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First Semester 2003 Compliance Report for Lawrence Livermore National Laboratory Site 300

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September 30, 2003

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Environmental Protection Department

Environmental Restoration Division

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1. Introduction

This report summarizes the Lawrence Livermore National Laboratory (LLNL) Site 300 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Remedial Action compliance monitoring activities for the first and second quarters of 2003 (first semester). The report is submitted in compliance with the Compliance Monitoring Plan (CMP)/Contingency Plan for Interim Remedies at Lawrence Livermore National Laboratory Site 300 (Ferry et al., 2002). As agreed to with the Regional Water Quality Control Board (RWQCB), the Central General Services Area (GSA) monitoring data, which was collected in compliance with the GSA CMP (Rueth, 1998), is also included in this report. This report does not cover the Eastern GSA, which is governed by the RWQCB National Pollutant Discharge Elimination System (NPDES) Order No. 97-242 and reported separately.

During the reporting period of January 1, 2003 through June 30, 2003, 2,622,380 gallons of ground water and 4,219,861 cubic feet of vapor were treated at Site 300, removing approximately 1,508 grams (g) of volatile organic compounds (VOCs), 371,849 g nitrate, 49 g RDX, and 41 g perchlorate (Table Summ-1).

Since remediation began in 1992, approximately 18,225,028 gallons of ground water and over 132,189,000 of cubic feet of vapor have been treated, removing approximately 175 kilograms (kg) of VOCs, 266,263 kg nitrate, 0.34 kg RDX, 9.6 kg tetrabutyl ortho silicate (TBOS), and 12.5 kg perchlorate (Table Summ-2).

2. Extraction and Treatment System Monitoring and Ground and Surface Water Monitoring Programs

Section 2 presents the monitoring results for the Site 300 remediation systems, ground water monitoring network, and surface water sampling and analyses. These results are presented and discussed by OU as follows:

- 2.1. General Services Area OU 1
- 2.2. Building 834 OU 2
- 2.3. Pit 6 Landfill (Pit 6) OU 3
- 2.4. High Explosive Process Area OU 4
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- 2.6. Building 854 OU 6
- 2.7. Building 832 Canyon OU 7
- 2.8. Site-Wide OU 8 (Building 833, Building 801, Building 845, Building 851)

The locations of the Site 300 OUs are shown in Figure 1-1. The Pit 2, 8, and 9 Landfills (OU 8) are discussed in Section 3.

2.1. General Services Area (GSA) OU1

The GSA OU consists of the Eastern GSA and Central GSA areas. This report does not cover the Eastern GSA, which is governed by the RWQCB NPDES Order No. 97-242 and reported separately. At the Central GSA, chlorinated solvents, mainly trichloroethylene (TCE), were used as degreasing agents in craft shops, such as Building 875. Rinse water from these degreasing operations was disposed of in dry wells. Typically, dry wells were gravel-filled holes about 3 to 4 feet deep and two feet in diameter. The Central GSA dry wells were used until 1982. In 1983 and 1984, these dry wells were decommissioned and excavated.

A ground water extraction and treatment system has been operating in the Central GSA since 1992. Contaminated ground water is extracted from six wells (W-7I, W-875-07, W-875-08, W-873-07, W-872-02, and W-7O) each producing 0.5 to 7 gallons per minute (gpm). The current treatment configuration includes particulate filtration, air stripping to remove VOCs from extracted water, granular activated carbon (GAC) to treat vapor effluent from the air stripper, and discharge to the surrounding natural vegetation using misting towers.

A soil vapor extraction and treatment system began operating in the Building 875 dry well contaminant source area in 1994. Seven wells (W-7I, W-875-07, W-875-08, W-875-09, W-875-10, W-875-11 and W-875-15) are used as vapor extraction or passive air inlet wells. Simultaneous ground water extraction in the vicinity lowers the elevation of the ground water surface and maximizes the volume of unsaturated soil influenced by vapor extraction. The current treatment configuration includes a water knockout chamber, a rotary vane blower, and four 140-lb vapor-phase GAC vessels arranged in series. Treated vapors are discharged to the atmosphere under permit from the San Joaquin Valley Unified Air Pollution Control District. A map of the Central GSA, showing the locations of monitoring and extraction wells and treatment facilities, is presented in Figure 2.1-1.

2.1.1. Central GSA Ground Water and Soil Vapor Extraction and Treatment System Operations and Monitoring

This section is organized into five sections; facility performance assessment; operations and maintenance issues; receiving water monitoring; compliance summary; and sampling plan evaluation and modifications.

2.1.1.1. Central GSA Facility Performance Assessment

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The Central GSA ground water treatment facility discharge is regulated by the RWQCB Substantive Requirements for Waste Discharge.

The monthly ground water and soil vapor discharge volumes and rates and operational hours are summarized in Table 2.1.1.1-1. The total volume of ground water and vapor extracted and treated and mass removed during the reporting period is presented in Table Summ-1. The cumulative volume of ground water and soil vapor treated and discharged and mass removed is summarized in Table Summ-2. Analytical results for influent and effluent samples are shown in Table 2.1.1.1-2 through 2.1.1.1-3. The pH measurement results are presented in Appendix A.

2.1.1.2. Central GSA Operations and Maintenance Issues

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The treatment facility operated continuously throughout the first semester 2003, except for six days in late February when maintenance on the misting towers was performed.

2.1.1.3. Central GSA Receiving Water Monitoring

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During the reporting period, no surface water was present at the Central GSA discharge location. Therefore, receiving water monitoring was not conducted.

2.1.1.4. Central GSA Compliance Summary

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The Central GSA ground water and soil vapor extraction and treatment systems operated in compliance with the Substantive Requirements for Wastewater Discharge. No Environmental Protection Agency (EPA) Method 601 compounds (Table 2.1.1.1-2) were detected above the detection limit of 0.5 μg/L in any of the ground water treatment system effluent samples collected during the semester. Measurements of pH (Appendix A) were within permit limitations.

2.1.1.5. Central GSA Facility Sampling Plan Evaluation and Modifications

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The Central GSA treatment facility sampling plan complies with Substantive Requirements and the GSA CMP (1998) monitoring requirements. The treatment facility sampling plan is presented in Table 2.1.1.5-1. There were no modifications made to the plan during the first semester of 2003.

2.1.2. Central GSA Surface Water and Ground Water Monitoring

During the reporting period, ground water monitoring was conducted in accordance with the GSA CMP sampling schedule with the following exceptions; 6 semiannual samples were not collected. The sampling plan and schedule by quarter for ground water and surface water is presented in Table 2.1.2-1. This table also delineates and explains deviations from the sampling plan and indicates any additions made to the CMP. Ground water analytical results are summarized in Tables 2.1.2-2 and 2.1.2.4. Soil vapor analytical results are presented in Table 2.1.2-3.

Ground water elevations measured during the reporting period are summarized in Table 2.1.2-5. Ground water elevation data collected from wells within the OU are similar to those collected during past quarters. A ground water potentiometric surface map for the OU will be presented in the next report and annually thereafter.

2.1.3. Central GSA Remediation Progress Analysis

This section is organized into five sections; mass removal; contaminant concentration/plume reductions; analysis of contaminant distribution and concentration trends; remediation optimization evaluation; and performance issues.

2.1.3.1. Central GSA Mass Removal

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The monthly ground water and soil vapor mass removal estimates are summarized in Table 2.1.3.1-1. The cumulative mass estimates are summarized in Table SUMM-2.

2.1.3.2. Central GSA Contaminant Concentrations and Distribution

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At the Central GSA, VOCs are the primary contaminants of concern (COC) detected in ground water. VOCs are present in two hydrostratigraphic units (HSU): a shallow HSU (Qt-$Tnsc_1$) contained within the Quaternary terrace deposits (Qt) and portions of the $Tnbs_2$ and $Tnsc_1$ bedrock units which subcrop beneath the Qt; and a deeper HSU ($Tnbs_1$) consisting of the $Tnbs_1$ bedrock units where it is hydraulically separate from the shallow Qt deposits. Ground water contaminant concentration contour maps of the COCs will be presented in the next report.

The extent of detectable total VOCs in the shallow Qt-$Tnsc_1$ HSU is similar to that shown in past quarterly reports. The current maximum total VOC concentration in the Qt-$Tnsc_1$ HSU (824 μg/L) occurs in well W-875-07, located in the Building 875 dry well pad area where the historical maximum total VOC concentration was detected. The current total VOC concentrations in these source area wells have decreased by two orders-of-magnitude since remediation began in 1994.

Historically, total VOC concentrations in the deeper $Tnbs_1$ HSU have always been two to three orders-of-magnitude lower than the Qt-$Tnsc_1$ HSU. Additionally, in previous quarterly reports, well W-7P was considered to be part of the deeper $Tnbs_1$ HSU. This well was recently redefined as a Qt-$Tnsc_1$ HSU well based on a comparison of its hydrograph with shallow zone wells. The current total VOC concentration in well W-7P is 22.7 micrograms per liter (μg/L). Historically, total VOC concentrations in well W-7P have ranged from 1.6 to 62.9 μg/L. Based on the new interpretation of the $Tnbs_1$ HSU, of the 14 wells monitoring this HSU, only well W-7N contains detectable VOCs at a concentration of 0.96 μg/L.

2.1.3.3. Central GSA Remediation Optimization Evaluation

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During the reporting period, two current monitoring wells (W-7R and W-7P) were evaluated in anticipation of conversion of these wells to extraction wells to further optimize remediation at Central GSA. Capture zone analyses, pumping evaluations, and treatment facility expansion evaluations were conducted in order to prepare for bringing these wells online in the future.

2.1.3.4. Central GSA OU Performance Issues

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There were no performance issues during this reporting period.

2.2. Building 834 (B834) OU2

Past spills, piping leaks, and septic-system effluent at the Building 834 Complex have resulted in soil and ground water contamination, primarily of VOCs. Additional COCs are TBOS and nitrate. In addition, a previously leaking underground diesel storage tank released diesel into a small region of the subsurface. Although diesel has been included as a secondary COC, the extent of contamination and monitoring requirements are being evaluated.

Ground water and soil vapor extraction and treatment systems have been operating in the Building 834 OU since 1995 and 1998, respectively. These systems are located in the main part of the Building 834 Complex, referred to as the Building 834 core area. The area to the south of the core area is referred to as the distal area. Due to the very low ground water yield from individual extraction wells (< 0.1 gallons per minute), the ground water and soil vapor extraction and treatment systems are operated simultaneously in batch mode. The treatment process utilizes an oil-water separator to remove TBOS, followed by air sparging to remove VOCs from ground water. The VOC laden vapors are removed using vapor phase GAC. Treated ground water is then discharged through a misting tower system.

The soil vapor extraction system also utilizes GAC for VOC removal. The current well field consists of 15 extraction wells, of which 13 are used for both ground water and soil vapor extraction, and two are solely used for vapor extraction. The average ground water extraction rate is estimated at approximately 4,300 gallons per month for the entire well field. Treated vapors are discharged to the atmosphere under permit from the San Joaquin Valley Unified Air Pollution Control District. A map of the Building 834 OU showing the locations of monitoring and extraction wells and the treatment facility is presented in Figure 2.2-1.

2.2.1. Building 834 OU Ground Water and Soil Vapor Extraction and Treatment System Operations and Monitoring

This section is organized into five sections; facility performance assessment; operations and maintenance issues; receiving water monitoring; compliance summary; and sampling plan evaluation and modifications.

2.2.1.1. Building 834 OU Facility Performance Assessment

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The Building 834 ground water treatment facility discharge is regulated by the RWQCB Substantive Requirements for Waste Discharge.

The Building 834 treatment facility was off-line the entire first semester of 2003 due to activities conducted by the LLNL Defense Program. Due to the potential hazards associated with these activities, the Building 834 area was not accessible. Therefore, no data related to facility activities are presented. The cumulative volume of ground water and soil vapor treated and discharged and mass removed prior to the first semester of 2003 are summarized in Table Summ-2.

2.2.1.2. Building 834 OU Operations and Maintenance Issues

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There are no operational or maintenance issues to report as this facility did not operate during the first semester of 2003.

2.2.1.3. Building 834 OU Compliance Summary

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The Building 834 treatment facility was not operated during the entire semester.

2.2.1.4. Building 834 OU Facility Sampling Plan Evaluation and Modifications

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The Building 834 facility sampling plan complies with CMP monitoring requirements. The sampling plan is presented in Table 2.2.1.4-1.

2.2.2. Building 834 OU Ground Water Monitoring

During this reporting period, a limited amount of ground water monitoring was conducted due to area access limitations. Full access to the area was granted in June, at which time an attempt was made to complete as much of the CMP monitoring requirements as possible. The monitoring well sampling plan and schedule for ground water and surface water monitoring are presented by quarter in Table 2.2.2-1. This table also delineates and explains deviations from the sampling plan and indicates any additions made to the CMP. Biennial or annual samples not collected during the first semester will be attempted during the second semester. Analytical results are summarized in Tables 2.2.2-2 through 2.2.2-6.

Monitoring well W-834-1712 was completed as a shallow vapor monitoring point within the vadose (unsaturated) zone. Therefore, this well will be removed as a required CMP ground water monitoring well.

Ground water elevations measured during this reporting period are summarized in Table 2.2.2-7. A ground water potentiometric surface map for the OU will be presented in the next report and annually thereafter. Ground water elevation data collected from wells within the OU are similar to those collected during past quarters.

2.2.3. Building 834 OU Remediation Progress Analysis

This section is organized into five sections; mass removal; contaminant concentration/plume reductions; analysis of contaminant distribution and concentration trends; remediation optimization evaluation; and performance issues.

2.2.3.1. Building 834 OU Mass Removal

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No monthly ground water and soil vapor mass removal estimates are reported since the facility was not operational during the entire reporting period. The cumulative mass removed presented in Table SUMM-2 is the same as reported in the last quarterly report.

2.2.3.2. Building 834 OU Contaminant Concentrations and Distribution

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At the Building 834 OU, VOCs are the primary COCs detected in ground water; TBOS, diesel, and nitrate are the secondary COCs. The highest concentrations of these constituents have always been detected in the core area. These constituents have been identified in two shallow HSUs, the Tpsg perched water-bearing gravel zone and the underlying Tps-clay perching horizon. Ground water contaminant concentration contour maps of the COCs will be presented in the next report.

The extent of total VOCs in the Tpsg HSU differs from the last quarterly report mainly due to increases in the extent of saturation. The increased saturation extent is due to the combined effects of recharge from late season rainfall and ground water rebound as a result of the discontinuation of ground water extraction since June 2002. Although the extent of VOC ground water contamination has increased during the last 6 months, the magnitude has not changed significantly since the last quarterly report.

The current maximum total VOC concentration in the Tpsg HSU (42,000 μg/L) occurs in well W-834-C5, located in the core area. This well has historically contained some of the highest total VOC concentrations (up to 800,000 μg/L) along with nearby core area wells W-834-D3, W-834-D4, and W-834-D11. High total VOC concentrations have also been detected in the underlying Tps clay HSU. The current maximum total VOC ground water concentration in the Tps-clay perching horizon (121,000 μg/L) occurs in core area well W-834-A1. High total VOC ground water concentrations (>10,000 μg/L) also exist outside the core area. The current maximum total VOC concentration (25,000 μg/L) outside the core area occurs in well W-834-T2, located about 500 feet south of the core area. To date, VOCs have not been detected in the $Tnbs_1$ regional aquifer guard wells W-834-T1 and W-834-T3. These deep guard wells are screened about 300 feet below the shallow, contaminated HSUs.

Among the secondary COCs for the Building 834 OU, TBOS continues to be detected at high concentrations in the Core Area. The current maximum TBOS concentration (520,000 μg/L) occurs in well W-834-D4. Historically, TBOS concentrations in this well have ranged from 33 to 770,000 μg/L. TBOS was detected in only one well outside of the core area, W-834-T2D, at a low concentration of 1.7 μg/L, and remains below detection limits in the deep $Tnbs_1$ guard wells W-834-T1 and W-834-T3.

Nitrate occurs in both the core and distal areas of the Building 834 OU. The current maximum nitrate concentration (110 milligrams per liter [mg/L], as NO_3) occurs in well W-834-C5, located in the core area. Historically, nitrate concentrations in this well have ranged from 49 to 120 mg/L. The current maximum nitrate concentration in the distal area occurs in well W-834-1824. This new well had previously been sampled twice for nitrate, with concentrations of 99 and 100 mg/L. Nitrate concentrations remains below detection limits in ground water samples from the deep $Tnbs_1$ guard wells W-834- T1 and W-834-T3.

Diesel range compounds have been detected in ground water from several wells in the Building 834 OU. These diesel analyses are performed using the modified EPA Method 8015. The analytical laboratory reports the total of all compounds found within the diesel fuel range, regardless of whether the chromatogram matches the typical diesel fuel fingerprint. After a review of analytical results and chromatograms, only one well's chromatogram (W-834-U1) matched the diesel fingerprint indicative of weathered diesel fuels. This well, although completed in the deeper Tps clay perching horizon, is located near the former underground diesel storage tank that has been removed. Currently, there is a lack of monitoring wells screened in the Tpsg in the immediate vicinity of W-834-U1. A Tpsg well will be installed in this area during Fiscal Year 2004 and sampled for diesel range compounds. The analytical chromatograms for the remaining wells that had diesel range organic compounds reported did not show the typical fuel fingerprint. The chromatograms indicated distinct unidentified compounds that were being calculated and reported as diesel. Additional analyses using a mass spectrometer (EPA Method 8270) were performed after this reporting period to verify the identity of these compounds, the results of which will be presented in the next CMP report. To date, none of the extraction wells have been found to contain diesel fuel. A similar diesel range compound was also detected in $Tnbs_1$ guard well W-834-T3 at a concentration of 60 μg/L during this reporting period. This well is being re-sampled to confirm this unexpected result.

As reported in previous quarterly monitoring reports, chromium monitoring continues in wells that were affected by improperly wired pressure transducers that produced electrical short circuits. Chromium data are included in Table 2.2.2-6. Due to access limitations, only one of these wells, W-834-M1, was sampled for chromium during this reporting period. Although still above background concentrations, the current concentration of 0.02 mg/L remains below the maximum contaminant level (MCL) of 0.05 mg/L for chromium. Ground water extraction from this well was terminated after September 2002 when concentrations dropped below the MCL. Additional organic compounds related to galvanic reactions associated with the shorting transducers were detected in W-834-M1 during the second quarter sampling. These additional compounds include 1,3-dichlorobenzene, bromodichloromethane, bromoform, and dibromochloromethane.

2.2.3.3. Building 834 OU Remediation Optimization Evaluation

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The ground water and soil vapor extraction systems were shut down for the entire reporting period due mainly to access restrictions related to Defense Program activities. For some time prior to the facility shutdown in June 2002, there had been a decline in VOC concentrations in ground water and soil vapor. In addition, the areas of saturation had also been decreasing, due in part, to long term dewatering from ground water extraction. During this shutdown period, ground water recovery was monitored in four core area wells (W-834-D3, -D7, -D13 and –D15) using pressure transducers. In addition to ground water rebound data, soil vapor zone-of-influence data are being collected and will be reported in the next CMP report. These data will be used to evaluate microbial dechlorination of VOCs related to intrinsic bioremediation and to help optimize the ground water and soil vapor extraction systems once they return to full operation.

2.2.3.4. Building 834 OU Performance Issues

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There were no performance issues because the Building 834 ground water and soil vapor extraction and treatment systems did not operate during this time period.

2.3. Pit 6 Landfill (Pit 6) OU3

The Pit 6 Landfill is a 14-acre area near the southern boundary of Site 300 that was used from 1964 to 1973 to bury waste in nine unlined debris trenches and animal pits. The buried waste, which includes laboratory equipment, craft shop debris, and biomedical waste is located on the Corral Hollow-Carnegie fault. Further to the east, the fault trends to the south of two nearby water-supply wells CARNRW1 and CARNRW2. These active water-supply wells are located about 1,000 feet east of the Pit 6 landfill. They provide water for the nearby State Vehicle Recreation Area and are monitored on a monthly basis.

The Pit 6 Landfill was capped and closed in 1997 under CERCLA to prevent further leaching of contaminants resulting from percolation of rainwater through the buried waste. The engineered, multi-layer cap is intended to prevent rainwater infiltration into the landfill, mitigate potential damage by burrowing animals and vegetation, prevent potential hazards from the collapse of void spaces in the buried waste, and prevent the potential flux of volatile organic compound vapors through the soil. Surface water flow onto the landfill is minimized by a diversion channel on the north-side and drainage channels on the east, west, and south sides of the engineered cap. A map of Pit 6 OU showing the locations of monitoring and water supply wells is presented in Figure 2.3-1

2.3.1. Pit 6 OU Surface Water and Ground Water Monitoring

During this reporting period, ground water monitoring was conducted in accordance with the CMP monitoring and post closure requirements with the following exceptions; 18 monthly and 2 semiannual samples were not collected. The sampling plan and schedule by quarter for ground water and surface water is presented in Table 2.3.1-1. This table also delineates and explains deviations from the sampling plan and indicates any additions made to the CMP. Biennial or annual samples not collected during the first semester will be attempted during the second semester. Analytical results are summarized in Tables 2.3.1-2 through 2.3.1-7.

In addition to satisfying the CMP and post closure sampling requirements, ground water is also monitored at Pit 6 to verify that the COCs continue to decline as a result of natural attenuation processes. The selected remedy for Pit 6 in the Site 300 Interim Record of Decision (ROD) is Monitored Natural Attenuation (MNA), which requires monitoring to verify that ground water contaminants are decreasing in magnitude and extent.

Ground water beneath Pit 6 during this reporting period remained in excess of 18-20 ft below the buried waste trenches. Ground water north of the fault flows eastward in response to pumping from the two nearby water-supply wells, CARNRW1 and CARNRW2. Wells located south of the fault exhibit little or no response to pumping. Ground water elevations south of the fault indicate southerly and easterly flow directions. Ground water elevations measured during the reporting period are summarized in Table 2.3.1-8. A ground water potentiometric surface map for the OU will be presented in the next report and annually thereafter.

2.3.2. Pit 6 OU Remediation Progress Analysis

This section is organized into four sections; contaminant concentration/plume reductions; analysis of contaminant distribution and concentration trends; remediation optimization evaluation; and performance issues.

2.3.2.1. Pit 6 OU Analysis of Contaminant Distribution and Concentration Trends

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At the Pit 6 OU, VOCs and tritium are the primary COCs detected in ground water, and perchlorate and nitrate are the secondary COCs. Ground water contaminant concentration contour maps of the COCs will be presented in the next report.

As presented in Table 2.3.1-2, no significant changes were observed in ground water TCE concentrations compared to the previous quarterly report. TCE concentrations remain below the MCL in all wells. The maximum TCE concentration (4.8 μg/L) was detected in well EP6-09 that is located about 100 feet due south of Pit 6. This maximum TCE concentration is significantly lower than the historical maximum concentration (> 200 μg/L) that was detected in the late 1980s.

Other VOCs detected in ground water include cis-1,2-dichloroethylene (DCE) and perchloroethylene (PCE). Cis-1,2 DCE was detected in ground water from well K6-01S at a concentration of 2.3 μg/L, and from well K6-01 at 0.5 μg/L. PCE has been detected in ground water samples from several Pit 6 OU wells during the past 15 years. During this reporting period, PCE was detected in wells EP6-08 at a concentration of 1 μg/L, and K6-36, at a concentration of 0.52 μg/L. Trace detections of PCE have occurred in ground water samples from these wells for several years.

As presented in Table 2.3.1-3, ground water tritium activities measured during this reporting period remained far below the 20,000 picocuries per liter (pCi/L) MCL. However, tritium continues to be detected above background (> 100 pCi/L) in ground water from wells located north and south of the fault. During this reporting period elevated tritium activities were detected in ground water samples from wells K6-24, K6-33, K6-36, and W-PIT6-1819 located north of the fault, and wells K6-01, K6-01S, K6-16, K6-18 and K6-19 located south of the fault.

Along a transect north and sub-parallel to the fault, ground water tritium activities decrease from a maximum of 1,850 pCi/L at well K6-36, located immediately east of Pit 6, to 123 pCi/L at well W-PIT6-1819, located immediately west of the CARNRW1 and CARNRW2 water-supply wells. This maximum ground water tritium activity is about half the maximum historical activity of 3,420 pCi/L indicating that tritium activity is decreasing with time. All of the wells along the transect are screened in a fractured bedrock water-bearing zone where water levels respond to pumping from CARNRW1 and CARNRW2.

Tritium remains below the 100 pCi/L background activity in ground water sampled from the CARNRW1 well, however, tritium was detected at 136 pCi/L in the February 2003 ground water sample from CARNRW2. Five confirmatory ground water samples collected from CARNRW2 after February did not yield tritium above 102 pCi/L. TCE, nitrate, and perchlorate concentrations in ground water in these water-supply wells remain below detection limits.

Wells K6-26, K6-27, K6-34, K6-35, and EP6-07 are screened in a deeper water-bearing zone than the wells along the transect discussed above. During this reporting period, elevated tritium was detected in ground water samples from wells K6-35 (294 pCi/L) and EP6-07 (313 pCi/L). These wells show some response to pumping from CARNRW1 and CARNRW2.

As presented in Table 2.3.1-4, there were no significant changes in perchlorate ground water concentrations during this reporting period when compared to those from the previous quarter. Perchlorate was detected above the State Action Level of 4 μg/L in wells K6-36 at 5.8 μg/L, K6-18 at 12 μg/L, and EP6-09 at 4.2 μg/L during this reporting period. In general, perchlorate ground water concentrations have been steadily decreasing from their historical maximum concentration of 65 μg/L in well K6-19 in 1998. Perchlorate concentrations remain below detection limits in water supply wells CARNRW1 and CARNRW2.

During this reporting period nitrate was detected above the 45 mg/L MCL in only one ground water sample from one well, K6–23 (159 mg/L as NO_3). Nitrate was not detected in ground water samples from water supply wells CARNRW1 and CARNRW2.

2.3.2.2. Pit 6 OU Remediation Optimization Evaluation

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In the Pit 6 OU, ground water elevations and contaminants are monitored on a regular basis to: 1) evaluate the effectiveness of the natural attenuation remedy in reducing contaminant concentrations and 2) detect any new chemical releases from the landfill. In general, all primary and secondary ground water COCs at the Pit 6 OU exhibit stable to decreasing trends and ground water elevations beneath the landfill remain a safe distance below the buried waste. The main concern at this time is whether tritium from the landfill will impact the nearby active water-supply wells, CARNRW1 and CARNRW2. Several ground water monitoring wells have been installed during the past two years to monitor tritium between the landfill and these nearby water-supply wells. Each of these new monitoring wells was carefully evaluated and screened in a fractured bedrock unit that responds to pumping from these water-supply wells. In addition, a numerical model is being developed to evaluate the potential impact of tritium from the Pit 6 landfill on these water-supply wells. Several alternatives are under consideration to mitigate any impact that this tritium could have on these wells. All tritium in ground water in this area remains far below the 20,000 pCi/L MCL.

2.3.2.3. Pit 6 OU Performance Issues

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There were no performance issues during this reporting period.

2.4. High Explosives Process Area (HEPA) OU4

The HEPA has been used since the 1950s for the chemical formulation, mechanical pressing, and machining of HE compounds into shaped detonation charges. Surface spills from 1958 to 1986 resulted in the release of contaminants at the former Building 815 steam plant. Subsurface contamination is also attributed to waste water discharges to former unlined rinsewater lagoons.

Three ground water extraction and treatment systems operate in the HEPA: Building 815-Source (B815-SRC), Building 815-Proximal (B815-PRX), and Building 815-Distal Site Boundary (B815-DSB). A map of HEPA OU showing the locations of monitoring and extraction wells and treatment facilities is presented in Figure 2.4-1.

B815-SRC currently treats ground water extracted from well W-815-02 for TCE, RDX, perchlorate, and nitrate. Well W-815-02 extracts ground water at a rate of about 1.5 gpm. This facility has been in operation since September 2000. It consists of an aqueous phase GAC unit, an ex-situ anaerobic bioreactor, and an ion-exchange unit. These treatment sub-units are connected in series and the treated effluent is discharged to a misting system.

B815-PRX currently treats ground water extracted from wells W-818-08 and W-818-09 for TCE, perchlorate, and nitrate. Wells W-818-08 and W-818-09 extract ground water at 3 and 1 gpm, respectively. This facility has been in operation since October 2002 and consists of an aqueous phase GAC unit and an ion-exchange unit. Treated effluent is discharged to a misting system.

B815-DSB treats low concentrations ($< 10\ \mu g/L$) of TCE contained in ground water extracted from wells W-35C-04 and W-6ER located near the Site 300 boundary. Wells W-35C-04 and W-6ER extract ground water at 2 and 1.5 gpm, respectively. This treatment facility has been in operation since September 1999 and consists of a solar-powered aqueous phase GAC treatment unit (STU04). Eight Solarex MSX83 solar panels generate 83 watts each and the battery bank is 115 amp/hours at 24 volts. Three GAC canisters connected in series are designed to treat up to 5 gpm of ground water at the expected influent concentrations. Treated effluent is discharged to an infiltration trench.

2.4.1. HEPA OU Ground Water Extraction and Treatment System Operations and Monitoring

This section is organized into four sections; facility performance assessment; operations and maintenance issues; compliance summary; and sampling plan evaluation and modifications.

2.4.1.1. HEPA OU Facility Performance Assessment

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The HEPA ground water treatment facility discharge is regulated by the RWQCB Substantive Requirements for Waste Discharge.

The monthly ground water and soil vapor discharge volumes and rates and operational hours are summarized in Tables 2.4.1.1-1 through 3. The total volume of ground water and vapor extracted and treated and mass removed during the reporting period are presented in Table Summ-1. The cumulative volume of ground water and soil vapor treated and discharged and mass removed is summarized in Table Summ-2. Analytical results for influent and effluent samples are shown in Table 2.4.1.1-4 through 2.4.1.1-6. The pH measurement results are presented in Appendix A.

2.4.1.2. HEPA OU Operations and Maintenance Issues

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During the first semester 2003, the B815-SRC ground water treatment system operated continually, except for three days in late May when the misting tower pipe line was drained and misting heads replaced. B815-PRX was periodically down throughout the first semester 2003 due to low flows and misting tower problems. B815-PRX was also shut down in late March to replace the flow meter on W-818-08 and in late May to replace misting tower parts. B815-DSB operated continually throughout first semester 2003.

2.4.1.3. HEPA OU Compliance Summary

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The B815-SRC, B815-PRX, and B815-DSB ground water treatment systems operated in compliance with the Substantive Requirements for Wastewater Discharge.

2.4.1.4. HEPA OU Facility Sampling Plan Evaluation and Modifications

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The HEPA facility sampling plans comply with CMP monitoring requirements. The sampling plans are presented in Table 2.4.1.4-1. There were no additional modifications made to the plans.

2.4.2. HEPA OU Ground Water and Surface Water Monitoring

During the reporting period, ground water monitoring was conducted in accordance with the CMP monitoring requirements with the following exceptions; 4 monthly, 1 quarterly, and 31 semiannual samples were not collected. The sampling plan and schedule by quarter for ground water and surface water is presented in Table 2.4.2-1. This table also delineates and explains deviations from the sampling plan and indicates any additions made to the CMP. Biennial or annual samples not collected during the first semester will be attempted during the second semester. Analytical results are summarized in Tables 2.4.2-2 through 2.4.2-6.

Ground water elevations measured during the reporting period are summarized in Table 2.4.2-7. A ground water potentiometric surface map for the OU will be presented in the next report and annually thereafter. Ground water elevation data collected from wells within the OU are similar to those collected during past quarters.

2.4.3. HEPA OU Remediation Progress Analysis

This section is organized into five sections; mass removal; contaminant concentration/plume reductions; analysis of contaminant distribution and concentration trends; remediation optimization evaluation; and performance issues.

2.4.3.1. HEPA OU Mass Removal

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The monthly ground water and soil vapor mass removal estimates are summarized in Tables 2.4.3.1-1 through 3. The cumulative mass estimates are summarized in Table SUMM-2.

2.4.3.2. HEPA OU Analysis Of Contaminant Distribution and Concentration Trends

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At the HEPA OU, VOCs (primarily TCE) are the primary COCs detected in ground water; RDX, perchlorate, and nitrate are the secondary COCs. These constituents have been identified in the Tnbs$_2$ HSU. Ground water contaminant concentration contour maps of the COCs will be presented in the next report.

During this reporting period, TCE was detected at 0.6 μg/L in two (W-35B-02 and W-35B-04) of the five offsite guard wells for the HE Process Area. Historically, these Tnbs$_2$ HSU wells have had sporadic trace detections of TCE ranging from 0.6 to 1.3 μg/L. As shown in Figure 2.4-1, these offsite guard wells are located just southeast of the HE Process Area. TCE was also detected in one of the onsite guard wells (W-880-02) at 0.62 μg/L. W-880-02 is screened in the Quaternary alluvial (Qal) HSU and it is located where the Tnbs$_2$ HSU subcrops beneath the Qal HSU and Building 832 Canyon flows into Corral Hollow Creek (Figure 2.4-1). It acts as a guard well for both the HE Process Area and Building 832 Canyon. It has had sporadic trace detections ranging from 0.55 to 1.0 μg/L. TCE was also detected in offsite water-supply well Gallo-1 at 0.54 μg/L. This well has a long screen that extends from the Qal HSU near the surface to a depth of nearly 200 feet at the base of the Tnbs$_2$ HSU. Although Gallo-1 has had sporadic detections of TCE ranging from 0.2 to 1.5 μg/L, TCE has never been detected in ground water samples collected from upgradient guard wells (W-6H and W-6J). If TCE continues to be detected in these guard wells, then modifications will be considered to the extraction wellfield to prevent further offsite migration of contaminants.

The shape of the TCE plume remains similar to that shown in recent quarterly reports. The current maximum TCE concentration (56 μg/L) occurs in wells W-818-08 and W-818-11. These wells have historically contained the highest TCE plume concentrations. The leading edge of the TCE plume at the 0.5 μg/L detection limit remains in the vicinity of the site boundary. TCE was not detected in ground water samples from offsite guard wells W-35B-03 and W-35B-05, located just south of the Site 300 boundary, during this reporting period.

During this reporting period, secondary COCs RDX and perchlorate were not detected in any of the HEPA site boundary or water supply guard wells. The extent of RDX and perchlorate in the Tnbs$_2$ HSU is more limited than TCE and the shape of these plumes remained essentially the same as shown in recent quarterly reports. The current maximum RDX concentration (83 μg/L) occurs where it has historically in well W-815-04. Well W-815-04 is planned as an extraction well as part of the B815-SRC expansion that is scheduled for fiscal year 2004. RDX decreases rapidly downgradient to below the 0.6 μg/L Preliminary Remediation Goal (PRG) limit just north of well W-818-08. The current maximum perchlorate concentration (24 μg/L) occurs in well W-817-01. Well W-817-01 is planned to be an extraction well for the B817-SRC facility that is due to startup by October 1, 2003. Perchlorate decreases rapidly downgradient of W-817-01 to the 4 μg/L detection limit just north of well W-6G.

During this reporting period, nitrate was not detected above the 45 mg/L MCL in any of the HE Process Area guard wells. The current maximum nitrate concentration (130 mg/L) occurs in well W-809-02, located near the former HE rinse water lagoons. Nitrate concentrations decrease significantly due to microbial denitrification near the Site 300 boundary where the $Tnbs_2$ HSU is under confined conditions. Nitrate concentrations near the Site 300 boundary are significantly lower than the drinking-water standard of 45 mg/L and in many wells nitrate is below the method detection limit of 0.4 mg/L (as nitrate).

2.4.3.3. HEPA OU Remediation Optimization Evaluation

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The key to remediation optimization at the HE Process Area OU is to manage extraction flow rates to balance the influence of site boundary pumping with source area pumping. The most significant change in extraction flow rates during this reporting period was due to the startup of the extraction wellfield for the B815-PRX treatment facility. The total flow from the two B815-PRX extraction wells (W-818-08 and W-818-09) is about 3 gpm, which increases the total flow near source areas to 4 gpm. This increase in flow rate is designed to offset the effect of site boundary pumping at 3 gpm for the B815-DSB facility. With the addition of the B815-PRX facility, TCE mass removal has increased by 10 grams per month.

2.4.3.4. HEPA OU Performance Issues

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TCE detections in some of the site boundary guard wells during this reporting period indicate that the leading edge of the plume may not be adequately captured. Continued pumping at B815-PRX and startup of the B817-SRC by September 30, 2003 should address this issue. If TCE continues to be detected in the site boundary guard wells, then modifications to the extraction wellfield will be considered, including increased pumping in existing upgradient extraction wells or adding new extraction wells.

2.5. Building 850 (B850) OU5

High explosives experiments have been conducted at the Building 850 firing table. Until 1989, gravels on the firing table surface were disposed of in several disposal pits in the northern portion of the site. Presently, the firing table is used very rarely. Infiltrating ground water has mobilized chemicals from contaminated gravel and debris to underlying soil, bedrock, and ground water. A map of Building 850 OU showing the locations of monitoring wells is presented in Figure 2.5-1.

2.5.1. Building 850 OU Ground Water Monitoring

During the reporting period, ground water monitoring was conducted in accordance with the CMP monitoring requirements with the following exceptions; 10 semiannual samples were not collected. Additionally, as stated below, seventeen water samples for uranium analysis were analyzed by alpha spectrometry, rather than by mass spectrometry as specified in the sampling plan. The sampling plan and schedule by quarter for ground water and surface water is presented in Table 2.5.1-1. This table also delineates and explains deviations from the sampling plan and indicates any additions made to the CMP. Biennial or annual samples not collected during the first semester will be attempted during the second semester. Analytical results are summarized in Tables 2.5.1-2 through 2.5.1-12.

Barcad samplers K1-01A, K1-01B, and K1-02A, and lysimeters K1-03A, K1-05A, and K1-02C were listed in the CMP as monitoring locations for Building 850. However, the lysimeters are inoperable and the functioning barcard samplers tap deep ground water and do not provide chemical data for the first (shallowest) water-bearing zone. Thus, these locations were not sampled during the reporting period and will be removed from future sampling plans.

Ground water elevations measured during the reporting period are summarized in Table 2.5.1-13. A ground water potentiometric surface map for the OU will be presented in the next report and annually thereafter. Ground water elevation data collected from wells within the OU are similar to those collected during past quarters.

2.5.2. Building 850 OU Remediation Progress Analysis

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This section is organized into four sections; contaminant concentration/plume reductions; analysis of contaminant distribution and concentration trends; remediation optimization evaluation; and performance issues.

2.5.2.1. Building 850 OU Analysis of Contaminant Distribution and Concentration Trends

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At the Building 850 OU, tritium is the primary COC detected in ground water; depleted uranium and nitrate are the secondary COCs. These COCs have been identified in ground water in the Qal and $Tnbs_1$ water-bearing zones. Ground water contaminant concentration contour maps of the COCs will be presented in the next report.

During this reporting period, the maximum detected tritium activity in $Tnbs_1$ bedrock-hosted ground water within the OU was 44,200 pCi/L in a sample from well NC7-61 (Table 2.5.1-3); the maximum alluvial tritium activity detected in the OU was 29,700 pCi/L in a ground water sample from well NC7-54, located adjacent to Well 8 Spring. These highest tritium activities in ground water in the OU continue to be located immediately downgradient of the tritium sources at the Building 850 firing table and continue to decline. The extent of the 20,000 pCi/L tritium activity contour continues to diminish, as indicated by the decline in ground water tritium activities at well K2-04S (14,900 pCi/L) and in samples from other wells completed in alluvium and bedrock in Doall Ravine. The distribution of ground water tritium activities in the East Firing Area (distal portion of the Building 850 tritium plume) is more complex. Tritium activities in ground water north of Pit 2 and Pit 1 are generally below recent highs detected during the last few years. The maximum current ground water tritium activity detected in this area is 4,880 pCi/L in a sample from well K1-06. Immediately south and east of Pit 2, maximum ground water tritium activities are 8,580 and 10,400 pCi/L at wells K2-01C and NC2-08, respectively (these analytical results are included in Table 3.1.1-2 of the Pit 2 section of this report). These activities are below recent highs of 19,200 pCi/L and 17,600 pCi/L, respectively, observed in ground water samples in 1999. Ground water samples collected in recent years from wells further south in Elk Ravine show very gradual increases in tritium activities over time, as the distal, low activity portion of the tritium plume continues to migrate south beneath Elk Ravine. These increases have recently been leveling off. During the reporting period, the maximum tritium activity in southern Elk Ravine was 8,550 pCi/L in a ground water sample from well NC2-12D. During 2002, the maximum tritium activity detected in ground water in this area was 8,880 pCi/L in a sample collected from this well.

Evidence of depleted uranium was identified in ground water samples collected from several wells in the OU (Table 2.5.1-6) and analyzed by mass spectrometry. The natural atom ratio of $^{235}U/^{238}U$ is about 0.0072 +/- 0.001. Atom ratios below this range indicate some addition of depleted uranium to the naturally-occurring uranium activity in the water. Such atom ratios were detected in ground water samples from several wells and a spring in the OU. The wells in which depleted uranium was detected (W-850-05, NC7-70, NC7-10, Well 8 Spring, and NC7-54) are proximal and downgradient of the Building 850 firing table except for well NC2-06A that is located in Elk Ravine). The maximum total uranium activity in ground water samples from these wells was 2.67 pCi/L. The distribution of uranium in ground water downgradient of Building 850 is similar to that seen in past quarters. The ground water sample from well NC2-06A contained 1.16 pCi/L of total uranium. The source of depleted uranium in this latter sample is being investigated. The MCL for uranium in drinking water is 20 pCi/L. During the reporting period, seventeen wells were inadvertently sampled and analyzed for alpha spectrometry (Table 2.5.1-5), which does not provide conclusive evidence of uranium provenance, rather than the mass spectrometry that was prescribed in the sampling plan. These data yielded a maximum uranium activity of 2.68 pCi/L in a ground water sample from K1-02B. In the future, ground water from these wells will be sampled and analyzed by mass spectrometry.

During the reporting period, nitrate was detected in the OU at a maximum concentration of 140 mg/L in a ground water sample from well NC2-10. Nitrate was also detected above 45 mg/L MCL in ground water samples from wells NC7-29, NC7-44, NC7-70, and NC7-61, at concentrations of 120 mg/L, 72 mg/L, 67 mg/L, and 63 mg/L, respectively. These latter nitrate concentrations may be at least partly a result of leachate from the Building 850 septic system. Ground water samples from the vast majority of wells in the OU yield tens of mg/L of nitrate, although ground water samples from several wells do not contain nitrate above the method detection limit of 0.1 mg/L. Perchlorate was detected in ground water samples from two wells in the OU, NC7-61 and K2-04S, at concentrations of 39 and 8.1 μg/L, respectively.

Analytical results for ground water samples collected in the OU for other constituents (VOCs, nitrate and perchlorate; metals; VOCs; HE compounds; gross alpha and beta radioactivity; general minerals; PCBs; and diesel range organic compounds) are presented in Table 2.5.1-2, Table 2.5.1-4, and Tables 2.5.1-7 through -12. These analytical results do not indicate releases of any of these chemicals to the environment.

2.5.2.2. Building 850 OU Remediation Optimization Evaluation

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Monitored Natural Attenuation (MNA) is the accepted method for remediation of tritium in ground water emanating from the Building 850 area. MNA continues to be effective for reducing tritium activities in ground water. The highest tritium activities in ground water in the OU continue to be located immediately downgradient of the tritium sources at the Building 850 firing table and continue to decline. The extent of the 20,000 pCi/L tritium activity contour also continues to diminish. In general, ground water tritium activities continue to decline or are below historic highs in all areas except in southern Elk Ravine where there have been very gradual increases in tritium activities over time, as the distal, low activity portion of the tritium plume continues to migrate south beneath Elk Ravine. These increases have recently been leveling off and are well below the 20,000 pCi/L MCL for tritium in drinking water. The distribution of depleted uranium is similar to previous years and total uranium in ground water continues to be well below the 20 pCi/L MCL in all wells in the Building 850 area. The extent of nitrate and perchlorate in ground water is also similar to that observed in previous years.

2.5.2.3. Building 850 OU Performance Issues

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Ground water elevation and chemical monitoring are a high priority in the Building 850 OU. Next semester, wells that were inadvertently sampled and the ground water analyzed for uranium by alpha spectrometry will be re-sampled and the ground water will be analyzed by mass spectrometry as prescribed in the sampling plan.

The increases in ground water tritium activities in the distal portion of the Building 850 plume (in southern Elk Ravine) are to be expected and will continue to be monitored on a regular basis.

The depleted uranium detected in a ground water sample from well NC2-06A will be investigated to determine the likely source. Several additional wells in the area will be sampled to facilitate this source evaluation.

2.6. Building 854 (B854) OU6

The Building 854 complex was used to test the stability of weapons and weapon components under various environmental conditions and mechanical and thermal stresses. A map of Building 854 OU showing the locations of monitoring and extraction wells and treatment facilities is presented in Figure 2.6-1.

Two ground water extraction and treatment systems currently operate in the Building 854 OU; Building 854-Source (B854-SRC) and Building 854-Proximal (B854-PRX).

The B854-SRC ground water extraction and treatment system began operation in December 1999 and treats ground water extracted at a rate of approximately 1 gpm from well W-854-02. Influent water passes from the filtration system into two ion-exchange vessels containing SR-7 resin connected in series for perchlorate removal prior to entering the portable Solar-powered Treatment Unit outfitted with aqueous-phase GAC for VOC removal. The effluent water is discharged through misting towers to remove nitrate.

B854-PRX began operation in November 2000 and treats ground water extracted at a rate of 1 gpm from well W-854-03 located southeast of the Building 854 complex. This facility has been in operation since November 2000. It consists of a STU outfitted with aqueous-phase GAC for VOC removal, above ground containerized wetland bio-treatment for perchlorate and nitrate removal, and an ion-exchange resin treatment for polishing prior to being discharged into an infiltration trench.

2.6.1. Building 854 OU Ground Water and Soil Vapor Extraction and Treatment System Operations and Monitoring

This section is organized into five sections; facility performance assessment; operations and maintenance issues; receiving water monitoring; compliance summary; and sampling plan evaluation and modifications.

2.6.1.1. Building 854 OU Facility Performance Assessment

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The Building 854 ground water treatment facility discharge is regulated by the RWQCB Substantive Requirements for Waste Discharge.

The monthly ground water and soil vapor discharge volumes and rates and operational hours are summarized in Tables 2.6.1.1-1 and 2. The total volume of ground water and vapor extracted and treated and mass removed during the reporting period is presented in Table Summ-1. The cumulative volume of ground water and soil vapor treated and discharged and mass removed are summarized in Table Summ-2.

Analytical results for influent and effluent samples are shown in Table 2.6.1.1-3 and 2.6.1.1-4. The pH measurement results are presented in Appendix A.

There were no performance issues at B854-SRC during the reporting period. Perchlorate was detected in samples collected between the B854-PRX wetland bioreactor and the ion-exchange resin in April and again in June. The wetland bioreactor may not be treating all the perchlorate because residence time has decreased due to a decrease in pore space caused by silting. Until maintenance can be performed, the resin columns are treating perchlorate prior to discharge.

2.6.1.2. Building 854 OU Operations and Maintenance Issues

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The power to the B854-SRC facility, supplied by Building 854F, was turned off from January 11th to 13th for building maintenance. From February 18th to 24th, the B854-SRC treatment facility was taken off-line for routine maintenance of plant growth around the misting towers. The facility was also shut down from February 27th to March 5th to repair a water level transducer in extraction well W-854-02. A power outage in the Building 854 area interrupted operations from March 17th to 24th, 2003.

The B854-PRX facility was shut down from February 12th through 19th to replace pressure gauges.

2.6.1.3. Building 854 OU Compliance Summary

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The B854-SRC and B854-PRX ground water treatment systems operated in compliance with the Substantive Requirements for Wastewater Discharge.

2.6.1.4. Building 854 OU Facility Sampling Plan Evaluation and Modifications

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The Building 854 facility sampling plans comply with CMP monitoring requirements. The sampling plans are presented in Table 2.6.1.4-1. There were no additional modifications made to the plan.

2.6.2. Building 854 OU Ground Water Monitoring

During the reporting period, ground water monitoring was conducted in accordance with the CMP monitoring requirements with the following exceptions: six semiannual samples were not collected. The sampling plan and schedule by quarter for ground water and surface water are presented in Table 2.6.2-1. This table also delineates and explains deviations from the sampling plan and indicates any additions made to the CMP. Biennial or annual samples not collected during the first semester will be attempted during the second semester. Analytical results are summarized in Table 2.6.2-2 through 2.6.2-8.

Ground water elevations measured during the reporting period are summarized in Table 2.6.2-9. A ground water potentiometric surface map for the OU will be presented in the next report and annually thereafter. Ground water elevation data collected from wells within the OU are similar to those collected during past quarters.

2.6.3. Building 854 OU Remediation Progress Analysis

This section is organized into five sections; mass removal; contaminant concentration/plume reductions; analysis of contaminant distribution and concentration trends; remediation optimization evaluation; and performance issues.

2.6.3.1. Building 854 OU Mass Removal

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The monthly ground water and soil vapor mass removal estimates are summarized in Tables 2.6.3.1-1 and 2. The cumulative mass estimates are summarized in Table SUMM-2.

2.6.3.2. Building 854 OU Analysis Of Contaminant Distribution and Concentration Trends

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At the Building 854 OU, VOCs (primarily TCE) are the primary COCs detected in ground water and perchlorate and nitrate are the secondary COCs. Past quarterly reports have shown the $Tnbs_1$ to be the main contaminated water-bearing zone, however this conceptual model was revised for the Draft Building 854 Remedial Design report. Although the lower Neroly $Tnbs_1$ and the $Tnsc_0$ are distinct stratigraphic units, the ground water contained in these units appears to be in hydraulic communication. These stratigraphic units comprise a single HSU, the $Tnbs_1/Tnsc_0$ HSU. Contaminant plumes for TCE, perchlorate, and nitrate have been identified in the $Tnbs_1/Tnsc_0$ HSU. Ground water contaminant concentration contour maps of the COCs will be presented in the next report.

The definition of the TCE plume, as shown in the Draft Building 854 Remedial Design, has been revised from plumes shown in past quarterly reports. TCE has not been detected in ground water samples collected from recently installed wells W-854-1701, W-854-1822, W-854-1823, and W-854-1902 indicating that the plume is not as extensive downgradient as previously shown. During this reporting period, the plume shape remains similar to that shown in the Draft Building 854 Remedial Design report. The current maximum TCE concentration (210 μg/L) occurs where it has historically in well W-854-02. TCE decreases to below the 0.5 μg/L detection limit north of wells W-854-1701, W-854-1822, and W-854-1902. Localized TCE contamination occurs in wells W-854-06 (1.9 μg/L) and W-854-07 (33 μg/L) located in the vicinity of former water-supply Well 13 and downgradient of the main TCE plume.

The extent of the perchlorate plume, as shown in the Draft Building 854 Remedial Design report, is slightly longer than that shown in past quarterly reports due to the detection of perchlorate in recently installed wells W-854-1823 and W-854-1902. During this reporting period, the plume shape is slightly different than that shown in the Draft Building 854 Remedial Design report. The previous northernmost (upgradient) detection of perchlorate in the Building 854 OU occurred in ground water from well W-854-02 with concentrations ranging from 4.5 to 8.3 μg/L. However, during this reporting period, perchlorate was not present in ground water samples from that well above the detection limit (4 μg/L). The current northernmost detection of perchlorate occurs in well W-854-03 at a concentration of 10 μg/L. The current maximum perchlorate concentration (27 μg/L) in the OU was detected in ground water from well W-854-1823. Perchlorate concentrations in ground water decreases to below the detection limit north of well W-854-07.

During the reporting period, the nitrate plume shape remains similar to that shown in the Draft Building 854 Remedial Design report. The current maximum nitrate concentration (53 mg/L) occurs in well W-854-02. Nitrate decreases to below the drinking water standard of 45 mg/L just south of well W-854-03.

2.6.3.3. Building 854 OU Remediation Optimization Evaluation

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As reported in the Building 854 Remedial Design report, remediation at the Building 854 OU can be optimized by:

- Adding extraction wells in the source and proximal treatment areas,
- Conducting soil vapor extraction treatability testing at B854-SRC to evaluate of the long-term efficiency of soil vapor extraction to remove VOC mass from the vadose zone and ground water, and
- Installing a ground water extraction and treatment system (B854-DIS) in the vicinity of former water-supply well 13.

These actions are planned as part of the remedial design for ground water cleanup at the Building 854 OU and will be implemented in phases.

2.6.3.4. Building 854 OU Performance Issues

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The main issue influencing mass removal performance at the Building 854 OU continues to be low permeability and well yield. Although fractures appear to be important ground water flow-controlling features in this area, the overall primary and secondary permeability in many wells is relatively low. At the B854-SRC facility, extraction well W-854-02 continues to be pumped at 1 gpm. This well has approximately 5 more feet of available drawdown under pumping conditions and is being considered for increased pumping to 1.5 to 2 gpm. Performance of the B854-PRX facility is limited by well yield and the constructed wetland treatment technology that is being used to treat perchlorate. An expansion of the constructed wetland would be necessary to increase the flow rate at this facility above the current rate of 1 gpm.

2.7. Building 832 Canyon (B832) OU7

Building 832 Canyon facilities were used to test the stability of weapons and associated components under various environmental conditions. Contaminants were released from Buildings 830 and 832 through piping leaks and surface spills during testing activities at these buildings.

Four ground water extraction and treatment systems operate in the Building 832 Canyon OU, Building 832-Source (B832-SRC), Building 830-Source (B830-SRC), Building 830-Proximal (B830-PRX), and Building 830-Distal South (B830-DISS). Soil vapor extraction and treatment systems operate at B832-SRC and B830-SRC. A map of Building 832 OU showing the locations of monitoring and extraction wells and treatment facilities is presented in Figure 2.7-1

B832-SRC currently treats ground water for VOCs, perchlorate, and nitrate and has been in operation since October 1999. Approximately 230 gallons per day of ground water are extracted from nine wells (W-832-12, W-832-13, W-832-14, W-832-15, W-832-16, W-832-17, W-832-18, W-832-20 and W-832-22) to lower the water table and enhance soil vapor extraction. Ground water from these wells is treated using three aqueous-phase GAC reactors in series to remove VOCs followed by treatment using two ion exchange reactors in series to remove perchlorate. Treated water is then discharged by misting towers. Soil vapor is extracted from the same nine wells used for ground water extraction. A positive displacement rotary lobe blower is used to create a vacuum at each well head through a system of manifolded piping and the contaminated vapors are treated using three vapor-phase GAC reactors in series. Treated soil vapors are then discharged to the atmosphere under a permit from the San JoaquinValley Unified Air Pollution Control District.

B830-SRC currently treats ground water for VOCs, perchlorate, and nitrate and has been in operation since February 2003. Ground water is extracted from three wells (W-830-1807, W-830-19, and W-830-59) to lower the water table and enhance soil vapor extraction, remove source contamination and mitigate plume migration. These wells exhibit very low sustainable yield and are operated by timers that pump the well at low flow rates until dry and then shut off while the water levels recover. Ground water from these wells is treated using three aqueous-phase GAC reactors in series to remove VOCs followed by treatment using two ion exchange reactors in series to remove perchlorate. Treated water is then discharged by two misting towers. The B830-SRC soil vapor extraction and treatment system is being tested to evaluate whether this is a viable remediation technology for this low permeability source area. Soil vapor is extracted from well W-830-1807 using a regenerative blower and the contaminated vapors are treated using three vapor-phase GAC reactors in series. Treated soil vapors are then discharged to the atmosphere under a permit from the San JoaquinValley Unified Air Pollution Control District.

B830-PRX currently treats ground water for VOCs, perchlorate, and nitrate and has been in operation since June 2000. Approximately 2,000 gallons per day of ground water are extracted from one well (W-830-57) using a solar-powered ground water treatment unit. This water is treated using three aqueous-phase GAC reactors to remove VOCs. The treated ground water is discharged to the ground via a French drain.

B830-DISS currently treats ground water for VOCs, perchlorate, and nitrate and has been in operation since July 2000. Approximately 1,400 gallons per day of ground water are extracted from three wells (W-830-51, W-830-52, and W-830-53) using pressure developed through artesian and elevation forces and treated using GAC reactors to remove VOCs followed by treatment using two ion exchange reactors in series to remove perchlorate. Nitrate is removed from the extracted ground water using biological methods. Water flows through three Open Container Bio-Reactors that contain micro-organisms that utilize nitrate during cellular respiration. Acetic acid is added to the process stream prior to biological treatment as a carbon source. Treatment system effluent is discharged via a storm drain that empties to the Corral Hollow floodplain.

2.7.1. Building 832 Canyon OU Ground Water and Soil Vapor Extraction and Treatment System Operations and Monitoring

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This section is organized into five sections; facility performance assessment; operations and maintenance issues; receiving water monitoring; compliance summary; and sampling plan evaluation and modifications.

2.7.1.1. Building 832 Canyon OU Facility Performance Assessment

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The Building 832 ground water treatment facility discharge is regulated by the RWQCB Substantive Requirements for Waste Discharge.

The monthly ground water and soil vapor discharge volumes and rates and operational hours are summarized in Tables 2.7.1.1-1 through 4. The total volume of ground water and vapor extracted and treated and mass removed during the reporting period are presented in Table Summ-1. The cumulative volume of ground water and soil vapor treated and discharged and mass removed are summarized in Table Summ-2.

Analytical results for influent and effluent samples are shown in Table 2.7.1.1-5 and 2.7.1.1-6. The pH measurement results are presented in Appendix A.

The main performance issue impacting mass removal from the Building 832 Canyon OU facilities is low ground water yield. The contaminated water-bearing zones have such low hydraulic conductivity and the ground water yield is so low that the extraction wells cannot be operated continuously. Instead these wells are operated intermittently at low extraction rates with pumps that are turned on and off by timers.

2.7.1.2. Building 832 Canyon OU Operations and Maintenance Issues

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The B832-SRC and B830-DISS facilities were operated continuously during the first half of 2003. B830-SRC was operated intermittently during this reporting period while system operational parameters were adjusted to accommodate low ground water yield from the extraction wells. B830-PRX is solar-powered and operated approximately 50% of the time during first semester 2003. Operations at both the B832-SRC and the B830-SRC soil vapor extraction and treatment systems were interrupted for 1 to 2 days due to overheating during the hottest days of the summer.

2.7.1.3. Building 832 Canyon OU Compliance Summary

The B832-SRC, B830-SRC, B830-PRX, and B830-DISS ground water treatment systems operated in compliance with the Substantive Requirements for Wastewater Discharge.

2.7.1.4. Building 832 Canyon OU Facility Sampling Plan Evaluation and Modifications

The Building 832 facility sampling plans comply with CMP monitoring requirements. The sampling plan is presented in Table 2.7.1.4-1. There were no additional modifications made to the plan.

2.7.2. Building 832 Canyon OU Ground Water Monitoring

During the reporting period, ground water monitoring was conducted in accordance with the CMP monitoring requirements with the following exceptions; 17 semiannual samples were not collected. The sampling plan and schedule by quarter for ground water and surface water are presented in Table 2.7.2-1. This table also delineates and explains deviations from the sampling plan and indicates any additions made to the CMP. Biennial or annual samples not collected during the first semester will be attempted during the second semester. Analytical results are summarized in Tables 2.7.2-2 through 2.7.2-7.

Ground water elevations measured during the reporting period are summarized in Table 2.7.2-8. A ground water potentiometric surface map for the OU will be presented in the next report and annually thereafter. Ground water elevation data collected from wells within the OU are similar to those collected during past quarters.

2.7.3. Building 832 Canyon OU Remediation Progress Analysis

This section is organized into five sections; mass removal; contaminant concentration/plume reductions; analysis of contaminant distribution and concentration trends; remediation optimization evaluation; and performance issues.

2.7.3.1. Building 832 Canyon OU Mass Removal

The monthly ground water and soil vapor mass removal estimates are summarized in Tables 2.7.3.1-1 through 4. The cumulative mass estimates are summarized in Table SUMM-2.

2.7.3.2. Building 832 Canyon OU Analysis of Contaminant Distribution and Concentration Trends

At the Building 832 Canyon OU, VOCs (primarily TCE) are the primary COCs detected in ground water. Perchlorate and nitrate are the secondary COCs. These constituents have been identified primarily in the $Tnsc_{1b}$ HSU. Lower concentrations have also been detected in the $Tnbs_2$ and $Tnbs_1$ HSU. Ground water contaminant concentration contour maps of the COCs will be presented in the next report.

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During this reporting period, TCE was detected at 0.62 μg/L in one (W-880-02) of four site-boundary guard wells for the Building 832 OU. Historically, this Quaternary alluvial guard well has had sporadic trace detections of TCE ranging from 0.54 to 1.0 μg/L. The current maximum TCE concentration (13,000 μg/L) occurs in well W-830-49. This well, which is located just south of the Building 830 source area, has historically contained the highest TCE plume concentrations. The leading edge of the plume at the 0.5 μg/L TCE detection limit remains in the vicinity of the site boundary.

Secondary COCs, perchlorate and nitrate, were not detected in any of the Building 832 OU guard wells. The extent of perchlorate and nitrate is more limited than TCE. The current maximum perchlorate concentration (9 μg/L) occurs in well W-830-25. The current maximum nitrate concentration (190 mg/L) occurs in well W-830-19.

Three wells (W-832-1927, W-830-1831, and W-830-1832) were recently installed to evaluate the downgradient extent of the ground water plumes emanating from Buildings 832 and 830. Well W-832-1927 is located southwest of Building 832 and screened in the $Tnsc_{1b}$ water-bearing zone and wells W-830-1831 and W-830-1832 are located southwest of Building 830 and screened in the $Tnsc_{1b}$ and $Tnbs_1$, respectively. Based on initial results from these wells, the downgradient extent of the $Tnsc_{1b}$ TCE and perchlorate plumes emanating from Building 832 and the downgradient extent of the $Tnbs_1$ TCE plume emanating from Building 830 have increased. TCE was not detected in the initial ground water sample from $Tnsc_{1b}$ well W-830-1831 but was detected at 1.4 μg/L in $Tnbs_1$ well W-830-1832. Perchlorate and nitrate were not analyzed in the W-830-1831 and W-830-1832 wells during this reporting period. Further sampling and analysis of these key wells are planned for the second half of 2003.

2.7.3.3. Building 832 Canyon OU Remediation Optimization Evaluation

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Evaluation of the Building 832 Canyon OU treatment facility operational parameters continues. During this reporting period, optimization testing was conducted mainly at the B830-SRC facility. The extraction wells for this facility are very low yield requiring timers to operate the pumps. These tests include the use of the soil vapor extraction blower to create a negative pressure in the well to enhance ground water yield. Initial results indicate that ground water yield can be increased two-fold using this method.

2.7.3.4. Building 832 Canyon OU Performance Issues

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Overall, as expected well yields remain low due to a combination of dewatering and low hydraulic conductivity in the B832-SRC and B830-SRC facility areas. An evaluation will be conducted to determine how to increase well yield and mass removal at the OU treatment facilities.

The guard wells at the Site 300 boundary were generally below analytical detection limits for the COCs with a few exceptions. Trace concentrations of TCE (0.62 μg/L) were detected in one of the three samples collected during this reporting period in the site boundary guard well W-880-02. This well is screened in the shallow Quaternary alluvium (Qal) where the $Tnbs_2$ HSU subcrops beneath the Qal. In addition, low concentrations of TCE (1.4 μg/L and 1.7 μg/L) were detected in guard well W-830-1832. This well was installed as a Well 20 guard well between the leading edge of the $Tnbs_1$ TCE plume and Site 300 water-supply well 20. If VOCs continue to be detected in this guard well, a new Upper $Tnbs_1$ guard well will be installed downgradient (southwest) of well W-830-1832, and upgradient of Well 20. Expansion of the B830-SRC extraction wellfield, including $Tnbs_1$ extraction wells, will be considered to prevent further migration of contaminants toward onsite water-supply wells.

2.8 Site 300 Site-Wide OU

The Site 300 Site-Wide OU is comprised of release sites at which no significant ground water contamination and no unacceptable risk to human health or the environment is present. For this reason, a monitoring-only interim remedy was selected for the release sites in the Interim Site-Wide Record of Decision (U.S. DOE, 2001). The monitoring conducted during the first semester of 2003 for these release sites is discussed below.

2.8.1. Building 801 and Pit 8 Landfill

Minor VOC contamination is present in the subsurface as a result of discharges of waste fluid to a dry well adjacent to Building 801D from the late 1950s to 1984. A map showing the locations of monitoring wells is presented in Figure 2.8.1-1. During the reporting period, ground water monitoring was conducted in accordance with the CMP monitoring requirements with the following exceptions; 4 quarterly and 1 semiannual sample were not collected. The sampling plan and schedule by quarter for ground water are presented in Table 2.8.1-1. This table also delineates and explains deviations from the sampling plan and indicates any additions made to the CMP. Biennial or annual samples not collected during the first semester will be attempted during the second semester.

For the last ten years TCE in wells K8-01 and K8-03B, located downgradient from the former Building 801D dry well, has ranged from below detection limits (<0.5) μg/L to a maximum of 4.9 μg/L. The MCL for TCE is 5 μg/L. The analytical results for the Building 801 monitoring well samples are presented in Tables 2.8.1-2 through 2.8.1-8. Ground water elevation measurements for the detection monitoring wells are presented in Table 2.8.1-9. A ground water potentiometric surface map for the OU will be presented in the next report and annually thereafter. Ground water elevation data collected from wells within the OU are similar to those collected during past quarters.

To date, no contaminant releases have been identified from the Pit 8 Landfill. Detection monitoring of this landfill, which is discussed in Section 3.2, is conducted to determine if releases have occurred.

2.8.2. Building 833

Spills and rinsewater disposal at Building 833 resulted in minor VOC contamination of shallow soil/bedrock and perched ground water. A map showing the locations of monitoring wells is presented in Figure 2.8.2-1. During the first half of 2003, all the wells in the shallow, perched water-bearing zone except for well W-833-30 were dry or had too little water to collect a valid sample. This trend has occurred for several years. TCE has not been detected in deep regional aquifer well W-830-30 indicating that the TCE contamination continues to be confined to the shallow, perched water-bearing zone. The sampling plan and schedule by quarter for ground water are presented in Table 2.8.2-1. This table also delineates and explains deviations from the sampling plan and indicates any additions made to the CMP.

The analytical results for the Building 833 monitoring well samples are presented in Tables 2.8.2-2 and 2.8.2-3. Ground water elevation measurements for the detection monitoring wells are presented in Table 2.8.2-4. A ground water potentiometric surface map for the OU will be presented in the next report and annually thereafter. Ground water elevation data collected from wells within the OU are similar to those collected during past quarters.

2.8.3. Building 845 Firing Table and Pit 9 Landfill

Leaching from the Building 845 firing table debris resulted in minor contamination of subsurface soil with depleted uranium and HMX. No ground water contamination has been detected. A map showing the locations of monitoring wells is presented in Figure 2.8.3-1. Ground water samples were collected from the monitoring wells in the vicinity of Building 845 firing table and analyzed for high explosives compounds and other constituents of concern as specified by the sampling plan presented in Table 2.8.3-1. The analytical results for the Building 845 monitoring well samples are presented in Tables 2.8.3-2 through 2.8.3-8. Water from well K9-01 had a borderline U^{235}/U^{238} ratio of 0.00697, which means that this result is slightly below the natural atom ratio of 0.0070 ratio, indicating a slight but measurable addition of depleted uranium.

Ground water elevation measurements for the detection monitoring wells are presented in Table 2.8.3-9. A ground water potentiometric surface map for the OU will be presented in the next report and annually thereafter. Ground water elevation data collected from wells within the OU are similar to those collected during past quarters.

To date, no contaminant releases have been identified from the Pit 9 Landfill. Detection monitoring of this landfill, which is discussed in Section 3.3, is conducted to determine if any releases have occurred.

2.8.4. Building 851 Firing Table

High explosives experiments at the Building 851 firing table resulted in minor VOC and RDX contamination in soil and low levels of uranium with a depleted uranium component in ground water. A map showing the locations of monitoring wells is presented in Figure 2.8.4-1.

During the reporting period, ground water monitoring was conducted in accordance with the CMP monitoring requirements with the following exceptions; 1 semiannual sample was not collected. The sampling plan and schedule by quarter for ground water and surface water is presented in Table 2.8.4-1. This table also delineates and explains deviations from the sampling plan and indicates any additions made to the CMP. Biennial or annual samples not collected during the first semester will be attempted during the second semester.

The analytical results for the Building 851 monitoring well samples are presented in Tables 2.8.4-2 through 2.8.4-8. Ground water elevation measurements for the detection monitoring wells are presented in Table 2.8.4-9. A ground water potentiometric surface map for the OU will be presented in the next report and annually thereafter. Ground water elevation data collected from wells within the OU are similar to those collected during past quarters.

Tritium was detected in a ground water sample from well W-851-08 at an activity of 270 pCi/L during the first half of 2003. This is a typical result compared to the previous year and continues the trend of decreasing tritium activities in this well from the one-time high of 3,790 pCi/L in late 1998. Ground water from well W-851-08 was also sampled for RDX, HMX, and TCE this semester but they were not detected.

Before the first half of 2003, the U^{235}/U^{238} ratios in ground water indicated depleted uranium in a ground water sample from well W-851-04. The total uranium activities in ground water samples from the four Building 851 wells ranged from 0.01 to 1 pCi/L. The distribution of total uranium in ground water is similar to previous years.

3. Detection Monitoring, Inspection, and Maintenance Program for the Pits 2, 8, and 9 Landfills

The Pits 2, 8, and 9 Landfills received firing table debris from the 1950s to the 1970s. At present, there is no evidence of contaminant releases to ground water from any of these three landfills, and no unacceptable risk or hazard to human or ecological receptors has been identified. The Detection Monitoring Program is designed to detect any future releases of contaminants from these landfills. Section 3 presents the results for the Pit 2, 8, and 9 Landfills ground water detection monitoring network, and any landfill inspections or maintenance that was conducted during the 1st semester of 2003.

3.1 Pit 2 Landfill

3.1.1. Contaminant Detection Monitoring Results

During the first semester of 2003, ground water samples were collected from the two Pit 2 detection monitoring wells (K2-01C and NC2-08) and analyzed for tritium. During the first quarter of 2003, ground water samples were also collected and analyzed for VOCs, fluoride, RDX and HMX, nitrate, perchlorate, and Title 26 metals including thorium, lithium, and beryllium. No release of chemicals from Pit 2 is indicated by Detection Monitoring Program ground water data from the current reporting period. A map of showing the locations of monitoring wells is presented in Figure 3.1.1-1. The analytical data for the Pit 2 detection monitoring well samples are presented in Tables 3.1.1-1 through 3.1.1-6. Depth to ground water was measured at 50-55 ft beneath the Pit 2 Landfill. These data are consistent with previous water elevations. Ground water elevation measurements for the detection monitoring wells are presented in Table 3.1.1-7. A ground water potentiometric surface map for the OU will be presented in the next report and annually thereafter.

3.1.2. Sampling and Analysis Plan Modifications

The sampling plan and schedule for the Pit 2 ground water Detection Monitoring Program are presented in Table 3.1.2-1. Ground water samples to be analyzed for uranium and thorium isotopes were not collected during the reporting period and will be collected and analyzed next semester. There were no other deviations from the sampling plan.

3.1.3. Landfill Inspection Results

The Pit 2 Landfill was inspected during the first semester of 2003 to identify any degradation or damage to the surface of the landfill that could lead to: 1) increased infiltration of precipitation, 2) exposure of the landfill contents, and 3) flow of surface water onto or adjacent to the landfill. Landfill conditions were reported as satisfactory. The soil cover was intact and the vegetative cover was in good condition.

3.1.4. Annual Subsidence Monitoring Results

The annual subsidence monitoring will be conducted during the second semester of 2003.

3.1.5. Maintenance

The inspection indicated that the soil and vegetative cover appeared to be intact and in good condition. Thus, no maintenance was necessary during the first semester of 2003.

3.2. Pit 8 Landfill

3.2.1. Contaminant Detection Monitoring Results

During the first half of 2003, ground water samples were collected from the Pit 8 monitoring wells and analyzed for a suite of chemicals. Perchlorate was detected at a concentration of 5 μg/l in a water sample from well K8-04 and fluoride was detected at a concentration of 10 mg/L. This was the first time a sample from this well had been analyzed for perchlorate. Fluoride concentrations in previous samples collected from well K8-04 were typically around 0.4 mg/L. Confirmation sampling of perchlorate and fluoride will be done during the second semester of 2003 as part of the regular CMP program. In addition, first semester samples were analyzed for VOCs, high explosives compounds RDX and HMX, nitrate, uranium and thorium isotopes, and Title 26 metals. Thorium, lithium and beryllium metals analyses are scheduled for later in 2003, as is sampling of well K8-02B.

Except for the perchlorate and fluoride detections cited above, there were no new detections of constituents of concern from Pit 8 area wells as indicated by the Detection Monitoring Program ground water data collected during the first semester of 2003. The analytical results for the Pit 8 detection monitoring well samples are presented in Tables 2.8.1-2 through 2.8.1-8. Ground water elevation measurements for the detection monitoring wells are presented in Table 2.8.1-9. There was no significant change in ground water elevations during the first semester of 2003 compared to the previous year. Depth to ground water was approximately 60 ft beneath the Pit 8 Landfill.

3.2.2. Sampling and Analysis Plan Modifications

The sampling plan and schedule for the Pit 8 ground water Detection Monitoring Program are presented in Table 2.8.1-1. There were no additional modifications made to the plan. Well K8-02B was not sampled this semester due to the personnel shortage, and will be sampled in the second semester of 2003. Analysis of samples for thorium, lithium and beryllium are scheduled for later in 2003.

3.2.3. Landfill Inspection Results

Inspections of the landfill with repeated surveys to compare to a baseline survey are in the working stage and will be completed in the second half of 2003.

3.2.4. Annual Subsidence Monitoring Results

The annual subsidence monitoring will be conducted during the second semester of 2003.

3.2.5. Maintenance

The inspection indicated that the soil and vegetative cover appeared to be intact and in good condition. Thus, no maintenance was necessary during the first semester of 2003.

3.3. Pit 9 Landfill

3.3.1. Contaminant Detection Monitoring Results

During the first half of 2003, ground water samples were collected from the four Pit 9 monitoring wells and analyzed for a suite of chemicals. Perchlorate and nitrate were not detected in the ground water. Fluoride was detected in each of the wells at a concentration of 0.5 mg/L or less. In addition, first semester samples were analyzed for VOCs; high explosives compounds; RDX and HMX; uranium and thorium isotopes; and Title 26 metals. Analysis of samples for thorium, lithium, and beryllium are scheduled for later in 2003. There were no new detections of constituents of concern from Pit 9 area wells as indicated by the Detection Monitoring Program ground water data collected during the first semester of 2003. The analytical results for the Pit 9 detection monitoring well samples are presented in Tables 2.8.3-2 through 2.8.3-8. Ground water elevation measurements for the detection monitoring wells are presented in Table 2.8.3-9. There was no significant change in ground water elevations during the first semester of 2003 compared to the previous year. Depth to ground water was approximately 110 ft beneath the Pit 9 Landfill.

3.3.2. Sampling and Analysis Plan Modifications

The sampling plan and schedule for the Pit 9 ground water Detection Monitoring Program are presented in Table 2.8.4-1. There were no additional modifications made to the plan.

3.3.3. Landfill Inspection Results

Inspections of the landfill with repeated surveys to compare to a baseline survey are in the working stage and will be completed in the second half of 2003.

3.3.4. Annual Subsidence Monitoring Results

Inspections of the landfill with repeated surveys to compare to a baseline survey are in the working stage and will be completed in the second half of 2003.

3.3.5. Maintenance

A maintenance related inspection of the landfill will be completed in the second half of 2003.

4. Risk and Hazard Management Program

4.1 Human Health Risk and Hazard Management

Institutional controls, such as restricting access to or activities in areas of elevated risk, remained in place during the first semester of 2003 to prevent unacceptable exposure to contaminants during remediation. Section 4 presents the results of soil sampling and analyses for polychlorinated biphenyl compounds (PCBs) conducted at Building 854 and the semi-annual ecological survey. The results of the annual modeling and sampling to assess human health risk status will be presented in the annual report as specified in the Compliance Monitoring Plan (2002).

4.1.1. Building 854

During the first quarter of 2003, surface soil sampling was conducted in the Building 854 OU as specified in the sampling plan submitted in the Building 854 Characterization Summary report (2002). This work was conducted to verify whether PCBs are present in soil at Building 854 at concentrations and a frequency that pose a risk to onsite workers warranting a remedial action.

As reported in the 1998 Building 854 OU Characterization summary, PCBs were detected in surface soil in 1995. Based on these results, additional sampling and analysis were performed in 2003 to fully characterize the extent of PCB contamination in surface soil.

In 1995, two surface soil samples were collected from the Building 854 OU and analyzed for PCBs. The locations of these samples are shown on Figure 4.1.1-1. The 1995 sample and a duplicate collected from location 3SS-854-21 contained 34 milligrams per kilogram (mg/kg) of Aroclor-1242 and 52 mg/kg of Aroclor-1248, respectively. Surface soil sample 3SS-854-22 contained 0.16 mg/kg of Aroclor-1254. The presence of PCBs in these samples, which were collected from the Building 855 lagoon and adjacent to Building 855, respectively, are presumably the result of past activities where oils and other liquid wastes were discharged to the lagoon. These liquids were used to clean parts and test assemblies.

In the baseline risk assessment, risk and hazard were calculated for inhalation of resuspended particulates, incidental ingestion of surface soil, and direct dermal contact with PCB-contaminated surface soil. These estimates assumed an onsite worker would spend 8 hours a day, 5 days a week, for 30 years working near the contamination. An unacceptable risk ($7 \times 10^{-}$

^{5}) was identified at Building 854. Building 854 is not currently occupied on a full-time basis, and local site use restrictions are in effect.

During January 2003, LLNL collected 38 additional surface soil samples using the ERD Standard Operating Procedure (SOP) 1.12, "Surface Soil Sampling" (Dibley and Depue, 2003). The samples were analyzed by the immunoassay onsite technique, EPA Method 4020. Eight duplicate samples were submitted to an offsite analytical laboratory and analyzed by EPA Method 8082. The locations of the samples collected in January 2003 are shown on Figure 4.1.1-2. Figure 4.1.1-3 shows the locations of samples collected within the Building 855 former disposal lagoon.

One sample (3SS-854-112) located within the Building 855 lagoon gave an absorbance reading that was extrapolated to equal 26 mg/kg PCBs using EPA Method 4020. The absorbance for all other samples indicated PCB concentrations lower then 1 mg/kg.

Of the eight samples analyzed by EPA Method 8082, two samples had PCB detections above the reporting limit of 0.007 mg/kg. The sample collected from location 3SS-854-112 contained 3.6 mg/kg of Aroclor-1248 and 4.7 mg/kg of Aroclor-1254 and a sample collected from the edge of the lagoon, 3SS-854-113, contained 0.023 mg/kg of Aroclor-1254. Only one sample (3SS-854-112) contained PCBs at concentrations above the EPA Industrial Soil PRG of 0.74 mg/kg for PCBs. Table 4.1.1-1 contains the PCB field immunoassay and analytical laboratory results.

A sample from location 3SS-854-112 was collected and analyzed for dioxins and furans using EPA Method 8290. A total toxicity equivalent concentration for the dioxin/furan compounds was calculated to be 2.6×10^{-5} mg/kg. This concentration was calculated by multiplying the measured dioxin/furan compound concentration by the Toxicity Equivalence Factor (TEF). The TEF is defined as an order of magnitude estimate of the toxicity of the various dioxin and furan compounds relative to the toxicity of 2, 3, 7, 8-Tetrachlorodibenzo-p-dioxin (TCDD). The total toxicity equivalent concentration is above the industrial soil PRG of 1.6×10^{-5} mg/kg. Table 4.1.1-2 contains the dioxin/furan analytical results and calculated TEF.

In April 2003, LLNL collected several additional samples in the location of the highest surface soil result detected in the lagoon (3SS-854-112). The samples were collected at 0.5 ft intervals starting at 0 ft and ending at 2.5 ft to profile the vertical extent of PCB contamination within the former disposal lagoon. The PCB 1248 was detected at all depths (see Table 4.1.1-3). LLNL will be collecting additional depth profile samples and will pursue a removal action/excavation if appropriate.

4.2. Ecological Risk and Hazard Management

During the late spring of 2003, surveys for important burrowing species were conducted in the survey areas specified in the Compliance Monitoring Plan (2002). Soil sampling and analysis for the presence of cadmium in the Building 834 survey area and the initiating of burrow air sampling for the presence of VOCs in the Pit 6 and Building 834 survey areas, as specified in the Compliance Monitoring Plan (2002), are scheduled for the late summer/early fall of 2003. Results of these sampling activities will be presented in future monitoring reports.

4.2.1. Wildlife Surveys Spring 2003

Wildlife surveys were conducted in the spring of 2003 to satisfy the requirements of the Compliance Monitoring Plan (2002). These requirements included semiannual surveys for important burrowing species in areas associated with hazard indices greater than 1. Three areas were identified as requiring semiannual monitoring: Building 834, Building 850 and Pit 6. Important species include special status species such as State of California or federally listed threatened or endangered species or State of California species of special concern.

4.2.1.1. Review of Historic Observations and Habitat Requirements

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Historic observations of special status species at each survey location were reviewed to determine which species should be targeted during future field surveys. Based on this review the fossorial special status species most likely to be observed in the area are the San Joaquin coachwhip (*Masticophis flagellum ruddocki*), coast horned lizards *(Phrynosoma coronatum frontale)*, silvery legless lizard (*Anniella pulchra pulchra*), burrowing owls (*Athene cunicularia*), San Joaquin pocket mice *(Perognathus inornatus)* and American badgers *(Taxidea taxus)*. We also reviewed the historic occurrences for the San Joaquin kit fox (*Vulpes macrotis mutica*). The results of this review are briefly described below.

San Joaquin kit fox (*Vulpes macrotis mutica*). The San Joaquin kit fox *(Vulpes macrotis mutica)* is a federal endangered species and a State of California threatened species. The range of the San Joaquin kit fox extends through much of the San Joaquin Valley from southern Kern County north through San Joaquin, Alameda and Contra Costa Counties and near La Grange in Stanislaus County (USFWS 1998). They occupy a variety of shrub and grassland communities, in addition to cultivated and urban areas that are adjacent to remnants of suitable habitat (USFWS 1998). Site 300 is within the northern range of the San Joaquin kit fox. Most recent observations of San Joaquin kit fox near Site 300 are from the 1980s and early 1990s. Historic observations of San Joaquin kit fox are known from the Carnegie area (immediately south of the Site 300), Bethany Reservoir (northeast of the Site 300), and Los Vaqueros Reservoir/Altamont Pass area (northwest of Site 300) (Orloff 1986a, Sproul and Fleet 1993) although there are no recorded observations of San Joaquin kit fox at Site 300. A study conducted in 1986, which included ground surveys, scent stations and night spotlighting did not detect the presence of the fox (Orloff 1986b). In 2002, a study was conducted to determine the presence and distribution of mesocarnivores (medium-sized carnivores, such as American badger) at Site 300 (Clark 2002). Three survey techniques were used: nocturnal spotlighting, infrared-triggered camera stations, and scat detection dogs. There were no observations of the endangered San Joaquin kit fox at Site 300 during this study, which validates earlier study results. Because of the lack of observations of San Joaquin kit fox during recent or historic surveys at or near Site 300 and the lack of recent observation in adjacent areas, it is extremely unlikely that San Joaquin kit foxes occur in any of the three survey areas.

American Badger *(Taxidea taxus)*. The American badger is not currently considered a state or federal special status species, although it was previously a State of California special concern species. This species occurs throughout Site 300.

San Joaquin pocket mouse *(Perognathus inornatus)*. The San Joaquin pocket mouse is a federal species of concern, but this species has no special status with the California Department of Fish and Game. San Joaquin pocket mice were observed in two locations during a small mammal inventory conducted at Site 300 in 2002 (West 2002). The 2002 small mammal surveys did not include an inventory of the entire site, but instead consisted of trapping at seven locations that represent the most common habitat types present at Site 300. San Joaquin pocket mice were observed in two of these locations during the 2002 surveys (Figure 4.2.1.1-1). San Joaquin pocket mice occur in dry open grasslands or scrub habitats on fine-textured soils between 1,150 and 2,000 ft (Harvey and Ahlborn 1990). The open grasslands that surround Building 850 provide appropriate habitat for this species.

Burrowing owl (*Athene cunicularia*). The burrowing owl is a federal species of concern and a California special concern species. Burrowing owls frequently nest in existing burrows located in the open valley (bowl) immediately north of Building 850. There are no historic burrowing owl nesting sites near Building 834 or Pit 6 although these areas provide suitable nesting habitat where existing burrows are present.

San Joaquin coachwhip (*Masticophis flagellum ruddocki*). The San Joaquin coachwhip is a California special concern species and a federal species of concern. San Joaquin coachwhip utilize open, dry, vegetation with little or no tree cover (Morafka and Banta 1976). In the western San Joaquin Valley, it occurs in valley grassland and saltbush scrub associations (Jennings and Hayes 1994, Montanucci 1965, Banta and Morafka 1968, Sullivan 1981). The San Joaquin coachwhip is generally found in areas with mammal burrows, which it uses for refuge during cold weather and for egg-laying sites. In 2002, field surveys were conducted at Site 300 that focused on determining the presence and distribution of four special status reptiles: the Alameda whipsnake *(Masticophis lateralis euryxanthus),* the San Joaquin coachwhip, the California legless lizard *(Anniella pulchra)*, and the California horned lizard *(Phrynosoma coronatum frontale)*. This study included trapping and visual surveys conducted in two areas in the southwest quarter of Site 300 during the spring and fall of 2002 (Swaim 2002). During the 2002 study, six San Joaquin coachwhips were observed in the southern half of the site, most along roads (Figure 4.2.1.1-2). The nearest observation of this species is approximately one mile from Building 850 and 3,700 feet from Pit 6. There have not been any site-wide surveys for this species at Site 300, although it is likely to occur throughout the site. All three survey areas provide potential habitat for this species.

Silvery legless lizard (*Anniella pulchra pulchra*). The silvery legless lizard is a California special concern species and a federal species of concern. The silvery legless lizard requires loose soil for burrowing (Stebbins 2003). It is found in areas with sparse vegetation including sand dunes, chaparral, pine-oak woodlands, desert scrub and riparian areas (Jennings and Hayes 1994, Stebbins 2003). During the special status reptile survey conducted at Site 300 in 2002, there was one observation of a silvery legless lizard near Building 858 (Swaim 2002). There have not been any site-wide surveys for this species at Site 300, therefore its distribution throughout the site is unknown. Areas of loose soil and open vegetation at the Building 850 areas provide potential habitat for this species. The dense annual grassland vegetation at the Building 834 and Pit 6 areas are likely to make this habitat unsuitable for the silvery legless lizard.

Coast horned lizard *(Phrynosoma coronatum frontale)*. The coast horned lizard is a federal species of concern and a California special concern species. In 2001, the location of adventitious observations of this species during unrelated wildlife surveys were recorded. In 2002, most Site 300 fire trails were surveyed from a vehicle in April or May prior to the grading of these trails. The locations of all horned lizards observed during these surveys were recorded using a geographical positioning system unit. The locations of all horned lizards observed at Site 300 during 2001 and 2002 are shown in Figure 4.2.1.1-3. Horned lizards have been observed within 1,140 feet of Building 850 and 1,760 feet of Building 834.

California red-legged frog *(Rana aurora draytonii)* and California tiger salamander *(Ambystoma californiense).* The California red-legged frog is a federally threatened species, and the California tiger salamander is proposed for federal listing as threatened. California red-legged frogs have been observed at a pond located on Carnegie State Vehicular Recreation Area (SVRA) property 1,200 feet to the east of the Pit 6 survey area and at the intermittent drainage 1,800 feet to the west of the Pit 6 survey area (Figure 4.2.1.1-3). Despite the proximity of these observations, it is unlikely that California red-legged frogs occur in the Pit 6 survey area because no wetland habitat suitable for the frog is present in or near the survey area. There have been no observations of California red-legged frogs within 1/2 mile of the Building 834 and 850 survey areas. A small seep occurs at Well 8 in the Building 850 survey area. Although unlikely, there is a potential for California red-legged frogs to use this seep. Although we know of no California tiger salamander observations within 1/2 mile of any of the three survey areas, the Carnegie SVRA pond located to the east of Pit 6 is likely to support the species (Figure 4.2.1.1-4).

4.2.1.2. Field Surveys

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Field surveys consisted of walking (or driving where roads and fire trails are present) transects through the survey areas around Building 834, Building 850 and Pit 6 in the Compliance Monitoring Plan (2002). At each area, easily identifiable features were chosen to delineate the survey areas in the field. Because of this, the survey areas are slightly larger then the actual areas of concern. The boundaries of the actual field survey areas are shown in Figures 4.2.1.2-1 through 3. All locations were surveyed twice during the spring survey period. However, it was only possible to obtain access to the entire Building 834 area once during the spring of 2003. To maximize the likelihood of observing coast horned lizards, an attempt was made to conduct surveys on sunny days at temperatures between 65° F and 95°F.

The results of the surveys are shown in Table 4.2.1.2-1. One group of badger dens, and a pair of golden eagles were observed at Building 850. A burrowing owl nest was observed outside of the survey area about 1,200 feet north of Building 850. No other special status species were observed during field surveys.

4.2.1.3. Future Work

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The second semi-annual survey for 2003 will be conducted during the September/October time frame, using similar methods as for the spring survey. As noted above, coast horned lizards have been observed within 1/3 mile of the Building 834 and Building 850 survey areas. To better determine the presence of this species in these two survey areas, the first of the semi-annual surveys in 2004 will be conducted in April or May, which are the months in which horned lizards are most active at Site 300. The distribution of the San Joaquin pocket mouse, San Joaquin coachwhip and silvery legless lizard at Site 300 is unknown. We are considering conducting small mammal trapping using Sherman live traps and pit fall trapping to determine if these special status species occur in any of the survey areas. Walking and driving surveys will continue to monitor for the presence of burrowing owls and American badgers. It is unlikely that California red-legged frogs or California tiger salamanders occur in any of the survey areas. The distribution of these species at Site 300 will continue to be monitored as part of the Site's routine endangered species monitoring program, and the seep at well 8 will be surveyed for California red-legged frogs during the walking surveys.

Reptiles and amphibians were not explicitly addressed in the original baseline ecological risk assessment (Webster-Scholten 1994). Therefore, we are evaluating appropriate models and toxicity reference values in the event these species are observed in the survey areas and thus toxicological hazard would need to be addressed.

5. Data Management Program

The management of data collected as part of the first semester 2003 compliance monitoring at Site 300 was subject to the standard Environmental Restoration Division (ERD) data management process and standard operating procedures. This process tracks sample and analytical information from the initial sampling plan through data storage in a relational database. As part of the standard procedures for data quality, this process includes chain-of-custody tracking, electronic and hard copy analytical results receipt, strict data validation and verification, data quality control procedures, and data retrieval and presentation. The use of this system promotes and provides a consistent data set of known quality. Quality assurance and quality control are performed uniformly on all data.

5.1. Modifications to Existing Procedures

There were no modifications to existing procedures.

5.2. New procedures

The Site 300 CMP sampling plan was developed based upon the negotiated sampling locations and frequencies. New web generated scripts were developed to query the database for ground water data and for the analytical data at all CMP locations. The locations and requested analyses to be reported for each area were reviewed by the responsible task leaders for accuracy prior to table generation.

6. Quality Assurance/Quality Control Program

LLNL conducted all compliance monitoring in accordance with the approved Quality Assurance Project Plan (QAPP) (Dibley, 1999) requirements for planning, performing, documenting, and verifying the quality of activities and data. The QAPP was prepared for CERCLA compliance and ensures that the precision, accuracy, completeness, and representativeness of project data are known and are of acceptable quality. The QAPP is used in conjunction with the LLNL ERD Standard Operating Procedures (SOPs), Operations and Maintenance (O&M) Manual, Site Safety Plan (SSP), and Quality Assurance Management Plan (QAMP). Section 6 discusses any modifications to existing LLNL quality assurance/quality control (QA/QC) procedures or any new QA/QC procedures that were implemented during the first semester of 2003, as well as self-assessments, quality issues and corrective actions, and analytical and field quality control.

6.1. Modifications to Existing Procedures

During March 2003, revisions were made to the O&M Manual consisting of revised monitoring and reporting schedules due to implementation of the CMP. Renewed permits were issued by the San Joaquin Valley Unified Air Pollution Control District to operate ground water/vapor treatment units and were included in the O&M update. During the same month, SOPs, Chapter 3 were reviewed and updated to reflect current field procedures pertaining to pressure transducer calibration and hydraulic testing. Operational Safety Procedures, "Site 300 On-site Ground Water Investigation Activities" and "Vapor Extraction and Water Treatment for the Building 834 Trichloroethylene Remediation Action" were reviewed and renewed in February and April 2003, respectively.

6.2. New Procedures

Only one new procedure SOP 4.18 titled "ERD Document Control" was written. There were no other new procedures written other than implementation of the CMP resulting in revised monitoring and reporting schedules.

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6.3. Self-assessments

Self-assessments are performed by the ERD on an annual basis and by Safety and Environmental Protection (SEP) Environmental Safety and Health (ES&H) teams on a triennial basis. These assessments are used to evaluate ongoing treatment facility activities to QA and ES&H requirements and procedures. During this reporting period, there were a total of eight assessments performed. Quality Improvement Forms were generated and processed as a result of these assessments

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6.4. Quality Issues and Corrective Actions

Quality improvement, nonconformance, and corrective action reporting is documented using the Quality Improvement Form (QIF). There were five QIFs generated as a result of the self-assessments. A total of fifteen QIFs were processed during this reporting period. Suggested improvements were addressed and corrective measures employed to improve treatment facility and sampling activities.

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6.5. Analytical Quality Control

Data review, validation, and verification are conducted on 100% of the incoming analytical data. The contract analytic labs (CALs) are contractually required to provide internal quality control checks in the form of method blanks, laboratory control samples, matrix spikes, and matrix spike or sample duplicate results with every analysis. These results are evaluated during the data review process and are used to determine data quality. Data flags are used to inform the end user of insufficiencies detected during the data review process. There were no noteworthy discrepancies identified during this reporting period.

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6.6. Field Quality Control

Quality control is implemented during the sample collection process in the field. Ten percent of samples are collocated (5% intralaboratory and 5% interlaboratory). Field blanks and trip blanks are used to identify contamination that occurs during sample collection, transportation, or handling of samples at the analytical laboratory. Equipment blanks are used to determine the effectiveness of decontamination processes of portable equipment used for purging and/or sample collection. There were no significant problems encountered during the first reporting semester.

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