U.S. Department of Energy

Oakland Operations Office, Oakland, California

FINAL
DOMESTIC SEPTIC SYSTEMS INVESTIGATION AND 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

August 8, 2001
Rev. 0

DOE Oakland Operations Contract DE-AC03-96SF20686

Weiss Associates
Environmental Science, Engineering and Management

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Issued to: Dolores Loll Date: August 8, 2001

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Approvals Page

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Appendix A. Domestic Septic Systems 1 and 5 Removal Action Summary

Appendix B. Activity Hazard Analyses

ACRONYMS AND ABBREVIATIONS

AHA	Activity Hazard Analysis
ALARA	as- low-as-reasonably-achievable
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
Cr^{+6}	hexavalent chromium
cu yd(s)	cubic yard(s)
dBA(s)	decibel(s)
DGI	Data Gaps Investigation
DOE	United States Department of Energy
DQOs	data quality objectives
DSS	domestic septic system
DSSI	Domestic Septic Systems Investigation
DST	domestic septic tank
DZ	Decontamination Zone
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

HI(s)	hazard index(ices)
HSC	Health and Safety Coordinator
HSP	Health and Safety Procedure
HVAC	heating, ventilation and air conditioning
HW	hazardous waste
HWP	hazardous work permit
ID	identification
IDW	investigation-derived waste
IT Corp.	IT Corporation
LEHR	Laboratory for Energy-Related Health Research
LFI	limited field investigation
LLW	low-level waste
mg/kg	milligrams per kilogram
MW	mixed waste
NFA	No Further Action
NHW	non-hazardous waste
OSHA	Occupational Safety and Health Administration
PCB	polychlorinated biphenyl
pCi/g	picoCuries per gram
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
Ra-226	radium-226
RAOs	removal action objectives
RA	removal action

RBAS	risk-based action standard
RCT	Radiological Control Technician
RMMA	Radioactive Material Management Area
RPM	Remedial Project Manager
RPP	Radiological Protection Plan
RSO	Radiological 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
WMP	Waste Management Plan
WS	Waste Specialist

1. INTRODUCTION

This Work Plan addresses the Domestic Septic Systems Investigation (DSSI) and Removal Action (RA) that will be conducted at the Laboratory for Energy-Related Health Research (LEHR or the Site) facility located at the University of California, Davis (UC Davis) (Figure 2-1). The RA at Domestic Septic System (DSS) 6 and DSS 3 Confirmation Sampling were previously addressed in the *Work Plan for Removal Actions in the Southwest Trenches, Ra/Sr Treatment Systems, and Domestic Septic Systems Areas* (WA, 2000c) and will be discussed in greater detail in this document. The DSSI RA is 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 summarizes background information for the Domestic Septic Systems (DSSs), lists the constituents of concern (COCs), and presents the investigation objectives and the technical approach investigation sequence. A project organization chart and contacts list are also provided.

Additional information regarding previous investigations conducted at the DSSs is contained in the following documents:

- *Final Work Plan for Data Gaps Investigation* (IT Corp., 1997);
- *Limited Field Investigation Work Plan* (IT Corp., 1996);
- *Site Characterization Summary Report* (WA, 1997),
- *Remedial Investigation/Feasibility Study (RI/FS) Work Plan* (Dames & Moore, 1994);
- *Technical Memorandum Results of Data Gaps Investigation – Domestic Septic Tank Systems* (WA, 1999a); and,
- *Engineering Evaluation/Cost Analysis for the Southwest Trenches, Ra-226/Sr-90 Treatment System and Domestic Septic System Areas* (WA, 1998b).

1.1 Site Background and Summary of Previous Investigations

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 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).

Beginning in 1958, the DSSs served LEHR offices and laboratories. A typical DSS consists of a domestic septic tank (DST), leach field, and interconnecting piping. Seven known DSSs were located throughout the Site (Figure 3-1).

Liquid wastes and sewage were discharged to six of the seven DSTs (DSTs 1 through 6) prior to the Site's connection to the UC Davis Wastewater Treatment Plant in 1971. In 1971, DSTs 1 through 6 were reportedly backfilled with sand and the influent/effluent lines for each tank were reportedly cut and capped (IT Corp., 1996). No formal closure reports for these DSTs have been discovered. (Dames & Moore, 1994). DST 7 was installed adjacent to the Cobalt-60 (Co-60) Field to receive wastes from the irradiator building. This tank was reportedly never used, and was abandoned and backfilled with sand in 1988 (Dames & Moore, 1994).

DSTs 1 through 6 reportedly received all liquid wastes from the LEHR facility except for Sr-90 and Ra-226 wastes generated in Buildings AH-1 and AH-2. Domestic sewage is not classified as hazardous waste according to USEPA, 40 CFR Part 260. However, the DSSs may have potentially received fluids from laboratory sinks and floor drains. Therefore, the potential exists that hazardous and/or radioactive materials were disposed in these septic systems during operation of the LEHR facility.

In 1990, DST 1 was located during preliminary work conducted during the Phase II Site Characterization (Dames & Moore, 1993). In 1996, as part of the Limited Field Investigation (LFI), DST 7 was located in exploratory trenches on the north side of the Co-60 building (WA, 1998b).

DSTs 1, 3, 4, 5 and 6 were included in a Data Gaps Investigation (DGI) conducted in 1997 (WA, 1997). DSTs 2 and 7 were not included in the DGI because they had been previously assessed (Dames & Moore, 1993; WA, 1997). DST 2 was removed in 1999 during the adjacent Removal Action (RA) for the Ra/Sr Treatment System (WA, 2000c). This tank had been investigated in June 1995 (WA, 1998b). Also during the 1999 RA, a distribution box, leach lines, and five dry wells connected to DSTs 1 and 5 were uncovered, sampled, and partially excavated.

During investigation of DSS 3, boreholes were drilled that encountered gravelly materials believed at the time to be the DSS 3 leach field. However, new information from site maps indicates that these gravels are likely to be part of a former drain field receiving storm water runoff.

1.2 Constituents of Concern

COCs in soil samples from previous investigations at the DSSs are presented in Table 2-1. While all of these compounds were detected at one place or another in the samples taken from the domestic tanks, most were detected in only one or two samples. Compounds that were present at significant concentrations include Ra-226 and mercury. An RA has been planned to address these

occurrences, and will be carried out in parallel to this DSSI (WA, 2000c). A detailed description of the extent of contamination at each DSS identified to date is presented in Section 2.

1.3 Removal Action Scope and Objectives

As described in the Engineering Evaluation/Cost Analysis (EE/CA) (WA, 1998b), the Removal Action Objectives (RAOs) for the DSS 3 and 6 Areas are:

- Lower 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 (HIs) to levels below 1;
- Mitigate potential future impact to ground water;
- Mitigate potential ecological risks during and after the RAs; and,
- Minimize impact to site university research.

To achieve these objectives, the EE/CA evaluated two remedial alternatives for the DSS 6 Area. Alternative 1, No Action, was rejected. Alternative 2 included excavation, off-site disposal and institutional controls and was selected. This alternative intends to achieve RAOs through removal of surface and subsurface soil impacted with carcinogenic COCs. The DSS 6 RA will consist of excavating approximately 7 cu yds of mercury-contaminated soil. The soil will be disposed off-site at a Class I landfill, as detailed in the *Work Plan for Removal Actions in the Southwest Trenches, Ra/Sr Treatment Systems, and Domestic Septic System Areas* (WA, 2000c). The DSS 3 RA will consist of confirmation sampling to ensure that no RA is required and to determine whether institutional controls are necessary. In addition, analyses of confirmation samples taken from DSS 6 excavation limits would be appraised to evaluate achievement of RAOs. This appraisal will be included as part of a final Confirmation Report documenting the completed RAs.

1.4 Investigation Objectives

Previous investigations of the DSSs could not locate some of the tanks and their leach fields, or did not completely sample some of the known tanks, leach fields, or the dry wells discovered during the 1999 Ra/Sr Treatment Systems RA. The purpose of this investigation is to further characterize the occurrence, if any, of COCs at DSSs 1, 3, 4, 5, 6 and 7 with sufficient certainty to obtain No Further Action (NFA) closure, or alternatively to recommend appropriate RAs or another appropriate remedy necessary to obtain NFA closure. The scope of the investigation is discussed below in Section 1.5.

1.5 Investigation Sequence

The DSSI includes locating and uncovering each DST, its associated leach field; opening the DSTs, drilling and/or excavating to collect samples in and below the DSTs and below the leach lines and/or dry wells; field analysis, replacement of, or in some cases storage and disposal of, DST fill and drill cuttings; possible confirmation sampling and analysis of additional samples; backfill and compaction; and site restoration.

The sequence of activities for conducting the DSSI is summarized below.

1. Conduct pre-job planning activities including facility coordination, subcontracting, underground utility location, geophysical surveying, 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 investigation area including installing temporary perimeter barricades, concrete/asphalt cutting, clearing and grubbing, setting up the on-site laboratory, and preparing a material/waste storage area;
5. Remove concrete, asphalt, and/or soil overburden from the DSTs and place in stockpiles within the investigation area perimeter;
6. Secure and/or relocate utilities if necessary;
7. Open the DST by cutting holes in its top with a concrete-cutting saw or hydraulic ram/shears;
8. Remove DST backfill sufficient to reach bottom of the DST;
9. Collect and analyze samples in the field;
10. Locate leach fields either by line tracing or exploratory hand augering, followed by sampling and field analyses;
11. Drill and sample the dry wells, if any are found;
12. Conduct a preliminary evaluation (Phase I) to determine whether RAOs have been attained;
13. Review Phase I data evaluation results with DOE and the regulatory agencies;
14. Collect additional samples (Phase II), if required;
15. Perform a land survey of the DSS features and sample locations;
16. Return DST contents to the tanks, return cuttings to hand auger holes, and backfill and compact the overburden soils;
17. Dispose overburden concrete and asphalt as sanitary waste;
18. Restore site features;

19. Demobilize equipment and personnel from the Site;
20. Evaluate analytical results, perform the Phase II data evaluation and prepare the DSSI Confirmation Report; and,
21. Evaluate disposition options for any residual DSSI-generated drill cuttings (not covered under this Work Plan).

1.6 Project Organization

Roles and responsibilities for the project staff are described in the Quality Assurance Project Plan (QAPP) (WA, 2000a). The DSSI team consists of WA, IT Corporation (IT Corp.), Environmental Management Services (EMS), and other subcontractors. WA is responsible for the overall management, quality assurance, radiological protection, and health and safety (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.

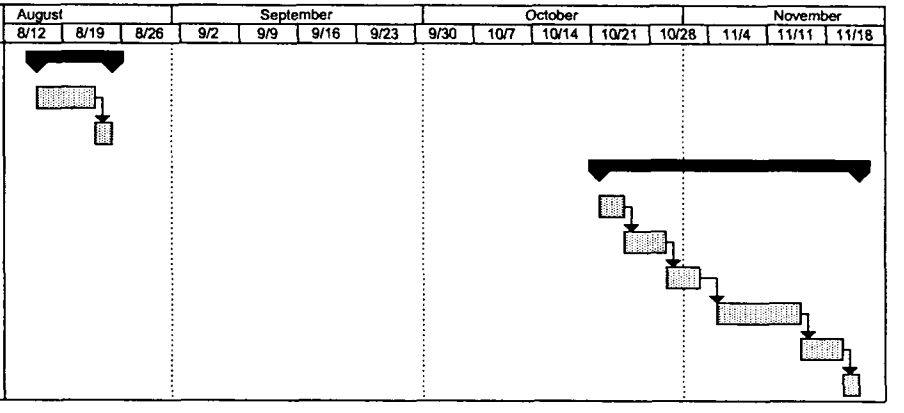
Waste Specialist – Dawn Mitchell

1.8 Project Schedule

The RA at DSS 6 and the confirmation sampling at DSS 3 will commence following gravel/concrete removal in the Western Dog Pens (WDPs). Therefore, the projected start date for these field activities is August 16, 2001 (Figure 1-1), subject to completing the WDPs gravel/concrete removal. The DSS investigations are scheduled to begin on October 22, 2001. The investigations will start with the best-known and most accessible systems, and proceed to the least known and least accessible. The first DSS to be investigated will be DSS 1, followed in order by DSS 6, DSS 7, DSS 3 and 4, and ending with DSS 5. This schedule only includes the Phase I sampling which is discussed in greater detail in Section 3.1 of the text.

Figure 1-1. Domestic Septic Systems Removal Actions and Sampling Schedule, LEHR, UC Davis, California

Task Name	Duration	Start	Finish
Domestic Septic Systems RA/Sampling	**7 days**	**Thu 8/16/01**	**Fri 8/24/01**
DSS 6 Removal Action	5 days	Thu 8/16/01	Wed 8/22/01
DSS 3 Confirmation Sampling	2 days	Thu 8/23/01	Fri 8/24/01
Investigation Sampling	**23 days**	**Mon 10/22/01**	**Wed 11/21/01**
DSS 1 Investigation Sampling	3 days	Mon 10/22/01	Wed 10/24/01
DSS 6 Investigation Sampling	3 days	Thu 10/25/01	Mon 10/29/01
DSS 7 Investigation Sampling	4 days	Tue 10/30/01	Fri 11/2/01
DSS 3 and 4 Investigation Sampling	8 days	Mon 11/5/01	Wed 11/14/01
DSS 5 Investigation Sampling	3 days	Thu 11/15/01	Mon 11/19/01
Dry Wells A-E Drilling/Sampling	2 days	Tue 11/20/01	Wed 11/21/01



2. DOMESTIC SEPTIC SYSTEMS INVESTIGATION

2.1 Common Elements

This section describes elements and supporting activities of the DSSI common to all DSTs and dry wells (Figure 2-1), including pre-job planning, mobilization, site setup, excavation, sampling, material/waste staging, backfill and compaction, site restoration, and demobilization. Detailed investigation elements specific to each DSS are presented in Section 2.2.

2.1.1 Pre-Job Planning

Several tasks need to be completed before starting the DSSI to facilitate efficient field operations and to optimize field activities. These include:

- Coordinating with UC Davis facility personnel;
- Locating utilities and conducting geophysical surveys of the work area;
- Providing worker training; and,
- Conducting pre-construction meetings with project staff.

2.1.1.1 Facility Coordination

Meetings will be held with UC Davis prior to starting the DSSI 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, utility modifications/re-routes (if any), and UC Davis facility support.

Facility coordination during the DSSI will focus primarily on the field work that will be performed adjacent to the buildings used by UC Davis researchers. Investigation 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. Building access will be provided to occupants according to UC Davis Fire Department policy.

Assistance from the UC Davis Facilities Services 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 full time through the duration of the RA and will be consulted on any decisions that affect UC Davis.

2.1.1.2 Geophysical Survey

A geophysical survey will be conducted at each DST to attempt to accurately identify tank and leach field locations, and to locate utility crossings. The first geophysical survey will be conducted at DST 1 because the location of this tank is known. The type of signal that it may produce will be used to interpret the results of surveys conducted in the vicinity of the tanks of unknown location. 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 investigation area will be marked on the ground surface with spray paint.

The geophysical survey will verify utility locations and attempt to 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 mark on the ground and 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 DSSI field staff prior to commencing invasive field activities. Copies of the report and map will be kept in the project and the field files.

2.1.1.3 Training

All workers and subcontractor personnel performing DSSI 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, 2000d);
- 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) (WA, 2000h);
- Site hazard briefing to include instructions on emergency response procedures, location of emergency equipment, and location of an 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, 2000b), for the specific job assignments; and,
- Training on the LEHR QAPP (WA, 2000a).

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) for those 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;
- Use of personal protective equipment (PPE);
- Respirator fit test (if respirator usage is required);
- Medical surveillance; and,
- Preparation of hazardous and radioactive 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.

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

2.1.1.4 Pre-Construction Meetings

A readiness review will be held with project personnel prior to the start of the DSSI 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.

2.1.2 Mobilization

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

2.1.2.1 Personnel

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

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

The following personnel are already assigned to the Site on an ongoing basis:

- Radiological 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 it is being conducted according to the Work Plan and other applicable project and program documents. During the performance of the DSSI, 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.

2.1.2.2 Equipment

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

- Concrete-and asphalt-cutting diamond saws and coring devices;
- Track-mounted hydraulic compact excavator and skid steer loader, each with a hydraulic jackhammer attachment for breaking concrete, and bucket for removing concrete and other overburden;
- Front End loader to move excavation materials to and from the storage areas within the investigation area perimeter ;

- Limited-access drilling/sampling rig and/or casing-setting vibrohammer;
- Direct-push drilling/sampling rig;
- Pickup trucks, including one with a fuel cell, for on-site transportation and fueling;
- Compaction equipment for compacting backfill material;
- Steel/rebar-cutting saw;
- Hoses and sprayers for dust suppression;
- Construction hand tools for miscellaneous activities; and,
- Air and radiological monitoring equipment for environmental and H&S monitoring.

2.1.3 Site Setup

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

2.1.3.1 Environmental Protection Measures

Prior to the start of the DSSI, several environmental protection measures will be implemented to prevent impacts to the surrounding environment. These protection measures include: controlling storm water runoff and preventing airborne contaminants from impacting UC Davis heating, ventilation and air conditioning (HVAC) systems.

2.1.3.1.1 Storm Water/Runoff Protection

All investigation activities will be performed in a manner that will mitigate the spread of contamination to surface and ground waters To mitigate storm water pollution and ensure compliance with environmental regulations, the following will be implemented:

- To reduce storm water runoff velocities, temporary check dams or berms will be constructed, where appropriate;
- Before storm events, materials will be swept and removed from surfaces that drain to storm drains;
- Construction entrances for vehicles entering and leaving the investigation area, will be stabilized; and,
- Storm drain covers, tarps and sand bags will be available and kept on site for use in the 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 exposed temporary storage piles of drill cuttings and loose materials, tools and equipment from exposed locations.

2.1.3.1.2 Building HVAC Modification

Past and recent RA air modeling (WA, 2001b) indicates that there are no concerns with potentially airborne contaminants. The anticipated levels of dust and contaminant concentrations are significantly lower for the DSSI than other RA or investigation areas, and dust suppression will be practiced continually during excavation activities. For these reasons, there are currently no plans to modify the HVAC systems at any of the buildings. However, in the event that additional air modeling indicates potential impacts to indoor air quality by airborne contaminants, work will be stopped and the UC Davis Facilities Services Division will be contacted to perform the necessary modifications.

2.1.3.2 Site Preparation

The DSS and dry well areas will be prepared for DSSI activities prior to commencing the investigation. Site preparation will include the following tasks:

- Installing temporary chain-link fencing around the investigation area;
- Protecting or relocating existing utilities, if necessary; and,
- Preparing the overburden/drill cuttings (waste) storage areas.

2.1.3.2.1 Temporary Perimeter Fencing Installation

Temporary chain-link fencing will be installed around the perimeter of each DSS investigation area to control access. 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, and Standard Operating Procedure (SOP) 24.1, Radiological Areas and Postings (WA, 1999b).

2.1.3.2.2 Utility Protection/Relocation

Numerous active utilities will be encountered during the DSSI. A review of site records and the geophysical survey should identify these utilities. All known utilities will be marked on the ground with spray paint prior to excavation. During excavation, measures will be taken to protect, support or relocate the lines according to UC Davis specifications. Where necessary, utilities will be carefully uncovered with hand tools to avoid damage and minimize any safety hazards.

2.1.3.2.3 Overburden and Drilling Waste Storage Area

At each DST, an area within the investigation area perimeter will be set aside for temporary storage of overburden. Topsoil, where present, will be set aside separately. Drill cuttings stockpiles with potential radiological or chemical impacts will be properly managed in an area specified by the waste coordinator, outside of the investigation area perimeter and enclosed with high-density polyethylene (HDPE) sheeting with a 20-mil thickness.

2.1.4 Excavation

A compact excavator and/or skid steer loader will be used to conduct exploratory trenching at the approximate DST locations based on existing site maps. This exploratory trenching will be limited to an area approximately 20 ft wide by 20 ft long and will not exceed 3 ft bgs in depth for DSS 3, 4, and 7 (all of the DSS, where the exact DST locations are unknown). The exploratory trenching at the approximate location of DST 5 will be limited to an area approximately 10 ft wide, 30 ft long and 7 ft deep because DSS 5 is believed to be located partly or wholly beneath Buildings H-213 as shown in Figure 2-7. For the DSS with known locations, DSS 1 and DSS 6, the investigation excavation boundaries will be limited to approximately 10 ft wide by 15 ft long and will not exceed 3 ft bgs in depth. The DSS excavation boundaries are presented in Figures 2-3, 2-5, 2-7, 2-9 and 2-10. For all of the DSS, the excavation will exceed the 3 ft bgs in depth in the areas adjacent to the influent and effluent lines, but will not exceed 8 ft bgs in depth. After the tanks are located, the leach lines will be exposed to locate the points where the first perforations begin.

Once the top of each DST is uncovered, a section of the top of the tank about three ft by four ft will be cut out with concrete saws and removed. The fill material will be removed with a compact excavator and/or skid steer loader to uncover a sufficient area of tank contents for sampling. The sampling and analysis plan for the DSS are discussed in Section 3.1.

2.1.5 Material/Waste Removal and Staging

Most of the materials removed from the subsurface during the DSSI, including overburden sand, gravel, and soil; drill cuttings from hand auger borings; and the contents of the DSTs, will be returned to the locations from which they were removed. Decontamination wash water and associated sediment generated during each investigation will be returned to the corresponding DST.

Wastes expected to be generated by the DSSI, and their handling/removal requirements include:

- Concrete and asphalt overburden is assumed to be clean and will be disposed as sanitary waste; and,
- Drill cuttings from the dry wells sampling, if any will be handled as low-level waste (LLW) unless process knowledge, field screening or radiological surveys indicate otherwise.

2.1.6 Surveying and Backfill

Following sampling, all excavated and sampled areas will be surveyed, backfilled to subgrade with the original materials, and compacted. Backfill and compaction activities will conform to Specification 02200, Earthwork, of the UC Davis Campus Standards and Design (UC Davis, 1994).

2.1.6.1 Land Survey of Identified Features

Following field activities at each work location, key features such as corners of the DSTs, hatch locations, presumed leach line locations, and borehole/sampling locations will be marked with paint or survey tape on the ground. These surveys will locate each feature both horizontally and vertically and to the nearest foot and tenth of a foot, respectively, to at least three permanent benchmarks. A State of California-licensed land surveyor will do all surveying. When complete, the land survey subcontractors will provide hard and electronic copies of survey maps and survey data for the project file.

2.1.6.2 Materials and Compaction

Backfill material will consist of the original materials removed from each excavation, DST, or borehole, with the exception of surface asphalt or concrete. Subgrade materials will be compacted thoroughly by mechanical means. Topsoil, where originally present, will be returned uncompacted to its original location. Any boreholes exceeding 20 ft in depth will be backfilled with a cement/bentonite grout containing at least 5% bentonite.

2.1.7 Site Restoration

After the investigation areas have been backfilled and compacted, they will be restored as specified below. Site restoration activities will include surface grading, site access control, utility restoration, paving, and site cleanup.

In unpaved investigation areas such as DST 3, surfaces will be restored to match original grade, with topsoil used for the upper six inches. When surface grading is complete, the temporary chain-link fencing surrounding each investigation area will be reduced to enclose only the drilling and decontamination waste storage area. This area will be secured and posted according to the RPP requirements for LLW storage.

Utility restoration will be performed if DSSI activities result in modification or cause damage to existing utilities. Asphalt and concrete paving will be performed where DSSI activities required removal of paved walkways or roadways. Any utility restoration and/or paving will follow UC Davis design specifications (UC Davis, 1994).

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

2.1.8 Demobilization

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

2.2 Area-Specific Elements

This section provides a separate background description and investigation work plan for each DSS, with emphasis on the elements unique to each tank. A summary of the prior and proposed actions for each DSS is presented in Table 2-1. While the DSSs are presented here in numerical order, the investigation is planned to begin with the best-known and most accessible systems, and proceed to the least known and least accessible. This will allow application of lessons learned to the more difficult, subsequent parts of the investigation. Therefore the first DSS to be investigated will be DSS 1, followed by DSS 6 and 7, DSS 3 and 4, and ending with DSS 5. The investigation work for dry wells associated with DSS 1 and 5 does not depend on any of the DSS investigation activities, and can be carried out at any time. Investigation elements common to each DSS were presented in the previous section.

The RA planned for DSS 6 (WA, 2000c) will take place concurrently with the investigation of that area to avoid having to mobilize and demobilize to this area again.

2.2.1 Domestic Septic System 1

DSS 1 is located just west of ITEH's Main Office and Laboratory (Building H-213) (Figure 2-3). Its leach field has already undergone extensive investigation, but the interior of the tank itself has not yet been sampled. The results of previous investigations and the work plan for further investigation are presented below.

2.2.1.1 Domestic Septic System 1 Background and Summary of Previous Investigations

The tank associated with DSS 1, DST 1, is assumed to have been installed and used between 1962 and 1970. This assumption is based on its absence on a site map dated April 25, 1962, and a map dated September 28, 1970 that shows DST 1 being bypassed. The tank was located in 1990 using a shovel, probe, and backhoe (WA, 1998a). It was located again and opened in 1993 (Dames & Moore, 1993). The original tank contents had been removed, and the tank was backfilled with clean, sandy gravel. No tank sediment samples were collected.

During the 1996 LFI, DST 1 was opened and sampled, and soil was sampled in a boring outside and beneath the tank (WA, 1998a). According to the Final Site Characterization Summary Report, DST 1 is a concrete, five-foot diameter, six-foot tall, (approximately 800-gallon capacity) vertical cylindrical tank located on the west side of Building H-213. During the LFI, the concrete lid of the tank was found to be broken and the tank had been filled with sand and gravel. The top of the

tank was buried 1.5 ft below ground surface (bgs) and the base of the tank was found at 7.5 bgs (WA, 1997).

Soil samples were collected in the excavation outside of the tank (Figure 2-3). No sediment samples were collected within the tank because material inside the tank (i.e., sand and gravel) was not characteristic of septic tank contents (WA, 1997).

A cast iron effluent line that discharged from the tank was identified and traced 80 ft south of the tank using a transmitter mounted on a fiberglass rod. Field observations suggested that the line was truncated about 4.25 ft bgs and left uncapped during the installation of a sanitary sewer line. The end of the pipeline on the other side of the sewer line was not located.

During the 1997 DGI, trenching and sampling were conducted to determine the southern extent of the DST 1 cast iron effluent line south of the point of truncation by the sanitary sewer (WA, 1998a). The effluent line and leach field material were located, and some COCs were detected above background in soil samples (Table 2-1). A single borehole was drilled adjacent to DST 1. Ra-226, Sr-90, gross beta, copper, manganese, and zinc were detected in some of the soil samples from this boring at activities/concentrations that are less than twice the background levels (Figure 2-3, Table 2-1). Carbon-14 was detected at 2.1 picoCuries per gram (pCi/g) in the sample at 7.5-ft depth, less than 3 times the background level of 0.87 pCi/g (WA, 1998b).

Other elements of DSS 1 include the distribution box, leach lines, and dry wells ultimately receiving the effluent. The area between the tank and dry wells (effluent lines) was characterized during the DGI (WA, 1988a). The dry wells were partially characterized and removed during the 1999 Ra/Sr Treatment System Removal Action (Appendix A) as discussed further in Section 2.2.7.

2.2.1.2 Domestic Septic Tank 1 Work Plan

The location of DST 1 is known. However, all underground utilities in the vicinity will be located as a safety precaution. An area of pavement approximately six feet by six feet will be cut and removed, and overburden subsoil removed to expose the top of the tank and the hatch cover. Topsoil, where present, will be set aside separately within the investigation area perimeter. The DST 1 excavation boundaries are shown in Figure 2-3.

Sampling at the bottom of DST 1 and replacement of the excavated materials will be conducted following the procedures described in Section 3.1. The interior of the tank will be sampled, and one boring will also be drilled just outside the tank below the point where the effluent line joins the tank. A second exterior boring will not be needed since it was drilled as part of the LFI (Section 2.2.2.1). The distribution box for DSS 1 has already been characterized. The work plan for characterizing the dry wells is presented in Section 2.2.7.

2.2.2 Domestic Septic System 3

DSS 3 is believed to be located between Buildings H-215 and H-216 (Figure 2-4). This area has already undergone investigation, but the tank has not been found or sampled. The results of previous investigations and work plan for further investigation are presented below.

2.2.2.1 Domestic Septic System 3 Background and Summary of Previous Investigations

DST 3 was installed and used between 1965 and 1970. DST 3 may have been built during the construction of Buildings H-215 and H-216 between 1962 and 1964, as the capacity of the tank serving existing Building H-217 may have become insufficient.

The tank was reported to have been positively located in 1990 using shovel, probe, and backhoe (WA, 1998a). According to the Final Site Characterization Summary Report, this tank was in good condition and filled with gravel (WA, 1997). During Phase II Site Characterization (Dames & Moore, 1993), no tank sediment, leach field material, or adjacent soils were sampled. This was also true of the 1996 LFI, where the exploration area was limited by underground utilities (WA, 1998a).

During the 1997 DGI, 9 borings were hand-augered to 5-ft depth, and 4 borings were drilled up to 16-ft depth near the suspected location of DSS 3 (Figure 2-4) (WA, 1998a). The tank was not located, but gravelly materials were found between 4- and 8-ft depth in borings 7, 8, 14, and 15, which were considered at that time to be the leach field of DST 3. This location coincides with a former "drain field" (Figure 2-5) that is shown connected to the storm water catchment system on the 1962, 1964, and 1965 site drawings.

COCs detected above background in what was presumed to be the leach field for DSS 3 area in the DGI are presented in Figure 2-4 and Table 2-1. However, it is now believed that this location and materials encountered are associated with the former drain field, not the leach field. Review of existing analytical data from the area south of DSS No. 3 indicates that, except for Ra-226, no COCs are present above the RBAS levels. Ra-226 at 1.5 pCi/g was detected in a composite sample from three borings at a depth of 15.5 ft bgs (See Figure 2-4).

2.2.2.2 Domestic Septic System 3 Work Plan

The specific location of DST 3 is not known, but its approximate location is indicated on site maps dated November 22, 1965 and August 28, 1970. Three hand auger holes were drilled in the vicinity of the 1970-mapped location (Figure 2-5), but no records are available describing the materials encountered. No holes have been drilled in the 1965-mapped location or associated leach field.

Prior to investigation activities, an arborist will be consulted to determine if the tree shown on Figure 2-5 will be impacted. If the tree will be impacted, it will be removed or mitigative measures will be taken. Before intrusively investigating the mapped DST 3 locations, all underground utilities in the vicinity will be located and a geophysical survey will be performed. In the area of the mapped location, and any additional areas indicated as potential tank locations by the

geophysical survey, topsoil will be removed and set aside in a separate location within the investigation area perimeter. Overburden subsoil will then be removed to expose the top of the tank and hatch covers. The DSS 3 excavation boundaries are shown in Figure 2-5.

The single Ra-226 detection discussed in Section 2.2.2.1 does not warrant removal activities. The confirmation sampling will be conducted to determine whether localized Ra-226 contamination exists.. After the DSS 3 confirmation sample analytical results are received, a Phase I data evaluation will be conducted. The results will be presented to the RPMs to determine if additional removal action is necessary. Five soil borings will be drilled surrounding the radium detection to a depth of 20 ft. The sampling plan for this area is discussed in greater detail in Section 3.1.5.

2.2.3 Domestic Septic System 4

DSS 4 is believed to be located south of Building H-217 (Figure 2-5). This area has undergone some investigation, but the tank has not been located or sampled. The results of previous investigations and the work plan for further investigation are presented below.

2.2.3.1 Domestic Septic System 4 Background and Summary of Previous Investigations

DSS 4 appears to have been installed at the time of construction of Building H-217. It is shown as "existing" on the 10/2/1960 site map, and is likely to have been in service at least until the construction of DSS 3, some time between 1965 and 1970, and it may have served in parallel with DSS 3 up to 1970.

The DSS 4 tank, leach field material, and adjacent soils were not sampled during the Phase II Site Characterization (Dames & Moore, 1993), or the 1996 LFI (WA, 1998a).

During the 1997 DGI (WA, 1998a), 7 borings were hand-augered to 5-ft depth, and 4 borings were drilled up to 13-ft depth (Figure 2-4) near the suspected location of DSS 4. The tank was not located, but gravelly materials believed to be the leach field were found at depths between 2 and 5.5 ft in borings 8, 9, 10, and 11. This location does not coincide with either of the mapped locations for DST 4 and the leach field (Figure2-5). However, it does potentially coincide if the leach field for the November 1, 1965 depicted location of DST 4 follows the same pattern as the leach field depicted on the 1962 map.

COCs detected above background in the DGI in the presumed DSS 4 leach field are presented in Figure 2-4 and Table 2-1. Cadmium, chromium, lead (Pb), nickel, vanadium, and zinc were detected in some soil samples at activities/concentrations that are less than two times the background levels (WA, 1998a). Mercury was detected at 1.52 mg/kg in a sample at 8-ft depth, slightly more than three times the background level of 0.49 mg/kg. Tritium was detected at 1270 pCi/L, about 12 times the background concentration, in a sample from 8-ft depth. Uranium-235 was detected at 0.16 pCi/g, about twice its background concentration, in a sample from 5.5 ft.

2.2.3.2 Domestic Septic System 4 Work Plan

The specific location of DST 4 is not known, but three overlapping locations are shown on site maps dated April 25, 1962, November 1, 1965, and November 22, 1965. The April 25, 1962 and November 22, 1965 maps show nearly identical locations, lending credibility to the indicated location. However, several lines of evidence indicate that the location shown on the map from November 1, 1965 may be accurate:

- The November 1, 1965 map also shows an air conditioning unit on the south side of Building H-217, near the DST, which coincides with an area on the building with different colored paint and the remains of bolt anchors imbedded in the wall. This detail is absent on the maps from April 25, 1963 and November 22, 1965;
- Field notes from the drilling of hand auger holes 1, 2, 3, 4, and 5 (Figure 2-4) indicate that there is no evidence of leach lines or a tank in these five-foot depth holes. However, at least two of the holes coincide with "hard" features on the maps from April 25, 1962 and November 22, 1965—the distribution box and the tank itself. These features should have been intersected if those maps were accurate, and;
- If the configuration for the leach field shown in the April 25, 1962 and November 22, 1965 maps is transposed to the November 1, 1965 location (which does not show a leach field), the leach field would coincide with the area of borings 8, 9, 10, and 11 where leach field materials were found.

Both of the potential DSS 4 locations present major access problems. Many underground utilities are present, and the November 1, 1965 location partly underlies Building H-216. As with all the tanks, before intrusively investigating the mapped location, all underground utilities in the vicinity will be located and a geophysical survey will be performed. In the area most likely to overlie the tanks, just west of the wall extending north of the northwest corner of Building H-216 (Figure 2-5), careful hand excavation will be performed to attempt to locate the top of the tank. Topsoil will be removed and set aside in a separate location. Overburden subsoil will then be removed to expose the top of the tank and hatch covers. Utilities, if encountered, will be supported and protected from the excavation activities, and if necessary, rerouted. The DSS 4 excavation boundaries are shown in Figure 2-5.

If the tank is not encountered at the November 1, 1965 location, the area about five feet northwest, coinciding with the center of the tank depicted on the April 25, 1962 and November 22, 1965 maps will be excavated (Figure 2-5). This is not because it is the more likely tank location, but it can be excavated without disturbing any surface features. If the tank is not located there, the concrete sidewalk on the north side of Building H-216 will be cut and excavation attempted at the location indicated on the map from November 1, 1965 (Figure 2-5). None of the excavations will extend beneath the building foundations.

Sampling inside and outside of the tank, and leach field, and replacement of excavated materials will be conducted according to the procedures described in Section 3.1.

2.2.4 Domestic Septic System 5

DSS 5 is believed to be located partly or wholly beneath Buildings H-213 (Figures 2-6 and 2-7). This area has undergone some investigation, but the tank has not been located or sampled. The results of previous investigations and the work plan for further investigation are presented below.

2.2.4.1 Domestic Septic System 5 Background and Summary of Previous Investigations

DSS 5 appears to have been installed at the time of construction of Building H-213, before the additions were constructed. It is shown as a "new septic tank" on the site map from February 2, 1960, which shows Building H-213 as "new construction". A drawing of the DST and leach line layout dated November 31, 1961 shows the building in place. The tank itself appears to have been in service until 1970 when the sanitary sewer system was connected. At some point between 1960 and 1970, probably by 1962, this tank was disconnected from its original leach field, and connected to the leach field serving DSS 1, which includes the five dry wells west of Building H-213 (WA, 1998a).

The DSS 5 tank, leach field material, and adjacent soils were not sampled during the Phase II Site Characterization (Dames & Moore, 1993), or the 1996 LFI, due to limitations imposed by underground utilities (WA, 1998a).

No samples were collected for chemical analysis from DSS 5 during the DGI (WA, 1998a) the tank was not found. It is believed that an extension of Building H-213 was constructed atop DST 5 and that the effluent drained to the DSS 1 leach field. Facility drawings indicate the effluent line from DST 5 was installed at an angle in the approximate direction of the DSS 1 leach field. A pipe draining into the leach field from the purported direction of DST 5 was also located in the field (WA, 1998a).

2.2.4.2 Domestic Septic System 5 Work Plan

The specific location of DST 5 has not been discovered, but five locations are shown within an 8-ft by 35-ft area on different site maps (Figure 2-7). The two 1962 locations are considered the most accurate, due to their coincidence and accurate portrayal of other site features. The map dated January 31, 1961 shows details of a tank, distribution box and leach field, which may be useful for determining the relative locations of the ancillary features once the tank is located. The map dated February 8, 1962 shows the effluent line and a cleanout, which may be more easily located than the tank itself. Once located, the effluent line could be followed to the tank.

DSS 5 appears to be nearly inaccessible, lying partly or wholly under Building H-213. Underground utilities are present, and two building fire exits are located where excavation activities will need to occur. As with all the tanks, before intrusively investigating the mapped locations, all underground utilities in the vicinity will be located, and a geophysical survey will be performed. In the area most likely to overlie the tanks, where mapped locations from 1962 nearly coincide (Figure 2-7), the sidewalk will be cut and removed, and careful hand excavation will be performed to locate the top or southern side of the tank. The tank will not be opened for sample collection due to concerns about undermining the foundation of Building H-213. If possible, soil samples will be

collected near the tank exterior and the leach field as described in Sections 3.1.2. and 3.1.3. The DSS 5 excavation boundaries are shown in Figure 2-7.

2.2.5 Domestic Septic System 6

DSS 6 is believed to be located just east of Building AH-2, below the exterior spiral staircase (Figures 2-8 and 2-9). This area has undergone some investigation, but the tank has not been located or sampled. The results of previous investigations and the work plan for further investigation are presented below.

2.2.5.1 Domestic Septic System 6 Background and Summary of Previous Investigations

DSS 6 is likely the oldest DSS at LEHR. A plan dated December 12, 1958 shows it connected to the existing "Animal Holding Building." Other maps dated February 2, 1960, April 25, 1962, and September 28, 1970 all show DSS 6 in essentially the same location (Figure 2-9). DSS 6 appears to have been in service until 1970 when the sanitary sewer system was connected.

During the 1997 DGI (WA, 1998a), 11 borings were hand-augered to a depth of five feet, and 4 borings were drilled up to a depth of 13 ft (Figure 2-8) in the suspected location of DSS 6. The tank was not located, but gravelly materials believed to be the leach field were found between 1- to 1.5-ft depth and 5-ft depth in borings 10, 12, and 13. Borings 8 and 9 also encountered sand and gravel at an unspecified depth. These five borings are all located within a few feet of a mapped leach line at DSS 6 (Figures 2-8 and 2-9).

COCs detected above background in the DGI in the presumed leach field for DSS 6 are presented in Figure 2-8 and Table 2-1. Bismuth-214, thallium-208, iron, vanadium, and zinc were detected in some soil samples at activities/concentrations less than two times the background levels (WA, 1998a). Tritium was detected in a sample at 8-ft depth at 460 pCi/L, about 4 times the background concentration of 105 pCi/L. U-235 was detected at 0.16 pCi/g, about twice the background concentration of 0.071 pCi/g, in a sample from 8-ft depth. Trichloroethene was also detected in another sample from the same depth at a low concentration of 0.004 mg/kg. Mercury was detected at 49.4 mg/kg in the sample collected from 5.5-ft depth on June 12, 1997 (LEHR-S-T601) (Figure 2-8). The background level for mercury is 0.49 mg/kg.

2.2.5.2 Domestic Septic System 6 Work Plan

The location of DST 6 is accurately co-located on four different site maps (Figure 2-9). In addition, concrete paving at this location has been cut out and replaced, probably to access the tank and distribution box in the past. The 1958, 1960 and 1962 maps all show details of the tank, distribution box and leach field, which, if accurate, will enable field location of all these features. However, before intrusive work begins, all underground utilities in the vicinity will be located and a geophysical survey performed.

In the area most likely to overlie the tank, concrete pavement will be cut and removed, and careful hand excavation will be performed to locate the top of the tank. Utilities, if encountered, will

be supported and protected from the excavation activities, and if necessary, rerouted. Overburden subsoil will then be removed to expose the top of the tank and hatch covers. The DSS 6 investigation excavation boundaries are shown in Figure 2-9. Sampling of the tank and replacement of excavated materials will be conducted according to the procedures described in Section 3.1. The leach field will be traced and sampled where drilling can be safely conducted.

A 5-foot by 5-foot area will be excavated to a depth of 5 ft around the mercury detection of 49.4 mg/kg using a backhoe. This area will be excavated to a depth of 5 feet bgs and represents the expected volume of mercury contamination. The removal action excavation boundaries are shown in Figure 2-9. Excavated soil will be transported to the Western Dog Pens area and placed on and covered with plastic sheeting. Soil stockpiling will be performed in accordance with SOP 12.1, Soil Stockpiling. This material will require characterization for proper disposal. The RA will be done concurrently with the DSSI activities for DSS 6. The excavation screening and confirmation sampling for the DSS 6 RA is discussed in greater detail in Sections 3.1.6 and 3.1.7.

2.2.6 Domestic Septic System 7

DSS 7 is located about 15 ft north of the Co-60 Building (Figure 2-10). This area has been previously investigated, and the soil near DST 7 sampled. The results of previous investigations and work plan for further investigation are presented below.

2.2.6.1 Domestic Septic System 7 Background and Summary of Previous Investigations

DST 7 was installed around 1970, about the same time the Site was switched from septic systems to a sanitary sewer system. UC Davis personnel indicate that before the tank was used, the Co-60 Building was connected to the new sewer. However, this has not been positively documented. The tank was reportedly filled in place and abandoned in 1988 by Dames & Moore (Dames & Moore, 1994). No reports or drawings of a possible distribution box or leach field associated with DST 7 have been found.

In 1996, as part of the LFI, exploratory trenches were excavated using a backhoe around DST 7. The size of the tank was not confirmed, but its long axis is north-south. Utilities prevented exposing the entire tank. The concrete lid of the tank had been broken and the tank was filled with concrete and dirt (WA, 1997; WA, 1998b).

Soil samples were collected from a borehole immediately west of the tank from a depth equal to the tank bottom (S-428), 2.5 to 3 ft below the tank (S-429), and 5.5 ft below the tank (S-430) (WA, 1997). Ra-226, Sr-90, and uranium-235 were detected slightly above background (Figure 2-10). Nitrate, barium, copper, manganese, zinc, sulfate, and chloride were also detected slightly above background. Of these, only nitrate and one chloride sample exceeded two times background. Trace concentrations of formaldehyde (2.2 mg/kg) were detected in one sample.

DSS 7 was not investigated during the 1997 DGI (WA, 1998a).

2.2.6.2 Domestic Septic System 7 Work Plan

Before intrusive work begins at DSS 7, all underground utilities in the vicinity will be located, and a geophysical survey will be performed.

In the area most likely to overlie the tank, asphalt pavement will be cut and removed, and careful machine excavation will be performed in areas clear of utilities to locate the top of the tank. Overburden subsoil will be removed to expose enough of the top of the tank to allow removal of the tank contents. The DSS 7 excavation boundaries are shown in Figure 2-10. If utilities encountered in previous investigations interfere with this activity, they will be supported and protected from the excavation activities, and if necessary, rerouted. Sampling of the tank and replacement of excavated materials will be conducted according to the procedures described in Section 3.1. The leach field will be traced and sampled where drilling can be safety conducted.

2.2.7 Dry Wells

Five dry wells, discovered during the Ra/Sr Area 1 RA, are located west of ITEH's Main Office and Laboratory (Building H-213) on the western edge of the Site (Figures 2-2 and 2-11). The upper parts of the dry wells have already been investigated and removed where necessary; the lower parts remain to be investigated. The results of previous investigations and the work plan for further investigation are presented below.

2.2.7.1 Dry Wells Background and Summary of Previous Investigations

The five dry wells, labeled A, B, C, D, and E (Figure 2-11), were connected to DSSs 1 and 5. They were discovered during the RA for the Ra/Sr Treatment System in the summer of 1999. The dry wells and associated distribution box were sampled at the locations shown on Figure 2-11.

Several COCs above background and RBAS were found in some of the samples, particularly in Sample CWRSC024 (Table A-1). The portions of the dry wells with concentrations above background and RBAS were excavated using a large-diameter auger, along with material up to 5 ft beyond the well bore. The results of this investigation have not been formally published, but are presented in detail in Appendix A. Confirmation samples were not collected from the walls of the excavations.

2.2.7.2 Dry Wells Work Plan

The dry wells will be investigated for two purposes: to confirm that the RA succeeded, and to assess impacts to ground water of any potential residual COCs.

One borehole will be drilled near each dry well. The boreholes will be within 2 ft of the axis of the dry well, and samples will be collected at 10-ft intervals from 10- to 40-ft depth if this depth is above the seasonal water table (Phase I). If COCs are detected in any of the samples above background and RBAS, an additional borehole will be drilled seven feet horizontally from the axis of the dry well, with samples collected at the same depth intervals as any samples with COCs above

background and RBAS, and from the next-deeper 10-ft interval, if this depth is above the seasonal water table (Phase II).

A total of four borings will be drilled around Dry Well D (Figure 2-11). All of the borings will be drilled within 2 ft of the axis of the dry well. One boring will be sampled from 10- to 40- ft if this depth is above the seasonal water table (Phase I). Phase II sampling will occur if necessary as discussed above. Three additional borings will be drilled in the three other compass directions from the center of the dry well. Samples will be collected at 10, 15 and 20 ft bgs. The additional borings will be collected to determine if the removal action surrounding sample CWRSC024, successfully removed the associated contamination.

Table 2-1. LEHR Site Domestic Septic Systems Action Summary, UC Davis, California

Septic System	Location	Prior Actions	Proposed Actions
DSS 1	Known	A sample was collected beneath the DST 1 influent line during the 1997 DGI.	Collect 1 tank contents sample and 1 sample adjacent to the tank bottom near the effluent line.
DSS 2	Removed	DST 2 was removed during the Ra/Sr Treatment Systems RA in 1999.	No action.
DSS 3	Unknown	Samples were collected from the area south of DST 3 during the DGI (Ra-226 was detected above background/RBAS at 1.5 pCi/g).	Collect samples from 5 borings surrounding the Ra-226 detection. Collect 1 tank contents sample, 2 samples adjacent to the tank bottom near the influent and effluent lines, 1 composite sample from the locations where the effluent lines become perforated; 1 field duplicate.
DSS 4	Unknown	Samples were collected from the area southwest of DST 4 during the DGI.	Collect 1 tank contents sample, 2 samples adjacent to the tank bottom near the influent and effluent lines, 1 composite sample from the locations where the effluent lines become perforated; 1 field duplicate.
DSS 5	Unknown	No actions.	DST 5 is either partially or wholly under building H-213, if possible, the following samples will be collected: 2 samples adjacent to the tank bottom near the influent and effluent lines, 1 composite sample from the locations where the effluent lines become perforated.
DSS 6	Known	Samples were collected from the DSS 6 leach field during the DGI (mercury was detected at a concentration of 49.4 mg/kg).	Excavate and remove a 5ft x 5ft x 5ft area of soil surrounding the mercury detection; collect excavation screening and confirmation sampling. Collect 1 tank contents sample, 2 soil samples adjacent to the tank bottom near the influent and effluent lines, 2 composite samples from the locations where the effluent lines become perforated, 1 field duplicate.

Table 2-1. LEHR Site Domestic Septic Systems Action Summary, UC Davis, California (continued)

Septic System	Location	Prior Actions	Proposed Actions
DSS 7	Known	Samples were collected immediately west of DST 7.	Collect 1 tank contents sample, 2 samples adjacent to the tank bottom near the influent and effluent lines, 1 composite sample from the locations where the effluent lines become perforated.
Dry Wells A-E (DSS 1 & 5 leach field)	Known	The distribution box, piping and upper dry well structures were removed; the excavation depth ranged from 5.5 to 20 feet bgs.	Drill 1 boring adjacent to each dry well; collect samples at 10-ft intervals starting at the former excavation limit to a depth of 40 feet bgs; 2 field duplicates. Drill 3 additional boring around Dry Well D; collect metals samples at 10, 15 and 20 ft bgs; 2 field duplicates.

Abbreviations

bgs	below ground surface
DGI	Data Gaps Investigation
DSS	Domestic Septic System
DST	Domestic Septic Tank
ft	foot
mg/kg	milligram per kilogram
pCi/g	picocurie per gram
Ra-226	radium-226
RBAS	Risk-based action standard

Table 2-2. Analytes Detected in Soil Above Background, Domestic Septic Systems, LEHR, UC Davis, California

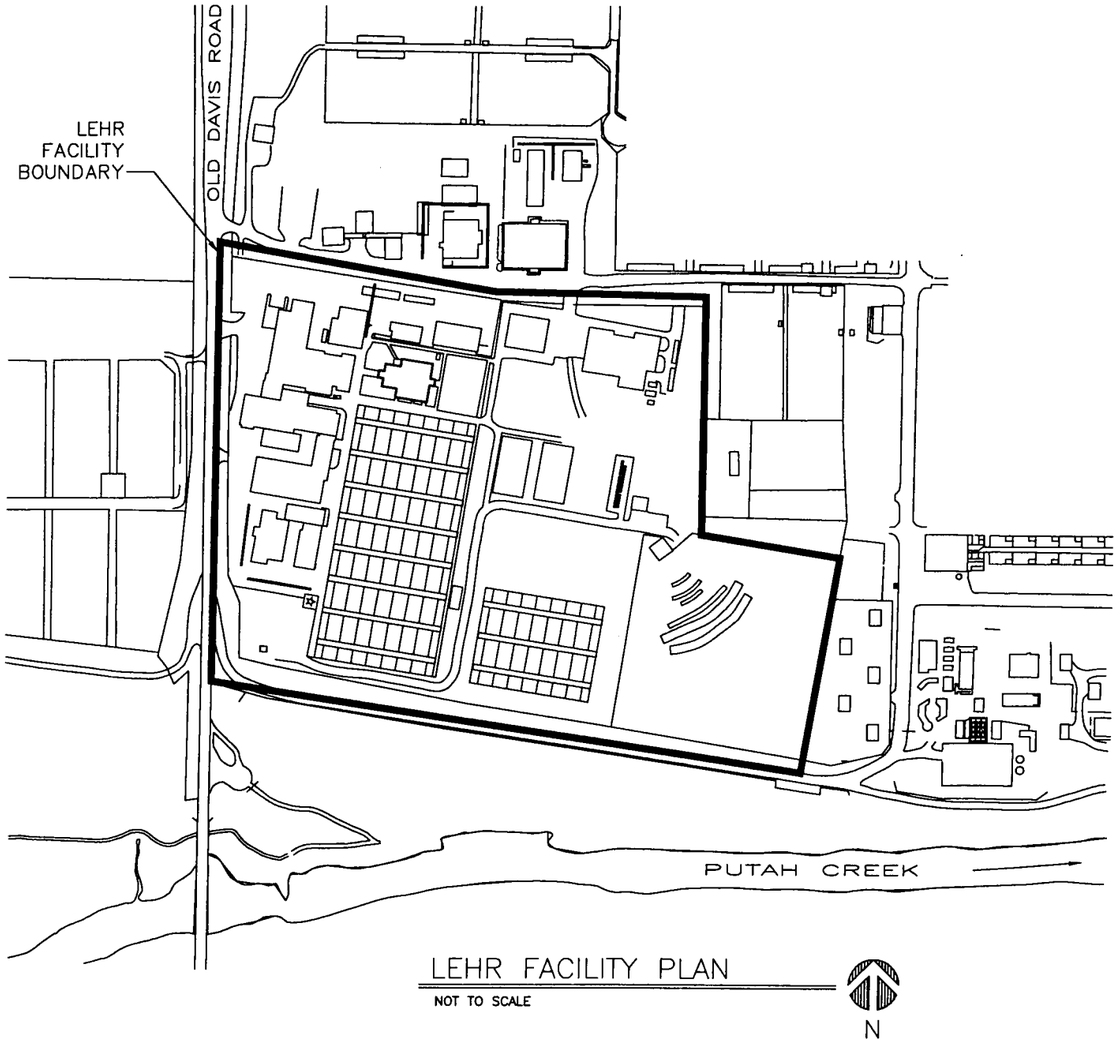
Analyte	Background	Max. Conc./Activity	Location	Depth	Date
Cations and Anions (mg/kg)					
Nitrate (as N)	36	23.5	Trench T1A	7.5	6/11/97
Chloride	NE	100	Tank 7	12	8/16/96
Nitrate (as N)	36	120	Tank 7	9.5	8/16/96
Sulfate	NE	69	Tank 7	9.5	8/16/96
Metals (mg/kg)					
Manganese	750	776	Trench T1A	7.5	6/11/97
Vanadium	66.8	73.1	Trench T1A	12	6/11/97
Zinc	72.4/93.1	136	Trench T1A	5	6/11/97
Copper	48.8	56	Tank 1	10	8/19/96
Copper	48.8	59.3	Tank 3	8	6/12/97
Manganese	750	770	Tank 1	13	8/19/96
Arsenic	8.14/10.9	11	Tank 3	11	6/12/97
Chromium (VI)	0.054	0.132	Tank 3	15.5	6/12/97
Manganese	750	808	Tank 3	15.5	6/12/97
Vanadium	66.8	76.7	Tank 3	11	6/12/97
Zinc	72.4/93.1	258	Tank 3	8	6/12/97
Cadmium	0.51	0.78	Tank 4	5.5	6/12/97
Chromium	199/125	319	Tank 4	8	6/12/97
Lead	9.5	12	Tank 4	5.5	6/12/97
Mercury	3.94/0.248	1.52	Tank 4	5.5	6/12/97
Nickel	334/246	405	Tank 4	8	6/12/97
Vanadium	66.8	74.5	Tank 4	13	6/12/97
Zinc	72.4/93.1	97	Tank 4	5.5	6/12/97
Mercury	3.94/0.248	49.4	Tank 6	5.5	6/12/97
Vanadium	66.8	84.8	Tank 6	13	6/12/97
Zinc	72.4/98.1	94.6	Tank 6	13	6/12/97
Copper	48.8	60	Tank 7	7	8/16/96
Manganese	750	790	Tank 7	7	8/16/96
Zinc	72.4/93.1	110	Tank 7	12	8/16/96
Radionuclides (pCi/g)					
Gross Alpha	7.42/8.85	16.2	Trench T1A	5	6/11/97
Radium-226	0.75	0.9	Trench T1A	12	6/11/97
Tritium (pCi/L)	105	340	Trench T1A	5	6/11/97
Uranium-235	0.038	0.091	Trench T1A	12	6/11/97
Carbon-14	0.13	2.1	Tank 1	7.5	8/19/96
Gross Beta	15	17.6	Tank 1	10	8/16/96
Radium-226	0.75	0.78	Tank 1	13	8/19/96
Strontium-90	0.056	0.4	Tank 1	10	8/19/96
Bismuth-214	0.54	0.593	Tank 3	15.5	6/12/97
Cesium-137	0.102/0.00695	0.126	Tank 3	8	6/12/97
Radium-226	0.75	1.45	Tank 3	15.5	6/12/97
Uranium-235	0.038	0.1	Tank 3	15.5	6/12/97
Tritium (pCi/L)	105	1270	Tank 4	8	6/12/97
Uranium-235	0.038	0.16	Tank 4	5.5	6/12/97

Table 2-2. Analytes Detected in Soil Above Background, Domestic Septic Systems, LEHR, UC Davis, California (continued)

Analyte	Background	Max. Conc./Activity	Location	Depth	Date
Thallium-208	0.204/0.223	0.242	Tank 6	8	6/12/97
Tritium (pCi/L)	105	460	Tank 6	8	6/12/97
Uranium-235	0.038	0.16	Tank 6	8	6/12/97
Radium-226	0.75	0.85	Tank 7	12	8/16/96
Strontium-90	0.056	0.45	Tank 7	12	8/16/96
Uranium-235	0.038	0.1	Tank 7	7	8/16/96
Organics (mg/kg)					
1,2-Dichloroethene	NE	0.004	Trench T1A	12.5	9/17/97
Aroclor-1254	NE	0.091	Trench T1A	12.5	9/17/97
Trichloroethene	NE	0.010	Trench T1A	12.5	9/17/97
Trichloroethene	NE	0.004	Tank 6	8	9/17/97
Formaldehyde (mg/kg)	NE	2.2	Tank 7	12	8/16/96

Abbreviations

Max. Conc.	Maximum Concentration
mg/kg	milligrams per kilogram
NE	Not Established
pCi/g	picoCuries per gram
pCi/L	picoCuries per liter
72.4/93.1	The background concentrations are for samples collected from zero to four feet below ground surface/greater than four feet below ground surface.



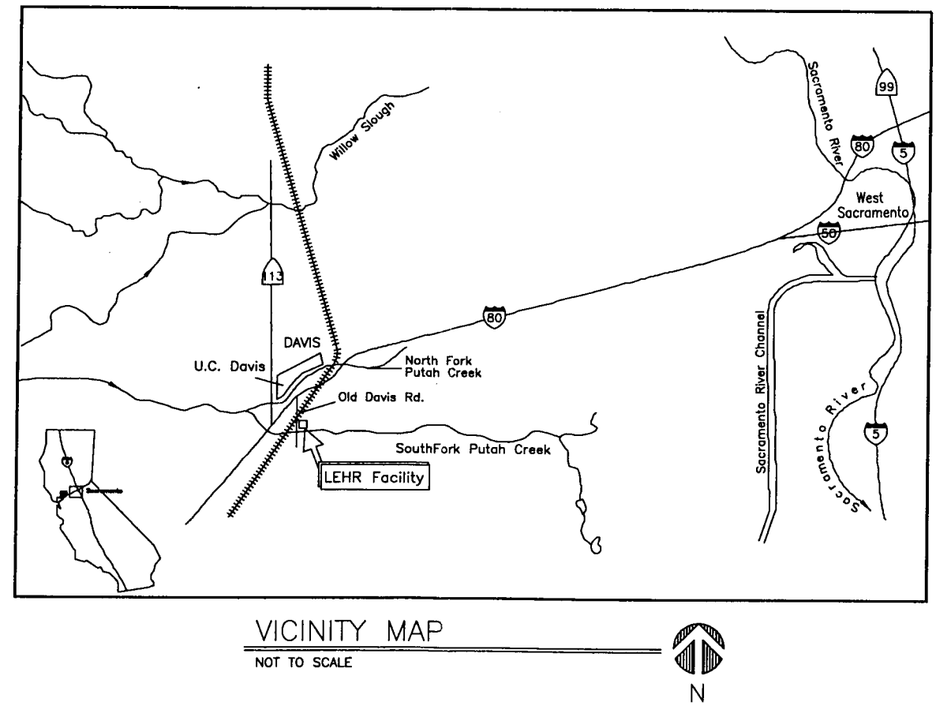


Figure 2-1. Location of the LEHR Facility, UC Davis, California

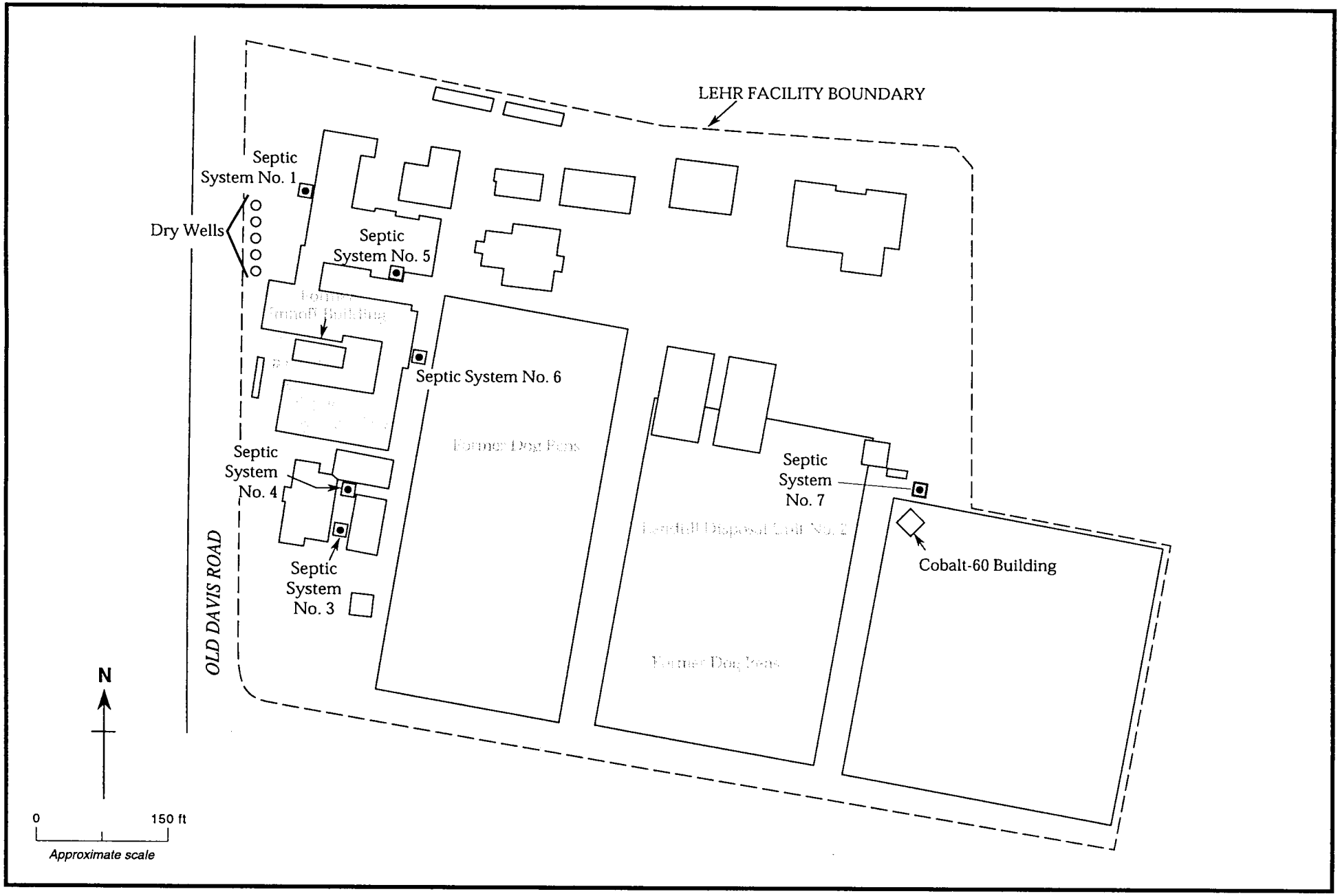


Figure 2-2. Locations of LEHR Facility Domestic Septic Systems and Dry Wells

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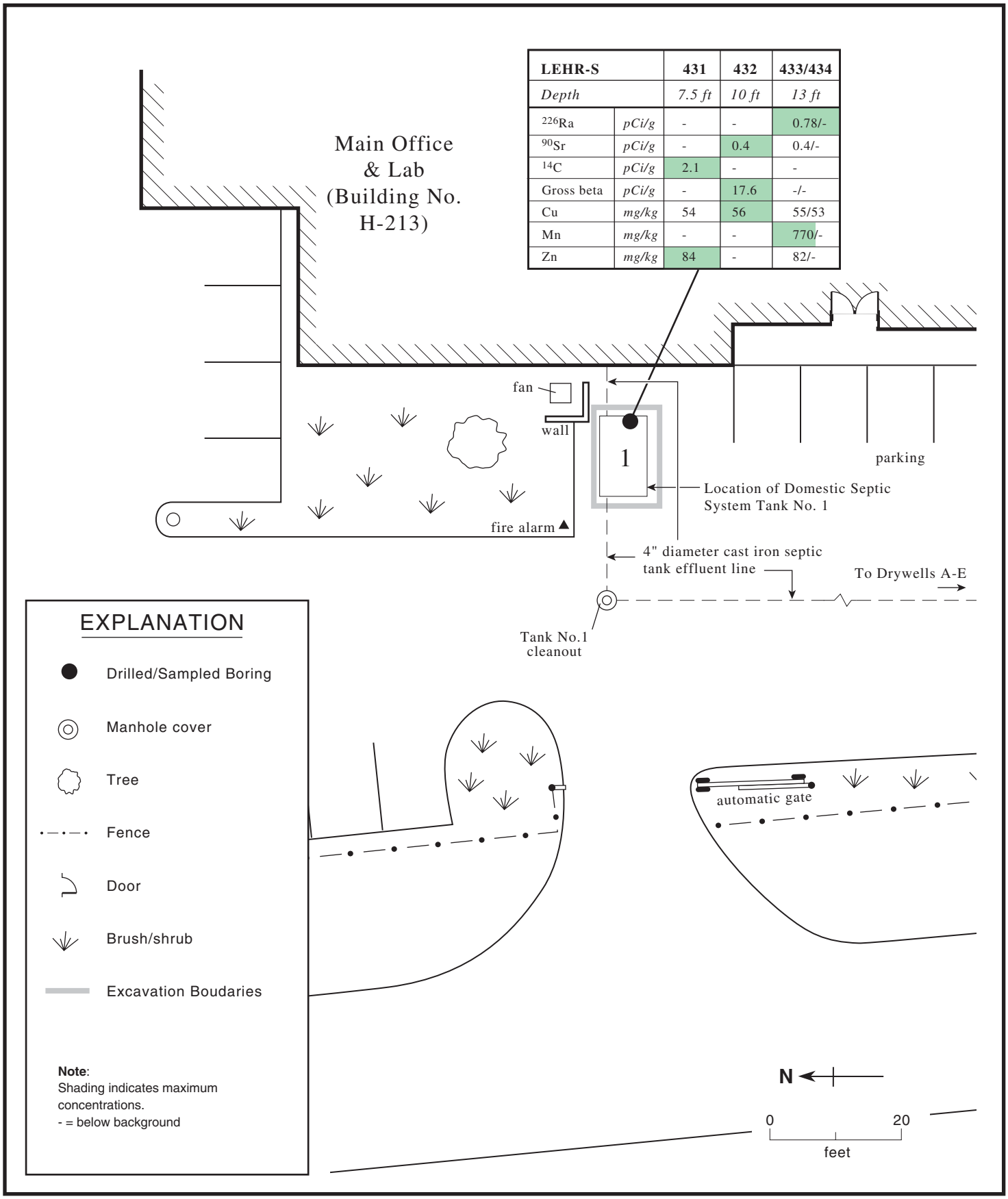

LEHR-S		431	432	433/434
Depth		*7.5 ft*	*10 ft*	*13 ft*
^{226}Ra	*pCi/g*	-	-	0.78/-
^{90}Sr	*pCi/g*	-	0.4	0.4/-
^{14}C	*pCi/g*	2.1	-	-
Gross beta	*pCi/g*	-	17.6	-/-
Cu	*mg/kg*	54	56	55/53
Mn	*mg/kg*	-	-	770/-
Zn	*mg/kg*	84	-	82/-

Figure 2-3. Boring Locations and Analytic Results Above Background for Soil Samples, Domestic Septic System 1

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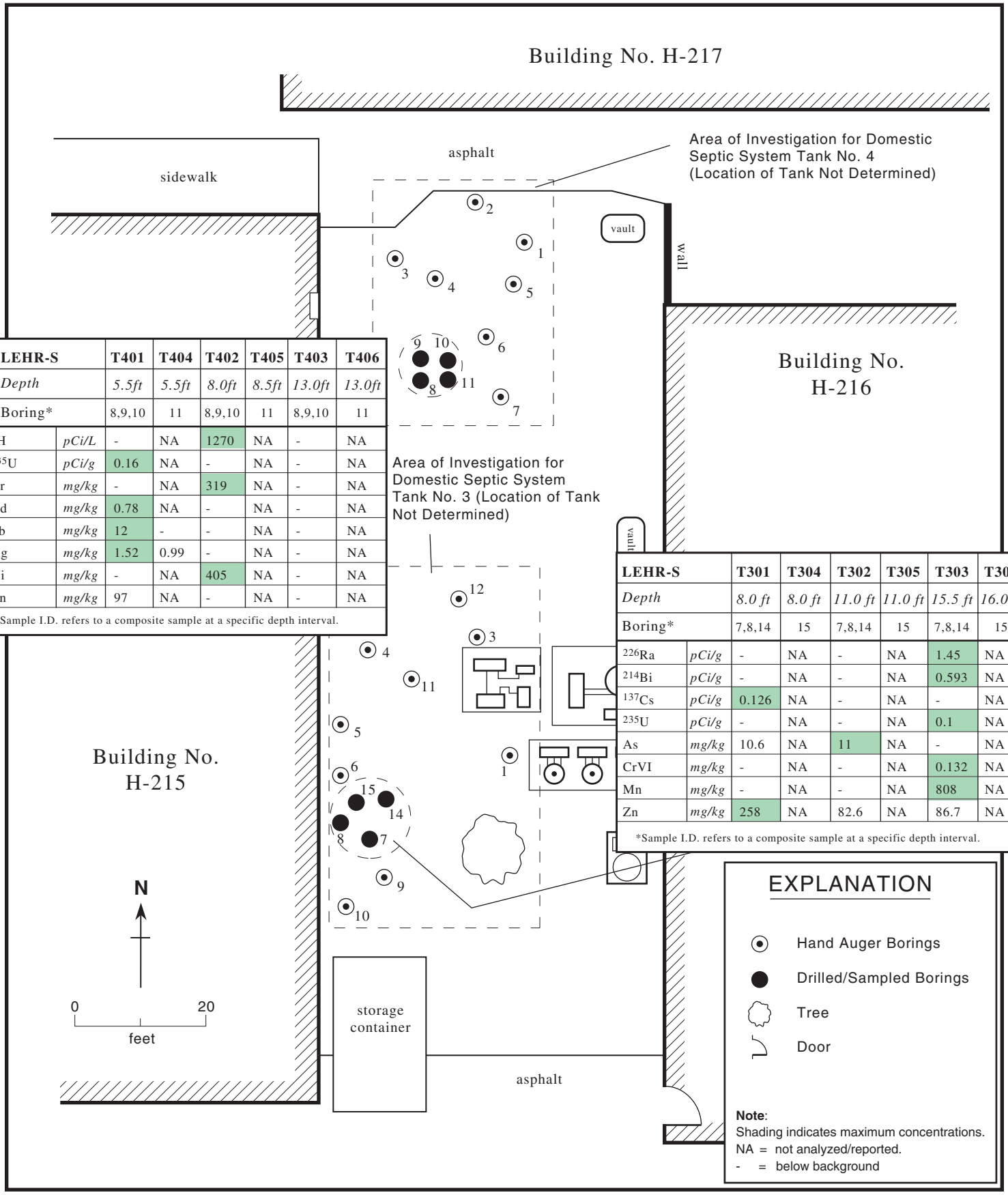

LEHR-S		T401	T404	T402	T405	T403	T406
Depth		*5.5ft*	*5.5ft*	*8.0ft*	*8.5ft*	*13.0ft*	*13.0ft*
Boring*		8,9,10	11	8,9,10	11	8,9,10	11
^{3}H	*pCi/L*	-	NA	1270	NA	-	NA
^{235}U	*pCi/g*	0.16	NA	-	NA	-	NA
Cr	*mg/kg*	-	NA	319	NA	-	NA
Cd	*mg/kg*	0.78	NA	-	NA	-	NA
Pb	*mg/kg*	12	-	-	NA	-	NA
Hg	*mg/kg*	1.52	0.99	-	NA	-	NA
Ni	*mg/kg*	-	NA	405	NA	-	NA
Zn	*mg/kg*	97	NA	-	NA	-	NA

*Sample I.D. refers to a composite sample at a specific depth interval.

LEHR-S		T301	T304	T302	T305	T303	T306
Depth		*8.0 ft*	*8.0 ft*	*11.0 ft*	*11.0 ft*	*15.5 ft*	*16.0 ft*
Boring*		7,8,14	15	7,8,14	15	7,8,14	15
^{226}Ra	*pCi/g*	-	NA	-	NA	1.45	NA
^{214}Bi	*pCi/g*	-	NA	-	NA	0.593	NA
^{137}Cs	*pCi/g*	0.126	NA	-	NA	-	NA
^{235}U	*pCi/g*	-	NA	-	NA	0.1	NA
As	*mg/kg*	10.6	NA	11	NA	-	NA
CrVI	*mg/kg*	-	NA	-	NA	0.132	NA
Mn	*mg/kg*	-	NA	-	NA	808	NA
Zn	*mg/kg*	258	NA	82.6	NA	86.7	NA

*Sample I.D. refers to a composite sample at a specific depth interval.

Figure 2-4. Boring Locations and Analytic Results Above Background for Soil Samples, Domestic Septic Systems 3 and 4

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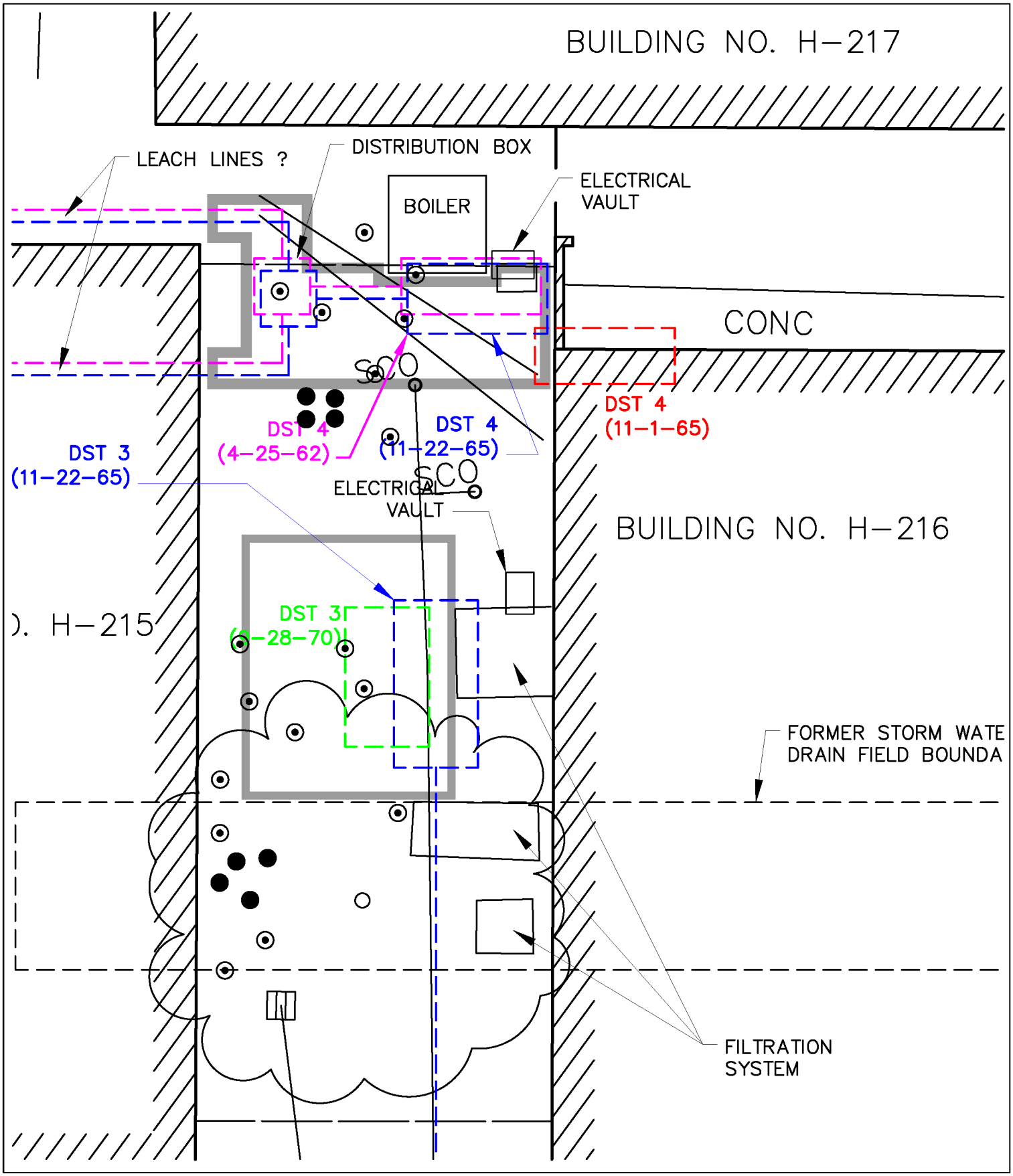

Figure 2-5. Mapped Locations of Domestic Septic Systems 3 and 4

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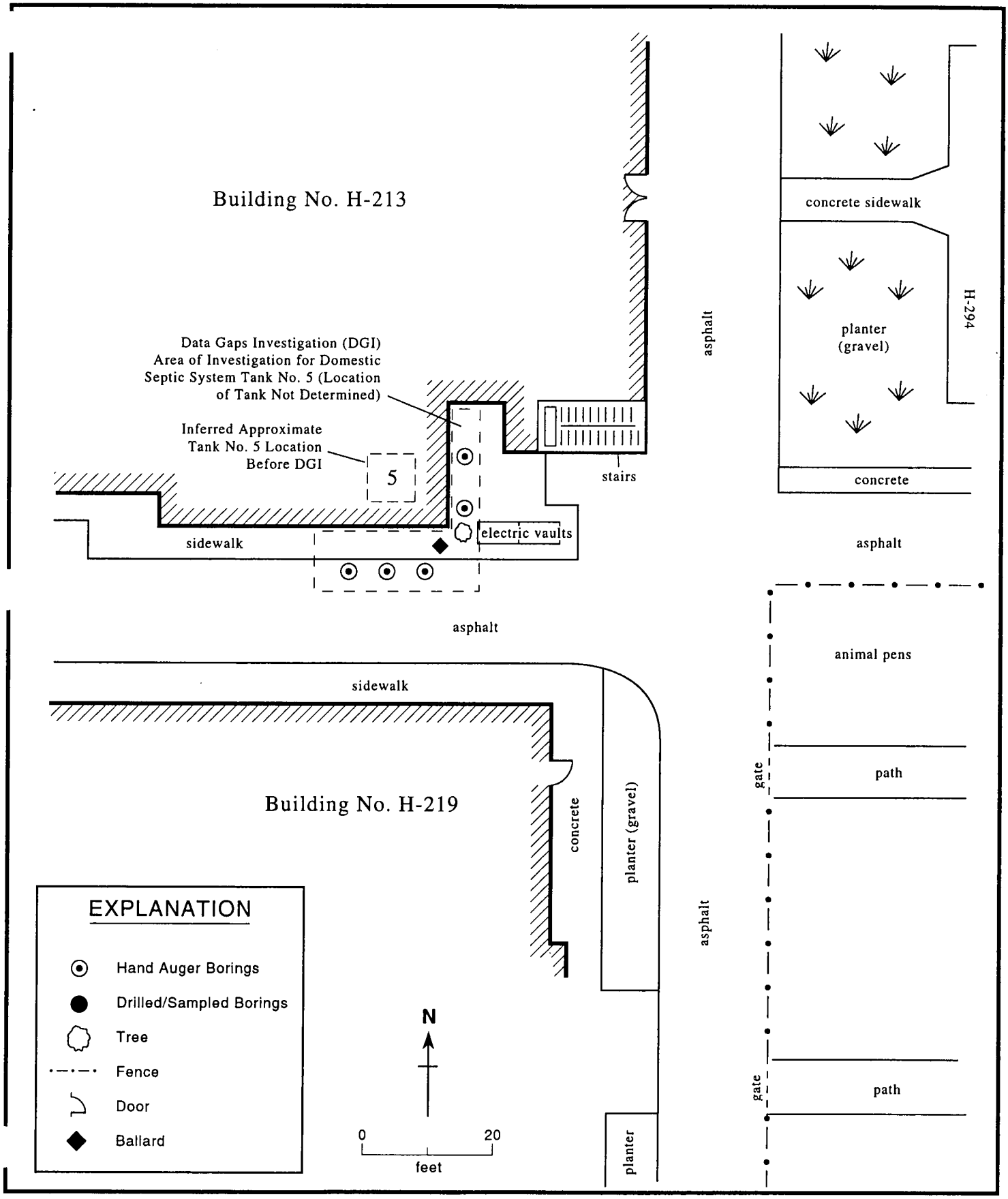

Figure 2-6. Inferred Locations of Domestic Septic Tank 5 and Associated Boreholes

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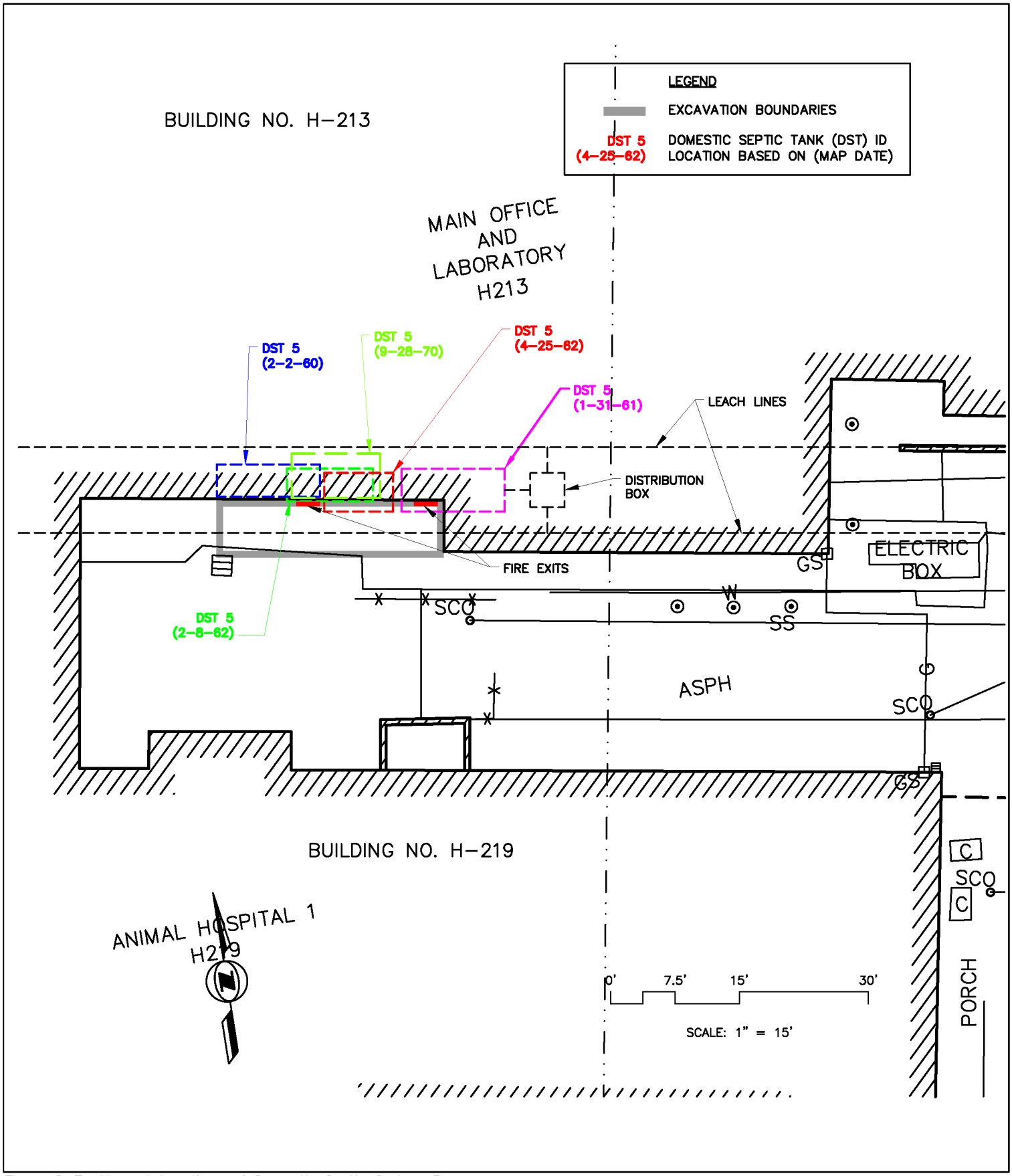

Figure 2-7. Mapped Locations of Domestic Septic System 5

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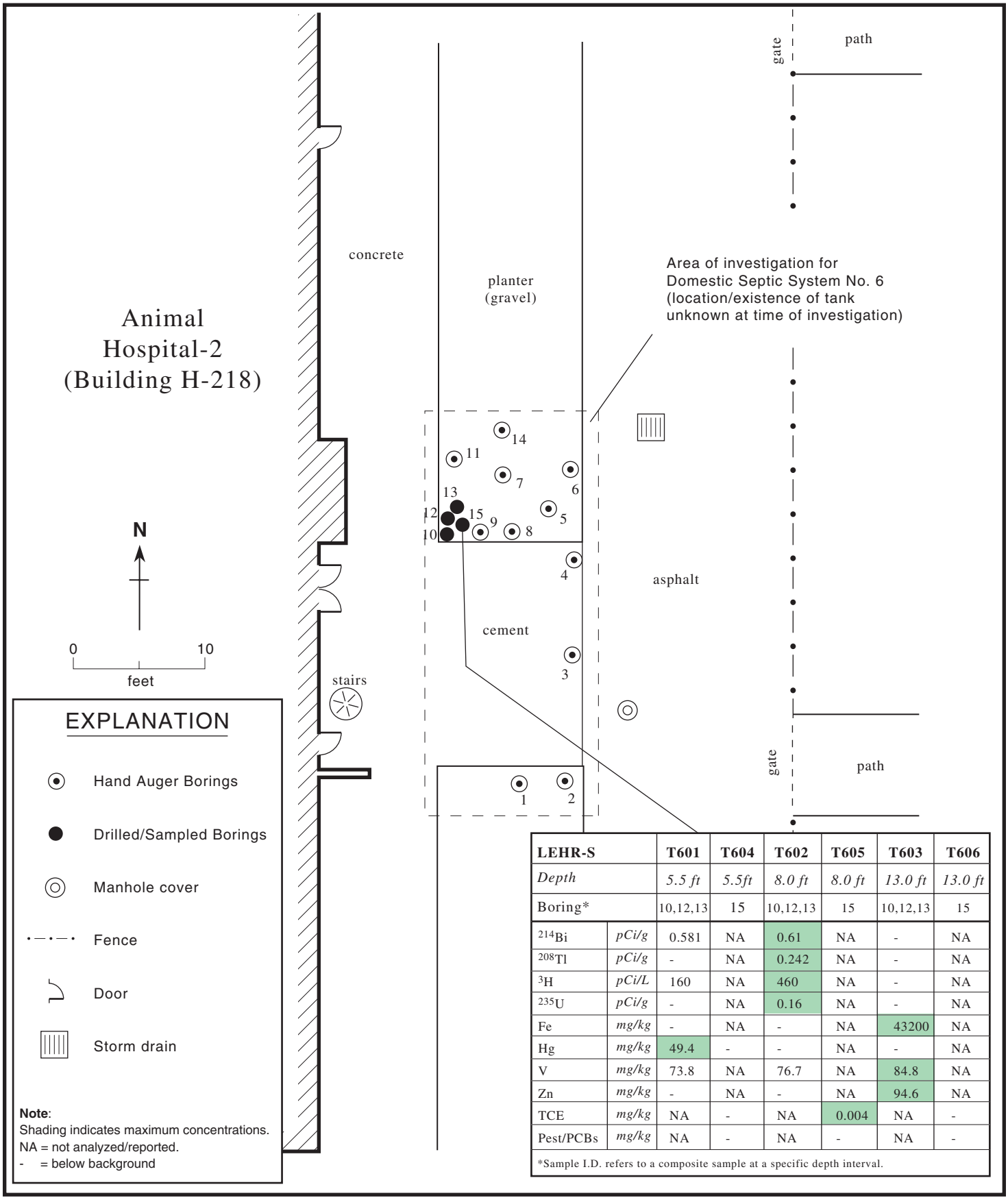

LEHR-S		T601	T604	T602	T605	T603	T606
Depth		*5.5 ft*	*5.5ft*	*8.0 ft*	*8.0 ft*	*13.0 ft*	*13.0 ft*
Boring*		10,12,13	15	10,12,13	15	10,12,13	15
^{214}Bi	*pCi/g*	0.581	NA	0.61	NA	-	NA
^{208}Tl	*pCi/g*	-	NA	0.242	NA	-	NA
^{3}H	*pCi/L*	160	NA	460	NA	-	NA
^{235}U	*pCi/g*	-	NA	0.16	NA	-	NA
Fe	*mg/kg*	-	NA	-	NA	43200	NA
Hg	*mg/kg*	49.4	-	-	NA	-	NA
V	*mg/kg*	73.8	NA	76.7	NA	84.8	NA
Zn	*mg/kg*	-	NA	-	NA	94.6	NA
TCE	*mg/kg*	NA	-	NA	0.004	NA	-
Pest/PCBs	*mg/kg*	NA	-	NA	-	NA	-

*Sample I.D. refers to a composite sample at a specific depth interval.

Figure 2-8. Boring Locations and Analytic Results Above Background for Soil Samples, Domestic Septic System 6

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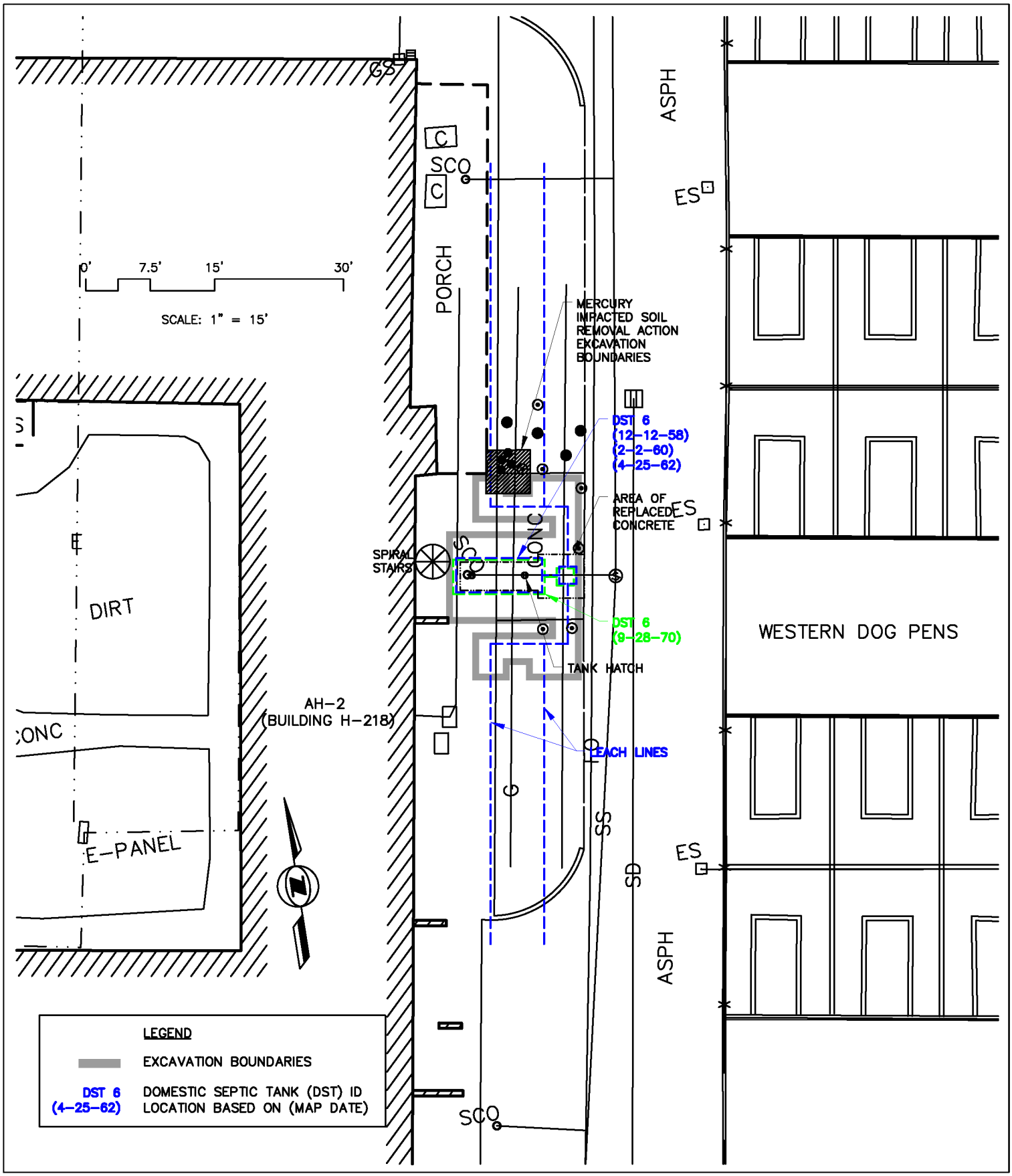

Figure 2-9. Mapped Locations of Domestic Septic System 6

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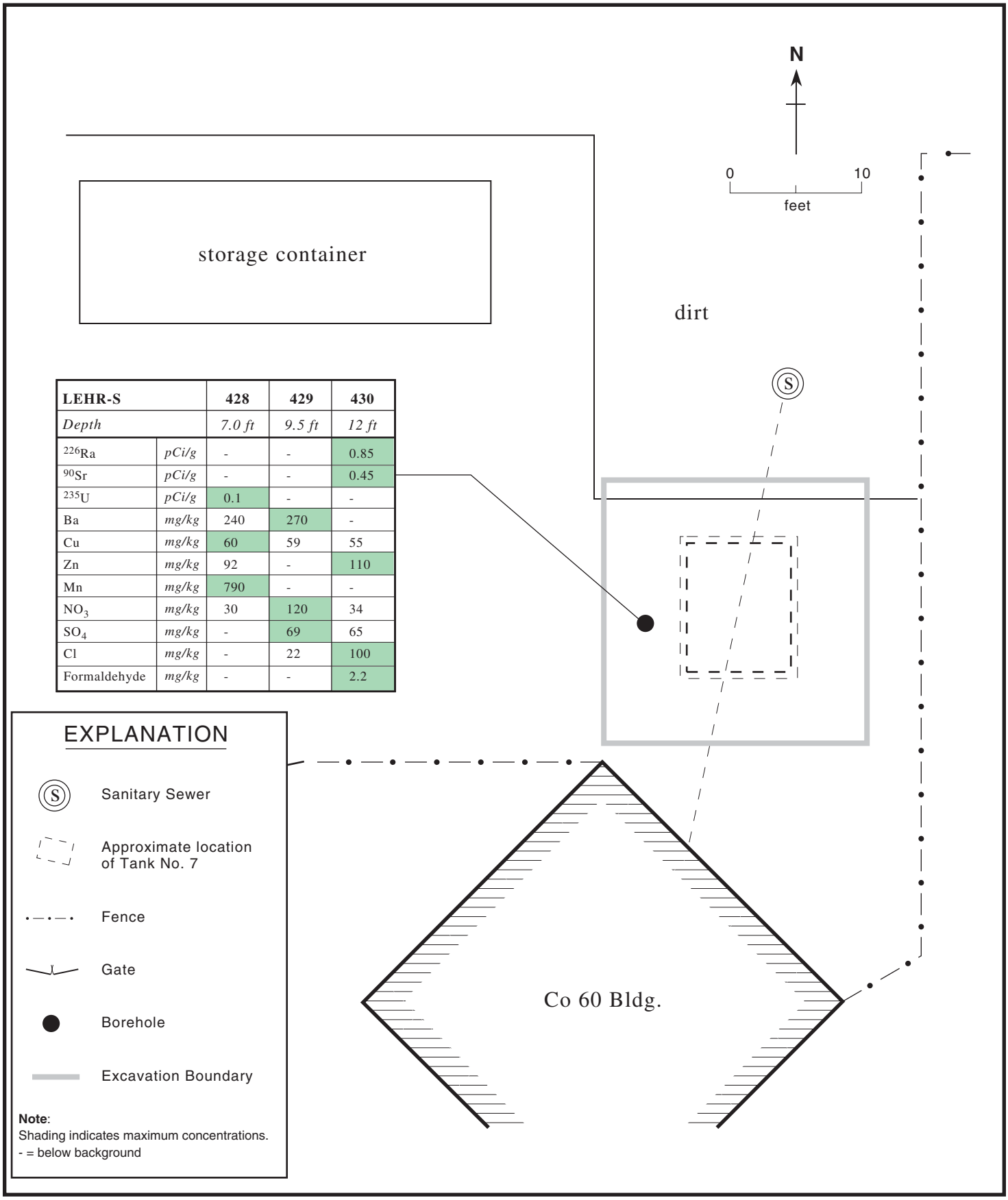

LEHR-S		428	429	430
Depth		*7.0 ft*	*9.5 ft*	*12 ft*
^{226}Ra	*pCi/g*	-	-	0.85
^{90}Sr	*pCi/g*	-	-	0.45
^{235}U	*pCi/g*	0.1	-	-
Ba	*mg/kg*	240	270	-
Cu	*mg/kg*	60	59	55
Zn	*mg/kg*	92	-	110
Mn	*mg/kg*	790	-	-
NO_3	*mg/kg*	30	120	34
SO_4	*mg/kg*	-	69	65
Cl	*mg/kg*	-	22	100
Formaldehyde	*mg/kg*	-	-	2.2

Figure 2-10. Analytic Results Above Background for Soil Samples, Domestic Septic System 7

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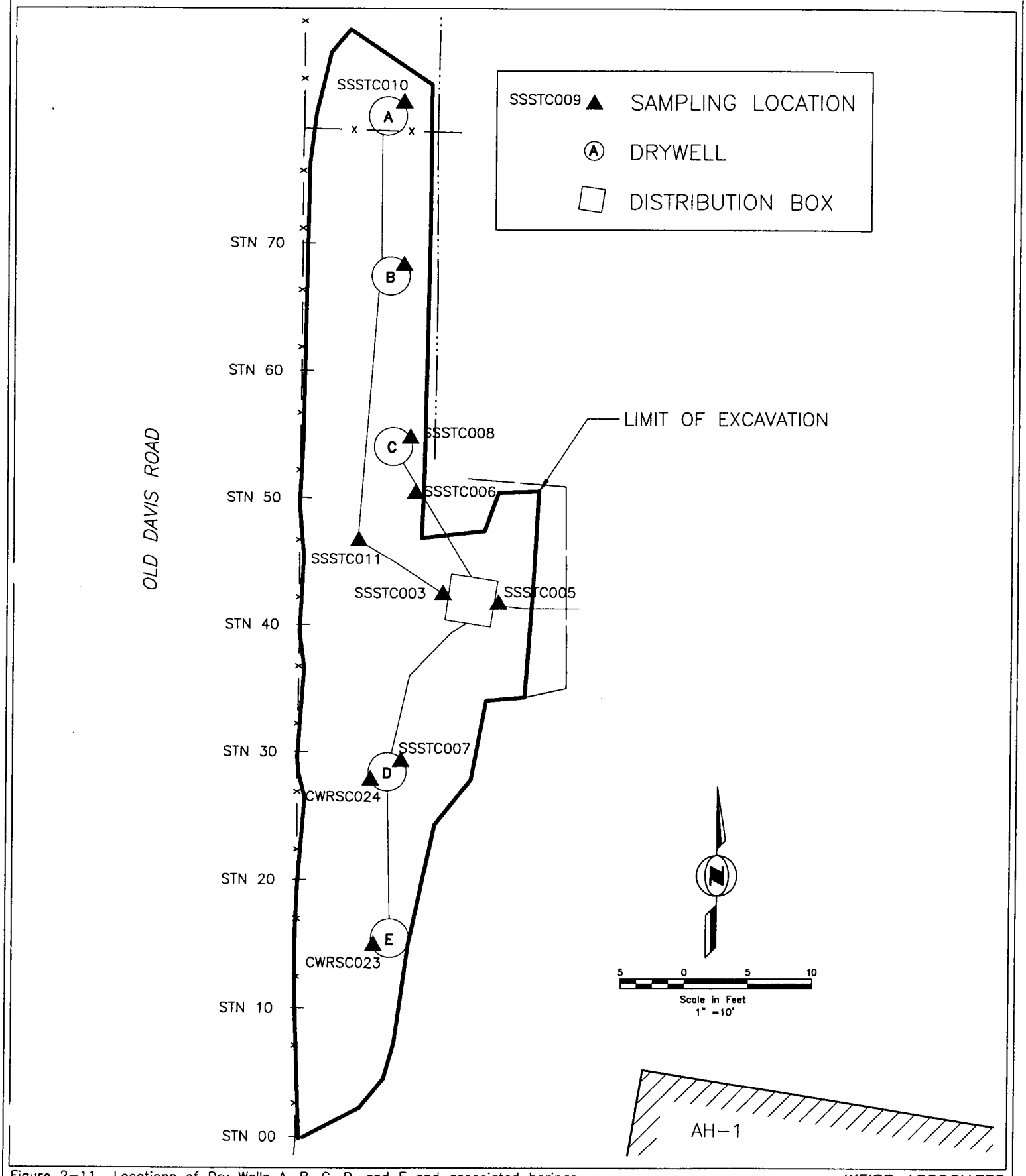

Figure 2-11. Locations of Dry Wells A, B, C, D, and E and associated borings

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3. SAMPLING AND ANALYSIS PLAN

This section discusses the sampling and analysis program that will be used to achieve the RAOs during the DSSI, including the sampling strategy and analytical plan. Sampling and analysis activities will include:

- Screening sampling and on-site laboratory analysis for an initial set of samples (Phase I); and,
- Investigation/risk assessment sampling and off-site laboratory analysis to ensure that cleanup criteria have been attained within the limits of the investigation and/or excavation areas (Phase II).

Waste characterization sampling and analysis are addressed in Section 5.

3.1 Sampling Approach

The COCs for the DSSI include a wide range of elements and compounds, because many activities occurred at the site, and the laboratory sinks that drained to the DSSs may have been use to dispose small quantities of a variety of chemicals. Therefore, samples from each DSS will be analyzed for the full suite of COCs (except DSS 6 screening samples, DSS 3 and 6 confirmation samples) historically found at LEHR, including VOCs, SVOCs, pesticides/PCBs, radionuclides, metals, Cr^{+6}, and nitrate. The number of duplicate samples will be 10% of the field samples collected and will be sent to an off-site laboratory for the required analysis.

Samples will be initially screened for Ra-226, Hg, Cr and Pb by the on-site laboratory (see the discussion in Section 3.1.8). Table 3-1 presents the planned DSSI field and laboratory analytical methods. The sampling and analysis plan is summarized in Table 3-2. Figure 3-1 presents the proposed samples locations for DSS Phase I sampling.

Phase I screening samples will be collected as follows:

- One tank contents sample from the interior bottom of each DST (sludge/sediment layer just above concrete tank floor);
- Two samples on opposite sides of the exterior of each DST, one below the inlet and one below the outlet;
- One sample beneath the point of first perforation of each leach line, or a single composite sample if more than one leach line is present, downstream of the DST or distribution box;

- Four samples, from boreholes drilled two feet horizontally from the axis of the dry well. Samples will be collected at 10-ft depth intervals between 10- and 40-ft depth, inclusive; and,

- Fifteen samples from 5 boreholes surrounding a Ra-226 detection of 1.5 pCi/g south of DSS 3. Samples will be collected at 4-ft depth intervals, starting at 8-ft bgs.

In the event that physical constraints prevent collection of samples from the locations noted above, samples will be collected as close as possible to, preferably below, those locations.

The samples will be screened at the time of collection for Ra-226, Hg, Cr and Pb, and if necessary, additional samples (Phase II) will be collected immediately as follows:

- DST exterior: An additional sample at a depth of 5 ft below the sample with COCs above background and RBAS;
- Leach lines: For each discrete sample with screening result above background and RBAS and for each multi-point screening composite sample with results greater than the higher of background or RBAS divided by the number of leach lines present, one discrete sample 5 ft deeper and one discrete sample from the estimated mid-point of the leach line; and,
- Dry wells: For each sample with COCs above background and RBAS, an additional borehole will be drilled 7 ft horizontally from the axis of the dry well and samples collected at the same depth and 10 ft deeper than the samples with COCs, if this depth is above the seasonal water table.

Regardless of presence or absence of COCs above screening criteria in the Phase I field analyses, a full suite of laboratory analyses for all COCs will be run for each sample collected, with the exception of the boring samples that will be collected south of DSS 3 as discussed in Section 3.5. All Phase II samples will be discrete samples and will be analyzed for VOCs, SVOCs, pesticides/PCBs, radionuclides, metals, Cr^{+6}, and nitrate.

Collection methods for each sample type are outlined in the following sections.

3.1.1 Septic Tank Interior Sampling

The septic tank interiors will be accessed by cutting open the tops or sides of the tanks with a concrete saw or hydraulic ram/shear system. Any sand or gravel tank fill will be excavated until a sufficient quantity (14 liters) of tank contents is exposed for sampling. The sample itself will be collected either in the excavator bucket, or with a shovel. 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.

If there is less than 14 liters of tank contents, the surface of the concrete floor of the tank will be chipped with a jackhammer and ground up. If sufficient sample material is still unavailable, priority for analysis will be given in the following order: radionuclides, metals, Cr^{+6}, pesticides/PCBs, SVOCs, VOCs, and nitrate.

3.1.2 Sampling Near Septic Tank Exterior

Samples will be collected below the tank inlet and outlet connections. Hand augers will be used to collect one soil sample approximately one ft below the level of the bottom of the tank, within one ft horizontally of the wall of the tank (Figure 3-1). Sample collection and handling will be performed according to SOP 2.1, Sample Handling, Packaging and Shipping and SOP 3.1, Surface and Shallow Subsurface Soil Sampling.

3.1.3 Leach Field Sampling

Each leach field will be sampled downstream of its distribution box where the first perforations begin in the leach line. If more than one leach line is present, Phase I screening samples will be taken below the point of first perforation at each line, and composited. If leach line composite samples are necessary, SVOC and VOC sample compositing will be performed at the analytical laboratory under controlled conditions (i.e., 4°C). Sample compositing for other COCs will be performed in the field. Leach field analytical samples will be analyzed for radionuclides, metals, Cr^{+6}, pesticides/PCBs, SVOCs and nitrate.. Duplicate samples will be provided to the on-site laboratory to provide screening-level results for Ra-226, Hg, Cr and Pb. Leach field samples will be collected with a hand auger or excavator bucket from the native soil just below the leach field backfill.

For discrete samples, the screening results will be compared to background and RBAS. For composite samples, the screening results will be compared to the higher of background or RBAS values divided by the number of leach lines present. If the Phase I screening results exceed their respective standards, additional samples will be collected and analyzed from points 5-ft deeper and from the estimated mid-point of the leach lines at the same depth as the initial sample (Phase II). Phase II samples will be collected and analyzed discretely. 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.

3.1.4 Dry Well Sampling

The area near the residual lower portions of the dry wells will be sampled by direct-push drilling. Samples will be collected at 10-, 20-, 30-, and 40-ft intervals from a borehole located approximately 2 ft from the axis of the dry well (Phase I). For each sample with COCs above background and RBAS, an additional borehole will be drilled approximately 7 ft horizontally from

the axis of the dry well and samples collected at the same depth, and 10 ft deeper than the sample with COCs, if this depth is above the seasonal water table. (Phase II).

A total of four borings will be drilled surrounding Dry Well D (Figure 2-11). All of the borings will be drilled within 2 ft of the axis of the dry well. One boring will be sampled from 10- to 40- ft if this depth is above the seasonal water table (Phase I). Phase II sampling will occur if necessary as discussed above. Three additional borings will be drilled in the three other compass directions from the center of the dry well. Samples will be collected at 10, 15 and 20 ft bgs. The additional borings will be collected to determine if the removal action surrounding sample CWRSC024, successfully removed the associated contamination. The samples collected from the additional borings will be analyzed for metals (Table 3-4).

Sample collection and handling will be performed according to SOP 2.1, Sample Handling, Packaging and Shipping and SOP 3.1, Surface and Shallow Subsurface Soil Sampling.

3.1.5 Domestic Septic System 3 Confirmation Sampling

Five soil borings will be drilled to a depth of 20 ft (4.5 ft below the Ra-226 detection using a direct-push drill rig. Figure 3-2 presents the planned sampling locations in this area. Soil samples will be collected every 4 ft starting at 8 ft bgs (the termination point of the former drain field). A total of three samples will be collected per boring: the first composite sample will be collected from 8 to 12 ft bgs; the second composite sample will be collected from 12 to 16 ft bgs; and, the third composite sample will be collected from 16 to 20 ft bgs.

Soil samples from DSS 3 will be collected using pre-sterilized liners in the direct-push sampling equipment. Sample cores will be screened in the field for VOCs using a PID, and for radiologic activity using a GM counter and SCIN detector to guide sample selection. Sample handling, packaging, and shipping are described in SOP 2.1, Sample Handling, Packaging and Shipping. Duplicate samples will be collected for QC purposes. The number of duplicate samples will be 10% of the field samples collected. All samples (including QC samples) will be submitted to an off-site analytical laboratory and analyzed for gamma emitters and Ra-226 as presented in Table 3-2.

3.1.6 Domestic Septic System 6 Excavation Screening

The locations of the sidewall samples (one sample per sidewall) will be collected based on field observations, about 6 inches into the native soil. The sample from the bottom of the excavation will be collected approximately 12 inches below the excavation. Table 3-2 presents the screening sampling and analysis plan for DSS 6.

A Niton XL-700 Multi-Element Spectrum Analyzer or the equivalent will be used on-site to provide quick TAT results to assist in making rapid decisions regarding where to excavate and when to cease excavation. In order to obtain the required detection limits, an EPA approved off-site

laboratory will also be used. Screening samples will be analyzed for mercury. Screening results will be compared to the mercury screening criteria of 3.94 mg/kg for samples collected above 4 ft bgs and 0.248 mg/kg for sample collected below 4 ft bgs. If all screening results are below the criterion, then excavation will cease and confirmation samples will be collected and sent to an off-site laboratory and analyzed for mercury using CLP methods.

3.1.7 Domestic Septic System 6 Confirmation Sampling

Confirmation soil samples will be collected from the sidewalls and the bottom of the excavation. One soil sample will be collected from each sidewall and bottom of the excavation. 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. These samples will be submitted to an off-site analytical laboratory to be analyzed for mercury using a CLP method. Duplicate samples will be collected for QC purposes. The number of duplicate samples will be 10% of the field samples collected and will be sent to an off-site laboratory for analysis of mercury.

3.1.8 Screening Sampling

Samples from the locations specified in Sections 3.1.1 through 3.1.5 will be screened during excavation. Screening samples will be collected according to the procedures in Section 3.2 The samples will be analyzed for Ra-226 according to the desktop procedures for gamma spectrometer. The samples will also be screened for Hg, total-Cr and Pb using a Niton 700 Soil Multi-Element Analyzer by EPA Method 6200 (WA, 2000d). 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 results will be compared against the screening criteria shown in Table 3-3. If results are above the screening criteria, additional samples will be collected (Phase II) to further define the extent of contamination, as specified in Sections 3.1.3 and 3.1.4. Regardless of the presence or absence of COCs above the screening criteria in Phase I field analysis, a full suite of laboratory analysis for all COCs will be run for each sample collected, with the exception of samples for DSS 3 (Section 3.5).

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.

3.2 Sample Collection Procedures

Soil samples will be collected according to SOP 3.1, Surface and Shallow Subsurface Soil Sampling, and SOP 3.2, Subsurface Soil Sampling While Drilling. 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 3-4 summarizes the container type, volume and holding time for each analysis.

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 an excavator bucket, shovel, drilling rig or 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.

Field duplicate samples will be collected for quality control purposes. Duplicates will be collected at a rate of at least 10% for all soil samples, and analyzed for the full suite of COCs.

3.3 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 forms,
- Field logbook,
- Sample numbers,
- Sample labels, and
- Custody seals.

3.3.1 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.

3.3.2 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 the soil samples collected using direct-push drilling. 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.

3.3.3 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

TC – tank contents

WS – water sample

CS – concrete sample

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

D3 – DSS 3

c = Type of sample

F – field screening sample

C – investigation/confirmation sample

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

An example of a confirmation soil sample collected from the DSS 5 area is:

SSD5C001

3.3.4 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.

3.3.5 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.

3.4 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 DSSI samples. Proper labeling and packaging for shipment is required along with the appropriate documentation.

3.5 Analytical Methods

Table 3-1 summarizes the analytical methods that will be performed on soil samples collected from the DSSI areas. 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.

Field analytical methods include using gamma spectroscopy equipped with a high-purity germanium detector for Ra-226 analysis, and Hg, total-Cr and Pb analysis using a Niton 700 Soil Multi-Element Analyzer or equivalent by EPA Method 6200 will be performed by on-site laboratory technicians trained to use the appropriate instruments.

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

3.6 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 the first round (Phase I) in excavation screening and investigation 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.

3.6.1 Phase I Data Evaluation

The Phase I data evaluation will be conducted on the initial set of samples collected at each former DSS dry well. If screening analytical results indicate that the soil has been impacted, Phase II sampling will commence.

3.6.2 Phase II Data Evaluation

Upon receipt of all Phase I and Phase II analytical results, data validation will be conducted to ensure data usability. The analytical results will be validated by WA according to the procedures defined in SOP 21.1, Data Validation (WA, 1999b). Sample results and associated QA/QC data 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.

3.6.2.1 Screening Risk Evaluation

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

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, and other COCs 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.

3.6.2.2 Removal Action Completion Analysis

Upon completion of the screening risk evaluation, a comprehensive review and analysis of all DSSI/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 a DSSI/RA completion analysis:

- 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 to DOE and the RPMs for review and discussion. Based on these discussions, a determination will be made regarding the need for and scope of additional actions, if any, to achieve the RAOs.

3.7 Data Quality Objectives

The sampling and analysis program presented in Sections 3.1 through 3.6 above 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 and for developing data collection designs. The following sections demonstrate how the seven steps of the DQO process were used in designing the DSSI sampling and analysis program.

3.7.1 Statement of the Problem

Under National Contingency Plan guidelines, a non-time critical RA may be conducted to minimize and reduce the threat posed by environmental contaminants in the DSSs. 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 DSSs. The purpose of this DSSI is to characterize the occurrence and distribution of any COCs associated with the DSSs with sufficient certainty to obtain No Further Action (NFA) closure, or to recommend appropriate RAs necessary to obtain NFA closure.

The primary decision-maker, DOE-Oakland, will make the final decisions on all activities associated with the DSSs based on recommendations from the 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 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 DSSs (Section 1.3) have been achieved. The program described in Sections 3.1 through 3.6 is designed to provide DOE Oakland and the planning team with the data needed to answer this question.

3.7.2 Identification of Decisions

The decision statements for the DSSI can be summarized as follows:

1. Determine whether or not the RAOs for the DSSs have been achieved and NFA closure can be obtained.
2. If RAOs have not been achieved, determine appropriate removal action or other remedy necessary to achieve RAOs and obtain NFA closure.

3.7.3 Identify Inputs to Decisions

In order to resolve the decision statements in Section 3.7.2, the existing inputs that will be used include risk-based and background levels, and previous DSSI 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, Hg, Pb and/ or total-Cr (screening sampling only),
- Laboratory analyses for Ra-226, Hg, Pb, total-Cr, and other COCs, and,
- Laboratory data validation.

3.7.4 Definition of Study Boundaries

The geographical area addressed by the sampling and analysis program consists of the DSTs and their leach fields, and the dry wells, at various locations in the LEHR facility (Figures 2-2 through 2-12).

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. During Phase I, screening samples will be collected as well as an initial round of samples for laboratory analysis. If screening results indicate Ra-226, Hg, Pb and/ or total-Cr above screening levels, Phase II will be conducted and will consist of additional sample collection and laboratory analysis.

3.7.5 Development of Decision Rules

The decision rules for this investigation can be stated as follows:

- Phase I Data Evaluation Decision Rule: If Ra-226, Hg, Pb and/ or total-Cris detected above the screening criteria in any Phase I sample, then Phase II samples will be collected as described in Section 3.1 and both Phase I and Phase II samples will be analyzed for the full suite of potential COCs. Otherwise, only Phase I samples will be analyzed for the full suite of potential COCs.
- Phase II Data Evaluation Decision Rule: If evaluation of Phase I/Phase II data indicates RAOs have been achieved for a given DSS (see Section 3.6.2 for details), then NFA closure should be obtainable. Otherwise, recommendations will be made on additional actions required to obtain NFA closure.

3.7.6 Specification of Limits on Decision Errors

As described in Section 3.1, this DSSI is designed to sample the locations most likely to be impacted by COCs, rather than based on a grid, random location, or other statistical approach. This judgmental approach is appropriate because of the nature of DSS operation and the likely resultant COC distribution, if any. However because this sampling design is judgmental rather than statistical, there is no real basis for quantitative decision error analysis.

A qualitative assessment indicating that the RAOs have been met when they actually have not is low because:

1. The Phase I screening analyses will help ensure that potential COC impact is thoroughly delineated for each DSS; and,
2. For each DSS, the 95% UCL on the mean of all valid data for each COC will be used in the screening-level risk evaluation. Because the DSSI targets the locations most likely to be impacted by COCs, the 95% UCL provides a conservative representation of potential risk associated with each DSS.

3.7.7 Sample Design Optimization

The output from each of the first six DQO steps described in Sections 3.7.1 through 3.7.6 was used in optimizing the sampling and analysis program described in Sections 3.1 through 3.6. This sampling and analysis program should provide the data needed to determine, at an appropriate level of certainty, whether or not the DSSI 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 reasonably likely only at DSS 5 and possibly 4. If one or more of these conditions occur, potential impact on achieving DQOs will be evaluated and addressed.

Table 3-1. Field and Laboratory Analytical Methods for the Domestic Septic Systems Investigation, LEHR, UC Davis, California

Parameter	Analytical Method	Required Detection Limit (pCi/g for radiochemicals, mg/kg for metals/general chemistry, ug/kg for organics)
Driver COCs		
Radium-226	Gamma Spectroscopy/HPGe	0.5
Mercury	EPA Method 6200 (Niton XL-700)	10
Chromium	EPA Method 6200 (Niton XL-700)	150
Lead	EPA Method 6200 (Niton XL-700)	10
Full Suite of COCs		
Radionuclides:		
Americium-241	Lab SOP	0.01
Carbon-14	Lab SOP	0.1
Gamma Emitters	EPA Method 901.1	
Actinium-228		0.1
Bismuth-212		0.1
Bismuth-214		0.1
Cesium-137		0.01
Cobalt-60		0.005
Lead-210		0.5
Lead-212		0.1
Lead-214		0.1
Potassium-40		1
Radium-223		2
Radium-228		0.1
Radium-226 (*)		0.1
Thallium-208		0.05
Thorium-234		0.5
Gross Alpha	EPA Method 9310	1
Gross Beta	EPA Method 9310	1
Plutonium-241	Lab SOP	0.5
Strontium-90	EPA Method 905.0, modified	0.05
Thorium-228	Lab SOP	0.1
Thorium-230	Lab SOP	0.05
Thorium-232	Lab SOP	0.05
Tritium	EPA Method 906.0	1
Uranium-233/234	Lab SOP	0.025
Uranium-235/236	Lab SOP	0.01
Uranium-238	Lab SOP	0.025
Metals:	CLP SOW ILM 02.1	
Antimony		0.5
Arsenic		2
Barium		40
Beryllium		1

Table 3-1. Field and Laboratory Analytical Methods for the Domestic Septic Systems Investigation, LEHR, UC Davis, California (continued)

Parameter	Analytical Method	Required Detection Limit (pCi/g for radiochemicals, mg/kg for metals/general chemistry, ug/kg for organics)
Cadmium		0.25
Chromium (total)		1
Cobalt		10
Copper		0.25
Iron		20
Lead		0.3
Manganese		3
Mercury		0.1
Molybdenum		0.1
Nickel		1
Selenium		1
Silver		0.1
Thallium		0.5
Vandium		1
Zinc		4
General Chemistry		
Chromium (VI)	SW-846 Method 3060A/7196	0.05
Nitrate-N	EPA Method 300.0	1
Organics:		
Volatile Organic Compounds	CLP SOW OLM 03.1	Exhibit C of SOW OLM 03.1
Semi-Volatile Organic Compounds	CLP SOW OLM 03.1	Exhibit C of SOW OLM 03.1
Organochlorine Pesticides/PCBs	CLP SOW OLM 03.1	Exhibit C of SOW OLM 03.1

Abbreviations:

(*)	Requires 30-day ingrowth-time and 1,000-minute count-time
CLP SOW	Contract Laboratory Program Statement of Work
ILM 3.0	Inorganic Laboratory Method 3.0
OLM 3.1	Organic Laboratory Method 3.1
SOP	Standard Operating Procedure

Table 3-2. Domestic Septic System Sampling and Analysis Plan, LEHR, UC Davis, California

Sampling Activity	No. of Samples	Assumptions	Analysis/Turnaround Time
DSS 1 Investigation Sampling	2	1 tank contents sample, 1 soil sample adjacent to the tank bottom	VOCs, SVOCs, pesticides/PCBs, radionuclides, metals, Cr^{+6} and NO_3 at normal TAT
DSS 3 Investigation Sampling	6	1 tank contents sample, 2 samples adjacent to the tank bottom, 2 samples from the locations where the effluent lines become perforated (screening samples will be composited), 1 field duplicate	VOCs, SVOCs, pesticides/PCBs, radionuclides, metals, Cr^{+6} and NO_3 at normal TAT
DSS 4 Investigation Sampling	6	1 tank contents sample, 2 samples adjacent to the tank bottom, 2 samples from the locations where the effluent lines become perforated (screening samples will be composited), 1 field duplicate	VOCs, SVOCs, pesticides/PCBs, radionuclides, metals, Cr^{+6} and NO_3 at normal TAT
DSS 5 Investigation Sampling	5	1 tank contents sample, 2 soil samples adjacent to the tank bottom, 2 samples from the locations where the effluent lines become perforated (if a leach field is present) (screening samples will be composited)	VOCs, SVOCs, pesticides/PCBs, radionuclides, metals, Cr^{+6} and NO_3 at normal TAT
DSS 6 Excavation Screening Sampling	5	1 sample from the 4 excavation side walls and bottom	Mercury at 48-hr TAT
DSS 6 Confirmation Sampling	6	1 sample from the 4 excavation side walls and bottom, 1 field duplicate	Mercury at normal TAT
DSS 6 Investigation Sampling	6	1 tank contents sample, 2 soil samples adjacent to the tank bottom, 2 samples from the locations where the effluent lines become perforated (screening samples will be composited), 1 field duplicate	VOCs, SVOCs, pesticides/PCBs, radionuclides, metals, Cr^{+6} and NO_3 at normal TAT
DSS 7 Investigation Sampling	5	1 tank contents sample, 2 samples adjacent to the tank bottom, 2 samples from the locations where the effluent lines become perforated (screening samples will be composited)	VOCs, SVOCs, pesticides/PCBs, radionuclides, metals, Cr^{+6} and NO_3 at normal TAT
Dry Wells A-E Investigation Sampling	33	1 boring adjacent to each dry well; sampling at 10-ft intervals starting at the former excavation limit to a depth of 40 ft bgs; 2 field duplicates	VOCs, SVOCs, pesticides/PCBs, radionuclides, metals, Cr^{+6} and NO_3 at normal TAT
		3 additional borings adjacent to Dry Well D; sampling at 10, 15 and 20 ft bgs; 2 field duplicates	Metals at normal TAT
DSS 3 Confirmation Sampling	17	5 borings around the Ra-226 detection of 1.5 pCi/g; 3 composite samples per boring; 2 field duplicates	Ra-226 and gamma emitters at normal TAT

Table 3-2. Domestic Septic System Sampling and Analysis Plan, LEHR, UC Davis, California (continued)

Abbreviations

bgs	below ground surface
Cr^{+6}	hexavalent chromium
NO_3	nitrate
DSS	Domestic Septic System
ft	feet
pCi/g	picoCuries per gram
PCBs	polychlorinated biphenyls
Ra-226	radium-226
SVOCs	semi-volatile organic compounds
TAT	turnaround time
VOCs	volatile organic compounds

Table 3-3. Screening Criteria for Driver Constituents of Concern, LEHR, UC Davis, California

Driver COC [1]	Screening Criteria [2]	Background Concentration	RBAS [3] (10^{-6} Risk or HQ=1)
Radium-226	0.75 pCi/g	0.75 pCi/g	0.0042 pCi/g (<Background)
Mercury	10 [4]	3.94/0.248 mg/kg [5]	0.22 mg/kg
Chromium	700	199/125 mg/kg [5]	721.9 mg/kg
Lead	10 [4]	9.5 mg/kg	0.044 mg/kg

Notes

[1]Driver COCs were detected consistently during previous investigations and/or are known to have been released at the Site.
[2]Screening criteria are determined based on cleanup criteria and field analytical instrument detection limits.
[3]RBAS value is the lowest of all three risk scenarios for either excess cancer risk of 10^{-6} or HQ of 1.
[4]The screening criteria is above background and the RBAS because this is the detection limit for the Niton XL-700.
[5]Background concentration is stratified for soil from 0-4 ft bgs. The second number is soil from greater than four ft bgs.

Abbreviations

bgs below ground surface
COC Constituent of Concern
ft feet
HQ hazard quotient
pCi/g picoCuries per gram
RBAS risk-based action standard

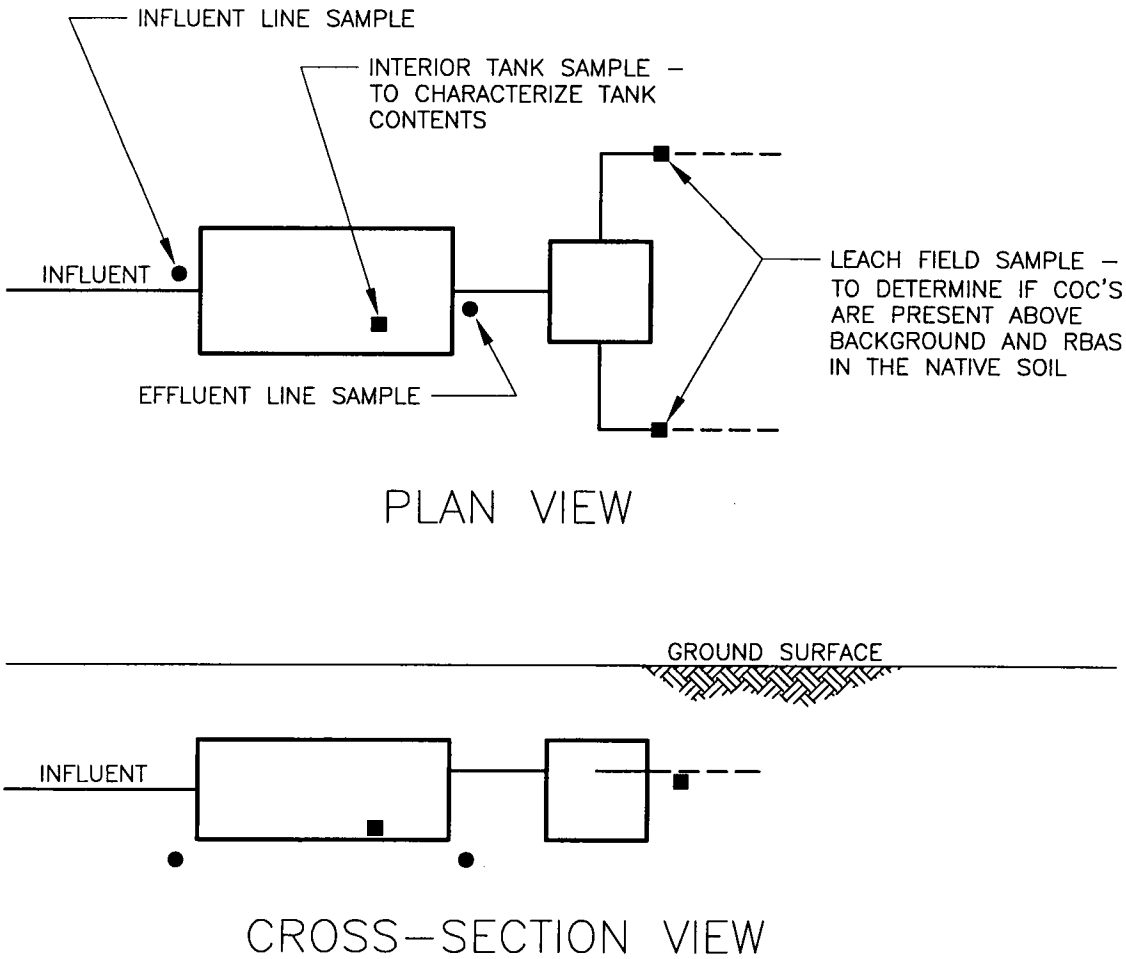
Table 3-4. Containers and Holding Times for Laboratory Analytical Methods for the Domestic Septic Systems Investigation, LEHR Site, UC Davis, California

Parameter	Analytical Method	Holding Time
Radionuclides (1 x 2-L P):		
Americium-241	Lab SOP	6 months
Carbon-14	Lab SOP	6 months
Gamma Emitters	EPA Method 901.1	6 months
Actinium-228		
Bismuth-212		
Bismuth-214		
Cesium-137		
Cobalt-60		
Lead-210		
Lead-212		
Lead-214		
Potassium-40		
Radium-223		
Radium-228		
Radium-226*		
Thallium-208, 234		
Thorium-228, 230, 232	Lab SOP	6 months
Gross Alpha	EPA Method 9310	6 months
Gross Beta	EPA Method 9310	6 months
Plutonium-241	Lab SOP	6 months
Strontium-90	EPA Method 905.0, modified	6 months
Tritium	EPA Method 906.0	6 months
Uranium-233/234, 235/236, 238	Lab SOP	6 months
Metals/Other Inorganics (1 x 4-oz G):	CLP SOW ILM 3.0	
Antimony		6 months
Arsenic		6 months
Barium		6 months
Beryllium		6 months
Cadmium		6 months
Chromium (total)		6 months
Cobalt		6 months
Copper		6 months
Iron		6 months
Lead		6 months
Manganese		6 months
Mercury		28 days

Table 3-4. Containers and Holding Times for Laboratory Analytical Methods for the Domestic Septic Systems Investigation, LEHR Site, UC Davis, California (continued)

Parameter	Analytical Method	Holding Time
Molybdenum		6 months
Nickel		6 months
Selenium		6 months
Silver		6 months
Thallium		6 months
Vandium		6 months
Zinc		6 months
General Chemistry (1 x 4-oz. G)		
Chromium (VI)	EPA Method 3060A/7196	30 days
Nitrate	EPA Method 300.0	48 hours
Organics:		
Volatile Organic Compounds (1 x 4-oz G; no headspace)	CLP SOW OLM 03.1	14 days
Semi-Volatile Organic Compounds (1 x 4-oz G)	CLP SOW OLM 03.1	14 days to extraction, 40 days to analysis of extract
Organochlorine Pesticides/PCBs (1 x 4-oz G)	CLP SOW OLM 03.1	14 days to extraction, 40 days to analysis of extract

Abbreviations:
CLP SOW = Contract Laboratory Program Statement of Work
ILM 03.0 = Inorganic Laboratory Method 03.0
OLM 03.1 = Organic Laboratory Method 03.1
* = Requires 30-day ingrowth-time and 1000-minute count-time
G = Glass container
oz = ounces
P = Plastic container



DRAWING NOT TO SCALE

LEGEND

- DOMESTIC SEPTIC SYSTEM
- DISTRIBUTION BOX (MAY NOT BE PRESENT FOR ALL SYSTEMS)
- COMPOSITE SAMPLE
- DISCRETE SAMPLE (LOCATIONS MAY CHANGE BASED ON FIELD CONDITIONS)
- PERFORATED LEACH LINE
- INFLUENT/EFFLUENT LINES

Figure 3-1. Domestic Septic Systems, Planned Sample Locations, LEHR Site, UC Davis, California

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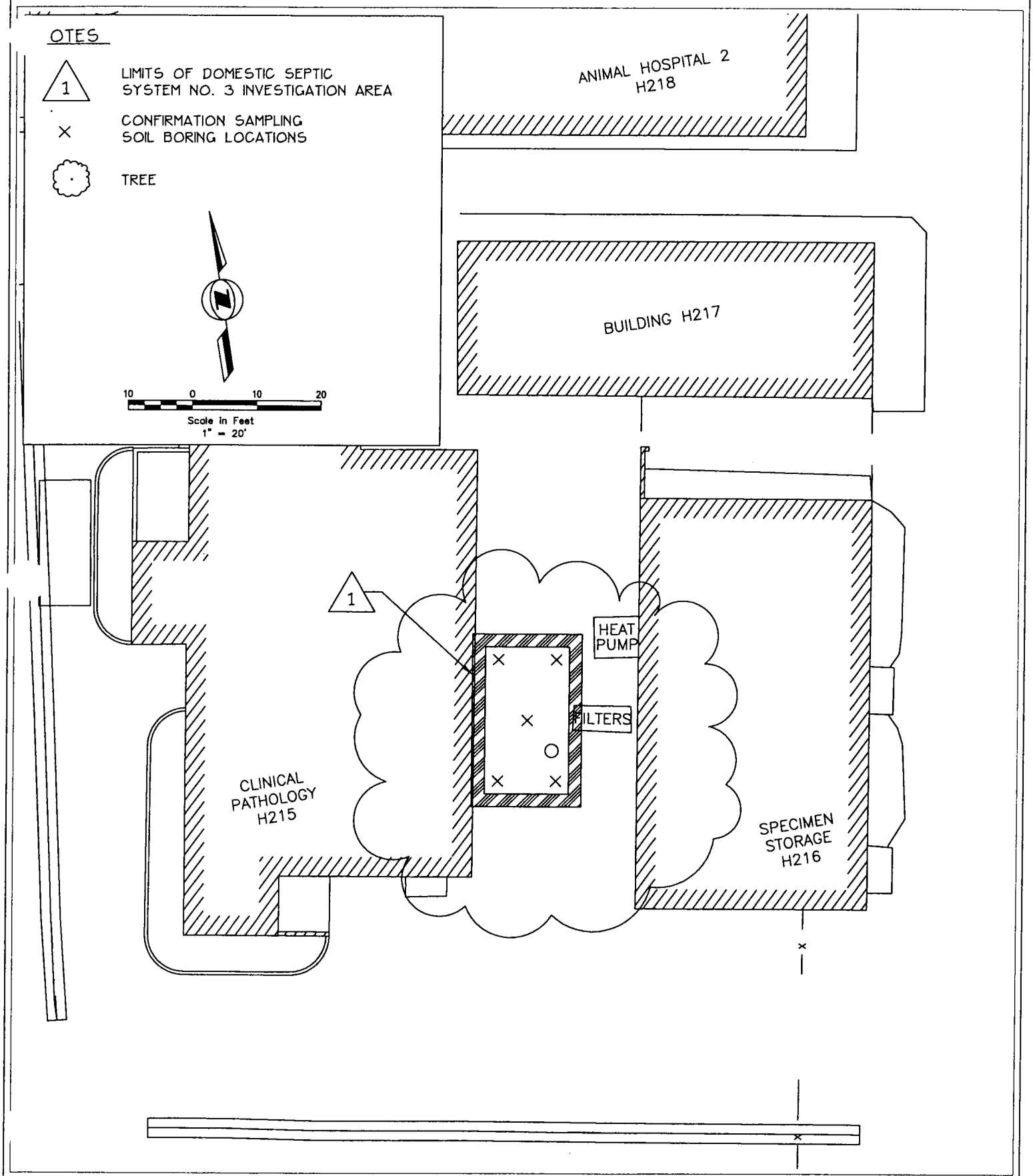

Figure 3-2. Planned Confirmation Sample Locations in the Domestic Septic System No. 3, LEHR Site, UC Davis, CA

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4. WASTE MANAGEMENT

This section is a project-specific waste management plan (WMP) for waste streams and material associated with the DSSI at LEHR. It details procedures developed for and specific to RA waste management activities. A general description of the LEHR waste management system is followed by RA-specific waste management guidance that is structured to specify practices for each waste stream for the following activities:

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

4.1 Program Description

In general, the initial determination of waste type and subsequent management of waste materials is dictated by process knowledge and relevant analytical data from waste streams of similar origin. Management practices are supported by collection of analytic data. Once validated, analytical data are used to accurately characterize and designate project waste streams. Waste designation, documented in 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 presents process knowledge and analytical data in a concise format that is used by project staff to gain acceptance of RA waste streams to selected facilities.

4.1.1 Definitions

The following terms are defined for use in this WMP:

- *Waste*: Any solid or liquid material generated as a result of RA activities that requires disposal.
- *Material*: Any solid or liquid material generated as a result of the RA that may be re-used, recycled or requires off-site disposal as non-regulated waste.
- *Hazardous Waste (HW)*: Waste that meets the HW definition under Federal 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 (LLW):* Waste that contains radioactivity and is not classified as high-level waste, transuranic (TRU) waste, or spent nuclear fuel or 11E(2) by-product material as defined by DOE Order 5820.2A. 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 transuranic materials is less than 100 nanoCuries per gram. (DOE Order 5820.2A).
- *Mixed Waste (MW)*: Waste classified as both LLW and HW (Federal and State) based on the definitions above.
- *Non-Hazardous Waste (NHW)*: Material that does not meet the definition of applicable federal and/or state HW laws and regulations. This includes construction debris and other non-regulated waste and material.

4.1.2 Regulatory Drivers and Standard Operating Procedures

This document references the Draft Radioactive Waste Management Plan (WA, 2001c), the LEHR RPP (WA, 1999a) and SOPs (WA, 1999b). The SOPs used to develop this WMP are listed below:

- 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 QC 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 31.1, Lead Characterization, Packaging and Shipping
- 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 and Material Tracking System
- SOP 35.1, Waste Certification
- SOP 39.1, Waste Management Program Inspection
- SOP 42.2, Building Survey Procedures

4.1.3 Key Personnel Responsibilities

Proper management of LEHR RA waste streams requires expertise from various LEHR project team members. The responsible members and waste management organizational chart is presented in Section 4 of the Draft Radioactive Waste Management Plan.

4.1.4 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. Applicable waste minimization activities include:

- Avoiding use of porous materials in radiological contamination areas that cannot be decontaminated and released to unrestricted service;
- Minimizing personal protective equipment waste through effective worker logistics;
- Using real-time analyses 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 as dust suppressant on contaminated soil/debris excavations and stockpiles;
- Minimizing the generation of investigation-derived waste (IDW);
- Conducting dry decontamination of equipment whenever possible in order to minimize the generation of liquid IDW;
- Removing surface contamination from subsurface structures and pipes; and,
- Re-using uncontaminated soil and materials on site as backfill or in other approved applications.

A detailed description of the LEHR Waste Minimization Program is included in Section 7 of the *Waste Management Annual Report for Fiscal Year (FY) 1997 and Waste Management Plan* (WA, 1998c). In general, overburden soils will be re-used as backfill and drill cuttings from boreholes will be returned to their source.

4.2 Waste Descriptions

The DSSI and RA are expected to generate several waste and material streams. In general, the anticipated and /or potential waste stream types include:

- NHW
  - Soil (overburden)
  - Metal (fencing)
  - Asphalt
  - Concrete
  - Construction debris
- MW
  - Soil
  - Drill Cuttings

Because these waste and material streams originate from a chemically-impacted, Radioactive Material Management Area (RMMA), they will be managed as potential MW until analytical data are available for final designation. Waste streams that are not covered by the project WMP (WA, 2000c) or the WMP discussed within this section will be handled under separate WMP updates that will be developed as the need arises. Based on process knowledge and site history of operations the concrete and asphalt is certified as containing no-added radioactivity and no chemical contamination and will be managed as NHW.

4.2.1 Constituents of Concern and Analytic Methods

The DSSI COCs are listed in Table 2-1 of this Work Plan.

4.3 Excavation, Sorting, Packaging and Storage

During the DSSI, it is assumed that NHW and MW will be excavated. Table 4-1 summarizes anticipated waste streams, authorized packaging and authorized storage areas managed under this WMP. Waste types that may be generated by the DSSI are described below. Additional descriptions of RA waste excavations are located in Section 2 of this Work Plan.

- LLW—No LLW is expected or anticipated.
- HW—Soil excavated from DSS 6 may be designated as HW. However, this waste will be managed as potentially MW until analytical results from this waste stream are evaluated. See Section 1.2.
- MW—Soil excavated from DSS 6 and drill cuttings not returned to their source will be managed as potentially MW. The material will be packaged in one-cu yd soft-sided containers and will be placed in an HDPE-lined cell in the Former Co-60 field. To expedite designation of this waste, two soil samples will be analyzed for mercury using the Toxicity Characteristic Leaching Procedure and the Waste Extraction Test (Table 4-4).
- NHW—Surface soil and gravel in the DSSI are likely to be characterized as NHW. Overburden soils will stockpiled in the work area at a safe distance from the excavation. In the event that any liquid IDW (equipment decontamination fluids) is produced, the liquid will be placed in lined, 55-gal drums and will be incorporated into the existing WDP liquid waste stream for analysis and disposition. The 55-gal drums will be stored in Former Co-60 field or the Geriatrics building. Concrete and asphalt will be removed and accumulated in HDPE lined stockpiles in the Former Co-60 field until off-site disposal as NHW waste is coordinated.
- Sanitary Waste (miscellaneous debris)—Other non-hazardous construction debris will be disposed of through our existing sanitary waste disposal venue, the UC Davis landfill.

4.4 Sampling and Characterization

All project waste streams with the exception of concrete and asphalt will be sampled for waste characterization purposes following segregation, processing and placement in appropriate stockpiles and/or packages. Concrete and asphalt are certified through process knowledge as containing no radioactive or otherwise regulated constituents. Samples will be collected prior to stockpile and/or package closure. Sampling and analysis will be conducted in accordance with:

- SOP 1.1, Chain-of-Custody;
- SOP 2.1, Sample Handling, Packaging and Shipping;
- SOP 6.1, Sampling Equipment and Well Material Decontamination;
- SOP 17.1, Sample Labeling;
- SOP 17.2, Sample Numbering;
- SOP 18.1, Field QC Sampling;
- SOP 19.1, On-Site Sample Storage; and,
- SOP 20.1, Sample Containers, Preservation, and Holding Times.

We intend to obtain the required data necessary to certify the waste as containing no added radioactivity and determine if the waste contains constituents above California or Federal hazardous waste definitions. Sampling frequencies and parameters will be according to existing agreements with these facilities and are presented in Table 4-1.

4.4.1 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 LEHR QAPP (WA, 2000a). The Waste Characterization Sampling and Analysis Plan is summarized in Table 4-1.

4.4.2 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 his designee according to SOP 21.1, Data Validation. Once validated, the data will be transferred to the project database using procedures described in the QAPP (WA, 2000a) and provided to the Waste Coordinator (WC) and Waste Specialist (WS) for use in waste designation. The Draft Radioactive Waste Management Plan completely describes this process (WA, 2001c).

4.5 Labeling and Tracking

All DSSI waste and material streams will be incorporated into the LEHR Waste and Material Tracking System (WMTS) per SOP 34.5, Waste and Material Tracking System. Temporary stockpiles within the work areas will not be managed in this system, only packages and waste removed from the area for storage will be managed in the WMTS.

4.6 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.

4.7 Waste Designation

Initial waste designation is provided in Table 4-1 of this document, and shall be amended by the WC at the time of waste generation, if required. 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 NHW, HW, LLW or MW. This designation process determines the practices required to properly manage RA waste streams according to LEHR SOPs and applicable Federal and State requirements. One designation report will be prepared for the DSSI, addressing potential MW. All MW or HW shall be properly disposed within 90 days of its designation. See SOPs 34.4, Clean Waste Handling, and 35.1, Waste Certification for a complete description of the designation process.

4.8 Profiling

The purpose of waste profiling process is to verify that the selected disposal facility WAC are met. One profile is planned for DSSI waste streams (Table 4-1). DSSI waste streams will be incorporated into existing profiles whenever possible as a best-management practice. See SOP 35.1, Waste Certification for Offsite Disposal, for a complete description of the profile process.

4.9 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 according to LEHR 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 according to LEHR SOP 34.3, Waste Shipment. As discussed in Section 4.7, all MW and HW shall be properly disposed within 90 days of its designation. Likely disposal scenarios are summarized in Table 4-1.

4.10 Schedule

All DSSI waste streams will be disposed by December 31, 2002. All waste streams will be managed for disposal per the Draft Radioactive Waste Management Plan (WA, 2001c).

Table 4-1. Domestic Septic Systems Investigations Waste Types, Volumes and Management, LEHR, UC Davis, California

Description	Volume (cu yd)	No. of Containers	Type of Containers	Authorized Storage Location	No. of Samples	Analytic Requirements	Preliminary Designation	Required Designation Report	Profile Required
Asphalt	1	1	Stockpile [1]	Co-60	N/A	PK	NHW	NR	NR
Concrete	6	1	Stockpile [1]	Co-60	N/A	PK	NHW	NR	NR
Soil-Mercury Impacted	5	6	Soft-sided [2]	Co-60	2	FS TCLP and WET for mercury	MW	Yes	Yes
Misc. Debris	10	1	Roll-off (12 cu. yd.)	NR	0	PK	SW	NR	NR
Overburden [3]	10	1	Stockpile [1]	Work Area	0	PK	NHW	NR	NR

Notes
[1]Stockpile contained with high density polyethylene sheeting (20 mil.).
[2]One cubic yard soft-sided container, no specialized handling equipment required.
[3]Overburden, assumed clean and authorized for onsite re-use as backfill.

Abbreviations

Co-60	Former Cobalt-60 Field
cu yd	cubic yard
FS	Full suite
MW	Mixed waste
N/A	not applicable
NHW	Non-hazardous waste or material
NR	Not required
On-Site	Material assumed clean, approved for re-use on site
PK	Process knowledge and radiological screening using field instruments
SLF	Sanitary Landfill
TBD	To be determined
TCLP	Toxicity Characteristic Leaching Procedure
WDP	Western Dog Pens
WET	Waste Extraction Test (CA Title 22 66261.24)

5. HEALTH AND SAFETY

H&S considerations for DSSI activities are based on the Integrated Safety Management System principles and are addressed by: the PHSP (WA, 2000h); Health and Safety Procedures (HSPs) (WA, 2000g) and SOPs (WA, 1999b); CPGERP (WA, 2000d); As-Low As Reasonably Achievable Plan (WA, 2001a), and RPP (WA, 1999a). 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, and relevant DOE Orders.

5.1 Hazard Analysis

Hazards associated with field activities are identified and evaluated using the Activity Hazard Analysis (AHA) process. The SC and 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 surveys and contaminated soil and waste excavation, have been evaluated in the LEHR PHSP. Those activities specific to the DSSI are discussed in this Work Plan, and the associated AHAs are included in Appendix B.

During the DSSI, 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.

5.1.1 Underground Utilities

All available drawings, plans and diagrams will be reviewed to determine the locations of underground utilities. Interviews will also attempt to identify locations not mapped but known to UC Davis staff. 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 2. 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;
- Lockout/tagout procedures defined in HSP 9.1, Control of Hazardous Energy (Lockout/Tagout), will be implemented anytime the potential for exposure to hazardous energy stored in electrical, gas, water or other utility lines is present; and,
- Samples will be collected using a hand auger in the first five feet 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.

5.1.2 Heavy Equipment Operation

A portion of the DSSI work includes drilling and/or removal of material from the DSS areas using heavy machinery such as drill rigs, excavators, backhoes, and skid-steer loaders. 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.

5.1.2.1 Drilling Operations

Drilling operations present numerous hazards, including:

- Personnel injury by rotating moving parts;
- Impact hazards due to visual impairment;
- Flying debris from rotating drill stem;
- Punctures with metal shavings from drill stem;
- Electrical hazards from contact with power lines; and,
- Collision hazards with other overhead structures.

To minimize the potential hazards associated with drilling operations, only necessary personnel will be allowed in the area during drilling operations. Caution will be exercised when drill rig masts are set up near buildings, power lines and any other structures. A person will be designated to observe clearance of equipment and give timely warning for all operations where it is difficult for the operator to maintain desired clearance by visual means.

Proper drill stem speeds will be determined to ensure that material from the drill stem auger does not create a projectile hazard. Spotters or other support personnel will maintain a safe distance from the drill rig. No one will be present in the swing radius of moving parts. Faceshields will be used if engineering and administrative controls prove insufficient as determined by the SHSO.

Personnel will wear leather or kevlar gloves when changing out any parts that may create sharp metal shavings.

5.1.2.2 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. An illustration of the hand signals will be posted at the Site. 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.

5.1.2.3 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.

5.1.3 Overhead Electrical Lines

There are two energized overhead lines approximately 15 and 30 ft above ground near DSS 7 (Figure 5-1). The lines convey 240 volts and 12.5 kilovolts, respectively. 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.

5.1.4 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 Underwriters Laboratory-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.

5.1.5 Concrete Removal and Mechanical Sifting

Cutting of the concrete tanks and the pavement around the tanks will likely generate airborne dust. 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 5-1 are not exceeded. If dust exposure cannot be kept below the Action Levels presented in Table 5-1, respiratory protection will be used in accordance with the PHSP.

5.1.6 Fall Protection

During some phases of the DSSI, excavations/trenches up to eight feet in depth will be created. Evaluation of shoring, sloping, or other means to eliminate the potential for cave-ins associated with the excavations will be performed prior to the start of work by a trained person who is knowledgeable in the areas of excavation stability/safety, use of protective systems, and the requirements of applicable standards and regulations.

If entry into an excavation deeper than four feet is required, it will be under the immediate supervision of a qualified person. Excavated material will be placed at least two feet from the edge of any trench or excavation. Adequate precautions will be taken to ensure that vibrating equipment and vehicular traffic do not cause a cave-in. Safe access/egress into the excavation or trench will be provided by ladders or ramps located such that no worker must laterally travel more than 25 ft to access the egress point. All excavations will be inspected daily by a competent person to ensure that no deterioration such as sloughing or cracking is occurring, and that the excavation remains safe to enter and does not present a hazard to adjoining structures.

5.1.7 Stockpile Management

Material/waste storage cells will be constructed within the investigation area perimeters. Material/waste will be stockpiled up to four feet high in these cells. The stockpiles will be covered with HDPE. Personnel will not be allowed to walk on top of the stockpiles, and will use care when walking around them. 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.

5.1.8 Trips and Falls

The investigation areas will contain uneven surfaces and open excavations. Unless the open excavation can be guarded or a barricade is constructed to prevent access to the area, all open excavations will be covered as soon as practical with a cover that is larger than the opening and is capable of supporting at least a 200-pound load, secured against displacement, and labeled "Floor Opening, Do Not Remove". If the excavation must be open, 42-inch high barricades with a mid-rail, capable of withstanding a 200-pound load, will be installed around the perimeter. Workers will be instructed to exercise caution when working in the area. They will be periodically reminded of the hazards. Any potential trip hazards will be cleared from the immediate work area to provide a stable ground surface for work activities such as augering or spotting the operation.

5.1.9 Material Handling

Some of the activities associated with the DSSI 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.

5.1.10 Repetitive Motion Hazard

Clearing and grubbing and manual sample collection involve the use of hand tools such as rakes, hoes 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 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 soil or 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.

5.1.11 Biological Hazards

Many areas at LEHR 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. 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.

5.1.12 Radiological Exposure

Analysis of the material/waste in the DSSI areas indicates that no occupational hazard from exposure to radionuclides exists.

Dust suppression and other appropriate engineering controls will be used wherever possible to reduce the potential for internal and external exposure to as-low-as-reasonably-achievable (ALARA) levels as required by the LEHR RPP. The use of administrative procedures to control occupational radiological worker exposures is not anticipated for this project. Applicable ALARA principles and procedures are presented in the ALARA Plan (WA, 2001a) and will be discussed with the workers during on-the-job training.

If analytical sample data from the investigation indicates that radiological levels are higher then expected, the LEHR RPP will be implemented, potential occupation exposure analyzed and additional controls defined to prevent exposure above regulatory levels.

5.1.13 Chemical Exposure

Chemical constituents present in the DSS are presented in Table 2-1 and include heavy metals, 1,2-dichloroethane, trichloroethane, arcolor-1254 and formaldehyde. All of the constituents, with the exception of formaldehyde, are below occupational concern levels. Real-time qualitative field monitoring for formaldehyde will be conducted using a Draeger bellows pump with a formaldehyde detection tube with a detection range of 0.2-5 parts per million to ensure that worker exposure is below OSHA-permissible exposure limits (Table 5-1).

Concrete removal, 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 (Table 4-1), respiratory protection will be required.

5.1.14 Heat Stress

The DSSI is currently scheduled for the period July and August 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 according to 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 kilocalories expended per hour) are provided in Table 5-2 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 located adjacent to the DSS where field activities are occurring. The areas will be covered with a portable tarp, when necessary, to provide the workers with shade. During the morning tailgate safety meetings (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.

5.1.15 Noise Exposure

High noise levels from equipment, such as jackhammers and percussion hammers used to demolish the concrete sidewalk and DSS tanks, 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.

5.2 Hazard Controls

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

5.2.1 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 according to the procedures specified in the PHSP (WA, 2000h) and according to HSP 17.1, Hazardous Work Permits. The following information will be described or referenced in the HWP.

5.2.2 Boundaries

The work areas will be enclosed by barricades, boundary ropes or tape supported with stanchions 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.

5.2.3 Personal Protective Equipment

Workers in the CA will wear the modified Level D PPE identified below when the potential for chemical exposure exists, unless otherwise specified in an HWP.

Modified Level D PPE will consist of the following:

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

Chemical-resistant PPE will be required only when the potential for chemical skin exposure is present.

5.2.4 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 and posted with the appropriate warning sign. Decontamination procedures will be conducted according to 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 according to Section 10 of the PHSP.

5.2.5 Training

All workers performing investigation RA and support activities on site shall have completed the training required by Section 2.1.1.3 of this Work Plan in addition to training required by the PHSP, RPP and the QAPP.

5.2.6 Buddy System

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 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 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.

5.2.7 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.

5.2.8 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 (WA, 2000d).

5.2.9 Air Monitoring

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 DSSI activities will consist of visual observations and respirable dust readings. 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 5-1 are exceeded and periodically to confirm the validity of real-time monitoring. TWA monitoring for other chemical constituents (e.g., formaldehyde) will be conducted as required by 29 CFR 1910.120, if baseline qualitative field monitoring data indicate the potential for exposure at or above the OSHA PEL.

All air equipment will be maintained and calibrated according to the manufacturer's recommendations. Air monitoring will be conducted daily or until collected data are sufficient to predict exposures to airborne contaminants.

Table 5-1. Airborne Chemical Action and Permissible Exposure Levels

Compound	Action Level	PEL in ppm (TWA)	Action
Nuisance Respirable Dust	2.5 mg/m^3	NA	Actions to include the following progressive steps for all compounds: • Notify SHSO of concentrations; • SHSO stop work or apply engineering controls, as necessary; • SHSO 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 Total Dust	7.5 mg/m^3	NA	
Chlordane	.25	0.5 mg/m^3	
1,2-Dichloroethane	NA	50 CLG/STEL 100	
Trichloroethane (Methylene Chloride)	NA	350	
Arcolor-1254	NA	240 to 7200 (ASTM Std)	
Formaldehyde	.375	0.75 CLG/STEL 2	

Abbreviations

ASTM Std	American Society for Testing and Materials Standard
CLG/STEL	Ceiling/Short-Term Exposure Limit
HEPA	High-efficiency particulate air
mg/m^3	milligrams per cubic meter
NA	Not Applicable
PEL	Permissible Exposure Limit
PPE	personal protective equipment
SHSO	Site Health and Safety Officer
TWA	time-weighted average

Table 5-2. Estimated Employee Workload per Activity

Activity	Workload (kcal/hour)
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

Abbreviations
kcal/hour kilo-calories per hour

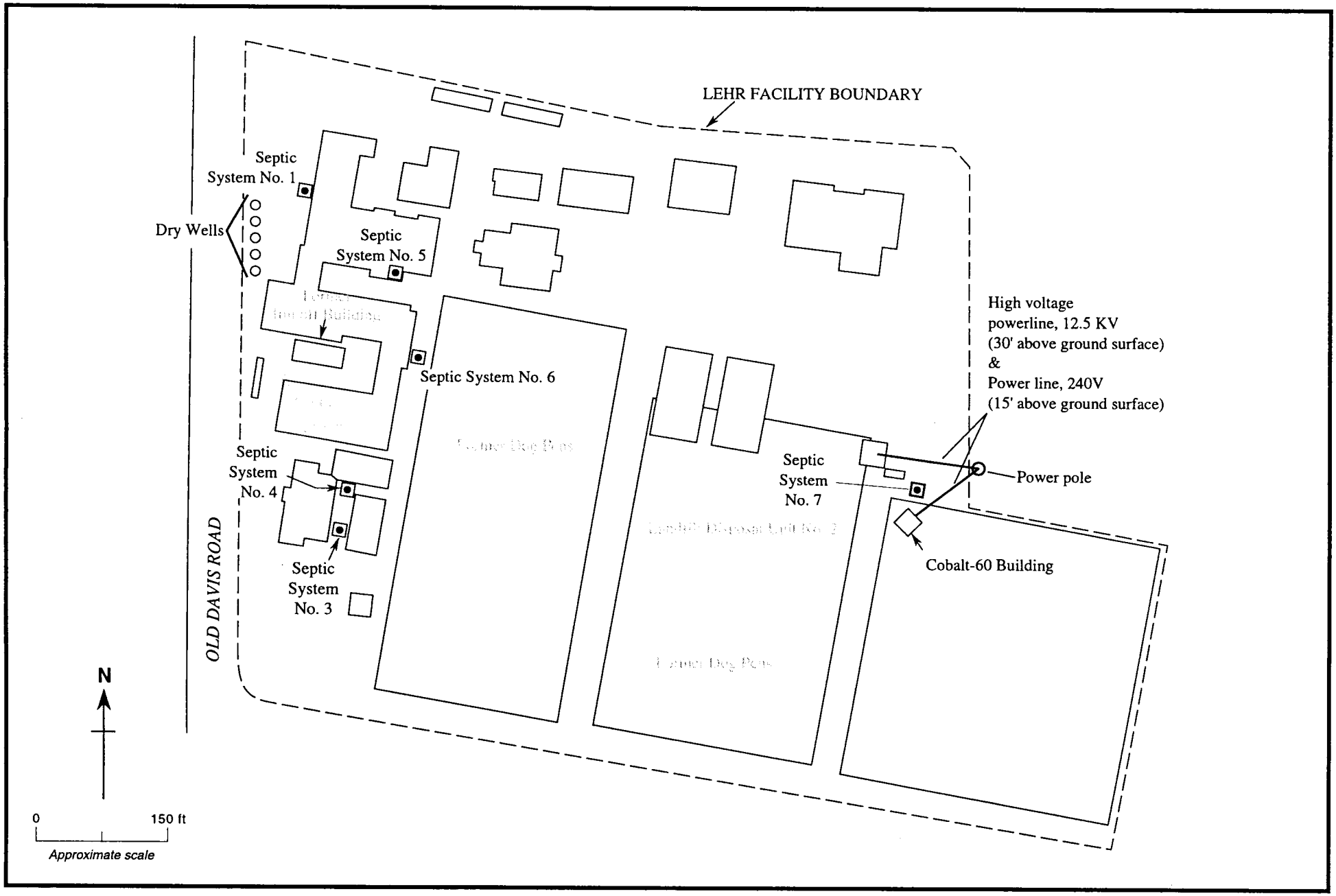

Figure 5-1. Locations of Overhead Electrical Power Lines near Domestic Septic System No. 7

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6. QUALITY ASSURANCE

The objective of this section is to ensure that quality is integrated into all DSSI project activities. This section provides guidance to project personnel to implement the QAPP (WA, 2000a) and associated SQPs, as they are applicable to DSSI activities.

6.1 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, 2000h).

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.

6.2 Personnel Training and Qualification

Prior to the start of the DSSI activities, personnel training and qualification will be conducted and evaluated according to 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, 2000b) will be distributed to project personnel. These matrices will list all of the project documents and procedures that pertain to the DSSI, 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.

6.3 Field Documentation and Records Management

All quality-affecting records generated during the DSSI 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 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.

6.4 Test Control

Analytical 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.

6.5 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.

6.6 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 and radiological detection instruments.

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.

6.7 Field Sampling

Field sampling will be conducted according to Section 3 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.

6.8 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.

6.9 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.

6.10 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 DSSI, 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.

6.11 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.

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APPENDIX A

DOMESTIC SEPTIC SYSTEMS 1 AND 5 REMOVAL ACTION SUMMARY

DOMESTIC SEPTIC SYSTEMS 1 AND 5 REMOVAL ACTION SUMMARY

A.1 Excavation Activities

During the 1999 Radium/Strontium (Ra/Sr) Treatment Systems Area I removal action (RA), exploratory trenching was conducted to confirm the termination point of the radium-226 (Ra-226) northern leach trench (NLT). On July 26, 1999 a concrete structure was uncovered approximately 15 ft north of the NLT. Additional excavation in this area revealed a leach system containing five drywells (Dry wells A-E), a distribution box and piping connecting the system (Figure A-1). After conducting historical research, it was determined that Drywells A-E and their distribution box were part of the Domestic Septic Systems No. 1 and 5 (DSS 1/5) leach system.

The dry well structures consisted of circular concrete manways 30 inches in diameter that expended from 1 foot (ft) below ground surface (bgs) to 6 ft bgs. Two-inch rounded drain rock was contained within the manway structure starting at a depth of 3 ft bgs and continuing to 8 ft bgs. In Dry wells B and E, large cobbles 6 to 12 inches in diameter were observed at 7 to 8 ft bgs. The DSS 1/5 excavation depths ranged from 5.5 ft to 20 ft bgs. Excavation in the vicinity of Dry wells A, C, D and E reached a depth 8 ft bgs. Dry well B was excavated to depth 20 ft bgs at which point the excavator arm could not reach any deeper. Gravel was observed to the maximum excavation depth indicating that Dry well B is at least 20 ft deep. The distribution box (DB) was located approximately 1 ft bgs and measured four feet wide by four feet long by three feet high. The DB was removed and the area was excavated to a depth of approximately 5.5 feet bgs. On August 30, 1999, the area was backfilled and compacted using an excavator with a compaction wheel.

A.2 Sampling Activities and Analytical Results

A.2.1 Excavation Screening Sampling

A total of 36 screening samples were collected from the DSS 1/5 area between July 23 and August 27, 1999. Soil samples were collected adjacent to the distribution box, Dry wells A-E and from the excavation sidewalls and floor. A pipe sediment sample was also collected from the effluent lines. All 36 samples were analyzed on-site for Ra-226. Ra-226 concentrations ranged from 0.36 to 0.68 picoCurie per gram (pCi/g). Ten samples were analyzed on-site for strontium-90 (Sr-90). Sr-90 concentrations ranged from non-detectable to 0.65 pCi/g.

A.2.2 Investigation Sampling

A total of 11 investigation samples including 1 field duplicate were collected from the DSS 1/5 area. The sample locations are shown in Figure 2-11. Samples were collected between 5 and 10 ft bgs using a hand auger advanced from an extendable boom or directly from the excavator bucket. Samples were put directly into pre-sterilized glass jars, packaged and shipped to an off-site laboratory. Samples were analyzed for a full suite of COC, consisting of radionuclides, pesticides/PCBs, metals, volatile and semi-volatile organic compounds, and nitrate.

The investigation sampling analytical results are summarized in Table A-1. The maximum Ra-226 and cesium-137 activities and the majority of the maximum detected metals concentrations were reported in sample CWRSC024. All soil within an approximately 5 foot radius of sample CWRSC024 was excavated and removed.

A.3 Waste Management

Waste consisting of soil, gravel, cobbles, concrete and piping was generated during the RA. The soil, gravel, cobbles and piping were loaded directly into B-25 boxes. Thirteen B-25 boxes containing DSS 1/5 waste were filled and transported to the former Co-60 field for temporary storage. A sample was collected from each B-25 box and analyzed for total chromium and hexavalent chromium. Two composite samples were collected from the B-25 boxes. One sample was analyzed for a full suite radionuclides, pesticides/PCBs, metals, VOCs, SVOCs and $N0_3$. The second sample was analyzed for a full suite, excluding radionuclides. The waste is currently being designated and profiled for disposal.

The concrete manways were removed and placed directly onto pallets. The pallets were then transported to the Co-60 field for temporary storage until the Western Dog Pens (WDP) RA scheduled for summer 2001. During the WDP RA, the concrete will be pulverized and added to the WDP waste.

Table A-1. Domestic Septic Systems Dry Wells A, B, C, D, and E Sampling Summary

Constituent	Units	Number of Detections > Reporting Limit[1]	Number of Detections > Background	Number of Detections > RBAS	Number of Detections > PRGs	Background Concentration[2]	RBAS Concentration	PRG Concentration	Maximum Detected Concentration	Sample ID of Maximum Concentration	Sample Depth (ft. bgs)
Metals											
Antimony	mg/kg	9	1	9	1	1.4	0.3	31	68	CWRSC024	9.5
Arsenic	mg/kg	10	1	N/A	10	10.9	N/A	0.39	12.8	CWRSC024	9.5
Barium	mg/kg	10	1	10	0	294	53	5400	307	CWRSC024	9.5
Beryllium	mg/kg	10	0	N/A	0	0.92	N/A	150	0.57	SSSTC006	5
Cadmium	mg/kg	1	1	1	0	0.51	0.38	9	5.6	CWRSC024	9.5
Chromium	mg/kg	10	6	1	1	125	721.9	210	14,300	CWRSC024	9.5
Chromium, Hexavalent	mg/kg	9	9	1	7	0.05	3.8	0.2	5.29	CWRSC024	9.5
Cobalt	mg/kg	10	0	N/A	0	31	N/A	4700	27.8	CWRSC024	9.5
Copper	mg/kg	10	0	10	0	61.8	28	2900	277	CWRSC024	9.5
Iron	mg/kg	8	0	N/A	8	44,000	N/A	23000	40,300	SSSTC006	5
Lead	mg/kg	10	2	10	0	9.5	0.044	400	134	CWRSC024	9.5
Manganese	mg/kg	8	0	9	0	750	36	1800	745	SSSTC007	20
Mercury	mg/kg	10	8	8	0	0.25	0.22	23	5.3	SSSTC007	20
Molybdenum	mg/kg	9	6	N/A	0	0.26	N/A	390	1.1	CWRSC024	9.5
Nickel	mg/kg	10	1	N/A	9	246	N/A	150	249	SSSTC003	6
Selenium	mg/kg	7	1	0	0	1.2	58	390	3.4	CWRSC024	9.5
Silver	mg/kg	10	8	6	0	0.55	3.8	390	177	CWRSC024	9.5
Vanadium	mg/kg	10	0	N/A	0	80.3	N/A	550	70.2	CWRSC024	9.5
Zinc	mg/kg	10	1	0	0	93.1	3400	23000	916	CWRSC024	9.5
Pesticides/PCBs											
alpha-Chlordane	mg/kg	3	N/A	0	0	0.00	0.8	1.6	0.25	CWRSC024	9.5
gamma-Chlordane	mg/kg	3	N/A	0	0	0.00	0.81	0.42	0.32	CWRSC024	9.5
Radionuclides											
Actinium-228	pCi/g	10	3	N/A	N/A	0.64	N/A	N/A	0.67	SSSTC006	5
Bismuth-212	pCi/g	10	1	N/A	N/A	0.434	N/A	N/A	0.438	SSSTC005	6
Bismuth-214	pCi/g	10	0	N/A	N/A	0.54	N/A	N/A	0.52	SSSTC011	5
Carbon-14	pCi/g	2	1	0	0	0.13	4200	770	0.42	CWRSC024	9.5
Cesium-137	pCi/g	7	7	1	6	0.007	0.1	0.02	0.41	CWRSC024	9.5
Lead-210	pCi/g	2	0	0	0	1.6	9.6	0.78	0.58	SSSTC011	5
Lead-212	pCi/g	10	1	N/A	N/A	0.68	N/A	N/A	0.70	SSSTC006	5
Lead-214	pCi/g	10	0	N/A	N/A	0.58	N/A	N/A	0.58	SSSTC009	8
Potassium-40	pCi/g	10	0	N/A	N/A	14	N/A	N/A	12.90	SSSTC010	8
Radium-226	pCi/g	10	1	10	10	0.75	0.0042	0.0062	1.26	CWRSC024	9.5
Radium-228	pCi/g	10	1	N/A	N/A	0.66	N/A	N/A	0.67	SSSTC006	5
Strontium-90	pCi/g	7	5	0	0	0.06	10	14	0.21	CWRSC023	10
Thallium-208	pCi/g	10	0	N/A	N/A	0.22	N/A	N/A	0.22	SSSTC006	5
Thorium-228	pCi/g	10	0	10	10	0.771	0.032	0.041	0.77	SSSTC006	5
Thorium-230	pCi/g	10	0	N/A	N/A	1.04	N/A	N/A	0.76	CWRSC023	10

Table A-1. Domestic Septic Systems Dry Wells A, B, C, D, and E Sampling Summary (continued)

Constituent	Units	Number of Detections > Reporting Limit[1]	Number of Detections > Background	Number of Detections > RBAS	Number of Detections > PRGs	Background Concentration[2]	RBAS Concentration	PRG Concentration	Maximum Detected Concentration	Sample ID of Maximum Concentration	Sample Depth (ft. bgs)
Thorium-232	pCi/g	10	1	10	0	0.80	0.022	24	0.88	SSSTC006	5
Thorium-234	pCi/g	10	1	0	2	0.78	3.2	0.69	0.90	SSSTC005	6
Uranium-233/234	pCi/g	10	1	N/A	N/A	0.71	N/A	N/A	1.24	CWRSC024	9.5
Uranium-235	pCi/g	10	4	0	0	0.038	0.15	0.16	0.08	CWRSC024	9.5
Uranium-238	pCi/g	10	1	N/A	N/A	0.645	N/A	N/A	0.81	CWRSC024	9.5
SVOCs											
Bis-(2-Ethylhexl)phthtalate	mg/kg	1	N/A	0	0	0.00	7.7	350	1.58	CWRSC024	9.5
VOCs											
2-Butanone	mg/kg	4	N/A	0	0	0.00	12	6900	0.07	SSSTC011	5
EthylBenzene	mg/kg	1	N/A	0	0	0.00	10	230	0.001	CWRSC023	10
Methylene Chloride	mg/kg	1	N/A	0	0	0.00	0.13	8.9	0.02	CWRSC023	10
Toluene	mg/kg	6	N/A	0	0	0.00	19	520	0.21	SSSTC008	8
Xylenes (Total)	mg/kg	1	N/A	0	0	0.00	700	210	0.01	CWRSC023	10
General											
Nitrogen, Nitrate	mg/kg	10	0	N/A	N/A	36	N/A	N/A	13.4	SSSTC005	6

Notes

(1) Number of samples > reporting limit represents the number of samples greater than the "detection limit" for volatile and semi-volatile organic compounds, pesticides, the IDL for metals, the MDL for general chemistry, and MDA, minimum activity for radionuclides.

(2) The background concentration is for samples collected at depths greater than four ft bgs.

Abbreviations

bgs	below ground surface
ft	feet
IDL	instrument detection limit
mg/kg	milligram per kilogram
MDL	minimum detection limit
N/A	Not Available
RBAS	risk-based action standard
PRG	Preliminary Remediation Goal (U.S. Environmental Protection Agency)

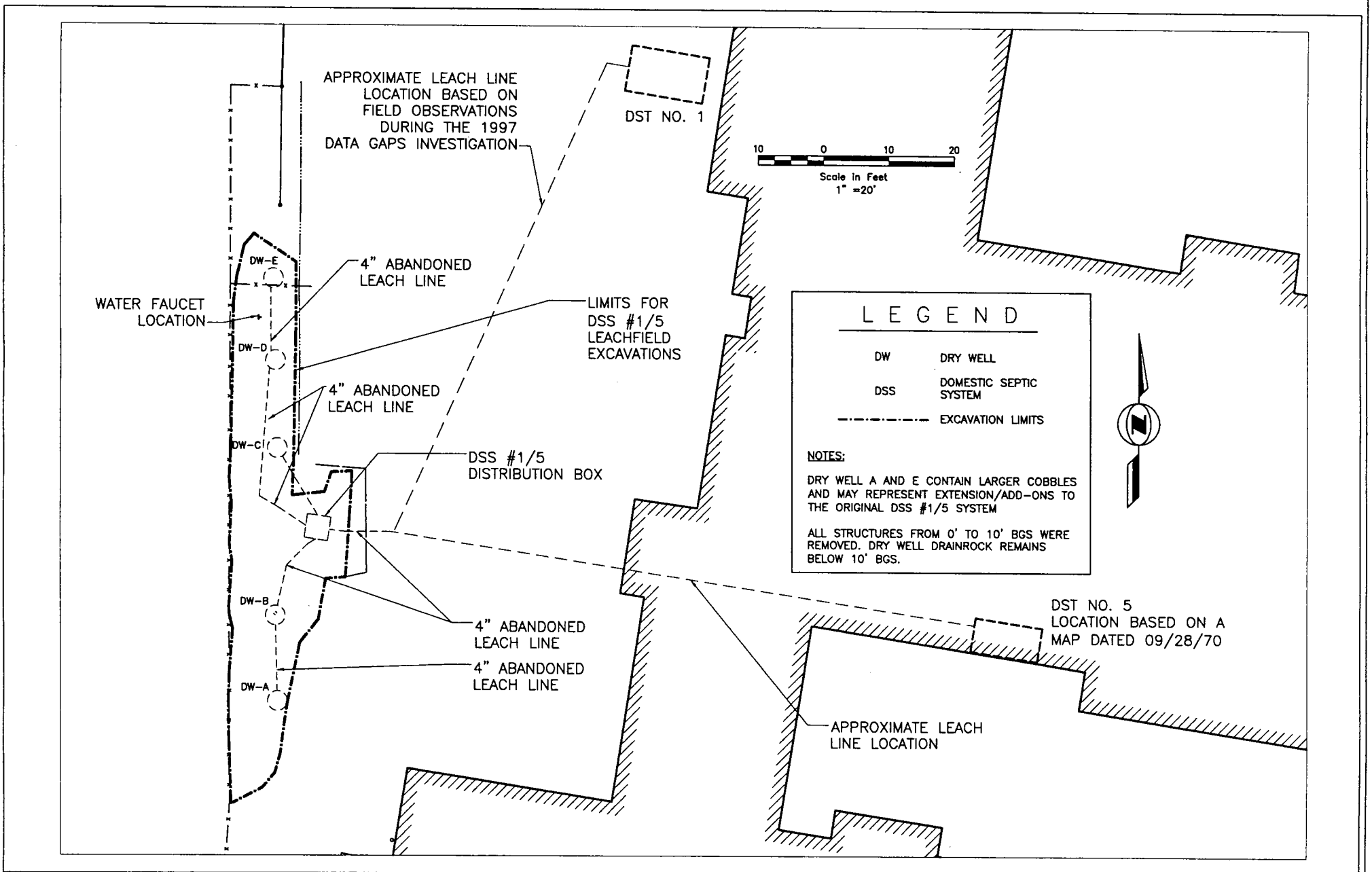

Figure A-1. Locations of Domestic Septic Systems Numbers 1 and 5 Removal Action Features

WEISS ASSOCIATES

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APPENDIX B

ACTIVITY HAZARD ANALYSIS

ACTIVITY HAZARD ANALYSIS

ACTIVITY: Domestic Septic System Investigation—All Activities

ANALYZED BY/DATE: Agata Sulczynski/ March 9, 2001

REVIEWED BY/DATE:

PRINCIPLE STEPS	POTENTIAL HAZARDS	RECOMMENDED CONTROLS
All investigation	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	All activities will be performed according to 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, including work gloves	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: Domestic Septic Systems Investigation – Utility Protection/ Relocation

ANALYZED BY/DATE: Agata Sulczynski/ March 9, 2001

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 subsurface 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 utility 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% of the LEL, work will be stopped and procedures re-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: Domestic Septic Systems Investigation – Barricade Installation

ANALYZED BY/DATE: Agata Sulczynski/ March 9, 2001

REVIEWED BY/DATE:

PRINCIPLE STEPS	POTENTIAL HAZARDS	RECOMMENDED CONTROLS
Installation of barricades	Back strain due to improper lifting of heavy objects	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 with hand 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. Caution will be exercised when removing nails and screws.

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

ACTIVITY HAZARD ANALYSIS

ACTIVITY: Domestic Septic Systems Investigation – Asphalt and Concrete Cutting

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

REVIEWED BY/DATE:

PRINCIPLE STEPS	POTENTIAL HAZARDS	RECOMMENDED CONTROLS
Asphalt and concrete cutting	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. A Noise Reduction Rating (NRR) of at least 25 shall be adhered to in the selection of hearing protection devices. Wherever possible, the use of barriers is encouraged.
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.
Consolidation of asphalt and concrete	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: Domestic Septic Systems Investigation – Asphalt and Concrete Cutting

ANALYZED BY/DATE: Agata Sulczynski/ March 9, 2001

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 will be used.
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: Domestic Septic Systems Investigation – Drilling

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

REVIEWED BY/DATE:

PRINCIPLE STEPS	POTENTIAL HAZARDS	RECOMMENDED CONTROLS
Crane operation to set up drill rig	Impact from swing of overhead heavy loads	Only necessary personnel will be allowed in the area where loads are being moved. If swinging of load(s) is possible and/or anticipated, tag lines will be used to direct the load and prevent swing. Hard hats will be worn by all personnel in the area of operation.
	Impact due to visual impairment	Hand signals will be used for communication between crane operator and spotter or other support personnel. An illustration of the hand signals will be posted at the job site.
	Exceeding load capacity	Load capacities will be posted on all equipment. Manufacture recommended capacity, rating or scope will not be exceeded. Properly rated rigging equipment will be used to lift all loads.
	Impact from rotating structures	Areas within the swing radius will be temporarily barricaded to prevent persons from being struck or crushed by crane.
	Electrical hazards and impact with other overhead structures	Caution will be exercised when loads are being moved near buildings, power lines and any other structures. A person will be designated to observe clearance of equipment and give timely warning for all operations where it is difficult for the operator to maintain desired clearance by visual means.
Drilling operation	Rotating mechanical parts and impact from boom swing	Only necessary personnel will be allowed in the area during drilling operation. Spotters or other support personnel will maintain a safe distance from drill rig. No one will be present in swing radius of moving parts.

ACTIVITY HAZARD ANALYSIS

ACTIVITY: Domestic Septic Systems Investigation – Drilling

ANALYZED BY/DATE: Agata Sulczynski/ March 9, 2001

REVIEWED BY/DATE:

PRINCIPLE STEPS	POTENTIAL HAZARDS	RECOMMENDED CONTROLS
Drilling operation (cont.)	Punctures from metal shavings	Personnel will wear leather or kevlar gloves when changing out any parts that may create sharp metal shavings.
	Contact with contamination	Personnel will wear modified level D PPE. Air monitoring will be conducted in the area. Monitoring data will be used to upgrade/modify PPE requirements. Hip waders will be used if contact with slurry is anticipated. Poly tyvek coveralls will be used if potential contact with wet materials is anticipated.
	Fire	Fire extinguishers will be available in the area or operator cab.
Repair/trouble shooting operations for drill rig	Fall hazards from drill rig mast	If possible, repair operations will be conducted with the mast fully lowered. In case the mast cannot be safely lowered, fall protection will be worn by personnel conducting repair operations where falls from 6 feet or greater are possible. Positioning devices will be rigged so that a person cannot free fall more than 2 feet and will be secured to an anchorage supporting 3,000 lbs or twice the person's potential impact load.

EQUIPMENT TO BE USED	INSPECTION REQUIREMENTS	TRAINING REQUIREMENTS
Crane	Annual and daily inspection of crane	OSHA 40-hour or OSHA 24-hour, and OSHA 8-hour refresher, and OSHA 8-hour supervisor training (as appropriate). Competent person training for operators and persons performing inspections.
Hoisting cables, hooks, shackles, links and other rigging hardware	Daily visual inspection of rigging hardware prior to use	OSHA 40-hour or OSHA 24 hour, and OSHA 8-hour refresher, and OSHA 8-hour supervisor training (as appropriate). Competent person training for riggers and persons performing inspections.

ACTIVITY HAZARD ANALYSIS

ACTIVITY: Domestic Septic Systems Investigation – Drilling

ANALYZED BY/DATE: Agata Sulczynski/ March 9, 2001

REVIEWED BY/DATE:

EQUIPMENT TO BE USED	INSPECTION REQUIREMENTS	TRAINING REQUIREMENTS
Drill rig	Daily visual inspection	OSHA 40-hour or OSHA 24-hour, and OSHA 8-hour refresher, and OSHA 8-hour supervisor training (as appropriate). Competent person training for drillers and helpers.
Fall protection equipment – harness, lanyards, etc.	Inspected prior to each use	OSHA 40-hour or OSHA 24-hour, and OSHA 8-hour refresher, and OSHA 8-hour supervisor training (as appropriate). Personnel instructed in proper use of fall protection equipment and in inspection procedures.
Loaders and forklifts	Daily vehicle inspection	OSHA 40-hour or OSHA 24-hour, and OSHA 8-hour refresher, and OSHA 8-hour supervisor training (as appropriate). Forklift certification.

ACTIVITY HAZARD ANALYSIS

ACTIVITY: Domestic Septic Systems Investigation – Drilling

ANALYZED BY/DATE: Agata Sulczynski/ March 9, 2001

REVIEWED BY/DATE:

PRINCIPLE STEPS	POTENTIAL HAZARDS	RECOMMENDED CONTROLS
Sample collection using a hand auger	Fall hazard into open excavation	Fall protection equipment will be used as necessary to prevent fall hazards. An anchor capable of supporting 5,000 lbs will be used. No more than 6 feet of slack will be allowed on the lanyard.
	Injury due to excavation or trench cave-in	Protective systems must be designed and installed for excavations of five feet or more in depth. No person shall enter the trench when materials are mechanically being moved or when heavy equipment is in operation. Prior to entry, inspections of trench and protective system will be conducted by a competent person.
	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
Shoring, sloping	A competent person will inspect the trench daily for signs of sloughing, caving, etc.	Personnel must be trained in excavation operations and safety. Workers inspecting excavations will be competent persons.
Hand auger	Visual inspection prior to use	NA

ACTIVITY HAZARD ANALYSIS

ACTIVITY: Domestic Septic Systems Investigation – 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 locations 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.

ACTIVITY HAZARD ANALYSIS

ACTIVITY: Domestic Septic Systems Investigation – Backfill and Compaction

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 will be followed.
Nuclear compaction gauge	To be inspected per manufacturer's instructions	Only a certified operator may operate the equipment.

ACTIVITY HAZARD ANALYSIS

ACTIVITY: Domestic Septic Systems Investigation – 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: Domestic Septic Systems Investigation – 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: Domestic Septic Systems Investigation – 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.
	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.