U.S. Department of Energy

Oakland Operations Office, Oakland, California

DOG PENS REMOVAL ACTION WORK PLAN

for the

LABORATORY FOR ENERGY-RELATED HEALTH RESEARCH
UNIVERSITY OF CALIFORNIA, DAVIS

Prepared for:

United States Department of Energy
Oakland Operations Office
1301 Clay Street
Oakland, California 94612-5208

Prepared by:

Weiss Associates
5801 Christie Avenue, Suite 600
Emeryville, California 94608-1827

June 22, 2001
Rev. 0

DOE Oakland Operations Contract DE-AC03-96SF20686

Weiss Associates
Environmental Science, Engineering and Management

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Approved by: Dolores D. Loll Date: 6/22/01
Dolores D. Loll
Project Quality Assurance Manager
Weiss Associates

Approved by: Robert O. Devany Date: 6/22/01
Robert O. Devany, C.E.G., C.H.G.
Project Manager
Weiss Associates

Approved by: Michael D. Dresen Date: 6-22-01
Michael D. Dresen, C.E.G., C.H.G.
Program Manager
Weiss Associates

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ACRONYMS AND ABBREVIATIONS

AHA	Activity Hazard Analysis
ALARA	As Low As Reasonably Achievable
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
bgs	below ground surface
CA	Contamination Area
CFR	Code of Federal Regulations
Co-60	cobalt-60
COC	constituent of concern
CPGERP	Contingency Plan and General Emergency Response Procedures
cu yd(s)	cubic yard(s)
DAC	derived air concentration
dBA	decibels
DOE	United States Department of Energy
DQOs	data quality objectives
DZ	Decontamination Zone
EDPs	Eastern Dog Pens
EE/CA	Engineering Evaluation/Cost Analysis
EMS	Environmental Management Services
EPA	United States Environmental Protection Agency
ft	feet
GERT	General Employee Radiological Training
H&S	health and safety
HAZWOPER	Hazardous Waste Operations and Emergency Response
HDPE	high-density polyethylene
HSC	Health and Safety Coordinator

HSP	Health and Safety Procedure
HVAC	heating, ventilating and air conditioning
HW	hazardous waste
HWP	hazardous work permit
ID	identification
IT Corp	IT Corporation
lb	pound
LEHR	Laboratory for Energy-Related Health Research
LEL	lower explosive level
LLW	low-level waste
MW	mixed waste
NA	Not applicable
NH	non-hazardous
NRR	Noise Reduction Rating
OSHA	Occupational Safety and Health Administration
PCB	polychlorinated biphenyl
PEL	permissible exposure limit
PHSM	Project Health and Safety Manager
PHSP	Project Health and Safety Plan
PM	Project Manager
PPE	personal protective equipment
PQAM	Project Quality Assurance Manager
PQAS	Project Quality Assurance Specialist
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
QC	quality control
Ra-226	radium-226
RAOs	removal action objectives
RA	removal action
RBAS	risk-based action standard
RCT	Radiological Control Technician

RPM	Remedial Project Manager
RPP	Radiological Protection Plan
RSO	Radiation Safety Officer
SC	Site Coordinator
SHSO	Site Health and Safety Officer
SOP	Standard Operating Procedure
SQP	Standard Quality Procedure
Sr-90	strontium-90
SRA	Site Records Administrator
SVOC	semi-volatile organic compound
TRU	transuranic
TSM	tailgate safety meeting
TWA	time-weighted average
UC Davis	University of California, Davis
UCL	upper confidence limit
USCS	Unified Soil Classification System
VOC	volatile organic compound
WA	Weiss Associates
WAC	waste acceptance criteria
WBGT	Wet Bulb Globe Temperature
WC	Waste Coordinator
WDPs	Western Dog Pens
WRS	Wilcoxon Rank Sum
WS	Waste Specialist

1. INTRODUCTION

This Work Plan addresses the non-time-critical removal actions (RAs) that will be conducted at the Western and Eastern Dog Pens (WDPs and EDPs) at the Laboratory for Energy-Related Health Research (LEHR or the Site) facility located at the University of California, Davis (UC Davis) (Figure 3-1). The RAs are being implemented in accordance with the National Contingency Plan, 40 Code of Federal Regulations (CFR) Part 300.415. Weiss Associates (WA) prepared this Work Plan under United States Department of Energy (DOE) Environmental Restoration/Waste Management Contract No. DE-AC03-96SF20686.

This section of the Work Plan summarizes background information for each RA area, lists the constituents of concern (COCs), and presents the removal action objectives (RAOs). A project organization chart and contacts list are also provided.

Additional information regarding previous investigations conducted at the WDPs and EDPs may be found in the following documents:

- *Draft Final Engineering Evaluation/Cost Analysis for the Western and Eastern Dog Pens* (WA, 2000i);
- *Results of Western Dog Pens, Background and Off-Site Investigations* (WA, 1998b);
- *Results of Data Gaps Investigation* (WA, 1998a);
- *Draft Technical Memorandum: Statistical Comparison of Western Dog Pen Soil Data with Risk-Based Target Levels* (WA, 1999a);
- *Investigative Results for the Former Eastern Dog Pens* (WA, 1999c); and,
- *Addendum to Former Dog Pens Technical Memoranda* (WA, 2000a).

1.1 Site Background

The Atomic Energy Commission (now DOE) began conducting radiological studies on laboratory animals at LEHR in the early 1950s. Initial studies were carried out on the main UC Davis campus and involved the irradiation of beagles. The Site began operating in its present location in 1958 when full-scale experimental use of radioactive materials began. Research at LEHR through the mid-1980s focused on the health effects from chronic exposure to radionuclides, primarily strontium-90 (Sr-90) and radium-226 (Ra-226).

Beagles that had been exposed to radioactive substances were moved outside to the Dog Pens (Figure 3-2). From available architectural drawings and site documents, the following timeline for dog pen construction was developed. By June 1958, 64 outside pens (Rows A and B) were nearly completed, except for installation of dog houses and crushed-rock floors. These outside pens were scheduled to be completed and occupied by September 1958. By 1960, 96 outdoor pens (Rows A through C) were completed and put into operation. By February 3, 1961, 128 pens (Rows A through D) were complete. Based on site investigations, these original four rows, A through D, contain sub-grade cobble-filled trenches that are oriented east-west. Construction drawings indicate that these trenches contain a water line. Otherwise the design purpose of these trenches is not known. Between 1961 and 1964 an additional 64 pens were constructed (Rows E and F) for a total number of 192 pens. Between 1964 and 1968, the remaining 128 WDPs were constructed (Rows G through J). In rows E through J of the WDPs, field observations and construction drawings indicate that the cobble-filled trenches are not present. In 1975, 64 pens (Rows A and B) were removed during construction of the Cellular Biology Laboratory. The gravel and interior curbing were removed, but the perimeter curbing was left in place. According to aerial photographs, Rows K and L of the EDPs were constructed by May 1968. The final row of the EDPs (Row M) was completed by March 1970 (WA, 2000i).

From the 1940s through the mid-1960s, portions of the Site were used as the UC Davis campus landfill. UC Davis landfills were operated at the Site until 1967. Landfill Disposal Unit 2, which underlies the EDPs, was used from 1956 through 1967.

The aboveground structures associated with the Dog Pens were dismantled and removed in 1995 and 1996. The pedestals, tables, roof, interior fences, and barrels were disposed as low-level waste (LLW) at Hanford.

The site was placed on the United States Environmental Protection Agency's (EPA's) National Priorities List in May 1994. UC Davis is currently using the Site for research activities and is likely to continue these activities in the foreseeable future.

1.2 Constituents of Concern

During the research period, excreta containing residual levels of radionuclides may have impacted the Dog Pen areas. Several investigations have been conducted in the past ten years to characterize the Dog Pens. These investigations included analyses of soil samples from up to 3 feet (ft) below ground surface (bgs) in the EDPs and up to 40 ft bgs in the WDPs. Statistical evaluation of Dog Pens data indicates that COCs (i.e., radionuclides, metals and pesticides) in soil beneath the Dog Pens are below the risk-based target levels (WA, 2000i). However, the analytical data for the gravel, asphalt and concrete curbs that comprise the Dog Pens are not sufficient to eliminate them as potential risks.

1.3 Removal Action Objectives

As described in the Engineering Evaluation/Cost Analysis (EE/CA), the Dog Pens RAOs are:

- Mitigate potential excess cumulative cancer risk to an individual from exposure to site contaminants to a level within a nominal range of 10^{-4} to 10^{-6}, using 10^{-6} as the point of departure;
- Reduce potential non-cancer hazard indices to levels below 1;
- Mitigate potential future impact to ground water;
- Mitigate potential ecological risks during and after the RAs;
- Minimize impact to site university research; and,
- Facilitate UC Davis' remediation of the landfill underlying the EDPs.

To achieve these objectives, the EE/CA evaluated several remedial technologies and recommended implementation of institutional controls for the EDPs until UC Davis conducts its remediation of the underlying landfill, and removal and disposal of the concrete curbs, gravel and asphalt for the WDPs.

1.4 Cleanup Criteria

To determine successful attainment of the RAOs and completion of the WDPs RA, confirmation samples will be collected from the underlying soil and analyzed for Ra-226, Sr-90, chlordane, mercury and hexavalent chromium. Results of these analyses will be compared to the higher of the background values or risk-based action standards (RBAS) for soil (Table 4-3).

Cleanup criteria for the EDPs will be determined prior to the remediation of Landfill Unit 2 by UC Davis.

1.5 Removal Action Sequence

Implementation of institutional controls is the selected RA for the EDPs. Under this alternative, administrative and physical controls will restrict land use pending the remediation of the underlying landfill by UC Davis, which is expected to occur within the next five years. Enforcement of institutional controls will require vigilance from local regulatory bodies.

The sequence of activities for implementing institutional controls in the EDPs is summarized below.

1. Repair and maintain the perimeter fence to prevent public access to potentially impacted areas;

2. Affix permanent postings to prohibit unsupervised soil disturbance in the EDPs; and,
3. Develop and implement a site monitoring and inspection program to verify that the EDPs remain in a safe and stable condition.

Removal and disposal of concrete curbs, gravel and asphalt is the selected RA for the WDPs. The scope of this task includes removal and evaluation of potentially contaminated waste streams, confirmation sampling and analysis of the underlying soil, backfill and compaction, and site restoration.

The sequence of activities for conducting the WDPs RA is summarized below.

1. Conduct pre-job planning activities including facility coordination, subcontracting, underground utility location, air modeling for health and safety (H&S) purposes, worker training, and pre-construction meetings;
2. Mobilize equipment and personnel to the Site;
3. Conduct site setup activities including implementation of environmental protection measures and site preparation;
4. Prepare the construction area including installation of a temporary perimeter fence around the construction area, removal of the eastern perimeter sidewalk, clearing and grubbing, setup of the on-site laboratory, and preparation of a material/waste storage area in the former Cobalt-60 (Co-60) Field;
5. Remove asphalt from the WDP aisles and consolidate into stockpiles;
6. Prepare material/waste staging, processing and storage areas within the WDPs;
7. Remove metal grating and place in the appropriate waste container;
8. Remove concrete curbing and fence stubs, and consolidate into stockpiles pending evaluation;
9. Remove gravel and sift to remove soil particles;
10. Stockpile sifted gravel and soil pending characterization and designation;
11. Collect field screening samples to verify that the underlying soil has not been radiologically impacted during debris removal;
12. Deposit sifted soil particles onto the WDPs soil and grade the surface after the sifted and surface soils have been screened and approved for reuse by the on-site laboratory;
13. Collect soil samples from cobble trenches to verify that they have not been impacted by COCs;
14. Conduct a preliminary evaluation (Phase I) to determine whether RAOs have been attained;
15. Review Phase I data evaluation results with DOE and the regulatory agencies;

16. Collect soil and cobble confirmation samples from the WDPs for Ra-226, Sr-90, chlordane, mercury and hexavalent chromium;
17. Perform a radiological survey of 100% of the WDPs surface.
18. Perform a land survey of the excavation limits and confirmation sample locations;
19. Backfill and compact the excavation;
20. Restore site features;
21. Demobilize equipment and personnel from the Site;
22. Evaluate analytical results, perform the Phase II data evaluation and prepare the RA Confirmation Report;
23. Evaluate disposition options for RA-generated material/wastes including gravel, concrete curbs, asphalt and fencing (not covered under this Work Plan).

1.6 Project Organization

Roles and responsibilities for the project organization are described in the Quality Assurance Project Plan (QAPP) (WA, 2000b). The RA team consists of WA, IT Corporation (IT Corp), Environmental Management Services (EMS), and other subcontractors. WA is responsible for the overall construction management, quality assurance, radiological protection, and H&S aspects of the project. IT Corp is responsible for performing RA field activities safely and to appropriate quality standards. EMS provides waste management expertise and senior technical input.

1.7 Project Contacts

The following individuals are contacts for this project. The names of project deputies are shown in parentheses.

Weiss Associates (510) 450-6000

Executive Sponsor – Richard Weiss, R.G., C.E.G.

Program Manager – Michael Dresen, R.G., C.E.G., C.H.G.

Project Manager – Robert Devany, R.G., C.E.G., C.H.G. (Dolores Loll)

Site Coordinator – Erik Nielsen, R.G.

Project Health and Safety/Radiological Control Manager – Jerry McHugh, P.E., C.I.H. (Agata Sulczynski – Health & Safety, Dawn Mitchell [EMS] – Radiological Control)

Project Quality Assurance Manager – Dolores Loll

IT Corporation (925) 288-9898

Program Manager – Gerhard Locke, P.E., Ph.D.

Task Manager – Kevin O'Leary

Radiation Safety Officer – Dave Ochs, OHST

Environmental Management Services (925) 939-0687

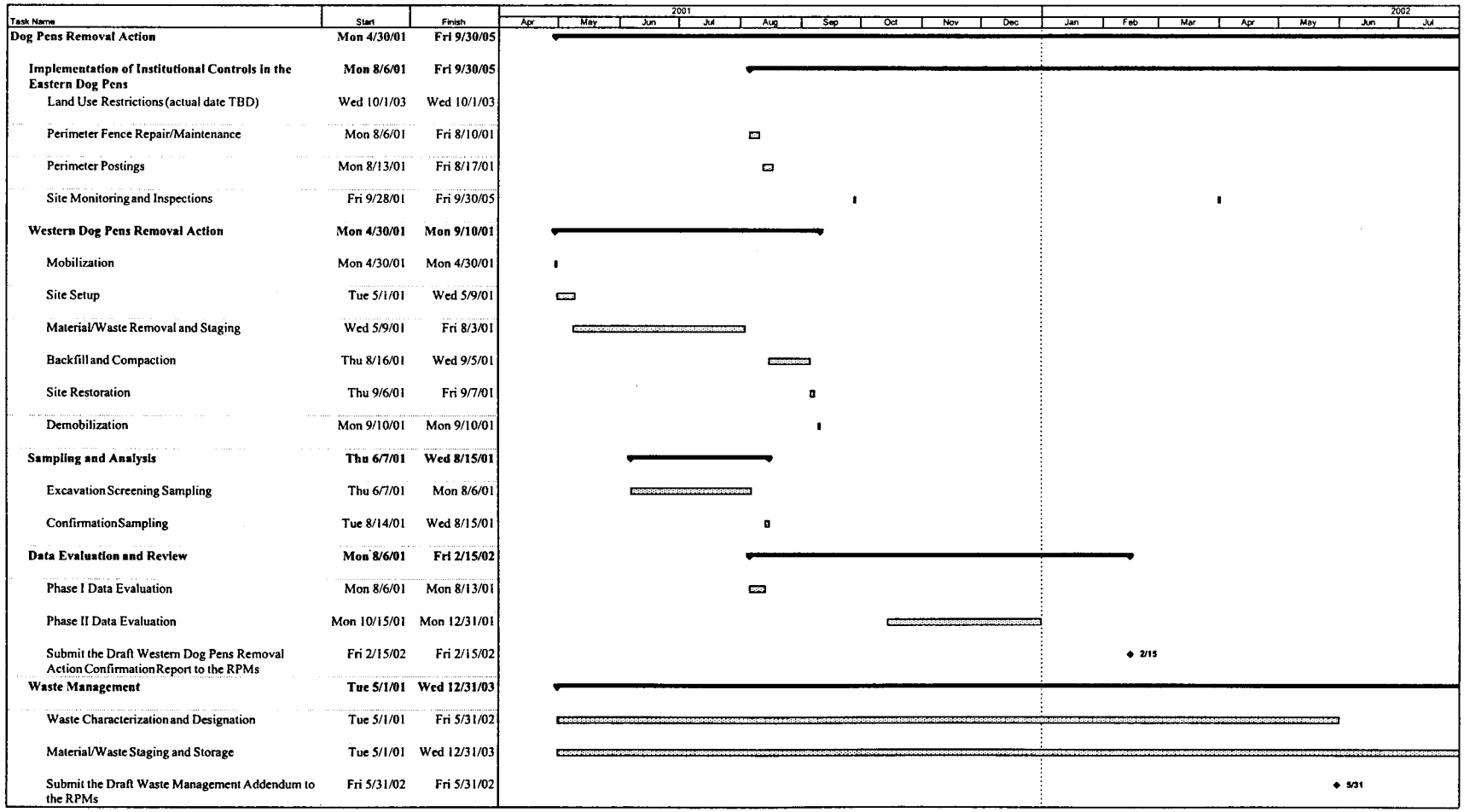
Senior Technical Advisor – Salem Attiga, Ph.D.

Waste Specialist – Dawn Mitchell

1.8 Project Schedule

The Dog Pens RA schedule is provided in Figure 1-1.

Figure 1-1. Dog Pens Removal Action Schedule



Task Name	Start	Finish
Dog Pens Removal Action	**Mon 4/30/01**	**Fri 9/30/05**
Implementation of Institutional Controls in the Eastern Dog Pens	**Mon 8/6/01**	**Fri 9/30/05**
Land Use Restrictions (actual date TBD)	Wed 10/1/03	Wed 10/1/03
Perimeter Fence Repair/Maintenance	Mon 8/6/01	Fri 8/10/01
Perimeter Postings	Mon 8/13/01	Fri 8/17/01
Site Monitoring and Inspections	Fri 9/28/01	Fri 9/30/05
Western Dog Pens Removal Action	**Mon 4/30/01**	**Mon 9/10/01**
Mobilization	Mon 4/30/01	Mon 4/30/01
Site Setup	Tue 5/1/01	Wed 5/9/01
Material/Waste Removal and Staging	Wed 5/9/01	Fri 8/3/01
Backfill and Compaction	Thu 8/16/01	Wed 9/5/01
Site Restoration	Thu 9/6/01	Fri 9/7/01
Demobilization	Mon 9/10/01	Mon 9/10/01
Sampling and Analysis	**Thu 6/7/01**	**Wed 8/15/01**
Excavation Screening Sampling	Thu 6/7/01	Mon 8/6/01
Confirmation Sampling	Tue 8/14/01	Wed 8/15/01
Data Evaluation and Review	**Mon 8/6/01**	**Fri 2/15/02**
Phase I Data Evaluation	Mon 8/6/01	Mon 8/13/01
Phase II Data Evaluation	Mon 10/15/01	Mon 12/31/01
Submit the Draft Western Dog Pens Removal Action Confirmation Report to the RPMs	Fri 2/15/02	Fri 2/15/02
Waste Management	**Tue 5/1/01**	**Wed 12/31/03**
Waste Characterization and Designation	Tue 5/1/01	Fri 5/31/02
Material/Waste Staging and Storage	Tue 5/1/01	Wed 12/31/03
Submit the Draft Waste Management Addendum to the RPMs	Fri 5/31/02	Fri 5/31/02

2. IMPLEMENTATION OF INSTITUTIONAL CONTROLS IN THE EASTERN DOG PENS

Available data for the EDPs indicate that all contaminants in the upper three ft are below RBAS or background levels and do not pose a threat to the public or the environment. However, data are not available to sufficiently assess whether residual contamination contained in the gravel, concrete and asphalt in the EDPs achieve the RAOs (Section 1.3).

Access to the EDPs will be controlled pending the remediation of the underlying UC Davis landfill. It is assumed that UC Davis will complete the landfill remediation prior to the end of 2006. In the interim, the following controls will be implemented:

- Repair and maintain the perimeter fence to prevent public access to potentially impacted areas;
- Affix permanent postings to the perimeter fence to prevent unsupervised gravel, asphalt or concrete disturbance; and,
- Conduct semi-annual monitoring and inspections to verify that the EDPs remain in a safe and stable condition.

Semi-annual inspections will be conducted to verify that the above controls remain in place until the UC Davis landfill is remediated and a final solution meeting regulatory requirements is implemented. According to the Memorandum of Agreement, UC Davis will also continue ground water monitoring in this area.

The Site-Wide Risk Assessment is planned in 2004 in conjunction with the Remedial Investigation/Feasibility Study to evaluate risks associated with exposure to residual contamination. Land use restrictions would be determined at this time, if necessary.

2.1 Perimeter Fence Repair/Maintenance

The EDPs perimeter fence will be repaired and maintained to prevent the public from entering potentially impacted areas. All three of the gates and approximately 100 ft of fencing on the western perimeter have been damaged during recent waste transfer activities and will require restoration. The condition of the restored fence will be evaluated and documented during the semi-annual site inspections. Maintenance will be performed as required. The Activity Hazard Analysis (AHA) for the EDPs fence repair is provided in Appendix C1.

2.2 Perimeter Postings

Permanent postings will be affixed to the EDPs perimeter fence to prevent unsupervised soil disturbance. In addition to the radiological postings required by Standard Operating Procedure (SOP) 24.1, Radiological Areas and Postings, postings will prohibit unauthorized entry. These signs will read, "Superfund Site, Do Not Enter, Authorized Personnel Only, Contact the UC Davis Police at (530) 752-1230 to report suspicious activity." Signs will be posted at a height of 4 ft, and be placed around the entire perimeter of the EDPs, specifically at all access points, and at intervals not exceeding 60 ft. Postings will be subject to modification if site conditions change.

2.3 Site Monitoring and Inspections

Site monitoring and inspections will be conducted on a semi-annual basis to verify that the EDPs remain in a safe and stable condition. Site monitoring and inspections will be conducted by DOE until these activities are transferred to UC Davis or are no longer deemed necessary due to the remediation of the EDPs. Site monitoring will consist of radiologically surveying the perimeter of the EDPs to verify that there have been no releases outside of the controlled area. Site inspections will evaluate the condition of the perimeter fence, the postings, and any noticeable changes to the EDPs ground surface since the prior inspection.

3. WESTERN DOG PENS REMOVAL ACTION

The following sections describe the WDPs RA and supporting activities, including pre-job planning, mobilization, site setup, material/waste removal and staging, backfill and compaction, site restoration, and demobilization. Construction drawings are provided in Figures 3-1 through 3-7.

3.1 Pre-Job Planning

Several tasks need to be completed prior to the start of the RA to facilitate efficient field operations and to optimize field activities. These tasks include:

- Coordinating with UC Davis facility personnel;
- Conducting a geophysical survey of the work area;
- Performing air modeling;
- Providing worker training; and,
- Conducting pre-construction meetings with project staff.

3.1.1 Facility Coordination

Meetings will be held with UC Davis prior to starting the RA to discuss planned field activities and measures for mitigating impacts to UC Davis operations. Discussion topics will include, but are not limited to, schedule, work scope, construction area boundaries, site access, haul routes, utility modifications/re-routes (if any) and UC Davis facility support.

Facility coordination during the WDPs RA will primarily focus on the field work that will be performed adjacent to the Cellular Biology Laboratory, a building that is currently used by UC Davis researchers. Removal activities will be conducted in a manner that will minimize disturbance (i.e., noise and vibration) to research activities and damage to existing site features in this area. Building access will be provided to occupants according to UC Davis Fire Department policy.

Assistance from the UC Davis Grounds Division is not anticipated, but will be coordinated, if required, through the UC Davis Facility Engineer. The UC Davis Facility Engineer, or designee, will be on site through the duration of the RA and will be consulted on any decisions that affect UC Davis.

3.1.2 Geophysical Survey

A geophysical survey will be conducted around the perimeter of the Cellular Biology Laboratory and the WDPs construction area to locate utility crossings. The survey will be scheduled after existing site drawings have been reviewed and Underground Services Alert has been contacted to locate underground utilities in the field. Underground utilities located within the construction area will be marked on the ground surface with spray paint.

The geophysical survey will verify utility locations and locate any other underground structures that have not been previously identified. As directed by WA, an independent geophysical survey contractor may use any of the following techniques to conduct the survey: electromagnetic line locating, electromagnetic terrain conductivity, ground penetrating radar and visual observations of surface structures.

When the survey is complete, the contractor will issue a report and map showing the locations of underground utilities and/or structures that were identified during the geophysical survey. The Site Coordinator (SC) will review the map and other applicable supporting information with RA field staff prior to commencing invasive field activities. Copies of the report and map will be kept in the project and the field files.

3.1.3 Air Modeling

Air modeling will be conducted prior to the start of the WDPs RA. The objective of this task is to assess whether emissions generated during RA activities would have an effective dose rate below the 10 millirem per year standard, and comply with requirements of 40 CFR Part 61 Subpart H – National Emissions Standards for Hazardous Air Pollutants for Emissions of Radionuclides from DOE Facilities. The emissions rates for concrete curb removal, pulverizing and waste container loading will be calculated using the American Society for Testing and Materials (ASTM) Risk-Based Corrective Action Box Model. The maximum Ra-226 and Sr-90 concentrations of concrete curb samples will be used with the calculated emissions rates to determine the CAP88-PC Dose Assessment Model inputs.

3.1.4 Training

All workers performing RA and support activities at the Site shall have completed the following training prior to beginning work:

- Forty hours of hazardous waste (HW) operations-related training, as required by the Occupational Safety and Health Administration (OSHA), 29 CFR 1910.120;
- Eight-hour refresher course within the past 12 months if the 40-hour training was completed more than 12 months prior to the start of field activities;

- Training covering the Contingency Plan and General Emergency Response Procedures (CPGERP) (WA, 2000e);
- A minimum of three days of actual field experience under the direct supervision of a trained, experienced supervisor. The SC shall have also completed an additional eight hours of relevant supervisory H&S training;
- Hazard communications training in accordance with Section 15 of the Project Health and Safety Plan (PHSP);
- Site hazard briefing to include instructions on emergency response procedures, location of emergency equipment, and location of emergency notification list;
- Integrated Safety Management System training;
- RA Work Plan training;
- Training in accordance with the requirements specified in Standard Quality Procedure (SQP) 3.2, Indoctrination and Training (WA, 2000c), for the specific job assignments; and,
- Training on the LEHR QAPP (WA, 2000b).

Additionally, unescorted workers entering radiological control areas shall have completed:

- Radiological Worker training in accordance with the Radiological Protection Plan (RPP);
- Site-specific Radiological Worker training in accordance with the RPP; and,
- General Employee Radiological Training (GERT) will be provided for escorted workers that are not Radiological Worker trained and routinely enter controlled areas, or are likely to encounter radiological barriers and postings during the course of their work.

Employees working with hazardous and radioactive waste shall have completed training for the following:

- Initial assignment as defined in Section 14 of the PHSP;
- Preparation of H&S planning documents as defined in Section 14 of the PHSP;
- Waste minimization;
- Personal protective equipment (PPE);
- Respirator fit test (if respirator usage is required);
- Medical surveillance; and,
- Preparation of hazardous materials for shipment.

All visitors entering site areas that require Level A, B, or C PPE will be required to provide evidence of completing the 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) course. Visitors entering the controlled areas will be escorted and required to complete GERT training.

Two or more people certified in First Aid, Cardiopulmonary Resuscitation and Bloodborne Pathogen Exposure Control will be on site at all times during the RA.

3.1.5 Pre-Construction Meetings

Pre-construction meetings will be held with project management personnel prior to the start of, and during the RA to discuss work scope, review preparatory tasks and address logistical concerns. The SC will document and track any actions that are assigned during these meetings, and provide a summary of the action items to meeting attendees. This summary will, at a minimum, include: the action description, the assignee, the assigned date, the projected completion date, and the actual completion date.

3.2 Mobilization

The personnel and equipment that are required to mobilize for the WDPs RA are listed below.

3.2.1 Personnel

The following personnel will mobilize to the Site for the duration of the WDPs RA:

- SC,
- Waste Coordinator (WC),
- Sample Manager,
- Sampling Technicians,
- Superintendent,
- Radiological Control Technicians (RCTs),
- Heavy Equipment Operators, and
- Laborers.

The following personnel are already assigned to the Site on a permanent basis:

- Radiation Safety Officer (RSO),
- Waste Specialist (WS),
- Site Health and Safety Officer (SHSO), and
- Health and Safety Coordinator (HSC).

The aforementioned personnel will be responsible for performing the work and ensuring that work is being conducted according to the Work Plan and other applicable project and program documents. During the performance of the RA, the following personnel may be mobilized to the Site on a part-time or as-needed basis:

- Project Manager (PM),
- Project Quality Assurance Manager (PQAM),
- Project Quality Assurance Specialist (PQAS),
- Task Manager,
- Senior Technical Advisor, and
- Limited Service Subcontractors.

Following mobilization and prior to commencing field activities, all personnel entering the construction area will attend daily tailgate safety meetings (TSMs), as required by Section 3.3.3 of the PHSP (WA, 2000k). During these meetings, which are held prior to the start of the work shift, the SHSO or designated representative will review health and safety information that is relevant to the work scope. This information will be summarized on the TSM form, which will be signed by meeting attendees to document their understanding of the potential hazards and related controls. Personnel that are not able to attend the TSM, but plan on entering the construction area, must check in with the SHSO, review the information on the TSM form, and sign the TSM form to document their understanding of the information.

3.2.2 Equipment

Equipment will be mobilized to the Site on an as-needed basis during the WDPs RA. The equipment that will be mobilized includes, but is not limited to, the following:

- Large (i.e., 13-ton) forklift for transporting soft-sided containers;
- Lifting frame for lifting soft-sided containers;
- All-terrain forklift for transporting pallets and B-25 boxes;
- Track-mounted hydraulic excavator with a concrete pulverizer attachment for breaking concrete;
- Track-mounted hydraulic excavator(s) with thumb attachment for removing concrete;
- Compact excavator(s) with thumb attachment for removing concrete;
- Backhoe(s) for gravel removal;
- Bulldozer for consolidating material/waste;
- Front-end loaders for transporting and stockpiling material/waste;
- Mechanical sifter for separating fine particles from gravel;
- Tractor for weed abatement;
- Dumptruck(s) for transporting material/waste;
- Pickup trucks, including one with a fuel cell, for on-site transportation and fueling;
- Compaction equipment for compacting backfill material;
- Concrete-cutting saw for cutting the sidewalk outside of the WDPs;

- Chainsaw for tree removal;
- Hoses and sprayers for dust suppression;
- Construction hand tools for miscellaneous activities; and,
- Air and radiological monitoring equipment for environmental and H&S monitoring.

3.3 Site Setup

Site setup for the WDPs RA will consist of implementing environmental protection measures and preparing the construction area for RA activities.

3.3.1 Environmental Protection Measures

Prior to the start of the RA, several environmental protection measures will be implemented to prevent impacts to the surrounding environment. These protection measures include: protecting sensitive habitats, controlling stormwater runoff, installing barriers around existing monitoring wells and preventing airborne contaminants from impacting UC Davis heating, ventilating and air conditioning (HVAC) systems.

3.3.1.1 Sensitive Habitat Protection

Three elderberry shrubs, which are a potential habitat for the protected Valley Elderberry Longhorn Beetle, are located within the WDPs (Figure 3-4). Metal stakes and orange construction netting will be used to construct a 20-ft radius fence around each of the elderberry shrubs to minimize disturbance to the shrubs during RA activities. Heavy equipment will not be used unless required within the fenced area. To the extent feasible, manually-operated hand or power tools will be used within the fenced area in the event that material/waste needs to be removed.

3.3.1.2 Storm Water/Runoff Protection

All construction activities will be performed in a manner that will mitigate the spread of contamination to surface and ground waters. Since the RA is planned during the dry season, the threat of storm runoff is minimal. Per the California and U.S. EPA Storm Water Regulations, the dry season is defined as May to September. Storm drain covers, tarps and sand bags will be available and kept on site for use in the unlikely event of significant precipitation.

If a severe storm warning is issued, precautions will be taken to protect workers, the public, the work area and any nearby property from damage. Precautions shall include, but are not limited to, covering the exposed removal area, and removing loose materials, tools and equipment from exposed locations.

3.3.1.3 Monitoring Well Protection

Monitoring wells located within the construction zone, not located within traffic rated vaults, will be protected to prevent damage during the RA (Figure 3-4). Posts and orange construction netting will be used to construct a three-ft radius fence around each of the monitoring wells. No heavy equipment will be used within the fenced area; hand tools will be used within the fenced area in the event that material needs to be removed.

3.3.1.4 Cellular Biology Laboratory HVAC Modification

Past and present RA air modeling indicates that there are no concerns with potentially airborne contaminants. The anticipated levels of dust and contaminant concentrations are significantly lower for the WDPs than other RA areas, and dust suppression will be practiced continually during RA. For these reasons, there are currently no plans to modify the Cellular Biology Laboratory HVAC system. However, in the event that additional air modeling or RA air monitoring indicates potential impacts to indoor air quality by airborne contaminants, work will be stopped and the UC Davis Grounds Division will be contracted to perform the necessary modification.

3.3.2 Site Preparation

The RA area will be prepared for RA activities prior to removing material/waste from the WDPs. Site preparation will include the following tasks:

- Transferring waste containers;
- Installing a temporary perimeter fence around the construction area;
- Removing the eastern perimeter sidewalk;
- Clearing and grubbing;
- Protecting or relocating existing utilities, if necessary;
- Establishing the on-site laboratory; and,
- Preparing the material/waste storage area in the former Co-60 Field.

3.3.2.1 Waste Container Transfer

Soft-sided containers containing waste generated during the Ra/Sr Area II RA are currently stored in Aisles 6, 7 and 8 of the WDPs (Figure 3-3). To facilitate waste removal, these containers will be transferred to Aisles 1 and 3 of the EDPs prior to the start of the RA. A large forklift and lifting frame will be used to transfer the containers, each of which weighs in excess of 10 tons.

3.3.2.2 Temporary Perimeter Fence Installation

Approximately 1,500 linear ft of temporary fencing will be installed to control access to the construction area. The construction area (Figure 3-3) will surround the WDPs and extend 60 ft east along the southern portion to the EDPs fenceline, while the northern portion will extend 30 ft east of the WDPs to maintain access to Geriatrics-I. The temporary fence will be installed prior to the removal of the WDPs fence to maintain control of the RA area at all times.

To maintain access to the Cellular Biology Laboratory, a temporary barrier will be installed in the immediate work area during curb removal. To comply with UC Davis Fire Department policy, all points of building access will remain open at all times. However, access may be temporarily re-directed with the approval of the UC Davis Fire Department (Telephone Number: 530-752-1236).

The RA area will be controlled and posted according to Chapter 7 of the PHSP (WA, 2000k) and SOP 24.1, Radiological Areas and Postings (WA, 1999e).

3.3.2.3 Eastern Sidewalk Removal

The sidewalk located outside of the eastern boundary of the WDPs will be removed and disposed prior to removing the existing fence. A concrete-cutting saw may be used if the sidewalk cannot be easily removed from adjacent site features during demolition. The sidewalk will be lifted with a front-end loader and direct-loaded into a dumptruck for off-site disposal.

3.3.2.4 Clearing and Grubbing

Clearing and grubbing will be required in the WDPs area. As discussed in Section 3.3.1.1, the elderberry bushes are a sensitive habitat and will be protected through the duration of the RA. As significant weed overgrowth is expected, weed abatement will be performed prior to the start of the RA.

The pine tree located in the pens south of Aisle 8 (Figure 3-4) will be removed to facilitate material/waste removal and to provide space for concrete staging during processing operations. The tree will be toppled with an excavator and cut with a chainsaw prior to being loaded into the appropriate waste container.

3.3.2.5 Utility Protection/Relocation

No active utilities are expected to be encountered during the WDPs RA. However, if active utilities are identified during the geophysical survey, then measures will be taken to protect or relocate the lines according to UC Davis specifications.

3.3.2.6 On-Site Laboratory Setup

As discussed in Section 4, the on-site laboratory will be used to screen material/waste streams for potential radiological impacts. The on-site laboratory will also be used for screening sampling prior to backfill. The gamma spectrometer will be used for Ra-226 analyses and the BetaScint detector will be used for Sr-90 analyses.

On-site laboratory setup will consist of cleaning all surfaces, covering all surfaces with plastic sheeting, and configuring and calibrating the gamma spectrometer and the BetaScint detector. Instrumentation will be calibrated and configured according to manufacturer standards. Liquid nitrogen will also be procured to maintain the gamma spectrometer cryostat at the required temperature. Once the on-site laboratory is set up and ready to receive samples, it will be posted as a Contamination Area (CA).

3.3.2.7 Cobalt-60 Field Material/Waste Storage Area

A material/waste storage area will be prepared in the former Co-60 Field to accommodate the asphalt and fencing that will be removed during the RA (Figure 3-3). The areas will be graded as necessary to provide smooth, clean surfaces for stockpiles and pallets. High-density polyethylene (HDPE) sheeting with a 20-mil thickness will be used to enclose all stockpiles with potential radiological or chemical impacts. Stockpiles will be constructed according to Figure 3-6.

3.4 Material/Waste Removal and Staging

All material/waste will be removed following asphalt removal and preparation of the staging, storage and processing areas within the WDPs. The perimeter fence, asphalt, metal grates, concrete, and gravel will be handled as LLW unless process knowledge, field screening or radiological surveys indicate otherwise. The cobble-lined trenches below the surface of the native soil (Figure 3-5) are assumed to be non-impacted based on previous sampling during the 1997 WDPs investigation, but will be characterized further to verify this assumption.

3.4.1 Perimeter Fence

The existing WDPs perimeter fence (Figure 3-4) will be removed once the temporary fence has been installed and site control has been established. Low levels of fixed radioactive contamination may be encountered during removal, so all fencing, fence posts and gates will be handled as potential LLW pending the appropriate radiological surveys.

Chainlink fencing will be removed in 10-ft sections using hand tools, radiologically surveyed and rolled. Based on process knowledge, radiological contamination, if any, is expected to be found on the bottom two ft of the fence. Fence posts and stubs will be pulled out with the excavator and transferred to the concrete processing area if concrete is attached to the base of the posts. Once the concrete is removed, the bottom two ft of the posts will be radiologically surveyed prior to removal from the CA.

If contamination is detected during radiological surveys, the affected area will be cut out with the appropriate hand tools and deposited into a waste container. All other material will be transported to the former Co-60 Field, where it will be stacked on pallets and stored pending disposition.

3.4.2 Asphalt

Each of the eight WDP aisles (Figure 3-4) is paved with two to three inches of asphalt. The asphalt layer will be removed with the bucket of a front-end loader and deposited into a dumptruck that will haul it to the former Co-60 Field for stockpiling (Figure 3-3). The equipment operator will be instructed to minimize removal of underlying soil during the asphalt removal process.

Aisle 3 was once used to store stockpiles containing chlordane-impacted soil from the Southwest Trenches. The soil stockpiles were generated during the Southwest Trenches RA in the summer of 1998, and were loaded for off-site HW disposal in the summer of 1999. During this loading process, residual soil was left on the surface of Aisle 3. Therefore, this aisle will be handled, stored and sampled separately from the other asphalt to determine whether it was impacted by the HW stockpiles. Asphalt, residual soil and underlying soil removed from Aisle 3 will be loaded into soft-sided containers pending characterization.

All asphalt will be treated as potential LLW until waste characterization sampling and analysis indicate otherwise. Between loading and stockpiling, the dumptrucks containing the asphalt will be required to travel across a clean area that is outside of the posted CAs. To prevent the haul route from potentially becoming contaminated during asphalt transport, radiological surveys will be performed on all dumptrucks leaving the CAs in the WDPs and the former Co-60 Field.

3.4.3 Western Dog Pens Material/Waste Staging, Processing and Storage Areas

Following asphalt removal, material/waste will be cleared from the WDPs locations that are designated for waste staging, processing and storage. To minimize the potential for mixing and cross-contamination, the excavated materials/wastes will be segregated and temporarily stored in their respective staging areas (Figure 3-3).

Storage cells will be constructed following localized material/waste removal, screening sampling, confirmation sampling, radiological surveying and land surveying in the pen areas between Aisles 5 and 6, and between Aisles 6 and 7 (Figure 3-3). Once the areas have been sampled and surveyed, they will be backfilled to grade with 18 to 24 inches of compacted fill, covered with a sheet of 20-mil HDPE, layered with two inches of compacted fill, covered with a sheet of construction indicator fabric, and layered with two more inches of compacted fill. Screening and confirmation sampling will be conducted according to Section 4. Backfill and compaction activities will be performed according to Section 3.5. Concrete and soil stockpiles will be enclosed in 20-mil HDPE and will be sloped and bermed to prevent storm water accumulation (Figure 3-6).

Gravel and concrete processing areas will be established on the western and eastern sides of Aisle 8, respectively (Figure 3-3). Three pens will be cleared on the north side of Aisle 8 in the southwestern corner of the WDPs to provide space for the mechanical sifter that will be used for sifting gravel from soil particles. Gravel will be staged in the 10 westernmost pens that lie immediately south of Aisle 8. Concrete curbing will be removed from the six pens on the south side of Aisle 8 in the southeastern corner of the WDPs to clear a staging area for concrete processing,

which will be conducted adjacent to the staging area between the WDPs and EDPs (Figure 3-3). The underlying gravel will be removed and processed when concrete processing is complete.

Following localized material/waste removal, screening sampling, confirmation sampling, radiological surveying and land surveying in the gravel staging and processing areas, the depressions will be backfilled to grade and compacted. Screening and confirmation sampling will be conducted according to Section 4. Backfill and compaction activities will be performed according to Section 3.5. Prior to starting processing operations, the gravel sifting and concrete processing areas will be covered with steel plates and 20-mil HDPE.

3.4.4 Metal Grates

Deteriorating metal grates may be present at the native soil/gravel interface or within the gravel in each of the pens. These grates are lightweight and detached from any other structures, so it is anticipated that they can be removed with relative ease. Due to the porous nature of the deteriorating metal, it is unlikely that the grates can be adequately surveyed for radiological release. When metal grating is uncovered, it will be segregated from other debris, handled as potential LLW and deposited into the appropriate container.

3.4.5 Concrete

There are approximately 18,075 linear ft of unreinforced, 18-inch deep concrete curbs within and around the perimeter of the WDPs. Except for the curbing in the immediate vicinity of the Cellular Biology Laboratory and the protected elderberry shrubs, most of the curbing will be lifted out of the gravel using a track-mounted excavator with a thumb attachment. The curbing near the Cellular Biology Laboratory will be removed using a compact excavator with a thumb attachment, and the curbing within a 20-ft radius of the elderberry shrubs will be removed using manually-operated hand or power tools, where feasible. The sidewalk adjacent to the Cellular Biology Laboratory will be repaired if any damage is incurred during the perimeter curb removal.

Once the concrete curbing has been lifted out of the gravel, it will be deposited into the bucket of a front-end loader and transported to the concrete staging area located adjacent to the concrete processing area in the southeast corner of the construction area (Figure 3-3). From there, the concrete will be picked up using a track-mounted excavator with a concrete pulverizer attachment. The concrete pulverizer will break the concrete into pieces not exceeding four inches in diameter and consolidate the metal from the fence post stubs. Once rubblization is complete, a front-end loader will pick up the rubblized debris and transport it to the storage cell between Aisles 5 and 6 for stockpiling (Figure 3-3). Concrete will be handled and stored as potential LLW until waste characterization sampling and analysis indicate otherwise.

3.4.6 Gravel

Gravel will be removed after the concrete curbing and grates are removed from all of the pens. Based on the results of the *in-situ* characterization conducted prior to the RA, gravel from individual pens will be classified according to its degree of radiological impact. Gravel will be removed, sifted and stockpiled according to these classifications.

To minimize the need for decontamination and the potential for cross-contamination, gravel removal will begin in areas identified to have the lowest radiological impacts before proceeding to areas with progressively higher impacts. Gravel will be removed with a backhoe and loaded into a dumptruck, which will haul the gravel to the staging area in the southwest corner of the WDPs. Prior to loading, a bulldozer may be used to consolidate gravel if the size of the removal area warrants. Efforts will be made to minimize the removal of underlying soil during the gravel removal process.

A front-end loader will load gravel into the mechanical sifter that will separate the gravel from soil particles. When sifting is complete, the gravel will be transferred to the gravel storage area between Aisles 6 and 7 (Figure 3-3). The gravel will be placed in the stockpile that correlates to its degree of radiological impacts.

The remaining soil will be temporarily stockpiled and sampled for on-site Ra-226 and Sr-90 analyses to ensure that the soil was not cross-contaminated during debris removal. The soil will be deposited on the cleared surfaces of the WDPs if on-site analyses confirm that there are no radiological impacts. In the unlikely event that radiological impacts are discovered during on-site analyses, the soil will be stockpiled in the storage area between Aisles 5 and 6 pending further characterization (Figure 3-3).

3.4.7 Cobble Trenches/Water Pipes

The cobble-lined drainage trenches that run across the Dog Pens (Figure 3-5) were sampled during the WDPs investigation and were found to be free of radiological and chemical impacts. However, since only a limited number of samples were collected during this investigation, additional sampling will be conducted to adequately characterize the cobbles. The cobble sampling is discussed in detail in Section 4.

Abandoned water lines have been identified on site drawings, but not found in the field. Based on process knowledge, these lines were used to carry clean water to the pens and are not expected to have any radiological or chemical impacts to either the interior or exterior surfaces of the pipes. It is anticipated that these lines are within two to three ft of the existing ground surface and may be uncovered during cobble sampling or removal activities. In the event that these lines are encountered, they will be removed and radiologically surveyed for release from the CA.

3.5 Backfill and Compaction

Following completion of material/waste removal, confirmation sampling and radiological surveying, all excavated areas will be surveyed, backfilled to grade with clean soil and compacted. Backfill and compaction activities will conform to Specification 02200, Earthwork, of the UC Davis Campus Standards and Design (UC Davis, 1994).

3.5.1 Land Survey of Removal Area Limits

Prior to backfilling and grading, a land survey crew will survey the lateral and vertical extents of the removal area to accurately define its dimensions and position relative to at least three permanent benchmarks. Confirmation sample locations will also be surveyed. When complete, the land survey subcontractors will provide hard and electronic copies of survey maps and survey data for the project file.

3.5.2 Backfill

Backfill material will be free of trash, debris, organic matter, or stones larger than two inches in diameter, and will compact thoroughly without the presence of excessive voids when compacted by mechanical means. At a minimum, one sample will be collected for every 1,000 cubic yards (cu yds) of backfill material to verify its physical properties. Analyses will include optimum dry density and moisture content (ASTM D 1557), and permeability and conductivity (ASTM D 5084).

Prior to being brought on site, imported fill will be sampled and analyzed to evaluate its chemical and radiological composition. One sample will be collected for every 100 cu yds of imported fill. All samples will undergo full-suite radiological analyses, and 10% will be analyzed for metals, volatile organic compounds (VOCs) semi-volatile organic compounds (SVOCs), pesticides/polychlorinated biphenyls (PCBs), nitrate, and hexavalent chromium. Analyses will include: EPA priority pollutant metals (EPA Method 6010/7471), VOCs (EPA Method 8260), SVOCs (EPA Method 8270), pesticides/PCBs (EPA Method 8080), hexavalent chromium (EPA Method 3060A/7196), nitrate (EPA Method 300.0), and a full radiological suite. Backfill material must not contain any chemical or radiological constituents that are above site background concentrations or the RBAS.

Fill will not be placed on surfaces that contain debris, trash, loose soil, or excessively wet or dry soil. Satisfactory materials will be placed horizontally in eight-inch loose lifts. Backfill material will be broken up, moisture-conditioned and thoroughly mixed to optimize compaction.

3.5.3 Compaction

Each eight-inch lift of backfill will be compacted with standard compaction equipment and techniques. Compaction equipment may include vibratory plate compactors, sheepsfoot rollers, or other acceptable methods. Each lift will be compacted to at least 85% of the optimum dry density for cohesive soils or 90% of the optimum dry density for cohesionless soils.

A qualified individual will test the in-place dry density (ASTM D 2922) and moisture content (ASTM D 3017) of the backfill using a nuclear compaction gauge. At least one test will be performed for every 5,000 square ft of surface area for each lift.

3.6 Site Restoration

After the removal area has been backfilled and compacted, it will be restored as specified below. Site restoration activities will include surface grading, implementing site access controls, winterizing and housekeeping. Utility restoration and paving will be performed as required.

3.6.1 Surface Grading

The WDPs surface will be restored to match original grade. Material/waste storage cells will be elevated at least four inches above the ground surface (Figure 3-6) to prevent storm water from accumulating in the storage cells. Additional grading will be done in the WDPs area when the storage cells are dismantled following material/waste disposal.

3.6.2 Site Access Control

When surface grading is complete, the temporary fence surrounding the construction area will be reduced to only enclose the WDPs material/waste storage cells. This area will be secured and posted according to the RPP requirements for LLW storage.

Sign posts will be installed at 40-ft intervals around the unfenced portion of the WDPs perimeter to prevent vehicle access and dumping. Signs will consist of ¾-inch high lettering that reads, "Do Not Enter, Vehicle Access and Dumping is Strictly Prohibited."

3.6.3 Utility Restoration

Utility restoration is not anticipated but will be performed if RA activities result in modification or cause damage to existing utilities.

3.6.4 Paving

Asphalt and concrete paving is not anticipated, but will be performed if RA activities cause significant damage to paved walkways or roadways. No paving is planned for the WDPs area, as it will likely be used by UC Davis for future construction.

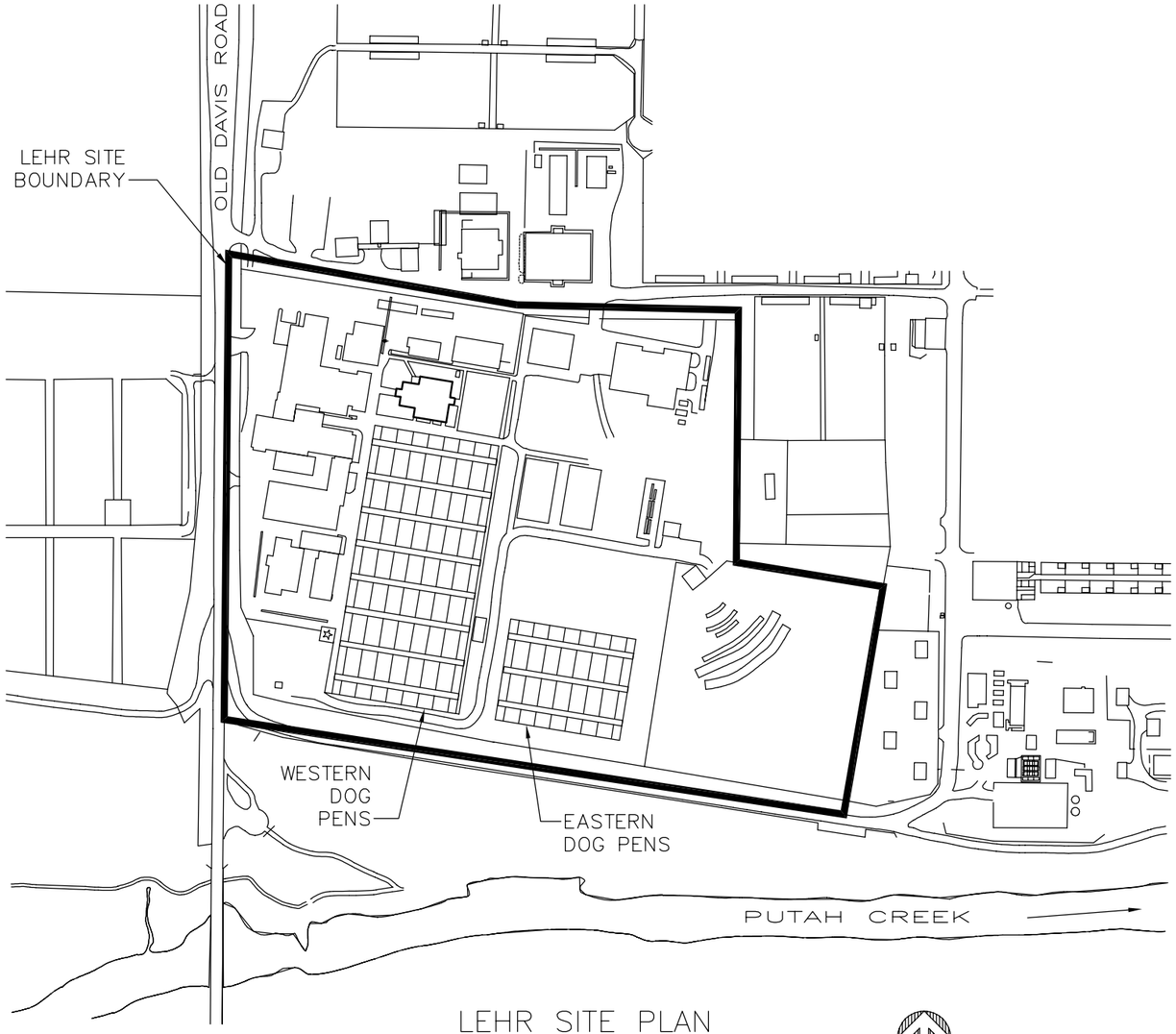
3.6.5 Winterizing/Housekeeping

The RA area will be winterized and cleaned prior to demobilization. Stockpiles and other waste storage areas will be winterized to prevent damage or environmental releases that may be caused by high winds or storm water. Concrete, asphalt, and soil stockpiles will be enclosed in 20-mil HDPE sheeting. Adjoining sheets will overlap at least two ft and be secured by the appropriate method. The stockpile perimeter will be sealed by rolling the ends of the sheeting with sandbags (Figure 3-6).

Tools, equipment and unused material will be stored and secured according to site property management practices. All trash and excess debris will be disposed in the appropriate manner.

3.7 Demobilization

All personnel and equipment that were temporarily assigned to the Site for the RA will demobilize when site restoration is complete.



LEHR SITE PLAN

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LIST OF FIGURES

FIGURE	FIGURE TITLE
3-1	LEHR SITE PLAN, VICINITY MAP AND LIST OF FIGURES
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3-3	WESTERN DOG PENS REMOVAL ACTION CONSTRUCTION AREA, HAUL ROUTES, AND STORAGE AREAS
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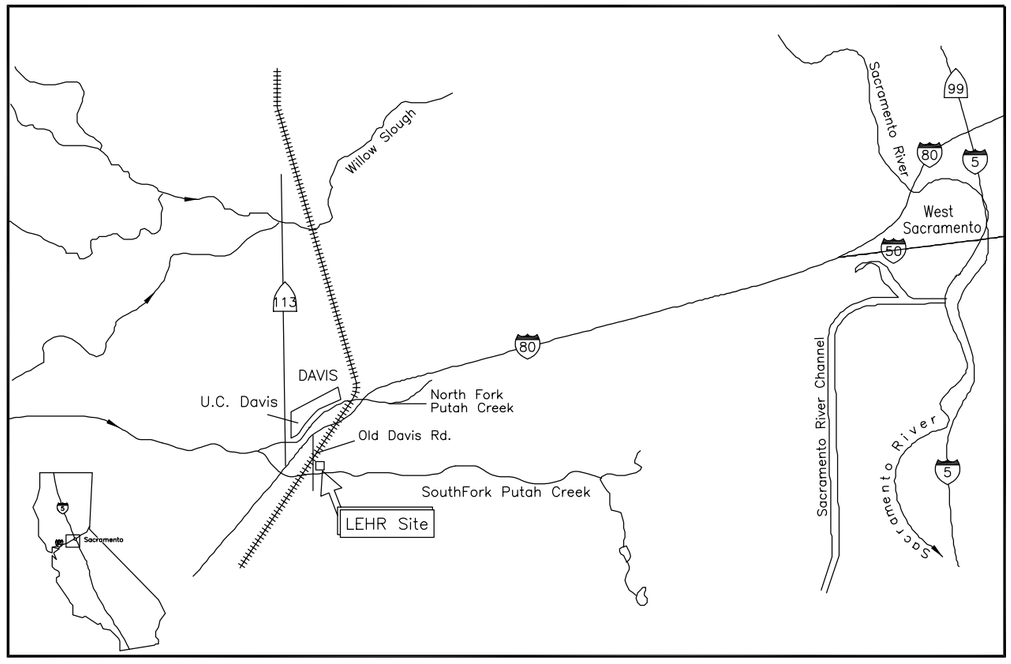
3-5	WESTERN DOG PENS EXISTING SITE DETAILS
3-6	WESTERN DOG PENS SEPARATION CELL AND STOCKPILE DETAILS



VICINITY MAP

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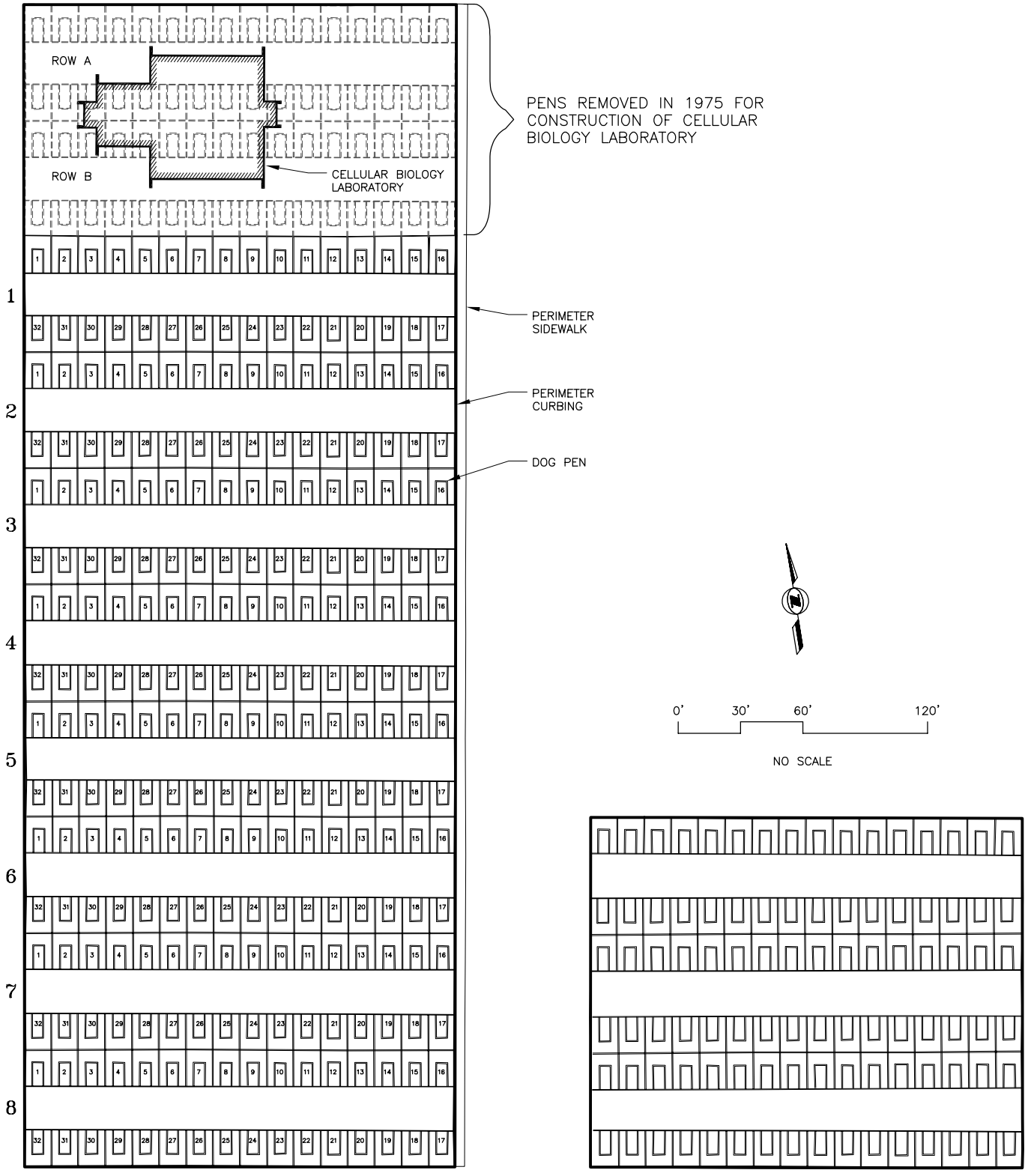

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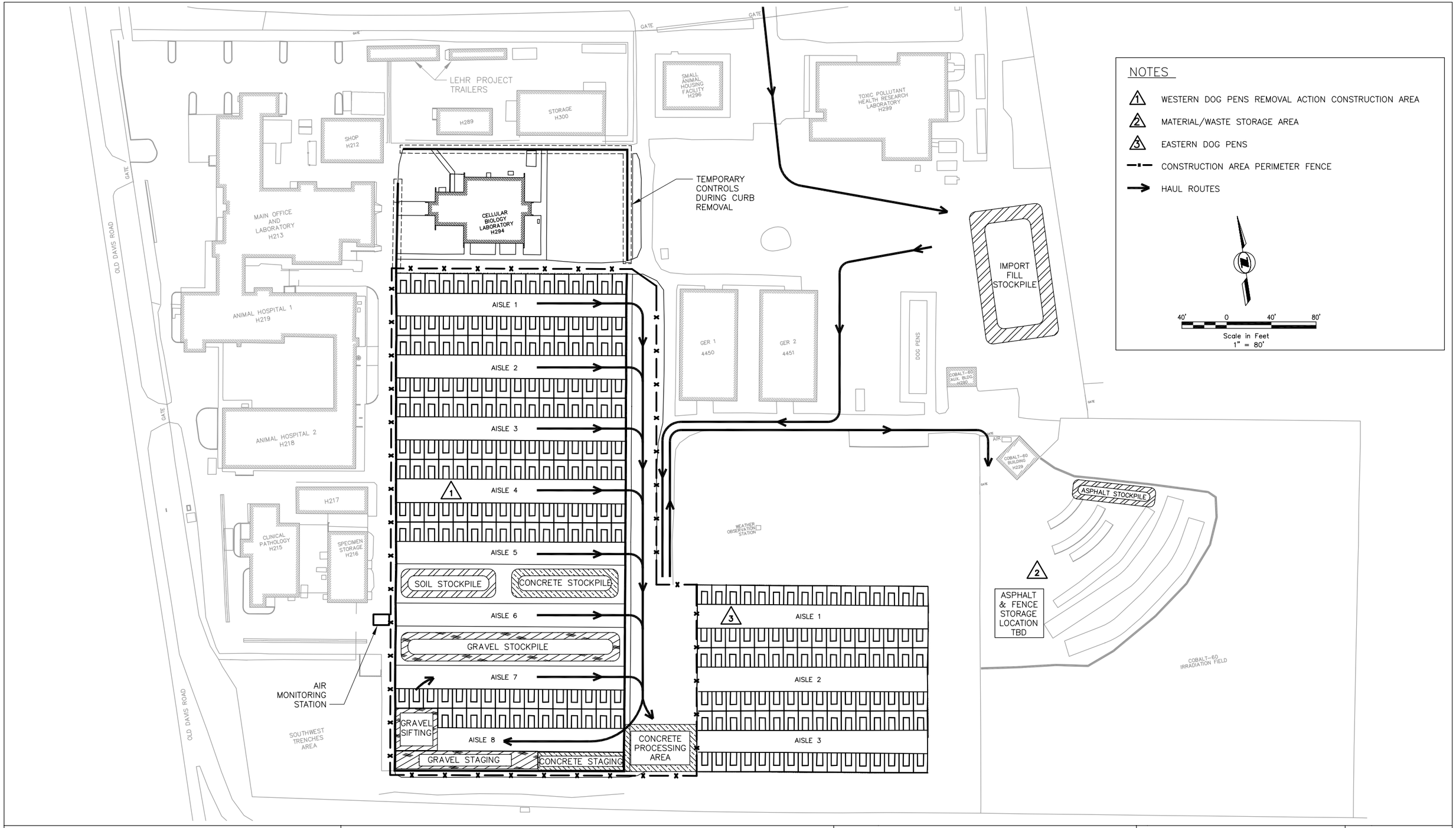

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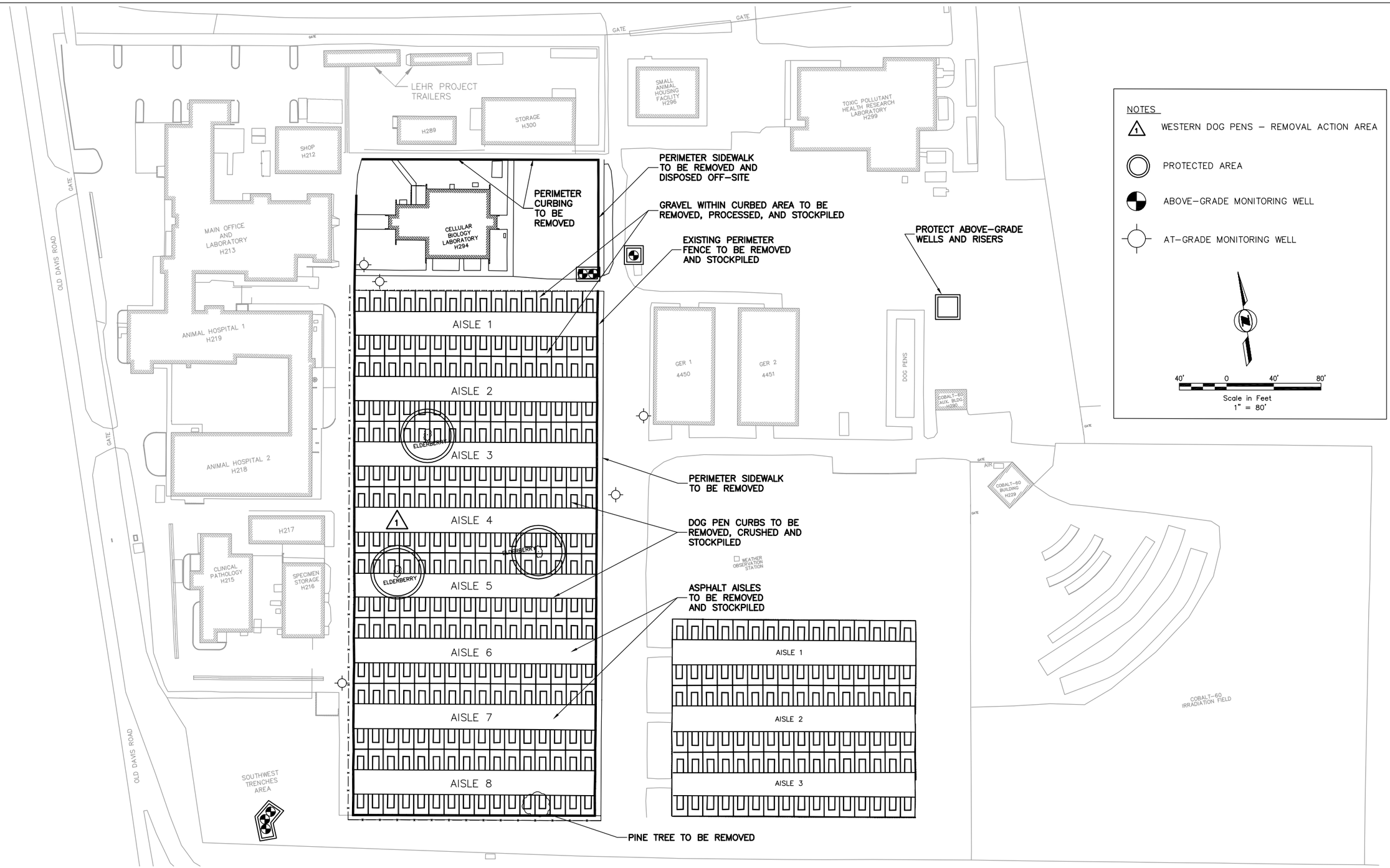

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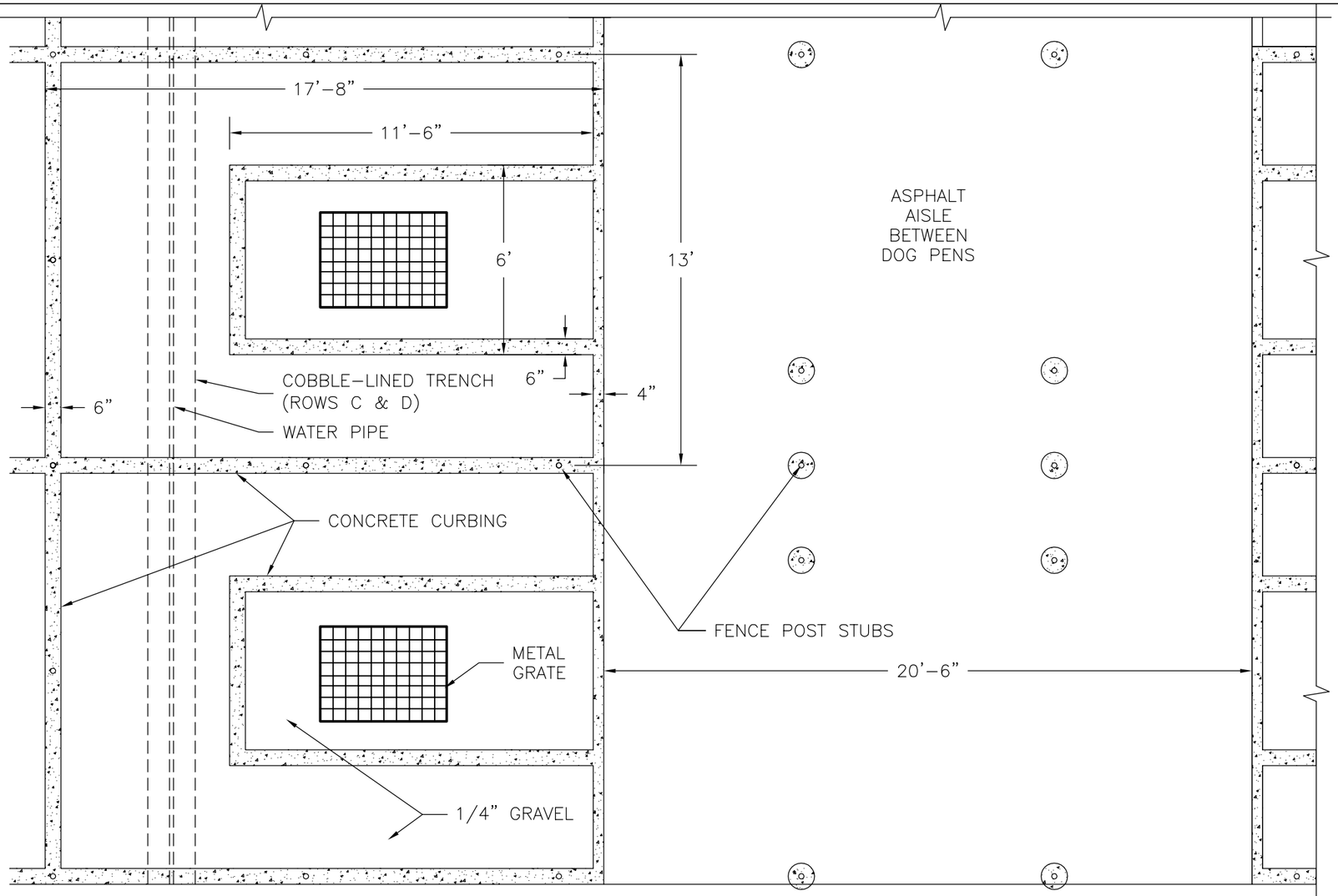
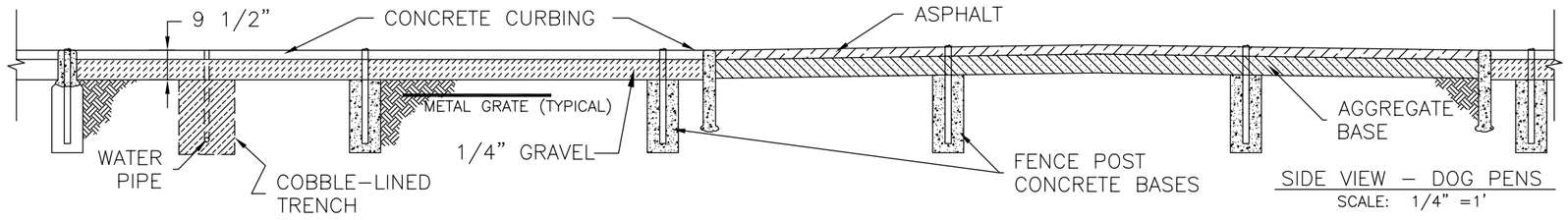
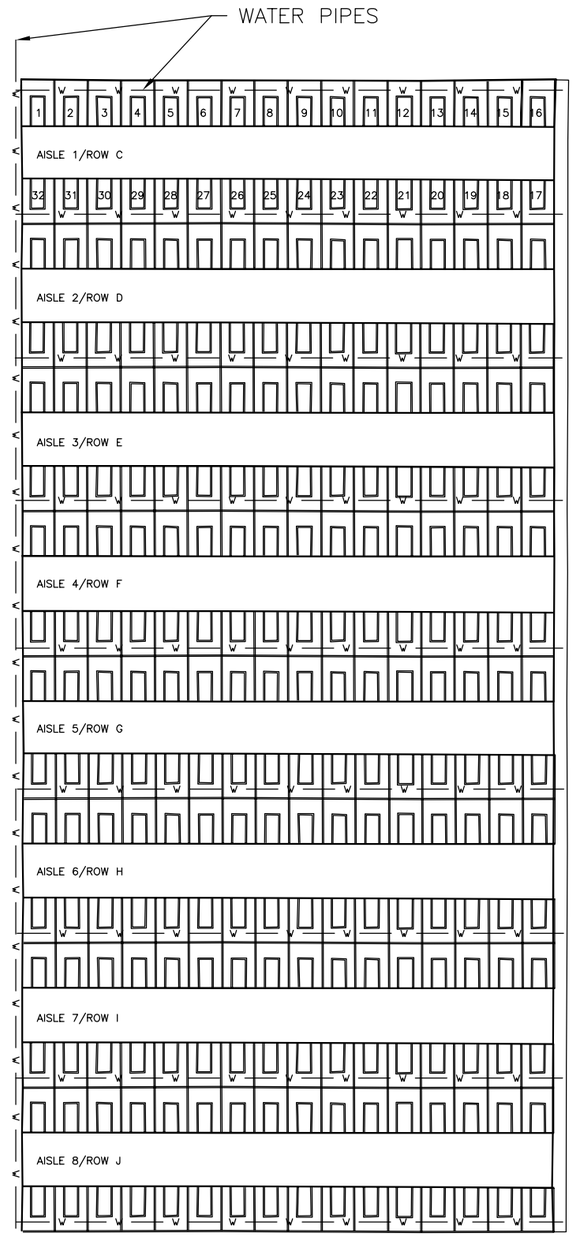


PLAN VIEW – DOG PENS
SCALE: 1/4" =1'

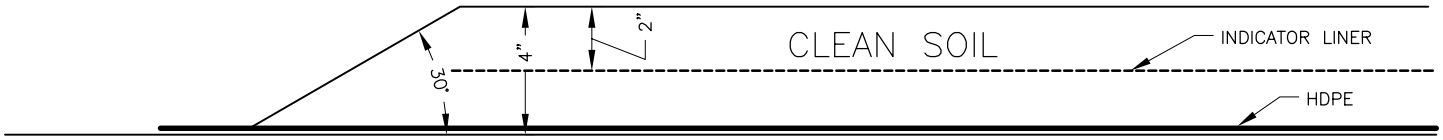


SIDE VIEW – DOG PENS
SCALE: 1/4" =1'



PLAN VIEW – WESTERN DOG PENS
SCALE: 1" =60'

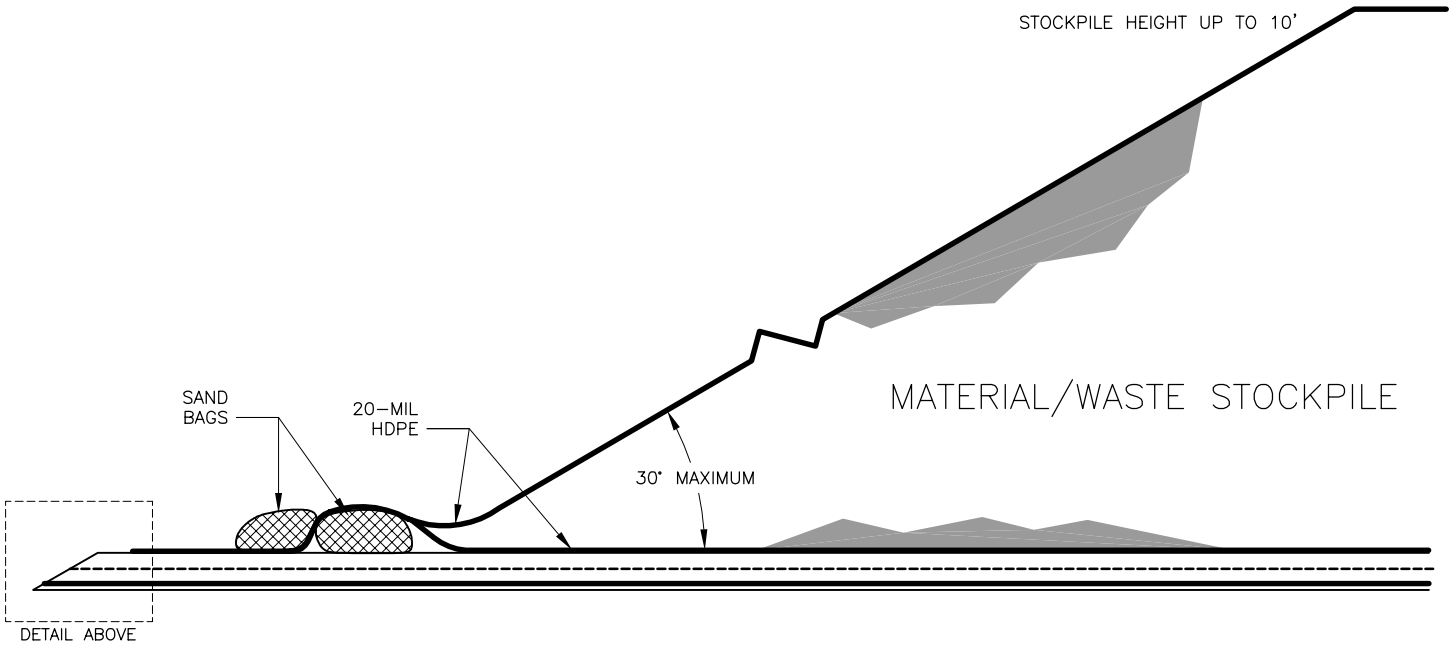
SCALE: AS NOTED WA PROJECT NUMBER: 128–4006–232 DESIGNED: JAM DRAWN: CPA CHECKED: EJN DATE: 02/08/01 FILE: 4006–024.DWG	Weiss Associates Environmental Science, Engineering and Management 5801 CHRISTIE AVENUE, SUITE 600, EMERYVILLE, CALIFORNIA 94608	L E H R DOG PENS REMOVAL ACTION WORK PLAN DOE CONTRACT NO. DE–AC03–96SF20686	FIGURE TITLE WESTERN DOG PENS EXISTING SITE DETAILS	FIGURE 3-5



BACKFILLED AND COMPACTED EXCAVATION AREA

SEPARATION CELL

SCALE: 1" = 6"



SEPARATION CELL AND STOCKPILE

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WEISS ASSOCIATES	SCALE: 1" = 60' PROJECT. NO. 128-4006-232 DATE: 11/01/02 - 4:35pm L:\LEHR\4006\4006-025.dwg	L E H R DOG PENS REMOVAL ACTION WORK PLAN DOE CONTRACT NO. DE-AC03-96SF20686	WESTERN DOG PENS SEPARATION CELL AND STOCKPILE DETAILS	FIGURE 3-6

4. SAMPLING AND ANALYSIS

This section discusses the sampling and analysis program that will be used to attain the RAOs in the WDPs, including the sampling strategy and analytical program that will be utilized during the WDPs RA. Sampling and analysis activities will include:

- Screening sampling and on-site/off-site laboratory analysis to verify that material/waste removal has not impacted the underlying soil; and,
- Confirmation/risk assessment sampling and off-site laboratory analysis to ensure that cleanup criteria have been attained within the limits of the excavation area.

Waste characterization sampling and analysis are addressed in Section 5.

4.1 Sampling Approach

The driver COCs for the WDPs are Ra-226 and Sr-90. Driver COCs will be analyzed to verify that the soil underlying the WDPs has not been impacted by material/waste removal. During removal activities, driver COCs will be analyzed by both the on-site and off-site laboratories. At the conclusion of excavation activities, confirmation samples will be collected and a radiological survey will be performed over the WDPs surface. Table 4-1 presents the field and laboratory analytical methods planned for the RA in this area. The planned field screening sampling and analysis program is presented in Table 4-2.

4.1.1 Excavation Screening Sampling

As curbs and gravel are removed, field screening samples will be collected from the underlying soil and analyzed for Ra-226 and Sr-90. Field screening samples will be collected from the removal area at grid node locations on a 25-ft by 25-ft grid. Figure 4-1 presents the planned screening sample locations within the removal area.

Visual observation will also be used to select screening sample locations. Soil in visibly stained areas will be sampled and analyzed by an off-site laboratory for chlordane.

Additional screening samples will be collected around the Cellular Biology Laboratory (Figure 3-4). Sections of the original WDPs perimeter curbing still remain in this area, and are designated for disposal during this RA. Screening samples will be collected every 25 ft along the excavated area.

Screening samples will be collected according to Section 4.2 and analyzed according to the desktop procedures for gamma spectrometer and BetaScint detector analyses (WA, 2000f and WA, 2000g). Samples will be collected, handled and documented according to SOP 10.3, Sample Collection, Handling and Data Documentation for Field Analysis Using Gamma Spectrometer and Beta Scintillation Detector.

Screening sample analytical results will be compared against the screening criteria shown in Table 4-3. If results are above the screening criteria, additional screening samples will be collected to further define the extent of contamination around hot spot locations as shown in Figure 4-2. Samples will be collected 5 ft from the hot spot location in a lateral direction and at depth intervals of 12 inches (bgs) in the vertical direction. The decision process for additional screening sample collection, and excavation and removal of hot spots is shown in Figure 4-3. As noted in Figure 4-3, the risk/impact from the residual COC(s) may be re-evaluated based on the actual vertical and lateral extent. This effort could involve risk assessment, ground water impact assessment, and other methods. DOE and Remedial Project Manager (RPM) input on these evaluations will be solicited if this situation arises.

Sample collection and handling will be performed in accordance with SOP 2.1, Sample Handling, Packaging and Shipping and SOP 3.1, Surface and Shallow Subsurface Soil Sampling. Duplicate samples will be collected for quality control (QC) purposes. The number of duplicate samples will be 10% of the field screening samples collected. These samples will be analyzed off site for Ra-226 and Sr-90.

4.1.2 Sifted Soil Screening

During gravel removal operations in the WDPs, some of the non-impacted underlying soil will likely be removed along with the gravel. To minimize waste volume, the gravel will be sifted to remove soil particles. Once sifted, the soil will be transferred from the processing area and stockpiled between Aisles 5 and 6 of the WDP (Figure 3-3). The stockpiled soil will be analyzed for driver COCs by the on-site laboratory to evaluate the potential for on-site reuse.

A four-point composite sample will be collected at a frequency of one per 10 cu yds of loose soil. The sample locations will be recorded for future reference. Soil samples collected from the stockpiles will be analyzed for Ra-226 and Sr-90 by the on-site laboratory. Sifted soil sampling parameters are summarized in Table 4-2.

4.1.3 Cobble Trench Sampling

Cobble trenches have been encountered beneath a number of pens during previous investigations. These trenches, which are approximately one ft wide and located at a depth of one to two ft bgs, run east to west along the rear of the pens (Figure 3-5). At three random locations in each

trench, soil directly beneath the soil/cobble interface will be sampled for on-site analysis of driver COCs.

The cobbles are two to three inches in diameter and well-rounded, thus making on-site analysis infeasible. Therefore, cobble samples will be collected during confirmation sampling and analyzed by the off-site laboratory, as discussed in Section 4.1.4.

4.1.4 Confirmation Sampling

Following evaluation of excavation screening sample results, confirmation samples will be collected to confirm that Ra-226, Sr-90, chlordane, mercury and hexavalent chromium have not impacted the underlying soil during RAs. The confirmation sample frequency and locations were determined using the Noether Calculation (a random-start grid sampling approach) as described in Appendix B. The confirmation sampling program is summarized in Table 4-2 and the sample grid locations are shown in Figure 4-4.

In addition to the confirmation grid sampling, one soil and one cobble sample will be collected at a random location from each cobble-filled trench encountered. Soil samples will be collected according to SOP 3.1, Surface and Shallow Subsurface Soil Sampling and packaged in the appropriately-sized glass jar (Table 4-4). Each cobble sample will be collected with a shovel or a trowel and packaged in a poly bucket. Once packaged, samples will be managed according to SOP 2.1, Sample Handling, Packaging and Shipping. Soil and cobble samples from the cobble-filled trenches will be analyzed for the full confirmation suite.

Since the random grid (Figure 4-4) did not identify any confirmation sample locations in Aisle 3, discretionary samples will be collected to verify that no residual chlordane remains after the asphalt removal (Section 3.4.2). Surface soil samples will be collected at four random locations within Aisle 3 and shipped off-site for chlordane analyses only.

4.1.5 Radiological Survey

A radiological survey will be performed over the Western Dog Pens surface following the collection of confirmation samples. The radiological survey plan will be distributed for DOE and regulatory review prior to implementation.

4.2 Sample Collection Procedures

Soil samples will be collected in accordance with SOP 3.1, Surface and Shallow Subsurface Soil Sampling. Soil samples will be placed in plastic containers, plastic bags or glass jars for field

analysis, and in glass jars, plastic containers or brass sleeves for laboratory analysis. Table 4-4 summarizes the container type, volume and holding time for each analyte. The following methodology will be followed for sample collection.

A sample preparation area will be established adjacent to the sampling location. The work surface will be covered with plastic sheeting to minimize the potential spread of contamination. The following equipment will be staged in the sample preparation area:

- Spill kit,
- Sample containers,
- Demineralized water,
- Sampling tools,
- Custody seals and chain-of-custody forms, and
- Preservatives, as required.

Samples will be collected with a hand auger and trowels will be used to transfer material into the appropriate containers. Sample handling, packaging and shipping are described in SOP 2.1, Sample Handling, Packaging and Shipping.

Duplicate samples will be collected for QC purposes. Duplicates will be collected at a rate of 10% for all excavation screening and cobble trench soil samples, and analyzed on site for Ra-226 and Sr-90. To evaluate the performance of the on-site laboratory, duplicates will be sent to an off-site analytical laboratory for Ra-226 and Sr-90 analyses. Duplicates will also be collected at a rate of 10% for confirmation samples and analyzed for Ra-226, Sr-90, chlordane, mercury and hexavalent chromium at an off-site laboratory.

4.3 Sample Documentation

The usability of the data obtained during this investigation will depend on its quality. A number of factors affect data quality. Following proper procedures for both sample collection and analysis reduces sampling and analytical error. To ensure sample integrity, samples will be handled using complete chain-of-custody documentation and preserved using proper sample preservation techniques, holding times, and shipment methods. Obtaining valid and comparable data also requires adequate quality assurance/quality control (QA/QC) procedures and documentation.

The components of the sample documentation and custody system will include the following:

- Chain-of-custody,
- Field logbook,
- Sample numbers,
- Sample labels, and
- Custody seals.

4.3.1 Chain-of-Custody

Chain-of-custody forms will be completed by the sample team members to track sample custody, as well as to specify the requested analyses. Chain-of-custody forms will be completed in accordance with the requirements of SOP 1.1, Chain-of-Custody.

4.3.2 Field Logbook

Descriptions and observations made during field sampling activities will be documented in the field logbook. In addition, boring logs with detailed lithologic descriptions will be prepared in accordance with SOP 15.1, Lithologic Logging, for any soil borings. The following will be recorded in the field logbook:

- Project name and number;
- Site location;
- Purpose of sampling;
- Description of field activities;
- Names of sampling personnel;
- Date and time of entries;
- Sample medium description using the Unified Soil Classification System (USCS) method for soil samples;
- Date and time of sample collection;
- Sample location, identification (ID) number and sampling methodology;
- Field observations;
- Results of field measurements; and,
- Results of field calibrations for instruments used.

4.3.3 Sample Numbers

All sample numbers will contain a unique sample ID number (i.e., sample designation) using the following format:

aabbcddd

Where,

aa = Type of sample and matrix

GS – gravel/cobble sample

SS – soil sample

CW – composite waste

WS – water sample

bb = Two letter acronym designating the sample area at the Site

WD – Western Dog Pens Area

c = Type of sample

F – field screening sample

C – confirmation sample

ddd = Chronological sample number (e.g., 001, 002, 003)

An example of a field screening soil sample collected from the WDPs is:

SSWDF001

4.3.4 Sample Labels

Sample labels will be attached to individual sample containers and will contain the following information:

- Project number,
- Sample ID number,
- Date and time collected,
- Initials of sampler, and
- Requested analyses.

4.3.5 Custody Seals

Custody seals will be used to detect tampering and will be placed over the lid of the container and annotated with the following information:

- Project number,
- Sample ID number,
- Date and time collected, and
- Initials of sampler.

4.4 Sample Shipping

Shipping procedures are described in SOP 2.1, Sample Handling, Packaging and Shipping. Pre-designated containers and coolers for off-site shipment will be used for the WDPs samples. Proper labeling and packaging for shipment is required along with the appropriate documentation.

4.5 Analytical Methods

Table 4-1 summarizes the analytical methods that will be performed on soil samples collected from the WDPs area. The analytical methods are divided into field and laboratory methods. Field analytical methods will be used on site to provide real-time results for screening samples. Fixed-base laboratory analytical methods will be used for confirmation samples.

Field analytical methods include Ra-226 analysis using gamma spectroscopy equipped with a high-purity germanium detector, and Sr-90 analysis using the BetaScint detector. Ra-226 and Sr-90 analyses will be performed by on-site laboratory technicians trained to use the instruments.

Laboratory analytical results will be validated upon receipt and transferred to the project database in accordance with procedures described in the QAPP (WA, 2000b). Sample tracking, data receipt, and storage will be performed in accordance with SQP 4.2, Records Management.

4.6 Data Evaluation

Data evaluation will be conducted in two general phases as analytical results (both field and laboratory) become available. Phase I will consist of reviewing field analytical results generated from analysis of driver COCs in excavation screening samples. Phase II data evaluation will consist of reviewing analytical results generated by all sampling activities. Each phase of data evaluation and the scope and level of complexity are described below.

4.6.1 Phase I Data Evaluation

The Phase I data evaluation is conducted following material/waste removal. During prior RAs at the Southwest Trenches and the Radium/Strontium Treatment Systems Areas I and II, the decision to excavate hinged upon the results of screening sample analyses. Based on previous investigations, the soil in the WDPs is assumed to be clean. Therefore, the screening sample results will not guide the excavation activities, but will verify that the underlying soil was not impacted during material/waste removal. Once screening analytical results indicate that the soil has not been impacted, confirmation sampling will commence. If analytical results indicate that driver COC concentrations are above the screening criteria (Table 4-3), then additional delineation sampling will be performed in the areas where elevated driver COCs concentrations were detected (hot spots).

4.6.2 Phase II Data Evaluation

Upon receipt of all confirmation sample analytical results, data validation will be conducted to ensure data usability. The confirmation sample analytical results will be validated by WA according to the procedures defined in SOP 21.1, Data Validation (WA, 1999e). Sample results and associated QA/QC measures will be reviewed including: holding times, field and laboratory blank results, laboratory control sample spike results, matrix spike/matrix spike duplicate results, laboratory matrix duplicate results, surrogate recoveries and internal standard performance. All sample results will be identified as usable (no qualifier), estimated and usable (with J or UJ qualifier), or rejected and unusable (with R qualifier).

Phase II of the data evaluation will then commence and include screening risk evaluation and RA completion analyses. These analyses will be used to determine whether RAOs have been attained and, if not, make recommendations on any additional actions required. The scope of each analysis is described below.

4.6.2.1 Screening Risk Evaluation

Screening risk evaluation will help assess whether the first and second RAOs (Section 1) have been attained. For each COC, confirmation sampling results and, if appropriate, previous analytical results from sample locations other than those in excavated areas, will be used to develop a data distribution for each COC and to calculate the mean, standard deviation and 95% UCL on the mean.

The procedures outlined in Statistical Methods for Evaluating the Attainment of Cleanup Standards, Volume 3 (EPA, 1992) will be used to compare the sample data with the RBAS for each COC. For those COCs where the RBAS is set at background, specifically Ra-226, the Wilcoxon Rank Sum Test and/or the Quantile Test will be used. For COCs where the RBAS is above the background concentration, the 95% UCL on the mean of the cleanup unit data will be compared to the RBAS. In certain cases, the actual vertical and lateral distribution of residual COCs may warrant modification of the existing RBAS. In this case, methods will be used that are consistent with the

EPA's Risk Assessment Guidance for Superfund and project-specific guidelines developed for RBAS.

Existing RBAS are the *lowest* values derived for the following three potential exposure scenarios:

- Scenario 1: On-Site Researcher—This scenario is consistent with the UC Davis long-range plan to continue research activities at the Site.
- Scenario 2: East Side Residential Farmer—This scenario assumes a residential farmer is located immediately east of the 1997 UC Davis property boundary. This scenario represents the nearest reasonable downgradient (with respect to ground water) location for a potential off-site receptor.
- Scenario 3: South Side Residential Farmer—This scenario assumes a residential farm is located immediately south of the UC Davis property boundary and Putah Creek. This location represents the nearest reasonable downwind location for an off-site receptor.

A screening-level risk evaluation will then be completed. For each COC, the 95% UCL on the mean will be divided by the RBAS at specified risk levels (10^{-4}, 10^{-5} or 10^{-6}). The sum of the ratios for Ra-226, Sr-90 and chlordane will then be computed cumulatively for the three risk scenarios. If the sum is less than one, the screening level evaluation will conclude that the first RAO has been met. A similar ratio will be calculated for the hazard quotient of non-carcinogenic COCs to determine whether the second RAO has been attained.

4.6.2.2 Removal Action Completion Analysis

Upon completion of the screening risk evaluation, a comprehensive review and analysis of all RA activities, analytical results and decision processes will be performed to determine whether the RAOs defined in Section 1 have been attained. During this phase of data evaluation, all applicable and available information, including the following items, will be compiled for an RA completion analysis:

- A description of waste materials encountered;
- Volume calculations for all waste streams generated;
- Excavation dimensions;
- All field and laboratory analytical results from each sampling and analysis activity; and,
- Results of the screening risk evaluation.

Based on review of the above data, as well as previously collected site data, an evaluation will be performed to determine whether the RAOs have been attained. This evaluation will consider the use of institutional controls, if necessary, for risk reduction and RAO attainment. The results of the Phase II data evaluation will be presented in the Draft Western Dog Pens Confirmation Report, as

required by the Federal Facility Agreement. Based on these discussions, a determination will be made regarding the need for and scope of additional actions to achieve the RAOs.

4.7 Data Quality Objectives

The sampling and analysis program presented in Sections 4.1 through 4.6 and in Appendix B was developed using the Data Quality Objectives (DQOs) process described in Guidance for the Data Quality Objectives Process, EPA document number QA/G-4, and Data Quality Objectives Process for Superfund, Interim Final Guidance, EPA document number EPA540-R-93-071. The DQO process is a systematic planning tool for establishing criteria for data quality (DQOs) and for developing data collection designs. The following sections demonstrate how the seven steps of the DQO process were used in designing the WDPs RA sampling and analysis program.

4.7.1 Statement of the Problem

Under National Contingency Plan guidelines, a non-time critical RA will be conducted to minimize and reduce the threat posed by environmental contaminants in the WDPs. Under the Federal Facility Agreement signed between DOE and EPA, DOE is the lead agency for cleanup of soil contamination associated with LEHR-related activities, including that in the WDPs.

The primary decision-maker, DOE Oakland, will make the final decisions on all activities associated with the RA based on recommendations from the RA planning team. The planning team consists of DOE Oakland; RPMs including EPA Region IX, California Department of Toxic Substance Control, Central Valley Regional Water Quality Control Board and Department of Health Services; UC Davis; the Davis South Campus Superfund Oversight Committee; and the DOE contracting team of WA, IT Corp and EMS.

The key question to be answered by the sampling and analysis program is whether or not the RAOs for the WDPs (Section 1.3) have been achieved. The program described in Sections 4.1 through 4.6 and in Appendix B is designed to provide DOE Oakland and the planning team with the data needed to answer this question.

4.7.2 Identification of Decisions

The decision statements for the WDPs RA can be summarized as follows:

1. Determine whether or not "hot spots" are present beneath the excavated material and require additional excavation. The excavation screening sampling and data evaluation (Sections 4.1.1 and 4.6.1) and Field Excavation Decision Flowchart (Figure 4-3) have been designed to address this decision statement.

2. Determine whether or not the WDPs RA achieved the RAOs. The confirmation sampling and data evaluation (Sections 4.1.3 and 4.6.2 and Appendix B) have been designed to address this decision statement.

4.7.3 Identify Inputs to Decisions

In order to resolve the decision statements in Section 4.7.2, the existing inputs that will be used include risk-based and background levels, and previous WDPs area results for COCs.

New environmental measurement inputs will include:

- Field observations,
- Sampling at appropriate locations and depths,
- Soil sample description using the USCS method,
- Field screening measurements for Ra-226 and Sr-90 (excavation screening sampling only),
- Laboratory analyses for Ra-226, Sr-90, chlordane, mercury and hexavalent chromium (confirmation sampling), and,
- Laboratory data validation.

4.7.4 Definition of Study Boundaries

The geographical area addressed by the sampling and analysis program consists of the WDPs Area (Figure 3-3). Additional information on the project area is presented in the Section 3 drawings of the Southwest Trenches RA Work Plan (WA, 2000d).

The sampling and analysis program focuses on COCs potentially introduced after 1958, when DOE first began operations at the Site. The sampling and analysis program consists of two phases; screening samples will be collected during excavation, and confirmation samples will be collected at the completion of the RA, when the final extent of excavation has been attained.

4.7.5 Development of Decision Rules

The decision rule for the excavation screening sampling is summarized in the Field Excavation Decision Flowchart (Figure 4-3). In summary, if a sample exceeds the screening criteria (Table 4-3), the "hot spot" extent will be determined, additional excavation costs will be estimated, and/or residual risk will be evaluated. Based on this, additional excavation and screening analysis may be performed.

The decision rule for the confirmation sampling is described in Section 4.6.2, Phase II Data Evaluation. In summary, the confirmation sampling results and other appropriate WDPs data will be compared with the appropriate RBAS for each COC. These statistical comparisons will be used in a screening-level risk evaluation to determine whether or not the RAOs have been achieved.

4.7.6 Specification of Limits on Decision Errors

The excavation screening sampling grid was designed to provide data for the entire WDPs area where curbing remains, with a frequency of approximately one sample for every 1.5 dog pens remaining.

As described in Appendix B, the confirmation sampling was designed to attain Type I and II errors of 20% and 10%, respectively. The number of samples needed was predicted based on the distribution of Ra-226 results for previous WDPs samples. The sampling locations were determined using a random-start grid, with grid spacing based on the calculated number of samples needed. Based on previous WDPs sample results, this sampling and analysis design is expected to limit Type I and Type II errors for Ra-226, Sr-90 and chlordane results to maximums of 20% and 10%, respectively.

4.7.7 Sample Design Optimization

The output from each of the first six DQO steps described in Section 4.7.1 through 4.7.6 above was used in optimizing the sampling and analysis program described in Sections 4.1 through 4.6 and in Appendix B. This sampling and analysis program should provide the data needed to determine, at an appropriate level of certainty, whether or not the WDPs RAOs have been achieved.

Conditions that may cause deviation from the planned sampling and analysis activities include:

- Physical obstructions such as buildings and underground utilities that prevent excavation and sampling in selected locations;
- Field screening measurements indicating that the work environment, or some aspect of it, is unsafe for human or environmental health and/or welfare; and,
- Equipment required to perform the intended work safely is unavailable.

These conditions are considered unlikely. If one or more of these conditions occur, potential impact on achieving DQOs will be evaluated and addressed.

Table 4-1. Field and Laboratory Analytical Methods for the Western Dog Pens Removal Action

Constituent	Analytical Method	Required Detection Limit
	Field	
Radium-226	Gamma Spectroscopy/HPGe Screening	1 pCi/g
Strontium-90	Proprietary BetaScint, Inc. Scintillation	10 pCi/g
	Laboratory	
Radium-226*	DOE EML HASL 300	0.1 pCi/g
Strontium-90	EPA Method 905.0, modified	0.05 pCi/g
Chlordane	SW-846 Method 8081	8.33 µg/kg
alpha-Chlordane	CLP SOP OLM 03.1	1.7 µg/kg
gamma-Chlordane	CLP SOP OLM 03.1	1.7 µg/kg
Mercury	CLP SOW ILM 04.0	0.1 mg/kg
Hexavalent Chromium	SW-846 Method 3060A/7196	0.05 mg/kg

Abbreviations

HPGe high-purity germanium
mg/kg milligrams per kilogram
µg/kg micrograms per kilogram
pCi/g picoCuries per gram
* 30-day ingrowth-time and 1,000-minute count-time

Table 4-2. Sampling and Analysis Summary for the Western Dog Pens Removal Action

Sampling Activity	Sampling Strategy	Assumptions	Sampling Method	Method of Analysis [1]	Analytical Parameters	Estimated Total Samples
Screening sampling	Fixed grid	Samples from excavation floor on a 25-ft x 25-ft grid	Hand Auger	Field	Ra-226 and Sr-90	171
Screening hot spot sampling (as necessary)	Fixed grid	Hot spot sampling as shown in Figure 4-2	Hand Auger	Field	Ra-226 and Sr-90	20
Cobble-lined trench soil sampling	Fixed grid and discretionary	Three soil samples per trench (underlying cobbles)	Hand Auger	Field	Ra-226 and Sr-90	6
Duplicate samples (Field QC)	NA	10% of all samples analyzed in field	Hand Auger	Field	Ra-226 and Sr-90	20
Duplicate samples (Laboratory QC)	NA	10% of field and laboratory samples analyzed at laboratory	Hand Auger	Laboratory	Ra-226 and Sr-90	20
Sifted soil screening	4-point composite	One sample per 10 cu yd of soil	Grab	Field	Ra-226 and Sr-90	100
Duplicate samples (Field QC)	NA	10% of all samples analyzed in field	Grab	Field	Ra-226 and Sr-90	10
Excavation confirmation/ risk assessment sampling	Stratified random and at hot spots	Random sampling within the excavation area	Hand Auger	Laboratory	Ra-226, Sr-90, chlordane, Hg and Cr-VI	23
Cobble-lined trench samples	Discretionary	One cobble and one soil sample per cobble-lined trench in Rows C and D	Shovel/Trowel/ Hand Auger	Laboratory	Ra-226, Sr-90, chlordane, Hg and Cr-VI	4
Aisle 3 surface samples	Discretionary	Four soil samples from the Aisle 3 surface	Hand Auger	Laboratory	Chlordane	4

Table 4-2. Sampling and Analysis Summary for the Western Dog Pens Removal Action (continued)

Sampling Activity	Sampling Strategy	Assumptions	Sampling Method	Method of Analysis [1]	Analytical Parameters	Estimated Total Samples
Duplicate samples (Laboratory QC)	NA	10% of samples analyzed at laboratory	Shovel/Trowel/ Hand Auger	Laboratory	Ra-226, Sr-90, chlordane, Hg and Cr-VI	4

Notes
Constituents of concern (COCs) detected in the WDPs Area include radionuclides, metals, pesticides, and nitrate.
[1] See Table 4-3.

Abbreviations
Cr-VI hexavalent chromium
cu yd cubic yard
ft foot
Hg mercury
NA not applicable
QC quality control
Ra-226 radium-226
Sr-90 strontium-90

Table 4-3. Cleanup Criteria for Constituents of Concern for the Western Dog Pens Removal Action

Constituent of Concern	Screening Sampling	Confirmation Sampling	
	Screening Criteria [2]	Background Concentration [3]	RBAS [4] (10^{-6} Risk or HQ=1)
Radium-226 [1]	0.8 pCi/g	0.75 pCi/g	0.0042 pCi/g (<Background)
Strontium-90 [1]	10 pCi/g	0.056 pCi/g	10 pCi/g
Chlordane	None	Not Applicable	0.78 mg/kg
Mercury	None	3.94/0.248 mg/kg	5.75 mg/kg
Hexavalent Chromium	None	0.054 mg/kg	3.8 mg/kg

Notes

1 Driver constituents of concern are those indicative of releases to the environment based on previous investigations and/or process knowledge (Section 4.1).

2 Screening criteria are determined based on existing Risk-based Action Standard (RBAS) values (WA, 1997) and field analytical instrument detection limits and precision.

3 Sampling and Analysis Plan for Removal Actions in the Southwest Trenches, Ra/Sr Treatment Systems, and Domestic Septic System Areas for LEHR, Rev. 0, July 2000.

4 RBAS value is the lowest of all three risk scenarios for either excess cancer risk of 10^{-6} or hazard quotient (HQ) of 1.

Abbreviations
mg/kg milligrams per kilogram
pCi/g picoCuries per gram

Table 4-4. Containers and Holding Times for Soil Laboratory Analytical Methods for the Western Dog Pens Removal Action

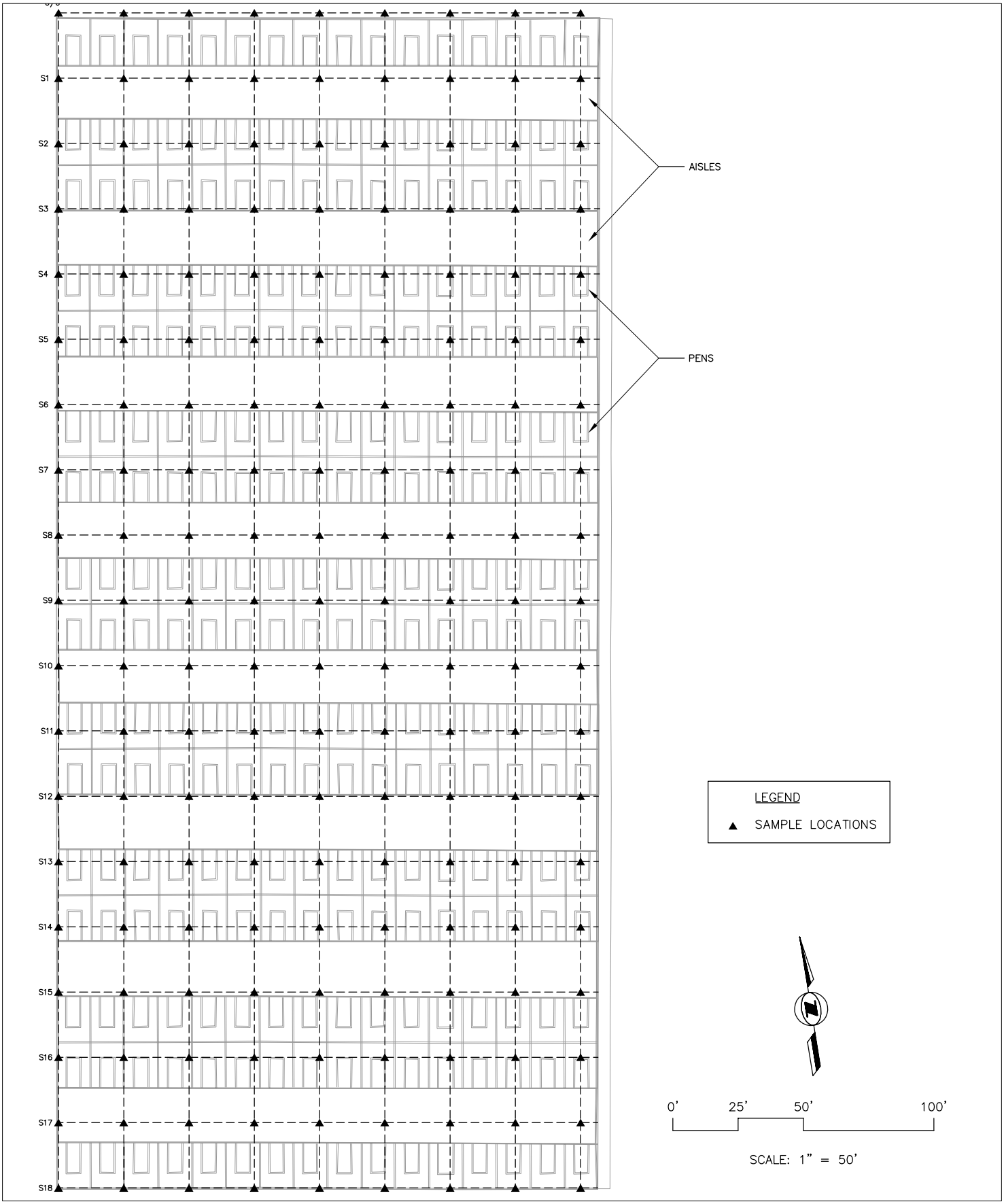
Constituent	Analytical Method	Container and Volume	Holding Time
Radium-226*	DOE EML HASL 300	P,G / 200 g	6 months
Strontium-90	EPA Method 905.0, modified	P,G / 20 g	6 months
Chlordane	SW-846 Method 8081	G / 4 oz.	14 days to extraction, 40 days to analysis of extracts
alpha-Chlordane	CLP SOW OLM 03.1	G / 4 oz.	14 days to extraction, 40 days to analysis of extracts
gamma-Chlordane	CLP SOW OLM 03.1	G / 4 oz.	14 days to extraction, 40 days to analysis of extracts
Mercury	CLP SOW ILM 04.0	P,G / 4 oz.	28 days
Hexavalent Chromium	SW-846 Method 3060A/7196	G / 4 oz.	14 days to extraction

Note

Cobble samples will packaged in poly buckets. The required cobble sample volume, which is a function of cobble surface area, will be determined at the time of collection by the Sample Manager in consultation with the off-site analytical laboratory.

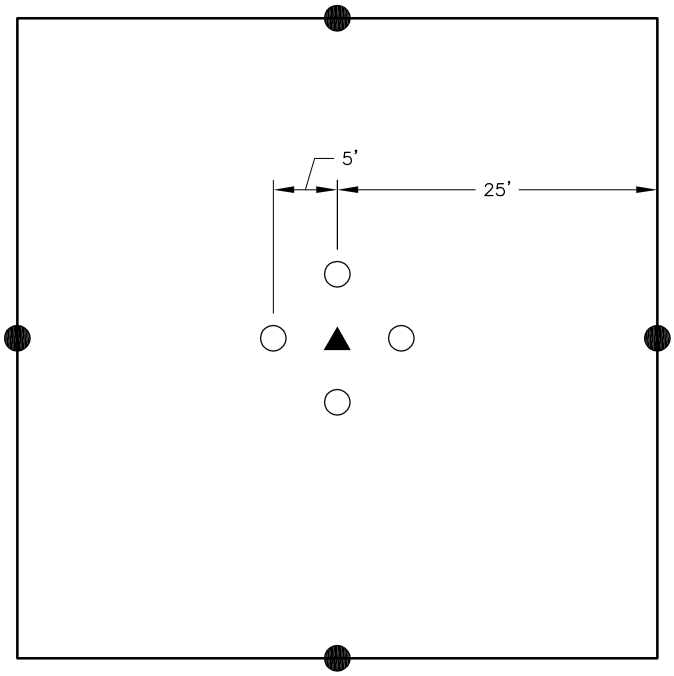
Abbreviations

G Glass container
g grams
oz ounces
P Plastic container
* 30-day ingrowth-time and 1,000-minute count-time

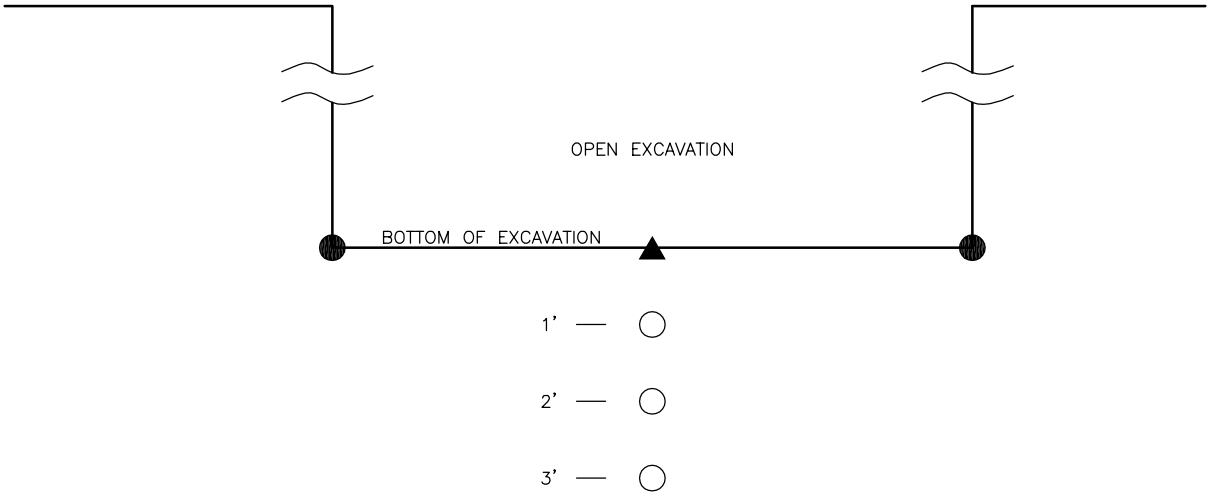


WEISS ASSOCIATES	SCALE: 1" = 50' PROJECT. NO. 128-4006-232 DATE: 11/01/02 - 4:49pm L:\LEHR\4006\4006-013.dwg	L E H R DOG PENS REMOVAL ACTION WORK PLAN DOE CONTRACT NO. DE-AC03-96SF20686	WESTERN DOG PENS REMOVAL ACTION EXCAVATION SCREENING SAMPLE LOCATIONS	FIGURE 4-1

PLAN VIEW



CROSS SECTION



LEGEND

- ▲ "HOT SPOT"
- ● CLEAN SCREENING SAMPLE RESULT
- ○ HOT SPOT DELINEATION SAMPLE LOCATION

WEISS ASSOCIATES	SCALE: 1/4" = 1' PROJECT. NO. 128-4006-232 DATE: 11/01/02 - 4:49pm L:\LEHR\4006\4006-015.dwg	L E H R DOG PENS REMOVAL ACTION WORK PLAN DOE CONTRACT NO. DE-AC03-96SF20686	WESTERN DOG PENS REMOVAL ACTION HOT SPOT SAMPLE LOCATIONS	FIGURE 4-2

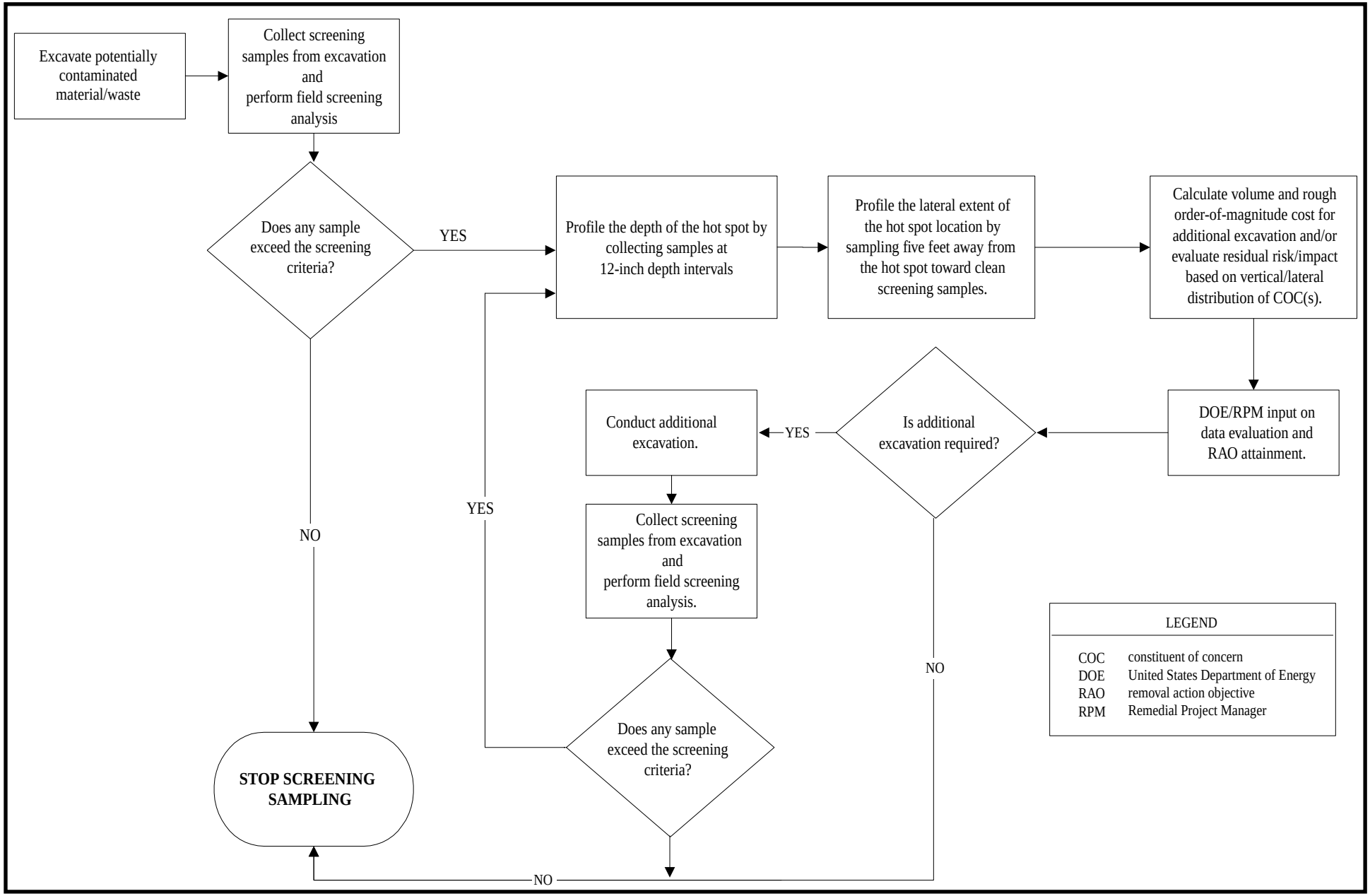
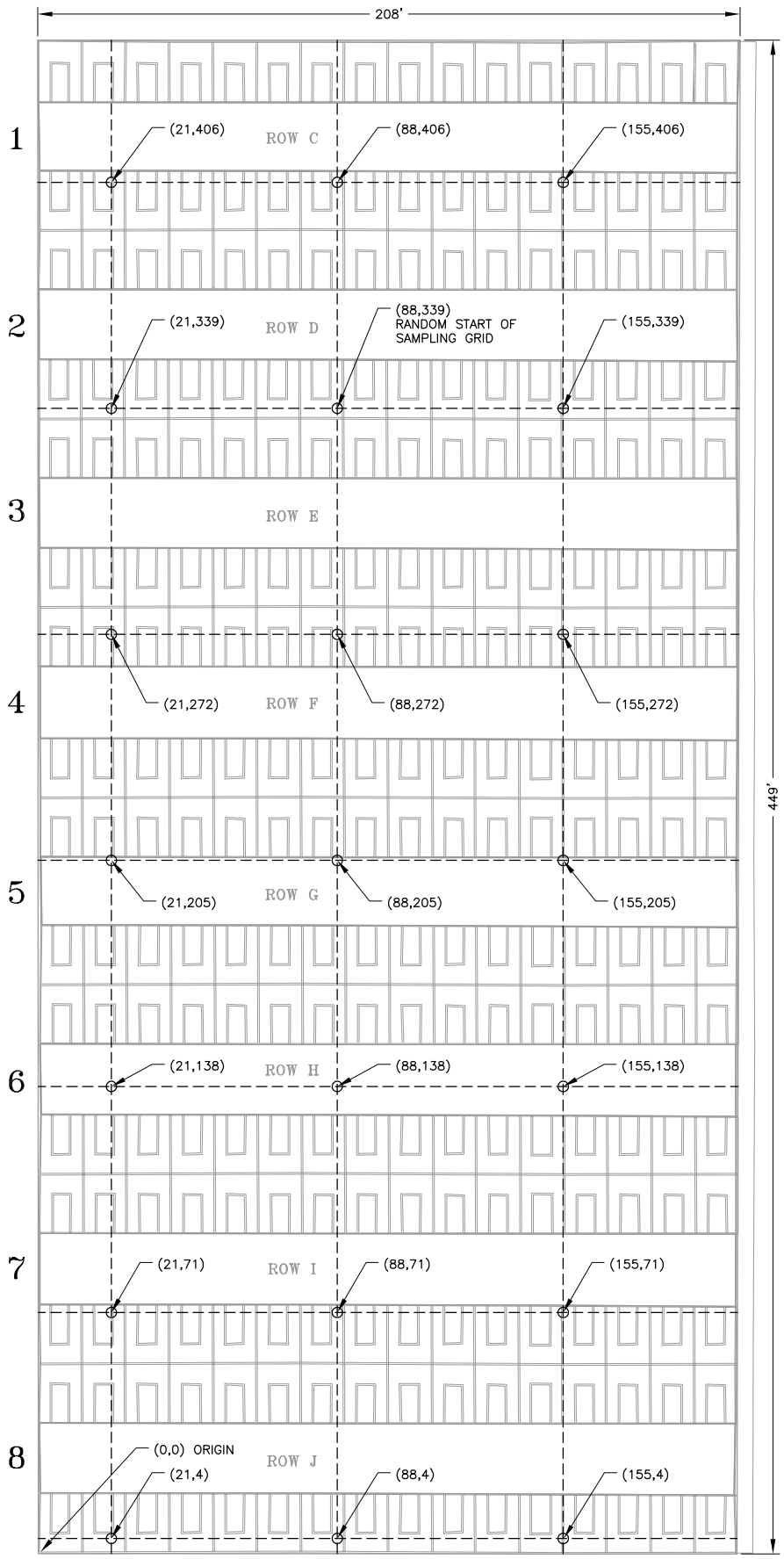


Figure 4-3. Western Dog Pens Removal Action Field Excavation Decision Flowchart

Weiss Associates

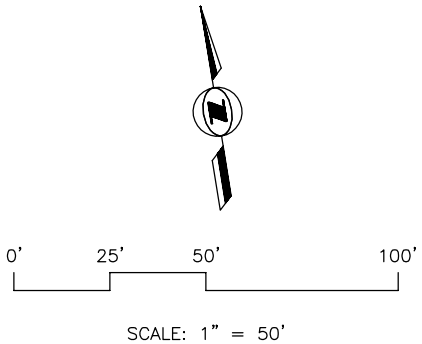


LEGEND

(21,4) LOCATION OF CONFIRMATION SAMPLE (COORDINATES IN FEET).

ORIGIN LOCATED AT SOUTHWEST CORNER OF PENS.

GRID SPACING = 67 FEET
NUMBER OF SAMPLES = 21



SCALE: 1" = 50'

WEISS ASSOCIATES	SCALE: 1" = 50' PROJECT. NO. 128-4006-232 DATE: 11/01/02 - 4:49pm L:\LEHR\4006\4006-017.dwg	L E H R DOG PENS REMOVAL ACTION WORK PLAN DOE CONTRACT NO. DE-AC03-96SF20686	PROPOSED CONFIRMATION SAMPLE LOCATIONS FOR THE WESTERN DOG PENS REMOVAL ACTION	FIGURE 4-4

5. WASTE MANAGEMENT

This section provides information for managing material and waste streams associated with the WDPs RA. A general description of the LEHR waste management system is provided followed by RA-specific waste management guidance that is structured to provide specific practices for each waste stream for the following activities:

- Excavation,
- Sorting, packaging and storage,
- Labeling and tracking,
- Inspection and radiological surveys,
- Disposal,
- Sampling and characterization,
- Data validation and compilation,
- Waste designation, and
- Profiling.

5.1 Program Description

In general, the initial determination of waste type and management of waste materials is dictated by process knowledge and relevant analytical data from waste streams of similar origin. Management practices are supported by the collection of additional analytical data. Once validated, analytical data are used to accurately characterize and designate material and waste streams. Waste designation, in the form of a report submitted to the LEHR project file, determines final storage locations, physical inspection schedules and, if required, radiological survey schedules. Waste designation also initiates profile generation according to the disposal facility's waste acceptance criteria (WAC). This waste stream profile distills process knowledge and analytical data into a concise format that is used by project staff to gain acceptance of RA waste streams to selected facilities.

5.1.1 Definitions

The following terms are defined as follows:

- *Waste*—Any material, solid or liquid, generated as a result of the RA that requires disposal.
- *Material*—Any material, solid or liquid, generated as a result of the RA that may be reused, recycled or requires off-site disposal as non-regulated waste.
- *Hazardous Waste*—Waste that meets the HW definition under the EPA Resource Conservation and Recovery Act, 40 CFR Part 261; California

Hazardous Waste Regulations in Title 22 of the California Code of Regulations; and DOE Orders.

- *Low-Level Radioactive Waste,* also referred to as *Low-Level Waste*—Waste that contains radioactivity and is not classified as high-level waste, transuranic (TRU) waste, spent nuclear fuel or 11E(2) by-product material as defined by DOE Order 435.1. A test specimen of fissionable material irradiated for research and development only, and not for the production of power or plutonium, may be classified as LLW provided the concentration of TRU materials is less than 100 nanoCuries per gram (DOE Order 435.1).
- *Mixed Waste*—Waste classified as both LLW and HW (federal and state) based on the definitions above.
- *Non-Hazardous Waste*—Waste that does not meet the definition of applicable federal and/or state HW laws and regulations.

5.1.2 Applicable Standard Operating Procedures

The SOPs applicable to WDPs RA waste management are:

- SOP 1.1, Chain-of-Custody;
- SOP 2.1, Sample Handling, Packaging and Shipping;
- SOP 6.1, Sampling Equipment and Well Material Decontamination;
- SOP 12.1, Soil Stockpiling;
- SOP 17.1, Sample Labeling;
- SOP 17.2, Sample Numbering;
- SOP 18.1, Field Quality Control Sampling;
- SOP 19.1, On-Site Sample Storage;
- SOP 20.1, Sample Containers, Preservation and Holding Times;
- SOP 21.1, Data Validation;
- SOP 24.1, Radiological Areas and Postings;
- SOP 25.1, Radiological Surveys and Instrumentation;
- SOP 32.1, Contamination Control;
- SOP 34.1, Waste Processing and Packaging;
- SOP 34.2, Low-Level Radioactive Waste Storage;
- SOP 34.3, Waste Shipment;
- SOP 34.4, Clean Waste Handling;

- SOP 34.5, Waste Tracking System;
- SOP 35.1, Waste Certification; and,
- SOP 39.1, LEHR Site Inspection.

5.1.3 Key Personnel Responsibilities

Proper management of WDPs RA waste streams requires contributions from various LEHR project team members. The waste management organizational chart is presented in Section 4 of the Draft Radioactive Waste Management Plan (WA, 2000h).

5.1.4 Waste Minimization

The LEHR Waste Management Program is committed to minimizing waste volumes at the Site by giving preference to source reduction, material substitution, decontamination, and recycling. Waste minimization activities applicable to the WDPs RA include:

- Avoiding use of porous materials that cannot be decontaminated;
- Minimizing PPE waste through effective worker logistics;
- Using real-time analysis to delineate extent of contamination and to segregate and sort material based on contamination levels;
- Optimizing waste container utilization and recycling;
- Using equipment decontamination solutions such as dust suppressant on contaminated soil/debris excavations and stockpiles;
- Removing surface contamination from contaminated material; and,
- Reusing uncontaminated soil and materials on site.

5.2 Western Dog Pens Removal Action Guidance

5.2.1 Waste Stream Descriptions

During the WDPs RA, it is assumed that non-hazardous (NH) waste and material, LLW and mixed waste (MW) will be generated. Table 5-1 summarizes anticipated waste streams and authorized storage areas. WDPs RA material/waste streams are described below.

- *Low-Level Waste*—Excavation of LLW is anticipated during the WDPs RA. Potentially contaminated asphalt, gravel, concrete and soil will be excavated

from the WDPs. Gravel, asphalt and concrete will be transported to either a processing area for rubblizing or directly to a stockpile as the excavation proceeds. Asphalt will be removed from the area and stored in an HDPE-covered stockpile in the former Co-60 Field pending analysis. Soil removal will be minimized to reduce waste volumes and disposal costs. Due to the porous nature of the deteriorating metal, the metal grates will be directly loaded into the appropriate LLW containers. The existing perimeter fence, which is likely NH waste, will be handled as LLW pending the completion of radiological surveys.

- *Mixed Waste*—No HW is anticipated in the WDPs. All potential HW, specifically asphalt and surface soil from Aisle 3, will be managed as potential MW because it was removed from a radioactive material management area. Materials from this area may contain added radioactivity based on the operational history of the area. As a best-management practice, we assume that radiation has been added to these materials until analytical data have been evaluated and the waste has been designated.
- *Non-Hazardous Material and Waste*—Surface soil and gravel in the WDPs are likely to be characterized as NH waste and material. Soil will be segregated from gravel with a mechanical sifter and delineated with the use of the on-site laboratory. In addition, some concrete, asphalt and decontamination water will also be excavated and/or accumulated, that will likely be considered NH waste and material. Concrete removed outside of the RA area will be direct-loaded and disposed at a sanitary landfill. Decontamination water will be stored in 55-gallon drums and removed from the RA area following the conclusion of RA activities. The existing perimeter fence will be radiologically surveyed and stockpiled pending evaluation of disposition options, which may include reuse or recycling pending the resolution of the DOE moratorium on the release of metals. Contamination detected during these surveys will be removed and handled as LLW.

5.2.2 Sampling and Characterization

All potentially impacted waste streams will be sampled for waste characterization purposes to determine the ultimate disposition of the waste. Sampling and analysis will be conducted in accordance with appropriate QC with the intent of obtaining the data necessary to meet the WAC for the selected disposal facility. Material with a potential for reuse may also be sampled to meet the acceptance criteria of the receiving facility.

5.2.2.1 Non-Hazardous Waste

Material assumed to be clean through process knowledge or the use of the on-site laboratory and intended to be reused on site, shall be sampled according to SOP 34.4, Clean Waste Handling.

Stockpile sampling will be performed as defined in the *Addendum to Sampling and Analysis Plan for Chlordane Stockpile Characterization* (WA, 1998c) (Table 5-1).

5.2.2.2 Low-Level Waste

Material assumed to be impacted with radioactive constituents will be sampled and characterized to meet the WAC of the selected waste facility.

5.2.2.3 Mixed Waste

Material assumed to be impacted with hazardous and radioactive constituents will be sampled and characterized to meet the WAC of the selected waste facility.

5.2.2.4 Decontamination Waste

Composite samples will be collected from remaining RA decontamination water not used for dust suppression to meet the WAC of the UC Davis Wastewater Treatment Facility (Tables 5-1).

5.2.2.5 Quality Assurance/Quality Control

In all cases, duplicate samples will be collected at a frequency of 10%, and equipment rinseate samples will be collected to comply with the objectives of the QAPP (WA, 2000b).

5.2.2.6 Data Validation and Compilation

Samples collected for laboratory analysis will be analyzed by General Engineering Laboratories, Inc. in Charleston, South Carolina. These results will be validated by the Project Chemist and/or designee in accordance with SOP 21.1, Data Validation. Once validated, the data will be transferred to the project database in accordance with procedures described in the QAPP (WA, 2000b) and provided to the WC and WS for use in waste designation.

5.2.3 Labeling and Tracking

Data for all WDPs RA waste and material streams will be incorporated into the LEHR Waste and Material Tracking System per SOP 34.5, Waste and Material Tracking System.

5.2.4 Inspection and Radiological Surveys

All waste and material packages/stockpiles will be inspected and surveyed per SOP 34.2, Low-Level Radioactive Waste Storage, and SOP 39.1, Waste Management Program Inspection.

5.3 Waste Designation

Preliminary waste designation is provided in Table 5-1. This designation will be updated by the WS. The WS will use validated analytical data and process knowledge of RA waste streams to certify and designate waste as NH material and waste, HW, LLW or MW. This designation process determines the practices required to properly manage RA waste streams in accordance with LEHR SOPs and applicable federal and state requirements. Three designation reports addressing all waste stream types will be prepared for the WDPs RA. The designation process is described in SOPs 34.4, Clean Waste Handling; 35.1, Waste Certification; and 35.2, Waste Characterization for Off-Site Shipments.

5.4 Profiling

The purpose of the waste profiling process is to verify that the selected disposal facility WAC are met. One LLW and one MW profile are planned for the WDPs RA waste streams as shown in Table 5-1. A complete description of the profile process is provided in SOP 35.1, Waste Certification for Off-Site Disposal.

5.5 Disposal

All waste disposal documents, including but not limited to waste manifests, bills of lading, waste profiles and DOE commercial facility exemption packages, will be completed in accordance with SOP 34.3, Waste Shipment. Staging, loading, and hauling of RA waste streams will be conducted in accordance with all applicable federal and state regulations and in accordance with SOP 34.3, Waste Shipment.

Table 5-1. Waste Types, Volumes and Management for the Western Dog Pens Removal Action

Site Setup

Description	Ex Situ Volume (cu. yds.)	No. of Containers	Container Type	Storage Location	Preliminary Designation [1]
Misc. Debris	12	1	roll off (12 cu. yd.)	NR	NH
Decontamination Water	50 gal	1	55-gal. drum	Geri-1	UCD

Asphalt Removal

Description	Ex Situ Volume (cu. yds.)	No. of Containers	Container Type	Storage Location	Preliminary Designation [1]
Asphalt (Aisles 1-2, 4-8)	750	1	Stockpile	Co-60	LLW
Asphalt (Aisle 3)	107	13	Lift Liner	Co-60	MW
Decontamination Water	50 gal	1	55-gal. drum	Geri-1	UCD

Metal Grates

Description	Ex Situ Volume (cu. yds.)	No. of Containers	Container Type	Storage Location	Preliminary Designation [1]
Metal Grates	21	7	B-25	Co-60	LLW
Decontamination Water	50 gal	1	55-gal. drum	Geri-1	UCD

Fencing

Description	Ex Situ Volume (cu. yds.)	No. of Containers	Container Type	Storage Location	Preliminary Designation [1]
Cyclone Fencing	24	1	Stockpile	Co-60	NH
Decontamination Water	50 gal	1	55-gal. drum	Geri-1	UCD

Concrete

Description	Ex Situ Volume (cu. yds.)	No. of Containers	Container Type	Storage Location	Preliminary Designation [1]
Concrete Curbing/ Post Mounts	986	1	Stockpile	WDP	LLW
Decontamination Water	150 gal	3	55-gal. drum	Geri-1	UCD

Gravel and Soil

Description	Ex Situ Volume (cu. yds.)	No. of Containers	Container Type	Storage Location	Preliminary Designation [1]
Gravel	1,825	1	Stockpile	WDP	NH
Decontamination Water	150 gal	3	55-gal. drum	Geri-1	UCD

Note

[1] Material/waste designation and the evaluation of disposition options will be provided in the Waste Management Addendum.

Abbreviations

Co-60 = Former Cobalt-60 Field
Geri-1 = Geriatrics Building No. 1
LLW = Low Level Radioactive Waste
MW = Mixed Waste
NH = Non-hazardous waste
NR = Not required
UCD = University of California, Davis, Sanitary Sewer
WDP = Western Dog Pens

6. HEALTH AND SAFETY

H&S considerations for the activities at the WDPs incorporate the Integrated Safety Management System and are addressed by the following documents: the PHSP (WA, 2000k); Health and Safety Procedures (HSPs) (WA, 2000j) and SOPs (WA, 1999e); CPGERP (WA, 2000e); As-Low-As-Reasonably-Achievable (ALARA) Program (WA, 1999b), and RPP (WA, 1999d). The H&S considerations presented in this section coupled with the foregoing documents represent the H&S program required by 29 CFR 1910.120, HAZWOPER and 10 CFR 835, Occupational Radiation Protection.

6.1 Hazard Analysis

Hazards associated with field activities are identified and evaluated using the AHA process. The SC, together with the H&S and Radiation Control staff, identify potential safety and health hazards, and define controls necessary for the protection of personnel. This hazard identification and evaluation is documented for each task. Some activities, such as radiological field survey and contaminated soil and waste excavation, have been evaluated in the LEHR PHSP. Those activities specific to the WDPs RA are discussed in this Work Plan, and the associated AHAs are included in Appendix C2.

During the WDPs RA, the SC, SHSO, HSC, Radiological Control Manager, RSO, or RCT will monitor the Site for any changes in conditions that would require modification of hazard controls (i.e., PPE). In the event that changes arise in radiological or industrial H&S conditions that are not addressed by this Work Plan or referenced documents, any new hazards will be evaluated in an AHA.

6.1.1 Transfer to Waste Containers

Prior to beginning RA activities in the WDPs, all waste presently stored in the area must be transferred to the EDPs. This operation will involve moving soft-sided containers using a forklift and a specialized lifting frame. The tasks associated with this activity and the required hazard controls are detailed in Appendix C2.

A pine tree located in the pens south of Aisle 8 (Figure 3-4) will be removed to facilitate material/waste removal and to provide space for concrete staging during processing operations. The tree will be toppled with an excavator, cut into sections and loaded into a waste container. During the tree felling activity, the work area will be clear of all personnel except the excavator operator. A chain will be attached to the excavator with sufficient length to ensure that the tree does not fall onto

the excavator. The chain will be inspected and the load ratings verified prior to the operation. Once the tree has been felled, it will be cut into sections using a chain saw. Workers will be trained in proper chain saw operation and the saw will be inspected prior to use.

6.1.2 Underground Utilities

All available drawings, plans and diagrams will be reviewed for the existence and locations of underground utilities. UC Davis personnel will be interviewed to determine additional potential utility locations that may not be on existing maps. A qualified person will identify and mark the location of all underground utilities prior to commencement of any subsurface or intrusive activity described in Section 3. However, this may not completely eliminate the potential for encountering unmarked or mislocated underground utilities during the proposed activities. To minimize the dangers associated with such accidental encounters, the following precautions will be followed during removal activities:

- The main shutoff valve(s) or switch(es) for gas lines, water lines, and electric lines at each excavation and sampling location will be located prior to the start of work;
- Areas of potential concern will be identified prior to the start of work; and
- Samples will be collected using a hand auger in the first five ft of each boring after utilities are cleared.

Hand augering is one of the least intrusive and safest sampling methods that can be employed to sample soil in areas containing utilities.

6.1.3 Heavy Equipment Operation

A large part of the WDPs RA work includes removal of waste and material from the WDPs area using heavy machinery, such as excavators, loaders, backhoes, forklifts, and dump trucks. Various hazards associated with the operation of such construction equipment include:

- Collisions with buildings, other vehicles or pedestrians;
- Spotters or pedestrians caught in the pinch points of the bucket arms or the pivot areas of articulated machines;
- Load drops and spills on workers;
- Machine malfunction;
- Falls when mounting or dismounting or performing maintenance on the equipment; and,
- Falling objects.

General safety precautions should be observed when operating heavy equipment. Equipment should be operated slowly and with care, especially when traveling downgrade, when empty, or when traveling on uneven terrain. Accidents occur most frequently when reversing equipment, therefore additional caution should be exercised when reversing. The operator should be aware of the surroundings, use properly adjusted rear view mirrors and, when lighting is poor, use both front and rear lights or spotlights placed in the work area (see Table 5-5 of the PHSP for required work area illumination). A spotter should be utilized whenever the operator's visibility is impaired. The drive train should never be put into reverse gear without looking behind the equipment. Back-up alarms and horns should be inspected daily and be functional. Work should be stopped and the horn used if anyone is observed in the equipment's danger zone.

The operator should always use the three-point contact rule when climbing onto or off heavy equipment: both feet and one hand, or one foot and both hands, should be in contact with the ladder access at all times. No one other than the operator should ride in or on the equipment, unless the equipment is designed to carry a passenger. The equipment cage is designed to protect the operator in the event of rollover as long as the operator is inside the cage, with the seat belt fastened.

Extreme caution should be used when operating articulated extensions to prevent an injury in a pinch point at the pivot. Operators should always check both sides of the machine before moving it to make sure no one is in this danger area. The heavy equipment work area should be demarcated using barricade tape or traffic cones and only spotters should be allowed in the area. The spotter should exercise caution, especially when there is a raised attachment (e.g., bucket). The spotter should never walk under any raised attachment.

6.1.3.1 Communication

Good communication between the operator and a spotter is essential for safe operation of construction equipment. Two-way radios should be used when feasible to ensure clear communication. If the use of radios is impractical, a standardized set of hand signals must be used. All ground-based workers in the vicinity of heavy equipment should wear high visibility vests to help the operator locate them quickly. The equipment should have a back-up warning alarm that can be heard by all nearby workers.

6.1.3.2 Training and Inspections

Equipment operators must be properly trained in the use of heavy equipment and must inspect the equipment daily as defined in HSP 1.1, Health and Safety Forms. Additional safety information specific to equipment safety is available in Section 5 of the PHSP.

6.1.4 Overhead Electrical Lines

There are no overhead electrical lines in the WDPs. However, there are energized 1.2 kilovolt overhead lines approximately 30 ft above ground near the entrance to the former Co-60 Field storage area and adjacent to the import fill stockpile (Figure 3-3). Equipment traveling in these areas

will avoid travel under the electrical lines to the extent feasible. When equipment is required to travel under the electrical lines, all parts of the equipment will be positioned to maintain a 10-ft minimum vertical clearance. A notice of the 10-ft minimum vertical clearance will be provided to the equipment operator and posted in the cab of the equipment.

6.1.5 Equipment Fueling Operations

The discharge of static electricity while dispensing fuel is a serious hazard that can potentially result in a catastrophic fire or explosion. All piping, tanks, valves and dispensing equipment must be bonded continuously so that all non-current-carrying metal parts have the same potential to ground. This is especially important at the dispensing hose and nozzle because fuel passing through a hose creates static electricity. The risk of static electricity discharge is greatest when the nozzle is being removed from the tank being filled.

All dispensing equipment including pumps, hoses and nozzles must be UL-listed for the intended usage. Pumping fuel from a truck requires that a bonding wire be attached anytime flammable liquids are discharged into a top fill tank. Trucks are insulated from ground by rubber tires, so when a bonding wire is attached to the tank being filled, a continuous path to ground is provided. Because the length of time required for static electricity to dissipate varies, removing the bonding wire before static electricity is dissipated can create a spark. Grounding the truck in addition to bonding to the tank being filled addresses this issue, is required by OSHA and is prescribed in National Fire Protection Association guidelines. Allowing a few minutes to elapse before removing nozzles when the pumping is complete helps to ensure that static electricity has dissipated.

Diesel fuel is exempt from bonding requirements. However, when diesel fuel is pumped into a container that has previously held a higher-grade product, bonding and grounding are necessary.

6.1.6 Concrete Demolition and Mechanical Sifting

Breaking, cutting, and crushing concrete curbs in the WDPs and sifting material/waste will likely generate airborne dust. A light mist will be maintained during these processes to reduce the potential for fugitive dust and potential worker exposure, while maintaining the material/waste at an acceptable moisture content (i.e., no free liquids) for storage and disposal. Dust exposure will be controlled by the use of water spray or other wetting methods. Continuous monitoring of the dust levels will be performed to ensure that Action Levels and OSHA permissible exposure limits (PELs) listed in Table 6-1 are not exceeded. If dust exposure cannot be kept below the Action Levels presented in Table 6-1, respiratory protection will be used.

6.1.7 Stockpile Management

Material/waste storage cells will be constructed in the pen areas between Aisles 5 and 6, and between Aisles 6 and 7 (Figure 3-3). Material/waste will be stockpiled in these cells up to ten ft high. The stockpiles will be sloped with a maximum slope of 30 degrees to prevent material from sliding. A 30-degree slope meets OSHA sloping requirements for excavations less than 200-ft deep with Type C soil and provides a conservative stockpile management approach. The stockpiles will be covered with HDPE. Personnel will be instructed to use care when walking on top of and around the stockpiles. If samples need to be collected from the stockpiles, they will be collected from the surface of the stockpile and care will be taken to minimize any potential for material movement. At least six ft of clearance will separate individual stockpiles to allow for safe access.

6.1.8 Trips and Falls

The WDPs area contains uneven surfaces, with many holes, sharp pieces of metal grating, nails, broken concrete curbs and shrubbery. While most of the removal work in the area will be performed with heavy equipment, there may be tasks that require workers to be on the ground. In such cases, the potential for injury due to trips and falls can be high. Prior to any on-the-ground activity, workers will be instructed to exercise extreme caution when working in the area. They will be periodically reminded of the hazards. When possible, the potential trip hazards will be cleared from the immediate work area to provide a more stable ground surface for work activities such as manual shoveling or spotting the equipment operation.

6.1.9 Material Handling

Some of the activities associated with the WDPs RA require handling of heavy materials, including tools, sheet plywood and concrete pieces. When loading or unloading materials or tools, care should be taken to avoid bending, twisting or carrying loads for long distances. HSP 10.1, Manual Lifting, provides additional detail on safe lifting practices.

6.1.10 Repetitive Motion Hazards

Installation, repair and maintenance of the perimeter fencing and manual sample collection involve the use of hand tools such as screwdrivers, hammers and augers. Steady and prolonged use of hand tools can involve a constant twisting of the wrist. Activities that require repetitive hand or wrist motion will be alternated with other tasks to the extent practical. Battery-operated screw guns and other mechanized tools will be considered when the use of manual tools is expected to be continuous. For prolonged activities using a hammer, hammers with wooden handles will be provided as they tend to transmit less vibration than steel and fiberglass hammer handles. When using vibrating tools, special gloves that "dampen" vibration will be provided.

For activities involving the use of a shovel, such as clearing gravel from areas inaccessible to heavy equipment, the workers will be instructed to alternate the left hand and right hand forward to reduce the repetitive stress by allowing muscles on both sides of the body to share the work.

6.1.11 Puncture Hazards

Due to the potential presence of sharp metal grating and nails in the WDPs, steel-toed safety shoes conforming to American National Standards Institute (ANSI) Z41.1/75 are required for work in the WDPs. Gloves are required when manually handling material presenting a puncture hazard.

6.1.12 Biological Hazards

The WDPs area may house brown recluse spiders, black widow spiders, rabid animals (mice, rats, etc.), rattlesnakes, deer ticks carrying lyme disease, ticks carrying rocky mountain spotted fever, and scorpions. Boots are required for work in the WDPs. Gloves will be worn if workers are required to place their hands in areas of potential biological hazard (e.g., brush, bushes, or under concrete). Additional measures for protection against biological agents described in Section 5.4.5.1 of the PHSP will be implemented as necessary when required by the SHSO.

6.1.13 Radiological Exposure

The material/waste removed from the WDPs may contain low levels of radioactivity. Based on previous investigations and RAs, the radionuclides of concern from an H&S perspective appear to be limited to Ra-226 and Sr-90. The potential for occupational exposure to these radionuclides appears to be minimal and mostly limited to hot spots in the concrete curbing.

Removal, stockpiling, sorting, packaging and sampling activities may result in exposure to radioactive materials through contact, ingestion and inhalation. Exposure to radionuclides will be monitored and controlled by the RCTs in accordance with the LEHR RPP. Gross alpha, beta, and gamma radioactivity readings will be collected by RCTs using field instruments to identify the presence of radionuclides above background levels that may pose an occupational hazard. Ingestion of radionuclides will be minimized by use of proper PPE (gloves) and personal hygiene (washing of hands and face). Area air monitoring will be conducted to determine potential exposure to airborne radioactivity (Section 6.2.9 of this Work Plan and Section 11 of the PHSP). The PPE level described in Section 6.2.3 may be modified based on monitoring results.

Dose limits for radiation exposure are listed in Table 1 of HSP 15.1, External Radiation Exposure Control. The action level for airborne radioactivity will be 10% of the derived air concentration (DAC) as shown in Table 6-1 of this Work Plan and as discussed in Section 6 of the PHSP.

Engineering controls will be used wherever possible to reduce the potential for internal and external exposure to ALARA levels. The use of administrative procedures for the control of occupational radiological worker exposures is not anticipated for this project. Applicable ALARA principles and procedures are presented in the ALARA Program (WA, 1999b) and will be discussed with the workers during on-the-job training.

Occupational radiological exposure in exceedance of regulatory limits is not likely for the proposed RA tasks. LEHR occupational radiation exposure monitoring programs for routine occupational exposure are not required at LEHR, as presented in the technical basis documents that address Site parameters and activities. Therefore, RA activities are not likely to result in radiological exposure, assuming that the standard/appropriate engineering controls are in place. Radiological field surveys and area air monitoring are performed during RA activities to ensure that these assumptions remain valid and to confirm that occupational exposure monitoring is not required for occupational compliance purposes.

6.1.14 Chemical Exposure

Due to the fact that chlordane-impacted soil was stockpiled in Aisle 3 of the WDPs, chlordane may be encountered at levels of concern during the RA activities. Because of uncertainty of the chlordane levels in this aisle, respiratory protection will be used by workers performing remediation activities on the ground in Aisle 3 to ensure that the PEL is not exceeded. Chlordane contact with exposed skin will be controlled by the proper use of PPE. Aside from chlordane, no other chemicals of occupational concern have been identified in the WDPs.

Concrete demolition, waste removal, stockpiling, sorting, packaging and sampling activities may present an inhalation exposure to nuisance dust. Real-time nuisance dust (total) air monitoring will be performed using field instruments and the data will be evaluated for any potential occupational hazard. Engineering controls, such as water spray, will be used to reduce the potential exposure to nuisance dust. If nuisance dust levels cannot be maintained below the Action Levels with engineering controls, respiratory protection will be required.

6.1.15 Heat Stress

The WDPs RA is scheduled to be performed between May and October when wearing PPE may put workers at risk of heat stress. All workers will have medical clearance prior to working on site and will be required to undergo an acclimation period. Heat stress prevention will include the following mitigation measures:

- Proper rest prior to work,
- Scheduled breaks,
- Appropriate water intake,
- Shaded work/rest areas when feasible, and
- Rotation of heavy work tasks.

A work/rest regime established in accordance with Section 5 of the PHSP will be implemented to prevent heat-related injuries. A Wet Bulb Globe Temperature (WBGT) instrument will be used to monitor weather conditions. Estimated employee work loads for each anticipated RA activity (expressed in calories expended per hour) are provided in Table 6-2 and will be used in conjunction with the WBGT readings to adjust the work/rest cycle as required by the PHSP and HSP 3.1, Working in Hot Environments. Integrated heat stress monitoring will be performed daily and may require modification of this regimen. Body temperature, heart rate and the physical appearance of workers will be monitored as discussed in Section 5 of the PHSP and detailed in HSP 3.1, Working in Hot Environments.

To minimize the effects of heat-related injuries, an area will be established to conduct entrance/exit activities, sample preparation and other support functions. This area will be covered with a portable tarp, when necessary, to provide the workers with shade. During the TSMs, the SHSO will communicate to the workers the signs and symptoms of heat stress, appropriate engineering controls, and the need to replenish body fluids. The buddy system will be used to help monitor heat stress symptoms.

6.1.16 Noise Exposure

High noise levels from equipment, such as jackhammers and percussion hammers used to demolish the concrete sidewalk at the eastern perimeter of WDPs, can create noise in excess of maximum permissible levels of 85 decibels (dBA) time-weighted average (TWA). Long term exposure to excessive noise may cause permanent hearing loss. Hearing protection will be required and provided when noise levels exceed a TWA of 85 dBA in accordance with Section 5.4.3.3 of the PHSP.

6.2 Hazard Controls

The following control measures will be implemented during the WDPs RA to supplement the requirements of the PHSP and the QAPP.

6.2.1 Hazardous Work Permit

Hazardous work permits (HWPs) will be used to control work in areas where hazardous conditions may exist. An HWP will be issued in accordance with the procedures specified in the PHSP (WA, 2000k) and in accordance with HSP 17.1, Hazardous Work Permits. The following information will be described or referenced in the HWP.

6.2.2 Boundaries

The work areas will be enclosed by temporary fencing. Additional boundary ropes or tape supported with stanchions may be used to delineate internal work area boundaries as determined necessary by the RSO and/or the SHSO. The boundaries will be set up in a manner that facilitates personnel and equipment access to the work area. Appropriate signs will be posted in accordance with the PHSP and the RPP.

6.2.3 Personal Protective Equipment

Workers in the CA will wear the modified Level D PPE identified below, unless otherwise specified in an HWP.

Modified Level D PPE will consist of the following when specified in the HWP:

- Coveralls (chemical-resistant or Tyvek®)
- Steel-toed boots;
- Boots or boot covers (chemical-resistant or Tyvek®)
- Inner and outer gloves (chemical-resistant or Tyvek®);
- Full tape of wrists and ankles Safety glasses with side shields;
- Leather work gloves, as necessary; and,
- ANSI-approved hardhat, if potential for overhead hazards or head impact hazards is present.

Chemical resistant PPE will be required only when potential for chemical skin exposure is present (e.g. work on the ground in Aisle 3). Tyvek® PPE will be required during concrete demolition and mechanical sifting activities and associated waste handling activities due to potential for skin contact with fixed radioactive contamination which can be disturbed during these activities.

6.2.4 Decontamination Procedures

A decontamination zone (DZ) for equipment and personnel will be established adjacent to the CA when workers are handling hazardous or mixed waste. The zone will be delineated with traffic cones and/or radiological barrier tape. The DZ will be posted with the appropriate warning sign. Decontamination procedures will be conducted in accordance with Section 10 of the PHSP for personnel decontamination, equipment decontamination and PPE decontamination.

Workers will survey themselves with radiological field instruments to ensure that they are free of radiological contamination before exiting the CA or DZ as appropriate. If contamination is

found, an RCT will be notified to determine the extent of contamination and direct/supervise radiological decontamination.

Equipment will be cleaned and surveyed for radiological contamination by an RCT prior to its removal from the CA/DZ, in accordance with Section 10 of the PHSP.

6.2.5 Training

All workers performing RA and support activities on site shall have completed the training required by Section 3.1.4 of this Work Plan in addition to training required by the PHSP, RPP and the QAPP. Additional training may be provided at the daily TSMs, which are required by the PHSP.

6.2.6 Buddy System

The buddy system will be utilized to protect personnel in the work area. At least two persons will be required to be in the work area when there is a potential for worker contamination or injury.

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

The responsibility of the buddy is to:

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

6.2.7 Safety Equipment

The following safety equipment will be staged in the support zone:

- First aid kit;
- Portable eyewash station and hand shower;

- Hearing protection;
- Spill kit;
- Air horn;
- Directions to medical facilities;
- Heat stress monitoring equipment;
- Portable radio for emergency communications; and,
- Fire extinguisher.

6.2.8 Spill Containment

A spill and discharge control plan has been prepared to address potential spills and discharges from handling and movement of potentially hazardous materials or waste during field activities. This spill and discharge control plan is in the PHSP and the CPGERP (2000e).

6.2.9 Air Monitoring

Air monitoring is essential to ensure that all field personnel are adequately protected from airborne contaminants. Air monitoring will be conducted in accordance with HSP 6.1, Air Monitoring; HSP 14.1, Airborne Radioactivity Monitoring; Section 11 of the PHSP; and the RPP.

General area radiological air monitoring locations will be established in areas having the highest potential for generating airborne radioactive contaminants. This monitoring will be conducted daily as may be required by the RSO.

If the general area air samples indicate that workers may be exposed to airborne radioactive contaminants that are >10% of the DAC, listed in 10 CFR 835, Appendix A, then personal air samples (8-hr TWA) will be used to monitor worker exposure and the RSO will take steps to reduce exposure through engineering controls.

All personal air monitoring samples and direct reading instrumentation readings taken for the purpose of determining appropriate H&S controls will be collected in the approximate "breathing zone" of site personnel and integrated over an appropriate time interval. As appropriate, selective monitoring of high-risk workers (i.e., those who are closest to the source of contamination) will be conducted.

Real-time continuous monitoring during RA activities will consist of visual observations, radiological surveys, and respirable dust readings. Air monitoring for radionuclides will be conducted daily during the RAs. Nuisance respirable dust and nuisance total dust TWA (8-hour OSHA) monitoring will be conducted if the field instruments indicate that action levels in Table 6-1

are exceeded and periodically to confirm the validity of real-time monitoring. TWA monitoring for chlordane will conducted during activities in Aisle 3 to meet the requirements of 29 CFR 1910.120.

All air equipment will be maintained and calibrated in accordance with manufacturer's recommendations, SOP 25.1, Radiological Surveys and Instrumentation, and HSP 14, Airborne Radioactivity Monitoring. Air monitoring will be conducted daily or until collected data are sufficient to predict exposures to airborne contaminants.

Table 6-1. Western Dog Pens Removal Action Airborne Radiological and Chemical Action Levels

Compound	Action Level (8-hr TWA)	OSHA PEL (8-hr TWA)	Action if Action Level is Exceeded
Radionuclides	10% DAC	—	Actions to include the following progressive steps for all compounds: • Notify SHSO and RSO of concentrations; • SHSO or RSO to stop work or apply engineering controls, as necessary; • SHSO or RSO to decide if upgrade of PPE to Level C with full-face respirators with organic/HEPA cartridges is necessary; and, • Ensure 8-hr TWA exposure is below PELs.
Nuisance Respirable Dust	2.5 mg/m^3	5.0 mg/m^3	
Nuisance Total Dust	7.5 mg/m^3	15.0 mg/m^3	
Chlordane	0.25 mg/m^3	0.5 mg/m^3	

Abbreviations

DAC	Derived Air Concentration
HEPA	High-efficiency particulate air
hr	hour
mg/m^3	milligrams per cubic meter
PELs	Permissible Exposure Levels
PPE	personal protective equipment
RSO	Radiation Safety Officer
SHSO	Site Health and Safety Officer
TWA	time-weighted average

Table 6-2. Estimated Employee Workload per Activity for the Western Dog Pens Removal Action

Activity	Workload (kcal/hr)
Hand Tool Operation (e.g. screwdriver)	120
Heavy Equipment Operation (e.g. excavator)	168
Manual Debris Removal	246
Sample Collection – Manual Sifting	246
Sample Collection with Hand Auger	306
Shoveling/Digging	516
Spotter – Standing and Spraying Water	120
Spotter – Walking	210
Waste Container Surveying	186

Abbreviation
kcal/hr kilo-calories per hour

7. QUALITY ASSURANCE

The objective of this section is to ensure that quality is integrated into project activities. This section provides guidance to project personnel in implementing the QAPP (WA, 2000b) and associated SQPs, as they are applicable to WDPs RA activities.

7.1 Roles and Responsibilities

The roles and responsibilities of key project personnel are described in Section 2.1 of the QAPP. Additional H&S responsibilities are also provided in Section 3 of the PHSP (WA, 2000k).

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 project 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, and provided to the PM and the PQAM.

7.2 Personnel Training and Qualification

Prior to the start of the RA, personnel training and qualification will be conducted and evaluated in accordance with Section 5 of the QAPP and SQP 3.2, Indoctrination and Training. Personnel training and qualification review will be required for all management and staff positions. Any training or qualification review that is required beyond H&S training for temporary subcontractor services will be determined by the PM and the PQAM.

The Program Manager, PM and Project Health and Safety Manager (PHSM) will review and approve project management and staff qualifications against the requirements listed in the project job descriptions. Following their review, documentation of staff qualifications (i.e., academic credentials, personal resumes, certifications and/or training records) will be attached to the approved job descriptions and filed in the project record.

Following the qualification review and prior to the start of field activities, job-specific required reading matrices (similar to Attachment 6.1 of SQP 3.2, Indoctrination and Training) (WA, 2000c) will be distributed to project personnel. These matrices will list all of the project documents and procedures that pertain to the RA, each of which will be marked with an "X" or an "O," depending on whether the reading material is required ("X") or recommended ("O") for a specific position. Project personnel will document their review of each document or procedure by initialing and dating the matrix. When the matrix is complete, it will be submitted to the PQAM for

review and approval. Once approved, the required reading matrices will be filed in the project record.

7.3 Field Documentation and Records Management

All quality-affecting records generated during the RA 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.

All records generated by project personnel must be complete, legible and written in ink. Corrections must be made with a single line, and documented with the initials of the person making the correction and the date the correction was made.

Field documentation will be collected and compiled on a daily basis by the SC or designee. Completed packages will be submitted to the Site Records Administrator (SRA) within three working days for a quality review, copying and filing. If a package is deemed unacceptable by the SRA during the quality review, it will be returned to the SC (or designee) for prompt correction prior to copying and filing. After records have been copied and filed in the project record, the originals will be forwarded to the Project Records Administrator for inclusion in the project file.

7.4 Test Control

Analytical and geotechnical testing will be performed and documented in accordance with Section 15 of the QAPP. The PQAS will verify that the tests have been ordered, performed and documented correctly.

7.5 Design Control

Project design calculations and drawings will be developed, reviewed, documented and filed in accordance with Section 10 of the QAPP. The PM will be primarily responsible for the implementation of design control requirements.

7.6 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 includes, but is not limited to, H&S monitoring equipment, radiological detection instruments and compaction testing gauges.

Measuring and test equipment shall be calibrated, source checked and maintained according to manufacturer specifications, or as specified by project documents, procedures or guidelines. Calibration and/or source check data shall be recorded each day calibrations and/or source checks 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/source checks are not within the tolerances specified by the manufacturer or by project documents, procedures or guidelines. Failed calibration results should be reported immediately to the PQAM.

7.7 Field Sampling

Field sampling will be conducted according to Section 4 of this Work Plan, and conform to the requirements of Section 8 of the QAPP and all applicable SOPs. The Sampling Manager will coordinate sampling activities in the field, report to the SC, and interface with the Project Chemist on a regular basis.

7.8 Procurement

All material, equipment and subcontractor services will be procured and received according to the requirements of the Federal Acquisition Regulations, the Department of Energy Acquisition Regulations, Section 7 of the QAPP and SQP 7.2, Receipt Inspection. The SC or designated Field Procurement Agent will initiate procurement actions through the Contracts Manager and document the receipt of all procurements in the field. Copies of all procurement documents that are generated in the field will be kept in the project contract files, the field office procurement file, and the daily field package for the day the document was generated.

7.9 Change Control

Changes to scope, schedule and cost will be documented in field work variances, as specified in Section 17 of the QAPP and SQP 11.1, Field Work Variance. Field work variances will be documented and tracked by the SC, and reviewed and approved by the PM. The PHSM and/or the PQAM will be consulted on any changes that have the potential to affect H&S and/or quality.

7.10 Inspections, Audits and Surveillances

Inspections, audits and surveillances will be conducted according to Sections 13 and 18 of the QAPP and SQP 3.3, Readiness Review Inspection, SQP 7.1, Quality Inspections and Inspection Records, SQP 12.1, Quality Audits, SQP 12.2, Management Assessment, and SQP 12.3, Quality Surveillances.

A readiness review will be conducted with DOE and project staff prior to the start of the RA, prior to major activities that were not covered during the initial readiness review or prior to resuming work after any significant work stoppages. All other activities will be addressed with preparatory phase inspections at the discretion of the PM and the PQAM.

Periodic inspections and section audits will be conducted by the PQAS or 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.

Third-party reviewers will also participate in audits and surveillances to maintain the integrity of the Quality Assurance Program and promote continuous improvement within the project. During the RA, an annual quality assurance system audit will be conducted and completed by the Executive Sponsor or designee, and periodic assessments will be performed by the Program and Project Managers. Project staff will also be assigned to conduct surveillances of tasks for which they are familiar, but not directly involved.

7.11 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. The PQAM will be notified immediately of potentially nonconforming conditions, so that the appropriate course of action can be determined (i.e., nonconformance report, stop work order, etc.). Nonconformances will be reviewed with project staff once the root cause, corrective action, and preventative measures have been identified and documented. Corrective actions will be submitted to the corrective action database for tracking pending verification of completion.

8. REFERENCES

U.S. Environmental Protection Agency (EPA), 1992, Statistical Methods for Evaluating the Attainment of Cleanup Standards, Vol. 3, EPA 230-R-94-004.University of California, Davis (UC Davis), 1994, Campus Standards and Design.

Weiss Associates (WA), 1998a, Technical Memorandum, Results of Data Gaps Investigation for the Laboratory for Energy-Related Health Research, January.

WA, 1998b, Technical Report: Results of Western Dog Pens, Background, and Off-Site Investigations at the Laboratory for Energy-Related Health Research (LEHR), University of California at Davis, June.

WA, 1998c, Addendum to Sampling and Analysis Plan for Chlordane Stockpile Characterization, LEHR, University of California at Davis, California, July.

WA, 1999a, Draft Technical Memorandum: Statistical Comparison of Western Dog Pen Soil Data with Risk-Based Target Levels for the Laboratory for Energy-Related Health Research (LEHR), University of California at Davis, California, June, Rev. A.

WA, 1999b, Final As Low As Reasonably Achievable (ALARA) Program for the Laboratory for Energy-Related Health Research (LEHR), University of California at Davis, California, Rev. 3, July.

WA, 1999c, Technical Memorandum: Investigative Results for the Former Eastern Dog Pens at the Laboratory for Energy-Related Health Research (LEHR), University of California at Davis, California, Rev. 0, September.

WA, 1999d, Final Radiological Protection Program for the Laboratory for Energy-Related Health Research (LEHR), University of California at Davis, California, Rev. 3, November.

WA, 1999e, Final Standard Operating Procedures for the Environmental Restoration/Waste Management Laboratory for Energy-Related Health Research (LEHR), University of California at Davis, California, December.

WA, 2000a, Addendum to Former Dog Pens Technical Memoranda for the Laboratory for Energy-Related Health Research, University of California at Davis, California, Rev. C, February.

WA, 2000b, Final Quality Assurance Project Plan for the Laboratory for Energy-Related Health Research, University of California, Davis, Rev. 3, June.

WA, 2000c, Final Standard Quality Procedures for the DOE Areas at the Laboratory for Energy-Related Health Research, University of California, Davis, June.

WA, 2000d, Work Plan for Removal Actions in the Southwest Trenches, Ra/Sr Treatment Systems, and Domestic Septic System Areas at the Laboratory for Energy-Related Health Research, University of California, Davis, Rev. 0, July.

WA, 2000e, Final Contingency Plan and General Emergency Response Procedures for the Laboratory for Energy-Related Health Research, University of California, Davis, Rev. 3, August.

WA, 2000f, Operating Procedure for Radium-226 Analysis by Gamma Spectrometer for the Laboratory for Energy-Related Health Research, University of California, Davis, Rev. 2, August.

WA, 2000g, Operating Procedure for Strontium-90 Analysis by Beta Scintillation Sensor for the Laboratory for Energy-Related Health Research, University of California, Davis, Rev. 2, August.

WA, 2000h, Draft Radioactive Waste Management Plan for the Laboratory for Energy-Related Health Research, University of California, Davis, Rev. B, September.

WA, 2000i, Draft Final Engineering Evaluation/Cost Analysis for the Western and Eastern Dog Pens at the Laboratory for Energy-Related Health Research, University of California, Davis, Rev. E, November.

WA, 2000j, Final Health and Safety Procedures for the DOE Areas at the Laboratory for Energy-Related Health Research, University of California, Davis, December.

WA, 2000k, Final Project Health and Safety Plan for the Laboratory for Energy-Related Health Research, University of California, Davis, Rev. 4, December.

APPENDIX A

LIST OF PROPOSED WORK PLAN PROCEDURES

Appendix A. List of Proposed Work Plan Procedures

No.	Title
SOP 1.1	Chain-of-Custody
SOP 2.1	Sample Handling, Packaging and Shipping
SOP 3.1	Surface and Shallow Subsurface Soil Sampling
SOP 4.1	Compaction of Fill Material
SOP 6.1	Sampling Equipment and Well Material Decontamination
SOP 6.2	Drilling, Development and Heavy Equipment Decontamination
SOP 7.1	Surface and Subsurface Geophysics
SOP 10.3	Sample Collection, Handling and Data Documentation for Field Analysis Using Gamma Spectrometer and Beta Scintillation Detector
SOP 12.1	Soil Stockpiling
SOP 17.1	Sample Labeling
SOP 17.2	Sample Numbering
SOP 18.1	Field Quality Control Sampling
SOP 19.1	On-Site Sample Storage
SOP 20.1	Sample Containers, Preservation, and Holding Times
SOP 21.1	Data Validation
SOP 24.1	Radiological Areas and Postings*[see RPP]*
SOP 25.1	Radiological Surveys and Instrumentation *[see RPP]*
SOP 25.2	Radiological Survey Forms (Update 1) *[see RPP]*
SOP 32.1	Contamination Control *[see RPP]*
SOP 34.1	Waste Processing and Packaging
SOP 34.2	Low-Level Radioactive Waste Storage
SOP 34.5	Waste Tracking System
SOP 37.1	Tennelec Series 5 Low Background Counting System *[see RPP]*
SOP 37.2	Liquid Scintillation Counter *[see RPP]*
SOP 38.1	Check-in and Orientation for Radiological Workers, General Employees and Members of the Public *[see RPP]*
SOP 38.3	Radiation Protection Records *[see RPP]*

Appendix A. List of Proposed Work Plan Procedures (continued)

No.	Title
HSP 1.1	Health and Safety Forms (Update 1)
HSP 2.1	Handling Drums and Containers
HSP 3.1	Working in Hot Environments
HSP 4.1	Trenching and Excavation
HSP 6.1	Air Monitoring
HSP 8.1	Use of Liquid Nitrogen
HSP 10.1	Manual Lifting
HSP 12.1	Safety and Health Signs and Labels
HSP 13.1	Electrical Safety
HSP 14.1	*Airborne Radioactivity Monitoring
HSP 15.1	* External Radiation Exposure Control
HSP 17.1	*Hazardous Work Permits
HSP 18.1	*Personnel Contamination (Update 1)
HSP 19.1	*Embryo/Fetus Protection Program
HSP 20.1	* Employee and Subcontractor Training Requirements
HSP 21.1	Respiratory Protection
SQP 3.2	Indoctrination and Training
SQP 3.3	Readiness Review Inspection
SQP 4.1	Document Control
SQP 4.2	Records Management
SQP 7.1	Quality Inspections and Inspection Records
SQP 7.2	Receipt Inspection
SQP 8.1	Calibration and Maintenance of Measuring and Test Equipment
SQP 10.2	Corrective Action
SQP 10.3	Stop Work Order
SQP 11.1	Field Work Variance
SQP 12.1	Quality Audits

Appendix A. List of Proposed Work Plan Procedures (continued)

No.	Title
SQP 12.2	Management Assessment
SQP 12.3	Quality Surveillances

Abbreviations and Notes

SOP = Standard Operating Procedure
SQP = Standard Quality Procedure
HSP = Health and Safety Procedure
RPP = Radiological Protection Plan

*These procedures and associated forms represent procedures developed to facilitate compliance with 10 CFR 835, Occupational Radiological Protection, and are contained in a separate binder along with other controlled documents dealing with the Radiological Protection Program.

The above list represents SOPs, SQPs and HSPs that are proposed to be used during the Removal Actions at the Dog Pens.

SQPs are not numbered sequentially. Therefore, a missing number in the above list does not signify that a SQP or associated form is missing. HSPs and associated forms may be revised, added, or deleted in accordance with the provisions of the Quality Assurance Project Plan and Project Health and Safety Plan. HSPs and associated forms are not numbered sequentially. Therefore, a missing number in the above list does not signify that a HSP or associated form is missing.

APPENDIX B

WESTERN DOG PENS REMOVAL ACTION CONFIRMATION SAMPLING DESIGN

B. REMOVAL ACTION CONFIRMATION SAMPLING DESIGN

B.1 Statistical Basis for the Removal Action Confirmation Sampling Design

Statistical methods were selected for RA confirmation sampling at the DOE areas of the Site to ensure that decisions regarding attainment of cleanup standards are made in a scientifically valid fashion. A statistical approach cannot declare with 100% certainty that cleanup standards are achieved. However, it is reasonable to assume cleanup criteria have been met if statistical tests show that the reference-based cleanup standard was achieved with an acceptable level of certainty. The statistical approach described in this appendix was taken from Statistical Methods for Evaluating the Attainment of Cleanup Standards (EPA, 1994) and the Multi-Agency Radiation Survey and Site Investigation Manual (EPA, 2000), and is intended for use for those contaminants for which cleanup at or near background is desired (e.g., Ra-226).

The statistical hypothesis testing procedure begins with the statement of a null hypothesis (H_o) and alternative hypothesis (H_a). These are:

- H_o: Reference-Based Cleanup Standard Achieved; and,
- H_a: Reference-Based Cleanup Standard Not Achieved.

The above hypotheses allow some cleanup unit measurements to be larger than reference area (background data set) measurements without rejecting H_o. In addition, the statistical tests recommended in the EPA statistical methods (EPA, 1994) are designed to determine whether cleanup unit measurements are significantly larger, as a whole, than reference area (background) measurements.

Associated with H_o are Type I and Type II decision errors. A Type I decision error (α) is the probability of rejecting H_o when it is true. In the context of the WDPs RA, α is the probability that the statistical tests will indicate the cleanup standard was not achieved when it actually was. A Type II decision error (β) is the probability of accepting H_o when it is false. In the context of the WDPs RA, β is the probability that the statistical tests will indicate cleanup standard was achieved when it actually was not achieved. Table B-1 illustrates the relationship between α, β, the actual condition of the cleanup unit, and the results of the statistical tests.

Table B-1. Decision Error Relationships

Result of Statistical Test, Based on Sample Data from Cleanup Unit	Actual Condition of Cleanup Unit	
	Standard Achieved	Standard Not Achieved
Test Indicates Standard was Achieved	Correct Test Result (Probability = $1 - \alpha$)	Incorrect Test Result Type II Error (Probability = β)
Test Indicates Standard was Not Achieved	Incorrect Test Result Type I Error (Probability = α)	Correct Test Result (Probability = $1 - \beta$)

The above table illustrates how often a statistical test may produce incorrect results. The test will be correct 100% of the time if α and β are equal to zero. However, the required number of test samples approaches infinity as α and β approach zero. Therefore, the test cannot be correct 100% of the time because an infinite number of samples cannot be collected.

To demonstrate achievement of the null hypothesis, H_o, a compromise must be made between the decision error rates α and β and the number of samples required to conduct the test. Decision error rates α and β of 0.2 and 0.1, respectively, were previously agreed upon by the LEHR RPMs. Estimates of the required number of samples based on these allowable decision errors are described in detail in Section B.2.

B.2 Estimation of the Required Number of Confirmation Samples

Ra-226 was selected as the indicator COC for estimating the number of confirmatory samples (n) to be collected in the WDPs. Ra-226 was selected because it's cleanup goal is background, and sample statistics for this constituent indicate it will result in the largest (most conservative) n value.

As recommended in the EPA statistical methods (EPA, 1994), the Wilcoxon Rank Sum (WRS) test, a non-parametric statistical comparison of two data distributions to determine whether there is a difference in the mean, will be the primary method to determine whether COC levels are below background. The WRS test requires a minimum number of samples, n, to be statistically valid based on the decision errors α and β. A secondary Hot Measurement Comparison, the comparison of data suspected to be "hot" to determine if the data is in agreement with hot measurement standards, will be used as necessary and appropriate to further confirm whether cleanup criteria have been met. However, that comparison does not have a minimum sample number requirement.

According to the EPA statistical methods (EPA, 1994), "cleanup unit" refers to the area undergoing RA while "reference area" refers to that area off-site representing the background area. The minimum required number of confirmatory samples is determined using the following steps:

1. Determine the permissible Type I error (α) and Type II error (β) for the statistical hypothesis. Values of $\alpha = 0.2$ and $\beta = 0.1$ were established (WA, 2000) for confirmation sampling in previously completed RA areas at the Site.
2. A relative difference of 30% was established (WA, 2000) for previously completed RAs at the Site.
3. Calculate the standard deviation (σ) of previously collected data from the WDPs.
4. Calculate the relative shift (Δ/σ).
5. Determine the probability (P_r) that a measurement performed at a random location in the survey area will result in a larger value than a measurement performed at a random location in the reference (background) area. P_r is a function of the relative shift.
6. Determine the percentiles $Z_{1-\alpha}$ and $Z_{1-\beta}$, represented by the selected decision error levels, α and β, respectively. These values can be found in tables of the cumulative normal distribution.
7. Calculate the total number of data points (N) for the cleanup unit (n) and reference area (m), where N = n + m. The formula for calculating N is shown below.

$$N = \frac{(Z_{1-\alpha} + Z_{1-\beta})^2}{12c(1-c)(P_r - 0.5)^2(1-R)}$$

where,

$Z_{1-\alpha} = 0.8418$

$Z_{1-\beta} = 1.282$

$c = 0.398$

$P_r = 0.7677$

$R = 0$

These parameters were used to predict N for Ra-226.

8. Calculate the minimum number of data points required in the cleanup unit and reference area using the equations n = (1 – c)N and m = cN, respectively.

Once the RA data are collected, the data set from the WDPs will be evaluated independently against the reference area data set using the WRS test. As stated above, the Hot Measurement Comparison will be used to further confirm whether cleanup goals have been met. The combined results of the WRS test and Hot Measurement Comparison will determine whether residual contaminants in the cleanup unit exceed the target cleanup goals.

B.1.1 Sample Number Calculation

The Noether calculation, which determines the number of samples required in the background and cleanup units based on statistical parameters, was run for Ra-226. Data were selected from previous investigation activities performed in the WDPs in 1994, 1997, and 1998. Sample collection, analysis, and validation details for these data sets are described in the Dog Pens EE/CA (WA, 2001). WDPs soil data were from depths less than or equal to two ft bgs for the Noether calculations because the proposed RA in the WDPs involves excavating native soil to depths ranging from 0.5 to 1.5 ft bgs.

The results of the Noether calculations indicate that a minimum of 14 samples are required. Applying a safety factor of 1.5 results in the total recommended sample count of 21.

To date, more than 100 WDPs soil samples have been analyzed for chlordane and about 96% of the results were below the RBAS. Since the RA activities are not expected to cause additional chlordane contamination, 21 samples (the prediction derived from Ra-226 statistics) plus four discretionary and additional hot spot sampling if staining is observed will be sufficient to supplement existing data to show that the RBAS has been attained. The WRS test isn't applicable to chlordane or Sr-90 because their RBASs are substantially higher than background.

The 21 samples will be collected at positions defined by a rectangular grid with a random start as described in Section B.3.

B.3 Removal Action Confirmation Sample Locations and Grid Spacing

Post-RA confirmation sampling will be performed when excavation is complete to verify that residual contaminant levels in the WDPs are below the cleanup standards, defined as either background or the RBAS. The RBAS is selected as the cleanup criterion when background is zero for a COC (as is the case for most organic compounds), or when the background value is below the RBAS.

A random-start grid sampling approach will be used. Confirmation samples will be collected from the WDPs area using a rectangular grid with a random start in a planar (x,y) coordinate system.

The random start location will be determined by selecting the origin of the coordinate system and determining the x and y coordinates of the random start. The random start x coordinate will be a random number between 0 and W and the y coordinate will be a random number between 0 and L, where W and L are the width and length of the area, respectively. The spacing between sampling points (a) in the rectangular grid is determined from the equation $a = (A/n)^{0.5}$ where A is W x L and n is the required number of samples. The calculated grid spacing for the WDPs confirmation sampling is 67 ft.

The predicted number of confirmatory samples (n) was determined in the statistical analysis presented in Section B.2. The proposed locations of the WDPs confirmation samples are shown in Figure 4-4.

B.4 References

United States Environmental Protection Agency (EPA), 1994, Statistical Methods for Evaluating the Attainment of Cleanup Standards, Vol. 3, EPA 230-R-94-004.

EPA, 2000, Multi-Agency Radiation Survey and Site Investigation Manual, EPA 402-R-97-016, Rev. 1.

WA, 2000, Sampling and Analysis Plan for Removal Actions in the Southwest Trenches, Ra/Sr Treatment Systems, and Domestic Septic Systems Areas for the Laboratory for Energy-Related Health Research, University of California, Davis, Rev. 0, July.

WA, 2001, Final Engineering Evaluation/Cost Analysis for the Western and Eastern Dog Pens at the Laboratory for Energy-Related Health Research, University of California, Davis, Rev. 0, February.

APPENDIX C1

ACTIVITY HAZARD ANALYSIS FOR THE EASTERN DOG PENS FENCE REPAIR

ACTIVITY HAZARD ANALYSIS

ACTIVITY: Eastern Dog Pens Fence Repair **ANALYZED BY/DATE:** Agata Sulczynski/ December 8, 2000 **REVIEWED BY/DATE:**

PRINCIPLE STEPS	POTENTIAL HAZARDS	RECOMMENDED CONTROLS
Fence repair	Back strain due to improper lifting of heavy objects (e.g., fence sections)	Workers will be trained in proper lifting techniques. Two or more people are required to lift objects weighing more than 60 pounds. Use of proper lifting equipment is limited to trained personnel as instructed by the SHSO. Inspect lifting equipment daily at a minimum.
	Slips, trips and fall	Workers will be instructed to pay close attention to uneven surfaces, grade changes or other slip, trip and fall hazards.
	Contact with contamination	Personnel will wear appropriate PPE to prevent skin contact with any form of contaminant.
	Injuries due to hand and power tools	Safety glasses will be worn when working with hand and power tools. Work gloves will be used as necessary to prevent blisters and cuts.
	Loud noise/communication when using power tools	When noise levels exceed 85 dBA (or wherever voices must be raised in order to be understood at arms' length), hearing protection must be worn. A Noise Reduction Rating of at least 25 shall be adhered to in the selection of hearing protection devices.
	Heat/cold stress	Workers will be properly trained to identify signs and symptoms of heat/cold stress. Drinking water and Gatorade will be available. Work shift duration will be designed appropriately for environmental conditions.

ACTIVITY HAZARD ANALYSIS

ACTIVITY: Eastern Dog Pens Fence Repair

ANALYZED BY/DATE: Agata Sulczynski/ December 8, 2000

REVIEWED BY/DATE:

EQUIPMENT TO BE USED	INSPECTION REQUIREMENTS	TRAINING REQUIREMENTS
Hand tools, power tools	Visual inspection of area prior to work. Daily visual inspection of hand and power tools. Lockout/Tagout procedures.	OSHA 40-hour, OSHA 8-hour refresher, and OSHA 8-hour supervisor training (as appropriate) are required. Workers will be trained in operation of hand and power tools and appropriate PPE. Rad Worker training and site-specific training will be provided for unescorted workers and visitors.

APPENDIX C2

ACTIVITY HAZARD ANALYSES FOR THE WESTERN DOG PENS REMOVAL ACTION

ACTIVITY HAZARD ANALYSIS

ACTIVITY: Western Dog Pens Removal Action—All Activities

ANALYZED BY/DATE: Agata Sulczynski/ December 8, 2000

REVIEWED BY/DATE:

PRINCIPLE STEPS	POTENTIAL HAZARDS	RECOMMENDED CONTROLS
All removal action activities	Heat stress	Workers will be properly trained to identify signs and symptoms of heat stress. Drinking water will be available. Work shift duration will be designed appropriately for environmental conditions.
	Contact with contamination	Personnel who may be exposed to ionizing radiation will, at a minimum, have completed the appropriate level of Radiological Worker training. All activities will be performed in accordance with the provisions of the HWP.
	Biological agents	Workers will be instructed to recognize potential biological agents (spiders, mice, etc.). Gloves to be worn if there is a need to place hands in areas where spiders, mice and other biological agents may be present.

EQUIPMENT TO BE USED	INSPECTION REQUIREMENTS	TRAINING REQUIREMENTS
PPE	Verify integrity prior to use	OSHA 40 hour, OSHA 8 hour refresher, and OSHA 8 hour supervisor training (as appropriate).
Water, cooling vests, other heat reducing "equipment"	Verify potability of water. Use cooling vests according to manufacturer's recommendations.	Not applicable (NA).

ACTIVITY HAZARD ANALYSIS

ACTIVITY: Western Dog Pens RA – Waste Transport to Cobalt-60 Field

ANALYZED BY/DATE: Agata Sulczynski/ December 8, 2000

REVIEWED BY/DATE:

PRINCIPLE STEPS	POTENTIAL HAZARDS	RECOMMENDED CONTROLS
Soft-sided-container loading	Impact due to loading frame failure	All personnel will stay at least one foot away from lifting the frame during loading.
Soft-sided container transport	Heavy equipment operations	Operators must be trained and experienced in use of heavy equipment operations. Loading area is to be clear of unnecessary personnel. Emergency equipment is to include portable radio, first aid kit, and fire extinguisher. Equipment must have seat and seat belts for all riders.
	Traffic accidents	All vehicle movements shall be monitored for location of obstacles. Trees will be trimmed as necessary (a separate AHA will be used for this operation). Back-up alarms will be operational. Traffic control is to be implemented, as appropriate, using cones and/or road signs. Ground personnel in high traffic areas are to wear traffic safety vests.
Soft-sided container unloading (by forklift)	Pinch points	Personnel will ensure that feet and hands are clear of all pinch points between the soft-sided container and the loading frame when the container is being removed from the frame. Workers will ensure the container is properly hooked to the lifting frame prior to lifting the container. If opening the loading frame, keep a safe distance from the moving wall of the frame (at least one foot).
	Injury with hand tools	Safety glasses and work gloves will be used by workers using a hammer to open the loading frame. The hammer will be inspected daily prior to use for integrity.
Soft-sided container storage	Slips, trips and falls	Workers will be instructed to pay close attention to uneven surfaces, grade changes or other slip, trip and fall hazards. Plywood platforms will be placed over uneven surfaces when practical, to minimize the hazards.

ACTIVITY HAZARD ANALYSIS

ACTIVITY: Western Dog Pens RA – Waste Transport to Cobalt-60 Field **ANALYZED BY/DATE:** Agata Sulczynski/ December 8, 2000 **REVIEWED BY/DATE:**

PRINCIPLE STEPS	POTENTIAL HAZARDS	RECOMMENDED CONTROLS
Soft-sided container storage (continued)	Falls from ladder	Ladders will be placed on even, sturdy surfaces. Workers will be trained in, and will observe, ladder safety. Ladders will be inspected on a periodic basis.
	Crushing	Containers will be placed to allow safe access for unhooking them from the loading frame. Workers will visually inspect each container after it has been placed to ensure that it is securely stacked prior to unhooking the loading frame.
B-25 box loading and transport	Heavy equipment operations – forklift	Operators must be trained and experienced in use of heavy equipment operations. The loading area is to be clear of unnecessary personnel. Emergency equipment is to include portable radio, first aid kit, and fire extinguisher. Forklifts must have seats and seat belts for all riders.
	Traffic	All vehicle movements shall be monitored for location of obstacles. Trees will be trimmed as necessary (a separate AHA will be used for this operation). Back-up alarms will be operational. Traffic control is to be implemented, as appropriate, using cones and/or road signs. Ground personnel in high traffic areas are to wear traffic safety vests.
	Vehicle use and traffic	All vehicle movements shall be monitored for location of obstacles. Trees will be trimmed as necessary (a separate AHA will be used for this operation). Field vehicles' emergency equipment will include portable radio, first aid kit, and fire extinguisher. Daily vehicle safety inspections are required prior to use. Vehicles will have seats and seat belts for all riders. Back-up alarms will be operational. Initiate traffic control by using cones and/or road signs, as appropriate, and wearing safety vests.

ACTIVITY HAZARD ANALYSIS

ACTIVITY: Western Dog Pens RA – Waste Transport to Cobalt-60 Field

ANALYZED BY/DATE: Agata Sulczynski/ December 8, 2000

REVIEWED BY/DATE:

PRINCIPLE STEPS	POTENTIAL HAZARDS	RECOMMENDED CONTROLS
B-25 box placement in storage	Slips, trips and falls	Workers will be instructed to pay close attention to uneven surfaces, grade changes or other slip, trip and fall hazards. Plywood platforms will be placed over uneven surfaces when practical, to minimize the hazards.

EQUIPMENT TO BE USED	INSPECTION REQUIREMENTS	TRAINING REQUIREMENTS
Loader/forklift	Daily vehicle safety inspections. Daily visual lifting equipment inspections. Visual inspection of area prior to work. Daily inspection of field vehicle emergency equipment.	Contractor to be trained on work routes. Only appropriately qualified personnel will be permitted to operate loader/forklift.
Hand tools	Daily visual inspection of hand and power tools	Workers will be trained in the proper operation of hand and power tools.
PPE	Inspection of PPE for integrity prior to donning	Workers will be trained in the proper use of PPE.

ACTIVITY HAZARD ANALYSIS

ACTIVITY: Western Dog Pens RA – Utility Protection/ Relocation

ANALYZED BY/DATE: Agata Sulczynski/ December 8, 2000

REVIEWED BY/DATE:

PRINCIPLE STEPS	POTENTIAL HAZARDS	RECOMMENDED CONTROLS
Utility line protection or relocation	Hazards associated with breach of potential natural gas lines, water supply lines, and electrical lines	Utility lines will be identified and marked before removal work begins. If utilities are present, workers will hand dig in several areas to expose the lines and verify the location of the utilities. Shut off valves will be located if feasible for any utilities expected. Utilities will be shut off before work begins in conformance with Lock Out and Tag Out procedures when possible and practical. The excavator bucket will keep at least one foot of horizontal distance from any identified line. If work around natural gas lines is necessary, a lower explosive level (LEL) monitor will be used to ensure that no natural gas build-up exists. If the LEL monitor shows >10% LEL, work will be stopped and procedures evaluated.

EQUIPMENT TO BE USED	INSPECTION REQUIREMENTS	TRAINING REQUIREMENTS
Line location equipment	Manufacturer's inspection requirements will be applied.	Line location equipment is to be used by qualified contractor/personnel.

ACTIVITY HAZARD ANALYSIS

ACTIVITY: Western Dog Pens RA – Fence Removal **ANALYZED BY/DATE:** Agata Sulczynski/ December 8, 2000 **REVIEWED BY/DATE:**

PRINCIPLE STEPS	POTENTIAL HAZARDS	RECOMMENDED CONTROLS
Removal of perimeter fence	Back strain due to improper lifting of heavy objects (e.g. fence sections)	Workers will be trained in proper lifting techniques. Two or more people required for objects weighing more than 60 pounds (lbs). Use of proper lifting equipment by trained personnel as instructed by the SHSO. Inspect lifting equipment daily at a minimum.
	Slips, trips and falls	Workers will be instructed to pay close attention to uneven surfaces, grade changes or other slip, trip and fall hazards.
	Injuries due to hand and power tools (e.g. puncture hazard from nails and screws)	Safety glasses will be worn when working with hand and power tools. Work gloves will be used as necessary to prevent blisters and cuts. Caution will be exercised when removing nails and screws.
	Cuts with sharp ends of fencing material	Work gloves will be worn to prevent cuts.
	Loud noise/communication when using power tools	When noise levels exceed 85 dBA (or wherever voices must be raised in order to be understood at arms' length), hearing protection must be worn. A Noise Reduction Rating (NRR) of at least 25 shall be adhered to in the selection of hearing protection devices.

EQUIPMENT TO BE USED	INSPECTION REQUIREMENTS	TRAINING REQUIREMENTS
Hand tools, power tools	Visual inspection of area prior to work. Daily visual inspection of hand and power tools.	Workers to be trained in operation of hand and power tools and appropriate PPE.

ACTIVITY HAZARD ANALYSIS

ACTIVITY: Western Dog Pens RA – Sidewalk Demolition and Removal

ANALYZED BY/DATE: Agata Sulczynski/ December 8, 2000

REVIEWED BY/DATE:

PRINCIPLE STEPS	POTENTIAL HAZARDS	RECOMMENDED CONTROLS
Demolition of sidewalk	Injury with jackhammer and/or saw-cutter	Equipment will be inspected prior to use. Personnel will be trained on the proper use of equipment. Safety glasses will be worn.
	Loud noise	When noise levels exceed 85 dBA (or wherever voices must be raised in order to be understood at arms length), hearing protection must be worn. An NRR of at least 25 shall be adhered to in the selection of hearing protection devices. Wherever possible, the use of barriers is encouraged.
Removal of demolished sidewalk	Heavy equipment operation – loader	Operators must be trained and experienced in the operation of heavy equipment. The loading area is to be clear of unnecessary personnel. Emergency equipment is to include a portable radio, first aid kit, and fire extinguisher. Equipment must have seats and seat belts for all riders
	Traffic	All vehicle movements shall be monitored for location of obstacles. Trees will be trimmed as necessary (a separate AHA will be used for this operation). Back-up alarms will be operational. Traffic control is to be implemented, as appropriate, using cones and/or road signs. Ground personnel in high traffic areas are to wear traffic safety vests.

ACTIVITY HAZARD ANALYSIS

ACTIVITY: Western Dog Pens RA – Sidewalk Demolition and Removal

ANALYZED BY/DATE: Agata Sulczynski/ December 8, 2000

REVIEWED BY/DATE:

EQUIPMENT TO BE USED	INSPECTION REQUIREMENTS	TRAINING REQUIREMENTS
Hand tools, power tools	Visual inspection of area prior to work. Daily visual inspection of hand and power tools.	Workers will be trained in operation of hand and power tools and appropriate PPE. Lockout/tagout procedures.
Heavy equipment operation	Daily vehicle safety inspections. Daily visual lifting equipment inspections. Visual inspection of area prior to work. Daily inspection of field vehicle emergency equipment.	Only qualified operators may operate the equipment.

ACTIVITY HAZARD ANALYSIS

ACTIVITY: Western Dog Pens RA – Tree Removal **ANALYZED BY/DATE:** Agata Sulczynski/ December 8, 2000 **REVIEWED BY/DATE:**

PRINCIPLE STEPS	POTENTIAL HAZARDS	RECOMMENDED CONTROLS
Tree removal	Crush hazard from falling tree	Work area to be clear of all personnel. Chain used to pull the tree down will be of sufficient length to prevent the tree from falling on excavator.
	Heavy equipment operations	Operators must be trained and experienced in use of heavy equipment operations. Emergency equipment is to include portable radio, first aid kit, and fire extinguisher. Equipment must have seat and seat belts for all riders.
	Traffic accidents	All vehicle movements shall be monitored for location of obstacles. Back-up alarms will be operational. Traffic control is to be implemented, as appropriate, using cones and/or road signs.
	Injury for improper use of chain saw	Hard hats will be worn to provide protection from chain saw kick back. Cut-resistant chaps will be worn when to prevent cuts to legs and thighs. Cut and slip resistant footwear will be worn. Safety glasses will be worn to prevent projectile hazard. Proper work gloves will be used to protect hands from cuts. Workers will be instructed to place their body on one side of the tree and the saw blade on the other and to avoid the saw crossing in front of the body. Workers will be instructed to avoid cutting with the saw at or above shoulder height and to shut off the saw before setting it down.
	Loud noise/communication when using chain saw	When noise levels exceed 85 dBA (or wherever voices must be raised in order to be understood at arms' length), hearing protection must be worn. A Noise Reduction Rating (NRR) of at least 25 shall be adhered to in the selection of hearing protection devices.

ACTIVITY HAZARD ANALYSIS

ACTIVITY: Western Dog Pens RA – Tree Removal **ANALYZED BY/DATE:** Agata Sulczynski/ December 8, 2000 **REVIEWED BY/DATE:**

EQUIPMENT TO BE USED	INSPECTION REQUIREMENTS	TRAINING REQUIREMENTS
Chain	Visual inspection prior to work. Verification of load rating.	Workers will be trained on rigging procedures.
Excavator	Daily vehicle safety inspections. Daily visual lifting equipment inspections. Visual inspection of area prior to work. Daily inspection of field vehicle emergency equipment.	Only appropriately qualified personnel will be permitted to operate excavator.
Chain saw	Visual inspection of area prior to work. Visual inspection of chain saw, including sprockets and chain brakes and other manufacturer's requirements.	Workers will be trained in proper operation of chain saw.

ACTIVITY HAZARD ANALYSIS

ACTIVITY: Western Dog Pens RA – Asphalt Removal and Consolidation

ANALYZED BY/DATE: Agata Sulczynski / December 8, 2000

REVIEWED BY/DATE:

PRINCIPLE STEPS	POTENTIAL HAZARDS	RECOMMENDED CONTROLS
Asphalt removal	Loader operation	Operators must be trained and experienced in the operation of heavy equipment. The loading area is to be clear of unnecessary personnel. Emergency equipment to include portable radio, first aid kit, and fire extinguisher. Equipment must have seats and seat belts for all riders.
	Traffic	All vehicle movements shall be monitored for location of obstacles. Trees will be trimmed as necessary (a separate AHA will be used for this operation). Back-up alarms will be operational. Traffic control to be implemented, as appropriate, using cones and/or road signs. Ground personnel in high traffic areas are to wear traffic safety vests.
Spotting	Slips, trips and falls	Workers will be instructed to pay close attention to uneven surfaces, grade changes or other slip, trip and fall hazards.

EQUIPMENT TO BE USED	INSPECTION REQUIREMENTS	TRAINING REQUIREMENTS
Heavy equipment – loader	Daily vehicle safety inspections. Daily visual lifting equipment inspections. Visual inspection of area prior to work. Daily inspection of field vehicle emergency equipment.	Only qualified operators may operate the equipment.

ACTIVITY HAZARD ANALYSIS

ACTIVITY: Western Dog Pens RA – Removal and Consolidation of Concrete Curbing and Fence Post Stubs

ANALYZED BY/DATE: Agata Sulczynski/ December 8, 2000

REVIEWED BY/DATE:

PRINCIPLE STEPS	POTENTIAL HAZARDS	RECOMMENDED CONTROLS
Concrete breaking with universal processor	Projectile hazard	A 20-foot minimum clearance must be provided for all personnel other than the spotter. A faceshield and hardhat must be worn by the spotter when the universal processor is in operation. Equipment is to be inspected daily per vendor's checklist.
Rebar removal	Cuts from manual rebar cutter	Equipment will be inspected prior to use. Personnel will ensure that hands and feet are kept away from the cutting mechanism.
Concrete curbing and fence stubs removal	Injury associated with heavy equipment operation – excavator /loader	The loading area is to be clear of unnecessary personnel. Emergency equipment to include portable radio, first aid kit, and fire extinguisher. Equipment must have seats and seat belts for all riders

EQUIPMENT TO BE USED	INSPECTION REQUIREMENTS	TRAINING REQUIREMENTS
Heavy equipment	Daily vehicle safety inspections. Daily visual lifting equipment inspections. Visual inspection of area prior to work. Daily inspection of field vehicle emergency equipment.	Only qualified operators may operate the equipment.

ACTIVITY HAZARD ANALYSIS

ACTIVITY: Western Dog Pens RA – Consolidation and Sifting of Gravel

ANALYZED BY/DATE: Agata Sulczynski/ December 8, 2000

REVIEWED BY/DATE:

PRINCIPLE STEPS	POTENTIAL HAZARDS	RECOMMENDED CONTROLS
Consolidation of gravel	Bulldozer/loader	The work area is to be clear of unnecessary personnel. Emergency equipment to include portable radio, first aid kit, and fire extinguisher. Equipment must have seats and seat belts for all riders
Sifting	Mechanical sifter	Pinch points should be identified and access restricted where feasible. Electric power, when used, should be appropriately grounded.

EQUIPMENT TO BE USED	INSPECTION REQUIREMENTS	TRAINING REQUIREMENTS
Heavy equipment	Daily vehicle safety inspections. Daily visual lifting equipment inspections. Visual inspection of area prior to work. Daily inspection of field vehicle emergency equipment.	Only qualified operators may operate the equipment.

ACTIVITY HAZARD ANALYSIS

ACTIVITY: Western Dog Pens RA –Stockpiling of Gravel **ANALYZED BY/DATE:** Agata Sulczynski/ December 8, 2000 **REVIEWED BY/DATE:**

PRINCIPLE STEPS	POTENTIAL HAZARDS	RECOMMENDED CONTROLS
Stockpiling	Loader	Work area is to be clear of unnecessary personnel. Emergency equipment to include a portable radio, first aid kit, and fire extinguisher. Equipment must have seats and seat belts for all riders

EQUIPMENT TO BE USED	INSPECTION REQUIREMENTS	TRAINING REQUIREMENTS
Heavy equipment	Daily vehicle safety inspections. Daily visual lifting equipment inspections. Visual inspection of area prior to work. Daily inspection of field vehicle emergency equipment.	Only qualified operators may operate the equipment.

ACTIVITY HAZARD ANALYSIS

ACTIVITY: Western Dog Pens RA – Removal and Packaging of Water Piping

ANALYZED BY/DATE: Agata Sulczynski/ December 8, 2000

REVIEWED BY/DATE:

PRINCIPLE STEPS	POTENTIAL HAZARDS	RECOMMENDED CONTROLS
Pipe removal	Injury during backhoe operation	Depth of excavation is not to exceed three feet. Work area is to be clear of unnecessary personnel. Emergency equipment is to include a portable radio, first aid kit, and fire extinguisher. Equipment (backhoe) must have seats and seat belts for all riders
	Injury from improper use of shovels and other hand tools	Work area is to be clear of unnecessary objects. Work gloves will be worn to prevent blisters and cuts. Eye protection is to be worn when projectile hazards are present (i.e. hammer operation). Workers will be instructed in proper body position to avoid repetitive stress injury.
Packaging	Back strain due to improper lifting of heavy objects	Workers will be trained in proper lifting techniques. Two or more people are required to lift objects weighing more than 60 lbs. Use of proper lifting equipment is limited to trained personnel as instructed by the SHSO. Inspect lifting equipment daily at a minimum.

EQUIPMENT TO BE USED	INSPECTION REQUIREMENTS	TRAINING REQUIREMENTS
Heavy equipment	Daily vehicle safety inspections. Daily visual lifting equipment inspections. Visual inspection of area prior to work. Daily inspection of field vehicle emergency equipment.	Only qualified operators may operate the equipment.
Hand tools	Visual inspection of area prior to work. Daily visual inspection of hand tools.	Workers will be trained in operation of hand and power tools and appropriate PPE. Lockout/Tagout procedures.

ACTIVITY HAZARD ANALYSIS

ACTIVITY: Western Dog Pens RA – Sampling of Cobble Trench

ANALYZED BY/DATE: Agata Sulczynski/ December 8, 2000

REVIEWED BY/DATE:

PRINCIPLE STEPS	POTENTIAL HAZARDS	RECOMMENDED CONTROLS
Sampling	Slips, trips and falls	Workers will be instructed to pay close attention to uneven surfaces, grade changes or other slip, trip and fall hazards.
	Biological agents	Workers will be instructed to recognize potential biological agents (spiders, mice, etc.). Gloves will be worn if there is a need to place hands in areas where spiders, mice and other biological agents may be present.

EQUIPMENT TO BE USED	INSPECTION REQUIREMENTS	TRAINING REQUIREMENTS
NA	NA	NA

ACTIVITY HAZARD ANALYSIS

ACTIVITY: Western Dog Pens RA – Backfill and Compaction

ANALYZED BY/DATE: Agata Sulczynski/ December 8, 2000

REVIEWED BY/DATE:

PRINCIPLE STEPS	POTENTIAL HAZARDS	RECOMMENDED CONTROLS
Backfill	Loader	Work area is to be clear of unnecessary personnel. Emergency equipment must include a portable radio, first aid kit, and fire extinguisher. Equipment must have seats and seat belts for all riders
	Traffic	All vehicle movements shall be monitored for location of obstacles. Trees will be trimmed as necessary (a separate AHA will be used for this operation). Back-up alarms will be operational. Traffic control to be implemented, as appropriate, using cones and/or road signs. Ground personnel in high traffic areas are to wear traffic safety vests.
Compaction	Excavator	Work area to be clear of unnecessary personnel. Emergency equipment to include portable radio, first aid kit, and fire extinguisher. Equipment must have seat and seat belts for all riders
Compaction testing	Radiation exposure from nuclear gauge	Only a certified operator may use the compaction gauge. Areas will be clear of unnecessary personnel.
	Injury with slide hammer	Work gloves will be worn and care to be taken when hammering.
	Loud noise during slide hammer operation	When noise levels exceed 85 dBA (or wherever voices must be raised in order to be understood at arms length), hearing protection must be worn. An NRR of at least 25 shall be adhered to in the selection of hearing protection devices. Wherever possible, use of barriers is encouraged.

EQUIPMENT TO BE USED	INSPECTION REQUIREMENTS	TRAINING REQUIREMENTS
Hand tools, power tools	Visual inspection of area prior to work. Daily visual inspection of hand and power tools.	Workers will be trained in operation of hand and power tools and appropriate PPE. Lockout/Tagout procedures.

ACTIVITY HAZARD ANALYSIS

ACTIVITY: Western Dog Pens RA – Backfill and Compaction

ANALYZED BY/DATE: Agata Sulczynski/ December 8, 2000

REVIEWED BY/DATE:

EQUIPMENT TO BE USED	INSPECTION REQUIREMENTS	TRAINING REQUIREMENTS
Nuclear compaction gauge	To be inspected per manufacturer's instructions	Only a certified operator may operate the equipment.

ACTIVITY HAZARD ANALYSIS

ACTIVITY: Western Dog Pens RA – Restoration of Site Features

ANALYZED BY/DATE: Agata Sulczynski/ December 8, 2000

REVIEWED BY/DATE:

PRINCIPLE STEPS	POTENTIAL HAZARDS	RECOMMENDED CONTROLS
Grading	Loader/road graders	Work area is to be clear of unnecessary personnel. Emergency equipment is to include a portable radio, first aid kit, and fire extinguisher. Equipment must have seats and seat belts for all riders.
	Traffic	All vehicle movements shall be monitored for location of obstacles. Trees will be trimmed as necessary (a separate AHA will be used for this operation). Back-up alarms will be operational. Traffic control is to be implemented, as appropriate, using cones and/or road signs. Ground personnel in high traffic areas are to wear traffic safety vests.

EQUIPMENT TO BE USED	INSPECTION REQUIREMENTS	TRAINING REQUIREMENTS
Heavy equipment	Daily vehicle safety inspections. Daily visual lifting equipment inspections. Visual inspection of area prior to work. Daily inspection of field vehicle emergency equipment.	Only qualified operators may operate the equipment.

ACTIVITY HAZARD ANALYSIS

ACTIVITY: Western Dog Pens RA – Demobilization **ANALYZED BY/DATE:** Agata Sulczynski/ December 8, 2000 **REVIEWED BY/DATE:**

PRINCIPLE STEPS	POTENTIAL HAZARDS	RECOMMENDED CONTROLS
Moving tools and equipment	Slips, trips and falls	Workers will be instructed to pay close attention to uneven surfaces, grade changes or other slip, trip and fall hazards.
	Back strain due to improper lifting of heavy objects	Workers will be trained in proper lifting techniques. Two or more people are required to lift objects weighing more than 60 lbs. Use of proper lifting equipment by trained personnel as instructed by the SHSO. Inspect lifting equipment daily at a minimum.

EQUIPMENT TO BE USED	INSPECTION REQUIREMENTS	TRAINING REQUIREMENTS
NA	NA	NA

ACTIVITY HAZARD ANALYSIS

ACTIVITY: Western Dog Pens RA – Stockpiles **ANALYZED BY/DATE:** Agata Sulczynski/ January 23, 2001 **REVIEWED BY/DATE:**

PRINCIPLE STEPS	POTENTIAL HAZARDS	RECOMMENDED CONTROLS
Stockpile Management	Back strain due to improper lifting of heavy objects (e.g. HDPE)	Workers will be trained in proper lifting techniques. Two or more people are required to lift objects weighing more than 60 lbs.
	Injury from improper use of utility knife during HDPE cutting	Work gloves will be worn to prevent blisters and cuts. Workers will be instructed to point the knife away from their person when cutting the HDPE cover. Employees will be instructed not to place the knife in pockets, unless the blade can be safely retracted. Knife will be properly stored when not in use.
	Injury from stockpile material slide	Sloping (no more than approximately 34 degrees) of the stockpile will be maintained at all times. The stockpile height will not exceed 10 ft. Workers will minimize the need to walk or work on top of the stockpiles by work planning. Samples will be taken as close to the stockpile surface as feasible. A 6 ft minimum clearance will be maintained between individual stockpiles where personnel access is anticipated.
	Slips on HDPE	Care will be taken when walking on the HDPE. Proper non-slip footwear will be worn. When the HDPE is wet and slip hazards cannot be avoided, sand bags or other materials may be used to create safe walkways on the HDPE.

EQUIPMENT TO BE USED	INSPECTION REQUIREMENTS	TRAINING REQUIREMENTS
Hand tools (utility knife)	Visual inspection of area prior to work. Daily visual inspection of hand tools.	Workers will be trained in operation of hand tools.