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Environmental Protection Department
Operations and Regulatory Affairs Division

LLNL Experimental Test Site 300

Compliance Monitoring Program for the CERCLA-Closed Pit 6 Landfill

Annual Report for 2004

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Summary

This combined fourth-quarter and annual monitoring report is required by the *Post-Closure Plan for the Pit 6 Landfill Operable Unit, Lawrence Livermore National Laboratory Site 300* (Ferry *et al.* 1998). It summarizes post-closure compliance activities performed at the closed Pit 6 landfill during 2004, with emphasis on fourth-quarter results. Compliance activities conducted in 2004 include: ground water sampling and analysis, an annual inspection by an independent Professional Engineer (appended to the third quarter report), an annual survey of pit cap marker elevations, and minor maintenance activities (also appended to the third quarter report). Quantitative analyses of chemical constituents of concern (COCs) in ground water samples were completed by state-certified analytical laboratories. Complete tables of COCs and physical parameter measurements for all quarters are included in this report.

No new release of any COC from Pit 6 was indicated by ground water monitoring data collected during 2004. A few COCs that were released to ground water from the landfill prior to its closure in 1998 continued to be detected. These include tritium, several volatile organic compounds (VOCs), and perchlorate.

Introduction

Site 300 is the Lawrence Livermore National Laboratory (LLNL) Experimental Test Facility located in the Altamont Hills approximately 13 kilometers (8 miles) southwest of Tracy, California (**Figure 1**). Site 300 is owned by the United States Department of Energy (DOE) and is operated by the Regents of the University of California. The closed Pit 6 landfill is located within Site 300 near its southern boundary (**Figure 2**). A post-closure plan requiring quarterly and annual reports of compliance monitoring activities at the Pit 6 landfill (Ferry *et al.* 1998) was implemented during the second quarter of 1998.

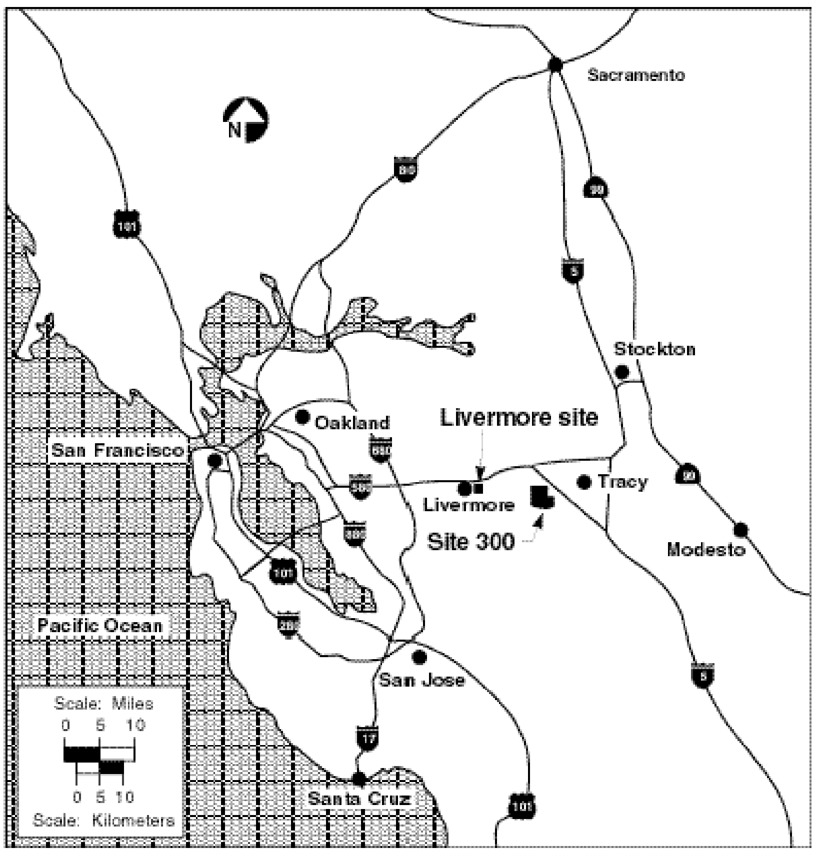

Figure 1. Location of LLNL Site 300.

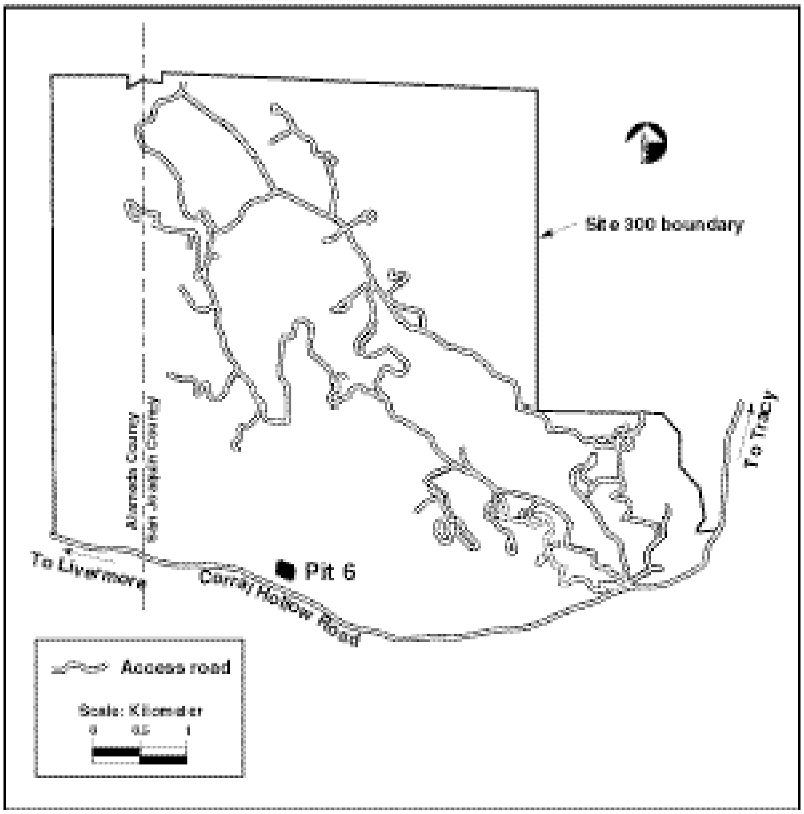

Figure 2. Location of Pit 6 at LLNL Site 300.

Figure 3 shows the locations of the wells that are used to monitor the ground water in the vicinity of the Pit 6 landfill, including upgradient wells, detection monitoring wells, and corrective action monitoring wells (Ferry *et al.* 1998). The northern limit of the Carnegie-Corral Hollow Fault Zone extends beneath Pit 6 as shown in **Figure 3**. Ground water flows southeastward, following the inclination (dip) of the underlying sedimentary rocks. Depths to the water table range from 10 to 20 meters (m) (32.8 to 65.6 feet [ft]). A trough containing terrace gravel within the fault zone beneath Pit 6 provides a channel for ground water to flow east-southeast, parallel to the Site 300 boundary fence (Webster-Scholten 1994).

Monitoring program overview

The primary post-closure monitoring activity performed by LLNL at Pit 6 is the quarterly collection of ground water samples for chemical analyses. Field measurements of ground water physical parameters are collected at the time of sampling. Two ground water monitoring programs have been implemented at the Pit 6 landfill to ensure compliance with regulations. The Detection Monitoring Program (DMP) detects any new release of COCs to ground water from wastes buried in the Pit 6 landfill, while the Corrective Action Monitoring Program (CAMP) monitors the movement and fate of historically released COCs in the ground water. COCs, as defined by Title 23 of the *California Code of Regulations* (CCR), Chapter 15, are waste constituents, reaction products, and hazardous constituents that are reasonably expected to be in or derived from waste buried in the Pit 6 landfill.

Twenty-four COCs, including VOCs and radioisotopes, were identified initially for monitoring (Ferry *et al.* 1998). Perchlorate and nitrate were discovered subsequently in the ground water near Pit 6 during CERCLA site-wide surveys. Perchlorate was added to the COC list, and quarterly monitoring and reporting on it began during the third quarter of 2000. Since January 2003, an expanded set of CAMP wells (**Figure 3**) have been monitored for tritium activity, volatile organic compounds (VOCs), nitrate, and perchlorate. Additional changes to the monitoring program implemental since January 2003 are discussed in **Appendix D**.

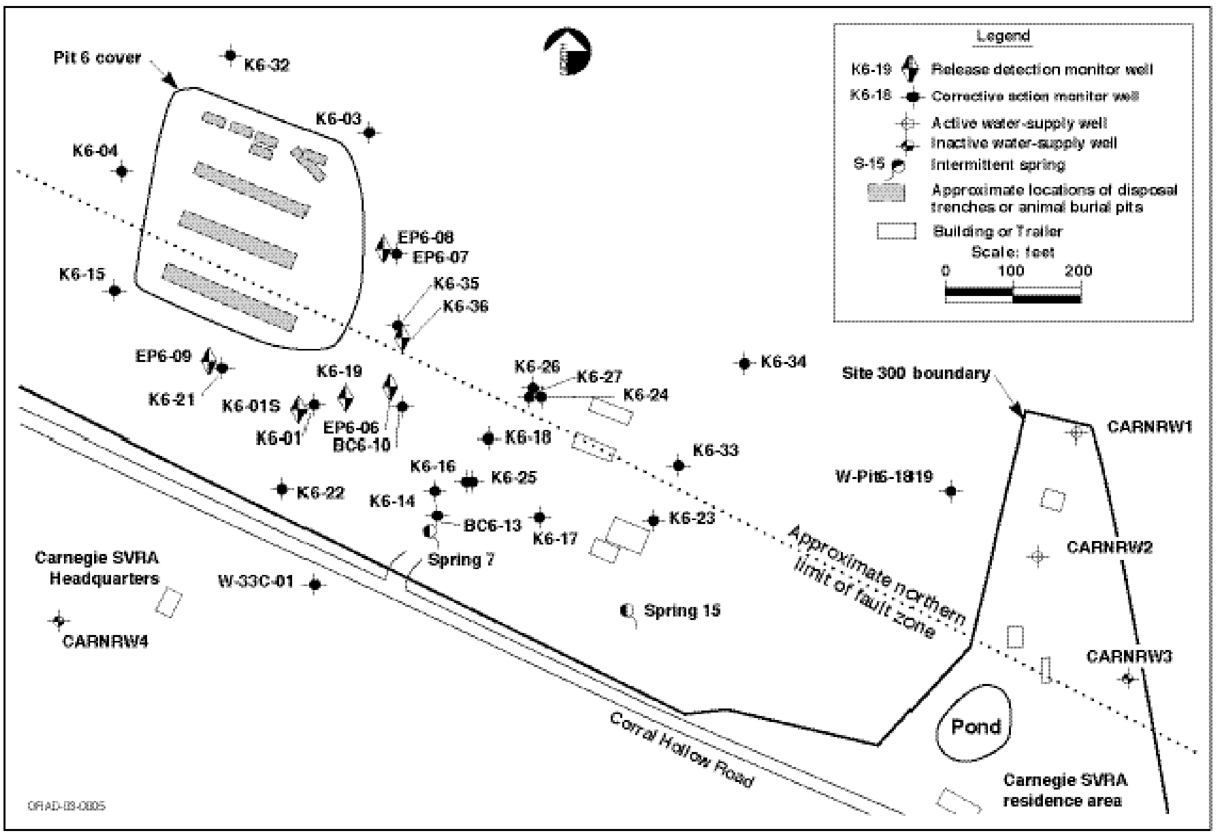

Figure 3. Locations of Pit 6 monitoring wells.

DMP objective. The primary DMP objective is to detect any new release of COCs to ground water. Ground water is sampled quarterly from six wells located hydraulically downgradient of Pit 6 along the point of compliance. These wells are identified as EP6-06, EP6-08, EP6-09, K6-01S (K6-01 if K6-01S is dry), K6-19, and K6-36 in **Figure 3**. Water samples are sent to state-certified laboratories where they are analyzed quantitatively for the presence (or absence) of COCs (see **Table C-1** for the list of DMP COCs). Gross alpha and gross beta radioactivity measurements are used as surrogates for seven radionuclide COCs other than uranium and tritium. Additional field measurements of ground water general parameters are obtained quarterly at the time of sample collection.

Potential releases of COCs from Pit 6 are indicated by comparing analytical results for ground water samples with statistically determined limits of concentration, called statistical limits, or SLs (see **Appendix C**, **Table C-1**, for the list of COCs and their respective SLs). If a COC measurement exceeds an SL, the measurement is investigated further to determine its validity. Consistent with state regulations, two independent ground water samples, called retest samples, are obtained at least one week apart from the associated monitoring well and analyzed for the suspect COC. If the COC is present in either sample at a concentration that exceeds the SL, then the initial analysis is deemed to be validated and it is reported as statistically significant evidence of a release. If neither retest sample measurement exceeds the SL, then the initial exceedance is not confirmed, and a release report is not made. Any further investigation of a COC is at the discretion of the Site 300 Remedial Project Managers (RPMs) and is conducted by LLNL under CERCLA.

CAMP objectives. The primary CAMP objectives are to: (1) evaluate the effectiveness of the corrective action, (2) evaluate natural attenuation of the ground water VOC and tritium plumes, (3) monitor perchlorate and nitrate in ground water, and (4) evaluate the need for implementing contingency actions. To accomplish the CAMP objectives, ground water measurements from the monitoring wells shown in **Figure 3** are evaluated on a quarterly basis as direct by the CAMP sampling plan.

Several VOCs, tritium, and perchlorate were released to ground water from Pit 6 prior to its closure. The VOCs, primarily the solvents PCE and TCE, have been described and evaluated previously in the *Final Site-Wide Remedial Investigation Report, Lawrence Livermore National Laboratory Site 300* (Webster-Scholten 1994), the *Final Feasibility Study for the Pit 6 Operable Unit, Lawrence Livermore National Laboratory Site 300* (Devany *et al*. 1994), the *Addendum to the Pit 6 Engineering Evaluation/Cost Analysis, Lawrence Livermore National Laboratory, Site 300* (Berry 1996), the *Final Site-Wide Feasibility Study for Lawrence Livermore National Laboratory Site 300* (Ferry *et al*. 1999), and the *Interim Site-Wide Record of Decision for Lawrence Livermore National Laboratory Site 300* (DOE 2001).

Tritium activity is above the background activity in ground water downgradient from Pit 6, suggesting that a localized tritium release occurred prior to pit closure (Ferry *et al*. 1998). Monitored natural attenuation is the interim remedial action selected for the tritium plume.

Additional post-closure activities for Pit 6 include: (1) inspection of the landfill by LLNL technical staff annually and following major storms; (2) an annual comprehensive inspection of the landfill by an independent state-certified Professional Engineer (PE) usually in the third quarter; (3) an annual pit cap elevation survey; (4) repairs as necessary to maintain the integrity of the landfill cap, its water diversion system, and its network of monitoring wells; and (5) preparation of reports. Reports of post-closure activities are provided quarterly to the participating regulatory agencies for their information and use.

Quality Assurance

To ensure data quality, we work within the established Quality Assurance (QA) program of the LLNL Environmental Protection Department (EPD). We use protocols and procedures that cover all aspects of ground water sampling, sample tracking, and data management. These written protocols and procedures are contained in the *LLNL Livermore Site and Site 300 Environmental Restoration Project Standard Operating Procedures (SOPs)* (Dibley and Depue 2002), the *Environmental Monitoring Plan* (Woods *et al*. 2002), and the *EPD Quality Assurance Management Plan* (Merrigan 2001). Data quality is assessed by the following four methods: (1) analytical results for the routine and duplicate samples are compared by the analysts responsible for this report, (2) field blank samples are submitted to the analytical laboratories together with the routine ground water samples for identical analyses, (3) equipment blanks are prepared and analyzed to ensure that sampling equipment is properly cleaned before use, and (4) when samples are collected for volatile organic compound (VOC) analysis, a trip blank (prepared at the analytical laboratory) is carried into the field. A summary of QA results may be found in **Appendix E, Table E-1**.

DMP summary for 2004

COC measurements for the DMP wells are listed in **Appendix A**, **Table A-1**. Field measurements of ground water parameters and laboratory measurement of total dissolved solids (TDS) for the DMP wells are listed in **Appendix A**, **Table A-2**. Data collected during the fourth quarter of 2004 do not differ significantly from past quarters and do not contain evidence of a new release of COCs from Pit 6. A few COCs that were released to ground water from the landfill prior its closure in 1998 continued to be detected, including tritium and a few volatile organic compounds (VOCs) (**Table A-1**). Tritium activity continues to exceed the SL of 3.7 Bq/L (100 pCi/L) in ground water at downgradient DMP wells K6-19 (9.77 Bq/L [264 pCi/L]) and K6-01S (7.59 Bq/L [205 pCi/L]). More on the monitored natural attenuation of tritium may be found in the CAMP summary following.

As in the past, VOCs including cis-1,2-dichloroethene (cis-1,2-DCE), tetrachloroethene (PCE), and trichloroethene (TCE) were detected in one or more DMP wells at K6-01S, K6-19, EP6-08, and EP6-09 (**Table A-1**). The detectible concentrations, however, were all below their respective SLs. Historical values of TCE at monitoring wells K6-19 and EP6-09 have been plotted in **Figure 4**. These wells have had higher concentrations of TCE in the past, but a decreasing trend may be observed in the data. In particular, since TCE concentrations in well K-19 dropped below the SL (13 μg/L) in 1994, the SL has not been exceeded again and TCE concentrations continue to decline in this well.

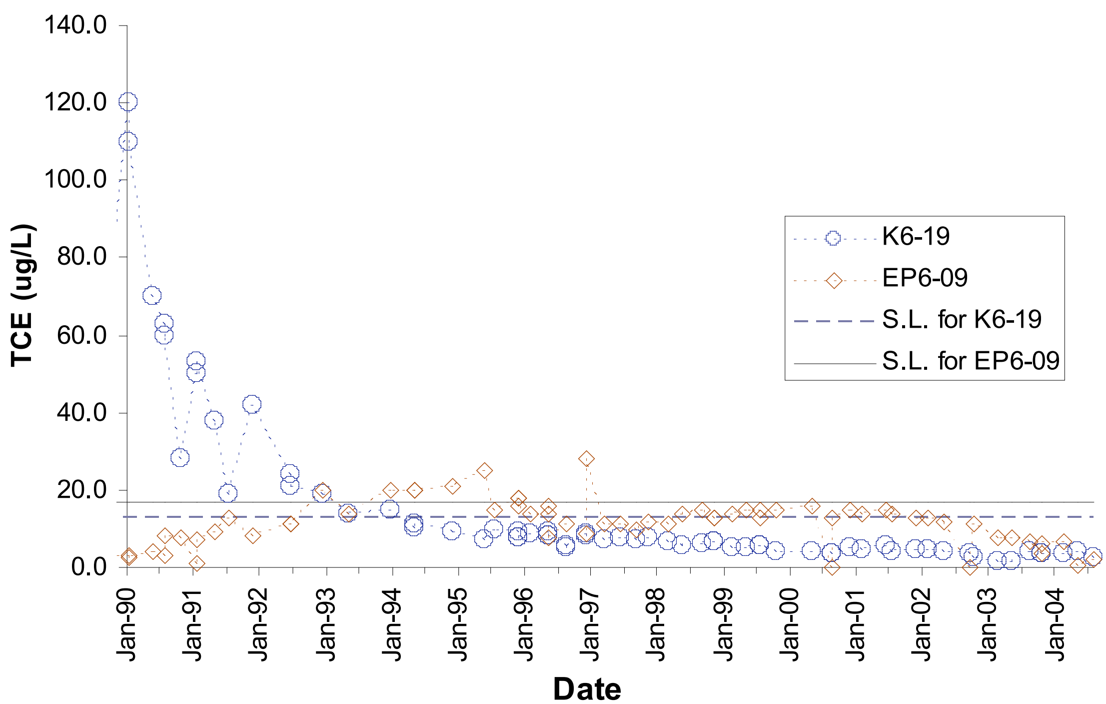

Figure 4. Historical ground water trichloroethene (TCE) concentrations (μg/L) in selected monitoring wells at Site 300 Pit 6.

Historically, the most elevated perchlorate concentrations at Pit 6 were observed at DMP monitoring well K6-19. Perchlorate concentrations measured at this well and K6-36 since the year 2000, are presented in **Figure 5**. Since 2002 perchlorate concentrations at well K6-19 have fallen below the statistical limit (SL = 27.5 µg/L). For monitoring well K6-36, perchlorate concentrations have not exceeded the SL (14.4 µg/L). The limit of sensitivity (LOS) values is also plotted in the figure to define the limits of the analytical techniques. Data from other DMP monitoring wells (EP6-06, EP6-08, EP6-09, and K6-01S) have not revealed more than occasional detections of perchlorate above the LOS. No new releases of perchlorate from Pit 6 are revealed by these data.

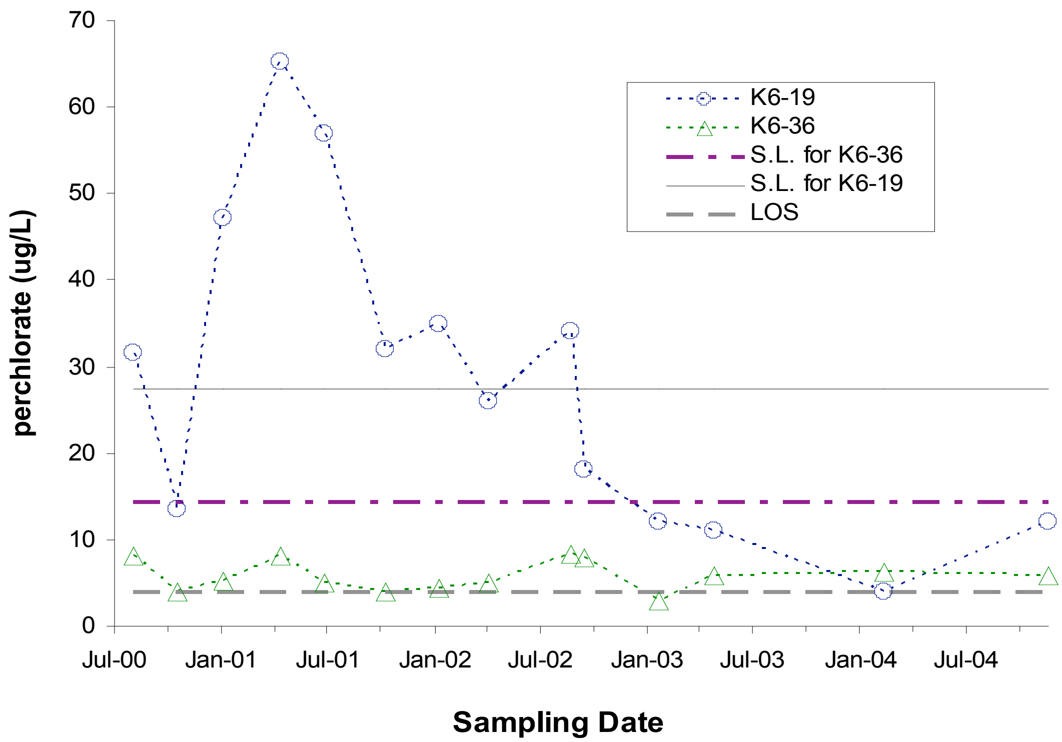

Figure 5. Historical ground water perchlorate concentrations (µg/L) in selected monitoring wells at Site 300 Pit 6.

Total uranium activities remained consistent in ground water samples collected from DMP wells throughout 2004 and ranged from 0.03 Bq/L (0.81 pCi/L) in well EP6-06 (1st quarter) to 0.16 Bq/L (4.32 pCi/L) in well K6-01S (2nd quarter). During the fourth quarter 2004 uranium activities detected in DMP well ground water samples were below the statistical limit, except for K6-36 (0.07 Bq/L, SL=0.05 Bq/L), and all results were below the MCL for total uranium (0.74 Bq/L [20 pCi/L]). The isotopic $^{235}U/^{238}U$ mass ratio of 0.007 for samples collected from DMP wells is indicative of natural uranium.

CAMP summary for 2004

This section contains a summary evaluation of ground water elevation data and ground water COC data collected for the CAMP during the fourth quarter of 2004. The primary COCs for the Pit 6 area are several VOCs and tritium (Ferry *et al*. 1998). Perchlorate and nitrate were subsequently detected at concentrations above the MCL in ground water samples from several Pit 6 monitoring wells during site-wide investigations by LLNL. Perchlorate was designated a secondary COC in 2000. Beginning in 2003, nitrate also became a secondary COC, and its occurrence in the ground water is discussed below. Ground water elevations for the fourth quarter of 2004 are listed in **Table B-1**. Detections of VOCs, tritium, perchlorate, and nitrate during the fourth quarter are listed in **Tables B-2, B-3,** and **B-4**, respectively.

Ground water elevations (GWE). **Figure 6** is a GWE contour map or potentiometric surface map for the fourth quarter of 2004. Ground water elevations beneath Pit 6 are approximately 10 m (33 ft) below the buried waste trenches. During the three-month period between the third and fourth quarter measurements, GWEs north of the fault zone rose an average of 0.3 m (1.0 ft), while GWEs within the fault zone remained relatively stale.

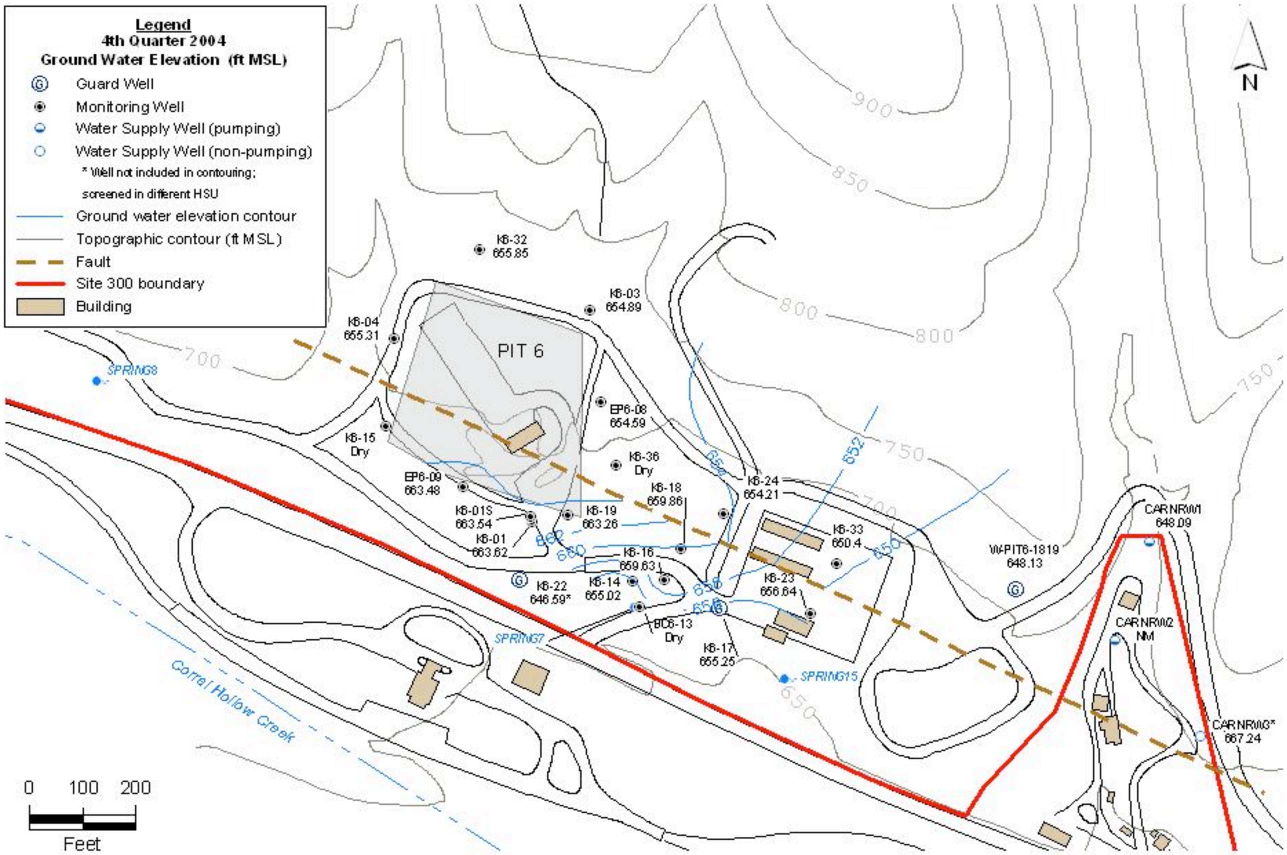

Figure 6. Ground water potentiometric surface map (ft) for the first water-bearing zone at Site 300 Pit 6, fourth quarter 2004.

Figure 6 is consistent with previous potentiometric surface maps, in that the general ground water flow gradient is to the southeast. South of the fault zone, ground water flows to the south and southeast with a hydraulic gradient of approximately 0.03, whereas ground water north of the fault flows to the southwest with a hydraulic gradient of 0.007. Fractures in the Neroly formation $Tnbs_1$ unit play a dominant role in ground water flow.

Special GWE monitoring of several key wells between Pit 6 and the water supply wells CARNRW1 and CARNRW2 was initiated in 2000. This monitoring continued into the fourth quarter of 2004. Analysis of the data obtained indicates that GWEs north of the fault zone are strongly influenced by pumping from the two supply wells, whereas GWEs in wells within the fault zone to the south do not appear to be significantly influenced.

Ground water TVOC concentrations (Figure 7). In previous Compliance Monitoring Program reports for the Pit 6 Landfill, maps have been presented for TCE only. Starting with this report, a new format for presenting CAMP VOC data will be used to maintain consistency with the CERCLA Compliance Monitoring Report. As shown in **Figure 7**, the concentrations of all VOCs detected in ground water monitor wells in the Pit 6 area have been summed and are presented as Total VOCs (TVOCs). The concentrations of individual compounds contributing to the TVOC concentration in each well are included in **Appendix B**, **Table B-2**. TCE, PCE, and cis-1,2-DCE were the only VOCs detected in ground water at concentrations above the method reporting limit of 0.5 in the Pit 6 Landfill monitoring well during the fourth quarter 2004.

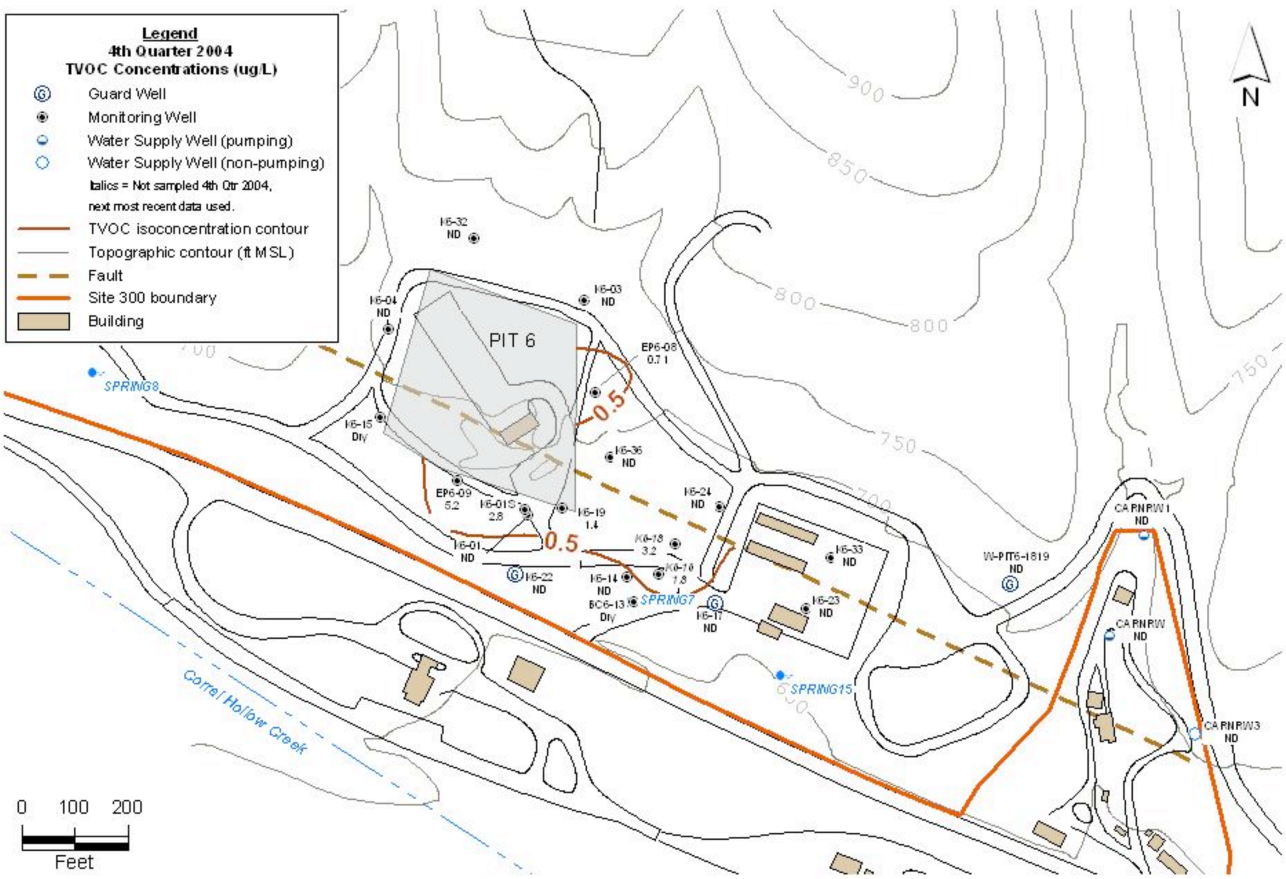

Figure 7. Ground water TVOC concentrations (μg/L) in the first water-bearing zone at Site 300 Pit 6, fourth quarter 2004 or the most recent sample collected in 2004.

The distribution of VOCs in ground water during the fourth quarter 2004 or most recent data are shown in **Figure 7**. TCE was detected in ground water samples from six wells in 2004 with concentrations ranging from 0.6 μg/L in well K6-17 to 5.4 μg/L in well EP6-09. Overall, TCE concentrations generally decreased in all six wells during the year. In the fourth quarter 2004, TCE was detected in a ground water sample from only one well, EP6-09, at a concentration (5.2 μg/L) that exceeded the 5 μg/L MCL for TCE. PCE was detected in ground water samples from two wells in 2004 with concentrations ranging from 0.7 μg/L in well EP6-08 to 1.0 in well K6-36. During 2004, PCE concentrations remained fairly stable and well below the 5 μg/L MCL for PCE. Cis-1,2-DCE was detected in ground water samples from two wells in 2004 with concentrations ranging from 0.5 μg/L in well K6-01 to 2.8 μg/L in well K6-01S and remained well below the 6 μg/L MCL for cis-1,2-DCE. The cis-1,2-DCE detected in ground water is likely a product of the natural degradation of TCE.

Based on the DMP and CAMP data, the VOC plume presented in **Figure 7** appears to be relatively stable with slight decreases in contaminant concentrations and there is no indication of new releases of VOCs from the Pit 6 Landfill.

Bromoform, bromodichloroform, and chloroform were detected in samples collected from CARNRW-2, a water-supply well for the Carnegie State Vehicular Recreation Area park. These constituents were not detected in ground water samples from any upgradient monitor wells. The total trihalomethane concentration was 13.6 μg/L, well below the MCL of 80 μg/L. It is likely that these trihalomethanes detected in the well are the result of laboratory error, backflow of chlorinated water from the Carnegie chlorination system into the well, and/or direct chlorination of the well water by Carnegie Park staff.

Ground water tritium activity. **Figure 8** shows the areal distribution of tritium activity in ground water for the fourth quarter of 2004. During this period, tritium activity in excess of the 3.7 Bq/L (100 pCi/L) detection limit was found in ground water samples from well K6-36, K6-24, K6-33, and W-Pit6-1819 north of the fault zone, and wells K6-01S, K6-01, K6-14, K6-16, K6-18, K6-19, located within the fault zone. The highest tritium activity this quarter was measured in the ground water at well K6-36 north of the fault at an activity of 62.2 Bq/L (1680 pCi/L). The ground water tritium activity at well K6-36 was 61.4 Bq/L (1660 pCi/L) during the first quarter of 2004, but the well was dry during the second and third quarters of 2004. Tritium activities in samples from this well have decreased form an historical maximum of 126.5 Bq/L (3,420 pCi/L) in 2003.

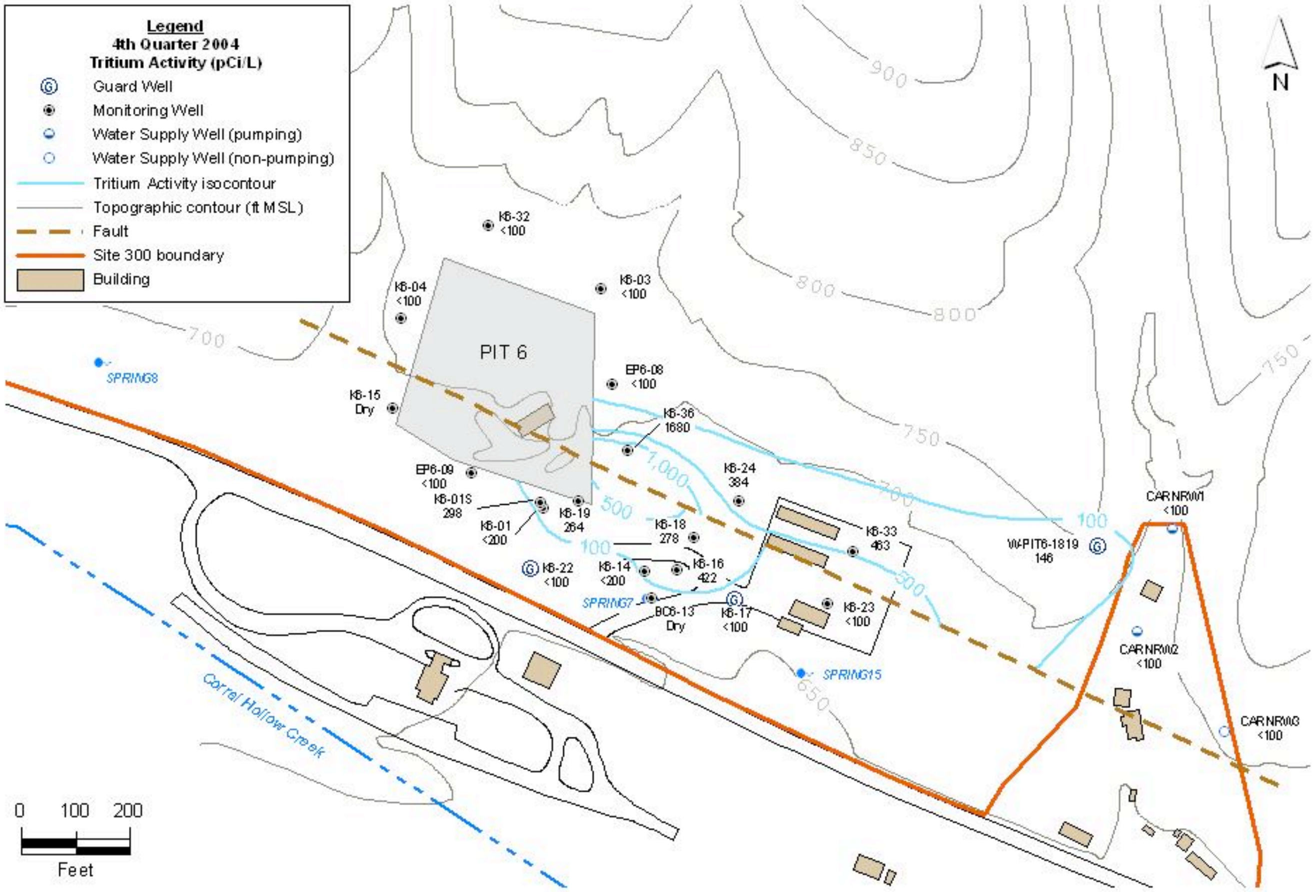

Figure 8. Ground water tritium activities (pCi/L) in the first water-bearing zone at Site 300 Pit 6, fourth quarter 2004 or the most recent sample collected in 2004.

Well W-Pit6-1819 is a guard well and is used to define the down gradient extent of the tritium plume. It is located about 30 m (100 ft) west of the Site 300 boundary with the Carnegie SVRA residence area and about 60 m (200 ft) west of the CARNRW1 and CARNRW2 water-supply wells (**Figure 6**). During 2004, tritium activities in ground water samples collected from well W-Pit6-1819 ranged from 8.9 Bq/L (240 pCi/L) in April 2004 to 5.4 Bq/L (146 pCi/L) in October 2004.

During 2004, tritium activities in samples from offsite CARNRW wells remained around 3.7 Bq/L (100 pCi/L), consistent with historical tritium activities detected in these wells with one exception. As shown in **Table B-3**, tritium was detected at anomalously high levels in samples collected from wells CARNRW-1 (31.9 Bq/L [862 pCi/L]), CARNRW-2 (31.5 Bq/L [852 pCi/L]), CARNRW-3 (17.8 Bq/L [480 pCi/L]), and CARNRW-4 (17.1 Bq/L [463 pCi/L]) in October 2004. The samples from wells CARNRWs 1-4 were all sampled and analyzed on the same days and the activities reported for samples collected on this date are incongruous with both historical data for these wells and with tritium data from upgradient monitor wells during the fourth quarter 2004. In addition, CARNRW-4 is located cross-gradient from the Pit 6 Landfill and over 1,500 ft from CARNRW-1, -2, and -3. During the fourth quarter of 2004, no significant changes were observed in: 1) the operations of the CARNRW wells, 2) tritium activities in the upgradient guard well W-Pit6-1819, or 3) any of the plume monitor wells, that would indicate dramatic changes in tritium activities or movement in ground water. Tritium activities slightly above the background were also observed at monitoring wells CARNRW1 and CARNRW2 on November 10, 2004, however, these values are low and relatively indistinguishable from the limits of detection. Tritium data from samples collected from the CARNRW wells in subsequent months returned to levels that are consistent with previous data for these wells. For these reasons, it appears that the high tritium activities detected in the CARNRW wells in October 2004 are an artifact of laboratory contamination. We will continue to closely monitor tritium activities in these wells.

Ground water perchlorate concentrations. A map showing the ground water monitoring well locations and perchlorate concentrations in samples collected from these wells during 2004 is presented in **Figure 9**. Because well sampling and analysis for secondary COCs, including perchlorate, is limited in the fourth quarter, perchlorate data collected during the most recent previous quarter in 2004 is shown for wells not sampled during the fourth quarter. In 2004, perchlorate was detected in samples from only two wells, K6-18 and K6-36, at concentrations above the Public Health Goal of 6 μg/L. As shown in **Table B-4**, by the fourth quarter of 2004, perchlorate concentrations in samples from well K6-36 dropped below 6 μg/L. Although perchlorate has been consistently detected in samples from well K6-18, concentrations have continued to decrease from a maximum historical concentration of 19 μg/L in 2001 to 12 μg/L in the fourth quarter of 2004.

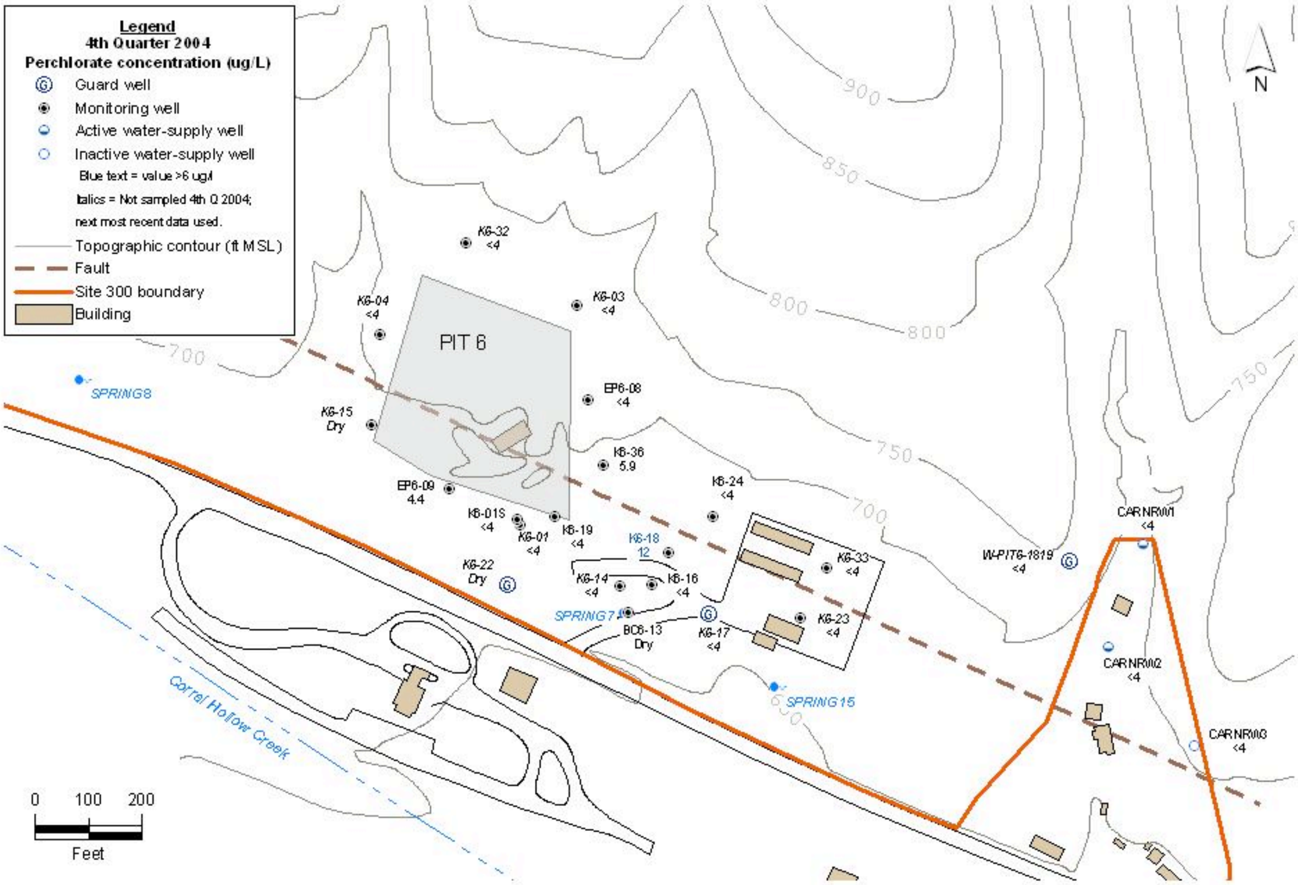

Figure 9. Ground water perchlorate concentrations (μg/L) in the first water-bearing zone at Site 300 Pit 6, fourth quarter 2004 or the most recent sample collected in 2004.

Ground water nitrate concentrations. A map showing the ground water monitoring well locations and nitrate concentrations in samples collected from these wells during 2004 is presented in **Figure 10**. Because well sampling and analysis for secondary COCs, including nitrate, is limited in the fourth quarter, nitrate data collected during the most recent previous quarter in 2004 is shown for wells not sampled during the fourth quarter. In 2004, nitrate was detected in samples from only one well, K6-23, at concentrations above the 45 mg/L MCL. Well K6-23 is located near the septic system for Building 899B. The elevated nitrate levels detected in ground water from this well are likely related to septic system discharge rather than from the Pit 6 Landfill. Nitrate was not detected at concentrations above the MCL in samples from any of the 8 wells sampled during the fourth quarter of 2004.

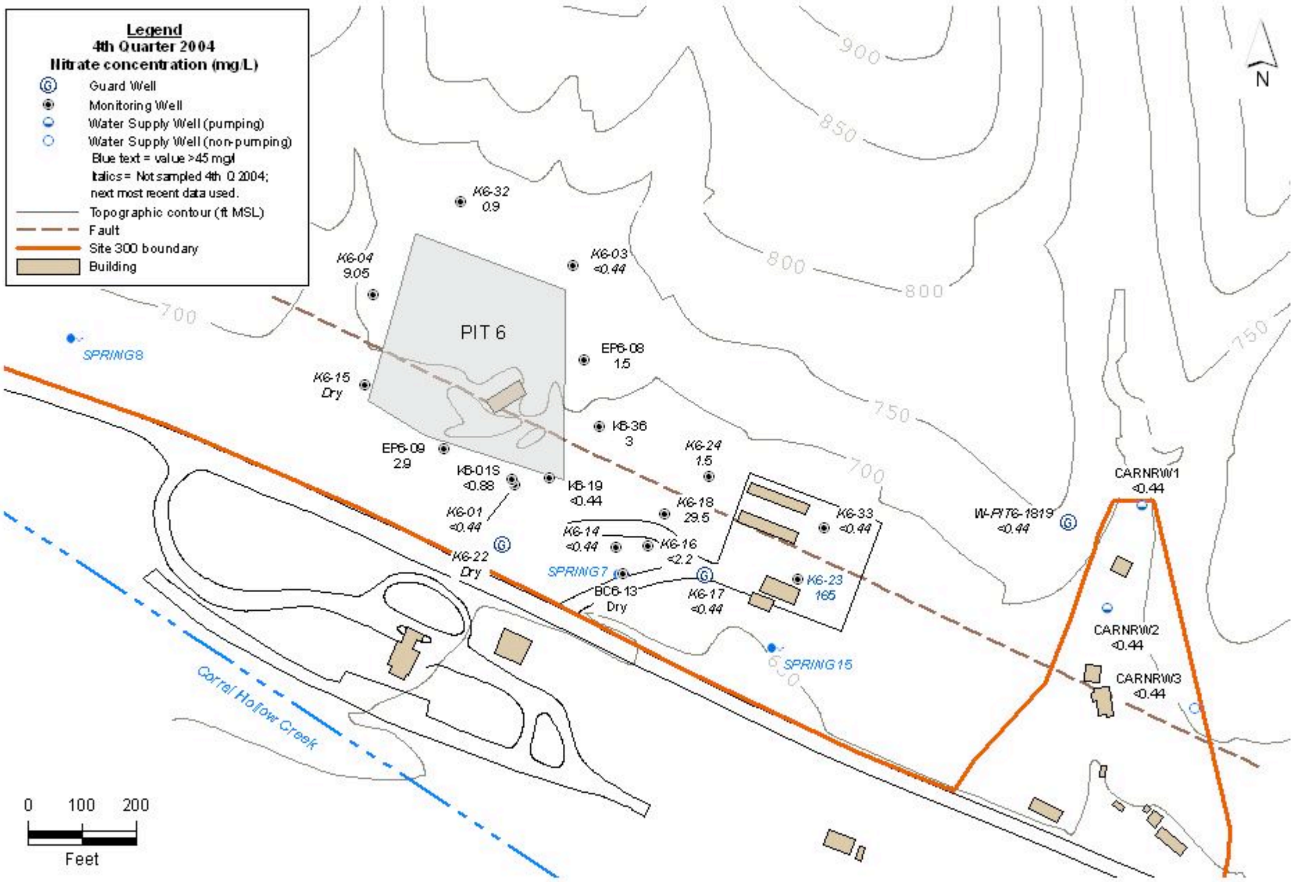

Figure 10. Ground water nitrate concentrations (mg/L) in the first water-bearing zone at Site 300 Pit 6, fourth quarter 2004 or the most recent sample collected in 2004.

Inspection and maintenance summary

The annual Pit 6 inspection was conducted on August 4, 2004, by an independent, state-registered PE. A copy of the PE's inspection report was appended to the third quarter report for 2004 (Campbell and Blake 2004). The PE reviewed existing documentation regarding the closed landfill and conducted a visual inspection of it. There were no significant findings. The PE found the pit cap to be fully intact, with vegetation in very good condition and the drainage system functioning properly. No settlement or subsidence was observed. The PE noted minor deficiencies and recommended corrective maintenance in the channels for vegetation and minor cracking, monitoring and filling of rodent burrows, and continued monitoring for cracking, erosion, and settlement. All the required maintenance was completed by

November 9, 2004. The fourth quarter visual inspection performed by LLNL on November 22, 2004 identified no deficiencies requiring additional maintenance.

An elevation survey to detect any subsidence of the pit cover was completed in September 2004. LLNL surveyors measured the elevations of numerous fixed markers that had been installed on the pit cover in 1998. Tables comparing the marker elevations for surveys made in 1998 and 2004 were provided in the third quarter report for 2004 (Campbell and Blake 2004). A comparison of the year 2004 marker elevations with their baseline elevations established in 1998 shows a maximum marker elevation change during the six year interval of 0.018 m (0.06 ft) and -0.024 m (-0.08 ft). It is unlikely that these small elevation changes have adversely affected the integrity of the pit cover.

Effectiveness of the corrective action

The corrective action implemented for the landfill Pit 6 is discussed in the *Interim Site-Wide Record of Decision for Lawrence Livermore National Laboratory Site 300* (DOE 2001). An impermeable cap was constructed over the landfill in 1997 to prevent any surface water from infiltrating and contacting buried waste. It was also engineered to prevent volatilization and escape to the atmosphere of organic compounds buried in the landfill. Visual inspections and an elevation survey conducted during 2004 indicate that the cap is sound. Ground water levels continued to fall beneath the closed landfill during 2004 and are in excess of 8 m (about 26 ft) from the soil surface in the DMP monitoring wells. No new releases of COCs from the closed landfill during 2004 are indicated. Concentration/activities of COCs in ground water show generally low or decreasing trends over time. VOCs, nitrate, and perchlorate concentrations currently exceed the drinking water MCLs and Public Health Goals (for perchlorate) in only one well each. Tritium activities in ground water continue to be below the MCL. Thus, the corrective action taken continues to be effective.

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Abbreviations and acronyms

Bq	becquerel (international unit of radioactivity equal to 27 pCi)
CAMP	Corrective Action Monitoring Program
CC	control chart (statistical method)
CCR	California Code of Regulations
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Cis-1,2-DCE	Cis-1,2-dichloroethene
CL	Concentration limit (background concentration of a chemical)
COC	constituent of concern
CVRWQCB	Central Valley Regional Water Quality Control Board
DEHP	di(2-ethylhexyl)phthalate, bis(2-ethylhexyl)phthalate
DMP	Detection Monitoring Program
DOE	U.S. Department of Energy
DTSC	California Department of Toxic Substances Control
EPA	U.S. Environmental Protection Agency
EPD	LLNL Environmental Protection Department
ERD	LLNL Environmental Restoration Division
ft	foot (used as a measure of elevation above MSL)
GWD	ground water depth
GWE	ground water elevation in feet above MSL
km	Kilometer
L	Liter
LLNL	Lawrence Livermore National Laboratory
m	Meter
MCL	Maximum contaminant level (for drinking water)
MSL	mean sea level (datum for elevation measurements)
mg	Milligram
μg	Microgram
nd	none detected
PCB	polychlorinated biphenyl
PCE	perchloroethene, tetrachloroethene
pCi	picocurie (unit of radioactivity)
PE	Professional Engineer
PI	Prediction interval (statistical method)

QA	quality assurance
RL	reporting limit (contractual concentration near zero)
RPM	Remedial Project Manager
Site 300	Experimental Test Facility, LLNL
SL	statistically determined concentration limit
SOP	standard operating procedure
TCE	Trichloroethene
TDS	total dissolved solids
THM	trihalomethane
Tnbs1	Neroly Formation lower blue sandstone unit
TVOC	Total Volatile Organic Compound
VOC	volatile organic compound
yr	Year

Appendix A

Tables of Ground Water Measurements

and Chemical Data

for Detection Monitoring Wells

Table A-1. Pit 6 post-closure monitoring plan constituents of concern (COCs), detection monitoring wells, SLs, MCLs, and quarterly analytical results for 2004.

				Quarter			
COC (units)	**Well**	**SL**	**MCL**	**First**	**Second**	**Third**	**Fourth**
Metals (μg/L)							
Beryllium	EP6-06	0.2	4	< 0.2	< 0.2	< 0.2	< 0.2
	EP6-08	0.2		< 0.2	< 0.2	< 0.2	< 0.2
	EP6-09	0.2		< 0.2	< 0.2	< 0.2	< 0.2
	K6-01S	0.2		< 0.2	< 0.2	< 0.2	< 0.2
	K6-19	0.2		< 0.2	< 0.2	< 0.2	< 0.2
	K6-36	0.2		< 0.2	dry	dry	NA
Mercury	EP6-06	0.2	2	< 0.2	< 0.2	< 0.2	< 0.2
	EP6-08	0.2		< 0.2	< 0.2	< 0.2	< 0.2
	EP6-09	0.2		< 0.2	< 0.2	< 0.2	< 0.2
	K6-01S	0.2		< 0.2	< 0.2	< 0.4	< 0.2
	K6-19	0.2		< 0.2	< 0.2	< 0.2	< 0.2
	K6-36	0.2		< 0.2	dry	dry	< 0.2
Radioactivity (Bq/L)							
Tritium	EP6-06	3.7	740	– 1.2	– 1.3	– 0.1	– 1.6
	EP6-08	3.7		1.3	– 1.9	– 1.4	0.0
	EP6-09	3.7		– 0.1	– 1.0	0.1	– 0.2
	K6-01S	3.7		3.6	7.3	11.0	7.6
	K6-19	3.7		9.9	11.0	7.8	9.8
	K6-36	88		61	dry	dry	62.2
Uranium (total)	EP6-06	0.13	0.74	0.03	0.03	0.14	0.05
	EP6-08	0.06		0.04	0.059	0.05	0.02
	EP6-09	0.14		0.08	0.09	0.08	0.08
	K6-01S	1.00		0.13	0.16	0.14	0.15
	K6-19	0.27		0.12	0.11	0.12	0.12
	K6-36	0.05		0.08	dry	dry	0.07
Gross alpha	EP6-06	0.29	0.56	0.04	0.06	0.15	0.01
	EP6-08	0.15		0.01	0.05	0.03	– 0.06
	EP6-09	0.18		0.11	0.06	0.02	0.03
	K6-01S	0.95		0.10	0.08	0.08	0.02
	K6-19	0.34		0.10	0.07	0.03	– 0.02
	K6-36	0.07		0.03	dry	dry	– 0.13
Gross beta	EP6-06	0.79	1.85	0.22	0.28	0.39	0.28
	EP6-08	0.79		0.35	0.36	0.41	0.32
	EP6-09	0.79		0.41	0.41	0.50	0.40
	K6-01S	2.13		0.61	0.35	0.63	0.60
	K6-19	0.79		0.33	0.35	0.40	0.30
	K6-36	0.97		0.39	dry	dry	0.26
Volatile organic compounds (μg/L, EPA method 601 or 624)							
Benzene	EP6-06	0.5	1	< 0.5	< 0.5	< 0.5	< 0.5
	EP6-08	0.5		< 0.5	< 0.5	< 0.5	< 0.5
	EP6-09	0.5		< 0.5	< 0.5	< 0.5	< 0.5
	K6-01S	0.5		< 0.5	< 0.5	< 0.5	< 0.5
	K6-19	0.5		< 0.5	< 0.5	< 0.5	< 0.5
	K6-36	0.5		< 0.5	dry	dry	< 0.5
Carbon disulfide	EP6-06	5	none	< 1	< 1	< 0.5	< 1
	EP6-08	5		< 1	< 1	< 0.5	< 1
	EP6-09	5		< 1	< 1	< 0.5	< 1
	K6-01S	5		< 1	< 1	< 0.5	< 1
	K6-19	5		< 1	< 1	< 0.5	< 1
	K6-36	5		< 1	dry	dry	< 1
Chloroform	EP6-06	0.5	100	< 0.5	< 0.5	< 1	< 0.5
	EP6-08	1.0		< 0.5	< 0.5	< 1	< 0.5
	EP6-09	0.5		< 0.5	< 0.5	< 1	< 0.5

Table A-1. Pit 6 post-closure monitoring plan constituents of concern (COCs), detection monitoring wells, SLs, MCLs, and quarterly analytical results for 2004.

COC (units)	Well	SL	MCL	Quarter First	Second	Third	Fourth
	K6-01S	0.5		< 0.5	< 0.5	< 1	< 0.5
	K6-19	1.5		< 0.5	< 0.5	< 1	< 0.5
	K6-36	0.5		< 0.5	dry	dry	< 0.5
1,2-dichloroethane	EP6-06	0.5	0.5	< 0.5	< 0.5	< 0.5	< 0.5
	EP6-08	0.5		< 0.5	< 0.5	< 0.5	< 0.5
	EP6-09	0.5		< 0.5	< 0.5	< 0.5	< 0.5
	K6-01S	0.5		< 0.5	< 0.5	< 0.5	< 0.5
	K6-19	0.5		< 0.5	< 0.5	< 0.5	< 0.5
	K6-36	0.5		< 0.5	dry	dry	< 0.5
Cis-1,2-dichloroethene	EP6-06	0.5	6	< 0.5	< 0.5	< 0.5	< 0.5
	EP6-08	0.5		< 0.5	< 0.5	< 0.5	< 0.5
	EP6-09	0.5		< 0.5	< 0.5	< 0.5	< 0.5
	K6-01S	7.0		2.3	2.6	2.0	2.8
	K6-19	0.5		< 0.5	< 0.5	< 0.5	< 0.5
	K6-36	0.5		< 0.5	dry	dry	< 0.5
Ethyl benzene	EP6-06	0.5	700	< 0.5	< 0.5	ns	< 0.5
	EP6-08	0.5		< 0.5	< 0.5	ns	< 0.5
	EP6-09	0.5		< 0.5	< 0.5	ns	< 0.5
	K6-01S	0.5		< 0.5	< 0.5	ns	< 0.5
	K6-19	0.5		< 0.5	< 0.5	ns	< 0.5
	K6-36	0.5		< 0.5	dry	ns	< 0.5
Methylene chloride	EP6-06	1	5	< 1	< 1	< 1	< 1
	EP6-08	1		< 1	< 1	< 1	< 1
	EP6-09	1		< 1	< 1	< 1	< 1
	K6-01S	1		< 1	< 1	< 1	< 1
	K6-19	1		< 1	< 1	< 1	< 1
	K6-36	1		< 1	dry	dry	< 1
Tetrachloroethene (PCE)	EP6-06	0.5	5	< 0.5	< 0.5	< 0.5	< 0.5
	EP6-08	1.6		0.7	0.9	0.7	0.65
	EP6-09	0.5		< 0.5	< 0.5	< 0.5	< 0.5
	K6-01S	0.5		< 0.5	< 0.5	< 0.5	< 0.5
	K6-19	0.5		< 0.5	< 0.5	< 0.5	< 0.5
	K6-36	1.0		1.0	dry	dry	< 0.5
Toluene	EP6-06	0.5	150	< 0.5	< 0.5	< 0.5	< 0.5
	EP6-08	0.5		< 0.5	< 0.5	< 0.5	< 0.5
	EP6-09	0.5		< 0.5	< 0.5	< 0.5	< 0.5
	K6-01S	0.5		< 0.5	< 0.5	< 0.5	< 0.5
	K6-19	0.5		< 0.5	< 0.5	< 0.5	< 0.5
	K6-36	0.5		< 0.5	dry	dry	< 0.5
1,1,1-trichloroethane	EP6-06	0.5	200	< 0.5	< 0.5	< 0.5	< 0.5
	EP6-08	0.5		< 0.5	< 0.5	< 0.5	< 0.5
	EP6-09	0.5		< 0.5	< 0.5	< 0.5	< 0.5
	K6-01S	0.5		< 0.5	< 0.5	< 0.5	< 0.5
	K6-19	0.5		< 0.5	< 0.5	< 0.5	< 0.5
	K6-36	0.5		< 0.5	dry	dry	< 0.5
Trichloroethene (TCE)	EP6-06	0.5	5	< 0.5	< 0.5	< 0.5	< 0.5
	EP6-08	0.5		< 0.5	< 0.5	< 0.5	< 0.5
	EP6-09	17		5.4	5.2	5.1	5.2
	K6-01S	1.5		< 0.5	< 0.5	< 0.5	< 0.5
	K6-19	13		3.5	4.1	2.8	1.4
	K6-36	2.1		1.3	dry	dry	< 0.5
Xylenes (total)	EP6-06	1	1750	< 1	< 1	< 1	< 1
	EP6-08	1		< 1	< 1	< 1	< 1
	EP6-09	1		< 1	< 1	< 1	< 1

Table A-1. Pit 6 post-closure monitoring plan constituents of concern (COCs), detection monitoring wells, SLs, MCLs, and quarterly analytical results for 2004.

				Quarter			
COC (units)	**Well**	**SL**	**MCL**	**First**	**Second**	**Third**	**Fourth**
	K6-01S	1		< 1	< 1	< 1	< 1
	K6-19	1		< 1	< 1	< 1	< 1
	K6-36	1		< 1	dry	dry	< 1
Perchlorate (μg/L)	EP6-06	4.7	6 [a]	< 4	< 4	< 4	< 4
	EP6-08	4		< 4	< 4	< 4	< 4
	EP6-09	4		4.5	< 4	4.4	4.4
	K6-01S	4		< 4	< 4	< 4	< 4
	K6-19	27.5		< 4	< 4	< 4	< 4
	K6-36	14.4		6.2	dry	dry	5.9

(a) California state action level.

Concluded

ns - not sampled 3rd quarter

Table A-2. Pit 6 ground water physical parameters for DMP wells sampled fourth quarter 2004.

Well	Date sampled	GWD (ft)	GWE (ft)	Temp. (Degrees C)	pH (pH units)	Conductivity (umhos/cm)	TDS (mg/L)
EP6-06	13-Dec-04	28.38	659.35	20.7	7.48	1320	873
EP6-06	20-Dec-04	42.91	645.17	18.5	7.42	1304	--
EP6-08	14-Dec-04	51.03	657.38	19.1	7.42	1107	720
EP6-09	15-Dec-04	30.78	663.50	21.1	7.81	1456	950
K6-01S	29-Nov-04	29.03	663.49	21	7.25	3390	2370
K6-19	9-Dec-04	29.73	663.31	21.5	7.56	1154	773
K6-36	16-Dec-04	32.83	657.17	21.6	8.12	1071	690

Appendix B

Tables of Ground Water Measurements

and Chemical Data

for Corrective Action Monitoring Wells

Table B-1. Pit 6 ground water elevations (GWE) during 2004.

Well	Date Sampled	Elevation (ft)
BC6-10	01/12/04	660.4
BC6-10	04/05/04	660.0
BC6-10	07/08/04	660.3
BC6-10	10/05/04	659.8
BC6-13	01/12/04	DRY
BC6-13	04/05/04	DRY
BC6-13	07/08/04	DRY
BC6-13	10/05/04	DRY
CARNRW1	01/12/04	652.7
CARNRW1	04/05/04	646.7
CARNRW1	07/14/04	646.3
CARNRW1	10/04/04	648.1
CARNRW1	10/25/04	649.8
CARNRW3	01/07/04	670.0
CARNRW3	04/05/04	667.0
CARNRW3	07/14/04	666.0
CARNRW3	10/04/04	667.2
CARNRW4	01/05/04	638.8
CARNRW4	04/05/04	645.8
CARNRW4	07/01/04	641.6
CARNRW4	10/04/04	637.8
EP6-06	02/18/04	661.0
EP6-06	06/01/04	660.0
EP6-06	01/12/04	660.5
EP6-06	04/05/04	658.3
EP6-06	07/08/04	655.3
EP6-06	08/19/04	658.6
EP6-06	08/25/04	646.8
EP6-06	10/05/04	656.3
EP6-06	12/13/04	659.3
EP6-06	12/20/04	645.2
EP6-07	01/12/04	655.8
EP6-07	04/05/04	654.3
EP6-07	07/13/04	653.3
EP6-07	10/05/04	654.9
EP6-08	03/10/04	658.3
EP6-08	04/29/04	653.5
EP6-08	05/06/04	653.8
EP6-08	06/01/04	653.4
EP6-08	01/12/04	655.6
EP6-08	04/05/04	653.8
EP6-08	07/13/04	653.3
EP6-08	08/19/04	654.3
EP6-08	10/05/04	654.6
EP6-08	12/14/04	657.4
EP6-09	02/18/04	663.2
EP6-09	06/01/04	663.3
EP6-09	01/12/04	663.0
EP6-09	04/05/04	663.2

Table B-1. Pit 6 ground water elevations (GWE) during 2004.

Well	Date Sampled	Elevation (ft)
EP6-09	07/08/04	663.5
EP6-09	08/19/04	653.5
EP6-09	10/05/04	663.5
EP6-09	12/15/04	663.5
K6-01	01/12/04	663.2
K6-01	04/05/04	663.3
K6-01	07/08/04	663.5
K6-01	10/05/04	663.6
K6-01S	02/18/04	663.1
K6-01S	05/06/04	663.3
K6-01S	01/12/04	663.0
K6-01S	04/05/04	663.1
K6-01S	07/08/04	663.4
K6-01S	08/24/04	663.4
K6-01S	10/05/04	663.5
K6-01S	11/29/04	663.5
K6-03	01/12/04	655.8
K6-03	04/01/04	657.0
K6-03	07/13/04	653.3
K6-03	10/05/04	654.9
K6-04	01/12/04	656.0
K6-04	04/01/04	657.7
K6-04	07/13/04	654.2
K6-04	10/05/04	655.3
K6-14	01/12/04	654.3
K6-14	04/05/04	657.4
K6-14	07/08/04	656.0
K6-14	10/05/04	655.0
K6-15	01/12/04	DRY
K6-15	04/05/04	DRY
K6-15	07/08/04	DRY
K6-15	10/05/04	DRY
K6-16	01/12/04	660.3
K6-16	04/05/04	660.7
K6-16	07/08/04	660.0
K6-16	10/05/04	659.6
K6-17	01/12/04	659.2
K6-17	04/05/04	660.2
K6-17	07/08/04	658.0
K6-17	10/05/04	655.3
K6-18	01/12/04	660.0
K6-18	04/05/04	660.1
K6-18	07/13/04	659.9
K6-18	10/06/04	659.9
K6-19	02/23/04	662.8
K6-19	05/06/04	663.3
K6-19	01/12/04	662.6
K6-19	04/05/04	663.1
K6-19	07/08/04	663.3

Table B-1. Pit 6 ground water elevations (GWE) during 2004.

Well	Date Sampled	Elevation (ft)
K6-19	10/05/04	663.3
K6-19	12/09/04	663.3
K6-21	01/12/04	DRY
K6-21	04/05/04	DRY
K6-21	07/08/04	DRY
K6-21	10/05/04	DRY
K6-22	01/12/04	647.3
K6-22	04/05/04	DRY
K6-22	07/08/04	681.5
K6-22	10/05/04	646.6
K6-23	01/12/04	657.4
K6-23	04/01/04	657.6
K6-23	07/08/04	657.0
K6-23	10/06/04	656.6
K6-24	01/12/04	655.2
K6-24	04/05/04	653.3
K6-24	07/13/04	652.7
K6-24	10/06/04	654.2
K6-25	01/12/04	660.2
K6-25	04/05/04	660.5
K6-25	07/13/04	660.0
K6-25	10/05/04	659.6
K6-26	01/12/04	655.5
K6-26	04/05/04	653.7
K6-26	07/13/04	652.9
K6-26	10/06/04	654.5
K6-27	01/12/04	654.5
K6-27	04/05/04	652.4
K6-27	07/13/04	651.5
K6-27	10/06/04	653.5
K6-32	01/15/04	656.6
K6-32	04/05/04	658.1
K6-32	07/13/04	654.7
K6-32	10/06/04	655.9
K6-33	01/15/04	652.0
K6-33	04/01/04	652.1
K6-33	07/08/04	648.5
K6-33	10/06/04	650.4
K6-34	01/15/04	650.6
K6-34	04/01/04	652.3
K6-34	07/08/04	649.0
K6-34	10/05/04	648.9
K6-35	01/12/04	656.7
K6-35	04/05/04	655.0
K6-35	07/13/04	654.1
K6-35	10/05/04	655.7
K6-36	03/10/04	657.9
K6-36	01/15/04	DRY/CB
K6-36	04/05/04	DRY/CB

Table B-1. Pit 6 ground water elevations (GWE) during 2004.

Well	Date Sampled	Elevation (ft)
K6-36	07/13/04	DRY/CB
K6-36	10/05/04	DRY/CB
K6-36	12/16/04	657.2
W-33C-01	01/15/04	635.4
W-33C-01	04/05/04	643.5
W-33C-01	07/01/04	640.4
W-33C-01	10/04/04	633.9
W-PIT6-1819	01/21/04	663.7
W-PIT6-1819	04/01/04	662.2
W-PIT6-1819	07/08/04	658.6
W-PIT6-1819	10/05/04	648.1

Table B-2. Organic compounds detected in ground water at Pit 6 during 2004.

Organic compound	Well	Date Sampled	Result (μg/L)
1,2-Dichloroethene (total)	K6-01S	18-Feb-04	2.3
1,2-Dichloroethene (total)	K6-01S	18-Feb-04	2.2
1,2-Dichloroethene (total)	K6-01S	6-May-04	2.6
1,2-Dichloroethene (total)	K6-01S	24-Aug-04	2.0
1,2-Dichloroethene (total)	K6-01S	24-Aug-04	2.1
1,2-Dichloroethene (total)	K6-01S	29-Nov-04	2.8
Bromodichloromethane	CARNRW2	8-Dec-04	1.1
Bromoform	CARNRW2	8-Dec-04	12.0
Chloroform	CARNRW2	8-Dec-04	0.5
cis-1,2-Dichloroethene	K6-01	27-Jan-04	0.5
cis-1,2-Dichloroethene	K6-01S	18-Feb-04	2.3
cis-1,2-Dichloroethene	K6-01S	18-Feb-04	2.2
cis-1,2-Dichloroethene	K6-01S	6-May-04	2.6
cis-1,2-Dichloroethene	K6-01S	24-Aug-04	2.0
cis-1,2-Dichloroethene	K6-01S	24-Aug-04	2.1
cis-1,2-Dichloroethene	K6-01S	29-Nov-04	2.8
Dibromochloromethane	CARNRW2	8-Dec-04	4.3
Tetrachloroethene	EP6-08	10-Mar-04	0.7
Tetrachloroethene	EP6-08	29-Apr-04	0.7
Tetrachloroethene	EP6-08	6-May-04	0.9
Tetrachloroethene	EP6-08	19-Aug-04	0.7
Tetrachloroethene	EP6-08	14-Dec-04	0.7
Tetrachloroethene	EP6-08	14-Dec-04	0.7
Tetrachloroethene	K6-36	10-Mar-04	1.0
Total Trihalomethanes	CARNRW2	8-Dec-04	18.0
Trichloroethene	EP6-09	18-Feb-04	5.4
Trichloroethene	EP6-09	1-Jun-04	5.2
Trichloroethene	EP6-09	19-Aug-04	5.1
Trichloroethene	EP6-09	15-Dec-04	5.2
Trichloroethene	K6-16	27-Jan-04	1.0
Trichloroethene	K6-16	29-Jul-04	1.8
Trichloroethene	K6-17	27-Jan-04	0.7
Trichloroethene	K6-17	21-Apr-04	0.6
Trichloroethene	K6-17	8-Jul-04	0.6
Trichloroethene	K6-18	28-Jan-04	3.3
Trichloroethene	K6-18	28-Jan-04	3.6

Table B-2. Organic compounds detected in ground water at Pit 6 during 2004.

Organic compound	Well	Date Sampled	Result (μg/L)
Trichloroethene	K6-18	3-Aug-04	3.2
Trichloroethene	K6-18	3-Aug-04	3.1
Trichloroethene	K6-19	23-Feb-04	3.5
Trichloroethene	K6-19	6-May-04	4.1
Trichloroethene	K6-19	2-Aug-04	2.8
Trichloroethene	K6-19	9-Dec-04	1.4
Trichloroethene	K6-36	10-Mar-04	1.3

Table B-3. Tritium activity measurements in ground water samples near Pit 6 during 2004.

Well	Date sampled	Activity (pCi/L)	Activity (Bq/L)
BC6-10	01/27/04	< 100	< 3.7
BC6-10	07/29/04	< 200	< 7.4
CARNRW1	01/14/04	< 100	< 3.7
CARNRW1	02/17/04	< 100	< 3.7
CARNRW1	03/10/04	< 100	< 3.7
CARNRW1	04/14/04	< 102	< 3.8
CARNRW1	06/09/04	< 100	< 3.7
CARNRW1	05/12/04	< 100	< 3.7
CARNRW1	07/14/04	< 100	< 3.7
CARNRW1	07/14/04	< 100	< 3.7
CARNRW1	08/11/04	< 101	< 3.7
CARNRW1	08/11/04	< 101	< 3.7
CARNRW1	08/01/04	< 100	< 3.7
CARNRW1	08/01/04	< 100	< 3.7
CARNRW1	10/25/04	* 862	* 31.9
CARNRW1	11/10/04	* 168	* 6.2
CARNRW1	12/08/04	< 100	< 3.7
CARNRW2	01/14/04	< 100	< 3.7
CARNRW2	03/10/04	< 100	< 3.7
CARNRW2	02/17/04	< 100	< 3.7
CARNRW2	04/14/04	< 100	< 3.7
CARNRW2	05/12/04	< 100	< 3.7
CARNRW2	06/09/04	< 100	< 3.7
CARNRW2	07/14/04	< 100	< 3.7
CARNRW2	08/11/04	< 100	< 3.7
CARNRW2	09/21/04	< 100	< 3.7
CARNRW2	10/25/04	* 852	* 31.5
CARNRW2	11/10/04	* 155	* 5.7
CARNRW2	12/08/04	< 100	< 3.7
CARNRW3	01/14/04	< 100	< 3.7
CARNRW3	02/17/04	< 100	< 3.7
CARNRW3	03/10/04	< 100	< 3.7
CARNRW3	04/14/04	< 100	< 3.7
CARNRW3	05/12/04	< 100	< 3.7
CARNRW3	06/09/04	< 100	< 3.7

Table B-3. Tritium activity measurements in ground water samples near Pit 6 during 2004.

Well	Date sampled	Activity (pCi/L)	Activity (Bq/L)
CARNRW3	07/14/04	< 100	< 3.7
CARNRW3	08/12/04	< 100	< 3.7
CARNRW3	09/21/04	< 100	< 3.7
CARNRW3	10/26/04	* 480	* 17.8
CARNRW3	12/09/04	< 100	< 3.7
CARNRW3	11/10/04	< 100	< 3.7
CARNRW4	01/14/04	< 100	< 3.7
CARNRW4	02/17/04	< 100	< 3.7
CARNRW4	03/10/04	< 100	< 3.7
CARNRW4	04/14/04	< 100	< 3.7
CARNRW4	06/10/04	< 100	< 3.7
CARNRW4	05/12/04	< 100	< 3.7
CARNRW4	07/14/04	< 100	< 3.7
CARNRW4	08/12/04	< 100	< 3.7
CARNRW4	09/21/04	< 100	< 3.7
CARNRW4	10/26/04	* 463	* 17.1
CARNRW4	12/09/04	< 100	< 3.7
CARNRW4	11/10/04	< 100	< 3.7
EP6-06	02/18/04	< 100	< 3.7
EP6-06	06/01/04	< 100	< 3.7
EP6-06	08/19/04	< 100	< 3.7
EP6-06	12/13/04	< 100	< 3.7
EP6-07	01/27/04	< 100	< 3.7
EP6-07	07/29/04	< 200	< 7.4
EP6-08	03/10/04	< 100	< 3.7
EP6-08	05/06/04	< 100	< 3.7
EP6-08	08/19/04	< 100	< 3.7
EP6-08	12/14/04	< 100	< 3.7
EP6-08	12/14/04	< 100	< 3.7
EP6-09	02/18/04	< 100	< 3.7
EP6-09	06/01/04	< 100	< 3.7
EP6-09	08/19/04	< 100	< 3.7
EP6-09	12/15/04	< 100	< 3.7
K6-01	01/27/04	299	11.1
K6-01	07/29/04	< 200	< 7.4

Table B-3. Tritium activity measurements in ground water samples near Pit 6 during 2004.

Well	Date sampled	Activity (pCi/L)	Activity (Bq/L)
K6-01S	02/18/04	< 100	< 3.7
K6-01S	02/18/04	116	4.3
K6-01S	05/06/04	196	7.3
K6-01S	08/24/04	355	13.1
K6-01S	08/24/04	298	11.0
K6-01S	11/29/04	205	7.6
K6-03	01/28/04	< 100	< 3.7
K6-03	08/03/04	< 100	< 3.7
K6-04	01/27/04	< 100	< 3.7
K6-04	08/03/04	< 100	< 3.7
K6-14	01/27/04	< 100	< 3.7
K6-14	07/29/04	< 200	< 7.4
K6-16	01/27/04	520	19.2
K6-16	07/29/04	422	15.6
K6-17	01/27/04	< 100	< 3.7
K6-17	04/21/04	< 100	< 3.7
K6-17	07/08/04	< 200	< 7.4
K6-17	10/05/04	< 100	< 3.7
K6-18	01/28/04	420	15.5
K6-18	01/28/04	325	12.0
K6-18	08/03/04	< 238	< 8.8
K6-18	08/03/04	278	10.3
K6-19	02/23/04	267	9.9
K6-19	05/06/04	296	11.0
K6-19	08/02/04	212	7.8
K6-19	12/09/04	264	9.8
K6-22	10/05/04	< 243	< 9.0
K6-22	10/05/04	< 100	< 3.7
K6-23	01/29/04	< 101	< 3.7
K6-23	08/04/04	< 100	< 3.7
K6-24	01/28/04	456	16.9
K6-24	07/29/04	384	14.2
K6-25	01/29/04	< 104	< 3.8
K6-25	07/29/04	< 200	< 7.4
K6-26	01/28/04	126	4.7

Table B-3. Tritium activity measurements in ground water samples near Pit 6 during 2004.

Well	Date sampled	Activity (pCi/L)	Activity (Bq/L)
K6-26	07/29/04	< 200	< 7.4
K6-27	01/28/04	< 100	< 3.7
K6-27	07/29/04	< 200	< 7.4
K6-32	03/03/04	< 100	< 3.7
K6-32	08/03/04	< 100	< 3.7
K6-33	03/03/04	430	15.9
K6-33	08/04/04	463	17.1
K6-34	02/04/04	< 100	< 3.7
K6-34	02/04/04	< 100	< 3.7
K6-34	04/21/04	< 100	< 3.7
K6-34	07/08/04	< 200	< 7.4
K6-34	10/05/04	< 100	< 3.7
K6-35	01/29/04	258	9.5
K6-35	08/04/04	191	7.1
K6-36	03/10/04	1660	61.4
K6-36	12/16/04	1680	62.2
W-33C-01	01/29/04	< 102	< 3.8
W-33C-01	08/03/04	< 100	< 3.7
W-PIT6-1819	02/04/04	159	5.9
W-PIT6-1819	04/21/04	240	8.9
W-PIT6-1819	07/08/04	227	8.4
W-PIT6-1819	10/05/04	146	5.4

* = Unvarified sample data

Table B-4. Pit 6 perchlorate, and nitrate in ground water at Pit 6 during 2004.

LOC_ID	SAMPLED	Perchlorate ug/L	Nitrate (as NO3) mg/L
BC6-10	27-Jan-04	< 4	1
CARNRW1	14-Jan-04	< 4	< 0.44
CARNRW1	17-Feb-04	< 4	< 0.44
CARNRW1	10-Mar-04	< 4	0.51
CARNRW1	14-Apr-04	< 4	0.54
CARNRW1	12-May-04	< 4	0.61
CARNRW1	9-Jun-04	< 4	< 0.44
CARNRW1	14-Jul-04	< 4	< 0.44
CARNRW1	14-Jul-04	< 4	< 0.44
CARNRW1	11-Aug-04	< 4	< 0.44
CARNRW1	11-Aug-04	< 4	< 0.44
CARNRW1	15-Sep-04	< 4	< 0.44
CARNRW1	15-Sep-04	< 4	< 0.44
CARNRW1	25-Oct-04	< 4	< 0.44
CARNRW1	10-Nov-04	< 4	< 0.44
CARNRW1	8-Dec-04	< 4	< 0.44
CARNRW2	14-Jan-04	< 4	< 0.44
CARNRW2	17-Feb-04	< 4	< 0.44
CARNRW2	10-Mar-04	< 4	< 0.44
CARNRW2	14-Apr-04	< 4	< 0.44
CARNRW2	12-May-04	< 4	< 0.44
CARNRW2	9-Jun-04	< 4	< 0.44
CARNRW2	14-Jul-04	< 4	< 0.44
CARNRW2	11-Aug-04	< 4	< 0.44
CARNRW2	21-Sep-04	< 4	< 0.44
CARNRW2	25-Oct-04	< 4	< 0.44
CARNRW2	10-Nov-04	< 4	< 0.44
CARNRW2	8-Dec-04	< 4	< 0.44
CARNRW3	14-Jan-04	< 4	< 0.44
CARNRW3	17-Feb-04	< 4	< 0.44
CARNRW3	10-Mar-04	< 4	< 0.44
CARNRW3	14-Apr-04	< 4	< 0.44
CARNRW3	12-May-04	< 4	< 0.44
CARNRW3	9-Jun-04	< 4	< 0.44
CARNRW3	14-Jul-04	< 4	< 0.44
CARNRW3	12-Aug-04	< 4	< 0.44
CARNRW3	21-Sep-04	< 4	< 0.44
CARNRW3	26-Oct-04	< 4	< 0.44
CARNRW3	10-Nov-04	< 4	< 0.44

Table B-4. Pit 6 perchlorate, and nitrate in ground water at Pit 6 during 2004.

LOC_ID	SAMPLED	Perchlorate ug/L	Nitrate (as NO3) mg/L
CARNRW3	9-Dec-04	< 4	< 0.44
CARNRW4	14-Jan-04	< 4	< 0.44
CARNRW4	17-Feb-04	< 4	3.4
CARNRW4	10-Mar-04	< 4	8.74
CARNRW4	14-Apr-04	< 4	4
CARNRW4	12-May-04	< 4	2.5
CARNRW4	10-Jun-04	< 4	1.8
CARNRW4	14-Jul-04	< 4	1.1
CARNRW4	12-Aug-04	< 4	< 0.44
CARNRW4	21-Sep-04	< 4	< 0.44
CARNRW4	26-Oct-04	< 4	< 0.44
CARNRW4	10-Nov-04	< 4	< 0.44
CARNRW4	9-Dec-04	< 4	< 0.44
EP6-06	18-Feb-04	NS	< 0.44
EP6-06	18-Mar-04	< 4	NS
EP6-06	1-Jun-04	< 4	< 0.44
EP6-06	19-Aug-04	< 4	1
EP6-06	13-Dec-04	< 4	1.5
EP6-07	27-Jan-04	< 4	< 0.44
EP6-08	10-Mar-04	< 4	3.9
EP6-08	6-May-04	< 4	3.1
EP6-08	19-Aug-04	< 4	< 0.44
EP6-08	14-Dec-04	< 4	1.1
EP6-08	14-Dec-04	< 4	1.5
EP6-09	18-Feb-04	4.5	3.3
EP6-09	1-Jun-04	< 4	2.6
EP6-09	19-Aug-04	4.4	2.9
EP6-09	15-Dec-04	4.4	2.9
K6-01	27-Jan-04	< 4	< 0.44
K6-01S	18-Feb-04	< 4	< 0.88
K6-01S	18-Feb-04	< 4	< 0.88
K6-01S	6-May-04	< 4	< 0.88
K6-01S	24-Aug-04	< 4	< 0.88
K6-01S	24-Aug-04	< 4	< 0.88
K6-01S	29-Nov-04	< 4	< 0.88
K6-03	28-Jan-04	< 4	< 0.44
K6-04	27-Jan-04	< 4	9.05
K6-14	27-Jan-04	< 4	< 0.44
K6-16	27-Jan-04	< 4	< 2.2

Table B-4. Pit 6 perchlorate, and nitrate in ground water at Pit 6 during 2004.

LOC_ID	SAMPLED	Perchlorate ug/L	Nitrate (as NO3) mg/L
K6-17	27-Jan-04	< 4	< 0.44
K6-17	8-Jul-04	< 4	< 0.44
K6-18	28-Jan-04	13	29.5
K6-18	28-Jan-04	14	17
K6-18	9-Dec-04	12	NS
K6-19	23-Feb-04	< 4	< 0.44
K6-19	6-May-04	< 4	< 0.44
K6-19	2-Aug-04	< 4	< 0.44
K6-19	9-Dec-04	< 4	< 0.44
K6-23	29-Jan-04	< 4	181
K6-23	3-Mar-04	NS	165
K6-24	28-Jan-04	< 4	1.5
K6-25	29-Jan-04	< 4	< 0.44
K6-26	28-Jan-04	< 4	< 0.44
K6-27	28-Jan-04	< 4	4.2
K6-32	3-Mar-04	< 4	0.9
K6-33	3-Mar-04	< 4	< 0.44
K6-34	4-Feb-04	< 4	< 0.44
K6-34	4-Feb-04	< 4	< 0.44
K6-34	8-Jul-04	< 4	< 0.44
K6-35	29-Jan-04	< 4	< 0.44
K6-36	10-Mar-04	6.2	1.4
K6-36	16-Dec-04	5.9	3
W-33C-01	29-Jan-04	< 4	1.5
W-PIT6-1819	4-Feb-04	< 4	< 0.44
W-PIT6-1819	8-Jul-04	< 4	< 0.44

NS = Not Sampled

Table B-5. Pit 6 monitoring locations, functions, associated monitoring programs, COCs and their sampling frequencies, and fourth quarter of 2004 sampling summary.

Monitoring location	Monitoring function	Monitoring program	COCs[(a)] (sampling frequency)	Samples obtained	Reason(s), if not completed
K6-17	guard well	CAMP	P (Q), S (SA)	P	
K6-22	guard well	CAMP	P (Q), S (SA)	P	
K6-34	guard well	CAMP	P (Q), S (SA)	P	
W-PIT6-1819	guard well	CAMP	P (Q), S (SA)	PS	
CARNRW1	water supply well	CAMP	P (M), S (M)	PPP-SSS	
CARNRW2	water supply well	CAMP	P (M), S (M)	PPP-SSS	
CARNRW3	water supply well	CAMP	P (M), S (M)	PPP-SSS	
CARNRW4	water supply well	CAMP	P (M), S (M)	PPP-SSS	
SPRING7	plume tracking spring	CAMP	P (SA), S (A)	none	dry
SPRING15	plume tracking spring	CAMP	P (SA), S (A)	none	done 1st and 3rd quarters
BC6-10	plume tracking well	CAMP	P (SA), S (A)	none	done 1st and 3rd quarters
BC6-13 / Spring 7	plume tracking well	CAMP	P (SA), S (A)	none	dry
EP6-07	plume tracking well	CAMP	P (SA), S (A)	none	done 1st and 3rd quarters
K6-01[(b)]	plume tracking well	CAMP	P (SA), S (A)	PS	
K6-03	plume tracking well	CAMP	P (SA), S (A)	none	done 1st and 3rd quarters
K6-04	plume tracking well	CAMP	P (SA), S (A)	none	done 1st and 3rd quarters
K6-14	plume tracking well	CAMP	P (SA), S (A)	none	done 1st and 3rd quarters
K6-15	plume tracking well	CAMP	P (SA), S (A)	none	done 1st and 3rd quarters
K6-16	plume tracking well	CAMP	P (SA), S (A)	none	done 1st and 3rd quarters
K6-18	plume tracking well	CAMP	P (SA), S (A)	none	done 1st and 3rd quarters
K6-21	plume tracking well	CAMP	P (SA), S (A)	none	done 1st and 3rd quarters
K6-23	plume tracking well	CAMP	P (SA), S (A)	none	done 1st and 3rd quarters
K6-24	plume tracking well	CAMP	P (SA), S (A)	none	done 1st and 3rd quarters
K6-25	plume tracking well	CAMP	P (SA), S (A)	none	done 1st and 3rd quarters
K6-26	plume tracking well	CAMP	P (SA), S (A)	none	done 1st and 3rd quarters
K6-27	plume tracking well	CAMP	P (SA), S (A)	none	done 1st and 3rd quarters
K6-32	plume tracking well	CAMP	P (SA), S (A)	none	done 1st and 3rd quarters
K6-33	plume tracking well	CAMP	P (SA), S (A)	none	done 1st and 3rd quarters
K6-35	plume tracking well	CAMP	P (SA), S (A)	none	done 1st and 3rd quarters
W-33C-01	plume tracking well	CAMP	P (SA), S (A)	none	done 1st and 3rd quarters
EP6-06	release detection well	DMP	All (Q)	All	
EP6-08	release detection well	DMP	All (Q)	All	
EP6-09	release detection well	DMP	All (Q)	All	
K6-01S	release detection well	DMP	All (Q)	All	
K6-19	release detection well	DMP	All (Q)	All	
K6-36	release detection well	DMP	All (Q)	none	dry

(a) P means the primary COCs tritium and VOCs. S means the secondary COCs perchlorate and nitrate. All means all DMP COCs (see **Table C-1** for a list). (M) means sampled monthly. (Q) means sampled quarterly. (SA) means sampled semiannually (done first and third quarters of year). (A) means sampled annually (done first quarter of year).

(b) Whenever well K6-01S is dry, well K6-01 is substituted and is analyzed for all DMP COCs.

Appendix C

Statistical Methods

for Detection Monitoring

Appendix C

Statistical Methods for Detection Monitoring

Monitoring and reporting provisions of the CERCLA closure and post-closure plan for the Pit 6 landfill require the use of statistical methods from the *California Code of Regulations* (CCR), Title 23, Division 3, Chapter 15, Section 2550.7 (Ferry *et al*. 1998).

We use statistically determined limits of concentration (SLs) to detect potential releases of constituents of concern (COCs) to ground water from solid wastes contained in the Pit 6 landfill. We employ two statistical methods, prediction intervals (PIs) and control charts (CCs), to generate SLs. Both methods are sensitive to COC concentration increases. Both methods are cost-effective, requiring only one measurement of a COC per quarter per monitoring well.

We prefer the PI method when COC concentrations in ground water are similar upgradient and downgradient from the monitored unit. We use parametric PI methods when the upgradient COC concentration data are all above the detection limit and the data are approximately normally distributed. We may use parametric methods on log-transformed data, if the transformed data follow a normal distribution. Nonparametric PI methods are more effective when the data cannot be transformed to a normal distribution, or when they contain nondetections.

When the concentration of a COC is spatially variable in the vicinity of a monitored unit, we develop a control chart for each downgradient monitoring well. The control chart compares each new quarterly COC measurement with its concentration history for that well.

Wherever sufficient historical detections exist, we calculate an SL such that any future measurement has approximately a 1-in-100 chance of exceeding the SL, when no change in concentration has actually occurred. This yields a statistical test with a significance level of approximately 0.01. Where historical detections exist, but nondetections constitute part of the data, we set the SL equal to the highest concentration measured. If historical analyses of a COC show all nondetections, then we set the SL equal to the analytical reporting limit (RL). When a routine COC measurement exceeds an SL, we perform two discrete retests. This method of data verification is in accordance with CCR Title 23, Chapter 15, Section 2550.7.

Constituents of Concern

COCs were identified for monitoring in the ground water at the Pit 6 landfill prior to its closure (Ferry *et al.* 1998). COCs, as defined by CCR Title 22, Chapter 15, are waste constituents, their reaction products, or hazardous constituents that are reasonably expected to be in or derived from waste buried in Pit 6. The current COCs for Pit 6 are listed in **Table C-1** below.

Table C-1. Pit 6 COCs, typical analytical reporting limit (RL), concentration limit (CL),[a] and statistical limit (SL) for each of the six detection monitoring wells.

Constituent of concern (COC)	Typical analytical RL (units)	Well EP6-06 CL; SL	Well EP6-08 CL; SL	Well EP6-09 CL; SL	Well K6-01S CL; SL	Well K6-19 CL; SL	Well K6-36 CL; SL
1,1,1-TCA	0.5 μg/L	<RL; RL	<RL; RL	<RL; RL	<RL; RL	<RL; RL	<RL; RL
1,2-DCA	0.5 μg/L	<RL; RL	<RL; RL	<RL; RL	<RL; RL	<RL; RL	<RL; RL
Cis-1,2-DCE	0.5 μg/L	<RL; RL	<RL; RL	<RL; RL	5.4; 7.0	<RL; RL	<RL; RL
Chloroform	0.5 μg/L	<RL; RL	0.1; 1.0	<RL; RL	<RL; RL	0.2; 1.5	<RL; RL
Methylene chloride	0.5 μg/L	<RL; RL	<RL; RL	<RL; RL	<RL; RL	<RL; RL	<RL; RL
PCE	0.5 μg/L	<RL; RL	0.4; 1.6	<RL; RL	<RL; RL	<RL; RL	0.5; 1.0
TCE	0.5 μg/L	<RL; RL	<RL; RL	14; 17	1.1; 1.5	8.2; 13	0.8; 2.1
Benzene	0.5 μg/L	<RL; RL	<RL; RL	<RL; RL	<RL; RL	<RL; RL	<RL; RL
Ethylbenzene	0.5 μg/L	<RL; RL	<RL; RL	<RL; RL	<RL; RL	<RL; RL	<RL; RL
Toluene	0.5 μg/L	<RL; RL	<RL; RL	<RL; RL	<RL; RL	<RL; RL	<RL; RL
Total xylenes	1.0 μg/L	<RL; RL	<RL; RL	<RL; RL	<RL; RL	<RL; RL	<RL; RL
Beryllium	0.5 μg/L	<RL; RL	<RL; RL	<RL; RL	<RL; RL	<RL; RL	<RL; RL
Mercury	0.2 μg/L	<RL; RL	<RL; RL	<RL; RL	<RL; RL	<RL; RL	<RL; RL
Carbon disulfide	5.0 μg/L	<RL; RL	<RL; RL	<RL; RL	<RL; RL	<RL; RL	<RL; RL
Perchlorate	3.0 μg/L	<RL; RL	<RL; RL	<RL; RL	<RL; RL	10.2; 27.5	5.3; 14.4
Tritium	100 pCi/L	RL; RL	<RL; RL	<RL; RL	<RL; RL	<RL; RL	2060; 2390
Uranium (total)	0.5 pCi/L	1.9; 3.6	1.2; 1.5	2.1; 3.7	6.6; 27	3.2; 7.2	0.5; 1.4
Gross alpha [(b)]	2 pCi/L	2.7; 7.7	0.9; 4.0	1.0; 4.9	7.0; 26	2.0; 9.2	<RL; RL
Gross beta [(b]	2 pCi/L	8.6; 21	8.6; 21	8.6; 21	14; 58	8.6; 21	9.8; 26

(a) CL (concentration limit) is equivalent to the background concentration of a COC.
(b) Gross alpha and gross beta are surrogates for ^{125}Sb, ^{137}Cs, ^{60}Co, ^{22}Na, ^{90}Sr, ^{204}Tl, and ^{232}Th.

Chlorinated VOCs (including TCE, PCE, 1,2-DCA, 1,1,1-TCA, methylene chloride, chloroform, benzene, toluene, ethylbenzene, and total xylenes) were detected historically in ground water and/or in soil adjacent to Pit 6. These VOCs are COCs.

Beryllium and mercury are COCs because they are listed in the waste disposal records for Pit 6.

Nine radionuclide COCs are associated with waste buried in Pit 6. They are ^{125}Sb, ^{137}Cs, ^{60}Co, ^{22}Na, ^{90}Sr, ^{204}Tl, ^{232}Th, ^{238}U, and tritium. Gross alpha and gross beta radioactivity are used as surrogates for seven of these nuclides, but not for uranium and tritium, which are measured separately (**Table C-1**).

A minor tritium release occurred prior to closure of Pit 6 and is the object of a continuing LLNL CERCLA investigation. The detection monitoring well BC6-12 was destroyed during year 2000, because it was screened across two water-bearing zones and could have provided a conduit for tritium in the shallower zone to contaminate ground water in the deeper zone. Well BC6-12 was replaced by well K6-36, which was constructed adjacent to it. Well K6-36 is screened only in the shallow water-bearing zone. Our calculated COC SLs for replacement well K6-36 are shown **Table C-1**.

A post-closure LLNL CERCLA study detected perchlorate in ground water downgradient of Pit 6. Consequently, perchlorate was added to the COC list and we have calculated SLs for this chemical (**Table C-1**).

Pesticides were not detected over an 18-month period (6 quarterly sampling events) following pit closure and were removed from the COC list.

Phthalates were not designated as COCs, because they were rarely detected prior to pit closure. However, since post-closure monitoring began in 1998, we have detected bis(2-ethylhexyl)phthalate (also known as di[2-ethylhexyl]phthalate, or DEHP) in ground water both upgradient and downgradient from Pit 6. Phthalates are also a common sampling artifact.

Table C-2 lists COCs that have indicated statistically significant evidence of release to ground water since post-closure monitoring began in 1998. **Table C-2** also lists the date of our 7-day letter notification to CVRWQCB and the status of any additional investigation of the COC. Note that 1,2-DCA has not been detected since 1998.

Table C-2. Pit 6 COCs showing statistical evidence of post-closure release.

COC	Date of 7-day letter report	Status of release investigation
1,2-DCA	10/13/98[a]	Transferred to ERD[b]
Perchlorate	11/8/02[c]	Retests did not confirm a release

(a) Galles (1998).

(b) LLNL Environmental Restoration Division.

(c) Raber (2002).

Appendix D

Changes in Monitoring Programs or Methods

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Changes in Monitoring Programs or Methods

LLNL implemented a compliance monitoring program during the second quarter of 1998 for the CERCLA-closed Pit 6 landfill at Site 300. The program is described in detail in Ferry *et al.* 1998.

During 2000, two new monitoring wells, designated K6-35 and K6-36, replaced monitoring wells BC6-11 and BC6-12, which were destroyed by grouting. Well K6-36, which is screened in the first (shallower) of two water-bearing zones, replaced well BC6-12 for release detection. Well K6-35, screened in the next deeper water-bearing zone, is used for corrective-action assessment.

By request of the CVRWQCB, we added perchlorate to the list of Pit 6 COCs during the third quarter of 2000.

By request of the CVRWQCB, since the third quarter of 2000 we have provided a table of information (**Table B-5)** that lists the Pit 6 CERCLA monitoring wells, their monitoring program assignments, their sampling frequencies, the COCs they monitor, and a reason if they were not sampled during the reported quarter.

During 2001, quarterly tritium monitoring was expanded to include CERCLA well K6-33 and the private, off-site, water supply wells designated CARNRW1 and CARNRW2. During 2002 a new CERCLA guard well was completed downgradient from Pit 6 adjacent to the Site 300 boundary. This well is identified as W-PIT6-1819.

Beginning 1 January 2003, the CAMP sampling schedule and COCs have changed as described in the *Compliance Monitoring Plan/Contingency Plan for Interim Remedies at Lawrence Livermore National Laboratory Site 300* (Ferry, *et al.* 2002). An expanded set of CAMP wells and springs will be sampled semiannually for tritium and VOCs, and annually for nitrate and perchlorate, while DMP well monitoring remains essentially unchanged. However, upgradient wells K6-03, K6-04, K6-15, and K6-32, which were formerly sampled quarterly for all the DMP COCs listed in **Table C-1**, are now designated to be CAMP plume-tracking wells and are sampled semiannually for tritium and VOCs and annually for nitrate and perchlorate only.

Appendix E

Quality Assurance Samples

Table E-1. Pit 6 quality assurance samples for 2004.

			1st Quarter			2nd Quarter			3rd Quarter			4th Quarter		
			K6-01S	K6-01S	Pit 6	K6-36	K6-36	Pit 6	K6-01S	K6-01S	Pit 6	EP6-08	EP6-08	Pit 6
Constituent	**Method**	**units**	**routine**	**duplicate**	**field blank**	**routine**	**duplicate**	**field blank**	**routine**	**duplicate**	**field blank**	**routine**	**duplicate**	**field blank**
Total dissolved solids (TDS)	E160.1	mg/L	2290	2320	< 10	***Well***	***Well***	< 10	2430	2150	< 10	720	727	< 10
Beryllium	E210.2	ug/L	< 0.2	< 0.2	< 0.2	***Dry***	***Dry***	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Mercury	E245.2	ug/L	< 0.2	< 0.2	< 0.2			< 0.2	< 0.4	< 0.4	< 0.2	< 0.2	< 0.2	< 0.2
Nitrate (as NO3)	E300.0	mg/L	< 0.88	< 0.88	< 0.44			< 0.44	< 0.88	< 0.88	< 0.44	1.5	1.1	< 0.44
Perchlorate	E300.0	ug/L	< 4	< 4	< 4			< 4	< 4	< 4	< 4	< 4	< 4	< 4
1,1,1-Trichloroethane	E624	ug/L	< 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	E624	ug/L	< 0.5	< 0.5	< 0.5			< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
1,1,2-Trichloroethane	E624	ug/L	< 0.5	< 0.5	< 0.5			< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
1,1-Dichloroethane	E624	ug/L	< 0.5	< 0.5	< 0.5			< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
1,1-Dichloroethene	E624	ug/L	< 0.5	< 0.5	< 0.5			< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
1,2-Dichlorobenzene	E624	ug/L	< 0.5	< 0.5	< 0.5			< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
1,2-Dichloroethane	E624	ug/L	< 0.5	< 0.5	< 0.5			< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
1,2-Dichloroethene (total)	E624	ug/L	2.3	2.2	< 1			< 1	2	2.1	< 1	< 1	< 1	< 1
1,2-Dichloropropane	E624	ug/L	< 0.5	< 0.5	< 0.5			< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
1,3-Dichlorobenzene	E624	ug/L	< 0.5	< 0.5	< 0.5			< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
1,4-Dichlorobenzene	E624	ug/L	< 0.5	< 0.5	< 0.5			< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
2-Butanone	E624	ug/L	< 20	< 20	< 20			< 20	2	2.1	< 0.5	< 20	< 20	< 20
2-Chloroethylvinylether	E624	ug/L	< 10	< 10	< 10			< 10	< 0.5	< 0.5	< 0.5	< 10	< 10	< 10
2-Hexanone	E624	ug/L	< 20	< 20	< 20			< 20	< 20	< 20	< 20	< 20	< 20	< 20
4-Methyl-2-pentanone	E624	ug/L	< 20	< 20	< 20			< 20	< 10	< 10	< 10	< 20	< 20	< 20
Acetone	E624	ug/L	< 20	< 20	< 20			< 20	< 20	< 20	< 20	< 20	< 20	< 20
Benzene	E624	ug/L	< 0.5	< 0.5	< 0.5			< 0.5	< 20	< 20	< 20	< 0.5	< 0.5	< 0.5
Bromodichloromethane	E624	ug/L	< 0.5	< 0.5	< 0.5			< 0.5	< 20	< 20	< 20	< 0.5	< 0.5	< 0.5
Bromoform	E624	ug/L	< 0.5	< 0.5	< 0.5			< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Bromomethane	E624	ug/L	< 1	< 1	< 1			< 1	< 0.5	< 0.5	< 0.5	< 1	< 1	< 1
Carbon disulfide	E624	ug/L	< 1	< 1	< 1			< 1	< 0.5	< 0.5	< 0.5	< 1	< 1	< 1
Carbon tetrachloride	E624	ug/L	< 0.5	< 0.5	< 0.5			< 0.5	< 1	< 1	< 1	< 0.5	< 0.5	< 0.5
Chlorobenzene	E624	ug/L	< 0.5	< 0.5	< 0.5			< 0.5	< 1	< 1	< 1	< 0.5	< 0.5	< 0.5
Chloroethane	E624	ug/L	< 0.5	< 0.5	< 0.5			< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Chloroform	E624	ug/L	< 0.5	< 0.5	< 0.5			1.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Chloromethane	E624	ug/L	< 0.5	< 0.5	< 0.5			< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
cis-1,2-Dichloroethene	E624	ug/L	2.3	2.2	< 0.5			< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
cis-1,3-Dichloropropene	E624	ug/L	< 0.5	< 0.5	< 0.5			< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Dibromochloromethane	E624	ug/L	< 0.5	< 0.5	< 0.5			< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Dibromomethane	E624	ug/L	< 0.5	< 0.5	< 0.5			< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Dichlorodifluoromethane	E624	ug/L	< 0.5	< 0.5	< 0.5			< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Ethanol	E624	ug/L	< 800	< 800	< 800			< 800	< 800	< 800	< 800	< 800	< 800	< 800
Ethylbenzene	E624	ug/L	< 0.5	< 0.5	< 0.5			< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Freon 113	E624	ug/L	< 0.5	< 0.5	< 0.5			< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Methylene chloride	E624	ug/L	< 1	< 1	< 1			< 1	< 1	< 1	< 1	< 1	< 1	< 1
Naphthalene	E624	ug/L	< 0.5	< 0.5	< 0.5			< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Styrene	E624	ug/L	< 0.5	< 0.5	< 0.5			< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Tetrachloroethene	E624	ug/L	< 0.5	< 0.5	< 0.5			< 0.5	< 0.5	< 0.5	< 0.5	0.65	0.71	< 0.5
Toluene	E624	ug/L	< 0.5	< 0.5	< 0.5			< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Total xylene isomers	E624	ug/L	< 1	< 1	< 1			< 1	< 1	< 1	< 1	< 1	< 1	< 1
trans-1,2-Dichloroethene	E624	ug/L	< 0.5	< 0.5	< 0.5			< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
trans-1,3-Dichloropropene	E624	ug/L	< 0.5	< 0.5	< 0.5			< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Trichloroethene	E624	ug/L	< 0.5	< 0.5	< 0.5			< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Trichlorofluoromethane	E624	ug/L	< 0.5	< 0.5	< 0.5			< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Vinyl chloride	E624	ug/L	< 0.5	< 0.5	< 0.5			< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Tritium	E906	Bq/L	3.6±2.2	4.3±2.2	- 1.9±1.9			0.08±1.76	11.0±2.4	13.1±2.7	- 0.5±2.0	0.000±1.92	0.17±1.92	0.16±2.11
Gross alpha	E900	Bq/L	0.10±0.11	0.13±0.1	- 0.003±0.006			0.001±0.007	0.080±0.19	0.157±0.13	0.002±0.007	- 0.058±0.052	0.006±0.041	0.009±0.009
Gross beta	E900	Bq/L	0.61±0.19	0.49±0.1	- 0.017±0.022			0.006±0.025	0.629±0.24	0.803±0.18	0.001±0.023	0.319±0.059	0.323±0.08	- 0.004±0.021
Uranium (total)	AS	Bq/L	0.13±0.01	0.13±0.01	0.002±0.001			0.005±0.002	0.140±0.01	0.142±0.01	0.000±0.001	0.023±0.004	0.023±0.004	0.000±0.001

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