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Supplemental Sampling and Analysis Plan for Potential Release Sites 73-001(a) and 73-001(d)

Los Alamos
NATIONAL LABORATORY
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Produced by the Remedial Actions Focus Area

Contents

List of Acronyms and Abbreviations

BMP	best management practice
DOE	US Department of Energy
DQO	data quality objective
ET	evapotranspiration
ER	environmental restoration
GPR	ground penetrating radar
GPS	global positioning system
LANL	Los Alamos National Laboratory
PRS	potential release site
QA/QC	quality assurance/quality control
RCRA	Resource Conservation and Recovery Act
RFI	RCRA facility investigation
SAP	sampling and analysis plan
SOP	standard operating procedure
SWMU	solid waste management unit
TA	technical area
VES	vertical electric sounding

1.0 INTRODUCTION

Los Alamos National Laboratory (the Laboratory or LANL) is a multidisciplinary research facility owned by the Department of Energy (DOE) and managed by the University of California. The Laboratory is located in north-central New Mexico approximately 60 mi northeast of Albuquerque and 20 mi northwest of Santa Fe. The Laboratory site covers 43 mi^2 of the Pajarito Plateau, which consists of a series of fingerlike mesas separated by deep canyons containing ephemeral and intermittent streams that run from west to east. Mesa tops range in elevation from approximately 6200 to 7800 ft. The eastern portion of the plateau stands 300 to 900 ft above the Rio Grande.

The Laboratory's Environmental Restoration (ER) Project is involved in a national effort by DOE to clean up facilities that were formerly involved in weapons production. The goal of the ER Project is to ensure that DOE's past operations do not threaten human or environmental health and safety in and around Los Alamos County, New Mexico. To achieve that goal, the ER Project is currently investigating sites potentially contaminated by past Laboratory operations.

This sampling and analysis plan (SAP) describes the supplemental sampling that is proposed for potential release sites (PRSs) 73-001(a) (main landfill) and 73-001(d) (debris disposal area). The primary purpose of this sampling is to acquire the necessary data to proceed with the conceptual design of covers for the two landfill areas.

A Phase I Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) was conducted at these PRSs over a period of several years beginning in April 1994 and continuing, on and off, through September 1997. This investigation focused primarily on defining the nature and extent of potential contamination. The data generated during the various phases of this investigation were all summarized and presented in an RFI report (LANL 1998, 63070).

PRS 73-001(a) was subsequently consolidated with PRS 73-004(d) (landfill septic tank) into consolidated unit 73-001(a)-99. However, as discussed in the RFI report (LANL 1998, 63070), PRS 73-004(d) was physically incorporated into, and is indistinguishable from, PRS 73-001(a), and it will not be discussed further in this SAP. PRS 73-001(d) was combined with PRSs 73-001(b) (waste oil pit) and 73-001(c) (bunker debris pits) to create consolidated unit 73-001(b)-99. However, as was also discussed in the RFI report, PRSs 73-001(b) and 73-001(c) were destroyed by trench excavation for PRS 73-001(d) and are indistinguishable from that PRS. Therefore, these PRSs will not be discussed further in this SAP. Data collected pursuant to this SAP for PRSs 73-001(a) and 73-001(d) will be applicable to each of the respective consolidated units.

1.1 Objective and Scope

The overall objective of this SAP is to provide the necessary data to complete a conceptual design of a suitable landfill cover or covers at Technical Area 73 (TA-73).

Specific objectives of the SAP include

- providing sufficient data to run the landfill model,
- determining the thickness of the existing cover,
- determining soil gas profiles and rooting depths across the existing surface,
- mapping areas of subsidence and soil gas in relation to vegetation types to evaluate interactions of soil gases and vegetation,
- evaluating the effectiveness of the best management practices (BMPs) installed at the west end of the landfill to mitigate past run-on problems,

- obtaining 1-ft topological maps of the site to do cut-and-fill calculations needed for evaluating slope-stabilization options,
- measuring or obtaining soil properties of the existing surface material and proposed borrow material to evaluate their suitability as landfill cover materials,
- confirming that data exist to calculate expected subsidence and determine if an alternative variety of asphalt is likely to withstand waste settlement and thereby provide adequate support for aircraft hangars and tie-downs, and
- evaluating potential venting layer components to determine whether soil gases could adversely affect landfill cover performance.

1.2 Approach and Implementation

To meet the objectives of this supplemental SAP, all soil gas ports and lysimeters from which adequate media can be collected will be sampled. Soil gas samples will also be collected from the existing surface material on a grid pattern of approximately 100 × 200 ft. Additional biased samples will be collected, as necessary, based on site conditions. As many as 15 to 25 soil samples will be collected from the existing surface material for geotechnical and hydrological testing. These sampling locations will be selected, based on site conditions, to be representative of the range of geotechnical and hydrological properties present.

Specific information regarding sample collection design, types and quantities of samples to be collected, sampling methods, and analytical requirements is discussed in section 2.2.3.

1.3 Background Issues

1.3.1 Regulatory Requirements

The investigation, including sampling and analysis of solid waste management units (SWMUs), is conducted under the requirements of the Laboratory's Hazardous Waste Facility Permit, which was issued on May 23, 1990 (EPA 1990, 01585) and modified on May 19, 1994.

Sampling conducted for the purpose of designing a conceptual cap and long-term monitoring design will be conducted to meet RCRA Subtitle C design standards.

1.3.2 Other Issues

No other regulatory issues are applicable to the PRSs presented in this supplemental SAP.

1.4 Data Quality Objectives Process

The objectives and requirements of this SAP were developed after a review of landfill cap modeling requirements and Subtitle C landfill regulations. The existing data was then reviewed to determine if the data were adequate to meet the modeling and regulatory requirements. As a result of this review, data gaps were identified and a sampling plan was developed to fulfill the data needs. The data gaps and the data quality objectives are discussed in detail in sections 2.2.2.1 and 3.1, respectively.

2.0 PRSs 73-001(a) AND 73-001(d), MAIN LANDFILL AND DEBRIS DISPOSAL AREAS

2.1 Characterization and Setting

2.1.1 Site Description

PRSs 73-001(a) (main landfill) and 73-001(d) (debris disposal area) are inactive SWMUs and both are listed in Table A within Module VIII of the Laboratory's Hazardous Waste Facility Permit (LANL 1996, 57486). Both landfills are located within TA-73 on DOE property (Figure 2.1-1), immediately north of the Los Alamos Airport runway, between the runway and the edge of the mesa (Figure 2.1-2).

The main landfill consists of a natural hanging valley into which municipal and laboratory sanitary wastes were disposed. The west and south sides of the main landfill coincide, approximately, with the edges of the asphalt tie-down area and the asphalt taxiway to the hot pad, respectively. The north side extends approximately to the chainlink security fence along the north side of the airport. To the east, the landfill extends to the end of the hanging valley and pinches out toward the hot pad.

The debris disposal area consists of two, roughly parallel trenches excavated to a maximum depth of approximately 35 ft. To the west, the trenches extend to within approximately 150 ft of the windsock; to the east, the trenches extend approximately 800 ft beyond the end of the runway.

The main landfill covers a surface area of approximately 12 acres. The debris disposal area landfill covers a surface area of approximately 5 acres. Using approximate depths obtained from geophysical survey and drilling activities, the main and debris disposal area landfill volumes are estimated to be 489,500 and 126,000 yd^3, respectively.

The areas encompassing PRSs 73-001(a) and 73-001(d) are currently part of the airport, but are not being used for any specific purpose. Future land use projections indicate that these areas will continue to be part of the airport (i.e., have an industrial use). The current airport operations manager has stated that there is a desire to use a portion of the area of the main landfill for additional aircraft hangars and an aircraft tie-down area, assuming there are no restrictions on this type of activity following capping of the landfill.

For many years, access to PRSs 73-001(a) and 73-001(d) has been, and still is, controlled by a perimeter fence around the entire airport. Access to the tarmac is limited to private airplane owners, operators, passengers, and other individuals with legitimate reasons to be there.

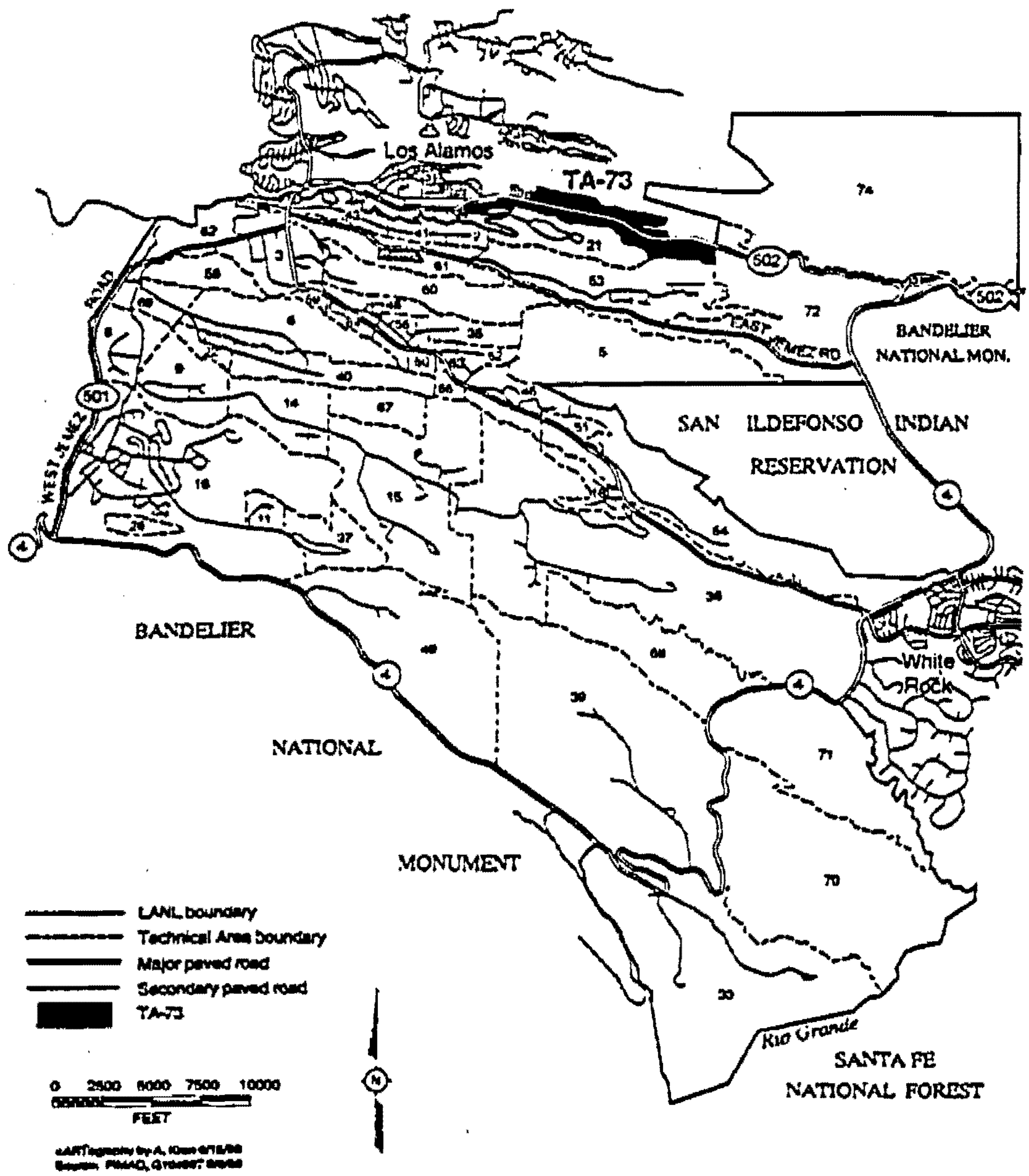

Figure 2.1-1. Location of TA-73 with respect to Laboratory TAs and surrounding landholdings

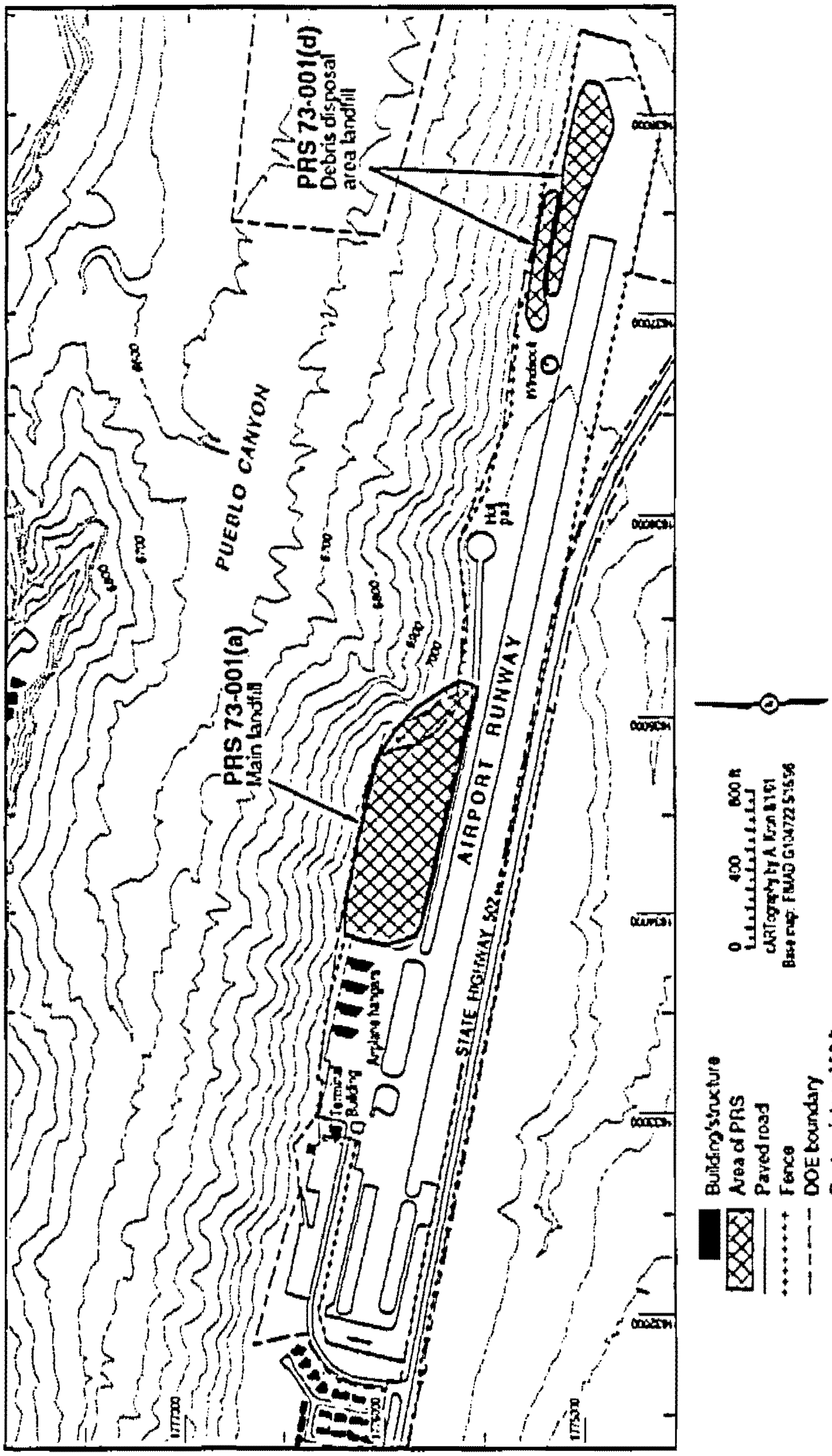

Figure 2.1-2. Locations of PRSs 73-001(a) and 73-001(d)

2.1.2 Operational History

In 1943, the DOE began using the hanging valley north of the airport runway as a landfill [PRS 73-001(a)]. Garbage was collected twice a week from the Laboratory and town site and burned on the edge of the hanging valley (Miller 1963, 00684). Heavy equipment was then used to push the burned residues and ash into whichever landfill disposal area was being used at the time. This intentional burning ceased in 1965, when Los Alamos County assumed operation of the landfill (Miller and Shaykin 1966, 36692). The county continued to operate the landfill until June 30, 1973 (Drennon 1990, 00650).

The debris disposal area landfill [PRS 73-001(d)] was used from 1984 to 1986 to bury debris excavated from the western portion of the main landfill (LANL 1990, 07514). This material was excavated and replaced with clean fill to prepare the western portion of the landfill for the construction of airplane hangars and tie-down areas. Since the wastes placed in the debris disposal area came from the main landfill, both areas contain similar types of debris. In 1986, the debris disposal area landfill was covered with soil and hydroseeded (LANL 1990, 07514).

2.1.3 Waste Characteristics

This section addresses the potential contaminants that may be present at PRSs 73-001(a) and 73-001(d) based on the information contained in section 2.3.4.3, Data Review, of the RFI report (LANL 1998, 63070). The sample results presented in the RFI report defined the nature of contamination present at both PRSs. In general, the contamination consisted of inorganic chemicals in three media (surface soil, subsurface soil and tuff, and soil pore water), radionuclides in two media (surface soil and subsurface soil and tuff), and organic chemicals in four media (surface soil, subsurface soil and tuff, soil gas, and soil pore water). The relevance of these data to any "solid waste," as that term is defined under RCRA, that might be generated by the activities presented in this supplemental SAP will be discussed in the waste characterization strategy form to be prepared prior to initiating field activities.

2.2 Investigatory Approach

2.2.1 Existing Data

This section briefly describes nonsampling and sampling investigations that have occurred at PRSs 73-001(a) and 73-001(d).

2.2.1.1 Nonsampling

As part of the field activities conducted over a period of several years, a number of nonsampling activities were completed. These included site surveys, radiological surveys, infrared photography surveys, geophysical surveys, geomorphologic mapping, and geodetic surveys. Detailed information regarding the results of these activities is provided in the RFI report (LANL 1998, 63070), section 2.3.4.

The geophysical survey results are the most relevant to this supplemental SAP. The survey methods involved several basic principles, including wave propagation at different wavelengths [seismic refraction and ground penetrating radar (GPR)], potential fields (magnetic total field and gravity field profiling and mapping), and Schlumberger vertical electric sounding (VES) resistivity measurement. The surveys were based on a measured grid and were performed using conventional methods. The surveys successfully provided data on landfill thicknesses and depths to the native tuff, and on the location of landfill boundaries and buried objects.

2.2.1.2 Sampling

Numerous sampling activities were also carried out over a period of several years. These activities consisted of soil gas sampling, surface soil and sediment sampling, interior and perimeter borehole drilling, subsurface soil and tuff sampling, cone penetrometer testing, monitoring well installation, pore water and leachate sampling, and related activities. Detailed information regarding the results of these activities is also provided in the RFI report (LANL 1998, 63070), section 2.3.4. An in-depth data review, screening assessment, and human health risk assessment were also presented in the RFI report, in sections 2.3.4.3, 2.4.2, and 2.4.3.1, respectively.

2.2.2 Conceptual Model

The preliminary and revised site conceptual models (including nature and extent, and fate and transport discussions) were both presented in the RFI report (LANL 1998, 63070), sections 2.3.4 (Preliminary Conceptual Model) and 2.3.5 (Revised Site Conceptual Model). However, the objective of this SAP is to provide the data needed to design and construct covers for the inactive landfill and debris disposal areas. The conceptual model for contaminant occurrence and distribution has only marginal relevance to this objective. Therefore, no further discussion of the conceptual model is provided in this SAP.

2.2.2.1 Data Gaps

The model for an evapotranspiration (ET) cover conceptual design uses a variety of data inputs, some of which are based on site-specific data and some of which are assumed by the designer. The assumed modeling input parameters are not necessarily data gaps, but are rather commonly used values based on site observations. Reasonable values for such parameters as leaf area index and root density shall be determined or agreed upon during the course of the project. Selected values used in modeling are based, to the extent possible, on site-specific conditions and must be conservative from the standpoint of cover performance.

To identify data gaps that would need to be addressed before a conceptual landfill cap design and long-term monitoring plan could be prepared, site-specific modeling input parameters and data needs were evaluated and compared to the existing data presented in the RFI report. Much of the existing data was collected for the purpose of determining the nature and extent of contamination and does not focus on parameters that are important for cover modeling and design. The specific tests and surveys listed below will acquire the remaining data needed to move forward with the conceptual design of a cover.

(a) Soil Gas Survey

A soil gas survey is needed to accurately assess current near-surface gas concentrations and to evaluate the effect this gas may have on plant transpiration in the cover profile. Low oxygen concentrations may result in reduced transpiration, increased percolation, and the possible need for a venting system in part of the cover. The rooting depth is an essential parameter in modeling as well as in the actual function of an evapotranspiration cover. If methane or other soil gases inhibit root growth, the cover may not perform in the manner it was designed. Previous surveys at the landfill have shown elevated gas concentrations near the surface. This near-surface gas may or may not inhibit transpiration or affect plant rooting depth. Since the initial surveys were conducted, BMPs have been installed to reduce stormwater run-on. This is expected to have resulted in reduced current gas concentrations.

(b) Existing Surface Properties

The present landfill surface is composed of native soil of varying thickness and coverage. The surface is vegetated and, by inspection, has significant evapotranspirative capacity. This surface will remain in place, and borrow material will be brought in and placed on top to bring the final cover up to proper thickness and final grade, as appropriate. To evaluate percolation, erosion protection, and longevity, more information about the existing surface material is needed. Several properties of this material need to be assessed.

Thickness. The thickness of the native soil currently in place needs to be evaluated as part of the completed final cover. The thickness of the existing soil layer ranges from 0 to over 10 ft. The average thickness of the current surface should be determined. Thickness determinations could be done concurrently with the soil gas survey and rooting depth survey.

Hydraulic properties. In order to properly model the existing surface as part of the final cover, samples will be gathered and tested for hydraulic properties. Samples will be tested for moisture retention, density, porosity, and hydraulic conductivity. Some samples will also be tested for water potential to evaluate root water uptake activity.

Geotechnical properties. Slope failure is evident in the existing surface at the east edge of the landfill. Regardless of the suitability of the borrow material, if the underlying soils are not characterized, long-term slope stability cannot be determined. Samples will be tested for laboratory compaction characteristics, Atterberg limits, internal shear strength, cohesive strength, and particle size distribution.

A borrow material site has not been identified for use at TA-73; therefore, hydraulic properties of borrow material have not yet been determined. Modeling can initially proceed using properties measured at other borrow sites in the area. When the actual borrow site is identified, the borrow material should be sampled and tested for hydraulic and geotechnical properties, and confirmatory modeling should be done to establish that the borrow material will be adequate for use in the cover.

2.2.3 Sampling Activities

This section describes the sampling activities that will be conducted to satisfy the objectives of this SAP. Section 3.3, Field Activities, provides additional details about the manner in which the sampling activities and related field tasks are to be performed. The proposed sampling activities are described below.

2.2.3.1 Determination of Effectiveness of Stormwater Run-on Controls

To determine the effect of reduced surface water run-on, additional samples will be collected from existing monitoring wells for assessment of current conditions within the refuse and surrounding vadose zone. The existing monitoring network is depicted in Figure 2.2-1. The types, numbers, and depths of instrumentation at each location are listed in Table 2.2-1. All gas ports, lysimeters, and other instrumentation from which adequate media can be collected will be sampled. However, only minimal efforts will be made to repair a port or instrument that is not functional. The samples to be collected and their analytical suites are presented in Table 2.2-2.

2.2.3.2 Soil Sampling

The geotechnical and hydrological properties of the existing surface must be determined. A sampling pattern that includes the landfill area and the debris disposal area will be established in the field, based on site conditions. Ten cores will be taken for hydraulic properties testing. Samples will be tested and evaluated for moisture retention characteristics, density, porosity, and hydraulic conductivity.

An additional 5 to 15 core samples will be taken from the existing surface and tested for laboratory compaction characteristics, Atterberg limits, internal shear strength, cohesive strength, and particle size distribution. This will be done to determine the suitability of the surface as part of the cover. More samples may be required in the area of the steeply sloped east edge of the landfill; this will be determined by observing the existing soil erosion conditions in this area.

2.2.3.3 Soil Gas Sampling

The soil vapor survey will use field investigation methods to sample soil gas. A sampling pattern will be established that includes the landfill area and debris disposal area. Sampling points will be located on a grid pattern of approximately 100 × 200 ft, with extra samples concentrated in areas where there is no vegetation, where stressed vegetation is observed, or where annuals predominate. Geodetic coordinates for sampling points will be determined using a global positioning system (GPS). Soil vapor measurements will be collected at 15-cm intervals within the top 1 to 2 m of existing landfill cover. Methane, carbon dioxide, and oxygen concentrations will be monitored with a field instrument. This will provide some understanding of the gas concentrations that might be expected in a new cover and whether roots could be expected to grow into, and extract stored water from, the deeper part of the new cover.

2.2.3.4 Vegetation and Rooting Survey

Rooting depth is an important parameter in the effective function of an ET cover. A survey will be performed to update the vegetated and non-vegetated areas on the existing surface. The surface of the landfill will be mapped, and the areas of vegetation under stress will be identified and plotted. This does not require precise measurements but should establish where vegetation may be influenced by soil gas. Determination of the actual rooting depth will then be used to set the evaporation depth in the modeling effort. This survey will be conducted concurrently with the soil gas survey.

2.2.3.5 Map Existing Cover Thickness

This task will be accomplished during the vegetation and rooting survey. Observations and measurements will include determination of the cover/waste interface.

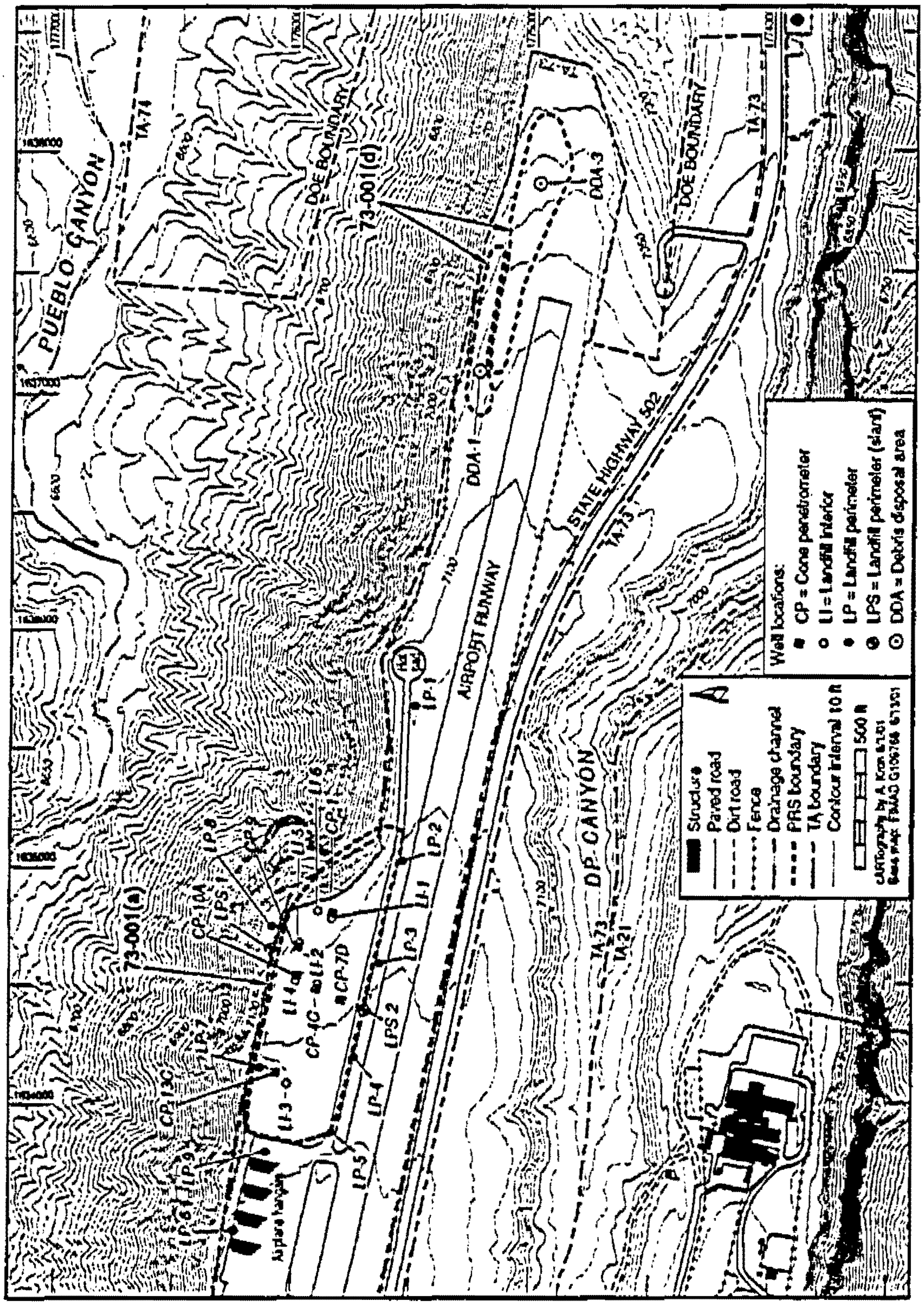

Figure 2.2-1. Locations of landfill interior and perimeter wells

Table 2.2-1
Existing Monitoring Well Information

Well ID	FIMAD ID	Total Depth (ft)	Depth to Tuff Interface (ft)	Well Instrumentation		
				Gas Ports	Lysimeters	Other
LP-1	73-01001	45	3.5	GP-1: 40.2 ft GP-2: 10.2 ft	NA	Neutron Access Tube Heat Dissipation Sensor #1: 34.2 ft
LP-2	73-01002	42.5	7.5	GP-1: 36 ft	NA	Neutron Access Tube
LP-3	73-01003	110	5	GP-1: 99.2 ft GP-2: 91.2 ft GP-3: 39.2 ft GP-4: 9.2 ft	20.2 ft	Neutron Access Tube Heat Dissipation Sensor #1: 20.4 ft
LP-4	73-01004	112.5	7	GP-1: 99.4 ft GP-2: 75.4 ft GP-3: 46.4 ft GP-4: 13.4 ft	34.4 ft	Neutron Access Tube Heat Dissipation Sensor #1: 34.6 ft Thermocouple #1: 99.4 ft Thermocouple #2: 75.4 ft Thermocouple #3: 46.4 ft Thermocouple #4: 13.4 ft
LP-5	73-01005	40	11.5	GP-1: 33.5 ft	10.7 ft	Neutron Access Tube Heat Dissipation Sensor #1: 23 ft Heat Dissipation Sensor #2: 11 ft
LP-6	73-01006	40	11.5	GP-1: 27 ft	11 ft	Neutron Access Tube Heat Dissipation Sensor #1: 11.2 ft
LP-7	73-01007	115 (113.3 TVD)	10	GP-1: 100 ft GP-2: 28 ft GP-3: 16 ft	55 ft	Neutron Access Tube Heat Dissipation Sensor #1: 55 ft Thermocouple #1: 100 ft Thermocouple #2: 28 ft
LP-8	73-01008	102.5	5	GP-1: 91.5 ft GP-2: 43.5 ft GP-3: 15.5 ft	NA	Neutron Access Tube Heat Dissipation Sensor #1: 54.5 ft Thermocouple #1: 91.5 ft Thermocouple #2: 43.5 ft Thermocouple #3: 15.5 ft
LP-9	73-01009	45	16	GP-1: 41 ft GP-2: 11.2 ft	26 ft	Neutron Access Tube Heat Dissipation Sensor #1: 26.2 ft
LPS-1	73-01010	162.5 (153 TVD)	0	GP-1: 145 ft GP-2: 114 ft GP-3: 61 ft GP-4: 22 ft GP-5: 7.5 ft	NA	Neutron Access Tube Thermocouple #1: 145 ft Thermocouple #2: 114 ft Thermocouple #3: 51 ft Thermocouple #4: 7.5 ft
LPS-2	73-01011	205 (186 TVD)	10	GP-1: 178 ft GP-2: 125 ft GP-3: 87 ft GP-4: 29 ft	62 ft	Neutron Access Tube Heat Dissipation Sensor #1: 160 ft Heat Dissipation Sensor #2: 62 ft Thermocouple #1: 178 ft Thermocouple #2: 125 ft Thermocouple #3: 87 ft Thermocouple #4: 29 ft
LI-1	73-02429	90	76	NA	76 ft 58 ft	Neutron Access Tube Heat Dissipation Sensor #1: 75 ft Heat Dissipation Sensor #2: 57 ft Heat Dissipation Sensor #3: 35 ft
LI-2	73-02425	40	29.6	NA	32.2 ft	Heat Dissipation Sensor #1: 31.5 ft Thermocouple #1: 15 ft

Table 2.2-1 (continued)
Existing Monitoring Well Information

Well ID	FIMAD ID	Total Depth (ft)	Depth to Tuff Interface (ft)	Well Instrumentation		
				Gas Ports	Lysimeters	Other
LI-3	73-02426	30	18	NA	23.3 ft	Heat Dissipation Sensor #1: 22.5 ft Thermocouple #1: 10 ft
LI-4	73-02427	29.1	19	NA	22.3 ft	Heat Dissipation Sensor #1: 21.3 ft Thermocouple #1: 10 ft
LI-5	73-02428	29.5	25	NA	28.8 ft	Heat Dissipation Sensor #1: 27.8 ft Thermocouple #1: 12 ft
LI-6	73-02430	75	66	GP-1: 60 ft GP-2: 25 ft	66 ft	Heat Dissipation Sensor #1: 65 ft Heat Dissipation Sensor #2: 19 ft
DDA-1	73-02424	36	30.8	GP-1: 24 ft	31.3 ft	Neutron Access Tube Heat Dissipation Sensor #1: 25.8 ft Thermocouple #1: 15 ft Thermocouple #2: 5 ft
DDA-3	73-02421	36.6	35	GP-1: 28 ft	35.5 ft	Neutron Access Tube Heat Dissipation Sensor #1: 34.5 ft Thermocouple #1: 18 ft Thermocouple #2: 5 ft
CP-1	73-02061	85.6	95.5	GP-1: 75 ft GP-2: 27.5 ft GP-3: 2.5 ft	NA	Thermocouple #1: 75 ft Thermocouple #2: 27.5 ft Thermocouple #3: 2.5 ft
CP-4C	73-02069	26	No tuff encountered	GP-1: 17.6 ft GP-2: 1 ft	NA	Heat Dissipation Sensor #1: 17.6 ft Thermocouple #1: 1 ft
CP-7D	73-02067	24.8	24.5	GP-1: 23.4 ft GP-2: 2 ft	NA	Heat Dissipation Sensor #1 23.4 ft Thermocouple #1: 2 ft
CP-9	73-02071	32.6	31	GP-1: 19 ft GP-2: 1 ft	NA	Heat Dissipation Sensor #1: 19 ft Thermocouple #1: 1 ft
CP-10A	73-02068	28	25	GP-1: 25.8 ft GP-2: 1.3 ft	NA	Heat Dissipation Sensor #1 25.8 ft Thermocouple #1: 1.3 ft
CP-13C	73-02089	88.7	87	GP-1: 74 ft GP-2: 30 ft GP-3: 1.2 ft	NA	Heat Dissipation Sensor #1: 74 ft Thermocouple #1: 74 ft Thermocouple #2: 30 ft Thermocouple #3: 1.2 ft

Table 2.2-2
Proposed Monitoring Well Samples and Analytical Suites

Sample Type	Number of Possible Samples	Analytical Suite		
		VOCs	TAL Metals	Soil Gases[a]
Pore water	16	Yes	Yes	No
Soil gas	48	No	No	Yes

[a] Soil gases consist of methane, carbon dioxide, and oxygen.

3.0 DATA COLLECTION DESIGN AND PROCEDURES

3.1 Data Quality Objectives

The information needed for the ET cover conceptual design includes

- quantitative confirmation that the ET cover will effectively minimize infiltration at the site, and
- assessment of the constructability of the ET cover.

Decisions will be based upon the cover performance meeting all specified design criteria. Modeling will be used to determine the cover infiltration reduction performance and compliance with RCRA Subtitle C design standards. An affirmative decision to proceed with an ET cover will be based upon the demonstrated ability of the ET cover to meet all essential design criteria at the conceptual design and feasibility study level.

The first step in developing decision rules is to identify the parameters of interest for design decisions. The ET cover design requires data regarding soil properties, climate, and vegetation. For the many parameters of interest, various descriptive measures (such as mean, median, proportion, or frequency) will apply. At the conceptual design stage of this project, in most cases, ranges of typical values will be examined rather than relying solely on a single descriptive measure.

Decisions regarding the suitability of data for cover performance, modeling, and engineering calculations at the conceptual design level are based, in many cases, on standard soil science and engineering practices. Data gaps will exist and be identified at this stage of the project, and they will need to be addressed for the final design and construction. In particular, extensive soil testing of actual borrow source soils will be needed for final design analysis. The currently available soils data include testing of limited samples that are representative of typical materials available at the closest potential borrow source. These soils data, and other typical values based on scientific and engineering judgement, are considered suitable as a basis for decisions at the conceptual design and feasibility level.

The following decision rules will guide the modeling and design efforts conducted under this project:

- If parameter ranges or parameter uncertainties are considered reasonable within the modeling framework, then the model results may be used in the next design step.
- If results of the modeling efforts indicate that cover design performance standards can be achieved, then modeling and design results may be used for decisions to proceed with final design and implementation of closure.

Model inputs and outputs will be reviewed by project personnel for reasonableness as a basis for decisions. Modeling the ET cover at the conceptual design stage will follow these data quality objectives (DQOs), with additional confirmatory analyses and modeling to be completed during the final design process.

3.2 Quality Assurance/Quality Control

All sampling and analysis activities will be conducted according to the requirements in Chapter 4 of the "Installation Work Plan for Environmental Restoration " (LANL 2000, 66802). All field measurements, surveys, and sampling will follow the quality assurance/quality control (QA/QC) requirements outlined in the standard operating procedures (SOPs) and other applicable procedures or standards specified in section 3.3 of this document.

Data from analytical laboratories will comply with the ER Project "Statement of Work (SOW) for Analytical Services" (LANL 1995, 49738) and will include all of the normal QA/QC parameters specified by the SOW.

3.3 Field Activities

Sampling activities designed to generate the data required to meet the objectives of this SAP are discussed in section 2.2.3. This section provides additional details about how the sampling activities and related field tasks are to be performed.

3.3.1 Soil Pore Water Sampling

The proposed sampling of the existing monitoring well network will include subsurface moisture monitoring using a neutron probe in the existing access tubes that were previously monitored.

Heat dissipation sensors and thermocouples will be measured with a 21X Campbell Scientific data logger, using the same program that was used during previous sampling events.

Deep soil gas ports will be monitored for methane, oxygen, and carbon dioxide using a Landtech GA90 infrared gas analyzer. Prior to sampling, each gas port will be purged of an appropriate volume. The samples will be collected after soil gas carbon dioxide concentrations stabilize.

All lysimeters will have vacuum applied to them in an attempt to collect leachate samples. It is possible that no samples can be collected, if vadose zone conditions are dryer than the range at which lysimeters can function (approximately -700 cm water potential).

3.3.2 Soil Sampling

To determine geotechnical and hydrological properties, soil cores will be collected from various depths within the existing surface. Each core will be collected by driving a brass sleeve of 3- to 6-in. in length into the existing surface material. The soil-filled sleeves will be extracted, sealed, and shipped to a laboratory for testing and evaluation of moisture-retention characteristics, density, porosity, hydraulic conductivity, proctor compaction, Atterberg limits, internal shear strength, cohesive strength, and particle size distribution, as required.

3.3.3 Soil Gas Sampling

The soil vapor survey will use temporary sampling points. A soil gas probe shall be used to advance a stainless-steel drive point with a perforated tip for allowing gas to enter the tubing. A length of tubing will connect the drive point to a sampling port at the surface. Immediately following installation of the perforated drive point, soil gas will be pumped out. After an appropriate purge volume has been removed, a measurement of the soil gas will be made using field instruments. Purging shall be accomplished by pumping and monitoring soil gas carbon dioxide until stable. The concentrations of methane, carbon dioxide, and oxygen in the soil gas shall be measured with a Landtech GA90 infrared gas analyzer.

This sampling should be done when no major pressure front is moving through the area. Such fronts greatly affect profiles measured. Profiles will also be affected by daily earth tides. Thus, the field notes should document the time of day at which each measurement is performed. If the sampling is conducted over several days, consideration will be given to measuring and recording barometric pressure during sampling.

3.3.4 Vegetation and Rooting Survey

A determination of the actual vegetation rooting depths in the existing surface shall be made using a Bob-cat-mounted backhoe (or equivalent) to dig 10–20 small pits down to the cover/waste interface, in order to evaluate rooting depth and cover thickness. Pits shall be excavated to no more than 4 ft for health and safety reasons. Photos will be taken and observations will be recorded.

3.3.5 Mapping Existing Cover Thickness

This task will be accomplished during the vegetation and rooting survey. Observations and measurements at the excavation sites shall include determination of the cover/waste interface.

ER Project guidelines for conducting field investigations will be followed. The following ER Project SOPs will be used during completion of the field activities:

- ER-SOP-1.01, Rev. 0, "General Instructions for Field Investigations"
- ER-SOP-1.02, Rev. 0 , "Sample Container and Preservation"
- ER-SOP-1.03, Rev. 2, "Handling, Packaging and Shipping of Samples"
- ER-SOP-1.04, Rev. 3, "Sample Control and Field Documentation"
- ER-SOP-1.06, Rev. 1, "Management of ER Project Wastes"
- ER-SOP-1.08, Rev. 1, "Field Decontamination of Drilling and Sampling Equipment"
- ER-SOP-1.12, Rev. 0, "Field Site Closeout Checklist"
- ER-SOP-6.31, Rev. 0, "Atmospheric and Sub-atmospheric Air Sampling"
- ER-SOP-7.05, Rev. 1, "Subsurface Moisture Measurements Using a Neutron Probe"

Analytical laboratory data will comply with the ER Project statement of work (SOW) for analytical services (LANL 1995, 49738). Specific analytical procedures are not provided in this supplemental SAP.

The following methods and procedures will be used to determine hydraulic, geotechnical, and basic soil physical properties, as required. Other methods and procedures that might be used in the determination of these or other soils properties will conform to accepted engineering standards and/or standards of the American Society for Testing and Materials (ASTM) or in *Methods of Soil Analysis* (MOSA) (Klute 1986, 70159).

- ASTM D2434-68(94) - Hydraulic Conductivity (Constant Head)
- MOSA Chp. 28 - Hydraulic Conductivity (Falling Head)
- MOSA, pp 597-618 - Moisture Retention Characteristics (Water Potential Method)
- ASTM D422-63(90) - Particle Size Analysis
- ASTM D4318-00 - Liquid Limit, Plastic Limit, and Plasticity Index of Soils (Atterberg Limit)
- ASTM D698-91/D1557-91 - Compaction (Proctor) Test
- ASTM D2166 (or equivalent) - Shear Strength
- ASTM D2937-94/MOSA Chp. 13 - Bulk Density
- MOSA Chp . 18 - Calculated Total Porosity

4.0 PROJECT MANAGEMENT

4.1 Project Scheduling and Reporting Requirements

These activities will be performed at the direction of the Town Sites Team of the Remedial Actions Focus Area of the ER Project at LANL. A proposed schedule of the activities is presented in Table 4.4-1.

The data-collection and waste-management activities will be summarized in a field operations report, to be prepared after the data assessment and analysis.

4.2 Health and Safety Plan

A site-specific health and safety plan will be developed in accordance with the ER Project's "Site-Specific Health and Safety Plan" (SSHASP) (LANL 2000, 65050).

4.3 Investigation-Derived Waste Plan

Investigation-derived waste will be handled in accordance with a waste characterization strategy form, to be prepared in accordance with ER-SOP-1.10, R0, "Waste Characterization."

4.4 Community Relations Plan

Community relations will be governed by the public involvement plan in Chapter 7 of the 2000 IWP (LANL 2000, 66802).

Table 4.4-1
Proposed Schedule of Activities

Activity	Schedule
Readiness review/field preparation	August 2001
Mobilization/implement SAP	September 2001
Complete field work/demobilization	November 2001
Sample analysis	December 2001
Data analysis and assessment	January 2002
Prepare field operations report	February 2002
Prepare conceptual design/VCM plan	March 2002
Submit VCM plan	April 2002

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