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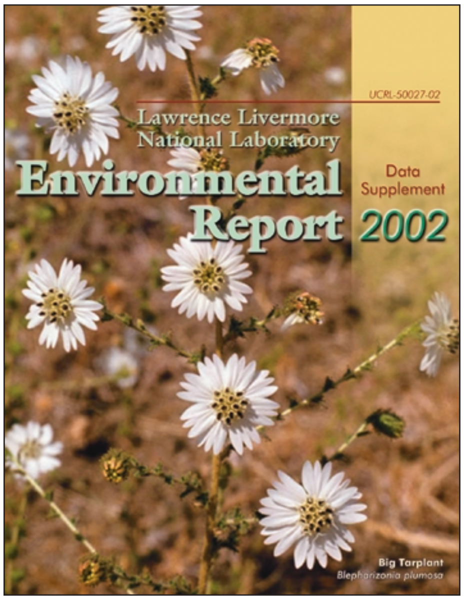
Lawrence Livermore National Laboratory

Environmental Report 2002

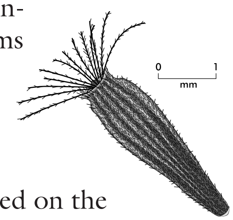
Data Supplement

Big Tarplant
Blepharizonia plumosa



Cover

The big tarplant (*Blepharizonia plumosa*) is an annual plant that flowers in the late summer and early fall, several months after most Site 300 annual plants are done flowering. This species is a member of the sunflower family (Asteraceae). As is common in many members of the sunflower family, the big tarplant has tiny glands on the stems and leaves that give this plant a distinctive smell. Its inner seeds have tiny feather-like appendages, called pappus, that help the seeds be disbursed by the wind.



The big tarplant is an extremely rare annual plant included on the California Native Plant Society's List 1B, which includes plants that are rare, threatened, or endangered. The big tarplant's range includes Alameda, Contra Costa, San Joaquin, Stanislaus, and Solano Counties. In these areas, it is found in dry grasslands at elevations less than 505 meters (CNPS 2001). This species often occurs in disturbed areas, such as along the edges of roads or in areas were there have been grassfires. Although several populations of big tarplant occur at Site 300, this species is extremely rare elsewhere and may be limited to as few as three general areas outside of Site 300 (California Natural Diversity Database 2003).

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Environmental Report 2002

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Preface

This Data Supplement to the Lawrence Livermore National Laboratory's (LLNL's) annual *Environmental Report 2002* was prepared for the U.S. Department of Energy. The main volume is intended to provide all information on LLNL's environmental impact and compliance activities that is of interest to most readers. The Data Supplement supports main volume summary data and is essentially a detailed data report that provides individual data points, where applicable. Some summary data are also included in the Data Supplement, and more detailed accounts are given of sample collection and analytical methods.

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

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

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Compliance Summary.**

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Please see the main volume for details about
Environmental Program Information.**

Air Effluent Monitoring

Paula J. Tate

Air Effluent Sampling Methods

In 2002, Lawrence Livermore National Laboratory used 74 continuously operating radiological sampling systems on air exhausts at seven facilities at the Livermore site and one at Site 300 (see 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. For a further discussion, see Chapter 4 of the main volume.

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

The sample filters are 47-mm-diameter membrane filters and are changed weekly or biweekly, depending on the facility. After sample collection, filters are placed in glassine envelopes, and each envelope is tagged with a unique bar code label. Filter sample data—including location, equipment identification, bar code, sampling start date, sampling stop date, and flow rate—are entered into the Hazards Control Department (HCD) sample tracking and reporting (STAR) computer system. Sampling procedures are contained in the environmental section of the discipline action plan for a facility.

Filters are analyzed at the HCD Radiological Measurements Laboratory (RML) for gross alpha and beta activity using gas proportional counters. Analysis is delayed for at least four days following sample termination to allow for the decay of naturally occurring radon daughters. To verify the operation of the counting system, calibration and background samples are intermixed with the sample filters for analysis. Analytical techniques are consistent with the Environmental Protection Agency (EPA) recommended procedures. Further details about sampling and analysis are discussed in the *Environmental Monitoring Plan* (Tate et al. 1999).

Each stack of the Tritium Facility (Building 331) is monitored for tritium release by both a continuous monitoring alarm system and continuous molecular sieve samplers. The alarmed samplers, Overhoff ionization chambers, provide real-time total tritium concentration release levels (tritiated hydrogen gas and tritiated water combined).

The sieve samplers, which can discriminate between tritiated water vapor and tritiated hydrogen gas, provide the values used for environmental reporting. Each sieve sampler (not alarmed) runs in parallel with an alarmed monitor and consists of two molecular sieves. The first sieve collects tritiated water vapor; the second sieve contains a palladium-coated catalyst that converts tritiated hydrogen to tritiated water and collects the tritiated water on the sieve. Sieves are changed weekly. The sieve samples are logged into the HCD STAR sample tracking system and submitted to the HCD Analytical Laboratory, where tritiated water is baked out and collected. RML analyzes the retrieved tritium for beta activity using scintillation counting techniques.

Data

Annual summaries of gross alpha, gross beta, and tritium data for samplers at each monitored facility are summarized in Tables 4-1 through 4-8. The tables present the ratio of the number of results that have activity concentration greater than the analysis' minimum detectable concentration (MDC) to the total number of samples in the year, and the minimum, median, and maximum activity concentrations of the samples (in Bq/m^3). 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 (see Chapter 14).

Table 4-1. Summary of gross alpha and gross beta in air effluent samples from monitored emission points at Building 175, 2002

B175 Emission Point	No.>MDC/[a] total samples	Minimum (10^{-6} Bq/m^3)	Median (10^{-6} Bq/m^3)	Maximum (10^{-6} Bq/m^3)
Gross Alpha				
#1	0/43	-81.8	25.5	440
#2	0/43	-106	20.9	390
#3	0/43	-88.4	26.2	310
#4	0/43	-86.2	12.8	286
#5	0/43	-115	27.5	291
#6	0/43	-112	-39.2	492
Gross Beta				
#1	14/43	-277	433	2720
#2	6/43	-340	115	1600
#3	3/43	-323	249	1140
#4	0/43	-529	86.6	925
#5	2/43	-403	94.7	1060
#6	0/43	-358	32.7	662

Note: The vacuum system was not operable for several weeks throughout the year and one sample for each emission point was two weeks long.

a MDC = minimum detection concentration

Table 4-2. Summary of gross alpha and gross beta in air effluent samples from monitored emission points at Building 177, 2002

B177 Emission Point[(a)]	No.>MDC/ total samples	Minimum (10^{-6} Bq/m^3)	Median (10^{-6} Bq/m^3)	Maximum (10^{-6} Bq/m^3)
Gross Alpha				
#1	0/8	-12.7	20.7	121
Gross Beta				
#1	1/8	-24.5	56.1	281

a The sampling system from B177 was removed in February.

b MDC = minimum detection concentration

Table 4-3. Summary of gross alpha and gross beta in air effluent samples from monitored emission points at Building 235, 2002

B235 Emission Point	No.>MDC/[a] total samples	Minimum (10^{-6} Bq/m^3)	Median (10^{-6} Bq/m^3)	Maximum (10^{-6} Bq/m^3)
Gross Alpha				
#1	0/51	-46.6	8.51	136
Gross Beta				
#1	1/51	-161	21.4	316

a MDC = minimum detection concentration

Table 4-4. Summary of gross alpha and gross beta in air effluent samples from monitored emission points at Building 251, 2002

B251 Emission Point[(a)]	No.>MDC/[(b)] total samples	Minimum (10^{-6} Bq/m^3)	Median (10^{-6} Bq/m^3)	Maximum (10^{-6} Bq/m^3)
Gross Alpha				
#1	1/25	-44.4	15.5	243
#3	0/25	-18.2	5.92	95.1
#5	0/25	-24.2	9.88	97.3
#6	0/25	-46.6	-23.3	178
#7	0/25	-10.7	8.18	38.5
#13	0/25	-27.9	-18.3	81.8
#14	1/25	-40.7	3.96	180
#16	0/25	-22.1	7.84	34.0
#17	0/25	-27.3	11.2	144
#18	0/25	-27.8	-0.49	43.7
#19	0/25	-26.0	8.40	72.2
#20	0/25	-20.5	2.59	100
#21	2/25	-34.4	30.0	162
#23	0/25	-25.0	-1.89	64.0
#24	0/25	-31.8	13.5	64.4
#25	0/25	-31.1	-13.8	36.5
#26	0/25	-44.0	-27.9	175
#33	0/1	40.7	40.7	40.7
#34	1/25	-33.2	52.5	285
#35	0/25	-17.7	7.10	69.2
#40	0/25	-12.0	5.81	67.7
#43	0/25	-12.2	1.83	35.2
#44	2/25	-22.4	34.9	266
#45	0/25	-29.1	2.09	80.3
#46	2/25	-19.7	32.2	144
#47	0/25	-28.5	45.1	192
#48	1/25	-29.9	11.7	218
#49	0/25	-17.6	65.5	233

Table 4-4. Summary of gross alpha and gross beta in air effluent samples from monitored emission points at Building 251, 2002 (concluded)

B251 Emission Point[(a)]	No.>MDC/[(b)] total samples	Minimum (10^{-6} Bq/m^3)	Median (10^{-6} Bq/m^3)	Maximum (10^{-6} Bq/m^3)
Gross Beta				
#1	0/25	-212	26.6	195
#3	0/25	-135	52.2	212
#5	6/25	-98.8	95.8	1620
#6	0/25	-195	61.8	255
#7	2/25	-52.9	43.3	181
#13	0/25	-178	-18.8	242
#14	4/25	-58.5	194	825
#16	0/25	-88.4	31.8	160
#17	5/25	-22.5	178	400
#18	0/25	-167	46.6	246
#19	0/25	-107	11.4	248
#20	1/25	-95.5	20.2	1025
#21	20/25	62.2	392	2390
#23	0/25	-138	-0.39	323
#24	0/25	-255	-45.1	182
#25	0/25	-103	-2.01	145
#26	0/25	-107	29.8	359
#33	0/1	44.0	44.0	40.0
#34	18/25	-4.03	357	2650
#35	1/25	-94.4	5.59	242
#40	0/25	-19.5	16.7	122
#43	0/25	-30.2	8.2	59.2
#44	5/25	-83.3	162	566
#45	1/25	-162	30.2	1620
#46	24/25	-20.6	367	840
#47	21/25	119	414	3270
#48	7/25	-74.0	108	750
#49	16/25	-58.1	368	3220

a Emission point #33 was removed from service in January.
b MDC = minimum detection concentration

Table 4-5. Summary of tritium in air effluent samples from monitored emission points at Building 331, 2002

B331 Emission Point	No.>MDC total samples[a]	Minimum (Bq/m^3)	Median (Bq/m^3)	Maximum (Bq/m^3)
HT[b]				
Stack 1	3/52	-2.52	0.182	61.8
Stack 2	52/52	85.8	191	4510
HTO[c]				
Stack 1	22/52	-0.592	3.37	11.3
Stack 2	52/52	167	3320	24400

a MDC - minimum detection concentration
b HT = tritiated hydrogen gas
c HTO = tritiated water and water vapor

Table 4-6. Summary of gross alpha and gross beta in air effluent samples from monitored emission points at Building 332, 2002

B332 Emission Point[a]	No.>MDC/[b] total samples	Minimum (10^{-6} Bq/m^3)	Median (10^{-6} Bq/m^3)	Maximum (10^{-6} Bq/m^3)
Gross Alpha				
SP-1A	0/52	-35.3	-9.51	67.0
SP-1B	0/52	-32.9	-1.29	98.4
SP-2A	0/52	-25.5	4.98	63.3
SP-2B	0/52	-26.4	-10.4	79.6
SP-3	0/52	-31.3	5.19	86.6
SP-4	0/52	-31.3	-9.79	34.4
SP-5	0/2	-14.5	17.2	48.8
SP-6A	0/52	-30.5	6.49	95.8
SP-6B	0/52	-24.1	8.01	147
SP-7A	0/52	-29.6	-10.3	47.0
SP-7B	0/52	-29.6	-9.19	42.2
SP-8	0/52	-32.9	-11.9	78.8
SP-9	0/52	-32.1	-10.0	114
SP-10	0/52	-67.3	-7.79	194
SP-11	0/52	-34.7	9.38	59.9
SP-12	0/52	-54.4	-20.7	143
Gross Beta				
SP-1A	0/52	-89.2	29.4	194
SP-1B	0/52	-134	-0.503	147
SP-2A	0/52	-137	20.2	158
SP-2B	0/52	-128	9.07	147
SP-3	0/52	-132	5.48	175
SP-4	1/52	-110	21.6	385
SP-5	1/2	-53.3	208	470
SP-6A	1/52	-108	-2.67	322
SP-6B	0/52	-104	-3.94	105
SP-7A	0/52	-178	-8.57	180
SP-7B	0/52	-91.8	7.23	225
SP-8	0/52	-130	17.4	156
SP-9	0/52	-130	2.55	174
SP-10	0/52	-201	-11.5	259
SP-11	0/52	-109	8.81	147
SP-12	0/52	-260	30.2	525

a Emission point Number 5 was removed from service in January.

b MDC = minimum detection concentration

Table 4-7. Summary of gross alpha and gross beta in air effluent samples from monitored emission points at Building 491, 2002

B491 Emission Point	No.>MDC/[a] total samples	Minimum (10^{-6} Bq/m^3)	Median (10^{-6} Bq/m^3)	Maximum (10^{-6} Bq/m^3)
Gross Alpha				
#1	1/46	-16.0	3.41	89.9
Gross Beta				
#1	6/46	-30.7	28.3	459

Note: The vacuum system was not operable for 6 weeks throughout the year and two samples were two weeks long.
a MDC = minimum detection concentration

Table 4-8. Summary of gross alpha and gross beta in air effluent samples from monitored emission points at Building 801A, 2002

B801 Emission Point	No.>MDC/[a] total samples	Minimum (10^{-6} Bq/m^3)	Median (10^{-6} Bq/m^3)	Maximum (10^{-6} Bq/m^3)
Gross Alpha				
#1	5/38	-32.9	29.4	278
Gross Beta				
#1	27/38	83.3	207	1380

Note: Several samples ran for more than one week

a MDC = minimum detection concentration

Ambient Air Monitoring

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Air Sampling

Lawrence Livermore National Laboratory conducts ambient air monitoring using several different networks, each one representing a general location and type of analysis. There are separate networks for high volume sampling of particulates at both the Livermore site and Site 300 as well as a low-volume radiological air sampling network and a tritium sampling network in Livermore and one tritium sampling location at Site 300. Three different collection media are employed: cellulose filters for high volume sampling of particulates, membrane filters for low-volume radiological particulates, and silica gel for tritium. **Table 5-1** in the main volume lists which sampling locations are included in each network; sampling locations are shown in **Figures 5-1**, **5-2**, and **5-3** in the main volume.

Air Particulate Networks

All particulate air samplers are positioned to ensure reasonable probability that any significant concentration of particulate effluents from LLNL operations will be detected.

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

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

After each particulate filter is removed from a sampler, it is identified by location, date on, date off, elapsed time, and flow rate; and it is given a sample identifier (a four-field code) that accompanies it throughout the analysis. Filters are then placed in glassine envelopes, and the sample information is recorded in a field tracking notebook. Air filters are delivered to the analytical laboratory each week. **Table 5-1** in the main volume shows the analytical requirements for each location.

Hi-vol samplers collect particulate at a continuous rate of 0.43 m^3/min using Whatman-41 cellulose filters. The low-volume samplers collect particulate at a continuous rate of 0.03 m^3/min using membrane filters.

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

Air Particulate

While DOE recommends that the collection efficiency of particulate filters be greater than 95%, studies at LLNL have shown that many recommended filters (glass fiber) possess background radiological activity higher that that which is detected in local ambient air. In addition some recommended filters (HEPA grade) have a high pressure drop across the filter thereby limiting the flow across the filter. LLNL gained approval from the DOE to use a Whatman 41 filter that allows a greater total flow capacity with no background interferences.

Data are grouped in categories representing the following areas: perimeter, upwind, downwind, diffuse source (tritium only), and special interest locations.

The hi-vol air particulate Livermore network maintains seven samplers at the perimeter (CAFE, COW, CRED, MESQ, MET, SALV, and VIS), shown in the main volume **Figure 5-1**. CRED location (also along the perimeter) was added in 1991 to monitor resuspension of plutonium from localized soil contamination and serves as the sitewide maximally exposed individual (SW-MEI) for NESHAPs reporting purposes. The Livermore Valley network shown in the main volume **Figure 5-2**, consists of four locations in the least prevalent wind directions (CHUR, FCC, FIRE, and HOSP), considered to be upwind or background, and four samplers located in the most prevalent downwind directions (AMON, PATT, TANK, and ZON7). An additional sampler is located upwind in an area of special interest at the Livermore Water Reclamation Plant (LWRP) because of a plutonium release to the sanitary sewer in 1967 that resulted in soil contamination.

The low-volume radiological air particulate network consists of two samplers located at HOSP and FCC which support the air effluent sampling network.

Site 300 is monitored at eight locations (801E, ECP, EOBS, GOLF, NPS, WCP, WOBS, and COHO) placed around the site boundary and near onsite firing tables as shown in the main volume **Figure 5-3**. The location COHO serves as the SW-MEI for NESHAPs reporting purposes. Off-site monitoring at Site 300 occurs at TFIR (in downtown City of Tracy).

As outlined in the *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* (DOE 1991), data for gross alpha, gross beta, and gamma isotopes detected on air-filters are used only as trend indicators; specific radionuclide analysis is done for plutonium and uranium, depending on the location.

All analytical results are reported as a measured concentration per volume of air. When activity is less than the minimum detection concentration (MDC), the calculated value is reported (see Chapter 14 for further details). 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 (DOE 1991) using the total particles collected.

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

Portions of the glass-fiber filters from the Livermore route locations are analyzed for the presence of plutonium-239+240. Similarly, portions of the glass-fiber filters from the Site 300 route are analyzed for the presence of uranium-235 and uranium-238. 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 hydro-fluoric acids. Plutonium and uranium are separated by an ion-exchange process. The plutonium is purified further by ion exchange, then electroplated onto a stainless steel disk and analyzed by alpha spectrometry while the uranium isotopes are determined by inductively coupled mass spectrometry.

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

The analytical laboratory digests part of the sample, using nitric acid, hydrochloric acid, and hydrogen peroxide during various heating and cooling phases. Care is taken to prevent the sample from boiling or baking dry. The resulting solution is diluted to 50 mL with blank water and the quantity of beryllium is determined by inductively coupled plasma-mass spectrometry.

For gamma scanning, two site composites are created using another portion of all weekly glass fiber filters. One site composite is created for the Livermore site (COW, MESQ, MET, SALV, and VIS) and another for the Site 300 perimeter locations (801E, ECP, EOBS, GOLF, NPS, WCP, and WQBS). Each site composite is placed into a Teflon container and counted for gamma-emitting radionuclides using a low-background germanium-(lithium) [Ge-(li)] detector.

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. The analytical laboratory also runs a series of quality control tests that include laboratory control spikes, blanks and duplicates.

Air Tritium

LLNL maintains 12 continuously operating, airborne-tritium samplers on the Livermore site (main volume, **Figure 5-1**), six samplers in the Livermore Valley (main volume, **Figure 5-2**), and one at Site 300 (main volume, **Figure 5-3**). Four of the Livermore site locations (B292, B331, B514, and B624) monitor diffuse source emissions.

The tritium samplers, operating at a flow rate of 500 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, instantaneous flow rate and the minimum, maximum and total flow during the sample period. The flow rate is verified 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 Livermore site or valley locations at two-month intervals to provide duplicate QA samples. Details of actual tritium sampling and a description of tritium sampler calibration can be found in Appendix B of the *Environmental Monitoring Plan* (Tate et al. 1999).

Once the samples are taken, water is separated from the silica gel by freeze-dried vacuum distillation, and the tritium concentration in the water is determined by liquid-scintillation counting. Airborne tritium sample analysis is done by LLNL's Chemistry and Materials Science Environmental Monitoring Radiological Laboratory (EMRL). All analytical results are reported as concentrations per liter of extracted water and per cubic meter of air flow through the sampling medium. Details of the analytical procedure are described in SOP-EM-P542 (Low-Level Tritium Analysis—Freeze Dry).

Data

Weekly concentration of gross alpha and gross beta data for the Livermore site perimeter, Livermore Valley, and Site 300 are presented in Tables 5-1, 5-2, 5-3, and 5-11. Monthly plutonium data for Livermore sampling locations are shown in Tables 5-4, 5-5, and Site 300 data are presented in Table 5-12. Table 5-6 presents the weekly low-volume air particulate data. Monthly uranium data for the Livermore site perimeter and Site 300 are presented in Table 5-13. Gamma result are presented in the main volume of this report. Biweekly tritium data for sampling locations in the Livermore Valley, Livermore site perimeter, and diffuse sources are shown in Tables 5-7, 5-8, and 5-9. Tables 5-10 and 5-15 present monthly beryllium data for Livermore site perimeter and Site 300 sampling locations. Table 5-14 shows tritium-in-air data for Site 300. 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. Weekly gross alpha and gross beta concentrations (µBq/m^3) from air particulate samples from the Livermore site perimeter locations, 2002[(a)]

Date	CAFE	COW	CRED	MESQ	MET	SALV	VIS
	Gross alpha						
8-Jan	[(b)]	17.3 ± 48.0	66.0 ± 48.3	78.2 ± 57.3	30.4 ± 55.8	-16.3 ± 54.0	-7.03 ± 36.0
15-Jan	39.4 ± 62.4	54.6 ± 46.7	106 ± 56.1	32.0 ± 38.8	32.6 ± 50.7	149 ± 74.1	13.7 ± 55.3
22-Jan	43.2 ± 43.9	55.4 ± 48.7	49.3 ± 43.1	101 ± 57.8	19.8 ± 33.0	25.3 ± 47.8	53.0 ± 54.0
29-Jan	3.58 ± 28.2	-11.0 ± 23.0	35.7 ± 44.2	21.1 ± 51.8	24.3 ± 42.2	-18.6 ± 27.0	27.2 ± 43.4
5-Feb	19.1 ± 37.4	76.4 ± 50.9	111 ± 57.1	45.8 ± 35.7	64.2 ± 48.7	33.0 ± 40.3	46.2 ± 35.8
12-Feb	-10.2 ± 12.8	50.2 ± 45.7	79.8 ± 52.3	30.5 ± 35.4	44.1 ± 39.7	26.8 ± 39.5	29.9 ± 35.5
19-Feb	66.6 ± 49.5	30.7 ± 35.1	35.2 ± 47.9	59.5 ± 45.0	31.2 ± 33.7	47.9 ± 39.9	55.7 ± 41.5
26-Feb	32.1 ± 37.6	43.4 ± 39.5	37.5 ± 35.7	25.4 ± 36.2	-0.652 ± 17.0	30.2 ± 34.9	11.2 ± 23.9
5-Mar	31.3 ± 34.8	157 ± 71.8	95.7 ± 60.5	92.5 ± 57.6	155 ± 70.3	122 ± 56.2[(c)]	169 ± 77.5
12-Mar	27.0 ± 37.4	51.3 ± 67.3	15.0 ± 29.5	73.8 ± 46.4	24.8 ± 34.4	35.2 ± 48.6	40.2 ± 46.8
19-Mar	26.0 ± 33.7	54.0 ± 47.7	-9.90 ± 29.1	55.5 ± 42.0	44.6 ± 50.5	6.02 ± 24.1	24.0 ± 39.4
26-Mar	36.9 ± 42.4	15.3 ± 46.5	7.16 ± 49.4	-8.15 ± 23.1	8.82 ± 36.7	57.3 ± 51.0	10.2 ± 48.4
2-Apr	62.4 ± 48.9	37.3 ± 41.1	89.5 ± 65.3	83.9 ± 54.6	35.6 ± 45.9	67.3 ± 50.4	92.1 ± 67.2
9-Apr	102 ± 68.0	87.8 ± 64.5	80.4 ± 57.6	92.7 ± 55.9	79.2 ± 52.5	71.6 ± 56.3	92.1 ± 71.1
16-Apr	32.0 ± 40.6	20.7 ± 49.1	27.0 ± 44.6	10.6 ± 56.5	29.4 ± 41.5	80.0 ± 51.9	51.0 ± 44.3
23-Apr	70.9 ± 50.2	48.8 ± 47.4	41.5 ± 40.8	39.3 ± 72.8	39.7 ± 52.3	60.7 ± 55.0	76.7 ± 49.2
30-Apr	103 ± 53.7	87.1 ± 55.7	-5.43 ± 38.6	60.0 ± 57.8	58.8 ± 44.5	67.3 ± 45.4	46.7 ± 53.3
7-May	75.8 ± 58.5	76.0 ± 50.3	10.7 ± 30.2	18.3 ± 34.8	84.5 ± 56.7	67.0 ± 63.5	120 ± 62.7
14-May	-1.53 ± 45.6	42.8 ± 47.7	10.1 ± 38.0	58.8 ± 51.8	109 ± 60.8	70.4 ± 55.3	72.0 ± 59.4
21-May	22.7 ± 37.9	41.7 ± 43.7	-18.4 ± 30.4	22.5 ± 34.8	39.5 ± 39.5	-11.8 ± 36.5	39.8 ± 46.5
28-May	21.3 ± 36.4	38.5 ± 43.3	22.7 ± 39.7	8.37 ± 40.8	34.6 ± 41.0	16.7 ± 36.1	-13.8 ± 40.6
4-Jun	1.28 ± 33.9	0.784 ± 42.2	-2.76 ± 47.4	25.8 ± 48.5	19.2 ± 35.4	-3.62 ± 46.3	-1.74 ± 48.8
11-Jun	5.14 ± 46.3	-5.81 ± 32.1	28.0 ± 41.8	2.68 ± 48.8	-0.992 ± 35.3	3.74 ± 29.2	29.7 ± 50.3
18-Jun	-14.4 ± 29.7	-3.15 ± 42.2	-10.6 ± 30.6	-2.77 ± 43.7	-6.77 ± 27.0	-11.2 ± 45.5	1.76 ± 50.3
25-Jun	-4.48 ± 31.0	17.4 ± 45.5	-1.03 ± 31.3	-5.81 ± 40.0	-5.22 ± 24.0	8.73 ± 50.3	2.09 ± 50.0
2-Jul	-1.92 ± 24.0	-3.18 ± 42.2	-0.947 ± 32.5	6.81 ± 34.6	-9.32 ± 48.1	8.47 ± 43.3	-7.18 ± 5.18
9-Jul	0.134 ± 26.5	-3.39 ± 38.5	11.0 ± 49.6	-0.592 ± 39.6	0.574 ± 24.8	1.30 ± 43.7	-3.66 ± 41.4
16-Jul	2.29 ± 41.4	1.86 ± 29.0	8.03 ± 36.0	-1.29 ± 42.9	0.722 ± 30.9	1.21 ± 26.3	4.74 ± 31.5
23-Jul	4.44 ± 43.3	8.14 ± 47.7	3.53 ± 29.5	7.70 ± 47.7	4.92 ± 29.5	13.0 ± 34.8	5.33 ± 29.5
30-Jul	11.5 ± 40.7	0.485 ± 42.2	1.53 ± 30.4	1.84 ± 42.9	4.88 ± 31.7	4.51 ± 45.9	7.22 ± 61.1
6-Aug	5.11 ± 44.8	6.62 ± 45.1	6.55 ± 46.6	0.648 ± 25.1	7.47 ± 48.5	9.40 ± 35.0	7.51 ± 31.3
13-Aug	31.6 ± 7.33	-18.6 ± 5.81	-0.995 ± 6.51	41.4 ± 5.99	29.9 ± 8.73	11.9 ± 5.11	22.2 ± 5.59
20-Aug	21.7 ± 6.81	6.51 ± 6.55	27.8 ± 7.51	23.9 ± 5.14	35.8 ± 8.51	9.25 ± 4.77	53.3 ± 6.33
27-Aug	1.21 ± 6.22	9.58 ± 6.55	17.3 ± 7.03	20.9 ± 5.77	39.2 ± 7.70	3.17 ± 4.22[(d)]	27.1 ± 5.48
3-Sep	13.7 ± 8.36	-24.2 ± 8.14	-1.18 ± 6.29	[(b)]	2.38 ± 7.62	38.5 ± 10.5	9.40 ± 6.92
10-Sep	7.96 ± 55.1	0.488 ± 51.8	3.25 ± 56.6	1.81 ± 36.7	-3.43 ± 52.2	2.62 ± 40.0	-1.61 ± 33.6
17-Sep	-12.1 ± 51.1	29.0 ± 57.7	7.70 ± 60.7	17.3 ± 45.5	16.8 ± 62.2	-9.29 ± 38.8	0.525 ± 39.2
24-Sep	48.8 ± 66.2	44.8 ± 66.2	35.9 ± 67.0	-4.74 ± 41.1	46.3 ± 70.3	57.4 ± 60.7	27.6 ± 51.1
1-Oct	4.03 ± 36.2	24.8 ± 54.8	-20.5 ± 32.9	3.14 ± 36.3	9.95 ± 52.9	-14.0 ± 31.8	-114 ± 45.9
8-Oct	120 ± 61.8	51.8 ± 58.8	38.5 ± 49.2	49.6 ± 48.8	64.4 ± 61.4	44.0 ± 45.9	53.7 ± 64.4
15-Oct	51.8 ± 51.4	28.6 ± 57.0	0.492 ± 41.8	37.7 ± 47.4	91.8 ± 68.8	88.4 ± 57.7	75.5 ± 71.8
22-Oct	33.0 ± 313	60.3 ± 354	20.0 ± 350	18.0 ± 377	17.0 ± 340	-10.2 ± 333	36.3 ± 332
29-Oct	28.9 ± 303	26.9 ± 341	7.84 ± 264	17.8 ± 286	-23.8 ± 256	-22.8 ± 185	13.3 ± 346
5-Nov	82.5 ± 59.2	36.9 ± 58.1	41.8 ± 52.5	88.8 ± 60.3	81.4 ± 65.9	42.9 ± 50.0	85.1 ± 72.5
12-Nov	1.39 ± 1.91	20.2 ± 50.3	1.37 ± 2.01	0.518 ± 1.67	33.4 ± 52.9	45.1 ± 45.1	1.67 ± 2.81
19-Nov	19.2 ± 41.4	-7.44 ± 45.9	8.47 ± 42.2	33.6 ± 46.3	42.2 ± 57.4	10.2 ± 38.1	-1.87 ± 55.5
26-Nov	25.7 ± 8.73	270 ± 90.6	18.2 ± 7.55	19.3 ± 7.84	248 ± 87.0	33.9 ± 9.69	27.2 ± 9.03
3-Dec	24.0 ± 54.4	7.29 ± 60.3	9.84 ± 55.1	16.6 ± 54.4	-3.05 ± 58.1	-6.48 ± 46.3	35.0 ± 72.1
10-Dec	45.9 ± 72.1	104 ± 85.1	0.821 ± 68.1	46.3 ± 72.1	144 ± 88.1	52.2 ± 66.6	95.5 ± 89.2
17-Dec	[(b)]	37.4 ± 6.11	23.8 ± 5.51	52.2 ± 6.81	30.3 ± 5.77	3.26 ± 4.26	45.9 ± 10.6
23-Dec	4.92 ± 6.40	45.1 ± 7.36	-12.1 ± 4.18	-4.11 ± 4.85	52.9 ± 7.66	-3.85 ± 4.51	-4.22 ± 5.00
30-Dec	17.7 ± 5.37	38.1 ± 6.22	51.4 ± 6.73	-3.51 ± 4.14	72.1 ± 7.51	23.0 ± 5.33	24.1 ± 5.55
Detection frequency	**14 of 50**	**17 of 52**	**15 of 52**	**18 of 51**	**18 of 52**	**18 of 52**	**19 of 52**
Median	**22.2**	**29.9**	**10.9**	**21.1**	**30.8**	**14.9**	**27.2**
IQR[(e)]	**34.6**	**43.9**	**35.1**	**45**	**41.1**	**46.7**	**47.4**
Maximum	**120**	**270**	**111**	**101**	**248**	**149**	**169**

Table 5-1. Weekly gross alpha and gross beta concentrations (µBq/m^3) from air particulate samples from the Livermore site perimeter locations, 2002[(a)] (concluded)

Date	CAFE	COW	CRED	MESQ	MET	SALV	VIS
	Gross beta						
8-Jan	(b)	428 ± 91.6	507 ± 112	419 ± 83.3	497 ± 98.2	464 ± 94.0	353 ± 80.8
15-Jan	714 ± 133	474 ± 83.6	741 ± 115	583 ± 88.4	661 ± 99.4	744 ± 103	553 ± 91.8
22-Jan	275 ± 67.1	366 ± 76.4	424 ± 80.1	471 ± 86.0	542 ± 86.6	577 ± 91.8	417 ± 83.7
29-Jan	91.4 ± 45.6	170 ± 56.2	120 ± 49.5	217 ± 61.4	212 ± 60.5	212 ± 64.2	200 ± 59.3
5-Feb	381 ± 88.4	645 ± 108	765 ± 126	585 ± 98.5	655 ± 113	605 ± 105	506 ± 92.8
12-Feb	-25.1 ± 49.6	558 ± 109	501 ± 105	640 ± 107	669 ± 105	607 ± 112	468 ± 93.0
19-Feb	520 ± 106	546 ± 110	449 ± 102	519 ± 102	688 ± 108	568 ± 111	553 ± 101
26-Feb	151 ± 79.6	151 ± 72.3	228 ± 84.2	164 ± 79.1	193 ± 70.3	251 ± 79.3	166 ± 69.0
5-Mar	418 ± 96.5	569 ± 89.0	484 ± 90.2	576 ± 102	843 ± 128	639 ± 102[(c)]	654 ± 100
12-Mar	150 ± 79.3	153 ± 81.7	135 ± 50.7	281 ± 85.0	324 ± 91.7	243 ± 95.9	240 ± 70.0
19-Mar	126 ± 67.9	253 ± 70.1	107 ± 46.0	181 ± 74.2	227 ± 84.3	169 ± 72.9	239 ± 67.7
26-Mar	355 ± 88.0	255 ± 65.8	276 ± 71.3	253 ± 84.6	367 ± 93.4	316 ± 87.6	285 ± 71.0
2-Apr	578 ± 111	593 ± 91.8	618 ± 96.6	592 ± 112	791 ± 114	716 ± 115	781 ± 107
9-Apr	470 ± 116	506 ± 92.1	467 ± 113	476 ± 109	499 ± 103	396 ± 97.3	504 ± 114
16-Apr	175 ± 79.5	161 ± 56.1	227 ± 84.0	80.6 ± 119	286 ± 89.9	222 ± 81.7	186 ± 80.3
23-Apr	460 ± 101	309 ± 72.1	555 ± 107	263 ± 142	428 ± 103	432 ± 101	461 ± 98.8
30-Apr	601 ± 108	469 ± 85.7	578 ± 111	427 ± 117	448 ± 103	468 ± 101	442 ± 103
7-May	270 ± 70.9	325 ± 73.5	254 ± 66.9	288 ± 69.7	262 ± 68.7	315 ± 89.0	256 ± 66.2
14-May	453 ± 84.6	411 ± 80.7	508 ± 106	343 ± 75.8	457 ± 84.4	283 ± 69.7	381 ± 80.0
21-May	204 ± 60.0	160 ± 54.6	136 ± 49.8	94.6 ± 45.9	199 ± 59.0	151 ± 52.2	141 ± 55.0
28-May	211 ± 63.7	224 ± 64.0	191 ± 59.9	196 ± 63.2	234 ± 65.2	191 ± 59.4	189 ± 60.5
4-Jun	225 ± 80.3	124 ± 111	79.6 ± 105	176 ± 114	253 ± 84.7	137 ± 106	159 ± 112
11-Jun	243 ± 120	241 ± 82.1	225 ± 79.9	171 ± 110	308 ± 88.1	297 ± 85.8	260 ± 120
18-Jun	282 ± 85.5	190 ± 115	268 ± 83.6	277 ± 120	338 ± 92.1	225 ± 112	202 ± 114
25-Jun	173 ± 75.5	138 ± 113	165 ± 74.0	188 ± 115	165 ± 75.9	206 ± 111	148 ± 112
2-Jul	160 ± 74.7	125 ± 92.9	211 ± 78.8	183 ± 75.9	191 ± 114	173 ± 110	210 ± 117
9-Jul	170 ± 75.9	243 ± 115	181 ± 107	225 ± 114	209 ± 82.1	217 ± 106	196 ± 109
16-Jul	339 ± 119	278 ± 84.7	295 ± 85.8	285 ± 112	330 ± 89.9	299 ± 85.8	353 ± 93.2
23-Jul	263 ± 116	142 ± 104	166 ± 74.7	218 ± 109	154 ± 73.6	181 ± 76.2	198 ± 80.7
30-Jul	265 ± 89.2	236 ± 116	259 ± 85.5	278 ± 119	284 ± 91.0	232 ± 108	272 ± 142
6-Aug	221 ± 122	226 ± 114	164 ± 105	247 ± 84.7	223 ± 110	192 ± 76.2	197 ± 79.9
13-Aug	29.4 ± 9.10	-15.8 ± 5.96	24.5 ± 6.59	19.9 ± 6.70	16.3 ± 6.88	27.8 ± 5.51	0.112 ± 5.77
20-Aug	22.6 ± 8.81	-0.755 ± 6.14	22.3 ± 6.62	33.0 ± 6.66	17.6 ± 6.81	40.0 ± 5.70	48.8 ± 7.07
27-Aug	370 ± 18.2	326 ± 17.9	281 ± 17.1	377 ± 14.9	215 ± 16.6	350 ± 11.8[(d)]	340 ± 13.3
3-Sep	707 ± 24.0	781 ± 25.0	673 ± 19.1	(b)	1090 ± 22.9	622 ± 25.5	870 ± 21.1
10-Sep	335 ± 149	278 ± 145	224 ± 140	344 ± 109	194 ± 138	299 ± 104	367 ± 111
17-Sep	440 ± 156	342 ± 150	525 ± 159	559 ± 127	485 ± 156	555 ± 125	533 ± 125
24-Sep	555 ± 164	622 ± 168	529 ± 161	681 ± 137	651 ± 168	688 ± 135	699 ± 138
1-Oct	559 ± 110	463 ± 145	559 ± 110	574 ± 112	629 ± 132	540 ± 125	1700 ± 200
8-Oct	492 ± 104	392 ± 140	574 ± 110	588 ± 112	463 ± 121	463 ± 119	511 ± 144
15-Oct	733 ± 121	588 ± 151	696 ± 118	681 ± 119	792 ± 141	714 ± 134	910 ± 164
22-Oct	788 ± 126	903 ± 161	884 ± 131	836 ± 130	840 ± 142	895 ± 146	958 ± 164
29-Oct	762 ± 121	666 ± 148	599 ± 111	751 ± 125	766 ± 137	692 ± 134	733 ± 151
5-Nov	781 ± 127	555 ± 150	722 ± 120	833 ± 129	736 ± 136	777 ± 138	770 ± 159
12-Nov	19.5 ± 4.59	238 ± 130	15.6 ± 4.26	20.4 ± 4.74	370 ± 111	367 ± 114	19.9 ± 6.51
19-Nov	603 ± 113	321 ± 138	581 ± 111	666 ± 119	537 ± 124	500 ± 122	588 ± 150
26-Nov	148 ± 17.0	1370 ± 166	150 ± 17.1	149 ± 17.2	1520 ± 174	137 ± 16.1	174 ± 18.3
3-Dec	1390 ± 158	1240 ± 182	1420 ± 159	1470 ± 166	1440 ± 172	1340 ± 165	1610 ± 195
10-Dec	2590 ± 210	2260 ± 222	2620 ± 211	2500 ± 211	2430 ± 213	2200 ± 201	2640 ± 233
17-Dec	(b)	250 ± 12.7	246 ± 12.7	265 ± 13.1	389 ± 14.4	257 ± 12.4	306 ± 21.9
23-Dec	75.5 ± 13.7	156 ± 13.0	83.3 ± 11.6	178 ± 13.4	149 ± 12.8	95.1 ± 11.3	138 ± 13.1
30-Dec	370 ± 14.5	377 ± 14.4	360 ± 14.1	297 ± 13.5	507 ± 15.9	396 ± 14.2	451 ± 15.2
Detection frequency	**49 of 50**	**50 of 52**	**51 of 52**	**50 of 51**	**52 of 52**	**52 of 52**	**51 of 52**
Median	**337**	**323**	**288**	**288**	**409**	**333**	**353**
IQR[(e)]	**373**	**333**	**386**	**388**	**431**	**368**	**355**
Maximum	**2590**	**2260**	**2620**	**2500**	**2430**	**2200**	**2640**

a See main volume, **Figure 5-1**, for description of sampling locations.
b No data available
c Sample collected March 6, 2002
d Sample collected August 28, 2002
e IQR = interquartile range

Table 5-2. Weekly gross alpha and gross beta concentrations (μBq/m³) from air particulate samples from Livermore Valley upwind and special interest locations, 2002[(a)]

Date	CHUR	FCC	FIRE	HOSP	LWRP
	Upwind				Special Interest
	Gross alpha				
8-Jan	71.9 ± 63.2	7.22 ± 47.9	78.4 ± 47.7	18.1 ± 37.4	114 ± 60.7
15-Jan	23.7 ± 42.2	84.1 ± 49.2	54.8 ± 37.2	(b)	113 ± 62.5
22-Jan	40.8 ± 42.9	37.6 ± 38.0	33.6 ± 38.0	45.3 ± 39.1	94.2 ± 51.5
29-Jan	31.9 ± 41.5	13.6 ± 28.7	17.8 ± 32.3	15.2 ± 33.1	57.9 ± 39.1
5-Feb	81.8 ± 55.1	27.0 ± 48.7	71.0 ± 61.1	7.89 ± 35.6	18.2 ± 43.0
12-Feb	75.8 ± 47.8	7.04 ± 38.7	0.916 ± 38.0	7.22 ± 49.2	82.1 ± 53.0
19-Feb	14.5 ± 28.0	27.3 ± 37.1	99.6 ± 68.7	59.4 ± 61.8	54.8 ± 45.8
26-Feb	22.5 ± 28.3	12.0 ± 32.1	-25.2 ± 23.7	15.1 ± 39.7	-4.03 ± 28.9
5-Mar	120 ± 58.4	111 ± 58.6	85.4 ± 69.4	166 ± 68.8	86.6 ± 55.9
12-Mar	48.0 ± 41.8	14.2 ± 32.3	-7.18 ± 34.9	3.80 ± 38.7	36.9 ± 46.9
19-Mar	35.1 ± 40.5	-7.90 ± 28.7	33.2 ± 42.1	14.7 ± 27.4	42.6 ± 45.1
26-Mar	-47.4 ± 23.7	55.6 ± 43.9	-19.5 ± 18.6	65.2 ± 45.7	25.4 ± 34.2
2-Apr	94.7 ± 52.1	91.7 ± 61.0	36.9 ± 44.7	102 ± 51.3[(c)]	113 ± 67.5
9-Apr	94.4 ± 60.0	43.2 ± 55.6	87.5 ± 50.3	86.3 ± 54.7	34.5 ± 35.0
16-Apr	28.9 ± 36.1	33.9 ± 32.0	36.2 ± 41.6	44.2 ± 42.5	20.4 ± 26.9
23-Apr	95.0 ± 62.7	35.0 ± 33.6	28.7 ± 31.7	10.5 ± 29.5	35.7 ± 35.0
30-Apr	77.1 ± 59.3	95.7 ± 61.2	56.8 ± 40.8	-39.6 ± 31.3	50.3 ± 39.0
7-May	67.2 ± 49.6	-6.12 ± 47.9	0.317 ± 31.6	6.20 ± 30.8	93.9 ± 57.9
14-May	34.3 ± 38.7	53.1 ± 45.2	16.4 ± 34.1	15.1 ± 32.0	52.6 ± 50.3
21-May	91.5 ± 55.2	12.4 ± 29.6	17.5 ± 31.3	22.6 ± 48.1	19.0 ± 34.7
28-May	11.1 ± 28.7	-7.66 ± 38.5	33.9 ± 48.9	57.3 ± 48.5	18.6 ± 35.5
4-Jun	7.40 ± 48.8	-3.13 ± 31.8	18.7 ± 47.0	1.99 ± 27.8	-0.0873 ± 48.5
11-Jun	1.64 ± 42.2	2.33 ± 29.6	14.3 ± 37.4	-25.5 ± 63.6	15.7 ± 46.6
18-Jun	19.7 ± 34.6	14.2 ± 33.6	-21.3 ± 26.0	11.3 ± 52.9	49.6 ± 54.4
25-Jun	-9.10 ± 45.9	-5.40 ± 30.3	2.75 ± 29.5	7.59 ± 30.6	58.5 ± 52.9
2-Jul	-34.3 ± 31.7	-0.455 ± 26.1	-16.5 ± 26.0	15.5 ± 52.2	-2.39 ± 42.2
9-Jul	10.3 ± 48.8	4.92 ± 30.9	-3.29 ± 36.2	5.07 ± 28.5	14.7 ± 51.1
16-Jul	2.00 ± 45.1	9.92 ± 35.7	(b)	10.6 ± 51.8	3.15 ± 44.0
23-Jul	2.99 ± 26.3	5.40 ± 29.3	-0.407 ± 24.2	0.312 ± 44.8	4.85 ± 43.3
30-Jul	12.8 ± 49.6	13.9 ± 40.3	3.57 ± 27.9	3.14 ± 29.9	6.25 ± 33.9
6-Aug	-0.962 ± 42.2	8.73 ± 44.4	9.55 ± 50.3	13.5 ± 51.8	7.66 ± 32.7
13-Aug	35.7 ± 7.51	4.18 ± 21.5	9.84 ± 7.96	25.5 ± 8.18	14.4 ± 6.73
20-Aug	23.6 ± 4.88	27.4 ± 7.03	29.3 ± 7.84	53.7 ± 7.44	35.9 ± 6.96
27-Aug	-2.91 ± 4.11	22.1 ± 7.07	29.0 ± 7.14	10.7 ± 5.85	37.7 ± 7.29
3-Sep	97.3 ± 9.84	-3.85 ± 7.99	36.2 ± 9.58	24.3 ± 9.32	37.7 ± 7.66
10-Sep	2.64 ± 40.0	58.5 ± 68.5	-1.39 ± 53.7	-4.00 ± 44.8	12.8 ± 60.3
17-Sep	17.1 ± 44.8	4.55 ± 59.9	3.64 ± 58.1	-23.2 ± 47.0	50.3 ± 64.8
24-Sep	26.4 ± 59.9	3.63 ± 61.1	24.0 ± 66.2	(b)	11.5 ± 58.8
1-Oct	-1.25 ± 30.2	6.11 ± 50.0	2.98 ± 47.7	(b)	33.0 ± 58.8
8-Oct	53.7 ± 47.0	87.0 ± 55.1	54.8 ± 56.6	(b)	84.4 ± 67.3
15-Oct	89.5 ± 57.7	47.0 ± 51.8	26.6 ± 55.1	63.3 ± 61.8	85.8 ± 70.3
22-Oct	51.1 ± 296	46.3 ± 321[(d)]	-17.4 ± 368	23.6 ± 177	38.1 ± 426
29-Oct	12.2 ± 260	24.3 ± 330	-1.21 ± 281	31.1 ± 263	35.7 ± 374
5-Nov	40.0 ± 47.4	58.5 ± 56.2	24.9 ± 56.2	1.37 ± 36.8	71.0 ± 68.5
12-Nov	(b)	13.2 ± 49.6	1.57 ± 2.46	0.718 ± 1.69	-0.755 ± 2.00
19-Nov	(b)	17.4 ± 52.9	22.1 ± 52.5	19.9 ± 34.8	58.5 ± 61.4
26-Nov	163 ± 72.5	-1.13 ± 2.38	25.8 ± 8.66	7.92 ± 5.48	23.1 ± 8.51
3-Dec	13.0 ± 45.1	44.0 ± 68.5	53.7 ± 68.1	-6.22 ± 44.4	70.3 ± 76.6
10-Dec	27.9 ± 67.7[(e)]	13.7 ± 73.6	57.7 ± 74.7	42.2 ± 68.8	(b)
17-Dec	17.4 ± 5.29	51.1 ± 6.66	3.30 ± 4.29	-3.27 ± 3.85	74.7 ± 7.77
23-Dec	-4.07 ± 4.77	-17.5 ± 3.07	-3.89 ± 4.55	-20.1 ± 3.52	4.03 ± 5.25
30-Dec	3.67 ± 0.360	100 ± 8.44	30.0 ± 5.70	10.2 ± 4.81	72.5 ± 7.55
Detection frequency	**19 of 50**	**14 of 52**	**13 of 51**	**14 of 48**	**23 of 51**
Median	**25**	**14.1**	**18.7**	**12.4**	**36.9**
IQR[(f)]	**55.7**	**39.7**	**33.8**	**23.3**	**49.2**
Maximum	**163**	**111**	**99.6**	**166**	**114**

Table 5-2. Weekly gross alpha and gross beta concentrations (μBq/m^3) from air particulate samples from Livermore Valley upwind and special interest locations, 2002[(a)] (concluded)

Date	CHUR	FCC	FIRE	HOSP	LWRP
	Upwind				Special Interest
	Gross beta				
8-Jan	415 ± 91.6	495 ± 95.8	406 ± 95.8	375 ± 99.0	533 ± 114
15-Jan	658 ± 96.2	663 ± 111	537 ± 97.6	(b)	914 ± 133
22-Jan	460 ± 81.9	393 ± 96.4	480 ± 97.0	432 ± 95.2	730 ± 111
29-Jan	245 ± 70.6	259 ± 79.6	202 ± 83.0	193 ± 78.6	278 ± 78.1
5-Feb	647 ± 118	511 ± 88.0	367 ± 76.2	367 ± 80.6	529 ± 86.4
12-Feb	522 ± 96.3	363 ± 74.7	502 ± 85.0	368 ± 77.5	564 ± 88.3
19-Feb	614 ± 104	364 ± 73.5	429 ± 83.1	419 ± 83.2	521 ± 85.4
26-Feb	209 ± 71.8	176 ± 55.8	170 ± 56.9	146 ± 55.1	142 ± 61.2
5-Mar	621 ± 106	606 ± 105	651 ± 98.0	507 ± 102	486 ± 85.5
12-Mar	219 ± 83.2	221 ± 82.0	235 ± 64.5	158 ± 70.0	236 ± 68.7
19-Mar	252 ± 85.7	221 ± 83.8	155 ± 52.5	202 ± 75.4	130 ± 60.3
26-Mar	331 ± 86.6	372 ± 94.3	312 ± 67.7	346 ± 90.0	284 ± 66.7
2-Apr	652 ± 109	617 ± 113	684 ± 98.9	638 ± 104[(c)]	654 ± 96.6
9-Apr	430 ± 81.1	443 ± 106	417 ± 99.2	394 ± 110	458 ± 96.8
16-Apr	134 ± 51.0	210 ± 79.1	211 ± 84.9	233 ± 83.9	180 ± 71.1
23-Apr	373 ± 78.0	305 ± 87.8	322 ± 88.7	407 ± 97.3	412 ± 92.8
30-Apr	373 ± 78.4	447 ± 103	428 ± 93.5	459 ± 104	486 ± 96.5
7-May	229 ± 62.1	374 ± 102	292 ± 87.5	345 ± 94.6	404 ± 104
14-May	353 ± 75.1	483 ± 104	469 ± 102	566 ± 106	649 ± 113
21-May	195 ± 59.3	233 ± 79.0	289 ± 83.0	375 ± 98.7	226 ± 86.3
28-May	149 ± 54.7	226 ± 85.3	332 ± 92.6	229 ± 81.9	333 ± 90.5
4-Jun	95.1 ± 104	196 ± 77.0	188 ± 112	193 ± 78.8	175 ± 110
11-Jun	197 ± 112	280 ± 86.6	241 ± 79.9	285 ± 159	290 ± 119
18-Jun	268 ± 83.3	274 ± 85.5	299 ± 84.4	272 ± 118	262 ± 116
25-Jun	138 ± 109	188 ± 76.2	272 ± 85.1	204 ± 80.7	392 ± 96.6
2-Jul	158 ± 110	181 ± 76.6	222 ± 78.1	105 ± 109	174 ± 112
9-Jul	198 ± 107	157 ± 74.4	188 ± 109	165 ± 77.7	209 ± 107
16-Jul	327 ± 124	303 ± 91.0	(b)	353 ± 120	400 ± 123
23-Jul	191 ± 78.1	194 ± 79.6	185 ± 75.5	229 ± 111	283 ± 115
30-Jul	261 ± 110	252 ± 83.6	252 ± 82.5	337 ± 93.2	273 ± 83.6
6-Aug	177 ± 105	290 ± 118	198 ± 111	188 ± 110	290 ± 88.4
13-Aug	25.2 ± 4.00	585 ± 15.6	16.0 ± 6.99	1.66 ± 5.88	19.1 ± 7.96
20-Aug	3.12 ± 1.92	18.2 ± 6.11	23.3 ± 6.66	34.6 ± 5.96	48.1 ± 7.96
27-Aug	274 ± 12.0	243 ± 16.5	295 ± 16.5	533 ± 15.8	350 ± 17.5
3-Sep	907 ± 21.5	670 ± 24.3	777 ± 24.0	1300 ± 25.9	747 ± 19.7
10-Sep	299 ± 104	212 ± 136	237 ± 141	810 ± 144	440 ± 156
17-Sep	370 ± 110	366 ± 152	411 ± 152	1130 ± 164	451 ± 157
24-Sep	451 ± 158	770 ± 158	681 ± 169	(b)	707 ± 172
1-Oct	358 ± 95.1	570 ± 125	514 ± 120	(b)	633 ± 155
8-Oct	414 ± 98.4	533 ± 107	511 ± 117	(b)	688 ± 154
15-Oct	648 ± 117	770 ± 127	692 ± 131	306 ± 150	762 ± 164
22-Oct	773 ± 125	740 ± 137[(d)]	751 ± 134	537 ± 130	999 ± 167
29-Oct	681 ± 119	807 ± 140	640 ± 127	278 ± 113	829 ± 158
5-Nov	673 ± 119	958 ± 137	895 ± 141	485 ± 126	740 ± 165
12-Nov	(b)	356 ± 112	20.8 ± 5.33	11.3 ± 5.07	12.7 ± 6.29
19-Nov	(b)	659 ± 130	648 ± 127	144 ± 97.7	488 ± 147
26-Nov	1360 ± 165	60.3 ± 7.51	147 ± 16.7	86.6 ± 13.6	145 ± 17.1
3-Dec	943 ± 137	1710 ± 183	1570 ± 175	1100 ± 159	1070 ± 194
10-Dec	2480 ± 205[(e)]	2920 ± 228	2360 ± 206	1510 ± 193	(b)
17-Dec	265 ± 13.1	292 ± 13.1	212 ± 11.9	166 ± 11.1	224 ± 12.8
23-Dec	182 ± 13.3	105 ± 10.7	90.6 ± 11.3	67.0 ± 11.2	169 ± 13.0
30-Dec	19.7 ± 0.692	759 ± 18.5	422 ± 14.5	157 ± 11.2	407 ± 14.8
Detection frequency	**49 of 50**	**52 of 52**	**51 of 51**	**46 of 48**	**51 of 51**
Median	**329**	**364**	**322**	**322**	**404**
IQR[(f)]	**394**	**366**	**301**	**256**	**368**
Maximum	**2480**	**2920**	**2360**	**1510**	**1070**

a See main volume, Figure 5-1, for description of sampling locations.
b No data available
c Sample collected April 3, 2002
d Sample collected October 23, 2002
e Sample collected December 11, 2002
f IQR = interquartile range

Table 5-3. Weekly gross alpha and gross beta concentrations (µBq/m³) from air particulate samples from Livermore Valley downwind locations, 2002[(a)]

Date	AMON	PATT	TANK	ZON7
		Gross alpha		
8-Jan	29.6 ± 62.3	33.1 ± 45.2	39.5 ± 43.1	-10.9 ± 41.6
15-Jan	70.6 ± 51.6	23.5 ± 58.6	38.2 ± 37.9	81.7 ± 62.6
22-Jan	9.62 ± 33.5	2.02 ± 36.0	47.7 ± 46.6	20.4 ± 32.2
29-Jan	7.09 ± 31.2	-2.95 ± 29.6	11.1 ± 25.4	20.2 ± 39.0
5-Feb	36.3 ± 33.3	21.4 ± 44.1	1.42 ± 35.1	74.5 ± 43.9
12-Feb	27.0 ± 48.7	50.5 ± 41.1	25.6 ± 36.5	9.05 ± 27.9
19-Feb	62.2 ± 41.8	54.2 ± 45.5	42.2 ± 42.2	40.1 ± 40.1
26-Feb	13.9 ± 25.6	-3.52 ± 24.5	2.59 ± 30.8	13.2 ± 32.4
5-Mar	105 ± 55.6	99.4 ± 60.6	(b)	165 ± 76.4
6-Mar	(b)	(b)	41.2 ± 55.6	(b)
12-Mar	33.8 ± 43.1	42.4 ± 41.3	3.43 ± 35.0	33.4 ± 43.8
19-Mar	-3.32 ± 19.1	19.7 ± 36.3	47.1 ± 39.8	13.0 ± 34.6
26-Mar	-4.57 ± 26.2	27.2 ± 51.1	4.02 ± 31.0	(b)
27-Mar	(b)	(b)	(b)	25.4 ± 50.1
2-Apr	57.3 ± 44.3	51.7 ± 47.2	91.6 ± 63.9	(b)
3-Apr	(b)	(b)	(b)	82.6 ± 64.7
9-Apr	93.7 ± 64.2	122 ± 64.9	61.2 ± 45.0	54.3 ± 58.9
16-Apr	27.3 ± 50.9	65.0 ± 48.2	29.6 ± 36.3	(b)
17-Apr	(b)	(b)	(b)	60.1 ± 43.8
23-Apr	74.1 ± 54.3	44.3 ± 50.9	19.6 ± 36.3	53.2 ± 61.6
30-Apr	149 ± 68.7	65.5 ± 48.1	71.7 ± 51.5	(b)
1-May	(b)	(b)	(b)	30.8 ± 47.5
7-May	40.7 ± 47.3	28.2 ± 37.0	38.6 ± 40.0	(b)
9-May	(b)	(b)	(b)	36.9 ± 37.5
14-May	49.6 ± 44.6	20.2 ± 33.0	63.8 ± 48.9	25.1 ± 50.8
21-May	79.3 ± 50.4	14.3 ± 37.5	48.8 ± 47.8	(b)
22-May	(b)	(b)	(b)	53.5 ± 40.6
28-May	34.0 ± 43.9	18.9 ± 37.5	14.1 ± 37.4	23.0 ± 45.3
4-Jun	(b)	-1.21 ± 25.8	-15.1 ± 28.3	1.10 ± 33.8
5-Jun	5.00 ± 41.1	(b)	(b)	(b)
11-Jun	22.5 ± 45.9	21.3 ± 53.7	-15.6 ± 23.4	(b)
12-Jun	(b)	(b)	(b)	15.4 ± 31.6
18-Jun	-9.69 ± 32.0	(c)	-8.84 ± 25.6	15.9 ± 44.0
25-Jun	30.1 ± 51.1	-4.92 ± 25.1	-13.8 ± 46.6	2.69 ± 34.1
2-Jul	-10.8 ± 28.3	-17.6 ± 44.8	16.8 ± 34.0	5.51 ± 29.3
9-Jul	2.91 ± 42.6	10.7 ± 33.3	(b)	4.14 ± 30.1
10-Jul	(b)	(b)	-0.346 ± 25.0	(b)
16-Jul	2.75 ± 32.4	6.77 ± 48.5	1.68 ± 35.0	5.70 ± 30.4
23-Jul	1.22 ± 27.8	-5.70 ± 18.5	0.470 ± 24.4	6.44 ± 44.0
30-Jul	7.59 ± 45.9	-2.18 ± 22.4	2.44 ± 47.4	4.22 ± 32.5
6-Aug	8.66 ± 32.3	5.14 ± 43.7	2.18 ± 30.6	4.59 ± 32.5
13-Aug	-11.6 ± 3.70	22.4 ± 6.18	29.8 ± 8.99	6.99 ± 4.92
20-Aug	20.6 ± 6.66	26.8 ± 5.11	44.4 ± 9.58	14.7 ± 6.70
27-Aug	(b)	-5.37 ± 3.70	17.0 ± 5.40	(b)
28-Aug	25.5 ± 6.33	(b)	(b)	17.6 ± 6.36
3-Sep	8.84 ± 10.1	17.8 ± 7.62	39.2 ± 10.2	18.9 ± 9.44
10-Sep	-7.40 ± 47.7	2.32 ± 36.6	-0.622 ± 37.0	6.14 ± 58.8
17-Sep	-19.3 ± 47.4	-11.6 ± 32.1	22.3 ± 48.1	19.8 ± 60.7
24-Sep	48.1 ± 71.0	19.9 ± 49.6	(b)	19.8 ± 48.1
25-Sep	(b)	(b)	8.51 ± 49.2	(b)

Table 5-3. Weekly gross alpha and gross beta concentrations (µBq/m^3) from air particulate samples from Livermore Valley downwind locations, 2002[(a)] (continued)

Date	AMON	PATT	TANK	ZON7
		Gross alpha		
1-Oct	-12.2 ± 34.9	11.0 ± 39.2	20.5 ± 44.8	-14.7 ± 52.2
8-Oct	70.3 ± 54.0	22.3 ± 40.0	44.4 ± 45.1	(b)
9-Oct	(b)	(b)	(b)	18.5 ± 51.1
15-Oct	130 ± 68.5	30.8 ± 61.8	68.5 ± 55.1	22.4 ± 50.7
22-Oct	41.4 ± 374	32.6 ± 403	29.1 ± 315	67.3 ± 357
29-Oct	12.2 ± 270	-13.9 ± 301	10.7 ± 269	27.8 ± 315
5-Nov	61.1 ± 54.8	81.8 ± 71.4	89.2 ± 59.9	76.2 ± 59.2
12-Nov	1.07 ± 1.77	1.11 ± 2.63	0.625 ± 1.63	2.36 ± 2.32
19-Nov	42.2 ± 44.0	26.6 ± 56.6	28.4 ± 42.2	0.740 ± 41.4
26-Nov	(b)	21.4 ± 8.03	26.0 ± 8.99	267 ± 89.5
27-Nov	145 ± 64.8	(b)	(b)	(b)
3-Dec	54.8 ± 70.3	58.1 ± 73.6	61.8 ± 64.4	9.55 ± 60.3
10-Dec	(b)	4.48 ± 60.3	102 ± 80.7	(b)
11-Dec	38.1 ± 69.9	(b)	(b)	139 ± 85.1
17-Dec	58.5 ± 7.03	54.0 ± 7.81	3.38 ± 4.40	-4.11 ± 4.85
23-Dec	4.07 ± 5.29	-12.0 ± 4.14	4.00 ± 5.18	-4.03 ± 4.74
30-Dec	65.5 ± 7.29	10.3 ± 4.85	(c)	59.2 ± 7.07
Detection frequency	**18 of 52**	**15 of 51**	**16 of 51**	**15 of 52**
Median	**28.5**	**20.2**	**22.3**	**19.4**
IQR[(d)]	**52.8**	**30.7**	**40.3**	**37.3**
Maximum	**149**	**122**	**102**	**267**
		Gross beta		
8-Jan	283 ± 75.2	131 ± 56.4	427 ± 111	428 ± 91.1
15-Jan	434 ± 82.3	544 ± 93.0	473 ± 96.5	716 ± 104
22-Jan	338 ± 72.0	254 ± 67.7	330 ± 91.4	447 ± 78.2
29-Jan	198 ± 59.2	161 ± 50.3	170 ± 69.3	148 ± 51.8
5-Feb	415 ± 88.2	517 ± 109	330 ± 69.8	745 ± 110
12-Feb	571 ± 109	418 ± 94.1	399 ± 75.3	508 ± 98.4
19-Feb	373 ± 88.8	472 ± 101	491 ± 83.3	605 ± 106
26-Feb	183 ± 73.8	170 ± 81.0	126 ± 58.5	245 ± 85.9
5-Mar	473 ± 102	562 ± 87.8	(b)	682 ± 101
6-Mar	(b)	(b)	568 ± 84.6	(b)
12-Mar	258 ± 89.8	181 ± 55.8	107 ± 56.3	217 ± 66.5
19-Mar	222 ± 80.0	130 ± 57.2	169 ± 56.4	202 ± 63.3
26-Mar	332 ± 93.3	329 ± 72.6	270 ± 67.1	(b)
27-Mar	(b)	(b)	(b)	389 ± 75.6
2-Apr	640 ± 110	670 ± 97.9	792 ± 108	(b)
3-Apr	(b)	(b)	(b)	791 ± 107
9-Apr	458 ± 87.3	384 ± 79.0	515 ± 105	437 ± 93.8
16-Apr	164 ± 56.6	222 ± 62.6	313 ± 89.7	(b)
17-Apr	(b)	(b)	(b)	232 ± 58.1
23-Apr	406 ± 80.8	474 ± 87.1	454 ± 101	418 ± 92.6
30-Apr	467 ± 86.2	314 ± 71.4	519 ± 105	(b)
1-May	(b)	(b)	(b)	457 ± 77.3
7-May	320 ± 73.5	390 ± 78.1	283 ± 92.1	(b)
9-May	(b)	(b)	(b)	347 ± 71.0
14-May	400 ± 80.3	398 ± 78.8	381 ± 95.7	402 ± 97.8
21-May	125 ± 52.2	225 ± 63.5	261 ± 83.9	(b)
22-May	(b)	(b)	(b)	194 ± 55.6
28-May	238 ± 65.3	271 ± 66.2	205 ± 84.5	200 ± 68.3

Table 5-3. Weekly gross alpha and gross beta concentrations (µBq/m^3) from air particulate samples from Livermore Valley downwind locations, 2002[(a)] (concluded)

Date	AMON	PATT	TANK	ZON7
		Gross beta		
4-Jun	[(b)]	244 ± 82.5	246 ± 81.4	224 ± 79.6
5-Jun	252 ± 108	[(b)]	[(b)]	[(b)]
11-Jun	253 ± 91.8	192 ± 112	333 ± 91.0	[(b)]
12-Jun	[(b)]	[(b)]	[(b)]	286 ± 79.6
18-Jun	303 ± 87.3	[(c)]	317 ± 89.2	293 ± 94.4
25-Jun	215 ± 119	209 ± 79.9	175 ± 113	203 ± 78.4
2-Jul	177 ± 75.1	143 ± 109	238 ± 82.5	227 ± 80.7
9-Jul	188 ± 114	158 ± 75.9	[(b)]	147 ± 74.0
10-Jul	[(b)]	[(b)]	248 ± 75.5	[(b)]
16-Jul	348 ± 92.9	301 ± 115	339 ± 99.2	233 ± 84.0
23-Jul	172 ± 76.2	176 ± 75.5	209 ± 81.0	228 ± 113
30-Jul	325 ± 120	268 ± 85.5	292 ± 117	273 ± 84.4
6-Aug	211 ± 83.3	236 ± 115	268 ± 84.0	223 ± 81.8
13-Aug	5.29 ± 5.40	27.3 ± 6.73	39.2 ± 7.14	3.70 ± 4.40
20-Aug	33.2 ± 6.99	23.6 ± 6.03	39.6 ± 7.18	17.4 ± 6.11
27-Aug	[(b)]	326 ± 12.8	348 ± 13.2	[(b)]
28-Aug	344 ± 16.2	[(b)]	[(b)]	297 ± 15.4
3-Sep	677 ± 26.9	881 ± 20.8	1190 ± 28.0	622 ± 26.0
10-Sep	354 ± 151	324 ± 107	316 ± 105	292 ± 145
17-Sep	503 ± 160	429 ± 117	463 ± 118	315 ± 146
24-Sep	692 ± 170	570 ± 127	[(b)]	644 ± 134
25-Sep	[(b)]	[(b)]	751 ± 140	[(b)]
1-Oct	522 ± 107	503 ± 125	463 ± 120	514 ± 146
8-Oct	433 ± 98.4	389 ± 116	544 ± 107	[(b)]
9-Oct	[(b)]	[(b)]	[(b)]	353 ± 123
15-Oct	873 ± 131	614 ± 150	792 ± 127	577 ± 121
22-Oct	858 ± 132	947 ± 163	814 ± 126	877 ± 130
29-Oct	703 ± 144	714 ± 151	792 ± 125	673 ± 117
5-Nov	810 ± 127	792 ± 158	784 ± 127	670 ± 117
12-Nov	16.3 ± 4.37	15.6 ± 6.22	19.0 ± 4.55	18.2 ± 4.51
19-Nov	407 ± 97.7	368 ± 133	611 ± 111	688 ± 117
26-Nov	[(b)]	123 ± 15.6	172 ± 18.5	1530 ± 174
27-Nov	1510 ± 162	[(b)]	[(b)]	[(b)]
3-Dec	1750 ± 191	1330 ± 184	1750 ± 175	1760 ± 178
10-Dec	[(b)]	2240 ± 205	2750 ± 216	[(b)]
11-Dec	2270 ± 195	[(b)]	[(b)]	2490 ± 208
17-Dec	249 ± 12.8	272 ± 15.0	313 ± 13.5	248 ± 14.6
23-Dec	138 ± 12.6	152 ± 12.7	93.2 ± 11.7	148 ± 12.7
30-Dec	500 ± 15.8	250 ± 12.7	[(c)]	474 ± 15.6
Detection frequency	**51 of 52**	**51 of 51**	**51 of 51**	**51 of 52**
Median	**346**	**314**	**330**	**350**
IQR[(d)]	**281**	**302**	**275**	**383**
Maximum	**2270**	**2240**	**2750**	**2490**

a See main volume, Figure 5-1, for description of sampling locations.
b Due to access problems, some samples were exchanged later than scheduled.
c No data available
d IQR = interquartile range

Table 5-4. Plutonium-239+240 concentrations (nBq/m^3) in air particulate samples, Livermore site perimeter[a], 2002

Month	CAFE	COW	CRED	MESQ	MET	SALV	VIS
Jan	162 ± 87.6[b]	13.4 ± 56.5	23.1 ± 19.0	20.1 ± 35.4	26.3 ± 41.7	23.6 ± 37.3	37.6 ± 91.6
Feb	-6.85 ± 49.2	14.6 ± 41.2	11.1 ± 30.4	0[c]	16.0 ± 75.3	19.6 ± 34.4	20.3 ± 58.8
Mar	3.72 ± 49.0	-24.2 ± 24.3	-8.01 ± 14.3	-34.9 ± 70.7	24.3 ± 31.6	0.822 ± 30.8	-8.54 ± 23.6
Apr	-82.9 ± 70.4	-18.6 ± 34.3	-16.1 ± 54.0	39.3 ± 51.1	-4.87 ± 30.3	22.9 ± 55.5	-7.06 ± 50.8
May	-38.8 ± 117	16.0 ± 48.2	39.5 ± 56.5	-12.4 ± 51.9	-41.9 ± 37.7	-20.5 ± 45.4	-84.8 ± 73.9
Jun[d]	-4.22 ± 18.3	0[c]	1.82 ± 8.21	15.6 ± 27.3	7.77 ± 10.1	20.4 ± 18.5[b]	1.53 ± 14.5
Jul	-5.33 ± 4.37	21.9 ± 15.2	13.0 ± 17.4	0[c]	0.629 ± 6.03	8.36 ± 8.36	2.44 ± 10.1
Aug	18.6 ± 14.6	2.22 ± 10.3	78.4 ± 24.9[b]	11.3 ± 29.2	0.411 ± 13.7	7.03 ± 13.2	12.7 ± 11.4
Sep	6.29 ± 12.0	105 ± 34.5[b]	12.1 ± 22.6	18.8 ± 17.2[b]	245 ± 43.7[b]	9.81 ± 12.4	21.9 ± 14.5[b]
Oct	8.66 ± 11.1	8.77 ± 10.6	0.418 ± 14.0	14.4 ± 13.2	2.23 ± 5.99	6.14 ± 8.18	4.63 ± 6.55
Nov	9.92 ± 9.51	0.636 ± 5.99	-0.217 ± 13.6	4.66 ± 7.25	3.61 ± 6.81	5.62 ± 7.14	-1.98 ± 9.99
Dec	1.05 ± 9.95	-1.21 ± 2.43	-0.253 ± 6.07	-0.271 ± 6.48	4.00 ± 9.99	8.36 ± 9.10	8.10 ± 11.0
Detection frequency	**3 of 12**	**2 of 12**	**2 of 12**	**2 of 12**	**1 of 12**	**1 of 12**	**2 of 12**
Median	**2.39**	**5.5**	**6.76**	**7.98**	**3.81**	**8.36**	**3.54**
IQR[e]	**14.9**	**15.7**	**15.8**	**16.5**	**18.3**	**14.4**	**18.1**
Percent of DCG[f]	**0.00032**	**0.00074**	**0.00091**	**0.0011**	**0.00051**	**0.0011**	**0.00048**

Note: Radioactivities are reported as the measured concentration and either the 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 main volume, Chapter 14.

a See main volume, **Figure 5-1**, for description of location.

b Indicates the maximum detection for the particular location.

c Actual reported zero value from analytical laboratory, associated uncertainty not applicable.

d Analytical laboratory change, detection capabilities improved.

e IQR = interquartile range

f DCG=Derived Concentration Guide of 7.4 × 10^{-4} Bq/m^3 established by DOE. The DCG is the amount of plutonium 239+240 that can be inhaled continuously 365 days a year without exceeding the DOE primary radiation protection standard for the public. The median value is used to determine the percent DCG .

Table 5-5. Plutonium-239+240 concentrations (nBq/m^3) in air particulate samples, Livermore Valley[a], 2002

Month	Livermore Valley downwind locations			
	AMON	**PATT**	**TANK**	**ZON7**
Jan	7.64 ± 28.5	3.28 ± 14.7	6.32 ± 15.7	-3.18 ± 16.8
Feb	11.4 ± 22.9	-4.02 ± 13.9	0[b]	22.5 ± 38.5
Mar	-3.36 ± 15.1	21.9 ± 41.1	-0.655 ± 10.3	0.532 ± 20.0
Apr	-1.81 ± 26.2	-12.0 ± 19.9	-2.16 ± 17.7	15.7 ± 36.5
May	54.5 ± 59.4	-29.6 ± 35.2	63.6 ± 55.3[c]	-13.6 ± 38.3
Jun	3.20 ± 9.62	0[b]	10.7 ± 18.0	8.92 ± 14.0
Jul	1.44 ± 10.5	4.48 ± 9.10	-1.37 ± 6.88	1.79 ± 6.85
Aug	9.03 ± 12.5	0.755 ± 7.10	7.59 ± 11.4	6.92 ± 13.2
Sep	9.44 ± 13.2	11.7 ± 13.4	2.95 ± 9.55	110 ± 39.6[c]
Oct	11.0 ± 11.2	5.66 ± 9.66	-0.525 ± 8.88	1.74 ± 12.7
Nov	5.92 ± 8.51	2.1 ± 6.77	0.559 ± 5.29	14.4 ± 12.8
Dec	-3.16 ± 6.51	3.12 ± 10.2	-5.00 ± 8.55	-2.32 ± 11.7
Detection frequency	**0 of 12**	**0 of 12**	**1 of 12**	**2 of 12**
Median	**6.78**	**2.61**	**0.280**	**4.36**
IQR[d]	**9.20**	**5.73**	**7.47**	**14.9**
Percent of DCG[e]	**0.00092**	**0.00035**	**0.000038**	**0.00059**

Month	Livermore Valley upwind locations				Special interest
	CHUR	**FCC**	**FIRE**	**HOSP**	**LWRP**
Jan	-31.4 ± 25.3	25.8 ± 24.6[b]	-10.4 ± 30.3	-2.35 ± 15.3	-13.2 ± 31.5
Feb	-38.1 ± 37.3	10.2 ± 11.9	-4.46 ± 29.6	29.3 ± 27.8[b]	173 ± 61.6[b]
Mar	-17.8 ± 20.6	0[c]	-8.92 ± 10.3	3.42 ± 15.3	3.22 ± 25.0
Apr	-14.4 ± 14.5	6.30 ± 19.8	-21.2 ± 37.5	-19.9 ± 27.1	74.5 ± 76.6
May	-29.9 ± 36.3	2.62 ± 55.9	52.7 ± 58.1	25.1 ± 40.4	6.26 ± 54.0
Jun	5.25 ± 8.25	2.38 ± 7.18	3.12 ± 14.1	9.88 ± 9.92	153 ± 48.5
Jul	-1.50 ± 5.51	2.06 ± 9.51	0.335 ± 5.48	1.58 ± 12.9	81.4 ± 25.3
Aug	0.829 ± 9.62	1.71 ± 12.5	-1.35 ± 5.00	16.7 ± 13.0	114 ± 28.8
Sep	-2.64 ± 9.58	3.27 ± 14.7	6.07 ± 10.3	18.4 ± 28.5	31.3 ± 18.1
Oct	2.54 ± 7.62	14.1 ± 13.6	-6.40 ± 13.2	8.07 ± 16.4	48.8 ± 26.2
Nov	3.89 ± 12.7	6.55 ± 7.92	0.851 ± 6.96	2.64 ± 6.33	-1.34 ± 6.73
Dec	-2.98 ± 2.98	0.829 ± 7.84	-0.796 ± 7.84	0.245 ± 4.03	-5.74 ± 22.8
Detection frequency	**0 of 12**	**2 of 12**	**0 of 12**	**2 of 12**	**6 of 12**
Median	**-2.81**	**2.95**	**-1.07**	**5.75**	**40.1**
IQR[d]	**22.1**	**5.49**	**8.45**	**15.9**	**87.5**
Percent of DCG[e]	**0.00071**	**0.0004**	**0.0071**	**0.00078**	**0.0054**

Note: Radioactivitites are reported as the measured concentration and either the 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 main volume, Chapter 14.

a See main volume, **Figure 5-2**, for description of location.

b Actual reported zero value from analytical laboratory, associated uncertainty not applicable.

c Indicates the maximum detection for the particular location.

d IQR = interquartile range

e DCG=Derived Concentration Guide of 7.4×10^{-4} established by the DOE. The DCG is the amount of plutonium 239+240 that can be inhaled continuously 365 days a year without exceeding the DOE primary radiation protection standard for the public. If the median value is zero or less, the highest positive result is used to determine the percent DCG.

Table 5-6. Weekly activities for gross alpha and gross beta from low-volume air samplers, 2002[a]

Date	Gross alpha FCC	Gross alpha HOSP	Gross beta FCC	Gross beta HOSP
8-Jan	-7.03 (164)	295 ± 185	862 ± 295	888 ± 295
15-Jan	168 ± 127	[b]	1100 ± 297	[b]
22-Jan	-9.88 (140)	47.7 (138)	932 ± 277	585 ± 227
29-Jan	55.1 (137)	104 (137)	344 ± 198	341 ± 196
6-Feb	105 (120)	105 (118)	1320 ± 304	969 ± 264
13-Feb	65.5 (137)	59.2 (135)	892 ± 279	951 ± 283
19-Feb	171 ± 140	79.2 (166)	944 ± 305	810 ± 285
26-Feb	-6.88 (145)	-4.66 (140)	548 ± 226	463 ± 209
6-Mar	108 (123)	75.1 (125)	1350 ± 303	932 ± 260
12-Mar	11.0 (159)	13.7 (159)	381 ± 228	339 ± 220
19-Mar	120 (138)	-1.35 (143)	463 ± 209	285 ± 184
26-Mar	20.5 (142)	38.1 (145)	355 ± 196	599 ± 238
3-Apr	105 (122)	149 ± 105	992 ± 264	1100 ± 279
9-Apr	78.4 (159)	42.2 (157)	562 ± 248	733 ± 270
17-Apr	17.4 (139)	12.0 (123)	514 ± 217	562 ± 208
23-Apr	209 ± 149	161 (164)	629 ± 267	492 ± 249
30-Apr	-24.0 (139)	28.9 (144)	836 ± 267	825 ± 271
7-May	38.1 (141)	44.8 (143)	762 ± 257	577 ± 234
14-May	28.4 (146)	54.4 (144)	814 ± 270	796 ± 264
21-May	65.1 (136)	138 ± 115	160 (259)	156 (259)
28-May	87.3 (140)	213 ± 129	537 ± 232	729 ± 254
4-Jun	-0.243 (141)	92.5 (139)	245 ± 174	514 ± 217
11-Jun	82.5 (137)	[b]	1010 ± 297	[b]
19-Jun	105 (121)	87.0 (121)	688 ± 235	507 ± 209
25-Jun	-2.10 (160)	19.0 (158)	455 ± 243	729 ± 284
2-Jul	79.9 (132)	101 (132)	249 (256)	444 ± 211
9-Jul	77.7 (138)	63.3 (140)	381 ± 205	258 (265)
16-Jul	77.7 (138)	112 (133)	644 ± 247	762 ± 258
23-Jul	28.1 (131)	71.8 (131)	321 ± 191	614 ± 236
30-Jul	124 (134)	92.5 (134)	607 ± 237	699 ± 251
6-Aug	151 ± 115	87.3 (138)	326 ± 195	496 ± 225
13-Aug	127 (138)	303 ± 156	1040 ± 300	918 ± 280
20-Aug	134 (153)	302 ± 172	685 ± 271	807 ± 271
27-Aug	70.7 (143)	165 ± 123	659 ± 256	1110 ± 315
3-Sep	82.5 (124)	98.8 (117)	1550 ± 351	1840 ± 366
10-Sep	133 ± 114	63.3 (124)	888 ± 266	759 ± 257
17-Sep	204 ± 123	249 ± 138	1030 ± 289	1010 ± 284
24-Sep	71.4 (129)	121 (125)	1590 ± 349	1370 ± 320

Table 5-6. Weekly activities for gross alpha and gross beta from low-volume air samplers, 2002[a] (concluded)

Date	Gross alpha	Gross alpha	Gross beta	Gross beta
	FCC	HOSP	FCC	HOSP
1-Oct	167 ± 122	143 ± 112	1300 ± 314	1100 ± 289
8-Oct	72.9 (132)	173 ± 121	1020 ± 291	1020 ± 289
15-Oct	107 (120)	124 (125)	1740 ± 356	1120 ± 300
22-Oct	[b]	141 ± 106	[b]	1490 ± 341
23-Oct	76.6 (115)	[b]	1420 ± 310	[b]
29-Oct	50.3 (144)	58.5 (121)	2020 ± 424	1140 ± 300
5-Nov	50.7 (128)	206 ± 136	1370 ± 324	1430 ± 338
12-Nov	35.3 (132)	246 ± 154	692 ± 247	895 ± 282
19-Nov	97.3 (117)	25.9 (121)	1220 ± 304	1180 ± 305
26-Nov	248 ± 117	396 ± 161	2350 ± 434	2460 ± 448
3-Dec	58.8 (124)	194 ± 125	3490 ± 503	3360 ± 498
10-Dec	46.3 (122)	302 ± 157	4290 ± 554	4220 ± 548
17-Dec	-14.5 (118)	-11.8 (122)	385 ± 196	133 (244)
23-Dec	46.3 (147)	104 (144)	216 (291)	374 ± 217
30-Dec	-16.4 (128)	33.2 (125)	485 ± 222	744 ± 256
Median	74.8	95.7	788	779
IQR[c]	73.7	109	651	554
Maximum	248	396	4290	4220

Note: Limit of sensitivity (LOS) is shown in parentheses when calculated value is less than the LOS.

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

b Data not available

c IQR = interquartile range

Table 5-7. Tritium concentration in air, Livermore Valley, 2002

Month	Sampling location[a]					
	AMON	FIRE	HOSP	PATT	VET	ZON7
	mBq/m^3					
Jan	15.7 ± 21.4	35.3 ± 32.4	5.7 ± 18.2	16.6 ± 22.2	38.5 ± 25.7	32.9 ± 21.5
	4.1 ± 17.2	34.0 ± 20.8	-3.8 ± 14.6	-6.1 ± 12.1	44.8 ± 17.5	34.0 ± 17.6
	-8.0 ± 14.8	-5.5 ± 8.5	-13.5 ± 12.1	3.4 ± 10.1	4.9 ± 14.0	-3.8 ± 13.2
Feb	-4.3 ± 19.1	11.8 ± 23.1	25.9 ± 15.9	5.8 ± 13.1	6.4 ± 17.5	26.6 ± 19.3
	-0.2 ± 22.8	-2.0 ± 26.6	-7.9 ± 17.6	10.2 ± 15.5	0.8 ± 19.3	32.5 ± 18.6
Mar	15.4 ± 19.8	7.8 ± 15.7	6.7 ± 14.9	18.4 ± 12.8	-0.6 ± 16.3	26.7 ± 14.7
	21.9 ± 16.2	23.2 ± 16.4	16.7 ± 16.2	13.9 ± 14.3	13.7 ± 16.6	59.9 ± 19.2
Apr	33.2 ± 18.4	19.7 ± 19.4	12.2 ± 18.0	6.5 ± 15.7	42.2 ± 20.6	38.8 ± 18.4
	5.5 ± 16.1	-10.4 ± 17.5	-4.7 ± 16.0	5.3 ± 14.8	22.1 ± 18.4	13.7 ± 15.2
May	6.1 ± 15.2	-9.9 ± 17.3	-13.2 ± 15.1	-8.5 ± 14.2	-12.4 ± 16.8	2.1 ± 15.1
	22.5 ± 15.5	32.3 ± 18.4	17.3 ± 16.9	10.7 ± 13.6	36.8 ± 18.8	31.1 ± 17.1
Jun	4.7 ± 20.2	28.4 ± 26.0	6.1 ± 20.6	-6.2 ± 18.1	16.4 ± 22.9	50.7 ± 22.6
	8.0 ± 18.1	3.9 ± 20.1	15.8 ± 20.0	4.2 ± 16.5	-1.7 ± 19.9	6.5 ± 15.9
Jul	13.6 ± 22.2	-17.9 ± 19.3	12.1 ± 22.9	28.3 ± 20.2	-13.4 ± 22.2	12.6 ± 18.3
	19.2 ± 19.5	17.6 ± 18.9	5.7 ± 20.0	11.2 ± 15.6	17.3 ± 18.2	27.6 ± 14.7
Aug	8.7 ± 22.5	2.6 ± 12.7	44.8 ± 24.1	20.8 ± 20.7	9.1 ± 21.3	58.8 ± 25.1
	8.5 ± 18.5	-6.0 ± 16.0	-28.2 ± 17.1	-5.0 ± 14.8	-19.4 ± 17.5	-16.5 ± 16.1
	13.3 ± 20.2	-11.4 ± 21.2	2.5 ± 20.3	-4.7 ± 19.9	-12.8 ± 19.9	-12.0 ± 19.6
Sep	25.9 ± 16.1	9.8 ± 17.0	15.3 ± 16.5	5.3 ± 13.6	44.0 ± 17.9	22.7 ± 9.1
	[b]	15.7 ± 15.7	-2.4 ± 13.8	4.4 ± 13.2	3.8 ± 15.1	[b]
Oct	8.4 ± 8.2	6.7 ± 11.5	5.0 ± 10.5	0.2 ± 10.5	21.9 ± 12.8	-0.9 ± 11.0
	7.8 ± 16.8	0.6 ± 17.1	-1.7 ± 17.4	0.0 ± 17.3	-8.0 ± 18.7	24.8 ± 17.5
Nov	11.5 ± 13.4	12.4 ± 12.0	14.1 ± 13.5	11.1 ± 13.0	19.2 ± 13.2	18.4 ± 12.8
	-14.7 ± 19.2	3.8 ± 19.1	9.8 ± 20.4	-12.9 ± 18.8	-9.3 ± 25.2	0.9 ± 30.7
Dec	7.5 ± 15.6	60.7 ± 17.3	9.6 ± 9.5	3.9 ± 15.4	59.2 ± 17.2	93.6 ± 18.4
	-11.5 ± 17.5	7.0 ± 19.3	-3.8 ± 18.1	-11.6 ± 17.7	8.7 ± 26.7	31.0 ± 21.6
Median	**8.4**	**7.4**	**5.9**	**4.9**	**8.9**	**26.6**
IQR[c]	**10.7**	**20.5**	**17.1**	**14.5**	**23.5**	**26.4**
Percent of DCG[d]	**0.00023**	**0.0002**	**0.00046**	**0.00013**	**0.00024**	**0.00072**
Mean	**8.9**	**10.4**	**5.6**	**4.8**	**12.8**	**24.5**
Dose (nSv)[e]	**1.9**	**2.2**	**1.2**	**1.0**	**2.7**	**5.1**

Note: Radioactivities are reported as the measured concentration and an uncertainty (± 2∞ counting error). If the concentration is less than the uncertainty, the result is considered to be a nondetection. See the main volume, Chapter 14.

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

b No data. See main volume, Chapter 14

c IQR = interquartile range

d DCG = Derived Concentration Guide of 3.7 ∞ 10^6 mBq/m^3 for tritium in air. Percent of DGC is calculated from the median concentration.

e This dose is calculated from the mean concentration and is the effective dose equivalent from inhalation and skin absorption.

Table 5-8. Tritium concentration in air, Livermore site perimeter, 2002

Month	Sampling location[a]							
	CAFE	COW	DWTF	MESQ	MET	POOL	SALV	VIS
	mBq/m3							
Jan	55.9 ± 20.6	24.5 ± 21.4	41.8 ± 21.5	43.7 ± 29.4	(b)	57.7 ± 14.7	(b)	(b)
	81.0 ± 16.0	41.1 ± 17.4	21.8 ± 18.4	44.8 ± 16.6	(b)	171 ± 24.7	61.1 ± 19.4	24.9 ± 14.6
	20.0 ± 3.57	5.14 ± 14.4	63.3 ± 19.3	13.2 ± 13.8	22.2 ± 12.9	120 ± 20.0	37.4 ± 14.6	14.3 ± 12.8
Feb	72.5 ± 17.1	43.7 ± 19.5	77.0 ± 29.0	29.9 ± 19.3	46.3 ± 18.4	153 ± 26.2	45.9 ± 16.1	41.1 ± 17.6
	24.5 ± 18.3	36.8 ± 21.2	44.4 ± 19.6	65.9 ± 23.3	7.03 ± 19.7	54.4 ± 14.1	42.9 ± 19.8	34.7 ± 21.4
Mar	42.2 ± 15.4	(b)	12.7 ± 14.7	18.2 ± 13.8	19.2 ± 16.2	64.8 ± 12.8	(b)	20.3 ± 15.4
	35.0 ± 15.0	(b)	65.5 ± 17.8	21.9 ± 16.4	18.4 ± 16.3	73.3 ± 14.2	25.5 ± 16.3	88.1 ± 19.8
Apr	86.2 ± 20.2	51.8 ± 19.5	32.6 ± 16.3	48.1 ± 18.8	30.1 ± 19.1	98.1 ± 16.1	36.5 ± 18.8	74.7 ± 19.6
	51.1 ± 17.5	19.5 ± 15.9	37.4 ± 17.4	4.88 ± 18.1	20.0 ± 17.7	79.9 ± 19.6	37.7 ± 16.9	21.9 ± 16.9
May	8.58 ± 15.4	28.0 ± 16.8	58.1 ± 17.4	-0.392 ± 15.1	-8.58 ± 15.9	41.4 ± 18.0	-18.1 ± 14.9	35.2 ± 17.1
	53.7 ± 16.3	43.3 ± 17.0	61.1 ± 18.1	14.2 ± 16.8	17.0 ± 16.4	96.2 ± 32.0	28.2 ± 16.1	75.1 ± 18.5
Jun	68.1 ± 23.8	31.8 ± 22.1	6.03 ± 20.2	10.4 ± 22.1	1.51 ± 18.9	100 ± 32.1	18.4 ± 21.6	89.5 ± 24.6
	38.5 ± 19.6	4.14 ± 17.4	26.2 ± 17.9	12.9 ± 19.1	-4.55 ± 15.4	56.6 ± 25.1	4.66 ± 17.8	35.8 ± 19.7
Jul	34.0 ± 24.2	38.5 ± 23.1	26.9 ± 22.2	3.49 ± 23.3	-10.7 ± 19.0	51.8 ± 28.4	7.96 ± 22.1	(b)
	67.7 ± 22.8	74.4 ± 21.3	68.8 ± 21.2	6.25 ± 19.1	13.4 ± 17.1	92.1 ± 27.5	33.9 ± 20.4	(b)
Aug	29.7 ± 25.0	70.3 ± 25.0	102 ± 25.9	11.6 ± 24.3	17.2 ± 21.1	42.6 ± 28.0	25.8 ± 22.9	52.5 ± 24.8
	44.8 ± 22.9	13.8 ± 10.8	49.6 ± 20.0	17.7 ± 20.9	-11.9 ± 15.1	57.0 ± 14.2	44.4 ± 21.7	64.8 ± 19.2
	37.7 ± 22.2	4.74 ± 20.4	36.3 ± 22.6	-7.66 ± 25.7	-16.9 ± 19.4	58.5 ± 29.0	7.44 ± 20.1	45.1 ± 23.9
Sep	62.9 ± 17.8	33.9 ± 17.0	55.9 ± 17.5	36.8 ± 17.5	19.1 ± 15.4	381 ± 33.5	58.8 ± 17.5	78.8 ± 16.2
	112 ± 20.8	51.4 ± 19.2	63.3 ± 18.6	50.3 ± 16.5	20.3 ± 16.4	210 ± 27.0	51.1 ± 18.5	(b)
Oct	115 ± 16.0	19.6 ± 13.5	26.0 ± 12.4	38.5 ± 12.9	21.0 ± 12.3	133 ± 17.6	41.4 ± 12.4	52.5 ± 12.9
	81.4 ± 20.1	160 ± 22.7	40.0 ± 21.2	17.9 ± 18.9	21.3 ± 18.4	127 ± 22.8	-4.92 ± 16.5	51.4 ± 18.6
Nov	58.5 ± 14.8	34.4 ± 13.5	38.1 ± 15.8	21.9 ± 14.6	36.6 ± 14.8	130 ± 17.9	91.0 ± 15.2	59.9 ± 14.6
	26.7 ± 20.4	29.5 ± 20.5	56.6 ± 23.4	16.0 ± 26.9	32.3 ± 22.2	100 ± 23.8	36.1 ± 20.7	65.9 ± 22.7
Dec	179 ± 21.2	132 ± 21.2	208 ± 23.0	125 ± 21.5	68.5 ± 20.1	429 ± 28.1	76.6 ± 17.3	289 ± 24.4
	122 ± 23.8	93.2 ± 21.3	75.5 ± 24.9	60.3 ± 23.6	28.0 ± 22.6	(b)	34.7 ± 19.2	83.6 ± 19.4
Median	**54.8**	**35.6**	**47**	**18.1**	**19.2**	**96.2**	**36.3**	**52.5**
IQR[c]	**43.2**	**28.2**	**29.8**	**30.5**	**18**	**72.3**	**21**	**39.7**
Percent of DCG[d]	**0.0015**	**0.00096**	**0.0013**	**0.00049**	**0.00052**	**0.0026**	**0.00098**	**0.0014**
Mean	**61.9**	**45.2**	**53.7**	**27.9**	**17**	**119**	**34.4**	**63.6**
Dose (nSv)[e]	**13**	**9.5**	**11**	**5.9**	**3.6**	**25**	**7.2**	**13**

Note: Radioactivities are reported as the measured concentration and an uncertainty (± 2∞ counting error).
If the concentration is less than the uncertainty, the result is considered to be a nondetection. See the main volume, Chapter 14.

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

b No data. See main volume, Chapter 14

c IQR = interquartile range

d DCG = Derived Concentration Guide of 3.7 ∞ 10^6 mBq/m^3 for tritium in air. Percent of DCG is calculated from the median concentration.

e This dose is calculated from the mean concentration and is the effective dose equivalent from inhalation and skin absorption.

Table 5-9. Tritium concentration in air at locations near diffuse sources, 2002

Month	Sampling locations[a]			
	B292	B331	B514	B624
	mBq/m³			
Jan	56.2 ± 24.4	214 ± 30.2	134 ± 22.6	(b)
	86.2 ± 18.9	253 ± 25.3	191 ± 19.6	1800 ± 49.2
	91.0 ± 16.2	188 ± 21.7	122 ± 14.8	1990 ± 48.1
Feb	93.6 ± 21.0	360 ± 34.4	182 ± 19.5	2070 ± 52.2
	53.7 ± 22.2	269 ± 27.0	120 ± 20.8	1980 ± 61.8
Mar	57.0 ± 16.3	179 ± 20.2	107 ± 16.7	2140 ± 58.5
	75.1 ± 17.0	263 ± 23.1	101 ± 16.9	1500 ± 45.1
Apr	49.2 ± 15.3	588 ± 35.5	126 ± 20.4	1710 ± 57.0
	41.1 ± 15.6	197 ± 23.4	77.0 ± 17.2	1710 ± 50.0
May	21.2 ± 17.2	187 ± 20.6	16.2 ± 15.2	740 ± 35.9
	24.2 ± 13.1	283 ± 23.3	67.3 ± 17.3	966 ± 40.7
Jun	22.2 ± 15.1	308 ± 29.7	90.3 ± 25.3	1060 ± 44.4
	33.4 ± 14.9	211 ± 23.3	33.1 ± 19.0	862 ± 37.4
Jul	9.32 ± 16.4	241 ± 28.6	21.9 ± 22.4	622 ± 38.5
	66.6 ± 21.2	614 ± 35.2	83.6 ± 22.7	(b)
Aug	16.8 ± 21.6	514 ± 37.7	9.10 ± 23.3	625 ± 37.7
	52.9 ± 17.6	718 ± 36.3	135 ± 28.0	1480 ± 43.7
	54.0 ± 22.1	829 ± 44.8	76.6 ± 25.6	1070 ± 48.5
Sep	96.6 ± 18.7	807 ± 35.5	194 ± 26.0	1780 ± 46.3
	62.2 ± 18.1	770 ± 34.1	185 ± 22.5	2740 ± 52.5
Oct	86.2 ± 14.5	466 ± 25.3	138 ± 16.1	1820 ± 44.8
	94.0 ± 19.8	367 ± 26.3	59.2 ± 18.8	1110 ± 42.2
Nov	79.6 ± 15.1	176 ± 17.6	124 ± 15.7	1880 ± 44.8
	75.5 ± 22.6	171 ± 23.1	(b)	5920 ± 101
Dec	173 ± 20.8	278 ± 21.5	346 ± 23.5	6550 ± 89.5
	113 ± 23.2	167 ± 20.5	174 ± 22.8	5960 ± 96.9
Median	**59.6**	**274**	**120**	**1750**
IQR[c]	**43.1**	**302**	**61.4**	**943**
Percent of DCG[d]	**0.0016**	**0.0074**	**0.0032**	**0.047**
Mean	**64.8**	**370**	**117**	**2090**
Dose (nSv)[e]	**14**	**78**	**24**	**440**

Note: Radioactivities are reported as the measured concentration and an uncertainty (± 2∞ counting error). If the concentration is less than the uncertainty, the result is considered to be a nondetection. See the main volume, Chapter 14.

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

b No data. See main volume, Chapter 14

c IQR = interquartile range

d DCG = Derived Concentration Guide of 3.7×10^6 mBq/m³ for tritium in air. Percent of DGC is calculated from the median concentration.

e This dose is calculated from the mean concentration and is the effective dose equivalent from inhalation and skin absorption.

Table 5-10. Beryllium concentration (pg/m^3) in Livermore site perimeter air particulate samples, 2002[(a)]

Month	CAFE	COW	MESQ	MET	SALV	VIS
Jan	4.39 (<5.31)	3.53 (<4.87)	5.77	3.24 (<4.85)	1.44 (<4.80)	3.65 (<4.83)
Feb	4.60 (<4.75)	4.53 (<4.68)	3.59 (<4.62)	3.08 (<4.54)	1.79 (<4.60)	2.25 (<4.65)
Mar	4.19 (<4.83)	10.7	7.16	5.77	3.93 (<4.57)	4.62 (<4.77)
Apr	6.36	14.3	5.96 (<11.9)	7.17	9.42	6.84
May	2.68 (<4.76)	12.8	1.69 (<4.71)	1.75 (<4.76)	1.39 (<4.95)	1.29 (<4.73)
Jun[(b)]	10.4	16.1	7.00	9.30	8.10	8.60
Jul	17.3	13.3	12.9	13.5	14.6	14.1
Aug	8.82	17.8	8.26	9.93	6.70	8.72
Sep	24.5[(c)]	19.2	19.7[(c)]	22.3[(c)]	0.866	15.4
Oct	18.1	27.8[(c)]	16.4	15.7	17.3[(c)]	19.1[(c)]
Nov	15.3	13.7	13.0	12.4	9.80	12.3
Dec	8.05	17.6	3.45	4.24	3.67	5.11
Detection frequency[(d)]	**8 of 12**	**10 of 12**	**9 of 12**	**9 of 12**	**8 of 12**	**8 of 12**
Median	**8.44**	**14.0**	**7.08**	**8.24**	**5.32**	**7.72**
IQR[(e)]	**11.3**	**5.38**	**7.70**	**8.69**	**7.81**	**8.37**
Percent of ACL[(f)]	**0.084**	**0.14**	**0.071**	**0.082**	**0.053**	**0.077**

Note: Miminum detectable concentration (MDC) is shown in parentheses when calculated concentration is less than the MDC.

a See main volume, **Figure 5-1**, for description of location.

b Analytical laboratory change, detection capabilities improved.

c Indicates the maximum detection for the particular location.

d Detection frequency is the number of samples with results above the detection limited.

e IQR = interquartile range

f ACL=Ambient concentration limit of 10,000 pg/m^3 is established by the Bay Area Air Quality Management District. Percent of ACL is calculated from the median value.

Table 5-11. Weekly gross alpha and gross beta concentrations (µBq/m^3) from samples collected at Site 300 and Tracy, 2002[a]

Date	801E	COHO	ECP	EOBS	GOLF	NPS	WCP	WOBS	TFIR
	Site 300								Tracy
	Gross alpha								
9-Jan	18.3 ± 36.9	90.9 ± 47.1	37.8 ± 43.1	60.7 ± 50.1	84.6 ± 51.2	48.5 ± 43.6	49.3 ± 51.1	42.1 ± 35.2	65.0 ± 47.3
16-Jan	62.8 ± 45.1	45.6 ± 40.0	50.7 ± 54.6	57.6 ± 65.3	34.9 ± 39.2	60.5 ± 45.4	28.8 ± 45.6	40.1 ± 33.5	89.2 ± 52.7
23-Jan	79.4 ± 48.9	11.8 ± 23.4	43.4 ± 50.8	19.3 ± 36.6	39.2 ± 39.5	-3.06 ± 32.9	53.1 ± 58.4	30.7 ± 28.6	66.8 ± 50.2
30-Jan	17.6 ± 29.2	34.0 ± 31.1	38.3 ± 38.0	8.97 ± 31.9	20.5 ± 30.2	36.7 ± 35.6	25.4 ± 31.3	27.2 ± 33.7	16.2 ± 28.0
6-Feb	55.3 ± 41.8	59.5 ± 49.7	100 ± 57.1	71.2 ± 50.9	59.0 ± 48.8	122 ± 60.6	63.3 ± 56.6	6.60 ± 31.5	-11.2 ± 38.8
13-Feb	63.7 ± 41.9	63.2 ± 51.8	71.1 ± 46.4	83.7 ± 45.8	39.5 ± 43.3	58.4 ± 46.9	67.0 ± 44.0	38.8 ± 40.5	12.7 ± 44.2
20-Feb	70.6 ± 43.0	16.5 ± 39.0	58.3 ± 46.8	40.3 ± 39.6	30.7 ± 35.2	73.3 ± 59.0	27.5 ± 31.7	31.3 ± 40.9	21.5 ± 33.3
27-Feb	33.0 ± 36.4	8.93 ± 36.1	7.33 ± 29.3	-4.60 ± 26.4	31.3 ± 36.5	36.0 ± 35.6	22.7 ± 40.6	68.1 ± 45.5	-4.41 ± 28.8
6-Mar	133 ± 64.3	101 ± 61.4	68.2 ± 57.0	86.2 ± 56.4	47.1 ± 52.0	113 ± 59.8	112 ± 53.0	73.0 ± 45.9	176 ± 68.3
13-Mar	23.4 ± 40.6	27.8 ± 37.4	-4.10 ± 45.9	-11.0 ± 41.0	40.1 ± 34.1	-1.94 ± 39.8	24.1 ± 27.5	14.9 ± 26.3	50.6 ± 43.6
20-Mar	50.0 ± 41.3	-5.05 ± 43.6	55.0 ± 58.5	11.1 ± 34.2	-5.56 ± 11.6	-19.3 ± 30.9	32.6 ± 43.0	51.3 ± 36.8	94.7 ± 55.9
27-Mar	8.31 ± 43.0	13.8 ± 39.7	38.4 ± 51.6	32.2 ± 46.6	38.9 ± 45.4	31.3 ± 34.8	77.5 ± 50.4	30.3 ± 38.1	48.4 ± 41.6
3-Apr	135 ± 64.2	101 ± 59.1	40.2 ± 51.2	83.9 ± 61.5	88.5 ± 52.6	104 ± 54.5	104 ± 57.0	97.4 ± 55.5	114 ± 57.8
10-Apr	81.7 ± 55.4	45.6 ± 42.1	65.3 ± 57.6	13.3 ± 31.8	135 ± 65.7	43.4 ± 51.9	49.6 ± 46.8	108 ± 61.3	79.5 ± 52.3
17-Apr	66.3 ± 49.6	61.4 ± 46.9	-9.19 ± 30.1	67.9 ± 64.7	46.6 ± 48.0	18.2 ± 50.0	36.3 ± 48.7	81.1 ± 52.2	60.8 ± 46.6
24-Apr	67.4 ± 54.0	39.3 ± 49.0	40.8 ± 46.6	23.5 ± 36.5	99.7 ± 59.4	70.4 ± 53.2	15.1 ± 48.0	70.5 ± 54.1	103 ± 57.1
1-May	[b]	73.7 ± 53.8	37.9 ± 48.1	22.8 ± 34.2	81.6 ± 60.8	64.5 ± 49.4	61.9 ± 51.0	16.1 ± 35.3	25.7 ± 46.6
8-May	27.2 ± 54.5	27.0 ± 44.7	54.1 ± 45.6	60.1 ± 56.6	18.9 ± 46.8	76.3 ± 51.6	88.5 ± 54.3	24.1 ± 35.7	64.8 ± 59.1
15-May	58.7 ± 50.7	72.0 ± 59.9	87.1 ± 56.8	118 ± 63.2	36.1 ± 44.9	39.9 ± 44.8	74.8 ± 56.9	19.5 ± 32.7	87.9 ± 47.7
22-May	45.7 ± 41.5	26.3 ± 51.4	47.7 ± 43.5	45.1 ± 51.2	-5.00 ± 35.2	25.1 ± 35.4	30.6 ± 38.2	38.0 ± 50.8	44.1 ± 38.3
29-May	43.8 ± 53.2[c]	65.1 ± 46.9	55.8 ± 50.9	7.59 ± 33.0	69.8 ± 51.5	16.4 ± 40.5	83.5 ± 51.9	13.9 ± 36.2	56.5 ± 44.8
5-Jun	-13.7 ± 57.4	15.9 ± 46.3	3.34 ± 50.7	-10.4 ± 22.9	32.6 ± 43.3	33.3 ± 39.2	-23.4 ± 37.4	-2.75 ± 49.2	16.5 ± 39.6
12-Jun	-3.06 ± 44.0	5.96 ± 44.8	-8.62 ± 48.1	-5.14 ± 43.3	-4.14 ± 34.0	13.1 ± 32.2	1.33 ± 44.8	16.1 ± 53.3	16.2 ± 39.2
19-Jun	-11.8 ± 22.0[d]	6.44 ± 47.0	3.17 ± 38.8	3.60 ± 45.5	18.2 ± 54.4	9.84 ± 47.0	3.00 ± 31.0	12.3 ± 38.5	6.85 ± 36.5
26-Jun	25.0 ± 40.7	9.66 ± 33.4	-4.11 ± 34.9	3.85 ± 44.8	-16.0 ± 46.3	3.81 ± 44.8	-9.47 ± 25.0	1.12 ± 36.1	4.74 ± 51.8
3-Jul	10.4 ± 32.1	4.00 ± 30.2	-9.51 ± 31.2	-17.9 ± 40.7	-7.29 ± 48.1	-7.07 ± 42.6	9.62 ± 32.9	-11.7 ± 30.3	6.92 ± 50.7
10-Jul	-3.00 ± 40.0	8.66 ± 46.3	6.85 ± 49.6	18.4 ± 42.6	1.07 ± 29.9	12.1 ± 37.4	2.97 ± 43.7	9.29 ± 50.7	6.07 ± 35.9
17-Jul	-3.52 ± 34.5	8.58 ± 46.3	5.51 ± 35.9	[b]	-0.696 ± 30.0	12.4 ± 40.0	6.29 ± 34.4	14.6 ± 54.0	16.1 ± 45.9
24-Jul	-2.63 ± 23.0	-1.88 ± 38.8	-1.04 ± 27.6	-0.329 ± 41.1	-9.88 ± 38.1	11.0 ± 48.1	2.51 ± 27.9	8.88 ± 36.1	0.836 ± 43.7
31-Jul	12.4 ± 39.6	11.4 ± 36.8	4.48 ± 36.6	[b]	6.99 ± 50.0	2.46 ± 45.5	8.44 ± 37.4	4.44 ± 36.4	-1.58 ± 45.9
7-Aug	[b]	-2.45 ± 23.3	6.77 ± 42.6	29.0 ± 38.5	34.2 ± 52.2	24.6 ± 34.2	-11.7 ± 37.7	5.99 ± 46.6	10.7 ± 33.4
14-Aug	12.6 ± 2.77	12.3 ± 6.96	4.03 ± 6.22	[b]	-2.54 ± 6.96	35.4 ± 6.33	-11.0 ± 5.92	32.0 ± 8.81	3.22 ± 7.29
21-Aug	15.8 ± 3.53	16.1 ± 5.11	48.5 ± 7.99	[b]	37.0 ± 5.88	91.0 ± 7.81	22.6 ± 6.99	96.2 ± 9.99	54.8 ± 7.99
28-Aug	6.66 ± 5.92	44.0 ± 9.07	31.8 ± 7.25	15.2 ± 6.22	45.9 ± 8.88	27.5 ± 6.25	26.0 ± 8.10	31.9 ± 9.14	19.3 ± 6.25
4-Sep	-5.55 ± 7.62	-1.88 ± 8.10	-19.7 ± 6.11	-8.81 ± 8.14	-2.99 ± 6.70	0.377 ± 6.36	-15.9 ± 5.40	62.9 ± 10.6	-1.78 ± 6.62
11-Sep	-12.8 ± 26.0	-12.8 ± 53.7	-5.77 ± 33.9	-3.63 ± 56.2	-4.29 ± 50.0	13.0 ± 55.9	3.43 ± 32.7	-2.53 ± 34.7	38.1 ± 49.2
18-Sep	-2.42 ± 33.7	3.89 ± 59.9	-4.92 ± 37.7	-6.25 ± 53.7	-7.81 ± 51.1	3.92 ± 57.4	-5.51 ± 32.3	-8.21 ± 34.7	-3.57 ± 33.7
25-Sep	44.4 ± 58.1	42.6 ± 62.2	36.3 ± 55.1	-32.8 ± 53.7	16.6 ± 50.7	45.1 ± 69.9	-6.62 ± 67.0	51.1 ± 58.5	35.7 ± 76.2
2-Oct	16.6 ± 37.4	14.0 ± 41.1	33.6 ± 41.4	-21.9 ± 42.2	-2.82 ± 31.7	11.1 ± 51.1	6.88 ± 54.8	-8.77 ± 35.7	34.9 ± 60.3

Table 5-11. Weekly gross alpha and gross beta concentrations (µBq/m^3) from samples collected at Site 300 and Tracy, 2002[a] (continued)

Date	801E	COHO	ECP	EOBS	GOLF	NPS	WCP	WOBS	TFIR
	Site 300								Tracy
Gross alpha									
9-Oct	7.99 ± 36.4	22.9 ± 41.8	39.6 ± 44.4	46.3 ± 57.7	-10.3 ± 52.2	-3.23 ± 49.6	25.9 ± 60.3	14.4 ± 41.4	42.6 ± 58.5
16-Oct	59.9 ± 52.9	77.3 ± 72.9	77.7 ± 60.3	50.0 ± 52.2	60.3 ± 58.5	90.3 ± 70.3	63.6 ± 55.9	59.9 ± 64.0	88.8 ± 62.5
23-Oct	35.3 ± 316	48.5 ± 414	69.9 ± 400	19.2 ± 292	18.4 ± 316	2.82 ± 322	7.03 ± 264	79.2 ± 429	35.3 ± 342
30-Oct	40.3 ± 306	45.9 ± 389	2.93 ± 236	13.5 ± 253	26.3 ± 315	10.8 ± 322	29.2 ± 285	21.0 ± 327	56.2 ± 361
6-Nov	88.1 ± 61.8	41.8 ± 68.1	32.4 ± 53.7	79.6 ± 59.2	86.2 ± 66.2	83.3 ± 71.0	85.5 ± 62.2	57.7 ± 68.1	105 ± 65.5
13-Nov	60.3 ± 46.6	22.9 ± 41.8	1.14 ± 29.2	72.1 ± 60.3	6.51 ± 32.1	42.9 ± 55.5	0.294 ± 53.3	-26.6 ± 21.6	15.7 ± 57.0
20-Nov	15.6 ± 39.2	26.8 ± 48.1	2.01 ± 34.6	15.0 ± 51.8	35.2 ± 44.4	15.1 ± 52.9	-2.08 ± 51.8[e]	13.4 ± 38.8[e]	5.11 ± 60.3
27-Nov	1.65 ± 2.32	0.310 ± 2.41	-0.633 ± 2.08	1.61 ± 2.95	1.13 ± 2.46	1.17 ± 2.97	0.294 ± 2.39	1.22 ± 1.85	0.688 ± 3.14
4-Dec	-28.9 ± 47.7	12.9 ± 58.8	-67.7 ± 44.0	-18.5 ± 58.8	55.5 ± 65.5	-39.6 ± 59.2	8.36 ± 69.2	37.4 ± 63.6	23.3 ± 74.0
11-Dec	-21.2 ± 54.8	36.6 ± 67.3	16.1 ± 66.6	37.4 ± 70.7	28.1 ± 64.8	40.7 ± 75.1	27.3 ± 74.7	3.54 ± 59.9	75.1 ± 85.8
18-Dec	[b]	3.05 ± 3.96	57.7 ± 6.44	9.21 ± 4.33	15.3 ± 4.63	30.9 ± 5.88	15.1 ± 4.59	[b]	75.5 ± 6.99
26-Dec	48.5 ± 5.03	27.4 ± 5.22	9.14 ± 4.29	45.9 ± 5.99	33.6 ± 5.48	24.1 ± 5.55	-9.07 ± 3.14	75.9 ± 7.03	51.4 ± 6.14
Jan 2 (2003)	[b]	-3.43 ± 4.03	3.43 ± 4.44	17.3 ± 5.25	-3.44 ± 4.03	-3.41 ± 4.00	-17.1 ± 3.00	-17.1 ± 2.99	10.2 ± 4.81
Detection frequency	**20 of 48**	**17 of 52**	**15 of 52**	**15 of 48**	**14 of 52**	**19 of 52**	**15 of 52**	**15 of 51**	**22 of 52**
Median	**24.2**	**22.9**	**32.1**	**17.9**	**29.4**	**24.9**	**22.7**	**24.1**	**35.1**
IQR[f]	**53.6**	**37**	**46.3**	**46.1**	**42.7**	**37.6**	**47.2**	**43.5**	**55.5**
Maximum	**135**	**101**	**100**	**118**	**135**	**122**	**112**	**108**	**176**
Gross beta									
9-Jan	479 ± 114	591 ± 102	285 ± 69.5	350 ± 79.9	565 ± 112	294 ± 88.2	357 ± 75.5	214 ± 74.0	789 ± 126
16-Jan	569 ± 109	552 ± 102	464 ± 87.9	519 ± 89.0	778 ± 120	538 ± 107	491 ± 85.9	384 ± 86.9	942 ± 130
23-Jan	406 ± 93.6	397 ± 88.9	301 ± 74.9	377 ± 76.8	305 ± 84.6	342 ± 96.2	200 ± 64.0	390 ± 86.7	606 ± 109
30-Jan	274 ± 83.3	206 ± 71.5	193 ± 56.9	141 ± 52.7	249 ± 80.0	218 ± 75.5	181 ± 74.9	90.0 ± 63.5	464 ± 94.6
6-Feb	766 ± 115	704 ± 101	598 ± 105	894 ± 125	787 ± 120	1330 ± 157	510 ± 106	674 ± 113	765 ± 109
13-Feb	623 ± 104	518 ± 87.9	506 ± 100	559 ± 97.6	531 ± 108	580 ± 110	541 ± 102	499 ± 105	634 ± 98.8
20-Feb	506 ± 94.0	493 ± 86.8	548 ± 106	406 ± 93.3	515 ± 109	632 ± 118	493 ± 98.6	344 ± 86.3	386 ± 75.8
27-Feb	274 ± 79.2	185 ± 64.6	294 ± 91.2	334 ± 93.7	315 ± 87.1	385 ± 97.0	339 ± 92.5	276 ± 78.5	192 ± 56.7
6-Mar	601 ± 111	391 ± 76.7	609 ± 102	554 ± 92.5	590 ± 107	616 ± 114	611 ± 107	598 ± 103	584 ± 108
13-Mar	288 ± 90.6	192 ± 56.3	199 ± 64.8	135 ± 52.2	314 ± 84.5	154 ± 72.5	153 ± 68.0	227 ± 74.0	230 ± 84.4
20-Mar	250 ± 83.3	204 ± 59.4	160 ± 61.0	257 ± 66.8	272 ± 79.5	243 ± 77.4	261 ± 84.2	230 ± 72.8	309 ± 92.6
27-Mar	346 ± 94.9	229 ± 63.1	377 ± 79.0	328 ± 76.9	310 ± 90.0	505 ± 101	425 ± 102	427 ± 101	347 ± 90.8
3-Apr	1030 ± 135	742 ± 99.3	777 ± 103	894 ± 115	875 ± 127	901 ± 119	996 ± 134	902 ± 128	857 ± 126
10-Apr	428 ± 81.7	382 ± 78.2	460 ± 105	401 ± 93.5	417 ± 81.6	381 ± 80.5	373 ± 77.0	273 ± 69.3	357 ± 76.0
17-Apr	257 ± 67.3	279 ± 69.1	300 ± 88.7	233 ± 92.4	265 ± 69.3	257 ± 67.5	262 ± 70.0	223 ± 63.1	313 ± 72.9
24-Apr	385 ± 79.1	313 ± 72.1	387 ± 103	413 ± 98.8	473 ± 84.8	501 ± 87.4	326 ± 72.3	368 ± 75.9	509 ± 87.4
1-May	[b]	322 ± 72.0	421 ± 100	414 ± 95.0	350 ± 77.7	308 ± 72.3	317 ± 72.8	345 ± 75.1	360 ± 77.0
8-May	435 ± 91.5	336 ± 96.7	400 ± 80.0	343 ± 73.8	380 ± 77.1	345 ± 75.6	272 ± 69.4	263 ± 67.8	591 ± 117
15-May	448 ± 83.1	532 ± 117	526 ± 89.9	449 ± 81.4	410 ± 79.9	510 ± 88.1	459 ± 84.8	422 ± 80.6	790 ± 118
22-May	223 ± 63.1	258 ± 98.6	296 ± 71.6	270 ± 69.7	232 ± 65.2	152 ± 57.2	291 ± 70.8	233 ± 63.2	314 ± 93.6
29-May	241 ± 77.2[c]	308 ± 88.6	294 ± 71.3	283 ± 68.9	238 ± 64.5	313 ± 73.3	259 ± 67.0	234 ± 63.7	427 ± 97.2
5-Jun	151 ± 157	201 ± 115	215 ± 115	251 ± 83.6	250 ± 82.5	261 ± 84.7	246 ± 118	222 ± 116	309 ± 87.3

Table 5-11. Weekly gross alpha and gross beta concentrations ($\mu Bq/m^3$) from samples collected at Site 300 and Tracy, 2002[a] (concluded)

Date	801E	COHO	ECP	EOBS	GOLF	NPS	WCP	WOBS	TFIR
	Site 300								Tracy
					Grosss beta				
12-Jun	235 ± 118	176 ± 114	270 ± 118	272 ± 121	308 ± 87.7	250 ± 84.0	257 ± 120	193 ± 114	270 ± 84.4
19-Jun	307 ± 82.1[d]	268 ± 121	433 ± 98.1	221 ± 118	252 ± 119	308 ± 123	320 ± 90.3	335 ± 90.3	333 ± 91.0
26-Jun	285 ± 95.1	346 ± 91.0	357 ± 92.1	216 ± 117	211 ± 115	216 ± 117	282 ± 87.0	322 ± 89.2	242 ± 117
3-Jul	247 ± 83.6	259 ± 85.5	300 ± 87.0	247 ± 119	162 ± 112	256 ± 120	310 ± 89.5	286 ± 85.8	243 ± 115
10-Jul	276 ± 118	242 ± 116	305 ± 117	296 ± 91.0	278 ± 86.6	265 ± 88.4	233 ± 116	259 ± 115	312 ± 90.3
17-Jul	-35.8 ± 92.9	381 ± 124	369 ± 93.6	[b]	346 ± 92.1	429 ± 101	396 ± 97.3	422 ± 123	459 ± 102
24-Jul	292 ± 89.2	228 ± 114	265 ± 84.7	263 ± 116	198 ± 109	334 ± 121	268 ± 87.0	229 ± 81.4	196 ± 107
31-Jul	418 ± 98.8	329 ± 92.9	455 ± 99.5	[b]	437 ± 124	477 ± 129	488 ± 104	451 ± 99.5	403 ± 123
7-Aug	[b]	223 ± 83.3	233 ± 115	243 ± 83.6	192 ± 110	221 ± 83.3	208 ± 114	240 ± 113	292 ± 88.1
14-Aug	169 ± 6.51	662 ± 20.0	374 ± 17.7	[b]	577 ± 19.3	633 ± 16.4	433 ± 18.2	814 ± 22.3	673 ± 20.1
21-Aug	48.8 ± 30.5	14.7 ± 4.77	36.1 ± 5.62	[b]	47.0 ± 7.18	76.6 ± 8.47	15.9 ± 6.85	78.8 ± 8.40	29.8 ± 7.14
28-Aug	592 ± 17.9	294 ± 19.9	529 ± 17.1	389 ± 15.5	437 ± 21.5	366 ± 15.4	316 ± 20.6	566 ± 22.6	507 ± 17.2
4-Sep	570 ± 23.3	629 ± 23.9	847 ± 20.8	810 ± 25.3	814 ± 20.4	833 ± 20.6	744 ± 19.9	795 ± 25.0	799 ± 20.3
11-Sep	320 ± 110	279 ± 141	314 ± 107	307 ± 143	332 ± 148	407 ± 153	299 ± 108	322 ± 107	474 ± 123
18-Sep	411 ± 116	392 ± 153	500 ± 122	374 ± 152	551 ± 165	511 ± 163	474 ± 122	518 ± 124	455 ± 120
25-Sep	873 ± 1480	888 ± 147	892 ± 148	814 ± 160	844 ± 145	651 ± 179	784 ± 185	685 ± 158	892 ± 190
2-Oct	437 ± 101	474 ± 101	455 ± 101	477 ± 119	470 ± 102	481 ± 143	433 ± 139	433 ± 132	440 ± 140
9-Oct	500 ± 107	414 ± 122	485 ± 105	474 ± 121	444 ± 142	540 ± 149	514 ± 147	551 ± 129	607 ± 149
16-Oct	740 ± 123	918 ± 167	951 ± 137	744 ± 126	836 ± 129	932 ± 149	725 ± 142	666 ± 157	962 ± 153
23-Oct	781 ± 124	918 ± 160	1010 ± 138	751 ± 126	829 ± 127	895 ± 145	692 ± 139	851 ± 157	966 ± 152
30-Oct	607 ± 113	670 ± 148	636 ± 116	548 ± 113	699 ± 119	755 ± 137	503 ± 127	651 ± 145	814 ± 145
6-Nov	1040 ± 141	1020 ± 171	1180 ± 148	840 ± 131	1100 ± 143	1230 ± 163	947 ± 154	1100 ± 177	1030 ± 154
13-Nov	302 ± 89.5	343 ± 92.1	327 ± 91.8	296 ± 107	325 ± 91.8	253 ± 132	360 ± 138	283 ± 112	477 ± 142
20-Nov	488 ± 108	599 ± 114	525 ± 110	440 ± 120	477 ± 106	440 ± 145	781 ± 145[e]	644 ± 123[e]	862 ± 164
27-Nov	39.2 ± 6.11	55.9 ± 6.92	63.6 ± 7.40	55.9 ± 7.55	57.0 ± 7.07	57.7 ± 8.51	29.5 ± 6.36	23.3 ± 5.29	67.7 ± 8.77
4-Dec	1770 ± 177	1660 ± 170	2240 ± 197	1740 ± 186	1830 ± 178	1920 ± 209	1760 ± 201	2000 ± 197	1930 ± 209
11-Dec	2160 ± 195	1970 ± 185	2640 ± 213	1960 ± 196	2080 ± 193	2140 ± 218	2030 ± 211	2190 ± 205	2700 ± 232
18-Dec	[b]	189 ± 10.8	176 ± 10.6	194 ± 10.9	226 ± 11.3	213 ± 12.2	228 ± 11.2	[b]	392 ± 13.3
26-Dec	291 ± 10.1	282 ± 12.1	367 ± 13.1	366 ± 13.1	222 ± 11.2	342 ± 13.9	6.07 ± 7.62	581 ± 15.4	349 ± 12.8
Jan 2 (2003)	[b]	121 ± 10.7	171 ± 11.5	150 ± 11.2	131 ± 10.9	111 ± 10.5	52.5 ± 9.51	148 ± 11.1	426 ± 14.9
Detection frequency	**45 of 48**	**52 of 52**	**52 of 52**	**48 of 48**	**52 of 52**	**52 of 52**	**51 of 52**	**51 of 51**	**52 of 52**
Median	**409**	**340**	**382**	**370**	**365**	**383**	**348**	**368**	**457**
IQR[f]	**302**	**323**	**233**	**265**	**317**	**332**	**244**	**353**	**457**
Maximum	**2160**	**1970**	**2640**	**1960**	**2080**	**2140**	**2030**	**2190**	**2700**

a See main volume, **Figure 53** , for description of sampling locations.
b No data available
c Sample collected May 31, 2002
d Sample collected June 20, 2002
e Sample collected November 21, 2002
f IQR = interquartile range

Table 5-12. Plutonium-239+240 activity (nBq/m^3) in air particulate sample, Site 300 composite[(a)], 2002

Month	Site 300 Composite
Jan	3.81 ± 14.2
Feb	5.69 ± 10.0
Mar	13.6 ± 17.0
Apr	-5.58 ± 15.1
May	-7.57 ± 12.4
Jun	4.11 ± 5.00
Jul	0.407 ± 3.32
Aug	10.4 ± 7.22[(b)]
Sep	3.60 ± 7.44
Oct	3.27 ± 4.40
Nov	1.52 ± 3.24
Dec	0[(c)]
Detection frequency	**1 of 12**
Median	**3.44**
IQR[(d)]	**4.21**
Percent of DCG[(e)]	**0.00046**

Note: Radioactivities are reported as the measured concentration and either the 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 main volume, Chapter 14.

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

b Indicates the only detection for 2002.

c Reported activity is less than the absolute value of 0.0005 nBq/m^3.

d IQR = interquartile range

e DCG=Derived Concentration Guide of 7.4×10^{-4} established by the DOE. The DCG is the amount of plutonium-239+240 that can be inhaled continuously 365 days a year without exceeding the DOE primary radiation protection standard for the public. Percent of DCG is determined from the median value.

Table 5-13. Uranium mass concentrations (pg/m^3) in air partculate samples[(a)], 2002

Month	U-235	U-238	U-235/U-238[(b)]	U-235	U-238	U-235/U-238[(b)]
	801E			COHO		
Jan	0.699 ± 1.18	12.9 ± 6.41	(c)	0.901 ± 0.444	11.8 ± 3.95	(c)
Feb	0.0854 ± 0.453	14.7 ± 6.23	(c)	0.396 ± 0.267	15.2 ± 4.67	(c)
Mar	0.402 ± 0.347	31.8 ± 7.85	(c)	0.428 ± 0.318	23.4 ± 4.92	(c)
Apr	0.488 ± 0.566	32.1 ± 9.19	(c)	0.932 ± 0.425	45.8 ± 8.66	(c)
May	1.01 ± 0.717	58.0 ± 12.2	(c)	0.586 ± 0.328	38.4 ± 7.51	(c)
Jun[(d)]	0.301 ± 0.00330	45.0 ± 0.126	0.00669 ± 0.0000757	0.240 ± 0.00280	33.0 ± 0.0925	0.00727 ± 0.0000873
Jul	0.267 ± 0.00730	41.0 ± 0.690	0.00651 ± 0.000209	0.298 ± 0.00770	41.0 ± 0.750	0.00727 ± 0.000230
Aug	0.707 ± 0.0214	270 ± 6.30	0.00262 ± 0.000100	0.314 ± 0.00490	44.0 ± 0.380	0.00714 ± 0.000127
Sep	0.425 ± 0.0105	62.4 ± 1.09	0.00681 ± 0.000206	0.453 ± 0.0114	61.7 ± 1.07	0.00734 ± 0.000224
Oct	0.292 ± 0.00790	47.1 ± 0.531	0.00620 ± 0.000182	0.306 ± 0.00650	42.7 ± 0.543	0.00717 ± 0.000177
Nov	0.235 ± 0.00550	34.9 ± 0.511	0.00673 ± 0.000186	0.240 ± 0.00500	38.2 ± 0.502	0.00628 ± 0.000155
Dec	0.0510 ± 0.00390	7.19 ± 0.170	0.00709 ± 0.000568	0.0790 ± 0.00200	10.7 ± 0.179	0.00738 ± 0.000224
Median	**0.352**	**38**		**0.355**	**38.3**	
IQR[(e)]	**0.282**	**22.3**	**na[(e)]**	**0.203**	**21.7**	**na**
Percent of DCG[(f)]	**0.00075**	**0.013**		**0.00076**	**0.013**	
	GOLF			NPS		
Jan	1.55 ± 0.763	28.2 ± 8.40	(c)	0.979 ± 0.606	12.9 ± 4.93	(c)
Feb	0.248 ± 0.287	22.2 ± 7.32	(c)	0.182 ± 0.469	22.8 ± 7.03	(c)
Mar	0.474 ± 0.407	34.9 ± 8.39	(c)	0.230 ± 0.283	25.8 ± 6.70	(c)
Apr	0.465 ± 0.491	53.8 ± 11.7	(c)	0.632 ± 0.504	46.1 ± 10.9	(c)
May	0.978 ± 0.572	37.9 ± 9.66	(c)	0.251 ± 0.398	35.3 ± 8.64	(c)
Jun[(d)]	0.202 ± 0.00260	27.7 ± 0.0493	0.00729 ± 0.0000948	0.197 ± 0.00430	26.5 ± 0.0850	0.00743 ± 0.000164
Jul	0.269 ± 0.00450	37.0 ± 0.400	0.00727 ± 0.000145	0.254 ± 0.00550	34.0 ± 0.430	0.00747 ± 0.000187
Aug	0.282 ± 0.0147	38.0 ± 0.440	0.00742 ± 0.000396	0.264 ± 0.640	36.0 ± 0.590	(c)
Sep	0.447 ± 0.0146	60.9 ± 1.38	0.00734 ± 0.000292	0.405 ± 0.0103	55.8 ± 0.878	0.00726 ± 0.000217
Oct	0.281 ± 0.00730	38.6 ± 0.521	0.00728 ± 0.000213	0.267 ± 0.00650	37.0 ± 0.592	0.00722 ± 0.000210
Nov	0.265 ± 0.00400	50.0 ± 0.476	0.00530 ± 0.0000946	0.259 ± 0.00480	44.9 ± 0.424	0.00577 ± 0.000120
Dec	0.0780 ± 0.00290	10.5 ± 0.161	0.00743 ± 0.000299	0.0910 ± 0.00360	12.1 ± 0.220	0.00752 ± 0.000327
Median	**0.282**	**37.5**		**0.257**	**34.7**	
IQR[(e)]	**0.206**	**13.4**	**na**	**0.0797**	**13.9**	**na**
Percent of DCG[(f)]	**0.0006**	**0.012**		**0.00055**	**0.012**	
	ECP			EOBS		
Jan	0.751 ± 0.689	13.6 ± 5.07	(c)	1.02 ± 0.831	16.8 ± 5.95	(c)
Feb	-0.108 ± 0.217	11.8 ± 4.41	(c)	-0.296 ± 0.419	17.5 ± 6.42	(c)
Mar	0.427 ± 0.344	24.0 ± 6.00	(c)	0.882 ± 0.629	29.1 ± 8.07	(c)
Apr	0.225 ± 0.555	41.8 ± 12.1	(c)	0.638 ± 0.485	54.6 ± 12.6	(c)
May	1.11 ± 0.842	19.7 ± 7.31	(c)	1.05 ± 0.634	37.3 ± 9.53	(c)
Jun[(d)]	0.198 ± 0.00290	27.7 ± 0.127	0.00715 ± 0.000110	0.201 ± 0.00270	28.2 ± 0.0945	0.00713 ± 0.0000987
Jul	0.233 ± 0.00810	33.0 ± 0.820	0.00706 ± 0.000302	0.256 ± 0.00630	37.0 ± 0.640	0.00692 ± 0.000208
Aug	0.211 ± 0.00360	30.0 ± 0.333	0.00703 ± 0.000143	0.252 ± 0.00830	36.0 ± 0.570	0.00700 ± 0.000256
Sep	0.403 ± 0.0163	56.1 ± 1.73	0.00718 ± 0.000365	0.415 ± 0.0106	57.0 ± 1.06	0.00728 ± 0.000230
Oct	0.265 ± 0.00830	36.8 ± 0.672	0.00720 ± 0.000261	0.248 ± 0.00620	35.0 ± 0.524	0.00709 ± 0.000206
Nov	0.244 ± 0.00590	36.3 ± 0.507	0.00672 ± 0.000188	0.264 ± 0.00570	55.9 ± 0.738	0.00472 ± 0.000120
Dec	0.0880 ± 0.00310	11.9 ± 0.191	0.00739 ± 0.000286	0.0770 ± 0.00330	10.6 ± 0.179	0.00726 ± 0.000335
Median	**0.239**	**28.9**		**0.26**	**35.5**	
IQR[(e)]	**0.201**	**18.3**	**na**	**0.463**	**16.1**	**na**
Percent of DCG[(f)]	**0.00051**	**0.0096**		**0.00055**	**0.012**	

Table 5-13. Uranium mass concentrations (pg/m^3) in air partculate samples[(a)], 2002 (concluded)

Month	U-235	U-238	U-235/U-238[(b)]	U-235	U-238	U-235/U-238[(b)]
	WCP			WOBS		
Jan	0.913 ± 0.680	18.0 ± 6.48	(c)	1.32 ± 0.680	19.5 ± 6.19	(c)
Feb	0.442 ± 0.490	16.1 ± 6.03	(c)	0.0681 ± 0.408	13.1 ± 5.79	(c)
Mar	0.445 ± 0.331	30.3 ± 6.86	(c)	0.482 ± 0.306	22.4 ± 5.68	(c)
Apr	0.524 ± 0.485	37.3 ± 8.32	(c)	0.443 ± 0.365	33.1 ± 8.46	(c)
May	0.684 ± 0.509	38.8 ± 9.76	(c)	0.686 ± 0.545	31.3 ± 7.79	(c)
Jun[(d)]	0.220 ± 0.00360	35.3 ± 0.118	0.00623 ± 0.000104	0.174 ± 0.00300	24.1 ± 0.0774	0.00722 ± 0.000127
Jul	0.218 ± 0.00460	31.0 ± 0.370	0.00703 ± 0.000170	0.211 ± 0.00710	30.0 ± 0.100	0.00703 ± 0.000238
Aug	0.207 ± 0.00870	31.0 ± 0.780	0.00668 ± 0.000327	0.245 ± 0.00560	34.0 ± 0.520	0.00721 ± 0.000198
Sep	0.376 ± 0.00950	55.2 ± 0.803	0.00681 ± 0.000199	0.371 ± 0.00720	49.9 ± 0.691	0.00743 ± 0.000177
Oct	0.243 ± 0.00390	35.4 ± 0.386	0.00686 ± 0.000133	0.245 ± 0.00310	33.4 ± 0.268	0.00734 ± 0.000110
Nov	0.507 ± 0.0102	155 ± 1.99	0.00327 ± 0.0000781	0.236 ± 0.00370	38.7 ± 0.327	0.00610 ± 0.000109
Dec	0.0750 ± 0.00250	10.6 ± 0.165	0.00708 ± 0.000260	0.0580 ± 0.00290	7.88 ± 0.174	0.00736 ± 0.000402
Median	**0.409**	**33.2**		**0.245**	**30.7**	
IQR[(e)]	**0.292**	**10.4**	**na**	**0.251**	**11.9**	**na**
Percent of DCG[(f)]	**0.00087**	**0.011**		**0.00052**	**0.01**	
	TFIR			Livermore composite		
Jan	1.11 ± 0.619	29.5 ± 7.23	(c)	0.835 ± 0.890	17.1 ± 9.85	(c)
Feb	0.231 ± 0.327	28.7 ± 7.22	(c)	0.186 ± 0.219	24.6 ± 4.77	(c)
Mar	0.718 ± 0.411	46.3 ± 8.37	(c)	0.556 ± 0.283	43.0 ± 6.38	(c)
Apr	1.17 ± 0.534	82.6 ± 13.1	(c)	1.87 ± 0.561	168 ± 19.6	(c)
May	1.56 ± 0.593	65.6 ± 10.4	(c)	1.17 ± 0.399	53.9 ± 8.31	(c)
Jun[(d)]	0.810 ± 0.00380	109 ± 0.262	0.00743 ± 0.0000392	0.253 ± 0.00380	34.5 ± 0.203	0.00733 ± 0.000118
Jul	0.727 ± 0.0159	99.0 ± 1.60	0.00734 ± 0.000200	0.531 ± 0.0147	72.0 ± 1.30	0.00738 ± 0.000244
Aug	0.903 ± 0.0117	120 ± 1.10	0.00753 ± 0.000119	0.321 ± 0.00860	44.0 ± 0.870	0.00730 ± 0.000243
Sep	1.33 ± 2.79	178 ± 2.94	(c)	0.136 ± 0.00230	18.4 ± 0.262	0.00739 ± 0.000163
Oct	1.18 ± 0.0238	161 ± 2.38	0.00733 ± 0.000183	0.367 ± 0.00520	49.1 ± 0.529	0.00747 ± 0.000133
Nov	0.701 ± 0.0145	103 ± 1.49	0.00681 ± 0.000172	0.202 ± 0.00480	28.1 ± 0.200	0.00719 ± 0.000178
Dec	0.159 ± 0.00330	22.0 ± 0.279	0.00723 ± 0.000176	0.178 ± 0.00510	24.1 ± 0.361	0.00739 ± 0.000239
Median	**0.857**	**90.8**		**0.344**	**38.8**	
IQR[(e)]	**0.459**	**69.7**	**na**	**0.428**	**25.8**	**na**
Percent of DCG[(f)]	**0.0018**	**0.03**		**0.00073**	**0.013**	

Note: Radioactivities are reported as the measured concentration and either the 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 main volume, Chapter 14.

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

b Naturally occuring uranium has a ratio of 0.00725; values less than that indicate the presence of depleted uranium which has a ratio of 0.002.

c Uranium ratios not determined when either isotope is negative, a nondetection, or close to the detection limit (as seen in data between January and May).

d Analytical laboratory change, detection capabilities improved.

e IQR = interquartile range

f DCG = Derived concentration guide, percent of DCG calculated from median. DCG for uranium-235 and uranium-238 are 0.047 µg/m^3, and 0.3 µg/m^3, respectively. Uranium-235 activities in Bq/m^3 can be determined by dividing the weight in µg/m^3 by 12.5. Uranium-238 activities in Bq/m^3 can be determined by dividing the weight in µg/m^3 by 80.3.

Table 5-14. Tritium concentration in air, Site 300, 2002

Month	Sampling location[a]
	COHO
	mBq/m^3
Jan	-2.04 ± 20.9
	[b]
	-5.22 ± 12.5
Feb	11.5 ± 15.7
	-14.3 ± 18.6
Mar	0.240 ± 15.2
	3.31 ± 17.5
Apr	37.7 ± 17.0
	-16.4 ± 12.8
May	3.07 ± 13.2
	-0.437 ± 11.2
Jun	-0.0100 ± 16.0
	-10.2 ± 13.1
Jul	-1.31 ± 16.0
	20.2 ± 14.8
	20.9 ± 18.6
Aug	-9.55 ± 14.4
	-10.8 ± 16.8
Sep	14.0 ± 13.4
	8.07 ± 13.4
Oct	-16.2 ± 9.25
	1.34 ± 15.8
Nov	0.718 ± 11.5
	5.00 ± 19.3
Dec	7.22 ± 15.8
	-29.3 ± 16.5
Median	**0.24**
IQR[c]	**16.8**
Percent of DCG[d]	**0.0000065**
Mean	**0.7**
Dose (nSv)[e]	**0.15**

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

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

b No data; see main volume, Chapter 14.

c IQR = interquartile range

d DCG= Derived Concentration Guide of 3.7×10^6 mBq/m^3 for tritium in air. Percent of DCG is calculated from the median concentration.

e This dose is calculated from the mean concentration and is the effective dose equivalent from inhalation and skin absorption.

Table 5-15. Beryllium concentration (pg/m^3) in air particulate samples, Site 300, 2002[(a)]

Month	801E	EOBS	GOLF	TFIR (offsite)
Jan	1.32 (4.84)	0.184 (4.75)	1.43 (4.76)	2.07 (4.74)
Feb	2.28 (4.70)	1.37 (4.72)	3.21 (4.74)	5.04
Mar	2.95 (4.70)	3.29 (4.72)	4.37 (4.74)	5.79
Apr	4.98	5.44 (9.14)	7.26	10.1
May	7.55	1.01 (4.72)	1.85 (4.76)	7.12
Jun[(b)]	9.8	7.1	7	7.9
Jul	11.3	10	13.2	19.6
Aug	5.49	6.66	6.51	13.3
Sep	18.9[(c)]	16.2[(c)]	20.4[(c)]	30.1
Oct	16.2	14.6	15.4	32.3[(c)]
Nov	10.2	9.8	12.1	19.3
Dec	3.78	3.02	3.25	5.51
Detection frequency	**9 of 12**	**7 of 12**	**8 of 12**	**11 of 12**
Median	**6.52**	**6.05**	**6.76**	**9.00**
IQR[(d)]	**6.9**	**7.24**	**9.14**	**13.7**
Percent of ACL[(e)]	**0.065**	**0.061**	**0.068**	**0.09**

Note: Minimum detection concentration (MDC) is shown in parenthesis when concentration is less than the MDC.

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

b Analytical laboratory change, detection capabilities improved.

c Reported the highest detection for the particular location.

d IQR = interquartile range

e ACL=Ambient concentration limit of 10,000 pg/m^3 is established by the Bay Area Air Quality Management District. Percent of ACL is calculated from the median value.

SEWERABLE WATER MONITORING

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Discharges of Treated Groundwater

LLNL's groundwater discharge permit (1510G 2001/2002) allows treated groundwater from site-wide cleanup activities under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980 to be discharged to the City of Livermore sanitary sewer in compliance with effluent limitations taken from the Livermore Municipal Code. During calendar year 2002, however, no LLNL groundwater was discharged to the sanitary sewer.

Flow Monitoring Methods

To monitor effluent flow, LLNL used a flow chart recorder installed inside the LLNL Sewer Monitoring Station (SMS) and an ultrasonic flow sensor in the adjacent underground sewer vault (see main volume, **Figure 6-1**). Every day a flow totalizer reading was recorded on the flow chart recorder when the daily composite sample was acquired from the SMS. Daily total flows were calculated by subtracting sequentially recorded flow totalizer readings and were estimated when flow totalizer readings were not available. Table 6-2a shows the daily total flows. Table 6-2b presents monthly and annual flow summary statistics for 2002.

Sewage Sampling Methods and Analytical Procedures

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

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

A third daily aliquot was submitted to LLNL's Chemistry and Materials Science Environmental Monitoring Radiological Laboratory (EMRL). From the aliquots submitted for each month, EMRL created a composite sample and analyzed it for ^{239}Pu, ^{137}Cs, gross alpha, gross beta and tritium.

The gross alpha and beta was analyzed by digesting a 150-mL aliquot, plating the digestate onto a planchette, and counting the planchette for a 100-min count in a gas-proportional counter. The tritium was measured using an Eichrom column to concentrate the tritium prior to 200-min scintillation counting.

The ^{239}Pu was analyzed by adding approximately 15 L of MnO_2 to the entire volume of the monthly composite sample to precipitate the plutonium. After the composite volume was digested with concentrated HNO_3, EMRL used ion-exchange chromatography to separate the plutonium from the rest of the sample. The plutonium eluted from the ion-exchange column was electroplated onto a stainless steel disk, and its activity was measured by alpha spectroscopy.

Before beginning analysis for ^{137}Cs activity in the monthly composite, EMRL returned any nonplutonium sample material generated from the ion-exchange process to the monthly composite sample in order to prevent ^{137}Cs loss. For the ^{137}Cs analysis, EMRL 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 6-5.**

In 2002, LWRP provided two types of sample—treated effluent and sludge—to LLNL for analysis. LWRP collected one 500-mL aliquot of treated effluent daily and used them to create a monthly composite. LLNL technologists transferred the monthly sample (composited in a 5-gal carboy) to EMRL. EMRL analyzed the LWRP monthly sample for ^{137}Cs, ^{239}Pu, gross alpha, gross beta and tritium. The results of the analysis are presented in **Table 6-5** of the main volume.

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

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

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

where

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

E = System counting efficiency

t = Sample counting time

LLNL also operated monitoring station C196 with a flow-proportional, peristaltic pump composite sampler adjacent to the SMS. This sampler functioned as a weekly composite sampler and acquired a 60-mL sample for every 30,280 L of effluent LLNL discharged during a seven-day period. Another sampler operated once a month for 24 hours as a single-day composite sampler and collected a 100-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. These aliquots were submitted to an off-site contract laboratory for analyses of the nine permitted metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc) as required by the LWRP permit (see the main volume, **Table 6-2**). The results for these analyses are presented in Table 6-5.

Two additional 500 mL aliquots from the weekly composite were submitted each week to HCAL for analyses of gross alpha, gross beta, and tritium. A subset of these results contributes to the completeness of the daily analytical results for gross alpha, gross beta, and tritium; this subset is reported and footnoted in Table 6-3.

Once a month aliquots were submitted to the contract analytical laboratory for more extensive analyses on the 24-hour composite than on the weekly composite sample. Under the heading of "Composite sample," Table 6-7 lists these results by parameters, the EPA method numbers used for the analyses, and month. (The analytical methods are EPA methods unless otherwise indicated. It should be noted that in mid-2002 the analytical method for several metals was changed by the contract analytical laboratory.) Tables 6-6 and 6-7 report the monthly analytical results for those permitted metals mentioned previously, as well as the additional metals included in this more extensive analysis.

Concurrent with the monthly acquisition of a 24-hour composite, a portable, peristaltic-pump sampler collected instantaneous grab samples from the sewage stream in the sewer vault adjacent to SMS. These samples were submitted to a contract analytical laboratory for additional monitoring of water quality parameters and organic compounds. The results of this monitoring are presented in Table 6-7 under the "Grab sample" heading. The table lists the parameters and the EPA method numbers used for the analyses. Samples for oil and grease (as well as cyanide) are collected semiannually rather than monthly. The entries for oil and grease show the results for samples that were acquired at intervals during the day as well as the time of collection of each oil and grease sample.

Quality Assurance Methods

Standard quality control and quality assurance procedures were followed in the collection of LLNL samples. When each sewage field sample was collected, it was labeled with the sampling location and date of sampling. In the laboratory, each sample was assigned a number that accompanied that sample during analysis. Additionally, split samples accounted for approximately 10% of the samples submitted for analytical work in 2002.

Table 6-1. Laboratory analytical results for groundwater discharges to the sanitary sewer, January 1 through December 31, 2002

There were no groundwater discharges to the sanitary sewer in 2002.

Table 6-2a. Daily flow totals for Livermore site sanitary sewer effluent (ML), 2002

31-Dec 0.474

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.390	1.041	1.076	0.368	1.057	1.021	0.604	1.199	0.481	1.039	1.038	0.448
2	0.397	1.463	1.039	0.515	1.052	0.501	1.153	1.114	0.462	0.982	0.889	0.550
3	1.191	0.620	0.398	1.004	1.054	0.495	1.194	1.064	0.546	1.089	0.435	1.084
4	0.981	0.567	0.393	1.067	0.907	1.213	1.252	0.344	1.039	0.989	0.478	1.040
5	0.846	1.166	1.158	1.033	0.343	1.119	0.519	0.332	1.045	0.836	1.048	1.111
6	0.374	1.166	1.156	0.826	0.357	1.084	0.891	0.981	1.045	0.438	1.064	1.148
7	0.401	1.300	1.298	0.420	1.036	1.133	0.451	1.076	0.978	0.470	1.170	0.893
8	1.054	1.422	1.134	0.376	1.069	0.988	0.551	1.049	0.433	1.026	1.128	0.514
9	1.174	1.016	1.018	1.042	1.107	0.380	1.193	1.041	0.452	1.078	1.326	0.463
10	0.983	1.012	0.461	1.020	1.034	0.402	1.403	0.935	1.009	1.149	0.474	1.128
11	1.102	0.115	0.509	1.061	0.923	1.121	1.088	0.388	1.030	1.138	0.577	1.078
12	0.921	1.107	1.208	1.026	0.400	2.124	1.094	0.474	1.106	0.985	1.075	1.043
13	0.358	1.015	1.135	0.929	0.379	1.191	0.953	1.091	1.113	0.450	1.077	1.014
14	0.396	1.049	1.061	0.357	1.050	1.133	0.453	1.378	1.116	0.517	1.102	1.055
15	1.014	1.072	1.041	0.419	1.148	1.048	0.466	1.074	0.539	1.105	1.250	0.604
16	1.161	0.958	0.980	1.010	1.187	0.485	1.091	1.047	0.606	1.188	1.055	0.880
17	1.021	0.434	0.402	1.098	1.222	0.503	1.118	1.040	1.082	1.160	0.586	1.304
18	0.924	0.405	0.488	1.023	1.133	1.176	1.264	0.468	1.242	1.036	0.599	1.160
19	0.945	0.489	0.984	1.066	1.020	1.272	1.193	0.542	1.242	0.990	1.149	1.062
20	0.366	1.256	1.057	0.964	0.866	1.327	1.088	1.065	1.077	0.530	1.109	2.371
21	0.399	1.022	1.054	0.531	1.093	1.231	0.450	1.081	1.000	0.670	1.115	2.357
22	0.510	1.401	1.077	0.404	1.179	1.178	0.547	1.204	0.463	1.035	1.104	0.402
23	1.038	1.106	0.973	1.089	1.093	0.593	1.177	1.192	0.501	1.059	1.041	0.385
24	1.143	0.434	0.395	0.940	1.970	0.600	1.243	1.121	0.980	1.062	0.456	0.893
25	1.177	0.390	0.379	0.985	1.102	1.244	1.170	0.520	1.134	1.052	0.464	0.451
26	0.929	1.083	1.064	1.070	0.433	1.302	1.199	0.730	1.142	1.039	1.222	0.506
27	0.378	1.037	1.092	0.909	0.473	1.212	1.079	1.073	1.035	0.427	1.008	0.609
28	0.381	1.066	1.155	0.330	0.498	1.177	0.469	1.070	0.909	0.442	0.898	0.649
29	1.104		1.145	0.391	1.109	1.115	0.339	1.118	0.398	1.057	0.489	0.518
30	1.105		0.876	1.018	1.245	0.553	1.112	1.145	0.456	1.045	0.431	0.424
31	1.032		0.413		1.151		1.062	1.006		1.180		0.735

Note: The majority of the flow volume recorded for a given day was actually discharged on the previous day.
Weekend and holiday daily flow totals are shown in the boxed areas, according to flow being discharged on the previous day.

Table 6-2b. Monthly and annual flow summary statistics for Livermore site sanitary sewer effluent (ML), 2002

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	2002
Weekend days and holidays													
Total	4.350	4.466	3.838	4.561	4.769	4.512	4.849	3.798	5.337	3.944	4.989	6.145	55.558
Daily Minimum	0.358	0.115	0.379	0.330	0.343	0.380	0.339	0.332	0.398	0.427	0.431	0.385	0.115
Daily Maximum	0.510	1.012	0.509	0.826	1.020	0.600	0.604	0.730	0.606	0.670	0.599	0.880	1.020
Daily Mean	0.395	0.496	0.426	0.456	0.530	0.501	0.485	0.475	0.485	0.493	0.499	0.512	0.480
Weekdays													
Total	20.845	21.746	23.781	19.730	24.921	25.409	24.017	25.164	20.324	24.319	21.868	21.734	273.858
Daily Minimum	0.846	0.958	0.876	0.376	0.907	0.988	0.891	0.935	0.909	0.836	0.889	0.609	0.376
Daily Maximum	1.191	1.463	1.298	1.098	1.970	2.124	1.403	1.378	1.242	1.188	1.326	2.371	2.371
Daily Mean	1.042	1.145	1.081	0.987	1.133	1.210	1.144	1.094	1.070	1.057	1.093	1.144	1.100
All Days													
Total	25.195	26.212	27.619	24.291	29.690	29.921	28.866	28.962	25.661	28.263	26.857	27.879	329.416
Daily Minimum	0.358	0.115	0.379	0.330	0.343	0.380	0.339	0.332	0.398	0.427	0.431	0.385	0.115
Daily Maximum	1.191	1.463	1.298	1.098	1.970	2.124	1.403	1.378	1.242	1.188	1.326	2.371	2.371
Daily Mean	0.813	0.936	0.891	0.810	0.958	0.997	0.931	0.934	0.855	0.912	0.895	0.899	0.903

Table 6-3. Daily monitoring results for gross alpha, gross beta, and tritium in the Livermore site sanitary sewer effluent, 2002

Date		Gross alpha (μBq/mL)	Gross beta (mBq/mL)	Tritium (mBq/mL)
Jan	1	107 ± 64.4	0.236 ± 0.0872	11.2 ± 6.39
	2	18.5 (92.1)	0.253 ± 0.0862	2.93 (10.7)
	3	64.0 (120)	0.836 ± 0.117	3.59 (8.18)
	4	12.5 (128)	0.988 ± 0.119	2.45 (8.32)
	5	135 (144)	0.914 ± 0.119	3.28 (8.32)
	6	44.8 (91.0)	0.297 ± 0.0863	-0.788 (8.40)
	7	222 ± 79.8	0.321 ± 0.0867	6.70 (8.10)
	8	153 ± 61.1	0.925 ± 0.120	-0.279 (8.29)
	9	176 ± 65.0	0.796 ± 0.111	-1.57 (10.5)
	10	11.3 (104)	0.988 ± 0.119	4.07 (10.0)
	11	38.5 (108)	0.833 ± 0.117	-1.94 (10.5)
	12	-70.3 (99.2)	0.903 ± 0.117	7.62 (10.1)
	13	33.7 (79.6)	0.239 ± 0.0835	-3.92 (10.7)
	14	82.1 ± 52.6	0.192 ± 0.0808	-0.966 (10.4)
	15	57.7 (111)	0.955 ± 0.115	0.581 (8.51)
	16	176 ± 56.4	4.37 ± 0.218	1.00 (8.44)
	17	87.3 (123)	1.01 ± 0.121	3.24 (8.25)
	18	119 ± 54.6	1.17 ± 0.128	2.12 (8.18)
	19	27.9 (128)	1.10 ± 0.132	3.46 (8.55)
	20	14.0 (114)	0.588 ± 0.106	0.503 (8.29)
	21	-43.7 (97.3)	0.331 ± 0.0894	-4.00 (8.47)
	22	-28.7 (95.5)	0.385 ± 0.0924	2.45 (8.44)
	23	18.0 (116)	1.16 ± 0.127	-1.58 (10.5)
	24	51.8 (108)	0.699 ± 0.105	9.88 (10.1)
	25	24.8 (107)	0.862 ± 0.112	-0.884 (10.4)
	26	64.4 (120)	0.966 ± 0.126	-1.13 (10.4)
	27	115 ± 61.0	0.335 ± 0.0905	1.23 (10.2)
	28	117 ± 59.6	0.186 ± 0.0800	0.104 (10.3)
	29	89.2 (121)	1.02 ± 0.123	10.4 ± 6.03
	30	165 ± 64.4	0.932 ± 0.121	-2.08 (10.2)
	31	118 ± 59.2	0.636 ± 0.108	0.106 (10.1)
Feb	1	62.5 (114)	4.88 ± 0.230	0.316 (10.2)
	2	-29.0 (111)	3.96 ± 0.210	1.81 (10.5)
	3	51.1 (105)	0.629 ± 0.107	6.85 (10.2)
	4	54.8 (74.4)	0.107 (0.114)	3.89 (10.3)
	5	154 ± 56.8	1.13 ± 0.125	2.56 (10.3)
	6	115 ± 47.2	0.977 ± 0.117	0.159 (8.14)
	7	121 (132)	0.977 ± 0.127	7.07 (8.14)
	8	-14.3 (144)	1.16 ± 0.128	1.24 (10.2)
	9	51.8 (116)	1.20 ± 0.132	-0.312 (10.5)
	10	411 ± 107	0.659 ± 0.105	-1.19 (10.5)
	11	99.5 ± 57.7	0.262 ± 0.0864	0.507 (10.2)
	12	118 ± 54.5	0.992 ± 0.119	-10.0 (10.9)
	13	-26.7 (111)	1.26 ± 0.126	-3.20 (10.6)
	14	224 ± 80.6	0.747 ± 0.112	2.40 (10.2)
	15	95.5 (100)	0.910 ± 0.118	2.39 (10.4)
	16	68.1 (99.2)	0.792 ± 0.111	1.57 (10.6)
	17	221 ± 75.0	0.269 ± 0.0835	-0.305 (10.4)
	18	37.7 (78.1)	0.196 ± 0.0804	4.63 (10.0)
	19	111 ± 55.5	0.525 ± 0.0998	-0.0599 (10.6)
	20	65.9 (110)	1.04 ± 0.124	4.59 (10.2)

Table 6-3. Daily monitoring results for gross alpha, gross beta, and tritium in the Livermore site sanitary sewer effluent, 2002 (continued)

Date		Gross alpha (μBq/mL)	Gross beta (mBq/mL)	Tritium (mBq/mL)
	21	51.4 (119)	0.762 ± 0.114	1.27 (10.0)
	22	79.2 (120)	1.14 ± 0.125	-1.93 (10.7)
	23	149 ± 55.3	0.977 ± 0.117	1.43 (10.1)
	24	113 ± 54.2	0.389 ± 0.0932	4.03 (10.2)
	25	141 ± 60.5	0.241 ± 0.0842	4.11 (10.1)
	26	127 ± 49.5	0.907 ± 0.118	-2.85 (10.4)
	27	-17.3 (111)	1.89 ± 0.149	3.51 (10.2)
	28	71.0 (102)	0.799 ± 0.112	-1.67 (10.4)
Mar	1	26.0 (106)	0.881 ± 0.114	-2.63 (10.6)
	2	840 ± 151	0.977 ± 0.117	1.58 (10.6)
	3	33.9 (82.9)	0.185 ± 0.0816	5.66 (10.2)
	4	102 ± 57.4	0.197 ± 0.0807	2.90 (10.5)
	5	148 ± 57.9	0.892 ± 0.116	-2.12 (10.4)
	6	88.8 (105)	0.899 ± 0.117	-4.92 (10.5)
	7	153 ± 62.8	1.04 ± 0.124	2.23 (10.3)
	8	149 ± 53.7	0.877 ± 0.114	-8.92 (11.0)
	9	152 ± 51.6	0.999 ± 0.120	0.825 (10.5)
	10	56.2 (87.0)	0.352 ± 0.0916	-2.75 (10.7)
	11	230 ± 80.5	0.325 ± 0.0878	2.55 (10.2)
	12	150 ± 54.1	0.951 ± 0.124	-1.77 (10.5)
	13	152 ± 53.4	0.858 ± 0.112	8.40 (10.2)
	14	69.6 (102)	0.977 ± 0.117	-4.51 (10.5)
	15	61.4 (130)	0.955 ± 0.124	2.09 (10.3)
	16	162 ± 58.3	0.884 ± 0.115	5.77 (10.3)
	17	77.0 (80.3)	0.294 ± 0.0852	6.40 (10.3)
	18	762 ± 122	0.273 ± 0.0819	0.622 (10.2)
	19	124 ± 47.2	0.918 ± 0.119	4.14 (10.3)
	20	-3.05 (102)	1.04 ± 0.125	0.396 (10.1)
	21	216 ± 71.4	0.873 ± 0.114	1.96 (10.3)
	22	77.7 (118)	0.932 ± 0.121	6.03 (10.2)
	23	426 ± 97.9	1.11 ± 0.122	5.44 (8.32)
	24	81.8 ± 44.2	0.303 ± 0.0847	3.96 (8.29)
	25	8.03 (82.1)	0.314 ± 0.0880	1.62 (8.25)
	26	362 ± 90.5	0.814 ± 0.114	-2.05 (8.73)
	27	175 ± 54.3	1.15 ± 0.127	4.55 (8.03)
	28	131 ± 48.6	0.966 ± 0.116	0.821 (8.21)
	29	-15.5 (95.1)	0.733 ± 0.110	5.40 (8.21)
	30	114 ± 42.3	0.951 ± 0.114	0.0214 (8.40)
	31	131 ± 54.9	0.385 ± 0.0924	6.14 (8.25)
Apr	1	118 ± 54.1	0.272 ± 0.0842	1.57 (8.18)
	2	85.5 ± 37.6	0.688 ± 0.103	-0.124 (8.44)
	3	86.2 (99.2)	0.851 ± 0.111	-0.392 (8.47)
	4	96.6 (117)	0.977 ± 0.117	-0.788 (8.51)
	5	192 ± 59.6	1.29 ± 0.129	3.08 (8.25)
	6	83.3 (110)	1.31 ± 0.131	-0.381 (8.29)
	7	64.4 (94.0)	0.377 ± 0.0944	-6.73 (8.55)
	8	105 ± 49.2	0.411 ± 0.0945	0.236 (8.47)
	9	162 ± 55.0	1.05 ± 0.116	-2.89 (8.62)
	10	225 ± 65.2	1.22 ± 0.122	5.81 (8.47)
	11	139 ± 49.9	1.17 ± 0.129	17.1 ± 5.14
	12	-19.0 (119)	2.75 ± 0.176	8.29 (8.44)

Table 6-3. Daily monitoring results for gross alpha, gross beta, and tritium in the Livermore site sanitary sewer effluent, 2002 (continued)

Date		Gross alpha (μBq/mL)	Gross beta (mBq/mL)	Tritium (mBq/mL)
	13	137 ± 137	2.93 ± 0.185	1.84 (8.25)
	14	70.3 (121)	1.07 ± 0.129	2.63 (8.25)
	15	73.3 (105)	0.566 ± 0.102	0.485 (8.55)
	16	52.9 (119)	0.858 ± 0.120	1.47 (10.5)
	17	169 ± 57.4	1.10 ± 0.121	9.73 (10.4)
	18	32.8 (101)	1.18 ± 0.130	0.448 (9.88)
	19	57.7 (103)	0.773 ± 0.108	-4.14 (10.6)
	20	1120 ± 179	1.06 ± 0.127	-0.0747 (8.51)
	21	3.74 (89.5)	0.302 ± 0.0905	5.40 (8.44)
	22	47.4 (88.4)	0.313 ± 0.0907	1.73 (8.44)
	23	35.7 (107)	0.936 ± 0.122	2.40 (8.25)
	24	21.1 (103)	1.23 ± 0.123	2.59 (7.88)
	25	171 ± 66.7	1.39 ± 0.135	-4.00 (8.47)
	26	114 (124)	0.907 ± 0.118	1.35 (8.32)
	27	77.0 (111)	0.844 ± 0.118	2.04 (8.40)
	28	46.3 (85.5)	0.325 ± 0.0878	0.751 (8.29)
	29	82.5 (88.1)	0.297 ± 0.0892	-1.20 (8.55)
	30	72.2 (125)	1.08 ± 0.130	-1.48 (8.44)
May	1	50.3 (110)	1.26 ± 0.126	1.75 (8.25)
	2	3.11 (121)	0.714 ± 0.114	-0.610 (10.3)
	3	40.3 (108)	1.33 ± 0.132	3.81 (10.3)
	4	117 ± 44.4	0.929 ± 0.121	-0.607 (10.5)
	5	100 ± 50.1	0.370 ± 0.0925	0.400 (10.4)
	6	31.6 (79.6)	0.248 ± 0.0842	1.62 (10.3)
	7	57.4 (97.7)	0.851 ± 0.111	24.8 ± 5.45
	8	96.2 (117)	1.23 ± 0.135	2.71 (8.40)
	9	82.5 (98.8)	0.629 ± 0.107	0.488 (10.6)
	10	33.3 (102)	1.13 ± 0.125	1.47 (10.5)
	11	35.5 (102)	1.10 ± 0.121	-0.503 (8.44)
	12	25.6 (89.9)	0.407 ± 0.0936	1.08 (8.29)
	13	41.8 (96.6)	0.374 ± 0.0934	4.37 (8.40)
	14	11.9 (115)	0.721 ± 0.108	2.52 (10.7)
	15	163 ± 68.5	0.829 ± 0.116	2.27 (10.2)
	16	370 ± 92.5	0.766 ± 0.107	-3.29 (8.32)
	17	163 ± 61.9	0.866 ± 0.113	2.65 (8.18)
	18	70.3 (121)	1.12 ± 0.123	-1.11 (8.58)
	19	96.2 ± 53.9	0.247 ± 0.0840	-1.02 (8.58)
	20	70.3 (83.6)	0.178 ± 0.0819	3.89 (8.14)
	21	165 ± 64.2	0.766 ± 0.115	3.49 (10.6)
	22	184 ± 64.4	1.12 ± 0.123	2.81 (10.6)
	23	131 ± 55.2	0.840 ± 0.118	3.33 (10.6)
	24	66.6 (88.8)	0.537 ± 0.0966	4.48 (10.4)
	25	202 ± 60.6	1.34 ± 0.131	-2.57 (10.8)
	26	518 ± 119	0.714 ± 0.107	8.92 (10.6)
	27	42.2 (87.7)	0.153 ± 0.0810	3.34 (10.7)
	28	116 ± 57.9	0.309 ± 0.0895	3.03 (10.7)
	29	134 ± 53.6	0.710 ± 0.107	-3.09 (11.0)
	30	134 ± 52.1	0.962 ± 0.115	-1.21 (10.7)
	31	673 ± 128	0.884 ± 0.115	-1.27 (11.0)
Jun	1	172 ± 54.9	1.07 ± 0.117	-0.995 (11.0)
	2	36.0 (102)	0.570 ± 0.103	-0.751 (10.6)

Table 6-3. Daily monitoring results for gross alpha, gross beta, and tritium in the Livermore site sanitary sewer effluent, 2002 (continued)

Date	Gross alpha (µBq/mL)	Gross beta (mBq/mL)	Tritium (mBq/mL)
3	57.7 (76.2)	0.396 ± 0.0911	6.85 (10.7)
4	91.0 (120)	0.788 ± 0.118	6.18 (10.4)
5	235 ± 58.6	1.50 ± 0.133	-0.881 (8.58)
6	53.3 (125)	0.903 ± 0.117	-2.27 (8.66)
7	93.2 (125)	0.836 ± 0.117	0.221 (10.9)
8	51.4 (119)	0.951 ± 0.124	-0.585 (10.9)
9	59.9 (82.9)	0.309 ± 0.0897	7.10 (10.7)
10	91.4 ± 56.7	0.158 ± 0.0806	-0.500 (10.8)
11	98.4 (110)	0.840 ± 0.118	8.14 (10.6)
12	154 ± 64.5	0.796 ± 0.111	4.22 (10.9)
13	185 ± 62.9	1.11 ± 0.122	4.22 (10.7)
14	18.7 (95.1)	0.858 ± 0.112	1.89 (11.0)
15	105 ± 45.2	0.773 ± 0.108	-1.31 (11.2)
16	88.4 ± 51.3	0.160 ± 0.0783	-3.47 (11.0)
17	69.2 (77.7)	0.127 ± 0.0764	5.00 (10.5)
18	196 ± 64.6	1.06 ± 0.116	-4.29 (8.58)
19	201 ± 68.4	0.940 ± 0.122	0.0825 (10.8)
20	79.6 (102)	0.755 ± 0.113	1.11 (10.7)
21	178 ± 69.4	0.685 ± 0.110	0.862 (10.7)
22	83.6 (89.2)	0.644 ± 0.103	0.0400 (10.8)
23	111 ± 55.7	0.148 ± 0.0782	-0.344 (10.6)
24	18.2 (73.6)	0.106 (0.115)	0.914 (10.6)
25	392 ± 94.1	0.869 ± 0.113	-2.95 (10.8)
26	354 ± 92.0	0.951 ± 0.114	-0.777 (11.0)
27	27.6 (95.5)	0.648 ± 0.104	-0.381 (11.1)
28	50.0 (101)	0.696 ± 0.104	3.50 (10.9)
29	119 ± 49.9	0.969 ± 0.116	-6.73 (11.2)
30	57.0 (87.0)	0.207 ± 0.0848	-4.70 (11.3)
Jul 1	35.9 (79.9)	0.161 ± 0.0805	3.06 (10.5)
2	115 ± 53.9	0.607 ± 0.103	0.622 (11.1)
3	345 ± 93.1	1.31 ± 0.131	10.4 (10.5)
4	50.3 (111)	0.696 ± 0.111	4.07 (11.0)
5	96.9 (125)	0.238 ± 0.0952	1.48 (10.8)
6	75.5 (97.7)	0.537 ± 0.102	4.11 (10.8)
7	138 ± 62.1	0.122 ± 0.0759	2.25 (10.8)
8	117 ± 58.5	0.116 ± 0.0753	0.462 (10.9)
9	137 ± 58.7	0.677 ± 0.108	0.607 (11.0)
10	243 ± 85.2	0.881 ± 0.114	2.38 (11.0)
11	215 ± 73.0	0.910 ± 0.118	2.33 (10.8)
12	142 ± 52.4	1.05 ± 0.116	-1.99 (10.8)
13	117 ± 50.1	0.862 ± 0.112	-1.53 (8.40)
14	56.6 (87.3)	0.186 ± 0.0821	5.59 (8.10)
15	86.2 ± 51.7	0.228 ± 0.0842	0.603 (8.40)
16	148 ± 60.8	1.01 ± 0.121	7.10 (8.25)
17	803 ± 153	1.19 ± 0.131	0.268 (8.21)
18	259 ± 67.4	0.566 ± 0.0736	4.07 (10.8)
19	194 ± 79.3	0.492 ± 0.0984	-0.784 (10.9)
20	132 ± 54.3	0.799 ± 0.112	-1.03 (10.7)
21	107 ± 57.5	0.357 ± 0.0927	1.25 (10.8)
22	42.2 (88.1)	0.219 ± 0.0853	3.03 (10.8)
23	32.3 (89.5)	0.444 ± 0.107	67.0 ± 6.30

Table 6-3. Daily monitoring results for gross alpha, gross beta, and tritium in the Livermore site sanitary sewer effluent, 2002 (continued)

Date		Gross alpha (μBq/mL)	Gross beta (mBq/mL)	Tritium (mBq/mL)
	24	159 ± 63.5	0.747 ± 0.112	24.1 ± 5.05
	25	151 ± 55.9	0.433 ± 0.104	5.14 (10.6)
	26	47.7 (109)	0.474 ± 0.0995	-3.21 (11.1)
	27	158 ± 66.5	0.610 ± 0.104	2.10 (10.7)
	28	111 ± 58.8	0.366 ± 0.0951	0.228 (10.8)
	29	92.5 ± 57.4	0.0740 (0.119)	2.68 (11.0)
	30	144 ± 58.9	0.825 ± 0.116	-1.39 (11.0)
	31	58.1 (99.9)	0.932 ± 0.121	1.15 ± 0.457
Aug	1	96.2 (106)	0.744 ± 0.112	2.92 (10.8)
	2	118 (122)	0.966 ± 0.126	-2.53 (11.1)
	3	184 ± 68.2	0.818 ± 0.114	2.73 (11.1)
	4	53.7 (84.4)	0.270 ± 0.0864	4.48 (11.1)
	5	168 ± 67.2	0.323 ± 0.0904	1.35 (11.1)
	6	877 ± 167	1.29 ± 0.142	-0.844 (11.2)
	7	230 ± 73.5	1.25 ± 0.138	-8.70 (11.3)
	8	-6.07 (106)	0.844 ± 0.118	-0.721 (8.29)
	9	139 ± 57.2	0.873 ± 0.122	45.5 ± 5.92
	10	136 ± 57.0	0.947 ± 0.123	1.69 (8.29)
	11	239 ± 83.8	0.389 ± 0.0971	5.33 (8.18)
	12	239 ± 85.9	0.525 ± 0.105	-0.162 (8.21)
	13	244 ± 85.3	1.07 ± 0.128	-0.334 (11.0)
	14	186 ± 70.6	0.862 ± 0.121	1.37 (8.29)
	15	218 ± 76.4	0.696 ± 0.111	1.41 (11.1)
	16	42.2 (115)	0.862 ± 0.121	-4.77 (11.4)
	17	66.2 (100)	0.492 ± 0.0984	-0.777 (10.6)
	18	222 ± 84.2	0.385 ± 0.0962	1.18 (11.1)
	19	130 ± 62.5	0.448 ± 0.0985	-0.862 (10.8)
	20	160 ± 62.3	1.01 ± 0.121	-2.54 (11.0)
	21	241 ± 77.0	1.11 ± 0.122	0.305 (8.18)
	22	101 (107)	0.881 ± 0.114	2.87 (10.7)
	23	27.3 (99.9)	0.796 ± 0.111	3.85 (8.40)
	24	66.6 (100)	0.662 ± 0.106	-2.09 (11.1)
	25	107 ± 57.7	0.233 ± 0.0840	-0.503 (10.9)
	26	58.5 (82.5)	0.201 ± 0.0822	-2.81 (10.9)
	27	127 ± 52.0	0.759 ± 0.106	-3.37 (11.1)
	28	231 ± 71.7	1.01 ± 0.122	0.869 (8.40)
	29	65.9 (107)	0.610 ± 0.104	6.29 (10.5)
	30	52.5 (118)	1.06 ± 0.127	-1.36 (10.9)
	31	142 ± 58.3	0.866 ± 0.113	-3.42 (11.2)
Sep	1	87.3 (93.6)	0.293 ± 0.0879	2.75 (11.0)
	2	41.8 (91.8)	0.269 ± 0.0861	4.07 (10.7)
	3	94.7 ± 58.7	0.173 ± 0.0812	-0.980 (10.6)
	4	230 ± 69.0	1.28 ± 0.128	4.11 (10.6)
	6[(a)]	137 ± 56.1	1.18 ± 0.129	1.48 (11.1)
	7	52.2 (112)	1.28 ± 0.128	-1.02 (10.8)
	8	205 ± 83.9	0.670 ± 0.107	-3.85 (11.0)
	9	138 ± 64.9	0.437 ± 0.0961	-2.25 (11.1)
	10	208 ± 77.1	1.04 ± 0.124	-3.07 (11.1)
	11	160 ± 62.5	1.21 ± 0.133	2.04 (11.0)
	12	81.0 (99.2)	0.869 ± 0.113	-6.70 (11.6)
	13	185 ± 70.2	0.969 ± 0.116	4.00 (10.6)

Table 6-3. Daily monitoring results for gross alpha, gross beta, and tritium in the Livermore site sanitary sewer effluent, 2002 (continued)

Date	Gross alpha (µBq/mL)	Gross beta (mBq/mL)	Tritium (mBq/mL)
14	247 ± 69.1	0.803 ± 0.112	-1.94 (11.3)
15	169 ± 60.9	0.403 ± 0.0928	-0.300 (10.8)
16	195 ± 68.2	0.264 ± 0.0872	3.29 (10.6)
17	156 ± 49.8	0.833 ± 0.117	0.102 (11.2)
18	400 ± 87.9	0.910 ± 0.118	-2.44 (11.2)
19	32.0 (105)	0.962 ± 0.115	0.359 (10.7)
20	111 ± 35.4	0.958 ± 0.115	5.40 (10.7)
21	22.3 (110)	1.05 ± 0.126	-1.52 (11.0)
22	65.1 (102)	0.455 ± 0.0956	0.881 (10.7)
23	66.2 (94.7)	0.559 ± 0.101	0.226 (10.9)
24	229 ± 64.1	0.955 ± 0.124	-2.42 (10.9)
25	-6.73 (99.2)	1.03 ± 0.124	-2.89 (11.4)
26	88.4 (97.7)	0.903 ± 0.117	-0.577 (11.3)
27	127 ± 49.5	0.881 ± 0.114	-0.340 (11.2)
28	128 ± 46.2	1.00 ± 0.120	0.551 (10.9)
29	89.5 (93.2)	0.392 ± 0.0941	0.840 (10.9)
30	51.8 (98.1)	0.392 ± 0.0941	-0.659 (11.1)
Oct 1	91.0 (98.1)	0.888 ± 0.115	18.4 ± 6.80
2	113 ± 44.2	0.962 ± 0.115	2.30 (11.1)
3	23.2 (109)	0.881 ± 0.114	1.52 (11.0)
4	-11.1 (110)	1.12 ± 0.124	-4.40 (11.2)
5	83.6 (112)	1.20 ± 0.132	4.81 (10.5)
6	74.0 (130)	0.636 ± 0.108	-1.58 (10.9)
7	28.3 (114)	0.477 ± 0.100	-1.08 (11.1)
8	19.9 (109)	0.629 ± 0.107	0.295 (10.7)
9	104 (141)	0.999 ± 0.130	1.91 (10.6)
10	176 ± 60.0	0.977 ± 0.117	0.000803 (10.7)
11	94.7 (101)	0.810 ± 0.113	-1.21 (10.7)
12	192 ± 61.3	0.944 ± 0.113	-3.14 (11.0)
13	38.1 (87.0)	0.177 ± 0.0814	-6.03 (11.1)
14	84.7 (87.7)	0.250 ± 0.0850	8.10 (10.1)
15	183 ± 62.1	0.944 ± 0.113	2.47 (10.7)
16	168 ± 60.5	1.02 ± 0.122	1.06 (8.40)
17	92.5 (127)	0.892 ± 0.116	-2.97 (10.8)
18	175 ± 57.8	0.944 ± 0.113	1.19 (10.7)
19	98.4 (108)	0.944 ± 0.113	-0.888 (8.70)
20	163 ± 66.7	0.346 ± 0.0899	1.23 (8.25)
21	202 ± 68.7	0.710 ± 0.107	0.440 (8.70)
22	85.1 (123)	0.958 ± 0.125	1.44 (8.32)
23	181 ± 54.4	0.910 ± 0.118	-3.25 (11.1)
24	112 ± 40.4	0.844 ± 0.110	1.57 (10.8)
25	120 ± 39.4	0.932 ± 0.112	1.35 (10.5)
26	226 ± 72.3	0.666 ± 0.107	6.77 (10.5)
27	115 ± 50.5	0.289 ± 0.0868	2.29 (10.8)
28	137 ± 58.7	0.155 ± 0.0789	-3.42 (10.7)
29	57.7 (129)	1.13 ± 0.124	11.0 ± 6.15
30	144 ± 47.4	1.05 ± 0.127	5.22 (10.4)
31	122 ± 47.6	0.740 ± 0.111	6.29 (10.7)

Table 6-3. Daily monitoring results for gross alpha, gross beta, and tritium in the Livermore site sanitary sewer effluent, 2002 (continued)

Date		Gross alpha (μBq/mL)	Gross beta (mBq/mL)	Tritium (mBq/mL)
Nov	1	8.81 (133)	0.781 ± 0.117	-5.00 (11.2)
	2	289 ± 83.8	0.807 ± 0.113	0.540 (11.2)
	3	69.9 (98.1)	0.381 ± 0.0915	0.696 (10.8)
	4[(b)]	191 ± 64.9	0.888 ± 0.12	-0.4222 (10.9)
	5	78.1 (112)	1.05 ± 0.126	1.19 (10.6)
	6	211 ± 65.5	1.17 ± 0.129	-2.89 (11.0)
	7	50.7 (103)	0.818 ± 0.114	0.00855 (10.9)
	8	158 ± 55.2	0.988 ± 0.119	5.81 (10.5)
	9	165 ± 61.2	0.747 ± 0.112	2.64 (10.7)
	10	127 ± 58.2	0.184 ± 0.0792	3.46 (10.3)
	11	61.8 (82.1)	0.175 ± 0.0805	3.14 (10.2)
	12	429 ± 94.4	1.49 ± 0.136	4.37 (10.5)
	13	239 ± 69.3	1.24 ± 0.124	4.74 (7.77)
	14	204 ± 65.4	0.866 ± 0.113	4.48 (11.0)
	15	108 ± 45.5	0.858 ± 0.112	1.03 (10.6)
	16	204 ± 67.4	0.818 ± 0.114	3.50 (10.5)
	17	124 ± 57.2	0.272 ± 0.0871	1.85 (10.7)
	18	132 ± 60.9	0.339 ± 0.0915	0.759 (11.1)
	19	448 ± 103	0.888 ± 0.115	-0.485 (10.8)
	20	418 ± 100	1.12 ± 0.123	6.73 (10.3)
	21	35.9 (95.5)	0.577 ± 0.0981	-0.511 (10.8)
	22	19.8 (41.1)	0.733 ± 0.0952	-0.603 (10.6)
	23	85.8 (114)	0.829 ± 0.116	-2.80 (10.9)
	24	137 ± 60.1	0.286 ± 0.0859	0.198 (11.0)
	25	68.1 (80.7)	0.189 ± 0.0815	1.83 (10.9)
	26	269 ± 78.0	0.944 ± 0.123	-0.259 (10.9)
	27	342 ± 85.6	1.25 ± 0.125	-2.33 (11.2)
	28	206 ± 64.0	0.777 ± 0.109	-4.74 (11.0)
	29	240 ± 79.1	0.242 ± 0.0848	-1.67 (10.9)
	30	84.0 ± 47.0	0.226 ± 0.0838	1.58 (10.7)
Dec	1	78.4 (80.7)	0.199 ± 0.0818	-1.94 (11.1)
	2	122 ± 57.2	0.240 ± 0.0839	-0.481 (10.7)
	3	470 ± 108	1.17 ± 0.129	5.59 (10.7)
	4	149 ± 52.1	1.02 ± 0.122	1.67 (10.8)
	5	143 ± 52.8	0.869 ± 0.113	-5.29 (11.1)
	6	135 ± 52.8	0.951 ± 0.114	7.14 (10.5)
	7	138 ± 53.7	0.903 ± 0.117	5.40 (10.8)
	8	98.1 ± 56.9	0.206 ± 0.0824	1.64 (10.9)
	9	32.9 (85.8)	0.221 ± 0.0841	6.40 (10.4)
	10	21.6 (135)	0.899 ± 0.117	4.88 (10.9)
	11	111 (115)	0.973 ± 0.117	-2.66 (11.2)
	12	533 ± 117	1.18 ± 0.129	6.36 (10.5)
	13	51.4 (93.6)	0.529 ± 0.101	9.88 (10.6)
	14	61.4 (123)	0.988 ± 0.119	0.181 (10.8)
	15	38.1 (107)	0.429 ± 0.0987	1.78 (11.0)
	16	128 ± 65.1	0.235 ± 0.0844	0.496 (11.1)
	17	33.7 (108)	0.592 ± 0.107	147 ± 9.38
	18	-13.0 (110)	0.829 ± 0.116	69.2 ± 8.30
	19	243 ± 77.9	0.936 ± 0.112	7.51 (11.1)
	20	285 ± 108	0.551 ± 0.105	2.08 (10.6)
	21	167 ± 83.6	0.342 ± 0.0993	8.88 (10.4)

Table 6-3. Daily monitoring results for gross alpha, gross beta, and tritium in the Livermore site sanitary sewer effluent, 2002 (concluded)

Date	Gross alpha (μBq/mL)	Gross beta (mBq/mL)	Tritium (mBq/mL)
22	50.0 (95.1)	0.279 ± 0.0865	3.50 (10.3)
23	104 ± 58.4	0.323 ± 0.0904	-1.84 (10.7)
24	101 (111)	0.470 ± 0.0987	-0.245 (11.1)
25	64.0 (104)	0.574 ± 0.103	-5.74 (11.2)
26	57.0 (96.9)	0.341 ± 0.0921	5.36 (10.4)
27	155 ± 63.6	0.755 ± 0.106	3.00 (11.1)
28	118 ± 59.2	0.651 ± 0.104	1.07 (8.25)
29	24.0 (91.0)	0.251 ± 0.0853	6.33 (8.03)
30	17.9 (87.7)	0.245 ± 0.0859	-1.45 (8.25)
31	67.7 (112)	0.810 ± 0.113	2.01 (8.25)

Note: The activities shown in this table are measured concentrations and their associated 2σ counting errors.

Miminum detectable concentration (MDC) is shown in parentheses when calculated concentration is less than the MDC.

a Results shown for September 6 are from a two-day composite. The September 5 daily sample was not acquired, thus resulting in a two-day composite sample for September 6.

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 October 30 through November 6, 2002.

Table 6-4. Monthly composite results for tritium (Bq/L) for the Livermore site and LWRP effluent, 2002

Date	LWRP[(a)]	B196
Jan	0.0603 (2.6381)	-0.0344 (2.664)
Feb	1.27 (2.50)	1.21 (2.53)
Mar	1.7 (2.68)	2.58 ± 2.24
Apr	0.429 (2.43)	1.49 (2.46)
May	-2.00 (2.6862)	0.496 (2.63)
Jun	0.32 (2.5234)	1.61 (2.55)
Jul	0.44 (1.7982)	1.13 (1.78)
Aug	0.10 (2.9711)	2.34 (2.94)
Sep	1.67 (2.3902)	2.84 ± 2.05
Oct	0.40 (2.7195)	1.26 (2.70)
Nov	1.58 (2.4901)	2.28 ± 2.09
Dec	-0.79 (2.6159)	9.66 ± 2.49

Note: The activities shown in this table are measured concentrations and their associated 2σ counting errors. If the activitiy is below the 2σ counting error, the limit of sensitivity (LOS) is in parentheses next to the measured value.

a LWRP = Livermore Water Reclamation Plant

Table 6-5. Weekly composite for metals in Livermore site sanitary sewer effluent, 2002

Composite dates[(a)]	Parameter (mg/L)								
	Ag	As	Cd	Cr	Cu	Hg	Ni	Pb	Zn
Jan 2	<0.01	<0.004	<0.005	0.026	0.24	0.00042	0.0076	0.044	0.53
Jan 9	<0.01	0.0032	<0.005	0.017	0.17	0.00061	<0.005	0.017	0.35
Jan 16	<0.01	0.004	<0.005	0.021	0.14	<0.0004	0.0069	0.018	0.48
Jan 23	<0.01	<0.002	<0.005	<0.01	0.12	<0.0004	0.006	0.012	0.37
Jan 30	<0.01	<0.002	<0.005	<0.01	0.13	0.00044	<0.005	0.013	0.38
Feb 6	<0.01	0.0051	<0.005	0.017	0.093	<0.0002	<0.005	0.0053	0.19
Feb 13	0.036	0.005	<0.005	0.017	0.15	<0.0002	0.0077	0.012	0.36
Feb 20	0.01	0.0027	<0.005	0.017	0.11	<0.0002	0.0062	0.02	0.28
Feb 27	<0.01	<0.004	<0.005	0.024	0.18	<0.001	0.0063	0.015	0.34
Mar 6	<0.01	0.0024	<0.005	0.016	0.12	0.00039	<0.005	0.031	0.25
Mar 13	<0.01	0.0024	<0.005	<0.01	0.11	<0.0002	0.0052	0.0054	0.25
Mar 20	<0.01	<0.002	<0.005	<0.01	0.12	0.0002	<0.005	<0.008	0.29
Mar 27	<0.01	0.0021	<0.005	<0.01	0.1	0.00025	0.0052	<0.008	0.29
Apr 3	0.02	0.0024	<0.005	0.01	0.17	<0.0002	<0.005	0.012	0.3
Apr 10	<0.01	0.0021	<0.005	0.013	0.13	0.00033	<0.005	0.01	0.29
Apr 17	<0.01	<0.004	<0.005	0.016	0.18	<0.0004	<0.005	0.018	0.33
Apr 24	<0.01	0.0026	<0.005	<0.01	0.14	<0.0004	<0.005	0.0094	0.25
May 1	<0.01	0.002	<0.005	<0.01	0.13	<0.0002	<0.005	0.016	0.34
May 8	<0.01	0.0023	<0.005	0.013	0.14	0.00057	<0.005	0.019	0.3
May 15	<0.01	0.0025	<0.005	0.017	0.16	0.0002	<0.005	0.032	0.29
May 22	<0.01	0.0027	<0.005	0.013	0.11	<0.0002	<0.005	0.019	0.22
May 29	0.021	<0.004	<0.005	0.018	0.17	<0.0002	<0.005	0.021	0.23
Jun 5	<0.01	0.004	<0.005	0.023	0.28	<0.0002	0.0059	0.048	0.48
Jun 12	<0.01	<0.04	<0.005	0.028	0.27	<0.0002	0.0062	0.015	0.42
Jun 19	<0.01	<0.04	<0.005	0.014	0.18	<0.0002	0.0059	0.029	0.35
Jun 26	<0.01	<0.004	<0.005	0.015	0.17	<0.0004	<0.005	<0.02	0.36
Jul 3	<0.01	0.0043	<0.005	0.021	0.2	<0.0004	0.0063	0.025	0.34
Jul 10	<0.01	0.0057	<0.005	0.022	0.18	0.00026	0.0053	0.018	0.27
Jul 17	<0.01	0.0086	<0.005	0.035	0.19	0.00024	0.0071	0.018	0.36
Jul 24	<0.01	0.0097	<0.005	0.071	0.33	0.00028	0.011	0.033	0.57
Jul 31	<0.01	0.0076	<0.005	0.036	0.25	<0.0002	0.011	0.033	0.47
Aug 7	<0.01	0.011	<0.005	0.43	0.27	0.00031	0.0086	0.11	0.39
Aug 14	<0.01	0.0076	<0.005	0.029	0.19	0.00033	0.0081	0.03	0.39
Aug 21	<0.01	0.0075	<0.005	0.028	0.28	0.00032	0.0072	0.038	0.46
Aug 28	<0.01	0.0057	<0.005	0.025	0.2	0.00027	0.0085	0.016	0.4
Sep 4	0.042	0.011	<0.005	0.043	0.33	0.00058	0.012	0.028	0.54
Sep 11	<0.01	0.0047	<0.005	0.019	0.16	0.00046	0.0083	0.023	0.37
Sep 18	<0.01	0.0057	<0.005	0.016	0.15	0.00041	0.0065	0.015	0.3
Sep 25	<0.01	0.0055	<0.005	0.018	0.19	<0.0004	0.0076	0.014	0.38
Oct 2	<0.01	0.005	<0.005	0.024	0.27	0.00029	0.01	0.031	0.41
Oct 9	0.035	0.0043	<0.005	0.027	0.16	0.00078	0.0086	0.018	0.39
Oct 16	<0.01	0.0038	<0.005	0.021	0.2	0.00097	0.0093	0.036	0.41
Oct 23	<0.01	0.0043	<0.005	0.024	0.19	0.00054	0.011	0.051	0.32
Oct 30	0.041	0.0034	<0.005	0.013	0.19	0.00025	0.0093	0.029	0.39
Nov 6	0.011	0.0039	<0.005	0.018	0.15	0.00044	0.0077	0.025	0.41
Nov 13	<0.01	0.0037	<0.005	<0.01	0.24	0.00034	0.0093	0.094	0.3
Nov 20	<0.01	0.0022	<0.005	0.013	0.14	0.00026	0.0065	0.029	0.45
Nov 27	0.042	0.0036	<0.005	0.026	0.19	0.00047	0.0067	0.1	0.51
Dec 4	0.021	0.004	<0.005	0.021	0.17	<0.0002	0.012	0.029	0.43
Dec 11	<0.01	0.003	<0.005	<0.01	0.12	<0.0002	0.0067	0.017	0.44
Dec 18	<0.01	0.0035	<0.005	0.018	0.12	<0.0002	0.0083	0.019	0.42
Dec 26	<0.01	0.0023	<0.005	<0.01	0.037	<0.0002	<0.005	0.0026	0.12
Summary of monthly composite results									
Detection frequency	10 of 52	42 of 52	0 of 52	42 of 52	52 of 52	28 of 52	36 of 52	49 of 52	52 of 52
Minimum (mg/L)	<0.01	<0.002	<0.005	<0.01	0.037	<0.0002	<0.005	<0.008	0.12
Maximum (mg/L)	0.042	<0.04	<0.005	0.43	0.33	<0.001	0.012	0.11	0.57
Median (mg/L)	<0.01	<0.004	0.005	0.018	0.17	<0.0003	0.0064	<0.019	0.36
IQR[(b)] (mg/L)	na[(c)]	na	na	0.011	0.063	na	na	na	0.12
EPL[(d)] (mg/L)	0.2	0.06	0.14	0.62	1	0.01	0.61	0.2	3
Maximum Percent of EPL	21	<67	<3.6	69	33	<10	2	55	19

a Ending date of composite period
b IQR = interquartile range
c na = not applicable because of the large number of nondetections. See main volume, Chapter 14.
d EPL = Effluent pollutant limit

Table 6-6. Monthly 24-hour composite results for metals in Livermore site sanitary sewer effluent, 2002

Composite dates	Parameter (mg/L)											
	Ag	Al	As	Be	Cd	Cr	Cu	Fe	Hg	Ni	Pb	Zn
Jan 8	<0.01	0.36	<0.004	<0.0005	<0.005	<0.01	0.12	1.2	<0.0002	<0.005	0.008	0.24
Feb 5	0.017	0.40	0.0047	<0.0005	<0.005	<0.01	0.13	1.6	0.00045	0.0068	0.0096	0.26
Mar 5	<0.01	0.44	<0.002	<0.0005	<0.005	<0.01	0.11	1.6	0.00030	0.006	0.02	0.26
Apr 3	0.10	0.54	0.002	<0.0005	<0.005	0.014	0.20	1.7	<0.0002	<0.005	0.014	0.26
May 7	<0.01	0.80	<0.002	<0.0005	<0.005	0.012	0.16	2.5	0.00035	0.007	0.022	0.31
Jun 4	<0.01	0.39	0.0052	<0.0005	<0.005	0.014	0.15	1.4	<0.0002	<0.005	0.013	0.24
Jul 9	<0.01	0.3	0.0082	<0.01	<0.005	0.02	0.12	1	<0.0002	<0.005	0.0068	0.16
Aug 6	<0.01	0.5	0.0036	<0.01	<0.005	0.02	0.17	1.7	0.00021	0.0065	0.060	0.32
Sep 10	<0.01	0.79	0.0042	<0.01	<0.005	0.013	0.14	2.4	0.00038	0.0076	0.012	0.29
Oct 8	0.02	0.6	0.0021	<0.01	<0.005	<0.01	0.11	1.7	0.00043	0.0061	0.013	0.27
Nov 5	<0.01	0.51	0.0056	<0.01	<0.005	<0.01	0.10	1.5	0.00035	0.0059	0.0091	0.23
Dec 4	<0.01	0.48	<0.002	<0.01	<0.005	<0.01	0.091	1.4	<0.0002	0.0055	0.0091	0.32
Summary of monthly results												
Detection frequency	**3 of 12**	**12 of 12**	**8 of 12**	**0 of 12**	**0 of 12**	**6 of 12**	**12 of 12**	**12 of 12**	**7 of 12**	**8 of 12**	**12 of 12**	**12 of 12**
Minimum (mg/L)	**<0.01**	**0.3**	**<0.002**	**<0.0005**	**<0.005**	**<0.01**	**0.091**	**1**	**<0.0002**	**<0.005**	**0.0068**	**0.16**
Maximum (mg/L)	**0.10**	**0.80**	**0.0082**	**<0.01**	**<0.005**	**0.02**	**0.20**	**2.5**	**0.00045**	**0.0076**	**0.060**	**0.32**
Median (mg/L)	**<0.01**	**0.49**	**<0.0038**	**na**[a]	**na**[a]	**<0.011**	**0.13**	**1.6**	**0.00026**	**0.0060**	**0.013**	**0.26**
IQR[b] **(mg/L)**	**na**[c]	**0.16**	**na**[c]	**na**[a]	**na**[a]	**na**[c]	**0.042**	**0.3**	**na**[c]	**na**[c]	**0.0064**	**0.055**
EPL[d] **(mg/L)**	**0.2**	[e]	**0.06**	[e]	**0.14**	**0.62**	**1.0**	[e]	**0.01**	**0.61**	**0.2**	**3.0**
Maximum Percent of EPL	**50**	[e]	**14**	[e]	**<3.6**	**3.2**	**20**	[e]	**4.5**	**1.2**	**30**	**11**

a na = not applicable because there are no detections. See main volume, Chapter 14.
b IQR = Interquartile range
c na = not applicable because of the large number of nondetections. See main volume, Chapter 14.
d EPL = Effluent pollutant limit
e There is no EPL for this parameter; therefore, no comparison value can be calculated.

Table 6-7. Monthly monitoring results for physical and chemical characteristics of the Livermore site sanitary sewer effluent, 2002

Analyte	EPA Method	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	24-hour composite sample parameters												
Alkalinity (mg/L)													
Bicarbonate alkalinity (as $CaCO_3$)	310.1	262	233	175	240	270	250	250	250	300	250	290	240
Carbonate alkalinity (as $CaCO_3$)	310.1	<5	<5	55.0	<5	<10	<5	<5	<5	<10	<5	<10	29.0
Hydroxide alkalinity (as $CaCO_3$)	310.1	<5	<5	<2.5	<5	<10	<5	<5	<5	<10	<5	<10	<2.5
Total alkalinity (as $CaCO_3$)	310.1	262	233	230	240	270	250	250	250	300	250	290	270
Anions (mg/L)													
Bromide	300.0	0.30	<0.1	<0.1	0.20	0.10	0.10	0.20	0.60	1.1	0.60	0.30	0.30
Chloride	300.0	62	59	41	114	45	75	74	52	95	44	63	47
Fluoride	300.0	0.25	0.12	0.076	0.052	0.091	0.23	0.24	<0.05	0.20	2.3	<0.05	0.10
Nitrate (as N)	353.2	<1	<1	<1	<1	<0.1	<1	<0.1	<0.1	<0.1	0.77	<0.1	<0.1
Nitrate (as NO_3)	353.2	<4.4	<4.4	<4.4	<4.4	<4.4	<4.4	<4.4	<0.4	<0.4	3.4	<0.4	<0.4
Nitrate plus Nitrite (as N)	353.2	<1	<1	<1	<1	<1	<1	<1	<0.1	0.39	0.82	<0.1	<0.1
Nitrite (as N)	353.2	0.32	0.20	<0.02	0.24	<0.02	0.18	0.20	<0.02	0.31	0.049	<0.02	0.33
Nitrite (as NO_2)	353.2	1.0	0.65	<0.065	0.79	<0.065	0.60	0.67	<0.065	1.0	0.16	<0.065	1.1
Orthophosphate	365.1	17	16	19	18	23	17	15	23	20	21	22	20
Sulfate	300.0	15	16	15	16	14	16	16	12	19	13	12	14
Nutrients (mg/L)													
Ammonia nitrogen (as N)	350.1	47	47	49	46	56	47	43	55	45	43	43	51
Total Kjeldahl nitrogen	351.2	58	66	57	60	60	61	49	95	57	52	74	72
Total phosphorus (as P)	365.4	10	8.0	9.5	7.8	14	8.6	6.8	11	11	11	12	9.0
Oxygen demand (mg/L)													
Biochemical oxygen demand	SM17-5210B	397	343	427	163	473	171	192	282	287	343	345	271
Chemical oxygen demand	410.4	655	585	599	257	776	357	358	537	542	658	595	545
Solids (mg/L)													
Settleable Solids	160.5	20.0	22.0	27.0	25.0	30.0	14.0	20.0	48.0	35.0	50.0	30.0	32.0
Total dissolved solids (TDS)	160.1	236	274	236	354	272	540	367	280	250	250	320	250
Total suspended solids (TSS)	160.2	260	300	330	330	660	190	230	460	330	490	240	370
Volatile Solids	160.4	350	403	244	337	400	210	260	270	477	440	427	350
Total metals (mg/L)													
Aluminum	200.7	0.36	0.40	0.44	0.54	0.80	0.39	0.30	0.50	0.79	0.60	0.51	0.48
Arsenic	200.8	(a)	(a)	(a)	(a)	(a)	(a)	0.0082	0.0036	0.0042	0.0021	0.0056	<0.002
Arsenic	206.2	<0.004	0.0047	<0.002	0.0020	<0.002	0.0052	(a)	(a)	(a)	(a)	(a)	(a)
Beryllium	200.8	(a)	(a)	(a)	(a)	(a)	(a)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Beryllium	210.2	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	(a)	(a)	(a)	(a)	(a)	(a)
Cadmium	200.7	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	(a)	(a)	(a)	(a)	(a)	(a)
Cadmium	200.8	(a)	(a)	(a)	(a)	(a)	(a)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calcium	200.7	18	18	15	16	19	20	27	16	18	17	18	15
Chromium	200.7	<0.01	<0.01	<0.01	0.014	0.012	0.014	0.020	0.020	0.013	<0.01	<0.01	<0.01

Table 6-7. Monthly monitoring results for physical and chemical characteristics of the Livermore site sanitary sewer effluent, 2002 (continued)

Analyte	EPA Method	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Copper	200.7	0.12	0.13	0.11	0.20	0.16	0.15	0.12	0.17	(a)	(a)	(a)	(a)
Copper	200.8	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	0.14	0.11	0.10	0.091
Iron	200.7	1.2	1.6	1.6	1.7	2.5	1.4	1.0	1.7	2.4	1.7	1.5	1.4
Lead	200.8	(a)	(a)	(a)	(a)	(a)	(a)	0.0068	0.060	0.012	0.013	0.0091	0.0091
Lead	239.2	0.0080	0.0096	0.020	0.014	0.022	0.013	(a)	(a)	(a)	(a)	(a)	(a)
Magnesium	200.7	2.9	2.8	2.5	2.6	3.0	2.8	2.9	2.8	3.0	2.7	3.0	2.8
Mercury	245.1	<0.0002	0.00045	0.00030	<0.0002	0.00035	<0.0002	<0.0002	0.00021	0.00038	0.00043	0.00035	<0.0002
Nickel	200.8	(a)	(a)	(a)	(a)	(a)	(a)	<0.005	0.0065	0.0076	0.0061	0.0059	0.0055
Nickel	249.2	<0.005	0.0068	0.0060	<0.005	0.0070	<0.005	(a)	(a)	(a)	(a)	(a)	(a)
Potassium	200.7	23	21	22	21	22	19	20	22	21	23	24	26
Selenium	200.8	(a)	(a)	(a)	(a)	(a)	(a)	<0.002	<0.002	0.0025	0.0025	<0.002	<0.002
Selenium	270.2	<0.002	<0.002	<0.02	<0.002	<0.002	<0.01	(a)	(a)	(a)	(a)	(a)	(a)
Silver	200.7	<0.01	0.017	<0.01	0.10	<0.01	<0.01	<0.01	<0.01	<0.01	0.020	<0.01	<0.01
Sodium	200.7	52	49	35	87	38	60	61	38	43	40	52	44
Zinc	200.7	0.24	0.26	0.26	0.26	0.31	0.24	0.16	0.32	0.29	0.27	0.23	0.32
Other (mg/L)													
Total Organic Carbon (TOC)	415.1	46	48	55	53	54	52	49	56	53	56	48	39
Tributyltin	GC-FPD	<6	(b)	(b)	(b)	(b)	(b)	10	(b)	(b)	(b)	(b)	(b)
	Grab sample Parameters												
Semivolatile organic compounds (µg/L)													
1,2,4-Trichlorobenzene	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,2-Dichlorobenzene	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,2-Diphenylhydrazine	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,3-Dichlorobenzene	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,4-Dichlorobenzene	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
2,4,5-Trichlorophenol	625	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
2,4,6-Trichlorophenol	625	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
2,4-Dichlorophenol	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
2,4-Dimethylphenol	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
2,4-Dinitrophenol	625	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
2,4-Dinitrotoluene	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
2,6-Dinitrotoluene	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
2-Chloronaphthalene	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
2-Chlorophenol	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
2-Methyl-4,6-dinitrophenol	625	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
2-Methylnaphthalene	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
2-Naphthylamine	625	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
2-Nitroaniline	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2

Table 6-7. Monthly monitoring results for physical and chemical characteristics of the Livermore site sanitary sewer effluent, 2002 (continued)

Analyte	EPA Method	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2-Nitrophenol	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
3,3-Dichlorobenzidine	625	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
3-Nitroaniline	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
4-Bromophenylphenylether	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
4-Chloro-3-methylphenol	625	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
4-Chloroaniline	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
4-Chlorophenylphenylether	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
4-Nitroaniline	625	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
4-Nitrophenol	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Acenaphthene	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Acenaphthylene	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Aldrin	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Aniline	625	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Anthracene	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
BHC, alpha isomer	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
BHC, beta isomer	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
BHC, delta isomer	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
BHC, gamma isomer (Lindane)	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Benzidine	625	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
Benzo(a)anthracene	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Benzo(a)pyrene	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Benzo(b)fluoranthene	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Benzo(g,h,i)perylene	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Benzo(k)fluoranthene	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Benzoic Acid	625	110	22	15	32	19	110	<10	13	20	46	75	<10
Benzyl Alcohol	625	80	4.3	15	3.8	1900	<2	<2	6.7	280	44	24	8.4
Bis(2-chloroethoxy)methane	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bis(2-chloroethyl)ether	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bis(2-chloroisopropyl)ether	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bis(2-ethylhexyl)phthalate	625	6.6	8.6	17	9.9	8.2	7.7	16	<5	8.0	6.8	<5	32
Butylbenzylphthalate	625	<2	<2	2.8	<2	<2	<2	<2	<2	<2	<2	<2	9.4
Chrysene	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Di-n-octylphthalate	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Dibenzo(a,h)anthracene	625	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Dibenzofuran	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Dibutylphthalate	625	<2	<2	4.4	<2	<2	<2	<2	3.8	<2	<2	<2	16
Dieldrin	625	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Diethylphthalate	625	7.6	8.5	22	6.6	19	6.2	23	24	23	33	8.9	35
Dimethylphthalate	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2

Table 6-7. Monthly monitoring results for physical and chemical characteristics of the Livermore site sanitary sewer effluent, 2002 (continued)

Analyte	EPA Method	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Endosulfan I	625	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Endosulfan II	625	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Endosulfan sulfate	625	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Endrin	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Endrin aldehyde	625	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Fluoranthene	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Fluorene	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Heptachlor	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Heptachlor epoxide	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Hexachlorobenzene	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Hexachlorobutadiene	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Hexachlorocyclopentadiene	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Hexachloroethane	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Indeno(1,2,3-c,d)pyrene	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Isophorone	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
N-Nitrosodi-n-propylamine	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
N-Nitrosodimethylamine	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
N-Nitrosodiphenylamine	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Naphthalene	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Nitrobenzene	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Pentachlorophenol	625	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Phenanthrene	625	<2	<2	<2	<2	<2	2.3	<2	<2	<2	<2	<2	<2
Phenol	625	6.5	2.9	<2	3.4	<2	29	<2	<2	20	2.8	<2	9.6
Pyrene	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
m- and p- Cresol	625	26	41	5.9	25	3.0	450	<2	4.0	17	20	110	4.3
o-Cresol	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
p,p-DDD	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
p,p-DDE	625	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
p,p-DDT	625	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Total oil and grease (mg/L)													
Oil and Grease - 07:00 AM	1664	13	(c)	(c)	(c)	(c)	(c)	12	(c)	(c)	(c)	(c)	(c)
Oil and Grease - 10:00 AM	1664	37	(c)	(c)	(c)	(c)	(c)	29	(c)	(c)	(c)	(c)	(c)
Oil and Grease - 02:00 PM	1664	30	(c)	(c)	(c)	(c)	(c)	28	(c)	(c)	(c)	(c)	(c)
Oil and Grease - 04:00 PM	1664	27	(c)	(c)	(c)	(c)	(c)	12	(c)	(c)	(c)	(c)	(c)
Volatile organic compounds (µg/L)													
1,1,1-Trichloroethane	624	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,2,2-Tetrachloroethane	624	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,2-Trichloroethane	624	<0.5	<0.5	<0.5	<0.5	0.58	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-Dichloroethane	624	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

Table 6-7. Monthly monitoring results for physical and chemical characteristics of the Livermore site sanitary sewer effluent, 2002 (continued)

Analyte	EPA Method	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,1-Dichloroethene	624	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	624	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichloroethane	624	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichloroethene (total)	624	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2-Dichloropropane	624	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,3-Dichlorobenzene	624	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,4-Dichlorobenzene	624	0.67	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-Butanone	624	<20	<20	<20	<20	<20	52	<20	<20	<20	<20	<20	<20
2-Chloroethylvinylether	624	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
2-Hexanone	624	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
4-Methyl-2-pentanone	624	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
Acetone	624	150	140	250	180	310	300	360	510	410	350	180	560
Benzene	624	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromodichloromethane	624	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromoform	624	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.87	<0.5	<0.5	<0.5
Bromomethane	624	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbon disulfide	624	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbon tetrachloride	624	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chlorobenzene	624	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chloroethane	624	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chloroform	624	11	14	9.5	8.6	11	14	10	5.7	9.1	13	11	17
Chloromethane	624	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dibromochloromethane	624	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dibromomethane	624	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dichlorodifluoromethane	624	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ethanol	624	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Ethylbenzene	624	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Freon 113	624	0.61	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Methylene chloride	624	<1	3.5	<1	1.0	<1	1.9	<1	<1	<1	<1	<1	<1
Naphthalene	624	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Styrene	624	<0.5	<0.5	<0.5	<0.5	0.59	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Tetrachloroethene	624	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene	624	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.67	<0.5	<0.5	0.55	<0.5	<0.5
Total xylene isomers	624	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Trichloroethene	624	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Trichlorofluoromethane	624	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Vinyl chloride	624	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
cis-1,2-Dichloroethene	624	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
cis-1,3-Dichloropropene	624	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

Table 6-7. Monthly monitoring results for physical and chemical characteristics of the Livermore site sanitary sewer effluent, 2002 (concluded)

Analyte	EPA Method	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
trans-1,2-Dichloroethene	624	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
trans-1,3-Dichloropropene	624	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Other (mg/L)													
Total Cyanide	335.3	0.024	(d)	(d)	(d)	(d)	(d)	<0.02	(d)	(d)	<0.02	(d)	(d)

a Analytical method was changed by the contract analytical laboratory during the year. See adjacent row for additional data.

b Sampling for this parameter is required on a semiannual (January & July) rather than a monthly basis.

c The requirement to sample for oil & grease has been suspended until further notice based on the LWRP letter of April 1, 1999. LLNL collects these samples semiannually as part of the source control program.

d Sampling for this parameter is required on a semiannual (January & July) rather than a monthly basis. An additional sample was taken in October during the annual co-sampling event with the LWRP.

Surface Water Monitoring

Chris Campbell
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Introduction

Lawrence Livermore National Laboratory monitors surface water at the Livermore site, in the surrounding regions of the Livermore Valley, and at Site 300 and its vicinity in the nearby Altamont Hills. At the first two locales, LLNL monitors reservoirs and ponds, the LLNL swimming pool, the Drainage Retention Basin (DRB), rainfall, tap water, and storm water runoff. Water samples are analyzed for radionuclides and a wide range of nonradioactive constituents.

The data shown for Site 300 and its vicinity include surface water monitoring, rainfall, and storm 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 additional datasets for 2002, from selected networks.

Storm Water

LLNL technologists collect storm water samples for nonradiological analysis with bottles. Samples analyzed for tritium are collected in 250-mL, amber glass containers; samples for gross alpha and gross beta measurements are collected in 1000-mL polyethylene bottles.

Results for Livermore site routine tritium, gross alpha, and gross beta are presented in Table 7-1. Table 7-2 summarizes results for nonradioactive compounds, physical and chemical properties, and anions in Livermore site storm water. Table 7-3 shows results for gross alpha, gross beta, tritium, and uranium in Site 300 storm water. Results of PCB analyses at the Livermore site are presented in Table 7-4.

Rainfall

Rainfall is collected in stainless steel buckets mounted at specified locations about 1 m above the ground to prevent collection of splashback water. Samples are decanted into 250-mL amber glass with Teflon-lined lids. The tritium activity of each sample is measured in a laboratory by scintillation counting (EPA Method 906). The results are presented in Table 7-5.

Drainage Retention Basin

DRB discharge sampling locations (CDBX and WPDC), which monitor compliance with the Livermore site's Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Record of Decision, are shown in the main volume in **Figure 7-2**. **Figure 7-6** of the main volume shows the sampling locations (CDBA and CDBC) used to monitor how water quality compares with maintenance goals and action levels.

Figure 7-6 of the main volume also shows all eight locations where weekly sampling for dissolved oxygen and temperature occurs. Weekly transparency measurements and monthly, quarterly, semiannual, and annual samples are collected at sample location CDBE.

Tables 7-6 and 7-7 show DRB discharge limits and water quality management levels, respectively. Table 7-8 shows the compliance monitoring data for samples collected at sample locations CDBX and WPDC. Dry season compliance monitoring data of the DRB are shown in Table 7-9. Monthly, quarterly, and semiannual maintenance monitoring data for 2002 that were collected at sample location CDBE are shown in Tables 7-10, 7-11, and 7-12. Table 7-13 provides the weekly field measurements collected from sample locations CDBA, CDBC, CDBD, CDBE, CDBF, CDBJ, CDBK, and CDBL.

Other Waters

LLNL technologists sample surface and drinking water at and 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 125-mL, argon-flushed glass containers; those for gross alpha and gross beta radiation analyses are collected in acidified 1000-mL polypropylene bottles. Results are presented in Table 7-14.

Table 7-1. Routine tritium, gross alpha, and gross beta sampling in storm water runoff at the Livermore site, 2002

Parameter/Date	Arroyo Seco	
	Site influent	Site effluent
	ASS2	ASW
Gross alpha (Bq/L)		
5/20	0.022 ± 0.016	0.016 ± 0.013
11/8	0.081 ± 0.026	0.021 ± 0.022
12/16	0.062 ± 0.055	0.097 ± 0.067
Gross beta (Bq/L)		
5/20	0.18 ± 0.044	0.12 ± 0.032
11/8	0.21 ± 0.044	0.12 ± 0.059
12/16	0.85 ± 0.16	0.77 ± 0.15
Tritium (Bq/L)		
5/20	0.26 ± 2.1	1.4 ± 2.1
11/8	23 ± 3.5	7.4 ± 2.4
12/16	-0.26 ± 2.5	0.091 ± 2.6

Parameter/Date	Arroyo Las Positas			
	Site influent			Site effluent
	ALPE	ALPO	GRNE	WPDC
Gross alpha (Bq/L)				
5/20	0.013 ± 0.013	0.096 ± 0.078	0.051 ± 0.023	0.027 ± 0.026
11/8	0.23 ± 0.074	0.17 ± 0.074	0.12 ± 0.036	0.015 ± 0.014
12/16	0.13 ± 0.093	0.093 ± 0.063	0.028 ± 0.019	0.0044 ± 0.024
Gross beta (Bq/L)				
5/20	0.14 ± 0.041	0.11 ± 0.081	0.18 ± 0.044	0.11 ± 0.037
11/8	0.61 ± 0.11	0.24 ± 0.063	0.22 ± 0.048	0.098 ± 0.037
12/16	0.42 ± 0.11	0.16 ± 0.096	0.10 ± 0.034	0.028 ± 0.041
Tritium (Bq/L)				
5/20	1.3 ± 2.1	0.60 ± 2.1	3.4 ± 2.2	5.6 ± 2.3
11/8	8.0 ± 2.5	-1.7 ± 2.2	20 ± 3.3	-0.34 ± 2.2
12/16	-8.3 ± 2.7	16 ± 3.2	-1.7 ± 2.5	18 ± 3.3

Parameter/Date	Drainage Retention Basin (DRB)		
	DRB influent		DRB effluent
	CDB	CDB2	CDBX
Gross alpha (Bq/L)			
5/20	0.026 ± 0.019	0.016 ± 0.012	-
11/8	0.018 ± 0.015	0.023 ± 0.017	0.050 ± 0.044
12/16	0.097 ± 0.067	0.095 ± 0.063	0.022 ± 0.025
Gross beta (Bq/L)			
5/20	0.089 ± 0.035	0.12 ± 0.033	-
11/8	0.12 ± 0.033	0.18 ± 0.041	0.098 ± 0.052
12/16	0.34 ± 0.096	0.32 ± 0.074	0.086 ± 0.033
Tritium (Bq/L)			
5/20	3.1 ± 2.1	16 ± 2.8	-
11/8	25 ± 3.6	5.5 ± 2.4	12 ± 2.7
12/16	4.2 ± 2.7	-1.2 ± 2.7	12 ± 3.0

Notes: Blank spaces indicate no analyses performed

A negative number means the sample radioactivity was less than the background radioactivity inside the measurement apparatus.

Table 7-2. Nonradioactive constituents detected in storm water runoff, Livermore site, 2002

Parameter	Storm Date	Arroyo Seco		Arroyo Las Positas				Drainage Retention Basin (DRB)		
		Site influent	Site effluent	Site influent			Site effluent	DRB influent		DRB effluent
		ASS2	ASW	ALPE	ALPO	GRNE	WPDC	CDB	CDB2	CDBX
Physical (mg/L)										
Chemical oxygen	5/20	96	100	64	130	110	43	66	80	
demand (mg O/L)	11/8	140	95	259	466	71	81	93	100	36
	12/16	240	180	190	70	35	30			36
Total suspended solids	5/20	120	67	190	25	430	5	100	33	
	11/8	800	410	1300	800	310	240	200	580	27
	12/16	1100	980	37	250	86	110	820	65	50
Anions (mg/L)										
Bromide	11/8	<0.1	<0.1	<0.1	1	<0.1	<0.1			0.9
	12/16	0.1	0.3	0.5	0.3	<0.1	0.5			0.4
Chloride	11/8	0.91	1.2	7.4	168	4.3	7.3			173
	12/16	42	40	180	48	6.1	69			104
Fluoride	11/8	<0.05	<0.05	0.066	0.53	0.051	<0.05			0.4
	12/16	0.2	0.18	1.1	0.27	0.1	0.18			0.22
Sulfate	11/8	1.2	1.2	17	120	3.1	4.1			62
	12/16	58	54	182	39	5.7	30			42
Nitrate (as N)	11/8	0.26	0.23	1.7	0.62	2.5	0.44			1.4
	12/16	3.2	3	2.1	1.7	4.4	0.72			<0.5
Nitrate (as NO_3)	11/8	1.1	1	7.5	2.7	11	1.9			6.1
	12/16	14	13	9.3	7.5	19	3.2			<2
Nitrate plus Nitrite (as N)	11/8	0.26	0.23	1.7	0.62	2.5	0.44			1.4
	12/16	3.3	3.1	2.1	1.7	4.4	0.74			<0.5
Nitrite (as N)	12/16	0.11	0.13	0.042	0.035	0.029	0.02			<0.02
Nitrite (as NO_2)	12/16	0.35	0.44	0.14	0.12	0.094	0.066			<0.065
OrthoPhosphate	11/8	0.999	0.839	4.24	0.21	0.877	0.717			0.087
	12/16	5.61	5.12	5.56	0.65	0.63	0.42			0.34
Alkalinity (mg/L)										
Bicarbonate Alk (as $CaCO_3$)	11/8	16	14	91	110	29	26			140
	12/16	80	79	220	79	54	92			120
Carbonate Alk (as $CaCO_3$)	11/8	<2.5	<2.5	<2.5	<5	<2.5	<2.5			29
	12/16	<2.5	<2.5	<5	<2.5	<2.5	<2.5			<2.5
Total Alkalinity (as $CaCO_3$)	11/8	16	14	91	110	29	26			170
	12/16	80	79	220	79	54	92			120
Herbicides (µg/L)										
Bromacil	11/8	<1	<1	<1	1.2	67	1.8			<1
	12/16	<1	<1	<1	<1	<1	1.8			<1
Butylbenzylphthalate	11/8	<2	<2	<2	<2	<2	<2			<2
	12/16	<2	<2	<2	<2	<2	<2			<2
Di (2ethylhexyl) adipate	11/8	<1	<1	<1	<1	<1	<1			<1
	12/16	<1	<1	<1	<1	<1	<1			<1
Diazinon	11/8	<0.5	<0.5	<0.5	<0.5	1.4	<0.5			<0.5
	12/16	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5			<0.5
Dibutylphthalate	11/8	<1	<1	<1	<1	<1	<1			<1
	12/16	<1	<1	<1	<1	<1	<1			<1
Diuron	11/8	<0.4	<0.4	0.7	1.4	2.2	0.8	0.9	2.4	<0.4
	12/16	0.5	0.58	<0.4	290	1.3	44	<0.4	2.8	2.4
Glyphosate	11/8	<25	<25	170	<25	40	38	<25	130	<25
	12/16	<25	<25	<25	<25	<25	<25	<25	<25	<25

Table 7-2. Nonradioactive constituents detected in storm water runoff, Livermore site, 2002 (concluded)

Parameter	Storm Date	Arroyo Seco		Arroyo Las Positas				Drainage Retention Basin (DRB)		
		Site influent	Site effluent	Site influent			Site effluent	DRB influent		DRB effluent
		ASS2	ASW	ALPE	ALPO	GRNE	WPDC	CDB	CDB2	CDBX
Dissolved metals (mg/L)										
Copper	5/20	0.018	0.0099	0.024	0.0071	0.018	0.0062	0.014	0.018	
	11/8	0.0040	0.0049	0.007	0.0047	0.0036	0.0038			0.0038
	12/16	0.0074	0.0073	0.012	0.0046	0.004	0.003			
Chromium(VI)	11/8	0.003	0.002	0.004	0.002	0.003	0.003			0.004
	12/16	0.005	0.005	<0.002	<0.002	0.002	0.003			
Zinc	5/20	0.6	<0.2	<0.2	<0.2	<0.2	<0.2	0.24	<0.2	
	11/8	0.028	0.051	<0.02	<0.02	<0.02	0.038			<0.02
	12/16	0.041	0.045	0.026	<0.02	0.041	0.027			
Total metals (mg/L)										
Copper	5/20	0.018	0.0099	0.024	0.0071	0.018	0.0062	0.014	0.018	
	11/8	0.0344	0.0283	0.0694	0.0552	0.0303	0.0179	0.0228	0.0189	0.0075
	12/16	0.0601	0.0514	0.0152	0.0209	0.009	0.0097	0.0465	0.0164	0.0065
Chromium(VI)	5/20	<0.01	<0.01	<0.01	<0.002	<0.02	<0.002	<0.01	<0.01	
	11/8							0.003	0.004	
	12/16							0.016	0.004	0.004
Zinc	5/20	0.6	<0.2	<0.2	<0.2	<0.2	<0.2	0.24	<0.2	
	11/8	0.46	0.41	0.28	0.23	0.38	0.26	0.43	0.15	0.054
	12/16	0.27	0.27	0.029	0.095	0.12	0.074	0.28	0.1	0.059
Miscellaneous organics (mg/L)										
Oil and grease	11/8	<5	<5	<5	<5	<5	<5	<5	<5	<5
	12/16	<5	<5	<5	<5	<5	<5	<5	<5	<5
Total organic carbon	5/20	11	19	14	19	8	9.4	9.4	21	
	11/8	7.5	11	35	8.4	6.7	10			5.6
	12/16	20	18	37	6.6	6.7	6			5.2

Note: Blank spaces indicate no analyses performed

Table 7-3. Radioactivity in storm water runoff, Site 300, 2002

Parameter/Date	Upstream location	Effluent locations	Effluent locations	Downstream location
	CARW	N883	NPT7	GEOCRK
Gross alpha (Bq/L)				
11/8	0.37 ± 0.15	0.013 ± 0.011	0.085 ± 0.031	0.12 ± 0.27
12/16	0.048 ± 0.035	0.012 ± 0.020	0.10 ± 0.036	0.13 ± 0.074
Gross beta (Bq/L)				
11/8	0.77 ± 0.25	0.073 ± 0.028	0.24 ± 0.052	0.76 ± 0.33
12/16	0.30 ± 0.081	0.14 ± 0.059	0.24 ± 0.074	0.59 ± 0.14
Tritium (Bq/L)[a]				
11/8	0.70 ± 2.3	-0.23 ± 2.2	0.46 ± 2.2	-0.46 ± 2.2
12/16	0.089 ± 2.3	-0.84 ± 2.4	0.63 ± 2.3	-0.81 ± 2.3
Uranium-234+233 (Bq/L)				
11/8	0.10 ± 0.014	0 ± 0.00067	0.017 ± 0.0037	0.11 ± 0.014
12/16	0.052 ± 0.0070	0.00089 ± 0.00081	0.020 ± 0.0033	0.14 ± 0.016
Uranium-235+236 (Bq/L)				
11/8	0.0043 ± 0.0020	0.00041 ± 0.00081	0.0010 ± 0.0012	0.0035 ± 0.0015
12/16	0.0033 ± 0.0013	-0.00030 ± 0.00019	0.00070 ± 0.00081	0.0050 ± 0.0017
Uranium-238 (Bq/L)				
11/8	0.10 ± 0.013	0.00067 ± 0.00070	0.016 ± 0.0037	0.089 ± 0.012
12/16	0.051 ± 0.0070	0.0016 ± 0.00081	0.020 ± 0.0034	0.16 ± 0.018

a Tritium activities are presented relative to a low activity standard or "dead water." As a result, it is possible to have negative values or measurements that are lower than the reference "dead water" standard.

Table 7-4. Polychlorinated biphenyls (µg/L) in storm water at the Livermore site, 2002

Locations		PCB 1016			PCB 1221		
		May	Nov	Dec	May	Nov	Dec
Arroyo Seco							
Site influent	ASS2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Site effluent	ASW	<0.3	<0.2	<0.2	<0.3	<0.2	<0.2
Arroyo Las Positas							
Site influent	ALPE	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	ALPO	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	GRNE	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Site effluent	WPDC	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Drainage Retention Basin (DRB)							
DRB influent	CDB	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	CDB2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
DRB effluent	CDBX	n/a[(a)]	<0.2	<0.2	n/a	<0.2	<0.2

Locations		PCB 1232			PCB 1242		
		May	Nov	Dec	May	Nov	Dec
Arroyo Seco							
Site influent	ASS2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Site effluent	ASW	<0.3	<0.2	<0.2	<0.3	<0.2	<0.2
Arroyo Las Positas							
Site influent	ALPE	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	ALPO	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	GRNE	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Site effluent	WPDC	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Drainage Retention Basin							
DRB influent	CDB	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	CDB2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
DRB effluent	CDBX	n/a	<0.2	<0.2	n/a	<0.2	<0.2

Locations		PCB 1248			PCB 1254		
		May	Nov	Dec	May	Nov	Dec
Arroyo Seco							
Site influent	ASS2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Site effluent	ASW	<0.3	<0.2	<0.2	<0.3	<0.2	<0.2
Arroyo Las Positas							
Site influent	ALPE	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	ALPO	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	GRNE	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Site effluent	WPDC	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Drainage Retention Basin							
DRB influent	CDB	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	CDB2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
DRB effluent	CDBX	n/a	<0.2	<0.2	n/a	<0.2	<0.2

Locations		PCB 1260		
		May	Nov	Dec
Arroyo Seco				
Site influent	ASS2	<0.2	<0.2	<0.2
Site effluent	ASW	<0.3	<0.2	<0.2
Arroyo Las Positas				
Site influent	ALPE	<0.2	<0.2	<0.2
	ALPO	<0.2	<0.2	<0.2
	GRNE	<0.2	<0.2	<0.2
Site effluent	WPDC	<0.2	<0.2	<0.2
Drainage Retention Basin				
DRB influent	CDB	<0.2	<0.2	<0.2
	CDB2	<0.2	<0.2	<0.2
DRB effluent	CDBX	n/a	<0.2	<0.2

a n/a = no data available

Table 7-5. Tritium in rain (Bq/L), Livermore site, Livermore Valley, and Site 300, 2002

Location	3/8	5/20	5/22	11/11	12/16	12/17
	Livermore site					
B343	15 ± 2.8	47 ± 5.6		12 ± 2.6	21 ± 3.4	
B291	4.2 ± 2.3	2.0 ± 2.1		0.46 ± 2.1	5.8 ± 2.5	
CDB	12 ± 2.7	14 ± 2.7		5.5 ± 2.3	8.2 ± 2.6	
VIS	3.6 ± 2.3	1.1 ± 2.1		2.7 ± 2.1	1.9 ± 2.4	
COW	3.1 ± 2.3	4.9 ± 2.2			3.6 ± 2.4	
SALV	0.22 ± 2.1	0.78 ± 2.0		1.7 ± 2.1	1.2 ± 2.4	
MET	0.28 ± 2.2	0.66 ± 2.1		0.46 ± 2.1	0.98 ± 2.3	
	Livermore Valley					
ESAN	-0.51 ± 2.1	-0.77 ± 2.0		0.23 ± 2.2	-1.1 ± 2.4	
ZON7	-0.38 ± 2.2	1.1 ± 2.0		1.4 ± 2.3	0.0 ± 2.4	
SLST	-0.75 ± 2.2	-0.40 ± 2.1		1.8 ± 2.3	-0.16 ± 2.4	
GTES	-0.30 ± 2.2	-1.7 ± 2.0		0.85 ± 2.2	0.24 ± 2.4	
VINE	-0.23 ± 2.3	0.31 ± 2.1		-0.31 ± 2.2	-0.94 ± 2.4	
BVA	0.37 ± 2.2	-1.3 ± 2.0		1.4 ± 2.2		
VET	-0.60 ± 2.2	-1.2 ± 2.1		0.98 ± 2.1	-0.16 ± 2.5	
PATT	-0.90 ± 2.2	-1.7 ± 2.1		1.6 ± 2.2	1.0 ± 2.5	
AMON	-0.38 ± 2.2	-0.46 ± 2.0		0.39 ± 2.2	0.87 ± 2.5	
	Site 300					
COHO	-0.84 ± 2.2		-0.24 ± 2.1	1.1 ± 2.1		-0.18 ± 2.3
COMP	-1.3 ± 2.1					-1.1 ± 2.3
TNK5			-0.080 ± 2.1			-1.5 ± 2.3

Notes: Blank spaces indicate no samples were collected on these dates.
A negative number means the sample radioactivity was less than the background radioactivity inside the measurement apparatus.

Table 7-6. Drainage Retention Basin discharge limits for CDBX, identified in CERCLA[(a)] Record of Decision as amended, and sampling frequencies for CDBX and WPDC

Parameter	CDBX	WPDC	Effluent discharge limits	
			Dry season Apr 1–Nov 30	Wet season Dec 1–Mar 31
Physical				
Specific conductance (µS/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
Turbidity (NTU)[(b)]	A & B	A & B	>15	>15
Toxicity				
Acute aquatic survival bioassay (% survival/96 hours)	A & B	A & B	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
Chronic bioassay Fathead minnow	A	—[(c)]	Not applicable	Not applicable
Water flea	A	—[(c)]	Not applicable	Not applicable
Algae	A	—[(c)]	Not applicable	Not applicable
General minerals (mg/L)				
Total alkalinity	A	—[(c)]	Not applicable	Not applicable
Nitrate (as N)	A	—[(c)]	Not applicable	Not applicable
Nitrite (as N)	A	—[(c)]	Not applicable	Not applicable
Metals (µg/L)				
Antimony	A & B	A & B	6	Not applicable[(d)]
Arsenic	A & B	A & B	50	10
Beryllium	A & B	A & B	4	Not applicable[(d)]
Boron	A & B	A & B	Not applicable[(e)]	Not applicable[(d)]
Cadmium	A & B	A & B	5	2.2
Chromium (total)	A & B	A & B	50	Not applicable[(d)]
Chromium(VI)	A & B	A & B	Not applicable[(e)]	22
Copper	A & B	A & B	1300	23.6
Iron	A & B	A & B	Not applicable[(e)]	Not applicable[(d)]
Lead	A & B	A & B	15	6.4
Manganese	A & B	A & B	Not applicable[(e)]	Not applicable[(d)]
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[(d)]
Zinc	A & B	A & B	Not applicable[(e)]	220

Table 7-6. Drainage Retention Basin discharge limits for CDBX, identified in CERCLA[(a)] Record of Decision 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	—[(c)]	Not applicable	Not applicable
Volatile organic compounds (EPA Method 601 only)	A	—[(c)]	5	5
Tetrachloroethene			4	4
Vinyl chloride			2	2
Chemical oxygen demand	A	—[(c)]	Not applicable	Not applicable
Total organic carbon	A	—[(c)]	Not applicable	Not applicable
Polychlorinated biphenlyls	A & B	A & B	Not applicable	Not applicable
Radioactivity (Bq/L)				
Alpha	A	—[(c)]	0.56	0.56
Beta	A	—[(c)]	1.85	1.85
Tritium	A	—[(c)]	740	740

a CERCLA = Comprehensive Environmental Response, Compensation and Liability Act of 1980

b NTU = Nephelometric turbidity units

c There is no sampling requirement for this parameter.

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

e No maximum containment level 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 7-7. Routine water quality management action levels and monitoring plan for the Drainage Retention Basin

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

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

Constituent	Location	Sampling frequency	Management action levels	
			Dry season Apr 1–Nov 30	Wet season Dec 1–Mar 31
Metals (µg/L) (continued)				
Lead	CDBE	Semiannually	>15	>6.4
Manganese	CDBE	Semiannually	Not applicable	Not applicable
Mercury	CDBE	Semiannually	>2	>2
Nickel	CDBE	Semiannually	>100	>320
Selenium	CDBE	Semiannually	>50	>10
Silver	CDBE	Semiannually	>100	>8.2
Thallium	CDBE	Semiannually	>2	Not applicable
Zinc	CDBE	Semiannually	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	Semiannually	Not applicable	Not applicable
Polychlorinated biphenyls (µg/L)	CDBE	Semiannually	Not applicable	Not applicable
Radiological (Bq/L)				
Gross alpha	CDBE	Semiannually	>0.56	>0.56
Gross beta	CDBE	Semiannually	>1.85	>1.85
Tritium	CDBE	Semiannually	>740	>740
Toxicity				
Aquatic bioassay (% survival/96-hour) 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
Water flea	CDBE	Annually	Not applicable	Not applicable
Algae	CDBE	Annually	Not applicable	Not applicable

a NTU = Nephelometric Turbidity Units

b MPN = Most probable number

Table 7-8. Compliance monitoring data for releases from the Drainage Retention Basin, wet season, 2002

Parameter	CDBX		WPDC	
	11/8	12/16	11/8	12/16
Biological				
Aquatic Bioassay				
Pimephales promelas survival (percent survival)	na [(a)]	na	100	100
Pimephales promelas chronic survival (percent survival)	na	na	70 [(b)]	na
Pimephales promelas chronic growth (mg)	na	na	0.4	na
Selenastrum capricornutum chronic growth (mean cells/mL x 10^6)	na	na	0.481	na
Anions (mg/L)				
Nitrate (as NO_3)	6.1	<2	1.9	3.2
Sulfate	62	42	4.1	30
Nitrate (as N)	1.4	<0.5	0.44	0.72
Fluoride	0.4	0.22	<0.05	0.18
Chloride	170	100	7.3	69
Ortho-Phosphate	0.087	0.34	0.72	0.42
Bromide	0.9	0.4	<0.1	0.5
Nitrate plus Nitrite (as N)	1.4	<0.5	0.44	0.74
Nitrite (as NO_2)	na	<0.065	na	0.066
Nitrite (as N)	na	<0.02	na	0.02
General minerals (mg/L)				
Magnesium	31	21	5	16
Total dissolved solids (TDS)	250	400	73	300
Total Hardness (as $CaCO_3$)	250	180	42	140
Sodium	100	70	5.8	52
Calcium	50	39	8.7	29
pH	8.6	7.9	7.2	7.9
Total Phosphorus (as P)	0.15	0.14	0.49	0.2
Potassium	2.5	3.2	5.1	3.5
Specific Conductance	1000	680	89	500
Surfactants	<0.5	<0.5	<0.5	<0.5
Bicarbonate Alk (as $CaCO_3$)	140	120	26	92
Carbonate Alk (as $CaCO_3$)	29	<2.5	<2.5	<2.5
Hydroxide Alk (as $CaCO_3$)	<2.5	<2.5	<2.5	<2.5
Total Alkalinity (as $CaCO_3$)	170	120	26	92
Dissolved metals (mg/L)				
Molybdenum	<0.025	na	<0.025	<0.025
Chromium	0.0017	na	<0.001	<0.001
Lead	<0.005	na	<0.005	<0.005
Cadmium	<0.0005	na	<0.0005	<0.0005
Iron	<0.1	na	0.3	0.1
Hexavalent Chromium	0.004	na	0.003	0.003
Copper	0.0038	na	0.0038	0.003
Cobalt	<0.05	na	<0.05	<0.05
Arsenic	<0.002	na	<0.002	0.0031
Manganese	<0.03	na	<0.03	<0.03
Mercury	<0.0002	na	<0.0002	<0.0002
Selenium	0.0023	na	<0.002	<0.002
Nickel	0.0023	na	0.0025	0.0026
Antimony	<0.005	na	<0.005	<0.005
Silver	<0.001	na	<0.001	<0.001
Thallium	<0.001	na	<0.001	<0.001
Zinc	<0.02	na	0.038	0.027
Vanadium	<0.02	na	<0.02	<0.02
Boron	1.7	na	0.099	0.64
Aluminum	<0.05	na	0.3	0.07
Beryllium	<0.0005	na	<0.0005	<0.0005
Barium	0.12	na	0.063	0.07

Table 7-8. Compliance monitoring data for releases from the Drainage Retention Basin, wet season, 2002 (continued)

Parameter	CDBX		WPDC	
	11/8	12/16	11/8	12/16
Total metals (mg/L)				
Molybdenum	<0.025	<0.025	<0.025	<0.025
Chromium	0.0063	0.011	0.022	0.012
Lead	<0.005	<0.005	0.0092	<0.005
Cadmium	<0.0005	<0.0005	<0.0005	<0.0005
Iron	1.1	2.3	10	4.8
Hexavalent Chromium	na	0.004	na	na
Copper	0.0075	0.0065	0.018	0.0097
Cobalt	<0.05	<0.05	<0.05	<0.05
Arsenic	<0.002	<0.002	0.0033	0.0027
Manganese	0.047	0.074	0.23	0.087
Mercury	<0.0002	<0.0002	<0.0002	<0.0002
Selenium	<0.002	<0.002	<0.002	<0.002
Nickel	0.0047	0.01	0.02	0.011
Antimony	<0.005	<0.005	<0.005	<0.005
Silver	<0.001	<0.001	<0.001	<0.001
Thallium	<0.001	<0.001	<0.001	<0.001
Zinc	0.054	0.059	0.26	0.074
Vanadium	<0.02	<0.02	0.02	0.01
Boron	1.4	0.94	0.11	0.92
Aluminum	0.9	3.4	8.3	5
Beryllium	<0.0002	<0.0002	0.0002	<0.0002
Barium	0.11	0.087	0.14	0.12
Volatile organic compound (µg/L)				
1,1,1-Trichloroethane	<0.5	<0.5	na	na
1,1,2,2-Tetrachloroethane	<0.5	<0.5	na	na
1,1,2-Trichloroethane	<0.5	<0.5	na	na
1,1-Dichloroethane	<0.5	<0.5	na	na
1,1-Dichloroethene	<0.5	<0.5	na	na
1,2-Dichlorobenzene	<0.5	<0.5	na	na
1,2-Dichloroethane	<0.5	<0.5	na	na
1,2-Dichloroethene (total)	<1	<1	na	na
1,2-Dichloropropane	<0.5	<0.5	na	na
1,3-Dichlorobenzene	<0.5	<0.5	na	na
1,4-Dichlorobenzene	<0.5	<0.5	na	na
2-Chloroethylvinylether	<10	<10	na	na
Bromodichloromethane	<0.5	<0.5	na	na
Bromoform	<0.5	<0.5	na	na
Bromomethane	<1	<1	na	na
Carbon tetrachloride	<0.5	<0.5	na	na
Chlorobenzene	<0.5	<0.5	na	na
Chloroethane	<0.5	<0.5	na	na
Chloroform	<0.5	<0.5	na	na
Chloromethane	<0.5	<0.5	na	na
cis-1,2-Dichloroethene	<0.5	<0.5	na	na
cis-1,3-Dichloropropene	<0.5	<0.5	na	na
Dibromochloromethane	<0.5	<0.5	na	na
Dichlorodifluoromethane	<0.5	<0.5	na	na
Freon 113	<0.5	<0.5	na	na
Methylene chloride	<1	<1	na	na
Tetrachloroethene	<0.5	<0.5	na	na
Total Trihalomethanes	<2	<2	na	na
trans-1,2-Dichloroethene	<0.5	<0.5	na	na
trans-1,3-Dichloropropene	<0.5	<0.5	na	na
Trichloroethene	<0.5	<0.5	na	na
Trichlorofluoromethane	<0.5	<0.5	na	na
Vinyl chloride	<0.5	<0.5	na	na

Table 7-8. Compliance monitoring data for releases from the Drainage Retention Basin, wet season, 2002 (continued)

Parameter	CDBX		WPDC	
	11/8	12/16	11/8	12/16
Polychlorinated biphenyls (µg/L)				
PCB 1016	<0.2	<0.2	<0.2	<0.2
PCB 1221	<0.2	<0.2	<0.2	<0.2
PCB 1232	<0.2	<0.2	<0.2	<0.2
PCB 1242	<0.2	<0.2	<0.2	<0.2
PCB 1248	<0.2	<0.2	<0.2	<0.2
PCB 1254	<0.2	<0.2	<0.2	<0.2
PCB 1260	<0.2	<0.2	<0.2	<0.2
Herbicides (µg/L)				
2,6-Dinitrotoluene	na	<0.5	na	<0.5
Acenaphthylene	<0.5	<0.5	<0.5	<0.5
Alachlor	<0.5	<0.5	<0.5	<0.5
Aldrin	<0.5	<0.5	<0.5	<0.5
Anthracene	<0.5	<0.5	<0.5	<0.5
Atraton	<0.5	<0.5	<0.5	<0.5
Atrazine	<0.5	<0.5	<0.5	<0.5
Benzo(a)anthracene	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene	<0.5	<0.5	<0.5	<0.5
Benzo(b)fluoranthene	<0.5	<0.5	<0.5	<0.5
Benzo(g,h,i)perylene	<0.5	<0.5	<0.5	<0.5
Benzo(k)fluoranthene	<0.5	<0.5	<0.5	<0.5
BHC, gamma isomer (Lindane)	<0.5	<0.5	<0.5	<0.5
Bis(2-ethylhexyl)phthalate	<3	<3	<3	<3
Bromacil	<1	<1	1.8	1.8
Butachlor	<0.5	<0.5	<0.5	<0.5
Butylbenzylphthalate	<2	<2	<2	<2
Chlordane	<2	<2	<2	<2
Chloropropham	<0.5	na	<0.5	na
Chlorpyrifos	<0.5	na	<0.5	na
Chrysene	<0.5	<0.5	<0.5	<0.5
Di (2-ethylhexyl) adipate	<1	<1	<1	<1
Diazinon	<0.5	<0.5	<0.5	<0.5
Dibenzo(a,h)anthracene	<0.5	<0.5	<0.5	<0.5
Dibutylphthalate	<1	<1	<1	<1
Dichlorvos	<0.5	<0.5	<0.5	<0.5
Diethylphthalate	<2	<2	<2	<2
Dimethylphthalate	<2	<2	<2	<2
Diuron	<0.4	2.4	0.8	44
Endrin	<2	<2	<2	<2
Ethoprop	<0.5	<0.5	<0.5	<0.5
Fluorene	<0.5	<0.5	<0.5	<0.5
Glyphosate	<25	<25	38	<25
Heptachlor	<0.5	<0.5	<0.5	<0.5
Heptachlor epoxide	<0.5	<0.5	<0.5	<0.5
Hexachlorobenzene	<1	<1	<1	<1
Hexachlorocyclopentadiene	<3	<3	<3	<3
Indeno(1,2,3-c,d)pyrene	<0.5	<0.5	<0.5	<0.5
Merphos	<0.5	<0.5	<0.5	<0.5
Methoxychlor	<0.7	<0.7	<0.7	<0.7
Metolachlor	<0.5	<0.5	<0.5	<0.5
Metribuzin	<0.5	<0.5	<0.5	<0.5
Mevinphos	<0.5	<0.5	<0.5	<0.5
Pentachlorophenol	<1	<1	<1	<1
Phenanthrene	<0.5	<0.5	<0.5	<0.5
Prometon	<0.5	<0.5	<0.5	<0.5
Prometryn	<0.5	<0.5	<0.5	<0.5
Propachlor	<0.5	<0.5	<0.5	<0.5
Pyrene	<0.5	<0.5	<0.5	<0.5
Simazine	<0.5	<0.5	<0.5	<0.5
Terbutryn	<0.5	<0.5	<0.5	<0.5

Table 7-8. Compliance monitoring data for releases from the Drainage Retention Basin, wet season, 2002 (concluded)

Parameter	CDBX		WPDC	
	11/8	12/16	11/8	12/16
Miscellaneous organics (mg/L)				
Chemical Oxygen Demand (mg O/L)	36	36	81	30
Oil and Grease	<5	<5	<5	<5
Total Organic Carbon (TOC)	5.6	5.2	10	6
Total suspended solids (TSS)	27	50	240	110
Radioactive (Bq/L)				
Gross alpha	0.05 ± 0.044	0.022 ± 0.025	0.015 ± 0.014	0.0044 ± 0.024
Gross beta	0.098 ± 0.052	0.086 ± 0.033	0.098 ± 0.037	0.028 ± 0.041
Tritium	12 ± 2.7	12 ± 3	-0.34 ± 2.2	18 ± 3.3

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

a na= Not analyzed because the analysis was not required, or because analytical laboratory oversight.

b The reduced survival rate of 70% was due to pathogen related mortality, not chemical toxicity.

Table 7-9. Compliance monitoring data for releases from the Drainage Retention Basin, dry season, 2002

Parameter	CDBX sampling dates					WPDC sampling dates				
	6/4	7/1	8/6	9/3	9/24	6/4	7/1	8/6	9/3	9/24
Total metals (mg/L)										
Aluminum	<0.05	<0.05	<0.05	<0.05	0.3	0.1	0.5	<0.05	0.05	<0.05
Antimony	<0.004	<0.002	<0.005	<0.005	<0.005	<0.004	<0.002	<0.005	<0.005	<0.005
Arsenic	<0.002	0.0019	<0.002	<0.002	<0.002	<0.002	0.0022	<0.002	0.0024	<0.002
Barium	0.03	0.08	0.1	0.11	0.11	0.071	0.082	0.092	0.1	0.1
Beryllium	<0.0002	<0.0002	<0.0002	<0.0002	<0.0008	<0.0002	<0.0002	<0.0002	<0.0002	<0.0008
Boron	1.8	2.0	2.1	2.0	2.0	1.4	1.4	1.2	1.6	1.4
Cadmium	<0.0005	<0.001	<0.0005	<0.0005	<0.0005	<0.0005	<0.001	<0.0005	<0.0005	<0.0005
Chromium	0.004	<0.001	0.0032	0.0022	0.0035	0.0092	0.011	0.011	0.0078	0.011
Cobalt	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Copper	0.001	0.0033	0.0037	0.0025	0.0024	<0.001	0.0044	0.0038	0.0031	0.0026
Hexavalent Chromium	0.004	0.004	0.002	0.002	0.002	0.011	0.011	0.0096	0.0055	0.0089
Iron	<0.05	<0.1	<0.1	<0.1	0.32	0.16	0.6	0.1	0.1	<0.1
Lead	<0.005	<0.001	<0.005	<0.005	<0.005	<0.005	<0.001	<0.005	<0.005	<0.005
Manganese	0.017	0.0083	<0.03	<0.03	0.033	<0.01	0.014	<0.03	<0.03	<0.03
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.025	0.0033	<0.025	<0.025	<0.025	<0.025	0.0027	<0.025	<0.025	<0.025
Nickel	<0.002	0.0031	0.0029	0.0024	0.0022	<0.002	0.0039	0.0037	0.003	0.0026
Selenium	<0.01	0.0017	<0.002	<0.002	<0.002	<0.01	<0.001	<0.002	<0.002	<0.002
Silver	<0.001	<0.001	<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	<0.001	<0.001
Vanadium	<0.01	<0.02	<0.02	<0.02	<0.02	<0.01	<0.02	<0.02	<0.02	<0.02
Zinc	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Volatile organic compound (μg/L)										
1,1,1-Trichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	na[a]	na	na	na	na
1,1,2,2-Tetrachloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	na	na
1,1,2-Trichloroethane	3	<0.5	<0.5	0.86	<0.5	na	na	na	na	na
1,1-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	na	na
1,1-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	na	na
1,2-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	na	na
1,2-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	na	na
1,2-Dichloroethene (total)	<1	<1	<1	<1	<1	na	na	na	na	na
1,2-Dichloropropane	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	na	na
1,3-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	na	na
1,4-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	na	na
2-Chloroethylvinylether	<10	<10	<10	<10	<10	na	na	na	na	na
Bromodichloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	na	na
Bromoform	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	na	na
Bromomethane	<1	<1	<1	<1	<1	na	na	na	na	na

Table 7-9. Compliance monitoring data for releases from the Drainage Retention Basin, dry season, 2002 (concluded)

Parameter	CDBX sampling dates					WPDC sampling dates				
	6/4	7/1	8/6	9/3	9/24	6/4	7/1	8/6	9/3	9/24
Carbon tetrachloride	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	na	na
Chlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	na	na
Chloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	na	na
Chloroform	0.6	<0.5	<0.5	<0.5	<0.5	na	na	na	na	na
Chloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	na	na
cis-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	na	na
cis-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	na	na
Dibromochloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	na	na
Dichlorodifluoromethane	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	na	na
Freon 113	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	na	na
Methylene chloride	<1	<1	<1	<1	<1	na	na	na	na	na
Tetrachloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	na	na
Total Trihalomethanes	<2	<2	<2	<2	<2	na	na	na	na	na
trans-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	na	na
trans-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	na	na
Trichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	na	na
Trichlorofluoromethane	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	na	na
Vinyl chloride	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	na	na
Polychlorinated biphenyls (µg/L)										
PCB 1016	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	na
PCB 1221	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	na
PCB 1232	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	na
PCB 1242	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	na
PCB 1248	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	na
PCB 1254	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	na
PCB 1260	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	na
Miscellaneous organics (mg/L)										
Total suspended solids (TSS)	1	4.2	<2	4	27	2.5	9.2	<2	<2	<2

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

7-10. Monthly analyses of water samples collected from the Drainage Retention Basin location CDBE, 2002

Parameter	Sampling dates											
	1/2	2/7	3/7	4/4	5/2	6/5	7/10	8/8	9/5	10/4	11/8	12/6
Nutrients (mg/L)												
Ammonia Nitrogen (as N)	0.1	0.05	0.05	0.06	0.04	0.04	0.04	0.06	0.05	0.03	<0.025	<0.025
Nitrate (as N)	2.2	2.3	2	1.1	0.57	0.9	<0.2	<0.2	<0.1	1.1	1.4	1.4
Nitrate (as NO_3)	9.9	10	9.1	5	2.5	4	<0.5	0.73	<0.4	4.9	6.3	6.2
Nitrate plus Nitrite (as N)	2.3	2.3	2	1.2	0.61	0.94	<0.1	0.2	<0.1	1.2	1.4	1.4
Nitrite (as N)	0.048	0.02	0.034	0.046	0.039	0.04	<0.02	0.035	<0.02	0.044	0.02	<0.02
Nitrite (as NO_2)	<0.5	<0.5	<0.5	<0.5	<0.5	0.13	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total Kjeldahl Nitrogen	0.8	0.68	0.62	0.56	0.66	0.72	1.4	0.85	0.72	0.56	0.78	0.5
Solids (mg/L)												
Total Solids	593	634	667	670	647	610	670	680	663	745	760	727
Total suspended solids (TSS)	<20	<2	6.3	<20	<2	<2	<10	<2	2	<2	6	2.5
Volatile Solids	100	120	140	130	110	100	160	160	120	100	170	230
Volatile Suspended Solids	<20	<2	5	<20	<2	<2	<10	<2	2	<2	6	2.5
General minerals (mg/L)												
Aluminum	0.6	<0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.2	<0.05
Bicarbonate Alk (as $CaCO_3$)	167	206	160	230	110	57	41	9.5	11	120	200	190
Calcium	46	72	65	62	53	41	29	38	30	58	61	56
Carbonate Alk (as $CaCO_3$)	<2.5	<5	71	<5	110	110	129	140	110	86	<5	16
Chloride	150	173	188	188	192	199	219	223	231	244	223	202
Copper	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fluoride	0.39	0.47	0.42	0.43	0.46	0.43	0.42	0.46	0.39	0.4	0.33	0.39
Hydroxide Alk (as $CaCO_3$)	<2.5	<5	<2.5	<5	<5	<5	<2.5	<2.5	<2.5	<2.5	<5	<2.5
Iron	0.72	0.069	0.056	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.15	<0.05
Magnesium	24	35	32	32	31	36	35	32	31	36	39	34
Manganese	0.034	0.013	0.028	0.016	0.017	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.026
Nickel	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nitrate (as N)	1.9	2.3	2	1.1	0.54	0.62	<0.1	0.17	<0.1	1.1	1.4	1.4
Nitrate (as NO_3)	8.3	10	9.1	5	2.4	2.7	<0.4	0.73	<0.4	4.9	6.4	6.2
Nitrate plus Nitrite (as N)	1.9	2.3	2	1.2	0.58	0.66	<0.1	0.2	0.1	1.2	1.5	1.4
Nitrite (as N)	0.048	0.02	0.034	0.039	0.039	0.04	<0.02	0.035	<0.02	0.044	0.02	<0.02
Ortho-Phosphate	0.551	0.28	<0.05	0.085	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
pH	7.97	8.34	8.81	8.3	8.77	9.21	9.87	9.62	9.44	8.8	8.7	8.28
Potassium	2.6	3	2.4	2.3	1.9	1.5	<1	<1	<1	1.8	2.1	4.2
Sodium	110	140	120	120	110	130	130	130	130	140	130	110
Specific Conductance	939	1070	1120	1110	1100	1070	1030	1160	1110	1270	1190	1020
Sulfate	78	84	82	74	74	73	75	82	77	88	80	71
Surfactants	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total Alkalinity (as $CaCO_3$)	167	206	230	230	220	170	170	150	130	200	200	210
Total dissolved solids (TDS)	557	646	647	660	647	630	643	688	653	775	820	690
Total Hardness (as $CaCO_3$)	214	324	294	287	260	202	216	227	203	293	313	280
Total Phosphorus (as P)	0.22	0.15	0.06	<0.05	<0.05	<0.05	0.07	<0.05	<0.05	<0.05	0.06	<0.05
Zinc	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Miscellaneous organics (μg/L)												
Chlorophyll a	19[a]	1	3.6	<2	<1	<1	27	4.2	0.78	3.6	5.4	20

a This chlorophyll a sample was collected on 1/10/02.

Table 7-11. Quarterly maintenance monitoring data from the Drainage Retention Basin location CDBE, 2002

Parameter	Sampling dates			
	1/2	4/4	7/10	10/4
Biological (MPN[a]/100 mL)				
Fecal Coliform	130	2	<2	4
Total Coliform	2400	46	<2	50
Miscellaneous organics (mg/L)				
Chemical Oxygen Demand	58	<25	36	29
Oil and Grease	<5	<5	<5	<5

a MPN = most probable number

Table 7-12. Semiannual/annual maintenance monitoring data from the Drainage Retention Basin location CDBE, 2002

Parameter	Sampling dates [(a)]	
	4/4	**10/4**
Aqueous bioassay		
Pimephales promelas survival (percent survival)	na [(b)]	100
Pimephales promelas growth NOEC [(c)]	na	>100
Pimephales promelas growth LOEC [(d)]	na	>100
Pimephales promelas growth (toxic units)	na	<1
Pimephales promelas survival NOEC	na	>100
Pimephales promelas survival LOEC	na	>100
Pimephales promelas survival (toxic units)	na	<1
Ceriodaphnia dubia reproduction NOEC	na	50
Ceriodaphnia dubia reproduction LOEC	na	100
Ceriodaphnia dubia reproduction (toxic units)	na	2
Ceriodaphnia dubia survival NOEC	na	>100
Ceriodaphnia dubia survival LOEC	na	>100
Ceriodaphnia dubia survival (toxic units)	na	<1
Selanastrum capricornutum growth NOEC	na	<12.5
Selanastrum capricornutum growth LOEC	na	12.5
Selanastrum capricornutum growth (toxic units)	na	>8.00
Total metals (mg/L)		
Aluminum	<0.05	<0.05
Antimony	<0.004	<0.005
Arsenic	0.002	<0.002
Barium	0.1	0.11
Beryllium	<0.0002	<0.0002
Boron	1.8	2
Cadmium	<0.0005	<0.0005
Chromium	0.005	0.003
Cobalt	<0.05	<0.05
Copper	0.004	0.0019
Hexavalent Chromium	0.004	0.003
Iron	<0.05	<0.1
Lead	<0.005	<0.005
Manganese	0.018	<0.03
Mercury	<0.0002	<0.0002
Molybdenum	<0.025	<0.025
Nickel	<0.002	0.0021
Selenium	<0.002	<0.002
Silver	<0.001	<0.001
Thallium	<0.004	<0.001
Vanadium	<0.01	<0.02
Zinc	<0.02	0.038
Volatile organic compound (µg/L)		
1,1,1-Trichloroethane	<0.5	<0.5
1,1,2,2-Tetrachloroethane	<0.5	<0.5
1,1,2-Trichloroethane	2.4	<0.5
1,1-Dichloroethane	<0.5	<0.5
1,1-Dichloroethene	<0.5	<0.5
1,2-Dichlorobenzene	<0.5	<0.5
1,2-Dichloroethane	<0.5	<0.5
1,2-Dichloroethene (total)	<1	<1
1,2-Dichloropropane	<0.5	<0.5
1,3-Dichlorobenzene	<0.5	<0.5
1,4-Dichlorobenzene	<0.5	<0.5
2-Chloroethylvinylether	<10	<10
Bromodichloromethane	<0.5	<0.5

Table 7-12. Semiannual/annual maintenance monitoring data from the Drainage Retention Basin location CDBE, 2002 (continued)

Parameter	Sampling dates [(a)]	
	4/4	10/4
Bromoform	<0.5	<0.5
Bromomethane	<1	<1
Carbon tetrachloride	<0.5	<0.5
Chlorobenzene	<0.5	<0.5
Chloroethane	<0.5	<0.5
Chloroform	<0.5	<0.5
Chloromethane	<0.5	<0.5
cis-1,2-Dichloroethene	<0.5	<0.5
cis-1,3-Dichloropropene	<0.5	<0.5
Dibromochloromethane	<0.5	<0.5
Dichlorodifluoromethane	<0.5	<0.5
Freon 113	<0.5	<0.5
Methylene chloride	<1	<1
Tetrachloroethene	<0.5	<0.5
Total Trihalomethanes	<2	<2
trans-1,2-Dichloroethene	<0.5	<0.5
trans-1,3-Dichloropropene	<0.5	<0.5
Trichloroethene	<0.5	<0.5
Trichlorofluoromethane	<0.5	<0.5
Vinyl chloride	<0.5	<0.5
Herbicides (μg/L)		
Acenaphthylene	<0.5	<0.5
Alachlor	<0.5	<0.5
Aldrin	<0.5	<0.5
Anthracene	<0.5	<0.5
Atraton	<0.5	<0.5
Atrazine	<0.5	<0.5
Benzo(a)anthracene	<0.5	<0.5
Benzo(a)pyrene	<0.5	<0.5
Benzo(b)fluoranthene	<0.5	<0.5
Benzo(g,h,i)perylene	<0.5	<0.5
Benzo(k)fluoranthene	<0.5	<0.5
BHC, gamma isomer (Lindane)	<0.5	<0.5
Bis(2-ethylhexyl)phthalate	<3	<3
Bromacil	<1	<1
Butachlor	<0.5	<0.5
Butylbenzylphthalate	<2	<2
Chlordane	<2	<2
Chloropropham	<0.5	na
Chrysene	<0.5	<0.5
Di (2-ethylhexyl) adipate	<1	<1
Diazinon	<0.5	<0.5
Dibenzo(a,h)anthracene	<0.5	<0.5
Dibutylphthalate	<1	<1
Dichlorvos	<0.5	<0.5
Dieldrin	<0.5	na
Diethylphthalate	<2	<2
Dimethylphthalate	<2	<2
Diuron	1.2	<0.4
Endrin	<2	<2
Ethoprop	<0.5	<0.5
Fluorene	<0.5	<0.5
Glyphosate	<25	<25
Heptachlor	<0.5	<0.5

Table 7-12. Semiannual/annual maintenance monitoring data from the Drainage Retention Basin location CDBE, 2002 (concluded)

Parameter	Sampling dates (a)	
	4/4	10/4
Heptachlor epoxide	<0.5	<0.5
Hexachlorobenzene	<1	<1
Hexachlorocyclopentadiene	<3	<3
Indeno(1,2,3-c,d)pyrene	<0.5	<0.5
Merphos	<0.5	<0.5
Methoxychlor	<0.7	<0.7
Metolachlor	<0.5	<0.5
Metribuzin	<0.5	<0.5
Mevinphos	<0.5	<0.5
Pentachlorobenzene	<0.5	na
Pentachlorophenol	na	<1
Phenanthrene	<0.5	<0.5
Prometon	<0.5	<0.5
Prometryn	<0.5	<0.5
Propachlor	<0.5	<0.5
Pyrene	<0.5	<0.5
Simazine	<0.5	<0.5
Stirophos	na	<0.5
Terbutryn	<0.5	<0.5
Polychlorinated biphenyls (µg/L)		
PCB 1016	<0.3	<0.2
PCB 1221	<0.3	<0.2
PCB 1232	<0.3	<0.2
PCB 1242	<0.3	<0.2
PCB 1248	<0.3	<0.2
PCB 1254	<0.3	<0.2
PCB 1260	<0.3	<0.2
Miscellaneous organics (mg/L)		
Total organic carbon (TOC)	4.5	4.5
Radioactive (Bq/L)		
Gross alpha	0.11 ± 0.052	0.084 ± 0.067
Gross beta	0.091 ± 0.059	0.095 ± 0.055
Tritium	8.3 ± 2.3	7.9 ± 2.5

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

a Annual sampling for toxicity was conducted on 9/30, 10/2, 10/4, 10/21, 10/23, and 10/25, because of scheduling conflicts and analytical laboratory errors resulting in re-sampling.

b na= Not analyzed (not required, sampled on a different date, or analytical laboratory oversight)

c NOEC= No observed effect concentration

d LOEC= Lowest observed effect concentration

Table 7-13. Weekly field data collected from the Drainage Retention Basin, 2002

Date	CDBA		CDBC		CDBD		CDBE			
	Dissolved oxygen (ppm)	Temp-erature (Degrees C)	Dissolved oxygen (ppm)	Temp-erature (Degrees C)	Dissolved oxygen (ppm)	Temp-erature (Degrees C)	Dissolved oxygen (ppm)	Temp-erature (Degrees C)	Trans-parency (Secchi Meters)	Turbidity (Hach NTU)
1/2	15	14.2	16.1	14.2	17.5	13.3	15.5	11.7	0.33	25.7
1/10	10.6	13.4	12.4	13.6	12.1	13.5	11.7	13.1	0.914	na[(a)]
1/18	18.4	10.4	18	11.8	17.1	10.6	16.9	10.2	0.787	na
1/25	[(b)]	11.3	[(b)]	11.6	[(b)]	10.2	[(b)]	9.6	1.32	na
2/7	20	13.4	18.8	12.5	18.5	11.3	18.4	10.7	1.52	3.13
2/15	[(b)]	14.1	[(b)]	14.7	[(b)]	13.4	[(b)]	12.8	1.14	na
2/22	16.2	15.7	16.2	16.2	17.4	16	12.8	13.6	0.635	na
3/1	13.3	15.5	13.8	14.6	14.1	14.5	14	14.4	0.838	na
3/7	12.8	14.3	12	14.3	11.9	14.5	11.8	14.4	1.17	3.98
3/15	11.4	13.5	10	13.4	9.43	13.4	8.91	13.2	3.35	na
3/22	11	14.1	11.3	14.9	10.8	14.2	10.9	13.9	3.48	na
3/29	11.6	16	10.9	17.4	11.3	16.2	11.2	15.9	4.09	na
4/4	13.6	17	13	17.5	12.1	17.5	11.7	17.4	3.78	1.83
4/12	[(b)]	[(b)]	[(b)]	[(b)]	[(b)]	[(b)]	[(b)]	[(b)]	3.63	na
4/19	13.3	19.5	14.7	19.7	14.3	18.5	12.9	17.9	3.73	na
4/26	12.3	18.1	15.8	19.4	15.5	20	15.5	19.9	4.17	na
5/2	17.2	20.4	13.6	19.9	12.9	18.4	12.2	18	3.71	1.12
5/10	14	18.7	13.7	19.4	14.7	19.5	14.8	19.3	3.66	na
5/17	14.4	22.3	14.9	22	13.5	21.7	13.3	21.5	3.35	na
5/24	11.6	20.6	12.2	22.8	11.4	21.3	11.8	21	3.66	na
5/31	10.1	24.3	12.8	24.4	13.8	25.1	13.5	24.6	1.83	na
6/5	13.9	32.7	11.3	31.7	10.1	28.7	10.2	27.3	2.44	1.22
6/14	11.2	28.2	12.6	27.5	10.4	28.1	10.8	28.1	1.88	na
6/19	11.2	29.4	13.5	29.6	12.4	28.9	11.4	28.3	1.6	na
6/28	7.2	31.1	10.4	32.1	9.57	32.5	8.85	32.4	0.914	na
7/5	[(b)]	[(b)]	[(b)]	[(b)]	[(b)]	[(b)]	[(b)]	[(b)]	1.57	na
7/10	[(b)]	[(b)]	[(b)]	[(b)]	[(b)]	[(b)]	[(b)]	[(b)]	1.22	5.89
7/19	[(b)]	[(b)]	[(b)]	[(b)]	[(b)]	[(b)]	[(b)]	[(b)]	1.68	na
7/26	[(b)]	[(b)]	[(b)]	[(b)]	[(b)]	[(b)]	[(b)]	[(b)]	2.39	na
8/2	[(b)]	[(b)]	[(b)]	[(b)]	[(b)]	[(b)]	[(b)]	[(b)]	2.03	na
8/8	[(b)]	[(b)]	[(b)]	[(b)]	[(b)]	[(b)]	[(b)]	[(b)]	1.73	1.17
8/16	7.85	23	13.2	22.3	12.6	23.8	7.72	23.6	1.63	na
8/23	6.53	18.8	10.8	18.6	8.84	20.7	6.08	20.5	1.73	na
8/30	9.82	20.1	14	22.6	12.9	22.4	6.42	21.7	1.3	na
9/5	11.3	25.8	15.7	24.3	11.3	23.3	7.25	22.5	1.27	2.45
9/13	10.7	19.5	12.7	19.5	10.5	21.2	0.43	20.9	1.3	na
9/20	7.83	19.8	10.7	19.7	13.4	21.5	1.02	20.7	1.4	na
9/27	4.68	19.3	13	20.6	9.67	20.8	2.37	20.7	1.22	na
10/4	4.85	14.4	8.45	17.4	9.44	18	8.74	17.8	2.13	1.14
10/11	9.07	17.2	9.74	18.2	12.1	19	11.1	18.7	1.68	na
10/18	8.55	15.9	9.39	16.9	9.68	17.5	10.8	17.3	2.21	na
10/25	8.3	15.6	8.26	16	8.14	16.4	7.91	16.4	2.01	na
11/1	10.3	12.9	10.2	13.5	9.99	14.6	10.1	14.5	2.46	na
11/8	9.15	15.5	9.94	14.9	10.1	14.9	9.95	14.8	0.229	9.33
11/15	7.73	16.3	8.43	14.6	8.06	14.6	7.97	14.6	0.711	na
11/22	7.02	14.7	5.13	14	5.38	13.8	4.93	13.8	1.22	na
11/27	6.62	13.8	6.47	13.7	5.37	13.2	6.08	13.1	1.52	na
12/6	8.26	13.6	8.48	12.7	7.54	12.6	6.7	12.4	1.83	[(c)]
12/13	9.23	13	9.73	12.8	9.28	12.1	8.16	12.1	2.87	na
12/20	7.02	13	6.48	11.6	5.87	10.3	5.14	10.2	0.178	na
12/27	5.97	13.7	5.77	11.4	5.96	10.6	4.05	9.8	0.686	na
Summary Statistics										
Median	**10.6**	**16**	**12.1**	**17.2**	**11.3**	**17**	**10.5**	**16.9**	**1.68**	**2.45**
IQR[(d)]	**5.22**	**5.85**	**3.89**	**6.15**	**3.8**	**7.75**	**4.73**	**7.58**	**1.23**	**3.74**
Maximum	**20**	**32.7**	**18.8**	**32.1**	**18.5**	**32.5**	**18.4**	**32.4**	**4.17**	**25.7**
Minimum	**4.68**	**10.4**	**5.13**	**11.4**	**5.37**	**10.2**	**0.43**	**9.6**	**0.178**	**1.12**

Table 7-13. Weekly field data collected from the Drainage Retention Basin, 2002 (concluded)

Date	CDBF		CDBJ		CDBK		CDBL	
	Dissolved oxygen (ppm)	Temp-erature (Degrees C)	Dissolved oxygen (ppm)	Temp-erature (Degrees C)	Dissolved oxygen (ppm)	Temp-erature (Degrees C)	Dissolved oxygen (ppm)	Temp-erature (Degrees C)
1/2	15.6	11.8	15.1	13.5	13.3	11.8	13.7	12.1
1/10	9.38	12.2	11.6	12.8	11.2	12.6	10.3	12.6
1/18	16.6	10	17.6	10.3	16.7	9.8	16.6	9.8
1/25	na	9.7	na	10.7	na	9.9	na	10.1
2/7	17.9	10.7	19.7	11.9	19.7	11.6	19.4	11.2
2/15	na	13	na	13.3	na	13.2	na	12.8
2/22	7.32	13	17	15.3	10.6	12.9	9.25	12.8
3/1	13.4	14.3	14.2	14.2	14.2	14	12.5	13.8
3/7	10.9	14.1	12.2	14.7	12.1	14.6	12.1	14.4
3/15	8.89	13.4	9.26	13.4	9.16	13.4	8.94	13.6
3/22	10	13.5	10.8	14.2	10.5	13.8	10.5	13.4
3/29	12.5	15.2	11.4	16.2	11.7	15.8	12.4	15.8
4/4	11.7	17.3	11.6	17.5	11.6	17.5	11.6	17.3
4/12	na	na	11.3	19.8	10.6	18.4	10.4	18.7
4/19	13.3	18.1	13.3	18.5	13.3	17.9	13.8	17.8
4/26	15.3	19.6	14.3	19.9	14.4	19.7	14.3	19.3
5/2	12.5	17.9	14.2	18.9	14.4	18.6	14.6	18.6
5/10	14.9	19.3	12.9	19.4	13	19.3	13.2	19.3
5/17	14.4	21.5	14	21.7	13.9	21.6	13.1	21.7
5/24	9.78	20.6	11.8	21.5	11.6	21.3	10.4	20.7
5/31	3.07	22.7	13.7	25.3	14.6	24.6	3.8	22.5
6/5	9.95	27.5	10.4	29	9.69	27.8	3.16	27.7
6/14	9.29	28.4	10.5	27.8	11.1	27.7	0.72	27.2
6/19	4.17	27.7	12.6	29.3	12.8	28.8	8.45	28.1
6/28	4.06	31.4	8.83	32.3	8.57	31.8	0.05	30.7
7/5	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)
7/10	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)
7/19	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)
7/26	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)
8/2	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)
8/8	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)
8/16	na	20.9	10.7	23.5	10.7	23.3	(b)	20.4
8/23	6.2	19.1	36.3	21	36.2	20.8	35.4	19.8
8/30	6.98	20.5	11.8	22.2	10.9	21.9	na	19.9
9/5	3.44	22.7	10.6	23.6	8.17	23	na	22.8
9/13	na	19.8	12.8	21.1	9.77	20.8	na	19.5
9/20	0.63	19.9	13.2	21.1	7.33	20.6	0.11	19.6
9/27	1.57	20.3	8.39	20.9	8.28	20.8	na	20.4
10/4	5.86	17.8	8.19	17.6	8.22	17.5	2.24	17.1
10/11	na	17.8	12.3	18.9	11.6	18.7	na	18.1
10/18	10.5	17	9.65	17.5	9.63	17.4	9.63	17.2
10/25	7.33	16.3	8.74	16.4	8.66	16.3	8.43	16.2
11/1	10.1	14.2	9.7	14.3	9.68	14.2	9.83	13.8
11/8	2.42	14.3	9.83	14.9	10.5	14.8	6.19	14.4
11/15	na	14.9	8.56	14.6	0.13	14.8	na	15
11/22	2.67	13.8	6.12	13.7	6.32	13.6	6.04	13.6
11/27	6.01	13.3	5.96	13.2	5.9	12.9	5.58	12.9
12/6	5.93	12.5	7.6	12.4	7.12	12.4	6.4	12.7
12/13	6.13	12.1	9.42	12.3	8.07	12.2	7.42	12.3
12/20	0.24	10.7	6.43	10.6	6.08	9.9	5.95	9.9
12/27	2.21	10	5.04	10.3	4.29	10	4.29	10.1
Summary Statistics								
Median	**9.09**	**16.7**	**11.4**	**17.5**	**10.6**	**17.4**	**9.73**	**17.1**
IQR(d)	**7.71**	**6.77**	**3.91**	**7.6**	**4.47**	**7.6**	**6.63**	**6.9**
Maximum	**17.9**	**31.4**	**36.3**	**32.3**	**36.2**	**31.8**	**35.4**	**30.7**
Minimum	**0.24**	**9.7**	**5.04**	**10.3**	**0.13**	**9.8**	**0.05**	**9.8**

a na= Not analyzed because the analysis was not required
b Measurement not taken because of equipment failure.
c Sample not collected due to scheduling oversight.
d IQR = interquartile range

Table 7-14. Radioactivity in surface and drinking water (Bq/L) in Livermore Valley, 2002

Location	Date	Tritium	Gross alpha	Gross beta
Drinking waters				
BELL	1/10	-0.281 ± 2.03	-0.00466 ± 0.0211	0.0411 ± 0.0326
	7/23	-1.47 ± 2.03	-0.0131 ± 0.0174	0.0744 ± 0.0277
GAS	1/11	1.12 ± 2.07	0.00540 ± 0.0166	0.0437 ± 0.0274
	7/23	0.951 ± 2.11	0.00870 ± 0.0192	0.0633 ± 0.0289
PALM	1/11	-0.365 ± 2.11	0.0304 ± 0.0270	0.0537 ± 0.0303
	7/23	4.81 ± 2.22	0.0134 ± 0.0211	0.0503 ± 0.0285
ORCH	1/11	0.699 ± 2.07	-0.00940 ± 0.0481	0.253 ± 0.0518
	7/24	-2.36 ± 2.03	-0.0339 ± 0.0370	0.189 ± 0.0703
TAP	1/11	0.219 ± 2.15	-0.00241 ± 0.00925	0.0283 ± 0.0248
	7/25	-1.09 ± 2.03	-0.00104 ± 0.0115	0.00762 ± 0.0289
Surface waters				
CAL	1/11	-0.555 ± 2.15	(a)	(a)
	7/25	-1.09 ± 2.03	0.00392 ± 0.0126	0.0339 ± 0.0248
DEL	1/11	0.212 ± 2.07	0.00470 ± 0.0178	0.0451 ± 0.0407
	7/24	-0.507 ± 2.03	-0.00307 ± 0.0163	0.0866 ± 0.0300
DUCK	1/11	0.955 ± 2.18	-0.110 ± 0.0962	0.141 ± 0.104
	7/24	-2.08 ± 2.03	-0.0158 ± 0.104	0.234 ± 0.0925
ALAG	1/10	1.81 ± 2.07	0.0459 ± 0.0518	0.110 ± 0.0555
	7/25	0.799 ± 2.07	0.0374 ± 0.0407	0.0696 ± 0.0481
SHAD	1/14	-1.05 ± 2.03	0.0220 ± 0.0351	0.117 ± 0.0344
	7/23	0.211 ± 2.00	-0.00522 ± 0.0355	0.171 ± 0.0629
ZON7	1/14	0.347 ± 2.03	0.0123 ± 0.0259	0.146 ± 0.0370
	7/24	-0.366 ± 2.07	-0.000481 ± 0.0185	0.0829 ± 0.0340
On-site pool				
POOL	1/11	1.35 ± 2.11	-0.00266 ± 0.0277	0.0239 ± 0.0289
	4/8	2.18 ± 2.15	(b)	(b)
	7/24	-1.85 ± 2.07	-0.0125 ± 0.0999	0.121 ± 0.0740
	10/7	0.189 ± 2.22	(b)	(b)

Note: A negative number means the sample radioactivity was less than the background radioactivity

a Samples were not analyzed for gross alpha and gross beta.

b Analysis was not planned for this sampling event. Semiannual sampling and analysis is planned for gross alpha and gross beta radiation.

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

GROUNDWATER MONITORING

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Methods

Representative samples of groundwater from monitoring wells were obtained by following the written protocols contained in the *LLNL Livermore Site and Site 300 Environmental Restoration Project Standard Operating Procedures (SOPs)* (Dibley and Depue 2002). The protocols cover sampling techniques and specific information for the chemicals that are routinely searched for in groundwater. 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 LLNL used nitrogen gas under pressure to extract water samples.

Typically, sampling technologists purged wells of standing water and waited for the wells to recover before they collected water samples. They wore disposable vinyl gloves to prevent accidental contamination during sampling and cleaned the 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 (primarily acids) to preserve the samples.

Off-site laboratories performed most of the water analyses during 2001, under contract with LLNL. (Note that the groundwater radioactivity data for 2001 include some small negative values [in Bq/L]. These can occur when the correction for background radioactivity within the measurement apparatus is subtracted from measurements of groundwater samples that contain little or no radioactive material.)

As with groundwater sampling, standard sample handling and hygiene procedures were employed to prevent cross-contamination (e.g., wearing disposable gloves, decontaminating sampling equipment, and maintaining samples at 4 ± 2° Celsius). Duplicates, 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, such as lower detection limits.

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

Livermore Site

Table 9-1(a,b,c) lists the constituents monitored in the groundwater at the Livermore site and at Site 300, the U.S. Environmental Protection Agency (EPA) (or other)-approved methods commonly used to measure them, and the detection limits (reporting limits) employed.

Table 9-2 reports tritium activities in Livermore Valley wells. Tables 9-3 through 9-14 present the results of Livermore site surveillance monitoring wells (background and perimeter, Taxi Strip area, East Traffic Circle Landfill, National Ignition Facility [NIF], Decontamination and Waste Treatment Facility [DWTF], Buildings 514/612 area, metals surveillance, Plutonium Facility, and Tritium Facility).

Site 300

Tables 9-15 through 9-27 contain chemical data for Site 300 surveillance monitoring wells (Elk Ravine drainage area, including closed landfill pits 2, 8, and 9, and Corral Hollow creek drainage area, including standby water supply, active water supply, and off-site wells).

Additional chemical data for Site 300 groundwater was obtained during 2002 from compliance monitoring of closed landfill pits 1, 6, and 7, the closed HE burn pit, the active surface water impoundments, and the sewage ponds. These data can be found in published compliance monitoring reports (Brown 2003; Christofferson and MacQueen 2003; Christofferson et al. 2003; Revelli 2003).

Table 9-1a. Analytical methods and contractual reporting limits for inorganic constituents of concern in groundwater

Constituents of concern	Analytical method	Reporting limit[a,b]
Metals and minerals (mg/L)		
All alkalinities	EPA 310.1	1
Aluminum	EPA 200.7 or 200.8	0.05 or 0.2
Ammonia nitrogen (as N)	EPA 350.3, 350.2, or 350.1	0.03 or 0.1
Antimony	EPA 204.2 or 200.8	0.005
Arsenic	EPA 206.2 or 200.8	0.002
Barium	EPA 200.7 or 200.8	0.025 or 0.01
Beryllium	EPA 210.2 or 200.8	0.0005 or 0.0002
Boron	EPA 200.7	0.05
Cadmium	EPA 213.2 or 200.8	0.0005
Calcium	EPA 200.7	0.5
Chloride	EPA 300.0	1 or 0.5
Chromium	EPA 218.2, 200.7 or 200.8	0.001
Chromium(VI)	EPA 218.4 or 7196	0.002
Cobalt	EPA 200.7 or 200.8	0.025 or 0.05
Copper	EPA 220.2, 200.7 or 200.8	0.001, 0.01 or 0.05
Fluoride	EPA 340.2 or 340.1	0.05
Hardness, total (as $CaCO_3$)	SM 2320B	1
Iron	EPA 200.7 or 200.8	0.1
Lead	EPA 239.2 or 200.8	0.002 or 0.005
Magnesium	EPA 200.7 or 200.8	0.5
Manganese	EPA 200.7 or 200.8	0.03
Mercury	EPA 245.2, 245.1 or 200.8	0.0002
Molybdenum	EPA 200.7 or 200.8	0.025
Nickel	EPA 249.2, 200.7 or 200.8	0.002, 0.005 or 0.1
Nitrate (as NO_3)	EPA 353.2, 354.1 or 300.0	0.5
Ortho-phosphate	EPA 300.0, 365.1 or 365.2	0.05
Perchlorate	EPA 314.0	0.004
Potassium	EPA 200.7	1
Selenium	EPA 270.2 or 200.8	0.002
Silver	EPA 272.2 or 200.8	0.001 or 0.0005
Sodium	EPA 200.7	1 or 0.1
Sulfate	EPA 300.0	1
Surfactants	EPA 425.1	0.5
Thallium	EPA 279.2 or 200.8	0.001
Total dissolved solids	EPA 160.1	1
Total Kjeldahl nitrogen	EPA 351.2 or 351.3	0.2
Total phosphorus (as P)	EPA 365.4 or SM 4500-P	0.05

Table 9-1a. Analytical methods and contractual reporting limits for inorganic constituents of concern in groundwater (concluded)

Constituents of concern	Analytical method	Reporting limit[(a,b)]
Metals and minerals (mg/L) (continued)		
Vanadium	EPA 200.7 or 200.8	0.02 or 0.025
Zinc	EPA 200.7 or 200.8	0.02 or 0.05
General indicator parameters		
pH (pH units)	EPA 150.1	none
Conductivity (μS/cm)	EPA 120.1	none
Total organic carbon (mg/L)	EPA 9060	1
Total organic halides (mg/L)	EPA 9020	0.02
Radioactivity (Bq/L)		
Gross alpha	EPA 900	0.074
Gross beta	EPA 900	0.11
Radioisotopes (Bq/L)		
Americium-241	U-NAS-NS-3050	0.0037
Plutonium-238	U-NAS-NS-3050	0.0037
Plutonium-239+240	U-NAS-NS-3050	0.0037
Radon-222	EPA 913	3.7
Radium-226	EPA 903	0.0093
Radium-228	EPA 904	0.037
Thorium-228	U-NAS-NS-3050	0.009
Thorium-230	U-NAS-NS-3050	0.006
Thorium-232	U-NAS-NS-3050	0.006
Tritium	LLNL-RAS-011	3.7
Uranium-234	EPA 907	0.0037
Uranium-235	EPA 907	0.0037
Uranium-238	EPA 907	0.0037

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

b Analytical reporting limits varied by laboratory used.

Table 9-1b. Analytical methods and contractual reporting limits for organic constituents of concern in groundwater

Constituents of concern	Reporting limit (μg/L)[(a,b)]
EPA Method 420.1	
Phenolics	5
EPA Method 502.2 (or 524.2)	
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 507 (or 525.2)	
Alachlor	0.5
Atraton	0.5
Atrazine	0.5
Bromacil	0.5
Butachlor	0.5
Diazinon	0.5
Dichlorvos	0.5
Ethoprop	0.5
Merphos	0.5
Metolachlor	0.5
Metribuzin	0.5
Mevinphos	0.5
Molinate	0.5
Prometon	0.5

Table 9-1b. Analytical methods and contractual reporting limits for organic constituents of concern in groundwater (continued)

Constituents of concern	Reporting limit (µg/L)[a,b]
EPA Method 507 (or 525.2) (continued)	
Prometryn	0.5
Simazine	0.5
Terbutryn	0.5
EPA Method 524.2	
1,1,1,2-Tetrachloroethane	1
1,1,1-Trichloroethane	1
1,1,2,2-Tetrachloroethane	1
1,1,2-Trichloroethane	1
1,1-Dichloroethane	1
1,1-Dichloroethene	1
1,1-Dichloropropene	1
1,2,3-Trichlorobenzene	1
1,2,3-Trichloropropane	1
1,2,4-Trichlorobenzene	1
1,2,4-Trimethylbenzene	1
1,2-Dibromo-3-chloropropane	2
1,2-Dichlorobenzene	1
1,2-Dichloroethane	1
1,2-Dichloropropane	1
1,3,5-Trimethylbenzene	1
1,3-Dichlorobenzene	1
1,3-Dichloropropane	1
1,4-Dichlorobenzene	1
2-Chlorotoluene	1
4-Chlorotoluene	1
Benzene	1
Bromobenzene	1
Bromodichloromethane	1
Bromoform	1
Bromomethane	2
Carbon tetrachloride	1
Chlorobenzene	1
Chloroethane	2
Chloroform	1
Chloromethane	2
cis-1,2-Dichloroethene	1
cis-1,3-Dichloropropene	1
Dibromochloromethane	1
Dibromomethane	1
Dichlorodifluoromethane	2
Ethylbenzene	1
Ethylene dibromide	1
Freon 113	1
Hexachlorobutadiene	1
Isopropylbenzene	1
m- and *p*-Xylene isomers	1
Methylene chloride	1
n-Butylbenzene	1
n-Propylbenzene	1
Naphthalene	1
o-Xylene	1
Isopropyl toluene	1
sec-Butylbenzene	1
Styrene	1
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	20
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

Table 9-1b. Analytical methods and contractual reporting limits for organic constituents of concern in groundwater (continued)

Constituents of concern	Reporting limit (μg/L)[(a,b)]
EPA Method 601 (continued)	
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-1,2-Dichloroethene	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-1,2-Dichloroethene	0.5
trans-1,3-Dichloropropene	0.5
Trichloroethene	0.5
Trichlorofluoromethane	0.5
Vinyl chloride	0.5
EPA Method 602	
1,2-Dichlorobenzene	0.3
1,3-Dichlorobenzene	0.3
1,4-Dichlorobenzene	0.3
Benzene	0.4
Chlorobenzene	0.3
Ethylbenzene	0.3
m-Xylene isomers	0.4
o-Xylene	0.4
p-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	0.2
Dieldrin	0.1
Endosulfan I	0.05
Endosulfan II	0.1
Endosulfan sulfate	0.1
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
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	10
Dicamba	1
Dichloroprop	2
Dinoseb	1
MCPA	250

Table 9-1b. Analytical methods and contractual reporting limits for organic constituents of concern in groundwater (continued)

Constituents of concern	Reporting limit (µg/L)[(a,b)]
EPA Method 615 (continued)	
MCPP	250
EPA Method 624	
1,1,1-Trichloroethane	1
1,1,2,2-Tetrachloroethane	1
1,1,2-Trichloroethane	1
1,1-Dichloroethane	1
1,1-Dichloroethene	1
1,2-Dichlorobenzene	1
1,2-Dichloroethane	1
1,2-Dichloroethene (total)	1
1,2-Dichloropropane	1
1,3-Dichlorobenzene	1
1,4-Dichlorobenzene	1
2-Butanone	20
2-Chloroethylvinylether	20
2-Hexanone	20
4-Methyl-2-pentanone	20
Acetone	10
Benzene	1
Bromodichloromethane	1
Bromoform	1
Bromomethane	2
Carbon disulfide	1
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
Freon 113	1
Methylene chloride	1
Styrene	1
Tetrachloroethene	1
Toluene	1
Total xylene isomers	2
trans-1,2-Dichloroethene	1
trans-1,3-Dichloropropene	1
Trichloroethene	0.5
Trichlorofluoromethane	1
Vinyl acetate	1
Vinyl chloride	1
EPA Method 625	
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
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
Acenaphthene	25
Acenaphthylene	5
Anthracene	5

Table 9-1b. Analytical methods and contractual reporting limits for organic constituents of concern in groundwater (continued)

Constituents of concern	Reporting limit (μg/L)[a,b]
EPA Method 625 (continued)	
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
N-Nitroso-di-*n*-propylamine	5
Naphthalene	5
Nitrobenzene	5
Pentachlorophenol	5
Phenanthrene	5
Phenol	5
Pyrene	5
	5

Constituents of concern	Reporting limit (μg/L)[a,b]
EPA Method 632	
Diuron	0.1
EPA Method 8082	
Polychlorinated biphenyls	0.5
EPA Method 8140	
Bolstar	1
Chlorpyrifos	1
Coumaphos	1
Demeton	1
Diazinon	1
Dichlorvos	1
Disulfoton	1
Ethoprop	1
Fensulfothion	1
Fenthion	1
Merphos	1
Methyl Parathion	1
Mevinphos	1
Naled	1
Phorate	1
Prothiophos	1
Ronnel	1
Stirophos	1
Trichloronate	1
EPA Method 8260	
1,1,1,2-Tetrachloroethane	0.5
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
1,2,3-Trichloropropane	0.5
1,2-Dibromo-3-chloropropane	0.5
1,2-Dichloroethane	0.5
1,2-Dichloroethene (total)	0.5

Table 9-1b. Analytical methods and contractual reporting limits for organic constituents of concern in groundwater (concluded)

Constituents of concern	Reporting limit (μg/L)[a,b]	Constituents of concern	Reporting limit (μg/L)[a,b]
EPA Method 8260 (continued)			
1,2-Dichloropropane	0.5	Dichlorodifluoromethane	0.5
2-Butanone	0.5	Ethanol	1000
2-Chloroethylvinylether	0.5	Ethylbenzene	0.5
2-Hexanone	0.5	Freon 113	0.5
4-Methyl-2-pentanone	0.5	Methylene chloride	0.5
Acetone	10	Styrene	0.5
Acetonitrile	100	Tetrachloroethene	0.5
Acrolein	50	Toluene	0.5
Acrylonitrile	50	Total xylene isomers	0.5
Benzene	0.5	Trichloroethene	0.5
Bromodichloromethane	0.5	Trichlorofluoromethane	0.5
Bromoform	0.5	Vinyl acetate	20
Bromomethane	0.5	Vinyl chloride	0.5
Carbon disulfide	5	*cis*-1,2-Dichloroethene	0.5
Carbon tetrachloride	0.5	*cis*-1,3-Dichloropropene	0.5
Chlorobenzene	0.5	*trans*-1,2-Dichloroethene	0.5
Chloroethane	0.5	*trans*-1,3-Dichloropropene	0.5
Chloroform	0.5	**EPA Method 8330**	
Chloromethane	0.5	HMX[c]	5 or 1
Chloroprene	5	RDX[d]	5 or 1
Dibromochloromethane	0.5	TNT[e]	5

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

b Analytical reporting limits varied by laboratory used.

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

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

e TNT is 2,4,6-trinitrotoluene.

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

Constituents of concern	Typical reporting limit (Bq/L)
Americum-241	1.3
Cesium-134	0.5
Cesium-137	0.4
Cobalt-60	0.4
Europium-152	1.0
Europium-154	1.2
Europium-155	1.0
Potassium-40	3.7
Radium-226	0.6
Thorium-228	0.9
Uranium-235	1.5

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

Table 9-2. Tritium activity in Livermore Valley wells, 2002

Location	Sampling date	Tritium activity (Bq/L) [a]
16C1	15-Aug	-0.2 ± 2.0
16A2	23-Jul	-2.2 ± 2.1
11B1	5-Jul	3.4 ± 2.3
12A2	5-Jul	-0.4 ± 2.1
12D2	5-Jul	3.3 ± 2.3
12G1	5-Jul	0 [b] ± 0
16L5	23-Jul	0 [b] ± 0
16L7	23-Jul	0.9 ± 2.1
17D12	22-Jul	-0.4 ± 2.0
18A6	22-Jul	0.4 ± 2.0
1H3	5-Jul	-0.4 ± 2.1
1P2	5-Jul	1.2 ± 2.2
1R2	5-Jul	0.4 ± 2.1
2R1	5-Jul	0.5 ± 2.1
7C2	5-Jul	0.7 ± 2.1
7P3	17-Jul	-1.9 ± 2.0
8F1	17-Jul	-0.4 ± 2.0
8H18	22-Jul	-0.8 ± 2.0
8P1	17-Jul	-0.2 ± 2.1
9B1	22-Jul	-2.2 ± 2.0
9M2	22-Jul	-0.5 ± 2.0
9M3	22-Jul	-1.2 ± 2.0
9M4	22-Jul	0.4 ± 2.1
9Q1	16-Aug	0.4 ± 2.0

a Nondetections of tritium are equal to, or are less than the 2σ uncertainty shown.

b The laboratory reported the results as zero

Table 9-3. Livermore site background surveillance wells, 2002

Constituents of concern	W-008			
	Jan 24	Apr 25	Jul 29	Nov 19
Inorganic (μg/L)				
Field pH (pH units)	7.37	7.21	7.24	7.13
Field Conductivity (μS/cm)	2250	2270	2320	2290
Water temperature (Degrees C)	18.8	19.3	20.2	19.5
Chromium(VI)	4	np[(a)]	4	np
General minerals (mg/L)				
Nitrate	23	np	24	24
Organic (μg/L)[(b)]				
EPA 507	nd[(c)]	nd	nd	np
EPA 8140	nd	nd	nd	np
Radioactive (Bq/L)[(d)]				
Gross alpha	0.037 ± 0.070	np	0.11 ± 0.11	0.083 ± 0.096
Gross beta	0.088 ± 0.048	np	0.091 ± 0.078	0.059 ± 0.089
Radium 226 (mBq/L)	0.11 ± 2.7	np	1.4 ± 4.8	np
Radium 228 (mBq/L)	-10.0 ± 33	np	np	np
Tritium	1.4 ± 2.1	np	-2.1 ± 2.2	0.83 ± 2.1
Uranium (total)	0.19 ± 0.017	np	0.18 ± 0.015	np

Constituents of concern	W-221			
	Jan 24	Apr 25	Sep 18	Nov 19
Inorganic (μg/L)				
Field pH (pH units)	7.23	7.12	np	7.03
Field Conductivity (μS/cm)	1360	1490	np	1570
Water temperature (Degrees C)	18.0	20.4	np	20.1
Chromium(VI)	3	np	2	np
General minerals (mg/L)				
Nitrate	28	np	27	30
Organic (μg/L)[(b)]				
EPA 507	nd	nd	nd	np
EPA 8140	nd	nd	nd	np
Radioactive (Bq/L)[(d)]				
Gross alpha	0.036 ± 0.078	np	0.16 ± 0.096	0.13 ± 0.11
Gross beta	0.073 ± 0.055	np	0.066 ± 0.093	0.067 ± 0.15
Radium 226 (mBq/L)	-1.1 ± 3.1	np	4.7 ± 2.8	np
Radium 228 (mBq/L)	-9.3 ± 30	np	np	np
Tritium	3.9 ± 2.2	np	6.1 ± 2.5	8.3 ± 2.4
Uranium (total)	0.24 ± 0.020	np	0.23 ± 0.018	np

Table 9-3. Livermore site background surveillance wells, 2002 (concluded)

Constituents of concern[(a)]	W-017		
	Jan 31	Apr 30	Jul 29
Inorganic (µg/L)			
Field pH (pH units)	7.26	7.14	7.39
Field Conductivity (µS/cm)	965	960	970
Water temperature (Degrees C)	20.4	20.4	20.9
Chromium(VI)	10	np	4
General minerals (mg/L)			
Nitrate	10	np	8
Organic (µg/L)[(c)]			
EPA 507	nd	nd	nd
EPA 8140	nd	nd	nd
Radioactive (Bq/L)[(e)]			
Gross alpha	0.064 ± 0.052	np	0.099 ± 0.052
Gross beta	0.56 ± 0.10	np	0.14 ± 0.048
Radium 226 (mBq/L)	12 ± 5.2	np	20 ± 6.3
Radium 228 (mBq/L)	-1.4 ± 14	np	np
Tritium	-1.9 ± 2.1	np	-2.2 ± 2.1
Uranium (total)	0.18 ± 0.018	np	0.17 ± 0.014

a Nondetections of nonradioactive constituents are shown as less than (<) the RL for that analysis.
b 'np' means the analysis was not planned for that sampling event.
c See Table 9-1b for list of constituents measured by each EPA method (number).
d 'nd' means no EPA method constituent was detected above its RL. See Table 9-1b for method RLs.
e Nondetections of radioactive constituents are equal to or are less than the 2σ uncertainty shown.

Table 9-4. Livermore site perimeter off-site surveillance wells, 2002

Constituents of concern[(a)]	14B1		W-121		W-151		W-571		
	Feb 21	Apr 25	Jan 30	Apr 30	Jan 30	Apr 30	Feb 6	May 7	Nov 19
Inorganic (µg/L)									
Field pH (pH units)	7.59	7.45	7.91	7.81	7.57	7.50	7.44	7.17	7.40
Field Conductivity (µS/cm)	np[(b)]	760	649	660	755	780	750	770	760
Water temperature (Degrees C)	18.4	19.8	18.4	19.3	17.9	19.1	18.8	19.6	19.1
Chromium(VI)	13	np	10	np	16	np	21	np	np
General minerals (mg/L)									
Nitrate	29	np	30	np	37	np	np	np	40
Organic (µg/L)[(c)]									
EPA 507	nd[(d)]	nd	nd	nd	nd	nd	nd	nd	np
EPA 8140	nd	nd	nd	nd	nd	nd	nd	nd	np
Radioactive (Bq/L)[(e)]									
Gross alpha	-0.012 ± 0.031	np	0.030 ± 0.032	np	0.016 ± 0.036	np	0.084 ± 0.044	np	0.036 ± 0.044
Gross beta	0.088 ± 0.044	np	0.075 ± 0.033	np	0.053 ± 0.041	np	0.12 ± 0.036	np	0.093 ± 0.059
Radium 226 (mBq/L)	-0.11 ± 3.6	np	9.7 ± 3.7	np	2.3 ± 3.7	np	3.4 ± 3.7	np	np
Radium 228 (mBq/L)	-36 ± 48	np	-31 ± 24	np	-16 ± 14	np	12 ± 150	np	np
Tritium	2.9 ± 2.1	np	-2.3 ± 2.2	np	1.8 ± 2.3	np	1.7 ± 2.2	np	23 ± 3.5
Uranium (total)	0.071 ± 0.0073	np	0.025 ± 0.0036	np	0.053 ± 0.0060	np	0.10 ± 0.011	np	np

a Nondetections of nonradioactive constituents are shown as less than (<) the RL for that analysis.
b 'np' means the analysis was not planned for that sampling event.
c See Table 9-1b for list of constituents measured by each EPA method (number).
d 'nd' means no EPA method constituent was detected above its RL. See Table 9-1b for method RLs.
e Nondetections of radioactive constituents are equal to or are less than the 2σ uncertainty shown.

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Table 9-5. Livermore site perimeter on-site surveillance wells, 2002

Constituents of concern[a]	W-1012			W-556			W-373		
	Jan 30	Apr 26	Nov 20	Jan 24	Apr 26	Nov 19	Jan 24	Apr 26	Nov 19
Inorganic (µg/L)									
Field pH (pH units)	7.23	np[b]	7.08	7.51	np	7.34	7.53	np	7.42
Field Conductivity (µS/cm)	967	np	1000	824	np	920	824	np	840
Water temperature (Degrees C)	18.3	np	19.7	18.1	np	18.4	18.3	np	18.9
Chromium(VI)	17	np	np	26	np	np	48	np	np
General minerals (mg/L)									
Nitrate	80	np	78	32	np	np	13	np	13
Organic (µg/L)[c]									
EPA 507	nd[d]	nd	np	nd	nd	np	nd	nd	np
EPA 8140	nd	nd	np	nd	nd	np	nd	nd	np
Radioactive (Bq/L)[e]									
Gross alpha	0.020 ± 0.044	np	0.054 ± 0.044	0.055 ± 0.037	np	0.088 ± 0.059	0.054 ± 0.037	np	0.037 ± 0.041
Gross beta	0.12 ± 0.044	np	0.12 ± 0.055	0.042 ± 0.035	np	0.13 ± 0.067	0.070 ± 0.032	np	0.062 ± 0.037
Radium 226 (mBq/L)	6.4 ± 4.1	np	np	-1.7 ± 3.0	np	np	4.4 ± 3.2	np	np
Radium 228 (mBq/L)	-14 ± 24	np	np	-19 ± 17	np	np	-15 ± 23	np	np
Tritium	-1.3 ± 2.1	np	-1.4 ± 2.1	1.5 ± 2.1	np	-0.42 ± 2.1	8.1 ± 2.4	np	25 ± 3.6
Uranium (total)	0.12 ± 0.012	np	np	0.078 ± 0.0075	np	np	0.082 ± 0.0077	np	np

a Nondetections of nonradioactive constituents are shown as less than (<) the reporting limit (RL)for that analysis.
b 'np' means the analysis was not planned for that sampling event.
c See Table 9-1b for list of constituents measured by each EPA method (number).
d 'nd' means no EPA method constituent was detected above its RL. See Table 9-1b for method RLs.
e Nondetections of radioactive constituents are equal to or are less than the 2σ uncertainty shown.
A negative number means the sample radioactivity was less than the background radioactivity.

Table 9-6. Nitrate concentrations in selected Livermore site surveillance wells, 2002

Location	Screened in HSU	Sampling date	Nitrate as NO_3 (mg/L)
Nitrate wells			
W-1012[(a)]	2	Jan 30	80
W-1012[(a)]	2	Nov 20	78
W-571[(a)]	1B	Nov 19	40
W-1013	1B	Nov 20	37
W-1420	2	Nov 20	35
W-422	2	Nov 19	30
W-610	1B	Nov 20	40
W-620	1B	Dec 11	39
W-621	2	Dec 11	38
W-705	1B	Nov 20	30

a All 2002 surveillance monitoring data for well W-1012 are presented in Table 9-5.

b All 2002 surveillance monitoring data for well W-571 are presented in Table 9-4.

Table 9-7. Livermore site Taxi Strip surveillance wells, 2002

Constituents of concern[a]	W-204		W-363		
	Feb 21	Jun 11	Feb 25	Jun 12	Dec 5
Inorganic (μg/L)					
Field pH (pH units)	7.55	np[b]	7.30	np	np
Field Conductivity (μS/cm)	np	np	420	np	np
Water temperature (Degrees C)	19.1	np	20.7	np	np
Copper	<10	np	<10	np	np
Lead	<2	np	<2	np	np
Zinc	<10	np	<10	np	np
Radioactive (Bq/L)[c]					
Americium 241(mBq/L)	0.22 ± 1.4	np	0.33 ± 1.3	np	np
Plutonium 238 (mBq/L)	0[d] ± 0.41	np	0.37 ± 0.41	np	np
Plutonium 239+240 (mBq/L)	0.074 ± 0.26	np	0.78 ± 0.55	np	np
Radium 226 (mBq/L)	-0.30 ± 3.0	np	-2.7 ± 3.0	np	np
Radium 228 (mBq/L)	-44 ± 37	np	-24 ± 23	np	np
Tritium	0.33 ± 2.1	-2.0 ± 2.2	5.4 ± 2.4	19 ± 3.2	18 ± 3.2

a Nondetections of nonradioactive constituents are shown as less than (<) the reporting limit (RL) for that analysis.

b 'np' means the analysis was not planned for that sampling event.

c Nondetections of radioactive constituents are equal to or are less than the 2□ uncertainty shown.

□□A negative number means the sample radioactivity was less than the background activity inside the measurement apparatus.

d The analytical laboratory reported the calculated value as zero.

Table 9-8. Livermore site East Traffic Circle Landfill surveillance wells, 2002

Constituents of concern[a]	W-1308	W-1303	W-119	W-1306	W-906
	Jan 29	Jan 28	Feb 6	Jan 29	Jan 29
Inorganic (μg/L)					
Field pH (pH units)	7.31	7.34	7.32	7.24	7.34
Field Conductivity (μS/cm)	912	788	754	1440	782
Water temperature (Degrees C)	18.0	14.7	18.2	15.5	18.2
Copper	<10	<10	<10	<10	<10
Lead	<2	<2	<2	<2	<2
Zinc	<10	<10	<10	<10	<10
Radioactive (Bq/L)[b]					
Americium 241 (mBq/L)	-0.55 ± 0.67	1.2 ± 1.0	0 ± 0.74	0.074 ± 1.1	-0.074 ± 0.70
Plutonium 238 (mBq/L)	-0.037 ± 0.26	-0.074 ± 0.26	0 ± 0.30	0.037 ± 0.19	0.48 ± 0.55
Plutonium 239+240 (mBq/L)	0.30 ± 0.26	0[c] ± 0.19	0.074 ± 0.30	0.037 ± 0.19	1.1 ± 0.55
Radium 226 (mBq/L)	0.74 ± 3.1	4.8 ± 4.8	0.33 ± 4.1	2.3 ± 3.7	7.4 ± 4.4
Radium 228 (mBq/L)	-12 ± 20	15 ± 12	-140 ± 480	8.5 ± 22	3.3 ± 13
Tritium	21 ± 3.2	21 ± 3.3	19 ± 3.1	5.8 ± 2.1	1.2 ± 2.1

a Nondetections of nonradioactive constituents are shown as less than (<) the reporting liumit (RL) for that analysis.

b Nondetections of radioactive constituents are equal to or are less than the 2σ uncertainty shown.

c The analytical laboratory reported the calculated value as zero.

Table 9-9. Livermore site near the National Ignition Facility (NIF) surveillance wells, 2002

Constituents of concern	W-653	W-1207
	Sep 19	Sep 19
Inorganics (µg/L)[(a)]		
Field pH (pH units)	7.71	7.09
Field Specific Conductance (µmhos/cm)	1000	1950
Water Temperature (°C)	21.9	22
Aluminum	<100	<100
Chromium	21	16
Copper	5.9	10
Iron	<100	<100
Lead	5.6	<5
Manganese	<10	<10
Nickel	<50	<50
Zinc	<50	<50
General minerals (mg/L)		
Bicarbonate Alk (as $CaCO_3$)	190	280
Calcium	68	170
Carbonate Alk (as $CaCO_3$)	< 5	<5
Hydroxide Alk (as $CaCO_3$)	<5	<5
Nitrate (as N)	6.1	7.4
Nitrite (as N)	<0.1	<0.1
Potassium	2.5	3.0
Sodium	100	130
Surfactants	<0.05	<0.05
Total Hardness (as $CaCO_3$)	280	730
Radioactivity (Bq/L) [(b)]		
Gross alpha	0.09 ± 0.06	0.1 ± 0.08
Gross beta	0.03 ± 0.06	0.2 ± 0.08
Radium 226	0.003 ± 0.002	np [(c)]
Tritium	1.0 ± 2.3	-0.09 ± 2.3

a Nondetections of nonradioactive constituents are shown as less than (<) the reporting limit (RL) for that analysis.

b Nondetections of radioactive constituents are equal to, or are less than the 2σ uncertainty shown.

A negative number means the sample radioactivity was less than the background activity inside the measurement apparatus.

c 'np' means the analysis was not planned for that sampling event.

Table 9-10. Livermore site near Decontamination and Waste Treatment Facility (DWTF) surveillance wells, 2002

Constituents of concern[a]	W-007	W-593	W-594
	Sep 19	Sep 18	Sep 12
Inorganic (µg/L)			
pH (pH units)	7.53	7.60	7.64
Field pH (pH units)	7.24	np[b]	7.12
Conductivity (µS/cm)	2000	2200	1100
Field Conductivity (µS/cm)	1830	np	680
Total dissolved solids (mg/L)	1200	1400	670
Water temperature (Degrees C)	20.0	np	20.2
Aluminum	<100	<100	<100
Chromium	16	6	9
Copper	<10	<10	<10
Iron	<100	<100	<100
Manganese	<10	<10	<10
Nickel	<50	<50	<50
Zinc	<50	<50	<50
General minerals (mg/L)			
Bicarbonate Alk (as $CaCO_3$)	180	250	330
Calcium	96	88	69
Chloride	420	440	93
Fluoride	1.1	1.3	0.7
Magnesium	47	47	29
Nitrate	36	21	11
Ortho-Phosphate	2.9	<0.1	<0.1
Potassium	2.6	1.9	<2
Sodium	220	310	110
Sulfate	140	240	57
Surfactants	<0.05	<0.05	<0.05
Total hardness (as $CaCO_3$)	430	410	290
Phosphate (as P)	<0.01	<0.01	0.03
Radioactive (Bq/L)[c]			
Americium 241 (mBq/L)	-0.48 ± 1.3	-0.67 ± 1.1	0.93 ± 1.0
Plutonium 238 (mBq/L)	0.22 ± 1.0	1.1 ± 2.2	0.074 ± 0.26
Plutonium 239+240 (mBq/L)	-0.30 ± 0.63	-0.37 ± 1.1	0[d] ± 0.19
Radium 226 (mBq/L)	-0.22 ± 3.2	2.5 ± 2.8	0.78 ± 2.6
Tritium	-1.5 ± 2.2	-0.99 ± 2.4	-0.088 ± 2.0

a Nondetections of nonradioactive constituents are shown as less than (<) the reporting limit (RL) for that analysis.

b 'np' means the analysis was not planned for that sampling event.

c Nondetections of radioactive constituents are equal to or are less than the 2σ uncertainty shown.

A negative number means the sample radioactivity was less than the background activity inside the measurement apparatus.

d The analytical laboratory reported the calculated value as zero.

Table 9-11. Livermore site Buildings 514/612 area surveillance wells, 2002

Constituents of concern[a]	GSW-011
	Sep 12
Inorganic (µg/L)	
pH (pH units)	7.41
Field pH (pH units)	6.98
Conductivity (µS/cm)	800
Field Conductivity (µS/cm)	810
Total dissolved solids (mg/L)	480
Water temperature (Degrees C)	23.3
Aluminum	<100
Chromium	<5
Copper	<10
Iron	<100
Manganese	540
Nickel	<50
Zinc	<50
General minerals (mg/L)	
Bicarbonate Alk (as $CaCO_3$)	350
Calcium	64
Chloride	60
Fluoride	0.6
Magnesium	31
Nitrate	11
Ortho-Phosphate	<0.1
Potassium	2.8
Sodium	67
Sulfate	32
Surfactants	<0.05
Total hardness (as $CaCO_3$)	300
Phosphate (as P)	0.06
Radioactive (Bq/L)[b]	
Americium 241 (mBq/L)	0.63 ± 0.85
Plutonium 238 (mBq/L)	-0.19 ± 0.41
Plutonium 239+240 (mBq/L)	-0.15 ± 0.26
Radium 226 (mBq/L)	1.3 ± 3.6
Tritium	3.7 ± 2.1

a Nondetections of nonradioactive constituents are shown as less than (<) the reporting limit (RL) for that analysis.

b Nondetections of radioactive constituents are equal to or are less than the 2σ uncertainty shown.

Table 9-12. Livermore site metals surveillance wells, 2002

Constituents of concern[(a)]	W-307	W-226	W-306
	Mar 20	Mar 20	Mar 20
Inorganic (µg/L)			
Field pH (pH units)	7.63	7.56	7.40
Field Conductivity (µS/cm)	660	480	790
Water temperature (Degrees C)	18.6	19.1	20.4
Aluminum	<50	<50	<50
Antimony	<4	<4	<4
Arsenic	<2	<2	<2
Barium	290	98	95
Beryllium	<0.2	<0.2	<0.2
Boron	710	580	1200
Cadmium	<0.5	<0.5	<0.5
Chromium	15	10	40
Chromium(VI)	7	7	21
Cobalt	<50	<50	<50
Copper	2	<1	12
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	<4	<4	<4
Silver	<1	<1	<1
Thallium	<1	<1	<1
Vanadium	<10	<10	<10
Zinc	<20	<20	30

a Nondetections of nonradioactive constituents are shown as less than (<) the reporting limit (RL) for that analysis.

Table 9-13. Livermore site Plutonium Facility surveillance wells, 2002

Constituents of concern	W-305	W-101	W-301	W-148	W-147
	Jan 28	Feb 6	Jan 29	Mar 20	Mar 20
Inorganic (µg/L)					
Field pH (pH units)	7.83	6.97	7.63	8.77	7.51
Field Conductivity (µS/cm)	540	882	704	350	830
Water temperature (Degrees C)	16.7	20.5	18.4	19.7	18.9
Radioactive (mBq/L)[(a)]					
Plutonium 238	0.15 ± 0.59	0.074 ± 0.30	0.074 ± 0.26	-0.11 ± 0.59	1.7 ± 0.85
Plutonium 239+240	0 ± 0.59	0.30 ± 0.44	0.074 ± 0.26	0.11 ± 0.41	1.9 ± 0.89

Note: Tritium monitoring results for groundwater from these wells are listed in Table 9-14.

a Nondetections of radioactive constituents are equal to or are less than the 2σ uncertainty shown.

Table 9-14. Livermore site Tritium Facility surveillance wells, 2002

Location	Screened in HSU	Sampling date	Tritium (Bq/L)
Upgradient of Tritium Facility			
W-305	2	Jan 28[a]	9.5 ± 2.5
W-305	2	Apr 25	8.3 ± 2.4
W-305	2	Aug 29	8.5 ± 2.3
W-305	2	Nov 20	6.2 ± 2.3
Downgradient of Tritium Facility			
SIP-331-001	2	Mar 20	9.4 ± 2.5
SIP-331-001	2	Aug 27	6.4 ± 2.3
W-101	1B	Feb 6[a]	13 ± 2.8
W-101	1B	Apr 30	15 ± 2.8
W-147	1B	Mar 20[a]	26 ± 3.7
W-147	1B	Jun 6	23 ± 3.6
W-147	1B	Aug 27	23 ± 3.4
W-147	1B	Dec 12	17 ± 3.3
W-148	1B	Mar 20[a]	65 ± 7.4
W-148	1B	Jun 6	100 ± 11
W-148	1B	Aug 27	110 ± 11
W-148	1B	Dec 12	98 ± 11
W-301	2	Jan 29[a]	8.4 ± 2.4
W-301	2	Apr 25	7.7 ± 2.3

a Plutonium monitoring results for groundwater from these wells at these dates are listed in Table 9-13.

Table 9-15. Site 300 Elk Ravine surveillance wells, 2002

Constituents of concern[a]	NC7-61	NC7-61	NC7-69	NC7-69	K2-04D	K2-04D
	16-May	25-Sep	16-May	27-Dec	16-May	26-Dec
Inorganic (μg/L)						
Arsenic	20	np(b)	<2	<2	13	14
Barium	84	np	25	<100	36	<100
Beryllium	<0.5	np	<0.5	<4	<0.5	<4
Cadmium	<0.5	np	<0.5	<0.5	<0.5	0.51
Chromium	<1	np	<1	<5	<1	<5
Cobalt	<25	np	<25	<50	<25	<50
Copper	<10	np	<10	<10	<10	<10
Lead	<2	np	<2	<5	<2	<5
Mercury	<0.2	np	<0.2	<0.2	<0.2	<0.2
Molybdenum	<25	np	<25	<50	<25	<50
Nickel	<5	np	<5	<5	<5	<5
Nitrate (mg/L)	48	np	np	np	40	np
Potassium (mg/L)	5	np	7	5.6	4	3
Selenium	<5	np	<5	<5	<5	<5
Silver	<0.5	np	<0.5	<1	<0.5	<1
Thallium	<2	np	<2	<5	<2	<5
Vanadium	100	np	<25	<50	52	56
Zinc	<20	np	<20	<50	<20	<50
Organic (μg/L)[c]						
EPA 601	0 of 32	np	0 of 32	0 of 32	0 of 32	0 of 32
Explosive (μg/L)						
HMX[d]	3	<1	<1	<2	<1	<2.1
RDX[e]	5	<1	<1	<2	<1	<2.1
Radioactive (Bq/L)[f]						
Gross alpha	0.031 ± 0.028	np	0.0038 ± 0.028	0.0073 ± 0.022	0.042 ± 0.031	0.034 ± 0.025
Gross beta	0.20 ± 0.044	np	0.17 ± 0.052	0.17 ± 0.044	0.098 ± 0.037	0.15 ± 0.036
Tritium	1700 ± 170	np	-1.8 ± 2.0	1.6 ± 2.4	160 ± 17	160 ± 17
Uranium (total)	0.11 ± 0.0095	np	0.0046 ± 0.0014	0.0031 ± 0.0012	0.097 ± 0.0086	0.086 ± 0.0094

Table 9-15. Site 300 Elk Ravine surveillance wells, 2002 (continued)

Constituents of concern	K2-04S		K2-01C	NC2-12D	
	May 16	Dec 27	May 14	May 14	Dec 26
Inorganic (μg/L)					
Arsenic	17	17	8.0	13	14
Barium	56	<100	43	<25	<100
Beryllium	<0.5	<4	<0.5	<0.5	<4
Cadmium	<0.5	0.54	<0.5	<0.5	<0.5
Chromium	<1	<5	<1	<1	<5
Cobalt	<25	<50	<25	<25	<50
Copper	<10	<10	40	<10	23
Lead	<2	<5	<2	<2	<5
Mercury	<0.2	<0.2	<0.2	<0.2	<0.2
Molybdenum	<25	<50	<25	<25	<50
Nickel	<5	<5	<5	<5	<5
Nitrate (mg/L)	42	np[b]	35	37	np
Potassium (mg/L)	5.0	3.6	6.0	5.0	3.9
Selenium	<5	<5	<5	<5	<5
Silver	<0.5	<1	<0.5	<0.5	<1
Thallium	<2	<5	<2	<2	<5
Vanadium	66	70	46	52	53
Zinc	<20	<50	20	<20	52
Organic (μg/L)[c]					
EPA 601	0 of 32	0 of 32	0 of 32	0 of 32	0 of 32
Explosive (μg/L)					
HMX[d]	<1	<2	<1	<1	<2.1
RDX[e]	<1	<2	<1	<1	<2.1
Radioactive (Bq/L)[f]					
Gross alpha	0.067 ± 0.034	0.054 ± 0.044	0.16 ± 0.059	0.051 ± 0.037	0.053 ± 0.034
Gross beta	0.11 ± 0.044	0.12 ± 0.055	0.25 ± 0.059	0.16 ± 0.044	0.16 ± 0.041
Tritium	630 ± 63	600 ± 59	320 ± 33	330 ± 33	320 ± 33
Uranium (total)	0.12 ± 0.010	0.11 ± 0.011	0.32 ± 0.026	0.13 ± 0.012	0.13 ± 0.012

Table 9-15. Site 300 Elk Ravine surveillance wells, 2002 (concluded)

Constituents of concern[a]	NC2-11D	NC2-11D	812CRK (Spring 6)	NC2-07
	May 14	Dec 27	May 15	May 15
Inorganic (µg/L)				
Arsenic	13	15	33	42
Barium	<25	<100	140	35
Beryllium	<0.5	<4	0.70	<0.5
Cadmium	<0.5	1.0	<0.5	<0.5
Chromium	<1	<5	11	2.0
Cobalt	<25	<50	<25	<25
Copper	<10	<10	10	<10
Lead	<2	<5	3.0	<2
Mercury	<0.2	<0.2	<0.2	<0.2
Molybdenum	<25	<50	<25	<25
Nickel	<5	<5	12	<5
Nitrate (mg/L)	39	np[b]	28	np
Potassium (mg/L)	6.0	4.7	12	8.0
Selenium	<5	<5	<5	<5
Silver	<0.5	<1	<0.5	<0.5
Thallium	<2	<5	<2	<2
Vanadium	50	53	110	49
Zinc	<20	<50	40	<20
Organic (µg/L)[c]				
EPA 601	0 of 32	0 of 32	0 of 32	0 of 32
Explosive (µg/L)				
HMX[d]	<1	<2	<1	<2
RDX[e]	<1	<2	<1	<2
Radioactive (Bq/L)[f]				
Gross alpha	0.14 ± 0.055	0.066 ± 0.041	0.11 ± 0.052	0.23 ± 0.078
Gross beta	0.14 ± 0.055	0.13 ± 0.052	0.29 ± 0.063	0.25 ± 0.059
Tritium	160 ± 17	170 ± 17	-1.2 ± 2.0	15 ± 2.8
Uranium (total)	0.16 ± 0.014	0.16 ± 0.013	0.19 ± 0.016	0.27 ± 0.022

a Nondetections of nonradioactive constituents are shown as less than (<) the reporting limit (RL) for that analysis.

b 'np' means the analysis was not planned for that sampling event.

c See Table 9-1b for the EPA method 601 constituents and their RLs.

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

e RDX is hexahydro-1,3,5-trinitro-1,3,5-triazocine.

f Nondetections of radioactive constituents are equal to or are less than the 2σ uncertainty shown.
A negative number means the sample radioactivity was less than the background radioactivity inside the measurement apparatus.

Table 9-16a. Site 300 Pit 2 surveillance Barcads, 2002

Constituents of Concern[a]	K1-02A		K2-01A	
	Jun 5	Oct 28	May 29	Oct 28
Inorganic (µg/L)				
Arsenic	13	14	<2	<2
Barium	39	<100	<25	<100
Beryllium	<0.5	<4	<0.5	<4
Cadmium	<0.5	<0.5	<0.5	<0.5
Chromium	<1	<5	<1	<5
Cobalt	<25	<50	<25	<50
Copper	<10	<10	<10	<10
Lead	<2	<5	<2	<5
Mercury	<0.2	<0.2	<0.2	<0.2
Molybdenum	<25	<50	<25	<50
Nickel	<5	<5	<5	<5
Nitrate (mg/L)	<0.1	np[b]	3.4	np
Potassium (mg/L)	5.0	4.3	7.0	4.3
Selenium	<5	<5	<5	<5
Silver	<0.5	<1	<0.5	<1
Thallium	<1	<5	<2	<5
Vanadium	<25	<50	<25	<50
Zinc	<20	<50	<20	<50
Explosive (µg/L)				
HMX	<1	<2.1	<1	<2.1
RDX	<1	<2.1	<1	<2.1
Radioactive (Bq/L)[c]				
Gross alpha	0.10 ± 0.041	-0.0097 ± 0.023	0.011 ± 0.033	0.0026 ± 0.032
Gross beta	0.11 ± 0.041	0.15 ± 0.037	0.19 ± 0.052	0.17 ± 0.044
Tritium	0.82 ± 2.1	4.0 ± 2.4	0.23 ± 2.2	0.53 ± 2.2
Uranium (total)	0.15 ± 0.013	0.072 ± 0.0079	0.0062 ± 0.0018	0.0031 ± 0.0014

a Nondetections of nonradioactive constituents are shown as less than (<) the RL for that analysis.

b 'np' means the analysis was not planned for that sampling event.

c Nondetections of radioactive constituents are equal to or are less than the 2σ uncertainty shown.

Table 9-16b. Site 300 Pit 2 surveillance Barcads, 2002

Constituents of concern[(a)]	K2-02A May 29	K2-02A Oct 28	K2-02B May 29	K2-02B Oct 28
Inorganic (µg/L)				
Arsenic	25	25	<2	<2
Barium	26	<100	25	<100
Beryllium	<0.5	<4	<0.5	<4
Cadmium	<0.5	<0.5	<0.5	<0.5
Chromium	<1	<5	<1	<5
Cobalt	<25	<50	<25	<50
Copper	<10	<10	<10	<10
Lead	<2	<5	<2	<5
Mercury	<0.2	<0.2	<0.2	<0.2
Molybdenum	<25	<50	<25	<50
Nickel	<5	<5	<5	<5
Nitrate (mg/L)	<0.1	np[(b)]	<0.1	np
Potassium (mg/L)	7.0	5.2	6.0	4.8
Selenium	<5	<5	<5	<5
Silver	<0.5	<1	<0.5	<1
Thallium	<2	<5	<2	<5
Vanadium	<25	<50	<25	<50
Zinc	<20	<50	<20	<50
Explosive (µg/L)				
HMX[(c)]	<2	<2.1	<1	<2.1
RDX[(d)]	<2	<2.1	<1	<2.1
Radioactive (Bq/L)[(e)]				
Gross alpha	0.043 ± 0.034	0.0012 ± 0.027	0.014 ± 0.028	0.028 ± 0.034
Gross beta	0.15 ± 0.063	0.17 ± 0.037	0.16 ± 0.052	0.17 ± 0.052
Tritium	-0.73 ± 2.1	0.0064 ± 1.9	0.074 ± 2.1	5.7 ± 2.4
Uranium (total)	0.069 ± 0.0072	0.057 ± 0.0046	0.00089 ± 0.00077	0 ± 0.00070

a Nondetections of nonradioactive constituents are shown as less than (<) the reporting limit (RL) for that analysis.

b 'np' means the analysis was not planned for that sampling event.

c HMX is octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine.
d RDX is hexahydro-1,3,5-trinitro-1,3,5-triazocine.

e Nondetections of radioactive constituents are equal to or are less than the 2σ uncertainty shown.
A negative number means the sample radioactivity was less than the background radioactivity inside the measurement apparatus.

Table 9-16c. Site 300 Pit 2 surveillance well K1-01C, 2002

Constituents of concern[a]	K1-01C			
	Jan 16	Apr 16	Jul 29	Dec 5
Inorganic (µg/L)				
Arsenic	5.0	11	12	11
Barium	<25	<25	<25	<25
Beryllium	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5	<0.5
Chromium	np[b]	<1	np	2.0
Cobalt	<25	<25	<25	<25
Copper	10	10	10	<10
Lead	<2	<2	<2	<2
Mercury	np	<0.2	np	<0.2
Nickel	<5	<5	<5	<5
Nitrate (mg/L)	np	37	41	np
Potassium (mg/L)	4.0	5.0	4.0	5.0
Selenium	np	<5	np	<5
Silver	np	<0.5	np	<0.5
Vanadium	70	68	68	71
Zinc	20	20	20	<20
Organic (µg/L)[c]				
VOCs (EPA 601 or 624)	np	np	np	nd[d]
Semi-VOCs (EPA 625)	np	np	np	nd
Pesticides (EPA 608)	np	np	np	nd
TOC (mg/L)	np	np	np	<1
Explosive (µg/L)				
HMX[e]	<1	<1	<1	<1
RDX[f]	<1	<1	<1	<1
Radioactive (Bq/L)[g]				
Gross alpha	0.058 ± 0.031	0.080 ± 0.036	0.026 ± 0.026	0.10 ± 0.037
Gross beta	0.11 ± 0.034	0.14 ± 0.036	0.11 ± 0.032	0.17 ± 0.041
Tritium	14 ± 2.7	13 ± 2.7	13 ± 2.8	15 ± 2.4
Uranium (total)	0.12 ± 0.011	0.11 ± 0.011	0.11 ± 0.011	0.10 ± 0.010

a Nondetections of nonradioactive constituents are shown as less than (<) the reporting limit (RL) for that analysis.

b 'np' means the analysis was not planned for that sampling event.

c See Table 9-1b for EPA method (number) constituents and their RL.

d Nondetections of radioactive constituents are equal to or are less than the 2σ uncertainty shown.

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

f RDX is hexahydro-1,3,5-trinitro-1,3,5-triazocine.

g 'nd' means no EPA method constituent was detected above its RL.

Table 9-17. Site 300 Pit 8 surveillance wells, 2002

Constituents of concern[a]	K8-01	K8-03B	K8-04
	Jun 25	Jul 5	Jun 25
Inorganic (µg/L)			
Arsenic	20	—[b]	—[b]
Barium	< 25	—[b]	—[b]
Beryllium	< 0.5	—[b]	—[b]
Cadmium	< 0.5	—[b]	—[b]
Chromium	11	—[b]	—[b]
Cobalt	< 25	—[b]	—[b]
Copper	< 10	—[b]	—[b]
Lead	< 2	—[b]	—[b]
Mercury	< 0.2	—[b]	—[b]
Molybdenum	< 25	—[b]	—[b]
Nickel	< 5	—[b]	—[b]
Nitrate (mg/L)	64	22	—[b]
Perchlorate	< 4	< 4	—[b]
Potassium (mg/L)	7	12	—[b]
Selenium	< 5	—[b]	—[b]
Silver	< 0.5	—[b]	—[b]
Thallium	< 1	—[b]	—[b]
Vanadium	73	—[b]	—[b]
Zinc	< 20	—[b]	—[b]
Organic (µg/L)[c]			
VOCs (EPA method 601)	1 of 32	1 of 32	1 of 32
Trichloroethene	3.3	0.5	1.1
Explosive (µg/L)			
HMX[d]	< 1	< 1	—[b]
RDX[e]	< 1	< 1	—[b]
Radioactive (Bq/L)[f]			
Gross alpha	0.14 ± 0.059	0.055 ± 0.041	—[b]
Gross beta	0.22 ± 0.048	0.38 ± 0.074	—[b]
Tritium (Bq/L)	0.21 ± 2.1	0.56 ± 2.1	-2.0 ± 2.1
Uranium (total)	0.28 ± 0.023	0.13 ± 0.011	—[b]

Note: Throughout 2002, well K8-02B was inaccessible because of construction activities, and well K8-05 was dry.

a Constituent units are µg/L (parts per billion) unless otherwise shown in parentheses.
Nondetections of nonradioactive constituents are shown as less than (<) the reporting limit (RL) for that analysis.

b Groundwater samples were not obtained for these analytes.

c See Table 9-1b EPA method 601 constituents and their RLs.

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

e RDX is hexahydro-1,3,5-trinitro-1,3,5-triazocine.

f Radioactive constituent nondetections are equal to, or are less than the 2σ uncertainty shown.
A negative number means the sample radioactivity was less than the background radioactivity inside the measurement apparatus.

Table 9-18. Site 300 Pit 9 surveillance wells, 2002

Constituents of concern[(a)]	K9-01	K9-02	K9-03	K9-04
	Sep 25	Sep 24	Sep 24	Sep 24
Inorganic (μg/L)				
Arsenic	3	12	7	<2
Barium	<25	<25	<25	<25
Beryllium	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5	<0.5
Chromium	<1	<1	<1	<1
Cobalt	<25	<25	<25	<25
Copper	<10	<10	<10	<10
Lead	<2	<2	<2	<2
Mercury	<0.2	<0.2	<0.2	<0.2
Molybdenum	28	49	26	26
Nickel	<5	<5	<5	<5
Nitrate (mg/L)	16	18	11	15
Potassium (mg/L)	18	19	21	17
Selenium	<5	<5	<5	<5
Silver	<0.5	<0.5	<0.5	<0.5
Thallium	<1	<1	<1	<1
Vanadium	<25	<25	<25	<25
Zinc	<20	<20	<20	<20
Organic (μg/L)[(b)]				
EPA 601	0 of 32	0 of 32	0 of 32	0 of 32
Explosive (μg/L)				
HMX[(c)]	<1	<1	<1	<1
RDX[(d)]	<1	<1	<1	<1
Radioactive (Bq/L)[(e)]				
Gross alpha	-0.064 ± 0.067	-0.043 ± 0.074	-0.0090 ± 0.059	0.0032 ± 0.067
Gross beta	0.34 ± 0.089	0.30 ± 0.085	0.38 ± 0.089	0.33 ± 0.096
Tritium	-1.9 ± 2.0	-1.7 ± 2.0	-0.81 ± 2.0	0.82 ± 2.1
Uranium (total)	0.0029 ± 0.00082	0.0090 ± 0.0013	0.013 ± 0.0018	0.0089 ± 0.0013

a Constituent units are μg/L (parts per billion) unless otherwise shown in parentheses.

Nondetections of nonradioactive constituents are shown as less than (<) the reporting limit (RL) for that analysis.

b See Table 9-1b for EPA method 601 constituents and their RLs.

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

d RDX is hexahydro-1,3,5-trinitro-1,3,5-triazocine.

e Radioactive constituent nondetections are equal to, or are less than the 2σ uncertainty shown.
A negative number means the sample radioactivity was less than the background radioactivity inside the measurement apparatus.

Table 9-19. Site 300 potable standby supply well 18, 2002

Constituents of concern[a]	WELL18			
	Jan 16	Apr 17	Jul 17	Oct 15
Inorganic (μg/L)				
Nitrate (mg/L)	np[b]	<0.44	<0.44	<0.44
Organic (μg/L)[c]				
EPA 502.2	0 of 58	0 of 58	1 of 58	0 of 58
Trichloroethene	<0.2	<0.2	0.30	np
Explosive (μg/L)				
HMX[d]	np	<5	<5	<5
RDX[e]	np	<5	<5	<5
Radioactive (Bq/L)[f]				
Gross alpha	0.015 ± 0.048	-0.040 ± 0.055	-0.015 ± 0.048	-0.032 ± 0.059
Gross beta	0.24 ± 0.059	0.21 ± 0.081	0.19 ± 0.063	0.18 ± 0.059
Tritium	<3.7	-0.39 ± 2.0	-4.2 ± 2.1	0.087 ± 2.3

a Constituent nondetections other than radioactive are shown as less than (<) the reporting limit (RL) for that analysis.

b np' means the analysis was not planned for that sampling event.

c See Table 9-1b for EPA method 502.2 constituents and their RLs.

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

e RDX is hexahydro-1,3,5-trinitro-1,3,5-triazocine.

f Radioactive constituent nondetections are equal to, or are less than the 2σ uncertainty shown.

A negative number means the sample radioactivity was less than background radioactivity inside the measurement apparatus.

Table 9-20. Site 300 potable supply well 20, 2002

Constituents of concern[a]	WELL20			
	Jan 31	Apr 17	Jul 22	Oct 14
Inorganic (µg/L)				
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	7.4	2.6
Cobalt	<25	<25	<25	<25
Copper	<10	<10	<10	29
Lead	<2	<2	<2	8.2
Mercury	<0.2	<0.2	<0.2	<0.2
Molybdenum	<25	<25	<25	<25
Nickel	<5	<5	<5	6.2
Nitrate (mg/L)	np[b]	<0.4	<0.44	np
Potassium (mg/L)	8.1	8.5	8.4	8.2
Selenium	<4	<4	<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	73
Organic (µg/L)[c]				
EPA 502.2	0 of 58	0 of 58	0 of 58	0 of 58
Explosive (µg/L)				
HMX[d]	13	<5	<5	<5
RDX[e]	<5	<5	<5	<5
Radioactive (Bq/L)[f]				
Gross alpha	-0.022 ± 0.044	0.011 ± 0.041	-0.021 ± 0.044	-0.011 ± 0.041
Gross beta	0.28 ± 0.059	0.28 ± 0.067	0.25 ± 0.081	0.26 ± 0.055
Tritium	-0.65 ± 2.1	-0.48 ± 2.1	-1.8 ± 2.1	0.98 ± 2.2

a Constituent nondetections other than radioactive are shown as less than (<) the reporting limit (RL) for that analysis.

b 'np' means the analysis was not planned for that sampling event.

c See Table 9-1b for EPA method 502.2 constituents and their RLs.

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

e RDX is hexahydro-1,3,5-trinitro-1,3,5-triazocine.

f Radioactive constituent nondetections are equal to, or are less than the 2σ uncertainty shown.

A negative number means the sample radioactivity was less than background radioactivity inside the measurement apparatus.

Table 9-21. Site 300 off-site surveillance well CARNRW1, 2002

Constituents of concern	Jan 31	Apr 17	Jul 22	Oct 14
Organic (μg/L)[(a)]				
EPA 601	0 of 32	0 of 32	0 of 32	0 of 32
Radioactive (Bq/L)				
Tritium	np[(b)]	np	np	1.5 ± 2.2

a See Table 9-1b for the EPA method 601 constituents and their reporting limits (RLs).

b 'np' means the analysis was not planned for that sampling event.

Table 9-22. Site 300 off-site surveillance well CDF1, 2002

Constituents of concern[a]	CDF1	
	Jan 31	**Jul 22**
Inorganic (μg/L)		
Arsenic	4.0	4.8
Barium	40	50
Beryllium	<0.5	<0.5
Cadmium	<0.5	<0.5
Chromium	<1	6.9
Cobalt	<25	<25
Copper	<10	<10
Lead	<2	<2
Mercury	<0.2	<0.2
Molybdenum	<25	<25
Nickel	<5	<5
Nitrate (mg/L)	np[b]	5.7
Perchlorate (mg/L)	np	<3
Potassium (mg/L)	9.5	9.1
Selenium	<4	4.2
Silver	<0.5	<0.5
Thallium	<1	<1
Vanadium	<25	<25
Zinc	150	48
Organic (μg/L)[c]		
EPA 502.2	0 of 58	0 of 58
Explosive (μg/L)		
HMX[d]	np	<5
RDX[e]	np	<5
Radioactive (Bq/L)[f]		
Gross alpha	0.00063 ± 0.059	-0.0090 ± 0.044
Gross beta	0.33 ± 0.070	0.34 ± 0.078
Tritium	-0.44 ± 2.1	-1.3 ± 2.0
Uranium (total)	np	0.068 ± 0.0069

a Constituent nondetections other than radioactive are shown as less than (<) the reporting limit (RL) for that analysis.

b 'np' means the analysis was not planned for that sampling event.

c See Table 9-1b for EPA method 502.2 constituents and their RLs.

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

e RDX is hexahydro-1,3,5-trinitro-1,3,5-triazocine.

f Radioactive constituent nondetections are equal to, or are less than the 2σ uncertainty shown.
A negative number means the sample radioactivity was less than background radioactivity inside the measurement apparatus.

Table 9-23. Site 300 off-site surveillance well CON1, 2002

Constituents of concern[(a)]	CON1		
	Jan 31	Apr 17	Jul 22
Inorganic (µg/L)			
Arsenic	<2	<2	2.5
Barium	30	<25	30
Beryllium	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5
Chromium	<1	<1	5.5
Cobalt	<25	<25	<25
Copper	<10	<10	<10
Lead	<2	<2	<2
Mercury	<0.2	<0.2	<0.2
Molybdenum	<25	<25	26
Nickel	<5	<5	<5
Nitrate (mg/L)	np[(b)]	<0.88	<0.88
Perchlorate (mg/L)	np	<3	<3
Potassium (mg/L)	9.5	10	9.9
Selenium	<4	<4	3.8
Silver	<0.5	<0.5	<0.5
Thallium	<1	<1	<1
Vanadium	<25	<25	<25
Zinc	<20	<20	<20
Organic (µg/L)[(c)]			
EPA 502.2	0 of 58	0 of 58	0 of 58
Explosive (µg/L)			
HMX[(d)]	np	<5	<5
RDX[(e)]	np	<5	<5
Radioactive (Bq/L)[(f)]			
Gross alpha	-0.015 ± 0.10	0.042 ± 0.10	-0.061 ± 0.067
Gross beta	0.27 ± 0.096	0.35 ± 0.096	0.29 ± 0.10
Tritium	-2.1 ± 2.1	-1.4 ± 2.1	-1.3 ± 2.0
Uranium (total)	np	np	0.0025 ± 0.0013

a Constituent nondetections other than radioactive are shown as less than (<) the reporting limit (RL) for that analysis.

b 'np' means the analysis was not planned for that sampling event.

c See Table 9-1b for EPA method 502.2 constituents and their RLs.

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

e RDX is hexahydro-1,3,5-trinitro-1,3,5-triazocine.

f Radioactive constituent nondetections are equal to, or are less than the 2σ uncertainty shown.
A negative number means the sample radioactivity was less than background radioactivity inside the measurement apparatus.

Table 9-24. Site 300 off-site surveillance well GALLO1, 2002

Constituents of concern[a]	GALLO1			
	Jan 31	Apr 17	Jul 22	Oct 14
Inorganic (µg/L)				
Arsenic	4.0	4.0	4.4	4.5
Barium	<25	<25	<25	<25
Beryllium	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5	<0.5
Chromium	<1	<1	8.6	3.2
Cobalt	<25	<25	<25	<25
Copper	<10	<10	<10	12
Lead	<2	<2	<2	<2
Mercury	<0.2	<0.2	<0.2	<0.2
Molybdenum	40	40	48	46
Nickel	<5	<5	<5	<5
Nitrate (mg/L)	np[b]	<0.4	<0.44	np
Perchlorate (mg/L)	np	<3	<3	np
Potassium (mg/L)	3.8	4.4	4.0	3.9
Selenium	<4	<4	2.8	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
Organic (µg/L)[c]				
EPA 502.2	1 of 58	3 of 58	1 of 58	0 of 58
1,2,4-Trichlorobenzene	<0.2	1.4	<0.2	<0.2
Trichloroethene	0.63	0.63	0.62	<0.2
n-Butylbenzene	<0.2	0.26	<0.2	<0.2
EPA 625	np	np	np	0 of 62
Explosive (µg/L)				
HMX[d]	np	np	np	<5
RDX[e]	np	np	np	<5
Radioactive (Bq/L)[f]				
Gross alpha	0.031 ± 0.059	-0.020 ± 0.055	-0.0038 ± 0.044	0.017 ± 0.067
Gross beta	0.13 ± 0.052	0.53 ± 0.11	0.14 ± 0.063	0.11 ± 0.055
Tritium	-1.7 ± 2.1	-1.7 ± 2.0	-0.98 ± 2.0	-0.68 ± 2.1
Uranium (total)	np	np	0.00093 ± 0.00088	np

a Constituent nondetections other than radioactive are shown as less than (<) the reporting limit (RL) for that analysis.

b 'np' means the analysis was not planned for that sampling event.

c See Table 9-1b for EPA method 502.2 constituents and their RLs.

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

e RDX is hexahydro-1,3,5-trinitro-1,3,5-triazocine.

f Radioactive constituent nondetections are equal to, or are less than the 2σ uncertainty shown.
A negative number means the sample radioactivity was less than background radioactivity inside the measurement apparatus.

Table 9-25. Site 300 off-site surveillance well CARNRW2, 2002

Constituents of concern[a]	CARNRW2			
	Jan 31	Apr 17	Jul 22	Oct 14
Inorganic (µg/L)				
Arsenic	2.0	3.0	3.5	3.3
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	7.3	2.9
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	26	<25
Nickel	<5	<5	<5	<5
Nitrate (mg/L)	np[b]	<0.4	<0.44	np
Perchlorate (mg/L)	np	<3	<3	np
Potassium (mg/L)	8.9	9.4	9.1	8.7
Selenium	<4	<4	<2	<2
Silver	<0.5	<0.5	<0.5	<0.5
Thallium	<1	<1	<1	<1
Vanadium	<25	<25	<25	<25
Zinc	21	<20	84	<20
Organic (µg/L)[c]				
EPA 502.2	0 of 58	0 of 58	0 of 58	0 of 58
EPA 625	np	np	np	0 of 62
Explosive (µg/L)				
HMX[d]	np	np	<5	<5
RDX[e]	np	np	<5	<5
Radioactive (Bq/L)[f]				
Gross alpha	0.019 ± 0.067	-0.0088 ± 0.048	-0.025 ± 0.044	-0.020 ± 0.037
Gross beta	0.23 ± 0.11	0.30 ± 0.070	0.30 ± 0.081	0.25 ± 0.067
Tritium	-1.2 ± 2.3	-1.3 ± 2.0	<3.7	1.5 ± 2.3
Uranium (total)	np	np	0.0012 ± 0.00085	np

a Constituent nondetections other than radioactive are shown as less than (<) the reporting limits (RL) for that analysis.

b 'np' means the analysis was not planned for that sampling event.

c See Table 9-1b for EPA method 502.2 constituents and their RLs.

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

e RDX is hexahydro-1,3,5-trinitro-1,3,5-triazocine.

f Radioactive constituent nondetections are equal to, or are less than the 2σ uncertainty shown.
A negative number means the sample radioactivity was less than background radioactivity inside the measurement apparatus.

Table 9-26. Site 300 off-site surveillance well CON2, 2002

Constituents of concern	Jan 31	Apr 17	Jul 22	Oct 16
Organic (µg/L)				
EPA 601[a]	0 of 32	0 of 32	0 of 32	0 of 32

a See Table 9-1b for EPA method 601 constituents and their RLs.

Table 9-27. Site 300 annual monitored off-site surveillance wells, 2002

Constituents of concern[a]	MUL1	MUL2	STONEHAM1	VIE1	VIE2	W-35A-04
	Sep 17	Sep 17	Sep 9	Sep 17	Sep 11	Jul 23
Inorganic (µg/L)						
Arsenic	4.6	<2	5.2	16	<2	3.8
Barium	40	<25	30	40	30	70
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	10	9.1	13	5.0	10	12
Cobalt	<25	<25	<25	<25	<25	<25
Copper	<2	<2	40	<2	3.6	<10
Lead	<2	<2	<2	<2	<2	<2
Mercury	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Molybdenum	<25	<25	<25	<25	<25	<25
Nickel	<5	9.1	16	<5	7.0	8.9
Nitrate (mg/L)	1.1	14	<0.88	26	20	11
Perchlorate (mg/L)	np[b]	np	np	np	np	<3
Potassium (mg/L)	6.5	8.8	6.8	6.8	2.9	6.6
Selenium	<2	6.7	25	7.7	4.4	7.5
Silver	0.59	<0.5	<0.5	<0.5	<0.5	<0.5
Thallium	<1	<1	<1	<1	<1	<1
Vanadium	<25	<25	<25	30	<25	<25
Zinc	50	<20	77	<20	60	<20
Organic (µg/L)[c]						
EPA 502.2	0 of 58	0 of 58	6 of 58[d]	0 of 58	0 of 58	0 of 58
EPA 625	0 of 62	0 of 62	0 of 62	0 of 62	0 of 62	0 of 62
Toluene	<0.5	<0.5	3.4	<0.5	<0.5	<0.5
Explosive (µg/L)						
HMX[e]	<5	<5	<5	<5	<5	<5
RDX[f]	<5	<5	<5	<5	<5	<5
Radioactive (Bq/L)[g]						
Gross alpha	0.087 ± 0.052	-0.017 ± 0.048	0.19 ± 0.13	0.096 ± 0.055	0.064 ± 0.052	0.050 ± 0.074
Gross beta	0.21 ± 0.063	0.29 ± 0.067	0.36 ± 0.096	0.25 ± 0.078	0.15 ± 0.044	0.26 ± 0.093
Tritium	0.65 ± 2.1	-0.074 ± 2.1	-0.35 ± 2.0	4.4 ± 2.3 -0.91 ± 2.0[h]	-0.37 ± 2.1	-0.26 ± 2.0
Uranium (total)	0.078 ± 0.0081	0.033 ± 0.0041	0.60 ± 0.043	0.090 ± 0.0088	0.17 ± 0.014	0.17 ± 0.014

a Constituent nondetections other than radioactive are shown as less than (<) the reporting limit (RL) for that analysis.

b 'np' means the analysis was not planned for that sampling event.

c See Table 9-1b for EPA method 502.2 constituents and their RLs.

d Five trihalomethane (THM) compounds were detected, because of incorrect sample location downstream of well chlorination unit.

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

f RDX is hexahydro-1,3,5-trinitro-1,3,5-triazocine.

g Radioactive constituent nondetections are equal to, or are less than the 2σ uncertainty shown.
A negative number means the sample radioactivity was less than background radioactivity inside the measurement apparatus.

h Sample obtained on December 5.

SOIL AND SEDIMENT MONITORING

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Richard A. Brown

Surface Soil Methods

Prior to 1988, surface soil samples were collected at sites selected at random from Livermore Valley locations. These sites had been previously sampled for a 1971–1972 study conducted to determine background concentrations of radionuclides in area soils. In 1988, Livermore Valley surface soil sampling locations were chosen to coincide with air sampling locations to cover areas with contaminants from past incidents or to sample other areas of special concern (see **Figure 10-1**, in the main volume). In 1991, five additional soil sampling locations associated with air sampling locations were established. The 2002 Livermore Valley surface soil samples were collected from generally the same locations as those in 1991 to 2001.

The 2002 Site 300 soil samples were scheduled to be collected from the same 14 locations as those sampled between 1990 and 1998, and 2000 and 2001. The PRIM location, which was sampled in 1999, became inaccessible and was removed from the sampling program in 2000 because the site owner discontinued operations. Analysis for plutonium in Site 300 soils was discontinued in 1997 because sample results have continuously been at background levels since sampling began in 1972. The use of established sampling locations is preferred, when possible, from year to year because it allows us to determine more meaningful trends in data. Sampling location 812N was inaccessible during the 2002 sampling campaign.

Sampling locations at areas with known or suspected contaminants were monitored to delimit the extent of the contaminants and to track the contaminants from year to year. For example, six surface soil sampling locations are used to monitor soils near the Livermore Water Reclamation Plant (LWRP). These soils contain slightly elevated plutonium levels due to the resuspension of sludge that had been contaminated from a significant accidental release in 1967, as well as other releases to the sewer. Surface soil sampling is conducted according to written, standardized procedures contained in the *Environmental Monitoring Plan* (Tate et al. 1999). Samples are collected from undisturbed areas near the permanent sampling location marker. These areas generally are level, free of rocks, and unsheltered by trees or buildings. The sampling technicians choose two 1 m squares from which to collect the sample and record how far away and in what direction from the permanent marker the sample is collected. Each sample is a composite consisting of 10 subsamples that are collected with an 8.25 cm diameter stainless steel core sampler at the corners and the center of each square. All subsamples are collected from the top 5 cm of soil because surface deposition from the air is the primary pathway for potential contamination.

Quality assurance (QA) duplicate samples are submitted with each batch of soil samples. At locations chosen for duplicate sampling, two identical samples are obtained by collecting adjacent cores from the corners and center of the sampling squares. Separate composites of 10 cores each are made, and the duplicate samples are identified with unique sample identifier codes.

Surface soil samples are dried, ground, sieved, and homogenized. Samples are analyzed by LLNL's Chemistry and Materials Science Environmental Monitoring Radiological Laboratory (EMRL). The plutonium content of a 100 g sample aliquot is determined by alpha spectroscopy. Other sample aliquots (300 g) are analyzed for more than 150 radionuclides by gamma spectroscopy, using a high-purity germanium (HPGe) detector. Only those nuclides measured above detection limits or of particular interest are reported. The 10 g subsamples of samples from Site 300 are sent to a contract analytical laboratory and are analyzed by atomic emission spectrometry (EPA Method 200.7) for beryllium. Chain-of-custody procedures are followed throughout the sampling, delivery, and analytical processes.

Surface Sediment Methods

Surface samples of a sediment are collected from arroyos and storm water drainages at and around the Livermore site after the cessation of spring runoff. For 2002, samples were analyzed for radionuclides.

Sediment was sampled from six Livermore site drainages. The sediment sampling locations coincide with storm water runoff sampling locations so that the sampling results from these two media can be compared.

All surface sediment locations are marked by a permanent location marker, which serves as a reference point for each sampling location. Ten subsamples, 5-cm deep, are collected at 1-m intervals along a transect of the arroyo or drainage channel. At one of the subsample locations, a 15 cm deep sample is acquired for tritium analysis. The sample collection technologists 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 EMRL. For samples collected for tritium analyses, EMRL uses freeze-drying techniques to recover water from the samples and determines the tritium content of the water by liquid-scintillation counting. The plutonium content of a sample aliquot is determined by alpha spectroscopy. Other sample aliquots are analyzed for radionuclides using gamma spectroscopy as described above for surface soil samples. The radioanalytical methods employed by the EMRL enable detection of concentrations at levels far more sensitive than regulatory limits. Chain-of-custody procedures are followed throughout the sampling, delivery, and analytical processes.

Vadose Zone Soil Methods

Vadose zone soil samples are collected at the same locations as the surface sediments. One of the 10 surface subsample locations is selected for collection of the deeper vadose zone samples. A hand auger is used to collect a 30 to 45 cm deep sample, which is submitted for analysis for total metals by EPA Methods 200.7, 245.2, 7471A and 6010B. Soluble extraction and metals analyses are carried out by California's Waste Extraction Test, followed by the same analyses used for total metals on that extract. Through the use of an electric drive, a sample is collected at 45–65 cm deep for analysis of polychlorinated biphenyls by EPA Method 8082 and for soluble extraction of volatile organic compounds by EPA's Toxicity Characteristic Leaching

Procedure (EPA Method 1311), followed by EPA Method 8260 analysis by gas chromatography/mass spectroscopy. Chain-of-custody procedures are followed throughout the sampling, delivery, and analytical processes.

Data

Table 10-1 presents the analytical data for gamma-emitting radionuclides for surface soil and sediment samples collected in 2002 in the Livermore Valley and Livermore site. Table 10-2 presents the data for background and fallout radionuclides, which include cesium-137, potassium-40, and thorium-232, for samples collected at Site 300. The data generally reflect historic data values for these analytes at these locations. A detailed discussion of results is provided in the main volume of this report.

Tables 10-3 and 10-4 list background levels for total and soluble metals in soils and sediments and de minimis concentrations for organics, respectively. Table 10-5 presents analytical values for soluble volatile organic compounds in Livermore site sediments. Tables 10-6 and 10-7 give results for total and soluble metals, respectively.

Table 10-1. Gamma-emitting background and fallout radionuclides in soil and sediment in the Livermore Valley, 2002

Location	Cesium-137 (Bq/dry g)	Potassium-40 (Bq/dry g)	Thorium-232[(a)] (µg/dry g)	Uranium-235[(b)] (µg/dry g)	Uranium-238[(c)] (µg/dry g)	U235/U238 ratio
Livermore Valley soil						
L-AMON-SO	0.0019 ± 0.00038	0.496 ± 0.0119	8.2 ± 0.18	0.017 ± 0.0085	1.9 ± 0.70	0.0089 ± 0.0056
L-CHUR-SO	0.0034 ± 0.00022	0.500 ± 0.0110	7.3 ± 0.16	0.018 ± 0.0099	1.5 ± 0.87	0.012 ± 0.0096
L-COW-SO	0.00038 ± 0.00016	0.514 ± 0.0123	7.7 ± 0.18	0.017 ± 0.0083	2.2 ± 1.5	0.0077 ± 0.0065
L-FCC-SO	0.00066 ± 0.00016	0.359 ± 0.00788	5.3 ± 0.12	0.011 ± 0.0072	1.4 ± 0.62	0.0079 ± 0.0062
L-HOSP-SO	0.0015 ± 0.00021	0.403 ± 0.00884	6.0 ± 0.13	0.015 ± 0.0066	1.5 ± 0.64	0.010 ± 0.0061
L-MESQ-SO	0.00073 ± 0.00025	0.488 ± 0.0127	7.8 ± 0.20	0.017 ± 0.0090	1.2 ± 1.2	0.014 ± 0.016
L-MET-SO	0.0012 ± 0.00026	0.518 ± 0.0124	7.5 ± 0.18	0.018 ± 0.0068	1.6 ± 0.80	0.011 ± 0.0071
L-NEP-SO	0.0016 ± 0.00021	0.470 ± 0.0132	7.3 ± 0.22	0.018 ± 0.011	1.5 ± 0.90	0.012 ± 0.010
L-PATT-SO	0.00087 ± 0.00019	0.503 ± 0.0161	8.1 ± 0.26	0.021 ± 0.014	1.6 ± 0.89	0.013 ± 0.011
L-SALV-SO	0.0012 ± 0.00020	0.407 ± 0.00892	8.3 ± 0.18	0.021 ± 0.0078	2.0 ± 1.1	0.011 ± 0.0070
L-TANK-SO	0.0035 ± 0.00021	0.303 ± 0.00847	6.8 ± 1.6	0.015 ± 0.0058	1.6 ± 0.75	0.0094 ± 0.0057
L-VIS-SO	0.0010 ± 0.00015	0.369 ± 0.0118	6.8 ± 0.19	0.020 ± 0.0094	1.9 ± 1.1	0.011 ± 0.0078
L-ZON7-SO	0.00058 ± 0.00021	0.377 ± 0.0129	7.8 ± 0.25	0.041 ± 0.0093	4.6 ± 1.3	0.0089 ± 0.0032
Median	**0.0012**	**0.470**	**7.5**	**0.018**	**1.6**	**0.011**
IQR	**0.00087**	**0.123**	**1.0**	**0.0030**	**0.40**	**0.0031**
Maximum	**0.0035**	**0.518**	**8.3**	**0.041**	**4.6**	**0.014**
LWRP soil						
L-WRP1-SO	0.0032 ± 0.00028	0.325 ± 0.00977	6.4 ± 0.18	0.016 ± 0.0093	2.0 ± 0.88	0.0080 ± 0.0058
L-WRP2-SO	0.0018 ± 0.00024	0.323 ± 0.0110	6.7 ± 0.15	0.015 ± 0.0082	1.2 ± 0.55	0.013 ± 0.0089
L-WRP3-SO	0.00035 ± 0.00025	0.339 ± 0.0115	7.2 ± 0.16	0.014 ± 0.0063	1.6 ± 0.73	0.0088 ± 0.0056
L-WRP4-SO	0.00051 ± 0.00014	0.346 ± 0.00899	6.7 ± 0.13	0.013 ± 0.0070	1.6 ± 0.74	0.0081 ± 0.0058
L-WRP5-SO	0.0010 ± 0.00015	0.414 ± 0.0117	7.2 ± 0.19	0.020 ± 0.0078	2.1 ± 0.63	0.0095 ± 0.0047
L-WRP6-SO	0.00048 ± 0.00022	0.392 ± 0.00940	7.3 ± 0.16	0.016 ± 0.0063	1.7 ± 0.74	0.0094 ± 0.0055
Median	**0.00076**	**0.343**	**7.0**	**0.016**	**1.7**	**0.0091**
IQR	**0.0011**	**0.0520**	**0.50**	**0.0017**	**0.32**	**0.0012**
Maximum	**0.0032**	**0.414**	**7.3**	**0.020**	**2.1**	**0.013**
Livermore site surface sediment						
L-ALPE-SD	0.00032 ± 0.00021	0.339 ± 0.00951	4.3 ± 0.15	0.011 ± 0.0068	1.1 ± 1.0	0.010 ± 0.011
L-ASS2-SD	0.00038 ± 0.00020	0.466 ± 0.0102	3.7 ± 0.11	0.0089 ± 0.0060	0.71 ± 0.57	0.013 ± 0.013
L-ASW-SD	0.00032 ± 0.00015	0.485 ± 0.00870	3.2 ± 0.090	0.0076 ± 0.0050	0.93 ± 0.34	0.0082 ± 0.0062
L-ESB-SD	0.0011 ± 0.00032	0.377 ± 0.00981	7.6 ± 0.17	0.019 ± 0.0074	1.9 ± 0.64	0.010 ± 0.0051
L-GRNE-SD	0.00027 ± 0.00016	0.477 ± 0.0134	5.7 ± 0.14	0.015 ± 0.0089	1.3 ± 0.71	0.012 ± 0.0093
L-WPDC-SD	<0.00012	0.459 ± 0.0110	8.2 ± 0.18	0.019 ± 0.0091	1.9 ± 0.76	0.010 ± 0.0062
Median	**0.00032**	**0.463**	**5.0**	**0.013**	**1.2**	**0.010**
IQR	**0.000083**	**0.0767**	**3.3**	**0.0086**	**0.78**	**0.0015**
Maximum	**0.0011**	**0.485**	**8.2**	**0.019**	**1.9**	**0.013**

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 non-detection. See the main volume, Chapter 14.

a Thorium-232 activities can be determined by multiplying the mass concentration provided in the table in µg/dry g by specific activity of thorium-232, i.e., 0.004044 Bq/µg, or 0.1093 pCi/µg.

b Uranium-235 activities can be determined by multiplying the mass concentration provided in the table in µg/dry g by specific activity of uranium-235, i.e., 0.080 Bq/µg, or 2.16 pCi/µg.

c Uranium-238 activities can be determined by multiplying the mass concentration provided in the table in µg/dry g by specific activity of uranium-238, i.e., 0.01245 Bq/µg, or 0.3367 pCi/µg.

Table 10-2. Background and fallout radionuclides in soil at Site 300, 2002

Location	Cesium-137 (Bq/dry g)	Potassium-40 (Bq/dry g)	Thorium-232[(a)] (µg/dry g)
3-801E-SO	0.0011 ± 0.00030	0.370 ± 0.0111	9.2 ± 0.22
3-801N-SO	0.0019 ± 0.00022	0.455 ± 0.0128	12 ± 0.40
3-801W-SO	0.0030 ± 0.00032	0.466 ± 0.0131	10 ± 0.24
3-834W-SO	0.0036 ± 0.00029	0.448 ± 0.0125	12 ± 0.23
3-851N-SO	0.0012 ± 0.00037	0.433 ± 0.0138	15 ± 0.27
3-856N-SO	0.0025 ± 0.00024	0.374 ± 0.0119	10 ± 0.23
3-858S-SO	0.0044 ± 0.00026	0.503 ± 0.0171	10 ± 0.30
3-DSW-SO	0.0050 ± 0.00039	0.440 ± 0.0132	9.2 ± 0.24
3-EOBS-SO	0.0013 ± 0.00021	0.492 ± 0.0177	10 ± 0.27
3-EVAP-SO	0.0022 ± 0.00031	0.377 ± 0.0114	11 ± 0.27
3-GOLF-SO	0.00085 ± 0.00023	0.503 ± 0.0161	8.8 ± 0.21
3-NPS-SO	0.0032 ± 0.00028	0.570 ± 0.0183	8.4 ± 0.29
3-WOBS-SO	0.0045 ± 0.00031	0.388 ± 0.00855	7.8 ± 0.16
Median	**0.0025**	**0.448**	**10**
IQR	**0.0023**	**0.104**	**1.8**
Maximum	**0.0050**	**0.570**	**15**

Note: Radioactivities are reported as the measured concentration and either an uncertainty (±2 counting error).

a Thorium-232 activities can be determined by multiplying the mass concentration provided in the table in µg/dry g by specific activity of thorium-232, i.e., 0.004044 Bq/µg, or 0.1093 pCi/µg.

Table 10-3. Background concentration values for metals in soils at the Livermore site

Metal	Background screening value Total (mg/kg wet weight soil)
Antimony	1.12
Arsenic	8.51
Barium	308
Beryllium	0.62
Cadmium	1.59
Chromium	72.4
Cobalt	14.6
Copper	62.5
Lead	43.7
Mercury	0.14
Molybdenum	Any detection
Nickel	82.8
Selenium	Any detection
Silver	Any detection
Thallium	Any detection
Vanadium	65.2
Zinc	75.3

Metal	Background screening value Soluble (mg/L)
Antimony	Any detection
Arsenic	0.237
Barium	16.7
Beryllium	Any detection
Boron	To be determined
Cadmium	Any detection
Chromium	0.727
Cobalt	0.985
Copper	2.6
Iron	To be determined
Lead	0.987
Manganese	To be determined
Mercury	0.0063
Molybdenum	Any detection
Nickel	1.68
Selenium	Any detection
Silver	Any detection
Thallium	Any detection
Vanadium	1.22
Zinc	4.52

Note: Background values were developed for all soils and sediments at the Livermore site but are used here as a basis for comparison with analytical results for vadose zone soils.

Table 10-4. De minimis concentration levels for organic and radioactive constituents of concern found in Livermore site soils and sediments

Constituents	Water quality objective	Reference	Attenuation factor	De minimis level
Organics (µg/L)				
1,2-Dichlorobenzene	600	CA Primary MCL[(a)]	100	3000
1,3-Dichlorobenzene	600	CA DHS Action Level	100	650
1-4-Dichlorobenzene	5	CA Primary MCL	100	25
1,1-Dichloroethane	5	CA Primary MCL	100	25
1-2-Dichloroethane	0.5	CA Primary MCL	100	2.5
1,1-Dichloroethene	6	CA Primary MCL	100	30
1,2-Dichloroethene	6	CA Primary MCL	100	30
cis-1,2-Dichloroethene	6	CA Primary MCL	100	30
trans-1,2-Dichloroethene	10	CA Primary MCL	100	50
1,1,1-Trichloroethane	200	CA Primary MCL	100	1000
1,1,2-Trichloroethane	5	CA Primary MCL	100	25
Benzene	1	CA Primary MCL	100	5
Carbon tetrachloride	0.5	CA Primary MCL	100	2.5
Chlorobenzene	70	CA Primary MCL	100	350
Chloroform	80	EPA Primary MCL	100	400
Diesel oil/kerosene	100	SNARL[(b)]	100	500
Ethyl benzene	700	CA Primary MCL	100	3500
Freon 11 (trichlorofluoromethane)	150	CA 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	CA Primary MCL	100	6000
Gasoline	5	Other[(c)]	100	25
Methylene chloride	5	CA Primary MCL	100	25
Methyl tertiary-butyl ether (MTBE)	13	CA Primary MCL	100	65
Tetrachloroethene (PCE)	5	CA Primary MCL	100	25
Toluene	150	CA Primary MCL	100	750
Trichloroethene (TCE)	5	CA Primary MCL	100	25
Xylene(s)	1750	CA Primary MCL	100	8750
PCB (total)	0.5	CA Primary MCL	100	2.5
Vinyl chloride	0.5	CA Primary MCL	100	2.5
Radioactivity (Bq/L)				
Tritium	740	CA Primary MCL	100	7400

Note: De minimis values were developed for all soils and sediments at the Livermore site but are used here as a basis for comparison for analytical results for vadose zone soils.

a MCL = Maximum contaminant level

b SNARL = Suggested No Adverse Response Level

c Other = Taste and odor threshold for gasoline

Table 10-5. Concentrations of volatile organic compounds in Livermore site vadose zone obtained by TCLP extraction by EPA Method 1311, followed by analysis by EPA Method 8260, 2002

Organic compounds (µg/L)	ASS2	ASW	ALPE	GRNE	WPDC	ESB
Benzene	<50	<50	<50	<50	<50	<50
Carbon tetrachloride	<25	<25	<25	<25	<25	<25
Chlorobenzene	<100	<100	<100	<100	<100	<100
1,1-Dichloroethene	<100	<100	<100	<100	<100	<100
Chloroform	<100	<100	<100	<100	<100	<100
1,2-Dichloroethane	<25	<25	<25	<25	<25	<25
1,4-Dichlorobenzene	<100	<100	<100	<100	<100	<100
Trichloroethene (TCE)	<100	<100	<100	<100	<100	<100
Vinyl chloride	<100	<100	<100	<100	<100	<100

Table 10-6. Total metals in Livermore site vadose zone soil, 2002

Total metals (mg/kg wet weight soil)[a]	Arroyo Seco		Arroyo Las Positas			Drainage Retention Basin
	Influent	Effluent	Influent	Influent	Effluent	Influent
	ASS2	ASW	ALPE	GRNE	WPDC	ESB
Antimony	<1	<1	<1	<1	<1	<1
Arsenic	2.8	2.1	2.2	2.6	2.8	2.1
Barium	53	69	120	180	160	130
Beryllium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.1	<0.1	<0.1	<0.1	<0.1	1.2
Chromium	20	22	24	11	26	31
Cobalt	5.0	6.0	10	6.0	8.0	8.0
Copper	10	12	18	10	20	33
Lead	10	<10	10	<10	<10	10
Mercury	<0.05	0.080	<0.05	<0.05	0.060	0.080
Molybdenum	<5	<5	<5	<5	<5	<5
Nickel	30	30	50	10	30	30
Potassium	790	790	830	920	1400	1200
Selenium	<2	<2	<2	<2	<2	<2
Silver	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5
Thallium	<1	<1	<1	<1	<1	<1
Vanadium	16	15	21	19	23	19
Zinc	56	51	28	21	32	45

a None of these total metals concentrations exceeds site background concentrations.

Table 10-7. Soluble metals in Livermore site vadose zone soil, 2002

Soluble metals (mg/L)	Arroyo Seco		Arroyo Las Positas			Drainage Retention Basin
	Influent	Effluent	Influent	Influent	Effluent	Influent
	ASS2	ASW	ALPE	GRNE	WPDC	ESB
Antimony	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06
Arsenic	0.060	0.060	0.060	0.12	<0.05	0.060
Barium	3.0	3.3	6.7	8.1	8.6	7.7
Beryllium	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Boron	<0.5	<0.5	0.90	0.70	<0.5	0.90
Cadmium	<0.05	<0.05	<0.05	<0.05	<0.05	0.13
Chromium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cobalt	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Copper	<0.5	<0.5	<0.5	<0.5	<0.5	1.4
Iron	22	25	23	43	20	28
Lead	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Mercury	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Manganese	15	16	26	12	21	29
Molybdenum	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Nickel	<0.5	<0.5	0.60	<0.5	0.60	0.70
Potassium	30	40	20	20	<10	20
Selenium[(a)]	0.090	0.090	0.080	0.060	0.060	0.080
Silver	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Thallium	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Vanadium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Zinc	1.1	1.9	<0.5	<0.5	<0.5	1.1

a Reported concentrations of selenium are biased high due to selenium detected in the method blank sample.

There are no supplemental data in this chapter.
Please see the main volume for details about
Vegetation and Foodstuff Monitoring.

ENVIRONMENTAL RADIATION MONITORING

Nicholas A. Bertoldo

Methods of Gamma-Radiation Monitoring

The environmental gamma-radiation is an important component of the laboratory's effort to maintain compliance and characterize the natural environment. In an effort to measure radiation levels in the vicinity of LLNL operations, 14 dosimeter locations are positioned on the Livermore site perimeter and 22 in the Livermore Valley. Similarly, 9 locations are maintained at Site 300 with 2 sites in the nearby area and 2 in the city of Tracy. These off-site locations were selected on the basis of proximity to LLNL operations. The off-site sampling locations are considered to be representative of the natural background and serve as a baseline comparison to operations.

Thermoluminescent dosimeters (TLDs) are deployed to the field on a quarterly basis following field preparation. Each TLD is labeled with an LLNL dosimeter identification number and placed into an aluminized mylar sample pouch for protection from light and moisture. Duplicate trip blanks, transit control, and calibration control TLDs are prepared in the same way as environmental samples for field deployment.

Each TLD deployed in the field is placed such that the sample is located at approximately 1 m above ground to comply with *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* (U.S. DOE 1991). Upon their removal from the site locations at the end of each quarter, the environmentally exposed TLDs are taken to the LLNL Hazards Control dosimetry laboratory for processing. A chain-of-custody form accompanies the field deployment and the collection of the TLDs. Details of the TLD calculations and reporting of external gamma-radiation dose are described in an Operations and Regulatory Affairs Division procedure.

LLNL uses the Panasonic Model UD-814AS1 TLD, which contains three thallium-activated calcium sulfate crystals ($CaSO_4$) and one lithium borate crystal ($Li_2B_4O_7$). The gamma-ray energy imparted to the TLD's crystal elements excite the electrons in the valence band to a higher energy state, creating a vacancy in the valence band known as a "hole." These electron holes are trapped in impurity sites within the crystal. When the TLDs are heated in the analytical laboratory, the thermal energy of the process raises the electron trap to the conduction band or the hole trap to the valence band, causing thermo-luminescence. This trapped energy is released in the form of light emission that is then measured by the photomultiplier tube output signal. The intensity of the light emission is proportional to the original gamma ray energy imparted to the TLD crystal elements (i.e., the TLD absorbed dose). After the TLD is measured, it is reheated and remeasured to affirm that all the energy has been release from the crystal elements. A near-zero reading indicates that all the stored energy has been released. This process, called annealing, also verifies that the TLD is again ready for field deployment. When a TLD is found open on the ground, damaged, or lost, the associated annual dose reported is calculated from the average of the available mean quarterly dose values for that given location.

Gamma-radiation exposure is measured in roentgens (R), which is defined as the electronic charge required to ionize a given volume of air (2.58×10^{-4} C/kg air). The equivalent absorbed dose is 8.7×10^{-3} Gy (0.87 rad) in air. The tissue equivalent absorbed dose is 9.6×10^{-3} Gy (0.96 rad). The measured exposure is converted to dose equivalent by calibrating the dosimeters against sources that deliver a known absorbed dose and then applying the gamma-radiation quality factor of 1. The resultant dose-equivalent is reported for environmental dose in submultiple factors of 1×10^{-3} sieverts or millisieverts (mSv) and compared to Department of Energy (DOE) Order 5400.5 radiation protection standards. Site boundary doses are compared to environmental background measurements to assess the contribution or impact, if any, from LLNL operations.

To ensure accuracy in TLD measurements, some TLDs are irradiated each quarter to specific exposures for calibration purposes, and others are irradiated to specific exposures to serve as quality control accuracy checks. Duplicate TLDs are located in the field at several locations each quarter to assess TLD measurement precision. When the field deployment time is either less than or exceeds 90 days, the data is normalized to a standard, 90-day quarter or 360 days per year for the purpose of comparison. LLNL participates in the National Intercomparison Laboratory Study for external gamma radiation measurements, and LLNL processing complies with the DOE Environmental Measurement Laboratory standards.

Tables

Data tables for the 2002 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, 2002

Location[(a)]	Quarterly dose (mSv)[(b)]				Annual Dose[(c)]
	Jan–Mar	Apr–Jun	Jul–Sep	Oct–Dec	(mSv)
L-001-TD	0.160 ± 0.015	0.161 ± 0.009	0.151 ± 0.005	0.174 ± 0.001	0.646 ± 0.018
L-004-TD	0.176 ± 0.009	0.154 ± 0.007	0.169 ± 0.003	0.202 ± 0.013	0.701 ± 0.018
L-005-TD	0.169 ± 0.009	0.162 ± 0.010	0.165 ± 0.006	0.193 ± 0.010	0.689 ± 0.018
L-006-TD	0.188 ± 0.009	0.172 ± 0.002	0.168 ± 0.004	0.208 ± 0.012	0.736 ± 0.016
L-011-TD	0.139 ± 0.004	0.135 ± 0.006	0.126 ± 0.010	0.153 ± 0.006	0.553 ± 0.014
L-014-TD	0.150 ± 0.010	0.140 ± 0.002	0.143 ± 0.003	0.175 ± 0.011	0.608 ± 0.015
L-016-TD	0.158 ± 0.009	0.144 ± 0.007	0.151 ± 0.005	0.177 ± 0.017	0.630 ± 0.021
L-042-TD	0.159 ± 0.010	0.153 ± 0.013	0.152 ± 0.007	0.189 ± 0.009	0.653 ± 0.020
L-043-TD	0.160 ± 0.012	0.146 ± 0.007	0.138 ± 0.004	0.176± 0.010	0.620 ± 0.018
L-047-TD	0.143 ± 0.018	0.135 ± 0.008	0.134 ± 0.013	0.167 ± 0.004	0.579 ± 0.024
L-052-TD	0.158 ± 0.009	0.152 ± 0.008	0.151 ± 0.005	0.180 ± 0.011	0.641 ± 0.017
L-056-TD	0.161 ± 0.009	0.159 ± 0.001	0.161 ± 0.005	0.191 ± 0.007	0.672 ± 0.012
L-068-TD	0.175 ± 0.015	0.155 ± 0.006	0.165 ± 0.003	0.192 ± 0.004	0.687 ± 0.017
L-069-TD	0.157 ± 0.005	0.149 ± 0.003	0.145 ± 0.004	0.185 ± 0.013	0.636 ± 0.015
Mean[(d)]	**0.161 ± 0.007**	**0.151 ± 0.006**	**0.151 ± 0.007**	**0.183 ± 0.008**	**0.646 ± 0.028**

Note: Measurement represents the TLD absorbed dose in mR converted to mSv.

a See **Figure 12-1** in the main volume for locations.

b Measurement uncertainty is reported as ±2σ of the data.

c Uncertainty is reported as the root mean square of the quarterly errors reported.

d Uncertainty associated with the quarterly means is reported as two standard errors of the location data.

Table 12-2. Calculated dose from TLD environmental radiation measurements, Livermore Valley, 2002

Location[a]	Quarterly dose (mSv)[b]				Annual dose[c] (mSv)
	Jan–Mar	Apr–Jun	Jul–Sep	Oct–Dec	
V-018-TD	0.132 ± 0.008	0.124 ± 0.005	0.118± 0.004	0.150 ± 0.001	0.524 ± 0.010
V-019-TD	0.155 ± 0.005	0.141 ± 0.003	0.143 ± 0.010	0.165 ± 0.002	0.604 ± 0.012
V-022-TD	0.170 ± 0.011	0.166 ± 0.008	0.162 ± 0.020	0.199 ± 0.007	0.697 ± 0.025
V-024-TD	0.166 ± 0.003	—[d]	0.158 ± 0.009	0.200 ± 0.006	0.699 ± 0.011
V-027-TD	0.151 ± 0.010	0.138 ± 0.008	0.143 ± 0.003	0.169 ± 0.009	0.601 ± 0.016
V-028-TD	0.163 ± 0.016	0.150 ± 0.005	0.149 ± 0.010	0.185 ± 0.016	0.647 ± 0.025
V-030-TD	0.163 ± 0.009	0.148± 0.009	0.151 ± 0.004	0.180 ± 0.017	0.642 ± 0.022
V-032-TD	0.158 ± 0.005	0.157 ± 0.007	0.189 ± 0.134	0.175 ± 0.006	0.679 ± 0.134
V-033-TD	0.178 ± 0.014	0.157 ± 0.003	0.163 ± 0.001	0.180 ± 0.009	0.678 ± 0.017
V-035-TD	0.167 ± 0.008	0.141 ± 0.006	0.145 ± 0.009	0.178 ± 0.006	0.631 ± 0.015
V-037-TD	0.172 ± 0.015	0.153 ± 0.007	0.167 ± 0.006	0.177 ± 0.003	0.669 ± 0.018
V-045-TD	0.157 ± 0.014	0.149 ± 0.005	0.154 ± 0.006	0.183 ± 0.003	0.643 ± 0.016
V-057-TD	0.172 ± 0.002	0.161 ± 0.013	0.170 ± 0.011	0.198 ± 0.002	0.701 ± 0.017
V-060-TD	0.177 ± 0.012	0.157 ± 0.008	0.153 ± 0.008	0.189 ± 0.006	0.676 ± 0.018
V-066-TD	0.153 ± 0.011	—[d]	0.157 ± 0.003	0.185 ± 0.002	0.660 ± 0.012
V-070-TD	0.157 ± 0.007)	0.147 ± 0.006	0.143 ± 0.007	0.189 ± 0.011	0.636 ± 0.016
V-072-TD	0.188 ± 0.007	0.187 ± 0.011	0.186 ± 0.030	0.215 ± 0.006	0.776 ± 0.033
V-074-TD	0.152 ± 0.008	0.148 ± 0.007	0.132 ± 0.003	—[d]	0.576 ± 0.011
V-075-TD	0.132 ± 0.008	0.122 ± 0.006	0.119 ± 0.011	0.153 ± 0.010	0.526 ± 0.018
V-076-TD	0.149 ± 0.009	0.131 ± 0.015	0.129 ± 0.002	0.164 ± 0.007	0.573 ± 0.019
V-077-TD	0.155 ± 0.006	0.141 ± 0.005	0.148 ± 0.006	0.186 ± 0.019	0.630 ± 0.021
V-122-TD	0.175 ± 0.014	0.187 ± 0.011	0.181 ± 0.009	0.211 ± 0.003	0.754 ± 0.020
Mean[e]	**0.161 ± 0.006**	**0.150 ± 0.008**	**0.153 ± 0.008**	**0.182 ± 0.007**	**0.646 ± 0.015**

Note: Measurement represents the TLD absorbed dose in mR converted to mSv.

a See **Figure 12-2** in the main volume for locations.

b Measurement uncertainty is reported as ±2 of the data.

c Annual dose is reported as 4 times the available quarterly mean data. The uncertainty is reported as the root mean square of the quarterly errors reported.

d Data not available due to missing or damaged TLD.

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

Table 12-3. Calculated dose from TLD environmental radiation measurements, Site 300 perimeter, 2002

Location[a]	Quarterly dose (mSv)[b]				Annual dose[c] (mSv)
	Jan–Mar	Apr–Jun	Jul–Sep	Oct–Dec	
3-078-TD	0.171 ± 0.004	0.156± 0.012	0.156 ± 0.010	0.198 ± 0.008	0.681 ± 0.018
3-081-TD	0.206 ± 0.007	0.189 ± 0.016	0.191 ± 0.010	—[d]	0.781 ± 0.020
3-082-TD	—[d]	0.183 ± 0.002	0.184 ± 0.003	0.209 ± 0.001	0.768 ± 0.004
3-085-TD	0.181 ± 0.012	0.174 ± 0.006	0.207 ± 0.010	0.163 ± 0.002	0.725 ± 0.017
3-086-TD	0.185 ± 0.002	0.183 ± 0.003	0.188± 0.014	0.216 ± 0.014	0.772± 0.020
3-088-TD	0.189 ± 0.008	0.173 ± 0.005	0.181 ± 0.011	0.220 ± 0.009	0.763 ± 0.017
3-089-TD	0.196 ± 0.008	0.187 ± 0.006	0.188 ± 0.007	0.222 ± 0.007	0.793 ± 0.014
3-091-TD	0.194 ± 0.007	0.180 ± 0.008	0.203 ± 0.013	0.225 ± 0.011	0.802 ± 0.020
3-121-TD	0.205 ± 0.002	0.212 ± 0.001	0.191 ± 0.007	0.250 ± 0.009	0.858 ± 0.012
3-123-TD	0.159 ± 0.004	0.151 ± 0.002	—[e]	—[e]	0.620 ± 0.004
3-124-TD	0.169 ± 0.012	0.157 ± 0.002	—[e]	—[e]	0.652 ± 0.012
3-125-TD	—[d]	0.143 ± 0.011	—[e]	—[e]	—[f], —[g]
3-126-TD	0.145 ± 0.021	0.145 ± 0.008	—[e]	—[e]	0.580 ± 0.022
Mean[h]	**0.182 ± 0.010**	**0.172 ± 0.011**	**0.188 ± 0.010**	**0.213 ± 0.018**	**0.755 ± 0.025**

Note: Measurement represents the TLD absorbed dose in mR converted to mSv.

a See **Figure 12-3** in the main volume for locations.

b Measurement uncertainty is reported as ±2σ of the data.

c Annual dose is reported as 4 times the available quarterly mean data. The uncertainty is reported as the root mean square of the quarterly errors reported.

d Data not available due to missing or damaged TLD.

e Location removed

f Insufficient number of samples to calculate the annual dose.

g Insufficient number of samples to calculate the Standard Error (SE).

h Uncertainty associated with the quarterly means is reported as two standard errors of the location data.

Table 12-4. Calculated dose from TLD environmental radiation measurements, Tracy and other off-site locations in the vicinity of Site 300, 2002

Location[(a)]	Quarterly dose (mSv)[(b)]				Annual dose[(c)]
	Jan–Mar	Apr–Jun	Jul–Sep	Oct–Dec	(mSv)
3-092-TD	0.187 ± 0.021	0.164 ± 0.005	0.165 ± 0.008	0.219± 0.009	0.735 ± 0.025
3-093-TD	0.147 ± 0.003	0.130 ± 0.010	0.140 ± 0.004	0.205 ± 0.014	0.622 ± 0.018
Mean[(d)]	**0.167 ± 0.040**	**0.147 ± 0.034**	**0.153 ± 0.025**	**0.212 ± 0.014**	**0.679 ± 0.060**
3-090-TD	0.207 ± 0.012	0.190 ± 0.005	0.194 ± 0.016	0.224 ± 0.007	0.815 ± 0.022
3-099-TD	0.169 ± 0.014	0.171 ± 0.071	0.165 ± 0.003	0.179 ± 0.009	0.684 ± 0.073
Mean[(d)]	**0.188 ± 0.038**	**0.181 ± 0.019**	**0.180 ± 0.029**	**0.202 ± 0.045**	**0.751 ± 0.068**

Note: Measurement represents the TLD absorbed dose in mR converted to mSv.

a See **Figure 12-3** in the main volume for locations.

b Measurement uncertainty is reported as ±2σ of the data.

c Annual dose is reported as 4 times the available quarterly mean data. The uncertainty is reported as the root mean square of the quarterly errors reported.

d Uncertainty associated with the quarterly means is reported as two standard errors of the location data.

**There are no supplemental data in this chapter.
Please see the main volume for details about
Radiological Dose Assessment.**

QUALITY ASSURANCE

Maria Nelson
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Participation in Laboratory Intercomparison Studies

Two laboratories at Lawrence Livermore National Laboratory participated in the annual Environmental Monitoring Laboratory (EML) intercomparison studies program sponsored by the U.S. Department of Energy (DOE). The two LLNL laboratories are the Chemistry and Materials Science Environmental Services (CES) Environmental Monitoring Radiation Laboratory (EMRL) and the Hazards Control Department's Analytical Laboratory (HCAL).

The results of CES EMRL's participation in the 2002 EML studies are presented in **Table 14-1**. According to the results, 23 of 28 analyses fell within established acceptance control limits. The results for Pu-239 and Ac-228 on soil samples for the QAP 56 Study were above the acceptable limits because the wrong sample weight was entered for the Pu-239 analysis. The counting time was not long enough and the branching ratios in the AC-228 needed to be corrected for the Ac-228 measurement by gamma counting. In the future, the branching ratios for Ac-228 will be rechecked to assure that the library is using the ones that work best with the Canberra Genie 2000 program. Two laboratory workers, prior to starting the count, will check the weights entered into the system. The results for H-3 on the water sample for the QAP 56 Study exceeded acceptable limits because an appreciable amount of hydrogen gas was released during the pH adjustment of the solution causing a decrease in the H-3 value. In the future, strong acidic solutions requiring H-3 analysis will be chilled during pH adjustment. The results for U-234 and U-238 in soil and water for the QAP 57 Study were below the acceptable limits because of a possible bias in the U-232 tracer. In the future, the U-232 tracer value will be corrected and this new value will be used for future sample analysis.

The results of HCAL's participation in the 2002 EML studies (see **Table 14-2**) indicate that 10 of 10 sample results fell within the 3σ acceptance control limits.

CES EMRL participated in two DOE Mixed Analyte Performance Evaluation Program (MAPEP) studies in 2002. The results of these studies are presented in **Tables 14-3** and **14-4**. 14 of 22 analytes reported by CES in these studies fell within acceptable limits.

There was a false positive for Pu-238 in the MAPEP-01-W9 Study because cleanup of the plutonium during the ion exchange column separation was incomplete. There were residual amounts of contamination showing up in the spectrum that indicated cross contamination in the Pu-238 region. In the future, the rinsing of the column after the load of the plutonium will be increased to improve the removal of the uranium and thorium. If counting of the sample shows residual amounts of contamination from the uranium and thorium, the plutonium will be stripped from the plated disc and reworked and plated and recounted. This process will be repeated until the spectrum no longer shows possible contamination.

Acceptable limits were exceeded for Cs-134, Cs-137, Co-57, Co-60, Mn-54, K-40, and Zn-65 in the MAPEP-02-S9 Study because the wrong sample was counted. The correct sample was counted and the nuclides were within range. In the future, new performance evaluation samples (still in process) will be stored separately from the old samples.

Although contract laboratories are also required to participate in laboratory intercomparison programs, permission to publish their results for comparison purposes was not granted for 2002.

Summary Statistics

The calculation of summary statistics is affected by the presence of nondetections. A nondetection indicates that no specific measured value is available; instead, the best information available is that the actual value is less than the reporting limit.

To calculate the median, we require at least four values. If the number of values is odd, the middle value (when sorted from smallest to largest) is the median. If the middle value and all larger values are detections then the middle value is reported as the median. Otherwise, the median is assigned a less-than (<) sign.

If the number of values is even, the median is halfway between the middle two values (i.e., the middle two when the values are sorted from smallest to largest). Both of the middle two values, and all larger values, must be detections. If this is not the case, the median is assigned a less-than sign.

The IQR is calculated from the 25th percentile and the 75th percentile of the data; these are interpolated from the data if necessary. If any of the values used to calculate the 25th percentile, or any values larger than the 25th percentile, are nondetections, then the IQR cannot be calculated. To calculate the IQR, we require at least six values.

Table Preparation

This year the data tables in the Data Supplement were created using computer scripts that retrieve data from the database, convert to SI units when necessary, calculate summary statistics for tables that included summary statistics, format data as appropriate, lay out the table into the desired rows and columns, and present a draft table. Previously these tasks were done as separate steps, often with different individuals doing different steps. This year's more automated process is intended to make the task of preparing data tables more efficient and less error-prone.

Data Presentation

The measurement uncertainties associated with results from analytical laboratories reported in this volume are represented in two ways.

The first of these, significant digits, relates to the resolution of the measuring device. For example, if an ordinary household ruler with a metric scale is used to measure the length of an object in centimeters, and the ruler has tick marks every tenth centimeter, then the length can reliably and consistently be measured to the nearest tenth of a centimeter (i.e., to the nearest tick mark). However, an attempt to be more precise is not likely to yield reliable or reproducible results, because it requires a visual estimate of a distance between tick marks.

The appropriate way to report such a measurement would be, for example, "2.1 cm". This would indicate that the "true" length of the object is nearer to 2.1 cm than to 2.0 cm or 2.2 cm (i.e., between 2.05 and 2.15 cm). This result is said to have two significant digits. Although not explicitly stated, the uncertainty is considered to be ± 0.05 cm.

A more precise measuring device might be able to measure an object to the nearest one-hundredth of a centimeter; in that case a value such as "2.12 cm" might be reported. This value would have three significant digits and the implied uncertainty would be ± 0.005 cm.

A result reported as "3.0 cm" has two significant digits. That is, the trailing zero is significant, and implies that the true length is between 2.95 and 3.05 cm; closer to 3.0 than to 2.9 or 3.1 cm.

When performing calculations with measured values that have significant digits, all digits are used. The final result is then rounded. However, summary statistics are calculated from values that have already been rounded (if necessary). The number of significant digits in the calculated result is the same as that of the measured value with the fewest number of significant digits.

Most unit conversion factors do not have significant digits. For example, the conversion from milligrams (mg) to micrograms (μg) requires multiplying by the fixed (constant) value of 1000. The value 1000 is exact; it has no uncertainty and therefore the concept of significant digits does not apply.

The other method of representing uncertainty is based on random variation. For radiological data, the random variation is due to the random nature of radioactive decay. As a sample is measured, the number of radioactive decay events is counted, and the reported result is calculated from the number of decay events that were observed. If the sample is recounted, the number of decay events will almost always be different—because the decay events occur randomly.

Uncertainties of this type are reported in this volume as 2σ uncertainties. A 2σ uncertainty represents the range of results expected to occur approximately 95% of the time, if a sample were to be recounted many times.

A radiological result reported as, for example, "2.6 ± 1.2 Bq/g" would indicate that with approximately 95% confidence, the "true" value is in the range 1.4 to 3.8 Bq/g (i.e., $2.6 - 1.2 = 1.4$ and $2.6 + 1.2 = 3.8$).

The concept of significant digits applies to both the radiological result and its uncertainty. So, for example, in a result reported as "2.6 ± 1.2", both the measurement and its uncertainty have the same number of significant digits, that is, two.

When expanding an interval reported in the "±" form, for example "2.4 ± 0.44", to a range of values, the rule described above for calculations involving significant digits must be followed. For example, $2.4 - 0.44 = 1.96$. However, the measurements 2.4 and 0.45 each have two significant digits, so 1.96 must be rounded to two significant digits, i.e., to 2.0. Similarly, $2.4 + 0.44 = 2.84$, and this must be rounded to 2.8. Therefore, a measurement reported as "2.4 ± 0.44 Bq/g" would represent an interval of 2.0 to 2.8 Bq/g.

When rounding a value having a final digit of "5", the software that prepared the tables follows IEEE Standard 754-1985, which is “go to the even digit”. For example, 2.45 would round down to 2.4, and 2.55 would round up to 2.6.

Table 14-1. LLNL's CES EMRL results from the DOE EML Quality Assurance Program, 2002

Analyte	EML study	CES value	EML value	CES/EML	Control limits[a]	Warning limits[a]	Performance[a]
Air filter (Bq/filter)							
Co-60	QAP 57	27.3	23.0	1.19	0.80-1.26	0.90-1.11	Warning
Cs-137	QAP 57	40.2	32.5	1.24	0.80-1.32	0.90-1.17	Warning
Mn-54	QAP 57	62.5	52.2	1.20	0.80-1.35	0.90-1.19	Warning
Soil (Bq/kg)							
Ac-228	QAP 56	40.0	51.2	0.782	0.80-1.38	0.87-1.19	Not Acceptable
Am-241	QAP 57	7.02	6.77	1.04	0.65-2.28	0.88-1.47	Acceptable
Cs-137	QAP 56	1190	1330	0.897	0.80-1.22	0.90-1.12	Warning
	QAP 57	767	829	0.925	0.80-1.25	0.90-1.16	Acceptable
K-40	QAP 56	587	622	0.944	0.80-1.32	0.90-1.19	Acceptable
	QAP 57	686	638	1.08	0.80-1.32	0.90-1.19	Acceptable
PB-212	QAP 56	59.0	51.1	1.16	0.78-1.32	0.89-1.19	Acceptable
Pu-238	QAP 57	18.4	19.2	0.958	0.59-2.88	0.87-1.49	Acceptable
Pu-239	QAP 56	134	19.1	7.02	0.71-1.30	0.87-1.13	Not Acceptable
	QAP 57	12.6	12.9	0.976	0.71-1.30	0.87-1.13	Acceptable
U-234	QAP 57	30.5	42.3	0.721	0.74-1.20	0.84-1.10	Not Acceptable
U-238	QAP 57	33.3	44.9	0.742	0.68-1.22	0.82-1.10	Warning
Vegetation (Bq/kg)							
Pu-239	QAP 57	3.09	3.43	0.902	0.69-1.31	0.84-1.14	Acceptable
Water (Bq/L)							
Am-241	QAP 57	2.97	3.04	0.976	0.79-1.41	0.90-1.19	Acceptable
Co-60	QAP 56	375	347	1.08	0.80-1.20	0.90-1.10	Acceptable
	QAP 57	277	269	1.03	0.80-1.20	0.90-1.10	Acceptable
Cs-137	QAP 56	59.6	56.1	1.06	0.80-1.22	0.90-1.12	Acceptable
	QAP 57	80.3	81.4	0.986	0.80-1.22	0.90-1.12	Acceptable
H-3	QAP 56	185	284	0.652	0.78-2.45	0.90-1.32	Not Acceptable
	QAP 57	247	227	1.09	0.78-2.45	0.90-1.32	Acceptable
Pu-238	QAP 57	4.28	4.33	0.988	0.74-1.20	0.90-1.10	Acceptable
Pu-239	QAP 56	4.36	4.22	1.03	0.79-1.20	0.90-1.10	Acceptable
	QAP 57	2.19	2.07	1.06	0.79-1.20	0.90-1.10	Acceptable
U-234	QAP 57	2.96	3.32	0.891	0.80-1.34	0.90-1.17	Warning
U-238	QAP 57	2.69	3.37	0.798	0.80-1.28	0.90-1.16	Not Acceptable

a Control and warning limits are established from historical QAP data and reported as the ratio of reported value to EML value. The criteria for acceptable performance is between the 15th and the 85th percentiles of the cumulative normalized distribution. The acceptable with warning criteria is between the 5th and the 15th percentiles and between the 85th and 95th percentiles. Values less than the 5th and greater than the 95th percentiles are not acceptable.

Table 14-2. LLNL's HCAL results from the DOE EML Quality Assurance Program, 2002

Analyte	EML study	HCAL value	EML value	HCAL/EML	Control limits	Warning limits	Performance[(a)]
Air filter (Bq/filter)							
Gross alpha	QAP 56	0.670	0.534	1.26	0.73-1.43	0.84-1.21	Warning
	QAP 57	0.335	0.287	1.17	0.73-1.43	0.84-1.21	Acceptable
Gross beta	QAP 56	1.35	1.30	1.04	0.76-1.36	0.85-1.21	Acceptable
	QAP 57	0.800	0.871	0.918	0.76-1.36	0.85-1.21	Acceptable
Water (Bq/L)							
Gross Alpha	QAP 56	407	375	1.09	0.58-1.29	0.79-1.13	Acceptable
	QAP 57	240	210	1.14	0.58-1.29	0.79-1.13	Warning
Gross Beta	QAP 56	1000	1030	0.976	0.61-1.43	0.81-1.29	Acceptable
	QAP 57	908	900	1.01	0.61-1.43	0.81-1.29	Acceptable
Tritium	QAP 56	281	284	0.990	0.78-2.45	0.90-1.32	Acceptable
	QAP 57	243	227	1.07	0.78-2.45	0.90-1.32	Acceptable

a Control and warning limits are established from historical QAP data and reported as the ratio of reported value to EML value. The criteria for acceptable performance is between the 15th and the 85th percentiles of the cumulative normalized distribution. The acceptable with warning criteria is between the 5th and the 15th percentiles and between the 85th and 95th percentiles. Values less than the 5th and greater than the 95th percentiles are not acceptable.

Table 14-3. LLNL CES EMRL performance in the MAPEP-01-W9 Intercomparison Program for Water

Analyte	CES value	Units	Reference value	Bias (%)	Acceptance range	Performance[(a)]
Americium-241	1.13	Bq/L	1.19	-5.0	0.83-1.55	Acceptable
Cesium-134	22.9	Bq/L	28.5	-19.6	20.0-37.1	Acceptable
Cesium-137	280	Bq/L	286	-2.1	200-372	Acceptable
Cobalt-57	155	Bq/L	143	8.4	100-186	Acceptable
Cobalt-60	151	Bq/L	141	7.1	98.7-183	Acceptable
Manganese-54	264	Bq/L	246	7.3	172-320	Acceptable
Plutonium-238	0.0168	Bq/L	False Positive	—	—	False Positive[(b)]
Plutonium-239/240	2.86	Bq/L	2.99	-4.3	2.09-3.89	Acceptable
Uranium-234/233	0.853	Bq/L	0.98	-13.0	0.69-1.27	Acceptable
Uranium-238	6.97	Bq/L	7.8	-10.6	5.46-10.1	Acceptable
Zinc-65	75.7	Bq/L	67.3	12.5	47.1-87.5	Acceptable

a Acceptable results have bias ≤20%. Results acceptable with warning have basis >20% and bias ≤30%. Results with basis >30% are not acceptable.

b Analyte was detected by the laboratory but not present in the sample.

Table 14-4. LLNL CES EMRL performance in the MAPEP-02-S9 Intercomparison Program for Soil

Analyte	CES value	Units	Reference value	Bias (%)	Acceptance range	Performance[(a)]
Cesium-134	1820	Bq/kg	862	111	603-1120	Not Acceptable
Cesium-137	296	Bq/kg	111	167	77.7-144	Not Acceptable
Cobalt-57	648	Bq/kg	246	163	172-320	Not Acceptable
Cobalt-60	241	Bq/kg	87.5	175	61.2-114	Not Acceptable
Manganese-54	1560	Bq/kg	546	186	382-710	Not Acceptable
Plutonium-238	34.1	Bq/kg	33.3	2.4	23.3-43.3	Acceptable
Plutonium-239/240	73.0	Bq/kg	72.9	0.1	51.0-94.8	Acceptable
Potassium-40	1700	Bq/kg	652	161	456-848	Not Acceptable
Uranium-234/233	191	Bq/kg	229	-16.6	160-298	Acceptable
Uranium-238	196	Bq/kg	220	-10.9	154-286	Acceptable
Zinc-65	2410	Bq/kg	809	198	566-1050	Not Acceptable

a Acceptable results have bias ≤20%. Results acceptable with warning have basis >20% and bias ≤30%. Results with basis >30% are not acceptable.

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