U.S. Department of Energy

Oakland Operations Office, Oakland, California

Closure Plan

for

Mixed Waste Storage Facility
Laboratory for Energy-Related Health Research (LEHR)
University of California at Davis, California

Submitted to:

Weiss Associates
5500 Shellmound Street
Emeryville, California 94608

Prepared by:

Environmental Management Services, Inc.
Concord, California

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Weiss Associates
Environmental and Geologic Services

LEHR-110

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University of California at Davis, California

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ACRONYMS AND ABBREVIATIONS

Am-241	Americium-241
ANSI	American National Standard Institute
C-14	Carbon-14
CCR	California Code of Regulations
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
Co-60	Cobalt-60
CPM	Count Per Minute
Cs-137	Cesium-137
D&D	Decontamination and Decommissioning
DAC	Derived Air Concentration
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
dpm	disintegration per minute
DTSC	Department of Toxic Substances Control
EPA	Environmental Protection Agency
FC	Field Coordinator
FFA	Federal Facility Agreement
FFCAct	Federal Facility Compliance Act
H-3	Tritium
HWP	Hazardous Work Permit
K-40	Potassium-40
LEHR	Laboratory for Energy-Related Health Research
MDA	Minimum Detectable Activity
MDL	Minimum Detection Limit
Mn-54	Manganese-54
MOA	Memorandum of Agreement
μR/h	Micro Rem per hour

MWSF	Mixed Waste Storage Facility
NIST	National Institute for Standards and Technology
NPL	National Priority List
NRC	Nuclear Regulatory Commission
OSHA	Occupational Safety and Health Administration
PARCC	Precision, Accuracy, Representativeness, Completeness, and Comparability
Pb-210	Lead-210
Pu-241	Plutonium-241
pCi/g	pico Curies per gram
PHSP	Project Health and Safety Plan
PPE	Personal Protection Equipment
PVC	Polyvinyl Chloride
QAMS	Quality Assurance Management Staff
QAPP	Quality Assurance Project Plan
Ra-226	Radium-226
RCRA	Resource Conservation and Recovery Act
RDL	Reporting Detection Limit
RF	Reliability Factor
SHSO	Site Health and Safety Officer
Sr-90	Strontium-90
SVOCs	Semi-Volatile Organic Compounds
Th-230	Thorium-230
UC Davis	University of California at Davis
VOCs	Volatile Organic Compounds

1. INTRODUCTION

1.1 Objectives

This closure plan is prepared for the final closure of the Mixed Waste Storage Facility (MWSF) at the former Laboratory for Energy-Related Health Research (LEHR) site located at the University of California Davis (UC Davis). The MWSF was used for the storage of hazardous and radioactive mixed waste left over from the Department of Energy (DOE) funded research program at LEHR. The MWSF has been owned by DOE and operated by the DOE contractor for the LEHR site under a RCRA Part A Permit Application submitted in 1989.

1.2 Site Background

LEHR was established in 1958 at UC Davis as a research laboratory. The DOE funded research at LEHR focused on the health effects from chronic exposures to radionuclides, primarily Strontium-90 (Sr-90) and Radium-226 (Ra-226) using beagles to simulate radiation effects on humans. In a separate but related project, research animals were exposed to gamma radiation to study the effect of this type of radiation on the development of cancers such as Leukemia. DOE funded research involving the use of small amounts of plutonium-241 (Pu-241), cesium-137 (Cs-137), carbon-14 (C-14), and other radioisotopes were also conducted at LEHR by University employed scientists.

In 1988, pursuant to a Memorandum of Agreement (MOA) between DOE and the UC Davis, DOE's Office of Energy Research decided to close out the research program, remediate the site as required, and turn the facility and land over to the UC Davis for unrestricted use. Site restoration activities, including decontamination and decommissioning of laboratory buildings, started in earnest in 1990. In May 1994, as a result of groundwater contamination detected during a

preliminary investigation and the potential threat of contamination to public health and the environment, the U.S. Environmental Protection Agency (EPA) placed the LEHR site on the National Priority List (NPL).

In concert with the ongoing Environmental Restoration activities, a waste management program was established by the DOE Oakland Operations Office Waste Management Division. This waste management program focuses on characterization, storage, and off-site transportation and disposal of the various legacy waste streams generated from past DOE-funded research activities at LEHR. The program also coordinates the operation of the Mixed Waste Storage Facility at the site.

1.3 Site and Facility Description

1.3.1 Site Description

The former LEHR site is a Department of Energy facility located 1.5 miles south of the main UC Davis campus (see Figure 1.1). UC Davis owns the land at the LEHR site and the Department of Energy owns the buildings and other facilities including the MWSF.

Given that DOE-sponsored research at LEHR has ceased, there are no ongoing routine operations associated with DOE programs that produce waste. After the conclusion of the DOE-funded research program in 1988, numerous legacy waste streams including laboratory containers of chemicals, specimens preserved in organic liquids, cleaners, lubricants, paints and other miscellaneous materials were inventoried during a comprehensive room-by-room inspection. These waste streams were collected from various on-site research buildings and transferred to the MWSF for storage.

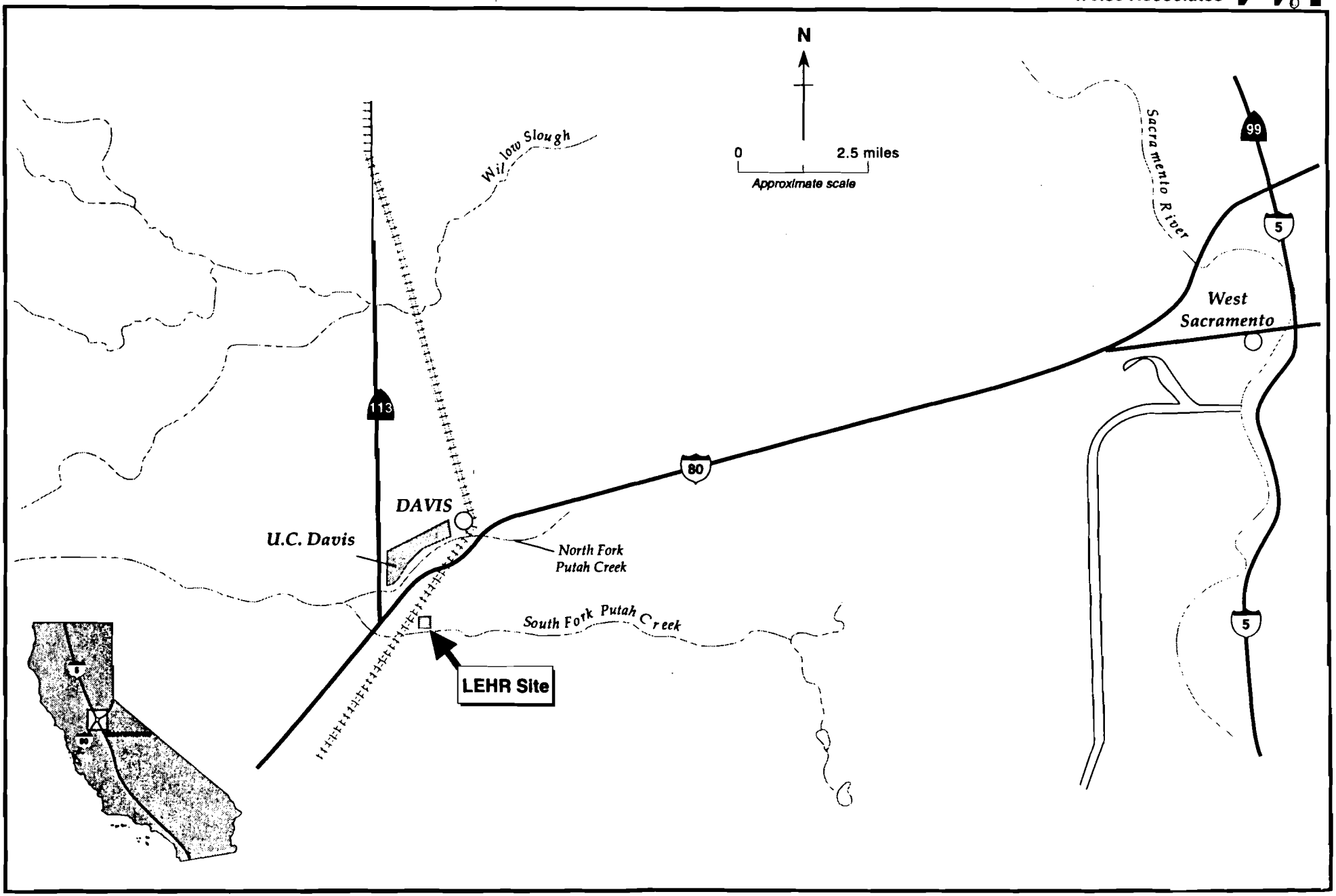


Figure 1-1. Site Location Map - LEHR Facility, Davis, California

1.3.2 Waste Management Unit Description

The MWSF, located in the Southeast quadrant of the LEHR site (Figure 1.2), consists of a pre-fabricated steel chemical storage shed with three separate lockers (Figure 1.3). The facility was designed to store hazardous or mixed waste/materials and to provide sound environmental protection against contamination due to spills or leaks. At the same time, these lockers provide a high level of security and protection from the elements. The lockers have built-in secondary metal type spill containment compartments and an integrated dry-chemical fire suppression system.

Designed and built, by Chem-Stor in 1989, to meet the requirements for storage of hazardous materials and/or waste, each of the 9'9" x 23'8" x 8'5" lockers features include:

- Venting to relieve internal pressures and limit structural damage during an explosion.
- Static ground connection to protect flammable or combustible materials from ignition by electrical discharge.
- Interior and exterior two-part chemical resistant epoxy paint to protect the steel components from corrosion.
- Additional coal tar sealant coating in reservoir containment.
- Structural grade 14 and 16 gauge steel construction for maximum security.
- Secondary containment for up to 750 gallons.
- Easy visual inspection of the secondary containment.
- Seismic Tie Downs.
- Pressure relief skylights and side vents.
- Continuous forced-air ventilation.

The MWSF was used for the storage of hazardous and mixed waste between 1989 and 1996. All contained waste streams have been properly characterized, packaged and shipped to off-site locations for treatment and/or disposal. At present, two of the three secondary containments contain rain water which is believed to have entered through the unit's ventilation openings. Depending on

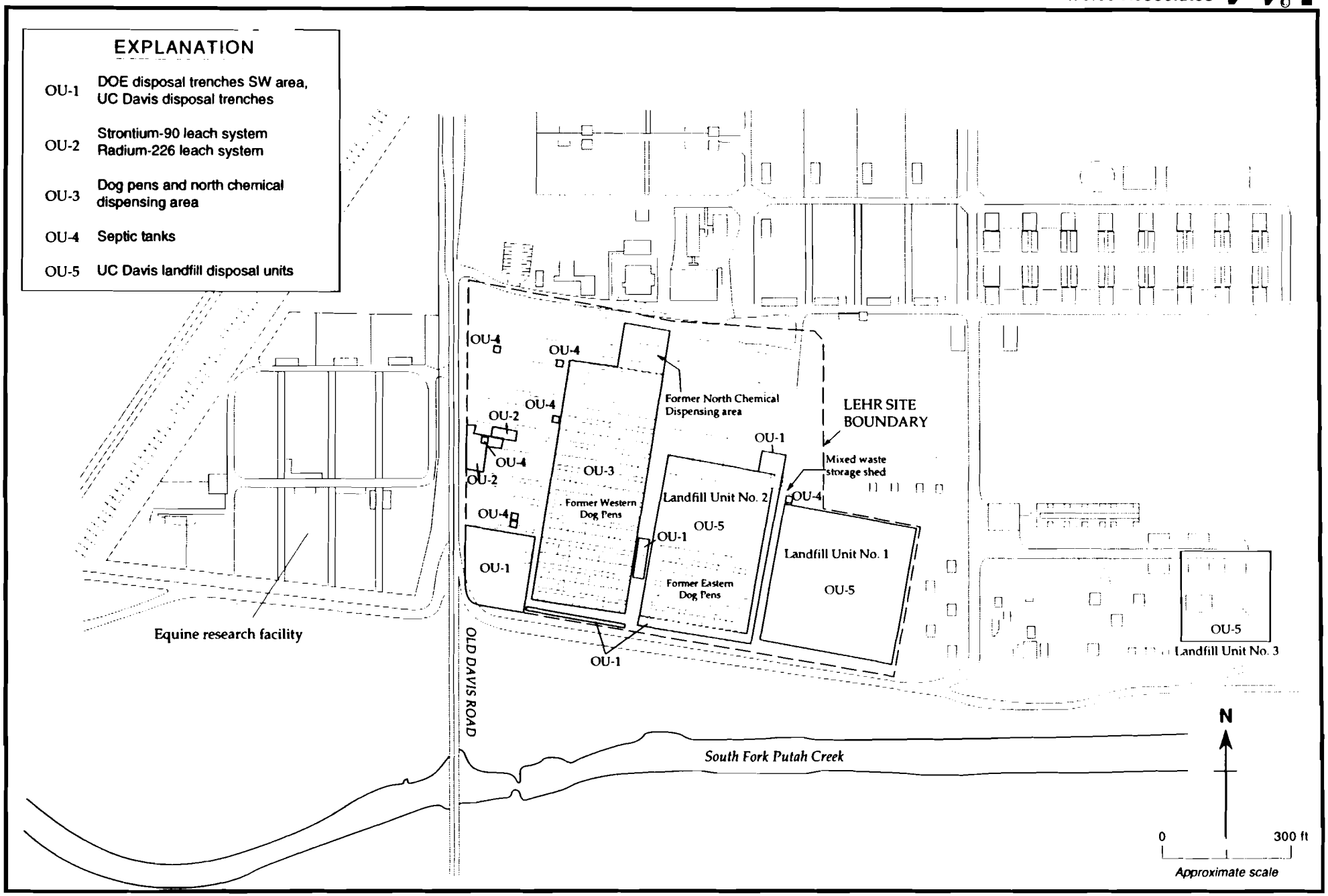
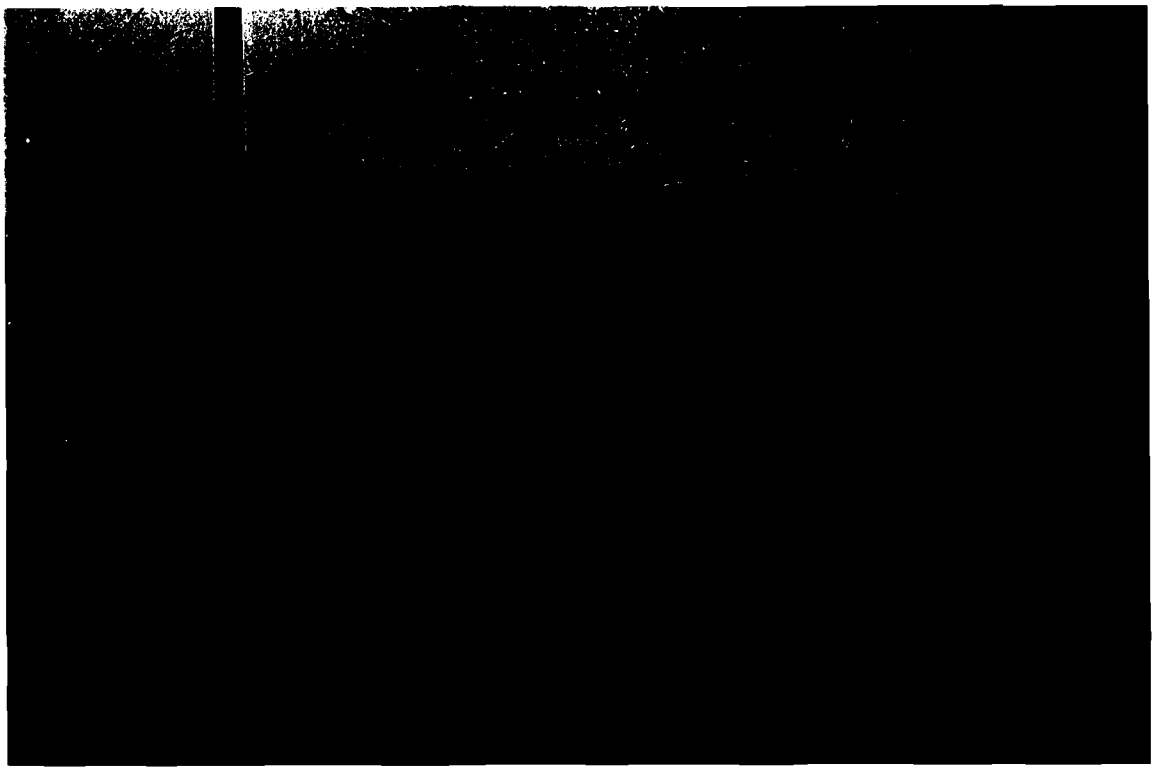


Figure 1-2. LEHR Site Map Showing Operable Units, LEHR Facility, Davis, California

Figure 1.3 Photo of MWSF Units



the time of closure (summer vs. winter) rain water may or may not be present in the secondary containtment at the time of closure.

1.3.3 Facility Survey and Inspection

Visual inspection of the MWSF and adjacent areas are performed and documented weekly. No waste containers were known to leak during facility operations. Radiological surveys were performed and documented on a monthly basis. After stored waste was removed, no radiation fields above background were detected inside or outside the MWSF.

1.3.4 Maximum Waste Inventory

The maximum inventory of waste stored in the MWSF during its operations is as follows:

Waste Designation	Waste Types	Maximum Inventory
Liquid scintillation cocktails	Flammable, Corrosive, Radioactive	150 gallons
Miscellaneous Aqueous Solutions	Toxic, Radioactive	100 gallons
Miscellaneous Organic Liquids	Flammable, Radioactive	40 gallons
Miscellaneous Organic Solids	Toxic, Carcinogenic, Radioactive	80 gallons
Total	-	370 gallons

This total (maximum) inventory represents less than 18% of the MWSF design capacity of 2100 gallons.

1.3.5 Potential Historical Waste Materials

A list of potential waste materials that may have been stored at the MWSF is provided below. These potential waste materials were identified based on sampling, historical records, and operational history of the MWSF (LEHR, 1995).

Radioisotopes

Gamma Emitters (Co-60, Cs-137, K-40, Mn-54, Pb-210)

Strontium-90

Radium-226

Tritium

Carbon-14

Plutonium-238, 239, 240, 241

Americium-241

Chemicals

Volatile Organic Compounds

Semi-volatile Organic Compounds

2. CLOSURE PERFORMANCE STANDARDS

This section describes the performance standards for the closure activities presented in this plan. Upon completion of clean closure of the MWSF, there will be no hazardous or mixed wastes residues remaining in the closed facility. This will preclude the need for post-closure care to control or prevent releases of hazardous chemical constituents or radioactive materials to the environment.

2.1 Closure Performance Standards

The performance standards to be met in conducting clean closure of the MWSF are as follows:

- Removal of any rain water that may have accumulated in the secondary containments of the chemical storage lockers. Disposition of this rain water will be determined based on the analytical results of the water and applicable discharge limitations.
- Decontamination of the physical surfaces of the unit so that:
  - no hazardous chemical residues remain at concentrations above those for characteristic waste (as established in 40 CFR 261 SubPart C (CFR, 1991) and 22 CCR Article 11) (CCR, 1996).
  - no surface radioactive material contamination remains at levels above those for unrestricted use established in DOE 5400.5 (DOE, 1990), NRC 1.86 (NRC, 1974), or by the State of California (CA, 1977). "Department of Health Services Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use."

- Collection and disposition of decontamination solutions and wastes (if any) to an approved off-site treatment, storage, or disposal facility for hazardous and mixed waste or an approved off-site disposal facility for radioactive waste.

- Performance of verification sampling that allows certification of the MWSF clean closure.

Sections 4 and 5 describe the closure activities in detail. The following further describes the performance standards and how, by meeting these standards, the need for post closure maintenance and hazard control is eliminated.

2.1.1 Maintenance Minimization

The objective of the MWSF closure is to eliminate, to the extent necessary to protect human health and the environment, the potential post-closure escape of residual contaminants or the migration of waste products to the ground, surface water, or atmosphere, and thus eliminate the need for post-closure maintenance and control. This will be achieved by removal of all contaminated waste or residuals to a permitted waste treatment, disposal, or storage facility. The MWSF structure will then be decontaminated, as required, or dismantled and shipped off-site for disposal. Decontamination procedures and selection of possible decontamination methods are described in Section 5 of this closure plan.

Verification sampling will be performed for the potential contaminants to verify that no radioactive or hazardous waste residues are present. If found, contaminated areas will be further decontaminated or removed. Follow-up confirmation sampling and/or surveys will be repeated, as necessary. Closure will then be considered complete.

Rainwater collected in the secondary containment tray(s), decontamination and rinse solutions, and debris that may be generated during decontamination activities will be analyzed, and disposed of according to applicable requirements.

If, during closure, it is determined that there is a possibility of soil contamination beneath a unit, the contamination will be dealt with as part of the ongoing site environmental restoration program. The following should be considered if soil contamination is found beneath the MWSF:

- Adding an evaluation phase to the ongoing DOE Environmental Restoration Program to identify which substances have contaminated the area under the MWSF and the extent to which they have migrated.
- Implementing additional remedial investigation activities for the area surrounding the MWSF.
- Including the area of the MWSF in the ongoing CERCLA clean up program of DOE areas to identify and evaluate alternative technologies to remediate and remove contamination.

2.1.2 Post-Closure Hazard Control

At completion of clean closure of the MWSF, all structures and equipment would have been decontaminated and the decontamination verified. Any wastes generated from decontamination and closure activities (e.g., decontamination solutions or other waste materials) will be disposed of and/or discharged, based on waste analyses in compliance with all applicable laws and regulations. Since there will be no hazardous chemical residues or by-products, nor any radioactive material contamination remaining at this facility, post-closure hazard control will not be necessary. If, during closure, it is determined that extensive contamination is present in any of the MWSF units and decontamination is ineffective, the contaminated unit will be dismantled and disposed of at an approved off-site disposal facility.

2.1.2.1 Control of Wastes and Waste Constituents

The MWSF will undergo clean closure. All wastes have been previously transferred to a permitted treatment, storage, and disposal facility. Because no wastes were disposed of at the MWSF, post-closure control requirements of wastes will not be applicable.

2.1.2.2 Control of Leachate

Leachate control is not applicable to a waste management unit such as the MWSF that has undergone a clean closure as described in this plan.

2.1.2.3 Control of Contaminated Runoff and Rainfall

No rainfall or runoff will become contaminated after completion of closure because any detected hazardous chemical or radioactive material residues will be removed from the MWSF structure.

2.1.2.4 Control of Waste Decomposition Products

Control of waste decomposition products will not be necessary because any detected hazardous chemical residues, and radioactive material contamination will be removed from the MWSF to an off-site treatment, storage, or disposal facility.

3. SCHEDULE FOR CLOSURE

3.1 Expected Year of Closure

The MWSF is planned to be closed in 1998 contingent on the California Department of Toxic Substances Control's (DTSC) approval of this closure plan. If it becomes necessary to operate the MWSF beyond the year 1998, this plan will be amended. DTSC will be notified at least 45 days in advance of the date that closure operations are scheduled to begin.

3.2 Frequency of Partial Closure

Partial closure of the MWSF is not expected.

3.3 Closure Milestones

Milestone	Due Date
Remove rain water collected in the secondary containment tray(s)	Within 90 days following approval of final closure plan
Complete closure activities	Within 180 days following approval of final closure plan
Certification of Closure	Within 60 days of completion of facility closure activities

3.4 Extension of Closure Time

Closure activities for the MWSF are expected to be completed within the prescribed 180 day period. DOE does not expect to require an extension to the prescribed 180-day period. However, should an extension become necessary, DOE will apply for an extension to the DTSC at least 30 days before expiration of the 180-day period.

4. INVENTORY REMOVAL PROCEDURES

4.1 On-site Treatment or Disposal

No wastes will be treated or will remain at the MWSF.

4.2 Off-site Treatment or Disposal and Transportation Distance

In the past, the former LEHR facility has shipped mixed and hazardous waste to off-site permitted facilities including, but not limited to, the following. The approximate transportation distances to these off-site waste treatment and disposal facilities are also listed.

Facility	Distance in Miles
Chemical Waste Management Kettleman Hills Disposal Facility 35251 Old Skyline Road Kettleman City, CA 93239	300
U.S. Department of Energy Hanford Site 2355 Stevens Blvd. Richland, WA 99352	700
Envirocare of Utah, Inc. Clive Disposal Site Clive, UT 84027	700

The former LEHR site may use these facilities or other permitted facilities as they become available. All waste to be transported off-site will be packaged and transported according to applicable state and federal regulations including DOE, DOT, NRC, EPA, and DTSC requirements.

5. DECONTAMINATION OR DISPOSAL OF FACILITY STRUCTURES

5.1 Specific Closure Activities

Specific closure activities will be performed based on the logic chart provided in Figure 5.1. The following is a brief step by step description of activities to be performed throughout the closure process. Detailed descriptions of radiological surveys and chemical analyses along with some typical decontamination methods are provided in Section 5.2.

Step 1: Remove rainwater accumulated in secondary containment tray(s), if any, analyze water samples for the potential contaminants listed in Section 1.3.5 and determine rainwater disposition method based on the analytical results and applicable discharge limitations.

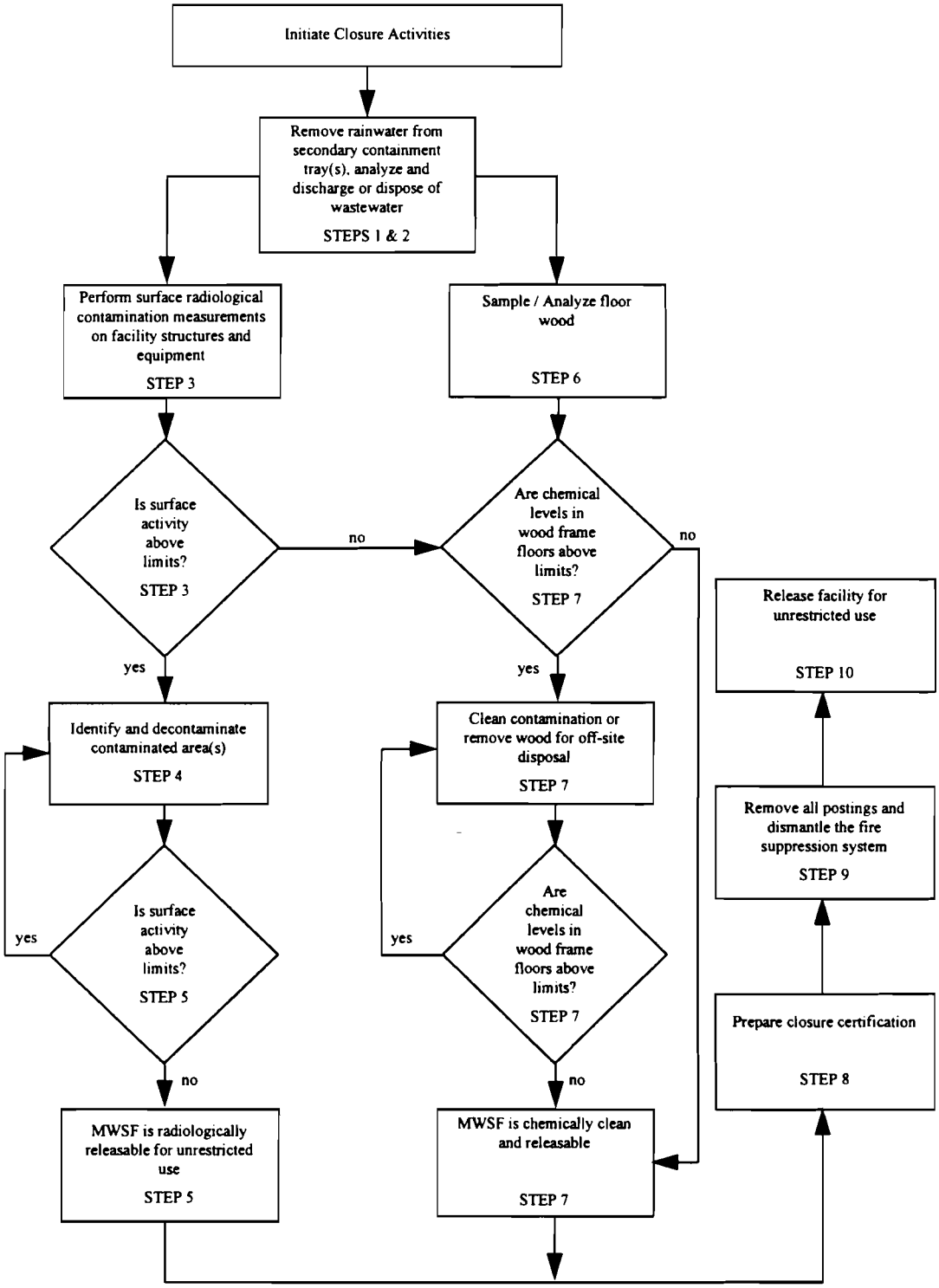
Step 2: Implement selected rainwater disposition method based on chemical analysis and regulatory limits for wastewater discharges.

Step 3: Perform surface radiological contamination measurements through surface scans and smears of walls, shelves, ceiling and secondary containments. Determine if radiological contamination is above the residual radioactivity guidelines referenced in Section 2.1.

Step 4: If surface activity measurements are above the release guidelines, identify contaminated area(s) including hot spots and decontaminate these areas as required using one or more of the decontamination methods identified in Section 5.3.2.

Step 5: Resurvey (scans and smears) decontaminated areas and repeat Step 4 as needed until contamination levels are below residual guidelines.

Figure 5.1 Logic Chart for MWSF Decontamination and Closure



Step 6: Obtain scrap wood samples from the floor of each chemical storage locker unit and analyze for potential chemical constituents provided in Section 1.3.5.

Step 7: If the results of chemical analyses of samples taken from the floor wood frame of the locker units are above the established criteria for hazardous classification, remove the contaminated wood frame for off-site disposal.

Step 8: Prepare closure certification packages as described in Sections 7.4 and 7.5 of this plan.

Step 9: Remove postings and dismantle fire suppression system.

Step 10: Release facility for unrestricted use.

In addition to the above 10 steps, three core samples of soil underyling the MWSF unit will be obtained from various depths and analyzed to confirm that no soil contamination has resulted from the operation of the MWSF.

At the conclusion of these steps, the MWSF three chemical storage lockers will be considered radiologically and chemically clean and closed in accordance with applicable RCRA requirements.

5.2 Radiological and Chemical Analysis

5.2.1 Rainwater Analysis

Rainwater that may have accumulated in the storage lockers' secondary containment tray(s) (if any) will be collected in suitable wastewater containers or 55 gallon drum(s). Representative water sample(s) will be analyzed for the potential contaminants listed in Section 1.3.5. Sampling and analysis protocol will be conducted in accordance with Table 5.1 and the LEHR Quality Assurance Project Plan (QAPP) (WA, 1997a).

5.2.2 Soil Sampling and Analysis

Based on the operation history and inspection logs of the MWSF, soil beneath the facility is not likely to be contaminated. Soil samples from underneath the facility will, however, be taken to confirm that soil contamination has not occurred. Soil samples will be taken as follows:

Using hand-held, air-rotary, or hollow-stem auger drill methods, obtain one core sample of soil underlying each of the three MWSF units at 0 to 4 inches depth and a composite soil sample at 1 to 5 ft. below ground surface. Soil sampling and analysis protocol will be as provided in Table 5.2 and in accordance with the LEHR QAPP (WA, 1997a).

Table 5.1 Water Sampling and Analyses Protocol

Analytical Parameters	Method	Matrix	Recommended Containers	Preservative	Maximum Holding Time	Minimum Volume Required for Analysis	Detection Limit
Americium-241	LAS 0108[3]	Water	Plastic (Polyethylene) or Glass	Field adjusted to pH<2 with HNO_3	180 days after collection	1L	.1 pCi/L
Carbon-14	LSC	Water	Plastic (Polyethylene) or Glass	None	180 days after collection	100 mls	20 pCi/L
Gross Alpha/Beta	9310	Water	Plastic (Polyethylene) or Glass	Field acidified to pH < 2 with HNO_3	180 days after collection	500 mls	2 pCi/L gross alpha 3 pCi/L gross beta
Gamma Emitters such as Co-60, Cs-137, K-40, Mn-54, and Pb-210	901.1	Water	Plastic (Polyethylene) or Glass	Field acidified to pH < 2 with HNO_3	180 days after collection	1L	Nuclide Dependent
Tritium	906	Water	Glass[1]	None	180 days after collection	100 mls	300 pCi/L
Plutonium-238, 239/240, 241	LAS 0108[3]	Water	Plastic (Polyethylene) or Glass	Field acidified to pH < 2 with HNO_3	180 days after collection	1L	1 pCi/L
Radium-226	903.1(m)	Water	Plastic (Polyethylene) or Glass	Field acidified to pH < 2 with HNO_3	180 days after collection	1L	1 pCi/L
Strontium-90	905	Water	Plastic (Polyethylene) or Glass	Field acidified to pH < 2 with HNO_3	180 days after collection	1L	1 pCi/L
Volatile Organic Compounds	8240	Water	Glass VOA Tubes	4^0 C, HCL, pH < 2	14 days	2 x 40 ml	see Appendix A
Semi Volatile Organic Compounds	8270	Water	Amber Glass	4^0 C	7 days to extraction, 40 days to analysis	2 L	see Appendix A

1 Tritium is very volatile. Sample containers must be air tight to eliminate tritium loss.
2 Extracted water is tested.
3 Laboratory Standard Operating Procedure

5.2.3 Radiological and Chemical Analysis of Facility Structure

5.2.3.1 Radiological Measurements

The purpose of the radiological surveys and analyses is to demonstrate that the radiological conditions of the MWSF structure and components satisfy the established surface residual radioactivity guidelines for unrestricted use.

Reference Grids: The chemical storage lockers interior walls, ceilings and floors, including the secondary containments of each unit, are classified as potentially affected for the purposes of establishing radiological measurements and therefore, will be gridded for the survey.

Frequency and Pattern: At each unit, a 1-meter grid system will be established on all interior surfaces. This grid system will be marked using indelible markers so that the grid reference could be easily reproduced. As shown below, the reference grids shall be divided into five sectors (A through E) in order to facilitate survey activities.

Table 5.2 Solid Waste Sampling and Analyses Protocol

Analytical Parameters	Method	Matrix	Recommended Containers	Preservative	Maximum Holding Time	Minimum Volume Required for Analysis	Detection Limit
Americium-241	LAS 0108[3]	Soil & Wood	Plastic (Polyethylene) or Glass	None	180 days after collection	50 gms	.1 pCi/g
Carbon-14	LSC	Soil & Wood	Plastic (Polyethylene) or Glass	None	180 days after collection	50 gms	50 pCi/g
Gross Alpha/Beta	9310	Soil & Wood	Plastic (Polyethylene) or Glass	None	180 days after collection	50 gms	5 pCi/g gross alpha 10 pCi/g gross beta
Gamma Emitters such as Co-60, Cs-137, K-40, Mn-54, and Pb-210 other fission/activation products	901.1	Soil & Wood	Plastic (Polyethylene) or Glass	None	180 days after collection	650 gms (dryout)	Nuclide Dependent
Tritium	906	Soil & Wood	Glass[1]	None	180 days after collection	100 gms	300 pCi/L
Plutonium-238, 239/240, 241	LAS 0108[3]	Soil & Wood	Plastic (Polyethylene) or Glass	None	180 days after collection	50 gms	1 pCi/g
Radium-226	903.1(m)	Soil & Wood	Plastic (Polyethylene) or Glass	None	180 days after collection	50 gms	1 pCi/g
Strontium-89, 90 and Total Strontium	905	Soil & Wood	Plastic (Polyethylene) or Glass	None	180 days after collection	50 gms	1 pCi/g
Volatile Organic Compounds	8240	Soil & Wood	4 oz. Glass with Teflon Liner	4^0 C	7 days	10 gms	see Appendix B
Semi Volatile Organic Compounds	8270	Soil & Wood	4 oz. Glass with Teflon Liner	4^0 C	14 days to extraction, 40 days to analysis	30 gms	see Appendix B

1 Tritium is very volatile. Sample containers must be air tight to eliminate tritium loss.
2 Extracted water is tested.
3 Laboratory Standard Operating Procedure

Measurement Methodology: Using the reference grids, individual surveys within each of these reference grids will be performed as described below:

All interior surfaces (walls, ceilings, and floors) of each unit will be 100 percent scanned for alpha, beta, and gamma radiation using instruments listed in Table 5.3.

Because of the low surface contamination guidelines, scanning surveys will be performed with large area gas proportional detectors. Alpha and beta-gamma measurements will be made with a gas proportional detector using the Ludlum Model 2221 scaler/rate meter.

Surfaces will be scanned at speeds no greater than five centimeters per second for alpha and beta detection instruments and gamma instruments. Audible indicators will be used as needed to identify locations having elevated (1.5 to 3 times ambient) levels of direct radiation. These scanning speeds, along with the use of audible indicators, will allow detection of contamination at levels below the surface contamination guidelines. Locations exhibiting elevated radiation levels will be marked with chalk so the area could subsequently receive a detailed measurement and, if necessary, decontaminated and/or removed followed by a re-survey.

Direct measurement will be made at the center and each corner of each grid. Unless precluded by surface conditions or physical parameters, the most sensitive of the instruments listed on Table 5.3 for surface measurements will be used. Measurements will be made by integrating counts over a 1-minute period. The one minute count times will ensure that the minimum detectable activity (MDA) is approximately 25 percent of the guidelines for beta-gamma emitters and 30 percent of the guidelines for alpha emitters. These measurements will be made with a large area gas proportional detector and Ludlum Model 2221 scaler/rate meter.

Removable contamination smear samples will be collected in each grid location at the rate of seven smears per grid. Smears for removable contamination will be

Table 5.3 Instrumentation for Radiological Surveys

Type of Measurement	Instrumentation Detector (window)	Instrumentation Meter	Bkgd.[a]	4π[a] Eff. (%)	Detection Sensitivity
Surface scans - alpha	large area gas prop. (100 cm^2) Ludlum Model 43-68	scaler/ratemeter[b] Ludlum Model 2221	1 cpm	10	70 dpm/100 cm^2
Surface scans - beta	large area gas prop. (100 cm^2) Ludlum Model 43-68	scaler/ratemeter[b] Ludlum Model 2221	80 cpm	19	370 dpm/100 cm^2
Surface activity (grids) - alpha	large area gas prop. (100 cm^2) Ludlum Model 43-68	scaler/ratemeter[c] Ludlum Model 2221	1 cpm	10	40 dpm/100 cm^2
Surface activity (grids) - beta	large area gas prop. (100 cm^2) Ludlum Model 43-68	scaler/ratemeter[c] Ludlum Model 2221	80 cpm	19	180 dpm/100 cm^2
Exposure rates	scintillation	Ludlum Model 19	5 μR/h	N/A	1 μR/h
Gross alpha/beta on smears	phoswich Ludlum Model 43-10-1	dual scaler Ludlum 2929	0.3 cpm α 35 cpm β	30 30	10 dpm 80 dpm
Low energy beta on smears	scintillation	Packard Tri-Carb LSC Model 1600TR	10 cpm	66	266 dpm

[a]Typical values
[b]Monitoring by audible signal
[c]1 minute integrated count

analyzed on site for gross alpha and gross beta activity. Results will be reported in dpm/100cm^2. The smears will be counted using a Ludlum Model 2929 dual channel scaler with the alpha-beta phoswich detector. The smears will be counted for 5 minutes to ensure that the minimum detectable activity is approximately 25 percent of the guideline for beta-gamma emitters and 40 percent of the guidelines for alpha emitters.

Low energy beta will be counted using liquid scintillation counter (LSC) Packard Tri-Carb LSC Model 1600 TR.

Gamma exposure rates will be measured at one meter above the floor and roof surfaces with a μR meter utilizing a scintillation detector. Measurements will be uniformly spaced, and one measurement will be made every square meter of surface area.

Survey Instrumentation: The instrumentation to be used to perform the release survey are listed in Table 5.3. Portable instruments are calibrated semiannually by the manufacturer using sources traceable to the National Institute for Standards and Technology (NIST), and they will be source checked daily prior to use. The bench-top alpha and beta counting systems will be calibrated using sources traceable to NIST and source checked daily before use. Electroplates sources made with Thorium-230 (Th-230) will be used for the alpha calibration and check sources. Beta calibration and check sources will be made with Strontium-90 (Sr-90). Carbon-14 and tritium standards will be used to calibrate the LSC instrument.

Prior to initiating radiological survey activities, instruments background levels will be determined. These background levels will be obtained from areas and structures known to be not radiologically contaminated and were not associated with site D&D or other cleanup activities. Background levels for scaler instruments will be determined by averaging the results of a series of 30 replicate counts.

5.2.3.2 Chemical Analysis

No chemical contamination is suspected at any of the MWSF units interior or exterior walls, ceiling, or roof. This is supported by a through review of facility operation history and inspection/incidents records. It is possible however, that the wood floor covers of the MWSF units may have become exposed to minor contamination during the facility operations. As a result, the wooden floor covers of each unit will be the only facility component that will be analyzed for chemical constituents.

In addition to the radiological measurements described in Section 5.2.3.1, wood samples will be taken from the wooden floor covers of each storage unit and analyzed for the potential contaminants listed in Section 1.3.5. Sampling and analyses protocol will be as specified in Table 5.2 and in accordance with the LEHR QAPP (WA, 1997a) and EPA approved procedures. Wood samples will be taken primarily from areas where waste may have been stored or handled or where visual inspection indicates discoloration.

5.3 Facility Decontamination

As discussed in the previous sections, the main components of the MWSF that must be decontaminated or removed in order to achieve a clean closure consist of:

- rainwater accumulated in secondary containments
- facility structures (i.e. walls, ceilings, floors and secondary containments)

The following is a brief description of the proposed decontamination and/or disposition methods to be followed for these components.

5.3.1 Secondary Containment Rainwater

This liquid waste will be transferred to a suitable container or drum(s) and analyzed. Wastewater may be released to the LEHR sanitary sewer system if analytical results are below the

UC Davis wastewater treatment plant discharge limit. If above the limit, the wastewater will be solidified and shipped off site for disposal.

5.3.2 Facility Structures and Equipment

Any hot spots (above release criteria) identified by the surface scan measurements or smears will be decontaminated using appropriate methods. Decontamination methods may include cloth wipes and detergent, mild acid solution, and top layer removal. The decontamination method will be based on the type and extent (localized or widespread) of contamination. If decontamination methods fail to remove contaminants to appropriate levels after few attempts, affected equipment and/or structures will be removed, packaged, and shipped off-site for disposal.

5.3.3 Soils

If it is determined during closure that there is a possibility of extensive contamination underlying the MWSF units, the potentially impacted areas will be further evaluated as part of the ongoing CERCLA remediation program of DOE areas. Considering that there were no reported spills from the MWSF, the potential for soil contamination beneath the facility is very small.

6. DATA VALIDATION

To ensure that the data collected during the closure activities of the MWSF are of known and acceptable quality, the data will be validated through an evaluation for precision, accuracy, representativeness, completeness, and comparability (PARCC). The validation will be an ongoing effort and will cover both chemical and radiological data that will be generated during closure activities.

6.1 Laboratory Data Validation

Validation of analyses performed by off-site laboratory of rainwater and solid waste (soil and wood) samples will be performed as specified in the LEHR Quality Assurance Project Plan (QAPP) and the associated Standard Quality Procedures (SQPs) (WA, 1997a). In general, to assess the validity of the reported analytical results and the quality of the analytical data, the following criteria will be addressed:

- Integrity and stability of the samples analyzed
- Performance of the instrument used for analysis
- Possibility of sample contamination
- Identification and quantification of the analyte in the sample analyzed
- Precision in analysis
- Accuracy of the results reported

The closure facility project team will include a chemist, who will review the sampling records, analytical results, and laboratory QA and QC information to ascertain the validity and quality level of the reported data.

6.2 Radiological Survey Data Validation

Radiological survey data will undergo a thorough review and validation including evaluation for PARCC. The following provides a detailed discussion of this validation process.

6.2.1 Precision

Precision is a measure of the mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision is determined by evaluating the distribution of a set of replicate measurements. Since the distribution of a set of replicate counts should follow a Poisson distribution, the property of the variance in those counts being equal to the mean of those counts can be used to test for the reliability of the instrument. This relationship is expressed as a Reliability Factor (R.F.)

The precision of each scaler instrument will be determined by making 30 replicate measurements of a known source with appropriate activity. The mean ($\bar{x}$) and standard deviation (σ) for the measurements will then be calculated.

The reliability factor, representing the probability that the observations show a greater deviation from the Poisson distribution than would be expected from change alone, will be calculated as follows:

$$R.F. = \frac{\sigma}{\sqrt{\bar{x}}}$$

This reliability factor will then be compared to established statistical limits of reliability to determine the normality of the distribution of events.

6.2.2 Accuracy

Accuracy is the degree of agreement between the observed (measured) value and the true value. Each instrument will be calibrated semiannually by the manufacturer using known sources traceable to the NIST or other recognized industry standards. Changes in accuracy will be monitored by constructing a control chart from the 30 replicate measurements obtained above. The mean ($\bar{x}$) and standard deviation (σ) of the measurements were used to establish the upper and lower warning limits ($\bar{x} \pm 2\sigma$) and the upper and lower control limits ($\bar{x} \pm 3\sigma$).

During the release survey, the instruments will be source checked daily and the count plotted on the control chart. If the source check fell outside a warning limit, its performance will be evaluated by a radiation measurement specialist. If the source check fell outside a control limit, the instrument will be removed from service and all data collected since the last acceptable source check will not be used.

In addition to the measurement system's ability to consistently and accurately reflect a true value, is the measurements system's ability to accurately measure contamination values at or below the residual radioactivity guidelines. This ability is quantified in the minimum detectable activity (MDA) value. The MDA for scaler counting instruments are calculated as follows:

$$MDA = \frac{2.71 + 4.65\sqrt{(R_b \cdot t)}}{t \cdot E \cdot \frac{A}{100}}$$

where

MDA = the minimum detectable activity for a scaler system in dpm/100 cm^2
t = the count time in minutes
R_b = the background count rate in cpm
E = the efficiency of the detector in cpm/dpm
A = the area represented by the measurement in cm^2

As shown above, the MDA for both scaler and ratemeter counting instruments is a function of the instrument's detection efficiency and background. Since the background of most alpha and beta/beta-gamma detectors will vary over time and with use, the associated MDA will also vary proportionately. As a consequence, each instrument's performance will be checked by making daily

background and source check measurements and tracking the detection efficiency on a control chart as described above.

6.2.3 Representativeness

Representativeness expresses the degree to which data represents the contaminants present in the area of interest. Therefore, representativeness is dependent on the following considerations:

- Appropriate measurement and sampling techniques for the matrix and contaminant
- Measurement and sampling locations that are typical of the area being surveyed

Measurement and sampling techniques and the strategy for selecting measurement and sampling locations for the final survey are provided in Section 1.3.5 and Table 5.1. These techniques and the strategy were developed based on the guidelines in NUREG/CR-5849 (Berger, 1992) and are consistent with the approaches contained in NUREG/CR-2082 (ORNL, 1981) which have been used successfully within the nuclear industry for many years.

6.2.4 Completeness

Completeness is a measure of the amount of valid data obtained (through both in situ measurements and sample analyses) from a measurement system compared with the amount that was specified by the protocol. The validity of the data obtained is based on whether the measured results satisfy field and laboratory protocols, mathematical data reduction techniques, and other requirements described herein. For each data type to be obtained (e.g., direct alpha, direct beta-gamma, removable activity, dose rate, etc.), the data set will be considered as complete when the number of usable samples or measurements is equal to or greater than 95 percent of the total samples or measurements taken. Invalid data that have been replaced by valid data will not be included in the determination of completeness.

6.2.5 Comparability

Comparability expresses the confidence with which one data set may be compared to another. This includes two elements of the survey process: the measurement instrument, and the technique by which measurements and samples are obtained.

Comparability of data collected with different measurement instruments is assured through achievement of precision and accuracy, as discussed earlier in this section. Comparability of survey technique is accomplished by adhering to procedures and by documenting that adherence in field logs and in sample results. This will be evaluated during periodic review of measurement records.

6.2.6 Radiological Data Review

Survey data will be reviewed by a radiation measurement specialist and will not be released for final use until the quality and usability of the data has been determined. The data review process will incorporate the following elements:

- Completeness of the data and appropriate supporting PARCC documentation
- Evaluation of data based on PARCC documentation
- Identification of suspect, reject, and usable data
- Elimination of previously rejected data that have been replaced with valid data

Each case review will be documented with a concise narrative that discusses changes in data quality status and where required, details the rationale for identifying data as rejected. Sufficient information shall be included to allow unaided independent evaluation. At a minimum, the narrative will address data usability.

6.2.7 Radiological Data Interpretation

Radiological measurement data will be converted to units of dpm/100 cm^2 (surface activity), μR/h (exposure rates), or pCi/g (solid waste concentrations). Detector backgrounds are subtracted from measured readings, and resultant values are corrected for efficiency and geometric factors associated with the instrumentation to complete the conversion of measured values to units suitable for comparison to the guidelines.

- Background - The background for each instrument will be determined and tracked as part of the routine instrument quality control checks. This background will be subtracted from measured values.

- Efficiency - NIST traceable standards will be used to determine the efficiency of each instrument.

- Geometry correction - A geometry correction factor will be used to convert the measurement results to dpm/100 cm^2. This factor will be primarily the ratio of 100 cm^2 to the area of the face of the detector. For example, a typical pancake Geiger Mueller probe has a window area of 15.5 cm^2; therefore, the reading is corrected by multiplying by 6.5 (the ratio of 100 to 15.5).

Scan, direct, and removable measurements will be individually compared with the average and hot spot guidelines. Average values for each grid will be determined and compared with the average guidelines. Where the values are greater than 50 percent of the guidelines, additional measurements will be made for confirmation. Additional decontamination will be considered for areas with contamination greater than 50 percent of the guideline and will be required for areas with contamination greater than the guideline.

6.3 Data Reporting

A report describing the procedures and findings of the closure activities will be prepared and included as part of the facility closure certification package described in Section 7. Data will be

summarized in tables. Measurement and sampling locations will be shown on scale drawings. The report will contain the following sections:

- Introduction - Scope of the closure effort, involved parties, and a brief description of the LEHR ER/WM project.
- Site Description - Brief physical description of the site and the MWSF.
- Historical Use of the Facility - Brief description of the facility's function and the processes conducted there.
- Project Description - Descriptions of closure activities, including methods and technologies used, waste handling, waste volumes, personnel exposure data, and project duration.
- Criteria for release to unrestricted use and chemical classification.
- Analytical and Survey Results - Description of the chemical analysis and radiological survey methodology and reports of data collected. Resulting analysis and discussion will also be included in this section.
- Conclusion - Conclusions based on data obtained and observations made during closure activities.

7. CLOSURE CERTIFICATION

7.1 Closure Monitoring

Site contractors and representatives from DOE Waste Management Division, Oakland Operations Office will monitor all closure activities described in this plan to verify proper implementation of the plan. Regulatory agencies representatives will be invited to observe closure activities.

7.2 Testing and Analysis

All sampling, analysis, and radiological surveys will be performed as described in Section 5 and in accordance with regulatory approved methods which will include U.S. EPA SW-846 (EPA, 1990). Waste Characterization and/or designation will be performed in accordance with 40 CFR 261, 22 CCR, and DOE 5400.5. Contract laboratory(s) selected to perform chemical or radiological analysis must be certified by the State of California and have in place an adequate and auditable quality control/quality assurance (QA/QC) program.

7.3 Criteria for Evaluating Adequacy

Closure activities will be considered complete when the validated results of chemical and radiological sampling, including verification sampling if needed, demonstrate that the MWSF units have been cleaned to the closure performance standards specified in Section 2 of this closure plan. If any analytical results or radiological measurements indicate levels of contamination in any of the MWSF component in excess of the closure performance standards, decontamination will be repeated for that component. Verification sampling will then be repeated. If decontamination cannot be adequately completed in accordance with the closure performance standards, and in a cost effective

manner, affected facility components will be removed, packaged and shipped to off-site disposal facilities.

7.4 Certification Activities

All closure activities will be reviewed by an independent, California-registered professional engineer to certify that these activities have been performed by qualified individuals and were completed in accordance with this Closure Plan. This engineer will review all log books, sampling and analytical data, and other closure records, including waste manifests, to certify that all closure activities have been properly completed. The independent engineer will maintain documentation of his/her closure inspections and reviews of all analytical and other data generated during closure.

7.5 Certification Documentation

Certification of closure will be provided by an independent, California-registered professional engineer. The closure certification will be exclusive to the closure of the MWSF.

The certification will confirm that closure activities were conducted in accordance with the approved practices, techniques, and procedures specified in the approved closure plan. The closure certification will be accompanied by a signed certification statement as required by 40 CFR 265.115 and 22 CCR 66265.115.

7.6 Post-Closure Plan

The MWSF was used for storage of hazardous and mixed waste only. No disposal of hazardous, radiological, or mixed waste has occurred at this facility. Because no hazardous or radioactive waste will remain in any of the MWSF units after closure, a post closure plan will not be required per 22 CCR 66265.110, and 22 CCR 66265.118.

7.7 Closure and Post-Closure Cost Estimate

Under 22 CCR 66265.140(c), the Federal Government as the owner and operator of the MWSF is exempt from the requirements to provide cost estimates and financial assurance for closure and post closure actions.

7.8 Closure Plan Amendments

The closure plan for the MWSF will be amended whenever any of the following situations occur:

- Changes in operating plans, waste management unit design, or waste types stored affect the plan.
- Expected year of closure changes.
- Unexpected events occur during closure activities that require modification of the approved plan.
- Changes in state or federal law or regulations affect the plan.

For the approved plan, if such changes occur, a written request will be submitted to the California DTSC detailing the proposed change and explaining the rationale for the change. Closure activities will not proceed further until approval of the modified plan is received from DTSC.

7.9 Regulatory Agency Notification

California DTSC will be notified in writing at least 45 days in advance of the date that closure operations are planned to begin.

8. HEALTH AND SAFETY CONSIDERATIONS

Health and safety procedures that will be followed during the MWSF closure activities are provided in the Project Health and Safety Plan (PHSP) (WA, 1997b). A hazard analysis for these activities as well as specific additional control measures to be followed are described below.

8.1 Hazard Analysis

The job hazard analysis identifies potential safety, health and environmental hazards and provides for the protection of personnel, the community, and the environment. A conservative approach will be taken to ensure that safety concerns associated with facility closure are addressed. During closure activities, the Field Coordinator (FC), Site Health and Safety Officer (SHSO), or Health and Safety Coordinator will monitor the site for any changes in conditions that would require modification of work conditions (i.e., personal protection equipment).

8.1.1 Radiological and Chemical Exposure

The potential for exposure to radiological or chemical contamination during closure activities is very low. This is supported by the following:

- All waste streams previously stored at the MWSF have been removed and shipped off-site for disposal.
- Facility operation logs indicate no chemical or radiological waste spills or overflow inside or outside the MWSF.
- Facility weekly inspection and survey records indicate no radiological contamination above background.

8.1.2 Heat Stress

Depending on the timing of closure activities, heat stress may be a concern if these activities are to be performed between May and September.

8.1.3 Heavy Equipment Operations

There may be a need to use a forklift to move the MWSF in order to access areas underneath the units for surface and subsurface soil sampling. Potential hazards may exist from the improper use of this equipment.

8.2 Hazard Controls

The following control measures will be implemented during closure activities. These control measures are intended to supplement the PHSP.

8.2.1 Hazardous Work Permit

A Hazardous Work Permit (HWP) will be used to control work in the exclusion zone. The following information will be described in the HWP.

- Scope of work to be performed;
- Anticipated radiological, safety, and industrial hygiene conditions;
- PPE and respiratory protection requirements;
- Radiological and industrial hygiene monitoring requirements;
- Activity Hazard Analysis;
- Period for which the HWP is valid; and

- Special instructions and miscellaneous requirements.

8.2.2 Boundaries

The work areas will be enclosed by boundary ropes or ribbons. Boundaries of the contamination area will be posted with signs stating "Contamination Area, Authorized Personnel Only."

8.2.3 Heat Stress

To minimize the effects of heat related injuries, an area will be established to conduct entrance/exit activities, sample preparation, and other support functions. This area will be covered with a portable tarp to provide the workers with shade. The control associated with heat stress are specified in the PHSP. The SHSO or designee shall ensure, during morning tailgate safety meeting, that all workers are aware of the signs and symptoms of heat stress, engineering control measures, and the need to replenish body fluids. If work area temperature is above 75°, integrated heat stress monitoring will be performed daily to determine the proper work/rest regiment.

8.2.4 PPE

Workers in the exclusion zone will wear modified Level D PPE in accordance with the PPE selection matrix in the PHSP.

Modified Level D PPE will consist of:

- ANSI approved hard hat;
- Steel-toed impermeable boots;
- Chemical resistant gloves;
- Full tape of wrists and ankles;

- Leather work gloves; and
- Safety glasses.

8.2.5 Training

Personnel performing closure activities will receive training covering this work plan. All on-site project personnel shall have completed at least 40 hours of hazardous waste operations-relating training, as required by OSHA Regulation 29 CFR 1910.120. Those personnel who completed the 40-hour training more than 12 months prior to the start of the field activities shall have completed an 8-hour refresher course within the past 12 months. The FC shall have completed an additional 8 hours of relevant supervisory health and safety training. In addition, any workers who will enter radiological control zones shall have successfully completed Radiological Worker II training and site-specific Rad Worker training. All site workers shall receive training covering the Contingency Plan and General Emergency Response procedures (WA, 1997d). Personnel performing activities within the contamination area will receive the training in accordance with the requirements specified in SQP-3.2, "Indoctrination and Training" (WA, 1997c), for the specific job assignments.

8.2.6 Buddy System

The buddy system will be utilized to protect personnel in the work area. The system will be implemented so that at least two persons will be required to be in the work area when work is conducted in the exclusion zone, which might result in worker contamination or injury.

The buddy system is a method of organizing employees into work groups and is designed to provide those employees with assistance when needed. Each employee in a work group is designated to be observed by at least one other person. Assignment of designated partners should take place during the tailgate safety meeting.

The responsibility of the buddy is to:

- Provide assistance, if needed;
- Maintain line of sight contact or verbal contact with workers in the contamination area;
- Observe for signs of chemical or physical trauma or heat stress such as:
  - * changes in complexion and skin discoloration,
  - * changes in coordination or demeanor,
  - * excessive saliva and papillary response,
  - * changes in speech pattern;
- Periodically verify the integrity of all protective clothing; and,
- Notify the Project Field Coordinator if emergency help is needed.

8.2.7 Safety Equipment

In addition to other equipment specified in this work plan, the following safety equipment will be staged at the boundary of the contamination area:

- First aid kit;
- Portable eyewash station and hand shower;
- Hearing protection;
- Spill kit;
- Air horn;
- Portable radio for emergency communications; and

- Fire extinguisher.

8.2.8 Air Monitoring

Air monitoring may be performed only during soil sampling activity. The levels of organic vapors in the work area during this activity will be monitored using a photoionization detector (PID).

General area air samples will be collected to monitor airborne radioactive contamination during soil sampling. Filters will be changed at the beginning of each work day. The filters will be analyzed on-site in a low-background area using a gross alpha/beta scaler counter (i.e., dual channel scaler). Filters will be counted initially after removal and at the start of the next working day shift. Air monitoring will be conducted in accordance with procedures for air surveillance program and airborne radioactivity monitoring in the PHSP.

If the general area air samples indicate that workers may be exposed to airborne radioactive contaminants that are >10% of the derived air concentration (DAC), listed in 10 CFR 835, Appendix A, then estimated radioactive material internal exposures will be made by the site health and safety officer for each worker. These estimates will be determined by calculating DAC-hours. Calculated results will be incorporated with dosimetry records. Workers that receive greater than two DAC-hours per day or ten DAC-hours per week will be subjected to bioassay testing.

The primary radionuclides of concern and their respective DACs are provided below:

- Strontium-90; 2E-9μCi/ml, and
- Radium-226; 3E-10μCi/ml.

8.2.9 Dosimetry

Individual dosimeters will be provided to all field workers. These dosimeters must be worn all the time while workers are inside the contamination zone or are performing activities that may have the potential for exposure to radioactivity.

9. QUALITY ASSURANCE

Details about the quality assurance requirements applicable to the MWSF closure activities are provided in the LEHR Quality Assurance Project Plan (QAPP) and the associated Standard Quality Procedures (SQPs) (WA, 1997a). This QAPP was prepared to comply with the requirements of DOE 5700.6C "Quality Assurance" and the U.S. EPA QAMS-005/80 (EPA, 1990).

10. REFERENCES

State of California (CA), 1977, Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use, State of California, Department of Health Services, 1977.

CFR, 1991, Identification and Listing of Hazardous Waste, Office of the Federal Register, 40 CFR 261, 1991, Washington, D.C.

CFR, 1996, Identification and Listing of Hazardous Waste, Part 66261, Title 22, California Code of Regulations, Chapter 11, 1996.

DOE, 1990, Radiation Protection of the Public and the Environment, DOE 5400.5, June 5, 1990.

EPA, 1990, U.S. Environmental Protection Agency Test Methods for Evaluation Solid Waste, EPA SW-846, 3rd Edition, Washington, D.C.

J. D. Berger, 1992, Manual for Conducting Radiological Surveys in Support of License Termination, NUREG | CR-5849, Oak Ridge Associated Universities.

LEHR, 1995, Mixed Waste Shipment Records, 1995.

NRC, 1974, Termination of Operating Licenses for Nuclear Reactors, Regulatory Guide 1.86, June 1974.

Oak Ridge National Laboratory, 1981, Monitoring for Compliance with Decommissioning Termination Survey Criteria, NUREG | CR-2082.

Weiss Associates, 1997a, Final Draft Quality Assurance Project Plan, LEHR Environmental Restoration and Waste Management.

Weiss Associates, 1997b, Project Health and Safety Plan, LEHR Environmental Restoration and Waste Management.

APPENDIX A

METHOD AND REPORTING DETECTION LIMITS FOR AQUEOUS SAMPLES

Appendix A

Table 1

METHOD AND REPORTING DETECTION LIMITS FOR AQUEOUS SAMPLES USING EPA METHODS 624, 8240, 8240B, 8260, 8260A - VOLATILE ORGANIC ANALYSES BY GC/MS

METHOD 624/8240/8240B/8260/8260A - AQUEOUS SAMPLES		
Routine Analytes	**MDL (µg/L)**	**RDL (µg/L)**
Chloromethane	1	5
Vinyl Chloride	2	5
Bromomethane	2	5
Chloroethane	1	5
Trichlorofluoromethane	1	5
Acetone	3	10
2-Chloroethyl vinyl ether	3	20
1,1-Dichloroethene	1	5
Methylene Chloride	1	5
Carbon Disulfide	1	5
Vinyl Acetate	2	10
1,1-Dichloroethane	1	5
2-Butanone	2	10
trans-1,2-Dichloroethene	1	5
cis-1,2-Dichloroethene	1	5
Chloroform	2	5
1,1,1-Trichloroethane	1	5
Carbon Tetrachloride	1	5
1,2-Dichloroethane	1	5
Benzene	1	5
Trichloroethene (TCE)	1	5

Appendix A

Table 1 (Continued)

METHOD 624/8240/8240B/8260/8260A - AQUEOUS SAMPLES		
Routine Analytes	MDL (µg/L)	RDL (µg/L)
1,2-Dichloropropane	1	5
Bromodichlormethane	1	5
4-Methyl-2-pentanone	1	10
2-Hexanone	1	10
cis-1,3-Dichloropropene	1	5
trans-1,3-Dichloropropene	1	5
1,1,2-Trichloroethane	1	5
Toluene	1	5
Dibromochloromethane	1	5
Tetrachlorethene (PCE)	1	5
Chlorobenzene	1	5
Ethyl Benzene	1	5
m,p-Xylenes	2	5
o-Xylene	1	5
Styrene	1	5
Bromoform	1	5
1,1,2,2-Tetrachloroethane	1	5
1,3-Dichlorobenzene	1	5
1,4-Dichlorobenzene	1	5
1,2-Dichlorobenzene	1	5

Appendix A

Table 2

METHOD AND REPORTING LIMITS FOR AQUEOUS SAMPLES FOR METHOD 8270B - SEMIVOLATILE ANALYSIS BY GC/MS

Method 8270B - Aqueous Samples		
CONSTITUENT	MDL (µg/L)	RDL (µg/L)
Pyridine	6.6	10
Phenol	4.1	10
bis(2-Chloroethyl)ether	8.6	10
2-Chlorophenol	8.2	10
1,3-Dichlorobenzene	9.4	10
1,4-Dichlorobenzene	8.3	10
Carbazole	6.9	10
Benzyl alcohol	7.8	10
1,2-Dichlorobenzene	9.3	10
2-Methylphenol	7.3	10
bis(2-Chloroisopropyl)ether	9.3	10
4-Methylphenol	6.7	10
N-Nitroso-di-n-propylamine	9.3	10
Hexachloroethane	9.5	10
Nitrobenzene	7.7	10
Isophorone	7.4	10
2-Nitrophenol	8.2	10
2,4-Dimethylphenol	5.5	10
Benzoic acid	2.8	50
bis(2-Chloroethoxy)methane	7.0	10
2,4-Dichlorophenol	6.9	10

Appendix A

Table 2 (Continued)

Method 8270B - Aqueous Samples		
CONSTITUENT	MDL (µg/L)	RDL (µg/L)
1,2,4-Trichlorobenzene	7.9	10
Naphthalene	7.0	10
4-Chloroaniline	13	20
Hexachlorobutadiene	8.8	10
4-Chloro-3-methylphenol (p-chloro-m-cresol)	5.4	10
2-Methylnaphthalene	7.5	10
Hexachlorocyclopentadiene	9.1	10
2,4,6-Trichlorophenol	6.4	10
2,4,5-Trichlorophenol	6.1	10
2-Chloronaphthalene	6.9	10
2-Nitroaniline	6.0	50
Dimethyl phthalate	5.8	10
Acenaphthylene	6.3	10
2,6-Dinitrotoluene	4.9	10
3-Nitroaniline	6.9	50
Acenaphthene	6.5	10
2,4-Dinitrophenol	2.6	50
4-Nitrophenol	3.6	50
Dibenzofuran	6.1	10
2,4-Dinitrotoluene	5.8	10
Diethylphthalate	5.3	10
4-Chlorophenyl phenyl ether	5.7	10
Fluorene	5.6	10
4-Nitroaniline	8.1	20
4,6-Dinitro-2-methylphenol	4.4	50

Appendix A

Table 2 (Continued)

Method 8270B - Aqueous Samples		
CONSTITUENT	MDL (µg/L)	RDL (µg/L)
N-nitrosodiphenylamine	6.4	10
4-Bromophenyl phenyl ether	6.3	10
Hexachlorobenzene	7.0	10
Pentachlorophenol	6.0	50
Phenanthrene	5.6	10
Anthracene	6.2	10
Di-n-butyl phthalate	5.3	10
Fluoranthene	6.5	10
Pyrene	7.3	10
Butyl benzyl phthalate	5.3	10
3,3'-Dichlorobenzidine	5.2	20
Benzo(a)anthracene	4.4	10
Chrysene	5.2	10
bis(2-Ethylhexyl)phthalate	6.0	10
Di-n-octyl phthalate	4.9	10
Benzo(b)fluoranthene	4.3	10
Benzo(k)fluoranthene	5.4	10
Benzo(a)pyrene	4.8	10
Indeno(1,2,3-cd)pyrene	7.0	10
Dibenz(a,h)anthracene	7.6	10
Benzo(g,h,i)perylene	6.5	10

APPENDIX B

METHOD AND REPORTING DETECTION LIMITS USING SOIL SAMPLES

Appendix B

Table 1

METHOD AND REPORTING DETECTION LIMITS FOR SOIL[1] SAMPLES USING EPA METHODS 624, 8240, 8240B, 8260, 8260A - VOLATILE ORGANIC ANALYSES BY GC/MS

METHOD 624/8240/8240B/8260/8260A - SOIL SAMPLES		
Routine Analytes	MDL (µg/kg)	RDL (µg/kg)
Chloromethane	1	5
Vinyl Chloride	1	5
Bromomethane	1	5
Chloroethane	1	10
Trichlorofluoromethane	1	5
Acetone	5	10
2-Chloroethyl vinyl ether	1	20
1,1-Dichloroethene	1	5
Methylene Chloride	4	5
Carbon Disulfide	1	5
Vinyl Acetate	3	10
1,1-Dichloroethane	1	5
2-Butanone	2	10
trans-1,2-Dichloroethene	1	5
cis-1,2-Dichloroethene	1	5
Chloroform	1	5
1,1,1-Trichloroethane	1	5
Carbon Tetrachloride	1	5
1,2-Dichloroethane	1	5
Benzene	1	5
Trichloroethene (TCE)	1	5

1 Also for use with solids.

Appendix B

Table 1 (Continued)

METHOD 624/8240/8240B/8260/8260A - SOIL SAMPLES		
Routine Analytes	MDL (µg/kg)	RDL (µg/kg)
1,2-Dichloropropane	1	5
Bromodichlormethane	1	5
4-Methyl-2-pentanone	2	10
2-Hexanone	2	10
cis-1,3-Dichloropropene	1	5
trans-1,3-Dichloropropene	1	5
1,1,2-Trichloroethane	1	5
Toluene	1	5
Dibromochloromethane	1	5
Tetrachloroethene (PCE)	1	5
Chlorobenzene	1	5
Ethyl Benzene	1	5
m,p-Xylenes	1	5
o-Xylene	1	5
Styrene	1	5
Bromoform	1	5
1,1,2,2-Tetrachloroethane	2	5
1,3-Dichlorobenzene	1	5
1,4-Dichlorobenzene	1	5
1,2-Dichlorobenzene	1	5

Appendix B

Table 2

METHOD AND REPORTING DETECTION LIMITS FOR SOLID SAMPLES USING EPA METHOD 3550/3550A/625/8270/8270A/8270B SEMIVOLATILE ANALYSES BY GC/MS

Method 3550/3550A/625/8270/8270A/8270B - Solid Samples		
CONSTITUENT	MDL (µg/kg)	RDL (µg/kg)
Phenol	100	660
bis(2-Chloroethyl)ether	90	660
2-Chlorophenol	110	660
1,3-Dichlorobenzene	120	660
1,4-Dichlorobenzene	90	660
Benzyl alcohol	190	1300
1,2-Dichlorobenzene	120	660
2-Methylphenol	130	660
bis(2-Chloroisopropyl)ether	120	660
4-Methylphenol	280	660
N-Nitroso-di-n-propylamine	200	660
Hexachloroethane	130	660
Nitrobenzene	170	660
Isophorone	180	660
2-Nitrophenol	150	660
2,4-Dimethylphenol	100	660
bis(2-Chloroethoxy)methane	120	660
Benzoic acid	120	3300
2,4-Dichlorophenol	190	660
1,2,4-Trichlorobenzene	160	660

Appendix B

Table 2 (Continued)

Method 3550/3550A/625/8270/8270A/8270B - Solid Samples		
CONSTITUENT	MDL (µg/kg)	RDL (µg/kg)
Naphthalene	160	660
4-Chloroaniline	140	1300
Hexachlorobutadiene	150	660
4-Chloro-3-methylphenol	110	1300
2-Methylnaphthalene	160	660
Hexachlorocyclopentadiene	90	660
2,4,6-Trichlorophenol	180	660
2,4,5-Trichlorophenol	200	660
2-Chloronaphthalene	170	660
2-Nitroaniline	200	3300
Dimethyl phthalate	250	660
Acenaphthylene	210	660
2,6-Dinitrotoluene	200	660
3-Nitroaniline	190	3300
Acenaphthene	190	660
2,4-Dinitrophenol	190	3300
4-Nitrophenol	190	3300
Dibenzofuran	200	660
2,4-Dinitrotoluene	150	660
Diethylphthalate	100	660
4-Chlorophenyl phenyl ether	210	660
Fluorene	160	660
4-Nitroaniline	270	3300
4,6-Dinitro-2-methylphenol	240	3300
N-Nitrosodiphenylamine	140	660
4-Bromophenyl phenyl ether	130	660

Appendix B

Table 2 (Continued)

Method 3550/3550A/625/8270/8270A/8270B - Solid Samples		
CONSTITUENT	MDL (µg/kg)	RDL (µg/kg)
Hexachlorobenzene	170	660
Pentachlorophenol	130	3300
Phenanthrene	90	660
Anthracene	100	660
Carbazole	100	660
Di-n-butyl phthalate	90	660
Fluoranthene	230	660
Pyrene	220	660
Butyl benzyl phthalate	110	660
3,3'-Dichlorobenzidine	70	1300
Benzo(a)anthracene	110	660
bis(2-Ethylhexy)phthalate	130	660
Chrysene	140	660
Di-n-octyl phthalate	160	660
Benzo(b)fluoranthene	120	660
Benzo(k)fluoranthene	290	660
Benzo(a)pyrene	120	660
Indeno(1,2,3-cd)pyrene	150	660
Dibenz(a,h)anthracene	210	660
Benzo(g,h,i)perylene	240	660