U.S. Department of Energy

Oakland Operations Office, Oakland, California

SAMPLING AND ANALYSIS PLAN FOR THE WESTERN DOG PENS IN-SITU GRAVEL CHARACTERIZATION

at 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:

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January 29, 2001
Rev. 0

DOE Oakland Operations Contract DE-AC03-96SF20686

Weiss Associates
Environmental Science, Engineering and Management

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Approvals Page

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ACRONYMS AND ABBREVIATIONS

COC	constituent of concern
ID	identification
LEHR	Laboratory for Energy-Related Health Research
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
RA	removal action
Ra-226	radium-226
SAP	Sampling and Analysis Plan
SOPs	Standard Operating Procedures
Sr-90	strontium-90
WDPs	Western Dog Pens

1. INTRODUCTION

1.1 Objectives

This document is the Sampling and Analysis Plan (SAP) for the Western Dog Pens (WDPs) *in-situ* gravel characterization. This SAP was prepared by Weiss Associates under Department of Energy Environmental Restoration/Waste Management Contract No. DE-AC03-96SF20686. The objective of the WDPs *in-situ* gravel characterization is to collect data to facilitate waste segregation during a removal action planned for the spring of 2001 at the Laboratory for Energy-Related Health Research (LEHR or the Site), University of California, Davis (Figure 1-1). Based on the analytical results, the gravel within each pen will be segregated and stockpiled accordingly during the WDPs RA. This document presents the approach and procedures for the characterization of gravel in the WDPs. In addition, it includes descriptions and rationale for the sampling activities, procedures for fieldwork, quality assurance/quality control (QA/QC), and data management.

1.2 Background

The details of the site background are presented in the *Draft Final Engineering Evaluation/ Cost Analysis for the Western and Eastern Dog Pens* (WA, 2000b). The following is a brief description of current site conditions. The WDPs encompass just over two acres at the LEHR Site and consist of 256 gravel-lined pens (Figure 1-2). Approximately 1,800 cubic yards of gravel in the WDPs may have been impacted by radium-226 (Ra-226) and strontium-90 (Sr-90) via dogs that were exposed to these radionuclides during previous health research activities.

During the 1997 WDPs investigation, gravel samples were collected from twelve dog pens (Figure 1-2) (WA, 1998). Table 1-1 summarizes the analytical results from that investigation. This SAP address the sampling and analysis for the other 244 pens.

Table 1-1. Summary of Analytic Results of Gravel Samples from the 1997 Western Dog Pens Investigation

Constituent	Radiation Survey Results	Units	No. of Samples Analyzed	No. of Samples Above Reporting Limit[1]	Min. Activity/ Conc.[2]	Max. Activity/ Conc.	Average Activity/ Conc.[3]	Sample ID w/ Max. Conc.	Dog Pen No. w/ Max. Conc.
Radium-226	NA	pCi/g	46	38	0.086	1.94	0.625	LEHRSSDP-0072	1-32
Strontium-90	NA	pCi/g	46	4	0.009	3.59	0.363	LEHRSSDP-0072	1-32

Notes:

1 Number of samples above Reporting Limit represents the number of samples greater than the minimum detectable activity for radionuclides.

2 Minimum value above laboratory reporting limit.

3 The average of all detected concentrations including concentrations below the reporting limit. If the sample results were censored, half the detection limit was used to calculate the average.

Abbreviations:

Conc. Concentration
Min. Minimum
Max. Maximum
No. Number
NA Not Applicable
w/ with

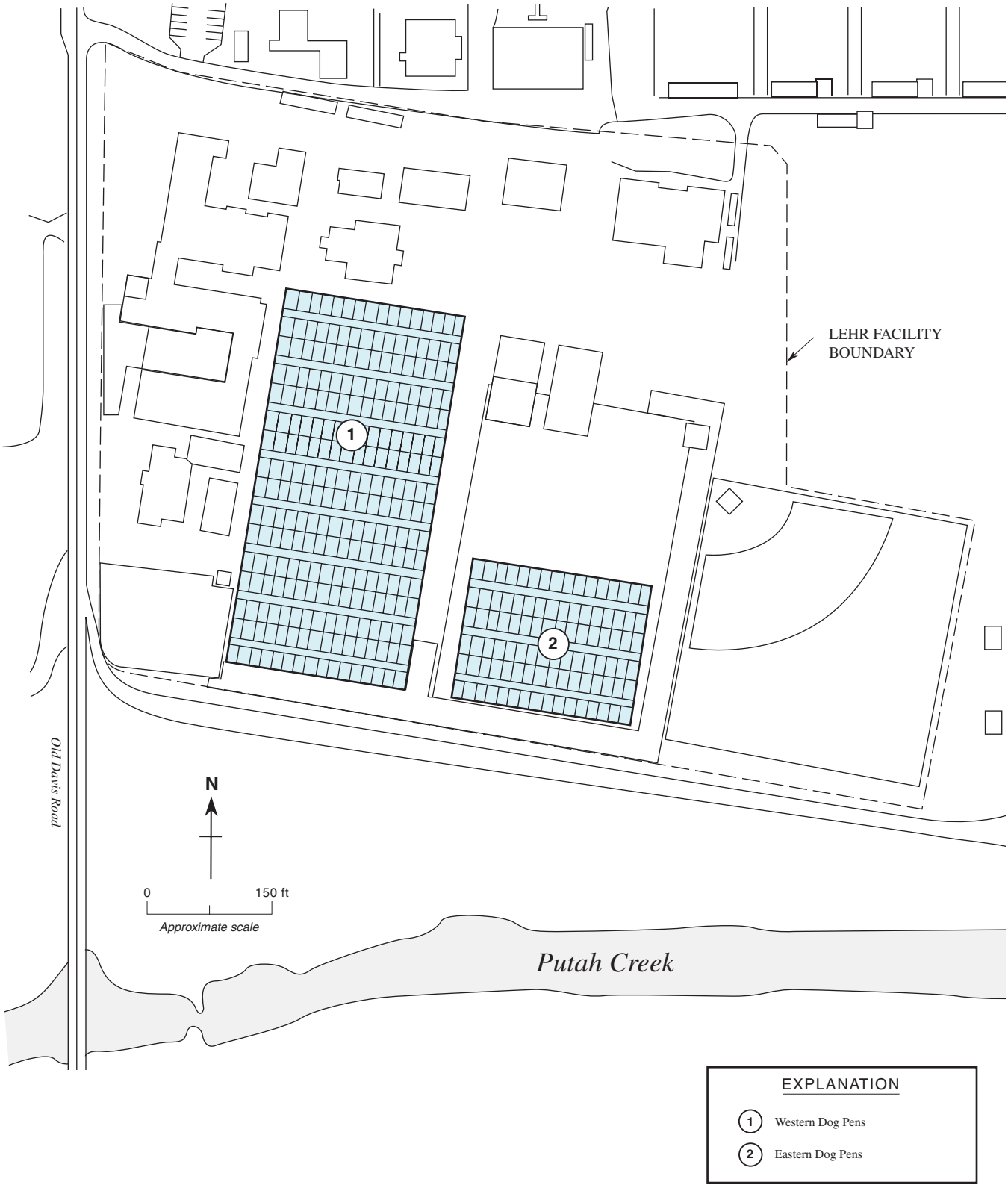
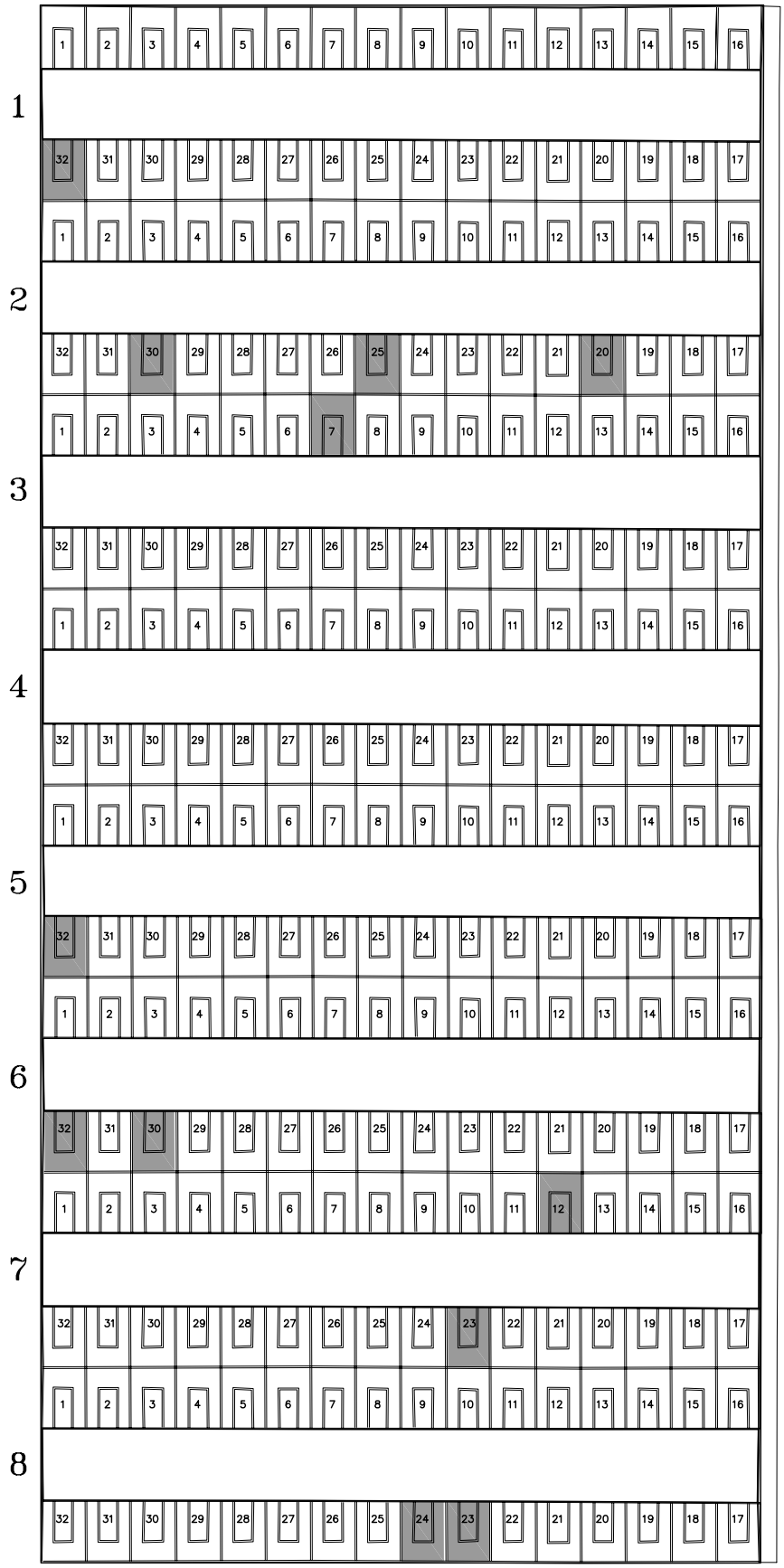


Figure 1-1. Dog Pen Locations at the LEHR Facility, Davis, California



LEGEND

DOG PEN AND IDENTIFICATION NUMBER

DOG PEN SAMPLED DURING 1997 WESTERN DOG PENS INVESTIGATION

1 AISLE NUMBER

0' 25' 50' 100'

SCALE: 1" = 50'

WEISS ASSOCIATES	SCALE: 1" = 50' PROJECT. NO. 128-4006-232 DATE: 11/17/05 - 3:59pm L:\LEHR\4006\4006-016.dwg	LEHR WESTERN DOG PENS NUMBERING SEQUENCE	FIGURE 1-2

2. SAMPLING AND ANALYSIS PLAN

This section describes the sampling and analysis process that will be used to determine which pens contain radiologically impacted gravel. All work will be conducted in accordance with the LEHR Quality Assurance Project Plan (QAPP) (WA, 2000a) and the appropriate Standard Operating Procedures (SOPs) (WA, 1999).

2.1 Sampling Approach

Each dog pen contains approximately 6 to 10 inches of gravel covering a 12 ft by 18 ft area. Each pen will be sampled to determine the presence and extent of radiological impacts.

One four-point composite sample will be collected from each of the 244 pens not sampled in1997. An arbitrary nine-section sample grid was developed (Figure 2-1). Using a random number generator, four sections were identified in each pen for sample collection. Table 2-1 indicates the sections to be sampled within each pen.

2.2 Analytical Plan

Based on the site history and existing gravel data, the gravel samples will be analyzed for selected radiological constituents:

- One composite sample per pen will be analyzed for Ra-226,
- One composite sample per pen will be analyzed for Sr-90, and
- One composite sample per pen will be analyzed for gross alpha/beta radiation.

Table 2-2 presents the complete list of analytical parameters and methods.

Ra-226 analysis will be conducted in an on-site laboratory using a gamma spectrometer with a high-purity germanium detector. The Sr-90 and gross alpha/beta analyses will be performed offsite by General Engineering Laboratory with a standard 45-day turnaround time. Table 2-3 summarizes the sampling and analytical plans and the total number of samples to be collected for the gravel in the WDPs.

2.3 Background Analysis

To establish background radionuclide activities, gravel samples will be collected from three off-site locations. A total of 14 gravel samples including two field duplicates will be collected from 3 different sources of gravel and analyzed by the methods in Table 2-2. The material will be of similar composition and physical characteristics and be generated from the same geologic setting as the gravel in the WDPs. The results of these analyses will provide the baseline radionuclide activities for the WDP gravel.

Table 2-1. Locations of Four-Point Composite Samples in the Western Dog Pens

AISLE 1

Aisle-Pen #	Grid Sections	Aisle-Pen #	Grid Sections	Aisle-Pen #	Grid Sections
1- 1	7, 4, 3, 6	1- 12	8, 1, 6, 3	1- 23	1, 6, 5, 3
1- 2	1, 3, 8, 6	1- 13	2, 9, 3, 7	1- 24	7, 3, 1, 6
1- 3	3, 6, 8, 6	1- 14	1, 5, 3, 9	1- 25	1, 2, 4, 9
1- 4	2, 4, 6, 5	1- 15	1, 5, 6, 8	1- 26	2, 5, 7, 4
1- 5	6, 2, 1, 7	1- 16	5, 3, 4, 9	1- 27	2, 7, 5, 9
1- 6	5, 3, 3, 9	1- 17	8, 1, 3, 5	1- 28	2, 7, 8, 1
1- 7	5, 3, 9, 1	1- 18	6, 5, 8, 4	1- 29	6, 9, 3, 8
1- 8	4, 2, 5, 7	1- 19	9, 4, 3, 3	1- 30	4, 8, 1, 5
1- 9	8, 9, 4, 1	1- 20	4, 7, 9, 6	1- 31	8, 6, 1, 3
1- 10	1, 1, 8, 2	1- 21	1, 2, 5, 6		
1- 11	8, 4, 6, 8	1- 22	5, 3, 7, 8		

AISLE 2

Aisle-Pen #	Grid Sections	Aisle-Pen #	Grid Sections	Aisle-Pen #	Grid Sections
2- 1	7, 9, 7. 6	2- 11	8, 7, 3, 4	2- 22	6, 6, 1, 3
2- 2	1, 3, 7, 2	2- 12	1, 5, 3, 9	2- 23	4, 1, 7, 5
2- 3	4, 8, 9, 5	2- 13	5, 4, 3, 6	2- 24	1, 5, 3, 6
2- 4	2, 8, 1, 5	2- 14	8, 7, 6, 2	2- 26	4, 9, 6, 1
2- 5	1, 9, 4, 2	2- 15	4, 7, 6, 2	2- 27	4, 2, 9, 3
2- 6	4, 6, 8, 5	2- 16	5, 2, 5, 7	2- 28	3, 9, 7, 1
2- 7	5, 2, 4, 1	2- 17	2, 5, 4, 3	2- 29	3, 4, 2, 6
2- 8	5, 5, 3, 7	2- 18	7, 8, 8, 4	2- 31	9, 7, 4, 3
2- 9	2, 6, 4, 2	2- 19	7, 6, 5, 7	2- 32	3, 6, 5, 1
2- 10	3, 7, 5, 8	2- 21	7, 9, 3, 2		

AISLE 3

Aisle-Pen #	Grid Sections	Aisle-Pen #	Grid Sections	Aisle-Pen #	Grid Sections
3- 1	1, 9, 5, 8	3- 13	7, 7, 1, 4	3- 24	2, 3, 2, 3
3- 2	1, 5, 3, 7	3- 14	6, 6, 2, 3	3- 25	3, 2, 3, 6
3- 3	5, 6, 1, 5	3- 15	6, 5, 9, 6	3- 26	2, 1, 9, 7
3- 4	9, 5, 3, 7	3- 16	7, 9, 1, 1	3- 27	5, 1, 5, 8
3- 5	9, 7, 5, 3	3- 17	7, 9, 5, 1	3- 28	1, 7, 3, 9
3- 6	6, 1, 6, 2	3- 18	8, 2, 7, 2	3- 29	2, 6, 3, 8
3- 8	1, 5, 3, 4	3- 19	3, 4, 1, 7	3- 30	4, 5, 6, 1
3- 9	3, 2, 4, 1	3- 20	1, 8, 5, 6	3- 31	7, 8, 5, 1
3- 10	4, 4, 5, 5	3- 21	5, 3, 9, 1	3- 32	3, 8, 2, 9
3- 11	6, 4, 9, 4	3- 22	7, 1, 8, 4		
3- 12	9, 5, 2, 3	3- 23	6, 9, 7, 1		

Table 2-1. Locations of Four-Point Composite Samples in the Western Dog Pens (continued)

AISLE 4

Aisle-Pen #	Grid Sections	Aisle-Pen #	Grid Sections	Aisle-Pen #	Grid Sections
4- 1	8, 5, 5, 8	4- 12	1, 1, 2, 9	4- 23	6, 9, 2, 7
4- 2	2, 8, 6, 7	4- 13	8, 2, 2, 8	4- 24	6, 6, 5, 4
4- 3	6, 3, 6, 5	4- 14	6, 6, 6, 6	4- 25	7, 6, 8, 5
4- 4	7, 9, 2, 1	4- 15	4, 6, 1, 9	4- 26	1, 9, 2, 8
4- 5	9, 6, 7, 1	4- 16	6, 4, 3, 7	4- 27	6, 9, 3, 4
4- 6	9, 3, 8, 3	4- 17	2, 1, 1, 3	4- 28	5, 4, 7, 1
4- 7	4, 9, 9, 7	4- 18	2, 3, 7, 1	4- 29	9, 7, 1, 1
4- 8	4, 3, 4, 6	4- 19	2, 5, 1, 3	4- 30	6, 3, 9, 6
4- 9	5, 7, 3, 5	4- 20	2, 2, 2, 2	4- 31	3, 7, 7, 2
4- 10	2, 2, 2, 5	4- 21	6, 3, 7, 5	4- 32	3, 1, 5, 8
4- 11	3, 4, 9, 5	4- 22	8, 4, 7, 3		

AISLE 5

Aisle-Pen #	Grid Sections	Aisle-Pen #	Grid Sections	Aisle-Pen #	Grid Sections
5- 1	2, 1, 6, 2	5- 12	6, 2, 1, 2	5- 23	4, 6, 6, 1
5- 2	2, 4, 8, 5	5- 13	9, 5, 6, 3	5- 24	6, 2, 1, 6
5- 3	7, 4, 6, 9	5- 14	6, 7, 4, 5	5- 25	6, 5, 1, 9
5- 4	4, 2, 5, 7	5- 15	2, 2, 4, 7	5- 26	4, 9, 2, 3
5- 5	8, 2, 2, 9	5- 16	2, 4, 1, 8	5- 27	5, 8, 6, 2
5- 6	9, 5, 4, 6	5- 17	7, 6, 3, 4	5- 28	6, 6, 2, 4
5- 7	5, 1, 7, 7	5- 18	4, 8, 7, 6	5- 29	8, 3, 2, 1
5- 8	4, 8, 1, 9	5- 19	1, 2, 3, 2	5- 30	1, 6, 5, 6
5- 9	5, 1, 4, 6	5- 20	6, 4, 6, 9	5- 31	7, 4, 6, 2
5- 10	5, 3, 6, 8	5- 21	4, 2, 7, 2		
5- 11	5, 9, 4, 3	5- 22	4, 8, 4, 6		

AISLE 6

Aisle-Pen #	Grid Sections	Aisle-Pen #	Grid Sections	Aisle-Pen #	Grid Sections
6- 1	1, 7, 4, 3	6- 12	3, 5, 2, 1	6- 23	6, 9, 8, 2
6- 2	4, 8, 6, 8	6- 13	4, 5, 3, 7	6- 24	1, 3, 3, 7
6- 3	1, 9, 7, 3	6- 14	8, 9, 5, 5	6- 25	9, 3, 8, 1
6- 4	1, 6, 7, 8	6- 15	8, 4, 7, 2	6- 26	4, 2, 5, 1
6- 5	1, 3, 8, 1	6- 16	1, 6, 1, 9	6- 27	4, 5, 2, 8
6- 6	7, 1, 5, 6	6- 17	3, 9, 1, 1	6- 28	5, 6, 8, 5
6- 7	6, 8, 6, 5	6- 18	3, 6, 3, 4	6- 29	3, 4, 5, 5
6- 8	1, 8, 4, 3	6- 19	6, 7, 6, 7	6- 31	4, 7, 4, 4
6- 9	2, 9, 1, 3	6- 20	4, 1, 6, 9		
6- 10	7, 5, 8, 3	6- 21	8, 6, 4, 5		
6- 11	4, 8, 8, 8	6- 22	6, 2, 7, 2		

Table 2-1. Locations of Four-Point Composite Samples in the Western Dog Pens (continued)

AISLE 7

Aisle-Pen #	Grid Sections	Aisle-Pen #	Grid Sections	Aisle-Pen #	Grid Sections
7- 1	1, 7, 7, 7	7- 13	8, 5, 6, 9	7- 25	3, 1, 1, 6
7- 2	2, 2, 6, 3	7- 14	2, 1, 7, 1	7- 26	5, 6, 6, 4
7- 3	1, 1, 1, 4	7- 15	1, 9, 1, 5	7- 27	8, 6, 3, 1
7- 4	3, 4, 8, 6	7- 16	2, 2, 4, 8	7- 28	5, 3, 8, 4
7- 5	4, 9, 6, 1	7- 17	4, 2, 7, 1	7- 29	5, 1, 2, 7
7- 6	7, 5, 1, 1	7- 18	4, 4, 5, 4	7- 30	2, 3, 1, 1
7- 7	2, 9, 3, 1	7- 19	1, 9, 7, 7	7- 31	3, 5, 1, 7
7- 8	6, 2, 8, 8	7- 20	8, 6, 7, 2	7- 32	5, 2, 1, 2
7- 9	5, 6, 5, 4	7- 21	5, 2, 9, 1		
7- 10	8, 1, 7, 8	7- 22	7, 7, 8, 4		
7- 11	5, 5, 2, 7	7- 24	2, 2, 7, 8		

AISLE 8

Aisle-Pen #	Grid Sections	Aisle-Pen #	Grid Sections	Aisle-Pen #	Grid Sections
8- 1	4, 6, 7, 8	8- 12	4, 2, 1, 2	8- 25	5, 8, 2, 7
8- 2	4, 2, 1, 4	8- 13	7, 3, 8, 6	8- 26	1, 5, 5, 6
8- 3	2, 2, 2, 2	8- 14	2, 1, 1, 3	8- 27	7, 2, 8, 2
8- 4	5, 1, 2, 5	8- 15	6, 1, 6, 9	8- 28	3, 6, 8, 1
8- 5	8, 1, 5, 6	8- 16	4, 8, 6, 4	8- 29	4, 7, 3, 3
8- 6	4, 6, 7, 2	8- 17	8, 2, 8, 1	8- 30	8, 9, 5, 7
8- 7	6, 5, 7, 3	8- 18	8, 1, 2, 5	8- 31	2, 8, 7, 5
8- 8	6, 6, 5, 8	8- 19	7, 9, 8, 1	8- 32	7, 9, 1, 6
8- 9	2, 7, 6, 7	8- 20	2, 3, 2, 6		
8- 10	4, 9, 2, 4	8- 21	9, 6, 5, 8		
8- 11	4, 6, 6, 2	8- 22	6, 2, 3, 2		

Table 2-2. Laboratory Analytical Methods Planned for Western Dog Pens Gravel Characterization

Parameter	Analytical Method	Required Detection Limit
	Field	
Radium-226	Ra-226 Analysis by Gamma Spectrometer	0.5 pCi/g
	Laboratory	
Radium-226	EPA Method 901.1	0.1 pCi/g
Strontium-90	EPA Method 905.0, modified	0.05 pCi/g
Gross Alpha/Beta	EPA Method 9310	1 pCi/g

Abbreviation:

pCi/g = picoCuries per gram

Table 2-3. Summary of Sampling and Analysis Plan for Western Dog Pens Gravel

Sampling Activity	Sampling Strategy	Specifications	Sample Collection Method	Method of Analysis	Analytical Parameters	Total Samples
Dog Pen Gravel sampling	Random Grid	Four-point composite sample from surface gravels in each pen.	Trowel	Field/Lab	Radium-226, Strontium-90, Gross Alpha/Beta	244
Duplicate samples (Field QC)	NA	10% of samples analyzed in field.	Trowel	Field	Radium-226	25
Duplicate samples (Laboratory QC)	NA	10% of field and laboratory samples analyzed in laboratory.	Trowel	Lab	Radium-226, Strontium-90, Gross Alpha/Beta	25
Background sampling	NA	Gravel samples collected from 3 off-site sources; 10% of field and laboratory samples analyzed in laboratory	Trowel	Field/Lab	Radium-226, Strontium-90, Gross Alpha/Beta	15

Abbreviations:

NA not applicable
QC quality control

3. SAMPLING AND ANALYSIS PROCEDURES

3.1 Gravel Sample Collection

As described in Section 2.1, a four-point composite sample will be collected from each pen. Each dog pen has nine discrete sections, as shown in Figure 2-1, which will determine the location of the four-point composite sample. Within each discrete section, the sample location will be selected randomly. Gravel samples will be collected from the surface to six inches below ground surface using a hand trowel. All vegetation and soil will be segregated from the gravel by hand or with a screen if necessary and placed back on the surface of the pens. The gravel samples will be homogenized in a stainless steel mixing bowl prior to on-site Ra-226 analysis and subsequent shipment for off site analysis. All gravel samples will be collected in accordance with SOP 3.1, Surface and Shallow Subsurface Soil Sampling and SOP 10.3, Sample Collection, Handling and Data Documentation for Field Analysis Using Gamma Spectrometer and Beta Scintillation Detector. Sample handling, packaging, and shipping will be conducted in accordance with SOP 2.1, Sample Handling, Packaging and Shipping.

Gravel samples collected for on-site Ra-226 analysis will be placed into one-liter Marinelli beakers. Ideally there should be no void space in the beaker. However, due to the geometry of the rounded gravel clasts there will inevitably be some voids present. The samples will be hand packed to minimize void space. The top of the beaker will be tightly sealed using electrical tape. The beakers will then be stored for a minimum of fourteen days. This in-growth period will allow the Ra-226 daughter products, lead-214 and bismuth-214, to reach over ninety percent equilibrium with Ra-226. Following laboratory analysis, the gravel samples will be stored on-site in the cargo containers located on the northeastern corner of the site. After all of the gravel has been segregated and stockpiled, the samples will be added to the appropriate stockpile.

3.2 Sample Documentation

The usability of the data obtained during this investigation will depend on its quality. Sample collection methods are as important as the methods used for sample analysis to ensure high quality data. 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, ingrowth and holding times, and proper shipment methods. Obtaining valid and comparable data also requires adequate QA/QC procedures and documentation.

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

- Chain-of-Custody Forms,
- Field Logbook/Field Activity Daily Logs,
- Sample Numbers,
- Sample Labels, and
- Custody Seals.

3.2.1 Chain-of-Custody

Chain-of-custody forms will be completed by the sampling 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.

3.2.2 Field Logbook/Field Activity Daily Log

Descriptions and observations made during field and sampling activities will be documented in the field logbook and/or field activity daily log. The following will be recorded in the field logbook and/or field activity daily log:

- Project name and number;
- Location of site;
- 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;
- Date and time of sample collection;
- Sample locations, identification (ID) number and methodology;
- Field observations;
- Results of field measurements; and,
- Results of field calibrations for instruments used.

3.2.3 Sample Numbers

The sample matrix will be identified by "GS" to denote gravel sample. Since these samples will be collected from the WDPs, they will be identified by the nomenclature WD, and since these

are screening samples, they will also include "F". Samples will be numbered sequentially. Therefore, the first soil sample collected will be identified as GSWDF001.

3.2.4 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.

3.2.5 Custody Seals

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

- Date and time, and
- Initials of sampler.

4. QUALITY ASSURANCE AND DATA MANAGEMENT

The quality assurance requirements applicable to this sampling activity are detailed in the QAPP for the environmental restoration activities at the Site (WA, 2000a). This plan is based upon the requirements of DOE Order 414.4a.6c *Quality Assurance* and EPA QAMS-005/80 *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans* as they are applicable to the scope of work. Additional task-specific quality assurance requirements are detailed in SOPs 1.1, Chain-of-Custody, 2.1, Sample Handling, Packaging and Shipping, 3.1, Surface and Shallow Subsurface Soil Sampling, 10.3, Sample Collection, Handling and Data Documentation for Field Analysis Using Gamma Spectrometer and Beta Scintillation Detector, and 20.1, Sample Containers, Preservation, and Holding Times.

The samples collected for this investigation will be analyzed by General Engineering Laboratories, Inc. in Charleston, South Carolina. Laboratory reports (hard copies and electronic files) will be forwarded from the laboratory to the Weiss Associates Project Chemist. These results will be validated and transferred to the project database by the Weiss Associates Database Manager in accordance with procedures described in the QAPP (WA, 2000a).

5. REFERENCES

Weiss Associates (WA), 1998, Final Technical Report: Western Dog Pens, Background and Off-Site Investigations at the Laboratory for Energy-Related Health Research, University of California, Davis, Rev. 0, June.

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

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TABLES

FIGURES