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WORK PLAN
LIMITED FIELD INVESTIGATION

LABORATORY FOR ENERGY-RELATED HEALTH RESEARCH (LEHR) UNIVERSITY OF CALIFORNIA AT DAVIS

Prepared for:

Battelle Pacific Northwest National Laboratory
Richland, Washington

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WORK PLAN
LIMITED FIELD INVESTIGATION
U.C. DAVIS LEHR FACILITY

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List of Acronyms

AH	Animal Hospital
ANSI	American National Standard Institute
CA	Contaminated Area
CFR	Code of Federal Regulations
CIH	Certified Industrial Hygienist
CLP	Contract Laboratory Program
COC	Chain of Custody
CQC	Contractor Quality Control
Cs	Cesium
DAC	Derived Air Concentration
D&D	Decontamination and Decommissioning
DOE	Department of Energy (United States)
DOT	Department of Transportation (United States)
DQOS	Data Quality Objectives
EPA	Environmental Protection Agency (United States)
FC	Field Coordinator
g	Gram
GC/MS	Gas Chromatography/Mass Spectrometer
GM	Geiger müeller detection
GPR	Ground Penetrating Radar
HASP	Health and Safety Plan
HSO	Health and Safety Officer
HSP	Health and Safety Procedure
HWP	Hazardous Work Permit
ID	Identification
IDW	Investigative Derived Waste
IT	IT Corporation
Kg	Kilogram
l	Liter
LAS	Lockheed Analytical Services
LEHR	Laboratory for Energy Related Health Research
LFI	Limited Field Investigation
mg	Milligram
ml	Milliliter
NaI	Sodium Iodide
OSHA	Occupational Safety and Health Association
OU	Operable Unit
PARCC	Precision, Accuracy, Representativeness, Completeness and Comparability
PID	Photoionization Detector
pCi	Picocurie
PM	Project Manager

PNNL	Pacific Northwest National Laboratories (Battelle)
PPE	Personal Protective Equipment
PQAS	Project Quality Assurance Specialist
QA/QC	Quality Assurance/Quality Control
QAPjP	Quality Assurance Project Plan
Ra	Radium
RI/FS	Remedial Investigation/Feasibility Study
SCIN	Scintillator detector
RPM	Remedial Project Manager
SOP	Standard Operating Procedure
SQP	Standard Quality Procedure
Sr	Strontium
STOMP	Subsurface Transport Over Multiple Phases
TSM	Tailgate Safety Meeting
µCi	Microcurie
USCS	Unified Soil Classification System
UCD	University of California at Davis
VOA	Volatile Organic Analysis
VOC	Volatile Organics Compound

1.0 Introduction

This Work Plan has been prepared for conducting a limited field investigation (LFI) for the Southwest Trenches, Radium and Strontium Leach Systems, and Domestic Septic Tanks at Laboratory for Energy-Related Health Research (LEHR) at the University of California at Davis (UCD). The LFI was presented in a preliminary manner to the LEHR Remedial Project Managers (RPMs) on April 24, 1996. Negotiated agreements regarding strategies and specific field activities are included in this Work Plan.

The primary objective of the LFI is to collect data necessary to determine if any of the above three sites pose an unacceptable threat to groundwater. The threat to groundwater will be judged by the "non-degradation," policy where groundwater is not considered to be contaminated above background levels. Groundwater contaminant concentrations will be determined using the soil sample concentrations determined during the LFI or from previously conducted site investigations and the STOMP or other EPA-approved groundwater model. In order to present a conservative approach, "total" analyses will be conducted. Selected samples may be analyzed via deionized water extraction methods as recommended by the LEHR RPMs. Samples will be collected at locations of likely maximum concentration based on the current conceptual model of each site, as discussed at the April 24, 1996 RPM meeting and on field screening measurements and rapid laboratory analyses associated with the LFI.

A description of each of the three sites being investigated in the LFI is provided below and in detail in the *Final Draft RI/FS Work Plan LEHR Environmental Restoration, University of California*, Dames and Moore, September 1994 (Reference 1).

1.1 Southwest Trenches (OU-1)

The Southwest Trenches are located in the southwest corner of the LEHR site and are part of Operable Unit No. 1 (OU-1). The trenches are reported to be approximately 120 feet long and oriented roughly in a north-south direction (Figure 1-1). The exact number, location and depth of the trenches is not known. The trenches are reported to have received primarily LEHR-generated low-level radioactive waste, fecal material, and laboratory wastes.

Records of information on the types of materials disposed in the trenches are lacking; however, it is reported that a resin column from the Imhoff system was buried in the trenches.

Based on reported disposal practices, the possibility exists that the trenches contain radioactive, hazardous, and potentially mixed wastes. Currently, there are limited analytical data from the area. Further, the exact locations of the disposal trenches are unknown.

During the previous investigations near the trenches, tritium and carbon-14 were reported up to 171 and 1,160 picocuries per gram (pCi/g), respectively (Reference 1). Additionally, nitrate was reported up to 220 milligrams per kilogram (mg/kg) and hexavalent chromium was reported up to 1.6 mg/kg. In addition, the concentration of chlordane and cesium-137 in one sample was reported present at 0.2 percent and .1 pCi/g, respectively (Reference 1). However, the sampling and analysis programs conducted during these previous investigations did not fully evaluate the contents of the trenches.

1.2 Radium and Strontium Leach Systems (OU-2)

The radium and strontium leach systems, which are described below, are located between Animal Hospital Nos. 1 and 2 (AH-1 and AH-2) along the west boundary of the LEHR site (Figure 1-2).

1.2.1 Radium Leach System

The radium-226 treatment tanks are located underground between the former Imhoff Building and AH-2. The radium-226 treatment system, part of OU-2, reportedly received radioactive waste, including fecal material and washdown water from facilities in AH-2 (Reference 1). The radium leach system consists of three dry wells and one seepage trench (Figure 1-2). The wells are approximately 30 inches in diameter and 40 feet deep. The radium trench is about 91 feet long, 3 feet wide, and 14 feet deep.

Analytical results of the treatment tank sludge content sampling performed by UCD in 1989 reported detections of radium-226 up to 206 pCi/g and strontium-90 up to 14 pCi/g (Reference 1). No liquid waste was found in the Ra-226 tank system during this sampling event. In 1992 the Ra-226 tank contents were homogenized, pumped, solidified, and shipped to Hanford site for disposal as a low-level waste.

Concrete cores were obtained from the bottom of each radium tank for analytical testing. Radium-226 was reported present in the cores from all four tanks in concentrations ranging from .3 to .6 pCi/g. Tritium was also reported in the cores from all four tanks in

concentrations ranging from .6 to 1.3 pCi/g. Thorium-232 was reported present in three of the cores in concentrations ranging from .1 to .5 pCi/g. Thorium-228 was reported present in two of the four cores at a maximum concentration of .8 pCi/g (Reference 2).

Soil samples were collected through the coreholes made in the bottom of each radium tank. These soil samples were subjected to analytical testing. Strontium-90 was reported present in the soil samples associated with all four tanks in concentrations ranging from .1 to .8 pCi/g. Radium-226 was reported present in three of the four samples in concentrations ranging from .4 to 1.6 pCi/g. Thorium-232 was also reported in three samples in concentrations ranging from .4 to 1.7 pCi/g. One of the four soil samples was reported to contain 2.1 pCi/g thorium-228 and .6 pCi/g tritium (Reference 2).

Soil samples collected from an area adjacent to the radium-226 dry well area reportedly contained up to .2 pCi/g radium-226 and .1 pCi/g strontium-90 (Reference 3).

1.2.2 Strontium Leach System

The strontium-90 leach system consists of a series of tanks and a leach field (Figure 1-2). The tanks are located in the ground beneath the area once occupied by the Imhoff Building. The "original" leach field was superseded by a second leach field, commonly referred to as the "existing" leach field. The leach system was used to treat effluent discharged from the filters and resin columns within the Imhoff Building.

Liquid samples collected from the Imhoff Sr-90 tanks were found to contain a maximum level of 498 pCi/l strontium. Other constituents, including radium and tritium, were also detected in the liquid fraction of the tank waste. The analytical results also indicated the presence of several organic compounds in the Tank "A" liquid. None of these compounds were detected in the other tank waste. In 1992, the contents of the Imhoff tanks were homogenized, pumped, solidified, and shipped to Hanford site for disposal as a low-level radioactive waste.

Concrete cores were obtained from the bottom of each Imhoff tank for radiological testing. Tritium was reported present in seven of eight concrete cores in concentrations ranging from .6 to 3.3 pCi/g. Radium-226 was reported in concentrations ranging from .1 to .2 pCi/g in six of the eight tanks cored. Thorium-228 and -232 were reported present in about one-half of

the tested cores in concentrations ranging from .1 to .6 pCi/g. Strontium-90 was reported present in only one concrete core at a concentration of 2.9 pCi/g (Reference 2).

Soil samples were collected through the coreholes made in the bottom of each Imhoff tank. These soil samples were subjected to analytical testing. Radium-226 and strontium-90 were reported present in all eight tested soils ranging in concentrations from .1 to 2.1 pCi/g. Thorium-232 was also reported in all samples in concentrations ranging from .4 to 1.0 pCi/g. Thorium-228 was reported present in one-half of the tested samples in concentrations ranging from .6 to .9 pCi/g. Tritium was reported present in two of the samples at about 1 pCi/g each (Reference 2).

To date, no samples have been collected from the strontium leach fields for laboratory testing.

1.3 Domestic Septic Tank Systems (OU-4)

There are seven known domestic septic tanks located throughout the LEHR site, and together they constitute preliminary OU-4 (Figure 1-3). The domestic septic tanks served the office and laboratory buildings prior to the LEHR facility being connected to the UC Davis Wastewater Treatment Plant at the main campus. When the facility was connected to the campus wastewater treatment plant in the mid 70s, the domestic septic tanks were reportedly abandoned and filled with sand. However, there are no formal closure records to confirm this (Reference 1). Although sewage is not considered hazardous, the domestic septic tank systems were the only treatment systems that serviced the LEHR facility and received influent from laboratory sinks and floor drains. Therefore, the potential exists that hazardous or radioactive materials were disposed through these systems during operation of the LEHR facility.

Three of the seven tanks (Tanks 1, 2, and 3) were positively located as part of preliminary work conducted during the Phase II Site Characterization (Reference 3). Based on observations made during this activity, it is suspected that the septic tanks were not closed as reported. For example, one of the tanks was partially destroyed and filled with soil and tank rubble, and another tank was only partially filled with pea-gravel, not sand. Since none of the associated leach fields were evaluated during the Phase II Site Characterization and no soil or sediment samples have been collected from any of the seven tanks or adjacent soil or

appurtenant leach systems, there are no analytical data to characterize the contents or evaluate the potential impacts to the environment from these systems (Reference 4).

2.0 Field Activities

This section describes the field activities proposed during the LFI for each of three sites. All field work will be conducted in accordance with either the referenced sections in Reference 1 or the Standard Operating Procedures (SOPs) presented in Appendix A of this Work Plan.

2.1 Southwest Trenches

LFI field activities at the Southwest Trenches will consist of the following:

- Surface radiation survey
- Exploratory trenching
- Soil borings
- Shallow soil sampling (if required).

2.1.1 Surface Radiation Survey

Prior to the start of field work, an attempt will be made to locate ground-penetrating radar (GPR) anomalies showing subsurface disturbances associated with the location of the Southwest Trenches. Field survey data from a previous contractor will be used to attempt to locate these trenches. This will be done by field surveying in reference points showing the outline of each anomaly of interest. The same type of activity will be followed to locate the shallow soil sampling borehole activities, which require samples to be collected at locations where high values of chlordane and cesium-137 were previously identified. The locations of trenches and shallow soil sample collection points will also be required to obtain utility clearances prior to the start of excavation work.

Following the location of the (GPR) anomalies, a detailed surface radiation survey will be performed over the entire surface area of approximately 78,400 square feet (ft^2). The survey will be conducted using an integrating scalar and sodium iodide (NaI) detector. The area to be surveyed will be sectioned off into 100-square-foot grids to facilitate tracking and comparison of the resultant survey data. Once the area has been gridded, the instrument, set on the ratemeter mode, will be used by a radiation technician to "sweep" the grid. Integrated one-minute counts will be taken at any point where the instrument reads twice the background level. At a minimum, five readings will be recorded for each survey grid.

2.1.2 Exploration Trenches

Five exploratory trenches (T-1 through T-5) will be excavated across suspected waste trenches, as shown in Figure 1-1. The approximate lengths of the five trenches will be 20 feet, 25 feet, 40 feet, 55 feet, and 75 feet. The exploratory trenches will be excavated with a backhoe and will be approximately fifteen feet deep. The final location of these trenches will be dependent on visual observation and the analytical results received as trenching progresses.

Trenching will be performed in accordance with SOP 5.0, Exploratory Trench Excavation (Appendix A). Photographs and written logs of the trenches will be made to document the materials encountered in accordance with SOP 3.0, Logging of Soil - Visual Unified Soil Classification System (USCS) (Appendix A). The materials from the trenches will be screened for VOCs using a photoionization detector (PID) and radiologic activity using a geiger müeller detector (GM) and a scintillator detector (SCIN) to guide the selection of waste and soil samples for chemical testing.

Soil samples will be collected at discrete intervals beneath the trench to assess the vertical migration of constituents. Soil sample collection will involve driving a shelby tube into the backhoe bucket as described in Section 4.3.3, Shelby Tube Sampling, of SOP 4.0 (Appendix A). Sample handling, packaging, and shipping are described in SOP 2.0 (Appendix A).

Approximately 220 feet of trenching will be excavated. One sample set will be collected for each 10 linear feet of trenching. A sample set consists of four samples. These four samples are described as follows:

- One composite of the waste material in the waste zone
- One composite of the interstitial soil in the waste zone
- One native soil sample directly below the waste
- One native soil sample approximately 2.5 feet below the waste.

Twenty-two sample sets (i.e., 88 samples) will be collected from the trenches for field screening (Table 2-1). Field screening will be based on discoloration, increased moisture, and readings with the PID, GM, and SCIN. Nine sample sets identified by field screening as having the highest VOC content and/or radiological activity will be sent to a contract

laboratory for testing. The nine sample sets (i.e., 36 samples) will be selected for laboratory testing per the following specifications (Table 2-1):

- One sample set from each of the 20- and 25-foot-long trenches
- Two sample sets from each of the 40- and 55-foot-long trenches
- Three sample sets from the 75-foot-long trench.

In addition, two QA/QC split samples and one equipment blank will also be collected (Table 2-1). See Table 3-1 for chemical and radiological analysis.

Following the excavation and sampling activities, the trenches will be backfilled using the same material as removed. Every effort will be made to attempt to return the waste matrix to the same level from which it was removed. In locations where trenches were cut through asphalted roadways or concrete sidewalks, they will be backfilled to within 6 inches of the top of the surface and brought to grade with the addition of imported gravel. The removed asphalt/concrete will be surveyed with the appropriate radiological instruments and released for unrestricted handling.

2.1.3 Soil Borings

Following the exploratory trench investigation, three soil borings will be continuously cored to a depth of 1 foot above the average high water level. In May 1996, the groundwater level was about 31 feet bgs. One soil boring will be located east of the Chemical Dispensing Area (Figure 1-1). The location of the other borings will be determined based on preliminary data received (within one week) following the completion of all exploratory trenches. Soil samples will be collected every 2 1/2 feet while drilling in wastes and every 5 feet while drilling below or adjacent to waste. During the logging of the soil core, a PID and radiation survey meters (GM and SCIN) will be used to screen for vapors and radionuclide activity. After screening the core, selected samples will be collected for chemical testing. Typically, four samples will be collected in each boring: one composite sample collected from the waste zone, one sample from native soil immediately below or adjacent to the waste (~12 ft), one sample from the bottom of borehole (approximately 30 ft), and one sample midway between the two (22 ft) will be selected based on results of VOC and radiologic field screening. An estimated 12 samples will be collected for chemical and radiological testing plus two QA/QC split samples, and one equipment blank (Table 2-1). See Table 3-1 for chemical and radiological analysis.

The soil borings will be drilled using sonic drilling methods. Soil logging will be performed using the USCS method as discussed in SOP 3.0, Logging of Soil - Visual USCS (Appendix A).

Sample collection during soil boring drilling will be in accordance with Section 4.3.2, Continuous Core Sampling System Methods, of SOP 4.0 (Appendix A). Sample handling, packaging, and shipping are described in SOP 2.0 (Appendix A).

Boreholes will be backfilled to within 5 feet of the surface with grout at each drilled location. The remainder of the borehole will be backfilled with soil and tamped to form a small mound. Grout will be emplaced into boreholes using a tremie pipe to facilitate filling the boreholes from the bottom.

2.1.4 Shallow Soil Sampling

If needed, an estimated 14 shallow soil samples (3 feet deep) will be collected in the vicinity of the chemical dispensing area, the wash down pad, and previously reported high values of chlordane and Cs-137 (Figure 1-1). The need to collect these samples will be determined following an examination of the data received from both the exploratory trenching and soil boring activities.

Shallow soil sampling will be performed using a hand auger and a slide hammer sampling device. The shallow soil sampling will be conducted in accordance with SOP 1.0, Surface/ Subsurface Sampling, and SOP 2.0, Sample Handling, Packaging, and Shipping (Appendix A). Shallow hand-augered sample collection holes will be backfilled with soil and tamped to form a small mound.

2.2 Radium/Strontium Leach Systems

LFI field activities at the Radium/Strontium Leach System will consist of the following:

- Exploratory trenching
- Soil borings
- Sediment sampling
- Surface soil sampling.

Prior to the onset of the field activities, an effort will be made to locate the Radium and Strontium Leach systems in the field so that utility clearances may be performed.

2.2.1 Exploratory Trenching

Five exploratory trenches (T-1 through T-5) will be excavated at this site (Figure 1-2). One exploratory trench, approximately 25 feet long, will be excavated across the original Strontium Leach Field. In order to excavate trench T-1 across the original Strontium Leach System, a 3-foot-wide and 27-foot-long section of a 4-inch concrete slab which overlies the leach field will be saw-cut and removed. Prior to the excavation of trench T-2, a concrete sidewalk, which is not in use, will have to be removed. Trenches T-2 and T-3, approximately 40 feet and 20 feet long, respectively, will be excavated along the west and south sides of the Imhoff tanks. A fourth trench (T-4), approximately 15 feet long, will be excavated to locate the Ra-226 seepage trench. Trenches T-1 through T-4 will be approximately fifteen feet deep. A fifth trench (T-5) will be excavated along the north and east sides of the Ra-226 distribution box. This trench will be approximately six feet deep. See Table 3-1 for chemical and radiological analysis.

Trenching will be performed in accordance with SOP 5.0, Exploratory Trench Excavation (Appendix A). Photographs and written logs of each trench will be made to document the materials encountered in accordance with SOP 5.0, Exploratory Trench Excavation, and SOP 3.0, Logging of Soil - Visual USCS (Appendix A). The materials from the trenches will be screened for VOCs (PID) and radiologic activity (GM and SCIN) to guide the selection of waste and soil samples for chemical testing. Soil samples will be collected at discrete intervals to assess the vertical migration of constituents.

Soil sample collections in association with trenching will involve driving a shelby tube sampler into the backhoe bucket as described in Section 4.3.3, Shelby Tube Sampling, of SOP 4.0 (Appendix A). Sample handling, packaging, and shipping are described in SOP 2.0 (Appendix A).

Approximately 100 feet of trenching will be excavated. One sample set will be collected for each 10 linear feet of trenching. A sample set consists of three samples. These three samples are described as follows for trenches T-1, T-2, T-3, and T-4:

- One native soil sample from below the leach field
- One native soil sample 2.5 to 5 feet below the first sample
- One native soil sample 7.5 to 10 feet below the first sample.

The sample set for trench T-5 is described as follows:

- One native soil sample from below the leach field
- One native soil sample 2.5 feet below the first sample
- One native soil sample from the bottom of the trench (approximately 6 feet deep).

Ten sample sets (i.e., 30 samples) will be collected from the trenches for field screening (Table 2-1). Field screening will be based on discoloration, increased moisture, and readings with the PID, GM, and SCIN. Sample sets identified by screening as having the highest VOC content and/or radiological activity will be sent to a contract laboratory for testing. Six sample sets (i.e., 15 samples) will be selected for laboratory testing per the following specifications (Table 2-1):

- One sample set from each of the four trenches 15 to 25 feet in length
- Two sample sets from the 40-foot-long trench.

In addition, one QA/QC split sample and one equipment blank will also be collected (Table 2-1). See Table 3-1 for chemical and radiological analysis.

Following the excavation and sampling activities, the trenches will be backfilled using the same material as removed. Every effort will be made to attempt to return the waste matrix to the same level from which it was removed. In locations where trenches were made through asphalted roadways or cemented sidewalks, trenches will be backfilled to within 6 inches of the top of the surface and brought to grade with the addition of imported gravel. Any removed asphalt or concrete will be surveyed with the appropriate radiological instruments and released for unrestricted handling.

2.2.2 Soil Borings

Five soil borings will be continuously cored to a depth 1 foot above the water table (approximately 30 feet) immediately adjacent to the three radium dry wells and leach trench, as shown in Figure 1-2. Prior to drilling, a concrete core drill will be used to cut the asphalt.

During the logging of the soil core, a photoionization detector (PID) and radiation survey meters (GM and SCIN) will be used to screen for vapors and radionuclide activity. The soil borings will be drilled using sonic drilling. Soil logging will be performed using the USCS method discussed in SOP 3.0, Logging of Soil - Visual USCS (Appendix A).

Soil sample collection during soil boring drilling will be in accordance with Section 4.3.2, Continuous Core Sampling System Methods, of SOP 4.0 (Appendix A). Sample handling, packaging, and shipping are described in SOP 2.0 (Appendix A).

After screening the core, selected samples will be collected for chemical testing. Eight to nine samples will be collected in each boring: one composite sample collected adjacent to the leach trench cobbles, one sample from native soil immediately below or adjacent to the cobbles, and one sample at 2.5 to 5-foot intervals at depths below the cobbles. The four samples from each borehole having the highest VOC content and/or radiological activity as determined by field screening will be sent to a contract laboratory for testing (Table 2-1). In addition, one soil sample from the bottom of each borehole will be sent to the laboratory for testing. An estimated 25 samples will be selected for analytical testing, plus two QA/QC split samples and one equipment blank.

Boreholes in asphalt and paved areas will be backfilled to the surface with grout at each drilled location. Grout will be emplaced into boreholes using a tremie pipe to facilitate filling the boreholes from the bottom to the surface. In asphalt paved areas, the top of the grout will be leveled with the surface. Boreholes not in asphalt or paved areas will be backfilled with grout to within 5 feet of surface. The remainder of the borehole will be backfilled with soil and tamped over to form a small mound.

2.2.3 Sediment and Surface Soil Sampling

Three surface soil samples will be collected in the ditch along the road on western boundary of the LEHR site (Figure 1-2). This location was selected to evaluate if overflow from the radium dry wells has contaminated surface soils. In addition, one sediment sample will be collected from the interior of the Radium Leach System distribution box.

Sediment and surface soil sample collection will be performed in accordance with SOP 1.0, Surface/Subsurface Sampling, and SOP 2.0, Sampling Handling, Packaging, and Shipping (Appendix A).

Sediment collection will involve driving a shelby tube sampler into the sediment within the Radium 226 Leach System distribution box. If there is not enough sediment present to accommodate the use of a shelby tube sampler, then a hand trowel or similar tool will be used to gather the sediment.

2.3 Domestic Septic Tanks

LFI field activities at the seven domestic septic tanks will consist of the following:

- Exploratory trenching
- Soil borings
- Sediment sampling from the interior of the radium-226 tank.

2.3.1 Exploratory Trenching

Using a backhoe, two 15-foot-long exploratory trenches will be excavated at each septic tank to locate and sample the soils beneath the septic tank, diversion boxes, and tilefield (Figure 1-3). The depth of these trenches is expected to terminate at 15 feet bgs.

Trenching will be performed in accordance with SOP 5.0, Exploratory Trench Excavation (Appendix A). Photographs and written logs of each trench will be made to document the materials encountered in accordance with SOP 5.0, Exploratory Trench Excavation, and SOP 3.0, Logging of Soil - Visual USCS (Appendix A). The materials from the trenches will be screened for VOCs (PID) and radiologic activity (GM, and SCIN) to guide the selection of soil samples for chemical testing. Soil samples will be collected at discrete intervals to assess the vertical migration of constituents.

Soil sample collection during exploratory trenching will involve driving a shelby tube sampler into the backhoe bucket as described in 4.3.3, Shelby Tube Sampling, of SOP 4.0 (Appendix A). Sample handling, packaging, and shipping are described in SOP 2.0 (Appendix A).

Approximately 180 feet of trenching will be excavated. One sample set will be collected for each 7.5 linear feet of trenching. A sample set consists of three samples. These three samples are described as follows:

- One native soil sample directly below the leach field or adjacent to septic tanks and distribution boxes
- One native soil sample 2.5 to 5.0 feet below the first sample
- One native soil sample 7.5 to 10 feet below the first sample.

Twenty-four sample sets (i.e., 72 samples) will be collected from the trenches for field screening (Table 2-1). Field screening will be based on discoloration, increased moisture, and readings from the PID, GM, and SCIN. Sample sets identified by field screening as having the highest VOC content and/or radiological activity will be sent to a contract laboratory for testing. Twelve sample sets (i.e., 36 samples) will be selected for laboratory testing, which equates to one sample set from each trench (Table 2-1). In addition, one QA/QC split sample and one equipment blank will also be collected (Table 2-1). See Table 3-1 for chemical and radiological analysis.

Following the excavation and sampling activities, the trenches will be backfilled using the same material as removed. Every effort will be made to attempt to return the waste matrix to the same level from which it was removed. In locations where trenches were made through asphalted roadways or cemented sidewalks, trenches will be backfilled to within 6 inches of the top of the surface and brought to grade with the addition of imported gravel. Any removed asphalt or concrete will be surveyed with the appropriate radiological instruments and released for unrestricted handling.

2.3.2 Soil Borings

Three soil borings will be continuously cored to a depth of 15 feet within each septic tank tilefield, if needed to find and/or sample the soil where maximum concentrations are expected. Some septic tanks may have two tilefields; therefore, six borings may be drilled at these sites. During the logging of the soil core, a PID and radiation survey meters (GM and SCIN) will be used to screen for vapors and radionuclide activity. The soil borings will be drilled using sonic drilling. Soil logging will be performed using the USCS method discussed in SOP 3.0, Logging of Soil - Visual USCS (Appendix A).

Soil sample collection during soil boring will be in accordance with Section 4.3.2, Continuous Core Sampling System Methods, of SOP 4.0 (Appendix A). Sample handling, packaging, and shipping are described in SOP 2.0 (Appendix A).

After screening the core, selected samples will be collected for chemical testing. Four samples will be collected in each boring: one composite sample from tilefield cobbles, one sample from native soil immediately below or adjacent to the cobbles, and at 2.5 to 5 foot intervals beneath the cobbles and from the bottom of the borehole. The three samples from each borehole having the highest VOC content and/or radiological activity as determined by field screening will be sent to a contract laboratory for testing (Table 2-1), as well as the sample from the bottom of the borehole. In addition, one QA/QC split samples, and one equipment blank will be sent to the laboratory for testing per septic tank (Table 2-1). See Table 3-1 for chemical and radiological analysis.

Boreholes in asphalt and paved areas will be backfilled to the surface with grout at each drilled location. Grout will be emplaced into boreholes using a tremie pipe to facilitate filling the boreholes from the bottom to the surface. In asphalt paved areas, the top of the grout will be leveled with the surface. Boreholes not in asphalt or paved areas will be backfilled with grout to within 5 feet of surface. The remainder of the borehole will be backfilled with soil and tamped to form a small mound.

2.3.3 Sediment Sampling

One sediment sample will be collected from the inside of each of the seven domestic septic tanks. Sediment collection will involve driving a shelby tube sampler into the sediment (if enough is present) or using a hand trowel or other tool to gather the sediment. Sediment soil sample collection will be performed in accordance with SOP 1.0, Surface/Subsurface Sampling, and SOP 2.0, Sample Handling, Packaging and Shipping (Appendix A).

2.4 Land Survey

Following the completion of LFI field activities, a land survey will be performed to establish coordinates which can be used to locate the trenches, soil borings, and surface samples. This survey will locate each feature both horizontally and vertically and to the nearest 1.0 foot and 0.1 foot, respectively. All surveying will be done by a surveyor licensed in the State of California.

Table 2-1

LFI Soil Sample Collection Summary (Minimum Requirements)

Operable Unit	Exploratory Trenches			Soil Borings			Shallow Surface		Surface Soil		Sediment	
	No. of Trenches	No. of Field Screen Samples[1]	No. of Lab Test Samples[2]	No. of Borings	No. of Field Screen Samples[1]	No. of Lab Test Samples[2]	No. of Locations	No. of Lab Test Samples	No. of Locations	No. of Lab Test Samples	No. of Locations	No. of Lab Test Samples
Southwest Trenches	5	88 (22)	36 (9)	3	12 (4)	12 (4)	14	14	-	-	-	-
Radium and Strontium Leach Systems	4	30 (10)	15 (5)	5	40 (4)	25 (4)	-	-	3	3	1	1
Domestic Septic Tanks	12	72 (24)	36 (12)	36	180 (36)	108 (36)	-	-	-	-	7	7
Equipment Blanks	-	3	3	-	7	4	-	-	-	-	-	-
QA/QC Samples	-	5	5	-	7	6	-	-	-	-	-	-
Estimated Totals	21	198	95	44	246	155	14	14	3	3	8	8

Estimated Total No. Field Screen Samples = 421
Estimated Total No. Lab Test Samples = 263

(1) Total number of samples collected in field. These samples will be screened to determine highest radiological activity and VOC content.
(2) Total number of samples with the highest radiological activity and/or VOC content to be sent to the laboratory for testing.
(3) Total number dependent on number of septic tank tilefields.

( ) Number of sample sets that are represented in the number of field screen or lab test samples.

3.0 Sampling Activities

This Section describes the sampling analysis and procedures to be used during the LFI. Soil sample collection will be conducted in accordance with SOP 1.0, Surface/Subsurface Sampling, and SOP 4.0, Borehole Sampling, in Appendix A. Sample chain-of-custody records will be prepared in accordance with SOP 6.0, Chain of Custody, in Appendix A. Sample handling, packaging, and shipping will be conducted in accordance with SOP 2.0, Sample Handling, Packaging and Shipping, in Appendix A. Samples will be collected from appropriate locations as described in Section 2.0.

3.1 Chemical and Radiological Analysis

The LFI chemical and radiological analysis, which will be performed for samples collected during the LFI for each site, is shown on Table 3-1.

3.2 Sampling Methodology

The minimum number of samples to be collected for each of the three sites being investigated in the LFI is described in Section 2.0 and shown on Table 2-1. The exact location of each sample will be determined in the field.

3.3 Sample Documentation

The usability of the data obtained during this sampling effort will depend on it's quality. A number of factors relate to quality of data. Sample collection methods are as important to consider as the methods used for sample analysis. Properly following procedures for both sample collection and analysis reduces sampling and analytical error. To ensure sample integrity, complete chain-of-custody documentation along with following sample preservation techniques, holding times, and proper shipment methods are required. Obtaining valid and comparable data also requires adequate QA/QC procedures and documentation.
The components of the sample documentation and custody system will include the following:

- Chain of Custody (COC) Form
- Field Logbook
- Sample Numbers
- Sample Labels
- Sample Seals.

3.3.1 Chain of Custody

Chain of Custody (COC) forms will be completed by the sample team members to track sample custody as well as to specify the requested analysis. COC forms will be completed in accordance with the requirements of SOP-6.0, Chain of Custody, in Appendix A.

3.3.2 Field Logbook

Descriptions and observations made during field and sampling activities will be documented in the Field Logbook. The following will be recorded in the Field Logbook:

- Project name and number
- Location of site
- Purpose of sampling
- Description of field activities
- Names of sampling personnel
- Date and time of entries
- Sample matrix
- Date and time of sample collection
- Sample locations; ID number and methodology
- Field observations
- Results of field measurements
- Results of field calibrations for instruments used.

3.3.3 Sample Numbers

All sample numbers will begin with a unique identifier (LEHR) and be numbered sequentially. The matrix of the sample will be identified by a letter in the middle of the sample number such as L-liquid or S-solids. LEHR-S-10 is an example of the tenth solid sample obtained at LEHR.

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
- Requested analytes.

3.3.5 Sample Seals

Sample 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
- Initials of sampler.

3.4 Sampling Procedures

The following methodology will be followed in order to collect the samples described in this Plan.

A sample preparation area will be established adjacent to the site. The sample preparation area will be set up on an elevated work surface such as a table. This work surface will be covered with poly sheeting to minimize the spread of any contamination. The following equipment will then be staged in the vicinity of the work area:

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

Samples will be collected at the locations described in Section 2.0 and summarized on Table 2-1. Soil sample collection will be in accordance with SOP 1.0 and SOP 4.0 in Appendix A. Soil samples that will be tested for metals will be collected in glass jars. All other samples will be collected in either brass sleeves or glass jars.

Confined Space entry is not anticipated during the performance of sampling activities. When necessary, structural planking will be used to allow worker access over the excavation and facilitate sampling.

Table 3-1
LFI Chemical and Radiological Analyses

Parameter	Method	Southwest Trenches	Radium and Strontium Leach Systems	Domestic Septic Tanks	Equipment Blanks
Gross Alpha	9310	●	●	●	●
Gross Beta	9310	●	●	●	●
Tritium	906.0	●	●	●	●
Carbon-14	LSC	●		●	●
Radium-226	903.1(M)	●	●	●	●
Strontium-90	905.0	●	●	●	●
Thorium (isotopic)	LAS 0108*				
Uranium (isotopic)	LAS 0108*				
Americium-241	LAS 0108*		●		
Plutonium-241	LAS 0108*		●		
Gamma Emitters	901.1	●	Radium Trench only	●	●
Volatile Organic Compounds	CLP SOW OLM 01.8	●	●	●	●
Formaldehyde	3500 Modified NIOSH	●		●	
Semi-Volatile Organic Compounds	CLP SOW OLM 01.8	●	●	●	
Organochlorine Pesticides (and PCBS)	CLP SOW OLM 01.8	●		●	
Nitrate	300.0	●	●	●	●
Total Organic Carbon	9060(M)				
Total Chromium	CLP SOW ILM 02.1	●	●	●	●
Hexavalent Chromium	7196	●	●	●	●
Antimony	CLP SOW ILM 02.1	●		●	●
Arsenic	CLP SOW ILM 02.1	●		●	●
Barium	CLP SOW ILM 02.1	●		●	●
Beryllium	CLP SOW ILM 02.1	●		●	●
Cadmium	CLP SOW ILM 02.1	●		●	●

*Laboratory Standard Operating Procedure

Table 3-1
LFI Chemical and Radiological Analyses
(Continued)

Parameter	Method	Southwest Trenches	Radium and Strontium Leach Systems	Domestic Septic Tanks	Equipment Blanks
Cobalt	CLP SOW ILM 02.1	●		●	●
Copper	CLP SOW ILM 02.1	●		●	●
Iron	CLP SOW ILM 02.1	●		●	●
Lead	CLP SOW ILM 02.1	●		●	●
Manganese	CLP SOW ILM 02.1	●		●	●
Mercury	CLP SOW ILM 02.1	●		●	●
Molybdenum	CLP SOW ILM 02.1	●		●	●
Nickel	CLP SOW ILM 02.1	●		●	●
Selenium	CLP SOW ILM 02.1	●		●	●
Silver	CLP SOW ILM 02.1	●		●	●
Thallium	CLP SOW ILM 02.1	●		●	●
Vanadium	CLP SOW ILM 02.1	●		●	●
Zinc	CLP SOW ILM 02.1	●		●	●
Kerosene	8015(M)				
Alkalinity	310.1				
TKN	351.1				
Ammonia	350.1				
Anions	300.0	●	●	●	
pH	ASTM 4972	●	●	●	
EC	ASTM G-57				
Sulfide	9030A				
Bacteria				●	
BTEX		●			

4.0 Quality Assurance

The quality assurance requirements which are applicable to the majority of the LFI activities are detailed in the Quality Assurance Project Plan (QAPjP), Revision 0, and Standard Quality Procedures, located respectively in Appendices B and C of Reference 5. The QA requirements not addressed by this QAPjP involve management, receipt, storage, validation, and reporting of laboratory data. These data-related activities are addressed in the QAPjP in Appendix C of the 1995 PNNL Field Activity Plan for the LEHR project (Reference 4).

The quality requirements have been developed to implement the requirements of IT Corporation's Battelle-approved QA Program Plan (QAPP) for the D&D activities at the LEHR site. It is based upon the requirements of DOE Order 5700.6c "Quality Assurance" and QAMS-005/80 (EPA, December 19, 1980) "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans" as they are applicable to the scope of work. Consistent with the concepts endorsed by the Secretary of Energy in memorandum SEN-35-91, the QAPP has incorporated selected provisions from best or accepted industry management practices and requirements from applicable national and international standards (e.g., NQA-1, ISO 9000, etc.) as they relate to the scheduled activities. These standards reflect the latest operational, technological, and engineering practices, thereby providing a sound QA systems approach to conduct LFI activities.

4.1 Data Management

Samples collected for laboratory analysis will be analyzed by Lockheed Analytical Services (LAS). Initial results generated by LAS will be transmitted via fax to the PNNL Project Manager, Ms. Dawn Mitchell, or her designee. This will facilitate decision making essential to maximizing field crew utilization and LFI progress. Laboratory report hard copies and electronic files will be forwarded from the LAS to the Data Management department at PNNL. These results will be validated and managed in the PNNL data base in accordance with procedures described in Section 8.0 Data Reduction, Validation, and Reporting of the QAPjP in Reference 4.

4.2 Data Receipt

In addition to original deliverables from the laboratories, a computer database will be maintained by PNNL to store field measurements, laboratory chemical and radiological analyses, and other measurements. Standardized data forms will be used to note the results of the LFI and analyses. Examples of these forms can be found in the QAPjP in Appendix C in Reference 4. The original completed forms will be forwarded from the LEHR facility to PNNL. Copies are to be retained by the originators. Data forms received by PNNL will be logged and filed. Employees that process these forms will record their initials and the date on the form(s) they handle.

4.2.1 Sample Tracking

Sample tracking procedures will be used to indicate whether samples were contained, transported and analyzed in accordance with specified methods and holding times. Sample tracking also verifies that analyses for each sample listed on the chain-of-custody were performed by the laboratories and that the results have been received. The database automatically calculates laboratory turnaround times and sample holding times to aid in the data validation process. Tracking will be performed electronically and printouts will be generated for any outstanding results or discrepancies.

4.2.2 Data Entry

PNNL will make entries into the database manually or by direct download. Data received from LAS will be entered by direct download. Data entry quality control will be maintained by checking temporary input files prior to merging them with the master database file. Checking will be achieved by directly comparing hard copy listings of the temporary input database to the hard copy laboratory or field report. If corrections are required, they will be written directly on the printout. Once the correction is made, a revised printout will be placed with the original to document the change. The date and the initials of the reviewer will be recorded. After the corrections are completed, the log will also be dated and initialed. Following correction of any inconsistencies in either the data file or the laboratory reports, the temporary input file will be merged to a proxy master file. This proxy file will be used as a daily working file and backups of it, as well as, the master file are maintained.

4.3 Data Storage

Following data entry, the data will be stored in the Database Management System, comprised of database modules that can be linked relationally to obtain information and status of samples. The desktop computer-based system is maintained on a Paradox platform. All recent and past data are stored in this system. Features of the system include management of chemical and physical data for soils, ground water, surface water, and the flexibility of generating a variety of reports. Other general features include data sorting, querying, and statistical analyses. Data subsets maybe exported to other applications for graphical and specialized computational needs. Chemical distribution maps may be prepared through direct export of data into AutoCad, or via intermediate contouring packages.

4.4 Data Validation

Data validation will be performed on analytical results upon receipt from LAS. The purpose of data validation is to identify data that do meet the quality required for the RI/FS program and risk assessment and to identify data that do not meet data quality objectives (DQOS) or quality assurance criteria set forth in the QAPjP for which there is agreement with the laboratory. These validation procedures are detailed in the QAPjP in Appendix C in Reference 4.

Data received from the laboratory will be reviewed with respect to the PARCC parameters (i.e., precision, accuracy, representativeness, comparability, and completeness). PARCC parameters are indicators of data quality and apply to the field program, as well as, laboratory results.

A U.S. Environmental Protection Agency (EPA) Contract Laboratory Program (CLP) or CLP equivalent data package will be provided for LFI laboratory results. When received, a detailed validation of 10% of the analytical data will be performed, based on EPA National Functional Guidelines. The remaining 90% of the data set will be reviewed for a limited set of validation criteria. Specific procedures for data validation are presented as part of the QAPjP in Appendix C in Reference 4.

The objective of the detailed data evaluation according to EPA National Functional Guidelines is to randomly select 10% of the data packages and then to completely regenerate the data values based on the original raw data (e.g., chromatograms, instrument values),

standards, instrument calibration runs, and GC/MS tuning, etc. This level of data validation technique allows an appropriately trained person outside the project to independently validate a data package at any later date.

The remaining 90% of the data will have the same CLP or equivalent data package; however, a limited validation will be performed. Holding times will be checked and surrogate recovery, blanks, matrix spikes, matrix spike duplicates will also be checked against the quality control guidelines.

4.5 Data Reporting

The database format allows numerous types of data reports to be produced. Raw data tables can be generated showing either samples or analytical parameters as column headings with the other variables listed vertically down the page. Laboratory data qualifiers, data validation qualifiers, detection limits, and regulatory criteria can be included as desired. Summary tables of detected compounds, compounds exceeding regulatory criteria, and comparisons of recent data to historical values can be generated. All tables can be organized by parameter class, date ranges, locations sampled, purpose of sampling, etc. In addition, customized table formats can be easily developed as specific requirements dictate. Tabular reports can be printed or exported as needed for use with other software programs.

5.0 Investigation Derived Waste Management

LFI activities with the potential to generate IDW include exploration trenching, soil borings, and shallow soil sampling. The method and type of waste generation associated with trenching and boring are described in Sections 3.1 and 3.2 of Appendix D, Final Draft Waste Management Plan for Investigation Derived Wastes, in Reference 1.

5.1 Exploratory Trenching

During excavation of each exploratory trench, materials will be segregated as soil cover, native soil, and waste and stockpiled on visqueen. Upon completion of the trench and receipt of field screening and/or quick turnaround analysis, the excavations will be backfilled in approximately the same areas and depth from which they were excavated. If warranted, waste material will be placed between sheets of visqueen to facilitate later retrieval for treatability studies. If isolated contained waste is encountered during excavation, it will be removed and disposed.

5.2 Soil Borings

Drill cuttings and discarded core from the soil borings will be placed adjacent to the borehole, in accordance with the IDW management plan. The location of such wastes will be accurately recorded.

5.3 Shallow/Surface Soil Sampling

Wastes associated with shallow soil sampling are similar to soil borings with the exception being that shallow soil sampling potentially creates significantly less waste than borings. It is similar enough, however, that procedures applicable to soil borings are applicable to near surface soil sampling. Management of these IDWs is discussed in Section 4.0, On-site Management and Storage of IDW, in Reference 1.

In addition, Sections 3.0 (in part), 4.0, 5.0, and 6.0 of Appendix B, Waste Management Plan for Investigation Derived Waste, in Reference 4 are applicable to sampling surface and shallow soils.

6.0 Health and Safety Considerations

The Health and Safety Plan (HASP) and Health and Safety Procedures contained in Appendices D and E of "Work Plan for the Decontamination and Decommissioning of the Imhoff Building, Cobalt-60 Building, and Tank Trailer at the Laboratory for Energy Related Health Research, University of California at Davis" (Reference 5) shall be followed during the field activities outlined in this Work Plan. A hazard analysis for these activities as well as specific additional controls measures to be followed are described below. Specific sections describing hazard analysis and controls from Reference 1 have been included where applicable.

6.1 Hazard Analysis

The job hazard analysis identifies potential safety, health and environmental hazards and provides for the protection of personnel, the community, and the environment. A conservative approach will be taken to ensure that excavation and sampling safety concerns are met. During excavation and sampling activities, the Field Coordinator (FC) and Health and Safety Officer (HSO) will monitor the site for any changes in conditions which would require modification of work conditions (i.e., PPE). A job hazard analysis for each of the activities to be performed is included as Section 6.0, "Job Hazard Analysis," of Reference 1. In the event that changes arise in radiological or industrial health and safety conditions warrant, this Work Plan will be modified in accordance with the procedures contained in SQP-07, "Control and Distribution of Plans, Procedures and Variances" (Reference 5). This Section is intended to supplement the HASP requirements outlined in Reference 5 and in all cases the most restrictive requirements will apply.

6.1.1 Confined Space Entry

Confined space entry will not be required during the performance of any excavation or sampling activities. All activities have been engineered such that the excavation will not be entered. In the event that the need arises to perform activities within a confined space, as defined by 29 CFR 1910.146, "Permit Required Confined Space." IT Health and Safety Procedure HSP-26, "Confined Spaces" (Reference 5), will be followed.

6.1.2 Radiological Exposure

The waste materials to be encountered may contain low-level radioactive material from prior animal research activities. The predominant nuclides used during these activities were Ra-226 and Sr-90. Excavation and sampling activities may present a risk of radiological exposure to personnel through direct exposure to radioactive materials as well as through ingestion and inhalation. Personnel in the vicinity of the excavation shall wear modified Level D PPE as described in Section 6.2.4.

6.1.3 Chemical Exposure

During excavation and sampling activities, grab samples and direct instrumentation will be used to detect the presence of hazardous chemicals.

6.1.4 Heat Stress

This work activity is scheduled to be performed at a time when workers may possibly be affected by heat related injuries. Heat stress may be a concern due to the open nature of the work area and the time of year at which activities are scheduled to be performed.

6.2 Hazard Controls

The following control measures will be implemented during these activities. These control measures are intended to supplement HASP requirements outlined in References 1 and 5. In all cases the most restrictive requirements are to be implemented.

6.2.1 Hazardous Work Permit

A Hazardous Work Permit (HWP) will be used to control work in the exclusion zone. The HWP will be issued in accordance with the procedures specified in HSP-52, "Hazardous Work Permits" (Reference 5). The following information will be described in the HWP:

- Scope of work to be performed
- Anticipated radiological, safety and industrial hygiene conditions
- PPE and respiratory protection requirements
- Radiological and industrial hygiene monitoring requirements
- Dosimetry requirements
- Period for which the HWP is valid
- Additional requirements for entry.

6.2.2 Boundaries

The work areas will be enclosed by boundary ropes or ribbons supported with stations. The placement of the stations and boundaries will be controlled by the FC to facilitate access to the work area for equipment. The boundaries will enclose the work area as well as the support zone. Boundaries of the contamination area (CA) will be posted with signs stating "Contamination Area, Authorized Personnel Only."

6.2.3 Heat Stress

To minimize the effects of heat related injuries, an area will be established to conduct entrance/exit activities, sample preparation and other support functions. This area will be covered with a portable tarp to provide the workers with shade. The controls associated with heat stress are specified in Section 4.2.14, Appendix D, of Reference 5. The HSO shall ensure that all workers are aware of the signs and symptoms of heat stress, engineering control measures, and the need to replenish body fluids will be re-emphasized during morning tailgate safety meetings (TSM). Integrated heat stress monitoring will be performed daily to determine the proper work/rest regiment.

6.2.4 PPE

Workers in the exclusion zone will wear modified Level D PPE in accordance with the PPE selection Matrix in Appendix D, Section 5.4 (Health and Safety Plan), of Reference 5.

Modified Level D PPE will consist of:

- Hard hat, ANSI approved
- Steel-toed impermeable PVC boots
- Tyvek hooded coveralls
- Chemical resistant gloves
- Full tape of wrists, ankles and hood
- Leather work gloves.

6.2.5 Training

Personnel performing activities associated with the LFI will receive training covering this Work Plan. All on-site project personnel shall have completed at least 40 hours of hazardous waste operations-related training, as required by OSHA Regulation 29 CFR 1910.120. All field employees receive a minimum of three days of actual field experience under the direct supervision of a trained, experienced supervisor. Those personnel who completed the 40-hour

training more than 12 months prior to the start of the field activities shall have completed an 8-hour refresher course within the past 12 months. The FC shall have completed an additional 8 hours of relevant supervisory health and safety training. In addition, any workers who will enter radiological control zones shall have successfully completed Radiological Worker II training and site-specific Radworker training. All site workers shall receive training covering the LEHR site contingency plan. Personnel performing activities within the contamination area will receive the training in accordance with the requirements specified in Section 4.2 of SQP-02, "Indoctrination and Training" (Reference 5), for the specific job assignments.

6.2.6 Buddy System

The buddy system will be utilized to protect personnel in the work area. The system will be implemented in the following manner:

- At least two persons will be required to be in the work area when work is conducted in the exclusion zone which might result in worker contamination.

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

The responsibility of the buddy is to:

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

Entry to or exit from the CA under the conditions described earlier without a designated partner is prohibited.

6.2.7 Safety Equipment

In addition to other equipment specified in this Work Plan, the following safety equipment will be staged at the boundary of the CA:

- First aid kit
- Portable eyewash station and hand shower
- Hearing protection
- Spill kit
- Portable radio for emergency communications
- Fire extinguisher.

6.2.8 Air Monitoring

Air monitoring is essential to ensure that all field personnel will be adequately protected from airborne contaminants. The levels of organic vapors in the work area will be monitored using a photoionization detector (PID) when the potential for these contaminants is present.

General area air samples will be continuously collected to monitor airborne radioactive contaminant levels. Filters will be changed at the beginning of each workday. The filters will be analyzed on-site using a gross alpha/beta scaler counter. Filters will be counted initially after removal and at the start of the next working day shift. Air monitoring will be conducted in accordance with procedures HSP-54, "Air Surveillance Program," and HSP-55, "Airborne Radioactivity Monitoring," in Reference 5.

If the general area air samples indicate that workers may be exposed to airborne radioactive contaminants that are $\geq$10% of the gross activity derived air concentration (DAC), listed in 10 CFR 835, Appendix A, then personal air samples will be used to monitor workers exposure. DAC hours of exposure will be logged. DAC's have been established to limit radiation exposure to workers through inhalation of radionuclides. All personal air samples, grab samples and direct reading instrumentation readings collected for the purpose of determining appropriate H&S precautions will be collected/taken in the approximate "breathing zone" of site personnel.

7.0 References

1. ***Final Draft RI/FS Work Plan, LEHR Environmental Restoration, University of California***, Dames and Moore, September 1994.

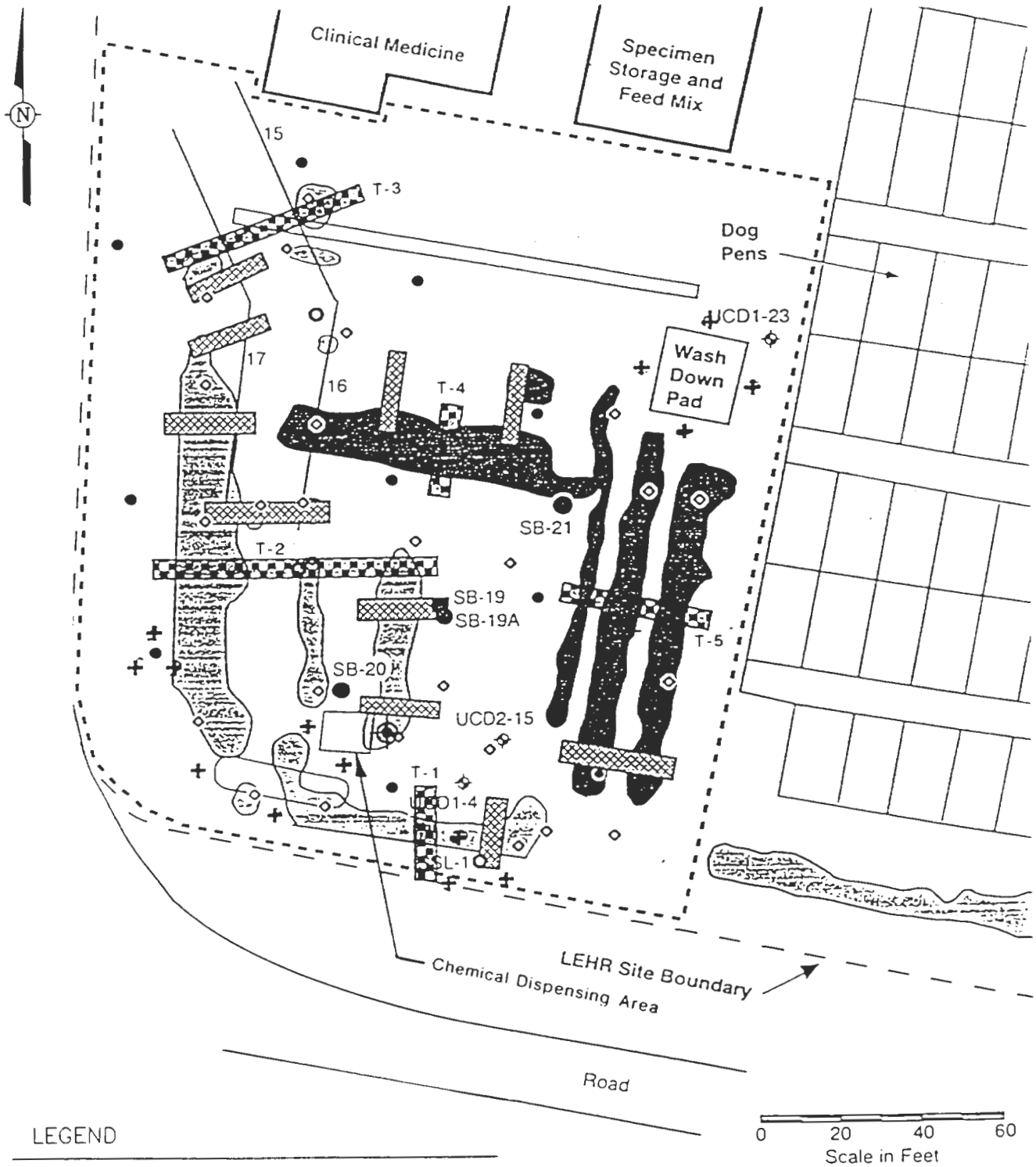
2. ***Final Report for the Liquid and Sludge Removal Project at the LEHR Facility at the University of California at Davis,*** Chemical Waste Management, Inc., 1992.

3. ***Phase II Site Characterization Report for the LEHR Environmental Restoration, University of California at Davis***, Dames and Moore, February 1993.

4. ***Field Activity Plan, Laboratory for Energy Related Health Research, Davis, CA,*** Pacific Northwest National Laboratory, August 1995.

5. ***Work Plan for the Decontamination and Decommissioning of the Imhoff Building, Cobalt-60 Building, and Tank Trailer at the Laboratory for Energy Related Health Research, University of California at Davis***, IT Corporation, 1994.

DRAWING NUMBER	CHECKED BY	APPROVED BY	DRAWN BY	T.R.S.
191226-A35	TRG 7-2-96	DG 7-2-96		6-3-96



LEGEND

GPR Anomalies: Distinct Subtle

15, 16, 17 Approximate Location of UC-Davis Solid Waste Burial Trenches

Shallow Soil Borings: Old New

Intermediate Soil Boring Trench

GW Monitoring Well

Soil Gas Monitoring Point

Proposed Borehole (3 total)

Proposed Trench (5 total)

Proposed Shallow Soil Boring (14 total)

FIGURE 1-1
SOUTHWEST TRENCHES
PREPARED FOR
LEHR FACILITY
DAVIS, CALIFORNIA

INTERNATIONAL TECHNOLOGY CORPORATION

LE-LSWD4(LE4)

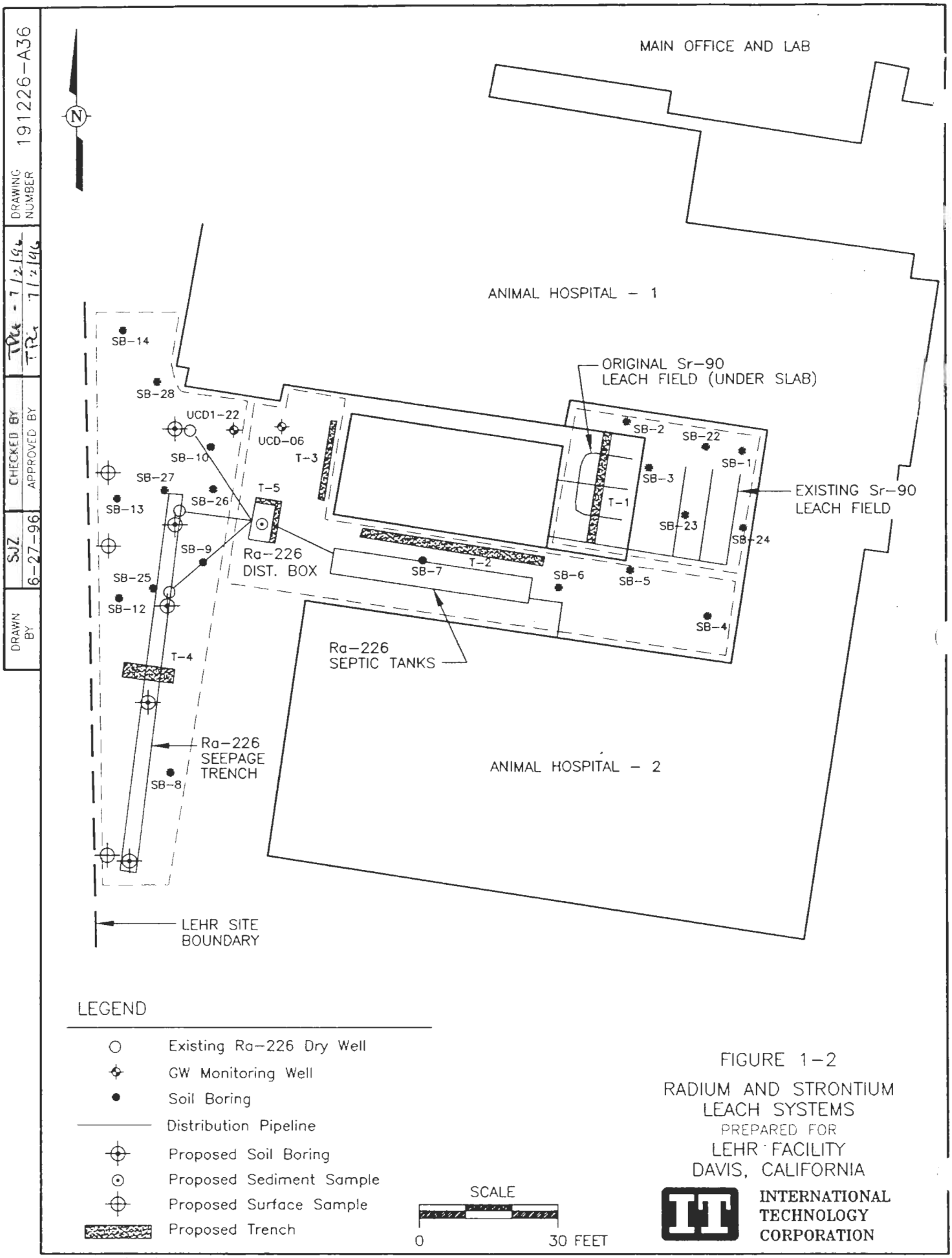


FIGURE 1-2

RADIUM AND STRONTIUM LEACH SYSTEMS

PREPARED FOR

LEHR FACILITY

DAVIS, CALIFORNIA

LE-PNSSA(LE4)

DRAWN BY	SJZ 6-3-96	CHECKED BY / APPROVED BY	7/2/96 TPG / 7/2/96 TPG	DRAWING NUMBER	191226-A34

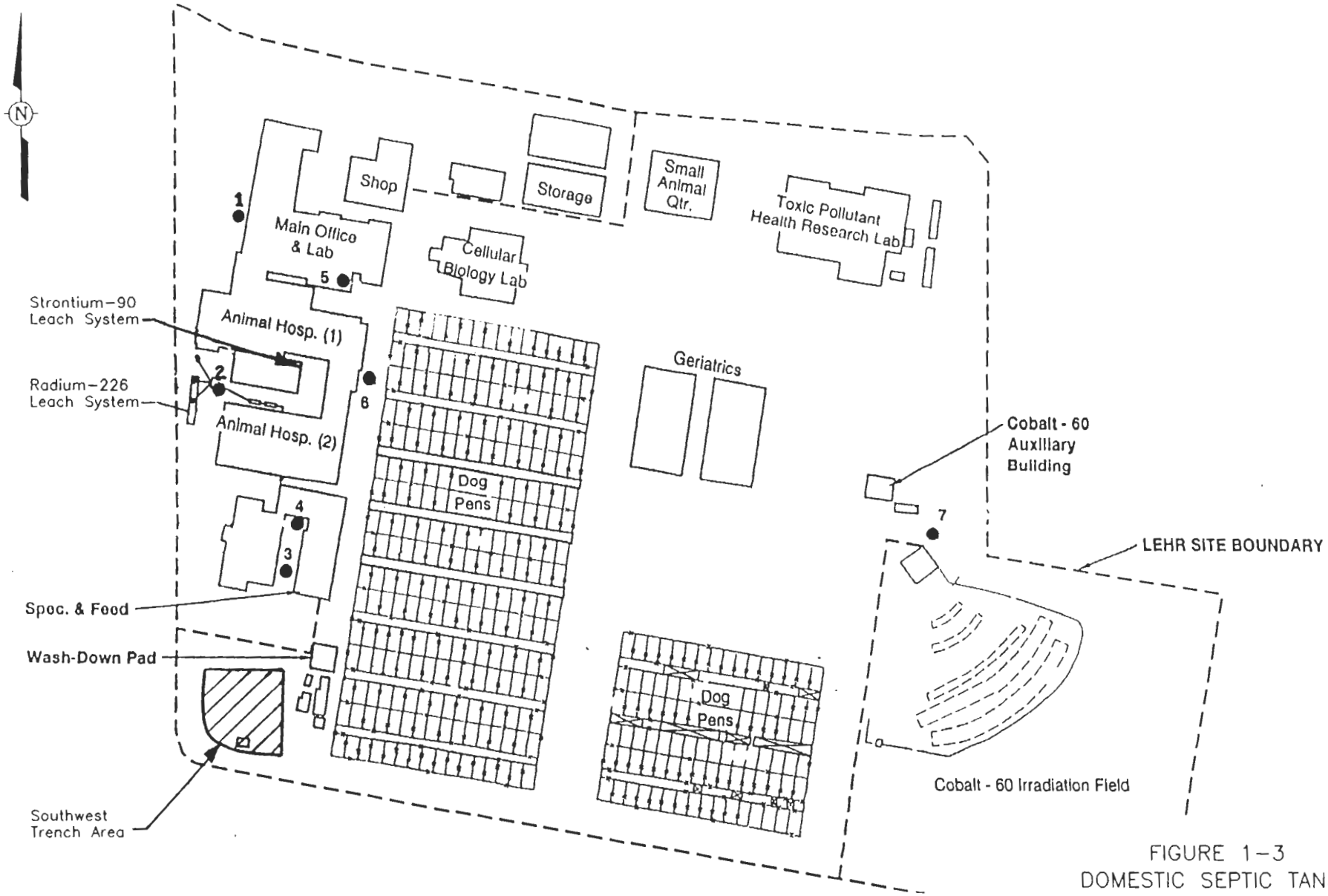


FIGURE 1-3
DOMESTIC SEPTIC TANKS
PREPARED FOR
LEHR FACILITY
DAVIS, CALIFORNIA

LEGEND

● DOMESTIC SEPTIC TANKS (No. 1-7)

SCALE

0 150 300 FEET

INTERNATIONAL TECHNOLOGY CORPORATION

F-LSSTS(LE4)

- Any sample that is suspect of being disturbed, contaminated, or chemically or physically altered during the excavation process.

5.0 Records

5.1 Records generated as a result of this SOP will be controlled and maintained in the project record files.

6.0 Attachment

6.1 Attachment 1, Visual Classification of Soils

6.2 Attachment 2, Field Activity Daily Log

4.5 Excavation Logging Procedures

On the Field Activity Daily Log in which the excavation trench log is recorded, the following information will be included if samples are to be collected:

- The sampler type. The abbreviations for sampler types are TW for thin-wall, P for piston, ST for Shelby Tube, and SS for standard split spoon. These abbreviations, or notations as to other sampler types, will be used in the "sampler type" column.

- Origin of sample. Specify if it is collected directly from the trench wall or from an excavator bucket or shovel.

- The depth and location from which the sample originated. The sample depth is always measured to the top of the sample. A sample attempt where no sample is recovered will not be numbered, but the fact that a sampling attempt was made must be noted.

- The sample number.

The log will contain a detailed description of the soil strata encountered and all pertinent information regarding trenching operations and estimated soil and ground water properties.

- Soil will be classified according to the Unified Soil Classification System (USCS) (Reference 2.1). The textural name for the soil will be written on the excavation illustration at the appropriate depth interval.

- Abrupt soil changes will be marked by a solid horizontal line and the appropriate depth in the USCS symbol column. Gradational soil changes will be marked by a dashed line. Diagonal lines should not be used. (Field personnel are best qualified to estimate the depth of changes. This task will not be delegated to office personnel, who have not observed the excavation operation.)

- Abbreviations will be used on the logs to save space for editing purposes.

Comments on the field log are extremely important. Some important aspects of the excavation operation that will be recorded follow:

- The organic content of the soil and the depth of topsoil and roots

- Any sudden change in the speed, sound, or penetration rate of the excavation

- If sampling is not continuous, drill cuttings will be used to complete the log; and
- Any sample that is suspect of being disturbed, contaminated, or chemically or physically altered during the drilling process.

4.4 Excavation Trench Logs

The excavation trench logs will be recorded in the Field Activity Daily Log (Attachment 2). This requires the Field Coordinator/Field Geologist to make an illustration of the trench excavation.

On the first page for each excavated trench, the following information must be recorded:

- Project Number
- Project Name
- Project Location
- Trench Number or Description
- Field Coordinator/Geologist Identity.

The following information will be recorded in the Field Activity Daily Log:

- Complete and accurate location sketch with dimensions to landmarks. Important features such as road intersections, corners of large buildings, or other man-made structures are best used. A north arrow will be included.

Samples collected for purposes other than soil classification are subject to handling, packaging, and shipping procedures as described in Reference 2.2.

Upon completion of each excavation, a standard completion note will be placed at the bottom of the last page of the trench log. The note will include:

- Excavation Completed at (Depth) Feet on (Date)
- Borehole Backfilled to Ground Surface on (Date)
- All depth numbers will be recorded in decimals.

4.3 Borehole Logging Procedures

The left side of the log form will be filled out accurately for each soil sample and sampling attempt. Boreholes that are logged entirely from cuttings and are not sampled must be indicated as such. The following information will be included:

- Depth - The sampling attempts will be marked in the "depth in feet" column. The sample depth is always measured to the top of the sample.

- Sample Type & No. - The abbreviations for sampler types are TW for thin-wall, P for piston, ST for Shelby Tube, and SS for standard split spoon. These abbreviations, or notations as to other sampler types, will be used in the "sampler type" column. Record the sample number in this column. A sample attempt where no sample is recovered will not be numbered, but the fact that a sampling attempt was made must be noted.

- Recovery - The distance the corer is driven and the length of recovered material for each sample attempt.

The log will contain a detailed description of the soil strata encountered and all pertinent information regarding drilling operations and estimated soil and ground water properties.

- Soil will be classified according to the Unified Soil Classification System (USCS) (Reference 2.1). The textural name for the soil will be written in the appropriate column using the USCS symbol.

- Abrupt soil changes will be marked by a solid horizontal line and the appropriate depth in the USCS symbol column. Gradational soil changes will be marked by a dashed line. Diagonal lines should not be used. (Field personnel are best qualified to estimate the depth of changes. This task will not be delegated to office personnel, who have not observed the drilling operation.)

- Abbreviations will be used on the logs to save space for editing purposes.

Comments on the field log are extremely important. Some important aspects of the drilling operation that will be recorded follow:

- The organic content of the soil and the depth of topsoil and roots;

- Any sudden change in the speed, sound, or penetration rate of the drill rig;

On the first page of the log for each boring, the following information at the top of the boring log will be filled in completely and will include:

- Project Number
- Project Name
- Project Location
- Boring Number
- Engineer/Geologist Identity
- Drilling Methods.

On the first page of the log for each boring, the following information at the bottom of the boring log will be filled in completely and will include:

- Drilling Contractor Identity
- Driller's Name
- Drilling Equipment
- Rig Number, if there is more than one at the site.

The following information will be recorded in the Field Activity Daily Log (Attachment 2):

- Complete and accurate location sketch with dimensions to landmarks. Important features such as road intersections, corners of large buildings, or other man-made structures are best used. A north arrow will be included.

Samples collected for purposes other than soil classification are subject to handling, packaging, and shipping procedures described in Reference 2.2.

Upon completion of each boring, the log will contain the following information:

- Boring Completed at (Depth) Feet on (Date)
- Hole Backfilled to Ground Surface on (Date)
- The boring size and depth will be recorded
- All depth numbers will be recorded in decimals.

3.8 Plasticity

This is a description of the test sample behavior derived during the performance of the toughness test. Plasticity is described with the terms *Nonplastic, Low, Medium,* and *High.* These terms are described in Table 11 and plasticity procedures are presented in Section 13.5 of Reference 2.1.

4.0 Procedure

This section provides both the responsibilities and procedures involved with soil logging. The details within this SOP will be used in conjunction with the Work Plan.

4.1 Responsibilities

4.1.1 The Field Coordinator will be responsible for ensuring that all sample collection activities are conducted in accordance with this SOP and any other appropriate procedures. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

4.1.2 The Project Quality Assurance Specialist (PQAS) will be responsible for periodic review of field generated documentation associated with this SOP. The PQAS will also responsible for implementation of corrective action (i.e., retraining personnel, additional review of work plans and procedures, variances to QC sampling requirements, issuing nonconformances, etc.) if problems occur.

4.1.3 Field personnel assigned to sampling activities will be responsible for completing their tasks according to specifications outlined in this SOP and other appropriate procedures. All staff will be responsible for reporting deviations from procedures to the Field Coordinator, IT Project Manager, or the PQAS.

4.2 Soil Boring Logs

The log form that will be used to record information during drilling is included in Attachment 1. The procedures which will be followed in completing the log are outlined below.

3.2 Sand

Particles of rock that will pass a No. 4 sieve and be retained on a No. 200 sieve. Criteria to distinguish coarse, medium, and fine is provided in Section 5.2.2 of Reference 2.1

3.3 Clay

Soil passing the No. 200 sieve that exhibits plasticity (putty-like properties) within a range of moisture contents, and which exhibits considerable dry strength when air-dry. Criteria to distinguish inorganic and organic clay is provided in Section 5.2.5 and 13.6 through 13.7.2 of Reference 2.1.

3.4 Silt

Material passing the No. 200 sieve that is non-plastic or very slightly plastic and exhibits little or no strength when air-dry. Criteria to distinguish inorganic and organic silt is provided in Sections 5.2.6, 13.7.3, and 13.7.4 of Reference 2.1.

3.5 Dry Strength

This is the resistance of a 1/4-inch air-dry ball made from the test material to crushing between the fingers. Dry strength is described with the terms *None, Low, Medium, High,* and *Very High.* These terms are explained in Table 8 and dry strength procedures are presented in Sections 13.2 of Reference 2.1.

3.6 Dilatancy

This is a measure of the ability of a 1/2- to 1-inch-long pat made from the test material to yield water when shaken horizontally. Dilatancy is described with the terms *None, Slow,* and *Rapid.* These terms are described in Table 9 and dilatancy procedures are presented in Section 13.3 of Reference 2.1.

3.7 Toughness

This is a measure of the test material's ability to be rolled into a 1/8-inch-diameter thread. Toughness is described with the terms *Low, Medium,* and *High.* These terms are described in Table 10 and toughness procedures are presented in Section 13.4 of Reference 2.1.

LOGGING OF SOILS - VISUAL UNIFIED SOIL CLASSIFICATION (USCS)

STANDARD OPERATING PROCEDURE

1.0 Purpose

This procedure describes basic methods for logging soil using the USCS visual method. Use of visual examination and simple manual tests associated with the USCS procedure gives standardized criteria and processes for describing and identifying soils. Logging soil assures that data, information, and descriptions generated from each borehole or excavation are properly collected and documented. This document describes equipment and forms required, the information necessary to complete logs, and methods for describing soil samples.

2.0 References

2.1 United States Department of the Interior, Bureau of Reclamation (USBR), 1986, Procedures for Determining Unified Soil Classification (Visual Method), USBR 5005-86.

2.2 SOP 2.0 - Sample Handling, Packaging, and Shipping (Appendix A).

3.0 Definitions

This section is designed to provide definitions to the common basic terminology utilized in soil classification. It is not intended to provide substitution of training and experience necessary to learn the multitude of definitions used in soil classification.

3.1 Gravel

Particles of rock that will pass a 3-inch sieve and be retained on a No. 4 sieve. Criteria to distinguish coarse and fine is provided in Section 5.2.1 of Reference 2.1

4.5.2 Using nylon reinforced strapping tape or mailing tape, seal the shipping container.

4.5.3 Place custody tape over opposite ends of the lid.

4.5.4 Mark the container "THIS END UP," or apply arrow labels that indicate the proper position to be maintained during shipping.

4.5.5 Apply a label stating the name and address of the shipper and the receiving laboratory on the outside of the cooler.

4.5.6 Turn the sample over to the courier or carrier for delivery to the laboratory. All samples should be shipped by the fastest available method to the laboratory as soon as possible after sample collection.

NOTE: The courier or carrier is not responsible for sample custody and is not required to sign the COC.

4.5.7 Contact the appropriate laboratory personnel to advise them of the sample shipment.

4.5.8 Review the COC and sample collection forms for completeness and turn them over to site or project management.

5.0 Records

5.1 Records generated as a result of implementation of this procedure will be controlled and maintained in the project record files.

4.4.3 Carefully check the COC record against the collected sample labels and containers to ensure that the sample numbers, sample description, date and time of collection, container type and volume, preservative, and the required analytical methods are correct and in agreement.

4.4.4 Place the samples in the shipping container, allowing sufficient room between the samples to place ice and/or packing material.

4.4.5 Double bag and seal crushed or cubed ice in heavy-duty polyethylene bags. Place these bags of ice on top of and between samples. Blue ice should not be used for sample shipping; it does not maintain the 4°C temperature necessary for regulatory compliance.

4.4.6 All samples requiring temperature preservation stated at 4°C will be acceptable "as in" within the range of 4°C ± 2°C. The laboratory should record the temperature of receipt upon the COC. For all samples received from 6°C to 10°C, the sample(s) and temperature (in 1°C increments) will be noted on the COC and then analyzed. For samples with temperatures greater than 10°C, the samples will be rejected by the laboratory for analysis and immediately reported to the Project Manager. For VOA samples below 0°C, the samples will be rejected and also reported.

4.5 Sample Shipping

Environmental samples shall be shipped in the following manner. Additional shipping requirements for samples identified as containing a known hazardous material or hazardous waste are contained in References 2.3 and 2.4. The FC shall identify any additional shipping requirements and ensure that they are completed.

4.5.1 The person in charge of sample custody will time, date, and sign over relinquishment of custody on the COC. When a common carrier is to be used for sample shipment, also record the air/waybill number (tracking number) and the name of the carrier on the COC record. Place the original copy of the COC record in a sealed, clear plastic envelop or bag and tape the COC record envelope to the inside lid of the shipping container. Retain a copy of the COC record for tracking purposes.

that any attempt to remove the cap will cause the tape to be broken. Do not place custody tape over a volatile organic analysis (VOA) vial septum.

4.3.3 Place all containers in separate, appropriately sized, airtight, seam sealing polyethylene bags (e.g., Ziploc™). Seal the bag, removing any excess air.

4.3.4 Place the bagged container inside an insulating shipping container, "cooler." This cooler should have frozen blue ice inside to assure samples remain cool, "4°," during transit from field to the packaging location.

4.3.5 Because blue ice does not maintain the 4°C standard required for sample shipping, it should only be used while in the field collecting samples.

4.3.6 Maintain the samples under chain of custody (COC) in accordance with the Work Plan and SOP 6.0, Chain of Custody (Appendix A).

4.4 Sample Packaging

Environmental samples shall be packaged in the following manner. Additional packaging requirements for samples identified as containing a known hazardous material or hazardous waste are contained in References 2.3 and 2.4. The FC shall determine the appropriate hazard classification and shall identify any additional packaging requirements and ensure that they are completed.

4.4.1 Inspect the integrity of the shipping container. The container is generally a "cooler" constructed of heavy plastic or metal with appropriate insulating properties so that variations in temperature during shipping are minimized. Also make sure that the drain plug has been sealed with nylon reinforced strapping tape or mailing tape.

4.4.2 Place two to four inches of absorbent packaging material (e.g., Vermiculite™) in the bottom of the shipping container.

4.1.4 Project Quality Assurance Specialist (PQAS) - is responsible for the periodic review of documentation generated during sample handling, packaging, and shipping and the periodic review and audit of field personnel as they perform the work.

If problems arise, the PQAS is also responsible for swift implementation of corrective action (i.e., retraining personnel, additional review of work plans and procedures, variances to requirements, issuing nonconformances).

4.1.5 Health and Safety Officer (HSO) - is responsible for ensuring complete compliance with the Health and Safety Plan by all personnel on site. He is responsible for ensuring all appropriate protective measures are identified and implemented to adequately protect site workers.

4.1.6 Radiological Controls Technician (RCT) - is responsible for assisting the HSO in the performance of monitoring, posting and evaluation of worksite safety and radiological controls conditions.

4.2 Sample Handling

4.2.1 Inspect the sampling containers (obtained from the analytical laboratory prior to the sampling event) to ensure that they are appropriate for the samples being collected, correctly preserved, and undamaged.

4.2.2 When collecting a sample always use approved/site specific personal protective equipment (e.g., gloves, etc.) to prevent cross-contamination from sample to sample but also as a health and safety requirement.

4.3 Field Packaging

4.3.1 Collect the samples in accordance with the site-specific work plans and SOP No. 1 (Appendix A).

4.3.2 As soon as possible after sample collection, tightly seal the container, and place a piece of custody tape over or around the cap. The custody tape should be placed over the cap so

Medium or high concentration sample requiring either DOT or IATA labelling as a hazardous waste or material.

3.3 Hazardous Waste

Any substance listed in 40 CFR Subpart D (260.30 et seq.) or otherwise characterized as ignitable, corrosive, reactive, or toxic as specified in Subpart C (261.20 et seq.) that would be subject to manifest and packaging requirements specified in 40 CFR 262. Hazardous waste is defined and regulated by the Environmental Protection Agency (EPA).

3.4 Hazardous Material

A substance or material in a quantity or form which may pose an unreasonable risk to health, safety, and/or property when transported in commerce. Hazardous material is defined and regulated by DOT (49 CFR 173.2 and 172.101) and IATA (Section 4.2).

3.5 Sample

Physical evidence collected from a facility or the environment which is representative of conditions at the point and time at which the sample is collected.

4.0 Procedure

4.1 Responsibilities

4.1.1 Compliance with this procedure is the responsibility of project management, site management, health and safety, and field personnel.

4.1.2 Project Manager - is responsible for the development and review of site-specific work plans which address the specific sample handling, packaging, and shipping requirements for the project. Review the project specific documentation forms to ensure they are appropriate for the field activities.

4.1.3 Field Coordinator (FC) - is responsible for seeing that field personnel receive proper training and maintain quality assurance/quality control (QA/QC). The FC is additionally responsible for approving, coordinating, and supervising all field activities associated with this Work Plan.

SAMPLE HANDLING, PACKAGING AND SHIPPING

STANDARD OPERATING PROCEDURE

1.0 Purpose

This Procedure outlines the methods and responsibilities for field personnel to use in the packaging and shipping of environmental samples, hazardous materials and hazardous waste samples for chemical and physical analysis.

2.0 References

2.1 EPA, September 1987, Compendium of Superfund Field Operations Methods, EPA 540/P-87/001a, OSWER 9355.0-14.

2.2 EPA, August 1988, EPA Guidelines for Conducting Remedial Investigation and Feasibility Studies under CERCLA, Interim Final OSWER Directive 9355.3-01.

2.3 Code of Federal Regulations, DOT 49 CFR parts 100 to 177, Revised October 1, 1992.

2.4 Dangerous Goods Regulations, IATA, January 1, 1994.

2.5 SOP 1.0 - Subsurface Sampling (Appendix A).

2.6 SOP 6.0 - Chain of Custody (Appendix A).

3.0 Definitions

3.1 Environmental Sample

A limited quantity, low concentration sample that does not require Department of Transportation (DOT) or International Air Transportation Association (IATA) hazardous waste labelling as a hazardous waste or material.

3.2 Hazardous Waste Sample

ATTACHMENT 1

SAMPLE COLLECTION LOG

INTERNATIONAL
TECHNOLOGY
CORPORATION

DATE	
TIME	
PAGE	OF
PAGE	
PROJECT NO.	

PROJECT NAME _____

SAMPLE NO. _____

SAMPLE LOCATION _____

SAMPLE TYPE _____

COMPOSITE _____ YES _____ NO

COMPOSITE TYPE _____

DEPTH OF SAMPLE _____

WEATHER _____

CONTAINERS USED	AMOUNT COLLECTED

COMMENTS:

PREPARED BY: _____

- Date and time of collection
- Parameters for analysis
- Sampler's initials.

4.3.11 Document the sampling event and any pertinent field observations, conditions or problems in the Field Activity Daily Log. Record sample collection on the Sample Collection Log (Attachment 1). Any encountered problems or unusual conditions should also be immediately brought to the attention of the Field Coordinator.

4.3.12 Appropriately preserve, handle, package, and ship the samples per the Work Plan. The samples shall also be maintained under custody per SOP 6.0, "Chain of Custody" (Reference 2.4).

4.4 Equipment Blanks

Equipment blanks will be collected during soil sampling activities to provide an additional check on possible sources of contamination related to field sampling instruments. Laboratory-supplied distilled or deionized water is passed through or over clean sampling equipment and collected directly into empty sample containers for analysis. Equipment blanks will be handled and transported in the same manner as the samples acquired that day. Equipment blanks will be analyzed for a specific parameter list according to water analytical methods. Equipment blanks will be collected for each investigation activity in each investigation area. For example, three equipment blanks would be collected in an investigation area during sampling activities that include a backhoe exploration, stage 1 soil boring, and stage 2 soil boring. The equipment blanks will be tested for the analytes specified in the Work Plan.

5.0 Records

5.1 Records generated as a result of this SOP will be controlled and maintained in the project record files.

6.0 Attachments

6.1 Attachment 1, Sample Collection Log

appropriate form(s), as specified in the Work Plan. Instruments that cannot be calibrated according to the manufacturer's specifications will be removed from service and tagged.

4.3.5 Don appropriate personal protection equipment as specified in the Work Plan.

4.3.6 If using the coring device, place the sleeve into the device and drive the assembly into the soil using the drive hammer. Drive the device into the soil until the trailing end of the sleeve is at the soil surface.

4.3.7 Retrieve the device; check to see that soil recovery is adequate in the sample sleeve. If there is sufficient recovery, mark or note the leading end of the sample sleeve.

4.3.8 If using a different sample collection device (other than the coring device), use the other device to scoop or collect soil and directly transfer the soil into the sample container (e.g., glass jar, brass sample sleeve, etc.). Fill the sample container such that little to no head-space exists.

4.3.9 If using sample sleeves, place teflon tape over each end of the sleeve and seal each end with plastic end caps. With a permanent marker, write a "T" for top on the trailing end and a "B" for bottom on the leading end. Place custody tape over each end cap so that any attempt to remove the cap will cause the tape to be broken.

If using glass jars, cap or seal the jars appropriately and place custody tape over the cap so that any attempt to remove the cap will cause the tape to be broken.

4.3.10 Appropriately label and number the sample containers per the Work Plan. The label will be filled out with waterproof ink and will contain, at a minimum, the following information:

- Project number
- Sample number
- Sample location
- Sample depth
- Sample type

undisturbed sample is collected in the sleeve. The sample is then handled and shipped in the sample sleeve.

When a core sample is not feasible or planned, a sample can be collected by using such devices as a shovel, hand auger, trowel, or stainless steel spoon, etc. The soil is transferred from the collection device into decontaminated sample containers (commonly glass jars). The Work Plan will specify the type of sampling equipment to be used. The sample containers to be used will also be specified in the Work Plan.

4.3 Subsurface Sample Collection

4.3.1 The common method to collect subsurface samples is to use a hand auger to bore to the desired sampling depth and then retrieve the sample with a core sampler. The hand auger might also be used to recover the sample for direct transfer into glass jars. The exact methodology to be used will be specified in the Work Plan.

For subsurface samples of less than 18 inches in depth, successive drives of the core sampler may potentially be used to recover shallow subsurface soil samples. In all methods cited above, borehole stability should be maintained to prevent the recovery of slough in the samples. If sloughing cannot be controlled, then another sampling methodology may have to be considered.

4.3.2 Prior to sampling and between sampling locations, decontaminate the sample equipment according to procedures outlined in the Work Plan.

4.3.3 Ensure that all subsurface soil sampling locations have been appropriately cleared of all underground utilities and buried objects per the Work Plan. Review all forms and diagrams documenting the location of the cleared sampling locations, as well as that of any underground utilities or lines, or other buried objects.

4.3.4 As required, calibrate any health and safety monitoring equipment according to the instrument manufacturer's specifications. Calibration results will be recorded on the

4.1 Responsibilities

4.1.1 The Field Coordinator will be responsible for ensuring that all sample collection activities are conducted in accordance with this SOP and any other appropriate procedures. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

4.1.2 The Project Quality Assurance Specialist (PQAS) will be responsible for periodic review of field generated documentation associated with this SOP. The PQAS will also responsible for implementation of corrective action (i.e., retraining personnel, additional review of work plans and procedures, variances to QC sampling requirements, issuing nonconformances, etc.) if problems occur.

4.1.3 Field personnel assigned to sampling activities will be responsible for completing their tasks according to specifications outlined in this SOP and other appropriate procedures. All staff will be responsible for reporting deviations from procedures to the Field Coordinator, IT Project Manager, or the PQAS.

4.2 Surface Sampling Equipment

A number of devices are available for the collection of surface soil samples. These include, but are not limited to: core samplers, hand augers, spoons, scoops, trowels, shovels, triers, etc. These devices are constructed of a number of materials including, but not limited to, stainless steel, brass, glass, teflon, etc.

The sampling and analytical requirements, as well as site characteristics, must be taken into account when determining the proper surface soil sampling equipment to use.

At present, the method commonly used for the collection of surface and subsurface samples, both disturbed and undisturbed, is a core sampler. The core sampler is usually a hollow, stainless steel cylinder, tapered at the leading end. A sample sleeve (brass, stainless steel, lexan, etc.) is inserted into the trailing end. The trailing end is then connected to a piston-type drive hammer. The core is driven into the soil by the hammer so that a relatively

3.3 Disturbed Soil Sample

A soil sample in which the in situ physical structure and fabric has been disturbed as the direct result of sample collection.

3.4 Undisturbed Soil Sample

A soil sample in which the in situ physical structure and fabric has not been disturbed as the result of sample collection.

3.5 Grab Samples

Representative disturbed soil sample that is collected by using such devices as a shovel, stainless steel spoon, etc.

3.6 Composite Samples

A soil sample comprised of material from more than one source or location.

4.0 Procedure

This section contains both the responsibilities and procedures involved with surface and subsurface soil sampling. Proper sampling procedures are necessary to insure the quality and integrity of the samples. The details within this SOP will be used in conjunction with the Work Plan. The Work Plan will generally provide the following information:

- Sample collection objectives
- Locations and depths of samples to be collected
- Numbers and volumes of samples to be collected
- Types of analyses to be conducted for the samples
- Specific quality control (QC) procedures and sampling required
- Any additional shallow subsurface sampling requirements or procedures beyond those covered in this SOP, as necessary.

At a minimum, the procedures outlined below will be followed.

SURFACE/SUBSURFACE SAMPLING

STANDARD OPERATING PROCEDURE

1.0 Purpose

This Procedure establishes guidelines and procedures for use by field personnel in the collection and documentation of surface and subsurface samples for physical and chemical analysis. Proper collection procedures are necessary to assure the quality and integrity of all surface and shallow subsurface soil samples. Additional specific procedures and requirements will be provided in the Work Plan.

2.0 References

2.1 EPA, September 1987, Compendium of Superfund Field Operations Methods, EPA 540/P-87/001a, OSWER 9355.0-14.

2.2 EPA, August 1988, EPA Guidelines for Conducting Remedial Investigation and Feasibility Studies under CERCLA, Interim Final OSWER Directive 9355.3-01.

2.3 SOP 2.0 - Sample Handling, Packaging and Shipping (Appendix A)

2.4 SOP 6.0 - Chain of Custody (Appendix A)

3.0 Definitions

3.1 Surface Soil Sample

Soil collected between a depth or zero and six inches.

3.2 Subsurface Soil Sample

Soil collected at any depth interval greater than 6 inches.

Appendix A

Standard Operating Procedures

1.0 Surface/Subsurface Sampling
2.0 Sample Handling, Packaging, and Shipping
3.0 Logging of Soil – Visual USCS
4.0 Borehole Sampling
5.0 Exploratory Trench Excavation
6.0 Chain of Custody

INTERNATIONAL TECHNOLOGY CORPORATION

ATTACHMENT 1
VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER:	PROJECT NAME:	
BORING NUMBER:	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED:
ENGINEER/GEOLOGIST:	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS:		PAGE OF

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS

NOTES:

Drilling Contractor _____

Drilling Equipment _____

Driller: _____

ATTACHMENT 2

FIELD ACTIVITY DAILY LOG

TECHNOLOGY CORPORATION

DAILY LOG			
DATE			
NO.			
SHEET		OF	

FIELD ACTIVITY DAILY LOG

PROJECT NAME	PROJECT NO.
FIELD ACTIVITY SUBJECT:	
DESCRIPTION OF DAILY ACTIVITIES AND EVENTS:	
VISITORS ON SITE:	CHANGES FROM PLANS AND SPECIFICATIONS, AND OTHER SPECIAL ORDERS AND IMPORTANT DECISIONS.
WEATHER CONDITIONS:	IMPORTANT TELEPHONE CALLS:
IT PERSONNEL ON SITE:	
SIGNATURE	

327A-7-84

BOREHOLE SAMPLING

STANDARD OPERATING PROCEDURE

1.0 Purpose

This Procedure establishes guidelines and procedures for use by field personnel in the collection and documentation of borehole subsurface samples for physical and chemical analysis. Proper collection procedures are necessary to assure the quality and integrity of all subsurface soil samples. Additional specific procedures and requirements will be provided in the Work Plan.

2.0 References

2.1 EPA, September 1987, Compendium of Superfund Field Operations Methods, EPA 540/P-87/001a, OSWER 9355.0-14.

2.2 EPA, August 1988, EPA Guidelines for Conducting Remedial Investigation and Feasibility Studies under CERCLA, Interim Final OSWER Directive 9355.3-01.

2.3 SOP 2.0 - Sample Handling, Packaging and Shipping (Appendix A)

2.4 SOP 6.0 - Chain of Custody (Appendix A)

3.0 Definitions

3.1 Subsurface Soil Sample

Soil collected at any depth interval greater than 6 inches.

3.2 Disturbed Soil Sample

A soil sample in which the in situ physical structure and fabric has been disturbed as the direct result of sample collection.

3.3 Undisturbed Soil Sample

A soil sample in which the in situ physical structure and fabric has not been disturbed as the result of sample collection.

3.4 Grab Samples

Representative disturbed soil sample that is collected by using such devices as a shovel, stainless steel spoon, etc.

3.5 Composite Samples

A soil sample comprised of material from more than one source or location.

4.0 Procedures

This section contains both the responsibilities and procedures involved with borehole sampling. Proper sampling procedures are necessary to insure the quality and integrity of the samples. The details within this SOP will be used in conjunction with the Work Plan. The Work Plan will provide the following information:

- Sample collection objectives
- Locations and depths of samples to be collected
- Numbers and volumes of samples to be collected
- Types of analyses to be conducted for the samples
- Specific quality control (QC) procedures and sampling required
- Any additional shallow subsurface sampling requirements or procedures beyond those covered in this SOP, as necessary.

At a minimum, the procedures outlined below will be followed.

4.1 Responsibilities

4.1.1 The Field Coordinator will be responsible for ensuring that all sample collection activities are conducted in accordance with this SOP and any other appropriate procedures.

This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

4.1.2 The Project Quality Assurance Specialist (PQAS) will be responsible for periodic review of field generated documentation associated with this SOP. The PQAS will also responsible for implementation of corrective action (i.e., retraining personnel, additional review of work plans and procedures, variances to QC sampling requirements, issuing nonconformances, etc.) if problems occur.

4.1.3 Field personnel assigned to sampling activities will be responsible for completing their tasks according to specifications outlined in this SOP and other appropriate procedures. All staff will be responsible for reporting deviations from procedures to the Field Coordinator, IT Project Manager, or the PQAS.

4.2 Sample Collection

Due to the wide variety of sampling conditions, types of samples, and purpose for collecting soil samples, several possible methods may be used to collect the soil sample. Specific procedures for various methods are described below. There are numerous procedures that can be followed for most soil sampling methods, and exact methodologies to be used will be specified in the Work Plan. The procedures include:

- Prepare sample collection logs and record relevant data on Field Activity Daily Logs prior to sampling
- Decontaminate sampling equipment as specified in the Work Plan or to EPA protocol, if samples destined for chemical analysis are to be collected
- Clear surface vegetation, rocks, and other material not designated for sampling from the sampling point
- Review all forms and diagrams documenting the location of the cleared sampling locations, as well as that of any underground utilities or lines or other buried objects
- As required, calibrate any health and safety monitoring equipment according to the instrument manufacturer's specifications. Calibration results will be recorded

on the appropriate forms, as specified on the Work Plan. Instruments that cannot be calibrated according to the manufacturer's specifications will be removed from service and tagged "non-operational."

- Use drilling or penetration methods if necessary to reach the desired sampling depth
- Collect samples using appropriate sampling method described in Section 4.3
- Lithologically log the sample and boring (SOP 3.0, Logging of Soil - Visual USCS)
- Fill necessary sample containers
- Affix sample container with appropriate labels, being sure to provide required information
- Place the properly labeled sample container in an appropriate carrying container at required temperature
- Either discard or decontaminate all items which contact the sample such as trowel, split-spoon sampler, and gloves before proceeding to the next sampling location
- Add information pertaining to the sample to the COC, Field Activity Daily Log, and Sample Collection Logs
- Package and ship samples as described in SOP 2.0 (Reference 2.3).

4.3 Soil Sampling

Several methods may be used to collect subsurface soil samples. Some of the procedures for the more common sampling methods are described below.

4.3.1 Set-up Procedures

Several drilling methods may be used to reach desired depths for soil sampling. Samples may be collected at any interval. In addition to drilling methods, subsurface depths can be reached by a power auger, a hand bucket auger, or a backhoe.

When the desired depth has been reached, the borehole will be prepared for sampling. To prepare for sampling, the borehole should be cleaned out to the desired sampling depth using equipment that will ensure that the material to be sampled is not disturbed by the operation. When drilling in saturated sands and silts, the bit should be withdrawn slowly, to prevent loosening of the soil around the hole. When using dual tube or casing hammer methods, care will be taken not to drive the casing below the desired sampling depth before the sample is collected.

When the desired sampling depth has been reached and the borehole has been prepared, there are several subsurface methods that will commonly be used to collect samples.

Samples will be collected with either a continuous coring or shelby tube sampler. The determination of which sampling procedure to use is a function of the specific activity at hand. Sonic drilling, for example, will predominantly utilize continuous coring for sample collection. Excavation trenching, for example, will predominantly utilize a shelby tube sampler for collection. A description of each of the procedures follows:

4.3.2 Continuous Core Sampling System Methods

Continuous core sampling system methods may be specified where continuous soil cores are to be recovered by sonic drilling. The continuous sampling system utilizes a barrel which recovers a soil core from the interval the barrel is advanced through. The barrel is recovered after the total depth of the borehole is attained.

Representative samples of the soil cores can be placed in glass jars or brass sleeves for future analysis. The entire length of the soil cores will be placed in core boxes, should it be necessary to retain them. Care will be taken to mark intervals of core loss with styrofoam blocks. All soil cores will be logged according to procedures outlined in SOP 3.0 (Logging of Soil - Visual USCS).

If the sample is transferred from the sonic corer into jars or sleeves, fill the sample container such that little or no head-space exists. If using sample sleeves, place teflon tape over each end of the sleeve and seal with plastic caps. Place custody tape over each end cap so that

any attempt to remove the cap will cause the tape to be broken. If using glass jars, cap or seal the jars and place custody tape over the cap so that any attempt to remove the cap will break the tape.

4.3.3 Shelby Tube Sampling

Shelby tube samples will be collected from excavator or backhoe buckets of removed soil during trench excavations. Procedures for collecting a Shelby tube sample are listed below:

- Determine location from trench or excavation to collect sample from
- Bring soil from desired location to surface with excavator or backhoe
- Clear the sample collection location using a spade or hand trowel by digging into the soil 6 to 8 inches
- Place the shelby tube firmly into the cleared sample collection location and drive it deeply enough into the excavated soil to fill it.

4.4 Equipment Blanks

Equipment blanks will be collected during soil sampling activities to provide an additional check on possible sources of contamination related to field sampling instruments. Laboratory-supplied distilled or deionized water is passed through or over clean sampling equipment and collected directly into empty sample containers for analysis. Equipment blanks will be handled and transported in the same manner as the samples acquired that day. Equipment blanks will be analyzed for a specific parameter list according to water analytical methods. Equipment blanks will be collected as specified in the Work Plan. The equipment blanks will be tested for the analytes specified in the Work Plan.

4.5 Sample Documentation

4.5.1 Appropriately label and number the sample containers per the Work Plan. The label will be filled out with waterproof ink and will contain, at a minimum, the following information:

- Project number
- Sample number
- Sample location

- Sample depth
- Sample type
- Date and time of collection
- Parameters for analysis
- Sampler's initials.

4.5.2 Document the sampling event and any pertinent field observations, conditions or problems in the Field Activity Daily Log. Record sample collection on the Sample Collection Log (Attachment 1). Any encountered problems or unusual conditions should also be immediately brought to the attention of the Field Coordinator.

4.5.3 Appropriately preserve, handle, package, and ship the samples per SOP 2.0 (Reference 2.3). The samples shall also be maintained under custody per SOP 6.0, "Chain of Custody" (Reference 2.4).

5.0 Records

5.1 Records generated as a result of this SOP will be controlled and maintained in the project record files.

6.0 Attachment

6.1 Attachment 1, Sample Collection Log

ATTACHMENT 1

SAMPLE COLLECTION LOG

INTERNATIONAL
TECHNOLOGY
CORPORATION

DATE	
TIME	
PAGE	OF
PAGE	
PROJECT NO.	

PROJECT NAME _____

SAMPLE NO. _____

SAMPLE LOCATION _____

SAMPLE TYPE _____

COMPOSITE _____ YES _____ NO

COMPOSITE TYPE _____

DEPTH OF SAMPLE _____

WEATHER _____

CONTAINERS USED	AMOUNT COLLECTED

COMMENTS:

PREPARED BY: _____

EXPLORATORY TRENCH EXCAVATION

STANDARD OPERATING PROCEDURE

1.0 Purpose

This procedure establishes guidelines and methodologies to be used in excavation and logging of exploratory trenches. Resulting excavations can be used for shallow stratigraphic description and sample collection for physical and chemical testing. Included in this procedure are descriptions of equipment, forms, and set-up activities. Additional specific procedures and requirements will be provided in the Work Plan.

2.0 References

2.1 SOP 2.0 - Sample Handling, Packaging, and Shipping (Appendix A)

2.2 SOP 3.0 - Logging of Soils - Visual USCS

2.3 SOP 4.0 - Borehole Sampling

2.4 HSP-61 - Excavation and Trenching (Appendix E). *Work Plan for the Decontamination and Decommissioning of the Imhoff Building, Cobalt-60 Building, and Tank Trailer at the Laboratory for Energy Related Health Research, University of California at Davis*, IT Corporation, 1994.

3.0 Procedures

This section contains both the responsibilities and procedures involved with exploratory trench excavations. Proper procedures are necessary to assure worker health and to assure the quality and integrity of collected samples. The details within this SOP will be used in conjunction with the Work Plan. The Work Plan will generally provide the following information:

- Sample collection objectives

- Locations and depths of samples to be collected
- Numbers and volumes of samples to be collected
- Types of analyses to be conducted for the samples
- Specific quality control (QC) procedures and sampling required
- Any additional shallow subsurface sampling requirements or procedures beyond those covered in this SOP, as necessary.

At a minimum, the procedures outlined below will be followed.

3.1 Responsibilities

3.1.1 The Field Coordinator will be responsible for ensuring that all sample collection activities are conducted in accordance with this SOP and any other appropriate procedures. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

3.1.2 The Project Quality Assurance Specialist (PQAS) will be responsible for periodic review of field generated documentation associated with this SOP. The PQAS will also responsible for implementation of corrective action (i.e., retraining personnel, additional review of work plans and procedures, variances to QC sampling requirements, issuing nonconformances, etc.) if problems occur.

3.1.3 Field personnel assigned to sampling activities will be responsible for completing their tasks according to specifications outlined in this SOP and other appropriate procedures. All staff will be responsible for reporting deviations from procedures to the Field Coordinator, IT Project Manager, or the PQAS.

3.2 Set Up Procedures

Set-up procedures and trench excavations will be conducted under the supervision of the Field Coordinator and field geologist. These personnel are responsible for:

- Identifying each trench location

- Confirming the trench location with the Battelle PNNL personnel
- Obtaining proper clearance for potential above- and below-ground hazards.

Prior to trench excavation, the sampling tools should be decontaminated. The work area will be well-marked with barricade tape. In some cases, special arrangements may need to be made to penetrate surface paving (concrete or asphalt). Each trench will be backfilled following logging and photographing as described in the Work Plan.

3.3 Excavation Procedures

This section provides a brief description of excavation procedures. Trenching procedures described below adhere to guidelines and requirements of Title 8 CCR, Article 6, Sections 1541 and 1542, and the Health and Safety considerations specified in the Work Plan.

Following excavation location approval, the trench will be excavated using a backhoe. The standard backhoe bucket width is 24 inches, but a larger bucket (36-inch) may be used. The width of the excavation, regardless of the width of the backhoe bucket, will be such that viewing into it is not restricted from the surface. Personnel will not enter these excavations.

Soils will be described as specified in SOP 3.0 (Reference 2.2). The exposed excavation wall(s) will be logged by the field geologist and photographed.

All excavation work will be in accordance with Reference 2.4. Excavations greater than five feet in depth will not be entered and observations for logging purposes will be made from the surface. In no case will an excavation greater than five feet in depth be entered without proper shoring. If soil samples from greater than five feet are required, samples will be collected from soil in the backhoe bucket taken from the desired depth. Soil sample collection methods are described in SOP 4.0 (Reference 2.3).

Excavations will be backfilled using the backhoe, as explained in the Work Plan.

4.0 Records

4.1 Records generated as a result of this SOP will be controlled and maintained in the project record files.

CHAIN OF CUSTODY

STANDARD OPERATING PROCEDURE

1.0 Purpose

This Procedure establishes the method and responsibilities associated with the maintenance and custody of samples which are to be used to provide data relative to making project related decisions. It outlines the general procedures for maintaining and documenting sample chain of custody from the time of sample collection through sample disposition.

2.0 References

2.1 IT LEHR Quality Assurance Project Plan, Appendix B, *Work Plan for the Decontamination and Decommissioning of the Imhoff Building, Cobalt-60 Building, and Tank Trailer at the Laboratory for Energy Related Health Research, University of California at Davis*, IT Corporation, 1994.

3.0 Definitions

3.1 Chain of Custody (COC)

The COC is the written record that traces the sample possession from the time each sample is collected until its final disposition, sometimes called the "cradle to grave" record. Chain of Custody is maintained by compliance with one of the following criteria:

- The sample is in the individual's physical possession
- The sample is maintained in the individual's physical view after being in his/her possession
- The sample is transferred to a designated secure area restricted to authorized personnel
- The sample is sealed and maintained under lock and key to prevent tampering, after having been in physical possession.

3.2 Waybill

A document that contains a list of the goods and shipping instructions relative to a shipment.

3.3 Common Carrier

For the purpose of this procedure, the common carrier is any commercial carrier utilized for the transportation of the sample(s) from the field to the laboratory.

4.0 Procedure

4.1 Responsibilities

4.1.1 Project Manager - The Project Manager is responsible for assuring proper COC is initiated at the time the sample(s) are collected and maintained throughout the handling and subsequent transportation of the sample(s) to the designated laboratory. Additionally, he/she is the project authority for determining the disposition and fate of sample(s) which have identified deficiencies (e.g., missed holding times, elevated temperature at receipt, etc.).

4.1.2 Sample Team Member(s) - Sample team members are responsible for properly documenting and maintaining the COC from the time of sample collection until the sample is delivered to the lab.

4.1.3 Laboratory - Laboratory personnel are responsible for receipt and entry of samples into the laboratory which have been submitted under a COC Record. Additionally, samples received will be entered into the laboratory COC procedures by properly documenting and maintaining COC from the moment that they take custody of the sample at the laboratory until the sample is disposed of or returned to the client.

4.2 General

4.2.1 An overriding consideration for data resulting from laboratory analyses is the ability to demonstrate that the samples were obtained from the locations stated and that they reached the laboratory without alteration. Evidence of collection, shipment, laboratory receipt, and laboratory custody until disposal must be documented to accomplish this. Documentation will be accomplished through a COC Record that lists each sample and the individuals performing the sample collection, shipment, and receipt.

4.2.2 The IT COC Record is a preprinted form with a unique six-digit control number in the upper right-hand corner. The white copy will accompany the samples while the yellow field copy will be retained in the project file.

4.3 Field Sample Custody

4.3.1 Sampling personnel upon collection of samples to be analyzed for project information will properly complete a COC Record form (Attachment 1). The COC Record form will be the controlling document to assure that sample maintenance and custody are maintained thereby assuring the sample(s) are representative of the environment from which they were collected. At a minimum, the following information will be recorded on the COC Record form:

- The unique identification number assigned to each sample.
- A brief description of the sampling location and a physical description of the sample type.
- The date and time of the sample collection.
- Container type (e.g., glass, poly, brass sleeve, etc.).
- Sample volume and number of containers (e.g., 2 x 40 ml, 3 x 1 liter).
- Sample preservation (e.g., HNO_3, H_2SO_4, 4°C).
- Requested analyses.
- Special instructions to the laboratory including handling requirements, quality assurance/quality control, health and safety, and sample disposition.
- The project name and number.
- The date the analytical report is due.
- The names of all sampling personnel.
- The name and phone number of the project contact.
- The name and phone number of the laboratory contact.

- The name of the courier and the waybill number (if applicable).
- A unique document reference number.

4.3.2 The COC Record form will be initiated in the field by the person collecting the sample and signed by each individual who has the samples in their possession. Each time that sample custody is transferred, the former custodian must sign over the COC as Relinquished By, and the new custodian must sign on to the COC as Received By. Each signature must be accompanied by the date, time, and the name of their project or company affiliation.

4.3.3 Transferring of COC from sampling personnel to the analytical laboratory will be performed in accordance with the requirements stated below.

4.3.3.1 If the sampling personnel deliver the samples to the laboratory, transfer of COC occurs as follows:

- The sample collector delivers the samples to the laboratory and relinquishes the sample directly to a laboratory representative.
- The collector signs the COC listing his/her name, affiliation, the date, and time. Any person involved in the collection of the sample may act as the sample custodian.
- The laboratory representative must receive the samples by signing his/her name, affiliation, the date, and time on the COC. The laboratory representative may decline to take receipt of the samples if the COC is not properly completed or if the samples are not properly packaged. All designated laboratory personnel may act as the sample custodian.
- One copy of the COC is given to the sample collector to be returned to the project files and one copy is maintained with the samples at the laboratory.

4.3.3.2 If the sampling personnel transfer sample(s) to the laboratory utilizing a common carrier, sampling personnel will retain COC responsibility and the common carrier is not esponsible for maintaining sample custody. The sample collectors are responsible for packaging the samples in a manner that meets the COC definition criteria, that is, the samples

are sealed to prevent tampering. When transferring samples to the courier for transport, COC procedures are maintained as follows:

- The sample collector lists the courier affiliation and waybill number on the COC.
- The sample collector relinquishes custody by signing his name, affiliation, date, and time. The collector keeps a copy of the relinquished COC for the project file.
- The relinquished original COC is sealed in a watertight plastic bag and taped to the inside of the lid of the container used for transportation.
- The transportation container is sealed to prevent tampering and given to the courier for delivery to the laboratory.
- The sample collector obtains a copy of the waybill from the courier for the project file.
- The laboratory representative must receive the samples by signing his/her name, affiliation, the date, and time on the COC. This copy is maintained with the samples at the laboratory.
- The laboratory representative obtains a copy of the waybill from the courier for the project file.

4.4 Analytical Laboratory Custody

4.4.1 Upon receipt at the analytical laboratory, the field generated COC Record form will be signed, dated, time marked, temperature marked, and laboratory identification will be provided in the appropriate spaces.

4.4.2 Laboratory receipt personnel will enter the samples into the laboratory by implementing the sample custody procedures addressed within their approved QA Program.

4.4.3 After completion of analytical testing, sample remnants not consumed during testing may be kept for six months beyond the completion of analysis, unless otherwise specified by Battelle PNNL Project Management. Once this time period has elapsed, the samples will be

disposed of and the disposal record number will be recorded on the laboratory record copy of the COC.

5.0 Records

5.1 Records generated as a result of this SOP will be controlled and maintained in the project files.

6.0 Attachment

6.1 Attachment 1, Chain of Custody Record Form

ATTACHMENT 6.1

CHAIN OF CUSTODY RECORD FORM

*See back of form for special instructions

NOTE: To accompany samples. Show Field copy

INTERNATIONAL TECHNOLOGY CORPORATION

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD*

Reference Document No. 371464
Page 1 of ____

Project Name/No. [1]
Sample Team Members [2]
Profit Center No. [3]
Project Manager [4]
Purchase Order No. [6]
Required Report Date [11]

Samples Shipment Date [7]
Lab Destination [8]
Lab Contact [9]
Project Contact/Phone [12]
Carrier/Waybill No. [13]

Bill to [5]

Report to [10]

ONE CONTAINER PER LINE

Sample Number [14]	Sample Description/Type [15]	Date/Time Collected [16]	Container Type [17]	Sample Volume [18]	Preservative [19]	Requested Testing Program [20]	Condition on Receipt [21]	Disposal Record No. [22]

Special Instructions [23]

Possible Hazard Identification [24]
Non hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐

Sample Disposal: [25]
Return to Client ☐ Disposal by Lab ☐ Archive (mos.)

Turnaround Time Required [26]
Normal ☐ Rush ☐

QC Level [27]
I ☐ II ☐ III ☐ Project Specific (specify)

1 Relinquished by [28] (Signature/Affiliation)	Date Time	1 Received by [28] (Signature/Affiliation)	Date: Time:
2 Relinquished by (Signature/Affiliation)	Date Time	2 Received by (Signature/Affiliation)	Date Time:
3 Relinquished by (Signature/Affiliation)	Date Time	3 Received by (Signature/Affiliation)	Date: Time:

Comments [29]

SOP NO. 6.0
REVISION NO. 0
DATE: 06/27/96

MZ/06-27-96/UCDAVIS/96-0033.jc