LMS/LEH/S05822-0.0

Remedial Design/Remedial Action Work Plan for the Former Laboratory for Energy-Related Health Research Federal Facility University of California, Davis

November 2010

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Former Laboratory for Energy-Related Health Research
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University of California, Davis

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Contents

Abbreviations iii
1.0 Introduction 1–1
1.1 Site Description 1–1
1.2 Applicable Terminology 1–2
1.3 Location 1–2
1.4 Operational History 1–5
1.5 Cleanup History 1–5
1.6 Selected Remedies for DOE Areas 1–6
2.0 Implementation of Land-Use Restrictions 2–1
2.1 Areas Subject to Land-Use Restrictions 2–1
2.1.1 Land Survey 2–3
2.1.2 Residential Use Restriction at DSS 4 Area 2–3
2.1.3 Prohibition Against Interference with Monitoring System 2–4
2.1.4 Soil Management Plan 2–4
2.2 Covenants to Restrict Use of the Property 2–5
2.2.1 Coordination with UC Davis 2–5
2.3 Agency Notification 2–6
2.4 Annual Inspections and 5-Year Reviews 2–7
2.5 Reporting 2–8
2.6 Termination of Land-Use Restrictions 2–8
3.0 Implementation of Long-Term Groundwater Monitoring 3–1
3.1 Groundwater Monitoring Locations 3–1
3.2 Establishing the Background Groundwater Condition 3–5
3.3 Establishing Baseline Conditions for COCs in Groundwater 3–5
3.4 Groundwater Sample Collection 3–5
3.5 Sample Analysis and Evaluation of Groundwater Monitoring Data 3–6
3.6 Groundwater Monitoring for Additional Constituents 3–12
3.7 Reporting 3–14
3.8 Modifications/Termination of Groundwater Monitoring 3–14
3.9 Quality Assurance Assessments 3–14
4.0 Implementation of Contingent Remediation 4–1
4.1 COCs with a Baseline Concentration Greater than Background Levels 4–1
4.2 COCs with a Baseline Concentration Below Background Levels 4–1
4.3 Groundwater Monitoring for Additional Constituents 4–2
5.0 Project Organization 5–1
5.1 Federal Facility Agreement 5–1
5.2 Memorandum of Agreement 5–1
5.3 Key Personnel 5–1
5.4 Documents for Public Review and Comment 5–3
5.5 Administrative Record and Public Reading Room 5–3
5.6 Records and Data Management 5–3
6.0 Schedule 6–1
7.0 Quality Assurance 7–1
7.1 Data Quality Objectives 7–1
7.2 Roles and Responsibilities 7–4
7.3 Personnel Training and Qualification 7–4

7.4 Field Documentation and Records Management 7–4
7.5 Test Control 7–4
7.6 Design Control 7–4
7.7 Calibration and Maintenance of Measuring and Test Equipment 7–5
7.8 Field Sampling 7–5
7.9 Procurement 7–5
7.10 Data Quality Assessment 7–5
7.11 Inspections, Audits, and Surveillances 7–8
7.12 Nonconformance Control and Corrective Action 7–9
8.0 References 8–1

Figures

Figure 1–1. Location of the LEHR Site, UC Davis, Solano County, California 1–3
Figure 1–2. LEHR Site Features 1–4
Figure 2–1. DOE Areas of the LEHR Federal Facility Subject to Land-Use Controls 2–2
Figure 3–1. Groundwater Monitoring Locations 3–3
Figure 3–2. Groundwater Monitoring Decision Process 3–13
Figure 6–1. Remedial Action Schedule 6–2

Tables

Table 1–1. Selected Remedies for Each DOE Area 1–1
Table 1–2. Human Health Risks by Exposure Route for Contaminants in Soil at the DOE Areas 1–8
Table 1–3. Remediation Goals for the Protection of Human Health 1–9
Table 1–4. Soil Remediation Goals for the Protection of Groundwater 1–10
Table 1–5. Additional Constituents to be Monitored due to Potential Impact on Groundwater Quality 1–11
Table 3–1. Groundwater Monitoring Program for DOE Areas 3–7
Table 3–2. Analytical Parameters for Groundwater Samples 3–9
Table 3–3. Full Suite Analytical Parameters for Groundwater Samples 3–11

Appendixes

Appendix A Soil Management Plan
Appendix B Memorandum of Agreement
Appendix C Travel Time Estimates for Constituents of Concern
Appendix D Well Installation Procedures
Appendix E Sample Collection Procedures
Appendix F Laboratory Reporting Limits
Appendix G Laboratory Quality Assurance Documentation
Appendix H Construction Quality Assurance Plan
Appendix I Standard Operating Procedures and Standard Quality Procedures

Abbreviations

ARAR	applicable or relevant and appropriate requirement
BBL	Blasland, Bouck, and Lee
C-14	carbon-14
CEL	CalScience Environmental Laboratories, Inc.
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Co-60	cobalt-60
COC	constituent of concern
CRWQCB	California Regional Water Quality Control Board, Central Valley Region
Cs-137	cesium-137
DI	deionized
DO	dissolved oxygen
DOE	U.S. Department of Energy
DQO	data quality objectives
DSS	Domestic Septic System
DTSC	California Department of Toxic Substances Control
EDPs	Eastern Dog Pens
EPA	U.S. Environmental Protection Agency
ft	feet
GEL	GEL Laboratories
HSU	hydrostratigraphic unit
ID	identification
LEHR	Laboratory for Energy-Related Health Research
LTS&M	long-term surveillance and maintenance
MCL	maximum contaminant level
NTU	nephelometric turbidity unit
ORP	oxidation-reduction potential
QAPP	Quality Assurance Project Plan
Ra/Sr	radium/strontium
Ra-226	radium-226
ROD	Record of Decision
SC	specific conductance
SOP	standard operating procedure

Sr-90	strontium-90
SWT	Southwest Trenches
TestAmerica	TestAmerica Laboratories
UC Davis	University of California, Davis
WDPs	Western Dog Pens
Weiss	Weiss Associates

1.0 Introduction

The objective of this Remedial Design/Remedial Action Work Plan is to document the requirements and methods for implementing remedies selected in the Record of Decision (ROD) (DOE 2009b) for the U.S. Department of Energy (DOE) areas of the Laboratory for Energy-Related Health Research (LEHR). The selected remedies are intended to monitor and control residual contamination at the site. Provided in this report are procedures to implement the selected remedies listed in Table 1–1, which include:

- Land-use restrictions, including a Soil Management Plan (Appendix A), and a prohibition of residential use,
- Long-term groundwater monitoring, and
- Contingency remediation.

Table 1–1. Selected Remedies for Each DOE Area

DOE Area	No Action/No Further Action	Long-Term Groundwater Monitoring/Contingency Remediation	Land-Use Restrictions	
			Soil Management Plan	No Residential Use
Radium/Strontium Treatment Systems (includes Domestic Septic System 2)		✓	✓	
Domestic Septic System 1	✓			
Domestic Septic System 3		✓	✓	
Domestic Septic System 4		✓	✓	✓
Domestic Septic System 5	✓			
Domestic Septic System 6	✓			
Domestic Septic System 7	✓			
DOE Disposal Box	✓			
Dry Wells A–E		✓	✓	
Eastern Dog Pens			✓	
Southwest Trenches		✓	✓	
Western Dog Pens	✓			

1.1 Site Description

LEHR is a former research facility that DOE operated at the University of California, Davis (UC Davis). The LEHR Federal Facility is defined in a Federal Facility Agreement signed in 1999 by DOE and the U.S. Environmental Protection Agency (EPA). The California Department of Public Health (formerly the California Department of Health Services) and the California Regional Water Quality Control Board, Central Valley Region, (CRWQCB) joined as signatories in 1999, and the California Department of Toxic Substances Control (DTSC) joined in 2000. The LEHR Federal Facility comprises the land and improvements within the former LEHR Facility boundary shown in Figure 1–1, including the following areas:

- All LEHR buildings;
- The Cobalt-60 (Co-60) Irradiation Field;

- The Radium/Strontium (Ra/Sr) Treatment Systems area;
- Seven septic tanks (including leach fields and dry wells);
- The Southwest Trenches (SWT) area;
- The Western Dog Pens (WDPs) area;
- The Eastern Dog Pens (EDPs) area;
- The DOE Disposal Box; and
- Areas where contamination originating from the areas listed above is located, excluding areas assigned to UC Davis, by a Memorandum of Agreement between the Regents of the University of California and DOE (DOE 2009a).

1.2 Applicable Terminology

The following terminology is used in this and other documents contained in the LEHR Administrative Record to refer to various areas of the site:

- LEHR Site—As defined in the Federal Facility Agreement, the area referred to on the National Priorities List as "LEHR/Old Campus Landfill."
- DOE areas—Portions of the LEHR Federal Facility (defined in Section 1.1) where Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) or California groundwater protection standards are exceeded (i.e., the SWT area, the Ra/Sr Treatment Systems area, Domestic Septic Systems (DSSs) 3 and 4, Dry Wells A–E, and the EDPs area) (Figure 1–2).
- UC Davis areas—Portions of the LEHR Site that include Landfill Disposal Units 1, 2, and 3; the 49 waste burial holes; the eastern and southern disposal trenches; and groundwater impacted by UC Davis's activities. (Figure 1–2).

1.3 Location

LEHR is immediately east of Old Davis Road, about 2,500 feet (ft) south of U.S. Interstate 80 in Solano County, California, in the southeast quarter of Section 21, Township 8 North, Range 2 East, Mount Diablo Base and Meridian (Figure 1–1). The former LEHR facility (Figure 1–2) is on the southern portion of Solano County Assessor's Parcel No. 110-05-04. It is approximately 1.5 miles south of the city of Davis, in the southeast portion (South Campus Area) of the UC Davis campus.

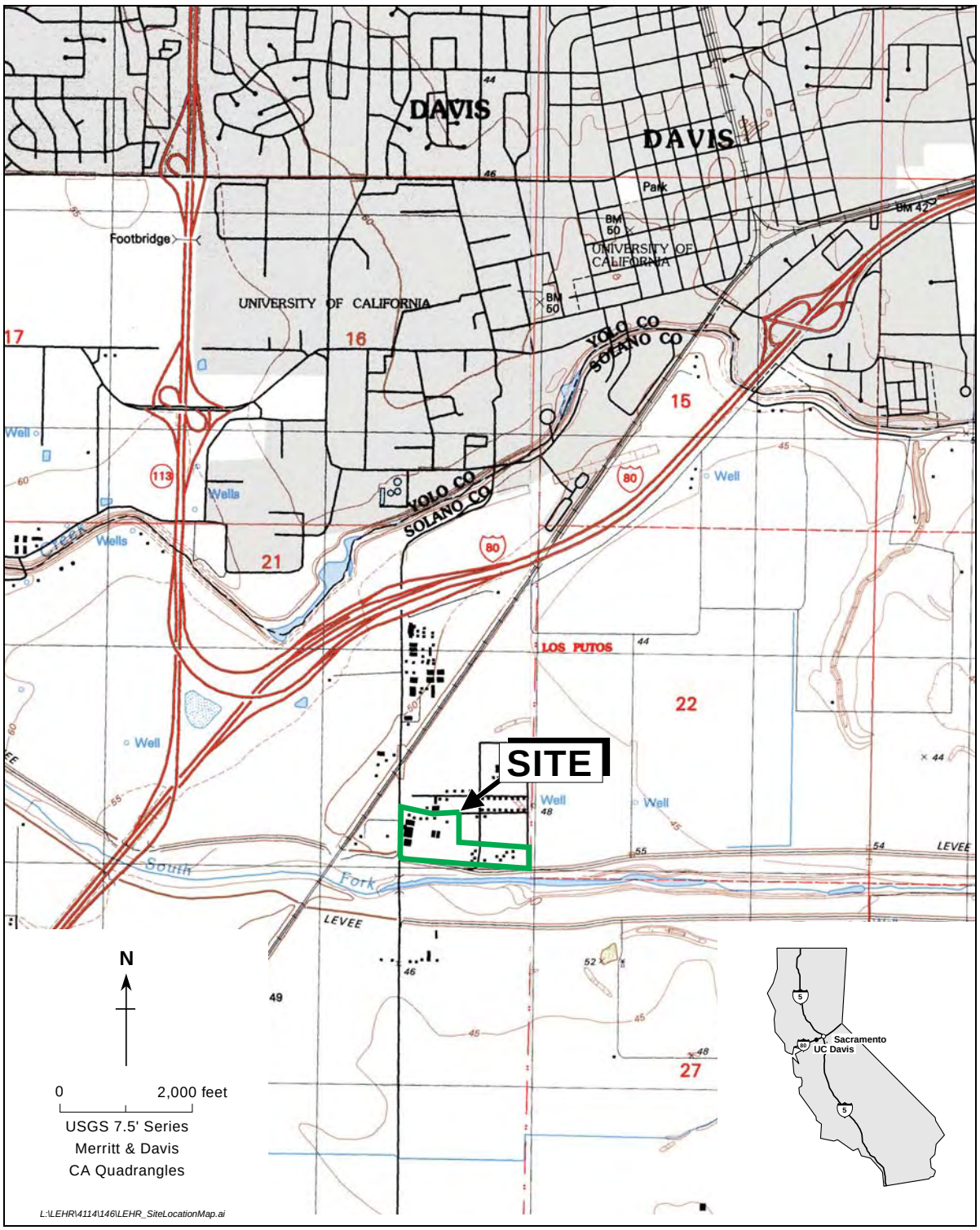

Figure 1–1. Location of the LEHR Site, UC Davis, Solano County, California

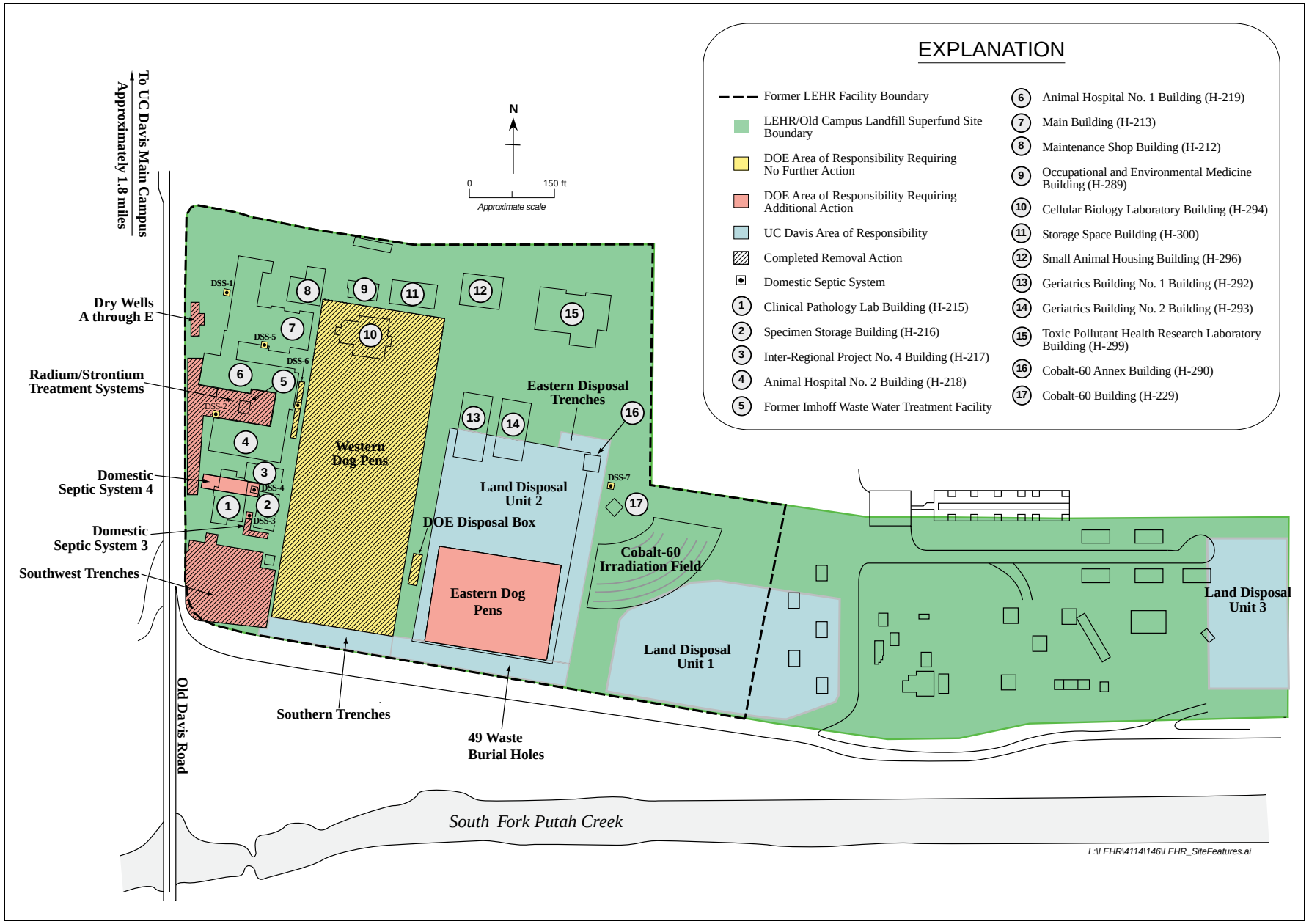

Figure 1–2. LEHR Site Features

1.4 Operational History

The U.S. Atomic Energy Commission first sponsored radiological studies on laboratory animals at UC Davis in the early 1950s. Initially on the main campus, LEHR was moved to its present location in 1958 (Figure 1–1). Research at LEHR through the late 1980s was focused on health effects from chronic exposure to radionuclides, primarily strontium-90 (Sr-90) and radium-226 (Ra-226), using beagles as research subjects. Other related research was conducted at the site concurrently with these long-term studies. In the early 1970s, a Co-60 irradiator facility was constructed at the site to study the effects of chronic exposure to gamma radiation on humans, again using beagles.

A campus landfill with two waste burial units used from the 1940s until the mid-1960s is at the site (Figure 1–2). Several low-level radioactive-waste burial areas were also at the site, and campus and LEHR research waste was buried in these areas until 1974 in accordance with regulations in effect at the time. The principal environmental threats posed by contaminant releases associated with LEHR activities have been mitigated during several removal actions conducted at the site since 1996.

All DOE-funded research activities at LEHR ceased by 1988, and in the same year, pursuant to the Memorandum of Agreement between DOE and the Regents of the University of California, DOE's Office of Energy Research initiated activities to close out the research program at LEHR.

1.5 Cleanup History

In May 1994, EPA placed the LEHR/Old Campus Landfill on the National Priorities List (Superfund Site Identification No. CA2890190000) because contamination at the site was considered to pose significant risk to human health and the environment. From 1975 to 2009, DOE decontaminated and decommissioned aboveground structures and performed the following removal actions:

- In 1975, gravel and curbing were removed from 64 pens in the WDPs.
- In 1995, DOE demolished the Imhoff Wastewater Treatment Facility (Figure 1–2) as a voluntary removal action.
- In 1995 and 1996, concrete pedestals and wooden barrels were removed from the EDPs and WDPs and disposed of as low-level radioactive waste at the Hanford Site in Washington (Weiss 1997).
- In 1996, IT Corporation removed the pedestals from the WDPs and EDPs and collected soil and gravel data during the removal activities (Weiss 1997).
- Before 1997, DOE decommissioned, decontaminated, and released for unrestricted use four of the 17 buildings associated with the LEHR Federal Facility that did not meet the release criteria of DOE Order 5400.5, *Radiation Protection of the Public and the Environment* (the Animal Hospital 1 building, the Animal Hospital 2 building, the Specimen Storage building, and the Co-60 building) (Figure 1–2). A notice of certification of the radiological condition of this real property was published in the *Federal Register* on October 3, 1997 (62 FR 51844–51845).

- In 1996, Weiss Associates (Weiss) conducted a time-critical removal action at the DOE Disposal Box area.
- In 1998, Weiss conducted a non-time-critical removal action at the SWT area.
- In 1999 and 2000, Weiss conducted a non-time-critical removal action at the Ra/Sr Treatment Systems area. DSS 2, which was associated with the Ra/Sr Treatment System, parts of DSS 1, and the DSS 5 leach field and parts of Dry Wells A–E were also removed (Figure 1–2).
- In 2001, Weiss conducted a non-time-critical removal action in the WDPs area.
- In 2002, Weiss conducted a non-time-critical removal action in the DSS 3 and 6 areas.
- In 2007, DOE removed and disposed of concrete from the EDPs.

Human health risks were below 1 in 1 million, and ecological risks were insignificant at DSS 7, so no removal action was performed, and no further action is required for this area.

A risk assessment at the DOE Disposal Box conducted after the completion of the removal action in this area (Weiss 2005) showed that no risk to human health, ecological receptors, or groundwater quality remained in the area; hence, no further action is required in the DOE Disposal Box. A risk assessment performed after the four non-time-critical removal actions in the SWT; Ra/Sr Treatment Systems; DSS 1, 2, 3, 5, and 6 and Dry Wells A–E; and WDPs areas showed that excess risk to human health from contaminants in all of these areas, except for the SWT area, was reduced to below 1 in 1 million (Weiss 2005), and ecological risks were insignificant after the removal actions (BBL 2006). Risks to human health were above 1 in 1 million at DSS 4 and the EDPs (Weiss 2005), but ecological risks were insignificant (BBL 2006).

Table 1–2 summarizes risks for all DOE areas where the risk remains above 1 in 1 million. The potential remains for future groundwater impacts from residual contaminants in vadose zone soil at the SWT, Ra/Sr Treatment Systems, Dry Wells, and DSS 3 and 4 areas, as discussed below. No further action is required at the WDPs and DSSs 1, 2, 5, 6, and 7.

1.6 Selected Remedies for DOE Areas

As described in detail in the risk characterization report for DOE areas (Weiss 2005), constituents of concern (COCs) for each area were selected based on their presence in soil at levels statistically above background and: (1) their presence at levels that were shown (by multiple lines of evidence) to present human health cancer risks above 1 in 1 million, and/or (2) their potential to impact groundwater above background levels. As discussed above and shown in Table 1–1, the SWT, DSS 4, and EDPs areas presently require additional actions (Weiss 2005) because residual COCs are present at these areas at concentrations above remediation goals.

Table 1–3 lists the COCs at each DOE area identified as presenting potential human health cancer risks exceeding 1 in 1 million. As described in *Final DOE Areas Feasibility Study* (Weiss 2008), the remediation goals for these COCs represent a 1 in 1 million cancer risk.

Table 1–4 presents groundwater quality goals developed in conformance with the CRWQCB Central Valley Region's guidance document *Designated-Level Methodology for Waste Classification and Cleanup Level Determination* (CRWQCB 1989). These remediation goals represent contaminant concentrations in soil that, based on modeling, would not contaminate groundwater above groundwater background levels or water quality goals. Residual soil contamination exceeding these goals remains at the SWT, Ra/Sr Treatment Systems, Dry Wells, and DSS 3 and 4 areas, and groundwater monitoring beneath and downgradient of these areas of contamination will continue until it can be shown that the wastes no longer threaten water quality.

Table 1–5 lists additional COCs that were identified as possibly having a small impact on groundwater in the future based on the analysis presented in the risk characterization report (Weiss 2005). As shown on the table, the areas where these constituents were identified are the SWT, Ra/Sr Treatment Systems, EDPs and DSS 1, 3, 4, 5, and 6 areas. Groundwater at the site shall be monitored for these constituents.

Table 1–2. Human Health Risks by Exposure Route for Contaminants in Soil at the DOE Areas

Cancer Risk by Exposure Route									
DOE Area	**Receptor/Constituent**	**Exposure Point Concentration (0–10 ft)[a]**	**Soil Ingestion**	**Soil Dermal Exposure**	**Aboveground Plant Ingestion[b]**	**Belowground Plant Ingestion[b]**	**External Radiation**	**Dust Inhalation**	**Total Cancer Risk**
Domestic Septic System 4	**On-Site Resident**								
	Benzo(a)anthracene	3.8	4.E-06	1.E-06	9.E-06	1.E-06	NA	3.E-10	2.E-05
	Benzo(a)pyrene	2.4	3.E-05	7.E-06	3.E-05	5.E-06	NA	2.E-09	7.E-05
	Benzo(b)fluoranthene	2.7	3.E-06	8.E-07	3.E-06	5.E-07	NA	2.E-10	7.E-06
	Benzo(k)fluoranthene	1.5	3.E-06	7.E-07	3.E-04	5.E-05	NA	7.E-11	4.E-04
	Dibenzo(a,h)anthracene	1.1	7.E-06	2.E-06	4.E-06	6.E-07	NA	5.E-10	1.E-05
	Indeno(1,2,3-cd)pyrene	0.86	2.E-06	4.E-07	1.E-06	1.E-07	NA	4.E-11	4.E-06
	Total								**5.E-04**
	On-Site Construction Worker								
	Benzo(a)pyrene	2.4	8.E-07	3.E-07	NA	NA	NA	7.E-10	**1.E-06**
Eastern Dog Pens	**On-Site Resident**								
	Dieldrin	0.019	5.E-07	9.E-08	2.E-06	2.E-07	NA	4.E-11	3.E-06
	Strontium-90	0.33[c]	4.E-08	NA	1.E-06	NA	5.E-08	5.E-13	1.E-06
	Total								**4.E-06**
Southwest Trenches	**On-Site Resident**								
	Strontium-90	0.94	1.E-07	NA	3.E-06	NA	2.E-07	2.E-12	**3.E-06**

Notes:
Source data from the *Revised LEHR/SCDS Site-Wide Risk Assessment*, Tables 7 and 8 (UC Davis 2004a). Constituents and risks are presented here if (a) the constituent is present above site background and if (b) the constituent contributes at least a factor of 1 in 1 million, or greater than 10 percent, to the excess cumulative cancer risk for a DOE area and receptor. Only exposure pathways for contaminants in soil at the DOE areas are presented here. Exposures to groundwater and surface water contaminants are not included, as they are being addressed by the UC Davis Feasibility Study.
[a] The 95 percent upper confidence limit on the mean or maximum sample concentration. Chemical concentrations are expressed in milligrams per kilogram, and radionuclide concentrations are expressed in picocuries per gram.
[b] Homegrown produce. For radionuclides, plant ingestion is not subdivided into aboveground and belowground produce.
[c] Exposure point concentration after Eastern Dog Pens maintenance action.

Abbreviations:
NA = not applicable

Table 1–3. Remediation Goals for the Protection of Human Health

DOE Area	Receptor/Constituent of Concern	Exposure Point Concentration[a]	Remediation Goal[b]
Domestic Septic System 4	On-Site Resident		
	Benzo(a)anthracene	3.8	0.2
	Benzo(a)pyrene	2.4	0.03
	Benzo(b)fluoranthene	2.7	0.4
	Benzo(k)fluoranthene	1.5	0.004
	Dibenzo(a,h)anthracene	1.1	0.1
	Indeno(1,2,3-cd)pyrene	0.86	0.2
	On-Site Construction Worker		
	Benzo(a)pyrene	2.4	2
Southwest Trenches	On-Site Resident		
	Strontium-90+daughter	0.94	0.3
Eastern Dog Pens	On-Site Resident		
	Dieldrin	0.019	0.006
	Strontium-90+daughter	0.33[c]	0.3

Notes:
[a] Maximum concentration or 95 percent upper confidence limit on the mean for soil located between 0 and 10 ft below ground surface.
[b] Remediation Goals based on 1 in 1 million risk, determined using one significant figure total cancer risk. All concentrations are based on dry weight of soil sample. Chemical concentrations are expressed in milligrams per kilogram, and radionuclide concentrations are expressed in picocuries per gram.
[c] Exposure point concentration after Eastern Dog Pens maintenance action.

Table 1–4. Soil Remediation Goals for the Protection of Groundwater

DOE Area	Constituents of Concern in Soil[a]	Maximum Soil Concentration[b]	Background Remediation Goal[c]	MCL Remediation Goal[d]
Domestic Septic System 3	Formaldehyde	2.2	0.00378	0.0151[f]
	Molybdenum	2.5	<0.26[e]	3.11[g]
	Nitrate	106	36[e]	36[e]
Domestic Septic System 4	Selenium	2.0[g]	4.0	35
Dry Wells A–E Area	Chromium	245	181[e]	181[e]
	Hexavalent Chromium	1.62	1.3[e]	1.3[e]
	Mercury	5.3	0.63[e]	0.63[e]
	Molybdenum	1.3	0.30	3.6[g]
	Silver	53.8	0.55[e]	0.83
	Cesium-137	0.191	0.1	20[i]
	Strontium-90	0.176	0.0595	0.28
Radium/Strontium Treatment Systems	Nitrate	304	36[e]	36[e]
	Carbon-14	2.41	0.13[e]	2.34[l,j]
	Radium-226	1.72[k]	0.752[e]	1.9
Southwest Trenches	Nitrate	909	36[e]	36[e]
	Carbon-14	5.84	0.13[e]	0.292[l,j]

Notes:
Chemical concentrations are expressed in milligrams per kilogram, and radionuclide concentrations are expressed in picocuries per gram.
MCL = maximum contaminant level
[a] Vadose zone soil contaminant with potential to impact groundwater.
[b] Maximum level of the specified constituent detected in soil samples collected from the specified DOE area.
[c] Soil concentration predicted by transport modeling above which groundwater impacts in excess of site background are possible. The calculated remediation goals are expressed as dry weight.
[d] Soil concentration predicted by transport modeling above which groundwater impacts above California drinking water MCL may occur, unless noted. The calculated remediation goals are expressed as dry weight.
[e] Soil background concentration was selected as the remediation goal because the calculated remediation goal is below soil background concentration. Calculated remediation goals are presented in the *Site-Wide Risk Assessment* for DOE areas (Weiss 2005).
[f] Based on the California Department of Public Health Notification Level of 100 micrograms per liter (*California Health and Safety Code* 116455).
[g] Based on the EPA Region 9 preliminary remediation goal for tap water (EPA 2010).
[h] Residual selenium soil concentrations exceeded soil background in 23 percent of the samples collected, and modeling suggests that selenium concentrations in the soil are unlikely to impact groundwater at levels exceeding the remediation goals. However, selenium was retained as a constituent of concern due to its presence (one result) in a downgradient hydrostratigraphic unit (HSU)-1 well at a concentration slightly above groundwater background.
[i] Based on the 4-millirem-per-year federal maximum contaminant level for beta particles and photon emitters (EPA 2000).
[j] The different maximum contaminant level remediation goals for the Ra/Sr Treatment Systems and SWT areas reflect the observed vertical distribution of contamination in these areas.
[k] The sample containing the maximum radium-226 result in the Ra/Sr Treatment Systems area was re-collected and reanalyzed. The reported maximum value is the average of the initial result (1.81 picocuries per gram) and re-collected sample result (1.63 picocuries per gram).

Table 1–5. Additional Constituents to be Monitored due to Potential Impact on Groundwater Quality

Area	Constituents of Potential Concern to Be Monitored
Domestic Septic System 1	Aluminum
Domestic Septic System 3	Aluminum, Silver
Domestic Septic System 4	Aluminum, Chromium, Nickel
Domestic Septic System 5	Aluminum
Domestic Septic System 6	Aluminum
Domestic Septic System 7	None
Dry Wells A–E	None
Radium/Strontium Treatment Systems	Americium-241
Southwest Trenches	Mercury, Zinc
Western Dog Pens	None
Eastern Dog Pens	Alpha-Chlordane, Gamma-Chlordane, Dieldrin
DOE Disposal Box	None

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2.0 Implementation of Land-Use Restrictions

Land-use restrictions are physical, administrative, or legal mechanisms used to limit exposure to residual contamination, and they are often applied when a site is not remediated to a level that would allow for its unrestricted use. The land-use controls for DOE areas are:

- Access to areas identified on Figure 2−1 for the purpose of collecting samples and maintaining groundwater monitoring wells;
- Prohibition against interference with the groundwater monitoring system;
- Implementation of a Soil Management Plan in all DOE areas listed in Table 1−1, except areas where No Action or No Further Action was identified;
- Prohibition against residential and agricultural use of the DSS 4 area.

Land-use restrictions at the DOE areas at LEHR shall:

- Prevent exposure to contaminated soil,
- Prevent the improper disposal of contaminated soils,
- Maintain the integrity of all present and future monitoring wells required for groundwater monitoring,
- Prevent the groundwater monitoring wells from being tampered with or destroyed,
- Provide EPA and DTSC reasonable right of entry and access to the property for periodic inspections to ensure compliance with land-use restrictions,
- Prohibit residential or agricultural use at DSS 4, and
- Prohibit the reuse of site soil from areas subject to land-use controls outside of the site boundary for any purpose without DTSC's and EPA's written approval.

These controls will be maintained until the concentrations of contaminants in the soil are at levels that allow unrestricted use (see remediation goals in Tables 1–3 and 1–4). These controls, except for the residential use restriction and access requirements, shall be implemented through the Soil Management Plan (Appendix A).

Any activity that is inconsistent with the objectives of these land-use controls or use restrictions, or any other action that may interfere with the effectiveness of these land-use controls or use restrictions will be addressed by DOE as soon as practicable. The process to remedy any action that may interfere with land-use controls will be initiated no later than 10 days after DOE becomes aware of such action.

2.1 Areas Subject to Land-Use Restrictions

Figure 2−1 shows the location of areas subject to land-use restrictions. The Soil Management Plan provides soil sample locations and analytical results that can be used to evaluate in detail the lateral and vertical extent of the contamination in each area. The lateral extent of the areas subject to land-use restrictions shall be confirmed by a survey. Figures or other descriptions of the areal extent of the residual contamination shall be included with the land-use covenants to be

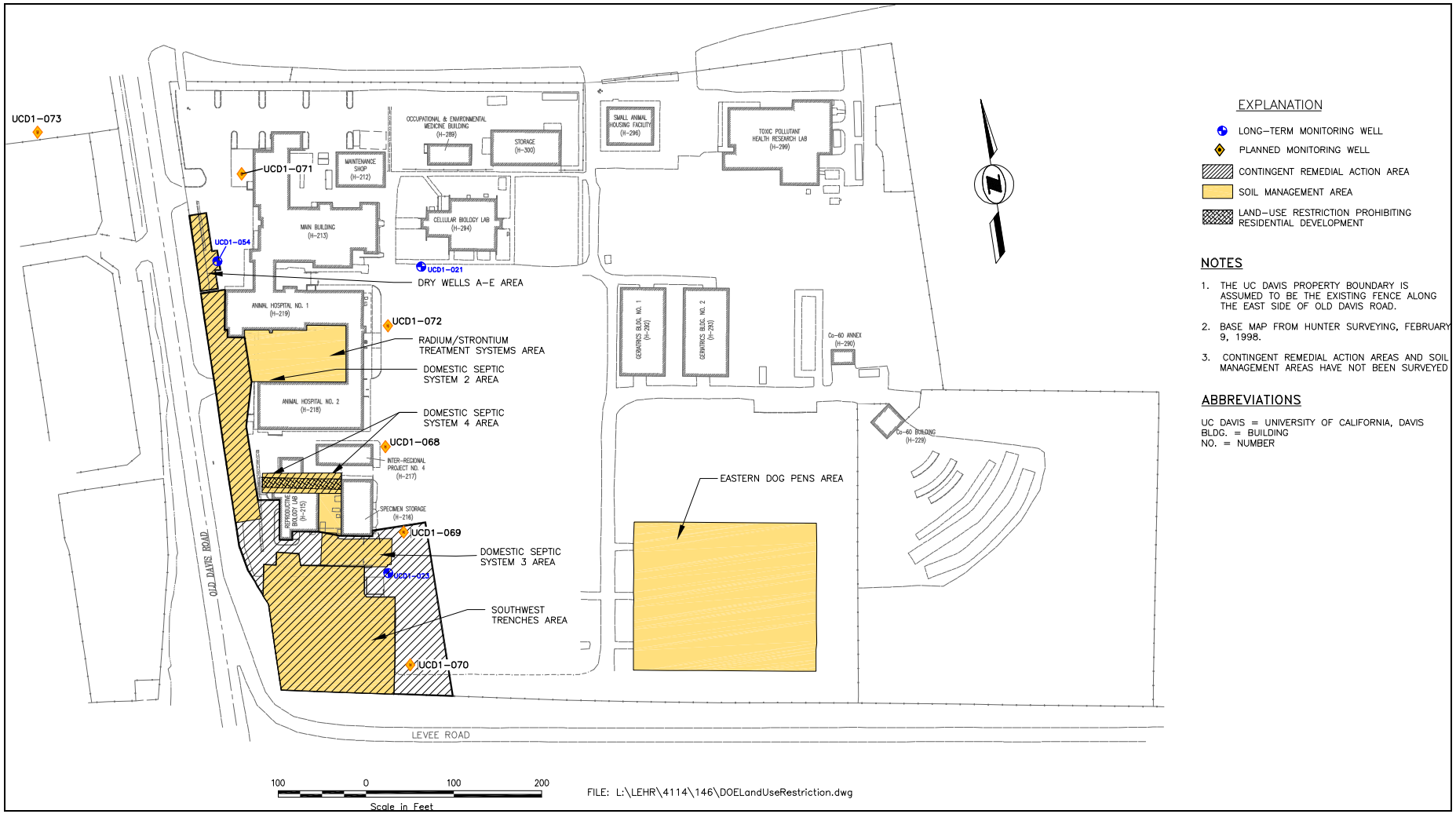

Figure 2–1. DOE Areas of the LEHR Federal Facility Subject to Land-Use Controls

recorded. Any changes to the recorded documents shall be approved by the regulatory agencies who are signatories to the ROD (DOE 2009b).

2.1.1 Land Survey

A professional land surveyor licensed by the California Board for Professional Engineers and Land Surveyors will survey areas subject to land-use restrictions and will develop a certified survey map and a legal description, which shall be recorded as discussed in Section 2.2 below. The basis for the location of the areas to be surveyed will be the native AutoCAD version of Figure 2−1. All survey work shall conform to the accepted standards of the engineering profession (ALTA/ACMS 2005). The surveys shall meet the following requirements:

- The accuracy of all boundary surveys done in connection with this project shall have a precision of 1 in 10,000.
- A map shall fully and clearly show and identify such monuments or other evidence determining the boundaries of the site as were found on the ground, together with sufficient corners of adjoining property, tract numbers, and place of record; by section, township, and range; or by another proper designation as necessary to locate precisely the limits of the site and to permit the survey to be retraced.
- The location, size, and depth of all monuments placed in making the survey shall be shown, and if any were reset by ties, that fact shall also be shown.
- Notice of setting final monuments shall be given.
- Monuments shall be placed and shall be of the type specified by the latest version of UC Davis's standard specifications.
- With DTSC's approval, the use of offset monuments properly tied to reference monuments may be allowed when necessary due to terrain, waterways, or other monuments other than those specified under subsections above.
- Benchmarks shall be set at locations required by the UC Davis Facilities Management engineer. The datum for the area within the city shall be based on datum established by the U.S. Coast and Geodetic Survey Sea Level Datum 1929, as amended.
- Identification of monuments and benchmarks shall be through the use of a standard plaque. Descriptions of all monuments and benchmarks shall be furnished for inclusion in the official records of UC Davis.
- All surveys shall conform to the California Coordinate System when required. Each final map shall show the California coordinate of every monument, and all California coordinates shall be used and shown on all traverse closure sheets, and other notes and ties that are required.

2.1.2 Residential Use Restriction at DSS 4 Area

Due to the potential elevated risk to a hypothetical resident in the DSS 4 area, residential land use, including gardening and any plant-growing activities, shall be prohibited in the DSS 4 area. Residential use includes, but is not limited to, single-family or multifamily residences, daycare facilities, and any type of educational facility for children under the age of 21. Educational use of the existing building (H-215) at the DSS 4 area is not subject to the land-use restriction, since there is no potential exposure to the contaminated soil within the building.

A covenant shall be recorded against the property with the Recorder Division of the Solano County Department of the Assessor/Recorder and DTSC prohibiting the current or future owners from permitting residential construction at the DSS 4 area.

2.1.3 Prohibition Against Interference with Monitoring System

Activities that may disturb the effectiveness of the groundwater monitoring well system (e.g. excavation, grading, removal, trenching, filling, earth movement, mining) shall not be permitted at the DOE areas at LEHR without prior review and written approval by DTSC and EPA unless such activities are expressly allowed under the terms of an approved Soil Management Plan or Operation, Maintenance, and Monitoring Plan that has not been superseded. The destruction or disturbance of monitoring wells shall be prohibited by land-use covenants. Each well shall be marked with a plaque or tag that contains a discrete identifier (CERCLA Groundwater Monitoring Well No. UCDX-XXX). The plaque or tag shall state that destructing or tampering with the well without approval from agencies who are signatories to the ROD is prohibited.

2.1.4 Soil Management Plan

Because residual contamination is left in place at LEHR, a Soil Management Plan is required to address the residual chemical and radionuclide soil contamination for all DOE areas listed in Table 1−1, except areas where No Action or No Further Action was identified. All soil-disturbing activities—including, but not limited to, excavation, grading, trenching, utility installation or repair—are subject to the requirements of the Soil Management Plan as Appendix A.

The plan defines requirements applicable to all soil-disturbing activities that may bring subsurface contaminants to the surface. The plan specifies requirements for managing radioactive waste and complies with the substantive requirements of DOE Order 435.1, *Radioactive Waste Management*.

The Soil Management Plan includes:

- An introduction to the plan, background on the site, and the plan's purpose;
- The plan's scope and applicability;
- Roles and responsibilities associated with the plan;
- The nature and extent of residual contamination based on existing soil data;
- Considerations in determining whether additional data should be collected and/or estimates of environmental fate and transport should be made;
- Identification of other required plans, permits, and documentation;
- Soil management procedures;
- Sampling and analysis procedures;
- Waste characterization and disposal; and
- Reporting and recordkeeping.

A covenant prohibiting the commencement of soil-disturbing activities without compliance with the Soil Management Plan shall be recorded against the property with the Recorder Division of the Solano County Department of the Assessor/Recorder and DTSC.

DOE has entered into a Memorandum of Agreement with the Regents of the University of California whereby UC Davis shall develop internal policies, procedures, and training to ensure the implementation of the Soil Management Plan in DOE areas (DOE 2009a). The Memorandum of Agreement is discussed in Section 2.2.1 and a copy is included as Appendix B.

2.2 Covenants to Restrict Use of the Property

A covenant is a legal document attached to the deed for real property that memorializes land-use restrictions for the subject property. Once signed and recorded, the covenant runs with the land pursuant to *California Health and Safety Code* Section 25355.5 and *California Civil Code* Section 147.1, and affects the title to the property by setting forth protective provisions, restrictions, and conditions (collectively called "restrictions"), upon and subject to which the property shall be improved, held, used, occupied, leased, sold, hypothecated, encumbered, or conveyed. Each restriction:

- Inures to the benefit of and passes with each portion of the property,
- Is for the benefit of and is enforceable by the DTSC[1],
- Is for the benefit of EPA as a third-party beneficiary[1], and
- Is imposed on the entire property unless expressly stated as applicable only to a specific portion thereof.

Covenants that address the requirements of Sections 2.1.2, 2.1.3, and 2.1.4 shall be drafted by DTSC with input from EPA, and signed by the University of California and DTSC, with EPA listed as a third-party beneficiary.[1] The CRWQCB and the California Department of Public Health will review the covenants prior to their execution.

After the covenants have been signed, the University of California shall record them against the property with the Recorder Division of the Solano County Department of the Assessor/Recorder and with DTSC to serve as a perpetual reminder to the University and all successive property owners that any change to the property that disturbs the subsurface soils must be undertaken with due care to prevent potential exposure to contaminants in those soils and that the DSS 4 area may not be used for residential occupancy.

2.2.1 Coordination with UC Davis

The University of California is the current property owner and shall enforce the covenants that restrict the use of areas of the former LEHR Federal Facility. The Regents of the University of California have agreed to provide such enforcement per a Memorandum of Agreement between DOE and the Regents (DOE 2009a). Although DOE has transferred the implementation of land-use restrictions to the University of California by agreement, CERCLA dictates that DOE

[1] The enforcement structure is based on an interagency agreement between DTSC and EPA.

retain ultimate responsibility for remedy integrity, including maintaining, reporting on, and enforcing the land-use restrictions.

In the Memorandum of Agreement, UC Davis has agreed to:

- Record a land-use covenant that will restrict the future use of the University-owned property above the DOE areas, as described in the ROD (DOE 2009b), so that DOE (and any person designated by DOE) will have access to the former DOE areas in order that DOE may perform any long-term surveillance and maintenance (LTS&M) or contingent remediation.
- Develop and maintain internal policies and procedures to ensure that land-use restrictions are maintained. (e.g., procedures for project-specific training that shall be provided for soil-disturbing activities required according to the Soil Management Plan, Section A4.1.4)
- Visit sites to ensure that land-use restrictions are maintained.
- Develop and provide annual training for campus stakeholders affected by land-use restrictions.

DOE has provided and shall continue to provide UC Davis grant funding for conducting these and other activities. The grant shall be renewed annually for as long as DTSC requires the land-use covenants. The grant funding mechanism has been established.

2.3 Agency Notification

DOE shall notify the regulatory agencies who are signatories to the ROD of:

- Any proposals for land-use change(s) that are inconsistent with the land-use controls and assumptions described in the ROD (DOE 2009b) and this plan,
- Any anticipated action that may disrupt the effectiveness of the land-use controls,
- Any action that might alter or negate the need for the land-use controls, and
- Any anticipated transfer of the property subject to the land-use controls.

Notification requirements include:

- Notifying the regulatory agencies 45 days before any proposed land-use change;
- Notifying the regulatory agencies six months before any transfer or sale of the property; and
- Notifying the regulatory agencies as soon as practicable, but no later than 10 days, after the discovery of any activity that is inconsistent with the objectives of the land-use restrictions, or any other action that may interfere with the implementation of the land-use restrictions. The notification shall include the description of action taken to remedy any activity inconsistent with the objectives of the land-use restrictions.

Any modification of land-use controls must be approved by the regulatory agencies.

DOE shall notify the signatories to the ROD at least 90 days before the commencement of any non-emergency demolition or construction activities that could expose contaminated soil. The notification shall include:

- A description of the proposed work, with a figure identifying the affected area;
- An evaluation of the proposed work's potential impacts on human health and the environment;
- An assessment of whether the proposed work changes the appropriateness of the remedies selected in the ROD (DOE 2009b); and
- A discussion of controls that will be used to prevent impacts associated with the proposed work.

If the work is conducted in an emergency (e.g., ruptured subsurface gas line), notification beforehand is not required. However, notification shall be provided to the regulatory agencies that are signatories to the ROD as soon as practicable thereafter. The notification shall include the description of action taken, the outcome, impacts associated with the emergency and/or the work conducted, and mitigation and/or control measures employed to protect human health and the environment. For excavation or other soil-disturbing activities, additional information described in Section A5.0 of the Soil Management Plan (Appendix A) shall be provided to the agencies. After soil-disturbing activities are complete, the agencies will be notified and given the opportunity to inspect the work site.

2.4 Annual Inspections and 5-Year Reviews

Annually, DOE shall visually inspect the DOE areas of the LEHR Site to ensure compliance with land-use covenants, and shall review whether the land-use restrictions are or are not effective in preventing exposures to subsurface contaminants. The review will include:

- A verification of permits obtained for any soil-disturbing activities;
- A review of soil-disturbing activities for compliance with the Soil Management Plan;
- A review of disposal practices for waste generated during soil-disturbing activities; and
- Suggested changes to the Soil Management Plan.

DOE shall also ensure that project-specific inspections are conducted when the implementation of the Soil Management Plan is triggered. These inspections will be conducted on a schedule developed for the specific activity by an environmental professional as described in the Soil Management Plan.

DOE shall also conduct 5-year reviews to ensure that the selected remedy remains protective.

2.5 Reporting

DOE shall submit a written land-use covenant report to all ROD signatories annually. The reports shall be submitted within 30 days of the anniversary date of the ROD signature date. The reports shall include:

- Annual inspection results;
- Results of inspections conducted to comply with the requirements of the Soil Management Plan;
- A certification attesting to the compliance of the terms and conditions of the land-use covenants; and
- A discussion of any soil-disturbing activities and the final disposal of any wastes generated, any violations of the land-use covenant, and any action taken to ensure compliance with the land-use covenant.

2.6 Termination of Land-Use Restrictions

Land-use controls shall be maintained until the concentrations of contaminants in the soil are at levels that allow unrestricted use (see remediation goals in Tables 1–3 and 1–4). As long as contamination requiring the implementation of a Soil Management Plan or land-use restrictions remains in place, DOE shall continue to conduct 5-year reviews to ensure that the selected remedy remains protective. The Soil Management Plan shall be maintained and updated during 5-year reviews.

DOE may apply to DTSC for a termination of the land-use restrictions or other terms of land-use covenants for all or any portion of the LEHR Federal Facility. Such application shall be made in accordance with *California Health and Safety Code* Section 25234, and a copy of the application shall be submitted to EPA. No termination may be granted without prior notice to and opportunity to comment by EPA, CRWQCB, and the California Department of Public Health, or the successors to these agencies.

In accordance with the Memorandum of Agreement between DOE and the Regents of the University of California, following each 5-year review, DOE shall consult with EPA, DTSC, CRWQCB, and the California Department of Public Health, or the successors to these agencies, to determine whether it is necessary for the land-use covenants to remain in effect or whether the land-use covenants can be terminated entirely or amended to delete specific DOE units from the land-use restrictions (DOE 2009a).

3.0 Implementation of Long-Term Groundwater Monitoring

Residual concentrations of contaminants remain in soil at LEHR (see Section 1.6). Some of these contaminants may migrate from soil into groundwater. Long-term groundwater monitoring has been selected to ensure that if contaminants begin to impact groundwater, remedial action will be taken to prevent the degradation of water quality.

This section discusses the location of monitoring wells, compliance monitoring requirements (e.g., frequency, analytical methods), and procedures for evaluating remedial options if groundwater is impacted. Requirements for preventing the destruction or disturbance of monitoring wells shall be established as land-use covenants implemented as discussed in Section 2.1.3.

3.1 Groundwater Monitoring Locations

Groundwater samples will be collected from six existing wells (UCD1-013, -018, -021, -023, -054, and -063) and six new wells (UCD1-068 through -073) that will be installed to provide sufficient data to represent the groundwater quality beneath the DOE areas and background water quality. Figure 3–1 shows well locations, the predominant hydrostratigraphic unit (HSU)-1 groundwater flow direction in the area to be monitored, and the variability in this flow direction. Groundwater flow is predominantly to the northeast, although it seasonally may vary to be more northerly or easterly. The HSU-1 groundwater seepage velocity has been estimated between 3 and 30 ft per year (UC Davis 2004b). Any DOE areas COCs that reach HSU-1 groundwater may migrate downgradient more slowly than this due to retardation (see Appendix C for estimates of COC travel times). The 12 monitoring well locations were selected to be close enough to the areas monitored to detect releases of high mobility COCs within a few years' time (allowing for some retardation), while being sufficiently far to monitor potential impacts from an entire DOE area or a specific portion of the larger areas. Potential accessibility issues were also considered in selecting new well locations. The wells designated for monitoring each DOE area and background and the rationale for their locations are as follows:

- Existing well UCD1-054 and planned well UCD1-071 will be used to monitor the concentrations of total chromium, hexavalent chromium, mercury, molybdenum, silver, cesium-137 (Cs-137), and Sr-90 (see Table 1−4) downgradient of the Dry Wells A–E area. Well UCD1-054 is located immediately adjacent to the east and near the center of the Dry Wells A–E area. Planned well UCD1-071 will be approximately 60 ft northeast of the Dry Wells area and immediately adjacent to the northeast of DSS 1. This well will also be used to monitor the concentrations of aluminum (see Table 1−5) downgradient of DSS 1.
- Existing well UCD1-021 will be used to monitor the concentrations of nitrate (as N), carbon-14 (C-14), radium-226, and americium-241 (see Tables 1–4 and 1−5) downgradient of the Ra/Sr Treatment Systems area. Well UCD1-021 will also be used to monitor the concentrations of aluminum (see Table 1−5) downgradient of DSS 5. Although existing well UCD1-021 is not ideally located for monitoring DSS 5 (due east approximately 130 ft), no new well is proposed specifically for monitoring aluminum from DSS 5 because (1) access for well installation is very limited in the nearby downgradient direction (northeast); (2) the potential groundwater impact by aluminum is based on limited de-ionized (DI) water extraction test results without background results for comparison; and (3) the aluminum DI extraction test results were similar to those for DSS 1, and DSS 1 will have a new

monitoring point immediately adjacent (UCD1-071). If significant aluminum impact is detected and confirmed at well UCD1-071, enhanced monitoring of DSS 5 will be included as part of the response. Enhanced monitoring might include increased sampling frequency, hydropunch sampling closer to DSS 5, installation of a new monitoring well closer to DSS 5, or other enhancement, depending on the recent aluminum results for both UCD1-071 and UCD-021. The proposed response would be presented to EPA, DTSC, DPH, and CRWQCB for approval prior to implementation.

- Planned well UCD1-072 will be used to monitor the concentration of aluminum (see Table 1–5) downgradient of DSS 6 and will also be used for monitoring the Ra/Sr Treatment System area. This well will be located approximately 10 ft east of DSS 6 and approximately 45 ft east of the Ra/Sr Treatment System area.
- Planned well UCD1-069 will be used to monitor the concentrations of formaldehyde, molybdenum, nitrate, aluminum, and silver (see Tables 1–4 and 1−5) downgradient of DSS 3. The planned well location is approximately 15 ft northeast of DSS 3.
- Planned well UCD1-068 will be used to monitor the concentrations of selenium, aluminum, chromium, and nickel (see Tables 1–4 and 1−5) downgradient of DSS 4 and to supplement monitoring of the Ra/Sr Treatment System area. The planned well location is approximately 60 ft northeast of DSS 4 and approximately 150 ft northeast of the Ra/Sr Treatment System area.
- Existing well UCD1-023 and planned well UCD1-070 will be used to monitor the concentrations of nitrate, C-14, mercury, and zinc (see Tables 1–4 and 1−5) downgradient of the SWT area. Remaining soil in the SWT area with COC levels above the groundwater protection remediation goals is primarily located in the southeast corner of the area; some is also present in the western portion (as described in Weiss 2005 and the Soil Management Plan). Planned well UCD1-070 is located to monitor potential impacts from the southeast corner of the SWT, while well UCD1-023 will monitor potential impacts from soil in the western portion of the SWT area.
- Existing well UCD1-013 is approximately 35 ft east of the EDPs area and will be used to monitor the concentrations of alpha-chlordane, gamma-chlordane, and dieldrin (see Table 1−5) downgradient of this area.
- Existing background wells UCD1-018 and -063 and new well UCD1-073 will be used to collect background data for all inorganic and radiological COCs and the constituents listed in Table 1−5. The proposed location for well UCD1-073 is approximately 100 ft west of the northwest corner of the site. This location is proposed to provide background data at a greater distance from Putah Creek than the other two background wells.

All new wells shall be installed in accordance with procedures presented in Appendix D.

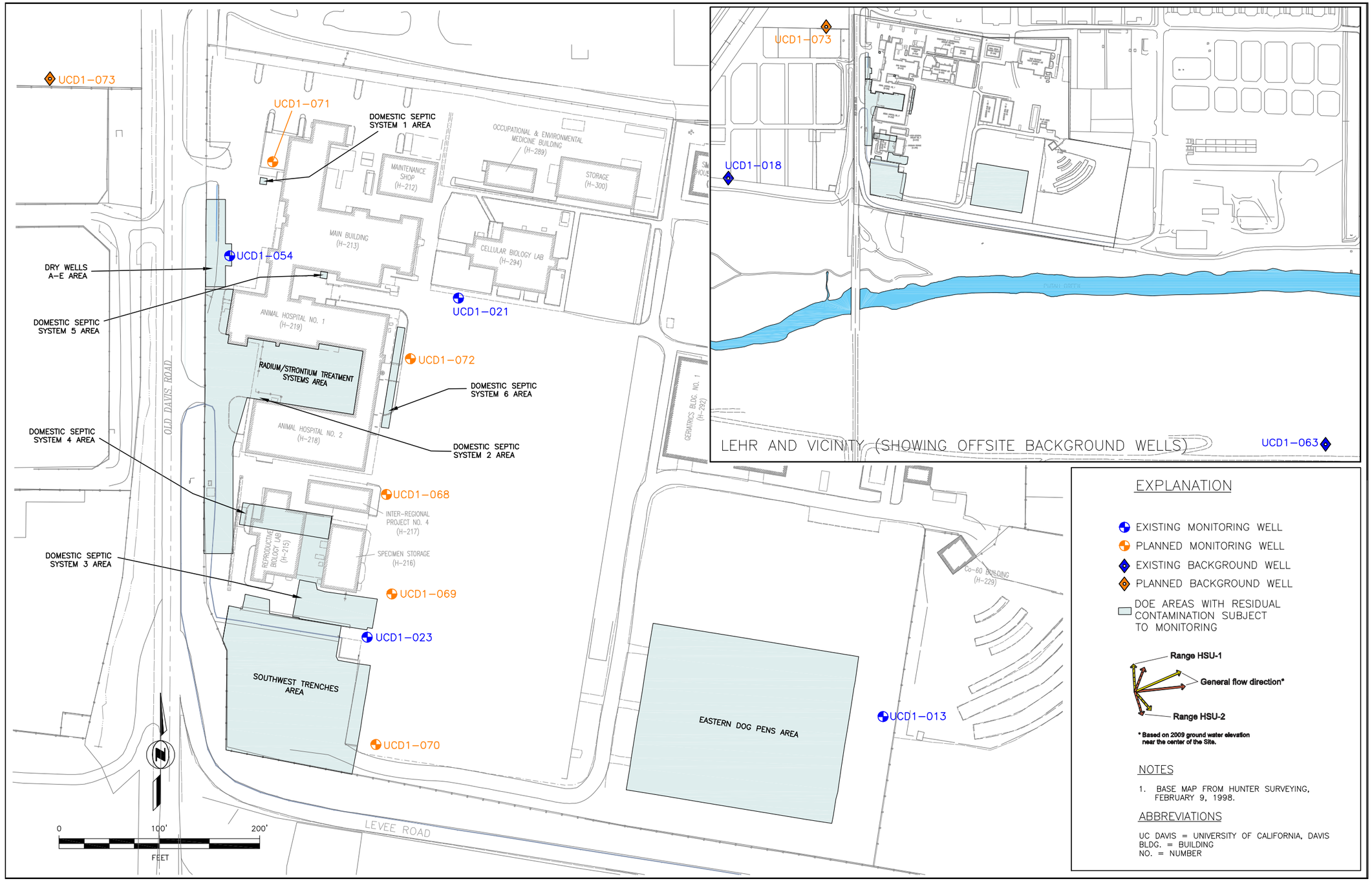

Figure 3–1. Groundwater Monitoring Locations

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3.2 Establishing the Background Groundwater Condition

Sufficient sampling will be conducted to establish background or baseline conditions against which subsequent sampling can be evaluated to determine if a contingent remedy is needed. To supplement existing background wells UCD1-018 and -063, new background well UCD1-073 will be installed west of the site (Figure 3–1). Samples will be collected from the three background wells quarterly for 1 year. One year of quarterly sampling will be sufficient to establish background because data collected over the past several years indicate no significant temporal trends in constituent concentrations for the existing background wells. Samples collected from the background wells during the first two quarters following installation of the new well will be analyzed for a full suite of potential site groundwater contaminants provided in Table 3–3 (reporting limits are provided in Appendix F).

Although the three background wells are not impacted by COCs from the site and are located upgradient of the LEHR Site, concentrations of some COCs may vary amongst the three wells due to varying influences from Putah Creek water and/or regional groundwater impacts. Provided the maximum concentration of a given COC in one well is not significantly higher than the maximum concentrations of the same COC in either of the other two wells, the maximum concentration of each constituent detected in the four quarterly samples from the three background wells will be used to represent background. If there are significant differences in concentrations detected in these background wells, the maximum concentrations for each individual background well may be used as the reference concentration for those monitoring wells that are more directly downgradient of the background well than the other background wells. Because natural variability and analytic uncertainty varies from one targeted groundwater analyte to the next, the significance of variability in maximum concentrations will be evaluated on a constituent-by-constituent basis. If all the analytical results from the background wells are below the detection limit for a given constituent, the detection limit will be used to represent a background concentration for that constituent. The evaluation of background concentrations collected over four quarters, the data collected, and the resulting background level proposed for each COC will be submitted to EPA, DTSC, CRWQCB, and the California Department of Public Health, or the successors to these agencies, for their approval.

3.3 Establishing Baseline Conditions for COCs in Groundwater

Samples will be collected from downgradient wells for four quarters to establish a baseline against which concentration trends can be evaluated. For each downgradient well, the maximum level reported for each COC will be used as the baseline value for that COC in that well.

3.4 Groundwater Sample Collection

Long-term monitoring consists of collecting groundwater samples from wells in HSU-1 that are close to the area with residual contamination, to detect contaminants in the aquifer before they can reach groundwater in HSU-2. COCs listed in Table 1−4 will be monitored at locations downgradient of DOE areas with residual contamination. COCs listed in Table 1−5 that the risk characterization (Weiss 2005) identified as possibly having a very small impact on groundwater in the future will also be monitored.

All groundwater samples will be collected according to the monitoring program shown in Table 3−1. For COCs shown in Table 1−4, samples will be collected quarterly for 1 year. Samples for COCs listed in Table 1−5 will be collected annually during the winter or spring quarter when water levels are expected to be higher. After 1 year, the sampling frequency may be adjusted based on evaluation of the monitoring data, as described in Section 3.5 below. Procedures to determine sampling frequency after the first year are given in Sections 4.1 and 4.2. Changes in sampling frequency will be proposed and documented in the annual water monitoring reports.

Samples collected at the new wells installed for this program will be analyzed for the full suite of potential site groundwater contaminants provided in Table 3–3 (laboratory-required reporting limits are specified in Table 3–3, and laboratory-specific reporting limits are provided in Appendix F) during for the first two quarters following installation. Data from these two quarterly events will be evaluated to determine if constituents other than the targeted COCs are present above the previously defined background levels provided in Table 3–3, and the levels detected in the first two quarterly samples from the one new and two existing background wells. This evaluation and any recommendations for additional sampling or other follow-up actions will be included in the Annual Water Monitoring Report and presented to EPA, DTSC, CRWQCB, and the California Department of Public Health, or the successors to these agencies, for their approval.

All monitoring activities will be conducted in accordance with the *Final Revised Field Sampling Plan* (Dames & Moore 1998) except for low-flow purging and sampling (described in Appendix E); sampling procedures provided in Appendix E; a Quality Assurance Project Plan (QAPP); and a Health and Safety Plan that addresses hazards specific to each work element, how the project will comply with environmental laws and regulations, and other issues such as area monitoring, worker training and safety, decontamination, and emergency response.

3.5 Sample Analysis and Evaluation of Groundwater Monitoring Data

Table 3–1 shows the analytical parameters and sampling frequency for all COCs subject to the long-term groundwater monitoring program. Table 3–1 also specifies the split samples required for this monitoring program, in accordance with the QAPP (DOE 2010). No trip, equipment, or field blanks are required because each well will have dedicated sampling equipment and VOCs are not part of the analytical suite. Table 3–2 specifies analytical methods, laboratory reporting limits, holding times, and maximum contaminant level remediation goals, and includes the background concentrations (provisional background) established in the *DOE Areas Remedial Investigation Report* (see Weiss 2003) for each analyte. As shown, the laboratory reporting limits are sufficiently low to allow for effective comparisons with background. The reporting limits specified for mercury, tritium, carbon-14, americium-241, and cesium-137 are the best available from among major accredited laboratories.

As shown on Table 3–2, samples for metals and radionuclides (except C-14) will be filtered prior to analysis, as specified in the QAPP approved for groundwater monitoring (DOE 2010). Due to the nature of HSU-1 soil (i.e., predominantly silt and clay), suspended solids often remain in groundwater sampled from HSU-1 wells even after thorough well development, and analyzing these samples without first filtering them can result in reported COC concentrations significantly higher than what is representative of the dissolved phase. Therefore, samples will be filtered with

Table 3–1. Groundwater Monitoring Program for DOE Areas

Wells	Well Status	Area Monitored	Radiological Analytes					Chemical Analytes												Electrical Conductivity
			Americium-241	Carbon-14	Cesium-137	Radium-226	Strontium-90	alpha-Chlordane gamma-Chlordane Dieldrin	Formaldehyde	Hexavalent Chromium	Nitrates (as Nitrogen)	Aluminum	Total Chromium	Mercury	Molybdenum	Nickel	Selenium	Silver	Zinc	
UCD1-013	Existing	EDPs	N/A	N/A	N/A	N/A	N/A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A
UCD1-018	Existing	Background	Q	Q	Q	Q	Q	N/A	N/A	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	A
UCD1-021	Existing	DSS 5 and Ra/Sr System	A	Q	N/A	Q	N/A	N/A	N/A	N/A	Q	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A
UCD1-023	Existing	SWT	N/A	Q	N/A	N/A	N/A	N/A	N/A	N/A	Q	N/A	N/A	A	N/A	N/A	N/A	N/A	A	A
UCD1-054	Existing	Dry Wells	N/A	N/A	Q	N/A	Q	N/A	N/A	Q	N/A	N/A	Q	Q	Q	N/A	N/A	Q	N/A	A
UCD1-063	Existing	Background	Q	Q	Q	Q	Q	N/A	N/A	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	A
UCD1-068	Planned	DSS 4 and Ra/Sr System	A	Q	N/A	Q	N/A	N/A	N/A	N/A	Q	A	A	N/A	N/A	A	Q	N/A	N/A	A
UCD1-069	Planned	DSS 3	N/A	N/A	N/A	N/A	N/A	N/A	Q	N/A	Q	A	N/A	N/A	Q	N/A	N/A	A	N/A	A
UCD1-070	Planned	SWT	N/A	Q	N/A	N/A	N/A	N/A	N/A	N/A	Q	N/A	N/A	A	N/A	N/A	N/A	N/A	A	A
UCD1-071	Planned	Dry Wells and DSS 1	N/A	N/A	Q	N/A	Q	N/A	N/A	Q	N/A	A	Q	Q	Q	N/A	N/A	Q	N/A	A
UCD1-072	Planned	DSS 6 and Ra/Sr System	A	Q	N/A	Q	N/A	N/A	N/A	N/A	Q	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A
UCD1-073	Planned	Background	Q	Q	Q	Q	Q	N/A	N/A	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
Field Duplicate	Random	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	N/A
Matrix Spike	Random	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	N/A
Matrix Spike Duplicate	Random	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	N/A

Notes:

All "Planned" wells will be sampled for a full suite of analytes for the first two quarters following installation. A full suite includes metals, nitrate as N, selected radionuclides, volatile organic compounds, pesticides, and polychlorinated biphenyls, as specified in Table 3–3. See Appendix F for list of analytes and reporting limits.

QA samples (field duplicate, matrix spike, and matrix spike duplicate) will be collected at random at the frequencies indicated. Percentages listed are of total samples per the QAPP (DOE 2010). When the percentage of QC samples is a fraction, the value will be rounded up to the nearest whole number.

Abbreviations:

N/A = not applicable

Q = sampling event conducted quarterly

A = sampling event conducted annually during winter or spring quarter

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Table 3–2. Analytical Parameters for Groundwater Samples

Parameter	Method Reference	Container	Sample Handling/ Preservation	Holding Time	Detection Reporting Limit[a]	Provisional Background Level[j]	MCL[k]
Metals							
Aluminum	SW-846, Method 6020[b]	250-milliliter polyethylene plastic	Filter[i], nitric acid, pH<2	180 days	50 µg/L	N/A	1,000 µg/L
Chromium (total)					1 µg/L	40.6 µg/L	50 µg/L
Molybdenum					1 µg/L	15 µg/L	N/A
Nickel					2 µg/L	77.9 µg/L	100 µg/L
Selenium					3 µg/L	5.67 µg/L	50 µg/L
Silver					1 µg/L	5 µg/L	N/A
Zinc					10 µg/L	30 µg/L	N/A
Mercury	SW-846, Method 7470[b]	250-milliliter polyethylene plastic	Filter[i], nitric acid, pH<2	28 days	0.2 µg/L[L]	0.1 µg/L	2 µg/L
Hexavalent Chromium	SW-846, Method 7199[b]	250-milliliter polyethylene plastic	Filter [i], 4°C	24 hours	1 µg/L	39.4 µg/L	N/A
Radionuclides							
Americium-241	EML HASL 300[c]	2-liter polyethylene plastic, glass	Filter[i], nitric acid, pH<2	180 days	1 pCi/L[L]	0.0155 pCi/L	N/A
Cesium-137	EPA Method 901.1[d]	1-liter polyethylene plastic, glass	Filter[i], nitric acid, pH<2	180 days	5 pCi/L[L]	1.0 pCi/L	N/A
Strontium-90	EPA Method 905.0[e]	2-liter polyethylene plastic, glass	Filter[i], nitric acid, pH<2	180 days	1 pCi/L	1.7 pCi/L	8 pCi/L
Carbon-14	EPA EERF C-01[f]	1-liter polyethylene plastic, glass	none	180 days	7 pCi/L[L]	3.5 pCi/L	N/A
Radium-226	EPA Method 903.1[g]	1-liter polyethylene plastic, glass	Filter[i], nitric acid, pH<2	180 days	1 pCi/L	1.14 pCi/L	5 pCi/L
General							
Nitrate (as Nitrogen)	EPA Method 300.0[h]	250-milliliter polyethylene plastic	4 °C	48 hours	10 mg/L	25 mg/L	10 mg/L
Formaldehyde	SW-846, Method 8315[b]	1-liter amber glass	4 °C	72 hours	50 µg/L	0	N/A
Organics							
Alpha-Chlordane	SW-846, Method 8081[b]	1-liter amber glass (2 each)	4° C	7 days to extraction, 40 days to analysis	1.0 µg/L	0	N/A
Gamma-Chlordane					1.0 µg/L	0	N/A
Dieldrin					0.1 µg/L	0	N/A

Table 3–2. (continued) Analytical Parameters for Groundwater Samples

Notes:
[a] As shown, reporting limits are at or below MCLs for all constituents and are below the previously defined background levels for all inorganics except for mercury, americium-241, cesium-137 and carbon-14. The background values for these four constituents were based on one-half of the lowest background detection limits; therefore, the specified reporting limits were sufficiently low for comparison with background.
[b] From the *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (EPA 2007).
[c] From *The Procedures Manual of the Environmental Measurements Laboratory* (DOE 1997).
[d] *Gamma Emitting Radionuclides* from *Prescribed Procedures for Measurement of Radioactivity in Drinking Water* (EPA 1980).
[e] *Radioactive Strontium* from *Prescribed Procedures for Measurement of Radioactivity in Drinking Water* (EPA 1980).
[f] EPA, *Eastern Environmental Radiation Facility* (EERF).
[g] *Radium-226 - Radon Emanation Technique* from *Prescribed Procedures for Measurement of Radioactivity in Drinking Water* (EPA 1980).
[h] *Determination of Inorganic Anions by Ion Chromatography* (EPA 1993).
[i] Glass fiber, 0.45 micron filter.
[j] Provisional background levels from Appendix G of the *DOE Areas Remedial Investigation Report* (Weiss 2003); will be redefined based on baseline monitoring.
[k] Lower of California or federal primary MCL.
[L] Best available reporting limit from among major accredited laboratories.

Abbreviations:
EERF = Eastern Environmental Radiation Facility
MCL = maximum contaminant level
µg/L = micrograms per liter
mg/L = milligrams per liter
N/A = not available
pCi/L = picocuries per liter

Table 3–3. Full Suite Analytical Parameters for Groundwater Samples

Parameter	Method Reference	Container	Sample Handling/ Preservation	Holding Time	Required Laboratory Reporting Limit	Provisional Background Level[a]
Metals						
Aluminum	SW-846, Method 6020A	250-milliliter polyethylene plastic	Filter, nitric acid, pH<2	180 days	50 µg/L	N/A
Antimony					5 µg/L	5 µg/L
Arsenic					3 µg/L	8.1 µg/L
Barium					20 µg/L	187 µg/L
Beryllium					1 µg/L	1.5 µg/L
Cadmium					1 µg/L	1 µg/L
Chromium (total)					1 µg/L	40.6 µg/L
Cobalt					1 µg/L	1.8 µg/L
Copper					1 µg/L	1.7 µg/L
Iron					100 µg/L	502 µg/L
Lead					1 µg/L	1.3 µg/L
Manganese					10 µg/L	10 µg/L
Molybdenum					1 µg/L	15 µg/L
Nickel					2 µg/L	77.9 µg/L
Selenium					3 µg/L	5.7 µg/L
Silver					1 µg/L	5 µg/L
Thallium					5 µg/L	6 µg/L
Vanadium					10 µg/L	20 µg/L
Zinc					10 µg/L	30 µg/L
Mercury	SW-846, Method 7470	1 liter polyethylene plastic	Filter, nitric acid, pH<2	28 days	0.2 µg/L [b]	0.1 µg/L
Chromium+6	SW-846, Method 7199	1 liter polyethylene plastic	Filter, 4°C	24 hours	1 µg/L	39.4 µg/L
Radionuclides						
Tritium	EPA 906.0	1-liter glass	4°C	180 days	220 pCi/L [b]	110 pCi/L
Strontium-90	EPA Method 905.0	2-liter polyethylene plastic, glass	Filter, nitric acid, pH<2	180 days	1 pCi/L	1.7 pCi/L
Gross Alpha	EPA Method 900.0	1-liter polyethylene plastic, glass	Filter, nitric acid, pH<2	180 days	2 pCi/L	N/A
Gross Beta					3 pCi/L	N.A
Carbon-14	EPA EERF C-01	1-liter polyethylene plastic, glass	4°C	180 days	7 pCi/L [b]	3.5 pCi/L
Radium-226	EPA Method 903.1	1-liter glass	Filter, nitric acid, pH<2	180 days	1 pCi/L	1.1 pCi/L
Uranium-235	EPA Method 901.1	2 each 2-liter polyethylene plastic, glass	Filter, nitric acid, pH<2	180 Days	19 pCi/L	19 pCi/L
Uranium-238	EPA Method 901.1	2 each 2-liter polyethylene plastic, glass	Filter, nitric acid, pH<2	180 Days	25 pCi/L	N/A
Organics						
Volatile Organic Compounds	SW-846, Method 8260/5030	3 each 40 mL VOA	4°C, hydrochloric acid, pH<2	14 days	See Appendix F	N/A
Semi-volatile Organic Compounds	SW-846, Method 8270/3510	2 each 1-liter amber glass	4°C	7 days to extraction, 40 days to analysis	See Appendix F	N/A

Table 3−3 (continued). Full Suite Analytical Parameters for Groundwater Samples

Parameter	Method Reference	Container	Sample Handling/ Preservation	Holding Time	Required Laboratory Reporting Limit	Provisional Background Level[a]
Pesticides	SW-846, Method 8081/3510	2 each 1-liter amber glass	4°C	7 days to extraction, 40 days to analysis	See Appendix F	N/A
Polychlorinated Biphenyls	SW-846, Method 8082/3510	2 each 1-liter amber glass	4°C	7 days to extraction, 40 days to analysis	See Appendix F	N/A

Notes:
[a] Provisional background levels from Appendix G in the *DOE Areas Remedial Investigation Report* (Weiss 2003)
[b] Best available reporting limit from among major accredited laboratories.

Abbreviations:
mg/L = milligrams per liter
N/A = not available
pCi/L = picocuries per liter
µg/L = micrograms per liter

glass fiber 0.45-micron filters to remove suspended solids as well as to provide data that are consistent with the historical database for the site.

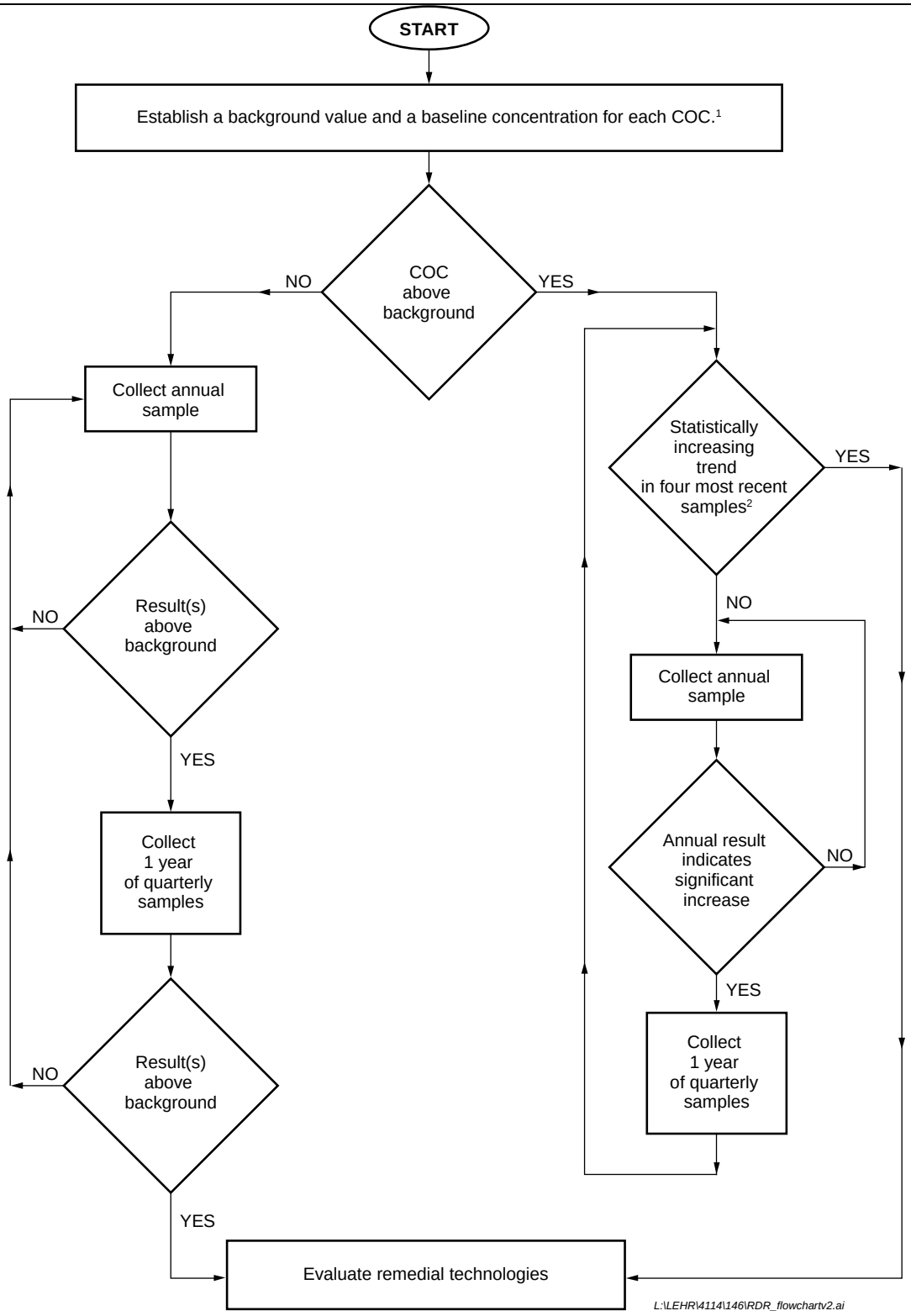
Laboratories certified through the California Environmental Laboratory Accreditation Program to perform the specified methods will analyze all samples. Laboratories selected to conduct these analyses are GEL Laboratories (GEL) in Charleston, South Carolina for radionuclides; Test America in North Canton, Ohio for formaldehyde, and CalScience Environmental Laboratories, Inc., (CEL) in Garden Grove, California for all other analyses. The completeness (that is, the percentage of valid results obtained compared to the total number of samples taken for a parameter) for each sampling event will be 90 percent (see Section 7.1, “Data Quality Objective” [DQO] Step 6). The completeness goal is per analyte per project.

As shown in Figure 3−2, after completion of the first four quarters of groundwater monitoring during which a baseline condition is established, monitoring data will be compared to the established groundwater background (see Section 3.2) and to the established baseline condition (see Section 3.3). The process for conducting these comparisons is described in Section 4.

3.6 Groundwater Monitoring for Additional Constituents

As discussed in Section 1.6, DOE has agreed to monitor groundwater concentrations of the constituents listed in Table 1−5 because these constituents were identified as possibly having a small impact on groundwater in the future at the SWT; Ra/Sr Treatment Systems; DSS 1, 3, 4, 5, and 6; Dry Wells A–E; and EDPs areas.

These constituents will be monitored in groundwater in downgradient wells annually. Background samples will be collected for these inorganic and radiological constituents quarterly for at least 1 year. Background will be established according to procedures discussed in Section 3.2. Background concentrations of organic constituents listed in Table 1−5 are presumed to be zero (below detection limits), as these constituents do not occur naturally.



Notes:

1. Background values and baseline concentrations will be established using data collected over the first four quarters of the groundwater monitoring program.
2. Increase must be above baseline to trigger contingency remediation evaluation; otherwise, proceed with annual monitoring.

Figure 3–2. Groundwater Monitoring Decision Process

The first year of monitoring data for inorganic and radiological constituents will be compared to the established background values. Inorganic and radiological constituents with concentrations below the background values and organic constituents without positive detections will continue to be monitored annually until it can be concluded that they do not threaten the groundwater.

3.7 Reporting

Results of the monitoring program will be evaluated and presented in annual water monitoring reports prepared for the site by UC Davis and in 5-year review reports. DOE will coordinate with UC Davis on the scope and content of the annual reports. These reports are expected to be similar in content and style to *Final 2009 Comprehensive Annual Water Monitoring Report* (UC Davis 2010) and will contain data evaluation including analysis of temporal COC trends, groundwater potentiometric surface maps, and isoconcentration maps of key COC. Additional data evaluation, such as Mann-Kendall or other statistical analyses, may also be included as appropriate and agreed to between UC Davis, DOE, and the regulatory agencies (EPA, DPH, CRWQCB, and DTSC)

The 5-year review reports will follow EPA's *Comprehensive Five-Year Review Guidance* (EPA 2001).

3.8 Modifications/Termination of Groundwater Monitoring

Annual adjustments to the groundwater monitoring program, including changes to requirements for split and blank sampling and analysis, will be proposed and documented in the annual water monitoring reports. If concentrations of COCs listed in Table 1−4 are below background levels or not detected for 5 consecutive years, the monitoring frequency will be reduced from annual to biannual until the next 5-year review. If concentrations of COCs listed in Table 1−4 continue to be below background levels or not detected in the following 5-year period, the sampling frequency may be further reduced to triennial or once every 5 years (approximately 1 year before the 5 year review report is due). Reduction in the monitoring frequency or termination of monitoring will be considered for specific COCs and shall be approved by the regulatory agencies prior to implementation.

Annual monitoring of COCs listed in Table 1–5 shall be conducted until it can be determined on the basis of monitoring data that these COCs no longer pose a threat to groundwater quality. Termination of monitoring of COCs listed in Table 1–5 shall be approved by regulatory agencies.

3.9 Quality Assurance Assessments

As discussed in Section 3.5, GEL, TestAmerica, and CEL will analyze samples collected as part of the groundwater monitoring program described above. Laboratory-required reporting limits are specified in Tables 3–2 and 3–3. Laboratory-specific reporting limits are provided in Appendix F. Standard operating procedures (SOPs) for the relevant analyses, and the Quality Assurance manuals for GEL, CEL, and TestAmerica laboratories are included as Appendix G.

As required by the QAPP (DOE 2010), audits of both the field and laboratory operations associated with this groundwater monitoring program will be periodically conducted. The frequency of these audits will be as follows:

- Laboratory audit—every 3 years, for laboratories providing ongoing analytical services, and prior to establishing a contract for any new laboratories.
- Field audit—once per year during the annual groundwater monitoring event conducted by UC Davis and/or its contractors (will be coordinated with the annual inspection described in Section 2.4, if practical).

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4.0 Implementation of Contingent Remediation

The long-term groundwater monitoring described in Section 3.0 may indicate that the COCs being monitored are migrating to groundwater and are impacting or may impact groundwater quality. In such a case, remedial cleanup technologies will be evaluated in accordance with CERCLA, applicable or relevant and appropriate requirements (ARARs), and the corrective action requirements of Title 27 of the *Code of California Regulations*. This section provides a decision process by which such an evaluation would be triggered.

4.1 COCs with a Baseline Concentration Greater than Background Levels

For COCs with a baseline concentration above background levels, a trend analysis will be conducted according the procedures in Chapter 6 of *Methods for Evaluating the Attainment of Cleanup Standards, Volume 2: Ground Water* (EPA 1992), or an equivalent method agreed on by EPA, CRWQCB, and DTSC. Confidence limits on the time-series linear regression slope will be tested at the alpha significance level of 1 percent. If the confidence limits are positive, the data indicate an increasing trend.

If quarterly monitoring data collected during the first year following the baseline monitoring period described in Section 3.3 suggest that there is an increasing concentration trend based on the trend analysis approach described above, background concentrations will be re-evaluated as a first step. Concentrations of COCs in samples collected from background wells since the initial establishment of background concentrations will be evaluated to assess whether background levels have increased. If no new data are available, sampling may be conducted to determine if concentrations have changed. If background levels have not increased, an evaluation of remedial cleanup technologies will be conducted.

If no increasing trend is detected based on the analysis approach described above, the sampling frequency will be changed from quarterly to annual. If the annual result does not indicate an increasing trend, the sampling frequency will remain annual, and the data will be reevaluated each year. If the annual result indicates a significant increasing trend over the baseline, the sampling frequency will return to quarterly for 1 year and will then be evaluated. If the evaluation indicates an increasing concentration trend, remedial cleanup technologies will be evaluated. The trend analysis procedures discussed above (EPA 1992), or an equivalent method agreed on by EPA and CRWQCB will be used to determine if there is an increasing trend.

Data collected during the first year will be shared with the regulatory agencies, and a path forward that may include additional data collection or a reduction in sampling frequency will be evaluated and approved by the regulatory agencies.

4.2 COCs with a Baseline Concentration Below Background Levels

COCs with baseline (first-year) concentrations below background levels will be monitored annually. If the annual monitoring result indicates that concentrations detected are above background levels, background concentrations will be re-evaluated as a first step. Concentration of COCs in samples collected from background wells since the initial establishment of background values will be evaluated to assess whether background levels have increased. If no new data are available, sampling may be conducted to determine if concentration have changed.

If background levels have not increased, the monitoring frequency for the affected downgradient well will be increased to quarterly for 1 year. If the quarterly monitoring results indicate that the concentration is consistently at or below background levels, the sampling frequency will revert to annual, and the data will be reevaluated each year.

If the quarterly monitoring data indicate that the COC concentrations have increased to levels that exceed the background levels, remedial options will be evaluated, and the appropriateness of remediation will be determined, in accordance with CERCLA and ARARs (including the evaluation and corrective action requirements of Title 27 *Code of California Regulations*).

If the COC concentrations remain below background levels for 5 years, termination of monitoring will be considered.

4.3 Groundwater Monitoring for Additional Constituents

As discussed in Sections 1.6 and 3.6, DOE has agreed to monitor groundwater concentrations of constituents listed in Table 1−5 since these constituents were identified as having a low probability of impact on groundwater in the future at the SWT; Ra/Sr Treatment Systems; DSS 1, 3, 4, 5, and 6; Dry Wells A–E; and EDPs areas.

If 1 year of quarterly monitoring confirms that inorganic or radiological constituents are present in downgradient groundwater at concentrations above background levels, or if organic constituents continue to be detected, response actions will be evaluated and implemented in accordance with CERCLA and ARARs. Since the ROD did not address these constituents, an amendment to the ROD will be necessary (DOE 2009b).

5.0 Project Organization

The DOE Office of Legacy Management is responsible for the implementation of the remedies selected in the ROD (DOE 2009b). The Site Management and LTS&M Plan (DOE 2005) defines DOE's responsibilities. The Site Management and LTS&M Plan will be updated after this Remedial Design/Remedial Action Work Plan is adopted, to ensure that the Site Management and LTS&M Plan accurately reflects the requirements of the Work Plan and those of the ROD.

A number of other organizations play a role in the remediation and long-term surveillance and maintenance of the LEHR Site. The Federal Facility Agreement and the Memorandum of Agreement for the LEHR Site define these roles, which are summarized below.

5.1 Federal Facility Agreement

The parties to the Federal Facility Agreement include DOE, EPA Region 9, DTSC, CRWQCB, and the California Department of Health Services (now California Department of Public Health). EPA has the primary regulatory authority under CERCLA, and other agencies provide active oversight with respect to State programs and regulations. All parties to the agreement have participated in project planning and prioritization and attend regular meetings. The parties provide general regulatory assistance and exchange data that they have collected. Although UC Davis is not a party to the agreement, the Federal Facility Agreement does provide for the integration of DOE and UC Davis data.

5.2 Memorandum of Agreement

The Regents of the University of California own the land on which the LEHR Federal Facility is situated, and UC Davis is responsible for most activities associated with the site. DOE has entered into a Memorandum of Agreement with the Regents, whereby DOE will provide UC Davis with a grant to perform the tasks, listed below, required by the ROD and this plan:

- Record covenants to enforce land-use restrictions;
- Conduct the tasks listed in Section 2.2.1 to ensure the implementation of land-use restrictions defined in the recorded covenants;
- Provide a process that ensures the implementation of the Soil Management Plan;
- Conduct groundwater and surface water monitoring and reporting, defined in Section 3.0, as requested by DOE; and
- Provide other services as agreed to by DOE and UC Davis.

DOE's grant to UC Davis shall be renewed annually for as long as the DTSC land-use covenants remain in place. The University of California has also agreed to give regulatory agencies access to the DOE area of the site according to the ROD requirements.

5.3 Key Personnel

Vijendra Kothari, of DOE's Office of Legacy Management, manages the implementation of the selected remedies at LEHR. As discussed in Section 5.2 above, UC Davis shall implement the

groundwater monitoring, soil management, and land-use control inspections on behalf of DOE's Office of Legacy Management. In addition to UC Davis, S.M. Stoller Corporation (Stoller) supports DOE as a prime contractor in installation of the new monitoring wells, annual reporting, 5-year reviews, and general project supervision. Weiss Associates supports DOE as a subcontractor to Stoller and provides support to UC Davis under a separate contract with UC Davis.

Key positions and associated responsibilities for this project are defined in the QAPP. The persons filing these key positions at UC Davis are:

- Executive Sponsor—Jill Parker. (UC Davis)
- Program Manager—Sue Fields (UC Davis)
- Project Manager, Land Use Restrictions and Soil Management—Jim Aborn (UC Davis)
- Project Manager, Groundwater Monitoring—Bob Devany (Weiss Associates)
- Project Task Leader, Groundwater Sample Collection—Jordie Bornstein (Weiss Associates)
- Contracts Administrator—Mary Anne Brayton (UC Davis)
- Project Health and Safety Manager—Jim Aborn (UC Davis)
- Project Quality Assurance Manager—Christine Judal (UC Davis)
- Project Chemist—Brian Bandy (Weiss Associates)

Key positions and associated responsibilities for this project are defined in the QAPP. The persons filing these key positions at Stoller are:

- Executive Sponsor—Joe Legare (Stoller)
- Program Manager—Michael Butherus (Stoller)
- Project Manager, Well Installation and Implementation of Institutional Controls—Bob Devany (Weiss Associates)
- Project Task Leader, Well Installation—Tim Utterback (Weiss Associates)
- Project Task Leader, Groundwater Sample Collection—Jordie Bornstein (Weiss Associates)
- Project Task Leader, Institutional Controls Implementation—Agata Sulczynski (Weiss Associates)
- Contracts Administrator—Julie Hendricks (Stoller)
- Project Health and Safety Manager—Thomas Maveal (Stoller)
- Project Quality Assurance Manager—Michael Finton (Stoller)
- Project Chemist—Tim Utterback (Weiss Associates)
- Occurrence Coordinator—Michael Finton (Stoller)
- Project Records Administrator—Scott Raynes (Stoller)

Changes in key personnel will be documented in either the Annual Land-Use Covenant Reports (See Section 2.5) or the annual water monitoring reports (Section 3.7) depending on the changes affecting land-use covenants or groundwater monitoring.

5.4 Documents for Public Review and Comment

A formal public involvement process for decision documents is an important part of the CERCLA process and is in place to ensure that stakeholders have the opportunity to comment on cleanup and closure decisions at the site. DOE releases a draft version of all decision documents for regulatory review and comment. After regulators' comments have been addressed, the document is released for public comment and can be viewed in the Public Reading Room (see Section 5.4). A copy of the approved document and the response to comments are placed in the Administrative Record.

5.5 Administrative Record and Public Reading Room

DOE has established a Public Reading Room at the Davis Branch of the Yolo County Library in Davis (315 E 14th Street, Davis, California 95616). It contains documents and information related to the LEHR Federal Facility and copies of key documents, including the CERCLA Administrative Record and Information Repository. The Administrative Record and Information Repository are updated as new documents are created, and an index of documents in the complete collections accompanies each update. Stakeholders are notified, through public notices, when a document is available for public comment, and review copies are placed in the Public Reading Room.

5.6 Records and Data Management

All records created by DOE's Office of Legacy Management shall be managed in accordance with Title 36 *Code of Federal Regulations* Parts 1220–1236, "Agency Records Management Program" and the Federal Facility Agreement for the Site.

DOE shall maintain active records as required by the Agency Records Management Program. Active records contain information essential to the long-term care and custody of the site pursuant to applicable laws and regulations. In general, these records include site characterization reports, remedial action plans, National Environmental Policy Act documents, engineering design and construction documents, as-built drawings, results of groundwater monitoring, and annual inspection reports.

DOE's Office of Legacy Management Business Center in Morgantown, West Virginia, is currently the designated facility for archived LEHR Federal Facility records. DOE shall retain custody of the records sent to the records facility and is responsible for their destruction at the end of their approved retention periods. As stated in the Federal Facility Agreement:

- DOE shall preserve, during the pendency of this agreement and for a minimum of ten (10) years after its termination, all records and documents contained in the CERCLA Administrative Record and any additional records and documents retained in the ordinary course of business which relate to the actions carried out pursuant to this agreement.
- After this ten (10) year period, each party to this agreement shall notify the other parties at least forty-five (45) days prior to destruction of any such documents.

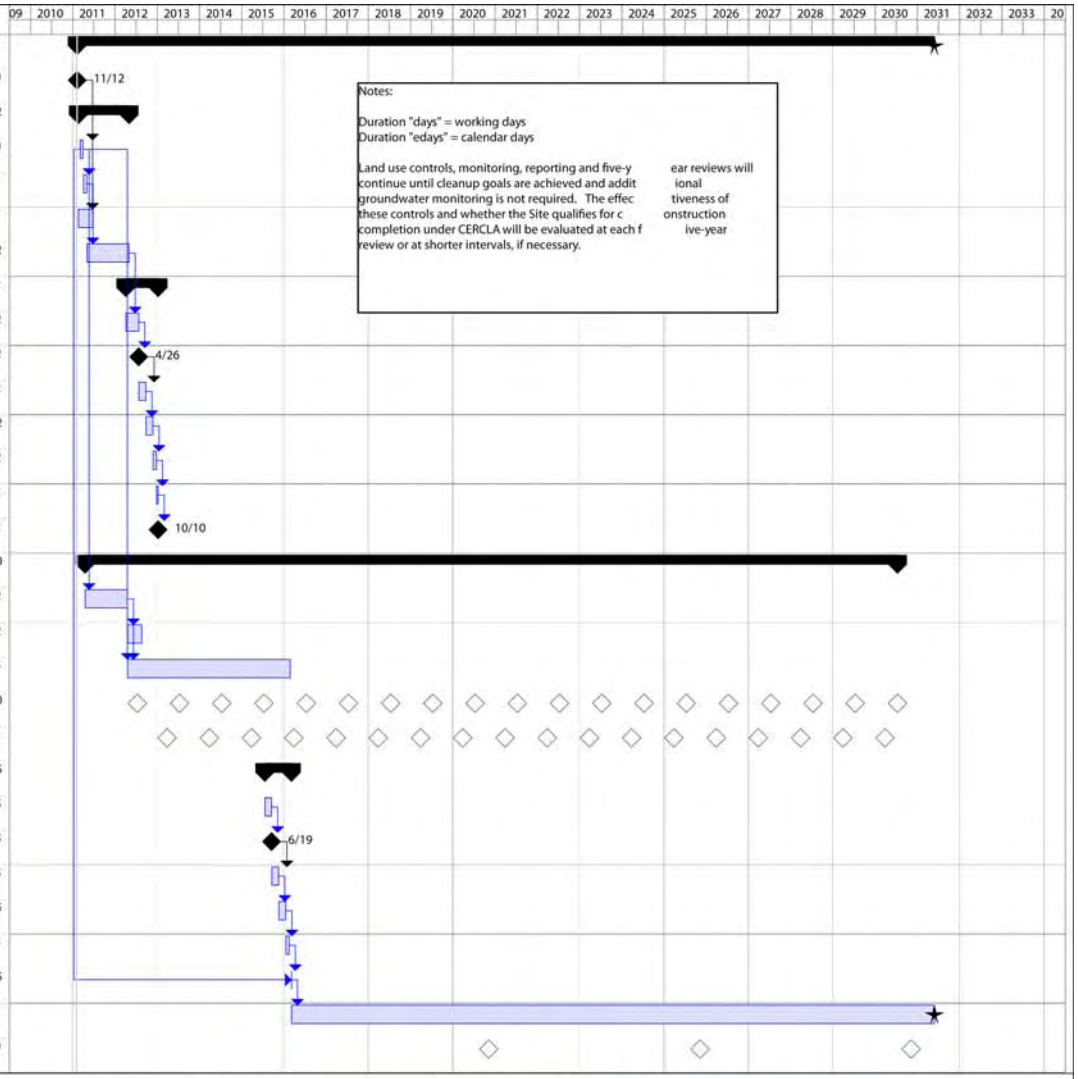
- Upon request by any party to this agreement, the requested party shall make available such records or copies of any such records unless withholding is authorized and determined appropriate by law.

All records with permanent value shall be transferred to and will be the responsibility of DOE's Office of Legacy Management.

6.0 Schedule

Figure 6–1 provides the project schedule and lists all activities required by the ROD (DOE 2009b) and detailed in this plan. The schedule will be updated in the annual report submitted to the EPA and DTSC to reflect completed milestones and changes to the schedule.

ID	Task Name	Duration	Start	Finish
1	DOE Post-ROD Activities	5295 days	Fri 11/12/10	Thu 2/27/31
2	Finalize RD/RA Work Plan	1 day	Fri 11/12/10	Fri 11/12/10
3	Conduct Remedial Actions	314 days	Mon 11/22/10	Thu 2/2/12
4	Install Monitoring Wells	20 days	Mon 12/6/10	Fri 12/31/10
5	Conduct land survey	23 days	Mon 1/3/11	Wed 2/2/11
6	Implement Soil Management Plan	90 days	Mon 11/22/10	Fri 3/25/11
7	Establish and record deed restrictions	365 edays	Wed 2/2/11	Thu 2/2/12
8	Remedial Action Completion Report	199 days	Fri 1/6/12	Wed 10/10/12
9	Develop Draft	80 days	Fri 1/6/12	Thu 4/26/12
10	Issue Draft	0 days	Thu 4/26/12	Thu 4/26/12
11	Agency Review	43 days	Fri 4/27/12	Tue 6/26/12
12	Resolve Comments/Revise Draft	44 days	Wed 6/27/12	Mon 8/27/12
13	Agency Review of Redline Draft	22 days	Tue 8/28/12	Wed 9/26/12
14	Issue Final	10 days	Thu 9/27/12	Wed 10/10/12
15	Remedy Operational and Functional	0 days	Wed 10/10/12	Wed 10/10/12
16	Long-Term Ground Water Monitoring (Initial Phase)	5018 days	Tue 1/18/11	Mon 4/15/30
17	Collect Baseline Groundwater Samples	365 edays	Tue 1/18/11	Wed 1/18/12
18	Develop Background Data	90 days	Thu 1/19/12	Wed 5/23/12
19	Long-term Groundwater Monitoring (Initial Phase)	1007 days	Thu 1/19/12	Fri 11/27/15
20	Present Monitoring Data in AWMR (Issued by UC Davis)	4695 days	Sun 4/15/12	Mon 4/15/30
40	Annual LUC Report to DTSC and EPA	4435 days	Sat 12/29/12	Sat 12/29/29
59	First Five-year Review	164 days	Wed 4/22/15	Mon 12/7/15
60	Develop Draft	43 days	Wed 4/22/15	Fri 6/19/15
61	Issue Draft	0 days	Fri 6/19/15	Fri 6/19/15
62	Agency Review	43 days	Mon 6/22/15	Wed 8/19/15
63	Resolve Comments/Revise Draft	43 days	Thu 8/20/15	Mon 10/19/15
64	Agency Review of Redline Draft	22 days	Tue 10/20/15	Wed 11/18/15
65	Issue Final	1 day	Mon 12/7/15	Mon 12/7/15
66	Ongoing Monitoring/Reporting (As required; See note)	3973 days	Tue 12/8/15	Thu 2/27/31
67	Ongoing 5-year Reviews (As required, See note)	2609 days	Tue 8/11/20	Sun 8/11/30



Date: Wed 11/3/10

Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone

Page 1

Longterm_ ScheduleRevT

Figure 6–1. Remedial Action Schedule

7.0 Quality Assurance

This section defines the DQOs for the remedial activities and provides guidance to project personnel in implementing the QAPP (DOE 2010) and associated Standard Quality Procedures (SQPs) as they apply to activities required by this Work Plan. The QAPP may be obtained from the UC Davis ES&H Unit.

7.1 Data Quality Objectives

To ensure consistency with the LEHR QAPP, EPA's *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA 2006) was followed in developing DQOs for this Work Plan.

The EPA DQO process is used to develop performance and acceptance criteria (or DQOs) that clarify study objectives, define the appropriate type of data, and specify tolerable levels of potential decision errors that will be used as the basis for establishing the quality and quantity of data needed to support decisions. Use of the DQO process leads to efficient and effective expenditure of resources; consensus on the type, quality, and quantity of data needed to meet the project goal; and the full documentation of actions taken during the development of the project.

The following are the DQOs that apply to monitoring and control of residual contamination at the site (long-term groundwater monitoring, contingency remediation, and land-use restrictions):

STEP 1. STATE THE PROBLEM. Define the problem that necessitates the study; identify the planning team; and examine budget and schedule.

Problem: The objective of this Remedial Design/Remedial Action Work Plan is to document the requirements and methods for implementing remedies selected in the ROD (DOE 2009b) for the DOE areas of LEHR. The remedies are intended to protect human health and the environment from residual contamination remaining in soil at the DOE areas of LEHR. The selected remedies (long-term groundwater monitoring; contingency remediation; and land-use restrictions) are intended to monitor and control the residual contamination at the site.

Planning Team: The planning team is comprised of DOE, UC Davis, and the regulatory agencies who are signatories to the ROD. DOE is responsible for implementing the remedies selected in the ROD, preparing this Work Plan, and ensuring its implementation. UC Davis has agreed, through a Memorandum of Agreement with DOE, to support DOE in implementing the Work Plan. UC Davis will record deed restrictions required by the ROD, conduct groundwater monitoring, oversee the implementation of the Soil Management Plan, conduct training and inspections, and provide required records to DOE. DOE retains the ultimate responsibility for compliance with the requirements of the ROD and for ensuring that the post-ROD activities presented in this Work Plan continue to be protective of human health and the environment.

Budget and Schedule: The implementation of this Work Plan is funded by DOE's Office of Legacy Management, which was established in 2003 with the primary mission of ensuring that DOE's long-term cleanup obligations are met. A LTS&M Plan identifies the post-closure actions that are defined in the ROD, remedial implementation work plans, and 5-year review findings.

The LTS&M Plan is used to communicate funding requirements to DOE management and to obtain funds from Congress for the implementation of the remedies.

Figure 6–1 provides a schedule for the implementation of post-ROD activities. This Work Plan is scheduled for approval in September 2010, and remedial action activities are scheduled to begin in August 2010. Land-use controls will run with the land in perpetuity and will bind the current property owner and all subsequent title holders. Groundwater monitoring will be conducted on a schedule included in Table 3–1. The Soil Management Plan will be in force as long as contamination remains in the soil. Updates to this plan may be made during 5-year reviews.

STEP 2. IDENTIFY THE GOAL OF THE STUDY. State how environmental data will be used in meeting objectives and solving the problem; identify study questions; and define alternative outcomes.

The data obtained from groundwater monitoring will be evaluated to determine if the remedy selected in the ROD continues to be protective of human health and the environment. The data obtained will help DOE and the regulatory agencies to:

- Define background conditions (as described in Section 3.2) at and near the site against which contaminant concentration trends can be evaluated,
- Determine if residual contaminants begin to impact groundwater,
- Undertake remedial action to prevent the degradation of water quality.

The data will be used to help answer this question: *Are residual contaminants in soil migrating to groundwater and impacting its quality as defined in the ROD?* The objective of the monitoring program is to identify threats to groundwater quality beneath the site and to determine the appropriate remedial action to be taken in case such a threat is identified.

Data collected according to the requirements of the Soil Management Plan will be used to determine the disposition of any soil that has been disturbed. The data obtained will help DOE to:

- Identify waste segregation strategies;
- Develop appropriate worker health and safety controls;
- Identify materials recycling opportunities;
- Appropriately dispose of sanitary, hazardous, low-level radioactive, and low-level mixed waste generated during soil-disturbing activities.

The data will be used to help answer this question: *What are the appropriate management and disposal options for soil generated from DOE areas subject to the Soil Management Plan?* The objective of the data collection requirements in the Soil Management Plan is to determine waste segregation, reuse, and disposal requirements.

STEP 3. IDENTIFY INFORMATION INPUTS. Identify data and information needed to answer study questions.

Data and information inputs include:

- Site background and historical information, including previous environmental investigation provided on data CD-ROM (Appendix A, Attachment C);
- Analytical results from groundwater and soil samples collected;
- Data gathered in the field (notes, photos, etc.);
- Validated laboratory analytical results; and
- Laboratory data validation.

STEP 4. DEFINE THE BOUNDARIES OF THE STUDY. Specify the target population and characteristics of interest; define spatial and temporal limits and scale of inference.

Groundwater monitoring and analysis of disturbed soil will continue until the regulatory agencies and DOE agree that such monitoring is no longer necessary for the protection of human health and the environment. Schedule modifications are subject to approval by the regulatory agencies.

The physical limits of the study area are areas of LEHR subject to land-use controls shown on Figure 2–1 and groundwater monitoring wells shown on Figure 3–1. The decision boundaries are defined in Sections 3.5 and 4.0 of this Work Plan.

STEP 5. DEVELOP THE ANALYTIC APPROACH. Define the parameter of interest, specify the type of inference, and develop the logic for drawing conclusions from findings.

Concentrations of COCs detected in groundwater will be compared to background concentrations and EPA maximum contaminant levels. Excavated soil will be evaluated according to the requirements of the Soil Management Plan in Appendix A.

If concentrations of COCs listed in Table 1−4 are below background levels for 5 consecutive years or are not detected, termination of monitoring for these COCs will be considered.

Results of the monitoring program will be evaluated as described in Sections 3.5, 3.6 and 4. Results of the evaluation will be presented in annual site water monitoring reports prepared by UC Davis and in 5-year review reports. Annual adjustments to the groundwater monitoring program will be proposed and documented in the annual water monitoring reports as described in Section 3.8.

STEP 6. SPECIFY PERFORMANCE OR ACCEPTANCE CRITERIA. Develop performance criteria for new data being collected, or acceptance criteria for existing data being considered for use.

All new data collected in conformance with this Work Plan shall be consistent with the QAPP (DOE 2010). All data used, including data from previous characterization, shall meet minimum quality requirements stated in the QAPP. Existing data are acceptable if they were collected, analyzed, and validated as described in the QAPP (DOE 2010). If modifications to the collection

or analysis procedures described in this Work Plan are necessary, those changes will be evaluated for their impact on resulting data usability.

All laboratory data are from monitoring well samples. There will be a variable amount of sensitivity of project goals (identified in DQO step 2) to data completeness. An acceptance level of 90 percent should be sufficient to support most decisions. Monitoring well data can be re-collected to gain higher certainty if 90 percent is insufficient.

STEP 7. DEVELOP THE PLAN FOR OBTAINING DATA. Select the resource-effective sampling and analysis plan that meets the performance criteria.

The groundwater sampling and analysis plan is described in Section 3.0 of this Work Plan. The soil sampling and analysis plan is described in the Soil Management Plan (Appendix A).

7.2 Roles and Responsibilities

The roles and responsibilities of key personnel are described in Section 2.1 of the QAPP, and the current personnel filling key positions are presented in Section 5.3 above. Project personnel may delegate the execution of, but not the responsibility for, their quality-affecting tasks to other qualified project personnel at any time. However, key personnel may also delegate a substantial subset of their functions to a qualified deputy, who will assume full responsibility for the delegated duties. In either case, delegated duties and responsibilities shall be clearly defined, documented in writing.

7.3 Personnel Training and Qualification

Prior to the start of the any activities covered by this Work Plan, personnel training and qualification will be conducted and evaluated in accordance with Section 5 of the QAPP and SQP 3.2, “Indoctrination and Training.”

7.4 Field Documentation and Records Management

All quality-affecting records generated during activities covered by this Work Plan will be managed in accordance with Sections 4 and 8.2 of the QAPP, SQP 4.1, “Document Control,” and SQP 4.2, “Records Management.” Quality-affecting documents include, but are not limited to, personal field logs, calibration records, monitoring data, inspection checklists, sampling documentation, and procurement records.

7.5 Test Control

Analytical and geotechnical testing will be performed and documented in accordance with Section 15 of the QAPP.

7.6 Design Control

Project design calculations and drawings will be developed, reviewed, documented, and filed in accordance with Section 10 of the QAPP.

7.7 Calibration and Maintenance of Measuring and Test Equipment

Measuring and test equipment will be calibrated and maintained in accordance with Section 14 of the QAPP and SQP 8.1, "Calibration and Maintenance of Measuring and Test Equipment." Measuring and test equipment shall be calibrated and maintained according to manufacturer specifications, or as specified by project documents, procedures, or guidelines. Calibration data shall be recorded each day calibrations are performed. Data for multiple instruments may be recorded on a single form or on forms specific to the instrument. Measuring and test equipment will not be used in the field if results of calibrations are not within the tolerances specified by the manufacturer or by project documents, procedures, or guidelines.

7.8 Field Sampling

Field sampling will conform to the requirements of Section 3.0 of this Work Plan, Section 8 of the QAPP, and all applicable SOPs (Appendix I).

7.9 Procurement

All material, equipment, and subcontractor services will be procured and received according to the requirements of Section 7 of the QAPP and SQP 7.2, "Receipt Inspection."

7.10 Data Quality Assessment

As discussed in Section 7.1, long-term groundwater monitoring is intended to determine if residual contaminants in soil are impacting groundwater quality. Data quality assessment associated with soil management is addressed separately in Appendix A.

Groundwater monitoring data will be assessed as specified in the QAPP, SOPs, and SQPs and the requirements listed in this section. As a first step, the groundwater monitoring data will be evaluated to:

- Define background conditions (as described in Section 3.2) at and near the site against which contaminant concentration trends can be evaluated.
- Determine if residual soil contaminants begin to impact groundwater, by:
  - a) Establishing baseline conditions for COCs in onsite groundwater (see Section 3.3),
  - b) Determining concentration trends for COCs that are established as above background in groundwater (see Section 4.1),
  - c) Comparing concentrations to background for COCs that are established as below background (see Section 4.2), and
  - d) Determining concentration trends for constituents (non-COCs) that were identified as having a low probability of impact on groundwater (see Section 4.3).
- Undertake remedial action to prevent the degradation of water quality.

Data quality assessment will begin with validation of the sample data in accordance with the data validation procedures presented in SOP 21.1 (Appendix I). Precision and accuracy will be assessed through validation of sample duplicates, calibrations, and spike samples. The parameter

that will be used to validate precision is the relative percent difference (RPD). The RPD is used to determine whether a significant difference exists among duplicate samples, including matrix spike duplicates, laboratory control sample duplicates, and/or field duplicate samples. Other approaches to assessing precision involve statistical calculations or graphical representations that may be conducted after the data are validated. Laboratory-specific acceptance limits for the RPDs of matrix spike duplicates and laboratory control sample duplicates are provided in Appendix F. Field duplicate acceptance criteria are provided in SOP 21.1 (Appendix I).

The main parameters used to assess accuracy are the matrix spike recovery and laboratory control sample spike recovery. Laboratory-specific acceptance limits for matrix spike recovery and laboratory control sample spike recovery provided in Appendix F shall be used.

Calibration is another important aspect of accuracy. Calibration will be assessed in accordance with SOP 21.1. Depending on the analysis method and analyte, linearity in the calibrated range, detector response, reference standards, and continuing calibration check standards shall be reviewed. Acceptance criteria for these parameters are discussed in SOP21.1.

Data representativeness will be achieved through the careful, informed selection, installation, and sampling of groundwater monitoring wells to represent background and onsite conditions. Samples will be collected from three background wells and eight onsite wells. Background wells will be screened in the same hydrostratigraphic unit as onsite wells to gain background data that are generally representative of onsite conditions in the absence of impacts from DOE activities. The selected locations of the existing and planned onsite wells are in proximity to each DOE area with residual soil contamination subject to monitoring. The rationale used to locate the monitoring wells is presented in Section 3.1. Representativeness also will be achieved through the proper collection and handling of samples that avoid interferences and to minimize contamination and loss (see SOPs 1.1, 2.1, and 9.1).

Comparability among measurements will be achieved through the use of the standard procedures and standard field data sheets presented in Appendix I. Also, uniform concentration units will be used for comparability.

As specified in DQO step six, the completeness goal is 90 percent. This goal is per analyte per project. If project data are rejected during data validation and the completeness goal is not met, additional samples may be collected, as necessary, to provide sufficient data. When the data are validated and complete, they will be made available to data users for comparisons, calculations, and graphical representations to support project decisions.

The groundwater background condition and baseline conditions for COCs in groundwater will be determined using individual maximum concentrations to represent population data. COCs that are determined during the baseline assessments to be below background and additional constituents identified as possibly having a low probability of impact on groundwater (Section 4.3) will be evaluated based on a comparison of a single annual sample result to the maximum year 1 background sample result. If any of these annual results are not accurate, a decision error could result. The data validation process is designed to identify and assign qualifications to data that may not be accurate. Qualified data are generally usable in statistical evaluations that include a sufficient number of samples, but project decisions may not be well supported when based upon a single qualified result. The reason for the data qualification and its

impact on the decision should be taken into consideration upon use of single estimated results. To minimize decision errors, the following approaches will be taken for decisions that rely on single sample results:

1. Establishing the background groundwater condition. A maximum concentration from four quarterly samples will be used to represent groundwater background (see Section 3.2 for details regarding data from individual background wells). If the maximum concentration is qualified, its impact on the decision will be evaluated. If the qualification indicates a high bias or that the maximum concentration is not qualified but appears to be an outlier, the data can be tested according to an outlier test procedure (EPA 2006). Additional sample collection and/or selection of the next-highest concentration may be appropriate depending on the data qualification or outlier test result. Justification for the data management decision will be provided to the regulatory agencies for concurrence.
2. Establishing baseline conditions for COCs in onsite groundwater. Onsite baseline conditions will also be established using maximum concentration data. The same procedure as that stated above for establishing background condition will be used. If the maximum concentration is qualified, or determined to be an outlier, additional samples may be collected and/or the next highest concentration may be selected to represent the sample population.
3. Comparing concentrations detected in groundwater beneath the site to background concentrations (for COCs with concentrations below the established background values). The results of annual groundwater samples will be compared to the maximum background concentration. If the annual result is qualified as estimated it could lead to an incorrect decision. The reason for the qualification will be considered and the sample will be re-collected if the qualification indicates a likely decision error. Sample recollection will not be necessary for cases such as a qualified annual result that is below background, but for which the qualifier indicates that the annual result may be overestimated (high bias).
4. Comparing concentrations of additional constituents identified as having a low probability of impact on groundwater to site background values. The results of annual samples of these constituents will be compared to the maximum background concentration. If the annual result is qualified, the reason for the qualification will be considered and the sample will be re-collected if the qualification indicates a likely decision error.

Trend analysis will be used for COCs that are established as exceeding the site groundwater background values. Simple statistical quantities such as percentiles, central tendency, variance, and correlation may be calculated to supplement the trend analysis. Time series plots may also be presented. The trend analysis will be conducted according the procedures in Chapter 6 of *Methods for Evaluating the Attainment of Cleanup Standards*, Volume 2: Ground Water (EPA 1992), or an equivalent method agreed on by EPA, CRWQCB, and DTSC, such as the Mann-Kendall trend test. Based on the EPA guidance documents, the null and alternative hypotheses are:

Ho: There is no trend
Ha: There is an upward trend

The selected alpha significance level for the slope confidence limit test (EPA 1992) is 1 percent and the suggested alpha confidence level for the Mann-Kendall trend test is 5 percent (EPA 2006).

The EPA guidance documents (EPA 1992 and EPA 2006) do not indicate that Type II decision error or width of the grey region are parameters in the trend tests. The planned concentration comparisons and temporal trend analyses do not rely on distribution fit.

All of the planned data evaluations (point-to-point and trend analysis) could be significantly affected by outlier data. Statistical tests are available to determine whether a suspect result qualifies as an outlier (EPA 2006). One possible source of outlier data is a highly contaminated sample from an unrelated site inadvertently switched in the laboratory sequence with a project sample and reported as an accurate result with no data qualifications. Outlier tests provide an approach for handling this situation.

During the monitoring phase, after constituents have been established as above or below background, any significant changes or trends in concentration shall be verified by collecting a round of samples from the three background wells and the relevant onsite wells. The round of samples will be collected before taking actions such as increasing the sample frequency or conducting an evaluation of remedial technologies.

Censored data are not expected to be a significant problem for the simple comparisons and trend analyses that are planned herein, as long as contract reporting limits are met. When results are censored, the reporting limits will be compared to the requirements specified in Tables 3–2 and 3–3. Censored data that do not meet the reporting limit requirements may still be usable for project decisions if comparison criteria are above the elevated detection limits. If data with elevated reporting limits cannot be used, the reason for the reporting limit failure should be determined. Sample matrix/chemistry can cause elevated reporting limits and can be impossible to control. For cases where reporting limits can be controlled, the data set will be evaluated for completeness and the affected samples will be re-analyzed or re-collected, if necessary, to meet the 90 percent completeness goal.

When the point-to-point data comparisons and trend tests are performed, limitations will be identified and their effects on the comparison or test result explained. The tolerable limit on the trend test decision error will be verified (see alpha significance levels specified above). If a decision error exceeds the tolerable level, the error source will be identified, if possible, and corrective actions determined, if any.

Suggestions for improved data collection and statistical evaluation will be provided, as appropriate, for this ongoing groundwater monitoring project. The Project Chemist will identify the source of any failure to meet DQO performance/acceptance criteria and initiate corrective action, if necessary, to prevent future occurrences.

7.11 Inspections, Audits, and Surveillances

Inspections, audits, and surveillances will be conducted according to Sections 13 and 18 of the QAPP. Periodic inspections and audits will be conducted by trained Quality Assurance personnel. These inspections and audits will include observation of field activities and/or review of project documentation. All observations, findings, and supporting documentation resulting from the inspections and audits will be summarized in the appropriate report format and submitted to the project file.

7.12 Nonconformance Control and Corrective Action

Nonconformances and corrective actions will be addressed according to Section 16 of the QAPP and SQP 10.1, “Nonconformance Control,” SQP 10.2, “Corrective Action,” and SQP 10.3, “Stop Work Order.”

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8.0 References

ALTA/ACMS (American Land Title Association and National Society of Professional Surveyors), 2005, *2005 Minimum Standard Detail Requirement for ALTA/ACMS Land Title Surveys.*

BBL (Blasland, Bouck, and Lee), 2006. *Final Site-Wide Ecological Risk Assessment*, Laboratory for Energy-Related Health Research/South Campus Disposal Sites, University of California, Davis, August.

CRWQCB (California Regional Water Quality Control Board), Central Valley Region, 1989. *Designated-Level Methodology for Waste Classification and Cleanup Level Determination*, Sacramento, California.

DOE (U.S. Department of Energy), Environmental Measurements Laboratory, 1997. *The Procedures Manual of the Environmental Measurements Laboratory (HASL)*, New York, New York, February.

DOE Order 435.1, Change 1, *Radioactive Waste Management*, July 9, 1999.

DOE Order 5400.5, Change 2, *Radioactive Protection of the Public and the Environment*, January 7, 1993.

DOE (U.S. Department of Energy), 2005. *Management and Long-Term Surveillance and Maintenance Plan for the U.S. Department of Energy Laboratory for Energy-Related Health Research Federal Facility*, Davis, California, September.

DOE (U.S. Department of Energy), 2009a. *Memorandum of Agreement between the United States Department of Energy and the Regents of the University of California Regarding the Investigation, Remediation, Long-Term Surveillance, Maintenance, and Contingent Remediation of the Laboratory for Energy-Related Health Research at the University of California, Davis*.

DOE (U.S. Department of Energy), 2009b. *Record of Decision for DOE Areas of the Laboratory for Energy-Related Health Research at the University of California, Davis*.

DOE (U.S. Department of Energy), 2010. *Quality Assurance Project Plan for the U.S. Department of Energy Laboratory for Energy-Related Health Research Federal Facility*, Davis, California.

EPA (U.S. Environmental Protection Agency), 1980. *Prescribed Procedures for Measurement of Radioactivity in Drinking Water*, EPA Method 901.1, Cincinnati, Ohio, August.

EPA (U.S. Environmental Protection Agency), 1992. *Methods for Evaluating the Attainment of Cleanup Standards, Volume 2: Ground Water*, EPA 230-R-92-014, Washington, DC, July.

EPA (U.S. Environmental Protection Agency), 1993. *Determination of Inorganic Anions by Ion Chromatography*, Rev. 2.1, Method 300.0, Cincinnati, Ohio, August.

EPA (U.S. Environmental Protection Agency), 2000. *Soil Screening Guidance for Radionuclides: User's Guide*, EPA/540-R-00-007, October.

EPA (U.S. Environmental Protection Agency), 2001. *Comprehensive Five-Year Review Guidance*, EPA/540/R-01/007, June.

EPA (U.S. Environmental Protection Agency), 2006. *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G-4, February.

EPA, 2006. *Data Quality Assessment: Statistical Methods for Practitioners*, EPA QA/G-9S, EPA/240/B-06/003, Washington, DC, February.

EPA (U.S. Environmental Protection Agency), 2007. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, 3rd ed., SW-846, February.

EPA (U.S. Environmental Protection Agency), 2010. *Regional Screening Levels (Formerly PRGs)*, http://www.epa.gov/region9/superfund/prg/, May.

62 FR 51844–51845. U.S. Department of Energy, "Certification of the Radiological Condition of Four Buildings at the Laboratory for Energy-Related Health Research, Davis, California," *Federal Register*, October 3, 1997.

UC Davis (University of California, Davis), 2004a. *Revised LEHR/SCDS Site-Wide Risk Assessment, Volume I: Human Health Risk Assessment*, University of California, Davis, March.

UC Davis (University of California, Davis), 2004b. *Final Remedial Investigation Report, LEHR/SCDS Environmental Restoration ,University of California, Davis*, December.

UC Davis (University of California, Davis), 2010. *Final 2009 Comprehensive Annual Water Monitoring Report for the Laboratory for Energy-Related Health Research Old Campus Landfill*, University of California, Davis, expected completion October, 2010.

Weiss (Weiss Associates), 1997. *Final Site Characterization Summary Report for the U.S. Department of Energy Areas at the Laboratory for Energy-Related Health Research*, University of California, Davis, November.

Weiss (Weiss Associates), 2003. *DOE Areas Remedial Investigation Report for the Laboratory for Energy-Related Health Research*, Rev. 0, University of California, Davis, September 18.

Weiss (Weiss Associates), 2005. *Site-Wide Risk Assessment, Volume I: Human Health Risk Assessment (Part B Risk Characterization for DOE Areas)*, Rev. 0, University of California, Davis, September 30.

Weiss (Weiss Associates), 2008, *Final DOE Areas Feasibility Study for the Laboratory for Energy-Related Health Research, University of California, Davis*, March 7.