

**U.S. DEPARTMENT OF ENERGY
SAN FRANCISCO FIELD OFFICE**

**ANNUAL SITE ENVIRONMENTAL REPORT
FOR THE
LABORATORY FOR ENERGY-RELATED HEALTH RESEARCH
UNIVERSITY OF CALIFORNIA, DAVIS
for Calendar Year 1991**

April 30, 1992

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**LABORATORY FOR ENERGY-RELATED HEALTH RESEARCH
ANNUAL SITE ENVIRONMENTAL MONITORING REPORT
FOR CALENDAR YEAR 1991**

1.0 EXECUTIVE SUMMARY

During 1991, the LEHR site and local environment was monitored for ambient radiation fields, and radiological and non-radiological contaminants in the groundwater, surface water, and, in one off-site location, soil. The LEHR Environmental Monitoring Program during this period involved ambient radiation monitoring at 17 locations around the site, 12 of which were added in the fall after sludge solidification began. No quarterly reading exceeded 3 mR in excess of natural ambient background radiation, with the exception of the radioactive material storage area used for storing radioactive waste. (Complete data summaries of environmental dosimetry are provided in Tables 5.5.1 - 5.5.4.) Groundwater and surface water monitoring results showed elevated levels of the following: chloroform and other volatile compounds, tritium, chromium, and nitrate. Results of soil analyses at the old Atomic Energy Commission Site (main campus) showed elevated levels (above background) of chlordane (Chlordane was a commonly used pesticide until the early 1980's).

2.0 INTRODUCTION

On September 30, 1989, the University of California at Davis (UC Davis) and the Department of Energy (DOE) terminated the Maintenance & Operations contract designated DE/AC0J/76SF00472. Until that time, the Laboratory for Energy-Related Health Research (LEHR) was an organized research unit of UC Davis. The Laboratory's broad research objective was to provide new knowledge and understanding of potential health problems associated with energy utilization and to contribute to the safe and healthful development of energy resources.

From October 1, 1989, through February 28, 1990, an interim contract (DE/AC03189SF18444) with UC Davis was implemented to succeed the M & O contract for the purpose of continuing certain necessary site characterization and decontamination and decommissioning (D&D) work at LEHR. In March, 1990, DOE selected Battelle's Environmental Management Operations (EMO) to perform overall LEHR Environmental Restoration (ER) project management. Since then, EMO has contracted with various organizations, including UC Davis, to perform specific tasks required by the project. The specific work tasks include: soil and groundwater site characterization, building assessment, decontamination and decommissioning, waste management including source removal (radioactive sludge, Cobalt-60 sealed source), chemical and radiological risk assessment, soil and groundwater remediation, community relations, and landlord/general site services. Project management, health and safety and quality assurance are components of all specific work tasks. Completion of the D & D and remediation efforts will allow DOE to transfer the buildings and facilities to UC Davis. These efforts are the major objectives of the LEHR (ER) Project.

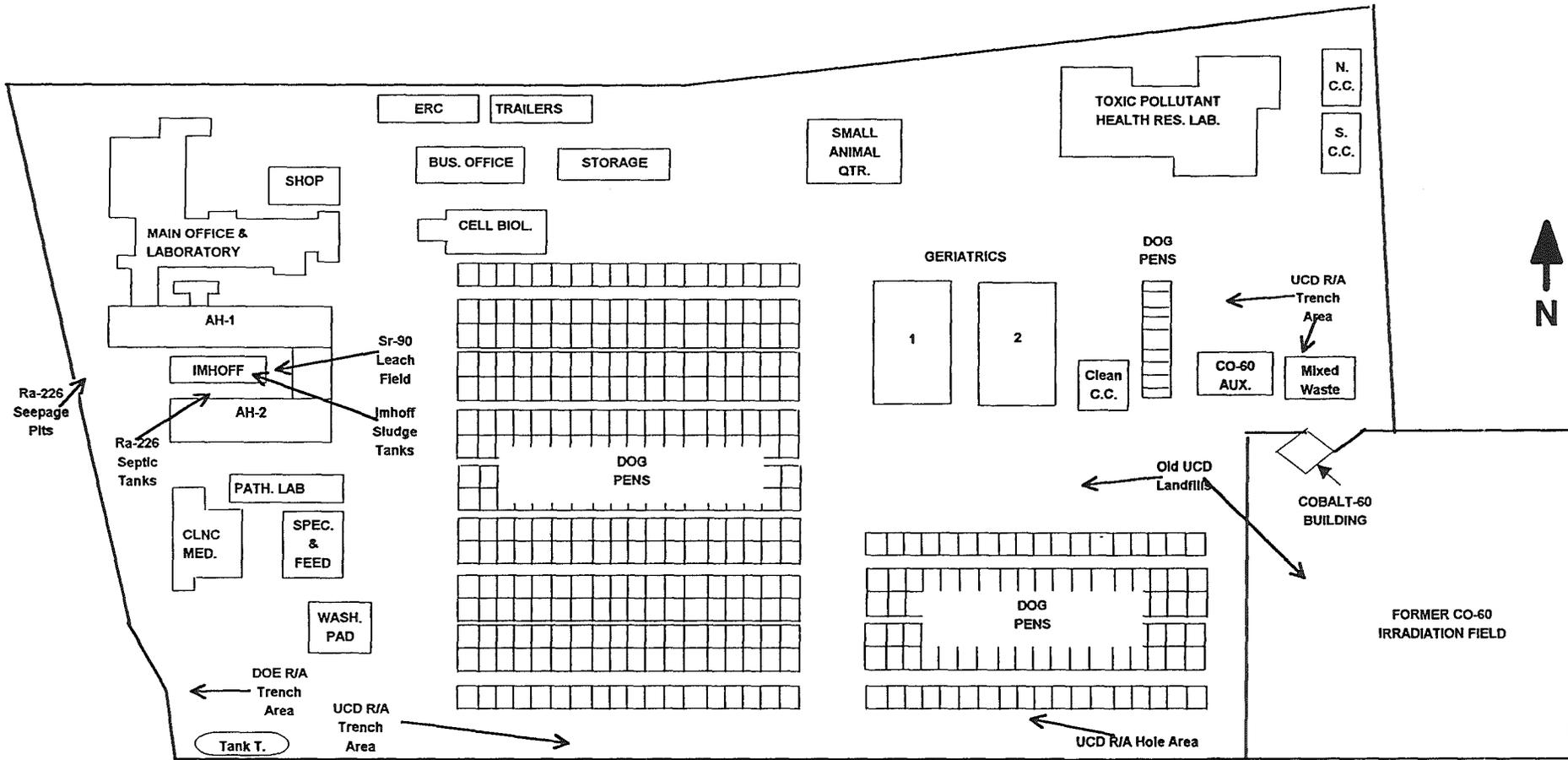
The LEHR facility is located on a 15-acre parcel of land owned by the Regents of the University of California, 1.5 miles south from the main UC Davis campus in a rural agricultural area and is bordered on the south by a levee on the north side of the South

Fork of Putah Creek. The LEHR site is separated into specific facilities and/or areas which may impact the environment. These include an inactive indoor/outdoor Cobalt-60 beam irradiator, inactive radioactive fluid waste treatment facilities, an inactive radioactive waste burial ground, and outdoor dog pens. In addition, LEHR is the location of two inactive campus landfill cells and numerous inactive campus low level radioactive disposal sites (trenches and holes), which were used by UC Davis and DOE to dispose of waste. The LEHR facility is located within an area under investigation by State-mandated landfill studies.

FIGURE 2.1 - LEHR SITE MAP

Primary Areas of Investigation

Annual Site Environmental Report
Ver:1 Rev:0 4/30/92
UCD/LEHR 17523



NOT TO SCALE
Rev.2 5/13/92 d:\excel\prienvmgpri.map

3.0 COMPLIANCE SUMMARY

This summary describes the environmental regulatory compliance status for the LEHR which, until October 1, 1989, was an organized research unit of UC Davis. With the cessation of the DOE-sponsored LEHR research program, all DOE-related work involves the environmental restoration (ER) and clean-up of the LEHR facility. Due to the non-operational status of the facility from a DOE standpoint, compliance with many of the pertinent acts, regulations (other than DOE orders) or permits is made through UC Davis. LEHR's status with respect to major environmental statutes is summarized as follows:

3.1 Comprehensive Environmental Response, Compensation & Liability Act (CERCLA)

The LEHR facility is currently being reviewed for inclusion on the National Priorities List (NPL) under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA). A CERCLA preliminary Assessment on the LEHR facility was completed in 1988, and the Hazardous Ranking System (HRS) process is currently being completed by the U.S. Environmental Protection Agency (EPA). Depending on the ranking, the site investigation could be required to comply with the formal Remedial Investigation/Feasibility Study (RI/FS) process under CERCLA. At this time, although the site is not under any enforcement action, water quality monitoring performed during 1991 was conducted according to QAMS-5 and NQA-1 criteria, which meet the intent of the EPA CERCLA RI/FS guidance document. Work to be performed as part of Phase III will, however, be conducted pursuant to the EPA CERCLA RI/FS criteria.

Numerous site characterization activities have been conducted at the LEHR facility since 1984. Below is a summary of the major soil and water investigations to date.

3.1.1. Initial Assessment Survey

Rockwell International conducted the Initial Assessment Survey of the LEHR facility in October 1984. The objective of the Rockwell investigation was to obtain environmental data by conducting an initial survey of the nature and extent of radioactivity and chemical

contamination at the LEHR site. The purpose of the survey was to assess the presence of radiological or chemical impacts which could either migrate to the environment or present an unanticipated cost in the decontamination and decommissioning of the LEHR facility. Investigative methods included soil borings for subsurface soil sampling, surface soil sampling, hand-held meter surveys, and wipe sample collection. A full characterization study was recommended to identify the nature and extent of contamination at the LEHR facility (especially the former waste disposal sites).

3.1.2. Environmental Survey Preliminary Report

The DOE prepared an Environmental Survey Preliminary Report in March 1988. The investigation was primarily a document research investigation to assess past site activities so that the site could be priority-ranked by the DOE for future investigation. The 1988 report describes past disposal practices at or near the LEHR facility, and concluded that certain areas are potential sources of soil and groundwater contamination beneath the site.

3.1.3 Phase I Investigation

During late 1987 and early 1988, Wahler Associates performed work for both the DOE and UC Davis and targeted radioactive burial sites in an effort to evaluate the potential for soil and groundwater impacts downgradient of the site. Field work, including monitoring well installations, soil borings and exploration trenching for both investigations, was conducted concurrently. A total of nine wells (eight completed at the water table, one completed in a deeper aquifer) were constructed, 43 soil borings drilled, and 36 backhoe trenches excavated.

3.1.4 Evaluation of On-Site Wells

In February 1990, Dames & Moore evaluated high turbidity levels in nine wells previously installed by Wahler Associates during their 1987 and 1988 investigations. The scope of the evaluation included redevelopment of the wells using swab/surge, bailing, and pumping techniques. In addition to well development, groundwater samples were collected and analyzed for various chemical parameters to assess whether chemical properties of the groundwater and/or soil were the cause of, or contributed to, high turbidity. The report concluded that the high turbidity levels in the wells appeared to be due to improper sizing

of well construction materials, and not the geochemical character of the groundwater. Information obtained from this study was used to design monitoring wells installed as part of the Phase II Site Characterization.

3.1.5 Solid Waste Assessment Test

The Solid Waste Water Quality Assessment Test (SWAT) was conducted from June 1989 to March 1990 to assess the possibility of leakage from the Old UC Davis Landfill disposal units and the potential impacts to groundwater, surface water, vadose-zone water and soil. A SWAT Report was prepared in accordance with the Calderon Bill (AB 3525) and Title 23, Chapter 3, Subchapter 15 of the California Code of Regulations (CCR). The focus of the SWAT investigation was the three landfill units located on and adjacent to the LEHR Facility. During the SWAT investigation, five groundwater monitoring wells were installed (UCD-10 through UCD-14), one pre-existing monitoring well was destroyed (UCD-2), four vadose-zone wells (lysimeters LW-1 through LW-4) were installed, and surface water in Putah Creek upgradient and downgradient of the site was sampled.

3.1.6 Waste Burial Trench Investigation LEHR Facility

During late 1989, Dames & Moore supervised the excavation of 18 exploratory trenches and performed Ground Penetrating Radar (GPR) surveys for the purpose of locating and sampling the contents of waste burial trenches. Exploratory trenches were excavated in areas where documented waste burial trenches exist. These areas include the vicinity of monitoring wells UCD-9 and UCD-12, along the east side of the eastern block of dog pens, along the south side of both blocks of dog pens, and in the southwest corner of the site. The report concluded that the majority of the waste burial trenches exist as documented; however, some undocumented burial trenches also exist. Results of limited analyses were consistent with materials expected or known to have been buried at the site.

3.1.7 Old UCD Landfill Additional Characterization

In April 1991, a CPT and Hydropunch investigation was performed to address comments and recommendations by the RWQCB on the SWAT report for the Old UC Davis Landfill. The purpose of the investigation was to further evaluate the vertical and lateral extent of site constituents detected in groundwater samples collected during the SWAT investigation.

Results indicated that the extent of migration of site constituents were not completely delineated and that further evaluation was necessary. A second-round CPT/Hydropunch investigation was conducted in September 1991 to further evaluate the lateral and vertical extent of site constituents detected in groundwater during SWAT monitoring and first-round Hydropunch samples.

3.1.8 Phase II Investigation

As a followup to Phase I findings, the Phase II investigation was initiated in 1990. The Phase II investigation consisted of soil and sediment sampling in targeted areas (completed primarily in 1990), installation of groundwater monitoring wells (also completed in 1990), quarterly surface water and groundwater sampling (ongoing), and some aquifer testing. The purpose of the Phase II investigation was to gather and evaluate data to further assess the lateral and vertical extent of contaminants identified in previous investigations; to identify potential contaminant source areas; to further assess geologic and hydrogeologic relationships at the site; to identify data gaps; and to develop recommendations for further work. Results from the Phase II investigation will be used to develop the scope of work for the Phase III investigation, which will be initiated in 1992.

3.1.9 Remediation Plans

The nature and extent of soil and groundwater remediation activities is unknown at this time. Results from previous investigations and Phase II and Phase III activities will be used to support the development of any soil and groundwater remedial actions, if necessary.

3.2 Resource Conservation and Recovery Act (RCRA)

In 1989, UC Davis, as operator, and the DOE, as Owner, submitted a Part A permit application to EPA for the storage of mixed waste generated during DOE funded research work. In 1990, LEHR was contacted by the State of California, Toxic Substances Division, Department of Health Services (DHS) requesting a copy of the permit application. LEHR submitted a copy of the application as requested. During 1991, no other actions, including the issuance of a permit, were taken by the EPA or DHS regarding this application.

3.3 California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA)

As part of the LEHR Environmental Restoration (ER) project, certain decommissioning, decontamination and remedial tasks require that appropriate NEPA, and in some cases CEQA, documentation be in place prior to performing those tasks. In 1991, DOE Headquarters issued a "Memo-to-file" for the sampling stabilization/solidification and disposal of 35,000 gallons of sludge (solid and water) being stored in underground concrete tanks at LEHR. The tanks were specifically designed to process and handle biological excreta. The sludge was the product of normal degradation processes of the excreta used by conventional septic tank systems. In September 1991, the process of removing and solidifying that waste began, with work completed in March 1992.

In addition, an environmental assessment (EA) was prepared for the decommissioning and decontamination of the buildings and the removal of the Co-60 source. This document was submitted to DOE headquarters in May 1992 and should be finalized in June 1992. The final EA will be forwarded to the State of California and the local community for comments. Some additional site characterization work related to the LEHR site, funded and performed by UC Davis, has required the performance of a Preliminary Study in compliance with CEQA. In February 1991, UC Davis completed the Preliminary study and forwarded it to the State Clearinghouse (a State office which gathers and maintains environmental documents for public access) for distribution to the appropriate State or local agencies having jurisdiction.

3.4 Clean Air Act (CAA)

The National Emission Standards for Hazardous Air Pollutants (NESHAPS) model was run for the sludge solidification occurring in 1991/92 and it verified that continuous air monitoring was not required.

3.5 Clean Water Act (CWA)

LEHR discharges its sanitary waste to the UC Davis wastewater treatment system. UC Davis has a National Pollutant Discharge Elimination System (NPDES) permit #CA0077895, granted by the California Central Valley Regional Water Quality Control Board (RWQCB).

3.6 Solid Waste Water Quality Assessment Test (SWAT)

At the request of the Central Valley Regional Water Quality Control Board, based on the conclusion in the UC Davis 1990 SWAT Report, UC Davis has initiated additional soil and groundwater characterization work to further define the extent of the leakage. The additional characterization efforts initially involved the use of cone penetrometer testing/hydropunch (CPT/HP) sampling techniques. Results of those tests show that elevated levels of Volatile Organic Compounds (VOCs), hexavalent chromium, and nitrates exist outside the boundaries of LEHR.

3.7 Quarterly Monitoring of Surface and Groundwater

As part of the Phase II Site Characterization, quarterly monitoring of groundwater is performed using the 23 monitoring wells located on or near the LEHR site (see Figure 6.4.1). Results from this year's quarterly monitoring are consistent with the results reported in the previous year. Groundwater monitoring results showed elevated (above drinking water standards) levels of chloroform, VOCs, tritium, chromium and nitrates. Intensive site investigations are planned for 1992 and 1993 to characterize the source areas for this contamination.

Off-site investigations consist of quarterly sampling of Putah Creek and surrounding

neighbors' wells. "Neighbors' wells" refer to 10 domestic wells and 3 irrigation wells located on property adjacent to the LEHR site. (In 1991, two neighbors' wells were added to the sampling group.) Sample analysis for hexavalent chromium and nitrates is routinely done on neighbors' wells, and gross alpha and beta analyses have been performed in the past.

The 1991 Putah Creek sample results were consistent with the results reported in 1990 which show that all levels were within the normal background range. Some of the neighbor wells showed slightly elevated levels of nitrate and hexavalent chromium. A complete summary of neighbor well data is provided in Table 5.8.

3.8 Current Issues and Actions

3.8.1 Co-60 Dose Reconstruction Study

Based on community interest, DOE completed, in 1991, a radiological dose reconstruction analysis for local environs of LEHR. The analysis studied the outdoor operation of an 170 Curie Co-60 source. The Co-60 facility was used for external beam low-level radiation studies on beagles from 1970 to 1985.

The study was performed in two parts, involving two separate potentially exposed population groups. The first group included the general public (residents) of the nearby farms. The second group included UC Davis campus employees and volunteers who worked in the Raptor Center, Goat Facility, and Equine Research Facility. The first study concluded that the potential dose to members of the general public was well below the current 100 mrem/yr DOE limit. The results of Part 2 of this study which addresses radiation exposure to UC Davis employees and volunteers showed that the potential dose to staff, students, and volunteers who worked in the vicinity of LEHR was below the regulatory limit (500 mrem per year) in place during the period of the irradiator's outdoor operation. The largest potential annual radiation dose was 360 mrem for a few individuals residing in a trailer at the Raptor Center 24 hours per day for approximately 1 year.

The study also calculated annual radiation doses to employees and volunteers at other locations near LEHR. The study calculated the annual radiation dose to Raptor Center staff as 200 mrem for 30 hours per week and 94 mrem for 14 hours per week for Raptor Center students and volunteers. For the Animal Resources Services area, known as the Goat Facility since 1981, the annual radiation dose was calculated as 190 mrem for isolation building areas for 7 hours per week. The annual radiation dose calculated for LEHR site buildings, Equine Research facility and Comparative Oncology area ranged from 13 to 34 mrem based on 50 hours per week, 50 weeks per year.

3.8.2 Summary First Quarter of 1992

A Notice of Intent to comply with the State General Stormwater Discharge Permit for industrial facilities was filed by UC Davis in March 1992.

DOE continued its efforts of source reduction by initiating and completing work for the characterization, stabilization and disposal of the 35,000 gallons of radioactive sludge. The sludge was contaminated primarily with Strontium-90 and Radium-226, the two major isotopes used in the LEHR research efforts. A total of 780 55-gallon drums of sludge and two liners were solidified and shipped to the Westinghouse Hanford facility in Washington between September 1991 and March 1992.

3.9 Permits

The permits which are applicable to the site are discussed in Section 4.8.

4.0 ENVIRONMENTAL PROGRAM INFORMATION

4.1 Purpose of Program

The LEHR Environmental Protection Program is required under DOE Order 5400.1 and

shall encompass all environmental monitoring programs.

4.2 Environmental Management Policy

It is the policy of LEHR to conduct operations in an environmentally safe and sound manner. The Environmental Protection Program at LEHR shall reflect the policy stated in the EMO Project Manager's Environmental Management Policy (**Attachment 1**). This program shall ensure the project's operation in compliance with applicable Federal, State, and local regulations and with DOE orders and management directives and will be proactive in preventing environmental problems.

4.3 Summary of Environmental Protection Program

The Environmental Protection Program shall consist of ongoing programs and monitoring for compliance and any other relevant environmental protection requirements.

This Program shall consist of, but is not limited to, those actions needed for compliance with the following areas:

- Hazardous waste management, including storage, segregation, characterization, designation, and disposal;

- Oversight of remedial actions involving cleanup of past actions;

- Environmental assessment documentation under the National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA);

- Hazardous materials inventory and usage and other reports and information as requested or required by regulatory agencies;

- Oversight of Spill Prevention Controls and Countermeasures (SPCC) Program;

- Ground and surface water monitoring for the site investigation;

- Report to DOE as required by orders, including the Annual Site Environmental

Report, OMB A-106 updates and status reports, and
EPA permit for storage of mixed waste.

4.4 Notification of Environmental Occurrences and Reporting

Requirements regarding notification and reporting of environmental occurrences are defined in DOE orders and/or in the regulations governing release of hazardous materials. Environmental monitoring personnel have been instructed to notify appropriate laboratory management if monitoring data indicates that hazardous material has been released above the reportable quantities. Problems that are identified as a result of routine notifications are corrected as a part of normal procedural updates.

The EMO Project Manager is responsible for reporting environmental occurrences under 5484.1 and 5000.3. These reports are submitted to DOE for review and analysis and development of annual summary reports prior to transmittal to System Safety and Development Center (SSDC) and Headquarters. ORPS (Occurrence Reporting and Processing System) format is currently being incorporated into UC Davis/LEHR procedures. All reports are available for review by any organization, and can be obtained by contacting SSDC, DOE, or LEHR Site Office.

4.5 General Planning and Reporting

Environmental reporting for the items indicated below is the responsibility of the EMO Project Manager

- Annual Site Environmental Report
- Environmental Implementation Plan
- OMB Circular A-106
- Other environmental status reports as required

4.5.1 Annual Site Environmental Report

This report summarizes the environmental status and monitoring at LEHR. Environmental projects are noted, as well as notices of violation, summaries of operating parameters set by permits and compliance during the year with those conditions. Both radioactive and nonradioactive monitoring are noted in the Report.

4.5.2 OMB Circular A-106

The data used for this annual report is gathered and verified by the EMO Project Manager. Report deadlines are set by DOE Headquarters.

4.5.3 Environmental Protection Implementation Plan

The LEHR Environmental Protection Implementation Plan (EPIP) sets specific site environmental policies, objectives and implementation strategies. The EIP describes an integrated approach to maintaining and ensuring that LEHR and its environs are not adversely impacted by the decontamination and decommissioning and remediation activities performed at LEHR. The EIP for the LEHR site has been written and is currently under review.

4.6 Special Programs

Special environmental programs are required at LEHR for evaluating the impact of the ER Project on the environment. Oversight and documentation for effectiveness of each program will be made by the EMO Project Manager. Review and update of the programs will be performed by the EMO Program Manager. Overviews of each program are summarized below:

4.6.1 Groundwater Protection Management Program

The Groundwater Protection Management Program will consist of routine groundwater monitoring, characterization, reporting and remediation plans as necessary.

4.6.2 Waste Minimization and Characterization Program

The specific requirements for characterizing, handling, processing, packaging, and designating individual waste streams will be developed after complete waste stream evaluation has been accomplished for each specific work task. Work plans will include procedures, quality assurance, health and safety and waste management plans for all work undertaken.

4.7 Environmental Monitoring Programs

LEHR performs environmental monitoring in accordance with permit and regulatory requirements, for background information and in conjunction with site restoration. The EMO Project Manager will have responsibility for the oversight of these programs/plans, and will also be responsible for review and update of this plan as required by DOE Orders.

4.7.1 Environmental Monitoring Plans

Environmental monitoring plans have been developed as part of the cleanup effort and to comply with DOE Orders. Monitoring of potentially contaminated sites is determined on a site-specific basis. The monitoring plan for such actions is goal oriented to regulatory guidance standards.

4.7.2 Environmental Monitoring Activities

The environmental monitoring activities for the LEHR ER project included, in 1991, ambient radiation monitoring, soil sampling, and surface/groundwater sampling. Sampling and analytical results for soil, surface water, groundwater and radiation monitoring are summarized in Sections 5 (Environmental Radiological Program Information), 6 (Environmental Non-Radiological Program Information), and 7 (Groundwater Protection). Information and data relevant to this environmental monitoring is summarized from data given in the Dames and Moore Draft Phase II Site Characterization Report. This report is a final draft, and information regarding samples should be considered tentative until the Phase II report has been finalized.

4.8 Permits

Following is the list of permits related to operations occurring at LEHR.

4.8.1 NPDES Permit #CA0077895

Waste Water Discharge Requirement for the Campus Waste Water Treatment Plan.

4.8.2 California Radioactive Material License #1334-57

Authorizes the use of radioactive materials on campus property, including LEHR. (Radiation Use Authorization #1280, issued under the above license, is the specific authorization under which work at the LEHR site is performed.) Areas under Federal (DOE) jurisdiction are specifically excluded from the regulatory requirements specified in this Radioactive Material License.

4.8.3 Well Permits

- M 90-04 for installation of monitoring wells.

- D 90-04 for destruction of two site wells.

4.8.4 EPA RCRA Permit # CAD982469702

Part A of the application for the EPA RCRA Permit for the storage of Mixed Waste was sent to the EPA approximately two years ago. (Per normal procedure, Part B of the application will be sent in when results regarding Part A are received.)

5.0 ENVIRONMENTAL RADIOLOGICAL PROGRAM INFORMATION

5.1 Radioactive Effluent

There are no radioactive effluents emitted to the environment during the current non-production/non-research decontamination, waste disposal and site characterization work performed at LEHR. Surface Water and Groundwater sampling analysis results are summarized in the following sections.

5.2 Soil Sampling

A total of 20 soil samples were collected in 1991 from ten shallow soil borings (18 to 60 feet below grade) drilled in former dog pens and in the area of a reported septic leach system at the Old AEC Project site, located on the main UC Davis campus. Samples were collected and analyzed in accordance with standard procedures and an approved work plan which included sampling and analyses, quality assurance and health and safety plans. Sample results for radionuclides are summarized below:

AEC Site

Soil samples collected from the Old AEC Project site were analyzed for tritium, strontium-90, and carbon-14. No detections of tritium or strontium-90 were reported for samples

collected from the Old AEC Project site. Carbon-14 was reported in one replicate sample at 0.5 pCi +/- 0.2.

5.3 Surface Water Sampling

In 1991, monitoring for surface water was performed quarterly at LEHR. Samples were collected by Dames and Moore (a sub-contractor to EMO/UCD) in February, May, August and November 1991. Samples were collected from the three locations specified in the Work Plan for the Phase II Site Characterization (Dames and Moore, August 1990): the Wastewater Treatment Plant Outfall tributary (designated STPO); upstream of the LEHR facility (designated PCU); and downstream of the LEHR facility (designated PCD). These locations can be seen in Figure 6.20. Surface water sampling procedures are on file in the EMO office, and with Dames and Moore. Samples were shipped by overnight carrier to Controls for Environmental Pollution (CEP) laboratories in Santa Fe, New Mexico. Complete analytical results are listed in the Phase II draft report, and are summarized below:

5.3.1 Winter Quarter (Feb 91)

Gross alpha, gross beta and strontium-90 were reported in the four Winter 1991 surface water samples. Gross alpha detections were reported in samples PCU at 3 +/- 2 pCi/L and STPO at 7 +/- 3 pCi/L. Gross beta detections were reported for all four samples, and ranged from 7 +/- 5 pCi in PCU to 34 +/- pCi/L in STPO. Strontium-90 was reported only in STPO at 0.8 +/- 0.7 pCi/L. Neither tritium nor gamma-producing radionuclides were reported in Winter 1991 surface water samples.

5.3.2 Spring Quarter (May 91)

Two radionuclides, gross alpha and gross beta, were reported in the Spring 1991 surface

water samples. Gross alpha was reported in samples PCU and STPO-replicate at 3 +/- pCi/L. Gross beta was reported for all four samples, and ranged from 7 +/- pCi/L in PCD to 16 +/- pCi/L in STPO-replicate. Strontium-90, tritium and gamma-producing radionuclides were not reported in Winter 1991 surface water samples.

5.3.3 Summer Quarter (August 91)

Three radionuclides, gross alpha, gross beta, and strontium-90, were reported in Summer 1991 surface water samples. Gross alpha and strontium-90 were reported only in sample PCD at 3 +/- 2 pCi/L and 1.8 pCi/L, respectively. Gross beta detections were reported for the four samples and ranged from 3 +/- 2 pCi/L in PCU to 13 +/- 3 pCi/L in STPO replicate. Tritium and gamma-producing radionuclides were not reported in Summer 1991 surface water samples.

5.3.4 Fall Quarter (November 1991)

Two radionuclides were reported in Fall 1991 surface water samples -- gross alpha and gross beta. Gross alpha detections were reported for PCD at 31 +/- 6 pCi/L and PCD-replicate at 25 +/- 5 pCi/L. Gross beta detections were reported for PCD at 62 +/- 8 pCi/L, PCD replicate at 46 +/- 8 pCi/L, and STPO at 4 +/- 3 pCi/L. Tritium and Strontium-90 were not reported in any Fall 1991 samples., No gamma producing radionuclides were reported from the gamma spectral analysis.

5.4 Groundwater Sampling

Twenty-three groundwater monitoring wells have been installed at or near the LEHR

facility. Of these, seventeen are on site; six are off site. (See Figure 5.4) The wells have been completed in both a shallow, seasonal water-bearing zone consisting primarily of silts and clays to 70 feet and in a deeper sand and gravel aquifer to 120 feet. These wells were installed by DOE and UC Davis as part of the LEHR site characterization efforts and the Solid Waste Assessment Test (SWAT) on the inactive UC Davis landfill, which closed in 1966 and occupies a portion of the site. Four lysimeters have also been installed as part of the SWAT investigation. In addition, tasks will be implemented to determine aquifer characteristics to develop flow model(s) for the site to aid in risk assessment, and, if necessary, for the design of remedial action programs. Sampling for organic and inorganic chemicals and radiologic constituents is performed quarterly.

For the 1991 calendar year, groundwater sampling was performed in February, May, August, and November. 18 groundwater wells were sampled in February, May and November, 13 in August (due to the fact that some of the wells were dry). All wells were purged and sampled with dedicated pumps. Replicate samples from two monitoring wells, UCD -12 and UCD-22, were obtained by collecting identical sets of sample bottles from each well, and labeling the replicate samples with a fictitious sample identification, UCD-12B and UCD-22B. Samples were shipped daily via overnight courier to CEP Laboratories.

5.4.1 Winter Quarter (Feb 91)

Requested analyses were performed on all Winter 1991 samples. Holding times were met, except for alkalinity for samples UCD-13 and UCD-14 and Hexavalent Chromium (CrVI) for samples UCD-10, UCD-11, UCD-12, and UCD-12B. The holding time for CrVI was exceeded due to a malfunctioning laboratory instrument. Dames and Moore was notified of this problem by CEP and authorized analysis of CrVI by a colorimetric method one day beyond the recommended holding time.

During the QA review of Winter 1991 data, Dames and Moore found that the reported

tritium results for UCD-13 and UCD-14 were transposed in the laboratory reports. This finding was based on comparability of previously collected data, which consistently shows high values of tritium in UCD-13 and low values and non-detection in UCD-14. CEP Laboratories confirmed results presented in the laboratory report. It is therefore unclear whether these two samples were labelled incorrectly, or mishandled during processing. Values reported for remaining parameters for these samples appear to be consistent with past results, and therefore, only tritium results have been affected.

Gross alpha, gross beta, strontium-90, and tritium, were reported in Winter 1991 groundwater samples. Gross alpha detections were reported for four samples. Reported values ranged from 3 +/- 2 pCi/L to 10 +/- 5 pCi/L. Strontium-90 was reported in samples UCD-13 at 0.9 pCi/L and UCD-23 at 0.8 pCi/L. Tritium was reported in only UCD-13 at 28,744 pCi/L. No gamma-producing radionuclides were reported for the gamma spectral analysis.

5.4.2 Spring Quarter (May 91)

Dames and Moore sampled eighteen groundwater monitoring wells between May 13 and May 21, 1991. All wells were purged and sampled with dedicated pumps. Replicated samples from two monitoring wells, UCD-11 and UCD-23, were obtained by collecting identical sets of sample bottles from each well and labeling the replicate samples with a fictitious sample identification, UCD-11B and UCD-23B. Samples were shipped daily to CEP Laboratories. Requested analyses were performed on all Spring 1991 groundwater samples.

Detections were reported for all six radiochemical analyses for Spring 1991 groundwater samples. Gross alpha detections were reported for three samples, ranging from 4 +/- 2 pCi/L to 10 +/- 5 pCi/L. Detections for gross beta were reported for seven samples, ranging from 4 +/- 2 pCi/L to 17 +/- 5 pCi/L. Tritium was reported in only UCD-13 at

26,168 +/- 846 pCi/L and in UCD-14 at 7,728 +/- 617 pCi/L. Strontium-90 was reported in UCD-1 at 4.3 +/- 0.8 pCi/L, UCD-7 at 5.7 +/- 0.9 pCi/L, and UCD-10 at 3.8 pCi/L. Gamma producing radionuclides were reported only in UCD-12 at 11 +/- 4 pCi/L.

5.4.3 Summer Quarter (August 91)

Dames and Moore sampled 13 groundwater monitoring wells between August 5 and August 14, 1991. Monitoring wells UCD-1, UCD-45, UCD-11, UCD-12, and UCD-13 were dry, and no groundwater samples were collected. Eleven wells were purged and sampled with dedicated pumps. Due to low water levels, wells UCD-10 and UCD-19 were purged and sampled using a disposable bailer. Because of slow recharge and low initial water levels in UCD-10, only samples for Method 624 (VOCs), formaldehyde, and tritium were collected. Replicate samples were collected from two locations (UCD-14 and UCD-19) by collecting identical sets of sample bottles from each well and labelling the replicate samples with fictitious sample identifications UCD-14B and UCD-19B. Samples were shipped daily to CEP Laboratories. Requested analyses were performed on all Summer 1991 samples.

Detections were reported for four radiochemical analyses for Summer 1991 groundwater samples. Gross alpha detections were reported for seven samples, ranging from 3 +/- 2 pCi/L to 6 +/- 5 pCi/L. Detections for gross beta were reported for eight samples ranging from 6 +/- 3 pCi/L to 22 +/- 7 pCi/L. Tritium was reported in only UCD-14 and UCD-14B at 4,557 +/- 822 pCi/L and 5,482 +/- 839 pCi/L, respectively. The highest values reported for tritium are generally from UCD-13, which was dry during Summer 1991. Carbon-14 was reported in only UCD-14 and UCD-14B at 1,002 +/- 466 pCi/L and 662 +/- 461 pCi/L, respectively.

5.4.4 Fall Quarter (Nov 91)

Dames and Moore sampled 18 groundwater monitoring wells between November 18 and

November 16, 1991. Sixteen wells were purged and sampled with dedicated pumps. Due to low groundwater levels, wells UCD-1 and ICD-4 were purged and sampled with disposable bailers. Replicate samples from two monitoring wells, UCD-10 and UCD-22, were obtained by collecting identical sets of sample bottles from each well, and labelling the replicate set with a fictitious identification, UCD-10B and UCD-22B. Samples were shipped daily to CEP Laboratories. Requested analyses were performed on all Fall 1991 samples.

Carbon-14, gross alpha, gross beta, and tritium, were reported in Fall 1991 groundwater samples. Strontium-90 was not reported in any Fall 1991 groundwater samples. No gamma-producing radionuclides were reported for the gamma spectral analysis.

Carbon-14 was reported only in UCD-13 at a value of 1,815 +/- 352 pCi/L. Gross alpha detections were reported for UCD-4, UCD-10B, UCD-11, UCD-13, UCD-20, and UCD-24. Reported values ranged from 3 +/- 2 pCi/L to 7 +/- 5 pCi/L. Detections for gross beta were reported for samples from eight wells, and ranged from 3 +/- 2 pCi/L to 16 +/- 3 pCi/L. Tritium was reported for three wells; UCD-13 at 24,576 pCi/L, UCD-14 at 652 +/- 534 pCi/L, and UCD-21 at 9,752 +/- 942 pCi/L. Although tritium has been reported in UCD-13 and UCD-14 in previous rounds, this is the first reported detection of tritium in UCD-21.

5.5 Ambient Radiation Monitoring

Quarterly TLDs monitor perimeter fenceline dose rates and various work areas around the LEHR site. TLD readings for 1991 showed no significant above-background levels, and all levels were well below regulatory limits. Tables 5.4 A, 5.4 B, 5.4C and 5.4 D summarize this data. Figures 5.1 - 5.3, which follow the tables, show locations for each group of TLDs.

TABLE 5.5.1: 1991 Radiation Monitoring Results, Group 63
 (Results in mrem)

	1/1 TO 3/31 1991	4/1 TO 6/30 1991	7/1 TO 9/30 1991	10/1 TO 12/31 1991	ANNUAL TOTAL 1991
South #1	2	1	2	3	8.00
South #2	1	2	2	3	8.00
North #1	0	0	0	2	2.00
East #1	2	2	2	3	9.00
East #2	0	2	2	1	5.00
Control	0	0	0	0	0.00
Background	0	0	0	N/A	0.00
RDC Background	24	24	21	29	98.00

All exposure rates are measured in mR above the RDC background.

The RDC background is calibrated to Co-60 with a precision of +/- 2 or 10%.

**TABLE 5.5.2: 1991 Radiation Monitoring Results, Group 88
 (Results in mrem)**

EXPOSURE PERIOD	SEPT 91	OCT 91	NOV 91	DEC 91	TOTAL 1991
AH-2 North	N/A	0	0	0	0.00
Geriatrics I East	0	N/A	0	0	0.00
Geriatrics I North	NE/NW	0	0	0	0.00
Geriatrics I South	0	0	0	0	0.00
Geriatrics I West	0	0	0	0	0.00
Imhoff Fence	--	0	0	0	0.00
Mixed Waste	N/A	0	0	0	0.00
Rad Storage N.E.	N/A	0	0	20	20.00
Rad Storage S.E.	N/A	20	30	25	75.00
S.W. Corner	N/A	0	0	0	0.00
Geriatrics NW*	0	N/A	N/A	N/A	0.00
Geriatrics NE*	0	N/A	N/A	N/A	0.00
Imhoff North*	0	N/A	N/A	N/A	0.00
Imhoff South*	0	N/A	N/A	N/A	0.00
Imhoff West*	0	N/A	N/A	N/A	0.00
Gate*	0	N/A	N/A	N/A	0.00
Pole*	0	N/A	N/A	N/A	0.00
RT ¹	0	N/A	N/A	N/A	0.00
Control	N/A	0	0	0	0.00
Background	0	0	0	0	0.00

* Indicates initial dosimeter sites that were changed or discontinued.

¹ Test only, not part of the original or continued group.

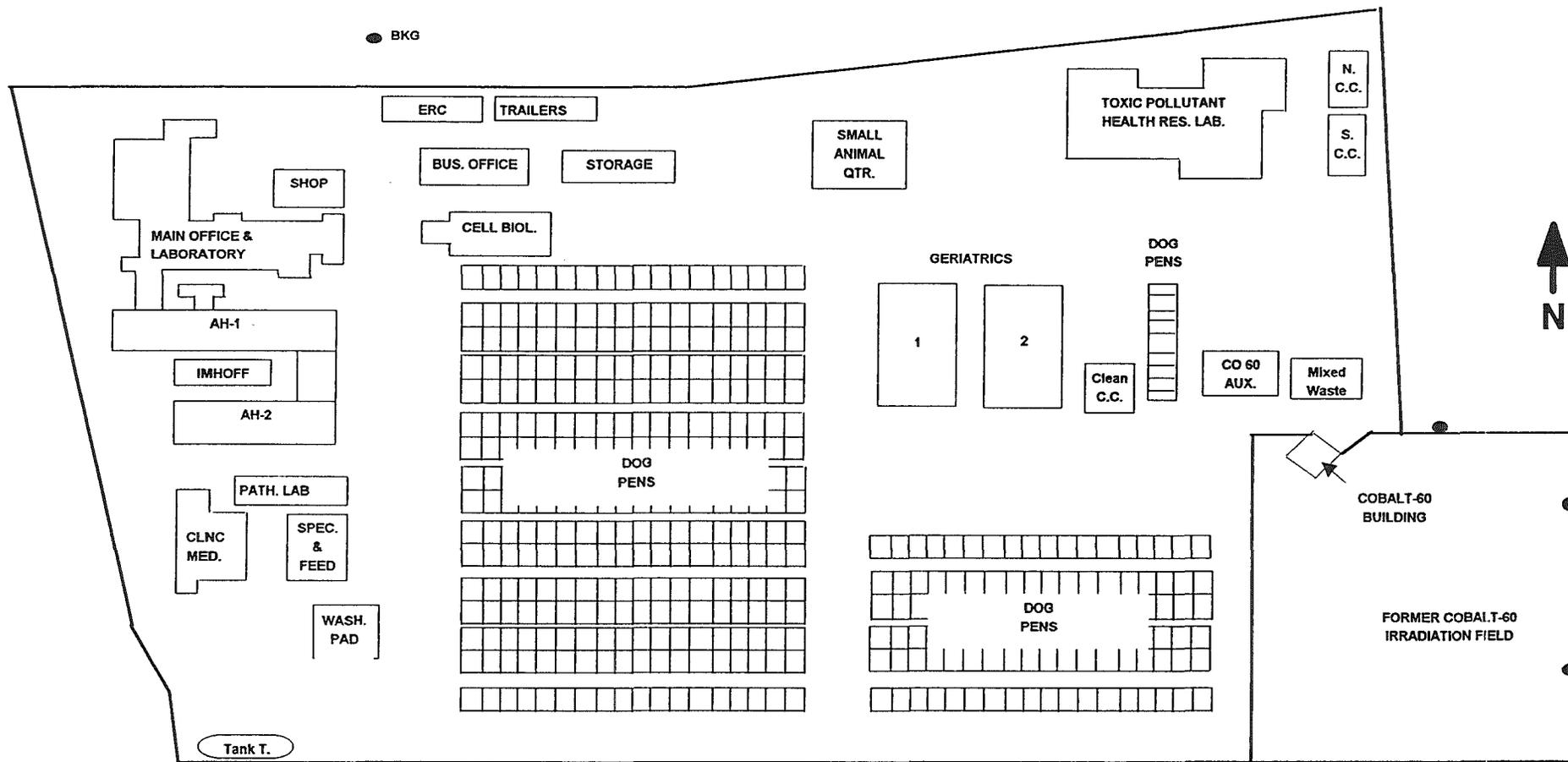
**TABLE 5.5.3: 1991 Radiation Monitoring Results, Group 83
 (Results in mrem)**

Location	12/28/90-3/27/91	4/1/91-6/30/91	7/1/91-9/30/91	10/1/91-12/31/91
Bulletin Board	0	0	0	0
Desk	0	0	0	0
Freezer	0	0	0	0
Calibrator W.	0	0	0	0
Kitchen	0	0	0	0

**TABLE 5.5.4: 1991 Radiation Monitoring Results, Group 82
 (Results in mrem)**

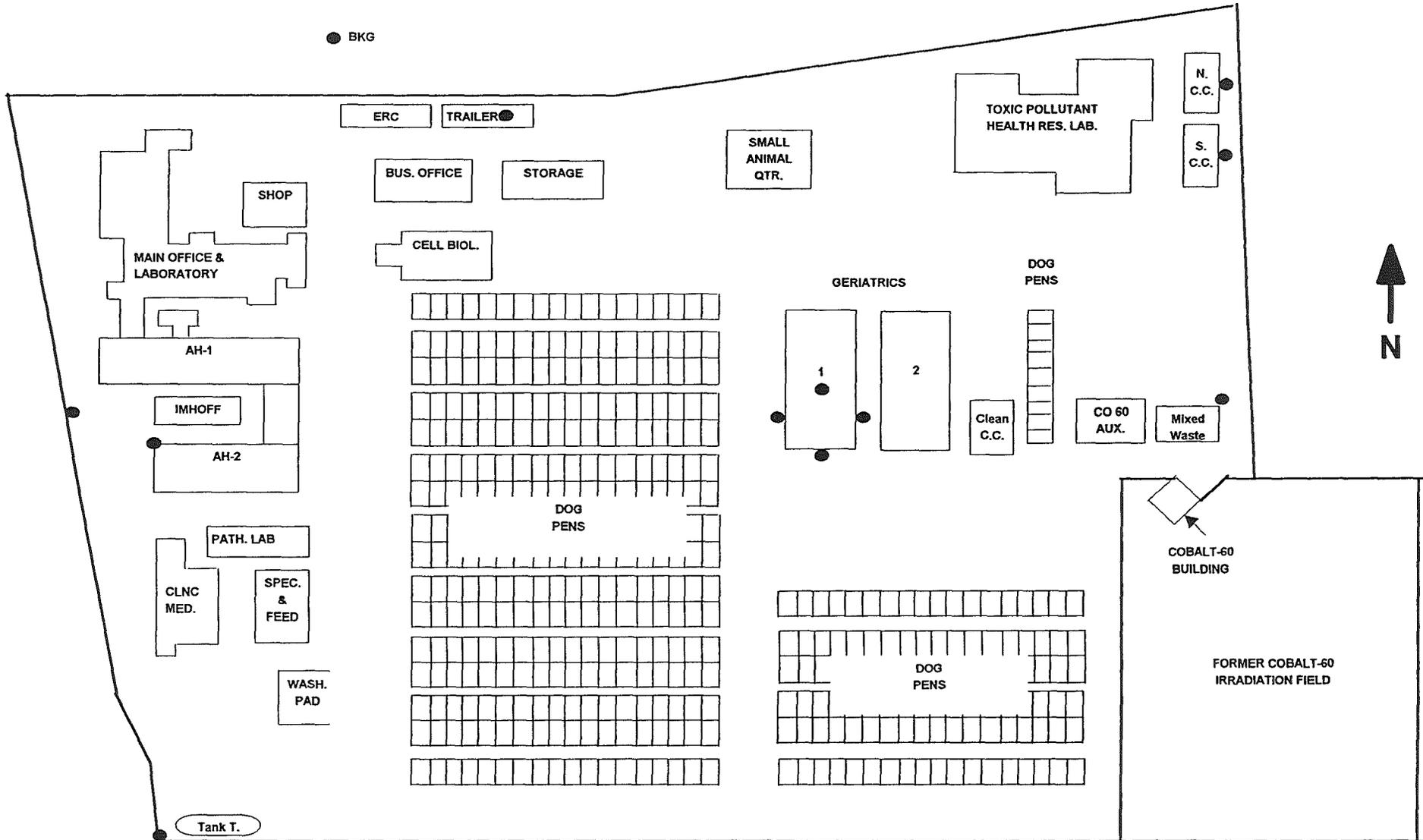
Location	1/1/91-1/31/91	2/4/91-2/28/91	3/1/91-3/31/91	4/1/91-4/30/91	5/1/91-5/31/91	6/1/91-6/30/91	7/1/91-7/31/91	8/1/91-8/31/91	9/4/91-10/3/91	10/1/91-10/31/91	11/1/91-12/1/91	12/1/91-12/31/91
Bulletin Board	0	0	0	0	0	0	0	0	0	0	0	0
Desk	0	0	0	0	0	0	0	0	0	0	0	0
Freezer	0	0	0	0	0	0	0	0	0	0	0	0
Calibrator W.	0	0	0	0	0	0	0	0	0	0	0	0
Kitchen	0	0	0	0	0	0	0	0	0	0	0	0

FIGURE 5.5A: TLD Locations for Group 63



NOT TO SCALE ● = Environmental Dosimeter Location
Rev.2 5/13/92 d:\excel\prlenvmg63.map

FIGURE 5.5B: TLD Locations for Group 88



NOT TO SCALE

● = Environmental Dosimeter Location

5.6 Cobalt-60 Reconstruction Study

A special two-part Cobalt-60 Dose Reconstruction study was initiated in 1990. In March, 1991, the first part, dose reconstruction for the public residing in the vicinity of LEHR concluded that all potential doses were less than the current 100 mrem/yr DOE public radiation dose limit. The second part of the study, which is discussed in section 3.81, evaluates the potential dose to UC Davis employees and volunteers who worked near the Co-60 field between 1970 and 1985.

5.7 Characterization of Animal Hospital Buildings AH-1 and AH-2 (Executive Summary from Characterization Report by Bechtel)

From July 15, 1991 to September 18, 1991, a team consisting of Bechtel and TMA/Eberline health and safety specialists completed a survey to characterize the radiological and asbestos content and distribution in Buildings H-218 (AH-2) and H-219 (AH-1) at the LEHR facility at the University of California, Davis. The survey consisted of in-situ measurements of alpha, beta and gamma activity using pre-established grids, supplemented by bias location measurements. Samples were obtained for laboratory analysis, which identified isotopes and confirmed the existence of asbestos in selected structural materials.

The results of the radiation surveys, which are included as Appendix D, indicate that the primary sources of radioactive contamination are contained on the inside surfaces of the dog cages and in associated drain and HVAC systems in each building, with beta activity levels to $>10^6$ dpm/100 cm² and alpha activity levels 10,000 dpm/100 cm². Localized spots of elevated activity (slightly above unrestricted release criteria) were noted outside of each of the buildings, on the roofs, on the walls, and in gutters and downspouts. Extensive contamination levels were measured on floors and inside lab equipment in Room 209, 211, 212, and 219 of Building H-219 (AH-1). The primary contaminant is beta (Strontium-90) except in Room 219 which is extensively alpha contaminated (Thorium-228). Most of the

contamination is "fixed", with most locations surveyed indicating no removable activity at levels above the criteria for unrestricted release.

The results of the asbestos analysis indicate that asbestos is present in the floor tile and/or mastic backing, wallboard tape and grout, piping insulating, and roofing layers. The asbestos material content is estimated at approximately 600 ft³.

5.8 Neighbors' Well Sampling

During 1991, the domestic and some irrigation wells at houses surrounding the LEHR site were sampled twice by UC Davis Staff. Results of analyses are presented in Table 5.8, highest reported detections in neighbors' wells during 1991.

TABLE 5.8: Highest Reported Detections in Neighbors' Wells During 1991

Constituent	MCL	MDW	MIW	RDW	RUSDW	IHDW	OHDW	MARDW	MARIW	NIW	NDW	CMDW	CWDW
Coliform MPN/100ml	UR	•	16	>16	•	•	•	•	>16	•	•	•	•
Methylene Chloride (502.1) ug/l	5.0*	•	•	•	•	•	•	•	•	•	•	1.4	0.3
Chloroform (601) ug/l	100	0.11	0.07	0.06	•	0.11	0.07	0.07	0.07	24.86	•	•	•
1,1-Dichloro- ethene (601) ug/l	6.0	•	•	•	•	•	•	•	•	0.25	•	•	•
1,1-Dichloro- ethane (601) ug/l	5	•	•	•	•	•	•	•	•	0.18	•	•	•
1,2-Dichloro- ethane (601) ug/l	0.5	•	•	•	•	•	•	•	•	0.15	•	•	•
Dibromochloro methane (601) ug/l	100	•	•	•	•	•	•	•	•	0.27	•	•	•
Vinyl Chloride (601) ug/l	0.5	•	•	•	•	•	•	•	•	•	•	0.19	•
Nitrogen as N mg/l	10.2	19.6	19.0	19.9	32.8	28.8	15.8	12.6	23.8	9.4	11.2	11	10.8

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Constituent	MCL	MDW	MIW	RDW	RUSDW	IHDW	OHDW	MARDW	MARIW	NIW	NDW	CMDW	CWDW
Hex Chrom mg/l	UR	0.04	0.05	0.05	0.02	0.06	0.06	0.04	0.01	0.04	0.08	0.13	0.10
Chromium - Total mg/l	0.05	0.05	0.06	0.05	0.03	0.08	0.07	0.06	•	0.05	0.07	0.14	0.13
Copper - Total mg/l	1.3*	•	•	•	•	•	•	0.05	•	•	•	0.05	•
Selenium - Total mg/l	0.01	•	0.01	0.01	0.01	0.02	0.02	0.01	•	0.003	0.03	0.004	•
Zinc - Total mg/l	5.0	0.11	•	0.68	0.44	0.14	0.22	1.87	•	•	0.06	0.5	0.04
Antimony - Total mg/l	0.005	0.004	0.005	0.004	0.002	0.004	0.003	0.004	0.002	0.001	0.002	0.005	•
Barium - Total mg/l	1.0	0.33	0.33	0.33	0.15	0.23	0.21	0.25	0.13	0.18	0.11	0.28	0.26
Cadmium - Total mg/l	0.010	•	•	•	•	•	•	0.001	•	•	•	•	•
Lead - Total mg/l	0.05	0.001	•	0.002	0.006	0.001	0.002	0.036	0.001	•	0.001	0.003	•
Molybdenum - Total mg/l	UR	0.06	0.05	0.05	0.03	0.06	0.05	0.09	0.04	0.07	0.12	0.1	•
Thallium - Total mg/l	0.002*	0.011	0.08	0.008	0.004	0.009	0.009	0.007	0.004	0.004	0.007	0.011	•

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Constituent	MCL	MDW	MIW	RDW	RUSDW	IHDW	OHDW	MARDW	MARIW	NIW	NDW	CMDW	CWDW
Gross Alpha pCi/l	15	4±3	•	•	•	•	•	6±2	•	•	3±2	•	0.56±2.88
Gross Beta pCi/l	50	7±3	•	4±3	•	•	26±4	10±3	4±3	•	5±3	8±4	6.65±12.51

NOTES:

MCL - Maximum Contaminant Level (primary), Title 22, Division 4, Chapter 15

• - Indicates sample was analyzed for this constituent results were below detectable limits.

The codes across the top of the page are abbreviations for the neighbors' wells.

Many wells were tested more than once for the same constituents. Where different results were found, the greatest level has been reported.

* Proposed MCL

UR Unregulated by MCLs

6.0 ENVIRONMENTAL NON-RADIOLOGICAL PROGRAM INFORMATION

In 1991, a number of soil, surface and groundwater samples were collected and analyzed for chemical constituents. Details of surface and groundwater sampling are identical to those presented in section 5.0: Environmental Radiological Program Information. Summaries of results are presented below.

6.1 Soil Sampling

AEC Site

A total of 20 soil samples were collected from ten shallow soil borings (18 to 60 feet below grade) drilled in former dog pens and in the area of a reported septic leach system at the Old AEC Project site, located on the main UC Davis campus. Samples were collected and analyzed in accordance with standard procedures and an approved work plan which included sampling and analyses, quality assurance and health and safety plans.

Chlordane

Chlordane was reported in nine soil samples at concentrations ranging from 4.77 ug/Kg to 67.0 ug/Kg. No other detections of pesticides or PCBs were reported for samples collected from the Old AEC Project site. However, chlordane was a commonly used pesticide until the early 1980's.

6.2 Surface Water Sampling

Sampling and analyses for chemical parameters of surface water are performed quarterly at LEHR. In 1991, surface water sampling was performed quarterly. Following is a summary of results:

6.2.1 Winter Quarter (Feb 91)

Winter 1991 surface water samples were collected on February 6, 1991 from the STPO, PCU, and PCD surface water sample locations. A replicate sample was collected at location PCU.

6.2.1.1 Volatile Organic Compounds -- EPA Method 624

Chloroform was the only VOC reported in Winter 1991 surface water samples. Chloroform was reported only in sample STPO at 7.4 ug/L, with a reported detection limit of 1.6 ug/L.

6.2.1.2 Semivolatile Organic Compounds -- EPA Method 625

No semivolatile organic compounds were reported for Winter 1991 surface water samples by EPA Method 625.

6.2.1.3 Pesticides and PCBs -- EPA Method 608

Ten organochlorine pesticide compounds were reported in Winter 1991: 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, aldrin, alpha-BHC, beta-BHC, dieldrin, endosulfan I, endosulfan II, and gamma-BHC. The values ranged from 0.006 to 0.103 ug/L.

6.2.1.4 Title 22 Metals

Nine of the Title 22 Metals were reported in Winter 1991 samples: antimony, barium, beryllium, cadmium, chromium, copper, lead, nickel, and zinc. Antimony was reported in one sample (PCD) at 19 ug/L. Barium was reported in PCD(70ug/L), PCU (40 ug/L), and PCU-replicate (80 ug/L). Beryllium was reported in PCU and PCU-replicate at 1 ug/L. Cadmium was reported in all four samples at either 1 ug/L or 2 ug/L. Chromium was reported only in sample PCD at 11 ug/L. Copper was reported in two samples, PCU-replicate and STPO, at 30 ug/L. Lead was reported in three samples, ranging from 4 ug/L to 7 ug/L. Nickel was reported in PCU (50 ug/L) and PCU-replicate (70 ug/L). Zinc was reported in all four samples, ranging from 40 ug/L to 60 ug/L.

Hexavalent Chromium (CrVI) was not reported in any Winter 1991 surface water samples.

The reported detection limit for CrVI was 10 ug/L.

6.2.1.5 Nitrates

Nitrate (as N) was reported in the four surface water samples. Reported values ranged from 400 ug/L in PCU to 11, 900 ug/L in STPO.

6.2.2 Spring Quarter (May 91)

Spring 1991 surface water samples were collected on May 16, 1991 from the STPO, PCU, and PCD surface water sample locations. A replicate sample was collected from location STPO.

Surface water samples were shipped by overnight delivery to CEP Laboratories on May 16, 1991. Due to a handling error by Federal Express, samples arrived on May 18, 1991, which caused exceeding of the holding times for CrVI and turbidity. Each location (including replicate) was resampled for these two parameters on May 21, 1991 for analysis within the recommended holding times.

6.2.2.1 Volatile Organic Compounds - EPA Method 624

Chloroform, bromodichloromethane, and methylene chloride were the only VOCs reported in Spring 1991 surface water samples. Chloroform was reported in samples PCD (10.0 $\mu\text{g/L}$), STPO (3.1 $\mu\text{g/L}$), and STPO-replicate (3.1 $\mu\text{g/L}$). Bromodichloromethane was reported in samples PCD (4.1 $\mu\text{g/L}$) and STPO (2.2 $\mu\text{g/L}$). Methylene chloride was reported in one trip blank (3.4 $\mu\text{f/L}$) and in samples STPO (5.4 $\mu\text{g/L}$) and STPO-replicate (5.7 $\mu\text{g/L}$).

6.2.2.2 Semivolatile Organic Compounds - EPA Method 625

One semivolatile organic compound, bis(2-ethylhexyl)phthalate, was reported in samples STPO (4.4 $\mu\text{g/L}$) and STPO-replicate (7.8 $\mu\text{g/L}$) by EPA Method 625. No other

semivolatile compounds were reported for Spring 1991 surface water samples.

6.2.2.3 Pesticides and PCBs - EPA Method 608

Three organochlorine pesticide compounds, alpha-BHC, beta-BHC, and delta-BHC, were reported in Spring 1991 surface water samples. The compound alpha-BHC was reported in PCD at 0.005 $\mu\text{g/L}$. Beta-BHC and delta-BHC were reported only in sample STPO-replicate at 0.019 $\mu\text{g/L}$ and 0.13 $\mu\text{g/L}$, respectively.

6.2.2.4 Title 22 Metals

Five of the Title 22 metals were reported in Spring 1991 surface water samples; antimony, barium, lead, thallium, and zinc. Antimony was reported in all four samples, ranging from 1 $\mu\text{g/L}$ to 3 $\mu\text{g/L}$. Barium was reported in PCD (70 $\mu\text{g/L}$), and PCU (80 $\mu\text{g/L}$). Thallium was reported in all four samples ranging from 1 $\mu\text{g/L}$ to 4 $\mu\text{g/L}$. Lead was reported in three of four samples at 1 $\mu\text{g/L}$. Zinc was also reported in three of four samples at 30 $\mu\text{g/L}$.

Hexavalent chromium (CrVI) was reported in the four Spring 1991 surface water samples, ranging from 11 $\mu\text{g/L}$ to 19 $\mu\text{g/L}$.

6.2.2.5 Nitrates

Nitrate (as N) was reported in three Spring 1991 surface water samples: PCD at 5,700 $\mu\text{g/L}$; STPO at 6,500 $\mu\text{g/L}$; and STPO-replicate at 6,800 $\mu\text{g/L}$.

6.2.3 Summer Quarter (Aug 91)

Summer 1991 surface water samples were collected on August 8, 1991 from the STPO, PCU, and PCD surface water sample locations. A replicate sample was collected at sample location STPO.

Surface water samples were shipped by overnight carrier to CEP Laboratories on August 8, 1991.

6.2.3.1 Volatile Organic Compounds - EPA Method 624

Chloroform, bromodichloromethane, dibromochloromethane, and methylene chloride were the only VOCs reported in Summer 1991 surface water samples. Chloroform was reported in samples PCD at 14 $\mu\text{g/L}$, STPO at 5.7 $\mu\text{g/L}$, and STPO-replicate at 5.8 $\mu\text{g/L}$. Bromodichloromethane and dibromochloromethane were reported only in sample PCD, at 5.8 $\mu\text{g/L}$ and 3.4 $\mu\text{g/L}$, respectively. Methylene chloride was reported only in sample STPO at 4.4 $\mu\text{g/L}$.

6.2.3.2 Semivolatile Organic Compounds - EPA Method 625

One semivolatile organic compound, di-n-butylphthalate, was reported in samples PCD at 4.4 $\mu\text{g/L}$, STPO at 4.6 $\mu\text{g/L}$, and STPO-replicate at 4.4 $\mu\text{g/L}$. No other semivolatile compounds were reported for Summer 1991 samples.

6.2.3.3 Pesticides and PCBs - EPA Method 608

Four organochlorine pesticide compounds, delta-BHC, endosulfan-II, gamma-BHC, and heptachlor, were reported in Summer 1991 surface water samples. Delta-BHC was reported in STPO and STPO-replicate at 0.032 $\mu\text{g/L}$ and 0.033 $\mu\text{g/L}$, respectively. Endosulfan II and gamma-BHC were reported only in sample STPO-replicate at 0.007 $\mu\text{g/L}$ and 0.009 $\mu\text{g/L}$ respectively. Heptachlor was reported in sample STPO at 0.012 $\mu\text{g/L}$ and STPO-replicate at 0.018 $\mu\text{g/L}$.

6.2.3.4 Title 22 Metals

Seven of the Title 22 metals were reported in Summer 1991 surface water samples, including antimony, barium, copper, lead, silver, thallium, and zinc. Antimony, barium, lead, and zinc were reported in all four samples. Antimony ranged from 2 $\mu\text{g/L}$ and 3 $\mu\text{g/L}$, barium ranged from 40 $\mu\text{g/L}$ in STPO-replicate to 120 $\mu\text{g/L}$ in pCD, lead ranged from 3 $\mu\text{g/L}$ in

PCU to 7 $\mu\text{g/L}$ in PCD, and zinc ranged from 30 $\mu\text{g/L}$ in PCU to 100 $\mu\text{g/L}$ in STPO. Copper was reported in STPO at 30 $\mu\text{g/L}$ and in PCD at 50 $\mu\text{g/L}$. Thallium was reported in PCD at 1 $\mu\text{g/L}$ and PCU at 4 $\mu\text{g/L}$. Silver was reported in STPO and STPO-replicate at 30 and 50 $\mu\text{g/L}$, respectively.

Hexavalent chromium (CrVI) was reported in three of four Summer 1991 surface water samples ranging from 10 $\mu\text{g/L}$ in STPO and PCU to 20 $\mu\text{g/L}$ in PCD. The reported detection limit for CrVI was 10 $\mu\text{g/L}$.

6.2.3.5 Nitrates

Nitrate (as N) was reported in three Summer 1991 surface water samples: PCD at 3,910 $\mu\text{g/L}$; STPO at 5,220 $\mu\text{g/L}$; and STPO-replicate at 5,340 $\mu\text{g/L}$. These are similar to Spring 1991 surface water sample results.

6.2.4 Fall Quarter (Nov 91)

Fall 1991 surface water samples were collected on November 21, 1991 from the STPO, PCU, and PCD surface water sample locations. A replicate sample was collected at sample location PCD. In addition to an unfiltered metals sample, a filtered metals sample was collected at each surface water location to compare reported concentrations for total metals (unfiltered), and dissolved metals (filtered) in surface water.

All requested analyses were performed on the Fall 1991 surface water samples.

Required holding times for all analyses were met, except for EPA Method 624 (VOCs). The 624 analyses were complete one day after the recommended holding times. CEP Laboratories indicated that the data was unaffected by the missed holding time.

6.2.4.1 Volatile Organic Compounds - EPA Method 624

Chloroform was the only VOC reported in Fall 1991 surface water samples. Chloroform was reported in two samples, PCU at 2.0 $\mu\text{g/L}$ and STPO at 7.2 $\mu\text{g/L}$, with a reported detection limit of 1.6 $\mu\text{g/L}$.

6.2.4.2 Semivolatile Organic Compounds - EPA Method 625

No semivolatile organic compounds were reported for Fall 1991 surface water samples.

6.2.4.3 Pesticides and PCBs - EPA Method 608

Alpha-BHC was the only organochlorine pesticide compound reported (using EPA method 608) in Fall 1991 surface water samples. It was reported in STPO at 0.010 $\mu\text{g/L}$, with a detection limit of 0.003 $\mu\text{g/L}$.

6.2.4.4 Title 22 Metals

Eight Fall 1991 surface water samples were analyzed for Title 22 metals. Four samples (STPO, PCU, PCD, and PCD-replicate) were not filtered in the field. Four samples (STPO-F, PCU-F, PCD-F, and PCD-replicate) were filtered in the field. Seven of the Title 22 metals were reported in the eight samples: barium; chromium; lead; molybdenum; selenium; silver; and zinc. Barium was reported in the eight samples: barium; chromium; lead; molybdenum; selenium; silver; and zinc. Barium was reported in six samples, ranging in concentration from 30 $\mu\text{g/L}$ to 80 $\mu\text{g/L}$, with a reported detection of 30 $\mu\text{g/L}$. Chromium was reported in samples PCD and STPO at a concentration of 70 $\mu\text{g/L}$. Lead was reported in samples PCD, PCD-replicate, STPO, and STPO-F at values ranging from 1 $\mu\text{g/L}$ to 3 $\mu\text{g/L}$. The reported detection limit for lead is 1 $\mu\text{g/L}$. Silver was reported at 80 $\mu\text{g/L}$ in samples PCD and STPO. Molybdenum, selenium, and zinc were reported in samples STPO and STPO-F. Hexavalent chromium (CrVI) was analyzed only for unfiltered surface water samples, and was not reported above the detection limit.

6.2.4.5 Nitrates

Nitrate (as N) was reported in three of four surface water samples. Reported values ranged from 3,470 $\mu\text{g/L}$ in PCD-replicate and 4,080 $\mu\text{g/L}$, to 10,490 $\mu\text{g/L}$ in sample STPO.

6.3 Groundwater Sampling

Groundwater Sample Analysis

Presented below are results for quarterly groundwater sampling of monitoring wells on and around the LEHR Facility. Eighteen groundwater monitoring wells were sampled each in November 1990, February 1991, May 1991, August 1991, and November 1991. The actual number of samples varied from quarter to quarter due to dry wells. Samples were analyzed for the parameters listed below.

- 17 Title 22 Metals
- Hexavalent Chromium
- Nitrates (as Nitrogen)
- Turbidity (Lab)
- Formaldehyde
- Organochlorine Pesticides
- Volatile Organic Compounds
- Semivolatile Organic Compounds
- Gross-Alpha
- Gross-Beta
- Carbon-14 (for wells UCD-4, -13, -14, -15, -17, -18)
- Tritium
- Gamma-Emitters
- Strontium-90
- Chloride
- Alkalinity
- Total Dissolved Solids
- Constant Oxygen Demand
- Calcium
- Magnesium
- Potassium
- Sulfate
- Sodium
- Temperature (Field)
- pH (Field)
- Turbidity (Field)
- Electroconductivity (Field)
- Phosphate

Detections for each quarter are presented below. Anomalous data values were identified by Dames & Moore during quality review of analytical results and are discussed below for each quarter.

6.3.1 Winter Quarter (Feb 91)

Reported detections for Winter 1991 groundwater samples are presented in Table 6.51 and are summarized below. Complete results for Winter 1991 groundwater samples are presented in Appendix G of this report.

6.3.1.1 Volatile Organic Compounds - EPA Method 624

Three VOCs: 1,1,1 trichloroethane; methylene chloride; and chloroform, were reported in Winter 1991 groundwater samples. Detections of 1,1,1 trichloroethane were only reported in a trip blank, at 9.7 $\mu\text{g/L}$, for samples shipped on February 5, 1991. Chloroform was reported in five samples and one trip blank, ranging from 2.5 $\mu\text{g/L}$ in UCD-18 to 21,000 $\mu\text{g/L}$ in UCD-12, and 24,000 $\mu\text{g/L}$ in UCD-12B. Methylene chloride was reported in two trip blanks shipped on February 4 and 5, both at 3.4 $\mu\text{g/L}$, and in UCD-18 at 3.9 $\mu\text{g/L}$ sampled on February 4.

6.3.1.2 Semivolatile Organic Compounds - EPA Method 625

One semivolatile organic compound, bis(2-ethylexyl)phthalate, was reported for Winter 1991 groundwater samples by method 625. Bis(2-ethylexyl)phthalate was reported in eight samples ranging from 3.1 $\mu\text{g/L}$ (UCD-17) to 33.3 $\mu\text{g/L}$ in UCD-22.

6.3.1.3 Pesticides and PCBs - Method 608

Eight organochlorine pesticide compounds were reported in Winter 1991 groundwater samples by EPA Method 608. The pesticide 4,4'DDE was reported in three samples ranging from 0.006 $\mu\text{g/L}$ in UCD-22 to 0.008 $\mu\text{g/L}$ in UCD-17. Aldrin was reported only in UCD-12 at 0.006 $\mu\text{g/L}$. Alpha-BHC was reported in UCD-1 and UCD-21 at 0.006 $\mu\text{g/L}$. Beta-BHC was reported in UCD-12 and UCD-12B at 0.007 and 0.012 $\mu\text{g/L}$, respectively. Dieldrin was reported in UCD-12 and UCD-12B at 0.005 $\mu\text{g/L}$ and in UCD-13 at 0.021 $\mu\text{g/L}$. Endrin was reported only in UCD-13 at 0.020 $\mu\text{g/L}$. Endrin aldehyde was reported

only in UCD-12B at 0.028 $\mu\text{g/L}$. Heptachlor was reported in seven samples, ranging from 0.004 $\mu\text{g/L}$ to 0.008 $\mu\text{g/L}$.

6.3.1.4 Title 22 Metals

Eight Title 22 metals, including barium, cadmium, chromium, copper lead, mercury, thallium, and zinc, were reported in Winter 1991 groundwater samples. Barium was reported in 14 of 20 samples, ranging from 50 $\mu\text{g/L}$ in UCD-24 to 560 $\mu\text{g/L}$ in UCD-12 and UCD-12B. Cadmium was reported in six samples, ranging from 1 $\mu\text{g/L}$ to 7 $\mu\text{g/L}$. Total chromium was detected in 15 samples, ranging from 11 $\mu\text{g/L}$ in UCD-15 to 377 $\mu\text{g/L}$ in UCD-11. Lead was only reported in UCD-10 at 1 $\mu\text{g/L}$, mercury was reported only in UCD-14 at 0.4 $\mu\text{g/L}$. Thallium was reported in seven samples, ranging from 30 $\mu\text{g/L}$ to 80 $\mu\text{g/L}$. Zinc was reported in seven samples, ranging from 30 $\mu\text{g/L}$ to 40 $\mu\text{g/L}$.

CrVI was reported in 18 of 20 Winter 1991 groundwater samples. The highest values for CrVI were reported in samples from UCD-11 at 230 $\mu\text{g/L}$ and UCD-19 at 290 $\mu\text{g/L}$.

6.3.1.5 Nitrates

Nitrate (as N) was reported in all twenty Winter 1991 groundwater samples. Reported values ranged from 1,000 $\mu\text{g/L}$ in UCD-22 to 123,000 $\mu\text{g/L}$ in UCD-12.

6.3.2 Spring Quarter (May 91)

Reported detections for Spring 1991 groundwater samples are presented in Table 6.53 and are summarized below. Results for Spring 1991 groundwater samples are presented in Appendix G of this report.

6.3.2.1 Volatile Organic Compounds - EPA Method 624

Five VOCs, 1,1 dichlorethane (1,1DCA), 1,1 dichloroethene (1,1DCE), 1,2 dichlorethane (1,2DCA), chloroform, and methylene chloride, were reported in Winter 1991 samples. Detections of 1,1DCA at 23 $\mu\text{g/L}$, 1,1DCE at 3.9 $\mu\text{g/L}$, and 1,2DCA at 19 $\mu\text{g/L}$ were only reported in the sample from UD-12. Chloroform was reported in three samples and one trip blank, ranging from 2.7 $\mu\text{g/L}$ in UCD-21 to 18,000 $\mu\text{g/L}$ in UCD-12. Methylene chloride was reported only in three trip blanks, ranging from 3.4 $\mu\text{g/L}$ to 4.6 $\mu\text{g/L}$.

6.3.2.2 Semivolatile Organic Compounds - EPA Method 625

One semivolatile organic compound, bis(2-ethylexyl)phthalate, was reported for Spring 1991 groundwater samples by EPA Method 625. Bis (2-ethylexyl)phthalate was reported in five samples ranging from 4.6 $\mu\text{g/L}$ in UCD-19 to 24.3 $\mu\text{g/L}$ in UCD-11.

6.3.2.3 Pesticides and PCBs - EPA Method 608

Two organochlorine pesticide compounds, delta-BHC and gamma-BHC, were reported in Spring 1991 groundwater samples by EPA Method 608. Delta-BHC and gamma-BHC were only reported in sample UCD-12 at 0.129 $\mu\text{g/L}$ and 0.0437 $\mu\text{g/L}$, respectively.

6.3.2.4 Title 22 Metals

Seven Title 22 metals, including antimony, barium, chromium, molybdenum, selenium, and thallium, were reported in Spring 1991 groundwater samples. Antimony was reported in 19 of 20 samples, ranging from 2 $\mu\text{g/L}$ in UCD-16 and UCD-18 to 65 $\mu\text{g/L}$ in UCD-22. Barium was reported in 18 of 20 samples, ranging from 30 $\mu\text{g/L}$ in UCD-23 and UCD-23B to 500 $\mu\text{g/L}$ in UCD-12. Total chromium was detected in 11 samples, ranging from 30 $\mu\text{g/L}$ in UCD-24 to 340 $\mu\text{g/L}$ in UCD-11. Molybdenum was reported in 15 samples, ranging from 30.1 $\mu\text{g/L}$ in seven samples to 70 $\mu\text{g/L}$ in UCD-1. Selenium was reported in three samples

at the detection limit of 10 $\mu\text{g/L}$. Thallium was reported in all 20 samples, ranging from 2 $\mu\text{g/L}$ in UCD-1 to 30 $\mu\text{g/L}$ in UCD-12.

CrVI was reported in seventeen to twenty Spring 1991 groundwater samples. The highest values for CrVI were reported for UCD-11 and UCD-11B at 330 and 340 $\mu\text{g/L}$, UCD-4 at 260 $\mu\text{g/L}$, and UCD-12 at 200 $\mu\text{g/L}$.

6.3.2.5 Nitrates

Nitrate (as N) was reported in all twenty Spring 1991 groundwater samples. Reported values ranged from 2,200 $\mu\text{g/L}$ to 122,000 $\mu\text{g/L}$ in UCD-12.

6.3.3 Summer Quarter (August 91)

Reported detections for Summer 1991 groundwater samples are presented in Table 6.55 and are summarized below.

6.3.3.1 Volatile Organic Compounds - EPA Method 624

Two VOCs, chloroform and methylene chloride, were reported in Summer 1991 samples. Chloroform was reported in four samples, ranging from 1.6 $\mu\text{g/L}$ to 4.8 $\mu\text{g/L}$ in UCD-14 and UCD-14B. The highest detections of chloroform are generally reported for monitoring well UCD-12, which was dry for this quarterly sampling round. Methylene chloride was reported only in one trip blank at 12.0 $\mu\text{g/L}$.

6.3.3.2 Semivolatile Organic Compounds - Method 625

No semivolatile organic compounds were reported for Summer 1991 groundwater samples by EPA Method 625.

6.3.3.3 Pesticides and PCBs - EPA Method 608

Two organochlorine pesticide compounds, alpha-BHC and heptachlor, were reported in Summer 1991 groundwater samples by EPA Method 608. Alpha-BHC was reported in sample UCD-15 at 0.004 $\mu\text{g/L}$ and in UCD-21 at 0.020 $\mu\text{g/L}$. Heptachlor was reported in UCD-15 at 0.020 $\mu\text{g/L}$, UCD-16 at 0.019 $\mu\text{g/L}$, and UCD-17 at 0.018 $\mu\text{g/L}$. No other pesticide or PCB compounds were reported for Summer 1991 groundwater samples by this method.

6.3.3.4 Title 22 Metals

Seven Title 22 metals, including antimony, barium, chromium, lead, nickel, selenium, and thallium, were reported in Spring 1991 groundwater samples. Antimony was reported in 14 samples, ranging from 3 $\mu\text{g/L}$ in four samples to 10 $\mu\text{g/L}$ in UCD-19. Barium was reported in 13 of 14 samples, ranging from 30 $\mu\text{g/L}$ in UCD-22 to 270 $\mu\text{g/L}$ in UCD-14. Total chromium was detected in 9 samples, ranging from 50 $\mu\text{g/L}$ in UCD-16 to 290 $\mu\text{g/L}$ in UCD-19. Lead was reported in UCD-7 and UCD-14 at 1 $\mu\text{g/L}$. Selenium was reported in only one sample, UCD-19, at the detection limit of 10 $\mu\text{g/L}$. Thallium was reported in 14 samples, ranging from 5 $\mu\text{g/L}$, in four samples, to 10 $\mu\text{g/L}$, in three samples.

CrVI was reported in all fourteen Summer 1991 groundwater samples. The highest values for CrVI were reported for UCD-19 and UCD-19B at 200 $\mu\text{g/L}$.

6.3.3.5 Nitrates

Nitrate (as N) was reported in all fourteen Summer 1991 groundwater samples. Reported values ranged from 2,160 $\mu\text{g/L}$ in UCD-17 to 54,000 $\mu\text{g/L}$ in UCD-24.

6.3.4 Fall Quarter, November 1991

Reported detections for Fall 1991 groundwater samples are summarized below.

6.3.4.1 Volatile Organic Compounds - EPA Method 624

Three VOCs, methylene chloride, chloroform, and trichloroethene, were reported in Fall 1991 groundwater samples. Methylene chloride was reported in five travel control blanks and two groundwater samples, UCD-15 and UCD-16, ranging from 2.8 $\mu\text{g/L}$ to 4.1 $\mu\text{g/L}$, with a reported detection limit of 2.8 $\mu\text{g/L}$. Chloroform was reported in one travel control blank and in four samples, UCD-12, UCD-13, UCD-14, and UCD-21, ranging from 1.7 $\mu\text{g/L}$ in UCD-13 to 21,000 $\mu\text{g/L}$ in UCD-12. The reported detection limit for chloroform was 1.6 $\mu\text{g/L}$. Trichloroethene was reported in sample UCD-20 at 3.1 $\mu\text{g/L}$, with a reported detection limit of 1.9 $\mu\text{g/L}$.

6.3.4.2 Semivolatile Organic Compounds - EPA Method 625

No semivolatile organic compounds were reported for Fall 1991 groundwater samples by this method.

6.3.4.3 Pesticide and PCBs - EPA Method 608

Three organochlorine pesticide compounds, dieldrin, endrin, and gamma-BHC, were detected in Fall 1991 groundwater samples by EPA Method 608. Gamma-BHC was reported in UCD-4 at 0.010 $\mu\text{g/L}$, with a reported detection limit of 0.004 $\mu\text{g/L}$. Dieldrin was reported in UCD-12 (0.004 $\mu\text{g/L}$) and UCD-13 (0.030 $\mu\text{g/L}$), with a reported detection limit of 0.002 $\mu\text{g/L}$. Endrin was reported in UCD-13 at 0.010 $\mu\text{g/L}$, with a reported detection limit of 0.006 $\mu\text{g/L}$. No PCB compounds were reported for Fall 1991 groundwater samples by this method.

6.3.4.4 Title 22 Metals

Six Title 22 metals, including barium, beryllium, chromium, nickel, selenium, and thallium were reported in Fall 1991 groundwater samples. Barium was reported in 17 of 20 samples,

ranging from 30 $\mu\text{g/L}$ in UCD-22 and 22B, to 410 $\mu\text{g/L}$ in UCD-12. Beryllium was reported in eight samples, including UCD-18, the upgradient well, at a reported concentration of 1 $\mu\text{g/L}$. Total chromium was detected in 14 groundwater samples ranging from 30 $\mu\text{g/L}$ in UCD-7 to 340 $\mu\text{g/L}$ in UCD-12. Nickel was reported only in UCD-23 at 30 $\mu\text{g/L}$. Selenium was reported in four samples, UCD-11, UCD-12, UCD-19, and UCD-21, ranging from 12 $\mu\text{g/L}$ to 31 $\mu\text{g/L}$. Thallium was reported in 14 samples, ranging from 5 $\mu\text{g/L}$ in upgradient well UCD-18 to 23 $\mu\text{g/L}$ in UCD-12.

CrVI was reported in all but one Fall 1991 groundwater sample (UCD-22). Reported values for CrVI ranged from 10 $\mu\text{g/L}$ in UCD-15, -22B, and -23, to 290 $\mu\text{g/L}$ in UCD-19.

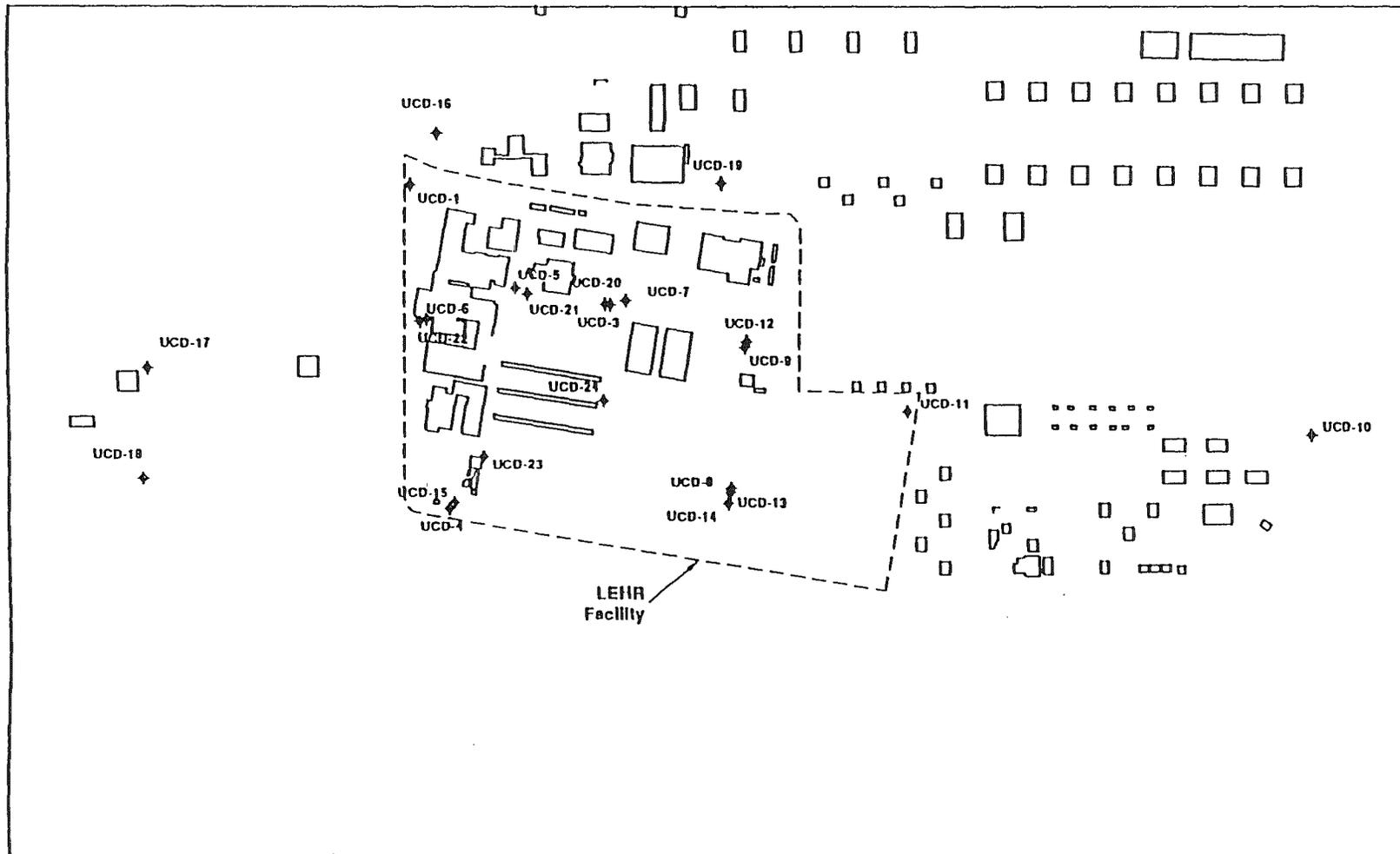
6.3.4.5 Nitrates

Nitrate (as N) was reported in all twenty Fall 1991 groundwater samples. Reported values ranged from 2,410 $\mu\text{g/L}$ in UCD-15 to 100,400 $\mu\text{g/L}$ in UCD-12.

6.4 GROUNDWATER PROTECTION

To date, 23 groundwater monitoring wells have been installed at or adjacent to the LEHR facility. Well locations are shown in Figure 6.4.1. Eighteen wells have been completed in a shallow (about 10 feet below ground surface) water-bearing zone designated the "first hydrostratigraphic unit" (HSU). Five wells have been completed in the uppermost regional aquifer (about 60 feet below ground surface), designated "second hydrostratigraphic unit". A list of wells, depths and screened intervals is shown in Table 6.4.2. The groundwater flow direction in both units varies from northeast to southeast. Putah Creek, which lies south of the facility, recharges the first hydrostratigraphic unit. Groundwater level data obtained during 1991 indicates that the first and second hydrostratigraphic units are interconnected. Monitoring wells UCD-17 and UCD-18 currently provide upgradient background data. Monitoring wells UCD-1, UCD-5, UCD-7, UCD-8, UCD-9, UCD-10, UCD-11, UCD-12, UCD-13, UCD-14, UCD-16, UCD-19, UCD-20, UCD-21, UCD-22, UCD-23 are sidegradient and/or downgradient wells.

FIGURE 6.4.1



EXPLANATION

◆ Monitoring Wells

0 300
Scale in Feet



**GROUNDWATER MONITORING
WELL LOCATION MAP**

Source: Phase II Site Characterization,
LEHR Environmental Restoration, Draft Report, April 1992

(Dames & Moore)

TABLE 6.4.2

Annual Site Environmental Report
 Ver:1 Rev:0 4/30/92
 UCD/LEHR 17523

SUMMARY OF MONITORING WELLS
 PHASE II SITE CHARACTERIZATION
 LEHR ENVIRONMENTAL RESTORATION

Well Name	Total Depth	Screened Interval	HSU	Investigation	Date Completed
UCD - 1	56.5	46.5 - 56.5	First	Wahler Associates 1989	10/09/87
UCD - 3	49.0	39.0 - 49.0	First	Wahler Associates 1989	10/23/87
UCD - 4	57.2	45 - 55	First	Wahler Associates 1989	10/14/87
UCD - 5	48.0	38.0 - 48.0	First	Wahler Associates 1989	10/22/87
UCD - 6	50.0	40 - 50	First	Wahler Associates 1989	10/21/87
UCD - 7	90	80 - 90	Second	Wahler Associates 1989	11/05/87
UCD - 8	53.5	43.5 - 53.5	First	Wahler Associates 1988	11/03/87
UCD - 9	50.0	40.0 - 50.0	First	Wahler Associates 1988	11/04/87
UCD - 10	70.0	54 - 69	First	Dames & Moore SWAT, 1990	10/11/89
UCD - 11	66.5	50 - 65	First	Dames & Moore SWAT, 1990	10/17/89
UCD - 12	65.0	49.5 - 64.5	First	Dames & Moore SWAT, 1990	10/19/89
UCD - 13	65.0	50 - 65	First	Dames & Moore SWAT, 1990	10/26/89
UCD - 14	85	75 - 85	Second	Dames & Moore SWAT, 1990	11/15/89
UCD - 15	120.5	91 - 116	Second	Dames & Moore, DOE Phase II	03/28/90
UCD - 16	122	92 - 117	Second	Dames & Moore, DOE Phase II	04/04/90
UCD - 17	143	88 - 113	Second	Dames & Moore, DOE Phase II	04/10/90
UCD - 18	70	54 - 69	First	Dames & Moore, DOE Phase II	10/04/90
UCD - 19	74.5	71.5 - 56.5	First	Dames & Moore, DOE Phase II	10/01/90
UCD - 20	73	57 - 72	First	Dames & Moore, DOE Phase II	10/09/90
UCD - 21	73	57 - 72	First	Dames & Moore, DOE Phase II	10/11/90
UCD - 22	73	57 - 72	First	Dames & Moore, DOE Phase II	10/25/90
UCD - 23	73	56.5 - 71.5	First	Dames & Moore, DOE Phase II	10/17/90
UCD - 24	73	57 - 72	First	Dames & Moore, DOE Phase II	10/22/90

HSU = Hydrostratigraphic Unit

Source: Phase II Site Characterization, LEHR Environmental Restoration, Draft Report, April 1992 (Dames & Moore)

Four quarterly rounds of groundwater sample collection and analysis were conducted between February 1991 and November 1991. Results reported from groundwater sample analysis for volatile organics show consistent detections of 1,1-dichloroethane, 1,1-dichloroethene, and 1,2-dichloroethane in well UCD-12 at concentrations up to 27 ug/L, 53.8 ug/L and 20 ug/L, respectively. Chloroform was reported in UCD-12 and UCD-21 in three out of four sampling rounds, and in all four sampling rounds, respectively. Maximum concentrations of chloroform were reported at 24,000 ug/L in the UCD-12 sample from Winter Quarter 1991. The semi-volatile organic bis (2-ethylhexyl) phthalate was reported in a variety of wells at concentrations up to 13.4 ug/L; however, only three wells, UCD-13, UCD-19, and UCD-24, had repeated detections of bis (2-ethylhexyl) phthalate, and there were no reported detections in the Summer or Fall 1991 Quarters. Other organic parameters were reported, but were not detected on a consistent basis (consecutive rounds or repetitive wells).

Nitrate was reported in all wells sampled in all quarters. Wells UCD-1, -7, -10, -11, -12, -13, -19, -20, -21, and -24 had reported concentrations of nitrates above background in quarterly monitoring rounds. Highest concentrations of nitrate were reported in the UCD-12 sample at 231 mg/L from Winter Quarter 1991.

Antimony, beryllium, molybdenum, and thallium were consistently reported in groundwater samples collected at concentrations exceeding regional background concentrations. However, these five metals were also reported as detected at similar concentrations in background wells (UCD-17 and UCD-18). Selenium was detected 7 times in 4 sampling quarters in downgradient groundwater wells, but was never reported as detected in groundwater samples analyzed from background groundwater monitoring wells. Chromium was reported above background in most quarterly sampling rounds in wells UCD-11, -12, -13, -19, -20, and -21, and more than once in wells UCD-7 and -14. Hexavalent chromium was reported above background concentrations in most quarterly sampling rounds in wells UCD-1, -11, -12, -13, -19, -20, -21. Hexavalent chromium was consistently detected in UCD-11, which also had the highest concentration (340 ug/L) during the Spring Quarter 1991.

Detectable levels of radionuclides for gross-alpha, gross-beta, tritium, strontium-90 and carbon-14 were reported in groundwater samples analyzed. Gross-alpha levels were reported above detection in most quarterly sampling rounds in wells UCD-20, -21, and -24, with the highest level of 10 pCi/L in the UCD-20 sample from Spring Quarter 1991. Gross-beta levels were reported above detection in most quarterly sampling rounds in wells UCD-1, -7, -10, -12, -13, -20, -21, -22, and -24, with the highest level of 22 pCi/L in the sample from UCD-22 from Summer Quarter 1991. Tritium has been reported in most quarterly sampling rounds in wells UCD-13 and UCD-14, with highest levels in the sample from UCD-13 from Winter 1991 (28,744 pCi/L). Strontium-90 has been reported in the Winter 1991 and Spring 1991 quarterly sampling rounds in wells UCD-1, UCD-7, UCD-10, UCD-13, UCD-23, the highest detection was 5.7 pCi/L in UCD-7 during the Spring 1991 quarter; however no repeated results were reported. Carbon-14 was reported in groundwater samples collected from UCD-13 and -14 in Spring 1991 and Fall 1991 Quarters, and Spring and Summer 1991 Quarters, respectively. The highest concentration was 1815 pCi/L detected in UCD-13 during the Fall 1991 sampling round. However, these are the only wells where carbon-14 was analyzed.

Additional hydrogeologic and chemical/radiologic data are needed in order to fully assess trends, estimate contaminant plume movement, and evaluate the impact to off-site water quality. This new information will be added to the existing data and further evaluated during the next phase (Phase III) of the groundwater investigation scheduled for fiscal year 1992-1993.

7.0 QUALITY ASSURANCE

All samples are collected, analyzed and reviewed according to approved quality assurance plans. The environmental sampling program includes appropriate quality assurance checks such as sample duplicates, splits, spikes, etc. In addition, all quality assurance plans are prepared in accordance with EPA QAM-005 and NQA-1 specifications.

7.1 Field and Trip Blanks

The protocol for collecting a field blank requires that field sampling procedures be simulated. This will be done by decanting the laboratory-supplied field blank water into a complete set of sample bottles and adding preservatives as appropriate. The filled sample bottles are packed with ice packs in the ice chest and transported to the laboratory for analyses.

Trip blanks are samples of organic free water which are prepared in VOC sample bottles (with Teflon septums) at the same time and location as the preparation of the bottles which are used for sampling. Trip blanks remain with the sample bottles while in transit to the site, during sampling, and during the return trip to the laboratory. Trip blanks are not opened at any time during these procedures. Upon return to the laboratory, they are analyzed as other samples, including the same QA/QC procedures.

7.2 QA Duplicates

For each round of sampling, "blind" duplicate samples, amounting to a number which is 10% of the soil samples, will be collected from a selected sample point at the same time as the original sample. The duplicate samples will be labeled with a fictitious sample number and sent to the laboratory for analysis with the other samples. The QA duplicate serves as a check on the precision of the sampling and analytical procedures.

7.3 Data Quality Objectives

The objective of analytical data is to evaluate and determine the nature and extent of radiological and chemical contamination at the LEHR site. Additional data will be obtained as required for site remediation. The overall completeness objective of data is to validate

greater than 90% of the total number of required analyses. The limits of detection accuracy and precision for the laboratory measurements for soil and groundwater samples are provided in Table 7.1.

TABLE 7.1:
Data Quality Objectives for Soil and Groundwater Samples

Annual Site Environmental Report
Ver:1 Rev:0 4/30/92
UCD/LEHR 17523

ANALYTE	MATRIX	METHOD	MINIMUM REPORTING LIMIT	ACCEPTABLE ACCURACY LIMIT	ACCEPTABLE PRECISION RANGE
Turbidity	Water	180.1	0.001 NTU	85-120	0-25
pH	Water	150.1	----	75-125	0-25
Special Condition	Water	120.1	0.2 uS	75-125	0-25
Nitrate	Water	353.2	0.10 mg/l	75-125	0-25
	Solid	H ₂ O EX-353.2	1.0 ug/g		
Antimony	Water	204.2	0.01 mg/l	75-125	0-25
	Solid	7041	1.00 ug/g		
Arsenic	Water	206.2	0.10 mg/l	73-132	0-21
	Solid	7060	10 ug/g		
Barium	Water	200.2	0.001 mg/l	68-129	0-5.8
	Solid	6010	0.10 ug/g		
Beryllium	Water	200.7	0.001 mg/l	75-125	0-25
	Solid	7131	0.10 ug/g		
Cadmium	Water	213.2	0.001 mg/l	55-168	0-27
	Solid	7131	0.10 ug/g		
Chromium	Water	200.7	0.001 mg/l	80-117	0-5.3
	Solid	6010	0.10 ug/g		
Chromium (IV)	Water	218.4	0.01 mg/l	75-125	0-25
	Solid	H ₂ O EX/218.4	0.10 ug/g		
Cobalt	Water	200.7	0.10 mg/l	77-119	0-6.4
	Solid	6010	1.00 ug/g		

TABLE 7.1:
Data Quality Objectives for Soil and Groundwater Samples

Annual Site Environmental Report
Ver:1 Rev:0 4/30/92
UCD/LEHR 17523

ANALYTE	MATRIX	METHOD	MINIMUM REPORTING LIMIT	ACCEPTABLE ACCURACY LIMIT	ACCEPTABLE PRECISION RANGE
Copper	Water	200.7	0.001 mg/l	73-123	0-7.1
	Solid	6010	0.10 ug/g		
Lead	Water	239.2	0.001 mg/l	57-142	0-19.8
	Solid	7421	0.10 ug/g		
Mercury	Water	245.1	0.0004 mg/l	66-138	0-16
	Solid	7471	0.04 ug/g		
Molybdenum	Water	200.7	0.001 mg/l	75-125	0-25
	Solid	6010	0.10 ug/g		
Nickel	Water	200.7	0.014 mg/l	67-123	0-5.3
	Solid	6010	1.00 ug/g		
Selenium	Water	270.2	0.01 mg/l	70-110	0-27
	Solid	7740	1.00 ug/g		
Silver	Water	200.7	0.01 mg/l	75-125	0-25
	Solid	6010	1.00 ug/g		
Thallium	Water	279.2	0.01 mg/l	75-125	0-25
	Solid	7841	1.00 ug/g		
Vanadium	Water	200.7	0.01 mg/l	75-125	0-25
	Solid	6010	1.00 ug/g		
Zinc	Water	200.7	0.01 mg/l	92-107	0-4.1
	Solid	6010	1.00 ug/g		
Strontium 90	Water	*	0.5 pCi/l	86-105	0-8.0
	Solid	*	0.05 pCi/g		

TABLE 7.1:
Data Quality Objectives for Soil and Groundwater Samples

ANALYTE	MATRIX	METHOD	MINIMUM REPORTING LIMIT	ACCEPTABLE ACCURACY LIMIT	ACCEPTABLE PRECISION RANGE
Gross Alpha	Water	900.0	2.0 pCi/l	93-103	0-5.0
	Solid	9310	0.3 pCi/g		
Gross Beta	Water	900.0	3.0 pCi/l	93-103	0-5.0
	Solid	9310	0.1 pCi/g		
Tritium	Water	(1)	500 pCi/l	76-114	0-8.0
	Solid	(1)	0.05 pCi/g		
Volatile Organic	Water	624	See Method	See Method	See Method
	Solid	8240	See Method		
BNA Organic	Water	625	See Method	See Method	See Method
	Solid	8270	See Method		
Pest/PCBs	Water	608	See Method	34-93 (2) 80-105 (3)	0-29 (2) 0-13 (3)
	Solid	8080	See Method	30-52 (4)	0-32 (4)
Petroleum Hydrocarbon	Water	GC/MS	10 ug/l	In Development	In Development
	Solid	GC/MS	333 ug/kg		
Chlordane	Water	608	0.014 ug/l	In Development	In Development
	Solid	608	0.47 ug/kg	21-53	0-43
Formaldehyde	Water	HEAD SPACE GC/MS	5.0%	In Development	In Development
	Solid	HEAD SPACE GC/MS	12.5%		

Notes:

- (1) Radiochemistry Procedures for Environmental Samples, EPA.
- (2) Endrin
- (3) Lindane
- (4) Methoxychlor

8.0 REFERENCES

1. DOE Orders 5400.1, 5400.5, 5484.1, and 5000.3.
2. DOE Memorandum dated January 31, 1991 regarding "Final Guidance for the Preparation of Annual Site Environmental Reports for Calendar year 1990".
3. LEHR Environmental Monitoring Reports, 1989, 1988, 1987, 1986, 1985, 1984, 1983, 1982, and 1981.
4. Title 17, California Radiation Control Regulations.
5. Title 10, Code of Federal Regulations.
6. LEHR Site Map (Figures 1 & 2).
7. California Radioactive Material License No. 1334-57 expiration date November 15, 1994.
8. EPA, 1986 "Test Methods for Evaluating Solid Waste" SW-846, third edition, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington D.C.
9. Practical Guide for Groundwater Sampling, U.S. E.P.A., 1985, p. 72-155.
10. A Guide to the Selection of Materials for Monitoring Well Construction and Groundwater Sampling, Illinois State Water Survey, 1983, p. 13-30.
11. Draft Phase II Characterization Report, April 1992, Dames and Moore.
12. Characterization Report for Animal Hospital Buildings AH-1 and AH-2 at LEHR - ER, Volumes 1 - 4, Bechtel Environmental, Inc.

ATTACHMENT 1: ENVIRONMENTAL MANAGEMENT POLICY STATEMENT

It is the policy of the Laboratory for Energy-Related Health Research (LEHR) Environmental Restoration (ER) Project to conduct operations in an environmentally safe and sound manner. The environmental management program is expected to ensure that:

1. LEHR is operated in an environmentally safe manner.
2. LEHR is in compliance with applicable Federal, State, and local regulations and with DOE orders and management directives, and
3. LEHR is active in preventing environmental problems.

These objectives are to be achieved through awareness, education, and commitment on the part of cleanup management and personnel. Environmental protection includes the correction of past problems and implementation of a preventative program. It is LEHR's objective to achieve compliance and to establish policies and procedures that will ensure compliance and prevent future problems.

ATTACHMENT 2: ACRONYMS AND ABBREVIATIONS USED

AEC	Atomic Energy Commission
AH-1	Animal Hospital 1
AH-2	Animal Hospital 2
CEP	Controls for Environmental Pollution
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response, Compensation & Liability Act
Ci	Curie
cm, cm ²	Centimeters, Centimeters squared
CMDW	Cydney Marshall Domestic Well
Co-60	Cobalt 60
cpm	Counts per minute
CPT/HP	Cone Penetrometer Testing/Hydropunch
CrVI	Hexavalent Chromium
CWDW	Chris Watkins Domestic Well
D&D	Decontamination and Decommissioning
D&M	Dames and Moore
DDD	Dichlorodiphenyl Dichloroethane
DDE	Dichlorodiphenyl Ethane
DDT	Dichlorodiphenyl Trichloroethane
DHS	Department of Health Services
DOE	Department of Energy
dpm	Disintegrations per minute
EIP	Environmental Implementation Plan
EMO	Environmental Management Operations
EPA	Environmental Protection Agency
ER	Environmental Restoration
ERC Group	Environmental Restoration and Cleanup Group
IHDW	Irene Hamel Domestic Well
LEHR	Laboratory for Energy-Related Health Research
M&O	Management & Operations
MARDW	Martinelli Domestic Well
MARIW	Martinelli Irrigation Well
MCL	Maximum Concentration Level
mg/l	Milligrams per liter
MIW	Miller Irrigation Well
mrem	Millirems
nCi	Nanocuries
NDW	Nishi Domestic Well
NE or N.E.	Northeast
NEPA	National Environmental Protection Act
NESHAPS	National Emmission Standards for Hazardous Air Pollutants

NIW	Nishi Irrigation Well
NPDES	National Pollution Discharge Elimination System
NPL	National Priorities List
NQA	National Quality Assurance
NW or N.W.	Northwest
OHDW	Owen Hamel Domestic Well
OMB	Office of Management & Budget
ORPS	Occurrence Report & Processing System
PA	Preliminary Assessment
PCB	Poly-chlorinated Biphenyl
PCD	Putah Creek Downstream
pCi	Picocurie
PCU	Putah Creek Upstream
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QAM	Quality Assurance Manual
Ra-226	Radium 226
Rad	Radiation
RDC	Radiation Detection Company
RDW	Roth Domestic Well
RUSDW	Rust Domestic Well
RWQCB	Regional Water Quality Control Board
SPCC	Spill Prevention Controls & Countermeasures
Sr-90	Strontium 90
SSDC	System Safety & Development Center
STPO	Wastewater (Sewage) Treatment Plant Outfall
SWAT	Solid Waste Water Quality Assessment Test
TLD	Thermo Luminescent Detector
TMA	Thermo Analytical Inc.
UC DAVIS	University of California at Davis
UCD	University of California at Davis
ug/kg	Micrograms per kilogram
ug/l	Micrograms per liter
UR	Unregulated
VOC	Volatile Organic Compound
RCRA	Resource Conservation & Recovery Act
CAA	Clean Air Act
CWA	Clean Water Act
HRS	Hazardous Ranking System
NPL	National Priorities List
HSU	Hydrostratigraphic Unit