.813–1.47	0.895–1.39	Acceptable
Nickel	WP-039	01	705	702	674–780	688–767	Acceptable
	WP-040	01	2670	2500	2340–2860	2400–2790	Acceptable
Silver	WP-039	02	137	130	118–150	122–146	Acceptable
	WP-040	02	817	851	736–930	760–906	Acceptable
Zinc	WP-039	01	132	131	113–150	118–146	Acceptable
	WP-040	01	650	631	563–709	581–690	Acceptable

a All results reported in µg/L. Based upon theoretical calculations or a reference value when necessary.

b Acceptance limits are a 99% confidence interval calculated from available performance evaluation data of EPA and state laboratories. Warning limits are a 95% confidence interval produced in the same way as the acceptable limits. Results should fall within acceptable limits 99 times out of 100. Results outside warning limits but inside acceptable limits should be reviewed for possible problems but are not necessarily considered unacceptable.

Environmental Protection Department • Lawrence Livermore National Laboratory
University of California • P.O. Box 808 • Livermore, California 94551